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User-Centered Design of a Mobile App to Support Peer Recovery in a Clinical Setting

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Abstract The use of legal and illegal drugs has grown to such an acute level that it now represents a public health crisis in the United States. To support clinical treatments of substance use disorders (SUDs), formal non-clinical peer recovery support programs pairing coaches with people new to recovery are gaining in popularity. Using a user-centered design approach, we designed a mobile application to support the peer coach recovery program of a health system. The application addresses the needs associated with the coaches' workflows, encompasses social supports for recoverees, and provides a space for fostering the coach-recoveree relationship. Finally, we then evaluated a prototype with recoverees and program coaches. Through this process, we identified tensions between stakeholder needs and translated these tensions into design features and future design considerations.

1 INTRODUCTION

Improper use of substances, including illegal use of opioids, is a public health crisis across the United States. In 2018, 19.4 percent of people aged 12 or older reported using an illicit drug in the

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past year [8]. This epidemic has escalated to the point that death from opioids and other illegal substances surpassed many other causes of death and is now the leading cause of death for those aged 50 and younger [33]. The impact of this epidemic varies but touches people of all ages, races, socioeconomic groups, and geographic locations. In addition to the impact on the individual, this epidemic imposes a significant burden on the healthcare system—an approximate annual $11.3 billion in hospital care for overdose patients [69]. The system also appears ill-equipped to care for people needing substance use treatment despite this huge expenditure: only 17% of them received any treatment in 2018 [8], with no to limited increase in treatment service use since the beginning of 2014[21].

Recovery is a complex, non-linear journey [1]. The definition of recovery can vary based on the context. The US Substance Abuse and Mental Health Services Administration (SAMHSA) defines "recovery" as *a process of change through which individuals improve their health and wellness, live a self-directed life, and strive to reach their full potential* [6]. Many would agree this includes total abstinence from all substance use, yet others believe that the ongoing ability to process negative feelings without using and living a fuller, more productive life is a more important aspect of recovery [65]. Additionally, recovery is a personalized and individualized process which takes place not in isolation, but within a myriad of social and interpersonal contexts [2].

For those fortunate enough to obtain treatment, behavioral therapies (e.g. cognitive behavioral therapy, rational emotive behavior therapy, and contingency management) and medications (e.g. buprenorphine, methadone, and naltrexone) are the most common course of action. Beyond clinical approaches, many non-clinical approaches have gained popularity in the treatment of OUD and SUD (e.g. exercise, yoga, meditation, and equine-assisted therapy). Peer support is also a core approach, commonly seen in traditional 12-step programs. An emerging type of peer support gaining traction is *Peer Recovery Coach* programs [7, 8, 80]. Delivered by certified personnel, these programs consist of coaches engaging in non-clinical assistance to support clients in their long-term recovery from SUDs [74]. Peer recovery coaches focus on reducing the likelihood of relapse by engaging with clients on a more regular basis and extending the reach of treatment beyond a clinical setting into the everyday lives of people seeking sustained recovery [9].

In addition to these clinical and non-clinical in-person services, there is a growing market for technologies targeted at supporting the recovery journey. Examples of commercial applications that support general recovery include Addicaid and SoberGrid while applications like Pear reSET are only usable within a clinical setting [83, 91]. Within the human-computer interaction (HCI) domain, mobile apps that support alcohol recovery [43, 87, 92] and smoking cessation [66, 78, 82] are the most frequently built and studied. Additionally, peer support services like 12-step programs (e.g. Narcotics Anonymous) have many mobile applications to support programmatic needs. While most of these mobile applications support aspects of the individual recoveree's journey, they do not support the dynamic relationship between peer coaches and the clients they serve. Mobile applications for peer recovery coaching are largely absent from research and the marketplace, thus highlighting a need for applications supporting this structured, non-clinical relationship between coach and recoveree.

In this paper, we share the outcomes of a multi-phase study leading to the conception of a mobile application—Peer Mobile Application (PMA)—to support peer recovery coaches and the individuals in recovery that are using this service. Following the three phases of user-centered design (UCD) we first consulted OUD and SUD recovery professionals embedded in a large Midwestern health system, reviewed existing mobile applications for recovery support, and conducted two focus groups with peer recovery coach and recoveree stakeholders (formative research phase). We then devised requirements for PMA and implemented them in a high fidelity prototype (design phase) that we evaluated with the stakeholders (evaluation phase). The use of UCD ensured that the tool

reflected the needs not only of the health system and the peer coaches they employ, but also the individuals in recovery that the peer coaches support.

The main contributions of this work are:

- Designing and testing a mobile application for a peer recovery coach program through the use of UCD to integrate peer coaches, recoverees, and program management in a collaborative manner throughout the design and evaluation of the mobile application,
- Uncovering tensions between needs and workflows of peer coaches and recoverees, and
- Translating tensions into design features and future design considerations.

We begin by providing background research on OUD and SUD, the use of technology to support SUD recovery, UCD in the design of mobile health (mHealth) applications and peer recovery coach programs (Section 2). In Section 3, we describe the research setting and how the peer recovery coach program is integrated in our specific setting. In Section 4, we discuss the multiple phases of the PMA study and how the UCD approach was operationalized for the research. In Section 5, we describe the initial research and designs that seeded the research, including a review of popular consumer substance abuse support platforms/tools. In Section 6–8 we review the collection of requirements, design of the tool, and the results from the usability study of the PMA tool. Finally we conclude with a discussion, limitations/ethical considerations, future work, and a conclusion (Sections 9-12). Understanding that there are various health-related acronyms used throughout the paper, we have also included a specific section highlighting the definitions of these abbreviations for the reader's benefit.

2 BACKGROUND

2.1 Substance Use Disorders

Substance use disorders (SUD) are a widespread and growing public health concern. In the United States, 20.8 million people meet the diagnostic criteria for SUD [57]. Of those, only about 10 percent receive treatment for SUD in a given year [5, 57]. People with SUD who wish to seek treatment face a host of barriers, including a shortage of affordable treatment options, cost concerns, and a fear of the stigma that is often associated with individuals facing SUD [70, 84, 86].

SUD is a medical illness characterized by impaired control over substance use that causes clinically significant impairments in health and social functions, as defined in the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [15]. Treatment options are varied, and may include components of behavioral therapy, medical interventions, and peer recovery support [57, 67, 71].

High-quality, evidence-based treatment often takes a comprehensive approach that incorporates multiple modes of treatment [37]. This type of integrated treatment is complex and can require the support of multiple healthcare professionals working together. Furthermore, many cases of SUD are chronic, meaning they are characterized by cycles of improvement and relapse [57]. As with any chronic illness, this means that ongoing care is required; for severe chronic cases, one common approach is a period of intensive inpatient care followed by long-term outpatient care [89].

A critical component of many inpatient and outpatient treatment options is peer recovery support. In this type of relationship, a recoveree is mentored by a peer (often called peer coaches [71]) who has also gone through substance use disorder and is in recovery; peer coaches draw on their lived experience to support the recoveree in their recovery journey [71, 74]. These relationships are distinct from formal, professional counseling. Research has shown that recoverees who participate in peer recovery support, particularly as a form of long-term outpatient care, have better long-term outcomes than recoverees who participate in treatment alone [17].

