Barcode Scanning Technology to Improve Pre-dispensing Errors

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Abstract:

Background: Unsafe medication practices and medication errors are leading causes of avoidable harm in health care systems across the world. Medication errors occur when weak medication systems and/or human factors. World Health Organization (WHO) suggests using computer technology to improve safety at all levels of healthcare. Pre-dispensing errors incident at Mae Fah Luang University Medical Center Hospital was higher than other university hospital that led to dispensing errors.

Objective: To describe handheld computer improving pre-dispensing errors.

Materials and Methods: This research was prospective and quasi-experimental study. This study was divided into 2 phases; the first phase was the development and run-in with handheld computer. The second phase was the effectiveness before and after study using handheld computer for packing.

Results: Handheld computer could reduce pre-dispensing errors caused by handling wrong drug, wrong dosage form and wrong strength of medicines as compared with those using traditional methods significantly (p-value < 0.01). This was a statistically significant reduction of the errors from 41.7% to 26.4% especially in look-alike, sound-alike (LASA) drugs 8.3% to 2.8%. Two errors were found because of the returned medication in the wrong location and pharmacist assistant not using the handheld computer. Median outpatient waiting time was decreased from 11 minute to 9 minute. The satisfaction of users was statistically significant with an increase from moderate to high level of the average scoring (3.2 to 3.8) (p-value = 0.03).

Conclusion: The study showed that barcode scanning technologywith handheld computer could help reduce medication errors, especially LASA drugs. Furthermore, this technology could improve efficacy and patient safety other than the use of barcode scanning system by pharmacist and barcode medication administration (BCMA) by nurse

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Introduction

Global Patient Safety Challenges identify patient safety burden that poses significant risk to health, then develop frontline interventions and partner with countries to disseminate and implement the interventions. Each Challenge focuses on topic that poses major and significant risk to patient health and safety. WHO provides leadership and guidance in collaboration with Member States, stakeholders and experts, to develop and implement interventions and tools to reduce risk, improve safety and facilitate beneficial change. Unsafe medication practices and medication errors are leading causes of avoidable harm in health care systems across the world. The scale and nature of this harm differs between low-, middle- and high-income countries. Globally, the cost associated with medication errors has been estimated at US$ 42 billion annually. Medication errors occur when weak medication systems and/or human factors such as fatigue, poor environmental conditions or staff shortages affect prescribing, transcribing, dispensing, administration and monitoring practices, which can then result in severe harm, disability and even death.[1]

Implementing system changes and practices are crucial to improve safety at all levels of healthcare. Recognizing the paucity of accessible information on primary care, World Health Organization (WHO) set up a Safer Primary Care Expert Working Group. The Working Group suggests using clinical pharmacists, computer technology and educational programmes, often within multifaceted interventions such as medication reviews and reconciliation.[2]

Several types of information technologies can be used to decrease rates of medication errors. Computerized physician order entry with decision support significantly reduces serious inpatient medication error rates in adults. Other available information technologies that may prove effective for inpatients include computerized medication administration records, robots, automated pharmacy systems, barcoding.[3]

Barcodes are simple, universal and low cost, which makes them the most common form of auto-identification and data capture. Barcodes and scanning technology systems implemented in the medication management process in Mae Fah Luang University Medical Center Hospital for decrease medication errors is limited. The most common initiatives are the use of barcode scanning technologies can be used from medication dispensing. In the packing process, scanning technology is the use of machine-readable codes with standard terminologies, and is also known as, auto-identification and data capture with handheld computer (Zebra® the Wi-Fi/cellular TC26) connect to Hospital information system improving pre-dispensing errors.

Materials and Methods

This research was a prospective and quasi-experimental study. This study was divided into 2 phases; the first phase was the development and run-in with handheld computer. The second phase was the effectiveness before and after study using handheld computer for packing during 1 April to 15 May 2022 and 16 May to 30 June 2022 at department of pharmacy, Mae Fah Luang University Medical Center Hospital

In phase 1 of the research, pharmacist assisants used handheld computer for packing during 4 p.m. to 8 p.m. feedback and interview measured by questionnaire. In phase 2, primary outcomes evaluate the efficacy of interventions to reduce the prevalence caused by handling the wrong

drug, wrong dosage form and wrong strength of medicines, especially look-alike, sound-alike (LASA) medication name errors. Secondary outcomes evaluate the Outpatient waiting time and record the same questionnaire with phase 1.

The total number of medication orders placed in both study periods was obtained from the pharmacy department. Using this information, the rates of errors and items in the pre- and post-implementation periods were compared using rate ratio. Error rates within medication-use phases were then calculated, and rate ratios were calculated to determine if there was a change between pre- and post-implementation. To determine whether the severity of errors had changed, a chi-square test was used to compare the mean values within handheld computer use phases. The satisfaction of users and outpatient waiting time, a paired t-test and Mann-Whitney U Test were used to compare respectively.

Results

Amount items for packing pre- and post-implementation were 77,938 items and 80,963 items. This wasn't statistically significant (p-value = 0.86). Handheld computer could reduce pre-dispensing errors caused by handling wrong drug, wrong dosage form and wrong strength of medicines as compared with those using traditional methods significantly (p-value < 0.01). This was a statistically significant reduction of the errors from 41.7% to 26.4% especially in look-alike, sound-alike (LASA) drugs 8.3% to 2.8% (table 1). Two errors were found because of the returned medication in the wrong location and pharmacist assistant not using the handheld computer (table 2).

