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Stethoscopes: A Potential Vector of Infection?

Study objectives: To survey emergency care providers about their stethoscope-cleaning measures and to determine the correlation between these measures and the extent of *Staphylococcus* carriage.

Design: Prospective cross-sectional analysis.

Setting: University-affiliated community hospital ED.

Participants: One hundred fifty health care providers, comprising emergency medicine house staff and attending physicians (n=50), ED nurses (n=50), and prehospital personnel working in Kent County, Michigan (n=50).

Interventions: Providers were asked how often they cleaned their stethoscopes and which cleaning agents were used. We then cultured each stethoscope by pressing the diaphragm on mannitol agar and incubating the culture aerobically for 48 hours. *Staphylococcus aureus* was identified by means of standard measures. We examined the effects of different cleaning agents on 24 stethoscopes. The numbers of colony-forming units (CFUs) before and after cleaning with alcohol, nonionic detergent, and anti-septic soap were noted.

Results: Overall, 48% of health care providers (74 of 150) cleaned their stethoscopes daily or weekly, 37% monthly, and 7% yearly; and 7% had never cleaned their stethoscopes. No significant differences were found in the hygiene routines of the three groups of providers surveyed. Use of an alcohol swab was the preferred method of cleaning. One hundred thirty-three stethoscopes (89%) grew staphylococci; 25 (19%) yielded *S aureus*. Mean Staphylococcal bacterial counts (\pm SD) were 52 ± 78 CFUs per stethoscope among physicians, 46 ± 92 CFUs among emergency medical service personnel, and 13 ± 21 CFUs from the nursing staff (ANOVA, $P=.01$). Cleaning the

stethoscope diaphragm resulted in immediate reduction in the bacterial count: by 94% with alcohol swabs, 90% with nonionic detergent, and 75% with antiseptic soap.

Conclusion: Our results confirm that stethoscopes used in emergency practice are often contaminated with staphylococci and are therefore a potential vector of infection. This contamination is greatly reduced by frequent cleaning with alcohol or nonionic detergent.

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INTRODUCTION

Nosocomial infections in hospitals occur at a rate of 5 to 10 per 100 admissions.¹ Stethoscopes, an almost universal tool of the medical profession, may be a vector of infection because they are brought into contact with many patients. Twenty years ago stethoscopes were shown to harbor staphylococci², yet standard sources on infection control still give no advice on cleaning these instruments.³

A recent study in the British medical literature demonstrated that many physicians' stethoscopes were contaminated with staphylococci and could serve as a vector of infection.⁴ This phenomenon may be a particular problem in areas where outbreaks of methicillin-resistant *Staphylococcus aureus* occur or where patients with increased susceptibility to infection are to be found (eg, those with burns or otherwise compromised immune systems). We evaluated the problem by surveying current practices of stethoscope hygiene among emergency care professionals and culturing their stethoscopes for bacteria.

MATERIALS AND METHODS

This prospective, cross-sectional analysis was conducted in the ED of a 700-bed community teaching hospital and Level I trauma center. The annual ED census at the time of the study was 72,000. The study protocol was approved by the institution's investigational review board.

Three different groups of emergency health care providers were asked to participate in the survey: emer-

gency medicine residents and attending physicians (n=50), ED nursing staff (n=50), and prehospital personnel working in Kent county, Michigan (n=50). Using a random-numbers table, we chose potential participants' names from a list of health care providers. Each interview was conducted by the same investigator, who was trained in the technical aspects of infection control, interviewing skills, and data collection. Participants were blinded to the content of the survey until the time of the interview. Providers were asked how frequently they cleaned their stethoscopes and what cleaning agent was used. They were also asked whether they could recall ever being advised to clean or disinfect their stethoscopes.

After the interview, each provider's stethoscope was examined and cultured. We obtained cultures by pressing the large stethoscope diaphragm directly onto mannitol salt agar for 5 seconds. The cultures were incubated aerobically overnight. *S aureus* was identified by means of standard laboratory methods.

