

Contaminated Stethoscopes Revisited

Melinda A. Smith, MPH; John J. Mathewson, PhD; I. Alan Ulert, MD;
Ernesto G. Scerpella, MD; Charles D. Ericsson, MD

Background: Because of their universal use by medical professionals, stethoscopes can be a source of nosocomial infections.

Objective: To determine the frequency of contamination of stethoscopes with bacteria and fungi.

Methods: Cultures were obtained from 200 stethoscopes from four area hospitals and outpatient clinics in Houston, Tex. The frequency of stethoscope contamination in different groups of hospital personnel and medical settings was determined. We also measured the frequency of antimicrobial resistance of the staphylococcal strains that were isolated.

Results: One hundred fifty-nine (80%) of the 200 stethoscopes surveyed were contaminated with microorganisms. The majority of organisms that were isolated were gram-positive bacteria, primarily *Staphylococcus* species. Fifty-eight percent of the *Staphylococcus* species that

were isolated, including four (17%) of 24 *Staphylococcus aureus* isolates, were resistant to methicillin. Physicians' stethoscopes were contaminated more often than those of other medical personnel groups ($P=.02$). Stethoscopes used only in designated areas were contaminated less frequently than stethoscopes belonging to individual medical personnel ($P=.01$). Although stethoscopes were contaminated in all areas, stethoscopes from the pediatric medical setting were contaminated less frequently than those from other hospital areas ($P=.009$).

Conclusions: Stethoscope use may be important in the spread of infectious agents, including antimicrobial-resistant strains, and strategies to reduce the contamination of stethoscopes should be developed. We recommend disinfection of stethoscopes or regular use of disposable stethoscope covers.

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MORE THAN 2 million patients acquire nosocomial infections annually in the United States and the cost of treating these nosocomial infections is more than \$4.5 billion a year.¹ In 1988, the Centers for Disease Control and Prevention estimated that one third of all nosocomial infections may be preventable and are frequently caused by organisms in the hospital environment.² To prevent nosocomial infections, it is necessary to determine the many sources that facilitate the transmission of infectious agents to patients. Because of their universal use by medical professionals, stethoscopes might be a source of microorganisms that cause nosocomial infections. Stethoscopes often come in direct contact with numerous patients daily and disinfection of stethoscopes after each use is not an established practice.

Previous studies conducted to deter-

mine the frequency of stethoscope contamination with infectious agents concluded that stethoscopes were most frequently contaminated with *Staphylococcus* species.^{3,6} With one exception, these studies did not have a large sample size. One study³ had a large sample size and addressed all potential nosocomial pathogens, but it was conducted in 1972 before the emergence of the large immunosuppressed populations that exist today owing to the acquired immunodeficiency syndrome and immunosuppressive drug therapy. In our study, cultures were obtained from a large number of stethoscopes from multiple hospitals and

From the Center for Infectious Diseases, University of Texas at Houston.

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MATERIALS AND METHODS

SPECIMEN COLLECTION

Two hundred stethoscopes used by medical personnel in different hospital services were cultured from a private teaching hospital, a public community teaching hospital, a cancer center hospital, and a community human immunodeficiency virus outpatient clinic. An attempt was made to take a sample of representative areas of the hospitals and types of medical personnel, based on the willingness of staff to participate, to obtain the most random sample possible. A sterile cotton-tipped applicator moistened in a sterile solution of physiologic saline (0.85% sodium chloride) was used to swab the entire surface of the diaphragm of the stethoscope and the resulting specimen was cultured for bacteria and fungi within 3 hours.

