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Article

Development of Perceived Technological Competency as Caring in Healthcare Providers Instrument (TCCHI): A Modified Delphi Method

Risa Yamanaka [1], Krishan Soriano [1], Yoshiyuki Takashima [2], Kaito Onishi [1], Hirokazu Ito [3], Youko Nakano [4], Yueren Zhao [5], Allan Paulo Blaquera [6], Ryuichi Tanioka [7], Feni Betriana [8], Gil Platon Soriano [9], Yuko Yasuhara [3], Kyoko Osaka [4], Mutsuko Kataoka [10], Misao Miyagawa [11], Masashi Akaike [3], Minoru Irahara [3], Savina Schoenhofer [12] and Tetsuya Tanioka [3,*]

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Abstract

Background/Objectives: As healthcare increasingly depends on technology, instruments to evaluate the caring competencies of healthcare professionals beyond the nursing domain have become essential. This study aimed to develop the Technological Competency as Caring in Healthcare Providers Instrument (TCCHI) for multidisciplinary use, based on Locsin's theory of Technological Competency as Caring in Nursing. **Methods:** The face and content validation process used a two-round modified Delphi method. Ten experts were consulted to assess the proposed 67 items. Face validity addressed the overall appropriateness and relevance of the items, while content validity involved rating their relevance using the Content Validity Index with a 9-point Likert scale over two rounds. Items with a median rating of 6–9 and an item-level Content Validity Index (I-CVI) of ≥ 0.80 were retained. **Results:** Among the 67 initial items, 38 were retained after two rounds of the Delphi method, with an I-CVI of 0.80–0.90, indicating strong content validity. **Conclusions:** The TCCHI is a comprehensive and theoretically grounded instrument applicable across healthcare disciplines. TCCHI can measure the following concepts: (1) supporting healthcare professionals' growth, (2) building trusting relationships with patients, (3) providing person-centered care, (4) enhancing the physical and emotional comfort of patients, (5) promoting patient learning and growth, and (6) engaging in ethico-moral practice. Using this instrument, healthcare professionals can evaluate their caring competencies in technologically advanced settings. The TCCHI can also be used to create in-service training plans and evaluate their effectiveness.

Keywords: delphi; technological competence; caring; scale development; healthcare professionals; person-centered care

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1. Introduction

1.1. Theoretical Background

The rapid evolution of healthcare technology, from electronic health records to artificial intelligence, offers unprecedented opportunities to improve patient outcomes and safety. Through technological innovations, patient safety can be improved using task automation, medication alerts, clinical reminders, improved diagnostic and consultation reports, information sharing, clinical decision-making, intercepting potential errors, reducing variation in practice, managing workforce shortages, and making complete patient data available [1]. However, this technological integration also poses a significant challenge: how to ensure that technology enhances rather than diminishes, the humanistic, compassionate core of healthcare.

Locsin's "Technological Competency as Caring in Nursing" (TCCN) theory is a middle-range nursing theory that emphasizes the harmonious coexistence of technology and caring in nursing practice. It addresses the crucial role of nurses in a technologically advanced healthcare environment, ensuring that technology enhances rather than detracts from human caring [2]. Locsin's TCCN inherently integrates ethical considerations, particularly concerning the potential for technology to dehumanize care if not used with a caring intent [3]. Empirical knowledge facilitated by technological competency provides a factual basis for understanding patients. However, this "knowing" is always guided by a strong ethical-moral compass, ensuring that technology enhances human care, preserves patient dignity, and fosters a more profound and holistic appreciation of the person being nursed. This integration of technological competency and ethical care is crucial for navigating the complexities of modern healthcare while remaining rooted in the fundamental humanistic values of nursing [4].

Caring competency requires a caregiver's sensitivity, empathy, observational skills, and a humble attitude to share and learn from others' experiences, along with the resolve to face patients with a sense of mission to support them [5–7]. The importance of caring is increasingly recognized in nursing; however, professionals outside the field remain largely unfamiliar with the concept [8].

