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Research paper

A Study on the Recognition of Students in Radiology on the Reorganization of Safety Management System by Nuclear Safety Act

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Abstract

Background/Objectives: The study developed a radiation dose measurement program in the radiology laboratory to measure how much exposure the students are exposed to during the radiology class, to request for the improvement and the revision of the current Nuclear Safety Act.
Methods/Statistical analysis: The experimental program is shown in the following figure, and experiments were conducted to determine the degree of radiation exposure in the control room with a lead gown at a distance of 1m, 2m, and 1m, and in a control room with a radiographic lead glass wall. The duration of the experiment was 3 months from April to June, when radiation imaging practice classes were conducted, and 128 hours of imaging practice per month were conducted.
Findings: In order to find out the dose of radiation dose during radiology imaging practice class, the experiment was carried out from April to June for 3 months, and according to the program, the results of exposure dose were 0.34mSv at 1m distance, 0.01mSv at shielding of lead gown at 1m distance, 0.16mSv at 2m distance, and 0.01mSv at control room with radiation lead glass wall. The exposure dose from the test results was much below the annual general public limit dose of 1mSv.
Improvements/Applications: The restriction on the operation of the radiation equipment in the practice of the students is a regulation that infringes the right of students to learn, and amendments or exemptions of Nuclear Safety Act should be enacted to ensure that it does not violate the fundamental right to learn for students in radiology.

Keywords: *Radiation safety management, Nuclear power, Learning rights, Radiation management area, Radiation exposure.*

1. Introduction

The research, development, and use of nuclear energy in Korea has developed rapidly over the years. Particularly, along with the development of industries, the use of radioisotopes has been increasing day by day, and their use has also diversified[1,2]. Especially the field of medicine has contributed greatly to the improvement of public health through the diagnosis and cancer treatment using radiation. However, the need for the Nuclear Safety Act, which presents various regulations and standards related to nuclear power, has been increasing due to the shocks caused by the nuclear accidents of Chernobyl and Fukushima and the social issues affecting nuclear safety recently[3-5].

The Nuclear Safety Commission revised the Nuclear Safety Act in April 2016, reflecting the need to improve the safety management system for people with frequent access to the radiation management area, which strengthened the safety management system for person with frequent access, such as radiation safety management education, health checkup, and radiation dose record keeping[6-8]. In addition, the students who participate in the practical training classes in Department of Radiology of the Universities around Korea were classified as persons with frequent access of the Nuclear Safety Act and was made to follow the revised safety management system[9,10]. Therefore, for radiology students, in order to carry out the photography exercise training, time and cost were additionally incurred by newly performing radiation safety management education, medical examination, radiation dose recording, and in addition, due to the Nuclear Safety Act person with frequent access classification, the students have been severely restricted in the use of the radiation generator[11,12].

The Nuclear Safety Act, which was amended to promote public safety from radiation, turned out that it infringes right to learn, which is the fundamental right of the people and it has been applied very unreasonably to students. Therefore, it is necessary to revise the current Nuclear Safety Act in order to guarantee legitimate learning rights to students of radiology around the nation. In addition, when reviewing the individual radiation dose records of radiology students after the revision of the Nuclear Safety Act in 2016, none of the students exceeded 1 mSv per year, which corresponds to the radiation dose limit of the general public, and this is a wrong revision of the Nuclear Safety Act applied to students without any consideration of the situation in the radiology and practice rooms[13,14]. Therefore, the study investigated the influence of the person with frequent access system applied during the two years since the revision of the Nuclear Safety Act on the subjects of learning rights, the students of radiology around the nation, explored the improvements needed, and developed a radiation dose measurement program for radiology and imaging laboratories to study much exposure to radiation the students participating in practical training are exposed to radiation, so that it is possible to request revision of the current Nuclear Safety Act to improve learning efficiency based

on the results.

The specific objectives of the study are as follows.

First, the study aimed to explore the perception of students after person with frequent access system was applied through the Nuclear Safety Act amendment, and study how to improve the violation of students' right of learning due to the reorganization of the person with frequent access safety management system, safeguard against radiation exposure, and improve the learning efficiency of radiography training.

