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Assessment Awareness and Knowledge of Apron to Protect Radiographer During Radiographic Examination

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Abstract

Aims: Empowering radiation workers with enhanced awareness and knowledge to effectively manage and minimise the risk of radiation exposure. The aim was to determine the level of awareness and knowledge of radiographers about aprons as personal protective equipment from radiation exposure during radiographic examinations.

Methodology: The research study employed a research method that involved 26 respondents who were radiographers. The objective of the study was to assess the level of awareness and knowledge regarding the apron. This assessment was done by analysing the results of both pre-test and post-test examinations, then statistical analysis was carried out using a paired sample t-test to determine the increase in awareness and knowledge after providing learning and practical materials with a p-value < 0.05.

Results: The research results showed that the awareness and knowledge of aprons had an average pre-test percentage score of 50% before providing material and practice on aprons, whereas after providing material and practice on aprons, the average post-test percentage value increased by 95%. Furthermore, the results of the paired sample t-test showed that there was an increase in radiographers' awareness and knowledge about aprons with a p-value <0.001.

Conclusion: Assessing the awareness and knowledge of radiographers through the distribution of questionnaires is an initial means of identifying areas for improvement within the radiology department. This allows for the implementation of training programs or courses aimed at enhancing awareness and understanding of aprons and the significance of radiation protection in the field of diagnostic radiology.

Keywords: Radiation Protection, Radiation Safety, Radiation Worker, Radiology Diagnostic.

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Introduction

Radiation workers in the radiology department, including a radiographer, must be mindful of minimising radiation doses during radiographic examinations. One way is to ensure that personal protective equipment that can be used and protect against radiation during radiographic examinations [1]. Aprons are personal protective equipment made

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from lead that is used to protect the body from the risk of increased radiation exposure during radiographic examinations, which in practice are often used by radiation workers in interventional radiology units [2].

Radiation exposure can increase the risk of cancer. Therefore, radiographers are obliged to implement radiation protection efforts by using an apron based on lead material which has a very high level of electron density so that it can absorb radiation [3]. Based on International Commission on Radiation Protection (ICRP) No. 105, provides the same dose limit value for radiation workers, namely not exceeding 20 mSv/year. It should be noted that radiographic examinations use a low radiation energy range of 40-120 keV, however, the risk of radiation exposure can still occur due to improper installation or use when carrying out radiographic examinations [4–7].

Research Problem

Based on one of the results of a survey on radiation protection, it was found that many radiation workers do not have the amount of radiation exposure they receive during work, this indicates that the level of awareness and understanding among radiation workers regarding radiation protection measures remains inadequate [8]. Radiation safety is mandatory for all people who use radiation sources for medical imaging, to increase the awareness for the public and other workers in the area around the source. Meanwhile, the knowledge of radiation safety ensures that the risk of radiation harm is not greater than the benefits of medical imaging [9,10].

Research Focus

The awareness and knowledge provide benefits in controlling the risk of radiation exposure for oneself [11]. However, radiographers need to carry out radiation protection efforts properly and correctly because there are differences between theory and practical application in hospitals regarding the implementation of radiation safety. Therefore, the role of educational institutions has a responsibility to implement basic radiation protection to create radiographers who prioritise radiation safety [12].

In Indonesia, radiation safety for use in the medical field is regulated in the Nuclear Energy Regulatory Agency of Indonesia regulation No. 4, 2020 concerning radiation safety for the use of X-ray equipment in diagnostic and interventional radiology. It should be noted that this regulation is a development of regulation No. 8, 2011. This regulation contains guidelines for implementing radiation protection and safety culture to protect patients, workers, society, and the environment from radiation hazards [13]. Therefore, the lack of awareness and knowledge about aprons can increase the risk of radiation hazards. In addition, work experience alone does not guarantee an increase in knowledge and awareness of radiation safety [9,14]. So, it is necessary to assess the awareness and knowledge about aprons for radiographers as a form of practical effort to reduce the risk of radiation exposure during radiographic examinations.

Research Aim and Research Questions

The research aimed to determine the level of awareness and knowledge of radiographers about aprons as personal protective equipment from radiation exposure during radiographic examinations.

Research Questions

1. What is the percentage of pre and post-test results regarding radiographers' awareness and knowledge of the apron?
2. Is there an increase in the level of radiographers' awareness and knowledge of aprons after providing learning and practice concerning aprons?