The definition of care is "the provision of what is necessary for the health, welfare, maintenance, and protection of someone or something" [9]. Locsin's TCCN theory [3] posits that nurses and healthcare providers can effectively integrate technology into their practice to enhance patient care [10], viewing it not as separate from but as integral to the care process. It emphasizes that nurses can use technology to understand patients as whole persons, recognize their unique experiences, and foster deeper connection and engagement in their care [4].

Scales for measuring caring were introduced in Watson's "Exploring Caring in Nursing: Measurement Tools as Clues" [11]. For example, questionnaires measuring caring behaviors include the Caring Behaviors Inventory (CBI) [12] and the Caring Assessment Report Evaluation Q-sort (CARE-Q) [13]. Additionally, Locsin's Technological Competency as Caring in Nursing Instrument (TCCNI) was developed as an assessment scale for measuring nurses' TCCN [14–16]. The Technological Competency as Caring in Nursing Instrument-Revised (TCCNI-R), developed by Yokotani et al. [17], is a scale used by nurses to measure their perception of TCCN, whereas the Perceived Inventory of Technological Competency as Caring in Nursing (PITCCN) [18] focuses on acute care nursing. Furthermore, to investigate nurses' perceptions of technological competency as caring and their actual practice, a revised version of the TCCNI—TCCNI-Revised with Practice Dimension—was developed, and its reliability and validity were confirmed [17,19].

However, a significant limitation of these conventional instruments is their exclusive focus on nurses. They fail to reflect the complexity and diversity of modern healthcare, which increasingly relies on collaborative, interdisciplinary teams. The absence of a standardized, multidisciplinary instrument means that the crucial intersection of technological competency and caring cannot be comprehensively measured across the healthcare profession. For example, in a clinical setting, a patient may feel dehumanized if a provider focuses solely on the technical procedure. A provider who can use the technology efficiently while also acknowledging the patient's anxiety and offering

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empathy demonstrates the essential integration of technological competency and caring. This skill is required not only of nurses but also of all healthcare professionals.

1.2. Toward a New Conceptual Framework: Technological Competency as Caring in Healthcare

Based on a comprehensive literature review and Locsin's Technological Competency as Caring in Nursing (TCCN) theory, we developed the conceptual framework of TCCH. This framework outlines six essential dimensions that define TCCH for healthcare professionals, reflecting a holistic approach in which technology is a tool for expressing genuine care and enhancing the patient-provider relationship.

In this context, "technology" refers to tools such as information and communication technology (ICT), artificial intelligence (AI), medical devices, and clinical systems used to understand and provide support to patients [20].

"Care" refers to demonstrating compassion and respect in communication, building trust, and supporting patient growth and development [21,22]. Technological competency in patient care involves the ethical and skillful use of technology to understand and respect patients [3].

Concept 1, Supporting healthcare professionals' own growth: This concept focuses on the continuous professional development required for healthcare providers to ethically and effectively integrate technology into their practice. It involves cultivating awareness of one's own capabilities and a willingness to learn from patients to expand knowledge and refine skills as a practitioner [23–25]. This growth is crucial for remaining competent, providing high-quality care, and adapting to new challenges. It also requires understanding not only how a technology works but also its capabilities, limitations, and ethical implications, such as data privacy and the risk of dehumanization [4,26]. A deep, critical understanding of technology ensures its use achieves humanistic goals, such as improving workflow efficiency, enhancing diagnostic accuracy, and ultimately improving patient safety.

Concept 2, Building trust relationships with patients: This concept highlights the importance of fostering trusting relationships through a thoughtful application of technology [3]. It encapsulates the core principles of person-centered care and a holistic approach by prioritizing human connections and demonstrating empathy [27–29]. This approach emphasizes that the art of caring lies in understanding, respecting, and connecting with individual patients in their entirety to build an effective therapeutic relationship.

Concept 3, Providing person-centered care: This concept involves placing patients at the center of all decisions and actions [30]. It goes beyond merely treating an illness to caring for the whole person, recognizing their unique values, preferences, needs, and goals [31,32]. This approach ensures that care is personalized, comprehensive, and compassionate, helping patients feel like partners in their own health journey. For example, considering a patient's desire to return to work after surgery is just as important as the surgical outcome itself.