ISOLATION AND IDENTIFICATION OF MICROORGANISMS

Swabs were vortexed in sterile saline for 2 to 3 minutes. The saline was then used to inoculate culture plates for the isolation of bacteria. The following media were inoculated: MacConkey agar (Difco, Detroit, Mich) for the isolation of gram-negative bacteria; chocolate and blood agar (Hardy Diagnostics, Santa Maria, Calif) for the growth of more fastidious organisms; mycobiologic agar (Difco) for the isolation of fungi; and mannitol salts agar (Difco) for the isolation of *Staphylococcus* species. Once the swab was used to inoculate the agar plates, it was placed in a tube of trypticase soy broth (Becton Dickinson, Cockeysville, Md) for enrichment. Agar plates and the trypticase soy broth tubes were then incubated at 35°C. The plates were observed for colony growth at 24 and 48 hours of incubation. After enrichment in trypticase soy broth, the swab was inoculated onto the same plate media.

Whenever growth was detected, a Gram-stained sample was used to differentiate between gram-positive and gram-negative colonies. Gram-positive organisms were further characterized by paper disks assimilated with biochemicals (Minitex System, Becton Dickinson)⁷ and by production of coagulase and catalase. Gram-negative organisms were identified by a test strip that is inoculated with the organism suspended in physiological saline (API 20E profiles, Bio Merieux Vitek Inc, Hazelwood, Mo),⁸ and the yeasts were identified by using a test strip containing dehydrated substrates for assimilation reactions (API 20C Clinical Yeast System, Bio Merieux Vitek Inc).⁹ Susceptibility testing was performed on most *Staphylococcus* isolates using the disk diffusion method according to standards set forth by the National Committee for Clinical Laboratory Standards, Villanova, Pa.¹⁰ Oxacillin (1 µg) (Difco) and methicillin (5 µg) (Difco) disks were used. The χ^2 test was used for statistical analyses.

Table 1. Organisms (N=265) Isolated From 159 Contaminated Stethoscopes

Organism	No. (%)
<i>Staphylococcus</i> species	219 (83)
<i>Staphylococcus epidermidis</i>	95 (36)
<i>Staphylococcus haemolyticus</i>	37 (14)
<i>Staphylococcus aureus</i>	24 (9)
<i>Staphylococcus hominis</i>	17 (6)
<i>Staphylococcus cohnii</i>	16 (6)
<i>Staphylococcus warneri</i>	13 (5)
<i>Staphylococcus capitis</i>	8 (3)
<i>Staphylococcus simulans</i>	3 (1)
<i>Staphylococcus saprophyticus</i>	3 (1)
<i>Staphylococcus lentus</i>	2 (1)
<i>Staphylococcus solni</i>	1 (0.4)
<i>Micrococcus</i> species	29 (11)
<i>Bacillus</i> species	9 (3)
<i>Listeria monocytogenes</i>	2 (1)
<i>Acinetobacter</i> species	2 (1)
<i>Candida albicans</i>	1 (0.4)
<i>Streptococcus faecalis</i>	1 (0.4)

Table 2. Prevalence of Organisms Isolated From Different Hospital Personnel Groups

Personnel Group	No. (%)
Physicians	61/68 (90)
Nurses	81/102 (79)
Designated areas*	7/13 (54)
Other	13/17 (76)
Medical students	6/9 (67)
Respiratory therapists	5/6 (83)
Physical therapists	2/2 (100)

*Stethoscopes that are designated for use in assigned areas only.

outpatient clinics to reassess how frequently they are contaminated with microorganisms that might cause nosocomial infections.

RESULTS

One hundred fifty-nine (80%) of the 200 stethoscopes tested were contaminated with microorganisms. Eighty-one (51%) of the 159 contaminated stethoscopes had two or more microorganisms isolated. A total of 265 organisms were isolated from the 159 contaminated stethoscopes and an average of 1.67 (265 of 159) microorganisms were isolated from each contaminated stethoscope. Seventeen distinct species of microorganism were isolated (Table 1). Gram-positive cocci constituted the group of organisms most frequently isolated (94% [249/265]), followed by gram-positive bacilli, gram-negative bacilli, and yeast.

