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Medical Imaging Student's Assessment on Radiation Protection in Clinical Training

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Abstract
This study evaluates pre- and post-clinical training radiation protection awareness and knowledge among medical imaging students. A cross-sectional study of 120 medical imaging students from Malaysian public universities was undertaken. The survey is based on the developed Healthcare Professional Knowledge of Radiation Protection (HPKRP) scale. There was a significant difference between the pre and post-clinical training students in their awareness of radiation protection but no difference in other radiological knowledge. Therefore, clinical training remained a fundamental component of medical imaging education for students to gain the skills and understanding of appropriate radiation protection procedures.

Keywords: Medical Imaging, Clinical Training, Radiation protection

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1.0 Introduction
Clinical training describes assisting students to acquire the required knowledge, skills and attitudes in practical settings, such as health service clinics, and fieldwork sites, to meet the standards defined by a university degree structure or professional accrediting or licensing board. Most professionally accredited university health and medical courses mandate the inclusion of clinical placement hours within the curricula (Ahpra, 2020). Clinical training in medical imaging involves students leaving the university and assisting actual examinations with educational guidance from qualified radiographers.

According to Kayembe & Bwanga, (2020), clinical training allows students to apply theoretical knowledge to practice while supervised by qualified radiographers. One of the major components of clinical training is the application of radiation protection and safety knowledge Kyei & Antwi (2015) before medical imaging students perform on their own, they seem to need to hear and observe to comprehend the professional connections to the material arrangements for each particular activity. This is mimetic learning, which is defined as an essential type of learning in practice that enables functioning in a particular location (Billet S., 2014). Moreover, according to the results by Lundvall et al., (2020), the students could not carry out procedures autonomously instead they watched the supervisors' actions which is a form of mimetic learning. It has been indicated that these instances were essential for the student's learning if the student and supervisor discussed that. However, it has been noted that radiographers often need more awareness of the dangers

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caused by X-ray exposure and the precautions that must be undertaken to minimize such hazards (Yurt et al., 2014). Such inappropriate practices could be adopted by medical imaging students.

Radiation protection protects people and the environment against the harmful effects of ionising radiation. The three fundamental concepts of radiation protection are the justification of practice, the optimisation of radiation protection, and the application of individual dose limits (Zekioğlu & Parlar, 2021). The primary objective of radiation protection is to provide clear and trustworthy guidance for working safely with ionising radiation while ensuring that deterministic effects are prevented, and stochastic effects are mitigated to the greatest extent feasible (Cho et al., 2018). In contrast, according to Zainuddin (2018), radiation protection in medical imaging aims to reduce radiation risks to a minimum for workers, patients, and the general public.

This is specifically related to healthcare providers' understanding of the adverse impact of radiation on human well-being. Proper acknowledgement allows healthcare professionals to do a risk-benefit analysis on their patients before performing a particular operation, shielding themselves and their patients from unnecessary radiation. International organizations, such as the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), the World Health Organization (WHO), and the European Commission (EC) have released numerous recommendations that recognize the importance of radiation protection education and training (Maharjan, 2017). The prime objective of the radiological protection system is to regulate and control ionising radiation exposures such that deterministic effects are avoided, and stochastic effects are minimised to the most significant degree possible (Cho et al., 2018). Luntsi et al. (2016) point out that it is critical that health professionals, especially radiographers, are informed of the potential hazards of radiation and the consequences of these threats in their field of work.

According to Luntsi & Ajikolo (2016), health professionals, especially radiographers, must be aware of the potential risks posed by radiation and how they may affect their line of work. Radiographers must acquire knowledge regarding radiation procedures and ensure the safety of both patients and radiation personnel as mentioned by (Yurt et al., 2014: Parsotam et al., 2020)

Radiation-safe practices are determined by the degree of radiation safety comprehension. Due to a lack of knowledge and understanding of the issue, all radiation-related activities will be dangerous and may have negative consequences (Sharma et al., 2016). Even though X-rays are used in minimally invasive procedures, radiation protection is becoming increasingly important as the use of radiation for radiological processes rises (Elamin, 2015; Jentzsch et al., 2015). Consequently, present and future. As a result, current and future radiographers must adhere to ALARA (As Low as Reasonably Achievable) concept; Due to the harmful effects of ionising radiation, it is essential to keep radiation doses and exposures as low as possible for workers, patients, and the general public (Botwe et al., 2015)

