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RESEARCH ARTICLE

KNOWLEDGE OF RADIATION EXPOSURE IN COMMON RADIOLOGICAL INVESTIGATIONS: A COMPARISON BETWEEN NON RADIOLOGIST AND RADIOLOGIST

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Abstract

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Introduction: Radiological examinations play an important role in daily medical practice in the hospital setting, patients are not adequately informed about the radiation dose they are exposed to when undergoing a radiological examination[1-3]. This may be partly explained by inadequate knowledge among referring doctors concerning the radiation dose of commonly performed examination regardless of years of clinical experience[4-6]. However to date limited studies have been performed to assess knowledge among the radiologists or to compare the results with non radiologist.

Aims and objectives: To assess knowledge about the radiation dosage of common performed radiological examinations among non radiologist and compare that with radiologist. Are radiologists and non-radiologists equally aware about the radiation hazards?

Material and methods: This is prospective multiple choice questionnaire based study, will be conducted at Peerless Hospital & B.K Roy Research Centre Kolkata and other Hospitals of Kolkata .The hospitals are multi-speciality hospitals that provides Cardio Department, CTVS Department, ENT Department, Gastro Department, Medicine Department, Nephrology Department, Neuro. Department, Orthopaedics Department, Paediatrics Department, Plastic Surgery Department, Surgery Department, Urology Department, paediatric and emergency department .Questionnaires will be distributed by both hard copies and by email to each doctor in these departments.

Sample Size: .For the proposal of this study sample size was one hundred and fifty.

Inclusion Criteria: Doctors working in Radiology department, Cardio Department, CTVS Department, ENT Department Gastro Department, House Officer, Medicine Department, MO/RMO, Nephrology Department, Neruro. department, Orthopaedics Department, Paediatrics Department, Plastic Surgery Department, Surgery Department, Urology Department and Doctors of Emergency department in Peerless Hospital Kolkata and other hospitals in Kolkata.

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Exclusion Criteria: Undergraduate medical trainees. Doctors working in obstetrics.

Statistical analysis: For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 25.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate. p-value ≤ 0.05 was considered for statistically significant.

Results: We found that the knowledge of radiation dose of investigation is significantly poor in non radiologist. Our study also showed that knowledge of radiation dose of investigation is generally inadequate among radiologists.

It was found that young practitioners among non radiologist as well as radiologist have better knowledge of radiation dose of investigation. Knowledge and awareness of the radiation hazards of radiological examinations can be raised among emergency physicians and other medical professionals as a part of continuous medical education programmes. Knowledge of radiation doses of investigation is generally inadequate among radiologists, and particularly poor in non-radiologist. Underestimation of radiation doses may expose patients to increasing radiological investigation and expose to radiation hazards.

Conclusion: Efforts to educate medical professional about radiation exposure and hazard are needed to ensure that medicinal professional are appropriately weighing the risks and benefits of medical imaging and to ensure high-quality, patient-centered care.

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Introduction:-

Radiological examinations play an important role in daily medical practice in the hospital setting, patients are not adequately informed about the radiation dose they are exposed to when undergoing a radiological examination[1-3]. This may be partly explained by inadequate knowledge among referring doctors concerning the radiation dose of commonly performed examination regardless of years of clinical experience[4-6]. However to date limited studies have be performed to assess knowledge among the radiologists or to compare the results with non radiologist.

Radiological examinations are commonly advised for patients to aid clinical diagnosis. However many of the doctors do not realise how much radiation dosage their patients are exposed to during such investigations.

Radiation is a constant concern in modern medicine as it is known to be related to higher cancer rates.[7]

The majority of radiological investigations are initiated by non-radiologists, they should have some basic idea of the radiation dose of the examination before ordering the test. Radiologists should advise referring doctors on the best possible imaging modality that can provide the best possible answer to the clinical question that needs to be answered. Both non-radiologists and radiologists should therefore have adequate knowledge of radiological examination doses, and work together to decide the best radiological examination for patients.

The recent dramatic evolution and increased use of ionising radiation-based diagnostic modalities such as multi-detector computed tomography (CT) has led to a multiplication of the number of examinations and hence of the overall radiation exposure to the population, with CT currently accounting for about 50% of the total radiation burden for medical purposes [8, 9]. This situation has raised concerns in the scientific community about the potential side effects on patients, with particular reference to radiation-related cancer and death [9, 10]. Moreover, several papers have recently shown a small, but significant increase of cancer risk in children and young patients with previous exposure to CT scans [10, 11, 12], paralleled by a measurable increase in radiation-induced DNA damage following several radiologic examinations that correlates with radiation dose [13, 14]. In this setting, a full awareness of radiation protection issues and a proper knowledge of the radiation doses delivered by the various imaging modalities are essential to make sure that all involved professionals adhere to up-to-date appropriateness and optimisation criteria [15].

General training about radiation protection should be provided starting from undergraduate courses and followed by specific update courses, as requested by the Guidelines on radiation protection education and training of medical professionals (2014), which has set the standard of minimum knowledge expected from each and every practitioner involved in radiation protection [16]. In the past decade, many studies conducted on selected cohorts of staff radiologists and referring physicians and technologists unveiled an alarming lack of radiation protection knowledge among them. In particular, a significant number of professionals resulted to be underestimating the overall radiation doses associated with various imaging modalities, and in some cases, they were even unable to correctly differentiate between ionising and non-ionising radiation-based imaging techniques [17, 18, 19]. Such disappointing findings needs a systematic, complete evaluation of the knowledge of basic radiation protection issues needed for daily practice by students in training (such as medical students, radiography students, and radiology residents), in an attempt to gain insight about the current status of radiation protection education among those who will advise, perform or interpret medical imaging examinations in their future professional life. In this point of view the advantages of creating a positive radiation safety culture in the higher education and research sectors have been outlined, with continuous education and testing for all people involved (including students during their training period) being key to optimise performance, minimise errors, and protect the entire workforce as well as the general public and the environment [20, 21, 22].

The fact that ionizing radiation can cause biological damage has been known for years. The average dose received by the public is 2.5 mSv per year; 15 percent of which is related to medical exposures [23, 24]. Although radiological imaging in medical diagnosis in hospitals plays an important role and benefits millions of people, promotion of awareness about the dangers of ionizing radiation is important [25, 26]. The most important effects of radiation on the health are deterministic effects which occur in high doses and stochastic effects at low doses of radiation [27, 28]. Recently, concerns about the awareness of physicians about the radiation dose during diagnostic radiological procedures are increasing [23, 29]. Therefore, it is essential that doctors and radiographers pay special attention to the patient's dose in different imaging procedures. A study showed that awareness about the radiation dose among radiologists is insufficient and among non-radiologists it is dramatically poor [26]. In general, various evaluations indicate low to moderate levels of knowledge of physicians in relation to radiation doses and health risks [30-34]. In this study, a survey about the radiation protection in Peerless Hospitals and other hospitals of Kolkata was done to assess the knowledge of doctors about radiological investigations taken routinely in hospitals, and the physicians' knowledge about radiation dose received by patients during prescribed diagnostic radiography.

Research Questions:

To assess knowledge about the radiation dosage of common performed radiological examinations among non radiologist and compare that with radiologist.

Are radiologists and non-radiologists equally aware about the radiation hazards?

Review Of Literature:

Radiation exposure:

Radiation exposure is a measure of the ionization of air due to ionizing radiation from photons; that is, and X-rays and gamma rays.[35]

The SI unit of exposure is the coulomb per kilogram (C/kg), and has largely replaced the roentgen (R).[36] One roentgen equals 0.000258 C/kg; an exposure of one coulomb per kilogram is equivalent to 3876 roentgens.

Types of radiation:

Radiation includes

1. High-energy electromagnetic waves (x-rays, gamma rays)
2. Particles (alpha particles, beta particles, neutrons)

Alpha particles are energetic helium nuclei emitted by some radionuclides they cannot penetrate skin beyond a shallow depth (< 0.1 mm).

Beta particles are high-energy electrons that are emitted from the nuclei of unstable atoms. These particles can penetrate more deeply into skin (1 to 2 cm) and cause both epithelial and sub-epithelial damage.

Neutrons are electrically neutral particles emitted by a few radionuclides. Their depth of tissue penetration varies from a few millimetres to tens of centimetres, depending on their energy.

X-rays and Gamma radiation are electromagnetic radiation (ie, photons) of very short wavelength and can penetrate deeply into tissue (many centimetres)..

Because of these properties, beta and alpha particles cause the most damage when the radioactive atoms that emit them are within the body (internal contamination) or, in the case of beta-emitters, directly on the body. X-rays and Gamma rays can cause damage distant from their source and are typically responsible for acute radiation syndromes.

Measurement of radiation:
Conventional units of measurement include the roentgen, rem and rad. The roentgen (R) is a unit of exposure measuring the ionizing ability of gamma radiation or x-rays in air. The radiation absorbed dose (rad) is the amount of that radiation energy absorbed per unit of mass. Because biologic damage per rad varies with radiation type (e.g. it is higher for neutrons than for or gamma radiation or x-rays), the dose in rad is corrected by a quality factor; the resulting equivalent dose unit is the roentgen equivalent in man (rem)., SI (International System) units are used outside the US and in the scientific literature, in which the rem by the sievert (Sv) and rad is replaced by the gray (Gy); 1 Sv = 100 rem and 1 Gy = 100 rad.

Types of exposure:
Radiation exposure may involve
1. Contamination
2. Irradiation

Radioactive contamination is the unintended contact with and retention of radioactive material, usually as a liquid or dust. Contamination may be
1. External
2. Internal

External contamination is that on clothing or skin, from which some can be rubbed off of or fall, contaminating objects other people. Internal contamination is unintended radioactive material within the body, which it may enter by inhalation, ingestion or through breaks in the skin.

Irradiation is exposure to radiation but not radioactive material (i.e. no contamination is involved). Radiation exposure can occur without the source of radiation (e.g., radioactive material, x-ray machine) being in contact with the person.

Sources of exposure:
Sources may be naturally occurring or artificial.

People are persistently exposed to low levels of naturally occurring radiation called background radiation.

In the US, people receive on the average about 3 mSv/year from man-made sources, the vast majority of which involve medical imaging. On a per person basis, the contribution of exposure from medical imaging is highest for CT and nuclear cardiology procedures. However, medical diagnostic procedures hardly impart doses enough to cause radiation injury, although there is a small theoretical increase in the risk of cancer. Exceptions may include certain prolonged fluoroscopically guided interventional procedures (e.g., endovascular reconstruction, vascular embolization, cardiac and tumour radiofrequency ablation); these procedures have caused injuries to skin and underlying tissues. Radiation therapy can also cause injury to normal tissues near the target tissue.

Factors affecting response:
Biologic response to radiation varies with
1. Tissue radio-sensitivity
2. Dose
3. Dose rate
4. Duration of exposure
5. The age of the patient
6. Co morbidities
7. Presence of genetic DNA repair defect disorders (e.g. ataxia-telangiectasia, Bloom syndrome, Fanconi anaemia)

Cells and tissues differ in their radio-sensitivity.
Cellular sensitivities in approximate descending order from most to least sensitive are
1. Lymphoid cells
2. Germ cells
3. Proliferating bone marrow cells
4. Intestinal epithelial cells
5. Epidermal stem cells
6. Hepatic cells
7. Epithelium of lung alveoli and biliary passages
8. Kidney epithelial cells
9. Endothelial cells (pleura and peritoneum)
10. Connective tissue cells
11. Bone cells
12. Muscle, brain, and spinal cord cells

Carcinogenic, teratogenic, and heritable effects:
Radiation-induced genetic damage to somatic cells may result in malignant transformation, while in-utero exposure can lead to teratogenic effects and damage to germ cells raises the theoretical possibility of transmissible genetic defects.

Symptoms and Signs:
Clinical manifestations depend on whether radiation is limited to a small portion of the body (focal radiation injury) or involves the whole body (acute radiation syndrome).

Preparation:
The Joint Commission mandates that all hospitals have protocols and that personnel have training to deal with patients contaminated with hazardous material, including radioactive material. Identification of radioactive contamination on patients should prompt their isolation in a selected area (if practical), decontamination, and notification of the hospital radiation safety officer, and law enforcement agencies and hazardous material teams, as appropriate to investigate the source of radioactivity.

Specific management:
Symptomatic treatment is given as needed and includes managing shock and hypoxia, relieving pain and anxiety, and giving.

There is no specific treatment for the cerebrovascular syndrome. It is invariably fatal; care should address patient comfort.

The GI syndrome is treated with electrolyte replacement and aggressive fluid resuscitation. Parenteral nutrition should be initiated to promote bowel rest.

Prevention:
Protection from radiation exposure is achieved by avoiding contamination with radioactive material and by minimizing the duration of exposure, maximizing the distance from the source of radiation, and shielding the source.

During imaging procedures that involve ionizing radiation and especially during radiation therapy for cancer, the most susceptible parts of the body (e.g., gonads, thyroid and female breasts) that are not being treated or imaged are shielded by lead aprons or blocks.

Although shielding of personnel with lead aprons or commercially available transparent shields effectively reduces exposure to low-energy scattered x-rays from diagnostic and interventional imaging studies, these aprons and shields are almost useless in decreasing exposure to the high-energy gamma rays produced by radionuclides.

Lee RK et al [37] (2012) found that radiological examinations are commonly advised for patients to aid clinical diagnosis. However, many doctors do not realise that during radiological investigations how much radiation dosage their patients are exposed to. This study aims to compare the knowledge of radiologists and non-radiologists about radiation doses of common radiological investigations. A prospective questionnaire study of doctors about the dosage of commonly done radiological investigations in a university teaching hospital in Hong Kong. For a standard chest x-ray exposure participants were asked to specify the average dose of radiation (in mSv). Doctors were then asked to give estimation of the doses of radiation (measured in chest x-ray equivalents) for radiological procedures. The results of non-radiologists and radiologists were compared. 158 doctors (133 non-radiologists and 25 radiologists) completed the questionnaire. The overall accuracy was 16% for non-radiologists and 40% for radiologists. One-third of non-radiologists could not distinguish radiological investigation with or without ionising radiation. No non-radiologists correctly stated the radiation dose (in mSv) of a normal chest x-ray, and 77% underestimated the dose of radiological examinations. For radiologists, only 32% were correct for the radiation dose of a normal chest x-ray while 7% underrated the radiation doses. Knowledge of radiation doses of investigation is overall inadequate among radiologists, and in particular poor in non-radiologists. Underestimation of radiation doses may expose patients to increasing radiological investigation and exposure to radiation hazards. Awareness of the radiation hazard of radiological investigations should be raised among medical professionals.

Atsina KB et al [38] (2020) found that the purpose of this study was to examine the degree to which nonradiologist physicians provide formal interpretations for advanced imaging and to consider whether adequate training can be achieved for those physicians. This investigation supposed that hospitals are the only places where formal imaging training occurs. The CMS Physician/Supplier Procedure Summary Master Files (PSPSMFs) of the Medicare Part B data sets for 2015 were reviewed. They selected the Current Procedural Terminology (CPT) codes for four categories of non-invasive diagnostic imaging: CT, MRI, PET, and general nuclear imaging. Medicare place-of-service codes allowed us to ascertain the location of each study interpretation. They narrowed this analysis to data from the three major hospital places of service: inpatient facilities, hospital outpatient departments, and emergency departments.

Provider specialties were determined using Medicare's 108 specialty codes. Procedure volumes among radiologist physicians were compared with those among non-radiologists. Of the 17,824,297 hospital-based CT examinations performed in the Medicare fee-for-service population, non-radiologists interpreted 125,937 (0.71%) and radiologists interpreted 17,698,360 (99.29%). Of the 4,512,627 MRI examinations performed, non-radiologists interpreted 43,352 (0.96%) and radiologist physicians interpreted 4,469,275 (99.04%) . Of 391,688 PET studies performed, non-radiologists interpreted 22,775 (5.81%) and radiologist physicians interpreted 368,913 (94.19%). Of the 2,070,861 general nuclear medicine studies performed, non-radiologists interpreted 763,318 (36.86%) and radiologist physicians interpreted 1,307,543 (63.14%). The largest involvement of non-radiologist physicians was of cardiologists, contributing approximately 3% of all advanced imaging interpretations. All other non-radiologist physicians interpreted a tiny fraction of advanced imaging studies. Besides radiologists and cardiologists, no other medical specialty provides adequate education for their trainees and practitioners in advanced imaging interpretation to justify letting them to interpret these studies in practice, except under carefully controlled circumstances.

Hobbs JB et al [39] (2018) found that medical imaging is an increasingly important source of radiation exposure for the general population, and there are risks associated with such exposure; however, recent studies have showed poor understanding of medical radiation among various groups of health care providers. This study had two aims: (1) examine physicians' knowledge of radiation exposure and risk in diagnostic imaging across multiple specialties and levels of training, and (2) assess the benefit of a short educational presentation on enhancing physicians' knowledge. From 2014 to 2016, 232 health care providers from a number of departments took part in an educational sessions and pre- and post-presentation tests assessing knowledge of radiation exposure and risk at a big academic institution. Knowledge of radiation exposure and risk was relatively less on the pre-presentation test, including in particular poor understanding of different imaging methods, with 26% of partakers not able to correctly point-out which procedure expose patients to ionizing radiation. Test scores significantly increased after the educational presentation. Radiologists had higher pre-presentation test scores than other specialties, and therefore less chance for improvement, but also showed improvement in radiation safety knowledge after education. Apart from radiology, there was no noteworthy difference in initial knowledge of radiation exposure and risk among the other specialties. Providers' knowledge of radiation exposure and risk was low at baseline but remarkably increased after a brief educational presentation. Efforts to educate ordering providers about radiation exposure and risk are needed to ensure that providers are appropriately weighing the benefits and risks of medical imaging and to ensure high-quality, patient-cantered care.

Krille L et al [40] (2010) found that the frequent use of computed tomography is a major cause of the increasing medical radiation exposure of the general population. Therefore, radiation protection and dose reduction is a topic of scientific and public concern. They evaluated the available literature on physicians' knowledge regarding radiation dosages and risks due to computed tomography. A systematic assessment in accordance with the Cochrane and PRISMA statements was carried out using eight databases. 3091 references were found. Only primary studies assessing knowledge of physicians about computed tomography were included. 14 appropriate articles were identified, all focussing on dose estimations for CT. On the whole, the surveys showed average to low knowledge among physicians concerning radiation doses and the involved health risks. However, the surveys varied significantly in quality and conduct. More than one survey was available for some countries. There was no general trend in knowledge in any country except a slight betterment of knowledge on health risks and radiation doses in two back to back local German surveys. Knowledge gaps concerning associated health risks and radiation doses among physicians are apparent from published research. However, knowledge on radiation doses cannot be interpreted as authentic indicator for good medical practice.

