Original Article

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Antimicrobial Susceptibility Pattern of Nosocomial Bacterial Contamination Isolated from Stethoscopes Used in Sylhet MAG Osmani Medical College Hospital

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ABSTRACT

Background: Stethoscope is the symbol of health professionals. Due to their universal use by health professionals, stethoscopes can be a potential source of infections.Nosocomial infection is a significant problem in each hospital. Such infections can result due to multiple causes like development and persistence of Multidrug Resistant (MDR) bacteria, immune compromised states of patients and mechanical transmission of agents from one patient to another. There are increasing reports of the risk of transmitting antibiotic resistant microorganisms from one patient to another by stethoscopes. 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 organism. The objectives of the study were to evaluate the bacterial profile in stethoscopes used by the physicians working in Inpatient and Outpatient Department.

Materials and methods: This cross-sectional and comparative study was conducted at Indoor and Outpatient Department of Sylhet MAG Osmani Medical College Hospital (SOMC) Sylhet for one year period (From January 2013 to January 2014). Stethoscopes used by the physician of IPD and OPD of Sylhet MAG Osmani Medical College Hospital were consecutively included as study population. Total 90 sample were collected from Medicine, Surgery and Gynaecology Department. Stethoscope used outside the hospital and which disinfected regularly were excluded. Here self-administered questionnaire was used to collect demographic data and information. Specimen were collected as swab stick impressions from diaphragm of the used stethoscope. Specimens were cultured and isolates were identified by using standard microbiological technique. The results were presented in tables and figures.

Results: Among contaminated gram positive bacterial pathogen in IPD and OPD *Staphylococcus aureus* 34% and 36% respectively was most frequent isolated and most frequent gram negative bacterial pathogen in IPD and OPD was *Esch. coli* which about 34% and 27%. Antibiotic susceptibility pattern were tested in all isolates collected from different department. Used antibiotics were Amoxyclave, Amikacin, Imipenem, Ciprofloxacin, Ceftriaxone, Cephradine, Flucloxacillin, Azithromycin, Novobiocin and Erythromycin. In this study both gram positive and gram negative bacteria have higher rates of resistance to different classes of antibiotics, where *E. coli* showed resistance to Ciprofloxacin and *S. aureus* isolated species were sensitive to Erythromycin.

Conclusion: High risk of nosocomial transmission by stethoscopes has been reported that sanitation of stethoscopes is one of the most neglected practices of health workers.

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Health worker; Nosocomial transmission; Stethoscopes.

INTRODUCTION

During auscultation stethoscope contamination is common if same stethoscope is used for the next patient without disinfection, it might bring risk of infection to the patient and may continuously impose

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the risk serially to all patients.[1] An important part of nosocomial infections are seen in the form of life threatening infections in intensive care units.[2]

Stethoscopes harbor potentially harmful various type of bacteria. As early as 1972, stethoscopes were identified as a fomite on which bacteria are capable of surviving for various length of time[3]. On inanimate objects, *Escherichia coli* has been reported to live 1.5 hours to 16 months, *Staphylococcus aureus* (Including the resistant form Methicillin Resistant *Staphylococcus aureus*) 17 days to 7 months; and *Clostridium difficile*, 5 months on inanimate objects.[4] Not only are these organisms able to surviveon the surface of inanimate objects, but it has also been reported that bacteria may betransferred to human skin from surfaces.[5]

Medical care equipments are more likely to carry pathogenic microorganisms. The contamination of stethoscope particularly the diaphragm is reported mainly due to lack of regular disinfection (Before and after examining each patient). A study from India reported that, 45% of general practitioners disinfect their stethoscope once a year or never and 35% disinfect their stethoscope monthly.[6] Moreover, the personal stethoscopes of health care workers who practice regular decontamination have been found to be less likely to be contaminated by MRSA and other MDR pathogens. As such, health care workers should be expected to routinely decontaminate the head of their personal stethoscope between patients, logically when they do post examination hand hygiene. Infection prevention protocols are effective in reducing the health care associated infections.[7] The use of 70% propyl alcohol found to be effective in reducing contamination of stethoscopes and other medical equipments than other agents like detergents.[8]

