

Evaluation of Awareness on Radiation Protection and Hazards among Paramedical Personnel Working in Radiology Department of a Teaching Hospital

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A B S T R A C T

Introduction: Today, in emergency setting of any hospital, most of the patients undergo various imaging procedures for diagnostic and therapeutic purpose, where the department of Radiology plays an important role. Most of the modalities use ionising radiation that has adverse effects on various organs to whoever exposed. Thus an adequate knowledge on radiation hazards and standard protective measures is a must among paramedical personnel for themselves and the patients

Material and methods: This was a descriptive cross-sectional study with purposive sampling technique conducted among 100 paramedical personnel in Father Muller Hospital who are involved in or come across Radiology department in an emergency setting. A set of self structured questionnaire with 17 questions was given and data analysed

Results: The knowledge on radiation was high in those working in Radiology department than those who visit with the patient for imaging. The overall assessment of knowledge among paramedical personnel was satisfactory with student radiographers scoring the highest range and nursing aids scoring the least. There was positive correlation between the groups with good scores and those taught by the institution

Conclusion: The paramedical personnel along with the patients are at utmost risk of adverse effects of radiation exposure where imaging is the backbone for management of a patient in emergency setting. Thus to protect oneself and patient as well, the institution must conduct regular training programs, talks, tutorials regarding radiation hazards, protection and safety practices for the best and safe outcome

Keywords: Knowledge, Paramedical Personnel, Radiation Safety, Radiation Protection, Questionnaire

INTRODUCTION

In general, 80% of exposure to ionizing radiation comes from natural sources of which radon gas is highest, while the rest comes from man-made sources, primarily medical X-rays¹.

Radiological examinations is a necessity in managing a patient as most of critical decisions are based solely on their interpretation despite biological adverse effects which vary based on dose and duration of exposure².

The potential risks of radiation (cataract, skin erythema, foetal anomalies, genetic mutations, cancers) comprises of stochastic effect where probability of disease increases with dose and deterministic effect where severity of disease increases with dose.³

Thus the paramedical personnel should follow “As Low as Reasonably Achievable” (ALARA) concept. A key part of managing radiation safety is through education⁴.

Every person involved must know what and how to handle radiation, safety precautions and issues relating to dose optimisation, to protect patient and oneself from unnecessary exposure, because the number of diagnostic radiology procedures performed in a hospital is growing exponentially with time.⁵

International bodies, e.g. the International Commission on Radiological Protection (ICRP), the World Health Organization (WHO), the International Atomic Energy Agency (IAEA) recognize the importance and necessity of education and training in radiation hazards and safety measures, especially with regards to deterministic effects³ Many studies have pointed at the poor knowledge among various cadres of health personnel as a reason for rise in prevalence of radiation induced adverse health effects. One of the reasons for inadequate knowledge could be of not having basic training programs.⁶

Thus this study was done to assess the knowledge and practices among paramedical personnel on X-ray safety and hazards

MATERIAL AND METHODS

This was a descriptive cross-sectional study with purposive sampling technique conducted among paramedical personnel in Father Muller Hospital, Mangalore that were involved in or come across Radiology department in an emergency setting. A set of self structured questionnaire that has about 13 questions to mark the correct answer and 4 questions based on predetermined scale and data analysed⁷

It was focused on participants' demographic data, education and experience profile, their knowledge towards X-ray safety and practice of safety techniques against radiation hazards⁸

The total sample size was 100 which consisted of student radiographers, staff radiographers, radiology clerks, nurses and nursing aids of MICU, SICU

STATISTICAL ANALYSIS

The response rate was 100%. Data was analyzed by descriptive statistics using Statistical Package for Social Sciences (SPSS) 16.0 version. Chi-square test (χ^2) was applied to determine the association between the level of knowledge, job profile, contact with imaging and if taught by institution. The assumed significance level was $P < 0.05$. Percentage frequency distribution was also used

RESULTS

Out of 100 participants, majority were in range of 25 – 45 years (51%), majority were females (80%). There were 10 each of student radiographers and assistant clerks, 11 staff radiographers, 14 nursing aids and 55 staff nurses (who comprise the majority group). Of all, majority were Bsc Nursing candidates (37%) followed by diploma/GNM candidates (35%).

Majority of the participants in contact with radiology department were the nurses and nursing aids from MICU (39%) (table-1).

