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Original Research Article

WONDEROUS STETHOSCOPE "THE FRIENDLY FOE"- A POTENTIAL VECTOR OF NOSOCOMIAL INFECTION

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ABSTRACT

Background: The stethoscope, an essential instrument in medical diagnosis, ironically serves as a "friendly foe" by becoming a potential vector for nosocomial infections. Despite its critical role in patient care, inadequate sterilization can facilitate the spread of harmful pathogens, threatening patient safety and healthcare outcomes worldwide.

Material and Methods: Swabs from stethoscopes were collected before and after cleaning with disinfectant and cultured on MacConkey and blood agar medium. The further processing was done as per standard microbiological procedures. A Questionnaire-based cross-sectional study was conducted among resident doctors and medical interns at tertiary care hospital in Punjab.

Results: Before decontamination of diaphragm of stethoscopes, 66 out of 71 diaphragms had growth. On 66 stethoscopes, a total of 90 bacterial strains were isolated, which means polymicrobial growth was observed on 18 stethoscopes. Of 90 bacterial strains, potential pathogens were methicillin resistant coagulase negative Staphylococci, methicillin resistant Staphylococcus aureus, Klebsiella species, Pseudomonas aeruginosa, Acinetobacter species. After cleaning with alcohol-based disinfectant, there was significant decrease in number of bacterial colony-forming units. According to questionnaire, 25.4% cleaned their stethoscope after examining patient while 1.4% never cleaned their stethoscope. The most common barrier reported to disinfection of stethoscope was forgetfulness to decontaminate stethoscope.

Conclusion: A stethoscope is physician's friend and helps them in management of patients, but if its cleaning aspect is not taken care of, it can turn from a valuable ally into an enemy by carrying pathogens on its surface. Therefore, regular cleaning practices should be followed to prevent growth and transmission of potentially pathogenic organisms.

Keywords: Stethoscope, Nosocomial Infection, Disinfection.

INTRODUCTION

Hospital acquired infections (HAIs) are a major safety concern for both health care providers and patients.[1] The World Health Organisation (WHO) defines HAI or nosocomial infection as an infection occurring in a patient during the process of care in a hospital or other health care facility which was not present or incubating at the time of admission. On average, around 1 in 10 patients are affected by HAIs as per WHO; however, the frequency can be much higher in low-/middle-income countries and in high-risk patients.[2]

The impact of healthcare-associated infections (HAIs) includes prolonged hospital stays, long-term disabilities, and the increased resistance of microorganisms to antimicrobials. These factors not only place a significant financial strain on healthcare systems but also result in high costs for patients and their families, as well as increased mortality rates.[3]

While hands are widely recognized as a primary vector for direct contact transmission during patient

care, recent studies have highlighted that hand hygiene alone is insufficient to fully prevent nosocomial transmission. In addition to hands, various medical devices—such as blood pressure cuffs, Doppler probes, and thermometers—have been identified as potential carriers of contact transmission, further contributing to the spread of infections in healthcare settings.[4]

Stethoscope, a physicians "Third Hand" can serve as a "foe" for his patients when it acts as a potential vector for transmission of dangerous pathogens because of its universal use. The key components of a stethoscope—namely the diaphragm, bell, and earpieces—are in direct contact with both the patient's skin and the physician's hands. These areas are frequently colonized by super-bugs, facilitating the transmission of pathogens from one patient to another and contributing to the spread of healthcare-associated infections (HAIs).[5] Hence, an effective surveillance programme to evaluate the role of the non-invasive devices in transmission of infection is the need of the hour.

The study was aimed to find out the contamination rate of stethoscopes, evaluate awareness and attitude of healthcare workers (HCWs) about stethoscope cleaning, and determine the efficacy of 70% alcohol as cleaning agent for stethoscope.

MATERIALS AND METHODS

A hospital based cross-sectional study was conducted. The study population comprised of healthcare workers including doctors and medical interns, working in the tertiary care hospital. The stethoscopes of HCWs working in critical areas like Intensive care units (ICUs), emergency room, wards, and those working in outpatient departments (OPDs) were sampled. The informed written consent from all the participants was incurred and those showing unwillingness were excluded.

The structured questionnaire was distributed among the participants to assess his or her awareness about the stethoscope handling, disinfectant use and adherence to the infection control practices and at the same time samples from their stethoscopes were collected.

