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BACTERIAL CONTAMINATION OF STETHOSCOPES USED BY HEALTH CARE WORKERS IN A TERTIARY CARE HOSPITAL IN NAVI MUMBAI

Gurjeet Singh[1*], A.D. Urhekar[2], Anahita V. Hodiwala[3], Neha Singh[4], Bhaskar Das[5]

[1*, 2,3,4,5] Department of Microbiology, MGM Medical College, Kamothe, Sector-18, Navi Mumbai-410209, Maharashtra, India.

*Corresponding Author Email: gurjeetsingh360@gmail.com

ABSTRACT

Background/Aim: *Stethoscopes are widely used by doctors and medical students for clinical examination of patients. However they can act as vehicle for transfer of bacteria from one patient to another and contribute to hospital acquired infections. Hence, this study was undertaken with an to study the presence of bacteria and their species types on the stethoscopes of doctors and other HCW.* ***Materials and Methods:*** *Swabs were collected from stethoscopes by rubbing sterile, moist swabs on the entire surface of the diaphragm. In the second part of the study, the same stethoscope diaphragm was cleaned with alcohol rubs, allowed to act for 3-5 minutes and again second swab was collected from the same stethoscope. The swabs were directly inoculated on blood agar, MacConkey agar plates. Standard methods were followed for isolation and identification. All Staphylococcal strains were tested for MRSA. Antibiotic sensitivity was performed by Kirby-Bauer disc diffusion method as per CLSI guidelines to study antibiotic susceptibility pattern.* ***Results:*** *100 swabs each were obtained before and after applying alcohol rub. 90 (90%) of stethoscopes showed bacterial contamination (χ^2 = 163.64, d.f. =1, P<0.05) showed statistically significant different, isolates were Staphylococcus aureus (56%) followed Bacillus species (42%), Micrococci (24%), CoNS (04%), Pseudomonas aeruginosa (04%), Diptheroids (04%), Enterobacter species (2%) and Candida species (02%). Out of 56 isolates of the Staphylococcus aureus tested for MRSA, 20 (35.72%) were MRSA and 36 (64.28%) were MSSA (χ^2 = 6.36, d.f. =1, P<0.05) showed statistically significant different. Swabs collected after alcohol rub did not show any bacterial growth in any samples.* ***Conclusion:*** *Our study highlights the need to disinfect the stethoscopes diaphragms by simply applying the alcohol rubs to prevent any spread of bacteria from patient to patients.*

KEY WORDS

Hospital acquired infection, stethoscope, transmission, bacteria, health care workers.

INTRODUCTION

Infection transmission in the hospital environment (nosocomial infection) remains a significant hazard for hospitalized patients, and health-care workers are potential sources of these infections. Many pathogens can be transmitted through hands [1], which is a major reason that all health-care workers must wash their hands before and after examining each patient [2]. Transmission of infections on contaminated medical devices is also possible and outbreaks of hospital-acquired infections have been linked to devices such as electronic thermometers, blood pressure cuffs, stethoscopes, latex gloves, masks, neckties, pens, badges and white coats [1,3-6]. Stethoscopes are commonly used to assess the health of patients and have been reported to be potential

vectors for nosocomial infections in various parts of the world [3,7-10]. Following contact with infected skin, pathogens can attach and establish themselves on the diaphragms of stethoscopes and subsequently be transferred to other patients if the stethoscope is not disinfected. [11-13]

There are increasing reports of the risk of transmitting antibiotic resistant microorganisms from one patient to another on stethoscopes. [3, 14, 15, 16]

Swiping stethoscopes with alcohol pads is currently the gold standard for cleaning these instruments, but physicians do not consistently use alcohol pads for this purpose, as this requires an extra step of purchasing alcohol pads and their disposal. [17]

There are increasing reports of the risk of transmitting antibiotic resistant microorganisms from one patient to another on stethoscopes. [18, 19, 20] These antibiotic-resistant organisms are capable of initiating severe infections in a hospital environment and could require contact isolation and aggressive treatment to prevent the spread of the organisms. [21] Examples of such antibiotic-resistant organisms are ceftazidime-resistant Klebsiella pneumoniae, vancomycin-resistant enterococci, methicillin-resistant staphylococci, ciprofloxin-resistant Pseudomonas aeruginosa, gentamicin-resistant P. aeruginosa, and penicillin-resistant pneumococci. [22-26]

MATERIALS AND METHODS

The study was conducted in June 2012 to December 2012 at Department of Microbiology, MGM Medical College, Navi Mumbai. Samples that were taken from health care worker and tests were done at the Microbiology laboratory. Laboratory testing was conducted within one hour of sample collection.

