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Bacterial Contamination of Radiological Equipment and Factors Affecting Disinfection among Radiology Health Professionals Addis Ababa, Ethiopia

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Abstract: As a result of the large influx of patients into the medical imaging department, the surfaces of equipment could represent a reservoir for pathological agents and source of transmission of infections to patients and healthcare professionals. A total of 178 swab samples collected from radiological equipmentof X-ray, Ultrasound, Computed tomography and Magnetic resonance Image equipment were selected and assessed for microbiological contamination in selected public hospitals of Addis Ababa. Self-administered structured questionnaire was used to collect factors affecting disinfection process among 137 medical radiology health professionals. The collected specimens were inoculated on (Blood agar and MacConkey agar) and incubated at 35-37±0.5°C for 24 hours. The suspected colonies were further subjected to gram staining and biochemical testing. A standard disc diffusion technique for antimicrobial susceptibility test (AST) was performed for all the isolates using CLSI (Clinical laboratory standard institute 2017). SPSS version 24 was used to analyze the data. Bacterial isolates resistant to two or more classes of drugs were considered as multidrug resistant (MDR). Results showed that 151(84.8%) bacterial isolates from 178 swab samples were found. High bacteria contamination rate was found on X-RAY machines accounts for 75(49.7%). Gram-positive organisms were the most frequently isolated bacteria, particularly, Coagulase negative *staphylococci* (CoNS) which accounts 98(55.1%). *Pseudomonas aeruginosa* was the most isolated Gram-negative bacteria and accounts 7(3.9%). Methicillin resistant *Staphylocoous aureus* (MRSA) were found 5 out of 12 (41.6%) of *S. aureus* isolates. *Conclusion*: This research showed high bacterial contamination rate of radiological equipment and isolates showed high resistance rate for different antimicrobial drugs. And there were factors affecting decontamination of radiological equipment. Hence, awareness for these factors should be raised among radiology health professionals.

Key words: Radiological Equipment · Hospitals · Isolates · Decontamination · Multidrug Resistance

INTRODUCTION

The medical imaging department plays a vital role in medical diagnoses. Hence, an appreciable number of patients that come into health care delivery institutions visit the MID (medical imaging department) for one investigation or the other [1, 2]. The department is central within the hospital to the diagnosis of illness and disease. Infection control is fundamentally about preventing the transmission of infection throughout the hospital and it is regarded as an essential part of clinical practice. It usually involves massive investments [3, 4].

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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 immuno-compromised. These conditions make them possible vectors of, or highly susceptible to nosocomial pathogens which in turn cause infections [1, 2]. 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 [5, 6].

In spite of the different characteristics of the patients, the examinations are often performed with the same equipment and within the same environment. In this context, the surfaces of equipment could represent a reservoir for pathological agents and source of transmission of infections to patients and healthcare professionals [7].

In radiological departments (RDs), similar to other hospital departments, it is recommended to adhere to international standards and guidelines of hygienic procedures [8]. The WHO [9] guidelines report that ‘‘cleaning and disinfection of all patient care areas is especially important for frequently touched surfaces. The Disease Control Bureau of different countries identified the RD as a setting with high-level risk of infection. As far as concerns the radiological settings, several articles are investigated the risk is focusing on mobile X-ray imaging techniques. For instance, Aso *et al*. [10] found highest levels of contaminationon CR consoles and HIS/RIS terminals and suggested this was attributable to wrong procedures in cleaning and disinfection. Levin *et al.* [11] reported a poor practice of infection control measures among radiography technicians demonstrated highly resistant bacteria colonizing frequently touched radiographic equipment.

Statement of the Problem: In developing countries, the magnitude of the problem remains underestimated or even unknown largely because HAI diagnosis is complex and surveillance activities to guide interventions require expertise and resources [12]. Surveillance systems exist in some developed countries and provide regular reports on national trends of endemic HAI [13] such as the National Healthcare Safety Network of the United States of America or the German hospital infection surveillance system. This is not the case in most developing countries because of social and health-care system deficiencies that are aggravated by economic problems. Additionally, overcrowding and understaffing in hospitals result in inadequate infection control practices and a lack of infection control policies, guidelines and trained professionals also adds to the extent of the problem [12, 13].