A single stethoscope often used for all inpatients and outpatients which increases the risk of bacterial transmission.[9] Patients with lowered immune system and who have undergone surgical manipulation may develop clinical infection with these microorganisms by "autoinoculation".[10] Periodic surveillance of medical equipments and hospital environments may help in identifying potential bacterial pathogens and associated factors. The objectives of the study were to evaluate the bacterial profile in stethoscopes used by the physicians working in Inpatient and Outpatient Department.

MATERIALS AND METHODS

This cross-sectional and comparative study was conducted Indoor and Outpatient Department of Sylhet MAG Osmani Medical College Hospital, Sylhet during the period between January 2013 & January 2014. Stethoscopes used by the physician of Inpatient and Outpatient Department of Sylhet MAG Osmani Medical College Hospital (SOMCH) were consecutively included as study population. Total 90 sample were collected from Medicine , Surgery and Gynaecology Department (15 inpatient and 15 OPD). Stethoscope used outside the SOMCH and which disinfected regularly were excluded. Specimens were collected after taking consent from stethoscope users. Here self-administered questionnaire was used to collect demographic data and information. Specimen were collected as swab stick impressions from diaphragm of the used stethoscope and numbered accordingly. Antimicrobial susceptibility test was done by disk diffusion methods. In this method, the standardized bacterial isolate is spread on an agar plate and then paper disc containing specific concentration of antibiotics are placed and incubated at 37ºC overnight. Strains resistant to an antibiotic grow up to the margin of disk. The diameter of zone of inhibition must be measured and result read from the Kirby Bauer chart as sensitive or resistant.

Before taking impression each sterile swab stick was moistened with sterile normal-saline solution (0.9% w/v normal saline). Data were collected in pre-designed data collection sheet from the inpatient and OPD physicians of Sylhet MAG Osmani Medical College.

RESULTS

Table I shows distribution of stethoscopes user according to different department such as Gynae and Obstetrics, Medicine, Surgery. A total 90 stethoscopes were studied. Out 0f them 15 were from Gynae and Obs IPD and 15 from OPD, 15 were from Medicine IPD and 15 from OPD, 15 were from Surgery IPD and 15 from OPD.

Table I Distribution of stethoscope users according to different departments

Department	IPD	OPD	Total
Gynae and Obs	15	15	30
Medicine	15	15	30
Surgery	15	15	30
Total	45	45	90

Table II Distribution of stethoscopes according to presence of isolated organism in IPD of different dept (n=45)

Organism	IPD			
	Gynae	Medicine	Surgery	Total
Staph. aureus	3	4	3	10 (34%)
Staph. epidermidis	1	1	1	03 (10%)
Esch.coli	1	6	3	10 (34%)
Klebsiella	1	1	0	02 (06%)
Mixed growth	1	2	1	04 (14%)
Total(%)	7 (24%)	14 (48%)	8 (28%)	29(100%)

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In IPD out of 45 stethoscope diaphragms 29 were contaminated and total 5 bacterial stains were isolated. Isolated organism were *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Esch. coli*, Klebsiella and mixed growth, are structured accordingly. Majority of the isolates were potential pathogens. Among gram positive isolates *Staphylococcus aureus* 10 (34%) was the most frequent isolates and there was also present *Staphylococcus epidermidis*. Among gram negative isolates Esch.coli 10 (34%) was the most frequent isolates and there was also *Klebsiella spp.*

This table also shows that in IPD among different department out of 29 contaminated stethoscopes 7 (24%) stethoscopes were contaminated from Gynae and Obstetrics department, 14 (48%) from Medicine, 8 (28%) from Surgery department. In IPD among different departments majority of the isolates 14(48%) were found from Medicine Department.

