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An Examination of Radiation Protection Knowledge and Practices Among Cardiac Catheterization Laboratory Team Members: A Preliminary Cross-Sectional Study on Carcinogenesis Risk in Cardiology Professionals

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ABSTRACT

Background : Radiation protection is the cornerstone of radiography for securing radiation-based imaging procedures. The survey assessed the knowledge, attitude, and practices relating to radiation hazards and the preventive measures for ionizing radiation. Out of 200 participants, 141 were male and 59 were female, with a mean age of 35.43 ± 10.33 years, a range of 24–67. Data were analyzed using SPSS Statistics software, version 20. Our study utilizes a p-value threshold of 5% to determine the statistical significance of our findings. The inadequate knowledge level was 20% for interventional cardiologists, 39.3% for cardiac technologists, and 31.2% for scrub nurses. In contrast, the excellent knowledge level was 77.8% for interventional cardiologists, 28% for cardiac technologists, and 52.1% for scrub nurses. Radiation protection is

an important topic worldwide, and everyone needs to work together to raise awareness about it. The curriculum for cardiology professionals should include radiation protection courses to improve their understanding of radiation safety regulations and equip them to protect themselves from its potential health risks.,

Keywords: *Knowledge, Attitude, Radiation Protection, Interventional Radiology, Interventional Cardiology, Interventional Cardiologists, Cardiac technologists, and Scrub nurses, Radiation Safety, Radiation exposure.*

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1. INTRODUCTION

Medical imaging has become an essential component of modern medicine. The application of X-ray technology has been in use for over a century.[1] During its early days, there was a limited understanding of the potential risks associated with ionising radiation.[2] However, exposure to ionising radiation can have deleterious consequences on patients and medical personnel.[3] Depending on the duration of exposure, potential harm can vary, including an increased risk of cancer being a general concern.[4] In interventional cardiology, there has been a growing concern regarding radiation dosage in cardiac catheterisation procedures.[5] Interventional Cardiologists are particularly at risk of radiation exposure, making them the primary contributors to collective radiation doses in their field.[6] Other medical personnel, such as cardiac technologists, technicians, and nurses, are also susceptible to internal contamination, with technologists facing a particularly heightened risk.[7] With this in mind, it is crucial to implement radiation protection (RP) strategies, such as the "as low as reasonably achievable" (ALARA) principle, to minimise exposure to ionising radiation.[8] The primary principles for all medical imaging procedures include justification, optimisation, and dose limits.[9] The optimisation concept has undergone refinement owing to increasing knowledge about the effects of radiation.[10] Furthermore, to achieve this, technologists must possess exceptional skills and education to develop and implement innovative solutions that align with the established policies and regulations.

The exposure of individuals in operating rooms is a matter of major importance particularly from the personnel and patient safety perspective.[11] The World Health Organization (WHO) advocates the importance of continuous training and regular refresher courses and emphasises the need for specific training in interventional radiology and basic training. In agreement with the WHO, the International Commission on Radiological Protection (ICRP) highlights interventional procedures' complexity and operator dependency. It stresses the significance of adequate training in radiation protection (RP) clinical techniques and knowledge for individuals performing such examinations.[12] A comprehensive knowledge of radiation safety principles and their practical application is imperative for all healthcare professionals.[13] There are, however, several misconceptions surrounding radiation, which may instil fear and apprehension among individuals, ultimately leading to compromised patient care.[14] The level of awareness surrounding radiation protection has a significant impact on staff behaviour.[15] Inadequate knowledge about radiation safety can lead to unsafe actions and adverse consequences.[16]

In the present-day healthcare landscape, it has become increasingly evident that effective health service delivery requires a collective effort from a diverse range of healthcare professionals, including both clinical and non-clinical personnel. The traditional notion of doctors and nurses being solely responsible for healthcare delivery has shifted, and the current landscape now recognizes the importance of other healthcare professionals, historically referred to as paramedical staff, cardiovascular technologists, or Cardiovascular invasive specialist.[17] A cardiovascular invasive specialist is a healthcare professional who supports physicians in diagnosing and treating cardiovascular ailments. Their responsibilities include reviewing and analyzing patient medical records, operating and adjusting medical imaging equipment, preparing patients for cardiac catheterization and intervention, and interpreting imaging data to assist in diagnosing and treating cardiovascular conditions.[18] The present study analysed the current knowledge and practice of radiation safety among Cardiac Catheterization Laboratory Team Members **(Interventional Cardiologists, cardiovascular technologists and nurses)** to address the gap in knowledge and practice. Notably, knowledge and practice of radiation safety among Cardiac Cath Lab Team members must be standardised and mandated. Several surveys have been conducted among interventional radiologists in India to explore their views on the issue. However, there is a lack of studies on the awareness of radiation doses among Indian Cardiac Cath Lab Team members. Ensuring the safety of these stakeholders entails implementing appropriate measures that minimise the risk of radiation exposure. This study intends to bridge the lacuna in knowledge and practice of radiation safety among Cardiac Cath Lab Team members.

