

ORIGINAL ARTICLE

Nurse's difficulty and their educational needs regarding pediatric cancer care in Japan

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Abstract

Aim: Aiming at environmental arrangements for pediatric cancer patients and their families to receive appropriate medical care and support with a sense of security, the Japanese Ministry of Health, Labour, and Welfare designated 15 hub hospitals for childhood cancer. These hub hospitals have established networks with approximately 200 centers/hospitals treating pediatric cancer. In order to promote equal access to nursing, we investigated nurses' difficulties and needs at these treatment hospitals with limited experience in pediatric cancer nursing.

Methods: In order to examine education on pediatric cancer nursing, we investigated difficulties felt by treatment hospital nurses, their educational experience and their educational needs. A total of 584 nurses (66.51%) from 52 hospitals from which written consent was received completed the questionnaires.

Results: Nurses had difficulties regarding nursing care for patients with critical conditions, such as terminal care, and actions to be taken when a patient's physical condition rapidly changes. Nurses most strongly desired education on nursing care for patients with serious problems, such as terminal care, and follow-up provided in the form of in- and hub-hospital lectures.

Conclusion: Our study suggested that in order to provide nurses in treatment hospitals with education focusing on nursing care for patients with serious problems, education systems based on cooperation between hub and treatment hospitals are needed.

KEYWORDS

cancer care facilities, education, needs assessment, pediatric nursing

1 | INTRODUCTION

The cure rate of pediatric cancer has markedly improved (Siegel, Miller, & Jemal, 2015; Smith et al., 2010; Ward, DeSantis, Robbins, Kohler, & Jemal, 2014), but pediatric cancer patients have several physical and psychosocial problems not only during treatment but also after treatment

(Bitsko et al., 2016; Bryant, 2003; Hudson et al., 2013; Ness et al., 2009; Patenaude & Kupst, 2005; Phipps, Long, & Ogden, 2007; Stuber et al., 2010; Zeltzer et al., 2009). Issues regarding these patients exist from disease onset through to their future and it is therefore important for them to receive high-quality treatment in their hometown from the perspective of their and their families' quality of life (QOL).

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In Japan, 2,000 to 2,500 children develop pediatric cancer each year, and they receive treatment at approximately 200 facilities. The imbalance between the incidence of pediatric cancer and number of medical institutions addressing it suggests that pediatric cancer care is being provided without sufficient experience, and pediatric cancer patients are not necessarily receiving appropriate care (Childhood cancer expert committee, Cancer Control Promotion Council, 2012).

Therefore, aiming at environmental arrangements for pediatric cancer patients and their families to receive appropriate medical care and support with a sense of security, the Japanese Ministry of Health, Labour, and Welfare designated 15 hub hospitals for childhood cancer (hub hospitals) from seven regions throughout Japan as main regional facilities providing pediatric cancer treatment in 2013 (Study Group on designation of childhood cancer hospitals, 2013).

Hub hospitals are expected to play leading roles in community-based pediatric cancer care, and improve the quality of medical services for patients with pediatric cancer throughout Japan. They provide multidisciplinary treatment, integrating different approaches, such as surgical therapy, chemotherapy, and radiotherapy, and organize palliative care teams. At many hub hospitals, multiple professionals, including nurses specializing in pediatrics, child life specialists, early childhood education and care workers, and clinical psychologists (Childhood cancer expert committee, Cancer Control Promotion Council, 2012), are engaged in care services, and nursing in terminal care and support for return to school have been reported to date as part of their activities (Gotoh, Shiwaku, & Matsumoto, 2018; Yamasaki & Naragino, 2014).

In order to promote uniform accessibility of pediatric cancer treatment, the Basic Plan to Promote Cancer Control Programs in Japan (Ministry of Health, Labour, and Welfare, 2012) recommends that the treatment environment for all pediatric cancer patients and survivors be provided in a manner in order for them to receive appropriate and specialized medical and nursing care regardless of their residential areas. (Childhood cancer expert committee, Cancer Control Promotion Council, 2012).

Accordingly, hub hospitals as central community facilities are expected to establish networks with medical institutions providing pediatric cancer care in communities and support their clinical functions in order for pediatric cancer patients to receive medical services and support in living and educational environments that are familiar to them as much as possible.

Regarding nursing in hospitals treating pediatric cancer (treatment hospitals), a hearing survey involving 19 treatment hospitals in a certain region out of seven regions throughout Japan was carried out (Sasaki et al.,

2016). The following challenges faced by nurses in pediatric cancer nursing practice were reported: care according to each developmental stage, relationships with medical staff, such as collaboration and nurse education, family support, infection control, long-term follow-up, and individualized care such as symptom control.

Based on this survey, Sasaki et al. (2016) conducted an educational program addressing pediatric cancer nursing consisting of lectures (on the current status of pediatric cancer nursing, explanation for and management of children and their families, and psychosocial issues related to adolescents and their families) and group work (long-term follow-up and infection control) to educate 32 nurses at 17 treatment hospitals in this region.

According to the website of the National Center for Child Health and Development, the annual mean number of pediatric inpatients with pediatric cancer treated in 2016 at 15 hub hospitals is 498.6, whereas the number at 116 treatment hospitals is 83.6, suggesting difficulty related to education for pediatric cancer nursing faced by treatment hospitals (Childhood cancer expert committee, Cancer Control Promotion Council, 2012; Sasaki et al., 2016). In hub hospitals, multiple professionals provide multidisciplinary treatment, and nurses integrate different approaches for children and their families and play trailblazing roles in difficult issues such as terminal care (Ministry of Health, Labour, and Welfare, 2012). On the other hand, it is considered that in treatment hospitals, nurses have concerns regarding the wide range of care from infection control to long-term follow-up (Sasaki et al., 2016).

Although the government recommends that all pediatric cancer children and survivors receive appropriate care regardless of their residential areas, this study revealed a gap in nursing care between hub hospitals and treatment hospitals. In order to improve the QOL of children and their families, closure of this gap is necessary. As education programs are useful for nurses concerned with pediatric cancer nursing practice in treatment hospitals, the present study examined the current status of such education and the needs of nurses working at these hospitals throughout Japan.

The clarification of nurses' difficulties and needs at treatment hospitals with limited experience in pediatric cancer nursing may be important to promote equal access to such nursing. The originality of this study lies in the identification of challenges in nursing education at treatment hospitals on a nationwide basis.

Considering this background, we investigated difficulties in caring for pediatric cancer patients felt by treatment hospital nurses, and their educational experiences and needs in order to assess the cooperation between hub hospitals, education systems for pediatric cancer nursing at treatment hospitals, and the promotion of education for pediatric cancer nursing at treatment hospitals.

