Nursing Technology Supporting Family Involvement in Critically Ill Patients: A Systematic Review

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ABSTRACT

Background: Family involvement in the care of critically ill patients positively impacts treatment outcomes and patient well-being. Nursing technology has become an essential tool in facilitating family engagement

Aims: This study aims to conduct a systematic review of nursing technology that supports family involvement in critically ill patients.

Methods: This article utilized a systematic review method. Articles were assessed using the JBI Critical Appraisal Checklist. The instruments were the JBI Critical Appraisal Checklist for Randomized Controlled Trials and the JBI Critical Appraisal Checklist for Cohort Studies. Literature from the past five years was obtained from four databases: Science Direct, Scopus, Springer Link, and ProQuest.

Results: Out of 148 articles, 15 were analyzed. Various technologies (such as web-based platforms, tablets, SMS tools, and video conferencing) were used to provide information, enhance decision-making, and provide virtual access to family conferences. Although interventions varied, "Information sharing" and "Activation and participation" were most commonly implemented in the family involvement model. In studies that discussed the components of family involvement more comprehensively, interventions allowed for information adjustment through two-way communication and active family participation in the decision-making process.

Conclusion: Based on the findings of this systematic review, it can be concluded that nursing technology has great potential in supporting family involvement in critically ill patients. This technology can significantly improve family well-being, communication, and decision-making. Further research can focus on a deeper understanding of the emotional impact experienced by families of critically ill patients due to the use of technology.

Keywords: critically ill patients, family involvement, technology

Introduction

Family plays a crucial role as a support system in the recovery of patients undergoing treatment in the intensive care unit (ICU) (Malliarou et al., 2014). Family involvement is an essential factor in providing safe and effective care in the ICU. In this context, family involvement is defined as active collaboration between healthcare professionals and families to enhance health outcomes, quality of care, safety, and decision-making (Hetland et al., 2018; Khatri Chhetri & Thulung, 2018; Mahrous, 2017).

Hospitals implement strict visitation policies in the ICU to ensure patient safety and minimize the risk of infection (Greenberg et al., 2022). This often results in limited visitation, restricting family access to their loved ones for extended periods. Not only do families experience prolonged restrictions on visiting patients, but they are sometimes not allowed to visit at all (Styani, 2017). One of the consequences of these policies is increased anxiety among family members, which can also impact the psychological well-being and stress levels of the patients themselves. This is an important consideration for nurses, as the nursing profession is tasked with providing holistic care for both patients and their families (Utami, 2017).

A study conducted in Bahrain on family involvement in the care of critically ill patients in two ICU units found that nurses were hesitant to involve families in the care process, despite the family members expressing a desire to be involved (Fateel & O'Neill, 2016). The factors that nurses consider before involving family in care, as well as reasons for hesitance in including families in care despite acknowledging the benefits, include previous unpleasant experiences, busy schedule, the patient's clinical condition and treatment being given, privacy and safety concerns, physician orders on how much information to provide to relatives type of caring activity, family relationships, lack of adequate ICU training and feelings of inadequacy, lack of skills in care and respect of nurses' role by family members, emotional responses, nurses discomfort and stress from constant observation by the visiting family communication challenges, culture, and religion, distrusting relatives, fear of blame if something goes wrong and lack of guiding policies on how to manage relatives (Fateel & O'Neill, 2016; Gondwe et al., 2011; Matlakala, 2015). The impact of not involving families in the care process can lead to feelings of despair, anxiety, and depression. Khatri Chhetri's research reported that families who were not involved in the care experienced anxiety in 58.5% of cases and depression in 26.2% (Khatri Chhetri & Thulung, 2018). Qualitative research reported that families felt guilty and neglected the patient when they were unable to participate in the care during critical conditions (Muthoni Maina, 2018).

Family involvement in ICU patient care has been proven to have benefits in recovery and treatment outcomes (Makmun et al., 2019). Families can provide emotional support, obtain crucial information, and participate in treatment decision-making. Therefore, it is important to explore alternative ways to enable family involvement despite visitation limitations. One alternative that can be used to support family involvement is the use of health technology. (Brown et al., 2016; Chiang et al., 2017; Makmun et al., 2019; Sepulveda Hermosilla et al., 2022). The use of technology in healthcare has significantly increased in recent years (Rohmawati, 2021). Hospitals and healthcare providers have adopted various technological innovations to improve the patient and family experience, as well as facilitate family involvement in care. The use of patient care applications, electronic portals, and remote monitoring technology has become increasingly common in many healthcare institutions (Czaja et al., 2016; del Carmen Ortega-Navas, 2017; Roberts et al., 2020).

Technology has become a valuable tool in facilitating family involvement in care when hospital regulations restrict physical visits. Through communication technology, families can stay connected with patients, obtain medical information, participate in treatment decision-making, and provide emotional support (Anggraeni & Ismail, 2018). Advances in communication technology and its application in healthcare have opened doors for families to remain involved and connected with their patients, even when they cannot physically visit the ICU (Sasangohar et al., 2021; Soemiati et al., 2023).

