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Curo — Patient home recovery guide for stress-free and better recovery after hospitalization

Khushboo Rajesh Agarwal

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Fine Arts in Visual Communication Design

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School of Design
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August 14, 2019

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Abstract

The transition from in-hospital illness management to self-management exposes patients to many risks such as inadequate training before leaving the hospital and medication errors which can lead to patient re-hospitalization. Effective care after discharge can improve patients' health, reduce chances of re-hospitalization and decrease healthcare costs.

A patient leaves the hospital with a complex and verbose discharge summary. Once home they rely on this discharge summary to guide their recovery. Most of the printed summaries use medical jargon that informs the clinicians more than the patients. To help patients understand better, nurses go through the discharge papers with the patient and caregivers orally. Still, patients find it difficult to process and remember all this information. It becomes overwhelming. This makes them unprepared to manage their care at home. Often times the delicate mental and physical condition of the patient also contributes to the loss of information. All these factors open the opportunity for design intervention for the cause of better post-discharge patient care.

This thesis provides an auxiliary design solution that provides patients with timely, easy to follow information without overwhelming them. Patients would focus on monitoring their health alone rather than struggling to understand complex hospital instructions. The interactive system serves as a guide that helps patients on their road to recovery. Finally, this thesis endeavors to make the process of patient recovery an easy and stress-free journey.

Keywords

Healthcare design, discharge summary, user experience design, interaction design, patient care

Introduction

A patient is discharged from a hospital when they no longer need inpatient care and are medically ready to go home. Discharging a patient usually is a multi-step process which focuses on prescribing medications, giving activity and follow-up care guidelines, and, follow-up scheduling with medical team. This discharge is a complex process for patients, caregivers and healthcare providers leading to critical risks impacting patient health outcomes that often lead to readmissions and ER visits. The hospital readmission rates for U.S. is 14.9% [1]. Patients returning to the hospital after a short period of time after discharge is very costly. Hospital readmission within the first 30 days after discharge accounts for more than \$17 billion in avoidable medical expenses [2]. In March 2010, the Hospital Readmission Reduction Program was passed (included in the Affordable Care Act) which applies financial penalties to hospitals that have higher readmission rates than expected for selected clinical conditions [3]. This has made hospital systems work toward creating strategies for reducing 30-day readmission rates.

Problem Statement

Poor discharge communication and coupled with the expectation that patients will remember critical information on self-care poses a steep challenge for patients going home after hospitalization which can lead to hospital readmission. While some readmissions are unavoidable, many are preventable and are indicators of quality of care received at the hospital. Studies have shown that effective discharge planning can significantly improve discharge outcomes and reduce hospital readmission rates [4]. Preventable readmission related issues like confusion about how, what and when to take medications, miscommunication by the hospital to the patient's primary care providers regarding critical health information and test results, and, unclear and inadequate discharge instructions on self-care; leave the patients and their caregivers underprepared for providing proper patient care at home [1]. Efforts need to be made to overcome these issues and reduce readmission rates.

This thesis focuses on studying the discharge process and leveraging that knowledge to create a viable product that can assist in effective discharge and reduce preventable hospital readmissions. This will be accomplished by using design thinking to create a mobile application that will facilitate fluid transfer of discharge information to patients and caregivers for better treatment adherence without overwhelming them.

Context

A patient's journey starts with the day they were told about the problem and that they needed surgery. After consultation and pre-hospitalization visit to the day of the surgery, patients have a lot of paperwork and procedures to understand combined with the stress and anxiety of the surgery. During the discharge process, the medical team will typically discuss the following with the patient and their caregivers — patient's medical condition at the time of discharge, follow-up care requirements such as physical therapy, what medications to take, when and how to take them, possible side effects to watch out for, how to dispose medicines no longer in use, getting access to any medical equipment needed, how and when to receive test results, instructions on exercises, food, drink, showering, wound care and other activities, things to expect at home or at a new care facility, instructions about who to contact, and, information about follow-up appointments [5]. After discharge, the patient leaves the hospital to go home or to rehab with a discharge summary. This summary outlines the do's and don'ts after surgery, medication lists, follow up schedule, hospitalization summary, etc. It also serves as a direct communication to the patient's primary care provider about all the information to ensure the continuity of care between hospital and general practice.

This discharge planning process is a common protocol at many hospitals that allows the development of individualized care plans for reducing length of stay and unnecessary re-hospitalization. Yet, the impact of this discharge planning has had mixed results on patient health outcomes [6]. Key challenges include poor understanding of patient's medical condition [7] and inability to access required health resources [8].

To close the gap in care and help patients transition to self-management after hospitalization, three key factors identified were knowledge, resources and self-efficacy [9]. This thesis expands on these key elements through design interventions to support unmet patients needs and reducing overall healthcare costs.

Methods

Understanding the discharge process

Though there are many unavoidable causes that lead to re-hospitalization, many are preventable and result from inadequate patient preparation [10] and patients not knowing what to expect at home after surgery. The initial approach to solve this problem was conducting literature reviews and interviews with physicians helped create a storyline of a typical discharge process. It was discovered that discharge

processes differ from hospital to hospital and different surgical procedures introduce variance into this process. A discharge summary, that is handed off to the patient while leaving the hospital, is the most critical part of any discharge process. It catalogues and acts as a reference for any future medical interventions. The style and format of these discharge documents may be unique to each institution but the information contained within remains consistent across institutions. To simplify the process and due to limited resources, two de-identified discharge summary papers were obtained from 1 institution (Figure 1). One contained information about a simple surgical procedure and the other one described a medium to complex procedure. It was observed that a large portion of the discharge summary contained information especially for primary care providers for continuation of care and used medical jargon. This meant that patients would have to carefully examine all the papers to find any relevant information.

