Austin Journal of Nuclear Medicine and Radiotherapy

Open Access

Austin Publishing Group

Research Article

Radiation Dose Awareness among Radiology Staff

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Received: September 28, 2017; **Accepted:** November 17, 2017; **Published:** November 24, 2017

Abstract

The purpose of this paper is to explore and compare the knowledge of radiation dose risk experienced in common radiology examination among radiology residents, Fellow, Radiologists, and technologists in different hospitals in the capital city of Saudi Arabia. Then to identify the gap and propose solutions thereof. A questionnaire of 15 multiple choice questions of knowledge of radiology technologists, radiologists, fellows and residents regarding radiation protection awareness have been distributed among radiology staff in four hospitals in Riyadh; two Ministry of health hospitals (Prince Muhammad Bin Abdulaziz and Alyamamah) and two university hospitals (King Khalid and King Abdul-Aziz). The samples distributed to (200) participants and a total number of (183) data were collected. All questions were in multiple-choice formats, with four options and there is only one answer. Statistical analysis using SPSS software package version 22 used for analyzing participants' responses. The results then compared among all the participants. The study concluded that conscientious effort to provide more education that is robust and acquire greater knowledge in these matters is required. Conducting periodic training courses to know how to reduce radiation dose and to avoid risk related. Using technology and modern methodology to assist in the optimum use of radiology equipment's and devices related to avoid unnecessary radiation dose to workers and patients.

Keywords: Awareness; Radiation dose; Questionnaire; Knowledge; Resident; Fellow; Radiologist

Introduction

The background level of radiation in the natural environment surrounds us at all the times, it is global, since the earth formed and the life developed. All existence on earth exposed to ionizing radiation. Background radiation emitted from both natural and manufactured radionuclides. Some natural radiation comes from atmosphere because of radiation from outer space, some come from earth and some is even from inside our bodies as we ingest food and water containing radionuclides in addition to the air we breathe. Manufactured radionuclides enter our environment from medical activities and nuclear power plants. In addition, radionuclides enter human bodies come from terrestrial and cosmogenic through food and water. Radionuclides that enter our bodies are terrestrial in origin such as radon gas, some radionuclides ingested in the body are such as uranium, thorium and potassium-40 as shown in Figure 1 [1]. The dose from terrestrial sources varies in different parts of the world, but locations with higher soil concentrations of uranium and thorium generally have higher doses, dose variation from one person to another is not as large as that linked with cosmic and terrestrial sources [NRC, 2014].

The largest source of human made radiation exposure or dose is from medical investigation and treatment. Figure 1 illustrates all source of background radiation according to the typical distribution of exposure. As it shown in the figure, the natural background radiation occupies the largest source of radiation exposure to human which is 50% and this include terrestrial background (3%), internal background (5%), space background (5%) and radon and thoron (37%). Nevertheless, radiation exposure arising from medical sources is almost as large 48%, the remaining two percent comes from consumers' products, occupational exposure, and industrial exposure, which include the exposure from nuclear power plants [1].

The use of medical radiation account for approximately more than 90% of the man–mad radiation dose. The U.S population exposed over the past quarter century to relatively high dose due to both the existing diagnostic X-ray examinations and the introduction of newer medical X-ray and nuclear medicine studies. These contributed less than 15% of the average yearly radiation exposure received by the US population. The large majority was attributable to radon and other natural sources [2]. The ACR, which has been an advocate for radiation safety since its inception in 1924 convened the ACR Blue Ribbon Panel on Radiation Dose in Medicine to address these issues [3]. This white paper details proposed action plan for the

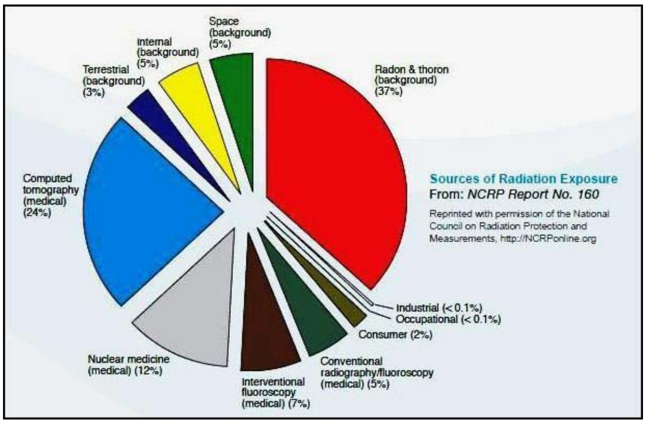

Figure: 1: Sources of Ionizing Radiation.

