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Bacterial contamination of radiological equipments and Factors affecting disinfection among radiology health professionals

Adds Ababa, Ethiopia

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This is to certify that the thesis prepared by Bethelhem Getu, entitled: **Bacterial Contamination Of Radiological Equipments And Assessment of Factors Affecting Disinfection Among Radiology Health Professionals in Addis Ababa, Ethiopia** and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Diagnostic and Public Health Microbiology) complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

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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	Multidrug 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

Abstract

Background: 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.

Objective: To assess Bacterial contamination level of radiological equipments and factors affecting disinfection among radiology health professionals at 12 public health hospitals, Addis Ababa Ethiopia.

Methods: A total of 178 swab samples collected from radiological equipments of X-ray, Ultrasound, Computed tomography, and Magnetic resonance Image equipments 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 specimen was 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's staining and biochemical test was performed for gram positive and negative isolates. A standard disc diffusion technique for antimicrobial susceptibility test (AST) test was performed for all the isolates using CLSI (Clinical laboratory standard institute 2017). SPSS version 24 used to analyze the data. Bacterial isolates which are resistant to two or more classes of drugs were considered as multidrug resistant (MDR).

Results: Out of 178 swab samples, we found 151(84.8%) bacterial isolates from all radiological equipments. High bacteria contamination rate were found on X-RAY machines accounts for 75(49.7%) and Gram-positive organisms were the most frequently isolated bacteria. particularly, C*oagulase negativestaphylococci* (CoNS) accounts 98(55.1%). *Pseudomonas aeruginosa* was the most isolated Gram-negative bacteria and accounts 7(3.9%). *Methicilin resistant Staphylocoous aureus (MRSA)* were found 5 of 12 (41.6%) of S. *aureus* isolates.

Conclusion: This research showed high bacterial contamination rate of radiological equipments and isolates shows high resistance rate for different antimicrobial drugs. And there are factors affecting decontamination of radiological equipments. Hence, awareness for these factors should be raised among radiology health professionals.

Key words: Radiological equipments, hospitals, Isolates, decontamination, Multidrug resistance

1. Introduction

1.1. Background

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 [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].

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 CDC 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 [9]. As far as concerns the radiological settings, several articles investigated the risk focusing on mobile X-ray imaging techniques. For instance, Aso et al. found highest levels of contamination on CR consoles and HIS/RIS terminals and suggested this was attributable to wrong procedures in cleaning and disinfection [10]. Levin et al. reported a poor practice of infections control measures among radiography technicians and demonstrated that the radiograph equipment is frequently colonized by highly-resistant bacteria [11].

1.2. 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 equipments could be potential source of HAI. For exapmle on the research conducted by Chu, et al. on the assessment of the Bacterial Contamination of Ultrasound probe, there was 25.9 % bacterial contamination rate [14]. and on other research the presence of nosocominal bacteria on x- ray equipment and accessories turned out positive, with bacteria such as *Staphylococcus aureus, Klabsiella spp, Coliform and Escherichia coli*, being the most commonly predominant [1,2,].

Other research conducted by Jeung et al, 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, Pantoea agglomeranss, Micrococcus, Bacillus, Saprophyticus, Brevundimona, and Myroides species* [15]. In this study area infection control is by the conventional disinfection methods of spraying and wiping which do not fully protect the patients, healthcare professionals or communities against major pathogens. These control measures exist more in surgical wards and operating theatres than any other part of the hospital including the MID. Because of this patients that come for investigations in the department are more prone to being infected by pathogens [4].

In Ethiopia, there is limited comprehensive research that presents the whole picture regarding HAIs in hospitals. The radiology department is one of the mainstays of modern medicine. It is therefore necessary to assess its role in the spread of nosocomial infections. On radiological diagnostic imaging department of Ethiopia there is no even single study on bacterial contamination of radiological equipments infection.

1.3. Significance of the study

The output of this study provides information on the bacterial contamination of radiological equipments 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 accounted for this bacterial contamination of radiological equipments for the radiology imaging departments. Results found in the study on the identification of bacterial drug resistance patterns provides information how serious this problem is and to direct the exact measurements for the problems.

2. Literature review

Cross sectional study conducted by Fox et al, on investigation of infection control for x-ray Cassettes in a diagnostic imaging department of a large hospital in the east of England, demonstrated that there were large levels of growth of samples taken from x-ray cassettes and developed in the Microbiology Department. *Coagulase-negative Staphylococcus, Micrococci, Diptheroids and species of Bacillus* were all identified [2].

Proper decontamination of this equipment is critical to prevent the transmission of infections between patients. Reusable devices are classified as critical, semi critical, or noncritical based on the Spaulding classification used by the Centers for Disease Control (CDC) and the U.S. Food and Drug Administration, Accordingly many devices and environmental surfaces encountered in diagnostic radiology are considered noncritical, such as the gantry, table, and other surfaces associated with CT and MRI scanners [16,17]. It is recommended that decontamination of noncritical items be performed after every use and include either washing with soap and water or disinfecting with an intermediate or low-level product [16]. The CDC has issued recommendations regarding the use of sterility and disinfectants, and guidance regarding the decontamination of specific equipment is often available from commercial manufacturers (17, 18).

A study was conducted in Italy on contamination of Portable Radiograph Equipment with Resistant Bacteria in the ICU Surveillance of 173, 113, and 120 chest radiographs during observation, intervention, and follow-up periods, respectively, was performed. Adequate infection control was practiced during the performance of 2 of 173 observation period radiographs (1%), 48 of 113 intervention period radiographs (42%; $p < 0.001$), and 12 of 120 follow-up period radiographs (10%; ($p< 0.001$) [follow-up vs intervention and observation periods]. Radiograph machine surface culture samples yielded resistant Gram negative bacteria on 12 of 30 occasions (39%), 0 of 29 occasions, and 7 of 14 occasions (50%), respectively, for the observation, intervention, and follow-up periods ($p< 0.001$) [11].

A study conducted in Canada (2013), on Bacterial Contamination of Ultrasound Probes at a Tertiary Referral University Medical Center ,assessed the prevalence of bacterial contamination(and thus the potential for bacterial transmission) by swabbing all ultrasound

probes (n = 31) in the radiology department and culturing the sample showed, seven of 31 (22.6%) probes were positive for bacterial growth [14].

