

Environmental Radiation Protection in Medical Institutions

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The study aimed to measure the levels of radiation protection for radiologists in medical institutions in three environmental categories (physical, administrative and social) and to establish a data base which can be used to increase awareness of environmental radiation protection in medical institutions within Korea. The study surveyed 10% of radiologists working in radiology departments in medical institutions which are supervised by the National Dose Registry overseen by the Korean Food and Drug Administration(KFDA). This study found that the level of environmental radiation protection was higher in the capital area and in larger hospitals. On the other hand, the study shows environmental radiation protection was lower in the Youngnam area and in clinics. Results from the questionnaires indicate the level of environmental radiation protection was higher when radiologists were given an individual dosimeter but lowest when the radiation protection apron quality test was conducted. Environmental radiation protection is an important factor for radiologists to conduct activities in a safe and protected environment. However, this study shows there are differences in the level of environmental radiation protection in medical institutions and location within Korea. In particular, the level of environmental radiation protection was lower in clinics, appropriate intervention strategies befitting these conditions are needed based on medical institution classification and location in order to improve the level of environmental protection.

Keywords : Environment, Protection, Harmful Effects, Radiation, Medical Institutions

1. INTRODUCTION

Doses of radiation exposure for patients and radiation workers is on an annual increase [1,2]. The International Commission on Radiological Protection(ICRP) emphasizes radiological protection in medical institutions where many people are exposed to ionizing radiation from medical care[3]. There is a possibility of drastically reducing radiation exposure for patients without disrupting medical care[4].

Radiation safety management is closely related to public health because it induces accurate use of medical radiation and safety on the part of radiation workers[5]. More than anything else, health can be improved through the physical environment[6]. As environmental radiation protection is not a technical term usually found in existing theories, this study focused on classifying and describing environment into three sub-categories; physical environment (equip-

ment and facilities), administrative environment (regulation and policies) and social environment (behaviors of following the regulations and policies).

Human behavior is explained through ceaseless interactions among individuals. Behavioral and environmental factors do not dictate human behavior rather they are important factors which determines behavior along with individual variables[7,8]. Accordingly, the study considered radiation protection which pertaining to the physical environment following health deterministic models. The level of radiation protection befitting the environment in Korea was measured in medical institutions charged with administering radiation to patients. A set of intervention strategies was suggested to improve environmental radiation protection in medical institutions based on the data of this study.

2. METHODS

This study surveyed 1,322 professionals in the medical radiation field(10% of the population based on propor-

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tionate stratified sampling of radiologists working in radiology departments within medical institutions supervised by the National Dose Registry).

A structured questionnaire was used as a research tool which included: two questions on the classification of the medical institution(university hospital, general hospital, hospital or clinic) and location(capital area, Chungcheong area, Younngnam area or Honam area), ten questions on radiation protection in medical institutions which were separated into two sub-categories: the physical environment(two questions on the facilities and 4 questions on the equipment) and; the administrative environment(4 questions).

Cronbach's α of radiation protection from radiation hazard was as high as 0.884. It was measured based on a five-point scale(Very much so, 5 points to Not at all, 1 point), totaling 100 points, which was designated as a perfect score. Higher scores represent an advanced environmental radiation protection level. The questionnaire-based survey was conducted over 50 days starting June 20, 2008.

The collected data was used to figure out: 1) the average and standard deviation of environmental (physical and administrative) radiation protection levels in medical institutions and; 2) the average and standard deviation of environmental radiation protection by each question on the questionnaire by classification of medical institution and location based on SPSS 15.0, and ANOVA which was applied to figure out; 3) the difference in the levels of environmental radiation protection by classification of the medical institution and location.

3. RESULTS

1,309 questionnaires were administered, of which, male

radiologists accounted for 75.9%, and females 24.1%. This result is similar to the ratio of male to female radiologists registered with the National Dose Registry.

3.1 The Level of environmental radiation protection by medical institution classification

University hospitals accounted for 52.0% of the response, general hospitals 32.7%, hospitals 10.7% and clinics 4.5%. The level of environment radiation protection of medical institutions is measured based on perfect score of 100 points, general hospitals received the highest points at 79.75, and it was followed by 77.83 in university hospitals, 72.70 in hospitals and 66.47 in clinics(Table 1).

Table 1. The Level of Environmental Radiation Protection for Medical Institutions.

Distinction	n	Mean \pm S · D
University hospital	660	77.83 \pm 11.99
General hospital	417	79.75 \pm 12.11
Hospital	135	72.70 \pm 12.41
Clinic	51	66.47 \pm 14.18
Total	1263	77.46 \pm 12.52

3.2 The level of environmental radiation protection by question and medical institution classification

General hospitals acquired the highest points in all questions on environmental radiation protection. In particular, on the question of are all radiologists given individual dosimeters, general hospitals received the highest points at 4.47, and on the question of quality tests conducted on radiation protection aprons general hospitals received its lowest points at 3.10 (Table 2).

