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Awareness of Radiation Protection Safety and Hazards among Healthcare Workers and Paramedical Students

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Abstract: ***Paramedic students get exposed to various departments of the hospital which increases the risk of unnecessary radiation exposure if they are not aware of it. Newly appointed staff and even some existing experienced staff may get exposed to unnecessary radiation if not trained. Thus knowledge about this topic is essential. Aim- To assess the awareness of the radiation protection, safety, and hazards among healthcare workers and paramedical students of various departments of a hospital Objectives- • To compare and evaluate the level of knowledge about the radiation protection, safety, and radiation hazards among healthcare workers and paramedical students of various departments of a hospital • To evaluate if the training session on radiation protection, safety, and hazards is provided to the healthcare workers and paramedical students and how often it is conducted • To evaluate if the healthcare workers and the paramedical students are able to identify if there is any source of radiation in their own department This study includes healthcare workers and paramedical students. The sample size is 74 participants. An online questionnaire was prepared which was distributed as Google forms. The questionnaire consists of 4 sections, they are- 1) Demographic data 2) Questions related to Radiation protection and safety. 3) Questions related to Biological effects of radiation 4) This sections includes questions related to the source of radiation in their respective department and frequency of visiting a radioactive area. In total, the questionnaire consists of 20 questions. All the questions were multiple-choice questions and contain 4 options for each question. Overall the awareness level was low. Effective and frequent training is necessary for all healthcare workers and paramedical students to improve the quality of knowledge on radiation protection, safety, and hazards to avoid unnecessary exposure to radiation to the workers, students, and patients.***

Keywords: Radiation, Radiation safety, Radiation protection, Radiation hazards, Paramedical staff, Paramedical students, Healthcare workers, Hospital staff

1. Introduction

Ionizing radiation may be defined as the type of radiation that travels in the form of electromagnetic waves. This is used widely in radiology as X-rays, in Nuclear medicine as gamma and beta rays and in oncology. Ionizing radiation has the potential to cause radiation induced damages in people exposed to it. Exposure may be by external irradiation, contamination with radioactive materials or incorporation of radioactive materials into the body through ingestion or inhalation. This can cause some serious damage to the cells depending on the amount of exposure received. (Lorenzo Faggioni et al., European Journal of Radiology 86 (2017) 135- 142)

The two major types of radiation effects are stochastic and deterministic effects. Stochastic effects are caused without a threshold dose and the most common example for it is the cancer. The deterministic effects occur with a threshold dose. Acute radiation syndrome, skin burn, hair loss etc fall under this category. Based on the site of action, the radiation effects can be classified into somatic and genetic effects. The former effect takes place in somatic cells and does not reflect on to the future generation while the latter effects occur in germ cells which are carried on to the next generation (offspring). (N A Yunus et al., Journal of Physics 546 (2014) 012015)

Acute radiation syndrome may otherwise be called as radiation sickness or radiation poisoning. It is one of the rare syndromes caused which is present in the database of National Organization for Rare Disorders. It may be classified as acute, delayed or chronic. After the Hiroshima and Nagasaki incident in Japan during World War II, the nuclear power plant accident in Chernobyl, Ukraine increased the number of radiation sickness cases. This increased the need for the study of radiation effects on human body. Effects of the radiation on human body depends on factors such as the dose absorbed by the individual, the type of radiation (strength), the duration of exposure to radiation and the distance between the individual and source of radiation. It also depends on the sensitivity of the cells exposed. Further, the advantages and medical effects of various types of radiation were discovered and used medically in hospitals for diagnostics and therapy. This lead to the studies on radiation protection, safety and hazards to monitor the level of exposure that the radiation worker receives, to follow the safety measures and lower the chances of being affected with radiation sickness. (Olivia Lanes et al., National organization for Rare Disorders (2011))

Ionizing radiation is used in many other forms in almost every department of the hospital due to which the healthcare workers and paramedical students carrying out their studies in a hospital based institution often come in contact with radiation exposure with or without their knowledge. So it is very important that the workers in hospital have appropriate and basic knowledge about the radiation protection, safety and its hazards. (N A Yunus et al., Journal of Physics 546 (2014) 012015)

Radiological/Nuclear medicine imaging became an essential tool in diagnosing various diseases. Cancer cases around the world are increasing tremendously every year. Cancer has become a major public problem. Gamma rays and X rays despite their harmful effects also help in destruction of tumour cells which helps treat cancer cells. Thus, it is inevitable. The only way to avoid the effects of radiation on individuals would be to bring awareness about it and follow protection and safety guidelines. According to ICRP (International Commission on Radiological Protection) recommendation three principles should be followed, they are Justification, Optimization and dose limitation. One of the most commonly known and followed principle for radiation safety is called as ALARA (As Low As Reasonably Achievable) which includes Time, Distance and Shielding. Timely Quality assurance, quality control, area monitoring, contamination monitoring etc. help in avoiding the risk of radiation hazards due to the equipments/ radioactive materials which cause unnecessary exposure such as leaks from machines, spillages of radioactive materials etc. Maintenance of the machines and the radioactive area not only reduces the risk of radiation exposure to the workers of the hospital, but also ensures patient safety as well. (Mohamed M. Abuzaid et al., Asian Journal of Scientific Research, 12: 54-59)

As the number of diseases and ailments increases, the demand for hospital workers also increases.

This interests students in opting for paramedical courses with practical trainings in hospitals. Thus it is necessary to train the staff and students beforehand to avoid unnecessary radiation exposure and accidents. The need for the training is further explained in this study.

2. Aim and Objectives

2.1 Aim

To assess the awareness of the radiation protection, safety and hazards among healthcare workers and paramedical students of various departments of a hospital

Lots of medical institutions provide clinical training to paramedical students as a part of their curriculum to gain exposure to various departments and to be able to adapt to the hospital environment as a staff post studies. Thus paramedic students get exposed to various departments of the hospital which increases the risk of unnecessary radiation exposure if they are not aware of it.

Newly appointed staff and even some existing experienced staff may get exposed to unnecessary radiation if not trained. In this study the primary goal is to assess the level of knowledge that the paramedical students and staff have about radiation, its effects, radiation protection and safety. With this data the standard of training, if given and the need for further training can be emphasized

2.2 Objectives

- To compare and evaluate the level of knowledge among healthcare workers and paramedical students about radiation protection, safety and identification of radiation source in their respective departments
- To assess if the healthcare workers and paramedical students are aware about the radiation hazards
- To evaluate the need for training session on radiation protection, safety and hazards and the willingness of the participants to learn about radiation safety, protection and hazards

All these objectives help in gathering the required data to analyze the overall knowledge of radiation protection, safety and hazard among the participants of various departments of the hospital. The analyzed data will prove if there is any requirement for radiation training or not. By looking at the number of answers section wise, it gives a clear picture about the area in which participants are strong and the area where they lack knowledge.

3. Review of Literature

The study "Awareness about radiation hazards and knowledge about radiation protection among healthcare personnel: A quaternary care academic center-based study" was first published in Jan 22, 2020. This research was carried out and written by Chaowanan Khamtuikrua and Sirilak Suksompong. The basic idea of this study was to examine the awareness about radiation hazards and knowledge about protection methods among the anaesthesia personnel and surgical subspecialists of a quaternary care academic center. The importance of this study lies in the workers and patient safety from radiation hazards as there is increasing demand for medical imaging in almost every department of the hospital. This study was conducted between April 1 2018 and June 30 2018.

It was a cross sectional study based on a validated questionnaire which was validated by six experts: three radiologists, two neurosurgeons who worked in neuro-radiology suites and one anaesthesiologist who was also a medical educator. It was distributed as Google forms as it would be convenient to collect data without bias. The questionnaire had 15 multiple choice questions which had 4 options out of which there was only one right answer. For every right answer 1 mark was assigned and for other options no marks were assigned. The questionnaire was examined by computing the index of item-objective congruence (IOC). This questionnaire consisted of three sections:
1) Demographic information like age gender occupation, experience, department and the percentage of working hours in radioactive area 2) This section consisted of questions regarding radiation hazards awareness, protection practices, and the use of personal protection devices such as lead apron, eye goggles and a thyroid shield while working in radioactive area. 3) The third section consisted of questions related to ALARA, Radiation dose, Source of radiation, personal monitoring device and radiation dose involved in medical procedures. The mean score of knowledge of the participants about radiation hazards was 6.4 ± 2.0. Most of the participants (85.5%) in this study identified ALARA principle. According to this study the healthcare workers need more improvement in their knowledge on radiation hazards. Most of the participants (65%) had never received training about radiation hazards. This may be the reason for inadequate knowledge among the healthcare workers regarding radiation hazards. There was no much difference in results comparing the two specialties however; there was slight difference in the level of knowledge among workers with more experience and workers with very less experience.

In conclusion the authors reveal that most of the participants accepted to using protective equipments (except lead googles) however, these workers need to enhance their knowledge about radiation hazards.

i. The study "Radiation awareness among physicians about the hazards of radiological examinations on the health of workers and their patients in Saudi Arabia" was published on October 2018. The authors of this research paper are Mohammed K. Saeed, Hussein Al-shaari, Mohammed M.S Almarzooq, Saeed A. Alsareii, Shakir A. Aljerdah, Mohammed S.Al-ayed. This study mainly aims at estimating the knowledge and awareness of physicians about radiation hazards for themselves and their patients. The comparison in this study included evaluation of knowledge of the physician who work in Saudi Arabia and physicians in different countries. It was carried out with the intention that it will be useful for Saudi Council for Health Specialities (SCFHS) in Saudi Arabia and for the other local educational institutions.

A questionnaire was sent through Google spreadsheet in English versions to different cities in Saudi Arabia over a period of 10 months. The questionnaire consisted of 26 questions. It focused on three main areas- General knowledge on radiation (10 questions), radiation safety for patients (5 questions) and radiation workers (3 questions). The demographic features of the participant included age, sex, nationality, educational level, speciality, city/religion in Saudi Arabia, years of experience and formal education in radiation protection. All questions were in a multiple choice format with 5-6 options and one correct answer. The physicians were allowed to ignore the questions if answers were not known. There was insignificant correlation between the experience of the doctors and the level of knowledge. The results of this study were worse comparing to the other studies which indicate that the lack of knowledge of the doctors on radiation hazards. The authors felt that results could have been better if doctors from different specialties were not chosen randomly.

The authors concluded from this study that training program provided to the different departments of the hospital was not sufficient and that was ineffective. The total mean score was just 5.3% which explains that the level of knowledge is extremely low among the doctors on the radiation hazards. The authors recommend including this topic in undergraduate studies and more studies on this topic should be encouraged across countries including healthcare workers from various specialities.

ii. The study "Awareness of radiation protection and dose levels of imaging procedures among medical students, radiography students and radiology residents at an academic hospital: Results of a comprehensive survey " was authored by Lorenzo Faggioni, Fabio Paolicchi, Luca Bastiani, Davide Guido, Davide Caramell. This study was published on 29th October 2016. The aim of the study was to evaluate the awareness of radiation protection issues and the knowledge of dose levels of imaging procedures among medical students, radiology residents and radiography students. The importance of the study lies in creating a positive radiation culture in higher education and research sectors which helps in minimising errors and protect entire workforce as well as the general public and environment. This study was conducted between January 1st 2015 and December 31st 2015.

A total of 159 participants were included in this study which included radiology residents, medical students and radiography students. The questionnaire consisted of 16 multiple choice questions which were divided into 3 broad sections. They were- demographic data, awareness about radiation protection and knowledge about radiation dose levels of common radiological examinations. Each question consisted of 6 options with only one correct answer. One mark was assigned to every correct answer and no marks were assigned to wrong answers or unattended questions. The survey was totally conducted on voluntary basis. Medical students claimed to have more knowledge about radiation protection issues more often than the radiology residents and radiography students. However the results revealed that the radiology students and radiology residents outperformed the medical students whose knowledge was significantly worse in the survey which contained questions about regulations, patient and tissue susceptibility to radiation damage, professional radiation risk, dose optimization and radiation doses delivered by common radiological procedures. Furthermore, the radiography students outperformed the radiology resident in radiation protection issues section. Only less than 50% of the participant could give the right answers to all the survey questions.

On the whole the radiology residents, radiography students and medical students had limited awareness of the radiation protection with more lack in knowledge about the doses of frequently performed radiological diagnostic procedures. Teaching needs to be more effective and frequent.

iii. The study "Radiation safety awareness among medical staff" was authored by Arkadiusz Szarmach, Maciej Piskunowicz, Dominik Swieton, Adam Muc, Gabor Mockallo, Jaroslaw Dzierzanowski and Edyta Szurowska. It was published on February 1st 2015. The main concept of the study was to evaluate the knowledge of radiation safety during diagnostic procedures among medical staff. It was important as because only if medical staff was aware of the risks involved due to radiation, planning for diagnostic procedures and therapy would be possibly safe. This study was carried out between July and October 2013 in three large hospitals of Gdansk.

It involved 150 participants who included nurses, doctors, medical technicians and support staff. The questionnaire consisted of 7 close ended questions related to the effects of exposure to ionizing radiation like basic principles of radiation protection in diagnostics and treatment carried out using ionizing radiation as well as demographic details like profession, work experience and frequency of contact with x-rays. The results obtained were analyzed using Microsoft Excel 2007 spreadsheet and Statistica 8.5 software package. Staff of radiology and emergency services with more mean experience of 1-5 years gave the maximum correct answers. The most vulnerable group was surgical ward staff with 11-15 years of experience.

