A Communication System to Care for Patients with COVID-19 Using Deep Learning Technology: A Mixed Method Study

Aree Cheevakasemsook, Sarun Nakthanom*

Abstract: COVID-19 is an emerging infectious disease whose rapid mutation outpaces timely drug or vaccine development and disrupts face-to-face communication in clinical care. This exploratory sequential mixedmethods study in Thailand employed a 3-stage approach to identify communication barriers and needs, develop a deep learning technology-based system for hospitalized patients, and evaluate its effectiveness. Phase 1, qualitative data were collected for descriptive purposes through focus group discussions with 16 participants, including nurses, physicians, and patients with COVID-19. The analysis revealed structural, process, and outcome obstacles, which were organized into four themes of barriers and three categories of requirements for the communication system. Phase 2 translated these requirements into a deep learning technology communication system featuring a two-way, real-time platform powered by a logistic regression classifier. Phase 3 quantitatively tested the prototype with 39 patients, 70 nurses, and 15 digital technology experts across four public hospitals. Instruments included Focus-Group Protocols, the Deep Learning Technology Communication System, the State-Trait Anxiety Inventory, and two Quality-Assessment Forms. Data were analyzed using descriptive statistics, content analysis, accuracy testing, and the Wilcoxon matched-pairs signed-rank test.

The study identified key communication barriers across structural, process, and outcome dimensions. Three core needs emerged: a user-friendly, real-time two-way system; systematic communication of patient needs; and timely responses via technology. The developed system, utilizing a logistic regression algorithm with an 80% accuracy rate, enabled clear and responsive communication, significantly reducing patient anxiety. Its quality was rated significantly higher than previous systems by digital experts. While effective in enhancing patient–nurse coordination, limitations included limited access for frail patients, unstable Wi-Fi, and a small sample size, which affected generalizability of the findings. Further refinement is needed to improve accessibility, reliability, and scalability.

Keywords: Caring, Communication system, COVID-19, Deep learning technology, Mixed methods, Nursing

Received 29 December 2024; Revised 27 August 2025; Accepted 29August, 2023

***Correspondence to:* Aree Cheevakasemsook**, *RN, MEd (Nursing Administration), PhD, Associate Professor, School of Nursing, Sukhothai Thammathirat Open University, Thailand. E-mail: areecheeva@gmail.com*
Sarun Nakthanom, *BS (Industrial Computer Technology), MEn (Data Storage Technology), PhD (Information and Communication Technology for Education), School of Science and Technology, Sukhothai Thammathirat Open University, Thailand. E-mail: saraun.nak@stou.ac.th*

Introduction

It is recognized that COVID-19 is undoubtedly an emerging infectious disease (EID) of the 21st century. It appeared at the end of 2019 in China and has continued to pose a significant threat, facilitating rapid and easy transmission worldwide. COVID-19 has undergone constant changes, transitioning from the rapid spread of the early pandemic to intermittent outbreaks, concurrent with the emergence of variants and sub-variants.[1] With this continuous mutation of COVID-19, it challenges prevention, treatment, and

https://doi.org/10.60099/prijnr.2026.272913

vaccine development, and has contributed to a global struggle against the pandemic. So far, COVID-19 remains a potential threat to spread globally. The World Health Organization announced on 13 October 2021 that COVID-19 has spread to 195 countries, infecting 237,655,302 people and resulting in 4,846,981 deaths.[2] As of 10 June 2023, the report indicated a total of 766,920,852 confirmed COVID-19 cases worldwide, with 6,959,380 related deaths, resulting in a case-fatality ratio (CFR) of 0.91%.[3] Overall, in five years of this outbreak in Thailand, there were 774,000,000 cases and 7,000,000 deaths from COVID-19.[4] In an update on 2 May 2024, the latest report in Thailand revealed 1,672 new admissions, nine deaths in the week prior, and 390 seriously sick patients, of which 148 required mechanical ventilation.[5] Therefore, COVID-19 has still unpredictably affected all walks of life.

Currently, there are several EIDs in addition to COVID-19, such as Ebola, severe acute respiratory syndrome or SARS, and the Nipah virus, which could all be the next pandemic. EIDs share similarities in terms of transmission modes and lethality, while people at risk vary from country to country.[1] Whenever a pandemic occurs, particularly COVID-19, it has wide-ranging and multi-dimensional impacts on global safety, including loss of family members, economic stagnation, business closures, job losses, and even drastic changes in daily living and personal work routines. The COVID-19 outbreak has directly impacted healthcare services and the safety of medical personnel, particularly nurses who provide round-the-clock care to patients. The continuous increase in the number of patients with COVID-19, averaging more than 10,000 new cases per day, poses challenges to healthcare systems. Each patient in the hospital requires close care for at least 1-2 weeks, depending on the risk of infection transmission and the severity of the disease. Many patients with COVID-19 experience not only severe physical symptoms but also psychological distress, particularly anxiety associated with the progression and uncertainty of their illness.[6-8] Nonetheless, numerous challenges persist in obstructing the effective delivery of care within healthcare settings. Ineffective communication constituted a major barrier to the provision of optimal care for patients affected by COVID-19.[9-13]

During the COVID-19 pandemic, nurse-patient communication primarily relied on traditional methods, including telephone conversations, written notes, and non-verbal forms such as bodily or hand gestures, eye contact, and facial expressions.[9,14] However, the use of personal protective equipment (PPE) posed significant barriers, limiting the ability to read lips, interpret facial expressions, perceive body language, and hear clearly—elements critical to patient-centered care. To overcome these challenges, nurses adopted alternative communication strategies, including enhanced use of gestures and written communication. Nursing care during this period was highly dynamic and often diverged from standard care models, requiring increased adaptability and a focus on effective communication to address both the physical and psychological needs of patients. Moreover, ineffective communication contributed to heightened anxiety among patients with COVID-19.[15-16] Despite this, limited research has examined patient anxiety in this context, highlighting a gap in the literature.

Amid these challenges, deep learning technology (DLT) emerged as a transformative tool in healthcare, aiding disease detection, classification, prognosis, remote monitoring, and cost-effective care delivery.[17-20] DLT supports clinical decision-making and patient management; however, its application in nursing remains limited, particularly in areas requiring direct patient contact—tasks inherently non-transferable and high-risk. From 2020 to 2024, most studies centered on treatment strategies and risk prevention, with few addressing communication, a core component of nursing care. Existing communication-focused studies predominantly emphasized public health messaging and community education regarding COVID-19.[21-22] DLT holds potential to enhance nursing practice by improving outcome prediction, enabling personalized care planning, and strengthening clinical decisions through efficient, data-driven communication. By autonomously processing patient data, DLT can provide timely responses, assist in workload management, and enable nurses to focus on delivering individualized, holistic care—an essential aspect of professional nursing.[24]

Conceptual Framework and Review of Literature

The conceptual framework of the study was adapted from Donabedian's Model of Quality Assessment, comprising three components: structure, process, and outcome.[25] A review of literature over the past three years, since the onset of the pandemic (2020-2022), indicates that there have been studies on communication in patients with COVID-19. Still, there has been no development of communication systems using technology for COVID-19 patient care in healthcare facilities, particularly for professional nursing care. Studies have explored communication patterns in patients with COVID-19, including the use of communication technology among vulnerable elderly individuals,26 risk communication during the COVID-19 pandemic,[27-28] and the use of speech-to-text applications for individuals with hearing impairments.[29]

Previous studies investigated the care of patients with COVID-19, identifying problems and obstacles in patient care, communication difficulties, challenges in older patients, and changes in patient care.[30,41] Moreover, there have been some cross-sectional studies on communication with healthcare teams, such as physician-patient communication in patients with COVID-19, which found communication issues in over 60% of cases.[31] It is evident that communication studies in patients with COVID-19 with healthcare teams remain limited, hindering the ability to meet the needs and alleviate the stress or anxiety of these patients. Regarding these issues, current communication with patients with COVID-19 continues to face challenges. Conventional communication methods, such as verbal communication, writing on paper, or using whiteboards, pose risks of direct contact with the virus and may lead to communication errors, which can result in adverse effects on patient care. Hence, it is argued that the best way to reduce the risk of infection transmission, improve communication quality, and reduce patient anxiety is for nurses to communicate safely with patients using technology instead of conventional methods, which can help reduce direct contact with equipment or individuals and enhance the efficiency of patient care.

