

Title and Abstract

Approximately 70% of Americans are on at least one prescription drug, with seniors making up more than 40% of those prescriptions and this high volume of prescription medications, as well as over-the-counter medicines used, increases the likelihood of potential mistakes. Caregivers have to keep track of medications, doctor appointments, phone numbers, and all the emotions that come with being safe and healthy for their patients or loved ones, making this very much stressful. That's where we come in, this app lets caregivers get real-time updates on their patients' medications and symptoms. While there are many planner apps, our app will connect to Bluetooth medication caps and will tell the user when the medication was last opened and alert them if the medication is late or was opened too early. We will evaluate our system by giving user testers caregiving to-do lists and surveying their stress before using the app to help plan and after they use the app.

Introduction

To keep tabs on different kinds of medical prescriptions, it is important that some kind of system is used to manage all of them so that no dosages will be missed which could cause medical complications. This is especially true among the elderly. Thus creating such a system that could automate this process could easily benefit them as well as those who are involved such as the caretakers. This system should also be useful to any kind of user.

The project involves creating a 3D-printed Bluetooth capsule cap that helps a user to track the dosages taken per day of a particular medicine. This tracking is done with the help of both hardware and software. If the cap was not opened, it meant that the user did not take the medicine and a reminder will be sent to the user. The software part also includes a separate login for the user as well as the caretaker if required with different settings available for different users. The software app will also contain a chat feature that will help the user to interact with the caretaker in case of any emergency. A nice feature to have is the scanning of medical prescriptions and storing the information automatically. Prescriptions can also be added manually. The project is a success if the target users, especially the elderly, can take their medication or the medication of the person they are caring for, hassle-free, without forgetting any dosage.

Background / Review of Past Work

Medications are widely used by many people. Our goal for this project is to provide a medication management platform that can assist both patients and caregivers. Caregivers are a vital part of our target users. For this reason, we have provided 3 published research papers regarding the roles of caregivers.

In addition to these papers, there are some existing medication management applications but they all have differences. One app is PillBox for iOS developed by Wachanga LTD. This app provides medication reminder notifications for prescriptions that are imputed by the users but it lacks many of the features of our app.

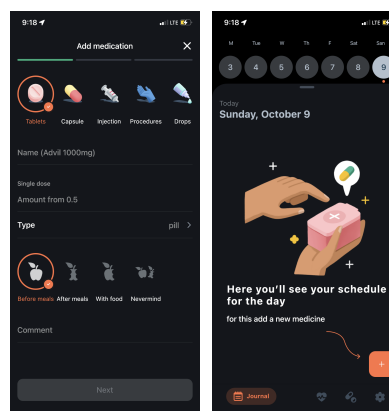


Figure 1: Screenshots of the Pillbox Medication Management in Action

Another app is Medisafe Medication Management developed by Medisafe Inc. for iOS. This app provides more in-depth features than the previous app such as caregiver support and health trackers which can be seen in the figure below.

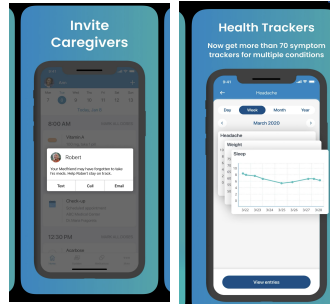


Figure 2: Examples of Medisafe app features

This app differs from ours because it does not use any sensors. Lastly, there is also an app called Tracker by Careclinic Software. This app also tracks medicine but mainly focuses on overall health tracking than medication management. There are also two more published papers that provide valuable insight into the role of mobile applications in healthcare and medication management in Germany and Korea. The first discusses the use of mobile in medicine education. This differs from medication management but medical education is important for the role of a caregiver. The second article assesses the effectiveness of health apps used by middle-aged people. These papers provide information that could be important to use as a reference in order to develop an effective application.

Target Users

For this project, we will be focusing on people caring for a loved one and individual users. All the target users and their needs are as follows:

- A. Licensed Caregivers
 - 1. Track medications for multiple people
 - 2. Get notifications for late/missed medications
 - 3. Keep contact information for patients, nurses, doctors, loved ones, neighbors, etc.
 - 4. Take notes
 - 5. Communicate with the people they are caring for
 - 6. Get mental health resources
 - 7. Communicate with other caregivers
- B. People caring for a loved one
 - 1. Track medications they may not know about
 - 2. Get notifications for late/missed medications
 - 3. Keep contact information for patients, nurses, doctors, neighbors, etc.

