Staff doses in Interventional Cardiology and other medical practices in Sudan

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1. Introduction

Over the last years, increasing application has been made of ionizing radiation in medical practices. Cardiac catheterization has been used frequently for the evaluation and treatment with heart diseases. The working staffs, particularly cardiologists who perform these procedures have the highest potential risk of receiving high radiation doses due to close contact with patients, long time of exposure and complexity of the procedures.
The UNSCEAR 2000 report states that fluoroscopic procedures are by far the largest source of exposure in medicine [1]. Occupational Exposure Control is an important part in the establishment of radiation protection infrastructure in a country. The individual monitoring, due to external exposure of ionizing radiation, is the primary procedure to ensure the safety for radiation workers and to control the doses received at workplace so that not to exceed the dose limits specified in the BSS -115 [2].

2. Objectives

1. Estimation of Staff effective doses in Interventional Cardiology at three centres in Khartoum
2. Comparison between the doses received by cardiology staff and those received by radiotherapy, nuclear medicine and diagnostic radiology staffs at the Institute of Nuclear Medicine and Technology (INMO) in El Gezira
3. Comparison of the doses received by the workers in the different practices with the dose limits

3. Methods

The study was conducted at three cardiac laboratories in three hospitals. Each worker at these laboratories was facilitated with two Thermoluminescence Dosimeters (TLDs) to be worn over and under the apron. The wearing period was one month. The annual doses were then estimated on the basis of 46 weeks (45 days leave per year).
Then the Effective dose, as recommended by the NCRP Report No 122 [3], was estimated from the two readings recorded by dosimeters under and above the apron using equation (1).

$$E\ (\ estimate\ )\ =\ 0.5\ H_w\ +\ 0.025\ H_N \qquad (\ 1\ )$$

The annual doses received by the workers in interventional cardiology were compared with those received by workers at the medical sections of radiotherapy, nuclear medicine and diagnostic radiology at the Institute of Nuclear Medicine (INMO) in El Gezira. Each worker at these sections: radiotherapy, nuclear medicine and diagnostic radiology was facilitated with one TLD do be worn on chest to measure H_p (10) which estimates the effective doses according to the ICRP [4] and NCRP.
Thermoluminescence dosimeters (TLD) LiF: Mg, Ti (TLD-100) was used to measure H_p (10).

4. Results and discussion

Table (1): Average H_p(10) measured under the lead apron (H_w) and above the apron (H_N) and the calculated effective doses for cardiology workers for one month period and the estimated annual effective dose

	No	H_W Mean ±SD	H_N Mean ±SD	E Mean ±SD	E_{Annual} Mean ±SD
Hospital 1					
Cardiologists	6	0.34±0.29	0.81±0.55	0.19±0.15	1. 98±1.56
Nurses	4	0.06±0.03	0.44±0.24	0.04±0.02	0.42±0.22
Technologists	1	0.060	0.290	0.035	0.37
Hospital 2					
Cardiologists	4	0.24±0.08	1.77±1.85	0.16±0.08	1.70±0.78
Nurses	5	0.07±0.08	0.24±0.41	0.04±0.06	0.41±0.57
Technologists	1	0.23	0.55	0.13	1.36
Hospital 3					
Cardiologists	4	0.34±0.25	2.07±1.18	0.22±0.14	2.33±1.43
Nurses	4	0.10±0.05	0.43±0.21	0.06±0.03	0.65±0.30
Technologists	7	0.22±0.12	1.34±0.68	0.15±0.05	1.49±0.53

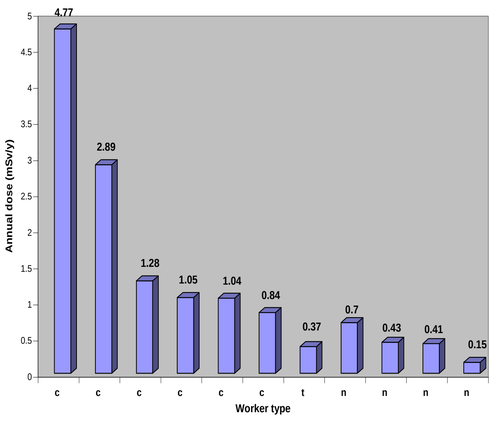

Figure (1): Plots of annual doses received by individual workers at Hospital 1 at the department of cardiology. C – Cardiologist, t – technologist, n – nurse

