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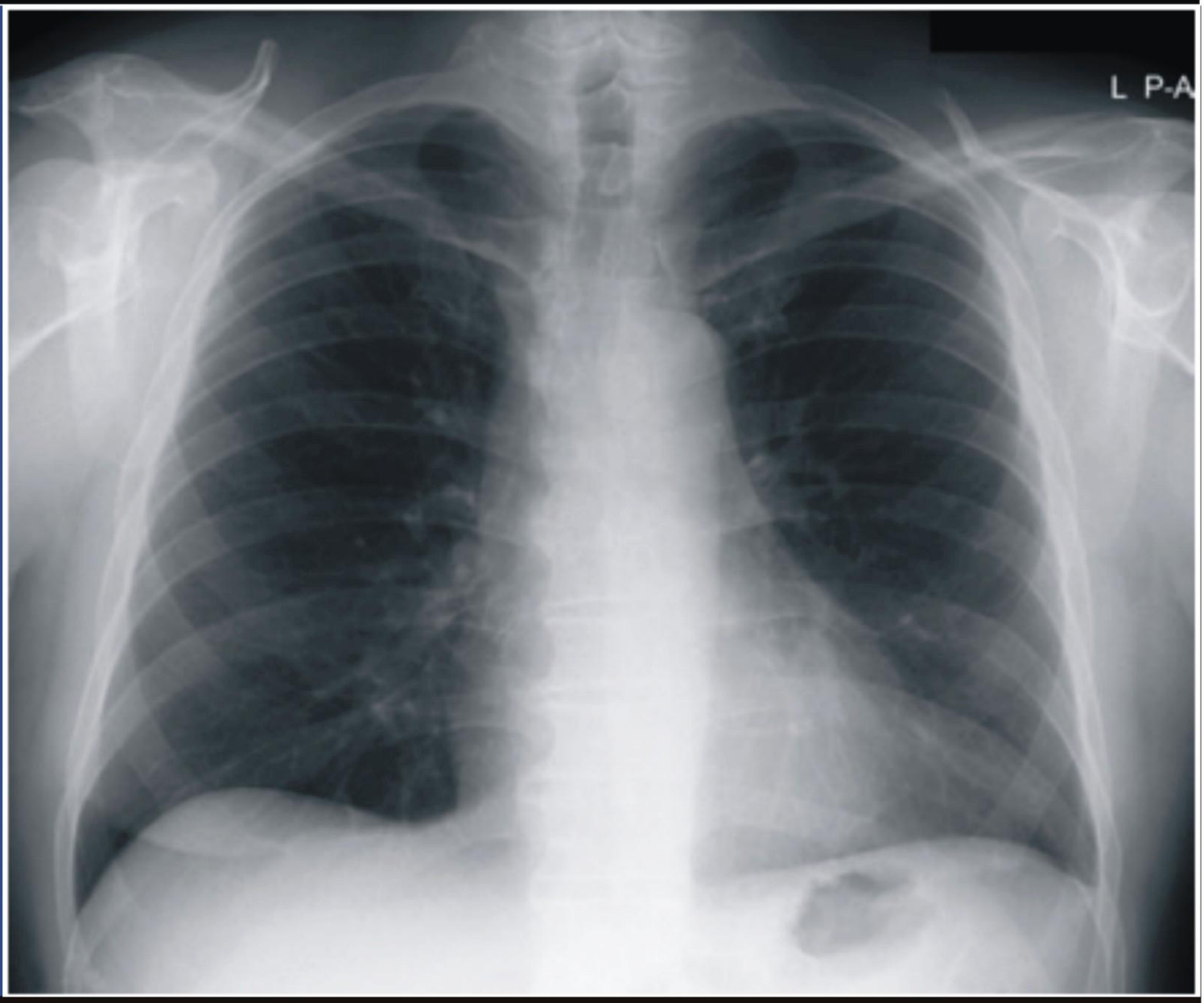

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Surface Management in Prevention of Nosocomial Infections in Radiography Practice

