**MAKERERE UNIVERSITY**

# RADIATION SAFETY AWARENESS AMONG CLINICAL STUDENTS AND IMAGING TECHNOLOGISTS AT MULAGO HOSPITAL X-RAY UNIT.

**BY**


**BALUKU GODWIN**

**BMR IV**

**REG NO. 19/U/21972/PS**


**SUPERVISOR**

**ROY MUBUUKE GONZANGA**

**(BSC, MSC, PHD )**

**A RESEARCH REPORT SUBMITTED TO COLLEGE OF**

**HEALTH SCIENCES SCHOOL OF MEDICINE**

**FOR THE AWARD OF A DEGREE OF BACHELORS OF SCIENCE IN MEDICAL RADIOGRAPHY OF MAKERE UNIVERSITY**

**JUNE, 2023**

# DECLARATION

I **BALUKU GODWIN**, do hereby declare that this report is my original work. The views expressed here are mine unless stated otherwise, and in such instances acknowledged or reference quoted.

This dissertation in full or partially, has never been submitted for an academic award in this or any university or institution of higher learning.

Signature ……………………………………………….. Date 19/06/2023……………………

This report has been submitted with the approval of my supervisor

Signature ………………………………………………..Date 19/06/2023…………………….

Mr. Roy Mubuuke Gonzaga

BSc. MSc, PhD

Lecturer Department of Radiology

School of Medicine

Makerere University

College of Health Sciences

# DEDICATION

I dedicate this book to my beloved Dad Kithaghenda Yona and Mum Ithungu Mary for their effort, love and care that they have put in me to ensure my successful completion of this course in terms of finance and guidance rendered. God bless my family.

# ACKNOWLEDGMENT

My sincere thanks go to Makerere University, the department of Radiography and Radiotherapy for having given me this chance to do this research proposal so as to gain more practical skills and knowledge.

Special gratitude goes to my supervisor Mr Roy Mubuuke who supported, encouraged and supervised me throughout from the conception of the concept paper through to the write up of the final report. I am eternally indebted to you for your professional inputs throughout this work.

My special thanks go to my Tutors who ensured that I remained on track and focused on the bigger picture of bringing my course to completion.

My thanks go to Mr Senonga Vincent aka Chair, Mr Bwangu John, Mr Lubowa Fred, Mr Murach Eric for imparting knowledge upon me, encouraging me and being available for consultation whenever I need guidance.

Lots of thanks to my classmates who spent all the time with me throughout the whole struggle.

Cannot forget my friends Adambire David, Komakech Erick, Mileke Erasmus that I could run to for guidance and support in case of stress.

Lastly but not least, Special thanks to my family and relatives for their support and guidance.

# LIST OF ACRONYMS

**CT** computed tomography

**MRI** magnetic resonance imaging

**mSv.** millisievert

**TLD** Thermoluminescent Dosimeter

**ALARA**. as low as reasonably achievable

**PPE.** Personal protective equipment

# DEFINITION OF TERMS

**Ionizing radiation: H**igh-energy radiation that is capable of causing ionization in substances through which it passes; also includes high-energy particles.

**Radiation protection:** The protection of people from harmful effects of exposure to ionizing radiation

**Radiation Dose:** The energy absorbed from exposure to radiation

**Radiology**: the scientific discipline of medical imaging using ionizing radiation, radionuclides/nuclear medicine, magnetic resonance and ultrasound in diagnosis and treatment of disease.

**Radiograph:** the examination of any part of the body for diagnostic purposes by means of x-rays with record of the findings usually exposed onto a radiographic film.

**Radiograph:** an image produced on a radiosensitive surface such as a radiographic film by radiation other than visible light as x-rays passed through an object.

**X-rays:** high energy electromagnetic radiation produced by the collision of a beam of electrons with a metal target in an x-ray tube.

**Fluoroscopy**: is an imaging modality that allows real-time x-ray viewing of a patient with high temporal resolution. It is based on an x-ray image intensifier coupled to a still/video camera

**Dose optimization**: process of minimizing radiation exposure to patients while maintaining image quality.

**Millisieverts:** millisievert (mSv) is a unit used to measure radiation dose

# Contents

# CHAPTER ONE


## ABSTRACT

## 1.0 Background:

The continuous use of ionizing radiation in imaging requires also radiation protection measures. The knowledge of ionizing radiation exposure risks among Clinical students and imaging technologists is important. Evaluating the knowledge of radiation protection and dose levels among Clinical students and imaging technologists and suggesting the possible solutions to ionizing radiation effects will help to reduce the risk and probability of occurrence of these harmful effects. The knowledge of ionizing exposure risks among Clinical students and imaging technologists is important in planning diagnostic procedures and therapy.

### 1.1 Aim:

The purpose of the study is to evaluate the awareness of radiation protection measures and knowledge of dose levels of imaging procedures among Clinical students and imaging technologists.

### 1.2 Methods used:

The study will involve Clinical students and imaging technologists at Mulago hospital. In the study a questioner will be prepared for Clinical students and imaging technologists including questions on their experience in ionizing radiation, the knowledge of ionizing radiation effects and the suggestion to possible solutions to the effects of ionizing radiation.

General training about radiation protection should be provided and followed by some specific update courses as required by guidelines on radiation protection.


### 1.3 Research question:

To what level are the Clinical students and imaging technologists aware of radiation protection measures and dose levels of different diagnostic procedures?

Problem statement: Ionizing radiations are being used worldwide in diagnosing and treatment of certain medical conditions with common use of these ionizing radiations also requiring radiation protection. Similar research was done in some hospitals in Italy, Saudi Arabia and UK, but it has not been conducted in Mulago hospital Uganda, East Africa.