Radiology department provided good results due to their specialist background in the field of radiation. Emergency department have frequent contact with the radiology which resulted in fair knowledge about radiation protection. However it was surprising to see the conclusion of oncology department show low knowledge in this area. So training should be given to all staff regardless of their experience or their position.

iv. The study "Knowledge and Adherence to Radiation protection among healthcare workers at Operation Theatre" was published on December 15th 2018. The authors of this research paper were Mohamed M. Abuzaid, Wiam Elshami and Hayder Hasan. Radiology technology is used in Operation theatres during certain surgeries. The need for the study was that it was extremely important to ensure that the healthcare team follows safety principles to ensure radiation protection and low dose exposure to them during the procedure. This would be possible only if the healthcare team is aware of the radiation protection. It was a cross sectional study which targeted healthcare workers like physicians, nurses and anaesthesia technologists working in the operation theatre who were exposed to the radiation during certain surgeries or procedures. A questionnaire was distributed and was asked to fill and give it back within a week. A reminder was sent in between to improve the response rate. The questionnaire was piloted by four expert panels- two medical physicists, a radiologist and an operation theatre senior nursing staff. The questionnaire consisted of three sections- they were demographic section which included age, experience and job, knowledge section which included questions related to annual dose limits, ALARA principle and radiation protection training and the third section had questions related to personnel's adherence to radiation protection during a procedure or surgery. Consent form was signed by the participants which explained that the information would be confidential and that the participants can withdraw from it at any point of time. Ethical approval was obtained from Research Ethics Committee at the Institution and Ministry of Health and Prevention before the study was initiated. In this study the overall adherence mean score was 4.08±1.33 and overall mean knowledge score was 4.08±1.33. Both the scores positively correlated with each other. The data showed that the technologists showed more adherence (4.5±1.0) score than the nurses and physicians. The data revealed that the physicians (95.7%) adhered to maintaining 1-2m distance from radiation source during procedures than the technologists and the nurses. There was no significant difference in knowledge score among the three groups.

The use of radiation during the surgeries in operating theatre is required to guide and confirm the location and placement of the surgical instruments at the accurate site. This study revealed that the knowledge and adherence of health care workers to ionizing radiation practice is similar or even higher comparing to other studies. Continuous education session should be conducted in regular intervals to reduce the radiation exposure to the staff as well as patients.

v. The study "Radiation Safety Awareness among Healthcare Workers in Middle Eastern countries" was published on 4th November 2017. The authors of this research paper is Bugra Kaya, Namaitijiang Maimaiti * and S.Didem Kaya. Aim of this study was to review the awareness level of radiation risks in healthcare sectors among healthcare workers in Middle Eastern countries. After reviewing some research papers it was found that nearly all nurses in Kuwait working in Nuclear Medicine department were not aware of radiation protection and risks. This lack of awareness could possibly be hazardous to both nurse and the patient. While the nurses had no idea about it, the Doctors and interns underestimated real radiation doses. The author found that very little data was available regarding awareness of radiation safety among healthcare workers.

It was intensive literature review study. A review of published articles on radiation safety awareness among healthcare workers in Middle Eastern Countries which included 17 countries from the Middle Eastern region was conducted. Google Scholar, PubMed and Science Direct were used as a tool for literature searches. The search was limited to articles written in English published between January 2005 and August 2016. The time period to search these articles was July 1, 2016 to August 31, 2016. Only original papers which included healthcare workers were included. All the results from the articles gathered were masked for full review. Agreement within the team members was good and all disagreements were sorted out with proper reasoning for the decision. Out of the 28 selected papers, only 12 papers met the inclusion criteria.

In total12 research papers were collected from7 countries. There were no publications from rest of the 10 countries which were chosen. The paper selected from Kuwait reported that the nurses did not have enough awareness.2 papers which were selected from the Saudi Arabia, one paper was specific to physicians and the other was specific to radiographers.3 papers which were collected from Turkey, one was carried out between Physicians, nurses and medical technicians, the second paper was carried out among doctors and the third paper was specific to medical staffs. From Iran region, 2 papers were selected where the first one was among doctors and patients, but considered only doctor's knowledge score and the second paper was carried among physicians. The rest of the 4 papers were selected from Palestine, Jordan and Egypt, where the papers represented the knowledge level of doctors, radiographers and physicians respectively.

From the articles collected it was found that the level of awareness of radiation hazards among healthcare workers is very poor in the Middle Eastern countries However, there were few limitations such as sample size which was only 22 in the study carried out in Kuwait among nurses, the knowledge score for radiation safety was fully not reported in all 3 papers from turkey, many papers were specific to doctors and radiographers. Another major limitation is that only English language articles using 3 specific search engines were carried out. The author suggests that in future researches, papers should not be limited only to English language as they may miss out some important articles published in the local language and that radiation safety training is necessary to healthcare workers.

vi. The study "Knowledge and awareness of the radiation safety among the medical students and resident doctors" was published in 2017 in Scholars Journal of Applied Medical Sciences (SJAMS). The authors of this article are Sushant Hari Bhadane, Sapana Sushant Bhadane. In the past, clinicians were not very aware about the radiation dose, its effects on health of the patient exposed to it and radiation safety precautions, so this study was carried out to assess the knowledge and awareness of the medical students regarding radiation safety precautions.

This study was carried out among 75 medical students and 45 resident medical doctors. A questionnaire was prepared with 12 questions which included questions regarding radiation safety principles, barriers to protect transfer of radiations, precautions to be taken, hazards of radiation etc. Ethical committee approval was taken prior to the start of the study and participants had to sign a detailed informed consent. Questionnaire were distributed to all the participants at the same time and 15mins time was given to all of them to answer and submit the questionnaire to the concerned authority.

The results of the questionnaire was collected and tabulated. Out of 75 students, answers of 4 student responses were excluded as they had marked multiple answers for the questions. Out of the 45 medical residents, 2 resident responses were excluded as most of the questions were left blank. After comparing the scores, it was found that both scores were almost equal and had similar level of knowledge and awareness about radiation safety. However, the overall score was very low especially at the safety precautions section.

The level of awareness about radiation protection is directly related to the behavior of the staff. When there is lack of knowledge about radiation safety, the actions will not be safe which in turn results in adverse effects. Thus medical students and resident doctors should improve their knowledge through seminars, symposiums, and other various methods. This will help in keeping themselves and the patient safe from unnecessary radiation exposure.

vii. The study “Investigation of awareness level concerning radiation safety among healthcare professionals who work in a radiation environment” was published on 6th August 2020. The authors of this research paper are Aysu Zekioglu and Sule Parlar. Radiation safety became extremely important after some issues due to exposure to ionizing radiation in large number. The aim of the study was to find out the awareness and knowledge level regarding radiation safety among healthcare workers working in the radiation area.

The research was carried out in a university, state, and a private hospital in the city. The study population was chosen from departments such as Cardiology, Radiology, Nuclear Medicine and Radiation Oncology. There were 123 participants from university hospital, 47 from state hospital and4 from private hospital. Out of 174 healthcare workers from the three chosen hospitals, 144 of them participated on voluntary basis. Approval from the ethical committee was taken prior to beginning the study, survey was carried only after obtaining permission from the hospitals. The survey had 2 parts, with a total of 28 questions. The first part consisted of demographics of the participants and the second part consisted of questions regarding principles and trainings on radiation safety. Specifically questions about trainings, radiation protection instruments, uses of dosimeter and assessment of risk. It also included questions regarding patient safety, precautions to be taken for pregnant women during procedures involving radiation. This survey consisted of multiple choice questions with single correct answers for questions on staff safety and patient safety and Yes or No questions with reasoning was present for questions regarding safety training, dosimeter usage and risk analysis. SPSS.23 program was used for data analysis.

Out of the results obtained, 68.6% was the rate of correct answers in questions regarding radiation safety among healthcare workers. The success rate of this study was higher than other studies performed with other healthcare workers. 98.6% of the participants stated that they had knowledge about radiation protection and 61.8% participants stated that they gained the knowledge through training. 85.4% of the participants confirmed the presence of radiation safety committee in their area of work and 60.4% of the participants reported that there was periodic training and that (63.4%) confirmed that the training was effective. Additionally, interactive and case based training modalities are stated to be more effective in terms of raising awareness (Sheng et al., 2016)

This study reported that there is insufficient level of knowledge and awareness on radiation safety even in healthcare workers who worked in radiation area. Periodic trainings should be given to all radiation area workers and regular trainings should be given to all other healthcare professionals who are exposed to ionizing radiation but are not continuously present in radiation area.

viii. The study “Assessment of the Awareness and Knowledge Level about Radiation Protection: An Empirical Study on the Radiology Professionals of the Radiology departments, East Java Indonesia” was published in September 2016.The authors of this article are Meftah Ali Elnari, Johan AE Noor, Yuyun Yueniwati. This article first aims at the radiation protection to prevent biological effects(deterministic effects) in the human body by keeping the dose at threshold and to also reduce the chances of experiencing stochastic effects by exposure to radiation for a long period of time to healthcare workers in the radiation area. Then comes the safety aspect, where the individuals, society and environment is protected from harm from radiation effects and helps to maintain safety from the radiological hazards from source. Thus this study has explained some of the evident issues which have not been cared about for many years especially, to radiation workers.

A questionnaire was prepared with 37 questions in total. 15 questions were based on general awareness and knowledge, 4 questions about radiation dose knowledge, 4 questions about biological effects/ side effects and 14 questions about protection. All the questions were multiple choice questions with Likert sale ranging from1 to 4. This questionnaire was distributed to radiology workers who work in the CT unit of radiology department. This paper research targeted mainly the technologists, physicists and radiologists to assess their knowledge on ionizing radiation and its protection. The data which was obtained was analyzed using SPSS and PLS software.

There were overall 102 participants in this study. Their level of awareness was between fairly good and good overall. 69.6% of the participants were technologists “radiographers”, 2% of them were physicists and 28.4% of them were radiologists. This shows that most of the hospitals did not have physicists. In spite of that the results obtained were either good or fairly good. There was a strange finding that a few of these participants did not know that MRI and Ultrasound do not require ionizing radiation.

This study shows that the general assessment and knowledge related to ionizing radiation, protection, radiation doses and side effects is sufficient among the target group in the CT unit of radiology department. This proves that the courses during their study period included radiation protection protocols in hospitals. It was also found that there was a linear relationship between awareness & knowledge, knowledge on radiation doses and knowledge on side effects.

ix. The study “Assessing radiation protection knowledge in diagnostic radiography in the Republic of Cyprus- A questionnaire survey” was published on November 28, 2019. The authors of this article are C.Zervides, L.Sassis, P.Kefala-Karli, A.Derlagen, P.Papapetrou, A.Heraclides, V.Christou. This study aims at assessing the knowledge on radiation protection among radiographers in Cyprus.

This was a cross sectional study which was carried out among radiographers in Cyprus via the Cyprus Society of Registered Radiologic Technologists & Radiation Therapy Technologists. It was a quantitative descriptive analysis where a questionnaire with 22 multiple choice questions was used as a tool to collect data. Analysis of the data was done using Stata (statistical software).

From the results obtained, it was noted that due to wide range of correct to incorrect ratio, radiation protection is less known compared to others. When the answers were correlated to the participant’s characteristics, some important determinants such as workplace of the participant, type of work licence the participant had at the time of the questionnaire, and years of clinical experience of the participant were identified.

Overall this study shows that the knowledge level on radiation protection is very good among the healthcare workers. It also indicates the importance of education for radiographers which is required for the national radiation protection legislation.

x. The study “Knowledge of Radiation Hazards, Radiation Protection Practices and Clinical Profile of Health Workers in a Teaching hospital in Northern Nigeria” was published on Aug 1, 2016. The authors of this article are KJ Awosan, MTO Ibrahim, SA Saidu, SM Ma’aji, M Danfulani, EU Yunusa, DB Ikhuenbor, and TA Ige. The aim of this study was to assess the level of knowledge of healthcare workers in UDUTH, Sokoto and Nigeria about radiation hazards, radiation protection practices and clinical profiles.

This study consisted for totally 110 participants from Radiology, Radiotherapy and Dentist department. Selection was done on the basis of universal sampling technique on voluntary basis. The questionnaire distributed was semi structured, self and interviewer-administered. This questionnaire was pre tested in Radiology Department of Specialist Hospital in Sokoto, Nigeria among 10 healthcare workers. The questionnaire was based on questions regarding socio-demographic characteristics, knowledge of radiation hazards; radiation protection practices of the participants in the first section, clinical assessment such as questions regarding chest X-ray, abdominal ultrasound and laboratory investigation on hematological parameters in the second section, and finally evaluation of radiation exposure of participant which were extracted from the hospital records in the third section. The data collected was analyzed using IBM SPSS version 20.0 software package.

The participants aged between 20-65 years. Most of the participants were found to be male and married. 65of them had good knowledge on radiation hazards 58 of them had good knowledge on Personal Protective Devices (PPDs). Only 30 participants wore dosimeters and very few participants consistently wore PPDs at work. The radiation exposure ranged from 0.0475 mSv and 1.8725 mSv. 1 of the participant had abnormal chest X-ray findings while 85 participants had abnormal abdominal ultrasound findings. Out of 110 participants 17 and 11 participants had anemia and leucopenia respectively.

Surprisingly, this study showed good knowledge on radiation hazards but poor protection radiation protection practices among the participants. Prevalence of abnormal findings due to radiation exposure was found to be low. Frequent training and monitoring is suggested at the end of the study.

xi. The study “Evaluation of Awareness on Radiation Protection and Hazards among Paramedical Personnel Working in Radiology Department of a Teaching Hospital” was published in December 2017. The authors of this article are Soujanya Mynalli, Basavaraj N Biradar, Ram Shenoy Basti, Anston Vernon Braggs.

There were a total of 100 participants consisting of paramedical workers life radiographers, students, radiology clerks, nurses and nursing aids of MICU, SICU who were in or come across radiology department in Father Muller Hospital, Manglore. This study was a descriptive cross sectional study which utilized purposive sampling technique. A self structured questionnaire consisting of 17 questions was distributed among the participants. Out of the 17 questions, 13 were to mark correct answers and 4 were based on predetermined scale and data analyzed. The questionnaire focused on the demographic data, educational status, experience profile of the participants, their knowledge about X-ray safety and safety measures against radiation hazards.

It was found that compared to those who visit the department occasionally along with the patients, the knowledge of radiation was high in those who work in the radiology department. The overall assessment was satisfactory. Students scored the highest while nurses scored the least. There was a positive correlation between the number of right answers and the training given by the institution. This study proved that the institution must conduct regular training programs, talks, teaching sessions on radiation hazards, protection and safety practices for best results.

