

Radiation Protection Attitude, Practices, and Clinical Experiences of Radiologic Technologists in Batangas: Basis for Improving Radiation Safety Protocols

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Abstract

The increasing utilization of ionizing radiation in healthcare has heightened concerns about radiation protection for both patients and healthcare professionals. The primary principle of radiation protection is to be more effective when supported by a radiation protection culture, which includes attitudes, practices, and clinical experiences. According to Alamoudi et.al (2025), radiation protection is a vital practice that minimizes unnecessary exposure to ionizing radiation, thereby reducing its harmful effects on healthcare providers and patients. The principles of radiation protection are based on three fundamental principles: justification, optimization, and dose limitation. Despite the established importance of radiation protection attitudes, practices, and clinical experience, empirical studies that examine these variables collectively remain limited, particularly in the Philippine healthcare context. This study utilized a descriptive-correlational research design to systematically identify the influence of attitude, practice, and clinical experience on radiation protection among radiologic technologists. The survey questionnaire was disseminated in the selected hospitals in Batangas, and 56 radiologic technologists who volunteered answered the survey. To enhance the radiation protection attitude, practices, and clinical experiences, a safety survey should conduct to assess the staff confidence in handling radiation protection policies, the implementation of non-punitive systems/reports for incidents and annual mandatory radiation protection trainings for all the staff which include the equipment handling & technique, use of dosimeter and personal protective equipment (PPE), operating radiographic equipment and strict adherence to the radiation protection protocols. Finally, future researchers are encouraged to conduct research with similar variables and to expand the scope of respondents, thereby serving as a valuable reference that guides the development of future research frameworks and methodologies.

Keywords: Attitude, Practices, Clinical Experiences, Radiation Protection, Radiologic Technologists

Introduction

The increasing utilization of ionizing radiation in healthcare has heightened concerns about radiation protection for both patients and healthcare professionals. The principles of justification, optimization, and dose limitation fundamentally guided radiation protection. These principles provided a strong technical foundation, and the effectiveness depends largely on healthcare professionals' attitudes, practices, and level of clinical experience. Radiation protection attitude refers to healthcare professionals' beliefs, perceptions of radiation risk, and sense of responsibility toward radiation safety. Alongside attitude and practice, clinical experience was a key determinant of radiation protection behavior and decision-making. Clinical experience contributed to professional competence, situational awareness, and the ability to appropriately manage radiation risks during complex procedures. Despite the established importance of radiation protection attitudes, practices, and clinical experience, empirical studies that examine these variables collectively remain limited, particularly in the Philippine healthcare context. Existing research tends to focus on isolated components of radiation safety. This gap limits the development of comprehensive, evidence-based strategies to strengthen radiation protection in clinical settings.

To address this gap, the present study sought to assess respondents' attitudes, practices, and levels of clinical experience regarding radiation protection and to investigate the significant relationships among the variables. This study also provided insights into areas requiring intervention, ensuring a safer environment for both healthcare workers and patients during radiation handling during each imaging procedure. By systematically analyzing these components, this study aimed to provide empirical evidence to support improvements and strengthen radiation safety protocols in radiology departments.

Methodology

The researcher used a descriptive correlational research design to examine relationships among variables and to analyze radiation protection attitudes, practices, and levels of clinical experience among radiologic technologists in Batangas. The primary data were collected using questionnaires completed by radiologic technologists at Mary Mediatrix Medical Center (MMMC), Healthway Daniel Mercado Medical Center, Tanauan Medical Center, The Paramount Medical Center (TPMC), and Metro Lipa Medical Center. This study involved 60 radiologic technologists from five hospitals in Batangas, selected through stratified random sampling from a target population of 56.

A researcher developed a self-made questionnaire, which was composed of ninety (90) items, and each part consisted of thirty (30) indicators relevant to each variable. Experts validated the questionnaire, which demonstrated strong reliability with a Cronbach's Alpha value indicating good internal consistency. After securing the necessary approval, the online survey questionnaire was distributed to respondents. The data was collected while maintaining confidentiality. The researcher then compiled the data for statistical analysis.

Results and Discussions

A discussion of radiation protection attitudes, practices, and levels of clinical experience among radiologic technologists was presented in the succeeding tables and textual presentations.

Table 1

The Attitude of the Respondents in the Radiation Protection: Risk Perception

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Concerned about radiation exposure resulting from medical imaging procedures.	3.57	Very Positive	3
2. Medical uses of radiation involve risks that may be comparable to or greater than their potential benefits.	3.18	Positive	8
3. Occupational exposure to radiation presents unacceptable health risks to workers.	3.09	Positive	9
4. Insufficient knowledge contributes to increased concern about radiation exposure.	3.64	Very Positive	1
5. Radiation protection standards may be adjusted based on assessed risk levels.	3.41	Very Positive	6
6. Without proper protection, one could experience negative health effects from radiation.	3.59	Very Positive	2
7. As much as possible, patients of childbearing age should avoid exposure to radiation except in emergency cases.	3.55	Very Positive	4
8. Understanding of how radiation affects the human body may be limited or incomplete.	3.07	Positive	10
9. Safety measures may not fully prevent some health risks associated with radiation exposure.	3.20	Positive	7
10. Worried about the long-term health consequences of radiation exposure	3.50	Very Positive	5
Average	3.38	Very Positive	

Legend: Strongly Agree/Very Positive-4, Agree/Positive-3, Disagree/Negative-2, Strongly Disagree/Very Negative-1

Table 1 presents the findings from a study examining respondents' attitudes towards radiation protection in terms of Risk Perception. The highest mean score was attributed to indicator 4, where the radiologic technologists believed that "insufficient knowledge contributes to increased concern about radiation exposure", which achieved a score of 3.6, ranked first, and interpreted as "Very Positive". The indicator 6, "Without proper protection, one could experience negative health effects from radiation," was ranked second, with a mean score of 3.59, and was interpreted as "Very Positive." Furthermore, indicator 1 was ranked third, which stated "Concerned about radiation exposure resulting from medical imaging procedures" with the mean score of 3.57 and interpreted as "Very Positive". Indicator 7 had a mean score of 3.55 and ranked fourth, stating, "As much as possible, patients of childbearing age should avoid exposure to radiation except in emergency cases," and was interpreted as "Very Positive". The indicator 10 ranked fifth, stating that "Worried about the long-term health consequences of radiation exposure" with the score of 3.50 and an equivalent verbal interpretation "Very Positive". Indicator 5, "Radiation protection standards may be adjusted based on assessed levels of risk," ranked sixth, with a mean score of 3.41 and a verbal interpretation of "Very Positive."

Moreover, the lowest-mean indicator is 9, which states that “Some health risks associated with radiation exposure may not be fully prevented by safety measures,” with a mean score of 3.20, interpreted as “Positive” and ranked seventh. Indicator 2 had a mean score of 3.18, indicating that “Medical uses of radiation involve risks that may be comparable to or greater than their potential benefits,” ranked eighth and interpreted as “Positive.” Indicator 3 “Occupational exposure to radiation presents unacceptable health risks to workers” ranked as ninth, got the mean score of 3.09, and had the corresponding verbal interpretation of “Positive”. The indicator that ranked tenth was indicator 8, which stated, “Understanding of how radiation affects the human body may be limited or incomplete,” with a mean score of 3.07 and an equivalent verbal interpretation of “Positive.” Collectively, the assessment yielded an overall weighted mean of 3.38, categorized as “Very Positive,” reflecting a very positive attitude among radiologic technologists toward radiation protection in terms of risk perception. In summary, the findings indicated that although the radiologic technologists' attitude led to a positive outcome, some gaps remain to be addressed to improve the respondents' risk perception. A strong influence of institutional and cultural factors, and proper orientation, will help minimize the perception of risk within the department.

The results were supported by the study conducted by Yashima and Chiba (2022), which assessed the understanding of radiation, disaster exposure, and radiation protection. According to the results, the respondents believed that natural, artificial, internal, and external radiation have different health effects. Therefore, the application of the three basic protective measures is essential, regardless of whether radiation exposure comes from natural or artificial sources, or from internal or external exposure. The misconception about the genetic effects of radiation indicates that the respondents have a low level of perception of the effective dose in radiation protection.

Table 2

The Attitude of the Respondents in the Radiation Protection: Safety Consciousness

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Understand the basic principles of radiation protection (time, distance, and shielding).	3.84	Very Positive	2
2. Aware of the potential health risks associated with radiation exposure.	3.73	Very Positive	5
3. Familiar with radiation warning signs and symbols.	3.86	Very Positive	1
4. Understand the procedures to follow in case of a radiation incident or spill.	3.63	Very Positive	7
5. Feel personally responsible for minimizing radiation exposure to self and others	3.75	Very Positive	3.5
6. Aware of radiation dose limits and try to stay within safe levels.	3.64	Very Positive	6
7. Feel concerned when someone forgets to use radiation-protective equipment.	3.61	Very Positive	8
8. Conscious of how actions can increase or decrease radiation exposure.	3.55	Very Positive	10
9. Believe my personal attitude toward radiation safety influences my long-term health.	3.75	Very Positive	3.5
10. Actively reflect on radiation safety practices after completing procedures.	3.57	Very Positive	9
Average	3.69	Very Positive	

Legend: Strongly Agree/Very Positive-4, Agree/Positive-3, Disagree/Negative-2, Strongly Disagree/Very Negative-1

As shown in Table 2, the study examined respondents' attitudes towards radiation protection in terms of Self-Consciousness. Indicator 3 got the highest mean score of 3.86, which stated, "Familiar with radiation warning signs and symbols" with an equivalent verbal interpretation of "Very Positive". Following closely, indicator 1 stated that "Understand the basic principles of radiation protection (time, distance, and shielding)" with the mean score of 3.84 and interpreted as "Very Positive". The indicators 5 "Feel personally responsible for minimizing radiation exposure to self and others" and 9 "Believe in personal attitude toward radiation safety influences the long-term health" both ranked 3.5, with a score of 3.75, interpreted as "Very Positive". Furthermore, indicator 2, "Aware of the potential health risks associated with radiation exposure," ranked fifth, with a mean score of 3.73 and a corresponding verbal interpretation of "Very Positive." Followed by the indicator 6 that ranked a sixth stated, "Aware of radiation dose limits and try to stay within safe level", with the score of 3.64 and interpreted as "Very Positive". Indicator 4, "Understand the procedures to follow in case of a radiation incident or spill," ranked 7th, with a mean score of 3.63 and a verbal interpretation of "Very Positive." The statement "Feel concerned when someone forget to use radiation protective equipment" ranked eight, with the verbal interpretation of "Very Positive" got the mean score of 3.61. The indicator 10 had a mean score of 3.57 and was interpreted as "Very Positive," indicating that "Actively reflect on radiation safety practices after completing procedures." The indicator 8, which stated, "Conscious of how actions can increase or decrease radiation exposure" got the tenth place with the mean score of 3.55 and interpreted as "Very Positive".