### 1.4 General objective:

To evaluate knowledge of radiation safety during diagnostic procedures among Clinical students and imaging technologists.

### 1.5 Specific objectives:

1. To assess the knowledge of effects of radiation exposure to Clinical students and imaging technologists.

2. To suggest the possible solutions to the harmful effects of ionizing radiation exposure to Clinical students and imaging technologists.

# CHAPTER TWO:

## 2.0 INTRODUCTION AND LITERATURE REVIEW

X-rays were discovered by Wilhelm Roentgen on 8th, November, 1895 which increased the hopes for application of this discovery in medicine and other areas of everyday life, such as industry and business. In the early days of ionizing radiation usage, no one suspected the adverse effects of ionizing radiation despite its unquestionable advantages. The early users of ionizing radiations were exposed to high radiation doses leading to harmful effects which were deterministic for example dermatoses, hematological disorders and stochastic affects for example cataracts and cancer diseases.

### 2.1 Imaging modalities

Radiography (also called radiologic technology) includes conventional x-ray imaging as well as additional imaging modalities such as fluoroscopy, mammography, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicines (NM) and radiation therapy (RT). Radiography is an essential diagnostic tool of modern medicine. Within a hospital, radiologists, radiology and nuclear medicine technicians, and others involved in the performance of x-ray and computed tomography (CT)scan examinations, have an increased risk for radiation exposure than the general hospital population (Salama, et al., 2016).

### 2.2 Risks associated with X-rays

The risks associated with the growing diagnostic applications of X-ray in medicine will potentially increase the radiation dose received by the patients. It further confirms the report issued by the Health Protection Agency Centre for Radiation that 90% of the total dose to the UK population because of exposure to ionizing radiation for diagnostic purpose, and accounts for 15% of the dose from all natural and artificial sources. Accordingly, there is worldwide interest in developing recommendations and guidance on radiation protection and some were set out by different organization such as the International Commission on Radiological Protection and National Council on Radiation Protection and Measurements. (Hart, Hillier, & Shrimpton, 2012)

Also the recent rapid evolution and increased use of modalities that use ionizing radiation for diagnosis like multi-detector computed tomography has led to increased number of examinations and therefore the overall radiation exposure to the patients, medical staff and the population with CT contributing about 50% of the total radiation burden for medical purposes.

These effects of X-rays had triggered scientific research in radiation protection and as a result, personal protective equipments were introduced and principles were passed that define the dose limit values and established regulations for radiological protection of the medical staff, students and the patients.

### 2.3 Dose justification and optimization

All radiological examinations using ionizing radiation should be performed only when necessary to answer a medical question, or guide a procedure (Keijzers & Britton, 2010).

The appropriate radiological examinations should be justified by the advantages that can give and should be associated with efforts to minimize the risk from ionizing radiation. The ICRP suggested the general principles of radiation protection as three key words; justification, optimization and dose limit (DO, 2016).

## 2.4 Effects of radiation to biological processes

Despite the recent wide radiation applications in medicine, it can be hazardous if not properly handled. A careful balance between the benefits of enhancing human health, and the risks related to the radiation exposure of radiographers, patients, and the public, has to be involved in the practice of diagnostic and interventional radiation. X-rays have the potential for damaging healthy cells and tissues. After interaction of ionizing radiation with biological tissues through various mechanisms, the ions caused by such interactions can affect normal biological processes. Improper protection against high exposures of ionizing radiation can lead to death, cancer, skin burn, cataract, and radiation infertility (deterministic effects) (Adejumo et al., 2012).

## 2.5 Radiation protection awareness

Similar research was conducted in Italian hospital with an aim to evaluate radiation protection basic knowledge and dose assessment for radiological procedures among Italian radiographers with the objective of evaluating radiation protection basic knowledge and dose assessment for radiological procedures among Italian radiographers. It was a quantitative cross-sectional study in which validated questionnaires were distributed to 780 participants with balanced demographic characteristics and geographic distribution.  The results showed that only 12.1 % of participants attended radiation protection courses on a regular basis. Despite 90 % of radiographers stating to have sufficient awareness of radiation protection issues, most of them underestimated the radiation dose of almost all radiological procedures. About 5 % and 4 % of the participants, respectively, claimed that pelvis magnetic resonance imaging and abdominal ultrasound exposed patients to radiation. On the contrary, 7.0 % of the radiographers stated that mammography does not use ionizing radiation. About half of participants believed that radiation-induced cancer is not dependent on age or gender and were not able to differentiate between deterministic and stochastic effects. Young radiographers (with less than 3 years of experience) showed a higher level of knowledge compared with the more experienced radiographers. Conclusions from the study showed that there is a substantial need for radiographers to improve their awareness of radiation protection issues and their knowledge of radiological procedures. Specific actions such as regular training courses for both undergraduate and postgraduate students as well as for working radiographers must be considered in order to assure patient safety during radiological examinations. (https://www.ncbi.nlm.nih,gov/pmc/rticles/PMC48019#!po=0.757576)

