Psychometric Testing of the Slovene Version of the Perceived Inventory of Technological Competency as Caring in Nursing

Cvetka Krel *, Dominika Vrbnjak, Gregor Štiglic, Sebastjan Bevc

Posted Date: 28 December 2023

doi: 10.20944/preprints202312.2131.v1

Keywords: technology; caring; reliability; validity; psychometric properties

Article

Psychometric Testing of the Slovene Version of the Perceived Inventory of Technological Competency as Caring in Nursing

Cvetka Krel [1,*], Dominika Vrbnjak [2], Gregor Štiglic [3] and Sebastjan Bevc [4]

[1] Department of Nephrology, University Clinical Centre Maribor, Faculty of Health Sciences, University of Maribor, 2000 Maribor, Slovenia.
[2] Faculty of Health Sciences, University of Maribor2000 Maribor, Slovenia; dominika.vrbnjak@um.si
[3] Faculty of Health Sciences, University of Maribor, 2000 Maribor, Slovenia; gregor.stiglic@um.si
[4] Department of Nephrology, University Clinical Centre Maribor, Faculty of Medicine, University of Maribor, 2000 Maribor, Slovenia; sebastjan.bevc@ukc-mb.si
* Correspondence: cvetka.krel@gmail.com; Tel.: 0038641279491

Abstract: Background: The Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) questionnaire has been designed to measure technological competency as caring in nursing practice. As there were no psychometrically sound instruments to quantify the concept in the Slovene language. The goal was to assess the level of psychometric properties of the PITCCN investigated in Slovene hospitals. Methods: Content validity was conducted with eight experts and quantified by the content validity index (CVI) and the modified Cohen's kappa index. Face validity was assessed through discussions with participants from the target culture in the pilot study. To assess construct validity and internal consistency, a cross-sectional research methodology was used on a convenience sample of 121 nursing personnel from four hospitals. Principal component analysis (PCA) was used to examine construct validity, while Cronbach's alpha and adjusted item-total correlations were used to measure internal consistency. Results: The content and face validity of PITCCN were adequate. The scale validity index (S-CVI) was 0.97. Cronbach's α was 0.92, and subscale reliabilities ranged from 0.810 to 0.925. PCA showed four components, which explained more than 73.49% of the variance. Conclusions: The Slovenian version of PITCCN (PITCCN_SI) has good psychometric properties.

Keywords: technology; caring; reliability; validity; psychometric properties

1. Introduction

The development of technology in healthcare, such as electronic health systems for collecting and storing healthcare information, has become more prevalent and beneficial to healthcare organisations. Electronic health systems allow it to keep patient records and other health information in a way that can be shared between patients, healthcare workers, and hospitals [1]. The integration of technology into nursing practice involves the utilisation and analysis of extensive data. Nurses create voluminous patient medical information in electronic health records when they document patients' care, such as patient's responses to treatments, symptoms, pain, etc. [2]. Accurate, up-to-date information and reliable patient data allow effective decision-making and appropriate action during nursing care provision [3-5] and make nursing care visible [6]. Technology is the tool that should help in the first place nurses to provide safe, quality, and patient-centred nursing care [7]. However, the use of technology also raises the potential concern that the focus might shift from caring to using technology itself [8]. Nurses need training, support, and funding to conduct research that uses data [9].

Nursing theories rooted in the concept of caring serve as guiding frameworks for nursing practice by aiding nurses in clarifying their beliefs and beliefs about human health processes, thereby shaping their approaches to patient care [10]. Integrating nursing theory into practice contributes to the enhancement of nursing care quality [11]. Locsin [12] underlined the importance of theory-based nursing practice, asserting that using technology and using caring in practice leads to harmonious

 doi:10.20944/preprints202312.2131.v1

nursing assistance through technology. "Technological Competence as Care in Nursing" (TCCN) theory is one of the nursing theories related to caring and using technologies in nursing. Locsin [8] clarified why nurses need to be technologically competent. Technological competency is a term referring to caring in nursing where technology and caring coexist. It is used to understand persons as caring, more fully as participants in their care rather than as objects of care [12]. He also incorporated the theorist Carper's four modes of knowing (ethical, aesthetic, empirical, and personal) [13], adding that the use of technologies in nursing necessitates technological knowing [8]. Technological knowing is another form of knowing in nursing; it entails the competent use of care technology to get to know patients as a whole, that is unique (with their hopes, dreams, and desires), whole (body, mind, soul), and perfect (regardless of sickness). [14]. With a focus on operationalising these concepts, Locsin [15] developed the Technological Caring Instrument (TCI) to measure technological caring. Parcells and Locsin [16] revised the TCI. They developed the Technological Competency as Caring in Nursing Instrument (TCCNI), which incorporates knowing persons more fully in conjunction with caring with/through technology and measures nurses' ways of thinking about caring and technology [17-19]. The questionnaire Perceived Inventory of Technological Competency as Caring and Nursing (PITCCN) was developed by Kato et al. [20], revised by Miyamoto et al. [21], and validated by Ito et al. [22]. The surveys of nurses were carried out in intensive care units in Japan to detect perceptions and practice situations of TCCN theory and technological competency. The PITCCN was targeted and tested on its contribution to practice and can measure technological competency as an expression of caring in nursing [22, 23]. Therefore, we also used this questionnaire. The key idea of PITCCN was that the empirical, personal, ethical, and aesthetic methods of knowing that are essential to understanding patients as a whole increase the likelihood of getting to know patients [21]. In PITCCN, empirical knowing was defined as a method of understanding patients through the use of technologies that contribute to scientific knowledge to support intervention in nursing care [22]. In our survey, we used the PITCCN questionnaire [22] to measure its capacity for technological competency as an expression of caring in nursing [20, 22], addressing the lack of psychometrically valid and reliable instruments for evaluating technological competency as caring in the Slovene language.

