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Radiation Safety Awareness Among Healthcare Workers In King Saud University Medical City

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Abstract

This study aimed to investigate the knowledge, attitudes and behavior of health personnel working with ionizing radiation sources on the risks and radiation safety of ionizing radiation in King Saud University Medical city. The study was cross-sectional and survey based in design. The context for the study are healthcare workers in King Saud University Medical city. A sample size of 130 participants was adequate for this study based on a 95% confidence level. There were 70(53.8%)males, and 60(46.2%) females included in this study, of which there 33 doctors, 44 nurses, and 50 Technologists and other medical professions. 90(69.2%) of the participants worked in University hospital or medical center, and 40(30.7%) worked in Regional general hospital (>300 beds) . 49(37.6%) answered "yes" for Operation of the fluoroscopy unit, 110(84.6%) for Use of lead apron, 110(84.6%) for Use of thyroid collar, 110(84.6%) for Use of lead glasses, 120(92.3%%) for Use of radiation dosimete, 50(38.4%) for RE of each procedure, 80(61.5%) for Basic lecture on RE, 80(61.5%) for Three principles of RP and 20(15.3%) Fluoroscopy unit type. There were differences between doctors and nurses(p = 0.046) , Technologists and other medical professions (p = 0.034) respectively .However, there was no difference between the nurses and Technologists and other medical professions.

Keywords. Radiation safety awareness ,healthcare workers , King Saud University Medical city

Introduction

Natural radiation comes from many sources including more than 60 naturally-occurring radioactive materials found in soil, water and air. Radon, a naturally-occurring gas, emanates from rock and soil and is the main source of natural radiation. Every day, people inhale and ingest radionuclide from air, food and water (Thakkar et al.,2021).

Since the end of the 19th Century, man has learned to use radiation for many beneficial purposes. Today, many sources of radiation, such as X-ray machines, linear accelerators and radionuclides are used in clinical and research applications. Such beneficial uses may at times create potentially hazardous situations for personnel who work within the hospital (Bugra ,Namaitijiang & Didem ,2017)

The use of ionizing radiation in medicine has led to major improvements in the diagnosis and treatment of human diseases. More than 3,600 million X-ray examinations are performed, 37 million nuclear medicine procedures are carried out, and 7.5 million radiotherapy treatments are given every year worldwide(Bugra et al. ,2017).

Today, many healthcare personnel, who are working in hospitals, oral and dental health hospitals and veterinary field, are exposed to radiation in some medical procedures. It is estimated that there are 2.3 million healthcare personnel in the world who are working with radiation related practices, and half of them are exposed to human-made artificial radiation and ionized radiation(Erkan,Yarenoglu, Yukseloglu &Ulutin,2019).

Radiation has also been associated with preventable risks for patients, healthcare providers and technicians, these risks can be minimized by the development of the advanced technologies that make the application to be safer. The average radiation dose given to the general population is 2.5 mSv/annum, of which the medical exposure is almost 15%. It was found that unnecessary medical exposure to radiation was responsible for 100–250 cancer fatalities occurring in the UK every year . The ionizing radiation has dangerous effects on the biological systems (Alotaibi1& Muhyi,2019).

The dose of radiation given in any diagnostic procedure should be enough to answer the relevant clinical question, but as low as reasonably achievable to lower the risk to the patient. Therefore, it is important that doctors who request imaging are well-trained in deciding the diagnostic imaging indicated, and have an accurate knowledge of the associated risks (Abdellah, Attia, Fouad, &Abdel-Halim, 2015).

Problem Statement

Several medical procedures, including angiography, fluoroscopy, computed tomography (CT) and radiographic imaging, utilise ionising radiation. The availability and usage of fluoroscopic services have also been increased in keeping with worldwide trends towards fluoroscopic- assisted procedures. The operation of these machines should be done by qualified technicians who in our setting are radiographers. However, due to the lack of sufficient radiography staff within the hospitals, these machines are not always operated by specifically trained individuals. As a result, staff operating such equipment may not be appropriately skilled or knowledgeable regarding patient safety.

