Dissertation Title

"ASSESSING AWARENESS AND PRACTICES IN AREA OF RADIATION SAFETY FOLLOWED IN NATIONAL HEART INSTITUTE"

A Dissertation Proposal for

Post Graduate Diploma in Health and Hospital Management

by

Rituparna Ganguly
Roll No. PG/11/081

International Institute of Health Management Research
New Delhi

Internship Completion Certificate

INDIAN INSTITUTE OF NUCLEAR MEDICINE & SCANNING

I/S National Heart Institute, 49/50 Community Center, East of Kailash
New Delhi - 110065

Dr. AWADHESH PANDEY
Sr. Consultant & Head
Ex: FACULTY N.I.M.S. HYDERABAD
Mob-9815099999

Tel. No. : 011-46520151
Fax : 011-26225733
E-mail : scans_01@yahoo.com

Certificate of Internship Completion Date:.....

TO WHOM IT MAY CONCERN

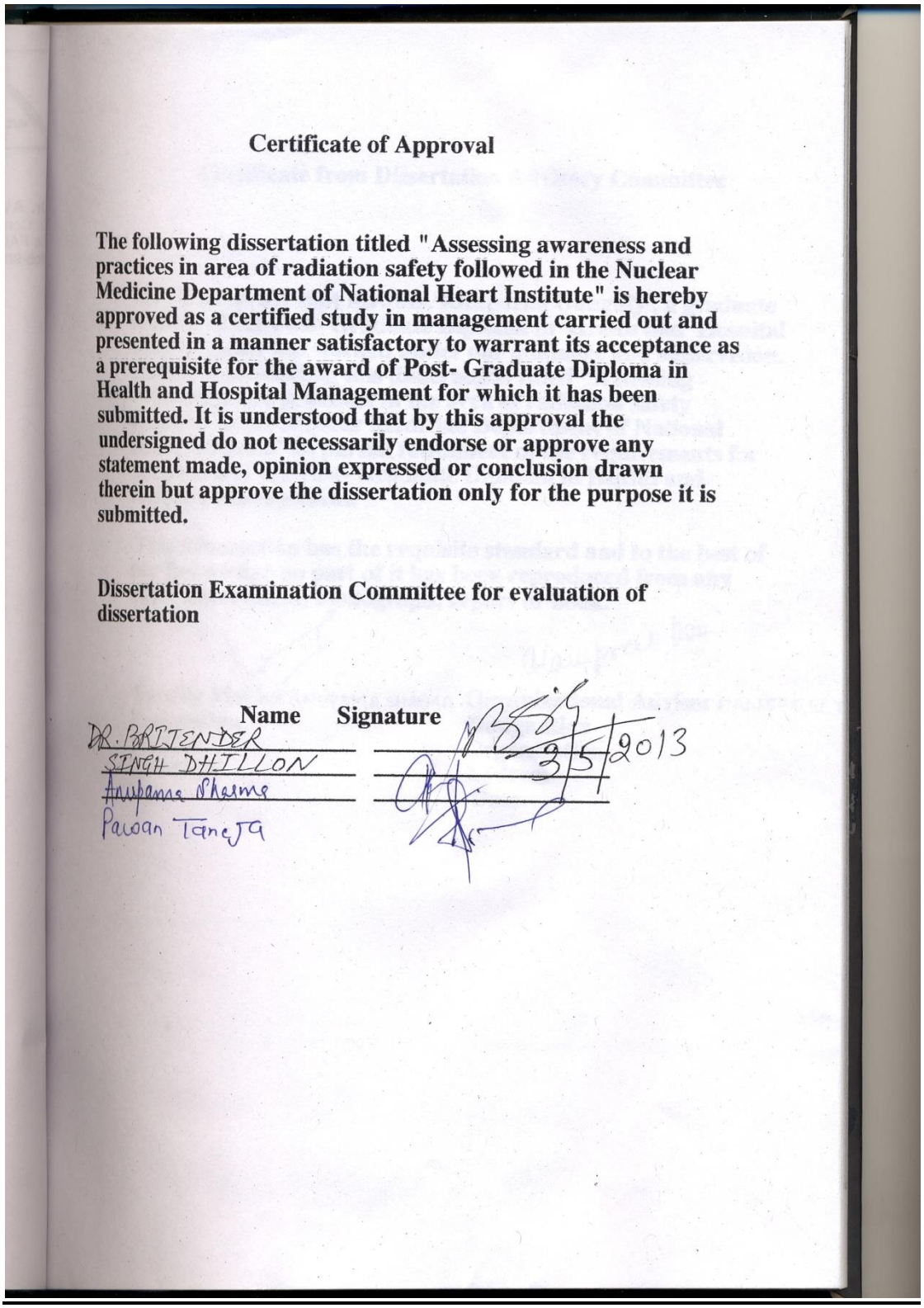
This is to certify that Ms. RITUPARNA GANGULY has successfully completed her 3 months internship in our organization from January 11, 2013 to April 30, 2013. During this internship she has worked on RADIATION SAFETY AWARENESS under the guidance of me and my team at IINMAS. During the time of internship she was found hardworking, sincere and dedicated. We wish her good luck for her future assignments

(Signature)

Dr A PANDEY **(Name)**

Sr. CONSULTANT **Designation**

Approval Certificate



Certificate of Approval

The following dissertation titled "Assessing awareness and practices in area of radiation safety followed in the Nuclear Medicine Department of National Heart Institute" is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of Post- Graduate Diploma in Health and Hospital Management for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name	Signature
DR. BRIJENDER SINGH DHILLON	3/5/2013
Anupama Sharma	
Pawan Taneja	

Dissertation Advisory Committee

Certificate from Dissertation Advisory Committee

This is to certify that Mr./Ms. Rituparna Ganguly , a graduate student of the Post- Graduate Diploma in Health and Hospital Management, has worked under our guidance and supervision. He/She is submitting this dissertation titled "Assessing awareness and practices in the area of radiation safety followed in the Nuclear Medicine Department of National Heart Institute" in partial fulfillment of the requirements for the award of the Post- Graduate Diploma in Health and Hospital Management.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Faculty Mentor ANUPAMA SHARMA	**Organizational Advisor** HANSPREET KAUR
Designation	**Designation**
IIHMR	**Organization**
New Delhi	**Address**
Date	**Date**

Feedback Form

FEEDBACK FORM

Name of the Student: RITUPARNA GANGULY.

Dissertation Organisation: IINMAS, NHI

Area of Dissertation: Nuclear Medicine Dept.

Attendance: Full attendance

Objectives achieved: The induction of Rity in to Nuclear Medicine dept. has been a wonderful experience and she is has manage the dept. well. All tasks given were promptly and properly addressed.

Deliverables:

Strengths: Responsible hardworking sincere can manage well.

Suggestions for Improvement:

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

Date:
Place:

Acknowledgement

I would like to extend my heartfelt gratitude towards all the personnel at “National Heart Institute” who helped me get through this project.

This project would never have been possible without those who went out of their way to help me.

I start expressing my sincere gratitude to**, Dr. Awadhesh Pandey** who gave me the opportunity to work in this renowned organization.

Sincere thanks to all staff at all levels, for helping me at each and every step of my work. Heartiest gratitude to them for making my stay and work at this place a memorable one.

Last but not the least I would like to thank my institution, my faculty members and my mentor **Ms**. **Anupama Sharma** without whose guidance this project would have been a distant reality.

Rituparna Ganguly

Signature

Hospital Profile

NATIONAL HEART INSTITUTE

National Heart Institute, brain child of doyen of Cardiology in India, Dr. S. Padmavati, was inaugurated in 1981 by the then Prime Minister of India, Mrs.Indira Gandhi, as the Clinical Research and Medical Care Delivery wing of All India Heart Foundation, with the aim of providing State-of-art Modern Cardiac Care Technology to the financially impoverished section of the society. It was intended to be a self sufficient, stand alone facility and therefore it was decided that people with paying capacity should also be taken up and the surplus generated from them be channelized for the treatment of the poor.

The National Heart Institute is the Research & Referral tertiary care Heart Hospital of the All India Heart Foundation, which acts as a nucleus for diagnosis and treatment of heart ailments and allied diseases and is equipped with state of the art equipments. Surgical services include all kinds of closed and open Heart Surgeries like Coronary Artery Bypass Surgery, off pump bypass surgery (beating heart surgery), valve repair & replacement surgeries, aortic / carotid surgeries, congenital heart surgeries including blue babies and minimally invasive (Key hole) surgeries. It has modern Cath lab facilities where procedures like Angiographies, Angioplasties, Stenting of the Coronary arteries, valvotomies correction of birth heart defects and closure of holes of the heart, Electrophysiological studies, Radio Frequency ablation, Rotablation, Intra-vascular ultrasound, pacemaker and internal defibrillator implantation are carried out. Highly qualified staff trained in India & abroad, with extensive experience in Cardiology & Cardiac Surgery service these areas.

Apart from indoor treatment, the Institute also provides comprehensive medical check-up, i.e. Executive health check-ups, at nominal rates with a view to ensuring good physical conditioning and health of all individuals. Cardiac patients with other ailments are also admitted to this hospital, as specialists for diseases other than heart are available round the clock for consultation and treatment.

The Institute has been recognised for open heart surgeries, coronary artery bypass surgery, angiography and angioplasties and other specialised cardiac treatment by the Central Govt. Health Scheme (CGHS), Employees State Insurance (ESI), and Employee Contributory Health Scheme (ECHS), besides the Governments of Himachal Pradesh, Haryana, Madhya Pradesh, Mizoram and Govt of NCT of Delhi. Ministry of Defence, Office of the Director General of Armed Forces Medical Services and Directorate General of Medical Services Naval Headquarters have recognised NHI for treatment of their employees and their families. 122 Public sector bodies, almost all the TPAs and International Organisations like World Health Organisation & UNICEF are also empanelled with the National Heart Institute.

Keeping in tune with its ethos of service to the humanity, National Heart Institute carries out regular Community outreach programmes (heart camps) and also ‘Executive Health Checks’ and ‘Recruitment Checks’ to detect cardiac problems early and take remedial action.

National Heart Institute is recognized by National Boards for post doctoral training and runs an active teaching and training programme in the specialities of Cardiology & Cardiovascular & Thoracic Surgery. It also carries out research in all facets of Cardiology & Cardiac Surgery.National Heart Institute is recognised as a Collaborative Centre of WHO in Preventive Cardiology since 1983. It is an affiliate of the World Hypertension League and Heart Beat International.National Heart Institute lays special emphasis on "Lifestyle Disorders" and caters to outdoor consultation, education and counselling on Diabetes, obesity, cholesterol related diseases, thyroid disorders, alcohol and smoking. Indoor care for Diabetes & Lifestyle disorders are taken care of.The hospital has a department of Pulmonology and Sleep Medicine which is equipped with sophisticated machines and is manned by dedicated Pulmonologists, Thoracic Surgeons and Physiotherapists.10% indoor beds are earmarked for poor patients having monthly income of Rs.4000/- and below and the hospital regularly provides free treatment to such patients and lots many at subsidized rates. The hospital also runs free OPDs for two hours on all working days.In collaboration with Heartbeat International; the hospital provides free Cardiac Pacemakers for needy patients.

INTRODUCTION

It has been estimated (UNSCEAR, 2000) that worldwide there are about 2000 million x-ray studies, 32 million nuclear-medicine studies and over 6 million radiation therapy patients treated annually, and the numbers are constantly increasing.
The use of radiation for medical diagnostic examinations contributes over 95 % of the manmade radiation exposure and is only exceeded by natural background as a source of

exposure (UNSCEAR, 2000). **Nuclear medicine** is a medical specialty involving the application of radioactive substances in the diagnosis and treatment of disease.

In nuclear medicine procedures, radio nuclides are combined with other elements to form chemical compounds, or else combined with existing pharmaceutical compounds, to form radiopharmaceuticals. These radiopharmaceuticals, once administered to the patient, can localize to specific organs or cellular receptors. This property of radiopharmaceuticals allows nuclear medicine the ability to image the extent of a disease process in the body, based on the cellular function and physiology, rather than relying on physical changes in the tissue anatomy.

Nuclear Medicine is a branch of medical science where radio nuclides are used for diagnosis and treatment of human diseases. Discovery of artificial radioactivity and development of nuclear reactors and particle accelerators have played a significant role in radiotracer technology. Nuclear medicine imaging and non-imaging procedures provide important information about functional status of the body organs. Radionuclides are also used for therapy of malignant and non-malignant conditions. A lot of progress has taken place over the past few years in therapeutic nuclear medicine. With the use of suitable radiopharmaceuticals targeted therapy is also possible. In nuclear medicine imaging, radiopharmaceuticals are taken internally, for example intravenously or orally. Then, external detectors (gamma cameras) capture and form images from the radiation emitted by the radiopharmaceuticals. This process is unlike a diagnostic X-ray where external radiation is passed through the body to form an image.

Giving larger radiation exposures can reduce the noise in an image, and make it more photographically appealing, but if the clinical question can be answered without this level of detail, then this is inappropriate. The radiation dose from nuclear medicine imaging varies greatly depending on the type of study. The effective radiation dose can be lower than, or comparable to, or can far exceed the general day-to-day environmental annual background radiation dose. The end result of the nuclear medicine imaging process is a "dataset" comprising one or more images. In multi-image datasets the array of images may represent a time sequence (i.e. cine or movie) often called a "dynamic" dataset, a cardiac gated time sequence, or a spatial sequence where the gamma-camera is moved relative to the patient. SPECT (single photon emission computed tomography) is the process by which images acquired from a rotating gamma-camera are reconstructed to produce an image of a "slice" through the patient at a particular position. A collection of parallel slices form a slice-stack, a threedimensional representation of the distribution of radionuclide in the patient.

There are several important principles of radiation protection, the main one being that radiation dose should always be kept as low as reasonably achievable (ALARA). Although these practices are essentially basic, it can be challenging to apply them as the number of diagnostic procedures and types of imaging equipment continue to expand. Even though new radiology equipment has drastically improved image quality and speed, it is now much easier to expose patients to excessive amounts of radiation, making it necessary for healthcare professions to be continually educated about radiation safety to protect their patients and themselves. The general population also is more aware of radiation risks than ever before, and as a result, they demand and deserve accurate information regarding radiation protection.

Radiation Basics

Overall, radiation protection may be defined as effective measure employed by radiation workers to safeguard patients, personnel, and the general public from unnecessary exposure to ionizing radiation. Protective measures take into consideration both human and environmental physical determinants, technical elements, and procedural factors. They consist of tools and techniques used to minimize radiation exposure.[1]

Radioactivity is the process of nuclear decay or disintegration whereby an unstable isotope releases energy in the form of particles and/or electromagnetic radiation. Radiation is classified as ionizing or non-ionizing according to the effects it has on matter. Ionizing radiation is radiation that is capable of producing ions when interacting with matter. It is both natural and man-made. Natural sources include cosmic rays, gamma rays from the Earth, radon decay products in the air, and various radio nuclides found naturally in food and drink. Artificial sources include medical X-rays, fallout from the testing of nuclear weapons in the atmosphere, discharges of radioactive waste from the nuclear industry, industrial gamma rays, and miscellaneous items such as consumer products. In a more simplistic form, ionizing radiation includes cosmic rays, X-rays, and radiation from radioactive materials.[2]

Radiation interactions include direct and indirect interactions. Direct interaction is when ionizing radiation produces damage by knocking electrons off atoms. Indirect interactions occur by ionizing atoms in human cells that can initiate chemical changes which may harm the cell.

Types of Ionizing Radiation: Alpha, Beta, Gamma, and X-Rays

Alpha radiation is radiation that is not able to penetrate the skin and is often referenced as positive radiation.[4] Alpha-emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds.[5] Alpha is considered particulate radiation, which is a specific form of ionizing radiation consisting of atomic or subatomic particles that carry energy in the form of kinetic energy or mass in motion.[4]

Beta radiation may travel meters in air and is moderately penetrating and is sometimes noted as negative radiation.[4] It can penetrate human skin to the "germinal layer," where new skin cells are produced. If beta-emitting contaminants are allowed to remain on the skin for a prolonged period of

time, they may cause skin injury. They also may be harmful if deposited internally.[6] Beta is also considered particulate radiation.

Gamma and X-rays are electromagnetic radiation such as visible light, radio waves, and ultraviolet light. These electromagnetic radiations only differ in the amount of energy they have. Gamma rays and X-rays are the most energetic of these electromagnetic radiations. Gamma radiation is able to travel many meters in air and many centimeters in human tissue. Gamma and X-rays are "penetrating radiation." Radioactive materials that emit gamma radiation and X-rays constitute both an external and internal hazard to humans. Dense materials are needed for shielding from gamma radiation. Gamma radiation and X-rays frequently accompany the emission of alpha and beta radiation.[7] There is no such thing as a "pure" gamma emitter. Gamma rays are used to form images in nuclear medicine and include technetium-99^{m}. Another gamma emitter, cesium-137, is used for calibration of nuclear instruments.

Units of Radiation Exposure

There are 2 systems for measuring the intensity of radiation or units of radiation exposure. They are the classical or conventional system (sometimes also known as the traditional system) and the SI system or Systeme International. The classical/conventional system was developed and defined over the past century and is often the most familiar to the radiology community in the United States. It is sometimes referred to as the "Three Rs": the roentgen, rad and rem.

The SI system is derived from the metric system and has been adopted by most organizations and the radiology community for the purpose of having 1 unified system. The SI units are coulomb/kilogram, gray, and sievert. Due to familiarity, the traditional measurement units continue to be used by the radiology community.

Because radiation affects people, we must be able to measure its presence. We also need to relate the amount of radiation received by the body to its physiological effects. Two terms used to relate the amount of radiation received by the body are exposure and dose. When you are exposed to radiation, your body absorbs a dose of radiation. Certain units are used to properly express the measurement. For radiation measurements they are[9]:

Roentgen (R): This is the traditional unit used to measure exposure. It only applies to absorption of gamma rays and X-rays in air. It is named after the German physicist who discovered X-ray, Wilhelm Conrad Roentgen. This unit of radiation dose is normally measured by a physicist. The SI equivalent is the coulomb/kilogram (C/kg).

$$1\ R = 2.58 \times 10^{-4}\ C/kg$$

If conversion between the 2 units is necessary, the conversion is:

$$1\ C/kg \text{ of air} = 3876\ R$$

rad (Radiation absorbed dose): This is the traditional unit of absorbed energy or dose. rad is the amount of energy deposited per unit weight of human tissue. This is the quantity most directly related

to biological effects. Absorbed does expresses the concentration of radiation energy actually absorbed in tissue. The SI equivalent is the gray (Gy).

100 rad = 1 Gy

rem (radiation equivalent man): The rem is used for specifying biologically equivalent dose and is the traditional measure for biological exposure to radiation after compensating for the type of radiation involved. It is the unit of occupational exposure and biological risk. The SI equivalent is the Sievert (Sv).

100 rem = 1 Sv

Not all radiation has the same biological effect, even for the same amount of absorbed dose. rem attempts to take into account the variation in biologic harm that is produced by different types of radiation.[1] It enables the calculation of effective dose, a dose that takes into account the dose for all types of ionizing radiation to organs or tissues in the human body being irradiated and the overall harm or the weighting factor of those biologic components for developing a radiation-induced cancer.[1] Equivalent dose is often expressed in terms of thousandths of a rem, or mrem. To determine equivalent dose (rem), multiply absorbed dose (rad) by a quality factor (Q) that is unique to the type of radiation.

rem = rad x Q

To summarize, exposure may be described as the amount of ionizing radiation that may strike an object such as the human body when in the vicinity of a radiation source. Absorbed dose is the deposition of energy per unit mass by ionizing radiation in the patient's body tissue. Dose equivalent is a quantity that attempts to summarize all of the aspects of different types of ionizing radiation that may lead to biologic harm.

Risks

Exposure to ionizing radiation affects various organs and tissues in the body and may result in a finite possibility for radiation-induced disease in persons exposed to the radiation, and in their descendants. Health effects are know to be influenced by radiation characteristics and biological factors and include cancer induction, genetically determined ill health, nonspecific life shortening, developmental abnormalities, and degenerative diseases. Some factors that can affect the probability and significance of potential effects are:

Age: Response to radiation differs with age. Children are more sensitive to exposure than most adults.