We examined the effect of different cleaning agents on 24 additional stethoscopes chosen at random from ED personnel. Diaphragms from all instruments were cultured and then cleaned with commercial swabs saturated with alcohol (n=8), nonionic detergent (Shur-clens; Merck, Incorporation) (n=8), or antiseptic soap (n=8). The stethoscopes were allowed to air dry and then cultured a second time. Staphylococcal counts before and after cleaning with the three agents were compared.

We stored all data in an epidemiology database (Epi Info; USD Incorporated) for retrieval and statistical analysis. Data are expressed as mean±SD unless otherwise noted. Categorical variables (stethoscope hygiene) were evaluated with the use of χ^2 contingency tables. We measured culture results in mean numbers of colony-forming units (CFUs) and analyzed them with ANOVA. We considered *P* values less than .05 statistically significant.

RESULTS

Overall, 48% of health care providers (74 of 150) cleaned their stethoscopes daily or weekly, 37% monthly, and 7% yearly; 7% had never cleaned their stethoscopes (Table). None of the providers cleaned the stethoscope after every patient. We found no statistically significant differences in stethoscope hygiene among the three groups (*P*=.37).

Cultures from 133 of the stethoscopes (89%) grew

staphylococci. Most of the staphylococci were coagulase negative, but 25 stethoscopes (19%) yielded *S aureus*. Mean counts were 52±78 CFUs per stethoscope among physicians, 46±92 CFUs among emergency medical service personnel, and 13±21 CFUs among the nursing staff (*P*=.01; Table).

Data from all emergency care providers were combined for further analysis. Culture results were compared with the reported frequency of stethoscope cleaning (Figure). As expected, the mean number of staphylococcal CFUs markedly increased as the stethoscopes went for longer periods of time between cleanings (ANOVA, *P*<.001). An alcohol swab was the preferred cleaning method of most respondents (96%).

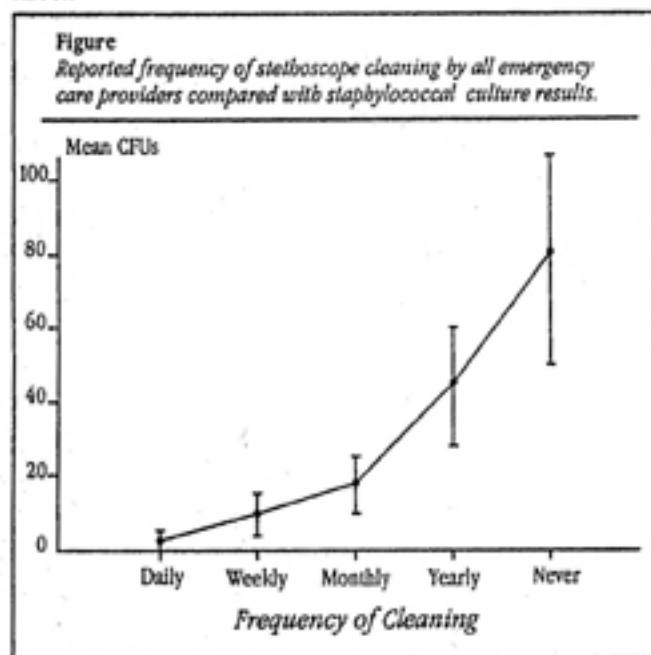
We examined the effect of three different cleaning agents on 24 stethoscopes. Before cleaning, the mean number of staphylococcal colonies was 16 CFUs per stethoscope. Disinfecting the stethoscope diaphragm resulted in an immediate reduction in the bacterial count to 1.0 CFU per stethoscope (94%) with alcohol swabs, 1.6 CFUs per stethoscope (88%) with nonionic detergent, and 4.0 CFUs per stethoscope (75%) with antiseptic soap. ANOVA indicated no significant difference between these cleaning agents (*P*=.06); however, there was a consistent trend in favor of alcohol swabs.

