Knowledge, Attitude, and Practice of Infection Prevention and Control among Radiologic Technologists in Davao City

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Abstract

This study developed an enhancement program aimed at improving the infection prevention and control strategies of radiologic technologists by assessing their current level of knowledge, attitude, and practice regarding infection prevention and control. This research used a developed survey questionnaire that underwent a rigorous process including qualitative interviews, quantitative Exploratory Factor Analysis (EFA), and validation through content validity. Reliability was measured using Cronbach's alpha, while the Mann-Whitney U and Kruskal-Wallis tests were used to ensure fair measurement across different demographic groups. This investigation employed a quantitative descriptive survey method. It adhered to ethical standards and research laws to protect participants' rights and ensure research integrity. Employing simple random sampling, 39 radiologic technologists from selected Level 3 Private hospitals in Davao City participated in the study. Mean and Standard Deviation analyses were conducted. The findings showed that radiologic technologists demonstrated a very high knowledge (M=71.79, SD=17.947), a strongly positive attitude (M=4.47, SD=0.403), and excellent practices concerning infection prevention and control (M=4.43, SD=0.426). However, their knowledge of transmission-based precautions was moderate (M=54.70, SD=24.765), indicating an area for improvement. Based on these findings, the proposed enhancement program primarily aims to increase their knowledge of infection prevention and control, particularly on transmission-based precautions. This will be achieved through expert-led educational workshops and seminars, hands-on training, and peer mentorship. These findings underscore the need for continuous education and reinforcement of infection prevention and control protocols to uphold the highest patient safety standards in medical imaging departments.

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Introduction

Infection prevention and control are vital for ensuring patient safety and reducing the incidence of healthcare-associated infections (Tabash et al., 2024). However, despite the availability of comprehensive infection prevention and control guidelines, improper implementation and low compliance rates among healthcare professionals, including radiologic technologists, remain a global concern (Nyirenda et al., 2019; Duwal et al., 2022; Alshahrani et al., 2024). Several studies have reported inconsistencies in the levels of knowledge, attitude, and practices of radiologic technologists toward infection prevention and control (Abu Awwad et al., 2023; Alnahhal et al., 2023).

For instance, a study by Gareeballah et al. (2023) highlights that although radiologic technologists demonstrate acceptable knowledge of infection prevention and control, significant gaps persist. Dihako et al. (2023) echoed these concerns, stating that while knowledge and attitudes are adequate, adherence to protocols remains poor. Similarly, Jimenez and Lewis (2023) noted inconsistencies in training and implementation of infection prevention and control guidelines within medical imaging departments, advocating for system-based approaches to mitigate risks of healthcare-associated infections and protect both healthcare professionals and patients.

In the Philippines, a study by de Claro et al. (2023) pointed out that inconsistent monitoring undermines the effective implementation of infection prevention and control practices among Filipino healthcare professionals. Ablin et al. (2021) also highlights gaps in the knowledge, attitudes, and practices of radiologic technologists regarding aseptic techniques in emergency and trauma imaging, suggesting a pressing need for reinforced infection prevention and control strategies in medical imaging departments.

Previous studies have emphasized the importance of adequate knowledge and positive attitudes in ensuring proper infection prevention and control practices (Alhumaid et al., 2021) and have focused on healthcare professionals in the nursing department (Nasiri et al., 2019). However, research on infection prevention and control among radiologic technologists remains limited and methodologically inconsistent (Lewis et al., 2022). Moreover, recent studies emphasize the need for on-going education and monitoring to ensure adherence to infection prevention and control practices among radiologic technologists (Dihako et al. 2023; Gareeballah et al. 2023).

To address this gap, the present study developed a proposed enhancement program aimed at improving the knowledge, attitude, and practice of radiologic technologists regarding infection prevention and control. This was achieved by assessing their current levels through a rigorously developed survey questionnaire tailored specifically for radiologic technologists. As emphasized by Naji et al. (2022), assessing these factors is a crucial first step in designing an effective and responsive enhancement program.

