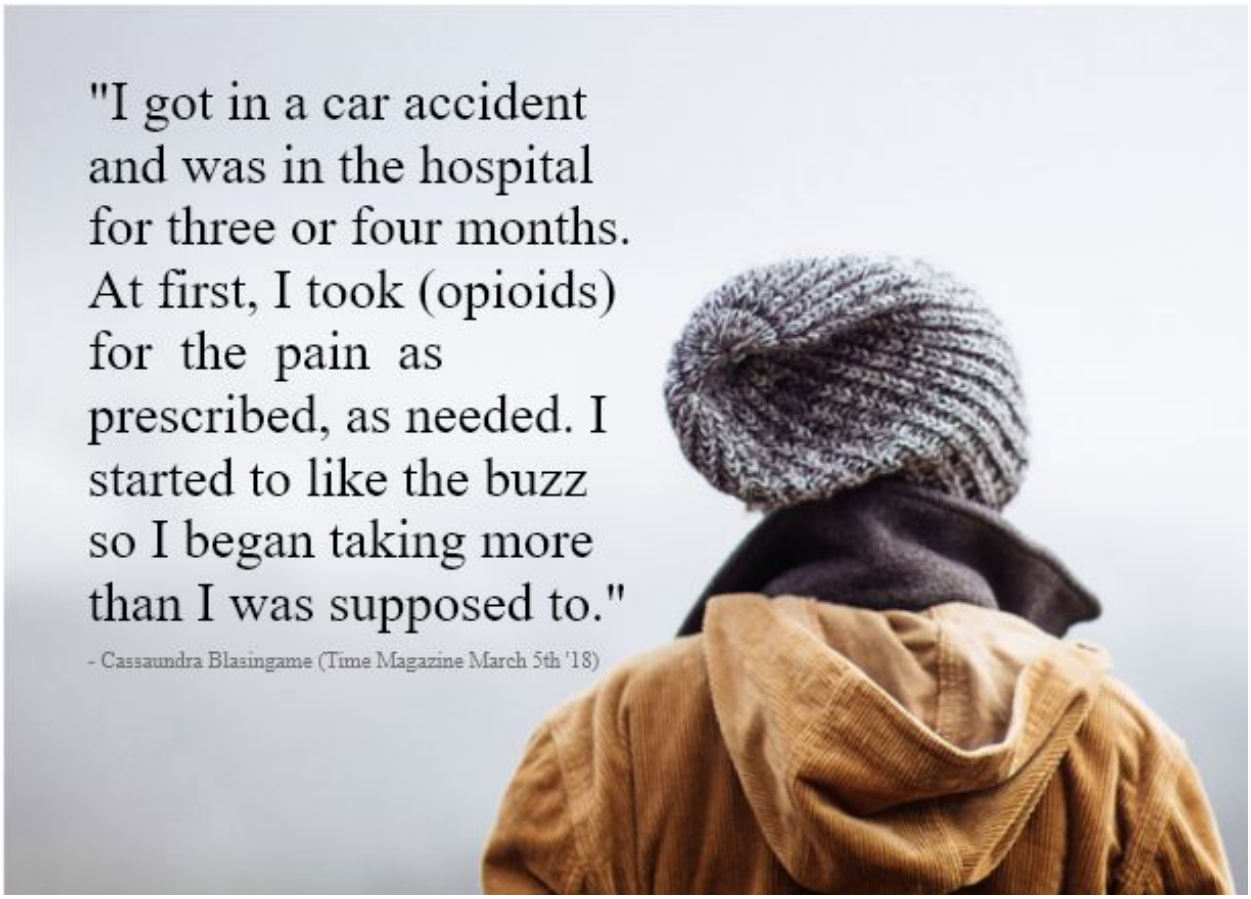
April 2nd 2018

HCDE Capstone
Project Proposal



Postoperative Patient-Controlled Analgesia
Uniting doctors and patients for effective pain relief

Team	Recovery Improvement Interactive Technologies (RIIT)
	Ian Russell, Finn Thompson, Ali Morgan, Michael Beach
Sponsor	Seattle Children's Hospital (Stuart Solomon, Lance Patak, Jacob Gross)

Foreword

All undergraduate Human Centered Design & Engineering (HCDE) students must complete a Capstone Project over their final two quarters in the program. During this time, they work in teams with sponsors who provide real-world projects. These projects allow students to demonstrate the skills they have developed throughout their coursework. Capstone projects are broken into phases; each phase is highlighted by a milestone deliverable. The Capstone process culminates in a presentation and demonstration video at the HCDE Undergraduate Open House, taking place in the University of Washington HUB Ballroom on May 29.