Table 1 Work load and Pre-dispensing errors (N = the total number of medication orders 158,901 items)

	pre-implementation	post-implementation	p-value
The total number of medication orders	77,938	80,963	0.86
Pre-dispensing errors (per event)	144	72	<0.01
Wrong drug, wrong dosage form and wrong strength of medicines	60 (41.7%)	19 (26.4%)	<0.01
- LASA drugs	12 (8.3%)	2 (2.8%)	0.01
- Non-LASA drugs	48 (33.4%)	17 (23.6%)	<0.01
Others (such as wrong amount)	84 (58.3%)	53 (73.6%)	<0.01

Table 2 Description of LASA drugs in post-implementation

LASA drugs	Cause
AMITRIPTYLINE TAB 10 MG – BETAHISTINE TAB 12 MG	pharmacist assistant returned medication in the wrong location
LOSARTAN POTASSIUM TAB 50 MG - LORAZEPAM TAB 0.5 MG	pharmacist assistant not using the handheld computer

Table 3 Outpatient waiting time

	pre-implementation	post-implementation	p-value
Overall outpatient waiting time (min)	11	9	<0.01
Rush hour outpatient waiting time (min)	17	13	<0.01
Amount of prescription in rush hour time*	5,647	6,713	0.09
Amount of rush hour time prescription coverage in 30 min (percentage)	1,415 (25)	704 (11)	<0.01

* rush hour time 10.00 a.m. to 1.59 p.m.

Median Outpatient waiting time was decreased from 11 minute to 9 minute. Subgroup analysis in rush hour interval (10.00 a.m. to 1.00 p.m.) was decreased from 17 minute to 13 minute. This was a statistically significant reduction of both percentage of coverage in rush hour over a 30-minute period was a statistically significant reduction of the errors from 25% to 11% (table 3).

The satisfaction of users was statistically significant with an increase from moderate to high level of the average scoring (3.2 to 3.8) (p-value = 0.03) (table 4).

Discussion

Barcode scanning technology has been used in many industries to more accurately reconcile and verify the identity of objects and would have logical application in verifying the identity of medicines, the persons handling them, and the patient to whom they are administered. This technology has been used in both the pharmacy to improve the safety and efficiency of drug storage, preparation, and dispensing, and by nursing to improve the safety and efficiency of drug administration and documentation in the medication administration record.[4] Dispensing and drug preparation errors made in the pharmacy are significant sources of medication errors. A barcode-assisted dispensing system at a large academic hospital was associated with a large and significant reduction in target dispensing errors (i.e. errors that barcode technology is designed to address) by 85%, target potential ADEs by 74%, and all potential ADEs by 63%.[5] The use of machine-readable coding to verify the accuracy of drug dispensing has increased from 5.7% in 2002 to 61.9% in 2017.[6]

Safety design and error proving when the pharmacist assistant used a handheld computer was the screen showing the right drug. These were shown a green screen when scanning with the right location that the doctor ordered in prescription and a red screen in the incorrect location. Data screen showed important data such as name, amount, bin location and picture. Safety design for high alert drugs was a cosign system between the pharmacist assistants (figure 1).

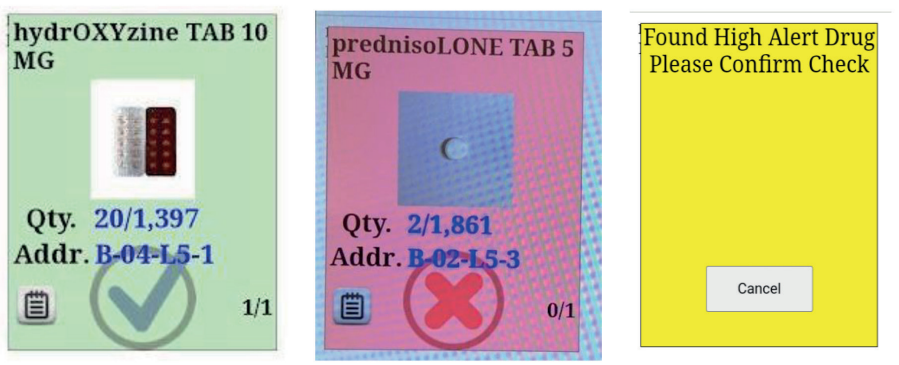
Table 4 The satisfaction of users in pre- and post-implementation periods (N=28)

	pre-implementation	post-implementation	p-value
Infrastructure	3.0	3.6	
1. Handheld was easier to pack the medicine			
2. Handheld detected the QR code correclty	3.0	2.9	
Implementation			
1. User trusted using handheld computer could reduce pre dispensing errors	3.8	4.5	
2. User felt comfortable	3.2	3.9	
3. Overall in post-implementation periods	3.1	3.8	
Average	3.2	3.8	0.03

The effect of the barcode scanning in our study was similar to the effect of the shelf controlled by the barcode system. The LASA safety shelf could reduce pre-dispensing errors caused by handling the wrong drug, wrong dosage form and wrong strength of medicines as compared with those using traditional shelves. There was a statistically significant (p-value <0.01) reduction of the errors from 26.50% to 6.45%.[7]

Although our study suggests that the prevention of many of the pre-dispensing errors could be reduced by using handheld computer, the pharmacist assistants weren't packing the medicine following work instructions that lead to pre-dispensing errors.

There are some limitations to outpatient waiting time because before study was covid-19 situation lead to workload or working in a pharmacy room. The relation between time and technology needs more study. Handheld signaling failure that couldn't connect with the hospital information system led to non-compliance with the use of handheld computer of pharmacist assistants so the data center accepted to fix them.



For right medicine For wrong medicine For High alert drug

Figure 1 Safety design on handheld computer screen

Conclusion

The study showed that barcode scanning technology with handheld computer could help to reduce medication errors, especially LASA drugs. Furthermore, this technology could improve waiting time and patient safety other than the good satisfaction on using of barcode scanning system by pharmacist.

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