According to the Substance Abuse and Mental Health Services Administration (SAMHSA), the active ingredient in peer recovery support for the recoveree is the social support provided by the peer recovery coaches. SAMHSA identifies four types of social support: emotional, informational (sharing information and resources), instrumental (provide concrete assistance with tasks), and affiliational (facilitating community building) [17, 74]. Facilitating these types of support is critical in any peer recovery support intervention.

2.2 The Use of Technology in SUD Treatment

There is growing interest in incorporating technology into SUD interventions in order to meet demand for flexible treatment options that can be delivered in a scalable, cost-effective way [47, 81]. Many of these are online or app-based versions of face-to-face therapy interventions, such as cognitive behavioral therapy [26, 49, 50], motivational interviewing [11, 13], and cognitive training [38]. Pear reSET is the most commercially mature mHealth application and one of the few having received US Food and Drug Administration (FDA) approval [62]. This therapeutic tool requires the user to have a prescription to download and use. The main treatment component is provided through cognitive behavioral therapy; the application also provides patient education, the ability to report cravings and triggers, as well as reporting relapse. There is also a gamification component, providing compliance awards [83].

Other mHealth interventions have focused on approaches such as self-monitoring tools [88] or automated supportive messages [10] for recoverees in outpatient care. Within the HCI field, research on various technologies associated with SUD treatment include the automation of SUD counseling using virtual agents [63], assessing user gaze behavior while discussing SUD with a virtual agent [93], and characterizing online sharing of alternative SUD treatments [27]. Research on mobile applications that support therapeutic constructs associated with relapse prevention has also shown better outcomes for people in recovery [42].

Research has also investigated different types of technology-assisted peer support. Multiple studies have investigated social support in online forums devoted to SUD recovery [28], including how individuals ask for support [52] and the effect of social support on relapse prevention [53]. HCI research has investigated the role of video meetings in peer support online [73] and provider perceptions of facilitators and barriers to using mobile applications with clients [54]. Most of this research has focused on informal or mutual aid support, distinct from peer recovery support services delivered by a peer coach. A majority of the evidence-based supportive tech is in clinical domains and thus uses a top-down approach during the design, primarily focusing on the clinicians, and rarely involving patients [76]. What is missing from this literature is the incorporation of both the recoveree and the support staff into the design process and implementation of a tool to support people in recovery from opioid and substance use disorder.

In addition to mHealth technologies built specifically for clinical support of SUD, there is a growing market of consumer technologies focused on supporting various aspects of the OUD and SUD recovery journey. Popular apps on Google Play and Apple AppStore include SoberWorx, Sober Grid, Addicaid, and Habit Tracker. While these are targeted at the general public, clinicians and health systems have started incorporating tools like these within their clinical processes [16]. The functionality of these tools is varied. Addicaid[1] connects people in recovery to others on the app in recovery and, using the GPS in the tech, provides a list of support meetings and groups near the individual. SoberWorx[2] is an interactive resource created by people in recovery that provides peer support but also connects users to resources and treatment options (in-patient facilities, sober

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[1]https://www.f6s.com/addicaid
[2]https://soberworx.com/

housing, counselors, and therapists). While the commercial product space is growing, there is still an absence of applications being developed to support the relationship between peer recovery coaches and recoverees.

2.3 User-centered Design in the Design of Mobile Health Applications

User-centered design (UCD) is a design philosophy that promotes early involvement of stakeholders and multiple iterations over its formative research, design, and evaluation stages [36, 41, 59]. These iterations are repeated until the production of a solution which, in the context of mobile health (mHealth) applications, should be "safe, sound, and desirable" [12].

The formative research stage traditionally consists of stakeholder interviews, focus groups, surveys, and observations to gather requirements for design [44, 72]. Successful projects tend to have designers involved in this stage to learn about the end users from first-hand experience, usually resulting in more desirable and usable solutions [23, 48, 51].

In the design stage, designers utilize the requirements formulated during the formative research stage to propose designs of the intended solution. Within this stage, the roles of key stakeholders— e.g. patient representatives, clinical experts—range from consultants answering designers' questions as needed, to co-designers providing feedback on early designs [75].

The solution is then evaluated with end users with methods that include heuristic evaluations, usability evaluations with end users, and less common in-the-wild trials [18, 32, 44]. Overall, the UCD framework promotes early and steady stakeholder involvement, a process that particularly benefits mHealth projects as they usually involve multiple stakeholders with opposing goals (e.g. patients, clinicians, caregivers, health systems) [55, 77].

In the context of mHealth, UCD has been used in multiple studies ranging from the treatment of chronic conditions to STI prevention [30, 56, 79, 90]. For such projects, UCD iterations help researchers and designers understand the stakeholders' context of use and unarticulated needs [20], first extracted during formative research and then refined during the design and evaluation stages [29, 40, 72]. As long as technological feasibility and clinical realities are considered [19, 29], these UCD iterations help expose designers'—and sometimes clinicians'—assumptions about the end users with opportunity to confront them in subsequent iterations [32]. UCD is thus a key tool for creating "valid digital health" solutions [29].

2.4 Peer Recovery Coaching Programs

Peer recovery coaching is a new evidence-based approach to substance use recovery [17, 80]. Peer Recovery programs focus on "long-term recovery and is rooted in a culture of hope, health, and wellness. The focus of long-term peer recovery support goes beyond the reduction or elimination of symptoms to encompass self-actualization, community and civic engagement, and overall wellness" [7]. Peer recovery coaching programs target reducing the likelihood of relapse by having coaches engaged with clients on a more regular basis and extending the reach of treatment beyond a clinical setting into the everyday lives of people seeking sustained recovery [9].Recovery coaches provide various types of support which include emotional (concern, empathy), informational (connections to community resources), instrumental (support like housing, childcare, or employment), and affiliational (connections to community activities and events) [7].

Peer recovery coaches are different from clinical providers in several key things that they *do not* do: diagnose, order labs, prescribe medication, provide treatments, or document within the electronic health record. Emergent research has shown the value of connecting peer recovery coach programs to traditional clinical treatments for substance use. While there is currently no formalized educational program, peer recovery coaches go through a formal certification process [34] and are typically individuals who have a lived experience (personally or within their family) and desire to

Fig. 1. SUD support ecosystem.

help peers in addiction recovery. The state of Indiana has a specific certification process for coaches that includes the initial credentialing and an additional 40 hours of continuing education every two years, including six hours in peer recovery ethics [64].

3 DESCRIBING THE RESEARCH SETTING

Parkview Health is a not-for-profit community-based hospital system in the United States. The system serves a population of over 900,000 people across fifteen counties in two states. Like many other communities across the United States, our area has seen a rise in risky use of opioids and substances. Between 2010 and 2017, drug overdoses almost doubled; and between 2000 and 2014, drug-induced mortality rates quadrupled [85]. Regionally in 2017, there were 73 opioid prescriptions written per 100 residents [3] compared to the national average of 59 per 100 Americans [35]. With respect to drug overdose deaths, in 2019 there were 30.3 opioid deaths per 100,000 people in our region, which was 2.5 times the amount from the previous year and almost double the state average for 2019 [4].