Our team, Recovery Improvement Interaction Technologies (RIIT), consists of Ian Russell, Finn Thompson, Ali Morgan, and Michael Beach. We are working with Dr. Lance Patak, Dr. Stuart Solomon, and Dr. Jacob Gross of the Seattle Children's Hospital and the University of Washington School of Medicine to design and prototype a prescription management system to help address the intensifying opioid crisis in the United States. With this device, our sponsor hopes to collect prescription use data, aid post-operative patients as they wean off opioids with supplemental over-the-counter anti-inflammatory medications, and reduce the total number of opioids that are prescribed.

Our team seeks to answer one overarching question: What would be an effective design for an in-home oral PCA device and optional companion app that helps prevent opioid addiction in postoperative patients?

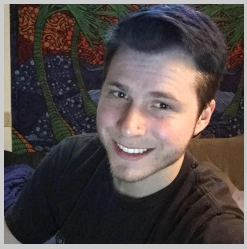
This document, our project proposal, serves to define our Capstone Project by sharing our background research and motivation that drives our project. Also included in this document are the timeline that we will follow and milestones that we will deliver throughout Spring quarter, the resources we need to complete the project, and the contract our team members will adhere to throughout the Capstone process.

Our Team

Ian Russell

For me academia has been a journey from 3D animation, psychology, biology, economics, teaching and now to Human Centered Design and Engineering (HCDE). I've found HCDE to be a place where my diversity of skills, interests and experiences can shine. Currently I am the webmaster for the Universities 3D printing club called WOOF3D. I have a passion for creativity, design of all kinds, prototyping, finding and creating solutions. Additionally I have conducted and lead groups through directed research involving storyboarding complex ideas.

Finn Thompson



For my capstone project, I hope to contribute efforts in programming tied into UX/usability research, design, and development. I have experience with client/server web programming (HTML, CSS, JS, SQL, PHP, Python) and desktop programming (Java). I am also interested in prototyping, both through physical computing and model creation (3D printing, etc.). I look forward to incorporating these interests into the design and development our capstone project.

Ali Morgan

Hi! I am excited to work on a project in the medical field creating a device that could hopefully make a difference in people's lives. I have a background in Medical Anthropology and I hope to bring that understanding of human behavior and of user research to the project - along with the principles of prototyping and design that we have learned in HCDE. I have some experience with 3D modeling as well (in solidworks) and I hope to use that and other tools to effectively communicate ideas and demonstrate solutions.

Michael Beach

I am a senior undergraduate at the University of Washington working toward a double degree in Human Centered Design & Engineering (HCDE) with a focus on HCI and Comparative History of Ideas (CHID) with a focus on media studies. I have been working in the CSC Lab (Computer Supported Collaboration) in HCDE for three years on MoCA (Model of Coordinated Action), a theoretical framework that describes collaboration. For my CHID thesis, I am designing a creative agency with a funky org structure that brings the power of CHID and Google's Design Sprint methodologies to nonprofits and other socially and ecologically conscious orgs. For this capstone project, I am hoping to incorporate some design sprint methodologies to help with efficiency and contribute my design, prototyping, and research skills.

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Introduction

Opioids provide necessary pain relief to postoperative patients. However, opioids can be addictive, dangerous, and are often subject to misuse. Our project, an in-home oral Patient Controlled Analgesia (PCA) box, hopes to address these issues by providing patients with the guidance they need to manage their pain effectively during their postoperative recovery.

The United States has witnessed a growing opioid epidemic in recent years. In 2016, 11.7 billion opioid pills were prescribed, equating to 36 pills per American, and 3.3 billion of those pills went unused [1]. In 2015, 12.5 million people misused prescription opioids while there were nearly 90 deaths every day from opioid overdoses [2][3]. Deaths from opioid overdoses continued to increase, highlighting an extreme uptick in opioid-related deaths in recent years, as shown in Figure 1.

