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Antimicrobial Medical Textiles Used in Clinical Settings May Play an Important Role in Reducing Healthcare-Acquired Infections

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Editorial

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Abbreviations: HAI: Healthcare-Acquired Infection; VRE: Vancomycin-Resistant Enterococci; MRSA: Methicillin-Resistant *Staphylococcus aureus*.

Editorial

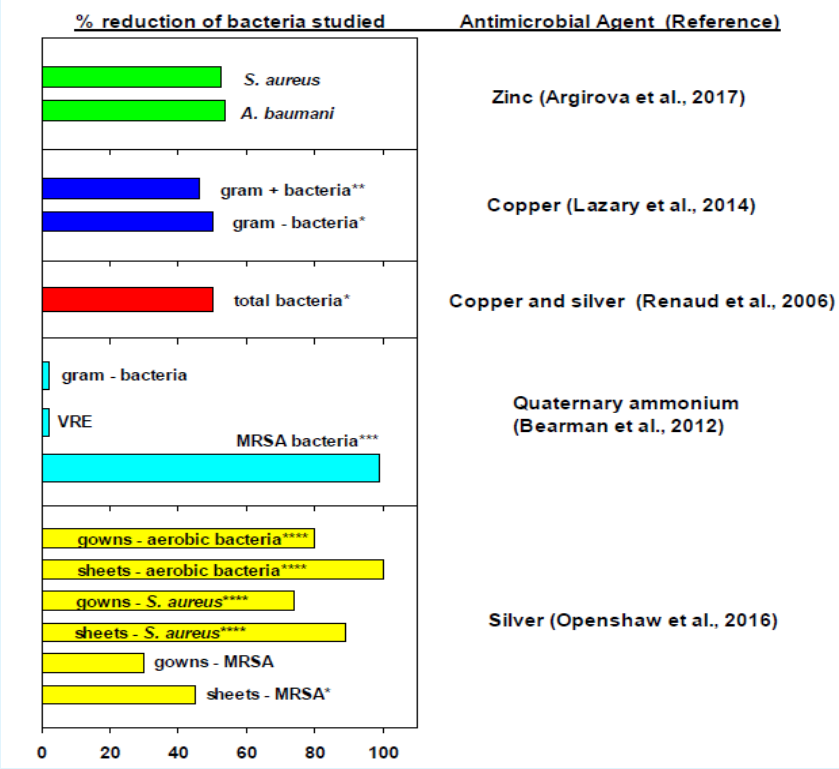
Millions of individuals worldwide acquire a Healthcare-acquired infection (HAI) each year, making HAIs a global problem contributing significantly to mortality, morbidity, and hospitalization costs, especially as many pathogens have developed high resistance to the existent antibiotic arsenal [1]. The association between HAIs and environmental contamination within the healthcare environment is now well established [2,3]. It has become clear that contaminated surfaces contribute to the transmission of different pathogens such as *Clostridium difficile*, vancomycin-resistant enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), *Acinetobacter baumannii*, *Pseudomonas aeruginosa* and norovirus [2,4]. It has also become clear that decontamination of the contaminated surfaces contributes to the reduction of nosocomial infection outbreaks [3]. However, decontamination of contaminated surfaces is not always effective and even the effect of thorough cleaning can be short lived [5,6].

Copper has potent wide spectrum biocidal properties [7,8]. It has been shown in several laboratory and clinical studies that the incorporation of metallic copper or copper oxide particles into inanimate surfaces, such as countertops, knobs, and handles, significantly reduces bioburden as compared to non-biocidal respective surfaces [9-18]. The biocidal activity of copper was demonstrated against an array of healthcare-associated pathogens such as *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Acinetobacter baumannii* and *Clostridium difficile* [12,19]. Furthermore, the biocidal efficacy was also demonstrated against antibiotic resistant pathogens, such as MRSA, VRE, carbapenemase-producing Gram-negative bacteria and several multi drug resistant pathogens [20,21]. In two studies, the use of copper hard surfaces, such as the inanimate surfaces mentioned above, resulted in statistically significant reduction of HAI rates [22,23], while one study found that exposure of pediatric patients to copper-surfaced objects resulted in decreased HAI rates as compared to exposure to non-copper surfaces; however, the relative risk reduction did not reach statistical significance [24].

