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The Role of Stethoscopes in the Transmission of Hospital Infections

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A B S T R A C T

Among medical care equipments Stethoscope is one of the most frequently used device. Stethoscopes are mainly used by the health professionals for the assessment of the patients and have been reported to be one of the common vectors for the nosocomial infection in various parts of the world. The contamination of Stethoscope particularly the diaphragm is mainly reported due to the lack of regular disinfection. The objective of this study was Isolation and identification of the microorganisms responsible for nosocomial infection from the stethoscopes used by health care professionals and to know the antibiotic resistance pattern of the isolated microorganisms. The prospective study was conducted in the Department of Microbiology, Government Medical College, Azamgarh. Samples were collected from the 100 stethoscopes of the clinicians and other health care personnel working in the Government Medical College, Azamgarh. Swab samples were taken from the surface of the diaphragm of each 100 stethoscopes. Swabs were cultured onto appropriate culture media, biochemical tests were performed for identification and antibiotic susceptibility test was done to know the pattern of resistance and multi drug resistant isolates. Out of 100, 88 stethoscopes were found to be contaminated with different microorganisms. CONS was the most frequently isolated organism followed by *S. aureus*, *Micrococci*, *Bacillus* spp, *Candida* spp, *Pseudomonas* spp, *Aspergillus* spp and *Enterobacter* spp. Gram positive isolates showed resistance towards Gentamicin, Clindamycin and Erythromycin. It is necessary to disinfect the stethoscope after each use. This is the only way to prevent dissemination.

Introduction

Nosocomial infection is a significant problem worldwide. Infection transmission remains a significant hazard for hospitalized patients.(1) Transmission of infections can result due to multiple causes like development and persistence of multidrug resistant bacteria; prolong hospital stay and immunocompromised state of patients and mechanical transmission of agents from one patient to another.

Unwashed hands and contaminated medical devices can act as the source of nosocomial infections.[2] Medical devices such as electronic thermometer, blood pressure cuffs, stethoscopes, latex gloves, gowns, masks, neckties, pens, badges, white coats, respiratory devices can act as a potential source of nosocomial infection. [1, 3]Medical equipments used in the non-critical care setting are less likely to have standard disinfection and cleaning protocols than equipments in the critical care settings. Thus medical care equipments are more likely to carry considerable number of pathogenic microorganism. [4]Among medical care equipments Stethoscope is one of the most frequently used device. Stethoscopes are mainly used by the health professionals for the assessment of the patients and have been reported to be one of the common vectors for the nosocomial infection in various parts of the world. [5] The contamination of Stethoscope particularly the diaphragm is mainly reported due to the lack of regular disinfection (Before and after examining each patient). Stethoscopes can be a potential source of infection and can transfer microorganisms from one person to another person.

The objective of this study was Isolation and identification of the microorganisms responsible for nosocomial infection from the stethoscopes used by health care professionals, to know the antibiotic resistance pattern of the isolated microorganism and to know the effectiveness of 70% ethanol as cleaning agent for stethoscopes.

Materials and Methods

The prospective study was conducted in the Department of Microbiology, Government Medical College, Azamgarh. Samples were collected from the 100 stethoscopes of the clinicians and other health care professionals working in the Government Medical College, Azamgarh. Swab samples were taken from the surface of the diaphragm of each 100 stethoscopes. Sterile cotton swab dipped in sterile saline was used for sample collection. Swabs were immediately transferred to Microbiology laboratory and inoculated onto 5% Sheep blood agar, Mac Conkey agar and Sabouraud's dextrose agar. The inoculated plates were incubated aerobically at 37^0 Celsius for 48 hours. One of each uninoculated plates were also incubated with these as quality control.

Afterwards bacterial colonies were counted and identification of the organism was done by the colony morphology, gram staining and biochemical reactions. Antibiotic sensitivity test of the isolated microorganisms was performed by Kirby Baeur disk diffusion method. Antibiotics used were Vancomicin, Erythromycin, Gentamicin, Cefoxitin, Rifampicin and Clindamicin for gram positive bacteria and Imipenem, Meropenem, Tetracyclin, Teicoplanin, Cefotaxime, Ceftazidimeand Ciprofloxacin for gram negative bacteria.