Out of 100 personnel visiting or working in Radiology department, majority (57%) had several contact with imaging per day and thus is the significance of this study to assess their knowledge on radiation safety and hazards. Majority (54%) of them scored good (10 – 13 marks out of 13) indicating a satisfactory knowledge overall of which more than half was contributed by those employed in Radiology department.

None of them scored <4 out of 13. 57% of them were given a training or taught by the institution regarding radiation protection and its hazards, while 40% (33% not taught and 7% not attended) were not educated or trained.

89% overall were able to maintain a satisfactory score in answering questions related to knowledge and practices. It

was found that there was significant correlation between being taught and their scores in this study hence proving the role of education.

66% of them believe that their present knowledge on radiation hazards and safety is average while 31% believe it to be good. 96% of them feel the need to update their knowledge after attending the questionnaire, of which 59% strongly recommend to be updated in their curriculum (table 2,3).

DISCUSSION

- Questions such as modalities that work using ionising radiation, adverse effects of radiation on eyes, the standard measure to protect oneself during a portable bedside X ray exposure, necessity to protect oneself from radiation irrespective of completing family – there is significant difference between scores of those who are employed within radiology department (asst clerks, radiographers) when compared to nursing group who visit the department frequently.

About 23% of SICU staff nurses, 47% of MICU staff nurses and 36% of nursing aids who have maximum contact with imaging did not know that MRI does not work on X rays.

95% of SICU nurses, 19% of MICU nurses, 57% of nursing aids did not know that chest is least affected by radiation when compared to eyes.

36% each of SICU nurses and nursing aids, 41% of MICU nurses do not know the standard measure of protection during bedside exposure and practice standing behind a wall/pillar

- Questions related to presence of radiation in CT scanner room at all times, safety of MRI during pregnancy – there was significant difference between the scores of student radiographers when compared to the rest.

CT being the modality of choice in emergency setting of trauma and stroke, it makes a big difference that 64% of SICU nurses, 62% of MICU nurses, 43% of nursing aids, 45% of staff radiographers believed that radiation is “on” in CT scanner at all.

- Questions on prevention of exposure to radiation in pregnancy, usage of lead aprons as barrier from radiations, significance of TLD and serum creatinine (renal function test, which needs to be evaluated as intravenous contrast has added effect on kidneys) – were answered correctly by all cadres. However nursing aids showed lower level of knowledge compared to others

In nursing aids, 35% lacked knowledge on radiation protection in pregnancy, 23% did not know that serum creatinine is a prerequisite prior to contrast imaging, 29% were unaware of lead aprons and 29% believed that even if required, the bystanders should not be allowed inside CT scanner. So they need to be educated regarding protection

Parameter	Scale	Frequency	Percent (%)
Age (years)	<25	45	45
	25 – 45	51	51
	>45	4	4
	Total	100	100.0
Gender	Female	80	80
	Male	20	20
Education	Class XII	12	12
	BSc (Nursing)	37	37
	BMIT (medical imaging technology)	16	16
	GNM (nursing and midwifery)/Diploma	35	35
Designation	Staff nurse	55	55
	Nursing AID	14	14
	Assistant clerk	10	10
	Staff radiographer	11	11
	Student radiographer	10	10
Experience (years)	<5	68	68
	5 – 15	23	23
	15 – 25	8	8
	>25	1	1
Department	Radiology	33	33
	Surgical	28	28
	Medical	39	39
Contact with imaging	Several times / day	57	57
	Several times / week	15	15
	Several times / month	23	23
	Infrequent	5	5
Score (total 13)	Good (10 - 13)	54	54
	Average(7 - 9)	35	35
	Poor (4 - 6)	11	11
	Fail(<4)	0	0
Current knowledge	Very good	31	31
	Average	66	66
	Poor	3	3
	Nil	0	0
Taught	Yes	57	57
	No	33	33
	Dont remember	3	3
	Could not attend	7	7
Updating of knowledge	Strongly agree	59	59
	Strongly disagree	0	0
	Agree	37	37
	Dont know	4	4

Table-1: Percentage frequency distribution of this study

Questions	Chi square	P value
Modalities working on x rays	17.02	0.004
Radiation "on" in CT 24/7	13.887	0.016
MRI being safe in pregnancy	16.367	0.006
Least affected organ by radiation	51.428	<0.001
Use of TLD	23.001	<0.001
Safety measure during portable exposure	11.397	0.044
Malignancy risk with single chest radiograph	14.372	0.013

Table-2: Illustrating p values on comparing those employed in radiology department and those visiting with patients

for bystanders when required.