4. Take notes
 5. Communicate with the people they are caring for
 6. Get more knowledge about being a caregiver
 7. Get mental health resources
 8. Communicate with other caregivers - licensed and unlicensed
- C. Individuals tracking medication
1. Track medications
 2. Get notifications for late/missed medications
 3. Get mental health resources
- D. Nurses/Doctors
1. Read caregiver notes
 2. Get a chart of how often medication was taken to find any inconsistencies

Formative User Research

Introduction

We conducted a formative evaluation using two qualitative methods and gathered user perspectives (in-patient older adults, carers, nurses) whose views were crucial in this developmental and early implementation phase. We decided to take two different approaches, one being a more generalized survey and the other being scheduled one-on-one interviews. The generalized survey was used to gather information on current practices to remember medications and track symptoms from a large number of users while the one-on-one interviews with specific users were used to understand their specific needs and current failings in greater detail.

Participant

For the recruitment, We first identify potential participants who may be eligible and discuss all aspects with them, ensuring comprehension and voluntariness, and subsequently obtaining verbal consent for participation. We have participants who take medications while the nurse and carer are interviewed one-on-one. These participants were selected to learn more about our target populations and how to effectively help them.

Participant Number	Type of Response	Medication Management Role
Participant 1	Survey	Individual taking medication
Participant 2	Survey	Individual taking medication
Participant 3	Interview	Nurse
Participant 4	Survey	Individual taking medication
Participant 5	Survey	Individual taking medication
Participant 6	Interview	Caregiver for family member

Procedure

When starting to plan for the qualitative formative research, first of all we identified the needs and figured out what do we want to learn from this research. In the second step we recruited the respondents (nurse and caretaker). A list of the questions including both open ended and closed form were drafted that matches our research objectives. We ensured that those questions are not biased and do not have language that might encourage participants to answer in a specific manner. Lastly we chose the setting for the interview, transcribe the audio files and then analyze the information. The data were collected mostly in two specific settings, one in the homes of the participants, and second hospital setting. We interviewed two people so it took about 40 mins, 20 mins for each participant. Examples of the questions asked during the interview include: What was/is the hardest part of caregiving/medication management, If you were feeling stressed or overwhelmed, would you know where to find resources for assistance or advice?, etc.

Data and Analytical Method

When collecting our data through surveys, we tracked all responses with Google Forms. Google Forms generated charts for each question which helped us with analyzing the results. When conducting our interviews, we took notes of each response. We also took mental notes of emotion and body language throughout the interview. All data, including reviewed documents, interviews (which were audio-recorded where possible), and observations were documented. This data allowed us to fully understand all the aspects that go into medication management, what are actually problems and what are just add-ons that should be seen as secondary to main features.

Formative User Research Results

Results from Survey

We were able to collect results from a total of 4 participants, to get a better understanding of more daily habits surrounding medication. The focus of the questions was to gather information on users current habits and to understand the effectiveness of those habits. We combined questions concerning the specifics of their habits with questions on their opinions of the medication process and where the most troublesome aspects lie. As our data shows, most of the current methods are not integrated applications but just simple alarms and some electronic noting.

Results from Interviews

We conducted two interviews. One person is a nurse and the other used to care for her mother. Our first interview gave us a professional perspective of how medication is managed in a hospital setting. The interviewee explained the digital report system used, and what resources they offer families going home with medications to manage. During this interview, I thought of something I had not before; images of medications. The interviewee explained why pill boxes may be difficult to use because most people are not able to differentiate their medications especially if the medications look alike. We also got more information about medication interaction and how important it is to keep track of, especially if you are taking 3 or more medications. Our second interview gave us a more personal perspective. This person cared for her mother during her time in hospice care. While dealing with the pain of seeing a family member sick, she had to manage medications and appointments, as well as track symptoms for the nurse. The interviewee used paper notes to track medication information, symptoms, instructions, and interactions. She stated this was not very effective as papers got lost or damaged. She explained that

resources were very slim. Doctors and nurses would send her home with hundreds of pages of notes relating to her mother's treatment and medications. She did not know where to go to get resources.

Conclusion

Based on our research, we learned that many individuals do not keep track of their medications but also forget their medications frequently. In our interviews, we learned how important it is to keep track of medication interactions, appearances, and notes from doctors and nurses. Going forward, we plan to add a feature that allows patients to upload a picture of their medication to keep track of medication appearances.