In addition randomly 25 stethoscopes were cleaned with 70% ethanol, allowed to dry and then sampled, to know the effect of 70% ethanol as cleaning agent.

Results and Discussion

One hundred stethoscopes of health professionals from different wards, OPD's, and ICU's were included in this study. After 48 hours of incubation the bacterial load varied from one stethoscope to other. Total 88 stethoscopes showed the culture positivity represents the contamination of the diaphragm of the stethoscope. 12 stethoscopes were sterile. Out of 12 sterile stethoscopes 07 showed very less number of colonies (2-3), so

considered as sterile or not significant (Table 1 and 2).

The average number of colonies per stethoscope was 30-35 and highest was 74. Totally of 131 bacterial strains were isolated from 88 contaminated stethoscopes. The maximum isolation per diaphragm was 03 types of organism and minimum isolation was single organism.

Majority of the isolated organism were found to be potential pathogens. CONS were the most frequent isolate (41.22%) among gram positive isolates followed by *S. aureus* (23.66%), *Micrococci* (10.68%) and *Bacillus spp* (9.16%) (Fig. 1).

From gram negative isolated organism *Pseudomonas spp* (3.81%) was the most common followed by *Enterobacter spp* (2.29%).

Among fungal isolates *Candida* spp (6.10%) was the most frequent followed by *Aspergillus* spp (3.05%).

Antibiotic susceptibility pattern of the isolates

Among the 54 isolated CONS species and 31 *S. aureus*, most of the strains showed sensitivity to the Rifampicin (100%), Vancomycin (100% and 98%) and Cefoxitin (83% and 79%) respectively and they showed resistance towards Gentamycin, Clindamycin and maximum resistance to the Erythromycin.

Among the 05 isolates of *Pseudomonas spp* and 03 isolates of *Acinetobacter spp* sensitivity was seen to the Imipenem, Meropenem, Teicoplanin, Tetracycline and resistance was seen to the Cefotaxime, Ceftazidime and Ciprofloxacin.

Cleaning the randomly selected 25 stethoscopes with70% ethanol demonstrated significant decrease in the bacterial count. Out of 25 cleaned stethoscopes only 02 stethoscopes showed the bacterial growth with very less number of colonies thus demonstrating the effectiveness of cleaning (Fig. 2 and 3).

Table.1 Number of contaminated and sterile stethoscopes

Parameter	Number of stethoscopes
Total number of stethoscopes studied	100
Number of stethoscopes showing bacterial and fungal growth	88
Number of stethoscopes showing no growth / not significant growth	12

Table.2 Number of isolates per stethoscope

S.No.	Number of Stethoscope	Number of isolated organism per stethoscope	Total number of organism (131)
1.	45	01	45
2.	28	02	56
3.	10	03	30

