

Improving practical skills in radiological nursing: Results of questionnaire surveys from “radiological nursing seminars”

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Abstract : Diagnosis and treatment involving radiation are advanced and specialized, and the application range of radiation use is expanding year by year. Under these circumstances, nurses are engaged in caring for patients undergoing radiation for diagnosis and treatment in various clinical settings. Meanwhile, in response to the Fukushima Daiichi Nuclear Power Plant accident, the importance of radiation education for basic nursing and continuing education was recognized. Therefore, Hirosaki University Graduate School of Health Sciences has been holding “radiological nursing seminars” aimed at improving nurses’ knowledge of and practical ability in radiation. In addition to reporting on this activity, we examined the interests and needs related to radiological nursing based on the results of questionnaire surveys conducted on the participants of the seminars. The results of the surveys suggest that nurses have a high degree of interest in radiation and motivation for learning and that radiological nursing seminars are effective for helping nurses obtain a better understanding of radiological nursing.

I . Introduction

The use of radiation in diagnosis and treatment is advanced and specialized, and its range of applications is expanding year by year. According to the United Nations Scientific Committee on the Effects of Atomic Radiation, the annual number of diagnostic medical radiological examinations conducted around the world increased 2.25-fold from 1988 to 2008, and the annual effective dose per caput has been rising. In Japan, the number of annual computed tomography (CT) examinations increased 25-fold from 1979 to 2000, and the annual effective dose per caput increased about threefold from 1989 to 2000. The number of annual examinations

conducted worldwide involving diagnostic nuclear medicine procedures increased gradually between 1988 and 2008, and after having doubled between 1988 and 1993, the annual per caput dose has remained constant since 1993.¹⁾ In nuclear medical practice in Japan, the number of positron-emission tomography examinations and radionuclide-targeted therapies has been increasing.²⁾ Radiation exposure in the family members of patients receiving radioactive I-131 therapy for thyroid cancer has also been measured and reported.³⁾ In addition, there are a diverse number of interventional radiology (IVR) procedures for which not only patient, but also staff exposure has been pointed out.^{1, 4-7)} Cancer is

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expected to be an increasingly prevalent disease in aging populations, and this will likely lead to the growth of radiation therapy in most countries.¹⁾ In Japan, about 26% of cancer patients currently undergo radiotherapy. However, the number of patients undergoing radiation treatment is increasing rapidly, and a process of increasing from 26% to about 50–60%, which is on par with the US, is anticipated.⁸⁾

Under these circumstances, nurses are engaged in providing care to patients undergoing diagnosis and treatment involving radiation in a variety of clinical settings; therefore, knowledge regarding radiation and associated practical techniques on radiation protection is important.^{9–12)} However, in the aftermath of the Fukushima Daiichi Nuclear Power Plant accident, a shortage of public health nurses with radiological

nursing training was apparent, which reaffirms the importance of radiation education for basic nursing and continuing education.^{13,14)} Previously, there was no requirement of radiation education for the basic nursing curriculum.¹⁵⁾ Therefore, in recent years, radiation education has started to be offered more frequently to nursing and public health nursing students.^{16,17)}

In addition, Hirosaki University Graduate School of Health Sciences has started holding “radiological nursing seminars” aimed at improving nurses’ knowledge of and practical ability in radiation. In addition to reporting on this activity, here we examine nurses’ needs and concerns in relation to radiological nursing based on the results of questionnaire surveys conducted on the participants of the seminars. It is meaningful to show the findings of this research to let foreign countries know about the current

