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Perceptions of nurse managers and staff nurses regarding Technological Competency as Caring in Nursing theory in general hospitals in Japan

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Abstract

Background: Nurses as primary healthcare providers demonstrate quality nursing care through competencies with healthcare technologies, while nurse managers assume the primacy of managing quality healthcare in their respective care settings. However, little is known about perceptions of the influence of care technologies on their nursing practice.

Objective: This study aimed to determine managers' and staff nurses' perceptions regarding the Technological Competency as Caring in Nursing (TCCN) theory in general hospitals in Japan.

Methods: This study employed a cross-sectional survey design, with 421 participants selected using a stratified sampling method. Technological Competency as Caring in Nursing Instrument-Revised (TCCNI-R) was used for online data collection using Survey Monkey®. Data were analyzed using Welch's t-test and ANOVA.

Results: Nurses with years of experience within the range of 20 to less than 30 years showed the highest TCCNI-R scores among the two groups. Nurses who had received education on caring in nursing showed significant differences for Factor 2 (Technological Competency as Caring), that of expressing Technological Competency as Caring. Three other factors showed no significant difference, namely in Factor 1 (Nursing Expression as Caring), Factor 3 (Technology and Caring), and Factor 4 (Technological Knowing). However, the average scores of these factors were high, which reflect high professional ethics and occupational discipline and increased awareness of caring in nursing. It was also found that the nurse managers were more aware of the TCCN than were the staff nurses. The nurse managers were also more aware of providing care using technology, recognizing the need-to-know patient needs through technology and providing care to the ever-changing patient's condition.

Conclusion: The study discovered that continuing education is needed regarding the practice of nursing based on theory, enabling appropriate and accurate understanding of practicing knowing persons as caring in nursing.

Keywords

advanced technologies; caring in nursing; in-service education; technological competency; nurse administrators; nursing staff; Japan

The rapid development of technology has affected hospitals to improve the quality of healthcare service (Juhana et al., 2015). The theory of Technological

Competency as Caring in Nursing (TCCN) developed by Locsin (2005) illuminated the harmonious coexistence between technologies and caring in nursing through

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technological knowing, mutual designing, and participative engaging (Locsin, 2017). The items of the TCCNI were developed through the TCCN theory. The theory of TCCN has been examined among different groups of nurses in several countries, for example, nursing professionals in Spain (Rincón-Álvarez & Chaparro-Díaz, 2017), ICU nurses in Japan (Kato et al., 2017), and ICU nurses in Bangladesh (Biswas, 2016). However, only a limited number of studies were found that specifically examine the extent to which TCCN is recognized by nurse managers (Kato et al., 2017). To measure the nurses' technological competency, the Technological Competency as Caring in Nursing Instrument (TCCNI) was developed by Parcells and Locsin (2011).

The items in the Technological Competency as Caring in Nursing Instrument-Revised (TCCNI-R) were theoretically derived from the understanding of the TCCN theory formulated by Tanioka (2018). The TCCNI-R can be used in both the Japanese and English languages, and it has been confirmed for its reliability and validity (Yokotani et al., 2021). However, in that study, the population consisted of general nurses working in a limited area in Japan. Alternatively, technology-related studies conducted among nurse managers frequently discuss nursing informatics, such as electronic information systems (Lammintakanen et al., 2010) and utilizing informatics (Gunawan et al., 2020).

The coexistence of technology and caring is best exemplified in nursing. Recently, these technologies have become fundamental to the delivery of quality human healthcare now and in the future (Locsin, 2017; Nakano et al., 2019; Locsin, 2020). Complex health problems demand a highly skilled response that mobilizes teams of professionals from various disciplines.

When the engineering lens is expanded to include the practical perspective of nursing, opportunities emerge for greater technology-nurse interface and subsequent innovation. However, important patient care improvement opportunities are missed when nurses are not actively engaged in patient care device innovation and creation (Glasgow et al., 2018). In addition, the quality of nursing care can be valued based on how nurses practice their nursing as caring and on their technological competency in practicing their care (Croke, 2020).

