

Reducing SSI's Through Improved Environmental Hygiene- A Threshold ROI Analysis

Executive Summary

Faced with the need to reduce healthcare acquired infections (HAIs), providers are using a multi-modal approach that incorporates improved environmental hygiene. In addition to traditional methods, providers are turning to whole room disinfection systems to improve outcomes. While the literature demonstrating the clinical benefits of these systems is building, many providers are skeptical of their return on investment (ROI) due to potential hidden costs related to maintenance, training, and compliance. This emphasizes the need for a simple, threshold ROI analysis to assess the myriad of systems on the market while highlighting the need for products that are simple to operationalize across the institution, have no hidden costs, and augment their current cleaning protocols.

The Need for Improved Environmental Hygiene

Surgical Site Infections (SSIs) are a concern for every healthcare provider due to associated financial burdens on the institution and their personal impacts on the patient. While different types of SSIs with varying degrees of severity, in total, they represent the largest excess cost to the US healthcare system as compared to all other HAI modalities¹.

The effect of these burdens and impacts is further exacerbated by the growing public awareness of Healthcare Acquired Infections (HAIs) and the potential impact this has upon their choice of provider for elective procedures such as orthopedic joint replacements. These procedures are, relatively speaking, financially lucrative and not surprisingly, providers are touting their commitment to reducing HAIs as a key differentiator when marketing their services to potential patients.

With this in mind, healthcare providers are continuously looking at a variety of interventions they can bundle to collectively reduce their SSI rates^{2,3}. These interventions typically include a range of activities focused directly upon the patient such as screening for MRSA/MSSA, CHG skin prep, antibacterial sutures, and incisional adhesives. What is often minimized or overlooked in this approach is the influence of the environment upon wound contamination and the increased risk of infection it creates.

The solution to improving environmental hygiene has typically been a combination of personnel, compliance, and technology as shown in Figure 1 below.

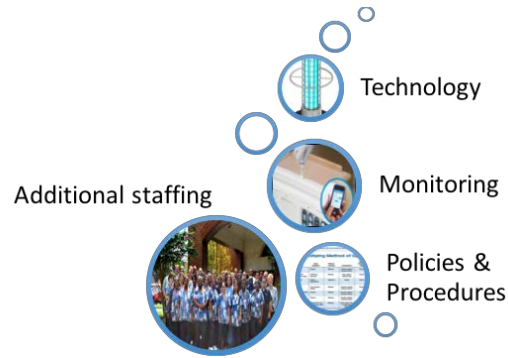


Figure 1. Methods of improving environmental hygiene.

While these efforts are certainly logical, they ultimately reach a point of diminishing return as they require people to implement making it costly to perform also introducing the potential for human error. This challenge is best exemplified by a simple comparison with handwashing. Every provider knows they need to perform and improve handwashing, yet the average compliance rate for handwashing across the US is less than 50% at many institutions^{4,5}. This highlights the impracticality of expecting workers to wash their hands after each potential event. To do so would slow the delivery of healthcare to a crawl. With decreased reimbursements and the associated ongoing challenge, forcefully improving environmental hygiene is simply not practical in today's healthcare environment.

Improving Environmental Hygiene- The Case for Whole Room Disinfection

As a result, healthcare providers are increasingly looking for solutions that provide a safety net by disinfecting surfaces that may have been insufficiently disinfected. Typically referred to as "whole room disinfection", such solutions exist to compliment or bolster their current efforts. These technologies are commonly segmented by the time over which the disinfection occurs. Most products and technologies are effective for the short period of time over which they are applied as an extension of their regular cleaning protocols. Such efforts are commonly referred to as "episodic". By comparison, those products and technologies that operate over an extended period of time (e.g. HEPA air filters) are referred to as "continuous". A brief comparison of episodic and continuous whole-room disinfection technologies is shown in Figure 2 below.

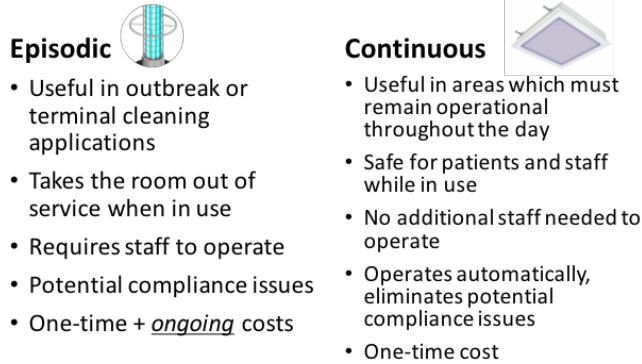


Figure 2. Comparison of Episodic and Continuous Whole-Room Disinfection.

