sicians using any EMR system to be vigilant and provide constant feedback to improve this vital tool.

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Extrinsic Contamination of Liquid Soap with Various Gram-Negative Bacteria in a Hospital in Turkey

To the Editor—Because washing hands before and after direct contact with patients is the major component of infection control programs, microbial contamination of hand-washing soaps used in the hospital setting can present a challenge for infection control. Potentially pathogenic microorganisms, including diphtheroids, staphylococci, *Escherichia coli,* and *Klebsiella, Pseudomonas, Serratia, Aspergillus,* and *Candida* species, were found in bar soaps and their containers.[1,2] Not only bar soaps but also liquid soaps can be contaminated intrinsically during the manufacture or extrinsically during use, particularly by gram-negative bacteria.[3,4] Staphylococci are isolated more often from bar soaps rather than liquid soaps. Gram-negative bacteria are isolated from liquid soaps, including those that contain antibacterials.[3-5] *Klebsiella pneumoniae* contaminated chlorhexidine-containing soap, *Pseudomonas aeruginosa* contaminated triclosan-containing soap, and *Serratia marcescens* contaminated chlorxylenol-containing soap, in several studies investigating infection outbreaks.[3,4,6] *S. marcescens* was associated with hospital infections and infection outbreaks following contamination of soap, particularly in critical patient groups, such as newborns and transplantation recipients.[4,7,8]

In this study, we aimed to evaluate the microbial contamination of "in use" soaps and the clonal relatedness of the soap-contaminating microorganisms in our hospital, a 450-bed university hospital in Turkey. This research was performed with the approval of the university's Training and Research Hospital Ethics Committee. We performed cultures of samples from 383 soaps that were in use in our hospital during a 1-week period. For each soap included in the study, we used a form to indicate the type of soap (liquid or bar), the unit and the room in which the soap was used, the date and hour at which samples for culture were taken, the time the container was last replenished with fresh soap, and the population using the soap. Bacterial and fungal cultures were performed. The clonal relatedness of the isolates obtained from soaps was assessed using pulsed-field gel electrophoresis (PFGE) of the genomic DNA, as described elsewhere.[9] Statistical analyses were performed with SPSS, version 11.0 (SPSS), using the χ^2 test.

Of the 383 soaps, 378 were liquid and only 5 were bars. Also, 361 of the samples were from soap in general use (which does not contain a germicide), and the remaining 22 samples were from the private soaps of patients. Bacterial growth was found in 44 (11.4%) of the soaps (all liquid); 1 bacterial isolate came from an antibacterial-containing private liquid soap of a patient. A single microorganism was isolated from 43 of the 44 positive samples, whereas one yielded 2 different bacteria. No growth was observed on fungal cultures. No contamination was found in the original container or the plastic cans used to distribute the soap, demonstrating extrinsic contamination of the soaps during use. The organisms isolated from the soaps were *P. aeruginosa* (16 isolates), *Enterobacter aerogenes* (9), *E. coli* (8), *K. pneumoniae* (6), *Enterobacter cloacae* (3), *S. marcescens* (2), and *Klebsiella oxytoca* (1).

By unit, the proportion of samples that yielded microorganisms on culture was as follows: 6 of 16 from the ophthalmology ward, 6 of 15 from private clinics, 4 of 9 from the dermatology ward, 3 of 16 from the pediatrics ward, 3 of 20 from the physical medicine and rehabilitation ward, 3 of 39 from the obstetrics and gynecology ward, 2 of 9 from the emergency department, 2 of 5 from the gastroenterology ward, 2 of 10 from the dialysis unit, 2 of 7 from the cardio-

