Radiological technicians' Compliance with Safety Measures Practices at Zagazig University Hospitals

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Abstract

Background: The nature of radiological technicians' work exposes them to ionizing radiation-related occupational hazards, underscoring the critical role of compliance with radiation safety measures in safeguarding their occupational health. This study aimed to assess radiological technicians' compliance with safety measures practices at Zagazig University Hospitals. **Methods: Research design:** A descriptive, cross-sectional design was utilized. **Setting:** This study was conducted at eleven radiation units of Zagazig University Hospitals, Sharkia Governorate, Egypt. **Participants:** A convenient sample of 140 radiological technicians from the above-mentioned setting. **Tools of data collection:** Two tools were used for data collection: a self-administered questionnaire assessing demographic characteristics, work-related health hazards and occupational safety equipment status, and an observational checklist assessing compliance with safety measures practices. **Results:** The study found that 97.5% of the technicians reported physical hazards as the most prevalent occupational health hazards, 62.9% had moderate total compliance level regarding safety measures practices, with education, experience, work-related health hazards and training as key determinants for compliance level. **Conclusion:** The most prevalent occupational health hazards among technicians was physical hazard. Nearly two-thirds of radiological technicians had a moderate total compliance level regarding safety measures practices. Educational level, years of experience, exposure to work-related health hazards, and training were all significant positive predictors of compliance levels regarding safety measures practices.

Recommendation: pre-and-maintaining periodic program on radiological hazards and compliance with safety measures should be conducted to all radiological technicians.

Keywords: Compliance; Occupational Hazards; Radiation Safety; Radiological Technicians; Safety Measures.

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Introduction

Radiological technicians play a vital role in contemporary healthcare by operating sophisticated diagnostic imaging equipment, including X-ray systems, computed tomography (CT) scanners, and magnetic resonance imaging (MRI) units, to support the accurate diagnosis and management of various medical conditions **(Abuzaid et al., 2022).** Despite their essential contribution to patient care, they are routinely exposed to occupational hazards, particularly ionizing radiation, which may result in both short- and long-term adverse health effects **(Shubayr, 2024).**

Compliance with radiation safety measures involves the consistent use of personal protective equipment, including lead aprons, thyroid shields, lead gloves, lead glasses, and personal dosimeters, in addition to applying the fundamental radiation protection principles of time, distance, and shielding **(International Atomic Energy Agency, 2022).** Effective compliance significantly reduces occupational radiation exposure and protects both healthcare workers and patients from unnecessary radiation risks **(World Health Organization, 2024).** However, previous studies have demonstrated that compliance among radiological personnel remains inconsistent due to factors such as inadequate radiation safety training, limited availability of protective equipment, excessive workload, and insufficient institutional supervision **(Allam *et al.*, 2024; Fataftah *et al.*, 2024).**

Despite the widespread availability of radiation protection measures, compliance with recommended safety practices remains inconsistent due to the influence of both individual and organizational factors. Individual determinants, particularly radiological technicians' knowledge and awareness of radiation hazards, play a fundamental role in promoting adherence to safety

guidelines. Organizational factors, including the provision of high-quality radiation protective equipment (RPE), a positive workplace safety culture, continuous organizational support, and effective hazard awareness programs, also significantly influence compliance with radiation safety practices **(Abuzaid et al., 2022).**

Healthcare institutions that implement comprehensive radiation safety policies, provide regular educational and training programs, and ensure the availability of adequate protective resources generally achieve higher levels of compliance than institutions with insufficient support or inconsistent safety procedures. Therefore, assessing radiological technicians' compliance with radiation safety measures is essential for improving workplace safety, minimizing occupational health risks, and promoting the well-being of healthcare professionals working in radiology departments **(Ali et al., 2025).**

