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BACTERIAL CONTAMINATION OF STETHOSCOPES AT A TERTIARY CARE HOSPITAL IN SOUTHWESTERN NIGERIA

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ABSTRACT

Hospital acquired infections are a recognized cause of morbidity and mortality all over the world. They are frequently caused by organisms residing in healthcare environment, including contaminated medical equipment like stethoscopes. There is limited awareness of health workers of the contribution of contaminated hospital equipment to nosocomial infections. Hence we aimed to determine the level of bacterial contamination and bacterial profile of the isolates from stethoscopes at our centre- a tertiary care hospital in Abeokuta, Southwest Nigeria.

To achieve this, 2 stethoscopes were selected from each of the clinical care units in the hospital and studied. Specimens were collected using moistened sterile cotton swab from the ear pieces and diaphragms of each stethoscope and processed following standard microbiological techniques. In all, 26 stethoscopes were studied. 46.2% (12) of the diaphragms cultured yielded growth of bacteria while only 11.5% (3) of the ear pieces cultured yielded a growth of bacteria . *Staphylococcus aureus* (58.3%) was the most commonly cultured organism. Other organisms cultured included: Diphtheroids, *Proteus species* and *Escherichia coli*.83.3% of the isolated organisms were gram positive while 16.7% were gram negative organisms.In conclusion,the study shows that there is a high level of contamination of stethoscopes in use by health care workers. Disinfection of stethoscopes before and after use is advocated to reduce the spread of infections.

Keywords: Stethoscopes, Contaminated medical equipment, Disinfection, Hospital acquired infections, Health care workers, Bacterial profile.

CONTAMINATION BACTÉRIENNE DES STÉTHOSCOPES À UN HÔPITAL DE SOINS TERTIAIRES DANS LE SUD-OUEST DU NIGERIA

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ABSTRAIT

Contexte: Les infections acquises dans les hôpitaux sont une cause reconnue de morbidité et de mortalité dans le monde entier. Ils sont fréquemment causés par des organismes résidant dans l'environnement des soins de santé, y compris l'équipement médical contaminé comme les stéthoscopes.Objectif: Déterminer le niveau de contamination bactérienne et le profil bactériologique des isolats provenant des stéthoscopes dans un hôpital de soins tertiaires à Abeokuta, dans le sud-ouest du Nigeria.

Méthodologie: Deux stéthoscopes ont été sélectionnés dans chacune des unités de soins cliniques de l'Hôpital et étudiés. Les échantillons ont été prélevés à l'aide d'un tampon de coton stérile humidifié des morceaux d'oreille et des diaphragmes de chaque stéthoscope et traités selon des techniques microbiologiques standard. Résultats: 26 stéthoscopes ont été étudiés. 46,2% (12) des diaphragmes cultivés ont produit une croissance de bactéries alors que seulement 11,3% (3) des morceaux d'oreille cultivés ont produit une croissance de bactéries. *Staphylococcus aureus* (58,3%) était l'organisme le plus couramment cultivé. D'autres organismes cultivés comprenaient: les diphtéroïdes, les espèces *Proteus* et

Escherichia coli. 83,3% des organismes isolés étaient Gram positif tandis que 16,7% étaient Gram négatif organismes. Conclusion: L'étude montre qu'il ya un niveau élevé de contamination des stéthoscopes utilisés par les travailleurs de la santé. La désinfection des stéthoscopes avant et après usage est recommandée pour réduire la propagation des infections.

Mots clés : Stéthoscopes, Equipement médical contaminé, Désinfection, Infections hospitalières, Travailleurs de la santé, Profil bactérien.

INTRODUCTION

Hospital acquired infections continue to be a challenge to physicians and patients worldwide. It contributes to prolonged stay on admission, increase in hospital bills and occasionally may result in deaths (1). In the United States more than 2 million people a year, contract a health care-associated infection, resulting in 90,000 deaths and economic costs of \$4,500 to \$5,700 million(1). In a developing country like Mexico, approximately 30 deaths per 100,000 inhabitants were attributed to hospital-acquired infections; and were the fourth commonest cause of death in the country(2). Whereas, there is no comparable data from Nigeria on the quantity of losses in terms of expenditure and mortality, available studies suggest that the prevalence of hospital acquired infections ranges from 2.6 –4.2% in Nigerian tertiary care hospitals (3,4,5).