The initial samples were collected using sterile swabs moistened with physiological saline (0.9%w/v) from the entire surface of the stethoscope diaphragm to document the baseline microbial load on the diaphragm. The diaphragm of stethoscope was then cleaned by alcohol-based disinfectant (70% isopropyl alcohol). After cleaning and allowing the stethoscope to dry for 30s, another sample was further collected using sterile swabs from the diaphragm of stethoscope.

Both the swabs were labeled with the date and time of collection along with the clinical area of work of the participant. Each participant was assigned a unique identification number. The collected samples were taken to the microbiology laboratory and were cultured on MacConkey agar and blood agar medium and incubated for 24 h at 37 °C. After 24 hours, all plates were examined for growth. If there was growth on plates, then the organisms were identified by Gram staining, oxidase test, catalase test, and biochemical tests according to standard microbiological procedures.

All the gram-positive cocci were tested against cefoxitin [30 µg] for detection of methicillin resistance, using disk diffusion method according to Clinical Laboratory Standards Institute [CLSI 2024] guidelines. The reference strain used as control was Staphylococcus aureus [ATCC 25923].

RESULTS

Stethoscopes of 71 health care workers were sampled. The demographic details are depicted in [Table 1]

Table 1: Demographic details of the participants

Sr.no		Number(n)	Percentage (%)
	Gender		
1	Male	45	63.4%
2	Female	26	36.6%
	Total	71	100%
	Health care workers		
1	Junior Resident	27	38%
2	Medical Interns	23	32.4%
3	Senior Resident	17	23.9%
4	Consultants	4	5.6%
	Total	71	100%
	Department		
1	Medicine	27	38%
2	Anaesthesia	12	17%
3	TB[❋] & Chest	10	13.2%
4	Emergency	9	12.1%
5	Paediatrics	8	11.3%
6	Gynaecology & obstetrics	5	8.4%
	Total		100%

[❋]TB - Tuberculosis

Before decontamination of diaphragms of stethoscope with 70% isopropyl alcohol, 66 (93%) diaphragms had "growth" (>20 CFUs/diaphragm) while 5(7%) had "no growth." On 66 stethoscopes, a total of 90 bacterial strains were isolated, which means polymicrobial growth was observed on 18 stethoscopes. The maximum isolation per diaphragm was three species and the minimum was one bacterial species. The most of stethoscopes of consultants (100%), medical intern students (96%), senior residents (94%) and junior Residents (89%) were contaminated.

Out of the 90 organisms isolated from stethoscope diaphragm, 68 were Gram positive bacteria and 22 were Gram negative bacteria. The bacterial profile of isolates is depicted in [Table 2]

Table 2: Bacterial profile isolated from stethoscope diaphragm

Sr.no	Bacterial isolates	Number (n)	Percentage (%)
	Gram positive bacteria		
1	Coagulase negative staphylococci	37	54.4%
2	Bacillus species	15	22%
3	Staphylococcus aureus	12	17.6%
4	Diphtheroids	3	4.4%
5	Candida species	1	1.4%
	Total	68	100%
	Gram negative bacteria		
1	Klebsiella species	12	55%
2	Acinetobacter lwoffii	5	23%
3	Pseudomonas aeruginosa	2	9%
4	Acinetobacter baumannii	2	9%
5	Escherichia coli	1	5%
	Total	22	100%

Coagulase negative Staphylococci (CONS) species was the most frequent isolate (54.4%) among gram-positive isolates and from Gram negative isolates, Klebsiella spp. (55%) were the most common isolates. Stethoscope from Medicine ward harboured the highest (36.3%) potential pathogenic bacteria and least isolation for potential pathogenic bacteria (7.5%) was recorded from Gynaecology ward.

After decontamination with isopropyl alcohol, there was a marked reduction in the number of colony forming units of all isolates as depicted in [Table 3].

