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Patient changing gowns as source of microorganisms for nosocomial infections in the radiology department: A cross-sectional study

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Abstract

Background: Radiology department is an essential integral part of a very standard hospital based on its diagnostic roles in the hospital, as no hospital can claim to be of a high standard without a radiology unit. Most radiological examinations such as chest, abdomen/pelvis, thoracic and lumbosacral require that patient remove their clothing and wear a radiolucent gown provided by the radiology unit, which may serve as a source of microorganisms that causes nosocomial infection. This study was designed to evaluate the possibility of patients changing gowns acting as a source of microorganisms that can cause nosocomial infection.

Materials and Methods: This prospective study, which was conducted with a sample of 20 gowns in the radiology department of a tertiary hospital in Anambra State, Nigeria was carried out from April to May 2023. Swab samples were collected from the inner parts of the clean changing gowns intended for patient use for radiological examinations before they were used and the swab was cultured.

Results: Eight out of the 20 gowns (40%) harboured some microorganisms. The isolated microorganisms from the gowns were *Staphylococcus aureus*, *staphylococcus epidermidis*, and *Klebsiella* spp.

Conclusion: It is therefore possible that the patient's changing gowns can be a source of nosocomial infections.

Keywords: Changing gowns, microorganisms, patient, radiology department

Introduction

The radiology department is one of the important departments in the hospital. It plays very important diagnostic roles via various imaging modalities. Most of the diagnostic investigations carried out in the department require the patients to remove their clothing and put on radiolucent gowns (called changing gowns) provided by the radiology department. This is to avoid the possibility of artifacts on the resulting radiographs which may result from any radiopaque materials on the patients' clothing. Artifacts, if present, can interfere with proper diagnosis. Most radiological investigations of the chest, abdomen, pelvis, and thoracic and lumbosacral regions require patients to put on a changing gown.

The aim of healthcare professionals and in fact, the hospital as a whole is to restore sick persons to health. It is, however, seen at times that patients contract certain infections from the hospital environment while receiving treatment. Such infections which were not with the patient at their time of arrival at the hospital for treatment are called nosocomial infections or hospital-acquired infections or healthcare-associated infections. According to WHO, approximately 15% of all hospitalized patients suffer from nosocomial infections [1]. During hospitalization, the patient is exposed to pathogens through different sources including the hospital environment, healthcare staff, and other infected patients. Healthcare-acquired infection is something that can be seen in many hospitals both in developing and developed countries.

Fatima *et al.* [2] reported that about seven percent (7%) of hospitalized patients in developed countries and about ten percent (10%) in developing countries can contract one hospital-

acquired infection or the other and that the groups of patients often affected include those in the intensive care units- where the rate can be as high as 51%, burns units, those undergoing organ transplants and neonates. Patients often get infected through instruments used for their care of the patient such as catheters and ventilators [3]. The infection can also result from contaminated surgical wound.

In the radiology department, nosocomial infections were reported to come from sources such as X-ray equipment and accessories. Eze *et al.* [4] isolated bacterial from 182 out of 200 swab samples from x-ray equipment and x-ray cassettes. *Staphylococcus aureus* constitutes 140 of the isolates while 80 were coliform Spp and streptococcus in 52 samples. In another study by Chingarande and Chidakwa [5] 58% of 30 swab samples from x-ray accessories such as x-ray cassettes, lead aprons x-ray tube handles, etc. yielded coagulase-negative staphylococcus bacteria. Similarly, Ochie and Ohagwu [6] isolated staphylococcus, micrococci, diphtheroid, and species of bacillus from x-ray cassette swab samples. A study also demonstrated that the microorganism can survive for a long period on x-ray accessories such as the image receptor and can become a source infection to both patient and staff [7].

Nosocomial infection can be of bacterial, viral, or fungal origin and is of health concern because it can lead to complications in the condition of the patient. They thus can lead to prolonged stay in the hospital, long-term disability, increased antimicrobial resistance with an increased financial burden to the patient, and increased death rate [8].

