ORIGINAL ARTICLE

TRENDS IN OCCUPATIONAL RADIATION EXPOSURES AT IRNUM (2000-2008)

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ABSTRACT

OBJECTIVES: To evaluate the radiation exposure of the radiation workers and to study the exposure trends in the institute by calculating average annual effective doses and annual collective effective doses using film badge dosimetry technique. **RESULTS:** The results show that in the reported period three radiation workers had received more than annual dose limit while all other workers involved in radiation oriented practices are in the range of 1mSv to 1.5 mSv.The annual average effective dose of all the radiation workers falls in the range of 0.320-4.421mSv. The highest annual average effective dose 4.421mSv was found in nuclear medicine department. **CONCLUSION:** The personnel dosimetry results indicate that two radiation workers in the year 2001 while one radiation worker in the year 2006 received radiation dose more than the annual dose limit. However the rest of the radiation workers doses are within the annual dose limit, reflecting safe radiation oriented practices in the institute and compliance to the regulatory requirements. The average collective effective doses are higher in radiotherapy group followed by nuclear medicine, maintenance, radioimmunoassay, diagnostic radiology, and nursing groups.

Keywords: Radiation dosimetry; personal dosimetry; ionizing radiation.

Introduction

The use of ionizing radiations and radioisotopes in medicine has increased dramatically since last 5-6 decades due to both in its breadth of application and technological improvements in diagnosis and treatment modalities. The International Commission on Radiation Protection (ICRP) and International Atomic Energy Agency (IAEA) had been working since long for the promotion of the radiation protection system in medicine.[1,2] The occupational radiation exposure of the workers carrying out ionizing radiation oriented practices in medicine had become more important and regulatory bodies all over the world are more concerned about its monitoring and record keeping. Therefore the radiation exposures of the occupational personnel involved in radiation oriented practices are monitored and assessed throughout the world.[3-8] The Institute of Radiotherapy & Nuclear medicine (IRNUM) is one of the major cancer hospitals in the north west of the Pakistan since 1975. The institute is a licensee of the Pakistan Nuclear Regulatory Authority (PNRA)[9] and has well established radiation protection programme that addresses the radiation protection aspects of the workers, patients and general public. The whole body occupational radiation exposure monitoring is carried out by the monthly film badge services provided by the health physics division, Pakistan Institute of Science & Technology (PINSTECH), Islamabad. The reported work presents the initial statistics on personal dose equivalent to ionizing radiation of IRNUM radiation workers for the period 2000-2008 and provides a source of data for epidemiological investigation and dose trends observed within the institute.

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Methodology

The film badge dosimeters used consist of personal monitoring film in a film holder. Each badge contained one film. The film badge had five filters which provided a detailed analysis of the radiation exposure. Radiation workers were provided the film dosimeter on monthly

basis. The radiation workers were divided into five categories according to their job description in the institute. The films were processed and analyzed at health physics division PINSTECH and the results were communicated to the Institute on monthly basis. The radiation workers registry contains dose information of 548 workers for the period 2000-2008. The collective effective dose S was determined according to expression.[1,2]

$$S = \sum_{i=1}^{N} E_i$$

Where E_i is the annual effective dose received by the ith worker and N is the total number of workers. The average annual effective dose E is equal to S/N.

Results

The reported results show occupational radiation exposures of workers involved in ionizing radiation oriented practices of the Institute The minimum detectable limit is 0.1mSv and the annual dose limit is 20 mSv averaged over five years. The result in the (Tab.1) show that three radiation workers had received more than annual dose limit while all other workers involved in radiation oriented practices are in the range of 1mSv to 1.5 mSv.

Year	Total No. of Workers	No of Workers in effective dose interval/year		
		0.1mSv-1mSv	>1 < 20 mSv	> 20 mSv
2000	59	1	58	0
2001	59	0	57	2
2002	60	0	60	0
2003	61	0	61	0
2004	70	1	69	0
2005	65	2	63	0
2006	65	8	56	1
2007	59	5	54	0
2008	56	25	31	0

Table-1: Trend in occupational exposures in IRNUM hospital from 2000-2008.

The annual average effective dose of all the radiation workers falls in the range of 0.320-4.421mSv. The highest annual average effective dose 4.421mSv was found in nuclear medicine department in the year 2006 (Tab.2). The range of annual total collective effective dose was found to be 0.97-66.31 man Sv.