A study in Ireland conducted to explore the potential risk to patients and healthcare workers of acquiring *Meticillin Resistant Staphylococcus aureus* (MRSA) in clinical and non-clinical areas within a radiology department revealed that one of 125 samples was culture positive for MRSA [19].

In another related study conducted by Lestar et al Germany2013, a total of 408 cleaned ECG lead wires from 93 bed-side ECG devices and 43 ECG lead wires from 5 portable ECG devices from 4 in-University Medicine, Greifswald, Germany intensive care units (ICUs) and 1 post-anaesthesia care unit (PACU) were sampled. More than half of examined ECG lead wires (n=232; 51.4%) were contaminated with >30 CFUs/mL sample of bacteria or with risk pathogens. Gram-positive bacteria were the most frequently isolated organisms; particularly, *Coagulase negative staphylococci* (96%) and aerobic spore forming bacteria (71.2%) [20].

A study on the measurement of bacterial contamination of MRI Examination equipment and disinfection conditions was conducted by Jeung SW et al., 2013 in Hanseo University Korea. The survey targeted 150 employees, and the distribution of bacteria was measured in ten medical facilities. The result showed various bacteria, including *Staphylococcus, Acinetobacter, Sphingomona, Pantoea agglomeranss, Micrococcus, Bacillus, Saprophyticus, Brevundimona, and Myroidesspecies*. the status of MRI room disinfection showed that the disinfections of the head coil, block, and bore were implemented well, and the largest proportion was carried out once a day in the morning. They were implemented well when the manager was the MRI room examiner [15].

Important study was conducted by Giacometti M et al., in 2013, which aims to examine the level of microbiological contamination in the main RDs of nine hospitals in Turin, Italy. The study consisted of two contemporary phases: microbiological monitoring of radiological surfaces and questionnaire about prevention of biological risks in the same structures. The X-ray tube was found to be contaminated in 41.7% of samples, with a minimum value of 0 CFU and a maximum value of 120 CFU. The greatest number of samples above the threshold of 20CFU was found in the Petri dishes applied to the control panels (91.7%; range, 6–1000 CFU) and to the imaging

plates (91.7%; range, 7.5 CFU–250 CFU). Most frequently used PPE in the various RDs were the gloves with an average score of 3.3 points on a range of 1 to 5. [21]

Study conducted in Zimbabwean hospital by Chingarande GR et al., 2014, collected swab samples from selected X-ray equipment and accessories. Bacteria were isolated in 38 swabs representing 42% of all the swab samples. S*taphylococcus aureus, Lactose fermenting Coliforms, Staphylococcus saprophyticus, Pseudomonas aeruginosa and Coagulase-Negative staphylococcus* were the bacteria isolated from the swab samples. Lactose fermenting *Coliforms* were isolated the most, namely 17 times (45%); *Pseudomonas aeruginosa* were only isolated once. X-ray cassettes recorded the highest number of times that bacteria were isolated (55%) with *Coliform* being isolated most often (52%) [22].

Important related article assessed the amount of cross infection present in the dental x-ray devices of the School of Dentistry of the Federal University of Maranhão by investigating the presence of pathogenic microorganisms in high-touch areas of dental x-ray devices (tube head, timer button, portable processing box and lead apron). Twenty surfaces of 4 dental radiology clinics were cultured in different media. 70 percent of the surfaces had contamination. All the dental x-ray devices assessed were contaminated (tube head, timers or both) as well as all the lead aprons. The portable processing boxes showed 75 percent of contamination. The highest frequent microorganisms found were from Staphylococcus genus [23].

Convectional study conducted in Enugu metropolis, Nigeria 2009 by Ochie and Ohagwu identify the nosocomial bacteria commonly found on x-ray equipment and accessories in this locality and assess the effectiveness of some common chemical disinfectants. Bacteria were isolated in 142 swabs representing 47.2% of all the swab samples. *Staphylococcus aureus, Klebsiella spp, Coliform and Coagulase-negative staphylococcus* epidermidis were the bacteria isolated from the swab samples. *Klebsiella spp* were isolated most often (49 times; 34.5%) and and *Coagulase-negative staphylococcus* epidermidis were isolated the least number of times (18 times; 12.7%). The x-ray cassettes recorded the highest number of times bacteria were isolated (54 times; 38%) with *Coliform* being isolated most often (45 times; 31.7%) [1].

Non – experimental prospective study conducted in the medical imaging department of health care delivery institutions within Anambra State Nigeria done by Eze JC et al, The swabs were collected from 200 hospitals, Bacteria were isolated in 182 samples (86%), Bacteria isolated

were; *Staphylococcus aureus (140), Pseudomonas aeruginosa (88), Proteus spp (28), Streptococcus (52), and Coliform spp (80) Staphylococcus aureus* was the bacterium isolated most often (140 times), while *Proteus spp.* was isolated the least number of times (28 times). But the largest number of sample was recorded on cassettes (60times).

3. Objective

3.1. General Objective

The general objective of the study is Bacterial contamination level of radiological equipments and assessment of factors affecting disinfection among radiology health professionals.

3.2. Specific Objectives

1. To determine the rate of bacterial contamination of radiological equipments.
2. To determine the antimicrobial susceptibility pattern of bacterial isolates.
3. To assess some factors affecting disinfection.

4. Materials and Methods

4.1. Study design and period

A hospital based cross sectional study was conducted from Feb 2018 to April 2018 at 12 public hospitals.

4.2. Study area

The study was conducted in Addis Ababa which is the capital city of Ethiopia. The city has 51 hospitals. Only ten are 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 has focused on 12 public hospital in Addis Ababa, namely:- St Paul's hospital millennium medical college, Tikuir Anbesa special, Armed Force General, Ras Desta Dametew, Menelik II, Yekatit12, Zewditu memorial, Ghandi memorial, St Peter TB specialized, Tirunesh Beging, ALERT and Police hospitals. These hospitals selected for the study because they are the largest hospitals in the country in terms of patient flow and workload.

Zewditu; - The hospital provides diagnostic radiological services and has one x-ray and ultrasound machine.

Menelik II; - Provides CT scan, X-ray examination and ultrasound service but the CT machine was non functional during the study period.