3.1 Peer Recovery Coach Program

As previously mentioned, our health system implemented a peer recovery coach program. Our peer recovery program is embedded within the behavioral health branch of our healthcare system. While similar to other types of both nonclinical (e.g. AA sponsors) and clinical (e.g. clinical navigators) support, Parkview peer recovery coaches play a unique and critical role in health services that address substance use disorder using a recovery oriented, chronic care approach [17].

The Parkview health system's Peer Recovery Coach program was established in 2016 through support from the Indiana Division of Mental Health Addiction through the CURES grant. Individuals are enrolled into the Peer Coaching Program through a variety of pathways: Parkview Health System emergency departments and in-patient behavioral health hospital, MAT clinics, law enforcement agencies (court, jails), community support programs, and homeless shelters. Not all who are referred to peer recovery coaches end up enrolled; people may choose among other clinical or non-clinical recovery options such as therapy or faith-based support, or decline support in starting their recovery journey. Figure 1 represents the range of clinical and non-clinical support options available to people choosing recovery, including Peer Recovery Coach programs.

The primary functions of the peer coach in our health system are to regularly monitor the well-being of individuals recovering from SUD and offer support as needed. Areas of support often include counseling for emotional well-being, providing resources on child support, housing, employment and transportation during recovery as well as sharing information about community
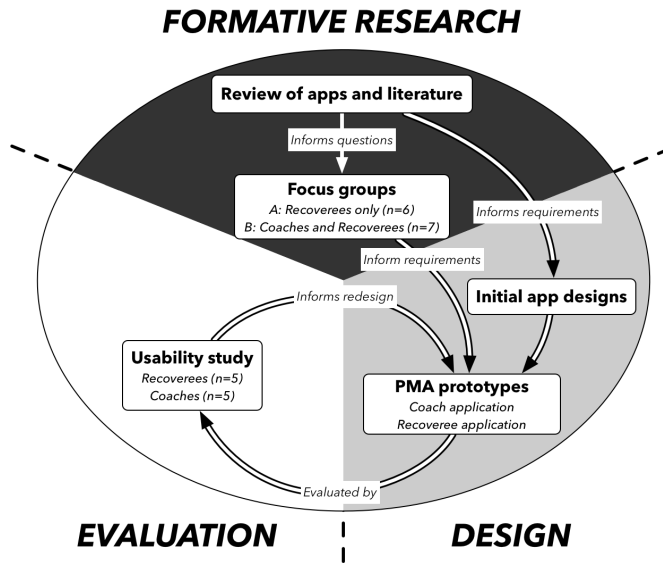
FORMATIVE RESEARCH

Fig. 2. UCD process utilized for the development of PMA.

support groups and how to avail halfway housing and Medication Assisted Treatment (MAT). Peer recovery support programs have been shown to create better long-term outcomes when connected to other clinical approaches [60]. Because coaches are paid employees, they have access to patients' health data through our electronic healthcare record system. Our coaches are currently embedded in emergency departments, MAT facilities, the women's and children hospital, and dispersed across the community.

The review of the literature highlights the increasing number of people struggling with SUD, providers expanding the portfolio of tools used to treat SUD (including formal peer recovery support) and an increasing number of clinical and commercial mHealth applications to support people in recovery. SUD, like other chronic conditions, has a complex and diverse presentation and course of illness. Because of the various clinical and non-clinical aspects to managing long-term recovery, UCD is well suited to help identify and illuminate these needs. In the remainder of this manuscript, we describe the formative research, design and evaluation of a mobile application to support a formal peer recovery coach program embedded within a clinical setting.

4 THE PEER MOBILE APPLICATION (PMA) STUDY

Based on the needs described in the previous section, we began ideation on a mobile application—Peer Mobile Application (PMA)—to support the peer recovery coach program at Parkview Health. To do so we followed a multi-phase, UCD approach to elicit the needs of peer recovery coach and recoveree stakeholder groups.

Our study started with a review of commercial SUD recovery applications and consultations with our behavioral health experts—including our peer recovery coaches—from which we derived initial design considerations for a mobile app (as part of the UCD process' formative research phase; section 5). We then conducted focus groups with peer recovery coach and recoveree participants who shared personal insight on concepts and features we were proposing (formative research

Application	Social Support	Schedule	Rewards	Connect Locally	Motivation Messages	Coaching	Resource Library
Sober Grid	x		x	x			
Sober Tool	x		x		x		
Turn	x					x	
Clean Today					x		
Connections	x						
FlexDek	x	x	x			x	x
Modern Support						x	
MA Lifeline							x
Sober Peer	x	x		x			
In the Rooms	x			x	x		
Addicaid	x				x		x
SoberWorx	x			x	x		x

Table 1. Substance Use Mobile Application Functionality Review

phase; section 6). Their feedback informed design requirements that we implemented in a high-fidelity prototype of PMA (design phase; section 7). We finally evaluated this high-fidelity prototype through usability evaluations with stakeholders (evaluation phase; section 8). Figure 2 provides an overview of our multi-phase UCD process.

5 INITIAL APP DESIGNS

As part of the formative research stage, we met with several of our behavioral health experts, including the peer recovery coach manager, to elicit initial core needs. The features that we uncovered through those initial conversations included recoverees' ability to establish urgent contact with their peer coaches, an effective means to maintain scheduled check-in appointments, and coaches' ability to monitor missed appointments and reach out to family or friends if necessary. With this core set of functionality, we looked to the various app stores to assess available substance use-focused applications. All of the apps we reviewed allowed users to track aspects of their recovery such as total number of days sober and triggers leading to use. Table 1 lists the core functions of these applications. As the table highlights, there was not one commercial application that met the programmatic needs of our peer recovery coach program.

6 FOCUS GROUPS

We held two focus groups to generate ideas for a mHealth solution (Focus Group A) and collect current experiences from existing coach-recoveree partnerships (Focus Group B). We used focus groups as a formative research method to better understand the recoverees' views of using a mobile application to support their interactions with peer coaches during the initial stages of their recovery journeys.

The focus groups took place at the Parkview Mirro Center for Research and Innovation and were facilitated by members of the research team. The goals of these focus groups were to collect data on the information needs of both groups of participants, how they found needed information, and the general workflow of the peer recovery coaches. The study was approved by the Parkview institutional review board.

Recruitment for participants varied by focus group, however the strategy for participant payment was the same for both Focus Groups A and B. Participants were paid $60.00 USD for their participation, which was estimated for 3 hours of time and an hourly rate based on the October 2018 average non-farm payrolls from across Indiana from the U.S. Bureau for Labor and Statistics. All payments were made via pre-loaded debit cards at the completion of the focus group.

6.1 Focus Group A

Focus Group A centered on understanding the basic communication and informational needs for individuals in all stages of recovery. This focus group was comprised of individuals who had never been part of the Parkview Peer Recovery Program to ensure we captured a broad perspective. Facilitators lead two discussions: 1) general information and data needs at the beginning of a recovery journey (e.g. support groups, housing and emotional support, and source of support and resources); and 2) desired tool functionality (e.g. pros and cons of each function, potential road blocks, and perceived benefits).

