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Radiation Safety Awareness and Practice among Radiology Staff in Kabul National Specialty Hospitals

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Abstract. Background and Aim: In the world, more than ten million photographs and hundreds of thousands of nuclear medicine operations are performed daily. The exposure of such a large population even at the low dose levels used in diagnostic radiology due to definite effects and the possibility of ionizing radiation has caused public concern. This study aimed to determine the awareness of radiology staff from X-Rays adverse effects and the extent of use of safety measures in their practice in Kabul National hospitals. Methodology: A cross-sectional descriptive study was conducted among 60 radiology staff in national specialty hospitals of Kabul Afghanistan. A structured multiple-choice questionnaire was used. Data were coded and analyzed using the statistical package for social science (SPSS) software. Results: 83.3% of participants were male. 71% of the participants had >40 years old and the mean age of them was 41 years old. The type of job of participants was radiology technician. The mean of the years of job experience was 16 years. The knowledge or awareness of 95.0 % of participants was weak and 5.0% was intermediate. 96.7% of participant's practice was good and 3.3 % was intermediate. Conclusion: The level of awareness of 95.0 % of radiology staff was very poor. This is of concern as technologists are the first point of contact with the patients and they should be adequately trained to answer common patient questions and concerns. The level of practice of 3.3 % of the staff was intermediate and 96.7% was good. Based on our results, a conscientious effort to provide a more robust education and acquire greater knowledge in these matters is required.

Keywords. Radiology staff, awareness, practice, national specialty hospitals

1. Introduction

Currently, the share of human exposure to natural resources, ionizing radiation such as cosmic rays, and available radioactive materials is about 80% of the earth's surface and about 20% of artificial or man-made resources. Due to the significant expansion of peaceful use of ionizing radius in various centers such as industry, agriculture, and education the most important in research and medicine that has been started since its discovery is an average of 2.5 millisieverts per year. In the year radiation dose is attracted to ordinary people from various natural and industrial sources of man-made. [1] According to studies, 13% of all human activities are exposed, of which 12% are medical diagnostic methods. These figures represent methods

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for detecting radiation the largest source of exposure to human-made sources. [8] In the world, more than ten million photographs and hundreds of thousands of nuclear medicine operations are performed daily. [1] The exposure of such a large population even at the low dose levels used in diagnostic radiology due to definite effects and the possibility of ionizing radiation has caused public concern. The potential hazards of radiation did not have a certain limit. Even the smallest amount of radiation can cause these effects, including carcinogenic effects, hereditary effects. Its effects on the hematopoietic system and nerves were mentioned. But in contrast, the definite effects had a certain dose limit, which for their appearance should exceed the absorbed dose of a certain level, these effects include hair loss, nausea, and skin irritation, even at high doses, it destroys living organisms.[5] To prevent ionizing radiation exposure and hazards, various international organizations, including the International Commission for Radiology Protection (ICRP), have established standards for radiation protection. That the non-compliance of radiology departments, and such criteria lead to the production of low-quality images and an increase in the dose received by patients, staff, and the general public. Measures should be taken to decrease the exposure of patients and radiation staff during tests. The diagnosis is minimized and with this minimum exposure, the maximum conclusion is reached which is the diagnosis of the disease ALARA. [1][3], [4] Recently, there has been a heightened awareness regarding the lack of knowledge of referring doctors about radiation doses incurred during diagnostic radiological procedures.[10] The use of imaging equipment is a vital part of any hospital and surgical specialty. In recent years, the use of X-ray and computed tomography (CT) scans has continually increased as a means of accurately diagnosing patients' conditions to render the most appropriate treatment available. [1],[4] As a result, patients and hospital staff are repeatedly exposed to increasing doses of ionizing radiation in comparison to previous years. In 2006, Americans were exposed to more than seven times as much ionizing radiation from medical procedures as was the case in the early 1980s. [3]

There have been several studies in recent years that make them divided into 4 groups. The first groups were studies that only measure and examined the knowledge of radiologists, such as studies conducted by SU and his colleagues in the field of assessing the awareness of radiation protection cases performed on 114 radiologists working in 5 medical centers located in Taiwan. The average correct score was 65.83%. In a study by Chap Arian et al. To assess the level of Awareness of radiation protection among 112 radiologists in the province's hospitals Yazd, the level of awareness of radiation protection cases was 46.5- 15.3. [12] The second group of studies was just performance measures and examined, such as a study by Reagan et al and his colleagues, to determine the extent of observance of personnel safety practices and patient safety and its relationship with basic vocational training, the highest level Education, background and type of workplace among 1200 radiologists in California was performed. In this study, the mean score was observed for Patient safety practices at 77.1% and the mean score of compliance practices for Staff safety was 70.5%. [6] The third group of studies was they examined the knowledge and practice of radiologists, such as the studies by Leachate et al. To determine compliance Radiation protection by radiologists and its relationship with professional training, Continuing education, employment history in radiology, and the workplace between 2000 radiologists working at California Radiology Centers were performed. The mean scores of awareness and observance of safety practices were 82% and 72%. [7] The fourth groups of studies were the general score of radiologists' knowledge did not calculate, but only scores related to specific questions such as a study by Mojiri et al in the field of assessment of knowledge and attitudes about radiation protection. It was performed among 81 radiologists in Hamadan. According to the results of this study, The level of awareness of the participants