As nurses are at the front liner of care providers in healthcare institutions, the quality of nursing care, including nursing competency in terms of technology, plays a significant role in influencing healthcare service. Nurse managers have an essential role in controlling the quality of nursing services (Tanioka et al., 2011). Also, managers' time spent, engagement, and work can influence the quality and safety of clinical outcomes, processes, and performance (Parand et al., 2014). Excellence in nursing care will not occur without the development of genuine shared working partnerships and collaborations between nurse managers, leaders and educators, and their associated organizations (McSherry et al., 2012). Nurses work with various technologies; however, they may not be

aware of them. In addition, as the experience of nurses increases, the experience of caring for patients and their families increases as well, and awareness of caring may increase. Furthermore, the nurse manager influences the staff nurse's view of nursing. Therefore, there is a distinct possibility that nurse managers' awareness of nursing as caring is high.

Caring is the basis of nursing, and in order to gain a deeper understanding of the TCCN among the technologies that are advancing day by day, it is important to educate stakeholders about the TCCN. However, little is known about the differences in terms of the years of nursing experience, the experience of receiving education on TCCN, and their position. Nurse managers' perception of caring in nursing reflects promoting enhanced patient understanding, thereby fostering quality nursing care management focused on patient-centered care and improving quality nursing care services. Thus, their thinking and behavior are thought to influence the thinking and behavior of nursing staff.

This study aims to determine managers' and staff nurses' perceptions regarding the theory of TCCN in general hospitals in Japan.

Methods

Study Design

This is a cross-sectional study with a web-based questionnaire survey using the TCCNI-R.

Settings and Samples

The study settings were 11 general hospitals in Chugoku-Shikoku district, Japan. These hospitals have 200 or more in-patient beds. The sample of the study was selected based on the following inclusion criteria: a) currently employed as nurse managers and staff nurses; b) practicing in a private or public healthcare system or both; c) qualified and registered to practice nursing; d) agreed to participate in the survey; e) nurse managers included the director of nursing, vice director of nursing, head nurse, and chief nurse; and f) nursing staff was registered nurses (RNs) only. Excluded from the study were professionals who were ineligible to participate in the survey, such as nursing students who decided to quit the study at any stage and for any reason.

For sample size estimation, the researcher performed a statistical power analysis. The effect size in this study is considered large using Cohen (1988)'s criteria. With an $\alpha = 0.05$ and power = 0.80, the projected sample size needed with effect sizes (G*Power 3.1.9.7) (Faul et al., 2007) reflected values for the t-test ($N = 128$), for the one-way analysis of variance ($N = 200$) and for correlation coefficient ($N = 82$). Therefore, the sample size was adequate for the main objective of this study. The data were collected using a stratified sampling method in which 20% was allocated to each group who were within the age range of 20 to 60 years old.

Instrument

The TCCNI-R was used to evaluate the participants' perception of TCCN. TCCNI-R utilizes a 5-point Likert scale measurement with values ranging from 1 as "Strongly Disagree" to 5 as "Strongly Agree." Former TCCNI-R has 25 items. In this study, we used the 19 items version with the original numbers of items based on confirmatory factor analysis results of the study by Yokotani et al. (2021). This instrument is available in Japanese and English. The Japanese version was used in this study.

Exploratory factor analysis, confirmatory factor analysis, and Cronbach's alpha coefficient established validity and reliability. The root means square error of approximation (RMSEA) showed less than or equal to about 0.08, indicating the result as having a reasonable approximation error. The covariance structure analysis with a causal model revealed that the structural theory of TCCN had similar causal relationships to the model that has been hypothesized (Yokotani et al., 2021). The authors had obtained permission from its creator to use TCCNI-R in this study.

