



## KNOWLEDGE, ATTITUDE AND PRACTICE OF RADIATION SAFETY AMONG RADIOLOGISTS, TECHNOLOGISTS AND X-RAY TECHNICIANS IN HOSPITALS OF KASHMIR

### Medical Science

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### ABSTRACT

**Background:** All ionizing radiations are harmful. This is the premise that mandates a radiation safety policy. A few months after the discovery of x-rays by Roentgen in December 1895, many somatic dangers of radiations become evident. All individuals are exposed to radiations in low doses. Of concern is the risk involved in this low dose radiation, especially the induction of cancer or genetic defects.

**Methods:** A prospective study about Knowledge, Attitude and Practice of Radiation Safety among health professionals was conducted for a period of two months in Kashmir Valley. All the ten districts of the Valley viz Srinagar, Anantnag, Pulwama, Baramullah, Shopian, Bandipora, Kupwara, Ganderbal, Badgam, and Kulgam were included in the study. Study was conducted at primary and secondary health care levels of the valley viz district hospital, sub district hospital, and primary health center. Study population included radiologists, technologists, and technicians working in radiology departments of district, sub district hospitals and primary health centers. The study population was selected randomly and questionnaire was subjected to them. It was a self-structured questionnaire designed and pretested via a pilot study. The questionnaire was collected on spot from the participants and data was later analyzed and inferences were drawn.

**Results:** The present study revealed that the staff working in radiology had good knowledge about radiation safety. Majority of the workers knew about radiation safety regulatory authority. When attitude towards implementation of basic principles of protecting from radiation exposure was assessed it was high among doctors and technologists while very low among x-ray technicians where it was only 53.1% and 57.1% among male and female x-ray technicians respectively. When practice of using a dosimeter was assessed it was seen that no one among the doctors or technologists were using a dosimeter. While among x-ray only 15.6% were using dosimeter to measure the exposure. The proportion of staff that had undergone a training course in radiation safety was very less.

**Conclusion:** Majority of the staff did not practice a radiation safety programme. Most of the staff had knowledge about safe radiation dose per year and use of lead apron. There is strong need to enforce radiation safety rules by the staff. Standard operating procedures and radiation safety manual should be made available to all health facilities. Moreover, staff directly involved in radiation should receive proper training in radiation safety and then made accountable.

### KEYWORDS

Paediatric, Blunt trauma abdomen (BAT), retroperitoneal air, duodenal injuries.

### INTRODUCTION

Man has lived with, and tolerated, natural radiation since the beginning of time. There are evidences that even small doses of radiation can cause both mutations and neoplasms<sup>1</sup>. No one knows just how much radiation is tolerable. The National Council on Radiation Protection's recommendations is designed to protect both general public and radiation worker. Many of the recommendations have been turned into laws<sup>2</sup>. The most important recommendations are those involving maximum permissible doses, which is currently 5rem/year for a radiation worker and 0.5rem/year for the occasionally exposed individual.

### Biological Effect of Radiation

All ionizing radiations are harmful. This is the premise that mandates a radiation safety policy. The harmful effects fall into two broad categories: somatic, those effects harmful to the person being irradiated; and genetic, those effects harmful to the future generation.

There is no data available to indicate if there is a threshold below which no harmful effect will occur<sup>3</sup>. In actual practice, radiation levels should be kept at lower practicable level, and we should not think of permissible doses as being perfectly safe. The most important somatic effect of radiation is carcinogenesis, and leukemia is the most common neoplasia. The exact risk is unknown<sup>3</sup>. Most experts agree that low doses of radiations can cause neoplasms. The genetic effect of radiations are more frightening than the somatic ones, because they may not manifest themselves for several generations and because of this fear dose limits are placed on exposure to large segments of population, as opposed to maximum permissible dose<sup>4</sup>.

**Radiation Measurement Units:** The Roentgen (R) is defined as a unit of radiation exposure that will liberate a charge of  $2.58 \times 10^{-4}$  coulombs per kilogram of air. It is the approximate exposure to the body surface for an AP film of the abdomen for a patient of average thickness<sup>5</sup>.

The rad is the unit of absorbed dose. One rad is equal to the radiation necessary to deposit energy of 100 ergs in 1 gram irradiated material.