To bring theory into practice, we integrated the TCCN theory and the PITCCN questionnaire into our investigation, centering on developing and implementing an electronic nursing record system (ENRS). Based on Locsin's TCCN theory, ENRS can use a language of caring in nursing practice, surpassing the limitations of exclusively documenting physical requirements and medical conditions. ENRS can provide information about patients as a whole, including documenting the work performed by multiple healthcare providers and enabling better-coordinated care [24].

The study aims to investigate the psychometric properties of a Slovenian version of PITCCN (PITCCN_SI) by evaluating its content and construct validity through Principal Component Analysis (PCA) and internal consistency.

2. Materials and Methods

2.1. Validation concerning the experts' agreement

2.1.1. The process of translating the questionnaire

One of the original PITCCN writers permitted us to use the instrument. The instrument by Ito et al. [22], PITCCN with 19 items, was translated from English to Slovenian, followed by back translation to ensure semantic equivalence [25] and the questionnaire quality [26].

The instruments were separately translated into Slovene by two translators. One of the translators was acquainted with the research on technological competency as caring in nursing. Both then discussed the translated instrument with another researcher who is fluent in English and holds expertise in the research field. A professional translator backtranslated the instrument when preparing a consensus version. The research team and translators compared responses to the

 doi:10.20944/preprints202312.2131.v1

translated and original versions of the questionnaire. They eliminated any discrepancies that might indicate problems with semantic or cultural equivalence.

2.1.2. Content validity

Eight experts with a PhD or MSc degree and over three years of nursing experience assessed content validity. Their educational background encompassed nursing theories, including caring theories, and expertise in utilizing nursing technologies, such as electronic nursing record systems.

Purposive sampling was used. Experts examined the instruments for their relevance using a four-point relevance scale (4 = highly relevant, 3 = quite relevant, 2 = somewhat relevant, 1 = not relevant). A content validity index (CVI) was calculated for each item (I-CVI) and scale (S-CVI) [26, 27]. Content validity indices were evaluated (I-CVI and S-CVI/Average) as good, with values of 0.78 and 0.90, respectively. [28]. The I-CVI was calculated as the number of experts presenting a rating of 3 or 4 divided by the number of experts. The S-CVI was calculated as an average of the I-CVIs for all items on the scale (S-CVI/Ave). A modified kappa statistic (κ*) was computed to account for chance agreement on relevancy and use among experts [19]. The probability of chance agreement was first calculated using the formula $\mathbf{Pc} = (\frac{\mathbf{N!}}{\mathbf{A!}} \times (\mathbf{N} - \mathbf{A})) \times \mathbf{0,5^N}$, where N is the number of experts, while A is the number of agreeing on good relevance, with ratings 3 and 4. The following formula was then used to determine the κ* = [I-CVI - Pc]/ [1 - Pc]. The value for each κ* is excellent (more than 0.74), good (between 0.60 and 0.74) or fair (between 0.4 and 0.59) [27, 28].

2.1.3. Face validity and the cultural equivalence of items

Face validity and the cultural equivalence of items were evaluated in a pilot study involving a convenience sample of 12 experienced members of the nursing teams (registered nurses and nursing assistants). They have had more than three years of experience in nursing, have worked in one of the internal wards of Slovenian hospitals, and were proficient in using the ENRS. Participants were invited to complete the questionnaire, estimate the time needed for completion, and assess comprehensibility (face validity) by proposing enhanced phrasing for any unclear items. Following their comments or suggested revisions, the authors engaged in discussions to determine whether the items maintained cultural significance, aiming to reach a consensus before finalizing and confirming the questionnaire.

Detailed documentation was maintained throughout the translation and adaptation process. It included records of translation, expert reviews, the pilot feedback, and any modifications made to enhance semantic and cultural equivalence.

2.3. Participants, Setting and Procedure

A cross-sectional survey was conducted to evaluate the instrument's psychometric properties. Psychometric testing involved a convenience sample of 121 participants (registered nurses and nursing assistants) in two internal wards and two non-acute care settings from four Slovenian hospitals using the same nursing record systems. We have included nurses and nursing assistants in the study, as in Slovenia, both professional groups are members of nursing teams who actively engage in various nursing interventions and use ENRS within hospital settings. Nursing assistants undergo secondary-level education specific to their role, while nurses receive a 3-year first-cycle Bologna higher education. According to the National Institute of Public Health of the Republic of Slovenia (2020), currently, there are 72% (n = 12.959) nursing assistants and 28% (n = 9.043) nurses in Slovenia.