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Appendix

Original Pitch

Medication Management

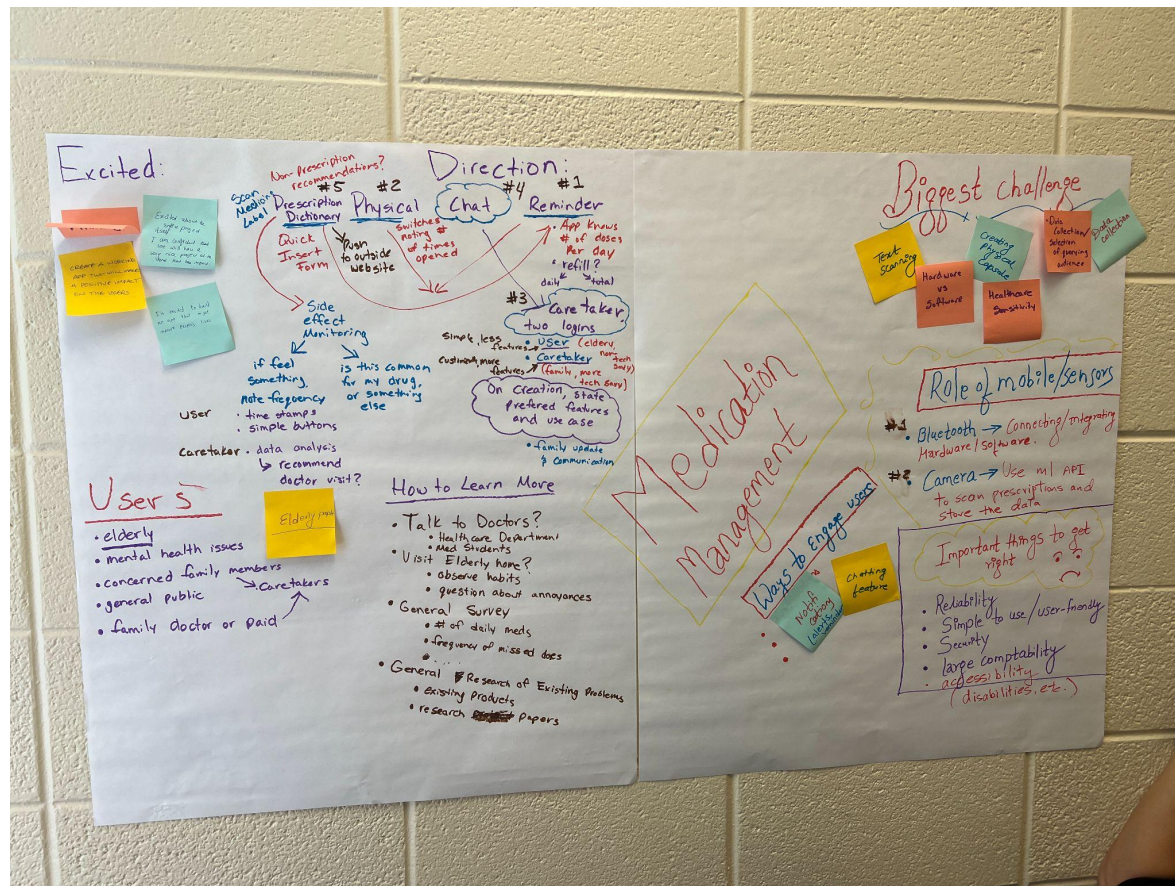
Providing real-time medication updates for caregivers and loved ones

Providing care for someone can be extremely stressful. Caregivers have to keep track of medications, doctor appointments, phone numbers, and all the emotions that come with being a caregiver. Becoming burnt out is extremely common [1], but caregivers truck through for the safety and health of their patients and/or loved ones. One way to combat burnout is with lots of planning, communication, and extra help [2]. Many caregivers are family members rather than professionals. Without background knowledge, “caregiving is like on the job training but no one has the manual”[3]. Seeing a loved one sick is heartbreaking, trying to stay strong and manage their healthcare is even harder. That’s where we come in. With this app, caregivers can get real-time updates on their patients’ medications and symptoms. While there are many planner apps, our app will connect to Bluetooth medication caps. The app will tell the user when the medication was last opened and alert them if the medication is late or was opened too early. Having a way to quickly contact neighbors, doctors, and other caregivers is also extremely important in providing care. Our app will put all these emergency contacts in one place, making it easier to contact anyone the user may need to call as quickly as possible. Being able to manage the difficult emotions that come with caregiving is extremely important. That is why we plan to have a forum, where users can read other caregivers’ stories, read studies, journal their feelings, and even privately chat with other users. We will evaluate our system by giving user testers caregiving to-do lists and surveying their stress before using the app to help plan and after they use the app. Planners and to-do lists can help, but our app will work hand-in-hand with the user to help lessen their stress. This app will provide caregivers with the manual and training the job did not come with.