Investigations, which have been conducted by various researchers, showed that radiological equipment could be potential source of HAI. For example on the research conducted by Chu *et al*. [14] on the assessmentof the Bacterial Contamination of Ultrasound probe, there was 25.9 % bacterial contamination rate and on other research the presence of nosocomial bacteria on x- ray equipment and accessories turned out positive, with bacteria such as *Staphylococcus aureus, Klebsiella spp,* coliforms and *Escherichia coli,* being the most commonly predominant [1, 2].

Other research conducted by Jeung *et al.* [15], on the bacterial distribution of MRI head coils:- which have the most frequent contact with patients, patient fixation blocks and bores:- which are confined spaces, showed various bacteria including Staphylococcus, *Acinetobacter, Sphingomona, Pantoeaagglomeranss, Micrococcus, Bacillus, Saprophyticus, Brevundimona and Myroidesspecies* [15]. In this study area infection control was applied by the conventional disinfection methods of spraying and wiping which do not fully protect the patients, healthcare professionals or communities against major pathogens.

The output of this study provides information on the bacterial contamination of radiological equipment for the radiology department personnel and the hospitals participated in the study. It also provides baseline information on factors affecting disinfection among radiology health professionals as well as identification of the gap which accounts for this bacterial contamination of radiological equipment for the radiology imaging departments. Results found in the study on the identification of bacterial drug resistance patterns would provide information how serious this problem is and to direct the exact measurements for the problems.

MATERIALS AND METHODS

Study Setting and Design: A hospital based cross sectional study was conducted from Feb 2018 to April 2018 at 12 public hospitals. The study was conducted in Addis Ababa, which is the capital city of Ethiopia.

The city has 51 hospitals. Only tenare public hospitals, of which 6 are under Addis Ababa Regional Health Bureau (AARHB), three are armed forces (military and police) and the rest are NGO's (Non-governmental organizations) and private hospitals. The study was focused on 12public hospital in Addis Ababa, namely: St Paul's hospital millennium medical college, TikuirAnbesa special, Armed Force General, Ras Desta Dametew, Menelik II, Yekatit 12, Zewditu memorial, Ghandi memorial, St Peter TB specialized, Tirunesh Beging, ALERT and Police hospitals. These hospitals were selected for the study because they are the largest hospitals in the country in terms of patient flow and workload.

Sample Size and Sampling Techniques: A total of 50 radiological equipment from 12 hospitals was included. This includes 14 x-ray, 28 ultrasound, 5 CT and 3MRI equipment. 137 radiology health professionals were included for structured questionnaires'.

Sampling Techniques: All radiological personnel who met the inclusion criteria during the study period were included in the study. Data was collected using convenient sampling technique.

Data Collection and Laboratory Processes: Structured questionnaire was used for factors affecting disinfection among radiology health professionals. The questionnaire consists of twelve questions regarding the use of hygiene measures and personal protective equipment (PPE).

Before sample collection was carried out, the main aim of this study was explained to the head of the department in order to proceed with sample collection from radiological equipment. Informed consent was also obtained from the participating health workers prior to the self-administered questionnaire.

The specimen was collected by the laboratory technologist from the selected parts of radiological equipment using moisten sterile cotton swab, with (0.9% w/v) physiological saline. The swab was kept quickly into its container and sealed with unique code number. All the collected specimens were transported to the EPHI microbiology laboratory and cultured within 2 hours of collection and before analysis the laboratory personnel has checked the proper labeling to perform the test.

Microbiological monitoring of radiological equipment´s surfaces was done following standard protocols. We has included microbiological activities using the following criteria:

- Where a large number of patients had direct skin contact with the equipment.
- Where patients respired directly onto the equipment surface
- Where the equipment used was in contact with the radiographer or technologist

Specimens were collected from some part of the following radiological equipment:

- X-ray machine: x-ray tube, x-ray table/couch, stand Bucky, control panel and cassettes
- Computed Tomography: CT table/couch and control panel or console
- Magnetic Resonance Image: sample wascollected from body coils, patient table and MRI Consol.
- Ultrasound machine: Ultrasound probe and ultrasound console

Laboratory Process

Inoculation and Isolation of Bacteria: The collected specimens were inoculatedon (Blood agar and MacConkey agar) and then the inoculated plates were incubated at 35-37±0.5°C for 24 hours after which their cultural characteristics was observed and recorded. The suspected colonies were further subjected to Gram's staining to characterize their morphology. For gram-positive isolated bacteria catalase and coagulase test was performed. For Gram negative bacteria biochemical tests like, citrate, indole, oxidase, urease, TSI (Triple Sugar Iron) and motility was carried out to authenticate their identity [16].