In summary, the collective assessment yielded an overall weighted mean of 3.69, categorized as "Very Positive", demonstrating a very positive attitude of the radiologic technologists towards radiation protection in terms of self-consciousness. The result highlighted that the respondents have a high level of proactive awareness of risks and take steps to protect themselves from unnecessary radiation exposure while maintaining the quality of care for their patients. Additionally, the respondents retained the fundamental foundations and core principles of their profession, which proved beneficial in performing their duties.

The results supported the study by Kyei et al. (2025), which concluded that the majority of respondents were extremely confident in their ability to practice radiation safety measures and believed that, along with safety protocols, these measures effectively reduced workplace injuries. The authors also identified that strong consensus can affect healthcare workers' well-being and patient care. The authors highlighted the significance of encouraging continuous education and regular updates in radiation safety to enhance a comprehensive safety culture among health professionals.

Table 3

The Attitude of the Respondents in the Radiation Protection: Perceived Importance of Radiation Protection

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Radiation protection is essential to ensuring patient safety.	3.91	Very Positive	1
2. Radiation protection is a critical responsibility in a professional role.	3.86	Very Positive	2
3. The risks of radiation exposure are significant enough to require strict protective measures.	3.75	Very Positive	5.5
4. Adhering to radiation protection principles is as important as achieving diagnostic or treatment goals.	3.75	Very Positive	5.5
5. Radiation protection should always be prioritized, even if it increases procedure time.	3.55	Very Positive	9.5
6. Proper radiation protection significantly reduces the risk of long-term health effects.	3.68	Very Positive	7
7. Neglecting radiation protection can have serious consequences for both workers and patients.	3.79	Very Positive	3.5
8. Continuous emphasis on radiation protection is necessary in radiological environments.	3.79	Very Positive	3.5
9. Believe radiation protection deserves more attention than it currently receives in workplace/training.	3.55	Very Positive	9.5
10. Radiation safety measures should never be ignored, even during emergencies.	3.66	Very Positive	8
Average	3.73	Very Positive	

Legend: Strongly Agree/Very Positive-4, Agree/Positive-3, Disagree/Negative-2, Strongly Disagree/Very Negative-1

Based on the table above, indicator 1 had the highest mean score of 3.91, indicating "Radiation protection is essential for ensuring the safety of patients" and a verbal interpretation of "Very Positive". Followed closely by indicator 2, the Radiologic Technologists believed that "Radiation protection is a critical responsibility in the professional role", with a mean score of 3.86 and an interpretation of "Very Positive". Both indicators 7 "Neglecting radiation protection can have serious consequences for both workers and patients" and 8 "Continuous emphasis on radiation protection is necessary in radiological environments" ranked 3.5, with a mean score of 3.79, indicating "Very Positive". Furthermore, both the indicator 3 "The risks of radiation exposure significant enough to require strict protective measures and indicator 4 "Adhering to radiation protection principles are as important as achieving diagnostic and treatment goals" got the mean score of 3.75 with the verbal interpretation of "Very Positive" and ranked 5.5 based on the result. Indicator 6 ranked seventh which stated, "Proper radiation protection significantly reduces the long-term health effects" got the score of 3.68 and interpreted as "Very Positive". Moreover, the indicator 10 "Radiation safety measures should never be ignored even during emergencies" ranked eighth with the mean score of 3.66 and have a verbal interpretation of "Very Positive". Lastly, both indicator 5 "Radiation protection should always be prioritized even it increases procedure

time" and indicator 9 which stated, "Believed that radiation protection deserves more attention than currently receives in workplace/training" ranked 9.5 with the mean score of 3.55 and interpreted as "Very Positive"

Cumulatively, the evaluation resulted in an overall weighted mean of 3.73, categorized as "Very Positive". This reflected a very positive attitude among radiologic technologists toward radiation protection, with a perceived importance of radiation protection. This implies that they place substantial value on radiation safety measures and clearly recognize the necessity of adhering to radiation safety principles in radiographic practice.

This result was supported by Choi's (2023) study, which found that respondents with prior perceptions of radiation were more active in their attitudes and practices to protect against radiation damage than those with no prior knowledge.

Table 4

Summary Table of the Attitude of the Respondents in the Radiation Protection

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Risk perception	3.38	Very Positive	3
2. Safety consciousness	3.69	Very Positive	2
3. Perceived importance of radiation protection	3.73	Very Positive	1
Overall Weighted Mean	3.60	Very Positive	

Legend: Strongly Agree/Very Positive-4, Agree/Positive-3, Disagree/Negative-2, Strongly Disagree/Very Negative-1

Table 4 summarizes the sub-variables related to respondents' attitudes toward radiation protection. Among these, the perceived importance of radiation protection obtained the highest mean score (3.73), followed by self-consciousness (3.69) and risk perception (3.38). The overall weighted mean was 3.60, which corresponds to a verbal interpretation of "Very Positive." These findings indicated that Radiologic Technologists demonstrate a very positive attitude toward radiation protection.

The results were supported by a study by Shubayr (2023) that identified factors influencing radiologic technologists' commitment to radiation protection. Those factors are the perceived seriousness, benefits, barriers, cues to action, and self-efficacy. It showed a significant association between radiologic technologists who always use radiation-protection equipment and those who are not fully committed. The effect of this result was the recognition of the benefits of using radiation protection equipment and confidence in their ability to perform the task. Additionally, this suggests that the group that always uses RPE has a stronger belief that radiation exposure is a serious health threat, that using RPE can reduce the risk of radiation exposure and its consequences.

Table 5

The Respondents' Practices in Radiation Protection: Personal Protective Equipment

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Consistently use appropriate PPE to minimize radiation exposure during procedures.	3.39	Always	8
2. Follow institutional policies and guidelines on PPE use for radiation protection during all applicable procedures.	3.50	Always	3
3. Wear PPE correctly and ensure that it is fully fastened during procedures.	3.52	Always	2
4. Check PPE for cracks, tears, or other damage before use.	3.20	Often	10
5. Store PPE properly after use (e.g., hang it correctly and do not fold it).	3.55	Always	1
6. Personally ensure that PPE is worn whenever radiation exposure is possible.	3.45	Always	5.5
7. Department actively promotes and supports strict compliance with PPE use.	3.39	Always	8
8. Supervisors consistently enforce the proper use of radiation protective PPE.	3.39	Always	8
9. Able to perform procedures effectively while wearing required radiation protective PPE.	3.48	Always	4
10. Thyroid shields are consistently available and used when required during procedures.	3.45	Always	5.5
Average	3.43	Always	

Legend: Always-4, Often-3, Rarely-2, Never-1

Table 5 presents indicators of respondents' practices regarding radiation protection, including personal protective equipment, and ranks them by mean score. Based on the table above, indicator 5 got the highest mean score of 3.55, which stated "Store PPE properly after use" with the verbal interpretation of "Always". Followed closely, indicator 3 ranked second, stating that "Wear PPE correctly and ensure that it is fully fastened during procedures," with a mean score of 3.52 and an interpretation of "Always". The indicator 2 ranked third, stating, "Followed institutional policies and guidelines on PPE use for radiation protection during all applicable procedures," with a mean score of 3.50 and an interpretation of "Always". The indicator 9, ranked fourth, had a mean score of 3.48, indicating that the Radiologic Technologists are "able to perform the procedures effectively while wearing required radiation protective PPE" and have a verbal interpretation of "Always". Furthermore, indicators 6 "Personally ensure that PPE is worn whenever radiation exposure is possible" and 10 "Thyroid shields are consistently available and used when required during procedures" both ranked 5.5, with a mean score of 3.45 and a verbal interpretation of "Always".

Moreover, three indicators are tied in eight places. The indicators 1 "Consistently use appropriate PPE to minimize radiation exposure during procedures", indicator 7 "Department actively promotes and supports strict compliance with PPE use", and indicator 8 "Supervisors consistently enforce the proper use of radiation protective PPE" got the mean score of 3.39 and interpreted as "Always". Lastly, indicator 4 had the lowest mean score of 3.20, indicating

that radiologic technologists often “Check the PPE for cracks, tears, or other damage before use,” with the corresponding verbal interpretation of “Often.”

Overall, the results revealed a weighted mean of 3.43, corresponding to a verbal interpretation of “Always,” indicating that the majority of respondents always practice wearing personal protective equipment, adhere to the department’s radiation safety protocols during radiation procedures, and store lead gowns in accordance with manufacturer guidelines. Although the result reflects an extremely high level of radiologic technologists’ practice in radiation protection, the checking of PPE for cracks, tears, and damage should be addressed.