6.1.1 Recruitment & Participants. The research team worked with peer coaches and local recovery-focused establishments to recruit participants, including distribution of recruitment flyers and snowball sampling. Individuals were eligible to participate if they met the following criteria: over the age of 18, in recovery from substance use, able to provide consent, agree to recording of participation, and able to read/write/speak fluent English. We did not attempt to stratify sampling in this exploratory phase because of the anticipated recruitment challenges among SUD recoverees in early recovery stages. Six participants were successfully recruited and five completed their demographic survey (see Table 2 for participant demographics). Age and zip code were not collected to provide additional anonymity to the participants.

6.1.2 Results. During the first half of the focus group, participants were asked to reflect on their experiences in the early stages of recovery (Figure 2).

Information Needs: Most participants stressed the value of connecting to the larger recovery community and services. Information sought from the recovery community included plugging into the established networks (both in-person and online), best practices for managing life stressors, and tips for finding the right meetings and a good a sponsor. With respect to services, participants found value in help connecting to various community resources that could help get them get reestablished (e.g. finding lodging/apartments, childcare, and assistance with paying bills). People new to recovery often look to their community for advice on navigating legal issues associated with their past substance use. The information that participants found on their own includes resources and support groups (both online and offline). Participants discussed using online chat, videos (e.g. YouTube), podcasts, and other online social platforms as information sources and found them valuable and convenient.

During the second half of the focus group, participants were asked to walk through potential strategies for eliciting social support via a mobile application during those early stages of recovery.

General Communication: The participants were clear that purely digital communication is not wanted or valued. During early stages of recovery, in-person contact is important because "sometimes you just need a hug and you can't hug your phone, right?" Participants also discussed the need to not only connect with support personnel but also peers so they could share experiences and build community.

Resources and Information: All respondents discussed the need for a tool to have a space for curated resources and information. Their information needs included centralized local community resources, frequently asked questions, details about different kinds of recovery programs, domestic violence assistance, tips/resources for meetings, and connections to aspects discussed in the first

Demographics	Focus Group A (n=6*)	Focus Group B (n=7)
Age average (SD)	41.4 (23.7)	34.3 (9.7)
Female	3 (60%)	6 (86%)
Male	2 (40%)	1 (14%)
White/Caucasian	4 (80%)	4 (57%)
Black/African American	1 (20%)	1 (14%)
Multi-racial	0 (0%)	2 (29%)
Single	2 (40%)	1 (14%)
Married/Has a Partner	2 (40%)	3 (43%)
Divorced/Separated	1 (20%)	3 (43%)
Less than high school	1 (20%)	1 (14%)
High school diploma or equivalent		1 (14%)
Some college	2 (40%)	2 (29%)
Bachelor degree or higher	1 (20%)	3 (43%)
Unemployed	2 (40%)	2 (29%)
Employed full-time	1 (20%)	4 (57%)
Employed part-time	2 (40%)	1 (14%)
Living alone	3 (60%)	3 (43%)
Living with spouse/partner	2 (40%)	2 (29%)
Living with family/friend	0 (0%)	2 (29%)

Table 2. Focus Groups A & B participant demographics. *Only 5 Focus Group A participants provided demographics.

half of the group (such as how to accesses assistance in finding lodging, childcare, employment, and help with bills). Additionally, participants wanted testimonials of those who had experience in the recovery journey. Participants described the need for this information to be organized and searchable within the tool.

As the discussion about functionality continued, the ability to link the mobile application into the electronic health record (EHR) for purposes of reminding about medical appointments came up. All participants were adamant that the tool should not have any connection to the EHR. They shared that formal health systems often let people in recovery down and healthcare providers often negatively judge them based on their SUD history. Although participants could see the benefits of connecting the application into the data-rich environment, for them the costs outweighed the potential benefits.

6.2 Focus Group B

Focus Group B was targeted on validating the findings uncovered in Focus Group A with a group of recoverees actively participating in the Parkview Peer Recovery Program and their recovery coaches. The focus group was broken into two phases: a group discussion followed by a card sorting exercise (Figure 3). This was done in order to get feedback from both the group as a whole and individual stakeholder groups. The discussion was general in nature like the group discussion in Focus Group A. Additionally, coaches and their clients discussed typical communication patterns for them and associated workflows.
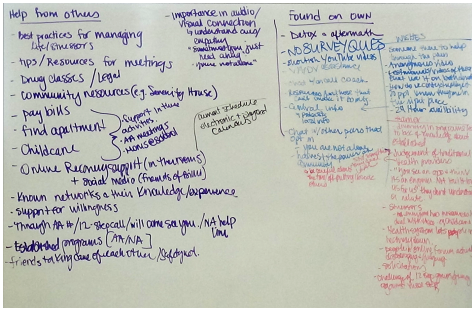
Fig. 3. Focus Group A: Whiteboarding Informa-tion Needs During Initial Recovery Journey
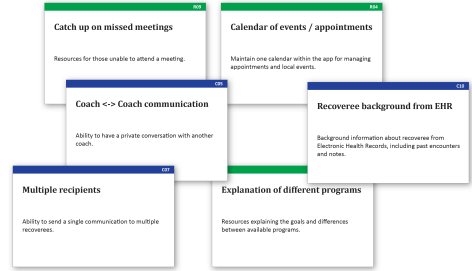

Fig. 4. Focus Group B: Card Sorting tools for both Recoverees and Peer Coaches

For the card sorting activity, we used the findings related to the tool from Focus Group A to create a set of cards. We broke participants up into stakeholder groups, we gave each participant a set of identical cards and asked them to pull 10 cards that they felt were important for the development of a mobile application to support the peer recovery coach program. The functional prompts on the cards for the recoverees and coaches included: information about treatment including meeting preparation guides and explanation of different programs, resources, connections to the electronic health record (EHR), and calendars. Cards for coaches included: coach-coach communication, recoveree information, archiving/recalling recoverees, managing recoverees, and utilization of a web interface. Participants were asked to sort cards twice: first they were asked to select ten cards with functionalities they wanted in a mobile application that would support the recoveree-peer coach relationship. Each selection in the first set earned a card a +1 preference score. Once these cards were selected, the participants were then asked to select their top 3 cards. These cards were given a higher weight (+3) to denote the strength of that preference. Additionally, we gave participants blank cards to write in functionality they felt was important missing from the initial decks.

6.2.1 Recruitment & Participants. Two types of participants were recruited for this focus group: peer coaches and their clients who are also recoverees. The team first recruited coaches through email. Coaches who were successfully enrolled in the study then distributed recruitment information to their clients. Clients had to directly contact the research team to enroll. Participants were eligible to participate if they met the following criteria: over the age of 18, in recovery from SUD, able to provide consent, agree to recording of participation, and able to read/write/speak fluent English. **Like Focus Group A we did not exclude any participant based on their stage of recovery.** A total of four peer coaches and three recoverees were recruited (see Table 2 for participant demographics).

6.2.2 Results - Group Discussion. The discussion section of Focus Group B validated the findings from the discussion in Focus Group A and expanded on functionalities related to workflows of peer recovery coaches.