Table 3: Average number of colony-forming units (CFUs) of isolates before and after cleaning the stethoscopes with alcohol-based disinfectant

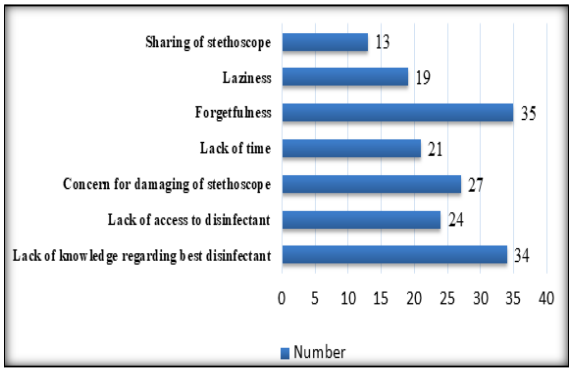
Sr. No	Bacterial isolates	Diaphragm before cleaning (CFUs)*	Diaphragm after cleaning (CFUs)
1	Coagulase negative staphylococci	300-400	5
2	Bacillus species	150-200	0
3	Staphylococcus aureus	100-150	0
4	Diphtheroids	50-100	0
5	Candida species	50-100	0
6	Klebsiella species	>500	50-100
7	Acinetobacter lwoffii	200-300	10
8	Pseudomonas aeruginosa	150-200	5
9	Acinetobacter baumannii	100-150	0
10	Escherichia coli	50-100	0

CFUs- colony forming units

Antibiotic profile of Coagulase negative Staphylococci and Staphylococcus aureus against cefoxitin showed that 75% of Staphylococcus aureus and 73% of CONS isolates were resistant to cefoxitin.

Based on the questionnaires filled by participants, 98.6% believed that stethoscopes could be potential vectors of infection, with only one participant disagreeing. Additionally, 26 participants (37%) indicated that only the diaphragm could transmit infection between individuals, while 21 participants (30%) believed that diaphragm, bell, and ear piece, all three have the potential to carry and transmit infection.

Only 28.2% of participants were aware of the guidelines for stethoscope disinfection, while 71.8% were unaware of these guidelines. Regarding cleaning practices, 25.4% of participants cleaned their stethoscopes only after examining a patient, 23.9% cleaned them once daily, 21.1% cleaned them once weekly, 15.5% cleaned them when visibly soiled, 12.7% cleaned them once monthly, and 1.4% never cleaned their stethoscopes. Among those who did clean their stethoscopes, the majority (56.3%) used an alcohol-based disinfectant (70% isopropyl alcohol) for a contact time of less than 15 seconds, while the remaining 43.7% used hand sanitizer for a contact time of more than 15 seconds. In terms of decontamination frequency, 37 participants (52.1%) last cleaned their stethoscopes within the past week, 18.3% cleaned them between 1 and 4 weeks, another 18.3% cleaned them more than 4 weeks ago, and 11.3% never decontaminated their stethoscopes.



Graph 1: Reported barriers to cleaning the stethoscope

The various barriers faced by participants concerning disinfection of stethoscope have been depicted in [Graph 1]. The most common barrier reported to disinfection of stethoscope was forgetfulness to decontaminate stethoscope.

The sharing of stethoscope was seen among 69% of the participants while 31% of the participants didn't share their stethoscope among their colleagues. Fifty-seven (80.3%) participants took their stethoscope back home in bag while 14(19.7%) kept their stethoscope in car. The hand hygiene was performed by only 28.2% and 43.7% of the individuals before and after using the stethoscope respectively.

Statistical Analysis

Statistical analysis shows that there was a significant association between cleaning practices and reduction of colony forming units [P value < 0.05]. After cleaning the stethoscopes with alcohol-based disinfectant, there was a significant reduction in bacterial counts [P value < 0.01].

However, even after cleaning with alcohol-based disinfectant, there was a persistence of Klebsiella species growth in the stethoscopes. This is most likely due to resistance of the nosocomial Klebsiella isolates to disinfectants. For such resistant pathogens, hydrogen peroxide-based disinfectants have been shown to have maximum efficacy.