Of all the x-ray equipment and accessories, the patient changing gown is the one that comes most in contact with the patient's skin. The purpose of this study is to investigate whether the patient changing gown can harbour microorganisms that can lead to nosocomial infection in patients using them for radiographic investigations.

Materials and methods

This prospective cross-sectional was carried out from April to May 2023 using 20 gowns obtained from a total of 80 laundered gowns kept in the department for use. The studied 20 gowns were randomly sampled. Institutional Ethical Approval NAUTH/ CS/ 66/ VOL.16/ VER.3/ 22/ 2023/ 08 was obtained before the commencement of the study. Data collection lasted for four days. On average, the study centered uses 20 gowns per day, so five gowns were sampled for each of the four days. One swab stick was used for each gown. The inner surface of each gown (the side that will be in contact with the patient's skin when the patient wears it) was scrubbed using a sterile swab stick. The sampling was spread for four days to ensure proper handling both during the data collection and culture analysis in the Microbiology laboratory of the hospital. After data collection for each day, the swabs were taken to the Microbiology laboratory of the hospital for culture and analysis.

Culture

Samples were inoculated by the standard streak plate method. This involves the progressive dilution of inoculum of bacteria or yeast over the surface of solidified agar medium in a Petri dish. The samples were prepared and put into the autoclave and heated for some minutes at a certain temperature to achieve sterilization of the culture medium. Thereafter, the medium was allowed to cool to 47°C and

then poured into Petri dishes. The culture plates were covered and allowed to be set before the inoculation of samples. After inoculation, culture plates were placed in an incubator and incubated for 24 hours at a 37 °C to grow microorganisms. After inoculation, the culture plates were examined microscopically under a bright light to identify the isolated microorganisms based on their colonial characteristics.

Identification Tests

Gram Staining: This was done to differentiate the bacteria into Gram Positive and Gram-negative Bacteria, which helps in the classification and differentiations of microorganisms [9].

On a clean grease-free slide, a thin smear of the isolate was made and the smear was then allowed to air dry. The back of the slide was passed rapidly over a flame for it to fix and it was then covered with Crystal Violet (CV) for one minute and rinsed with water. It was covered with Lugol's iodine for one minute and rinsed with water. Decolorization was done rapidly with water acetone and rinsed again with water. Safranin was applied for one minute and then rinsed off with water. After that, the slide was allowed to air-dry and was examined using the oil immersion objective lens. Gram Positive microorganisms show a Blue/Purple Color while the Gram-Negative show a Red Color.

Principle of Gram Staining

When the bacteria are stained with primary stain Crystal Violet and fixed by the mordant, some of the bacteria can retain the primary stain and some are decolorized by alcohol. The cell walls of gram-positive bacteria have a thick layer of protein-sugar complexes called peptidoglycan and lipid content is low. Decolorizing the cell causes this thick cell wall to dehydrate and shrink which closes the pores in the cell wall and prevents the stain from exiting the cell. So the ethanol cannot remove the Crystal Violet-Iodine complex that is bound to the thick layer of peptidoglycan of gram-positive bacteria and appears blue or purple. In the case of gram-negative bacteria, the cell wall also takes up the Crystal Violet-Iodine (CV-Iodine) complex but due to the thin layer of peptidoglycan and a thick outer layer that is formed of lipids, the CV-Iodine complex gets washed off. When they are exposed to alcohol, the decolorizer dissolves the lipids in the cell walls, which allows the CV-iodine complex to leach out of the cells. Then when again stained with Safranin, they take the stain and appear red in color [9].

Reagents Used in Gram Staining

The materials include Crystal Violet (the primary stain), Iodine (the mordant), a decolorizer made of acetone and 95% alcohol, and Safranin (as the counter stain).

Data analysis

Data were analyzed using descriptive statistics such as mean and standard deviation and percentages and were presented using tables of frequency and charts.