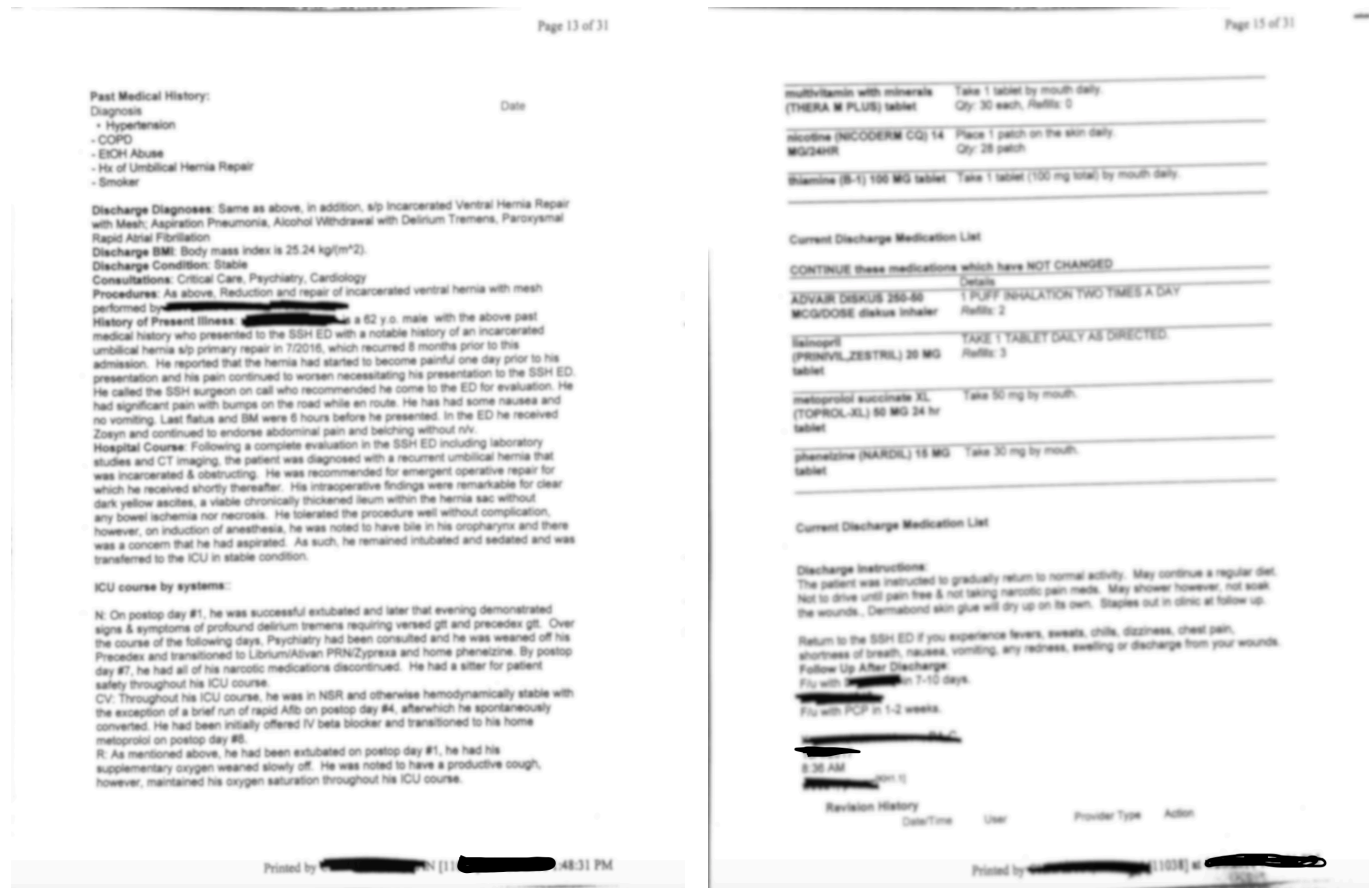


Figure 1: Two Sample Pages from a 31 Pager Discharge Paper (Blurred for Privacy)

Understanding the users

A young mom of two with no prior health issues may need a kidney surgery as much as a 70 year old man suffering from prolonged diabetes. With a wide variety of people needing surgery, it was hard to classify patients into specific personas. Instead, the approach was to focus on a patient pain points and motivations that would drive the design of this thesis.

The following are patient pain-points:

- Discharge summary is verbose and uses medical jargon.
- Insufficient understanding of diagnosis and treatment.
- Medication errors like missing or taking wrong medication.
- Forgetful and confused about do's and don't after surgery.
- Lack at home support & guidance from medical team.
- Delayed or missed follow up appointments.

The following are patient goals and motivations:

- Want to be better informed to act efficiently in case of any issues.
- Avoid staying at the hospital when care can be managed by self
- Having a system that reminds to take medications and go to appointments
- Getting medical support at home

Prioritizing information based on patient needs

To make sense of the data gathered from the discharge summaries and keeping the pain pain-points in mind, commonalities were mapped to define, sort and prioritize the information given to the patient. This exercise resulted in the following hierarchy of information that guided the rest of the project.

Primary Information

Medication

- Medication lists
- How to take meds
- When to take meds
- Dosage

Discharge Instruction

- Activity

- Diet
- Driving
- Bath/Showering
- Incision Care
- Exercise
- Other Instructions

Return to Hospital if

- Signs & Symptoms
- Emergency contacts

Follow Up Appointment

- Name of PCP
- Date and Time
- Emergency contacts

Secondary Information

- Emergency Contact
- After Surgery Immediate Symptoms
- Discharge details
 - Discharge Physical Exam - Vitals, etc.
 - Date Admitted - discharged
 - Past History
 - procedures
 - Discharge Diagnosis
 - Admission Diagnosis
 - Consultations
 - Where to buy medicines
 - Old medication records

Design Ideation and Explorations

Exploring Conversational Interfaces

Conversational interfaces are based on the idea that if a machine can give the impression to other humans of being human itself [12]. Conversational interfaces including virtual private assistants like Apple's Siri, Amazon Alexa have become increasingly popular owing to its speech and image recognition

abilities, usability and increasing plethora of connected devices. In order to present patients with critical information in an effective and digestible manner, the thesis explored conversational interfaces as a possible solution. The following are the initial sketches and wireframes (Figure 2-4) for designs exploring conversational interfaces.