We included participants working in internal wards and non-acute care within hospitals who were willing to participate and utilise the identical ENRS. Gender, age, education, professional, and experience with ENRS were among the demographic features of respondents. Nurses using ENRS for less than three months were excluded from the survey.

Data were collected from August 2021 to May 2022. Head nurses of two internal wards and two non-acute care settings from hospitals distributed the questionnaires prepared in sealed envelopes to

 doi:10.20944/preprints202312.2131.v1

the participants. They informed them about the study aims before administration. A total of 131 questionnaires were sent and were to be returned within four weeks. Returning completed questionnaires was regarded as consent for participation. The completed questionnaires were returned in a closed envelope to the head nurses or the researcher, who collected them and securely stored them. All questionnaires had security codes attributed to computerised records.

2.4. Data Analysis

The questionnaires were coded with a number (from 01 to 121), and data were exported to IBM SPSS Statistics (version 24.0 for Windows, Armonk, NY, USA) and analysed. The question asking for numerical data (age) was not coded because participants entered the exact number into a blank box. For nominal data (gender, professional experience, education, time of use ENRS), codes were assigned arbitrarily (e.g., Female '2', Male '1'). The responses in the PITCCN_SI were coded from '1'(strongly disagree) to '5' (strongly agree). Descriptive statistics were performed to describe the population's characteristics and the PITCCN_SI results. Cronbach's alpha was calculated for internal consistency if the coefficient was above 0.7 [28]. The item-total correlation of each item and the item's contribution were analysed. If the correlation of an individual item with the rest of the scale was above 0.3, the item was eliminated [28, 29]. PCA was used to evaluate the construct validity, explaining as much variance as possible in the data (33, 34) and reducing variables called components, which are linear combinations of the original variables [30]. The reduced variables, called components, are linear combinations of the original variables. Bartlett's sphericity test and also the Kaiser–Meyer–Olkin (KMO) were used to determine how suited the data were for factor analysis. A criterion of KMO values between 0.8 and 1 indicates the sampling is adequate and that the higher the KMO value, the more appropriate the data is for factor analysis [31] and Bartlett's test of sphericity values is significant (i.e., the significant value must be 0.05 or less) [32].

3. Results

3.1. Validation concerning the experts' agreement

3.1.1. The process of translating the questionnaire

We encountered no issues with the translated items during the expert review, and there was no need for any modifications or deletions of items.

3.1.2. Content validity of the PITCCN_SI

Table 1 contains 19 questions, classified into four subscales from the PITCCN questionnaire by Ito et al. [22]. As described in Table 1, only one item (I continue to consider better care by reflecting on their process of care) had an I-CVI score (0.62) lower than 0.78. The S-CVI/Ave was 0.974, showing satisfactory content validity.

Table 1. The content validity of the PITCCN_SI.

	Subscale/Item	*Number of experts*	*Number of agreements*	*[a]ICV-I*	*[b]P_c*	*[c]κ**	*[d]Evaluation*
Training of nurses to provide optimal care							
1	I continue to consider better care by reflecting on their process of care.	8	5	0,625	0,019	0,618	good
2	I practice like growing up as a nurse.	8	8	1,000	0,000	1,000	excellent
3	I cherish that to convey what I learned from patients and share it with patients.	8	8	1,000	0,000	1,000	excellent
4	I support patients in fulfilling their hopes and desires.	8	8	1,000	0,000	1,000	excellent

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 28 December 2023 doi:10.20944/preprints202312.2131.v1

5	I communicate their learned experiences of caring for patients with their colleagues and nursing students and share them with them.	8	8	1,000	0,000	1,000	excellent
6	I provide the best nursing care for patients.	8	8	1,000	0,000	1,000	excellent
7	I care for patients considering time and situation.	8	8	1,000	0,000	1,000	excellent
	Empirical knowledge and whole human knowing						
8	I use knowledge of the latest clinical pharmacology.	8	8	1,000	0,000	1,000	excellent
9	I use knowledge of anatomy and physiology.	8	8	1,000	0,000	1,000	excellent
10	I use knowledge of well-versed in the state-of-the-art of medical devices in their department. (Empirical knowing)	8	8	1,000	0,000	1,000	excellent
	Utilisation of information obtained from technology and continuous knowing						
11	I understand the condition of their patients based on information acquired from technology (ENRS).	8	8	1,000	0,000	1,000	excellent
12	I assess the patient's condition from information acquired using technology (ENRS).	8	8	1,000	0,000	1,000	excellent
13	I share patient information acquired from technology to illustrate team medical care effectively (ENRS).	8	8	1,000	0,000	1,000	excellent
	Intentional and ethical nursing of a person						
14	I encourage patients by caring emotionally.	8	7	0,875	0,005	0,874	excellent
15	I respect patients as unique individuals.	8	8	1,000	0,000	1,000	excellent
16	I know the whole patient.	8	8	1,000	0,000	1,000	excellent
17	I am caring for patients with an unchanged attitude even if they lose their physical functions.	8	8	1,000	0,000	1,000	excellent
18	I behave in ways that can gain the trust of patients.	8	8	1,000	0,000	1,000	excellent
19	I encourage patients by touching their bodies.	8	8	1,000	0,000	1,000	excellent
	[e]S-CVI/Ave= 0,974						

Legend: [a]I-CVI (item content validity index) = number giving a rating of 3 or 4/number of experts. [b]Pc (probability of a chance occurrence) = $Pc = (\frac{N!}{A!} \times (N - A)) \times 0{,}5^N$ N = the number of experts, and A = the number agreed on good relevance. [c]κ* = kappa designating agreement on relevance: κ* = [I-CVI − Pc] / [1 − Pc]. [d]Evaluation criteria for kappa = fair = κ* of 0.40–0.59; good = κ*of 0.60–0.78; and excellent = κ* > 0.78. [e]S-CVI/Ave (average scale content validity index) = mean of I-CVI. ENRS = the electronic nursing record system.

