Antimicrobial Efficacy Comparison of Floor Coverings

a report by
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Beth Joiner is Manager of Technical Sales and Services for the Georgia Laboratory of North American Science Associates, Inc. (NAMSA). She is responsible for advising clients on technical matters, preparation of routine and non-routine cost estimates and proposals and providing technical education, training and orientation to clients. Ms Joiner has 24 years of experience in the field of microbiology – four years with Custom Biologics and the Murray State University Diagnostic and Research Center and 20 years with NAMSA. She is a member of the Association for the Standard Testing of Materials (ASTM) and the American Association of Textile Chemists and Colorists (AATCC) RA31 Antimicrobial Test Methods committee and the American Society of Microbiology (ASM). Ms Joiner is a registered microbiologist with the National Registry of Microbiologists in the area of consumer products and quality assurance microbiology, pharmaceutical/medical devices/ cosmetics. She has published an article on determining antimicrobial efficacy in *Nonwovens Industry Magazine* and wrote a chapter, "Determining Antimicrobial Efficacy and Biocompatibility of Treated Articles Using Standard Test Methods", in the American Chemical Society (ACS) Symposium Series 792 *Bioactive Fibers and Polymers*. Ms Joiner holds a BSc Degree in Biological Sciences from Murray State University.

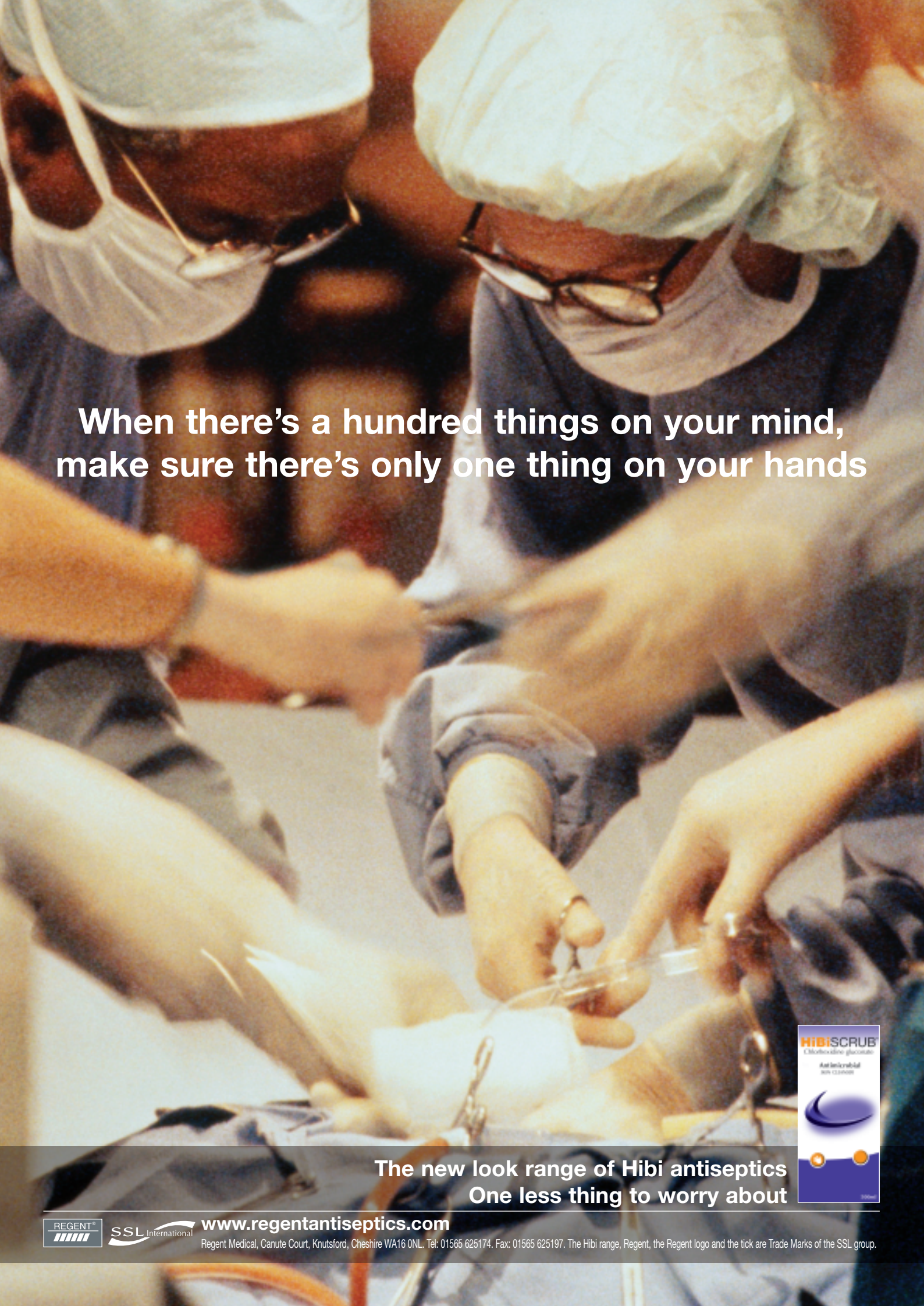
The purpose of this article is to determine which floor covering performed the best when challenged with multiple bacteria, mould and yeast. Antimicrobial efficacy testing was performed on four floor-covering samples: homogeneous polyvinyl chloride (PVC) sheet; medical-grade soft surface floor; linoleum sheet material with two coats of acrylic floor sealer and two coats of acrylic floor finish; and linoleum sheet material with factory finish.