2. METHODOLOGY:

Study design and population:

The present cross-sectional study was conducted in 2023, focusing on Cardiac Cath Lab Team members employed at Private medical centers in India. The study's inclusion criteria encompassed Cardiac Cath Lab Team members with experience operating X-ray or fluoroscopy equipment in the cardiac catheterization laboratory for interventional procedures and holding at least one year of clinical experience. Participants who did not complete the questionnaire or had less than one year of clinical experience were excluded from the study. **(Figure 1)**.

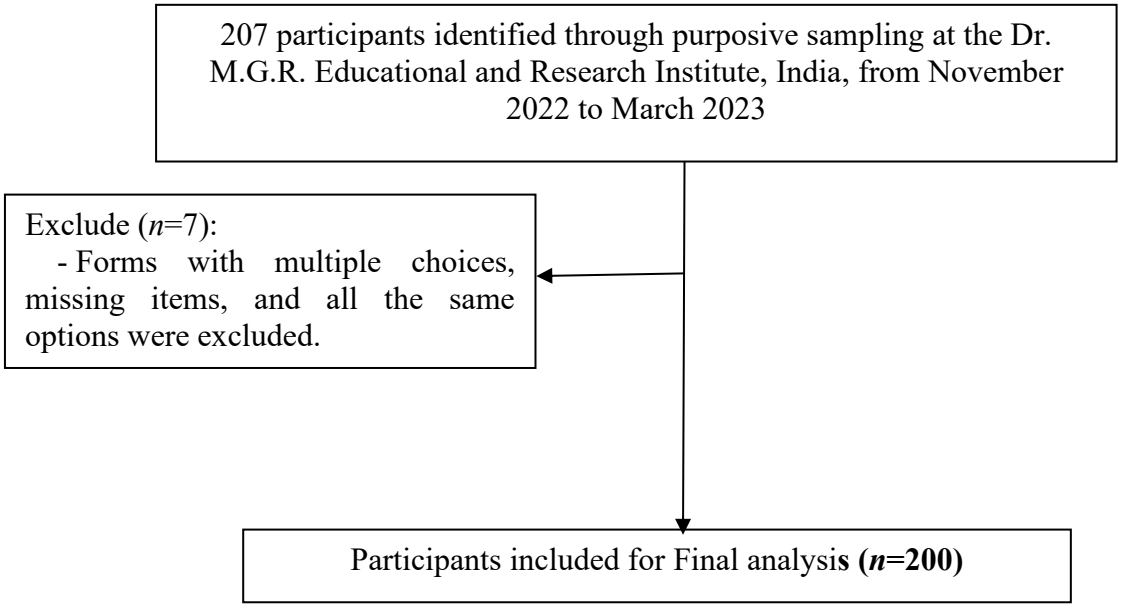

Figure: 1 – Illustration of the study design.

Sampling:

A study's required sample size was 200, with a 95% confidence level and a P value of less than or equal to 0.05, based on the formula $n=Z^2P(1-P)/d^2$ and following a similar study [19].

Data Collection:

The research study utilized online and offline survey questionnaires to gather responses from participants. The designated principal investigator distributed the offline version at a tertiary care hospital in and around Chennai, Tamil Nadu, India, and subjects were requested to provide written informed consent during data collection. The investigator collected the completed questionnaire forms from the respondents on-site. Meanwhile, the online survey was disseminated to cardiologists, Cardiovascular technologists and Scrub nurses through a telecommunications platform that combined the internet and telephone, leveraging popular social media networks such as WhatsApp and Facebook, as well as email.

Instrumentation:

The current research study obtained a survey questionnaire from a scholarly article by Uthirapathy, I. et al, C. Zervides. et al, [20,22]. The questionnaire comprised sixteen multiple-choice questions to evaluate participants' knowledge of radiation, safety practices, and demographic information.

Validity and reliability:

A panel of experts, including professors and scholars with master's degrees in Cardiovascular Technology, Psychology, Radiology Imaging and Science Technology, confirmed the content validity of the questionnaire. The Content Validity Ratio (CVR) and Content Validity Index (CVI) were also calculated, with results showing a CVR of 0.74 and a CVI of 0.79. Face validity was assessed by a group of forty cardiac cath lab team members who shared similar characteristics with the target population. Furthermore, the questionnaire's internal consistency (Cronbach's alpha) was determined, with each part of the questionnaire having a Cronbach's alpha greater than 0.77 based on the results.

Radiation knowledge, safety practices and Sociodemographic factors-related questionnaire:

The survey consisted of two distinct categories of questions. The first set of questions comprised six items that evaluated the participants' knowledge of radiation. Meanwhile, the second set of questions comprised ten items that assessed their comprehension of radiation safety measures. The radiation knowledge questions included topics such as the benefits of collimation, the most critical view during angiography, the frequency of machine calibration, the most valuable parameter for predicting radiation exposure, and the recommended dose limit for individuals exposed to radiation. Each correct

answer was assigned a "1" score, with no negative scoring for incorrect responses. The remaining ten questions focused on evaluating the level of understanding of radiation safety measures.