Digital technology interventions can also enable family engagement, even without the family's physical presence around the patient's bedside. Despite the increasing use of digital technology and the significance of family engagement in the ICU, up to this point, there have yet to be any broad studies that extensively examined or consolidated findings to evaluate the current state of family engagement interventions in the ICU using digital technology. Given the gap in the existing literature, this systematic review aims to identify and evaluate research that has employed digital technology to promote family engagement.

Method

The research method used in this study was a systematic review conducted following the PRISMA guidelines (Page et al., 2021). Systematic reviews play a critical role in synthesizing knowledge and addressing research questions.

Search Strategy

The title and abstract of articles were explored in four databases: Scopus, Science Direct, Springer Link, and ProQuest. A comprehensive search strategy was employed to search for articles published from July 2012 to July 2022. The search keywords were constructed based on the PICOS framework (Patient, Intervention, Control, Outcome, and Study Design. In this review, the subject focused on families of critically ill patients; the study investigated the use of technology for family involvement, comparing families of critically ill patients involved in care using health technology with those not using health technology, the outcome was the technology that could be utilized by families of critically ill patients, and the study design used quantitative design, RCT and Cohort study. Therefore, several main keywords such as (technology) AND (family involvement) AND (critical ill OR critical patients) were used. A complete search can be found in Supplementary Table 1.

Inclusion and Exclusion Criteria

The inclusion criteria for this study were full-paper articles with quantitative design, RCT and Cohort study methods that discussed the use of technology to enhance family involvement in the care of critically ill patients. The exclusion criteria included non-quantitative studies, articles that were not full-text, and articles not published in English.

Screening

Initially, 148 potentially relevant articles were identified in the four databases. After removing duplicates using Mendeley software, 128 articles remained. The titles and abstracts of these articles were individually read for further screening. Subsequently, 29 full-text articles were further evaluated for eligibility. Twenty-four of these articles were excluded for various reasons (e.g., not discussing technology for family involvement in patients' care). Finally, five studies were considered eligible for inclusion in this review (Figure 1). All literature searches conducted by peer reviewers involved all available fields, including titles, abstracts, and keywords. All studies were identified by the primary reviewer (SN) using EndNote X9 software, and the titles/abstracts were assessed for eligibility by the primary reviewer (SN). A second reviewer (S) independently examined 20% of the full-text studies randomly assigned to ensure agreement on eligibility criteria, and any differences of opinion

were resolved through discussion between the two reviewers, involving a third author if necessary.