In Nigeria, this study was conducted with an aim of assessing the knowledge of radiation hazards, radiation protection practices and clinical profile of health workers in UDUTH, Sokoto, Nigeria. It was a cross-sectional study conducted among 110 Radiology, Radiotherapy and Dentistry staff selected by universal sampling technique. The study comprised of administration of standardized semi-structured pre-tested questionnaire (to obtain information on socio-demographic characteristics, knowledge of radiation hazards, and radiation protection practices of participants), clinical assessment (comprising of chest X-ray, abdominal ultrasound and laboratory investigation on hematological parameters), and evaluation of radiation exposure of participants (extracted from existing hospital records on their radiation exposure status). Results showed that Sixty-five (59.1%) had good knowledge of radiation hazards, 58 (52.7%) had good knowledge of Personal Protective Devices (PPDs), less than a third, 30 (27.3%) consistently wore dosimeter, and very few (10.9% and below) consistently wore the various PPDs at work. The average annual radiation exposure over a 4-year period ranged from 0.0475mSv to 1.8725mSv. Only 1 (1.2%) of 86 participants had abnormal chest X-ray findings, 8 (9.4%) of 85 participants had abnormal abdominal ultrasound findings; while 17 (15.5%) and 11 (10.0%) of 110 participants had anemia and leucopenia respectively. This study demonstrated poor radiation protection practices despite good knowledge of radiation hazards among the participants, but radiation exposure and prevalence of abnormal clinical conditions were found to be low and periodic in-service training and monitoring on radiation safety was suggested. (Awosan Kj, Ibrahim M, Saidu SA and Danfulani M, 2016).

In Nigeria, to ascertain the true position a Radiation Safety Awareness, a survey was conducted among patients who receive X-ray irradiation at three Hospitals in Port Harcourt, Rivers State. The study employed the use of a carefully thought-out questionnaire administered to one hundred and fifty (150) patients and radiographers at the selected hospitals. Seventy-five of eighty (93.8%) of the radiographers, and sixty of seventy (85.7%) of patients responded. Of these 44 (58.7%) of the radiographers reported that they were aware of the dangers of ionizing radiation, while 52 (86.7%) of the patients expressed ignorance. We have shown that the patients' awareness of the dangers of ionizing radiation is very poor while level awareness by the radiographers is unacceptable. In conclusion, concerted effort is to be made by all concerned for a successful healthcare delivery. (Margaret A, Briggs K, Polycarp C. Okoye and Valentine B.Omubbo, 2013).

Also, a similar study was conducted in Tehran Province, Iran with the objective of assessing the radiation protection knowledge, attitude, and practice (RP-KAP) of health-care workers who are occupationally exposed to radiation regarding protecting themselves from radiation. It was a cross-sectional study and was carried out in 16 hospitals affiliated to the Tehran University of Medical Sciences between May and September 2014. Total health-care workers who were occupationally exposed to radiation comprising 670 individuals were included in the study based on census sampling method. In total, 413 individuals consented to complete an anonymous 32-item questionnaire comprising single best choice questions with a numerical value assigned to each correct answer. Each set of RP-KAP questions was scored and categorized as poor, medium, and good. The effect of independent variables for prediction of RP-KAP was explored using linear regression analyses. Results showed that a significant number of participants had poor RP-knowledge (78.9%), RP-attitude (70.7%), and RP-practice (32.4%). Based on linear regression analyses, it was found that field of study ($\beta = 0.1$, $P = 0.001$), marital status ($\beta = -0.14$, $P = 0.01$), and level of education ($\beta = 0.2$, $P < 0.001$) were the predictors of higher RP-knowledge. In-service RP-training ($\beta = 0.1$, $P = 0.04$) was associated with an increased RP-attitude. Being a woman ($\beta = 0.2$, $P < 0.001$) and longer years of experience with radiation ($\beta = 0.2$, $P < 0.001$) were significantly related to better practice. In conclusion, In-service training with appropriate qualified and up-to-date materials based on radiation workers' educational needs and approved protocols and guidelines is recommended. (Seyedeh S. Alavi, Sima T. Dabbagh, Mahya A. and Ramin M, 2017)

This study was also conducted with the aim of determining the knowledge, attitude and behaviors of the personnel on radiation safety, who are exposed to radiation and working in a university hospital in Istanbul Turkey. In the research, which was a descriptive study, a questionnaire that consists of 20 questions conducted to 101 healthcare personnel who are working with radiation source in operating room, endoscopy, radiology units. The obtained data is analyzed with Statistical Package for the Social Sciences (SPSS) 22.0 program and chi-square test is applied. In the results 58.4% of the participants are women and 41.6% of them are men. 32.7% of the participants stated that they got fluoroscopy education and 50.5% of them stated that they got dosimeter education. 64.4% of the participants stated that they use in fluoroscopic environment at least two times a day and 78.2% of them stated that they did not use legal ray permission. 2% of the participants stated that they do not know about the protective equipment that should be used during fluoroscopy. 74.3% of the participants stated that they do not feel qualified enough about radiation measuring and dosage units. Findings indicated that the healthcare personnel, who participated in this research and working with ionizing radiation sources, do not have the adequate knowledge about radiation safety. For this reason, the most important subject is that the managements of the institutions which are practicing radiation should take precautions with providing either personnel or necessary substructure in terms of equipment and necessary trainings. (Erkan1, A. Yarenoglu, E.H. Yukseloglu, H.C. Ulutin, 2019)

A similar study which was conducted in Saudi Arabia with an aim of estimating the knowledge and awareness of physicians about the hazards of radiological examinations on their health and on their patients. In this cross-section quantitative study, 466 questionnaires administered through a Google spreadsheet were answered by physicians from the 20 cities of Saudi Arabia. The sample included 167 radiologists, 106 neonatologists, 19 oncologists, 45 surgeons and 18 orthopedists, 11 pediatricians and 100 physicians on different specialties. Only 133 of the physicians had received a radiation protection course in the workplace. A total of 73% from participants revealed many gaps in knowledge. For example, 51% of the respondents were unable to classify mammography as ionizing radiation and 69.3% did not know the recommended annual dose limit to the whole body of a radiation worker. The overall knowledge score ranged from 0% to 16.5% (mean 5.3%), with a low score among surgeons and orthopedists. These results clearly indicated that heterogeneous knowledge for the physicians' and needs to be improved by implementation of pre-employment orientation courses or adding a subject in the under or postgraduate curricula. (http://creativecommons.org/licenses.

