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Assessment of Adherence to Radiation Protection Protocol and Practice in Radiology Department

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Abstract

Aims: This study assesses the knowledge of radiation protection and adherence to radiation safety measurements of healthcare workers who employ ionizing radiation as a day-to-day practice. **Material and Methods**: Data on 130 occupational workers who work in the radiology department of King Abdul-Aziz Medical City, Riyadh, Saudi Arabia, were acquired using a convenience sampling technique. The duration of the study was from May 2021 to December 2021. A cross-sectional study and a suitably and structured questionnaire adapted from the previous similar studies was used. **Results:** A total of 130 distributed questionnaires, 101 of which were received back with a response rate of 77.69%. In total, 37 (36.6%) female and 64 (63.4%) male radiographers participated in this study. Table 1 summarizes the radiographer's demographic information, including age and degree of education. The radiographer's ages ranged from 24 to 45 years old. Approximately 94.1% held a bachelor's degree, whereas less than a quarter earned a master's degree (4%) or Ph.D. (2%). The results show that many radiology technologists have good adherence, but we find that they need more knowledge about the importance of wearing aprons and keeping the minimum distance to improve their adherence to radiation protection. **Conclusion:** Our study showed that the majority of the radiographers had high to moderate adherence to radiation protection practices, except for a few of the parameters.

Keywords
Radiation Protection, Awareness, Thermoluminescent Dosimeter (TLD), Protection Protocols.

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INTRODUCTION:

Excessive exposure to radiation is dangerous, and strong exposure may even cause skin burns and radiation sickness. Studies have shown that children are at greater risk of radiation-related illnesses than adults; therefore, the application of radiation protection protocols is vital. It is essential to properly protect patients and healthcare workers against ionizing radiation because it has harmful effects, such as genetic mutations and somatic effects. Medical radiology workers are more often exposed to radiation than patients and therefore are more susceptible to diseases associated with radiation, and it is important for them to know the importance of the radiation protection protocol and apply it to themselves before applying it to patients. [1-2] Uncontrolled exposure to ionizing radiation has been shown to cause damage to live tissue, such as deterministic effects like radiation sickness and skin burns, as well as stochastic effects like an increased risk of tumors and genetic damage at low exposure. [5] Recent studies have shown that about 3.6 billion imaging studies per year are carried out worldwide, indicating an increase of 70% in the collective effective dose of radiation for medical diagnostic procedures.[6] The use of radiation in medical applications continues to increase worldwide; all these procedures must be performed by medical personnel who could potentially be exposed to occupational radiation. Does the rising demand for X-ray imaging indicate that medical staff are correspondingly protected against radiation? Increased usage could be a workload problem that contributes no new challenges. However, there is also variation in the types of X-ray imaging procedures being performed and by whom. There are differences between procedures requiring medical staff to be close to the patient, and these methods require that staff ensure the use of appropriate radiation protection. Education and training in radiation protection as it applies to circumstances, setting up working environments, accessibility, and utilization of proper defensive tools, as well as an effective monitoring program, are all fundamental components in ensuring that clinical staff involved with X-ray imaging are adequately and acceptably protected.[7] Some studies have been conducted to assess the appropriate personal dose internationally to ensure the radiation safety of occupational workers. Most study results have indicated that the monitored doses were well below the internationally recommended dose limit. [10] The framework for guaranteeing radiation assurance and well-being should shape part of the larger framework to ensure great clinical practice. This Safety Guide centers on ways to safeguard radiation security and well-being.[9]

MATERIALS & METHODS:

The aim of this study was to assess the knowledge of radiation protection and adherence to radiation safety measurements of healthcare workers who employs in the department of diagnostic radiology including x-ray technologist, computed tomography technologist, fluoroscopy technologist and interventional radiology technologist at National Guard Health affairs, Riyadh, Saudi Arabia. A cross sectional study and a suitably and structured questionnaire was adapted from the previous similar studies and assess knowledge of radiation protection and adherence to radiation safety measurement designed in line with the current research objectives were collected from occupational workers. The data collected consisted of the technologists' knowledge of radiation protection and the application of shielding devices, such as gonad shields. The answers were vetted and analyzed carefully. All participants were above 18 years of age and willing to provide written informed consent. Participants who are unwilling to give consent and work as a nurse, administrators, magnetic resonance imaging (MRI) technologists, and ultrasound technologists are excluded from the research. The duration of the study was from May 2021 to December 2021. Using a convenience sampling technique, we surveyed 130 radiology technologists. The collected data were entered in Microsoft Excel and transferred to JMP statistical computer program for statistical analysis. The statistical tests used were the Kruskal–Wallis test for age, education, and specialty, as well as the Mann–Whitney U test for gender. Frequencies and percentages represent the categorical variable data. In our study, a P-value of less than 0.05 was considered statistically significant. Each patient's data were kept confidential in a password-protected data collection spreadsheet, and anonymity was ensured. No documentation of the MRN number was required. Only investigators have access to the data, which are recorded on a password-protected sheet.