Drug Susceptibility Testing: A standard disc diffusion technique for antimicrobial susceptibility test (AST) was performed for all identified isolates as recommended by Clinical and Laboratory Standard Institute [17] on Mueller-Hinton agar. The bacterial suspension prepared equivalent to the McFarland standard (0.5 CFU) was seeded on Muller-Hinton agar and the impregnated antibiotic disks were placed in to it after few minutes. The plates were incubated for 18-24 hrs at 37°C based on the organisms tested. Diameters of the zone of inhibition around the discs was measured to the nearest millimeter using a ruler and classified as sensitive, intermediate and resistant. Bacterial isolates which are resistant to two or more classes of drugs were considered as multidrug resistant (MDR) [18].

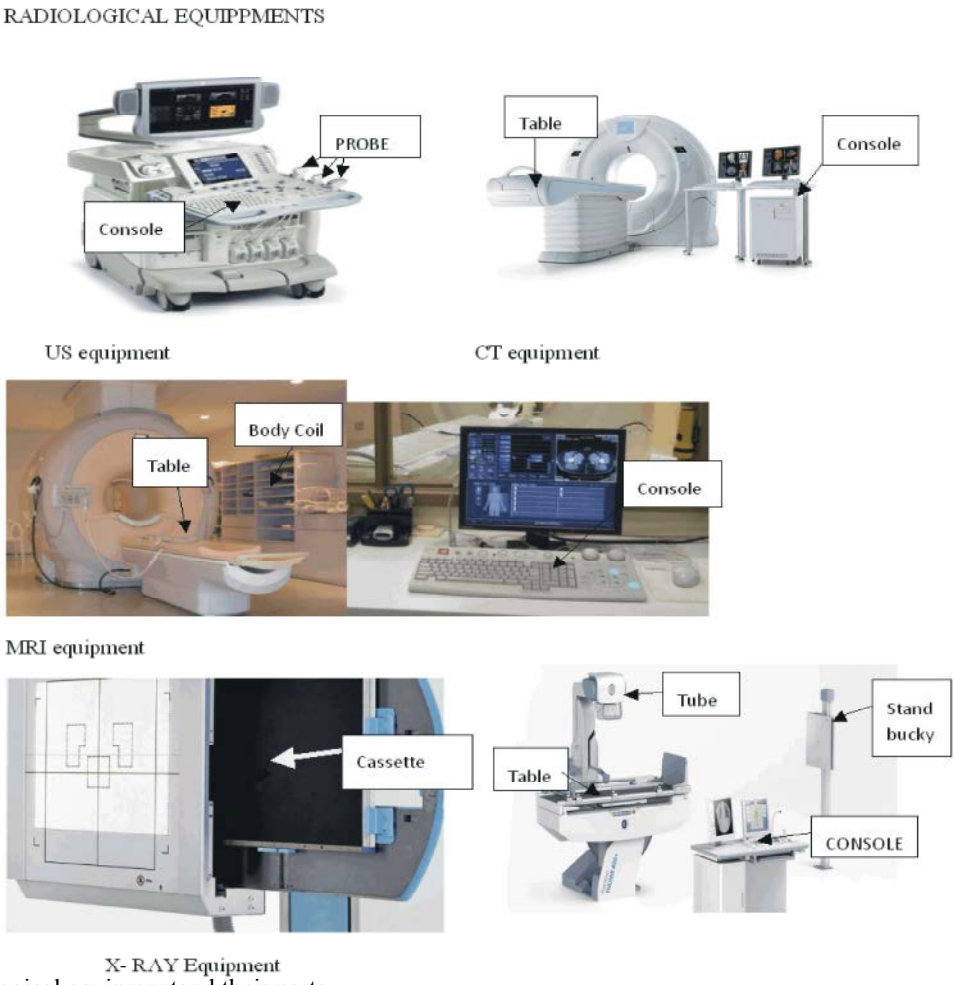

Fig. 1: Radiological equipmentand their parts

Quality Assurance: Before we proceeded to sample collection the functionality of all the equipment was checked. The prepared culture media was also checked for sterility by incubating 2 % percent of the prepared media overnight and observed for the presence of any growth. We have also used control strains before we performed culture and sensitivity tests in the whole process of this study. The organisms we used were *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Pseudomonas aeruginosa* (ATCC 27853). The self-administered questionnaire was assessed for completeness and incomplete questionnaires were discarded.