# CHAPTER THREE:

## 3.0 RESEARCH METHOD

### 3.1 Study Design

A questionnaire survey will be prepared consisting of a number of questions and will be given to radiography students of third and fourth year of Makerere University and the radiography staff at Mulago hospital. The questionnaire will consist of closed-ended question regarding professional, experience of working with ionizing radiation and the knowledge of the basic principles of radiation protection in diagnostics.

### 3.2 Study setting

The study will be conducted at Mulago National Referral Hospital X-ray department in Uganda. Mulago hospital was founded in 1913 and is the main National Referral hospital in Uganda, a teaching hospital for Makerere University College of health sciences and also serves as a general hospital for the Kampala Metropolitan.  The number of patients in Mulago hospital has been greatly increasing in number ever since it started and in the year 2014/2015, it received 829,817 outpatients, 761,573 inpatients, 61,568 emergencies, 28,759 antenatal care visits, 39,081 deliveries 11,120 postnatal visits, 1,738,652 lad tests, 33,949 X-rays, 27,142 Ultrasound scans, 49,680 immunization contacts, and 13,397 major surgeries. (https://health.go.ug/affliated-institutions/hospitals)

### 3.3 Study population

The study will consist of Makerere university year three and year four radiography students and the radiography medical stuff at Mulago hospital X-ray unit. The first- and second-year students have been excluded from this study as they have a short time experience in Ionizing radiation and have not been taught much about radiation protection as per the curriculum.

### 3.4 Sample size estimation

Sample size is calculated from formulae Kish and Leslie (1964)

$$n = \frac{Z^2PQ}{d^2}$$

Where:
n is the sample size
Z is a constant defining confidence interval at 92%
p is the radiation protection awareness among clinical students and imaging Technologist (Galukande, 2006) which is 20%.
Q is 1-p
d is the margin of error at 92% confidence interval
n= 60 participants

## 3.5 Sampling

A sample of 60 people, some of which will be students and some Radiography staff at Mulago hospital will participate in the study. These will be provided with questionnaires with a consent form and questions on knowledge of radiation protection.

## 3.6 Selection criteria

### 3.6.1 Inclusion criteria:

All clinical students and imaging Technologist at radiology department and willing to give consent were included in the study.

### 3.6.2 Exclusion criteria:

All non-clinical students and support staff at radiography unit were not included in the study. And those who refused to consent to participate.

## 3.7 Study variables

Socio-demographic variables;

These were age, gender, educational levels, and occupation.

## 3.8 Data collection and management

Data will be obtained from radiography students and staff at once at Mulago hospital. Questionnaires will be distributed to students in third year and fourth year during their lecture time and the staff on duty. The participants will be informed about the advantages of the research and the participation will be voluntary and completely unnamed.

The questionnaire will consist of four sections which included;

Section 1(Demographics and perceived radiation protection skills) which will contain personal biodata and their degree of training.

Section 2(radiation protection awareness) that will focus on evaluating perceived radiation protection knowledge, ionizing radiation effects, knowledge about imaging profession with higher radiation exposure risks, tissue more sensitive to radiation, diseases caused by radiation damage and knowledge about dose optimization.

Section 3(knowledge about radiation dose limits) which will investigate common examinations like average dose for posteroanterior and lateral chest X ray, Lumber spine X ray and abdominal CT.

Section 4 (resolutions) will allow for participants' suggestion on the possible solutions on how to improve radiation protection among students and medical staff and to minimize the effects of radiation injury.

Questions on section 2 and 3 will be formulated in a multiple choice form with four or five options and one or two options correct including the I don't know option. The question in the 4th section will be in a short answer format. One mark will be given to the correct option and no mark given to the incorrect or the I don't know option.

## 3.9 Data analysis

A descriptive analysis of the sample will be performed. Categorical variables will be expressed as percentages, a pie chart constructed and continuous variables as mean and standard deviation respectively. The total score from the questionnaire on the two subsections of radiation awareness and the knowledge of dose limits will be expressed as median and percentages.

## 3.10 Ethical approval

Permission to conduct the study will be obtained from Mulago Hospital Radiology Department Research Ethics Committee and consent will also be obtained from the study participants. Names of the participants will not be included on the questionnaires and the participation will be voluntary.

# CHAPTER FOUR

## 4.0 RESULTS

### 4.1 Socio demographic characteristics of respondents

A total of 60 respondents participated in the study, of these, majority (78%) of them were aged 18-30 and majority (70%), were males. Majority (75%) were undergraduate students. About (75%) are students, followed by degree holders (18%). Majority (75%) are students followed by (18.3%) imaging technologist.

