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Status and Issues of Occupational Exposure Protection for Nurses Involved in Radiation Therapy - a Nationwide Survey in Japan

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Abstract: Purpose: This study aimed to clarify nurses' knowledge, awareness, and safe behavioral practices regarding occupational exposure. Methods: A mail-based questionnaire survey was conducted for 2,820 nurses engaged in radiation medicine and working in randomly selected hospitals in Japan. Results: Overall, 1,385 questionnaire responses were obtained (1284 females and 87 males; average clinical experience of 19.12±8.7 years, and 49.1% collection rate), and 1,370 were included in the analyses (98.9% valid response rate). It was found that 40% the content of basic nursing education on radiation treatment, which was "insufficient" in terms of quantity and quality. Occupational exposure protection measures were different depending on the organization size and position, with significantly higher rates of protective equipment use and manual maintenance in organizations with >400 beds and considerably higher rates of use of "partitioning screen," "neck guard," and "protective goggles" by nurse administration than by nurses during emergency interventional radiology. Additionally, only 46% of the general wards correctly answered that "a distance of >2 m" was required when using mobile X-ray equipment. These results indicate that nurse administrators and nurses involved in radiation therapy have insufficient professional knowledge and skills and that nurses in general wards lack knowledge about radiation therapy. Therefore, a systematic risk management program is necessary.

Keywords: Occupational Radiation, Radiation Nursing, Nurse Administrator, Nurse, Safe Behavior Practices

1. Introduction

"Healthcare is a risky business," and as such, nurses are considered a high-risk group of professionals [1]. These conclusions and the confirmation of the need for systemic countermeasures were reached in 1998 at the International Conference on Workplace Injuries (Occupational Health Problems) for healthcare workers, co-sponsored by the International Council of Nurses and the American Nurses Association. Moreover, a survey by the Japanese Nursing Association in 1999 reported that many nurses and facilities are aware of the dangers in the workplace but do not take thorough measures to prevent them [2].

Interventional radiology (IVR) is a medical treatment involving many professionals, including physicians and nurses. IVR includes minimally invasive techniques, and its use has rapidly increased. However, one of the techniques, namely, X-ray fluoroscopy, involves a long procedure, resulting in an increased risk of occupational exposure if medical personnel do not have suitable knowledge and take appropriate protective measures. According to the International Commission on Radiological Protection, IVR increases radiation doses to the eye lens and can cause cataracts in nurses and surgeons; therefore, avoiding radiation injury during IVR is a significant global issue [3]. Notably, nurses' knowledge of radiation is generally low, and basic nursing education is inadequate for radiation safety,

resulting in unnecessary anxiety and misunderstandings about radiation [2, 4-6]. Furthermore, protective actions depend on individuals regarding the risks [7]; however, few nurses are aware of occupational radiation exposure risks. Moreover, the current lack of necessary radiation protection measures [8, 9] is a major problem concerning occupational safety. Nurses are responsible for alleviating anxiety and distress in patients, and many nurses are of reproductive age. Therefore, knowledge of radiation and protection methods is crucial to ensure the safety of patients and nurses.

Objectives

This study aimed to examine the current safety education on occupational exposure for nurses involved in radiological treatment, daily preventive behaviors, and staff management by managers by comparing job positions and organization sizes to inform suggestions for improving employment and creating a foundation for safety education.

Significance of the study

By clarifying the status of occupational exposure protection for nurses according to hospital bed size and job position in a constantly changing healthcare environment, awareness of the need for systematic protective measures can be raised. Furthermore, this study focuses on how to educate and train nurses. These findings will enhance occupational safety among nurses and improve healthcare quality.

Definition of terms: Nurses: This term collectively refers to those working as nurses during this survey, regardless of whether they were qualified as public health nurses or midwives.

2. Research Methods

2.1. Survey Target

A survey was conducted with 2,820 randomly sampled nurses working in hospitals in Japan who were engaged in radiological treatment. The administrator of each facility made the selection.

2.2. Survey Method

A mail-based self-administered questionnaire survey was conducted from 2016 to 2017. Overall, 384 hospitals with 400 or more beds and 436 with 200–400 beds were selected using stratified and random sampling from hospitals nationwide, and questionnaires were distributed to four nurses, including nursing managers from each facility.

2.3. Survey Content

The survey contained questions regarding the following:

(1). Basic attributes: Respondents were asked to provide the age, sex, job title, facility, and department to which they were assigned.

