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# A Medication Reminder Mobile App: Does It Work for Different Age Ranges

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**Abstract.** Successful medication adherence particularly in elderly with chronic diseases will improve their self-management. Medication reminder systems could be useful to improve this adherence. This study consists of two phases, designing a mobile medical app based on Android platform and then its evaluation. To develop this application, first, the use case scenarios have been hypothesized in partnership with health professionals and patients used to take medications daily. Unified Modeling Language was used to model the use cases. The evaluation was performed with usability testing and efficacy testing. The results show that the app was well accepted both in young people and older adults. Engaging target users and health professionals in the conception and development of a health-related app could have better results in the usability and the efficacy of the app.

**Keywords.** mHealth, Reminder System, patient adherence,Mobile Applications

## 1. Introduction

Improving medication adherence particularly in older adults with chronic disorders will enhance their disease management. This would be more serious when the medicines are vital. Most patients occasionally forget to take their medications[1]. Patient adherence to medication is clinically crucial in reducing mortality of serious diseases and total health care costs [2].

Patients with chronic conditions, regardless of age, take generally multiple daily medications with various frequencies. This will increase the risk of medication errors or non-adherence to medication treatment. Non adherence to medication is a complex problem that can lead to exacerbations of chronic health conditions, hospital admissions, and other avoidable health care costs [3].

Smartphones have been rapidly adopted by the general population and now represent a promising technology that can improve health care [4]. The intersection of mobile technology, apps and healthcare is currently in its most dynamic phase. Since the information and communication technology (ICT) develops, a system using mobile phones to support medication-taking will become increasingly necessary as a part of the m-Health (mobile health) system [5].

There are more than 165000 health related apps available in the global markets today [6]. All of these apps are not necessarily “good” ones and studies have shown that many of these applications have some problems concerning content validity,

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security, usability, etc. [7]. Unfortunately, the five-star rating scale provided in the app stores is not a reliable assessment method [8]. Some studies in the literature have already demonstrated that older people differ from young people in their perceptions, preferences and usage of mobile technology. There are also differences within the older adult groups regarding mobile technology adoption [9]. Generally, the people using new technologies are young; it seems that the elderly may use mobile applications rarely. However, older adults may have more need to a medication reminder system than the youngsters.

Well-designed applications that are proper for elderly would be adopted by the elderly. We hypothesized that a medication reminder system would be used among all age ranges if it is designed with the participation of its target users and health professionals.

Therefore, in this study, a medication system reminder app has been designed and evaluated by the users from various age ranges.

## 2. Methods

In the analysis phase, first, we identified the main actor who is the application user. Each user can add one or more patients (medication consumers) and for each patient, the user could allocate various medications. In the first step, the user should identify the patient information including name, gender, and date of birth, height, and weight and phone number (only the name is mandatory).

For visualizing, constructing and, documenting the application, all of the use cases should be recognized. Two IT specialists and two medical doctors and two patients, one above 50 years old and the other under 50 years old, both used to take various medications daily, agreed on the list of use cases and validated the model obtained.

The recognition of the activities of the system was the second step of the development. The activity diagram helps to understand the main business of the system.

Once the application had been developed, one medical doctor and two users tested the application to find bugs and defects.

The evaluation was then performed on the efficiency and the user friendliness of the application. We have created a questionnaire including two questions assessing the function efficacy of the app and 10 usability questions. The usability questions were derived from SUS method [11]. We have adapted the SUS questions for mobile application use. We asked 60 users (30 under 50 years old and 30 over 50 years old) to use the application for at least 10 days and answer to the questionnaire. The evaluators were from both sexes. We have then analyzed the global user satisfaction and the application efficacy and compared the results in the two groups.

## 3. Result

### *3.1. Development*

The actor list includes the user (the person who uses the application for himself or for others), medication consumer (the person who should take the medication), medication (the medication that should be taken by the patient), patient relative (if user does not take medication, a text massage will be sent to the patient's relative) and trip (Specify a

time limit for providing the medicines in sufficient quantities. Figure 1 shows the use case model.