Results

Out of the 20 swab samples obtained from the x-ray changing gowns eight (40.0%) of samples showed the presence of growth of bacteria capable of causing nosocomial infections while 60.0% of samples showed no growth. Among the bacteria species are staphylococcus

aureus, seen in 25% of the samples, *Klebsiella pneumoniae* Spp seen in 10% of the gowns, and staphylococcus epidermidis found in 5% (table 1). From the result, staphylococcus aureus is the most common bacteria on the changing gown followed by *Klebsiella pneumoniae* Spp, and the least was staphylococcus epidermidis (fig 1)

Table 1: Number of gowns with bacteria growth and the species

Bacteria species	Frequency (%)	
	Present	Absent
Staphylococcus aureus	5 (25%)	15 (75%)
<i>Klebsiella</i> spp.	2 (10%)	18 (90%)
Staphylococcus epidermidis	1 (5%)	19 (95%)
Total	8 (40%)	12 (60%)

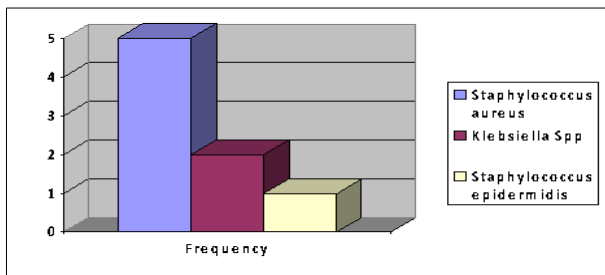


Fig 1: Distribution of the bacteria species found on x-ray changing gowns.

Discussion

Nosocomial infections have negatively impacted the duration of hospital stay with the increasing length of the period of hospitalization with an attendant drain on the financial resources of patients. It can also result in increased morbidity and mortality and may be a cause for medico-legal issues for the hospital.

Our results revealed that patients' changing gowns can harbor infectious microorganisms and so are possible vectors for nosocomial infections. The study revealed a 40% prevalence of microorganisms capable of causing nosocomial infections. The isolates from the gowns from this study include *Staphylococcus aureus*, *Klebsiella* Spp, and *Staphylococcus epidermidis*. Similar organisms were isolated from swabs of X-ray equipment and accessories by Eze *et al.* [4] and Chingarande and Chidakwa [5] from x-ray cassettes, lead aprons, and X-ray tube heads handles and by Ochie and Ohagwu from X-ray cassettes. Their findings might not be very surprising because some of the accessories they investigated, for example, cassettes, are overtly seen as contaminated and even stained with blood, and they are often placed on the floor of the diagnostic rooms. Likewise, x-ray couches often come into contact with fluid from patients. But the discovery of bacteria in laundered, unused patients' changing gowns is rather surprising and therefore, calls for attention to the laundering and sterilization techniques. There is also the need to review the methods of transporting the gowns from the laundry department to the X-ray department to ensure adequate hygiene. The gown storage methods in the department need to be reviewed. Also, awareness has to be created for patients of the possibility of nosocomial infections from changing gowns. This will make them know they have the right to reject any changing gown that is not seen to be decent. This is important because in some radiology centres X-ray changing gowns are seen rumpled on the floor of the changing room and one gown is used for many patients.

Some are even used for days before being washed. The centre we studied has a policy of one gown per patient and the gown is washed before being used again. The presence of microorganisms on gowns used in the centre points suggests that changing gowns in many radiology centres could harbor microorganisms. Also worthy of note is the fact that among the microorganisms isolated is *Staphylococcus aureus* which is known to show resistance to many antibiotics [8].

Conclusion

The patients' changing gowns used in the radiology department can harbor infection-causing microorganisms including *staphylococcus aureus*, which is highly resistant to many antibiotic drugs. They are, therefore, possible vectors for nosocomial infections. Hospital radiology departments should therefore give more attention to the handling of the gowns to reduce nosocomial infections from the gowns.

Limitations of the study

The major limitation of this study was the use of small sample size. A larger sample size might have revealed more other species of microorganisms.

Acknowledgment

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Conflict of interest

The authors declare no conflict of interest.

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