

# Biocidal Surfaces May be an Important Adjunct in the Arsenal of Measures to Fight Healthcare-Acquired Infections

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## Editorial

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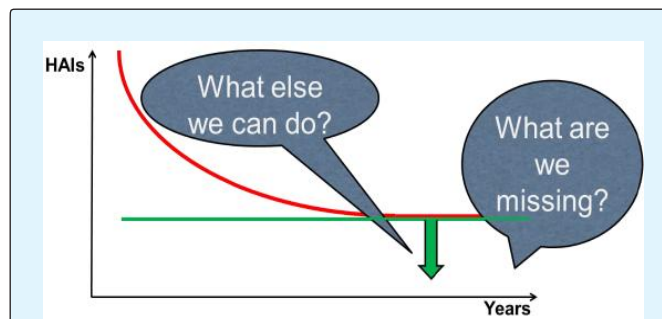
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## Editorial

Healthcare-acquired infections (HAIs) pose a critical threat to patients and have become a significant medical concern, especially as many microorganisms have developed high resistance to the existent antibiotics armory. Even in countries and settings where extensive infection control measures are routinely implemented, the risk of contracting HAIs by all types of microorganisms is very high. It is assessed that millions of people worldwide acquire a HAI each year. These infections contribute significantly to morbidity, mortality and hospitalization costs. For example, in the USA it is estimated that HAIs cause or contribute to ~100,000 deaths and add annually ~\$10 billion in additional healthcare expenses [1-3]. The risk of contracting a HAI in a clinical setting is extremely high, especially in developing countries. For example, the HAI rate reported for intensive care units in Morocco was 50%, in China 26.8%, in Turkey 29.1%, in Argentina 27%, in Mexico 24.4%, in India - 33.3%, in Jordan between 14.2 to 73.5%, and in Brazil between 8.3% to 60.8% [4-13].

In order to reduce HAI rates, aggressive measures have been implemented over the years by many medical entities. These include monitoring and isolation of infected patients, improved disinfection and hygiene regimens, increased number of nurses and infection control personnel, increased healthcare staff education, use of disposable equipment, and use of aggressive antibiotic control programs. These measures have resulted in significantly lower HAI rates; however, no elimination of HAI has been achieved even in settings where these infection control measures were rigorously implemented (Figure 1), and in many medical centers the HAI rates are still unacceptably high. It is clear that the current modalities to eliminate HAIs are not sufficient and

additional ways to fight HAI need to be taken into consideration. What are we missing and what else can we do?



**Figure 1:** Although rigorous infection control measures are being implemented it clear that the current modalities eliminate HAIs are not sufficient.

There is increasing evidence that contaminated non-intrusive soft and hard surfaces located in the clinical surroundings serve as a reservoir for nosocomial pathogens, which may then be transmitted to patients through contact and aerosolized particles (reviewed in [14]). The transmission may be direct or indirect. For example, patients may contaminate themselves directly by touching contaminated surfaces. Hospital personnel, even when using protective equipment such as gloves, may contaminate themselves by touching contaminated solid surfaces or textiles and then indirectly transfer the microorganisms to the patients. There is a clear correlation between the environmental bioburden present in a clinical setting and the risk of patients acquiring an infection [15-21]. Most common nosocomial

pathogens may persist on surfaces for months and can be a continuous source of microbial transmission [22,23].

Improved hygiene and better environmental decontamination contribute to control of epidemic and endemic transmission of many microorganisms, including antibiotic resistant and/or spore-forming bacteria, such as vancomycin-resistant enterococci, methicillin-resistant *Staphylococcus aureus*, and *Clostridium difficile* [24,25]. However, cleaning and disinfection do not always eradicate pathogens from surfaces [18,20]. Furthermore, the hospital environment is complex and often difficult to clean and the use of a cleaning agent that is not effective against the target organism can spread pathogens to other surfaces [14]. Only some of all hospital surfaces are routinely cleaned and enhanced surface cleaning practices in healthcare settings are difficult to sustain. Other approaches to eliminate environmental contamination, such as the use of ultraviolet irradiation and chemical fumigation, have significant limitations, for instance the need to remove the room occupants, and present safety risks [25].

A relatively new approach to overcoming the limitations of cleaning and disinfecting, and serving as an adjunct measure in the fight against environmental contamination and HAIs, is the use of self-disinfecting biocidal innate surfaces, especially those surrounding the patients [26-28]. The use in medical environments of surfaces containing copper or copper oxide has been found to reduce bioburden and the transmission of nosocomial pathogens [29-33]. For example, use of copper alloys surfaces in different clinical settings resulted in the reduction of bioburden from 58% to 98% as compared to matched controls. Furthermore, in a multi-center trial in which patients were randomly placed in rooms with or without copper alloy surfaces, there was a 58% reduction ( $P=0.013$ ) in the rate of HAI [30]. Methicillin-resistant *Staphylococcus aureus* (MRSA)/Vancomycin-resistant enterococci (VRE) patient colonization was found to be significantly lower by 42% in the copper arm of the study than in the control arm ( $P=0.02$ ). More recently, the use of linens, such as sheets, patient robes, patient pyjamas, and towels, containing copper oxide particles, has been found to reduce HAIs in several different clinical settings [34-37].

The use of self-disinfecting surfaces does not require special maintenance or personnel training, change in the routine work of the ward personnel and in the many measures already being taken to fight HAIs. Thus it may be an important adjunct to the arsenal of measures to fight Healthcare-Acquired Infections.

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