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ASSESSMENT OF RADIATION DOSE AND MONITORING FOR X-RAY TECHNICIANS IN THE RADIOLOGY DEPARTMENTS - LIBYA

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Abstract

The levels of radiation dose for radiology personnel (X-ray technicians) were assessed in five major hospitals in two different cities at Libya. A data collection instrument was a semi structured self-completion questionnaire, designed in line with the objectives of the study. Personnel radiation monitoring was available in 5(100%) hospitals under study. Radiation monitors were found to be fairly read about every quarter of the year in three (5) hospitals. Radiation safety officers were available in only 3(60%) hospitals. About (22) 49% believe the hospital management does not make provision for it. Quality control was not available in 5 hospitals. Dosimetric records of staff are not given any consideration during recruitment of new staff. Our results show personnel radiation monitoring in Libya is abysmally poor. This is a significant precautionary lapse as radiations risks cannot be assessed and corrective measures taken.

***Key words*: Personnel radiation monitoring Radio-diagnostic departments –Libya**

I. INTRODUCTION

Exposures to radiation to which the Standards apply include any occupational, medical or public exposure [1]. The term 'occupational exposure' has been used by the International Labour Office (ILO) to refer to the exposure of a worker during work hours [2]. The International Atomic Energy Agency (IAEA) provides a more limited definition of occupational exposure: 'All exposures of workers incurred in the course of their work with the exception of exposures excluded from the Standards and exposures from practices or sources exempted by the Standards' [3]. Occupational exposure to radiation can occur as a result of human activity. This includes work associated with the different stages of a nuclear fuel cycle, the use of radioactive sources and x-ray machines in medicine, scientific research, education, agriculture and activities that involve handling of materials containing enhanced concentrations of naturally occurring radio-nuclides. In order to control this exposure, it is necessary to be able to assess the magnitude of the associated doses [4]. When protection and safety are not adequately or properly implemented, the exposure of the workers to ionizing radiation at the workplace can create to them injuries or disease [2]. Hence, occupational exposure is subject to regulatory control with the requirements defined in Publication 103 of the International Commission on Radiological Protection [5]. Exposure is usually determined by individual monitoring, but sometimes by evaluation of the results of environmental monitoring. An important objective of such determination is to provide information on the adequacy of protective measures that are key input for operational decisions related to radioprotection optimization. In addition, they demonstrate compliance

With relevant dose limits [6].

The aim of study is to assessment of the effective occupational radiation doses received by x-ray technicians in Libya over the year 2014 in two different cities within several governmental hospitals And to compare radiation dose levels with limits permissible internationally, in addition to verify the efficiency of radiation protection, Quality control programs and requirements at hospitals, aiming to reduce Personnel Radiation Doses (PRD)**.**

The United Nations Scientific Committee on the Effects of Atomic Radiation reviews the distributions of individual annual effective doses and annual collective effective doses from occupational radiation exposure in various sectors of industry or from sources based on studies done in different countries [7, 8]. It is of particular interest to examine changes that have taken place over time after the introduction of improved practices, new technology and revised regulations [6].

II. MATERIALS AND METHODS

This study was conducted in five governmental hospitals in Libya and targeted X-ray technicians working in medical imaging centers. The data collection instrument was a sixteen-item semi-structured self-completion questionnaire designed in line with the objectives of the study. A total of 50 questionnaires were distributed and 45 were duly filled out and returned to the researchers during the period of data collection, giving a response rate of 90 %. The data collected were analyzed to describe the personnel radiation monitoring practices in the selected hospitals spread across the two different cities , collaboration with The National Rabat University Faculty of Radiology and Nuclear Medicine Collage., Khartoum., Sudan during the year of 2015- 2016

III. RESULTS

Table - 1 Shows Distribution of practice duration (years) of x-ray technicians under study, (n=50).

	Practice duration (years)		
Hospital name	Minimum	Mean ±S.E.M	Maximum
A	3	8.54± 1.38	15
B	1	9.27± 1.67	15
C	1	3.78± 1.02	10
D	5	6.25± 0.82	10
E	2	7.00± 4.16	15

Table - 2 Availability and methods of personnel radiation monitoring in the various hospitals.

Hospital	A	B	C	D	E
Number of x-ray technicians	52	26	10	32	15
Number of x-ray technicians monitored	100%	100%	100%	100%	50%
Type of radiation monitor	TLD	TLD	OSL	OSL	EPD

Note: All study samples monitored (n=50).