Among sources of hospital acquired infections, contaminated fomites such as stethoscopes and other commonly used hospital equipment such as electronic thermometers, blood pressure cuffs and latex gloves have been implicated (6,7,8). Instruments such as stethoscopes are constantly in contact with patients and may become contaminated with pathogenic microorganisms, they are however, seldom included in disinfection protocols(9).

Virulent organisms may be transferred by stethoscopes from carriers (asymptomatic and symptomatic patients) to other patients who may have impaired immunity and may be unable to resist the infection(9). Other category of patients at risk is those with open wounds like burns or tracheostomies which may be contaminated (10).

Our extensive search of English medical literature revealed that there are very few studies in sub Saharan Africa on the role of stethoscopes in the spread of nosocomial infections with none previously carried out in the South western part of Nigeria (the most densely populated part of the country). We aimed to investigate the role of stethoscopes as potential fomites for potentially pathogenic microorganisms in our hospital – a referral hospital serving residents of Abeokuta and neighboring towns in Southwest, Nigeria. Our specific objectives were to determine the prevalence of bacterial contamination

and bacterial profile of the isolates from stethoscopes used by healthcare workers. In addition we aimed to evaluate the disinfection protocol for stethoscopes in the various clinical units within the hospital.

METHODS

This was a cross-sectional study conducted in September 2015 at our institution, a Federal Government funded tertiary care hospital located in Abeokuta, South West, Nigeria. The hospital has 250 beds located in 20 wards/ clinical care units including the Intensive care Unit and Neonatal care unit. It serves Abeokuta and adjoining towns- an estimated population of about 1.5million people.

Sample Size and Sampling Technique

Two stethoscopes, used by the hospital staff in clinical care of patients, was randomly selected from each of the ward/clinical care units of the hospital and studied. Ethical clearance was obtained from the Hospital Ethics committee before commencement of the study. A pre-structured questionnaire was used to interview a senior nurse on each ward on the condition of anonymity, regarding the disinfection protocol on each ward including -frequency of cleaning and type of disinfectant used to clean the stethoscope. An identification number was assigned to each ward/ clinical care area, and anonymity was maintained for all participants and wards by substituting random numbers in place of wards in each survey distributed.

Specimen Collection and Identification of Pathogen

Cultures from stethoscopes were obtained by swabbing the diaphragm and the bell of the stethoscope with a sterile swab moistened with saline. Subsequently the ear pieces were swabbed with separate moistened saline swabs. These swabs were immediately streaked onto blood agar plates and incubated in air at 37°C for 48 hours. Cultures were identified by colony morphologic characteristics, Gram stain characteristics, and standardized microbiological biochemical tests.(11).

Statistical analysis

Data was analyzed using SPSS version 16.0 computer software. P-value of <0.05 was considered indicative of a statistically significant difference.

RESULTS

26 stethoscopes regularly used stethoscopes were selected in total from the 20 clinical care units in the hospital. 46.2% (12) of the diaphragms cultured yielded growth of organisms while only 11.5% (3) of the ear pieces cultured yielded a growth of organisms (Table I). *Staphylococcus aureus* was the most

TABLE 1: ISOLATES FROM CULTURES OF DIAPHRAGMS AND STETHOSCOPIES

Isolated organisms	no growth	Total
Diaphragm 12 (46.2%)	14 (53.8%)	26
Ear piece 3 (11.5%)	23 (88.5%)	26

TABLE II: MICROORGANISMS ISOLATED FROM DIAPHRAGMS OF STETHOSCOPIES

Microorganism	Gram stain	Number	%
<i>Staphylococcus aureus</i>	positive	75	8.3
Diphtheroids	positive	21	6.6
<i>Proteussp</i>	negative	1	8.3
<i>Staphylococcus epidermidis</i>	positive	1	8.3
<i>Escherichia coli</i>	negative	1	8.3

TABLE III: MICROORGANISMS ISOLATED FROM EAR PIECES OF STETHOSCOPIES

Microorganism	gram stain	Number	%
<i>Staphylococcus aureus</i>	positive	2	66.6
<i>Staphylococcus epidermidis</i>	positive	1	33.3

TABLE IV: FREQUENCY OF CLEANING BY RESPONDENTS

Frequency	number	%
Before and after use	7	35
Three times a day	1	5
Daily	9	45
Rarely	3	15

commonly cultured organism from the ear piece and the diaphragm (Table II and III). Other organisms cultured include: Diphtheroids, *Proteus species* and *Escherichia coli*. 83.3% (13) of the isolated organisms were gram positive while 16.7% (2) were gram negative organisms.