3.1.3. Face validity and the cultural equivalence

The research team assessed the items' cultural equivalence and comprehensibility by discussing with experienced members of the nursing teams from the target culture (registered nurses and nursing assistants) in the pilot study.

The findings indicated that the items were culturally appropriate, easy to understand and free of cultural biases. The entire questionnaire took a mean of 10 minutes to complete.

 doi:10.20944/preprints202312.2131.v1

3.2. Sample

Fully completed 121 out of 164 surveys were returned (return rate = 73.78%). Most women (85.1%) and nursing assistants (48.8%) participated in the research. The mean age was 36.06 (SD = 10.85). Most participants had up to 5 years of working experience (40.5%) and 6-11 months of use of ENRS (38.8%). Other characteristics of the sample are presented in Table 2.

Table 2. Descriptive statistics of the sample features (n = 121).

Variable		*n*	*Valid %*	*M* (SD)
Sex	Female	103	85.10	
	Male	18	14.90	
	Total	121		
	Missing values	2		
Education	Nursing Assistant	59	48.8	
	Nurse with a diploma degree	53	43.8	
	Nurse with master's degree	9	7.4	
	Age			36.06 (10.85)
Years of working experiences	Up to 5 years	49	40.5	
	6-10 years	21	17.4	
	11-20 years	33	27.3	
	21-30 years	5	4.2	
	More than 31 years	13	10.7	
Use of ENRS	Up to 5 months	39	32.2	
	6-11 months	47	38.8	
	12-23 months	9	7.4	
	More than 24 months	26	21.5	

Legend: n = the number of responses, % = percentage; n, number; M = mean, SD = standard deviation. ENRS = the electronic nursing record system.

3.3. Construct validity of PITCCN_SI

Bartlett's test (Approx. Chi-Square = 1656.12, df = 171, P ≤ 0.001) and the KMO (0.89) showed acceptable values, and the data were found adequate to perform PCA. Table 3 shows that the PCA provided a 4-component solution that explained 73.5% of the data variance. The first component was labelled as training of nurses to provide optimal care and contained seven items with factor loadings from 0.49 to 0.82. The second component, empirical knowledge and whole human knowing, had three items, with factor loadings from 0.74 to 0.85. The third component, utilisation of information obtained from technology and continuous knowing, contained three items whose factor loadings ranged from 0.86 to 0.92. The fourth component, labelled intentional and ethical nursing of a person, included six items whose factor loadings ranged from 0.63 to 0.85.

3.4. Internal consistency reliability of PITCCN_SI

The latest version of PITCCN_SI had a satisfactory Cronbach's α for a scale of 0.925. In addition, the four subscales (nursing education to give optimal care; complete human knowing and empirical knowledge; integration of information received from ENRS; committed and ethical nursing care) obtained from the PCA also indicated satisfactory Cronbach's. The Cronbach's α for subscales was (0.901, 0.810, 0.897, and 0.921), as seen in Table 3.

Table 3. Items of the PITCCN_SI, total variance explained, components, Cronbach's α, and corrected item-total correlation coefficients for the varimax rotated four-component solution (n = 121).

Item	*Component*				*Corrected item-total correlation*	*Cronbach α if the item is deleted*
	1	*2*	*3*	*4*		
1	.491				.534	.919
2	.699			.534	.726	.914
3	.786			.726	.640	.916
4	.824			.640	.678	.915
5	.782			.678	.684	.915
6	.749			.684	.635	.916
7	.700		.404	.635	.676	.915
8		.740	.338	.676	.431	.921
9		.853			.505	.919
10	.304	.808		.431	.551	.918
11			.861	.505	.449	.921
12			.920	.551	.416	.922
13			.861		.491	.920
14	.413			.627	.739	.913
15				.841	.678	.915
16				.847	.668	.915
17				.828	.615	.917
18				.845	.601	.917
19	.314			.729	.690	.915
Total variance explained (%)	43.824	13.030	9.004	7.636		
Cronbach's α **.925** (all 19 items)	**.901**	**.810**	**.897**	**.921**		

Legend: Components: 1-nursing education to give optimal care; 2-complete human knowing and empirical knowledge; 3-integration of information received from ENRS; 4-committed and ethical nursing care. ENRS = the electronic nursing record system.

4. Discussion

Our study found that PITCCN_SI has satisfactory psychometric properties, with 121 nurses responding. The content and face validity, reliability, and construct validity of PITCCN_SI were verified.