RESULTS:

Table 1. Demographic details of the study subjects.
Of the 130 questionnaires distributed, 101 completed responses were returned, resulting in 77.69% response rate. The participants were NGHA radiographers who were licensed to practice diagnostic radiography at the hospital. A total of 37 (36.6%) female and 64 (63.4%) male radiographers (n = 101) participated in this study. Table 1 summarizes the demographic statistics of radiographers in terms of age, specialty, and level of education. The radiographers' ages ranged from 24 to 45.

Approximately 94.1% held a bachelor's degree, whereas fewer than a quarter had a master's degree (4%) or PhD (2%).

Table 2. Adherence to radiation protective practices among radiographers. Personal protection was assessed in terms of wearing a thermoluminescent

dosimeter (TLD), wearing a lead apron during fluoroscopy, keeping a minimum distance, wearing lead gloves and a thyroid collar during work, and using a lead apron during portable radiography. Practices that were either ignored or never implemented by a substantial percentage of radiographers were wearing lead gloves and thyroid collars during work (20.8%) and using lead aprons during portable radiography (15.8%). Regarding the practices related to patient protection, using proper collimation (88.1%), adhering to the minimum exposure time (79.2%), checking the last menstrual period of every female patient (78.2%), and using a lead gonadal shield (63.4%) were the least adhered to. Lastly, in environmental radiation protection practices, the use of a lead apron to protect co-patients and staff was shown to have a high level of adherence (97%) and to keep the doors closed during examinations (93.1%).

Table 3. The scoring for participants' adherence to radiation protection techniques was determined for practices related to the protection of the radiographer's own protection, the protection of patients, and the protection of the environment, as shown in Table 3. The highest proportion of good adherence was found for practices related to environmental protection (99%), followed patient protection practices (90.1%). Unfortunately, Personal protective techniques received the lowest proportion of adherence (81.2%). Overall adherence rating for all the radiographers (90.1%) showed that they had good adherence to the protection practices, a lower percentage (8.9%) of radiographers have intermediate levels of adherence, and the studied group had poor adherence (1%).

Table 4. Adherence scores for radiation protection practices and demographic characteristics of the subjects. In terms of the association between the adherence score and radiographer age, it is clear that older radiographers adhere to personal safety practices to a larger extent. The disparity between the age groups studied P = 0.4. Indeed, higher adherence rates were observed among radiographers aged 35–45 (94 (86, 75, 97, 25)) compared to lower rates for younger radiographers, who encompassed those aged less than 35 years. Additionally, regarding the relationship between the adherence scores and the gender of radiographers, it shows that males adhered better to radiation protection measures (93 (89, 95)). This was less the case for female radiographers (86 (75, 93)); the difference observed between the genders studied was statistically significant (P = 0.001). Regarding the relationship between the adherence score and education, it is clear that radiographers with master's degrees demonstrated greater adherence (94.5 (89.5, 98)), followed by radiographers with a bachelor's degree (91 (83, 95)). The lowest adherence score in relation to education was the PhD radiographer at 86.5 (80). Ultimately, regarding the relationship between adherence score and specialty, all specialties demonstrated the same adherence (P = 0.805).

Table 1: Demographic details of the study subjects

Variable	Number (%)
Gender	
Male	64 (63.4)
Female	37 (36.6)
Age (in Years)	
Less than 25	28 (27.7)
25–35	61 (60.4)
35–45	12 (11.9)
Specialty	
X-rays	45 (44.6)
CT	31 (30.7)
VIR	25 (24.8)
Education	
Bachelor's	95 (94.1)
Master's	4 (4)
PhD	2 (2)
Total	101 (100)

