

Otoscope and stethoscope: Vehicles for microbial colonization at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia

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Abstract

Background: In a hospital setting, medical equipment carried by health care workers such as otoscopes and stethoscopes may serve as harbors for microorganisms and may cause nosocomial infection.

Objective: This study was undertaken to determine microbial colonization of otoscopes and stethoscopes used by health care workers at Tikur Anbessa Specialized Referral Hospitals, Addis Ababa, Ethiopia.

Methods: A cross sectional study was conducted from November 2011 to April 2012. After obtaining verbal consent, a total of 130 stethoscopes and 6 otoscopes were swabbed by rubbing the diaphragm and bells of stethoscopes as well as handle and tips of otoscopes with sterile cotton tip applicator moistened in sterile saline. The swabbed sample was inoculated immediately on blood agar and Sabouraud dextrose agar for bacterial and fungal growth respectively.

Results: 136 (130 stethoscopes and 6 otoscopes) were swabbed for this study. The owners of the medical devices were nurses, general practitioners, resident medical doctors, interns and other healthcare workers from different departments. The overall microbial colonization from 136 medical devices sampled was found to be 82 (60.3%). About 111 microbial isolates were identified of which 94/111 (84.7%) were gram positive bacteria, 5/111 (4.5%) were gram negative bacteria and 12/111 (10.8%) were fungi ($p < 0.05$). *Staphylococcus aureus* and coagulase negative *Staphylococci* isolates showed low level of resistance against most of the antibiotics tested.

Conclusion: Otoscopes and stethoscopes act as a vehicle for microbial colonization. Therefore, there is a need to evaluate efficacy of recommended cleaning practices in reducing the level of microbial colonization on these medical devices. [*Ethiop. J. Health Dev.* 2014;28(1):35-39]

Introduction

Nosocomial infections are significant causes of morbidity and mortality in hospitalized patients and remain a health problem throughout the world (1). It is estimated that more than 1.4 million people world-wide are suffering from infections acquired in hospitals (2). Many of the pathogens that cause nosocomial infection have a high level of resistance for commonly used antibiotic therapy (3).

In addition to the devices used in invasive procedures, the equipment commonly used in the hospital, such as sphygmomanometers, thermometers and stethoscopes bear a high risk of transmitting infections from patient to patient (4, 5).

As described by Cohen *et al*, 1997 (6), *Staphylococci* were isolated from 47 (85.4%) of stethoscopes and 35 (83.3%) of the otoscopes: *Staphylococcus aureus* was isolated from 54.5% and 45.2% of the stethoscopes and otoscopes respectively. Four isolates (7.3%) from the stethoscopes and four (9.5%) from the otoscopes yielded *S. aureus* resistant to Methicillin.

In Ethiopia, there have been no published reports, which revealed microbial colonization rate of otoscopes and stethoscopes. Therefore, this study was undertaken to determine microbial colonization of otoscopes and

stethoscopes used by health care workers (HCWs) at the Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia.

Methods

A hospital based cross-sectional prospective study was conducted from November 2011 to April 2012 at Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia. Tikur Anbessa (Black Lion) is the largest of all the hospitals in Ethiopia and provides a tertiary level treatment and is also open 24 hours for emergency services. This hospital gives services approximately to 370,000- 400,000 patients a year but the exact number is not known. The hospital's emergency department gives services to around 80,000 patients per year. It has 800 beds, with 130 specialists, 50 non-teaching doctors. This is the largest teaching hospital for about 300 medical students and 350 residents every year for Addis Ababa University (AAU), School of Medicine in Ethiopia.

Convenient sampling technique was used to select otoscopes and stethoscopes used by HCWs working at Intensive Care Units (ICU), Outpatients Departments (OPD), Pediatrics Ward, Gynecology Ward and Emergency Department (ED) in Tikur Anbessa Specialized Referral Hospital. All stethoscopes (n=130) and otoscopes (n=6) available during the study period from the specified department were swabbed and

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investigated for microbial colonization. Ethical approval for the study was granted by the Research and Ethical Committee of the Department of Microbiology, Immunology and Parasitology, College of Health Sciences, AAU.

Swab samples from stethoscope were taken by rubbing the diaphragm as well as from the bells of the stethoscope and also the handle and tips of otoscope with the sterile cotton tip applicators moistened with 2 ml of sterile saline solution and put into test tube by the principal investigator.