50% of them had the wrong notion that TLD is for identification of a Radiology department employee

- Question on risk of malignancy on single exposure of chest radiograph was the least scored where the correct answer is very low i.e. $1:10^6$ (most of them answered as no risk)

55% of SICU nurses, 50% of MICU nurses, 71% of nursing aids, 30% of asst clerks, 91% of staff radiographers and 90% of student radiographers failed to answer right

Score	Taught		Not taught		Chi square	P value
	Number	Percent	Number	Percent		
Good	31	54.38596	16	48.48485	7.304	0.02593
Average	23	40.35088	9	27.27273		
Poor	3	5.263158	8	24.24242		
Total	57	100	33	100		

Table-3: Illustrating p values between groups with good scores and those taught by the institution

Limitations of The Study

This study was done focussed on the radiological department of a teaching hospital setting and covers paramedical personnel that are related to radiology department. So, it cannot be generalized to whole population.

Strengths of The Study

The study included all the paramedical personnel involved in an emergency setting of a hospital who work or come in contact with Radiology department

This study has separately assessed the scores of individual with being taught about radiation hazards and safety measure and has a message to institution, as well, in necessity of addition about ionising radiation in their regular curriculums

Controversies In Study

Student radiographers scored 100% in strongly agreeing for necessity of oneself from radiation protection irrespective of reproductive function. But 64% of SICU nurses, 56% of MICU nurses, 50% of nursing aids and 20% of asst clerks and staff radiographers wrongly marked as strongly disagree instead of strongly agree. This might be due to misinterpretation of question than lack of knowledge

59% of SICU nurses, 62% of MICU nurses, 36% of nursing aids 36% of staff radiographers did not know about the safety of pregnant ladies to undergo MRI.

Most of them believed that recent orthopaedic fracture fixation implants is safer for MRI (where the topic is debatable).¹⁰

CONCLUSION

The overall knowledge of radiation amongst paramedical staffs was good (54%) and satisfactory.

However only 24% of nurses could get a good score, which depicts poor knowledge among them, more specifically the nursing aids as this is not acceptable in the context of care they provide to hospitalized patients and their active participation in preparation for scheduled imaging examinations.

Responders and radiographers employed at radiology departments had the best knowledge of radiation protection measures. It appears that this is due to the frequent contacts of these professionals with imaging diagnostics, resulting in better understanding of radiological procedures.

In radiographers, students scored better than the staff due to updated knowledge from frequent classes and tutorials.

Group	Staff nurses (surgical) 22		Staff nurses (medical) 34		Nursing Aids		ASST clerks		Staff radiographers		Student radiographers		P value
	Count	Column	Count	Column	Count	Column	Count	Column	Count	Column	Count	Column	
Q.2	17	77.30%	18	52.90%	9	64.30%	10	100.00%	11	100.00%	9	90.00%	0.004
Q.3	8	36.40%	13	38.20%	8	57.10%	5	50.00%	6	54.50%	10	100.00%	0.016
Q.4	9	40.90%	13	38.20%	9	64.30%	9	90.00%	7	63.60%	9	90.00%	0.006
Q.5	21	95.50%	31	91.20%	12	85.70%	10	100.00%	11	100.00%	10	100.00%	0.509
Q.6	1	4.50%	7	20.60%	6	42.90%	7	70.00%	11	100.00%	10	100.00%	<0.001
Q.7	21	95.50%	32	94.10%	11	78.60%	10	100.00%	11	100.00%	9	90.00%	0.259
Q.8	10	45.50%	17	50.00%	4	28.60%	7	70.00%	1	9.10%	1	10.00%	0.013
Q.9	22	100.00%	34	100.00%	11	78.60%	10	100.00%	11	100.00%	10	100.00%	0.002
Q.10	21	95.50%	30	88.20%	10	71.40%	10	100.00%	11	100.00%	10	100.00%	0.061
Q.11	17	77.30%	34	100.00%	7	50.00%	8	80.00%	11	100.00%	9	90.00%	<0.001
Q.12	14	63.60%	20	58.80%	9	64.30%	9	90.00%	11	100.00%	9	90.00%	0.044
Q.13	19	86.40%	28	82.40%	10	71.40%	9	90.00%	10	90.90%	9	90.00%	0.738
Q.14	8	36.40%	15	44.10%	7	50.00%	8	80.00%	9	81.80%	10	100.00%	0.002

Table-4: Depicting number of correct answer for each question in each group with p values

Finally this study recommends including regular trainings, workshops and continuing medical education (CME) programs on radiation safety and its updates in paramedics curriculum.

