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## Brief report

## Evaluation of two organosilane products for sustained antimicrobial activity on high-touch surfaces in patient rooms

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## Key Words:

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Inanimate environment

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A controlled trial of applying 2 organosilane-based products with antimicrobial properties to high-touch surfaces was conducted in 9 patient rooms. Cultures of surfaces obtained before daily cleaning with a quaternary ammonium disinfectant showed no significant residual antimicrobial activity of the organosilane products, although a modest reduction could not be excluded.

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Cleaning and disinfection of noncritical surfaces on a routine basis is recommended in health care facilities.<sup>1</sup> Cleaning practices are often suboptimal, and contaminated surfaces can lead to transmission of health care-associated pathogens.<sup>2-4</sup> Additionally, recontamination of surfaces in patient rooms most likely begins soon after daily cleaning has been completed. Products are available that claim to have sustained antimicrobial activity and decrease bio-burden between cleanings. New water-based organosilane compounds (composed of silicon and a quaternary ammonium moiety) are reported to covalently bond to surfaces and provide residual antimicrobial activity by inactivating bacteria that come into contact with the coated surface.<sup>5</sup> We investigated 2 organosilane products on surfaces in patient rooms to determine the duration of their antimicrobial activity and impact on environmental contamination.

## METHODS

We conducted a prospective observational study in a 500-bed, community teaching hospital. Nine high-touch sites were selected for sampling in each of 9 patient rooms on an in-patient

rehabilitation ward. The sites selected for inclusion (bedside rail, overbed table, television remote, telephone, door handle, dresser, toilet seat, bathroom grab bar, and sink faucet handles) have been considered high-touch sites in previous studies.<sup>6,7</sup> Each organosilane product was applied in 3 randomly selected rooms, and an additional 3 rooms served as controls. Trained personnel initially cleaned each site using a standard hospital-grade, 1-step, quaternary ammonium-based disinfectant (Quat) (Virex 256; Johnson Diversey, Sturtevant, WI). Each site was labeled to identify the product that was applied along with the original room location to ensure that each item could be identified if moved from the patient room during the study period. The Quat disinfectant was allowed to dry completely before applying the organosilane product. Organosilane products 1 and 2 (Eco Antimicrobial; Micro-Texpur, Conover, NC; and Bio-Protect AM500; PureShield, Inc, Jupiter, FL) were each applied following manufacturers' instructions and on-site direction to the 9 high-touch sites in 3 rooms using a saturated microfiber cloth. The Micro-Texpur product required pretreatment with a surface cleaner before the application of the product. No test product was applied to surfaces in the 3 control rooms. Each site, in all 9 rooms, was sampled daily for 4 weeks (Monday-Friday) beginning the day after product application, using D/E neutralizing contact agar plates (Remel Products, Lenexa, KS or Becton, Dickinson and Company, Franklin Lakes, NJ), immediately before daily cleaning with the Quat disinfectant. Sampling was conducted by 2 experienced hospital personnel (N.L.H. and K.A.G.) before daily cleaning to determine the amount of accumulation of aerobic bacteria on surfaces during the 24 hours since the previous day's cleaning. D/E contact plates were incubated at 37°C for 48 hours and aerobic colony counts (ACCs)

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Conflicts of interest: J.M.B. is a consultant to 3M Company, Bioquell PLC, and Clorox Company and has received research support from 3M Company, Clorox Company, and Lumalier. N.L.H. is a consultant to 3M Company. S.J.S. is a consultant to Crothall Healthcare and GOJO Industries. All remaining authors report no conflicts of interest.

were computed. The individuals collecting the samples and reading the results were not blinded to the study groups. Because of a skewed distribution of ACCs, log transform values were evaluated using a mixed-model analysis (SPSS Inc, Chicago, IL).

## RESULTS

During the 4-week study period, 1,587 of the 1,710 (92.8%) surfaces were available for sampling; the remaining 123 items were unable to be located or lost to follow-up because of staff frequently moving bedside furniture to meet patient needs. Of the 1,587 surfaces sampled, 432 samples were taken in rooms that were not occupied by a patient at the time of sampling and were not included in further analysis because these data would underestimate the level of bacterial bioburden that would occur when a patient is actively moving about the room. The mean ACCs for all sites for the 3 arms of the study are summarized in Figure 1. Mean log ACCs varied significantly among the 2 products and control rooms over the different surfaces ( $P < .001$ ). Neither product yielded lower mean ACCs than those observed in control rooms, for all sites, except the dresser and the faucet handles. Overall, mean ACCs were lowest for overbed tables, telephones, door handles, bedside dressers, and TV remotes and were highest on bedside rails, toilet seats, bathroom grab bars, and sink faucet handles. Based on Bonferroni adjusted follow-up tests, control rooms had lower ACCs than the test product rooms at the bedside rail, TV remote, and telephone. There were no significant effects for the other surfaces. A similar pattern was indicated if an ACC break point of  $<50$  colonies was evaluated dichotomously.

