

Development of the Attitude Scale on Radiation Emergency Medicine for Japanese nurses and evaluation of its reliability and validity

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Aim: This study aimed to develop an Attitude Scale on Radiation Emergency Medicine (ASREM) for Japanese nurses and to evaluate its reliability and validity. **Methods:** The original ASREM was developed based on interview data and a comprehensive review of the literature. A revised 35-item version was developed by examining the content validity of the original scale. Subsequently, we investigated the reliability and validity of the scale in 798 nurses employed at 31 primary, secondary, and tertiary medical institutions providing radiation treatment in Japan. **Results:** Valid responses were received from 376 nurses. After selecting items based on response bias, we conducted exploratory factor analysis using principal factor analysis with promax rotation. The following four factors comprising 25 items were finally extracted: 14 items, “confidence in knowledge and skills”; 6 items, “psychological resistance”; 3 items, “responsibility as a medical professional”; and 2 items “interest in radiation emergency medicine.” The reliability of the scale was confirmed by a Cronbach’s alpha internal consistency reliability coefficient of 0.93 (0.69–0.72 for subscales; the correlation coefficient for the fourth factor was 0.52). Criterion-related validity was confirmed by intervention using the resistance score related to nurses’ fears of contamination from patients with radiation exposure. Construct validity was confirmed using consent to participate in the radiation exposure medical care team. Confirmatory factor analysis was conducted, and a hypothesized statistical model was found to fit the actual data. **Conclusion:** The present ASREM was determined to be appropriate for Japanese nurses and to have satisfactory reliability and validity.

I. Introduction

A severe earthquake occurred in Japan on March 11, 2011. It was the most powerful earthquake known to have hit Japan, and one of the five most powerful earthquakes in the world since modern record keeping began in 1900. The giant tsunami unleashed by the magnitude 9.0 earthquake devastated many coastal communities across a wide area of eastern Japan. As a result, approximately 16,000 people died, and approximately 2,650 people are still considered missing.¹⁾ In addition to the loss of life and destruction of infrastructure, the tsunami caused the Fukushima Dai-ichi nuclear power plant accident. Many electrical generators

were damaged, and at least three nuclear reactors suffered explosions due to hydrogen gas that had built up within their outer containment buildings after a cooling system failure. Fortunately, there were no deaths or injuries as a direct result of the nuclear plant accident. However, residents within a 20-km radius of the Fukushima Dai-ichi nuclear power plant were evacuated.²⁾

Improvement in the radiation emergency medicine system is an urgent social need in Japan. Nurses are involved with the mid- and long-term care of victims after a radiation accident, and assume an important role. The population of Japan, as the only country ever to have

been subjected to a nuclear attack, is very sensitive to the issue of radiation, and the nation has strong negative emotions toward radiation. Logical thinking about radiation is enabled by acquiring knowledge, and irrational fear of the risk is reduced; however, a sensible fear persists. Behavior has a correlative relationship with attitude, and a positive evaluation of a phenomenon promotes positive behavior. Therefore, in Radiation Emergency Medicine Education, it is necessary to provide education aimed at positive attitude formation. However, systematic Radiation Emergency Medicine Education has a history of being superficial, and empirical knowledge has not accumulated. In addition, there has not been a scale that can evaluate attitudes toward radiation emergency medicine. Suggestions that would be useful in the development of effective Radiation Emergency Medicine Education can be obtained by developing a scale for which reliability and validity can be confirmed.

II. Aim

This study aimed to develop an Attitude Scale on Radiation Emergency Medicine (ASREM) for Japanese nurses and to evaluate its reliability and validity.

III. Method

1. Preparation of the item pool

First, seven nurses who were familiar with radiation emergency medicine were interviewed in semi-structured formal interviews. We asked them their “thoughts about acceptance and the nursing of patients with radiation exposure and contamination from a radiation accident” to collect items constituting the attitudes of nurses toward radiation emergency medicine. The interviewer used an interview guide and tape-recorded the interviews. Data analysis was conducted using a qualitative descriptive method. Transcriptions of the tape-recorded interviews were coded. All codes were subsequently examined and compared for any similarities and differences, and sorted in order to identify clusters of codes. These sorted codes were used to form categories. We also extracted an item from previous studies³⁻¹⁰⁾ about behavior and the nurses’ recognition of radiation nursing and radiation exposure

when providing medical care. Based on these, we developed an original 35-item scale for assessing the attitudes of nurses toward radiation emergency medicine.