Acute or chronic exposure: Was exposure delivered over a short period of time or spread over an extended period?

Internal or external exposure: External means the source of radiation is outside the body and internal means the source of radiation was ingested, inhaled, absorbed, or injected.

What part and how much: Was the exposure localized to a specific area?

Type of radiation: Forms of radiation differ in their penetrating power and ability to cause damage to biological tissues.

Somatic effects are not usually seen in medical workers during the course of their work in the medical environment. In order to see a radiation response in humans within a few days to weeks after exposure, the dose must be quite high. Somatic effects of radiation include skin erythema, cataracts, and radiation-induced malignancies. Somatic radiation effects can be acute or delayed. Acute effects include skin reddening, hair loss, and radiation burns. Delayed effects include cataract formation and cancer induction that can occur months or years after radiation exposure. The probability of developing radiation-induced cancer increases with radiation does, but the severity of the malignancy is independent of the radiation does. Genetic effects do not produce any significantly observable effect in the exposed individual but may appear in descendants of the exposed individual.[11] The effects may lie dormant for several generations. It is unlikely that any worker in the medical environment would be exposed to ionizing radiation at a level high enough to cause genetic effects.

Teratogenic effects are those such as cancer or congenital malformation. These effects can be observed in children who where exposed during the fetal and embryonic stages of development.

It is important to set limits for the protection of radiation workers and the general public because of the known biological effects of exposure to ionizing radiation.

ALARA

Radiation cannot be seen, smelled, or heard. That is why the ALARA concept (As Low as Reasonably Achievable) is at the forefront of our profession. ALARA is the responsibility of all healthcare professionals dealing with radiation, however the burden largely falls on the technologist as a professional caregiver and operator of the radiation-emitting equipment. These individuals are responsible for compliance with radiation safety requirements, and must be familiar with and follow specific instructions for protocols and radiation protection. Radiation exposure must be kept to the lowest achievable level by using protective equipment and following the principles of ALARA. ALARA applies to both internal and external exposure, as well as occupational and public exposure. ALARA is far-reaching and must be applied to ensure that individual dose, collective dose, radioactive waste, and radioactive emissions are all as low as reasonably achievable. The basic principles of ALARA are:

- Time

- Distance
- Shielding

Time

Radiation Dose Received = Dose Rate x Time. Therefore the least amount of time spent around radiation, the lower the dose, whether it be for a patient or healthcare team member. Time around radiation can be reduced through careful planning of X-ray procedures, making sure all equipment is available and in working condition, and by performing "dry runs" of certain procedures without radiation to ensure that everything is in place to reduce time. This type of preparation also can better prepare the imaging team, so they do not feel rushed through procedures. Another way to decrease time is to determine who needs to be present during a procedure. Whenever possible, either remain out of the room or behind protective barriers.

Distance

Increasing the distance between the individual and the source of radiation is an effective method to reduce exposure to radiation.[11] As distance from the source of radiation is increased, the radiation level decreases dramatically. Doubling the distance from the radiation source reduces exposure by a factor of 4. Tripling the distance reduces exposure by a factor of 9. Maximizing the distance from the source significantly reduces exposure. Exposure varies inversely with the square of the distance from the source and is calculated using the inverse square law. The inverse square law states that the intensity of radiation at a given distance from a point source is inversely proportional to the square of the distance.

$$\frac{I_1}{I_2} = \frac{D_2^2}{D_1^2}$$

Where: I_1 = old intensity
I_2 = new intensity
D_1^2 = old distance squared
D_2^2 = new distance squared

Maximizing the distance from the source is important for minimizing dose when working with all types of radiation. Along with the other methods to increase distance, the use of remote handling tools, or working at arms length in order to maximize distance from the source, is important. Use forceps,

tongs, and trays to increase the distance and even move items being worked on away from radiation if possible. Know the radiation intensity in your work area and move to lower dose areas when possible. These recommendations directly affect workers in radiation therapy and nuclear medicine.

Shielding

Shielding is used either when time or distance are ineffective or as an additional exposure reduction strategy. By placing material between the source of radiation and the user, a certain reduction in exposure will be achieved. The degree of exposure reduction will depend on the physical characteristics of the material (atomic number, density, and thickness).[11] The type of shielding that is most appropriate to use depends on the nature of the penetrating power of the radiation. Increasing the amount of shielding will decrease the amount of exposure. For fixed X-ray imaging facilities, lead and concrete shielding are used. Mobile shields, lead-equivalent aprons, and gloves should be used when it is not possible to take advantage of fixed structural barriers. This is common during fluoroscopy and mobile procedures. The greater the lead equivalent in the aprons, the greater the protective ability it has. A protective lead apron attenuates approximately 90% of scatter radiation. It is good to keep in mind that as the lead content in the apron increases, so does the weight of the apron.

Time/Distance/Shielding for Patients

Time, distance, and shielding are just as important for the patient as they are for the imaging professional. From diagnostic imaging to radiation therapy, decreasing the amount of time, increasing distance, and providing shielding for the patient helps to decrease dose. Time can be reduced by the radiographer through decreasing repeat images and decreasing fluoroscopy X-ray beam time. Distance can be addressed by making sure that examinations are being performed at the proper source to image receptor distance (SID). Shielding should be used at all times whenever it will not compromise the image by covering up the anatomy being imaged.

Radiation Safety

In nuclear medicine procedures, a very small amount of radioactive materials is inhaled, injected, or swallowed by the patient. Remember, nuclear medicine involves gamma rays instead of X-rays. However, ALARA must still be practiced.

The 2 potential hazards in nuclear medicine are from radioactive contamination and radiation exposure. Contamination is the uncontrolled spread of radioactive material. Radioactive contamination can be easily

detected with the use of Geiger counters or portable scintillation counters. Nuclear medicine technologists perform other forms of radiation protection and quality control; however, many of the same patient safety precautions are followed in this modality as in the others.

When working in the nuclear medicine radioisotope laboratory, otherwise known as the "hot lab," it is important to work quickly and efficiently so as to keep exposure ALARA. Eating, drinking, smoking, and loitering should never be permitted when working with radioisotopes.

Communication with the patient is crucial so they are aware of what they can do to assist during the nuclear medicine study. For example, patients need to remain still while being injected with radioactivity and they also need to maintain a secure seal while inhaling radioisotopes.

Above all, educate the patient on the examination they are having and what they can do to make it a success. Also make them aware of any post-procedure guidelines.

The Basic Principles of Radiation Protection

External contamination occurs when radioactive material, in the form of dust, powder, or liquid, comes into contact with a person's skin, hair, or clothing. In other words, the contact is external to a person's body. People who are externally contaminated can become internally contaminated if radioactive material gets into their bodies.
Internal contamination occurs when people swallow or breathe in radioactive materials, or when radioactive materials enter the body through an open wound or are absorbed through the skin. Some types of radioactive materials stay in the body and are deposited in different body organs. Other types are eliminated from the body in blood, sweat, urine, and feces.
A person exposed to radiation is not necessarily contaminated with radioactive material. A person who has been exposed to radiation has had radioactive waves or particles penetrate the body, like having an x-ray. For a person to be contaminated, radioactive material must be on or inside of his or her body. A contaminated person is exposed to radiation released by the radioactive material on or inside the body. An uncontaminated person can be exposed by being too close to radioactive material or a contaminated person, place, or thing.

AERB GUIDELINES FOR LAYOUT

In Nuclear Medicine (NM), the diagnostic and therapeutic procedures using unsealed radioisotopes shall be carried out only in a facility approved by the Atomic Energy Regulatory Board (AERB). The approved nuclear medicine facility should not be located in the residential building and shall comply with all the regulatory requirements as specified in the AERB safety code on nuclear medicine facilities.

The various stages of approval of nuclear medicine facility by AERB are given as

follows:

1. Site and Layout Plan Approval
2. Application for Authorization for Commissioning of the Facility
3. Pre-commissioning Inspection.
4. Approval for Commissioning / Routine Operation.
5. Decommissioning.

OBJECTIVE OF THE INTERNSHIP

It is imperative in the field of management to do internship at the end of the classroom teaching. It allows hands on experience that is sometimes missing in theoretical knowledge.
Fundamental objective to internship are:

- To get involved in day to day operations.
- To comprehend the interdepartmental coordination.
- To find an area in the organization where improvement is required and where management knowledge and skills can be imparted.

MANAGERIAL TASKS:

To prepare the department for final assessment of NABH:

- Documentation :
  1. Radiopharmaceutical log book from Jan'12-Jan'13
  2. Bio-Medical Waste disposal log book
  3. Inventory log book from Jan'12-Jan'13
  4. Employee safety manual
  5. Collimation & Gamma camera register
  - Crash cart audit
  - Signage Displays
  - HIS entries
  - TAT preparation
  - Area monitoring along with RSO with Gieger Muller meter of Nuclear medicine department, X-ray lab, Cath lab
  - Infection control and Biomedical Waste Disposal and Coding. Also, training of the staff regarding BMW and Spillage management.
  - An internal assessment was done and report was made for working on every non compliance and awareness based on questionnaire and checklist.

Other tasks

Patient registration
Patient history taking
Camera handling
Console machine operation
Scanning (16scans) and Processing of scans
Reporting of scans

Elusion (preparation of radioactivity)
Labeling (preparation of radiopharmaceuticals)
Injecting radiopharmaceuticals to patients (IV injections)
Visits to ECHO lab for Stress Thallium patients

GENERAL OBJECTIVE: To assess awareness and practices in area of radiation safety followed in National Heart Institute

SPECIFIC OBJECTIVES:

1. To assess the compliance level of radiation safety according to NABH guidelines.
2. To measure the deviation against the set norms.
3. To find out the awareness level on radiation safety among hospital staff.
4. To provide recommendations on areas of improvement in the department.

REVIEW OF LITERATURE

1. **Radiation protection in Nuclear Medicine: a review on present situation in Sri Lanka Manjula Hettiarachchi***Senior Lecturer in Nuclear Medicine, Faculty of Medicine, University of Ruhuna, Karapitiya, Galle.*

The principles followed in the radiation safety measurement ensure that workers and members of the public are not exposed beyond the specified limits as directed by the competent authority, follow the ALARA (As Low As Reasonably Achievable) principle, ensure safe handling and security of the radiopharmaceuticals, patient protection and waste management along with handling radiation emergencies. This is to ensure safety of persons handling radiation sources for medical applications, patients undergoing medical procedures, persons connected with the patient living with him and members of public unrelated to medical use of radiation. Following steps have been taken to ensure Maximum safety:

- Distribute the responsibilities among the occupational personal: Occupational personals (radiation safety officer (RSO), radiation safety supervisor (RSS), technical and other staff) are assigned with job descriptions and responsibilities along with radiation protection concept.
- Classification of areas: Units classify three areas in view of reducing the risk of radiation hazard as ALARA by proper instructions on billboard, labeling (Caution! Radiation Area, Caution! Radioactive Material, Caution! Controlled Area, etc).General patients and the attendants are seated in separate areas from the injected patients (Supervised area); Only those who needed imaging and uptake are allowed to enter 'Controlled area' and no one is allowed to enter 'Restricted area' without proper authorization.
- Immediate notification to the competent authority in case of any inadvertent spillage and contamination after ensuring all appropriate decontamination measures.
- Radioactivity survey on all working areas could be conducted once a week and documented.

2. **Radiation Safety: A Growing Concern** Aimee J. Phillips, MS, RT(R)(M)(CV)(QM)

One of the basic principles of radiation protection is that radiation dose should always be kept as low as reasonably achievable, or ALARA. Although radiation safety practices are essentially basic, they seem to have become challenging as the number of diagnostic procedures and types of imaging equipment continue to expand. Even though new radiology equipment has drastically improved image quality and speed, it is now much easier to expose patients to excessive amounts of radiation. Therefore, the healthcare team must remain educated in regard to radiation safety so that they can protect their patients and themselves. In addition, the general population is more aware of radiation risks than ever before, and as a result, they demand and deserve accurate information regarding radiation protection. Risks associated with ionizing radiation are complex. There are many variables to consider, such as

patient size, age, the region of the body being imaged, and the type of radiation generating equipment being utilized. Imaging procedures are important for determining appropriate treatment and imaging professionals play a vital role in providing not only the images that assist with that treatment but also the patient care that protects and educates the patient. As imaging modalities and the number of procedures continue to grow, it is imperative that radiographers use every means at their disposal to protect the patient, patient families, co-workers, and themselves.

3. **Theories and Practice of Radiation Safety in Nuclear Medicine**
Alan Vespie, MED, CNMT, RT (N) Safety issues in nuclear medicine are numerous and may involve hazardous material issues, infection control, patient care, and radiation safety. Although all these safety issues are relevant in the daily duties of nuclear medicine technologists, radiation safety issues are perhaps the most pervasive and hence, most influential in the duties of technologists. This article will serve as a refresher course for experienced technologists, a study aid for technologists in training, and an educational tool to the layperson. The topics covered will include the nature of radioactivity, the biological effects of radiation, and finally, radiation safety precautions the nuclear medicine technologist can take to minimize radiation exposure. The three most important methods for reducing radiation exposure are time, distance, and shielding. Regarding time, the technologist should minimize time spent near radioactive sources. However, because patients are themselves a source of radiation, special care needs to be taken to minimize exposure without alienating the patient. This means that technologists need to learn to work quickly, efficiently, and accurately. Repeating one's work may beannoying to the technologist, patient, and physician, but it also increases the amount of exposure time. Strive to perform procedures correctly the first time. If practical, rehearse new or infrequently performed tasks before working with the radioactivity.

4. **A comparative study of radiation safety practices at selected hospitals in the UK and USA.** **White DR, Showalter CK, Hamilton DR.**

   The radiation safety practices in a group of 25 UK and USA hospitals have recently been assessed. This took the form of detailed inspections of some 62 medical radiation departments, including Diagnostic X-ray, Radiotherapy, Nuclear Medicine and Pathology/Research (Radionuclide) Departments. Empirical expressions called "Radiation Safety Indices" were devised to evaluate the incidence of personal doses and radiological incidents occurring from 1977-82 and to characterise the safety facilities, procedures, supervision and educational techniques in each department. An outline is given of national legislative material and voluntary codes of conduct, together with the results of the departmental inspections. The computed indices are presented graphically and an analysis given of apparent national trends.

5. **Permeability of gloves used in nuclear medicine departments to [99mTc]-pertechnetate and [18F]-fluorodeoxyglucose: Radiation protection considerations.**
   Ridone S, Matheoud R, Valzano S, Di Martino R, Vigna L, Brambilla M
   In order to evaluate the safety of the individual protection devices, the permeability of four different types of disposable gloves, commonly used in hospitals, was tested in relation to [^{99m}Tc]-pertechnetate and to [^{18}F]-fluorodeoxyglucose ([^{18}F]-FDG). From these

radiopharmaceutical solutions, a drop was deposited on the external surface of the glove which was opened and stretched with the external surface placed upward. The smear test technique permitted to evaluate the activity onto the inner surface of the glove at different times. The smear tests were measured in a well sodium iodide detector calibrated in efficiency for ^{99m}Tc and ^{18}F. The permeability was tested on ten samples of each type of gloves and was expressed as the ratio of the activity onto the inner surface at each time interval to the activity deposited on the external surface of the glove. For each type of gloves and for each sampling time, mean value, standard deviation and percentage coefficient of variation of permeability were evaluated. One type of gloves showed a low resistance to permeation of both radiopharmaceuticals, while another one only to pertechnetate. The other gloves were good performers. The results of this study suggest to test permeability for gloves used for handling radiopharmaceuticals, before their adoption in the clinical routine. This practice will provide a more careful service of radiation protection for nuclear medicine department staff.

6. **[Investigation of radiation safety management of nuclear medicine facilities in Japan; contamination of radioactivity in the draining-water system. A Working Group of Japanese Society of Nuclear Medicine for the Guidelines of Nuclear Medicine Therapy].**Endo K, Koizumi M, Kinoshita F, Nakazawa K
Radiation safety management condition in Japanese nuclear medicine facilities were investigated by the questionnaire method. The first questionnaire was asked in all Japanese 1,401 Nuclear Medicine facilities. Answers from 624 institutes (44.5%) were received and analyzed. The radiation-safety management in nuclear medicine institutes was considered to be very well performed everyday. Opinion for the present legal control of nuclear medicine institutes was that the regulation in Japan was too strict for the clinical use of radionuclides. The current regulation is based on the assumption that 1% of all radioactivity used in nuclear medicine institutes contaminates into the draining-water system. The second questionnaire detailing the contamination of radioactivity in the draining-water system was sent to 128 institutes, and 64 answers were received. Of them, 42 institutes were considered to be enough to evaluate the contamination of radioactivity in the draining-water system. There was no difference between 624 institutes answered to the first questionnaire and 42 institutes, where the radioactivity in the draining-water system was measured, in the distribution of the institute size, draining-water system equipment and the radioactivity measuring method, and these 42 institutes seemed to be representative of Japanese nuclear medicine institutes. Contamination rate of radioactivity into the draining system was calculated by the value of radioactivity in the collecting tank divided by the amount of radionuclides used daily in each institute. The institutes were divided into two categories on the basis of nuclear medicine practice pattern; type A: in-vivo use only and type B: both in-vivo and in-vitro use. The contamination rate in 27 type A institutes did not exceed 0.01%, whereas in 15 type B institutes the contamination rate distributed widely from undetectable to above 1%. These results indicated that the present regulation for the draining-water system, which assumed that 1% of all radioactivity used in nuclear medicineinstitutes contaminated into draining-water system, should be reconsidered in nuclear medicine facilities where radionuclides are used only in in-vivo studies.

7. **A questionnaire about radiation safety management of the draining-water system at nuclear medicine facilities].**Shizukuishi K, Watanabe H, Narita H, Kanaya S, Kobayashi

K, Yamamoto T, Tsukada M, Iwanaga T, Ikebuchi S, Kusama K, Tanaka M, Namiki N, Fuiimura Y,Horikoshi A, Inoue T, Kusakabe K; Working Group of Ministry of Health, Labour and Welfare for Study about Fitness Management; of Medical Radioactive Waste

Of 1,125 institutions, 642 institutes (52.8%) returned effective answers. The questionnaire covered the following areas: 1) scale of an institution, 2) presence of enforcement of radiotherapy, 3) system of a tank, 4) size and number of each tank, 5) a form of draining-water system, 6) a displacement in a radioactive rays management area, 7) a measurement method of the concentration of medical radioactive waste in draining water system, 8) planned and used quantity of radioisotopes for medical examination and treatment, 9) an average displacement of hospital for one month. In most institutions, a ratio of dose limitation of radioisotope in draining-water system was less than 1.0, defined as an upper limitation in ordinance. In 499 hospitals without facilities of hospitalization for unsealed radioisotope therapy, 473 hospitals reported that sum of ratios of dose limits in a draining-water system was less than 1.0. It was calculated by used dose of radioisotope and monthly displacement from hospital, on the premise that all used radioisotope entered in the general draining-water system. When a drainage including radioactivity from a controlled area join with that from other area before it flows out of a institution, it may be diluted and its radioactive concentration should be less than its upper limitation defined in the rule. Especially, in all institutions with a monthly displacement of more than 25,000 m3, the sum of ratio of the concentration of eachradionuclide to the concentration limit dose calculated by used dose of radioisotope, indicated less than 1.0.

8. **[Investigation of actual condition of management and disposal of medical radioactive waste in Korea].** Watanabe H, Nagaoka H, Yamaguchi I, Horiuchi S, Imoto A Department of Radiological Technology, Yokohama Rosai Hospital, Japan.

In order to realize the rational management and disposal of radioactive waste like DIS or its clearance as performed in Europe, North America, and Japan, we investigated the situation of medical radioactive waste in Korea and its enforcement. We visited three major Korean facilities in May 2008 and confirmed details of the procedure being used by administering a questionnaire after our visit. From the results, we were able to verify that the governmental agency had established regulations for the clearance of radioactive waste as self-disposal based on the clearance level of IAEA in Korea and that the medical facilities performed suitable management and disposal of radioactive waste based on the regulations and superintendence of aradiation safety officer. The type of nuclear medicine was almost the same as that in Japan, and the half-life of all radiopharmaceuticals was 60 days or less. While performing regulatory adjustment concerning the rational management and disposal of radioactive waste in Korea for reference also in this country, it is important to provide an enforcement procedure with quality assurance in the regulations.