Ghandi memorial: - It provides gynecology and obstetrics ultrasound examination and x-ray study for mothers and their babies. X-ray machine was non functional during the study period.

Ras Desta Damtew memorial hospital: - gives diagnostic radiological services, these are x-ray and US scan for outpatients and inpatients.

Yekatit 12 hospital medical college: - provides medical services for patients from different departments of the hospital include radiology service like x-ray, CT scan examination and ultrasound diagnosis.

St.Paul hospital millennium medical college: - provides service includes x-ray, ultrasound, CT scan and MRI examination with full equipped radiology room.

Tikur Anbesa Specialized Hospital is one of teaching hospitals. The hospital has different departments with different medical service like radiology facilities, which gives x-ray, ultrasound, CT scan and MRI examination with well-organized radiology room. Among the four X-ray machines only one was functional during the study period.

ALERT hospital: - provides diagnostic and imaging service for patients using CT scan, US and X-ray examination. CT machine was non functional during the study period.

Tirunesh Beging hospital: - has radiology department and gives diagnostic services for patients using X-ray and US machines

Police Hospital: - gives x-ray examination and US diagnosis for their patients in the radiology department of the hospital.

Armed Force General Hospital is military hospitals in the country. It provides clinical diagnostic radiology service for clients by different radiological equipments. These are CT scan, x-ray, ultrasound and MRI equipments with well-organized and disciplined radiology department. CT scan machine was not functional during the study period.

5.3. Population

5.3.1. Source Population

- All radiological equipments found in the 12 governmental and military hospitals Addis Ababa Ethiopia.
- All radiology health professionals found in the 12 governmental and military hospitals.

5.3.2. Study Population

- All functional radiological equipments found in 12 governmental and military hospitals Addis Ababa Ethiopia were included during the study period.
- All radiology health professionals found in 12 governmental and military hospitals which give full information were included.

5.4. Inclusion and Exclusion Criteria

5.4.1. Inclusion Criteria

- All functional radiological equipments during the study period.
- All radiology health professionals who were available and willing to participate during the study period.

5.4.2. Exclusion Criteria

- Personnel with less than 6 months of work experience.
- Radiological equipments available during the study period.

5.5. Study Variables

5.5.1. Dependent variables

- Bacteria burden
- Antimicrobial susceptibility patterns

5.5.2. Independent variables

- Sex
- Age
- work experience

- IP training
- Time scale of decontamination
- Standard guideline
- Disinfectant agents
- Use of glove

5.6. Sample size and sampling techniques

5.6.1 Sample size

All radiological equipments from 12 hospitals were included and there are 50 radiological diagnostic equipments. This includes 14 x-ray equipments, 28 ultrasound equipments, 5 CT and 3 MRI equipments. 137 radiology health professionals included for structured questionnaires'.

5.6.2 Sampling Techniques

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

5.7. Data collection and laboratory processes

5.7.1. Data Collection

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

5.7.2. Sample Collection

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 equipments. Informed consent was also obtained from the participating health workers prior to the self-administered questionnaire.

The sample was then collected from medical radiological equipments by the laboratory technologist. The specimen was collected from the selected parts of radiological equipments 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 equipments surfaces was done following standard protocols. We have 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

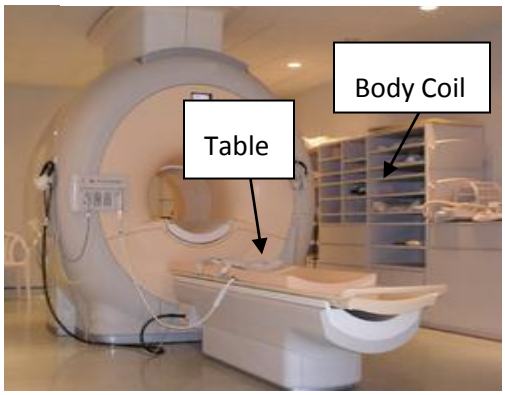
Specimens were collected from some part of the following radiological equipments:-

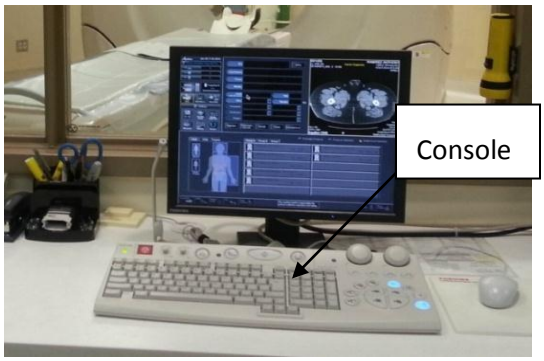
- X-ray machine:- x-ray tube, x-ray table/couch, stand Bucky , control panel and cassettes
- Computed Tomography:- CT table/couch and control panel or consol
- Magnetic Resonance Image:- sample was collected from body coils, patient table and MRI Consol.
- Ultrasound machine:- Ultrasound probe and ultrasound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

