

## HOW DOES A MOBILE NURSING APP PLAY A ROLE IN JOB RETENTION OF NURSES?

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**ABSTRACT.** *A mobile nursing app (mNurse) applied to the daily nursing records and drug administration has been implemented in several regional hospitals located in Taiwan. A total of 75 nurses from four different units participated in this study. The mNurse app has integrated the functions of patient identification with QRcode, taking photos for nurse recording, the Electronic Medical Records (EMR) and Nurse Information System (NIS). A multiple regression model was generated to predict the correlation of mNurse's performance and the willingness score of job retention. The model had revealed a significant impact of the mNurse's performance to the job retention of nurses. The  $R^2$  was 0.9748. A larger scale of study may be warranted in the future.*

**Keywords:** Mobile nursing app, Job retention, Nursing shortage

1. **Introduction.** In the recent decades, policies promoting higher patient throughput in hospitals have led to many wards operating near full capacity, leading to increasingly frequent staff shortage situations, which challenge hospitals to continuously provide safe, quality care to acute and critically ill patients [1]. A temporary nurse shortage may affect the quality of care in the ICU [2] and operating room [3]. This serious shortage of trained health workers globally has been identified as one of the most critical constraints to achieving health and development goals [4]. New evidence suggests less than optimal hospital work environments may undermine efficient and effective delivery of nursing care and contribute to job dissatisfaction and nurse turnover among nurses who are in short supply [5]. Mobile health, the use of mobile computing and communication technologies in health care and public health, is a rapidly expanding area within e-health [6]. These include the apps for a smoking cessation [7], and post-operative follow-up in breast reconstruction and orthopedic surgery patients [8,9]. Additional benefit to the hospital

administrative, the mobile apps have been applied in patient adherence reporting, appointment reminders, home follow-up to ambulatory surgery [8,9]. 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, health service delivery processes as well as the improvement of the working time and satisfaction of the nurses [10]. A good integration of mobile nursing apps may provide an more efficient and time saving working environment for a good quality nursing records in terms of wound status record and drug administration than a decentralized tradition Nursing Information System (NIS) [10]. We have reviewed the previous studies with mobile nursing app and none of them have highlighted the impact of their apps with the willingness of job retention. The objective of this study is to predict the willingness of job retention by providing them a mobile app (mNurse) in terms of time saving on the process of drug administration. The organization of this study is listed with 5 sections including: Introduction; Participants and Method; (Design of mNurse app, Features and functions of mNurse app, Questionnaire design, Statistical analysis and model for prediction); Results (Demographics, Comparison of mNurse and NIS, Prediction multiple regression model); Discussion and Conclusions.

**2. Participants and Method.** The study was conducted from the perspective on the inpatient nurses upon the traditional NIS and a newly developed mNurse app applied to the drug administration of their patients in four different units of oncology, surgery, non-surgery and Intensive Care Unit (ICU).

**2.1. Design of mNurse app.** Both iOS and Android versions were designed and 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). The main design of the app is to integrate the features and function of the smart-phone and the traditional NIS. The details will be stated below.

**2.2. Features and functions of mNurse app.**

1) Network connection and Account: It should be connected with the hospital network for security and exchange information with NIS and EMR. Single Sign-On (SSO) of nursing ID and password from NIS was used. When the nurses log out, they can login efficiently by scanning working badge's bar code or Near Field Communication (NFC).

2) Patient identification mode: Nurses can apply their mobile apps upon patient's identification with QRcode over their hand ring and bed as well.

3) Camera activation: A nurse can use the camera to take pictures of drug Identity (ID), patient ID and relevant pictures of the patients for nursing records purposes. Nurse may upload the wound picture into the Picture Archiving and Communication System (PACS).

4) Camera deactivation and pictures clearance: If the app is idle for 2 minutes, the camera will be deactivated and need to rescan the patient ID (QRcode). All pictures taken by the app will be automatically deleted within a requested period (default 48 hours).

5) 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 match with the patients' information by the QRcode of the same patient. Alarm will be notified when wrong matching occurs.

**2.3. Questionnaire design.** Questionnaire was collected from participants (nurses) in comparison of working time between NIS and mNurse app upon drug administration. The willingness score (worst 0-100 best) of job retention as well as the satisfaction score upon the app and additional feedback were also collected.

**2.4. Statistical analysis and model for prediction.** Descriptive statistics were generated for social demographic variables. We used Student *t* test, ANOVA to analyze the differences between NIS and mNurse. Results with  $\alpha = 0.05$  represent a statistical significance using two-tailed tests. Multiple independent variables such as age, education level, working experience as a nurse, number of smart device (smart-phone and tablet computer) owned by a nurse and finally, the working time upon drug administration in NIS and mNurse as well as the differences in between were analyzed. A multiple linear regression model was used to predict the impact of multiple independent variables to the willingness score of job retention (dependent variable). A backward elimination procedure was used to remove insignificant factors until all remaining variables became significant in the final model. We used Microsoft Excel 2010 to perform the regression model.

