

Patient Medication Self-Management Mobile Application

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ABSTRACT

Managing medication schedules has become a daunting challenge for many seniors. Of the 75% of seniors who take one or more medication a day, 25% are known to take at least 5 or more pills on a regular basis [9]. Inadequate administration of pills, such as taking medication at the inappropriate time, forgetting to take medication, taking more medication than required, often leads to medication non-adherence. As a consequence, seniors have a higher likelihood of incurring an even more severe illness and subsequently being readmitted into hospital. Not only does medication non-adherence pose health threats for the patient themselves, hospital readmission due to medication problems also take on enormous toll on Americas health care system, adding more than 100 billion dollars to the nations health care bill annually [9]. Patients deteriorating health also puts a great deal of stress upon patients loved ones. In order to mitigate the effects of medication non-adherence, seniors need an intuitive tool that allows them to gain control over their medication schedule, thereby improving medication adherence and as a consequence their health. Making use of the capabilities of todays smartphones, the android application presented here hopes to assist seniors in their medication management routine. The application provides a framework that reduces the complexity of creating reminders for each medication the patient needs to take and also minimizes the interruptions through reminders by being sensitive towards a patients surroundings. The ultimate goal is thus to afford seniors a better quality of life.

Author Keywords

Mobile Application, human factors, reminder

MOTIVATION

Medication adherence is defined as the act of taking the correct amounts of prescribed drugs at designated times and in an appropriate manner. [6] It has been shown that adherence is often predicated by measures of cognition; specifically, by the use of the executive function and working memory [6]. A decline in the cognitive ability for remembering is often

in association with aging. With most sets of medication regimen requiring strict dietary specifications, the challenge of keeping track of the schedule becomes an even more burdensome task for many seniors thus leading to medication non-adherence. Besides the demanding cognitive workload many seniors have to deal with in managing their own health, medication non-adherence also stems from weak patient doctor communication. Seniors' difficulty in adhering to medications is also due to the fact that many stops the process either because they perceive that the drug in fact has an adverse effect on themselves thus ceasing to take anymore on their own terms. Along a similar vein, patients also cease taking certain medication because they are not experiencing any physical health improvement of the medications being prescribed or believing the fact that high quantity of medications is not necessary for the betterment of their health. These choices for discontinuing prescribed medication schedule is due in a large extent to a lack of closed loop communication between the patients themselves and their doctors.

BACKGROUND

According to the World Health Organization, older adults consume approximately 50% of prescription drugs and 34% of the elderly takes 3 or more prescriptions. The percentage of senior medication consumers will only increase, as the whole of the United States population age. The number of adults age 65 and over will more than double over the next 40 years, from 40 billion currently to an estimate of 89 million by the year 2050 [10]. As the size of the aging population continues its positive growth, the issue of medication compliance becomes an even more pressing matter for the aging cohort. The burdensome task of adhering to the proper treatment of their illnesses has rippling effects as previously described. With the growing ubiquity of cellular phones world wide, the mobile platform presents itself as a high potential candidate in enabling seniors with greater degree of freedom and control over their health. To see whether or not seniors are indeed open to the idea of adapting to new technology, a group of researchers from Taiwan has conducted a research experiment regarding the usability of mobile pill applications versus the use of a physical electronic pillbox [8]. In the study, the 15 elderly seniors were asked to complete the task of setting an alarm for medication then later removing the medication once the alarm has sounded. The subjects were able to complete the task at a faster rate with the use of the electronic pillbox than through the use of the mobile application. The slower performance through the use of the mobile phone mainly stems from the fact that elderly adults

are still unfamiliar with using these smartphone devices even they might have adjusted to using a regular cellphone. The follow up interview after the completion of the task revealed that if the interface can be simplified and be made in a more intuitive way to the norms seniors are accustomed to, it will provide a higher amount of incentives for them to learn to utilize the new technology. Other incentives for senior to use mobile application include the large variety of interface designs presented through the medium of a smartphone which can lead to a more pleasant experience, smartphones versatility in carrying out multiple functionalities, its ability to store long term data regarding the users intake schedule, and finally smartphones capability in enforcing privacy [8]. This study clearly suggest that the elderly population is not completely closed off to the unfamiliar paradigm of using smartphones, but with improvements made with focus on the design of usability issues, elderly adults can and will come to adopt the use of mobile reminder applications into their daily life routines.