9. **Regulation of nuclear radiation exposures in India. Mishra UC** Health, Safety and Environment Group, Bhabha Atomic Research Centre, Mumbai 400 085, India. ucmishra@yahoo.com

India has a long-term program of wide spread applications of nuclear radiations and radioactive sources for peaceful applications in medicine, industry, agriculture and research and is already having several thousand places in the country where such sources are being routinely used. These places are

mostly outside the Department of Atomic Energy (DAE) installations. DAE supplies such sources. The most important application of nuclear energy in DAE is in electricity generation through nuclear power plants. Fourteen such plants are operating and many new plants are at various stages of construction. In view of the above mentioned wide spread applications, Indian parliament through an Act, called Atomic Energy Act, 1964 created an autonomous body called Atomic Energy Regulatory Board (AERB) with comprehensive authority and powers. This Board issues codes, guides, manuals, etc., to regulate such installations so as to ensure safe use of such sources and personnel engaged in such installations and environment receives radiation exposures within the upper bounds prescribed by them. Periodic reports are submitted to AERB to demonstrate compliance of its directives. Health, Safety and Environment Group of Bhabha Atomic Research Centres, Mumbai carries out necessary surveillance and monitoring of all installations of the DAE on a routine basis and also periodic inspections of other installations using radiation sources. Some of the nuclear fuel cycle plants like nuclear power plants and fuel reprocessing involve large radioactive source inventories and have potential of accidental release of radioactivity into the environment, an Environmental Surveillance Laboratory (ESL) is set up at each such site much before the facility goes into operation. These ESL's collect baseline data and monitor the environment throughout the life of the facilities including the decommissioning stage. The data is provided to AERB and is available to members of the public. In addition, a multi-tier system of AERB permissions is in place to ensure that all aspects of safety have been considered before permission to operate is granted. The stages where permission of AERB is essential are site selection, design data, and several stages during construction and operation. The details required by AERB include provision for treatment and storage of radioactive waste, de-commissioning procedures and provision of costs. In addition to AERB, nuclear power plants have to comply with the requirements of Ministry of Environment and Forests and get their clearance. This is given on the basis of Environmental Impact Assessment Report which should satisfy the authorities that no ecological damage will be caused and the facility will not have adverse effect on the environment. In addition, the State Pollution Control Board where the facility is to be located has to permit the site of the plant for its proposed discharges into the environment. It is largely due to the above comprehensive regulatory controls that none of the plants in India had any accident during the last 34 decades of operation. The type of measurements carried out by the ESL's and results from a few typical ESL's will be presented.

METHODOLOGY

1. **Study Area:** National Heart Institute, New Delhi
2. **Sample Population**: Radiation Working Staff
3. **Study period**: 11th Jan2013- 11th April 2013
4. **Sample Size:** 25 (4 Doctors, 12 technicians, 2 managers, 5 trainees, 2 class IV employees)
5. **Sample design**: Descriptive and Cross sectional study
6. **Data collection techniques and tools:** quantitative and qualitative questionnaire (open ended and close ended), checklist

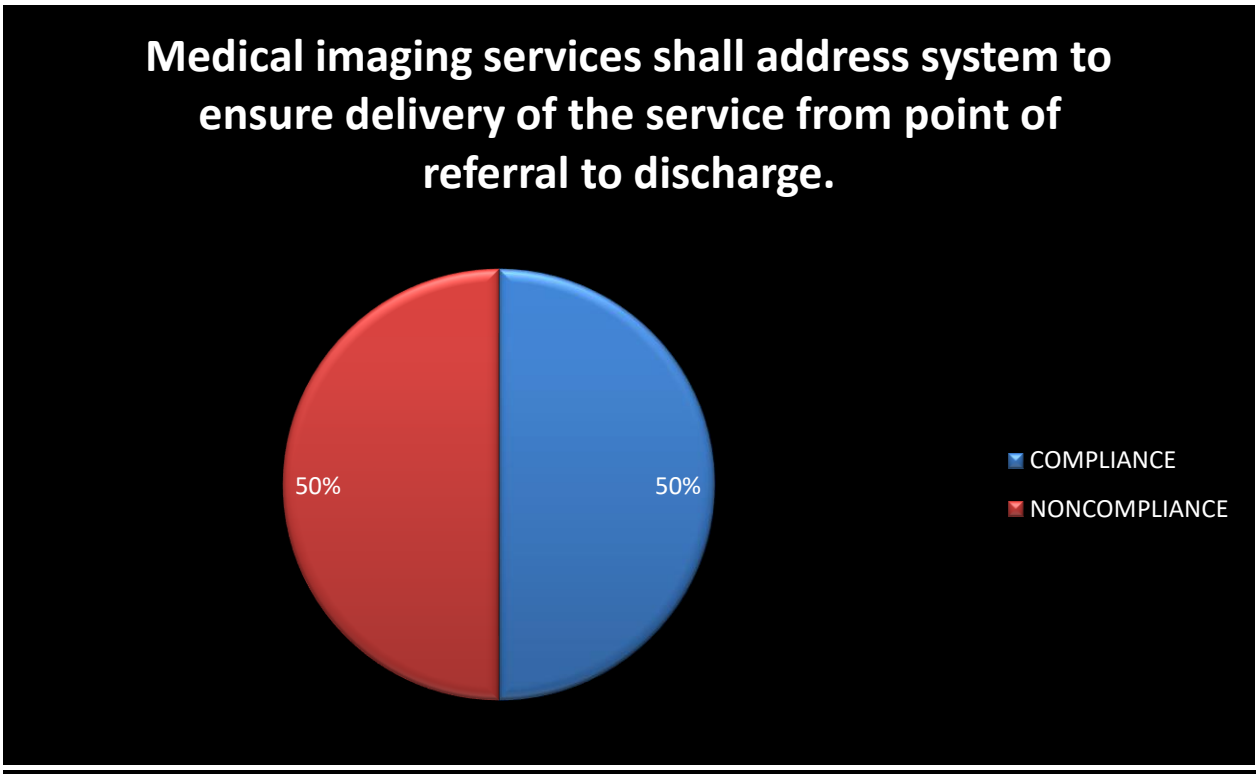
RATIONALE OF THE STUDY

The main issue of setting up of nuclear medicine department is radiation safety. One of the basic principles of radiation protection is that radiation dose should always be kept as low as reasonably achievable, or ALARA. Although radiation safety practices are essentially basic, they seem to have become challenging as the number of diagnostic procedures and types of imaging equipment continue to expand. Even though new radiology equipment has drastically improved image quality and speed, it is now much easier to expose patients to excessive amounts of radiation. Therefore, the healthcare team must remain educated in regard to radiation safety so that they can protect their patients and themselves. In addition, the general population is more aware of radiation risks than ever before, and as a result, they demand and deserve accurate information regarding radiation protection. The following research discusses the basics of radiation safety as they relate to different imaging modalities and equipment to provide imaging professionals with the information they need to adequately address their patient's concerns.

The aim of the study is not only assess the knowledge of the staff about radiation safety measures and there ill effects but also assess the non compliance in maintaining safety standards and correct them by recommending measures to be followed.

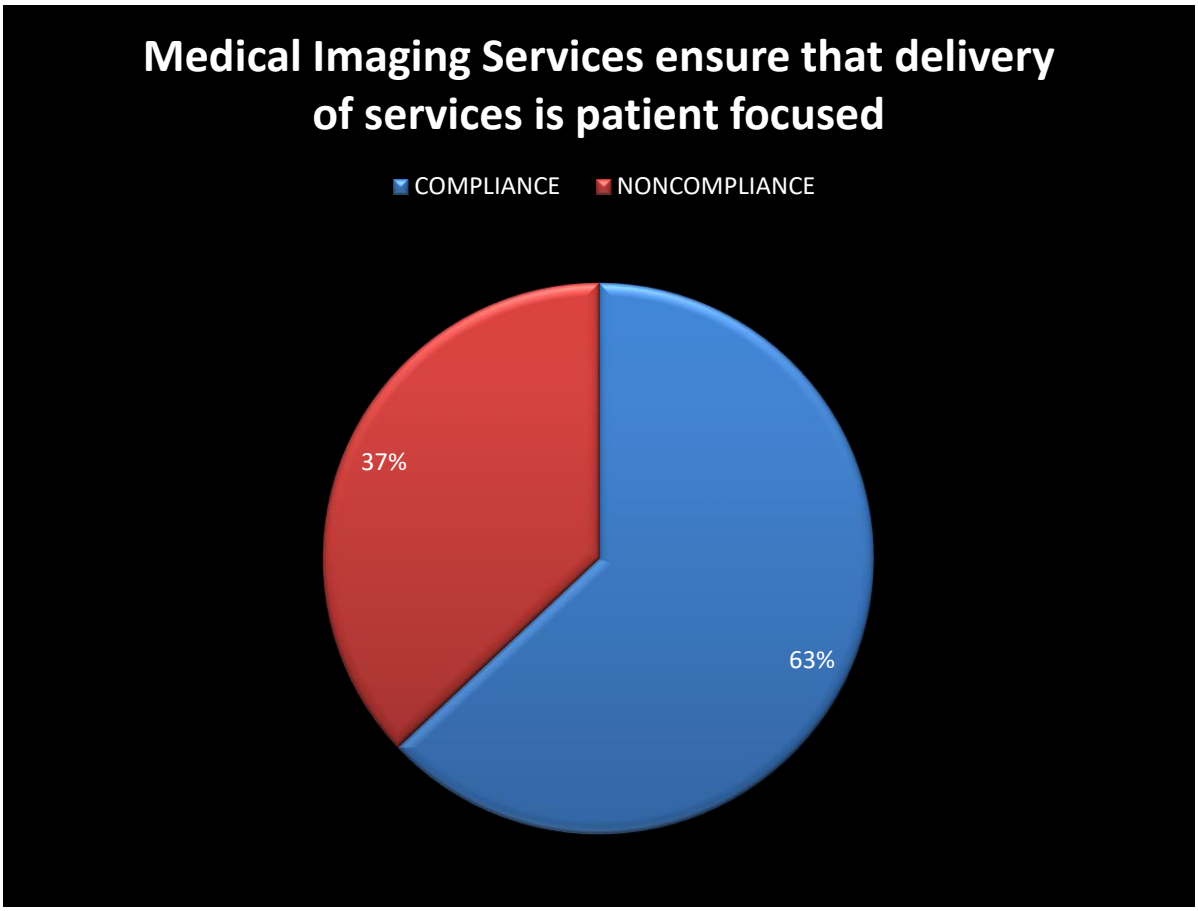
RESULTS AND FINDINGS

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		Compliance
Medical Imaging Services shall address system to ensure delivery of the service from point of referral to discharge.							
a	Roles and responsibilities of each area of service delivery are defined.	Y	Y	MANUAL	10		
b	Medical Imaging Services ensure justification of referrals according to patients condition, urgency of diagnosis and radiation risk.	N	Y		5		
c	Medical Imaging Services ensure that protocols for imaging pathways and processes are defined, documented, implemented and monitored.	N	Y		5		
e	Timeframe to manage imaging pathways from receiving of referral to discharge from the Medical Imaging Services is defined, documented, implemented and monitored.	N	N		0	20	50%



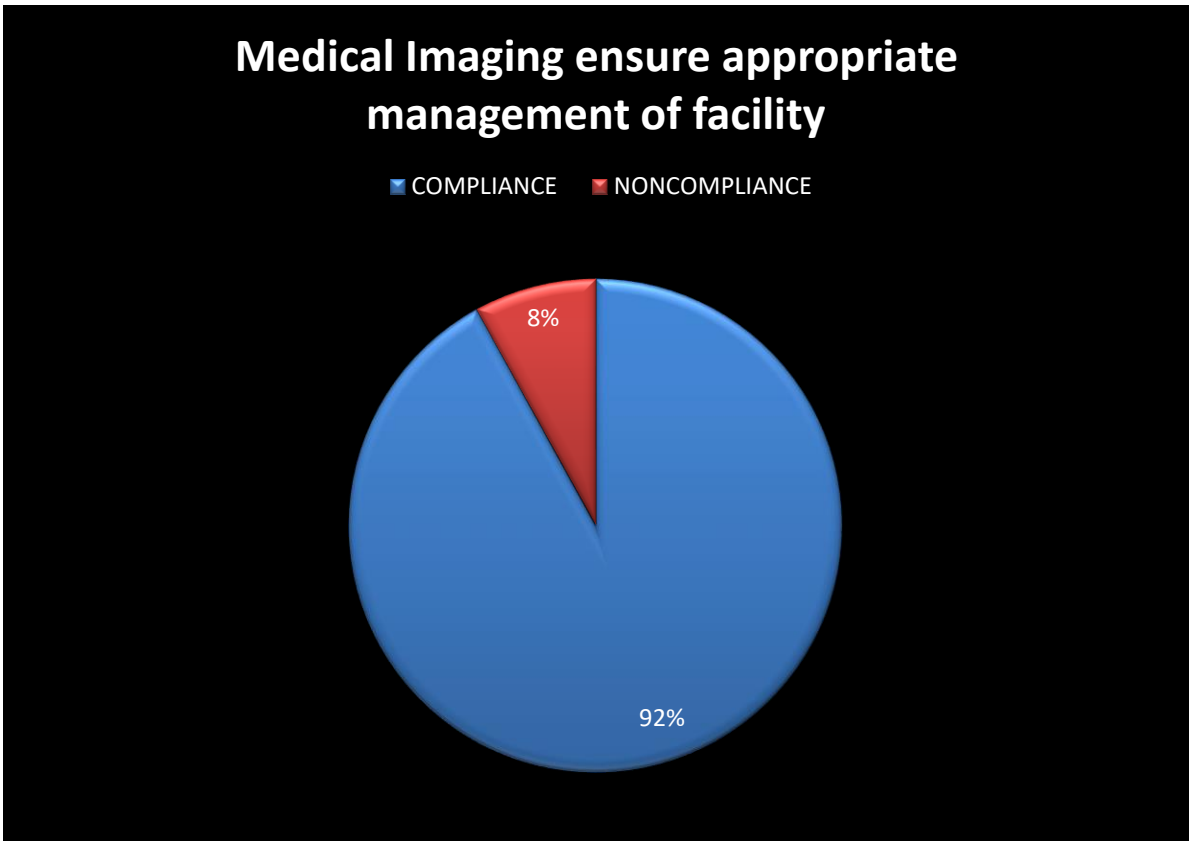
On the basis of analyzing the checklist for assessment of compliance to the set norms by AERB and NABH it was found that there is 50% compliance in delivering the services to the patient from point of referral to discharge. 50% non compliance was seen that there was no documentation to ensure justification of referrals according to patients condition, urgency of diagnosis and radiation risk. Moreover there was no written protocol for imaging processes. It was also seen that time frame to manage imaging pathways from receiving of referral to discharge was not documented.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents / manuals etc.)	Scores (0/ 5/ 10)		Compliance
Medical Imaging Services ensure that delivery of services is patient focused.							
a.	Roles and responsibilities of staff managing each area of service to the patient (information, delivery of service and care, safety, privacy) are defined.	Y	Y	MANUAL	10		
b.	Medical Imaging Services ensure that the information about specific procedure is available to patients and attendants in relevant format and language.	N	Y		5		
c.	Medical Imaging Services ensure that patient and attendants are informed about expected cost prior to imaging.	Y	Y	PRICE LIST	10		
d.	Medical Imaging Services ensure safety of patients, attendants and their belongings while in the facility.	Y	Y	SAFETY MANUAL	5		
e.	Medical Imaging Services ensure safe transport of the patients within, to and from the facility whenever required.	Y	Y		10		
f.	Medical Imaging Services ensure privacy and dignity of the patient without any discrimination.	Y	Y	CONSENT FORMS	10		
g.	Medical Imaging Services ensure that patients feedback is utilised to improve the service delivery system.	N	N		0		
h.	Medical Imaging Services ensure that staff is aware about patients rights and responsibilities.	N	N		0	**50**	**63%**



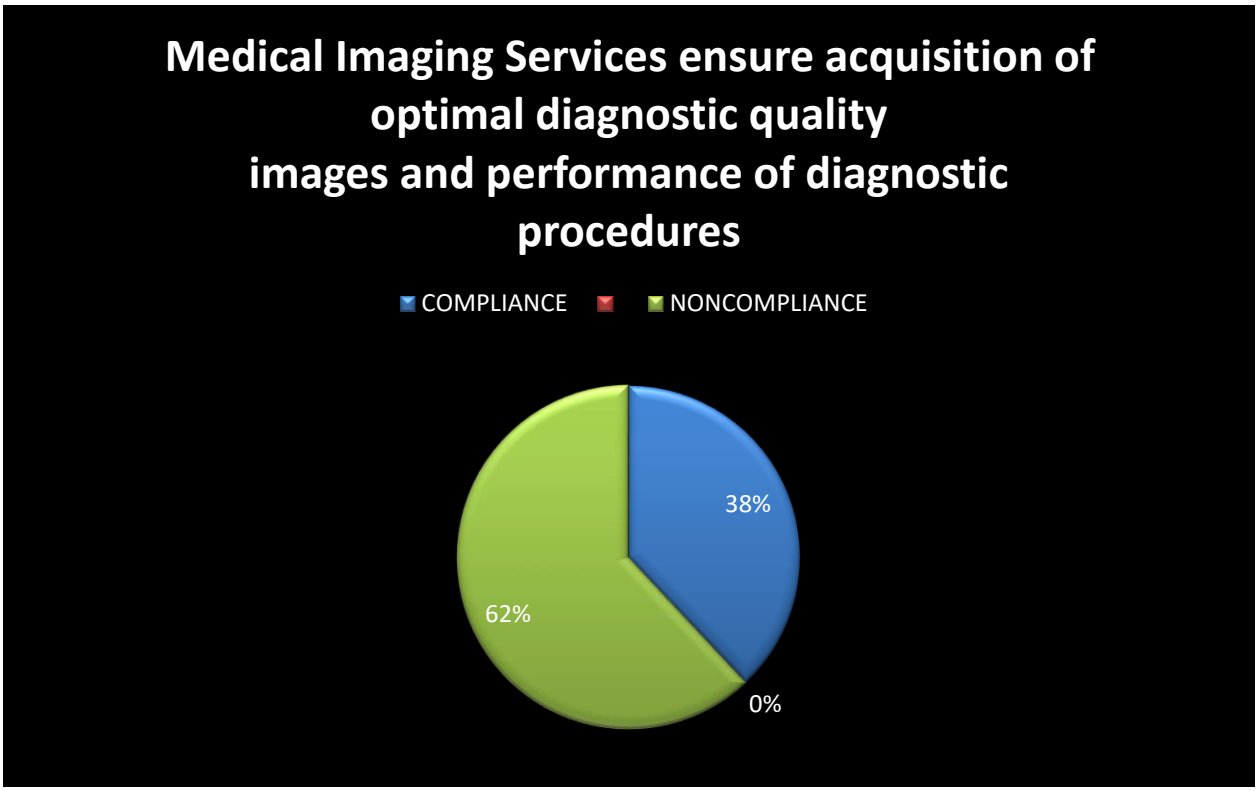
Further it was evaluated that 63% compliance is seen in as the delivery of services is patient focused. It was observed that no information about specific procedure was available to patients and attendants in relevant format and language. Also patient's feedback is not taken which contributes to 37% noncompliance in the delivery of services. Moreover staff awareness about patient's rights and responsibilities are also not seen.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		Compliance
	Medical Imaging Services ensure appropriate management of facility and environment.						
a.	Roles and respons ibi l i t ies of management of each area of facility are defined	Y	Y	MANUAL	10		
b.	Medical Imaging Services ensure signage in appropriate language and format to guide the patient and attendant to and within the facility.	Y	Y		10		
c.	Medical Imaging Services ensure that design and construction of the facility is in accordance with the legal requirements pertaining to the equipment and the services offered.	Y	Y	PERMIT LETTER	10		
d.	Medical Imaging Services ensure that design and construction of the facility supports specific needs of the patient population (including children and those with special needs) and staff.	N	N		10		
e.	Medical Imaging Services ensure that access to particular areas is restricted according to specific needs and risks with proper barrier and signage.	Y	Y	SIGNAGE	10		
f.	Medical Imaging Services ensure that water, electricity, ventilation and medical gases & vacuum installation in all area of service is maintained with provision of alternate sources.	N	Y		5	55	92%