Objective

This study aimed to investigate the knowledge, attitudes and behavior of health personnel working with ionizing radiation sources on the risks and radiation safety of ionizing radiation in King Saud University Medical city.

Methodology

The study was cross-sectional and survey based in design. The context for the study are healthcare workers in King Saud University Medical city.

Population and sample

This study included a spectrum of individuals who are exposed to ionizing radiation including cardiologists, orthopaedic and general surgeons, radiologists, radiographers, and urologists. Only individuals who signed the consent for participation were included and asked to complete the questionnaire. Individuals who were unwilling to give written consent and those who were temporarily assigned to the departments were excluded from the survey. A sample size of 130 participants was adequate for this study based on a 95% confidence level. The calculated margin of error based on the calculated sample size and assuming a 95% confidence level was 8%. Ethics Committee approval was obtained prior to initiation of the study, and the survey was started only after obtaining separate permissions.

Data Collection Tool

The questionnaire used in the survey included 14 multiple-choice questions(Hayashi et al.,2021) divided among the following three parts: background, equipment, and knowledge. The details of the questionnaire details are shown in Table 1. Briefly, questions 1–6 regard the background of each person or institution. Questions 7–10 asked about the proper equipment for radiation protection. Questions 11–14 focused on knowledge of radiation exposure and protection. The internal consistency reliability was calculated using Cronbach's alpha (α = 0.89). To determine the face validity, the questionnaire was reviewed by 10 medical experts who rated each question in terms of its clarity, understandability, and length of each question.

TABLE 1 Questionnaire questions and answers

Question	Answer
1. What is your gender?	a) Female, b) Male
2. How old are you?	a) Twenties, b) Thirties, c) Forties, d) Fifties, e) Over sixty
3. What is your job title?	a) Medical doctor, b) Nurse, c) Technologist
4. What is the size of your institution?	a) University hospital or medical center, b) Regional general hospital (>300 beds), c) Other
5. How many years of career experience do you have?	a) 1–5, b) 6–10, c) 11–15, d) 16–20, e) Over 21 years
6. Do you operate the fluoroscopy unit?	a) Yes, b) No
7. Do you always wear a lead apron?	a) Yes, b) No
8. Do you always wear a thyroid collar?	a) Yes, b) No
9. Do you always wear lead glasses?	a) Yes, b) No
10. Do you always wear a radiation dosimeter?	a) Yes, b) No
11. What type is your fluoroscopy unit, an under-couch or over-couch C-arm system?	a) Under-couch (exposure from below), b) Over-couch (expose from above), c) I don't know
12. Do you know how much radiation dose you are exposed to in each endoscopic procedure under fluoroscopy?	a) Yes, b) No
13. Have you ever attended a basic lecture on radiation exposure?	a) Yes, b) No
14. Do you know the three principles of radiation protection?	a) Yes, b) No

ETHICS DECLARATIONS

All participants were informed about the study. After giving their informed consent, the participants were enrolled in the study. Ethical approval was not sought for the present study because of the anonymous questionnaire survey.

Results

All participants answered and responded to the questionnaire questions. As shown in table 2, there were 70(53.8%)males, and 60(46.2%) females included in this study, of which there 33 doctors, 44 nurses, and 50 Technologists and other medical professions. 90(69.2%) of the participants worked in University hospital or medical center, and 40(30.7%) worked in Regional general hospital (>300 beds) . 49(37.6%) answered "yes" for Operation of the fluoroscopy unit, 110(84.6%) for Use of lead apron, 110(84.6%) for Use of thyroid collar, 110(84.6%) for Use of lead glasses, 120(92.3%%) for Use of radiation dosimete, 50(38.4%) for RE of each procedure, 80(61.5%) for Basic lecture on RE, 80(61.5%) for Three principles of RP and 20(15.3%) Fluoroscopy unit type.