Citation: Alotaibi AT and Alnafea MA. Radiation Dose Awareness among Radiology Staff. Austin J Nucl Med Radiother. 2017; 4(1): 1023.

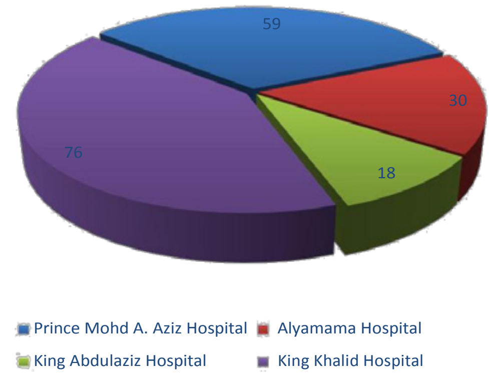

Figure 2: Distribution of Participants according to Hospitals.

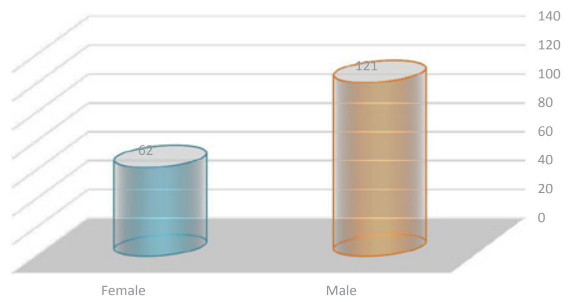

Figure 3: Distribution of Participants according to Gender showed that (121) of participants are male with percentage of (66.0%) While (62) of the participants are female with percentage of (34%).

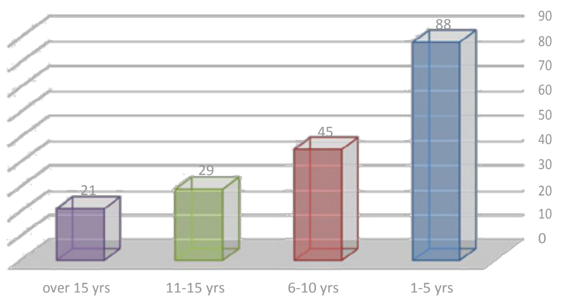

Figure 4: Distribution of Participants according to Length of Service.

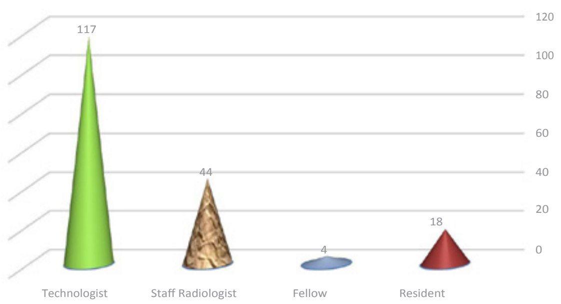

Figure 5: Distribution of Participants according to current designation.

college derived from the deliberations of that panel [2]. In addition, the increase in the use of Computed Tomography (CT) accounted for the increase in exposure to radiation by enrollee, with the mean per capita effective dose escalating from 1.2mSv in 1996 to 2.3mSv in 2010. The percentage of receiving high (>20-50 mSv) or very high (>50mSv) radiation exposure by enrollee during a given year. By 2010, enrollees received a high annual dose of greater than 20 to 50 mSv with percentage of 2.5 and with percentage of 1.4; enrollee received a very high annual dose of greater than 50mSv, [2,4]. Medical usage of radiation exposure in radiological facilities as part of treatment for the harmful effects. Therefore, radiation dose awareness carried out to raise awareness among workers who occupationally exposed to ionizing radiation [4].