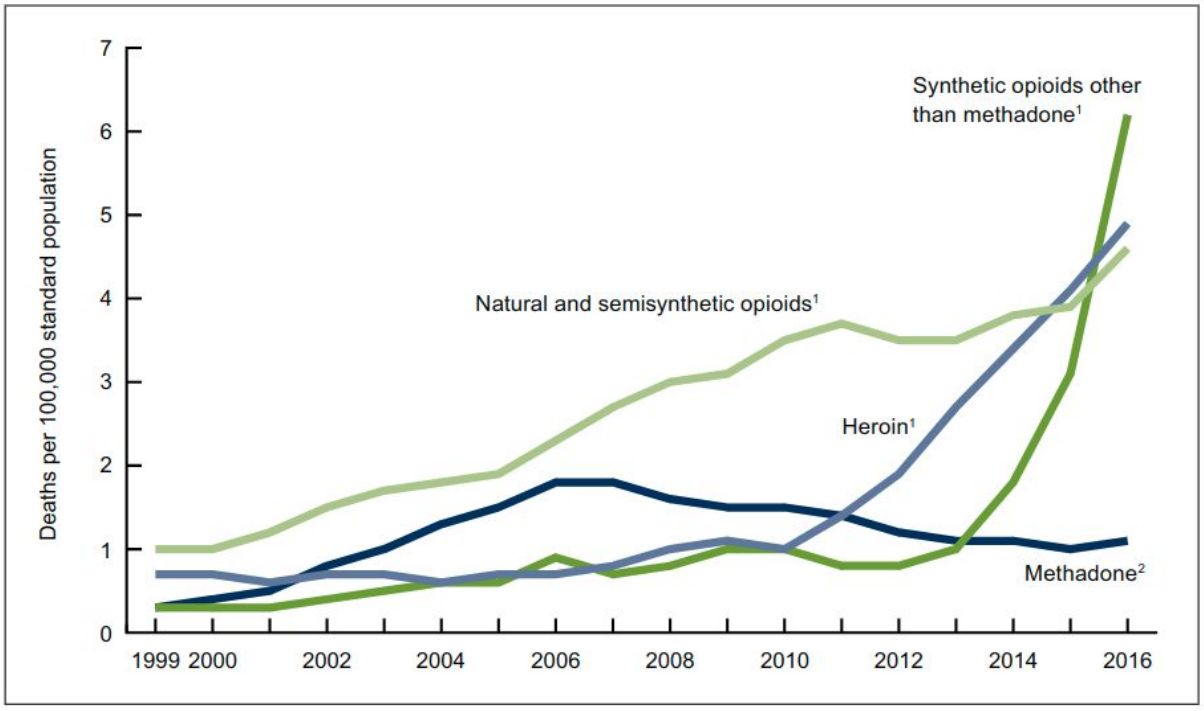


Figure 1. Age-adjusted drug overdose death rates, by opioid category: United States, 1999–2016. [4]

With this project, Seattle Children's Hospital seeks to provide an oral PCA device and companion app that make opioid prescription information less ambiguous and allows pain medication control to be guided by a device and companion application. Additional goals include being able to better regulate safe return of unused opioids as well as the ability to remotely adjust prescriptions as needed. One goal is to generate individualized patient usage data that can be observed in real time by medical staff which can lead to identifying high risk behaviors before addiction occurs, thus allowing improvements to be made to treat future pain needs, reducing opioid waste, incidence of addiction and overall costs.

Our team will be researching, designing, prototyping, and evaluating a Patient-Controlled Analgesia (PCA) device and companion app that monitors and manages opioid prescriptions while connecting patients to doctors throughout the postoperative recovery phase. Through design, we will explore

various solutions to the problem as supported by our initial research. We will then create prototypes and introduce them to users for further data on the overall experience and ability for the design to achieve our goals. Our final deliverable will be an iteration of our initial prototypes per what we have learned from all previous steps in this process.

Background

We have conducted literature reviews and competitive analyses to contextualize our understanding of the opioid epidemic and existing solutions to determine what affordances we must consider when designing our device.

Literature Review

We have identified several areas in which an effective mobile PCA box can benefit all users. In one study broadly directed at medication adherence, researchers determined patients who diligently took their medication as prescribed had reduced recovery times and required fewer hospital visits to recover [5]. In another study, researchers identified connecting physicians directly with caregivers empowered the caregivers, improved patient care experiences and provided parents of children in treatment with additional assurance [6]. We also found research confirming adherence benefits from designing systems around temporal and habitual indicators of users. Designing a medication dispenser system around specific users may help users take their medications safely and effectively [7]. Lastly, we found research data indicating that using the capabilities of modern technology, data retrieval and organization algorithms may be capable of detecting the habits, and actions that lead individuals to addiction [8]. This information could become a boon to medical professionals striving to prescribe opioids safely and with greater precision.

All our combined research points to the increase in value and user experience that comes from directly linking patients and doctors with meaningful data. By providing usage data directly to the prescribing doctor and their teams, individuals could receive intelligent adjustments to their prescriptions between office visits. Doctors can prevent addiction, improve recovery time and increase patient interaction efficiency by utilizing accurate opioid usage data. As we learned from our sponsors, doctors also suggest the use of adjuvants to assist pain relief while reducing opioid addiction. Adjuvants are over-the-counter medications such as ibuprofen or acetaminophen used to accompany or replace opioids for managing pain.