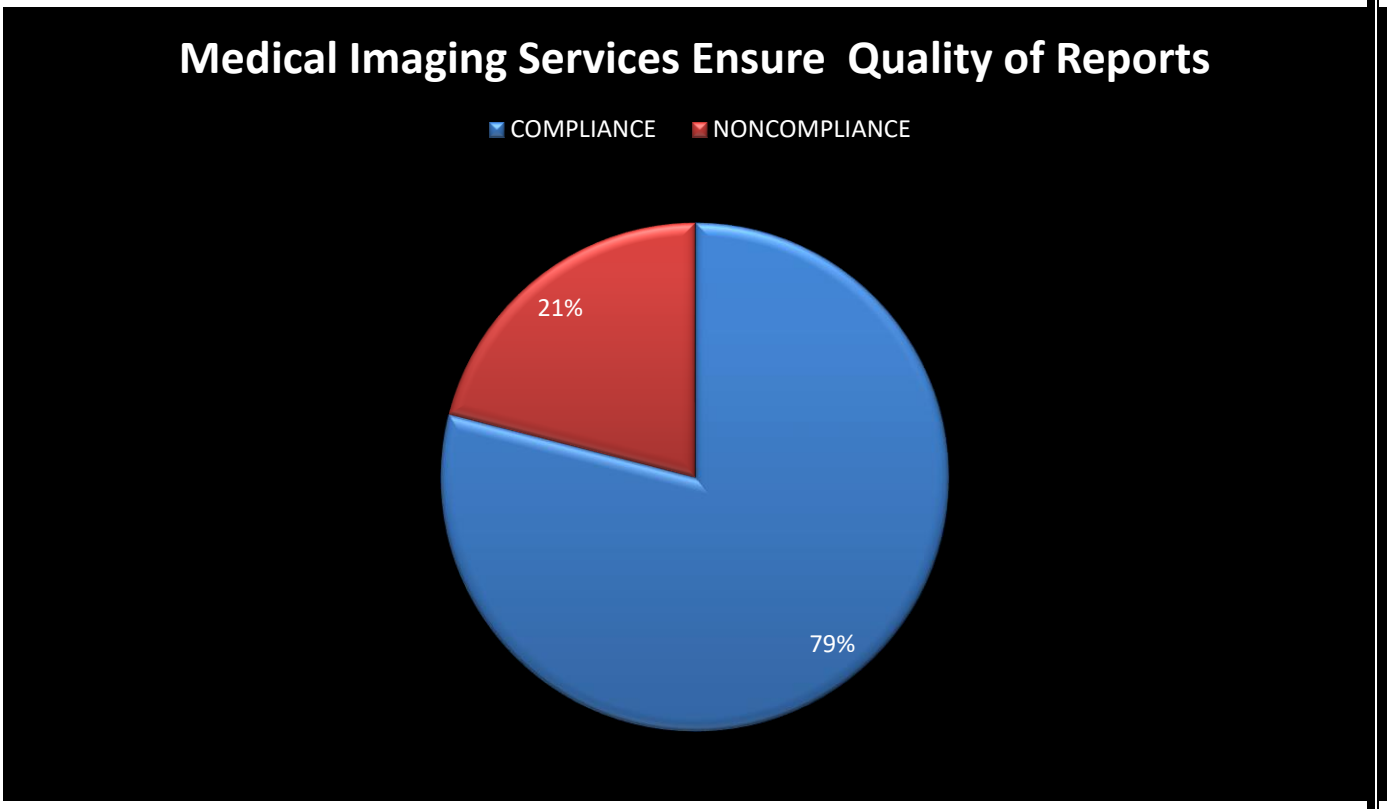
92% compliance level was found in ensuring appropriate management of facility. 8% lack was observed as a provision for low-dose active patient waiting has not been made in the Department. The approved active waiting patient waiting area is used as general waiting area also. The approved dose administration room is being used for general purpose & the dose administration is found to be carried out in the Imaging room.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		Compliance
Medical Imaging Services ensure acquisition of optimal diagnostic quality images and performance of diagnostic procedures.							
a	Roles and responsibilities of staff for management of each area of image acquisition and image quality are defined.	N	Y		5		
b	Medical Imaging Services ensure that protocols for image acquisition for all examination are developed, defined, document ed, communi c a t ed, implemented and monitored.	N	Y		5		
c	Medical Imaging Services ensure quality of diagnostic images and procedures.	N	Y		5		
d	Medical Imaging Services ensure analysis of feedback on images and procedures through documented process of internal verification & external validation.	N	N		0	15	38%



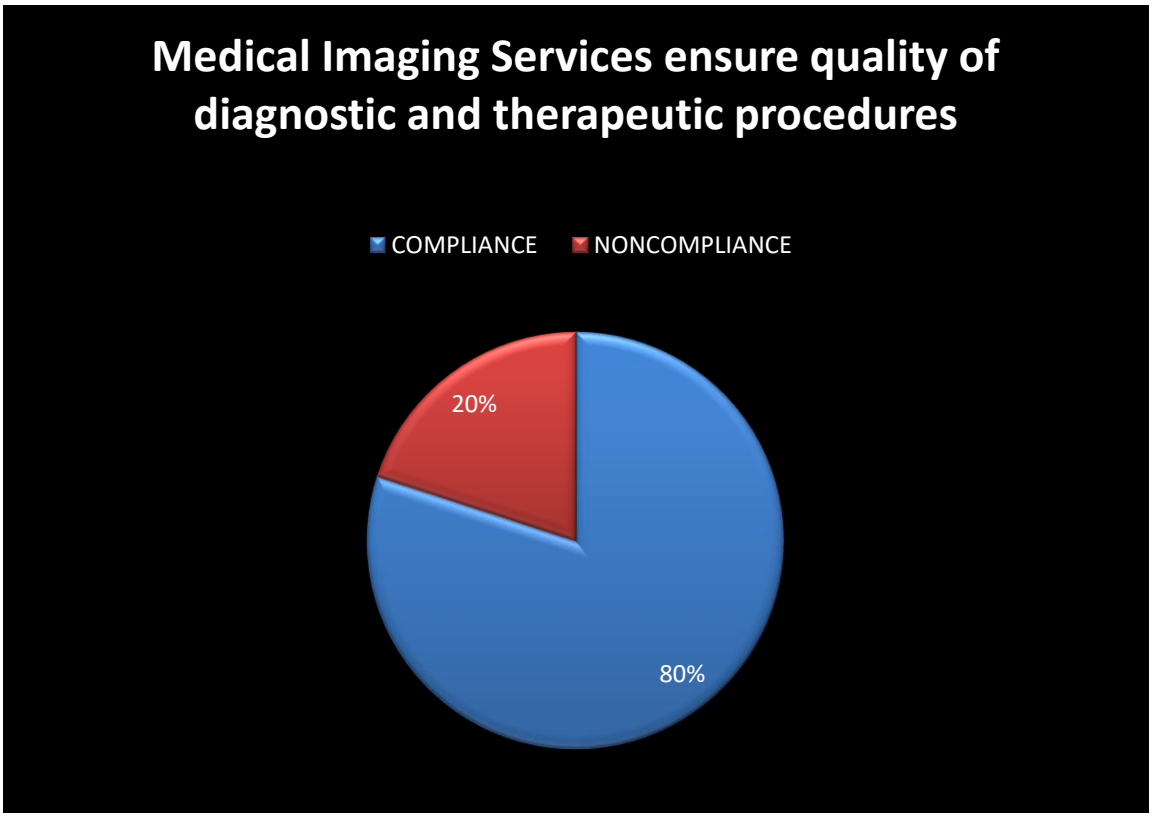
There is only 38% compliance towards ensuring acquisition of optimal diagnostic quality images and performance of diagnostic procedures. Majority that is 62% non compliance is observed as the roles and responsibilities of staff for management of each area of image acquisition and image quality are not defined and documented. Also protocols for image acquisition for all examinations are not defined and documented. No feedback on images and procedures is done through documented process of internal verification & external validation.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		Compliance
Medical Imaging Services ensure the quality of reports (clinical and technical).							
a	Roles and responsibilities for staff reporting the images are defined.	Y	Y	MANUAL	10		
b	Medical Imaging Services ensure that the structure, content and format of report is standardized.	Y	Y	REPORT FORMAT	10		
c	Medical Imaging Services ensure the generat ion, verification and amendments of reports are within appropriately defined timeframe.	Y	Y	TAT	10		
d	Medical Imaging Services ensure that all attempts are made so that the imaging interpretation is collated with relevant clinical laboratory and previous imaging details.	Y	Y	HISTORY SHEETS	10		
e	Medical Imaging Services ensure communication of reports to patient and/or referrer within appropriately defined timeframe.	Y	Y	REPORT REGISTER	10		
f	Medical Imaging Services ensure appropriate quality of images and reports for teleradiology services	N	Y		5		
g	Medical Imaging Services ensure analysis of feedback from Referrer/Professional colleagues on the content and quality of reports through defined & documented process.	N	N		0	55	79%



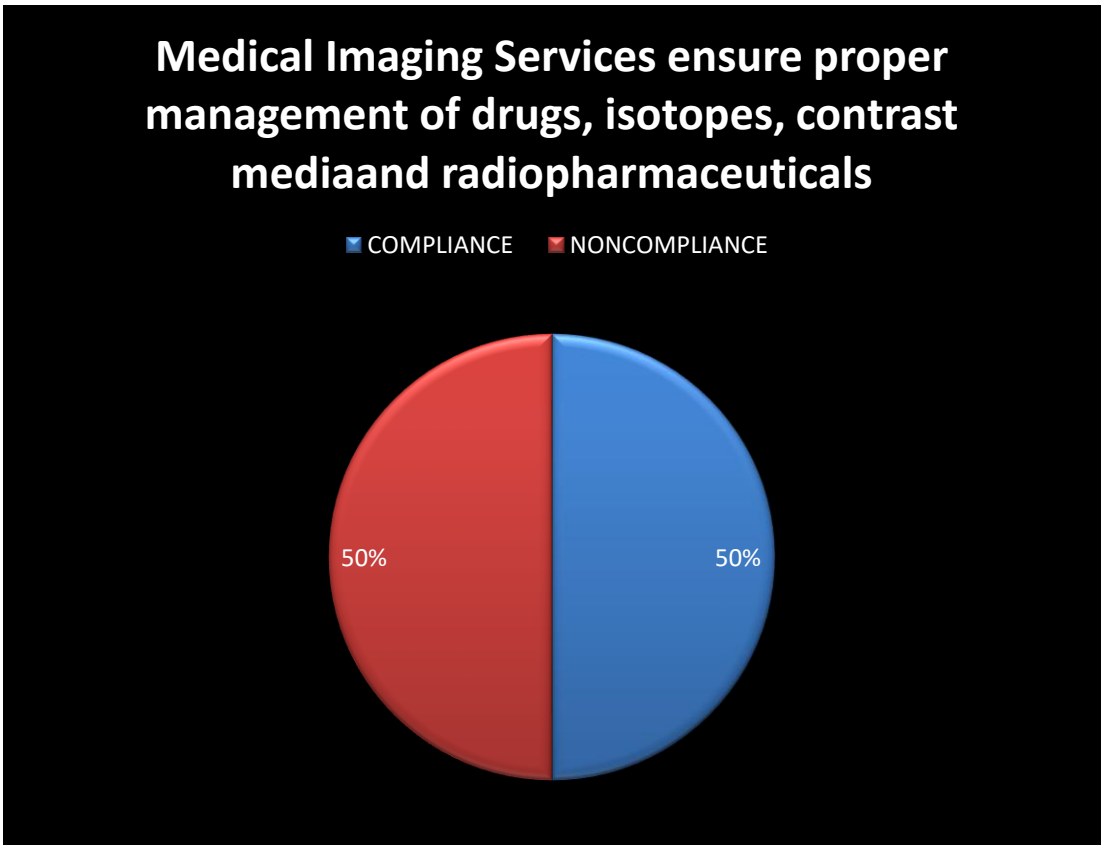
The main reason for noncompliance is not ensuring analysis of feedback from Referrer/Professional colleagues on the content and quality of reports through defined & documented process. Also to ensure quality of reports no documentations are done.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
: Medical Imaging Services ensure quality of diagnostic and therapeutic interventional procedures.							
a	Roles and responsibilities for staff conducting diagnostic and therapeutic interventional procedures are defined.	Y	Y	MANUAL	10		
b	Medical Imaging Services ensure that the risk, the expected outcome and alternative treatment protocols are explained to the patient, the attendant and the referrer; and same is documented.	Y	Y	HISTORY SHEETS	10		
c	Medical Imaging Services ensure that protocols for all diagnostic and therapeutic interventional procedures are defined , documented , implemented and monitored.	N	Y		5		
d	Medical Imaging Services ensure that appropriate sedation/anaesthesia, clinical and emergency support is available before, during and after the procedure.	N	Y		5		
e	Medical Imaging Services ensure that the outcomes of diagnostic and therapeutic interventional procedures are monitored.	N	N		10	40	80%



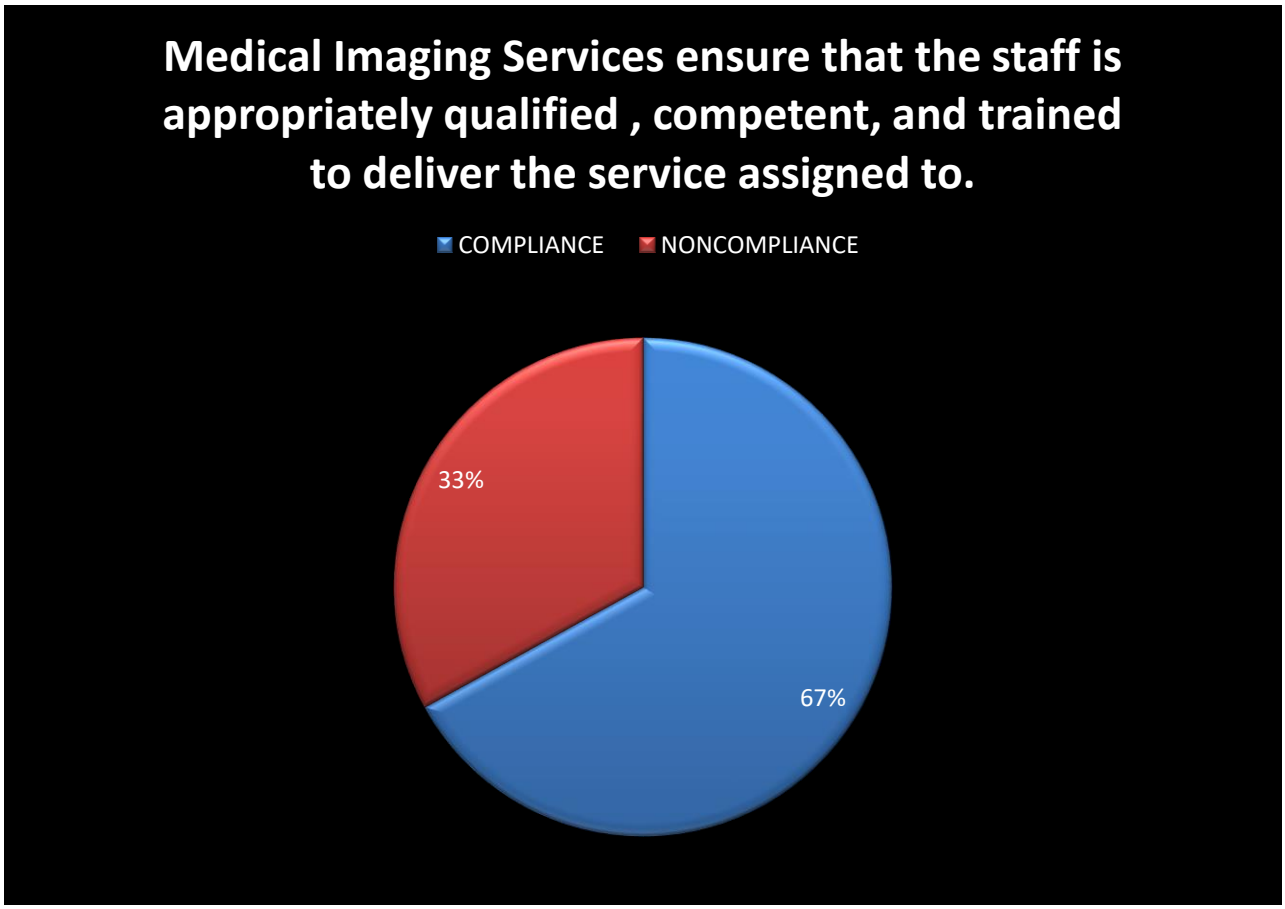
20% non compliance was found in ensuring quality of diagnostic and therapeutic procedures as the protocols for all diagnostic and therapeutic interventional procedures were not defined and documented. Also there was no documentation done during sedation/ aesthesia procedure. Also the outcomes of the diagnostic procedures were noted but not documented.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		compance
Medical Imaging Services ensure proper management of drugs, isotopes, contrast media and radiopharmaceuticals.							
a	Roles and responsibilities for staff in the area of drugs, isotopes, contrast media and radiopharmaceuticals are defined.	Y	Y	MANUAL	10		
b	Medical Imaging Services ensure that protocols for prescription, purchase, storage, supply, handling and labeling of drugs, isotopes, contrast media and radiopharmaceuticals are defined, documented, implemented and monitored.	Y	Y		10		
c	Medical Imaging Services ensure that protocols for administration of drugs, isotopes, and contrast media and radio pharmaceuticals to the patients including corrective action taken in case of adverse drug/contrast reaction are defined, documented, implemented and monitored.	N	N		0		
d	Medical Imaging Services ensure that patients at higher risk of adverse reactions to specific drugs, isotopes, contrast media and radiopharmaceuticals are assessed and managed.	N	N		0	20	50%



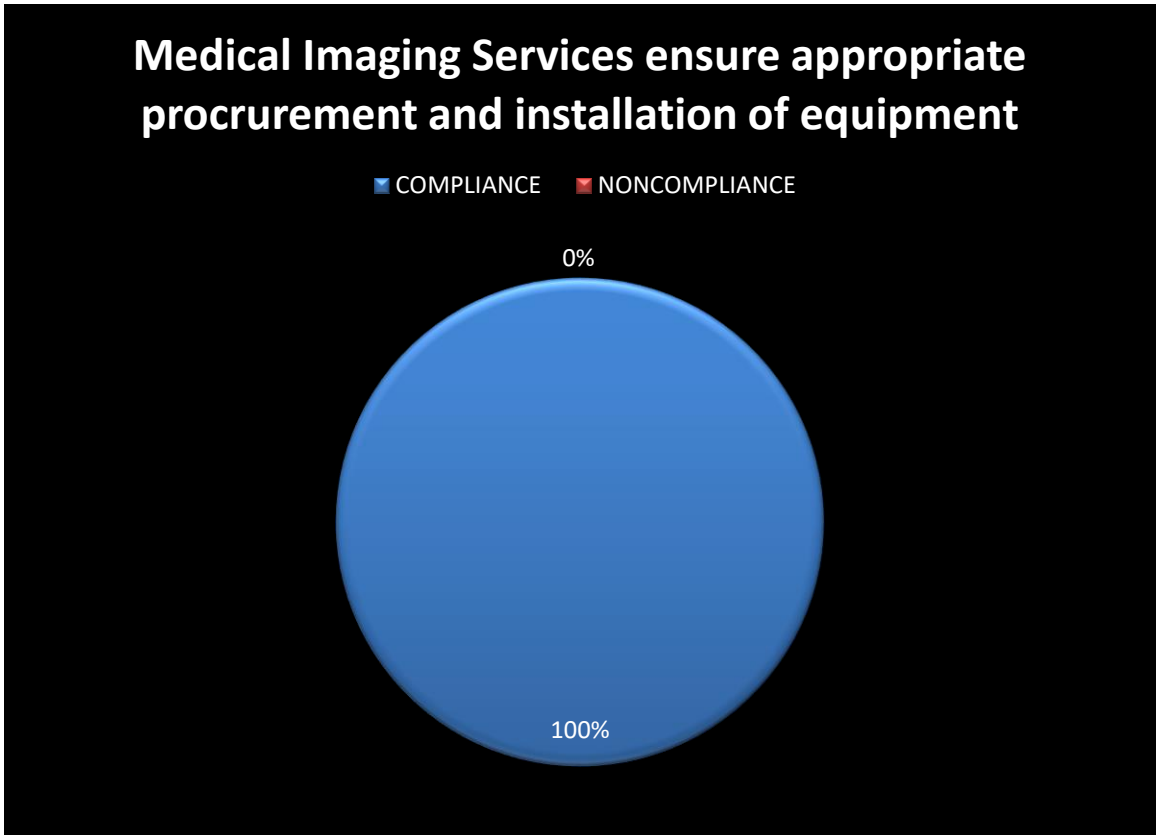
In ensuring proper management of drugs, isotopes and radiopharmaceuticals 50% non compliance was observed in ensuring the protocols for administration of drugs, isotopes, and contrast media and radio pharmaceuticals to the patients including corrective action taken in case of adverse drug/contrast reaction are neither documented nor implemented. Also there is no documentation in case of adverse reactions to specific drugs, isotopes, contrast media and radiopharmaceuticals.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure that the staff is appropriately qualified, competent and trained, to deliver the service assigned to them.							
a	Roles and responsibilities for ma int enanc e of r e cord and verification of credentials of the staff are defined.	Y	Y	HR FILE	10		
b	Medical Imaging Services ensure that policies and procedures for selection, recruitment, retention and succession planning of staff are defined, documented and implemented.	N	N		0		
c	Medical Imaging Services ensure that there is a documented personal record for each staff member.	Y	Y		10	20	67%

