A SURVEY ON RADIATION PROTECTION AWARENESS ABOUT THE RADIATION HAZARDS AND SAFE PRACTICE AMONGST THE NURSING FACULTY AND STAFF IN RAJASTHAN, INDIA

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Abstract— **The application of ionizing radiation in medicine has immensely revolutionized healthcare. However, the knowledge of radiation protection is of utter importance for those involved or assisting in medical radiological procedures in order to ensure patient and staff safety. The present study attempted to assess knowledge of radiation protection among nursing faculty and practicing nurses. A questionnaire based online survey was performed among nursing faculty and staff in the state of Rajasthan of India. Total 88 nursing faculty and practicing nurses completed the online radiation protection survey google form. Fifty percent of the participants in the survey were relatively young and were in the age group 28 - 37 years. Majority of responses were received from males (N = 58, 66%). The outcome of present work revealed that the knowledge of radiation protection is very limited among nursing faculty and practicing nurses in Rajasthan state, India and needs appropriate corrective measures. The Government, regulatory bodies, nursing associations and institutes should take effective measures to bridge the gap that exists in radiation protection education among faculty and practicing nurses in India.**

Keywords— **Radiation Protection, Nurses, Awareness, Survey.**

I. INTRODUCTION

The use of ionizing radiation is rapidly increasing in healthcare sector for diagnosis and treatment of various diseases [1]. Furthermore, the use of radiation in paediatric imaging saves many young lives by early appropriate diagnosis and treatment [2]. However, ionizing radiation is hazardous and has potential to cause harm to staff as well as patient if not used judiciously and appropriately. Therefore, underlying radiation protection and safety measures are a great concern for patients and occupational staff during medical radiological examinations and treatment [3].

The current approach to radiation protection is widely accepted globally based on advice from International Commission on Radiological Protection (ICRP) based on three fundamental principles of justification, optimization and dose limitation [4, 5]. Many healthcare workers presume conformity with these basic principles is sufficient, however, this is not always so and current framework does not address many dilemmas that may arise in clinical use of ionizing radiation in medicine [6]. Moreover, inappropriate use of medical radiological technologies by unskilled health professionals can result in potential health hazards for patients as well as staff [7].

Insufficient knowledge level on the use of medical ionizing radiation and radiation protection may induce radiophobia that can lead to compromised patient care and safety [8-10]. Practicing nurses can perform a variety of work during medical radiological procedures. Several studies have reported that practicing nurses lack knowledge of radiation health hazards and various methods of radiation protection [11, 12]. Few attempts have also been made to provide fundamentals of radiation protection, especially for nurses [13]. Notably, the competency of nurses during radiological procedures is not studied well nor do formal guidelines/curriculum of radiation protection training for them exist in this part of the country.

The present study was aimed to explore the radiation protection knowledge among nursing faculty and practicing nurses in Rajasthan state of India. In our study, the target population is nursing faculty and practicing nurses who are working as teaching faculty in nursing colleges and nursing staff practicing in hospitals, clinics and other healthcare sectors in Rajasthan state.

In India, practicing nursing staff are exposed to medical radiation in routine who are working in operating theatres, radiology, Cathlab, interventional radiology, nuclear medicine and radiation oncology practices and assisting in radiological procedures. The purpose of present work was to identify the key areas of radiation protection where in nursing faculty and practicing nurses can be educated by recommending the additional modules of radiation hazards and safety for nurses in the nursing curriculum.

II. MATERIALS AND METHODS

An online cross-sectional survey questionnaire was prepared following universally employed guidelines for conducting online cross-sectional surveys using google form. This was an electronic survey prepared in English language. The questionnaire consists of two parts. In the first part, personal and demographic details were included such as name, email ID, age, gender, institute, work experience, education level, type of employment etc. The details of personal and demographic responses are shown in Table 1. In addition, the radiation protection knowledge was

tested using 40 multiple choice questions (MCQ) in part two. The survey was conducted among nursing faculty and practicing nurses from Rajasthan.