In the present study, care-related difficulties felt by nurses were defined as “difficulties faced by nurses during pediatric cancer nursing practice” and education support in pediatric cancer nursing was defined as “the content of education and educational approaches to resolve difficulties faced by nurses during pediatric cancer nursing practice”.

2 | METHODS

2.1 | Study design: Descriptive survey

The present article partially reports the results of an investigation: difficulties felt by pediatric cancer treatment hospital nurses and their support needs, which was carried out from September to November, in 2016. This article reports the contents of pediatric cancer nursing education provided for pediatric cancer treatment hospital nurses and their educational needs.

2.2 | Participants and measures

Nurses at 146 treatment hospitals described in the community pediatric cancer plans of seven regions were recruited in the investigation.

Inclusion criteria were nurses with more than 1 year of nursing experience working in a pediatric ward in a general hospital or a ward for cancer and blood diseases in a pediatric hospital. Exclusion criteria were nurses with less than 1 year of nursing experience after graduation. The Guidelines for Novice Nurse Training, created by the Ministry of Health, Labour, and Welfare, organize an education curriculum for nurses in their first year to acquire general knowledge and technical skills (Ministry of Health, Labour, and Welfare, 2014). They also establish education for nurses with clinical experience of 2 years or longer to acquire experiences and knowledge in specialty areas. Based on these guidelines, we considered that new nurses would not be an accurate source of information to identify the educational needs of treatment hospital pediatric cancer nurses due to marked anxiety and limited experience in pediatric cancer nursing.

Head nurses of a pediatric ward or a ward for cancer and blood diseases were asked about: type of hospital, equipment and function of their hospital, as well as the professions and the number of them, and activities of hospital staff members. As general information on hospitalized pediatric cancer patients in 2015, we investigated the number of these patients, and grouped these patients according to each disease (leukemia, neuroblastoma, lymphoma, brain tumors, and others).

Nurses with more than 1 year of nursing experience were asked about their age, gender, years of nursing experience, and years of working at a pediatric ward or a ward for cancer and blood diseases. Treatment hospitals include pediatric hospitals, university hospitals, and general hospitals. Considering that the only children's hospital in the target bloc was included in the recruited hospitals, and that nurses of pediatric hospitals work in hematology wards, we did not ask respondents to clarify their wards in the questionnaire to maintain the anonymity of nurses working at children's hospitals.

Based on the difficulties and stresses felt by pediatric cancer nurses, as well as findings concerning pediatric cancer nursing education programs, we selected 30 items regarding difficulties in pediatric cancer nursing, examples of which were: managing of central venous catheters (Day et al., 2012; Day, Segovia, Viveros, Alqudimat, & Rivera, 2013), chemotherapy nursing care (Day et al., 2012, 2013; Gibson et al., 2013), hematopoietic stem cell transplantation (Huang, Kellett, Wang, Chang, & Chih, 2014), preparation for procedures (Japanese Society of Pediatric Oncology Nursing, 2012), support for long-term follow-up (Maru et al., 2013), terminal care (Gibson et al., 2013; Hinds et al., 1990; Tomlinson, 2004), communication with children and their families (Citak, Toruner, & Gunes, 2014), and support for learning and playing (Japanese Society of Pediatric Oncology Nursing, 2012).

The level of difficulty was assessed on a four-point scale from 1 to 4 (1: Strongly disagree, 2: Disagree, 3: Agree, 4: Strongly agree).

Concerning educational experience in pediatric cancer nursing, we inquired with the participants about their experience regarding 30 items similar to difficulties in pediatric cancer nursing in the following seven educational approaches: lectures (Day et al., 2012; McInally, Masters, & Key, 2012; Tomlinson, 2004), skill seminars and role-playing (McInally et al., 2012; Wilimas et al., 2003), e-learning (Day et al., 2012), attending academic conferences, and training in hub hospitals (Day et al., 2013). Based on these findings, we asked the respondents about their education experiences related to lectures, skill seminars, and role-playing in treatment/hub hospitals. As for training, we examined related experiences at hub hospitals treating a larger number of inpatients with pediatric cancer. In contrast, we included e-learning and attending academic conferences in the choices, as it is possible to participate in these activities personally. We asked the nurses about their education experiences using a two-point scale: Yes/No. Similar to the above-mentioned 30 items, we selected 30 items regarding desired education on pediatric cancer nursing. The level of desire for each educational approach was assessed on a four-point scale from 1 to 4 (1: Strongly disagree, 2: Disagree, 3: Agree, 4: Strongly agree).

2.3 | Procedure

We sent the study protocol, questionnaire, consent form, withdrawal document, and the sheet to write down the number of nurses to directors of the nursing department at 146 treatment hospitals by mail, and requested them by telephone to participate in the study. We sent questionnaires to hospitals from which written consent was received asking the directors of their nursing departments to respond to a questionnaire for head nurses, and distribute copies of another questionnaire among nurses. We asked the nurses to respond to the latter questionnaire, and insert their sealed responses into a return envelope for response collection. To protect the anonymity of the investigated hospital, we also asked the head nurses to send sealed return envelopes back to a third party at the research facility. The third party opened the return envelope with the investigated hospital written as the sender, and handed only sealed responses to the researchers. Each response was regarded as consent from a respondent to cooperate with the study.

2.4 | Ethical considerations

The completed questionnaires were returned to a third party from each researcher's facility. The researcher only received responses from the third party. The questionnaire was completed anonymously, with considerations being made to prevent the identification of the participants and their hospitals.

The present study was conducted with the approval of Ethics Committee for Epidemiology of Hiroshima University (approval date: August 23, 2016, and approval number: E-469).

2.5 | Statistical analysis

In order to analyze the similarities of 30 items for difficulties or educational needs, an exploratory factor on difficulties in and desired education on pediatric cancer nursing was used to extract the factor solution. The feasibility of factor analysis to interpret the similarities was examined by the following analytical approaches: EFA (exploratory factor analysis) was performed using a polychoric correlation due to the categorical nature of the data: four-category Likert scales. Because unweighted least-squares on EFA makes no assumptions of normality and is feasible with large samples, unweighted least-squares were used for factor extraction as an estimation method, along with a promax rotation. The decision on how many factors to retain was guided by the use of

Cattell's Scree method, and the Kaiser rule (factors with an eigenvalue greater than or equal to 1.0 to be retained). Factor solutions were interpreted with salient factor pattern loadings greater than 0.45. To confirm factor reliability, Cronbach's alpha values were calculated.