General Communication: Similar to findings in Focus Group A, Focus Group B participants shared the importance of face-to-face interactions early in the recovery process. As they have been working with recovery coaches through phone and emails, Group B participants appeared more comfortable using technology earlier in the process, speaking to how experience influences attitudes

with regards to technology. Trust is highly valued within the recovery community and is potentially easier for some to establish when meeting face-to-face rather than virtually. Both peer coaches and recoverees discussed the importance of having more communication and fast responses during the initial phases of recovery, with one recoveree stating that they "kept calling their coach until they finally answered." The need for several modes of communication was discussed because of the variety of individual preferences among participants, including voice, text, and video. Recoverees not having a phone, plan, or minutes/data available for talk/text was identified as a communication barrier.

Resources and Information: Recoverees in both Focus Groups A and B felt that having information that was searchable was crucial. Likewise, from the coaches' perspective, having this information architecture was perceived as an aid to better accomplish their mission. Further, both recoverees and coaches felt having this shared view of information was important for effective communication. Both stakeholder groups stressed the importance of actionable information and relevant, dependable resources. Recoverees desired an option to save information from conversations as notes for later reference. For example, one participant mentioned they used phone notes in the past to save information related to resources shared by a friend or provider. Peer coaches wanted to make sure that any resource uploaded into the tool would be visible to all coaches and recoverees, reducing the current workload where coaches sometimes curate their own sets of resources.

Privacy: Privacy was a new concern that emerged during Focus Group B. One coach mentioned that some of their clients actually share a phone with other family members. They felt it it is important to have a secure log-in for the app itself to ensure the recoverees' privacy was maintained. Another coach raised the issue that coaches are sometimes unavailable. Both participant groups discussed the benefits of having another coach be able to join the communication within a mobile application so that there was seamless support to the recoveree.

6.2.3 Results - Card Sorting Exercise. The tensions between the wants and needs of coaches and recoverees was evident in the card sort activity. Table 3 highlights the card sorting scores of both stakeholder groups. Recoverees strongly desired a chat feature to instantly communicate with their coach, but coaches did not share this desire. The peer coaches' top priority was EHR integration, while recoverees had no wishes for the information shared with their coaches to be incorporated in their medical record for potentially any provider to see. However, coaches and recoverees both deemed resources and treatment information as top needs for a recovery application.

A disparity of needs for coaches and recoverees meant that compromises would need to be made in future designs to accommodate both groups, such as omitting EHR integration despite being a top desire for coaches. While recoverees prioritized having modes of instant communication with their coaches (phone calls, chat, etc.) we learned that recoverees may find themselves without access to a smartphone, data or minutes; they would thus be unable to access such feature.

6.3   Summary of Focus Groups A and B

Both Focus Groups A and B validated and challenged the initial assumptions derived from the review of commercial SUD recovery applications and conversations with health system leadership. In light of our UCD process (see Figure 2), the results of the focus groups were foundational to support the design of PMA.

7   DESIGNING THE TOOL

7.1   Transforming Focus Group Findings into Requirements

We undertook a major redesign of PMA that addressed the wants and needs of participants of the second focus group. We ranked the most wanted features for both coaches and recoverees by scoring

Feature	Recoveree	Coach
Recoverees and Peer Coaches		
Resources/local services	+17	+7
Chat/instant communications	+11	+0
Information about treatment	+10	+7
Calendar of events/appointments	+5	+3
Select/Appoint substitute coach	+4	+4
Create a private group	+4	+0
Connection with the EHR	+1	+8
Peer Coaches Only		
Manage recoveree lists	N/A	+10
Archive/recall recoverees	N/A	+7
Recoveree contact info	N/A	+6
Coach-coach communication	N/A	+5
Having a web/desktop interface	N/A	+3
New Functionality		
Goal setting/to-do lists	*	
Urgent messaging/priority labels	*	
Video Chat		*
Read receipts for messages		*
Shared device security		*

Table 3. Card Sorting Exercise Results

the card order elicited from focus group participants, attributing a score of 2 for cards ranked high priority and 1 for cards ranked low priority. The most-requested features among recoverees were accessing resources to help them in their recovery (17 points), instant communication with coaches (11), and information about treatment (10). Coaches favored managing their list of recoverees (10), integrating the app with the electronic health record (8), and archiving/recalling recoverees (7). Interestingly, some cards such as integration with the EHR system and video communications were viewed negatively by some recoverees during the card sorting exercise because of privacy concerns. Recoveree and coach participants also suggested new ideas that did not appear in the supplied cards; these included sending urgent messages (recoverees), setting goals for oneself (recoverees), video chatting (coaches) and implementing security protocols for shared device use (coaches). Table 3 lists cards features and their implementation as functional/non-functional requirements.

7.2 Overview of PMA: Peer Recovery App

The Peer Mobile Application (PMA) is proposed as a way to offer essential support to the peer assisted recovery program. PMA will provide an opportunity to connect peer coaches with the recoverees post discharge to check on their well-being and begin building the relationship that will hopefully help them to begin and maintain the recovery journey. PMA is comprised of four main concepts: coach-recoveree communication, resource management, appointment scheduling, and client management (coach only). *Coach-recoveree communication* is supported by a messaging feature allowing coaches and recoverees to send and receive messages, with optional urgent and read receipt flags, and by individual profiles where users provide information to foster the relationship

with their peer. These functions were derived from the results of Focus Groups A & B, which were used to devise a set of functional and non-functional requirements to drive the development of PMA.

7.2.1   Coach-Recoveree Communication: Inbox and Messages. PMA's main purpose is to support communication between coaches and recoverees; both coaches and recoverees thus have the ability to initiate text, audio, and video conversations. Recoverees are only able to communicate with the coach assigned to them in the program, while coaches are able to contact all the recoverees they manage either permanently or temporarily (e.g. in case of another coach's absence). Recoverees have the option of flagging and sending messages as urgent, a feature that was requested during focus groups; coaches instead can ask for read receipts to be automatically sent by the application when a message is opened by the recoveree. Text messages can be initiated from different places within PMA; recoverees can for example send a message about an upcoming appointment using a contextual menu, while coaches can browse and share resources in a text message directly from the resources screen without going back to the messages screen. Compared to recoverees, coaches have access to additional screens to better support their workflow: a screen presenting a list of recoverees that can be sorted to their liking, and an *Inbox* screen that always displays the most recent messages first. Both recoverees and coaches also have access to a history of messages exchanged, including shared resources and scheduled appointments.

7.2.2   Resource management: Resources and Events. Resources are another core component of PMA as determined by our focus group data. Coaches can use PMA to add resources to a database shared between colleagues, either by inputting resource information manually or by copying a web link. Resources can be of two types: articles and directories about recovery resources available in the community, such as lists of halfway houses or food banks; and upcoming events, like faith-based recovery groups. The database can be consulted by both coaches and recoverees, with multiple filter and sort settings (e.g. "most shared resources first," "events happening near me"). Coaches can share resources with recoverees, and recoverees can send a message to their coach about a specific resources. By design we limited recoverees adding resources to the common database and sharing resources with other PMA users and outside PMA to prevent safety and liability issues from arising.