Table 1: Questionnaire details of survey for participant's personal and demographic information

Parameters	Details
Name	
Email ID	
Age (in years)	18-27 28-37 38-47 48-60 Over 60
Gender	Male Female
Institute	
Work experience (in years)	0-4 5-9 10-14 15-20 Over 20
Education in Nursing	Diploma Undergraduate Postgraduate Higher degree
Type of Employment/job	Private Public Others (Please specify)
Working unit	Teaching faculty Operating theatre Medical ward Emergency ward Cath lab Radiology department Radiation Oncology department Nuclear Medicine department
Are you taught/ gained knowledge about Radiation Protection during your study?	Yes/ No
Are you involved in teaching students?	Yes/ No
If you are involved in teaching, how many years of teaching experience?	_____
If you are involved in teaching, are you teaching Radiation Protection to your students?	Yes No Leave empty
Any other comment/ suggestion(s)	

The questionnaire was distributed to various nursing colleges and hospitals for voluntary participation for receiving responses from 1 July 2024 - 31 August 2024. The questionnaire was provided to nursing faculty and practicing nurses for easy access using a google form link shared on email and WhatsApp. The participants were invited to complete self-reported questionnaire. The response of participants was anonymous and followed adherence to standards of good research practice for publication. Confidentiality of the records were maintained. Analysis of data was performed using Excel (MS Office 365). After collecting all of the data, it was checked for any missing or duplicate entry of data. All the categorical data were mentioned as numbers and percentage.

III. RESULTS AND DISCUSSION

Total 88 responses have been received through online radiation protection survey google form. Nearly half of the responders (N = 44, 50%) were relatively young in the age group of 28-37 years. A complete gist of demographic details of participants is provided in Table 2.

Table 2: Demographic details of nurses (N=88) participated in the study

Parameters	Number (%)
Age (in years)	18-27: 18 (20.5%) 28-37: 44 (50%) 38-47: 20 (22.7%) 48-60 :3 (3.4%) Over 60: 3 (3.4%)
Gender	Male: 58 (66%)
Work experience (in years)	0-4: 27 (30.7%) 5-9: 19 (21.6%) 10-14: 22 (25%) 15-20: 12 (13.6%) Over 20: 8 (9.1%)
Education in Nursing	Diploma :3 (3.4%) Undergraduate: 29 (33%) Postgraduate: 43 (49%) Higher degree: 13 (14.8%)
Type of Employment/job	Private: 74 (84%)
Working unit	Teaching faculty: 75 (85.2%) Operating theatre :5 (5.7%) Medical ward: 3 (3.4%) Emergency ward: 2 (2.3%) Cath lab: 0 (0%) Radiology department: 2 (2.3%) Radiation Oncology department: 2 (2.3%) Nuclear Medicine Department: 0 (0%)
Are you taught/ gained knowledge about Radiation Protection during your study?	Yes: 77 (87.5%)
If you are involved in teaching, are you teaching Radiation Protection to your students?	Yes: 50 (66.7%)

As suggestion, responders have appreciated the efforts for conducting the online survey and they have stressed on mandating the radiation protection teaching to students. Few nurses were interested in knowing more about radiation protection for teaching to students.

Interestingly, there were no participants who were practicing in Cath lab and Nuclear Medicine. Likewise, only two participants each were involved in the voluntary online survey from Radiology and Radiation Oncology Departments. Therefore, the outcome of our survey has a great significance since most of the participants (N = 75, 85%) belong to teaching faculty in nursing colleges and

they were involved in the teaching of nursing students. Hence, the results of the present survey were skewed towards responses reported from nursing teaching faculty. The findings of present work generalizable to the population of nursing teaching faculty in the state.

In our work, it was noticed while analyzing the data that only 23 out of 40 questions have been answered correctly by the participating nurses with a response rate of more than 50%. In other words, forty-three percent (N = 17, 43%) of the questions were answered wrongly by participants with a low correct response rate i.e. below 50%. This fact provided empirical evidence and strongly suggests that the knowledge of radiation protection is very limited among the study participants, especially in the group of nursing teaching faculty. All the forty multiple choice questions related to radiation protection were summarized with correct response rate in Table 3.