Factors on difficulties in and desired education on pediatric cancer nursing were compared using the Friedman test. If the difference among factors was significant, the Wilcoxon signed rank test was performed as a post-hoc paired comparison (Benavoli, Corani, & Mangili, 2016; Kim, 2014) and the Bonferroni-corrected alpha level was applied for each comparison.

According to the seven educational approaches, multiple correspondence analysis was performed to investigate the correlations among the 30 items regarding educational experience in pediatric cancer nursing. For all analyses, SAS 9.4 was used.

3 | RESULTS

By mail and telephone, we requested directors of the nursing department at 146 pediatric cancer treatment hospitals to participate in the study and, as a result, 58 hospitals declined our request. The directors' reasons for declining when asked for cooperation by telephone included: there were no pediatric cancer patients (28 hospitals), it would be a heavy burden for nurses to participate in the study (11 hospitals), no investigation was acceptable (nine hospitals), no external investigation was acceptable (six hospitals), and the number of hospitalized pediatric cancer patients was low (three hospitals). In addition, one hospital required approval from its ethics committee to cooperate with surveys conducted by other facilities. As the ethics committee did not meet during the study period, we were unable to investigate this hospital. Of the 88 hospitals that considered study cooperation, 54 provided consent (61.36%). Thirty-four of these did not return their consent forms for unknown reasons. The questionnaire was distributed to 54 head nurses and 878 nurses from the 54 hospitals. As a result, 46 head nurses (response rate: 85.19%) and 584 nurses from 52 hospitals (response rate: 66.51%) provided completed questionnaires.

3.1 | Demographic variables of the investigated hospitals and participants

Of the investigated institutions, 24 were university hospitals (52.17%) and 11 (23.91%) were in the Chugoku or Shikoku region (Table 1). The annual number of hospitalized pediatric cancer patients for 2015 was

26.20 ± 25.58. Their diseases were: leukemia ($n = 14.56 \pm 18.46$), neuroblastoma ($n = 2.71 \pm 4.63$), lymphoma ($n = 2.43 \pm 3.10$), and brain tumors ($n = 1.79 \pm 3.17$). Their age ranges were: 0–6 ($n = 13.05 \pm 13.68$), 7–14 ($n = 8.84 \pm 9.81$), 15–29 ($n = 3.22 \pm 5.06$), and ≥ 30 ($n = 0.14 \pm 0.51$) years. Some patients were adolescents and young adults with cancer.

The participants comprised 541 women (95.92%), and the number of those in their 20s was 275 (47.33%) (Table 2). The duration of working as a nurse was less than 5 years for the highest percentage of participants ($n = 183$, 31.5%). The average duration of working in a pediatric ward or a ward for cancer and blood diseases was 5.67 ± 4.87 years.

3.2 | Difficulties in caring for pediatric cancer patients

Regarding the 30 items for difficulties in caring for pediatric cancer patients, the polychoric correlation coefficient matrix was generated, and EFA (non-weighted least-squares method, promax rotation) was performed. On the basis of Catell's scree test, it was decided to extract five factors, as the decrease of plotted eigenvalues appeared to level off after factor five. Likewise, a five-factor structure was obtained in accordance with the final eigenvalues, which were higher than 1.0, the reference value set by the Kaiser rule. As EFA was performed to identify similarities among the 30 items, rather than developing a scale, a two-factor solution was not adopted for item exclusion. Factor 1 comprised seven items (e.g., terminal care and actions to be taken when a patient's physical condition rapidly changes), and was named [Nursing care for patients with critical conditions] (Table 3). Factor 2 comprised eight items (e.g., learning

support for elementary and junior high school students), and was named [Play and learning]. Factor 3 comprised seven items (e.g., chemotherapy: care for diarrhea and constipation), and was named [Chemotherapy nursing]. Factor 4 comprised six items (e.g., support for procedures such as bone marrow puncture), and was named [Challenging communication]. Factor 5 comprised two items (care for graft-vs.-host disease and infection control adopted at the time of hematopoietic stem cell transplantation), and was named [Nursing care for patients undergoing stem cell transplantation]. Cronbach's alpha values for each factor and 30 items were $\geq .82$.

As the five factors compared using the Friedman test were significantly different, the Wilcoxon signed rank test was performed at a significance level of .005 using the Bonferroni correction. The significant differences among the five factors were indicated by different letters.

The level of difficulty was significantly higher for [Nursing care for patients with critical conditions] compared with the other four factors ($p < .0001$). The level of difficulty was significantly higher for [Nursing care for patients undergoing stem cell transplantation] compared with [Play and learning], [Chemotherapy nursing], and [Challenging communication] ($p < .0001$).

3.3 | Educational experience in pediatric cancer nursing

When focusing on in-hospital lectures, the experience rate was 20% or higher for 14 items (Table 4). As for in-hospital skill seminars and role-playing, the experience rate was 20% or higher for four items. The rates for e-learning as a self-learning method and attending academic conferences ranged from 0 to 15%. Few nurses received education at hub hospitals.

TABLE 1 Demographic variables of the investigated hospitals and participants $N = 584$

Variables	Items	<i>n</i>	%
Type of hospital	University hospital	24	52.17
	National and public hospital	13	28.26
	Other	9	19.57
Region (the number of pediatric cancer hospitals)	Hokkaido (15)	1	2.17
	Tohoku (19)	5	10.87
	Kanto and Koshinetsu (33)	10	21.74
	Tokai and Hokuriku (17)	5	10.87
	Kinki (27)	6	13.04
	Chugoku and Shikoku (17)	11	23.91
	Kyushu and Okinawa (18)	8	17.39

Note: Due to missing values, the total numbers and percentages are different among the items.

Variables	Items	n	%
Gender	Male	23	4.08
	Female	541	95.92
Age	20s	275	47.33
	30s	159	27.37
	40s	110	18.93
	≥50s	37	6.37
Duration of working as a nurse (years)	<5	183	31.5
	≥5, <10	144	24.78
	≥10, <15	89	15.32
	≥15, <20	49	8.43
	≥20, <25	60	10.33
	≥25	56	9.64
Duration of working in a pediatric ward (years)	Mean, SD	5.67	4.87

Note: Due to missing values, the total numbers and percentages are different among the items.

In order to summarize the detailed contents of the educational approaches, multiple correspondence analysis of the 30 items was performed according to each approach. To classify the nurses' education experiences related to the 30 items by correspondence analysis, we used the same names for categories of approaches with many identical items.