Table III Distribution of stethoscopes according to presence of isolated organism in OPD of different department (n=45)

Organism	OPD			
	Gynae	Medicine	Surgery	Total (%)
Staph. ureus	2	2	1	05 (36%)
Staph. epidermidis	0	0	1	01 (07%)
Esch.coli	0	3	1	04 (27%)
Klebsiella	1	1	1	03 (21%)
Mixed growth	0	1	0	01 (07%)
Total (%)	3 (21%)	7 (50%)	4 (29%)	14 (100%)

In OPD out of 45 stethoscope diaphragms 14 were contaminated and total five bacterial stains were isolated. Isolated organism were *Staphylococcus aureus*, *Staphylococcus epidermidis, Esch.coli, Klebsiella* and mixed growth, are structured accordingly. Majority of the isolates were potential pathogens. Among gram positive isolates *Staphylococcus aure*us 05 (36%) was the most frequent isolates and there was also present *Staphylococcus epidermidis*. Among gram negative isolates *Esch. coli* 04 (27%) was the most frequent isolates and there was also *Klebsiella spp.*

This table also shows that in OPD among different department out of 14(100%) contaminated stethoscopes 3 (21%) stethoscopes were contaminated from Gynae and Obstetrics Department, 7 (50%) from Medicine, 4 (29%) from Surgery. In OPD among different dept majority of the isolates 7 (50%) were found from Medicine Department.

Table IV Antibiotic susceptibility pattern to isolated organism in IPD and OPD of Gynae and Obstetrics Department

Drugs	*Staph. aureus* (05)		Staph. epidermidis (01)		*Esch.coli* (01)		Klebsiella (02)		Mixed growth (01)	
	S	R	S	R	S	R	S	R	S	R
AML	05				01			02	02	
AK					01		02		01	
IPM					01		02		01	
CIP						01		02		01
CRO	05		01		01		02		02	
CE		05		01		01		02		02
E	05		01						01	
AGM	05		01						01	
NV			01							
FLU		05								01

Figure in the parenthesis shows total number of isolates.

In Gynae and Obstetrics Department a total of 30 stethoscopes were studied. Out of 30 stethoscopes both in IPD and OPD 10(33%) stethosscopes were contaminated and 20 (67%) were not contaminated.

Table IV shows antibiotic susceptibility pattern to presence of isolated organism in Gynae and Obstetrics IPD and OPD. Isolated organisms were *Staphylococcus aureus*, *Staphylococcus epidermidis, Esch.coli,* Klebsiella and mixed growth. Used antibiotics were Amoxyclave, Amikacin, Imipenem, Ciprofloxacin, Flucloxacin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin and Novobiocin. Among them Flucloxacillin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin, Novobiocin and Amoxyclave were used to see antibiotic sensitivity pattern of gram positive organism and Ciprofloxacin, Amoxyclave, Amikacin, Imipenem, Ceftriaxone, Cefradine were used to see antibiotic sensitivity pattern of gram negative organism.

Table V Antibiotic susceptibility pattern to isolated organism in IPD and OPD of Medicine Department

Drugs	Staph. aureus (06)		*Staph. epidermidis* (01)		**Esch.coli* (09)		Klebsiella (02)		Mixed growth (03)	
	S	R	S	R	S	R	S	R	S	R
AML	06				09			02	06	
AK					09		02		03	
IPM					09		02		03	
CIP						09		02		03
CRO	06		01		09		02		06	
CE		06		01		09		02		06
E	06		01						03	
AGM	06		01						03	
NV			01							
FLU		06		01						03

Figure in the parenthesis shows total number of isolates.

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*In Medicine Department 2 to 3 *Esch. coli* were also resistant to amoxiclave .

In Medicine Department a total of 30 stethoscopes were studied. Out of 30 stethoscopes both in IPD and OPD 21(70%) stethoscopes were contaminated and 9(30%) were not contaminated.

