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Radiation Workers' Occupational Doses: Are We Really Careful or Overconscious

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***Abstract*—**The present study represents the occupational radiation doses received by selected workers of Nuclear Institute of Medicine and Radiotherapy (NIMRA) Jamshoro Pakistan and conducted to discuss about how we be careful and try to avoid make ourselves overconscious. Film badges with unique identification number were issued to radiation worker to detect occupational radiation doses. In this study, only 08 workers with high radiation doses were assessed amongst 35 radiation workers during the period of January 2012 to December 2012. The selected radiation workers' occupational doses were according to designated work areas and in the range of 1.21 to 7.78 mSv (mili Sieveret) out of the annual dose limit of 20 mSv. By the comparison of different studies and earth's HNBR (High Natural Background Radiation) locations' doses, it is concluded that the worker's high doses are of magnitude of HNBR Regions and were in the acceptable range of National and International regulatory bodies so we must not to show any type of overconsciousness but be careful in handling the radioactive sources.

***Keywords*—**Natural background radiation, Occupational dose, Overconscious, Personal monitoring.

I. Introduction

THE low level natural background radiation and man-made sources are continually exposing humans since their birth [1]. Natural radioactivity is exposing mankind at every place and position and it depends upon their living status, occupation, diet, type of building material used in houses etc. [2]. Although the man-made sources/radiation generating devices used in nuclear medicine procedures, diagnostic x-rays and therapeutic purposes are contributing very little but are threat to the population [3]. For the purpose of protection of radiation workers and general public from these man-made radiation generating devices and sources, the imperial rule of radiation protection i.e. TDS (Time, Distance, Shielding) rule is being implemented since their usages and this can be achieve by (a) spending less time in radiation area, (b) maintaining distance from radioactive sources and (c) placing appropriate shielding [4]-[10].

To detect radiation dose to the worker, film badge is being used since long and is one of the modality for personal dosimetry [10]-[12]. The doses received by the radiation worker can be estimated by the degree of blackness on the developed film [13].

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On the basis of recommendations of International Commission on Radiological Protection [14], Pakistan Nuclear Regulatory Authority [15] has approved 20 mSv as an occupational dose limit for radiation workers in Pakistan. This study was carried out to address the matter of overconsciousness & fear among professionals about radiation by evaluating the higher doses received by radiation workers of NIMRA Jamshoro, Pakistan with other studies & HNBR location of different countries.

II. Material and Methods

For detecting occupational radiation doses, each of the radioactive material handling worker at NIMRA possess a film badge bearing unique identification number and Pakistan Institute of Nuclear Science and Technology (PINSTECH) Islamabad Pakistan has facilitate our institute by provided film badge monitoring service on monthly basis [10]. For occupational radiation dose measurement of the workers, film badge is one of the recommended devices [12].

In this study, from 35 radiation workers of NIMRA, only 08 workers receiving some higher radiation doses than other workers during the year 2012 have been selected. The film badges readings provided by PINSTECH were kept as records for workers' radiation dose evaluating history purposes [10], [16].

Statistical analysis of current study was done by SPSS 17 (SPSS Inc. USA) and significant value of $P<0.05$ was considered for the study.

III. Results

The annual doses of 08 selected workers for year 2012 (January-December 2012) and their percentages with respect to annual occupational dose limit are summarized in Table I.

The data of annual doses for selected radiation workers showed that the occupational doses of radiation workers were ranging from 1.21 mSv (6.1% of annual dose) to 7.78 mSv (38.9% of annual dose) and statistical analysis revealed significant P in the order of 0.013. Although the doses of selected workers were somehow higher than other radiation workers due to their nature of duties but were in the annual dose range i.e. 20 mSv as recommended by the International and National regulator organizations [14], [15].

TABLE I
NIMRA'S RADIATION WORKERS' DOSES

Section	Worker #	Annual Dose (Jan-Dec 2012)	Percentage with Limit (20 mSv)
Radiology	1	1.73	8.7%
	2	2.36	11.8%
Nuclear Medicine	3	3.95	19.8%
	4	7.78	38.9%
Radio Immune Assay	5	1.21	6.1%
	6	1.23	6.2%
Radiotherapy	7	1.62	8.1%
	8	1.29	6.5%

IV. DISCUSSION

The different studies including current about high doses of radiation workers are summarized in Table II and graphically represented in Fig. 1. The results of all the previous studies [10], [17]-[20] and the current study as mentioned in Table II shows that the doses of radiation workers are quite lower than the recommended annual limits for one year [14], [15].