"In-hospital lectures" comprised the following three clusters: [Symptom management], [Psychosocial care], and [Learning support]. Concerning [Symptom management], a high percentage of participants had learned about actions to be taken when a patient's physical condition rapidly changes ($n = 313$, 53.6%), and the management of central venous catheters ($n = 282$, 48.3%). "In-hospital skill seminars and role-playing" comprised the following two clusters: [Symptom management] and [Psychosocial care]. Concerning [Symptom management], 193 (33.1%), 167 (28.6%), and 148 (25.3%) participants had learned about actions to be taken when a patient's physical condition rapidly changes, the management of central venous catheters, as well as sampling blood from children and securing an intravenous route, respectively.

"E-learning" comprised the following clusters: [Symptom management], [Play and learning], and [Communication]. "Attending academic conferences" comprised the following clusters: [Symptom management], [Psychosocial care], and [Play, learning and communication]. "Lectures in hub hospitals" and "Skill seminars and role-playing in hub hospitals" comprised the following clusters: [Symptom management], [Psychosocial care]. "Training in hub hospitals" comprised the following clusters: [Symptom management], [Psychosocial care], and

TABLE 2 Demographic variables of the investigated hospitals and participants $N = 584$

[Learning support]. Participants hardly experienced e-learning and three educational approaches in hub hospital.

3.4 | Desires regarding education on pediatric cancer nursing

Regarding the 30 items of desires regarding education on pediatric cancer nursing, the polychoric correlation coefficient matrix was generated, and EFA (non-weighted least-squares method, promax rotation) was performed. On the basis of Catell's scree test, it was decided to extract three factors, as the decrease of plotted eigenvalues appeared to level off after factor three. Likewise, a three-factor structure was obtained in accordance with the final eigenvalues, which were higher than 1.0, the reference value set by the Kaiser rule. As EFA was performed to identify similarities among the 30 items, rather than developing a scale, a two-factor solution was not adopted for item exclusion. Factor 1 comprised 13 items (e.g., learning support for elementary and junior high school students), and was named [Care for psychosocial development] (Table 5). Factor 2 comprised seven items (e.g., disclosure of negative news to children), and was named [Nursing care for patients with serious problems]. Factor 3 comprised 10 items (e.g., chemotherapy: care for diarrhea and constipation), and was named [Management of treatment-related adverse events]. Cronbach's alpha values for each factor and 30 items combined were $\geq .97$.

To compare the level of difficulty among the factors, scores representing the level of desire for education

among the factors, and scores for factors representing different educational content among the six educational approaches, we used Wilcoxon signed rank test and Bonferroni correction. When using Bonferroni correction,

we compared the level of difficulty among the five factors at a significance level of .005, the level of desire for education among the three factors at .017, and the level of desire among the six educational approaches at .003.

TABLE 3 Difficulties in caring for pediatric cancer patients $N = 584$

Factor	Items	F1	F2	F3	F4	F5	C	Mean	SD	
Nursing care for patients with critical conditions (F1) $\alpha = .90$								3.7	0.44	A
	Terminal phase: mental care	0.9	0.18	0.15	0.16	0.11	0.9	3.75	0.54	
	Disclosure of negative news to children	0.87	0.24	0.24	0.11	0.06	0.88	3.76	0.5	
	Care for families who have lost their children	0.85	0.16	0.03	0.21	0.2	0.84	3.76	0.53	
	Terminal phase: pain control	0.85	0.19	0.14	0.12	0.16	0.82	3.67	0.6	
	Disclosure of negative news to families	0.84	0.18	0.21	0.17	0.09	0.83	3.72	0.53	
	Mental care provided at the time of cancer recurrence	0.76	0.21	0.28	0.19	0.14	0.76	3.7	0.55	
	Actions to be taken when a patient's physical condition rapidly changes	0.49	0.12	0.23	0.33	0.36	0.54	3.55	0.68	
Play and learning (F2) $\alpha = .90$								2.83	0.58	D
	Learning support for elementary and junior high school students	0.14	0.89	0.17	0.19	0.07	0.88	2.77	0.75	
	Learning support for high school students	0.15	0.8	0.16	0.08	0.07	0.7	2.98	0.8	
	Support for children's play	0.16	0.73	0.13	0.37		0.72	2.73	0.75	
	Support for returning to kindergarten/school	0.34	0.66	0.14	0.34	0.13	0.71	2.89	0.72	
	Support for lifestyle acquisition (self-care)	0.27	0.62	0.14	0.3	0.08	0.58	3.03	0.69	
	Communication with children	0.04	0.59	0.29	0.58	0.05	0.77	2.45	0.8	
	Support for siblings	0.29	0.56	0.22	0.37		0.59	3.03	0.72	
	Communication with adolescents and young adults	0.2	0.53	0.19	0.44	0.06	0.56	2.73	0.76	
Chemotherapy nursing (F3) $\alpha = .85$								2.97	0.53	C
	Chemotherapy: care for diarrhea and constipation	0.1	0.15	0.81	0.23	0.2	0.79	2.89	0.75	
	Chemotherapy: care for nausea and vomiting	0.17	0.13	0.81	0.24	0.15	0.78	2.97	0.72	
	Chemotherapy: care for stomatitis	0.16	0.15	0.75	0.17	0.16	0.67	3.03	0.69	
	Chemotherapy: dietary care	0.19	0.26	0.63	0.17	-0.01	0.54	3.08	0.72	
	Chemotherapy: pain control	0.32	0.12	0.57	0.11	0.19	0.49	3.15	0.74	
	Care of medicine for internal use	0.2	0.13	0.56	0.32	0.02	0.47	3.09	0.74	
	Management of central venous catheters	0.02	0.2	0.48	0.45	0.11	0.48	2.58	0.76	
Challenging communication (F4) $\alpha = 0.82$								2.8	0.56	D
	Support for procedures such as bone marrow puncture	0.06	0.2	0.33	0.72	0.12	0.68	2.49	0.77	
	Preparation at the time of testing and treatment	0.22	0.26	0.22	0.67	0.01	0.61	2.83	0.76	
	Communication with families	0.19	0.45	0.26	0.57	0.14	0.65	2.74	0.77	
	Outpatient treatment: cooperation with outpatient nurses	0.17	0.29	0.11	0.55	0.08	0.44	2.7	0.77	
	Support for long-term follow-up	0.3	0.25	0.17	0.55	0.08	0.49	3.1	0.7	
	Sampling blood from children and securing an intravenous route	0.18	0.17	0.23	0.53	0.09	0.41	2.94	0.82	

(Continues)

TABLE 3 (Continued)

Factor	Items	F1	F2	F3	F4	F5	C	Mean	SD	
Nursing care for patients undergoing stem cell transplantation (F5) $\alpha = .83$								3.34	0.71	B
	Care for graft-vs.-host disease	0.38	0.12	0.29	0.1	0.77	0.84	3.41	0.74	
	Infection control adopted at the time of hematopoietic stem cell transplantation	0.3	0.08	0.29	0.19	0.77	0.81	3.27	0.78	
Total $\alpha = .94$								3.09	0.42	