TABLE 2 Answers from all participants

	Medical doctors	Nurses	Technologists and other

					medical professions
Questions	**Answer**	**All N = 130**	**N = 36**	**N = 44**	**N = 50**
1. Sex, N (%)	Male	70, 53.8%	20, 15.3%	18, 13.8%	32, 24.6%
	Female	60, 46.2%	16, 12.3%	26, 20%	18, 13.8%
2. Age group, N (%)	20–25	10, 13%	2, 1.5%	40, 20%	10, 13%
	26–32	70, 53.8%	20, 15.3%	2, 1.5%	30, 23%
	33–40	40, 30.7%	10, 13%	2, 1.5%	8, 6.1%
	Over 40	10, 13%	4, 3%	0%	2, 1.5%
3. Job title		130	36, 27.6%	44, 33.8%	50, 38.4%
4. Institution size	University hospital or medical center	90, 69.2%	20, 15.3%	26, 20%	32, 24.6%
	Regional general hospital (>300	40, 30.7%	16, 12.3%	18, 13.8%	18, 13.8%
			beds)		
5. Career experience, years	1–5	25, 19.2%	10, 13%	20, 15.3%	15, 11.5%
	6–10	60, 46.1%	13, 10%	15, 11.5%	30, 23%
	11–15	30, 23%	10, 10%	5, 3.8%	3, 2.3%
	Over 16	15, 11.5%	3, 2.3%	4, 3%	2, 1.5%
6. Operation of the fluoroscopy unit	Yes	49, 37.6%	20, 55.5%	20, 45.4%	9, 18%
7. Use of lead apron	Yes	110, 84.6%	36, 100%	44, 100%	30, 60%
8. Use of thyroid collar	Yes	110, 84.6%	36, 100%	44, 100%	30, 60%
9. Use of lead glasses	Yes	110, 84.6%	36, 100%	44, 100%	30, 60%
10. Use of radiation dosimeter	Yes	120, 92.3%	36, 100%	44, 100%	50, 100%
11. Fluoroscopy unit type	I don’t know	20, 15.3%	4, 3%	3, 2.3%	13, 10%
12. RE of each procedure	Yes	50, 38.4%	36, 100%	10, 22.7%	4, 8%
13. Basic lecture on RE	Yes	80, 61.5%	36, 100%	40, 90.9%	3, 6%
14. Three	Yes	80, 61.5%	36, 100%	40,	3, 6%

principles of RP				90.9%	

To investigate if there is significant difference due to Job title(doctors, nurses, and Technologists and other medical professions) ANOVA was used . The result of the ANOVA shows that the F-value was 0.021 (i.e., p = .021), which is below 0.05. and, therefore, there is a statistically significant difference due to the variables of Job title (see table 2).

Table 2. ANOVA for differences due to the variable of Job title

	Sum of Squares	df	Mean Square	F.	Sig.
Between Groups	32.514	3	10.838	3.56	0.021 sig.
Within Groups	89.887	126	0.365		
Total	115.938	129			

From the results so far, there are statistically significant differences between the groups as a whole. The table below, Multiple Comparisons, shows which groups differed from each other. The Tukey post hoc test was used. table 3 shows that there is a statistically significant difference due to the variable of Job title. There were differences between doctors and nurses(p = 0.046) , Technologists and other medical professions (p = 0.034) respectively .However, there was no difference between the nurses and Technologists and other medical professions (p = 0.989).(see table 3).

Table 3. Tukey SHD results due to the variable of Job title

G(I)	G(J)	Mean Difference(i-j)	Std.Error	Sig
1	2	4.1000*	1.5460	0.046
	3	4.3000*	1.5460	0.034
2	1			
	3	.375	1.5460	.837
3	1			
	2		1.5460	

Note: group1=doctor, 2= nurses, 3= Technologists and other medical professions

Discussion

The exposure to radiation from medical procedures has become a topic of recent public and scientific discussion (Abdellah et al.,2015). Radiation is a constant concern in modern medicine, as it is related to dangerous health effects.