2.0 Literature Review

The International Commission on Radiological Protection (ICRP) announced three principal terms to delineate generic radiation protection principles: justification, optimisation, and dose limit (Crane & Abbott, 2016: Do, 2016). Dose restrictions are unsuitable due to the medical exposure of patients with specific conditions. These principles are key and complementary radiological safety tenets. DRL is the Commission's term for a form of investigation level used to aid in the optimisation of protection in the medical exposure of patients for diagnostic and interventional procedures (International Commission on Radiological Protection [ICRP], 2017).

In Malaysia, the Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010-P.U. (A) 46 address "Dose Limit and Dose Constrain" issues. (Atomic Energy Licensing Board, 2010). The dose restriction is in place to ensure that no employees, apprentices, students, or members of the public are exposed to practices exceeding the legal dose limit. In a calendar year, a worker's effective dose is limited to 20 millisieverts (mSv). Apprentices aged sixteen to eighteen years who are learning in areas of work that require radiation exposure, and also students aged sixteen to eighteen years who are presumed to be using radiation sources during their training, are subject to dose limits of 6 mSv effective dose per calendar year.

Many studies have reported that the majority of medical students and interns have limited knowledge about the risk of radiation and its protection, and radiation doses from commonly requested imaging modalities (Abrar, 2020). Faggioni et al., (2017) acknowledge that medical imaging students need a better knowledge of radiation protection compared to dentistry students. Some medical imaging students needed to be made aware of the monitoring device's significance in clinical settings, although most were aware of radiation protection (Makanjee et al., 2021).

Furthermore, since medical imaging students mimic radiographers' behaviours throughout clinical training (Kong et al., 2015), there are times when radiographers are not appropriate role models. According to Ahmed et al. (2015), radiographers' knowledge of radiation protection varies, with more than half having inadequate comprehension. General radiation protection training should commence with undergraduate courses and continue to apply up-to-date practices, as recommended by the radiation protection educational standards, which set the acceptable degree of knowledge expected of all health professionals in radiation protection.

In conjunction with medical imaging, medical and dentistry students study the fundamentals of radiology in their final year and practise clinical radio-diagnosis evaluation during their clinical training. Many medical and dental examinations depend solely on radiographic techniques such as radiography, CT scans, and fluoroscopes (Alhasan et al., 2016). The perception regarding radiation risk among health sciences students of different disciplines was low, as noted by (Samuel Wong et al., 2016).

A study done by Abrar (2020) concludes that knowledge and awareness of radiation doses among medical students and intern doctors in Saudi Arabia is still low and where only 41.4% ad prior education on ionizing radiation. However, the score is higher among intern doctors. The result showed that awareness and knowledge can be improved by experience in clinical training.

3.0 Methodology

3.1 Research design

A descriptive cross-sectional study was conducted on 120 undergraduate medical imaging full-time undergraduate students across three public universities. The samples consist of students, either with or without clinical training. Yet, students from other undergraduate study modes were excluded from this study. The participation invitation was distributed using participants were invited to participate in this study by distributing questionnaires using social media networks.

3.2 Research tool

A survey was performed using a questionnaire adapted from The Healthcare Professional Knowledge of Radiation Protection (HPKRP). This questionnaire is used to ensure safe radiation usage in clinical settings. This questionnaire is intended to assess the knowledge of healthcare professionals in radiation protection and the efficacy of radiation education. Additionally, the scale can determine how well medical imaging students comprehend radiation protection before and after training. The questionnaire was divided into four parts, one for demographic information and three for the HPKRP scale. The section covered were radiation physics, biology, and principles of radiation use (12 items), guidelines for safe ionising radiation use (9 items) and radiation protection (12 items). Respondents used a 10-point Likert scale to rate various areas of their radiation knowledge described in the items, from 1 (no knowledge) to 10 (full knowledge).

3.3 Statistical analysis

The data were analysed, Kolmogorov-Smirnov test and Levene's test were used to determine the conformity of numeric data to a normal distribution and homogeneity of variance, respectively, $P < 0.05$ was considered statistically significant for numeric data. Descriptive statistics assess the background data, which is then reported as percentages, means, and standard deviations. Next, an independent sample T-test was performed to compare the mean value score of pre-clinical and post-clinical training students.