Authorities should provide adequate classes on safety measures (including dosimeters), radiation hazards and protective measures for a positive outcome.

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QUESTIONNAIRE

Age:

Gender

Education (degree):

Designation

Experience (years):

Worked maximum in which Department (surgical/medical/radiology)

- 1) How frequent is your contact with imaging examination of patients?
 - a) Several times a day
 - b) Several times a week
 - c) Several times a month
 - d) Infrequent
 - 2) Which of them does not work on x rays?
 - a) CT (Computed Tomography)
 - b) Mammogram
 - c) MRI (Magnetic Resonance Imaging)
 - d) Barium studies
 - 3) Radiation is on in CT scanner at all times. Is it true?
 - a) Yes
 - b) No
 - c) CT does not work by radiations
 - d) Don't know
 - 4) Which situation is safe for a patient to undergo an MRI?
 - a) Patient with cardiac pacemaker
 - b) Patient with cochlear implant
 - c) Patient with recent orthopaedic surgery for fracture fixation
 - d) Patient with pregnancy
 - 5) Which of the following modality is safe for a pregnant lady?
 - a) Mammogram
 - b) CT
 - c) Chest X ray with gonad shield
 - d) Ultrasonography
 - 6) Which of the organs/ parts is least affected by diagnostic radiation?
 - a) Thyroid gland
 - b) Gonads
 - c) Eyes
 - d) Chest
 - 7) Prerequisite test to undergo any procedure in radiology that includes intravenous contrast?
 - a) Total counts
 - b) Haemoglobin
 - c) Serum creatinine
 - d) Total bilirubin
 - 8) What do you think is the risk of developing cancer in future with radiation dose of a single chest radiograph?
 - a) Very high
 - b) Very low
 - c) No effect
 - d) Don't know
 - 9) Which age group of females should be extra cautious in department of radiology?
 - a) Postmenopausal
 - b) Menstruating
 - c) Young girls
 - d) Pregnancy / reproductive age group
 - 10) What is the material of protective cloth used against ionising radiations?
 - a) Aluminium
 - b) lead
 - c) Iron
 - d) Plastic
 - 11) TLD (Thermo luminescent dosimeter) badge is used for?
 - a) Protection against radiations
 - b) Identification of working in radiology department
 - c) Assess the amount of radiation exposure
 - d) Don't know
 - 12) Standard measure for radiation protection during exposure (portable radiography)?
 - a) Stand behind any wall/pillar
 - b) At least 6 feet away from x ray tube
 - c) No need of protection
 - d) Isolate the room
 - 13) During CT or portable radiograph, the bystanders of the patient must be with the patient?
 - a) Yes
 - b) Depends on cost of procedure
 - c) Never
 - d) If patient is restless, then with lead apron on, the bystander is allowed
 - 14) Taking protective measures against radiation when my family is completed?
 - a) Strongly agree
 - b) Strongly disagree
 - c) One's own choice
 - d) Don't know
 - 15) My knowledge regarding radiation protection and measures is
 - a) Very good
 - b) Average
 - c) Poor
 - d) No knowledge
 - 16) Have you been taught or educated on radiation protection and hazards by the institution
 - a) Yes
 - b) No
 - c) Don't remember
 - d) Could not attend
 - 17) I need to update my knowledge regarding radiation protection
 - a) Strongly agree
 - b) Strongly disagree
 - c) Agree
 - d) Don't know
- One category of questions is to assess the knowledge and practices of the paramedical staff with respect to radiation hazards and there are 13 such questions. Each of these questions is given a score of 1 for correct answer only. There is no negative marking
- The other category of questions is based on a predetermined scale for which scoring is not made, but rather used in statistical analysis for comparison between groups to acquire a more accurate results
- Overall, there are 4 questions based on knowledge of ionising radiation, 3 questions on radiation hazards and 6 questions on radiation protection and safety measures
- The answers for the above 13 questions are
2. c) MRI
 3. b) No
 4. d) patient with pregnancy
 5. d) Ultrasonography
 6. d) Chest
 7. c) serum creatinine
 8. b) Very low
 9. d) Pregnant / reproductive age group
 10. b) lead
 11. c) Assess the amount of radiation exposure
 12. b) At least 6 feet away from X-ray tube
 13. d) If patient is restless, then with lead apron on, the bystander is allowed
 14. a) Strongly agree
- The total score (13) is categorised into three – good, average, poor and fail based on percentage cut off of 75, 50, 35 respectively