CT: Computed Tomography, VIR: Vascular Interventional Radiology

Table 2: Adherence to radiation protocols and practices among radiographers

Practice of Subjects Regarding Radiation Protection	Response of Subjects No. (%)				
A. Personal Protection	**Never**	**Sometimes**	**Most of the time**	**Always**	**Total**
1. Wearing thermoluminescent dosimeters during work	-	3 (3)	3 (3)	95 (94.1)	101 (100)
2. Wearing lead apron during fluoroscopy procedure	4 (4)	3 (3)	2 (2)	92 (91.1)	101 (100)
3. Keeping a minimum distance of two meters from the source of radiation in the image intensifier	5 (5)	14 (13.9)	15 (14.9)	67 (66.3)	101 (100)
4. Wearing lead gloves and thyroid collar during work	21 20.8)	33 (32.7)	18 (17.8)	29 (28.7)	101 (100)
5. Using a lead apron during portable radiography	16(15.8)	16 (15.8)	19 (18.8)	50 (49.5)	101 (100)
B. Patient Protection					
6. Using proper collimation	-	2 (2)	10 (9.9)	89 (88.1)	101 (100)
7. Checking the last menstrual period of every female patient	6 (5.9)	10 (9.9)	6 (5.9)	79 (78.2)	101 (100)
8. Adhering to the minimum exposure time	1 (1)	16 (15.8)	4 (4)	80 (79.2)	101 (100)
9. Using lead/gonadal shielding	9 (8.9)	16 (15.8)	12 (11.9)	64 (63.4)	101 (100)
C. Environmental Protection					
10. Closing the room door during the procedure	-	3 (3)	4 (4)	94 (93.1)	101 (100)
11. Using lead apron to protect co-patients or staff	-	1 (1)	2 (2)	98 (97)	101 (100)

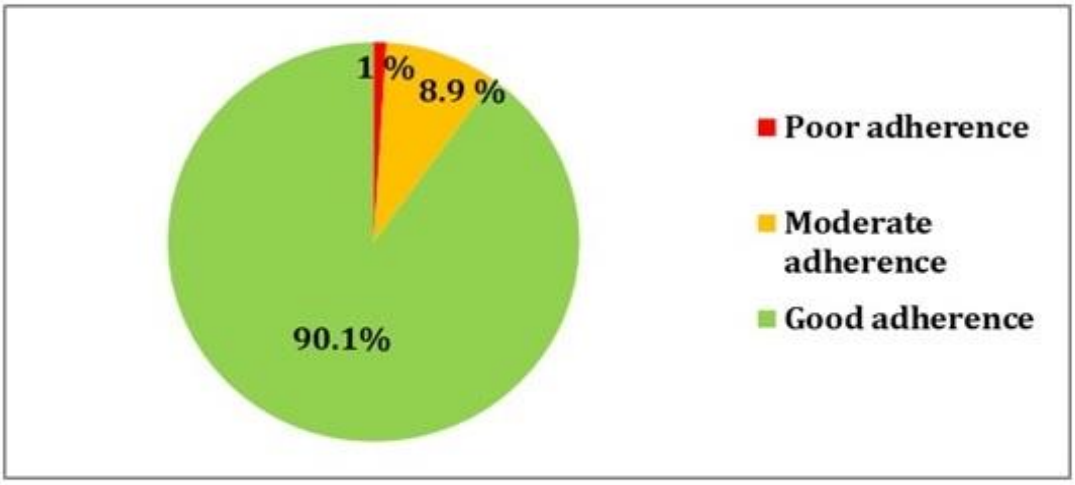

Fig. 1: Adherence of study subjects to radiation protection practices.

Table 3: Adherence scores for the radiation protection practices of subjects

Particulars	Median (IQR)	Adherence classification		
		Poor	Moderate	Good
		No. (%)		
1. Practices to ensure subjects' personal protection	85 (80, 90)	4 (4)	15 (14.9)	82 (81.2)
2. Practices to ensure patient protection	93.75 (81.25, 100)	2 (2)	8 (7.9)	91 (90.1)
3. Practices to ensure environmental protection	100 (100, 100)	1 (1)	-	100 (99)
Total adherence score	91 (84, 95)	1 (1)	9 (8.9)	91 (90.1)

Table 4: Adherence score for the radiation protection practices and demographic characteristics of subjects

Variable	No. of subjects	Median (IQR)	P-value
1. Age in years			
Less than 25	28	90 (81.5, 95)	0.422
25–35	61	91 (84, 95)	
35–45	12	94 (86.75, 97.25)	
2. Gender			
Male	64	93 (89, 95)	0.001*
Female	37	86 (75, 93)	
3. Education			
Bachelor's	95	91 (84, 95)	0.363
Master's	4	94.5 (89.5, 98)	
PhD	2	86.5 (80)	
4. Specialty			
X-ray	45	91 (85, 95)	0.805
CT	31	91 (82, 95)	
VIR	25	91 (81.5, 95)	

CT: Computed Tomography, VIR: Vascular Interventional Radiology

DISCUSSION:

This study was conducted to assess adherence to radiation protection protocols and practices among radiation workers working in the radiology department at the NGHA. Similar studies have been undertaken in the region, including in the United Arab Emirates and Jordan. [6-7]