4. Methodology

This study included healthcare workers and paramedical students from various departments like Radiology, Nuclear Medicine, Urology, Anaesthesia Technology, Neuroscience Technology, Dialysis Technology, Respiratory Technology, Laboratory Technology and Perfusion Technology. It was not specific to one hospital, it included various healthcare workers from various hospitals and diagnostic centres from Chennai, Kerala and Madurai.

Sample size is 74 participants. This study included wide range of participants. B.Sc Students & Interns, M.Sc Students & Interns and staff of few departments participated in this study. This study also covers participants who have clinical experience, either as staff or intern and participants without any experience at all. Most of the participants were between 18-25 years of age. All the participants participated on voluntary basis.

An online questionnaire was prepared using Google forms. Online medium was chosen instead of distributing questionnaires in person as it makes it easy to collect and analyze the data in a short span of time and distribute across various cities in South India such as Kerala, Madurai and Chennai. A detailed message explaining the reason for the study was sent along with the link to Google form through WhatsApp. A reminder message was sent the next day. The total time given for the participants to fill in the form was 2 days.

Reponses for the questions in Google form were automatically stored in excel sheet which is one the advantage of using Google forms as a tool to collect data. The collected data was then analyzed using some tools and functions in the spreadsheet and arrived to results. Finally a pictorial representation of the acquired data was prepared and attached in the results section given below.

The questionnaire consisted of 4 sections, they are-
1) Demographic data such as Name (for my reference), Age, Gender, Occupation/ Student, Experience and the department that the participant belonged to.
2) Questions related to Radiation protection and safety like Personal Monitoring devices, ALARA principle, annual safe dose limit, area/contamination monitoring etc were included in this section. Most basic questions such as abbreviation of ALARA, identification of personal monitoring device which should be commonly known to all healthcare workers and paramedical students, annual acceptable dose limit for radiation workers and public which everyone should be aware of in general and uses of survey meter were the questions of section 2.
3) This section included questions related to biological effects of radiation, mishandling/misadministration of radioactive materials, Sources of radiation etc. Topics which are generally known to healthcare workers, paramedical students only if proper training sessions are conducted such as questions on stochastic and deterministic effects, identification of source of radiation in Nuclear Medicine department, a basic question related to diagnostic procedure and what is considered as misadministration of radiopharmaceutical were included in section 3.
4) This section includes questions related to frequency of visiting a radioactive area, identification of source in their respective departments, if participants think training to all healthcare workers on radiation safety protection and hazards is necessary and if necessary precautions are taken in radioactive area known to them.

In total the questionnaire consists of 20 questions. All the questions of section 2, 3 and 4 were multiple choice questions which contains 4 options for each question. For every correct answer 1 mark is rewarded and for every wrong answer no marks were given. All questions were compulsory except question number 19. Question 19 is an exemption as there is a possibility that some participants who took part in this study wouldn't have visited radiation area. This study was carried out in Feb 2020.

5. Results

The results are classified into 4 sections where the first section involves demographic details such as gender, age, department, experience, and their level of education/occupation. These details are further correlated with the other sections.

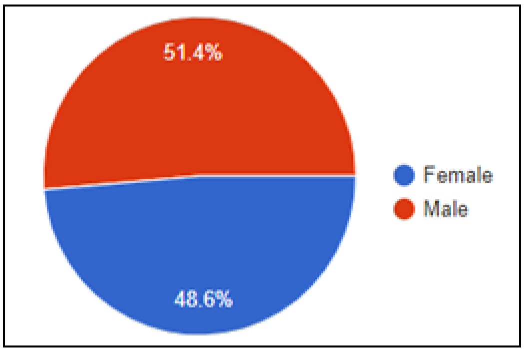

Figure 1.1

Out of 74 responses received 38 participants were male and 36 participants were female.

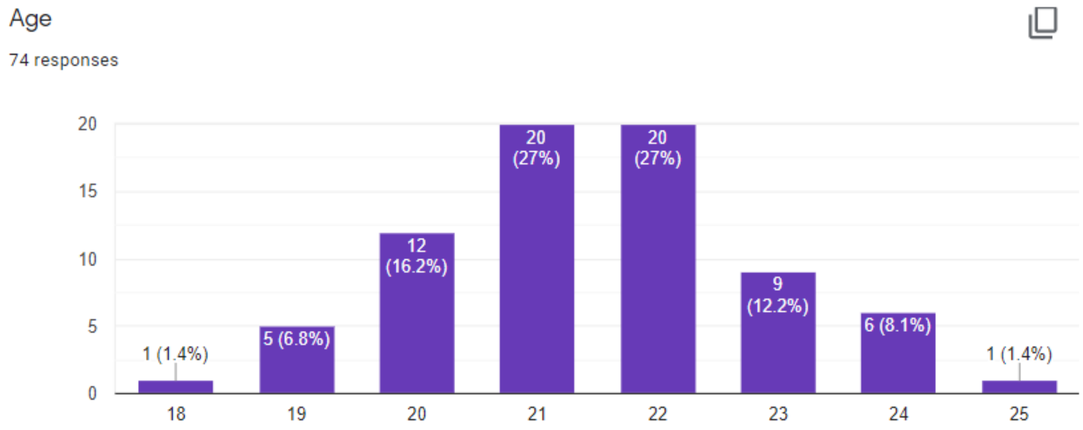

Figure 1.2

This bar chart represents how the participants are categorized age wise. Out of the 74 reponses received the age of participants ranged from 18 to 25. Out of which maximum number of participants were of age 21 and 22. Only 1.4% of the participants i.e 1of them belonged to the age group 18 and 25.

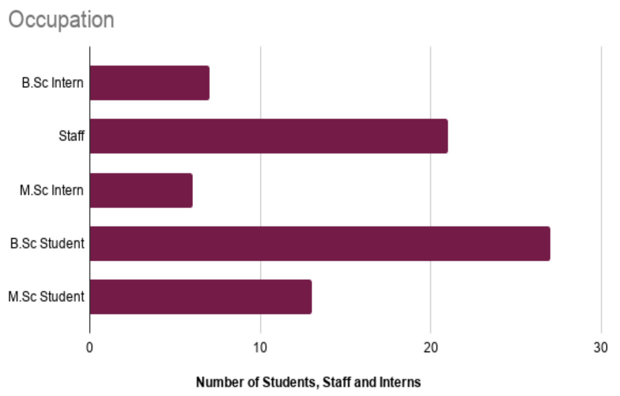

Figure 1.3

This chart represents the level of education, occupation of the participants who gave in their responses out of which majority (27) of them were B.Sc students followed by Staff (21) and M.Sc Students (13) respectively. M.Sc interns (6) are the group with lowest number of participants.

Figure 1.4

This chart represents how the participants are categorized based on their level of experience at work or in the clinical setting. 42 respondents come within the interval of 0-5 months of experience. 21 respondents come within the interval of 5- 10 months of experience. 5 respondents lie between 10-15 months of experience and 3 respondents fall between the intervals 20-25 months and 35-40 months each.

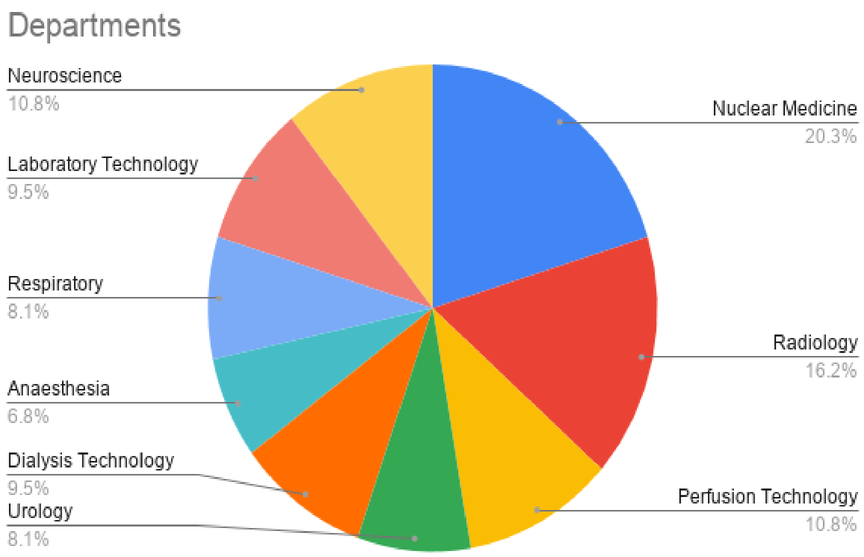

Figure 1.5

This pie chart represents the various departments that the participants belonged to. Out of the 74 responses received majority of them belonged to Nuclear Medicine Technology department, followed by Radiology, Perfusion Technology, Neuroscience Technology Laboratory Technology, Dialysis Technology, Respiratory Technology and Urology. Only 6.8% of responses belonged to participants of Anaesthesia Technology department.

Section 2 (Radiation Protection and Safety)

Which of the following is a personal monitoring device
74 responses

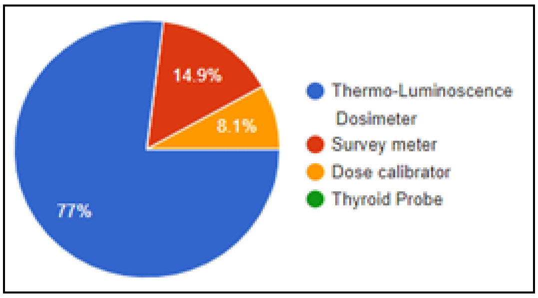

Figure 2.1

It is one of the most basic questions related to the field of radiation. 77% (57) of the participants selected the option Thermo-Luminoscence Dosimeter as the answer. 14.9% (11) of them chose survey meter and 8.1% (6) of them chose dose calibrator as the answer. None of the participants chose the option of thyroid probe.

Abbreviation of ALARA
74 responses

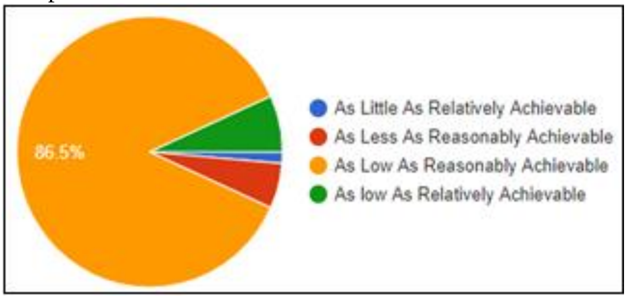

Figure 2.2

One of the most important questions in radiation protection is the abbreviation of ALARA. From Fig 2.2, Majority of the participants 86.5% (64) chose the answer, As low As Reasonably Achievable while others chose As Low As Relatively Achievable 6.8% (5) and As Less As Reasonably Achievable 5.4% (4) in almost equal number and very less participants chose As Little As Relatively Achievable 1.4% (1).

What is the effective dose limit (whole body) for radiation workers?
74 responses

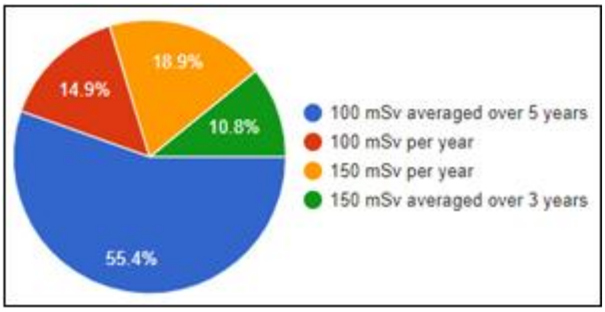

Figure 2.3

Only 55.4% (41) of the participants identified 100 mSv averaged over 5 years as the answer for the effective dose limit (whole body) for radiation workers. 18.9% (14) of them chose 150 mSv per year and 100 mSv per year. 14.9% (11)of the respondents chose 100 mSv per year Least number of respondents 10.8% (8) chose 150 mSv averaged over 3 years.

What is the effective dose limit (lens and extremities) for public?
74 responses

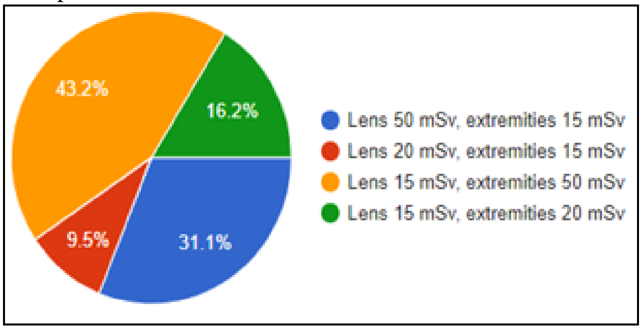

Figure 2.4

In Fig 2.4, 43.2% (32) of the participants chose the answer, Lens 15mSv, extremities 50 mSv, followed by the answer Lens 50 mSv, extremities 15mSv chosen by 31.1% (23) of them. 16.2% of them chose Lens 15 mSv, extremities 20 mSv and least number of participants (9.5%) chose Lens 20mSv, extremities 9.5%.

Survey meter is used for which of the following
74 responses

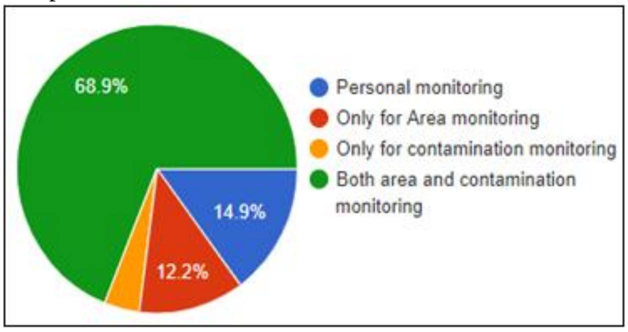

Figure 2.5

68.9% (51) of the participants identified that the survey meter is used both for area and contamination monitoring. 14.9% (11) of them chose personal monitoring as the answer followed by 12.2% (9) who chose only area monitoring as the answer. A very minimal number of participants 4.1% (3) chose the answer only for contamination monitoring.