4.0 Findings

4.1 Demographic characteristics

One hundred twenty students from different institutions responded to the study with 81.2% females and 18.8% males. Upon investigation, 45% of the respondents underwent clinical training while 55% were not. A total of 33 items in the questionnaire were grouped into three sections. Section 1 and Section 2 are based on knowledge of radiation physics, biology, and principles of radiation use and guidelines for safe ionising radiation use. In contrast, section 3 is an evaluation of awareness of radiation protection. The mean score was divided into three levels from 1.00 to 3.33 (weak knowledge), from 3.34 to 6.66 (moderate knowledge), and from 6.67 to 10 (excellent knowledge). The mean scores for the three sections of radiation protection knowledge ranged from 7.35 to 8.12 (Table 1). Radiation physics, biology, and principles of radiation use rated the highest mean score $\pm$SD, 8.12$\pm$1.19, followed by radiation protection $\pm$SD, 7.79$\pm$1.52 and guidelines for safe ionising radiation use $\pm$SD, 7.35$\pm$1.7.

Table 1: Mean and standard deviation of the three concepts of the HPKRP scale

Section	HPKRP-scale main factor	Mean	Standard deviation
1	Radiation physics, biology, and principles of radiation use	8.12	1.19
2	Guidelines for safe ionising radiation use	7.35	1.7
3	Radiation protection	7.79	1.52

Based on Table 2, awareness and knowledge for pre-clinical training students answering three sections of question were 38.7% have excellent knowledge while 61.7% are moderate knowledge. In contrast, 85% of post-clinical students have excellent knowledge while 15% got moderate knowledge.

Table 2: Level of knowledge for pre and post-clinical training students.

Category	Knowledge	Frequency	Percentage
Students with clinical training experience	Moderate	9	15

	Excellent	51	85
Students with no clinical training experience	Moderate	23	61.7
	Excellent	37	38.7

4.2 Evaluation of knowledge of radiation protection among pre and post-clinical training medical imaging students

Section three was a section to evaluate knowledge of radiation protection among pre and post-clinical training medical imaging students. A total score was tested using the independent t-test, where data was run with a 95% confidence interval (CI) for the mean difference. As presented in Table 3 the mean score for this section was statistically significant differences between pre and post-clinical training students (6.92 ± 1.57 versus 8.34 ± 1.05) for, ($t(120) = -5.85$, $p = 0.002 < .5$). Consequently, we reject the null hypothesis since P-value < 0.05.

Table 3: The mean and standard deviation in Section 3 (radiation protection)

Variables	Pre-clinical (n = 60)	Post-Clinical (n = 60)	Mean diff (95% CI)	t-stats (df)	P value
	6.92 (1.57)	8.34 (1.05)	-1.43 (-1.91,-.94)	-5.85 (102.6)	.002

Next, evaluation of the pre-clinical and post-clinical training students for their knowledge of radiation physics, biology and principles of radiation use and guidelines of safe ionising radiation use, total score was tested using the independent t-test, where data was run with a 95% confidence interval (CI) for the mean difference. The test revealed that this section scores were not statistically significantly different in the medical imaging students that did not have clinical training experience with a mean 7.11±1.24, in contrast to the medical imaging students that have clinical training experience 8.19±1.01 ($t(120) = -5.28$, $p = 0.141 > .5$). The 95% confidence interval of the difference between means ranged from [-1.5 to -.67] and did indicate there is no differences between the means of the sample. Thus, we accept the null hypothesis since the P-value is >.141.

Table 4. The mean and standard deviation in sections 1 and 2

Variables	Pre-clinical (n = 60)	Post-Clinical (n = 60)	Mean diff (95% CI)	t-stats (df)	P value
	7.11 (1.24)	8.19 (1.01)	-1.09 (-1.5,-.67)	-5.85 (118)	.141

5.0 Discussion

This study evaluated the awareness and knowledge of radiation protection among pre and post-clinical training medical imaging students. This study compared awareness and knowledge of three aspects of radiation protection. Throughout the evaluation, respondents achieved an excellent and moderate knowledge level of radiation protection. Despite this, students who had received clinical training were statistically more aware and knowledgeable in all aspects of radiation protection than those who had not.