As a general rule the absorbed dose is proportional to the degree of attenuation. The rem is a unit of absorbed dose equivalent<sup>6</sup>.

### NCRP recommendations for the Radiation Dose Limits:

Class of exposed individual	Rems	mSv
<b>Occupational exposure (annual)</b>		
Stochastic effects	5	50
Non-stochastic effects-	15	150
Lens of eye	50	500
All other areas		
Lifetime cumulative exposure	1x age in years	10 x age in years
<b>Public exposure (annual)</b>		
Effective dose equivalent limit	0.5	5
Dose equivalent limits for lens of eye, skin, and extremities	5	50
<b>Trainee under 18 years of age</b>		
Effective dose equivalent limit	0.1	1
Dose equivalent limits for lens of eye, skin, and extremities	5	50
<b>Embryo-fetus Exposures</b>		
Total dose equivalent limit	0.5	5
Dose equivalent limit in a month	0.05	0.5

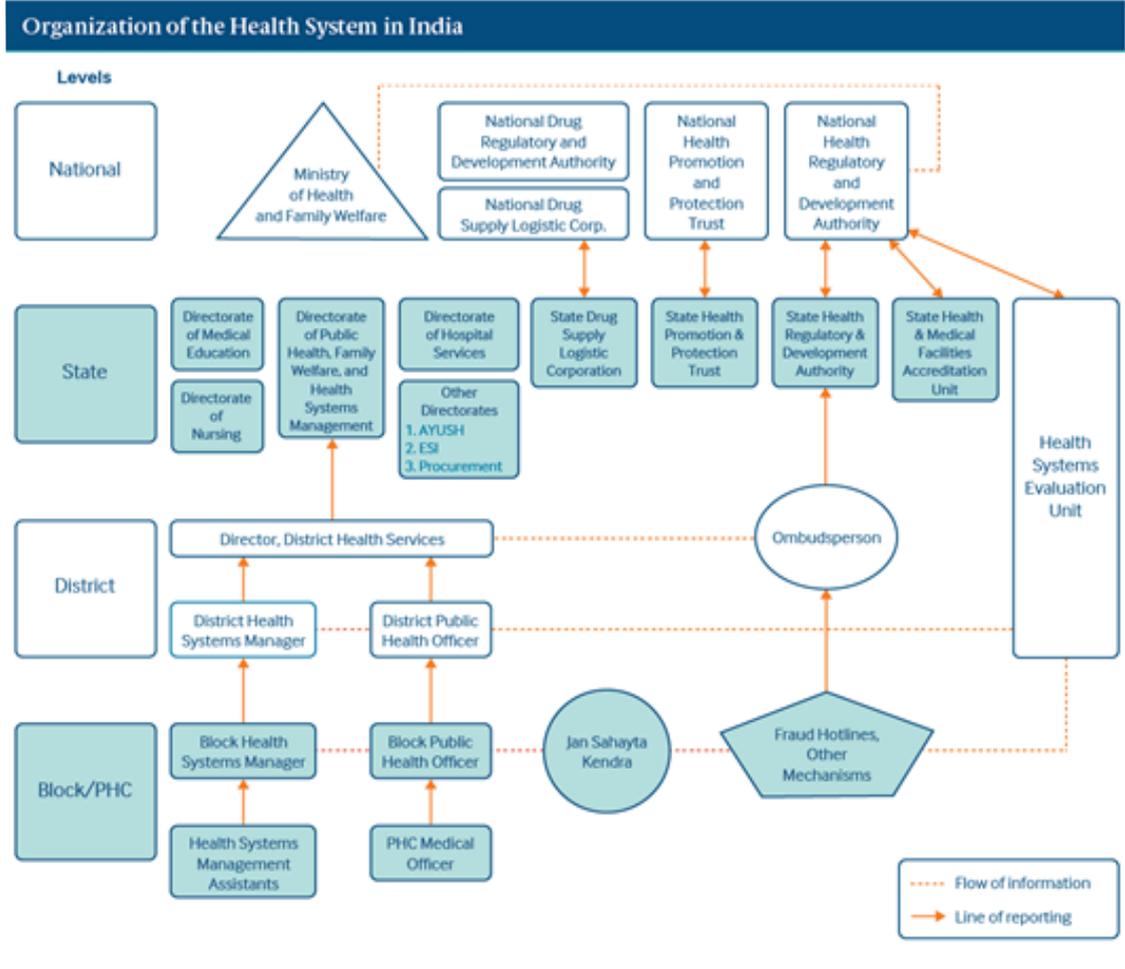
### Protective Barriers

Three parameters are available to reduce radiation exposure: time, distance and barriers. Time plays its role in three ways: in the amount of time that the machine is turned on at a particular current expressed as mA and is called the workload; in the amount of time that the beam is directed at a particular area, called the use factor; and in the amount of time that an area is occupied, called the occupancy factor. Distance attenuates the beam by the familiar inverse square law. Barriers are usually constructed of either sheet lead or concrete<sup>7</sup>. Barriers can be primary and secondary depending on whether they protect from primary radiation (the useful beam) or stray radiation (a combination

of leakage and scatter radiations). As a general rule no secondary barrier is required for areas protected by a primary barrier, i.e. a primary serves both a primary and secondary barrier.

The government health care system is designed as a three-tier structure comprising primary, secondary, and tertiary facilities. In rural areas, primary health care services are provided through a network of sub centers, primary health centers, and community health centers.<sup>7</sup> The sub center is the first point of contact between the primary health care system and the community, designed to handle maternal and child health, disease control, and health counseling for a population of 3,000 to 5,000. At least one auxiliary nurse midwife or female health worker,