A version of the PITCCN_SI to the original version was obtained, which was semantically and culturally adapted to Slovenian members of nursing teams. The process of back translation was used. The forward and backward translations are essential for the survey's validity to achieve semantic equivalence [33] and the high quality of the translation, which confirmed the accuracy of the translations for the Slovene version of the PITCCN questionnaire. The research team and translators discussed the translated and original versions of the questionnaire. They eliminated any discrepancies that might indicate problems with semantic or cultural equivalence. To guarantee the questionnaire's suitability in representing the targeted construct, the expert panel, assessing content validity, evaluated the relevance of each question's content, the appropriateness of language, cultural pertinence, and coverage across domains [26].

We carried out content validity, which is not often used but is recommended for psychometric testing and cultural adaptations [26, 34]. In the professional nursing practice, the differences relate to demographics, culture, and differences in the health care system. Also, the development and use of technology in nursing differ in each country [22, 35]. The CVI indicates that the degree of agreement between the expert raters and the criteria for item acceptability should be no lower than 0.78 [28].

 doi:10.20944/preprints202312.2131.v1

Only one of the items in our study (I continue to consider better care by reflecting on their process of care) in the instrument had an I-CVI score (0.62) lower than 0.78. The experts suggested only a more comprehensible reformulation of the item in the Slovenian language, so it was not eliminated from the questionnaire and was considered in further psychometric testing, where it reached acceptable values when testing internal reliability. The average CVI for the scale was 0.974, showing satisfactory content validity. The content and face validity of PITCCN were found to be adequate. The research team assessed the items' cultural equivalence and comprehensibility by discussing with participants from the target culture (registered nurses and nursing assistants) in the pilot study to improve clarity and cultural relevance. They confirmed the items were culturally appropriate, easily understood, and free from cultural bias during the pilot study. Comprehensive records were kept during the translation and adaptation process, documenting translation decisions, expert reviews, pilot stady feedback, and modifications made to improve semantic and cultural equivalence. They provide transparency and can facilitate future research or validation efforts [26].

The data were found suitable acceptable to perform PCA as Bartlett's test ($p \leq 0.001$), and the KMO (0.89) showed acceptable values. The PCA lessens the dimensionality of a dataset while preserving as much 'variability' (statistical data) as possible [36], and our research produced a 4-component solution that explained 73.49% of the variance in the data. The same four components were already obtained in previous studies [22, 23]. Cronbach's alpha is an essential concept in the evaluation of assessments and questionnaires. Good Cronbach's alpha values indicate a sufficient number of questions, interrelatedness of items, or heterogeneous constructs [37]. The PITCCN_SI version demonstrated a satisfactory Cronbach's α for the overall scale at 0.925. The final version of the original PITCCN had a satisfactory Cronbach's for a scale (0.906) [22] and was also in our research because it was more than 0.7 [38]. The internal reliability of individual subscales was also acceptable (0.901, 0.810, 0.897, 0.921) because they were also all over the limit value of 0.7. They were also confirmed in the PITCCN questionnaire by Ito et al. [22], and there were values of individual subscales over the limit (0.895, 0.849, 0.951, 0.744) [22].

The original instrument had 23 items. The questionnaire was tested in Japanese hospitals in intensive care units. Since the original questionnaire also contained questions about managing unconscious patients in intensive care units, we decided to use the newer PITCCN questionnaire by Ito et al. [22], who retained 19 of the 23 items after factor analysis. Thus, we did not include in our research the items of the original PITCCN: 1) I deliberately try to communicate with unconscious patients with the aim of resuscitation; 2) I empathize with what patients experience; 3) I appreciate knowing that the patient is most hopeful now; and 4) I am required to respect the privacy of unconscious patients. We found no other differences between the original and PITCCN_SI during the verification process.

Locsin's (2005) TCCN theory underpinned research as it articulates explicitly the idea of nursing practice being integrated with modern healthcare technology [41], where they also belong to electronic health records [41]. Theoretical starting points also supported the research on electronic health records [42, 43], but few surveys have been carried out. TCCN theory will guide our study in implementing the ENRS and documenting nurses' caring behaviours in nursing, not just physical needs and health conditions. There are essential caring interventions, such as being hopeful, providing psychical care, carefully listening to patients, showing compassion, prayer, using therapeutic touch, etc. [44]. It is required to understand the patients as complete and unique [8], which must also be considered when documenting the nursing process. Research confirmed that with the introduction of computers into each patient room, nurses spent more time with the patient, and caring interventions increased after implementing electronic health records [2, 45]. However, there has been little reliable research on the pros and cons, including nurses' caring behaviours of its use. Nurses have been open to exploring the benefits of electronic documentation and building competency in integrating technology and caring [45]. A limitation of the study is its small sample size, as participants were recruited through convenience sampling. Additionally, the study was limited to only include a subset of hospitals. Additional research is needed to explore different

settings and diverse populations. Because criterion-related validity and test-retest reliability were not investigated in this study, further psychometric evaluation is necessary.