Notes: Exploratory factor analysis (non-weighted least-squares method, promax rotation) $\alpha =$ Cronbach's alpha coefficient, F1: Factor1, F2: Factor2, F3: Factor3, C: Community Comparison among five factors was assessed with the Friedman test that represents that the test indicates not accepting the null hypothesis under alpha = .05. Using Bonferroni correlation, Wilcoxon signed rank test represents that the test indicates not accepting the null hypothesis under alpha = .005. Each alphabetic letter indicates that a significant difference exists between the factors. (A > B > C > D). The level of difficulty was significantly higher for F1 compared with the other four factors ($p < .0001$). The level of difficulty was significantly lower for F5 compared with F1, and significantly higher compared with F2, F3 and F4 ($p < .0001$, $p < .0001$, $p < .0001$). The level of difficulty was significantly lower for F3 compared with F1 and F5 ($p < .0001$, $p < .0001$), and significantly higher for F3 compared with F2 and F4 ($p < .0001$, $p < .0001$). The level of difficulty was significantly lower for F2 compared with F1, F3 and F5 ($p < .0001$, $p < .0001$, $p < .0001$). The level of difficulty was significantly lower for F4 compared with F1, F3 and F5 ($p < .0001$, $p < .0001$, $p < .0001$). The level of difficulty of F2 was the same as that of F4 ($p = .0634$).

Concerning “In-hospital lectures,” “Lectures in hub hospitals,” and “Training in hub hospitals,” the score for [Nursing care for patients with serious problems] was significantly higher than those for the other two factors ($p < .0015$). In addition, regarding “In-hospital seminars and role-playing,” as well as “Skill seminars and role-playing in hub hospitals,” the scores for [Nursing care for patients with serious problems] and [Management of treatment-related adverse events] were significantly higher than that for [Care for psychosocial development] ($p < .0001$).

Regarding all of three factors, “In-hospital lectures” were more strongly desired than the five other educational approaches ($p < .0001$). In addition, regarding [Nursing care for patients with serious problems], “Lectures in hub hospitals” were more strongly desired than the four other approaches ($p < .0001$).

4 | DISCUSSION

Nearly 50% of the participants were in their 20s. The duration of working as a nurse was <5 years for approximately 30% of the participants, and <10 years for more than 50% of the participants. The average duration of working in a pediatric ward or a ward for cancer and blood diseases was approximately 6 years. According to the Japanese Nursing Association, 21.3 and 29.2% of the nurses were in their 20s and 30s, respectively, at the end of 2014 (Japanese Nursing Association, 2008, 2014). According to the Employment Security Bureau, Ministry of Health, Labour, and Welfare, the average duration of working as a nurse is 6.0 and 7.2 years for males and

females, respectively (Employment Security Bureau, Ministry of Health, Labour, and Welfare, 2014). As the average duration of working as a nurse in our study was similar to that reported in previous studies, our participants were considered as general nurses.

4.1 | Difficulties in caring for pediatric cancer patient and their receiving education

The level of difficulty of [Chemotherapy nursing] including care for diarrhea, vomiting and stomatitis etc. was lower among nurses at treatment hospitals. Education related to [Symptom management] included chemotherapy nursing such as for diarrhea, vomiting and stomatitis etc. was often in-hospital lecture-based. The reason for the well-developed in-hospital education may be because symptom management is mandatory in pediatric cancer nursing. In addition, based on the Guidelines for Novice Nurse Training, the Clinical Ladder for Nurses states that competencies for such control can be acquired by novice nurses in 1 year (Japanese Nursing Association, 2016). Therefore, participants had many opportunities for in-hospital education on less challenging nursing care, demonstrating the beneficial effects of such education. Thus, in-hospital education is popular and essential as an educational approach to clinical nursing practice.

Regarding “actions to be taken when a patient's physical condition rapidly changes,” the rate of attending in-hospital lectures related to this item was the highest, at 53.60%, but it was included in [Nursing care for patients with critical conditions] as the factor with the highest

TABLE 4 Receiving education on and undergoing training for pediatric cancer nursing *N* = 584

Item	In-hospital lectures			In-hospital skill seminars and role-playing			e-learning			Attending academic conferences			Lectures in hub hospitals			Skill seminars and role-playing in hub hospitals			Training in hub hospitals		
	<i>n</i>	%	C	<i>n</i>	%	C	<i>n</i>	%	C	<i>n</i>	%	C	<i>n</i>	%	C	<i>n</i>	%	C	<i>n</i>	%	C
Management of central venous catheters	282	48.29	A1	167	28.60	B1	50	8.56	C1	50	8.56	D1	23	3.94	E1	17	2.91	F1	8	1.37	G2
Chemotherapy: care for stomatitis	264	45.21	A1	62	10.62	B1	21	3.60	C1	80	13.70	D1	38	6.51	E1	7	1.20	F1	5	0.86	G1
Chemotherapy: care for nausea and vomiting	241	41.27	A1	36	6.16	B1	22	3.77	C1	59	10.10	D1	31	5.31	E1	4	0.68	F1	3	0.51	G1
Chemotherapy: care for diarrhea and constipation	216	36.99	A1	30	5.14	B1	20	3.42	C1	54	9.25	D1	32	5.48	E1	4	0.68	F1	3	0.51	G1
Chemotherapy: pain control	259	44.35	A1	36	6.16	B1	21	3.60	C1	60	10.27	D1	32	5.48	E1	6	1.03	F1	3	0.51	G1
Chemotherapy: dietary care	191	32.71	A1	25	4.28	B1	13	2.23	C1	54	9.25	D1	25	4.28	E1	4	0.68	F1	3	0.51	G1
Care of medicine for internal use	145	24.83	A1	32	5.48	B1	17	2.91	C1	38	6.51	D1	14	2.40	E1	3	0.51	F1	4	0.68	G1
Infection control adopted at the time of hematopoietic stem cell transplantation	181	30.99	A1	29	4.97	B1	7	1.20	C1	65	11.13	D1	31	5.31	E1	4	0.68	F1	4	0.68	G1
Care for graft-vs.-host disease	172	29.45	A1	22	3.77	B1	7	1.20	C1	63	10.79	D1	28	4.79	E1	3	0.51	F1	3	0.51	G1
Actions to be taken when a patient's physical condition rapidly changes	313	53.60	A1	193	33.05	B1	32	5.48	C1	40	6.85	D1	25	4.28	E1	17	2.91	F1	9	1.54	G1
Sampling blood from children and securing an intravenous route	182	31.16	A1	148	25.34	B1	21	3.60	C1	14	2.40	D1	8	1.37	E1	7	1.20	F1	7	1.20	G1
Support for procedures such as bone marrow puncture	180	30.82	A1	124	21.23	B1	21	3.60	C1	10	1.71	D1	7	1.20	E1	7	1.20	F1	5	0.86	G2
Preparation at the time of testing and treatment	164	28.08	A1	76	13.01	B1	8	1.37	C1	65	11.13	D1	14	2.40	E1	6	1.03	F1	11	1.88	G2
Outpatient treatment: cooperation with outpatient nurses	75	12.84	A2	19	3.25	B1			C1	22	3.77	D2	13	2.23	E1	2	0.34	F1	4	0.68	G2
Support for long-term follow-up	73	12.50	A2	14	2.40	B2			C1	60	10.27	D2	31	5.31	E2	4	0.68	F2	4	0.68	G2
Mental care provided at the time of cancer recurrence	62	10.62	A2	10	1.71	B2	1	0.17	C1	35	5.99	D2	17	2.91	E2	4	0.68	F2	2	0.34	G3
Disclosure of negative news to families	68	11.64	A2	12	2.05	B2	1	0.17	C1	43	7.36	D2	18	3.08	E2	3	0.51	F2	2	0.34	G2
Disclosure of negative news to children	61	10.45	A2	12	2.05	B2	1	0.17	C1	41	7.02	D2	16	2.74	E2	3	0.51	F2	2	0.34	G2
Terminal phase: mental care	101	17.29	A2	14	2.40	B2	3	0.51	C1	51	8.73	D2	20	3.42	E2	4	0.68	F2	1	0.17	G2
Terminal phase: pain control	122	20.89	A2	12	2.05	B2	4	0.68	C1	41	7.02	D2	21	3.60	E2	4	0.68	F2	1	0.17	G2
Care for families who have lost their children	80	13.70	A2	9	1.54	B2	1	0.17	C1	63	10.79	D2	20	3.42	E2	3	0.51	F2	3	0.51	G1