Singh P et al [41] (2015) found that exposure to radiation during radiological investigations is of health concern, which referring physicians should rationalize. Hence, they assessed the clinician's awareness and concern of radiation exposure to patients, in relation to their referral practice. A prospective study was conducted involving specialists from Punjab (India), who were handed a standard set of questionnaire about knowledge of doses and radiation hazards from imaging procedures, consideration of age and radiation dose when referring, referrals not likely to influence treatment, and use of referral guidelines were included. Of the 150 medical doctors given the questionnaire, 106 returned it. While a few overestimated it, Majority of the clinicians underestimated radiation doses. Almost half of the clinicians (55.5%) favoured to select the rationale of asking about earlier radiological examinations as clinical need only, which was surprising. Rates of referrals not likely to affect treatment were more (66%) than reported rates in previous studies. Worryingly, only 30.1% of the clinicians had knowledge of referral guidelines and surprisingly only 10.5% had made use of it. Their study although in a small population size identifies insufficient knowledge on radiation and its guidelines among referral physicians, which justifies the immediate need for training Programs to decrease this knowledge gap.

Parikh JR et al [42] (2017) found that the risk of injury associated with long-term occupational exposure to ionizing radiation is low for radiologists. The motive of this article is to systematically review and inform radiologists about radiation-related effects to which they are possibly susceptible. Formal training and education on radiation safety and management, careful attention to better radiation protection habits, and continued attention on radiation management and as low as reasonably achievable principle are recommended for all radiologists.

Paolicchi F et al [43] (2016) found that to evaluate radiation protection basic knowledge and dose assessment for radiological procedures among Italian radiographers. A validated questionnaire was distributed to 780 participants with balanced geographic distribution and demographic characteristics. Only 12.1 % of candidates attended radiation protection courses on a regular basis. Despite 90 % of radiographers saying to have adequate awareness of radiation protection issues, a lot of them underestimated the radiation dose of nearly all radiological procedures. About 4 % and 5 % of the participants, respectively, claimed that abdominal ultrasound and pelvis magnetic resonance imaging exposed patients to radiation. On the other hand, 7.0 % of the radiographers said that mammography does not use ionising radiation. About half of participants believed that radiation-induced cancer is not dependent on age or gender and were not able to differentiate between stochastic and deterministic effects. Young radiographers (with less than 3 years of experience) showed a better level of knowledge compared with the more experienced radiographers. There is a considerable need for radiographers to improve their knowledge of radiological procedures and awareness of radiation protection issues. Specific actions such as regular training courses for both undergraduate and postgraduate students as well as for working radiographers should be considered in order to assure patient safety during radiological examinations.

Azmoonfar R et al [44] (2016) found that although ionizing radiation is very important in diagnostic and treatment of many diseases, the hazards of this radiation are considerable and irrefutable. Knowledge about radiation dose in radiological investigation is one of the main stages in radiation protection. The aim of this study was to determine the physicians' knowledge in radiological examinations. The data collected by questionnaire were designed and the most commonly requested radiological investigations were listed. The questionnaire was distributed among 106 consultant physicians. The survey was conducted on the awareness about the risks and radiation dose among health professionals in Iran. The results showed that the most of physicians did not know about ionizing radiation and evaluation of absorbed dose in patients. Many of these physicians were not familiar with radiations risks and the most important aspects of radiation protection; although, they have passed some courses in medical physics and radiobiology. Since radiological examinations play an important role in medicine, knowledge about hazards and radiation doses is very important. On the whole, this study showed that knowledge of radiation doses is inadequate among physicians.

Khan MO et al [45] (2018) found that junior doctors routinely request radiological investigations for patients. Earlier studies have noted that among this group there is a lack of knowledge on radiation exposure and radiation legislation in common radiological investigations. However, no studies have compared this with radiology trainees and radiographers. They compared knowledge of radiation exposure and radiation legislation in common radiological investigations among foundation year doctors (FY1, FY2) final year medical students (FYMS), against specialist radiology trainees (SRT) and radiographers (RG). A 12-question multiple choice questionnaire (MCQ) was distributed to FY1, FYMS, FY2, SRT and RG at a UK teaching hospital. Questions assessed knowledge of radiation-dose estimates legislation and radiation-dose legislation of common radiological investigations. Mean MCQ scores were compared using one-way ANOVA and Tukey post-test to determine statistical significance (p-value < 0.05). In the study 127 participants were included. Mean scores (%) for FYMS (49.3%), FY2 (51.1%) and FY1 (52.6%) were significantly lower compared to RG (66.3%) and SRT (64.4%) (p-value < 0.05). Mean test scores between FYMS, FY1 and FY2 did not remarkably differ (p-value > 0.05). FYMS, FY1 and FY2 knowledge of radiation exposure and radiation legislation in common radiological investigations was not so good compared to SRT and RG. Patients need knowledge of radiation risk to provide informed consent as per IRMER regulations, thus they suggest formal teaching on the subject matter to promote radiation safety culture among medical undergraduates and postgraduates.

Lee WJ et al [46] (2016) found that imaging methods that use ionizing radiation in emergency departments (EDs) have increased with advances in radiological diagnostic methods. Physician and nurse awareness of the radiation dose in the ED and the associated cancer risks to which the patients are exposed were surveyed with a questionnaire. A total of 191 subjects in six EDs participated in this study. ED physicians and ED nurses were asked about the radiation doses and the risks of imaging methods ordered in the ED. The variance between the two groups was compared using Student's t-test for continuous variables. A Fisher's exact and Chi-squared tests were used for categorical variables. A total of 109 ED nurses and 82 ED physicians finish the questionnaire; 8 (7.3%) nurses' 38 and (46.3%) physicians correctly gave answer to the question about the chest X-ray radiation dose. A question about the number of pelvic X-rays that is equivalent to the dose of a chest X-ray was answered correctly by 9 (8.3%) nurses and 5 (6.1%) physicians (P = 0.571). Questions regarding magnetic resonance imaging, abdominal ultrasonography, abdominal computed tomography (CT), chest CT and brain CT were answered correctly more frequently by the physician group than the nurse group (P < 0.05). The risk of developing cancer over a lifetime due to a brain CT was correctly answered by 30 (27.5%) nurses and 21 (25.6%) physicians (P = 0.170). A similar question about abdominal CT was correctly answered by 42 (38.5%) nurses and 21 (25.6%) physicians (P = 0.127). Knowledge of the radiation exposure of radiology examinations was less in nurses than physicians, but overall knowledge was poor in both groups. ED physicians and nurses should be educated about cancer risks and radiation exposure associated with various diagnostic radiological methods.

Maharjan S et al [47] (2017) found that the usage of radiation has become an inevitable part of human life. From medical usage they receive 19.7% (0.6mSv) of radiation. Radiation technology not only helps medical management, but also causes severe adverse effects. So the knowledge and practice of radiology professionals regarding radiation safety and harmful biological effects of ionizing radiation is an utmost important topic to be addressed. Awareness of measures of precautions and radiation protection is the biggest hurdle in order to manage radiation hazards promptly and properly. To accomplish this difficult task and to set standard guidelines, various international organizations have been established. The importance of safe operation and knowledge and of radiation has been drawing special attention, from the era of Roentgen's discovery of x-rays. Medical exposure is closely associated with many times increase in lifetime cancer risk. To avoid unnecessary exposure and facilitate better patient care, radiology professionals should be well aware of these issues. Many radiology professionals still disregard as x-rays do not cause immediate severe adverse effects. Till today, x-ray imaging technology have glanced many advancement. Still, they are reluctant and neglect to practice radiation using safety precautions. This shows the lack of inadequate knowledge of radiation protection principles and they are still not sensitive about their daily working ethics. To the best of their knowledge, this is the first study in Nepal that identifies the perception of radiation protection and its safe usage. To date, only a few of studies have been done to assess awareness and knowledge of radiation protection elsewhere as well. When the title of this manuscript was typed in the Pub Med Central (PMC) database, only 129 articles were shown and a sufficient of relevant literatures was accessed in this article. This also shows the importance of this study in international context as well. The main goal behind this survey-based study was to obtain a better understanding of the current status, awareness and knowledge of radiation protection, the need for safe practices among radiology professionals and to compare the data with international literatures.

Algohani KA et al [49] (2018) found that more than 3,600 million radiology examinations are carried out every year worldwide. In spite of the great benefits of diagnostic and therapeutic radiations, they may result in some hazards if used inappropriately. However, these hazards can be prevented through raising the awareness of health care professionals about these hazards and the protective measures to be considered. Several regulations and guidelines were issued for this purpose including; the ALARA principle and POPUMET regulations and the WHO global initiative on radiation safety in health care settings. The current study aimed at assessing the level of radiation protection awareness among clinicians and radiologists in addition to exploring if radiation protection courses have a beneficial effect on the awareness level or not. Methods: This was a cross-sectional study where the level of radiation protection awareness was assessed using an anonymous questionnaire. A total of 101 (100%) participants responded to the questionnaire. Of which; 49 (48.5%) were residents, 30 (29.7%) were specialists and 22 participants (21.8%) were consultants. A little less than half of the participants (48, 47.5%) have taken part in a radiation protection course before. The majority of participants who attended a course (68.8%) have heard about the POPUMET regulations ($p<0.001$). Attendants were asked about the procedures with risk equivalent to 0.25 mSy of radiation estimated dose equivalent. And it was found that course attendance improved the knowledge about the risk of 3 (out of 4) procedures ($p<0.05$). On the other hand, course attendance didn't improve the knowledge about the approximated radiation doses of some procedures ($p>0.05$) or the degree of radio-sensitivity of different organs ($p>0.05$). Most of the participants (96%) were not aware that there is no annual limit of radiation dose for patients. More than half of the participants (56.4%) were aware about what the word "ALARA" stands for. Results of the current study suggested that the level of radiation protection awareness among healthcare professionals is not adequate to ensure workers and patients' safety. And accordingly, they suggested that more efficient awareness programs for health care professionals are conducted on regular basis with regular monitoring of awareness level to explore areas for improvement.

Madrigano RR et al [50] (2014) found that to assess the non-radiologist physicians' knowledge on the use of ionizing radiation in imaging. Cross-sectional study using an anonymous questionnaire responded by surgical specialties and physicians in clinical, divided into two parts as follows: one including multiple choice questions approaching general knowledge about radiation, radioprotection and optimization principles and another part include questions about the physicians' characteristics, participation in professional updating events and frequency of imaging studies requests. From a total of 309 questionnaires, 120 (38.8%) were responded, 50% in clinical specialties and 50% by physicians in surgical specialties; respectively 2.5% and 45% of physicians responded that ultrasonography and magnetic resonance imaging use ionizing radiation. On the whole, the overall grade was higher for surgical specialists with no remarkable difference, except for the question about exposure in pregnant women ($p = 0.047$). Physicians who are professionally updated, particularly those and taking part in teaching activities ($p = 0.047$) and take part in clinical meetings ($p = 0.050$), showed statistically better knowledge about ionizing radiation as compared to others. The non-radiologist physicians' knowledge is varying and in some points needs to be improved. Multidisciplinary clinical meetings and teaching activities are important ways to spread information on the subject.

Awosan KJ et al [51] (2016) found that use of ionizing radiation in medical imaging for diagnostic and interventional purposes has risen substantially in recent years with a consequent increase in exposure of health workers and patients to radiation hazards. To assess the knowledge of radiation protection practices, radiation hazards and clinical profile of health workers in UDUTH, Sokoto, Nigeria a cross-sectional study was conducted among 110 Dentistry staff, Radiotherapy, Radiology picked by universal sampling technique. The study comprised of administration of standardized pre-tested semi-structured questionnaire (to obtain information on knowledge of radiation hazards, socio-demographic characteristics, and radiation protection practices of participants), clinical assessment (comprising of abdominal ultrasound, chest X-ray and laboratory investigation on haematological parameters) and evaluation of radiation exposure of participants (extracted from existing hospital records on their radiation exposure status).The participants were aged 20 to 65 years (mean = 34.04 ± 8.83), most of them were married (65.7%) and males (67.3%). 58 (52.7%) had better knowledge of Personal Protective Devices (PPDs), Sixty five (59.1%) had better knowledge of radiation hazards, less than a third, 30 (27.3%) consistently wore dosimeter, and very few (10.9% and below) consistently wore the various PPDs at work. The average annual radiation exposure over a 4 year period ranged from 0.0475mSv to 1.8725mSv. 8 (9.4%) of 85 participants had abnormal abdominal ultrasound findings only 1 (1.2%) of 86 participants had abnormal chest X-ray findings, while 11 (10.0%) and 17 (15.5%) of 110 participants had leucopoenia and anaemia respectively. This study shows not so good radiation protection practices despite better knowledge of radiation hazards among the participants, but prevalence of abnormal clinical conditions and radiation exposure were found to be low. Periodical in-service training and monitoring on radiation safety was suggested.

Dellie ST et al [53] (2014) found that to evaluate the level of knowledge about the radiation exposure to diagnostic imaging procedures among the final-year medical students and interns and to suggest how education could be improved. From Tikur Anbessa Teaching Hospital in Addis Ababa all 355 interns and final-year medical students were included in the study. Participants were asked to complete a questionnaire consisting of their preferred method of learning and actual knowledge on ionizing radiation. All questions were in multiple choice formats ranging from 4 to 7 choices. Statistical software was used to analyse the obtained data. 343 completed questionnaires were received in total. Up to 78.9% of respondents do not know or underestimated or the radiation dose from commonly requested radiological procedures. Surprisingly, 254 (79.3%) and 245 (71.4%) students faultily believed that MRI and ultrasound, respectively, emit ionizing radiation or they have no idea if they emit radiation or not. Both medical students and interns did not have notable difference in their knowledge of ionizing radiation. A combination of tutorials or workshops (29.7%) learning modules (19.8%) combined were their first and last preferred methods of teaching for future radiation awareness, respectively. This study showed that awareness of ionizing radiation from diagnostic imaging is lacking among senior medical students and interns. The results show the need for better education to decrease unnecessary exposure of patients.

Faggioni L et al [54] (2017) found that 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 at an academic hospital. A total of 159 students (including 56 medical students,60 radiology residents, and 43 radiography students) and young doctors were given a questionnaire having 16 multiple choice questions divided into three separate sections (i.e. awareness about radiation protection issues, demographic data, and knowledge about radiation dose levels of common radiological examinations). Medical students claimed to have at least a better knowledge of radiation protection issues more frequently than radiology residents and radiography students (94.4% vs. 55% and 35.7%, respectively; $P < 0.05$), with no cases of recognised excellent knowledge among radiography students. However, the actual knowledge of important radiation protection topics such as professional radiation risk and dose optimisation, as well as of radiation doses delivered by common radiological procedures, patient and tissue susceptibility to radiation damage, regulations, was significantly worse among medical students than radiology residents and radiography students ($P < 0.05$). Those later notably outperformed radiology residents as to knowledge of radiation protection issues ($P < 0.01$). on the whole less than 50% of survey respondents correctly answered all questions of the survey. Radiology residents, radiography students and medical students have a less knowledge about radiation protection, with a certain gap of knowledge concerning real radiation doses of daily radiological examinations. Both postgraduate and undergraduate teaching needs to be constructively implemented with radiation safety courses.

Mterial And Methods:-

This is prospective single centre multiple choice questionnaire based study, was conducted at Peerless hospital & B.K Roy research centre Kolkata and other Hospitals of Kolkata .The hospitals are multi-speciality hospitals that provide Radiology , Cardio Department CTVS Department, ENT Department Gastro Department, , Medicine Department, Nephrology Department, Neruro. department, Orthopaedics Department, Paediatrics Department, Plastic Surgery Department, Surgery Department, Urology Department and Emergency department and .Questionnaires was distributed by both hard copies and by email to each doctor in these departments.

Questionnarie Format:
For the purpose of this proposal, a closed question format to collect data was used. Closed questions yield data that allow for comparison between respondents as all the response are in the same format, this additionally allows for the collection of valid and reliable data. They can be answered quickly and therefore improve response rates and can be pre coded, thereby making analysis easier (Parahoo 1997).The limitations of closed question format, is that an appropriate response may be omitted thereby obtaining an invalid response . This according to Parahoo (1997) can be offset by care and skill full construction of the questionnaire. It is proposed that the questionnaire initially asks demographics question. To determine knowledge level a multiple choice format was used. Polit et al (2001) suggest that this format is appropriate in cases where there is more or less fixed number of alternatives. Multiple -choice offers the participant a list of response, from which they select the one most appropriate.

Sample size:
For the proposal of this study sample size was one hundred and fifty

Inclusion Criteria:
Doctors working in Radiology department, Cardio Department, CTVS Department, ENT Department Gastro Department, House Officer, Medicine Department, MO/RMO, Nephrology Department, Neruro. department, Orthopaedics Department, Paediatrics Department, Plastic Surgery Department, Surgery Department, Urology Department. Doctors of Emergency department in Peerless Hospital and other hospitals in Kolkata.

Exclusion Criteria:
Undergraduate medical trainees.
Doctors working in obstetrics.

Ethical Consideration:
Ethics refers to the right and protection of subjects according to Cormack(2000) there are ethical considerations at every at every stage of a research process including the choice of topic to search .A written explanation of the nature of study was given along the questionnaire. Participants can make an informed decision whether to enter in to the study, by the informed consent form (appendix II). No name was attached to the questionnaires, which will allow participant anonymity. Confidentiality of the data gathered from participants was respected at all times .This research proposal was submitted to the Peerless Hospital’s Ethics committee for scrutiny and was undertaken if approval is granted.

Statistical Analysis:
For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 25.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer’s exact test, as appropriate.

Explicit expressions that can be used to carry out various t-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a t-distribution under the null hypothesis is given. Also, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.

Once a t value is determined, a p-value can be found using a table of values from Student's t-distribution. If the calculated p-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favor of the alternative hypothesis.

p-value ≤ 0.05 was considered for statistically significant.

Result And Analysis:-

Table 1:- Distribution of age in years.

Age in Years	Frequency	Percent
≤30	38	25.3%
31-40	49	32.7%
41-50	35	23.3%
51-60	28	18.7%
Total	150	100.0%

38(25.3%) doctors were ≤30 years old, 49(32.7%) doctors were 31-40 years old, 35(23.3%) doctors were 41-50 years old and 28(18.7%) doctors were 51-60 years old.

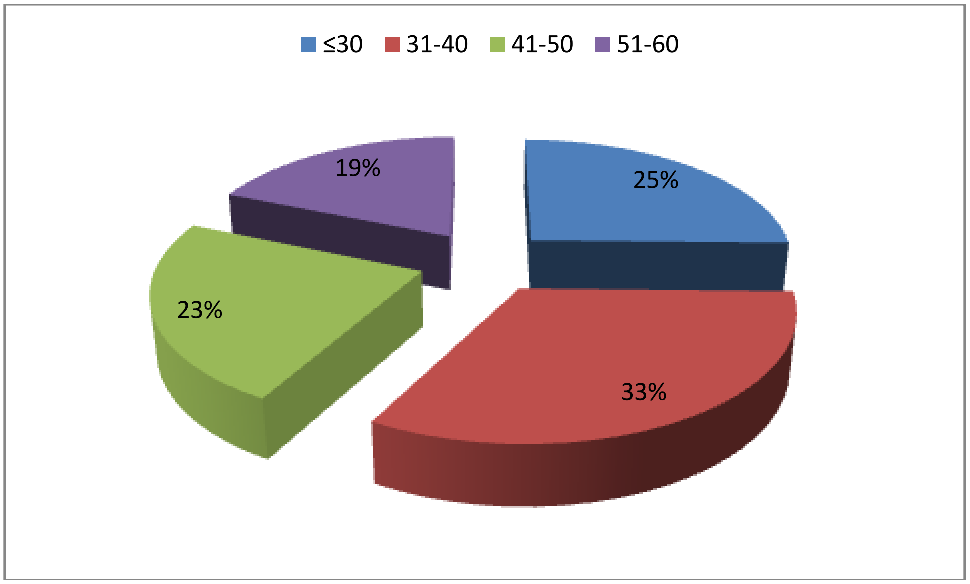

Figure 1:- Distribution of age in years.

