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STETHOSCOPE HYGIENE PRACTICES AMONG PHYSICIANS AND MEDICAL STUDENTS AT A PUBLIC HOSPITAL IN GUYANA: A COMPARATIVE STUDY ON KNOWLEDGE, ATTITUDES AND MICROBIAL CONTAMINATION

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ABSTRACT

The study aimed to compare the knowledge, attitudes, and practices of doctors and medical students about stethoscope hygiene and investigate the microbial load and prevalence of MRSA on stethoscopes. This cross-sectional, experimental study surveyed 100 participants, including 50 doctors and 50 medical students, and used microbiological tests to determine the microbial load and presence of MRSA on the stethoscopes. The results showed that medical students had a significantly higher median bacterial load than doctors, and 8 stethoscopes were contaminated with MRSA. All participants had excellent knowledge of nosocomial pathogen spread and the role of stethoscopes in transmission. However, only half acknowledged cleaning their stethoscopes after each patient; time constraints, complacency over time, and too many patients were common reasons for not cleaning frequently. The study suggests that hospital management and quality specialists should introduce rigorous quality assurance and infection control training.

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INTRODUCTION

The stethoscope is one of the most used medical equipment in all healthcare facilities. Its use by doctors, medical students and other healthcare staff brings it into contact with patients, including those that carry pathogenic bacteria such as Methicillin Resistant *Staphylococcus aureus* (MRSA). Health Care Associated Infections (HCAIs) have been associated with medical devices such as thermometers, blood pressure cuffs and gloves. Pathogens have also been cultured from stethoscopes (36.3%), pagers (36.3%), and lab coat sleeves (50%) (Arora *et al*., 2020). These devices have yielded not only normal skin flora like Coagulase-negative *Staphylococcus* (CONS) but also seriously pathogenic and drugresistant bacteria like MRSA, vancomycin-resistant *enterococci* (VRE), *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa,* and *Acinetobacter baumannii* (Arora *et al*., 2020; Horiuchi *et al*., 2018).

The diaphragm of a stethoscope serves as a hub for MRSA (Russell, 2012). This can possibly be linked to poor cleaning habits. The research indicated that poor cleaning habits involve either inadequate cleaning frequency or unsatisfactory methods of disinfection. Furthermore, studies have indicated that many medical practitioners do not disinfect their stethoscopes after every patient (Kalra *et al*., 2020). If not properly disinfected, the stethoscope can serve as a means for transmission of pathogens from one patient to another. This can lead to an increased risk of HCAIs and promote the additional burden of increased cost for both the patient and the institution (Schabrun & Chipcase, 2006). Research indicates that about 1 in 20 hospital admissions is complicated by a HCAI and the stethoscope plays a significant role in the transmission of these pathogens (Horiuchi *et al*., 2018, Klevens *et al*.). Currently, the recommended protocols involve the use of 70% isopropyl alcohol solution to clean the surface of all medical equipment between patients. However, physicians and possibly medical students sometimes find it laborious to locate and dispose of alcohol pads and therefore ignore cleaning

(Lecat *et al*., 2009). Other barriers include forgetfulness, lack of knowledge of the best disinfectant, sharing of stethoscopes and paucity of visible cues to disinfect (Muniz *et al*., 2012). KAP studies on stethoscope hygiene have illustrated that that although health care professionals may be aware of the cleaning protocols, they do not regularly put them into practice (Jamal *et al*., 2020). Researchers emphasise that continuous training and monitoring are key to ensure frequent cleaning. It is even recommended that the CDC guidelines are revised to encourage the practice of cleaning stethoscopes between each patient (Kalra *et al*., 2020). Although there are many studies available which focus on either medical students or doctors or compare medical and nursing students, there are very few studies that assess medical students and physicians. This study is therefore very timely and relevant. The researchers sought to evaluate and compare the KAP of doctors and medical students about stethoscope hygiene. It further seeks to investigate the microbial load and prevalence of MRSA on the stethoscopes of doctors and medical students at the public hospital.

METHODS

This was a cross-sectional and experimental study with 50 doctors and 50 medical students at Georgetown Public Hospital Corporation. This hospital is a 600-bed tertiary and referral health care facility. There are approximately 242 doctors and 302 medical students based at the hospital. The calculated sample size needed for a 95% confidence level was 49 doctors and 45 medical students. This was further rounded up to a total of 50 participants for each group.

The following research questions (RQs) were investigated with respect to (wrt) comparing *doctors and medical students (independent variables)* at the public hospital. The dependent variables are in bold.

1. Is there a significant difference in the level of bacterial contamination (**microbial load**) and prevalence of MRSA on stethoscopes?
2. What are the barriers and perceived benefits wrt to cleaning of stethoscopes?
3. Is there a significant difference wrt KAP of transmission and hygiene practices?

