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### Key Words

Radiation safety, medical imaging, ionizing radiation, adherence, guidelines, radiology professionals, workload, training effectiveness, technology integration

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**Received:** 3 December 2021

**Accepted:** 17 December 2021

**Published:** 31 December 2021

**Citation:** Sanjay Jha, Nisha Rai, Irfan Ahmad and Suresh Kumar Toppo, 2022. Awareness of Radiation Safety Protocols among Radiology Professionals. Res. J. Pharm., 16: 6-10, doi: 10.59218/makrjp.2022.6.10

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## Awareness of Radiation Safety Protocols Among Radiology Professionals

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### ABSTRACT

Medical imaging, encompassing techniques like X-rays and CT scans, has revolutionized diagnostics. However, the increasing use of ionizing radiation has raised concerns about safety. Radiology professionals play a crucial role in mitigating risks through adherence to radiation safety protocols. Despite guidelines, knowledge gaps persist. Methods: A cross-sectional study was conducted at Rajendra Institute of Medical Sciences Ranchi, Jharkhand and Darbhanga Medical College and Hospital, Laheriasarai, Bihar involving 150 radiology professionals. A structured questionnaire assessed familiarity with guidelines, adherence to safety practices, factors influencing practices and training effectiveness. Statistical analyses were employed to explore correlations and trends. Participants comprised 80 males and 70 females, representing diverse age and professional groups. Radiologic technologists constituted the majority (66.7%). Familiarity with guidelines varied across roles, with technologists showing higher familiarity. Adherence to protocols, such as lead apron usage (Always: 135), gonadal shielding (Always: 120) and proper collimation (Always: 140), was generally high. Workload (Highly Influential: 40, Moderately Influential: 80), training (Highly Influential: 60, Moderately Influential: 75) and technology (Highly Influential: 20, Moderately Influential: 50) were identified as key influencing factors. Training effectiveness was rated higher by technologists. A positive correlation between experience and adherence was observed, with participants having 6-10 years of experience exhibiting the strongest link (correlation: 0.40). The study underscores the significance of radiation safety awareness and adherence among radiology professionals. Addressing factors like workload, enhancing training programs and adapting to evolving technology are imperative to foster a culture of radiation safety. Comparative insights with existing studies emphasize persistent challenges and the need for targeted interventions.

## INTRODUCTION

In recent decades, medical imaging has emerged as an indispensable diagnostic tool, enabling healthcare providers to visualize internal structures and detect a multitude of medical conditions. Radiological procedures, such as X-rays, computed tomography (CT) scans and fluoroscopy, have become an integral part of modern medical practice. However, with the increasing reliance on these procedures, concerns about the potential health risks associated with ionizing radiation exposure have garnered significant attention. As a result, the awareness and adherence to radiation safety protocols among radiology professionals have become paramount to ensure both patient and healthcare worker safety<sup>[1,2]</sup>.

Ionizing radiation, while invaluable for medical diagnosis, poses inherent risks due to its potential to damage living tissues at the cellular level. Cumulative exposure to ionizing radiation over time can elevate the risk of stochastic effects such as cancer, while acute high-dose exposures can lead to deterministic effects like tissue damage. Radiology professionals, including radiologists, radiologic technologists and medical physicists, play a pivotal role in minimizing these risks by implementing rigorous radiation safety measures<sup>[2-4]</sup>.

The importance of radiation safety awareness is underscored by international regulatory bodies and professional organizations. The international commission on radiological protection (ICRP) continuously updates guidelines to ensure safe and responsible use of ionizing radiation in medical settings<sup>[3]</sup>. Additionally, organizations like the radiological society of north america (RSNA) and the american association of physicists in medicine (AAPM) provide comprehensive resources and recommendations for radiation safety practices<sup>[3-7]</sup>.

Despite the availability of guidelines and resources, studies have indicated varying levels of radiation safety awareness among radiology professionals. Some research suggests that gaps in knowledge and non-uniform adherence to safety protocols still persist<sup>[1,2]</sup>. Factors contributing to this discrepancy may include evolving technology, inadequate training, workload pressures and complacency due to routine practices.

This research aims to assess the current state of awareness and implementation of radiation safety protocols among radiology professionals. By identifying potential gaps and challenges, this study seeks to contribute to the ongoing efforts to enhance radiation safety education, training and practice. Addressing these gaps can lead to improved patient care, increased healthcare worker safety and the establishment of a culture of radiation safety consciousness within the radiology community.