Methods

This study utilized a descriptive survey research design and involved 39 radiologic technologists from selected Level 3 private hospitals in Davao City. Participants were selected through simple random sampling, ensuring each individual had an equal chance of selection, promoting an unbiased and statistically robust sample (Taylor, 2023).

The study used a developed survey questionnaire that underwent a rigorous process. It began with qualitative interviews with seven radiologic technologists. Each interview lasted approximately 40 to 55 minutes and followed a semi-structured format, including sample questions such as "Can you share important principles you think are crucial for infection prevention and control in your role as a radiologic technologist?" and "Are there difficulties you see in maintaining a positive outlook on infection prevention and control in your workplace?". The data gathered from the qualitative interviews were analyzed using Colaizzi's (1978) method. This systematic approach involved extracting significant statements, formulating meanings, and clustering these meanings into themes, which formed the basis for developing the initial 75 items of the survey tool. Exploratory Factor Analysis (EFA) was conducted with 220 radiologic technologists, refining the questionnaire to 47 items by removing those with factor loadings below 0.30 (Tavakol & Wetzel, 2020) and those with face validity concerns (Hair et al., 2010). Content validity was confirmed by expert evaluation, yielding a Content Validity Index (CVI) score of 1. Reliability was assessed using Cronbach's alpha (≥ 0.70) (DeVellis, 2016). To ensure fairness, Mann-Whitney U and Kruskal-Wallis tests were conducted, showing no significant differences across gender, age, and years of experience ($p > 0.05$).

The knowledge scale includes three components: standard precautions, transmission-based precautions, and infection risks, assessed through 14 true or false statements (1 point per correct answer, 0

for incorrect). The attitude scale consists of 19 statements on self-efficacy, perception of effectiveness, sense of responsibility, and perceived importance, rated on a five-point Likert scale (strongly disagree to strongly agree with a neutral option). The practice scale also has three components: disposal and disinfection, personal protective and hygiene measures, and patient placement and environmental safety, measured using 21 statements on a five-point Likert scale (never to always).

Data collection was conducted in coordination with the Chief Radiologic Technologists of selected Level 3 private hospitals in Davao City. To minimize disruption, the researcher provided the survey questionnaires to the Chief Radiologic Technologists, who then distributed them to their teams. Participation in the survey was voluntary with no coercion or pressure from the Chief Radiologic Technologists. Informed consent was obtained before survey completion, and confidentiality and anonymity of responses were strictly maintained. Explanations about the study and instructions for completing the survey were included in the questionnaire form. After retrieving all completed questionnaires, the data were carefully screened for outliers, then encoded, tabulated, and analyzed. Upon completion of the study, all raw data were securely and properly disposed of.

To analyze the results, Mean and Standard Deviation were used to assess the levels of knowledge, attitude, and practice of radiologic technologists regarding infection prevention and control.

Results and Discussion

Table 1. Level of Knowledge of Infection Prevention and Control among Radiologic Technologists

Knowledge of Infection Prevention and Control Items	Mean	SD	Description
Standard Precautions	70.83	28.000	High
Transmission-based Precautions	54.70	24.765	Moderate
Infection Risks	91.45	21.245	Very High
Overall Mean	**71.79**	**17.947**	**High**

Legend: 84.00-100. 00 Very High, 68.00-83.99 High, 52.00-67.99 Moderate, 36.00-52.99 Low, 20,00-35.99 Very Low

Table 1 presents the level of knowledge regarding infection prevention and control among radiologic technologists. The knowledge of infection prevention and control includes three indicators: standard precautions, transmission-based precautions, and infection risks. It garnered an overall mean score of 71.79, described as high, which indicates a high level of knowledge across these indicators, with a notable standard deviation of 17.947 suggesting variability in knowledge levels within the surveyed group.

Among the three indicators, radiologic technologists demonstrate high proficiency in infection risks, achieving a mean score of 91.45 which is described as very high, highlighting high knowledge of infection risks associated with infection prevention and control protocols. In terms of standard precautions, the results show that radiologic technologists exhibit a high knowledge with a mean score of 70.83, which is described as high. This means that radiologic technologists are knowledgeable about the basic and fundamental standard precautions in infection prevention and control. In contrast, in terms of transmission-based precautions, radiologic technologists garnered the lowest mean score of 54.70, which is described as moderate, suggesting an area for potential improvement within this specific aspect of infection prevention and control.