Investigation of responses received from the participants by MCQs revealed vital information regarding the online survey. For instance, question 15 was reported with a 41% correct response rate only. In contrast, question 3 was reported with a 69% correct response rate. This fact showed that participants have average knowledge in basic radiation physics.

Similarly, a mixed response was received from the questions prepared in the domain of basic principles of radiation protection. Question 20 was reported with a 60% response rate. However, questions such as 21 and 23 were reported with 40% of correct response rate only. Broadly, the participants showed average knowledge of basic principles of radiation protection.

Furthermore, the questions such as number 6, 7, 9, 24, 25, 26, 32 and 36 were related to the use of ionizing radiation and radiation protection application in hospital setting. These eight questions were observed with correct response rate below 40% only. In this line, during the survey, the question "What is the factor affecting patient radiation doses?" was reported with the lowest correct response rate of 9% only. Hence, the findings suggest that the participants showed below average knowledge in radiation usage and application of radiation protection principles at workplace during occupational exposure. The possible explanation for this observation can be because of large number of responded nurses were teaching faculty who were not regularly involved with the use of radiation at clinics.

Additionally, the questions such as "Which of the following is considered as most sensitive tissue to radiation?" and "Which of the following is the correct increasing order of sensitivity to radiation?" were related with basic radiobiology. These two questions were reported with the lowest correct response rate, around 10% only. For these reasons, the performance of participants showed poor in the context of basic radiobiology.

Table 3: Findings of forty multiple choice questions* related to radiation protection is presented with correct answer and response rate responded by nurses (N = 88)

Question	Correct answer	Number (response rate)
1. What are the types of radiation?	All the Above	76 (86%)
2. The removal of one or more electrons from Atom is known as:	Ionization	67 (76%)
3. Which of the following is a non-ionizing radiation:	All the above	61 (69%)
4. Which of the following is a correct pair of ionising radiation:	X-rays & Gamma rays	68 (77%)
5. Where is ionizing radiation in healthcare used?	All the above	67 (76%)
6. What is the most commonly used Radioisotope in Nuclear Medicine?	Technicium-99m	35 (40%)
7. What is the most commonly used Radioisotope in Tele-gamma machines of Radiation Oncology?	Cobalt-60	33 (38%)
8. Which one is the Competent Authority for issuing licenses for Radiation equipment in India?	Atomic Energy Regulatory Board (AERB)	57 (65%)
9. Which of the following is correct pair of imaging modality, do not use ionizing radiation?	MRI & Ultrasound	35 (40%)
10. Which types of cells is most sensitive to radiation?	White blood cells	55 (63%)
11. Which of the following is considered as most sensitive tissue to radiation?	Breast	10 (11%)
12. Which of the following is the correct increasing order of sensitivity to radiation?	Adult, Old People, Pregnant Women, Child	6 (7%)
13. Which of the following period of pregnancy is the most sensitive to radiation?	Organogenesis and early foetal period	59 (67%)
14. Which phase of pregnancy is the most sensitive to radiation?	8 to 25 weeks	28 (32%)
15. What is the radiation Absorbed Dose?	Energy imparted per unit Mass	36 (41%)
16. What is the S.I. unit of Radiation Absorbed Dose?	J/Kg	64 (73%)
17. What is the unit of Radiation Absorbed Dose?	Gray (Gy)	49 (56%)
18. No dose of radiation is safe dose:	True	56 (64%)
19. What is the full form of ALARA?	As low as Reasonably achievable	56 (64%)

