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Development of a notification delivery specimen system for perioperative Thai nurses via the LINE application

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Abstract

Objective: The aim of the study was to develop and examine satisfaction in using a notification delivery specimen system for perioperative Thai nurses through the LINE application.

Methods: Design and development research was used in the study and 100 perioperative nurses were recruited from the three operating theatres in hospital settings in Thailand. Data analysis was performed using descriptive statistics.

Results: The overall satisfaction in using a notification delivery specimen system for perioperative Thai nurses through the LINE application was at the high level (M = 4.09, SD = 0.75). The perioperative nurses reported ease of use and safety scored high (M = 4.24, SD = 0.62), followed by sharpness of figures and the coloured light alert (M = 4.15, SD = 0.92), sending messages via LINE notification, and delivering the specimen quickly within the time period (M = 4.10, SD = 0.69).

Conclusion: The notification delivery specimen system, designed specifically for perioperative Thai nurses and integrated with the LINE application, yielded exceptionally high levels of satisfaction among users. These promising results suggest the potential for widespread adoption in various hospital settings in the coming years.

Keywords

Notification, delivery specimen system, perioperative Thai nurses, LINE application

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Introduction

Perioperative Thai nurses perform their professional service based on the four nursing perioperative nurse competencies. These are: (a) patient safety care, (b) physical care, (c) behavioural response patients care and (d) healthcare system.[1] According to patient safety care, the delivery and collection of the microbiological specimens for investigation to and from the laboratory within a time frame can be beneficial to the patient's clinical outcomes.[1] Microbiological examination comprises many types including blood, pus, throat swab, sputum, urine, faeces, tissue and other fluid from the human body.[2] The type of specimen, the appropriate time to obtain the sample, the method of sampling and the storage and transport are important points in the diagnosis process.[3] If all specimen delivery is delayed, it may affect cell deterioration and result in not achieving accurate diagnosis and effective treatment approaches. Consequently, it may affect the patient physically, mentally and financially. After specimen collection, the specimen has to be delivered in 1–2 h to prevent cell degeneration and result in an accurate diagnosis.[2]

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According to operating theatre No. 2, in the tertiary hospital in Southern Thailand, perioperative nurses are responsible for providing patient surgery services and managing frozen sections specimens for investigation using transportation by labour. This role is crucial and the specimen for collection needs to be sent to the laboratory promptly and correctly. The specimen's statistics in the setting hospital in 2021 included: culture (79.19%), cytology (15.12%), cerebrospinal fluid (3.38%) and parathyroid (1.58%).[4] However, there were four incidences of delaying specimen delivery (0.29%) between 6 and 12 h.[4] The main reason for errors included communication problems between the staff while changing the duty schedule. This was also related to the delivery method, for which, staff delivery in state pneumatic tube carrier system was used to prevent blockage and destroy microbiological specimens. Therefore, the researchers aimed to develop a notification delivery specimen system for perioperative Thai nurses via the LINE application in order to ensure that the process of sending specimens to the laboratory adheres to the specified timeline. Additionally, to expedite the delivery of frozen section results and inform physicians promptly.

Theoretical framework

Microbiological examination encompasses various specimen types, including blood, pus, throat swab, sputum, urine, faeces, tissue and other bodily fluids.[2] In the diagnostic procedure, the nature of the specimen, the optimal timing for sample acquisition, the methodology employed for sampling, as well as the protocols for storage and transportation, are of paramount importance.[3] Delays in specimen handling can lead to cell deterioration and inaccurate diagnoses. Therefore, researchers considered the development of innovations to help reduce the delay in microbiological examination results and ensure accurate diagnosis, which is crucial to role of the perioperative Thai nurses.

In the field of healthcare, notification systems, which are technology-based tools and processes used to deliver timely and critical information to healthcare professionals, have become increasingly important.[5] The development of this medical device prompted a review of the literature to assess its clinical efficacy. This assessment focused on several aspects, including usability, safety, cost-effectiveness, user confidence and device design.[6–8] The current study specifically examined four dimensions of clinical efficacy, which are: (a) usability: this relates to how user-friendly and practical the intervention or device is for both patients and healthcare providers. It evaluates whether the device or intervention can be easily incorporated into regular clinical practices without significant inconvenience or the need for extensive training, (b) safety: a crucial aspect in any medical setting. This dimension assesses the risks associated with the intervention or device, looking at potential side effects, complications or other adverse events, (c) cost-effectiveness: this dimension concerns value for money. If the intervention or device provides significant benefits in relation to its costs, it is not only about being low-cost; it is about being economical, while still delivering the desired outcomes and (d) device design: this might relate to the physical design, ergonomics and functionality of a medical device. It can also involve the technical aspects, durability and other features that make the device effective and user-friendly.[6–8] To enhance the quality of healthcare, a specimen notification device was developed with the aim of improving clinical efficiency.

