

## Original Research

# Assessment of Level of Awareness Towards Radiation Protection Among the Staff Working at Angiography Suite at Public Hospitals

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## ABSTRACT

### Introduction

Several challenges with radiation protection and safety culture in radiology departments needs to be addressed as few studies done in this aspect in our country. Especially with regard to the awareness about radiation protection, hazards, dosimetry usage and measurement.

### Objective

The objective of this study is to find knowledge about radiation exposure hazard and practices among various auxiliary staff working in radiation units.

### Material and Methods

Cross-sectional study done by using stratified random sampling method. A questionnaire made to check the awareness level of the radiological staff regarding radiation protection working in angiography suite. The questionnaire had two parts with various questions about radiation protection measures and safety related knowledge for staff and patient. Data collected from angiography suite of three public sector hospitals of Lahore, Pakistan. All the data entered in statistical package for the social science (SSPS) version 16 and analyzed for statistically significant outcomes.

### Results

Total of 67 staff members were included in this study from three different public sector hospitals, 55.2% were males 44.77% were females. Twenty-nine (29) persons belonged to the age group of 20-30-years. Twenty (20) doctors, 21 nurses, 12 radiographers and 14 paramedical staff were included. 89.55% staff members were aware of radiation hazard. 55.22% had training on radiation protection and 44.77%. 56.71% were aware of dosimeter. Only 16% were aware of as low as reasonably achievable (ALARA).

### Conclusion

The radiological staff members were partially aware about radiation hazards and radiation safety. They were lacking from training and workshops. Essential steps required to develop nationwide strategies for improving the situation and maintaining a safe working environment.

### Keywords

Angiography; Radiation hazards; Radiation protection; X-ray; Radiation protection devices.

## INTRODUCTION

In developing countries, about 3.6 billion imaging studies per year carried out worldwide, which leads to an increase of 70% collective effective dose for medical diagnostic procedures.<sup>1</sup> The knowledge of doctors about radiation doses exposure during diagnostic radiological procedures is lacking. Such information is im-

portant when the expansion of imaging technology is increasing.<sup>2</sup>

All radiology workers need proper monitoring and protection equipment. They must also acquire education and training during their jobs.<sup>3</sup> The level of training should be dependent upon the level of risk. The International Commission on Radiological Protection (ICRP) assumes the responsibility of providing

guidance in matters of radiation safety.<sup>4</sup> According to as low as reasonably achievable (ALARA), no practice relating exposures to radiation should be approved unless it produces a sufficient benefit to the exposed individual or to the society and in relation to any particular source within practice. The magnitude of individual doses, the number of people exposed and the likelihood of gaining exposures should be kept as low as reasonably achievable.<sup>5</sup> Mojiri et al<sup>6</sup> also revealed that 83.1% were aware of radiation hazards in her study and 78.9% used the safety measures to protect themselves. Mehmet et al<sup>7</sup> study revealed that about 50% of health care workers had less knowledge about radiation protection awareness.

There was limited study on awareness of radiation hazards and radiation protection among medical staff working in angiography suite found in low socio-economic country as Pakistan. Therefore, this study was performed to assess the level of knowledge about awareness regarding radiation protection.

## MATERIALS AND METHODS

This is a cross-sectional study aiming to survey healthcare professionals working in angiography suite with regard to their knowledge or aware of radiation protection. A semi-structured, close-ended questionnaire used as a data-collecting tool after pre-testing to check the reliability of the questionnaire. The reliability of the questionnaire was 70% in this study by using Cronbach's Alpha. Data collected prospectively from angiography department of three public sector hospitals i.e., The Children hospital, General hospital and Gulab Devi hospital, Lahore, Pakistan after the approval of institutional review board (IRB). Duration of the study was 6-months, from September 2020 to March 2021. Staff members were divided into four groups. First group consisted of cardiologist and neurologist, the second group consisted of nurses, the third one radiographers and fourth para-medics working only in angiography suite.

The questionnaire had mainly three parts with various questions around radiation protection and safety related to staff and patients. The first part contained information about demographic data like age, gender and working experience, etc. The second part was about the awareness of employees around radiation

protection and protection devices and the third part was about the implementation of the safety measures and the hard copies were distributed.

### Including Criteria

Data are collected only from angiography suite of three public hospitals of Lahore after their consent.

### Excluding Criteria

1. Non-ionizing modalities like magnetic resonance imaging (MRI), ultrasound (US) and echocardiography (ECG). Other ionizing modalities such as X-rays, computed tomography (CT), fluoroscopy, positron emission tomography (PET) scans, single-photon emission computed tomography (SPECT) scans, nuclear medicine were excluded from the study.
2. Incomplete questionnaires, members from whom we failed to receive the consent regarding participation in the study.

