

## The Role of Environmental Surfaces in Transmitting Infections

### ABSTRACT

The medical and economic toll of infections continues to escalate. Dating back to the mid-1800's and Florence Nightingale, there has long been an understanding in the medical field regarding the importance of maintaining a clean environment. With the introduction of antibiotics the focus on infections moved perhaps more towards the cure than preventing the transmission.

This is not to say that the environment has been ignored completely, as all facilities; healthcare, schools, office buildings have cleaning programs but to say that like an ugly step sister, the focus on the environment was moved to the back of the bus so to speak. In recent years, with the emergence of antibiotic resistant organisms such as MRSA, VRE and Acinetobacter, the emergence of a more virulent strain of C. difficile and the increased number outbreaks associated with viruses such as SARS, Norovirus and the pandemic Influenza A H1N1 more effort is being spent on understanding the role the environment plays in transmitting infections and how through effective cleaning and disinfection such outbreaks or infections can be decreased.

### BACKGROUND

The June 2010 edition of the American Journal of Infection Control (AJIC) included a Supplement of five articles discussing various aspects the role the environment plays in infection transmission. The intent of this technical bulletin is not to summarize each of the studies but rather highlight the consistency in thought between the 11 authors who contributed to the articles.

1. Bartley, J et al. Current views of health care design and construction: Practical implications for safer, cleaner environments. AJIC 2010;38(Suppl 1):S1-S12

2. Bartley, J et al. Applications of ultraviolet germicidal irradiation disinfection in health care facilities: Effective adjunct, but not stand-alone technology. AJIC 2010;38(Suppl 1):S13-S24

3. Weber, DJ et al. Role of hospital surfaces in the transmission of emerging health care-associated pathogens: Norovirus, Clostridium difficile and Acinetobacter species. AJIC 2010;38(Suppl 1):S25-S33

4. Sattar SA, Promises and pitfalls of recent advances in chemical means of preventing the spread of nosocomial infections by environmental surfaces. AJIC 2010;38(Suppl 1):S34-S40

5. Carling PC et al, Evaluating hygienic cleaning in health care settings; What you do not know can harm your patients. AJIC 2010;38(Suppl 1):S41-S50

### Healthcare Design and Construction

Addressing economic challenges while maintaining the quality and safety of patient care has lead to the development and use of a number of different performance and assessment tools such as Six Sigma Lean methods<sup>1</sup>.

Numerous studies have provided especially strong evidence that facility design which incorporates an increased number of single-bed rooms and rooms that can accommodate a variety of patients would minimize the need for multiple room transfers and would have a direct effect on improving health care outcomes<sup>1</sup>. The 2010, Guidelines for Design and Construction of Hospital and Healthcare Facilities has made a concerted effort to provide guidance with respect to selection of surfaces and furnishings especially as they relate to

environmental contamination. Current evidence demonstrating the efficacy of antimicrobials when applied or incorporated into or onto inanimate surfaces, patient care equipment, fixtures or furnishes, specifically for the prevention of hospital acquired infections is lacking.

The focus instead needs to be on selecting ideal surfaces and ensuring these surfaces allow for ease of cleaning, resistance to moisture and reduction in the risk of fungal contamination. The Pathogens It is estimated that each year in the US of the 1.7 million hospital acquired infections (HAIs), 99 000 result in death. Furthermore, 20 – 40% of HAIs can be attributed to cross infection via the hands of healthcare workers (HCWs)<sup>3</sup> .

HCW hand contamination can result in two primary ways; from direct patient contact or indirectly from touching contaminated environmental surfaces. While thought to be less common, HAIs may also occur when a patient becomes colonized by direct contact with a contaminated environmental surface. For environmental contamination to play a role in transmission of infection the pathogen must first demonstrate a set of specific characteristics<sup>3</sup> :

1. The ability for the pathogen to survive for prolonged periods of time on environmental surfaces
2. The ability for the pathogen to remain virulent after environmental exposure
3. The possibility of frequent contamination of the hospital environment The ability to colonize patients
5. The ability to transiently colonize the hands of HCWs
6. Transmission via the contaminated hands of HCWs
7. The need for small inoculating dose of the pathogen
8. Relative resistance to disinfectants used on environmental surfaces

The role of surface contamination in transmission of HAIs is an important issue because transmission can be interrupted by appropriate hand hygiene and cleaning/disinfection of environmental surfaces.

## Cleaning and Disinfection Technologies

With environmental surfaces now receiving their due recognition as potential reservoirs for transmission of HAIs, there is a corresponding increase in the overwhelming number of surface disinfectants available to end users. This intense competition by those who manufacture and sell disinfectants is confounding the issue by providing a bewildering array of claims for effectiveness and often contradictory information relating to safety and environmental sustainability<sup>4</sup> .

Moreover, traditionally used products and practices used for cleaning and disinfecting environmental surfaces are now under scrutiny for their effectiveness against the ever changing list of pathogens associated with HAIs as well as their associated affects on human health as more direct links are reported supporting the association between cleaning chemicals and cancer and occupational asthma. There are currently some 5000 registered antimicrobial products available in the US. Of these, nearly 60% are used for infection control purposes for controlling pathogens in healthcare settings with a major proportion of these products used directly for environmental surface decontamination<sup>4</sup> .