Data Analyses: Data was collected, entered and analyzed using SPSS version 24 software according to the study objectives. A frequency analysis was carried out to determine the general status of surveys and $p<0.05$ was taken to be statistically significant.

Ethical Consideration: Ethical clearance was obtained from Department of Research and Ethical Review Committee (DRERC) of Medical laboratory Science, College of Health Science, Addis Ababa University. Written informed consent was obtained from study participants. Permission was obtained from all hospitals management. Participant confidentiality was strictly maintained during the process of assessment of factors affecting disinfection as well as anonymity was kept during data processing and report writing. Finally findings of the study were communicated to the hospital management body for corrective measures still keeping anonymity.

RESULTS

Bacterial Contamination Level of Radiological Equipment: We found 151(84.8%) bacterial isolates from 178 swab samples. High bacterial contamination rate was

Table 1: Bacterial Contamination Level of Radiological Equipmentfound at 12 public hospitals from Feb to April 2018

Machine type	Frequency (%)
Magnetic Resonance Image (MRI)	10(6.6%)
CT (Compute Tomography)	13(8.6%)
US (Ultrasound)	53(35.1%)
X-RAY	75(49.7%)
Total	151(100%)

Table 2: Bacterial Isolates from Radiological Equipmentfound at 12 public hospitals from Feb 2018 to April 2018

Isolates	Frequency (%)
CoNS	98(64.9 %)
P. aeruginosa	7(4.6 %)
Bacillus	11(7.2 %)
S. aureus	12(7.9 %)
E. coli	5(3.3 %)
Acinetobacter spp.	5(3.3 %)
Enterobacter spp.	4(2.6 %)
Klebsiella spp.	5(3.3 %)
Micrococcus	4(2.6 %)
Total	151(100%)

P. aeruginosa: *Pseudomonas aeruginosa*, **CoNS**: Coagulase negative staphylococci, *S. aureus*: *Staphylococcus aureus*, *E. coli*: *Escherichia coli*,

Table 3: Bacterial profile at different parts of Radiological Equipmentfound at 12 public hospitals from Feb to April 2018

	Isolates frequency (%)								
Machine type	CoNS	*P. aeruginosa*	*Bacillus*	*Micrococcus*	*S. aureus*	*E. coli*	*Acinetobacter* spp.	*Enterobacter* spp.	*Klebsiella* spp.
MRI	7(7.1%)	0(0%)	1(9.09%)	0(0%)	0(0%)	1(20%)	0(0%)	0(0%)	1(20%)
M B.COIL	2(28.6%)	0(0%)	1(100%)	0(0%)	0(0%)	1(100%)	0(0%)	0(0%)	1(100%)
M TABLE	3(42.8%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
M CONSOL	2(28.6%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
CT	6(6.1%)	1(14.2%)	0(0%)	1(25%)	1(8.3%)	0(0%)	2(40%)	0(0%)	2(40%)
C TABLE	4(66.7%)	1(100%)	0(0%)	1(100%)	0(0%)	0(0%)	2(100%)	0(0%)	2(100%)
C CONSOL	2(33.3%)	0(0%)	0(0%)	0(0%)	1(100%)	0(0%)	0(0%)	0(0%)	0(0%)
US	40(40.8%)	2(28.6%)	3(27.27%)	1(25%)	4(33.3%)	2(40%)	0(0%)	0(0%)	1(20%)
U PROBE	21(52.5%)	0(0%)	1(33.3%)	1(100%)	2(50%)	1(50%)	0(0%)	0(0%)	0(0%)
U CONSOL	19(47.5%)	2(100%)	2(66.7%)	0(0%)	2(50%)	1(50%)	0(0%)	0(0%)	1(100%)
X-RAY	45(45.9%)	4(57.1%)	7(63.6%)	2(50%)	7(58.3%)	2(40%)	3(60%)	4(100%)	1(20%)
X TABLE	12(26.7%)	3(75%)	1(14.2%)	0(0%)	3(42.9%)	0(0%)	1(33.3%)	3(75%)	1(100%)
X CONSOL	8(17.8%)	1(25%)	3(42.9%)	1(50%)	0(0%)	1(50%)	1(33.3%)1	1(25%)	0(0%)
X STAND BUCKY	10(22.2%)	0(0%)	1(14.2%)	0(0%)	3(42.9%)	1(50%)	0(0%)	0(0%)	0(0%)
X CASSETT	7(15.5%)	0(0%)	1(14.2%)	0(0%)	1(14.2%)	0(0%)	0(0%)	0(0%)	0(0%)
X TUBE	8(17.8%)	0(0%)	1(14.2%)	1(50%)	0(0%)	0(0%)	1(33.3%)1	0(0%)	0(0%)

