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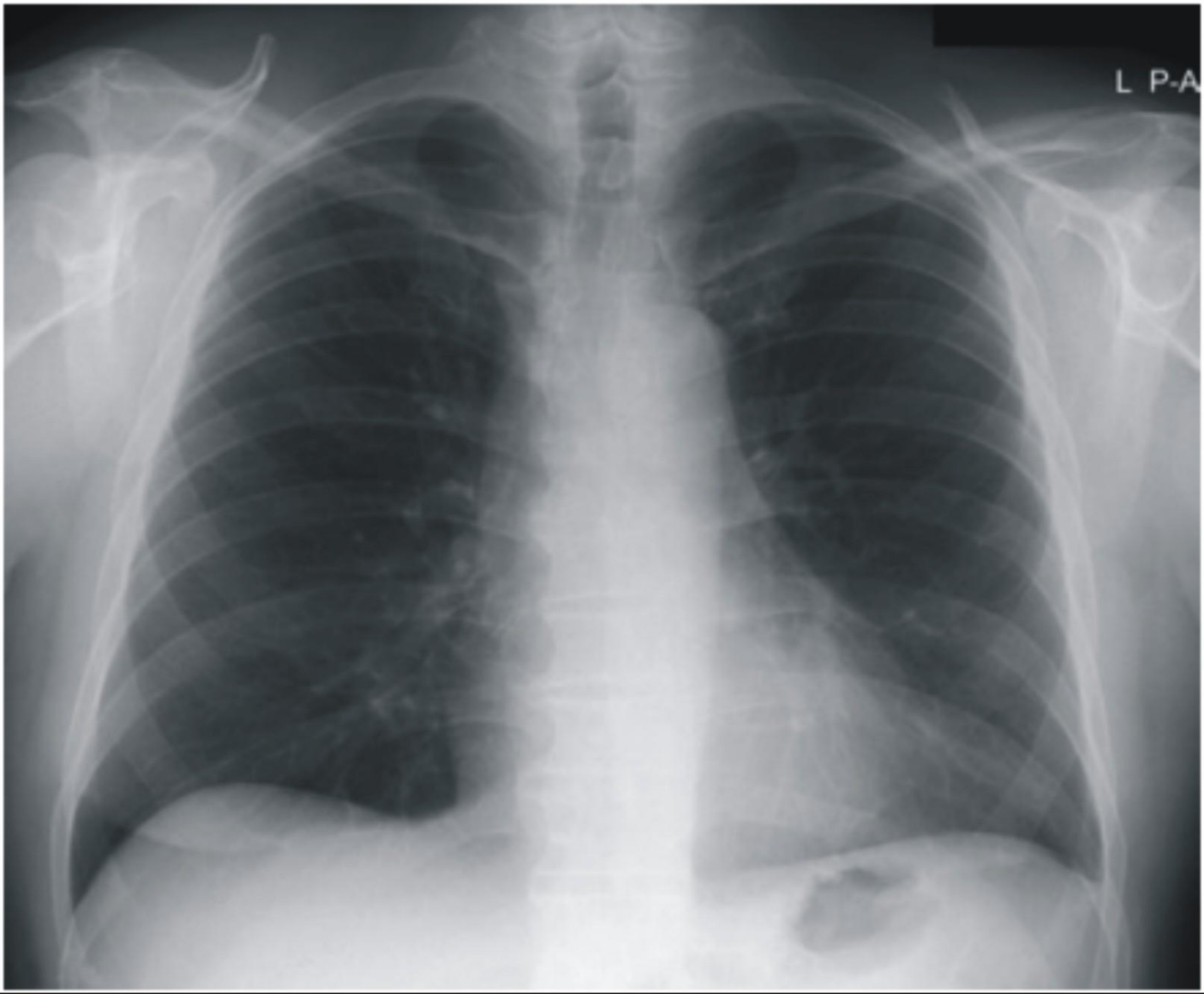

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Radiological equipment and accessories as sources of nosocomial infection