**3. Result.** In total, 75 nurses participated in this study. Figure 1 shows the nursing menu, the QRcode scanning and pictures taken by camera. Figure 2 shows the main menu after login successfully, with extensible framework and link to other applications such as wound picture upload, drug administration, patient identification and ebaby. Figure 3 shows the menu of drug administration with patient identification. Figure 4 shows the process of the drug administration with all prescription displayed and aligned the mNurse app with the NIS. Figure 5 shows verified drugs to upload to NIS. Figure 6 shows double sign of another nurse for alerted drug administration.



FIGURE 1. Nursing menu, QRcode scanning and pictures taken by camera

**3.1. Demographics.** 75 nurses from four different settings, including oncology ward, Intensive Care Unit (ICU), non-surgery and surgery wards, were recruited in this study. The mean age was 30.6 (range 21-48). All the participated nurses were Asian and female. The average working experience in the nursing career was 8.8 (range 1.5-27) years. 60% of the nurses had used more than one smart device.

**3.2. Comparison of mNurse and NIS.** In traditional NIS, the nurses needed to login frequently on the computer and much more complicated on the patient identification, drug administration and verification process. The mNurse app has been integrated with the security and camera function on the mobile device for an efficient procedure of drug administration. It took 216.1 (range 96-450) seconds in the NIS and 113.4 (range 30-360) seconds in the mNurse app. It had significantly decreased the time cost. The average



FIGURE 2. Main menu after login successfully

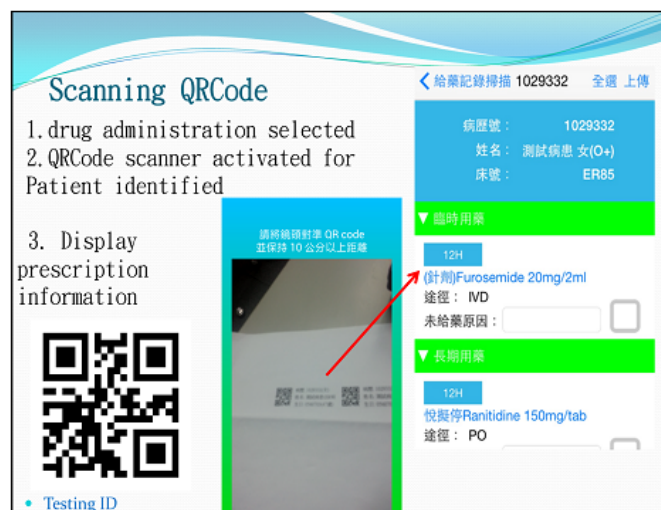


FIGURE 3. Menu of drug administration

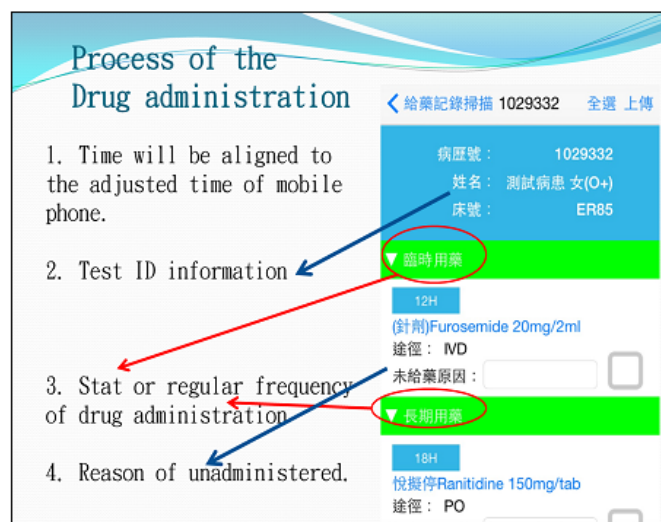


FIGURE 4. Process of drug administration



FIGURE 5. Verified jobs (drugs administered) that can be uploaded and aligned with their nursing record



FIGURE 6. Alerted drugs that will need another nurse to double co-sign and upload

time saved was 102.7 (range 40-225) seconds for a drug administration of a patient ( $P < 0.0000$ ).

**3.3. Prediction multiple regression model.** The average score of willingness of job retention was 55 (range 17-84). 24% of the nurses scored good or excellent and 28% of the nurses scored poor willingness on this. Therefore, some other independent variables may have influenced the willingness of job retention.