Data Collection

The 11 general hospitals in Chugoku-Shikoku Island, Japan, introduced a category of general care wards for advanced care, with a higher staffing standard, a patient-to-nurse ratio of 7:1. The "7:1" nursing placement standard is an accurate placement, with one nurse assigned to every seven patients on average over 24 hours. In addition, it is obligatory to display information on the number of nursing staff working during the day, evening, and night in each ward (Morioka et al., 2017; Japanese Nursing Association, n.d.). Those hospitals were contacted to obtain permission from their respective management administrators for their nurse managers and staff to participate in the survey. Survey Monkey® platform was used for this survey. The survey was conducted from October to December 2019. The researcher provided a letter of invitation to participate and disseminated information about the study together with the Survey Monkey URL to the Nurse Managers who agreed to distribute the document containing the URL for participants to access the survey instrument. After permission was obtained, a briefing document containing the URL of the questionnaire was distributed to nurse managers in each hospital. The document package included information for nurses' cooperation in this survey. The nurse managers at each hospital distributed the survey briefing documents to their respective staff.

Data Analysis

This study tested the following hypotheses: a) Nurses with years of nursing experience show a high perception of TCCN, b) Nurses with experience of receiving education on caring in the nursing show a high perception of TCCN, and c) Nurse managers show a high perception of TCCN.

From the Survey Monkey® data, only 421 responses could be used for the study. Excluded were questionnaire responses that had missing data. Statistical analysis was

conducted using IBM SPSS Version 21 (IBM Institute, Chicago, USA) and R (version 3.6.2, R Foundation for Statistical Computing, Vienna, Austria).

The mean and standard deviation with a 95% confidence interval (95% CI) was calculated. The ceiling and floor effects for each question item were confirmed with the basic statistics. Descriptive statistics were used to describe the gender, age, the experience of receiving education on caring in nursing (respondents judged whether they experienced receiving education on caring in nursing based on their subjectivity), employment position, length of experience as an RN, and educational background.

The mean for each factor of the TCCNI-R was calculated: Welch's t-test was used to determine differences by the experience of receiving education on caring in nursing, and employment position (nurse manager or staff nurse); Welch's analysis of variance (ANOVA) with posthoc tests of Games-Howell was used to determine the differences by the length of experience as an RN. To identify significant differences between specific groups, a pairwise comparisons post hoc test was performed. Games-Howell's multiple comparison method is appropriate when using Welch's ANOVA. The level of statistical significance was set at $p < 0.001$. Statistical analyses were conducted using IBM SPSS Version 24 (IBM Institute) and R (version 3.6.2, R Foundation for Statistical Computing). The level of statistical significance was set at $p < .001$.

Ethical Consideration

Ethical approval was obtained from the Ethics Review Committee of Tokushima University Hospital (Approval Number 2914-3). When participants accessed the URL, information was made available about this study. This information included the details of the research and a request for their agreement or permission to participate and collect personal data. Participation was voluntary, and no penalty would be imposed if they decided to quit the study at any time. Personal information was kept confidential. All respondents' data were secured in the researcher's computer that was also accessible only through a password known only by the main researcher.

Results

Demographic characteristics are presented in **Table 1**. Participants' employment positions were nurse manager (22.8%) and staff nurse (77.2%). In the nurse managers' group, the length of experience as RN was 1- less than 5 (Years) (0%), 5- less than 10 (2.1%), 10- less than 20 (13.5%), 20- less than 30 (46.9%), and more than 30 (37.5%). In the staff nurses' group, length of experience as an RN was 1- less than 5 (18.5%), 5- less than 10 (24.6%), 10- less than 20 (29.8%), 20- less than 30 (17.2%), and more than 30 (9.8%). In the nurse managers, the educational background was Master of Science in Nursing (MSN) (0%), Bachelor of Science in Nursing (BSN) (6.2%),

Associate degree (7.3%), and Advanced Diploma (86.5%). In the staff nurses, MSN (0.9%), BSN (18.8%), Associate degree (8.9%), and Advanced Diploma (71.4%). In the

nurse managers, the experience of receiving education on caring in nursing was 24%, and 24.3% in staff nurses.

