

# Electronic Medication Reminder for Older Adults

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**Abstract.** As the numbers of the elderly people is increasing rapidly, it is important and urgent to design appropriate products for older adults. Because of physical and mental function decline, the elderly need to take multiple drugs, they often occurring medication non-compliance behavior, seriously affecting the health of the elderly. Forget to take medicine is one the most frequency problem, so there were several products designed for reminder, such as electronic pillbox. In recent years, with the development of smart phone, some software was also designed for medication reminder. For the lifestyle and electronic products using experience, not all of the elderly use cell phone in Taiwan, and they do not operate any other function except making a phone call. To discusses whether the software suitable to the elderly was the purpose of this study.

This is an exploratory study about electronic medication reminder in Taiwan, there were total 30 volunteers join the project, included 15 older adults; through interviews and a questionnaire survey with the elderly, try to gather difficulties and needs from the elderly when using an electronic medication reminder. The results showed correlations between the interface-complexity and preference of older adults; they would rather choose electronic pillbox than smart phone because it is easier setting and more “approachable”. Through the study results, hope the findings will help clarify the direction of further research and to develop more suitable for the elderly on the operating trends.

**Keywords:** Older Adults, Medication Compliance, Pillbox, Electronic Medication Reminder.

## 1 Introduction

The problem of aging population is the trend all over the world [1] [2]. It has become an aging society in Taiwan since 1993. If the elderly people can take care themselves well in the daily living, it will be able to lower the care burden among younger generation; If we can improve the medication compliance, it will promote the physical and mental health of the senior citizens and assist them to live independently [3].

With the aging process is often accompanied by the occurrence of chronic diseases, there are more than half of the older people suffered from different diseases in Taiwan [4]. Because of physical and mental function decline, the elderly need to take multiple drugs, they often occurring medication non-compliance behavior, seriously affecting the health of the elderly. The behavior not only affects the disease, but also seriously

endangers their health and security [5][6]. Compliance can be defined as the extent to which a patient's behavior corresponds to the physician's therapeutic recommendations. Improvement of the medication compliance would increase cost-effectiveness. Studies have demonstrated the prevalence of poor adherence (/compliance) across all types of regimens and diseases, including life threatening illnesses; for this reason, often caused by medication non-compliance with more discussion and concern [7].

The non-compliance behavior of the elderly often caused from forgotten or misunderstanding[8]; a review of the literature indicates that forgotten is the most frequent problem on older adults[9], whether "forget to take medicine" or "forget taking medicine", these problems were hazardous to health for the elderly; so there were several products designed for reminder, such as electronic pillbox.

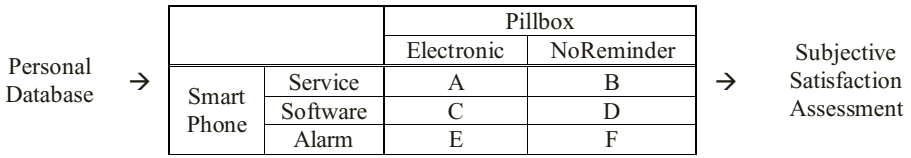
In recent years, with the development of electronic communication products, some software was also designed for medication reminder. Not only notice the medication time, some software also could connect to a comprehensive medication database, or search a list of local personal physicians with office contacts [10]. These powerful features are developed in general NB, PDA, or smart phone, change the act and lifestyle on people. However, the previous studies were targeted on younger adults with computer or other small screen device usage, but few data are available on how different variables vary with electronic reminder products using performance and comprehension for older adults. There are much more information to be presented on the electronic reminder products, however, there is no accurate way to be understood by all users. We would like to analyze the layout and usability of existing products by interviews through the concept of universal design.

As the numbers of the elderly people is increasing rapidly, it is important and urgent to design appropriate products for older adults. Universal design is a process intended to promote the development of products or environments that can be used effectively by all without adaptation or stigmatization [11]. To put it simply, describes universal design as "design for people of all ages and abilities" [12]. For the lifestyle and the different electronic products using experience, not all of the elderly use cell phone in Taiwan, or they do not operate any other function except making a phone call. Although the smart phone had bring more possibility of medication reminder to people, it should be put more concern on the technological generation gap, to make the products close to the elderly's living habits, and easier to be learned and used. There has thus far been relatively little research into the area; the study try to primarily explore the issue about needs and difficulties for older adults on using electronic medication reminder products.

## 2 Methods

For the purpose, the study includes three aspects: Operating practice, observation and interview to the elderly are carried out to primarily explore the issue about the electronic medication reminders products. Their response measures included operating performance (speed and accuracy) and subjective satisfaction assessment. The study was a 3 x 2 factor between-subjects design. The first factor was cell phone (three levels: Phone call services, reminder software, and built-in alarm) and the second factor was pillbox (two levels: electronic reminder and no reminder); show as Table.1. Based on the factorial design, there are totally six articles composed of designated levels for the study.