20.	The lesser the time spent near a radioactive source or an X-ray tube:	Less radiation dose will be received	53 (60%)
21.	When the distance from the source of radiation is doubled, the amount of radiation received will be	Reduce by 1/4	35 (40%)
22.	Limiting radiation dose to patient will help to limit dose to staff:	True	57 (65%)
23.	TLD badge is a Radiation Protection device.	False	35 (40%)
24.	TLD badge should be worn above the lead apron during medical radiological procedures.	No	23 (26%)
25.	In case a lead apron is being used, where should the TLD badge be placed?	Below the lead apron	32 (36%)
26.	TLD badge should be worn by a:	Nurse regularly assisting fluoroscopic guided procedures	22 (25%)
27.	The main source of radiation for the staff in a fluoroscopy room is the patient:	True	61 (69%)
28.	Scatter Radiation Dose is directly proportional to:	Both of the above	48 (55%)
29.	Tube under couch position reduces, in general, high radiation dose rates to the specialist's eye lens	True	60 (68%)
30.	As patient size increases:	All the above	57 (65%)
31.	What is the factor affecting patient radiation doses?	Relative Patient entrance Dose	8 (9%)
32.	What are the protection tools from ionising Radiation?	Thyroid Collar	14 (16%)
33.	Cataract can occur because of ionising Radiation?	True	65 (74%)
34.	Ceiling suspended movable lead glass is generally used in:	Interventional Radiology	49 (56%)
35.	Which of the following radiation protection device are used in Cath lab?	All the above	60 (68%)
36.	Which of the following is the correct increasing order of energy of radiation used for medical radiological procedure?	Mammography, Chest X-ray, CT scan	25 (28%)
37.	What is the annual radiation dose limit for the radiation worker?	20 mSv	42 (48%)
38.	What is the permitted minimum age limit of the radiation worker for occupational exposure?	18 years	39 (44%)
39.	What is the most appropriate location of diagnostic X-ray machine installation?	Low occupancy areas	58 (66%)
40.	What is the most appropriate scenario from radiation protection point of view, during Chest X-ray of adult?	Check for nobody staying inside X-ray room except patient with door closed before imaging	52 (59%)

In present work, most of our responders were relatively young in the age group of 28-37 years of age who holds postgraduate degree educational level and working as a teaching faculty in nursing education. Contrary to the fact, the present study reported lack of radiation protection knowledge amongst nurses. Henceforth, it is important to make aware and train the nursing faculty in radiation hazards and philosophy of radiation protection so that the knowledge is appropriately transferred to nursing students and then they can apply this knowledge and skill in practice.

Similar to our study, 44 intensive care nurses from same hospital in Iran were studied for the knowledge of radiation safety and their behaviour towards portable radiological examinations. They have reported that nurses lack knowledge of radiation protection and recommended in-service training programmes [12].

In another study reported from Malaysia, a cross-sectional survey among 395 nurses conducted on usage of radiation and radiation protection knowledge. They have shown that nurses have sufficient radiation protection knowledge but lack in knowledge of radiation physics and radiation usage principles. They also stressed strengthening the training of nurses involved or assisting in medical radiation environment [11].

In a study carried out by Rowantree et al. on radiation safety knowledge of orthopaedic surgeon's during fluoroscopy environment reported low level of knowledge of ALARA principle and lack in formal radiation safety training. Formal and continuous radiation safety training is advised to prevent the long-term effects of ionizing radiation during fluoroscopy procedures [14].

In a policy perspective for nurses reported by Wang et al., advocated to implement a policy mandating annual radiation protection training for nurses assisting in medical radiological examinations [8].

From the present study, it is clear that a gap exists in radiation protection knowledge among nursing faculty and practicing nurses. Further, the study findings suggest that the lack of radiation protection knowledge can be attributed to absence of provisions for periodic radiation protection training programmes during employment after completion of formal education. Typically, the development of curricula of radiation protection and its inclusion in nursing education is not sufficient. This is just the first and immediate action to address the issue. Next, a robust periodic radiation protection education programmes in the form of online modules or training at institutes is required to fulfil the patient safety goals comprehensively in the context of radiation protection globally. In summary, commutative attempts are needed on priority from government, regulatory body, nursing associations, nursing education

institutes, healthcare institutes to address this gap in a holistic manner.

IV. CONCLUSIONS

The present study evaluated the radiation protection awareness amongst nursing faculty and practicing nurses. The outcomes of present study showed that nurses are well qualified, however, knowledge of radiation protection is very limited. This may seriously impact patient care and occupational safety. Periodic radiation protection training programmes are key to enhancing knowledge of radiation protection in this ever growing and technologically advanced field of ionizing radiation in medicine.

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