Concept 4, Enhancing the physical and emotional comfort of patients: This concept focuses on relieving both physical and mental discomfort. Physical comfort refers to the absence of pain or distress [33], while emotional comfort is a state of psychological well-being in which an individual feels safe and supported [34] . Prioritizing both is fundamental to healing and is not a luxury. When healthcare teams are well-trained in technology, they can work more efficiently and avoid errors, which reduces patient anxiety and enhances overall outcomes [35–37].

Concept 5, Promoting patient learning and growth: This concept emphasizes that healthcare involves facilitating the patient's journey toward greater understanding, self-management, and independence. This approach highlights the importance of using technology to support patient autonomy by coaching them to manage their health rather than unilaterally delivering information. Without clear, accessible information, patients cannot provide informed consent or meaningfully participate in their care, which can lead to distrust and poor outcomes [38]. Respecting a patient's self-determination fosters trust and a sense of control, which is vital for their psychological well-being and satisfaction with care [39,40].

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Concept 6, Engaging in ethico-moral practice: This concept emphasizes the ethical responsibility of healthcare professionals to use technology with caring intent. It involves not only being proficient in technologies such as AI and telemedicine but also cultivating ongoing awareness of the ethical issues they present, including data privacy, patient advocacy, and consent [41–47]. This concept also involves having the moral courage to speak on behalf of patients who cannot express their wishes and maintaining professional accountability by addressing inappropriate behavior among colleagues [48–50]. It requires a profound commitment to ethical sensitivity and to recognizing each patient as a unique and invaluable individual.

1.3. Study Aim

The need to facilitate person-centered, compassionate care in high-tech settings requires an innovative instrument to assess technological competence among a variety of healthcare professionals. Therefore, this study aimed to develop and validate the new multidisciplinary Technological Competency as Caring in Healthcare Providers Instrument (TCCHI) for use across the healthcare profession.

2. Materials and Methods

2.1. Methods

The face and content validation process used a two-round modified Delphi method. This process was conducted in two phases: 1) instrument development, and 2) face and content validation. The reliability and validity of this study were ensured in accordance with the reporting guidelines for Delphi studies in the health sciences [51].

2.1.1. Phase 1: Instrument Development

The draft TCCHI includes an initial pool of 67 items. This pool was developed by reviewing existing care scales, synthesizing applicable elements across healthcare disciplines, and aligning them with the conceptual framework of TCCH.

2.1.2. Phase 2: Face and Content Validation

A two-round modified Delphi study was conducted to gather expert feedback on the appropriateness and content of items. The face validity of the draft item tool was examined in the first round, and its content validity was examined in the second round [52].

Ten experts with a solid understanding of Locsin's theory participated in the two-round Delphi process. The panel consisted of healthcare professionals specializing in nursing, medicine, patient care quality, and healthcare research. The participants' ages ranged from 30–60 years, with an average professional experience of 27.5 years. Seven were nurses, two were physiotherapists, and one was a physician, all of whom had master's degrees or higher and expertise in TCCH. **Table 1** shows the characteristics of the expert panel.

Table 1. Characteristics of expert panel

Characteristics	**Respondent (n = 10)**
	Frequency (%)
Gender	
Male	5 (50)
Female	5 (50)
Age, years	
30–39	2 (20)
40–49	3 (30)

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50–59	3 (30)
60–69	2 (20)
Working period in healthcare	
10–29 years	5 (50)
More than 30 years	5 (50)
Discipline	
Medicine	1 (10)
Nursing	7 (70)
Physical Therapy	2 (20)
Institutional affiliation/Occupation	
University hospital staff	1 (10)
University staff	7 (70)
JICA consultant	1 (10)
Director of nursing	1 (10)
Educational attainment	
MA	1 (10)
PhD	9 (90)

JICA: Japan International Cooperation Agency

Panelists rated each item's relevance and importance using a 9-point Likert scale across two rounds of the Delphi process. We calculated the level of consensus by summing the Likert scores, where 1 = Not at all important, 2 = Very unimportant, 3 = Not important, 4 = Somewhat unimportant, 5 = Neither important nor unimportant, 6 = Somewhat important, 7 = Important, 8 = Very important, and 9 = Extremely important [53]. The item-level content validity index (I-CVI) was calculated by dividing the number of experts who rated an item between 6 and 9 by the total number of experts. The minimum consensus level was set at I-CVI ≥ 0.78.