Table 2:- Distribution of category.

Category	Frequency	Percent
Consultant	57	38.0%
House Officer	4	2.7%
MO/RMO	6	4.0%
PGT/PDT /MEM-PGT	43	28.7%
Registrar/Resident	40	26.7%
Total	150	100.0%

57(38.0%) doctors were Consultant, 4(2.7%) doctors were House Officer, 6(4.0%) doctors were MO/RMO, 43(28.7%) doctors were PGT/PDT /MEM-PGT and 40(26.7%) doctors were Registrar/Resident.

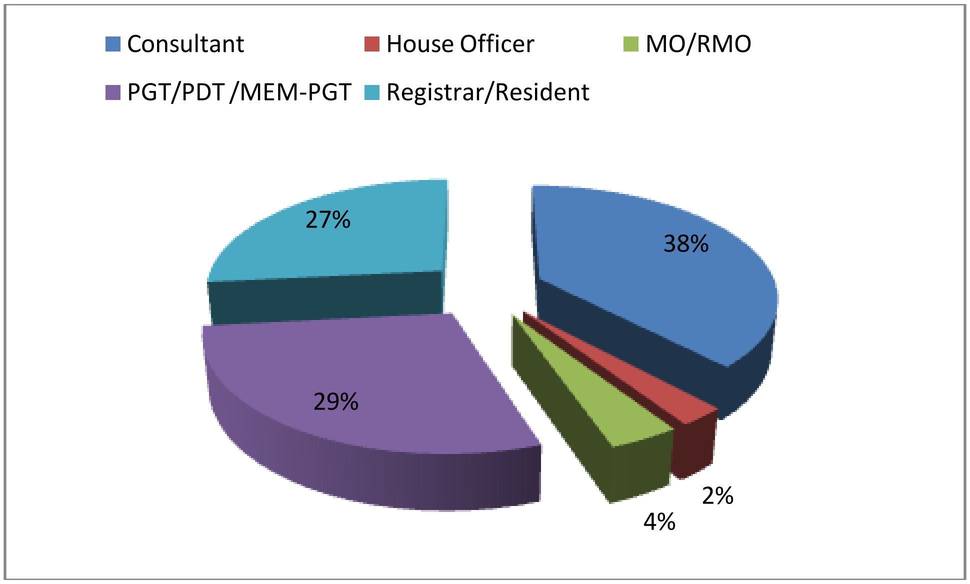

Figure 2:- Distribution of category.

Table 3:- Distribution of Group.

Group	Frequency	Percent
Non Radiologist	100	66.7%
Radiologist	50	33.3%
Total	150	100.0%

100(66.7%) doctors were Non Radiologist and 50(33.3%) doctors were Radiologist.

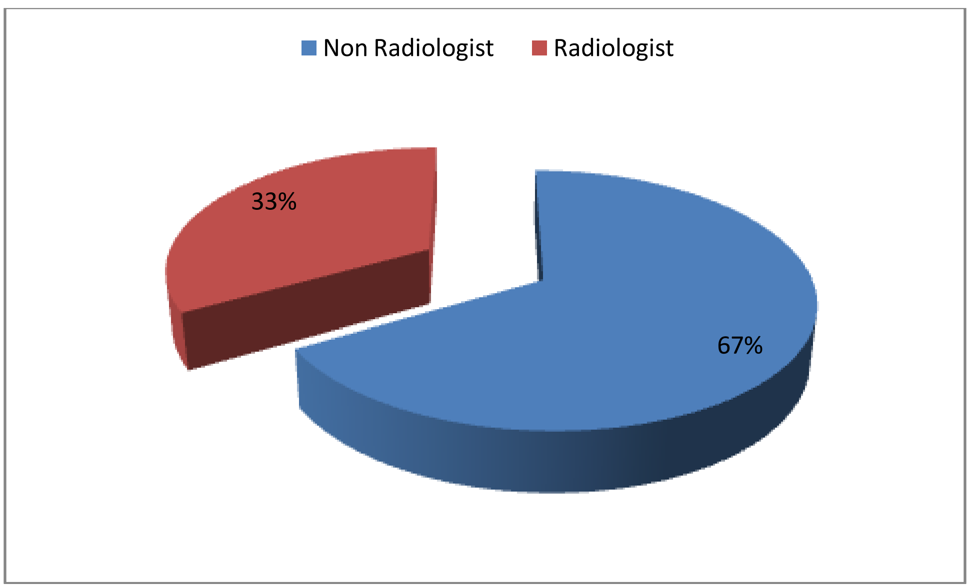

Figure 3:- Distribution of Group.

Table 4:- Distribution of Department.

Department	Frequency	Percent
Cardio	5	3.3%
CTVS	4	2.7%
Emergency Medicine	23	15.3%
ENT	1	0.7%

Gastro	4	2.7%
House Officer	4	2.7%
Medicine	7	4.7%
MO/RMO	6	4.0%
Nephrology	8	5.3%
Neruromedecine	8	5.3%
Orthopaedic	10	6.7%
Pediatrics	5	3.3%
Plastic Surgery	5	3.3%
Radiology	50	33.3%
Surgery	2	1.3%
Urology	8	5.3%
Total	150	100.0%

5(3.3%) doctors were in Cardio Department, 4(2.7%) doctors were in CTVS Department, 23(15.3%) doctors were in Emergency Medicine Department, 1(0.7%) was in ENT Department, 4(2.7%) doctors were in Gastro Department, 4(2.7%) doctors were in House Officer Department, 7(4.7%) doctors were in Medicine Department, 6(4.0%) doctors were in MO/RMO Department, 8(5.3%) doctors were in Nephrology Department, 8(5.3%) doctors were in Neruromedecine Department, 10(6.7%) doctors were in Orthopaedic Department, 5(3.3%) doctors were in Pediatrics Department, 5(3.3%) doctors were in Plastic Surgery Department, 50(33.3%) doctors were in Radiology Department, 2(1.3%) doctors were in Surgery Department and 8(5.3%) doctors were in Urology Department.

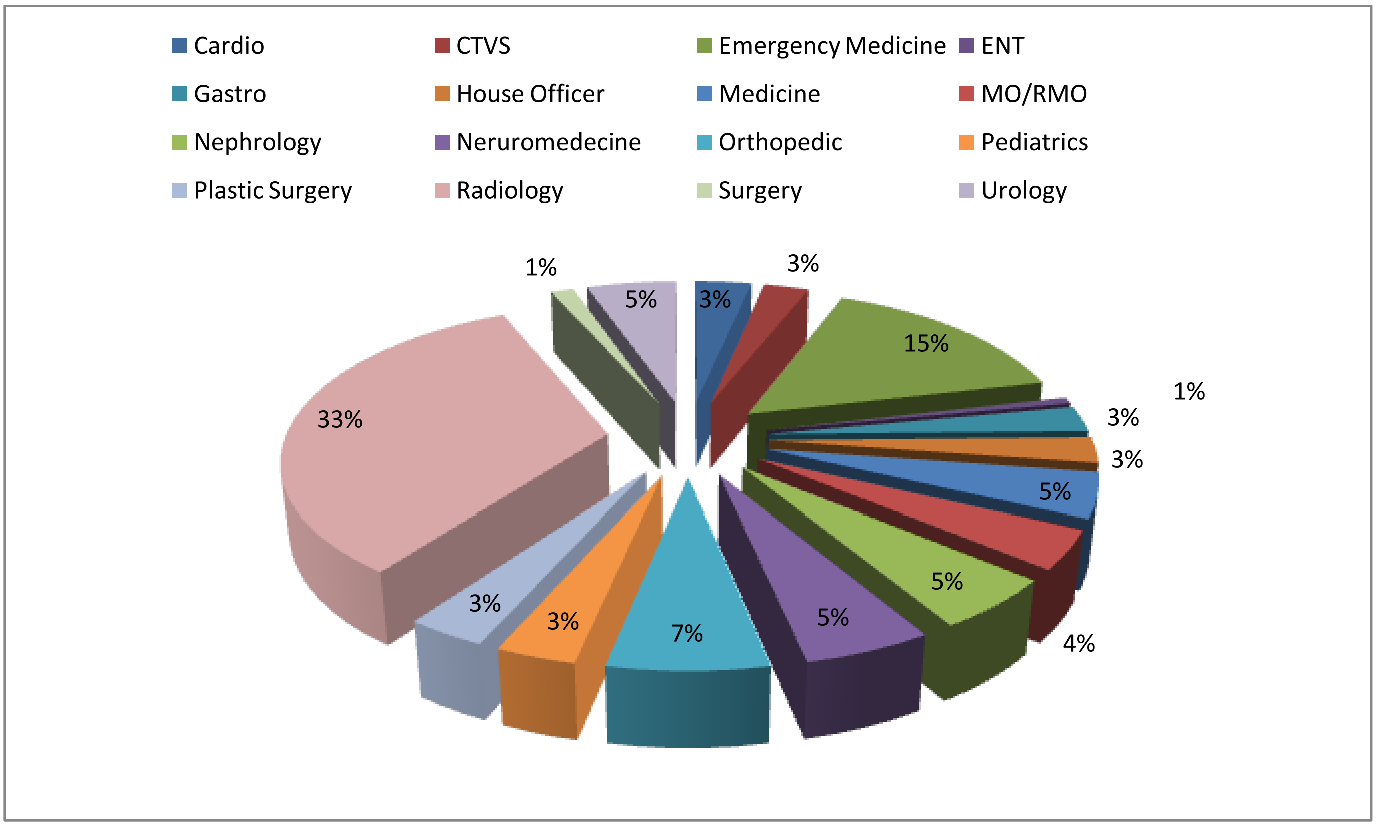

Figure 4:- Distribution of Department.

Table 5:- Distribution of abdominal X-ray.

RE during abdominal X-ray	Frequency	Percent
Wrong Answer	76	50.7%
Right Answer	74	49.3%

Total	150	100.0%

74(49.3%) doctors had told a Right Answer.

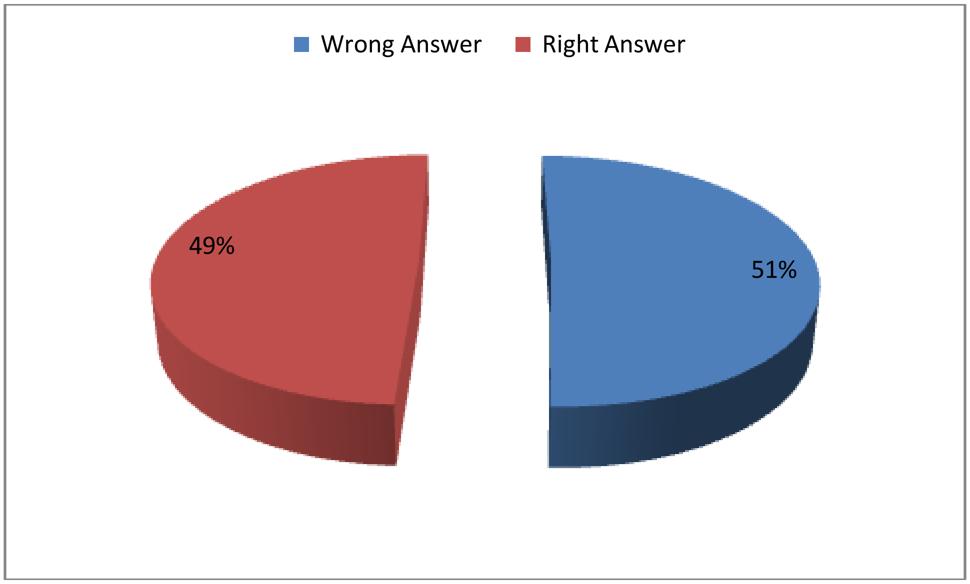

Figure 5:- Distribution of abdominal X-ray.

Table 6:- Distribution of thoracic spine x-ray.

RE during thoracic spine x-ray	Frequency	Percent
Wrong Answer	77	51.3%
Right Answer	73	48.7%
Total	150	100.0%

73(48.7%) doctors had told a Right Answer.

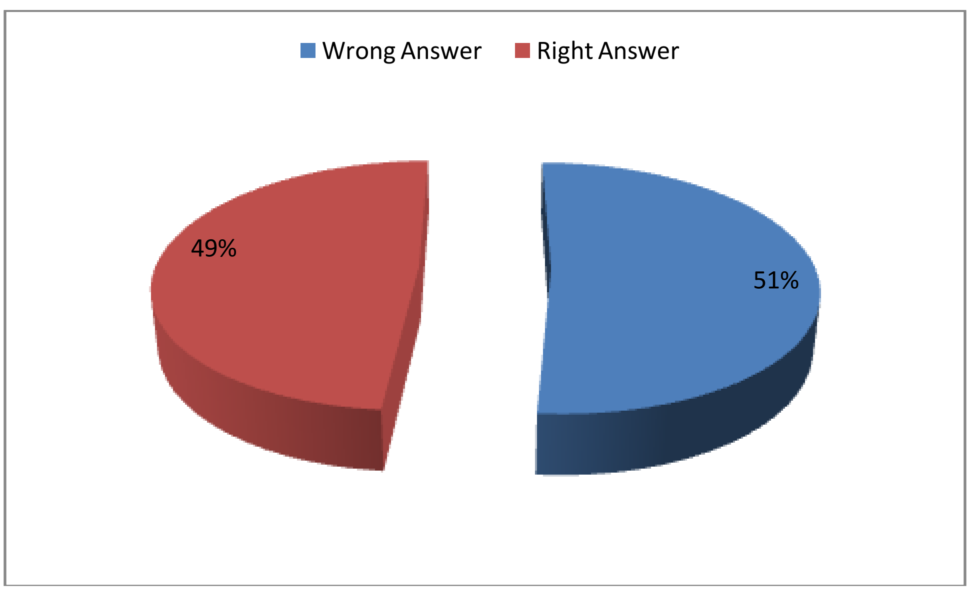

Figure 6:- Distribution of thoracic spine x-ray.

Table 7:- Distribution of lumbar spine x-ray.

RE during lumbar spine x-ray	Frequency	Percent

Wrong Answer	78	52.0%
Right Answer	72	48.0%
Total	150	100.0%

72(48.0%) doctors had told a Right Answer.

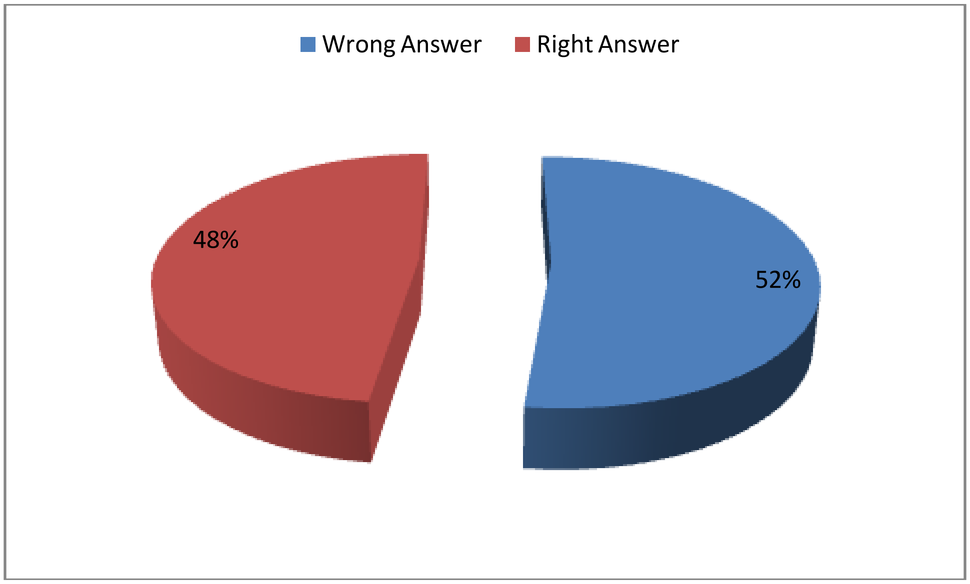

Figure 7:- Distribution of lumbar spine x-ray.

Table 8:- Distribution of pelvis x-ray.

RE during pelvis x-ray	**Frequency**	**Percent**
Wrong Answer	80	53.3%
Right Answer	70	46.7%
Total	150	100.0%

70(46.7%) doctors had told a Right Answer.

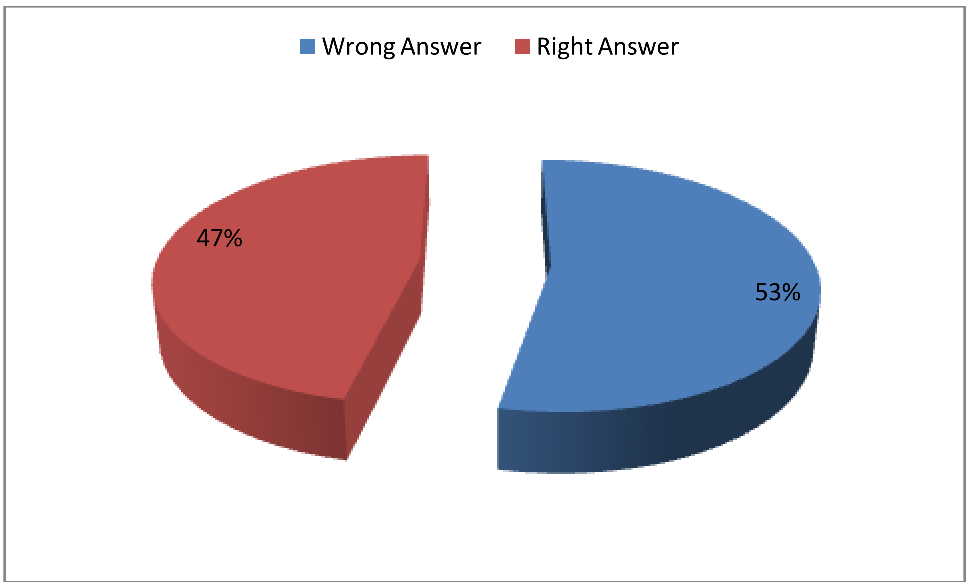

Figure 8:- Distribution of pelvis x-ray.

Table 9:- Distribution of hip x-ray.

RE during hip x-ray	**Frequency**	**Percent**

Wrong Answer	81	54.0%
Right Answer	69	46.0%
Total	150	100.0%

69(46.0%) doctors had told a Right Answer.