Significance of the study

The utilization of ionizing radiation in medical imaging and radiation therapy has increased substantially in recent years, reflecting its expanding role in healthcare. Globally, more than 3.6 billion diagnostic radiological examinations, approximately 37 million nuclear medicine procedures, and nearly 7.5 million radiotherapy treatments are performed annually **(World Health Organization, 2025).** In addition, an estimated 2.3 million healthcare professionals work in environments involving radiation exposure worldwide, with nearly half of all healthcare workers being exposed to artificial sources of ionizing radiation during their professional duties **(Provenzano et al., 2021).** Improved compliance contributes to reducing occupational radiation doses, protecting healthcare workers from both deterministic and stochastic effects of ionizing radiation, and enhancing patient safety by minimizing unnecessary radiation exposure during imaging procedures **(International commission of radiation protection, 2021).**

In Egypt, recent evidence has revealed inadequate awareness of radiation safety and suboptimal adherence to radiation protection practices among healthcare professionals, highlighting the need for continuous education and training initiatives **(Allam et al., 2024).**

Aim of the study

The aim of this study was to assess radiological technicians' compliance with safety measures practices at Zagazig University Hospitals.

Research question

- What is the radiological technicians' practice regarding compliance with safety measures?
- Is there a relation between radiological technicians' practice regarding compliance with safety measures and their characteristics?
- Is there a relation between radiological technicians' practice regarding compliance with safety measures and the status of occupational safety equipment?

Methods

Research design

A descriptive cross- sectional study design was utilized in the current study.

Study setting

This study was carried out in the radiology units of Zagazig University Hospitals, Sharkia Governorate, Egypt. Zagazig University Hospitals comprise two healthcare sectors: the Main University Hospital Sector and the Sidnawi Hospital Sector. The radiology services are distributed across 17 radiology units, of which 11 units are located within the University Hospital Sector and 6 units are located within the Sidnawi Hospital Sector.

Study sample

A convenience sample of 140 radiology technicians working in the radiation units of Zagazig University Hospitals was recruited for the study. The sample included 95 technicians from the University Hospital Sector and 45 technicians from the Sidnawi Hospital Sector. In addition, 14 radiology technicians participated in the pilot study, bringing the total number of participants to 154. However, those who participated in the pilot study were excluded from the final study sample. Within **the main University Hospital Sector,** X-ray Units and Intervention Radiation Units each comprised 25.3% (n = 24) of the technicians, followed by Nuclear Radiation Units (17.8%, n = 17), while CT Units and DXA Scan Units each accounted for 15.8% (n = 15). In **the Sidnawi Hospital Sector,** Cardiac Catheterization Units represented the highest proportion of technicians (28.9%, n = 13), followed by X-ray Units (22.3%, n = 10), Mammography Units (17.8%, n = 8), and both CT and MRI Units (15.5%, n = 7 each).

Tools of data collection

Data was collected using two tools:

Tool I: Self-administered questionnaire consisted of three parts:

Part (I): Demographic Characteristics of the Radiological Technicians: It involved data such as age, sex, residence, educational level, years of experience, income, and training courses.

Part (II): Work-related health hazards as reported by technicians: This section assessed the presence of work-related health hazards among

technicians, including the types of hazards encountered and the health effects of radiation exposure on different body systems. It also explored other health-related problems, such as signs of infection, acute radiation sickness, cancer, and psychological disorder

Part (II): Occupational safety equipment status in the workplace environment: This section included asking about the availability of personal protective equipment PPE, sufficiency, appropriateness or fitness and periodical maintenance, supervision, punishment against unused personal safety measures and its type.

Tool II: An observation checklist of the radiological technicians' compliance with safety measures practices: It was adapted from **Abuzaid et al (2022)** and **Ahmed et al (2021)** to assess compliance of radiological technicians with safety measures practice before, during and after work. The checklist consisted of 30 observational items distributed across four dimensions include compliance with personal protective equipment PPE (9 items including gloves, gown, mask, badges, apron, lead cover, etc.……), safe work procedures (5 items including time, distance, shielding, hand and eye washing), client protection (7 items including instructions given to patients before and after procedure, use of patient protection devices and methods), work setting compliance (9 items including posting, labeling, security, cleaning as well as protecting the surrounding environment).

Scoring system

The observation checklist was scored using a three-point Likert scale: **3 = Always, 2 = Sometimes, and 1 = Never**, with higher scores indicating a greater level of compliance with safety measures among radiographers. The total score was converted into a percentage by dividing the obtained score by the maximum possible score and multiplying the result by 100. The total possible score ranged from **30 to 90**.