Number of right answers given in relation to the demographic data of the participants in section 2

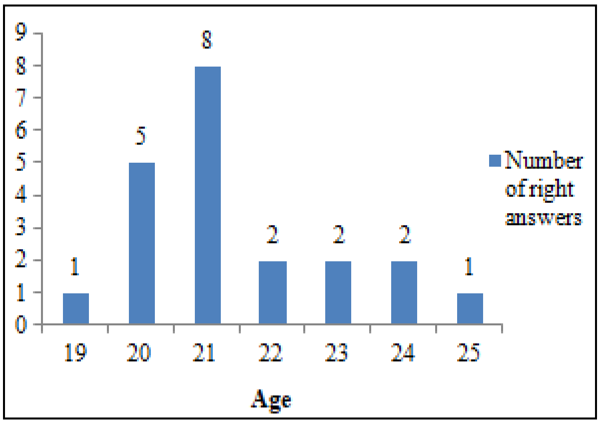

Figure 5.1

From Fig 5.1 it is evident that 8 participants of age group 21 gave all right answers to questions in section 2 followed by 5 participants of age group 20, 2 participants from age group 22, 23,24 each and 1 participant of age group 19 and 25 each.

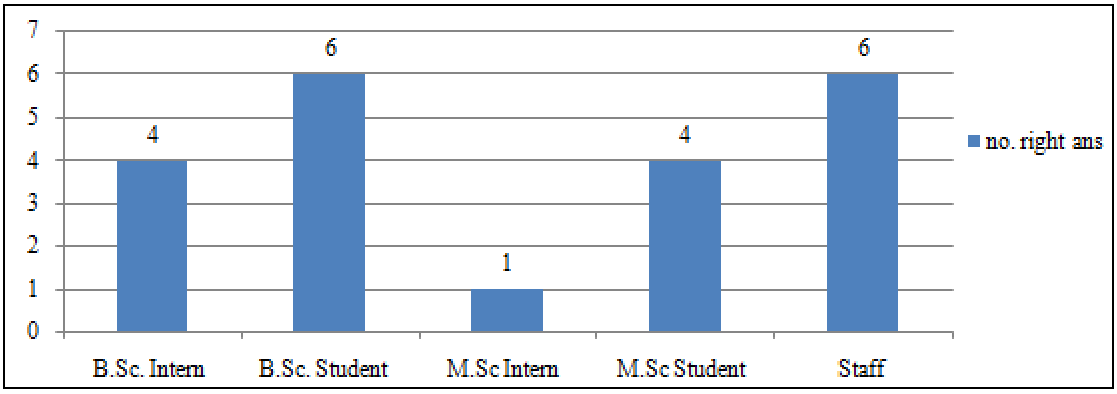

Figure 5.2

From 5.2, equal number of staffs(6) and B.Sc students gave right answers to all questions of section 2 while 4 B.Sc Interns and M.Sc students each and only 1 M.Sc Intern chose all right answers in section 2.

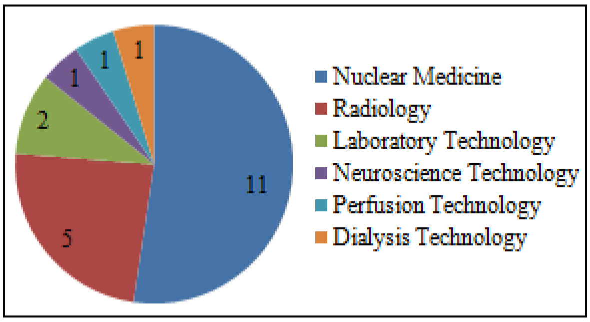

Figure 5.3

It is clear from the pie chart that most number (11) of students, staff and interns from Nuclear Medicine department gave all right answers in section 2. The second highest being department of radiology (5) followed by Laboratory Technology (2) and 1 each from departments Neuroscience Technology, Perfusion Technology and Dialysis Technology.

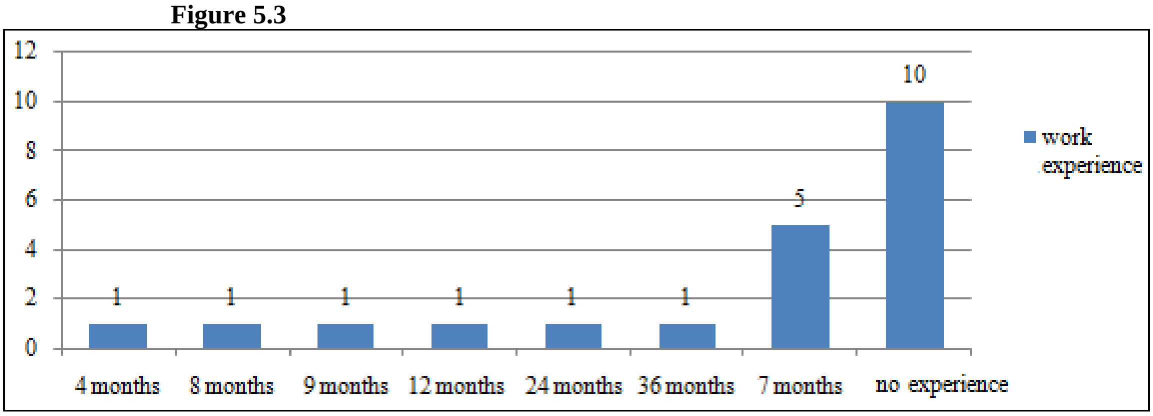

Figure 5.4

From Fig 5.4, 10 participants who had no clinical experience had answered all questions correctly followed by3 participants with 7 months clinical experience and 1 participant from 4 months, 8 months, 9 months, 12, months, 24months, 35 months each.

Section 3 (Biological Hazards of Radiation)

Which of the following is caused due to Stochastic effects
74 responses

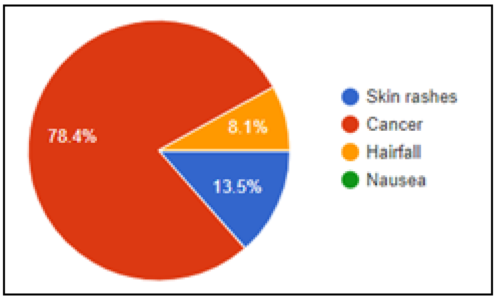

Figure 3.1

From Fig 3.1, 78.4% (58) of the participants have chose cancer as a cause of stochastic effect. 13.5% (10) of the them chose skin rashes and 8.1% (6) chose hair fall. None of them chose nausea.

Which of the following is considered as misadministration of radiopharmaceutical
74 responses

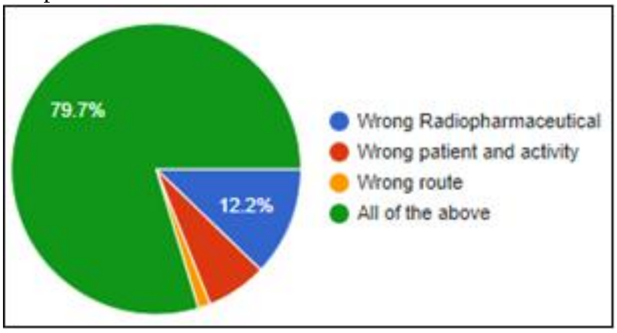

Figure 3.2

From Fig 3.2, Majority of the participants79.7% (59) chose all of the above as the answer for this specific question.12.2% (9) of people chose wrong pharmaceutical and very minimal number of participants chose wrong patient and activity 6.8% (5) followed by wrong route 1.4% (1).

Which of the following is the source of radiation in Nuclear Medicine department
74 responses

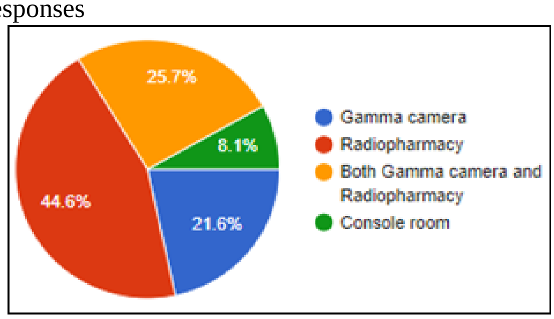

Figure 3.3

Out of the 74 responses received 44.6% (33) of the participants have identified radiopharmacy as the source of radiation in Nuclear Medicine department. While 25.7% (19) of them chose both gamma camera and radiopharmacy, it is followed by 21.6% (16) who chose gamma camera as the source. Least number of them8.1% (6) chose console room option.

Which of the following diagnostic procedure does not require radiation
74 responses

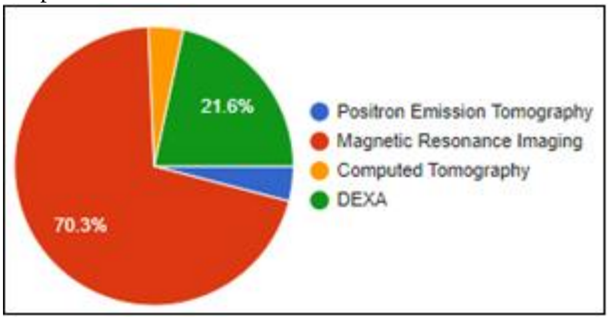

Figure 3.4

From Fig 3.4, 70.3% (52) of the participants chose Magnetic Resonance Imaging as the procedure that does not require radiation. 21.6% (16) of them chose DEXA scan while others chose Computed Tomography4.1% (3) and Positron Emission Tomography in equal number.

Deterministic effects occur due to
74 responses

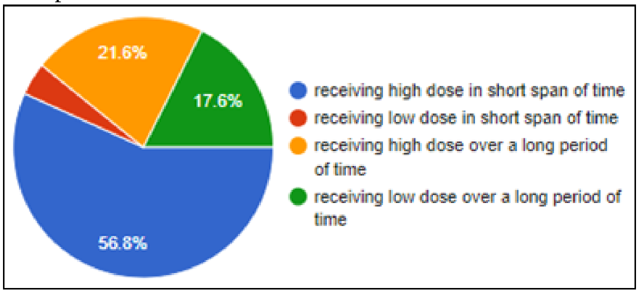

Figure 3.5

Majority of the participants 56.8% (42) have identified that deterministic effects occur due to receiving high dose in short span of time, while 21.6% (16) chose receiving high dose over a long period of time and 17.6% (13) chose receiving low dose over a long period of time. Avery minimal number of participants 4.1% (3) chose receiving low dose in short span of time as the answer.

Number of right answers given in relation to the demographic data of the participants in section 3

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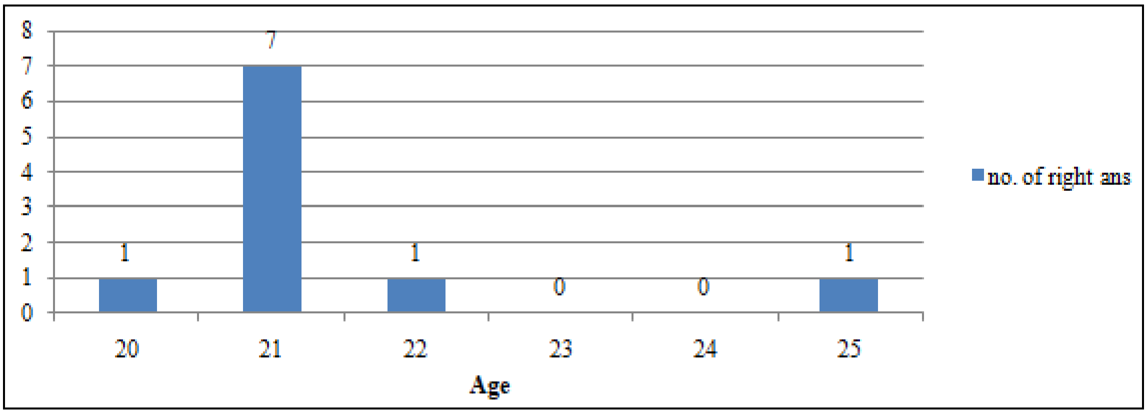

Figure 6.1

From 6.1 it is visible that right answers to all questions in section 3 were majorly given by participants of age 21 (7) followed by 1 participant from age 20 and 25 each and no participants gave all right answers from the age group 23 and 24.

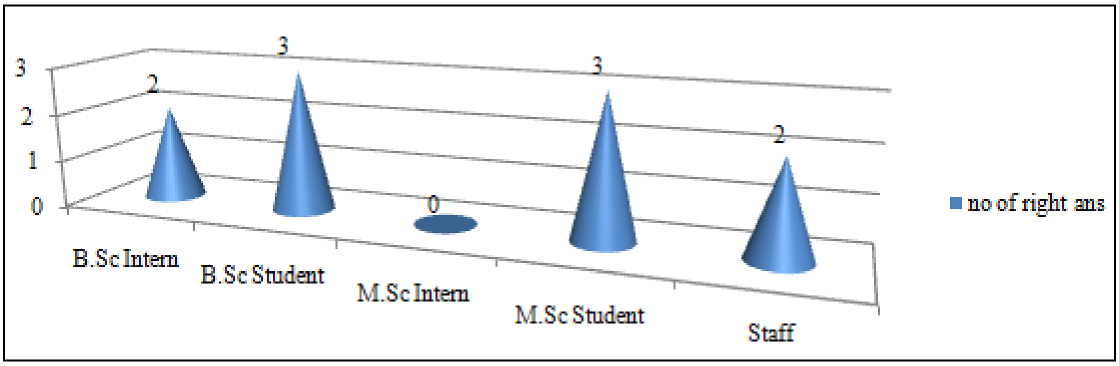

Figure 6.2

This chart represent that 3 participants each from the group B.Sc students and M.Sc students have answered all questions of section 3 rightly followed by 2 staff and B.Sc Interns each and no M.Sc intern gave all right answers.