Aims and Hypotheses

This study aimed to explore the communication problems and needs of patients with COVID-19 during hospitalization and among healthcare personnel, to develop a new communication system utilizing deep learning technology, and to investigate the effectiveness of this system. The hypotheses were that the level of anxiety among patients with COVID-19 after using the developed communication system would be significantly lower than before the experiment, and the quality of the communication system for patient care with deep learning technology would be significantly higher than the prior system.

Methods

Design: This study was an exploratory sequential mixed methods design with three phases:[32] Phase 1, exploration of problems and needs of a communication system for caring patients with COVID-19 through a qualitative descriptive approach; Phase 2, development of the communication system using deep learning technology; and Phase 3, implementation and evaluation of the effects of using the developed communication system. The system was developed following the framework of the system development life cycle (SDLC)[33] (Figure 1). The writing of this report was guided by the Standards for Reporting Qualitative Research (SRQR),[34] a comprehensive instrument to enhance the clarity, transparency, and completeness of this study.

Sampling and Setting: Purposive sampling was employed to select key informants and three sample groups across the study's three phases, based on defined hospitals that aligned with the study objectives. These included healthcare providers with experience in caring for patients with COVID-19 and patients who had been hospitalized with the disease. Four hospitals were selected based on their willingness to participate and the availability of sufficient COVID-19 cases. In Phases 1 and 2, key informants who expressed voluntarily to participate in focus group discussions were categorized into two groups: 1) eight healthcare professionals, comprising six nurses and two physicians who had provided care to patients with COVID-19 in government hospitals located in Bangkok and its metropolitan areas, and 2) eight patients diagnosed with COVID-19 who had received treatment at government hospitals within the same areas. Healthcare professionals were selected through purposive sampling, targeting a relatively homogeneous group that varied in job positions, length of work experience, departments, and institutional settings (heterogeneous group). The patients were also purposively selected using similar means, focusing on diverse backgrounds in terms of age, occupation, and length of hospitalization within the same geographic region. This approach aimed to gather data that comprehensively explained the phenomena related to issues and requirements for creating the required communication system in all dimensions.[35]

In Phase 3, three groups of samples comprised 39 patients with COVID-19, 72 nurses, and 15 digital technology experts. Patients and nurses affiliated with four public hospitals at the provincial level, located in three Bangkok metropolitan areas and one suburban area, were selected based on predetermined criteria for inclusion and exclusion. The inclusion criteria of the patients were: 1) diagnosed by a physician as having COVID-19 infection and requiring hospitalization, 2) aged 15 years or older without gender restriction, 3) not requiring the use of mechanical ventilation, 4) capable of using a smartphone, 5) able to communicate in Thai, and 6) willing to participate in the research. Exclusion criteria were that the patient with acute illnesses prevented participation in the research project, for example, such as requiring emergency surgery or being in a critical condition necessitating mechanical ventilation. The inclusion of patients with COVID-19 in this study was influenced by the Ministry of Public Health's policy, which, since October 2022, has restricted hospital admission to individuals classified as high-risk. Consequently, the number of eligible patient participants was limited.[36]

The inclusion criteria for the participating nurses were: 1) working in inpatient units; 2) being responsible for the direct care of patients with COVID-19; 3) possessing smartphone literacy; and 4) being willing to participate in the study. The exclusion criteria were: 1) illness that prevented participation, such as severe sickness requiring more than two weeks of leave; and 2) assignment to urgent personal commitments lasting more than two weeks, such as official work obligations or participation in academic training. The experts involved in application analysis and design included nine experts from government education institutes and six other experts from the private sector. Purposive sampling was employed to recruit experts who met the inclusion criteria: willingness to participate, demonstrated expertise in deep learning technology, and a minimum of one year of professional experience in the field.

Ethical Considerations: This research was approved by five research ethics committees (REC); REC in Human Research, Sukhothai Thammathirat Open University, Certificate No. 003.66. on 23 March 2023, REC, Nopparat Rajathanee Hospital, Certificate No. 6/2566, REC, Priest Hospital, Certificate No. 1/2566., REC, Lerd Sin Hospital, Certificate No. 115/2566., and REC for Human Research, Oncology Institute, COA No.093/2566 REC No.047/2566.

Participants were informed of the study's objectives, data collection procedures, and their right to voluntary participation, including the option to withdraw at any time without consequences. Informed consent was obtained verbally and in writing from those who agreed to participate. All personal identifiers were kept confidential and replaced with research codes in any publication. Data collection was conducted with respect for participants' privacy, dignity, and rights, ensuring their physical and psychological comfort.

Instruments: These consisted of four types, all underwent content validity assessment by three experts using an index of item objective congruence (IOC) with a ranking of 0.80-1.00 (**Table 1**). Focus group discussion guidelines were used to identify communication problems and assess the needs of both patients and nurses in Phase 1. These guidelines encompassed two key inquiries focusing on communication problems and communication needs. The developed Communication System to Care for Patients with COVID-19: Using DLT was applied through the smartphones of the patients and nurses in Phase 2. The system was designed with input, output, and a database based on the problems and requirements of both patients with COVID-19 and healthcare providers in communication. This communication system was user-friendly, enabling both patients and nurses to access relevant information from predefined messages easily.

Table 1. Research instruments in three phases of the research

Phase	Instruments
1. Qualitative data collection and analysis: investigating communication problems and needs of both patients and healthcare team members	Focus group guidelines
2. Identify feature for testing: developing the communication system using DLT	The communication system with Deep Learning Technology (DLT)
3. Quantitatively test the feature designed: implementing and evaluating the developed communication system with three measures.	
3.1 Patients anxieties	- Anxiety levels of patients analyzed through DLT via smartphone - Anxiety levels of patients analyzed through DLT via smartphone
3.2 Quality of the communication system perceived by the nurses	A Questionnaire on the Quality of the Communication System for Providing Care to Patients (QQCSPCP) with COVID-19
3.3 Quality of the communication system using the digital technology experts	A Quality Assessment Checklist of the Communication System (QACCS) using DLT

The effectiveness of DLT was demonstrated using WangchanBERTa, a pre-trained transformer model optimized explicitly for the Thai language. WangchanBERTa was employed in two key tasks: 1) sentiment pre-labeling of user comments from Pantip.com, and 2) zero-shot classification for filtering domain-relevant data. These stages ensured high-quality, context-aware input data, which is critical for training reliable models. The performance of the downstream sentiment classifiers with logistic regression, which achieved 0.95 accuracy, precision, recall, and F1-score on the test set, reflected the foundational role that deep learning played in enriching the dataset. Therefore, a vocabulary corpus consisting of 26,162 words was created as a data dictionary, focusing on adjective words that reflected the anxious feelings of patients, to enable the machine to learn patient anxiety from their reflections within the system autonomously. The communication system was evaluated to determine its accuracy for application. This evaluation was based on prediction results through four methods: Logistic Regression, Naive Bayes, Decision Tree, and Support Vector Machine. The study on DLT found that the logistic regression algorithm provided the highest accuracy, achieving 80% (**Figure 1**).