MRI:- Magnetic Resonance Image, CT:- Computed Tomography, US;- Ultrasound, M B.COIL:- MRI body coil, M TABLE:- MRI table, M CONSOL:- MRI console, C TABLE:- CT table, C CONSOL:- CT console, U PROBE:- US probe, U CONSOL:- US console, X TABLE:- X-RAY table, X CONSOL:- X-RAY console, X STAND BUCKY:- X-RAY stand Bucky, X CASSETT:- X-RAY cassette, X-TUBE:- X-RAY tube

found on X-RAY machines, which accounts 75(49.7%), followed by US machines 53(35.1%) and CT 13(8.6%) machines respectively (Table 1).

Bacterial Isolates from Radiological Equipment: From a total of 151 bacteria isolates, Gram-positive bacteria were themost frequently isolated bacteria. Particularly, Coagulase negative Staphylococci (CoNS) which had been found in 98(64.9%), followed by *S. aureus* 12(7.9%) and *Bacillus spp* 11(7.2%) respectively. *Pseudmonas aeruginosa* accounted for the most common isolated Gram-negative rods 7(4.6%) of all the four radiological equipment and it was classified as high risk pathogen in this study. And then followed by *E. coli* 5(3.3%), *Acinetobacter* spp. 5(3.3%), *Klebsiella* spp. 5(3.3%) and *Enterobacter* spp. 4(2.6%) respectively (Table 2).

Bacterial Profile at Different Parts of Radiological Equipment: High Bacteria contamination rate was observed from parts of MRI body coil, CT table, US console and X-Ray table, which have had high patient contact (Table 3).

Table 4: Antibiotic Resistance patterns of bacterial isolates from radiological equipment found at 12 public hospitals from Feb. to April 2018

	Resistance patterns of isolates							
Antibiotic used	CoNS 98(64.9%)	*P. aruginosa* 7(4.6%)	*Micrococcus* 4(2.6%)	*S. aureus* 12(7.9%)	*E. coli* 5(3.3%)	*Acinetobacter* spp. 5(3.3%)	*Enterobacter* spp. 4(2.6%)	*Klebsela* spp. 5(3.3%)
AK(30 µg)	6(6.1%)	5(71.4%)	0(0%)	1(8.3%)	1(20%)	0(0%)	0(0%)	1(20%)
Amp (10 µg)	-	-	-	-	4(80%)	2(40%)	3(75%)	5(100%)
Aug (20/10)	-	-	-	-	1(20%)	-	-	0(0%)
CAZ (30µg)	-	0(0%)	-	0(0%)	1(20%)	3(60%)	1(25%)	0(0%)
CPR (5 µg)	16(16.3%)	1(14.3%)	1(25%)	4(33.3%)	0(0%)	1(20%)	1(25%)	0(0%)
GEN (10 µg)	18(18.4%)	0(0%)	0(0%)	2(16.7%)	1(20%)	2(40%)	1(25%)	1(20%)
CHL (30 µg)	16(16.3%)	-	1(25%)	0(0%)	3(60%)	3(60%)	1(25%)	1(20%)
CXT (30 µg)	89(90.8%)	-	2(50%)	5(41.7%)	-	-	-	-
CLN (2 µg)	9(9.2%)	-	0(0%)	3(25%)	-	-	-	-
Dox (30 µg)	49(50%)	-	0(0%)	3(25%)	2(40%)	3(60%)	0(0%)	1(20%)
ER (15 µg)	56(57.1%)	-	1(25%)	6(50%)	-	-	-	-
Mero (10µg)	-	0(0%)	-	-	1(20%)	3(60%)	1(25%)	0(0%)
COT (25 µg)	77(78.6%)	-	0(0%)	7(58.3%)	5(100%)	4(80%)	1(25%)	4(80%)
TOB (10 µg)	18(18.4%)	0(0%)	0(0%)	5(41.7%)	1(20%)	2(40%)	1(25%)	0(0%)
PIP (100 µg)	-	2(28.6%)	-	-	4(80%)	3(60%)	1(25%)	5(100%)
IMP (10 µg)	-	0(0%)	-	-	1(20%)	1(20%)	1(25%)	0(0%)