DISCUSSION

The introduction of medical devices for management and treatment of diseases has contributed to the development of HAIs worldwide with the consequence that put the patient into poor prognosis. The introduction of such devices is not wrong by itself, instead facilitates the medical procedures, but commitment deficit of the medical personnel's to the infection prevention protocols is significant.[6]

Health care workers are a potential source of nosocomial infections. Many endemic pathogens are transmitted through hand carriage, and since the time of Semmelweis, hand washing has been repeatedly shown to reduce the risk of nosocomial infections. However, transmission of infection through medical devices is also well documented. Outbreaks of nosocomial infections attributed to electronic thermometers, blood pressure cuffs, and latex gloves have been reported.[7]

Stethoscope being one of the most commonly and universally used instruments in daily medical practice frequently gets contaminated as it comes in contact with remarkably large numbers of patients.[5] Nevertheless, stethoscope asepticism is infrequently reflected or accomplished by consultants, residents and medical students, despite a large number of existing infection control guidelines laid by different medical bodies worldwide. This habit adds to bacterial contamination of stethoscope and further promotes hospital acquired infections.[5,8]

In this study, bacterial contamination was observed in 93% of the stethoscope diaphragms before decontamination which is consistent with previous studies reported by Shiferaw et al,[6] and Srivastava P et al.[9] After decontamination of stethoscope with70% isopropyl alcohol there was significant reduction in colony forming units as depicted in [Table 3], which is similar to the finding observed in study done by Bansal A et al.[3] The complete elimination of potential pathogenic organisms was not seen in 6% of stethoscope diaphragm which could be due to less contact time given for decontamination.

Gram-positive isolates(76%) were more frequent than gram-negative isolates (24%) as depicted in [Table 2]. Our findings are congruent with the study done by Shiferaw et al,[6] Bansal A et al,[3] and Venkatesan KD et al,[10] The higher prevalence of gram-positive bacteria might be because of the direct contact of stethoscopes to human skin flora which contains mostly gram-positive bacteria. Also, the life span of gram-negative bacteria is not more than six hours in vitro; the half-life is less than an hour.[10]

Among gram positive bacteria, coagulase negative Staphylococci (CONS) species was the most frequent isolate (54.4%) and from Gram negative isolates, Klebsiella spp. (55%) were the most common isolates as depicted in [Table 2]. A study done by Shiferaw et al,[6] and Bansal A et al,[3] also reported identical findings. A high resistance was reported by coagulase negative Staphylococci and Staphylococcus aureus against cefoxitin in the present study which are constant with the findings of Shiferaw et al.[6]

The responses obtained from the questionnaire illustrate that the majority (98.6%) of healthcare personnel had good knowledge regarding the role of stethoscopes in the transmission of hospital-acquired infections. Akin findings were observed in study done by, Gazibara et al,[11] and Jain et al.[12]

Only 28.2% participants were familiar will the guidelines for disinfection of stethoscope as per responses obtained from the questionnaire, this is in contrast to the studies done by Priya Datta PD et al,[5] and Carducci A et al.[13] The reason for this could be due to lack of clear guidelines on stethoscope disinfection.[14]

The Cleaning practices of stethoscopes by health care professionals in our study were not in accordance with the studies done by Bansal A et al,[3] and Gazibara et al,[11] The most likely reason for this could be little or no formal teaching as to how to maintain a stethoscope in a hygienic condition.[11] The Spaulding Classification of Equipment & Medical Devices, grades Stethoscope as a "noncritical medical device" (i.e. in contact with intact skin, no bodily fluids). In the majority of cases, stethoscopes are used on intact skin and so the CDC (Centres for Disease Control and Prevention) recommendations suggest to disinfect it for "each patient or once daily or once weekly", whereas in the case of semi critical contact, as in the case of use on skin that is not intact (e.g., trauma), stethoscopes should be disinfected "before use on each patient" for at least 1 minute using an alcohol or bleach-based disinfectant. The practice of disinfection after every use has a potential impact of reducing transmission of HAIs.[15]

The most common barrier reported to disinfection of stethoscope was forgetfulness to decontaminate stethoscope. The findings are congruent to the study done by Tahir MJ et al.[16]

Fifty-seven(80.3%) participants took their stethoscope back home in bag and only 28.2% followed hand hygiene practices while using stethoscope, thus contributing to HAI's. Agnate findings were observed in study done by Alali SA et al,[1] and Thapa S et al,[17] respectively.