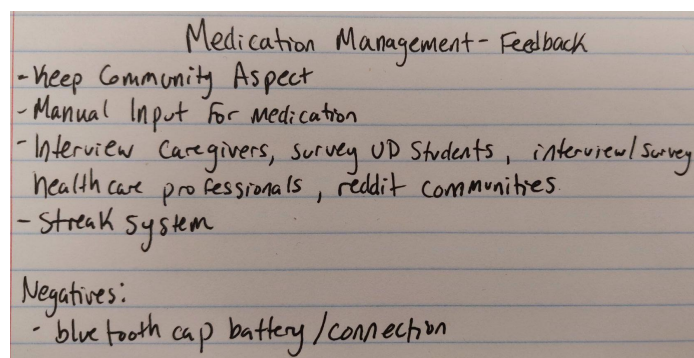
Changelog

Our project was initially about making an application to add prescriptions and keeping tabs on medication frequency with the help of a bluetooth device placed on a pill capsule. This has evolved to adding chat and correlation between caregivers and users to improve the experience as well as care given to the users. We also want to add a feature to allow users to take pictures of their prescription and have the application to automatically add it to their medication schedule by scanning it using a ML/AI api.

Brainstorming Notes



October 3rd Feedback Notes



Survey Data

- #### Medication Management Survey (Responses)

Interview Notes

Interview 1:

- 1: Have you ever had to manage medication either for yourself or someone else?
Yes
- 2: How many people have you cared for at one given time?
3-4 per shift
- 3: On average, how many medications do you have to keep track of per person?
Per shift, 6 medications
- 4: What tools do/did you use to track medication times/instructions/etc?
EPIC - electronic health record system, that tracks times they are due and administered, printed out for families
- 5: Have you ever heard of medication caps with timers? (show pictures)
No
- 6: Have you ever used them? Do you think they would be helpful for at-home management?
Yes, pill boxes may be confusing if medication is taken at different times. Patients may not know what the medication looks like so it could be confusing if they are not in separate containers
- 7: What was/is the hardest part of caregiving/medication management?
Easy at hospital
In-home setting, hard to keep track of what they look like when to take them, and interactions with medications
- 8: On average, how often did you/someone you were caring for miss their medication? This includes late or missing dosages.
Not often in the hospital setting
Easily 1-2 times during 7 week period for patients
- 9: If the person you are caring for misses a dose (including late), would you track this? If so, how?
Hospital setting, document time late, missed a dose - give asap after realizing it was late
Home setting, not sure, take next dose
- 10: (Healthcare professionals): For outpatient treatment, how can you tell if someone has been taking their medication properly?
Interview, can tell from symptoms, sometimes people admit to missing dosages, some parents lie, but there are some clear signs
- 11: If you were feeling stressed or overwhelmed, would you know where to find resources for assistance or advice?
Yes
- 12: Is there anything else you would like us to know about medication management?
Elderly population will have difficulty managing apps, hospital recommends apps for families going home with multiple medications, examples of what medication looks like, descriptions and diagrams on how to manage it, can print/save, can track through app.

Interview 2:

This interview is anonymous and is held for educational purposes. If there are any questions you would prefer not to answer, just say skip and we will move on. You may end this interview whenever you would like, no questions asked.

- 1: Have you ever had to manage medication either for yourself or someone else?
Yes, mom

2: How many people have you cared for at one given time?

1

3: On average, how many medications do you have to keep track of per person?

5 medications

4: What tools do/did you use to track medication times/instructions/etc?

Paper notes

5: Have you ever heard of medication caps with timers? (show pictures)

Yes

6: Have you ever used them? Do you think they would be helpful for at-home management?

Never used them, would be helpful

7: What was/is the hardest part of caregiving/medication management?

Managing everything alone

8: On average, how often did you/someone you were caring for miss their medication? This includes late or missing dosages.

Late 1-2 times daily, missed about 1 per week

9: If the person you are caring for misses a dose (including late), would you track this? If so, how?

Would not track, just take asap or if really late just wait for the next dosage

10: (Healthcare professionals): For outpatient treatment, how can you tell if someone has been taking their medication properly?

N/A

11: If you were feeling stressed or overwhelmed, would you know where to find resources for assistance or advice?

No

12: Is there anything else you would like us to know about medication management?

N/A