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ABSTRACT

Background: For prevention of nosocomial infections in Radiography practice, it is imperative to disinfect surfaces used by all patients with appropriate disinfectants.
Objective: To determine the disinfectants that are most active in eliminating micro-organisms identified on hard surfaces of equipment and accessories in the radiology department of a tertiary hospital.
Methodology: Efficacy of Savlon (chlorohexidine), Jik (Sodium hydrochlorite), and Dettol (Chloroxylenol) were tested. Each examined surface was divided into three horizontal parts. Three BS medichem swabs were moistened with distilled water and used to collect sample along each surface at different points. The surfaces were cleaned with each undiluted disinfectant and allowed to dry for 20 minutes. Three different moistened swabs were used to collect another fresh sample. Chocolate agar was used to prepare the samples and later incubated in incumax^{TM} incubator for 24 hours at 37^0C. Colonies were identified under national light microscope.
Results: Colony count before disinfection was one 150. After cleaning, it reduced to 60. The isolated organisms were: Staphycoccus aureus, Candida albicans, Pseudomonas aeruginosa coliform and Escherichia coli. Staphylococcus aureus which had the highest colony count of 51 before disinfection was reduced to 14 after disinfection. Escherichia coli had the least colony count before and after disinfection. Jik (sodium hydrochlorite) reduced the total bacterial load form 51 to 14 counts.
Conclusion: Sodium hypochlorite (Jik) is the most effective disinfectant noticed in our centre.
Keywords: Surface, Disinfectants, Radiography, Prevention, Nosocomial.

Introduction

Cleaning is important in most economic sectors but, it is essential in health care industry for environmental surface management and infection control [1]. The centers for disease control and prevention describes disinfection as the process of inactivating micro-organisms such as (bacterial, virus, fungi) [2]. Disinfection is applicable to the treatment of inanimate objects, materials, skin and other body membranes [3].

Disinfectants are antimicrobial agents that are applied to non living objects used to suppress the growth of microorganisms and they come in several formulations such as sprays, liquids, concentrated powder and gases [4]. Types of disinfectants are; Air disinfectants, Aldehydes, Oxidizing agents, Sodium hydrochlorite, Hydrogen peroxide, Iodine, Ozone, Peracetic acid and Phenolics.

For disinfectants to be effective, they must reduce bacterial contamination; kill about 95% of gram negative and gram positive bacteria, inhibit bacteria build up and growth, cost effective, harmless to humans and non corrosive [1].

Nosocomial infections, otherwise called hospital acquired infection (HAI) are infections which a patient develops during hospitalization which was not present or incubating at the time of their admission. It first appears between 48 to 72 hours after a patient is admitted to the hospital or 30 days after leaving the hospital [5,6,7].

A previous study on the antimicrobial efficacy of four selected disinfectants; Jik, z-germicide, Izal and Dettol, recorded that Jik has a greater inhibition zone of 25mm and z- germicide has the least inhibition zone of 7mm on micro organism [8]. Another study was on the evaluation of antimicrobial activity of 3 surface disinfectants; poly hexa methylene guanidine hydrochloride (PHMG), Sodium hydrochlorite and iodine complex. The study reported that both PHMG and sodium hydrochlorite showed good antifungal activity at a contact time of 15min while iodine solution was not effective [9]. Yet another study in 2008, reported that Savlon showed the highest Antibacterial activity against all the test organisms. Dettol antibacterial activity was high against all the test organisms expect Pseudomonas aeruginosa. TCP showed a low activity against all the test organisms [10].

There has been increase in Nigerian population and therefore increase in number of people that patronize public hospitals. This has led to crowding of health institutions which, is a very fertile ground to easily transmit nosocomial infections. The radiology department is no exception as it a high traffic one, as such there is a possibility of transmission of hospital acquired infection from patient to patient or to personnel and vice versa [5].

The radiology department under study makes use of only disinfectants for surface cleaning to prevent the transmission of nosocomial infections. Therefore, there is need to critically identify the most effective chemical disinfectant for disinfection purposes. Also, with the increasing and emerging antimicrobial resistance of isolated pathogens [11], it is therefore necessary to test the efficacy of common disinfectants used in radiography practice on identified nosocomial bacteria. This study sets to do that. The result of this study will help to choose the best disinfectant for surface management.

Material and methods

This is a prospective experimental research carried out in a tertiary hospital in south-eastern Nigeria. Materials used in data collection include: swab sticks, distilled water, petri dishes/plates, incubator, microscope, Savlon (chlorohexidine), Jik(Sodium hydrochlorite),Dettol (Chloroxylenol), chalk and cotton wool. This study tested the efficacy of 3 disinfectants; savlon, Jik, and Dettol.

Since three disinfectants were tested, the surfaces where samples were collected were divided into three horizontal sections. Each represent testing site for each antiseptic. BS medichem swab sticks were moistened in distilled water. Samples were collected by rubbing each moistened swabs along the length of each study surface before disinfection. The surfaces were not cleaned with water before collection of this sample. Different undiluted disinfectants were used to clean the length of each section. After cleaning, the sites were left for 20 minutes to dry. Samples were then collected with moisten swab sticks as described above. Chocolate agar, a non-selective medium used for isolation of pathogenic bacteria was prepared. It is prepared by heating pancreatic digest of casein, papaic digest of soy meal, sodium chloride, agar and distilled water at pH of 7.3 and 80^{o}C and sterilized by autoclaving.