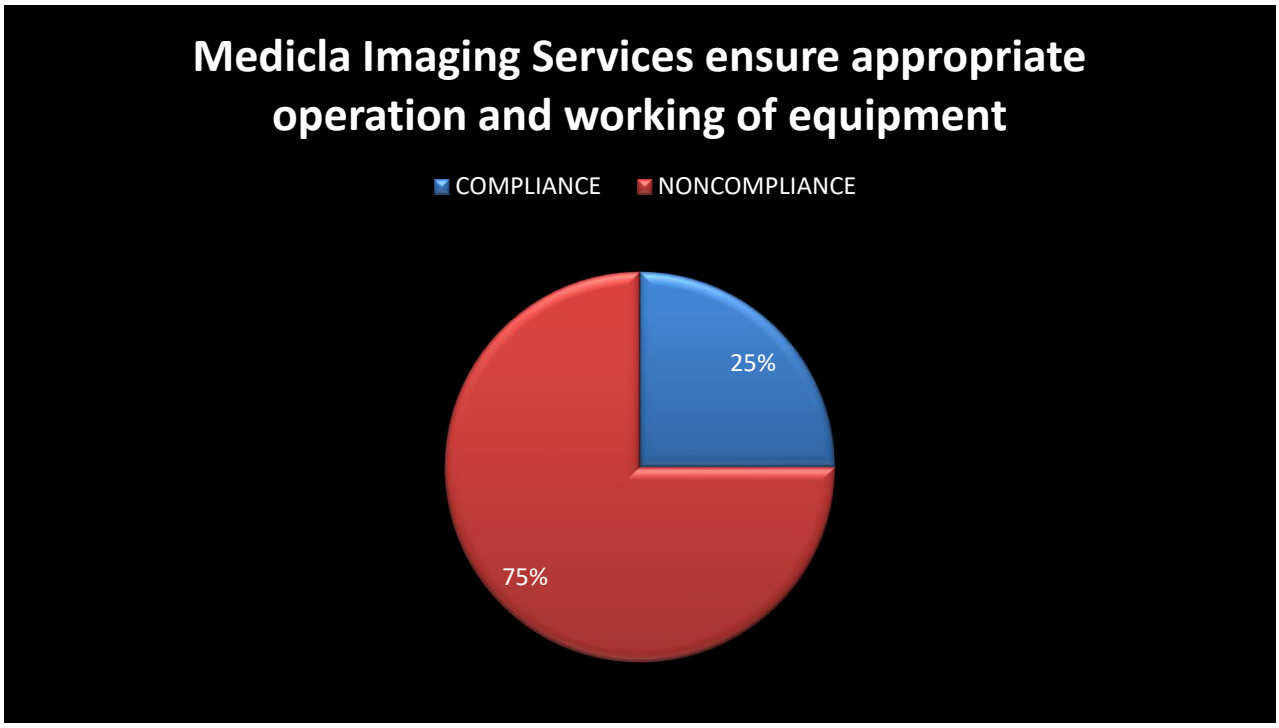


There is 33% non compliance level seen in documentation and implementation of policies and procedures for selection, recruitment, retention and succession planning of staff.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure appropriate procurement and installation of equipment.							
a	Medical Imaging Services ensure that the policies and procedures for the procurement of all equipment and c onsumables are defined, implemented and monitored in a collaborative manner between user and management.	Y	Y	INVOICE	10		
b	Medical Imaging Services ensure that the policies and procedures for the installation of equipments are defined, documented, implemented and monitored and record of same is maintained.	Y	Y	DOCUMENTS	10	20	100%

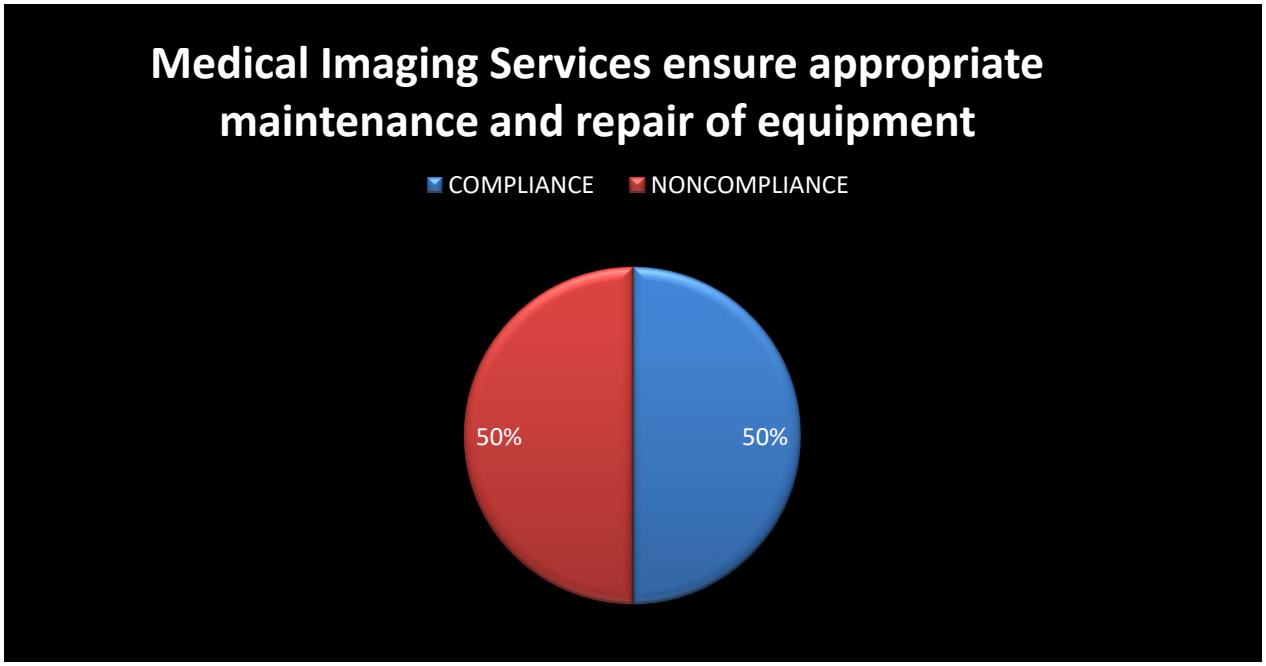


	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure appropriate operation and working of equipment.							
a	Roles and responsibilities for each area of the operation and working of all equipment are defined.	N	Y		5		
b	Medical Imaging Services ensure that the policies and procedures for operation and calibration of equipment are defined, documented, implemented, monitored and record of the same is maintained.	N	N		0	5	25%



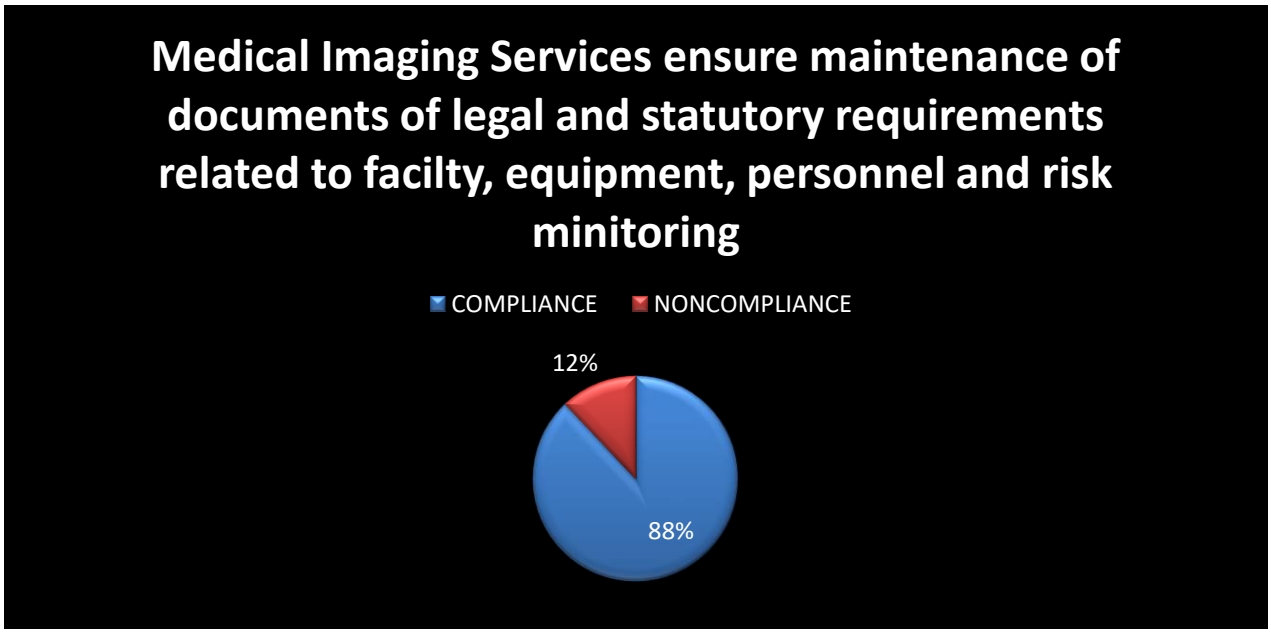
It was seen that policies and procedures for operation and calibration of equipment are neither defined nor implemented and also no records were maintained thus giving us 25% non compliance.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
: Medical Imaging Services ensure appropriate maintenance and repair of equipment.							
a	Roles and responsibilities for maintenance, service and repair of the equipment are defined.	Y	Y	BILLS	10		
b	Medical Imaging Services ensure that equipment downtimes are monitored and managed within defined timeframe.	N	N		0		
c	Medical Imaging Services ensure that policies and procedure for maintenance and repair of equipments are defined, documented, implemented and monitored and record of the same is maintained.	N	Y		5	15	50%



The main pint in which noncompliance was found was that equipment downtimes management and monitoring was neither documented nor implemented. Also there is no documentation done on repair of equipments.

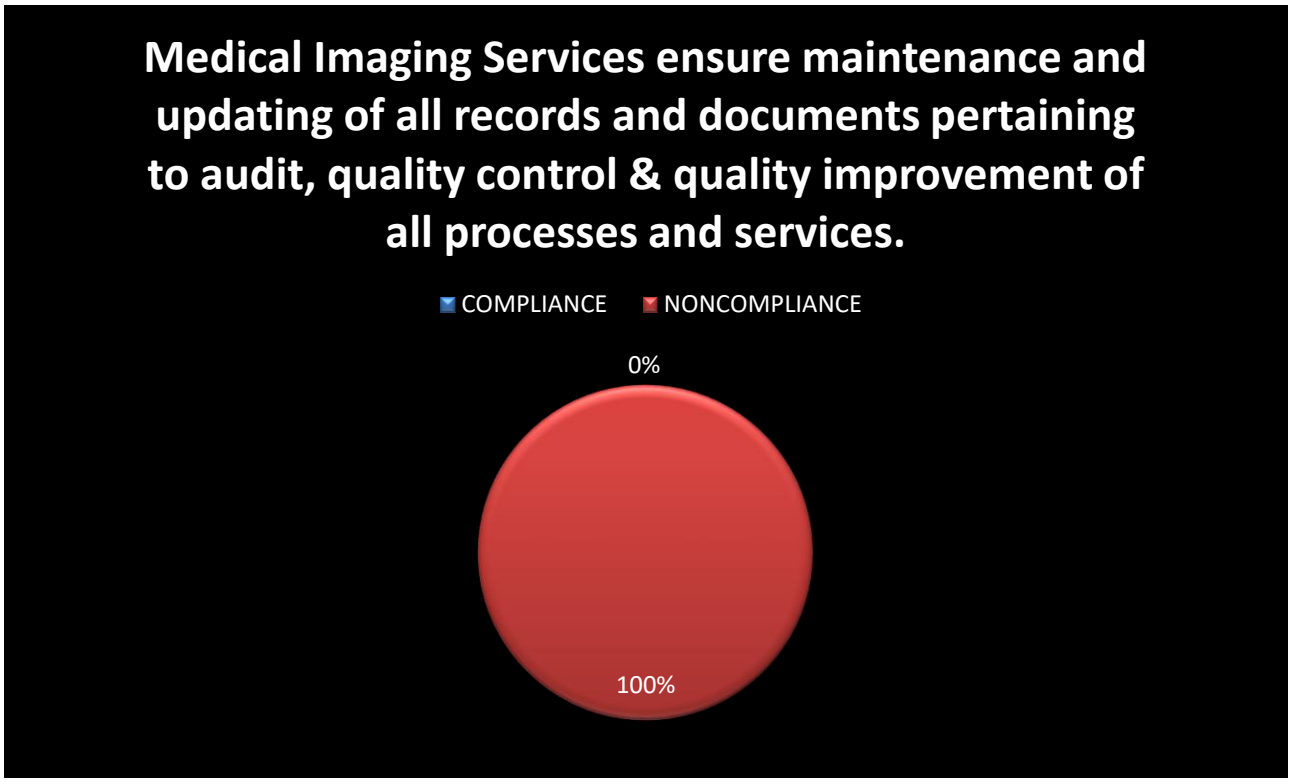
	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure maintenance of documents of legal and statutory requirements related to facility, equipment, personnel and risk monitoring.							
a	Roles and responsibilities for maintenance of documents of legal and statutory requirements related to facility, equipment, personnel and risk monitoring are maintained.	Y	Y	LICENSES	10		
b	Medical Imaging Services ensure that documents of legal and statutory requirements related to facility, are maintained.	Y	Y	LICENSES	10		
c	Medical Imaging Services ensure that document of legal and statutory requirements related to equipments are maintained.	Y	Y	LICENSES	10		
d	Medical Imaging Services ensure that document of legal and statutory requirements related to all staff (including risk monitoring) are maintained.	N	Y		5	35	88%



Documentation for legal and statutory requirements related to all staff and risk monitoring were not maintained. But still 88% compliance level was achieved in maintenance f legal and statutory requirements related to facility, equipment, personnel and risk monitoring.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)
Medical Imaging Services ensure maintenance and updating of all records and documents pertaining to audit, quality control & quality improvement of all processes and services.					
a	Roles and responsibilities for maintenance and updating of all records and documents pertaining to audit, quality control & quality improvement of all processes and services are defined.	N	N		0
b	Medical Imaging Services ensure that policies and procedures for audit, quality check, verification and validation are maintained.	N	N		0
c	Medical Imaging Services ensure that all documents related to quality improvement are maintained.	N	N		0

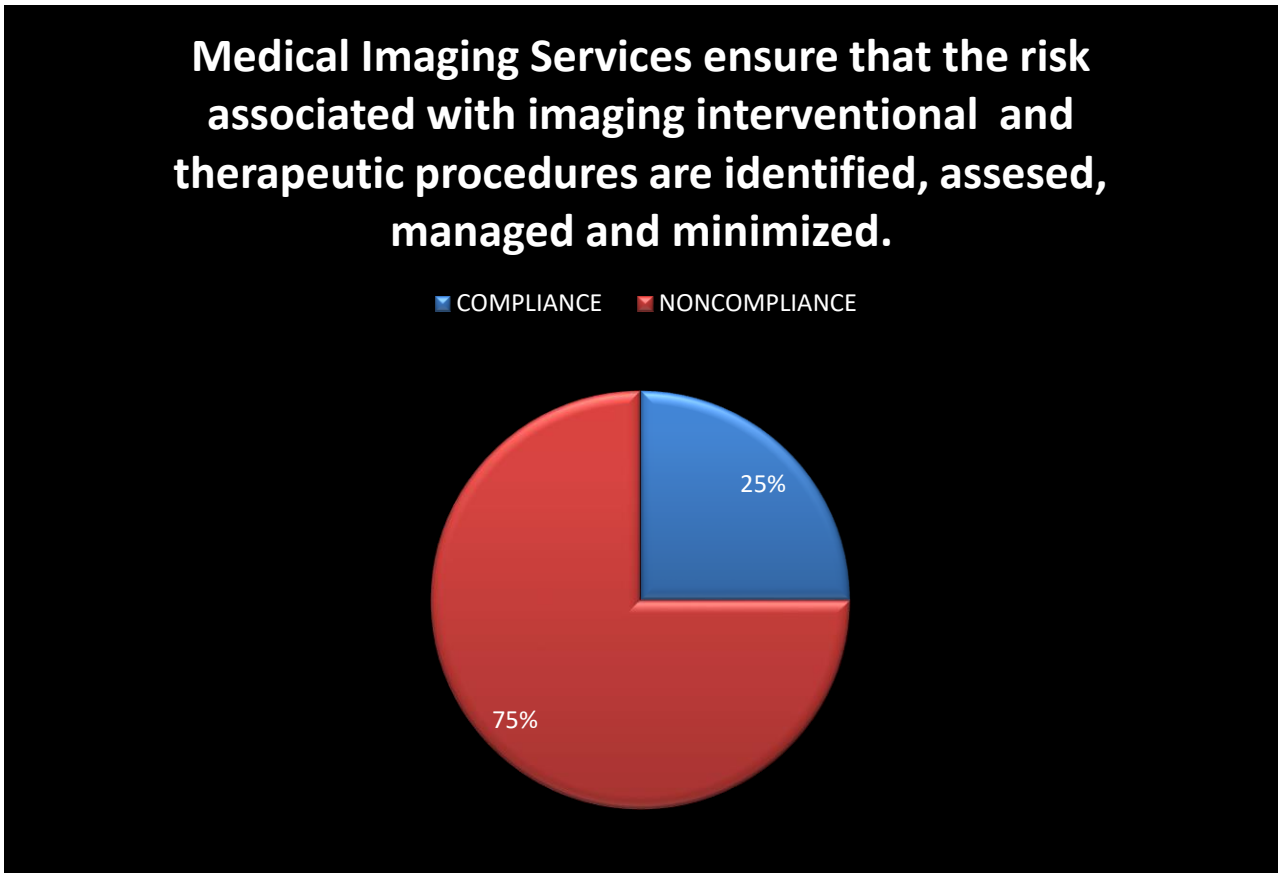
0 0



0 % compliance was received in maintenance and updation of all records and documents pertaining to audit, quality control & quality improvement of all processes. Roles and responsibilities for