The study by Khalili et al. (2022) supported some of the indicators in this study, highlighting the importance of lead protective shields and their significant dose-reducing effect on the radiologic technologist, particularly in nuclear medicine. The use of a lead apron, radiation attenuation gloves, and thyroid shields was recommended, although the use of lead protective shields is difficult and, to some extent, reduces working speed. Restricting exposure time and implementing appropriate shielding strategies could considerably reduce staff doses during nuclear medicine procedures. The indicator in this study that the radiologic technologists often check the PPE for cracks, tears, or damage before use was relevant to the study of Shungube et al. (2023), which noted that radiation protection garments sometimes had defects such as tears, holes, and cracks. Some were not replaced even when defective. This failure indicates that staff are not adequately inspecting and monitoring protective equipment.

Table 6

The Respondents’ Practices in Radiation Protection: Radiation Exposure Monitoring

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Wear a personal dosimeter whenever involved in radiation-related work.	3.13	Often	10
2. Wear the dosimeter correctly in accordance with radiation safety guidelines.	3.21	Often	9
3. Personal dosimeters are readily available whenever needed for radiation work.	3.43	Always	4
4. Ensure that the dosimeter is exchanged or submitted for reading at the required intervals.	3.34	Always	8
5. Immediately report lost, damaged, or malfunctioning dosimeters to the proper authority.	3.48	Always	2.5
6. Follow established procedures for workplace radiation exposure monitoring.	3.55	Always	1
7. Observe occupational radiation dose limits during all radiation-related activities.	3.41	Always	5
8. Apply proper dosimeter use as instructed during radiation safety training.	3.38	Always	6.5
9. Able to perform work duties effectively while wearing a personal dosimeter.	3.48	Always	2.5
10. Consistently comply with institutional requirements for radiation exposure monitoring.	3.38	Always	6.5
Average	3.38	Always	

Legend: Always-4, Often-3, Rarely-2, Never-1

Based on the table above, indicator 6 had the highest mean score of 3.55, indicating that the Radiologic Technologists "follow the established procedures related to radiation exposure monitoring in the department," interpreted as "Always". Followed by two indicators that tied the ranked second, the indicator 5 "immediately report lost, damage, malfunctioning dosimeters to the proper authority" and indicator 9 "Able to perform work duties effectively while wearing a personal dosimeter" with the mean score of 3.48, and have a verbal interpretation of "Always". The indicator 3 ranked fourth and received a score of 3.43, indicating "Personal dosimeters are readily available whenever needed for radiation work," with an interpretation of "Always". Furthermore, the ranked 6.5 was tied by the indicators 8 "Apply proper dosimeter use as instructed during radiation safety training" and 10 "Consistently comply with instructional requirements for radiation exposure monitoring", with a mean score of 3.38 and an interpretation of "Always". Followed by the indicator 4, which the Radiologic Technologists, "ensure that the dosimeter is exchanged or submitted for reading at the required interval" with the mean score of 3.34 and interpreted as "Always."

Moreover, indicator 2 obtained one of the lowest mean values, "Wear dosimeter correctly in accordance with radiation safety guidelines," with a mean score of 3.21 and a corresponding verbal interpretation of "Often". Lastly, the indicator had the lowest mean of 3.13, indicating "Wear a personal dosimeter whenever involved in radiation-related work," with an equivalent verbal interpretation of "Often."

In summary, the collective assessment yielded a weighted mean of 3.69, with a verbal interpretation of "Always". This demonstrated that the radiologic technologists always practice radiation protection through radiation exposure monitoring. This included respondents being proactive in reporting dosimeter issues and performing their duties effectively while using them. Although the present results demonstrated a high level of practice among the respondents, wearing a dosimeter and proper placement should be aligned with the guidelines and protocols.

According to the study by Hijikata et al. (2023), although radiation safety guidelines are available, only about half of the participants reported using dosimeters and thyroid shields, while roughly one-third used lead glasses and lead gloves. Over 90% of the participants avoided continuous irradiation; however, only around half were aware of the radiation source and used this knowledge to determine their positioning. Protective measures for all vulnerable body parts were not consistently applied, and approximately 17% of respondents believed that radiation protection devices—aside from trunk lead protectors and dosimeters—were unnecessary. These findings may lead to inaccurate radiation dose assessments and an increased risk of occupational exposure.

Table 7

The Respondents' Practices in Radiation Protection: Equipment Handling and Technique

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Inspect radiation equipment for proper functioning before use.	3.45	Always	8
2. Ensure that all required radiation protection devices (e.g., lead aprons, shields) are available and in good condition prior to procedures.	3.39	Always	9
3. Handle radiation equipment in accordance with manufacturer and institutional guidelines.	3.70	Always	7
4. Apply proper patient positioning techniques to avoid unnecessary repeat exposures.	3.80	Always	1.5
5. Maintain a safe and appropriate distance from the radiation source whenever possible.	3.75	Always	5
6. Collimate the radiation beam appropriately for each procedure performed.	3.77	Always	3.5
7. Correctly position and secure protective equipment during radiation procedures.	3.77	Always	3.5
8. Operate radiation equipment using correct exposure factors and techniques.	3.73	Always	6
9. Store radiation equipment and protective devices properly after use.	3.80	Always	1.5
10. Apply the ALARA principle by using the lowest radiation dose necessary to achieve adequate image quality.	3.18	Often	10
Average	3.63	Always	

Legend: Always-4, Often-3, Rarely-2, Never-1

As shown in Table 7, two indicators rank first equally, with a mean score of 3.80. The indicator 4 “apply proper patient positioning techniques to avoid unnecessary repeat exposures” and indicator 9 “store radiation equipment and protective devices properly after use” with the corresponding verbal interpretation of “Always”. Subsequently, indicators 6 “collimate the radiation beam appropriately for each procedure performed” and 7 “correctly position and secure protective equipment during radiation procedures” received a mean score of 3.77, with an equivalent verbal interpretation of “Always”. Furthermore, the indicator 5 ranked fifth, highlighting that radiologic technologists “maintain a safe and appropriate distance from the radiation source whenever possible,” with a mean score of 3.75 and a verbal interpretation of “Always.” The indicator 8, “operate radiation equipment using correct exposure factors and techniques” ranked sixth, with the mean score of 3.73 and a corresponding verbal interpretation of “Always”.

Moreover, the indicator 2 “ensure that all required radiation protection devices (e.g., lead aprons, shields) are available and in good condition prior to procedures” obtained the mean score of 3.39 and yielded a verbal interpretation of “Always”. Lastly, the indicator 10, which stated “apply the ALARA principle by using the lowest radiation dose necessary to achieve adequate image quality,” attained a mean score of 3.18 and was accompanied by a verbal interpretation of “Often.”

In summary, the collective assessment yielded a weighted mean of 3.63, with a verbal interpretation of “Always”. This demonstrated that radiologic technologists always practice radiation protection, including equipment handling and technique, and the application of basic technical rules to avoid repetition of the examination. Although the present results demonstrated a high level of practice among the respondents, the respondents often apply the ALARA principle, which needs to be correlated with their practices.

Several studies have reported similar findings, indicating a low level of application of the ALARA principles. Although the studies conducted by Wan et al. (2021), Sheth et al. (2022), and Kumar et al. (2023) involved respondents outside the radiology field, their results also demonstrated a low level of ALARA practice. This suggests that inadequate implementation is not limited to radiologic technologists but extends to other healthcare professionals as well. According to the authors, formal education and training are recommended, particularly for individuals who work with radiation. Such initiatives may help reduce uncertainty about radiation exposure and foster a more informed, positive attitude toward the use of radiation-related equipment.

Table 8

Summary Table of the Respondents' Practices in the Radiation Protection

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Personal protective equipment	3.43	Always	2
2. Radiation exposure monitoring	3.38	Always	3
3. Equipment handling and technique	3.63	Always	1
Overall Weighted Mean	3.48	Always	

Legend: Always-4, Often-3, Rarely-2, Never-1

Table 8 presents a summary of the sub-variables related to respondents' practices toward radiation protection. Among these, equipment handling and technique obtained the highest mean score (3.63), followed by Personal protective equipment (3.43) and Radiation exposure monitoring (3.38). The overall weighted mean was 3.48, corresponding to a verbal interpretation of “Always,” indicating that radiologic technologists always practice radiation protection through personal protective equipment, radiation exposure monitoring, and equipment handling and technique.

The results were supported by the studies conducted by two different authors, Fiabedzi et al. (2022) and Jha et al. (2022). Understanding radiographers' safety practices and knowledge is critical for effective management in the radiography unit. Radiographers' knowledge and practice of radiation safety can vary, making it essential to evaluate current knowledge and adherence to radiation safety practices within the radiology department (Fiabedzi et al. 2022). A key component of radiation safety is proper training and education for staff, adherence to strict protocols and guidelines for the use of radiation equipment, monitoring radiation doses, and implementing safety measures to limit unnecessary exposure (Jha et al. 2022). The primary responsibility of radiology experts, including doctors and technologists, is to determine whether procedures should be performed. However, referring physicians should also be aware of the risks associated with radiological procedures, as they are the ones who refer patients for these tests.