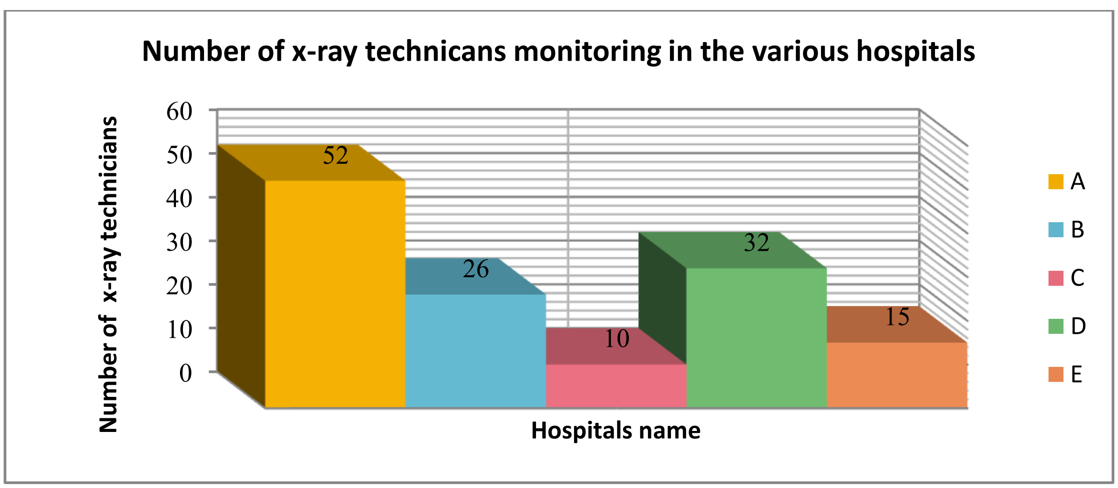

Fig. 1..Personnel radiation monitoring in the various hospitals.

Table - 3 Regularity and consistency of personnel radiation monitoring

Hospital	A	B	C	D	E
Time interval before monitors are read (months)	>3M	>3M	>3M	3>M	3>M
Last time fresh supply of monitors was made (years)	5	8	5	6	3

Note: (M) = Month

Table - 4 Availability of radiation protection officer and quality control program

Hospital	A	B	C	D	E
Availability of radiation safety officer (RSO)	Yes	Yes	Yes	No	No
Availability of quality control program (QC)	No	No	No	No	No

Table - 5 Reasons for not performing personnel radiation monitoring in the hospitals

The Reasons	Yes Available%	Not Available %
Radiation safety officer to provide service	(3) 60%	(2) 40%
Quality control program	Not available	Not available
Hospital management do not provide for it in its budget	-----------------	(22) 49%
Others (Knowledge of radiation protection)	-----------------	(23) 51%

Table - 6 Ranges of annual effective occupational radiation doses reported in all hospitals During year January 2014 – December 2014.

Hospital Name	Minimum	Mean ±S.E.M	Maximum
A	0.434	1.50±0.4742	5.16
B	0.800	1.52±0.2467	3.21
C	1.47	5.71±1.0327	12.75
D	1.50	3.67±0.4853	6.04
E	0.795	1.31±0.2798	2.19