(Continues)

TABLE 4 (Continued)

Item	In-hospital lectures			In-hospital skill seminars and role-playing			e-learning			Attending academic conferences			Lectures in hub hospitals			Skill seminars and role-playing in hub hospitals			Training in hub hospitals		
	n	%	C	n	%	C	n	%	C	n	%	C	n	%	C	n	%	C	n	%	C
Support for lifestyle acquisition (self-care)	59	10.10	A2	10	1.71	B2	3	0.51	C2	19	3.25	D3	10	1.71	E2	3	0.51	F2	2	0.34	G3
Support for children's play	66	11.30	A2	19	3.25	B2	2	0.34	C2	31	5.31	D3	11	1.88	E2	5	0.86	F2	6	1.03	G2
Learning support for elementary and junior high school students	40	6.85	A3	10	1.71	B2	1	0.17	C2	23	3.94	D3	8	1.37	E2	2	0.34	F2	2	0.34	G3
Learning support for high school students	32	5.48	A3	7	1.20	B2	1	0.17	C2	20	3.42	D3	6	1.03	E2	2	0.34	F2	2	0.34	G3
Support for returning to kindergarten/school	41	7.02	A3	10	1.71	B2	1	0.17	C3	38	6.51	D3	11	1.88	E2	2	0.34	F2	2	0.34	G3
Communication with children	62	10.62	A2	14	2.40	B2	1	0.17	C3	27	4.62	D3	10	1.71	E2	3	0.51	F2	5	0.86	G2
Communication with adolescents and young adults	41	7.02	A3	8	1.37	B2	1	0.17	C3	41	7.02	D3	10	1.71	E2	3	0.51	F2	2	0.34	G1
Communication with families	67	11.47	A2	14	2.40	B2	1	0.17	C3	44	7.53	D3	13	2.23	E2	2	0.34	F2	4	0.68	G2
Support for siblings	59	10.10	A2	8	1.37	B2	2	0.34	C2	63	10.79	D2	16	2.74	E2	3	0.51	F2	4	0.68	G2

Notes: The alphabetic letters show the names of the clusters as extracted by multiple correspondence analysis. C: Cluster-A1: Symptom management, A2: Psychosocial care, A3: Learning support. B1: Symptom management, B2: Psychosocial care, C1: Symptom management, C2: Play and learning, C3: Communication. D1: Symptom management, D2: Psychosocial care, D3: Play, learning and communication. E1: Symptom management, E2: Psychosocial care, F1: Symptom management, F2: Psychosocial care, G1: Symptom management, G2: Psychosocial care, G3: Learning support.

TABLE 5 Level of desire for education in pediatric cancer nursing N = 584

Factor	Item	F1	F2	F3	C	In-hospital lectures		In-hospital skill seminars and role-playing		e-learning		Lectures in hub hospitals		Skill seminars and role-playing in hub hospitals		Training in hub hospitals			
						Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Care for psychosocial development (F1) $\alpha = .98$		3.00	0.70	C	2.70	0.79	B	2.48	0.92	C	2.67	0.82	C	2.39	0.85	B	2.32	0.87	C
						a	b	c	c	b	b	c	c	b	c	c	c	d	
	Learning support for elementary and junior high school students	0.82	0.35	0.34	0.91	0.88	0.94	3.11	0.94	2.60	1.05	2.79	0.97	2.58	1.01	2.39	1.02		
	Support for children's play	0.80	0.33	0.36	0.88	0.86	0.95	2.90	0.95	2.72	1.04	2.94	0.91	2.62	0.96	2.44	0.99		
	Learning support for high school students	0.80	0.38	0.35	0.90	0.89	0.95	2.75	0.95	2.73	1.03	2.92	0.90	2.53	0.95	2.39	0.98		
	Communication with children	0.79	0.39	0.38	0.92	0.87	0.96	2.72	0.96	2.71	1.02	2.90	0.89	2.51	0.95	2.38	0.98		
	Communication with adolescents and young adults	0.77	0.45	0.36	0.92	0.85	0.98	2.83	0.98	2.80	1.03	3.03	0.91	2.61	0.98	2.46	1.00		
	Communication with families	0.74	0.49	0.35	0.91	0.84	0.98	2.69	0.98	2.68	1.02	2.91	0.91	2.52	0.95	2.37	0.96		
	Support for returning to kindergarten/school	0.73	0.48	0.36	0.88	0.83	0.97	2.81	0.97	2.67	1.04	2.84	0.93	2.49	0.94	2.35	0.97		
	Support for siblings	0.70	0.48	0.38	0.86	0.82	1.01	2.99	1.01	2.89	1.06	3.17	0.90	2.75	1.01	2.63	1.06		
Support for lifestyle acquisition (self-care)	0.68	0.48	0.40	0.86	0.80	1.01	3.00	1.01	2.93	1.06	3.23	0.90	2.80	1.02	2.67	1.06			
Outpatient treatment: cooperation with outpatient nurses	0.64	0.42	0.41	0.76	0.87	0.71	3.62	0.71	2.98	1.10	3.20	0.92	3.01	1.03	2.77	1.08			

