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Brief report

Bacterial contamination of medical devices in a Greek emergency department: Impact of physicians' cleaning habits



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We investigated the bacterial contamination of physicians' stethoscopes, electrocardiography machines, cardiac monitors, and pulse oximeters, as well as physicians' self-reported cleaning habits in the emergency department of a university hospital. Among 100 devices evaluated (stethoscopes included), 99% developed a positive bacterial culture. Coagulase-negative staphylococci predominated (80.3%). Only 13% of physicians reported cleaning their stethoscope after each patient examination; multinomial regression analysis found less contamination on those stethoscopes ($P < .001$). Studies on the implementation of hygiene measures are needed.

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Hospital-associated infections (HAIs), defined as infections acquired during hospitalization and not present or incubating at admission, represent one of the leading causes of death, with considerable associated economic costs.¹ Factors related to the microbial agent, the patient's clinical status, the environment, and the widespread use of antimicrobials contribute to the emergence and expansion of HAIs.¹ Concerning the environment, the contamination of objects and devices by microbial flora may play an important role.¹ Stethoscopes, white coats, and other surfaces have been shown to yield significant bacterial contamination.²⁻⁶

The primary objective of the present study was to determine whether physicians' stethoscopes and other medical devices in an emergency department (ED) harbored bacteria. A secondary objective was to survey the physicians' self-reported cleaning habits and evaluated whether these practices are associated with the stethoscope contamination.

METHODS

Setting

This observational study was conducted in the ED of the University General Hospital of Patras, a 700-bed tertiary care facility in Patras, Greece. The research protocol was approved by the hospital's Committee of Research, Ethics and Deontology and the Scientific Board.

Data collection

During a 5-month period, specimens were collected from physicians' stethoscopes and from reusable medical devices (cardiac monitors, pulse oximeters, and electrocardiography machines) in the ED. The ED operates 24 hours, 4 days a week. The participating physicians completed an anonymous questionnaire eliciting demographic data and information on self-reported cleaning habits.

All eligible physicians were invited to participate in the study. Physicians who did not carry their own stethoscope or had already participated were excluded. Stethoscope diaphragms and surfaces of the reusable devices that come into contact with patients' bodies were swabbed with sterile cotton swabs moisturized with sterile

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Conflicts of interest: None to report.

Table 1
Demographic characteristics of the participating physicians (n = 88)

Characteristic	Number (%)
Sex	
Male	50 (56.8)
Female	38 (43.2)
Age group	
25-35 y	54 (61.4)
>35 y	34 (38.6)
Specialized	
Yes	18 (20.5)
No	70 (79.5)
Specialty	
Internal medicine	36 (40.9)
General practice	27 (30.7)
Cardiology	12 (13.6)
Other	13 (14.8)
Working in the ED	
Permanently	11 (12.5)
In shifts	19 (21.6)
In shifts, changing with shifts at wards	58 (65.9)

Table 2
Physicians' self-reported stethoscope cleaning habits and level of hygiene training

Questionnaire	Cleaning habits	Number (%)
How often do you clean your stethoscope?	After every shift/patient examination	31 (35.2)
	After suspected contamination	26 (29.6)
	In certain cases/randomly/when time allows it	31 (35.2)
Means used for stethoscope cleaning?	Cleaning soap	5 (5.7)
	Alcohol	8 (9.1)
	Alcohol solution	75 (85.2)
Have you been educated about the need to clean your instruments?	Yes	10 (11.4)
	No	78 (88.6)
If yes, who provided this education?	Your department	1 (10)
	Infection Control Committee	9 (90)
Have you been educated about the means of cleaning your instruments?	Yes	4 (4.5)
	No	84 (95.5)
If yes, who provided this education?	Your department	0 (0)
	Infection Control Committee	4 (100)

normal saline. The swabs were inoculated onto blood and MacConkey agar plates and incubated at 37°C for a total of 48 hours before being assessed as negative. Colony-forming units (CFUs) were measured, and phenotypically different colonies were subcultured and characterized by Gram stain. Gram-positive cocci were classified as *Staphylococcus aureus*, coagulase-negative staphylococci (CoNS), or *Streptococcus viridans* based on biochemical reactions. Gram-negative bacteria and *Corynebacterium* spp, *Bacillus* spp, and *Micrococcus* spp were identified using the Vitek 2 system (bioMérieux, Marcy l'Etoile, France). Antimicrobial susceptibility was analyzed by the disk diffusion method.⁷ For cefoxitin-resistant staphylococci (ie, methicillin-resistant staphylococci [MRS]), methicillin resistance was verified by polymerase chain reaction for the *mecA* gene.⁸ Minimal inhibitory concentrations (MICs) of oxacillin, vancomycin, daptomycin, and linezolid in MRS were determined by the E-test (bioMérieux).⁷