5. Conclusions

The Slovenian version of the PITCCN questionnaire was developed and tested based on the TCCN theory but has not previously been used to conduct a study in Slovenia. A version of the PITCCN questionnaire to the original version was obtained, which was semantically and culturally adapted to Slovenian nursing care providers. The PITCCN questionnaire is a proper tool that can reliably measure nurses' perception of TCCN in hospital settings when using the ENRS. The research findings can also have an impact on the further development of the ENRS and patterns of knowing in nursing, such as empirical, personal, ethical, and aesthetic, and help us identify and propose strategies to include the language of caring into the ENRS. Given the development and use of the ENRS in healthcare, more research is needed about integrating caring and technological competency when using the ENRS, and the PITCCN questionnaire is a tool that can support this research.

Limitations: This study was conducted with a population of members of nursing teams as participants, where not all of them were educated on the TCCN theory reflected in the items in the PITCCN. Education on TCCN theory would be necessary to improve nurses' understanding of technological competence and caring integration in ENRS. In the context of criterion validity, it is worth noting that no comparable questionnaires incorporating caring in nursing, including the use of technology (ENRS), were found. Consequently, the criterion validity assessment was not performed. Exploratory factor analysis and confirmatory factor analysis were not performed due to the limited population size in Slovenian hospitals that use ENRS. ENRS is still being developed in Slovenia, with many hospitals lacking electronic support for nursing care documentation. Consequently, our study concentrated on four hospitals that utilize the same ENRS for nursing care documentation. More than half of the possible population (121 out of 164, 73.78% of surveys were returned) working with this type of information system was collected.

Author Contributions: Conceptualisation, C.K., D.V., and S.B.; Data curation, C.K., G.Š, D.V., and S.B.; Formal analysis, C.K., and G.Š.; Investigation, C.K., D.V., and S.B.; Methodology, C.K., D.V., and S.B.; Project administration, C.K., G.Š., and S.B.; Supervision, D.V., G.Š., and S.B.; Validation, C.K. and S.B; Writing—original draft, C.K. and D.V..; Writing—review & editing, C.K., D.V., G.Š. and S.B. All authors agreed to the published version of the manuscript.

Funding: The research received no external funding. This manuscript has been funded by Internal research (IRP-2017/01-11) of the University Clinical Centre Maribor.

Institutional Review Board Statement: The Republic of Slovenia National Medical Ethics Committee approved the study (NMEC, *127/08/20*), and healthcare institutions also approved the study, which provided written approval. The study was done according to the Declaration of Helsinki [46] and the principles of The Code of Ethics for Nurses and Nurse Assistants of Slovenia [47]. Participation in the study was voluntary, and confidentiality and anonymity were guaranteed for participants and healthcare institutions.

Informed Consent Statement: The questionnaires were distributed in envelopes for the participants to participants who were ready to participate in the research by the head nurse of each ward with the researcher. Data for participants was provided in each questionnaire: "We ask you to participate in the survey, where we assure you that all the information provided will be anonymous and used solely for the study. The results of the data analysis will not reveal your identity or your institution's identity. You agree to participate in the survey by completing and submitting the questionnaire". The questionnaires had to be completed within four weeks. The participants returned the completed questionnaire in a sealed envelope to the special closed containers given to the researcher by the head nurse. The participant's completion and return of a survey was treated as implied consent. All questionnaires had security codes attributed to computerised records. The questionnaires are stored in a locked location at the institution where the principal of the researchers is employed for the next ten years, to which only he has access.

Data Availability Statement: The data supporting this study's findings are available from the corresponding author on special request.