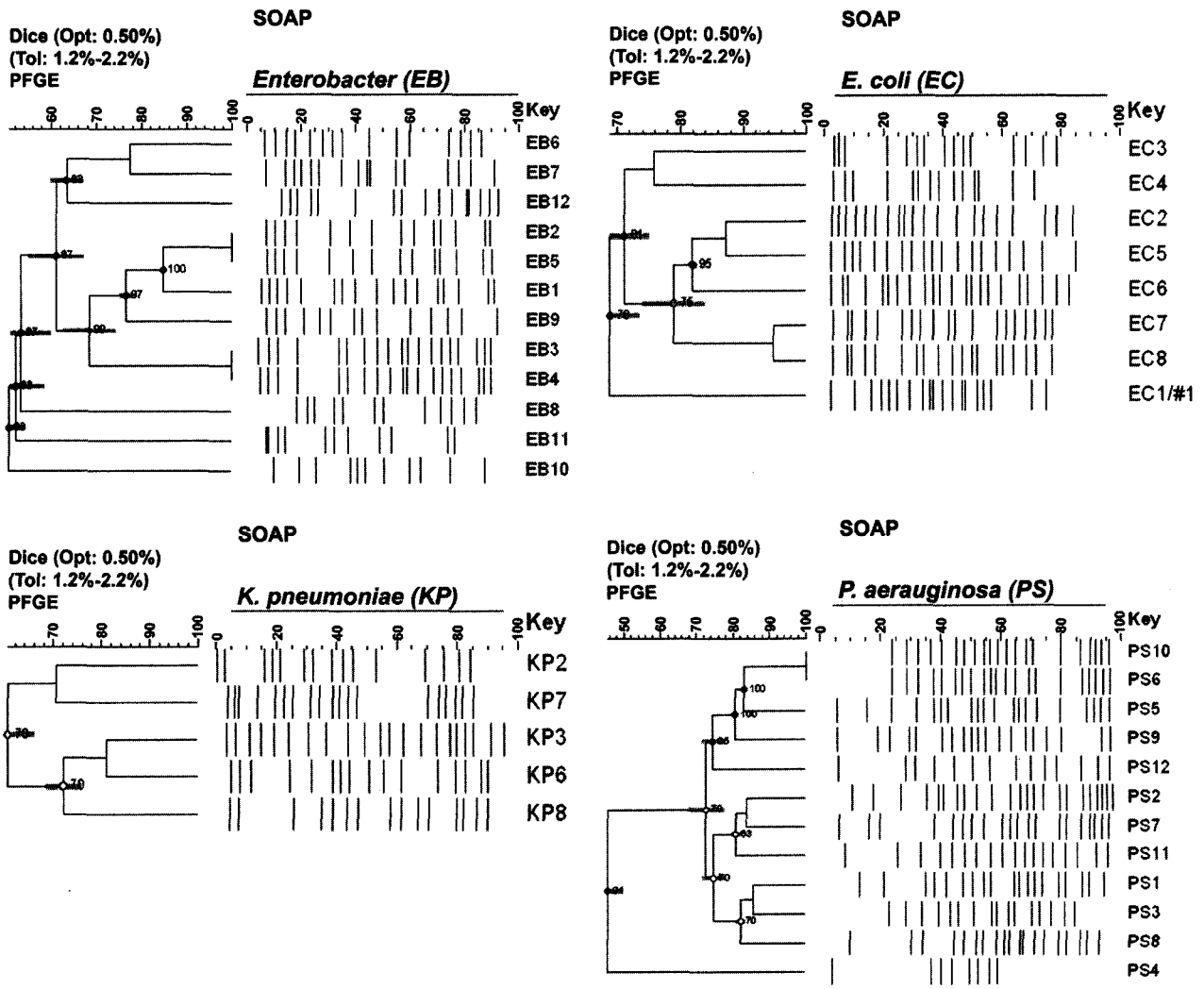

FIGURE 1. Banding patterns determined by pulsed-field gel electrophoresis (PFGE) and dendrograms showing the clonal relatedness of the isolates obtained from soaps. There was no evident cluster among the isolates in each genus. Results are shown for *Enterobacter* species, *Escherichia coli, Klebsiella pneumoniae,* and *Pseudomonas aeruginosa.* Dice, Dice coefficient; Opt, optimization value; Tol, tolerance value.

vascular surgery wards, 2 of 4 from the nuclear medicine unit, 2 of 42 from the general surgery department, 1 of 13 from the intensive care unit, 1 of 16 from the internal medicine ward, 1 of 15 from the oncology ward, 1 of 19 from the pulmonary diseases ward, 1 of 4 from the psychiatric unit, 1 of 13 from the plastic surgery ward, and 1 of 9 from the otorhinology ward.