Competitive Analysis

We have identified several comparable or competing products in the domain of medication dispensers: SMRxT, a smart pill bottle; tricella, a smart pill box that has a companion app; ProsperSafe, a set of non-smart devices designed to aid with addiction recovery; Livi, a smart pill hopper; and Adheretech, another smart pill bottle. We found that these products each tackled problems somewhat different from our own. For example, SMRxT and tricella market towards helping keep track of your family's prescription adherence. ProsperSafe markets to addiction recovery clinics. It does not allow patients to access their prescriptions unless it is time for their next dose. Livi and Adheretech market more towards personal prescription usage and adherence. All of the devices except for ProsperSafe collect and transmit data either over Bluetooth Low Energy or cellular connections. Every one of these devices requires that the user fill it with their prescription when they receive it. With Livi, the user must measure their pills for successful use.

Our comprehensive competitive analysis table can be found in Appendix B.

Considerations

With this competitive analysis, we recognize that no product exists that satisfies all of our anticipated requirements. We want to design a device that can be filled at the hospital pharmacy and then delivered to the patient during the postoperative patient check-out process. With this approach, we hope that our device would be able to seamlessly integrate with the existing patient-pharmacy paradigm. We envision that before the operation, a nurse would explain how to use the device and companion app.

As noted in the literature review, data is an important factor in ensuring that patients and doctors stay connected throughout the postoperative process. With this in mind, we want to design a companion app that allows patients and doctors to view prescription usage data and easily communicate with each other in case the patient has questions about their prescription, the doctor wants to modify the prescription, or the doctor recognizes a need to intervene, such as, if the patient is using too much or too little to their prescription.

To assist users in weaning off of their opioid prescription, we want our device to carry multiple kinds of medication, allowing it to dispense either opioids or over-the-counter pain medication depending on the level of the patient's pain.

We have identified the following preliminary design guiding questions based off of the results of our background research and discussions with our sponsor:

- What is the life cycle of the device?
- How will the PCA be processed, who owns it, who cleans it, how does it get delivered to the patient and where and how do they return it?
- How should we collect data? What data should we collect?
- How will it be used by pharmacists?
- How will patient pain levels be monitored?
- How will data be updated?
- What questions do we ask the patient to understand their current pain level and if their pain is well controlled?
- How will the device identify and alert the medical care team to irregular usage patterns?
- How can we introduce adjuvants in combination with opioids to reduce opioid requirements?
- How will timing intervals be set? Will they change throughout the postoperative recovery phase?
- How will the patients be alerted that a dose is ready? Will the patient always be alerted? How can we prompt patients to adjuvants around the clock?
- If its battery operated or AC operated, what if the batteries die, what if the electrical cord is broken or gets misplaced?
- What happens when people have to break a pill in half?
- When a patient has unexpected increase in pain and require a breakthrough dose, how might we afford a "breakthrough" dosing?

These considerations leave us with two primary user groups: postoperative patients and doctors. We also have two secondary user groups: patients' caregivers (such as when the patient is young, elderly, or disabled) and pharmacists, who would fill the device.

Action

We hope to answer one overarching question with our project: What would be an effective design for an at-home oral PCA device and optional companion app that helps prevent opioid addiction in postoperative patients? The design should connect doctors and patients with meaningful individualized data and help promote healthy habits when taking medications. Through further research-led design, prototyping, and testing, we intend to determine the fundamental components and design points of this system.

Project Deliverables and Timeline

Our project will consist of four phases: Design, Implementation, Evaluation, and Iteration. Figure 2 captures these phases, the product manager for each phase, and a brief overview of each phase.

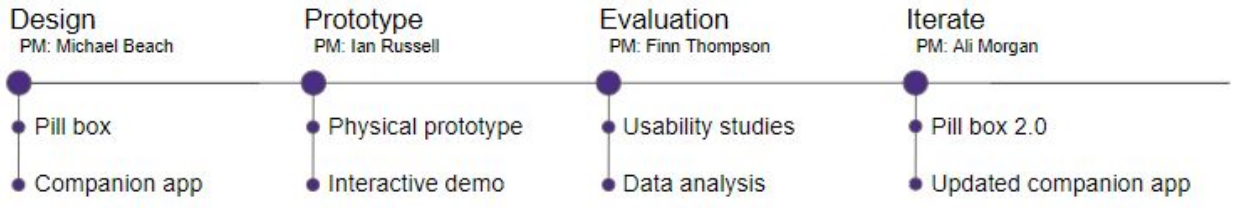


Figure 2: Our project phases and what each consists of in brief.

Phase I - Design

Project Manager: Michael Beach

How can we design for every user and their capabilities? How can we account for existing research on appropriate medication routines for avoiding prescription abuse and addiction?

The design phase is an essential part of the process where conceptual ideas become concrete artifacts and systems that can be built and tested. In this phase, we will utilize the contextual understanding we gained from the preliminary research we conducted to design concepts for the PCA device and interface. We will identify the top most viable solutions to design and create sketches, user flow, and sitemap using design sprint methodologies.

