A QUALITATIVE STUDY ON THE KNOWLEDGE AND PRACTICE OF RADIATION PROTECTION AMONG MEDICAL STUDENTS

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ABSTRACT
Radiation has become an indispensable component of modern healthcare, particularly in diagnostic imaging and interventional procedures such as X-ray, computed tomography (CT), and fluoroscopy. While these modalities significantly enhance diagnostic accuracy and patient outcomes, they also expose healthcare workers and patients to ionizing radiation, which carries potential biological risks. Medical and radiation technology students, who are actively involved in clinical training, are particularly vulnerable to occupational radiation exposure due to their frequent interaction with imaging equipment and procedures.
The present study was conducted to assess the level of knowledge and practices related to radiation protection among medical students and to identify gaps in their understanding and clinical application of safety measures. A cross-sectional, questionnaire-based study was carried out among 150 students undergoing academic and clinical training. Data were collected using a structured questionnaire consisting of 25 multiple-choice questions designed to evaluate knowledge of radiation safety principles, biological effects, dose limits, ALARA concept, personal protective equipment, and practical safety measures in clinical settings.
The results revealed that students demonstrated an overall moderate to good level of knowledge, with an average correct response rate of 79.86%. Strong performance was observed in areas such as fundamental radiation safety concepts, awareness of hazards, and the use of protective equipment. However, notable deficiencies were identified in fluoroscopy safety, shielding techniques, and dose optimization practices, indicating a significant gap between theoretical knowledge and practical implementation.
The findings of this study highlight the need for strengthening radiation safety education by incorporating practical training, simulation-based learning, and structured clinical supervision. Enhancing these aspects will improve competency, reduce unnecessary radiation exposure, and promote a culture of safety in healthcare settings.

Keywords: Radiation protection, ALARA principle, radiation safety, medical students, fluoroscopy, occupational exposure

INTRODUCTION
Ionizing radiation plays a pivotal role in contemporary medical practice, particularly in diagnostic imaging and interventional radiology. Techniques such as X-ray radiography, computed tomography (CT), and fluoroscopy have revolutionized disease diagnosis and management by providing detailed anatomical and functional information. However, the increasing reliance on these modalities has also raised concerns regarding radiation exposure and its associated risks.
Exposure to ionizing radiation can lead to both deterministic and stochastic effects. Deterministic effects, such as skin erythema, cataracts, and tissue damage, occur above certain threshold doses, whereas stochastic effects, including cancer and genetic mutations, may occur even at low levels of exposure without a defined threshold. These risks highlight the importance of strict adherence to radiation protection principles in clinical practice.

Medical students and radiation technology trainees are an essential part of the healthcare system and are frequently exposed to radiation during their clinical training. Their involvement in patient positioning, operation of imaging equipment, and assistance during procedures places them at increased risk of occupational exposure. Therefore, it is imperative that they possess adequate knowledge and practical skills in radiation protection to ensure both personal safety and patient care.

The fundamental principles of radiation protection include justification of procedures, optimization of radiation dose, and adherence to dose limits. Among these, the ALARA (As Low As Reasonably Achievable) principle is central to minimizing radiation exposure while maintaining diagnostic efficacy. Additional protective measures include the use of personal protective equipment such as lead aprons, thyroid shields, lead glasses, and the implementation of shielding barriers.

Despite the availability of international guidelines and safety protocols, studies have consistently reported variability in knowledge, awareness, and compliance among healthcare students and professionals. A major concern is the gap between theoretical knowledge and its practical application in clinical settings. Students often receive adequate theoretical instruction but lack sufficient opportunities to apply this knowledge effectively during real-world procedures.

The present study aims to evaluate the current level of knowledge and practices related to radiation protection among medical students and to identify areas requiring improvement. By addressing these gaps, the study seeks to contribute to the development of more effective educational strategies and promote a safer clinical environment.

MATERIALS AND METHODS

The present study was designed as a descriptive cross-sectional survey aimed at assessing the knowledge and practices of radiation protection among medical students. The study was conducted in institutions offering medical and radiation technology programs, including affiliated hospitals where students undergo clinical training.

A total of 150 students were included in the study. Participants were selected using a convenience sampling method based on their availability and willingness to participate. Students from different academic years were included to obtain a comprehensive understanding of knowledge progression and variation across levels of training.

Data were collected using a structured questionnaire consisting of 25 multiple-choice questions. The questionnaire was developed based on standard radiation protection guidelines and previously published studies. It was designed to evaluate multiple domains, including basic concepts of radiation, biological effects, radiation dose limits, ALARA principle, awareness of safety protocols, use of personal protective equipment, and practical application of radiation protection measures in clinical settings.