All the swabs were streaked on 5% sheep blood agar and MacConkey agar (Oxoid Ltd, UK), and incubated at 37°C for 24 to 48 hours under aerobic conditions. Bacterial isolates were identified by standard microbiological methods. Catalase and coagulase tests were used for gram positive bacteria whereas oxidase test and API 20E/NE were used for gram negative bacterial identification.

For fungi isolation, swabs were inoculated on Sabouraud Dextrose Agar (Oxoid Ltd, UK) supplemented with Chloramphenicol and incubated at room temperature for molds and at 37°C for yeast for 3 to 10 days. Once fungal growth was observed, identification of colonies was made using a combination of macroscopic and microscopic examination of growth and also temperature tolerance test.

Bacteria isolates were subjected to antibiotic sensitivity tests using disc diffusion method according to the criteria set by the Clinical and Laboratory Standards Institute (CLSI) (7).

The drugs for the disc diffusion testing used were: Ampicillin (AMP) (10 µg), Oxacillin (OX) (1µg), Chloramphenicol (C) (30 µg), Erythromycin (E) (15 µg), Vancomycin (VA)(30µg), Trimethoprim+ Sulfamethoxazole (SXT) (25µg), Ceftriaxone (CRO) (30µg), Penicillin G (P) (10units) and Clindamycin (DA) (30µg), Ciprofloxacin (CIP) (5 µg), Gentamicin (CN) (10 µg), and Nalidixic Acid (NA) (30µg).

Statistical Analysis:

The collected data were entered in to a Microsoft Excel and analyzed with SPSS version 20.0 software. The level of significance was set at 0.05 as indicator of a statistically significant.

Results

A total of 130 stethoscopes were swabbed and were investigated for microbial colonization. The owners of the stethoscopes were nurses 18 (13.8%), general practitioners 25 (19.2%), resident medical doctors 44 (33.8%), interns 28 (21.5%) and other HCWs 15 (11.5%). Five departments were included in the study;

from ED 39 (30%), Gynecology ward 21 (16.2%), ICU 35 (26.9%), OPD 14 (10.8%) and Pediatrics wards 21 (16.2%). The owners of the otoscopes were nurses 5 (83.3%), and general practitioners 1 (16.7%). Four Departments were included in the study; from ED 1 (16.7%), ICU 1 (16.7%), OPD 1 (16.7%) and Pediatrics wards 3(50%) otoscopes investigated for microbial colonization.

The overall microbial colonization from 136 medical devices was 82 (60.3%). Generally, 111 microbial isolates were identified of which 94/111 (84.7%) were gram positive bacteria, 5/111 (4.5%) were gram negative bacteria and 12/111 (10.8%) were fungi ($p < 0.05$).

Of 130 stethoscopes swabbed, 70/130 (53.8%) were positive for bacterial colonization. Out of 95 bacteria isolated, 50/95 (52.6%) and 45/95 (47.4%) recovered from diaphragm and bell of the stethoscopes respectively ($p > 0.05$). Among the bacteria isolated, *CoNS* accounted for 72/95 (75.7%) followed by *S. aureus* 18/95 (18.9%) and *Klebsiella terrigena* 2/95 (2.1%), *Erwina species*, *Flavimonas oryzihabitans* and *Pantoea species* accounted for 1/95 (1.1%) each (Table 1).

In addition, 9 (6.9%) stethoscopes were positive for fungal colonization. From these 9 (6.9%) stethoscopes; 11 fungi isolates that means 5/11 (45.4%) and 6/11 (54.5%) were recovered from diaphragm and bells of the stethoscopes respectively ($p > 0.05$). Among the fungal isolated from the stethoscopes, *Candidia albicans* accounted for 6/11 (54.5%) and *Aspergillus flavus* accounted for 5/11 (45.4%).

From 6 otoscopes swabbed, 3/6 (50%) were positive for bacterial colonization. A total of 4/6 (83.4%) bacteria were isolated from handle and tips of otoscopes. Among fungi colonization of otoscope, only 1 (16.6%) *Candia albicans* were isolated from the tips part (Table 1).

Of the total of stethoscopes sampled ($n=130$) and became culture positive for microbial colonization ($n=79$), 26/39 (66.7%), 12/21 (57.1%), 25/35 (71.4%), 6/14 (42.9%), 10/21 (47.6%) were from ED, Gynecology ward, ICU, OPD and Pediatrics ward respectively ($P > 0.05$) (Table 2).