one male health worker, and one female “health visitor” supervise six sub centers. The private hospital sector has expanded rapidly, and government-sponsored health schemes also rely on private hospitals as a part of public-private partnerships. From 2002 to 2010, the private sector created more than 70 percent of new beds, contributing 63 percent of total hospital beds.<sup>8</sup> Private hospitals currently provide about 80 percent of outpatient care and 60 percent of inpatient care.<sup>9</sup> Until the 1980s, private-sector hospitals were mainly nonprofits run by charitable trusts. With India’s economic liberalization, growing middle class, and the rise in medical tourism, the number of private, for-profit hospitals has grown substantially.<sup>10</sup>



Source: Planning Commission of India, 2011.

**Objective**

To study the Knowledge, Attitude and Practice of Radiation Safety among Radiologists, Technologists and X-ray Technicians in Hospitals of Kashmir

**Methodology**

A prospective study about Knowledge, Attitude and Practice of Radiation Safety among health professionals was conducted for a period of two months in Kashmir Valley. All the ten districts of the Valley viz Srinagar, Anantnag, Pulwama, Baramullah, Shopian, Bandipora, Kupwara, Ganderbal, Badgam, and Kulgam were included in the study.

Study was conducted at primary and secondary health care levels of the valley viz district hospital, sub district hospital, and primary health center.

All the district hospitals were included in the study. District hospital is a hospital at secondary referral level responsible for a district of a definite geographical area containing a defined population. Its objective is to provide comprehensive secondary health care services to the people in the district.

Out of two hundred twelve(212) primary health centers, fifteen(15) sub district hospitals and forty three(43) primary health centers were included in the study. Sub district hospitals and primary health centers are the primary health care institutions catering to the population of defined geographical of sub district and block respectively. In addition to above mentioned health care institutions, five leading private Nursing Homes of Srinagar city were included.

Study population included radiologists, technologists, and technicians working in radiology departments of district, sub district hospitals and primary health centers. The study population was selected randomly and questionnaire was subjected to them. It was a self-structured questionnaire designed and pretested via a pilot study. The questionnaire was collected on spot from the participants and data was later analyzed and inferences were drawn.

**Observations**

All living beings are exposed to background ionizing radiation. Ionizing radiation in medical imaging is one of the powerful diagnostic tools in medicine. Radiation which is applied in radiology departments has hazardous effects on biological systems. They produce some type of injury that is incurable.

