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Assessment of awareness of radiation protection and ALARA principles among radiography students

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ABSTRACT

INTRODUCTION

On November 8, 1895, Wilhelm Conrad Roentgen discovered x-rays. Recent developments in imaging technology have led to a rapid increase in the use of ionizing radiation in medicine, which has potential for resolving a variety of clinical problems (1,2).

The application of medical radiation in the diagnosis of disease, various procedures, and the surgical management of patients is increasing day by day.

Radiation is defined as a moving form of energy (3).We use both ionizing and non-ionizing radiation commonly in our day-to-day practice (4).According to its effects on the substance, radiation is divided into two groups: ionizing and non-ionizing radiation (5).

Different types of radiation:

1) Ionizing radiation: Ionizing radiation is divided into direct and indirect

- **Direct ionizing radiation** includes alpha particles and beta particles.
- **Indirect ionizing radiation** includes X-rays, gamma rays, and UV rays.

2) Non-ionizing radiation

Radiation accidents have enabled the study of the effects of high levels of radiation.

The first x-ray machine was introduced in India at the Madras Medical College in 1900. New setups are being established, and radiation workers are constantly being produced through various academic programs.

A worker typically wears the personnel monitoring equipment for three months. The employer registers the dosage recorded by the personnel monitoring equipment, which is subsequently forwarded to the dosimetry service provider for evaluation in order to determine the radiation exposure level (6).

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ALARA is a sound safety principle and a regulatory requirement for all radiation safety programs. The ALARA optimization principle has to be in place from time to time whenever radiological examinations are performed.

Radiation is a double-edged sword. Radiation is more damaging to the molecular, cellular, and organ systems, which are known health stress agents (6).

Biological Effects are of two types

a) Deterministic Effect

b) Stochastic Effect

According to the International Atomic Energy Agency (IAEA), a health effect that requires a specific level of exposure to ionizing radiation before it can occur is called a **deterministic effect**. The severity of the deterministic effects depend on time of exposure, doses, type of Radiation. Deterministic effects are those responses which increase in severity with increased dose, if the dose increases the severity of an effect increases (7).

Some examples of deterministic effects include

Radiation-induced skin burns, acute radiation syndrome, radiation sickness, cataracts, sterility, and tumor necrosis

Non-deterministic effects, also known as **stochastic effects**, arise from radiation exposure and are characterized by a probability that increases with the dose. Unlike deterministic effects, there is no specific threshold at which these effects are triggered. The manifestation of stochastic effects, such as cancer development, is often identified many years after the initial exposure to radiation(8). The probability of occurrence is typically proportional to the dose received. Stochastic effects after exposure to radiation occur many years later (the latent period). The severity is independent of the dose originally received.

Some examples of non-deterministic effects include cancer and heritable or genetic changes.

Radiation protection has three main principles: justification, optimization (ALARA, as low as reasonably achievable), and dose limitation(4). It also has rules that can be divided into three categories: distance, exposure time, and shielding from external irradiation.

Maximum protection is therefore recommended for the radiographers and patients under examination.

OBJECTIVES

The main aim of this survey-based study was to determine the knowledge of radiation protection and the ALARA principle among B.Sc. imaging and diploma imaging students.

Materials and Methods

Place of Study

Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, 533201

DURATION OF STUDY

1st November 2022 to February 2023

INCLUSION CRITERIA

First, second, and third-year radiography students of B.Sc. medical imaging technology

First- and second-year radiography students of diploma medical imaging technology

EXCLUSION CRITERIA

Degree and diploma holders in medical imaging technology

SAMPLE SIZE: 60

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STUDY DESIGN

This study was a questionnaire-based cross-sectional study. It was carried out among sixty (60) B.Sc. diploma students of medical imaging in the radiology department of Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram. The study was carried out from November 1, 2022, to February 2023.

Method of Collection of Data

The study tool in this research included a validated, self-administered, and self-structured questionnaire that will be prepared and circulated among B.Sc. and diploma paramedical students of medical imaging technology. It consists of questions regarding demographic information and also regarding radiation protection and the ALARA principle.

This questionnaire consists of three parts: A, B, and C. Section A comprised questions regarding personal protection, Section B comprised questions regarding patient protection, and Section C comprised questions regarding awareness of radiation protection among radiographers, with 13 questions under the personal protection section, 10 questions under the patient protection section, and 7 questions under the awareness of radiation protection among radiographers.

This questionnaire is circulated among radiography students of B.Sc. medical imaging technology and diploma medical imaging technology who were asked to answer the questionnaire. Each positive answer was scored as 1, and each negative answer was scored as 0. The higher the score, the better the radiography students knowledge regarding radiation protection and the ALARA principle. The data collected from the questionnaire was tabulated into different groups based on their experience, i.e., first-year degree, second-year degree, third-year degree, first-year diploma, and second-year diploma students. This score was converted into percentages for each part of the questionnaire based on the experience of the students separately.

CONSENT

Informed consent was obtained from the participants with the assurance of confidentiality and anonymity of the data before the study commenced.

STASTISTICAL ANALYSIS

The collected data will be compiled, tabulated, presented in graphs, and statistically analyzed using Statistical Package for Social Sciences software (SPSS), 21st version.

Results and discussion

Socio-demographic characteristics of the participants:

Table 1 shows a summary of the socio-demographic characteristics of the participants. 63.3% of them were males, and 36.7% of them were females. 85% of them are degree students, and 15% of them are diploma students. 36.7% of the students have 1 year of exposure to medical imaging technology; 33.3% of the students have 2 years of exposure to medical imaging technology; and 30% of the students have 3 years of exposure to medical imaging technology.