Secondly, the study developed a radiation dose measurement program in the radiology laboratory to measure how much exposure the students are exposed to during the radiology class, to request for the improvement and the revision of the current Nuclear Safety Act.

2. Materials and Methods

2.1. Survey and Analysis

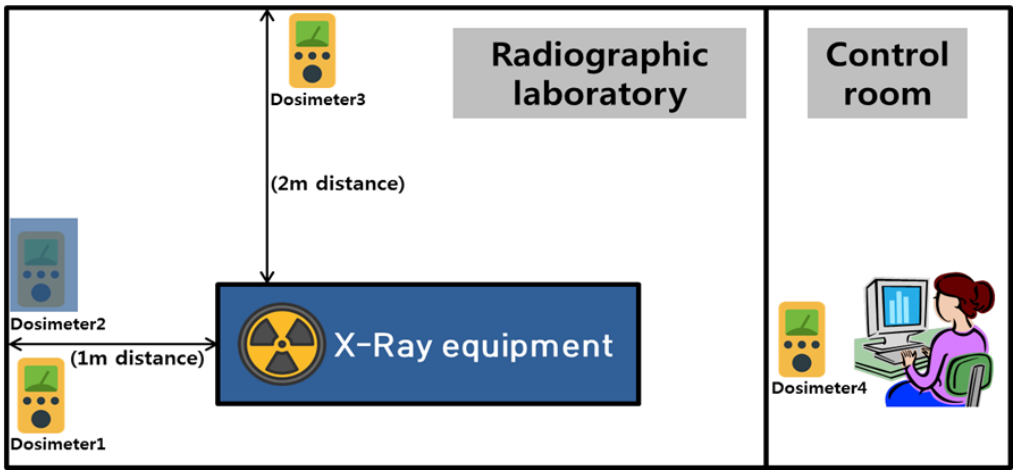
A questionnaire survey was conducted on the awareness of the person with frequent access safety management system according to the Nuclear Safety Act reorganization for 209 students at Gimcheon University radiology department, and the analytical method was to conduct a written survey on questionnaires of radiologists and students, and for accurate data analysis, the significance level of all analyzes was set to 5% using the SPSS version 18.0 statistical program, and univariate and multivariate analyzes were performed.

This study was supported by research grant from Gimcheon University and was approved by the Bioethics Committee of Gimcheon University after reviewing the research proposal and questionnaire. In addition, the participants were informed when preparing the questionnaires, and it was explained that the collected data were not used for purposes other than research and that anonymity was guaranteed.

2.2. Radiation Dose Measurement Experiment

The research program was developed to study the radiation dose measurement for the students who participated in radiation dose measurement and imaging practice training in radiology and imaging laboratory. Through this, the study explored how much the students are exposed to the risk of the dangers of radiation through the dose radiation leakage during imaging practice lessons.

The experimental program is shown in the following figure, and experiments were conducted to determine the degree of radiation exposure in the control room with a lead gown at a distance of 1m, 2m, and 1m, and in a control room with a radiographic lead glass wall. The duration of the experiment was 3 months from April to June, when radiation imaging practice classes were conducted, and 128 hours of imaging practice per month were conducted.



- **Dosimeter 1: Installed at 1m distance from radiographic imaging device**
- **Dosimeter 2: Shielded with lead gown after installation at 1m distance from radiographic imaging device**
- **Dosimeter 3: Installed at 2 m distance from radiographic imaging device**
- **Dosimeter 4: Installed in control room behind radiation shielding wall**

Figure 1: Design of the radiation dose measurement

3. Results and Discussion

2.1. General Characteristics of Subjects

Gimcheon University Radiology Department students were surveyed. A total of 209 radiology students participated in the survey with 54 students in the first year, 66 students in the second year, 37 students in the third year, 53 students in the fourth year. At present, there are 155 students in years 2, 3, and 4 were in radiation imaging practice classes, and 54 students in the first year did not take radiation imaging practice classes. The general characteristics of the subjects surveyed are shown in the following table 1.