RADIOLOGICAL EQUIPPMENTS

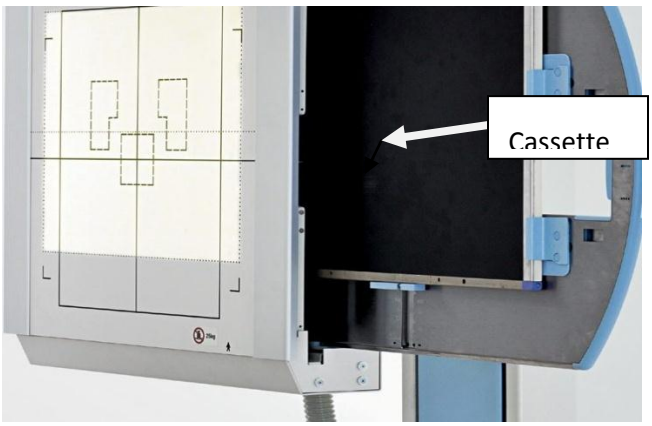
US equipment

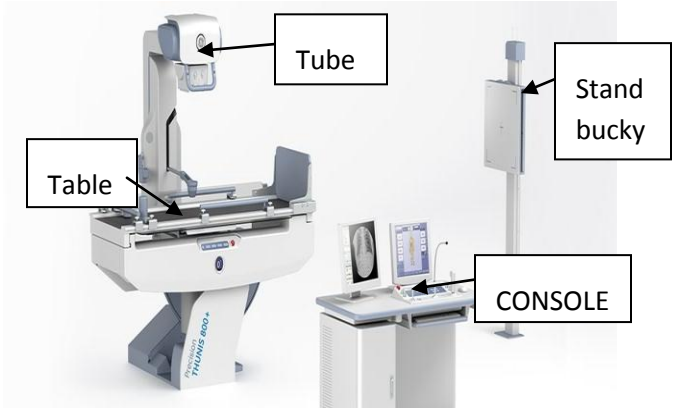
CT equipment





MRI equipment





X- RAY Equipment

Fig 1:- Radiological equipments and their parts

5.7.3. Laboratory Process

5.7.3.1. Inoculation and Isolation of Bacteria

The collected specimen was inoculated on (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 [25]. All the identified bacteria isolates were stored at standard temperature of -40ċ to -180ċ (deep freeze) for further investigation and analysis as needed.

5.7.3.2. 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 (CLSI 2017) [24] 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 place in to it after few minutes. The plates were incubated for 18-24hrs at 37^{o}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) [25].

5.8. Quality Assurance

In order to assure the quality of the data and increase the reliability of the study, a number of quality assurance measures were taken. Before we proceeded to sample collection the functionality of all the equipments 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. The self-administered questionnaire used to collect factors affecting disinfection of radiological equipments was assessed for completeness and incomplete questionnaires were discarded. We have also used control strains before we performed culture and sensitivity tests in the whole process of this study. The organisms we used are

Staphylococcus aureus(ATCC 25923), *Escherichia coli*(ATCC 25922) and *Pseudomonas aeruginosa* (ATCC 27853)

5.9. Data Analyses

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

5.10. 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 will be communicated to the hospital management body for corrective measures still keeping anonymity.

5.11. Dissemination of Result

The finding of this study disseminated to Addis Ababa University College of health sciences department of medical laboratory sciences, the 12 governmental and military health hospitals, and it will submit to peer reviewed journal for publication.

6. Result

6.1. Bacterial Contamination Level of Radiological Equipments

A total of 178 swabs were collected from the four radiological equipments and from the parts and there are 151 bacterial isolates were found on these equipments. High bacteria contamination rate was 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 Contamination Level of Radiological Equipments found 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%)

6.2 Bacterial Isolates from radiological equipments

From a total of 151 bacteria isolates, Gram-positive bacteria were the most frequently isolated bacteria. Particularly, C*oagulase negative staphylococci* (CoNS) which has found in 98(64.9%), followed by *S.aureus* isolated in 12(6.7%) and *Bacillus spp* isolated in 11(6.2) % respectively. *Pseudmonas aeruginosa* accounted for the most common isolated Gram-negative rods, which identified in 7(3.9%) of all the four radiological equipments, and it is classified as high risk pathogen in this study. And then followed by *E.coli 5(2.8%).Acinetobacter spp 5(2.8%), Klebsiella spp 5(2.8%) and Enterobacter spp 4(2.2%) respectively.*

Table 2 Bacterial Isolates from Radiological Equipments found 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 %)
Klebsiellaspp	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,*

6.3 Bacterial profile at different parts of Radiological Equipments

High Bacteria contamination rate were observed from different parts of all the four radiological equipments and from the parts, MRI body coil, CT table, US consol and X-Ray table which have high patient contact had the most bacteria isolates.

Table 3 Bacterial profile at different parts of Radiological Equipments found at 12 public hospitals from Feb to April 2018.

Machine type	**Isolates frequency (%)**								
	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(28.7%)	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(28.7%)	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 consol, **C TABLE**:- rCT table, **C CONSOL**:-CT consol, **U PROBE**:- US probe, **U CONSOL**:-US consol, **X TABLE**:- X-RAY table, **X CONSOL**:-X-RAY consol, **X STAND BUCKY**:- X-RAY stand bucky, **X CASSETT** :-X-RAY cassette, **X-TUBE**:- X-RAY tube

6.4 Resistance pattern of the bacterial Isolates from radiological equipments

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). Most gram positive bacterial isolates were found resistance for the antimicrobial susceptible test discs of Cefoxtin, Cotrimozazole and Erythromycin. However, most gram positive isolates were sensitive for antimicrobial susceptible test discs of Amikacin, Chloramphnicol and Clindamycin. Additionally, for the gram negative isolates, most of *P.aeruginosa* found high resistant for Amikacin. Whereas, E.coil, *Acinetobacter spp, Enterobacter spp and Kelbisella spp* have shown high resistance for the drug Ampicilin. And also Multi-drug resistant bacteria were found in 15(57.7%) of gram negative bacteria and 92 (80.7%) of gram positive bacteria isolates.

Table 4. Antibiotics Resistance patterns of bacterial isolates from radiological equipments found at 12 public hospitals from Feb to April 2018.

Antibiotic used	Resistance patterns of isolates							
	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%)***	***Klebselaspp 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.

6.5 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.

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%)
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

6.6 Factors affecting disinfection among radiology health professionals

There were twelve questions found in self structured questioners and nine of the questions identify some of the factors which affect the disinfection and decontamination of radiological equipments and summarized as table shown at below.

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

Variables	**YES/NO**	**Frequency(%)**
IP training	Yes	51(37.2%)
	No	86(62.8%)
Do you think Importance of glove during examination	Yes	106(77.4%)
	No	22(16.1%)
	I don't know	9(6.5%)
Do you think Disinfection/ decontamination agents importance	Yes	95(69.6%)
	No	42(30.5%)
Importance of time schedule for decontamination	Yes	95(69.3%)
	No	27(19.7%)
	I don't know	15(11.0%)
Do you think Cleaning radiological equipments 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 use of your radiological equipments	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

7.0 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 equipments 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 equipments. However, we don't associate results found on factor affecting disinfection of radiological equipments of radiology health professional with the contamination level of radiological equipment, because of 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 equipments; 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 which found bacterial growth in 182 (86%) out of the 200 samples while 28 samples (14%) yielded no growth [4]. Another study conducted by Fox, et al., has also shown that 38 out of the 40 (95%) of cassettes swabbed were contaminated with bacteria [2]. To the contrary, our result is far from comparison with studies conducted by others. For instance, Chingarande, et al., has isolated bacteria in 38 (42%) of 90 of the swab samples [22]. Moreover, in a study by Ochie and his colleagues, bacteria were isolated in 142 swabs representing 47.2% of all the swab samples obtained from X ray machines [1].