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Radiation protection knowledge among and ALARA principles among radiography students

Table 2 shows the questionnaire that was circulated among the degree and diploma students of medical imaging technology.

TABLE - 1

Socio-demographic characteristics of the participants.				
Educational qualification		**Working experience**		
Degree	**Diploma**	**1 year**	**2 years**	**3 years**
51	09	22	20	18
sex				
Male	**Female**			
38	22			

TABLE - 2

Question number	**Research questions**
Personal protection	
1	What is the maximum exposure that ICRP allows an occupational worker per year?
2	What is the maximum exposure that AERB allows an occupational worker per year?
3	Which of the following recommends or defines the dose limits?
4	Which one of the following professionals is more at risk for radiation exposure?
5	Thickness of Lead Apron?
6	All are radiation protection devices, except?
7	Do you wear personal dosimeters during your work in the radiology department?
8	Minimum safe distance from the x-ray machine while taking X-rays?
9	TLD badge during the fluoroscopy procedure?
10	Annual dose limit for lenses of the eye for occupational radiation workers?
11	Annual dose limit for limb extremities for occupational radiation workers?
12	TLD badge composition?
13	Exposure factors for chest X-rays?
Patient protection	
1	What is the annual whole-body dose limit for the public?
2	What is the dose limit for a pregnant radiation worker?
3	Which rule is followed by women of childbearing age for radiation exposure?
4	Which of the following is a stochastic effect?
5	To reduce the radiation dose to individuals
6	Radiation protection for pediatric patients, all except
7	Which of the following tissues is more susceptible to ionizing radiation?
8	Which of the following diseases may result from stochastic radiation damage?
9	Will you ask women in the reproductive age group about their pregnancy status before an X-ray?
10	Patient protection measures?

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Awareness of radiation protection among radiographers	
1	Maximum effective dose for which radiology procedure?
2	X-rays are electrically
3	Which modality has the maximum ionizing radiation exposure?
4	Full form of ALARA?
5	S.I. Units of Effective Dose?
6	Full form of AERB?
7	S.I. Unit for measurement of radioactivity?

TABLE -3

Parameter	Ratio of Correct and Incorrect									
	Degree						Diploma			
	1st		2nd		3rd		1st		2nd	
	n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Personal Protection	247	57.49	182	79.67	234	76.5	39	58.97	78	62.82
Patient Protection	190	60.53	140	70	180	69.44	30	70	60	63.33
Awareness of radiation protection among radiographers.	133	48.87	98	66.33	126	73.81	21	52.38	42	61.9

The main objective of radiation protection is to establish precise guidelines for the safe use of ionizing radiation by the general public, employees, and patients, without causing any adverse effects from the radiation (9,10). As a result, all requirements must be properly adhered to in order to ensure the safety of personnel, patients, and the general public. In order to improve radiological staff safety and radiation protection, every practitioner was required to have a specific level of radiation protection knowledge. (11,12). The essential learning outcomes in radiation protection for radiographers were developed in this safety standard and included: the use of suitable and effective devices, the use of proper radiation measures, and the application of concepts and tools for radiation protection and optimization (13). According to Ismanto et al., conforming to these guidelines will reduce the risks associated with ionizing radiation and its radiological examinations.

A study conducted to evaluate awareness and ionizing radiation protection practices among radiographers and exposed health workers in Egypt revealed that about 51.3% of the radiology department's working crew was aware of radiation protection practices, which is pretty satisfactory. Workers with a higher educational level (44.2%) and workers with more than 10 years of working experience (36.8%) had a satisfactory awareness of radiation safety measures. (14). According to the results of the data collected, the radiation protection

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measures and the safety-related use of the radiation protection procedures at the department were quite satisfactory.

Another study by Abuzaid et al., when studying radiation protection and radiation protection compliance in the radiology department, it was discovered that 75.1%, 60.4%, and 45.7% of radiographers followed environmental protection, patient protection, and self-protection policies, respectively. Despite higher compliance practices, more knowledge and awareness are needed to improve safety measures and practices (15)

In this study, out of the 30 research questions provided to the radiography students, 2nd and 3rd year degree students have better knowledge of personal protection and awareness of radiation protection among radiographers sections compared to diploma and 1st year degree students. 2nd year degree and 1st year diploma students have better knowledge in the patient protection section compared to 1st and 3rd year degree and 2nd year diploma students.

CONCLUSION

Radiographers are also at a higher risk of having an ionizing radiation-related problem since they are exposed to substantially higher doses of ionizing radiation on a daily basis than the general public, they are at a greater risk of developing an ionizing radiation-related complications. Therefore, knowledge of radiation protection is of the utmost important. Because the general public is unaware of the dangers of ionizing radiation exposure, radiological personnel who are directly affected must implement radiation protection measures to safeguard themselves, the general public, and the environment.

This survey-based study was to determine the knowledge of radiation protection and the ALARA principle among B.Sc. imaging and diploma students. The study showed that radiographers knowledge of radiation protection practices was satisfactory and good. The results of this study show that radiographic students with more years of experience have more knowledge compared to those with less experience. In this study, 2nd and 3rd year degree students have better awareness of radiation protection and ALARA principles compared to 1styear degree and diploma radiography students.

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