Table 1. Details of the radiological nursing seminars

1st* ¹	Venue, year, open time	Tokyo, 2013, 13:00–16:00
	Target, recruitment number	Medical professionals who are interested in radiological nursing and examinations (about 100 people)
	Theme	Education and prospects aiming for advancement and specialization of radiological nursing
	Educational lecture	Exposure of nurses in nuclear medical examinations
	Symposium	I think about future radiological nursing
2nd	Co-organized	Radiological Nursing Society of Japan (RNSJ)
	Venue, year, open time	Hirosaki, 2014, 17:40–18:40
	Target, recruitment number	Undergraduate and graduate students, graduate school teachers, and nurses (about 100 people)
	Theme	Advanced practice nursing & cancer clinical trials in the USA
	3rd* ¹	Venue, year, open time
Target, recruitment number		Medical professionals who are interested in radiological nursing and examinations (about 100 people)
Theme		Towards the latest knowledge of medical radiation use and nursing consultations in radiological examinations
Educational lecture		Forefront of radiological examinations, current status and future of bone metastasis treatment
Topics offered		Activity Introduction of Japan Network for Research and Information on Medical Exposure (J-RIME)
4th* ^{1,*2}	Exchange of opinions	How can we respond to a patient’s anxiety?
	Co-organized	RNSJ, National Institute of Radiological Sciences (NIRS)
	Venue, year, open time	Tokyo, 2015, 13:00–16:20
	Target, recruitment number	Medical professionals who are interested in radiological nursing and examinations (about 80 people)
	Theme	The latest knowledge necessary for nursing in radiological examinations
5th* ^{1,*2}	Educational lecture 1	IVR practice, I and Narumi Hospital, every day, INE nurse
	Educational lecture 2	The latest nuclear medical examinations and radiological nursing
	Co-organized	RNSJ
	Venue, year, open time	Tokyo, 2016, 13:50–16:25
	Target, recruitment number	Medical professionals who are interested in radiological nursing and examinations (about 80 people)
6th* ^{1,*2}	Theme	Would you like to learn the basics as well? Fundamentals of radiation necessary for nurses
	Educational lecture 1	“Basics of radiation and radiation protection” useful from tomorrow
	Educational lecture 2	Thinking about “radiation hypersensitivity” to fear radiation correctly
	Venue, year, open time	Tokyo, 2017, 13:30–16:10
	Target, recruitment number	Medical professionals who are interested in radiological nursing and examinations (about 80 people)
	Theme	Basic knowledge necessary for nursing in radiological examinations
	Educational lecture 1	“Basics of radiation and radiation protection” useful for nursing
	Educational lecture 2	“Radiological examination and nursing” for nurses

*¹: This seminar is the subject of a self-study achievement addition for certified nurses in all fields

*²: “Program of Certified Nurse Specialist in Radiological Nursing” was explained

IVR: Interventional radiology

INE: Intervention nursing expert

situation on radiological nursing in Japan.

II. Method

1. Radiological nursing seminars

Six radiological nursing seminars were held in 2013–2017. The details of these seminars are shown in Table 1.

2. Participants

The numbers of participants attending the first through the sixth seminar were 120, 140, 52, 53, 63, and 75, respectively. The participation fee was free, and there was no subsidy for travel expenses.

3. Questionnaire items

In the first seminar, the questionnaire items focused on nurses' motivation for participation and hopes for

participating in the next seminar. In the second seminar, the items focused on hopes for participating in the next seminar, and in the third seminar, nurses' motivation for participation. In the fourth through the sixth seminars, 11 check-off, three entry and two free entry items were included, and all are presented in Table 2.

4. Data collection

At reception, all seminar participants received an anonymous self-administered questionnaire, and these were collected at the end of each seminar. The data were then compiled and analyzed.

5. Ethical considerations

We provided oral explanations, involving the voluntary nature of the questionnaire, to the participants

Table 2. The questionnaire item in the 4th–6th radiological nursing seminars

Questionnaire item	Questionnaire item
Job category	How interested were you in the contents of educational lecture 1
Nurse	Very interested
Midwife	Interested
Public health nurse	Not very interested
Faculty member	Not interested at all
Other	How interested were you in the contents of educational lecture 2
Nurse specialist qualification (overlapping responses)	Very interested
Certified Nurse in Radiation Therapy Nursing	Interested
Certified Nurse Specialist in Cancer Nursing	Not very interested
Intervention Nursing Expert (INE)	Not interested at all
Nuclear Medicine Nurse	Would you be interested in a "Program of Certified Nurse Specialist in Radiological Nursing"?
Other specialist qualification	Very interested
No specialist qualification	Interested
Gender	Not very interested
Male	Not interested at all
Female	Where would be a good location for a seminar in the future?
Seminar participant's workplace (prefecture) (entry)	Tokyo
Clinical experience as a nurse (y) (entry)	Other place
Clinical experience in radiation as a nurse (y) (entry)	How was the seminar time?
How did you find out about the seminar? (overlapping responses)	It was appropriate (afternoon only)
From my boss and colleagues	Other times are good (morning only)
From a guide inside the facility	Other times are good (all day)
From a seminar guide poster	Other times are good (no desired time)
From a leaflet at an academic meeting of RNSJ* ¹	Other times are good (after evening)
From acquaintances and friends	Will you participate in the next seminar?
From the website of Hirosaki University	I want to participate
Other	I will participate if convenient
What was your motivation for participation? (overlapping responses)	I will not participate
Interesting contents	
Recommended by my boss	
Necessary for earning points to renew Certified Nurse status	
A colleague participated	
Other	