Material and Methods

This paper based on descriptive study using a questionnaire of multiple-choice questions consisting 15 questions regarding knowledge of radiology technologists radiologists, fellows and residents to explore and compare knowledge of radiation dose and risk incurred in common radiology examinations among radiology staff [5-7]. A questionnaire of 15 multiple-choice questions format, with four options and only one true answer. The questionnaire distributed among radiology staff to investigate their knowledge about radiation dose awareness. Four hospitals surveyed in Riyadh region, Two Ministry of health hospitals (Prince Muhammad Bin Abdulaziz and Alyamamah) and two university hospitals (King Khalid University and King Abdul-Aziz) [8]. The sample size was (200) and thus, distributed to 200 participants. It is worth pointing out that the questionnaires personally conducted with interviews. During the data collection, a total number of (183) samples were received. Then, statistical analysis of the collected data carried out using SPSS software program version 22 to analyze participants' responses and then compared the results among the participants.

The questionnaires in this work is descriptive study consisted mainly of among others of socio-demographic variables, and other variables based on the objectives and literature review [9]. However, the questionnaire contains two sections, the first, is about socio-demographic information of employees and the second is about the radiation dose in radiology facilities, first few questions assess the basic knowledge of the average natural background radiation and radiation protection knowledge. All questions were in multiple-choice formats, with four options and there is only one correct answer Statistical analysis using SPSS software program used to analyze responses obtained from data and compare the results among the participants. To achieve the objectives of the study and analyzing data, the Statistical Package for Social Sciences (SPSS) used is only frequencies and percentages, which used for the demographic characteristics of the study sample and thus, to determine the responses of the main axes [10].

Results

The data collected by means of a structured questionnaire over a period of 6-7 weeks. The questionnaire distributed among the entire staff at King Abdulaziz Hospital, King Khalid hospital, Prince Mohamed Bin Abdulaziz hospital and Alyamamah Hospital. The targeted participants were Radiology residents, Fellows, Staff Radiologists and Technologists, data entered and analyzed using the Statistical Package for Social Science (SPSS 22) for windows.

Table 1 showed that illustrates participants worked in Prince Mohammed Bin Abdulaziz Hospital, in Alyamamah hospital, in King

Table 1: Distribution of participants according to hospital variable.

Hospitals	Frequency	Percent
Prince Mohd. A. Aziz Hospital	59	32.00%
Alyamamah Hospital	30	16.00%
King Abdulaziz Hospital	18	10%
King Khalid Hospital	76	42%
Total	183	100

Table 2: Distribution of participants according to the question of length of service variable.

Age	Frequency	Percent
1-5 yrs	88	48.00%
6-10 yrs	45	25%
11-15 yrs	29	16.00%
over 15 yrs	21	12%
Total	183	100

Table 3: Distribution of participants according to the question of current designation variable.

Radiology Staff	Frequency	Percent
Resident	18	10%
Fellow	4	2.00%
Staff Radiologist	44	44
Technologist	117	64.00%
Total	183	100

Table 4: Distribution of participants for the question of the average natural background radiation according to current designation variable.

Dose	Current designation				Total
	Resident	Fellow	Staff Radiologist	Technologist	
20-30mSv	3	2	11	23	39
2-3 mSv	13	0	22	50	85
0.2-.3 mSv	2	2	9	40	53
200-300 mSv	0	0	2	4	6
Total	18	4	44	117	183

Abdulaziz hospital and in King Khalid hospital respectively.

Table 2 showed that (88) of the participants have experience in range (1-5) years with percentage of (48.0%), while (45) have experience in range (6-10) years with percentage of (24.6%), (29) of participants have experience in range (6-10) years with percentage of (16.0%) and (21) of participants have experience over (15) years with percentage of (12.0%).

Table 3 showed that (18) of participants have been working as resident with percentage of (10%), while (4) of participants have been working as fellow with percentage of (2.0%), (44) of participants have been working as staff radiologist with percentage of (24%) and (117) of participants have been working as a technologist with percentage of (64%).

The above Table 4 illustrates that (85) of participants answered with 2-3 mSv for the average natural background radiation i.e. which represents most participants and correct answer. While (39) of participants answered with 20-30 mSv for the average natural background radiation, (53) of participants answered with 0.2-0.3 mSv for the average natural background radiation; and (6) of participants answered with 200-300 mSv for the average natural background radiation.