Preparation was transferred to water bath at 50^0C. The mixture was then dispensed 25ml into agar petri dishes; allowed to solidify and condense. The dishes were placed in sterile plastic bags and stored at 4^0C to avoid contamination. To ensure sterility, non-inoculated dishes were incubated for 48 hours at 35-37^0C with approximately 55 carbon dioxide. The samples were then prepared with the chocolate agar, placed in petri dishes and incubated for 24 hours at 37^0C with incumax^{TM} incubator model IC850 manufactured in 2009. Afterwards the samples were view under a light binocular microscope model 138 manufactured by national medical equipments to identify different micro-organisms. Colonies were then identified. These procedures were carried out by a paid laboratory scientist.

Results

The result obtained from this study showed that the total colony count of micro-organisms before cleaning with the respective disinfectants was one hundred and fifty. This is demonstrated in table 1. As shown in Table 2, isolated organisms were Staphylococcus aureus, Candida albicans, Pseudomonas aeruginosa coliform and Escherichia coli. The colony of Staphylococcus aureus has highest frequency of fifty-one. The least colony count was Escherichia coli with a frequency of twenty.

Shown in Table 3 are colony counts at different sites of study. It was highest in direct radiography area with a count of ninety-six and least in Magnetic Resonance Imaging (MRI) with a count of fourteen. Table 4 shows that the total colony count after disinfection was markedly reduced to sixty after disinfection. Staphylococcus was reduced from thirty-nine before cleaning to twelve after cleaning. This is followed by Escherichia coli which, recorded colony count of twenty before cleaning to seven after. Candida albican recorded the least count of five after cleaning.

The study showed that among the three disinfectants tested, Jik (sodium hydrochlorite) was the most effective in reducing the bacterial load from fifty-one counts before cleaning to fourteen counts after cleaning. Savlon (chlorohexidine) was on the moderate side. Dettol on the other hand was least effective with a count of 48 before cleaning to 26 after cleaning. This reduction in bacterial load was shown in table 5. Table 6 shows that the colony load was also reduced across various sites of study.

Discussion

This study investigated surface management in prevention of nosocomial infection in radiography practice because adequate surface management via disinfection is crucial. Pathogens were isolated from hard surfaces in in this study. However, adequate disinfection with appropriate disinfectants must be used to inhibit their action because all patients that visit the radiology department make use of same surfaces for their examinations. Some of these patients may have open wounds and infectious diseases. Trauma patients and patients with open wound are mostly endangered as pathogens can easily migrate via the wound into the patient's body. Consequently, inappropriate surface management will increase load of nosocomial pathogens as equipments are known to harbour these organisms no matter where it is found in the hospital [12].

Table 1: Isolated micro-organisms from all examined surfaces.

Isolated organism	Frequency	%
Staphylococcus aureus	39	26.0
Candida albicans	35	23.3
Pseudomonas aeruginosa	30	20.0
Coliform	26	17.3
Escherichia coli	20	13.4
TOTAL	150	100

Table 2: Colony count with each section before disinfection

Micro organisms	Jik	Savlon	Dettol
Staphylococcus aureus	15 (10%)	13(8.7%)	11 (7.3%)
Candida albicans	11(7.3%)	15 (10%)	9 (6%)
Pseudomonas aeruginosa	10 (6.7%)	7 (4.7%)	13 (8.7%)
Coliform	10 (6.7%)	8 (5.3%)	8 (5.3%)
Escherichia coli	5 (3.3%)	8 (5.3%)	7 (4.7%)
TOTAL micro-org.	51 (34%)	51(34%)	48 (32%)

Table 4: Isolated organism and their frequency of occurrence after disinfection

Isolated organism	Frequency	%
No growth	23	38.3
Staphylococcus aureus	12	20.0
Escherichia coli	7	11.7
Pseudomonas aeruginosa	7	11.7
Coliform	6	10.0
Candida albicans	5	8.3
Total	60	100

Table 3: Colony count of micro-organisms at site of collection before disinfection