Two swabs were taken-one before cleaning and second after cleaning with alcohol rub. The swabs taken from the stethoscope of health workers were inoculated directly onto blood agar and MacConkey agar and incubated at 37ºC for 24 hours. The colony morphology was recorded. Bacterial isolates were identified by standard methods. Antibiotic sensitivity test of isolated bacteria was done by Kirby-Bauer method as per CLSI guidelines [27]. Gram-positive isolates were tested for susceptibility against ampicillin/sulbactam, cefotaxime, linezolid, gentamicin, cloxacillin, roxithromycin, tetracycline, and ciprofloxacin and the Gram-negative isolates were tested for susceptibility against amikacin, gentamicin, ciprofloxacin, lomefloxacin, cefoperazone, ceftazidime, and csefuroxime.

RESULTS AND DISCUSSION

This project was undertaken to study the presence of bacteria and their species types on the diaphragm of the stethoscopes of different health care workers groups-doctors working in the medicine and surgery department, MBBS internship students and nursing staff.

Out of 100 stethoscopes studied, 90 (90%) of the total stethoscopes showed growth of bacteria. However 10 (10%) showed no growth on culture plate. The frequency of bacteria isolates was 100% for medicine, 88.89% for surgery, 85.71% MBBS internship students and 80% for nursing staff. Chi-square (χ^2) = 6.60, d.f. =3, P value >0.05, not significant (means there is no statistically significant difference in the number of stethoscopes showing bacterial growth from different groups) [**Table No.1**].

Table 1: shows ward wise distribution.

Sr. No.	Ward	Sample tested	No growth	Bacterial growth (%)
1.	Medicine	34	-	34 (100)
2.	Surgery	18	02	16 (88.89)
4.	MBBS Intern	28	04	24(85.71)
5.	Nursing	20	04	16(80)
	Total	100	10	90

In a study conducted by Chigozie J. et al (2010), of the 107 stethoscopes surveyed, 84 (79%) were contaminated with bacteria; 59 (81%) of the contaminated stethoscopes belonged to physicians and 25 (74%) were from other health workers. [16]

In another study by Uneke CJ et al (2008), on stethoscopes of medical students, bacterial contamination was found on 80% stethoscopes. [18]

In our study the maximum number of bacteria isolated were Staphylococcus aureus 56% followed by Bacillus species 42%, Micrococcus 24%, Coagulase Negative Staphylococci 4%, Pseudomonas aeruginosa 4%, Diphtheroids 4%, Enterobacter species 2% and Candida species 2% [**Table no.2**].

Table 2: shows all bacterial isolates from stethoscopes

Sr. No.	Isolated Bacteria	Total No. %
1.	Staphylococcus aureus	56 (56%)
2.	Bacillus species	42 (42%)
3.	Micrococcus	24 (24%)
4.	Coagulase Negative Staphylococci	04 (4%)
5.	Pseudomonas aeruginosa	04 (2%)
6.	Diptheroids	04 (4%)
7.	Enterobacter species	02 (2%)
8.	Candida species	02 (2%)
	Total	**138**

In a study conducted by Chigozie J. et al (2010), of the 107 stethoscopes surveyed, isolates included Staphylococcus aureus (54%), Pseudomonas aeruginosa (19%), Enterococcus faecalis (14%), and Escherichia coli (13%). [16]

In another study conducted by Uneke CJ et al (2008), on the stethoscopes of medical students

in Nigeria, Staphylococcus aureus and Pseudomonas aeruginosa were major isolates. [18]

In our study the stethoscope without cleaning with alcohol rub showed 90% growth of bacteria and after cleaning with alcohol rub did not show any type of growth. Chi-square (χ^2) = 163.64, d.f. =1, P value <0.05, significant (means there is statistically significant difference with results of bacterial cultures before and after alcohol rub) [**Table no.3**].