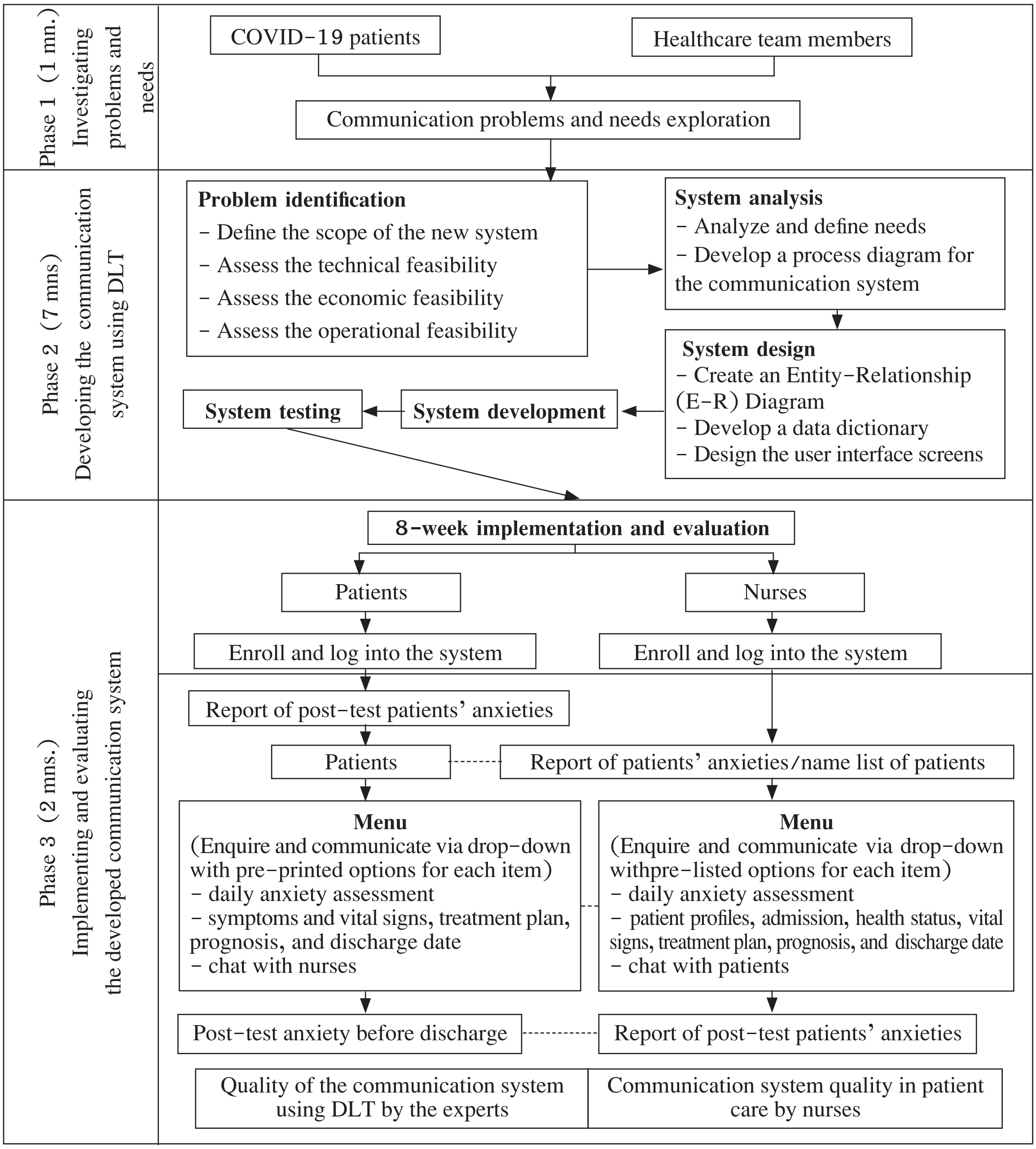

Figure 1. Three phases of the study process and data collection

In Phase 3, three research tools were involved in the process. Firstly, the Anxiety Assessment Questionnaire (AAQ) was included in the smartphones of the developed communication system used by the patient. It was adapted from Baker's Anxiety Questionnaire,[37] which uses a 5-point rating scale consisting of 15 items. Example items from the questionnaire included statements such as "I feel nervous, tense, restless, or agitated" and "I worry about adverse events that might occur to myself or to those I care about." Secondly, a Questionnaire on the Quality of the Communication System for Providing Care to patients with COVID-19 (QQCSPCP) was evaluated by the nurses who cared for the patients. This questionnaire was designed based on Donabedian's framework, focusing on structure, process, and outcome.[25] It uses a 5-point rating scale for evaluating each of 17 statements. Examples of this questionnaire included: "Designing communication with patients through portable communication devices is an appropriate approach," and "Entering information to contact patients is easy and convenient." The last tool was a Quality Assessment Checklist of the Communication System (QACCS) using DLT, which was evaluated by 15 digital technology experts. It was based on the framework by Nidhra and Dondeti[38] and using a 5-point rating scale composed of 28 items. Example items from the questionnaire included statements such as "The system operates with speed and accuracy," and "The completeness and integrity of the data within the system." Three research instruments in this phase were calculated by Cronbach's alpha coefficient, yielding reliability values of 0.902, 0.96, and 0.87, respectively. Determining the interpretation of mean scores for questionnaires derived from the calculated interval was: very high (4.21–5.00); high (3.41–4.20); moderate (2.61–3.40); low (1.81–2.60); very low (1.00–1.80).[39]

Data Collection:

The study steps included 3 phases as follows (**Figure 1**).

In Phase 1, the key informants were scheduled on specific dates and times via Microsoft Teams during the COVID-19 pandemic. Patients with COVID-19 and healthcare team members separately conducted focus group discussions (FGDs) on communication problems and needs regarding communication during care provision to patients with COVID-19. FGDs were done through Microsoft Teams and lasted 90 minutes.[35] In Phase 2, no further data collection was conducted, as this phase focused on the development of the communication system. Participants from Phase 1 were involved in verifying and confirming the accuracy of the previously gathered data. During the final two-month phase, data collection was conducted to evaluate the effectiveness of the system, including patients' anxiety and the quality of the developed communication system. Patients' anxiety was assessed using two main data sources. The first consisted of daily anxiety assessment forms completed by patients during their hospital stay. These forms contained self-reported anxiety scores during hospitalization, offering valuable insights into the progression of each patient's emotional state and supporting continuous anxiety analysis to enhance care effectiveness. The second source involved sentiment analysis using logistic regression. The model was trained on conversational data scraped from the popular Thai forum www.pantip.com, focusing on COVID-19-related discussions, such as patient anxiety during hospitalization and experiences of inpatient care settings. This method facilitated sentiment prediction within chat-based interactions. Additionally, the quality of the communication system for caring patients with COVID-19, as well as the quality of the system utilizing deep learning technology (DLT), was assessed using structured questionnaires distributed via Google Forms prior to further data analysis.

Data Analysis and Study Trustworthiness: Demographic and communication technology data were analyzed by descriptive statistics with frequencies and percentages. Problems and needs of communication in patient care were analyzed by content analysis.[40] The data obtained from Microsoft Teams recordings and filed notes were transcribed verbatim. The accuracy of the transcriptions was verified by the researcher prior to conducting the content analysis. The next step was to develop a robust category scheme through a thorough review of the data to identify underlying concepts and clusters. When the category scheme was established, the data were coded accordingly, analyzed for similarities and differences, and grouped into subcategories, which were then abstracted into broader categories. This study employed person triangulation, collecting data from nurses, physicians, and patients with COVID-19 to validate findings through multiple perspectives on the phenomenon. Afterward, the analyzed data were provided to participants with feedback on emerging interpretations and their reactions to enhance the study's trustworthiness.[40] The qualitative data from the different groups of participants were integrated, and examples of the integrated data are shown in **Table 2.**

The developed communication system with DLT was done for an accuracy test, and also the Wilcoxon matched-pairs signed-rank test. Both patient anxieties and quality of the communication system were compared before and after implementing the new system with the Wilcoxon matched-pairs signed-rank test, while descriptive statistics examined quality of communication systems from digital technology experts in terms of mean score and standard deviation.

Table 2. Examples of integration of qualitative data across diverse participant groups involved in focus group discussions

Patients with COVID-19	**Healthcare team members**	**Integration of qualitative data**
Theme: Limitations of communication devices	**Theme: Limitations of communication devices**	**Theme: Limitations of communication devices**
"The hospital's equipment readiness is inconsistent. Some patients admitted here do not have a camera, an emergency button, or anything like that—only a single mobile phone. If the patient experiences an accident, there is no immediate way to alert the nurse or doctor about their critical condition." (P7)	"Initially, we wrote notes on paper and taped them to the glass window so people outside could see the patient's status—for example, fluid intake/output. Later, we switched to taking photos and sending them via Line for faster communication. Sometimes, the paper wouldn't stick to the glass, fell off, or got lost, and we could not tell which round of monitoring it belonged to. This made communication difficult." (N6)	

Remark: P = Patient, N = Nurse

Results

Key informants and samples

The key informants who participated in the group discussions (Phase 1 and Phase 2) included eight patients with COVID-19 and eight healthcare team members. Most patients worked for the private sector, while healthcare team personnel who closely provided care to patients with COVID-19 worked at diverse hospitals in the same area. In Phase 3, the patients with COVID-19 admitted to state hospitals in the Bangkok metropolitan and surrounding areas totaled 39 individuals from four hospitals. There were nearly equal numbers of females and males (20 and 19 individuals, respectively). Seventeen patients with unspecified ages (43.6%) were roughly equal to the combined total of 16 patients (41%) aged between 61–80 years (eight cases) and over 81 years (eight cases). The majority held a bachelor's degree (33.3%). The most commonly used digital communication tool was a smartphone (81.30%), and smartphones were also the most knowledgeable and skilled device for communication (71.43%). When feeling unwell, most patients preferred to contact family members (42.11%), and their primary concern for communication was about their illness. The top three topics of required communication, ranked from most to least, were their illness (32.89%), concerns about worsening illness severity (27.63%), and worry about their family members (23.70%).