Research Methodology

General Background

The research method employed in this study is a descriptive-analytical approach, involving the distribution of questionnaires to radiographers to gauge their level of awareness and knowledge concerning the use of aprons as a protective tool used during radiographic examinations by providing learning and practical material. This research was conducted on radiographer respondents with the research time between August – October 2023.

The data collection process involved utilising a Google form questionnaire where respondents were required to input the initial data characteristics in the first section: name, gender, work experience. The second part was a questionnaire about apron level awareness and knowledge by giving pre-test and post-test questions, the results were converted into a percentage value by dividing the total value by the maximum value multiplied by one hundred. Furthermore, the results of the percentage of awareness and knowledge were categorised into <60%: bad, 60-75%: moderate, >75: good [15].

Data Analysis

Statistical analysis used SPSS 28 with pre-existing data coding. After that, the data was processed using descriptive statistics to find out the characteristics of the data, namely the percentage, average, and standard deviation. Then to found out the increase in radiographers' awareness and knowledge about the apron after following the learning and practice with a p-value <0.05.

Research Results

From the results of research conducted on radiographer respondents, there were 26 respondents with the characteristics of the respondent data shown in Table 1. The percentage of radiographer respondents with gender data: 62% male, and 38% female. Work experience: < 2 years 4%, 2-5 years 8%, > 5 years 23, > 10 years 65%.

Table 1. Data characteristics

Data characteristics	n	Percentage (%)
Gender		
Man	16	62
Women	10	38
Work experience		
< 2 years	1	4
2-5 years	2	8
> 5 years	6	23
> 10 years	17	65

In Table 2, the questions given to radiographers to test the radiographer's level of awareness and knowledge about aprons are presented, consisting of questions 1 to 6 covering awareness of the use of aprons, while 7 to 12 are knowledge about radiation safety in radiographic examinations. This question is based on the results of a literature review and clinical practice of using aprons in radiographic examinations. Before giving the questionnaire to the radiographer, the researcher discussed with the clinical radiographer to ensure that the questions asked were within the radiographer's competence in carrying out radiation safety. This shows that radiographers' awareness and knowledge about aprons is an indicator of quality assurance of radiology services[16].

Table 2. Percentage of apron awareness and knowledge among radiographers

Question	Answer	Percentage (%)	
		Pre-test	Post-test
Is the photoelectric effect influenced by high-energy photons?	No	8	96
Is the Compton effect affected by high-energy photons?	No	12	92
Is an apron a radiation protection device?	Yes	100	100
Does the size of the irradiation field affect the permeability of the apron?	No	38	92
Is the frequency of apron testing done once a year?	Yes	73	100
Is the apron test evaluation carried out by visual observation?	Yes	70	100
Are patient dose-limiting values replaced with diagnostic reference levels?	Yes	61	96
Are radiation workers' doses limited for each radiographic examination procedure?	Yes	57	92
What is the limiting dose of 1 mSv/year for society?	Yes	85	100
Is the dose limitation 25 mSv/year for radiation workers?	No	38	88
Do a head CT scan and contrast fluoroscopy have a very low risk of cancer?	Yes	15	100
Does radiographic examination of the chest, and extremities have a negligible risk of cancer?	Yes	38	88
Mean ± standard deviation		50 ± 29.7	95 ± 4.8

Table 2 shows the results of the awareness and knowledge pre-test questionnaire before learning and practice are given, and the post-test after practical learning. The pre-test percentage score is 50%, which is included in the low criteria, while the average post-test percentage score is 95%, which is included in the good criteria. Then, from the paired sample t-test, the p-value <0.001 shows that there has been an increase in radiographers' awareness and knowledge about aprons.

Discussion

The research findings indicated that radiographers' awareness and understanding of the apron remained inadequate, as evidenced by the results of the pre-test questionnaire, 50% of which felt into the bad criteria. These results indicated that aprons had not yet been effectively used for radiation protection. The same problem was also found in several studies regarding radiation workers' awareness and knowledge of radiation protection, with many radiation workers still ignoring radiation safety [17–19]. So, the solution obtained from the results of this research was the need for collaboration between the radiology department and academics in designing training or courses in order to increase awareness and knowledge about radiation safety in the radiology department [20]. It must be noted that from the results of this research, there was an increase in the awareness and knowledge after providing learning and training with a post-test percentage of 95% falling into good criteria. The same results were also found by Hobbs' research, that there was a significant difference in the pre and post-tests after learning and training on understanding radiation safety to radiation workers [21].

