

In-Vitro Evaluation of a Shoe-Sole Microbial Decontamination Device

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ABSTRACT

Background: Shoe sole bottoms are commonly contaminated with bacterial pathogens that can be transmitted to healthcare environments and cause subsequent healthcare associated infections (HAIs). Ultraviolet light C (UVC) is used in hospitals to decontaminate hospital rooms, but data on UVC decontamination of shoe soles are scarce. The objective of this study was to evaluate the efficacy of a UVC-based microbial decontamination device on shoe-soles spiked with *Enterococcus* bacteria.

Method: A randomized, blinded, laboratory-based trial was conducted to determine the efficacy of an UV germicidal device, HealthySole Plus (HealthySole LLC, Minden NV) to reduce *Enterococcus faecalis* (*E. faecalis*) on shoe soles. Known concentrations of *E. faecalis* were spiked on shoe soles, incubated (1-hr), and then shoes were randomized 1:1 to UVC exposure (8 second exposure) or no UVC exposure (controls). Shoes were then swabbed, bacterial suspension prepared and serially diluted, plated onto *Enterococcus* agar, incubated aerobically for 48 hours, and counted (colony forming units/mL (CFU)). Investigators who prepared the spiked shoes and evaluated CFU counts were blinded to the intervention. Log reduction in CFU counts were compared between UVC exposed shoes and controls.

Results: Fifty pairs of shoes were spiked with 10^6 to 10^9 /ml concentration of *E. faecalis* (80 shoe samples). A 2.31 log reduction in *E. faecalis* CFU count was observed in shoes exposed to UVC light compared to control shoes ($p < 0.05$). Similar log reduction differences were observed at different spiked concentrations.

Conclusion: Shoe sole exposure to an UVC device for 8 seconds was effective in reducing Enterococci contamination on shoe soles. This result suggests that UVC devices targeting shoe soles may be able to reduce shoe sole transmission of pathogenic bacteria to hospital environs and prevent HAIs.