These findings support the study of Abu Awwad et al. (2023), which also found a high level of knowledge among radiologic technologists regarding infection prevention and control. However, the study highlighted gaps in knowledge related to infection control measures, emphasizing the need for enhanced education on transmission-based precautions within medical imaging departments. Moreover, the results align with the study of Naji et al. (2022), which revealed that nearly half of the radiologic technologists

who participated in the study had a moderate understanding of transmission modes. Furthermore, Gareeballah et al. (2023) emphasized the importance of training in improving radiologic technologists' knowledge of infection prevention and control. Thus, these findings highlight a specific area for improvement in the knowledge of infection prevention and control among radiologic technologists, particularly regarding transmission-based precautions.

Table 2. Level of Attitude towards Infection Prevention and Control among Radiologic Technologists

Attitude towards Infection Prevention and Control Items	Mean	SD	Description
Self-efficacy	4.35	.451	Strongly Positive
Perception of Effectiveness	4.65	.353	Strongly Positive
Sense of Responsibility	4.41	.527	Strongly Positive
Perceived Importance	4.32	.721	Strongly Positive
Overall Mean	**4.47**	**.403**	**Strongly Positive**

Legend: 4.20-5.00 Strongly Positive, 3.40-4.19 Positive, 2.60-3.39 Neutral, 1.80-2.59 Negative, 1.00-1.79 Strongly Negative

Table 2 shows the level of attitude towards infection prevention and control of radiologic technologists. The attitude towards infection prevention and control has four indicators such as self-efficacy, perception of effectiveness, sense of responsibility, and perceived importance. The overall mean is 4.47, described as strongly positive while its standard deviation is 0.403, suggesting a positive and high level of consensus or agreement among radiologic technologists.

In the category of self-efficacy, the highest mean was observed in confidence in infection prevention and control improving patient outcomes, with a mean of 4.79, described as strongly positive. Meanwhile, the lowest mean value is in the confidence in properly donning and doffing PPE, with a mean of 4.08, also described as strongly positive. The category mean is 4.35, which is described as strongly positive. This means that radiologic technologists generally possess a high level of confidence in their ability to implement infection prevention and control measures effectively, although there is slightly less confidence in their skills related to the proper use of PPE. This high level of self-efficacy suggests that radiologic technologists are well-prepared to handle infection prevention and control responsibilities, contributing positively to overall healthcare safety.

In the category of perception of effectiveness, the results show that radiologic technologists exhibit the highest mean in the belief that infection prevention and control maintain a safe and healthy environment in the medical imaging department, with a mean of 4.87, described as strongly positive. While the lowest mean is in the belief that infection prevention and control is applicable everywhere not just in hospitals, with a mean of 4.41, also described as strongly positive. The category mean is 4.65, which is described as strongly positive. These findings suggest that radiologic technologists have strong belief in the effectivity of infection prevention and control practices in maintaining a safe and healthy environment within the medical imaging department. The slightly lower, though still strongly positive, response regarding the applicability of infection prevention and control measures beyond hospital settings may indicate that while radiologic technologists recognize the positive effect of infection prevention and control in their immediate work environment, there may be less emphasis of its broader application in non-healthcare settings. Overall, the category indicates a strong positive perception of effectiveness among radiologic technologists regarding infection prevention and control practices in their professional environment.

Regarding sense of responsibility, the highest level is represented by recognizing the responsibility to uphold infection prevention and control measures, with a mean of 4.79, described as strongly positive.

The lowest mean is in the taking of responsibility for applying infection prevention and control in every medical imaging procedure, described as strongly positive, with a mean of 4.21. The category mean is 4.41, which is described as strongly positive. This denotes that radiologic technologists take their responsibility for infection prevention and control seriously, particularly in recognizing the importance of upholding infection prevention and control measures in their practice. However, the slightly lower mean for consistently applying these measures in every procedure suggests there may be room for improvement in ensuring full compliance across all medical imaging tasks.