According to Alvarado's report 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 [26]. In our study area also there is an alarmingly high level of contamination of radiological equipments 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 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 *Coagulas negative Staphylococcus* [27]. Whereas from the study by Eze et al., *Staphylococcus aureus* was the most occurring bacteria, with a frequency of 140 (70%) [4]. Fox and Harvey have also found *Staphylococcus aureus* to be the most common bacteria to be isolated from x–ray cassettes [2].

*Coagulase negative staphylococcus*are 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 [27]. 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 [28].

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 [29]. 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 [30]. 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 1.6, 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 *Meticillin-resistant Staphylococcus aureus* (MRSA) in a significantproportion: 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 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[19]. 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., meticillin, 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 [31].

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 [32].

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 were due to the use of an effective disinfectant, education of health professionals, and implemented changes [14].

Jeung et al., (2008) reported that the disinfection of MRI test equipment is generally good. And awareness of nosocomial infection control by radiologists was lower than that by nurses, clinical pathologists, and radiologists in the department of nuclear medicine, and that their rate of disinfection practice as well was lower than that of nurses, clinical pathologists and radiologists in the department of nuclear medicine [15]. Our study also digs out some factors on the

disinfection and decontamination of radiological equipments. This corresponds to this research on disinfection, which supports the importance of implementing education about disinfection.

8. Strength and limitation of the study

8.1. Strength

- Most studies mainly focused on only one of the parts of radiological equipments or one of the machine were studied however, in this study four of major radiological equipments were assessed.
- To the best of our knowledge, this study is the first attempt to assess the bacterial contamination of radiological equipments and to evaluate factors affecting disinfection among radiology health professionals in Ethiopia.

8.2. Limitation

- The study didn't associate the contamination rate of bacterial isolate with factors affecting the disinfection condition. Because the examination machines were used by many of the radiology health professionals found at that departments.
- The study was not much supported by different study finding because of lack of literatures related with these research objectives.

9. Conclusion and recommendation

9.1. Conclusion

This research showed high bacterial contamination rate of radiological equipments and most of bacteria isolates shows high resistance rate for different antimicrobial drugs. There are also some factors which affect the disinfection/decontamination of radiological equipments.

9.2 Recommendation

The fact that almost all radiological equipments has one or more bacteria and this show 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.

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11. Annexes

Annex I. Permission from the Institute

Dear sir/madam

My name is Bethelhem Getu and I am Diagnostic and Public Health Microbiology student at AAU, college of health science department of medical laboratory science, the research I wish to conduct for my master's thesis involves bacterial contamination of radiological equipments and factors towards disinfection. This research will be conducted under the supervision of my advisors Mr Kassu Desta amd Ms Meron Yohannes(AAU, College of health science, medical laboratory).

I am here by seeking your consent in order to collect samples from the selected parts of your radiological equipments using sterile swab moistened in normal saline.

I have provided you with a copy of my research proposal which includes copies of the measure and consent form to be used in the research process, as well as a copy of approval letter which received from the department of ethical and research committee (DERC).

Upon completion of the study, I undertake to provide for the department of education with a bound copy of the full research report, if you require any further information, please do not hesitate to contact me. Thank you for your time and consideration in this matter.

The address of the principal investigator and advisor is:

1. AAU (SMLT) Tel: +251-112-75-51-70
2. Principal Investigator: Bethelhem Getu: Tel: +251913756296/ +251911988827

Annex II. General Information sheet for the Study Participants in English

Principal Investigator: Bethelhem Getu

Name of Organization: AAU, College of Health Sciences, School of Allied Health Sciences,

Department of Medical Laboratory Sciences

Name of the sponsor/s: AAU School of Graduate studies

Information sheet: on bacterial contamination of medical radiological equipments

Title: Bacterial contamination level of radiological equipments and factors affecting disinfection among radiology health professionals.

Aim: Conducting of this study will provide information on Bacterial contamination level of radiological equipments and factors affecting disinfection among radiology health professionals. the study will identify the gap for this bacterial contamination of radiological equipments, for the radiology imaging departments. Results found in the study on the identification of bacterial drug resistance patterns also provide information how serious the problem is and to direct the exact measurements for the problems, and the research will show the problems of HAI in the country particularly in radiology departments.

Study Participants

In this study all radiological diagnostic equipments will include for the assessment of bacterial contamination, and all medical imaging departments personnel who fulfilled the inclusion criteria will participate for the analysis of factors affecting disinfection among radiology health professionals.

Samples Required

If you agree to participate in the study you the department personnel expect to fill the self administered structured questionnaires.

Duration: The duration of this study depend upon the availability of study subjects. It might take about three months or more.

Risk: The risk associated with the sample collection is free of any risk and associated factors you do not have to answer any question or take part in the questioner if you don't wish to do so.

Benefits: The benefit of this study is to create awareness on bacterial contamination of medical equipments like X-Ray, CT, MRI, Ultrasound this result will give hint to the health worker to keep their medical equipments clean.

Compensation: There is no any payment or direct benefit for participating

Confidentiality: All your personal information collected for the purpose of this study will be kept confidential.

Right: Participation in the study is voluntary, and refusal to participate involves no penalty or loss of benefits to which you are otherwise entitled. The study participants have a right to withhold information, decline to cooperate in the study and refuse provision of specimens.

Approval: This research thesis got ethical clearance from Addis Ababa University Department of medical laboratory sciences.