The second sample group in Phase 3 was 70 nurses working in hospitals where patients with COVID-19 were being treated. The majority were female (94.29%), aged 20–30 years (50%), and held a bachelor's degree (97.14%). Most worked in inpatient wards (67.14%) and had been employed at the hospitals for 10 years or less (74.3%). Additionally, 67.14% had 1–2 years of experience in delivering care to patients with COVID-19. Furthermore, the majority had experience using smartphones to communicate with patients with COVID-19 (45.5%). The most common issue encountered with communication tools was the inability to resolve problems during usage (31.2%). The last sample was digital technology experts with educational backgrounds in engineering or computer science, specializing in analyzing and designing applications. Most held positions in engineering or technology fields and work in government educational institutions (two-thirds, or 66.67% of all experts).

Qualitative findings: Communication problems in caring for patients with COVID-19

Troublesome communication, as reported by both patients and healthcare team members, was broadly similar, though minimal differences were noted. Patients with COVID-19 indicated a lack of health information communication, whereas care providers reported that the communication process was limited. Nonetheless, both the commonalities and the few differing aspects of these communication issues could be systematically classified into three key dimensions as structure, process, and outcome aspects.[25] The identified communication problems were categorized into four themes, as follows.

Category 1: Limited and insufficient communication equipment. There were no cameras, no emergency buttons or the inability to communicate unless the communication button is pressed, limited use of the LINE application, unclear sound, as exemplified in the following excerpts:

> *"...one patient may not have a camera, an emergency button, or anything like that. If a patient has an accident, they only have a phone, how do they notify the nurse or doctor?"* (Patient 7)

> *"We used to write on paper and stick it on the wall near the glass so that people outside could see how the case was. Later, we started taking pictures and sending them via LINE to speed things up, because sometimes the paper would slide off the glass, or it would get blown away, and we wouldn't know which shift it was from..."* (Nurse 6).

Category 2: Poorly installed equipment and Wi-Fi limitations. Some communication tools were not properly installed, such as cameras that were installed too far from patients to observe their conditions. For instance:

> *"There are limitations with the CCTV system, which is more like an overview—patients are seen from a distance and not clearly. Mostly, we wait for nurses to check in during their rounds. If there's an issue, it will be reported later. This is another limitation."* (Doctor 2)

> *"Some rooms do not have Wi-Fi, making it hard to communicate with patients through online platforms."* (Nurse 1)

Category 3: Patient communication barriers. Some patient conditions inhibited or disturbed efficient communication, such as anxiety, fear, a lack of skills in using the LINE application, and elderly patients with poor communication. For example:

> *"What worries me is that the patient in the next bed didn't stay long and was able to go home quickly. I'm scared I might not get to go home."* (Patient 3)

> *"In the case of patients who cannot take care of themselves, such as yellow-code patients or elderly patients, they might disturb the green-code patients who have already had their vital signs checked."* (Nurse 2)

Category 4: Inadequate nurse-to-patient ratios and poor communication of patient needs. An increased patient volume with limited nursing staff led to significant communication barriers. Nurses, overwhelmed by workloads, were unable to provide timely and comprehensive information regarding treatment plans, disease progression, prognosis, and discharge. For example:

> *"It was like loading 50 to 300 people on a truck and dropping them at the hospital—no history, no medications, just COVID-19. We had two doctors and twenty to thirty nurses."* (Doctor 1)

> *"What's my condition? When can I be discharged? I want to know if my condition is improving."* (Patient 5), *and*

> *"I've asked three or four times when I can go home. They said it depends on the doctor's evaluation."* (Patient 7)

Infection control protocols intensified process-related communication challenges, while the use of PPE reduced the frequency and duration of nurse-patient interactions, thereby constraining meaningful exchanges. In shared rooms, stronger patients often assisted weaker ones due to reduced staff accessibility. For instance,

> *"Wearing PPE is tight, exhausting, and makes communication difficult."* (Nurse 2)

> *"We wear PPE about four times per shift. Sometimes when we go in, the patient doesn't need anything yet."* (Nurse 3)

Outcome-related challenges included delays in responding to urgent needs, particularly during shift changes. For example:

> *"We post messages in the LINE group, but no one responds or even reads them. We don't know what to do."* (Patient 7). *Similarly,*

> *"We wait until nurses come during rounds. Doctors are usually assigned to multiple wards."* (Doctor 2)

Overall, the combination of staffing shortages, infection control measures, and inefficient communication systems compromised the delivery of timely, patient-centered care during the pandemic.

Qualitative findings: Requirements arising from communication barriers

The communication needs in the care of patients with COVID-19, as expressed by both patients and healthcare team members, were generally similar, with minor differences. Patients emphasized the need for daily provision of health-related information, whereas nurses highlighted the importance of non-face-to-face communication. These needs were classified into three themes corresponding to the previously identified communication barriers.

Category 1: System structure. The communication system should be constructed to enable real-time, fast, and user-friendly two-way communication for all age groups through technology, replacing face-to-face interactions and addressing patients' needs. For example:

> *"I want communication to be provided without having to ask. Actually, I would prefer if there was routine information sharing—like what tests were done, what the results were, and any updates, just inform us directly."* (Patient 2)

> *"The communication tools, as mentioned earlier, should allow real-time updates so that patients can clearly express their needs. It should be a two-way communication, such as via phone, so patients can reach out when they need something without having to wait for the nurse's rounds...."* (Doctor 2)

Category 2: Process component. The process was requested to ensure clear daily communication of patients' needs through technology. Communication of patients' daily needs, such as informing them of laboratory test results, for example, was mentioned in the group discussion:

> *"We don't want to have to ask. Actually, I would prefer if routine information was provided—like what tests were done, what the results were, and any updates, just inform us directly."* (Patient 2)

> *"There should be technology to help with communication while wearing protective gear, so the other party can understand what is needed, and the other party can communicate clearly as well. We could use current technology, whether it's an intercom or various applications."* (Doctor 1)

Category 3: Outcomes. The expected outcome was meeting patients' needs effectively using technology. The outcome of communication issues was to respond to patients' communication requirements, such as a patient wanting to know the types of COVID-19, and healthcare team members requesting telenursing to communicate with patients. For instance:

> *"Sometimes I really want to know which strain of COVID-19 I have contracted."* (P7)

> *"Self-checking or receiving various vaccines could use a telecommunication system, where they can communicate with us via phone. However, there are limitations, such as some people not having a mobile phone, and some not being able to afford a data plan."* (N5)

Qualitative findings: The new communication system to care for patients with COVID-19 using DLT

This communication system was constructed based on the problems and needs of patients and healthcare team members. The system featured the following characteristics: Structure—a two-way communication system utilizing DLT that was user-friendly, operated through a stable Wi-Fi network, and allowed the patient to select desired information from predefined messages in the system. Process— facilitated systematic, clear, convenient, and rapid communication between patients and nurses. Outcome—prompt reaction to the needs of patients. The communication system comprised two main components. First, predefined messages—accessible via smartphone without manual input or printing—were designed to address specific needs of patients and care providers, such as treatment plans, clinical progression, prognosis, expected discharge dates, and other relevant concerns or individual requests. Moreover, DLT, inspired by human cognition, enabled the extraction of relevant anxiety-related information from both patient self-assessments and nurse-patient conversations. By analyzing large volumes of such data, deep learning can systematically classify levels of anxiety with greater speed, comprehensiveness, and accuracy (**Figure 2**). The communication system was evaluated for its application accuracy using logistic regression, achieving a maximum accuracy of 80.00%.