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about the necessity of using the film and Periodic examinations were 70% and 63%, in terms of the application of radiation protection devices for self-irradiators and patients, respectively, 83.1% and was 9.78%.[8] Therefore, the goal of this study is to assess the awareness of radiology staff of X-Rays adverse effects and the extent of use of safety measures in their practice in Kabul national specialty hospitals.

2. Methodology

A cross-sectional descriptive study was conducted to assess the knowledge and practices about radiation safety among 60 staff working in the radiology wards of national specialty hospitals (jamhorait, antani, Wazir Akbar Khan, Indra Gandhi, ibn Sina, Malalai, rabe balkhi, isteqlal, Ataturk) in Kabul city of Afghanistan, during the period from November 2020 to May 2021. In total from 70 questionnaires distributed 60 were returned fully completed, giving a response rate of 85.71% the inclusion criteria are all staff of radiology departments in national specialty hospitals, present on the days of study. Data was collected using a structured self-administrated questionnaire, which had been designed after an extensive literature search. This questionnaire was used in similar studies [Questionnaire on radiation risk and doses Questionnaire responses regarding radiation dose and associated risks "Determination of Radiation Safety Information Level" questionnaire. [12],[13] The questionnaire was divided into three main components. The first part included demographic characteristics such as (age, sex, occupational experience, and occupational type), and the second part included thirteen multiple-choice questions reflecting the knowledge or awareness of the staff toward radiation safety. The participants were requested to respond to questions according to their awareness of the subject. The third part included ten yes/no questions reflating the practice of radiology staff. The questionnaire was validated by experts at the Ministry of public health and Kabul University of medical science. The scores were converted to levels. The knowledge score levels were considered weak knowledge or awareness with a score of < 5 in awareness; intermediate knowledge or awareness 6-10 and good knowledge or awareness with a score of 10- 13. Data were coded and analyzed using the statistical package for social science (SPSS) software.

3. Results

In total, 83.3% of the participants were male. 71.7% of the participants had >40 years old and the mean age of them was 41 years old. The type of job of participants was radiology technician, there are no doctors and nurses in the radiology ward of these hospitals. The mean of the years of job experience was 16 years. The knowledge or awareness of 95% of participants was weak and 5% was intermediate. 96.7% of participants' practice was good and 3.3% were intermediate. The practice of staff was good in all fields except in the thyroid and gonadal protection from radiation.

The demographic characteristics of respondents at Kabul national specialty hospitals are presented in (table 1).

Table 1: Demographic characteristics of participants (n=60).

Demographic Characteristics	Variables	Frequency	Percent
Gender	Male	50	83.3
	Female	10	16.7
Type of job	radiology technician	60	100.0
Age of participants	20-40 years	17	28.3

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Job experience of participants	41-65 years	43	71.7
	1-10 years	17	28.3
	11-20 years	43	71.7

The awareness and practice of radiology staff at Kabul national specialty hospitals

Table 2: The level of awareness of radiology staff.

Level of awareness	Frequency	Percent
low level	57	95.0
Intermediate level	3	5.0
Good level	0	0
Total	60	100.0

Table 2 indicates that the knowledge or awareness of 95.0. % of participants was weak.

Table 3: The level of practice of radiology staff.

Level Of practice	Frequency	Percent
low level	1	1.7
Intermediate level	1	1.7
good level	58	96.7
Total	60	100.0

Table 3 indicates that 1.7% of participants were at a low level, 1.7% of participants were at an intermediate level and 96.7% of participants were at a good level.

Table 4: The difference between the awareness of males and females in radiology staff.

level for awareness	gender of participants		Total
	female	male	
low level	9	47	57
Intermediate level	1	3	3
Good level	0	0	
Total	10	50	60
gender of participants	N	Mean	Std. Deviation
female	10	3.40	.843
male	50	3.66	1.136
Total	60	3.62	1.091

In the table above 47 male participants and 9 female participants were at low level. 3 male participants and 1 female participants were at an intermediate level. As can be seen in the table, the level of awareness among male employees is better because the male staff were high in number thus out of 50 male employees, 3 of them have intermediate knowledge, while out of 10 female employees, only one of them has intermediate knowledge.