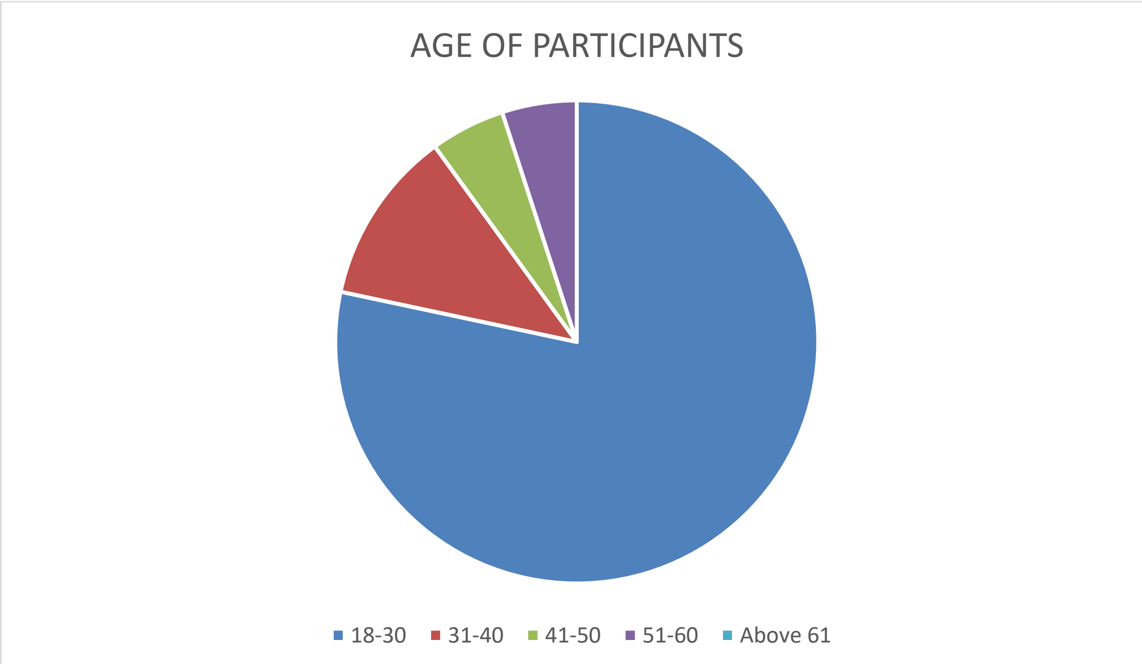
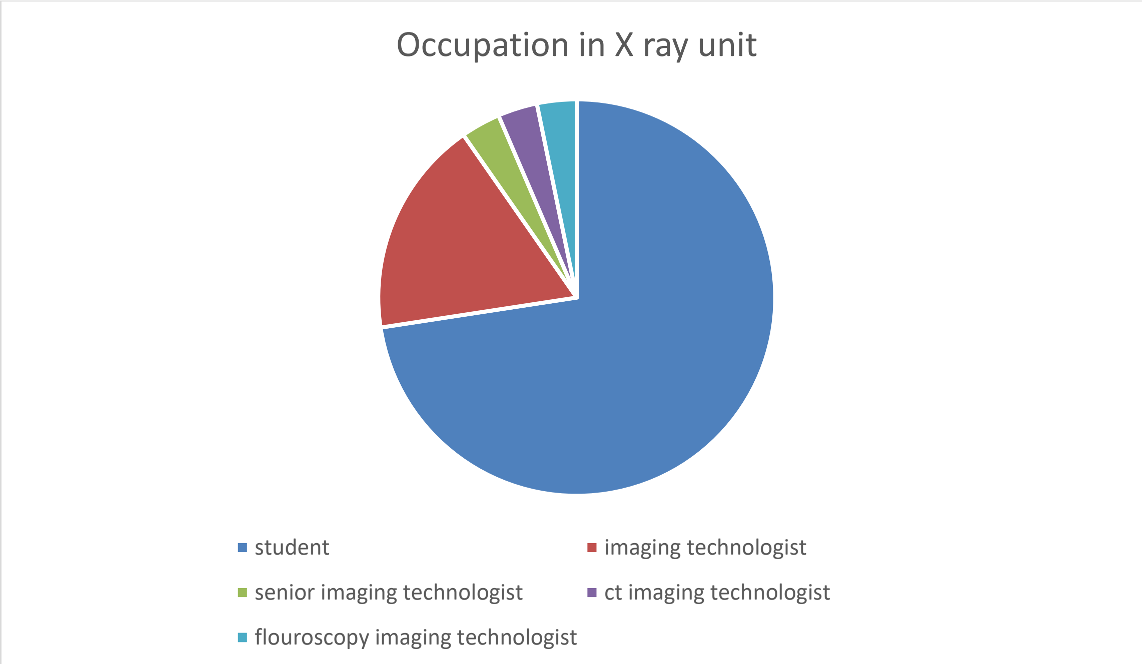



Table 1: Socio demographic characteristics of respondents

| Variable | Frequency N=60 | Percentage |
|---|---|---|
| **Sex** | | |
| Male | 42 | 70% |
| Female | 18 | 30% |
| **Education level** | | |
| Undergraduate students | 45 | 75% |
| Degree | 11 | 18.3% |
| Masters | 4 | 0.67% |
| PhD | 0 | 0.00% |




## 4.2 Radiation protection awareness

The study revealed that majority of the participants (61.9%) know all the basic radiation protection guidelines that is justification and as low as reasonably achievable (ALARA) and few (31.1%) who were students didn't know all the radiation protection guidelines.