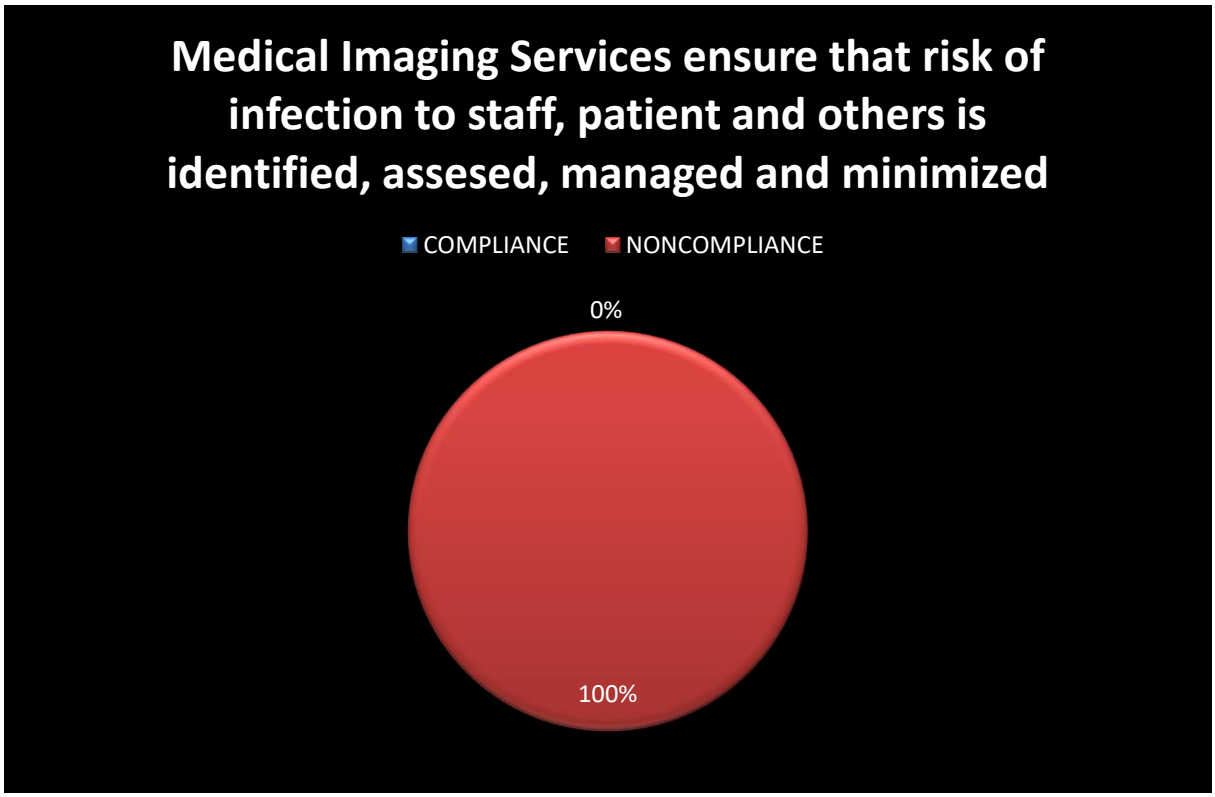
maintenance and updating of all records and documents pertaining to audit, quality control & quality improvement of all processes and services was not defined and documented. Policies and procedures for audit, quality check, verification and validation are also not maintained. There was no documentation related to quality improvement.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents / manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure that the risk associated with imaging, interventional and therapeutic procedures are identified, assessed, managed and minimized.							
a	Roles & responsibilities for all levels of risk management in all areas of imaging are defined.	N	N		0		
b	Medical Imaging Services ensure that the radiation doses are as low as reasonably possible for all patients (ALARP principle) especially for children, women of child bearing age, pregnant women and patients undergoing repeated exposures.	N	Y		5		
c	Medical Imaging Services ensure that there is a system in place to define, assess and manage risks of occupational exposure to ionising radiation and record for the same is maintained.	N	Y		5		
d	Medical Imaging Services ensure that risks of acoustic output and exposure times are defined, assessed, managed and minimized.	N	N		0		
f	Medical Imaging Services ensure that risk associated with use of ablative, therapeutic devices during diagnostic & interventional procedures are defined, assessed, managed & minimized.	N	Y		5		
g	Medical Imaging Services ensure that the incidents & errors pertaining to risks associated with all the procedures are reported, investigated, recorded, acted upon, analysed, and used to guide and plan the future action.	N	N		0	15	25%



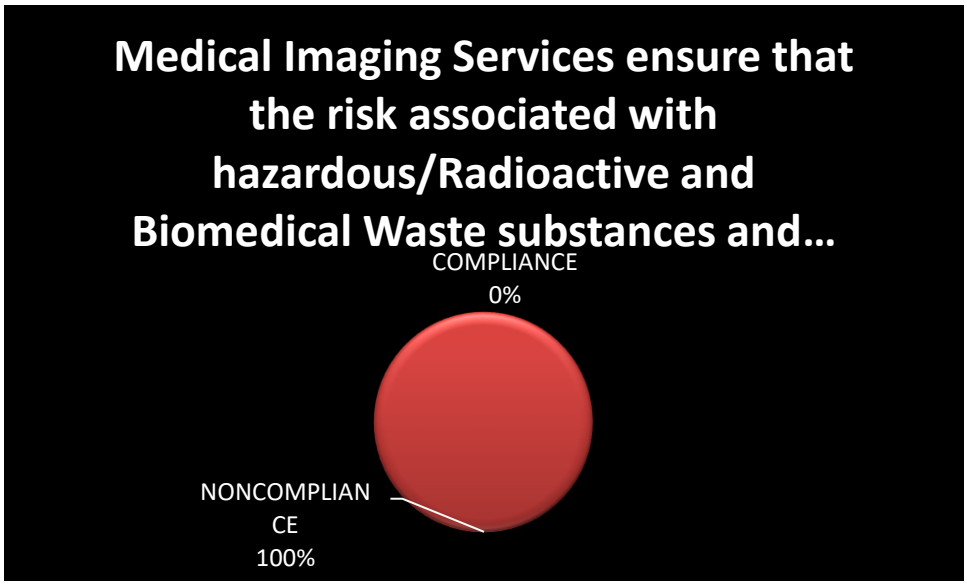
Only 25% compliance to be found in managing, assessing and minimizing the risks associated with imaging and therapeutic procedures as roles & responsibilities for all levels of risk management in all areas of imaging were not identified. It was found that there was very little knowledge about ALARA amongst the staff which resulted in no documentations but still they try to implement the safety precautions possible. Risks associated with use of ablative, therapeutic devices during diagnostic & interventional procedures are not documented. Also there are no incidents & errors reporting pertaining to risks associated with all the procedures which could be investigated, acted upon, analyzed, and used to guide and plan the future action.

	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure that the risk of infection to staff, patient and others is identified, assessed, managed and minimised.							
a	Roles and responsibilities regarding infection control are defined.	N	N		0		
b	Medical Imaging Services ensure that policies and procedures to identify, assess, manage and minimise the risk of infection to staff, patient and others are defined, documented, implemented and monitored.	N	N		0		
c	Medical Imaging Services ensure that policies and procedures for decontamination of equipment and environment are defined, documented, implemented and monitored.	N	N		0		
d	Medical Imaging Services ensure that protocols and procedures for needle stick injuries and subsequent post exposure prophylaxis are defined, documented, implemented and monitored.	N	N		0	0	0



From the above graph it was noticed that it was observed that there is 0% non compliance in assessing and managing infection to staff, patient or others. No documented roles and responsibilities were found regarding infection control. No measures were taken to identify, assess, manage and minimize the risk of infection to staff, patient and others and neither were they documented, implemented or monitored. No policies and procedures are maintained regarding decontamination of equipment and environment. Protocols and procedures for needle stick injuries and their precautions were not known.

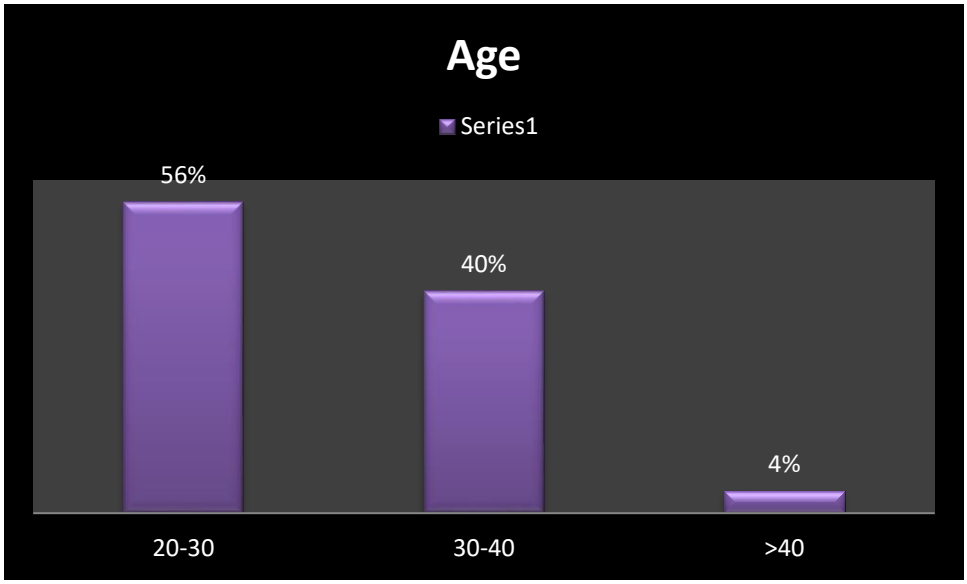
	Elements	Documentation (Yes/ No)	Implementation (Yes/ No)	Evidence (cross reference to documents/ manuals etc.)	Scores (0/ 5/ 10)		
Medical Imaging Services ensure that the risk associated with hazardous/ Radioactive and Bio-Medical Waste (BMW) substances and materials to staff, patient and others are identified, assessed, managed and minimised.							
a	Roles and responsibilities for control of hazardous/radioactive and Bio- Medical Waste (BMW) substances and materials are defined.	N	N		0		
b	Medical Imaging Services ensure that policies and procedures to identify, assess, manage and minimise the risk a s soc i a t ed wi th ha z a rdous / radioactive and Bio-medical waste (BMW) substances and materials to staff, patient and others are defined, documented, implemented and monitored.	N	N		0		
c	Medical Imaging Services ensure that appropriate protective equipment required decontaminating and managing exposure to hazardous/ radioactive substances are available and maintained.	N	N		0		
d	Medical Imaging Services ensure that the incidents & errors pertaining to risks associated with hazardous/ radioactive substances and materials are reported, investigated, recorded, analysed, acted upon and used to and plan the future action.	N	N		0	0	0



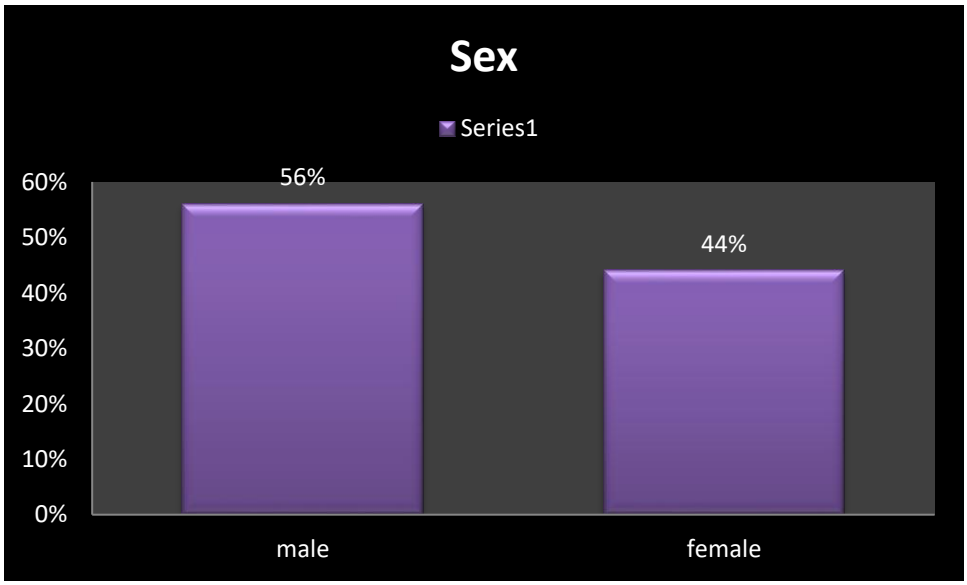
Medical Imaging Services ensure that the risk associated with hazardous/ Radioactive and Bio-Medical Waste (BMW) substances and materials to staff, patient and others are identified, assessed, managed and minimised.

Above graph shows 0% compliance level was achieved. Roles and responsibilities for control of hazardous/radioactive and Bio- Medical Waste (BMW) substances and materials were not defined. Ensuring policies and procedures to identify, assess, manage and minimize the risk associated with hazardous / radioactive and Bio-medical waste (BMW) substances and materials to staff, patient and others were not documented. Appropriate protective equipment required decontaminating and managing exposure to hazardous/ radioactive substances were not available and maintained. The incidents & errors pertaining to risks associated with hazardous/ radioactive substances and materials were not reported, investigated, recorded, analysed, acted upon and used to and plan the future action.

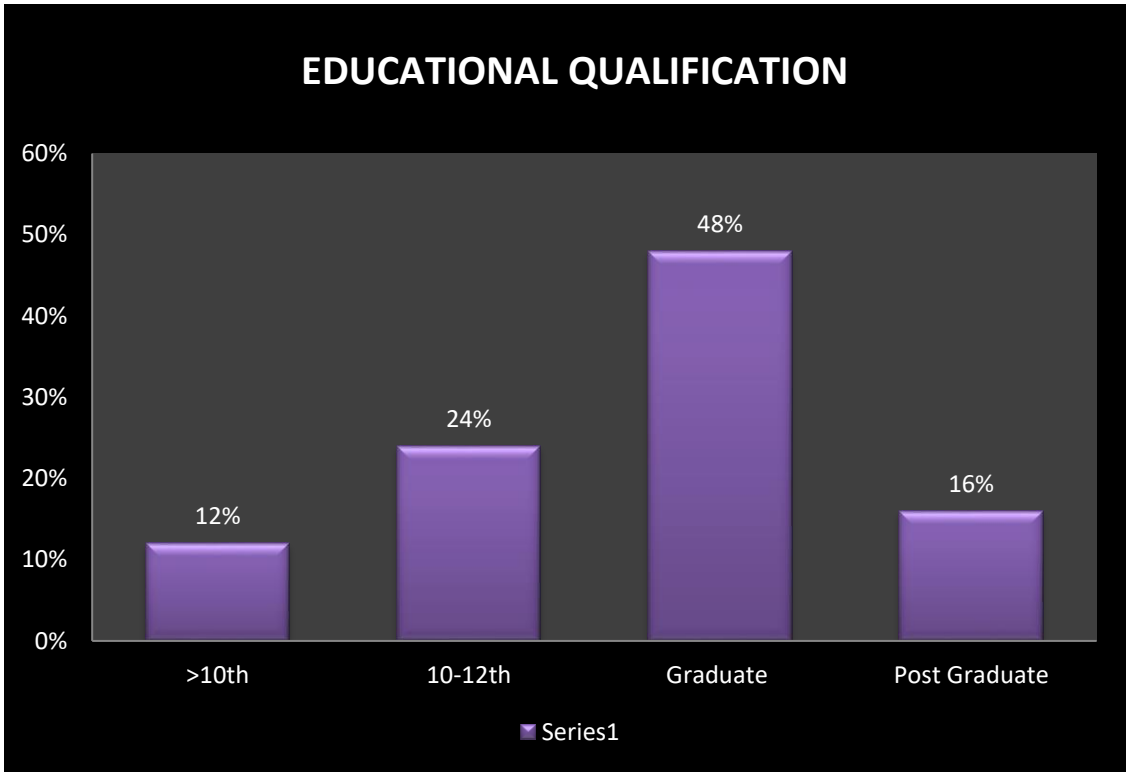
Analysis on awareness level on radiation safety among hospital staff.



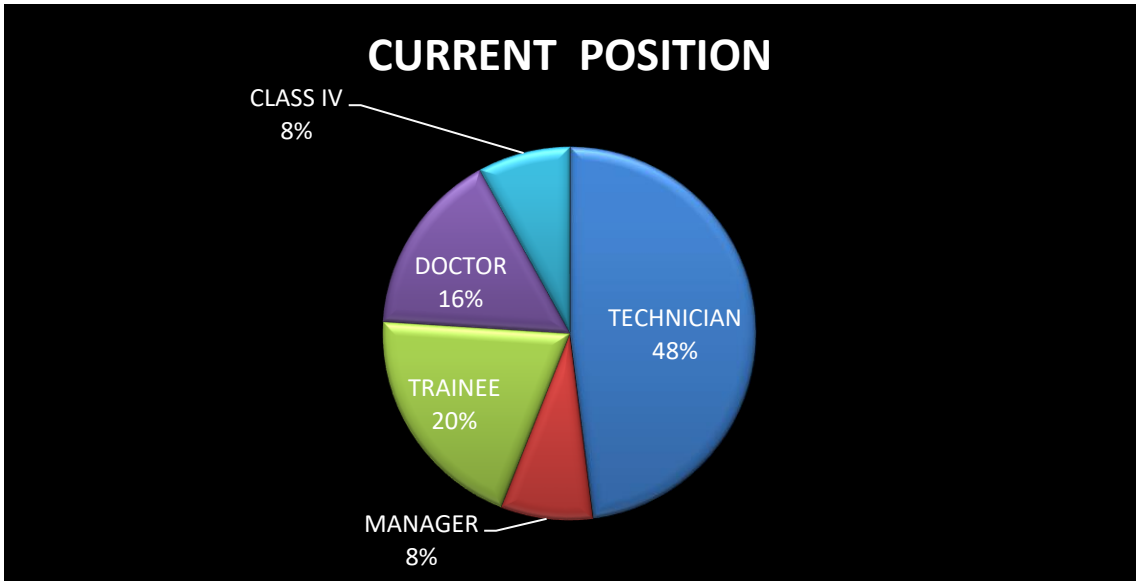
On analysis of above graph it shows that 56% of the employees were of age between 20-30, 40% were between 30-40 and 4% were above 40 yrs of age.



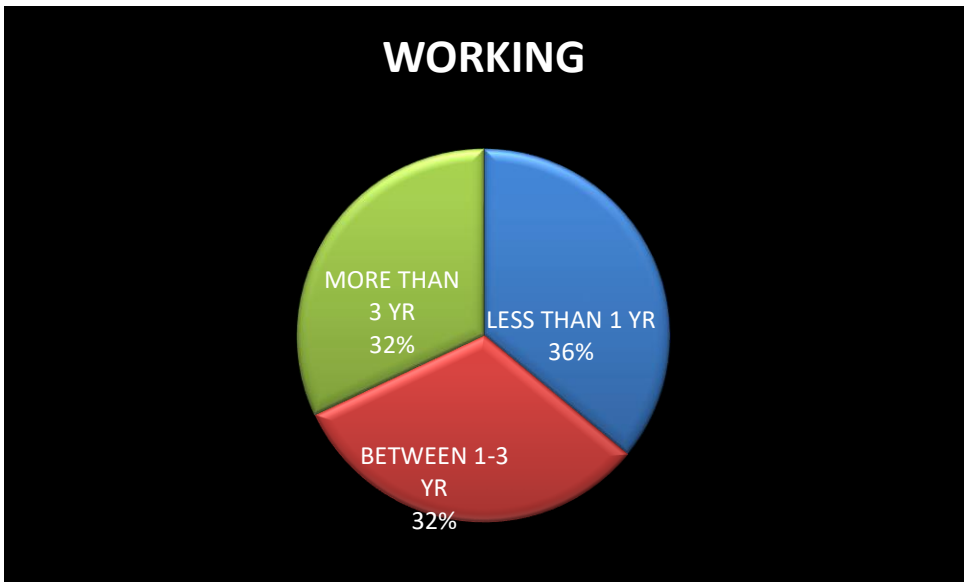
56% of employees are male whereas 44% were female.