Lastly, in terms of perceived importance, the highest mean garnered a score of 4.41, described as strongly positive in the belief that strict implementation of infection prevention and control protocols is important. While the lowest mean is in the belief that consistently wearing PPE is necessary for self-protection, with a mean of 4.21, described as strongly positive. The category mean is 4.32, which is described as strongly positive. This indicates that radiologic technologists place a high value on the strict implementation of infection prevention and control protocols, demonstrating a strong understanding of their significance. However, the slightly lower mean for consistently wearing personal protective equipment (PPE) suggests there may be varying levels of adherence to this practice, highlighting an area where further emphasis on PPE use could enhance protection.

These findings support the study of Dihako et al. (2023), which revealed that the majority of radiologic technologists hold a positive attitude toward infection prevention and control. Moreover, similar findings were also revealed by Naji et al. (2022), where more than two-thirds of the participating radiologic technologists had a positive attitude toward infection prevention and control. This high percentage of radiologic technologists with positive attitudes reinforces the consistency of these findings, suggesting a broadly shared commitment to infection prevention and control measures among radiologic technologists.

Table 3. Level of Infection Prevention and Control Practice among Radiologic Technologists

Infection Prevention and Control Practice Items	Mean	SD	Description
Disposal and Disinfection	4.68	.325	Excellent
Personal Protective and Hygiene Measures	4.14	.734	Good
Patient Placement and Environmental Safety	4.38	.399	Excellent
Overall Mean	4.43	.426	**Excellent**

Legend: 4.20-5.00 Excellent, 3.40-4.19 Good, 2.60-3.39 Moderate, 1.80-2.59 Poor, 1.00-1.79 Very Poor

Table 3 presents the result of the level of infection prevention and control practice of radiologic technologists. There are three indicators of infection prevention and control practice namely disposal and disinfection, personal protective and hygiene measures, and patient placement and environmental safety. The overall mean is 4.43, described as excellent, while the standard deviation is .426. This indicates a high degree of proficiency and uniformity in infection prevention and control practices among radiologic technologists. The consistently high mean score and low standard deviation suggest that radiologic technologists not only practice infection prevention and control effectively but also demonstrate a consistent approach across the different indicators, ensuring reliable and standardized implementation of these measures.

In the category of disposal and disinfection, the highest mean was observed in adherence to proper disposal procedures for used gloves and masks, with a mean score of 4.82, described as excellent. While the lowest mean was in ensuring proper doffing and disposal of PPE, with a mean of 4.51, also described as excellent. The category mean is 4.68, described as excellent. This indicates that radiologic technologists consistently demonstrate proper disposal and disinfection practices, particularly in handling used gloves and masks. The slightly lower mean for the proper doffing and disposal of PPE suggests that while these practices are excellent overall, there may be minor gaps in consistently following the correct procedures for removing protective equipment.

For personal protective and hygiene measures, the highest mean was recorded in the use of different

gloves for every patient, with a mean of 4.28, described as excellent. Whereas the lowest mean was in the use of UV light for room disinfection after medical imaging procedures, with a mean of 3.74, described as good. The category mean is 4.14, which is described as good. This indicates that radiologic technologists are highly diligent in using gloves appropriately for each patient, reflecting a strong adherence to basic personal protective measures. However, the lower mean for using UV light to disinfect rooms suggests that advanced sanitation practices may not be as consistently implemented, possibly due to limitations in resources or equipment availability.

Regarding patient placement and environmental safety, the highest mean was found in sanitizing equipment and high-touch areas between patients, with a mean of 4.77, described as excellent. While the lowest mean was in ensuring appropriate PPE use based on patient condition and placement needs, with a mean of 4.00, described as good, The category has a mean score of 4.38, which is described as excellent. This denotes that radiologic technologists excel in sanitizing equipment and high-touch areas, ensuring a clean and safe environment for patients. However, the lower mean for appropriate PPE use based on patient condition suggests there may be opportunities to improve compliance with PPE protocols in relation to patient placement and specific clinical needs.