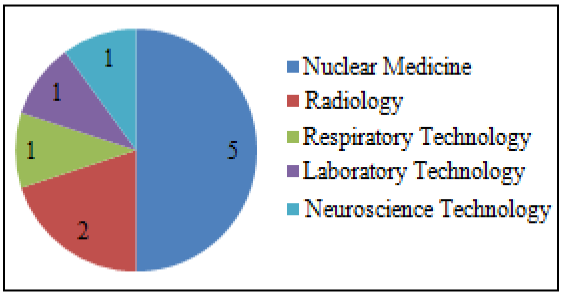

Figure 6.3

From 6.3, 5 participants from Nuclear Medicine Department have given right answers to all questions in section 3 which is followed by 2 participants from Department of Radiology and 1 participant each from Respiratory Technology, Neuroscience Technology and Laboratory Technology.

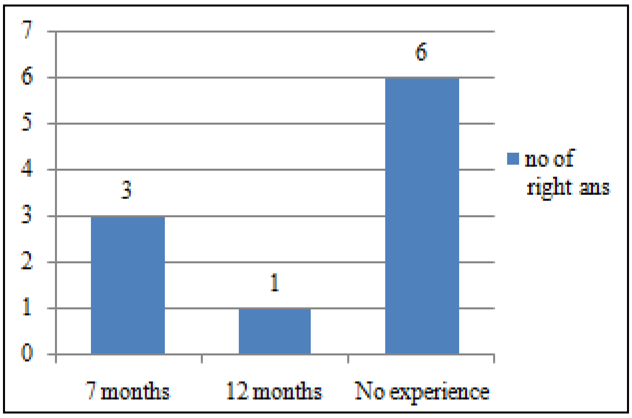

Figure 6.4

This chart represents 6 participants with no experience have answered all the 5 questions of section 3 correctly while 3 participants with 7 months experience and 1 participant with 12 months experience gave the right answers to all questions of section 3.

Section 4- Frequency

Frequency of exposure to radiation

How often do you visit radiation area
74 responses

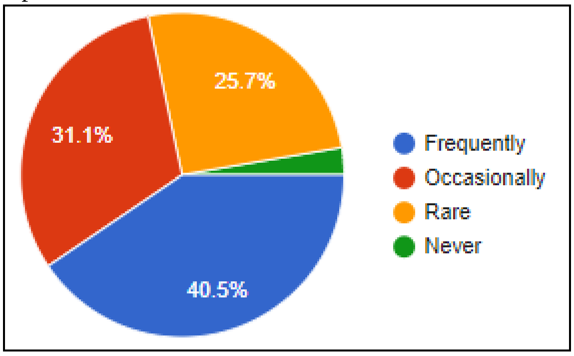

Figure 4.1

40.5% (30) of participants visit radiation area frequently, 31.1% (23) occasionally, 25.7% (19) rarely and least number 2.7% (2) of them has never visited a radiation area.

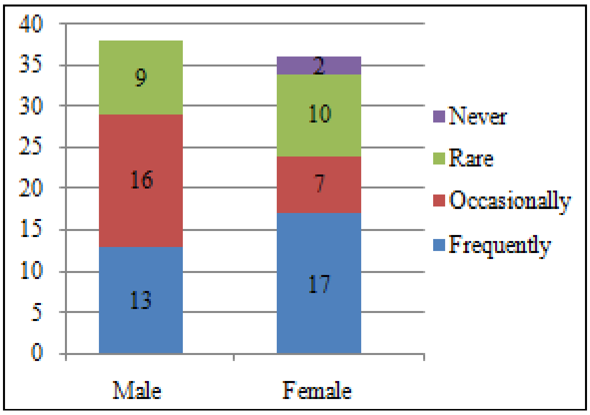

Figure 4.1.1

From chart 4.1.1, Compared to male participants (13), female participants (17) visit radiation area more frequently. Majority of the male participants visit radiation area occasionally (16) compared to females (7). There are no males who never visited radiation area while 2 female participants have never been to a radiation area. 9 participants from the males and 10 participants from the females rarely visited an area with radiation source.

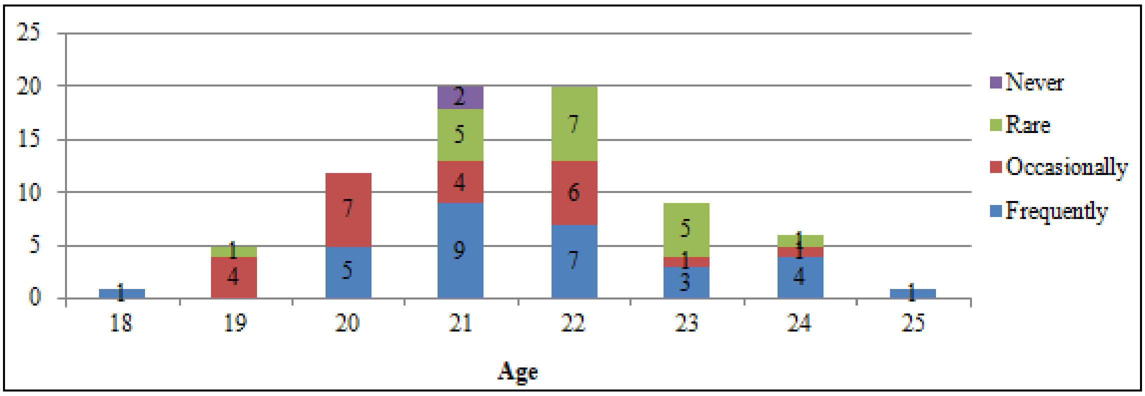

Figure 4.1.2

9 participants from age group 21 frequently visit radiation area, followed by 7 participants of age 22, 5 participants of age 20, 4 participants from age 24, 1 participant each from age 18 and 25. 7 of them from age group 20, 6 from age 22, 4 from age group 19 and 21 each and 1 from age 23,24 each have occasionally visited a radiation area. 7 participants from age group 22 have rarely visited an area which contains radiation exposure, followed by 5 of them each from age 21 and 23 each, and 1 of each from age group 19 and 24. Only 2 participants from age group 22 have never visited a radiation area.

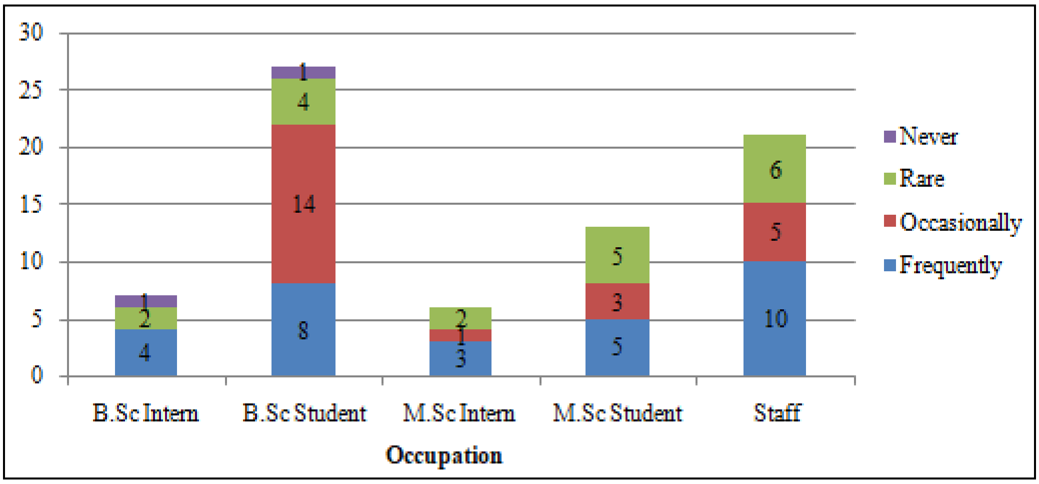

Figure 4.1.3

10 staff has chosen to frequently visit radiation area, followed by 8 B.Sc students, 5 M.Sc students, 4 B.Sc Interns and 3 M.Sc Interns. 14 B.Sc students, 5 staff, 3 M.Sc students and only1 M.Sc Intern has occasionally visited the radiation area. 6 staff has rarely visited the radiation area followed by 5 M.Sc students, 4 B.Sc students and 2 B.Sc and M.Sc Interns. 1 B.Sc Intern and 1 B.Sc student have never visited the radiation area.

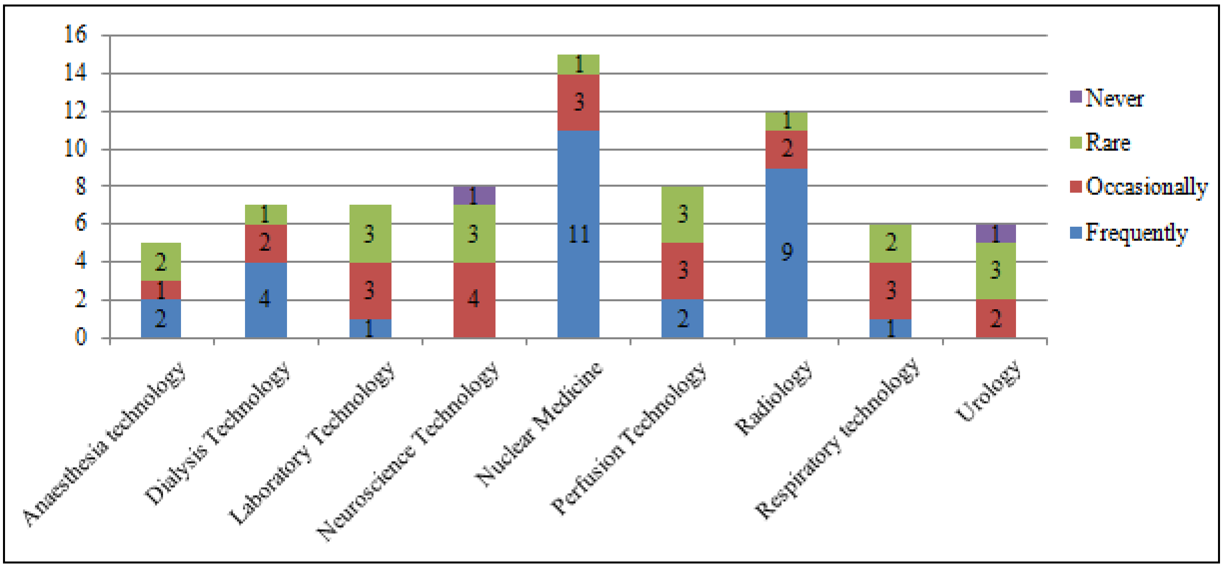

Figure 4.1.4

11 participants from Nuclear Medicine Department have frequently visited radiation area, followed by 9 participants from radiology department, 4 participants from Dialysis Technology, 2 participants from Anesthesia and Perfusion Technology, and 1 participant each from Laboratory and Respiratory Technology. 4 participants from Neuroscience Technology, 3participants each from Laboratory Technology, Perfusion Technology, Nuclear medicine technology and Respiratory technology have visited the radiation area occasionally. 3 participants each from urology, perfusion technology, Neuroscience technology, Laboratory technology have rarely visited radiation area, followed by 2 participants each from anesthesia technology and respiratory technology and 1 participant from Dialysis Technology, and 1 from Radiology department each. 1 participant each from Neuroscience technology and urology has never visited a radiation area.

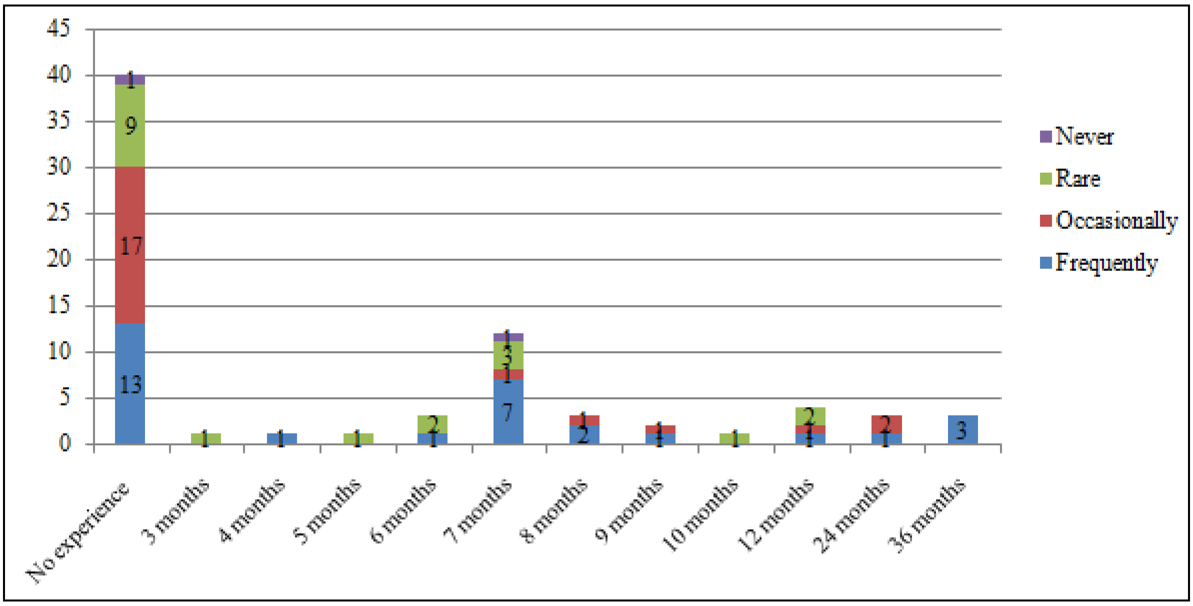

Figure 4.1.5

13 participants with no clinical experience, 7 participants with 7months experience, 3with 36 months experience, 2from 8 months experience and 1 participant each with 4 months, 6 months, 9 months, 12 months and 24 months experience have frequently visited the radiation area. 17 participants with no experience have occasionally visited the radiation area followed by 2 with 24 months and 1each with 12 months, 9 months, 8 months experience. 9 participants with no experience, 3 with 7 months experience, 2 participants each with 6 months and 12 months experience

and 1 participant each with 3 months, 5 months, 10 months experience have rarely visited the area with radiation exposure.1 participant each with no experience and 7 months experience have never visited a radiation area.