Table 1 Demographic data of the participants

Items (N = 421)		Nurse managers		Staff nurses	
		N	(%)	N	(%)
		96	(22.8)	325	(77.2)
Gender	Male	6	(6.2)	31	(9.5)
	Female	90	(93.8)	294	(90.5)
Age (Years)	20-29	0	(0)	105	(32.3)
	30-39	8	(8.3)	88	(27.1)
	40-49	36	(37.5)	72	(22.2)
	more than 50	52	(54.2)	60	(18.5)
Length of experience as a registered nurse (Years)	1- less than 5	0	(0.0)	60	(18.5)
	5- less than 10	2	(2.1)	80	(24.6)
	10- less than 20	13	(13.5)	97	(29.8)
	20- less than 30	45	(46.9)	56	(17.2)
Educational background	more than 30	36	(37.5)	32	(9.8)
	Master of Science in Nursing	0	(0.0)	3	(0.9)
	Bachelor of Science in Nursing	6	(6.2)	61	(18.8)
	Associate degree	7	(7.3)	29	(8.9)
Experience of receiving education on caring in nursing	Advanced diploma	83	(86.5)	232	(71.4)
	Received	23	(24.0)	79	(24.3)
	Not received	73	(76.0)	246	(75.7)

Table 2 shows the mean, standard deviation, and 95% confidence interval of each item in the TCCNI-R. From those items, several items were identified to have a lower mean than other items. However, the means of those particular items are still in the range from 3 (neutral) to more than 4 (agree). Those items were Q25 (Nurses use technology and caring to facilitate patients' recovery with

enhanced self-esteem), Q3 (Nurses must provide care for patients by using necessary technology), Q2 (Nurses are professionals who express caring utilizing technology from the perspective of compassion to patients), and one reverse item Q11 (Nurses must complete their nursing duties within the established timeframe without needing to know the patient's feelings or needs).

Table 2 Mean, standard deviation, and 95% confidence interval of the TCCNI-R

Question number and Items (N = 421)		Mean	SD	95% CI	
				LL	UL
Factor 1: Nursing Expressions as Caring					
Q17	Nurses must act by carefully listening to the patient's voices and showing compassion for the patient.	4.38	0.74	4.31	4.45
Q16	Nurses must be devoted to meeting the patients' needs, hopes, wishes, and dreams.	4.09	0.85	4.01	4.17
Q14	Nurses must emphasize thoughtful consideration of patients' feelings, giving encouragement and respect to patients.	4.45	0.72	4.38	4.52
Q13	Nursing is caring to maintain patients' lifestyles and allow them to regain their healthy lives.	4.13	0.85	4.05	4.21
Q18	Nurses must consider the patient's stress and anxiety occurring in the nurse-patient relationship.	4.40	0.72	4.33	4.47
Factor 2: Technological Competency as Caring					
Q22	Caring is nurses' involvement with patients and families in ways that allow others to grow together in the nursing situations shared.	4.20	0.74	4.13	4.27
Q23	Nurses use technological competency as an expression of caring in order to know patients and their families.	4.03	0.80	3.95	4.11
Q21	Knowing a patient is understanding the whole patient, always regarding the person as an irreplaceable human being.	4.33	0.73	4.26	4.40
Q25	Nurses use technology and caring to facilitate patients' recovery with enhanced self-esteem.	3.70	0.83	3.62	3.78
Q20	Nurses' competence includes the use of medical technologies from the perspective of being a compassionate person.	4.16	0.75	4.09	4.23
Q19	Knowing a patient is not only focusing on the person's physical aspects but also accurately understanding "who is this person?"	4.38	0.72	4.32	4.45

Table 2 (Cont.)

Factor 3: Technology and Caring					
Q3	Nurses must provide care for patients by using necessary technologies.	3.79	0.78	3.72	3.87
Q2	Nurses are professionals who express caring utilizing technology from the perspective of compassion to patients.	3.73	0.82	3.65	3.81
Q4	Nurses must provide nursing care through the harmonious interactions between technology and caring.	4.05	0.78	3.97	4.12
Factor 4: Technological Knowing					
Q11	Nurses must complete their nursing duties within the established timeframe without needing to know the patient's feelings or needs. (R)	3.88	1.20	3.77	4.00
Q15	Nurses do not need to provide nursing care that includes the patients' physical and emotional conditions every moment. (R)	4.52	0.95	4.43	4.61
Q7	Nurses do not care for patients by knowing their health data. (R)	4.36	0.98	4.27	4.45
Q24	Technology is not useful for understanding patients' health conditions. (R)	4.09	0.93	4.00	4.18
Q5	Nurses do not need to consider providing nursing care because each patient's wishes always change. (R)	4.04	0.91	3.95	4.12

