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Protective Environmental Surface Barriers in Health Care

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Until recently, environmental surfaces were thought to have only a low risk for transmission of microbial pathogens in health care settings. In recent years, however, published clinical data have implicated contaminated surfaces in the cross-infection of a variety of microorganisms, including methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile,* vancomycin-resistant enterococci (VRE), and norovirus.[1-3] While there have not been any clinical investigations to date showing cross-infection from dental environmental surfaces, numerous reports are present in the literature showing that a wide variety of viruses and bacteria are able survive for extended periods on inanimate surfaces.[4-6]

There are two effective approaches to reduce the potential for cross-contamination and cross-infection from environmental surfaces in dental and other healthcare settings. These involve either the application of barrier covers to prevent surfaces from becoming contaminated, or cleaning and disinfecting environmental surfaces after contamination occurs. When a surface is too difficult to clean with a chemical spray or wipe, the application of surface covers could provide a more useful solution. Single-use disposable covers can be found in a variety of forms, including clear plastic wrap, bags, sheets, and plastic-backed paper. Among other positive features, covers can limit the number of surfaces that must be cleaned and disinfected, save time between patient appointments, and be impervious to microbial contamination and colonization **(Table 1).**

A **major requirement** for utilizing surface covers in clinical settings is that they should be resistant to penetration by moisture. A variety of single-use, impermeable barriers have become available in recent years, and yet not long ago commercial dry cleaning bags and waste can liner bags were considered acceptable choices and used. Many of these thinner, non-healthcare products appeared to protect only because they visually covered surfaces exposed to spatter, aerosols, and contact biological debris. However, the question that needs to be answered is: do covers manufactured for use in healthcare settings provide a more effective barrier than commercial dry cleaning and waste container covers when challenged with fluids containing suspensions of viable microorganisms? Any material sold and intended to be used as a surface barrier in patient care areas should have demonstrated evidence of impermeability. To investigate this feature, the present study evaluated two types of dental environmental surface covers manufactured for use in clinical settings, and compared them against commercial dry cleaning bags and waste container bags when challenged with laboratory-prepared, contaminated microbial fluids.

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Fresh cultures of methicillin-resistant *Staphylococcus aureus* (MRSA) ATCC #33591 were prepared daily in trypticase soy broth (TSB) and incubated at 37C for 18-24 hours. Sterile TSB (150mL) was placed in 250mL glass beakers with 1mL of the 24-hour bacterial culture. The final bacterial concentration in the beakers was calculated to be approximately 3 x 10^6 cfu/mL. Barriers were loosely positioned over the opening of each beaker and 10mL of sterile TSB was pipetted into the barrier allowing the central portion to immerse itself in the contaminated TSB (**Figure 1**). ***Pinnacle™ Headrest Barriers*** *(Kerr TotalCare)* and ***Pinnacle™ Arm Sleeve Barriers*** *(Kerr TotalCare)* were used as the test healthcare surface covers. Their ability to prevent fluid penetration was compared against test results using commercial dry cleaning and waste container bags. Immediately after the sterile TSB was applied, 1mL was collected, cultured on CHROMagar MRSA II, and incubated at 37C for 24 hours.

Table 1.
Consideration factors for use of environmental surface covers

- Reduce potential risk for cross-contamination
- Protect difficult-to-clean surfaces
- Single-use and disposable
- Less time-consuming than cleaning and disinfection
- Reduce use of potentially harmful chemicals
- Provide an impervious surface barrier

Figure 1. New barrier immersed in contaminated trypticase soy broth.

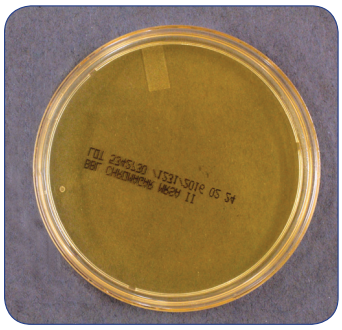

Figure 2. Negative MRSA culture; Kerr TotalCare Pinnacle Head Rest Covers at 120 minutes of exposure.

CHROMagar MRSA II is a growth media containing the antibiotic cefoxitin and chromogenic substrates. CHROMagar selects and specifically identifies MRSA (colonies appear mauve in color). In a similar manner as described above, test samples were collected at 30, 60, 90 and 120 minutes of exposure and then cultured. Any observed bacterial growth was analyzed and recorded. All testing was done in duplicate.

Following exposure to challenge bacteria, both *Kerr TotalCare* protective healthcare barriers effectively inhibited the transfer of MRSA from the contaminated TSB into the sterile TSB at all time points tested (**Table 2** and **Figure 2**). In contrast, bacterial suspensions were able to penetrate both trash bags and dry cleaning bags (non-healthcare barriers), resulting in contamination of the sterile TSB at all sample times (**Figures 3**-**4** and **Table 2**). In fact, small amounts of liquid were observed penetrating these latter experimental barriers within the first minute of exposure.

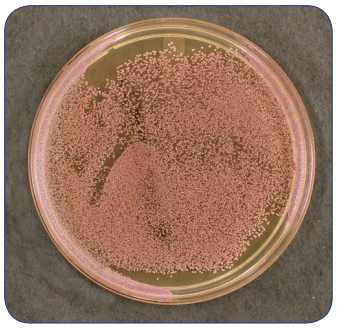

Figure 3. MRSA collected from trash bag test sample collected at time 0.

Figure 4. MRSA collected from dry cleaning bag test sample at time 0.

Discussion:

The use of surface barriers is useful in dentistry, especially if the surfaces are: a) frequently touched by gloved hands during patient care; b) likely to be contaminated with blood or other potentially infectious fluids, and c) difficult to clean and disinfect (e.g. chair control panels, air/water syringe buttons, and light handles). In this study we compared the barrier effectiveness of two commercially available healthcare covers and two non-healthcare covers following challenge with high concentrations of methicillin-resistant *Staphylococcus aureus* (MRSA). The barriers designed to be utilized in healthcare facilities, represented by *Kerr TotalCare's Pinnacle*™ barriers, reduce the risk of microbial penetration throughout the entire 120 minute experimental interval. In contrast, dry cleaning and waste container barriers failed immediately, as they were penetrated within the first moments of exposure. It should also be noted that no visible holes or punctures were observed in either the trash or dry cleaning bag samples used.

Table 2. Presence of MRSA in sterile TSB

	0 mins.	30 mins.	60 mins.	90 mins.	120 mins.
Pinnacle HR* cover	—	—	—	—	—
Pinnacle CS* cover	—	—	—	—	—
Trash bag	++	++	++	++	++
Dry Cleaning bag	++	++	++	++	++

*HR = head rest cover, CS = chair sleeve cover

Conclusion:

As shown in this study, choosing a reliable protective barrier for use in dental facilities, such as *Kerr TotalCare's Pinnacle*™ barriers, can provide far better protection from microbial contamination than that afforded with less impervious covers. The latest advancements in dental technology have also seen an increase in the number of sensitive medical devices and equipment that cannot be sterilized or immersed in cold sterilants, due to their heat sensitivity, incompatibility with chemicals, or complex design. Using barriers to protect surfaces and equipment can be a useful tool in a comprehensive infection control program.

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