(Continues)

TABLE 5 (Continued)

Factor	Item	F1	F2	F3	C	In-hospital lectures			In-hospital skill seminars and role-playing			e-learning			Lectures in hub hospitals			Skill seminars and role-playing in hub hospitals			Training in hub hospitals		
						Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Support for long-term follow-up																							
Management of treatment-related adverse events (F3)						3.43	0.56	B	2.93	0.79	A	2.82	0.87	A	2.97	0.80	B	2.63	0.87	A	2.48	0.91	B
$\alpha = .97$																							
Chemotherapy: care for diarrhea and constipation		0.44	0.41	0.75	0.92	3.34	0.70	a	2.97	1.00	b	2.85	1.07	b	3.19	0.91	b	2.72	1.01	c	2.58	1.06	d
Chemotherapy: care for nausea and vomiting		0.44	0.42	0.74	0.92	3.37	0.69		2.68	0.94		2.58	1.01		2.75	0.92		2.41	0.96		2.36	0.99	
Chemotherapy: care for stomatitis		0.42	0.40	0.74	0.89	3.42	0.68		2.67	0.95		2.48	1.00		2.65	0.94		2.39	0.96		2.32	0.97	
Chemotherapy: pain control		0.39	0.49	0.73	0.91	3.53	0.65		2.48	0.96		2.44	1.02		2.62	0.92		2.27	0.92		2.23	0.95	
Chemotherapy: dietary care		0.49	0.39	0.70	0.88	3.36	0.71		2.45	0.97		2.41	1.01		2.60	0.93		2.26	0.94		2.22	0.95	
Infection control adopted at the time of hematopoietic stem cell transplantation		0.32	0.53	0.68	0.84	3.49	0.77		2.59	0.97		2.53	1.02		2.75	0.95		2.34	0.95		2.31	0.98	
Care of medicine for internal use		0.54	0.35	0.67	0.85	3.24	0.77		2.65	0.96		2.51	1.03		2.68	0.96		2.39	0.96		2.32	0.98	
Management of central venous catheters		0.51	0.29	0.66	0.78	3.26	0.78		2.65	0.95		2.54	1.03		2.72	0.94		2.39	0.96		2.30	0.96	
Care for graft-vs.-host disease		0.27	0.60	0.66	0.86	3.52	0.76		2.69	0.95		2.58	1.04		2.77	0.95		2.43	0.97		2.32	0.98	
		0.34	0.50	0.60	0.72	3.72	0.57		2.72	0.95		2.63	1.04		2.84	0.95		2.48	0.99		2.38	1.00	

(Continues)

TABLE 5 (Continued)

Factor	Item	F1	F2	F3	C	In-hospital lectures		In-hospital skill seminars and role-playing		e-learning		Lectures in hub hospitals		Skill seminars and role-playing in hub hospitals		Training in hub hospitals	
						Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Actions to be taken when a patient's physical condition rapidly changes																	
Total $\alpha = 0.99$						3.26	0.56	2.83	0.76	2.63	0.91	2.87	0.84	2.53	0.84	2.42	0.88

Notes: Exploratory factor analysis (non-weighted least-squares method, promax rotation) $\alpha =$ Cronbach's alpha coefficient, F1: Factor1, F2: Factor2, F3: Factor3, C: Communnality. Line: Comparisons between the three factors (capital letters). Comparison among three factors was assessed with Friedman test that represents that the test indicates not accepting the null hypothesis under $\alpha = .05$. Using Bonferroni correlation, Wilcoxon signed rank test represents that the test indicates not accepting the null hypothesis under $\alpha = .0167$. Friedman test: In-hospital lectures $p < .0001$, in-hospital skill seminars and role-playing $p < .0001$, e-learning $p = .0048$, lectures in hub hospitals $p < .0001$, skill seminars and role-playing in hub hospital $p < .0001$, training in hub hospitals $p < .0001$. Each capital letter indicates a significant difference between the two factors within each educational approach. ($A > B > C$). Column: Comparisons between the six educational approaches (lower-case letters). Comparison among six educational approaches was assessed with the Friedman test that represents that the test indicates not accepting the null hypothesis under $\alpha = .05$. Using Bonferroni correlation, Wilcoxon signed rank test represents that the test indicates not accepting the null hypothesis under $\alpha = .0033$. Friedman test: Care for psychological development $p < .0001$, Nursing care for patients serious problems $p < .0001$, Management of treatment-related adverse events $p < .0001$. Each lower-case letter indicates a significant difference between the two educational approaches within each factor. ($a > b > c > d$).

level of difficulty. The Guidelines for Novice Nurse Training specify “becoming able to perform life-saving procedures, such as airway maintenance, artificial respiration, and closed cardiac massage, under supervision” as a goal to be achieved within 1 year. The high rate of attending in-hospital lectures on this topic may be explained by “actions to be taken when a patient’s physical condition rapidly changes” being highly difficult but requiring high-level nursing skills.

On the other hand, participants felt the greatest difficulty in [Nursing care for patients with critical conditions], such as terminal care and care for patients with recurrence. The percentage of participants receiving education on [Psychosocial care] that involves serious problems, such as terminal care, was low for all educational approaches investigated. Such difficulties are included in the comprehensive framework for pediatric cancer expertise in Europe (Tomlinson, 2004), and represent those felt by nurses providing pediatric cancer care (Citak et al., 2014; Gibson et al., 2013; Hinds et al., 1990; Ohara et al., 2008). Thus, issues regarding nursing care for patients with serious problems should be addressed, and education and support for such care are necessary. A modified systematic review of studies on palliative care educational interventions for pre-registration student nurses reported that palliative care education is delivered to students at a variety of stages in their nursing program, using a mix of both didactic and experiential educational strategies (Bassah, Seymour, & Cox, 2014).

Education and experience are important to provide high-quality nursing service (Belgen, Vaughe, & Goode, 2001). Compared with hub hospitals, treatment hospitals deal with a smaller number of patients, and their experience is particularly limited in palliative care, suggesting a paucity of those qualified to provide both palliative care for pediatric patients and related education. Education that integrates case reports and conferences at hub hospitals with more extensive experience may be required to resolve the difficulties faced by nurses and to provide high-quality nursing service.