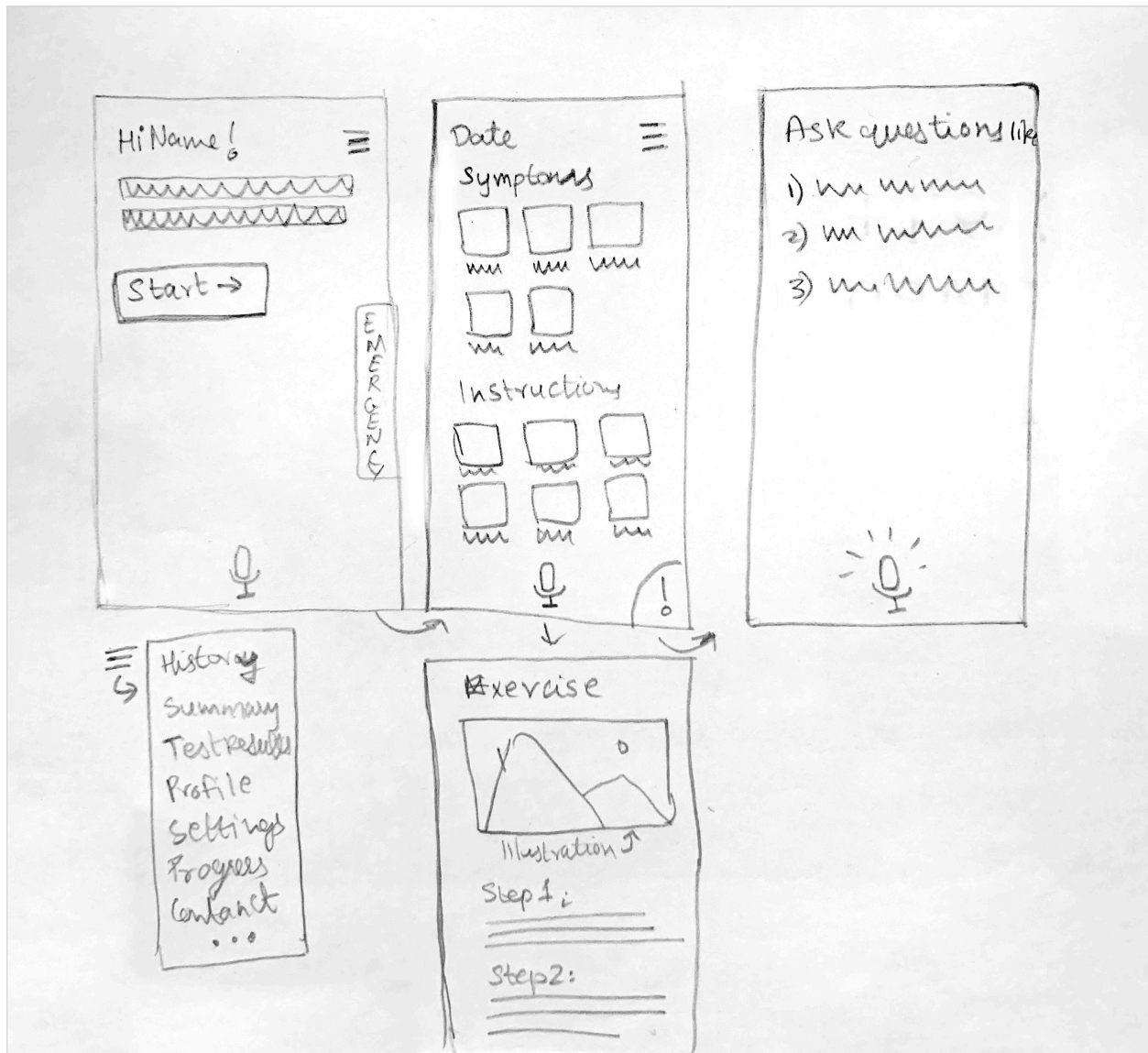


Figure 2: Initial Sketches for Conversational Interfaces

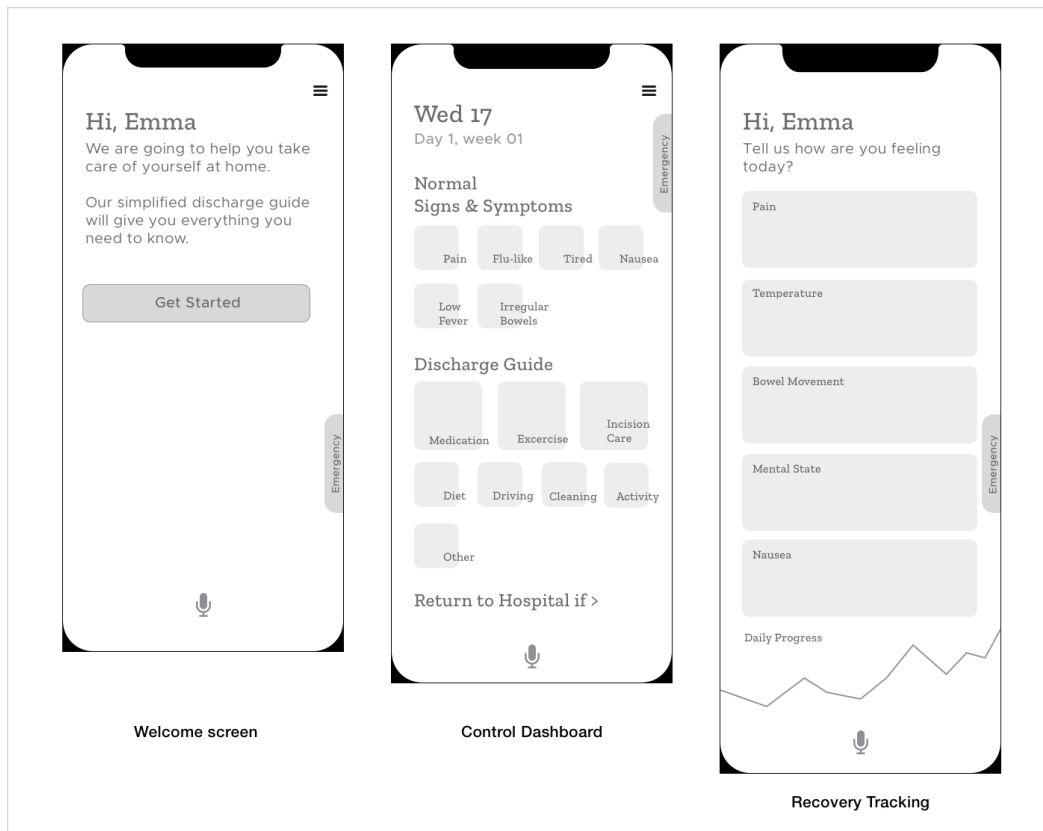


Figure 3: Exploring conversational interfaces - route 1

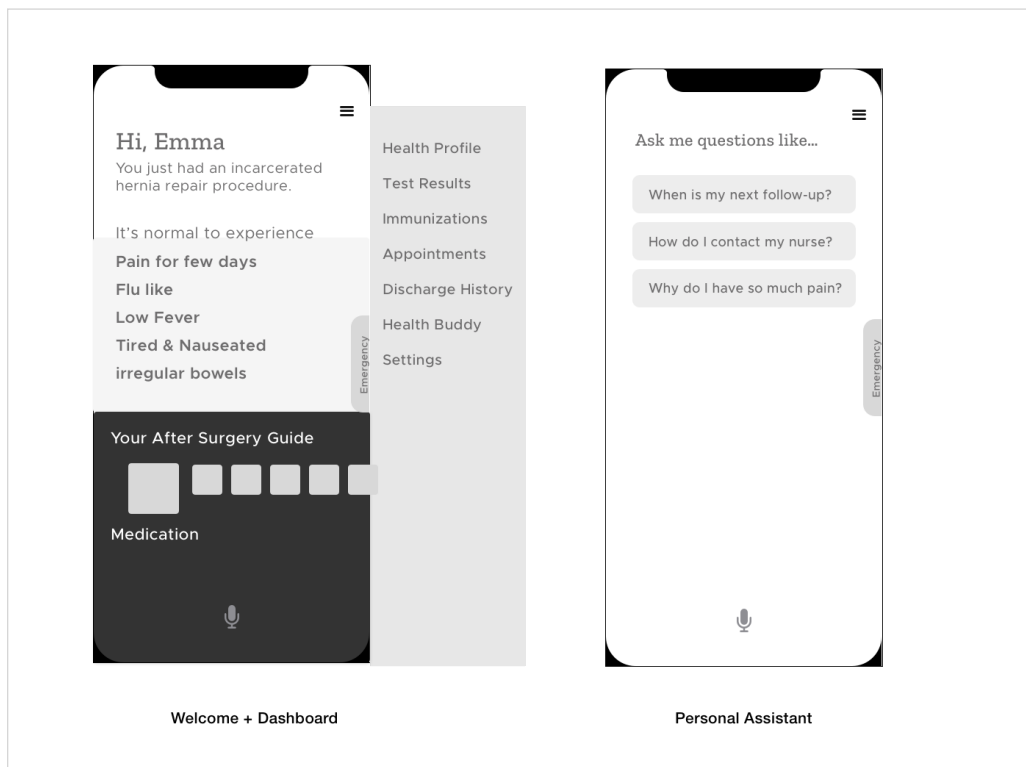


Figure 4: Exploring conversational interfaces - route 2

Challenges and iterations

To evaluate the initial wireframes, feedback was gathered from thesis committee members and fellow students on where this approach was solving for the problem. This evaluations suggested that it was difficult for patients to know what and when to ask relevant questions. The users would also be left on their own as to what action to take and when. The thesis needed a system that provides an itemized plan that's easier to follow than to ask questions to a bot or dig through the app for relevant information.