Content desired to be picked up at the radiological nursing seminar (free entry)

Free comments and opinions about the radiological nursing seminars (free entry)

*¹: Radiological Nursing Society of Japan

Table 3. Results of the questionnaires from the 4th-6th radiological nursing seminars

(N=191)

Questionnaire item	n	%* ¹	Questionnaire item	n	%* ¹
Job category			Clinical experience in radiation as a nurse (y)		
Nurse	188	98	<1	33	17
Midwife	0	0	1-5	91	48
Public health nurse	0	0	6-10	43	23
Faculty member	2	1	>10	17	9
Other	1	1	No response	7	4
Nurse specialist qualification (overlapping responses)			How did you find out about the seminar? (overlapping responses)		
Certified Nurse in Radiation Therapy Nursing	30	15	From my boss and colleagues	78	41
Certified Nurse Specialist in Cancer Nursing	2	1	From a guide inside the facility	58	30
Intervention Nursing Expert (INE)	17	9	From a seminar guide poster	42	22
Nuclear Medicine Nurse	8	4	From a leaflet at an academic meeting of RNSJ* ²	22	12
Other specialist qualification	36	18	From acquaintances and friends	15	8
No specialist qualification	71	36	From the website of Hirosaki University	6	3
No response	33	17	Other	20	10
Gender			What was your motivation for participation? (overlapping responses)		
Male	11	6	Interesting contents	167	87
Female	179	94	Recommended by my boss	42	22
No response	1	1	Necessary for earning points to renew		
Seminar participant's workplace (prefecture)			Certified Nurse status	26	17
Tokyo	64	34	A colleague participated	12	6
Kanagawa	43	23	Other	8	4
Saitama	14	7	How interested were you in the contents of educational lectures 1 and 2? (total)		
Chiba	11	6	Very interested	181	47
Shizuoka	8	4	Interested	188	49
Yamanashi	7	4	Not very interested	6	2
Ibaraki	6	3	Not interested at all	1	0
Gunma	4	2	No response	6	2
Hokkaido	3	2	Would you be interested in a "Program of Certified Nurse Specialist in Radiological Nursing"?		
Fukushima	3	2	Very interested	40	21
Tochigi	3	2	Interested	94	49
Miyagi	2	1	Not very interested	34	18
Yamagata	2	1	Not interested at all	7	4
Shimane	2	1	No response	16	8
Fukuoka	2	1	Where would be a good location for a seminar in the future?		
Nagasaki	2	1	Tokyo	167	87
Akita	1	1	Other place	19	10
Osaka	1	1	No response	5	3
Niigata	1	1	How was the seminar time?		
Nagano	1	1	It was appropriate (afternoon only)	172	90
Gifu	1	1	Other times are good (morning only)	10	5
Aichi	1	1	Other times are good (all day)	7	4
Tokushima	1	1	Other times are good (no desired time)	2	1
Mie	1	1	Other times are good (after evening)	0	0
Okayama	1	1	Will you participate in the next seminar?		
Okinawa	1	1	I want to participate	84	44
No response	5	3	I will participate if convenient	103	54
Clinical experience as a nurse (y)			I will not participate	0	0
≤ 9	32	17	No response	4	2
10-19	70	37			
20-29	64	34			
≥ 30	25	13			
No response	0	0			

*¹: Rounded to the first decimal place*²: Radiological Nursing Society of Japan

upon entry to the seminar. We explained that the purpose of the questionnaire survey was to improve the seminar and that we would seek to publish the results. We also explained that non-participants would not be disadvantaged and that the results would not be used for any other purpose.