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Table 5: The difference between the practice of male and female radiology staff.

level of practice	gender of participants		Total
	female	male	
low level	1	0	1
Intermediate level	0	1	1
Good level	9	49	58
Total	10	50	60
gender of participants	N	Mean	Std. Deviation
female	10	7.60	1.897
male	50	8.50	1.147
Total	60	8.35	1.325

According to the table above 1 female and no male participants were in the low level. No female and 1 male participant were in the intermediate level. 9 female and 49 male participants were in the good level. Table 5 indicates that In terms of the practice of radiology staff, among 50 male employees, 49 male employees have a good practice, and among 10 female employees, 9 of them have a good practice, and considering that the number of female employees is low, we can say that performance is not much different for males and females.

Table 6: The difference between awareness among age groups of radiology staff.

level for awareness	age groups		Total
	20-40	41-65	
low level	16	41	57
Intermediate level	1	2	3
Good level	0	0	0
Total	17	43	60
age groups	N	Mean	Std. Deviation
20-40	17	3.88	1.111
41-65	43	3.51	1.077
Total	60	3.62	1.091

In the table above the age of 16 participants between 20-40 years were in the low level and 1 participant between 20-40 years was in the intermediate level. 41 participants between ages 41-65 were in low level and 2 of them were in intermediate level.

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Table 7: The difference between practices among age groups of radiology staff.

level of practice	age groups		Total
	20-40	41-65	
low level	0	1	1
Intermediate level	0	1	1
Good level	17	41	58
Total	17	43	60
age groups	N	Mean	Std. Deviation
20-40	17	8.24	1.033
41-65	43	8.40	1.433
Total	60	8.35	1.325

In terms of staff performance, the level of performance was good for the ages of 41-65 years, while the level of performance for the participants aged 20-40 years.

Table 8: The difference between job experience and awareness of participants.

level for awareness	job experience by grouping		Total
	1-10	11-20	
low level	0	0	57
Intermediate level	2	1	3
Good level	15	42	0
Total	17	43	60
job experience by grouping	N	Mean	Std. Deviation
1-10	17	4.06	1.088
11-20	43	3.44	1.053
Total	60	3.62	1.091

In the table above the awareness level of a group with high job experience was good and in the group with less job experience is also good.

Table 9: The difference between job experience and practice of participants.

level of practice	job experience by grouping		Total
	1-10	11-20	
low level	0	1	1
Intermediate level	0	1	1
Good level	17	41	58
Total	17	43	60
job experience by grouping	N	Mean	Std. Deviation
1-10	17	7.88	.857

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level of practice	job experience by grouping		Total
	1-10	11-20	
low level	0	1	1
Intermediate level	0	1	1
Good level	17	41	58
11-20	43	8.53	1.437
Total	60	8.35	1.325

In the table above the practice level of staff with high job experience and with less job experience was good.

4. Discussion

This study assessed the awareness and practice of radiology staff in the Kabul national specialty hospitals. 83.3% of participants were male. 73% of the participants had >40 years old and the mean age of them was 41 years old. The type of job of participants was radiology technician. The mean of the years of job experience was 16 years. The knowledge or awareness of 95.0 % of participants was weak and 5.0% was intermediate. 96.7% of participants' practice was good and 3.3% was intermediate. All participants were staff of radiology. There is no doctor, nurse, or fellow.

The lack of knowledge and awareness of medical professionals regarding their understanding of ionizing radiation or the use of equipment involved in the process has been previously highlighted by numerous studies. [6],[9]

Zhou et al. [12] evaluated the awareness of medical students and interns regarding the radiation exposure associated with common diagnostic investigations and found that 31.6% of participants correctly reported the dose received by patients during a standard chest x-ray and 25.5% did not know that ionizing radiation is not used during MRI. An assessment of the knowledge regarding radiological examination radiation doses among Italian radiographers found that 5% of their studied population believed that MRI scans of the pelvis expose the patient to radiation.[11]Our results have demonstrated that our radiology staff is equally unaware of basic radiation facts when compared with our international counterparts.

The level of knowledge regarding the use of personal protective equipment was satisfactory with approximately 80% appreciating the need for such equipment. The French Association for Radiology Residents in their prospective study found that 90% of their participants reported good practice in their operating rooms. [13] Our study yielded a similar result with the majority of our participants (80%) reporting Good practices such as lead aprons and shields.

Unfortunately, only one-fourth of the participants knew the radiation dosage from both single-view and two-view chest X-rays and their relationship, indicating an important knowledge gap. This is comparable to a recent study that revealed that only 32 % of radiologists identified the correct dosage of chest X-rays. [6]

On the whole, less knowledge of radiation exposure from CT abdomen was found among all the staff. This is in contrast to a small prospective study in 2004, where only 13 % of radiologists identified the same.[12] Except for CT abdomen, there is, however, a significant underestimation of dosage from other common examinations. There is also a significant underestimation of cancer risk as expected from significant underestimation of dosages.