Fig.1 The pie diagram showing the distribution of the isolated microorganisms

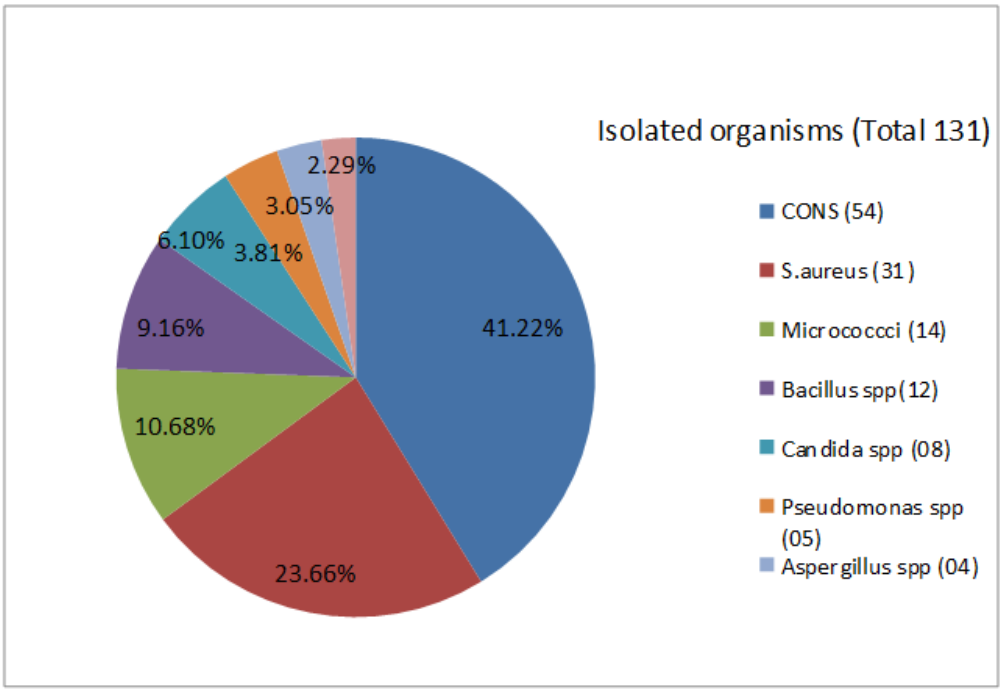


Fig.2 Antibiotic resistance pattern of *S. aureus* and CONS

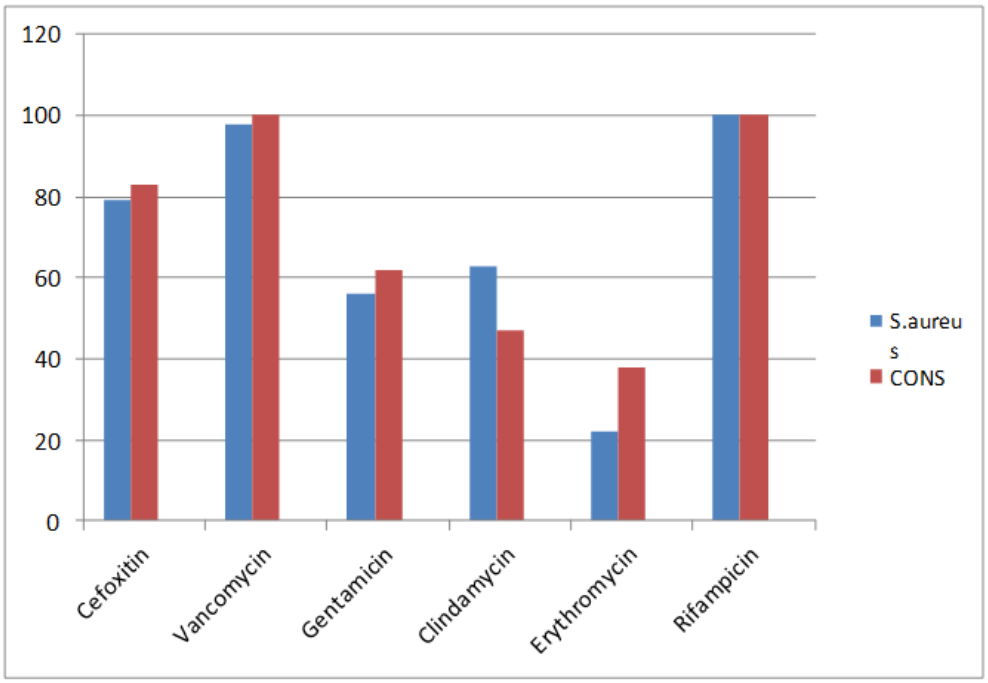
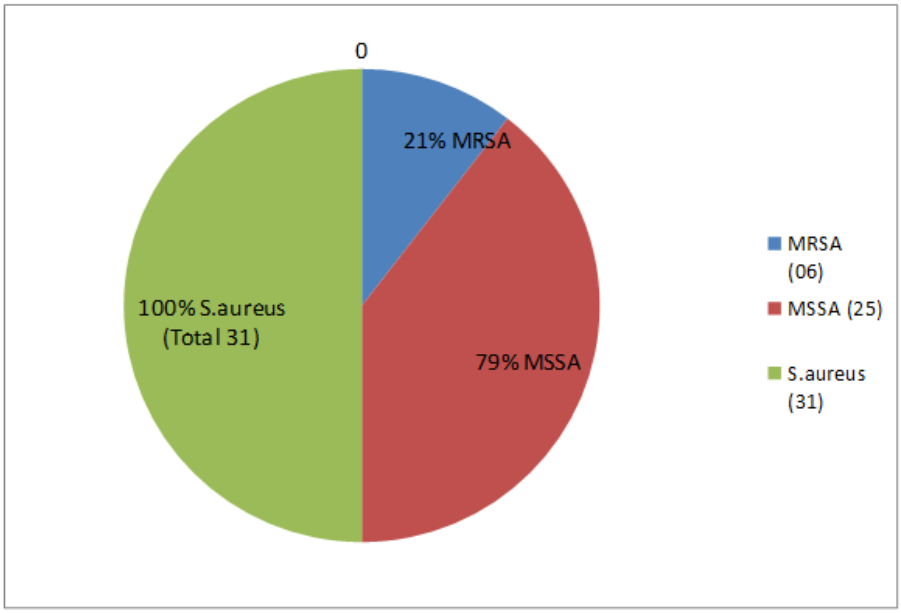