Is there any ionizing radiation source present in your department
74 responses

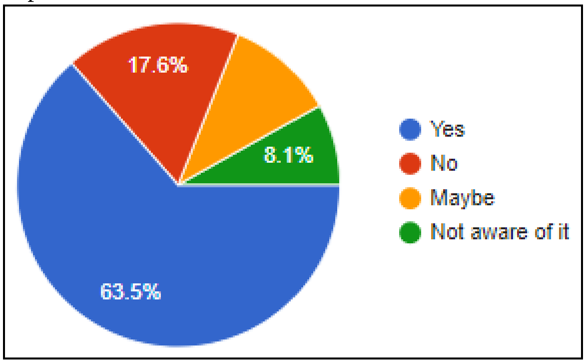

Figure 4.2

From Fig 4.2, 63.5% (47) participants have identified the presence of ionizing radiation source in their respective department, while 17.6% (13) respondents responded that there is no ionizing radiation source in their department. Rest of them is not sure 10.8% (8) and not aware 8.1% (6) of it.

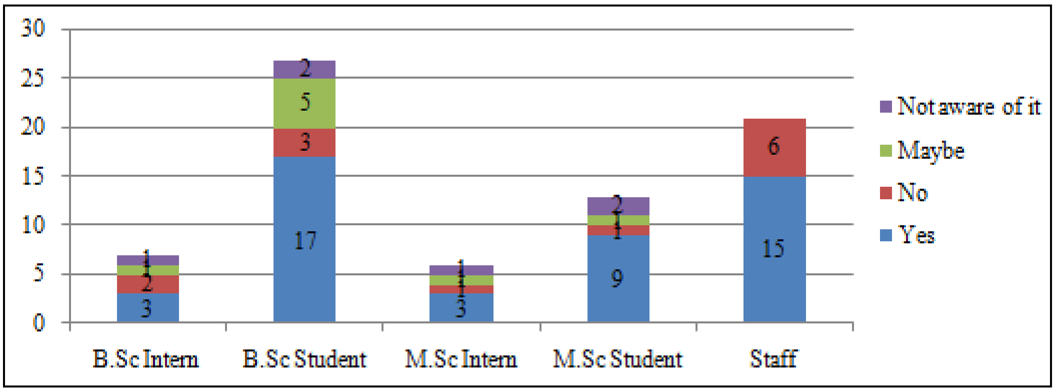

Figure 4.2.1

17 B.Sc students were able to identify the source of radiation in their respective departments, followed by15 staff, 9 M.Sc students, 3 B.Sc Interns and 3 M.Sc Interns. 6 staff, 3 B.Sc students, 2 B.Sc Intern and 1 M.Sc Intern and M.Sc student were not able to identify the source of radiation. 5 B.Sc students answered that they might be able to identify the source of radiation in their department followed by 1 participant each who belonged to the category of B.Sc Intern, M.Sc Intern and M.Sc student. 2 B.Sc students, 2 M.Sc students and 1 B.Sc Intern were not aware of the source of radiation.

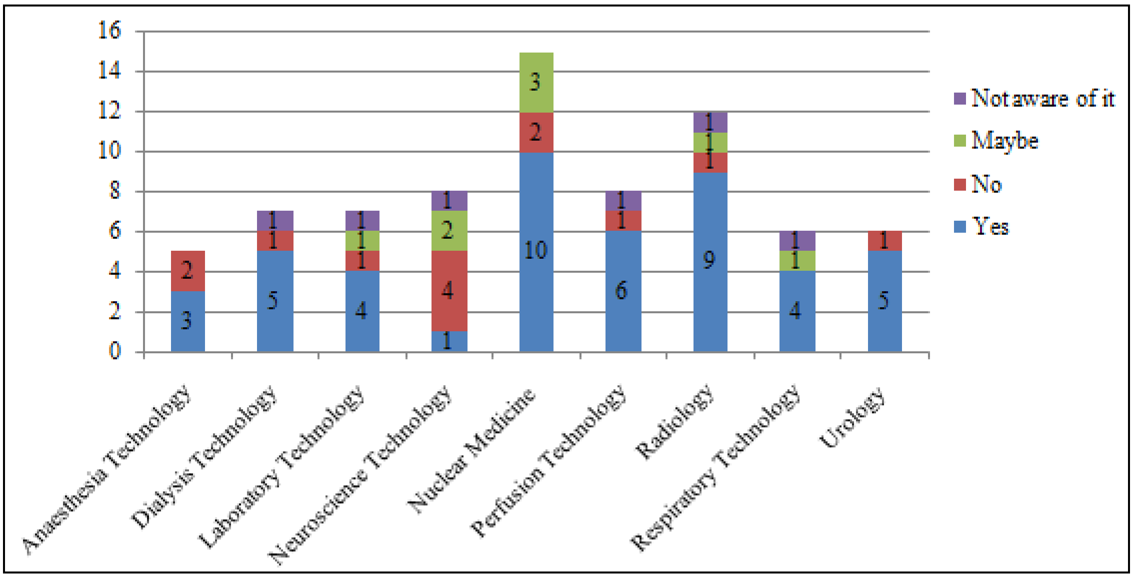

Figure 4.2.2

10 participants from Nuclear medicine department were able to identify the source of radiation in their department followed by, 9 from radiology, 6 from perfusion technology, 5each from dialysis technology and urology, 4each from laboratory technology and respiratory technology, 3 from anesthesia technology and 1 participant from neuroscience technology. 4 participants from neuroscience technology, 2 each from anesthesia technology and nuclear medicine technology, and 1 each from dialysis technology, laboratory technology, perfusion technology, radiology and urology were not able to identify the source. 3 participants from nuclear medicine technology thought they could be able to identify the source of radiation followed by 2 participants form neuroscience technology and 1 participant each from laboratory technology, radiology and respiratory technology. 1 each from dialysis technology, laboratory technology, neuroscience technology, perfusion technology, radiology and respiratory technology were not aware of the source of radiation.

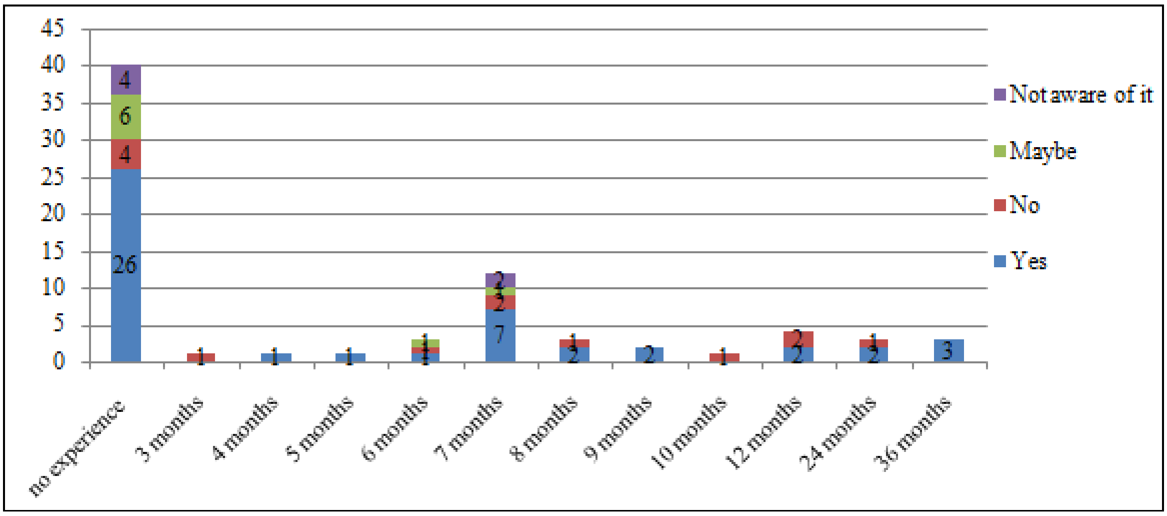

Figure 4.2.3

26 participants with no clinical experience, 7 participants with 7months experience, 3 with 36 months experience, 2 with 8 months, 9 months, 12 months and 24 months experience and 1 participant each with 4 months, 5months and 6 months experience were able to identify the source of radiation. 4 participants with no experience were not able to identify the source of radiation followed by 2 participants with 7 months and 12months experience, 1 each with3 months, 6 months, 8 months, 10months and 24 months experience.6 participants with no experience and 1 participant each with 6 months and 7months clinical experience feel that they might be able to identify the source of radiation in their respective departments. 4 participants with no clinical experience and 2 participants with 7 months experience are not aware of it.

Have you ever worn lead apron and thyroid collar in presence of radiation exposure
71 responses

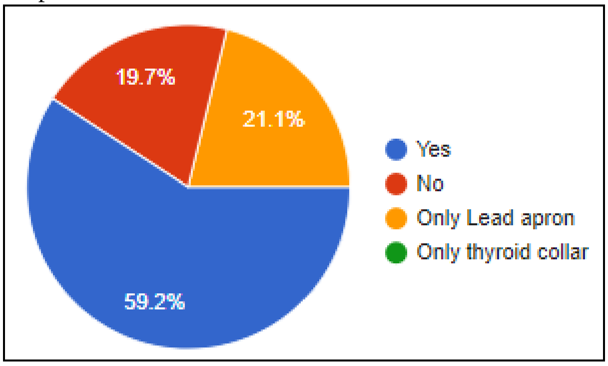

Figure 4.3

59.2% (42) of participants have worn a lead apron and thyroid collar in the presence of radiation exposure, while 21.1% (15) of them only wore lead apron.19.7% (14) never wore it and none of them wore only thyroid collar.

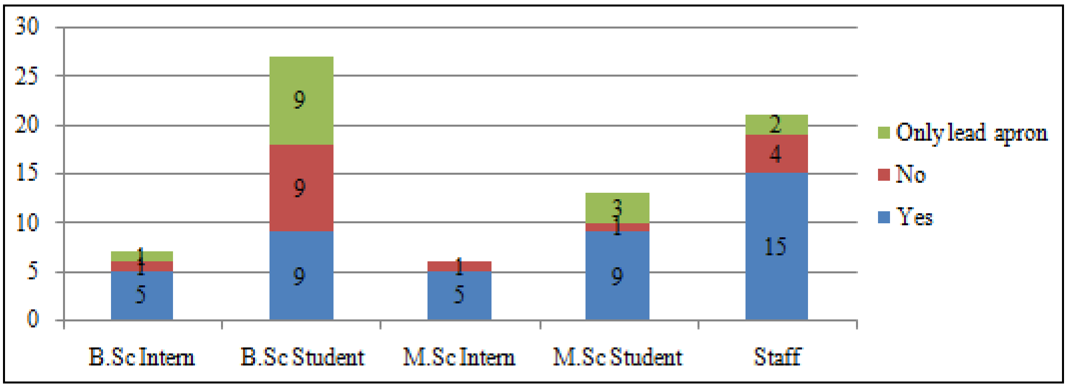

Figure 4.3.1

From Fig 4.3.1 15 staff wore the precautionary lead apron and thyroid collar in presence of radiation exposure followed by 9 M.Sc and B.Sc students each and 5 B.Sc and M.Sc Interns each. 9 B.Sc students, 4 staff, 1 participant each who belonged to the category of B.Sc Interns, M.Sc Interns and M.Sc students did not wear both lead apron and thyroid collar. 9 B.Sc students wore only lead apron followed by, 3 M.Sc students, 2 staff and 1 B.Sc Intern.

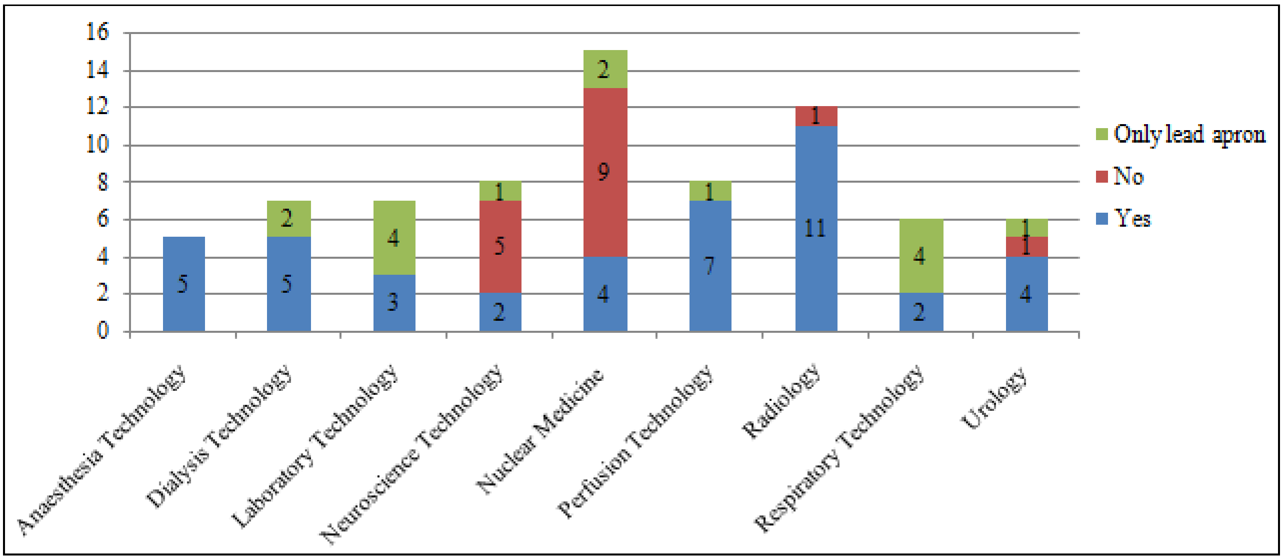

Figure 4.3.2

11 participants from the radiology department wore lead apron and thyroid collar in the presence of radiation exposure followed by 7 from perfusion technology, 5 each from anesthesia and dialysis technology, 4 each from urology and Nuclear medicine technology, 3 from laboratory technology and 2 each from Neuroscience and respiratory technology did not wear lead apron and thyroid collar. 4 participants each from laboratory and respiratory technology wore only lead apron, followed by 2each from dialysis and nuclear medicine technology and 1 participant each from neuroscience, perfusion technology and urology.