DESIGN

User Interface

The area of user interface design now plays a crucial role in enabling the wider acceptance of mobile applications for the seniors. There are many aspects that are taken into consideration when designing an application that will be used by an older age group. First and foremost, the font sizes have to be large and legible. Findings have shown that to achieve best reading speed for seniors, font sizes should be at least 14 points in columns that are 4 inches wide or 12 points in columns that are 3 inches wide. Visually, fonts in the sans serif group should be used when designing for elderly to create better sensing limitation. With each buttons in the application, the size to adhere to should at least be 180 by 22 pixels. In order to keep the interface design as concise and clean cut as possible, typing should be cut down to minimum and greater emphasis should be placed on users making choices. Overall, good design technique such as grouping and consistency should always be applied to the application. By putting these techniques into action, the application will be much more suitable for the targeted elder audience it is meant for.

Design Flow

As described in the study conducted by the Taiwanese researchers, seniors are indeed willing to learn to adapt to the new technology if incentives are strong. For many currently available reminder applications out in the market, reminder applications are not designed in such a way that places a great emphasis on the needs of the elderly patients, but rather designed as a general application for the public. Individuals who would like to create reminders for themselves more often than not has to tread through a series of long winded forms just to setup one reminder for a single pill they are currently taking. With most seniors consuming more than three types of medications during the treatment process, the tedious nature of creating and managing multiple reminders can become a source of frustration. Once an aversion takes root, mobile application will soon be neglected as a mean to

enable seniors control over their daily regiment of pill taking. The purpose of this application is to reduce the hassle and the stress that is involved in seniors sticking to their sets of medication regiments. To see the effect that application can have upon the patients life, lets first create a scenario. Imagine a patient obtaining a new batch of pills at the local pharmacy one day. The pharmacist who is assisting the patient pulls up the patient profile on the computer. With each new pill bottle purchased by the patient, the pharmacist scans the bottle then enters the information regarding the pills proper dosage time, dosage amount, drug intake description, etc. into the patients profile. All the information that the pharmacist has entered then syncs with the users smartphone if one is available. If not, the user can still access all the information through the patients profile online. This way, the hassle and the confusion that often comes with setting up reminders would be removed for the patients themselves. This is not to say that users will have no say in how to manage their reminders. It is taken into consideration that most medication regiments, though there are guidelines, are often not set in stone. That is to say, patients themselves can have the freedom to manage the schedule to their convenience while sticking to the medications most necessary requirements. If there are indeed changes that patients themselves find necessary to modify, the patient can access the created reminder through the reminder icon of the application. There the patient can add and edit any reminders that they already have in place and provide additional reminder or notes that the patient would like to see. Any and all modifications that can be made on a smartphone version of the application are also available through users online profile. Once the reminders are all set in place, upon due time, a reminder dialog would appear on the patients mobile device. The dialog would include picture(s) of the medication(s) that the patient need to take at the moment, what the medication(s) need to be taken with, how much to take, and possible warning regarding drug interaction. With a simple touch of the screen, the patient can either indicate that they have taken the medication(s) or they would like to skip the medication(s) for now. If the patient does not have access to a smartphone but a regular cell phone, the patient will then receive a text message providing the same information. Since the application can account for patients drug inventory, if and when the patient is running low on certain medication(s), warning will be issued to the user. The user can then seek to refill their medication once the desire to purchase has been indicated and the application will then assist the user in auto-completing the online refill form. If the information needed is too personal, then the patient can choose to send an email to their pharmacist or the doctor. The pharmacist can fulfill the patients request or contact the patient directly to talk through the request. The doctor can have the final say in whether or not the patient should continue using the drug or a new drug should be administered to the patient. This way, patients can avoid the dangerous pitfall of either taking expired medication or running out of medication all together. With the valuable data being collected as the patient continues to use the application, the patient can use this as a tool to communicate possible concerns that they may find with the drug or convey with certainty the drugs effectiveness in

the curing of ones disease. If the patient wishes to do so, they are able to grant certain individual(s) permission to access the patients drug taking history, but all is still within the control of the patient whether or not they would like to disseminate this information. The applications schema has the potential to ease a lot of frustrations that come as a part of keeping track of ones health. It does not in anyway coerce the patient into taking medication, but instead act as an assistant in helping patients get through daily sets of important tasks on a timely manner.