The results revealed that the majority of participants adhered to radiation protective techniques at a high to moderate level. Regarding personal protection, the results showed that the radiographers were aware of and educated about the importance of using lead aprons during fluoroscopy radiation exposure. Of the radiographers, 94.1% stated that they always wore lead aprons during procedures, which is a higher rate than the results determined by other studies (78.1%)[6], but regarding the use of lead gloves and thyroid collars during radiation exposure, almost 53.5% of radiographers said that they had never/sometimes used lead gloves and a thyroid collar during their practice because these tools were unavailable or the radiographers lacked knowledge of the importance of using them during the procedures. A TLD is a passive radiation detection device that is used for measuring and monitoring occupational doses. The results indicated that 94.1% of radiographers wore it during radiation exposure. In our study, only 28.7% of radiographers in all three specialties used the thyroid collar, compared to other studies, which included only interventional radiology and showed a rate of 93.5%. [9] Regarding the wearing of a protective apron during portable radiography, 49.5% of radiographers in our study adhered to this practice, while in another study on interventional radiology, the rate was 100%. Regarding patient protection, proper collimation is important for reducing the radiation field. As a result, the radiation dose is reduced of 50%, and 75% of radiographers stated that they use proper collimation. This result was higher than that in the nationwide dose survey conducted in United Arab Emirates, which showed a rate of 88.1%. This rate is also higher than that shown by other studies (43.7% and 34%). [1, 6, 7] Regarding the shielding of sensitive organs, especially the gonads, we found that 75.3% of radiographers answered "most of the time/always". Regarding environmental protection, 93.1% of radiographers strictly close the room door during a procedure compared to the results of another study (89.3%). [6] The principle of as low as Reasonably Achievable (ALARA) is an essential theme in protection from radiation in radiology to avoid unwanted radiation exposure and to optimize radiation doses the three guiding principles of ALARA are time, distance, and shielding. Radiographers can protect themselves and others by adhering to established worldwide principles and practice standards, as well as through using appropriate tools and equipment.

CONCLUSION: The results of the current study revealed that a few of the parameters in personal and patient protection are unsatisfactory, such as wearing lead aprons during portable radiography, maintaining a minimum distance from the source of radiation in the image intensifier, wearing lead gloves/thyroid collars during work, and using lead aprons and gonadal shielding for patient protection. Similar studies with a large sample size are required to obtain empirical evidence that can definitively strengthen radiographers' adherence to radiation protection protocols and practices.

ETHICAL CONSIDERATION:

The study was carried out after receiving IRB permission. We extracted information from electronic files using a data collection sheet (no informed consent from the patient was required). Each patient's data were kept confidential in a password-protected data collection spreadsheet, and anonymity was ensured. No documentation of the MRN number was required. Only investigators have access to the data, which are recorded on a password-protected sheet.

FINANCIAL SUPPORT AND SPONSORSHIP:

Nil

CONFLICTS OF INTEREST:

There are no conflicts of interest

REFERENCES:

1. Eze C, Irurhe N, Njoku J, Olowu O, Abonyi L. Assessment of radiation protection practices among radiographers in Lagos, Nigeria. Nigerian Medical Journal. 2013; 54(6):386.
2. Alavi S, Taghizadeh Dabbagh S, Abbasi M, Mehrdad R. Radiation protection knowledge, attitude and practice (RP-KAP) as Predictors of job stress among radiation workers in Tehran Province, Iran. Iranian Red Crescent Medical Journal. 2016; 18(10).
3. Mallam S, Akpa T, Oladipupo M, Sa'id A. A reappraisal of existing expressions for estimating radiation output from diagnostic X-ray machines. Nigerian Journal of Physics. 2006; 16(2).
4. Rehani M, Ciraj-Bjelac O, Vañó E, Miller D, Walsh S, Giordano B et al. Radiological protection in fluoroscopically guided procedures performed outside the imaging department. Annals of the ICRP. 2010; 40(6):1–102
5. Le Heron J, Padovani R, Smith I, Czarwinski R. Radiation protection of medical staff. European Journal of Radiology. 2010; 76(1):20–23.
6. Abuzaid M, Elshami W, Tekin H, Ghonim H, Shawki M, Salama D. Computed tomography radiation doses for common computed tomography examinations: a nationwide dose survey in United Arab Emirates. Insights into Imaging. 2020; 11(1).
7. Paolicchi F, Miniati F, Bastiani L, Faggioni L, Ciaramella A, Creonti I et al. Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. Insights into Imaging. 2015; 7(2):233–242.
8. Jafri M. Book review: IAEA safety standard 'Radiation protection and safety in medical uses of ionizing radiation', SSG-46 (2018). Journal of Radiological Protection. 2021; 41(3):604–605.
9. Valuckiene Z, Jurenas M, Cibulskaite I. Ionizing radiation exposure in interventional cardiology: current radiation protection practice of invasive cardiology operators in Lithuania. Journal of Radiological Protection. 2016; 36(3):695–708.
10. Aldhebaib A, Singh O, Haq F, Alqurbani S, Barakheel Albarkheel A, Alshamrani A et al. A cross-sectional study based on the assessment of the radiation dose for medical radiation workers. King Khalid University Journal of Health Sciences. 2021; 6(2):93.