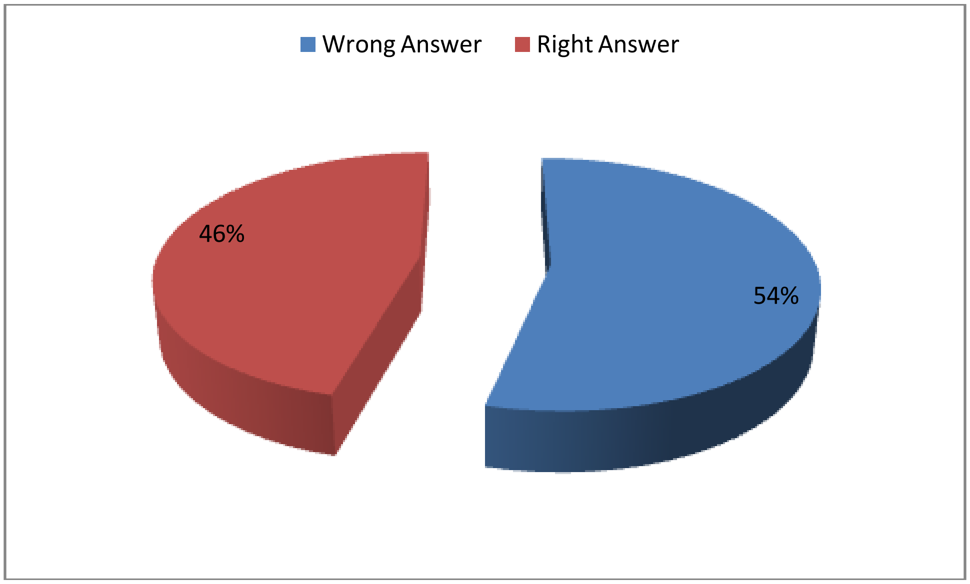

Figure 9: Distribution of hip x-ray

Table 10: Distribution of CT-head

RE during CT-head	Frequency	Percent
Wrong Answer	77	51.3%
Right Answer	73	48.7%
Total	150	100.0%

73(48.7%) doctors had told a Right Answer.

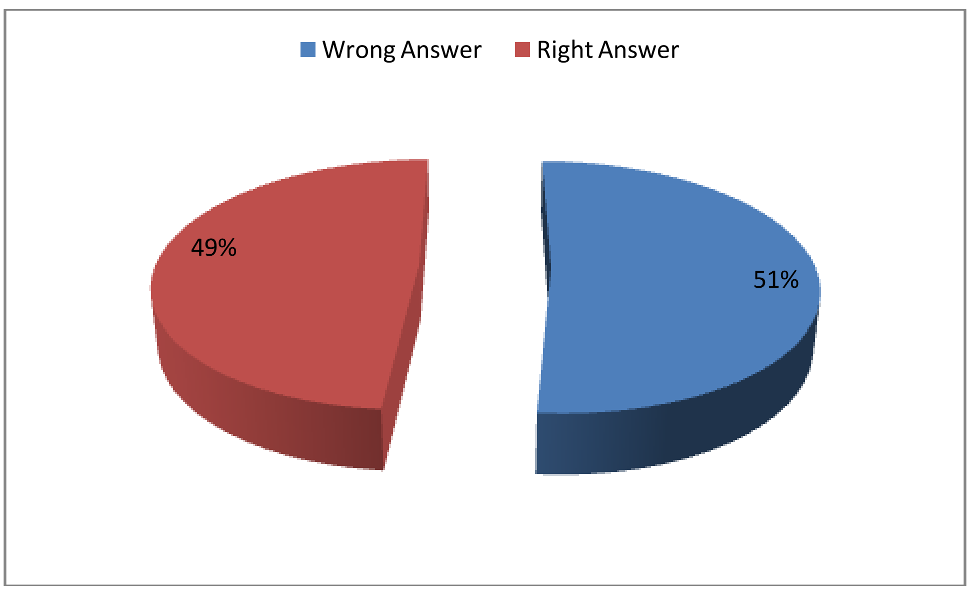

Figure 10: Distribution of CT-head

Table 11: Distribution of CT abdomen

RE during CT abdomen	Frequency	Percent

Wrong Answer	75	50.0%
Right Answer	75	50.0%
Total	150	100.0%

75(50.0%) doctors had told Right Answer.

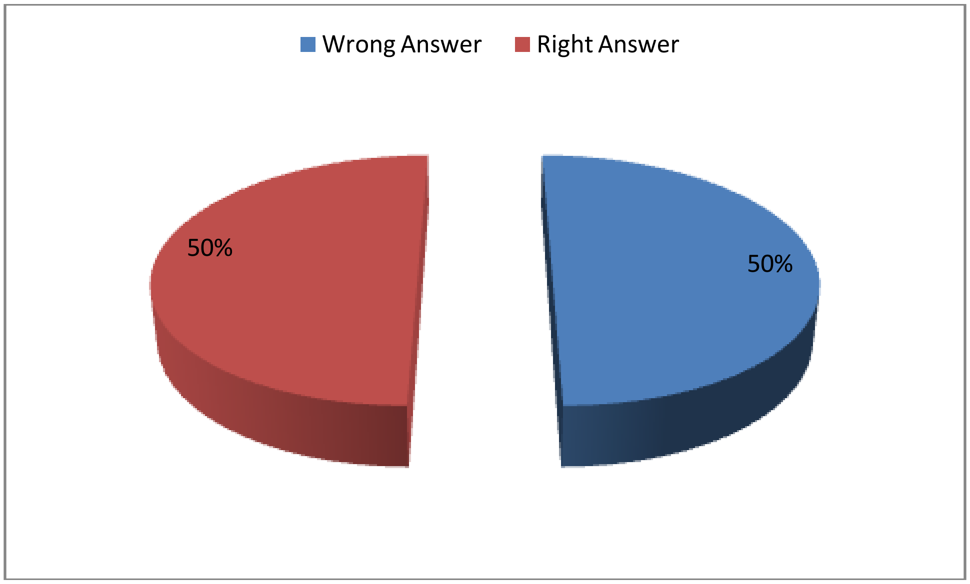

Figure 11: Distribution of CT abdomen

Table 12: Distribution of IVU

Radiation dose during IVU	Frequency	Percent
Wrong Answer	76	50.7%
Right Answer	74	49.3%
Total	150	100.0%

74(49.3%) doctors had told a Right Answer.

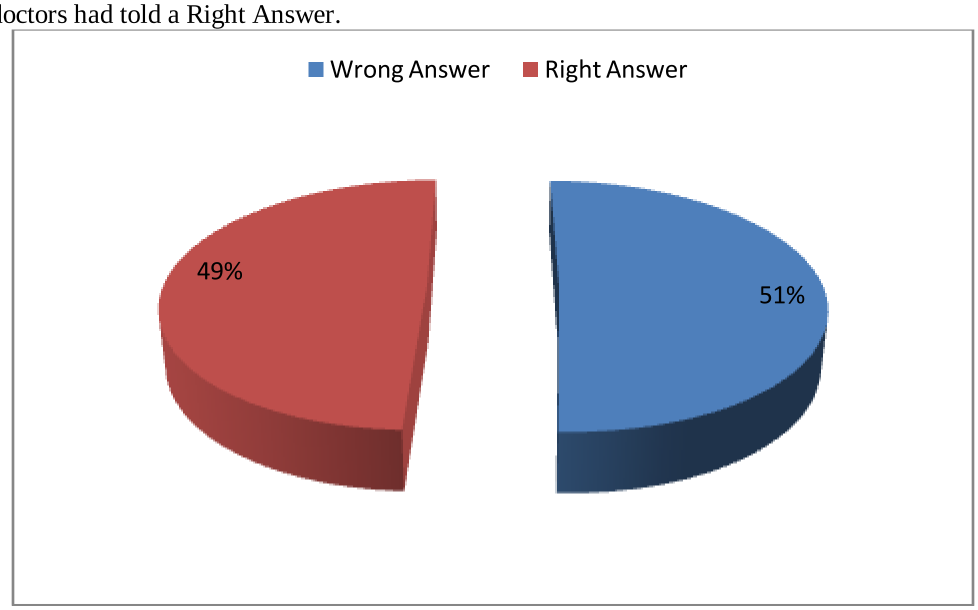

Figure 12: Distribution of IVU

Table 13: Distribution of barium enema

RE during barium enema	Frequency	Percent

Wrong Answer	80	53.3%
Right Answer	70	46.7%
Total	150	100.0%

70(46.7%) doctors had told a Right Answer.

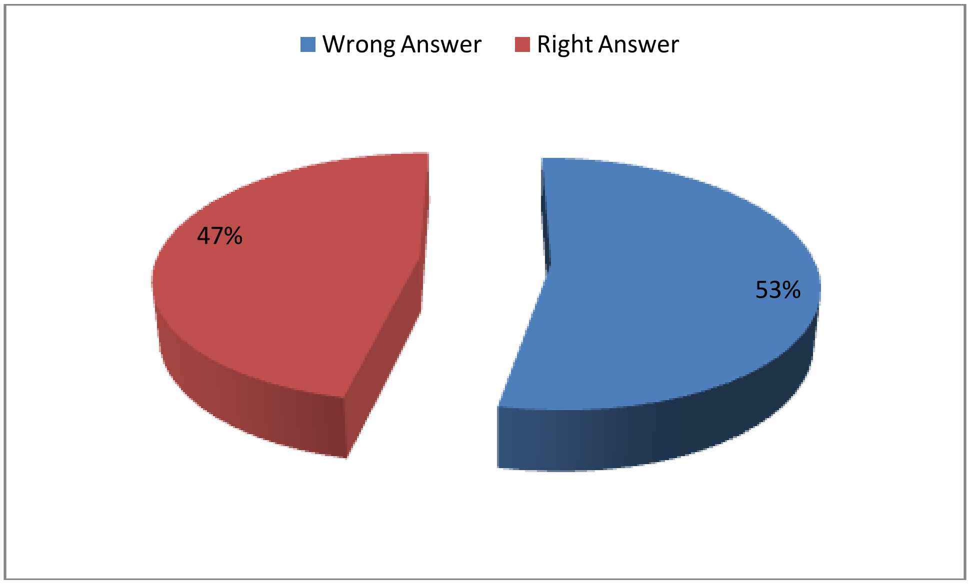

Figure 13: Distribution of barium enema

Table 14: Distribution of Barium Swallow

RE during Barium Swallow	Frequency	Percent
Wrong Answer	85	56.7%
Right Answer	65	43.3%
Total	150	100.0%

65(43.3%) doctors had told a Right Answer.

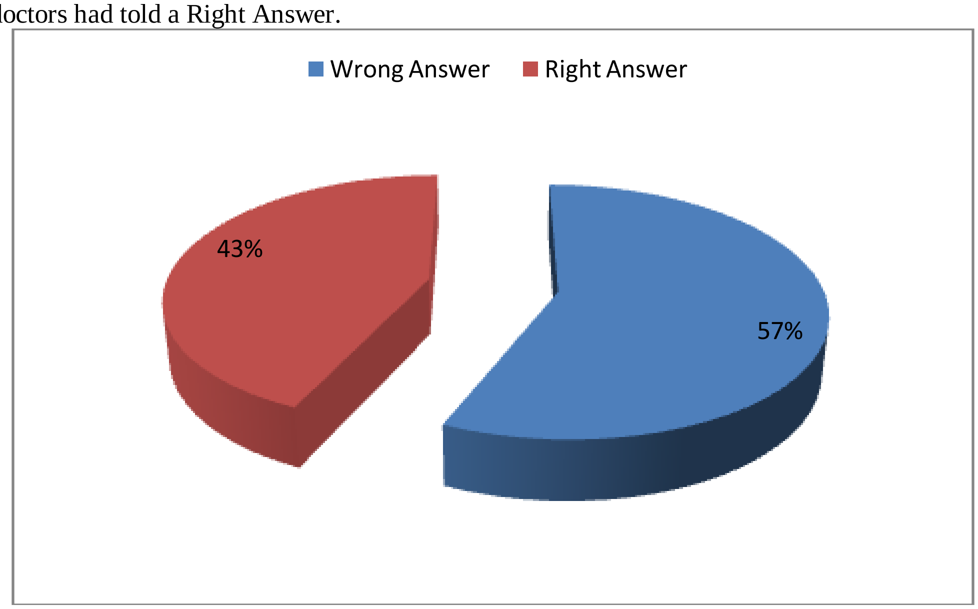

Figure 14: Distribution of Barium Swallow

Table 15: Distribution of ultrasound abdomen

RE during ultrasound abdomen	Frequency	Percent

Wrong Answer	19	12.7%
Right Answer	131	87.3%
Total	150	100.0%

131(87.3%) doctors had told a Right Answer.

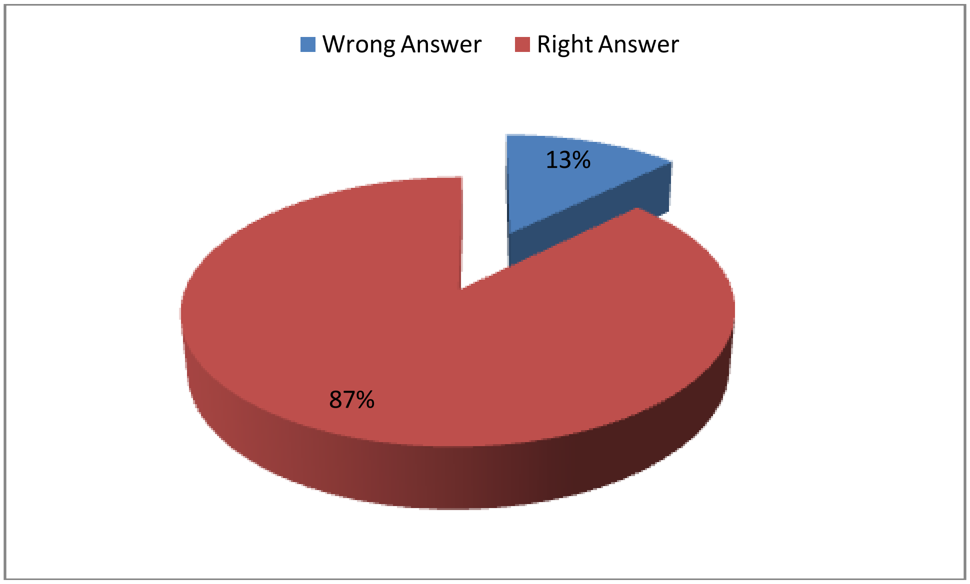

Figure 15: Distribution of ultrasound abdomen

Table16: Distribution of MRI brain

RE during MRI brain	Frequency	Percent
Wrong Answer	14	9.3%
Right Answer	136	90.7%
Total	150	100.0%

136(90.7%) doctors had told a Right Answer.

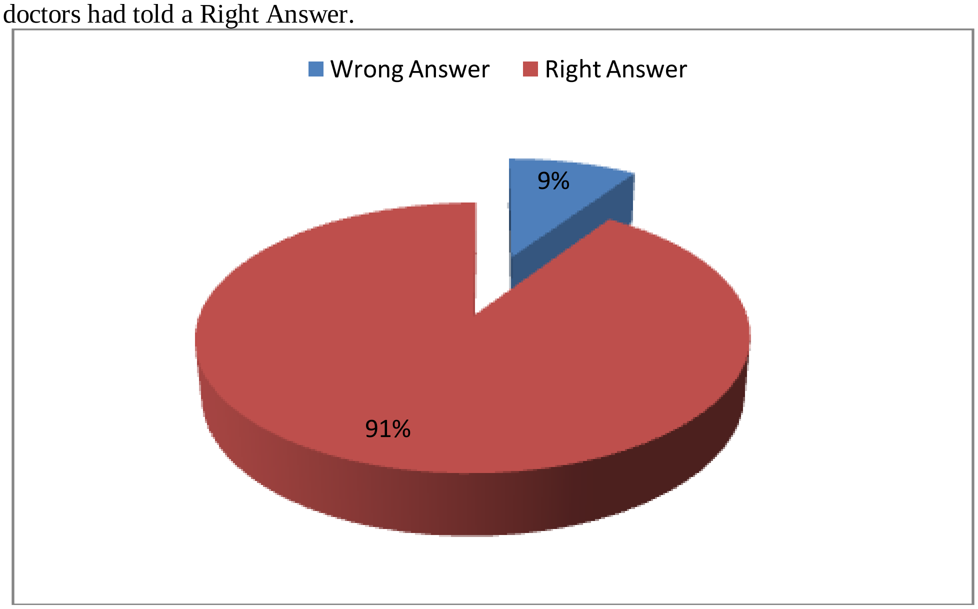

Figure 16: Distribution of MRI brain

Table 17: Distribution of MRI abdomen

RE during MRI abdomen	Frequency	Percent

Wrong Answer	18	12.0%
Right Answer	132	88.0%
Total	150	100.0%

132(88.0%) doctors had told a Right Answer.

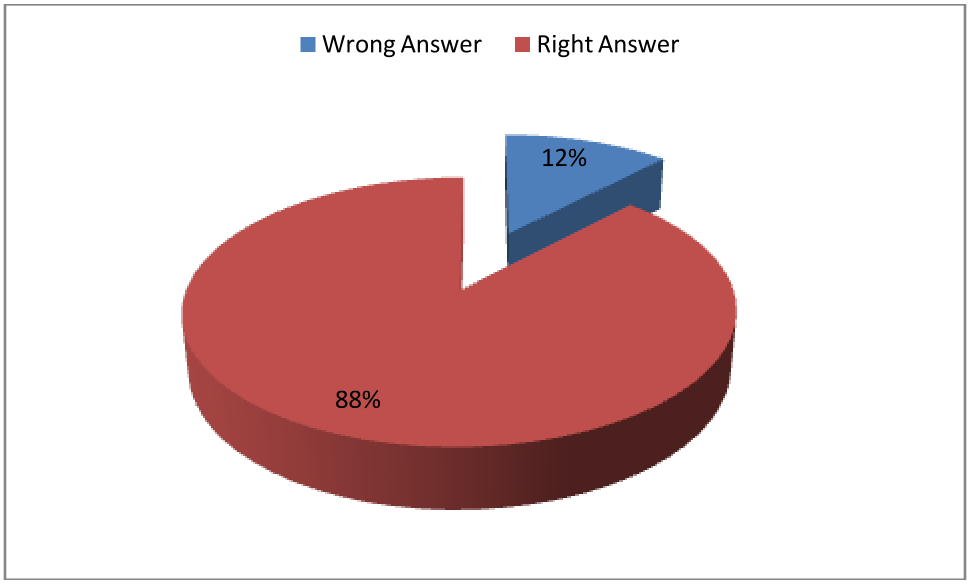

Figure 17: Distribution of MRI abdomen

Table 18: Distribution of MRI limbs

RE during MRI limbs	Frequency	Percent
Wrong Answer	12	8.0%
Right Answer	138	92.0%
Total	150	100.0%

138(92.0%) doctors had told a Right Answer.