III. Results

The numbers of questionnaire responses and the collection rates from the first through the sixth radiological nursing seminars were 113 (94%), 136 (97%), 41 (79%), 53 (100%), 63 (100%), and 75 (100%), respectively.

1. Motivation for participation and/or hopes for participating in the next seminar in the first through the third radiological nursing seminars

In the first and third radiological nursing seminars, 93% (143) of the participants responded "Interesting contents" when selecting from the following five options as their motivation for participation: "Interesting contents", "Recommended by my boss", "Necessary for earning points to renew Certified Nurse status", "A colleague participated", and "Other". Regarding participation in the next radiological nursing seminar, in the first and second seminars, 94% (233) of the participants responded "I want to participate" and "I will participate if convenient".

2. Questionnaire results from the fourth through the sixth radiological nursing seminars

Details of the questionnaire results from the fourth through the sixth seminars are shown in Table 3. In the job category, "nurse" accounted for 98% (188) of the responses. Two faculty members were licensed as a nurse and/or a public health nurse, and another as a medical radiological technologist.

Regarding specialist qualifications (overlapping response), 29% (57) of the participants were certified in regard to radiological nursing as "Certified Nurse in Radiation Therapy Nursing", "Certified Nurse Specialist in Cancer Nursing", "Intervention Nursing Expert (INE)", "Nuclear Medicine Nurse"; 36% (71) had no

specialist qualifications; 18% (36) had other specialist qualifications; 17% (33) gave no response.

Regarding the participants' gender, 94% (179) of the participants were female, and 6% (11) were male.

Regarding the participants' workplaces, 76% (145) selected the Kanto Region (Tokyo, Kanagawa, Saitama, Chiba, Ibaraki, Gunma, Tochigi), followed in order by the Chubu Region (Shizuoka, Yamanashi, Niigata, Nagano, Gifu, Aichi), Tohoku district (Fukushima, Miyagi, Yamagata, Akita), Kyushu district (Fukuoka, Nagasaki, Okinawa), Hokkaido Region (Hokkaido), Chugoku Region (Shimane, Okayama), Kansai Region (Osaka, Mie), and Shikoku Region (Tokushima), at 10% (19), 4% (8), 3% (5), 2% (3), 2% (3), 1% (2), and 1% (1), respectively.

Regarding clinical experience as a nurse, 83% (159) had 10 years or more of clinical experience, and 17% (32) had less than 10 years. On the other hand, 9% (17) had more than 10 years of clinical experience in radiation as a nurse, and 87% (167) had less.

Regarding the question "How did you find out about the seminar?" (overlapping response), 41% (78), 30% (58), 22% (42), and 12% (22) responded, "From my boss and colleagues", "From a guide inside the facility", and "From a seminar guide poster", and "From a leaflet at an academic meeting of the Radiological Nursing Society of Japan", respectively.

Regarding motivation for participation (overlapping response), 87% (167) replied that they were "Interesting contents". Furthermore, regarding interest in educational lectures, 97% (total 369) responded that they were "Very interested" or "Interested" in the contents of educational lectures 1 and 2. Conversely, only 2% (7) replied that they were "Not very interested" or "Not interested at all".

We made explanations about "Program of Certified Nurse Specialist in Radiological Nursing" in advance. On that, regarding interest in a "Program of Certified Nurse Specialist in Radiological Nursing", 70% (134) replied that they were "Very interested" or "Interested", while 22% (41) replied that they were "Not very interested" or "Not interested at all".