As of today, only copper alloys and polymeric surfaces containing copper oxide microparticles have received EPA approval to make public health claims (EPA registrations 85012, 1-6 and 84542-7, respectively) and thus in many hospitals metallic copper and polymeric surfaces containing copper oxide microparticles are being installed in frequently touched surfaces [25]. We and others have postulated that the immediate inanimate surfaces in direct contact with the patients play a very significant role in HAIs [26,27], more than the surfaces in indirect contact with the patients [28,29]. This was based on the following main observations: humans shed bacteria directly from their skin and other areas onto the textiles they use. Spillages and body exudates, such as blood, stool, urine, and other secretions, all of which can contain large amounts of bacteria that may come in direct contact with

hospital textiles. Textiles are an excellent substrate for microbial proliferation when in contact with the human body. The moisture and temperature conditions present between the skin and the textiles and the very large surface area, provide an ideal environment for microbial proliferation. Indeed, heavy microbial colonization of sheets, patient pajamas and healthcare worker uniforms, including by antibiotic resistant bacteria, has been reported [26,28-32]. Some microorganisms remain viable on textiles, even after industrial laundry, for very prolonged periods of time, even months, under ambient temperature and humidity [33,34].

The microorganisms that multiply or remain on the textiles can be a source of healthcare-acquired pathogens. These pathogens can be transmitted via endogenous route (i.e. from one part of the host's body to another), via a direct or indirect route (through surfaces in indirect contact with the patients) to other patients and hospital personnel, and via aerosol transmission [28,29,35,36].The notion that hospital linens and patient and personnel clothing play an important role in HAIs has gained recognition since then [37,38]. We have also hypothesized that biocidal surfaces in direct contact with the patient, such as the linen, pajamas, and robes, may play a significant role in reducing the spread of pathogens and the risk of HAI in the clinical environment by reducing bioburden [28,29]. Today many wide spectrum antimicrobial agents are introduced into medical textiles endowing the textiles with antimicrobial properties [37]. Several studies have been conducted in clinical settings with antimicrobial textiles in which their capacity to reduce bioburden and HAIs have been examined. Figure 1 summarizes the studies conducted in clinical settings with different antimicrobial medical textiles [39-43], all of which demonstrated reduction of bioburden of all or some of the microorganisms studied.



*p<0.05; **p<0.01; ***p<0.001; ****p<0.0001 When there is no specification either the p value was not reported or there was no statistically significant difference between the arms studied.

Figure 1: Reduction of bioburden by antimicrobial medical textiles in clinical settings.

More importantly, several studies [23,39,42,44-49] conducted with antimicrobial medical textiles (mostly medical textiles containing copper oxide), with exception of one study, demonstrated a significant reduction of HAIs in the study arm using the antimicrobial medical textiles (Figure 2).

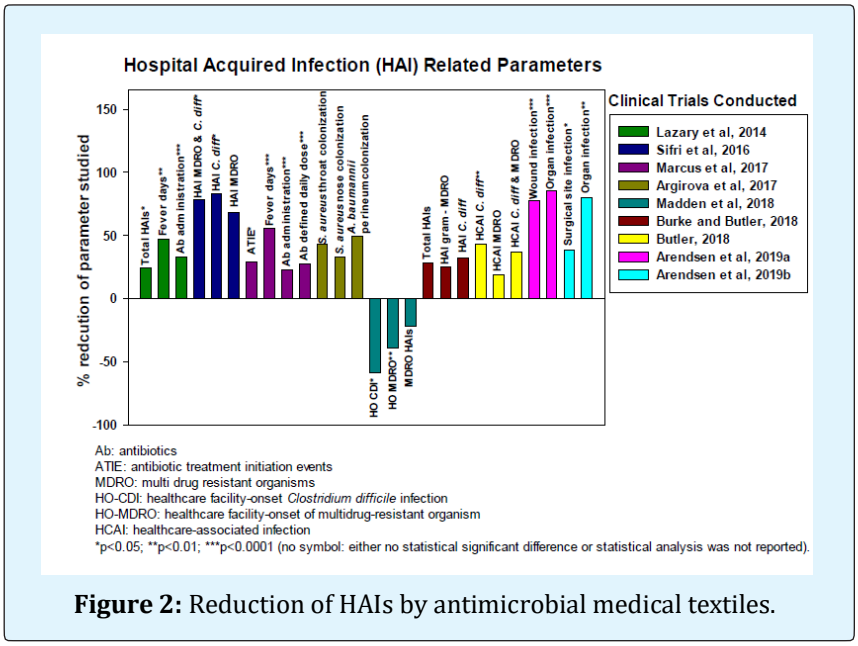


Figure 2: Reduction of HAIs by antimicrobial medical textiles.

While additional studies may be needed to better understand the effect of antimicrobial medical textiles and reduction of HAIs in different medical settings, the described studies in Figures 1 and 2 overall have given significant support to the notion that biocidal textiles used in clinical settings may be an important adjunct in the fight against HAIs.

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