Design sprint methodologies provide ways of moving from concept to testable design in a fast and efficient manner. After this stage, we will create higher fidelity mockups that will be translated into a physical prototype.

Design Session 1: Mapping Exercise

We will begin our first design session with a Mapping Exercise - a simple diagram that represents the complexity and life cycle of the device in relation to the various actors. It will show actors moving through the phases: Discovery, Learn, Use, and Goal. The map will provide structure for the solution sketches and prototypes and will help us keep track of how everything fits together.

We will use our map to provide context for our PCA device and companion app. This tool will help us identify where the different users (patients, clinicians, and health care workers) will interact with each other and with the PCA device and companion app.

Design Session 2: Sketching and User Flow

Our next design session will be focused on sketching for both the 3D device and the 2D interface. To begin conceptualizing our product, we will independently sketch several ideas based on what our research leads us to believe will work well. After we have accumulated many sketches, we will present our sketches to each other and then individually provide feedback on what worked well and what needs work using a voting process. We will then group similar concepts together to identify our three prototypes, identify which aspects we want to keep, problem areas we need to fix, and pieces we will exclude from our next round of sketching.

Once we have identified the three prototype concepts, we will create user flows to show the sequence of how each user navigates through the interface from their perspective. This process will help us identify edge cases and specific moments that need more clarity in our next round of sketches.

Milestone I: April 9

For this phase, we will deliver a report collecting the results of the design sessions to demonstrate the first iteration of our design. We will also include a brief overview of our competitive analyses and background research to contextualize our design.

Phase II - Prototype

Project Manager: Ian Russell

How can we create effective interactive prototypes? What physical affordances must be made to achieve our design goals?

A prototype is a low to high fidelity version of a new or modified design system that can be used in usability testing. In this phase, we will prototype a set of user interfaces based on the preliminary research and the designs we created in the design phase. Each prototype will be focused on a particular interaction of the interface. For example, a prototype may test that an algorithm is providing the appropriate information for a specific task, while another may test a user's understanding of a feature. We will use these prototypes in Phase III where we will evaluate the viability of our designs.

External resource acquisition is imperative within this prototyping phase. Each member of our team is qualified to work in the CoMotion MakerSpace, which provides access to 3D printers, tools, software and materials. The MakerSpace provides materials at cost, which we will fund by splitting costs among team members.

Medium Fidelity Mockups

With the set of screens organized during Phase 1, we will create higher fidelity mockups. We will also develop physical models with 3D modeling software. These medium fidelity mockups will be used in our prototyping process.

Interactive Prototypes

Using our higher-fidelity app screen mockups, we will create interactable prototypes using a prototyping application like Invision or POP. With apps like these, we can imitate clickable screen navigation in order to create a more realistic experience for users in our evaluation phase.

3D Printing

We will transform our initial 3D models, made of cardboard and clay, to a higher fidelity 3D printed model that can fit a microcontroller and any relevant sensors. This model will be used during the physical computing stage of this phase.

Microcontroller Prototyping

While part of our team works on the 3D printed model, other team members will create an embedded system on an Arduino that will facilitate communication between our device and our app.

We have purchased a small, square Arduino microcontroller called the TinyDuino, and modules that will allow us to control two motors and power the system from a battery. We also purchased a 2.8” touchscreen that we intend to use as the primary display and mode of interaction for the device.

Milestone II: April 23

For this phase, we will deliver our first working app and device prototypes paired with a reporting documenting the design and use.

Phase III - Evaluation

Project Manager: Finn Thompson

What do potential users think of our device? Is our device usable?

In this phase we will test our device and app prototypes to explore the effectiveness of the device while focusing on the inclusivity of the design. We will acquire compensation for our participants either through funding or split among members. Individual recruiting will be a backup means to gaining participants within our target audience if our sponsor or funding can not provide additional assistance.

Usability Evaluation

To evaluate our prototypes, we will conduct usability evaluations with 6-8 users comprised of doctors, pharmacists, and/or former patients. We will recruit users through a combination of Craigslist, fliers posted around campus, grocery stores, and acquaintances. We will not reveal the topic of the study until an evaluation. We will inform users that the study will take around 30 minutes (or other time determined later) in a reserved room on the UW campus. We intend to compensate our users upon completion, but we will determine the amount at a later time depending on how much funding we are able to acquire or contribute. Prospective participants will complete a screening survey to allow us to select people who meet the criteria for our study, which we will define during this phase. This approach will allow us to test our product on a variety of different abilities and backgrounds relevant to evaluating our prototypes.

In each evaluation, we will ask the participant to complete a series of tasks related to use patterns (scenarios) based on the initial research phase of the project. We will use usability benchmarks (errors, task times, etc.) and pre- and post-evaluation interviews to inform our evaluation and serve as the basis of our analysis. We will use the information collected from these tests to inform the iteration presented in the final deliverable.