Interestingly, for whole-body PET, fewer staff correctly identified the level of cancer risk and nearly 90 % underestimated the risk. This might be explained by the fact that our group consisted of only radiologists who do not practice nuclear medicine, and nuclear medicine is a separate department. This knowledge deficit of underestimating the cancer risk of commonly performed examinations is of serious concern, as it may lead to the acceptance of many unwarranted examinations from physicians and repeat studies, which all add up to significant radiation hazards and major public health concerns.

90 % of technologists correctly identified the absence of radiation risk in MRI and increased radiation risk in the population. This is in strong contrast to prior studies among physicians reporting variably poor knowledge. This is important, as the radiologist with adequate knowledge about the exposures in different modalities can suggest appropriate alternate imaging options, depending on the clinical question and the patient's age.

Lastly, the subject of radiation exposure in pregnancy is complex and the risk-benefit ratio needs to be considered carefully before proceeding with the examination. Radiologists play a prominent role in deciding the appropriate imaging modality based on the trimester, clinical question, and availability. In our study, though very limited, knowledge of radiation risk in pregnancy was assessed based on a single question. Importantly, only 60 % of technologists gave the correct answer, and a significant proportion of the participants suggested medical termination of pregnancy as an option. Our study suffered from several limitations. It is a single tertiary care institutional study and this may limit the extrapolation of the results to different settings, especially small community and non-teaching hospitals. Our sample size, although not very small, is not large enough and needs countrywide studies before taking major actions. Our questionnaire is limited to 25 questions focusing mainly on radiation dose and cancer risk of common examinations. Ideally, it cannot be equated to comprehensive radiation knowledge. Many of the questions asked for precise numerical answers which were felt not practicable by many of our participants. However, my opinion is that radiology workers, are expected to have deeper and more accurate knowledge of radiation dose and cancer risks and this needs to be imparted in the early stages of radiology training. Few of the questions were interrelated and theoretically, it was possible to deduce the answers from other questions. Few questions on effective dose and cancer risk have a wide range of variable answers depending on the source of information. However, with results showing significant knowledge gaps, the real or true knowledge of radiation could be even worse than evaluated.

We must take knowledge about radiation dose and risk more seriously. Many of our subspecialty leads and the Chair of the Medical Imaging Department were surprised and disappointed with the results. I do believe that our institution is not alone in this battle and unfortunately, currently, there are no published data on radiation knowledge to compare with other teaching institutions in Afghanistan. I am trying to enforce many of the recommendations of the American College of Radiology blue ribbon panel, which includes improving medical physics training during residency, including radiation safety topics in exit examinations, regular in-service training for technologists on radiation safety. Periodic continuous medical educational (CME) activities are recommended among radiology workers and we are working to make this mandatory for all, including the staff radiologists irrespective of subspecialties, to update themselves on radiation dosage and risks and provide the evidence of acquired CME credits. This could help in providing optimal usage of imaging resources and minimizing the unpredictable and unavoidable risk of cancer, albeit very small. Pre- and post-educational session assessments can be performed to assess improvement by these endeavors. Other measures such as including the patient's total radiation exposure in the imaging report, and

including the radiation dosages in the radiology request forms could also create greater awareness among physicians and patients, and potentially reduce the injudicious usage of imaging, although this needs extensive discussion among physicians and patients for ethical concerns and practical difficulties.

5. Conclusion

The level of awareness of 95% of radiology staff was poor this is of concern as technologists are the first point of contact with the patients and they should be adequately trained to answer common patient questions and concerns. The next level of practice of staff was intermediate and good (3.3% and 96.7%). Staff radiologists have the most important role of acquiring and imparting knowledge about radiation and any updates in the field to the technologists, residents, and fellows periodically, and to provide expert counsel on risk and dose issues. Based on our results, a conscientious effort to provide a more robust education and acquire greater knowledge in these matters is required.

However, the findings of this study are self-report, so they cannot be generalized to all students and all disciplines. Further studies needed to be done.

6. Recommendations

According to the results of the study, the researcher recommends to:

- The training course is necessary to increase the radiology staff's awareness of radiation safety.
- Training courses should be regularly done and updated given changing knowledge and practices.
- Hospital management should arrange different seminars and workshops to update the knowledge and practices of radiology staff about radiation safety.

7. Strength

This study was conducted in Kabul national specialty hospitals among radiology staff were male and female.

8. Conflicts Of Interest

"The author(s) declare(s) that there are no conflicts of interest regarding the publication of this paper."

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