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Stethoscopes and otoscopes—a potential vector of infection?

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Objectives. We aimed to determine whether stethoscopes and otoscopes used in community paediatric clinics harboured pathogenic micro-organisms, and, if so, which measures could prevent this.

Methods. Fifty-five stethoscopes belonging to paediatric physicians working in 12 community clinics were sampled for bacterial cultures by two methods: (i) direct impression of the diaphragm and bell section of each stethoscope for 5 seconds onto blood agar plates and a mannitol–salt–agar plate; (ii) swabbing the entire surface of the diaphragm of the stethoscope with a sterile cotton-tipped applicator. Forty-two otoscopes from the same physicians were sampled by rubbing the handles of the otoscopes with cotton-tipped swabs. The plates were incubated at 37°C for 48 hours and examined for colony growth at 24 and 48 hours of incubation. Culture results were recorded as mean numbers of colony-forming units (CFUs). Eight additional stethoscope diaphragms were chosen at random at the participating clinics and cultured as described above. They were then wiped with alcohol swabs (isopropyl alcohol 70%), allowed to air dry for approximately 10 minutes and cultured a second time.

Results. All the stethoscopes and 90% of the otoscope handles were colonized by micro-organisms. Staphylococci were isolated from 85.4% of the stethoscopes and 83.3% of the otoscopes, with 54.5% and 45.2% respectively being *S. Aureus*. Methicillin-resistant *S. aureus* were found in four each of the stethoscopes (7.3%) and otoscopes (9.5%). Cleaning with alcohol reduced the colony count by an average of 96.3%.

Conclusions. Fomites can harbour potentially pathogenic bacteria, and with the increasing trend for children with more complex medical problems to be managed in an ambulatory setting, often by physicians who also work in hospitals, there is a real risk of spreading potentially serious infections to such patients. Simple cleansing with alcohol effectively eliminates the bacterial contamination of the fomites, and should be encouraged.

Keywords. Community paediatric clinics, otoscopes, *Staphylococcus aureus*, stethoscopes, vector of infection.

Introduction

Nosocomial infections occur at a rate of 5–10 per 100 admissions.[1] It has been estimated that one-third of all nosocomial infections may be preventable, and are frequently caused by organisms acquired within the hospital environment.[2] Stethoscopes and otoscopes, universal tools of the medical profession, may be vectors for nosocomial infection, and, indeed, several studies in hospital settings demonstrated that stethoscopes were frequently contaminated with Staphylococcus species, and could serve as a vector of infection.[3–6] Furthermore, *Staphylococcus aureus* resistant to methicillin has been isolated from 17% of stethoscopes of medical personnel in a hospital setting.[5] However, there are no reported data on stethoscopes and otoscopes in a community primary care paediatric setting as potential vectors for infection with

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methicillin-resistant *Staphylococcus* and other organisms. Methicillin-resistant *S. aureus* (MRSA) and other organisms can be involved in serious infections in children with a compromised immune system, in patients undergoing haemodialysis or organ transplants, or in children with open wounds. In the past, such children were almost exclusively treated in hospital wards, whereas today there is an increasing trend to deal with them in paediatric community clinics.

The purpose of this study was to determine whether stethoscopes and otoscopes used by physicians working in primary care paediatric community clinics could serve as a potential source of pathogenic bacteria which might be responsible for bacterial infection.

Materials and methods

Fifty-five stethoscopes belonging to paediatric physicians working in 12 community clinics were sampled for bacterial cultures by two methods:

(i) direct impression of the diaphragm and bell section of each stethoscope for 5 seconds onto blood agar plates (TSA + 5% sheep blood; HY-LAB, Rehovot, Israel) and a mannitol–salt–agar plate (Novamed, Israel); and
(ii) swabbing the entire surface of the diaphragm of the stethoscope with a sterile cotton-tipped applicator moistened in sterile transport medium solution (COPAN®; Bovezzo, Italy), which was inoculated within 2 hours onto a blood agar plate and a mannitol–salt–agar plate.

Forty-two otoscopes from the same physicians were sampled by rubbing the handles of the otoscopes with cotton-tipped swabs moistened in transport medium solution. The swabs were cultured within 2 hours on blood agar and mannitol–salt–agar plates.

The plates were incubated at 37°C for 48 hours and examined for colony growth at 24 and 48 hours of incubation; the culture results were recorded as mean numbers of colony-forming units (CFUs).

Staphylococcus aureus was identified by standard laboratory methods. Slide coagulase tests (Microgen Bioproducts Microscreen, STAPH, UK) were performed on suspected staphylococci. Sensitivity testing on *Staphylococcus* isolates was performed using the disc diffusion methods in accordance with the standards set out by the National Committee for clinical laboratory standards;[7] Oxacillin (1 mg; Difca) and methicillin (5 mg; Difca) discs were used.

Gram-negative organisms were identified by a test strip that was inoculated with the organism suspended in physiological saline (API, VITEK).

Eight additional stethoscope diaphragms were chosen at random at the participating clinics and cultured as described above. They were then wiped with alcohol swabs (isopropyl alcohol 70%), allowed to air-dry for approximately 10 minutes, and cultured a second time on blood agar and mannitol–salt–agar plates. Isolation of bacteria, classification, sensitivities and colony counts were carried out as described above.