Prior to data collection, participants were informed about the purpose and objectives of the study, and informed consent was obtained. Confidentiality and anonymity were strictly maintained, and no personal identifiers were recorded. Participants were given sufficient time to complete the questionnaire independently to ensure unbiased responses.

The collected data were entered into statistical software and analyzed using descriptive statistical methods. Frequencies and percentages were calculated for each question, and the overall mean knowledge score was determined. Knowledge levels were categorized as good (≥75% correct responses), moderate (50–74%), and poor (<50%).

RESULTS

A total of 150 students participated in the study, representing different academic levels and clinical exposure. The analysis of responses revealed that the overall average correct response rate was 79.86%, indicating a moderate to good level of knowledge regarding radiation protection.

Students demonstrated strong understanding in several key areas. These included identification of different types of radiation used in medical imaging, awareness of radiation hazards, understanding of the ALARA principle, and knowledge of personal protective equipment such as lead aprons and thyroid

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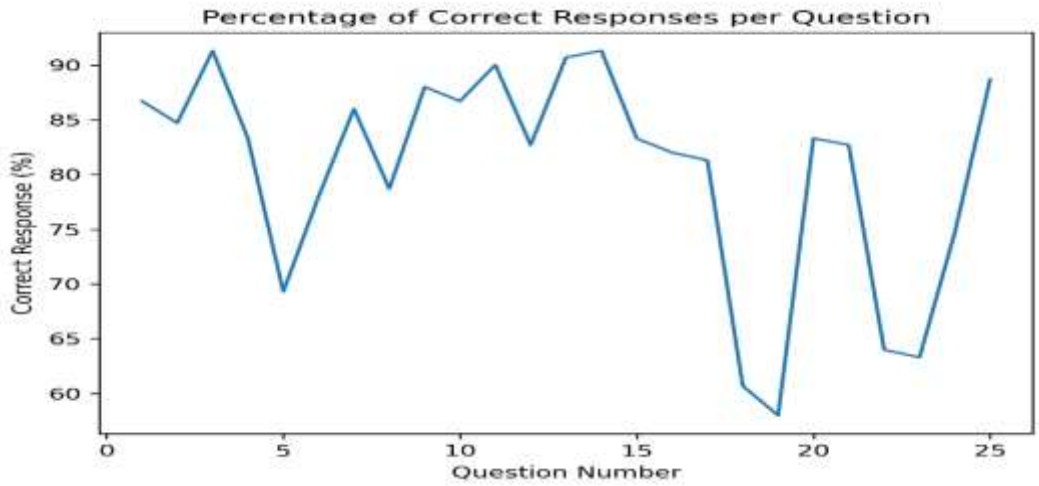
shields. Additionally, most students were aware of radiation monitoring devices such as thermoluminescent dosimeters (TLDs) and the importance of radiation warning signs.

Despite these strengths, certain areas showed relatively lower performance. Questions related to fluoroscopy safety, shielding practices, and dose optimization received lower correct response rates. Students demonstrated limited understanding of continuous radiation exposure during fluoroscopy and the importance of minimizing exposure time and maintaining appropriate distance.

Furthermore, gaps were observed in the practical application of radiation protection measures. While students were aware of safety principles in theory, their ability to apply these principles effectively in clinical scenarios appeared to be limited.

Overall, the results highlight a discrepancy between theoretical knowledge and practical competency, indicating the need for enhanced training and education.

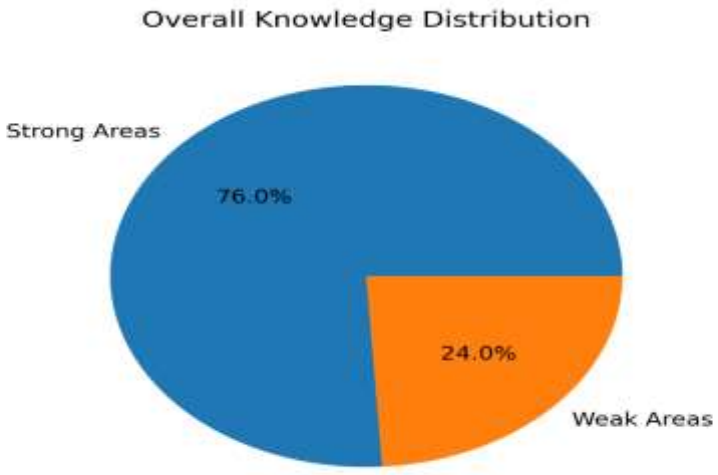
Figure 1: Student Performance



Caption:

Figure 1. Percentage of correct responses for each question, showing overall student performance in radiation protection knowledge.

Figure 2: Knowledge Distribution



Caption:

Figure 2. Distribution of strong and weak knowledge areas among students based on performance thresholds.