ISOLATED ORGANISMS	DR1	DR2	CT	U/S	FLUORO	MRI
Staphylococcus aureus	12(8%)	18(12%)	8(5.3%)	0(0%)	1(0.7%)	0(0%)
Escherichia coli	6(4%)	7(4.7%)	4(2.7%)	1(0.7%)	2 (1.3%)	(1.3%)
Pseudomonas aeruginosa	9(6%)	12(8%)	6(4%)	1(0.7%)	1(0.7%)	1(0.7%)
Coliform	7(4.7%)	8(5.3%)	5(3.3%)	1(0.7%)	5(3.3%)	1(0.7%)
Candida albicans	7(4.7%)	10(6.7%)	9(6%)	2(1.3%)	4(2.7%)	0(0%)
Total number of isolates	41(27.4%)	55(36.7%)	32(21.3%)	5(3.3%)	13(8.6%)	4(2.7%)

Table 5: Anti-bacterial sensitivity of the disinfectants after disinfection

Micro organisms	Jik (%)	Savlon (%)	Dettol (%)
No growth	10 (16.7)	8 (13.3)	5 (8.3)
Staphylococcus aureus	2 (3.3)	2 (3.3)	6 (10)
Escherichia coli	1 (1.7)	3 (5)	3 (5)
Pseudomonas aeruginosa	0	4 (6.7)	5 (8.3)
Coliform	0	2 (3.3)	4 (6.7)
Candida albicans	1 (1.7)	1 (1.7)	3 (5)
Total bacterial load	14 (23.4)	20 (33.3)	26 (43.3)

Table 6: Bacterial count with site of collection after disinfection

Isolated organisms	X-Ray2	X-Ray1	CT	U/S	FLUORO	MRI
No growth	7(11.6%)	5(8.3%)	2(3.3%)	2(3.3%)	4(6.7%)	2(3.3%)
Staphylococcus aureus	6(10%)	1(1.7%)	2(3.3%)	Nil	1(1.7%)	Nil
Escherichia coli	4(6.7%)	3(5%)	1(1.7%)	Nil	1(1.7%)	Nil
Pseudomonas aeruginosa	3(5%)	1(1.7%)	3(5%)	Nil	Nil	Nil
Coliform	5(8.3%)	1(1.7%)	Nil	Nil	Nil	Nil
Candida albicans	3 (5%)	2(3.3%)	1(1.7%)	0(0%)	0(0%)	0(0%)
Total	28(46.7%)	13(21.7%)	9(15%)	2(3.3%)	6(10.1%)	2(3.3%)

In this study, pathogens isolated from various surfaces in the area of study were Staphylococcus aureus, Candida albicans, Pseudomonas aeruginosa Coliform and Escherichia coli. A total of 150 colony counts of pathogens were isolated in the study. This is in tandem with an earlier work where they found 47% isolates from their study culture [5]. This could be as a result of non-adherence of surface disinfection in this study area after examinations and in-between patients as there was no strict monitoring; no adequate provision of waste bin as such used hand gloves were seen almost everywhere and introduction of new invasive procedure in the unit due to availability of many functional imaging equipment at the time of study. The pathogen load was reduced to 60 after disinfection with appropriate disinfectants showing an evidence of non-adherence to surface disinfection.

Pathogens were mostly isolated from conventional x-ray examination rooms in this study. Even though radiographers wore hand gloves to work in the area of study, this high load could be as a result of using the same hand gloves to attend to many patients. Same practice was observed by another study [5], where they queried the hand washing hygiene of radiographers. It is then advisable that radiographers practise good hand washing hygiene and change hand gloves in between patients [3]. Patients' throughput for conventional x-ray examinations was noted to be higher when compared to other imaging modalities. This could also contribute to high pathogen load as patients come with different disease conditions.

Jik (sodium hypochlorite) was found to be more effective amongst tested chemical disinfectants. This is in tandem with similar studies [5, 9], but at variance with two other works where Dettol was found to be a more effective disinfectant [8, 10]. This present study revealed a marked reduction in number of different isolated pathogens, unlike a similar work which reported that all test organisms were killed expect Pseudomonas aeruginosa [10].

This is to show the importance of chemical disinfectants in surface management in Radiography. Radiodiagnostic units should be made free of these nosocomial bacteria as much as possible in daily practice. Equipment and accessories should be cleaned properly before disinfection as organic matter may prevent disinfectants from having contact with the surface [3].

Conclusion

Sodium hypochlorite was found to be the most effective disinfectant. The World Health Organization (WHO) recommends that it be used on surfaces like radiographic equipment that come in contact with blood. However, it is corrosive, calling for appropriate dilution. Our team also recommends that sodium hypochlorite be adopted for surface disinfection in radiography practice to avoid spread of nosocomial infection.

Conflict of interest: Nil

Sponsorship: Nil

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