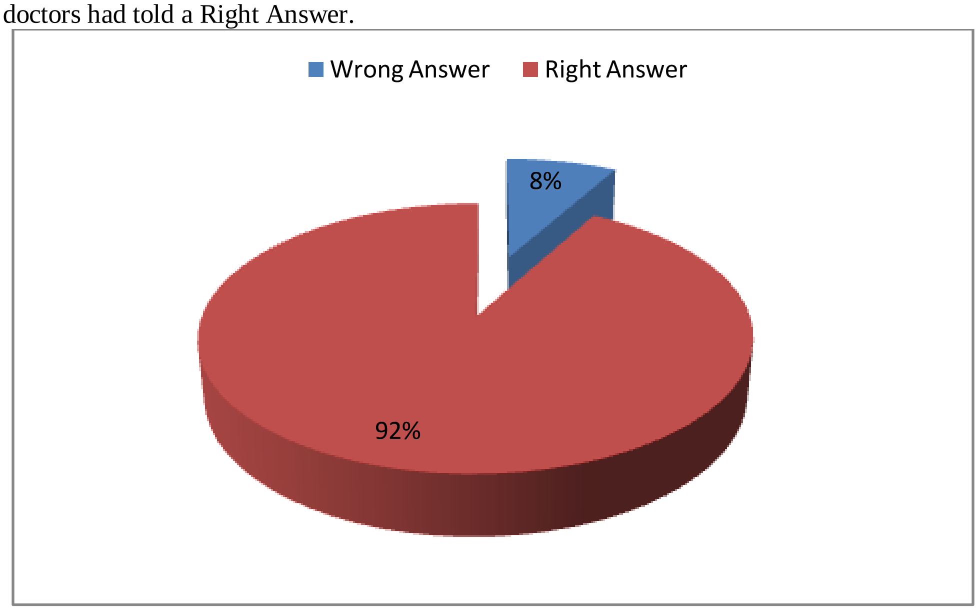

Figure 18: Distribution of MRI limbs

Table 19: Distribution of leg arteriogram

RE during leg arteriogram	Frequency	Percent
Wrong Answer	66	44.0%
Right Answer	84	56.0%
Total	150	100.0%

84(56.0%) doctors had told a Right Answer.

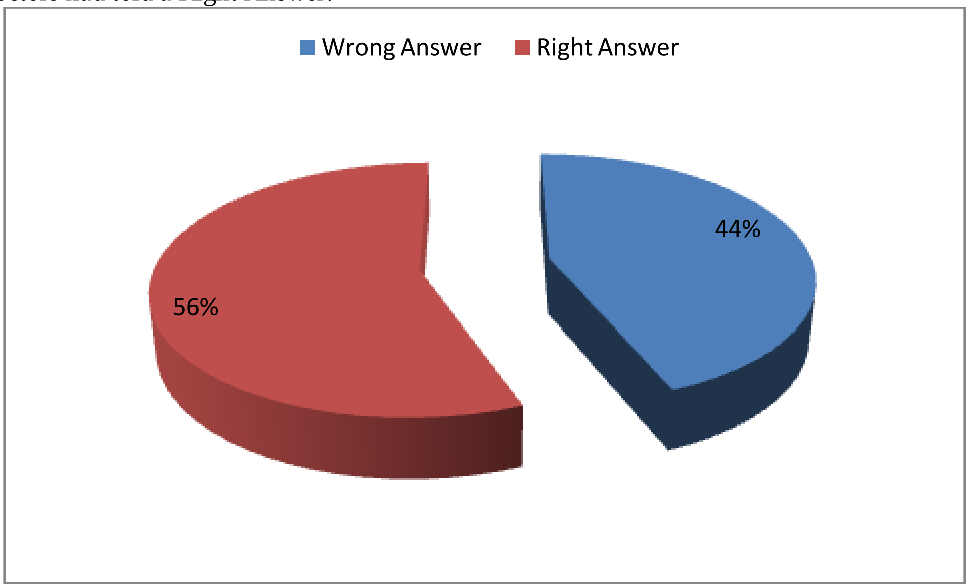

Figure 19: Distribution of leg arteriogram

Table 20: Distribution of thyroid isotope scan

RE during thyroid isotope scan	Frequency	Percent
Wrong Answer	70	46.7%
Right Answer	80	53.3%
Total	150	100.0%

80(53.3%) doctors had told a Right Answer.

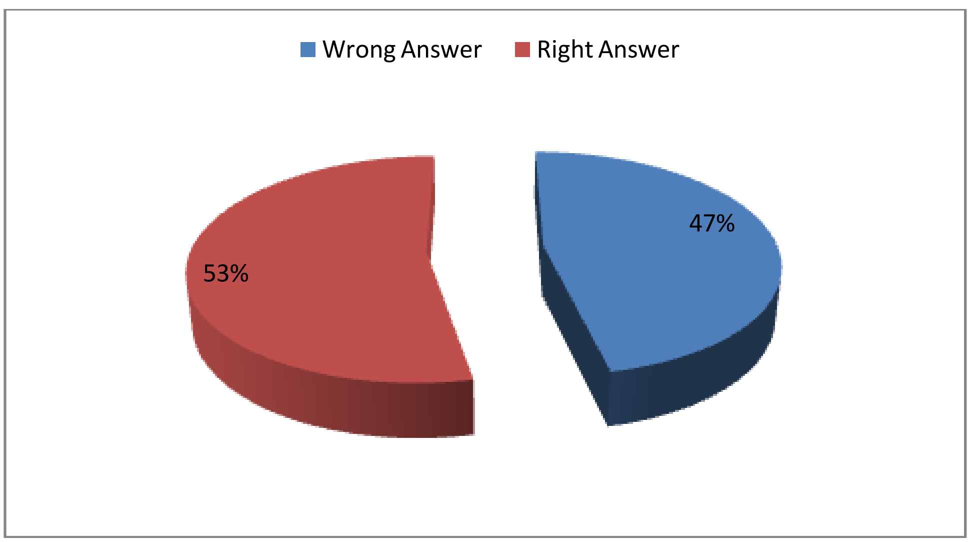

Figure 20: Distribution of thyroid isotope scan

Table 21: Distribution of PET scan

RE during PET scan	Frequency	Percent
Wrong Answer	71	47.3%
Right Answer	79	52.7%
Total	150	100.0%

79(52.7%) doctors had told a Right Answer.

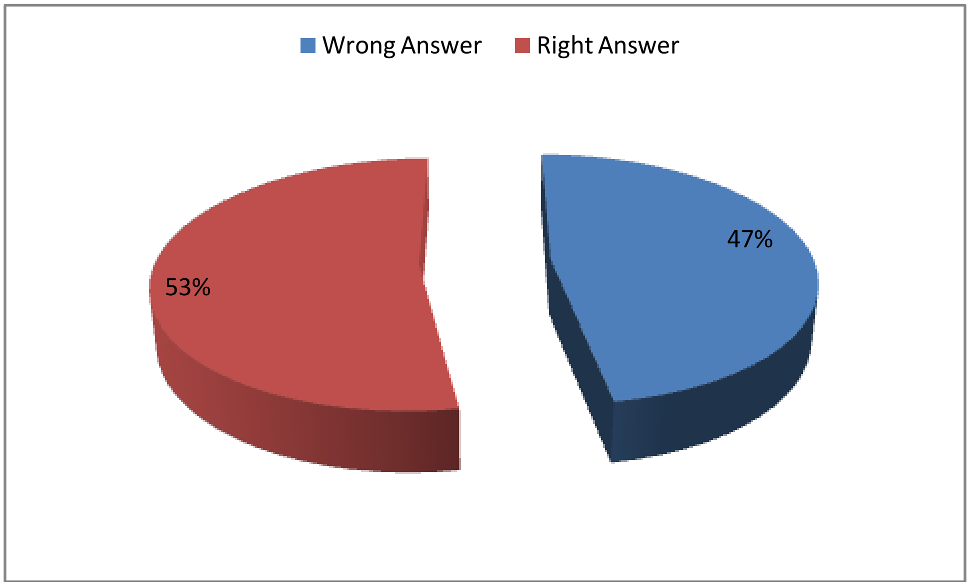

Figure 21: Distribution of PET scan

Table 22: Association between Age: Group

GROUP			
Age	**Non Radiologist**	**Radiologist**	**TOTAL**
≤ **30**	26	12	38
Row %	68.4	31.6	100.0
Col %	26.0	24.0	25.3
31-40	32	17	49
Row %	65.3	34.7	100.0
Col %	32.0	34.0	32.7
41-50	23	12	35
Row %	65.7	34.3	100.0
Col %	23.0	24.0	23.3
51-60	19	9	28
Row %	67.9	32.1	100.0
Col %	19.0	18.0	18.7
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: .1256; **p-value:** 0.9886

In Non Radiologist group, 26(26.0%) doctors were ≤ 30 years old, 32(32.0%) doctors were 31-40 years old, 23(23.0%) doctors were 41-50 years old and 19(19.0%) doctors were 51-60 years old.

In Radiologist group, 12(24.0%) doctors were ≤ 30 years old, 17(34.0%) doctors were 31-40 years old, 12(24.0%) doctors were 41-50 years old and 9(18.0%) doctors were 51-60 years old.

The association of Age vs. two groups was not statistically significant (p=0.9886).

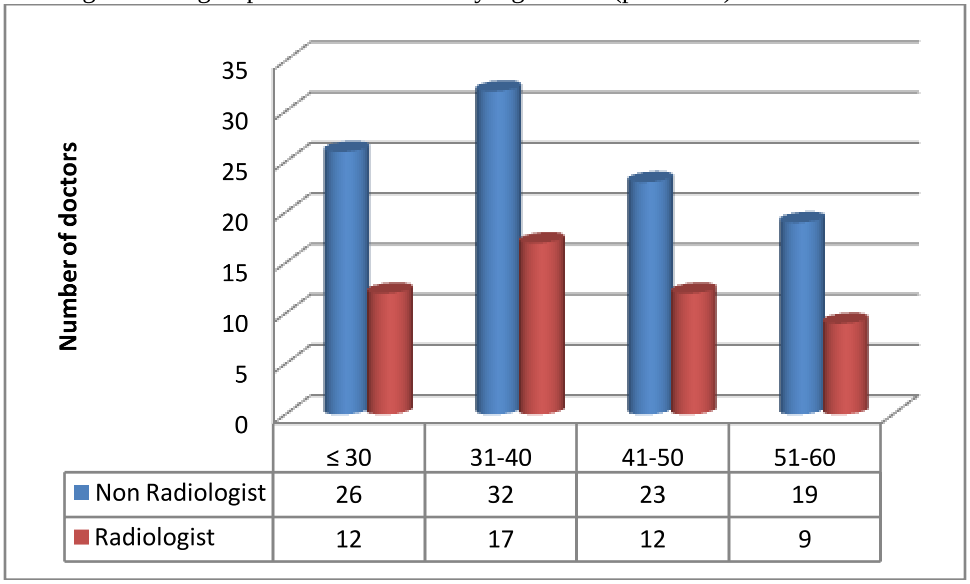

Figure 22: Association between Age: Group

Table 23: Association between category: Group

GROUP			
category	**Non Radiologist**	**Radiologist**	**TOTAL**
Consultant	38	19	57
Row %	66.7	33.3	100.0
Col %	38.0	38.0	38.0
House Officer	4	0	4
Row %	100.0	0.0	100.0
Col %	4.0	0.0	2.7
MO/RMO	6	0	6
Row %	100.0	0.0	100.0
Col %	6.0	0.0	4.0
PGT/PDT /MEM-PGT	30	13	43
Row %	69.8	30.2	100.0
Col %	30.0	26.0	28.7
Registrar/Resident	22	18	40
Row %	55.0	45.0	100.0
Col %	22.0	36.0	26.7
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 7.6360; **p-value:** 0.1059

In Non Radiologist group, 38(38.0%) doctors were Consultant, 4(4.0%) doctors were House Officer, 6(6.0%) doctors were MO/RMO, 30(30.0%) doctors were PGT/PDT /MEM-PGT and 22(22.0%) doctors were Registrar/Resident.

In Radiologist group, 19(38.0%) doctors were Consultant, 13(26.0%) doctors were PGT/PDT /MEM-PGT and 18(36.0%) doctors were Registrar/Resident.

The association of category vs. two groups was not statistically significant (p=0.1059).

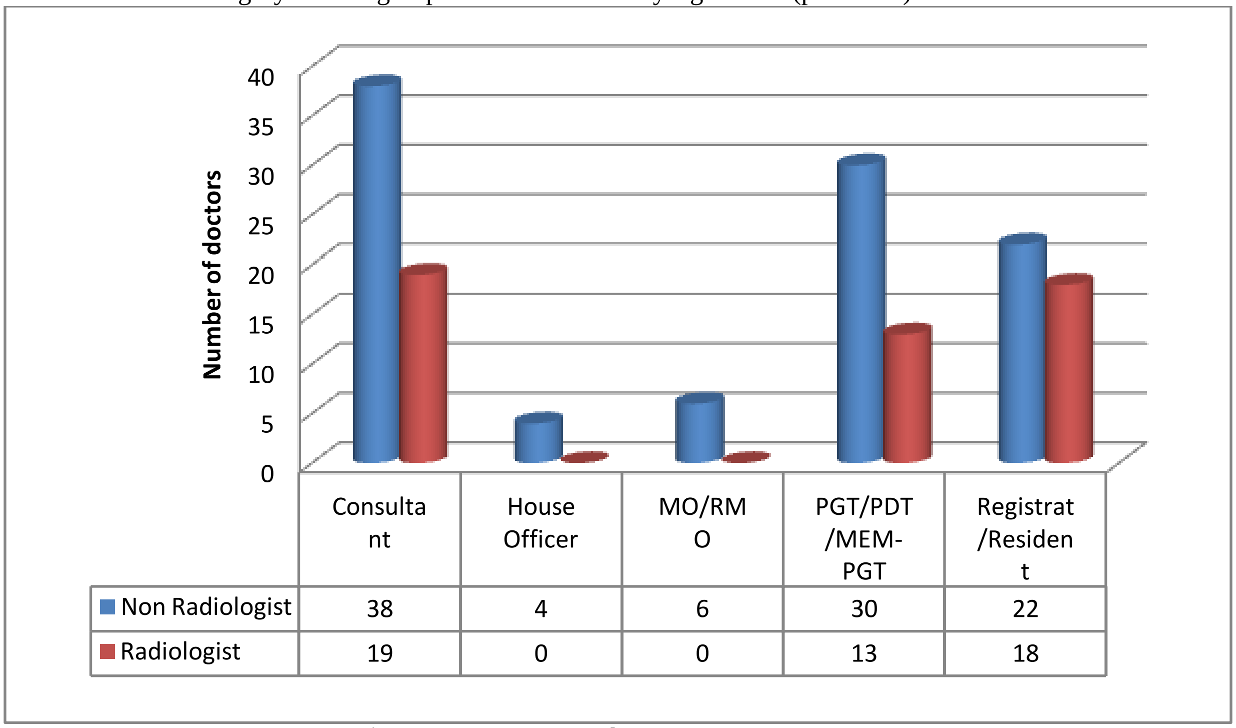

Figure 23: Association between category: Group

Table 24: Association between Department: Group

GROUP			
Department	**Non Radiologist**	**Radiologist**	**TOTAL**
Cardio Row % Col %	5 100.0 5.0	0 0.0 0.0	5 100.0 3.3
CTVS Row % Col %	4 100.0 4.0	0 0.0 0.0	4 100.0 2.7
Emergency Medicine Row % Col %	23 100.0 23.0	0 0.0 0.0	23 100.0 15.3
ENT Row % Col %	1 100.0 1.0	0 0.0 0.0	1 100.0 0.7
Gastro Row % Col %	4 100.0 4.0	0 0.0 0.0	4 100.0 2.7
House Officer Row % Col %	4 100.0 4.0	0 0.0 0.0	4 100.0 2.7
Medicine Row %	7 100.0	0 0.0	7 100.0

Col %	7.0	0.0	4.7
MO/RMO Row % Col %	6 100.0 6.0	0 0.0 0.0	6 100.0 4.0
Nephrology Row % Col %	8 100.0 8.0	0 0.0 0.0	8 100.0 5.3
Neruromedecine Row % Col %	8 100.0 8.0	0 0.0 0.0	8 100.0 5.3
Orthopaedic Row % Col %	10 100.0 10.0	0 0.0 0.0	10 100.0 6.7
Paediatrics Row % Col %	5 100.0 5.0	0 0.0 0.0	5 100.0 3.3
Plastic Surgery Row % Col %	5 100.0 5.0	0 0.0 0.0	5 100.0 3.3
Radiology Row % Col %	0 0.0 0.0	50 100.0 100.0	50 100.0 33.3
Surgery Row % Col %	2 100.0 2.0	0 0.0 0.0	2 100.0 1.3
Urology Row % Col %	8 100.0 8.0	0 0.0 0.0	8 100.0 5.3
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 150.0000; **p-value:** <0.0001

In Non Radiologist group, 5(5.0%) doctors were in Cardio Department, 4(4.0%) doctors were in CTVS Department, 23(23.0%) doctors were in Emergency Medicine Department, 1(1.0%) doctor was in ENT Department, 4(4.0%) doctors were in Gastro Department, 4(4.0%) doctors were in House Officer, 7(7.0%) doctors were in Medicine Department, 6(6.0%) doctors were MO/RMO, 8(8.0%) doctors were in Nephrology Department, 8(8.0%) doctors were in Neuro. department, 10(10.0%) doctors were in Orthopaedics Department, 5(5.0%) doctors were in Paediatrics Department, 5(5.0%) doctors were in Plastic Surgery Department, 2(2.0) doctors were in Surgery Department and 8(8.0%) doctors were in Urology Department.

In Radiologist group, 50(100.0%) doctors were in Radiology Department. The association of Department vs. two groups was statistically significant ($p<0.0001$).