(2). Practice, education, and training on occupational exposure: Respondents were asked to select, using a multiple-choice format, the frequency of their involvement in radiological treatment, whether they had received education or training on occupational exposure, and the type and usage status of protective equipment used when assisting in IVR procedures.

2.4. Analysis Method

Descriptive statistics were calculated to confirm the distribution of organizational size, nurses' attributes, and the presence/absence of training. Moreover, simple tabulations were performed for the presence or absence, venue, and level of satisfaction with the education and training for occupational exposure. Pearson's chi-square test was used to compare staff management by organization size and the use of protective equipment during IVR care by job position and organization size. Finally, simple tabulations were performed for daily occupational exposure prevention behaviors. The analyses were performed using the Statistical Package for Social Science version 25 for Windows, and the significance probability was set at 0.5% and 0.1% on one side.

2.5. Ethical Considerations

A request form clearly stating the freedom to participate in this study, right to refuse, protection of privacy, publication of the results, research plan, and questionnaire was enclosed and mailed via post to the head nurse of selected institutions. The questionnaires were returned individually without names, and consent was obtained upon the return of the questionnaires. The Ethical Review Board of the School of Nursing, Aichi Medical University, approved this study (approval no. 83).

3. Results

Of the 2,820 distributed questionnaires, 1,385 were returned (collection rate: 49.1%). Questionnaires lacking gender and job position responses were excluded, leaving 1,370 respondents for analysis (valid response rate: 98.9%).

3.1. Background of the Target Population

Participant attributes are presented in Table 1, and Table 2 shows the departments managed by nursing managers (below, "managers") and the worksites of the nurses (below, "nurses"). Notably, there were cases where nurses were involved in nursing department management and placement sites or were in charge of or assigned to hospital wards and outpatient clinics; therefore, multiple selections were made. In the target population, >90% of managers and nurses were females. The most common educational background was a 3-year course at a nursing school (managers: 71.3% and nurses: 68.8%). Most managers were 40–49 years old (54.0%; n=282), and a small percentage were in their 60s (2.5%; n=13). Additionally, most nurses were in their 40s (38.8%; n=329), 30s (31.0%; n=263), or 20s (6.4%; n=54). Moreover, the mean years of clinical experience were 19.12±8.7 and 27.17±6.9 years for nurses and managers, respectively. The most common affiliation was with acute-care hospitals, followed by advanced treatment (or "special functioning hospitals") and advanced acute-care hospitals.

Regarding the allocation of specialists in radiotherapy and

cancer nursing by organizational size, 176 (22.1%) and 48 (8.4%) certified nurses were in cancer radiotherapy nursing institutions with ≥400 and <400 beds, respectively. Moreover, 397 (49.7%) and 149 (26.0%) nurses specializing in cancer nursing worked in institutions with ≥400 and <400 beds, respectively. Finally, most managers and nurses worked in outpatient radiology (managers, 33.5%; nurses, 46.4%) and angiography departments (managers, 21.4%; nurses, 28.5%).

Table 1. *Individual attributes by number of beds (N=1371).*

		N (%)	
Position	Manager nurse (Manager)	522 (38.1)	
	Nurse	849 (61.9)	
		Supervisor nurses (n=522)	Nurses (n=848)
Sex	Female	490 (93.9)	794 (93.5)
	Male	32 (6.1)	55 (6.5)
Final educational attainment	3-year course in nurse training	371 (71.1)	583 (68.8)
	Nursing college	14 (2.7)	31 (3.7)
	Graduate school of nursing (master's degree)	9 (1.7)	5 (0.6)
	Associate nurse training school	5 (1.0)	40 (4.8)
	Other (e.g., nurse training junior college)	121 (23.3)	182 (21.5)
	Missing values	2	7
Chronological age (years)	20–29	0	54 (6.4)
	30–39	36 (6.9)	263 (31.0)
	40–49	282 (54.0)	329 (38.8)
	50–59	191 (36.6)	184 (21.7)
	60–69	13 (2.5)	18 (2.1)
		Mean ± SD	
Years of clinical experience	Manager nurse (manager)	27.17±6.89	
	Nurse	19.12±8.7	
		N (%)	
Type of working facility	Advanced treatment hospital	228 (16.6)	
	Advanced acute care hospital	137 (10.0)	
	Acute care hospital	920 (67.2)	
	Convalescent hospital	36 (2.6)	
	Chronic hospital	46 (3.4)	
	Other	3 (0.2)	