Methods

This study employed a design and development research approach. It was conducted in three operating theatres within a hospital setting in Southern Thailand.

Study sampling

The samples were selected purposively based on the following inclusion criteria: (a) experienced as perioperative nurse 1 year and over, (b) able to communicate, read and write in Thai and (c) be able to provide informed consent. The sample size was estimated for the study and determined using Krejcie and Morgan,[9] as this method helps in ensuring that the sample size is statistically valid. This is essential for drawing meaningful conclusions from the data and reducing errors. Based on the Krejcie and Morgan[9] table for determining sample size, with a total population of 120 perioperative nurses, the recommended sample size for the study is 92 participants. Based on Grove and Ciphe's recommendations,[10] researchers should identify a sufficiently large accessible population to compensate for potential refusals. With a refusal rate of 10% factored in, the study achieved a sample size of 100.

Instrument

There were two instruments used for data collection in this study including: (a) personal characteristics questionnaire and (b) the satisfaction in using a notification delivery specimen system questionnaire (SUNDSSQ). The personal characteristics questionnaire included age, gender, religion, position and experience of working in operating theatres. The satisfaction of using a notification delivery specimen system questionnaire was developed by the researcher based on the literature review.[11–13] The researchers, based on theoretical understanding, identified these four areas as key components to thoroughly evaluate and understand clinical efficacy in specific context. Therefore, this questionnaire consists of the 4 dimensions of clinical efficacy assessment, including 12 items. The details of the four dimensions were (a) usability 4 items (items 1–4), (b) safety 1 item (item 5), (c) cost-effectiveness 1 item (item 6) and (d) device design 6 items (items 7–12).

The questionnaire has a five-point Likert-scale ranging from 1 (lowest) to 5 (highest). The level of satisfaction in using a notification delivery specimen system in this study was categorised as highest (4.51–5.00), high (3.51–4.50), moderate (2.51–3.50), low (1.51–2.50) and lowest (1.00–1.50). The content validity of the SUNDSSQ was reviewed by a team of three experts. The two experts are professors of nursing at the Faculty of Nursing and the Faculty of Engineering, Prince of Songkla University and one expert is a perioperative Thai nurse, Songklanagarind Hospital. The experts accessed the content to determine whether the projects were accurate, appropriate and consistent. Based on the opinions of the three experts some amendments were made to the questionnaire. The content validity index (CVI) value of the SUNDSSQ is 10, and this is considered as an acceptance value (>0.8).[14] The Cronbach's alpha coefficient of the SUNDSSQ scale was 0.87.

Data collection procedure

The study was divided into two phases. In the first phase, the researcher engaged in the development of the notification delivery specimen system for perioperative Thai nurses through the LINE application from March to June 2022. Figure 1 shows the notification delivery specimen system. The notification delivery specimen system consists of: number 1, which is shaped like a box with a geometrical cross-sectional area, the number 2 that features a light emitting diode (LED) screen showing time intervals, number 3, which is a system on and off button, number 4 is a cylindrical light, number 5 is a power cord socket, number 6 is the main electronic control and processing unit of the device and number 7 is a unit for transmitting and receiving data via a wireless internet network (WIFI) (Figure 2).

Figure 2 illustrates the notification delivery specimen system dispatch with the following steps:

Step 1: Press the button (number 3) to send a signal to the control and processing unit (number 6). This activates the notification device for the specimen dispatch for perioperative nurses via the wireless network to start working. The control and processing unit (number 6) then commands the display section (number 2) to show the countdown time starting from 30:00 min. The control and processing unit (number 6) also instructs the status indicator light (number 4) to flash in green, indicating that the specimen is ready to be sent to the laboratory. The control and processing unit (number 6) instructs the wireless signal transmitter (number 7) to send a notification from the device notifying the perioperative nurses about the specimen for dispatch through the wireless network to the user's mobile phone. This indicates that the specimen is ready to be sent to the laboratory. The user is prompted to collect the specimen at the designated point, with a message displayed on their mobile phone stating, 'OR: There is specimen'.