**Demographic Profile**

Designation		DOCTORS		TECHNOLOGISTS		TECHNECIANS	
		n08	(%)	n09	(%)	n78	(%)
Age (in years)	20-29	-		01	(11.1)	03	(3.8)
	30-39	06	(75)	04	(44.4)	14	(17.9)
	40-49	02	(25)	03	(33.4)	03	(3.8)
	>50	-		01	(11.1)	01	(1.2)
	not mentioned	-		-		57	(73.3)
Sex	Male	06	(75)	09	(100)	14	(17.9)
	Female	02	(25)	-		61	(78.3)
	not mentioned	-		-		03	(3.8)
Education	Degree	08	(100)	-		-	
	Diploma	-		-		-	
	Graduation With Dip. Radiology	-		09	(100)	24	(30.7)
	10+2 With Dip. Radiology	-		-		49	(62.8)
	Others	-		-		05	(6.5)
Experience (in years)	1-5	01	(12.5)	01	(11.2)	34	(43.5)
	6-10	02	(50)	03	(33.3)	32	(41.1)
	11-15	01		01	(11.1)	01	(01.3)
	16-20	01	(12.5)	-		-	
	>20	-		04	(44.4)	03	(03.8)
	not mentioned	-		-		08	(10.3)

**Gender of Staff**

Among doctors six were males and two were females. All technologists were males and among x-ray technicians sixty were males and fourteen were females while 3 did not mention their gender.

Out of 78 x-ray technicians that were interviewed, 3 were in the age group of 20-29yrs, 14 were in the age group 30-39yrs, 3 were in the age group of 40-49yrs, 1 was above 50yrs and 57 did not mention their age.

**Age distribution of staff:**

Out of 8 doctors 6 were in the age group of 30-39years and two were in the age group of 40-49 years.

**Qualification of staff:**

All the doctors were having a degree in radiology. All the technologists had done graduation and a diploma in radiology. Among x-ray technicians 24 had done graduation and a diploma in radiology while 49 were having a qualification of 10+2 and a diploma in radiology.

Out of 8 technologists 4 were in the age group of 30-39yrs, 3 were between 40-49yrs and 1 was having an age>50yrs.

**Table: Knowledge of Health Professionals**

Knowledge	Doctors 08									X Ray Technologists 09									X Ray Technicians 78								
	Male 06			Female 02			Male 09			Female 00			Male 64			Female 14											
	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a									
Knowledge of Radiation Safety	6	1	-	2	100	-	9	100	-	64	100	-	13	92.8	-	1	7.2	-									
Knowledge about Radiation Safety Regulatory Authority	5	8	1	2	100	-	8	88.9	1	11	-	27	42.2	36	56.2	1	1.6	3	21.4	9	64.3	1	7.2				
Knowledge about Monitoring of workers	4	6	1	2	100	-	8	88.9	1	11	-	51	79.8	13	20.2	-	-	12	85.7	2	14.3	-	-				
Knowledge about safe Radiation dose per year	4	6	-	1	50	1	4	44.5	2	33	-	31	48.4	27	42.2	6	9.4	7	50	7	50	-	-				
Knowledge about Protection from Radiations	5	8	-	2	100	-	8	88.9	1	11	-	51	79.7	11	17.2	2	3.1	10	71.4	4	28.6	-	-				
Knowledge about Radioactivity of Intravenous Contrast	4	66.7	2	33.3	-	1	50	66.8	1	11	-	30	46.9	31	48.4	3	4.7	7	50	4	28.6	3	21.4				

