CSC 59867: Capstone Project Final Report

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Background

Drugs are the most common medical intervention and are crucial for the medical care of older people. Without them, many older people would not function well or would die at an earlier age. Senior citizens make up 12% of the U.S. population but account for 34% percent of all prescription medication use [1]. Almost 90% of older adults regularly take at least 1 prescription drug, almost 80% regularly take at least 2 prescription drugs, and 36% regularly take at least 5 different prescription drugs [2]. Adherence to prescriptions is extremely important for the effectiveness of the medication, however, 55% of the elderly are non-compliant with their prescription drug orders, meaning they don't take their medication according to the doctor's instructions. Not taking a drug, taking too little, or taking too much can cause many problems, especially in the elderly. Approximately 200,000 older adults are hospitalized annually due to adverse drug reactions [4].

In addition to keeping up with medication, attending regular doctor visits are also just as significant. Studies show that patients with a greater number of long-term conditions had an increased risk of missing general practice appointments [3]. Research shows that there are several reasons as to why missing such important tasks is so common in the elderly, such as problems in their memory, vision, general confusion, and even social isolation [4]. With memory loss, it is very difficult for the elderly to remember to follow a medication and appointment schedule, especially if they have many prescription drugs to take and many appointments to follow up with. Vision is also a problem because they may not be able to see the information regarding their medication, such as when to take them and how many to take, since they are often written in a small font on the medicine labels. They also may face general confusion about what the drug is for and why they should be taking it. Lastly, social isolation is a big factor in this issue because 28% of older adults in the US live by

themselves, meaning they don't have anyone with them to remind them of their medication or appointments [5].

In addition to our research of numerous articles, journals, and studies, we have also conducted our own interviews to understand elderly individuals and their relationship with medication and technology on a real-world level. We decided to focus on elderly people because they take more medications compared to other age groups, are more forgetful, and are also more at risk of adverse drug reactions making it more important for them to take their medications properly than any other user group. We interviewed 20 people in the age range of 65-75 about our features and app ideas. The questions we asked in our interviews were about their general experience with medicine, doctors, pharmacies, and applications on their phone. A majority of our users we interviewed thought that most apps are hard to use and stated that they are too confusing. All of them forget to take their medications, most of them forget often (over three times a week) and some forget occasionally (less than three times a week). Many of our interviewees mentioned that apps that have many hidden layers and pages are very confusing for them to navigate. They also mentioned that they prefer bigger-sized buttons and fonts because it will make it easier for them to navigate the app. Additionally, they expressed their difficulty in contacting their pharmacy, doctor, and getting a hold of their test results. Most importantly, most of them mentioned that they have a lot of medications and it is hard to keep track of them all.

It is evident that it is difficult for elderly people to keep up with their medical matters and there are many reasons as to why this is, but studies report that memory aids, such as reminder apps, can help them remember such crucial tasks like these [2]. This conveys a genuine need for a reminder system that is simple and easy to use, specifically made with elderly people in mind, so that they can be healthy and avoid

the effects of adverse drug reactions. Our user interviews, combined with research and data, helped us formulate this problem and thus come up with a solution to target it.

Statement of Problem

There are so many things one must remember for their day-to-day activities and as one grows older it gets harder to keep track of everything because life gets busier and one could develop a mental disease such as amnesia. Therefore we decided to create an app that would make it easier for someone to remember when to take all of their prescribed medications.

On a personal level some of us even struggle with taking just regular everyday vitamins which is why we came up with this idea. We wanted to make it easier for elderly people to be able to remember their necessary medications and when to take them. Instead of simply just setting multiple alarms we wanted to make a place where one can login to and see all of their medications and information about them such as dosages and what they are for in case they have forgotten.

Another problem that we wanted to eliminate was how hard it is to speak or get an appointment with your doctor or pharmacist. We decided to have an option that would automatically connect them with their doctor or pharmacist if they needed help.