The American Association of Textile Chemists and Colorists (AATCC) test method 100 was the test method used to determine antimicrobial efficacy of these floor coverings. This method provided a quantitative procedure to evaluate the antimicrobial activity and provided bactericidal data. The standard test method normally uses two test organisms, *Staphylococcus aureus* and *Klebsiella pneumoniae*. However, for the purpose of this study, the following organisms were used as challenge organisms: five bacteria, *Staphylococcus aureus* American Type Culture Collection (ATCC) 6538, *Klebsiella pneumoniae* ATCC 4352, *Pseudomonas aeruginosa* ATCC 9027, *Salmonella choleraesuis* ATCC 10708 and *Bacillus cereus* ATCC 11778, both vegetative and spores; two fungi, *Aspergillus niger* ATCC 16404 and *Stachybotrys chartarum* ATCC 9182; and one yeast, *Saccharomyces cerevisiae* ATCC 9763. A sample size of 48mm disc was cut for each test organism and sample type. The test sample was inoculated with a population of (1-2) x 10^5 colony-forming units per 0.1ml. The inoculum was covered with a piece of sterile film to allow intimate contact of the flooring surface with the test organism. One container with each floor type and each test organism was incubated for 24 hours. The bacteria were incubated at 37°C±2°C and the mould and yeast at 28°C±1°C. Duplicate containers of each floor type and each organism were tested to determine the population at zero time. Population at zero time was determined by adding a neutraliser solution to each container and plating serial dilutions. The serial dilution plates were incubated at 37°C±2°C for 48 hours for bacteria and 28°C±1°C for the mould and yeast.

The test containers that were incubated for 24 hours were removed from their respective incubators and the population of any remaining viable organisms was determined by adding a neutraliser solution to each container and plating serial dilutions. The serial dilution plates were incubated at 37°C±2°C for 48 hours for bacteria and 28°C±1°C for the mould and yeast.

All plates, both zero exposure time and 24-hour exposure time, were counted using a Quebec® Colony Counter. The per cent reduction of bacteria, fungi and yeast for each test sample was calculated by taking the average of the zero time count plus the count of the inoculum concentration and divided by two. Next, the count of each bacteria, fungi and yeast per sample from the 24-hour plates is subtracted from that average and that number is divided by the average and multiplied by 100 to get per cent kill. The test results show that each of the test samples mentioned, with the exception of the homogeneous PVC sheet, showed greater than 99% reduction against non-spore-forming bacteria. One exception, other than the homogeneous PVC sheet, was the medical-grade soft surface floor that demonstrated a poor reduction against the gram-negative *Pseudomonas aeruginosa*. The spore-forming *Bacillus cereus* showed good reduction in the vegetative state for all samples except the homogeneous PVC sheet. The spore state of *Bacillus cereus* showed good reduction for all samples except the homogeneous PVC sheet and moderate reduction for the linoleum sheet material with two coats of acrylic floor sealer and two coats of acrylic floor finish. The fungal results, specifically looking at the fungal count after 24 hours, compare very closely for all samples except the homogeneous PVC sheet. The test results for the yeast also compare very closely for all samples except the homogeneous PVC sheet when looking specifically at the yeast count after 24-hour contact.

In summary, the homogeneous PVC sheet was the only test sample that consistently showed no effectiveness against any of the challenge organisms. The medical-grade soft surface floor showed consistent results against bacteria but was not as effective in the kill of yeast and fungi. However, the other linoleum sheet material samples presented very comparable results and show that they prevent the growth of bacteria, both vegetative and spore-formers, as well as yeast and mould. ■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