To assess RQ 1, the researchers used Nutrient agar (to determine microbial load) and Mannitol Salt agar (to presumptively identify *Staphylococcus aureus*) for each sample. The diaphragm of stethoscopes was pressed into the media in a method similar to the one used by Thapa & Sapkota (2017). Unique IDs were attached to each plate. The plates were transported in coolers within one hour to the main laboratory in the College of Medical Sciences and incubated at 37^{o}C for 18-24 hours. After incubation the number of colonies on manital salt agar were counted on the Nutrient Agar and the yellow colonies were selected for further testing. Gram positive cocci and coagulase positive colonies were identified as *Staphylococcus aureus*. The Kirby Bauer test with cefoxitin discs was used for susceptibility testing on Mueller Hinton agar to identify MRSA. A zone of inhibition of <19mm was regarded as Methicillin-Susceptible *S. aureus* (MSSA), 20-21mm was recorded as Intermediate and >22mm was MRSA. A piloted, self-administered, *de novo* questionnaire was used to evaluate RQ2 and 3. The variables recorded on the questionnaire included age, gender, and whether medical doctor or medical student. This survey examined the frequency and methods of, and barriers of, cleaning stethoscopes. The questionnaire was given to each participant who gave informed consent and a unique Participant ID number was given to each participant. This same ID was placed on the questionnaire and on the plate. The unique ID, the name and contact information of each participant were recorded in a password protected, encrypted database to which only the principal researcher had access. This was done in case a participant needed to be contacted after the microbiological analysis was done. The research proposal and questionnaire were approved by the Ministry of Health, Guyana (MoH) Institutional Review Board (IRB). To assess knowledge in the survey, we utilized Bloom's Cutoff for KAP where 1 point was awarded to the correct answers for 3 questions. The maximum score to be had was 3 and the minimum was 0. A percentage of the correct responses was calculated and ranked the respondents' knowledge as follows: <50% - inadequate knowledge; 50-79% - satisfactory knowledge and 80-100% - Excellent knowledge. The data were analyzed using SPSS v. 26.0. The Chi square test was used evaluate significant differences for the KAP and the t-test was used to compare means with respect to microbial load. P <0.05 was considered as statistically significant.

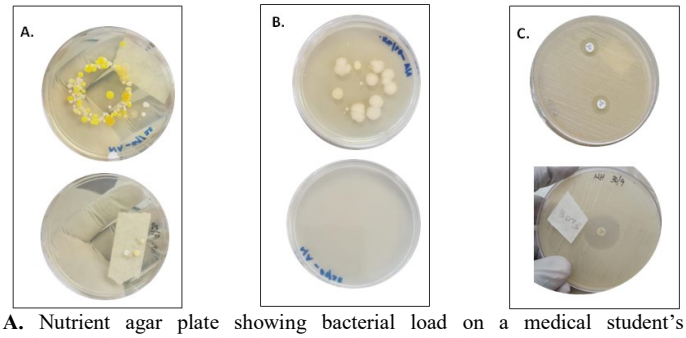
RESULTS

A total of 100 persons participated in this study; (M=27%, F=73%). Most respondents were of the 20-<30 age range (88%) (Table 1). Medical students, female participants and younger participants had more bacterial contamination than their respective counterparts. The difference was statistically significant in all cases (P<0.05) (Table 1). A perusal of the NA plates indicated that there were at least three types of colonies present, which is indicative that at least three bacterial species were present. This was confirmed by Gram staining where Gram-negative bacilli, gram negative cocci in clusters, Gram-positive cocci chains, yeasts and Gram positive, sporulating bacilli were observed.

Table 1. Comparison of characteristics of participants with median bacterial load

Variables		Median Bacterial Load on stethoscopes	P-value
Gender	Male (n=27)	102	0.000
	Female (n=73)	430	
	Total N=100	-	
Designation	Doctor (n=50)	151	0.005
	Medical student (n=50)	381	
	Total N=100	-	
Age range	20-<30 (n=88)	389	0.004
	30-<40 (n=12)	143	
	Total N=100	-	

*Median Bacterial Load is the median colony forming units counted on the NA plate



A. Nutrient agar plate showing bacterial load on a medical student's stethoscope before and after cleaning with 70% alcohol. **B.** Nutrient Agar plate showing bacterial load on the stethoscope of a doctor before and after cleaning with 70% alcohol. **C.** Susceptibility testing on Mueller Hinton, MRSA identified (top), MSSA (bottom)

Each plate of MSA had yellow colonies and when stained most appeared as Gram positive cocci in cluster indicative of *Staphylococcus sp.* 12 isolates were identified as *Staphylococcus aureus* and 8 of those isolates were MRSA. The participants who were students, less than 30 years, female and who did not study at University of Guyana were more likely to have MRSA on their stethoscopes. This was statistically significant (P<0.05). According to Bloom's Cut off for KAP study, this study found that all medical students and doctors had 'excellent knowledge' of the spread of pathogens and the role stethoscopes play in the spread. However, only about half of each group claimed to 'clean their stethoscopes after each patient' (medical students=48% and doctors=50%). The other half indicated that they only clean it 'sometimes' and one person indicated that they do not clean their stethoscopeat all.