Statistical analysis :

The data analysis was done with great precision and accuracy, using the highly reliable and effective SPSS statistical software. The radiation protection knowledge was assessed appropriately and classified as inadequate if it fell below 60%, adequate if it ranged between 60-80%, and excellent if it was greater than or equal to 80%. The descriptive variables were analysed using means and standard deviations with utmost clarity and precision. The categorical variables were analysed using the widely accepted chi-square test to test for differences between groups. A p-value of ≤0.05 was used as a benchmark to determine statistical significance, further strengthening the analysis's reliability and validity.

Results:

Out of 200 participants, 141 were male, and 59 were female, with a mean age of 26.09 ± 7.18 years. The participants in the study consisted of three distinct categories based on their respective roles. The first category, comprising 22.5% of the total participants (n = 45), consisted of interventional cardiologists. The second category, the most populous, consisted of 53.5% of the total participants (n = 107) and was occupied by cardiac technologists. The third and final category, consisting of 24% of the total participants (n = 48), comprised scrub nurses (**Figure 2).**

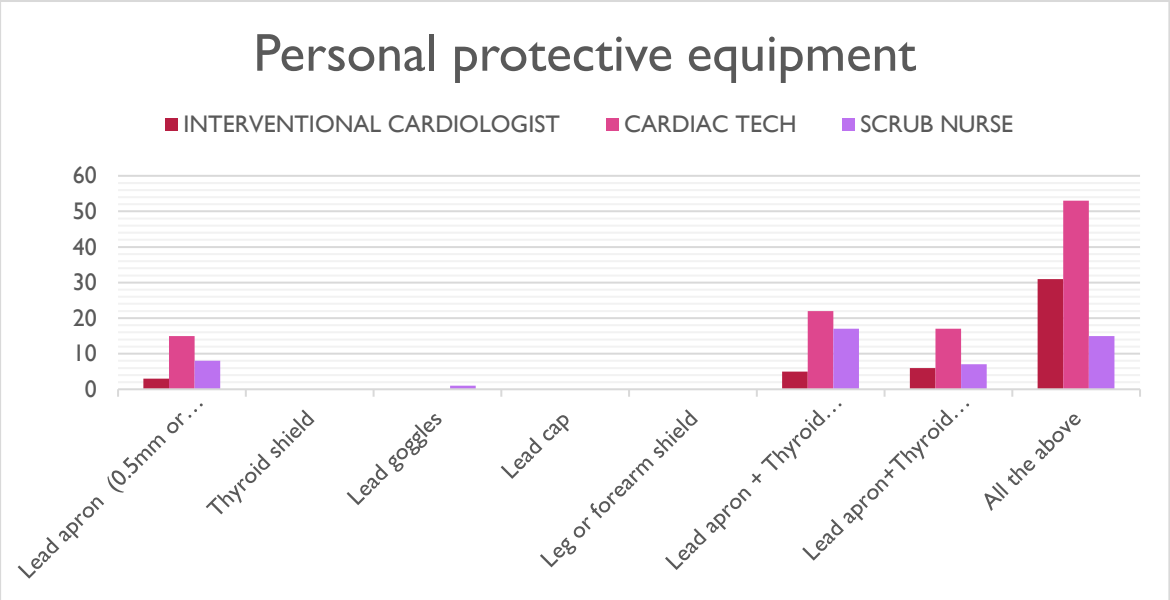

Figure 2: Personal protective equipment

Comprehensive Overview of Interventional Cardiologists:

Of the interventional cardiologists, 28 (62.2%) performed all interventional procedures. One cardiologist focused solely on diagnostic angiography, while another focused on structural interventions. Six cardiologists (13.3%) performed both coronary intervention and diagnostic angiography, two (4.4%) performed coronary intervention, diagnostic angiography, and electrophysiology study, and seven (15.6%) performed only coronary interventions.

Comprehensive Overview of Cardiac Technologists:

Fifty-two cardiac technologists, accounting for 48.6% of the sample, participated in every intervention procedure. Of the remaining cardiac technologists, 16 exclusively conducted diagnostic angiography, one solely performed structural interventions, and two conducted electrophysiology studies. Additionally, 1.9% of the technologists conducted both Coronary Intervention and Diagnostic Angiography, while the majority of the participants, 31.8%, performed coronary interventions.

Comprehensive Overview of Scrub Nurses:

A Present study on scrub nurses identified their level of involvement in interventional procedures. The study found that out of the total 48 participants, 15 scrub nurses (31.2%) were responsible for carrying out all interventional procedures. The remaining participants comprised subgroups based on their areas of expertise. Four scrub nurses were exclusively engaged in electrophysiology, whereas 14 performed only diagnostic angiography. One scrub nurse was involved solely in

structural interventions. Additionally, two scrub nurses (4.2%) were responsible for both coronary and diagnostic angiography, and one scrub nurse (2.1%) performed a coronary intervention, diagnostic angiography, and electrophysiology study. The study also provides detailed demographic information of all the participants, which is available in **Table 1.**

TABLE 1: Demographic Characteristics.