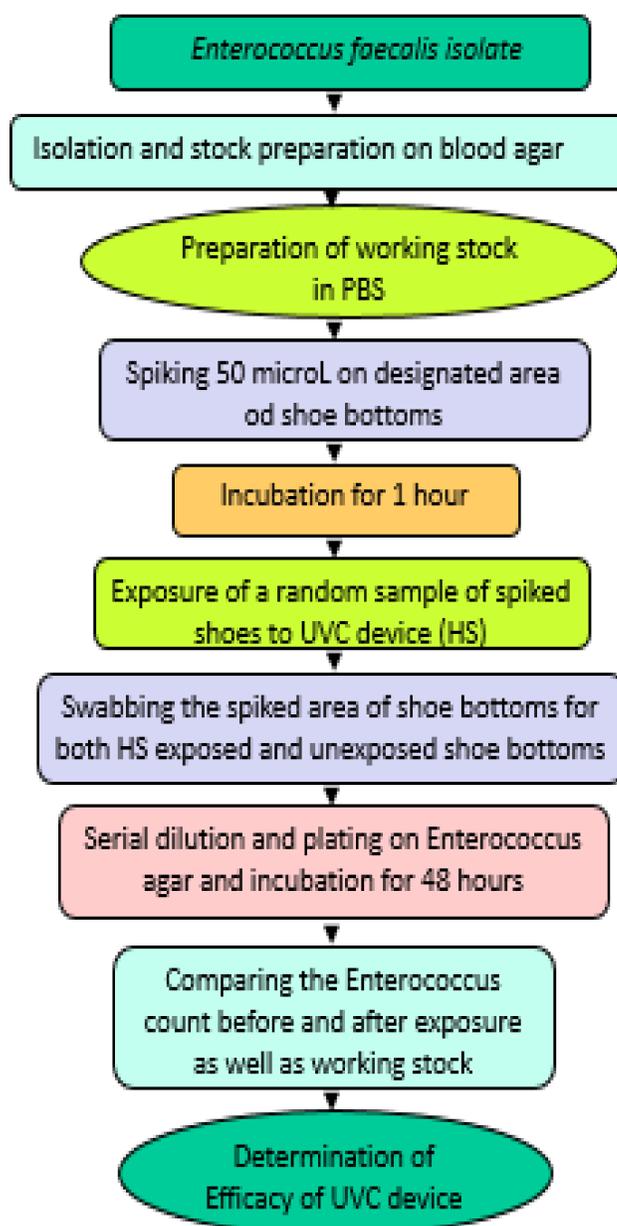
BACKGROUND

- ❖ Healthcare associated infections (HAIs) are one of the leading cause of morbidity and mortality in US and worldwide (1 out of every 25 patients)
- ❖ HAIs account for \$25 to \$31.5 billion health care cost each year.
- ❖ Shoe-soles have been found to be highly contaminated with various microbial pathogens and are an important source of HAIs
- ❖ Effective cleaning of shoe soles may be an important strategy in primary prevention of various HAIs including Vancomycin resistant Enterococci (VRE)
- ❖ Currently there is no effective decontamination strategy for shoe-soles

OBJECTIVE

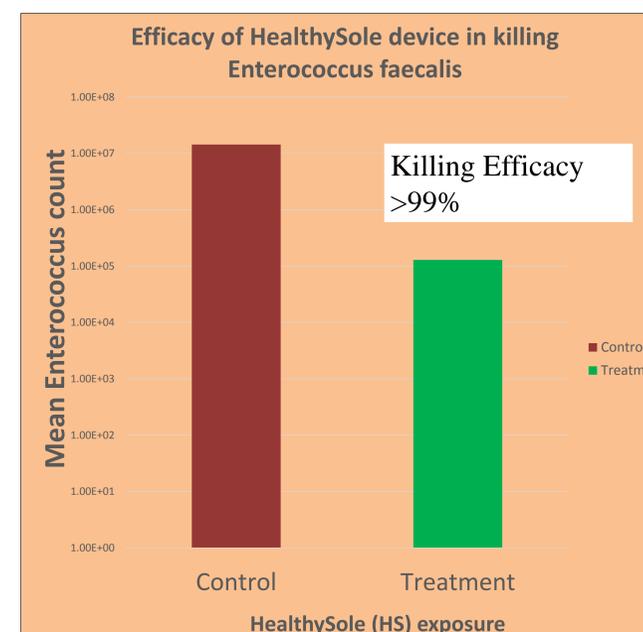
To determine the in vitro efficacy of an UVC based device in decontaminating shoe-soles spiked with *Enterococcus faecalis*

METHODS



RESULTS

Figure 1: Efficacy of UVC device



HealthySole (HS) Plus Device



Device Specification

- ❖ UVC lamp with plasma stable and plastic encapsulated technology
- ❖ UV view top plate reflects and retracts UV rays for effective killing
- ❖ Disinfection time – 8 sec
- ❖ Shoe sole disinfection

UVC – Ultraviolet radiation with wavelengths between 200 and 290 nm

SUMMARY

- ❖ A 2 log recovery difference was observed between working stock *Enterococcus faecalis* count and post exposure count from unexposed shoe soles
- ❖ A 2.31 log reduction was observed between HS exposed and unexposed shoes
- ❖ A student's T-test comparing the difference in the mean *Enterococcus* count in HS arm vs. no HS arm was found to be significant ($P=0.0053$)
- ❖ This trend in reduction of *Enterococcus* count was found to be consistent at different spiked concentration

CONCLUSION

- ❑ This randomized control trial indicated that UVC based devices may be able to prevent the transmission of various bacteria including Enterococci through contaminated shoe soles.
- ❑ The UVC based shoe decontamination devices may have an important role in the control of Hospital acquired infections (HAIs)

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