The items were assessed by using a five-point Likert scale: 0, “Disagree”; 1, “Moderately disagree”; 2, “Neither agree nor disagree”; 3, “Moderately agree”; and 4, “Agree.” For the items on negative attitudes, the scoring weights were reversed (reversed items). The weighted scores of responses marked 0, 1, 2, 3, and 4 for the reversed items were 4, 3, 2, 1, and 0, respectively. High scores indicated a more positive attitude toward radiation emergency medicine. We then sought opinions about the validity, clarity of expression, and ease of answering each item from radiation emergency medicine specialists and nursing faculty members—specifically, two graduate students of a Radiation Emergency Medicine Course, three nurses attending a 3-year Education Program for Professionals in Radiation Emergency Medicine, four nurses employed at a tertiary radiation emergency medical institution in Japan, and three nursing faculty members with experience in developing assessment scales. We then revised the wording of some of the question items and developed the Attitude Scale on Radiation Emergency Medicine (ASREM).

2. Participants

The participants were nurses who were employed by primary, secondary, and tertiary radiation emergency medical institutions in Japan, and who might provide care in the area of radiation emergency medicine. A request for cooperation with this survey was sent to 78 institutions, and 798 nurses in 31 institutions agreed to participate in the study.

3. Survey procedures

The manager of the nursing department distributed a paper questionnaire, and subjects returned the questionnaire by mail after completing it. The distributed questionnaire covered the following:

- Characteristics (age, sex, employment position, and participation in radiation emergency medicine training)
- Feelings of resistance toward assisting patients with radiation exposure and contamination
- Willingness of the nurse to accept a request to

participate as a member of a radiation emergency medicine care team

- Attitude Scale on Radiation Emergency Medicine (ASREM)

4. Statistical analysis

The statistical analyses were conducted using SPSS 20.0 J (SPSS Japan, Tokyo, Japan). The construct validity of the ASREM was examined by exploratory factor analysis and confirmatory factor analysis. Cronbach's alpha coefficient was used to test the internal consistency of each factor and that of the entire scale. The factor score of the ASREM and the characteristics of participants were compared using the *t*-test and one-way analysis of variance (ANOVA). All of the statistical tests were two-sided, and significance was defined as $p < .05$.

5. Ethical considerations

This study was approved by the Ethics Committee of Hirosaki University Graduate School of Medicine. The intent of the study was explained to the participants, and the study was conducted after obtaining informed consent.

IV. Results

1. Participant characteristics

Of the 798 questionnaires sent to 31 institutions, 403 replies were received (50.5%). The number of valid responses was 376 (response rate = 47.1%). The age of the participants was 38.1 ± 9.0 years (mean \pm SD). There were 354 female and 22 male respondents. The employment positions consisted of 277 staff nurses and 97 chief nurses or nurse managers; 2 respondents did not provide an answer for this question. The number of responders who had attended radiation emergency medicine training was 188, and the number of those who had not attended any training was 188 (Table 1).

2. Reliability and validity of the Attitude Scale on Radiation Emergency Medicine (ASREM)

A ceiling effect or a floor effect was shown for 4 of 35 items. We performed factor analysis (principal components analysis, promax rotation) using 31 of the items (excluding the 4 items having a ceiling or floor effect). An eigenvalue of >1 was set as the criterion for factor extraction, and items of low factor loading ($<.04$)

Table 1. Characteristics of the participants

($n = 376$)

Characteristics	
Mean age	38.1 \pm 9.0 (21–60)
Gender	
Female	354 (94.1)
Male	22 (5.9)
Employment position	
Staff nurse	277 (73.7)
Chief nurse or nurse manager	97 (25.8)
No response	2 (0.5)
Attended radiation emergency medicine training	
Yes	188 (50.0)
No	188 (50.0)
The resistance related to care for patients with radiation exposure and contamination	
Feel	84 (22.3)
Feel some	157 (41.8)
Do not know	56 (14.9)
Do not feel much	63 (16.8)
Do not feel any	16 (4.3)
Consent to participate as a member of the radiation emergency medicine team	
Accept	224 (59.6)
Decline or neither	152 (40.4)

Data are N (%) or mean \pm SD (range).

were excluded. A scale consisting of four factors with 25 items that could measure the attitudes of nurses toward radiation emergency medicine was subsequently obtained. The results of this factor analysis are shown in Table 2.