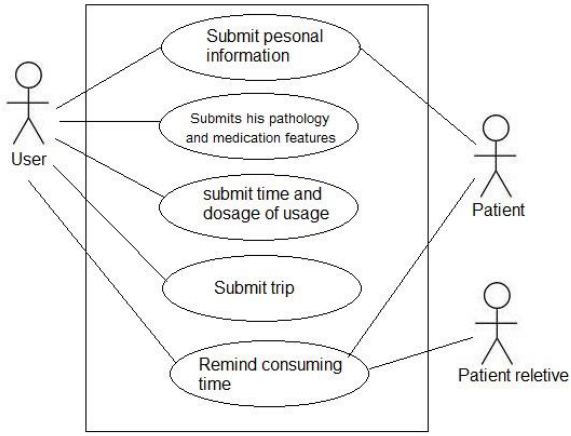


**Figure 1.** Use case Model

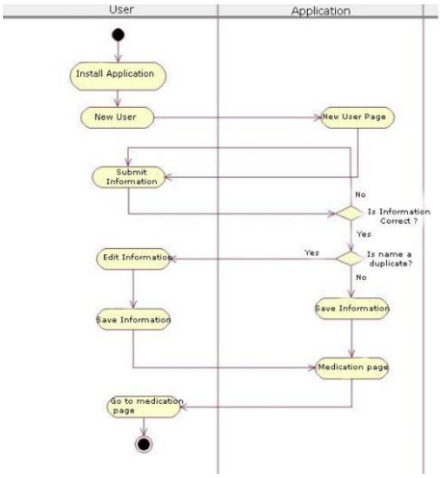


**Figure 2.** User Creation Activity

The system activities include: user creation, medication creation, consumption on a trip. Figure2 presents an example of activities (the user creation activity).

Our app database contains five tables: User, Alarm, Medication-alarm, User-Medication, and Medication-Info.

### *3.2. Evaluation*

Table 1 shows the efficacy questions and the SUS questions adapted to mobile apps and the mean score for the two groups of users. Both efficacy and usability test results

are promising. We did not find a significant difference in efficacy and global usability between the two groups of study.

**Table1.** Efficacy and usability evaluation of the application. The data is shown by mean values

| Efficacy questions | Under 50 | Over 50 | *P* value |
|---|---|---|---|
| Compared to the period when I did not use the app, the number of missing medication is reduced (0 for no , not at all and 10 for yes , definitely) | 8 | 8.3 | 0.2 |
| Compared to the period when I did not use the app, I miss less my medication but I take them sometimes with a delay which is generally more than 1 hour (0 for totally disagree , 10 for totally agree) | 2.6 | 2.9 | 0.18 |
| **Usability questions ( 0 for totally disagree , 5 for totally agree)** | | | |
| 1. I think that I would like to use this app frequently | 4.1 | 4.6 | 0.001 |
| 2. I found the app unnecessarily complex | 1.2 | 1.4 | 0.04 |
| 3. I thought the app was easy to use | 4.5 | 4.7 | 0.09 |
| 4. I think that I would need the support of a technical person to be able to use this app | 1.1 | 1.7 | 0.0001 |
| 5. I found the various functions in this app were well integrated | 4 | 4.5 | 0.001 |
| 6. I thought there was too much inconsistency in this app | 1.3 | 1.4 | 0.2 |
| 7. I would imagine that most people would learn to use this app very quickly | 4.4 | 4.4 | - |
| 8. I found the app very cumbersome to use | 1.3 | 1.4 | 0.2 |
| 9. I felt very confident using the app | 4.3 | 4.5 | 0.1 |
| 10. I needed to learn a lot of things before I could get going with this app | 1.2 | 1.6 | 0.002 |
| SUS Score | 87.8 | 88.2 | 0.4 |

## 4. Discussion and Conclusion

Medication adherence can affect patient health positively, improve the quality of the relationship between the patients and their health provider, and decrease health resource consumption [12]. Traditional reminder methods remind passively to take medication and are inefficient for complicated regimens.

In this study we've created a medication reminder app that could be appropriate for whom needing support with his drug regimens. The app can engage the medication consumer's entourage and the consumer should not carry a separate reminder device. The comparison between the two groups of study shows that the application was well accepted in the elderly and the young generation both in efficacy and usability scores.

A number of researches studied the use of smartphones in the medical settings. One systematic review study found that the short-term effectiveness of electronic reminders, especially Short Message Service (SMS) text messaging reminders and internet interventions could enhance medication adherence of the patients [12, 13]. The

results of our study corroborate the findings of other studies and show that the age of users does not affect the usability and efficacy of the app. We have found significant differences in some usability aspects and contrary to our expectations; they were better noted by the older group. This may be due to the comparison that the young people do when assessing an app. The young people have seen and tested more apps than the older group. Therefore, the expectations of this group may be higher.

One of the limitations of this study may be our small sample size. Another limitation would be the fact that we have evaluated our own app and the results may not be generalizable to other solutions. However, we believe that if the target users and health professionals participate in the conception and the development of the app, it will obtain a good level of acceptance[8]. Other usability and efficacy evaluation methods could be used in the future to validate these results. We considered "age" as a primary factor in this study. However, other factors including the knowledge, illness status and perceived support could be integrated in the future revisions of this study. The future app may have a verity of features including medication information, multi-platform functionality, and interoperability with the electronic patient records and particularly order entry systems.

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