These findings are supported by a study of Abu Awwad et al. (2023), demonstrating good infection prevention and control practices among radiologic technologists. Conversely, studies by Gareeballah et al. (2023) and Alnahhal et al. (2023) have revealed a moderate level of practice of infection prevention and control among radiologic technologists. Additionally, a study by Dihako et al. (2023) identified a poor level of practice toward infection prevention and control among radiologic technologists. The findings of this study suggest that while the current study demonstrates commendable infection prevention and control practices among radiologic technologists, there remains a need for continued research to explore ways to further improve these practices, particularly considering variations that may exist across different healthcare settings and geographic regions. This indicates a call for ongoing efforts in education, training, and policy implementation to sustain and elevate infection prevention and control standards in radiologic technology.

Table 4. Proposed Enhancement Program to Improve Knowledge, Attitude, and Practice Levels of Radiologic Technologists Toward Infection Prevention and Control

Program Objectives	Description
Increase Knowledge	Enhance understanding of infection prevention and control, with a focus on transmission-based precautions.
Strengthen Attitudes	Foster a more positive and proactive attitude towards infection control practices.
Improve Practices	Ensure consistent application of best practices in infection prevention and control.

Program Components	Objective	Activities	Evaluation	Expected Outcomes
Educational Workshops and Seminars	Improve knowledge, particularly on transmission-based precautions.	- Mandatory upon employment workshops on infection prevention and control led by infection prevention and control experts covering the World Health Organization (WHO) and Centers for	- Pre- and post-workshop quizzes. - Feedback forms for session evaluation.	10% increase in knowledge scores.

		Disease Control and Prevention (CDC) guidelines for standard precautions and transmission-based precautions. - Annual in-house interactive seminars on the latest updates regarding infection prevention and control protocols. - Case studies on common infection risks in medical imaging.		
Peer Mentorship and Support Programs	Reinforce a positive and responsible attitude towards infection prevention and control.	- Establish a mentorship program pairing experienced Technologists with new staff. - Regular peer and group discussions to share experiences, challenges and personal responsibility for infection prevention and control. - Recognition and rewards for exemplary adherence to infection control protocols.	- Attitude surveys to measure changes in perception and confidence. - Monitoring of mentorship participation and feedback.	20% increase in attitude scores.
Simulation-Based Training	Enhance skills and confidence in infection control practices.	- Quarterly simulation exercises on donning and doffing PPE in accordance with the WHO and CDC guidelines. - Hands-on waste management, environmental	- Skills assessment by trainers. - Self-efficacy surveys before and after training sessions.	- 90% increase in proficiency in PPE donning/doffing and environmental cleaning. - Pre/post self-efficacy surveys aiming for 25% confidence increase.

		cleaning, and disinfection drills based on WHO and CDC protocols. - Role-playing scenarios to practice communication and implementation of infection prevention and control measures.		
Hands-On Disinfection Practices	Strengthening compliance with disinfection protocols and improving technique.	- Hands-on training for proper disinfection of high-touch surfaces and equipment following WHO/CDC disinfection guidelines. - Spot-checks by infection prevention and control team or authorized personnel.	-Observational audits in compliance with disinfection protocol. - Participant feedback with a target 80% satisfaction on training effectiveness	90% improvement in adherence to equipment and surface disinfection protocols.
Personal Hygiene Improvement Initiative	Improve hand hygiene and personal protective equipment (PPE) use.	Hand hygiene practice sessions and demonstration on effective handwashing techniques. - Visual reminders in handwashing areas and PPE stations.	- Compliance audits with a target of 90% hand hygiene adherence. - Participant feedback aiming for 85% positive perception on hand hygiene importance.	85% increase in correct hand hygiene and PPE use.
Enhanced Communication and Feedback Mechanisms	Ensure continuous improvement and adherence to infection prevention and control protocols.	- Monthly meetings should include discussion on infection prevention and control issues and improvements. - Anonymous suggestion boxes for feedback on	- Analyze feedback trends and reports. - Track improvement in infection prevention and control adherence rates.	80% sustained improvement in infection prevention and control knowledge and practice adherence