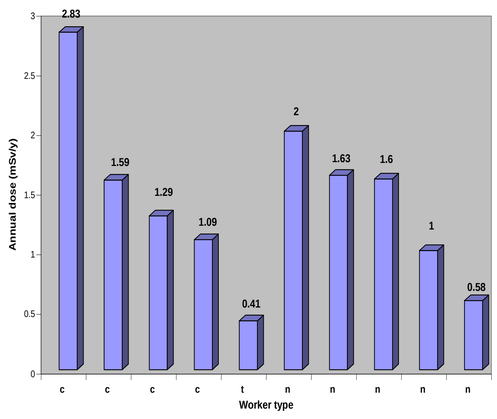

Figure (2): Plots of annual doses received by individual workers at Hospital 2 at the department of cardiology. C – Cardiologist, t – technologist, n – nurse

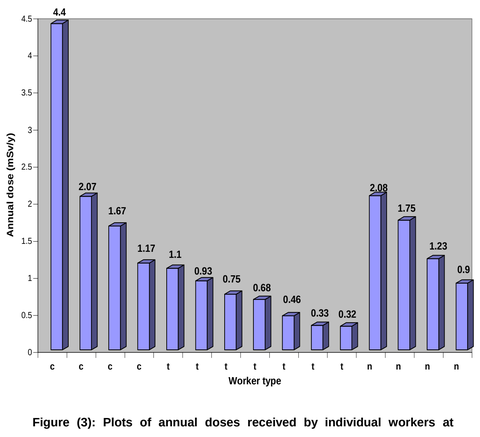

Figure (3): Plots of annual doses received by individual workers at Hospital 3 at the department of cardiology. C – Cardiologist, t – technologist, n – nurse

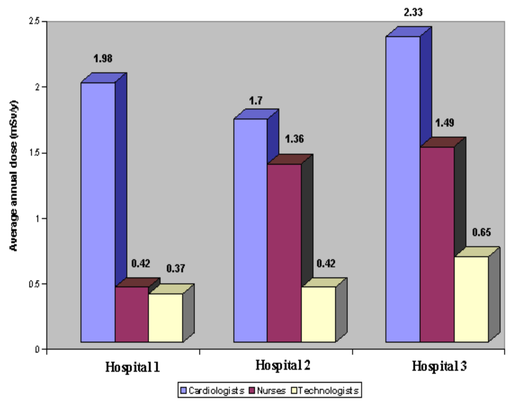

Figure (4): Plots of average annual doses received by the cardiologists, nurses and technologists at the three centres of cardiology

Table (2): Average annual doses at the three centres

No	Centre	Average annual effective dose ± SD (mSv)		
		Cardiologists	**Nurses**	**Technologists**
1	Hospital 1	1.98 ± 1.56	0.42 ± 0.22	0.37
2	Hospital 2	1.70 ± 0.78	1.36 ± 0.57	0.41
3	Hospital 3	**2.33 ± 1.43**	**1.49 ± 0.53**	**0.65 ± 0.30**

It could be observed that the cardiologists, nurses and technicians at Hospital 3 received the highest average annual doses among the three centres because it is a public hospital and the number of examinations performed was more than the two other centres. So the workers at this hospital has exposed to the highest dose.
All workers of Hospital 1 had the lowest average annual dose, except for the cardiologists who received a dose of 1.98 mSv which is higher than their colleagues at Hospital 2, 1.49 mSv.
It could be observed from the results that the average annual dose received by the cardiologists is greater than that received by the nurses at the three hospitals. The nurses received higher doses than the technologists. This is because during the examinations the cardiologist is positioned close to both the x- ray and the area under investigation and receives the dose primarily from scattered radiation from the patient. The nurse stays close to the cardiologist and the technologist is the farthest from the scattered radiation.