Step 2: If the user collects the specimen at the designated point, he/she presses the button (number 3) again to send a signal to the control and processing unit (number 6). This command causes the specimen notification device for perioperative nurses via the wireless network to cease operation and concludes the process. If no user collects

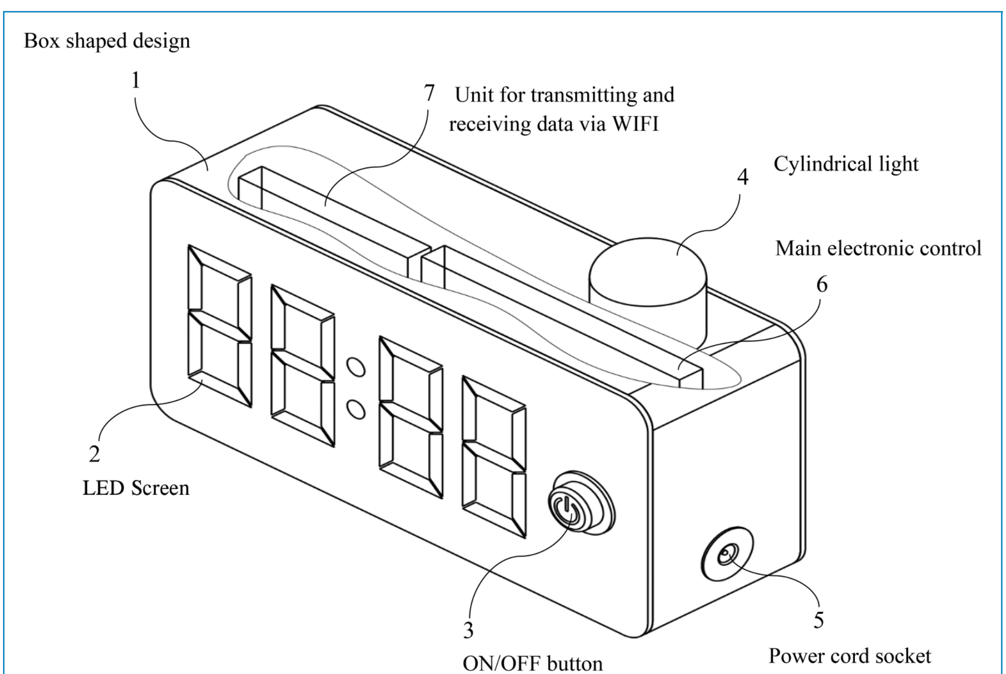

Figure 1. External components of the notification delivery system.