The use of such products is widely based on history and tradition. Those tasked at choosing a disinfectant must understand that while disinfectants are certainly the backbone for effective environmental control programs, they must be used correctly and effectively to provide the desired results and will not compensate for poor practice. The microbial activity of all disinfectants is inversely proportional to the level of soil found the environmental surface<sup>4</sup> . While certainly there are a number of accepted laboratory-based efficacy methodologies, this testing provides only an indication

of their performance in real life applications. There has been very little emphasis on research that focuses on proving the effectiveness of such products under field use conditions. The trend in “green” products is also creating a conundrum for infection prevention. The increasing pressure from Occupational Health and Safety to ensure that safer disinfectant alternatives are considered combined with the fact that many of these “green” products or products based on “all-natural” ingredients while safer, do not provide the speed and spectrum of efficacy necessary for disinfection of healthcare environmental surfaces.<sup>4</sup> Presently, only oxidizer-based environmental surface disinfectants are suitably formulated to provide a balance between efficacy and safety.<sup>4</sup>

The single largest area that deters industry from developing and commercializing new technologies is the registration process itself. The requirements for registration vary widely between countries and even between regions within a county and while certainly in place to ensure public safety, the slow and restrictive process of review of disinfectant submissions stifle the innovation process.<sup>4</sup> Furthermore, the testing requirements for registration lag behind the ever changing profile of HAI pathogens and advances in disinfectant test methodologies. The reality being that regardless of the strides and improvements made by industry in formulating more effective and safer disinfectants and regardless of the improvements made to the methods used to assess the microbial activity of a disinfectant, products cannot be brought to market without approval for sale by the various governmental agencies responsible for registration of disinfectants.<sup>4</sup>

### **The Need for a Quality Control/Assurance Program**

A number of well established studies have concluded that a wide range of environmentally stable HAI pathogens can be readily cultured from the patient’s environment including high touch surfaces and surfaces

closest to the patient. Additionally, several studies have confirmed that patients occupying rooms previously occupied by VRE, MRSA and C. difficile positive patients have a 73% increased risk of acquiring the same pathogen than patients not occupying such rooms.<sup>5</sup> With such staggering data positively correlating the effect a contaminated environment has on the risk of infection transmission has highlighted the need for studying the effectiveness of environmental cleaning in more detail. Several studies have concluded that only 40% of high touch surfaces are being cleaned according to hospital policies.

Additionally, researchers have documented that the thoroughness of disinfection cleaning can be improved to 82% with results in an average decrease in environmental contamination by 68% which directly results in the reduction of transmission of causative HAI pathogens.<sup>5</sup> In light of such supporting documentation, the CDC now strongly recommends that hospitals monitor cleaning performance to ensure consistent cleaning and disinfection of high touch surfaces and The Center for Medical and Medicaid Services now requires that infection prevention and control programs must include appropriate monitoring of housekeeping activities to ensure that hospitals maintain a sanitary environment.

Traditionally, such monitoring and evaluation has exclusively relied on the visual assessment of the cleanliness of surfaces and while this method may capture lapses in cleaning practice there is very poor correlation between what may look clean and what the actual level of microbial contamination is. Development of an enhanced quality control program that allows for objective evaluations and a more structured approach to monitoring needs to be implemented. Such a program should use an objective monitoring tool and includes repetitive monitoring on an ongoing basis by trained staff. When developing such a program, it is important to consider when the cleaning process of the

actual cleanliness of surfaces is to be monitored. Observation and fluorescent gel systems directly evaluate the cleaning process while swab or ATP bioluminescence systems measure cleanliness.<sup>5</sup> One of the most critical aspects of implementing such a program is to ensure it is developed as a joint blame-free project between Infection Prevention and Environmental Surfaces based on mutual understanding of the need to improve patient safety.<sup>5</sup>

## CONCLUSION

Healthcare-associated infections remain a patient safety issue and represent a significant adverse outcome of the provision of care. There is clear evidence that the environment around the patient influences the incidence of infection in hospitals and other health care settings. As highlighted by these and other studies, the importance of an environmental cleaning and disinfection program cannot be underestimated. The impact that cleaning and disinfection has as both a preventative measure for minimizing transmission of pathogens as well as part of the cure in controlling outbreaks and stopping environmental transmission of pathogens cannot be overlooked. The cost of HAIs is staggering. The need to ensure that both the infection prevention and control team and the environmental services team is provided the support and funding needed to develop, implement and monitor a cleaning and disinfection program that will help ensure that environmental transmission of pathogens is a must. It is clear that focusing efforts on stopping environmental transmission from the onset will save facilities money in the long run and improve patient safety outcomes. With the estimated annual cost of HAIs ranging from \$4.5 billion to \$11 billion, the relative cost associated to adequately funding an environmental services program to ensure the necessary staff and most effective tools and cleaner-disinfectant products are in place is but a drop in the bucket. As Carling et al indicated, improving the thoroughness of cleaning and disinfection can reduce environmental contamination by 68% which not

only has a direct result in reducing HAIs but more importantly a direct result in decreasing the costs associated with HAIs to the facility.