DISCUSSION

The results of the study demonstrate that most stethoscopes (89%) are contaminated with Staphylococcal species. Although most ED patients are not especially prone to infection after contact with contaminated stethoscopes, there are two main areas of concern. The patients with an open wound (eg, burn, tracheostomy) may be colonized, leading to infection at a later time. The other risk is the dissemination of multiresistant organism that may only become manifest later in an outbreak situation. Hospital endemics have been traced to the use of contaminated blood pressure cuffs⁵, electronic thermometers⁶, latex gloves⁷, and white coats.⁸ Practices such as hand-washing and barrier protection remain the simplest and most important infection-control measures. Despite the apparent simplicity of such practices, studies have documented poor compliance in the ED and prehospital setting, among others.^{9,10}

We found no significant differences in stethoscope

hygiene among the emergency care providers we surveyed. However, nurses had the lowest level of bacterial contamination (Table). This discrepancy may have been because the ED nurses cleaned their stethoscopes more thoroughly, if not more frequently, than physicians or prehospital personnel. In addition, stethoscopes that are used less frequently may therefore take longer to attain the steady state of microbial contamination. This phenomenon, which occurs with other fomites, is referred to as the "plateau effect."⁸



Cleaning with antiseptic soap or nonionic detergents is the simplest and most convenient method of washing a stethoscope head and tubing. Extrapolating from the Centers for Disease Control and Prevention guidelines for hand-washing, 10 seconds of vigorous washing followed by a thorough rinse is probably sufficient unless the stethoscope is visibly soiled. *Although not statistically significant in our small sample, alcohol swabs were effective in reducing the bacterial count by 94% (range, 86% to 100%). However, routine cleaning with alcohol may dry out rubber seals and damage stethoscope tubing.* Zimmerman et al¹⁰ recommended using a "hospital disinfectant" chemical with a label claim for tuberculocidal activity. If disinfectants are to be used in an emergency care setting, they should be conveniently located, and manufacturer recommendations for the disinfectant should be followed to avoid adverse effects of the chemical chosen.

Potential limitations to this provider survey include the possibility that the presence of a physician interviewer

influenced the answers of the participants. However, the reported frequency of stethoscope cleaning and disinfection seemed to correlate well with the number of CFUs cultured from the stethoscope diaphragm (figure). In addition, we attempted to keep participants blinded to the content of the survey until the time of the interview. We made no attempt to investigate the relationship of contaminated stethoscopes to the incidence of nosocomial infection. Our main interest were whether emergency care providers were washing their stethoscopes and whether routine cleaning actually reduced bacterial contamination.

Pathogenic gram-negative bacteria were not isolated in this study and were reported infrequently in other studies.¹⁴ This finding may have been due to the fact that many of these organisms need a warm, moist, environment for survival, an environment that is not present on a stethoscope diaphragm. It was not in the scope of this study to assess viral contamination, although it is known that several common viruses such as enteroviruses and small round structured viruses survive well in the environment and may be transmitted by fomites.⁸ Finally, our results may not be generalizable to other EDs. In areas with higher incidences of HIV infection, hepatitis, or other communicable diseases, emergency providers may be more "sensitized" to infection-control measures, including cleaning of stethoscopes.

Table.
Study results by group

Parameters	No. of Physicians (%) [n=50]	No. of Nurses (%) [n=50]	No. of EMS Personnel (%) [n=50]
Cleaning schedule			
Never	3 (6)	2 (4)	5 (10)
Yearly	4 (8)	3 (6)	4 (8)
Monthly	15 (30)	21 (42)	20 (40)
Weekly	14 (28)	10 (20)	11 (22)
Daily	14 (28)	14 (28)	10 (20)
CFUs			
Staphylococcal colonies*	52.3±78	13.0±21	45.7±92
Range	6-300	0-120	0-500
<i>S aureus</i> colonies*	2.0±4.1	.4±2.8	3.1±3.9
% <i>S aureus</i>	3.8	3.1	6.8

*Data expressed as mean±SD

CONCLUSION

Our results confirm that stethoscopes used in emergency practice are often contaminated with staphylococci and are therefore a potential vector of infection. This contamination is greatly reduced by frequently cleaning with alcohol or nonionic detergent.