TABLE V: FREQUENCY OF CLEANING FROM RESPONDENTS COMPARED WITH CULTURE RESULTS

Frequency of cleaning	Total	no growth	contaminated (rate %)
Before and after use	7	2	5(71.4 %)
Three times a day	11	0	(0.0 %)
Daily	95	4	(45.0 %)
Rarely	3	2	1 (33.3 %)

Regarding the disinfection practice of stethoscopes - 35% of wards clean the stethoscope parts before and after use while about 50% have various sub-optimal cleaning routines with 15% having no protocol for cleaning (Table IV). All respondents use methylated spirit (containing 70% isopropyl alcohol) in cleaning the ward stethoscopes. There was no association between the frequency of cleaning of the stethoscopes and contamination rate (Table V).

DISCUSSION

Stethoscopes because of their utility are the perfect fomite for transmission of hospital acquired infection in the hospital environment. Due to the load of patients on admission and in busy outpatient clinics, very few clinicians have the time to appropriately disinfect their stethoscope, as they proceed from one patient to the other.

This present study shows that almost half (46.2%) of the stethoscopes used by physicians and nurses in providing care for admitted patients at our institution are contaminated with virulent organisms. Our findings are in keeping with other international studies which demonstrated that 71% to 100% of stethoscopes analyzed were colonized by various species of bacteria (7-10,12-19). Previous African studies in Enugu, Nigeria and Ethiopia also recorded higher levels of contamination- 79% and 90% respectively (10,20).

Ten of the twelve isolates on the diaphragms are potential pathogens(excluding diphtheroids), 83.3% were gram positive while 16.7% are gram negative organisms. This was in keeping with previous studies and might be because of the direct contact of the stethoscope to human skin flora, which contains mostly gram-positive bacteria. Moreover, the lifespan of gram-negative bacteria is not more than six hours *in vitro*(21). Excessive bacterial colonization on stethoscope diaphragm, however, enables them to remain alive for a longer period exceeding eight hours whereas, gram-positive bacteria could remain alive for a longer period, even up to months (22).

Like other studies, *Staphylococcus aureus* was the most commonly isolated organism over other pathogenic organisms (10,20).

Another remarkable finding from this study is the level of contamination of the ear pieces of the stethoscopes used by health workers in the centre. Our value of 11.3% is lower than 20.8% reported by Whittington et al (23) in an intensive care unit in Hammersmith, United Kingdom but indicates a high risk of transmission of ear infections among health workers that share this equipment without disinfection. The lower rate of contamination compared to the diaphragms suggests that users probably clean the ear pieces before use.

Lack of an appropriate disinfection protocol and use of inappropriate disinfectants have been identified as being responsible for the high level bacterial contamination of stethoscopes in previous studies (10,20). Only 35 % of the ward respondents claimed to clean their stethoscopes before and after use. However, there was no positive correlation between frequency of cleaning claimed by the health workers and the level of contamination of stethoscopes determined from our study. This contradicts findings by other workers who found a significant correlation between frequency of cleaning and level of contamination (10, 20). This suggests non-adherence to the protocol or use of inappropriate disinfectant solutions by respondents.

Various agents have been used in cleaning stethoscopes including alcohol swabs, non-ionic detergent, and antiseptic soap. Previous studies have shown that regular cleansing before and after use

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with isopropyl alcohol will eliminate all contaminants from stethoscopes. In 2008, the Centres for Disease Control (CDC) recommended appropriate disinfection of all reusable equipment before use on another patient. Cleaning of stethoscopes with 70% ethyl or isopropyl alcohol after every use is recommended by CDC (24).

There is a need to educate health workers on the need for regular cleaning of their stethoscopes. The recent findings of Melanson *et al* (25) in this direction are encouraging. They evaluated the short- and long-term effect of an educational intervention on the contamination rate of physicians' stethoscopes. They found that a 30-minute lecture addressing the importance of stethoscope cleaning significantly decreased the contamination rate of physicians' stethoscopes at three weeks and the effect was maintained after a 6-month period (25).

CONCLUSION

This study shows that there is a high level of contamination of the diaphragms and ear pieces of stethoscopes used by health-care workers at our centre. There is no effective cleaning protocol in place. There is thus an urgent need to educate all clinicians and health workers on the need to carry out regular disinfection of stethoscopes and other diagnostic equipment used on patients to decrease the incidence of nosocomial infections.

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DECLARATION OF CONFLICTING INTERESTS

The authors declare that there is no conflict of interest.

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ETHICAL APPROVAL

Ethical clearance was obtained from the Hospital Ethics committee before commencement of the study.

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