Fig.3 Percentage of MRSA and MSSA



The result of this study revealed that 88 out of 100 studied stethoscopes showed growth of different microorganisms and 12 stethoscopes showed no growth. Many studies showed the similar results as Gurjeet Singh *et al.,* (2014) reported the growth in 91 (89.22%) stethoscopes out of 102 stethoscopes studied, Chicozie *et al.,* (2010) surveyed the 107 stethoscopes and they found 84 (79%) contaminated stethoscopes, Youngster *et al.,* (2008) also reported the rate of contamination of stethoscope was 85.7% while Kilic *et al.,* reported relatively low rate of contamination of stethoscopes than present study, as well as Marinella *et al.,* Neetu Gupta *et al.,* reported 100% stethoscope contamination which is higher than our finding.

Gram positive bacteria (84%) were more frequent than gram negative (07%) bacteria. This might be because of the direct contact of the stethoscope to human skin flora, which contain mostly gram positive bacteria similar to the study of Teklu Shiferaw *et al.,*

In this study maximum number of stethoscopes were contaminated with CONS (41%) which is same as finding of Marinella *et al.,* Neetu Gupta *et al.,* and Foteini *et al.,* while some studies as Gurjeetsingh *et al.,* Chigozie *et al.,* and Francis Marie *et al.,* showed the maximum isolated bacteria was *S. aureus*.

Different species of CONS and *S. aureus* have the ability to acquire multi drug resistance and these species can be extremely virulent for population at risk. Therefore their antimicrobial resistance pattern was studied. Maximum number of isolated CONS and *S. aureus* showed high rate of sensitivity to Vancomycin, Rifampicin and Cefoxitin and resistance towards Clindamycin, Erythromycin and Gentamicin similar to the study of Neetu Gupta *et al.,* where CONS showed sensitivity towards Cefoxitin and resistance to Erythromycin. One more study by TekluShiferaw *et al.,* also explained that isolated *S. aureus* and CONS were sensitive to Cefoxitin and Vancomycin.

On the other hand an average number of 4.5 % stethoscopes were colonized with MRSA and19% with MSSA in this study. Nevertheless, some studies reported rates as high as 69 % for MRSA (Sengupta *et al.*,) while some show very less number of MRSA 13% (Neetu Gupta *et al.*,).

Although most patients might not be especially prone to infection after contact with contaminated stethoscopes, those with open wounds like patients with burns or immunocompromised patients may be colonized leading to infection at a later time. The other risk likewise, would be the possible dissemination of multiresistant organisms that may be manifest in a later outbreak as has been seen in hospital endemics traced to the use of contaminated thermometers, blood pressure cuffs or stethoscopes. In this study the importance of cleaning the stethoscope with 70% ethanol was also demonstrated. Comparatively very fewer bacterial colonies were obtained and in maximum stethoscope which were cleaned by the 70% ethanol no growth was observed, it is similar to the study of Marinella *et al.*, Neetu Gupta *et al.*, and Chicozie *et al.*, that they also observed that bacterial isolates from stethoscopes were significantly reduced after they were cleaned with different cleaning agent.

In conclusion stethoscopes can be a potential source of infection as they transfer microorganisms from one patient to another. The major risk involves with the multidrug resistant strains. Our finding also gives strong evidence of the stethoscope mediated transfer of microorganisms. It is necessary to disinfect the stethoscope after each use. Hopefully our results may convince clinicians/health care personnel to understand the importance of proper disinfection of stethoscopes. This is the only way to control the dissemination of infection. Our study also showed the effectiveness of 70% ethanol as cleaning agent. Furthermore studies should be done for better methods of disinfection of stethoscopes.

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