To break the information into digestible chunks that tells the users what to do and when to do it, the thesis took to a new approach where the users will be provided a daily plan that's comprehensive and easy to follow. Each day, specific tasks and health checks will be assigned to the patient so that they always know what to expect and when to do recovery activities like taking medicines, physical therapy, etc. Other secondary information will also be made available at all times without diluting the daily plan. The information architecture (Figure 5) demonstrates the information hierarchy and the application flow for each day. This idea was validated with the same group of evaluators as before who came back with a favorable feedback.

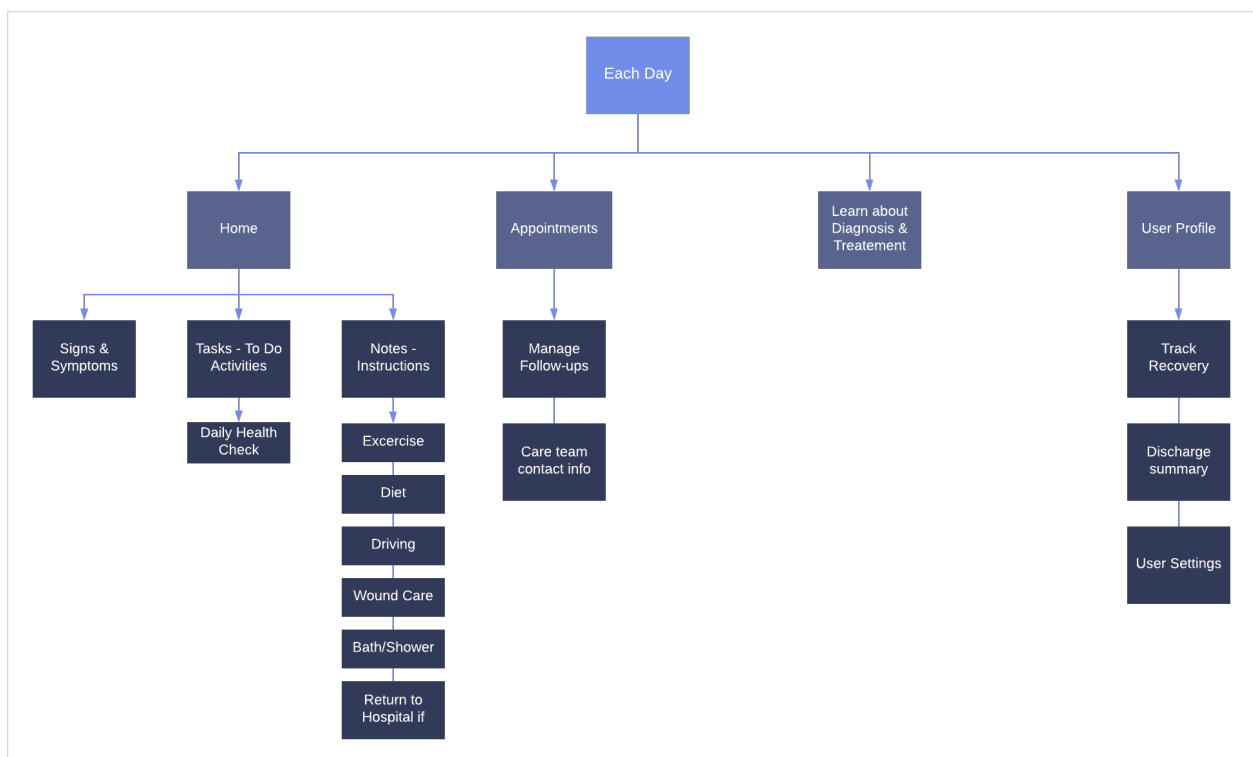


Figure 5: Information Architecture for the App

Results

Introducing a mobile application (Curo) designed to actively engage patients in self-recovery and improve patient care by providing comprehensible discharge information, recovery management tools and enabling at-home patient monitoring for catching warning signs sooner to reduce ER visits and readmissions. Since the scope of this thesis is limited, the thesis assumes that the patient's medical team will own a sister application for remote patient monitoring that is linked to the patient's Curo account. Hence, only the patient-facing application has been conceptualized and designed.

The following features that highlight the core functionalities of Curo.

Manageable discharge instructions

Discharge summary is long and verbose as seen in Figure 1. All discharge instructions and information relevant for the patient is interwoven with medical information for primary care providers and hospital staff. This makes it difficult for the patient to find any self-care information without careful examination of the discharge papers. Curo (Figure 6) makes the discharge summary straightforward and presents relevant information to patients in a manageable and easy to follow daily plan. The patients will be able to skim through the app (Curo) and look at various topics of interest without having to go through each page of the printed discharge summary. The app also uses plain language that patients can easily understand instead of the medical jargon commonly used in discharge papers. This solution puts the patient first by focusing on patient relevant information first and as a result will reduce the cognitive load on the patient.

The information is broken down into the following parts.

Symptoms & signs — know what's normal and signs to look out for at home

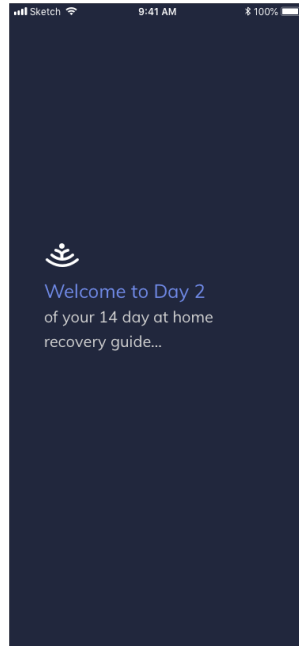
Checklist of daily tasks — medication and activity management, helps patient follow a daily plan of action

Do's and don'ts for recovery — post surgery exercise, diet, driving, wound care and bath guidelines helps patients understand exactly what they can and shouldn't do after surgery

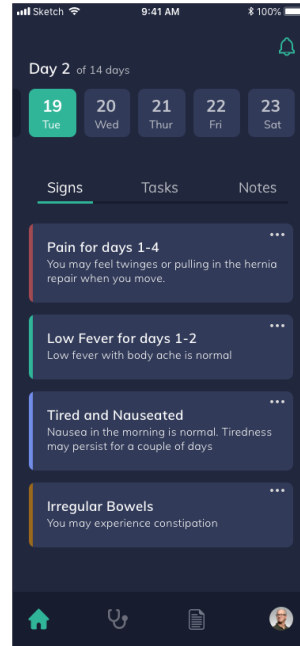
It also provides information on signs to watch out for and return to the hospital if necessary.



