An M-Pill Framework in the Electronic Healthcare

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Abstract This paper aims at developing a mobile pills framework in the electronic healthcare by using mobile information technologies. Specifically, an electronic based framework is developed to show how to mobile information technology and information system can be adopted in mobile pills. Then, a set of usability solution items are developed based on this framework. A prototype was created to show the real implementation of an m-pill system with these important features. The findings from this paper will be helpful to managers when making decisions on m-pills development.

Keywords: m-pills, electronic healthcare.

1   Introduction

Some electronic (e-) pharmacy prescriptions have been used in the healthcare system. However, mobile prescription on the nationwide scale still does not widely used. In order to offer a new way to patient, getting prescription refill quickly and conveniently, this paper will develop a new framework that will assist pharmacy in saving patient's time, helping doctor to track doctor shopping, and preventing misread medication names.

There are some proposed concepts on electronic prescription. The e-prescribing system benefits over traditional handwritten prescription. However, the system does not send electronic prescription to the patients' mobile devices. The e-prescribing system suggests that printing out the prescription and hand it to patients, or doctor can send it directly to the pharmacy. This system has limitation as patients may not want to buy prescription immediately or want to find the pharmacy by comparing prices and selecting the lowest price [2].

Numerous articles have been written on electrical records and mobile health [1] [2] [4] [5] [8]. People are embracing and adopting the implementation of mobile technology because mobile technology brings tremendous benefits over traditional paper record. However, there is a lack of research on mobile pills. The purpose of this paper is to develop an m-pills framework with usability features. Specifically, in Section 2, a framework was developed to show the adoptions of mobile technologies used in pills. A set of features were decomposed from this framework. A questionnaire is developed to illustrate important features. In Section 3, a prototype of an m-pills system is developed to implement these important features. Section 4 presents discussions and conclusions.

2   M-Pill Framework

M-pill framework is a mobile prescription system framework that not only prevents doctor shoppers but also saves patients' time in getting medication. Figure 1 illustrates this framework. It provides functions such as (a) Doctor uses PC to login to m-pills, (2) m-pills generates authentication code including saving a copy in the m-pills Database and sending the code to patient's mobile device, (3) Patient uses mobile device to conduct search for medication via m-pills, (4) Patient places an order on medication, and (5) Pharmacy receives the order & transmits the estimated pick-up time to patient's mobile device.
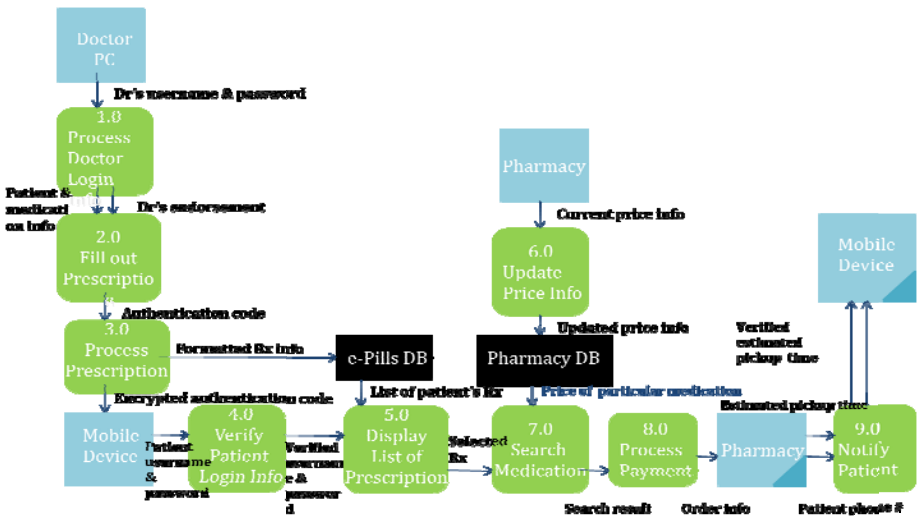

Fig. 1. M-Pill Framework

In Fig. 1, the doctors create their account with m-pills so that the doctors can use their username and password to log in to m-pills to generate electronic prescriptions for their patients. When an electronic prescription is generated through m-pills, m-pills saves a copy of the prescription generated and then it assigns a unique authentication code for each electronic prescription and sends that authentication code to the patient's mobile device.

Then, the patient can log in with his own user name which will be made up of the combination of the patient's last name and last four digits of his social security number. For example, Smith2345; and password will be the authentication code for the first time the patient logs in. Once the patient is logged in to m-pills, he will change the password to whatever password he wants. The patient will use the same username (combination of last name and last four digits of social security number) and the newly created password to log in the next time. He then can view the list of prescriptions he has with the most recent prescription on the top of the list. The patient then selects the desired prescription. Then, m-pills input the authentication

code corresponding to the selected prescription into m-pills and do a search on the particular type of medication prescribed. The patient is also asked to enter the search criteria to narrow the search by indicating his preferences for the pharmacies i.e. cheapest price, nearest pharmacy or pharmacy loyalty. M-pills will display the search result by listing the prices for the medication and the corresponding pharmacies according to the preference indicated by the patient. When patient makes his choice, he will be prompted to pay. The patient can either pay then with his credit card through m-pills or pay later when he goes to pick up the medication at the pharmacy. M-pills will also display an option letting the patient indicate whether the medication will be picked up by himself or by another person such as his spouse. If the patient indicates that another person will be picking up the medication for him, a message will display reminding the patient to tell that person who will be picking up the medication for him to bring ID with him as the pharmacy will need to verify the person picking up the medication.