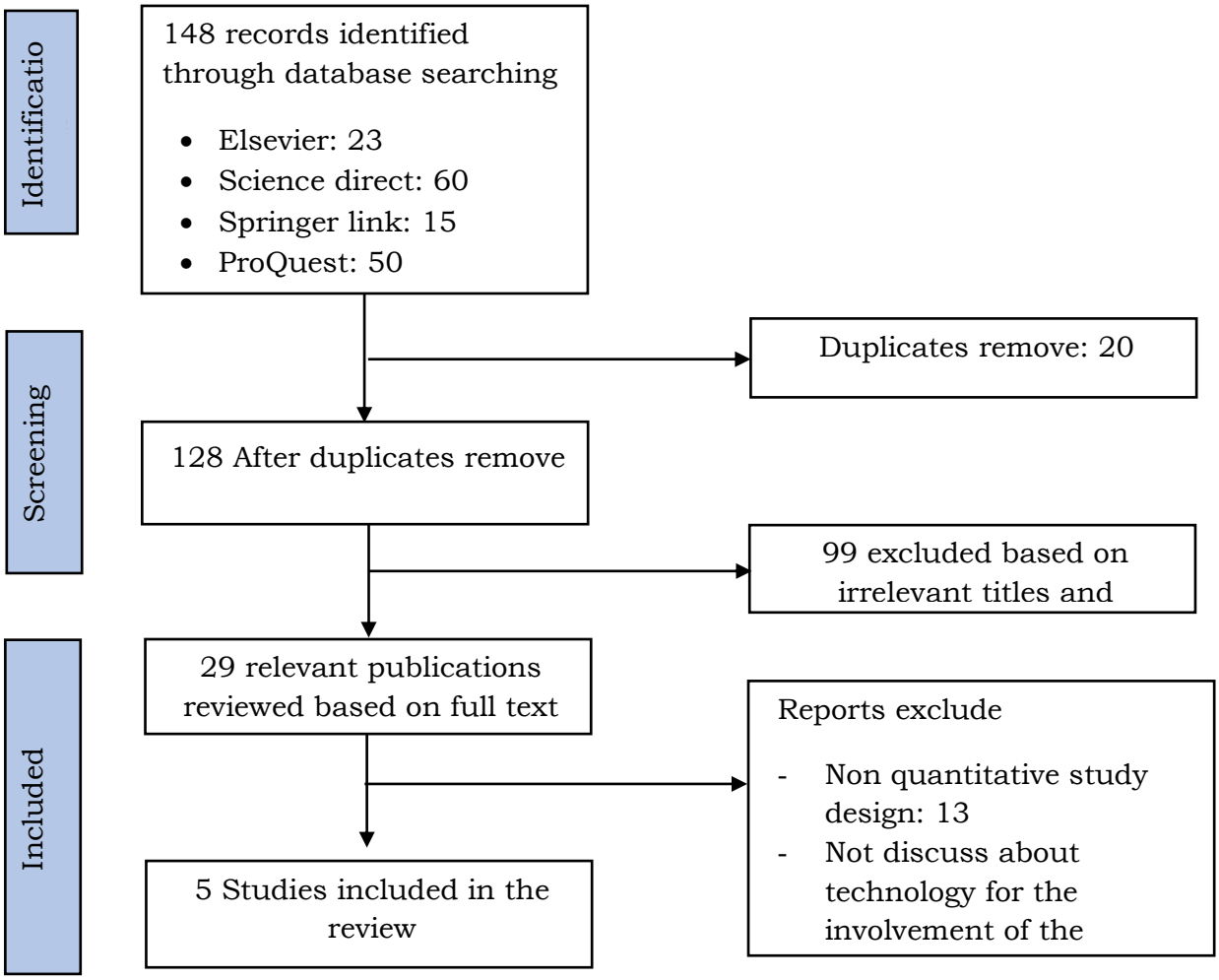

Figure 1. The flowchart in the article selection

Quality Assessment

The methodological quality of the articles was assessed using the JBI Critical Appraisal Checklist. The instrument used consisted of two types, tailored to the study design based on the screening process in this systematic review. The instruments were the JBI Critical Appraisal Checklist for Randomized Controlled Trials, which comprised thirteen questions, and the JBI Critical Appraisal Checklist for Cohort Studies, which comprised eleven questions. The JBI Critical Appraisal Checklists are instruments used to assess the methodological quality of a study and evaluate the extent to which the review addresses potential bias in the design, intervention, and analysis (Barker et al., 2023).

Table 2. Quality assessment for RCT studies

Authors	Checklist criteria for RCT studies												
	1	2	3	4	5	6	7	8	9	10	11	12	13
(Yuan et al., 2023)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Authors	Checklist criteria for RCT studies												
(Suen et al., 2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
(Chiang et al., 2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
(Shin et al., 2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y = yes; N = no; U = unclear. 1. Was true randomization used for the assignment of participants to treatment groups? 2. Was allocation to treatment groups concealed? 3. Were treatment groups similar at the baseline? 4. Were participants blind to treatment assignment? 5. Were those delivering treatment blind to treatment assignment? 6. Were outcomes assessors blind to treatment assignment? 7. Were treatment groups treated identically other than the intervention of interest? 8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed? 9. Were participants analyzed in the groups to which they were randomized? 10. Were outcomes measured in the same way for treatment groups? 11. Were outcomes measured reliably? 12. Was appropriate statistical analysis used? 13. Was the trial design appropriate, and were any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

Table 3. Quality assessment for COHORT studies

Authors	Checklist criteria for COHORT study										
	1	2	3	4	5	6	7	8	9	10	11
(Gorman et al., 2020)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y = yes; N = no; U = unclear. 1. Were the two groups similar and recruited from the same population? 2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?, 3. Was the exposure measured in a valid and reliable way?, 4. Were confounding factors identified?, 5. Were strategies to deal with confounding factors stated?, 6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?, 7. Were the outcomes measured in a valid and reliable way?, 8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?, 9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?, 10. Were strategies to address incomplete follow up utilized?, 11. Was appropriate statistical analysis used?

Data extraction and data synthesis

Two authors (SN and S) independently extracted data from all included studies using an Excel worksheet. Any discrepancies during the data extraction process were resolved through open discussion. The authors extracted data in five main categories: (a) study information including authors, publication year, and study country; (b) population; (c) study design; (d) measurements; and (e) findings. Narrative synthesis was used to analyze and explain the findings of this study. The process involved collecting data for the included studies, identifying the types of studies conducted, and presenting the results of the technology in nursing that supports family involvement in critical patients.