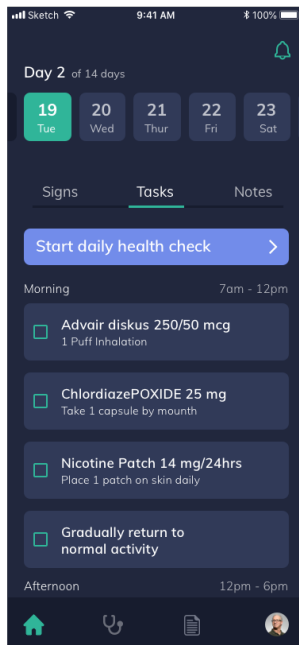
Intro



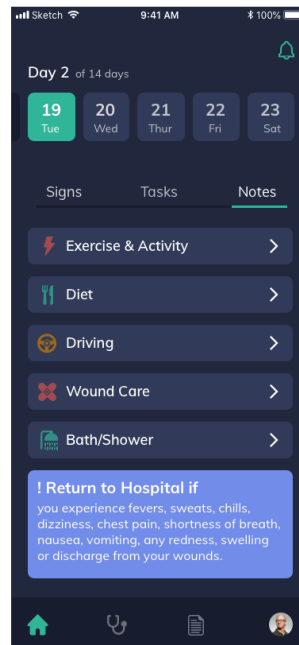
Welcome



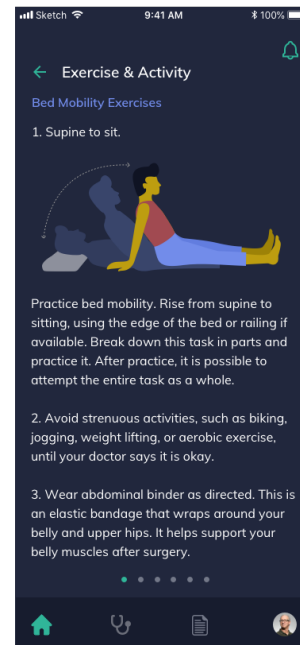
Know Signs & Symptoms



Perform Recovery Tasks



Learn do's and don'ts



Exercise guide

Figure 6: Screen Designs - Introductory, Symptoms & Signs, Daily Tasks, Do's and don'ts for recovery

Daily Health Check - Track recovery and detect risks early

Patients are susceptible to nosocomial infections and other risks after surgery. The printed discharge summary is limited to pointing out signs and symptoms that indicate the patient should return to the hospital. There is also no way for knowing if the patient is recovering as expected. Hence, through daily health checks the app provides a way for patients to track their recovery, know how they are recovering, and gives them tips on better self-care. All this information can also be sent back to the patient's medical team who can then initiate timely action in case of any issues.

The daily health checks (Figure 7) comprise of 5 to 10 questions depending on the type and complexity of patients recovery plan. Each question will be designed by the medical team that help detect infections and track recovery progress. At the end of the questions, the patient receives a recovery score and relevant tips.

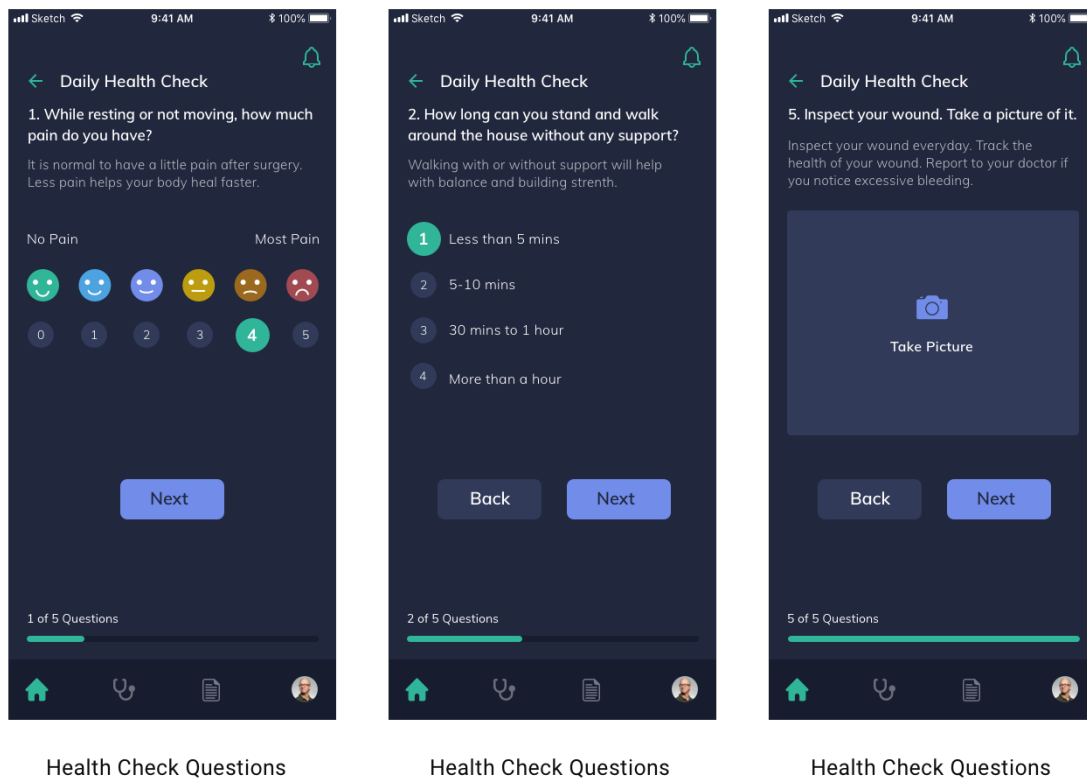


Figure 7: Screen Designs - Daily health check

In the user profile, patients can see a visualization of the recovery scores and view past daily health checks. This direct interaction with the patient to track recovery isn't possible through a printed discharge summary, making this design solution a valuable asset for personalized patient care.

User profile also houses an abbreviated version of the printed discharge summary that is patient relevant (Figure 8) so that the patient can find details about their hospitalization and medical history.

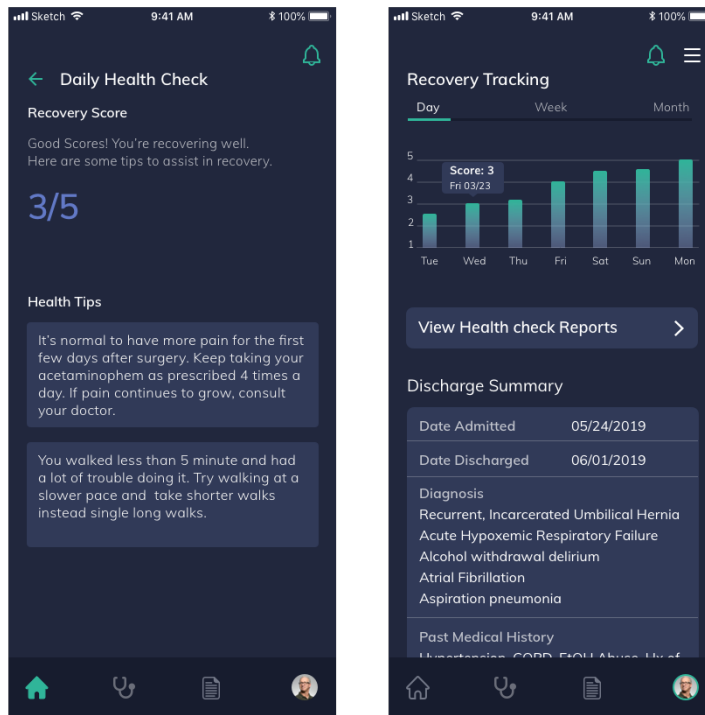


Figure 8: Screen Designs - Health Score, Health Tracking

Reminders for Medication, Tasks and Appointments

Although the printed discharge summary informs about all the recovery tasks, patients have difficulty adhering to this recovery schedule of timely intake of medicines, regular exercise and follow-ups with care providers. Neglecting or falling to follow these recovery tasks are major triggers in post discharge complications.