Rationale of Solutions

Therefore, our solution of having a notification system can solve the problem of elderlies forgetting to take their medications because it would be a reminder to them to take their medications at a specific time. This will make the consumption of medications much more effective because of consistency and show great results. It will help with their physical well-being and give comfort while managing their health and healthcare goals. According to research, forgetfulness is one of the main reasons patients miss appointments and miss dosages of their medications [6]. Forgetting,

confusion over time, date, or location of appointments are some reasons why elderlies miss doctor appointments and it is very easy to forget to take medications while also carrying the weight of daily tasks and responsibilities. Research has shown that an average elderly takes about five or more medications per day based on their specific medical problem. Therefore, it can be difficult to remember which medications to take along with the dosage. In a lot of cases, new mediations are assigned every couple of months, making it even more difficult to remember and adapt to the change. Therefore, this problem can be solved through our app. It will make sure elderlies are taking their medications properly without feeling overwhelmed. Our method of sending notifications is a great functionality because research has also shown that reminders are effective because they act as cues to prevent memory failures. Studies suggest that 80-90% of patients have a positive attitude towards receiving a reminder and in healthcare environments, the use of these reminders is acceptable and feasible [6]. Forgetfulness continues to be a commonly cited issue within the elderly community and reminders have a more complex mechanism than simply jogging the memory. Other than serving as a reminder, our app's easy navigation system will help our elderly users make use of all the features within this app. In addition to sending notification reminders, our app will feature other functionalities to help regulate our user’s medical life. For example, our app will allow our users to view their doctor’s information and book appointments that work with their schedule. It will also notify our user’s when their medication is ready for pickup at their local pharmacy along with requesting a refill all within a tap of a finger. It will hold all medication information for our users such as the dosage and the purpose of every medication because we all like knowing what we are consuming and the reason for it. Lastly, we are aware of how difficult it is to get your hands on previous test results and reports. Therefore, our app

will also feature a diagnostic history portfolio where our user's past test results and reports will be stored so they can get access to it easily.

While developing this app, we have to keep in mind that the older generation might not be tech-savvy. A lot of times, many elderly avoid or dislike the use of technology simply because of its complexity. Keeping this in mind, our simple design with a lot of visuals and tutorials will help them navigate through the app effortlessly while knowing the functionality of every feature. Our use of light colors throughout the app that won't reflect too harshly on their eyes will make this app very comfortable to use. Other than the use of light colors, we will also make use of fonts that will be very easy for them to read with a consistent stroke width such as Sans serif fonts. Keeping the app to its simplicity is another factor we are prioritizing because having too many features and options can confuse our users. Therefore, we will also make sure to have our features available on the home page without having to navigate through multiple screens, as that can be a hassle for our users and make this app too complex. In addition to these, another aspect we will implement in our app is the use of symbols. Replacing simple text with symbols is an effective method of communication as they can speak more directly than words. As a symbol is worth a thousand words, they remain a powerful way to present information by quickly and simply conveying meaning and they are also universal.[7] Additionally, we will be partnering with different hospitals, nursing homes, and AARP to make our application reach a greater audience and get feedback from a wide range of users. Our partners will offer our application to their patients which can also act as a source of revenue for us. Therefore with all these ideas and implementation, this app will serve as a helpful tool to provide a healthy lifestyle to elderlies and help them maintain and manage their health successfully.

Design and Development of Systems

To design our application and create a wireframe and mockup, our team decided to use Figma, an application used to design and prototype softwares. Using Figma, we planned out how our app will look and how all the pages will be laid out. We made sure to design the app in a way that kept our users' needs in mind and used large, bold, and easy-to-read fonts throughout the application and kept a consistent color theme. To develop our application and bring it to life, we used Xcode, Apple's integrated development environment used to create iOS applications, combined with the Swift programming language. In order to collaborate on coding this project, we used a shared Github repository where we continuously worked on our own branches, and merged to the main branch when needed. We also used Cloud Firestore for our database during development, which is a cloud database from Firebase for application development.

Upon opening the app, users will have the option to login or sign up. After either logging in or creating an account, the user will be greeted with a welcome message on the home page, where they can see all their medications for the day, along with the time it needs to be taken, instructions on how to take it (i.e. with food, with water, etc), and an image of the medication to help the user easily identify them. On this page, users can mark their medication as taken by clicking the circular checkbox next to each medication.

The next page is the calendar page, where medication is tracked and users can view their log. The calendar is in a monthly format, where days may be highlighted in green, signifying that the user has taken all their medications that day, or red, which means that they did not take all their medication that day. Clicking on any specific day will show details about which medications they have taken or missed that day and the time it was scheduled to be taken.

Following the calendar page is the pharmacy page, which allows the user to contact their pharmacy by phone or text, and also displays general information about the pharmacy such as the name, opening and closing hours, and medicine available for pickup. This page also allows users to request a refill for their medication by selecting a medication and submitting the request. Similarly, the doctor page also allows the user to contact their doctor by phone, text, or email, and also displays opening and closing hour information, along with information about their upcoming appointments, such as the date and time. The doctor page allows the user to book a doctor appointment, where they can choose an available date and time that works with their schedule and book their appointment.

