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Assessing the Early Stage of eHealth Adoption:
A Case Study From a Community Hospital in Thailand

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ABSTRACT

In this paper, the authors implement and determine the success the eHealth adoption for queue management when it was first deployed for a community hospital setting in Thailand. The electronic queue system was first implemented to improve conventional operations; then extensive evaluations were conducted to measure the effectiveness for each stakeholder. The healthcare staff shared a common perception that the new system could reduce their workload and increase the efficacy of queue fairness. The overall patient satisfaction and actual waiting time patients spent at the nurse interview station improved significantly. The majority of the patients agreed that the notification for attention from the computerized system is more effective. The community healthcare has strong potential to adopt the eHealth system. Being more automated enabled a reduced burden of administration jobs and significantly reduced waiting times for patients. Patients responded that they had greater satisfaction after the introduction of the electronic queue system.

KEYWORDS

Community Hospital, eHealth, Health Information Technology, Patient Queue Management

INTRODUCTION

The use of Health Information Technology (HIT) has resulted in big impacts on the efficiency of care in hospitals (Buntin et al., 2011). Systematic reviews of eHealth evaluations also show promising benefits for developing countries (Blaya et al., 2010). In Thailand, the Ministry of Public Health (MoPH) considers that eHealth can improve efficiency of the healthcare national service. The

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present ministry encourages more adoption of HIT in order to deliver significant benefits in three areas: time saving, providing insights into patients' health, and lowering the administrative burden (Witoolkollachit, 2017).

There is little academic literature that relates to the experiences and insights of eHealth deployment in a real working environment, and the evidence from a survey of eHealth evaluation reveals that many articles "lacked any evaluation of their concrete application to health care" (Blaya et al., 2010). Several current research studies explore the eHealth adoption of healthcare from a third-person perspective by investigating the success after deployment where most implementations are well established. Ahmadi et al. (2015) investigated the adoption factors through the lens of experts. Jha et al. (2008) evaluated the role and the progress of information technology application applied in healthcare sectors in seven industrialized nations from literature reviews and expert interviews. Additionally, there were previous studies to understand user perceptions to adopt eHealth in a developing country from the viewpoint of healthcare staffs (M. D. R. Hoque et al., 2016; Kijsanayotin et al., 2009) and patient (M. R. Hoque et al., 2017). The readiness to foster eHealth under the consideration of knowledge, attitude, and practice of staff in a medical school setting is also explored (Sadoughi et al., 2017).

This research conducts a usability evaluation of the deployed eHealth project at a community hospital employing a holistic assessment approach.

The eHealth solution employed for this project is an electronic queue system to replace the existing manual system. Effective queue management in hospitals is vital, because wait times are highly associated with patient satisfaction (Anderson et al., 2007; Campbell, 1994). Most healthcare providers seek to optimize their processes to increase system efficiency. The alteration of the process to reduce operational time is difficult (for example, resource constraints or a change in process might mean a trade-off with quality of services). However, such issues can be dealt with by managing perceived wait times of patients by enhancing emotional response to the wait by remedying the patients' experiences instead (Chien & Lin, 2015). In Chien and Lin (2015), both actual times and perceived times spent waiting were measured and analyzed for the before/after scenario to evaluate the efficiency of the electronic queue system.

THE CASE STUDY

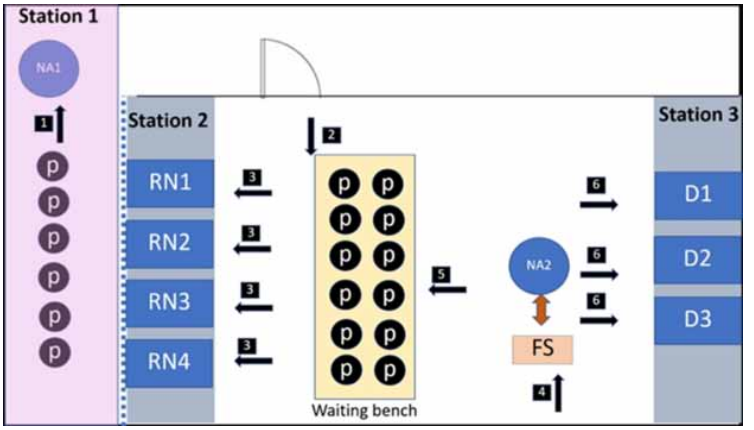
This research was conducted in cooperation with the Non-Communicable Disease (NCD) clinic at Kohka Hospital, Lampang Province in Thailand. Kohkha Hospital is a 120-bed community hospital that serves the local population. With a high volume of NCD patients, and because the nature of the treatment requires patients to revisit the clinic regularly, the hospital operates the clinic independently from the Out-Patient Department (OPD). Most of the procedural operations are manual and paper based. Figure 1 depicts the general environment of the clinic. The clinic serves approximately 100–200 patients each day. For each visit, patients are required to attend three stations, which are prescreening, nurse interview and doctor examination. Figure 2 outlines the conventional system used before the introduction of the electronic.