SD: Standard Deviation, CI: Confidence Interval, LL: Lower Limit, UL: Upper Limit. (R) reverse scoring; those are negatively worded items (Q5, Q7, Q11, Q15, and Q24) in the TCCNI-R. Likert scale measurement, with values ranging from 1 as Strongly Disagree; 2 Disagree; 3 Neutral; 4 Agree; to 5 as Strongly Agree.

Table 3 Differences in the TCCNI-R scores in the length of experience as RNs and nurse managers ($N = 421$)

Length of experience as an RN (Years)	a: 1- less than 5 ($N = 60$)		b: 5- less than 10 ($N = 82$)		c: 10- less than 20 ($N = 110$)		d: 20- less than 30 ($N = 101$)		e: more than 30 ($N = 68$)		<i>F</i>	<i>Posthoc</i>
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
TCCNI-R average total score	4.11	0.45	4.01	0.45	4.11	0.42	4.27	0.42	4.20	0.42	4.67 ***	b<d ***
Factors												
F1	4.28	0.56	4.22	0.56	4.25	0.65	4.40	0.55	4.29	0.55	1.56	NS
F2	4.23	0.59	4.01	0.55	4.05	0.54	4.20	0.53	4.21	0.50	2.83	NS
F3	3.82	0.74	3.64	0.75	3.82	0.69	4.01	0.59	3.98	0.65	3.94	NS
F4	3.95	0.84	4.00	0.64	4.22	0.58	4.37	0.60	4.23	0.65	5.25 ***	NS

Welch's Analysis of Variance, Abbreviations: TCCNI-R = Technological Competency as Caring in Nursing Instrument – Revised, SD = Standard Deviation.

F1 = Factor 1 (Nursing Expressions as Caring), F2 = Factor 2 (Technological Competency as Caring), F3 = Factor 3 (Technology and Caring), F4 = Factor 4 (Technological Knowing), NS = Not significant, *** = $p < 0.001$. Post hoc test (Games-Howell).

Table 4 Differences in the average score of the TCCNI-R by the experience of receiving education on caring in nursing, and employment position ($N = 421$)

Experience of receiving education on caring in nursing	Received ($N = 102$)		Not received ($N = 319$)		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
TCCNI-R average total score	4.26	0.41	4.11	0.44	3.20	0.002
F1 Nursing Expressions as Caring	4.40	0.59	4.25	0.57	2.26	0.03
F2 Technological Competency as Caring	4.30	0.50	4.08	0.55	3.83	0.00
F3 Technology and Caring	4.01	0.70	3.81	0.68	2.55	0.01
F4 Technological Knowing	4.20	0.79	4.17	0.62	0.37	0.71
Employment position	Nurse managers ($N = 96$)		Staff nurses ($N = 325$)		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
TCCNI-R average total score	4.32	0.36	4.09	0.44	5.27	0.00
F1 Nursing Expressions as Caring	4.41	0.48	4.25	0.60	2.72	0.01
F2 Technological Competency as Caring	4.27	0.47	4.09	0.56	3.13	0.002
F3 Technology and Caring	4.04	0.51	3.80	0.73	3.64	0.00
F4 Technological Knowing	4.46	0.48	4.10	0.69	5.81	0.00

Welch's *t*-test, Abbreviations: TCCNI-R = Technological Competency as Caring in Nursing Instrument – Revised,

SD = Standard Deviation, F1 = Factor 1, F2 = Factor 2, F3 = Factor 3, F4 = Factor 4

Table 3 shows the differences in the TCCNI-R scores in the lengths of experiences as RNs and nurse managers. In the average total score, nurses with a length of experience of five to less than ten years showed significantly lower TCCNI-R scores than those with years of experience of 20 to less than 30 years.