TableV shows antibiotic susceptibility pattern to presence of isolated organism in Medicine IPD and OPD. Isolated organism were *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Esch.coli,* Klebsiella and mixed growth. Used antibiotics were Amoxyclave, Amikacin, Imipenem, Ciprofloxacin, Flucloxacin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin and Novobiocin. Among them Flucloxacin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin, Novobiocin andAmoxyclave were used to see antibiotic sensitivity pattern of gram positive organism and Ciprofloxacin, Amoxyclave, Amikacin, Imipenem, Ceftriaxone, Cefradine were used to see antibiotic sensitivity pattern of gram negative organism.

Table VI Antibiotic susceptibility pattern to isolated organism in IPD and OPD of Surgery Department

Drugs	Staph. aureus (04)		Staph. epidermidis (02)		Esch.coli (04)		Klebsiella (01)		Mixed growth (01)	
	S	R	S	R	S	R	S	R	S	R
AML	04				04			01	02	
AK					04		01		01	
IPM					04		01		01	
CIP						04		01		01
CRO	04		02		04		01		02	
CE		04		02		04		01		02
E	04		02						01	
AGM	04		02						01	
NV			02							
FLU		04		02						01

Figure in the parenthesis shows total number of isolates.

In Surgery Department a total of 30 stethoscopes were studied. Out of 30 stethoscopes both in IPD and OPD 12 (40%) stethoscopes were contaminated and 18 (60%) were not contaminated.

Table VI shows antibiotic susceptibility pattern to presence of isolated organism in Surgery IPD and OPD. Isolated organism were *Staphylococcus aureus, Staphylococcus epidermidis, Esch.coli,* Klebsiella and mixed growth. Used antibiotics were Amoxyclave, Amikacin, Imipenem, Ciprofloxacin, Flucloxacin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin and Novobiocin. Among them Flucloxacin, Ceftriaxone, Cephradine, Erythromycin, Azithromycin, Novobiocin and Amoxyclave were used to see antibiotic sensitivity pattern of gram positive organism and Ciprofloxacin, Amoxyclave, Amikacin, Imipenem, Ceftriaxone, Cefradine were used to see antibiotic sensitivity pattern of gram negative organism.

DISCUSSION

Table I shows the distribution of stethoscope users according to different department such as Gynae and Obstetrics, Medicine, Surgery (IPD and OPD). This is comparatively lower than the study of Shiferaw in which almost all stethoscopes diaphragm collected from eight wards such as Gynae and Obs, Medicine, Surgery, Paediatrics, Maternity, ICU, OPD, Orthopaedies were studied.[11]

Table II, III in present study showed presence of most frequent bacterial pathogens. The study revealed that among contaminated gram positive bacterial pathogen in IPD and OPD *staphylococcus aureus* 34% and 36% respectively was most frequent isolates . This is comparatively higher than the study of Jones who found 19% stethoscopes contaminated with S. aureus.[12,13]

The current study also showed comparatively lower isolation of Staphylococcus aureus (36%) than the study of Marinella in which S. aureus was the most common bacterial pathogen isolated from the stethoscopes studied (53.6%) and the study of Uneke where *Staphylococcus aureus* contamination rate of 53.6% was recorded.[5,14,15]

A number of previous investigations found *Staphylococcus aureus* on 15.8% to 89% of stethoscopes used by health workers.[16-18] In another study conducted by Uneke, on the stethoscopes in Nigeria, Staphylococcus aureus was major isolates.[19]

This might be because of the direct contact of the stethoscope to human skin flora, which contains mostly gram-positive bacteria such as *Staphylococcus aureus* which is most common flora of human skin, it is also well documented fact that S. aureus is a primary causative agent of health care associated infection.[20] Although, the life span of Gram negative is maximally 6 hourin vitro, the half life span is less than an hour, Gram positive bacteria remain alive for a longer period of time. However, excessive bacterial colonization on stethoscope diaphragm enables them to remain alive for a period exceedin 8 hour.[21]