Variables	**INTERVENTIONAL CARDIOLOGIST**	**CARDIAC TECHNICIAN**	**SCRUB NURSE**	Pvalue
SEX				
Male	35(77.8%)	90(84.1%)	16(33.3%)	**0.00**
Female	10(22.2%)	17(15.9%)	32(66.7%)	
AGE, IN YEARS				
20-29	0(0.0%)	53(49.5%)	17(35.4%)	0.00
30-39	12(26.7%)	32(29.9%)	23(47.9%)	
40-49	18(40.0%)	20(18.7%)	5(10.4%)	
50-59	12(26.7%)	1(0.9%)	3(6.2%)	
≥60	3(6.7%)	1(0.9%)	0(0.0%)	
YEARS OF EXPERIENCE (IN YEARS)				
1	2(4.4%)	12(11.2%)	4(8.3%)	0.03
1-3	4(8.9%)	17(15.9%)	10(20.8%)	
3-5	3(6.7%)	17(8.5%)	8(16.7%)	
5-10	9(20.0%)	33(30.8%)	14(29.2%)	
10-20	21(46.7%)	24(22.4%)	10(20.8%)	
20-30	5(11.1%)	2(1.9%)	2(4.2%)	
>30	1(2.2%)	2(1.9%)	0(0.0%)	
LIST OF PROCEDURE				
Coronary Intervention	7(15.6%)	34(31.8%)	11(22.9%)	0.00
Diagnostic Angiography	1(2.2%)	16(15.0%)	14(29.2%)	
Electrophysiology Study	0(0.0%)	2(1.9%)	4(8.3%)	
Structural Intervention	1(2.2%)	1(0.9%)	1(2.1%)	
Coronary Intervention& Diagnostic Angiography	6(13.3%)	2(1.9%)	2(4.2%)	
Coronary Intervention, Diagnostic Angiography& Electrophysiology Study	2(4.4%)	0(0.0%)	1(2.1%)	
All the above	28(62.2%)	52(48.6%)	15(31.2%)	

The knowledge, attitude, and practice of healthcare workers regarding radiation safety in the cardiac catheterization laboratory:

According to the findings in **Tables 2 and 3**, interventional cardiologists demonstrate superior radiation safety knowledge and practice. The data shows that interventional cardiologists possess a significantly higher level of adequate knowledge, with only 20% having an inadequate knowledge level, compared to 39.3% for cardiac technologists and 31.2% for scrub nurses. Furthermore, the results reveal that interventional cardiologists have an excellent knowledge level of 77.8%, followed by scrub nurses with 52.1% and cardiac technologists with 28%. These results suggest that interventional cardiologists have a more comprehensive understanding of radiation safety knowledge and practice than other professionals involved in cardiac interventions (**Table 4)**.

TABLE 2: Knowledge and Safety practice by interventional cardiologists, cardiac technologists and Scrub nurses.

Knowledge based question	INTERVENTIONAL CARDIOLOGIST	CARDIAC TECHNICIAN	SCRUB NURSE	P value
1.Advantage of using collimation ?				0.00
A) Reduced area of exposure to the patient	4(8.9%)	18(16.8%)	7(14.5%)	
sB) Reduced scatter radiation to the operator and staff	0(0.0%)	17(15.8%)	3(6.2%)	
C) Improved quality of image	0(0.0%)	10(9.3%)	4(8.3%)	
D) all the above	41(91.1%)	62(57.9%)	34(70.8%)	
2. ---------- view was considered as the most hazardous for radiation exposure ?				0.00
A) LAO Cranial	42(93.3%)	55(51.4%)	31(64.5%)	
B) RAO Cranial	1(2.2%)	7(6.5%)	9(18.8%)	
C) LAO Caudal	2(4.4%)	32(29.9%)	6(12.5%)	
D) RAO Caudal	0(0.0%)	6(5.6%)	2(4.2%)	
E) Others	0(0.0%)	7(6.5%)	0(0.0%)	
3. Optimal frequency for equipment calibration (once in 6 months to one year) ?				0.61
A) Yes	35(77.8%)	79(73.8%)	33(68.8%)	
B) No	10(22.2%)	28(26.2%)	15(31.2%)	
4. -------- is the most useful predictor of radiation exposure to patient and the staff ?				0.00
A) Dose area product and Air Kerma compared to fluoroscopy time	38(84.4%)	48(44.9%)	28(58.3%)	
B) Air Kerma and fluoroscopy time compared to dose area product	5(11.1%)	24(22.4%)	9(18.8%)	
C) Dose area product and fluoroscopy time compared to Air Kerma	0(0.0%)	25(23.4%)	4(8.3%)	