Key: drugs brand name-OXOIDS, O-100% sensitive, AK-amikacin, Amp-ampicilin, Aug-augmentin, CAZ-ceftazidime, CPR-ciprofoxacilin, GEN-gentamycine, CHL-chloramphenicol, CXT-cefoxitin, CLN-clindamycine, Dox-deoxycycline, ER-erytromycine, Mero-meropenium, COT-cotrimoxazole, TOB-tobramycin, PIP-piperacilin, IMP-impenem, (-) -not done, CoNS- Coagulase negative staphylococci, No number, µg- Microgram, PA- *Pseudomonas aeruginosa*.

Table 5: Socio Demographic Characteristics of Study Participant found at 12 public hospitals from April to December 2017.

Variables		Frequency (%)
Sex	Female	22 (16.1%)
	Male	115 (83.9%)
Age group	<=31	82 (59.8%)
	32-41	40(29.2%)
	>=42	15(10.9%)
HCW group	Radiologists	48(35.0%)
	MRT	89(65.0%)
Work position	MRI	9(6.5%)
	CT	14(10.2%)
	Ultrasound	47(34.3%)
	X-RAY	67(48.9%)
Work experience	1-3YR	44(32.1%)
	4-7YR	54(39.4%)
	8-11YR	25(18.2%)
	≥12	14(10.2%)

HCW_ Health Care Work, YR_ year

Resistance Pattern of the Bacterial Isolates from Radiological Equipment: A standard disc diffusion technique for antimicrobial susceptibility test (AST) was performed for identified gram-positive and gram-negative isolates except for Micrococcus recommended by Clinical and Laboratory Standard Institute (CLSI 2017) [17]. Most gram-positive bacteria isolates were found resistant to Cefoxitin, Cotrimoxazole and Erythromycin. However, most gram-positive isolates were sensitive to Amikacin, Chloramphenicol and Clindamycin. Additionally, for the gram-negative isolates, most of *P. aeruginosa*s showed high resistant to Amikacin. Whereas, *E. coil, Acinetobacter* spp*, Enterobacter* spp. and *Kelbisella* spp. have shown high resistance to the drug Ampicillin. And also Multi-drug resistant bacteria were found in 15(57.7%) of gram-negative bacteria and 92/125(73.6%) of gram-positive bacteria isolates (Table 4).

Socio Demographic Factor: There were around 270 radiology health professionals from the 12 public health hospitals and 137 of them were participated for the structured questionnaires'. Among them 115 (83.9%) were male and 22 (16.1%) were female and the ages were ranged from 22 to 57 years old with the mean age of 31(SD = ±7.2). Majority of the study participants have a work experience of 4-7 years. The radiologists were worked on the US machines and the Medical radiology technologists were worked on MRI, CT and X-RAY machines.

Factors Affecting Disinfection among Radiology Health Professionals: There were twelve questions found in self-structured questioners and nine of the questions identified some of the factors which affect the disinfection and decontamination of radiological equipment are summarized in Table 6.