2.2 Statistical Analysis

The quantitative data were analyzed using descriptive statistics (median, minimum, and maximum) to determine the consensus level [54]. Microsoft Excel® was used for data entry and for tabulating the universal agreement (UA) for content validity calculation. A value of 1 was assigned when the experts were in perfect agreement and 0 when they were not. Content validity was assessed using the Content Validity Index (CVI). The following indices were used: I-CVI—number of experts in agreement divided by the total number of experts; Scale-level Content Validity Index (S-CVI)/Ave (I-CVI-based): mean of I-CVI scores for all items; S-CVI/Average (based on percentage relevance)—mean of the percentage relevance scores from all experts; and S-CVI/UA—mean of UA scores for all items. The item-level CVI (I-CVI) was set at >0.78 for each item [55,56].

3. Results

The development and validation of the TCCHI proceeded in two phases.

3.1. Phase 1: Instrument Development

An initial pool of 67 items was developed across six concepts, as detailed in Table 2. These items were designed to align with the proposed conceptual framework of TCCHI.

3.2. Phase 2: Face and Content Validation

A two-round modified Delphi study was conducted with a panel of 10 experts. Among the 67 initial items, 38 (56.7%) were retained after two rounds. Items were retained if they achieved a median rating of 7 or higher and an I-CVI ≥ 0.80.

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The final 38 items were distributed across the six concepts as follows: six items for "Supporting healthcare professionals' own growth," seven items for "Building trust relationships with patients," six items for "Providing person-centered care," six items for "Enhancing the physical and emotional comfort of patients," six items for "Promoting patient learning and growth," and seven items for "Engaging in ethico-moral practice."

A total of 29 items were deleted based on the consensus criteria.

Items related to "Building trusting relationships" and "Providing person-centered care" received consistently high ratings from the expert panel, demonstrating a consensus that these are essential components of technological caring. In contrast, ratings for items under "Supporting professionals' own growth" showed greater variability.

Table 2. Developed TCCHI items

Concept No.	No.	Questions	Med	Min–Max	I-CVI	UA
C 2	Q 7	Being close to the patient and respecting their rights.	9	6–9	**0.9**	1
C 4	Q 33	Focusing not only on the patient's medical condition but also on the problems they face in daily life.	9	4–9	**0.9**	1
C 2	Q 1	Always treating every patient with compassion.	8	3–9	**0.9**	1
C 3	Q 13	Working with other professionals to support patients in realizing their dreams and hopes.	8	4–9	**0.9**	1
C 5	Q 42	Providing necessary and sufficient information to support patients and their families' decision-making.	8	3–9	**0.9**	1
C 5	Q 45	Understanding and practicing what is best healthcare for patients.	8	6–9	**0.9**	1
C 6	Q 49	Always consider ethical issues that arise when providing care.	8	6–9	**0.9**	1
C 1	Q 66	Working in a way that allows you to grow as a healthcare professional.	8	2–9	**0.9**	1
C 4	Q 17	If the patient wishes, work with the patient's family and supporters.	8	4–9	**0.9**	1
C 5	Q 22	Pay attention to the patient's dreams, hopes, and requests, and support the patient's self-actualization.	8	3–9	**0.9**	1
C 3	Q 24	Technology is useful for correctly assessing a patient's condition.	8	5–9	**0.9**	1
C 5	Q 46	Striving to provide support that respects the patient's self-determination.	8	3–9	**0.9**	1
C 6	Q 54	Contributing to creating a workplace where colleagues can freely exchange opinions.	8	5–9	**0.9**	1
C 1	Q 58	Providing healthcare services with a correct understanding of technology's meaning and significance.	7	5–9	**0.9**	1
C 1	Q 59	Discussing the matter in a team conference in which the patient also participates, when worried about a patient's complaint.	7	3–9	**0.9**	1