The findings of this study indicate that there are statistically significant differences between the groups as a whole. The table below, Multiple Comparisons, shows which groups differed from each other. The Tukey post hoc test was used. table 3 shows that there is a statistically significant difference due to the variable of Job title. There were differences between doctors and nurses(p = 0.046) , Technologists and other medical professions (p = 0.034) respectively .However, there was no difference between the nurses and Technologists and other medical professions (p = 0.989). This finding is logic as doctor get courses on radiology are included in most medical degrees.

This lack of knowledge means that the healthcare professionals are unable to effectively protect either themselves or their patients from ionising radiation. In Saudi Arabia , no standard courses on radiation safety for health professionals exist. However, courses on radiation, the biological effects of radiation, and radiation protection should be included in the educational curriculum of health professionals (including nurses and medical technicians). Physicians should encounter these topics in radiology courses. In this study, the fact that there were significant difference between doctors and other professional staff is due to the courses on radiology are included in most medical degrees.

A study conducted to evaluate awareness and ionizing radiation protection practices among radiographers and exposed health workers in Egypt(Abdellah et al.,2015), revealed that about 51.3% of the working staff in the radiology department had awareness of radiation protection procedures which is quite satisfactory. However, the workforce, i.e. nursing staff and other supporting members of the radiology team, had insufficient practical value (18%) about the use of radiation exposure safety measures, which was quite bad and dangerous concerning the use of ionizing radiation. Furthermore, a satisfactory awareness of radiation protection measures was recorded (44.2%) in workers with higher educational level, 36.8% recorded in workers with over 10 years of working experience, 73.7% in the physicians, and about 61.6% in workers who were constantly getting training courses.

Another study by Maina et al. (2020)on the assessment and investigation of radiation protection and safety practices in public hospitals, showed that radiation protection practices were not sufficiently implemented in state hospitals. The study showed that only 58.62% of medical imaging professionals owned radiation dosimeters, with 29% of dose readings being inconsistent. However, lead aprons were present in 99.13% of the hospitals. Although they were available, 59% of the participants had never examined the integrity of the lead aprons, which is quite alarming. The study reported a lack of suitable radiation protective equipment. The level of training and experience of most radiographers also raised questions as their certifications and qualifications needed to be reviewed and properly questioned.

Another similar study by Abuzaid et al.(2019)evaluating radiation protection and radiation protection compliance in the radiology department found that the number of radiographers who followed practices of environmental protection, patient protection, and self-protection was 75.1%, 60.4%, and 45.7%, respectively. Despite higher compliance practices, more knowledge and awareness are required to improve safety measures and practices.

Hayashi et al.(2021) conducted a questionnaire survey on radiation protection from January to February 2020. The participants were medical staff, including medical doctors, nurses, and radiological and endoscopy technician in endoscopy-fluoroscopy departments. The questionnaire included 14 multiple- choice questions divided among three parts: background, equipment, and knowledge.

The rate of wearing a radiation dosimeter was insufficient (69%), especially among doctors (52%). A few subjects knew the radiation exposure dose of each procedure (15%), and slightly over half had attended lectures on radiation protection (64%) and knew about the three principles of radiation protection (59%). Protection adherence did not differ by years of experience, knowledge of fluoroscopy, awareness of radiation exposure doses, or attendance at basic lectures on radiation protection. However, medical doctors who were aware of the radiation exposure dose of each procedure were significantly more likely to wear dosimeters than those who were not ($p = 0.0008$).

Conclusion and recommendations

Based on the results reported here, it appears that improved education planning for healthcare professionals into safety measures associated with ionising radiation in required. Healthcare professionals working with ionising radiation should be provided with an educational program on doses per application, a risk/benefit analysis, the necessity of medical exposure, and the biological effects of radiation. In addition, an obligatory radiation safety course should be provided at medical schools, as well as postgraduate radiation protection and radiation safety training. Annual recertification courses are imperative so that individuals would be kept abreast with current changes and reminded of commonly neglected safety practices.

Limitations

This study is not without limitations. The questionnaire used multiple choice options, which lends itself to the risk of 'lucky guesses and therefore an erroneous skewing of results.

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Conflicts of interest

There are no conflicts of interest.

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