The following four factors comprising 25 items were finally extracted: 14 items for Factor 1, labeled “confidence in knowledge and skills,” including caring for patients with radiation exposure and contamination and providing advice to team members; 6 items for Factor 2, labeled “psychological resistance,” including resistance to caring for patients with radiation exposure and contamination; 3 items for Factor 3, labeled “responsibility as a medical professional,” including providing necessary care as professionals; and 2 items for Factor 4, labeled “interest in radiation emergency medicine,” including interest in radiation accidents and radiation emergency medicine.

The reliability of the scale was confirmed by a Cronbach's alpha internal consistency reliability coefficient of 0.93 (0.69–0.72 for subscales; the correlation coefficient for the fourth factor was 0.52). Resistance related to care for patients with radiation exposure and

Table 2. Factor loadings in the Attitude Scale on Radiation Emergency Medicine

(n = 376)

Items	Factor loading				Communality
	Factor 1	Factor 2	Factor 3	Factor 4	
Factor 1: Confidence in knowledge and skills ($\alpha = 0.94$)					
q23 When I take care of patients with radiation exposure and contamination, I think that I cannot give appropriate instructions to a team member.*	0.843	0.117	-0.223	-0.039	0.684
q31 I include knowledge and skills necessary to take care of patients with radiation exposure and contamination.	0.816	-0.002	0.068	-0.025	0.683
q15 I can image the care of patients with radiation exposure and contamination concretely.	0.788	-0.184	0.131	0.068	0.650
q30 I think that procedures necessary to prevent radiation exposure and the spread of contamination to medical personnel can be provided.	0.773	0.002	0.116	-0.095	0.594
q19 I am sure to act based on the principles of treating patients with radiation exposure and contamination.	0.767	-0.059	0.090	0.003	0.604
q17 I do not have confidence in planning the necessary care depending on the situation of patients with radiation exposure and contamination.*	0.765	0.003	-0.101	-0.015	0.537
q28 I do not think that I act without instructions on how to care for patients with radiation exposure and contamination.*	0.737	0.184	-0.015	-0.160	0.566
q21 I have no confidence to act in consideration for minimizing my radiation exposure during the care of patients with radiation exposure and contamination.*	0.725	0.175	-0.002	-0.237	0.511
q 4 When a radiation emergency medicine team is formed, I can suggest a better method for providing care.	0.702	-0.156	-0.021	0.287	0.661
q16 When a radiation emergency medicine team is formed, I can point out mistakes in assessments and care methods to a team member.	0.684	-0.101	0.009	0.175	0.561
q 5 I am sure to cope with an unexpected situation that are not covered in training of patients with radiation exposure and contamination appropriately.	0.662	-0.073	-0.011	0.165	0.524
q 7 I do not think that I can confidently reply to questions from patients with radiation exposure and contamination and their family.*	0.653	0.141	-0.213	-0.003	0.449
q 2 When I take care of patients with radiation exposure and contamination, I think that I can play my role as a member of a team.	0.555	0.029	0.059	0.279	0.608
q14 I think that I can apply my principles depending on the situation after having understood the principles of treating patients with radiation exposure and contamination.	0.414	-0.086	0.218	0.028	0.253
Factor 2: Psychological resistance ($\alpha = 0.81$)					
q35 When a place of employment determines the acceptance of patients with radiation exposure and contamination, I do not want to be engaged in care.*	-0.022	0.693	0.017	0.246	0.682
q25 After having removed contamination, I feel resistance to caring.*	-0.007	0.668	-0.023	0.027	0.443
q10 I am against a place of employment accepting patients with radiation exposure and contamination.*	-0.158	0.644	0.028	0.106	0.424
q24 When my family objects, they have a negative attitude toward my caring for patients with radiation exposure and contamination.*	0.052	0.530	0.057	0.138	0.437
q11 It is not acceptable that I am exposed to radiation while I care for patients with radiation exposure and contamination.*	0.052	0.518	0.154	0.086	0.465
q 3 When I take care of patients with radiation exposure and contamination, I think that the change from the feelings associated with normal duties is difficult.*	0.162	0.429	0.097	-0.227	0.239
Factor 3: Responsibility as a medical professional ($\alpha = 0.69$)					
q33 In the case of an emergency, I think that it is necessary to undertake responsibilities in addition to those I have as a nurse.	-0.053	0.036	0.663	-0.018	0.431
q32 When there is not a method to completely avoid radiation exposure, I provide the necessary care.	0.024	0.137	0.631	-0.047	0.479
q22 If it is a very small amount of radiation exposure, I provide the necessary care.	-0.030	0.134	0.501	0.047	0.353
Factor 4: Interest in radiation emergency medicine ($r = 0.52$)					
q 1 If there is an opportunity to experience radiation emergency medicine, I want to provide care positively.	0.054	0.230	-0.076	0.637	0.566
q 9 I am interested in radiation accidents and radiation emergency medicine.	0.061	0.086	0.077	0.497	0.385
Correlation of factors					
Factor 2	0.425				
Factor 3	0.323	0.493			
Factor 4	0.508	0.421	0.522		