Based on the percentage score, participants' compliance levels were categorized as follows:

- **Poor compliance:** < 60%
- **Moderate compliance:** 60% to 75%
- **Good compliance:** > 75%

Accordingly, higher percentage scores reflected better adherence to radiation safety measures and practices.

Tool validity and reliability

The validity of the study tools was assessed by a panel of five experts, including two professors and one assistant professor from the Department of Community Health Nursing, one professor from the Department of Geriatric Nursing, Faculty of Nursing, Zagazig University, and one professor from the Department of Community Medicine and Occupational Health and Safety, Faculty of Medicine. The panel reviewed the tools to evaluate the clarity, relevance, comprehensiveness, and suitability for the study objectives. The necessary modifications were made to ensure the accuracy and validity of the tools.

Reliability analysis of the study tools was assessed using Cronbach's alpha coefficient. The Observation Checklist of Compliance with Safety Measures Practices demonstrated a high level of internal consistency, with Cronbach's alpha value of **0.897.**

Field work

Following the acquisition of all required official approvals, data collection was conducted over a three-month period, from the beginning of January 2026 to the end of March 2026. The researcher met individually with each radiology technician to explain the study objectives, procedures, and data collection tools, and invited them to participate in the study. The time required to complete the study questionnaire ranged from 15 to 20 minutes for each participant. In addition, the observational checklist was completed by the researcher and required approximately 20 to 25 minutes for each observation. Data was collected during regular visits to the study settings. The researcher visited the Fieldwork of the Main University Hospital sectors twice weekly (Saturdays and Mondays) from 9:00 a.m. to 2:00 p.m., and the Sidnawi Hospital sector twice weekly (Sundays and Wednesdays) during the same time period. All data collection activities were carried out at the participants' workplaces within Zagazig University Hospitals. The number of radiology technicians recruited each day ranged from three to four participants.

Pilot study

A pilot study was carried out on 14 radiological technicians (10% of the calculated sample size) to assess the feasibility and applicability of the study tools, determine the clarity and comprehensiveness of the questionnaire items, and estimate the time needed for data collection. The technicians who participated in the pilot study were excluded from the main study sample.

Administrative and ethical consideration

Ethical approval was obtained from the Ethical Committee of the Faculty of Nursing, Zagazig University (Code: M.DZU.NUR/271/13/7/2025).

The study aims and objectives were explained to the participating radiological technicians, and oral informed consent was obtained prior to data collection. Participants were assured that the data would be kept confidential, used solely for research purposes, and reported anonymously. Participation was voluntary, and participants were informed of their right to refuse or withdraw from the study at any time without penalty.

Statistical analysis

Data were coded, entered, and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 20.0 (IBM SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. The Chi-square test (χ^2) or Fisher's Exact Test, when appropriate, was used to examine the association between categorical variables. Multiple linear regression analysis was performed to identify the predictors of radiological technicians' compliance with safety measures.

Significance of the results:

The level of statistical significance was determined according to the obtained p-value. Results were considered highly statistically significant when the p-value was less than 0.01, statistically significant when the p-value was less than 0.05, and not statistically significant when the p-value was equal to or greater than 0.05

Results

Table (1) clarifies that 51.4% of the radiological technicians were females and 41.4% aged less than 30 years old. Additionally, the residency of radiological technicians was equally distributed between rural and urban areas (50 % each), 75% graduated from a Technical Health Institute. Furthermore, 40% had more than 10 years of experience, 95.7% reported having only sufficient monthly income, while 70.7% stated that they had received training on radiation safety and protective measures.

Figure (1) delineates that 97.5% of the technicians reported physical hazards as the most prevalent occupational health hazards, followed by psychological hazards 26.4%, and then physics hazards 23.1%, and lastly biological hazards 5%.