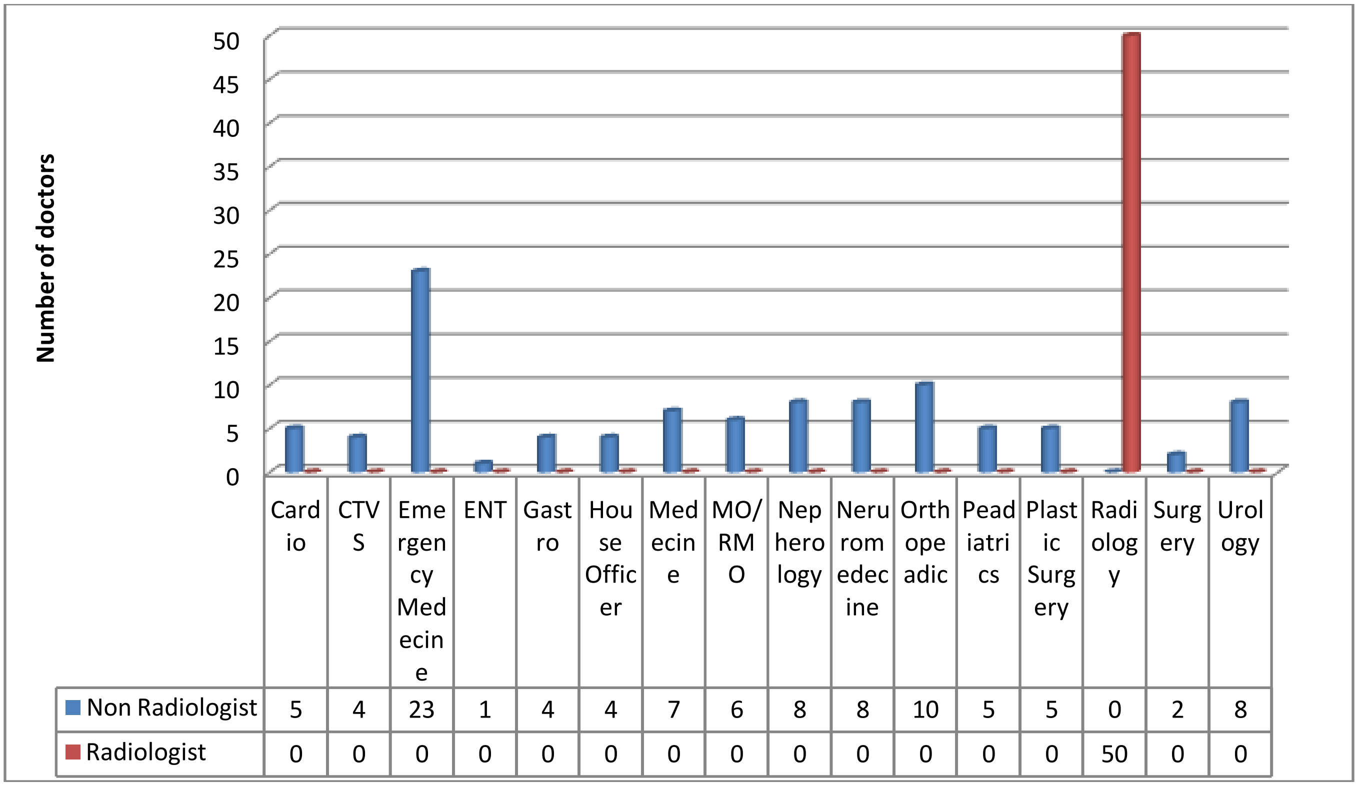

Figure 24: Association between Department: Group

Table 25: Association between RE during abdominal X-ray: Group

GROUP			
RE during abdominal X-ray	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	68 89.5 68.0	8 10.5 16.0	76 100.0 50.7
Right Answer Row % Col %	32 43.2 32.0	42 56.8 84.0	74 100.0 49.3
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 36.0597; **p-value:** <0.0001

In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of RE during abdominal X-ray vs two groups was statistically significant (p<0.0001).

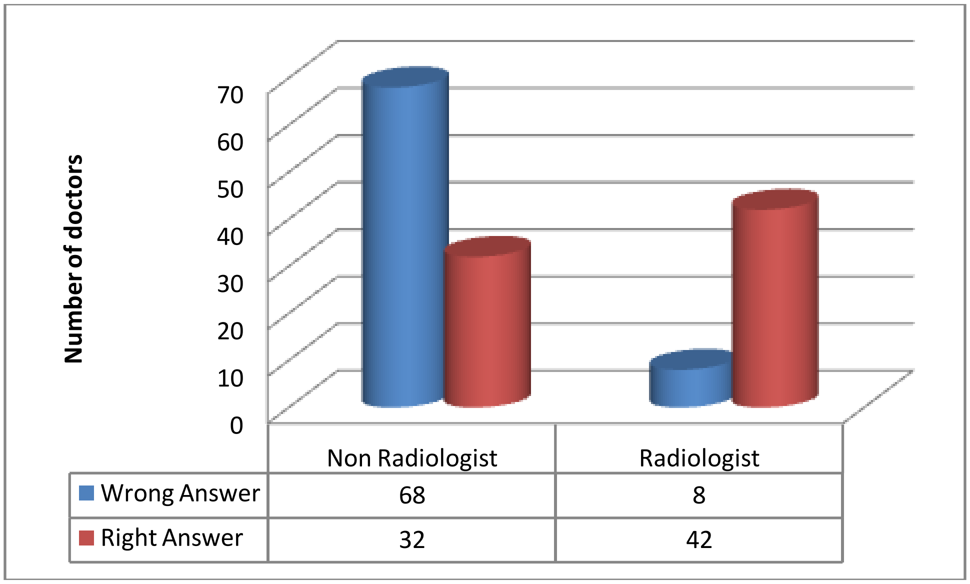

Figure 25: Association between RE during abdominal X-ray: Group

Table 26: Association between RE during thoracic spine x-ray: Group

GROUP			
RE during thoracic spine x-ray	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	69	8	77
Row %	89.6	10.4	100.0
Col %	69.0	16.0	51.3
Right Answer	31	42	73
Row %	42.5	57.5	100.0
Col %	31.0	84.0	48.7
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 37.4800; **p-value:** <0.0001

In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of RE during thoracic spine x-ray vs two groups was statistically significant (p<0.0001).

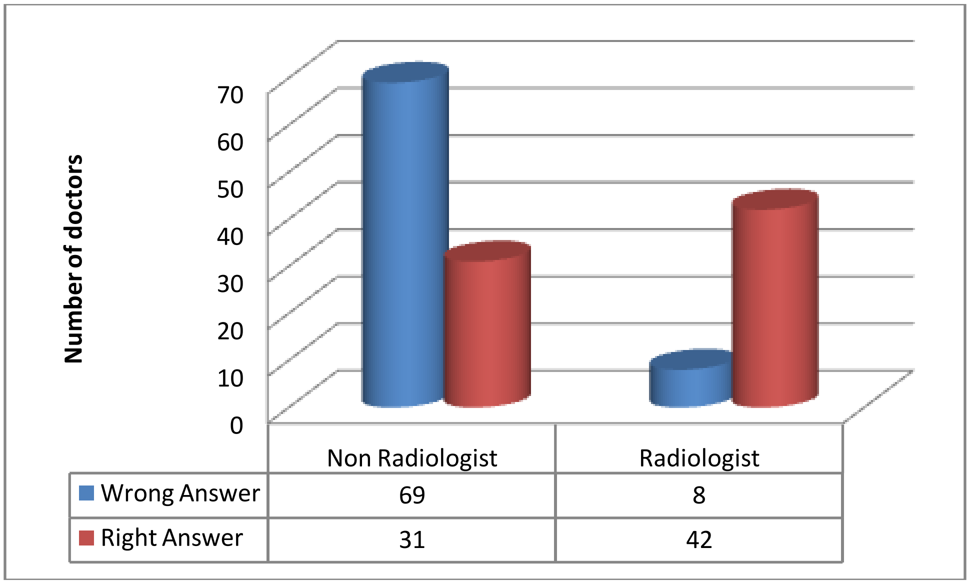

Figure 26: Association between RE during thoracic spine x-ray: Group

Table 27: Association between RE during lumbar spine x-ray: Group

GROUP			
RE during lumbar spine x-ray	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	69	9	78
Row %	88.5	11.5	100.0
Col %	69.0	18.0	52.0
Right Answer	31	41	72
Row %	43.1	56.9	100.0
Col %	31.0	82.0	48.0
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 34.7356; **p-value:** <0.0001

In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 41(82.0%) doctors had told a Right Answer.

The association of RE during lumbar spine x-ray vs two groups was statistically significant (p<0.0001).

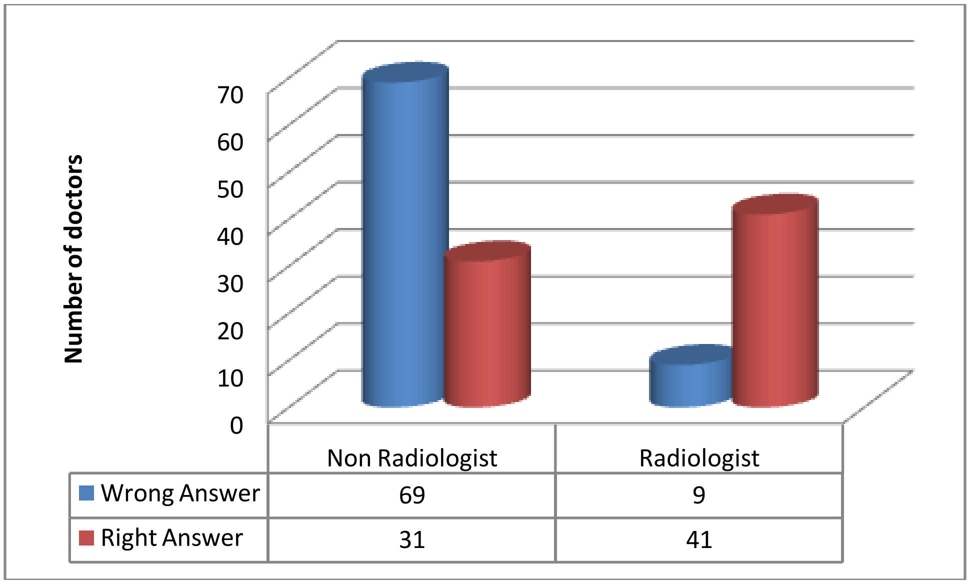

Figure 27: Association between RE during lumbar spine x-ray: Group

Table 28: Association between RE during pelvis x-ray: Group

GROUP			
RE during pelvis x-ray	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	69	11	80
Row %	86.3	13.8	100.0
Col %	69.0	22.0	53.3
Right Answer	31	39	70
Row %	44.3	55.7	100.0
Col %	31.0	78.0	46.7
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 29.5848; **p-value:** <0.0001

In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 39(78.0%) doctors had told a Right Answer.

The association of RE during pelvis x-ray vs two groups was statistically significant (p<0.0001).

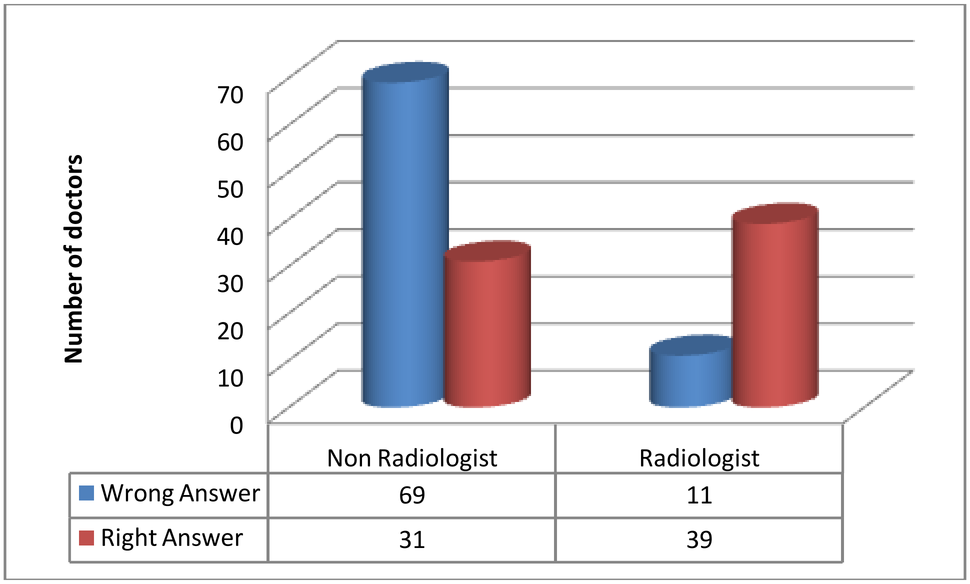

Figure 28: Association between RE during pelvis x-ray: Group

Table 29: Association between RE during hip x-ray: Group

GROUP			
RE during hip x-ray	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	65	16	81
Row %	80.2	19.8	100.0
Col %	65.0	32.0	54.0
Right Answer	35	34	69
Row %	50.7	49.3	100.0
Col %	35.0	68.0	46.0
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 14.6135; **p-value:** 0.0001

In Non Radiologist group, 35(35.0%) doctors had told a Right Answer. In Radiologist group, 34(68.0%) doctors had told a Right Answer.

The association of RE during hip x-ray vs two groups was statistically significant (p= 0.0001).

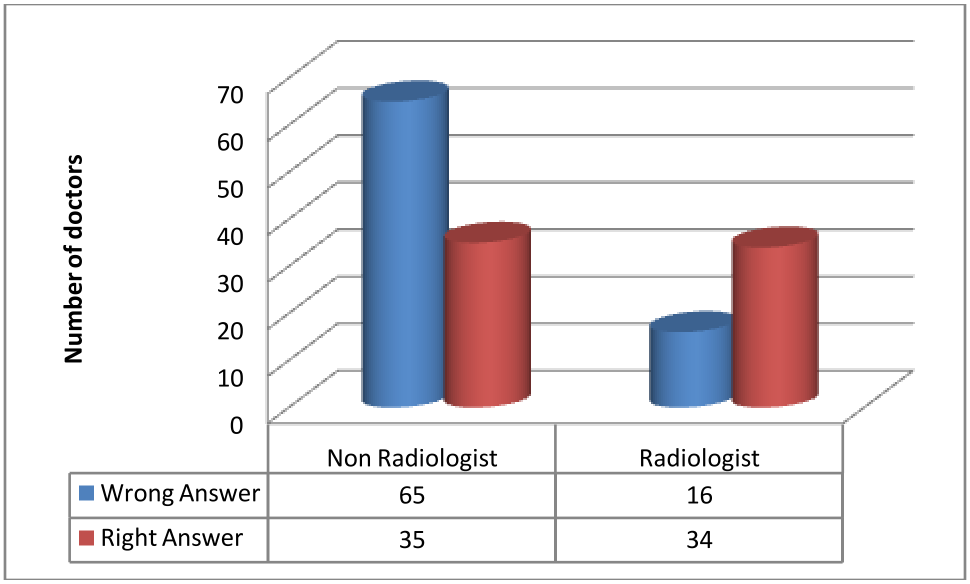

Figure 29: Association between RE during hip x-ray: Group

Table 30: Association between RE during CT-head: Group

GROUP			
RE during CT-head	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	69 89.6 69.0	8 10.4 16.0	77 100.0 51.3
Right Answer Row % Col %	31 42.5 31.0	42 57.5 84.0	73 100.0 48.7
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 37.4800; **p-value:** <0.0001

In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of RE during CT-head vs two groups was statistically significant (p<0.0001).

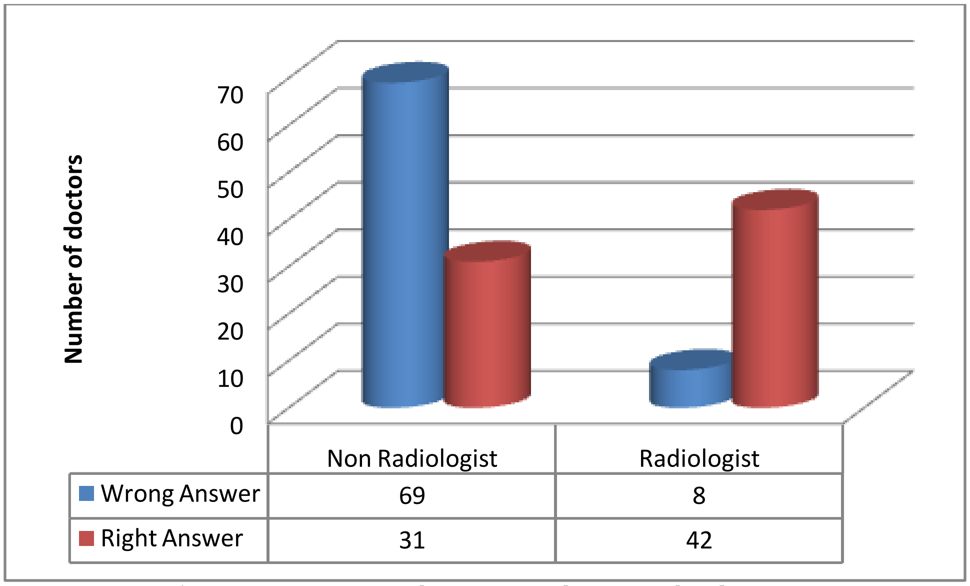

Figure 30: Association between RE during CT-head: Group

Table 31: Association between RE during CT abdomen: Group

GROUP			
RE during CT abdomen	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	67 89.3 67.0	8 10.7 16.0	75 100.0 50.0
Right Answer Row % Col %	33 44.0 33.0	42 56.0 84.0	75 100.0 50.0
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 34.6800; **p-value**: <0.0001

In Non Radiologist group, 33(33.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of RE during CT abdomen vs. two groups was statistically significant (p<0.0001).

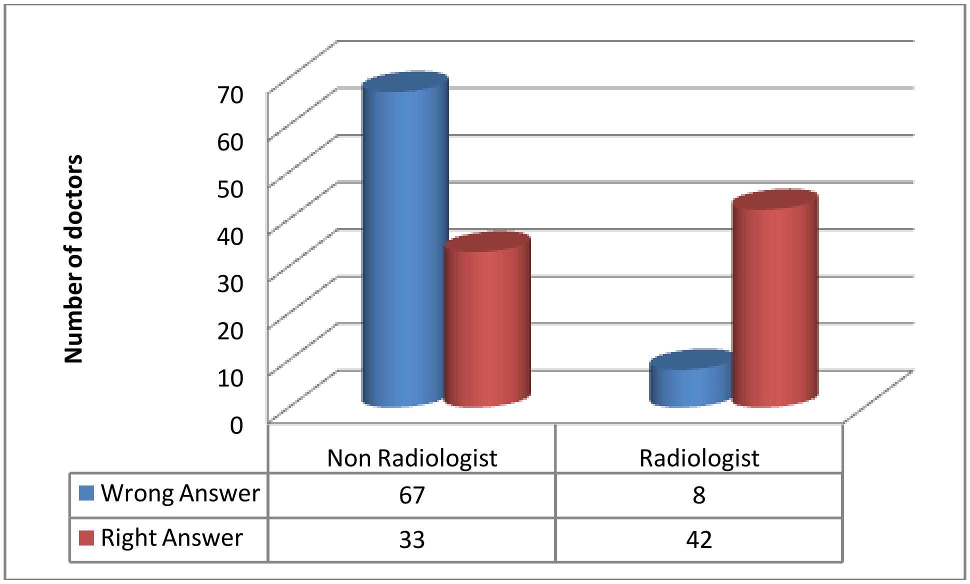

Figure 31: Association between RE during CT abdomen: Group

Table 32: Association between Radiation doses during IVU: Group

GROUP			
Radiation dose during IVU	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	68 89.5 68.0	8 10.5 16.0	76 100.0 50.7
Right Answer Row % Col %	32 43.2 32.0	42 56.8 84.0	74 100.0 49.3
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 36.0597; **p-value**: <0.0001

In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of Radiation dose during IVU vs. two groups was statistically significant (p<0.0001).