Table 3: shows effectiveness of alcohol rub on the diaphragm of stethoscopes.

Parameter	Growth	No growth	Total
Before applying alcohol rub	90	10	100
After applying alcohol rub	0	100	100
Total	90	110	200

In a study conducted by Chigozie J. et al (2010), contamination was significantly higher on stethoscopes cleaned with only water (100%) compared to those cleaned with alcohol (49%) (χ^2 = 30.17, P<.05). Significantly fewer (9%) stethoscopes from health workers who washed their hands after seeing each patient were contaminated when compared with the instruments (86%) of those who did not practice hand washing (χ^2 = 23.79, P < .05). [16]

Another study conducted by Uneke CJ et al (2008), **s**tethoscopes from students who cleaned them after use on each patient and from those who practised handwashing after contact with each patient had significantly lower bacterial contamination (chi^2 = 26.9; p < .05 and chi^2=31.9, p < 0.05, respectively). [18]

Ward wise distribution of bacterial isolates was - from medicine ward Staphylococcus aureus (48%), Bacillus (16%), Micrococcus (16%), CoNS (8%), P. aeruginosa (8%) and Candida (4%). From surgery ward Bacillus (63.64%), Staphylococcus aureus (18.18%) and Micrococcus (18.18%). From MBBS internship students Staphylococcus aureus (45.45%), Bacillus species (22.73%), Micrococcus (18.18%), Diptheroids (9.09%) and Enterobacter species (4.55%). From nursing staff Staphylococcus aureus (36.36%), Bacillus species (45.45%), Micrococcus (18.18%) [**Table no. 4**].

Table 4: shows number and bacterial isolates.

Bacteria isolated from Stethoscope	Doctors stethoscopes No. (%)			Nurses stethoscopes No. (%)	Total No.
	Medicine Ward	Surgery ward	MBBS Interns		
Staph aureus	24 (48)	04 (18.18)	20 (45.45)	08 (36.36)	56
Bacillus spp.	08 (16)	14 (63.64)	10 (22.73)	10 (45.45)	42
Micrococcus	08 (16)	04 (18.18)	08 (18.18)	04 (18.18)	24
CoNS	04 (8)	0	0	0	04
P. aeruginosa	04 (8)	0	0	0	04
Diptheroids	0	0	04(9.09)	0	04
Enterobacter spp.	0	0	02(4.55)	0	02
Candida spp.	02(4)	0	0	0	02
Total	50 (100)	22 (100)	44 (100)	22 (100)	138

In this study (35.71%) the MRSA were isolated whereas MSSA were (64.29%). The MRSA isolated from medicine ward 4/20 (20%), surgery ward 4/20 (20%), MBBS intern 4/20 (20%) and nurses staff 8/20 (40%). Chi-square (χ^2) = 6.36, d.f. =1, P<0.05, significant (means there is statistically significant difference of MRSA between doctors and nurses). Stethoscopes of doctors showed higher number of MRSA [**Table no. 5**].

Table 5: shows differentiation between MSSA and MRSA from total Staphylococci.

Bacteria isolated from Stethoscope	Doctors stethoscopes No. (%)			Nurses stethoscopes No. (%)	Total No. (%)
	Medicine Ward	Surgery ward	MBBS Interns		
MRSA (out of 56 Staphylococcus aureus)	04 (16.67)	04 (100)	04 (25)	08 (66.67)	20/56 (35.71)
MSSA (out of 56 Staphylococcus aureus)	20 (83.33)	0	12 (75)	04 (33.33)	36/56 (64.29)
Staph aureus (Total)	24 (100)	04 (100)	16 (100)	12 (100)	56 (100)

Youngster I et al (2008), studied 43 stethoscopes belonging to senior physicians, residents, interns and medical students at the paediatric ward. Bacterial cultures and antibiotic sensitivity testing were carried out. All but six bacterial cultures were positive (85.7%). Staphylococcal species were the most common contaminants (47.5%). One case of methicillin-resistant Staphylococcus aureus was encountered. Gram-negative organisms were isolated in nine different samples (21%) including one case of Acinetobacter baumannii in the neonatal intensive care unit. [26]

In our study of antibiotic susceptibility testing of isolated bacteria, Gram positive cocci were 100% resistant to roxithromycin and cefotaxime, whereas linezolid and ciprofloxacin and vancomycin showed 100% sensitivity [**Table No. 6**].