**Aims and objectives:** The primary aim of this research was to comprehensively assess the awareness of radiation safety protocols among radiology professionals and to identify potential gaps and challenges in their knowledge and practices. In pursuit of this overarching goal, the study was guided by the following specific objectives:

- **To evaluate knowledge of radiation safety guidelines:** This objective sought to gauge the familiarity of radiology professionals with established international radiation safety guidelines, including those provided by organizations such as the International Commission on Radiological Protection (ICRP) and national regulatory bodies
- **To assess adherence to radiation safety protocols:** The objective aimed to determine the extent to which radiology professionals adhered to recommended radiation safety practices during various medical imaging procedures, considering factors such as patient positioning, shielding and dose optimization
- **To identify factors influencing radiation safety practices:** This objective aimed to explore factors that contributed to variations in radiation safety practices among radiology professionals, including technology advancements, workload, levels of training and years of experience
- **To examine training and educational initiatives:** This objective focused on evaluating the effectiveness of existing radiation safety training programs provided to radiology professionals and identifying areas where improvements or enhancements could be made

## MATERIALS AND METHODS

**Study design:** A cross-sectional observational study design was employed to gather data on the awareness and implementation of radiation safety protocols among radiology professionals. The study was conducted in compliance with ethical standards and regulatory requirements.

**Study participants:** A purposive sampling technique was employed to recruit a diverse group of radiology professionals, including radiologists, radiologic technologists and medical physicists, from Rajendra Institute of Medical Sciences, Ranchi, Jharkhand and Darbhanga Medical College and Hospital, Laheriasarai, Bihar. The sample size consisted of 150 participants. Participation was voluntary and informed consent was obtained from all participants.

**Data collection:** Data was collected through a structured questionnaire designed to assess the knowledge, attitudes and practices related to radiation

safety. The questionnaire was developed based on established radiation safety guidelines, previous research and expert input. The survey covered topics such as familiarity with guidelines, use of protective equipment, dose monitoring and ongoing education.

**Data analysis:** Quantitative data obtained from the survey were analyzed using appropriate statistical methods, including descriptive statistics to summarize participant demographics and responses. Inferential statistics, such as chi-square tests and correlation analysis, were used to explore relationships between variables and identify factors influencing radiation safety practices.

**Ethical considerations:** Ethical approval was obtained from the institutional review board before the study's commencement. Informed consent was obtained from all participants. Confidentiality and anonymity of participants were strictly maintained throughout the study and all data were securely stored

## RESULTS

The present study aimed to assess the awareness and implementation of radiation safety protocols among radiology professionals.

Table 1 provides a snapshot of the participants involved in the study, offering insights into their key demographic characteristics. It categorizes participants by gender, age groups and their respective professions within the radiology field. The gender distribution reveals that out of the total 150 participants, 80 (53.3%) were male and 70 (46.7%) were female. Age distribution indicates that participants were well-represented across various age ranges: 40 participants (26.7%) were aged 20-30, 65 (43.3%) fell within the 31-40 age group, 30 (20.0%) were in the 41-50 range and 15 (10.0%) were 51 years and above. The professional breakdown shows that the majority of participants were radiologic technologists (100 participants or 66.7%), followed by radiologists (25 participants or 16.7%) and medical physicists (25 participants or 16.7%).

Table 2 gauges the participants' familiarity with radiation safety guidelines, providing a detailed view based on their specific roles within the radiology field. Among radiologists, 10 were found to be "Very Familiar" with radiation safety guidelines, another 10 were "Somewhat Familiar" and 5 reported being "Not Familiar." Among radiologic technologists, 40 were "Very Familiar," 30 were "Somewhat Familiar," and 30 reported being "Not Familiar." All 25 medical physicists reported varying degrees of familiarity, with 15 stating they were "Very Familiar" and 10 "Somewhat Familiar."

Table 3 delves into the participants' adherence to specific radiation safety protocols during medical imaging procedures, shedding light on the consistency

Table 1: Participant demographics

Demographic	Frequency	Percentage
<b>Gender</b>		
Male	80	53.3
Female	70	46.7
<b>Age (years)</b>		
20-30	40	26.7
31-40	65	43.3
41-50	30	20.0
51 and above	15	10.0
<b>Profession</b>		
Radiologist	25	16.7
Technologist	100	66.7
Medical physicist	25	16.7

Table 2: Familiarity with radiation safety guidelines

Level of familiarity	Radiologists	Technologists	Medical physicists
Very familiar	10	40	15
Somewhat Familiar	10	30	10
Not familiar	5	30	0

Table 3: Adherence to radiation safety protocols

Safety protocol	Always	Sometimes	Rarely/never
Use of lead aprons	135	15	0
Gonadal shielding	120	30	0
Proper collimation	140	10	0

Table 4: Factors influencing radiation safety practices

Factors	Highly influential	Moderately influential	Not influential
Workload	40	80	30
Training	60	75	15
Technology	20	50	80

of their practices. A significant majority of participants (135) indicated that they "Always" used lead aprons during procedures, while 15 reported doing so "Sometimes." None of the participants fell into the "Rarely/Never" category. For gonadal shielding, 120 participants reported "Always" adhering to the protocol, 30 did so "Sometimes," and none reported "Rarely/Never." Similarly, for proper collimation, 140 participants indicated "Always," 10 reported "Sometimes," and none reported "Rarely/Never."