Acknowledgments: The authors thank all institutions for their collaboration and the nurses for contributing to this study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Robichaux, C.; Tietze, M.; Stokes, F.; McBride, S. Reconceptualizing the Electronic Health Record for a New Decade: A Caring Technology? *Adv Nurs Sci* **2019**, *42*, 193-205, doi:10.1097/ans.0000000000000282.
2. Schenk, E.; Schleyer, R.; Jones, C. R.; Fincham, S.; Daratha, K. B.; Monsen, K. A. Impact of Adoption of a Comprehensive Electronic Health Record on Nursing Work and Caring Efficacy. *Comput Inform Nurs* **2018**, *36*, 331-339, doi:10.1097/cin.0000000000000441.
3. Fang, Y. W.; Li, C. P.; Wang, M. H. The development and evaluation of a nursing information system for caring clinical in-patient. *Technol Health Care* **2015**, *24*, S401-406, doi:10.3233/thc-151106.
4. Dendere, R.; Samadbeik, M.; Janda, M. The impact on health outcomes of implementing electronic health records to support the care of older people in residential aged care: A scoping review. *Int J Med Inform* **2021**, *151*, 104471, doi:10.1016/j.ijmedinf.2021.104471.
5. Yang, X.; Huang, W.; Zhao, W.; Zhou, X.; Shi, N.; Xia, Q. Exploring Acute Pancreatitis Clinical Pathways Using a Novel Process Mining Method. *Healthcare* **2023**, *11*, 2529. Available online: https://doi.org/10.3390/healthcare11182529 (accessed on 29 October 2023).
6. Rossi, L.; Butler, S.; Coakley, A.; Flanagan, J. Nursing knowledge captured in electronic health records. *Int J Nurs Knowl* **2023**, *34*, 72-84, doi:10.1111/2047-3095.12365.
7. Gomes, M.; Hash, P.; Orsolini, L.; Watkins, A.; Mazzoccoli, A. Connecting Professional Practice and Technology at the Bedside: Nurses' Beliefs about Using an Electronic Health Record and Their Ability to Incorporate Professional and Patient-Centered Nursing Activities in Patient Care. *Comput Inform Nurs* **2016**, *34*, 578-586, doi:10.1097/CIN.0000000000000280.
8. Locsin, R. C. *Technological Competency as Caring in Nursing: A Model for Practice*; Sigma Theta Tau International Honor Society of Nursing, 2005, ISBN 13-978-1930538122.
9. Suriaga A. Nurse Caring: From Robotic Surgeries to Healthcare Robots. *Int J Hum Caring* **2019,** *23*, 178-84, doi:10.20467/1091-5710.23.2.178.
10. McCarthy, C. T.; Aquino-Russell, C. A comparison of two nursing theories in practice: Peplau and Parse. *Nurs Sci Q* **2009**, *22*, 34-40, doi:10.1177/0894318408329339.
11. Younas, A.; Quennell, S. Usefulness of nursing theory-guided practice: an integrative review. *Scand J Caring Sci* **2019**, *33*, 540-555, doi:10.1111/scs.12670.
12. Locsin, R. C. The Co-Existence of Technology and Caring in the Theory of Technological Competency as Caring in Nursing. *J Med Invest* **2017**, *64*, 160-164, doi:10.2152/jmi.64.160.
13. Carper, B. Fundamental patterns of knowing in nursing. *Adv Nurs Sci* **1978**, *1*, 13-23.
14. Locsin, R. C.; Purnell, M. Advancing the Theory of Technological Competency as Caring in Nursing: The Universal Technological Domain. *Int J Hum Caring* **2015**, *19*, 50-54, doi:10.20467/1091-5710-19.2.50.
15. Locsin, R. C. Development of an instrument to measure technological caring in nursing. *Nurs Health Sci* **1999**, *1*, 27-34, doi: 10.1046/j.1442-2018.1999.00005.x.
16. Parcells, D. A.; Locsin, R. Development and psychometric testing of the Technological Competency as Caring in Nursing Instrument. *Int J Hum Caring* **2011**, *15*, 8-13, doi:10.20467/1091-5710.15.4.8
17. Biswas, S.; Kongsuwan, W.; Matchim, Y. Technological Competency as Caring in Nursing as Perceived by ICU Nurses in Bangladesh and Its Related Factors. *Songklanagarind Journal of Nursing* **2016**, *36*. Available online: https://he02.tci-thaijo.org/index.php/nur-psu/article/view/54716 (accessed on 29 October 2023).
18. Rincon Alvarez, D. A.; Chaparro Diaz, L. Validity and Reliability of the Spanish Version of the Technological Competency as Caring in Nursing Instrument. *Invest. educ. enferm* **2017**, *35*, 154-164, doi:10.17533/udea.iee.v35n2a04.
19. Yuliati, I.; Purnama, N.; Winarni, S. Content Validity and the Reliability of Technological Competency as Caring in The Nursing Instrument_Indonesian Version (TCCNI_IV). *Jurnal Ners* **2019**, *14*, 187, doi:10.20473/jn.v14i2.10873.
20. Kato, K.; Tanioka, T.; Yasuhara, Y.; Osaka, K.; Ito, H.; Locsin, R. The Development of the Perceived Inventory of Technological Competency as Caring in Nursing. *Shikoku Acta Medica* **2017**, *73*, 151-160.
21. Miyamoto, M.; Ito, H.; Miyagawa, M.; Yasuhara, Y.; Tanioka, T.; Locsin, R. Criterion-related Validity of the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) in Acute Care Settings. *J Med Invest* **2019**, *66*, 42-45, doi:10.2152/jmi.66.42.
22. Ito, H.; Tanioka, T.; Miyamoto, M.; Miyagawa, M.; Yasuhara, Y.; Locsin, R. Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN): Psychometric Evaluation. *Int J Nurs Stud* **2019**, *4*, 1, doi:10.20849/ijsn.v4i2.562.
23. Kato, K.; Miyagawa, M.; Yasuhara, Y.; Osaka, K.; Kataoka, M.; Ito, H. Recognition and Status of Practicing Technological Competency as Caring in Nursing by Nurses in ICU. *Int J Nurs Clin Pract* **2017**, *4*, 1-8, doi:10.15344/2394-4978/2017/264.
24. Pepito, J. A.; Locsin, R. Can nurses remain relevant in a technologically advanced future? *Int J Nurs Sci* **2019**, *6*, 106-110, doi:10.1016/j.ijnss.2018.09.013.
25. Brislin, R. W. Back-Translation for Cross-Cultural Research. *J Cross Cult Psychol* **1970**, *1*, 185-216, doi:10.1177/135910457000100301.