4.2 | Nurses’ educational needs and insight into nursing education

Participants most strongly desired that education on [Nursing care for patients with serious problems] be provided using six educational approaches. On examination of agreement between [Nursing care for patients with serious problems] as part of the desired education and [Nursing care for patients with critical conditions] as a difficult nursing practice, there was agreement in six out of the seven items (disclosure of negative news to

children and their families, terminal phase: mental care and pain control, mental care provided at the time of cancer recurrence and care for families who have lost their children). Based on a 5-year survival rate of approximately 80% (Siegel et al., 2015) among pediatric cancer patients, the estimated annual numbers of pediatric patients with recurrent cancer or those whose cancer progressed to its terminal phase are approximately 99.7 (annual number of hospitalized patients: 498.6) and 16.7 (annual number of hospitalized patients: 83.6) for hub and treatment hospitals, respectively (National Center for Child and Development 2019). We suggest that treatment hospital nurses with limited experience in the terminal phase desire education in hub hospitals, which have many experienced nurses.

[Nursing care for patients with serious problems] as a desired topic of education consisted of several items, including “support for long-term follow-up”. With recent improvements in the outcomes of pediatric cancer care, related mortality rates are decreasing, consequently increasing the number of survivors (Siegel et al., 2015; Smith et al., 2010; Ward et al., 2014). Hudson et al. (2013) examined the health conditions of 1,713 adult survivors of childhood cancer. They reported that at the age 45 years, the estimated cumulative prevalence of any chronic health condition was 95.5% (95% CI, 94.8–98.6%) and 80.5% (95% CI, 73.0–86.6%) for a serious/disabling or life-threatening chronic condition. Accordingly, the necessity of lifelong follow-up for patients, including inpatients and those after discharge, is being emphasized. The establishment of follow-up systems is a requirement for hub hospitals to open, and they are in charge of creating databases. The improvement of follow-up care at treatment hospitals is indispensable for all survivors throughout Japan to be equally followed up. The present study suggested that nurses at treatment hospitals recognize this, and they therefore desire education to address it.

Regarding educational approaches, the nurses desired in-hospital lectures, supporting the results of a previous study (Akiyama, Nakada, Sakamoto, & Kawakami, 2016). Although the necessity of covering palliative care as a comprehensive framework for education in pediatric cancer nursing was noted in the previous study, desirable educational approaches were not mentioned. In the present study, the nurses at treatment hospitals most frequently desired in-hospital lectures on [Nursing care for patients with serious problems], followed by those at hub hospitals. This suggests that nurses at treatment hospitals with limited experience in such nursing wish to receive education at hub hospitals with more extensive experience in this area.

“Skill seminars and role-playing in hub hospitals” and “Training in hub hospitals” were not strongly desired

for any educational approach. However, interactive workshops, rather than lectures and academic instruction, are the best method to promote changes in professional practice (Griscti & Jacono, 2006). Furthermore, it has been reported that, in addition to ensuring the self-effort of nurses within hospitals, there is a need to establish networks with hospitals in neighboring regions because their desire (willingness) to learn is positively correlated with the presence of training facilities (Takahashi, Kiyomura, Kajiwara, & Itoh, 2012).

To improve the QOL of pediatric cancer patients and their families, end-of-life care for the former and follow-up of survivors are required, as is the case for nursing care for patients with serious problems. Hub hospitals for the centralization of information and promotion of equal access to care should bear the responsibility of educating nurses at treatment hospitals seeking education. In order to promote equal access to pediatric cancer nursing care, it may be indispensable to establish education systems with lectures and seminars incorporated through collaboration between hub and treatment hospitals.

4.3 | Study limitations and issues that need to be addressed

Approximately one-third of all pediatric cancer hospitals participated in our study. On the basis of an assumption that one ward has 32 nurses (nursing standing order: 7 vs. 1, 50 beds) (Tohoku University Workers' Union, 2010), the 584 respondents accounted for approximately 35% of the nurses from the investigated hospitals (32 nurses/unit \times 52 hospitals [1,664 nurses]), and 12.5% of the nurses from pediatric cancer treatment hospitals (32 nurses/unit \times 146 hospitals [4,672 nurses]). The reasons why some hospitals refused to participate in our study were because we requested their cooperation during a period when requests for study cooperation were frequently made, and using a placement method would be burdensome for these hospitals. In order to secure participants, it is necessary to discuss the timing of and methods for investigations in consideration of expected burden on hospitals and participants. In addition, in order to protect participants' privacy, there is a need to consider collecting completed questionnaires by mail individually. In this study, the same 30 items were examined and analyzed individually regarding three issues: difficulties felt by nurses, and their educational experience and educational desire in pediatric cancer nursing. Due to this method, the three issues were unable to be compared and considered using the same factor (content). To clarify the relationship among the three issues,

a scale measuring the needs of pediatric cancer nursing practice must be developed.

Previous studies demonstrated that correlations exist between difficulties/stress felt by nurses and their work environment/years of experience (Citak et al., 2014; Gibson et al., 2013; Hinds, 2000; Hinds et al., 1990; Ohara et al., 2008). In order to develop education programs that are consistent with the needs of pediatric cancer nurses, it is necessary to analyze the relationships of their hospitals' equipment/function, and their years of experience with their difficulties and educational needs. In addition, there is a need to conduct studies concerning the quality of education provided by hub hospitals and the effects of such education, with the aim of ensuring cooperation between hub and treatment hospitals, as well as education support provided by the former for the latter.

Considering the clarification of the education needs of nurses at treatment hospitals with limited experience in pediatric cancer nursing as a challenge to be urgently addressed, the present study examined treatment hospitals throughout Japan. Based on the results, future studies should identify challenges in promoting collaboration between hub and treatment hospitals as a basis for the establishment of nursing education systems at treatment hospitals.

5 | CONCLUSION

Treatment hospital nurses felt great difficulty in caring for patients in critical conditions such as during the terminal phase or disclosing negative news. Many treatment hospital nurses attended in-hospital lectures on symptom management of treatment-related adverse events. On the other hand, they had limited opportunities to receive education on psychosocial care, including terminal care, both within and outside hospitals, and they had few opportunities to learn about nursing care for patients with critical conditions. Treatment hospital nurses desired in- and hub-hospital lectures on nursing care for patients with serious problems.

The results of our study indicate that, in order to provide nurses from pediatric cancer treatment hospitals with education focusing on nursing care for patients with serious problems, education systems based on cooperation between hub and treatment hospitals are needed.

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