Figure 3: Strength vs Weakness Bar Graph (journal standard)

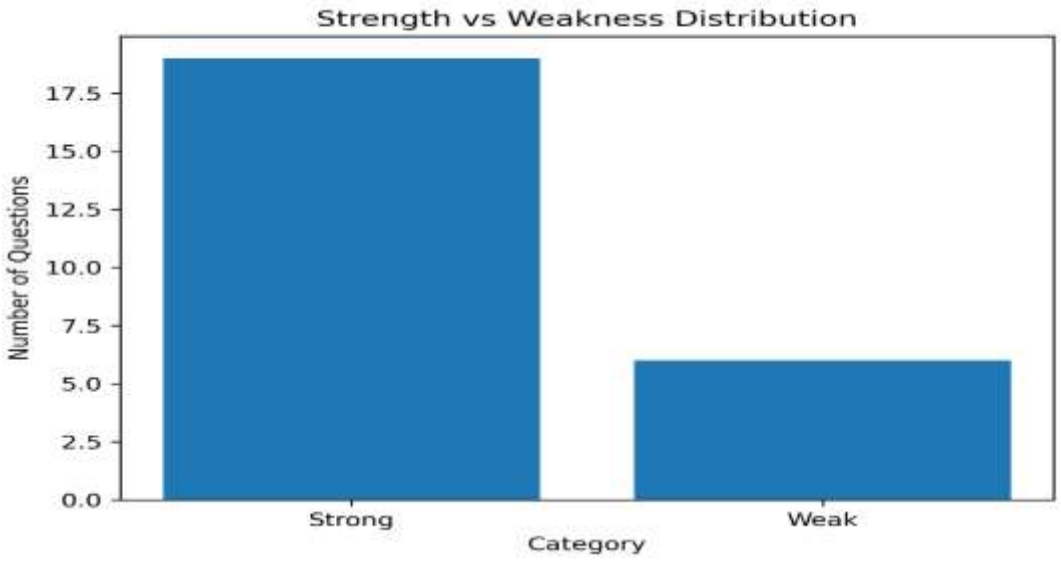


Figure 3: Strength vs Weakness Bar Graph (journal standard) Figure 4: Topic-wise performance analysis

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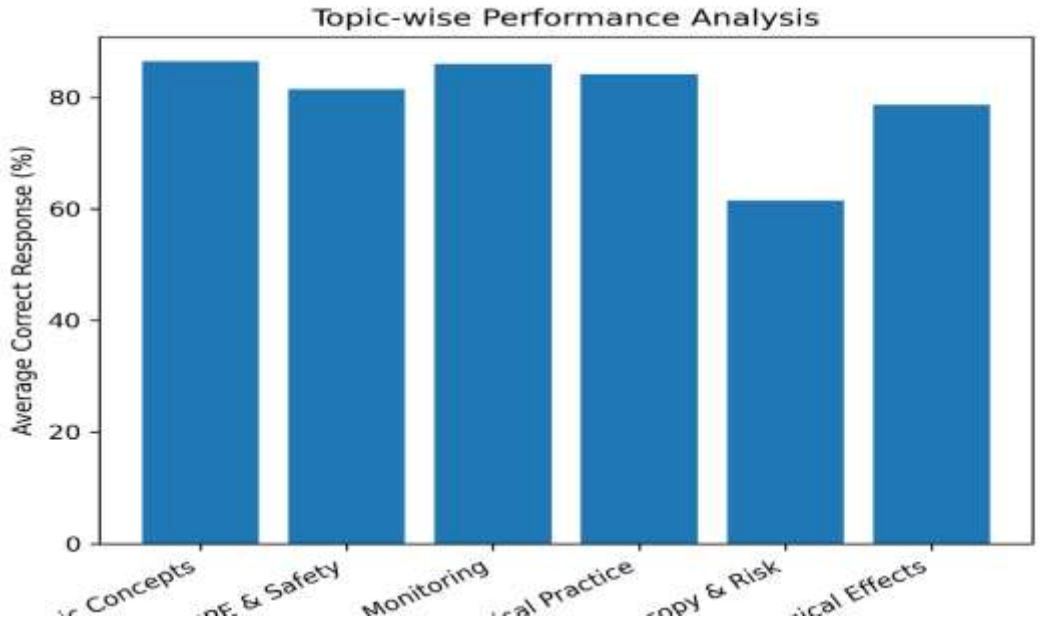

Figure 4

Figure 4. Topic-wise analysis of student performance showing average correct response percentages across key domains of radiation protection.

DISCUSSION

The findings of this study provide valuable insights into the current status of radiation protection knowledge and practices among medical students. The overall knowledge level was found to be satisfactory, as indicated by the average correct response rate of 79.86%. This suggests that existing educational programs are effective in delivering theoretical knowledge related to radiation safety.