**Table 1.** The study factors



### 2.1 Participants

There were total 30 volunteers join the project, included 15 older adults. All participants were fluent in Chinese as their first language and educated to at least secondary/high school level. The 7 females and 8 males were between the ages of 65 and 81 years (mean = 70.3, SD = 3.69). They were required to have at least 20/25 visual acuity with corrective lenses and to be without physical or mental problems. They were also requested not to stay up late, alcoholic drinks and any other substance that might possibly affect the test results. All older subjects had experience of taking medicine over 5 years. A small gift was given to participants as payment for taking part.

### 2.2 Equipment

In this study, there are 3 major equipments used in operating practice: 1. An iPhone 3GS (<http://www.apple.com/>) with the software of pillboxer (charged) and iPills (free), The touch screen could allow the participants use the finger to control the options. 2. An electronic pillbox, with a LCD panel and three buttons for setting remind alarm; and 3. A set of rainbow pillbox, three grids a day, totally seven days a set; show as Figure.1. Both pillboxes are made of transparent plastic.



**Fig. 1.** The study Equipment

### 2.3 Materials

**Pillboxer (charged):** Search through a database of more than 11,000 FDA-approved medications. Notification engine let’s people know when ones medications should be

taken. Visual "pill box" icons immediately let users know what medicines have taken during the week.

**iPills (free):** Start by entering the medications that needs to be taken along with the intervals for each, it will then present people with a daily pillbox showing the medicines one need to take for the day. Every time after taking the medicine the user needs to tap the corresponding pills on the screen. When it comes to appearance, users can further customize the way pills look with different colors and shapes. The application also lets user keep an overall record of the medications he have taken, or missed.

**Language:** Under the premise of maintaining the normal operation of the software, take English (the original language, Figure.2) as Interface plate; the researchers provide translation and interpretation.

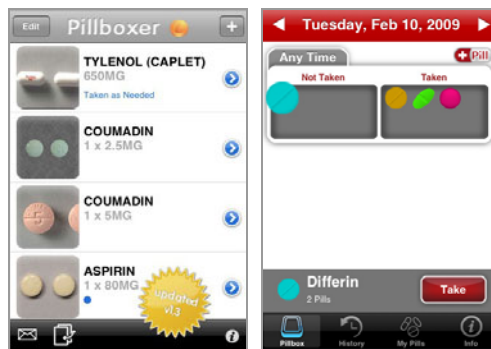


Fig. 2. The study materials of Pillboxer and iPills

## 2.4 Operating Performance and Subjective Satisfaction

Researchers would explain the functions and operating steps to the participants before the operating practice. All participants must complete the three setup tasks, including smart phone, electronic pillbox and phone alarm; Time-consuming and the behavior of the process were recorded as the reference for the follow-up analysis.

## 2.5 Experiment Procedure

A standard laboratory desk and chair were provided for experimentation. The experiment environment was standardized. Prior to the experiment each participant was instructed about the purpose and procedure of the study. Participants were asked hold the iPhone (or electronic pillbox) and to read the information from a comfortable position and were told that they could bring the iPhone (or electronic pillbox) closer to the face if necessary. Each participant should operate the process completely to setting the medication time on 13:45, then remove the medicine and cease the alarm.

After completed the process, the participants were requested to answer the subjective satisfaction on what they thought of the different electronic reminder and pillbox by 5 point Likert scale. An additional brief semi-structured interview was carried out on the elderly. For the analysis of the data, this study applied the statistical analysis by utilizing the Windows SPSS Statistics 13 Program.

### 3 Results

All participants completed the operating practice and subjective satisfaction survey; through interviews and a questionnaire survey with the elderly, they expressed the difficulties and needs on using the electronic medication reminders.

#### 3.1 Operating Performance

Operating performance was measured by setting speed and accuracy. Figure.3. shows the trends of the two groups. For the elderly, the operating performance of existing smart phone reminder was not as good as the electronic pillbox; however, the performance was not affected significantly for the general adults. The operating performance of older adults is: electronic pillbox> setting alarm> software reminder, and so does the general adults, but the difference among the products are not Obvious. Over all, the results indicate that the interface complexity has a positive effect on operation performance; however, this part yielded limited information about product design. Therefore, further questionnaires and interviews to be executed, the results show as the next section.