When it's time for the patient to get refills on the medication, the patient can simply enters the authentication code again onto m-pills. Then, m-pills will display the number of refills the patient has left. When there is no more refills allowed for a patient, m-pills will display a message saying "maximum number of refills reached, see doctor." M-pills is going to keep the expired prescription for a few years just in case the patient is unaware or forgot that his prescription has expired.

To prevent the patient from abusing the refill i.e. trying to get another prescription for the same medication from another doctor, a doctor is going to do a search on the patient's name in m-pills when he logs into m-pills. If the patient already has an un-expired prescription, m-pills will bring that situation to the attention of the doctor by displaying a warning message saying "Patient XXX already has an existing prescription, do you still wish to prescribe one?" The doctor then can decide whether or not he still wants to issue a prescription to that particular patient.

The further decomposition of flows in Figure 1 produced a set of features that are presented in Table 1 below.

Table 1. Decompositions of information flows in m-pills

Feature	Definition
1	Doctor's username & password
2	Doctor's endorsement
3	Patient's info & medication info
4	Authentication code
5	Formatted prescription info
6	Encrypted authentication code
7	Patient's username & password
8	Patient's verified username & password
9	List of patient's prescriptions
10	Current price info

Table 1. (*continued*)

11	Updated price info
12	Price info of a particular type of medication
13	Selected prescription
14	Search result
15	Order info
16	Estimated pick up time
17	Patient's phone number
18	Verified estimated pick up time
19	Location of pharmacy
20	Verified Doctor's username & password
21	Amount due
22	Order confirmation

These developed features in Table 1 were given to several medical doctors who used e-pills before for validation. Some features were modified and added based on the comments from these subjects. The final table was sent back to these subjects for verifications again. There is no further modification.

3   Prototype of M-Pill Business System

Based on the features developed in Table 1, a prototype m-pills system was developed. The m-pills system is a mobile prescription system that not only prevents doctor shoppers but also saves patients' time in getting medication. The nine attributes of a system are components, interrelated components, boundary, purpose, environment, interfaces, input, output and constraints. The components of our system are doctor's PC, patient's mobile device, pharmacies' databases, m-pills web server and all of the components are interrelated to each other. The boundary of the system is that the system can only provide electronic prescriptions, not medical records. The purpose of the system is to facilitate a means for patients to obtain his prescribed medication more conveniently using his mobile device and also to prevent doctor shopping. The environment for the system is doctor and pharmacy acceptance, government support and funding, and patients' support. The interfaces for the system are the doctor's PC, patient's phone, pharmacies' databases. The inputs to the system are the prescription the doctor creates through m-pills; the patient's preference i.e. cheapest price, nearest pharmacy or pharmacy loyalty for the medication search; the pries for the prescribed medications from different pharmacies and the pharmacy location. The outputs of the system are authentication code, the pharmacy location as a result of the patient's preference, the filled prescription to the pharmacy, payment options for the patient. The constraints on the system are that the patient must have a mobile device with internet capability, and that the doctor and pharmacy must also have access to the internet.

In the system analysis phase, the process modeling such data flow diagrams were used to construct users' required features in Table 1.

In the m-pills system design phase, we focused on database design and user interface design. A relational database model was created using Microsoft Access based on the m-pills entity relationship diagram in Figure 1.

Designing the user interface is the most important aspect of the m-pills system. There are two limitations of mobile devices: "limited attention span and the device constraint." [7] They recommend that all interface designers need to focus on these limitations. The scholars favors simple and easy to use interface. Wu, Shu, and Lin [8] also find out that "compatibility, perceived usefulness, and perceived ease of use significantly affect healthcare professional behavioral intent." As a result, a good interface design would solve all these issues when designing the m-pills prescription. Some key features of the m-pills system are user-friendly, meaningful functionality, and fun-to-use. Details of these features are auto text complete, windows-like display, and help menu.

The Visual Basic.net was used to design and implement menu driven interface and Microsoft Access for relational database. The system was built targeting to offer user-friendly interfaces as well.

4   Discussions and Conclusions

The current paper developed a mobile pill system by considering the usability features. It first developed a conceptual framework for m-pill, and then breakdown the m-pill information flows from this conceptual model to determine what features need to be concentrated on. The findings from the current research indicate that developing user-friendly m-pill features is crucial to the success of m-pill system development. There are major findings in the current study.

First, in the current research, we are trying to build the gap by trying to utilize the mobile technologies so that physicians can access patient's medical history anywhere. Physician can access and update patients' record instantly, reducing the times to enter the same information twice. The system also prevent misread medication name because handwritten prescription sometimes is hard to read. Meanwhile, m-pills system saves patients' time to get medication [3].

Second, the developed usability features in the current paper help an m-pill development company when consider distinguishing its system from its competitors, and enhance the user-friendliness for mobile pill interfaces' design.

Third, m-pill systems have usability limitations including limited size, display window, processing power, and bandwidth, comparing with e-pill system [6] [7]. The m-pill system development company needs to gain popularity by considering these features.

Fourth, m-pills systems have security concern, lack of technical support, and organizational support [4]. The systems lacks of technical support and organizational support because mobile healthcare are fairly new.

One limitation is that this prototype does not have evaluation. Future study is to evaluate this prototype this developed m-pills system, and investigate the importance of factors influencing m-pill adoptions by developing a survey so as to quantitatively measure these features.

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