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## Bacterial Contamination of Hospital Physicians' Stethoscopes

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### ABSTRACT

Because stethoscopes might be potential vectors of nosocomial infections, this study, conducted in a 450-bed general hospital, was devised to evaluate the bacterial contamination of stethoscopes; bacterial survival on stethoscope membranes; the kinetics of the bacterial load on stethoscope membranes during clinical use; and the efficacy of 70% alcohol or liquid soap for membrane disinfection. Among the 355 stethoscopes tested, 234 carried  $\geq 2$  different bacterial species; 31 carried potentially pathogenic bacteria. Although some bacteria deposited onto membranes could survive 6 to 18 hours, none survived after disinfection (*Infect Control Hosp Epidemiol* 1999;20:626-628).

Because stethoscope membranes might serve as a potential vector of infections from one patient to another,<sup>1-8</sup> we investigated the carriage of bacteria on stethoscopes in different departments of our hospital and the stethoscope cleaning practices of the physicians. In vitro studies were performed to determine bacterial survival on the membranes and the efficacy of disinfection.

## METHODS

### *Evaluation of Bacterial Contamination of Stethoscopes*

Of the 355 doctors working in our hospital whose stethoscopes were examined, 237 responded to questions on their cleaning practices. During the workday, stethoscope membranes were gently pressed onto blood agar plates, which were then incubated for 24 hours at 37°C. Colony-forming units (CFU) of various species growing on the plate surface were counted. Bacteria were isolated (gram-negative bacteria on Drigalski plates, gram-positive cocci on Chapman plates; Pasteur Diagnostics, Marne-la-Vallée, France). Bacteria were identified (API Identification System, bioMérieux Diagnostics, Marcy l'Etoile, France) and subjected to susceptibility testing.

### *Bacterial Survival on Stethoscope Membranes*

Survival of bacteria on UV-sterilized stethoscope membranes was evaluated. Membranes were inoculated with *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Klebsiella pneumoniae*, or *Escherichia coli*. For each strain, 100 µl of a bacterial suspension (10<sup>4</sup> CFU/mL, reflecting the numbers found in kinetic study, see below) was spread on seven identical membranes and incubated at room temperature. At different times (0-18 hours), membranes were pressed onto blood agar plates; CFU were counted after 24 hours of incubation at 37°C. Over 24 hours, the residual number of bacteria was counted every 30 minutes for gram-negative bacteria and every 2 hours for gram-positive bacteria.

### *Kinetics of the Bacterial Load in Clinical Use*

Four stethoscopes were monitored over an 8-hour period of use in a medical unit, after first being disinfected with 70% alcohol. Then, the lower half of the membrane was swabbed before and after each auscultation with a sterile cotton-tipped applicator moistened with a 0.9% sterile solution of sodium chloride. At the end of the monitoring period, the upper half of the membrane was swabbed. Organisms were collected from applicators by vortexing, and solutions were seeded onto blood agar plates, which were then incubated for 24 hours at 37°C.

### *Efficacy of 70% Alcohol Versus Liquid Soap for Membrane Disinfection*

Bacterial contamination of the membranes was assessed after they had been cleaned with either 70% alcohol or liquid soap. UV-sterilized stethoscope mem-

branes were incubated with bacterial species (*S aureus*, *S epidermidis*, *P aeruginosa*, or *A baumannii*) as described above. After 1 hour of incubation at room temperature, each membrane was rubbed thoroughly with a swab impregnated with 70% alcohol or liquid soap for at least 10 seconds. Then, one membrane for each sample was pressed onto blood agar plates every hour over 6 hours, and bacteria were quantified after 24 hours of incubation at 37°C.

## RESULTS

### *Bacterial Contamination of Stethoscopes*

Of the 237 individuals who consented to be interviewed, 53% were medical students or interns, and 47% were staff physicians. In all, 355 stethoscopes were sampled, 78% of which were personnel (collectives could be used by physicians, students, or nurses). The average stethoscope age was 4 years and its surface area 3.5 cm<sup>2</sup>. Stethoscopes were used ≥6 times per day in 53% of the cases. Questions about the cleaning practices revealed that only 22% of users regularly cleaned the membrane (with liquid soap or 70% alcohol), and 11% of doctors warmed the membrane before auscultation (with hand or laboratory coat). One hundred ninety-two stethoscopes (54%) were colonized with ≥20 CFUs per membrane, and 63 (18%) carried >100 CFU per membrane. Among the 355 stethoscopes, 234 had ≥2 different bacterial species, and up to 5 different bacterial species could be found on a membrane. Three hundred stethoscopes (85%) were colonized with nonpathogenic or weakly pathogenic bacteria, mainly coagulase-negative staphylococci (315), *Micrococcus luteus* (213), and *Bacillus* species (86). Potentially pathogenic bacteria were found on 31 stethoscopes (9%): *S aureus* (1 methicillin-resistant), 15; *Acinetobacter*, 11; *Enterobacter*, 8; *E coli*, 2; *Klebsiella*, 2; *Stenotrophomonas maltophilia*, 2. Apart from the single isolate of methicillin-resistant *S aureus*, no multidrug-resistant strain was detected.