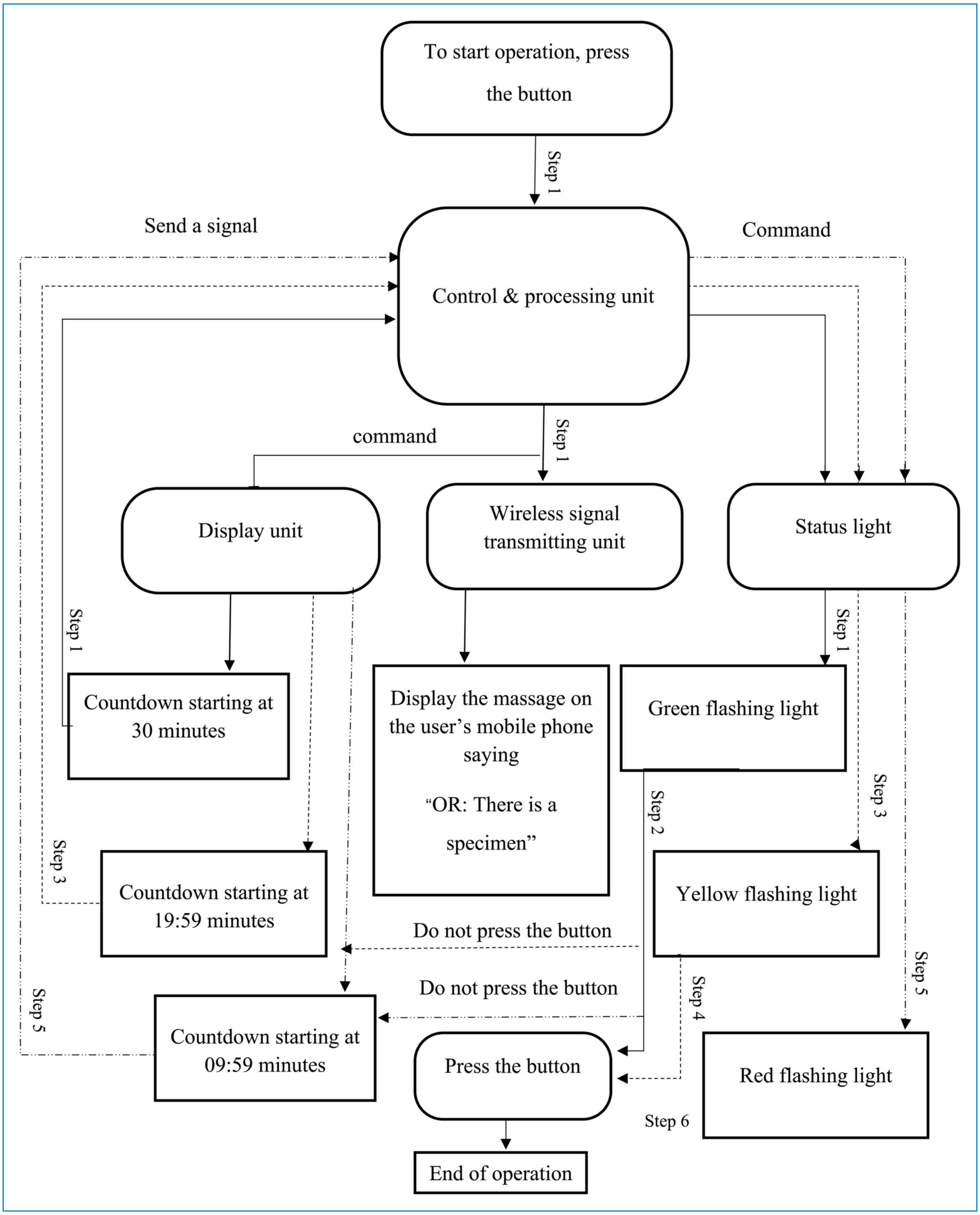

Figure 2. Operational mechanism of the notification delivery system.

the specimen at the designated point, the specimen notification device for perioperative nurses through the wireless network will proceed to Step 3.

Step 3: As the specimen notification device for perioperative nurses via the wireless network operates for 10 min, the display unit (number 2) shows a countdown timer at 19:59 min. The control and processing unit (number 6) instructs the status light (number 4) to blink in yellow, indicating that the specimen has still not been taken to the laboratory.

Step 4: If the user collects the specimen at the designated point, they press the button (number 3) again to send a signal to the control and processing unit (number 6). This command causes the specimen notification device for

perioperative nurses via the wireless network to cease operation and conclude the process. If no user collects the specimen at the designated point, the specimen notification device for perioperative nurses through the wireless network will proceed to Step 5.
Step 5: As the specimen notification device for perioperative nurses through the wireless network operates for 20 min, the display unit (number 2) shows a countdown timer at 09:59 min. The control and processing unit (number 6) instructs the status light (number 4) to blink in red, indicating that the specimen has still not been taken to the laboratory and should be delivered immediately.
Step 6: If the user collects the specimen at the designated point, they press the button (number 3) again to send a signal to the control and processing unit (number 6). This command causes the specimen notification device for perioperative nurses via the wireless network to cease operation and concludes the process. If no user collects the specimen at the designated point, the status light (number 4) continuously blinks in red to indicate that the specimen has still not been taken to the laboratory and should be delivered immediately (Figure 2).

In phase two, the researcher executed a trial of the aforementioned notification delivery specimen system for perioperative Thai nurses through the LINE application, establishing a testing period of three months (July to September 2022) to examine the functionality of the apparatus. Following the completion of the testing phase, the questionnaires were designed to examine satisfaction in using a notification delivery specimen system for perioperative Thai nurses in October. Ethical approval was obtained from the Office of Human Research Ethics Unit (REC.65–082-19-2 on March 12, 2022) Medicine Department, Prince of Songkla University, Thailand. In the study, researchers maintained the principle of respect for human dignity through a full explanation of information about the nature of the research such as objectives, procedures, risks and benefits of research to participants who were willing to participate. Verbal and written informed consent were obtained and researchers explained to participants that they could withdraw from the study at any time and were allowed to ask questions during data collection.

Data analysis

Data analysis was performed using BM SPSS Statistics Base Concurrent user lic. Before data checking was performed no missing data was revealed. The sociodemographic and satisfaction in using a notification delivery specimen system via the LINE application were analysed by descriptive statistics consisting of frequency, percentage, mean and standard deviation.

Results

A total 100 perioperative nurses were included in the study. The majority were female (82%). Participants were aged between 22 and 60 years old (M = 35.42, SD = 9.34). The majority were Buddhist (80%) followed by Muslim (18%). The perioperative nurses had between 1 and 38 years of experience (M = 10.75, SD = 9.29) (see Table 1). The overall satisfaction of using a notification delivery specimen system for perioperative Thai nurses via the LINE application was at the high level (M = 4.09, SD = 0.75). The perioperative nurses reported that ease of use and safety were high (M = 4.24, S.D = 0.62), followed by sharpness of figures and notification light (M = 4.15, SD = 0.92), and efficiency and promptness of messaging and specimen delivery (M = 4.10, SD = 0.69), respectively (see Table 2).

