

Stethoscopes: A Possible Mode for Transmission of Nosocomial Pathogens

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ABSTRACT

Background: The stethoscope, which is universally used as a medical device by health care workers, is likely to be contaminated by microorganisms, if it is not cleaned/disinfected and may transmit pathogens from one patient to another.

Objectives: This study was conducted to check the level of stethoscope contamination, to survey the practices of cleaning and disinfecting the stethoscope and to suggest remedial measures for it.

Material and Methods: A total of 58 stethoscopes were sampled and questionnaires were distributed among the participants.

Bacteriological cultures of the samples were done on blood and MacConkey agar plates.

Results: Out of a total of 58 diaphragms, 52 (89.65%) were colonized by bacteria. Only 38 (65.51%) bells were found to be contaminated. Out of a total of 116 earpieces (58 left and 58 right), 84 (72.41%) were contaminated.

Conclusion: Our study confirmed that, majority of the stethoscopes used by health care workers are contaminated with pathogenic as well as non-pathogenic bacterial agents and they may transmit nosocomial pathogens.

Key Words: Health care workers, Medical device, Nosocomial infection, Stethoscope

KEY MESSAGE

- Stethoscopes, if not cleaned/disinfected can transmit nosocomial pathogens and therefore regular cleaning with a suitable disinfectant is necessary.

INTRODUCTION

The transmission of infections in the hospital (nosocomial infections) from contaminated medical equipments and health-care workers (HCWs) is a major problem. Medical devices, if not sterilized/disinfected properly, may transmit microorganisms from one patient to the other.

The stethoscope, which is the symbol of health care, is one of the medical devices which are very commonly used by almost all the health-care workers like doctors, nurses and medical and nursing students. It has long been known that HCWs, despite their best intentions, sometimes act as carriers of infectious agents, thus disseminating new infections among their patients. Stethoscopes, the universal tools of the medical profession, are additional possible carriers, as these come in contact with many patients. Following their contact with the skin, microorganisms can attach and establish themselves on the stethoscopes and subsequently be transferred to other patients if the stethoscope is not disinfected before reuse [1-3].

The transmission of infections from contaminated medical devices is also a possible cause of the outbreaks of hospital-acquired infections. It has been linked to devices such as electronic thermometers, blood pressure cuffs, stethoscopes, latex gloves, masks, neckties, pens, badges and white coats [4-8]. Stethoscopes can carry staphylococci was known long ago [9-10]. One of the studies on stethoscopes had shown the presence of

gram negative bacilli also [11]. Infection control programmes can be significantly effective in reducing the nosocomial infection rates, but however, the implementation of such programs is hindered by poor compliance by the HCWs [12-13].

The major objectives of our study were, to determine the level of stethoscope contamination in Manipal Teaching Hospital (MTH), to survey the practices of cleaning and disinfecting the stethoscope and to suggest remedial measures for it.

MATERIALS AND METHODS

This prospective, cross sectional study was conducted by the Department of Microbiology, Manipal College of Medical Sciences (MCOMS) and MTH, Pokhara, Nepal, between April 2010 to October 2010. HCWs including consultants, medical officers, post graduate students, medical interns and staff nurses of the Medicine, Paediatrics and the Emergency Departments and the Intensive Care Unit (ICUs) were included in this study. The participants were given a questionnaire. A total of 58 HCWs participated in the study and the same number of stethoscopes was sampled. Specimens from the diaphragms, bells and both earpieces of the stethoscopes were collected either by direct inoculation onto blood agar plates (for the earpieces), or by swabs which were moistened in sterile normal saline (for the diaphragms and the bells). The inoculated blood agar plates were incubated under 5% CO₂ at 37°C for up to 48 hours. The growth was identified by standard microbiological

procedures [14] such as colony morphology, Gram's staining, growth on differential media and conventional biochemical tests. Antibiotic sensitivity tests were performed by the Kirby Bauer method [14].

RESULTS

The total number of HCWs who participated in the study was 58, which included 30 (51.72%) males and 28 (48.27%) females [Table/Fig-1] summarizes the designations of the HCWs.

The details of the questionnaires which were filled by all the HCWs revealed that 96.55% of them were aware that stethoscopes could transmit infectious agents, while all the 100% thought that stethoscopes needed to be disinfected. A majority (79.31%) of the HCWs used stethoscopes on the patients after removing their clothes, while 20.69% used them without removing the clothes of the patients. Overall, 79.31% of the HCWs (46 out of 58) reported that they cleaned their stethoscopes by one method or the other, but 20.68% (12 out of 58) said that they never cleaned their stethoscopes at all.

