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**AN INVESTIGATION OF X RAY EQUIPMENT AND ACCESSORIES AS POSSIBLE
VECTORS OF NOSOCOMIAL INFECTION: A COMPARATIVE STUDY BETWEEN
GOVERNMENT AND PRIVATE INSTITUTIONS IN ANAMBRA STATE, NIGERIA.**

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ABSTRACT

BACKGROUND: Nosocomial infections have become a major challenge in health care delivery institutions, as they affect the quality of health care delivered. The medical imaging department plays a vital role in medical diagnosis; hence the need to investigate the role of the imaging department in the spread of nosocomial infection within the health care institutions.

AIM : This study was carried out to investigate whether x – ray equipment and accessories harbour nosocomial pathogens, and their potential role in causing nosocomial infections within healthcare delivery institutions. It also compared the prevalence of these pathogens in government and private institutions within the study area.

METHOD: Sterile swab sticks were used to swab the surfaces of selected x-ray equipment and accessories, at the end of the work, for the days selected for collection of samples. The swab samples were then taken to the microbiology laboratory for culturing and identification. MacConkey and Blood agar media were used to prepare the culture media. The prepared media were put in petri dishes and swab samples were inoculated onto the culture plates. Culture plates were then incubated for 24 hours, at a temperature of 37°C. At the end of the incubation period, the culture plates were viewed macroscopically under a bright light, to identify the bacteria; according to their colonial characteristics.

RESULTS: Bacteria were isolated in 182 samples (86%), out of the 200 samples collected. Bacteria isolated were; Staphylococcus aureus, Pseudomonas aeruginosa, Proteus spp, Staphylococcus, and Coliform spp. Staphylococcus aureus was the bacterium isolated most often (140 times), while Proteus spp. was isolated the least number of times (28 times). X –ray cassettes recorded the highest amount of growth (60 times), for both government and private institutions. Bacterial isolates had a higher prevalence in government institutions, except Coliform spp. which had a higher prevalence in private institutions.

CONCLUSION: This study has established the bacteria contamination of X – ray equipment and accessories used in the medical imaging departments of health care delivery institutions. Hence, these equipment and accessories have a potential to cause nosocomial infections in patients and occupational

69 infections in health care workers. It also showed that the growth were more
70 prevalent in government than in private institutions.

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72 KEY WORDS: Investigation, Nosocomial bacteria, x – ray equipment,
73 accessories, government, private.

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UNDER PEER REVIEW

INTRODUCTION

The medical imaging department (MID) plays a vital role in medical diagnosis, hence, an appreciable number of patients that come into health care delivery institutions, visit the MID for one investigation or the other (Ochie and Ohagwu, 2009; Fox and Harvey, 2007; Paul Dorio MD, 2011).

Patients that come to the department include patients from the wards and from out- patient clinics. Such patients could be post – traumatic, post – operative, or immunocompromised. Such patient conditions make them possible vectors of, or highly susceptible to nosocomial pathogens which in turn cause infections (Ochie and Ohagwu, 2009; Fox and Harvey, 2007).

As a result of the large influx of patients into the MID, the chances of spread of nosocomial infections among patients, and to the staff are increased; as a result of increased contact between patients and health care delivery equipment (Ochie and Ohagwu, 2009; Fox and Harvey, 2007; Grundmann et al, 2005; Grogan et al, 2011).

Nosocomial infections (NI) or hospital acquired infections (HAI) are infections whose developments are favoured by hospital environments, such as one acquired by a patient during hospital visits, or one developing among hospital staff (www.wikipedia.org, accessed 6-2-12). Emmerson et al (1996) defined nosocomial infections as those infections which were not present or incubating at time of their admission. These infections usually manifest 48 hours or more after hospital admission, or within 30 days after discharge (www.wikipedia.org accessed 6-2-12). Nosocomial pathogens are microorganisms, including bacteria, algae, protozoa and fungi which are capable of causing nosocomial infections.

Studies have shown that healthcare providers become infected with nosocomial pathogens, leading to occupationally acquired infections amongst health care providers (Chong et al, 1998; Sepkowitz,1996). The hospital environment frequently becomes contaminated with pathogenic microorganisms (Horton and Parker, 2002; Vatapoulos et al 1996); the medical imaging department as part of the hospital environment should therefore not be an exception. It has also been shown that nosocomial infections lead to increased cost of health care delivery and prolonged admission of patients in the hospitals and hence congestion of the words(Plowman,2000; Nyamogoba and obala 2000), as well as high mortality rates (Yalcin et al 1997, Hussain et al 1996).