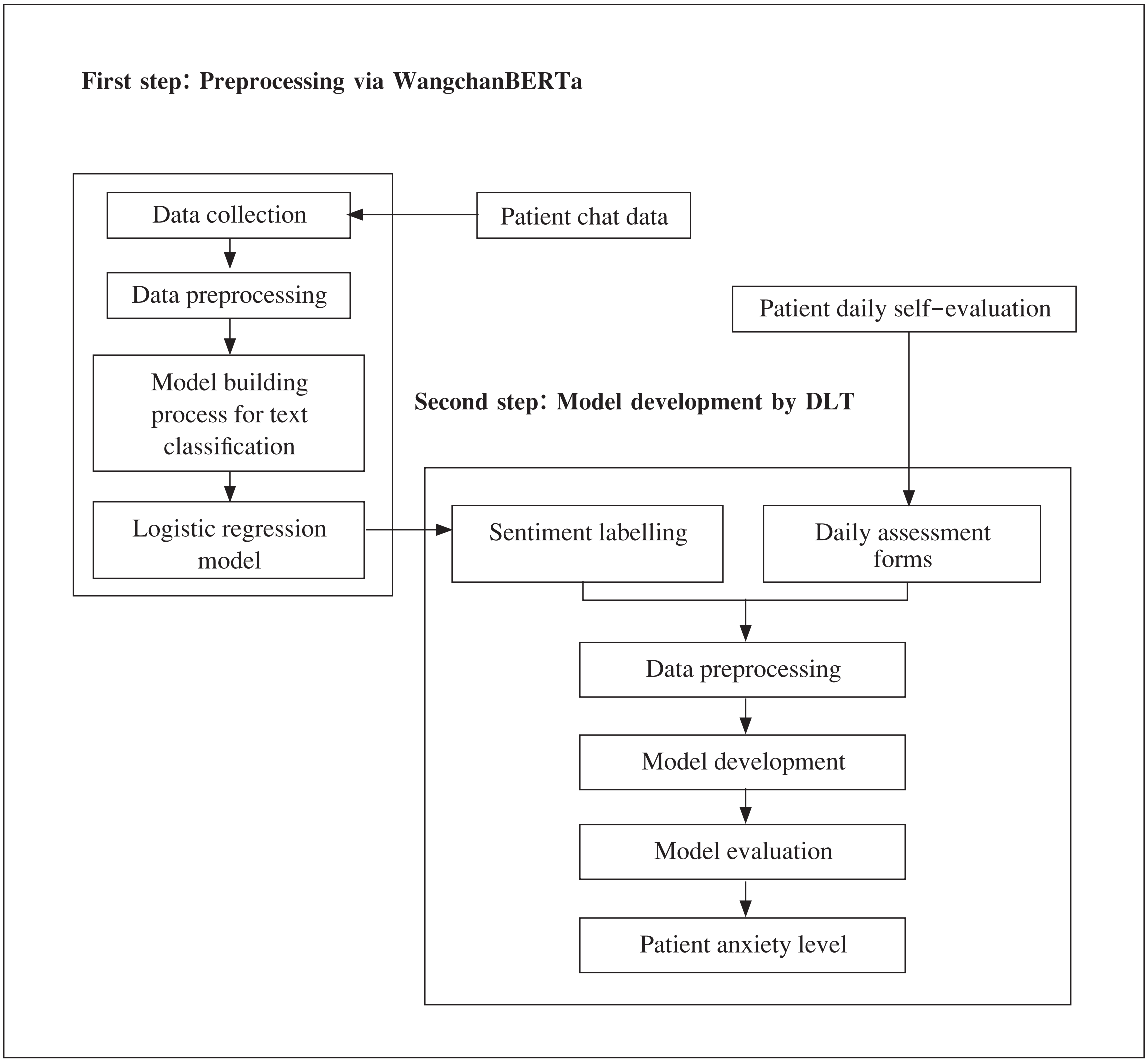

Figure 2. Algorithm of the communication system with DLT

Quantitative findings

The effectiveness of the developed communication system illustrated three effectiveness categories:

1. Anxiety levels in patients with COVID-19, both overall and item-specific, after implementing the developed communication system, revealed a lower anxiety level than the prior system, significantly at the statistical level of 0.001. The top three most significant differences, ranked from largest to smallest, include 1) fear of subsequent adverse events after contracting COVID-19 (a difference of 63.34%), 2) feelings of restlessness (a difference of 58.00%), and 3) sweating (a difference of 52.20%). On the other hand, the three least significant differences, ranked from smallest to largest: 1) shortness of breath or difficulty breathing (a difference of 43.60%), 2) memory difficulties (a difference of 44.00%), and 3) fatigue or exhaustion (a difference of 44.20%) (**Table 3**).

Table 3. A comparison of the mean scores for anxiety levels in patients with COVID-19 between the traditional system and the communication system with DLT, by each item and aspect

No.	Anxiety of patients	Before implementing Mean (%) (Level)	Before implementing SD	After implementing Mean (%) (Level)	After implementing SD	Z	p-value
1.	Restless	86.20 (Very high)	0.86	28.20 (Low)	0.64	5.064	< 0.001
2.	Easily irritated	77.40 (High)	0.92	28.20 (Low)	0.75	4.661	< 0.001
3.	Muscle tension	79.40 (High)	0.99	28.80 (Low)	0.82	5.132	< 0.001
4.	Difficult to relax	78.40 (High)	0.90	28.20 (Low)	0.64	4.970	< 0.001
5.	Trouble sleeping	78.00 (High)	0.85	33.40 (Low)	0.90	4.825	< 0.001
6.	Fatigue or exhaustion	79.00 (High)	0.89	34.80 (Low)	0.82	5.091	< 0.001
7.	Difficulty concentrating	75.80 (High)	0.89	30.20 (Low)	0.76	5.140	< 0.001
8.	Poor memory	77.40 (High)	0.89	33.40 (Low)	0.87	4.822	< 0.001
9.	Shortness of breath	77.40 (High)	0.89	33.80 (Low)	0.69	4.992	< 0.001
10.	Stomach discomfort	79.40 (High)	0.87	28.20 (Low)	0.55	5.225	< 0.001
11.	Dizziness	80.60 (High)	0.90	30.20 (Low)	0.72	4.989	< 0.001
12.	Numbness or tingling	78.40 (High)	0.96	28.80 (Low)	0.68	4.995	< 0.001
13.	Sweating	81.00 (Very high)	0.92	28.80 (Low)	0.92	5.101	< 0.001
14.	Agitated	80.00 (High)	0.97	31.20 (Low)	0.82	4.809	< 0.001
15.	Fear of negative consequences after COVID-19 infection	81.60 (Very high)	0.96	18.26 (Very low)	0.88	5.059	< 0.001
	Overall	79.40 (High)	0.68	30.80 (Low)	0.49	-5.304	< 0.001

2. Quality of the communication system in caring for patients with COVID-19 using the developed communication system with DLT had an overall average score significantly higher ($p < 0.001$) than the traditional system. Analysis revealed three key differences between the developed and traditional communication systems. The most notable was in structure, where 30.80% agreed that designing patient

communication via portable devices was appropriate. In the outcome domain, 29.40% supported enhancing continuity in patient care, followed by the item promoting holistic patient care. These results underscore the developed system's strengths in both design and care outcomes (**Table 4**).

Table 4. Mean score comparison for the quality of the communication system for caring patients with COVID-19 between the traditional system and the developed communication system with DLT by overall, aspect, and item

Quality of communication for caring patients	Traditional system		Developed system		Z	p-value
	Mean (%) (Level)	SD	Mean (%) (Level)	SD		
A. Structure	2.68 (53.60) (Moderate)	0.68	4.02 (80.40) (High)	0.54	-7.008	< 0.001
1. Communication design via mobile devices is appropriate	2.61 (52.20) (Moderate)	0.91	4.15 (83.00) (High)	0.74	-6.056	< 0.001
2. Interface design is user-friendly and appropriate	2.75 (55.00) (Moderate)	0.92	4.10 (82.00) (High)	0.72	-6.035	< 0.001
3. Menu design is easy and convenient to use	2.74 (54.80) (Moderate)	0.87	4.03 (80.60) (High)	0.69	-5.722	< 0.001
4. Font size is readable	2.65 (53.00) (Moderate)	0.87	4.00 (80.00) (High)	0.69	-5.953	< 0.001
5. Audio output is at a proper and clear level	2.58 (51.60) (Low)	0.96	3.90 (78.00) (High)	0.67	-6.013	< 0.001
6. Frequently used data can be added automatically	2.74 (54.80) (Moderate)	0.90	3.96 (79.20) (High)	0.70	-5.953	< 0.001
B. Process	2.64 (52.80) (Moderate)	0.61	3.95 (79.00) (High)	0.57	-6.751	< 0.001
7. Quick login	2.71 (54.20) (Moderate)	0.83	4.04 (80.80) (High)	0.72	-5.818	< 0.001
8. Easy and convenient data entry for communication with patients	2.72 (54.40) (Moderate)	0.83	3.88 (77.60) (High)	0.79	-5.089	< 0.001
9. Data entry via typing and voice	2.60 (52.00) (Moderate)	0.83	3.94 (78.80) (High)	0.73	-6.312	< 0.001
10. Data processing is accurate and fast	2.68 (53.60) (Moderate)	0.84	4.01 (80.20) (High)	0.74	-5.803	< 0.001
11. Clear and fast reception of patient text/audio data	2.64 (52.80) (Moderate)	0.77	3.90 (78.00) (High)	0.65	-5.957	< 0.001
12. Easy and convenient data editing	2.56 (51.20) (Low)	0.75	3.88 (77.60) (High)	0.69	-6.341	< 0.001
13. Easy and fast access to communication history	2.58 (51.60) (Low)	0.82	4.01 (80.20) (High)	0.64	-6.492	< 0.001
C. Outcome	2.63 (52.60) (Moderate)	0.70	4.06 (81.20) (High)	0.63	-6.854	< 0.001
14. Supports meeting patients' needs accurately and promptly	2.54 (50.80) (Low)	0.75	4.00 (80.00) (High)	0.73	-6.278	< 0.001

Table 4. Mean score comparison for the quality of the communication system for caring patients with COVID-19 between the traditional system and the developed communication system with DLT by overall, aspect, and item (Cont.)