Table 1. Summary of articles included in the systematic review

No	Author (Year)/Country	Populations	Research Design	Study Aim	Technology	Findings
1	(Yuan et al., 2023)/China	98 Families and 121 patients	RCT	To investigate the effect of video visitation on intensive care patients and family members' outcomes during the COVID-19 pandemic	Vidio virtual visitation	There is no statistically significant difference between the groups in terms of patient anxiety (t = 1.328, P = 0.187) and depression scores (t = 1.569, P = 0.119); and there is no statistically significant difference in the occurrence of delirium between the groups (7.7% vs 7.1%, p > 0.05). There is no significant difference in the change in anxiety scores among family members (t = 0.496, P = 0.621). A statistically significant difference in satisfaction was found between the two patient groups (86.1% vs 57.2% of patients satisfied with using video visits, P < 0.05), and the satisfaction of family members is also statistically significant (88% vs 62.5% of family members satisfied with using video visitation, p < 0.05).
2	(Suen et al., 2021)/Canada	52 Families	RCT	To assess the feasibility, usability, acceptability, and perceived effectiveness of a communication intervention that pairs proactive family meetings with an interactive, web-based tool to help surrogates prepare for clinician family meetings	Interactive web-based tool to support surrogate makers decision-makers	Out of 182 screened families, 77 met the criteria. We selected 52 (67.5%) families and their primary substitutes. Ninety percent of the intervention substitutes (24/25) accessed the tool before the first family meeting (average engagement time, 62 minutes 27.7 seconds) and logged an average of 4.2 times (± 21) during the hospital stay. The substitutes reported that the tool was highly beneficial (average rating of 82.4/100), acceptable (average rating of 4.5/5 ± 0.9), and effective (average rating of 4.4/5 ± 0.2). Compared to the control group, substitutes who used the tool reported higher overall quality in shared decision-making (average rating of 8.7/10 ± 1.5 vs 8.0/10 ± 2.4), but this difference was not statistically significant.
3	(Chiang et al., 2017)/China	74 Families	RCT	To determine whether 'education of families by tab' about the patient's condition was more associ- ated with improved anxiety, stress, and depression levels than	Education of families by tab	Although satisfaction with information needs did not differ significantly between the intervention and control groups, the intervention group reported significantly better depression scores on the Stress Anxiety Depression Scale compared to the control group (p < 0.01= 0.09) with a moderate effect size. There was a clinically significant

No	Author (Year)/Country	Populations	Research Design	Study Aim	Technology	Findings
				the 'education of families by routine'		reduction in anxiety in the intervention group.
4	(Shin et al., 2021)/California	34 Families	RCT	To explore family members' perceptions of an electronic communication application, VidaTalkTM, their communication experience, and emotional reactions to communication with mechanically ventilated patients in the intensive care units.	VidaTalkTMapp "opened up" communication with	The VidaTalk TM was helpful for family-patient communication. The VidaTalk TM may help families reduce psychological distress
5	(Gorman et al., 2020)/Australia	156 Families and 91 patiens	Cohort	To test the hypotheses that we could efficiently deliver real-time short message service (SMS) updates to families and that these SMS updates would be accepted and welcomed	Short message service (SMS)	We successfully sent five SMS messages to 72 patients out of 114 participants (73%). Among the 114 participants, all agreed that the SMS service was reassuring and that the SMS messages were easy to follow and provided ongoing information to the participants. Almost all participants felt that the SMS service did not add to their anxiety, and all participants disagreed that the SMS service was disruptive. All surveyed participants stated that they would recommend this service to other families.

Results

Study Characteristics

The studies included in the review had sample sizes ranging from 34 to 156 participants, with a total of 626 participants across all five studies. The age of the participants ranged from 23 to 77 years, and the average proportion of female participants (in studies that specified gender) was 63%. Two studies did not provide information on participants' ages (Chiang et al., 2017; Gorman et al., 2020), and one study did not specify participants' gender (Gorman et al., 2020). All of the studies focused on older adults. Four studies used a randomized controlled trial design (Chiang et al., 2017; Shin et al., 2021; Suen et al., 2021; Yuan et al., 2023), and one study used a cohort design (Gorman et al., 2020). The publication dates of the studies ranged from 2017 to 2023. Only studies published in English were included. Two studies were conducted in China (Chiang et al., 2017; Yuan et al., 2023), one in Canada(Suen et al., 2021), one in California(Shin et al., 2021),and one in Australia (Gorman et al., 2020). The interventions in these studies involved the use of web-, tablet-, SMS-, or video-based technologies to assist families in understanding the ICU environment and participating in decision-making during family meetings. All of the studies discussed the use of technology for families of critically ill patients.

Technologies that can be used by families of critically ill patients

1. Video virtual visitation

   Video virtual visitation is a technology that allows patients to have virtual visits with doctors or nurses through video conferences or video calls using smartphones, tablets, or computers. This technology enables patients to communicate with their families without the need for physical visits due to limited access to the intensive care unit. It helps overcome distance barriers or physical limitations (Yuan et al., 2023).
2. Interactive web-based tool to support surrogate decision-makers

   An interactive web-based tool is designed to assist surrogate decision-makers or legal guardians who are responsible for making healthcare decisions on behalf of individuals who are unable to make decisions for themselves, such as unconscious patients or those with cognitive impairments (Suen et al., 2021).
3. Education of families by tab

   Education of families by tab refers to the use of tablet devices to provide education and support to the families of patients in understanding the patient's health condition and required care. The use of tablets allows families to access relevant and easily understandable information and educational resources more interactively and visually (Chiang et al., 2017).
4. VidaTalkTM app 'opened up' communication

   The VidaTalkTM app facilitates communication with patients by allowing various levels of communication, expanded topics, and a better understanding of the patient's intended messages and needs. This intervention utilizes tablets, enabling patients to select pictures that correspond to their current condition, such as pictures of their family, indicating their need for family support (Shin et al., 2021).
5. Short message service (SMS)

   Short message service (SMS) is a text messaging service used to communicate with hospitalized patients. SMS can assist patients and their families in monitoring the patient's health condition, scheduling appointments with doctors or nurses, and providing important information about the patient's care. Additionally, SMS can help patients stay connected with their family and friends during the recovery process (Gorman et al., 2020).