Table 1: General characteristics of subjects

Unit: person (%)

Division		Male	Female	Total
Age	Under 20	36(17.3)	14(6.7)	50(23.9)
	20 ~ 21	17(8.1)	33(15.8)	50(23.9)
	22 ~ 23	62(29.7)	13(6.2)	72(35.9)
	Over 24	31(14.8)	3(1.5)	34(16.3)
University year	Freshman	41(19.6)	13(6.2)	54(25.8)
	Sophomore	49(23.4)	16(7.7)	65(31.1)
	Junior	23(11.0)	14(6.7)	37(17.7)
	Senior	33(15.8)	20(9.6)	53(25.4)

Current imaging practice participation	No	41(19.6)	13(6.2)	54(25.8)
	Yes	105(50.3)	50(23.9)	155(74.2)
Total		146(69.9)	63(30.1)	209(100)

2.2. Recognition of the Application of the Person with Frequent Access System

The students' perception was examined for the person with frequent access system that was applied according to the revised Nuclear Safety Act. Questions about the necessity of person with frequent access system were first year 48.1% and second year 89.2%, 73.0% third year and 88.7% fourth year students. When asked about the necessity of health screening, 55.6% of the 1st year, 96.9% of the 2nd year, 89.2% of the 3rd year, and 2.5% of the 4th year students responded positively. In the question about the necessity of radiation safety education, 77.8% of 1st year, 100% of 2nd year, 97.3% of 3rd year and 96.2% of 4th year students answered positively, and for question on the necessity of personal exposure dose management 63.0% in 1st year, 96.9% in 2nd year, 86.4% in 3rd year and 94.3% in 4th year students answered positively in table 2. In the questions about necessity, 1st year students who do not participate in practical training showed the lowest positive response, and 2nd year students who participate most in training showed the highest positive response.

Table 2: Recognition of the application of the person with frequent access system

Unit: person (%)

Distinction		Freshman	Sophomore	Junior	Senior	p-value
Necessity of person with frequent access system	yes	26(48.1)	58(89.2)	27(73.0)	46(86.8)	0.14
	no	28(51.9)	9(10.8)	10(27.0)	7(13.2)	
Necessity of health screening	yes	30(55.6)	63(96.9)	33(89.2)	49(92.5)	0.02
	no	24(44.4)	2(3.1)	4(10.8)	4(7.5)	
Necessity of radiation safety education	yes	42(77.8)	65(100)	36(97.3)	51(96.2)	0.04
	no	12(22.2)	0(0.0)	1(2.7)	2(3.8)	
Necessity of personal exposure dose management	yes	34(63.0)	63(96.9)	32(86.5)	50(94.3)	0.01
	no	20(37.0)	2(3.1)	5(13.5)	3(9.7)	

$p<0.05$, based on chi-square test

2.3. Results of Radiation Dose Measurement

In order to find out the dose of radiation dose during radiology imaging practice class, the experiment was carried out from April to June for 3 months, and according to the program, the results of exposure dose were 0.34mSv at 1m distance, 0.01mSv at shielding of lead gown at 1m distance, 0.16mSv at 2m distance, and 0.01mSv at control room with radiation lead glass wall in table 3. The exposure dose from the test results was much below the annual general public limit dose of 1mSv.

Table 3: Results of radiation dose measurement

Division	Exposure duration	Measurement result (mSv)		
		Surface	Deep	Cumulative
Dosimeter 1	2018. 04. 04 ~ 2018. 06. 30	0.39	0.34	0.34
Dosimeter 2	2018. 04. 04 ~ 2018. 06. 30	0.01	0.01	0.01
Dosimeter 3	2018. 04. 04 ~ 2018. 06. 30	0.18	0.16	0.16
Dosimeter 4	2018. 04. 04 ~ 2018. 06. 30	0.01	0.01	0.01

4. Conclusion

Korea's nuclear and radiation industries are rapidly developing as the year goes by through continuous investment and continuous research and development. In addition, along with the development of science, the use of radiation and radioisotopes has been increasing day by day, and the field of its use has also diversified. Especially in the field of medicine, it contributes greatly to the improvement of public health through the diagnosis and treatment using radiation, and the field is actively applied to diagnosis and treatment of diseases by using radiology such as radiology, nuclear medicine, and radiation oncology.