Table 2. *Nurse working sites and management departments of nurse managers (multiple choices).*

	Manager nurses	Nurses
	N (%)	
Nursing department	117 (14.6)	0
General ward	38 (4.7)	61 (5.6)
Operating room	36 (4.5)	42 (3.8)
Radiology outpatient clinic	269 (33.5)	510 (46.4)
Nuclear Medicine Diagnostics Department	93 (11.6)	136 (12.4)
Angiography Department	172 (21.4)	313 (28.5)
Other	78 (9.7)	37 (3.4)

3.2. Status of Participation in Education and Training Related to Radiology Treatment and Satisfaction with the Content of Basic Nursing Education

In addition to basic nursing education, nurses involved in radiological treatment required specialized education in their assigned medical departments. Table 3 presents the participation status in these education/training programs and the responses of those who received education/training. The responses included multiple selections for education/training sites and related institutions.

The most common education and training received involved occupational exposure (72.1%) and radiological examination (71.6%). Moreover, basic nursing education and workplace training accounted for >70% of the total, with 27%–30% of nurses voluntarily attending external training. The respondents were asked to select from "very satisfied," "fairly satisfied," "dissatisfied (insufficient)," and "do not know" regarding their basic nursing education on radiation. The distribution is shown in Figure 1. "Very satisfied" and "fairly satisfied" accounted for 27% of responses, and "dissatisfied (insufficient)" accounted for 41%.

Table 3. *Receipt of education and training related to radiology treatment (N=1370).*

		n (%)		Training venues (multiple responses)	
Radiotherapy (Cancer therapy)	Received	810 (60.5)	⇨	Basic nursing education	374 (46.2)
	Did not receive	465 (34.7)		Workplace training	322 (39.8)
	Do not know	64 (4.8)		Voluntary external training	268 (33.1)
	Missing values	31			
Radiological examination (e.g., X-ray, CT, scintigraphy)	Received	931 (71.5)	⇨	Basic nursing education	346 (37.2)
	Did not receive	310 (23.8)		Workplace training	280 (30.1)
	Do not know	62 (4.8)		Voluntary external training	228 (24.5)
	Missing values	67			77
Occupational exposure	Received	961 (72.1)	⇨	Basic nursing education	318 (33.1)
	Did not receive	301 (22.6)		Workplace training	284 (29.6)
	Do not know	70 (5.3)		Voluntary external training	242 (25.2)
	Missing values	38			117
Medical exposure	Received	691 (52.0)	⇨	Basic nursing education	246 (35.6)
	Did not receive	506 (38.0)		Workplace training	209 (30.2)
	Do not know	133 (10.0)		Voluntary external training	197 (28.5)
	Missing values	40			39

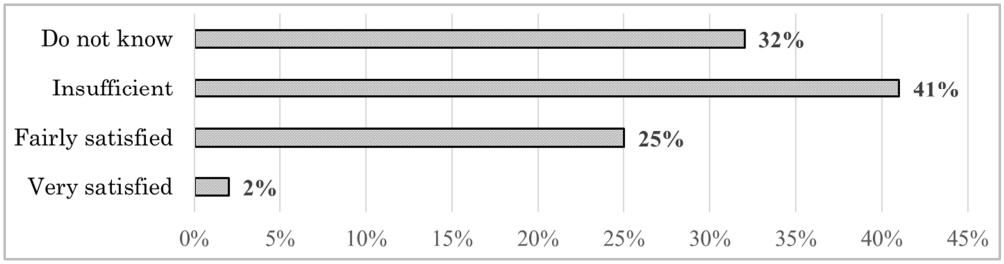

Figure 1. *Satisfaction with Nursing Basic Education on Radiology Practices.*

Table 4. *Logistic regression analysis.*

Related factor	Partial regression coefficient	Significance probability	Odds ratio	95% Confidence intervals for odds ratios	
				upper limit	lower limit
sex	-1.224	0.005	0.294	0.126	0.689
Position	0.748	0.017	1.022	1.144	3.904
Years of clinical experience	0.022	0.175	2.113	0.990	1.054
Age	-0.177	0.267	0.838	0.614	1.144
Risk is due to my lack of knowledge	0.404	0.001	1.498	1.192	1.882
Risk is inevitable in business	-0.199	0.001	0.820	0.726	0.927

1＝ training voluntarily; 0＝training is not voluntary

Furthermore, we explored the reasons for voluntary participation in occupational exposure prevention training (Table 4). Voluntary training was explained regarding "position" and the recognition that "lack of own knowledge leads to risks."