Table 9

The Level of Clinical Experiences of the Respondents in Radiation Protection: Application for Radiation Protection Protocols

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Time constraints sometimes make it difficult to implement radiation protection protocols fully.	3.07	High	10
2. The availability of equipment affects the ability to follow radiation protection guidelines.	3.16	High	9
3. Clinical workload occasionally leads to reduced adherence to radiation protection measures.	3.46	Very High	6
4. Consistently apply radiation protection protocols during clinical procedures.	3.39	Very High	8
5. Radiation protection measures are easy to integrate into the daily clinical workflow.	3.61	Very High	1
6. Confident in selecting appropriate shielding and protective equipment when needed.	3.61	Very High	1
7. Can adjust imaging or treatment techniques to minimize radiation exposure.	3.48	Very High	5
8. Lack of equipment interferes with the proper application of radiation protection protocols.	3.43	Very High	7
9. Appropriately adapt radiation protection measures during emergency or high-pressure situations.	3.59	Very High	4
10. The department's radiation protection protocols are practical and applicable to daily clinical work.	3.61	Very High	1
Average	3.44	Very High	

Legend: Strongly Agree/Very High-4, Agree/High-3, Disagree/Low-2, Strongly Disagree/Very Low-1

As presented in the Table 9, the indicator 5 “Radiation protection measures are easy to integrate into my daily clinical workflow”, indicator 6 “Confident in selecting appropriate shielding and protective equipment when needed” and indicator 10 “The departments’ radiation protection protocols are practical and applicable to daily clinical work” obtained the highest mean score of 3.61 with a corresponding verbal interpretation of “Very High”. Followed by the indicator 9, ranked second, which stated, “appropriately adapt radiation protection measures during emergency or high-pressure situations,” with a mean score of 3.59 and an equivalent verbal interpretation of “Very High”. Indicator 7 stated that radiologic technologists “can adjust imaging or treatment techniques to minimize radiation exposure.” The mean score was 3.48, interpreted as “Very High.” Indicator 3, which ranked sixth, stated “Clinical workload occasionally leads to reduced adherence to radiation protection measures” and yielded a mean score of 3.46 with the corresponding verbal interpretation of “Very High”. Furthermore, indicator 8 ranked seventh, stating “Lack of equipment interferes with the proper application of radiation protection protocols,” with a mean score of 3.43 and an interpretation of “Very High”. The indicator 4 obtained a mean score of 3.39, which indicates that radiologic technologists “consistently apply radiation protection protocols during clinical procedure” with the verbal interpretation of “Very High” ranked eighth and obtained a verbal interpretation of “Very High”.

Additionally, indicators with the lowest means include indicator 2, which states “Availability of equipment affects my ability to follow radiation protection guidelines,” with a mean score of 3.16, interpreted as “High”. Lastly, indicator 1 had a mean score of 3.07, indicating “Time constraints sometimes make it difficult to fully apply radiation protection protocols,” with a verbal interpretation of “High.”

In summary, the collective assessment yielded a weighted mean of 3.44, corresponding to the verbal interpretation of “Very High.” This indicates that radiologic technologists demonstrate a very high level of clinical experience in radiation protection, particularly in the application of radiation protection protocols. The respondents were easy to integrate into the workflow, felt confident in selecting appropriate shielding, and perceived protocols as practical and applicable in daily clinical work. Additionally, they are highly capable of adapting measures in high-pressure situations and adjusting techniques to minimize radiation exposure.

The results of this study are consistent with those of Matre et al. (2025), who found that respondents’ insights on radiation protection vary by educational background, clinical exposure, years of experience, and training. The authors reported that many respondents demonstrated varying levels of understanding and knowledge regarding radiation safety practices during radiologic procedures. These practices include proper use of personal protective equipment, understanding the ALARA principle, and correctly placing lead aprons. The previous study underscores the importance of continuous education and training programs to enhance radiographers’ awareness and understanding of radiation safety.

Table 10

The Level of Clinical Experiences of the Respondents in Radiation Protection: Use of Radiation Protection Devices

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Radiation protection devices in the department are well-maintained.	3.41	Very High	7
2. Lead aprons and shields are regularly inspected for cracks or damage.	3.34	Very High	9.5
3. Know the proper procedure for reporting defective radiation protection equipment.	3.46	Very High	5
4. Feel comfortable reminding colleagues to use radiation protection devices when necessary.	3.45	Very High	6
5. There is strong departmental support for radiation safety practices.	3.50	Very High	3.5
6. Radiation protection is a high priority in clinical practice.	3.34	Very High	9.5
7. Senior staff consistently model proper radiation protection practices.	3.61	Very High	2
8. Adequately trained in the correct use of radiation protection devices.	3.50	Very High	3.5
9. Use mobile lead barriers or protective screens whenever they are available.	3.66	Very High	1
10. Ensure that radiation protection devices are correctly positioned before and during procedures.	3.36	Very High	8
Average	3.46	Very High	

Legend: Strongly Agree/Very High-4, Agree/High-3, Disagree/Low-2, Strongly Disagree/Very Low-1

The results shown in table 10 indicate that indicator 9, "Use mobile lead barriers or protective screens whenever they are available," obtained a mean score of 3.66, corresponding to the interpretation "Very High". Subsequently, indicator 7 yielded a mean score of 3.61, indicating "Senior staff consistently model proper radiation protection practices" with a verbal interpretation of "Very High". The indicators 5 "There is a strong departmental commitment to radiation safety practices" and 8 "adequately trained in the correct use of radiation protection devices" ranked 3.5, which corresponds to the verbal interpretation "Very High". Furthermore, indicator 3 had a mean score of 3.46, indicating that radiologic technologists "know the proper procedure for reporting defective radiation protection equipment," with an equivalent mean score of "Very High" and ranking fifth. The indicator 4 ranked sixth, with a mean score of 3.45, and the belief that Radiologic Technologists "feel comfortable reminding colleagues to use radiation protection devices when necessary" yielded the verbal interpretation of "Very High". The statement 1 "Radiation protection devices in the department are well maintained " ranked seventh, obtaining the mean score of 3.41 with a corresponding verbal interpretation of "Very High". The radiologic technologists' "ensure that radiation protection devices are correctly positioned before and during procedures" ranked 8, with a mean score of 3.36 and an equivalent verbal interpretation of "Very High".

Moreover, indicators that obtained a low mean score but have a "Very High" rating include indicators 2, "Lead Aprons and shields are regularly inspected," and 6, " Radiation protection is a high priority in my clinical practice," with mean scores of 3.34.

Overall, the results yielded a weighted mean of 3.46, corresponding to a verbal interpretation of "Very High". This indicates that the radiologic technologist has a very high level of radiation protection clinical experience, particularly in the use of radiation protection devices, including the consistent use of a mobile lead barrier, and the influence of senior staff and adequate training in conducting radiation protection safety. These indicators can be improved with training.

The results are supported by the study conducted by Dayo et al. (2023), which indicated that radiologic technologists in the Philippines generally demonstrate a high level of insight regarding radiation protection, with most practitioners, regardless of age, practicing safety protocols to a very great extent. Furthermore, the authors noted that younger, less experienced radiographers often exhibit greater compliance with safety protocols than their older counterparts, potentially because of recent training or stricter adherence to new guidelines. In the present study, according to the respondents' demographic profile, the majority have less than 5 years of work experience. This shows that, regardless of the years of experience, the respondents can practically apply and use radiation protection devices in accordance with standard policies.

Table 11

The Level of Clinical Experiences of the Respondents in Radiation Protection: Operation of Radiologic Equipment

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Check radiologic equipment for proper functioning before each clinical use.	3.57	Very High	10
2. Confidently select exposure parameters that minimize radiation dose.	3.73	Very High	6
3. Consistently apply the ALARA principle during imaging procedures.	3.71	Very High	7
4. Adjust kVp and mAs appropriately to balance image quality and patient dose.	3.75	Very High	4
5. Use collimation effectively to limit radiation exposure to the area of interest.	3.70	Very High	8
6. Follow established radiation safety guidelines when operating radiologic equipment.	3.79	Very High	1
7. Verify patient positioning to avoid unnecessary repeat exposures.	3.75	Very High	4
8. Maintain an appropriate distance from the radiation source whenever possible.	3.77	Very High	2
9. Use appropriate shielding techniques during radiologic procedures.	3.68	Very High	9
10. Operate radiologic equipment in accordance with institutional radiation safety protocols.	3.75	Very High	4
Average	3.72	Very High	

Legend: Strongly Agree/Very High-4, Agree/High-3, Disagree/Low-2, Strongly Disagree/Very Low-1

Based on the information presented in Table 11, Indicator 6 got the highest mean score of 3.79, which mentioned “follow established radiation safety guidelines when operating radiologic equipment” with the equivalent verbal interpretation of “Very High”. Followed closely, indicator 8, “maintain appropriate distance from the radiation source whenever possible,” obtained a mean score of 3.77 and yielded a verbal interpretation of “Very High.” Furthermore, three indicators tied the ranked 4 which are the indicator 4 “adjust kVp and mAs appropriately to balance image quality and patient dose”, indicator 7 “verify patient positioning to avoid unnecessary repeat exposures”, and indicator 10 “operate radiologic equipment in accordance with institutional radiation safety protocols”, all three indicators obtained a mean score of 3.75 with the corresponding verbal interpretation of “Very High”. The radiologic technologists are “confidently select exposure parameters that minimize radiation dose,” an indicator 2 that ranked 6 with a corresponding mean score of 3.73 and a verbal interpretation of “Very High.” The indicator 3, “consistently apply the ALARA principle during imaging procedures” ranked seventh with the mean score of 3.71 and equivalent verbal interpretation of “Very High”. The indicator 5, which stated, “use collimation effectively to limit radiation exposure to the area of interest,” received a mean score of 3.70, corresponding to the “Very High” interpretation (rank 8).

Moreover, indicator 9, which states that radiologic technologists “use appropriate shielding techniques during radiologic procedures,” yielded a mean score of 3.68, corresponding to the verbal interpretation “Very High.” The last indicator, with the lowest mean of 3.57 (“Check radiologic equipment for proper functioning before each clinical use”), received the verbal interpretation of “Very High.”

In summary, the collective results from the sub-variable of operation of radiologic equipment yielded an average weighted mean of 3.72, with a verbal interpretation of “Very High”. This indicated that radiologic technologists have a very high level of clinical experience in radiation protection, particularly in the operation of radiologic equipment.

The results presented in Table 11 were supported by the study conducted by Magdaluyo and Quirante (2023), which indicates that the majority of respondents adhered to IEM (Imaging Equipment Maintenance) practices. Furthermore, these practices were found to be significantly related to the operation of radiation equipment. The primary factor influencing the level of IEM practice is respondents’ clinical experience in radiation protection, particularly in operating such equipment. The knowledge, skills, and experience of the respondents significantly affect radiologic technologists' ability to respond effectively to unexpected incidents and equipment malfunctions. The authors further suggested that continuous professional development makes a substantial contribution, especially in the current context of rapidly advancing technology.