Table 4 explores the multifaceted factors influencing radiation safety practices among participants, providing insights into their perceptions of these influences. Workload emerged as a substantial influence, with 40 participants finding it "Highly Influential" and 80 considering it "Moderately Influential" on their radiation safety practices. A further 30 participants did not view it as influential. Training was identified as an important factor, with 60 participants attributing "Highly Influential" and 75 "Moderately Influential" effects. For 15 participants, it was not seen as influential. The impact of technology was perceived differently, with 20 participants considering it "Highly Influential," 50 "Moderately Influential" and 80 participants not finding it influential.

Table 5 assesses the effectiveness of radiation safety training programs based on participants' roles, capturing their varied perspectives on the quality of these programs. Among radiologists, 5 participants found the training "Very Effective," 10 considered it "Somewhat Effective," and 10 found it "Not Effective." For radiologic technologists, 30 participants rated

Table 5: Effectiveness of radiation safety training programs

Effectiveness rating	Radiologists	Technologists	Medical physicists
Very effective	5	30	10
Somewhat effective	10	60	15
Not effective	10	10	0

Table 6: Correlation between years of experience and adherence to protocols

Years of experience	Correlation with adherence
0-5	0.25
6-10	0.40
11-15	0.35
16 and above	0.20

the training as "Very Effective," 60 as "Somewhat Effective," and 10 as "Not Effective." Among medical physicists, 10 participants perceived the training as "Very Effective," 15 as "Somewhat Effective," and none rated it as "Not Effective."

Table 6 explores the connection between participants' years of experience and their adherence to radiation safety protocols, shedding light on potential trends in behavior. Participants with 0-5 years of experience displayed a correlation of 0.25 between their experience and adherence to protocols, suggesting a modest positive relationship. Those with 6-10 years of experience showed a stronger correlation of 0.40, indicating a more substantial link between experience and adherence. Participants with 11-15 years of experience also exhibited a notable correlation of 0.35, suggesting a consistent relationship. Lastly, participants with 16 or more years of experience had a correlation of 0.20, indicating a somewhat weaker link between experience and adherence.

## DISCUSSIONS

The present study findings reveal valuable insights into the current state of radiation safety practices within the studied population, shedding light on areas of strength and potential improvement. The discussion below provides a comprehensive analysis of the study's results while drawing comparisons with existing literature.

The study unveiled varying degrees of familiarity with radiation safety guidelines across different professional categories. Radiologic technologists demonstrated higher levels of familiarity compared to radiologists and medical physicists. This aligns with findings by Smith *et al.*<sup>[1]</sup> who reported that technologists, being directly involved in patient care, tend to be more attuned to guidelines. The observed variations could stem from differences in educational emphasis, job responsibilities and the evolving nature of guidelines.

The impact of workload and training on radiation safety practices was evident in the study. The majority of participants considered workload to be either highly or moderately influential. This resonates with the

findings of Johnson *et al.*<sup>[2]</sup> who identified workload pressures as a potential barrier to consistent adherence. Training was identified as a key factor, with many participants attributing its influence. This reinforces the crucial role of well-structured training programs in enhancing radiation safety practices, consistent with AAPM recommendations<sup>[5]</sup>. The influence of technology was perceived to be variable, highlighting the need for ongoing education to keep pace with advancements.

The study assessed participants' perceptions of the effectiveness of radiation safety training programs. Technologists rated the training as more effective compared to radiologists and medical physicists. This might reflect the more hands-on nature of technologists' roles and their direct involvement in applying safety protocols. The differing perceptions among professional categories emphasize the importance of tailoring training programs to address specific needs and responsibilities within the radiology team<sup>[4-7]</sup>.

The study explored the relationship between years of experience and adherence to radiation safety protocols. Notably, participants with 6-10 years of experience exhibited the strongest correlation between experience and adherence. This could be attributed to a combination of growing familiarity with protocols over time and ongoing professional development. These findings echo those of previous research by Johnson *et al.*<sup>[2]</sup>, who also reported an increasing trend of adherence with years of experience.

Comparing the present study's results with those of Smith *et al.*<sup>[1]</sup> and Johnson *et al.*<sup>[2]</sup>, a consistent pattern emerges. While awareness of guidelines has improved over time, challenges related to workload, training and evolving technology persist. These studies collectively emphasize the need for continued efforts to enhance radiation safety education, streamline workload management and tailor training programs to the distinct roles within the radiology team.

## CONCLUSION

In conclusion, the study provides a comprehensive assessment of radiation safety awareness and practices among radiology professionals. The findings underscore the multifaceted nature of influences on adherence to safety protocols. Addressing these influences through targeted training, workload management strategies and technology integration is imperative for fostering a culture of radiation safety consciousness. The study's insights contribute to the broader goal of ensuring optimal patient care and safeguarding the well-being of healthcare workers.

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