3.3. Occupational Exposure Protection System in the Organization and Protective Measures for Nurses

To clarify the status of exposure protection within the organizational system, Table 5 presents occupations that administer radiopharmaceuticals (intravenous injection), whether protective gloves are worn during intravenous injection and the exposure protection behavior of nurses during mobile radiography. First, 35.0% of respondents (n=480) answered that "nurses" administer intravenous injections in nuclear medicine examinations, of which 87.1% (n=418) and 3.5% (n=17) answered that they "always wear protective gloves" and "do not wear protective gloves," respectively. Additionally, regarding ventilation to disperse radioactive particles exhaled by patients who had undergone a nuclear medical examination, 21.2% of nurses responded that they "perform ventilation," and 58.1% (n=795) responded that they either "do not perform ventilation" or that they "do not understand the need for ventilation" (Table 6).

Moreover, 70.4% of nurses wore gloves" to handle and dispose of materials, such as linen and diapers, that have come in contact with the bodily fluids of patients who have undergone nuclear medical examination. Finally, regarding radiation protection behaviors during mobile radiography, 46.2% (n=633) of nurses responded that they maintained a distance of ≥2 m from the radiation device, and 46.9% (n=643) stated that they "left the room" during the procedure.

Table 5. *Management of staff involved in radiology practice by organizational size (response by managers).*

	Facilities with 400 beds or more n=296	**Facilities with less than 400 beds n=226**	**Chi-square tests**
	Number (%) who answered yes		
Consideration of duties of nurses of childbearing potential	265 (89.5)	206 (91.2)	Ns
Manual checking of occupational exposure protection	125 (42.2)	48 (21.2)	24.313**
Guidance for complying with manuals	209 (70.6)	124 (54.9)	11.208**
Establishment of monitoring badges for required departments	277 (93.6)	211 (93.4)	Ns
Planning/implementation of regular workshops	141 (47.6)	48 (21.2)	38.987**
	Chi-square tests	**p<. 01	

Table 6. *Daily occupational exposure prevention behaviors.*

1. Occupation in charge of administration (intravenous injection) of radiopharmaceuticals in nuclear medicine examinations			
Doctor	Nurse	Doctors and nurses	
384 (28.0)	480 (35.0)	218 (15.9)	Missing value of 288
2. For nurses who inject intravenously (n=480): Do you wear protective gloves?			
Yes	Sometimes	No	
418 (87.1)	32 (6.7)	17 (3.5)	Missing value 13
3. Do you practice ventilation to diffuse radioactive concentration from the exhaled breath of patients undergoing treatment with nuclear medicine?			
Yes	No	Do not know	
291 (21.2)	220 (16.1)	575 (42.0)	Missing value of 284
4. Do you use gloves when handling or disposing of materials (e.g., linens and diapers) that were exposed to the sweat, vomit, and/or excretions of patients undergoing nuclear medicine examinations?			
Yes	No	Do not know	
964 (70.4)	8 (0.5)	146 (10.7)	Missing value of 253
5. Is the nurse in charge of supporting the patient's body when undergoing mobile radiology?			
Yes	No	Do not know	
516 (37.7)	537 (39.2)	211 (15.4)	Missing value of 106
6. Are family members asked to support the patient's body when taking a mobile radiograph?			
Yes	No	Do not know	
39 (2.8)	1026 (74.9)	211 (15.4)	Missing value 94
7. Which exposure prevention behaviours do you take when performing scans with mobile radiography equipment? (multiple answers)			
Maintain a distance of 2 m or more	Leave the hospital room	Wear protective equipment	Do nothing
633 (46.2)	643 (46.9)	186 (13.6)	6 (0.4)

3.4. Occupational Exposure Prevention for Nurses Involved in Radiological Treatment Performed by Managers

Assuming that the labor-management relationships differed depending on the organization size, education and considerations routinely performed by managers were compared by organization size (≥400 beds versus <400 beds) using the chi-square test. The results are presented in Table 5. Notably, no significant differences were found for either of the organization-size groups regarding whether "special considerations are made considering the work duties of nurses who may be pregnant." However, facilities with ≥400 beds had significantly higher implementation rates than those with <400 beds regarding the "checking of manuals," "guidance on manual compliance," and "the planning and holding of regular training sessions."