Milestone III: May 7

For this phase, we will deliver a report detailing the results of our usability evaluation and what design recommendations we believe will best inform our team as we move on to iterate both our device and app prototypes.

Final Deliverable: Iterated Prototype - May 21

Project Manager: Ali Morgan

How can we use the results of our usability evaluation to iterate upon and improve our prototype?

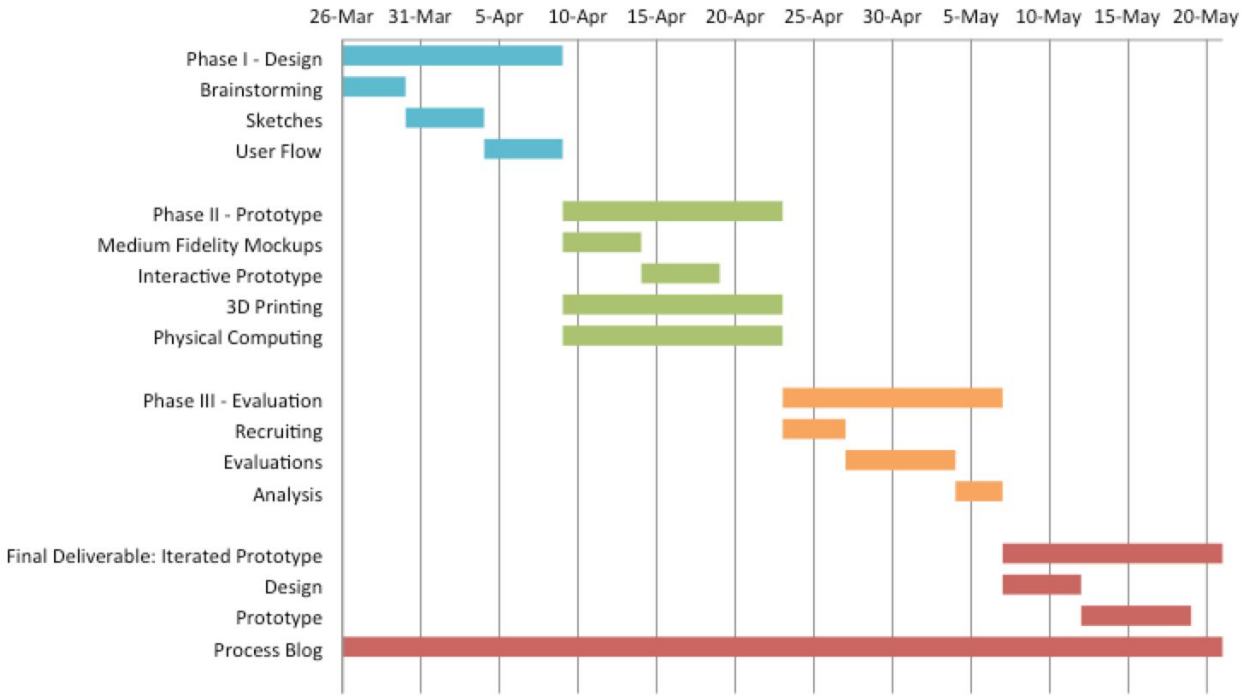
Our final deliverable for this project will be an iteration of our device and app prototypes based on our usability evaluations from Phase III. At this point in the process, we will have functional prototypes with which we have run and analyzed several usability evaluations. Iteration is an important part of the user-centered design process for us to address any issues or concerns that come up through our evaluations.

At the HCDE Capstone Open House, we will present these final iterations of our prototypes paired with a promotional product video to demonstrate our product's place in the world.

Throughout the project, we will document our design process at each phase. We will individually write process books describing our team's process and our individual contribution to our work, and we will each turn these in with the final deliverable at the end of the project.

Timeline

We have scheduled our milestones and methods according to the following Gantt chart.



Deliverables

Below is an outline of our deliverables, with associated milestone and dates:

- **Milestone I: Design (April 9)**
  - Report of results from research and design process
  - First iteration of our design
- **Milestone II: Prototype (April 23)**
  - Device prototype
  - Interactive app prototype
- **Milestone III: Evaluate (May 7)**
  - Report of results from usability evaluation and design recommendations for iteration
- **Final Deliverable: Iterate (May 21)**
  - Iterated prototype
  - Process Blog
- **Open House: May 29**
  - Present final iteration of project & promotional product video

Resources

The following table describes several resources we need that we do not currently have, which phase the resource applies to, and how we plan to access the resource. We have applied for an undergraduate HCDE capstone grant with this resource-cost table as reference.