Statistical analysis

Descriptive statistics were estimated, and the Pearson χ^2 test was used to control the statistical significance of proportions between different groups. Moreover, the relationships between stethoscope cleaning habits and the demographic variables

Table 3
Bacterial contamination of stethoscopes and devices

Bacteria	Contamination, n (%) [*]	Isolates, n (%)
Stethoscopes		
CFU		
>1000	28 (31.8)	
<1000	60 (68.2)	
Bacterial species		
CoNS	85 (96.6)	151 (80.8)
MRCoNS	18	19
<i>S aureus</i>	6 (6.8)	6 (3.2)
MRSA	2	2
Other Gram-positive bacteria [†]	27 (30.7)	27 (14.4)
<i>A baumannii</i> complex	3 (3.4)	3 (1.6)
Total	88 (100)	187 (100)
Devices		
CFU		
>1000	9 (75)	
<1000	2 (16.7)	
0	1 (8.3)	
Bacterial species		
CoNS	9 (81.8)	16 (76.1)
MRCoNS	1	1
Other Gram-positive bacteria [†]	5 (45.5)	5 (23.9)
Total	12 (100)	21 (100)

^{*}The majority of stethoscopes and devices were contaminated by multiple bacteria.
[†]*S viridans*, *Bacillus* spp, *Micrococcus* spp, *Corynebacterium* spp.

(Table 1), as well as the relationships between the independent variables plus stethoscope cleaning and handwashing habits and the stethoscope bacterial loads, was assessed by multinomial logistic regression. In the final step of the logistic regression, only possibly significant independent variables ($P < .15$, χ^2 test) were included. Analyses were performed using SPSS version 17.0 (SPSS, Chicago, IL).

RESULTS

Twelve medical devices (6 cardiac monitors, 2 pulse oximeters, and 4 electrocardiography machines) and 88 physician stethoscopes were sampled (n = 100). The physicians' demographic characteristics are summarized in Table 1. The vast majority practiced handwashing (n = 84; 95.5%); however, only 57 (64.8%) did so after each patient examination, and 20 (22.7%) did so only when they believed that their hands were dirty. The physicians' self-reported cleaning habits and level of education on cleaning of medical tools are presented in Table 2. Compared with female physicians, male physicians were less likely to clean their stethoscopes after each patient examination/after every shift than in certain cases/randomly/when time allows it ($P = .016$; odds ratio [OR], 0.19; 95% confidence interval [CI], 0.05-0.62). All stethoscopes (100%) and 11 devices (91.7%) had at least 1 positive bacterial culture (Table 3). Seventy-three of 88 stethoscopes (83%) and 6 of 11 devices (55%) revealed multiple bacteria. Contamination was greater on stethoscopes of general practitioners compared with those of other specialists ($P = .007$; OR, 0.07; 95% CI, 0.01-0.51). Stethoscopes cleaned after each patient examination/every shift had significantly lower bacterial loads (CFU <1000) compared with those cleaned in certain cases/randomly/when time allows it ($P = .001$; OR, 0.09; 95% CI, 0.02-0.35). The percentage of high bacterial loads (CFU >1000) was 11% in groups of stethoscopes cleaned after each patient examination, 45% in those cleaned after every shift, 69% in those cleaned after suspected contamination, and 100% in those cleaned in certain cases/randomly/when time allows it ($P < .001$). The stethoscopes that yielded methicillin-resistant *S aureus* (MRSA), *Acinetobacter baumannii* complex, and the majority of methicillin-resistant CoNS (MRCoNS; n = 10; 55.6%) belonged to internists.

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