*: Reversed items

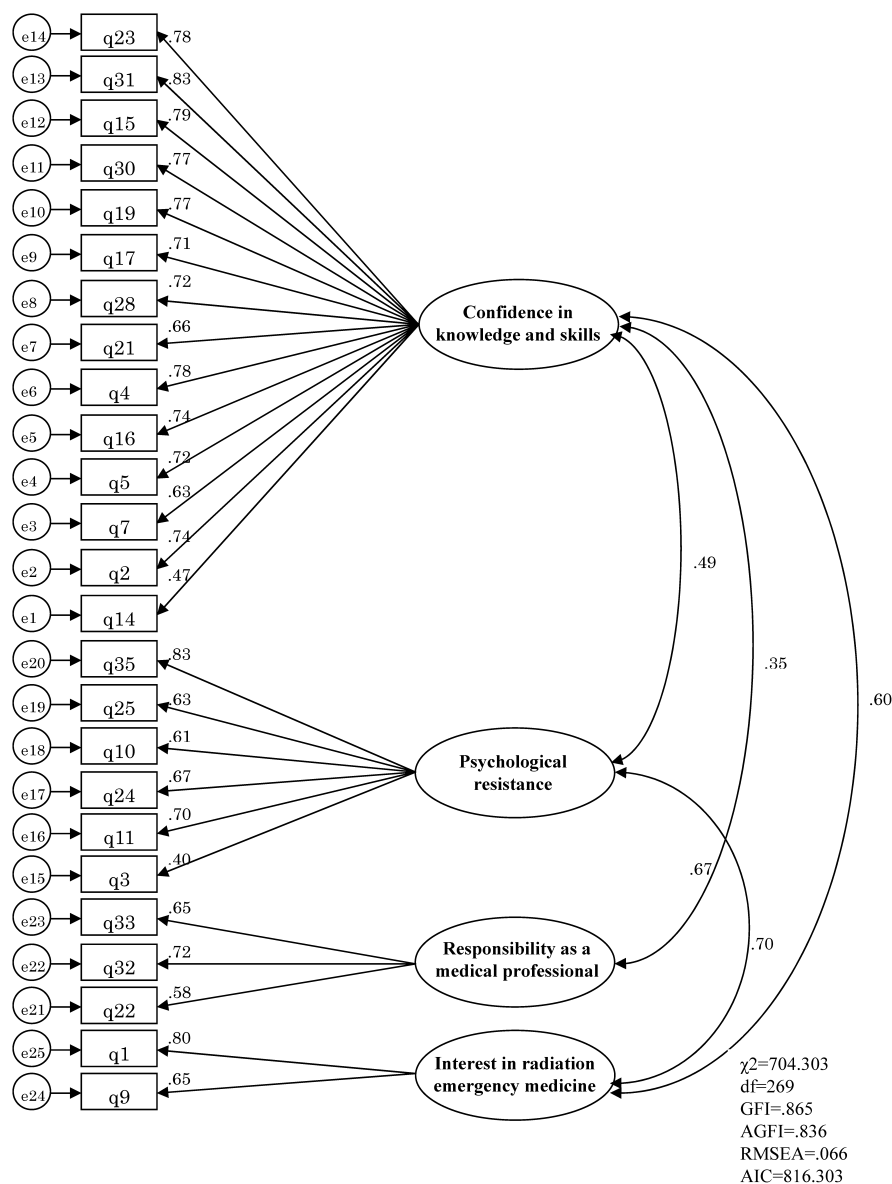


Figure 1. The confirmatory factor analysis for the ASREM

contamination was evaluated by a five-point Likert scale: 0, “Feel”; 1, “Feel some”; 2, “Do not know”; 3, “Do not feel much”; and 4, “Do not feel any.” We calculated this as the care resistance score. The total ASREM score and the care resistance score revealed a moderately significant correlation ($0.546, p<.01$). We asked whether the study participant consented when there was a request to participate as a member of the radiation emergency medicine team. The score for “Accept” (2.10 ± 0.65) was significantly higher than the score for “Decline or neither” (1.45 ± 0.53) ($p<0.001$). Regarding construct validity, second-order confirmatory factor analysis showed adequate model fit (goodness of fit index (GFI)

= .865, adjusted goodness of fit index (AGFI)= .836, root mean square error of approximation (RMSEA) = .066). These data are summarized in Figure 1.

3. Comparison of the participants’ characteristics

The mean scores for the ASREM factors were 1.46 ± 0.85 for “confidence in knowledge and skills,” 2.37 ± 0.82 for “psychological resistance,” 2.45 ± 0.83 for “responsibility as a medical professional,” and 1.99 ± 1.02 for “interest in radiation emergency medicine.”

From the comparison of the participants’ characteristics, the first factor, “confidence in knowledge and skills,” had a significantly higher score for individuals

Table 3. Correlates of ASREM

(n = 376)

	Factor 1	Factor 2	Factor 3	Factor 4	Total score
Age (n)					
20–29 (72)	1.09 ± 0.77	2.26 ± 0.83	2.49 ± 0.82	1.90 ± 1.09	1.60 ± 0.65
30–39 (142)	1.48 ± 0.85*	2.33 ± 0.76 n.s.	2.37 ± 0.88 n.s.	2.00 ± 1.05 n.s.	1.83 ± 0.69 n.s.
40–49 (109)	1.56 ± 0.81***	2.43 ± 0.81 n.s.	2.48 ± 0.74 n.s.	2.03 ± 0.92 n.s.	1.93 ± 0.65*
50–60 (52)	1.66 ± 0.89**	2.56 ± 0.88 n.s.	2.59 ± 0.80 n.s.	2.02 ± 1.09 n.s.	2.02 ± 0.71**
Employment position					