Resource	Cost	Phase	How we plan to access this resource
Sponsor expertise	Free	Recurrent	Regular planned meetings; constant communication via email / text messaging and maybe Slack
3D printers	Free	Prototyping	Every team member has access to the UW CoMotion Makerspace
Miscellaneous prototyping supplies	$15-30	Prototyping	We intend to model with clay, cardboard and thrift or office store supplies prior to printing; costs split between team members
Participant incentives (TBD)	$25-50	Evaluation	Costs split between team members
PLA printing material	$20-40	Prototyping	Purchase from UW Makerspace; costs split between team members
Microcontroller, accessories and wiring	$127+	Prototyping	Purchased from TinyCircuits and Amazon; costs split between team members
Access to target population	Free	Evaluation	Sponsors may be able to help us find ideal participants; otherwise, draw from UW/local community
Posters and brochures	$20	Presentation	Purchase from UW Bookstore, other local business, or online. Costs split between team members
Stock footage and audio	$0-15	Presentation	Find online from various paid or free sources, such as Adobe Stock, FreeStockMusic.com, Pexels, and/or Unsplash. Costs split between team members
Camera	Free	Presentation	The HCDE Department offers camera reservations
Total	$217-282		

References

[1] "The United States for Non-Dependence: An Analysis of the Impact of Opioid Overprescribing in America," QuintilesIMS Institute, Parsippany, NJ, USA, 2017.

[2] Center for Behavioral Health Statistics and Quality, "2015 National Survey on Drug Use and Health," Substance Abuse and Mental Health Services Administration, Rockville, MD, USA, 2016.

[3] R. A. Rudd, P. Seth, F. David, L. Scholl, "Increases in Drug and Opioid-Involved Overdose Deaths - United States, 2010-2015," *Morbidity and Mortality Weekly Report*, no. 65, pp. 1445-52, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, GA, USA, 2016.

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[6] H. Y. Jeong, S. Y. Park, J. Zimmerman, "Opportunities to support parents in managing their children's health," in *CHI'08 extended abstracts on Human factors in computing systems*, Florence, Italy, April 5-10, 2008, pp. 3225-3230. Available: ACM.

[7] L. Palen, S. Aaløkke, "Of pill boxes and piano benches: home-made methods for managing medication," in *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, Banff, Alberta, Canada, November 4-8, 2006, pp. 79-88. Available: ACM.

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Appendix A: Team Contract

Roles and Responsibilities

We have assigned each team member roles to perform throughout our capstone project.

Head Document Editor: Finn Thompson

The Head Document Editor is responsible for editing all deliverables to ensure that our goals and progress are conveyed as clearly as possible with a consistent voice throughout each document.

Sponsor Liaison: Michael Beach

The Sponsor Liaison is responsible for handling all team communication with the sponsor, including acting as the point of contact when scheduling sponsor meetings. While the entire team has email and text messaging access to the sponsors, the Sponsor Liaison serves as the formal face of our team's communication with the sponsor.

Visual Design Lead: Michael Beach

The Visual Design Lead is responsible for managing our capstone team's image through design. While other team members will contribute to the design, the Visual Design Lead is recognized as a proficient designer and will guide the team's direction in design.

Prototyping Lead: Ian Russell

The Prototyping Lead is responsible for managing our team's prototyping efforts. While every team member has at least some experience with various forms of prototyping, the Prototyping Lead is the most familiar with relevant equipment such as 3D printers and as such can guide the team during the prototyping phases. Other responsibilities under this role will be acquiring material andese makerspace time and reviewing design plans.

Process Documenter: Ali Morgan

The Process Documenter is responsible for tracking and recording evidence of the team's processes throughout the project. This team member will manage and update an online Process Blog through all phases of our project that our team can then edit and use towards the final Process Blog deliverable.

Video Editors: Ian Russell & Finn Thompson

The Video Editors are responsible for editing the final video deliverable, presented at the HCDE Undergraduate Capstone Open House. While all team members will assist with the planning and recording of the video and provide feedback on the editors' progress, these team members will edit all media collected into a clean, presentable deliverable.

	I Design	II Prototype	III Evaluation	Final Deliverable
Michael	PM 2D Designer Design Sprints Documentation	(Prep surveys for III) Documentation	Scheduling Evals Video Recorder Documentation	Poster Design Video Recorder Documentation
Ian	3D Designer	PM 3D Printer	Data Analyst Moderator	Video Editing 2nd Prototype (3D printing)
Finn	3D Designer	Arduino(er)	PM Moderator	Video Editing 2nd Prototype (arduino)
Ali	2D Designer Debriefer Process Blog	Debriefer Process Blog	Coding Analysis Debriefer Process Blog	PM Poster Editor Debriefer Process Blog

A visual representation of team member roles.

Team Meetings

We will meet regularly several times each week in reserved spaces Allen Research Commons, other UW libraries, Sieg Hall, or the UW CoMotion Makerspace. We will also schedule additional afternoons to meet as needed.