Lastly, the My Info page includes medical information about the user, such as their age, weight, height, blood type, etc. The user's diagnostic history and past lab results can also be viewed from this page by clicking the "View Diagnostic History" section. They can also view all their current medications by clicking "View All Current Medications". This page shows all the information about their medication such as dosage, instructions, purpose, an image of the medication, scheduled time, and frequency. They can also set the time they want to be reminded and how often the reminder is sent.

In addition to all the features mentioned above, there is also a tutorial on each page available by clicking on the help button. The tutorials are interactive so the users can learn to use the application and are also simple and easy to understand. We performed many iterations in both design and development to ensure the best possible value proposition for our users by taking their needs, suggestions, and opinions into account in each step.

Evaluation with Users and Partners

Since our app is going to be used by senior citizens we wanted to get their opinion on our app through all the phases. After we created our initial prototype as well as a couple pages that we had developed, we sent out a survey to family and friends that were either senior citizens or they knew of any. The first survey consisted of questions about how easy the pages were to use and how easy the functions of the overall app were. We also asked about which logo they preferred and if they had any additional feedback that they wanted us to take into consideration. The results we got for most of the pages were promising because they were in the **90% - 100%** range. However, for the home screen and the doctor page our users did not think that they were easy to use since the range was from **77% - 82%**. Finally, our current logo that is on our first page got **41%** so we decided to keep that one.

Our next survey was sent out based on the feedback that we got and it consisted of questions about the usability of the pages. We redesigned the pages that were not liked and the range of all the pages were **85% - 90%** which was very pleasing.

Finally, our last survey was sent after we developed all of our pages and again the survey consisted of how easy each page was. These results were perfect for our app since the range was **95% -100%** and we were confident that our users would have a great experience using it.

Discussion of Potential Markets and Future Work - Nayma

Our potential available market (PAM) includes 86.9 million which are people aged 40 to 75 in the U.S. Our main target audience are the elderly, which we have defined to be people who are aged 65+, however our potential available market includes a wider age range that may become our target audience in the future.

Although we believe that senior citizens may benefit greatly from our app, other age groups may also be forgetful and find it difficult to track their medication, which is why we made the decision to expand to this potential market. Our total available market (TAM) is more specific than our PAM and only includes people ages 40 to 75 in New York City, which creates a total market size of 6 million. Since this is where our team resides, we may start with NYC before making our application available on a national level. Our served available market (SAM) represents the users that are actually available to us and can reach through advertising, which is 75% of our TAM, making our market size 4.5 million. Finally, our served obtainable market (SOM) is 5% of our SAM and represents the users that we most realistically can acquire, which is 225,000 people.

In terms of future work, we would also like to start off our partnerships with a small hospital and pharmacy in NYC so we can begin benefitting our served obtainable market. After this, we also plan to expand our market to a wider age group, to include our potential available market of 40 to 75 year old people. In terms of future work in development, we would like to develop the application in an Android environment and release the application in the Google Playstore. Since our initial release only includes an iOS application, expanding to the Android marketplace will benefit a lot more users. Lastly, in the future we also plan on developing our application so that the user does not need to schedule the medication reminders themselves, so they can be reminded to take their medication automatically. For users who may have multiple medications they need to take, and especially for non-tech savvy elderly users, they may find it easier to be reminded automatically rather than scheduling reminders for all their medication on their own.

Branding

While keeping in mind how we can potentially come up with a name that speaks for the entire app, we first had to come up with a logo. While brainstorming ideas for our logo, we thought of objects or symbols that will define and represent our application most clearly. Our goal was to cater to elders who might not be tech-savvy, so having a color that is easy to spot with proper symbols representing the concept of medication and reminder was the main purpose of our logo. Therefore, we decided to use subtle colors throughout our app so that way it doesn't reflect too harshly on our user's eyes. We settled with the color Cambridge blue, as it sets a very calm and relaxed tone.[8] Cambridge Blue is a sort of green color that is related to nature, harmony, balance, and youth. It is a refreshing and soothing color that is associated with all things new and natural. It is also the color of life and flowering. It is one of the most neutral colors for viewing, meaning it does not strike our senses or bother our eyes as much. This was one of the main reasons we chose this color, as we didn't want to choose a color that would reflect harshly on our elderly user's eyes. Additionally, while doing our research, we noticed that a lot of apps in the market use a blue and white combination for logos. Though those two colors compliment each other very well, we think it has been overused which makes it hard to spot and differentiate one app from another.