However, the occurrence of large and small safety accidents of nuclear and radiation globally has become a social issue that affects nuclear safety and people have become more interested in nuclear safety, and the Nuclear Safety Act, which provides various regulations and standards related to nuclear power, has been strengthened. Accordingly, facilities using radiation should be approved by the Nuclear Safety Commission by providing various appropriate facilities as prescribed by the Nuclear Safety Act, and a person who has obtained a license to deal with radioactive isotopes are selected as radiation safety manager so that they can help to prevent radiation safety accidents.

However, the Nuclear Safety Act applies the radiation safety management regulations for the safety of the radiation generator installed in the university radiology departments, which our students are practicing for learning, as well as the medical field using the nuclear industry and radiation, and excessive regulations on radiation safety management as a result of this have to be taken into account that it is violating the right to education at educational institutions (see Article 31 of the Constitution).

For students enrolled in radiology departments in universities nationwide currently, they are classified as radiation management area ‘person with frequent access’ according to Enforcement Decree of the Nuclear Safety Act Article 2 No. 8, and students classified as person with frequent access must follow the safety management regulations for time and cost such as health examination, radiation safety education, and TLD badge wear for imaging practice. In addition, even while practicing with a radiographic imaging device, under the supervision of a radiation worker (professor) in a practice room equipped with radiation shielding facility, limiting the operation of a radiographic imaging device may be viewed as a violation of the right to learn. Students who enter the radiology departments in universities nationwide and pay full admission fee and have formal status as a student must have the right to study in accordance with the curriculum. However, before the Nuclear Safety Act, which limits the students' ability to use the radiation generator to conduct experiments at the school, the right to learn, which is the basic right of the people, has been infringed and damaged. In order to guarantee the right of students to learn, the revision of the current Nuclear Safety Act is needed.

In the study, looking at the perception of students after the person with frequent access system enactment by the amendment of the Nuclear Safety Act, in the question about the need of person with

frequent access system, positive responses were seen in 1st year 48.1%, 2nd year 89.2%. 3rd year 73.0%, and 4th year 88.7%. These results show that the perception of necessity was high in all years except the 1st year students who do not participate in imaging practice. At present, however, students are taught basic principles of radiology and safety management through courses such as radiation physics, radiation biology, radiation management, and radiation metrology, which correspond to radiation basic science and safety management in the school curriculum, and it is thought that it is possible to substitute with the curriculum because the contents to be learned in school are again invested in time and money.

In addition, the result of the radiation dose measurement experiment in the radiation imaging practice room shows that all the radiation dose values measured over 3 months do not reach the annual limit dose of 1mSv. It is considered too restrictive for the radiology students to apply the person with frequent access system according to the Nuclear Safety Act, and radiographic equipment used by the university for student learning purposes should be classified as an exception to the Nuclear Safety Act or a new set of educational methods should be established and administered.

Currently, in imaging practice in radiology departments in universities nationwide, the professor who is in charge of imaging practice has completed safety education for radiation workers and supervises students for the safety management necessary for the experiment of radiography. In addition, the radiology training center thoroughly monitors radiation safety by thoroughly managing the radiological equipment through regular safety surveillance of equipment and providing complete radiation shielding facilities and safety equipment. Therefore, the application of the Nuclear Safety Act and restrictions on the operation of the radiological equipment in the practice of students is a violation of the students' right to learn and it is considered necessary to amend the law.

In conclusion, for the fact that in order to learn radiation imaging practice, students are classified as a person with frequent access in the radiation management area according to the Nuclear Safety Act and follow the safety management regulations that require time and cost, such as health screening, radiation safety education, TLD badge, the Nuclear Safety Act requires amendments, and in addition, the restriction on the operation of the radiation equipment in the practice of the students is a regulation that infringes the right of students to learn, and amendments or exemptions of Nuclear Safety Act should be enacted to ensure that it does not violate the fundamental right to learn for students in radiology.

It is a limitation of the study to draw conclusions from the review of the literature and the subjective opinion of the researchers, as well as limiting the sample to a group of students in a single university radiology department. Based on this research in the future, it should be expanded nationwide to collect opinions from students in radiology, and further research should be done to protect the rights of radiology students who are being infringed on their learning rights through more specialized research, as well as to safeguard them from radiation exposure in an improved environment.

Acknowledgment

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