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Computer Keyboard Covers Impregnated with a Novel Antimicrobial Polymer Significantly Reduce Microbial Contamination

Natalie D'Antonio, M.S., John D. Rihs, B.S., Melissa Tosiano, B.S., Janet E. Stout, Ph. D.[1,2]
[1] Special Pathogens Laboratory, Pittsburgh, PA [2] University of Pittsburgh, Pittsburgh, PA

SPL
1401 Forbes Ave
Suite 209
Pittsburgh, PA 15219
T-(412) 281-5335
F-(412) 281-7445

Abstract

Contact with contaminated computer keyboards may contribute to the transmission of healthcare-acquired infections. A novel antimicrobial polymer (Biosafe HM 4100) can be incorporated into a variety of materials, including the polyurethane (PU) used to make keyboard covers. The study objective was to determine whether plastic keyboard covers compounded with HM 4100 effectively minimize the survival of bacterial species commonly present on environmental surfaces in the healthcare setting.

Polyurethane material with and without HM 4100 was obtained from the manufacturer (Biosafe, Inc. Pittsburgh, PA). Suspensions of approximately 1.5E+07 cfu/mL of four test organisms was prepared and 40 µL of the organism suspension was placed onto the material. Test organisms included *Staphylococcus aureus*, methicillin resistant (MRSA), ATCC No. 43300; *Enterococcus faecalis*, vancomycin-resistant (VREF), ATCC No. 51299; *E. coli*, ATCC No. 25922; *P. aeruginosa*, ATCC No. 27853. A cover-slip was placed on top of the inoculated material and viable bacteria were recovered after 0, 60, 120, and 240 minutes. The cover-slip and test material were placed in Ringer's solution and vortexed, and dilutions were plated on blood agar and enumerated.

All four test organisms showed a reduction in viability over the 240 minute time period. Percent reduction in viability at T= 240 min. on the test material compared to the PU control for MRSA, VREF, *E. coli* and *P. aeruginosa* was 97.8%, 95%, 99.999%, and 92.1% respectively.

Comparison of the percent reduction on the test material at T= 0 vs. T=240 min. was 99.8%, 99.9%, 100%, and 91.9% respectively.

The polyurethane material compounded with Biosafe HM 4100 demonstrated efficacy in reducing the number of viable bacteria over time. These data suggest that incorporation of HM 4100 into computer keyboard covers could reduce the transmission of infections due to hand carriage by healthcare workers during contact with contaminated computer keyboards.

Background

Contaminated computer keyboards have been acknowledged as a potential source for bacterial transmission between healthcare providers and patients, contributing to the high rate of healthcare-associated infections. Biosafe HM 4100 is an antimicrobial polymer that can be incorporated into the polyurethane material used to make keyboard covers. Consequently, a keyboard cover compounded with Biosafe HM 4100 has the potential to minimize disease transmission within the healthcare environment, specifically in high risk units. The efficacy of a keyboard cover compounded with the antimicrobial polymer was tested by inoculating its surface with each of four organisms commonly encountered in healthcare environments: methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus faecalis* (VREF), *E. coli*, and *P. aeruginosa*. Recovery of viable bacteria at various time intervals after the initial inoculation revealed bacterial reduction per each organism over time.

Objective

Demonstrate that Biosafe HM 4100 compounded into polyurethane (plastic) keyboard covers can provide an antimicrobial surface that minimizes bacterial survival.

Materials and Methods

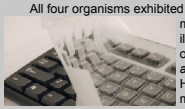
0.5 McFarland suspensions (approx. 1.5E+08 cfu/mL) of each organism (MRSA, ATCC No. 43300; VREF, ATCC No. 51299; *E. coli*, ATCC No. 25922; and *P. aeruginosa*, ATCC No. 27853) were prepared in 1:40 Ringer's solution. The concentration was verified by performing a viable count assay. The suspension was then diluted 1:10 to yield approximately 1.5E+07 cfu/mL inoculums.

Polyurethane material squares with and without Biosafe HM 4100 were provided by the manufacturer (Biosafe, Inc. Pittsburgh, PA) and separately inoculated with 40 µL of each of the 1.5E+07 cfu/mL organism suspensions. A 22 mm x 22 mm cover-slip was placed on top of each inoculated material surface. The recovery of viable bacteria occurred immediately following inoculation (T= 0 min.), sixty minutes after inoculation (T= 60 min.), 120 minutes and 240 minutes after inoculation (T= 120 min. and T= 240 min., respectively).

Recovery consisted of placing each cover-slip/material pair into a tube containing 5 mL of 1:40 Ringer's solution and manually separating the cover-slip from the material. The recovery tube was then vortexed on high for 30 seconds, dilutions plated on blood agar plates (Remel), and colonies enumerated after an overnight incubation at 35ºC.

Results

All four organisms exhibited a reduction in viability over the 240 minute time period. Figures 1 through 4 illustrate the log recovery of the test organisms MRSA, VREF, *E. coli*, and *P. aeruginosa*, respectively, on the Biosafe HM 4100 material versus the control material at the recovery times.



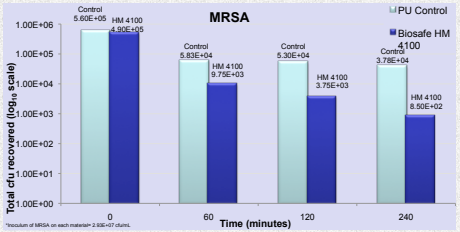


Figure 1: 97.8 % reduction of viable MRSA on Biosafe material at T= 240 min.

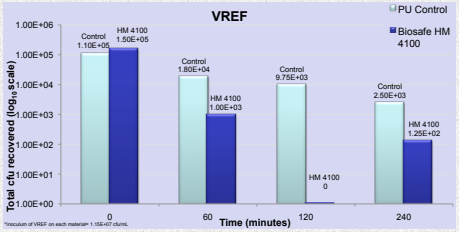


Figure 2: 95% reduction of viable VREF on Biosafe material at T= 240 min.

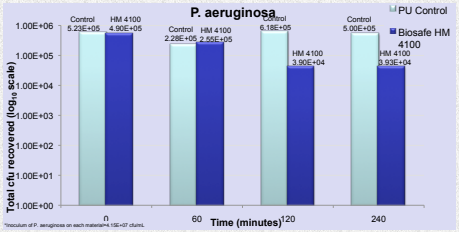


Figure 3: 92.1% reduction of viable *P. aeruginosa* on Biosafe material at T= 240 min.

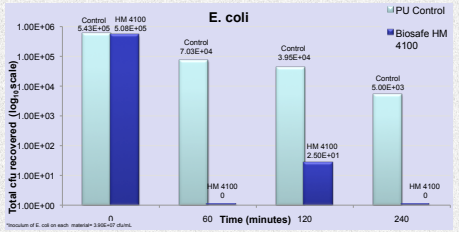


Figure 4: 99.999% reduction of viable *E. coli* on Biosafe material at T= 240 min.

Conclusions

The polyurethane material compounded with Biosafe HM 4100 demonstrated efficacy in reducing viability for all four test organisms. *P. aeruginosa* may be more resistant to the bactericidal properties of the antimicrobial polymer.

Discussion and Implications

Contaminated computer keyboards can be a potential source for bacterial transmission between healthcare providers and patients. The rank order of highest to lowest reduction in viability at T= 240 min. was *E. coli* > MRSA > VREF > *Pseudomonas*. Computer keyboards compounded with Biosafe HM 4100 could reduce the transmission of pathogens due to hand carriage during contact with contaminated computer keyboards.

References

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