Quality of communication for caring patients	Traditional system		Developed system		Z	p-value
	Mean (%) (Level)	SD	Mean (%) (Level)	SD		
15. Promotes patient safety	2.63 (52.60) (Moderate)	0.80	4.03 (80.60) (High)	0.73	-6.290	< 0.001
16. Enhances continuity of patient care	2.57 (51.40) (Low)	0.84	4.04 (80.80) (High)	0.72	-6.399	< 0.001
17. Promotes holistic care	2.76 (55.20) (Moderate)	0.85	4.15 (83.00)	0.72	-6.271	< 0.001
Overall average	2.65 (53.00) (Moderate)	0.53	4.01 (80.20) (High)	0.51	-7.196	< 0.001

3. The quality of the communication system using DLT, as assessed by digital technology experts, was rated as high overall (M = 4.10, SD = 0.58). The three highest-rated items were: ease of system access (M = 4.40, SD = 0.51), user-friendly or convenience of the system (M = 4.33, SD = 0.49), and uncomplicated (M = 4.33, SD = 0.62). In contrast, the three least significant differences from smallest to largest were: 1) coverage of intended communication contents (M = 3.73, SD = 0.70), a continuous and rapid system (M = 3.80, SD = 0.77), and results searching aligning with both current and past requirements (M = 3.87, SD = 0.64).

Discussion

The research findings indicated significant communication difficulties in caring for patients with COVID-19. These obstacles encompassed structural, procedural, and outcome-related aspects. They included limitations in the use and installation of communication tools and equipment, traditional means, barriers to patients with COVID-19 (such as being unable to use smartphones efficiently, fear, and anxiety), and insufficient healthcare team resources for patient care, leading to various communication constraints and delayed responsiveness to patient needs. These obstacles emerged due to COVID-19 being a novel disease with a short incubation period; it could spread easily within a range of no more than two meters, both widely and rapidly.[41] These crises happened abruptly and too speedily to handle in time. This led to communication insufficiencies, which made it difficult to care for the patients in all dimensions, including manpower, equipment, patient rooms, and management regulations. With regard to those three obstacles, both patients and healthcare team members expressed the need for improving the communication systems, as the previous communication system was implemented during the COVID-19 outbreak, an unprecedented virus that emerged suddenly in 2020.[20] Communication was conducted using tools available at the time, such as writing on paper, smartphones, the LINE application, and intercom systems. However, there was no specific communication system developed for nurses providing care to patients with COVID-19, except for the use of technology to communicate knowledge about COVID-19 to the public and to promote proper preventive practices.[42] As a result, the communication system for delivering care to patients with COVID-19 faced several issues and required the development of the limited existing communication systems at that time.

The developed communication system exhibited the following characteristics: It highlighted the necessity for structure-process-outcome improvement to facilitate real-time and efficient two-way communication accessible to all ages through user-friendly technology to ensure systematic, clear, and easy communication to respond to patients' daily needs as well as nursing practice demands. These requirements were confirmed,[43] and the statements of both patients and healthcare team members of this study. The traditional communication methods failed to address the challenges posed by the emerging COVID-19 pandemic, particularly the risks associated with close physical contact. This limitation led to significant difficulties in providing patient care, especially in terms of communication tools and message delivery necessary for ensuring safety and holistic care amidst staff and resource shortages. In contrast, the innovative communication system was able to meet both the physical and psychological needs of patients with COVID-19. It facilitated timely and comprehensive communication through predefined messages and automated interpretation of patients' anxieties, reducing the burden on both patients and nurses. These findings are consistent with previous studies.[21-23] Despite its advantages, the system still presents some limitations requiring improvement. Some frail patients struggled with manual typing, suggesting the need for more user-friendly features such as voice input. In addition, inconsistent Wi-Fi connectivity across clinical settings hindered efficient communication, necessitating collaboration between researchers and healthcare institutions. Lastly, future studies should include a larger sample of COVID-19 patients to enhance the generalizability of the findings.

Overall anxiety levels among patients with COVID-19 were significantly reduced following the implementation of the developed communication system, compared to pre-intervention levels, with statistical significance at the 0.05 level. This outcome can be attributed to the system's design, which was guided by the DLT approach. The system demonstrated automated analysis and interpretation of patients' anxiety scale responses and was developed based on the specific problems and needs of key stakeholders. In contrast, traditional communication methods were not tailored for this specific purpose. When the attending nurses could respond to patients' needs promptly and efficiently, it helped reduce patient anxiety compared to when they were first admitted to the hospital, a time when they were facing a severe and unpredictable illness, unlike any other disease.

The overall quality of the communication system to care for patients with COVID-19, as perceived by nurses, was significantly better than before the trial at the 0.05 level. This was consistent with the opinions of the digital technology expert sample in this research and the findings of previous studies.[23,44] This result was caused by the communication system being constructed based on the troubles and necessity reflections of healthcare team members, including nurses caring for patients with COVID-19. When these obstacles were resolved through using DLT, an intelligent system capable of automatically extracting key features necessary for classifying input data, it led to more systematic and effective communication between patients with COVID-19 and nurses. The system could overcome communication limitations quickly, easily, and conveniently, without the need for face-to-face interaction with patients. It reduced hindrances related to the insufficient number of nurses, the challenges of using personal protective equipment in hot and uncomfortable conditions, the difficulty of communicating clearly within limited time frames, and the lack of communication devices specifically designed to support nursing activities for patients with COVID-19. This communication system is suitable for use in managing other emerging severe infectious diseases, both in hospital settings and at home via telemedicine. It also aligns with the 2023-2027 Action Plan for Preparedness, Prevention, and Response to Emerging Infectious Diseases by the Department of Disease Control, Ministry of Public Health, Thailand.[45] However, as a novel system, it still requires refinement, particularly in simplifying data entry, automating frequent inputs, and improving patient data reception.

Limitations

Despite the valuable insights provided by this study, three limitations are worth noting. Many of the patients were frail, despite being able to use smartphones, and faced physical limitations of illness and age, which might have affected both their emotional well-being and their ability to use the communication system effectively. The DLT-based communication remained at the prototype stage, relying on manual typing for information beyond predefined messages, as voice recognition technology was still in its early development. In addition, inconsistent Wi-Fi infrastructure across hospitals occasionally disrupted effective communication. The Ministry of Public Health's policy restricting hospital admission to high-risk COVID-19 patients limited the sample size and resulted in a predominance of older adults, thereby reducing the study's generalizability.

Conclusions and Implications for Nursing Practice

In the digital era, healthcare policies in many countries are increasingly adopting artificial intelligence technologies, such as DLT, to enhance healthcare quality and safety. The DLT-based communication system developed for hospitalized COVID-19 patients offers clearer, faster, more secure, and less anxiety-inducing interactions compared to traditional methods. Although it was initially designed for COVID-19 care, this system is adaptable for other emerging infectious diseases in both hospital settings and telemedicine approaches. Future enhancements should incorporate large language models (LLMs) and voice input to facilitate easier and more efficient data entry and editing, thereby improving accuracy. Strengthening Wi-Fi infrastructure through inter-agency collaboration is also critical to support DLT-based communication. Further research with larger samples is essential to optimize deep learning parameters and establish a reliable patient-nurse communication tool in fragile and uncertain healthcare contexts.

Author Contributions

Conceptualization, Method and design, Data collection, Data interpretation, Drafting and revising the manuscript, Final approaval of the submitted version: A.C.

Critical revision of the manuscript, Final approval of the submitted version: S.N.

Acknowledgments

We especially thank all study participants, and the School of Nursing at Sukhothai Thammathirat Open University; and particularly, the National Science, Research, and Innovation Committee for funding the study. In addition, we sincerely thank Associate Professor Wilai Kusolvissidsakul for her insightful guidance and for reviewing the data analysis, and to Mr. Trevor Smith for his meticulous assistance in language editing.