Table 5 showed that (61) of participants answered with 0.5 mSv for the approximate effective dose received by the patient. While (30) of participants answered one mSv for the approximate effective dose received by the patient. In addition, (45) participants provide the correct answered i.e. 0.02 mSv for the approximate effective dose received by the patient. Unfortunately, (47) of participants answered 0.05 mSv for the approximate effective dose received by the patient.

Table 6 showed that (153) of participants told that the children is sensitive to radiation which represents the most percentage of participants. Nine participants stated that the adolescents are sensitive to radiation, while (14) participants chose that the adults are sensitive to radiation and finally (7) participants stated that the elderly is the most sensitive age grope to radiation.

Discussions

In every diagnostic and therapeutic procedures involving ionizing radiation, the safety of patients and radiology staff is the priority. Medical staff who contact with ionizing radiation must be aware of radiation dose in clinical practice and proceed to As Low As Reasonable Achievable (ALARA) [11]. This includes performing the radiology procedures with lowest possible radiation dose taking into account the desired diagnostic effect. The participants in this study were radiology staff, residents, fellows and technologists. The number of participants from technologists staff were 117 (63%), followed by radiologists 44 (24%). Then residents, 18 (9.8%) and fellow 4 (2.2%). The participants do not have adequate knowledge about the average natural background radiation, as those answered correctly were (83/183). In addition, the knowledge about the approximate effective dose received by patient in a single view chest X-ray was insufficient

Table 5: Distribution of participants for the question of approximate effective dose received by patient in a single View Chest X-ray according to current designation variable.

Dose		Current designation				Total
		Resident	Fellow	Staff Radiologist	Technologist	
Approximate effective dose received by patient in a single View Chest X-ray	0.5 mSv	4	1	7	49	61
	1 mSv	2	0	9	19	30
	0.02mSv	7	1	11	26	45
	0.05mSv	5	2	17	23	47
Total		18	4	44	117	183

Table 6: Distribution of participants for sensitive to radiation according to current designation variable.

		Current designation				Total
		Resident	Fellow	Staff Radiologist	Technologist	
Sensitive to radiation	Children	14	3	34	102	153
	Adolescents	2	1	1	5	9
	Adults	2	0	7	5	14
	Elderly	0	0	2	5	7
Total		18	4	44	117	183

among participant; only (45/183) gave the correct answer [12]. However, participants gave satisfied answer about the sensitivity to radiation, as the total of correct answer by responders was (153/183), while question of maximum permissible dose of radiation for workers, and were (74/183). The questions about the effective dose of radiation from a single view of Abdominal X-ray the participants answers were (56/183). Furthermore, the participants' knowledge about dose from CT abdomen was (82/183). The question about the pregnant woman underwent CT abdomen and pelvis with contrast, as the CT Technologist did not enquire her pregnancy status before performing CT, was (69/183). Finally, question regarding ALRA principles, the responders knowledge were (125/183). These results reveal a serious knowledge insufficiency among each of different group of radiology workers [13].

Conclusion and Limitations

Results show a variable level of knowledge about radiation dose and risk among radiology residents, fellows, radiologists and technologists. Overall knowledge is inadequate in all groups. There is significant underestimation of radiation doses in common examinations, which could potentially lead to suboptimal risk assessment and excessive or unwarranted studies. Consequently, posing significant radiation hazard to the patient and radiology workers. A conscientious effort to provide more education that is robust and acquire greater knowledge in these matters is required [14,15]. Conducting periodic training courses to know how to minimize radiation dose and to avoid risk related. In addition, using technology and modern methodology to assist in using radiology equipment and devices related to avoid unnecessary radiation dose to workers and patients. This study suffered from a number of limitations, the sample size although not very small, it is not large enough and needs countrywide studies before taking major actions. Many of the questions asked about precise numerical answers, which felt not practicable by many of the participants.

Acknowledgments

This Project funded by the National Plan for Science, Technology and Innovation (MAARIFAH), King Abdulaziz City for Science and Technology, Kingdom of Saudi Arabia, Award Number (MED_2516).

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Austin J Nucl Med Radiother - Volume 4 Issue 1 - 2017
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