If you have any question regarding to this study, the address of the principal investigator and advisor is:

3. AAU (SMLT) Tel: +251-112-75-51-70
4. Principal Investigator: Bethelhem Getu: Tel: +251913756296/ +251911988827

Annex III: General Information for the Study Participants In Amharic

የተመራማሪዉ ስም፡ ቤተልሄም ጌቱ፡፡

የድርጅቱ ስም፡ አአዩ ፣ የጤና ሳይንስ ኮሌጅ፣ ህክምና ላቦራቶሪ ሳይንስ ክፍል

የጥናቱ በጀት የሚሸፈነው፡ አዲስ አበባ ዩኒቨርስቲ

ርዕስ፡- በራዲዮሎጂ የህክምና መገልገያ መሳሪያዎች ላይ የሚገኙ ተዋህሲያን ምን ያህል እንደሆኑና ባለሙያዎቹ በመገልገያ መሳሪያዎች ላይ ያላቸውን የተዋህስያን ስርጭት እውቀትና ግንዛቤ እንዲሁም ለንፀህና አጠባበቅ ያላቸው ትግባራ ምን ያህል እንደሆነ ለማወቅ ነው፡፡

የጥናቱ ዋና አላማ፡-ይህንን ጥናት ማድረግ ምን ያህል የተባክቴሪያ ስርጭት መኖሩንና ባለሙያዎቹ ለእነዚህ ባክቴሪያ ያላቸው ግንዛቤ ለማወቅ ከፍተቱም ምን ያህል መሆኑን ለማሳየት ይረዳል፡፡

የጥናቱ ተሳታፊዎች፡ በራዲዮሎጂ ክፍል የሚጠቀሙትን የህክምና መገልገያ በመወሰድ ምን ያህል የባክቴሪያ ስርጭት መኖሩን ማወቅ እንዲሁም በራዲዮሎጂ ክፍል የሚገኙ ባለሙያዎቸች ስለባክቴሪያው ስርጭት ያላቸው እውቀትና አመልካከት እንዲሁም የተጽዳት ትግበራ ምን ያህል እንደሆነ ለማወቅ ይረዳሉ፡፡

የሚፈለገው ናሙና፡-በዚህ ጥናት ላይ ለመሳተፍ ከተስማሙ ከራዲዮሎጂ የህክምና መገልገያ ላይ የሚወሰድ ናሙና ያስፈልጋል እንዲሁም ለጥናቱ የሚረረዳ መጠይቅ ላይ የራዲዮሎጂ ክፍል ባለሙያዎች እንደሞሉ ያሰፈልጋል

የጥናቱ ጊዜ፡-የጥናቱ ጊዜ በሚገኙ የናሙና መጠን የሚወሰን ሲሆን 3 ወር እና ከዛም በላይ ለወስድ ይችላል፡፡

ሊከሰቱ ስለሚችሉ ስጋቶችና የምችት መጓደሎች፡- ከሕክምና መገልገያ መሳሪያዎች ላይ ናሙና መውሰድ ምንም አይነት ችግር አያሰከትልም እንዲሁም መጠይቁ ላይ የሰፍሩ ጥያቄዋች ምችት ካልሠጥዎት መመለስ አይጠበቅቦትም፡፡

ጥቅሞች፡- በጥናቱ በመሳተፎ ምንም አይነት ክፍያ አያገኙም ነገር ግን በዚህ ጥናት በሚገኘው መረጃ መሰረት አሰፈላጊ ጥያቃቂዎችን እንዲወሰዱ ይረዳዎታል፡፡

ሚስጥራዊነት፡- ለጥናቱ ተብለው የተሰባሰቡ መረጃዎች ሚስጢርነቱ የተጠበቀ ነው፡፡

የተሳታፊዉ መብት፡- ፈቃደኛ ካልሆኑ በዚህ ጥናት ላይ ያለመሳተፍ መብትዎ የተጠበቀ ነዉ፡፡

የጥናቱ ፈቃድ/ህጋዊነት፡- የዚህ ጥናት ህጋዊነት በ አዲስ አበባ ዩኒቨርስቲ (ህክምና ላቦራቶሪ ሳይንስ ዲፓርትመንት) ስነ ምግባር ቅኝት ኮሚቴ ያገኛል፡፡

መረጃ ስለማግኘት፡- ይህን ጥናት አስመልክቶ ምንም አይነት ጥያቄ ወይም ማብራሪያ ቢያስፈልግዎት፡

1. አዲስ አበባ ዩኒቨርሲቲ(ህክምና ላቦራቶሪ ሳይንስ ዲፓርትመንት)፡ስ.ቁ.፡- +251-112-75-51-70
2. የጥናቱ ተመራማሪ፡ ቤተልሄም ጌቱ፡፡ ስ.ቁ፡0913756296/0911988827

Annex IV: English version of Study Participant informed Consent Form

Name of the participant: _____Age _____Sex___

Code_ _____Study site_____

I confirm that I have been given adequate information about the research thesis on; Bacterial contamination level of radiological equipments and assessment of factors affecting disinfection among radiology health professionals, Addis Ababa, Ethiopia**.** The researchers informed that there is no major risk associated with participating in the study or providing the requested samples. I have also understood that the results of clinical and laboratory diagnosis will be used for research purposes. I am well informed that participation in the study is fully voluntary and I can withdraw anytime without giving any reason. I confirm that all the information provided to me is very clear and has been conveyed by the language that I fully understand. Finally, I declare that I have been given enough time to deliberate before I agree to participate in the study, and I signed this informed consent.

Name of participant.....Signature.....Date……

Name of the physician obtaining consent..... signature: …… date

Name of witness …….Signature……Date…….

Annex V: Amharic version of Study Participant informed Consent Form

የተሳታፊው ስም _____እድሜ _____ጾታ ___

የተሳታፊ ቁጥር _____

ጤና ተቅዋሙ ስም_____

በራዲዮሎጂ የህክምና መገልገያ መሳሪያዎች ላይ የሚገኙ ተዋህሲያን ምን ያህል እንደሆኑና ባለሙያዎቹ በመገልገያ መሳሪያዎች ላይ ያላቸውን የተዋህስያን ስርጭት እውቀትና ግንዛቤ እንዲሁም ለንፀህና አጠባበቅ ያላቸው ትግባራ ምን ያህል እንደሆነ ለማወቅ በሚል የተዘጋጀ ጥናት ላይ እድሳተፍ ተጠይቄ ስለ ጥናቱም ለመረዳት በቂ መረጃ ማግኘቴን አረጋግጣለው፡፡ የህክምና መረጃዎች እና የላቦራቶሪ ውጤት ለጥናት እንደሚውል ሚስጢራዊነቱ እንደሚጠበቅ ተገንዝቤአለው፡፡በጥናት ላይ መሳተፍ በፍቃደኝነት ላይ የተመሰረተ ሲሆን በፈለኩ ጊዜ ምክንያቴን ሳላሳውቅ ማቐረጥ እንደምችል ተረድቻለሁ፡፡ የተነገሩኝ ሁሉም መረጃዎች ግልጽ ናቸው እንዲውም በሚገባኝ ቅዋንቅዋ ተብራርተውልኛል፡፡ በመጨረሻም በጥናት ላይ መሳተፍ ከመስማማቴ በፊት እንዳስብበት በቂ ጊዜ የተሰጠኝ ሲሆን የስምምነት ቅጹ ላይ ፍቃደኝነቴን በፊርማዬ አረጋግጫለሁ፡፡