References

1. Bloch EM, Sullivan DJ, Casadevall A, Shoham S, Tobian AAR, Gebo K. Applying lessons of COVID-19 and other emerging infectious diseases to future outbreaks. mBio. 2024;15(6): e0110924. doi: 10.1128/mbio.01109-24.
2. World Health Organization. Weekly operational update on COVID-19 - 12 October 2021 [Internet]. 2021 Oct 13 [cited 2025 Feb 9]. Available from: https://www.who.int/publications/m/item/weekly-operational-update-on-covid-19---12-october-2021
3. World Health Organization. COVID-19 situation updates for week 23 (04-10 June 2023) [Internet]. 2023 Jun 4-10 [cited 2025 Feb 9]. Available from: https://www.emro.who.int/pandemic-epidemic-diseases/covid-19/covid-19-situation-updates-for-week-23-04-10-june-2023.html

4. World Health Organization. Update on COVID-19 in Thailand: 7 February 2024 [Internet]. 2024 Feb 7 [cited 2025 Feb 9]. Available from: https://www.who.int/thailand/news/detail/06-02-2024-update-on-covid-19-in-thailand--7-february-2024
5. World Health Organization. Update on COVID-19 in Thailand: 02 May 2024 [Internet]. 2024 May 2 [cited 2025 Feb 9]. Available from: https://www.who.int/thailand/ news/detail/02-05-2024-update-on-covid-19-in-thailand--02-may-2024
6. Altıntaş M, Korkut S. Investigation of coronavirus anxiety, health anxiety, and anxiety symptom levels in vertigo patients during COVID-19 pandemic. Braz J Otorhinolaryngol. 2023;89(2):313–20. doi: 10.1016/j.bjorl.2022.11.003.
7. Alacevich C, Thalmann I, Nicodemo,C, de Lusignan S, Petrou S. Depression and anxiety during and after episodes of COVID-19 in the community. Gainesville: Sci Rep. 2023; 13(1):8257. doi: 10.1038/s41598-023-33642-w.
8. Lovika A, González-Hijón J, Hoffartc A, Fawns-Ritchiee C, Magnúsdóttirg I, Luh L, et al. Elevated symptoms of depression and anxiety among family members and friends of critically ill COVID-19 patients – an observational study of five cohorts across four countries. *Lancet Reg Health Eur.* 2023;33(10):100733. doi: 10.1016/j.lanepe.2023.100733.
9. Díaz-Agea JL, Orcajada-Muñoz I, Leal-Costa C, Adánez-Martínez MG, De Souza Oliveira AC, Rojo-Rojo A. How did the pandemic affect communication in clinical settings? A qualitative study with critical and emergency care nurses. Healthcare (Basel). 2022;10(2):373. doi: 10.3390/healthcare 10020373.
10. Khademi Z, Imani E, Khormizi MH. Nurses' experiences of communication during the coronavirus disease 2019 pandemic: a qualitative study. J Multidiscip Care. 2021; 10(3):105-10. doi: 10.34172/jmdc.2021.21.
11. Gualandi R, Ivziku D, Caruso R, Di Giacinto C, Lommi M, Tartaglini D, et al. Nurse–patient communication and relationship when wearing personal protective equipment: nurses' experience in a COVID-19 ward. Healthcare (Basel). 2023;11(13):1960. doi: 10.3390/healthcare 11131960.
12. Bandaru SV, Augustine AM, Lepcha A, Sebastian S, Gowri M, Philip A, et al. The effects of N95 mask and face shield on speech perception among healthcare workers in the coronavirus disease 2019 pandemic scenario. J Laryngol Otol. 2020;134:895-8. doi: 10.1017/S002221512 0002108.
13. Zarei N, Negarandeh R, Neshat H. Communication challenges caused by wearing masks and strategies used by pediatric nurses during the COVID-19 pandemic: a qualitative study. J Pediatr Nurs. 2024; 77:e54-61. doi: 10.1016/j.pedn. 2024.03.020.
14. Teixeira D, Costa S, Branco A, Silva A, Polo P, Nogueira MJ. Strategies used by nurses to maintain person–family communication during the COVID-19 pandemic: a scoping review. Nurs Rep. 2023;13(3):1138-47. doi: 10.3390/nursrep13030098.
15. Kim S, Chang H, Kim T, Cha WC. Patient anxiety and communication experience in the emergency department: a mobile, web-based, mixed-methods study on patient isolation during the COVID-19 pandemic. J Korean Med Sci. 2023;38(39):e303. doi: 10.3346/jkms.2023.38e303.
16. Namadi F, Alilu L, Hemmati Maslakpak M, Yadegar Tirandaz S. Threats to the dignity of COVID-19 patients: a qualitative study. Nurs Ethics. 2022;29:(7-8):1647-57. doi: 10.1177/09697330221109937.
17. Biradar VG, Alqahtani MA, Nagaraj HC, Ahmed EA, Tripathi V, Botto-Tobar M, Atiglah HK. An effective deep learning model for health monitoring and detection of COVID-19 infected patients: an end-to-end solution. Comput Intell Neurosci. 2022;2022:7126259. doi: 10.1155/2022/7126259.
18. Jin S, Liu G, Bai Q. Deep learning in COVID-19 diagnosis, prognosis and treatment selection. Mathematics. 2023;11(6): 1279. doi: 10.3390/math11061279.
19. Islam MS, Al Farid F, Shamrat FMJM, Islam MN, Rashid M, Bari BS, et al. Challenges, issues and future recommendations of deep learning techniques for SARS-CoV-2 detection utilising X-ray and CT images: a comprehensive review. Peer J Comput Sci. 2024;10: e2517. doi: 10.7717/peerj-cs.2517.
20. Tan L, Yu K, Bashir AK, Cheng X, Ming F, Zhao L, Zhou X. Toward real-time and efficient cardiovascular monitoring for COVID-19 patients by 5G-enabled wearable medical devices: a deep learning approach. Neural Comput Appl. 2023;35(19):13921-34. doi: 10.1007/s00521 -021-06219-9.

21. Ho SS, Chuah ASF, Ho VS, Rosenthal S, Kim HK, Soh SSH. Crisis and emergency risk communication and emotional appeals in COVID-19 public health messaging: quantitative content analysis. J Med Internet Res. 2024;26:e56854. doi: 10.2196/56854.
22. Peter N, Donelle L, George C, Kothari A. Equity-informed social media COVID-19 risk communication strategies: a scoping review. BMJ Open. 2024;14(8):e085630. doi: 10.1136/bmjopen-2024-085630.
23. Wangpitipanit S, Lininger J, Anderson N. Exploring the deep learning of artificial intelligence in nursing: a concept analysis with Walker and Avant's Approach. BMC Nurs. 2024;23(1):529. doi: 10.1186/s12912-024-02170-x.
24. Hassanein S, El Arab RA, Abdrbo A, Abu-Mahfouz MS, Gaballah MKF, Seweid MM, et al. Artificial intelligence in nursing: an integrative review of clinical and operational impacts. Front Digit Health [Internet]. 2025 Mar 7 [cited 2025 Nov 13];7::1552372. Available from https://doi.org/10.3389/fdgth.2025.1552372
25. Donabedian A. Evaluating the quality of medical care. 1966. Milbank Q. 2005;83(4):691-729. doi: 10.1111/j.1468-0009.2005.00397.x.
26. Sacco G, Lléonart S, Simon R, Noublanche F, Annweiler C, TOVID Study group. Communication technology preferences of hospitalized and institutionalized frail older adults during COVID-19 confinement: cross-sectional survey study. JMIR mHealth uHealth. 2020;8(9):e21845. doi: 10.2196/21845.
27. Park SH, Hong SH, Kim K, Lee SW, Yon DK, Jung SJ, et al. Nonpharmaceutical interventions reduce the incidence and mortality of COVID-19: a study based on the survey from the international COVID-19 research network (ICRN). J Med Virol. 2023;95(2):e28354. doi: 10.1002/jmv.28354.
28. Ahmed N, Rony RJ, Sinha A, Ahmed MS, Saha A, Khan SS, et al. Risk communication during COVID-19 pandemic: impacting women in Bangladesh. Front Commun. 2022;7:878050. doi: 10.3389/fcomm. 2022.878050.
29. Madahana MC, Khoza-Shangase K, Moroe N, Mayombo D, Nyandoro O, Ekoru J. A proposed artificial intelligence-based real-time speech-to-text to sign language translator for South African official languages for the COVID-19 era and beyond: in pursuit of solutions for the hearing impaired. S Afr J Commun Disord. 2022;69(2):e1-11. doi: 10.4102/sajcd.v69i2.915.
30. Sangprapai N. Experiences of professional nurses caring for COVID-19 patients at Ban Phraek Hospital. J Health Environ Educ.2023;8(1):118-31. Available from: https://so06.tci-thaijo.org/index.php/hej/article/view/261977/176520 (in Thai).
31. Gopichandran V, Sakthivel K. Doctor-patient communication and trust in doctors during COVID 19 times—a cross-sectional study in Chennai, India. PLoS One. 2021;16(6):e0253 497. doi: 10.1371/journal.pone.0253497.
32. Creswell JW, Creswell JD. Research design: qualitative, quantitative, and mixed methods approaches. 5th ed. Thousand Oaks (CA): Sage; 2018.
33. Iamsiriwong O. Management information systems. Bangkok: SE-ED Education; 2017.
34. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. Acad Med. 2014;89 (9):1245-51. doi: 10.1097/ACM.0000000000000388.
35. Urwongse K. Focus group discussion: effective qualitative data collection technique. STOU Educ J. 2019;12(1):17-30. Available from: https://so05.tci-thaijo.org/index.php/edjour_stou/article/view/182081 (in Thai).
36. Ministry of Public Health. Notification of the Ministry of Public Health: revocation of the notification concerning names and major symptoms of dangerous communicable diseases (No. 3), B.E. 2563. Royal Thai Govt Gaz [Internet]. 2022 Sept 20 [cited 2025 Feb 9];139 (Spec Part 223):1. Available from: https://ddc.moph.go.th/uploads/files/15620220926033355.PDF (in Thai).
37. Baker A, Simon N, Keshaviah A, Farabaugh A, Deckersbach T, Worthington JJ, et al. Anxiety Symptoms Questionnaire (ASQ): development and validation. Gen Psychiatr. 2019;32(6):e100144. doi: 10.1136/gpsych-2019-100144. Erratum in: Gen Psychiatr. 2020;33(2): e100144corr1. doi: 10.1136/gpsych-2019-100144corr1.
38. Nidhra S, Dondeti J. Black box and white box testing techniques—a literature review. Int J Embed Syst. 2012;2(2):29-50. doi: 10.5121/ijesa.2012.2204.