Smart phones technologies enable notification systems and setting reminders for tasks. Curo uses this technology to notify and remind users of pending tasks. Receiving push notifications (Figure 9) for recovery tasks and appointments helps patient intake timely medications, keep follow-up appointments and stay on task with exercise and other recovery tasks. Printed discharge summaries fail to provide such interactivity and instant communication with the patient. This can only be achieved through an interactive mobile app like Curo which can keep patients cognizant of their daily recovery tasks on the go.

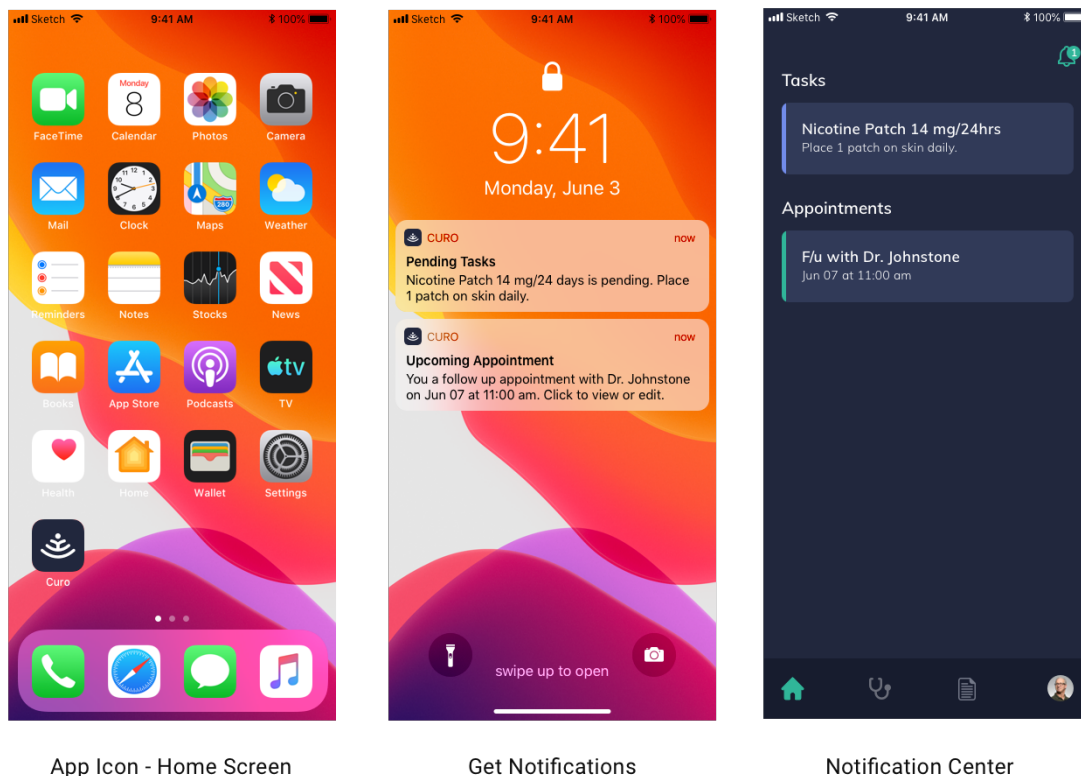


Figure 9: Screen Designs - App Icon on Home Screen, Get Notified, Notification Center

Be Informed and Manage Follow-ups

A prescribed schedule of follow-up appointments after hospitalization is included in the printed summary like ‘make an appointment with your doctor in 2-3 weeks after surgery’. These follow-ups may require manual appointment taking. Hence, it will be valuable to remind patients about making appointments and remembering upcoming ones. Increased visibility into follow-up schedules (Figure 10) helps patients stay on top of these appointments and manage them by providing ways to reschedule and view location of the appointment.

Patients well informed and conscious about their condition are more likely to make better decisions about self-care. With that insight, the knowledge center (Figure 10) is built to educate patients about diagnosis and treatment procedures. It also highlights sections of the most importance that enables patients to skim through all the information quickly and still get a sufficient understanding of their treatment. This information is sometimes available in the printed summaries but it is mixed in with other background information making this hard to find.