We wanted our application to stand out from the rest, hence why we chose the Cambridge blue color. We also didn't see any app in the market with our color combination. Therefore, we came up with three possible designs of our logo that might work the best:

Figure 1: Logo 1

Figure 1 is the first option which displays a calendar with some days checked off a calendar to indicate a completed task with a medication bottle and a syringe, which symbolizes the concept of medicine. All three objects are outlined with a white border, differentiating the objects from the background.

Figure 2: Logo 2

This logo, which eventually became our final logo follows a similar route as the first one. However, we enhanced the background color a bit more while outlining the symbols with a black border. This defined the symbols more clearly while also making the logo neater. Though we still used the symbol of a calendar and a medication bottle, we changed up the styling of these objects to make it clear and for better visualization. We also got rid of the symbol of the syringe because we felt like it was unnecessary and made the previous logo a bit too crowded which can confuse our users about what the app does. Also, since we already have a symbol of a medication bottle, having a syringe would be unnecessary since it serves the same purpose.

Figure 3: Logo 3

Our third optional logo uses the same color as the previous one while consisting of some new symbols. Though it explores the same concept of medication and reminder, we wanted to take a different approach using new symbols to see which one our audience would prefer and which one better conveys the message of our application. This logo consists of a phone with a pill and a bell to symbolize the concept of medication and reminder.

We sent out surveys to see which one our user liked out of the three displayed above. As a result, the second logo with the calendar and medication bottle outlined with a black border received a vote of 40.9%. Therefore, prioritizing our user's wants and needs, we finalized the second logo to be the final logo for our application.

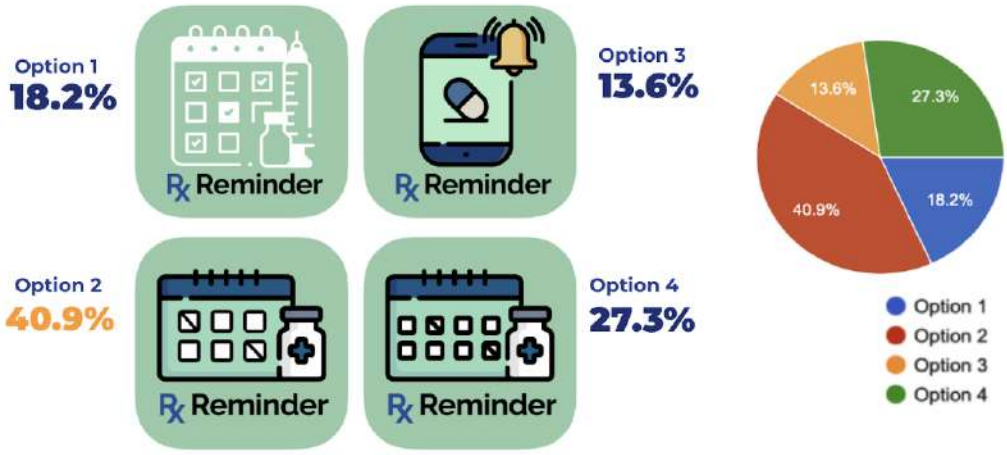

Figure 4: Survey results of all logo options

We needed a name for our application that is going to convey the message of our application without using too many words. Therefore, we decided to go with the name “Rx Reminder” as it is straightforward, only uses two words, and does a great job of letting any audience know or hypothesize what our app is potentially about. Without opening the app, any user would be able to tell just by reading the name and looking at the logo that this app is an application that sends medication reminders, which was our intention.

To make sure all the features in our application are easy to understand and navigate through, we also conducted various surveys among our elderly user groups. And based on those user surveys, we have received feedback that over **80%** of users believe that all of our pages are easy to use and believe that the app is easy to navigate through. To make navigation from one page to another very convenient for users, we also have a tutorial/help button on every page, which goes over the content that's on that page and how to use it along with the purpose. From the surveys conducted we found out that over **85%** of users believe that all of our tutorials are easy to understand. We also discovered that Over **95%** of users found our features to be useful. Whether it was the pharmacy, doctor, calendar, or my info page, our audience believed that all the features in our application were useful and served a great purpose. Additionally, the surveys also informed us that over **77%** of users believe that non-tech-savvy elders can use the app without difficulties. Initially, this number was a lot lower as some of our features seemed a little crowded. We solved those issues by creating new pages and putting all the pages accessible through the navbar instead of having many other options, as that can complicate the usability.

In addition to all that, readability is another aspect that we focused on. Our users must be able to read the content on our app. Because of this, we decided to stay consistent with the font throughout the app. We used only one font throughout the

app because an inconsistent font can confuse our users and make the content difficult to read. After doing some research, we decided to use a Sans Serif font type called **Montserrat** because it is easily legible and conveys simplicity. This font can also add a calming balance to any body of text. [9] Therefore, this font is perfect for our app as it will serve the purpose of easy readability without confusing our users while maintaining a calm setting.

