CONTRIBUTION OF OCCUPATIONAL DOSIMETRY AND WORKERS TOWARDS OCCUPATIONAL SAFETY CULTURE

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1. Background and Goal of the present work

Nuclear medicine in practice utilizes the radiation from the radionuclide to diagnose and treat the human disease. It potentially poses an occupational health risk to the workers, as the personnel monitoring is the most important aspect need to undergo when working in a radiation environment. External exposure of personnel monitoring had been long introduced in Malaysia as enacted in ACT 304 personnel monitoring section paragraph 22(1) and (4). Thus, personnel dose monitoring in medical is legally bound and considered as a must important component in the occupational safety especially to among nuclear medical imaging workers. Generally, the dosimetry of these workers are monitored using various type of personnel dosimeter such as optically stimulated luminescence dosimeters (OSLD), radiophotoluminescence (RPL), thermoluminescence dosimeter (TLD) or conventional film badge.

According to the International Atomic Energy Agency, there is need for the control and monitoring of radionuclide materials and medical. There are many professionals whose mandate includes nuclear security as just one of multiple areas of responsibility, in addition to the obvious contributors such as technical experts in nuclear sciences, plan writers, and analysts focused on the safety of their profession. Furthermore, the self-assessment allows an organization to develop and maintain a occupational safety among nuclear personnel by evaluating their knowledge and awareness involves radioactive sources. Hence, the present study aimed to evaluate the performance of difference dosimeters in estimating whole body exposure and for the second phase we assess the subjects knowledge on nuclear safety.

2. General experimental and occupational safety culture survey

2.1. Performance between OSLD and RPL

The OSLD is made from a luminescent material which contain aluminium oxide (Al_2O_3:C). It possesses deep electron traps that get progressively filled by exposure to radiation. A fraction of the trapped electrons get transmitted by light exposure to luminescent site during the reading process. OSL reader (Micro star) used in this study which operate manually, it has dimension of 368 mm × 597 mm × 419 mm with approximate weight of 22.7 kg and equip with 36 LED array.

The RPL dosimeter is the photoluminescence technology based on silver activated phosphate glass produced by Chiyoda Techno Corporation. The RPL is analysed by pulsed UV (~364 nm) light laser stimulation on glass element which will emit orange (~606 nm) luminescence and detected by RPL reader system. RPL glass dosimeter model GD-450 is employed in this study. RPL made with compact design that has dimension of 45 mm×13 mm×5 mm and approximate weight of 5 g.

We include 5 physicists, 6 pharmacists and 11 technologists which are permanent staff of Department of Nuclear Imaging in tertiary hospital in Malaysia. The dosimeters (RPL and OSL) were placed on the anterior of mid-chest area for a period of 3 month. Both dosimeters were analysed by in house by the physicist.

Table 1 Classification of working area for each profession

Group	Working Area
Physicist	Hot Laboratory, Gamma camera/SPECT CT room, radio waste room, decay tank, Radioiodine ward and physics laboratory
Pharmacist	Hot Laboratory and QC room
Technologist	Hot laboratory, injection room and gamma camera/SPECT CT room

Figure 1 Different working areas classified as hot and controlled area.

2.2. Occupational safety culture

In the second phase, this study evaluates awareness of the importance of occupational dosimeter among nuclear medicine worker. A survey was performed on 117 radiological personnel that handles radioactive materials direct and indirectly using developed cross-sectional questionnaires. The questionnaires are adopted from IAEA's model of an effective safety culture which is comprised of 4 characteristics which are beliefs, attitudes, behaviour and management system. There are other models that are built upon different sense of the occupational safety.

3. Findings

3.1. $H_p(10)$ of different dosimeters

Table 2 tabulate mean dose value $H_p(10)$ of the nuclear medicine worker using OSL and RPL. were and, respectively. The range of dose value recorded for OSL and RPL measurement was 0.20 - 0.26(0.23±0.11mSv) and 0.17 - 0.21(0.19±0.07mSv), respectively. As indicate from the result, there was a significant difference of dose recorded in OSL and RPL. We found that the OSL is more sensitive than RPL by a factor of 1.4.

Table 2 Occupational dose reported from OSLD and RPL

Profession	Radiation dose $H_p(10)$ (mSv)	
	Mean $H_p(10)_{Osl}$	Mean $H_p(10)_{Rpl}$
Physicist	0.16±0.09(0.02-0.28)	0.14±0.02(0.1-0.16)
Pharmacist	0.24±0.08(0.04-0.34)	0.23±0.06(0.14-0.32)
Technologist	0.24±0.12(0.02-0.46)	0.20±0.07(0.09-0.38)

3.2. Occupational safety culture survey

Based on Fig. 2, it can be concluded that occupational safety awareness does increase with the duration of service up to a certain point, in this case until 20 years of service. This justifies that as people work more, their awareness on safety culture does increase over time. This can be proven with the increase of scores is in line with the experience.

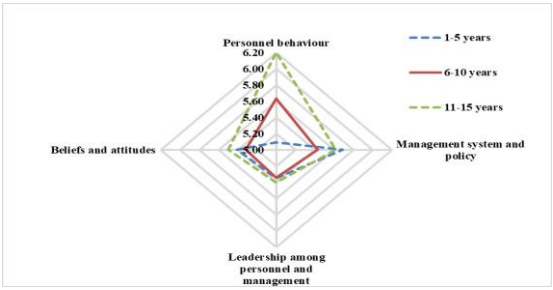

Figure 2 shows score of safety culture among nuclear medicine workers.

Since there is no observable relationship workers' age and their awareness on occupational safety culture, a closer look is taken into the categories of their responses. Among 26-30 years old and 31-40 years which account for 23.1 percent and 64.1 percent respectively of the total number of respondents. Workers between the age of 31-40 years old has better overall score in all categories compared to those who are between 26-30 years old. However, for beliefs and attitudes, workers in both age groups are somehow similar. This indicates that for 26-30 years old, training in categories other than beliefs and attitudes is required.

A comparison of scores in different categories by workers that have different years of working. Those that have been working for 6-10 years have much better score compared to those who are within 21-30 years of working. This is mainly because training on occupational safety is mostly given to workers who are young and still new in the organisation while those who are considered seniors in the field with longer experience are neglected from undergoing training.

4. Conclusions and Acknowledgements

- This study represents an actual in field intercomparison dosimetry performance of RPL and OSL at nuclear medicine facility. The arithmetic mean of the *$H_p(10)$* OSL is significantly higher than Hp(10)RPL.
- Higher sensitivity of the OSL offer better estimation for occupational exposure. Therefore, OSL will enhance occupational safety program by minimizing radiation risk among radiation workers.
- We are extending observation on the levels of occupational safety culture. The degree of awareness on safety culture of 117 workers was investigated based on multiple factors that may impact the scoring.
- Staff awareness on occupational safety culture significantly relate with their experience and length of work in the field.