Staff nurse (277)	1.35 ± 0.83	2.27 ± 0.80	2.36 ± 0.86	1.90 ± 1.05	1.73 ± 0.68
Chief nurse or nurse manager (97)	1.77 ± 0.83***	2.66 ± 0.78***	2.70 ± 0.70***	2.24 ± 0.89**	2.14 ± 0.61***
Radiation emergency medicine training					
Participation (188)	1.80 ± 0.89	2.52 ± 0.85	2.53 ± 0.81	2.29 ± 1.01	2.10 ± 0.73
No participation (188)	1.12 ± 0.65***	2.22 ± 0.75***	2.37 ± 0.84 n.s.	1.71 ± 0.95***	1.58 ± 0.52***

Factor 1: Confidence in knowledge and skills, Factor 2: Psychological resistance, Factor 3: Responsibility as a medical professional, Factor 4: Interest in radiation emergency medicine. The values are the item mean ± SD. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, n.s.: not significant. Factors for age were compared using an ANOVA; a significant difference was found between those 20–29 years old and those in the older age groups. Differences in “Employment position” and “Radiation emergency medicine training” were compared using a non-paired *t*-test.

aged ≥ 30 years compared with individuals aged < 30 years. From the comparison of the employment positions, all factors had a significantly higher score for the chief nurses or nurse managers compared with the scores for staff nurses. Furthermore, all factors except “responsibility as a medical professional” had a significantly higher score for individuals who had attended the radiation emergency medicine training compared with individuals who had not attended the training (Table 3).

V. Discussion

1. Factor structure and characteristics of the ASREM

In the present study, we developed the ASREM using four factors with 25 items from the results of questionnaire responses from 376 nurses. The ASREM can measure the opinions about and preparedness for radiation emergency medicine that direct an individual's behavior. The four factors constituting the ASREM are “confidence in knowledge and skills,” “psychological resistance,” “responsibility as a medical professional,” and “interest in radiation emergency medicine.”