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ABSTRACT

Background: Nosocomial infections have become a major challenge in health institutions, as they affect the quality of health care delivered. The radiology department is one of the mainstays of modern medicine. It is therefore, necessary to assess its contamination by nosocomial organisms.
Aim: The study aims at identifying the nosocomial bacteria associated with imaging equipment and accessories in Aminu Kano Teaching Hospital, Kano, Nigeria.
Methods: The study design was prospective and cross-sectional in nature, and was conducted between Oct 2014 to Jan 2015 using disproportionate stratified random sampling method. Four different conventional x-ray units, fluoroscopy, computed tomography, angiography and ultrasound units were selected. Swabs were collected from the surfaces of the selected parts of the equipment and accessories after working hours in each unit. The swabs were taken to the microbiology laboratory for culturing and identification using standard laboratory procedure. A total of 200 cultured samples were used in the study. The collected data was analyzed using SPSS version 16.0 software.
Results: Bacteria were isolated in 43.5 % (n = 87) of all the swab samples with ultrasound transducer as major culture. Specific bacteria isolated were: *Staphylococcus aureus (n* = 65; 74.7 %), *Pseudomonas aeruginosa (n* = 14; 16.1 %), *Bacillus spp (n* = 6; 6.9 %), *Klebsiella spp* (n = 1; 1.1 %) and *Proteus spp (n* = 1; 1.1 %). Methylated spirit was the most effective chemical disinfectant.
Conclusion: Radiology equipment and accessories in Aminu Kano Teaching Hospital are not entirely free of bacteria. Meticulous attention to disinfection will safeguard staff and other patients from nosocomial infections.
Key words: Nosocomial, Disinfection, Incubation.

Introduction

Nosocomial infections, also called hospital care associated infection (HCAI), are infections that first appears between 48 and 72 hours after a patient is admitted to hospital or a health care facility [1]. Developing countries are reported to have up to 20 times the risk of contracting a nosocomial infection compared with developed countries [2,3]. These infections are becoming a great concern to health care providers and institutions, as they affect the quality of health care delivery. This concern is also not different in Nigeria which was ranked by the World Health Organization as187th out of 191 countries for health delivery quality in 2000 [4].

Studies have demonstrated that pathogens can be transmitted from surfaces to personnel and patients, and that these pathogens are not adequately removed by routine room cleaning. This has led to an increased focus on the importance of cleaning and disinfecting hospital surfaces and medical equipment, and efforts to assess and improve the effectiveness of these practices. The radiology department plays a very important role in medical diagnosis. It regularly receives large throughput of both ward and non-hospital patients. This large traffic increases the chances of spreading pathogens amongst other patients and the radiology staff [5].

Nosocomial pathogens and infections are relatively common because hospitals receive large number of patients some of whom may be immuno-compromised. Pathogens are brought into the radiology department by patients. The close contacts between them and the radiographer, as well as equipment and accessories, cause a spread. The high-risk individuals are patients with varying degrees of illnesses who may be in close proximity to one another, and who use the same radiography equipment and accessories**,** which may have been contaminated [6].

This problem is complicated by personnel shortages, which have affected practice in such a manner that one radiographer is responsible for many severely ill patients spanning across HIV/AIDS, diabetic, tuberculosis, pyomyositis patients and road traffic accident victims. Nosocomial infections have become an increasingly recognized problem in our locality, and radiological equipment and accessories can be one of the vehicles for the spread of these infections. The study aims at identifying the nosocomial bacteria associated with imaging equipment and accessories in Aminu Kano Teaching Hospital.

Materials and Methods

The study design was a prospective and cross-sectional and was conducted between Oct 2014 and Jan 2015 in the radiology department Aminu Kano Teaching Hospital, Kano. Using disproportionate stratified sampling method, different units in the department were selected which include; three different conventional x-ray units, fluoroscopy, computed tomography, angiography and ultrasound units. Swabs were dabbed on x-ray couches, chest stands, x-ray cassettes, handles of x-ray tube heads, control panels, exposure buttons, patients x-ray gowns and ultrasound transducers. The materials used in the study comprise; sterile swab stick, sterile nutrient broth, Mac-conkey agar, chocolate agar, savlon, methylated spirit, sodium hypochlorite and incubator. These swabs were collected from the surfaces of the selected parts of the equipment and accessories after working hours of each unit. The surfaces and the sterile swabs sticks were moistened by sterile nutrient broth to keep the available bacteria alive from the site of data collection to the microbiology laboratory. The swabbed surfaces were than cleaned with disinfectant and allowed to dry and re-swabbed with a fresh moistened sterile sticks. All the specimens were labeled accordingly before and after cleaning with disinfectants. The swabs were taken to the microbiology laboratory for culturing and identification using standard laboratory procedure. Identified bacteria were checked for nosocomial agents. A total of two hundred cultured samples were used in the study. The collected data was analyzed using SPSS version 16.0 software.