The methods and the periodicity of cleaning the stethoscopes by the HCWs are summarized in [Table/Fig-3 & 4]. Out of a total of 58 diaphragms, 52 (89.65%) were colonized by bacteria. There were 94 isolates from 52 contaminated diaphragms, thus indicating that a majority of the contaminated diaphragms had more than one organism. *Micrococcus* species and coagulase negative staphylococci were the two most common isolates. [Table/Fig-2] summarizes the organisms which were isolated from the diaphragms and their percentages. Only 38 (65.51%) bells were found to be contaminated, *Micrococcus* species being the commonest type of bacteria which was isolated from them. [Table/Fig-2] summarizes the organisms which were isolated from the bells and their percentages. Out of a total of 116 earpieces (58 left and 58 right), 84 (72.41%) were contaminated. Aerobic spore bearers and *Micrococcus* were the two most prevalent isolates. The rate of contamination of the stethoscopes and the colony counts were found to be inversely related to the frequency of cleaning and the cleaning procedure of the stethoscopes. The questionnaires which were received from the HCWs revealed that 12 of them (20.68%) had never cleaned their stethoscopes and that the colony counts from these stethoscopes were comparatively higher than those from other stethoscopes. No pathogens were isolated from the stethoscopes which were cleaned daily/twice in a week. Only gram positive bacilli and *Micrococcus* spp were isolated, with a relatively less colony count, from the stethoscopes which were cleaned daily or twice a week. The growth of multiple organisms with high colony counts was observed on stethoscopes which were never cleaned.

DISCUSSION

Nosocomial infections occur at a rate of 5-10 per 100 hospital admissions each year [15]. Contaminated medical equipments and health care staff have been implicated as the carriers of pathogenic organisms [4-8]. The stethoscope is one of the medical equipments which are universally used by HCWs.

The knowledge, attitude and practices regarding the role of stethoscopes as carriers of infectious agents were assessed by a questionnaire in this study. The questionnaires were returned by all the participants. 55(94.82%) were answered fully while 3(5.17%) were answered partially. A majority (79.31%) of the HCWs used stethoscopes after removing the clothes of the patient, while 20.69% used

Health care worker	Number
Consultants	08
Medical officers	04
Medical Interns	35
Nurses	07*
Post graduate students	04
Total	58

[Table/Fig-1]: Groups of HCW

*Stethoscopes shared by more than one HCW.

Organisms	Number of isolates (%)			
	Bell	Diaphragm	Earpiece (left)	Earpiece (right)
<i>Micrococcus</i> species	32 55.17%)	40 68.96%)	10 17.24%)	18 31.03%)
Coagulase negative staphylococci	08 13.79%)	21 (36.20%)	10 17.24%)	12 20.68%)
Aerobic spore bearer	08 (13.79%)	18 31.03%)	22 37.93%)	16 (27.58%)
<i>Streptococcus</i> -viridans Group	02 (3.44%)	05 (8.62%)	–	–
<i>Staphylococcus aureus</i> (MSSA)	01 (1.72%)	03 (5.17%)	–	01 (1.72%)
<i>Staphylococcus aureus</i> (MRSA)	01 (1.72%)	02 (3.44%)	–	–
<i>Pseudomonas</i> species	–	02 (3.44%)	–	–
<i>Enterobacter</i> species	–	02 (3.44%)	–	–
<i>Escherichia coli</i>	–	01 (1.72%)	–	–
Total	52	94	42	47
No growth	20	06	18	14

[Table/Fig-2]: Organisms isolated from bell, diaphragm and earpieces of stethoscope

Methods	Numbers (%)
Spirit swab	43 (74.13%)
Dry cotton	01 (1.72%)
Cloth	01 (1.72%)
Fumigation	01 (1.72%)
Never Cleaned	12 (20.68%)

[Table/Fig-3]: Methods practiced by HCW for cleaning of stethoscopes

Frequency of cleaning	Numbers (%)
After every patient	04 (6.89%)
Every day	05 (8.62%)
Alternate day	07 (12.06%)
Once a week	10 (17.24%)
Once a fortnight	04 (6.89%)
Once a month	08 (13.79%)
Once in two months	05 (8.62%)

[Table/Fig-4]: Frequency of disinfection of stethoscopes

stethoscopes without removing the clothes of the patients. Besides interfering with the conduction of sound waves, clothes can also be an important source of a variety of microorganisms. This was more so in the rural settings in a developing country like Nepal, where high standards of personal hygiene were not always followed.

The senior HCWs were more aware of and they practised correct disinfection procedures as compared to the junior HCWs. Despite the growing awareness about the role of the stethoscope as a carrier of microorganisms and the need to clean/disinfect it, this knowledge is not always converted into practice.

The results of our study revealed that the rate of the bacterial contamination of the diaphragm was 89.65%, which is comparable to the observations of previous studies, which found that 71% to 100% of the stethoscopes were colonized by various bacteria [7, 8]. A study by Alothman *et al* had shown that only 48% of the stethoscopes were contaminated, which is significantly less than that which was found in our study [16].