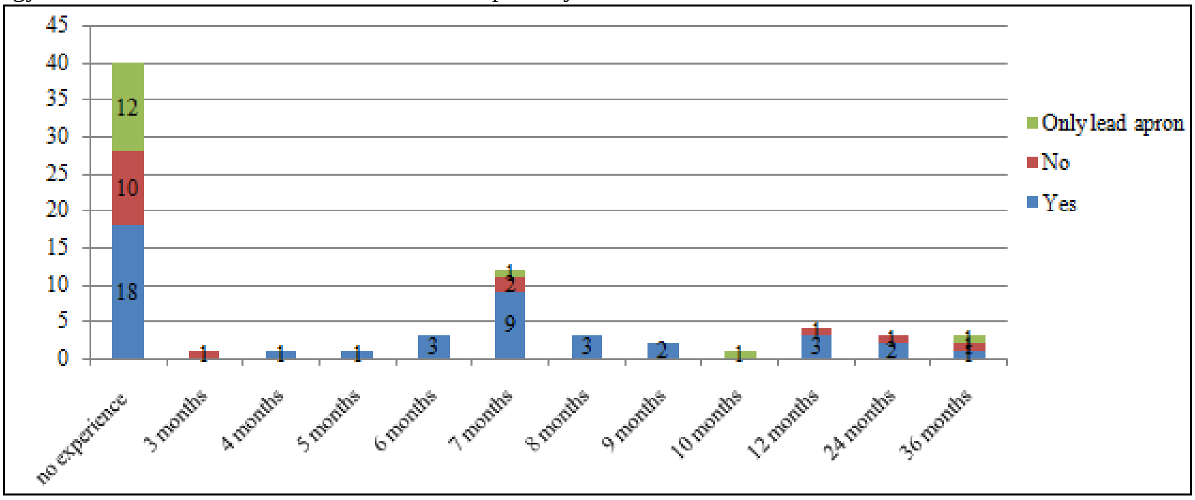

Figure 4.3.3

18 participants with no experience and 9 participants with 7 months experience wear lead apron and thyroid collar followed by, 3 each with 6 months, 8 months and 12 months clinical experience, 2 each with 9 months, 24 months experience and 1 participant each with 4months, 5months and 36months experience. 10 participants with no experience, 2 participants with 7 months experience, 1each with 3months, 12 months, 24 months and 36 months experience did not wear both lead apron and thyroid collar. 12 participants with no experience and 1 each with 7 months, 10 months and 36months experience wore only lead apron.

Is training regarding radiation protection, safety and hazards necessary to all healthcare workers?
74 responses

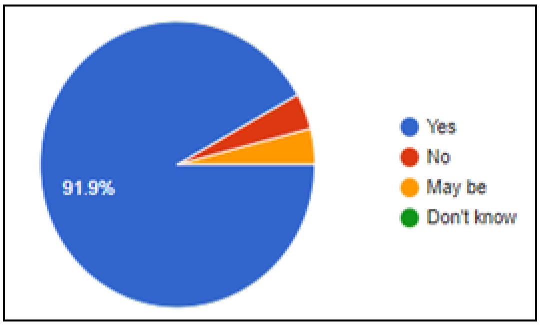

Figure 4.4

From Fig 4.4, 91.9% (68) participants have responded that training for all healthcare workers about radiation protection, safety and hazards is necessary. Some of them responded that it is not required 4.1% (3) and some are not sure 4.1% (3) about it. None of them responded that they do not know about it.

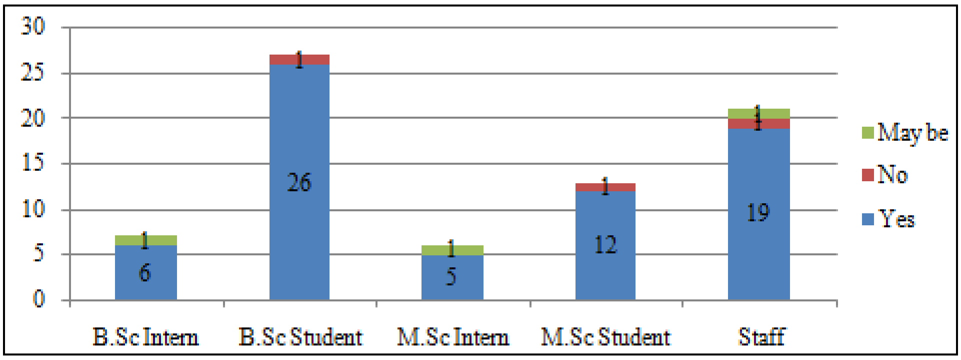

Figure 4.4.1

From Fig 4.4.1, 26 B.Sc students feel radiation safety, protection training is necessary followed by 19 staff, 12 M.Sc students, 6 B.Sc Interns and 5 M.Sc Interns. 1 B.Sc , M.Sc student and staff think it is not necessary for health workers to attend the radiation training. 1 B.Sc and M.Sc Intern each and 1 staff are not sure and think it might be necessary.

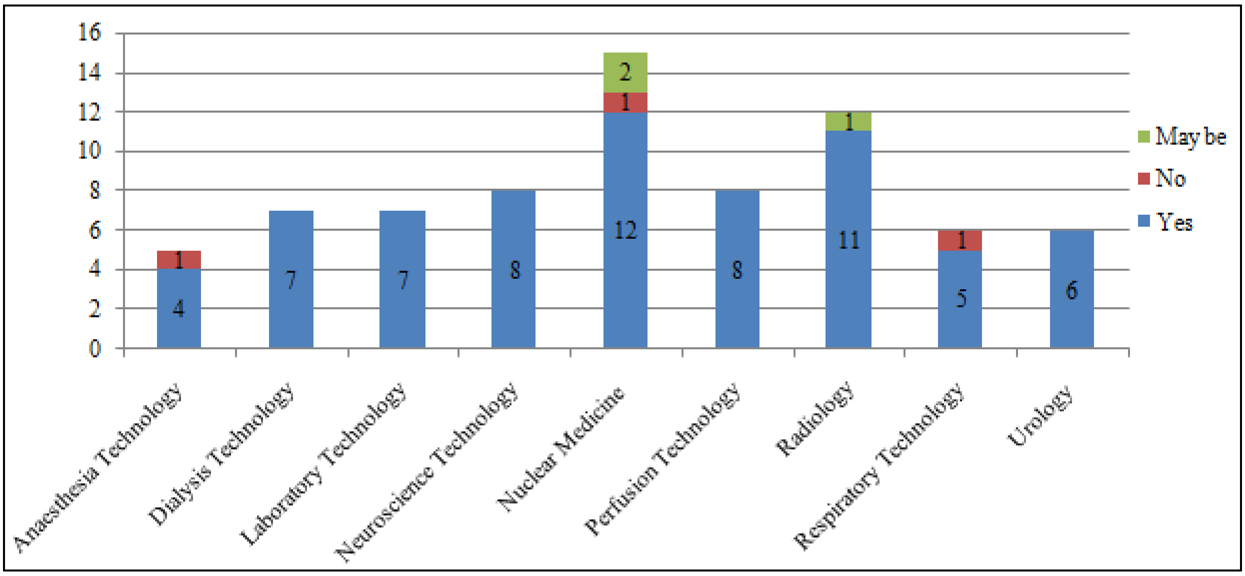

Figure 4.4.2

12 participants from Nuclear medicine technology feel that radiation training is necessary followed by 11 from radiology, 8each from neuroscience and perfusion technology, 7each from dialysis and laboratory technology, 6from urology, 5 from respiratory technology and 4 participants from anesthesia technology. 1 participant each from anesthesia technology, nuclear medicine technology and respiratory technology think it is not necessary. 2 participants from nuclear medicine technology and 1 participant from radiology think it might be necessary for the

healthcare workers to get the radiation training.

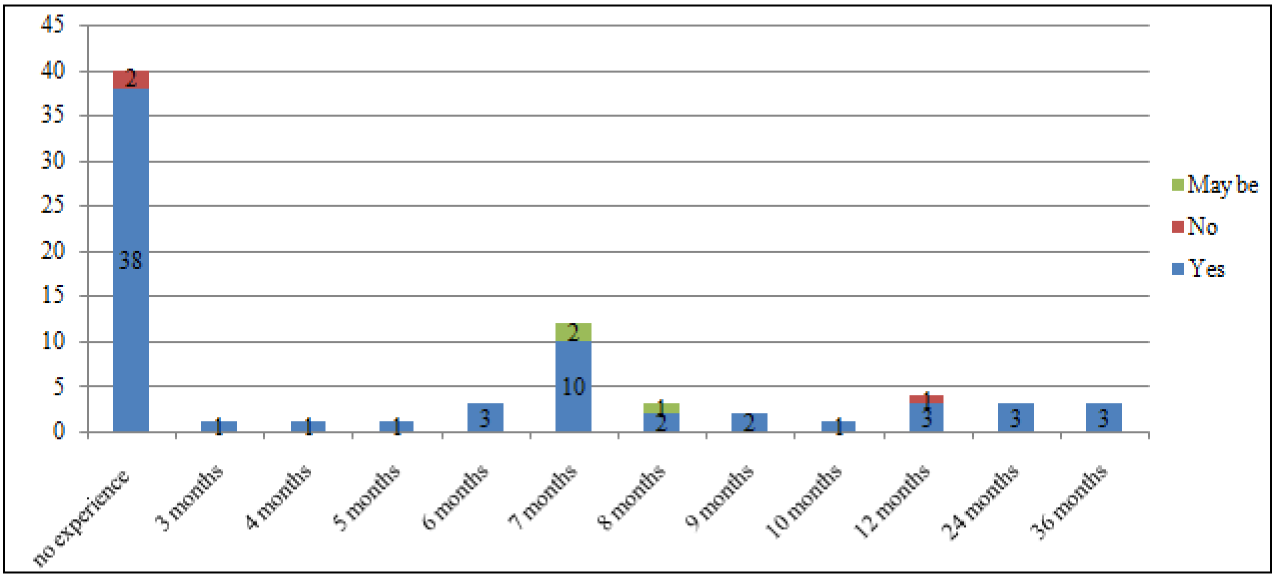

Figure 4.4.3

38 participants with no experience, 10 participants with 7 months experience, 3 participants each with 6 months, 12 months, 24 months, 36 months experience, 2 participants with 8 months and 9 months experience each and 1 participant each with 3 months, 4months, 5months and 10 months experience feel that radiation training is necessary. 2 participants with no experience and 1 participant with 12 months experience think that the training is not necessary. 2 participants with 7months experience feel that the training might be necessary.

6. Discussion

Radiation workers or other hospital workers, who come in contact with radiation exposure, do not receive direct radiation exposure from the source when proper personal protective equipments are used and precautions are taken. But they do receive scatter radiation which is extremely variable. This increases the risk of leukemia, multiple myeloma or solid cancers in radiation workers as reported in the article- Historical review of occupational exposures and cancer risks in medical radiation workers written by Linet MS, Kim KP et al., published in Radiat Res.December 2010; 174 (6): 739-808. Radiation effects are biologically induced in the human body either by directly damaging the DNA or indirectly by producing ROS (Reactive Oxygen Species). 70% of the biological effects in the body due to radiation is caused due to ROS. (Iman M Ahmad, Maher Y. Abdalla et al., NCBI Resources Jan; 8(1): 12)

To avoid the harmful effects of radiation exposure, dose limits were fixed by ICRP (International Commission on Radiological Protection), which ensures that no person is exposed to an excessive amount of radiation either in normal or planned situations. The ICRP says that the dose limits alone do not help an individual stay safe from radiation effects but it is just a parameter to be followed along with some fundamental principles such as justification and optimization. The dose limit is set on the basis of radiation exposure received excluding the natural background radiation. These limits are implemented only in planned exposure situations. The most important aspect of this dose limit is that it is specific only to workers and not to patients as it does not apply for medical exposures. The main motive is in justifying the medical procedures and optimization of protection. Effective dose combined with optimization of protection together is set to avoid the risks occurrence of stochastic effect, while equivalent dose specific to an organ combined with optimization of protection is set to avoid risks of occurrence of deterministic effects. (ICRP Publication 103)

Thus it is important that all healthcare workers and paramedical students wanting to purse career in a healthcare set up to know the basic dose limits, safety measures, protection from radiation and effects caused due to radiation to avoid unnecessary radiation exposure and the risks of occurrence of stochastic, deterministic effects. Questionnaire was setup with answers of ICRP standards.

In section 2, 5 questions related to radiation protection and safety were present. The right answers to each question and the interpretation of the results obtained are discussed below-

The right answer for question number 7 is Thermo-Luminoscence Dosimeter. It is used by all the radiation workers who are regularly present in radiation area, to monitor the dose received by the individual. It is specific to the individuals and cannot be shared. People who visit the radiation area very rarely and occasionally can make use of pocket dosimeter which gives instant readings and can be reused. The other options mentioned were Survey meter, which is used to monitor the area levels and contamination levels of radiation in a particular area, Dose calibrator which is used to measure the radioactivity level of radioactive materials and thyroid probe which is used to measure the counts received from thyroid gland after administration of radioactive substance. From Fig 2.1, 77% of the total participants chose the right answer. Since the questions was about personal monitoring device, the rest of the participants would have got carried away by the name Survey meter in which survey means to measure and dose calibrator which again means to measure the dose. None of the participants chose thyroid probe maybe because it wasn't relating to the question.

The right answer to question 8 (Fig 2.2) is As Low As Reasonably Achievable. This question can be answered only if there is good knowledge about radiation protection. The three basic principles of ALARA is time, distance, shielding. Majority of them chose the right answer while only few of the respondents chose the other options may be due to interchanging of the words which are closely linked to the right answer.