		infection prevention and control practices. - Regular updates on IPC policy changes based on WHO/CDC guidelines.		
Ongoing Monitoring and Evaluation	Maintain high standards and identify areas for continuous improvement.	- Routine audits of infection prevention and control practices in the medical imaging department. - Routine inspections of infection prevention and control adherence (e.g., hand hygiene, PPE use, cleaning protocols). - Continuous professional development opportunities related to infection prevention and control.	- Audit reports and comparison with WHO/CDC standards. - Regular reviews of infection prevention and control practice levels to ensure continuous improvement.	95% increase in consistency in daily and routine adherence to infection prevention and control practices.

Implementation Timeline	Activities
Month 1-3	- Kick-off workshops and initial training sessions. - Set up peer mentorship programs. - Establish communication channels for feedback.
Month 4-6	- Conduct the first round of simulation exercises. - Hold first peer discussion groups. - Implement the first round of audits and reviews.
Month 7-9	- Continue regular workshops and training sessions. - Evaluate the effectiveness of the mentorship program. - Analyze feedback and make necessary adjustments.
Month 10-12	- Conduct follow-up audits and performance reviews. - Hold an end-of-year evaluation meeting to assess overall program impact. - Plan for next year's training and improvement initiatives.

Overall Expected Outcomes	Description
Increased Knowledge	Higher scores on knowledge assessments, particularly in transmission-based precautions, with pre- and post-assessment scores showing a target 10% improvement in knowledge.
Enhanced Attitudes	More proactive and confident attitudes toward infection prevention and control, with stronger adherence to WHO/CDC recommendations, as measured by attitude surveys.

Improved Practices	Increased consistency in applying infection prevention and control protocols (e.g., PPE use, hand hygiene, and environmental disinfection) with higher compliance rates demonstrated through audits.

Table 4 presents the proposed enhancement program, designed to improve radiologic technologists' knowledge, attitudes, and practices in infection prevention and control. This was developed with the assistance of a data analysis expert, based on the survey findings, which highlighted strong attitudes and practices, as well as variable knowledge across key dimensions. The program integrates educational workshops and seminars, hands-on training, and peer mentorship. It aligns with the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) guidelines to ensure the adoption of best practices. The structured approach includes ongoing monitoring and feedback mechanisms to address identified gaps and reinforce high standards in infection prevention and control.

Conclusion and Recommendations

The current study concluded that the level of knowledge of radiologic technologists regarding infection prevention and control is high, particularly in infection risks. However, knowledge of transmission-based precautions was moderate, indicating a need for improvement. Attitudes toward infection prevention were strongly positive across all categories, and infection control practices were excellent, especially in disposal and disinfection measures. The proposed enhancement program, aligned with the World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) guidelines, is designed to address knowledge gaps, particularly in transmission-based precautions, and to strengthen infection prevention and control practices. It incorporates structured educational workshops, regular training and simulation exercises, peer mentorship, and improved communication strategies to ensure consistent and comprehensive adherence to infection control protocols.

To sustain and further enhance the high levels of knowledge, attitude, and practice among radiologic technologists, continuous professional development programs should be emphasized. Given the moderate knowledge of transmission-based precautions, targeted training initiatives such as workshops, seminars, and e-learning modules are recommended to improve understanding in this area. Additionally, implementing ongoing monitoring and evaluation mechanisms will help assess the effectiveness of these interventions and ensure continuous improvement over time.

Further research is encouraged to evaluate the long-term impact and sustainability of the proposed enhancement program by tracking changes in infection prevention and control knowledge, attitudes, and practices among radiologic technologists. Qualitative research methods, including interviews and focus groups, could provide deeper insights into the experiences and challenges faced by participants. Future studies should also consider using correlational or experimental designs to establish causality, increasing sample sizes for more robust factor analysis, and incorporating Confirmatory Factor Analysis (CFA) to strengthen the validation of measurement tools. Expanding the study's scope to a broader range of hospitals and regions, as well as refining the survey tool through additional validity tests and expert feedback, would enhance the reliability and applicability of the findings across diverse healthcare settings.

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