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C 1	Q 60	Constantly updating knowledge of healthcare and welfare as a professional.	7	4–9	**0.9**	1
C 1	Q 65	Considering how to improve healthcare quality by reflecting on the care process with the patient.	7	6–9	**0.9**	1
C 1	Q 67	Communicating and sharing experiences gained through patient care with colleagues and medical/health science students.	7	2–9	**0.9**	1
C 2	Q 3	Building relationships that patients can trust.	7	3–9	**0.9**	1
C 2	Q 8	Speaking and acting in a way that earns the patient's trust.	7	3–9	**0.9**	1
C 2	Q 9	Understanding the person not only based on their current illness and symptoms but also on their upbringing and lifestyle history.	7	3–9	**0.9**	1
C 2	Q 12	Focusing on the whole picture of the patient who needs care, not just the patient's illness or disability.	7	3–9	**0.9**	1
C 5	Q 14	Developing a treatment plan with the patient.	7	1–9	**0.9**	1
C 3	Q 15	Appropriately reflecting the patient's wishes in the treatment policy.	7	3–9	**0.9**	1
C 3	Q 18	Determining appropriate technology for patient care.	7	5–9	**0.9**	1
C 4	Q 29	Interacting appropriately according to the patient's physical/psychological condition, which changes depending on the situation.	7	3–9	**0.9**	1
C 3	Q 23	Understanding the complete picture of the patient.	7	3–8	**0.9**	1
C 3	Q 25	Devising and implementing an appropriate care plan tailored to each patient's individual needs.	7	3–9	**0.8**	0
C 6	Q 27	Providing medical treatment and care after understanding your own practical abilities.	7	3–8	**0.8**	0
C 4	Q 35	Providing care to ensure patients' physical and mental comfort.	7	4–9	**0.8**	0
C 4	Q 36	Making a goal for patients to be able to live a life that is true to themselves.	7	5–9	**0.8**	0
C 5	Q 40	Requesting an explanation from the necessary professionals if the patient does not fully understand their condition or treatment.	7	6–9	**0.8**	0
C 4	Q 43	Supporting patients in improving their self-care abilities.	7	5–9	**0.8**	0
C 6	Q 48	Holding regular conferences with the healthcare team to minimize restrictions on patients' behavior.	7	3–9	**0.8**	0
C 6	Q 56	Developing sensitivity to ethical issues.	7	1–9	**0.8**	0

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C 2	Q 47	Recognizing the patient as an individual and irreplaceable person.	7	3–9	**0.8**	0
C 6	Q 53	Understanding the wishes of patients who are unable to express them and speaking on their behalf when necessary.	7	3–8	**0.8**	0
C 6	Q 55	Reporting inappropriate comments or behaviors toward patients by colleagues to management.	7	3–8	**0.8**	0
C 1	Q 57	Always learning to adapt to new technology.	6	4–9	0.7	0
C 1	Q 62	Striving to grow together in medical situations shared by healthcare professionals, patients, and families.	6	3–9	0.6	0
C 1	Q 64	Improving yourself to become familiar with the latest medical equipment in your department.	6	3–9	0.6	0
C 2	Q 5	Using technology to understand patient deeply.	6	3–9	0.6	0
C 2	Q 6	Sharing necessary information with the patient in order to understand them.	6	2–9	0.6	0
C 2	Q 10	Evaluating the stress and anxiety that arise for both parties in the medical professional-patient relationship.	6	2–8	0.6	0
C 3	Q 19	Accepting and respecting the changing wishes of patients.	6	4–9	0.6	0
C 3	Q 21	Respecting the patient's wishes and supporting them with a focus on their recovery.	6	3–8	0.6	0
C 3	Q 30	Using caring competence to understand patients and their families.	6	2–8	0.6	0
C 3	Q 32	Providing flexible patient care according to time and circumstances.	6	3–8	0.5	0
C 5	Q 41	Providing the patient with the necessary and sufficient information to make his/her own decisions, then explaining and obtaining consent.	6	2–9	0.4	0
C 6	Q 50	Respecting patient privacy and observing patients as necessary to ensure patient safety.	6	2–9	0.3	0
C 6	Q 51	Listening to patients with compassion.	6	3–9	0.3	0
C 6	Q 52	Improving patient experience by correctly understanding and using technology to eliminate constraints and restrictions.	6	3–9	0.3	0
C 1	Q 63	Using technological competency to know the patient comprehensively.	6	3–8	0.2	0
C 2	Q 2	Empathizing with the patient's experiences and emotions.	6	3–9	0.1	0
C 2	Q 4	Helping patients express their hopes and dreams.	6	3–9	0.1	0
C 3	Q 20	Providing care according to the patient's health condition.	6	3–9	0.1	0