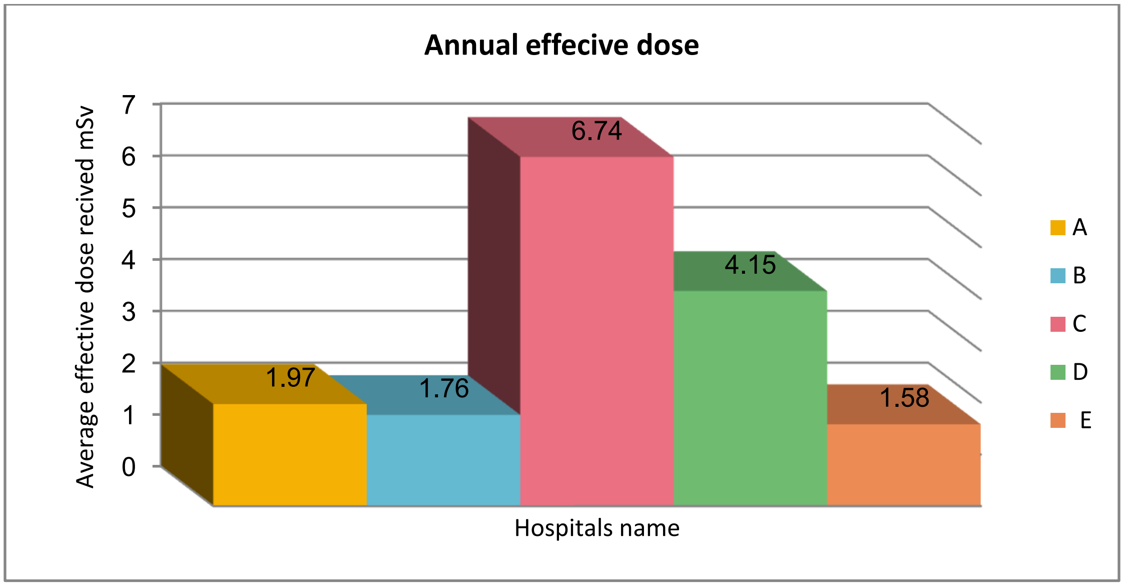

Fig. 2**.** Comparison Mean annual effective occupational radiation doses reported in all hospitals studied during year January 2014 – December 2014-Libya.

Table -7 Show comparison an effective annual radiation doses reported in this study with international limits ICRP 1991.

Dose (mSv)	Minimum	Mean ±S.E.M	Maximum
Annual effective dose (mSv)	0.434	2.90±0.3738	12.75

Note: *International Limits an effective dose of 20 mSv per year averaged over five consecutive years per year, an effective dose of 50 mSv in any single year ICRP.

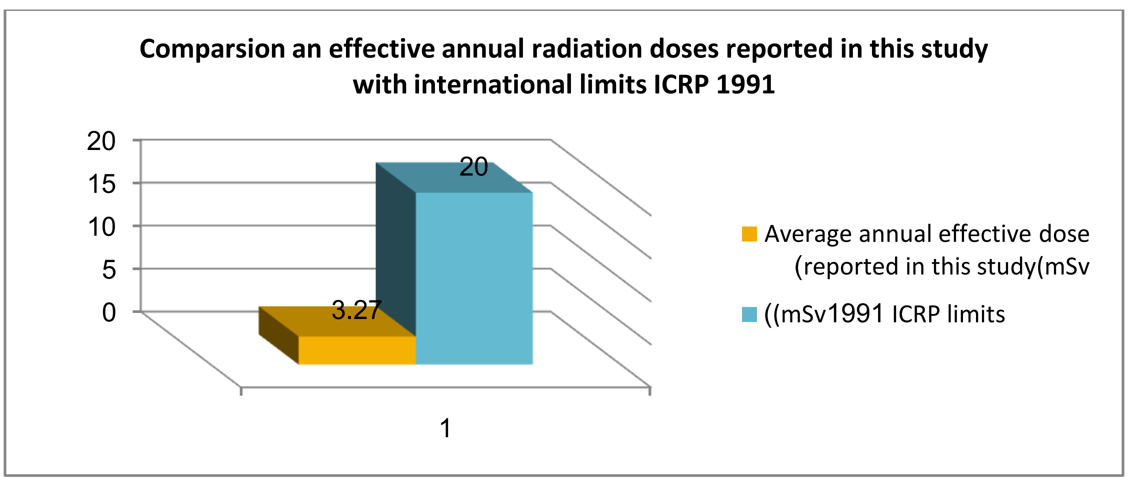

Fig. 3**.** Comparison an effective radiation doses reported in this study with international limits ICRP 1991.

IV. DISCUSSION

Table1. Shows the Distribution of practice duration (years) in five selected hospitals.

