OCCUPATIONAL EXPOSURE FROM EXTERNAL RADIATION USED IN MEDICAL PRACTICES IN ISLAMIC Republic OF IRAN BY FILM BADGE DOSIMETRY

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Abstract

In Iran, personnel monitoring of worker dealing with medical practices are mainly implemented by film badges. The present study was undertaken with the primary objective of analyzing the overall status of radiation protection and safety of workers in medical field within country base on film badge results during recent years. For this purpose, the radiation workers in medical practices are divided to five categories: 1-Interventional Radiology (IR), 2-Nuclear Medicine (NM), 3-Tele-Therapy (TT), 4-Diagnostic Radiology (DR) and 5-CT scanner workers. For each categories, collective and average effective dose of the 22000 workers are analyzed, based on the results of 342932 film badges which were used by them, from July 2008 to July 2012. Contribution of each above mentioned practices in exposing of the workers have been determined. Only 8.8% of total medical workers are dealing with IR practice, but they receive 38% of total collective dose in medical field. Averages of annual collective dose various practices are 832 mSv in IR, 708mSv in NM, 95 mSv in RT, 561 mSv in GR and 53 mSv in CT scanner. Also it found that occupational collective exposure per monitoring period (2 months) has been are increased by rate of 50mSv/y in IR, while it reduced by factor of 4.5 mSv/y in CT scanners since July 2008.

Introduction

People at work may be exposed to ionizing radiation called occupational exposure. This term has been used by the International Labor Organization, ILO, referring exposure of worker during a period of work (2). Occupational exposure defined by International Atomic Energy Agency (IAEA) safety standard is ‌all exposure 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 standards (3). United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) provided various working sheets for analysis of occupational exposure by classifying the type of radiation work in which the radiation workers exposed to ionizing radiation. Occupational exposures from external sources are usually measured by film badge or TLD. In Iran workers dealing with medical radiation sources mainly use film badge. Film Badge services in the Islamic Republic of Iran have a long history, dating back to 1970 when the Tehran University established film badge laboratory and provide services for workers in 4 nuclear medicines centers. After legislation of Atomic Energy Act, the responsibility for film badge service was transferred to the Atomic Energy Organization of Iran (AEOI) in 1974 and the number of person covered by the film badges, gradually increased. In 1989, Radiation Protection Act of Iran (RPAI) was ratified and precisely formulated the responsibilities of the AEOI to regulate and control the entire range of ionizing and non- ionizing radiation protection activities in different disciplines. So after empowering of the RPAI, almost all radiation workers in controlled area of the medical practices have been covered by the film badges. On July 2008,

AEOI designated a private company to continue the service of film badge. So, Parsian Radiation Dosimetry Service (PRDS) under supervision of AEOI have been established the film badge services at country level since July 2008. Film badge monitoring period is 2 months. The PRDS, in each period provide 27000 film badge dosimeters and send to 3800 radiation working centers. Approximately 80% of the radiation workers are dealing with medical Practices. So the authors decided to use these huge data to evaluate occupational exposure of medical workers.

The main objectives are to assess the annual average dose and distribution of radiation workers in different dose ranges along with their annual average effective doses. Various dose ranges are predefined by UNSCEAR for each major practice involving the use of ionizing radiation. This type of data sheets provides a basis for estimating the average individual risk in a major workforce and within its pertinent subgroups.

MATERIALS AND METHODS (FILM BADGE SERVICE)

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The film badge results are provided in quantities of personal dose equivalent Hp(d) as recommended in the BSS for individual monitoring. This quantity is the dose equivalent in soft tissue below a specified point on the body, at an appropriate depth d. The personal dose equivalent at 10 mm depth,Hp(10), is used to provide an estimate of effective dose that avoids both underestimation and excessive overestimation. The calibration of dosimeters is performed under simplified conventional, on an appropriate phantom [Ref. *1- IAEA Safety Standard Series, Assessment of Occupational Exposure Due to External Sources of Radiation, SAFETY GUIDE, No. RS-G-1.3, INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, August 1999*]. The quantity Hp(10) can be used to specify the effective dose at a point in a phantom representing the body.

All radiation workers are instructed to wear the film badge at the chest level under the lead apron to indicate the actual whole-body dose. Films are dispatched by registered postal service on interval of 2 months. Fresh films were dispatched at the end of every 2months to each before the first working day of every period in concerned centers. All measured doses are recorded in hard and soft copies for maintaining dose record. Dose record of radiation workers is maintained in a menu driven locally by computer software. In case of over doses (Hp(10) grater than investigation levels designated by the regulatory authority), the licensee of related center and AEOI are informed accordingly to investigate the causes of high dose and to confirm its genuineness. If the genuineness is not confirmed the said dose is deleted from the dose record. The PRDS regularly participates in intercomparison of personal dosemeters arranged by IAEA and AEOI at the international and national level to check the accuracy, harmonisation of measurement procedure and for quality assurance. Results of the PRDS, always have met the accuracy criteria and remained within the trumpet curves provided by IAEA for personal dosimetry.