Table (2) displays the technicians' compliance with safety measures practices. Regarding PPE, observations revealed that 66.4% of technicians occasionally complied with wearing masks, while 73.6% showed partial compliance to monitoring badges. In contrast, consistent compliance was lower for gloves (29.3%) and gowns (26.4%). Of particular note, 24% of technicians were observed to never comply with the use of lead gloves & thyroid shields. In terms of safe work practices, 65% of the technicians exhibited occasional compliance with both distance and shielding. Meanwhile, 25.7% of technicians also consistently complied with distance and 22.1% for timing. Nevertheless, 17.9% never complied with regular hand washing. With reference to patient protection procedures, partial compliance was markedly observed for both cone usage (74.4%) and beam limitation (68.6%), while 27.9% of technicians were consistently complied with providing instructions to the patient before radiological procedures, and 25.7% after procedures. Conversely, 18.6% demonstrated no compliance with using gonadal shields.

Table (3) reveals the radiation units' compliance with safety work conditions. With regard to compliance with radiation warning signs, it was observed that radiation warning signs were consistently displayed on the door in 27.9% of the units and sometimes displayed on equipment and contaminated areas (75% and 82.9%, respectively). Concerning units' cleaning and infection control standards, 67.1% of the units were observed to be sometimes complied with, both cleaning the department in each shift and disinfecting the surfaces. Additionally, 24.3% of the units were always compliant with infection control standards. As to protecting the surrounding environment, compliance was sometimes noted regarding the use of lead aprons inside the radiation room, keeping the radiation room door closed, and standing behind the control cabin during radiation exposure (67.1%, 20.7%, and 66.4%, respectively).

Table (4) elucidates that 62.9% of technicians had moderate compliance level regarding safety measures practices, whereas 24.3% demonstrated good compliance level, and 12.9% showed a poor compliance level.

Table (5) illustrates statistically significant relations between radiological technicians' total compliance levels regarding safety measures practices and specific types of occupational health hazards as biological hazards (P=0.032), physical hazards (P<0.001), radiation-related physical hazards (P<0.001), and psychological hazards (P<0.001).

Table (6) indicates that educational level (Beta=0.257), training on radiation safety (Beta=0.238), prior knowledge (Beta=0.201), years of professional experience (Beta=0.189), Presence of work-related health problems (Beta=0.181), and awareness of radiation hazards (Beta=0.140) were all significant positive predictors of radiation compliance levels regarding safety measures practices (P<0.05).

Discussion

Considering the answering of the first research question about radiological technicians' practice regarding compliance with safety measures, the findings of study results revealed that moderate compliance was predominant across all observation checklist domains. This reflected the technicians' moderate awareness level in addition to the fact that adhering to safety measures requires sustained behavioral change and consistent reinforcement.

Regarding Personal protective equipment, nearly three-quarters of technicians showed partial compliance with monitoring badges, while consistent compliance was lower for gloves at less than one-third and gowns at more than one-quarter, and nearly one-quarter of technicians were observed to never use lead gloves or thyroid shields. This might be attributed to the insufficient quantity of available PPE combined with the heavy workload that may lead technicians to prioritize procedural speed over full protective compliance.

This was affirmed by **Ali et al. (2025) in United Kingdom** who found that gonadal shielding and extremity protection were the least consistently applied safety measures among radiological technicians. Additionally, **Abuzaid et al. (2022) in United Arab Emirates** observed inconsistent compliance with radiation protection practices among radiology professionals, with partial use of PPE being the dominant pattern, particularly for thyroid collars and lead glasses.

In terms of safe work practices, occasional compliance with distance and shielding was observed in nearly two-thirds of technicians, while less than one-fifth never complied with regular hand washing. This might reflect a lack of integration of hand hygiene routines into the daily workflow of radiology department. This was compatible with **Awwad et al. (2023) in Palestine**, who reported inadequate hand hygiene compliance among radiographers in the radiology department, with less than one-third of staff washing their hands at the unit.

With reference to patient protection procedures, partial compliance was markedly observed for cone usage at nearly three-quarters and beam limitation at more than two-thirds, while less than one-fifth demonstrated no compliance with using gonadal shields. This might be attributed to the high daily volume of patients, which creates time pressure that may cause technicians to skip certain patient protection steps. This finding was supported by **Christensen et al. (2024),** who noted that techniques to minimize radiation exposure to patients, including using gonad shields, are sometimes not used consistently by radiology staff.