Current Work

The first rough prototype of the application has been developed. There is still much improvements to be made upon version one of the final design scope, but it is equipped with a set of functionalities needed that will be able to give users a preliminary glimpse into how the application should work in the later stages of development. As it currently stands, the medication reminder application consist of four main areas of functionality. They are:

- Today - Displays a list of pills the user is line up to take for the day. If the pill has been taken, it would be indicated by a check next to the name of the pill in the list view. The user can also preview their future medications schedules by opening a calendar and selecting any given day.
- Reminder - Contains an up to date list of medication reminders the user have already created. By selecting any reminder, the user can easily manage and edit the reminder accordingly.
- Pill Identifier - Helps the user identify the pill they are searching for. The finder conducts search of a prototyp medication database. To help with the identification of the drug itself, the user can filter the pill search through specifying the pill's imprint, color, and/or shape.
- Medications - Holds a selection of medications that the user has created reminders for and tracks the number of pills remaining for different medications the user have available.

If the user wishes to manually create a reminder for the pill they have recently obtained, they can navigate to the "Pill Identifier" icon and search for the pill in that fashion. Once the correct pill has been identified, the user can choose to create a new reminder for the pill by entering the necessary informations such as dosage amount, dosage time, starting period, and ending period, etc. When a reminder has been successfully created by the user, the newly generated reminder will be inserted into the "Reminder" section of the application. The "Today" section will update itself to incorporate the pill either into the current day's schedule or some set of future dates. The "Medication" section will also be notified of the newly added reminder for the pill and add the pill and information regarding the pill amount into its data set. Throughout the day, when the time has been reached to take the pill, a pop up reminder will appear on screen notifying the user to take the pill. All the information that has been recorded will persist between each usage of the application,

so users need not worry about loss of data. Thus far is where the application currently stands.

FUTURE WORKS

With the basis of the application design in place, there are still much improvements and additions to be made towards the application to provide seniors more incentives to put it into use. Given a patient who partakes in 10 or more pills on a daily basis, the chances of the patient heeding to 10 separate alarm reminders is not very likely. In fact, it could be a major cause of frustration. To reduce the amount of interruptions the application creates throughout the day, a scheduling algorithm would be utilized to condense the number of interruptions for the user by grouping multiple pills into few reminders.

Also, the applications ability to enact context aware decisions can also greatly reduce the annoyance that comes with reminder alarms. The application will incorporate the use of sensors to detect the optimal time to deliver pill reminders to the user. For example, if the application can sense that the user is currently driving, it will be intelligent enough to hold off the reminder until the fast movement has stopped. Or, if the user is currently on the phone having a conversation, the application will also be made aware of the situation and know to sent the interruption once the call has ended.

Once the patient has received a reminder about the pill they should be taking, confusion on taking the correct pill can arise since so many pills have very similar looks to them. In order to prevent users from wrongly taking the pill, a pill identifier would become a very useful tool in solving this particular issue. Simply by taking a snap shot of the pill you are about to take, the identifier will be able to verify what the drug is and if it is the one that correctly matches what the reminder requested the user to take.

Other improvements that will enable greater user acceptance may include providing the application to run in multiple different languages, having a voice over guide available for seniors to use in helping them navigate through the application, and offering tutorial videos so that the user can visually learn how to operate the application. Besides the additional functionalities described above, it is noted that there will always be room for improvement for an application of this nature and work will continue to be put force in making the application more optimal at all stages of development.

DISCUSSION

One question that is often raised about the application is that the application has definitive way of knowing whether or not the user have actually taken what they are suppose to instead of simply checking off on the application in order to use as false evidence when or if family members come to inquire about the patients medication history. Though this indeed is an important issue to take into consideration, it is not the aim of the application itself. The application is not designed as a monitoring system for patients, but rather, it is to enable them greater control over the management of their own health without the constantly needing assistance from oth-

ers. Therefore, in regards to this concern, the choice has been made to not turn it into a monitoring tool. Second issue that comes into discussion is on the topic of user privacy. The application always emphasize user control by allowing them to make the decision to share whatever and however much they desire either with their family members or doctors. As the applications development progress, it is always made clear what the application is meant to do, which is to assist people, and what it is not, which is to monitor.

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Figure 1. Pill identifier search



Figure 2. Search result for pill



Figure 3. Reminder dialog

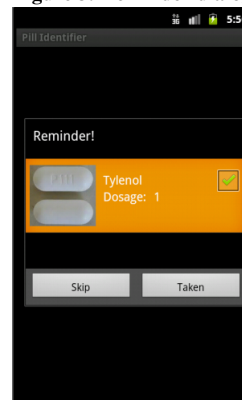


Figure 4. Pills to take for the day