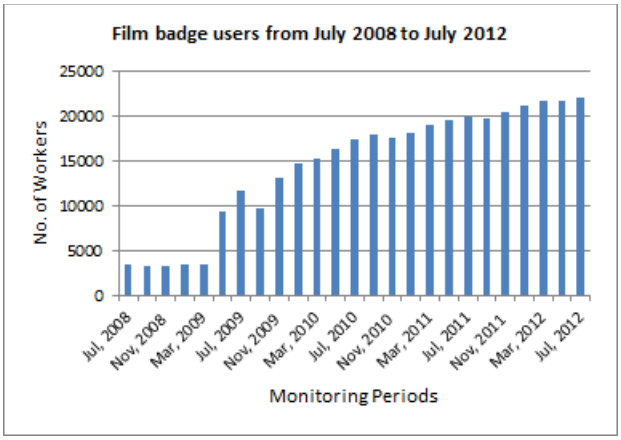
Calibration of films was carried out in Secondary Standard Dosimetry Laboratory (SSDL) of the AEOI. Its measurements are traceable to IAEA dosimetry laboratory. Austria. SSDL regularly participates in IAEA postal dose intercomparison exercises to check the field irradiation values. Results of SSDL were always in good agreement with IAEA.

Foma Personal Monitoring Film (Foma PMF) was used for recording radiations. Foma PMF is a set of two films intended for personal dosimetry of gamma radiation, x-radiation and electrons: Foma DF10 is a high speed film double coated on a blue colored polyethylene terephthalate base and Foma DF2 is a low speed (emergency) film. The film is carried by RPS/AERE film holder (*RPA/AERE : Radiation Protection Service and the Atomic Energy research Establishment in Great Britain*). Minimum detection limit of this type of film is 0.05mSv and it is equal to the recording level that advise by the Iranian competent authority (i.e. AEOI).

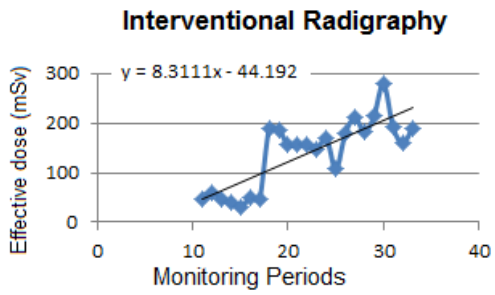
RESULTS AND DISCUSSION

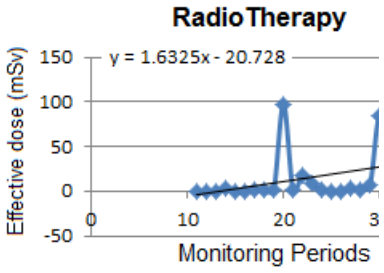
Table 1 shows the number of radiation workers during July 2008to July 2012 in medical practices.

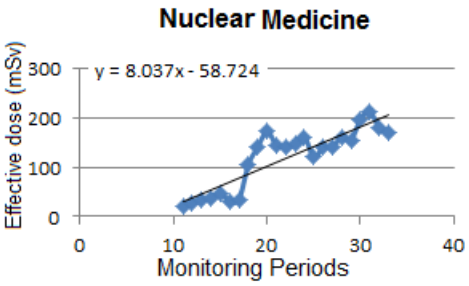
Average of total effective dose during each period of monitoring for various specified categories are separately calculated.

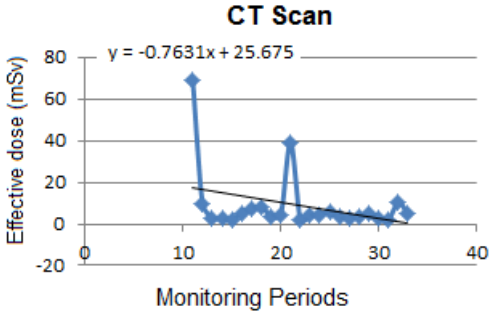


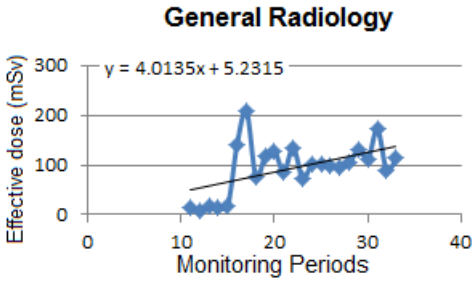
Annual average effective doses remained in the range of 1.39ت1.80, 1.05ت1.45 and 1.22ت 1.71 mSv, respectively, during 2008ت2012.All these values are not very high and well below the annual dose limit of 20 mSv. Comparison of various practices shows the highest value in NM followed by DR and then RT. Workers in NM use radionuclide generators, which, requires handling tens of giga Becquerels of radioactive material during the treatment process and remain close to the patient when giving the injections and positioning the patient or camera. Usually, the imaging pro











cess in NM involved unsealed radiation sources, making the greatest contribution of occupational exposure as compared with RT, where the occupational exposure is due to external beam therapy, which is carried out with highly protected sealed sources. During RT, the staff is not present in the treatment room during irradiation processes of patient; therefore, decreasing the occupational exposure values.

In DR, the radiographer stands in a shielded control booth that provides protection against X-ray tube leakage and scattered radiations from the room and patient. in fluoroscopy technique where radiologist required to be present in the examination room, close to the patient and has a chance to be exposed. Therefore, the highest value of AAED, although very less was seen in NMwhen compared with RTand DR.