Nosocomial infections usually require a vector by which to be transmitted. Direct contact between the patient and caregivers' hands, has been established as one of the ways of transmitting nosocomial bacteria (Horton and Parker, 2002; Bhalla et al, 2004). It has been observed that in the conventional x – ray unit of the MID, there is usually an appreciable level of contact between patients and accessories used in this unit (Ochie and Ohagwu, 2009; Fox and Harvey, 2007). Investigations which have been conducted by various researchers on the presence of nosocomial bacteria on x- ray equipment and accessories turned out positive, with bacteria such as *Staphylococcus aureus*, *Klasiella* spp, coliform and *Escherichia coli*, being the most commonly predominant (Ochie and Ohagwu, 2009; Fox and Harvey, 2007; Swain and Flinton, 2000).

Balla et al (2004) conducted a study to assess the frequency of pathogens on caregivers' hands after direct contact with patients, and confirmed the presence of nosocomial pathogens. Furthermore, investigations carried out to examine the life span of nosocomial pathogens on x – ray cassettes confirmed not only the survival but also the growth of these pathogens on x-ray cassettes (Lawson et al, 2002). The aim of this study was to establish the presence of the most commonly encountered nosocomial bacteria on the x ray equipment and accessories used in MIDs of Health care delivery institutions and also the prevalence of these microorganisms in government and private institutions within Anambra, State Nigeria.

MATERIALS AND METHODS

This was a non – experimental prospective study conducted in the medical imaging department of health care delivery institutions within Anambra State Nigeria. A total of 200 swab samples was collected; 100 from government institutions and 100 from private institutions. The swabs were collected for each of institutions on the days they had an appreciable number of patient inflow in the departments. Sterile swab sticks were used to aseptically swab the x-ray tube couches, chest stands, x-ray tube head handles, exposure buttons, control consoles, x-ray cassettes and anatomical markers. Precaution was taken to ensure that no cleaning method was carried out on these surfaces before the collection of samples, which was done at the end of work for the day. Swab samples were labeled appropriately and taken to microbiology laboratory for culturing.

The culture media (MacConkey and Blood agar) were prepared according to the manufacturer's instructions. The samples were prepared and put into the autoclave and heated for 15 minutes at a temperature of 121^oc to achieve

sterilization of the culture medium. The medium was afterwards poured into petri dishes, after allowing the medium to cool to 47 °c and culture plates were covered and allowed to set before inoculation of samples. After inoculation, culture plates were placed in an incubator and incubated for 24 hrs at a temperature of 37 °c in order to grow microorganisms. After incubation, the culture plates were examined macroscopically under a bright light in order to identify the isolated microorganisms based on their colonial characteristics.

RESULTS :

Table I shows the total number of samples collected from both government and private institutions and the number of growth recorded. A total of 182 (86%) out of the 200 samples had bacterial growth while 28 samples (14%) yielded no growth. 96 samples (48%) out of 200 samples had bacterial growth while 4 samples (2%) had no growth in government institutions. In private institutions 56 samples (38%) recorded bacterial growth whilst 28 samples (14%) had no bacterial growth.

Table II Shows the total number of samples collected from each surface and the number of growth recorded in government institutions. It showed that x – ray cassettes recorded the highest number of growth while the least growth was recorded in anatomical markers.

Table III Shows the number of samples collected from each surface and the number of growth recorded in private institutions. X – ray cassettes recorded the highest number while anatomical marker recorded the least.

Table IV Shows that staphylococcus aureus was the most commonly isolated bacteria in both institutions accounting for 140 (70%) of isolates

Table V shows X-ray equipment and accessories and their respective bacterial loads for each of the bacterial isolates. X-ray cassettes had the highest bacterial load for staphylococcus aureus, pseudomonas, aeruginosa, streptococcus and coliform spp.

Table 1: overall number of samples collected and the number of growth recorded

	Government Institutions	Private Institutions	Total (%)
Total number of samples	100	100	100%
Number of samples with growth	96(48%)	76 (38%)	182 (86%)
Number of samples without growth	4(22)	24(12%)	28 (14%)

Table II Number of samples collected from each surface and the number of growth recorded in government institutions

Surface	Number samples	Number with growth	Number without growth
X ray couch	16	16	-
Chest stand	8	8	-
Tube head handle	16	8	-
Exposure button	8	16	-
Control console	8	16	-
X ray cassettes	36	32	4
Anatomical markers	8	8	-
Total	100	96	4

Table III Number of samples collected from each surface and the number of growth recorded in private institutions

Surface	Number samples	Number with growth	Number without growth
X ray couch	16	12	4
Chest stand	8	8	-
Tube head handle	16	16	-
Exposure button	8	4	4
Control console	8	4	4

X ray cassettes	36	28	8
Anatomical markers	8	4	4
Total	100	76	24

Table IV: Bacteria isolates and their frequency of occurrence

	Staphylococcus aureus	Pseudomonas Aeruginosa	Proteins Spp	Streptococcus	Coliform Spp
Government institution	72	60	16	28	36
Private institution	68	28	12	24	44
Total	140 (70%)	88 (44%)	28 (14%)	52 (26%)	80 (40%)

Table V X – ray equipment and Accessories and their respective bacteria loads for each of the bacteria isolates.