“Confidence in knowledge and skills” includes items asking about the degree of confidence in being able to perform the following activities:

- perform nursing intervention for patients with radiation exposure and contamination
- act based on principle

- demonstrate practical ability to deal with unexpected situations
- minimize the radiation exposure of medical personnel
- conduct measures for extended contamination prevention
- take on an active role as a member of a radiation emergency medicine team
- collaborate with team members
- support and advise team members

Because the medical care for radiation exposure is different than ordinary medical care, there are few persons who have accumulated sufficient experiential knowledge through practice. Radiation education is effective for reducing a nurse's anxiety.^{11–13)} The radiation safety training intervention has been found to be effective for increasing cognitive knowledge, but less effective at improving overall attitude.³⁾ Education designed to merely provide knowledge does not result in change of attitude. Therefore, we believe that influencing attitudes toward this type of care is related to how realistically medical care personnel can visualize the situation, in other words, whether they can imagine providing appropriate care for patients with radiation exposure or contamination. Furthermore, so that nurses can have a realistic image, it is essential for them to have confidence in dealing with radiation and radiation protection, and have basic knowledge and skills about radiation emergency medicine.

“Psychological resistance” includes the following:

- having a feeling of psychological resistance toward care of patients with radiation exposure and contamination, and toward oneself being exposed to radiation through providing care
- believing the care of patients with radiation exposure and contamination is different from normal care

Nurses have anxiety concerning occupational exposure.¹¹⁾ Kanda et al.⁸⁾ describe it as follows. Nurses who have accumulated awareness of the risk, knowledge of radiation, and experience regarding the effects have anxiety about radiation similar to the anxiety found in women generally. Nurses have the potential ability to rationally distinguish acceptable risks from unacceptable ones and to have limited concern regarding the unacceptable aspects of radiation, based on their professional experience and knowledge. However, despite the minimal risk associated with caring for exposed individuals,¹⁴⁾ many nurses have significant anxiety related to treating patients who have been exposed to radiation. Psychological resistance to a phenomenon increases when the phenomenon is unknown and is associated with fear. Thus, the vague anxiety about radiation and radiation exposure will decrease if knowledge about radiation and radiation protection, as well as basic knowledge and skills about radiation emergency medicine, are acquired. By thinking logically through the process of acquiring knowledge, the anxiety and negative feelings directed toward the crisis are reduced. However, a sensible fear persists. We believe that anxieties and fears become the basis of resistance against caring for patients with radiation exposure and contamination.

“Responsibility as a medical professional” includes the following:

- when a small amount of radiation exposure to oneself is inevitable, provide the necessary care to the patient
- during an emergency, perform activities beyond those of nursing

Responsibility as a medical professional includes “duty.” Duty is required to perform a particular function. Duty is not only a social contract to care for patients, but also a

responsibility to coworkers and to the profession.^{15,16)}

During a crisis, nurses give top priority to medical treatment for patients only if they can be convinced that secondary radiation exposure to themselves will not damage their health. We believe that this behavior is equivalent to the social accountability demanded of healthcare professionals.

“Interest in radiation emergency medicine” includes the following:

- degree of interest in radiation emergency medicine

We believe that an individual who is made aware of radiation emergency medicine as part of the scope of nursing is more likely to have a positive attitude toward this type of medical care.

2. Reliability and validity of the ASREM

In the present study, the Cronbach’s alpha coefficient for the entire scale was 0.93, while it was 0.69–0.94 for the subscales. The correlation coefficient for the fourth factor was 0.52. Factors 3 and 4 were comprised of three and two items, respectively, which was considered to be a small number of items. Therefore, we believe the reliability is good.

We believe that the content validity is confirmed for the following reasons: 1) the ASREM was developed with items from an original scale from a previous study, and from the results of interviews with nurses who were familiar with radiation emergency medicine; and 2) a positive opinion was obtained regarding the ASREM from a radiation emergency medicine expert and nursing faculty members.

Furthermore, there are no other scales that can measure both positive and negative attitudes that direct behavior regarding radiation emergency medicine. Therefore, we investigated the degree of resistance to caring for patients with radiation exposure and contamination. Because this score and the ASREM revealed a significant correlation, we believe that the criterion-related validity was confirmed.