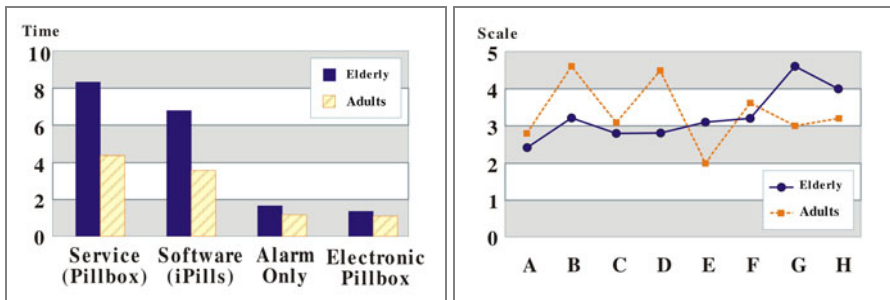


Fig. 3. The Operating Performance (L) and The Subjective Satisfaction (R)

#### 3.2 Subjective Satisfaction Results

Similar as the results of operational performance, the elderly were most satisfied with the electronic pillbox; the results of the satisfaction questionnaire were mixed, for the smartphone generally have higher adult satisfaction, but the elderly has the opposite.

The following is a summary of two interviews with the participants.

**The Older Adults:** The electronic pillbox could storage medicine and offer reminds at the same time, but the other two products could not. Despite the quite popularity of mobile phones in Taiwan, there are still a certain percentage of the elderly usually do not carry the mobile phone with them; so the medication reminder software might not exact fit the current older adults. Furthermore, the Flat-panel touch screen is too small, and the no-button design is relative unfamiliar to the elderly. Some advantages can attract the elderly try using the smartphone, such as the large medications information database and the medication identification photos; the prerequisite is to simplify operations.

**The General Adults:** The size of electronic pillbox is still too large to take away, for the participants, they would rather take a pillbox + smartphone, but do not take a "ringing box" with them, the ringing pillbox will remind other people how many times he has to take medicine. Second, the smartphone has a more beautiful interface, it also integrate more functions; to people whom carry mobile phones at any time, this product would conform more needs in more situation. Not all of the advantages are attributed to smartphone, existing software are in English, the steps are not simple enough to eliminate the language barrier; consideration of economic factors is another reason.

## 4 Discussions

The operating performance of smart phone was not as good as the electronic pillbox; consider of the reasons can be attributed to the interface type: The flat-panel touch screen is a new operation technique for the elderly, diversity options for the decision-making process is also a challenge; despite the two products are equal to the auditory feedback, but in the sense of touch, the elderly are more accustomed to a specific button or particles, can serve as a tactile aid, although smart phones have vibration feedback, the experience of the elderly is relatively new; the visually compensate for this disadvantage, compared to the limited LCD screen of electric pillbox, a larger area of smartphone with bright colors provide a better operating environment for the elderly. This inference should also be supported from the interviews.

The interview results showed that the language affect the user's operational behavior, thus have an influence on the interface preference. This study take two software as materials, which are both of English; this may suggest some effects of subjective satisfaction, another partial explanation for this may lie in the suppose that under an unfamiliar language, the interface essence could be tested more directly.

The elderly did not completely reject the use of smart phones, if the motivation stronger or the setting process easier, the elderly will be more willing to learn it; in addition, part of the interview reveal that some elderly do not often use the cell phone, not to mention carry with them. Even they heard the reminded on cell phone, but forgot to take the pillbox out of the house. Another interview has shown a similar reason: "electronic pillbox could storage medicine, but the cell phone could not." This is a direct and interesting answers, and also shows the demands of the elderly is so simple.

Comprehensive questionnaire and interview results, three of these finding are worth summarizing:

**Smartphone with Medication Reminder Software:** In the past ten years the science and technology for the creation and use of smartphone have progressed tremendously; we have seen a shift in patterns of user-behavior. In spite of the smartphone has some essentially problem (i.e. it cannot carry medicines, and economic considerations) there are four points support the trends: 1.Variety of interface make a easier and more beautiful reading experience; 2. Integration of multiple functions; 3. More complete and scalable information database; 4. Greater emphasis on privacy.

**Electronic Medication Reminded Pillbox:** It seems a kind of transitional products, before a better form of the medication reminder is developed, or before the “new elderly” whom are familiar with the electronic products are getting older; the contemporary older adults would choose these products which are easier operate or closer to their lifestyle. The advantage are integrating two functions, the elderly could receive the reminder message then take medicine right away.

**The Non-Reminder Pillbox:** The pillbox only used for medication storage. Because of the simple function, the product could be designed as different forms, or be designed from different material; so it received less controversy.

## 5 Conclusions

The results showed correlations between the interface-complexity and preference of older adults; they would rather choose electronic pillbox than smart phone because it is easier setting and more “approachable”. This interviews brought us a positive inference, improving operational processes and links medications to the cell phone, will help the elderly to accept the new form or new product of reminders. For the lifestyle and electronic products using experience, not all of the elderly use cell phone in Taiwan, and they do not operate any other function except making a phone call. With the design closer to the elderly, so can we reduce the learning difficulties of the elderly. Through the study results, hope the findings will help clarify the direction of further research and to develop more suitable for the elderly on the operating trends.

This method of investigation is not without problems, we readily acknowledged that our research is exploratory and that there are not precise with the statistical mode. While this study has its limitations, it can serve as a basis for further study in electronic medication reminders for the elderly.

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