7.2.3   Appointment Scheduling. Coaches can schedule appointments with recoverees directly from multiple sections of PMA to limit workflow interruptions; not only from the appointments screen but also from their home screen, conversations with recoverees, and their calendar view. Recoverees do not have the ability to schedule appointments or view their coach's availability; however, they can access a *Planner* that groups appointments with their coach and any recoveree-related events they have selected, or their coach has input for them. Recoverees can message about an upcoming appointment but can only cancel appointments with their coach by sending them a message.

7.2.4   Recoveree Management. Coaches can manage their recoveree clients without leaving PMA. Operations coaches can do include temporarily or permanently assigning a recoveree to another coach (a feature requested during focus groups), hiding or displaying recoverees who have not been engaging with them recently, and sending messages to multiple recoverees at the same time (equivalent to an email BCC). We also designed a web interface (pending user evaluation) on which coaches and their manager could perform similar client management tasks.

7.2.5   Other Requirements. Additional non-functional requirements emerged from the focus groups that were not directly translated to design elements. Notable examples include an offline mode to allow consultation of resources and past messages so that content can be accessed without mobile
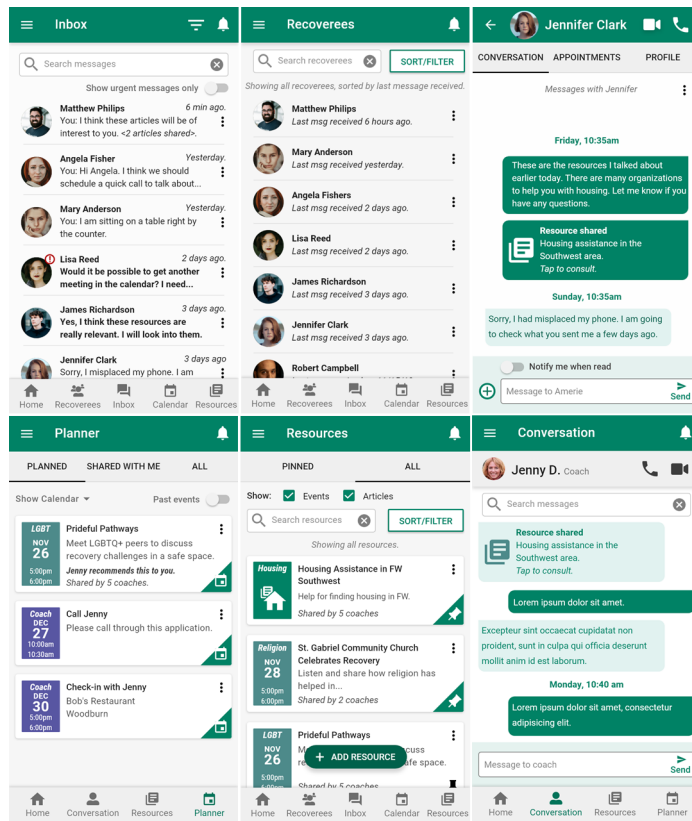
Fig. 5. Sample screens of the PMA application. Clockwise from top-left: Coaches' Inbox (recent messages), Coaches' Recoverees list, Coaches' Conversation screen, Recoverees' Conversation screen, Coaches' Resources screen, Recoverees' Planner screen. (No actual patient data was used for this example).

data, rules for redirecting urgent messages in case of a coach's unavailability, and the sign-up process involving coaches working with recoverees to securely register them for or with PMA. We consolidated these requirements into a document to share with app developers for future implementation.

8 USABILITY STUDY - ASSESSING THE PMA TOOL

8.1 Methods

We recruited five coaches and five recoverees to test PMA prototypes (one for coach participants, one for recoveree participants) developed with Adobe XD and deployed on a mid-range Android smartphone (Samsung J3). Fifteen coaches were informed of this project through their manager, and fie voluntarily accepted to complete the usability session. Among participants in recovery, we recruited three people referred by coaches and enrolled in the programs managed by our healthcare system, and two participants recruited from a convenience sample who were not part of any recovery program (see Table 4 for participant demographics). **We did not exclude any participant based on their stage of recovery, similar to our approach in focus groups A and B, because of challenges in recruiting people in early stages of SUD recovery.** Participants were given a $20 gift card for their participation in the study.

Demographics	All (n=10)		Coaches (n=5)		Recoverees (n=5)	
Age mean (SD)	33.0	(9.3)	38.0	(10.2)	28.2	(5.1)
Female (%)	7	(70%)	5	(100%)	2	(40%)
White (%)	6	(60%)	3	(60%)	3	(60%)
Other (%)	2	(20%)	1	(20%)	1	(20%)
Black (%)	2	(20%)	1	(20%)	1	(20%)
High school diploma or equivalent	2	(20%)	0	(0%)	2	(40%)
Some college	4	(40%)	1	(20%)	3	(60%)
Bachelor degree or higher	4	(40%)	4	(80%)	0	(0%)
Employed full-time	6	(60%)	5	(100%)	1	(20%)
Employed part-time	2	(20%)	0	(0%)	2	(40%)
Household income <$20,000	3	(30%)	0	(0%)	3	(60%)
Living with spouse/partner	4	(40%)	2	(40%)	2	(40%)
Living with family member	1	(10%)	0	(0%)	1	(20%)
Living in an assisted living facility	1	(10%)	0	(0%)	1	(20%)

Table 4. Demographics and technology use of usability study participants

Each 1:1 usability session was conducted by one facilitator trained in user experience research and one to two note takers (researcher names hidden for review) in a standard office room. While thinking aloud, participants were first instructed to explore the prototype, then performed a series of specific tasks testing PMA's features on a Samsung J3 smartphone. After each task, participants were asked follow-up questions on what they had just done. The session ended with the administration of the System Usability Scale (SUS) [22], an oral assessment of their familiarity with technology, a semi-structured interview about how PMA could benefit their workflow (coaches) or their recovery (recoverees), and a basic demographics questionnaire. Sessions were audio- and video-recorded (hand interactions with screen only). See Table 5 for technology survey results.

8.2 Results

The results of the focus groups found that recoverees' most-requested features were related to increasing access to support, and that coaches' most-requested features were related to improving efficiency in their workflows in order to improve care for their recoveree clients. The usability study evaluated how well the prototype design addressed these user needs. We report the results in terms of how well the two primary user needs are supported by each major concept of the prototype design: communication, resource management, appointment scheduling, and recoveree management. We also report results related to a feature that was not implemented (integration with the electronic health record) and new features that usability study participants requested.

