

Occupational Cumulative Effective Doses of Radiation Workers in Hamad Medical Corporation in Qatar

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H.M.AI Naemi, A. Al Attar, O.Bobes, A. Aly, M.H.Kharita

Hamad Medical Corporation, P.O. Box 3050, Doha, Qatar
dhudanaimi@hotmail.com

1. Background and Goal of the present work

The number of radiological examinations has increased steadily in recent years. As a result, the risk of possible, radiation-induced consequential damage also increases through continuous, lifelong and increasing exposure to ionizing radiation. Therefore, radiation dose monitoring in medicine became an essential element of medical practice. In order to limit the radiation exposure to workers and the public, the use of ionizing radiation is regulated by laws, ordinances, recommendations and guidelines. To protect radiation workers and the public from the negative effects of ionizing radiation, dose limits that must not be exceeded are set in order to reduce the risk of exposure to a reasonably achievable level.

In this study, the occupational cumulative doses for radiation workers in Hamad medical corporation (HMC) in Qatar have been assessed for a period of five years. The number of monitored workers selected for this study was 753 (out of a total of 1500 monitored workers) who have been working continuously with no interruption with ionizing radiation over the past five years from 2017 to 2021. This study aims to assess the radiation workers cumulative effective dose at HMC hospitals over the last five years and to examine for which occupational groups and the areas where the higher radiation exposure occurred.

2. Methodology

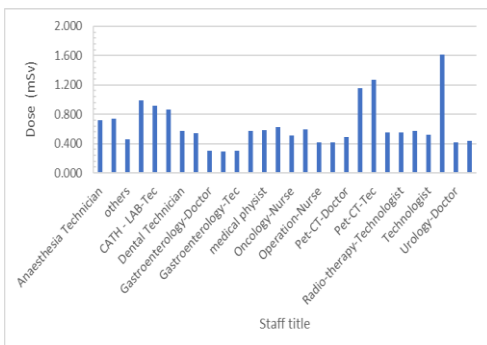
2.1. The number of participants selected in this study is 753 who have been working continuously with ionizing radiation without interruption over the past five years from 2017 to 2021. The dose measurements were carried out using Thermoluminescence Dosimeters (TLD). TLDs have the property of storing energy in long-lived states when exposed to ionizing radiation. Reading TLDs was carried out through the automatic card reader Harshaw 8800 plus. This Harshaw Reader is designed for large facilities and can read a carousel containing up to 1400 four-element cards in one load at 140 cards per hour. Effective dose, cumulative effective dose and average effective for radiation workers were estimated for the five years selected period. The staff who worked for continuous 5 years was included to this study.

In the present study, the cumulative effective dose to radiation workers at HMC hospitals were evaluated. Radiation workers included physicians, technicians, nurses, medical physicists, and paramedics who work with or near ionizing radiation in the following departments: Clinical Imaging, Oncology, Nuclear Medicine, Cath-Lab, Urology, and Operating Theater.

3. Results and Discussion

The total number of monitored staff, in all HMC (15 hospitals) is about 1500 workers 753 workers have worked continuously with ionizing radiation over the past five years from 2017 to 2021, 366 of them are Technologists, 237 physicians, 126 nurses, 18 medical physicists and 6 others (assistants and speech therapists). The percentage distribution of radiation workers according to different job category. The most exposed group was the nuclear medicine technologist staff with cumulative dose of 8.1 mSv. The highest individual cumulative dose was 10.2 mSv recorded for the PET-CT Technologist category.

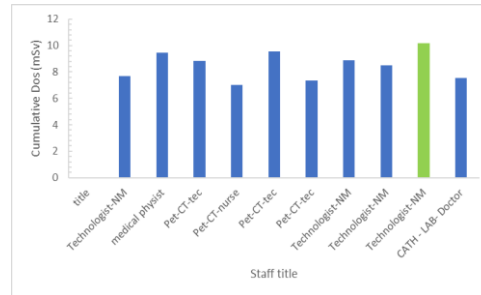
The relative high doses are registered for nuclear medicine and PET CT in addition to cardiological intervention categories. The cumulative dose in all other categories is less than 5 mSv, which is only 5% of the dose limit recommended by the ICRP and 15% of the investigation level according to the HMC policy.



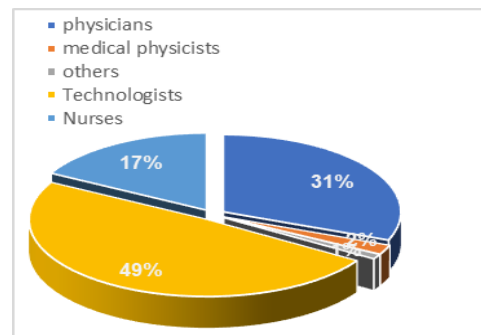
Cumulative effective dose of radiation workers in HMC from 2017 to 2021 as a function of occupational groups

The highest individual cumulative doses for all monitored workers were 10.2 mSv, 9.6 mSv, 7.5 mSv was recorded for the Nuclear Medicine Technologist, PET-CT technologist, interventional cardiologist respectively. On the other hand, the highest cumulative dose was 8.1 mSv, 6.3 mSv, 5.8 mSv and 4.9 mSv were registered for nuclear medicine technologist, PET CT technologist, PET CT nurse and Cath-lab doctor categories respectively.

The average annual effective dose for all categories did not exceed 2.25 mSv/year, which is 11% from the dose limit recommended by the ICRP (annual effective dose not exceed 20 mSv per calendar date) and almost 37% from the investigation level according to the HMC policy. As shown in the figure, the annual effective doses between 2017 and 2021 for nuclear medicine and interventional cardiology staff, which are the most exposed groups to ionizing radiation.



Top 10 cumulative effective dose for radiation workers during the 5 years



Percentage distribution of monitored workers for selected categories

Category	2017	2018	2019	2020	2021
NM technologists	1.5	1.4	1.73	1.62	1.88
PET-CT technologists	1.05	1.11	1.3	1.45	1.43
PET-CT nurses	1.11	1	1.64	1.08	0.96
Cath-Lab nurses	0.88	0.83	0.94	0.87	0.8
Cath-Lab technologists	1	0.94	1	0.87	0.78
Cath-Lab physicians	1.03	1.05	1.03	0.93	0.88

Average annual effective dose for some radiation worker categories in HMC from 2017 to 2021 as a function of occupational groups.

4. References

- Decree-law NO.31 OF (2002), Protection from Radiation, Qatar
- Monitoring and Investigation of Occupational Radiation Dose Levels, Hamad Medical Corporation policy number: SA 1065.
- International Atomic Energy Agency, Individual Monitoring, Practical Radiation Technical Manual No. 2 (Rev. 1), IAEA, Vienna (2004).
- M.H. Kharita, H.M. Al Naemi, A.M. Aly, Occupational Radiation Exposure for Radiation workers in Hamad Medical Corporation, International Conference on Radiation Safety: Improving Radiation Protection in Practice Vienna, Austria, 9–20 November 2020.

5. Conclusions and Acknowledgements

- In the present paper, the cumulative effective dose of radiation workers at Hamad Medical Corporation (HMC) was assessed over a period of five years. The most exposed group was the nuclear medicine technologist staff with cumulative dose of 8.1 mSv. The highest individual cumulative dose was 10.2 mSv recorded for the PET-CT Technologist category. All doses were well below the dose limit for radiation workers and did not exceed 15% of the limit. Moreover, all doses were also less than 50% of the investigation level for workers in nuclear medicine.