D) others	2(4.4%)	10(9.3%)	7(14.6%)	
5.Annual occupational dose limits for cath lab personnel (International recommendations) ?				0.00
A) 20mSv/year averaged over defined periods of 5 years with no individual annual exposure to exceed 30 mSv	6(13.3%)	30(28.0%)	9(18.8%)	
B) Lens of the eye 100 mSv 5 years (20 mSv/year)	0(0.0%)	19(17.8%)	7(14.6%)	
C)Skin 500 mSv/year Hands and feet 500 mSv/year.	2(4.4%)	5(4.7%)	1(2.1%)	
D) all the above	37(82.2%)	53(49.5%)	31(64.5%)	
6 Use of PPE (Personal protective equipment)				0.01
A) Lead apron (0.5mm or 1.0mm)	3(6.7%)	15(14.0%)	8(16.7%)	
B) Thyroid shield	0(0.0%)	0(0.0%)	0(0.0%)	
C) Lead goggles	0(0.0%)	0(0.0%)	0(0.0%)	
D) Lead cap	0(0.0%)	0(0.0%)	1(2.1%)	
E) Leg or forearm shield	0(0.0%)	0(0.0%)	0(0.0%)	
F) Lead apron (0.5mm or 1.0mm) and Thyroid shield	5(11.1%)	22(20.6%)	17(35.4%)	
G) Lead apron (0.5mm or 1.0mm) and Thyroid shield and Lead cap	6(13.3%)	17(15.9%)	7(14.6%)	
H) All the above	31(68.9%)	53(49.5%)	15(31.2%)	

TABLE 3 Safety measures by interventional cardiologists, cardiac technologists and Scrub nurses.

Safety measures or techniques	**INTERVENTIONAL CARDIOLOGIST**	**CARDIAC TECHNICIAN**	**SCRUB NURSE**	**P value**
1)Low fluoroscopic mode				**0.81**
A) Always	**32(71.1%)**	**76(71.0%)**	**31(64.6%)**	
B) Occasionally	**13(28.9%)**	**29(27.1%)**	**16(33.3%)**	
C) Never	**0(0.0%)**	**2(1.9%)**	**1(2.1%)**	
2) Frame rate selection for fluoroscopy and cine angiography?				**0.17**
A) Always	**37(82.2%)**	**67(62.6%)**	**30(62.5%)**	
B) Occasionally	**7(15.6%)**	**37(34.6%)**	**16(33.3%)**	

C) Never	**1(2.2%)**	**3(2.8%)**	**2(4.2%)**	
3) Timely termination of cine recording?				**0.53**
A) Always	**37(82.2%)**	**79(73.8%)**	**33(68.8%)**	
B) Occasionally	**8(17.8%)**	**25(23.4%)**	**14(29.2%)**	
C) Never	**0(0.0%)**	**3(2.8%)**	**1(2.1%)**	
4) Collimation				**0.27**
A) Always	**38(84.4%)**	**92(86.0%)**	**36(75.0%)**	
B) Occasionally	**6(13.3%)**	**13(12.1%)**	**12(25.0%)**	
C) Never	**1(2.2%)**	**2(1.9%)**	**0(0.0%)**	
5) Moving away from X-ray unit?				**0.38**
A) Always	**35(77.8%)**	**76(71.0%)**	**32(66.7%)**	
B) Occasionally	**10(22.2%)**	**23(21.5%)**	**13(27.1%)**	
C) Never	**0(0.0%)**	**8(7.5%)**	**3(6.2%)**	
6) Positioning image detector closer to patient's chest?				**0.15**
A) Always	**41(91.1%)**	**92(86.0%)**	**37(77.1%)**	
B) Occasionally	**4(8.9%)**	**15(14.0%)**	**11(22.9%)**	
C) Never	**0(0.0%)**	**0(0.0%)**	**0(0.0%)**	
7) Proper use of table and ceiling mounted shields?				**0.00**
A) Always	**33(73.3%)**	**104(97.2%)**	**36(75.0%)**	
B) Occasionally	**9(20.0%)**	**3(2.8%)**	**11(22.9%)**	
C) Never	**3(6.7%)**	**0(0.0%)**	**1(2.1%)**	
8) Use of dosimeters/TLD badge?				**0.78**
A) Always	**39(86.7%)**	**96(89.7%)**	**40(83.3%)**	
B) Occasionally	**3(6.7%)**	**7(6.5%)**	**4(8.3%)**	
C) Never	**3(6.7%)**	**4(3.7%)**	**4(8.3%)**	
9) Follow up of dosimeter readings?				**0.01**
A) Always	**32(71.1%)**	**87(81.3%)**	**26(54.2%)**	

B) Occasionally	**10(22.2%)**	**16(15.0%)**	**17(35.4%)**	
C) Never	**3(6.7%)**	**4(3.7%)**	**5(10.4%)**	
10) Placement of dosimeter?				**0.29**
A)Chest underneath the lead apron	**32(71.1%)**	**85(79.4%)**	**32(66.6%)**	
B) Collar dosimeter	**10(22.2%)**	**15(14.0%)**	**9(18.8%)**	
C) Ring badge/fore arm dosimeter	**3(6.7%)**	**7(6.5%)**	**7(14.6%)**	

TABLE 4: knowledge level of interventional cardiologists, cardiac technologists and Scrub nurses with statistical significance.