In the light of the current study, an observational checklist was used to assess the radiation units' compliance with occupational safety work conditions. **For posting and labeling,** the findings of the concurrent study results revealed that radiation warning signs were consistently displayed on the door in only more than one-quarter of units, while warning signs on equipment and contaminated areas were only sometimes present in three-quarters and nearly two-thirds of units respectively. **Regarding cleaning and infection control standards**, more than two-thirds of units were observed to sometimes comply, and nearly one-quarter consistently followed infection control standards.

As for protecting the surrounding environment, compliance with lead aprons used inside the radiation room, door closure, and standing behind the control cabin was only partial in more than two-thirds, more than two-thirds, and two-thirds of units respectively. These findings were attributed to the inadequate enforcement of unit-level safety protocols and the absence of a dedicated radiation safety officer who actively monitors daily environmental compliance.

In agreement with these findings, **Behzadmehr et al. (2021) in Iran** highlighted that environmental safety measures in radiology departments, including proper posting and labeling of radiation warning signs and room shielding compliance, were frequently inadequate. This finding was corroborated by **Allam et al. (2024) in Egypt** who noted that infection control and environmental safety compliance in Egyptian radiology settings required significant improvement. Additionally, **Bouabdellah et al. (2024) in Morocco**, elucidated that radiographers' attitudes toward patient radiation protection principles in the Souss Massa region remained variable and were not consistently reflected in actual environmental safety practice, reinforcing that positive attitudes alone are insufficient to ensure complete compliance without supportive institutional infrastructure.

With regard to the overall compliance levels, the current study results revealed that nearly two-thirds of the studied radiological technicians had a moderate total compliance level regarding safety measures practices. The predominance of moderate compliance reflects a pattern of inconsistent safety practice, which might expose technicians to avoidable radiation risks over their careers. This might be explained by the fact that work practice tends to be deeply rooted in established habits, organizational culture or routine habits.

On the same line, Abuzaid et al. (2022) in United Arab Emirates illustrated that moderate compliance was the prevailing pattern among

radiology professionals in their study, attributing this to knowledge gaps and organizational barriers. In consonance with this, Ali et al. (2025) in United Kingdom demonstrated that fewer than one third of radiological technicians in their study achieved good compliance with all safety measure domains, underscoring the need for targeted interventional strategies.

In terms of the occupational health hazards associated with radiation exposure at work as reported by the studied radiological technicians, the present study identified that physical hazards were the most prevalent occupational health hazards. This might be due to the high daily workload, as well as the partially available of protective equipment. This finding was in accordance with **Eliwa et al. (2018)** in **Egypt**, who noted that health problems related to radiation exposure at work were most prevalent among technicians, with physical hazards constituting the most frequently reported hazard type among technicians.

On the other hand, **Ogenyi et al. (2020) in Nigeria** revealed that the most prevalent occupational problems were psychological and biological hazards among medical radiation workers. This discrepancy might be attributed to differences in study settings, participants' characteristics, workload patterns or occupational health and safety policies.

With reference to the relationships between health hazards related to radiation exposure at work and technicians' total compliance levels regarding safety measures Practices, the findings of the study results illustrates statistically significant relations between radiological technicians' total compliance levels regarding safety measures practices and specific types of occupational health hazards as biological hazards, physical hazards, radiation-related physical hazards, and psychological hazards. This result was due to the effectiveness of consistent compliance with radiation safety measures in minimizing occupational health hazards.

This result was consistent with **Eliwa et al. (2018) in Egypt**, who found a statistically significant negative correlation between occupational hazard exposure and compliance with safety measures among radiation health team. Likewise, **Anim-Sampong et al. (2022) in Ghana** reported that limited ergonomic training and equipment access, reflecting gaps in compliance-related resources, remained a significant predictor of physical hazard outcomes among radiographers. Congruently, **Hussein et al. (2022) in Egypt** who reported statistically significant negative correlations between knowledge and health problems and between practices and health problems among radiology health teams.