TABLE 1 *Organisms isolated from contaminated stethoscopes and otoscopes of primary care community physicians*

Organism	Stethoscopes (n = 55) No. (%)	Otoscopes (n = 42) No. (%)
Staphylococcus aureus	30 (54.5)	19 (45.2)
Staphylococcus epidermidis	7 (12.7)	9 (21.4)
Staphylococcus coagulase-negative	37 (67.3)	29 (69.0)
Sarcinia lutea	28 (50.9)	22 (52.4)
Diphtheroides	9 (16.4)	4 (9.5)
Bacillus species	23 (41.8)	18 (42.9)
Serratia marcescens	4 (7.3)	4 (9.5)
Others (Gram-negative organisms)	6 (10.9)	2 (4.8)

Multiple organisms were cultured from several stethoscopes.

Results

All the stethoscopes, as well as 90% of the otoscope handles, were found to be contaminated with micro-organisms. The micro-organisms isolated are presented in Table 1. Staphylococci were isolated from 47 (85.4%) of the stethoscopes and 35 (83.3%) of the otoscopes; *S. aureus* was isolated from 54.5% and 45.2% of the stethoscopes and otoscopes, respectively.

Of the 19 otoscopes contaminated with *S. aureus*, for 16 (84.2%) the stethoscope of the same physician was also positive for that micro-organism. Four isolates (7.3%) from the stethoscopes and four (9.5%) from the otoscopes yielded *S. aureus* resistant to methicillin. The paired MRSA were from the same four physicians who worked in two different community clinics.

The other isolates were mostly Gram-positive bacteria—coagulase-negative staphylococci, anaerobes, *Sarcinia lutea*, *Bacillus* species and *Diphtheroides*.

Only a few Gram-negative bacteria and yeast were isolated. The micro-organisms isolated from the stethoscopes and the otoscopes were very similar (Table 1).

In the eight stethoscopes cultured before and after cleaning with alcohol there was a significant decrease in the colony count (Table 2). *S. aureus* was not isolated from any of the cleaned diaphragms, and there was a 95% reduction in the isolation of coagulase-negative Staphylococci following alcohol-swabbing. The decrease in the isolation of micro-organisms from the

TABLE 2 *Organisms isolated from stethoscopes before and after cleaning with alcohol*

Organisms	Before cleaning		After cleaning	
	No. of isolates	Mean CFUs	No. of isolates	Mean CFUs
Staphylococcus coagulase-negative	6/8	68±28	2/8	3±0
Staphylococcus aureus	4/8	49±30	–	–
Bacillus species	7/8	54±30	7/8	3±2
Sarcinia lutea	5/8	74±24	1/8	6±0
Diphtheroides	1/8	100±0	–	–
Flavobacteria	1/8	30±0	–	–

cleaned diaphragms ranged from 89% to 100%, the mean decrease being 96.3%. One stethoscope was completely sterile after cleaning.

Discussion

Most primary care paediatric patients are not prone to infection after contact with contaminated stethoscopes. However, the trend in recent years has been to transfer many children and adolescents from hospital wards to child-care community centres for their ongoing medical care. This has resulted in more immunocompromised patients (congenital and acquired) being seen in community clinics. By the same token, there has also been an increase in the number of patients with open wounds such as burns, trauma, gastrostomy feeding tubes, IV catheters etc. managed in a community ambulatory setting following hospitalization. In some cases the same physician manages the patient in hospital and then sees him/her in the community practice. This group of patients may be highly susceptible to infection by micro-organisms that can be transferred from the physician to patients by his hands, or fomites. Basic 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 paediatric ambulatory settings.[8]

This study demonstrates that most stethoscopes (85.4%) and otoscopes (83.3%) are contaminated with staphylococcal species. Methicillin-resistant *S. aureus* was found to have contaminated 7.3% of the stethoscopes (13.3% of the *S. aureus*-contaminated stethoscopes) and 9.5% of the otoscopes (21% of the *S. aureus*-contaminated otoscopes). Colonization and infection with MRSA are usually found in hospitals and hospitalized patients.

The isolation of MRSA in primary paediatric clinics is probably due to transmission of the organism by medical staff who work in hospitals as well as in community clinics. Patients with methicillin-resistant staphylococcal infection are commonly treated with vancomycin, which is potentially toxic and can only be administered parenterally.[9]

In this study the pairs of stethoscopes and otoscopes revealing MRSA were documented from two different primary care community clinics and from different physicians. Since normal skin flora consist primarily of Gram-positive bacteria it is not surprising that Gram-positive bacteria were isolated more often than Gram-negative bacteria. We did not attempt to investigate the relationship of contaminated stethoscopes and otoscopes to the incidence of nosocomial infection. Our main interests were to determine whether primary care physicians' stethoscopes and otoscopes were colonized with potentially pathogenic micro-orgamisms, and whether simple routine cleaning actually reduced bacterial colonization.

This is the first reported study of its kind carried out in a primary paediatric community clinics setting. We clearly showed that cleaning stethoscopes with alcohol resulted in a significant reduction of bacterial colony counts.

Extrapolating from the Center 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.[6] Stethoscope and otoscopes are a reservoir of infectious micro-organisms that might cause infections.

Although there is no direct evidence that the presence of micro-organisms on stethoscope/otoscopes directly results in infection of patients, the findings of this study are by no means trivial or inconsequential. With the increasing trend for ambulatory care of high risk patients with complex medical and surgical problems, the susceptibility of this patient population to infection, and the potential consequences thereof, are very worrying. We showed unequivocally that fomites are frequently contaminated with potentially pathogenic organisms, yet the method for dealing with such colonization is almost ridiculously simple and extremely effective.

We strongly recommend that instruments such as stethoscopes and otoscopes (not to mention physicians'

hands!) should be regularly disinfected so as to minimize the spread of infection.

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