SCORES	**INTERVENTIONAL CARDIOLOGIST (N=45) (%)**	**CARDIAC TECHNICIAN (N=107) (%)**	**SCRUB NURSE (N=48) (%)**	**P value**
INADEQUATE (<60%)	20%	39.3%	31.2%	**0.00**
ADEQUATE (60-80%)	2.2%	32.7%	16.7%	
EXCELLENT (80-100%)	77.8%	28%	52.1%	

3. DISCUSSION:

There is growing concern regarding the extent of knowledge, attitudes, and practices (KAP) about radiation hazards and protection in interventional cardiology practice in India. To our knowledge, no studies have been conducted in India to evaluate these concerns. The primary purpose of this research was to measure the level of radiation protection expertise among Cardiac Cath Lab Team members employed in an Indian tertiary care hospital. Previously, I. Uthirapathy, P. Dorairaj, S. Ravi, et al. [20] also carried out a similar study, which resulted in limited knowledge among cardiologists who participated in the study. In this study, only 77.8% of interventional cardiologists had excellent expertise regarding radiation protection, compared to 28% of cardiac technologists and 52.1% of scrub nurses. The study's outcomes indicate a pressing need for greater awareness among cardiovascular technologists regarding the importance of radiation protection. The research highlights that cardiovascular technologists must significantly enhance their understanding of radiation safety concerns to ensure the well-being of patients and themselves. Further, the results suggest that incorporating radiation protection subjects into the undergraduate curriculum of cardiovascular technologists is vital. This would enable them to acquire both theoretical and practical knowledge in the field and effectively implement radiation protection measures in their practice.

The results of a recent study on radiation protection knowledge revealed that participants demonstrated deficiencies in their understanding of critical concepts. The study revealed that the participants possessed limited awareness regarding the most hazardous projection or view employed for visualization of coronary arteries, as well as the most helpful parameter for quantifying radiation exposure to both the patient and the staff. Furthermore, there needed to be more knowledge regarding the ALARA principle, the annual occupational dose limits for cath lab personnel, and the correct use of radiation protective equipment during cardiac catheterization. Such knowledge gaps could have severe implications for the well-being of patients and staff, underscoring the importance of targeted educational initiatives to address these deficiencies.

It is recommended that medical and health workers undergo in-service training that includes up-to-date research documents, appropriate radiation protection protocols, and compulsory training guidelines [21]. Further research is necessary to determine the specific dose limits for radiation therapy, and the safety of healthcare workers must be considered when

implementing national protection legislation [22]. According to the KAR-RAD study, the use of low-dose radiation (7.5 frames per second) instead of standard-dose radiation (10 frames per second) led to a significant reduction in the dose area product (723.60 mGy/m2 [IQR, 313.09e2328.22 mGy/m2] vs. 5203.40 mGy/m2 [IQR, 2743.55e10064.71 mGy/m2; P-0.001]). No significant change was observed in the contrast dose or fluoroscopy time [23]. According to the data analysis, the safety practices of participants about radiation protection and hazards were evaluated. The present study reveals that interventional cardiologists frequently used low fluoroscopy mode and frame rate selection (71.1% and 82.2%, respectively), while 28.9% and 15.6% used them only occasionally. Likewise, cardiac technologists often utilized low fluoroscopy mode and frame rate selection (71% and 62.6%, respectively), while 27.1% and 34.6% used them only occasionally. Additionally, 64.6% of scrub nurses employed low fluoroscopy mode, 62.5% used frame rate selection regularly, and 33.3% used it only occasionally. These findings suggest that only a few cardiac invasive specialists adhere to established safety protocols in their respective fields.

The information presented in **Figures 3, 4, and 5** shows inconsistencies in implementing radiation safety protocols in the cardiac catheterization laboratory. Medical professionals frequently employ Collimation, a technique that utilizes a lead shield within the X-ray tube housing to reduce the aperture of the X-ray source to minimize radiation exposure.[24] However, a recent assessment of the frequency of collimation use indicates that many cardiologists, cardiovascular technologists, and scrub nurses still need to adopt this practice. Specifically, the study reveals that only 84.4% of cardiologists, 86% of cardiovascular technologists, and 75% of scrub nurses utilize Collimation. Additionally, the study found that while most cardiologists (91.1%) know Collimation, only a small percentage (84.4%) practice it routinely. These findings highlight a significant disparity in knowledge and practice among medical professionals. Therefore, it is imperative to increase awareness and provide training on the importance and benefits of Collimation, especially for those who have yet to adopt this technique.