Doses to Workers of other medical practices

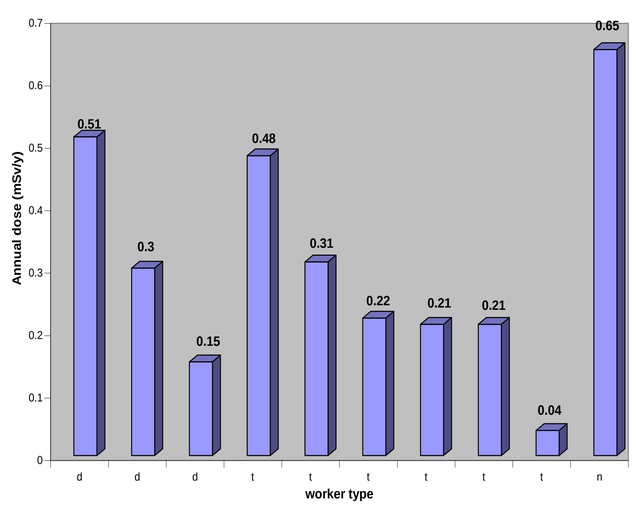

Figure (5): Plots of annual doses received by individual workers at the department of radiotherapy. D – Doctor, t – technologist, n – nurse

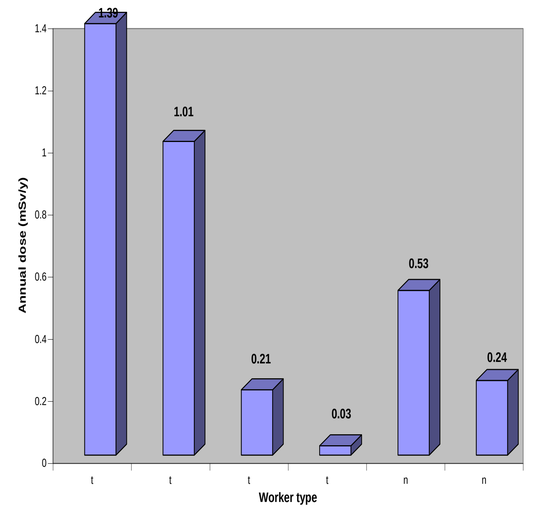

Figure (6): Plots of annual doses received by individual workers at the department of nuclear medicine. T – technologist, n – nurse

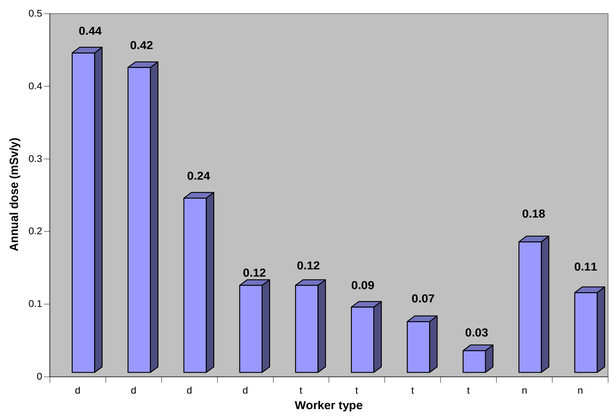

Figure (7): Plots of annual doses received by individual workers at the department of diagnostic radiology. D – Doctor, t – technologist, n – nurse

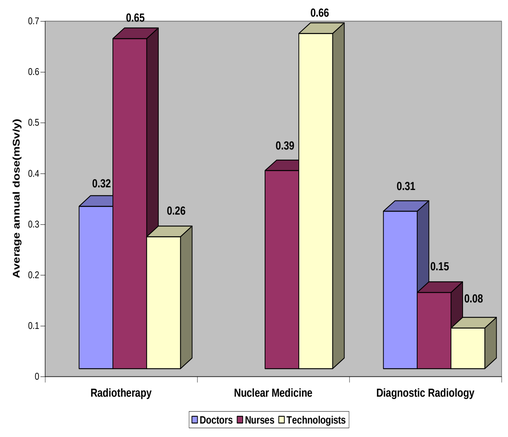

Figure (8): Plots of average annual doses received by the doctors, nurses and technologists at the three medical sections of radiotherapy, nuclear medicine and diagnostic radiology in the institute of nuclear medicine at El Gezira