Occupational Group	Year	Total Number of Workers	Annual total collective effective dose (man Sv)	Annual average effective dose(mSv)
Nuclear Medicines Section	2000	12	22.80	1.900
	2001	12	23.90	1.992
	2002	12	21.27	1.773
	2003	12	28.05	2.338
	2004	15	47.52	3.168
	2005	14	21.07	1.505
	2006	15	66.31	4.421
	2007	16	20.61	1.288
	2008	16	16.20	1.013
Diagnostic Radiology	2000	5	7.93	1.586
	2001	5	7.93	1.586
	2002	5	10.58	2.116
	2003	5	13.79	2.758
	2004	5	8.05	1.610
	2005	5	7.06	1.412
	2006	5	6.92	1.384
	2007	5	6.93	1.386
	2008	5	4.94	0.988
Radiotherapy Section	2000	22	30.16	1.371
	2001	22	29.93	1.361
	2002	23	29.46	1.281
	2003	24	38.57	1.607
	2004	27	38.05	1.409
	2005	25	31.49	1.260
	2006	25	33.77	1.351
	2007	25	29.75	1.190
	2008	24	24.78	1.033
Maintenance Section	2000	6	7.63	1.272
	2001	6	7.63	1.272
	2002	6	7.95	1.325
	2003	6	9.78	1.630
	2004	9	13.57	1.508
	2005	8	10.54	1.318
	2006	8	10.29	1.286
	2007	7	9.45	1.350
	2008	6	6.30	1.050
Nursing Staff	2000	7	10.61	1.451
	2001	7	10.61	1.451
	2002	7	8.66	1.237
	2003	7	10.74	1.534
	2004	7	10.23	1.461
	2005	7	8.98	1.283
	2006	6	1.92	0.320
	2007	1	1.50	1.500
	2008	1	0.97	0.970

Occupational Group	Year	Total Number of Workers	Annual total collective effective dose (man Sv)	Annual average effective dose(mSv)
RIA Laboratory	2000	7	11.28	1.611
	2001	7	11.28	1.611
	2002	7	9.20	1.314
	2003	7	11.39	1.627
	2004	7	10.28	1.469
	2005	6	7.47	1.245
	2006	6	7.60	1.267
	2007	5	7.17	1.434
	2008	4	4.28	1.070

Table-2: Film Badge Dosimetry Results.

Discussion

The personnel dosimetry results for the period 2000 to 2008 indicate that two radiation workers in the year 2001 while one radiation worker in the year 2006 received radiation dose more than the annual dose limit. However the rest of the radiation workers doses are within the annual dose limit (Fig.1). The nuclear medicine and radiotherapy form the largest number of radiation worker groups in the hospital. The results of the collective effective doses are schematically presented in (Fig.2). The average collective effective doses are higher in radiotherapy group followed by nuclear medicine, maintenance, radioimmunoassay, diagnostic radiology, and nursing groups which are 31.77, 29.75, 9.24, 8.88, 8.24 and 7.1 manSv respectively. This study provided an opportunity to understand the trends in the occupational radiation doses, the working environment and the compliance to the regulatory requirements of PNRA.

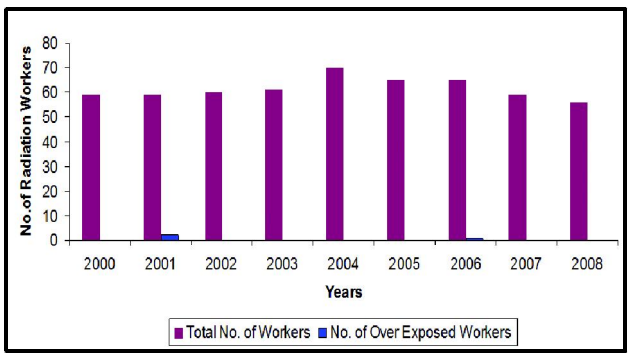

Figure-1: Personnel Dosimetry Results (2000-2008)

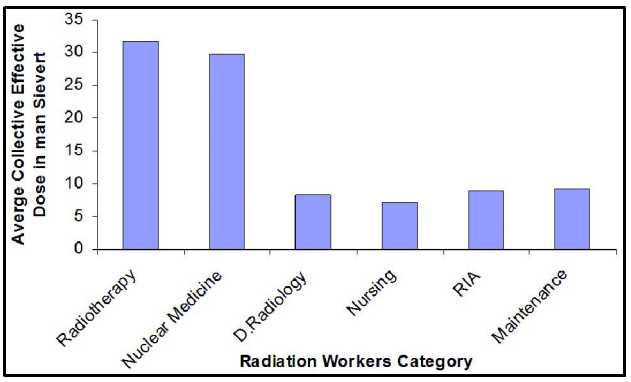

Figure-2: Radiation Doses Vs Radiation Category

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