About the relationships between occupational safety equipment status and compliance levels, the findings of the existing results indicated highly statistically significant relations between compliance levels and the sufficiency of safety equipment, the appropriateness of safety equipment, and the availability of periodic maintenance. These findings confirmed that the physical work environment and institutional resource allocation are critical determinants of safety compliance.

The finding aligned with, **Ali et al. (2025)** in **United Kingdom,** who identified equipment availability and maintenance as among the strongest institutional predictors of radiation protection compliance. As well, **Abuzaid et al. (2022)** in **United Arab Emirates** reported that inadequate PPE supply and poor maintenance were significantly associated with lower compliance rates, reinforcing the need for sustained institutional investment in occupational safety infrastructure.

Considering the best fitting multiple regression model for total compliance levels, the result of the current study demonstrated that educational level, training on radiation safety, prior knowledge, years of professional experience, presence of health problems, and total awareness levels were all significant positive predictors of radiation compliance levels regarding safety measures practices. These findings emphasized that compliance is not solely determined by awareness, but is also influenced by the accumulated experience, formal education, and the perceived health consequences of radiation exposure.

In this respect, **Shubayr (2024)** in **Saudia Arabia** demonstrated that educational level and training were the strongest independent predictors of safety compliance in a regression analysis among radiology professionals. This was further supported by **Ali et al. (2025)** in **United Kingdom** who confirmed that both individual factors such as education and experience, and contextual factors such as awareness and health problem history, contributed independently to compliance levels in a multivariate model, consistent with the present study's regression findings. Compatibly, **Cao et al. (2025) in China** indicated that years of experience was a significant determinant of radiation safety compliance and awareness among radiological staff. Moreover, **Cao et al. (2025)** in **China** found that radiation protection knowledge exerted the strongest direct effect on protective behavior, confirming knowledge as a principal driver of safety practice

Conclusion

In light of the study's findings and answers to research questions, it can be concluded that the most prevalent occupational health hazards among technicians was physical hazard. Nearly two-thirds of radiological technicians had a moderate total compliance level regarding safety measures practices. Educational level, years of experience, exposure to work-related health hazards, and training were all significant positive predictors of compliance levels regarding safety measures practices.

Recommendations

Based on the study findings, it was recommended that

- Pre-and-maintaining periodic programs compliance with safety measures should be conducted to all radiological technicians.
- Ensure the full and sufficient availability of all types of personal protective equipment in all radiology units, with regular periodic maintenance and timely replacement to enable consistent compliance.
- Further research should be conducted using longitudinal and qualitative designs to explore barriers to compliance and evaluate the effectiveness of radiation safety interventions among radiological technicians in Egyptian hospital settings.

Authors' contributions حسب استايل المجلة

E.G suggested that research the research concept, drafted the proposal and interviewed the sample, collected and analyzed interpreted the data, and drafted the manuscript. The researcher idea was proposed by S. M., B. S, H.H. Participated to the study by reviewing and assisting in developing the research methodology, analyzing and interpreting the data, and discussion. All authors have read and approved the final manuscript.

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Table 1. Demographic Characteristics of the Studied Radiological Technicians (n=140)

Personal / Demographic Characteristics	No	%
Age (Years)		
< 30	58	41.4
30 – 40	50	35.7
> 40	32	22.9
Gender		
Male	68	48.6
Female	72	51.4
Residence		
Rural	70	50.0
Urban	70	50.0
Educational level		
Secondary education	8	5.7
Technical Health Institute	105	75.0
University education	27	19.3
Years of professional experience		
Less than 5 years	39	27.9

From 5 years – 10 years	45	32.1
More than 10 years	56	40.0
Monthly income		
Insufficient and requires borrowing	6	4.3
Sufficient only	134	95.7
Have you received training on radiation safety and protective measures?		
No	41	29.3
Yes	99	70.7