### Statistical Analysis

All data were entered in statistical manner for the social sciences (SSPS) version 16 and then analyzed for statistically significant outcomes. Descriptive analysis was used to check the frequency and percentage. While Pearson chi-square ( $\chi$ ) used to check the association between categorical variables. Cronbach's alpha was used to measure the consistency and was found to be 70%.

## RESULTS

Out of 67, 37(55.22%) were males and 30(44.77%) were females. Most of the staff members belonged to the age group of 20-30-years. There were 20 doctors, 15 cardiologists and 5 neurologists. Twenty-one (21) nurses, 12 radiographers and 14 paramedical staff in the study groups working at angiography suite (Table 1), 89.55% staff members were aware of radiation hazard. Only 47.76% took all the all the safety measures i.e., lead aprons, thyroid shields and lead glasses, while 28(41.79%) used only lead aprons and 7(10.44%) people used lead aprons and thyroid shield only.

		Current Designation					Total	p Value
		Cardiologist	Neurologist	Nurses	Paramedics	Radiographer		
Gender	Male	8	4	12	1	12	37	0
	Female	7	1	9	13	0	30	
Age	20-30-Years	6	2	8	8	5	29	0.13
	31-40-Years	5	1	8	3	5	22	
	41-50-Years	3	0	5	3	2	13	
	51-60-Years	1	2	0	0	0	3	
Working Experience	1- 4-Years	7	2	3	6	2	20	0.38
	5 -9-Years	3	1	6	4	3	17	
	10-14-Years	1	0	7	2	5	15	
	≥14-Years	4	2	5	2	2	15	

Twenty-eight (28)(41.79%) used glass shield at head side, 13(19.40%) at leg side, 3(4.48%) at lateral side, 21(31.34%) were not aware of safety measures and 2(2.98%) did not answer. Regarding handling of lead aprons 53(79.10%) hanged the lead aprons on the hangers and 14(20.89%) did not know about it (Table 2).

Regarding awareness, 37(55.22%) completed the training on radiation protection and 30(44.77%) never took training on radiation protection. 38(56.71%) were aware of dosimeter and only 45(67.16%) were aware of ALARA (Table 3). Interestingly, out of

all the staff members, 70% consultants were not trained on radiation protection and 45% consultants were unaware of dosimeter and ALARA.

Only 30(44.77%) staff members were aware of implemented ALARA and 22 (32.83%) were not aware of ALARA. Out of which 7(10.45%) implemented ALARA by decreasing time, 1(1.49%) increased distance between radiation source and operator, 1(1.49%) used shield, 6(8.96%) decreased time and increased distance between source and operator (Figure 1). It was found that

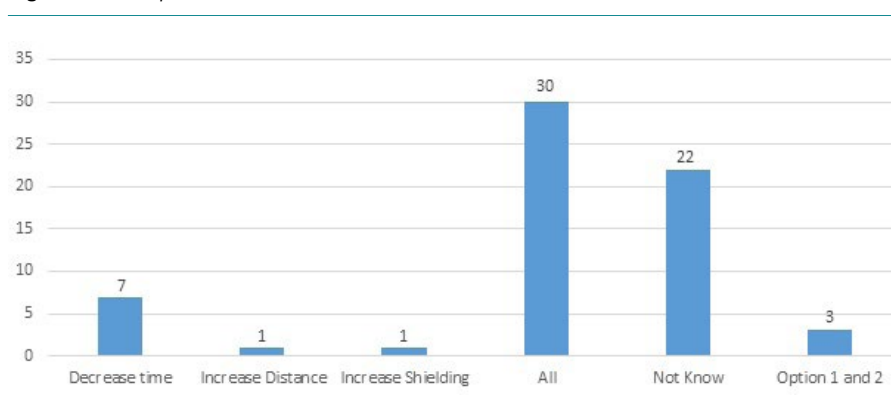
**Table 2. Radiation Protection Measures in Study Groups**

		Current Designation						Total	p Value
		Cardiologist	Neurologist	Nurses	Paramedical Staff	Radiographer			
Radiation Hazard	Yes	14	5	21	14	6	60	0	
	No	1	0	0	0	6	7		
Safety Measures	Lead aprons	8	2	2	4	12	28	0	
	All	7	3	15	7	0	32		
	Option 1 & 2	0	0	4	3	0	7		
Glass Shield	Leg side	3	2	3	5	0	13	0	
	Lateral side	0	0	3	0	0	3		
	Head side	7	3	13	5	0	28		
	Others	2	0	0	0	0	2		
	Not aware	3	0	2	4	12	21		
Apron Handling	Hang it on hangers	15	5	21	12	0	53	0	
	Not aware	0	0	0	2	12	14		