Table 12

Summary Table of the Level of Clinical Experiences of the Respondents in Radiation Protection

Indicator	Weighted Mean	Verbal Interpretation	Rank
1. Application for radiation protection protocols	3.44	Very High	3
2. Use of a radiation protection device	3.46	Very High	2
3. Operation of radiologic equipment	3.72	Very High	1
Overall Weighted Mean	3.54	Very High	

Table 12 presents a summary of the sub-variables for the respondents' level of clinical experience. According to the results, the “Operation of radiologic equipment” got the highest weighted mean of 3.72, followed by the “Use of radiation protection device” (3.46), and “Application for radiation protection obtained the lowest mean score of 3.44. The three sub-variables yielded an equivalent verbal interpretation of “Very High,” with a weighted mean of 3.54, and an overall level of clinical experience with radiation protection among respondents, which means that the radiologic technologists have a very high level of clinical experience in terms of application for radiation protection protocols, use of a radiation protection device, and operation of radiologic equipment.

The results were supported by Shungube et. al (2023) mentioned that participants further indicated that they primarily use the lowest exposure necessary to obtain diagnostic-quality images, utilize lead shielding devices, avoid repeated exposures, apply high kVp techniques, collimate to the area of interest, and screen request forms to prevent unauthorized staff from ordering unnecessary X-rays. However, despite demonstrating knowledge and awareness, unfavorable attitudes were also observed, as radiation protection measures were applied conditionally and in limited ways, leaving compliance a matter of

personal choice. This conditional compliance is often linked to a focus on pediatric patients and pregnant women, which is insufficient. All patient populations, without exception, must be protected from unnecessary radiation exposure.

Table 13

Relationship between the Respondents' Radiation Protection Attitude and Radiation Protection Practices

Variables	Statistical Treatment (Pearson's)	p-value	Decision	Interpretation
Attitude and practices	r=.259 (low correlation)	.0.054*	Failed to reject H ₀	Not Significant

*Significant @ 0.05

The relationship between respondents' radiation protection attitude and their radiation protection practices was analyzed using Pearson's correlation coefficient. The results revealed that there was no significant correlation between radiation protection attitude and radiation protection practices among radiologic technologists ($r = 0.259$, $p = 0.054$). Therefore, the null hypothesis is not rejected. This means that radiologic technologists' attitudes do not significantly influence their radiation protection practices.

The result is supported by the study conducted by Kyei et al. According to the findings, half of the respondents felt "extremely confident" in their ability to practice radiation safety. The proper and consistent use of personal protective equipment (PPE) is essential to protect healthcare workers from radiation exposure. However, some respondents are not confident in their ability to practice radiation safety. This level of confidence is significant, indicating that most healthcare workers are well-equipped to adhere to safety protocols. This positive safety culture is essential for effective radiation protection; however, targeted interventions were still needed to boost the confidence of other members of the department.

Table 14

Relationship between the Respondents' Radiation Protection Attitude and Radiation Protection Level of Clinical Experiences

Variables	Statistical Treatment (Pearson's)	p-value	Decision	Interpretation
Attitude and level clinical experiences	r=0.729* (Moderate correlation)	p=0.000	H ₀ rejected	Significant

*Significant @ 0.05

Table 14 presents the relationship between respondents' radiation protection attitudes and the level of clinical experiences, using Pearson's correlation analysis. The results revealed a significant correlation between the radiation protection attitude and the radiation protection level of clinical experience among radiologic technologists ($r = 0.729$, $p = 0.000$). Therefore, the null hypothesis is not rejected. Overall, this implies that respondents with more favorable attitudes tend to have greater clinical experience in radiation protection.

The results presented in the table were supported by the study of Goula et al. (2021), which found that healthcare workers with fewer years of experience tend to demonstrate lower compliance and higher levels of anxiety when handling radiation exposure. In contrast, respondents with 31 to 40 years of work experience exhibited greater confidence and adherence to safety protocols, likely due to their longer exposure to training and practical experience in managing radiation-related tasks.

Table 15

Relationship between the Respondents' Radiation Protection Practices and Radiation Protection Level of Clinical Experiences

Variables	Statistical Treatment (Pearson's)	p-value	Decision	Interpretation
Practices and level of clinical experiences	r=0.624* (Moderate correlation)	p=0.000	H ₀ rejected	Significant

*Significant @ 0.05

Table 15 presents the relationship between the respondents' radiation protection practices and level of clinical experiences using Pearson's correlation coefficient. The results revealed a significant correlation between radiation protection practices and the radiation protection level of clinical experience among radiologic technologists ($r = 0.624$, $p = 0.000$). Therefore, the null hypothesis is not rejected. Overall, the findings implied that radiologic technologists with stronger radiation protection practices tend to have greater clinical experience. This highlights the importance of reinforcing proper safety practices among respondents to enhance their protection during clinical experiences.

The result is supported by the study conducted by Allam et al. (2024), which reveals a strong association between the years of experience of the study sample and their total practice compliance score for radiation safety measures. Individuals who have been exposed to various clinical experiences and have worked for more than a year are more likely to demonstrate higher levels of practice and adherence to safety procedures. In contrast, nurses with less experience may be less familiar with the complexities of radiation safety protocols or may have had fewer opportunities to practice and reinforce their adherence to these procedures. This could potentially affect their compliance with safety measures.

Proposed Intervention Plan to Sustain the Radiation Protection Attitude, Practices, and Clinical Experiences of Radiologic Technologists

Areas of concern	Strategy/Task	Person(s) Responsible	Time-frame	Resources	Source of budget	Budget allocation (PHP)	Success indicator
Radiologic technologist's attitude towards radiation protection	Establish a radiation safety committee, provide clear visual guides on radiation protection within the exposure room, and conduct quarterly safety surveys to assess and strengthen staff confidence and compliance with radiation protection policies.	Chief Radiologic Technologist, Radiation Protection Officers, and Radiologic Technologists	Semi annually Update annually Quarterly	Radiation Protection Booklet and policies Poster and chart Survey Questionnaire	Department budget	10,000php 2,000php 5,000php	Atleast 98% improved confidence among staff
Radiologic technologist's practices towards radiation protection	Implementation of non-punitive system/reporting for incidents, mandatory check the lead apron by providing logbook in the radiology department, and enforce a strict dosimeter compliance especially during radiation exposure examinations	Chief Radiologic Technologist and Radiologic Technologists	Everyday Monthly Everyday	Logbook, reporting sheet Logbook Dosimeter	Department budget	2,000php 2,000php None	Atleast 98% actionable insights leading to improvement

Radiologic technologists' clinical experiences towards radiation protection	Organize annual mandatory radiation protection training for all personnel, including residents and technologists, track and report monthly dosimetry data to staff, with mandatory counseling if doses exceed intervention levels.	Radiation Protection Officers, Chief Radiologic Technologists	Annually Monthly	Training materials Logbook, Dosimeter	Department budget	10,000php 2,000php	Atleast 98% continuous improvement
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Rationale

Radiation protection attitudes, practices, and clinical experiences play a crucial role in shaping healthcare outcomes, particularly in environments where diagnostic imaging and therapeutic radiation were routinely used. The combination of these elements provides meaningful insights that extend beyond individual performance. They contribute to a more comprehensive approach that integrates external factors such as patient safety, workflow coordination, and interprofessional collaboration.

By implementing such strategies, healthcare institutions can significantly enhance their radiologic technologists' attitudes, practices, and clinical experiences regarding radiation protection protocols. This recommended intervention plan aims to foster a supportive environment for the development of radiologic technologists' approach to radiation exposure and to maintain a safe working environment.

Conclusion

Radiologic technologists in selected hospitals in Batangas demonstrate a very positive attitude toward radiation protection, always comply with the radiation protection practices and very high level of clinical experiences towards radiation protection. attitude does not significantly influence their radiation protection practices. However, the respondents with better attitudes and stronger radiation protection toward radiation protection tend to gain greater clinical experience. Therefore, the proposed intervention plan focuses sustaining radiologic technologists' attitudes, practices, and clinical experiences related to radiation protection protocols.

Recommendations

To maintain a strong radiation protection attitude, safe practices, and a high level of clinical competence among radiologic technologists, continuous assessment of both personal and professional development is essential. Strengthening awareness and adherence to radiation protection principles helps ensure the highest standards of patient safety and

quality care. Radiologic technologists must be consistently reminded and required to practice proper safety measures, including the mandatory use of dosimeters and appropriate radiographic protective equipment during all radiation exposure procedures to prevent deterministic effects (e.g., skin burns, cataracts) and reduce stochastic risks (e.g., cancer). Compliance with these protocols should be regularly monitored and reinforced within clinical settings. Furthermore, ongoing education through structured training programs, seminars, and workshops is highly recommended, these can lead to a better technical skills to reduce the exposure time, improve judgment in imaging decisions and have a greater familiarity with safety protocols. Sustained professional development will support radiologic technologists in delivering safe, effective, and high-quality diagnostic services.