Table 2. The Level of Environmental Radiation Protection Questions for Medical Institutions.

Questions	Distinction	N	mean \pm S · D
1. Radiation protection facilities are well equipped.	University hospital	674	3.85 \pm 0.81
	General hospital	426	4.02 \pm 0.75
	Hospital	139	3.66 \pm 0.82
	Clinic	56	3.50 \pm 0.99
	Total	1295	3.87 \pm 0.81
2. Department are equipped with various radiation protection tools.	University hospital	671	3.71 \pm 0.89
	General hospital	425	3.81 \pm 0.87
	Hospital	138	3.27 \pm 0.89
	Clinic	56	3.05 \pm 0.92
	Total	1290	3.67 \pm 0.90
3. Precautions related to radiation protection for patients' guardians are well indicated.	University hospital	672	3.72 \pm 0.92
	General hospital	425	3.84 \pm 0.95
	Hospital	139	3.48 \pm 0.97
	Clinic	54	2.98 \pm 1.04
	Total	1290	3.70 \pm 0.95
4. Doors in the quarantine areas are equipped to take pictures.	University hospital	670	3.97 \pm 0.88
	General hospital	425	4.14 \pm 0.83

	Hospital	139	3.78±0.83
	Clinic	56	3.73±0.94
	Total	1290	3.99±0.87
5. All radiologists are given an individual dosimeter.	University hospital	670	4.39±0.75
	General hospital	426	4.47±0.68
	Hospital	139	4.24±0.81
	Clinic	56	4.20±0.92
	Total	1291	4.39±0.75
6. Health checks are given every two years.	University hospital	672	4.41±0.71
	General hospital	424	4.44±0.73
	Hospital	137	4.15±0.75
	Clinic	56	3.80±1.02
	Total	1289	4.36±0.75
7. Education on radiation protection is provided on a regular basis.	University Hospital	671	3.74±0.98
	General Hospital	425	3.91±0.98
	Hospital	139	3.40±0.99
	Clinic	56	2.88±1.13
	Total	1291	3.72±1.02
8. Individual radiation exposure doses are checked on a regular basis.	University hospital	673	4.28±0.76
	General hospital	426	4.36±0.80
	Hospital	138	4.12±0.77
	Clinic	56	4.00±0.97
	Total	1293	4.28±0.79
9. Radiation safety procedures are clear and organized.	University hospital	673	3.71±0.93
	General hospital	424	3.84±0.93
	Hospital	139	3.35±0.95
	Clinic	54	3.11±1.06
	Total	1290	3.69±0.96
10. A radiation protection apron quality test is conducted.	University hospital	672	3.04±1.10
	General hospital	425	3.10±1.13
	Hospital	139	2.80±1.04
	Clinic	54	2.22±0.84
	Total	1290	3.00±1.11

3.3 The level of environmental radiation protection by medical institution classification and location

As for the location of the medical institutions who participated in the survey, the capital area accounted for 41.5%, the Youngnam area 40.4%, the Honam area 10.2% and the Chungcheong area 7.9%. In medical institutions in the capital area received the highest points on six questions including: "Radiation protection facilities are well equipped"; "Precautions related to radiation protection for patients' guardians are well indicated"; "All radiologists are

given an individual dosimeter"; "Individual radiation exposure doses are checked on a regular basis"; "Radiation safety procedures are clear and organized"; and "A radiation protection apron quality test is conducted".

In medical institutions in the Honam area received the highest points on four questions including: "Department are equipped with various radiation protection tools"; "Doors in the quarantine areas are equipped to take pictures"; "Health checks are given every two years"; and "Education on radiation protection is provided on a regular basis"(Table 3).

Table 3. The Level of Environmental Radiation Protection Questions by Location of Medical Institutions.

Questions	Affiliated area	N	mean±S · D
1. Radiation protection facilities are well equipped.	Capital area	543	4.04±0.77
	Chungcheong area	104	3.97±0.60
	Youngnam area	529	3.64±0.85
	Honam area	133	4.04±0.72
	Total	1309	3.87±0.81