Moreover, attitudes and behavior influence each other and are thought to be directly related to positive outcomes in given situations. However, we could not observe real behavior because radiation emergency medicine is not a daily phenomenon. Participants were asked if they would participate in a radiation emergency

medical team and could respond “participate,” “decline,” or “neither.”

Based on dividing the study participants into an aggressive group and a non-aggressive group for radiation emergency medicine, the ASREM score was found to be significantly higher in the aggressive group. Confirmatory factor analysis was conducted, and a hypothesized statistical model was found to fit the actual data. Thus, it can be concluded that the construct validity was confirmed.

3. Attitudes of nurses toward radiation emergency medicine

The average scores for “psychological resistance” and “responsibility as a medical professional” of the ASREM exceeded an intermediate value (two points). Therefore, when care of patients with radiation exposure and contamination is requested, it was found that respondents could overcome their “psychological resistance” and provide care under “responsibility as a medical professional.” On the other hand, there was no “confidence in knowledge and skills” for care and team-based care for patients with radiation exposure and contamination, and “interest in radiation emergency medicine” care was low. The chief nurses or nurse managers had significantly higher scores for all factors and a significantly higher total score than those who participated in the radiation emergency medicine training. Those who participated had significantly higher scores than those who did not participate.

Furthermore, because older individuals had a significantly higher score for “confidence in knowledge and skills,” compared with younger individuals, it was inferred that age, employment position, and participation in radiation emergency medicine training influenced the formation of a positive attitude toward radiation emergency medicine.

Anxiety is generally exacerbated by insufficient knowledge regarding the true effects of radiation, inability to recognize radiation injuries, or lack of relevant clinical experience with patients involved in radiological incidents.¹⁷⁾ Confidence usually develops from familiarity and experience. However, experience with radiation emergency medicine is not something that can be obtained routinely. For nurses in situations which

they have not experienced previously, they can rely on their years of clinical experience and have confidence that they can cope. Leaders and nurses in management, compared with staff nurses, feel a commitment to their institution and responsibility, not only as employees but also as medical professionals, which affects their behavior. Participation in training also has a large effect on behavior.

In the present study, we did not ask about the contents of the training; however, the contents seemed to be concerned with basic knowledge and skills about radiation, radiation protection and radiation emergency medicine, and simulation of the hospitalization of patients with radiation exposure and contamination. Training to perform a particular skill or task precedes the performance of duty. By taking part in a training event at least once, participants can better visualize radiation emergency medicine and form a more positive attitude toward radiation emergency medicine.

Nurses’ willingness to respond (*i.e.*, willingness to report to work during a radiological emergency) was positively associated with perception of personal safety.⁵⁾ So that nurses can accomplish their occupational duty in a difficult situation, it is essential for nursing administrators to protect their staff members.¹⁸⁾ The existence of a system and creation of policies for radiation emergency care in the institutions where nurses work are important factors for promoting a positive attitude.

4. Limitations of this study and future issues

In the process of developing the scale, the items that showed strong deflection or had low factor loading were deleted by item analysis and factor analysis. Although it is important to examine these as attitudes toward radiation emergency medicine, some items were excluded because the discriminative power was low. Therefore, not all attitudes toward radiation emergency medicine were included in the items. Further attention is required to expand the use of this tool.

It should also be noted that the developed scale does not assess actual behavior; rather, it assesses how respondents expect to prepare for a hypothetical disaster during the “calmness phase,” when an accident or disaster is not ongoing. Therefore, it does not reflect

actual behavior during real radiation emergencies. Because it was found that participation in training influences an individual's attitude toward radiation emergency medicine, we believe that the ASREM can be used as a tool for evaluating the effect of training to promote a positive attitude toward radiation emergency medicine.

VI. Conclusion

We developed a scale to measure personal attitudes toward radiation emergency medicine, and examined its reliability and validity. The four factors comprising 25 items for the ASREM were "confidence in knowledge and skills," "psychological resistance," "responsibility as a medical professional," and "interest in radiation emergency medicine." The ASREM has good reliability and validity. The participants in the present study demonstrated responsibility as medical professionals and experienced little psychological resistance to radiation emergency medicine, although they lacked confidence in their knowledge and skills. We also found that age, employment position, and participation in radiation emergency medicine training influenced the attitudes of the participants toward radiation emergency medicine. The present ASREM was determined to be appropriate for Japanese nurses and to have satisfactory reliability and validity.

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