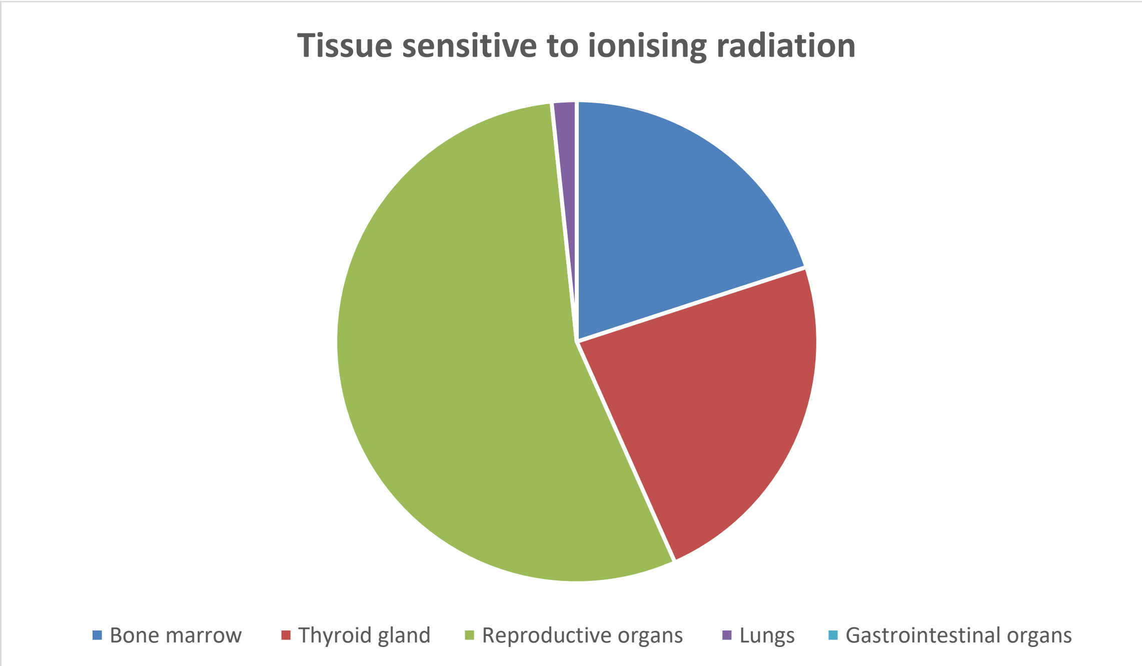
## 4.3 Knowledge about ionizing radiation effects

Majority of the participants (71%) at least knew five effects of ionizing radiation and a few who didn't know all the effects were students. The most obvious answer was increased cancer risk (90%), followed by DNA damage (80%), then reproductive issues (75%), Radiation burns and radiation sickness (10%)

## 4.4 knowledge about imaging profession with higher radiation exposure risks.

Majority (80%) answered imaging technologist because they do plainer X ray and (20%) answer fluoroscopy imaging technologist because of high dose.

## 4.5 knowledge about tissue most sensitive to ionizing radiation



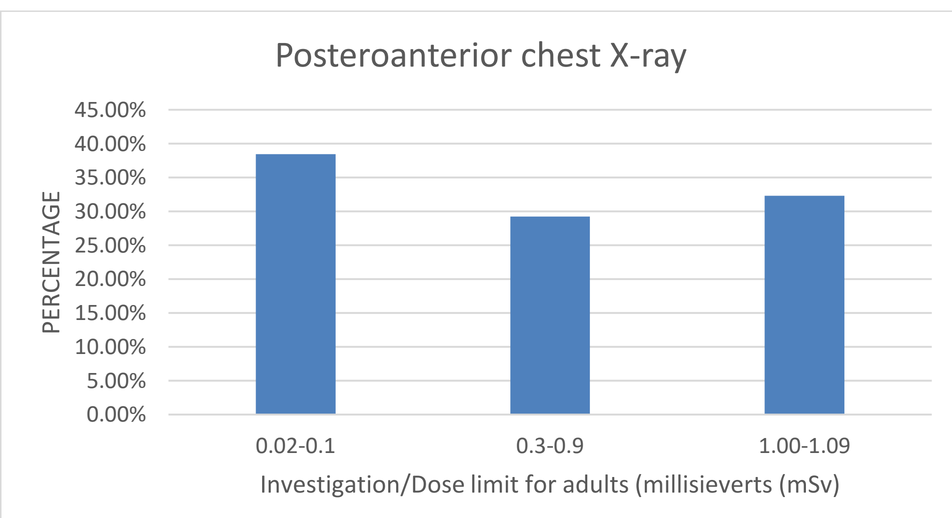

## 4.6 Diseases caused by ionizing radiation.

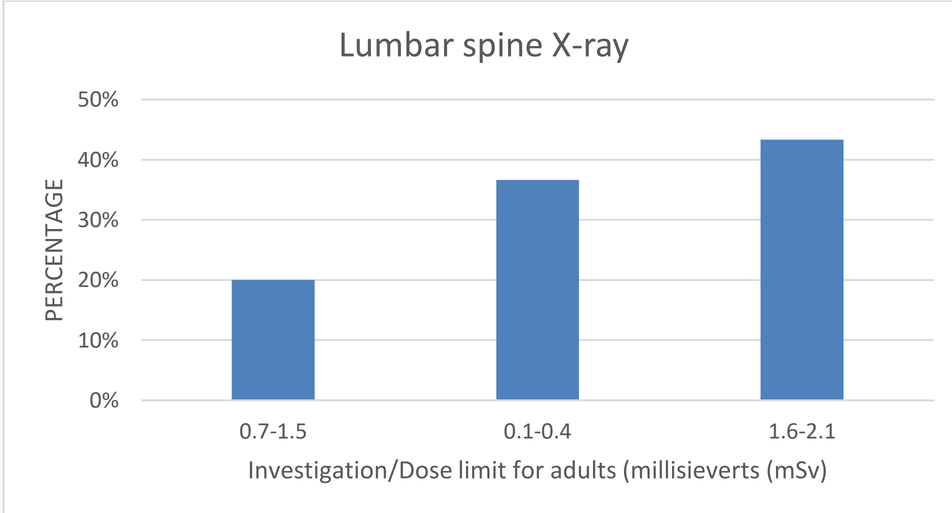
Majority (66%) mentioned 5 Diseases, (20%) mentioned 4 diseases, (11%) mentioned (3%) mentioned 3 and below.