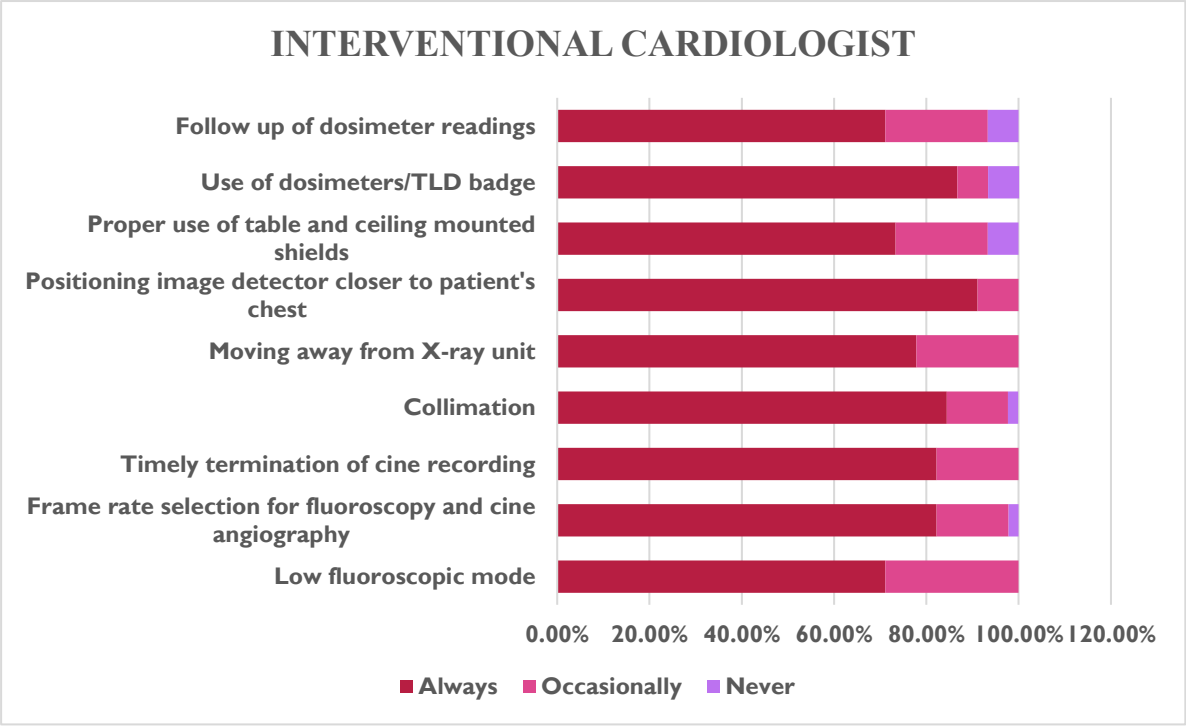

Figure 3: The uniformity of radiation safety measures used by interventional cardiologists.

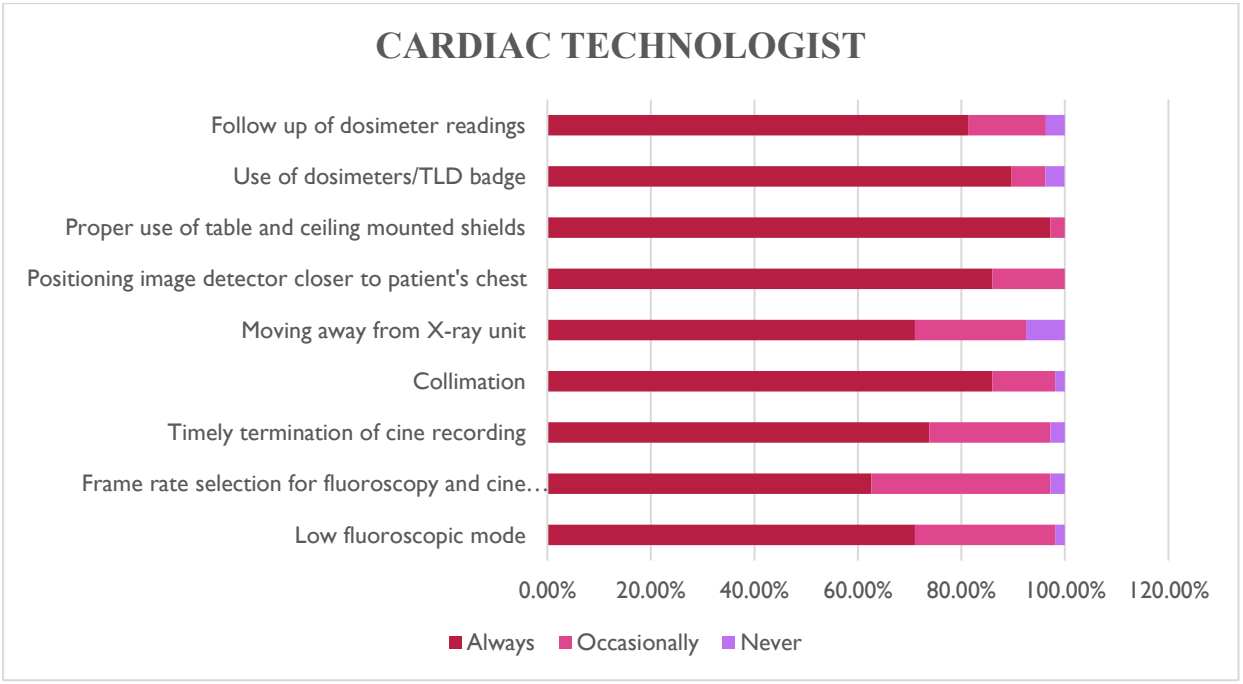

Figure 4: The uniformity of radiation safety measures used by cardiac technologists.