## DISCUSSION

To the best of our knowledge, ours is the first published controlled trial of applying organosilane compounds to high-touch surfaces in patient rooms as a strategy for reducing the level of microbial contamination of environmental surfaces between daily cleanings. Because both companies provided preliminary data suggesting that application of their products would inhibit accumulation of bacteria on environmental surfaces for weeks after

application, we did not perform any initial laboratory testing to confirm this. However, we found that the 2 organosilane products tested did not appear to have significant residual antibacterial activity on the surfaces as tested. Because the products were applied to surfaces by 2 experienced hospital personnel who observed company representatives demonstrate recommended application procedures, the lack of residual antimicrobial activity of the products in the present study was not related to failure to follow the manufacturers' instructions for product application. However, the unexplained lack of residual antimicrobial activity of the 2 compounds may have been due in part to several factors. The use of microfiber cloths saturated with the respective products to apply the compounds to the high-touch surfaces may have affected the amount of product delivered to test surfaces. Rutala et al<sup>8</sup> reported that "It is unclear whether the type of cloth (ie, cotton fiber mop or microfiber) used to apply the quaternary ammonium compound to the surface affected the concentration of the quaternary ammonium compound delivered to the surface. It has been shown in one study that cotton and cellulose-based wipers significantly absorb the quaternary ammonium compounds and do not release them to the surface." We are unaware of any published data on whether using a microfiber cloth to apply an organosilane product would affect the amount of product delivered to the surface. Of interest, preliminary studies conducted by one of the manufacturers had applied their product to hospital surfaces using a fogging technique, rather than a microfiber cloth. We favored using a cloth to apply these products to surfaces because this would more closely resemble normal housekeeping routines and be less disruptive than using a fogging technique for product application. A previous study by Baxa et al<sup>5</sup> of a different organosilane product that was applied to pieces of fabric and to Formica (Formica Corp, Cincinnati, OH) and stainless steel carriers yielded less than a  $1\text{-log}_{10}$  reduction in the majority of tests. The authors also concluded that the composition of surfaces to which it is applied, the method of applying the product, and the marker organism may affect the degree of antimicrobial activity observed. It is also possible that the organic material present in the health care setting is unlike that of a laboratory setting and may have had an effect on the antimicrobial activity of the products.

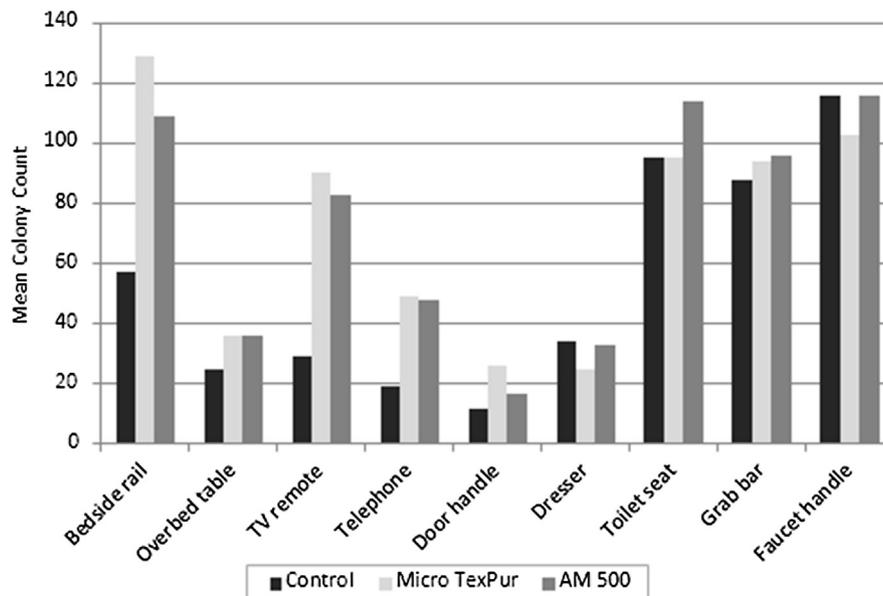


Fig 1. Mean aerobic colony counts (ACCs) for the 9 high-touch surfaces, for each of the 3 arms of the study.

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