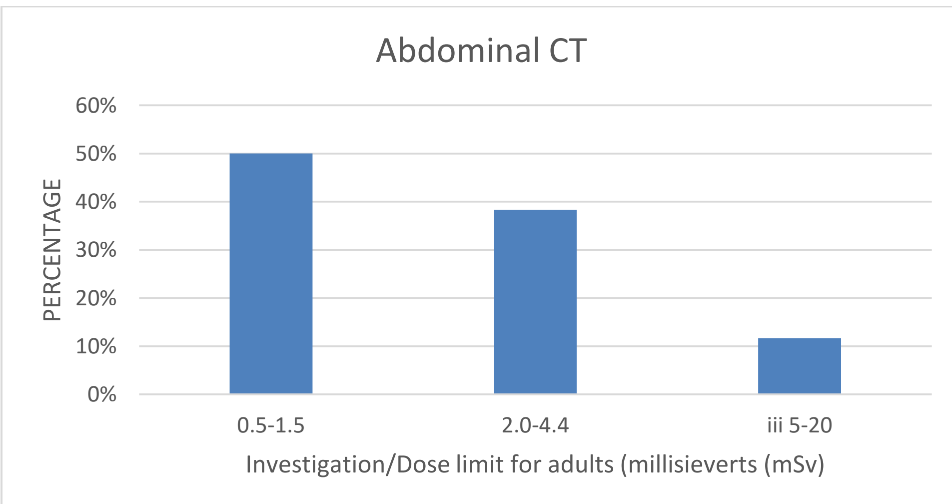
## 4.7 knowledge about dose optimization.

All the imaging Technologist who makes (25%) of the participants know dose optimization techniques and (30%) knew the basic dose optimization techniques, that is minimizing radiation exposure to patients while maintaining image quality, and (45%) did not know all the basic dose optimization techniques.

## 4.8 Radiation dose limits.






Majority (80%) of the participants were not able to mention the standard dose limits.

3.9 SUGGESTIONS

Education and Training: Provide comprehensive training programs on radiation safety and protection for both students and medical staff. This should include understanding the principles of radiation, proper handling of radiation equipment, use of protective measures, and emergency procedures.

Use of Personal Protective Equipment (PPE): Ensure that students and medical staff have access to and consistently use appropriate PPE, such as lead aprons, thyroid shields, lead gloves, and protective eyewear. Regular inspections and maintenance of PPE should also be conducted.

Radiation Monitoring: Implement regular monitoring of radiation exposure levels for students and medical staff. This can be done through personal dosimeters that measure individual radiation exposure. The collected data can help identify areas of concern and guide improvements in radiation safety practices.

Engineering Controls: Implement engineering controls to minimize radiation exposure. This can include the use of shielding materials, such as lead-lined walls, doors, and windows in radiation areas. Additionally, ensuring proper equipment maintenance and regular calibration can help reduce unnecessary radiation exposure.

Standard Operating Procedures (SOPs): Develop and enforce SOPs for handling radiation equipment and procedures. These procedures should emphasize safe practices, minimize unnecessary radiation exposure, and outline emergency response protocols.

Regular Equipment Maintenance and Quality Assurance: Establish a routine maintenance and quality assurance program for radiation-emitting equipment. This includes regular calibration, inspections, and repairs to ensure proper functioning and accuracy, reducing the risk of overexposure.

Regular Health Check-ups: Provide regular health check-ups for students and medical staff who work with radiation. These check-ups can help detect any early signs of radiation injury or exposure-related health issues, allowing for prompt intervention and treatment.

Continuous Improvement and Research: Encourage ongoing research and development in the field of radiation protection. Stay up-to-date with the latest advancements, guidelines, and best practices to ensure the implementation of the most effective radiation safety measures.

Emergency Preparedness: Develop and communicate clear emergency response plans for radiation-related incidents. Conduct regular drills and training sessions to ensure that students and medical staff are prepared to handle such situations effectively.

Monitoring and Compliance: Establish a system for monitoring compliance with radiation safety protocols. This can include regular audits, inspections, and reporting mechanisms to identify areas that require improvement and ensure adherence to safety guidelines.

# CHAPTER FIVE

## 5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

### 5.1 Discussion

The findings suggest the need for continuous education and training programs to improve radiation protection knowledge among students and radiology technologists. Strengthening the curriculum at Makerere University to include comprehensive radiation safety courses could enhance students' knowledge in this area. Furthermore, regular training and refresher courses for radiology technologists at Mulago Hospital are recommended to address the identified knowledge gaps.

### 5.2 Conclusion

This study provides valuable insights into the level of radiation protection knowledge among students of Makerere University and radiology technologists at the Radiography Unit in Mulago National Referral Hospital. The findings underscore the importance of ongoing education and training to ensure the safe and effective use of ionizing radiation in healthcare settings. Continuous efforts should be made to bridge the identified knowledge gaps and promote a culture of radiation safety among healthcare professionals.