Final Video Link

https://www.youtube.com/watch?v=U_89jtPRLgk

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Contributions of Individual Team Members

Since the beginning of last semester, all throughout planning the application, designing wireframes and creating mockups, and developing it on Xcode, the entire project has been a collaborative process among the three members and we have all worked on each part together through extensive meetings and work sessions. As a team we also took part in the Zahn Competition for Women’s track and became finalists. Our team also won $500 Zahn bux on final pitch night for getting the highest points in the following categories: presence on all Zahn boot camp meetings, meeting

etiquette, meeting all timelines and deadlines, customer insights, entrepreneurial ecosystems and prototype developments. This was the result of our great teamwork and contributions. In terms of individual contributions, here is the breakdown of our work:

Nayma

- Came up with the original idea of medication reminder app and the name Rx Reminder
- Conducted background research on users (elderly people and their relationship with medication and doctor appointments) and user needs
- Designed all iterations of app logo including the final logo
- Technology Solution Updates: conducted user survey for 22 individuals and created application mockup
- Branding and Interface Component Updates: Updated all UI components and features according to user feedback and created demo video for new interface
- Midterm Evaluation: completed development of MyInfo page, Diagnostic History page, and Current Medications page, also conducted survey for developed features
- Entrepreneurial Component Updates: worked on technology refinement for MyInfo page, Diagnostic History page, and Current Medications page, and added images of medications to homepage and current medication page, conducted customer interviews with 20 people for market research
- Assistive Application Evaluation: created tutorials for the application and conducted survey for 20 users to evaluate the tutorials
- Final Presentation: Worked on entrepreneurship section
- Worked on final prototype and editing final video
- Collaborated equally on all weekly wiki logs

- Collaborated equally on all Zahn assignments and presentations
- Parts in final report: Background, Design and Development of Systems, Discussion of Potential Markets and Future Work

Nour

- Conducted research on senior citizens in order to show why our app is needed
- Helped come up some functionalities and aesthetics of the application
- Helped set up the project on Xcode, GitHub, firebase
- Built the login, sign up, pharmacy page and doctor page
- Technology Solution Updates: thought of next steps based on survey results and wrote out a plan and worked with team to create slides
- Branding and Interface Component Updates: updated the UI based on our survey results as well as helped finalize the logo and worked with team to create slides
- Midterm Evaluation: finalized the development of login, sign-up, pharmacy and doctor page as well as created gifs on those pages and worked with team to create slides
- Entrepreneurial Component Updates: refined the login, sign-up, pharmacy and doctor pages as well and worked with team to create slides
- Assistive Application Evaluation: helped create the tutorial for the pages and worked with team to create slides
- Final Presentation: Worked on Technology Innovations and Branding
- Worked on final prototype and made sure everything was up and running on Github
- Collaborated equally on all weekly wiki logs
- Collaborated equally on all Zahn assignments and presentations
- Parts in final report: Statement of Problem, Evaluation With Users and Partners

Sanjida

- Did market research to get numbers for TAM, PAM, SAM and SOM to know the amount of people we can potentially and realistically reach out to
- Did research to back up our solution and why it makes sense. (rationale)
- Did research on competition and how our app stands out from the rest
- Helped come up with possible solution and functionalities of the app such as connecting to doctor, pharmacies and seeing all reports
- Technology and system development: helped set up the project on Xcode, GitHub, firebase. Developed the home page and the calendar page. Worked with the team to build and finalize the slides
- Branding and interface update: helped finalize logo and MVP product. Built some pages of the prototype. Worked with the team to build and finalize the slides. Created gifs of prototype and associated caption
- Midterm evaluation: finalized development of home page and calendar page based on user feedback from the surveys. Worked with the team to build and finalize slides
- Entrepreneur components: refined customer segments considering value proposition, users need, cost and revenue. Worked with team to prepare slides and refined technology based on user feedback
- Assistive application evaluation: Did research on competition and how our application stands out among the rest in the market. Worked as a team to refine and build slides for presentation
- Final Presentation: Worked on Assistive Applications and Acknowledgments
- Collaborated equally on all weekly wiki logs
- Collaborated equally on all Zahn assignments and presentations
- Created and edited video for Zahn Competition.

- Prepped and completed all requirements prior Final pitch night
- Edited and finalized final YouTube video
- Parts in final report: Rationale of Solution, Branding