Apart from that, research with radiographer respondents is still rarely conducted compared to medical students and professional doctors. Awareness and knowledge of radiation protection are crucial for radiographers as they directly impact worker safety regarding radiation, as radiographers who carry out radiological examination procedures use ionizing radiation. Meanwhile, doctors are concerned with patient safety during radiographic examination procedures. However, it is necessary to underline this explanation for conventional radiography examinations, computed radiography, or digital radiography in diagnostic radiology procedures. According to Jafri, the level of awareness and knowledge greatly influences the implementation of a radiation safety culture, one of which is understanding the apron: type of material, thickness, and correct way of using and storing it [22]. An apron is radiation protection equipment made from lead that is used to protect radiation workers from the risk of increased radiation exposure during radiographic examinations because lead material can absorb primary and secondary exposure. Apart from that, the use of aprons is not influenced by the shape and size. According to Irsal's research, there is no evidence to suggest that the size of the field area affects the penetrating power of radiation when it passes through an apron [23].

The awareness and knowledge about apron quality control is still low <75% with moderate criteria in questions 4 to 6 in this study, this shows that radiographers in the radiology department ignore the apron quality control tests. In addition, the apron test procedure uses a fluoroscopy tool, so it is often not carried out [24]. The apron quality control test procedure is carried out once a year to ensure the apron minimises radiation exposure by ensuring the condition of the apron can still be used without experiencing cracks, irregularities, and leaks, as well as ensuring that the Pb material is in the same condition when purchasing or accepting the apron [25]. Then, several research reports explain a simple apron quality control test using computed radiography with pixel value ratio analysis, because there is a linear relationship between pixel value and radiation exposure [26, 27]. Then you can evaluate the apron by dividing the apron into 4 quadrants: the top on the right and left, the bottom the same, and after that, a visual evaluation is carried out on the quadrants of the apron that are considered to have cracks or leaks [28].

The results of this research also showed that radiation workers have not carried out optimal radiation protection efforts, even though they were aware of the risks they will experience. Apart from that, in clinical practice, it has been found that the work experience did not guarantee that radiation workers carry out radiation protection efforts [29,30]. Therefore, training and courses on radiation protection are needed, as one report shows that after providing training and courses, the awareness and knowledge about radiation protection will increase significantly and it is hoped that this can be applied when carrying out radiographic examinations [31].

The limitation of this study is that the number of respondents is minimal, so the information used may not show actual data at the hospital. In addition, the questions used must be adapted to the practical conditions when using aprons in hospitals. Hence, it is advisable to consult the radiation workers at the hospital to better understand the current conditions before posing any inquiries, so that you can develop questions according to research needs.

Conclusions and Implications

Administering questionnaires to assess radiographers' awareness and knowledge is an early detection method so that the radiology department can plan training or courses to increase the awareness and knowledge about aprons and radiation protection efforts in diagnostic radiology. Implementing radiation protection and safety can be effectuated by continuously ensuring that workers have implemented radiation protection and safety procedures for themselves and patients, monitoring the level of individual radiation exposure of radiation workers using personal

dosimeters, and measuring exposure in the supervision and control area. Then ensure that radiation workers carry out regular health checks overnight for workers in radiology, this is done to improve radiation safety and reduce the risk of health problems that may occur due to radiation exposure, as well as conducting studies of the latest methods or practices regarding the application of radiation protection and safety issued by government agencies and international institutions, this can help in identifying areas that need improvement or that need to be improved. Then, to ensure that radiation workers can continuously implement radiation protection and safety efforts, there is a need for participation between medical physicists and radiation protection officers in supervising their implementation. In diagnostic radiology services, the duties and responsibilities of medical physicists participate in continuously reviewing the existence of human resources, equipment, procedures, and radiation protection equipment, while the duties and responsibilities of radiation protection officers are monitoring the implementation of radiation protection and safety programs, as well as identifying the needs, and coordinating radiation protection and safety training. Apart from that, several problems that need to be focused on in radiation protection and safety are a lack of awareness and knowledge, a lack of understanding of safety procedures for each worker, and limited human resources in the use of modern equipment and the implementation of training or courses. Therefore, an effective scenario involving all related parties including hospital management, the radiology department, and stakeholders is needed.

Declarations

Author contributions

All authors have sufficiently contributed to the study and agreed with the results and conclusions.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Data sharing statement

Data supporting the findings and conclusions are available upon request from the corresponding author.

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