Discussion

The study shows that the developed notification delivery specimen system for perioperative Thai nurses through the LINE application showed high satisfaction results (M = 4.09, SD = 0.75). It was developed and invented using in-depth information such as statistical data from stakeholders who face this issue. In addition, the device has been tested by experts and has passed preliminarily checks for quality before being used in this study. Therefore, the device helps to solve problems systematically and no errors were found, with specimen deliver at 100%. This approach ensures that the specimen's integrity is maintained and reduces the chances of specimens being misplaced, delayed or lost.

The results also show that each aspect found (a) ease of use and safety were at the high level (M = 4.24, SD = 0.62), (b) a sharpness of figures and notification light was at the high level (M = 4.15, S.D = 0.92) and (c) suitability of the display was at the high level (M = 4.11, SD = 0.91). In contrast, several studies highlighted that there is a rising trend among hospitals to incorporate automated transportation systems. These can either be in the form of pneumatic tube transportation systems (PTS)[15] or alternatives like electric track vehicles.[16] Such systems not only seamlessly integrate with the laboratory's in-house sample reception but also encourage wards to dispatch their samples in a timelier manner. This, in turn, ensures the laboratory adheres to the first in, first out (FIFO) principle, promoting rapidity, unidirectional flow and high throughput. Nonetheless, this system introduces challenges that necessitate consideration by laboratory experts. It is crucial to emphasise that the information pertaining to the test request should be present at the laboratory upon the sample's arrival. This signifies that electronic requisitions prove more streamlined than their paper-based counterparts. When samples and test request information are transported separately, particularly with paper requisitions, it results in additional delays in processing the specified

Table 1. Characteristics of users.

User characteristics	n (%)
Age	
18–29	23 (23)
30–39	45 (45)
≥40	32 (32)
Min = 22, Max = 60, Mean = 35.42, SD = 9.34	
Gender	
Female	82 (82)
Male	18 (18)
Religion	
Buddhism	80 (80)
Islam	18 (18)
Christianity	2 (2)
Position	
Registered nurse	84 (84)
Specialized professional nurse	16 (16)
Experiences	
≤10	57 (57)
11–29	38 (38)
30–39	5 (5)
Min = 1, Max = 38, Mean = 10.75, SD = 9.29	

Table 2. Domain of satisfaction context.

Satisfaction items	Mean	SD	Level
1. Efficiency and promptness of messaging and specimen delivery	4.10	0.69	High
2. Suitability for use	4.03	0.64	High
3. Sharpness of figures and notification light	4.15	0.92	High
4. Ease of use	4.24	0.62	High
5. Safety	4.24	0.62	High
6. Low cost	4.04	0.82	High
7. Appropriateness of size, shape and weight	4.09	0.75	High
8. Suitability of display	4.11	0.91	High
9. Appropriateness of material	4.07	0.64	High
10. Strength	3.88	0.86	High
11. Appropriateness of design, such as appearance and modernity	4.02	0.74	High
12. Overall satisfaction	4.09	0.75	High

analysis. Such delays frequently culminate in the need for resampling and initiate extensive tracing efforts, burdening both the wards and the laboratory. Consequently, for an automated sample reception system to function optimally, test requests must be managed electronically.[17]

Particularly, the microbiological laboratory must be notified in advance to prepare all the necessary materials and move to the immediate vicinity of the restricted access area since a pneumatic tube system should never be used to send these samples as they cause obstacles.[3,17] This study shows that a notification delivery specimen system was able to send the alarm immediately direct to the users LINE application and help them to manage their work duties effectively. Therefore, the device assists the nursing staff to manage and improve their responsibility related to supervision of specimen delivery safely within a time frame.

Limitations and future work

Constraints related to time and sample size potentially influenced the accuracy of this study. Replicating this research with a larger sample across various settings in Thailand would be beneficial. Additionally, future research should explore and contrast various specimen delivery systems.

Conclusion

The developed notification delivery specimen system for perioperative Thai nurses through the LINE application showed high satisfaction results. Such delays frequently culminate in the need for resampling and initiate extensive tracing efforts, burdening both the patients and healthcare providers. Therefore, this system is efficient, enhancing the quality of operating theatre units. It reduces delays in sending the microbiological sample and minimises errors, leading to more accurate disease diagnosis by physicians.

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Contributorship: KY, TK, MK and BS were involved in the study design. TK and KM designed the device. KY and BS collected the data. KY analysed the data and drafted the manuscript. All authors revised the manuscript.

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