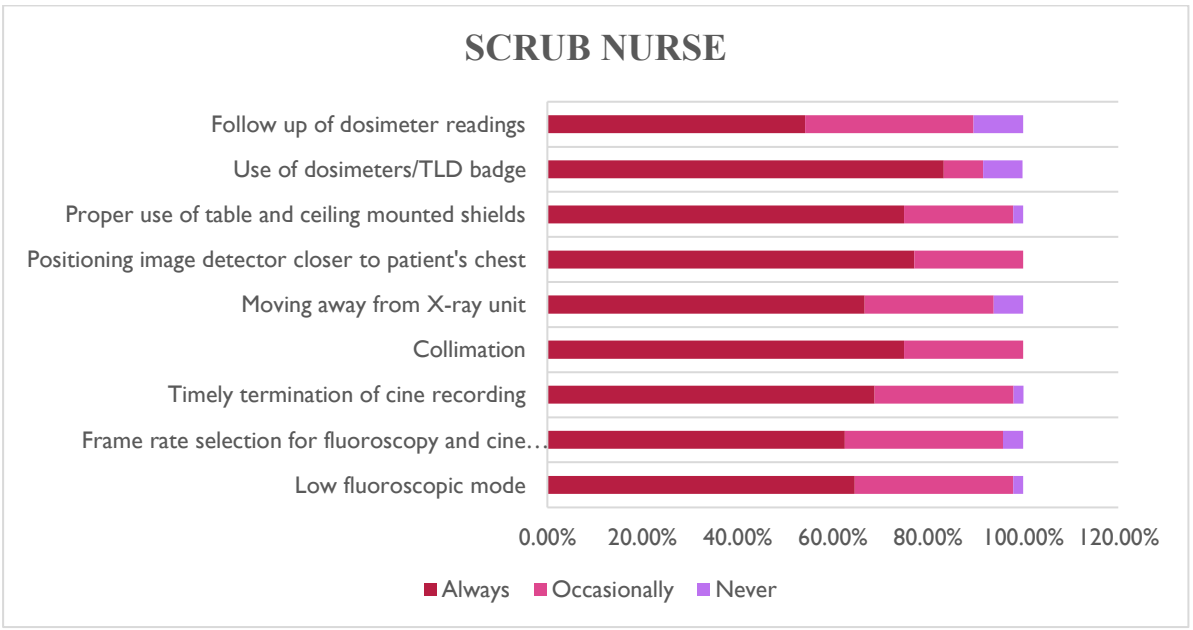

Figure 5: The uniformity of radiation safety measures used by scrub nurses

The assessment of radiation protection perception for X-rays has highlighted a notable area for improvement in the information available regarding the optimal frequency for equipment calibration. The catheterization laboratory must be regularly calibrated every 6 to 12 months because X-ray tube leaks increase radiation exposure.[25] Our research indicates that 77.8% of cardiologists, 73.8% of cardiovascular technologists, and 68.8% of scrub nurses agreed that equipment calibration must be every six months to a year. These findings highlight the need for greater clarity and consensus in the industry regarding optimal calibration frequencies to ensure adequate radiation protection measures are in place.

According to the Atomic Energy Regulatory Board (AERB), the whole-body dose limit is 20 mSv/year, averaged over five years, or 30 mSv in one year. Additionally, the equivalent dose for the lens is 150 mSv/year, and the equivalent dose for the skin and extremities is 500 mSv/year [26]. Based on our recent research, it has been found that a significant percentage of medical personnel working within cath labs adhere to the annual occupational dose limits as outlined by the International

recommendations. Expressly, 82.2% of cardiologists, 49.5% of cardiovascular technologists, and 64.5% of scrub nurses have agreed with these guidelines. In our study, we found that 68.9%, 49.5%, and 31.2% of cardiologists, cardiac technologists, and scrub nurses, respectively, routinely used all types of personal protective equipment (including lead aprons, thyroid shields, lead caps, lead goggles, and leg or forearm shields). However, some cardiovascular invasive specialists do not use personal protective equipment due to its unavailability or other reasons such as its weight or being used by others.

The following issues were identified as limitations of this study:

The study has certain limitations, particularly the small number of respondents and the need for more availability of the radiation exposure dose that can be linked to radiation safety knowledge. Future follow-up studies on radiation safety and practices involving more respondents are planned for upcoming conferences to address these limitations.

4. CONCLUSION:

We imply that mandatory training for Cardiac Cath Lab Team members, particularly cardiac technologists and scrub nurses, should include radiation protection and safety training. Radiation protection is an important topic worldwide, and everyone needs to work together to raise awareness about it. The curriculum for cardiovascular invasive specialists should include radiation protection courses to improve their understanding of radiation safety regulations and equip them to protect themselves from potential health risks such as cancer. Standardizing radiation safety and training among cardiovascular invasive specialists is essential in India.

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