### *Survival of Bacteria on Stethoscope Membranes*

All four gram-negative bacteria tested (*P aeruginosa*, *K pneumoniae*, *E coli*, and *A baumannii*) disappeared within 6 hours, whereas gram-positive bacteria (*S aureus*, *S epidermidis*, *E faecalis*) could survive for up to 18 hours (Figure 1).

### *Kinetics of the Bacterial Load in Clinical Use*

On the lower half of the stethoscope membrane, swabbed before and after each auscultation, the number of CFU ranged from 10 to 2,000 per membrane (Figure 2). At the end of the 8-hour monitoring period, >1,000 CFU per membrane were counted on the upper half of the membrane, representing the daily loading of the stethoscope. The potentially pathogenic bacteria isolated during the study of stethoscope loading were *S aureus*, 8; *Acinetobacter* species, 12; *Enterobacter* species, 3; *E coli*, 2; *Klebsiella*, 1; *Enterococcus faecium*, 4; and *Streptococcus sanguis*, 1.

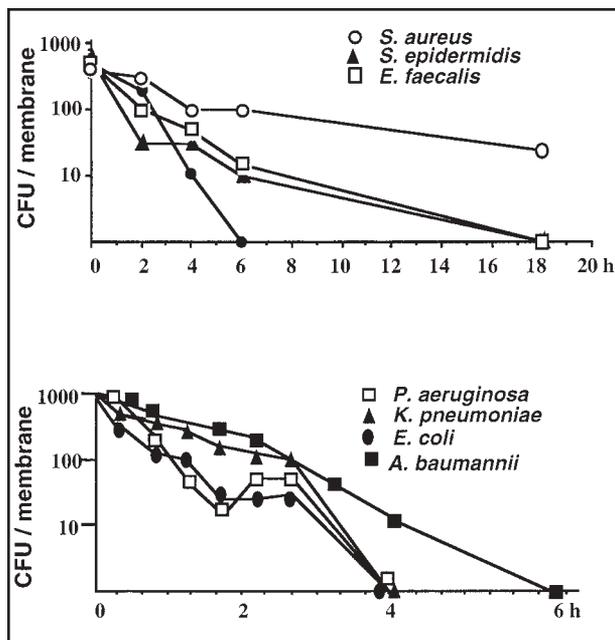


FIGURE 1. Survival of bacteria on stethoscope membranes. Abbreviation: CFU, colony-forming units.

#### Efficacy of 70% Alcohol Versus Liquid Soap for Membrane Disinfection

No bacteria survived after disinfection with 70% alcohol or liquid soap.

#### DISCUSSION

Several studies have investigated the presence of pathogenic bacteria on stethoscopes as a source of infections.<sup>2,6</sup> In our study, brief questioning of practitioners showed that only 22% regularly cleaned their stethoscopes. Although 54% of the stethoscopes examined did not meet the authorized norms of cleanliness (French Normalization Agency<sup>9</sup>: bacterial carriage <5 CFU/cm<sup>2</sup> or 20 CFU/membrane), and 18% were heavily colonized (>100 CFU/membrane), only 31 stethoscopes (9%) carried pathogenic species. In vitro, the survival of gram-negative bacteria did not exceed 6 hours, and their half-lives could be estimated at <1 hour. This observation does not completely exclude the risk of bacterial transmission from patient to patient over a short time period. Gram-positive bacteria survived for much longer. The monitoring of bacterial contamination over an 8-hour period demonstrated the progressive loading of the membrane and bacterial acquisition and appearance. The number of CFU fluctuated from one sample to another, and some species, especially gram-negative species, were not recovered in two consecutive samples. This variation could reflect the bacteria present on the patient's skin.

This study confirms that stethoscopes could be a vector for cross-transmission.<sup>10,11</sup> Systematic disinfection of stethoscopes with 70% alcohol or liquid soap or the use of dispos-

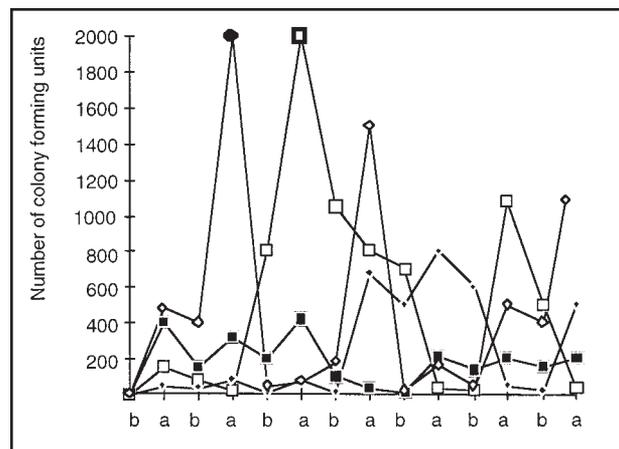


FIGURE 2. Bacterial load on four stethoscopes, represented by different symbols assessed before (b) and after (a) auscultation.

able covers<sup>12</sup> should be recommended to minimize the chance of spreading infectious agents between hospitalized patients. The benefit of these measures should be evaluated further.

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