Benefits of using technology for families and critically ill patients

The use of technology for families and critically ill patients can reduce anxiety among families. Research shows that VidaTalkTM opens up communication between families and patients by enabling clear communication and expanding the content of the communication. Family members feel happy and grateful to be able to communicate with the patient, and they express a sense of relief when communicating with the patient (Shin et al., 2021). Other studies also reveal that the use of technology can significantly reduce anxiety in the intervention group compared to the control group ($p < 0.01 = 0.09$)(Chiang et al., 2017). These statements are consistent with other studies that explain the influence of technology, such as SMS, in reducing family anxiety as they can monitor and stay informed about the patient's condition (Gorman et al., 2020).

The benefits of using technology in family involvement with critically ill patients include improving the well-being of both the family and the patient. Research shows that there is a statistically significant difference in satisfaction between the two patient groups (86.1% vs. 57.2%), with patients being satisfied with video visits ($p < 0.05$), and the satisfaction of family members is also statistically significant (88% vs. 62.5%) when using video visits ($p < 0.05$) (Yuan et al., 2023). Other studies indicate that families using communication technology in decision-making have higher communication quality compared to the control group (mean, 8.9 vs. 8.0) and are more confident in making joint decisions (mean, 8.7 vs. 8.0) (Suen et al., 2021).

Discussion

Technology has become an integral part of improving care and support for families of critically ill patients (Haig et al., 2023). The use of digital technology has also been shown to be an alternative for patient families to communicate and be involved, even without a physical presence around the patient's bedside (Heyward & Wood, 2020; Kebapcı & Türkmen, 2022; Rose et al., 2021). In a situation full of tension and anxiety about the patient's condition, technology provides a solution to keep families connected to their loved ones (Jelec et al., 2016).

One key aspect of technology that can be used by families of critically ill patients is communication (Choi & Powers, 2023). In this digital era, platforms like video virtual visitation allow families to communicate directly with patients through video. This allows them to see and hear their loved ones being treated in the intensive care unit, reducing feelings of isolation and providing much-needed emotional closeness (Lavin et al., 2015).

Families want honest and consistent information that is often conveyed in a way that can be understood during ICU admission (Kynoch, Cabilan, et al., 2016). It is often not possible for family members to continue to be at the bedside or available to talk to a doctor during or after their ward visits. Technology allows families to monitor the patient's health condition remotely. Short message service is used to communicate with patients who are being treated (Kynoch, Chang, et al., 2016). Short message service (SMS) can assist patients and families in monitoring the patient's health condition, scheduling appointments with doctors or nurses, and providing important information about patient care (Gorman et al., 2020). This information can be accessed via a mobile app or via a monitoring system that sends data directly to families and care teams. The ability to monitor a patient's health condition in real-time gives families a more relaxed feeling and allows them to act immediately if there is a significant change (Gurol-Urganci et al., 2013).

The potential of digital technology to contribute to the stress experienced by family members in the ICU may be a valid concern. In this review, only a few studies mentioned the emotional reactions of families to the use of digital technology. One study assessed whether the intervention itself (SMS messages) was disruptive or made family caregivers feel anxious using a survey questionnaire (Gorman et al., 2020). Another study found that technology (virtual ICU visits) contributed to feelings of sadness among families while exploring their feelings through qualitative interviews (Sasangohar et al., 2021). Additionally, most studies did not consider individual characteristics such as education level, age, or comfort with technology. Further studies need to incorporate an assessment of the potential emotional stress when using technology and consider any facilitators or barriers that may affect access or acceptance of digital technology.

Technology plays a crucial role in improving the well-being of families and patients. With access to medical information using smartphones, tablets, or computers, families can gain a better understanding of the patient's condition (Fadhila & Afriani, 2020). They can read in-depth about the diagnosis, treatment procedures, or medication side effects. This information helps families feel more empowered and allows them to actively participate in the patient's care, which, in turn, can enhance their mental and emotional well-being (Rustam & Chaidir, 2022).

Technology helps reduce the anxiety experienced by families of critically ill patients. In challenging and uncertain situations, the uncertainty about the patient's condition can lead to high levels of anxiety (Chong et al., 2023). However, with the presence of technology, families can communicate directly with the medical care team and receive real-time updates on the patient's progress. This provides a sense of calmness and allows families to feel more connected and informed about the care being provided to the patient, thereby reducing the anxiety they may feel (Chu & Mastel-Smith, 2010).

Technology also facilitates better decision-making. An interactive web-based tool to support surrogate decision-makers is a web-based tool or application designed to help surrogate decision-makers for patient families (Suen et al., 2021). With access to medical information, current research, and online resources, families can help understand the treatment options available and possible side effects. Families can participate in discussions about patient care plans and provide input based on the knowledge they gain through technology. This allows for more informed decision-making according to patient needs (Jones et al., 2011).

It is important to note that the use of technology in critical care has also raised some concerns. Several studies state that the use of technology does not affect the anxiety level of the family members (Gorman et al., 2020; Sasangohar et al., 2021). Therefore, further research is needed to understand the emotional impact that may occur and to identify factors that can affect the acceptance and accessibility of technology by families of critically ill patients.