In order to have a better prediction of the job retention, different variables were analyzed. Table 1 shows the analysis of variance to identify the effects of different variables on nursing willingness of job retention. Variables such as age, education level, and individual time performed using NIS or mNurse app were statistically not significant on the score of willingness of job retention. A new nurse of less than three years' experience or experienced nurses of working more than 9 years had a less willingness score of job retention by using mNurse ( $P < 0.0000$ ). Nurses with only one smart device have a better willingness score of job retention ( $P < 0.0000$ ). Table 2 shows a multiple regression model of the willingness score of job retention (dependent variable). Three independent variables were significantly influenced by the dependent variable. These include the time saved on drug administration by mNurse ( $x_1$ ), working experience as a nurse within three to

TABLE 1. Analysis of variance to identify the effects of different variables on nursing job retention

VARIABLES	GROUPS	NURSES (%)	MEAN SCORE	SD	P
AGE	< 30	42 (56%)	55.3	25.1	0.76
	>= 30	33 (44%)	56.9	21.2	
UNIVERSITY/ ABOVE DIPLOMA	UNIV.	57 (76%)	54.8	23.1	0.42
	DIPLOMA	18 (24%)	59.9	24.4	
WORKING (YEARS) AS A NURSE	3Y-9Y	30 (40%)	69.1	16.7	0.0000
	< 3Y OR >9Y	45 (60%)	47.2	23.2	
#SMART DEVICES	1	30 (40%)	73.8	13.7	0.0000
	> 1	45 (60%)	44.1	20.9	
TIME SAVED (C = A - B)	<= 90S	39 (52%)	36.6	14.0	0.0000
	> 90S	36 (48%)	77.0	8.2	
NIS (A)	< 240S	36 (48%)	57.8	17.9	0.521
	>= 240S	39 (52%)	54.3	24.9	
MNURSE (B)	<= 100S	39 (52%)	59.9	18.7	0.134
	> 100S	36 (48%)	51.8	27.2	

TABLE 2. Regression model for willingness score of job retention

PREDICTORS	COEFFICIENT	SE	T TEST	P	95% CI	
INTERCEPT	0*	NA	NA	NA	NA	
TIME SAVED (x <sub>1</sub> )	0.514	0.010	51.027	0.000	0.494-0.535	
WORKING3-9Y (x <sub>2</sub> )	9.748	1.588	6.139	0.000	6.583-12.913	
#SMART DEVICES = 1 (x <sub>3</sub> )	3.614	1.745	2.071	0.042	0.135-7.092	
SCORE OF JOB RETENTION (95%CI)Y = 0.514(0.494 ~ 0.535)x <sub>1</sub> + 9.748(6.583 ~ 12.913)x <sub>2</sub> + 3.614(0.135 ~ 7.092)x <sub>3</sub>						
R <sup>2</sup>	ADJUSTED R <sup>2</sup>	SE	OBS. NO.	ANOVA	REGRESSION	RESIDUAL ERROR
0.988967	0.974772	6.497572	75	DF	3	72
				F	2151.299 (P < 0.0000)	

nine years (x<sub>2</sub>) and ownership of only one smart phone (x<sub>3</sub>). The regression equation for job retention willingness score was  $Y(95\%CI) = 0.514(0.494 \sim 0.535)x_1 + 9.748(6.583 \sim 12.913)x_2 + 3.614(0.135 \sim 7.092)x_3$ . The coefficient of determination or R<sup>2</sup> was 0.9890 and the adjusted R<sup>2</sup> was 0.9748.

**4. Discussion.** Shortages have been experienced recurrently since the 1930s due to the increase in the demand of care (demographic and epidemiologic transitions, technological advances) [11]. A more recent systematic review of 39 studies found that improving the nurse practice environment was an important strategy to improve nurse retention [12]. Taiwanese nurses who had better perceptions of their practice environment were less likely to report their intentions to leave their place of employment [13]. Traditional method of drug administration using NIS on computer may provide a better working environment for the nurses on their daily work than using paper and pens of different colors. The mNurse app has integrated the traditional NIS with the specific function of the smart phone, such as camera for patient identification and drug verification. It has improved the frequent login problem in the NIS, which is due to the security requirement on the idle and unattended computers used by the nurses. In this study, we have generated a multiple regression model to predict the job retention of nurses by means of the time saved upon drug administration with mNurse app (x<sub>1</sub>) with coefficient of 0.514 (95% CI of 0.494 ~ 0.535). Two other independent variables were observed. These include the

working experience as a nurse for three to nine years ( $x_2$ ) and ownership of only one smart phone ( $x_3$ ). Further investigation may be warranted to understand the reasons of these two variables. Intercept for the model was not statistically significant and thus was adjusted to zero. In average, a nurse may perform 26 times (range 12-40, about 3 ~ 5 times drug administration in taking care of 4 ~ 8 patients per shift). The mNurse can save for about 44.5 minutes (range 8-150) per shift.

**5. Conclusions.** The mobile app may mitigate the overtime working of 44.5 minutes (range 8-150). In conclusion, a highly integrated nursing app which can shorten the working time and enhance the working quality has been predicted to increase the willingness score of job retention of the nurses. Other factors such as the number of smart phone owned as well as the working experience as a nurse which have shown a correlation may need a further study to clarify their roles.

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