Table II, III in present study also shows presence of most frequent gram negative bacterial pathogen in IPD and OPD was *Esch. coli* which was 34% and 27% which have no similarity with the study of Shiferaw where the most common Gram negative isolate was Klebsiella spp (4.7%).[11]

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Table IV,V,VI shows antibiotic susceptibility pattern of current study. Antibiotic susceptibility pattern were tested in all isolates collected from different department. Used antibiotics were Amoxyclave, Amikacin, Imipenem,Ciprofloxacin, Ceftriaxone, Cephradine, Flucloxacillin, Azithromycin, Novobiocin and Erythromycin. Among them Ceftriaxone, Cephradine, Flucloxacillin, Azithromycin, Erythromycin, Amoxyclave and Novobiocin were used to see antibiotic sensitivity pattern of gram positive organism and Amoxyclave, Amikacin, Imipenem, Ceftriaxone, Cephradine and Ciprofloxacin for gram negative organism. In this study both gram positive and gram negative bacteria have higher rates of resistance to different classes of antibiotics. In present study all gram positive and gram-negative bacterial isolates were susceptible to Ceftriaxone, which was also found in-line with a study conducted by Uneke and Gebre-Sealssie[22,23,14,24].

In this study Isolates of E. coli showed resistance to Ciprofloxacin. This may be due to irrational and extensive use of Ciprofloxacin in our hospitals. Uneke in their study, conducted in an another country, found *Esch. coli* uniformly sensitive to ciprofloxacin.[14] This is another evidence that judicious use of antibiotic can dramatically increase the useful life of a precious antibiotic.

A study of Gupta showed susceptibility to Imipenem which have similarity with the present study. The study of Gupta also showed *S. aureus* isolated species were resistant to Erythromycin but the present study revealed that *S. aureus* isolated species were sensitive to Erythromycin.[25] Another study conducted by Uneke, isolates of *Staphylococcus aureus* showed the highest susceptibility to antibiotics, while the most effective antibiotics was Erythromycin.[18]

In contrast to those organisms that acquire resistance over time, opportunistic pathogens are intrinsically resistant to many antibiotics and are capable of proliferating when an individual's immune system is depressed. With increasing numbers of immunocompromised patients, opportunistic pathogens are increasingly capable of inflicting serious and potentially life-threatening infections.[6]

In current study the disinfection history among 90 participants none disinfects the diaphragm of stethoscope by any disinfectant.

Swabbing of the head of stethoscopes with 70% ethanol indicates a solution to this potential danger and is easily available in hospitals. How often a stethoscope must be cleaned is not well established, but there is a correlation between the degree of contamination and frequency of cleaning. Considering the added burden in antibiotic costs and hospital stays which could arise from such infections, infection control programs will definitely be cost effective. However, the implementation of such programs is hindered by poor compliance among doctors, nurses and othe health workers.[23]

The fact that stethoscopes diaphragms can transmit nosocomial pathogens and can cause hospital-acquired infections, lead us to recommend that HCWs should be further motivated to comply with infection control regulations.[26]

LIMITATION

Sample size collected from single centre purposively and the sample size was not representative in number. So the study findings might not reflect the overall situation of the whole population.

CONCLUSION

Seventy percent alcohol was found to be a highly effective means of reducing contamination on healthcare equipment, with a pooled reduction of 82.1% in levels of contamination across the 12 repeated measures studies. Cleaning protocols involving 70% alcohol were more effective than cleaning protocols involving detergent, antiseptic soap, and single and double paper wipes.

RECOMMENDATION

It is suggested regular cleaning of stethoscopes, otoscopes, auriscopes, diagnostic ultrasound and interferential therapy equipment with 70% alcohol is sufficient to reduce the risk of nosocomial infection.

DISCLOSURE

All the authors declared no competing interest.

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