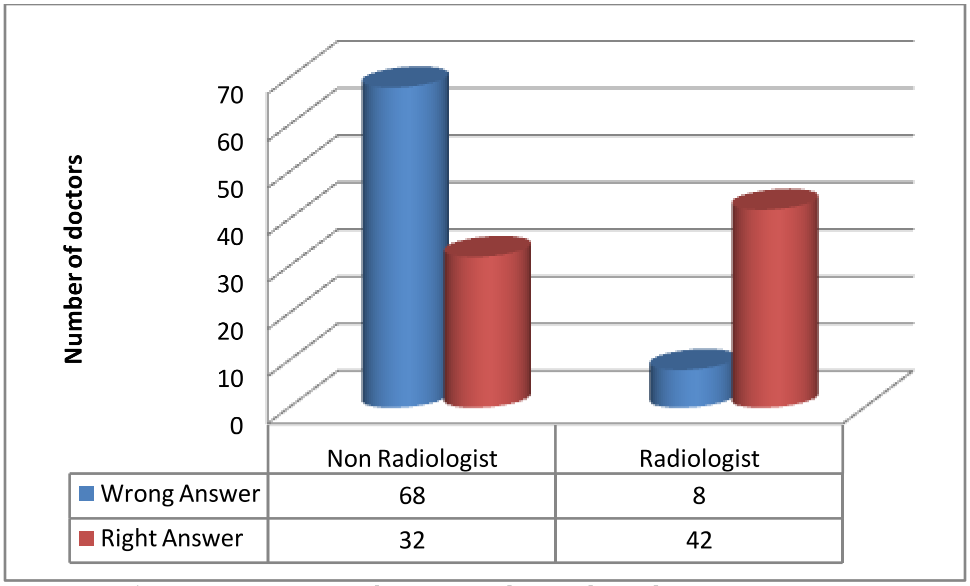

Figure 32: Association between Radiation doses during IVU: Group

Table 33: Association between RE during barium enema: Group

GROUP			
RE during barium enema	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	72 90.0 72.0	8 10.0 16.0	80 100.0 53.3
Right Answer Row % Col %	28 40.0 28.0	42 60.0 84.0	70 100.0 46.7
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 42.0000; **p-value**: <0.0001

In Non Radiologist group, 28(28.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

The association of RE during barium enema vs. two groups was statistically significant (p<0.0001).

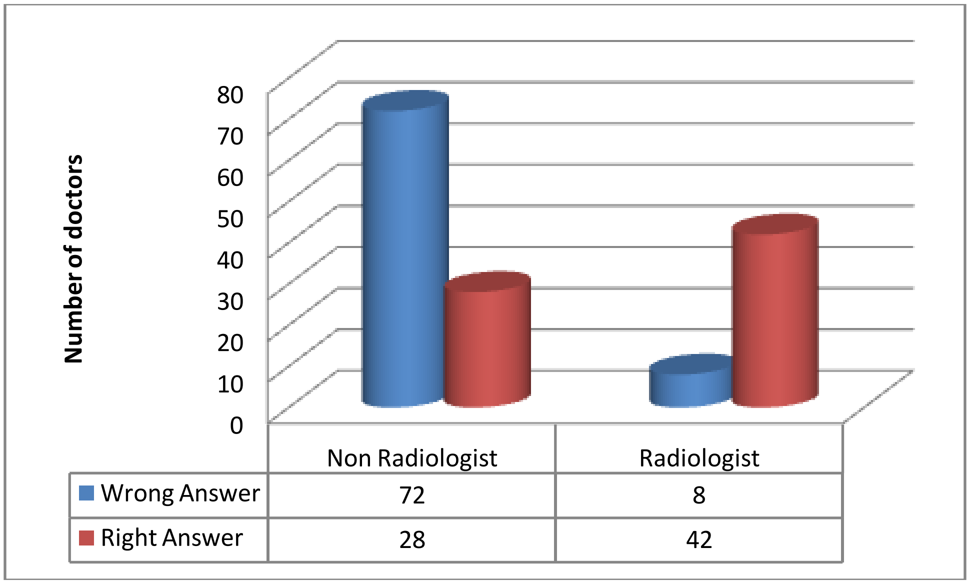

Figure 33: Association between RE during barium enema: Group

Table 34: Association between RE during Barium Swallow: Group

GROUP			
RE during Barium Swallow	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	73 85.9 73.0	12 14.1 24.0	85 100.0 56.7
Right Answer Row % Col %	27 41.5 27.0	38 58.5 76.0	65 100.0 43.3
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 32.5928; **p-value**: <0.0001

In Non Radiologist group, 27(27.0%) doctors had told a Right Answer. In Radiologist group, 38(76.0%) doctors had told a Right Answer.

The association of RE during Barium Swallow vs. two groups was statistically significant (p<0.0001).

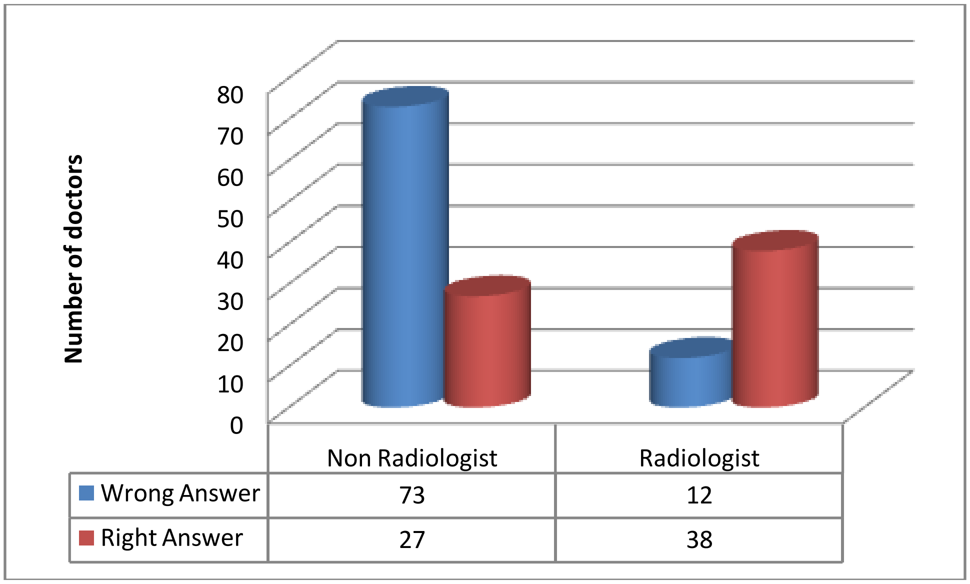

Figure 34: Association between RE during Barium Swallow: Group

Table 35: Association between RE during ultrasound abdomen: Group

GROUP			
RE during ultrasound abdomen	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	19 100.0 19.0	0 0.0 0.0	19 100.0 12.7
Right Answer Row % Col %	81 61.8 81.0	50 38.2 100.0	131 100.0 87.3
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 10.8779; **p-value**: 0.0009

In Non Radiologist group, 81(81.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer.

The association of RE during ultrasound abdomen vs two groups was statistically significant (p=0.0009).

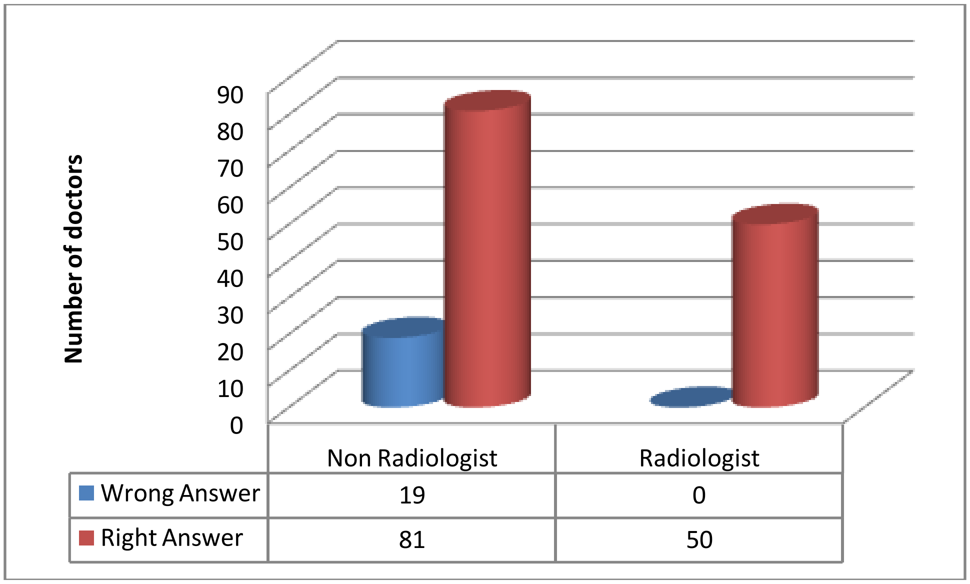

Figure 35: Association between RE during ultrasound abdomen: Group

Table 36: Association between RE during MRI brain: Group

GROUP			
RE during MRI brain	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	14 100.0 14.0	0 0.0 0.0	14 100.0 9.3
Right Answer Row % Col %	86 63.2 86.0	50 36.8 100.0	136 100.0 90.7
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 7.7206; **p-value**: 0.0054

In Non Radiologist group, 86(86.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer.

The association of RE during MRI brain vs. two groups was statistically significant (p=0.0054).

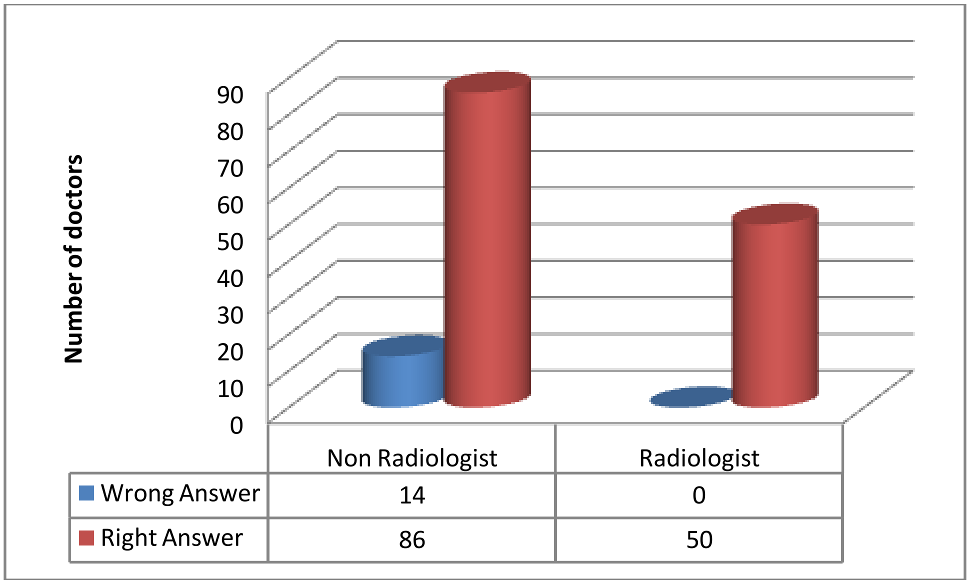

Figure 36: Association between RE during MRI brain: Group

Table 37: Association between RE during MRI abdomen: Group

GROUP			
RE during MRI abdomen	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	18 100.0 18.0	0 0.0 0.0	18 100.0 12.0
Right Answer Row % Col %	82 62.1 82.0	50 37.9 100.0	132 100.0 88.0
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 10.2273; **p-value**: 0.0013

In Non Radiologist group, 82(82.0%) doctors had answered a Right Answer. In Radiologist group, 50(100.0%) doctors had answered a Right Answer.

The association of RE during MRI abdomen vs. two groups was statistically significant (p=0.0013).

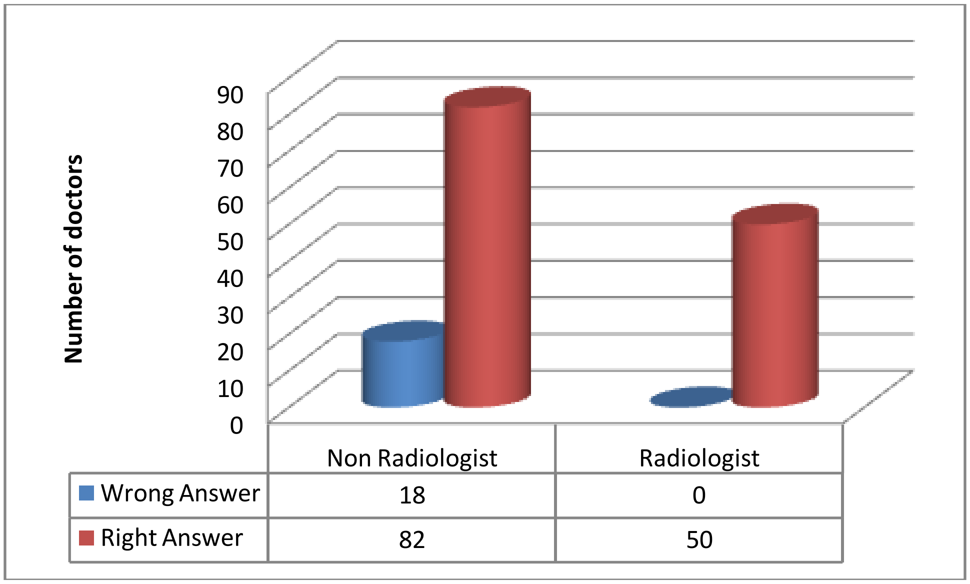

Figure 37: Association between RE during MRI abdomen: Group

Table 38: Association between RE during MRI limbs: Group

GROUP			
RE during MRI limbs	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	12 100.0 12.0	0 0.0 0.0	12 100.0 8.0
Right Answer Row % Col %	88 63.8 88.0	50 36.2 100.0	138 100.0 92.0
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 6.5217; **p-value**: 0.0106

In Non Radiologist group, 88(88.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer.

The association of RE during MRI limbs vs. two groups was statistically significant (p=0.0106).

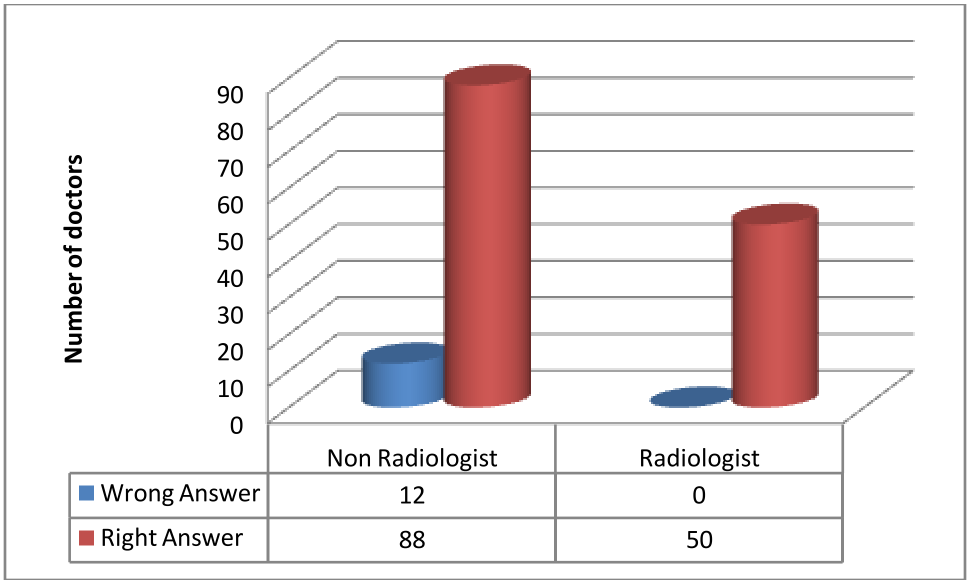

Figure 38: Association between RE during MRI limbs: Group

Table 39: Association between RE during leg arteriogram: Group

GROUP			
RE during leg arteriogram	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer Row % Col %	66 100.0 66.0	0 0.0 0.0	66 100.0 44.0
Right Answer Row % Col %	34 40.5 34.0	50 59.5 100.0	84 100.0 56.0
TOTAL Row % Col %	100 66.7 100.0	50 33.3 100.0	150 100.0 100.0

Chi-square value: 58.9286; **p-value**: <0.0001

In Non Radiologist group, 34(34.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer.

The association of RE during leg arteriogram vs. two groups was statistically significant (p<0.0001).

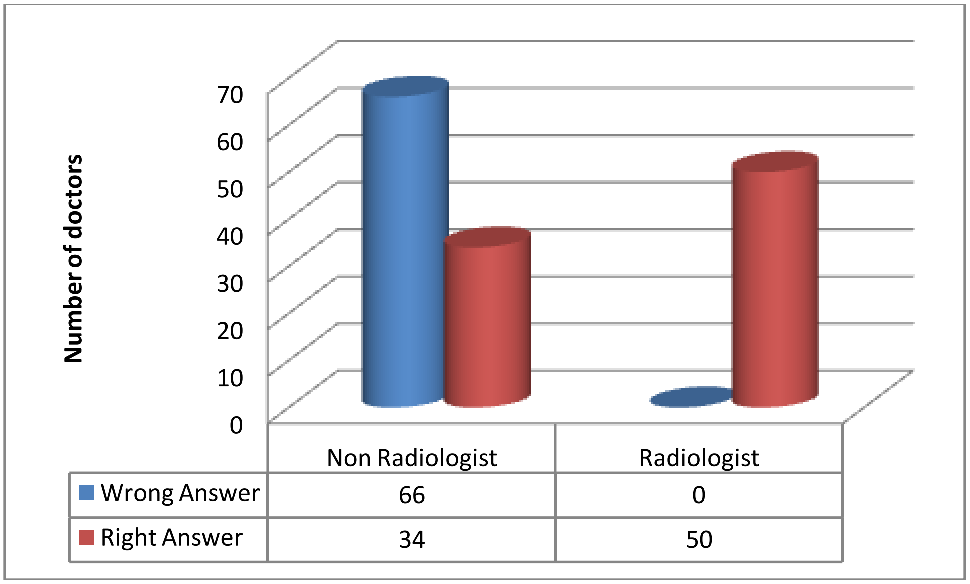

Figure 39: Association between RE during leg arteriogram: Group

Table 40: Association between RE during thyroid isotope scan: Group

GROUP			
RE during thyroid isotope scan	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	68	2	70
Row %	97.1	2.9	100.0
Col %	68.0	4.0	46.7
Right Answer	32	48	80
Row %	40.0	60.0	100.0
Col %	32.0	96.0	53.3
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 54.8571; **p-value**: <0.0001

In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 48(96.0%) doctors had told a Right Answer.

The association of RE during thyroid isotope scan vs. two groups was statistically significant ($p<0.0001$).