However, the study also identified significant gaps in practical application. Students demonstrated lower levels of understanding in areas such as fluoroscopy safety, shielding techniques, and dose

optimization. These findings are particularly concerning given the high radiation exposure associated with fluoroscopic procedures and the critical role of shielding in minimizing occupational risk.

The observed gap between knowledge and practice may be attributed to several factors. One of the primary reasons is insufficient practical training and limited hands-on experience. Students may not have adequate opportunities to apply radiation protection principles during clinical postings. Additionally, lack of supervision and guidance during procedures may contribute to improper practices. Another contributing factor is the lack of emphasis on applied learning in the curriculum. While theoretical knowledge is essential, it must be complemented by practical training to ensure effective implementation. Simulation-based learning and skill-based training programs can play a crucial role in bridging this gap.

The findings of this study are consistent with previous research, which has reported moderate knowledge levels but inadequate implementation of radiation safety practices among healthcare students. These studies emphasize the need for continuous education and reinforcement of safety protocols.

To improve radiation safety practices, it is essential to integrate comprehensive training programs into the curriculum. These should include hands-on workshops, simulation exercises, and regular assessments. Encouraging the use of personal dosimeters and monitoring exposure levels can further enhance awareness and accountability.

Developing a culture of radiation safety is equally important. Students should be encouraged to prioritize safety in all clinical procedures and to adhere strictly to established guidelines. This will not only protect them but also ensure the safety of patients and other healthcare workers.

LIMITATIONS

The study has certain limitations that should be considered. The sample size was limited to 150 students, which may restrict the generalizability of the findings. The use of a questionnaire-based approach may not accurately reflect actual clinical practices, as responses are based on self-reporting. Additionally, the study did not include direct observation of students during clinical procedures, which could provide a more comprehensive assessment of practical skills.

CONCLUSION

The present study concludes that medical students possess a satisfactory level of theoretical knowledge regarding radiation protection. However, significant gaps exist in the practical application of these principles, particularly in areas such as fluoroscopy safety, shielding techniques, and dose optimization.

Addressing these gaps requires a multifaceted approach, including strengthening curriculum design, enhancing practical training, and promoting a culture of safety within healthcare institutions. By improving both knowledge and practice, it is possible to reduce radiation exposure risks and ensure safer clinical environments for both healthcare providers and patients.

REFERENCES

1. Bushberg JT, Seibert JA, Leidholdt EM, Boone JM. The Essential Physics of Medical Imaging. 2012.
2. International Commission on Radiological Protection. ICRP Publication 105. 2007.
3. World Health Organization. Radiation Protection in Medicine. 2016.
4. European Commission. Radiation Protection No.180. 2014.
5. Vano E, et al. Radiat Prot Dosimetry. 1998;74:49–52.
6. Dauer LT, et al. J Vasc Interv Radiol. 2010;21:1706–1711.
7. Singh RK, et al. J Clin Diagn Res. 2017;11:JC01–JC04.
8. Paolicchi F, et al. Insights Imaging. 2016;7:565–573.
9. Faggioni L, et al. Eur J Radiol. 2017;89:135–142.
10. O'Sullivan J, et al. Insights Imaging. 2010;1:86–92.
11. Zhou GZ, et al. J Med Imaging Radiat Oncol. 2010;54:17–23.

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12. Lee RK, et al. Postgrad Med J. 2012;88:465–468.
13. Shah S, et al. Radiography. 2015;21:e103–e108.
14. Nyathi T, Merritt AJ. Radiography. 2008;14:e41–e47.
15. Soye JA, Paterson A. J Radiol Prot. 2008;28:165–174.
16. Brown N, Jones L. Radiography. 2013;19:e14–e19.
17. Mohan V, et al. Int J Health Sci Res. 2018;8:140–145.
18. Alotaibi M, et al. Radiat Prot Dosimetry. 2019;185:356–362.
19. Ahmad M, et al. Pak J Med Sci. 2020;36:312–316.
20. ICRP Publication 103. 2007.
21. UNSCEAR Report. 2010.
22. NCRP Report No.160. 2009.
23. WHO Radiation Risk Communication. 2016.
24. European Society of Radiology. Insights Imaging. 2019;10:45.
25. Hall EJ, Giaccia AJ. Radiobiology for the Radiologist. 2012.
26. IAEA Safety Standards. 2014.
27. IAEA Diagnostic Radiology Physics. 2014.
28. Brenner DJ, Hall EJ. N Engl J Med. 2007;357:2277–2284.
29. Smith-Bindman R, et al. Arch Intern Med. 2009;169:2078–2086.
30. Malone J, et al. Insights Imaging. 2012;3:349–359.