Limitations

Limitation of Data: Sometimes, research on healthcare technology involving family participation in critical patients may face difficulties in gathering adequate data. The required data to evaluate this technology may be challenging to obtain, or some data may be incomplete or inaccurate. Limitation of Methodology: Some studies may encounter limitations in the methods used. For instance, the chosen research design may not fully enable the identification of cause and effect, or the methods of data analysis may be less representative or problematic.

Contribution to Global Nursing Practice

Nursing technology enables families of critical patients to stay connected with the healthcare team, even when they are far from the patient. Communication features such as video conferencing, text messages, or phone calls through technology can assist families in participating in decision-making and providing emotional support to the patient. Through technology, families can participate in the decision-making process alongside the healthcare team. Discussions about treatment, discharge plans, and symptom management involve the perspective of the families of critical patients, which helps achieve more holistic and appropriate decisions. Nursing technology can provide access to medical information and educational resources for families of critical patients. This allows families better understand the patient's health condition, enhance their comprehension of the treatment plan, and prepare themselves for a more effective caregiving role.

Conclusion and Recommendations

Nursing technology has proven to be effective in supporting family engagement in critical patient care. Using technology in the care of critical patients can help families communicate with patients and involve families in making better decisions. Through video conferencing applications that allow direct communication, technology enables families to stay connected with the patient even when they are far away. This helps families feel involved in the care and provides crucial emotional support to the patient. Additionally, remote monitoring technology allows families to monitor the patient's vital signs in real time, better understanding the patient's condition and enabling them to respond quickly to any significant changes. Technology also facilitates better communication between families and the medical care team, enabling fast and accurate information exchange and providing opportunities for families to participate in decision-making regarding patient care.

The articles that have been found have the potential to be applied in Indonesia. Amid the current era of globalization, the application of this kind of technology in Indonesia is not impossible. The strong influence of smartphone use provides opportunities for the development of this technology in Indonesia. Taking into account the cultural and social context, as well as the existing infrastructure, the application of this nursing technology can provide good benefits for health practice in Indonesia.

Further research can focus on gaining a deeper understanding of the emotional impact experienced by families of critically ill patients due to the use of technology. Studies can explore levels of anxiety, stress, and depression that may occur in families and identify strategies to mitigate these negative impacts.

Author Contribution

All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

Conflict of Interest

The authors declare no conflict of interest.

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Reference

Anggraeni, L., & Ismail, S. (2018). Pengalaman Perawat Tentang Caring Berbasis teknologi pada pasien kritis di ruang intensive care unit. *Jurnal Perawat Indonesia*, *2*(2), 70–77.

Barker, T. H., Stone, J. C., Sears, K., Klugar, M., Tufanaru, C., Leonardi-Bee, J., Aromataris, E., & Munn, Z. (2023). The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials. *JBI Evidence Synthesis*, *21*(3). https://doi.org/10.11124/JBIES-22-00430

Brown, S. M., Aboumatar, H. J., Francis, L., Halamka, J., Rozenblum, R., Rubin, E., Sarnoff Lee, B., Sugarman, J., Turner, K., Vorwaller, M., & Frosch, D. L. (2016). Balancing digital information-sharing and patient privacy when engaging families in the intensive care unit. *Journal of the American Medical Informatics Association*, *23*(5), 995–1000. https://doi.org/10.1093/jamia/ocv182

Chiang, V. C. L., Lee, R. L. P., Ho, F. M., Leung, C. K., Tang, Y. P., Wong, W. S., Ho, Y. S., Tung, Y. W., & Lai, H. L. (2017). Fulfilling the psychological and information need of the family members of critically ill patients using interactive mobile technology: A randomised controlled trial. *Intensive and Critical Care Nursing*, *41*, 77–83. https://doi.org/10.1016/j.iccn.2017.03.006

Choi, S., & Powers, T. (2023). Engaging and informing patients: Health information technology use in community health centers. *International Journal of Medical Informatics*, *177*, 105158. https://doi.org/https://doi.org/10.1016/j.ijmedinf.2023.105158

Chong, T. W. H., Curran, E., Southam, J., Bryant, C., Cox, K. L., Ellis, K. A., Anstey, K. J., Goh, A., & Lautenschlager, N. T. (2023). The potential of physical activity and technology interventions to reduce anxiety in older adults. *Journal of Affective Disorders Reports*, *14*, 100633. https://doi.org/https://doi.org/10.1016/j.jadr.2023.100633

Chu, A., & Mastel-Smith, B. (2010). The outcomes of anxiety, confidence, and self-efficacy with Internet health information retrieval in older adults: a pilot study. *CIN: Computers, Informatics, Nursing*, *28*(4), 222–228. https://doi.org/10.1097/NCN.0b013e3181e1e271