The findings also revealed a significant difference in sections one and two between medical imaging students who experience clinical training and those who had not. Post-clinical training medical imaging students scored higher compared to pre-clinical training students. Presumably, this is related to the idea that clinical internships are one of the most crucial aspects of students' professional and personal growth during their university education in health sciences (Borrallo-Riego et al., 2021). According to Abad & Kronenburg (2020), internships assist students in identifying and acquiring new information and abilities while working in a clinical setting. It also increases the knowledge level, indicating that further training is advantageous. Supported by the study done by Khan et al. (2018) found that over 95% of healthcare professionals were aware of the need for radiation protection, with 61.8% of them stating that they learnt about it during their training sessions (Khan et al., 2018).

This study also showed that awareness of radiation protection between pre and post-clinical training students is statistically significant due to the experience that the students gained during a lengthy clinical posting in various hospitals and diagnostic centres, a competent radiographer is responsible for overseeing the student to ensure that relevant clinical skills and knowledge are conveyed to the students. As a result, they consistently implement their institution's established radiation protection rules. Parallel with the finding by Fayez (2020) that increasing early knowledge of medical students on radiation exposure in diagnostic acumens may improve the performance of late-year students regarding radiation dose and exposure.

While evaluating section one and two, which consists of radiation physics, biology, and principles of radiation use as well as guidelines of safe ionising radiation use concepts, it shows there is no statistically significant difference due to the syllabus of radiation protection being instilled in medical imaging students since early of studies. A supported study by Enabulele & Igbinedion (2013) regarding dentistry students' knowledge and practice of radiation protection, where the students had an outstanding comprehension of radiation biology. However, they also needed more knowledge about radiation protection in early studies. Regardless of their level of radiation protection knowledge, their practice was of high quality. This evaluation is in line with Behal (2016) observations from dental undergraduates and interns' perceptions of radiation protection safety protocols, which conclusively proved that only a tiny percentage of participants are well-versed about the protocols, with interns being the utmost well-informed, followed by the fourth year, and third-year dental students.

A study done by Partap et al. (2019) states there is a substantial difference in the degree of knowledge gained by people who've had or have not undergone formal training in the handling of ionising radiation equipment. Yunus et al. (2015) discovered that medical support staff training courses may result in noticeable advances in their competence. According to the data, the overall post-test results were higher than the pre-test scores. Besides, the average radiation safety knowledge score was seemingly more significant than the average general knowledge score.

This study also found that comparing pre and post-clinical training medical imaging students' percentages show higher frequency in students with clinical experience. Based on demographic data, post-clinical students' third- and fourth-year study implies the student's understanding of radiation protection would increase remarkably as the year of study progresses. The same conclusion was reached by Awadghanem et al. (2020) & Abuhadi (2019). As medical imaging students went through their undergraduate years, their levels of expertise in diagnostic radiology increased. Gumrukcuoglu (2016) determined that second-year medical imaging students have sufficient knowledge of radiation compared to first-year students since second-year students get more comprehensive training in clinical settings for a theoretical application.

Even though medical imaging students with clinical training have better-perceived knowledge and awareness than those without clinical training, most of the students in this research have a sufficient understanding of radiation protection concepts. It is critical to realise that radiation safety awareness and knowledge are built on the foundations of education and training (Vassileva & Mihaylova, 2014). According to Tsubokura et al. (2018), knowledge of radiation education may assist students in improving their attitudes and behaviours regarding radiation. On the other hand, it also stated that education and training on ionising radiation might reduce radiation doses, increase the use of radiation protection apparatus, and ensure compliance with the principles of radiation safety.

Everyone engaged in the medical use of ionising radiation must be familiar with the necessary safety precautions. Consequently, any radiation exposure's detrimental effects will be reduced to a bare minimum. According to a social interaction perspective, collaborative learning of clinical skills mediates its effects through social interaction, motivation, accountability and positive interdependence between learners. Motor skills learning theory suggests that positive effects rely on observational learning and action imitation, and negative effects may include decreased hands-on experiences (Tolsgaard et al., 2015). Specific updated undergraduate study programs include information concerning radiation safety and incorporate the minimum knowledge each student must have before working with ionising radiation (Abuzaid et al., 2018). Therefore, students must use appropriate radiation protection or safety standards after learning the knowledge throughout their studies.