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C 4	Q 37	Focusing on providing mental care to help patients live peaceful lives.	6	3–8	0	0
C 1	Q 61	Considering the use of technology from the perspective of caring.	5	3–9	0	0
C 2	Q 11	Striving to understand the patient's personality and developmental characteristics.	5	1–9	0	0
C 3	Q 28	Healthcare professionals coordinate with other professionals to meet patients' needs.	5	1–8	0	0
C 4	Q 34	Improving patients' quality of life as a treatment goal.	5	3–7	0	0
C 3	Q 16	Actively collaborating with other professionals to fulfill the patient's wishes.	4	3–7	0	0
C 3	Q 26	Communicate actively with patients and develop care plans based on mutual understanding to provide high-quality medical services.	4	1–8	0	0
C 5	Q 39	Helping patients live a quality of life.	4	2–8	0	0
C 5	Q 44	Sharing what you have noticed during your interactions with patients.	4	3–9	0	0
C 3	Q 31	Providing care and treatment with the utmost consideration for each patient, regardless of physical function.	3	1–9	0	0
C 4	Q 38	Enhancing patient self-esteem through technology-enabled care.	3	1–8	0	0

UA total = 27, S-CVI/Ave = 0.55, S-CVI/UA = 0.02. The average proportion of items judged as relevant by the ten experts was 0.66. C1: supporting healthcare professionals' own growth; C2: building trusting relationships with patients; C3: providing person-centered care; C4: enhancing the physical and emotional comfort of patients; C5: promoting patient learning and growth; C6: engaging in ethico-moral practice.

4. Discussion

4.1. Face and Content Validation

An I-CVI score ≥ 0.80 indicates that most experts agree on the relevance of an item to the overall construct being measured. Specifically, an I-CVI value above 0.80 suggests that the item is relevant and should be retained, whereas values below 0.70 indicate that the item should be eliminated [55,57]. Consequently, 38 items were selected, and 29 were deleted from the original 67 items.

The high I-CVI score of ≥ 0.80 for the retained items provides strong evidence of the content validity of the TCCHI. This is a crucial step in instrument development, as it ensures the tool is theoretically sound and measures what it is intended to measure.

4.2. Interpretation of Consistently High I-CVI Items

The Delphi panel demonstrated a strong consensus on various items, providing a clear picture of what experts consider to be the essential elements of TCCH in a multidisciplinary context. The items with consistently high I-CVI scores can be grouped into several core themes that align with the conceptual framework. These findings support the notion that TCCH is not merely a technical skill but a holistic and deeply humanistic practice [58].

The strongest consensus was found for items related to person-centered care, building trust, and ethico-moral practice. Items such as "Q 1, Always treating every patient with compassion," "Q 3, Building relationships that patients can trust," and " Q 47, Recognizing the patient as an individual

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and irreplaceable person" received very high ratings. This highlights the experts' agreement that the humanistic core of healthcare remains paramount, even as technology becomes more central.

The high ratings for items like " Q 49, Always consider ethical issues that arise when providing care" and "Q 55, Reporting inappropriate comments or behaviors toward patients by colleagues" further emphasize that a professional's ethical conduct is an inseparable part of their caring competency. These findings confirm the theoretical grounding of the TCCHI, which is rooted in the belief that technology must serve to enhance, not diminish, the human element of care [59].