Czaja, S. J., Perdomo, D., & Lee, C. C. (2016). The role of technology in supporting family caregivers. *Human Aspects of IT for the Aged Population. Design for Aging: Second International Conference, ITAP 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17–22, 2016, Proceedings, Part I 2*, 178–185. https://doi.org/10.1007/978-3-319-39943-0_17

del Carmen Ortega-Navas, M. (2017). The use of new technologies as a tool for the promotion of health education. *Procedia-Social and Behavioral Sciences*, *237*, 23–29. https://doi.org/10.1016/j.sbspro.2017.02.006

Fadhila, R., & Afriani, T. (2020). Penerapan telenursing dalam pelayanan kesehatan: Literature Review. *Jurnal Keperawatan Abdurrab*, *3*(2), 77–84. https://doi.org/10.36341/jka.v3i2.837

Fateel, E. E., & O'Neill, C. S. (2016). Family members' involvement in the care of critically ill patients in two intensive care units in an acute hospital in Bahrain: The experiences and perspectives of family members' and nurses'-A qualitative study. *Clin Nurs Stud, 4*(1), 57–69. https://doi.org/10.5430/cns.v4n1p57

Gondwe, W. T. M., Bultemeier, K., & Bhengu, B. R. (2011). Challenges encountered

by intensive care nurses in meeting patients' families' needs in Malawi. *Africa Journal of Nursing and Midwifery*, *13*(2), 92–102.

Gorman, K., MacIsaac, C., Presneill, J., Hadley, D., Nolte, J., & Bellomo, R. (2020). Successful implementation of a short message service (SMS) as intensive care to family communication tool. *Critical Care and Resuscitation : Journal of the Australasian Academy of Critical Care Medicine*, *22*(3), 221–226.

Greenberg, J. A., Basapur, S., Quinn, T. V, Bulger, J. L., Schwartz, N. H., Oh, S. K., Shah, R. C., & Glover, C. M. (2022). Challenges faced by families of critically ill patients during the first wave of the COVID-19 pandemic. *Patient Education and Counseling*, *105*(2), 297–303. https://doi.org/https://doi.org/10.1016/j.pec.2021.08.029

Gurol-Urganci, I., de Jongh, T., Vodopivec-Jamsek, V., Atun, R., & Car, J. (2013). Mobile phone messaging reminders for attendance at healthcare appointments. *Cochrane Database of Systematic Reviews*, *12*. https://doi.org/10.1002/14651858.CD007458.pub3

Haig, M., Main, C., Chávez, D., & Kanavos, P. (2023). A Value Framework to Assess Patient-Facing Digital Health Technologies That Aim to Improve Chronic Disease Management: A Delphi Approach. *Value in Health*. https://doi.org/https://doi.org/10.1016/j.jval.2023.06.008

Hetland, B., McAndrew, N., Perazzo, J., & Hickman, R. (2018). A qualitative study of factors that influence active family involvement with patient care in the ICU: Survey of critical care nurses. *Intensive and Critical Care Nursing*, *44*, 67–75. https://doi.org/https://doi.org/10.1016/j.iccn.2017.08.008

Heyward, G., & Wood, D. S. (2020). They couldn't say goodbye in person, so ICU patients are using tablets instead. *CNN Health*.

Jelec, K., Sukalic, S., & Friganovic, A. (2016). Nursing and implementation of modern technology. *Signa Vitae*, *12*(1), 23–27. https://doi.org/10.22514/SV121.102016.3

Jones, J. B., Bruce, C. A., Shah, N. R., Taylor, W. F., & Stewart, W. F. (2011). Shared decision making: using health information technology to integrate patient choice into primary care. *Translational Behavioral Medicine*, *1*(1), 123–133. https://doi.org/10.1007/s13142-011-0023-5

Kebapcı, A., & Türkmen, E. (2022). The effect of structured virtual patient visits (sVPVs) on COVID-19 patients and relatives' anxiety levels in intensive care unit. *Journal of Clinical Nursing*, *31*(19–20), 2900–2909. https://doi.org/10.1111/jocn.16117

Khatri Chhetri, I., & Thulung, B. (2018). Perception of Nurses on Needs of Family Members of Patient Admitted to Critical Care Units of Teaching Hospital, Chitwan Nepal: A Cross-Sectional Institutional Based Study. *Nursing Research and Practice*, *2018*, 1–7. https://doi.org/10.1155/2018/1369164

Kynoch, K., Cabilan, C. J., & McArdle, A. (2016). Experiences and needs of families with a relative admitted to an adult intensive care unit: a qualitative systematic review protocol. *JBI Evidence Synthesis*, *14*(11), 83–90. https://doi.org/10.11124/JBIES-20-00136

Kynoch, K., Chang, A., Coyer, F., & McArdle, A. (2016). The effectiveness of interventions to meet family needs of critically ill patients in an adult intensive care unit: a systematic review update. *JBI Evidence Synthesis*, *14*(3), 181–234. https://doi.org/10.11124/JBISRIR-2016-2477

Lavin, M. A., Harper, E., & Barr, N. (2015). Health information technology, patient safety, and professional nursing care documentation in acute care settings. *Online Journal of Issues in Nursing*, *20*(2). https://doi.org/10.3912/OJIN.Vol20No02PPT04

Mahrous, M. S. (2017). Relating family satisfaction to the care provided in intensive care units: quality outcomes in Saudi accredited hospitals. *Revista Brasileira de Terapia Intensiva*, *29*, 188–194. https://doi.org/10.5935/0103-507X.20170018

Makmun, M., Suhartini, & Utami, R. S. (2019). Persepsi Keluarga Terhadap Partisipasi Keluarga Dalam Merawat Pasien Di Ruang Icu: Studi Kualitatif. *Perawat Indonesia*, *3*(3), 197–200.