CONCLUSION

Stethoscopes represent a moderate to high risk of infection transmission, particularly in vulnerable settings, turning into 'foe' from 'friend'. This problem appears to stem from a lack of formal education on the matter, an absence or ignorance about the hospital protocol. It is wise for individual clinicians to err on the side of prudence and to consider that contaminated stethoscopes are indeed likely to result in clinical infection. Therefore, emphasizing strict adherence to disinfection practices by health workers to minimize cross contamination, regular symposiums or lectures for educating and motivating HCWs to adhere to infection control practices to prevent the nosocomial infections and ensure patient safety in the hospital.

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REFERENCES

1. Alali SA, Shrestha E, Kansakar AR, Parekh A, Dadkhah S, Peacock WF. Community hospital stethoscope cleaning practices and contamination rates. Am J Infect Control. 2020 Nov;48(11):1365-1369.
2. https://www.who.int/ detail/the-burden-of-health-care-associated-infection-worldwide
3. Bansal A, RS S, Bhan BD, Gupta K, Purwar S. To assess the stethoscope cleaning practices, microbial load, and efficacy of cleaning stethoscopes with alcohol-based disinfectant in a tertiary care hospital. J Infect Prev. 2019 Jan;20(1):46-50.
4. Lee R, Choi SM, Jo SJ, Han S, Park YJ, Choi MA, Kong BK. A quasi-experimental study on stethoscopes contamination with multidrug-resistant bacteria: its role as a vehicle of transmission. PLoS One. 2021 Apr 22;16(4)
5. Datta P, Kaur M, Rawat S, Gupta V, Chander J. Stethoscope, "the friendly foe": a study to evaluate bacterial contamination of stethoscopes and disinfection practices. J Infect Dev Ctries. 2018 Oct 31;12(10):887-893.
6. Shiferaw T, Beyene G, Kassa T, Sewunet T. Bacterial contamination, bacterial profile, and antimicrobial susceptibility pattern of isolates from stethoscopes at Jimma University Specialized Hospital. Ann Clin Microbiol Antimicrob. 2013 Dec; 12:1-8.
7. Bukharie HA, Al-Zahrani H, Rubaish AM, Abdulmohsen MF. Bacterial contamination of stethoscopes. J Fam Community Med. 2004 Jan;11(1):31-33.
8. Ahmed K, Shaikh S, Rehman R, Ali SM. Frequency of awareness and practice of stethoscope hygiene with regards to guideline among medical students, residents, and doctors in Karachi. J Bahria Univ Med Dent Coll. 2018 Mar 5;8(1):31-4.
9. Srivastava P, Tripathi A, Agrawal P, Arif D, Singh SP, Kumar A. The role of stethoscopes in the transmission of hospital infections. Int J Curr Microbiol App Sci. 2019;8(1):2472-2478.
10. Venkatesan KD, Chander S, Victor K. Stethoscopes: a potential source of hospital acquired infection. Int J Adv Med. 2019 Jul;6(4):1322-5.
11. Gazibara T, Radovanovic S, Maric G, Rancic B, Kisic-Tepavcevic D, Pekmezovic T. Stethoscope hygiene: practice and attitude of medical students. Med Princ Pract. 2015; 24:509-514.
12. Jain A, Shah H, Jain A, Sharma M. Disinfection of stethoscopes: gap between knowledge and practice in an Indian tertiary care hospital. Ann Trop Med Public Health. 2013; 6:236.
13. Carducci A, Cargnelutti M, Tassinari F, Bizzarro A, Cordio G, Carletti S, Maccarini L, Pelissero G. What's growing on general practitioners' stethoscopes. Ann Ig. 2016 Sep-Oct;28(5):367-72.
14. Şahan S, Güler S, Korkmaz E. Implementation of stethoscope disinfection: an observational study on nursing staff practice and knowledge. GMS Hyg Infect Control. 2024;19.
15. Rutala WA, Weber DJ. Guideline for disinfection and sterilization in healthcare facilities, 2008. Update: May 2019.
16. Tahir MJ, Zaman M, Babar MS, Imran F, Ajmal AN, Malik M, Khan JK, Ullah I, Asghar MS. Microbiological impacts of decontamination of stethoscopes and assessment of disinfecting practices among physicians in Pakistan: a quality improvement survey. Am J Trop Med Hyg. 2022 Jul;107(1):52.
17. Thapa S, Sapkota LB. Bacteriological assessment of stethoscopes used by healthcare workers in a tertiary care centre of Nepal. BMC Res Notes. 2017 Dec;10:1-6.