In this study, the specimens from the diaphragms, bells and earpieces (left and right) were cultured separately. The diaphragm was used more often [58 (100 %)] by the HCWs than the bell [45 (77.58 %)]. Bacteria were isolated from 52 diaphragms, While no growth was seen in remaining diaphragms. The bacterial contamination of the diaphragms (89.65%) was much higher than the bacterial contamination of the bells (65.51%). The diaphragm is the most frequently used part of the stethoscope on the patients' body. It has a relatively larger flat surface and has direct contact with the patient's skin or clothes, thereby increasing the chances of bacterial colonization. The bell which is less frequently used by our clinicians, with a smaller area with a central depression, may not allow much bacterial colonization. Most of the organisms which were isolated in our study were not considered to be conventional pathogens, but they could become opportunistic pathogens. The isolation of gram negative bacilli and methicillin resistant *Staphylococcus aureus* (MRSA), though from a small number of specimens, was worrisome. MRSA were isolated from two stethoscopes, one of which was cleaned only once in two months and the details of the cleaning of the other were not reported. Gram negative bacilli were isolated from the diaphragms of five stethoscopes and *Enterobacter* species were isolated from two stethoscopes of the medical interns, of which one was cleaned weekly with spirit and the other was cleaned "sometimes". *Pseudomonas* species were isolated from two stethoscopes, one of which belonged to a medical officer and the other to a staff nurse. One of them cleaned the stethoscope weekly with spirit, while the other also cleaned with spirit, but the frequency of the cleaning was not mentioned. *Escherichia coli* were isolated from the stethoscope of an intern who reported similar cleaning details (weekly with spirit). The above findings demonstrated that the weekly cleaning of the stethoscope with spirit may not prevent colonization by bacteria. This emphasizes the need for a more frequent and proper disinfection of the stethoscopes.

Although 72.41% of the earpieces were found to be contaminated, these may not have been important for the transmission of bacteria to the patients due to a lack of direct contact with the patient's skin. There was no significant difference in the number and types of organisms which were isolated from the right or left earpieces. The organisms which were isolated from the earpieces indicated the aural flora of the user and may not have played a part in the transmission of the infections. The isolation of MRSA from stethoscopes was worrisome. The sharing of stethoscopes, a common practice amongst the nursing staff, may have led to the transmission of these agents to the HCWs. The colonization in the ear may spread to the nose and skin and can lead to hospital acquired infections in the HCWs as well as in the patients.

Although the percentage of bacterial contamination was high in our

study, the numbers of the pathogenic bacterial isolates were less than those which was observed in other studies [17]. The isolation of drug resistant bacteria (MRSA) is worrisome and it is a serious public health concern, especially in the developing countries.

The colony counts of the stethoscopes which were used by the consultants and nurses were comparatively higher than those of the stethoscopes which were used by the medical interns. We could not determine the reasons for this variation. The physicians and nurses in different wards perhaps use stethoscopes more frequently than other health workers; this might explain the higher rate of bacterial contamination and the higher colony counts.

The present study demonstrated that the bacterial contamination of the stethoscopes was directly related to the area of the stethoscope which was in contact with the patient's skin or clothes, and that it was inversely related to the procedure and the frequency of cleaning of the stethoscopes. The period of contact between a patient's skin and the stethoscope can result in the transfer of bacteria. Our study demonstrated that stethoscopes (mainly the diaphragms) get contaminated with pathogenic as well as non-pathogenic bacteria. If these are not cleaned properly with a suitable disinfectant at regular intervals, this can transfer bacteria from the skin of one patient to another. Our study demonstrated the importance of cleaning the stethoscopes with a disinfectant. Comparatively fewer bacterial colonies were obtained from the stethoscopes of the individuals who cleaned their stethoscopes with alcohol. This is similar to the findings of Marinella and others [18].

Although we did not correlate the contamination of the stethoscopes with the prevalence of hospital associated infections, our study demonstrated that the stethoscopes were contaminated with pathogenic and non-pathogenic bacteria. Poor stethoscope cleaning/disinfection practices were significantly associated with this contamination.

CONCLUSION

Various strategies have been proposed to minimize the transmission of bacteria by stethoscopes, which include the use of disposable stethoscopes, especially for clinically high-risk environments, and the use of a single-use, silicone membrane over the stethoscope head to create a prophylactic barrier [19]. Although these strategies could minimize the risk of transmission of microbes, these are not practicable in the developing countries due to their high costs. We need to develop a better compliance to the regular stethoscope cleaning practices to minimize the contamination of the stethoscopes and the spread of organisms.

The HCWs usually carry the stethoscopes around their necks or in briefcases and take them to homes as well. The possibility of the transmission of organisms from hospitals to homes and *vice versa*, with the spread of microorganisms to their family members also needs to be explored.

Our results confirmed that stethoscopes are often contaminated with bacteria and therefore have a potential for the transmission of nosocomial pathogens. This contamination is greatly reduced by frequent cleaning with alcohol. There is a definite need for formulating a proper schedule and a method of using the stethoscopes and the disinfection of stethoscopes. Training and motivating the HCWs in understanding this aspect and converting their knowledge into practice can be an important step of intervention.

Limitations of the study: The study population was small (58) and it was from only one hospital. The frequency of the use of the

stethoscopes varied from participant to participant. The time period of the contact of the stethoscope with the patients' skin/clothes also was not known. We did not correlate the colonization of the stethoscopes with the hospital acquired infections in this study, nor did we compare the antibiograms of these isolates with the isolates from the clinical specimens.

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