Regarding the item "Where would be a good location for a seminar in the future?", 87% (167) chose "Tokyo", while only 10% (19) chose "Other place". About seminar

Table 4. Content desired to be picked up at the radiological nursing seminar (free comments)

Classification, no. of cases	Description
4th	<p>Basic knowledge, 2 cases Radiophysics, because I think that it will be fun if I can understand it. Radiation fundamentals, because there was no class of radiation.</p> <p>IVR, Nuclear medicine, 1 case Nursing at the IVR and Nuclear medicine ward, I want to know that it is based on legal grounds.</p> <p>Radiotherapy, 2 cases Effects of radiation in different diseases, types of radiotherapy.</p> <p>Exposure, 1 case Protection from exposure.</p> <p>Practice, 1 case Concrete practical content, reports, etc.</p>
5th	<p>Basic knowledge, 2 cases I would like to know the contents of examination and nursing.</p> <p>Nuclear medicine, 1 case I would like to know about nuclear medicine nursing.</p> <p>Radiotherapy, 4 cases Skin flame treatment timing and assessment, Treatment planning method and image viewing, How to detect adverse events by image. Interaction between radiotherapy and chemotherapy.</p> <p>Exposure, 2 cases Infant exposure. Proper nursing for adverse events such as dermatitis and gastrointestinal symptoms, and adverse event prevention.</p> <p>Practice, 5 cases Will it be necessary to obtain informed consent from now on? I urge you to give lectures including day-to-day cases useful for work.</p> <p>Education, 2 cases Education for nurses.</p>
6th	<p>IVR, 1 case I would like to ask about specific treatments such as new IVR.</p> <p>CT, 2 cases Attention point of nursing with contrast agents, response when sudden change at CT/MRI examination.</p> <p>Nuclear medicine, 1 case I would like to know effective nursing methods from the viewpoint of radiation protection when patients need RI or PET.</p> <p>Radiotherapy, 12 cases Neutron activation. Marking in radiation therapy, prevention of skin inflammation and points to be noted in everyday life, etc.</p> <p>Exposure, 3 cases Internal exposure. On radiation and emergency exposure, regarding exposure prevention at the time of a disaster.</p> <p>Practice, 3 cases The nurse's response at the time of radiation accident, the actual situation of radiological nursing between Japan and the world (especially countries where radiological nursing education is substantial).</p> <p>Education, 2 cases One day flow of college life.</p>

IVR: Interventional radiology
CT: Computed tomography
MRI: Magnetic resonance imaging
RI: Radioisotope
PET: Positron-emission tomography

time, 90% (172) responded that the time was appropriate. Regarding participation in the next seminar, 98% (187) chose "I want to participate" or "I will participate if convenient"; none of the respondents chose "I will not participate".

3. Results of questionnaire survey from the fourth through the sixth radiological nursing seminars in terms of free comments

The free comments given by the participants regarding the content desired to be picked up at the radiological nursing seminar are summarized in Table 4. In total, seven, 16, and 24 comments were given from the fourth through the sixth radiological nursing seminars; these were then classified into several types. Examples of characteristic descriptions for each classification are shown in Table 4, including basic knowledge of

radiation, IVR, CT, nuclear medicine, radiation therapy, exposure medicine, practice, and education. Radiation therapy was the most frequently requested, requested by 18 cases in total of 47 cases.

Free comments and opinions about the radiological nursing seminars are summarized in Table 5. In total, 16, 14, and 23 comments were given from the fourth through the sixth radiological nursing seminars; these were subsequently classified into "good" or "improvement" opinions. The "good" included being able to learn about radiation, and many respondents noted that they wanted to attend lectures by nurses in the improvement plan.

IV. Discussion

For nurses interested in continuing education, Hirosaki University Graduate School of Health Sciences has been implementing radiological nursing seminars aimed