3.5. Occupational Exposure Protection for Those Involved in IVR Treatment and Care

Currently, nurses are insufficiently educated on radiation safety. Therefore, we hypothesized that there might be differences in the protective behaviors of nurses and managers during the IVR procedures. Using a three-point Likert scale, nurses responded "always wear" to "never wear" concerning wearing protective equipment (for example, protective clothing and neck guards). The two groups (nurses and managers) were compared using the Mann–Whitney U test, and the results are presented in Table 7. Furthermore, protective aprons had the highest usage rate, with no significant differences between the two groups (job positions). However, managers had significantly higher usage rates for partitioning screens, followed by neck guards and protective glasses, than the nurses.

Table 7. *Mann–Whitney test of protective equipment worn during assistance in interventional radiology procedures.*

	Supervisor nurses n=440	**Staff n=703**	**Wilcoxon**
	Median (mean)		
Protective clothing	3 (2.99)	3 (2.98)	439565
Neck guard	2 (1.85)	1 (1.56)	366506**
Protective spectacles	1 (1.64)	1 (1.32)	361878**
Partitioning screen	3 (2.33)	2 (2.16)	384285**
Mann–Whitney test **p<. 01			

(Rated on a three-point Likert scale: "Always wear/use" to "Never wear/use")

4. Considerations

4.1. Background of Survey Participants

Females comprised 90%, with 60% and 6% of all nurses aged 30–49 and 20–29 years, respectively. This implies that there were nurses of reproductive age among those directly involved in the radiological treatment. Therefore, special considerations are required for job placements (assignments). Additionally, the ratio of radiology and cancer nursing specialists was higher in hospitals with ≥400 beds, possibly due to the greater number of advanced treatments provided by specialty hospitals.

4.2. Necessity of Basic Nursing Education and Post-Graduation Education for Radiology

Previous studies have indicated that few nurses have received sufficient education on radiation safety [6]. Poor knowledge among nurses may lead to their inability to take sufficient preventive actions when necessary or excessive preventive actions [10]. In our study, the rate of education and training regarding occupational exposure was <70%, and the rate of medical exposure was even lower. Takanami [8] conducted a survey at a general hospital where nurses could not provide accurate answers regarding the "effects and side effects associated with exposure" to patients concerned about radiation doses. Nurses involved in radiation treatment are responsible for explaining medical radiation exposure to patients and practicing reliable radiation protection, which necessitates their professional education. Konishi [6] indicated that radiation safety education is necessary for nurses involved in radiological treatments and for those in general wards, suggesting the need to review the targets and content of education and training.

Regarding the level of satisfaction with their classes in basic nursing education, 40% of the respondents answered that these were "insufficient." Moreover, education on radiation has not been specifically presented in the curricula of nursing education programs since 1951. Inoue and Yuka. [11] found in their survey of nursing colleges in Japan that the content of education on radiation is scattered from general education to specialized nursing subjects; they concluded that the content is currently insufficient to meet the needs of healthcare sites. According to the 2018 Model Core Curriculum [12] presented by the Ministry of Education, Culture, Sports, Science, and Technology, students should "learn about the effects of radiation on humans, its impact on health, risks, and exposure protection measures for medical personnel when using radiation."

4.3. Daily Exposure Protection Behavior and Safety Management Issues by Organization Size and Work Position

A knowledge and practice survey of MPs by Shafiee et al. [13] demonstrated that nurses rarely adhered to radiation protection measures. Shiro et al. [14] reported that medical staff in endoscopy departments in Japan have insufficient radiation protection equipment or education.

Regarding "occupational exposure protection" behavior, facilities with ≥400 beds checked manuals, guided manual compliance, and held regular training sessions significantly more frequently than hospitals with <400 beds. Therefore, safety measures are mandatory in such facilities. Another reason may be that the organizational strength of a nursing department is related to the number of beds in the facility. Furthermore, there is a high assignment (placement) rate of specialists in radiation oncology and cancer nursing in facilities with more beds. In 2009, the Japanese Nursing Association assigned medical positions to certified professional nurses with expertise in the field to ensure the quality of nursing. It has been suggested that these specialists should promote systematic safety measures.

Regarding the usage rates of protective equipment in emergency IVR interventions, usage rates were significantly higher for managers than for nurses, indicating an existing knowledge difference between the two jobs. Wilson [15] found that nurses were more likely than cardiologists to be exposed to dosages in their head areas during IVR, suggesting the need for proper training and provision of protective equipment, particularly skull caps, to nurses. Furthermore, several studies have reported eye lens exposure to radiation [3, 15-17]. Therefore, managers should share the knowledge and skills acquired through experience with their subordinates, and personal protective equipment, radiation shielding screens, and scattering curtains should be provided and used with urgency.