Table 6: Factors affecting disinfection among radiology health professionalsfound at 12 public hospitals from Feb. to April 2018

Variable	YES/NO	Frequency (%)
IP training	Yes	51(37.2%)
	No	86(62.8%)
Do you think wearinggloves during examination is important?	Yes	106(77.4%)
	No	22(16.1%)
	I don't know	9(6.5%)
Do you think that Disinfection/decontamination agents are important?	Yes	95(69.6%)
	No	42(30.5%)
Do you think time schedule for decontamination is important?	Yes	95(69.3%)
	No	27(19.7%)
	I don't know	15(11.0%)
Do you think Cleaning radiological equipment with belch can reduce 'bacterial contamination?	Yes	120(87.6%)
	No	7(5.1%)
	I don't know	10(7.3%)
Do you feel safe when usingyour radiological equipment?	Yes	43(31.4%)
	No	94(68.6%)
Do you Use of glove in contact with the patients	Yes	36(26.3%)
	No	101(73.7%)
Do you decontaminate before examination of patients?	Yes	25(18.3%)
	No	112(81.7%)
Do you Use standard guidelines to disinfect (decontaminate)??	Yes	36(26.3%)
	No	101(73.7%)

IP: Infection Prevention

DISCUSSION

Radiography plays a very important role in medical diagnosis but the equipment and accessories used bear a considerable risk of harboring nosocomial bacteria which may complicate patient's original condition. Although much has been written about the implementation of standardized infection control and prevention practices in the medical community, less research has focused on infection control in diagnostic imaging and the effectiveness of common disinfecting agents [1].

This study investigated the level of microbiological contamination of radiological machines in order to analyze the presence of a possible biological risk for patients attending the radiology department of the hospitals. It also assessed factors affecting disinfection of health professionals working in the department to possibly correlate it with the contamination pattern of the equipment. However, we don't associate results found on factor affecting disinfection of radiological equipment of radiology health professional with the contamination level of radiological equipment because the machines were shared with many of the radiology health professionals at a time or at different time of examinations.

Our result has shown high bacterial contamination of radiological equipment; 151 (84.8%) of 178 swabs has revealed bacterial isolates. This is in line with a study conducted in Nigeria by Eze and his colleagues [4], which found bacterial growth in 182(86%) out of the 200 samples while 18 samples (9%) yielded no growth. Another study conducted by Fox, *et al*. [2], has also shown that 38 out of the 40 (95%) of cassettes swabbed were contaminated with bacteria. To the contrary, our result is far from comparison with studies conducted by others. For instance, Chingarande *et al*. [18], has isolated bacteria in 38 (42%) of 90 of the swab samples. Moreover, in a study by Ochie and Ohagwu [1], bacteria were isolated in 142 swabs representing 47.2% of all the swab samples obtained from X ray machines.

According to Alvarado's *et al.* [19] who reported that there is more than 40% nosocomial infection rate in sub Saharan Africa. This could be attributed to the poor hygienic practices as there is no strict control or monitoring of disinfection practices in the radiology department. In our study area also there is an alarmingly high level of contamination of radiological equipment, which might be attributable to lack of training and knowledge on infection prevention.

In this study the most common bacteria to be isolated were *Coagulase negative staphylococcus* (CoNS); isolated in a frequency of 98(64.9%) of the 151 bacterial isolates followed by *S. aureus* which has constituted 7.9% of the total isolates. Our finding is in line with a study [20] which took a total of 132 cultures from various areas of the diagnostic imaging department using a swabbing

method for data collection. Their results has showed the presence of Coagulase-negative *Staphylococcus, Bacillus* and *Saprophytes* on X-ray cassettes and the most common bacterium to be isolated from equipment was Coagulase-negative *Staphylococcus* [20]. Whereas from the study by Eze *et al*. [4] *S. aureus* was the most occurring bacteria with a frequency of 140 (70%). Fox and Harvey [2] also found *S. aureus* to be the most common bacteria to be isolated from x–ray cassettes.

Coagulase-negative *Staphylococcus* is relatively harmless environmental organisms that are commonly found on the skin but although they do not pose a problem in the majority of patients, they are beginning to be recognized as an important pathogen with their colonization and subsequent infection of biomedical devices [20]. Additionally identified as an agent of clinically significant nosocomial bloodstream infections and also accounts for significant morbidity and mortality in patients with native valve endocarditic [21].