Table 4 shows differences in the average score of the TCCNI-R by the experience of receiving education on caring in nursing and employment positions. Those who had been educated on caring in nursing had significantly higher scores in Factor 2 (Technological Competency as Caring). In addition, in the result comparing employment positions, nurse managers show significantly higher

perceptions than staff nurses, except for Factor 1 (Nursing Expressions as Caring) and 2 (Technological Competency as Caring).

Discussion

Nursing experience in years

When considering the length of experience as an RN, nurses with years of experience within the range of 20 to less than 30 years showed the highest TCCNI-R scores among the two groups. This indicated that nurses with a length of experience within 20 to less than 30 years were aware of the necessity of knowing patients as important to nursing. In explaining how years of experience can influence nurses' thinking about caring in nursing, no related literature was found. However, some associated studies were found that examined the relationship between the periods of clinical experience and expressions of caring behavior (Aupia et al., 2018). Kato et al. (2017) revealed that nurses with ten or more years of clinical experience obtained a significantly higher score regarding the practice of nursing based on the theory of TCCN than nurses who had fewer years of clinical experience.

Jiang et al. (2015) found that nurses with a high-ranking job title had higher competency and feasibility. These results suggested that greater life experiences, years of work experience, and better competencies in practice enhance the promotion of more caring behavior among nurses. Lechleitner (2019) also found that nurses will be able to show more consideration for other people when they become older and gain new experiences.

In addition, a previous study (Takase, 2013) has reported that the relationships between the levels of nursing competence and the length of clinical experience were illustrated by a rapid increase in competence levels at the early stage of the nursing career. Therefore, length of experience as registered nurses in this study was classified into five groups of (a: 1- less than 5, b: 5- less than 10, c: 10- less than 20, d: 20- less than 30, e: more than 30), based on this idea, perception differences in TCCN theory were analyzed. As seen in these studies, support for the influence of years of experience in clinical practice is reflected well in the context of the TCCNI-R.

Experience of receiving education on TCCN theory

Caring in nursing is grounded on the fundamental concept that persons are caring and that nursing is a discipline and a profession (Boykin et al., 2001). In the nurse managers' group, the experience of receiving education on caring in nursing was 24%, and 24.3% in staff nurses in this study. Nurses who had received education on caring in nursing showed significant differences for Factor 2 (Technological Competency as Caring).

Three other factors, other than Factor 2, showed no significant difference, namely in Factor 1 (Nursing Expression as Caring), Factor 3 (Technology and Caring), and Factor 4 (Technological Knowing). However, the average scores of these three factors were about four

points, indicating high scores. These scores reflect the respondents' observance of professional ethics and occupational discipline, supported by items of the TCCNI-R, and as a result, their awareness of caring in nursing was considered high for TCCN.

Alternatively, Factor 2 (Technological Competency as Caring) is a factor that shows the basic concept of caring, that is, to know the patient more fully as a person intentionally and to respect the patient as a person in providing caring in nursing. The practice of caring in nursing requires an understanding of the other person. To that end, it is important to truly know the persons as participants in their care rather than as objects of care.

Nurses themselves may be able to share their own personal experiences. Similarly, in gaining clinical experience involving various patient situations and including their own life experience, it becomes easier to share humanistic caring practices with patients and their families. Learning nursing from situations of caring can enhance better appreciation of a person's lived experience.

The finding that the caring-educated group scored significantly higher in Factor 2 meant that nurses educated on caring in nursing were highly aware of the theory of "Nursing as Caring" by Boykin et al. (2001) and of "TCCN" theory by Locsin (2005).

Furthermore, the group of nurses who were educated on technological competency as an expression of caring in nursing had significantly higher scores about the TCCN compared with the group of nurses who had not received the educational intervention. Knowledge about caring has been valued most by nurses and nursing students regarding caring in their practice (Aupia et al., 2018). Still, in another study, it was found that nursing students had the lowest scores in caring behavior when compared to practicing nurses. These findings highlighted the importance of education on the concept of caring, particularly for nursing students, before they start engaging in their clinical nursing practice (Aupia et al., 2018).