	X – ray couch	Chest stand	Tube head handle	Exposure button	Control console	X – ray cassette	Anatomical marker	Total
S. aureus	28	16	16	12	12	44	12	150
Pseudomonas	8	8	20	4	-	40	8	88
Proteus spp	8	-	4	8	-	4	4	28
Streptococcus	12	4	-	4	8	24	-	52
Coliform spp	8	4	16	4	8	36	4	80

DISCUSSION

This study investigated x – ray equipment and accessories as possible vectors of nosocomial bacteria and also compared the prevalence between government and private institutions. The study has shown that x – ray equipment and accessories used in the medical imaging departments harbour

nosocomial pathogens, especially bacteria. Bacteria most commonly isolated were; staphylococcus aureus, pseudomonas aeruginosa, proteus spp, Streptococcus and Coliform spp.

From the study, Staphylococcus aureus was the most occurring bacteria, with a frequency of 140 (70%), as shown in table IV. This is in line with Fox and Harvey (2007) who found Staphylococcus aureus to be the most common bacteria to be isolated from x – ray cassettes. Staphylococcus aureus are cutaneous bacteria that colonize the skin and nose of both hospital staff and patients. They cause a wide variety of lung, bone, heart and blood stream infections, and are frequently resistant to antibiotics (WHO, 2002).

Pseudomonas aeruginosa was the second most prevalent bacteria, with a frequency of 88 (40%). This microorganism is often isolated in water and damp areas. They may colonize the digestive tract of hospitalized patient (WHO, 2002). The effect of infection with Pseudomonas aeruginosa may be mild, as in folliculitis and external otitis, but wound infection may be more severe. Furthermore, greater morbidity is associated with infection in individuals who have a compromised immune system, or who have another health condition, such as diabetes (CME Resource, 2010).

Coliform spp. with a frequency of 80 (40%) was also isolated. This is in line with Ochie and Ohagwu (2009), who found 45% prevalence of Coliform spp., on x – ray equipment and accessories.

Streptococcus (26%) and proteus spp. (14%) were also isolated. In a similar study by LeFrock et al (1978) Streptococcus was also identified as one of the microorganisms colonizing x – ray cassettes, x – ray tables, chest boards, Franklin head units and wheel chairs in the imaging department. Proteus spp. may colonize sites when the host defences are compromised, and can cause serious infections like; surgical site infections, bacteraemia and lung infections (WHO, 2002).

X- ray cassettes had the highest frequency of bacterial growth, for both government and private institutions, as shown in tables II and III. This result agrees with Ochie and Ohagwu (2009) who also found x – ray cassettes to be the most frequently contaminated accessories. The surface which the radiographer touches, like the tube head handle, exposure button and control console all recorded bacterial growth , as seen in tables II, III, V. This result suggests that microorganisms are spread by the radiographer's hands, and also, that radiographers are at risk of acquiring occupational infections.

The x- ray couches and chest stands also recorded appreciable bacterial growth, for both government and private institutions; as can be seen in table II and III. These surfaces are also considered as patient contact surfaces.

The anatomical markers also recorded bacterial growth, as seen in tables II and III. This result agrees with Hodges (2001) who also identified bacterial growth on radiographic marker tapes cultured. Bacteria identified include; *S. epidermis*, *Streptococcus*, *Micrococcus*, *S. aureus*, *Acinetobacteria*. It suggests that radiographic/ anatomical markers could be a source of nosocomial infection to the society – if they are carried out of the hospital environment, and to the radiographers – who carry them about – as occupational infection. All bacteria isolated had a higher prevalence in government institutions than in private institutions, except *Coliform* spp. which had a higher prevalence in private institutions. This may be attributed to the attitude of personnel / staff in handling government property within the area of study.

CONCLUSION

Nosocomial bacterial were found on the surfaces of x – ray equipment and accessories; hence they are potential sources of nosocomial infections within health care delivery institutions. Growths were recorded more in government than private institutions.

RECOMMENDATIONS

Based on the results of this study, the following recommended measures should always be taken, to minimize the risk of nosocomial infection in the imaging department.

- Dilute solution of sodium hypochlorite should be routinely used for disinfecting x – ray equipment and accessories, especially those without stainless steel components. This disinfecting solution was found to be most efficient in the clearance of bacterial load from x – ray equipment and accessories, by Ochie and Ohagwu (2009).
- Ideally, x – ray equipment and accessories should be properly disinfected immediately after use and before the next patient is attended to.
- Radiographers should wash their hands with bactericidal soap, after attending to a patient and before attending to the next patient. Radiographers should also imbibe the culture of proper hand washing with bactericidal soap at the end of procedures for the day.
- Radiographers should use a pair of sterile latex or polythene gloves for each patient.

298 - There should be constant monitoring of the bacterial load of the
299 equipment and accessories to reduce the risk of nosocomial bacteria
300 growing on them.

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