References

- Abis, A., & Felizarte, L. (2025). Attitude and Adherence to Radiation Safety Protocols among Radiologic Technologists in General Radiography: An Explanatory Sequential Design. *International Journal of Research Publication and Reviews*, 6(5), 17277–17285. <https://ijrpr.com/uploads/V6ISSUE5/IJRPR47154.pdf>
- Abuelhia, E., Alghamdi, A., Tajaldein, A., Mabrouk, O., Bakheet, A., Alsaleem, H., Alaraik, W., MSmar, A., Quwaihes, F., Alshahrani, K., Hlosh, Y., Alghamdi, S., & Aljondi, R. (2022). Dental Undergraduates and Interns' Awareness, Attitudes, and Perception of Radiological Protection. *International Journal of Dentistry*, 2022, 1–6. <https://doi.org/10.1155/2022/5812627>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Aldahery, S. T. (2023). Assessment of radiographers' knowledge about radiation doses and DRLs in computed tomography departments in Jeddah, Saudi Arabia: A cross-sectional study. *Saudi Pharmaceutical Journal : SPJ*, 31(11), 101820. <https://doi.org/10.1016/j.jsps.2023.101820>
- Alhaddad, O., Sherfad, M. H., & Shaka, M. A. (2024). Radiation Protection Knowledge, Attitudes, and Practices Among Fluoroscopy-Utilizing Doctors at Misurata Medical Centre, Libya. *AlQalam Journal of Medical and Applied Sciences*, 7(3), 664–670. <https://doi.org/10.54361/ajmas.247331>
- Alhorani, Q., Al-Ibraheem, A., Rawashdeh, M., Alkhybari, E., Sabarudin, A., Latiff, R. A., & Mohamad, M. (2024). Investigating knowledge of DRLs, image quality and radiation dose in PET/CT and CT imaging among medical imaging professionals. *Heliyon*, 10(9), e30030–e30030. <https://doi.org/10.1016/j.heliyon.2024.e30030>
- Alkhayal, A. M., Alothman, A., Alathel, A. H., Almaslamani, A., Alfrhaid, O. N., Alhassan, I. A., Alrabeeah, K. A., & Ghazwani, Y. G. (2023). Knowledge and attitude of radiation safety and the use of protective measures among healthcare workers in a tertiary center. *European Review for Medical and Pharmacological Sciences*, 27, 2047–2051. <https://www.europeanreview.org/wp/wp-content/uploads/2047-2051.pdf>
- Allam, S. M. E., Algany, M. M. A. and, & Mohamed, Y. I. A. K. (2024). Radiation safety compliance awareness among healthcare workers exposed to ionizing radiation. *BMC Nursing (Online)*, 23(1). <https://doi.org/10.1186/s12912-024-01858-4>
- Almas, S. W., Peristiowati, Y., & Wardani, R. (2023). Factors Related to the Implementation of X-Ray Radiation Safety Management in the Radiology Unit in East Kalimantan, Indonesia. *Journal of Health Policy and Management*, 8(3), 170–177. <https://doi.org/10.26911/thejhpm.2023.08.03.01>

- Alnaaimi, M. A., Alduaij, M. A., Shenawy, F. A., Algaily, M. M., Mohammedzein, T. S., Alkandri, F. A., Shaban, M. O., & Alenezi, S. A. (2021). National Diagnostic Reference Levels for Nuclear Medicine in Kuwait. *Journal of Nuclear Medicine Technology*, *50*(1), 54–59. <https://doi.org/10.2967/jnmt.121.262175>
- Alomairy, N. A. (2023). Evaluating the Knowledge and Attitudes Towards Radiation Protection in Portable Radiological Examinations Among Nurses in Pediatric Intensive Care Units. *Radioprotection*, *59*(1), 36–41. <https://doi.org/10.1051/radiopro/2023044>
- Alrobiee, H. O. S., Alsowihri, A. B., Alotaibi, F. A. M., Alotaibi, F. F., Alkhtani, M. F., Kabeer, M. O., Hamad, B. O., Alotaibi, A. Dufallh, Aldawsari, K. M., Almutairi, F. M., Al-Dosari, A. S. A., & Almousa, M. A. N. (2023). Awareness Of Radiation Protection Measures Among Radiologists And Non-Radiologists. *Migration Letters*, *20*(S1), 2422–2427. <https://migrationletters.com/index.php/ml/article/view/8741>
- Alshabi, Y. A., Yasawy, M. A., Makhdoom, A. K., Kablaghli, R. A., Alanazi, K. S., Eid, S. M., & Imran, W. M. (2022). Knowledge Regarding Ionizing Radiation Exposure Safety Among Orthopedic Surgeons at Hospitals in Al-Madinah. *Cureus*, *14*(10). <https://doi.org/10.7759/cureus.30738>
- Alsiddiky, A., Alabdulkarim, N., Altwaijri, N., Awwad, W., & Bakarman, K. (2021). Knowledge, Attitude and Practice of Occupational Radiation Safety among Physicians in Saudi Arabia. *International Journal of Medical Research & Health Sciences*, *10*(8), 95–106. <https://www.ijmrhs.com/medical-research/knowledge-attitude-and-practice-of-occupational-radiation-safety-among-physicians-in-saudi-arabia.pdf>
- Alyousef, K., Assiri, A., Almutairi, S., Aldalham, T., & Felimban, G. (2023). Awareness of Radiation Protection and Common Radiation Dose Levels among Healthcare Workers. *Global Journal on Quality and Safety in Healthcare*, *6*(1). <https://doi.org/10.36401/jqsh-22-14>
- Amaoui, B., Safini, F., Lahlou, L., El Fahssi, M., Abbaoui, S., & Semghouli, S. (2023). Physicians' knowledge about radiation protection of patients during prescription of CT scan procedures in Morocco. *Radiation Medicine and Protection*, *4*(1), 54–59. <https://doi.org/10.1016/j.radmp.2023.02.004>
- Antunes-Raposo, J. A., França, D., Lima, A., Mendonça-Galaio, L., & Sacadura-Leite, E. M. (2022). Evaluation of personal protective equipment use in healthcare workers exposed to ionizing radiation in a Portuguese university hospital. *Revista Brasileira de Medicina Do Trabalho*, *20*(02), 240–248. <https://doi.org/10.47626/1679-4435-2022-661>
- Anushya, P., Jayaraman, & Lakshmi, M. (2022). Knowledge, attitude, and practice of lead aprons among dental practitioners and specialists. *Journal of Advanced Pharmaceutical Technology & Research*, *13*. https://doi.org/10.4103/japtr.japtr_230_22
- Association of periOperative Registered Nurses (AORN). (2025). *Surgical, Operating Room, & Other Perioperative Standards*. AORN SAFE SURGERY TOGETHER. <https://www.aorn.org/guidelines-resources/guidelines-for-perioperative-practice>
- Babu, A., Wilson, M., Chawla, S., & Sukumar, S. (2024). Knowledge And Attitude Of Nurses About Radiation Safety And Radiation Protection: A Scoping Review. *Research Gate*, *13*(5), 49–53. <https://doi.org/10.9790/1959-1305064953>
- Bahakeem, B., Binafeef, R., Alammar, R., Aljadaibi, A., Alshammari, A., Alshammari, F., Orfi, M., Babour, R., Alyousif, S., Radif, W., & Alzahrani, K. (2024). Knowledge, Attitude, and Perception Regarding Radiation Hazards and Protection among Saudi Arabia's General Population. *Archives of Pharmacy Practice*, *15*(S).

- <https://archivepp.com/storage/files/article/e6336e1e-1409-41dd-9fef-9daf63e3de26-h7VwNpVXQNAPPZPC/yGsqGJ5raOf7XsR.pdf>
- Balter, S., Rodriguez, M. A., Pike, J. A., & Kleiman, N. J. (2021). Microbial Contamination Risk and Disinfection of Radiation Protective Garments. *Health Physics*, 120(2), 123–130. <https://doi.org/10.1097/hp.0000000000001387>
- Bandura, A. (1977). Social Learning Theory. *Canadian Journal of Sociology*, 2(3).
- Bernardo, M. O., Morgado, F., dos Santos, A. A. S. M. D., Foley, S., Paulo, G., & de Almeida, F. A. (2022). Impact of a radiological protection campaign in emergency paediatric radiology: a multicentric observational study in Brazil. *Insights into Imaging*, 13(1). <https://doi.org/10.1186/s13244-022-01180-0>
- Chatzis, A., Brilakis, E., Papadopoulou, D., Giannouli, V., Stamouli, M.-A. ., Goula, A., Sarris, M., & Soulis, S. (2021). Beliefs and behaviours of radiographers and other health professionals concerning radiation protection safety in a high-volume Greek public hospital. Development of a new measuring instrument. *Radiography*, 27(4), 1038–1043. <https://doi.org/10.1016/j.radi.2021.04.005>
- Cherry, K. (2024, May 5). *The Components of Attitude*. Verywell Mind. <https://www.verywellmind.com/attitudes-how-they-form-change-shape-behavior-2795897>
- Choi, K. (2023). An empirical analysis of the relationship between understanding, attitudes, and practices toward radiation – Focusing on the population eligible for South Korean National Health Insurance Service Examination. *Journal of Radiation Research and Applied Sciences*, 16(4), 100671. <https://doi.org/10.1016/j.jrras.2023.100671>
- Clarete, P. M. D., Mondejar, M. A. D., Quimba, N. R. L., & Carlos, J. G. (2023). A Descriptive-Correlational Study on Personality Traits and Entrepreneurial Intentions of Senior High School Learners. *International Journal of Multidisciplinary: Applied Business and Education Research*, 4(12), 4460–4472. <https://doi.org/10.11594/ijmaber.04.12.22>
- Dang-ao, D. B., & Cabatay, D. C. (2025). KNOWLEDGE, ATTITUDES, AND PRACTICES OF RADIOLOGIC TECHNOLOGISTS ON RADIATION PROTECTION IN SELECTED MILITARY HOSPITALS IN THE NATIONAL CAPITAL REGION. *International Journal of Education Humanities and Social Science*, 08(02), 714–729. <https://doi.org/10.54922/ijehss.2025.0951>
- Elmorabit, N., Obtel, M., Azougagh, M., & Ennibi, O. (2024). Radiation protection knowledge and practices among Moroccan dentists: A cross-sectional study. *Radiation Medicine and Protection*, 5(2), 131–138. <https://doi.org/10.1016/j.radmp.2024.03.001>
- Fadzil, M. S. A., Anuar, W. A. F. W., Yusof, N. E. M., Zuber, S. H., Ahmad, R., Saparuddin, A. K. A., & Kadir, A. B. A. (2025). Monitoring occupational radiation exposure and safety measures among radiological technologists in Malaysia: Trainees profile. *Radiation Physics and Chemistry*, 236, 112998. <https://doi.org/10.1016/j.radphyschem.2025.112998>
- Fataftah, J., Raed Tayyem, R., Al-Dwairy, S., Manasra, A., Ibrahim, A., Randa Al Ryalat, Mallak Alwreikat, Hebatuallah Al-Shraah, Alharbi, R., & Alharbi, B. (2024). Awareness of radiation hazards and knowledge of radioprotective measures among radiologists and non-radiology staff: a cross-sectional survey. *The Egyptian Journal of Radiology and Nuclear Medicine*, 55(1). <https://doi.org/10.1186/s43055-024-01300-4>
- Fiagbedzi, E., Gorleku, P. N., Nyarko, S., Asare, A., & Ackah Ndede, G. (2022). Assessment of radiation protection knowledge and practices among radiographers in the central region