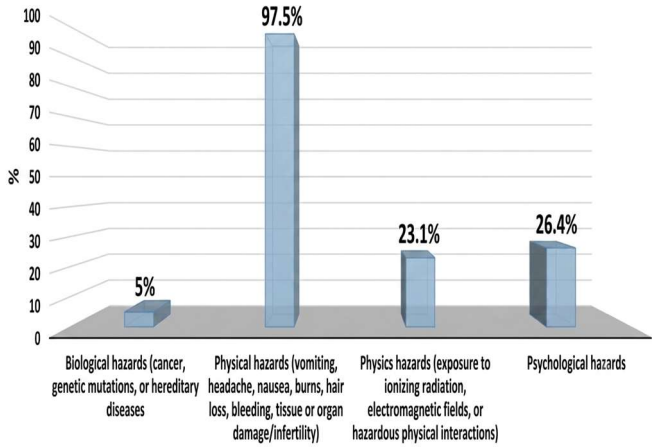

Figure 1: Occupational Health Hazards Resulting from Working in The Radiology Department as Reported by The Technicians Studied (Multi-Response) (n=121)

Table 2. Observation Checklist of Radiological Technicians' Compliance with Safety Measures Practices (n = 140)

Observed Safety Measures Practices	Never		Sometimes		Always	
	No	%	No	%	No	%
Commitment of the Healthcare Team to Personal Protective Equipment (PPE)						
Wearing gloves during work	13	9.3	86	61.4	41	29.3
Wearing a protective gown during work	14	10.0	89	63.6	37	26.4
Wearing an appropriate mask during work	18	12.9	93	66.4	29	20.7
Wearing appropriate monitoring badges during work	13	9.3	103	73.6	24	17.1
Wearing a head cover during work	19	13.6	85	60.7	36	25.7
Wearing eye protection during work	15	10.7	89	63.6	36	25.7
Wearing a lead apron during work	22	15.7	89	63.6	29	20.7
Using lead gloves during work	24	17.1	82	58.6	34	24.3
Wearing a thyroid shield during work	24	17.1	84	60.0	32	22.9
Commitment to Safe Work Practices						
Practicing safe work through optimal use of time	21	15.0	88	62.9	31	22.1
Practicing safe work while maintaining appropriate distance	13	9.3	91	65.0	36	25.7
Practicing safe work using protective shields	21	15.0	91	65.0	28	20.0
Washing hands regularly after each procedure	25	17.9	88	62.9	27	19.3
Washing eyes	21	15.0	89	63.6	30	21.4
Compliance with Patient Protection Procedures						
Providing instructions to the patient before radiological procedures	13	9.3	88	62.9	39	27.9
Providing instructions to the patient after radiological procedures	20	14.3	84	60.0	36	25.7
Using the light beam diaphragm to determine the size and area of X-rays emitted from the tube	15	10.7	96	68.6	29	20.7
Using the cone when necessary to accurately direct X-rays to a specific area	19	13.6	100	71.4	21	15.0
Using alignment (ensuring that the X-ray machine, the patient, and the detector are in a straight line)	20	14.3	90	64.3	30	21.4
Using a marker to place a radiographic mark on the image or document information	20	14.3	95	67.9	25	17.9
Using a gonadal shield	26	18.6	87	62.1	27	19.3

Table 3. Observation of the Radiation Units' Compliance with Occupational Safety Work Conditions (n = 10)

Compliance with Safety Conditions in the Work Environment (Radiation Unit)	Never		Sometimes		Always	
	No	%	No	%	No	%
Posting and Labeling						
Are radiation warning signs present on the door?	22	15.7	79	56.4	39	27.9
Are warning signs present on the equipment?	13	9.3	105	75.0	22	15.7
Placing signs on contaminated areas and Instruments	23	16.4	88	62.9	29	20.7
Units' Cleaning and Infection Control Standards						
Cleaning the department in each shift	18	12.9	94	67.1	28	20.0
Cleaning surfaces with a disinfectant solution	20	14.3	94	67.1	26	18.6
Following infection control standards	23	16.4	83	59.3	34	24.3
Protecting the Surrounding Environment						
Using a lead apron for all accompanying persons or staff inside the radiation room	21	15.0	94	67.1	25	17.9
Closing the radiation room door	14	10.0	99	70.7	27	19.3
Standing behind the control cabin or leaving the room	21	15.0	93	66.4	26	18.6