**Table 3. Awareness about Radiation Protection in Study Group**

		Cardiologist	Neurologist	Nurses	Paramedical Staff	Radiographer	Total	p Value
Training on radiation protection	Yes	5	1	18	9	4	37	0.003
	No	10	4	3	5	8	30	
Dosimeter	Yes	7	4	20	7	0	38	0
	No	8	1	1	7	0	17	
	Not Aware	0	0	0	0	12	12	
ALARA	Yes	8	4	21	12	0	45	0
	No	7	1	0	2	12	22	

**Figure 1. ALARA Implementation**



40% consultant and 14% paramedics did not implement ALARA, while 100% nurses implemented ALARA measures (Table 4).

Regarding patient protection, 27(40.29%) implemented minimum procedure time to protect patient from radiation hazard, 5(7.44%) reduced distance between patient and detector, 8(11.9%) used shield, 3(4.48%) applied all the safety measures, 11(16.42%) implemented both minimum time and reduced distance between patient and detector and about 13(19.40%) people this question was not applicable (Figure 2).

For reducing exposure factors, 3(4.48%) increased kvp and decreased mas, 8(11.94%) collimate the area of interest, 3(4.48%) decreased the use of cine angiography, 9(13.43%) used

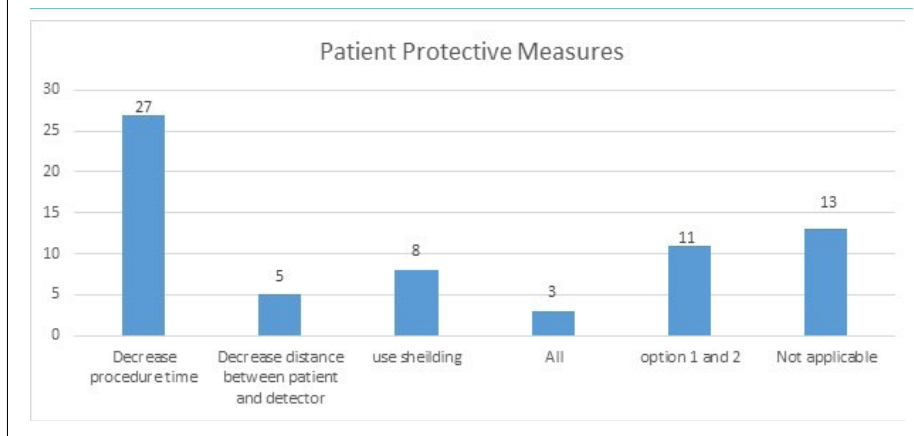
all (increase kvp and decreased mas, collimate the area of interest, decreased use of cine angiography copper filtration), 4(5.97%) decreased used of cine angiography and collimate area of interest, and 40(59.70%) were not aware of exposure factors used during the angiographic procedures (Figure 3).

Regarding workshops and guidance, 7(10.44%) attended 3 workshops in a year, 7(10.45%) attended 5, 21(31.34%) attended 1 workshop in a year and 32(47.76%) never attended any workshops on radiation protection in a year. Out of 67, 37(55.22%) persons guided their juniors by teaching, 7(10.45%) held workshops to guide their juniors, 5(7.46%) used both (workshops and teaching method), 4(5.97%) used some other methods to guide their students and about 14(20.89%) persons mentioned that, this question

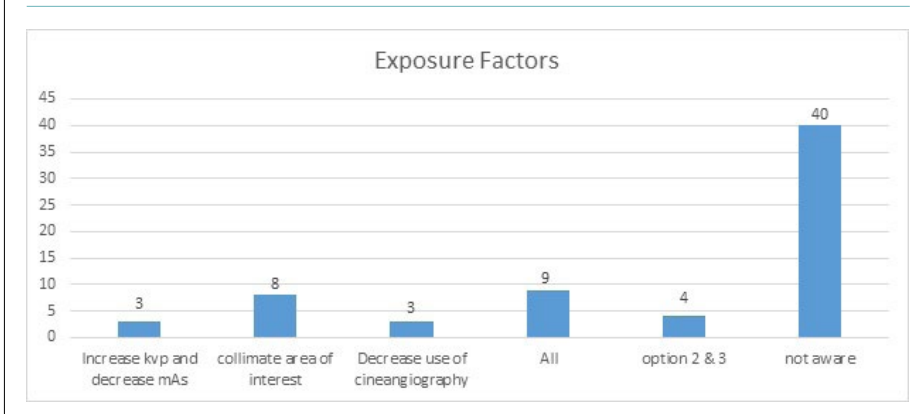
**Table 4.** ALARA Implementation in Study Groups