Table 5. Free comments and opinions about the radiological nursing seminars

Classification, no. of cases	Description
4th Good opinion, 12 cases	It was a good opportunity to learn about the current state of radiological nursing. Thank you for planning. Since the seminar was held in the afternoon, I was able to participate easily without having to stay overnight. As we will open a PET Center soon, it was nice to have a good talk in a timely manner. It is difficult to explain radiological nursing carefully to nursing students. I sincerely hope that the nursing school curriculum teaches about radiation.
Improvement opinion, 4 cases	Although there are only a few seminars related to radiation medicine and nursing, I have been able to participate and learn about the topic. I would like to attend lectures delivered not only by doctors, but also nurses. I hope to attend lectures from practitioners (nurses) in the future.
5th Good opinion, 13 cases	It was very stimulating. I also want to participate next year. Thank you very much. I thought that the foundations were learnable. I would like to lead education sessions for juniors, even if I have to conduct them myself.
Improvement opinion, 1 case	I wanted to participate and learn correct information about medical radiation exposure. At the seminar this time, I was able to confirm that there is hardly any exposure if I wear a lead apron, so I was relieved. The contents were difficult to see.
6th Good opinion, 14 cases	I was able to review the basics. Thank you very much. I liked the material. I was able to listen to radiological nursing lectures from doctors, which were very helpful. Thank you very much.
Improvement opinion, 9 cases	I learned a lot about fetal exposure. I understand the criteria, so now I can explain this with confidence. It would be nice to have a nurse (job) give a lecture on radiological nursing. I hope to learn more about cancer patients (including psychological aspects). I would like to hear about nursing experiences. The meeting place was cold. I wanted handout material.

PET: Positron-emission tomography

at improving the knowledge and practical ability of nurses in the field of radiation. The results from the first through the third seminars revealed that the participants had a high degree of interest in learning more about radiation and were motivated to participate in the seminars because of the interesting contents. The first through the third seminars were held in Tokyo, Hiroasaki city in Aomori Prefecture, and Chiba, respectively, but all seminars starting with the fourth were held in Tokyo (Table 1). As a result, 191 individuals from 26 prefectures nationwide, including Hokkaido in the north and Okinawa in the south, attended (Table 3). Because there were participants traveling from remote areas, it was also presumed that some attended because there were few opportunities to learn about radiological nursing in their own locality. Regarding the desired seminar venue and time, 87% of the respondents chose Tokyo and 90% chose afternoon only, allowing the possibility of day trips from distant areas (Table 3). One respondent also noted in the free comments that "Since the seminar was held in the afternoon, I was able to participate easily without having to stay overnight" (Table 5).

Of the nurses who participated in the seminar, 84% had 10 years or more of clinical experience. However, 88% had less than 10 years of experience in radiation-related clinical experience, and 65% had less than 5 years of experience (Table 3). One of the reasons why the clinical experience of nurses is long and experience in radiation-related clinical experience is short may be the rapid increase in radiation inspection and equipment in recent years.^{1, 2, 8)} Another reason may be that radiation education has not until recently been commonly offered to university nursing students and clinical nurses.¹⁷⁾

Similar results were seen in regard to motivation for participating in and the chance to learn about the radiological nursing seminars. In other words, the participants tended to be influenced by their bosses, colleagues, and friends. However, the participants' interest in seminars and educational lectures was very high (Table 3). Such high levels of motivation and interest were considered to be related to the Fukushima Daiichi Nuclear Power Plant accident, as in that disaster, medical treatment and radiation exposure could not be separated leading to an increased interest in radiation and radiation exposure among the general public.^{18, 19)} In

addition, the results regarding the content desired to be picked up at the radiological nursing seminar, six cases of “Protection from exposure” were noted. Furthermore, since there were 18 requests for radiation therapy, most of them concerned with adverse events, education of tissue response by radiation, these were also considered to be important (Table 4).

The seminar participants were also interested in radiological nursing education (Tables 3 and 4). At the end of the seminar, the participants were told that a master’s course for advanced nursing practitioners of radiology and nursing had been established at the Graduate School of Health Sciences at Hirosaki University (Program of Certified Nurse Specialist in Radiological Nursing). Furthermore, education in radiological nursing by nurses as a part of their job was desired, as shown in Table 5. Holding a workshop has been shown to be effective for increasing the knowledge necessary for teachers providing radiological nursing education.²⁰⁾ It is hoped that the quality of radiological nursing education will continue to improve in the future.^{18, 20)}

V. Conclusion

As the use of radiation in diagnosis and therapy is becoming increasingly advanced, the understanding of radiation and associated issues has become indispensable, particularly in regard to the roles of nurses. Based on the results of questionnaire surveys conducted on participants in radiological nursing seminars, nurses displayed a high degree of interest in radiation and motivation for learning. These findings suggest that radiological nursing seminars are effective for helping nurses obtain a better understanding of radiation nursing.

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Conflicts of interest

The authors have no conflicts of interests to declare.

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