- of Ghana. *Radiation Medicine and Protection*, 3(3).
<https://doi.org/10.1016/j.radmp.2022.06.001>
- Frane, N., & Bitterman, A. (2023). Radiation Safety and Protection. *StatPearls Publishing, Treasure Island*. <https://europepmc.org/article/nbk/nbk557499#impact>
- George, J., Shafqat, N., Verma, R., & Patidar, A. B. (2023). Factors Influencing Compliance with Personal Protective Equipment (PPE) Use among Healthcare Workers. *Cureus*, 15(2).
<https://doi.org/10.7759/cureus.35269>
- Göde, A., Erdem, H., Abdullah Dadak, & Güneş Açıkgoz. (2025). Investigation of the role of radiation protection knowledge of health workers on radiation attitude. *BMC Health Services Research*, 25(1). <https://doi.org/10.1186/s12913-025-13565-0>
- Goula, A., Chatzis, A., Stamouli, M.-A., Kelesi, M., Kaba, E., & Brilakis, E. (2021). Assessment of Health Professionals' Attitudes on Radiation Protection Measures. *International Journal of Environmental Research and Public Health*, 18(24), 13380.
<https://doi.org/10.3390/ijerph182413380>
- Gringco-Llegue, F. B. (2025). KNOWLEDGE, ATTITUDE, AND PERCEIVED RADIATION SAFETY CULTURE AMONG RADIOLOGIC TECHNOLOGIST IN DAVAO REGION. *DDC Professional Journal*, 6(2).
<https://www.davaodoctors.edu.ph/wordpress/wp-content/uploads/2025/06/LLEGUE-FLORIFE-G.pdf>
- Hammami, R., Ben Jmaa, A., Bahloul, A., Charfeddine, S., Ellouze, T., Mallek, S., Ben Mrad, I., Abid, L., Kammoun, S., & Jdid, J. (2021, March 23). *Assessment of the practices and knowledge among cardiologists regarding radiation protection in Tunisia*. <https://Europepmc.org/Article/Med/34178219#Free-Full-Text>; Europe PMC.
<https://europepmc.org/article/med/34178219#free-full-text>
- Harbaj, I., Kharchaf, A., Chakir, E., & Harbaj, S. (2024). Evaluation of radiation protection knowledge and practices among Moroccan operating room nurses. *Radioprotection*, 60(2). <https://doi.org/10.1051/radiopro/2024049>
- Heravi, M. A. Y., Keshtkar, M., Khoshdel, E., Pishgadam, M., Poorbarat, S., & Hesari, M. J. (2024). Evaluation of the Status of Knowledge, Attitude, and Performance of Radiology Department Staff Regarding Radiation Safety Principles at Hospitals in the North and Northeast of Iran. *Frontiers in Biomedical Technologies*, 11(2).
<https://doi.org/10.18502/fbt.v11i2.15346>
- Hijikata Yasukazu, Kotani, Y., Suzuki, A., Koichi Morota, Haruki Funao, Miyagi, M., Morimoto, T., Kanno, H., & Ishii, K. (2023). Protective Attitudes toward Occupational Radiation Exposure among Spine Surgeons in Japan: An Epidemiological Description from the Survey by the Society for Minimally Invasive Spinal Treatment. *Medicina*, 59(3), 545–545. <https://doi.org/10.3390/medicina59030545>
- Hijikata, Y., Kotani, Y., Suzuki, A., Koichi Morota, Haruki Funao, Miyagi, M., Morimoto, T., Kanno, H., & Ishii, K. (2023). Protective Attitudes toward Occupational Radiation Exposure among Spine Surgeons in Japan: An Epidemiological Description from the Survey by the Society for Minimally Invasive Spinal Treatment. *Medicina*, 59(3), 545–545. <https://doi.org/10.3390/medicina59030545>
- Hout, J. D., & Ryu, J. (2024). The association between musculoskeletal disorders and lead apron use in healthcare workers: A systematic review and meta-analysis. *Safety Science*, 181, 106669–106669. <https://doi.org/10.1016/j.ssci.2024.106669>
- Hussin, I., Khan, A., & Hussin, M. (2024). Assessing the Level of Radiation Protection and Safety Compliance of Radiographers Currently Employed in the Makkah Cluster

- Hospitals. *IJFMR*240522085, 6(5).
https://www.ijfmr.com/papers/2024/5/22085.pdf?utm_source=consensus
- Hwang, S.-Y., Park, J.-E., & Jang, J.-H. (2022). Factors Influencing Protective Behaviors for Dental Radiation Exposure among Female Korean Dental Hygienists Using Health Belief Model. *International Journal of Environmental Research and Public Health*, 19(1), 518. <https://doi.org/10.3390/ijerph19010518>
- International Commission on Radiological Protection (ICRP). (2024). ETHICS IN RADIOLOGICAL PROTECTION FOR MEDICAL DIAGNOSIS AND TREATMENT. *Annals of the ICRP*, 53(3), 3–149. <https://doi.org/10.1177/01466453231220518>
- International Safety Standards | IAEA. (2022). International Atomic Energy Agency. <https://www.iaea.org/resources/rpop/resources/international-safety-standards>
- Jang, S. Y., Kim, H. S., Jeong, S. H., & Kim, Y. M. (2023). Factors Affecting Radiation Protective Behaviors in Perioperative Nurses Applying the Theory of Planned Behavior: Path Analysis. *Journal of Korean Academy of Nursing*, 53(2), 222–222. <https://doi.org/10.4040/jkan.22099>
- Karpuz, N. (2023). Radiation Attitudes in Associate Degree Students. *International Journal of Computational and Experimental Science and ENgineering (IJCESEN)*, 9(3), 238–247. <https://doi.org/10.22399/ijcesen.1333513>
- Keshtkar, M., & Masoumi, H. (2021). Evaluation of Knowledge and Practice of Radiographers and Operating Room Personnel about Radiation Protection: Importance of Training Courses. *Frontiers in Biomedical Technologies*, 8(4). <https://doi.org/10.18502/fbt.v8i4.7759>
- Khalili, N., Zakariaee, S., Gharebaghi, E., Salehi, Y., & Changizi, V. (2022). Evaluation of annual staff doses and radiation shielding efficiencies of thyroid shield and lead apron during preparation and administration of ^{131}I , ^{81}Kr , and $^{99\text{m}}\text{Tc}$ -Labeled radiopharmaceuticals. *Journal of Medical Signals & Sensors*, 12(1), 90. https://doi.org/10.4103/jmss.jmss_45_20
- Khanday, S. A., & Khanam, D. (2023, February 4). *THE RESEARCH DESIGN*. ResearchGate. https://www.researchgate.net/publication/368257495_THE_RESEARCH_DESIGN
- Khiyani, N., & Singh, V. (2022). X-ray Image Production Equipment Operation. In *StatPearls*. StatPearls Publishing. <https://pubmed.ncbi.nlm.nih.gov/33232083/>
- Kim, S. J., & Kim, Y. H. (2024). Factors Influencing Radiation Protection Behavior of Nurses in Intensive Care Units. *Journal of Korean Critical Care Nursing*, 17(3), 1–13. <https://doi.org/10.34250/jkccn.2024.17.3.1>
- Kumar, S., Sinha, S., Khan, Y., Kumar, A., Qureshi, O. A., & Jameel, J. (2023). Knowledge, Attitude, and Practices Regarding Radiation and its Hazards Among Orthopaedic Surgeons in India: A Questionnaire-Based Study. *Indian Journal of Orthopaedics*, 58(2), 182–189. <https://doi.org/10.1007/s43465-023-01068-1>
- Kyei, K. A., Addo, H. B., & Daniels, J. (2025). Radiation safety: knowledge, attitudes, practices and perceived socioeconomic impact in a limited-resource radiotherapy setting. *Ecancermedicalscience*, 19. <https://doi.org/10.3332/ecancer.2025.1855>
- Lee, S. J., Boo, S., Ahn, J.-A., & You, M.-A. (2020). Factors Affecting Radiation Protection Behaviors among Emergency Room Nurses. *Journal of Korean Critical Care Nursing*, 13(1), 15–26. <https://doi.org/10.34250/jkccn.2020.13.1.15>
- Leonardsen, A. L. (2023). The Impact of Clinical Experience in Advanced Practice Nursing Education—A Cross-Sectional Study of Norwegian Advanced Practice Nurses'