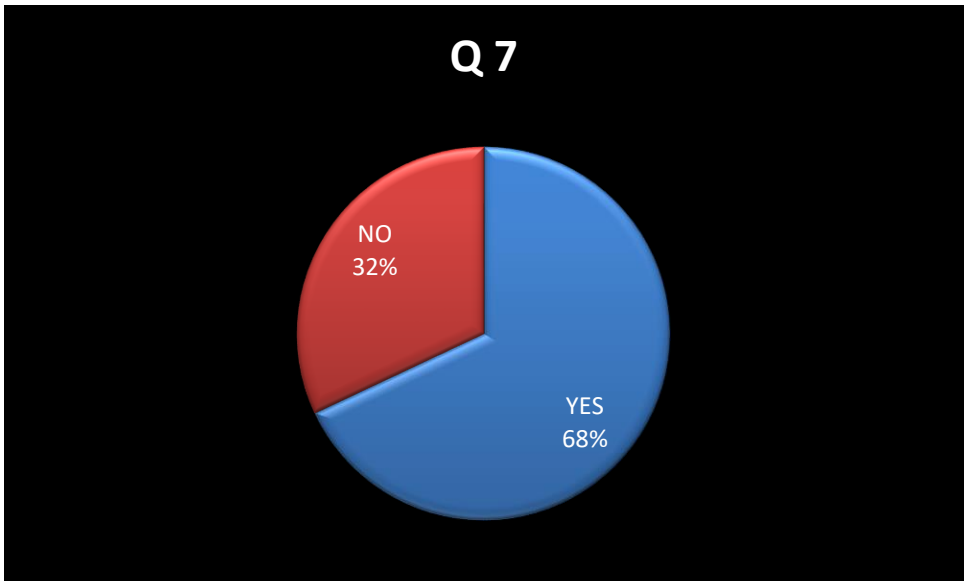
Above graph depicts that 48% of the employees are graduate, 24% were between 10-12th paas and 12% studied below 10th standard. 16% of the staff is post graduate.



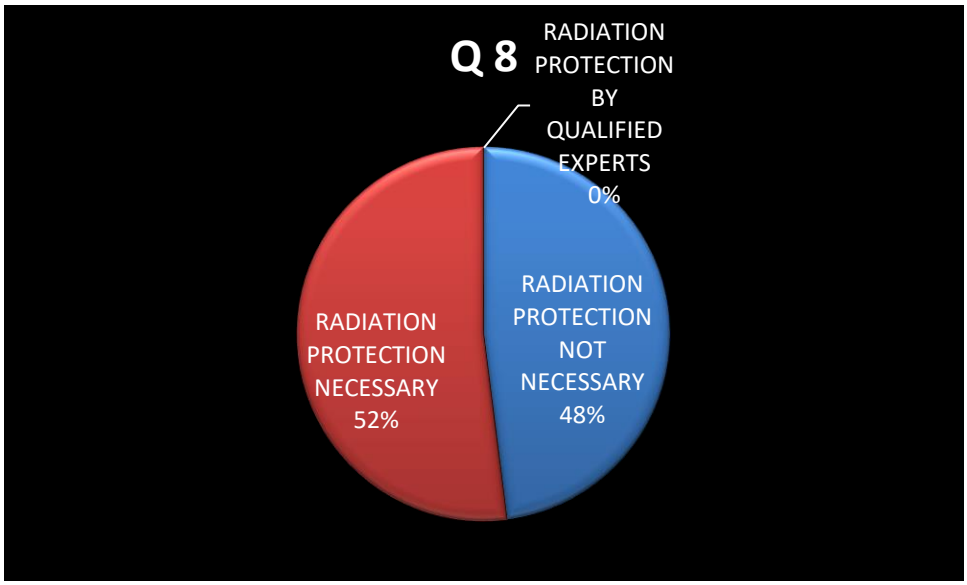
On analysis it was found that 16% of the staff are doctors, 48% are technicians, 20% are trainees and 8% each are managers and class IV staff.



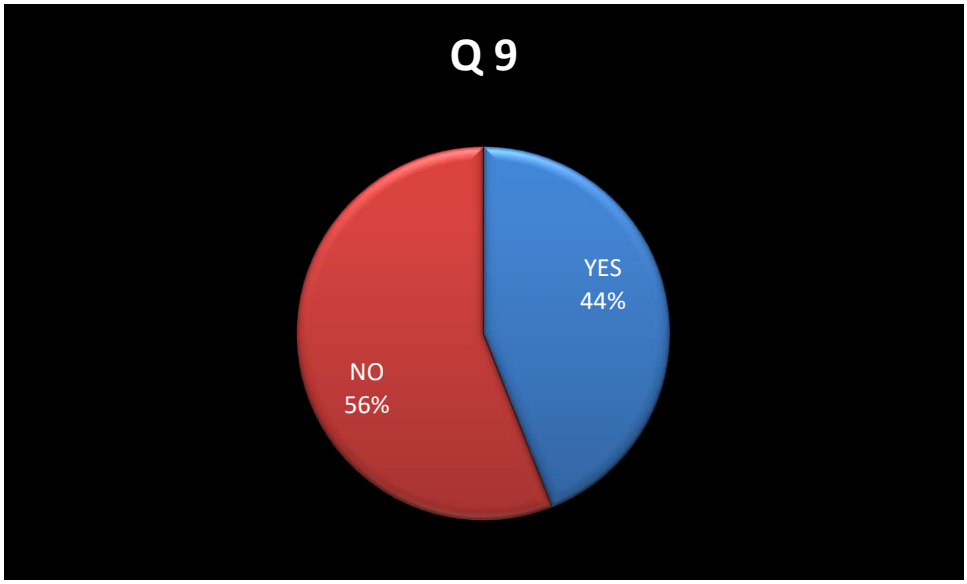
Majority i.e. 36% of the staff are working from less than 1 yr, 32% of the staff are working from more than 3 yrs, and rest 32% are working between 1-3 yrs.



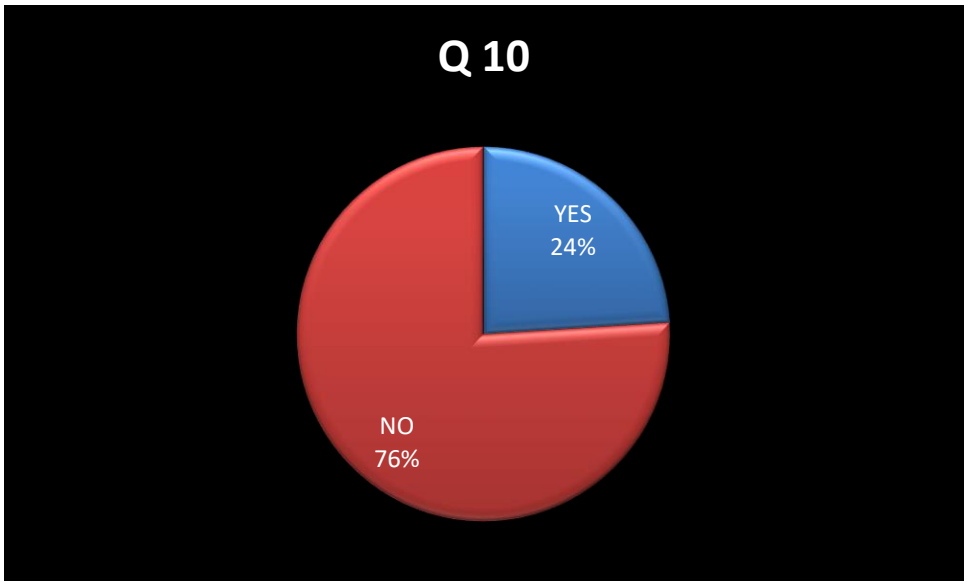
The above graph shows that 68% of the staff deals with radiopharmaceuticals or radiation substances 32% doesn't deal.



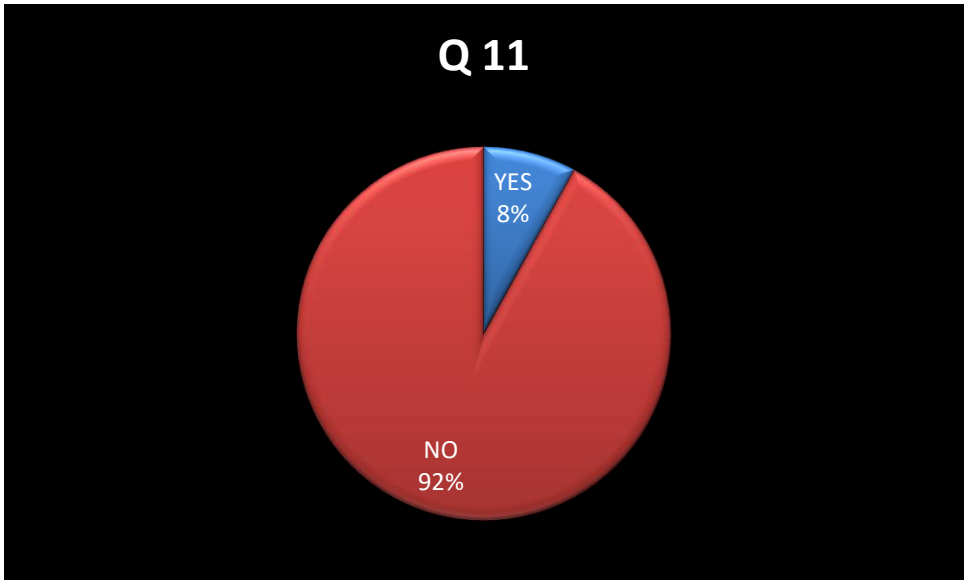
52% of the staff told that radiation protection is necessary during their working. Rest 48% told that radiation protection is not necessary.



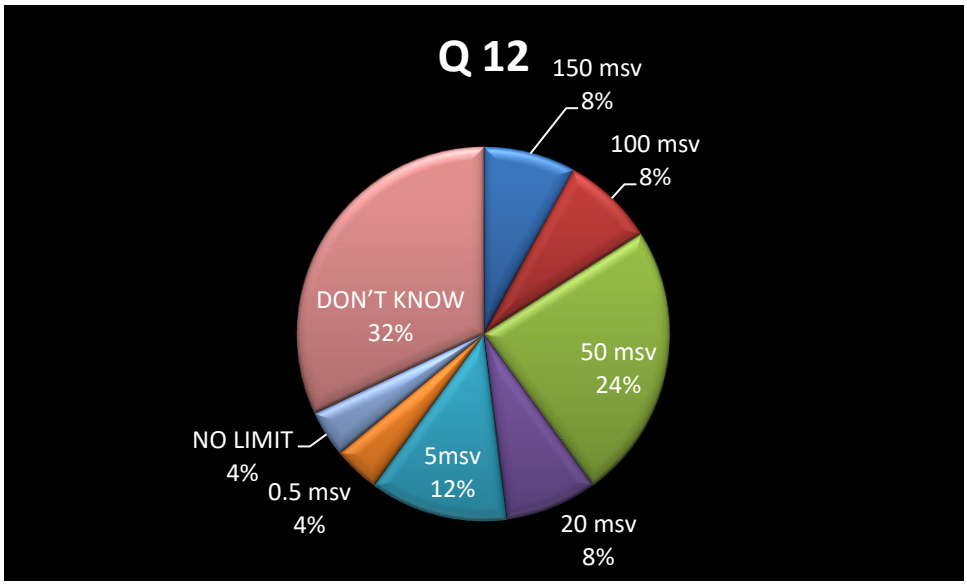
56% of the employees have never attended a radiation protection course and 44% employees have attended radiation protection course during their tenure of work.



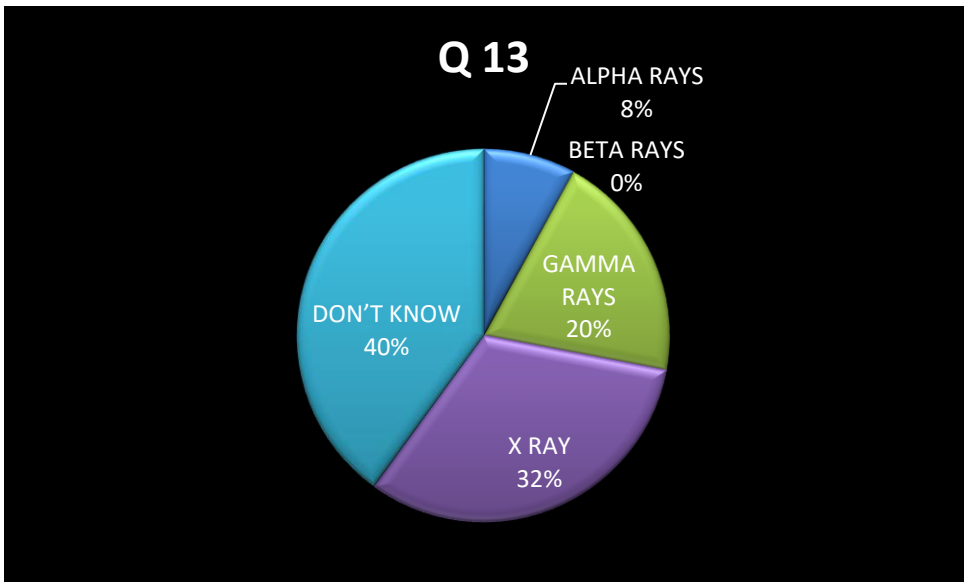
Only 24% of the staff knew the annual permissible radiation dose while 76% of the staff didn't know.



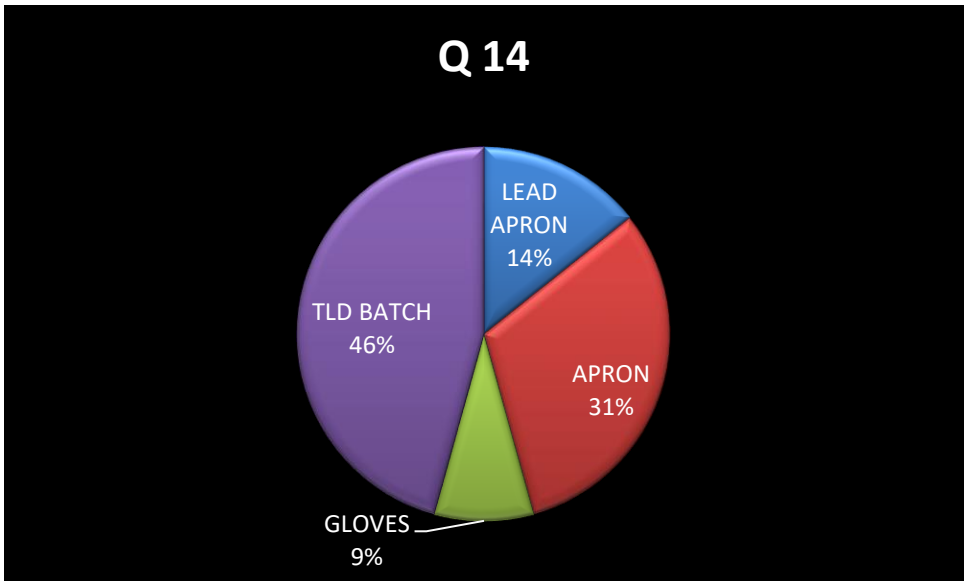
Only 8% of the employees have been trained from RSO on radiation safety rest 92% have not got training on radiation safety.



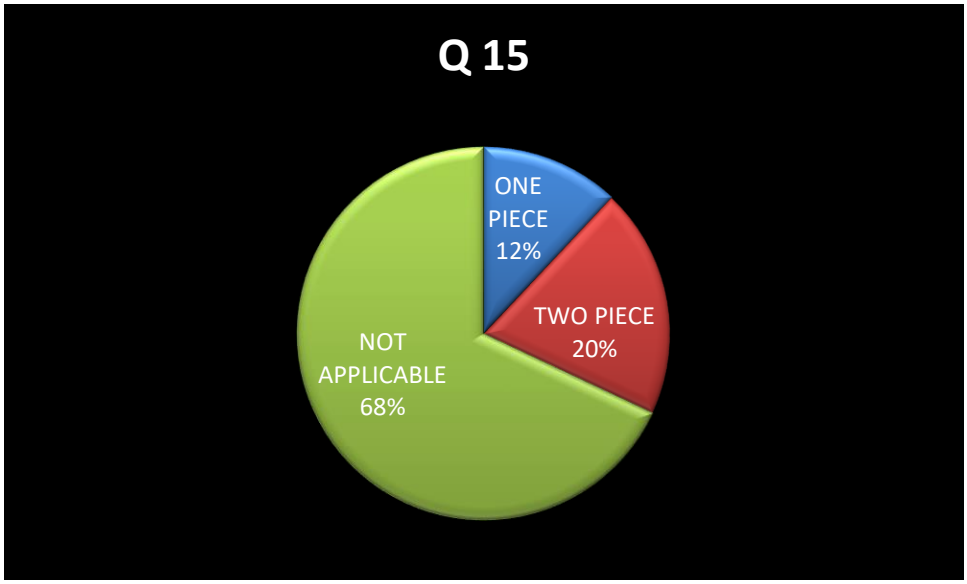
The annual whole body dose limit for a patient is 50 msv. Only 24% staff knew the correct answer as 50 msv. Majority of the staff i.e 32% didn't know about the whole body dose limit.



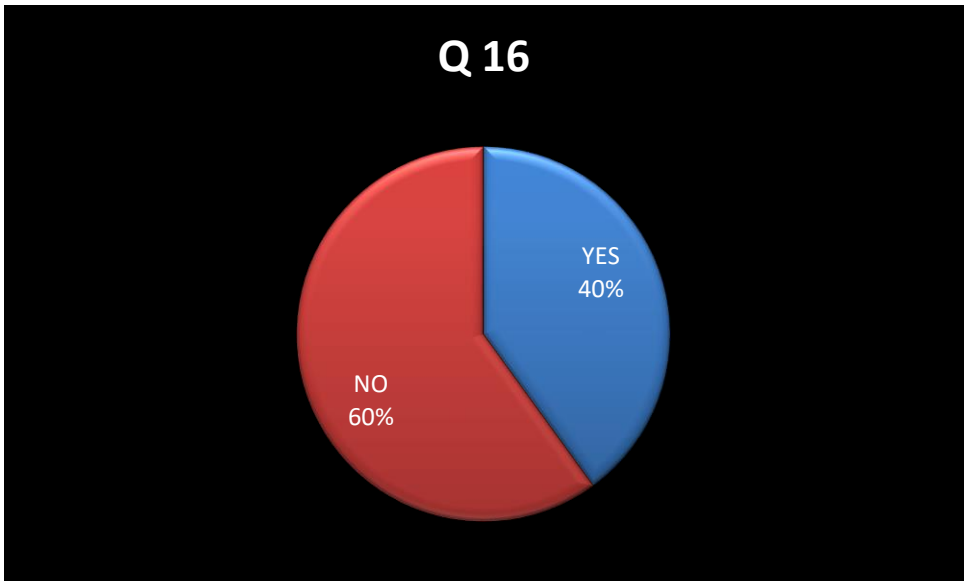
The above graph shows figures about the staff working with which type of rays. The greatest concern was that 40% of the staff didn't know about which kind of ray they are working with. 20% of the employees are working with gamma rays, 32% with x rays and 8% with alpha rays.



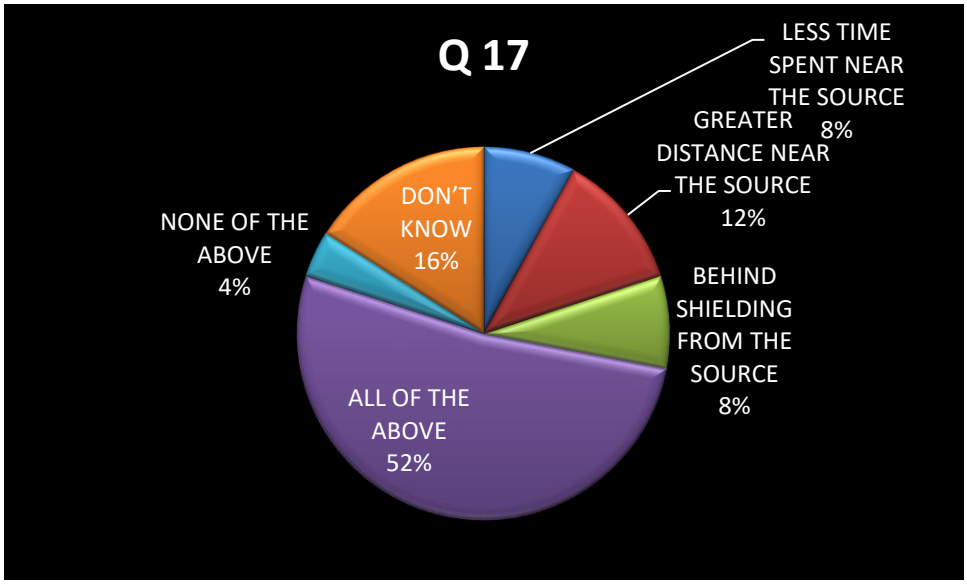
46% of the staff wear TLD badge regularly during their work timings. 14% of the staff wear lead apron daily, 31% of the employees wear apron regularly during the working hours.