It shows the duration of practice range (1-15) years and shows the number of x-ray technicians were employed and monitoring in five hospitals during year 2014.Table 2. Shows the availability and methods of personal radiation monitoring in the selected hospitals. It shows that personal radiation monitoring is available in all hospitals 100% and in one of the hospitals radiation monitoring does not cover the worker on employment. Table 3. Shows the regularity and consistency of reading and supply of personal radiation monitoring devices. Our results show that radiation monitoring are read fairly regularly at about every quarter of the year but it take (3-8) years for fresh supplies of radiation monitoring devices to be made in the hospitals where radiation monitoring is carried out. Radiation protection advisers or safety officer are in the employment of only 3(60%) hospitals out of 5 studied , Our result show that Quality control program not available in all hospitals studied, this adversely affects the application of radiation protection programs as shown in table 4. Table 5 shows the various reasons advanced by the x-ray technicians for not carrying out personal monitoring device. Majority of the x-ray technicians (48.8%, n= 22) think the hospital management do not make provision for it in their recurrent budget. Other miscellaneous reasons were advanced by (51%, n=23) of the x-ray technicians. The results also show that diametric records of staff are not given any consideration during recruitment of new staff. Table 6 indicates that the maximum annual effective radiation dose received by any person was 12.75 mSv, The average annual effective dose for all workers during the one year was,(Mean±SEM 2.90 ±0.3738) mSv which is a significantly below the annual occupational limit of 20 mSv/ year averaged over any 5-year period and 50 mSv in any one year set by the ICRP. Table7 Shows the comparison of an effective annual radiation doses reported in this study with international limits, were found to be well below the permissible annual limit is less than 50% of dose limits set by ICRP. Personal radiation monitoring is an important safety precaution in the practice of radiography. It does not in itself provide protection against ionizing radiation. Its main purpose is to measure radiation dose received by radiology personnel. Which can be used that radiation doses received are within permissible limits, verify that facilities for radiation protection are adequate and show that radiation protection techniques are acceptable [9]. The result of our survey shows that personnel radiation monitoring is available in five hospitals studied and in one hospital cover only 50% of x-ray technicians on employment. The survey result showed that radiation monitoring was almost non-existent in the centers [10]. The finding of our survey is appalling considering the importance of radiation monitoring to radiography practice. Determining radiation dose received by personnel will ensure reduction of unwanted biological radiation effects. Radiation exposures in medical practice are usually no accidental and protection is usually geared towards reducing stochastic effects, which likelihood is determined by the magnitude of the absorbed dose [11]. It's therefore important to estimate the risk of low dose radiation to radiography personnel. The most important of the stochastic effects is cancer induction. The risk associated with genetic effects of radiation is smaller than the risk of cancer induction, so it is the latter that is the principle consideration in determining dose limits [12]. To limit the probability of stochastic effects on radiographers. Exposure dose have to be constantly monitored using suitable devices. The radiation monitoring devices used in hospitals where radiation monitoring is available is the themoluminiscent dosimeter (TLD) badge, thermoluminiscent dosimetry is a phenomenon by which solid state detectors can be used to detect and measure exposures to ionizing radiations.when exposed to these radiation, free electrons in the TLD crystals become trapped in lattice imperfections and when heated to about 300^0C , the electrons escape the traps and emit light .The amount of light emitted is proportional to the dose of radiation asorbed [9]. The possible mechanism to explain this phenomenon is the band theory of multi-atomic crystalline structures [13, 14]. TLD is a convenient method of personnel radiation monitoring as it is portable, lightweight and can always be worn by the radiographer during work sessions. Its most important advantages are that it measures total radiation dose over a period of time, high sensitivity and reusability. (OSL) dosimeters devices used in radiation monitoring (OSL), electronic personnel dosimetry (EPD). Our finding is the TLD badge is available to x-ray technicians on employment in 2 hospitals where they used, OSL badge is available in 2 hospital and EPD used in 1 hospital. We therefore note that all x-ray technicians are exposed to radiation risk and therefore should be monitored. Leaving out some in the monitoring process may dampen their morale and affect their output negatively. Radiation protection advisers or safety officer are available in 3 out of 5 hospitals studied. They were found only in 3 hospitals when ideally they should be in every radiology department. It means that where they are not available no one oversees radiation monitoring in the department. In an ideal situation a medical physicist is employed to the job or x-ray technicians trained and assigned the duties. The poor level of personnel radiation monitoring is obvious. Majority of the x-ray technicians believe it's not provided for in the hospitals recurrent budgets. The dosimetric records which are not considered during recruitment of new staff are another lapse on the part of the hospitals. In other parts of the world it's recommended and practiced that persons who have worked with radiation in the past should make their dosimetric records available to their new employers [15, 16]. This is important as it helps to assess the radiation morbidity risk associated with the new employee.

V. CONCLUSION

The study has revealed that the levels of received radiation dose by x-ray technicians in most hospitals surveyed in Libya are very poor as such, precautionary motives and radiation risks cannot be purposely assessed and corrective measures will become difficult. The implication of which is that most radiology works are expose to some health risks that are not sufficiently perceived by health authorities.

VI. RECOMMENDATIONS

1. All departments working with ionizing radiation should ensure a strict adherence to radiation safety practices to protect x-ray technicians, patients and the public from harmful effects of ionizing radiation.
2. Periodic quality assurance tests should become mandatory in all diagnostic x-ray facilities in the country.
3. The Libyan national assembly should amend strong laws guiding diagnostic use of ionizing radiation in Libya to make them more effective.
4. Since knowledge alone, though very important, cannot translate to adequate radiation protection, radiographers must, therefore, update their knowledge often to include the most current trends in radiation protection and then make more concerted efforts to follow existing radiation protection protocols in their daily work routine.

VII. ACKNOWLEDGEMENT

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