Malliarou, M., Gerogianni, G., Babatsikou, F., Kotrotsiou, E., & Zyga, S. (2014). Family perceptions of intensive care unit nurses' roles: a Greek perspective. *Health Psychology Research*, *2*(1). https://doi.org/10.4081/hpr.2014.994

Matlakala, M. C. (2015). Sharing the critically ill patient's information with the family: Reflections and lessons learned. *Journal of Nursing Education and Practice*, *5*(10), 115. https://doi.org/10.5430/jnep.v5n10p115

Muthoni Maina, P. (2018). Involvement of Patients' Families in Care of Critically Ill Patients at Kenyatta National Hospital Critical Care Units. *American Journal of Nursing Science*, *7*(1), 31. https://doi.org/10.11648/j.ajns.20180701.14

Page, M. J., McKenzie, J. E., Bossuyt, P., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The prisma 2020 statement: An updated guideline for reporting systematic reviews. In *Medicina Fluminensis* (Vol. 57, Issue 4, pp. 444–465). https://doi.org/10.21860/medflum2021_264903

Roberts, S., Chaboyer, W., & Marshall, A. P. (2020). Hospital patients' perceptions of using a technology-based intervention to participate in their nutrition care: A qualitative descriptive study. *Clinical Nutrition ESPEN*, *39*, 79–86. https://doi.org/10.1016/j.clnesp.2020.07.014

Rohmawati, N. (2021). *Gambaran Persepsi Perawat tentang Caring Berbasis Teknologi di Ruang ICU dan IGD RSD Kalisat dan RS Jember Klinik*.

Rose, L., Yu, L., Casey, J., Cook, A., Metaxa, V., Pattison, N., Rafferty, A. M., Ramsay, P., Saha, S., & Xyrichis, A. (2021). Communication and virtual visiting for families of patients in intensive care during the COVID-19 pandemic: a UK national survey. *Annals of the American Thoracic Society*, *18*(10), 1685–1692. https://doi.org/10.1513/AnnalsATS.202012-1500OC

Rustam, J. S., & Chaidir, R. (2022). Partisipasi Keluarga dalam Perawatan Pasien Kritis di Critical Care Units: Review Studi. *'Afiyah*, *1X*(2), 28–32.

Sasangohar, F., Dhala, A., Zheng, F., Ahmadi, N., Kash, B., & Masud, F. (2021). Use of telecritical care for family visitation to ICU during the COVID-19 pandemic: An interview study and sentiment analysis. *BMJ Quality and Safety*, *30*(9), 715–721. https://doi.org/10.1136/bmjqs-2020-011604

Sepulveda Hermosilla, D., Irarrázabal Vargas, L., & Rojas Silva, N. (2022). Family participation in the care of the critical patient: An exploratory study. *Enfermería Intensiva (English Ed.)*, *33*(4), 173–184. https://doi.org/https://doi.org/10.1016/j.enfie.2021.07.003

Shin, J. W., Happ, M. B., & Tate, J. A. (2021). VidaTalk™ patient communication application “opened up” communication between nonvocal ICU patients and their family. *Intensive and Critical Care Nursing*, *66*, 103075. https://doi.org/10.1016/j.iccn.2021.103075

Soemiati, S., Haryanto, J., & Sumartono, C. (2023). Pengembangan ICU Card Talk sebagai Alat Bantu Komunikasi bagi Pasien dengan Ventilasi Mekanik. *Journal of Telenursing (JOTING)*, *5*(1), 323–332.

Styani, E. (2017). *Persepsi Keluarga Tentang Waktu Berkunjung Di Intensive Care Unit (ICU)*. Faculity of Medicine.

Suen, A. O., Butler, R. A., Arnold, R. M., Myers, B., Witteman, H. O., Cox, C. E., McComb, J. G., Buddadhumaruk, P., Shields, A. M., Morse, N., Argenas, A., & White, D. B. (2021). A pilot randomized trial of an interactive web-based tool to support surrogate decision makers in the intensive care unit. In *Annals of the American Thoracic Society* (Vol. 18, Issue 7, pp. 1191–1201). https://doi.org/10.1513/AnnalsATS.202006-585OC

Utami, R. S. (2017). *Literature Review: Kualitas Hidup Keluarga Pasien di Intensive Care Unit*.

Yuan, C., Xiao, Y., Wang, F., Wang, Y., Wang, Y., & Lin, F. (2023). Intensive & Critical Care Nursing The effect of video visitation on intensive care unit patients and family members outcomes during the COVID-19 pandemic : A randomised controlled trial. *Intensive & Critical Care Nursing*, *76*(January), 103394. https://doi.org/10.1016/j.iccn.2023.103394