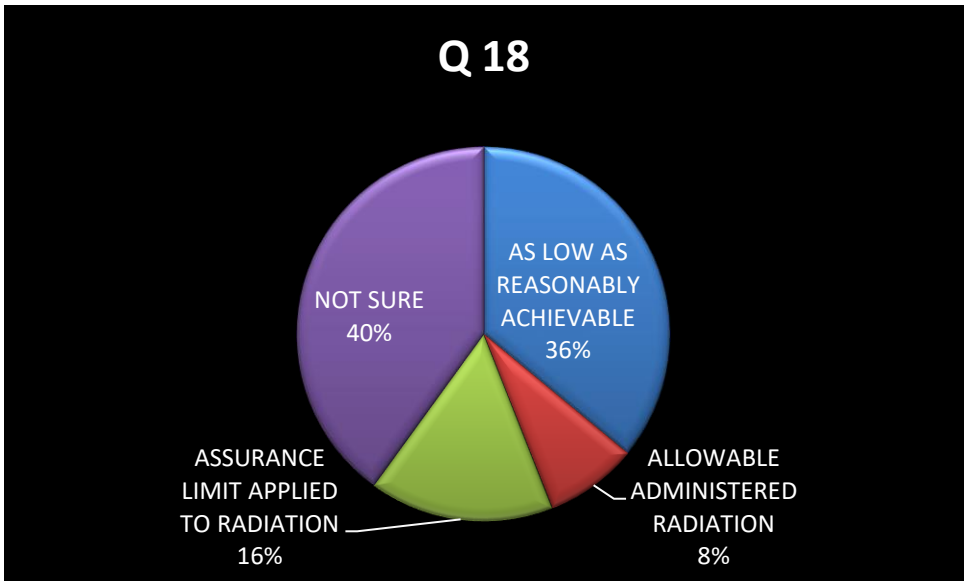
20% of the staff wears two piece lead apron and 12% of the staff wear one piece lead apron.



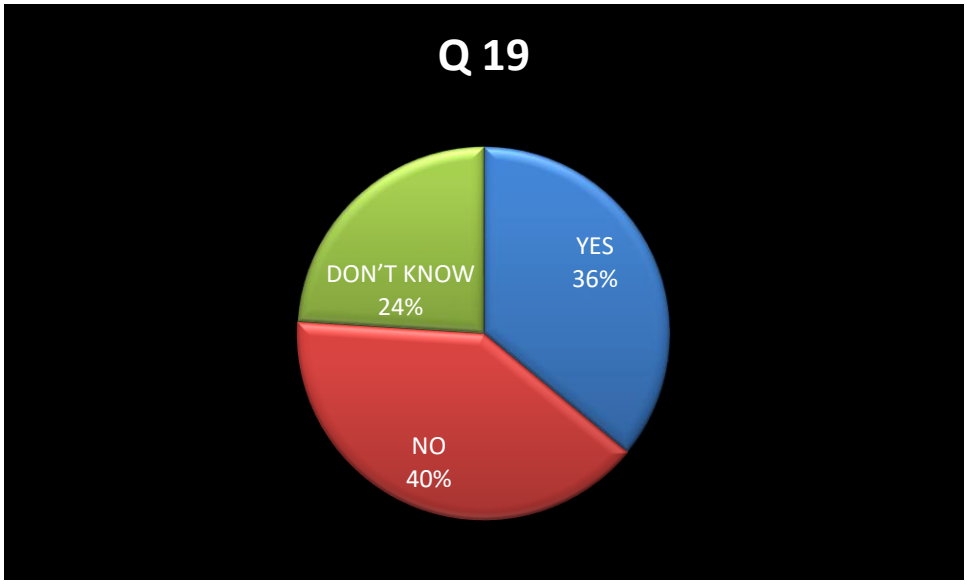
60% of the staff doesn't check the amount of radiation exposure regularly using the survey meter while 40% do.



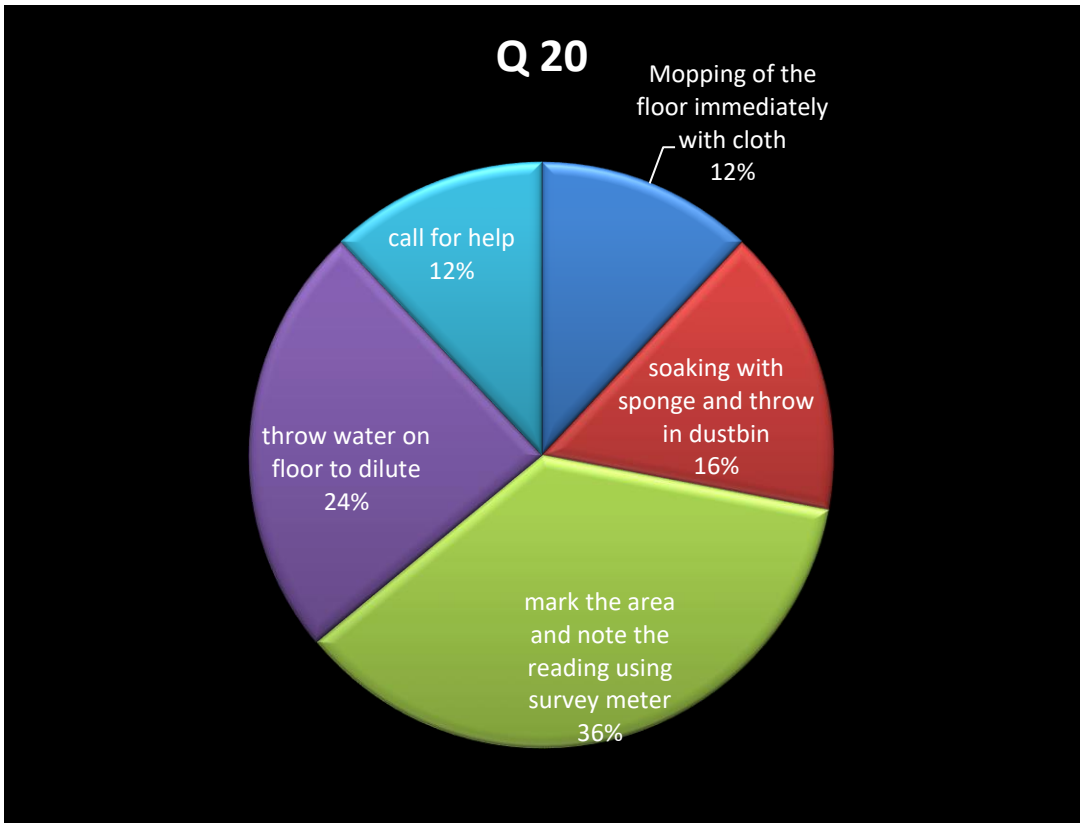
On asking about how exposure to radiation can be minimized 52% of the staff answered that radiation exposure can be minimized by less time spent near the source, greater distance near the source and behind shielding from the source. 16% of the staff didn't know about the minimization of radiation exposure.



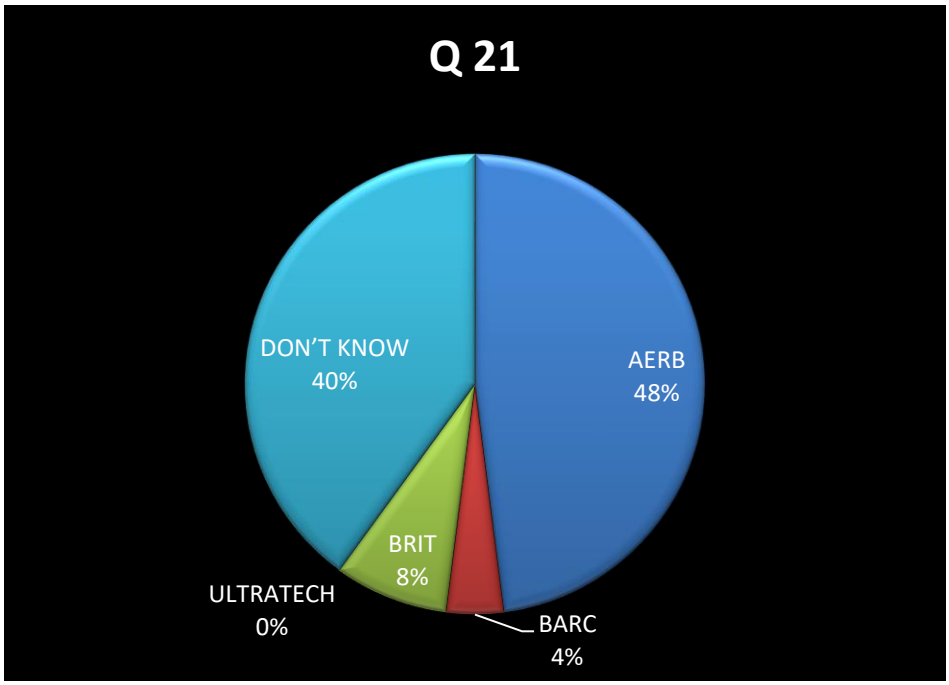
36% of the staff correctly answered the full form of ALARA. 40% of the staff was not sure of the answer.



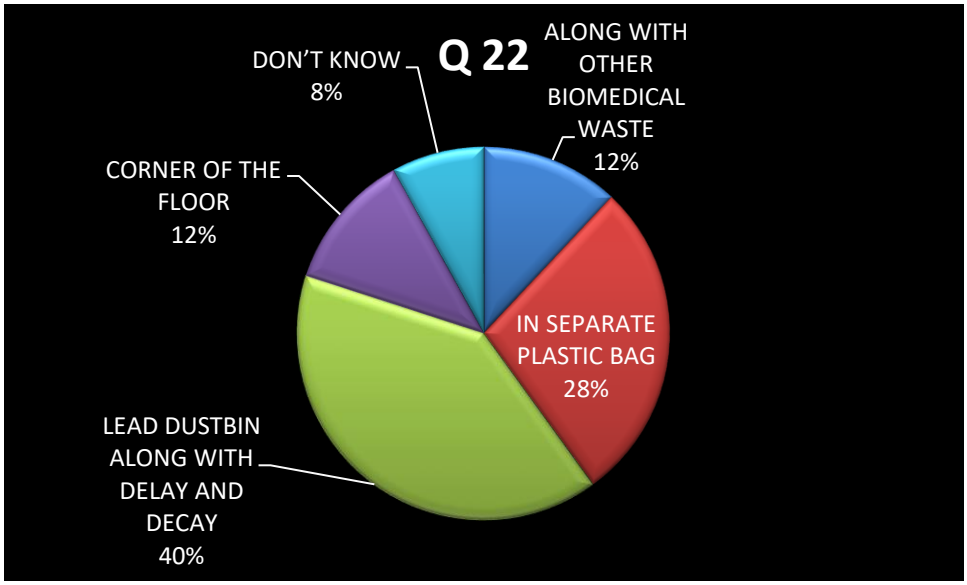
36% of the employees said that their department regulations specify dose limits for the occupational exposure of any worker. 40% of the staff said that there is no limit for dose limit and rest 24% didn't know about the dose limits.



Above graph explains about answers given when asked about measures taken in case of spillage of radioactive substance. To this question 36% of the staff answered to mark the area and note the reading using survey meter. This is the first measure to be taken during a spillage. Rest 24% of the staff told that they would throw water on floor to dilute the radioactive material which may lead to more area of spillage. 16% of the employees told that they would soak with sponge and throw in dustbin but throwing in a dustbin would again contaminate the dustbin and would again can harm with radiation. 12% of the staff told that mopping the floor immediately with cloth would be the immediate measure to be taken. But in this case the radioactive material will be spread over a large area and in case of high dose spillage may also lead to radiation exposure. 12% of the staff told that they would call for help in case of a spillage.

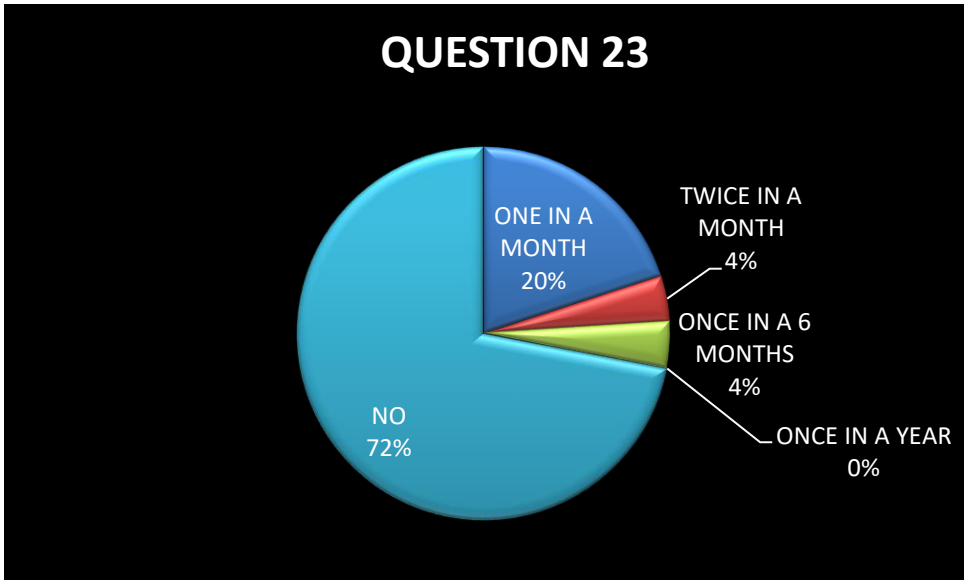


The employees were asked about the regulatory body of radioactive materials and radiation exposure. The above graph shows that majority of the employees i.e 48% said that AERB is the regulatory body of radiology. But 40% of the employees didn't know about the regulatory body. 8% told its BRIT and 4% said BARC.

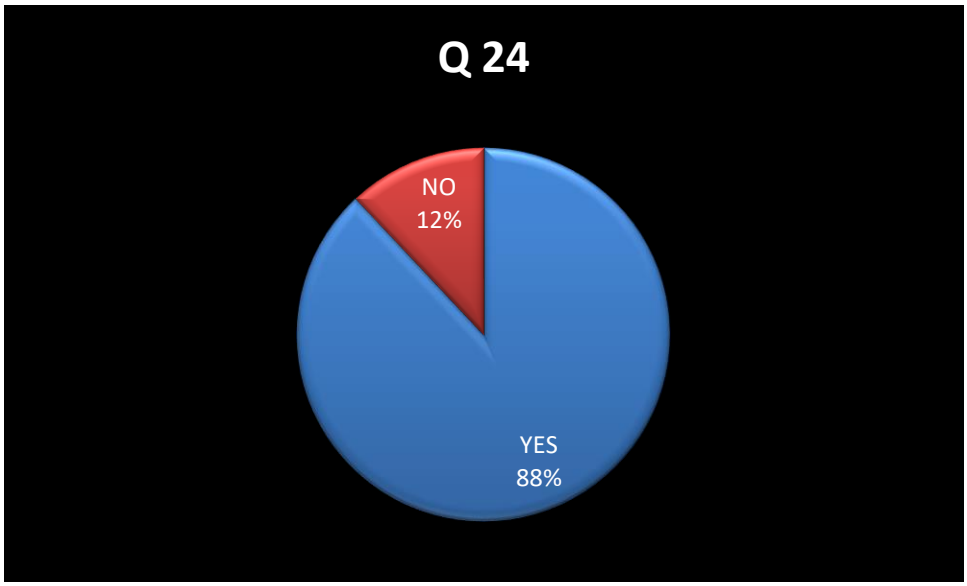


The above question was about the disposal of radioactive waste in the premises. 40% told the correct procedure that they disposed the radioactive waste in lead dustbin along with delay and decay. 28% said that they threw it in a separate plastic bag but they didn't mention about the radiation being exposed. 12% told that they dispose the radioactive waste along with other biomedical waste. This

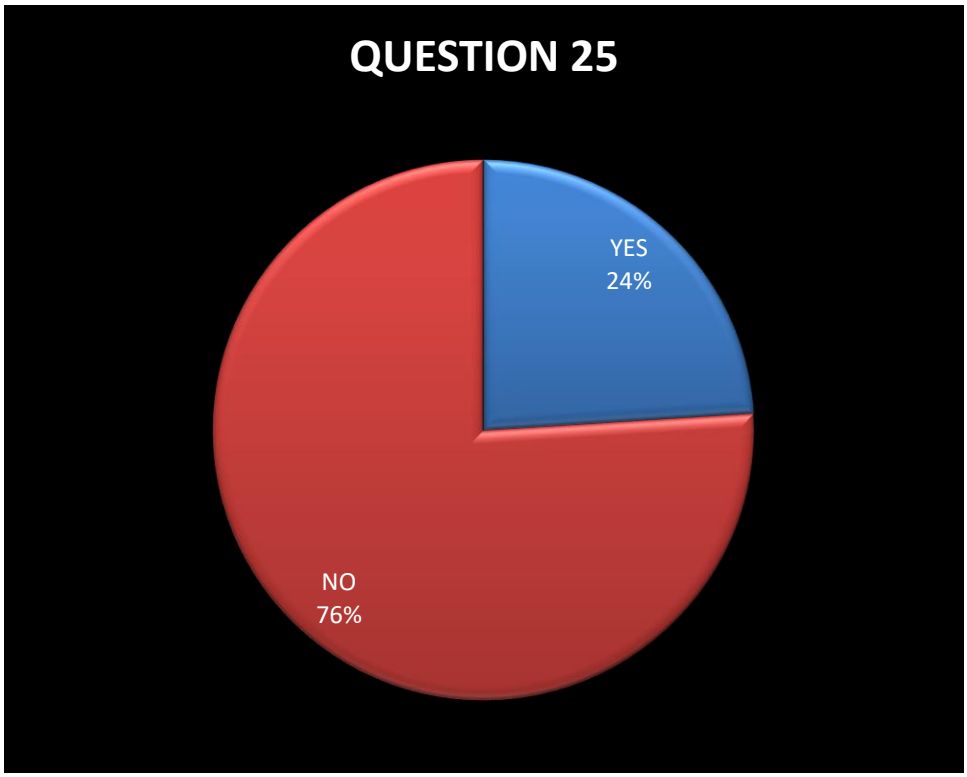
also may lead to radiation exposure. 12% also told that they dispose at the corner of the floor without any lead boundary. 8% didn't know how they are disposed.



72% of the staff didn't attend radiation safety training. 20% of the employees receive training once in a month. 4% receive twice a month. Rest 4% received once in 6 months.



88% of the employees told that hospital authority have conducted surveillance for radiation safety once in the past two years. Rests 12% have not seen the hospital authority to conduct the surveillance.



76% have not given any recommendations towards improvement of radiation safety.

Recommendations

1. Area assigned for dose administration should be used for the same purpose and not as general purpose which will result in public occupancy in the radioactive area. Dose administration should not be done in gamma camera room.
2. General public occupancy shall not be allowed in the radioactive patient waiting area.
3. Pamphlets can be made in which details about a specific procedure can be given in a relevant format and language to be understood by the patient.
4. Emergency procedures in case of radioactive spillage and misadministration need to be documented and displayed in the form of posters. Also the staff should be trained about spillage management protocol.
5. Radioactive waste shall not be accumulated in the hot lab and has to be disposed off timely by ensuring radiological safety.
6. TLD badge should be provided to all the staff including trainees.
7. Biomedical waste management rules and codes to be explained to the staff and followed strictly.
8. Employees should be informed about the various terms related to radiology like ALARA, AERB, Delay and Decay, Decontamination etc.
9. Daily amount of radioactive substance disposed should be noted.
10. Dose given to each patient for each procedure should be noted.
11. Radiation protection course shall be attended by each staff once in every month.
12. Appointment of RSO on permanent basis shall be done.
13. Training of staff under RSO shall be done once every month.
14. Radiation exposure to be checked daily in the department using survey meter.
15. Infection control measures to be taken and explain to the staff.
16. Patients and employees rights and responsibilities to be put on display.
17. Documentation should be done on:
    - Patient feedback
    - Protocols for image acquisition and processing.
    - Sedation/ anesthesia given to patients.
    - Drug administration and dosages
    - Calibration, repair and downtime
    - Staff risk monitoring register
    - Quality control and quality improvement.

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