Furthermore, students should be able to apply their educational and clinical training skills to execute excellent radiographic exams while exposing the patient and themselves to the least amount of radiation. Specified updated undergraduate study plans address radiation protection knowledge, covering the minimum required knowledge that each student should have before using ionising radiation (Abuzaid et al., 2018). As a result, after gaining this information during their studies, students must apply the proper radiation protection or radiation safety standards.

6.0 Conclusion & Recommendations

The awareness and knowledge of radiation protection among post-clinical training students were higher than among the pre-clinical training students. Demographic background, namely the student's education level and year of study, significantly affects the awareness and knowledge of radiation protection. Nonetheless, the overall awareness and knowledge regarding radiation protection among all the respondents were adequate. Clinical training is still important in the radiography curriculum (Cunningham et al., 2015; England et al., 2017). Clinical training placement is both theoretical and practical where students will be offered clear opportunities to explore, analyse, and expand on their academic learning methodically. They provide for integrating theory and practice and the student's proper and successful integration into the multidisciplinary health care team. These findings suggest that a thorough education programme is required to minimise unnecessary personnel and patient exposure. Additional radiation safety courses would assist students in gaining a better grasp of the topic and correcting any misunderstandings. Future studies should assess the same students for pre and post-clinical rather than use different persons as a respondent to increase effectiveness in answering the question.

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Paper Contribution to Related Field of Study

The results of this study would be valuable in evaluating awareness and knowledge among medical imaging students. The outcomes of this study would be helpful for the universities to plan an intensive radiation protection course in the department.

References

Ahpra . Accreditation Ahpra website: Ahpra. (2020). Available at: https://www.ahpra.gov.au/Accreditation.aspx.

Abrar A. M. (2020) Medical students' and intern doctors' awareness of ionizing radiation exposure doses during common radiological procedures: a cross-sectional study from Saudi Arabia. International Journal of Medicine in Developing Countries. doi: 10.24911/IJMDC.51-1541026632

Alhasan, M., Abdelrahman, M., Alewaidat, H., & Khader, Y. (2016, April 1). Radiation dose awareness of radiologic technologists in major Jordanian hospitals. Internatuinal Journal of Radiation Research, 14(2), 133–138. https://doi.org/10.18869/acadpub.ijrr.14.2.133.

Ahmed, R. M., Elamin, A. M. T., Elsamani, M., Wisal, B., & Hassan, W. (2015). Knowledge and performance of radiographers towards radiation protection, Taif, Saudi Arabia. IOSR J Dent Med Sci, 14(3), 63e8. doi:10.9790/0853-14326368

Annals of International Commission on Radiological Protection (ICRP Publication 135) Icrp.org. https://www.icrp.org/publication.asp?id=ICRP%20Publication%20135

Borrallo-Riego, L., Magni, E., Jiménez-Álvarez, J. A., Fernández-Rodríguez, V., & Guerra-Martín, M. D. (2021, April 21). Health Sciences Students' Perceptions of the Role of the Supervisor in Clinical Placements. International Journal of Environmental Research and Public Health, 18(9), 4427. https://doi.org/10.3390/ijerph18094427

Botwe, B. O., Antwi, W. K., Adesi, K. K., Anim-Sampong, S., Dennis, A. M., Sarkodie, B. D., & Opoku, S. Y. (2015). Personal radiation monitoring of occupationally exposed radiographers in the biggest tertiary referral hospital in Ghana. Safety in Health, 1(1), 1-7.doi:10.1186/s40886-015-0009-y

Cho, K. W., Cantone, M. C., Kurihara-Saio, C., Le Guen, B., Martinez, N., Oughton, D., ... & ZöLzer, F. (2018). ICRP Publication 138: ethical foundations of the system of radiological protection. Annals of the ICRP, 47(1), 1-65. doi 10.1177/0146645317746010.