Either form of disinfection is optimized for a specific application and therefore has advantages and disadvantages. Of course, any effort to remove bacteria from the environment is desirable, but given the fact that every healthcare provider has a limited amount of resources to deploy, their choice must ultimately balance product effectiveness vs. cost of ownership. This dilemma is best summarized in a recent survey of healthcare leaders, the overwhelming majority of whom believe that while the environment contributes to the transmission of pathogenic organisms, most are unconvinced that whole room disinfection systems offer a return on investment (ROI)⁶.

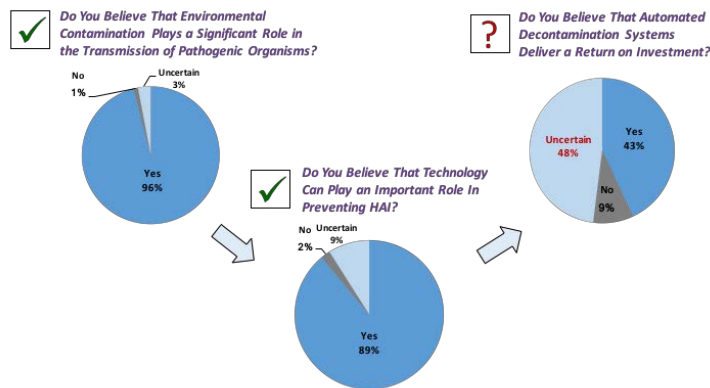


Figure 3. Survey of healthcare leader's perspectives on whole room disinfection systems.

This skepticism is natural, but fortunately, numerous studies including one from Anderson, Rutala, et. al.⁷, on whole room disinfection systems have been published in recent years using a variety of products in a range of applications. These studies correlate significant reductions of bacteria in the environment (>60%) with improved outcomes^{8,9,10} and collectively, they demonstrate that that these improved outcomes are largely agnostic to the method by which the bacteria are killed.

To be sure, it is important for any disinfection technology to be as effective as possible against a wide range of pathogens without damaging surfaces with a minimal contact time. The quest for this single, ideal disinfectant continues to this day and reinforces the need for providers to employ a combination of one or more disinfectants that collectively address their needs for a given application. As shown in Figure 2 below, adding visible light continuous environmental disinfection to current, episodic disinfection efforts has been clinically shown to reduce bacteria by up to 85% beyond normal cleaning measures over a 24 hour cycle¹¹.

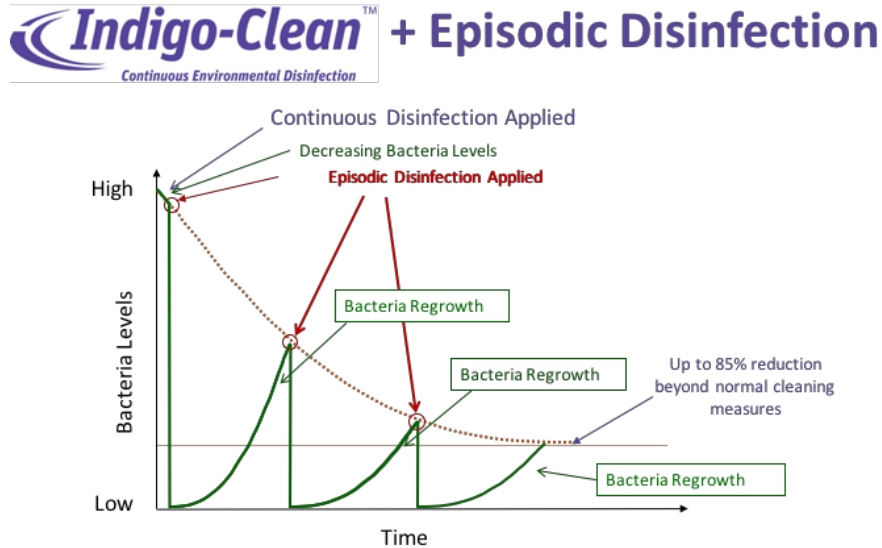


Figure 4. Benefit of using continuous, whole-room disinfection in addition to daily, episodic cleaning methods.

Finally, it is important that healthcare providers appropriately set their expectations regarding how a published ROI study may translate to their individual application. A typical ROI study has uncertainty around the exact number of infections prevented as well as ambiguity regarding the actual cost to the institution in capital, labor, and recurring costs for consumables and maintenance. More importantly, for providers to truly realize the calculated ROI, the product must be used “as directed” which emphasizes the need for training and compliance. Along with operational impacts, these “hidden” costs could undermine or eliminate the potential benefits. *This fact emphasizes the need for providers to deploy products that are simple to use and that create little to no disruption in their current activities.*



Figure 5. Potential “hidden” costs associated with whole room disinfection systems.