METHODS

The study was conducted in two major phases, which were: 1) implementation phase and, 2) evaluation phase. The purpose of implementation, in addition to supporting the digital transformation for the hospital, was to control the environment of the study so that an "exact" early evaluation could be conducted. The study employed several measurements and approaches to assess all possible aspects from the stakeholders, which are doctors, nurses, nurse aides, and patients. The parameters included in this research are: ac from medical staff, operational efficiency, and patient satisfaction system. The clinic has doctors (D), registered nurses (RN), and nurse aides (NA). There are roughly six steps that patients are required to go through. First, a patient (P) presents him/herself to the NA to obtain a

Figure 1. General environment of the clinic

Figure 2. Outline of the conventional system used before the introduction of the electronic



handwritten queue slip. The NA who is in charge of this station measures the patient's vital signs and inspects previous medical records to prescreen patients who need to see a doctor urgently or require a further laboratory test. The prescreening removes a patient from the standard flow.

Second, a patient is then sent to Station 2 to be interviewed by a registered nurse (RN). There are currently three to five active registered nurses on duty each day, and a patient is only required to meet with one of them. After entering the station area, a patient is required to sit on the waiting bench provided. The position of the bench implies the order of the queue, so a patient can only sit next to the patient who is in the previous queue position. The queue in this room is self-organizing, which means a patient who is sitting in the first position of a queue can present to one of the nurses directly. Thus, in the third step, when a patient notices the availability of one of the RNs, s/he can present him/herself to a nurse for an interview. After the interview is finished, the patient proceeds to the fourth step, carrying a medical chart to enter the Station 3 area, where the patient is required to put his/her medical chart on the provided shelf. At the fifth step, a patient is required to wait to be called. The NA who administers this station precedes the patient to the allocating doctor and informs the patient which examination room (doctor) to visit. The queue system at this station is, again, patient

administered. Finally, in the last (sixth) step, the patient watches the previous queue to know when to enter the examination room, and does so promptly, when the previous patient leaves the room.

IMPLEMENTATION PHASE

The research began with implementing the electronic queue system, taking the concerns of the hospital into consideration. The hospital wanted to ensure that the new system would avoid any radical changes to the current operational flow that might frustrate elderly patients who were already familiar with the system.

The implementation process adopted the User Centered Design (UCD) philosophy in a similar vein to the study done by Wilkinson and De Angeli (2014). At the beginning of this project, the team focused on conducting a user research to study the existing operations and requirements of the hospital. Semi-structured interviews and contextual observations were the primary tools the team utilized. For the User Interface (UI) design, the study took into consideration that the majority were NCD patients.

The new system needed some modifications to the existing flow of patients. The significant changes, which affected how the conventional system was operated, were:

- Handwritten queue paper was replaced by a printed queue number generated from a kiosk.
- Patients could only present to a clinician when they were called to do so.
- The staff announcement, which notified the patients of their queue number, was replaced by a computer-based on-screen notification, and the call was made by an audio system.

After the system implementation was finished, the new system allowed the nurse to interact with the UI to call patients for a medical interview for evaluation. The visual UI of this system is displayed on a large monitor allocated in the waiting area shown in Figure 3. From the UI shown in Figure 4, a user is required to click the "A" button to signal a patient to the next station, and then double click "B" to call the next patient. A user can assign a flag by hovering the mouse over the "C," then specifying the status of each patient. Additionally, the queue of this application is unique in that it requires the ability to visualize a queue for multiple service points on a shared screen.