Regarding the job types that handle radiopharmaceuticals, such as those used in positron emission tomography (PET), "nurses" and "doctors and nurses" accounted for 50%, suggesting no difference between job types. In a survey of PET facilities in 2006, Watanabe et al. [18] found that nurses performed 66.9% of the intravenous injections of radiopharmaceuticals. Notably, the Japan Ministry of Health, Labor, and Welfare changed the interpretation of the law on intravenous injection by nurses to "the category of medical assistance services" in 2002 [19]. However, intravenous injections in nuclear medicine examinations require expertise in radiation protection and injection techniques. Additionally, in an interprofessional PET dosage exposure survey, Watanabe et al. [18] found that the annual dose received by PET nurses was 10 times greater than that received by general nurses. Furthermore, Kawabata et al. [20] reported that using an automated PET injection system resulted in one-eighth of the annual dose exposure to nurses compared with manual injections. In our study, approximately 10% of the respondents stated that they did not wear protective gloves during the intravenous injection of radiopharmaceuticals, raising the concern that these nurses were exposed to higher radiation doses.

Concerning patient care, ventilation to diffuse radioactive concentrations from the exhalations of patients undergoing nuclear medicine examinations was implemented by a small

percentage of nurses (26%), and glove-wearing when handling linen and other items that had come into contact with the bodily fluids of these patients was 70%. Kawabata et al. [20] reported that the radiation doses of nurses who assisted patients in the bathroom (toilet) were higher than those of nurses who administered the injections. Therefore, since patients are a source of radiation, radiation exposure is unavoidable even for nurses in general wards unless appropriate protective measures are taken [21, 22]. If nurses with insufficient knowledge of nuclear medicine perform such medical procedures according to a doctor's instructions, the organization's safety measures would become implicated, and the safety of medical personnel could be significantly impaired.

Regarding the behavior of nurses in a clinical setting, Kojina et al. [10] reported that 40% of nurses left the room while imaging with a mobile X-ray machine. In our survey, less than half of the nurses correctly answered "maintain a distance of >2 m," and 46% and 13% of the nurses answered "leave the room" and "wear protective equipment," respectively, in the room. These results suggest that nurses act from a vague sense of "anxiety," which may significantly affect patient anxiety. In a survey by Watanabe et al. [23], 58% of nurses reported that they were "anxious" about "entering the examination room with the patient," which involved no possibility of exposure; however, 60% of "nurses of radio isotope/PET-computed tomography patients" were "not anxious" despite the possibility of exposure. Moreover, Oishi et al. [24], in their survey of nurses engaged in radiological treatment in Japan, reported two types of anxiety as follows: "anxiety due to uncertainty about the extent of exposure dosage" and "anxiety due to uncertainty about the effects of exposure." The lack of correct knowledge among nurses causes this phenomenon. Therefore, there is an urgent need to improve radiation safety education among nurses in general wards [6].

As professionals, nurses are responsible for maintaining and promoting physical and mental health [2]. However, there are limits to how they can solve health issues caused by their occupation and behavior. As "another type of risk management" [25], the risks surrounding and involving healthcare professionals should be managed systematically and organization-wide. Our survey included only a few hospitals in Japan; therefore, the results cannot be generalized. Nevertheless, the differences between the facilities were clear.

With the development and increase in radiological treatment, nurse involvement is expected to escalate. Therefore, to address insufficient or excessive protection caused by "radiation being invisible," basic nursing education should be enriched, and novel workplace education methods, such as on-the-job and classroom training after graduation, should be incorporated.

5. Conclusion

A survey of nurses working in hospitals across Japan, revealed that both nursing managers and nurses lacked sufficient knowledge and skills regarding occupational radiation protection. As a result, there were some who engaged in dangerous work without sufficient safety assurance, and some who harbored groundless anxiety and fear. In the background, both the quality and quantity of radiological treatment contents in basic nursing education in Japan are inadequate, and the participation rate of postgraduate specialized education is low at 70%. In the future, it will be necessary to develop human resources capable of providing specialized education on radiology during basic nursing training, and to secure sufficient time. We also believe that it would be effective to develop an educational method using VR (Virtual Reality), that allows students to visualize invisible radiation.

Conflict of Interest

The authors declare no conflicts of interest.

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