One solution to this is for each provider to do their own ROI study for each new product they wish to use. As Weber, et. al. notes¹², “logistic and cost reasons are likely to preclude randomized clinical trials. Rather, decisions on use on these devices will need to be based on consistent demonstration of effectiveness in killing pathogens as previously detailed and quasi-experimental studies.” Spencer, et. al.¹³ proposes a model for choosing a whole room disinfection system with a strong emphasis on thoroughly identifying and sharing operating costs across the institution.

Another approach which can allow a provider to quickly arrive at a conclusion is to look for a *threshold (or minimum) ROI* by simply evaluating if the product would pay for itself if it were to prevent a single infection in a single room or area. This approach emphasizes the providers understanding of the cost to deploy, operate, and maintain a product rather than the number of infections prevented which can be difficult and time consuming to determine and which ultimately contains a degree of uncertainty.

A simple example of this analysis is in the operating room where many institutions have specific rooms in which they conduct critical procedures such as total joint replacement. In these instances, adding whole-room disinfection is a responsible risk-mitigation strategy given the cost of remediation should the implant become infected. Figure 6 below summarizes this type of threshold analysis for an operating room comparing the types of costs for an episodic whole-room disinfection product with actual costs for Indigo-Clean Continuous Environmental Disinfection. To perform a more detailed comparison, providers should consult the manufacturer for the product in question.

Threshold ROI Analysis (1-Year)					
	Threshold # of SSI Prevented Per Year (N)	1		1	
	Average Additional Cost Per SSI (C)	\$20,785		\$20,785	
	Maximum Product Cost to Realize 1-Year ROI (=N*C)	\$20,785		\$20,785	
CAPEX	Cost to Purchase (for one OR)		*		\$16,000
	Cost to Install (for one OR)		*		\$3,000
OPEX	Training (per year per OR)		*		\$0
	Incremental Labor to Operate (per year per OR)		*		\$0
	Room Downtime Opportunity Cost (per year per OR)		*		\$0
	Consumables (per year per OR)		*		\$0
	Maintenance/Service Agreement (per year per OR)		*		\$0
ROI	1st Year Costs (CAPEX + OPEX)		*		\$19,000
	Potential Payback in 1-Year		Unknown		Yes
	Maximum Product Lifetime (Years)		*		10
	Potential Additional Benefits Beyond 1st Year Over Life of Product (assumes a reduction of 1 SSI per year per OR)		*		\$187,065
	* = Contact Product Manufacturer				

Figure 6. Threshold ROI Analysis for episodic, whole-room disinfection and Indigo-Clean Continuous Environmental Disinfection. Note the simplified analysis for Indigo-Clean due to the lack of operational costs.

This analysis highlights some of the benefits of visible light disinfection such as it doesn't require people to operate and is designed to last up to 10 years without consumable parts and/or maintenance. This makes the threshold ROI simple to calculate demonstrating a potential 1-year payback scenario with additional benefits after the 1st year for each infection prevented. Figure 7 below shows the use of Indigo-Clean in a typical OR.

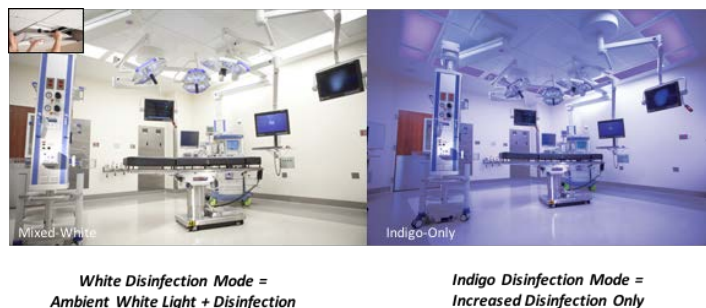


Figure 7. Indigo-Clean Continuous Environmental Disinfection in an OR. Note that both modes of operation provide disinfection that can be automatically selected depending upon room occupancy by overhead sensors

Beyond the ROI

While ROI is an important tool by which institutions allocate resources, it typically doesn't factor in the potential impact that whole room disinfection systems can have upon a patient's decision to have elective procedures performed at the institution. Increased access to information, consumer-directed healthcare plans, the shifting of care to outpatient settings, and patient autonomy have brought awareness to healthcare providers efforts to provide a cleaner, safer environment for their patient. While there are clearly many larger factors that may influence a patient's decision (in-network vs. out of network, prior physician relationship, recommendations from friends and family, etc.), whole room disinfection systems are very visible to patients and can provide great public relations opportunities when deployed. They serve to reassure the public that the institution is forward-thinking and making every possible effort to reduce surgical site infections.

Summary

Whole room disinfection systems can improve environmental hygiene and reduce infections. Using a simple, threshold ROI estimate allows providers to quickly evaluate the range of products in the market and identify those that best meet their application needs. For providers to realize these benefits and, ultimately an ROI, they must choose a product that is simple to operationalize across the institution, has no hidden costs, and augments their current cleaning protocols.

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