A Mobile Nursing App Applying to the Wound Care and Drug Administration of Patients

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***Abstract*—We have developed a mobile nursing app (mNurse) applying to the records of the wound status and drug administration in a regional hospital located in Taiwan since September of 2014. A total of 60 nurses participated in this study. It integrates the functions of identification, taking photos and integration with the Electronic Medical Records (EMR), Nurse Information system (NIS) and Picture Archiving Communication System (PACS). The mNurse app had significantly shortened the working time for more than 20 minutes per patient. Further larger scale study and application of the picture taken may be considered, particularly with the participation of the doctors.**

Keywords—Nursing Information System; NIS; Electronic Medical Record; EMR; Mobile; Wound care; Mobile Nursing app

I. INTRODUCTION

Mobile health, the use of mobile computing and communication technologies in health care and public health, is a rapidly expanding area within e-health. There is considerable enthusiasm for mobile-health interventions and it has been argued that there is huge potential for mobile-health interventions to have beneficial effects on health and health service delivery processes, especially in resource-poor settings [1-3]. Despite the availability of effective treatments, chronic diseases are often poorly controlled and remain a leading cause of preventable morbidity and mortality and excess costs worldwide [4, 5]. Pressure ulcers, also known as bedsores or decubitus ulcers, are a common but preventable condition seen most often in elderly persons and people with limited mobility. Pressure ulcer incidence rates vary widely from facility to facility. The Canadian Association of Wound Care reports that one in four people in any healthcare facility have a pressure ulcer at any given time [6, 7].

Relative to wound care, a user trial of wound care app (a prototype mHealth application) can contribute to improved documentation and compliance of wound care, while offering distinct benefits in the form of telehealth capabilities and automated data organization and interpretation that provides the user with information easily overlooked in a paper-based file [8].

The serious shortage of trained health workers globally has been identified as one of the most critical constraints to achieving health and development goals [9]. The objective of this study is to provide a mobile application for nurses (mNurse), an efficient integration of the daily work flow of a nurse, including wound care and drug administration.

II. METHODS AND PARTICIPANTS

The study was conducted from the perspective on the inpatient nurses upon the mNurse app applying to the wound care and drug administration of their patients. .

A. Design of MNurse

Both iOS and Android versions were designed. The mNurse app can be downloaded in the Appstore (iOS version 7 or above, mNurse V1.3) and Google play. (Android version 4 or above, mNurse V1.0.015)

B. Features and Functions

1) Network connection : As to achieve the Connection with the patient information of Nursing Information System (NIS) and security issue, network connection should be connected with the hospital network after the installation of the mobile app from the store.

2) Patient identification mode: QRcode was chosen as the mode for patient identification. In other words, nurses can only apply their mobile apps upon patients with QRcode over their hand ring and bed as well.

3) Configuration setup: Single sign-on (SSO) of their nursing ID and their password with the NIS was used to provide a proper user authentication account. Hospital selection should be chosen if a nurse was working on a different hospitals. The configuration status can be saved and when the nurses logout their account, they can login efficiently by scanning their working ID badge by using bar code or Near field communication (NFC).

4) Camera activation: The nurse can use the camera to take pictures of wounds (camera of the mobile device will always be activated after patient QRcode was scanned). In iOS

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version, the user needs to confirm as to allow the app to use the camera.

5) Nursing function: All records and pictures can be retrieved from the NIS and display on a click to display all integrated information, including prescription orders by the doctors, vital sign records, drug allergy history or important notes for specific patients and also linked to the other mobile apps for the doctors.

6) Camera deactivation: If the app is idled for 2 minutes, the camara will be deactivated and need to rescan the patient ID (QRcode).

7) Process Uploaded Picture: Uploaded pictures will be tagged with their patient information, time of taking the picture, nurse ID into the Picture archiving and communication system (PACS) as well as their nursing record in NIS.

8) Pictures inside the device: All pictures taken by the app will be automatically deleted within a requested period (default 48 hours)

9) Drug administration: Prescribed medication administration status by the physician can be shown on the app and the nurse can scan the QRcode of the current administration medication and matched with the patients' information by the QRcode of the same patient. Alarm will be notified when wrong matching occurs.

10) logut the app: For security consideration, logout of the app should be performed every time before the nurse left the hospital.

Table I shows 7 simple steps for using the mNurse app.

TABLE I: Simple steps of using mNurse app

1. User login and environment setup to connect with the hospital network.
2. Activate camera and scan patient ID (QRcode) for patient selection
3. Take picture before and after the wound care and uploaded into PACS and nursing record.
4. Uploading status can be checked in the app for transmission verification.
5. Drug administration can also be done with the QRcode scanning by the camera of the mobile device. Drug administered will be clicked when the nurse rescans the QRcode on the medication cover and all relevant data will be uploaded to the nursing record.
6. Logout the patient and go on take care another patient and return to step 2
7. Logout when leaving the work station or hospital.

C. Measurement

Questionnaire responses from 60 participants (nurses) were investigated. Descriptive statistics were generated for demographic variables. Time in minutes was used to measure the differences between no app and mNurse app. In mNurse app, Android group were compared with iOS group. Student T test is used and $p<0.05$ will be considered statistically significant different.