Results

Out of 200 (100%) cultured samples, different species of bacteria were isolated from 43.5% (n=87) swabs as shown in Table 1. Different modalities exhibited different bacterial loads (Table 2) with specifics also shown (Table 3). Disinfectants and their bacterial-clearing abilities are also shown (Table 4).

Discussion

The current study investigated the involvement of imaging equipment and accessories as reservoirs of nosocomial bacteria. It also investigated the effectiveness of four commonly used chemical disinfectants. The general objective was to assess the risk of nosocomial infections associated with the use of imaging equipment and accessories.

The results of the study show that imaging equipment and accessories carry a considerable risk of harboring nosocomial bacteria with about 43.5 % culture isolates of bacteria from different points as shown on table 1 above. This is comparable to a similar work, which reported that there was about 47% nosocomial infection rate associated with imaging equipments and accessories in Enugu state, Nigeria [6]. This similarity could be as a result of similar working environment, work attitude, practice, and same employer. Furthermore, the large number of bacteria isolated from equipment and accessories is worrisome. This result could be attributed to poor hygiene practices amongst radiographers. It has been observed that some times, radiographers are in a haste to start and finish their work, and neglect to clean up their equipment and accessories before and after work. In some units, disinfectants might be unavailable. It was noted that every instrument used in the hospital carries the risk of being a vector of nosocomial pathogens no matter where it is found [6].

The findings of the study show that *klebsiella spp*, *staphylococcus aureus*, *proteus specie*, *bacillus spp* and *pseudomonas* were the bacteria pathogens isolated from imaging equipment and accessories as indicated in Table 2. The results of the study is in concordance with another study conducted in Anambara state in 2013 *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Proteus spp Streptococcus*, and *Coliform spp* were isolated in 43 out of 45 samples.

This work is also in agreement with a similar one conducted in Enugu state, Nigeria in 2009, which shows that, *klebsiella spp*, *coliform*, *staphylococcus aureus* and coagulase-negative *Staphylococcus epidermidis* were isolated in 142 samples. All the bacteria isolated in this study were found in previous studies.

Ultrasound room had the highest bacterial load representing 20 (22.99%), followed by conventional x-ray room 18 (20.7%). The result from the ultrasound unit can be attributed to fact that the nature of the examinations carried out within this room necessitates that the ultrasound transducer comes into close contact with the patient's skin. Since *S. aureus* normally colonizes human skin and mucosa without causing any disease, then this result is justified. The new conventional block in AKTH receives a large turnout of patients in this hospital and is one of the most commonly used rooms. The increased number of times bacteria was isolated might be as a result of this workload.

Staphylococcus aureus was the most prevalent nosocomial bacteria identified in the study and appears to be spread by the radiographers' hands. It was found at all the places where radiographers made contacts with their hands such as anatomical marker, tube head handles, exposure buttons, control panels, x-ray couch and x-ray cassettes. This is comparable with the study conducted earlier which reported, *staphylococcus aureus* as the most common bacteria isolated from x-ray cassettes, couches, bucky and stretchers.

This result suggests that the hands of health care staff spread most infectious agents. The consistent manner in which *staphylococcus aureus* was found at all sites handled by radiographers call to questions their hand washing habits. In an ideal situation radiographers have to thoroughly scrub their hands after every patient and must use sterile gloves on each patient. The result suggests that adequate hand hygiene is not being practiced as has been noted by a previous study [6].

Amongst the x-ray accessories, patients gown were found to be the most frequently contaminated. This result is not in accordance with two similar studies conducted in Ebonyi and Enugu in the south-eastern part of Nigeria which both reported x-ray cassettes with the highest number of isolated bacteria and with *S.Aureus* forming the bulk of it. Patient's skin is often in direct contact with the patient gown making them potential sources of nosocomial infections.

Methylated spirit, savlon and antiseptic hand wash were the three most commonly used disinfectants in the units selected for the study. These chemicals were investigated for effectiveness and methylated spirit was found to be the most effective with complete clearance of bacteria pathogen after use as shown on Table 4. This result is comparable with study conducted by a previous researcher which found out that Sodium hypochlorite which was not studied in this work, was the most effective chemical disinfectant. No bacterial isolates were seen in the swab samples after its use but because of its adverse effect on stainless materials, it was not recommended for use, instead methylated spirit, which was the second most effective in the study, was considered.

The effectiveness of spirit is diminished if the disinfected surfaces were not cleaned first before its application. Articles to be disinfected must therefore be cleaned before they are disinfected because dirt diminishes the effectiveness of disinfectants and may even inactivate them [6]. Savlon and antiseptic hand wash recorded equal failure rates but are nonetheless useful and suitable for most purposes.