Table (3): Average annual doses at the three medical sections

No	Section	Average annual dose ± SD (mSv)		
		Doctors	**Nurses**	**Technologists**
1	Radiotherapy	0.32 ± 0.18	0.65	0.25 ± 0.14
2	Nuclear Medicine	-	0.39 ± 0.71	**0.66 ± 0.65**
3	Diagnostic Radiology	0.31 ± 0.15	0.15 ± 0.05	0.08 ± 0.02

Dose Comparison between the cardiology and the other medical sections

Table (4) presents the average annual dose to the workers of the medical sections of cardiology, radiotherapy, nuclear medicine and diagnostic radiology. The average annual doses received by the workers at these sections are plotted in figure (9).
It is observed that the highest average annual dose recorded was of the cardiologists' and the nurses'- who work close to the patient while the x-ray on.
Regarding the technologists, those of nuclear medicine had the highest average dose (0.66 mSv). The technologists in cardiology received an average dose of 0.59 mSv, This is because they work with open sources during the processes of separation, solvent extraction and purification.

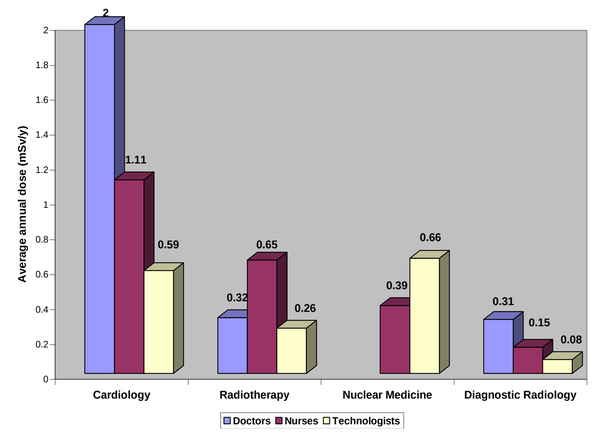

Figure (9): Plots of average annual doses received by the doctors, nurses and technologists at the four medical sections of cardiology, radiotherapy nuclear medicine and diagnostic radiology

Table (4): Average annual doses at the four medical sections

No	Section	Average annual dose ± SD (mSv)		
		Specialists	**Nurses**	**Technologists**
1	Cardiology	**2 ± 1.27**	**1.11 ± 0.65**	0.59 ± 0.28
2	Radiotherapy	0.32 ± 0.18	0.65	0.25 ± 0.14
3	Nuclear Medicine	-	0.39 ± 0.71	**0.66 ± 0.65**
4	Diagnostic Radiology	0.31 ± 0.15	0.15 ± 0.05	0.08 ± 0.02

5. Conclusion

The study shows the status of occupational exposure for workers of interventional cardiology in Sudan. Personal doses measured during this survey generally not exceed the dose limits specified in the BSS-115 . Doses to interventional cardiology staff, in particular cardiologists, were found to be relatively high compared with other medical practices. So it is important that these potentially high radiation doses are minimized.
This study shows the need to set constant individual monitoring for the workers to assist in reducing the occupational exposure.

References

1. United Nations Scientific Committee on the Effects of Atomic Radiation. Sources and Effects of Ionizing Radiation. UNSCEAR 2000 report to the General Assembly with scientific annexes. Annex E. Occupational radiation exposures. (Available at www. Unscear.org). New York: United Nations. 2000.
2. International Basic Safety Standards for protection against ionizing radiation and for the safety of radiation sources, safety series No. 115, IAEA, Vienna. 1996, pp. 91 .96.
3. NCRP Report No. 122. Use of Personal Monitors to Estimate Effective Dose Equivalent and Effective Dose to Workers for External Exposure to Low-LET Radiation. Copyright © National Council on Radiation Protection and Measurements.1995.
4. ICRP Publication 85. Avoidance of radiation injuries from medical interventional procedures. Ann ICRP. Oxford, UK: Pergamon, Elsevier Science Ltd, 2000;30(2)