- Perspectives. *Nursing Reports*, 13(3), 1304–1317.
<https://doi.org/10.3390/nursrep13030110>
- Lewis, S., Downing, C., & Hayre, C. M. (2021). Using the theory of planned behaviour to determine radiation protection among South African diagnostic radiographers: a cross-sectional survey. *Journal of Medical Radiation Sciences*, 69(1).
<https://doi.org/10.1002/jmrs.537>
- Liu, X., Liu, Y., Xiong, P., Guo, S., Zhang, L., & Liao, L. (2024). The radiation protection behavior of medical workers: A scoping review protocol. *PLoS ONE*, 19(8), e0308479–e0308479.
<https://doi.org/10.1371/journal.pone.0308479>
- Lumanog, I. K. (2025). Radiation Safety Awareness and Practices among Public Health Workers in Medina General Hospital. *IJIRMP*, 13(4).
<https://www.ijirmps.org/papers/2025/4/232690.pdf>
- Macharia, M. (2021). Evaluation of Radiation Protection (Knowledge, Attitude, and Practices) and Radiation Side Effects Awareness Among Health Workers in Bungoma Country Referral Health Facilities. *University of Nairobi*.
- Magdaluyo, K. B., & Quirante Jr., J. (Eds.). (2023). *Knowledge, Attitude, and Practices of the Radiologic Technologist in Imaging Equipment Maintenance*. Scribd.
<https://www.scribd.com/document/726595845/Research-for-Gramarian-1>
- Matre, S., Sapkal, S., Chunkhare, M., & Tulpule, S. (2025). Knowledge and practice of radiation safety among radiographers in the radiology department in Pune, India. *Egyptian Journal of Radiology and Nuclear Medicine*, 56(1). <https://doi.org/10.1186/s43055-025-01454-9>
- Melaño, C. (2023). Radiologic Technologists' Knowledge, Attitude and Practices in Radiation Protection: Formulation or Radiation Protection Plan. *DDC Professional Journal*, 4(4), 182–193.
<https://www.davaodoctors.edu.ph/wordpress/wp-content/uploads/2023/09/DDC-Professional-Journal-Vol-4No1-.pdf>
- Mellis, S., Zhang, Y., & McAteer, D. (2024). Awareness of radiation risks by medical students & referrers requesting radiological examinations in the North of Scotland: an audit. *BMC Medical Education*, 24(1). <https://doi.org/10.1186/s12909-024-05461-8>
- Occupational Safety and Health Administration. (2023). *Personal Protective Equipment - Overview | Occupational Safety and Health Administration*. [www.osha.gov](https://www.osha.gov/personal-protective-equipment).
<https://www.osha.gov/personal-protective-equipment>
- Omar, M., Esam E. A. Desoky, Basheer Elmohamady, Alaa El-Shaer, & Noureldin, Y. A. (2021). Awareness and implementation of ionizing radiation safety measures among urology community in Egypt: nationwide survey. *Journal Africain d'Urologie (French Additional)/African Journal of Urology/African Journal of Urology*, 27(1).
<https://doi.org/10.1186/s12301-020-00110-0>
- Park, S., & Yang, Y. (2021). Factors Affecting Radiation Protection Behaviors among Emergency Room Nurses. *International Journal of Environmental Research and Public Health*, 18(12), 6238. <https://doi.org/10.3390/ijerph18126238>
- Rahimi, A. M., Nurdin, I., Ismail, S., & Khalil, A. (2021). Malaysian Nurses' Knowledge of Radiation Protection: A Cross-Sectional Study. *Radiology Research and Practice*, 2021(1), 1–8. <https://doi.org/10.1155/2021/5566654>
- Rincón, G., González, Y., & Sánchez, C. (2024). RISK PERCEPTION AMONG WORKERS EXPOSED TO IONIZING RADIATION: A QUALITATIVE VIEW. *Radioprotection*, 59(3).
<https://doi.org/10.1051/radiopro/2024004>

- Risk Sciences International. (2025, July 4). *Risk perception research*. Risk Sciences International. <https://risksciences.com/risk-perception-research/>
- Rodrigues, B. V., Lopes, P. C., Mello-Moura, A. C., Flores-Fraile, J., & Veiga, N. (2024). Literacy in the Scope of Radiation Protection for Healthcare Professionals Exposed to Ionizing Radiation: A Systematic Review. *Healthcare*, 12(20), 2033–2033. <https://doi.org/10.3390/healthcare12202033>
- Roger, E. (1995). *Diffusion of innovations*, The Free Press, New York, NY.
- Rohland, L. (2023). *Practice (learning method) | Research Starters | EBSCO Research*. EBSCO. <https://www.ebsco.com/research-starters/religion-and-philosophy/practice-learning-method>
- Rollon, J., & Sison, M. (2025). Knowledge, Awareness & Compliance Of Radiologic Technologists With Radiation Safety Principles In Mobile Radiography In Selected Hospitals In Metro Manila. *International Journal of Education Humanities and Social Science*, 08, 630–645. <https://doi.org/10.54922/IJEHSS.2025.0943>
- Rühm, W., Yu, H., Clement, C., Ainsbury, E. A., Sylvain Andresz, Bryant, P., Chapple, C.-L., Pascal Croüail, Damilakis, J., Ermacora, M. G., Tapani Eurajoki, Gering, F., Molyneux-Hodgson, S., Hupe, O., Impens, N., Lassmann, M., Martins, J. O., Lorenzo Nicola Mazzone, Mogg, C., & Morgan, J. (2023). ICRP workshop on the review and revision of the system of radiological protection: a focus on research priorities—feedback from the international community. *Journal of Radiological Protection*, 43(4), 043001–043001. <https://doi.org/10.1088/1361-6498/acf6ca>
- Sain, A., Awasthi, S., Ukoh, O., Wattage, K., Elkilany, A., & Avasthi, A. (2023). SAFE USE OF FLUOROSCOPY AND PERSONAL PROTECTION EQUIPMENT IN TRAUMA & ORTHOPAEDICS. *Georgian Medical News*, 344, 129–132. <https://pubmed.ncbi.nlm.nih.gov/38236113/>
- Saleem, F., & Malik, M. I. (2022). Safety Management and Safety Performance Nexus: Role of Safety Consciousness, Safety Climate, and Responsible Leadership. *International Journal of Environmental Research and Public Health*, 19(20), 13686. NCBI. <https://doi.org/10.3390/ijerph192013686>
- Salem, H. T. (2022). A Questionnaire Survey on Radiation Protection among Medical Staff Working in Cardiac Catheterization Laboratory. *Egyptian Journal of Radiation Sciences and Applications*, 35(1-2), 83–89. <https://doi.org/10.21608/ejrsa.2023.174112.1142>
- Sheth, B., Jesia, A., Parihar, R., Somani, R., & Pawar, P. (2022). Are Indian orthopaedic surgeons aware of the health hazards of radiation exposure? A survey and review on awareness and ways to mitigate them. *Journal of Clinical Orthopaedics and Trauma*, 32, 101982. <https://doi.org/10.1016/j.jcot.2022.101982>
- Shiri, R., El-Metwally, A., Sallinen, M., Pöyry, M., Härmä, M., & Toppinen-Tanner, S. (2023). The role of continuing professional training or development in maintaining current employment: A systematic review. *Healthcare*, 11(21), 1–17. <https://doi.org/10.3390/healthcare11212900>
- Shubayr, N. (2023). Factors Influencing Radiologic Technologists' Commitment to Radiation Protective Equipment Utilization in Fluoroscopy Units: An Analysis Using the Health Belief Model Scale. *Radioprotection*, 59(2), 138–143. <https://doi.org/10.1051/radiopro/2023046>
- Shubayr, N., Muawwad, M., Shami, M., Jassas, H., Tawhari, R., Oraybi, O., Madkhali, A., Aldosari, A., & Alashban, Y. (2024). Assessment of radiation safety culture among

- radiological technologists in medical imaging departments in Saudi Arabia. *Radioprotection*, 59(1), 30–35. <https://doi.org/10.1051/radiopro/2023042>
- Shungube, A., & Khoza, T. E. (2023). Compliance with radiation protection among radiographers in Eswatini public health facilities. *Health SA Gesondheid*, 29(0), 12. https://hsag.co.za/index.php/hsag/article/view/2727/5369?utm_source=chatgpt.com
- Siddiquee, A. (2025). The Impact of Occupational Radiation Exposure on Radiographers and the Practical Realities of Radiation Protection Practices. *International Journal of Scientific Research in Engineering and Management (IJSREM)*, 9(6). <https://doi.org/10.55041/IJSREM50507>
- Snowden, G., Jabbal, M., & Akhtar, A. (2022). Radiation safety awareness and practices amongst orthopaedic surgeons in Scotland. *Scottish Medical Journal*, 67(3), 103–108. <https://doi.org/10.1177/00369330221099620>
- Umaru, Babagana, Yusuf, S. D., Idris, M. M., & Hambali, S. U. (2024). Assessment of Attitude, Behaviours and Knowledge of Health and Medical Staff on Radiation Safety Awareness and Protection Compliance. *African Journal of Advances in Science and Technology Research*, 15(1), 36–45. <https://doi.org/10.62154/1fhpvr53>
- Wan, R. C., Chau, W. W., Tso, C. Y., Tang, N., Chow, S. K., Cheung, W.-H., & Wong, R. M. (2021). Occupational hazard of fluoroscopy: An invisible threat to orthopaedic surgeons. *Journal of Orthopaedics, Trauma and Rehabilitation*, 28, 221049172110355. <https://doi.org/10.1177/22104917211035547>
- Yang, S., Liu, L., Wang, T., Guo, Y., Qian, Y., & Chen, H. (2024). The Impact of Accident Experience on Unsafe Behaviors of Construction Workers Within Social Cognitive Theory. *Buildings*, 15(1), 59–59. <https://doi.org/10.3390/buildings15010059>
- Yashima, S., & Chida, K. (2022). Awareness of Medical Radiologic Technologists of Ionizing Radiation and Radiation Protection. *International Journal of Environmental Research and Public Health*, 20(1), 497. <https://doi.org/10.3390/ijerph20010497>
- Yurt, A., Ayrancıoğlu, C., Kılınc, G., & Ergönül, E. (2022). Knowledge, attitude, and behavior of Turkish dentists about radiation protection and radiation safety. *Dentomaxillofacial Radiology*, 51(1), 20210120. <https://doi.org/10.1259/dmfr.20210120>