8.2.1 General. Overall, both coach and recoveree participants rated the PMA prototypes highly, with average respective SUS scores of 92.5 (A+; SD: 8.3) and 91 (A+; SD: 7.62). Participants were able to recover from most errors, such as navigation to the wrong screen or erroneous button taps. Participants appreciated the redundancy afforded by the prototype design, as many actions could be performed in several places they found intuitive; for example, coaches could schedule

Technology use	All (n=10)		Coaches (C) (n=5)		Recoverees (R) (n=5)	
Has computer at home	5	(50%)	5	(100%)	0	(0%)
Has smartphone	10	(100%)	5	(100%)	5	(100%)
Has internet on phone	10	(100%)	5	(100%)	5	(100%)
Comfort using... (1-4 Likert scale)						
...a computer, mean (SD)	3.6	(0.52)	3.6	(0.52)	3.6	(0.55)
...a mobile phone, mean (SD)	3.8	(0.42)	3.6	(0.55)	4.0	(0.00)
...the Internet, mean (SD)	3.8	(0.42)	3.8	(0.45)	3.8	(0.45)
Apps to talk to friends and family...						
...text/iMessage (%)	9	(90%)	5	(100%)	4	(80%)
...Facebook/Facebook Messenger (%)	7	(70%)	3	(60%)	4	(80%)
...Snapchat (%)	5	(50%)	1	(20%)	4	(80%)
Use of EHR to talk with doctors and other healthcare professionals (%)	5	(50%)	2	(40%)	3	(60%)

Table 5. Technology use of usability study participants

an appointment with a recoveree from the calendar view, from their Recoveree list, or from the messaging interface.

Although the prototype was created using Google Android's Material Design guidelines, participants who reported regularly using an iPhone did not have any navigation issues. Some however encountered icons that were unfamiliar, such as "share" and "filter" icons (C2, C5).

8.2.2 Communication. Recoverees had a positive response to the app's communication components:

> "When I go meet them [my coach] in person, I'll tell them I'm having trouble with this or that and then they'll give me, like things to fill the time, but it kind of makes it difficult 'cause I only see them like once a week so like an app like this would help me a lot better, so that way I can talk to them daily." (R4)

Other recoverees shared similar opinions. R5 said they liked having a direct line to their coach on bad days: *"On times that you just... want to talk to somebody... I have a direct line to her so... I can just send her a direct message [saying] I'm not having the best day today"* (R5).

Recoverees liked the prospect of having a direct line in times of crisis, and particularly liked the option to send their message as urgent (*"If you have that option to kind of ping that like 'Hey, look, I really need you to, like, get at me and talk to me,' I like it that there's that option on there"*; R3). Recoverees wanted more than just a crisis line, however, with participants saying they imagined using the messaging feature for quick check-ins (R3, R5), thank you messages (R1, R3, R5), and other non-urgent messages such as asking for resources (R2, R4).

Throughout the user evaluations, recoverees mentioned ways that anxiety prevented them from accessing support (*"It's hard to reach out and it's hard to even talk to somebody"*; R1). With messaging specifically, three recoverees said they worried about intruding on their coach's personal life and time if they messaged too much, because their coaches use their personal cell phones (R1, R3, R5). A quote from R3 summarizes this feeling: *"When I message my coach..., that's her personal phone, I'm assuming, so that gets mixed in with her family messaging her, [because] she has a life too... [But]*

with this app it's like a direct line." Having a professional line of communication would make the norms clearer and would make recoverees less worried about reaching out.

Participants pointed to two features of the app design that they said would particularly facilitate communication: supporting multiple modes of communication, and using WiFi instead of relying on a phone plan. The app allows users to choose between three modes of communication: text, phone calls, and video calls. Both coaches and recoverees said that this was important because using recoverees' preferred method would lower the barrier to communication between the recoveree and their coach:

> "Most people want to text, most people don't want to pick up the phone or they don't want to use their home phone, or their home phone is like their mother's phone... [so] they're not there anymore and we're trying to reach them, so we don't have a way to reach them until they show up again." (C3)

Both coaches and recoverees also said the app's use of WiFi would reduce instances of recoverees being intermittently unable to contact coaches because of temporary or disconnected phone numbers. Coach participants also said that it could be difficult and time-consuming to reach recoverees who may not have a stable phone number or address:

> "I might go out to a person's house and try to reach them and they might not live there anymore. So I might try another address [while] trying to reach out to them on their cell [or go back to their house if] they don't have access to... an actual phone number right now" (C5).

Coaches liked how the communication component would streamline their workflow by making it easier to contact recoverees. None of the coaches were concerned at the prospect of being overwhelmed by a potential increase in incoming communications despite an potential worsening of their workload: *"that just means that you have to have boundaries and not answer your app when you're not working"* (C5).

While coaches welcomed increased communications, they expressed reservations regarding the urgent message feature, although liked by recoverees. One coach said they thought recoverees might over-use the urgent message flag (C2)—and one recoveree said they sent *"very dramatic messages"* at the beginning of their recovery (R3)—but most coaches hesitated at the urgent message option simply because it added time pressure: *"If I'm with somebody, sometimes it's a half hour, forty minutes and then you know, they won't get their text right back because I'm with somebody"* (C4).

Adding to this, recoverees held different expectations for response times to urgent messages; one expected a response in less than 10 minutes (R1) while others found longer response times acceptable (R3, R5). Coaches liked the idea of being able to temporarily assign recoverees to other coaches when unable to respond quickly, whereas recoverees were mixed on whether they would like a response from a substitute coach; for example, R1: *"when I was in use, I did not trust anybody, I didn't want to talk to anybody, so getting an addict to open up to somebody [new would be] very hard."* [3]

8.2.3 Resource Management. Recoveree participants in the usability study echoed the findings from focus groups: access to resources is a top priority for them. *"Certain addicts don't have a support system or don't have a place to lay their head and they don't have access to resources and things like that... it's all different, it's not everybody, but some people don't have all these types of things"* (R5).

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[3]Recoverees sometimes referred to themselves as "addicts" or "junkies"; though some individuals with SUD use these terms to self-identify, they are not preferred terms and should not be used by individuals outside of the community or used to label others.

Recoverees thus found many advantages to PMA's Resources component, especially since they found resources shared on paper by coaches inconvenient and made it difficult for them to stay organized (R3-4). They liked that it created a central location of resources: *"for me, planning and keeping things organized is a big deal. So having that app… that will help me a lot better rather than just having papers everywhere all over the place"* (R4).

Several recoverees also appreciated being able to explore PMA's resources on their own. R2 mentioned how browsing resources independently helped reduce anxiety:

> "Sometimes when people tell me 'Oh, hey, there's an event coming up,'… then I'm like 'Depression, anxiety mode here we go! I'm just going to stay in.' But if I see something and it interests me… it kind of gives me that control to be like, this is something I want to do." (R2)

Coaches described their current resource sharing workflow during the usability study. Most coaches reported archiving and sharing resources with recoverees via printed materials (*"one of the biggest things we send out now is literally taking screen[shots] or pictures of sheets of paper that have a list of all the AA meetings"*; C1). One coach mentioned a bulletin board in their office where commonly shared resources are shared between coaches (C1), while another coach reported keeping digital copies of resources (C5). These resources are then shared during in-person meetings with recoverees (C4). Overall, coaches reported not being satisfied with their current resource management workflow: *"I don't have a system that I found that works. I've tried a couple of different ones, and none of them are sustainable, unfortunately"* (C2).

This dissatisfaction partly explains coaches' positive reception of PMA's Resources component. They highlighted the simplicity of tracking and organizing digital copies of resources through the same interface (*"it puts it all in one spot, and it's concise. You don't have to go sifting through files"* (C4)), as well as how PMA streamlines resource sharing between coworkers thanks to its common and centralized resource database (C1, C3). Coaches also liked the integration of messaging and resource sharing with recoverees within the same interface: *"It will help be more organized with the communication with my clients... I like that it shows you what resources you gave so I don't always have to go back... And it's all together, so I have my resources here"* (C1).