የተሳታፊ ስም_____ ፊርማ _____ቀን_____

የጥናቱ አስከያጅ ስም_____ ፊርማ _____ቀን_____

ምስክር (ማንበብና መፃፍ ለማይችሉ) _____ቀን_____

Annex VI: Questionnaire in English

Addis Ababa University Faculty of Medicine College of health sciences department of medical laboratory sciences clinical laboratory masters program in diagnostic and public health microbiology specialty track.

This questionnaire is prepared to collect the demographic data of Health care workers how do they disinfect, frequency of maintenance of medical radiological equipment and practice of disinfection.

Date_____/_____/_____

Candidate number/code _____

Currently assigned /department_____

Occupation _____

1. Age _____

2. Sex_____

3. Length of practice/experience in the hospital (number of years/months? _____

4. Have you ever train on infection prevention?

A. YES B. NO C. DON'T KNOW

5. Do you think use of glove during examining of patients is important on use of radiological equipments?

A. YES B. NO C. DON'T KNOW

6. Do you think have time scale to decontaminate your radiological equipments is important?

A. YES B. NO C. DON'T KNOW

7. Do you think disinfection agents important to decontaminate your radiological equipments?

A. YES B. NO C. DON'T KNOW

8. I think of Cleaning radiological equipments with belch can reduce 'bacterial contamination

A. YES B. NO C. DON'T KNOW

9. Do you feel safe when use of your radiological equipments?

A. YES B. NO C. DON'T KNOW

10. Do you use glove in contact with the patients important?

A. YES B. NO C. DON'T KNOW

11. Do use standard guidelines to disinfect (decontaminate) radiological equipments?

A. YES B. NO C. DON'T KNOW

12. do you decontaminate your radiological equipments before examination of patients?

A. YES B. NO C. DON'T KNOW

Annex VII: Questionnaire in Amharic

አአዩ ፣ የጤና ሳይንስ ኮሌጅ፣ ህክምና ላቦራቶሪ ሳይንስ ክፍል ማስተርስ ፕሮግራም የሕብረተሰብ ጤና ማይክሮላይሎጂ ክፍል

ይህ መጠይቅ የተዘጋጀው ሰለ ባለሙያው ያለው አጠቃላይ መረጃ ለማግኘነትና ጤና ባለሙያዎች በህክምና መገልገያ መሳሪያ ላይ ስራሚገኙ ተዋሲያን ያላቸውን እውቀት ግንዛቤ እንዲሁም ለንፅህና አጠ ባበቅ የሚኖራቸውን ትግበራ ለማሳየት ነው::

<u>አጠቃላይ መረጃ</u>

ቀን --------/-------/--------

የተጠያቂው ኮድ ----------

አሁን የሚገኝበት ቦታ----------

ሙያ ----------

1. እድሜ ----------
2. ፆታ ----------
3. በዚህ ሆስፒታል የልዎት የስራ ልምድ ----------
4. ኢንፎክሽንን ሰለመግታት የሚሰጥ ስልጠና ወስደው ያውቃሉ?

   A/ አዎ B/ አይደለም C/ አላውቅም

5. ታካሚዎችን በራዲዮሎጂ ክፍል በሚገኝ መሳሪያዎች ላይ ስንመርምር ጎንት መጠቀም አለብን ብለው ያሰባሉ?

   A/ አዎ B/ አይደለም C/ አላውቅም

6. የህክምና መገልገያ መሳሪያዎችን ለማፀዳት የሠዓት ገደብ ያሰፈልጋል ይላሉ?

   A/ አዎ B/ አይደለም

7. የህክምና መገልገያ መሳሪያዎችን ለማፅዳት የሆነ ወቅት ይጠብቃሉ?

   A/ አዎ B/ አይደለም C/ አላውቅም

8. የታካሚዎችን አካላት ከነሱ በኃላ እጅዎትን ይታጠባሉ ?

   A/ አዎ B/ አይደለም C/ አላውቅም

9. የህክምና መገልገያዎችን በበረኪና ማጽዳት የተዋሲያንን ስርጭት ለመቀነስ ይረዳል ::

   A/ አዎ B/ አይደለም C/ አላውቅም

10. የህክምና መሳሪያዎችን ለማፅዳት ምን አይነት የንፅህና መገልገያ ይጠቀማሉ?

    A/ አዎ B/ አይደለም C/ አላውቅም

11. የራዲዮሎጂ የህክምና መሳሪያዎችን በምጠቀምበት ጊዜ ደህንነት ይሰማኛል::

A/ አዎ B/ አይደለም C/ አላውቅም

12. የራዲዮሎጂ ክፍል ባለሙያዎች የህክምና መገልገያዎችን ለማፀዳት የሚረዱ መሳሪያዎችና የማፅጃ ኬሚካል ይጠቀማሉ

A/ አዎ B/ አይደለም C/ አላውቅም

Annex VIII: Standard Operative Procedures

Specimen collection

Specimen will be collected from the selected part of medical equipments using moisten sterile cotton swab, with (0.9% w/v) physiological saline. The swab will put quickly into its container and sealed with unique code number. and 1ml of normal saline will be used to transport the collected sample to microbiology department.