III. RESULTS

The mNurse app has been applied to the records of the wound status and drug administration in a regional hospital located in Taiwan since September of 2014. In total, 60 nurses participated in this study. Fig. 1 shows the iOS mNurse login page (on the left) and the confirmation to use the camera (on the right). Fig. 2 shows the nursing menu and the QRcode scanning (on the left) and pictures taken by camera (on the right). Fig. 3 shows the process where photos were uploaded to PACS (on the left) and the uploading status (on the right). Fig. 4 shows the drug administration (on the left) and the verification after the job has done (on the right).

Fig. 1. iOS mNurse login page (left) and camera confirmation (right).

Fig. 2. Nursing menu and QRcode scanning (left) and pictures taken by camera (right).

Fig. 3. Photos were uploaded to PACS (left) and the uploading status (right).

Fig. 4. Drug administratuin (left) and verification after the job has done (right).

A. Demographics

30 nurses using Android device (group A) and 30 nurses using iOS device (group i) were recruited in this study. The mean age was 38.2 (range 25-53) years in 60 nurses.

The mean age was 37.0 (range 25-49) years in group A and 39.3 (range 27-53) years in group I (P = 0.19 > 0.05). All the participated nurses were Asian and female. The demographic data was shown in Table II.

TABLE II: Demographics

Characteristic	Nurses(60)	Android(30)	iOS(30)
Age (Range)	38.2 (25-53)	37.0 (25-49)	39.3 (27-53)
Female	60	30	30
Male	0	0	0
degree or above	50	24	26
Diploma	10	6	4
Asian	60	30	30
Non-Asian	0	0	0

B. Comparison of mNurse and NIS

In traditional NIS, the nurses needed to draw the wound status or pasted the pictures after they uploaded to the PACS in separate steps. The procedure has been integrated and much more convenient in mNurse app. Table III shows the comparison of mNurse and traditional NIS in wound care. It took 15.0 (range 13-20) minutes in traditional NIS whereas with the assistant of mNurse app, it took only 1 minute (no significant different in group A and i, p= 0.17). It has proved that the mNurse app has significantly decreased the time cost for a wound care. Table IV shows the comparison of mNurse and traditional NIS in drug administration. For drug administration, it took 5.2 (range 5-10) minutes in traditional NIS and 1 minutes by using mNurse app (no significant different in group A and i (p= 0.64). It has also proved that the mNurse app has significantly decreased the time cost for drug administration.

TABLE III: Comparison of mNurse and traditional NIS in wound care

Performance Time (minute)		Total Nurses (60)	Group A (30)	Group i (30)
Wound status upload to PACS/ NIS	No app	15.0 (13-20)	15.3 (13-20)	14.8 (13-19)
	Use app	1	1	1

TABLE IV: Comparison of mNurse and NIS in drug administration

Performance Time (minute)		Total Nurses (60)	Group A (30)	Group i (30)
Drug administration	No app	5.2 (5-10)	5.4 (5-10)	5.1 (5-10)
	Use app	1	1	1

IV. Discussion

A. Cost Effectiveness

In average, the mean recording wound status in wound care setting is once a shift whereas the drug administration may take 3 or more times especially in a morning shift duty. We can save for at least 20 minutes time for their daily job in a nurse (assumption of performing a wound status recording

and twice drug administration). For a nurse caring for 6 acute patient, it may save for more than 2 hours.

The current worldwide nursing imbalances and shortages rank high in the agenda of stakeholders such as the WHO [10], nursing association [11] and health institutions [12, 13]. Shortages have been experienced recurrently since the 1930s due to the increase in the demand of care (demographic and epidemiologic transitions, technological advances) [7, 8]. Shortage is now projected to increase in all ageing countries, mainly due to the increasing prevalence of chronic diseases at all ages, the decrease in informal care provided by families, shorter hospital stays, substitution of inpatient with outpatient care, tasks-shifting from physicians to nurses, the ageing of the nursing workforce itself [14] and insufficient number of graduates mainly due to demographic shifts. It is well documented that insufficient nursing staffing significantly worsens the quality of health care, and increases patients' morbidity and mortality [15-17].

While increasing access to mobile or portable devices has enabled opportunities for promoting learning at the workplace in real-time [18]. There is the opportunity that mobile devices may enhancing the performance of wound care and drug administration which assists in nurse retention.

B. Limitation of the Study

A limitation reflects lack of knowledge about applicability of these findings across different wards on different hospital settings. Those aspects of work that promote or weaken nurse retention may differ in nature and strength across acute care, particularly in acute trauma setting than those in chronic wound care setting in this study. Such potential differences were not explored.

A second limitation to this study is in the small sample size. The study was designed as a feasibility pilot, we did not conduct a formal sample size calculation, and this study was not powered to detect the effects of the intervention on clinical outcomes.

V. CONCLUSIONS

The mNurse app is an iOS and Android app, designed for nurses to use on wound care and drug administration. The app has significantly shortened the working time for a nurse in more than 20 minutes per patient in a morning shift duty. Further study for a larger scale and the application in the picture taken may be considered, particularly with the participation of the doctors.

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