TABLE II
DIFFERENT STUDIES ABOUT HIGHEST DOSES OF RADIATION WORKERS

Study	Highest Dose mSv	Percentage with Limit (20 mSv)
S. A. Memon *et al.* [10]	< 3.7	< 18.5%
G. K. Korir *et al.* [17]	< 7.5	< 37.5%
W. Weizhang *et al.* [18]	< 3.0	< 15.0%
J. V. Carreiro, R. Avelar [19]	< 5.0	< 25.0%
A. Jabeen *et al.* [20]	< 2.0	< 10.0%
Current Study	< 7.8	< 39.0%

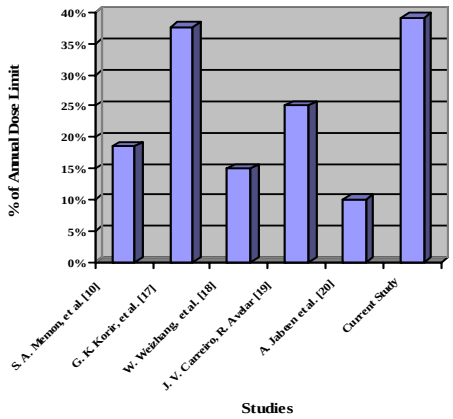

Fig. 1 Percentage of radiation workers' highest doses in different studies

Some of our colleagues and radiation generating devices handling professionals are scary about radiation dose received by them during handling of radiation sources/generating devices and showed overconsciousness about received radiation dose due to poor knowledge of radiation, its limits or high skillness and of opinion they might develop cancer if working with radiation [21] as they were worried that some of radiation workers developed ovarian, stomach cancer or have miscarriages or infertility problem. This indicates that the professionals are very much conscious due lack or excessive knowledge about radiation.

It is a fact that "Where there is radiation generating device/source, there will be radiation dose." We cannot eliminate it from that area. If anyone works in the radiation area and according to him "it is not bearable that he/she may receive any of the doses", he/she is very wrong. It is just like that we meet the winter/summer season and someone says that why his/her body feel coldness/hotness. In actual, one can reduce the feelings of cold/hot weather to his/her body by putting on/off the clothes and switching on the heater/air conditioner. Like this dose can be reduced by applying TDS principle [4]-[10]. To work in radiation area one must be careful not overconscious. In our opinion "the radiation worker is not to be called a radiation worker unless he/she has engaged himself/herself with radiation and received the radiation dose."

Though the usage of radiation sources in medicine increases medical radiation dose however the background radiation is also have significant effect on general public which is about 2-3 mSv worldwide [22]. United Nations Scientific Committee on the Effects of Atomic Radiation [23] reported the worldwide average natural dose per year to humans is about 2.4 mSv where as NCRP [3] indicated the natural dose per year to USA population is about 3.10 mSv.

The regions of HNBR reported by various researchers [24]-[31] as summarized in Table III showed that natural background radiations in these spots are almost equal or more than the doses of radiation worker as mentioned in Table II.

TABLE III
SUMMARIZED TABLE OF WORLDS' DIFFERENT LOCATIONS' HNBR

Area/Country	Natural Background	Study
Finland	>7 mSv	B. M.R. Green, *et al.* [24]
France	≥ 5 mSv	
Sweden	≥ 5 mSv	
Spain	≥ 5 mSv	
Brazil	≥7 mSv	L. H. S. Veiga, *et al.* [25]
China	≥ 6.2 mSv	UNSCEAR [26] W. Luxim [27] S. P. Zhang *et al.* [28]
India	≥ 6.0 mSv	M. K. Nair, *et al.* [29]
Iran	≥ 6.0 mSv	N. M. Ghiassi, *et al.* [30] J. H. Hendry, *et al.* [31]

V. CONCLUSION

The main rationale of this study was discuss the over consciousness & fear among professionals about radiation by the evaluation of some high radiation doses received by radiation personnel. It is concluded from the dose data as presented in Tables I and II, which are about almost equal or lower than HNBR regions as summarized in Table III and the radiation doses of all radiation workers were in the acceptable range of International and National organizations [14], [15] which indicates that the reasonability of radiation protection techniques [16], [32]. Radiation worker must take care of himself to avoid receiving excessive dose but not to be overconscious about radiation dose. The belief of authors

about radiation worker is that "the radiation worker is who which play with radiation sources and must receive some radiation dose during working environment." A radiation worker cannot be the best staff member until he/she wipes out the fear of exposing to radiation from his/her mind. The fear of exposing to radiation creates a barrier in working atmosphere and makes the worker reluctant to be fully involved. Consciousness is the first priority but it never mean that one keep himself/herself away from source related activities because of fear of exposing to radiation. So worker has to end this fear rather than be overconscious.

Although the radiation has some hazards but we may avoid any kind of risks by using it carefully [21]. The article [33] fully discussed the matter of risk of fearness of radiation rather than radiation hazard itself and concluded that the physiological impact of radiation is higher than the radiation effect by quoting the events of Hiroshima, Nagasaki and Chernobyl.

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