Of the three otoscopes swabbed from Pediatrics ward, 1/3 (33.3%) was positive for microbial culture. Each otoscope from OPD and ICU was culture positive for microbial culture. One otoscope swabbed from ED was culture negative for microbial colonization ($p > 0.05$).

Of the 11 stethoscopes cleaned between patients examination and swabbed, 5 (45.5%) was culture positive and of the 119 stethoscopes not cleaned between patients examination, 74 (62.2%) was culture positive for microbial growth ($P < 0.05$) (Table 3).

Table 1: Type of microorganisms isolated from stethoscopes and otoscopes in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012).

Isolates	Stethoscopes (n=130)			Otosopes (n=6)		
	Bells No. (%)	Diaphragm No. (%)	Total No. (%)	Handle No. (%)	Tips No. (%)	Total No. (%)
1.Bacteria						
CoNS	36 (37.9)	36 (37.9)	72 (75.7)	1 (25.0)	1 (25.0)	2 (50.0)
<i>S. aureus</i>	8 (8.4)	10 (10.5)	18 (18.9)	1 (25.0)	1 (25.0)	2 (50.0)
<i>K. terrigena</i>	1 (1.1)	1 (1.1)	2 (2.1)	-	-	-
<i>Erwina</i> species	-	1 (1.1)	1 (1.1)	-	-	-
<i>Pantoea</i> species	-	1 (1.1)	1 (1.1)	-	-	-
<i>F. oryzihabitans</i>	-	1 (1.1)	1 (1.1)	-	-	-
Total No. (%)	45 (47.4)	50 (52.6)	95 (100)	2 (25.0)	2 (25.0)	4 (100)
2.Fungi						
<i>C. albicans</i>	3 (27.3)	3 (27.3)	6 (54.5)	-	1 (16.7)	1 (16.7)
<i>A. flavus</i>	3 (27.2)	2 (18.2)	5 (45.4)	-	-	-
Total No. (%)	6 (54.5)	5 (45.4)	11 (100)	-	1 (16.7)	1 (16.7)

Table 2: Microbial colonization rate of stethoscopes from different wards in Tikur Anbessa Specialized Referral Hospital (November 2011-April 2012)

Departments or wards	Stethoscopes sampled from each ward (No.)	Stethoscopes with positive culture from each ward (No. (%))
ED	39	26 (66.7%)
Gynecology ward	21	12 (57.1%)
ICU	35	25 (71.4%)
OPD	14	6 (42.9%)
Pediatrics ward	21	10 (47.6%)
Total	130	79 (60.8)

Table 3: Microbial colonization rate of stethoscopes in relation to cleaning practice between patient examinations by HCWs in Tikur Anbessa Referral Hospital from November 2011 to April 2012

Cleaning between patient Examination	Stethoscopes sampled No. (%)	Stethoscopes with positive culture No. (%)	
Yes	11 (8.5)	6 (54.5)	p>0.05
No	119 (91.5)	73 (61.3)	
Total	130 (100)	79 (60.8)	

From the 130 stethoscopes; 94 were cleaned with alcohol, 11 were cleaned with soap and water and the rest 25 were not cleaned at all. Of the 94 stethoscopes cleaned with alcohol, 55/94 (58.5%) were culture positive and of 11 stethoscopes cleaned with soap and water, 7/11 (63.6%) were culture positive. No significance difference was found between alcohol and soap and water ($p>0.05$). Among 25 stethoscopes not cleaned with any disinfectant, 17 (68%) became culture positive (Table 4).

Of 6 otoscopes sampled, 3/6 (50%) were cleaned between patients examination, of them 1/3 (33.3%) was culture positive. From 3/6 (50%) otoscopes that were never cleaned, 2/3 (66.7%) were culture positive ($p<0.05$).

Of the 119/130 (91.5%) HCWs, who did not clean stethoscopes between patients examinations; from the reason not for cleaning they answered to the questionnaire, work overload accounted for 50 (38.5%), antiseptic shortage accounted for 18 (13.8%) and negligence accounted for 51 (39.2%).

Among gram positive bacterial isolates, *S.aureus* and CoNS showed low level of resistance (<60%) for most of the antibiotics tested (Table 5). Gram negative bacteria isolates showed low level of resistance (<60%) for Erythromycin, Ampicillin, Trimethoprim-sulfamethoxazole, Chloramphenicol, Ceftriaxone, Ciprofloxacin and Nalidixic Acid, but susceptible for Gentamicin.