Furthermore, the high ratings for items like " Q 13, Working with other professionals to support patients" and "Q 42, Providing necessary and sufficient information to support patients" underscore the importance of collaboration and patient education. This consensus reflects a modern understanding of healthcare as a team-based, collaborative effort where patient autonomy and empowerment are key [60–62].

The panel's strong agreement on items related to professional growth (e.g., " Q 60, Constantly updating knowledge of healthcare and welfare as a professional," "Q 66, Working in a way that allows you to grow as a healthcare professional") shows that TCCH is a dynamic concept that requires continuous self-improvement and a reflective practice [63,64].

Interestingly, several highly rated items explicitly link technology to caring, such as "Q 24, Technology is useful for correctly assessing a patient's condition" and "Q 58, Providing healthcare services with a correct understanding of technology's meaning and significance." This indicates that, in the experts' view, technology is not just a tool for efficiency but a crucial instrument for understanding the patient and providing care with a deeper sense of meaning and purpose [4]. This provides empirical support for Locsin's original idea [3,4,10], extending its applicability beyond nursing to the wider healthcare context.

4.3. Implication

The TCCHI is intended for use by multidisciplinary teams, reflecting the interprofessional realities of modern healthcare, in contrast to earlier tools that were limited to nursing. Global trends toward person-centered, team-based care are in line with its emphasis on both technology competency and caring intent.

The developed TCCHI can be used to evaluate healthcare professionals' attitudes toward patients and help reaffirm the direction of medical care within the healthcare team. The TCCHI can also be used for the hierarchical evaluation of multidisciplinary healthcare professionals in hospital settings. Additionally, the TCCHI may help unify healthcare professionals' competencies by leveraging differences in their caring skills. Using the TCCHI as an educational tool for healthcare personnel can enhance caring skills across multiple disciplines.

4.4. Limitations of the Study

Although the results show that the TCCHI is a comprehensive and theoretically grounded scale, this study has inherent limitations. The Delphi panel included only 10 experts, which may limit the generalizability of the results. Moreover, professionals from medicine, nursing, and physiotherapy participated in the study, and although they were experts familiar with TCCH, they were not involved in clinical practice. This study relied primarily on expert panel opinions, and no empirical validation was performed. Confirmatory and exploratory factor analyses will be conducted in the future to improve the scale's accuracy and assess its validity and reliability. We also plan to conduct reliability tests and evaluate internal consistency. Surveys should be conducted with experts from other fields as well as with clinical medical professionals to make the scale applicable to modern clinical practice. Following data collection, items will be further refined and potentially eliminated based on their psychometric properties, including item-total correlations and factor loadings, to create a final, more robust scale.

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5. Conclusions

The TCCHI is a comprehensive and theoretically grounded instrument applicable across healthcare disciplines. The TCCHI can measure the following concepts: (1) supporting healthcare professionals' growth, (2) building trusting relationships with patients, (3) providing person-centered care, (4) enhancing the physical and emotional comfort of patients, (5) promoting patient learning and growth, and (6) engaging in ethico-moral practice. Healthcare professionals can use this instrument to evaluate their caring competencies in technologically advanced settings. The TCCHI can also be used to create in-service training plans and evaluate their effectiveness.

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Data Availability Statement: The data presented in this study are available upon request from the corresponding author. These data are not publicly available due to privacy restrictions.

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Abbreviations

The following abbreviations are used in this manuscript:

TCCN	Technological Competency as Caring in Nursing
TCCNI	Technological Competency as Caring in Nursing Instrument
AI	Artificial Intelligence
TCCH	Technological Competency as Caring in Healthcare
TCCHI	Technological Competency as Caring in Healthcare Providers Instrument
I-CVI	Item-level Content Validity Index
UA	Universal agreement
S-CVI	Scale-level Content Validity Index
CBI	Caring Behaviors Inventory
CARE-Q	Report Evaluation Q-sort
TCCNI-R	Technological Competency Caring in Nursing Instrument-Revised
PITCCN	Perceived Inventory of Technological Competency as Caring in Nursing

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