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 [22]. Other bacteria isolated are also associated with various infections in humans, so their effective control is urgently called for.

Antimicrobial resistance (AMR) is the ability of living microbes, including bacteria, virus, fungi and parasites to grow in the presence of a chemical that would normally kill or limit its growth. Resistance to antimicrobial drugs is now widespread in both developing and developed nations and because of AMR many infectious diseases are difficult to treat. AMR is considered a serious threat to society because infections caused by resistant microorganisms often fail to respond to standard treatment and this ultimately results in higher healthcare expenditure, prolonged illness and more importantly greater risk of death [23]. Hospitals are an important breeding ground for the development and spread of antibiotic resistant bacteria. As a result, we have also assessed the drug resistance pattern of bacterial isolates in the radiology department of the hospitals. As shown in the table 4, a significant number of isolates were resistant to one or more of the antibiotics used. Like the other hospital environment, many shared factors might promote the emergence of resistant bacteria in the radiology department.

Surprisingly, we have also found Methicillin-resistant *Staphylococcus aureus* (MRSA) in a significant proportion: 5 out of 12 *S. aureus* bacteria isolate (41.6%). This is far beyond comparable with a study done in Dublin, Ireland by Shelly and his colleagues [24] who found only one isolate out of 125 cultured positive for MRSA. The organism is carried in the skin flora and transferred between individuals or from a contaminated surface to an individual by direct contact [24]. Unless and other wise an effective infection prevention strategy is employed in the radiology department, prevalence of MRSA might increase beyond this rate.

The resistance of *staphylococci* to many antibiotics has been reported rendering them difficult to manage clinically. MRSA is, by definition any strain of *S. aureus,* which has developed resistance to beta-lactam antibiotics, including the penicillins (e.g, methicillin, nafcillin andoxacillin) and the cephalosporins. Infections caused by MRSA are mainly nosocomial and are increasingly reported from many countries worldwide. Although MRSA strains are not necessarily more virulent than methicillin-sensitive *S. aureus* strains, some MRSA strains contain factors or genetic backgrounds that may enhance their virulence or may enable them to cause particular clinical syndromes [25].

The significance of this finding lies in the fact that plastics and metals, which have been identified as potential fomites, abound in radiology departments. This is particularly true of cassettes and x-ray equipment which are all made of metals [26].

Out of 28 ultrasound probe in our study there were 25 bacterial isolates (89.3%) which have some difference with a study conducted on bacterial contamination of ultrasound probes at a tertiary referral university medical center. Seven of 31 (22.6%) probes were positive for bacterial growth. This low contamination rate was due to the use of an effective disinfectant, education of health professionals and implemented changes [14].

Jeung *et al*. [15] reported that the disinfection of MRI test equipment is generally good. Our study also digs out some factors on the disinfection and decontamination of radiological equipment. This corresponds to this research on disinfection, which supports the importance of implementing education about disinfection.

CONCLUSIONS

This research showed high bacterial contamination rate of radiological machines and most of bacteria isolates showed high resistance rate for different antimicrobial drugs. There are also some factors, which affect the disinfection/decontamination of radiological equipment. The fact that almost all radiological machines had one or

more bacteria has showed a warning about the importance of regular disinfection using designated disinfectants to prevent cross contamination. There should be constant monitoring of the bacterial load of the radiological equipment to reduce the risk of bacteria growing on them. Moreover, awareness should be raised among radiology health professionals towards hygienic measures and impact on transmission of infectious agents.

List of Abbreviations:

AST	Antimicrobial sensitivity test
CFU	Colony forming unit
CLSI	Clinical and Laboratory Standard Institute
CoNS	Coagulase negative Staphylococci
CT	Computed tomography
DST	Drug Susceptibility Testing
EPHI	Ethiopia Public Health Institute
HCAI	Health care associated infections
HAI	Hospital acquired infections
ICU	Intensive care unit
MDR	Multi drug Resistance
MID	Medical imaging department
MRI	Magnetic resonance imaging
MRSA	Methicillin Resistant *Staphylococcus aureus*
NI	Nosocomial infections
PACU	Post anesthesia care unit
PPE	Personal protective equipment
TSI	Triple sugar iron
WHO	World Health Organization

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