Figure 3. Visual UI of this system is displayed on a large monitor allocated in the waiting area

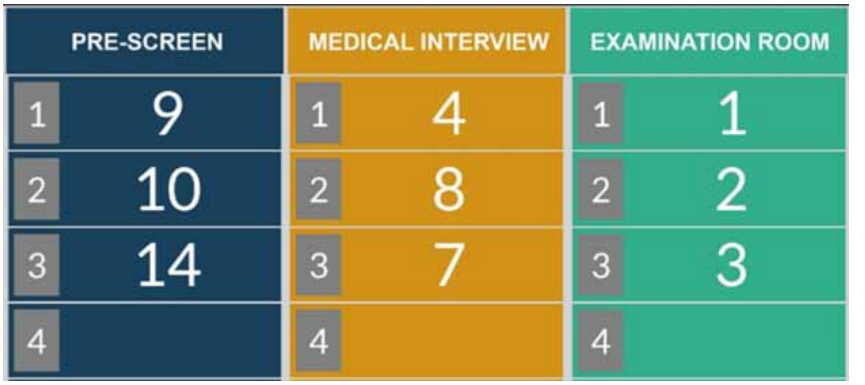
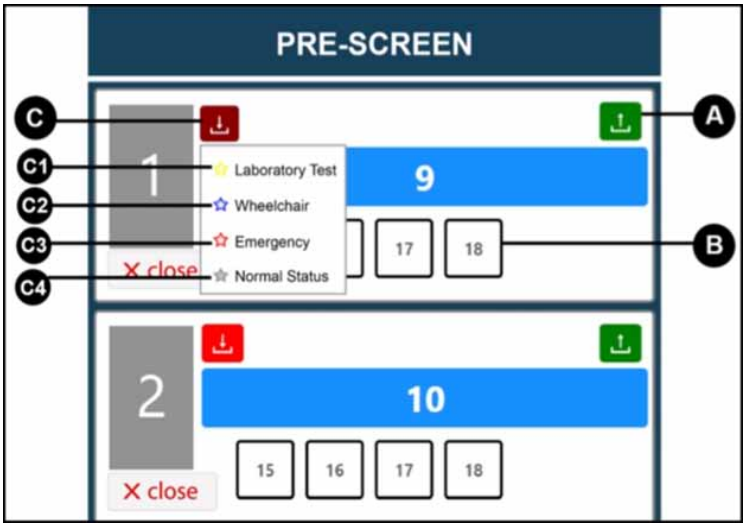


Figure 4. Pre-screen



EVALUATION PHASE

Investigating the User Experience After eHealth Adoption and Impacts to the Healthcare Operation

Three assessments were conducted as follows.

Medical Staff Feedback

A reflective session was organized at the end of the first day of deployment. Medical staff included two doctors, three registered nurses, and two nurse aides that experienced using the new system were encouraged to give open feedback by speaking out a few sentences about their experience after using the system. Thematic analysis, which is a technique to structure qualitative data to the theme (Tomitsch et al., 2018), was used to generate themes from common feedback.

Patient Satisfaction

Surveys were conducted to investigate patient satisfaction from two groups, which were patients who had participated in the system before (n = 44), and patients who participated after implementation (n = 59). In both surveys, patients were asked to rate using a 5-scale satisfaction rating to answer the question: "How do you rate your satisfaction (from 1-5) for the service today?" A survey was conducted after implementation adding a further two questions: "How do you like/dislike the new queue system?" and "Why do you like/dislike the new system?

Operational Efficiency

The study measured two timing quantities that affect patient satisfaction, which are actual time and perceived time spent waiting for a doctor's examination. A satisfaction evaluation of before/after deployment was also conducted. Before the deployment, the actual operation times were measured and determined by recording the time that a patient first arrived at each of the service points. After the deployment, the actual time was tracked from the service logs of the backend system, while the perceived times were surveyed again. Perceived time was measured by the subjective time that a patient approximated in minutes, how long they had spent waiting at each station. A short interview was conducted with each patient when they left the doctor examination rooms.

EVALUATION RESULTS

The results from conducting a focus group with staff that experienced the new system showed that the staff mostly felt an improvement using the new system. The common perception was that the new system could reduce the workload and increase the queue fairness. The system could be made more user friendly if it was integrated into the main system of the hospital. Feedback from thematic analysis revealed common opinions as illustrated in Table 1.

Soon after the deployment was finished, a survey was made of 59 patients who were familiar with the traditional system. They were asked to evaluate their first experience of using the new system compared to the conventional system. Fifty-five patients indicated that they liked the new system, and only two patients disliked it, preferring the conventional system. A further two patients had neutral opinions. When exploring the reasons for preferring the electronic system over the conventional system, the majority of patients thought the notification features of the new system (i.e. an electronic screen to visualize the queue and audio to verbally call the queue), were more effective than the conventional system, which required medical staff to call patients. Other reasons included: reducing stress caused by the concern that someone might jump the queue; feeling more peaceful; and feeling more freedom to do other activities during the wait (for example, going to toilet). However, the two patients who preferred the conventional process mentioned the interesting point that staring for the queue number on the screen is more stressful, and a human call was more preferable because it was clearer.

