Assessment of the Nuclear Medicine Personnel Occupational Exposure to Radioiodine in Thailand

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1. Background and Goal of the Research Project

The diagnostic and treatment of hypothyroidism and thyroid cancer using radiopharmaceutical with iodine-131 (I-131) are widely performed in Thailand. The utilization of large quantities of I-131 in nuclear medicine has been recorded and regulated by the Office of Atoms for Peace (OAP), Thailand. Although workplace safety regulations have been established, a review of reported data of routine handling of the radionuclide could result in a significant risk of occupational exposure of the workers chronically intake and intact to unsealed radioiodine. To ensure safety uses of the radiopharmaceutical to be aligned with national regulation and international standards, the radiation biology group under the regulatory support division of the Office of Atoms for Peace performed dose assessment for nuclear medicine personnel and radiation workers in Thailand. By measuring and evaluating the radiation dose of nuclear medicine practitioners using conventional internal dosimetry techniques including direct thyroid measurement and aerosol sample analysis, thus, ensuring the safety of I-131 exposure enters the body of nuclear medicine operators. Although results from internal dosimeter measurements for radiation workers are not required by the national laws and regulations, the practice raises awareness of the relevant stakeholders to understand the importance of routine monitoring iodine-131 contents and ultimately use these to improve work and to analyse the cause of radiation exposure.

2. Methods

2.1 Direct thyroid measurement to determine I-131 activity

The thyroid iodine intake was measured using a NaI based gamma radiation detector (ORTEC SN1310). More than 300 personnel from over 20 hospitals in Thailand were objected to the direct thyroid measurement for 3 years (2018-2020) before the interruption of the OAP service due to COVID-19 pandemic.

2.2 Aerosol sample analysis

Samples were collected using air pump and paper filters. Gamma radiation activity was measure and I-131 in the ambient atmosphere within each workplace was calculated.

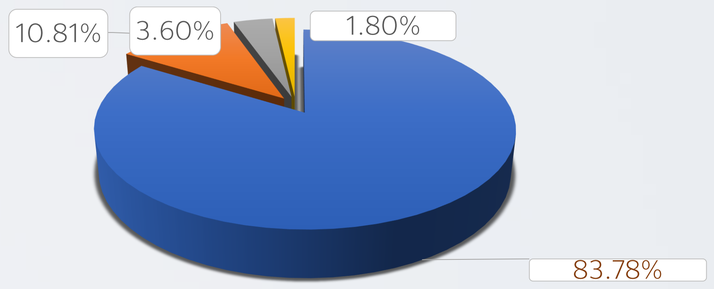
2.3 Data analysis

The data were analyzed and presented graphically using Microsoft® Excel® for Microsoft 365 MSO 64-bit. The standard deviation (S.D.) was calculated for all measured results. Student's t-test and One-way ANOVA test for comparison between the studied groups were used depending on the normality of the distribution of the readings as verified. P values of < 0.05 was considered to be significant.

3. Measurements

3.1 Direct thyroid measurement to determine I-131 activity

3.1.1 Direct thyroid measurement for radiation workers working for nuclear medicine department from 20 hospitals in Thailand.

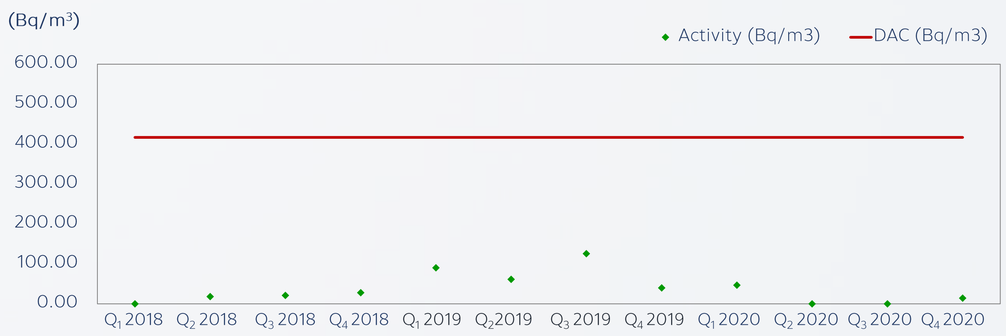


The results from direct thyroid measurement showed that 83.78% of personnel from nuclear medical department of these 20 hospitals received I-131 as the background level, 10.81% received I-131 over the background level but still within the recording level (RL), 3.60% received I-131 over the RL but still within the investigating level (IL), whereas only 1.8% received I-131 over the IL. The hospital where the personnel received the dose over IL was suggested to reviewed their procedures and keep monitoring the dose for the improvement.

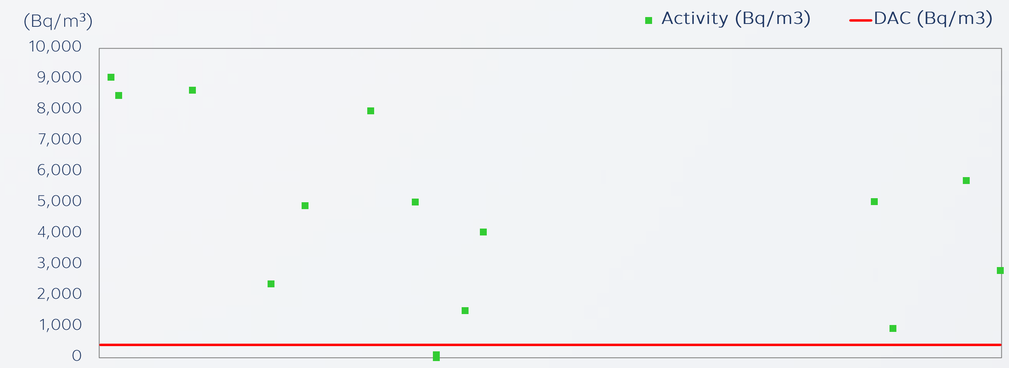
For the radio pharmacy facility, data was collected from eight radiation workers and their work processes were reviewed to reduce the dose. Optimisation work process for individual exposures needed to improve occupational radiation protection safety

The direct thyroid measurement results of I-131 from nuclear medicine department a radio pharmacy facility in Thailand. Data was collected from 8 individuals over the course of 3 years from 2018-2020.

3.2 Aerosol sample analysis



The analysis results of I-131 in aerosols from nuclear medicine department in hospitals, Thailand. Data was collected from 2018 – 2020 before the disruption of the survey process from the pandemic.



The analysis results of I-131 in aerosols from a radio pharmacy facility in Thailand. Data was collected from 2018 – 2020. Tha gap time shown above was when the team was not be able access the facility.

These results suggested nuclear medicine department in these hospitals are safe in terms of internal exposure of the personnel. However, OAP recommended that the presence of the I-131 should be periodically re-assessed and the individual effective doses should be continually monitored to ensure occupational safety in the workplaces.

4. Conclusions and Acknowledgements

Results from this study be used for predictive assessment of possible radiation induced health effects to occupationally exposed medical radiation personnel. However, it is suggested that radiation protection principles based on direct thyroid measurement and aerosol measurement might be insufficient to monitor the absorbed dose estimation of the nuclear medicine personnel who are occupationally exposed to I-131. Additionally, their possible health risks could be influenced by other confounding factors. Therefore, direct assessments comparing physical and biological dosimetry on the larger sample size are required to accurately monitor and analyse occupational radiation exposure. This study was mainly supported by regular budget from Thai Government (2018–2022).

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