Crane, G. D., & Abbott, P. V. (2016). Radiation shielding in dentistry: an update. Australian dental journal, 61(3), 277-281. doi:10.1111/adj.12389

Do, K. H. (2016). General principles of radiation protection in fields of diagnostic medical exposure. Journal of Korean medical science, 31(Suppl 1), S6. doi:10.3346/jkms.2016.31.S1.S6

Faggioni, L., Paolicchi, F., Bastiani, L., Guido, D., & Caramella, D. (2017, January). Awareness of radiation protection and dose levels of imaging procedures among medical students, radiography students, and radiology residents at an academic hospital: Results of a comprehensive survey. European Journal of Radiology, 86, 135–142. https://doi.org/10.1016/j.ejrad.2016.10.033

Fayez Saud Alreshidi (2020). The Familiarity of Medical Students at Clinical Years about the Influence of Ionizing Radiations Doses. International Journal of Medical Research & Health Sciences, 2020, 9(5): 39-45

Kayembe, R. M., & Bwanga, O. (2020). A study to explore the knowledge, attitudes, and practices of student radiographers regarding feedback on clinical performance in Zambia. South African Radiographer, 58(1), 8-14. Retrieved from https://sar.org.za

Kyei K. A. & Antwi W. K.(2015). Effect of Clinical Placement; the Radiography Student in Ghana. Clinical Medicine Research, 4(3), 14. https://doi.org/10.11648/j.cmr.s.2015040301.14

Luntsi, G., Ajikolo, A. B., Flaviuos, N. B., Nelson, L., Nwobi, C., Hassan, J. M., & Malgwi, F. A. (2016). Assessment of knowledge and attitude of nurses towards ionising radiation during theatre/ward radiography. J Nurs Care, 5(3), 342-5. doi:10.4172/2167-1168.1000342

Makanjee, C. R., Lipscombe, E., Haniz, A. N., & Cho, Y. S. (2021). Students' and Qualified Radiographers' Perspectives and Understanding on Occupational Dose Monitoring and Prevention Strategies. Health Physics, 121(2), 166-173. doi:10.1097/HP.0000000000001427

Parsotam, H., Warren-Forward, H., Shields, M., McNulty, J., Shaw Bonilha, H., O'Toole, C., Mathisen, B., Unicomb, R., Hearne, A., & Pownall, S. (2020, November). Are radiographers an influencing factor in the radiation protection practices of speech-language therapists performing videofluoroscopic swallowing studies? Radiography, 26(4), e229–e237. https://doi.org/10.1016/j.radi.2020.03.003

Partap, A., Raghunanan, R., White, K., & Seepaul, T. (2019). Knowledge and practice of radiation safety among health professionals in Trinidad. SAGE open medicine, 7, 2050312119848240. doi:10.1177/2050312119848240

Samuel Wong . (2016, December). Knowledge And Perception On Radiation Among Medical Students In A Malaysian Public University. https://remcp.hirosaki-u.ac.jp.

Tolsgaard, M. G., Kulasegaram, K. M., & Ringsted, C. V. (2015). Collaborative learning of clinical skills in health professions education: the why, how, when and for whom. Medical Education, 50(1), 69–78. https://doi.org/10.1111/medu.12814

Vassileva, J., & Mihaylova, H. (2014). Radiation Protection Training for Dental Students – Experience in Bulgaria. Journal of Medical and Dental Practice, 1(2), 76–79. doi:10.18044/medinform.201412.76

Yunus, N. A., Abdullah, M. H. R. O., Said, M. A., & Ch'ng, P. E. (2014, November). Assessment of radiation safety awareness among nuclear medicine nurses: a pilot study. In Journal of Physics: Conference Series (Vol. 546, No. 1, p. 012015). IOP Publishing. doi:10.1088/1742-6596/546/1/012015

Yurt, A., Çavuşoğlu, B., & Günay, T. (2014, June 5). Evaluation of Awareness on Radiation Protection and Knowledge About Radiological Examinations in Healthcare Professionals Who Use Ionised Radiation at Work. Malecular Imaging and Radionuclide Therapy, 22(2), 48–53. https://doi.org/10.4274/mirt.00719

Zainuddin, Z. I. (2018, December 30). Towards Holistic Radiation Protection | International Journal Of Allied Health Sciences. Towards Holistic Radiation Protection | International Journal of Allied Health Sciences. https://journals.iium.edu.my/ijahs/index.php/IJAHS/article/view/102

Zekioğlu, A., & Parlar, U. (2021, December). Investigation of awareness level concerning radiation safety among healthcare professionals who work in a radiation enviroment