Table 2. Comparison of characteristics of participants with MRSA and MSSA isolates

Variables		Number (%) of isolates			OR	P-value
		MRSA	MSSA	MISA		
Gender	Male (n=27)	2 (4)	0 (0)	0 (0)	4.0	0.04
	Female (n=73)	6 (12)	2 (4)	2 (4)		
	Total (N=100)	8 (16)	2 (4)	2 (4)		
Designation	Doctor (n=50)	1 (2)	2 (4)	2 (4)	7.9	0.026
	Medical student (n=50)	7 (14)	0 (0)	0 (0)		
	Total (N=100)	8 (16)	2 (4)	2 (4)		
Age range	20-<30 (n=88)	6 (12)	1 (2)	1 (2)	4.0	0.04
	30-<40 (n=12)	2 (4)	1 (2)	1 (2)		
	Total (N=100)	8 (16)	2 (4)	2 (4)		
University attended	University of Guyana (n=58) Non-UG Universities (n=42)	1 (2) 7 (14)	1 (2) 1 (2)	0 (0) 2 (4)	7.9	0.026
	Total (N=100)	8 (16)	2 (4)	2 (4)		

OR=Odds Ratio

Despite such claims and excellent knowledge, all stethoscopes were contaminated with at least three types of bacteria. This study found that time constraints (27%), 'become complacent over time' (20%), and 'too many patients' (17%) were the common reasons given for not cleaning stethoscopes.

DISCUSSION

Our findings indicate that almost all the participants knew that stethoscopes are a potential source and vehicle for transmission. Despite this knowledge, half of the participants did not clean their stethoscopes between patients. These findings coincide with prior studies that showed only a minority of Health Care Professionals (HCPs) clean their stethoscopes (Horiuchi *et al*., 2018). This discrepancy between high knowledge and low adherence among health professionals was exhibited in a local study by Panday *et al*., (2019). In this study, there were several factors identified that prevented cleaning of stethoscopes between patients including time constraints, complacency and high number of patients. Other researchers postulated that implementation of stricter policies which would ensure stethoscopes are cleaned as often as medical professionals washed their hands might be effective (Thapa & Sapkota, 2017). Worryingly, 20% of respondents admitted that they have 'become complacent over time'. This finding stresses the importance of constant education and training to prevent stethoscopes from being the source of spread of nosocomial pathogens. Furthermore, strict policy changes which mandate regular and timely quality assurance testing may be sufficient to curb the incidence of non-cleaning.

The microbiological findings revealed that all the stethoscopes were contaminated. This was similar to findings from Arora *et al*., (2020) in which pathogens were cultured from stethoscopes, pagers and lab coat sleeves. The average microbial load observed on the stethoscopes of medical students was more than twice as much as that found on the stethoscopes of doctors. This may indicate that stethoscope hygiene should be a formal part of the curriculum. Additionally, many different types of bacteria were observed following Gram staining, however financial constraints did not permit the identification of these various microbes. All the stethoscopes had microbial contamination and 8% of them harbored MRSA. It is, therefore, quite possible that stethoscopes are serving as sources of transmission of pathogenic organisms at the public hospital. To reduce bacterial contamination and subsequent spread while still saving time, one can disinfect stethoscopes while talking to the patient, the same way one sanitizes their hands or dons a pair of gloves. This seems to have been an effective strategy in prior studies (Kalra *et al*., 2021). Additionally, we recommend improving access to sanitizing supplies and placing reminders at sanitizing stations in each room. We advocate that our study be used as a template for a rigorous Quality Assurance and Infection Control program.We recommend that CME sessions and the medical schools' curriculum regularly incorporates stethoscope hygiene training.

Furthermore, there should be screening for MRSA for HCPs who interact directly with patients. This study was limited because of financial constraints which did not allow for the identification of all microbes on the NA plate. Also, the participants' practices were not observed, and their answers were therefore dependent on their honesty. However, we believe that useful information was gathered; this can propel decision makers to introduce robust stethoscope hygiene protocols as part of the infection control measures at the hospital. Our study found that the diaphragm of stethoscopes of both medical students and medical doctors were contaminated therefore, stethoscopes may be an unrealized source of spread of nosocomial pathogens. Though the participants displayed excellent knowledge on nosocomial infections and transmission, they did not clean stethoscopes as often as they should. This can increase the risk of spread of pathogens and may have health implications for patients receiving care at Guyana's tertiary health facility.

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