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Brief report

Stethoscopes as potential intrahospital carriers of pathogenic microorganisms

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Stethoscopes can take part in the transmission of health care-associated infections. We cultured 112 stethoscopes by direct imprint on blood agar to estimate the prevalence of potentially pathogenic microorganisms. Forty-eight (47%) produced 50 potentially pathogenic microorganisms; from these, 43 (86%) were *Staphylococcus aureus*, of which 18 (42%) were methicillin-resistant *S. aureus*. We concluded that stethoscopes should be considered as potential fomites and must be disinfected routinely before and after each patient contact.

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In the United States more than 2 million people a year contract a health care-associated infection, resulting in 90,000 deaths and economic costs of \$4,500 to \$5,700 million.¹ In Mexico, approximately 30 deaths per 100,000 inhabitants can be attributed to hospital-acquired infections; they are the fourth cause of death nationwide.²

Disease transmission in hospitals occurs via 3 main mechanisms: through the air; through droplets; and by contact, whether direct (eg, touching with the hands) or indirect (eg, fomite).³ Microorganisms on a fomite may remain viable for days or even months. They could therefore be transmitted among patients and hospital personnel. *Staphylococcus aureus* and *Candida* spp are microorganisms commonly associated with contact transmission.⁴

Simple, inexpensive measures like routine cleaning of equipment; hand washing with antiseptic solution; antibiotic stewardship; and the use of gloves, masks, and coats have been reported to lower the rates of hospital-acquired infections.^{2,5}

Instruments such as stethoscopes are constantly in contact with patients and may become contaminated with pathogenic microorganisms, but they are seldom included in disinfection protocols. We aimed to investigate the role of stethoscopes as

potential fomites for antibiotic-resistant and potentially pathogenic microorganisms.

METHODS

Institution

The General Regional Hospital of Leon is a leading health care institution in central Mexico. It has 221 beds, with a monthly average of 880 nonobstetric discharges and 745 obstetric ones. The hospital offers undergraduate and graduate education programs. A committee for prevention and control of nosocomial infections has been operating since 1990. A previous study from this hospital reported an increase in methicillin-resistant *Staphylococcus aureus* (MRSA) infections, from 12% to 49% between 1994 and 2007; gram-negative bacilli are common agents in severe infections.^{6,7}

Design

This was a cross-sectional study for the prevalence of potentially pathogenic microorganisms on stethoscopes.

Microbiologic methods

To find an efficient culture method, a pilot study was conducted. The methods tested were inoculation by direct imprint of the stethoscope diaphragm on blood agar (BBL, Becton, Dickinson, and Company, Mexico) and inoculation with a swab soaked in saline solution and swept over the stethoscope membrane. The direct

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method was chosen because it was quicker, simpler, and more efficient. Results for this pilot study are shown in the corresponding section.

Agar plates were incubated for 24 hours at 35°C in an aerobic atmosphere with 95% relative humidity. Colony-forming units (CFUs) were counted and their macroscopic features were analyzed for a preliminary classification. Coagulase-negative staphylococci, viridans group streptococci, and gram-positive coryneform bacilli were considered colonizing species with a low pathogenic potential.⁸

Microorganisms were identified according to their biochemical characteristics. Antibiotic susceptibility profiles were determined using the disk diffusion method. Methicillin resistance was determined using the cefoxitin disk and a double disk diffusion test with clindamycin and erythromycin disk approximation. Extended-spectrum β -lactamase production was determined with the ceftazidime and amoxicillin-clavulanic acid disk approximation method.⁹

Statistical analysis

Results are shown as median and range because they did not follow a normal distribution. The culture methods were compared using the Mann-Whitney *U* test. Descriptions of microbiologic data were based on proportions and their 95% confidence interval (CI). Comparison between proportions was determined using the χ^2 test. We consider a unilateral $\alpha < .05$ as significant.

RESULTS

For the pilot study, which sought to determine the most efficient culture method, 18 stethoscopes were cultured by direct imprint and 18 more were swabbed. The direct imprint method yielded a median of 22 CFUs (range, 3-300), whereas the swabbing method yielded a median of 15 CFUs (range, 1-200). This difference was statistically significant (Mann-Whitney *U*, 98.5; $P < .05$).

We analyzed 112 stethoscopes from 12 hospital departments; 106 produced at least 1 CFU (95%; 95% CI, 91%-99%). Of the stethoscopes with microbial growth, 58 showed only organisms considered as skin contaminants with low pathogenic potential (55%; 95% CI, 46%-64%). Of the 48 remaining stethoscopes, 50 microorganisms with pathogenic potential were isolated (47%; 95% CI, 38%-56%); 3 of these were gram-negative bacilli (*Klebsiella pneumoniae* subsp. *ozaenae*, *Acinetobacter baumannii*, and *Burkholderia cepacia*) (6%; 95% CI, 0%-13%); 4 were *Enterococcus faecalis* (8%; 95% CI, 1%-15%), and 43 were *S aureus* (86%; 95% CI, 76%-96%), 18 of which were identified as MRSA (42%; 95% CI, 27%-57%).

Table 1 shows the results of the stethoscope cultures and the microorganisms isolated from each hospital department. When we compared the results of *S aureus* contamination for each hospital department, we found that the proportion of MRSA was 62% for the adult services and 12% for pediatric ones (χ^2 , 10.5; $P < .01$).

DISCUSSION

Our study shows the results of cultures taken from all stethoscopes in use in a general hospital at the time of sampling. The results may reflect the elevated prevalence of MRSA infections in the hospital and suggest that stethoscopes may participate as fomites. Contamination with *Enterococcus* or gram-negative bacilli, albeit undesirable, seems to be of lesser importance.⁶

Our hospital's profile is similar to that of other public hospitals in Mexico. Our results could thus be considered an expression

Table 1

Staphylococcus aureus isolated from 112 stethoscopes cultured in clinical services

Department	Cultured stethoscopes n	Stethoscopes with bacterial pathogens*		<i>Staphylococcus aureus</i>		MRSA	
		n	%	n	%	n	%
Pediatrics	28	13	46	13	100	2	15
Neonatology	23	6	26	4	67	0	0
Internal medicine	21	11	52	11	100	6	55
Emergency	12	4	33	3	75	2	67
Surgery	11	7	64	7	100	3	43
Intensive care	9	6	67	4	67	4	100
Obstetrics and gynecology	8	1	13	1	100	1	100
Total	112	48	43	43	90	18	42

MRSA, methicillin-resistant *Staphylococcus aureus*.

*Potential pathogens included *Staphylococcus aureus*, *Klebsiella pneumoniae* subsp. *ozaenae*, *Acinetobacter baumannii*, *Pseudomonas cepacia*, and *Enterococcus faecalis*.

of a widespread problem. There are a number of studies about stethoscope contamination but, to our knowledge, our study found 1 of the highest rates of *S aureus* isolation.¹⁰

Rational culturing of surfaces and instruments can contribute to understanding transmission mechanisms. In the absence of epidemic phenomena, it helps modify behaviors to avoid risks of spreading and contagion. These cultures may be useful for educational purposes and to provide information for guiding cost-benefit decisions. However, it is not advisable to culture instruments and surfaces routinely; rather, more attention should be paid to preventive measures such as regular disinfection of medical instruments.

CONCLUSIONS

It is necessary to insist on cleaning stethoscopes routinely with antiseptics such as 70% alcohol, chlorhexidine, or triclosan, before and after they are used on each patient.

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