A study of in-service education programs based on TCCN theory found that such programs resulted in promoting patient understanding, and quality care management with the focus on patient-centered care, hoping to improve quality patient care services. There is a need for education on the practice of theory to enable better understanding and eventual practice of human caring in nursing. Vujanic et al. (2020) declared that it is necessary to stress the significance of caring theories during initial nursing education as well as during their further education. This educational activity supports the view that nurses need lifelong education and training in order to uphold the essential nursing values and ensure that caring remains vital in their nursing practice. It is desirable to have an in-service education system that allows nurses to grow through reflection as well as through actual nursing practice.

Differences in their positions in nursing practice

Participants' employment positions were nurse manager

(22.8%) and staff nurse (77.2%). It was found that nurse managers were more aware of the TCCN than were the staff nurses. Nurse managers were more aware of providing care using technology, as revealed in Factor 3 (Technology and Caring). Nurse managers also recognized the need-to-know patient needs through technology and provided care to the ever-changing patient's condition as revealed in Factor 4 (Technological Knowing). Nurse managers use technology as an expression of caring from a compassionate perspective using multiple methods toward knowing persons, reflecting the use of nursing technology in order to know persons as caring. This finding shows that nurse managers were aware of the importance of using technology (Nakano et al., 2019) in order to know persons as caring. This study also showed that nurse managers were more aware of using technologies of care, as evidenced by their higher evaluation points when compared to the staff nurses.

About half of the nurse managers surveyed had participated in an in-service educational activity on TCCN. This experience was reflected in the nurse managers' responses to the TCCNI-R. The nurse managers recognized that they could grow in their caring by learning about nursing, caring, and technology. It can be expected that these findings reflected the positive outcome of on-site education and human resource development as a staff management project for nurse managers. It is essential to underscore that nurse managers are responsible for improving the quality of nursing care throughout their assigned departments. Therefore, it is necessary that they show the direction of nursing for their staff and work together toward the same goal. In this situation, if it is only the nurse manager who will have an idea about caring in nursing, the goal of the department cannot be achieved. The staff that practice it must be engaged fully within the aims of the department. It has been documented that when nurse managers exemplify caring in nursing, the focus will lead to the development of the staff's caring competencies. Education focused on caring should be positioned as consolidating the basis of nursing as a practice of technological competency as an expression of caring with required ideals inculcated in the educational process.

Limitations

This study had several limitations. The results of the study are considered to be limited due to differences in perceptions regarding caring education, which may include "course, training, or formal education" among the target population, and the fact that the target facilities were limited to acute care hospitals and data were not collected in various nursing areas, such as chronic care. In addition, the length of experience as a nurse manager was not asked during the survey.

Conclusion

The study clarified perceptions of nurse managers and staff nurses regarding the theory of TCCN in general hospitals

in Japan. Nurses who have practiced nursing within the range of 20 to less than 30 years showed the highest scores in their expression of technological competency as caring in nursing. These nurses were found to be highly aware of the necessity of knowing patients as a focus of their nursing. It was also found that nurses who had received education on TCCN showed significant differences in their perceptions considering Factor 2 (Technological Competency as Caring). This factor illustrates that essential caring in nursing focuses on knowing the patient intentionally and how to express respect for patients as persons through technological expressions of caring. Therefore, there is a need to educate nurses regarding the theory-based nursing practice, enabling a critical understanding of practicing caring in nursing. Nursing managers were more aware of TCCN than the staff nurses. Nurse managers were more aware of technological competency as an expression of caring in nursing than staff nurses, as revealed in Factor 3 (Technology and Caring). Furthermore, nurse managers recognized the need-to-know patient needs through technology more fully and provided care to patients within the ever-changing healthcare condition. This finding was supported by Factor 4 (Technological Knowing).

Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

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Authors' Contributions

All authors contributed to the conception of this study, drafting and revising the work critically, approved for the final version, and agreed to be accountable for all aspects of the work.

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Data Availability Statement

The datasets generated during and/or analyzed during the current study are not publicly available due to ethical restrictions but are available from the corresponding author on reasonable request.

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