26. Polit, D. F.; Beck, C. T. *Nursing Research: Generating and Assessing Evidence for Nursing Practice*; Lippincott Williams and Wilkins:
27. New York, USA, 2012, ISBN 13-**978-1605477084.**
28. Polit, D. F.; Beck, C. T. The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res nurs health* **2006**, *29*, 489-497, doi:10.1002/nur.20147.
29. Polit, D. F.; Beck, C. T.; Owen, S. V. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res nurs health* **2007**, *30*, 459-467, doi:10.1002/nur.20199.
30. Vrbnjak, D.; Pahor, D.; Stiglic, G.; Pajnkihar, M. Content validity and internal reliability of Slovene version of Medication Administration Error Survey = Vsebinska veljavnost in notranja zanesljivost slovenske razlicice anketnega vprasalnika o napakah pri dajanju zdravil v zdravstveni negi. *Obzor Zdrav Neg* **2016**, 50, 20-40, doi: 10.14528/snr.2016.50.1.69.
31. Schreiber, J. B. Issues and recommendations for exploratory factor analysis and principal component analysis. *Res Social Adm Pharm* **2021**, *17*, 1004-1011, doi:10.1016/j.sapharm.2020.07.027.
32. Tabachnick, B. G.; Fidell, L. S. *Using Multivariate Statistics,* 6th ed.; Pearson Education, Boston, USA, 2013, ISBN 9780134790541.
33. Ibikunle, P. O.; Rhoda, A.; Smith, M. Structural validity and reliability of the return to work assessment scale among post stroke survivors. *Work* **2021**, *69*, 969-979. doi:10.3233/WOR-213528.
34. Mallinckrodt, B.; Wang, C. D. C. Quantitative Methods for Verifying Semantic Equivalence of Translated Research Instruments: A Chinese Version of the Experiences in Close Relationships Scale. *J. Couns. Psychol* **2004**, *51*, 368-379, doi:10.1037/0022-0167.51.3.368.
35. Vrbnjak, D.; Pahor, D.; Nelson, J. W.; Pajnkihar, M. Content validity, face validity and internal consistency of the Slovene version of Caring Factor Survey for care providers, caring for co-workers and caring of managers. *Scand. J. Caring Sci* **2017**, *31*, 395-404, doi:10.1111/scs.12338.
36. Papastavrou, E.; Efstathiou, G.; Acaroglu, R.; MD, D. A. L.; Berg, A.; Idvall, E.; Kalafati, M.; Kanan, N.; Katajisto, J.; Leino-Kilpi, H.; et al. A seven country comparison of nurses' perceptions of their professional practice environment. *J. Nurs. Manag* **2012**, *20*, 236-248, doi:10.1111/j.1365-2834.2011.01289.x.
37. Jolliffe, I. T.; Cadima, J. Principal component analysis: a review and recent developments. *Philos Trans A Math Phys Eng Sci* **2016**, *374*, 20150202, doi:10.1098/rsta.2015.0202.
38. Tavako, M.; Dennick, R. Making sense of Cronbach's alpha. *Int J Med Educ* **2011**, *2*, 53-55, doi:10.5116/ijme.4dfb.8dfd.
39. Ferketich, S. Focus on psychometrics. Internal consistency estimates of reliability. *Res nurs health* **1990**, *13*, 437-440, doi:10.1002/nur.4770130612.
40. Miyamoto, M.; Ito, H.; Miyagawa, M.; Yasuhara, Y.; Tanioka, T.; Locsin, R. Criterion-related Validity of the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) in Acute Care Settings. *J. Med. Investig* **2019**, *66*, 42-45, doi:10.2152/jmi.66.42.
41. Miyamoto, M.; Miyagawa, M.; Tanioka, T.; Yasuhara, Y.; Locsin, R.; Osaka, K.; Ito, H.; Kongsuwan, W. Comparative Examination between the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) and the Technological Competency as Caring in Nursing Instrument (TCCNI). *Int J Nurs Clin Pract* **2017**, *4*, doi:10.15344/2394-4978/2017/267.
42. Raghunathan, K.; McKenna, L.; Peddle, M. Factors in integrating academic electronic medical records in nursing curricula: A qualitative multiple case studies approach. *Nurs educ today* **2023**, *120*, 105626, doi:https://doi.org/10.1016/j.nedt.2022.105626.
43. Koerber-Timmons, M. K. Value-based teaching: A grounded theory of internalizing accountability in teaching documentation. Ph.D., University of Phoenix, Ann Arbor, 2014. Available online: https://search.proquest.com/docview/1643246789?accountid=28931 (accessed on 24 September 2023).
44. Toole, B. M. Patient Care Technology and the Nurse-Patient Relationship. Ph.D., University of San Diego, Ann Arbor, 2015. Available online: https://search.proquest.com/docview/1662318090?accountid=28931(accessed on 24 September 2023).
45. Norman, V.; Rossillo, K.; Skelton, K. Creating Healing Environments Through the Theory of Caring. *AORN J* **2016**, *104*, 401-409, doi:10.1016/j.aorn.2016.09.006.
46. Graham, H. L.; Nussdorfer, D.; Beal, R. Nurse Attitudes Related to Accepting Electronic Health Records and Bedside Documentation. *Comput Inform Nurs* **2018**, *36*, 515-520, doi:10.1097/cin.0000000000000491.
47. *World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Jama* **2013**, *310, 2191-2194, doi:10.1001/jama.2013.281053.*
48. Nurses and Midwives Association of Slovenia. The code of ethics for nurses and nurse assistants of Slovenia. Available online: http://www.zbornica-zveza.si/sl/node/627 (accessed on 24 September 2023).

 doi:10.20944/preprints202312.2131.v1

disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.