Table 6: shows antimicrobial susceptibility of Gram positive bacteria from stethoscopes

Antibiotics	Concentration	S. aureus n=56 (%)
Linezolid	30 mcg	56 (100)
Tetracycline	30 mcg	38 (67.86)
Gentamicin	10 mcg	45 (80.36)
Ciprofloxacin	5 mcg	56 (100)
Roxithromycin	30 mcg	R
Ampicillin/Sulbactam	20 mcg	36 (64.29)
Cefotaxime	30 mcg	R
Cloxacillin	1 mcg	36 (64.29)
Vancomycin	30 mcg	56 (100)

Antibiotic susceptibility testing of isolated Gram nsegative bacilli showed 100% resistance to cefuroxime, lomefloxacin, ofloxacin and ceftazidime. However amikacin, pefloxacin was 100% sensitivity [**Table No. 7**].

Table 7: shows antimicrobial susceptibility of Gram negative bacteria from stethoscopes

Antibiotics	Concentration	P. aeruginosa n=4 (%)	Enterobacter spp. n=2 (%)
Amikacin	30 mcg	04 100	02 (100)
Gentamicin	10 mcg	01 (25)	02 (100)
Cefuroxime	30 mcg	R	R
Lomefloxacin	30 mcg	R	R
Ofloxacin	5 mcg	R	02 (100)
Ciprofloxacin	5 mcg	2 (50)	02 (100)
Pefloxacin	5 mcg	04 (100)	02 (100)
Ceftazidime	30 mcg	R	01 (50)

Another study conducted by Uneke CJ et al (2008), isolates of Staphylococcus aureus showed the highest susceptibility to antibiotics, while the most effective antibiotics were Ciprofloxacin and Erythromycin. [18]

CONCLUSION

Our study revealed following findings-

- Incidence of bacterial contamination of stethoscopes ranged from 80 – 100%.
- Physician stethoscopes showed 100% bacterial contamination.
- Most commonly organisms isolated S. aureus, Bacillus species, Micrococcus, CoNS, P. aeruginosa, Diptheroids, Enterobacter species and Candida species.
- MRSA was isolated in doctors stethoscope higher than nurses stethoscope. (χ^2 = 6.36, d.f. =1, P<0.05) statistically significant difference between doctors and nurses stethoscopes.
- Antibiotic susceptibility testing of Gram positive cocci showed 100% resistance roxithromycin and cefotaxime, whereas linezolid and ciprofloxacin and vancomycin showed 100% sensitivity.
- Antibiotic susceptibility testing of Gram negative bacilli showed 100% resistance to cefuroxime, lomefloxacin, ofloxacin and ceftazidime. However amikacin, pefloxacin was 100% sensitivity.
- Antibiotic sensitivity patterns of bacterial isolates from different study groups was similar, indicates similar strain in the environment.
- Our study highlights the need to disinfect the stethoscopes diaphragms by simply applying the alcohol rubs to prevent any spread of bacteria from patient to patients.
- While it is impossible to destroy all bacteria or eliminate all infections in environment, many infections can be prevented with this

simple procedure of cleaning the stethoscopes. Alcohol rub is already in use for stethoscopes cleaning procedure which requires no added cost and no additional time.

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LIMITATION OF THE STUDY

- Other contaminating organisms like fungi, viruses, anaerobic bacteria were not studied.
- Non alcohol based products – not studied.
- It is not known whether the alcohol rub will damage stethoscope diaphragms.

SCOPE FOR FURTHER RESEARCH

Further research is necessary to determine whether the reduction of bacterial growth also corresponds to a reduction in clinically related diseases. The results of this study provide evidence that alcohol rub, decontaminated the stethoscopes. The research can also be made on comparing the use of stethoscope before and after hand wash.

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***Corresponding Author:**
Gurjeet Singh
Department of Microbiology,
MGM Medical College, Kamothe, Sector-18,
Navi Mumbai-410209, Maharashtra, India.