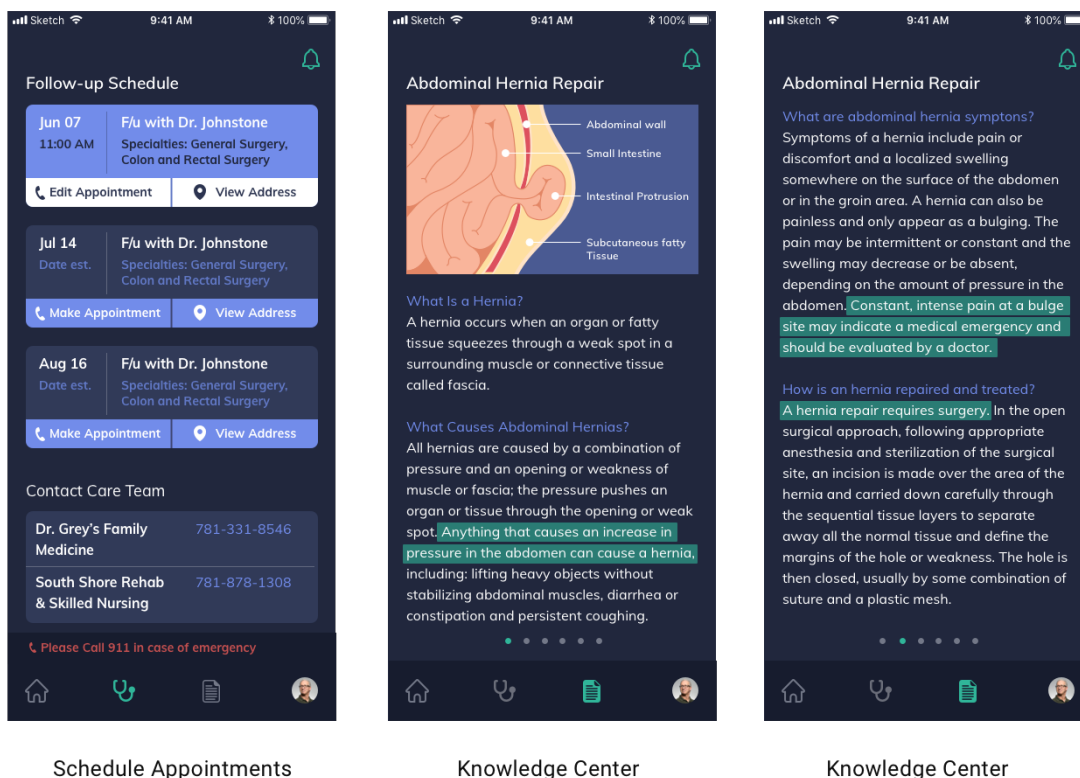


Figure 10: Screen Designs - Appointments, Knowledge Center

Accessibility for all users

A large portion of surgical procedures are performed on adults aged 55 and above who maybe suffering from temporary or permanent impairment of vision, hearing and speech. Hence, accessibility was an important design consideration for this thesis. Web Content Accessibility Guidelines (WCAG) 2.0 makes recommendations for making web content more accessible [11]. Based on the WCAG guidelines the screens below (Figure 11) showcase the progression from original design to accessible designs with larger font size, dark and light versions with higher contrast level.

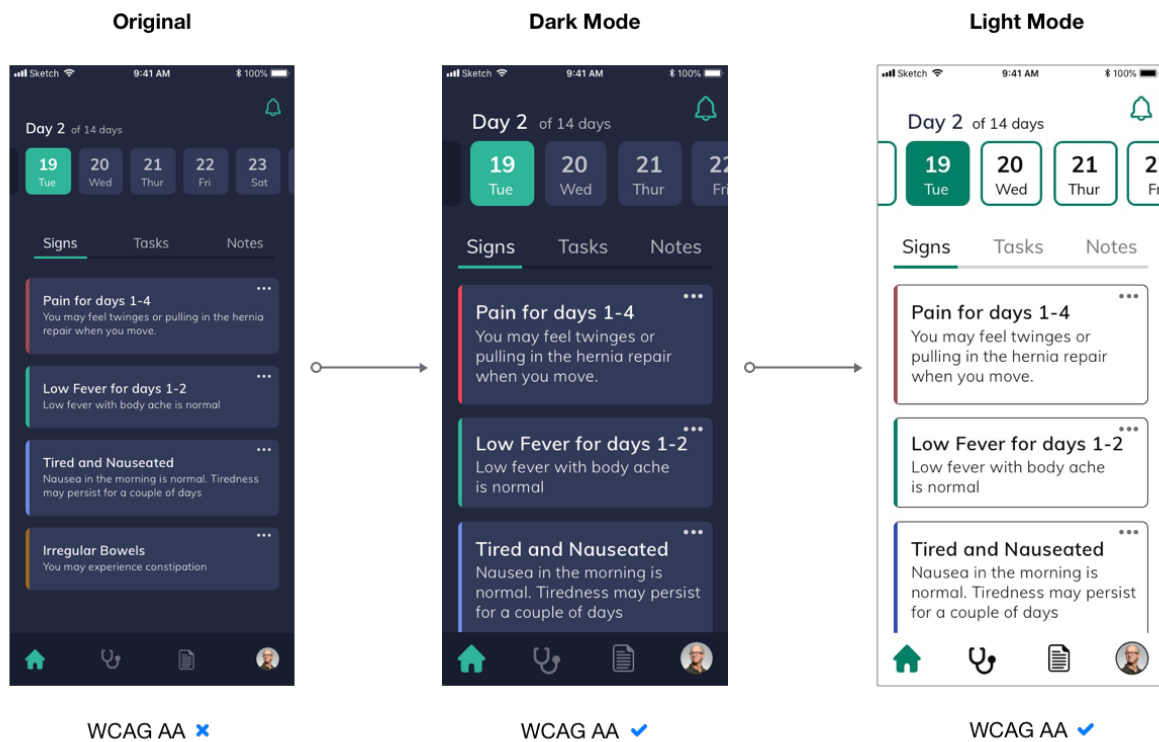


Figure 11: Accessibility exploration

Branding

Many naming concepts of good health, getting well, cured, recovery, care were explored for the brand identity of the application. Initially, the title of 'All is well' was explored which was later replaced by Curo.

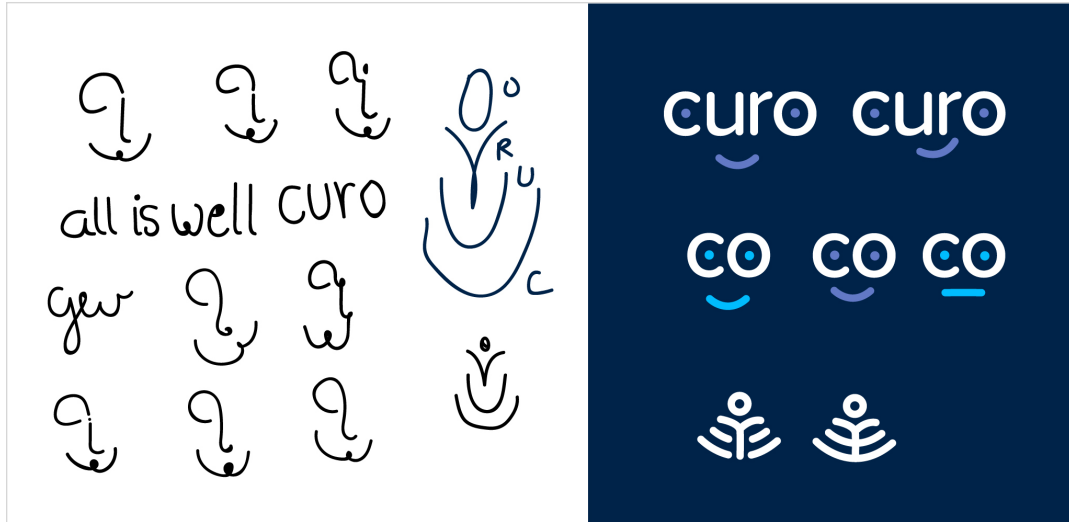


Figure 12: Initial logo sketches and semi-final drafts

Curò is an Italian word that means 'to take care' amongst other similar meanings. Curo aptly summarized and was synonymous with the app's vision and functionality. The sketches and designs (Figure 12, 13) illustrate the visual exploration for the brand identity.



Figure 13: Final Logo - Brand Identity

Visual Design

To design a consistent user experience, a visual design system was required. This design system guided the interaction and visual design of the mobile application. After many internal iterations, a limited design system (Figure 14) was created to support the scope of this project. The design system highlights what and how colors are used in the design, iconography and illustration styles. The illustrations are crafted to be minimalist to convey complex information plainly.