The right answer to question 9 (Fig 2.3) is 100 mSv averaged over 5 years. Majority of them chose the right answer while some of them chose other options maybe due to lack of recollection or insufficient training or no training at all.

The correct answer to question 10 (Fig 2.4) is Lens 15 mSv and extremities 50 mSv. Majority of them gave the right answers while almost equal number of them chose the answer Lens 50 mSv and extremities 15 mSv. This might be due to negligence (as both answers are almost similar with interchange in numbers), lack of clear understanding or lack of clarity. The rest of the participants who chose the other answers were maybe not aware of it and chose an option as it was compulsory to answer a question to move on to next question.

The correct answer for question 11 (Fig 2.5) is both area and contamination monitoring. Since it is well known and a basic question, majority of the participants chose the right answer while a noticeable number of participants chose personal monitoring as the answers which is in no way related to the question. These answers may be given by participants with no radiation training.

While comparing the demographic data to overall right answers in section 2, from Fig 5.1 it is clear that all right answers were majorly given by participants of age 21. This might be due to more number of participants of age 21 .6 B.Sc Students and Staff gave correct answers to all questions in section 2 (Fig 5.2) which is probably due to good training during the student period and good training at workplace. From Fig 5.3 it is obvious that more number of participants from Nuclear Medicine department answered all questions in section 2 correctly followed by participants of radiology. Since participants from Nuclear Medicine and Radiology are familiar with these questions due to regular tests, revision or trainings and inclusion of this topic in their curriculum it would have been easy for them to give the right answers. Surprisingly, more number of participants (Fig 5.4) with no clinical experience gave all right answers in section 2.

Section 3 contains questions related to risks associated with radiation. Correct answers for the questions in this section are discussed below along with interpretation of the results obtained-

The right answer to question number 12 (Fig 3.1) is cancer. It is the classic example of the effects on human body due to stochastic effect. Stochastic effect triggers cell modification mechanisms. It is probabilistic in nature and does not have a threshold. It can occur even with exposure to low doses. The other options Hair fall; Skin rashes and nausea are caused due to the deterministic effect. Deterministic effect is the right opposite of stochastic effect. It initiates cell killing mechanism. It has a threshold and the severity increases with increase in dose. It occurs only at high doses. From Fig 3.1 it is visible that majority of the participants chose the right answer while some of them chose skin rashes and hair fall which might be due to lack of clarity on the concept or lack of awareness. Nausea was not chosen by anyone maybe because the participants thought that nausea was only a side effect for drugs and not for radiation, but it is a symptom for deterministic effect.

The correct answer for question number 13 is all of the above. From Fig 3.2, Majority of the participants chose the right answer while some of them chose rest of the options. Since it is a general question which can be thought and answered very easily most of the participants would have chosen then right answer. Rest of the answers would have been chosen due to sheer guess work.

Radiopharmacy is the right answer for question number 14. From Fig 3.3, it is seen that majority of them chose the wrong answers while less than 50% of them chose the correct answers. Correct answers would have most been chosen by students, staff or interns of Radiology and Nuclear Medicine, while rest of the participants would have chosen the other options due to lack of awareness or due to confusion.

The correct answer for question 15 is Magnetic Resonance Imaging. From Fig 3.4, it is clearly seen that almost 3/4th of the total number of participants gave the right answer. Since it is commonly known to medical professionals and most of the common man, it would have been answered correctly. Magnetic Resonance Imaging is used to image the soft tissues of the human body. It is a spectroscopic technique which uses magnetic field and radio waves. It does not involve ionization radiation. Note able number of participants chose DEXA scan as the answer may be due to lack of awareness that its full form is Dual Energy X-ray Absorptiometry.

The right answer for question 16 (Fig 3.5) is receiving high dose in short span of time. The answers were set slightly with tricky changes to know how confidently the participants chose the right answer. Surprisingly most of them chose the right answer while others would have got confused and chose the wrong answers.

When the participants who gave all right answers to questions of section 3 were classified demographically, maximum number of participants of age group 21 (Fig 6.1) answered all 5 questions correctly in section 3. It is probably due to more number of participants belonging to this age group. It is surprising from (Fig 6.2) that none of the M.Sc Interns, inspite of having some clinical experience, answered all questions of section 5 correctly, while 3 B.Sc students and 3 M.Sc students did. From (Fig 6.3) it is obvious that Nuclear Medicine students, interns and staff have scored more than any other department in giving right answers to all questions in this section, followed by radiology. this might be due to adequate training and knowledge in this topic. Unexpectedly, it is visible from (Fig 6.4) that more number of participants without any clinical experience have answered all questions correctly in section 3 followed by some participants with 7 months of experience. Inclusion of this topic in curriculum could be a strong reason for this result.

In section 4 each question is correlated to demographic data of the participants as the questions do not have a right and wrong answer; they were set to show how many participants had previous training in radiation safety and protection. Considering the fact that females are more prone to get affected due to radiation due to more number of reproductive tissues compared to males, it is surprising from (Fig 4.1.1) that more number of females have visited the radiation area compared to male. Most of the participants of age 21 have agreed to have visited the radiation area frequently (Fig 4.1.2); this may be due to clinical exposure as a part of their curriculum. As the work of the staff involves patient care which may sometimes involve medical imaging, as expected (Fig 4.1.3) more number of staff has visited the radiation area frequently. Since Nuclear Medicine and Radiology department are radiation areas, participants of these groups have mostly chosen to have been frequently visiting radiation area. Participants of Urology and Neuroscience Technology department do have the necessity to visit a radiation area frequently but only once in a while so they chose to have occasionally visited the radiation area (Fig 4.1.4). Generally, students are not allowed to enter radiation area without a TLD, but from (Fig 4.1.5) it is shocking that more number of participants without any experience have frequently visited the radiation area. There is a high chance that this might be due to participation of more number of people in the survey with no clinical experience as such (students).

From (Fig 4.2.1) it is clear that more number of B.Sc students have identified the source of radiation than staff. This could possibly be due to inclusion of more number of B.Sc students as participants. As expected more number of participants from Nuclear Medicine and Radiology department has identified the radiation source in their respective departments (Fig 4.2.2). As these are the primary radiation area in a hospital, it is the first thing that is taught to be safe and avoid unnecessary exposure to students of these departments. Almost at least few of the other participants from each department did identify the source of radiation which could be due to training session or good curriculum. Unexpectedly, majority of the participants without any experience have identified the source while only few participants with experience did (Fig 4.2.3). This might be due to lack in repetition of training for the staff and continuous assessments in case of students with no experience.

From Fig 4.3.1 it is visible that more number of staff has worn lead aprons and thyroid collars. This might be due to adequate training or awareness. From 4.3.2, more number of participants of radiology department has used the lead apron and thyroid collar for protection against radiation exposure. In contrary majority participants of nuclear medicine department did not use it. This may be due to ineffectiveness of the lead shield against gamma rays and due to an effect called bremsstrahlung radiation which is caused when beta rays (used for therapy/treatment) interact with lead. This causes further harmful effects to human body. It can be worn in presence of only gamma rays. Rest of the departments has given mixed responses. From Fig 4.3.3, almost all participants who have clinical experience have agreed to have worn thyroid collar and lead apron or at least only the lead apron. This may be the result of awareness. On the other hand, considerable number of participants, without any experience has also agreed to have worn the lead apron and thyroid collar. This may be due to their occasional visits to the radiation area as a practical session.

Fig 4.4.1 shows that almost all participants ranging from B.Sc students to staff have chosen that training regarding radiation protection, safety and hazards is essential to all healthcare workers. Almost majority of the participants from each department agree to the requirement of training. (Fig 4.4.2) Participants with and without clinical experience agree to it too (Fig 4.4.3). All this may be due to awareness of the hazards caused due to human health due to radiation and will to learn new and important lessons as a paramedical student, intern or staff.

All these findings correlate with majority of the findings mentioned in the review of literature.

Limitations of this study-

- Small sample size
- Most number of participants of age 21 and 22
- More number of B.Sc students
- Time limit given was short

7. Conclusion

From the data obtained through online survey, the following points can be concluded-

- Radiology and Nuclear Medicine students and staff learn about radiation and its effects more than the other departments. So this study gave an opportunity to compare if the other department students/staff have equal knowledge about radiation and its effects compared to the Radiology and Nuclear Medicine students/staff. As expected the study proved that more number of right answers was given by these two departments compared to the rest and only a minimal number of participants from other departments gave the maximum number of right answers. Comparatively the awareness was low in other departments
- Overall B.Sc students, M.Sc students and Staff had more knowledge compared to M.Sc interns and B.Sc interns which shows that the former categories require more training sessions. More number of B.Sc students participated in this study which is another significant point for maximum number of right answers from this category
- Participants without any experience answered most of the questions correctly. B.Sc and some M.Sc students fall under this category. Since the study population consist more number of B.Sc and M.Sc students and that students

have regular assessments, this result was obtained. Due to clinical experience and exposure to various departments in the hospital, staff were also able to answer lot of questions with correct option

- In total 97.3% of the participants have visited the radiation area at least once but only 63.5% of them were aware of the radiation source and only 59.2% of them wore lead apron and thyroid collar while visiting radiation area. This means out of 97.3% who visited the radiation area, 33.8% of the participants of them entered the area without identifying source, 77.6% did not wear either lead apron alone or both lead apron and thyroid collar. This means that these participants were at higher risk of radiation exposure due to lack of knowledge on radiation safety and protection. Experience and the number of correct answers were inversely proportional which is a significant point
- 91.1% of the participants have answered that the training is necessary to all healthcare workers, which proves that the importance of this topic is known to these participants yet there is lack of training sessions which emphasizes the need for this study
- Overall the awareness level was low. Effective and frequent training is necessary to all healthcare workers and paramedical students to improve the quality of knowledge on radiation protection, safety and hazards to avoid unnecessary exposure to radiation to the workers, students and patients

8. Recommendations

Based on this study, some of the modifications that could be done for better and clear results are recommended as follows-

- A sample size more than 100 would give a better picture of the level of awareness among the participants who belong to the category of healthcare workers or paramedical students
- More number of staffs, M.Sc students, interns and B.Sc interns should be included, in further studies as this study predominantly had B.Sc students
- Participants of wide range of age group should be included for better results as this study shows more number of right answers from age group 21 only because the number of participants of that age group is high
- Time limit given should be increased, as the time period of this study was less, there were only 74 participants, if time limit increases, the sample size increases
- Since experience of staff, interns and students were generalized, it was difficult to categorize the right answers based on the experience. Experience should be classified if it is an experience as a staff, student etc
- In future studies, including doctors and nurses level of knowledge will give a wider range of idea
- The question "Has radiation training been given to you before?" would also add more value to this topic

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Annexure

AWARENESS OF RADIATION PROTECTION, SAFETY AND HAZARDS
Among healthcare workers and paramedical staff
*Required

Participation Details
Demographic Details

1) Name* ______________________________
2) Gender
   Mark only one oval
   Female ☐ Male ☐
3) Age* ______________________________

4) Occupation *
Mark only one oval
- ☐ B.Sc Student
- ☐ M.Sc Student
- ☐ B.Sc Intern
- ☐ M.Sc Intern
- ☐ Staff

5) Department *

____

6) Working experience, If any
If student, mention 0

____

Radiation Protection and Safety

7) Which of the following is a personal monitoring device *
Mark only one oval
- ☐ Thermo-Luminoscence Dosimeter
- ☐ Survey meter
- ☐ Dose calibrator
- ☐ Thyroid probe

8) Abbreviation of ALARA
- ☐ As little As Relatively Achievable
- ☐ As less As Reasonably Achievable
- ☐ As low As Reasonably Achievable
- ☐ As low As Relatively Achievable

9) What is the effective dose limit (whole body) for radiation workers? *
- ☐ 100 mSv averaged over 5 years
- ☐ 100 mSv per year
- ☐ 150 mSv per year
- ☐ 150 mSv averaged over 3 years

10) What is the effective dose limit (lens and extremities) for public? *
- ☐ Lens 50 mSv, extremities 15 mSv
- ☐ Lens 20 mSv, extremities 15 mSv
- ☐ Lens 15 mSv, extremities 50 mSv
- ☐ Lens 15 mSv, extremities 20 mSv

11) Survey meter is used for which of the following
- ☐ Personal monitoring
- ☐ Only for Area monitoring
- ☐ Only for contamination monitoring
- ☐ Both area and contamination monitoring

Biological Hazards of Radiation

12) Which of the following is caused due to stochastic effects
- ☐ Skin Rashes
- ☐ Cancer
- ☐ Hairfall
- ☐ Nauses

13) Which of the following is considered as misadministration of radiopharmaceutical*
- ☐ Wrong radiopharmaceutical
- ☐ Wrong patient and activity
- ☐ Wrong route
- ☐ All of the above

14) Which of the following is source of radiation in Nuclear Medicine Department*

- ☐ Gamma camera
- ☐ Radiopharmacy
- ☐ Both Gamma Camera and Radiopharmacy
- ☐ Console room

15) Which of the following diagnostic procedure does not require radiation*
- ☐ Position Emission Tomography
- ☐ Magnetic Resonance Imaging
- ☐ Computed Tomography
- ☐ Dexa

16) Deterministic effects occur due to*
- ☐ Receiving high dose in short span of time
- ☐ Receiving low dose in short span of time
- ☐ Receiving high dose over a long period of time
- ☐ Receiving low dose over a long period of time

Frequency of exposure to radiation

17) How often do you visit radiation area*
- ☐ Frequently
- ☐ Occasionally
- ☐ Rare
- ☐ Never

18) Is there any ionizing radiation source present in your department
- ☐ Yes
- ☐ No
- ☐ Maybe
- ☐ Not aware of it

19) Have you ever worn lead apron and thyroid collar in presence of radiation exposure
Answer this question only if you have visited radiation area
- ☐ Yes
- ☐ No
- ☐ Only lead apron
- ☐ Only thyroid collar

20) Is training regarding radiation protection, safety and hazards necessary to all healthcare workers? *
- ☐ Yes
- ☐ No
- ☐ Maybe
- ☐ Don't know

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