Table 1: Frequencies of isolated bacteria

Bacteria	Frequency (%)
S.aureus	65 (74.71%)
Pseudomonas spp	14 (16.09%)
Baccillus spp	6 (6.89%)
Proteus ssp	1 (1.14%)
Klebsiella spp	1 (1.14%)
Citrobacter spp	Nil
Mycobacterium tuberculosis	Nil
Total	87 (100%)

Table 2: Bacteria load in different diagnostic rooms

Room	Number of bacteria isolates	Bacteria strain
X-Ray room I	18 (20.7%)	*S.aureus and pseudomona spp*
X-Ray room II	4 (4.6%)	*S.aureus and bacillus spp*
X-Ray room III	17 (19.5%)	*S.aureus, bacillus spp, pseudomonas sp, proteus spp*
X-Ray room IV	14 (16.1%)	*S.aureus, bacillus spp, pseudomonas spp*
Fluoroscopy room	8 (9.19%)	*Klebsiella pneumonia and S.aureus*
Angiography	0	Nil
CT room I	5 (5.7%)	*bacillus spp and S.aureus*
CT room II	1 (1.15%)	*S.aureus*
Ultrasound	20 (23%)	*S.aureus*
Total	87(100%)	

The result of this study should be seen from the all or none law perspective. That is to say that if there was any degree of contamination, the unit carries a risk of nosocomial infection since the bacteria are constantly replicating. Any amount of microorganism is sufficient to cause infection. The radiology department should therefore, be bacteria-free and any presence of microorganisms represents a significant threat.

Conclusion

The X-ray department is a source of nosocomial bacteria. The common species of bacteria found in the radiology department of the study centre were: *Staphylococcus aureus; Pseudomonas Aeruginosa, Proteus spp, klebsiela spp, and bacillus spp*. Patients gown and ultrasound transducers were the most potent reservoir of bacteria amongst the accessories and equipment, followed by the x-ray couch and surfaces touched by the radiographer. *Staphylococcus aureus* was the most prevalent nosocomial bacteria identified in the study. Observation of medical aseptic technique before, during and after radiographic examinations will help reduce the spread of nosocomial infections.

Recommendations

Based on the results of this study, it was recommended that the following measures should always be taken to minimize the risk of nosocomial infection in the radiology department: more patients' gown should be provided, atleast a minimum of 10 per room, daily. For disinfection, methylated spirit should be used and should be made available in all units, while soap cleaning method should be used for ultrasound transducers. X-ray equipment and accessories should be properly disinfected immediately after use and before the next patient is attended to. Radiographers are advised to wash their hands after attending to a patient and before attending to the next patient. Also, they should not forget to use and change gloves after attending to each patient. Finally, the bacterial load of the equipment and accessories should be constantly monitored to reduce the risk of nosocomial infection.

Table 3: Bacteria load for parts of equipment and accessories

Equipment & accessories	*S.aureus*	*Klebsiella spp*	*Pseudomonas Aeruginosa*	*Proteus spp*	*Bacillus spp*	Total isolates
Couch	7	0	2	0	1	10 (11.49%)
Cassette	4	1	3	0	2	10 (11.49%)
Erect burky	6	0	1	1	0	8 (9.19%)
Patients gown	10	0	4	0	0	14 (16.09%)
Exposure button	4	0	1	0	2	7 (8.06%)
Anatomical marker	4	0	1	0	0	5 (5.75%)
Gantry	2	0	0	0	1	3 (3.45%)
Control console	4	0	0	0	0	4 (4.59%)
Foam pads	0	0	1	0	0	1 (1.15%)
Ultrasound probe	20	0	0	0	0	20 (22.99%)
HSG kit	1	0	0	0	0	1 (1.15%)
Sterile shelf	0	0	0	0	0	0 (0.00%)
Unsterile shelf	1	0	0	0	0	1 (1.15%)
X-ray tube handle	0	0	1	0	0	1 (1.15%)
Room door handle	2	0	0	0	0	2 (2.29%)
Total	65	1	14	1	6	87 (43.5%)

Table 4: Chemical disinfectants and number of bacterial isolates after their use

Disinfectant	Number of bacterial isolates
Antiseptic handwash	1 (1.149%)
Savlon	1 (1.149%)
Methylated spirit	0 (0.00%)
Total	2 (2.29)
Percentage clearance by all disinfectants	97.71 %

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