39. Kannasut P. Statistics for behavioral science research. 3rd rev ed. Bangkok: Chulalongkorn University; 1999. 335 p (in Thai).
40. Polit DF, Beck CT. Essentials of nursing research: appraising evidence for nursing practice. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2010.
41. Infectious Diseases Division, Faculty of Medicine Ramathibodi Hospital, Mahidol University. Basic knowledge of COVID-19: part 1. 2020 Mar 23 [cited 2025 Feb 9]. Available from: https://shorturl.at/zR457 (in Thai).
42. Commission on Information Technology, Communication, and Telecommunications, Senate. Lessons learned from the COVID-19 crisis in information technology: a summary report of the discussion. Bangkok: Commission on Information Technology, Communication, and Telecommunications, Senate; 2022. 72 p (in Thai).
43. Sonthiraksa T. Online medical communication in the COVID-19 era. J DMS [Internet]. 2021;46(1):252-5. Available from: https://he02.tci-thaijo.org/index. php/JDMS/article/ view/ 251896/171197 (in Thai).
44. Charoentham S, Rattanasirivongwuti M. Development of an intelligent business system for predicting the behavior of the working-age population leading to chronic non-communicable diseases. 18th National Conference on Computer and Information Technology (NCCIT 2022); 2022 May 19-20; King Mongkut's University of Technology North Bangkok. Faculty of Information Technology and Digital Innovation. Bangkok: King Mongkut's University of Technology North Bangkok; 2022 (in Thai).
45. Institute for Urban Disease Control and Prevention, Department of Disease Control, Ministry of Public Health, Thailand. The action plan for preparedness, prevention, and response to emerging infectious diseases (2023-2027). 1st ed. Bangkok: TS Interprint; 2023. 170 p (in Thai).

ระบบการสื่อสารเพื่อการดูแลผู้ป่วยโควิด-19 ด้วยเทคโนโลยีการเรียนรู้เชิงลึก

อารี ชีวเกษมสุข ศรันย์ นาคถนอม*

บทคัดย่อ : โรคโควิด-19 เป็นโรคติดเชื้อที่เกิดขึ้นใหม่ที่มีการกลายพันธุ์อย่างรวดเร็วจนทำให้การพัฒนายาหรือวัคซีนไม่ทันการณ์ และส่งผลกระทบต่อการสื่อสารแบบเผชิญหน้าในการดูแลผู้ป่วย การศึกษานี้ใช้วิธี exploratory sequential mixed methods ในประเทศไทย ดำเนินการผ่าน 3 ขั้นตอน เพื่อระบุอุปสรรคและความต้องการในการสื่อสาร พัฒนาระบบการสื่อสารสำหรับผู้ป่วยในโรงพยาบาลโดยใช้เทคโนโลยีการเรียนรู้เชิงลึก (Deep learning technology) และประเมินประสิทธิภาพของระบบ ระยะที่ 1 เก็บรวบรวมข้อมูลเชิงคุณภาพเพื่อวัตถุประสงค์เชิงพรรณนาด้วยการสนทนากลุ่ม (Focus group discussions) จากผู้เข้าร่วม 16 คน ซึ่งประกอบด้วยพยาบาล แพทย์ และผู้ป่วยโควิด-19 การวิเคราะห์ข้อมูลพบอุปสรรคทั้งเชิงโครงสร้าง กระบวนการ และผลลัพธ์ โดยพบอุปสรรค 4 ประเด็น และความต้องการสำหรับระบบการสื่อสาร 3 ประเด็น ระยะที่ 2 นำความต้องการเหล่านี้มาพัฒนาระบบการสื่อสารแบบสองทางเรียลไทม์โดยใช้เทคโนโลยีการเรียนรู้เชิงลึกและผ่านกลไกการตรวจสอบคุณภาพของระบบด้วยวิธี logistic regression classifier และระยะที่ 3 ทดสอบต้นแบบด้วยวิธีการเชิงปริมาณกับผู้ป่วย 39 คนและพยาบาล 70 คนจาก 4 โรงพยาบาลของรัฐ รวมทั้งผู้เชี่ยวชาญด้านเทคโนโลยีดิจิทัล 15 คน เครื่องมือประกอบด้วย แบบสอบถาม สนทนากลุ่ม ระบบการสื่อสารด้วยเทคโนโลยีการเรียนรู้เชิงลึก แบบวัดความวิตกกังวล (State-Trait Anxiety Inventory) และแบบประเมินคุณภาพ 2 ชุด

ผลการศึกษาแสดงให้เห็นอุปสรรคสำคัญในการสื่อสารทั้งด้านโครงสร้าง กระบวนการ และผลลัพธ์ ความต้องการสำคัญ 3 ประการ ได้แก่ ระบบสองทางเรียลไทม์ที่ใช้งานง่าย การสื่อสารความต้องการของผู้ป่วยอย่างเป็นระบบ และการตอบสนองได้ทันเวลาโดยใช้ระบบการสื่อสารที่พัฒนาขึ้นมีความแม่นยำร้อยละ 80 ช่วยให้การสื่อสารชัดเจน ลดความวิตกกังวลของผู้ป่วย และมีคุณภาพสูงกว่าระบบเดิม ในขณะเดียวกันก็มีข้อจำกัดสำหรับการเข้าถึงของผู้ป่วยเปราะบาง การเชื่อมต่อวายฟาย (Wi-Fi) ที่ไม่เสถียร และจำนวนกลุ่มตัวอย่างขนาดเล็ก ดังนั้นจึงต้องปรับปรุงการเข้าถึง ความเชื่อถือได้ และความสามารถในการขยายผลให้มากขึ้น

Pacific Rim Int J Nurs Res 2026; 30(1) 90-110

คำสำคัญ : การดูแล ระบบการสื่อสาร โควิด-19 เทคโนโลยีการเรียนรู้เชิงลึก การวิจัยแบบผสมผสาน การพยาบาล

ติดต่อที่ : อารี ชีวเกษมสุข* *รองศาสตราจารย์ สาขาวิชาพยาบาลศาสตร์ มหาวิทยาลัยสุโขทัยธรรมาธิราช E-mail: areecheeva@gmail.com*
ศรันย์ นาคถนอม *อาจารย์ สาขาวิชาวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยสุโขทัยธรรมาธิราช E-mail: saraun.nak@stou.ac.th*