A simple linear regression was calculated to predict the satisfaction scores from patients before and after implementing the queue system, as shown in Table 2 . A significant regression equation

Table 1. User Feedback

Heading	User Feedback
Workload Reduction	Nurse aide 1: “I think that the new system is good, because it can reduce my workload. I was usually required to prepare the queue, sometimes I had to do it at home. I felt worried if I could not manage to finish all the preparations before the clinic opened”
	Nurse aide 2: “Pretty good…. Normally, I had to spend a lot of time organizing the queues, I had to use my voice a lot”
	Nurse 1: “Usually I had to help organize patients who were not sitting in place…… Today, I don’t have to worry about anything”
	Nurse 2: “In my gut feeling, I feel we have fewer jobs. It is so quiet day”
	Doctor 1: “I like it {the new system}, when I made a mistake calling the wrong patient, I can edit my call…. I had no problem with the trade-off that I have to manage an extra screen { when I am in an exam room}”
Fairness	Nurse 3: “Our queue is fairer. Those who do not pay attention to the queue and lets the call passed has to accept that s/he has to wait”.
	Doctor 2: “Good... I personally don’t like it when someone jumps the queue. This {new} system is straightforward”
Suggestion	Doctor 2: “The only disadvantage is the {new} system operates independently from the HosXp (the main system) which requires opening another application to control the queue.”

Table 2. A comparative result of user satisfaction before and after e-health deployment

Satisfaction	Before	After
	4.1364 (n=44)	4.551 (n=59)

was found (F (1, 91) = 3.973, p < 0.05), with an R^2 of 0.042. Average scores before and after implementing the system are 4.136 and 4.551, respectively.

The impact of wait time reduction was studied and is shown in Table 3. The wait times before and after implementing the queue system was compared using the Mann-Whitney U-test. It was found that the actual wait time at the nurse interview unit was reduced significantly (p<0.005). However, there were no clear improvements for the perceived time. In other word, patients did not feel the wait times were shorter than before implementation.

The study failed to measure wait times at the pre-screening station, because the arrival time of patients could not be determined, with many patients arriving at the clinic very early (e.g. 5.00 p.m.) before the clinic opened at 8.00 p.m.

DISCUSSION AND CONCLUSION

The electronic queue system this study proposes not only satisfies the patients who mostly agree that the calling process made by an electronic system is more effective, but it also delivers benefits to the healthcare staff. For example, it facilitates reducing tedious and labor-intensive tasks that the healthcare staff was committed to in using the conventional system, such as preparing a daily handwritten queue-numbering system and calling tasks.

The informal conversations with the clinicians revealed that the new workflow empowered them in calling patients. These benefits of the new system helped clinicians to feel more comfortable than with the conventional system. For example, a patient sometimes presented to them before they finished seeing other patients.

The efficiency measurement indicated that the electronic queue system could reduce the patients' actual wait times at the nurse visit station. This was because the nurses could focus on the patient interview without leaving the station to help organize the queue. Moreover, the new system showed no negative impact at the doctor examination station, which implies a positive outcome in that the new system does not interfere with the routine of the doctors when they are seeing patients.

Finally, it is interesting to note that patients did not perceive that time spent waiting was reduced. They agreed that the electronic system was more preferable in the sense that the system provided a means to show the progress of the queue more clearly, and provided a clearer message to notify patients than the call made by a member of the staff. However, some patients did not feel relaxed when they concentrated on staring at the screen to monitor the queue.

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Table 3. Comparison of waiting time before and after the electronic system is deployed

	Actual Waiting Time (mins)			Perceived Waiting Time (mins)		
	Before	**After**	**P-values**	**Before**	**After**	**P-values**
Nurse Interview Unit	20 (n=23)	7 (n=59)	<0.05	52.5 (n=42)	30 (n=49)	0.62
Doctor Exam	46 (n=40)	46 (n=59)	0.85	10 (n=42)	10 (n=49)	0.24

implemented. The researchers are most thankful to the Upper Northern Research Administration Network, Office of the Higher Education Commission in Thailand, which provided support for the project from the beginning to the end of the pilot testing.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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