		Cardiologist	Neurologist	Nurses	Paramedical Staff	Radiographer	Total	p Value
ALARA Implementation	Decrease time	1	0	6	0	0	7	0
	Increase distance	0	0	0	1	0	1	
	Increase shielding	1	0	0	0	0	1	
	All	6	4	13	7	0	30	
	Not know	7	1	0	2	12	22	
	option 1 & 2	0	0	2	4	0	6	

**Figure 2.** Patient Protection Measures Used in Study Group



**Figure 3.** Reducing the Exposure Factors in Study Group



**Table 5.** Mode of Creating Awareness to Juniors

	No. of Workshops	Cardiologist	Neurologist	Nurses	Paramedical Staff	Radiographer	Total	p Value
Radiation hazard safety measures	3	2	0	4	1	0	7	0.002
	5	1	0	6	0	0	7	
	1	4	3	6	8	0	21	
Never attended		8	2	5	5	12	32	
Glass shield	By teaching	8	2	20	7	0	37	0
	By workshop	3	1	0	3	0	7	
	Both	3	1	1	0	0	5	
	Other method	1	1	0	2	0	4	
	Not applicable	0	0	0	0	2	12	

was not applicable at all (Table 5).

## DISCUSSION

Our study revealed that 89.55% healthcare workers were aware of radiation hazard and only 70.1% health workers working at angiography suite used safety measures out of which only 47.76% used all the safety measures. Majority of them were radiographers. In the health worker group, 20.89% cardiologists, 7.46% neurologists, 8.96% radiographers, 31.34% nurses and 20.89% paramedical staff were aware about the radiation hazard. The implementation of recommended radiation protection protocols and practices in the radiology departments is vital for the safety of the radiographers, the patients and the environment.<sup>8</sup> Mojiri et al<sup>6</sup> also revealed that 83.1% were aware of radiation hazards in her study and 78.9% used the safety measures to protect themselves. Mehmet et al<sup>7</sup> study revealed that about 50% of health care workers had less knowledge about radiation protection awareness. Lynskey et al<sup>9</sup> study showed that 99% used lead aprons, 94% used thyroid shields and 54% used lead glasses, 44% used ceiling suspended lead shields. Our study showed that 99% staff used lead aprons and 93% used thyroid shield. Abuzaid et al<sup>10</sup> showed that radiographer compliance related to patient protection and self-protection were 64.4% and 45.7% respectively, overall radiation protection practice compliance was 75.2% ±18.5. But in our study 47.77% used overall radiation protection practice in public sector hospital.

In our study, only 67.1% health care workers in angiography suite knew ALARA implementation. Abuzaid et al<sup>10</sup> study also showed lower radiation exposure factors used i.e., 43.7, 46.4 and 38.5%. Nevertheless, increase awareness is necessary to improve current practices. The ALARA concept is an essential theme in radiation protection in medicine. The three major principles of applying ALARA are time, distance and shielding. Radiographers can effectively improve radiation protection through compliance with the established international guidelines and standards of practice and by utilizing proper tools and equipments. The current study revealed that, currently, radiographers' practices are unsatisfactory about reducing radiation exposure for patients and themselves.<sup>10</sup> Therefore, a systematic and harmonized approach is required in the form of proper actions to ensure that radiation protection measures and standards should be implemented in radiology departments.

Radiation exposure factors was done by 46.26% in our set up and 56.71% were aware of dosimeter in our study, which was alarming. Briggs-Kamara et al<sup>11</sup> showed that 76.2% of radiographers use proper collimation. Eze et al<sup>12</sup> reported a better attitude to wearing radiation dosimeters among a sample of industrial radiographers in Port-Harcourt, Nigeria. The periodic radiation dose check is lacking in our public sector hospitals. Concerning the utilization of the patient protection tools, the study revealed that 10.2, 24.4 and 15.7% of the participants neglected to use the light beam diaphragm, cone and gonads shielding, respectively.<sup>12,13</sup> In our study it showed that patient protection measures used in 80.59% with different measures.<sup>14</sup>

Our study revealed lack of awareness regarding radiation protection along with implementation of ALARA in doctors and workers in angiography suite. There is also lack of study in this aspect in our country. We need to improve it by conducting frequent workshops, awareness programs and seminars.