Bacterial growth was found in 29 (11.3%) of the 257 samples collected from midnight to 5:00 PM, whereas 14 (11.1%) of the 126 samples taken from 5:00 PM to 7:00 PM were culture positive; there was no significant difference with respect to sampling time ($P > .99$). We took 214 samples from patient rooms, and these cultures yielded 27 isolates; we took 26 samples from doctor rooms, and these cultures yielded 4 isolates. A total of 25 samples were taken from nurse rooms, and these cultures yielded 4 isolates. A total of 28 samples were taken from women's toilets, and these cultures yielded 2 isolates. We collected 24 samples from men's toilets, and these cultures yielded 2 isolates. Finally, we collected 66 samples from other places, and these cultures yielded 5 isolates. Although the difference was not significant ($P = .70$), the rate of contamination was lower in the toilets, where the circulation and replenishment of the soap was much faster than in the other rooms.

The results of the molecular studies with PFGE showed no evident cluster among the isolates in each genus (Figure 1); there were only a few isolates with indistinguishable profiles. The indistinguishable isolates (EB2/EB5 and EB3/EB4 among *E. aerogenes* isolates, EC7/EC8 among *E. coli* isolates, and PS6/PS10 among *P. aeruginosa* isolates) were collected from different wards and rooms; no epidemiological link could be demonstrated. The 2 *S. marcescens* strains obtained in the

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study were indistinguishable by PFGE and were isolated from the same ward (one from a patient room and the other from the men's toilet in the obstetrics and gynecology department). However, there were no reported hospital infections or outbreaks attributable to this microorganism in this ward in the 3 months before and the 3 months after the study period.

During the study, it was observed that some of the staff responsible for cleaning the units did not wash the containers during replenishment of the soap, and they refilled the containers before they were totally empty. Infrequent replenishment of soap in particular units was also observed. There were some containers with open or spoiled lids, especially in the toilets, that seemed to be another route for extrinsic contamination. The head doctor, the directors, the supervisors, and the staff were informed about the rate and risks of contamination in our hospital, and the staff were re-educated to prevent any hospital infection due to soap contamination.

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Hydrogen Peroxide Vapor Is Not the Same as Aerosolized Hydrogen Peroxide

To the Editor—We read with interest the letter by Po and Carling[1] calling for additional investigation of room decontamination processes. In their critique of the study by Barbut et al,[2] Po and Carling state that "the average residual *[Clostridium] difficile* contamination rate of 2.6% in 3 studies of hydrogen peroxide vapor (HPV) published to date is essentially identical to the 1.8% residual contamination found by Eckstein and colleagues."[1, p776] However, it is important to note that the study by Boyce et al[3] was conducted using Bioquell hydrogen peroxide vapor (HPV), and the studies by Barbut and colleagues and by Shapey et al[4] were conducted using the Sterinis aerosolized hydrogen peroxide (aHP) system. The Bioquell HPV system generates a vapor from 30% w/w hydrogen peroxide solution, which is sporicidal, active against a wide range of hospital pathogens, and an Environmental Protection Agency (EPA)–registered sterilant.[3,5] The Bioquell process produces hydrogen peroxide vapor (gas) with a particle size of less than 1 micron in size. Therefore, HPV is considered a fumigant by the EPA.[6] The vapor from this system is completely dispersed throughout the room, and at the end of the process, the HPV is broken down catalytically to water vapor and oxygen.[7]

In contrast, the Sterinis aHP system produces a fine mist by aerosolizing a solution containing 5% w/w hydrogen peroxide, less than 50 ppm silver ions, less than 50 ppm phosphoric acid, less than 1 ppm arabica gum, and 95% bi-osmotic water.[2] Because the product is applied as an aerosol composed of charged particles ranging from 8 to 12 microns in diameter,[2,4,8] it is likely that the EPA would consider this process to be a fogging application rather than a fumigation process (Timothy Dole, EPA; personal communication, January 6, 2009). After exposure, the aerosol is left to decompose spontaneously.[2,4]

Published literature indicates a substantial difference in the microbiological impact of the 2 systems. For example, a study by Andersen et al[8] demonstrated that 13% of 146 *Bacillus atrophaeus* biological indicators remained viable after exposure to 3 Sterinis aHP cycles; all biological indicators grew if fewer than 3 cycles were used. In contrast, *Geobacillus stearothermophilus* biological indicators are completely inactivated by 1 Bioquell HPV cycle and are routinely used to verify cycle efficacy.[3] In studies of in vitro efficacy against *C. difficile* spores, the Bioquell HPV system resulted in a more than 6-