Table 4. Radiological Technicians' Total Compliance Levels Regarding Safety Measures Practices (n = 140)

Total Compliance Levels Regarding Safety Measures Practices	Poor compliance		Moderate compliance		Good compliance	
	n	%	n	%	n	%
Commitment to Personal Protective Equipment	11	7.9	91	65.0	38	27.1
Commitment to Safe Work Practices	14	10.0	89	63.6	37	26.4
Compliance with Patient Protection Procedures	12	8.6	92	65.7	36	25.7
Compliance with Safety Conditions in the Work	15	10.7	88	62.9	37	26.4
Observational checklist level	**18**	**12.9**	**88**	**62.9**	**34**	**24.3**

Table 5. Relationships Between Occupational Health Hazards Related to Radiation Exposure at Work and Technicians' Total Compliance Levels Regarding Safety Measures Practices (n = 121)

Items	Poor Compliance		Moderate Compliance		Good Compliance		Chi – square / Fisher's exact test	
	No	%	No	%	No	%	X2	P
Biological hazards (cancer, genetic mutations, or hereditary diseases								
No	17	94.4	87	98.9	30	88.2		
Yes	1	5.6	1	1.1	4	11.8	6.834	0.032*
Physical hazards (vomiting, headache, nausea, burns, hair loss, bleeding, tissue or organ damage/infertility)								
No	18	100	0	0.0	4	11.8		

Yes	0	0.0	88	100	30	88.2	113.352	<0.001**
Physical hazards (exposure to ionizing radiation, electromagnetic fields, or hazardous physical interactions)								
No	18	100	62	70.5	32	94.1		
Yes	0	0.0	26	29.5	2	5.9	13.746	<0.001**
Psychological hazards								
No	18	100	58	65.9	32	94.1		
Yes	0	0.0	30	34.1	2	5.9	17.187	<0.001**

(*) Statistically significant at p<0.05 (**) Statistically significant at p<0.01

Table 5. Relationships Between Occupational Safety Equipment Status in the Workplace Environment and Technicians' Total Compliance Levels Regarding Safety Measures Practices (n = 140)

Items	Poor Compliance		Moderate Compliance		Good Compliance		Chi – square / Fisher's exact test	
	No	%	No	%	No	%	X2	P
Are all types of safety equipment available in your work environment?								
Fully available	0	0.0	1	1.1	0	0.0		
Partially available	18	100.0	81	92.0	34	100.0		
Not available	0	0.0	6	6.8	0	0.0	4.354	0.360
Is safety equipment available in sufficient quantity?								
No	18	100.0	52	59.1	32	94.1		
Yes	0	0.0	36	40.9	2	5.9	22.910	<0.001**
Is the safety equipment in your work environment appropriate/usable?								
No	18	100.0	0	0.0	12	35.3		
Yes	0	0.0	88	100.0	22	64.7	93.882	<0.001**
Is periodic maintenance available for safety equipment in your work environment?								
No	18	100.0	0	0.0	19	55.9		
Yes	0	0.0	88	100.0	15	44.1	96.889	<0.001**

(**) Statistically significant at p<0.01

Table 6. Best fitting Multiple regression model for Technicians' Total Compliance Levels Regarding Safety Measures Practices (n = 140)

Items	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	60.252	5.206		11.574	<0.001**
Educational level	4.047	2.592	0.257	4.657	<0.001**
Years of professional experience	3.622	2.477	0.189	3.636	<0.001**
Do you have prior knowledge about radiation hazards and safety measures?	5.029	2.655	0.201	3.011	<0.001**
Have you received training on radiation safety and protective measures?	4.739	2.282	0.238	3.324	<0.001**
Do you have health insurance coverage	0.233	1.971	0.010	0.118	0.906
Do you have any health problems resulting from working in the radiology department?	4.670	2.241	0.181	2.084	0.039*
Total Awareness Levels	4.623	2.340	0.140	2.465	0.023*

(*) Statistically significant at p<0.05 **(**) Statistically significant at p<0.01**

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