**Assessment of Knowledge:**

1. Knowledge about radiation safety:  
Regarding knowledge about radiation safety among doctors and technologists, all were aware about radiation safety. All the male x-ray technicians knew about radiation safety. Among female x-ray technicians the awareness about radiation safety was 92.8%.
2. Knowledge about radiation safety regulatory authority:  
Regarding knowledge about radiation safety regulatory authority among doctors 87.5% (n=7) of doctors were aware about radiation safety regulatory authority. Among technologists the knowledge about radiation safety regulatory authority was 88.9% (n=8). Among male x-ray technicians, 42.2% (n=27) knew about radiation safety regulatory authority and among female x-ray technicians only 21.4% (n=3) were knowing about this.
3. Knowledge about monitoring of workers  
On assessing the knowledge about need for monitoring of workers in radiological work among doctors, 62.5% (n=5) knew that there is a need for monitoring of workers. Among technologists 88.9% (n=8) were aware about need for monitoring of workers. Among male x-ray technicians 79.8% (n=51) knew about it and among female x-ray technicians 5.7% (n=12) knew about monitoring of workers in radiological work.
4. Knowledge about safe radiation dose per year  
Among doctors 66.7% (n=4) were knowing about safe radiation dose per year whereas 12.5% (n=1) had no knowledge about safe radiation dose per year while as 3 doctors did not give any answer. Among technologists 44.5% (n=4) knew about safe radiation dose per year while 22.2% (n=2) did not know about it. Among male x-ray technicians 48.4% (n=31) knew about safe radiation dose per year while 9.4% (n=6) did not give any response. Among female x-ray technicians 50% (n=7) knew about safe radiation dose per year.
5. Knowledge about measures of protection from radiation  
Among doctors 87.7% (n=7) knew about measures of protection from radiation. Among technologists 88.9% (n=8) knew about these measures. Among male x-ray technicians 79.7% (n=51) knew about measures of protection from radiation while 3.1% (n=2) did not give any answer. Among female x-ray technicians 71.4% (n=10) knew about these measures.
6. Knowledge about radioactivity of IV contrast material  
Among 8 doctors 50% (n=4) knew about radioactivity of IV contrast material while 12.5% (n=1) did not give any answer and 37.5% (n=3) were not knowing about it. Among technologists only 22.1% (n=2) knew about radioactivity of IV contrast material while 11.1% (n=1) did not give any answer and 66.1% (n=6) did not have any knowledge about radioactivity of IV contrast material. Among male x-ray technicians 46.9% (n=30) knew about radioactivity of IV contrast material, while 4.7% (n=3) did not give any answer. Among female x-ray technicians 50% (n=7) knew about it while 21.4% (n=3) did not respond.

**Table: Attitude of Health Professionals**

Attitude	Doctors 08									X ray Technologists 09									X ray Technicians 78																	
	Male 06			Female 02			Male 09			Female 00			Male 64			Female 14																				
	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a															
Attitude towards Commitment for Radiation Safety programme	6	1	-	-	-	-	2	100	-	-	-	-	9	100	-	-	-	-	-	-	-	-	34	53	20	31	10	15	5	35	5	35	4	28	6	
Attitude towards Implementation of Basic Principles of Protecting Radiation Exposure	6	1	-	-	-	-	2	100	-	-	-	-	8	88	1	11	-	-	-	-	-	-	-	34	53	20	31	10	15	8	57	5	35	1	7	2

**Attitude towards Radiation Safety:**

Regarding the attitude of doctors towards radiation safety all were committed to radiation safety programme. All the technologists were also committed to radiation to a radiation safety programme. Out of 64 male x-ray technicians 53.1% (n=34) were committed to radiation safety programme, 31.3 % (n=20) were not committed and 15.6% (n=5) did not respond. Among 14 female x-ray technicians 35.7% (n=5) were committed while as 28.6% (n=4) did not respond.

All the doctors i.e. 100% (n=8) were committed to implementation of

basic principles of protecting from radiation exposure. 88.9% (n=8) technologists were committed to implementation of basic principles of protecting from radiation exposure and 11.1 % (n=1) were not committed.

Out of 64 male x-ray technicians 53.1 (n=34) recommended implementation of basic principles of protection from radiation exposure. Out of 14 female x-ray technicians 57.1% (n=8) recommended implementation of basic principles of protection from radiation exposure while 7.2% (n=1) did not respond.

**Table: Practice of Health Professionals**

Practice	Doctors 08									X ray Technologists 09									X ray Technicians 78																	
	Male 06			Femae 02			Male 09			Female 00			Male 64			Female 14																				
	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a	Yes	No	n/a															
Use of Dosimeter	-	-	6	100	-	-	-	2	100	-	-	-	-	9	100	-	-	-	-	-	-	-	10	15	44	68	10	15	4	28	7	50	3	21	4	
Undergone Training about Radiation Safety	3	50	3	50	-	-	-	2	100	-	-	3	33	3	66	7	-	-	-	-	-	-	-	16	25	46	71	2	3	2	14	12	85	-	-	-