Table 4: **Microbial colonization rate of stethoscopes in relation to use of disinfectant in Tikur Anbessa Referral Hospital from, November 2011 to April 2012**

Types of disinfectant used for cleaning stethoscopes	Stethoscopes sampled from different HCWs No. (%)	Stethoscopes with positive culture No. (%)	
Alcohol 70%	94 (72.3)	55 (56.4)	P>0.05
Soap and water	11 (8.5)	7 (63.6)	
Nil	25 (19.2)	19 (76.0)	
Total	130 (100)	79 (60.8)	

Table 5: **Antimicrobial susceptibility of gram positive bacteria isolated from otoscopes and stethoscopes in Tikur Anbessa Specialized Referral Hospital (November 2011 –April 2012)**

Antimicrobial agents (%)		AMP	C	CRO	DA	E	OX	P	SXT	VA
S.aureus(n=20)	R	10	5	15	-	10	10	30	30	-
	S	90	95	85	100	90	90	70	70	100
CoNS(n=74)	R	28.4	28.4	25.7	2.7	20.3	28.4	44.6	27.0	1.4
	S	71.6	71.6	74.7	97.3	79.8	71.6	55.4	73.0	98.6
Total (n=94)	R	31.1	23.4	23.4	2.1	18.1	24.5	41.5	27.6	1.1
	S	75.5	76.6	76.6	97.9	82.0	75.5	56.7	72.4	98.9

R=Resistant

S=Susceptible

Discussion

It is known that in health institutions, medical equipment such as stethoscopes, otoscopes, etc. may serve as reservoirs for microorganisms (4-6, 8). In the present study, of the 60.3% (82/136) total microbial colonization (130 stethoscope and 6 otoscope sampled), gram positive bacteria accounted for 84.7% whereas gram negative bacteria accounted for 4.5% and fungi accounted for 10.8%. This result is comparable with studies done in Turkey and other countries (9, 13, 14).

From 130 stethoscopes sampled, 60.7% (79/130) of them were colonized by microbial. This is comparable to other similar studies (13). From this total colonization, bacteria accounted for 53.8% and fungi accounted for 6.9%. Among the bacteria isolates, 52.6% and 47.4% were isolated from the diaphragm and bells of the stethoscopes respectively. This is comparable to a study done by Bhatta *et al.* (15). Among the bacterial isolates, *CoNS* accounted for 75.7% followed by *S.aureus* 18.9% and few gram negative bacteria. This result is comparable to studies done in other countries (9,13,14). Of the total 6.9% of stethoscopes fungal colonization; 45.4% isolated from the diaphragm and 54.5% isolated from bells which include 54.5% *Candida albicans* and 45.4% *Aspergillus flavus*. This result is in agreement with other study done in Nigeria (9).

In this study, 3/6 (50%) of otoscopes were colonized by gram positive bacteria and fungi. Of which 41.65% *S. aureus*, 41.65% *CoNS* and 16.7% *Candida albican* were isolated. The colonization rate of otoscopes showed lower (50%) in contrast to the study done in Israel (90%) (6).

In the present study, microbial colonization of 45.5% cleaned and 62.2% of not cleaned stethoscopes between patients examination were investigated. This is, in line with a study done in Nigeria, where more colonization was observed in stethoscopes not cleaned between patients examination (11).

In this study, 71.4% of stethoscopes from ICU showed microbial colonization, but no significant differences observed among the departments. This is in agreement with the study done in India (18).

In this study, it was observed that many HCWs did not clean their stethoscopes between patients examination because of the reason ranked as 39.2%, 38.5% and 13.8% were due to negligence, work overload, and antiseptic shortage respectively. This is comparable to the study done by Grecia *et al.* (16). Additional reasons were also identified in other studies which include, among these, lack of formal education, hospital protocol on the subject matter and shortage of positive role models were identified as a reason (17).

S.aureus and *CoNS* isolates showed low level of resistance (<60%) for antibiotics tested (except *S.aureus* for Clindamycin and Vancomycin.). This is in line with similar studies done in India, Nigeria and other countries (8, 11, 19-21).

Gram negative bacteria isolates showed low level of resistance (<60%) for all antibiotic tested but 100% susceptible for Gentamicin. This result is in agreement with study done in Taiwan and France (22, 23).

In conclusion, otoscopes and stethoscopes act as a vehicle for microbial colonization. There was no significant difference between those cleaned and not cleaned for microbial colonization. Therefore, there is a need to evaluate the frequency and efficacy of recommended cleaning agents and practices in reducing the level of microbial colonization on these devices.

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