2. Departments are equipped with various radiation protection tools.	Capital area	543	3.86±0.89
	Chungcheong area	104	3.71±0.78
	Youngnam area	525	3.38±0.90
	Honam area	132	3.93±0.80
	Total	1304	3.66±0.90
3. Precautions related to radiation protection for patients' guardians are well indicated.	Capital area	542	3.95±0.90
	Chungcheong area	104	3.85±0.72
	Youngnam area	526	3.39±0.96
	Honam area	132	3.78±0.97
	Total	1304	3.70±0.96
4. Doors in the quarantine areas are equipped to take pictures.	Capital area	541	4.13±0.88
	Chungcheong area	104	4.06±0.71
	Youngnam area	527	3.81±0.89
	Honam area	132	4.14±0.80
	Total	1304	3.99±0.87
5. All radiologists are given an individual dosimeter.	Capital area	541	4.52±0.66
	Chungcheong area	104	4.34±0.65
	Youngnam area	528	4.25±0.83
	Honam area	132	4.46±0.71
	Total	1305	4.39±0.75
6. Health checks are given every two years.	Capital area	542	4.47±0.75
	Chungcheong area	104	4.32±0.66
	Youngnam area	525	4.23±0.77
	Honam area	131	4.48±0.61
	Total	1302	4.36±0.75
7. Education on radiation protection is provided on a regular basis.	Capital area	542	3.86±1.03
	Chungcheong area	103	3.64±1.00
	Youngnam area	528	3.56±1.00
	Honam area	131	3.87±0.96
	Total	1304	3.72±1.01
8. Individual radiation exposure dose is checked on a regular basis.	Capital area	543	4.41±0.75
	Chungcheong area	104	4.25±0.67
	Youngnam area	527	4.12±0.84
	Honam area	132	4.39±0.68
	Total	1306	4.28±0.79
9. Radiation safety procedures are clear and organized.	Capital area	542	3.87±0.95
	Chungcheong area	103	3.73±0.83
	Youngnam area	527	3.46±0.97
	Honam area	131	3.82±0.87
	Total	1303	3.69±0.96
10. A radiation protection apron quality test is conducted.	Capital area	540	3.19±1.13
	Chungcheong area	103	3.06±1.06
	Youngnam area	528	2.76±1.07
	Honam area	131	3.15±1.05
	Total	1302	3.00±1.11

3.4 Differences in the levels of environmental radiation protection by medical institution classification

As a result of comparing differences in the levels of radiation protection according to the medical institution classification, it has been found that there was no difference

in the capital area, the Chungcheong area and the Honam area, however, the Youngnam area recorded a lower level of environmental radiation protection ($p < 0.01$). By medical institution classification, the level of environmental radiation protection was higher in university hospitals and general hospitals, and it was the lowest in clinics ($p < 0.01$) (Table 4).

Table 4. Differences in the Level of Environmental Radiation Protection by Medical Institutions Classifications.

Distinction				n	mean±S · D	F (p-value)
Capital area		b		532	80.54±12.03	33.270 (0.000)
Chungcheong area		b		102	78.060±10.18	
Youngnam area	a			510	73.39±12.51	
Honam area		b		131	80.18±11.75	
Total				1275	77.45±12.51	
University hospital			c	660	77.83±11.99	25.891 (0.000)
General hospital			c	417	79.76±12.11	
Hospital		b		135	72.70±12.41	
Clinic	a			51	66.47±14.18	
Total				1263	77.46±12.52	

4. CONCLUSION

The study aimed to measure the levels of environmental radiation protection for radiologists working in medical institutions and to establish a data base of environmental radiation protection levels. As the environmental radiation protection is not a technical term usually found in existing theories, the study is focused on classifying and describing environment (physical, administrative and social) which can induce changes in the environment to raise the overall awareness and environmental radiation protection levels in medical institutions in Korea. Citing mutual determinism, Bandura(1986) human beings, environment and behavior interact with one another and the three of them cannot be separated from one another to explain determinants of human behavior. It is necessary to improve the environmental radiation protection first so that radioactive protection can be provided. Health Determinant Model suggested by Healthy People 2010 in the U.S. indicates that individual biological predisposition, physical environment, environmental factors in terms of social policy and their interactions have an effect on health.

According to responses from 10% of radiologists working in radiology departments in medical institutions supervised by the National Dose Registry, it has been found that the level of environment radiation protection was higher in the capital area and in larger hospitals. On the other hand, it was lower in the Youngnam area and in clinics. As for the individual questions, the level of environmental radiation protection level was higher when all radiologists were given an individual dosimeter but it was the lowest on the question of conducting quality tests on radiation protection aprons.

Environment radiation protection is an important factor in order for radiologists to conduct activities in a safe and protected environment. However, there were differences in the levels of environmental radiation protection according to the classification of the medical institution and the location of the medical institution. In particular, as the environmental radiation protection levels are lower in clinics, ap-

propriate intervention strategies befitting these conditions are needed in order to improve the level of environmental protection. Further data is needed to build up a data base from which effective measures could be considered to reduce medical radiation exposure which may have detrimental effects on public health.

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