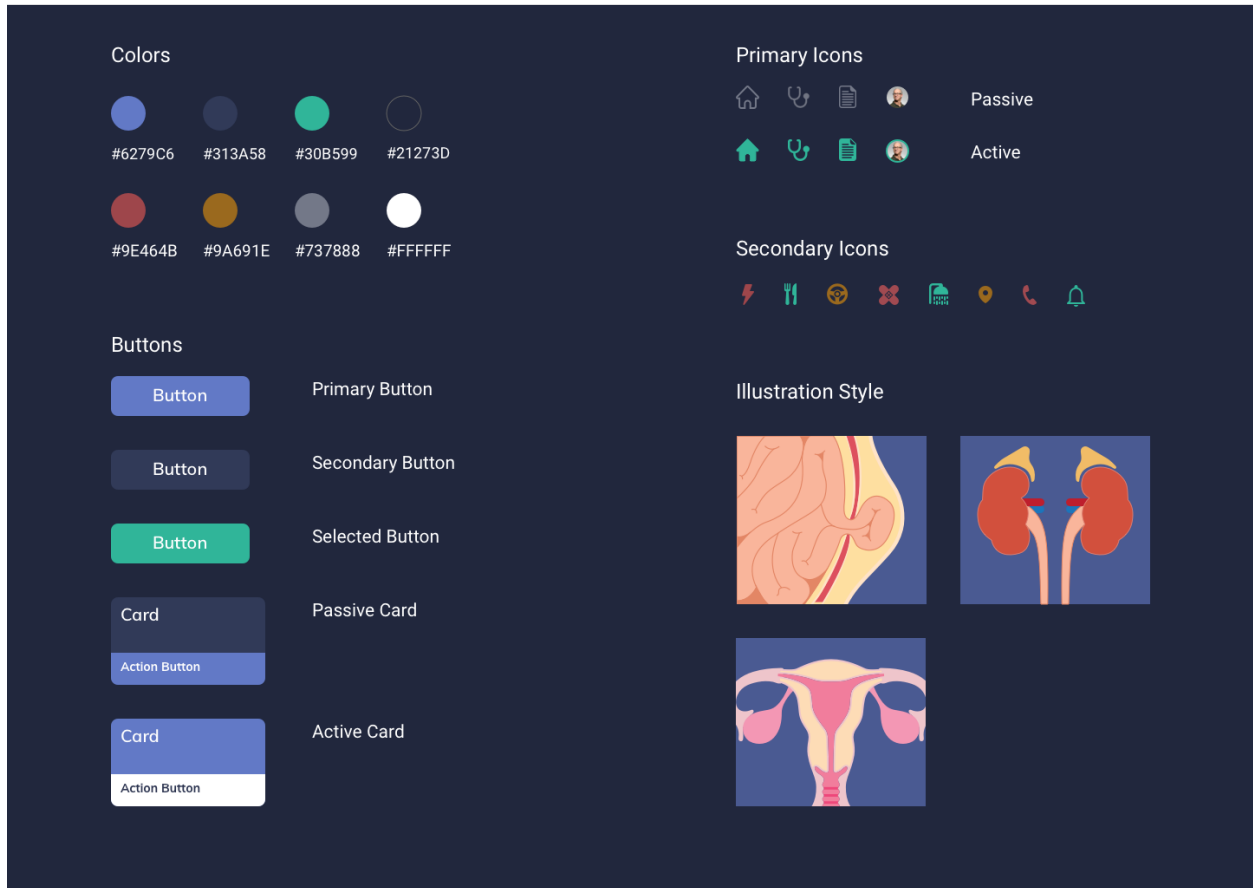


Figure 14: Visual Design System

The application uses a dark color palette accentuated with brighter hues of blue and green. A dark color palette is used to improve visibility for patients with low vision and those who are sensitive to bright light. The accessibility section earlier in the document explores a high contrast and a light version of the application so that the application design is accessible and cognizant of diverse user needs. The interactive system is also designed to be simplistic in nature for users of varied technological proficiencies. The motion and interactivity of the app can be found on the following website – <https://designed.cad.rit.edu/vcdthesis/project/curo-khushboo-agarwal>

Evaluation & Discussion

The final results are evaluated against the 5 major problem areas that patients have which may lead to preventable risks and hospital readmission. The results also take into account the need for an accessible solution that more users can benefit from. Each feature highlight solves for a patient pain point such as forgetful patients receiving reminders and to-do tasks for taking medication, exercising, keeping on top of all follow-up appointments, reading and learning about patient disease & treatment and knowing what to expect at home after surgery.

The initial feedback from the thesis defense was positive. There were suggestions for showing the notification center which were missing from the first prototype. The notification center has been designed since then and added to the final results. Reviewers also wanted to see the app interactivity which was absent from the initial static screen designs. All feature highlights have been turned to interactive prototypes using motion graphics and other prototyping tools. A demo is available on <https://designed.cad.rit.edu/vcdthesis/project/curo-khushboo-agarwal>

To collect more feedback from external sources, this thesis project will be submitted to the annual Adobe Achievement awards in 2020. It will also be submitted to other design competitions around the world.

Further enquiries into this thesis include exploring concepts like buddy system for additional encouragement and virtual appointments with medical team.

Conclusion

Poor discharge communication can cripple treatment efforts and weaken patient confidence and satisfaction with the care received. Of the average 15% 30-day readmission rate, a significant number of patients are coming back to the ER for non-urgent issues. After discharge, patients transition from hospital illness management to self-management which can lead to unnecessary risks. Patients engaged in self-management have better health outcomes and increased self-efficacy.

This thesis has proposed a solution for better patient care through the use of design thinking principles of empathy, organize and improve information hierarchy, visual design, interaction design, prototyping and evaluation. The solution consists of a mobile application that will enable healthcare providers to extend care beyond the walls of the hospital, monitor patient problems in real-time and ultimately prevent avoidable ER visits and readmissions. Patients on the other hand can actively engage in self-recovery and improve self-care by getting access to comprehensive discharge information, recovery management tools, track recovery progress and have quick access to their medical team. This application will enable them to focus on their recovery rather than dealing with complex paperwork and archaic systems.

“Healthcare is moving beyond the walls of hospitals and into communities and the role of healthcare providers is shifting. When design thinking methodologies are applied to healthcare they lead to a human focus and an openness to generate and test lots of ideas to find more innovative, far-reaching solutions.”

- IDEO Design Researcher Silvia Vergani and Principal Research Scientist at Verily Life Sciences Danielle Schlosser

The thesis has been influenced by the statement above and hopes that it has created an effective, intuitive and interactive solution for better patient outcomes.

The Summary

This thesis presents an interactive design solution that effectively solves for patient pain points and frustrations in the following ways:

Pain Points - Solution Summary

- Discharge summary is verbose and uses medical jargon - Curo uses plain language and eliminates all information that isn't directly relevant to the patient for recovery purposes
- Insufficient understanding of diagnosis and treatment - The knowledge center in the app provides a concise understanding of patient diagnosis and treatments without overwhelming patients
- Medication errors like missing or taking wrong medication - Using the notification system, Curo reminds patients of taking the right medicines at the right time.
- Forgetful and confused about do's and don't after surgery - The do's and don'ts after surgery are listed in the Notes section of the homepage.
- Lack at home support & guidance from medical team - Curo acts as an at-home patient support or guide to help patients in self-care. It aims to answer most questions a patient might have while also giving patients access to the contact details of their medical team.
- Delayed or missed follow up appointments - Using the appointments tab, Curo helps patients gain increased visibility into their appointment schedule. The system notifications further help in schedule adherence.

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