## CONCLUSION

Awareness regarding radiation protection in health care workers in angiography suite were unsatisfactory. The head nurse and radiographers should guide to implement ALARA. Workshops, webinars, training courses, meetings and teaching for radiation protection should be increased. By following the radiation protection guidelines, we can protect others and ourselves from the harm full hazards of radiations.

## LIMITATIONS

Small sample size. More hospitals should be involved including private sector. Survey should be done at country-level.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES

1. Rehani M, Ciraj-Bjelac O, Vaño E, et al. Radiological protection in fluoroscopically guided procedures performed outside the imaging department. *Medicine Annals of the ICRP*. 2010. doi:

[10.1016/j.icrp.2012.03.001](https://doi.org/10.1016/j.icrp.2012.03.001)

2. Shiralkar S, Rennie A, Snow M, Galland RB, Lewis MH, Gower-Thomas K. Doctor's knowledge of radiation exposures is deficient. *BMJ*. 2003; 327(7411): 371-372. doi: [10.1136/bmj.327.7411.371](https://doi.org/10.1136/bmj.327.7411.371)

3. European Commission. Radiation protection 116. Guidelines on education and training in radiation protection for medical exposures. 2000. Web site. <http://ec.europa.eu/energy/nuclear/radiation/protection/doc/publication/116.pdf>. Accessed August 16, 2009.

4. Ahmed RM, Elamin AMT, Elsamani M, Hassan WB. Knowledge and performance of radiographers towards radiation protection, Taif, Saudi Arabia. *Journal of Dental and Medical Sciences*. 2015; 14(3): 63-68. doi: [10.9790/0853-14326368](https://doi.org/10.9790/0853-14326368)

5. Sultan T, Sedairy A, Qasim HE, Al-Qasaby, Mahyuob F, Alshabana M. Radiation safety manual. 2011; (5): 6-7.

6. Mojiri M, Moghimbeigi A. Awareness and attitude of radiographers towards radiation protection. *Journal of Paramedical Sciences (JPS)*. 2011; 2(4): 2-5. doi: [10.22037/jps.v2i4.2714](https://doi.org/10.22037/jps.v2i4.2714)

7. Mehmet N, Kaya SD. Radiation safety awareness among healthcare workers in middle Eastern Countries. *Journal of Advances in Medicine and Medical Research*. 2017; 24(5): 1-6. doi: [10.9734/JAMMR/2017/37438](https://doi.org/10.9734/JAMMR/2017/37438)

8. Abuzaid MM, Elshami W, Hasan H. Research article knowledge and adherence to radiation protection among healthcare workers

at operation theater. *Asian J Sci Res*. 2019; 12: 54-59. doi: [10.3923/ajsr.2019.54.59](https://doi.org/10.3923/ajsr.2019.54.59)

9. Lynskey GE, Powell DK, Dixon RG, Silberzweig JE. Radiation protection in interventional radiology: survey results of attitudes and use. *J Vasc Interv Radiol*. 2013; 24(10): 1547-1551. doi: [10.1016/j.jvir.2013.05.039](https://doi.org/10.1016/j.jvir.2013.05.039)

10. Abuzaid MM, Elshami W, Shawki M, Salama D. Assessment of compliance to radiation safety and production at the radiography department. *International Journal of Radiation Research*. 2019; 17(3): 439-446. doi: [10.18869/acadpub.ijrr.17.3.439](https://doi.org/10.18869/acadpub.ijrr.17.3.439)

11. Briggs-Kamara M, Okoye P, Fatahi-Asl J, et al. Assessment of radiation protection awareness and knowledge about radiological examination doses among Italian radiographers. *J Postgrad Med Inst*. 2013; 4(45): 2-5. doi: [10.18869/acadpub.ijrr.17.3.447](https://doi.org/10.18869/acadpub.ijrr.17.3.447)

12. Eze CU, Okaro AO. Survey of personnel radiation protection practices in industrial radiography in Port Harcourt, Rivers State, Nigeria. *J Med Res Technol*. 2004; 1: 8. doi: [10.4103/0300-1652.126290](https://doi.org/10.4103/0300-1652.126290)

13. Warlow T, Walker-Birch P, Cosson P. Gonad shielding in paediatric pelvic radiography: Effectiveness and practice. *Radiography*. 2014; 20(3): 178-182. doi: [10.1016/j.radi.2014.01.002](https://doi.org/10.1016/j.radi.2014.01.002)

14. Tsai YS, Liu YS, Chuang MT, et al. Shielding during X-ray examination of pediatric female patients with developmental dysplasia of the hip. *J Radiol Prot*. 2014; 34(4): 801-809. doi: [10.1088/0952-4746/34/4/801](https://doi.org/10.1088/0952-4746/34/4/801)