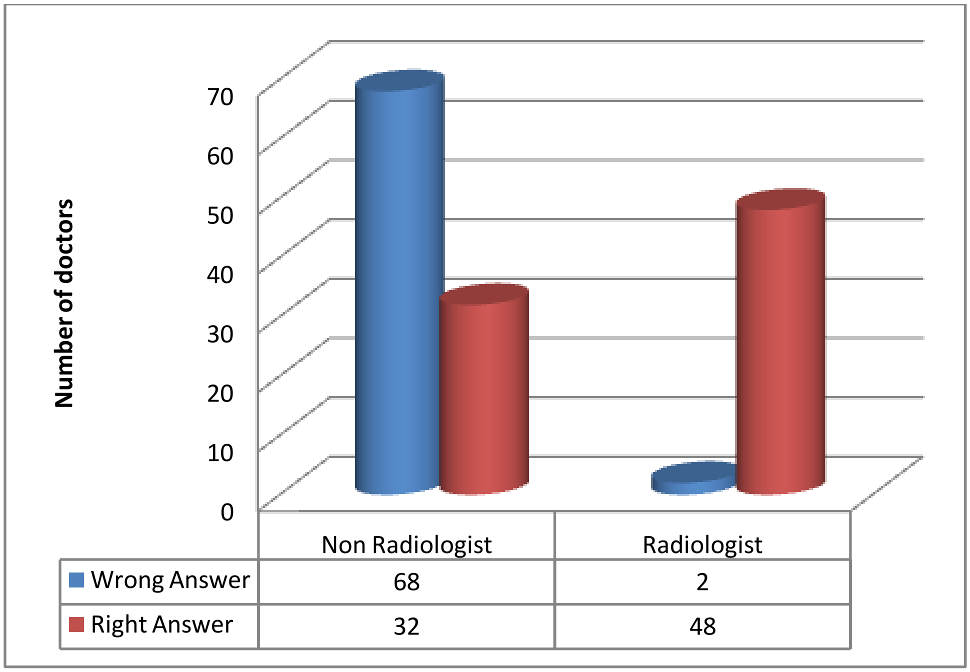

Figure 40: Association between RE during thyroid isotope scan: Group

Table 41: Association between RE during PET scan: Group

GROUP			
RE during PET scan	**Non Radiologist**	**Radiologist**	**TOTAL**
Wrong Answer	67	4	71
Row %	94.4	5.6	100.0
Col %	67.0	8.0	47.3
Right Answer	33	46	79
Row %	41.8	58.2	100.0
Col %	33.0	92.0	52.7
TOTAL	100	50	150
Row %	66.7	33.3	100.0
Col %	100.0	100.0	100.0

Chi-square value: 46.5457; **p-value**: <0.0001

In Non Radiologist group, 33(33.0%) doctors had told a Right Answer. In Radiologist group, 46(92.0%) doctors told answered a Right Answer.

The association of RE during PET scan vs. two groups was statistically significant ($p<0.0001$).

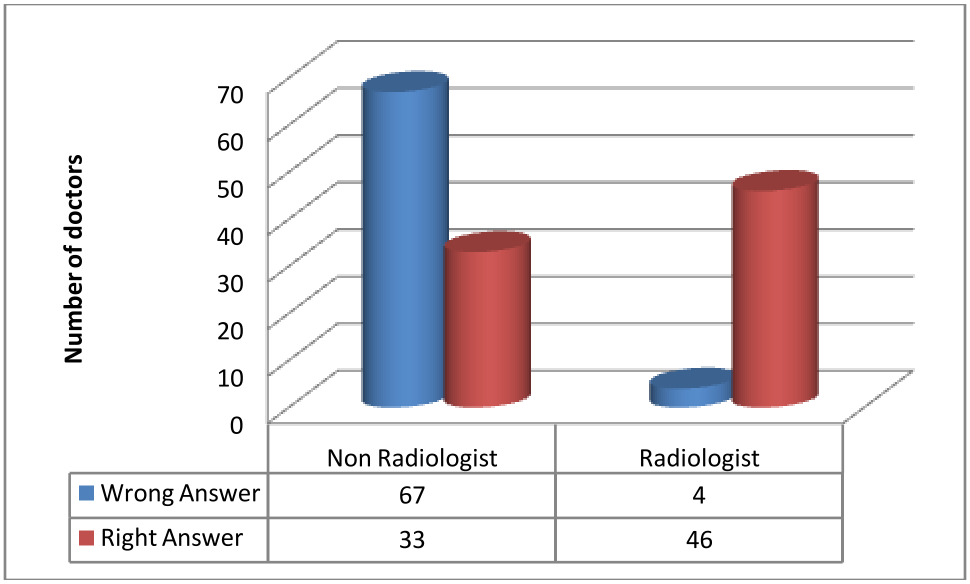

Figure 41: Association between RE during PET scan: Group

Table 42: Distribution of all parameters

		Frequency	Percent
RE during abdominal X-ray	**Wrong Answer**	76	50.7%
	Right Answer	74	49.3%
RE during thoracic spine x-ray	**Wrong Answer**	77	51.3%
	Right Answer	73	48.7%
RE during lumbar spine x-ray	**Wrong Answer**	78	52.0%
	Right Answer	72	48.0%
RE during pelvis x-ray	**Wrong Answer**	80	53.3%
	Right Answer	70	46.7%
RE during hip x-ray	**Wrong Answer**	81	54.0%
	Right Answer	69	46.0%
RE during CT-head	**Wrong Answer**	77	51.3%
	Right Answer	73	48.7%
RE during CT abdomen	**Wrong Answer**	75	50.0%
	Right Answer	75	50.0%
Radiation dose during IVU	**Wrong Answer**	76	50.7%
	Right Answer	74	49.3%
RE during barium enema	**Wrong Answer**	80	53.3%
	Right Answer	70	46.7%
RE during Barium Swallow	**Wrong Answer**	85	56.7%
	Right Answer	65	43.3%
RE during ultrasound abdomen	**Wrong Answer**	19	12.7%
	Right Answer	131	87.3%
RE during MRI brain	**Wrong Answer**	14	9.3%
	Right Answer	136	90.7%
RE during MRI abdomen	**Wrong Answer**	18	12.0%
	Right Answer	132	88.0%
RE during MRI limbs	**Wrong Answer**	12	8.0%
	Right Answer	138	92.0%
RE during leg arteriogram	**Wrong Answer**	66	44.0%

	Right Answer	84	56.0%
RE during thyroid isotope scan	Wrong Answer	70	46.7%
	Right Answer	80	53.3%
RE during PET scan	Wrong Answer	71	47.3%
	Right Answer	79	52.7%

Table 43: Association between all parameters: Group

		Non Radiologist	Radiologist	p-value:
RE during abdominal X-ray	Wrong Answer	68	8	<0.0001
	Right Answer	32	42	
RE during thoracic spine x-ray	Wrong Answer	69	8	<0.0001
	Right Answer	31	42	
RE during lumbar spine x-ray	Wrong Answer	69	9	<0.0001
	Right Answer	31	41	
RE during pelvis x-ray	Wrong Answer	69	11	<0.0001
	Right Answer	31	39	
RE during hip x-ray	Wrong Answer	65	16	0.0001
	Right Answer	35	34	
RE during CT-head	Wrong Answer	69	8	<0.0001
	Right Answer	31	42	
RE during CT abdomen	Wrong Answer	67	8	<0.0001
	Right Answer	33	42	
Radiation dose during	Wrong Answer	68	8	<0.0001

IVU				
	Right Answer	**32**	**42**	
RE during barium enema	**Wrong Answer**	**72**	**8**	<0.0001
	Right Answer	**28**	**42**	
RE during Barium Swallow	**Wrong Answer**	**73**	**12**	<0.0001
	Right Answer	**27**	**38**	
RE during ultrasound abdomen	**Wrong Answer**	**19**	**0**	0.0009
	Right Answer	**81**	**50**	
RE during MRI brain	**Wrong Answer**	**14**	**0**	0.0054
	Right Answer	**86**	**50**	
RE during MRI abdomen	**Wrong Answer**	**18**	**0**	0.0013
	Right Answer	**82**	**50**	
RE during MRI limbs	**Wrong Answer**	**12**	**0**	0.0106
	Right Answer	**88**	**50**	
RE during leg arteriogram	**Wrong Answer**	**66**	**0**	<0.0001
	Right Answer	**34**	**50**	
RE during thyroid isotope scan	**Wrong Answer**	**68**	**2**	<0.0001

	Right Answer	**32**	**48**	
RE during PET scan	**Wrong Answer**	**67**	**4**	<0.0001
	Right Answer	**33**	**46**	

Discussion:-

In our study found that 100(66.7%) doctors were Non Radiologist and 50(33.3%) doctors were Radiologist. We found that 38(25.3%) doctors were ≤30 years old, 49(32.7%) doctors were 31-40 years old, 35(23.3%) doctors were 41-50 years old and 28(18.7%) doctors were 51-60 years old. 57(38.0%) doctors were Consultant, 4(2.7%) doctors were House Officer, 6(4.0%) doctors were MO/RMO, 43(28.7%) doctors were PGT/PDT /MEM-PGT and 40(26.7%) doctors were Registrar/Resident.

Our study showed that 5(3.3%) doctors were in Cardio Department, 4(2.7%) doctors were in CTVS Department, 23(15.3%) doctors were in Emergency Medicine Department, 1(0.7%) was in ENT Department, 4(2.7%) doctors were in Gastro Department, 4(2.7%) doctors were in House Officer Department, 7(4.7%) doctors were in Medicine Department, 6(4.0%) doctors were in MO/RMO Department, 8(5.3%) doctors were in Nephrology Department, 8(5.3%) doctors were in Neruro medicine Department, 10(6.7%) doctors were in Orthopaedic Department, 5(3.3%) doctors were in Paediatrics Department, 5(3.3%) doctors were in Plastic Surgery Department, 50(33.3%) doctors were in Radiology Department, 2(1.3%) doctors were in Surgery Department and 8(5.3%) doctors were in Urology Department.

Our study showed that in Non Radiologist group, 26(26.0%) doctors were ≤ 30 years old, 32(32.0%) doctors were 31-40 years old, 23(23.0%) doctors were 41-50 years old and 19(19.0%) doctors were 51-60 years old. In Radiologist group, 12(24.0%) doctors were ≤ 30 years old, 17(34.0%) doctors were 31 40 years old, 12(24.0%) doctors were 41-50 years old and 9(18.0%) doctors were 51-60 years old.

It was found that the association of category vs. two groups was not statistically significant (p=0.1059).

Paolicchi F et al [43] (2016) found that young radiographers (with less than 3 years of experience) showed a higher level of knowledge compared with the more experienced radiographers. Specific actions such as regular training courses for both postgraduate and undergraduate students as well as for working radiographers must be considered in order to assure patient safety during radiological examinations.

We found that in Non Radiologist group, 5(5.0%) doctors were in Cardio Department, 4(4.0%) doctors were in CTVS Department, 23(23.0%) doctors were in Emergency Medicine Department, 1(1.0%) doctor was in ENT Department, 4(4.0%) doctors were in Gastro Department, 4(4.0%) doctors were in House Officer Department, 7(7.0%) do0ctors were in Medicine Department, 6(6.0%) doctors were in MO/RMO Department, 8(8.0%) doctors were in Nephrology Department, 8(8.0%) doctors were in Neruromedecine Department, 10(10.0%) doctors were in Orthopaedic Department, 5(5.0%) doctors were in Paediatrics Department, 5(5.0%) doctors were in Plastic Surgery Department, 2(2.0) doctors were in Surgery Department and 8(8.0%) doctors were in Urology Department.

Our study showed that in Radiologist group, 50(100.0%) doctors were in Radiology Department. We found that the association of Department vs. two groups was statistically significant (p<0.0001).

Lee RK et al [37] (2012) found that doctors were then asked to estimate the doses of radiation (measured in chest x-ray equivalents) for various radiological procedures. The results of radiologists and non-radiologists were compared. 158 doctors (25 radiologists and 133 non-radiologists) completed the questionnaire. The overall accuracy was 40% for radiologists and 16% for non-radiologists. One-third of non-radiologists could not distinguish radiological examinations with or without ionising radiation. No non-radiologists correctly stated the radiation dose (in mSv) of a conventional chest x-ray, and 77% underestimated the dose of radiological examinations. For radiologists, only 32% were correct for the radiation dose of a conventional chest x-ray while 7% underestimated the radiation doses.

In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer. The association of RE during abdominal X-ray vs. two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer. The association of RE during thoracic spine x-ray vs two groups was statistically significant ($p<0.0001$).

We found that in Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 41(82.0%) doctors had told a Right Answer. The association of RE during lumbar spine x-ray vs. two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 39(78.0%) doctors had told a Right Answer. The association of RE during lumbar pelvis x-ray vs. two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 35(35.0%) doctors had told a Right Answer. In Radiologist group, 34(68.0%) doctors had told a Right Answer. The association of RE during hip x-ray vs two groups was statistically significant ($p= 0.0001$).

Hobbs JB et al [39] (2018) found that knowledge of risk and radiation exposure was relatively low on the pre-presentation test, including specifically poor understanding of different imaging modalities, with 26% of participants not able to correctly identify which modalities expose patients to ionizing radiation. Efforts to educate ordering providers about radiation exposure and risk are needed to ensure that providers are appropriately weighing the risks and benefits of medical imaging and to ensure high-quality, patient-centred care.

Krille L et al [40] (2010) found that overall, the surveys showed moderate to low knowledge among physicians concerning radiation doses and the involved health risks. However, knowledge on radiation doses cannot be elucidated as reliable indicator for good medical practice.

Singh P et al [41] (2015) found that Majority of the clinicians underestimated radiation doses, while a few overestimated it. Almost half of the clinicians (55.5%) favoured to select the rationale of asking about earlier radiological examinations as clinical need only, which was surprising. Their study as such in a small population size shows inadequate knowledge on radiation and its guidelines among referral physicians, which shows the immediate need for training programs to bridge this knowledge gap.

Our study showed that in Non Radiologist group, 31(31.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer. The association of RE during CT-head vs. two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 33(33.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer. The association of RE during CT abdomen vs two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer. The association of Radiation dose during IVU vs two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 28(28.0%) doctors had told a Right Answer. In Radiologist group, 42(84.0%) doctors had told a Right Answer.

It was showed that the association of RE during barium enema vs two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 27(27.0%) doctors had told a Right Answer. In Radiologist group, 38(76.0%) doctors had told a Right Answer. The association of RE during Barium Swallow vs. two groups was statistically significant ($p<0.0001$). In Non Radiologist group, 81(81.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer. The association of RE during ultrasound abdomen vs. two groups was statistically significant ($p=0.0009$). In Non Radiologist group, 86(86.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer. The association of RE during MRI brain vs two groups was statistically significant ($p=0.0054$). In Non Radiologist group, 82(82.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer. The association of RE during MRI abdomen vs. two groups was statistically significant ($p=0.0013$).

Atsina KB et al [38] (2020) found that the 2,070,861 general nuclear medicine studies performed, radiologists interpreted 1,307,543 (63.14%) and non-radiologist physicians interpreted 763,318 (36.86%). Of non-radiologist Cardiologists had the largest involvement of non-radiologist physicians, contributing approximately 3% of all advanced imaging interpretations. All other non-radiologist physicians interpreted a small fraction of advanced imaging studies.

Azmoonfar R et al [44] (2016) found that the results indicated that the majority of physicians did not know about ionizing radiation and evaluation of absorbed dose in patients. Many of these physicians were not aware of the most important aspects of radiation protection and radiations risks. On the whole, this study showed that knowledge of radiation doses is not adequate among physicians.

We found that in Non Radiologist group, 88(88.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer. The association of RE during MRI limbs vs. two groups was statistically significant (p=0.0106). In Non Radiologist group, 34(34.0%) doctors had told a Right Answer. In Radiologist group, 50(100.0%) doctors had told a Right Answer. The association of RE during leg arteriogram vs. two groups was statistically significant (p<0.0001). In Non Radiologist group, 32(32.0%) doctors had told a Right Answer. In Radiologist group, 48(96.0%) doctors had told a Right Answer. The association of RE during thyroid isotope scan vs two groups was statistically significant (p<0.0001).

Our study showed that in Non Radiologist group, 33(33.0%) doctors had told a Right Answer. In Radiologist group, 46(92.0%) doctors had told a Right Answer. The association of RE during PET scan vs. two groups was statistically significant (p<0.0001). In Non Radiologist group, 35(35.0%) doctors had told a Right Answer. In Radiologist group, 44(88.0%) doctors had told a Right Answer. The association of F25 vs two groups was statistically significant (p<0.0001).

Khan MO et al [45] (2018) found that patients require knowledge of radiation risk to provide informed consent as per IRMER regulations, thus they propose formal teaching on the subject matter to promote radiation safety culture among medical undergraduates and postgraduates.

Maharjan S et al [47] (2017) found that Medical exposure is closely associated with manifold increase in lifetime cancer risk. To avoid unnecessary exposure and facilitate better patient care, radiology professionals should be well aware of these issues. Many radiology professionals still ignore as x-rays do not cause immediate severe adverse effects.

Parikh JR et al [42] (2017) found that formal education and training on radiation safety and management, careful attention to good radiation protection habits, and continued emphasis on radiation management and the as low as reasonably achievable principle are recommended for all radiologists.

Conclusion:-

We found that the knowledge of radiation dose of investigation is significantly poor in non radiologist.

Our study also showed that knowledge of radiation dose of investigation is generally inadequate among radiologists.

It was found that young practitioners among non radiologist as well as radiologist have better knowledge of radiation dose of investigation.

Knowledge and awareness of the radiation hazards of radiological examinations can be raised among emergency physicians and other medical professionals as a part of continuous medical education programmes.

Knowledge of radiation doses of investigation is generally inadequate among radiologists, and particularly poor in non-radiologist. Underestimation of radiation doses may expose patients to increasing radiological investigation and expose to radiation hazards.

Efforts to educate medical professional about radiation exposure and hazard are needed to ensure that medicinal professional are appropriately weighing the risks and benefits of medical imaging and to ensure high-quality, patient-cantered care.

Limitations of The Study:

In spite of every sincere effort my study has lacunae.

The notable short comings of this study are:
1. The sample size was small. Only 150 cases are not sufficient for this kind of study.
2. The study has been done in a single city.
3. The study was carried out in a tertiary care hospital, so hospital bias cannot be ruled out.
4. The obstratic part of study is not included in this study and wish to be used in future studies.

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Data collection form:
Questionnaire

Pick correct one

Demographics of doctor

1. What is your age?

 25 years 26-35years 36-50years 51-60 years > 60years

2. What category best describe your current position?

 House Officer MO/RMO PGT/PDT /MEM-PGT Registrar/Resident Consultant

3. How many years of work experience in the health sector you presently have?
4. Radiation exposure during abdominal X-ray is ?

35mSv 60mSv 10mSv 80mSV

5. Radiation exposure during thoracic spine x-ray is?

55mSv 15msv 35mSv 2mSv

6. Radiation exposure during lumbar spine x-ray is?

35mSv 50mSv 4mSv 40mSv

7. Radiation exposure during pelvis x-ray is?

40mSv 3mSv 30mSv 35mSv

8. Radiation exposure during hip x-ray is?

2mSv 20mSv 30mSv 35mSv

9. Radiation exposure during CT-head is?

60mSv 100mSv 140mSv 35mSv

10. Radiation exposure during CT abdomen is?

100mSv 200mSv 400mSv 500mSv

11. Radiation dose during IVU is?

2mSv 120mSv 300mSV 500mSv

12. Radiation exposure during barium enema is?

0mSv 200 mSv 360mSv 500mSv

13. Radiation exposure during Barium Swallow is?

0mSv 75mSv 150mSv 300mSV

14. Radiation exposure during ultrasound abdomen is?

0mSv 75mSv 150mSv 300mSv

15. Radiation exposure during MRI brain is?
0mSv 2mSv 100mSv 50mSv
16. Radiation exposure during MRI abdomen is?
0mSv 2mSv 100mSv 50mSv
17. Radiation exposure during MRI limbs is?
0mSv 2mSv 100mSv 50mSv
18. Radiation exposure during leg arteriogram is?
0mSv 2mSv 100mSv 50mSv
19. Radiation exposure during thyroid isotope scan is?
35mSv 50mSv 4mSv 40mSv
20. Radiation exposure during PET scan is?
100mSv 250mSv 0mSv 400mSv.