- Mondays: 3:30pm - 6:30pm+ (Deliverables are due on Mondays)
- Tuesdays: 2:00pm - 3:30pm
- Thursdays: 2:00pm - 6:30pm (with a 15 minute break)

We will meet with our sponsors every two weeks, allowing us to share our deliverables with them and work with them and their expert knowledge as much as possible. We do not yet have a regular time set for the sponsor meeting, but we have discussed meeting at the UW Health Sciences Library after our Tuesday or Thursday team meetings. If a team member is unable to meet during these scheduled times, they should inform the team of such at least a week in advance if possible. In this event, present team members will share meeting notes with the absent team member and give them a full debriefing of all progress made during that meeting as soon as possible. If a team member is habitually absent or fails to provide notice before absences according to the expectations laid out in this section, we will record and note such in our final team performance reviews.

Assignment Submissions

The Project Manager of each phase will be responsible for turning in each deliverable as well as leading editing efforts on each assignment. Before the Project Manager turns in the assignment, each team member will sign off their approval with a thumbs up in Slack. As a team, our goal is to finish each deliverable two days before the due date to allow for ample editing time. If a Project Manager cannot submit an assignment, they should inform the team and identify someone to turn it in. If the Document Editors fail to send off the revised deliverable in time or the Project Manager fails to submit the deliverable in time, we will record and note such in our final team performance reviews.

Communication

We will communicate through Slack outside of in-person meetings. We will also use our Google Docs chat and comment features. We will also use other resources such as when2meet to manage availabilities when meeting outside of our scheduled meet times. We will frequently check-in with each other whenever we are individually working on a component of the capstone. Team members can expect responses from teammates within 24 hours when assignments are not due, and typically within minutes on due dates, unless a member otherwise informs the team of special circumstances. Whenever a team member makes decisions that affect the team, assignment, or schedule, we will discuss the implications and plan jointly to best serve the group. If a team member habitually fails to communicate with the team according to the expectations laid out in this section, we will record and note such in our final team performance reviews.

Collaboration

We will use collaborative applications, like Google Drive or Figma, to share and collaborate on documents throughout the Capstone process where possible. When we use non-collaborative applications like Rhino3D, we will work from a file in our Google Drive while in communication with one another. We will upload images of all sketches or other physical materials to the drive so all team members can access everything.

Resolving Conflicts

In the event that a team member is close to breaching this contract, the other members will seek to understand what is affecting that teammate. If the team can help, we will quickly work to assist a struggling team member become and stay a valuable asset to the group. In situations beyond the control of the teammate or group, we will seek guidance from the instructional team. If a member has committed a breach of contract, we as a team will evaluate the severity, discuss what penalties are just, and act on that judgement jointly. These consequences may be lunch paid for by the infringing team member, docked points for team performance reviews, or other solutions as suggested by the instructional team. We will resolve other internal and project related disputes in order of the list below.

1. Majority vote
2. Step back for a day
3. Make a use case for each side.
4. Current PM makes the deciding vote.
5. Accept it and move on.
6. Involve instructional team.
7. Perform!

If we are unable to resolve conflicts or repeatedly find ourselves involving the instructional team due to one team member’s actions, we will record and note such in our final team performance reviews.

Team Member Performance Characteristics

Concluding our project, each member will rate and be rated by their expression of the following characteristics during the project:

1. Honesty
2. Punctuality
3. Communication
4. Commitment
5. Collaboration
6. Respect
7. Focusing on solutions rather than problems

Appendix B: Competitive Analysis

	SMRxT/Nomi	**tricella**	**ProsperSafe**	**Livi**	**AdhereTech**
Notification	Text messages	App, text messages, phone calls, audio recording	Alarm, lights	Light, sound, text alerts	Text, phone calls, lights, chimes
Connectivity	LTE	Bluetooth LE	None	LTE	LTE
Lockable	?	No	Yes	Yes	No
Form	Pill bottle	Pill box / drawer	Wheel / hopper	Hopper	Pill bottle
Portable	Yes	Yes	Yes, but needs power	Yes, portable travel packs	Yes
Adherence data collection	Yes	Yes	No	Yes	Yes
Adherence data access	Web portal	App with pill history	N/A	Web portal	Web portal
Doctors have data access	Yes	No	N/A	No	Yes
PRN support	?	Yes	No	Yes	Yes
Target audience	Anyone, families, caregivers	Anyone, families, caregivers	Addiction recovery / Clinics	Seniors / senior CG’s	Anyone
Power	?	Coin battery	Wall + backup battery	Wall	Rechargeable battery
Cost	?	$55 - 75	$400-850	Buy - $1,999 Rent - $79/mo (starting)	?