Medical personnel were divided into four groups to determine if any one group had a higher frequency of contaminated stethoscopes (Table 2). The first group consisted of physicians. The second group consisted of nurses of all types. The third consisted of stethoscopes from designated examining rooms (intensive care unit [ICU] and emergency department). The last group included medi-

cal students, physical therapists, and respiratory therapists. Stethoscopes from all groups of medical personnel were commonly contaminated. Compared with all other groups, the physician group had the highest percentage of contaminated stethoscopes (90% [61/68]) and was statistically significant (confidence interval, 1.07 to 7.61; $P=.02$). The stethoscopes designated for use only in assigned rooms were contaminated less frequently compared with any other group (54% [7/13]; confidence interval, 0.07 to 0.94; $P=.01$).

Hospital service areas, where culture specimens were obtained from the stethoscope, or where the hospital personnel worked, were also categorized into four groups: medicine, emergency department and ICU, pediatrics, and other departments (neurology, geriatrics, physical therapy, and anesthesiology).

Although stethoscopes were frequently found to be contaminated in all areas, stethoscopes from the pediatrics group were contaminated less frequently than those from other areas (61% [14/23]; 0.11, 0.88; $P=.009$).

Hospital Service	No. (%)
Medicine	69/83 (83)
ICU/emergency department	66/80 (82)
Pediatrics	14/23 (61)
Other	13/14 (92)

Resistance to methicillin was found in four (17%) of 24 specimens of *Staphylococcus aureus*, in 44 (46%) of 95 specimens of *Staphylococcus epidermidis*, and in 67 (84%) of 80 specimens of other *Staphylococcus* species.

Organism	No. (%)
<i>S aureus</i>	4/24 (17)
<i>S epidermidis</i>	44/95 (46)
<i>Staphylococcus</i> species	67/80 (84)

COMMENT

These results indicate that stethoscopes are frequently contaminated. Many of the microorganisms isolated from the stethoscopes in this study (eg, *S aureus*, *Candida*, *Acinetobacter*, and *Listeria monocytogenes*) are known to cause serious infections in hospitalized patient populations. Since normal skin flora consists primarily of gram-positive bacteria, it is not surprising that so few gram-negative bacteria were isolated. These findings are consistent with those of other surveys conducted.³⁻⁶

Contaminated stethoscopes were found in all hospital service areas and among all types of medical personnel. It is particularly interesting that stethoscopes designated for single room use (usually in the ICU, with the most critically ill patients, who are very susceptible to nosocomial infections) had statistically significantly fewer contaminated stethoscopes than other groups. This supports the practice of using a single stethoscope in designated rooms.

Many (58%) of the staphylococcal isolates were resistant to methicillin. Methicillin-resistant staphylococcal isolates are a genuine challenge to antimicrobial therapy because most methicillin-resistant strains are also resistant to several other drugs.¹¹ Patients with methicillin-resistant staphylococcal infections are commonly treated with vancomycin. However, vancomycin is potentially toxic and can only be administered parenterally.¹¹ In addition, vancomycin use in hospitalized patients might further promote the emergence of vancomycin-resistant strains that are difficult to treat. To prevent the occurrence of nosocomial methicillin-resistant staphylococci and vancomycin-resistant infections, it is particularly important to prevent the spread of staphylococci inside hospitals. In this context it is extremely alarming that many stethoscopes, as seen in this study, were found to harbor methicillin-resistant strains.

Stethoscopes are a reservoir of infectious agents that might cause nosocomial infections. Although there is no direct evidence that the presence of microorganisms on stethoscopes directly results in infection of patients, strategies to reduce contamination of stethoscopes should be developed. Regular disinfection of stethoscopes or disposable covers should be used to minimize the chance of spreading infectious agents to and among patients. Prospective studies to determine the benefit of regular disinfection are warranted.

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Reprint requests to 1200 Herman Pressler, Houston, TX 77030 (Dr Mathewson).

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