### 5.3 Recommendations

Based on the study's findings, the following Suggestions can be implemented to improve radiation protection among students and medical staff and to minimize the effects of radiation injury.

Makerere University should consider incorporating comprehensive radiation safety courses into the curriculum for radiography students.

Mulago National Referral Hospital should conduct regular training and refresher courses on radiation protection for radiology technologists.

Collaboration between the university and the hospital should be encouraged to share resources and expertise in radiation protection education.

Future research should explore the impact of radiation protection training on the practice and knowledge retention of radiology technologists and students.

### 5.4 Limitations

The study's limitations include the relatively small sample size and the focus on a single hospital and university. Future research should aim to include a larger and more diverse sample from multiple healthcare institutions to obtain more representative results.

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# APPENDIX I: CONSENT FORM

Study title: RADIATION SAFETY AWARENESS AMONG CLINICAL STUDENTS AND IMAGING **TECHNOLOGISTS AT MULAGO HOSPITAL X-RAY UNIT.**

**Introduction**

I am Baluku Godwin from School of Medicine, college of health sciences Makerere University, Kampala Uganda, Tel +256774029000, email Address bwin294@gmail.com.

You are being requested to take part in this study. The purpose of this study is to determine the Radiation safety awareness among clinical students and imaging technologist at Mulago hospital x-ray unit.

Study procedure: You have been identified to participate in this study and it requires your consent. You will be asked questions about your knowledge and awareness about radiation safety.

Your rights: Entry into the study is entirely voluntary and no penalty will be incurred for non-participation

Should you choose to withdraw from the study anytime for any reason, you are free to do so and this will have no affect your management

The benefits and risks

The study will remind you of talking keen of the radiation hazards while at work and can lead in change of behavior to always take in account of radiation protection measures.

There is no risk associated in this study.

Confidentiality: All information obtained from this study will be kept strictly confidential and used only for research purposes. Your identity will not be revealed in any publications of this study.

**CONSENT STATEMENT**

I have been informed about this study “Radiation safety awareness among clinical students and imaging technologist at Mulago hospital x-ray unit".

The purpose and the nature of the study, the benefits and risks will have all been explained to me

I was informed that the information given will be kept confidential and that my participation in this study is voluntary and that no consequences will result if I refuse to participate or if withdraw from the study.

I hereby give my informed consent to participate in this study

| | | |
|---|---|---|
| Name of the participant | Signature | Date |
| …………………………….. | ………………………………. | ………………… |
| Name of investigator/Researcher | Signature | Date |
| ……………………… | ………………………… | ………………………… |

MAKERERE UNIVERSITY
P.O. Box 7062 Kampala Uganda
Tel: 256-41-530137▪ Cables: MEDMAK.

COLLEGE OF HEALTH SCIENCES
SCHOOL OF MEDICINE

DEPARTMENT OF RADIOLOGY & RADIOTHERAPY

February 13, 2023

Baluku Godwin (19/U/21972/PS)

**RE: RAD 2023-007: RADIATION SAFETY AWARENESS AMONG CLINICAL STUDENTS AND IMAGING TECHNOLOGISTS AT MULAGO HOSPITAL X-RAY UNIT**

I am pleased to inform you that the Department of Radiology Research Committee at a meeting convened on 7th January 2023 approved the above referenced research protocol. Approval is for a period of one year effective **7th January 2023** and expires on **7th January 2024**.

As the investigator, you are required to ensure that participant rights, safety and welfare are observed and that informed consent is obtained prior to collecting data from participants. In addition, you are required to report any unexpected incidents that may occur during the research period. Ensure that you obtain any other relevant administrative clearances at the sites where you will be collecting data.

Yours Sincerely,

DEPARTMENT OF RADIOLOGY & RADIOTHERAPY MAKERERE UNIVERSITY
13 FEB 2023
SCHOOL OF MEDICINE P.O. BOX 7051, KAMPALA

Dr. Roy Gonzaga Mubuuke, PhD
**Chair, Research Committee**

# APPENDIX II-QUESTIONNAIRE

Radiation safety awareness among clinical students and imaging technologist at Mulago hospital x-ray unit

Participants Number ………..

Demographics

1). Age 18-30 years _______________

31-40 Years ________________

41-50 years ________________

51-60 years ________________

61 and above _______________

b). Sex

Male

Female

2). Educational background

Undergraduate student

Degree

Masters

PHD

3). Occupation in X-ray unit.

i.Student

ii.Imaging technologist

iii.senior imaging Technologist

iv.CT imaging Technologist

v.Flouroscopy imaging Technologist

4.Imaging profession with higher radiation risk

i X-ray unit

ii CT scan

iii Nuclear medicine

iv Ultrasound

v Flouroscopy

5.Mention two radiation protection guidelines.

I.

ii.

6.Mention 5 effects of ionising radiation

i

ii

iii

v

7.Mention 5 Diseases caused by ionisation radiation

i

ii

iii

iv

Mention the dose limits for Posteroanterior chest x-ray, lateral chest x-ray, lumbar spine X-ray and abdominal CT.

i

ii

iii

iv

## APPENDIX III: BUDGET

| **Activity** | Item | Quantity | Unit cost(ugx) | Total amount |
|---|---|---|---|---|
| Proposal development | Printing and photocopying | | | 40,000 |
| | Transport | | | 50,000 |
| | Binding book | 2 copies | 6,000 | 12,000 |
| | Communication and internet | | | 30,000 |
| | Stationery | | | 20,000 |
| Data collection | | | | 100,000 |
| Data analysis | | | | 200,000 |
| Total | | | | 452,000 |