Culture media preparation

1. Weighing and dissolving of culture media
2. Sterilization and sterility testing
3. Addition of heat sensitive ingredients
4. PH testing of culture media
5. Dispensing of the culture media
6. Quality assurance of culture media
7. Storage of culture media

Prepare media made from dehydrated products in as damp-free an environment as possible. To prevent the risk of inhaling fine particles of dehydrated media, wear a dust mask while handling dehydrated media. Powder or use granulated media

- Wash the hands immediately after preparing a media.
- Once the ingredients are weighed, do not delay in making up the medium. Follow exactly the manufacturer's instructions.
- Use completely clean glassware, plastic or stainless steel equipment that has been rinsed in pure water. The container in which the medium is prepared should have a capacity of at least twice the volume of the medium being prepared.
- Use distilled water from a glass still.
- When heating is required to dissolve the medium, stir while heating and control the heat to prevent boiling and foaming which can be dangerous and damage the medium, Overheating a medium can alter its nutritional and gelling properties, and also its PH.

- Autoclave a medium only when the ingredients are completely dissolved. Always autoclave at the correct temperature and for the time specified.
- Dispense medium in bottles or tubes in amounts convenient for use. Know the length of time prepared media can be stored without deteriorating.

Dispensing sterile media into Petri dishes

1. Lay out the sterile Petri dishes on a level surface.
2. Mix the medium gently by rotating the flask or bottle. Avoid forming air bubbles. Flames sterilize the neck of the flask or bottle and pour 15–20 ml of medium into each dish (90–100 mm diameter). Air bubbles enter while pouring, rapidly flame the surface of the medium before gelling occurs. Rotate the dish on the surface of the bench to ensure an even layer of agar.
3. When the medium has gelled and cooled, stack the plates and seal them in plastic bags to prevent loss of moisture and reduce the risk of contamination. Do not leave the plates exposed to bright light especially sunlight.
4. Store at 2–8 O^C.

Note: Agar plates should be of an even depth (not less than 4 mm) and of a firm gel. The surface of the medium should be smooth and free from bubbles.

How to inoculate culture media

Immediately before inoculating a culture medium check the medium for visual contamination or any change in its appearance which may indicate deterioration of the medium, e.g. darkening in color. When inoculating, or seeding, culture media an aseptic (sterile) technique must be used. This will:

– prevent contamination of cultures and specimens,

– prevent infection of the laboratory worker and the environment.

Aseptic techniques

1. Flame sterilizes wire loops, straight wires, and metal forceps before and after use. Whenever possible, use a Bunsen burner with a protective tube, e.g. *Bactiburner* to avoid particles being dispersed when flame sterilizing wire loops

2. Flame the necks of specimen bottles, culture bottles, and tubes after removing and before replacing caps, bungs, or plugs.
3. When inoculating, do not let the tops or caps of bottles and tubes touch an unsterile surface. This can be avoided by holding the top or cap in the hand. Always use racks to hold tubes and bottles containing specimens or culture media.
4. Make slide preparations from specimens after inoculating the culture media.
5. Decontaminate the work bench before starting the day's work and after finishing.
6. Use a safety cabinet when working with hazardous pathogens.
7. Wear protective clothing; wash the hands after handling infected material.

Antimicrobial susceptibility tests

Disc diffusion susceptibility tests

Disc diffusion techniques are used by most laboratories to test routinely for antimicrobial susceptibility. A disc of blotting paper is impregnated with a known volume and appropriate concentration of an antimicrobial, and this is placed on a plate of susceptibility testing agar uniformly inoculated with the test organism. The antimicrobial diffuses from the disc into the medium and the growth of the test organism is inhibited at a distance from the disc that is related to the susceptibility of the organism. Strains susceptible to the antimicrobial are inhibited at a distance from the disc whereas resistant strains have smaller zones of inhibition or grow up to edge of the disc.

Preparation of turbidity standard

1. Prepare a 1% v/v solution of sulphuric acid by adding 1 ml of concentrated sulphuric acid to 99 ml of water. Mix well.

Caution: Concentrated sulphuric acid is hygroscopic and highly corrosive, therefore do not mouth pipette, and never add the water to the acid.

2. Prepare a 1% w/v solution of barium chloride by dissolving 0.5 g of dehydrate barium chloride ($BaCl2.2H2O$) in 50 ml of distilled water.

3. Add 0.6 ml of the barium chloride solution to 99.4 ml of the sulphuric acid solution, and mix.

4. Transfer a small volume of the turbid solution to a capped tube or screw-cap bottle of the same type as used for preparing the test and control inoculate.

Procedure

1. Using a sterile wire loop, touch 3–5 well-isolated colonies of similar appearance to the test organism and emulsify in 3–4 ml of sterile physiological saline or nutrient broth.

2. In a good light match the turbidity of the suspension to the turbidity standard (mix the standard immediately before use). When comparing turbidities it is easier to view against a printed card or sheet of paper

3. using a sterile swab inoculate a plate of Mueller Hinton agar. Remove excess fluid by pressing and rotating the swab against the side of the tube above the level of the suspension. Streak the swab evenly over the surface of the medium in three directions, rotating the plate approximately 60^{o} to ensure even distribution.

4. With the Petri dish lid in place, allow 3–5 minutes (no longer than 15 minutes) for the surface of the agar to dry.

5. Using sterile forceps, needle mounted in a holder, or a multidisc dispenser, place the appropriate antimicrobial discs, evenly distributed on the inoculated plate ensure the discs are correctly placed.

Note: The discs should be about 15 mm from the edge of the plate and no closer than about 25 mm from disc to disc. No more than 6 discs should be applied (90 mm dish). Each disc should be lightly pressed down to ensure its contact with the agar. It should not be moved once in place.

6. Within 30 minutes of applying the discs, invert the plate and incubate it aerobically at 35^{o}C for16–18 hrs.

7. After overnight incubation, examine the control and test plates to ensure the growth is confluent or near confluent. By using a ruler on the underside of the plate measure the diameter of each zone of inhibition in mm. The endpoint of inhibition is where growth starts (25).

Declaration

I, the undersigned, declare that this M.Sc. research thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the research proposal have been duly acknowledged.

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Signature: _____

Date of submission: _____

Place Addis Ababa, Ethiopia.

This research thesis has been submitted with our approval as advisors.

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Date of submission_____/_____/_____

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Date of submission_____/_____/_____