Some coaches did have reservations with PMA's Resources component, primarily about responsibilities surrounding building and then maintaining the resources database in a new format despite convenient features such as autofill and sorting/filtering[4] (C1, C4).

8.2.4 Appointment Scheduling. Focus group findings indicated that in relation to appointment scheduling, recoverees were most interested in support for missed appointments. Usability study participants did not mention this as being particularly important; however, all recoverees found the rescheduling functionality easy to use and no participant reported any confusion during the task.

Recoveree responses indicated that anxiety around appointment scheduling may be a barrier to recoveree access to support. Two participants wanted to see their coach's calendar before requesting appointments via message (R1-2) to reduce stress associated with appointment scheduling:

> "For me personally, when I know I have to set up an appointment, … I kind of feel bad just trying to fit myself in [a schedule]. It puts me at ease to be like 'OK look, Here's her schedule, this is something I can work with...' When you have mental issues, you think of everything and anything like, 'Am I doing this OK? Am I going to make this person upset?' " (R2)

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[4]This particular program has an employee whose job it is to create and maintain this database of resources. In fact, the program already has a centralized list of resources maintained in a spreadsheet but no coach mentioned using this list in their current workflow, possibly because it is not convenient to access.

Coaches believe the appointment scheduling feature in the PMA prototype would make their workflow more efficient, when asked about it, a coach responded: *"Yes, a thousand percent, you can quote me on that one. One thousand percent!"* (C2). As the participant coaches were from a variety of work environments, there was some variation in the degree to which the feature helped, but all coaches said it would make their work more efficient.

However, some coaches said that the app was only conditionally better: in order to be useful, the app needed to be integrated into their work and/or phone calendars (*"I also don't want it to be just one more thing that I have to open up and do stuff on, you know? So, any way to tie anything together would be nice;"* C5) Not all coaches framed this as a requirement, but all the coaches said they would like an option to sync with their other calendars (C1-5).

Coaches also liked the appointment scheduling tool because it was bundled with PMA's communication tools. *"Now I have to do it [schedule appointments] over the phone, if I'm going to do it. And there's the matter of getting a hold of them. Where this way [with a texting option]… they can get to it at their leisure"* (C4).

8.2.5 Recoveree Management. The prototype included a number of features intended to facilitate client management, including a sortable and filterable list of their recoveree clients and the ability to archive and reactivate recoverees depending on their status in the program. Coaches responded positively to these features, particularly because they existed alongside communication tools and a resource database. *"The hardest part about this position [peer coach] is being able to have all of this at my fingertips. [If] I don't have to remember all the specifics of everything, [that] would just be really nice"* (C2).

Coaches in the usability study found unexpected ways to use the app to help with client management and improving quality of care. For example, coaches liked PMA's message inbox screen because it displayed the date of their most recent contact with a recoveree, surfacing information about their recoverees' care and facilitating the identification of recoverees who needed follow-up (C1, C3-5). As C3 said, *"I can see… when I talked to them last… if something says 'Hey, you talked to this person 3 weeks ago'… that would be a good like notification of maybe I should text them and see what's going on"*. This use case was unexpected; during the design process some designers thought PMA's inbox screen would be redundant with the recoveree list screen during the design process, while others thought coaches would appreciate seeing their most recent messages first.

Although coaches had positive feedback about the app's client management capabilities, coaches emphasized the necessity for PMA to integrate into their existing workflows for it to be useful. Coaches in the study had diverse workflows despite a sample size of only five coach participants; for example some coaches worked primarily in offices on desktop computers, while others relied heavily on their mobile phones while meeting recoverees in the community. Coaches thus appreciated features affording customization of PMA to their needs, e.g., filters on the recoveree and resource lists. They however desired even more customization, such as options to rearrange widgets on the home screen (C5) or creating custom categories for resources (C4).

Coach participants may also have been particularly sensitive to inefficiencies introduced by new digital tools; multiple coaches referenced EHR software as having a negative effect on workflow efficiency (C1, C3, C5). When evaluating PMA, coaches who could not find a particular functionality were quick to assume it did not exist at all. This suggests that successful adoption of PMA for coaches may depend on clearly signaling capabilities that coaches consider essential to doing their work efficiently.

8.2.6 Integration with EHR (Not Implemented). The prototype design did not include integration with EHR software, one of the most frequently requested components from coaches in the focus groups.

Coaches in the usability study agreed that they would like the app to be integrated with the EHR, but contrasted by saying that it was not a critical component. Integration with the EHR would slow down development of the app, coaches said, and they still found the app valuable without EHR integration. However, coaches did emphasize that other, related features were crucial in order to prevent the app from creating inefficiencies in their workflow: namely, integration with their work calendars and the ability to document their communication with recoverees without duplicating work.

EHR integration could also be in conflict with recoverees' privacy preferences. Recoverees were not comfortable with their app data being accessible to providers throughout the health system. During the interviews, recoverees were given four examples of providers who might access their app data: their peer coach, the coach manager, their primary care physician (PCP) and emergency room nurses. Recoverees were comfortable with their coach and coach manager being able to access their data, and most were also comfortable with their PCP accessing their data as well, though some hesitated before deciding. No recoveree was comfortable with an emergency room nurse seeing their data; as R4 mentioned, app users could be in the emergency room for reasons unrelated to SUD.

8.2.7 New Feature Requests. Two types of new features were commonly requested by participants. One type was features that would help build a community between recoverees. The app was designed to facilitate communication and information sharing between coaches, and between coaches and recoverees, but not between recoverees. Three recoverees in the usability study mentioned a desire to build a community with other recoverees, suggesting new features that would allow them to read other recoverees' stories and share their own (R5), share resources with each other (R1-3), and get recommendations for new resources (R1, R5). Facilitating recoveree-recoveree communication would however introduce liability risks (e.g. exposing recoverees' identities) for the health system, which is why no recoveree-recoveree communication was supported in the first PMA iteration.

The second type was requests related to expanding the recoveree profile. Recoverees in the usability study requested more fields in their profile so they could share more information about themselves with their coaches—their drug of choice (R2-3, R5), or their hobbies (R2, R4)—so that coaches can better tailor their resource recommendations.

Tensions	Recoveree Point-of-View	Coach Point-of-View
Urgent messaging	Better access to support	Human resource constraint
Substitute coaches	Impersonal/alienating	Manage workload
Curated resource database	Better access to support	Could increase workload
Integration with EHR	Privacy concerns	Workflow efficiency
Recovery community	Better access to support	Security/privacy concerns

Table 6. Tensions between Recoverees and Coaches seen in Focus Groups and Usability Testing

9 DISCUSSION

9.1 Balancing Health System Needs with User Needs

Results from the usability study revealed that recoverees mostly wanted a tool that would help them access various types of social support while coaches' top priority was a tool that would make their workflows more efficient. PMA would enable coaches to provide a higher quality of care for their recoverees within the operational constraints of the health system.

In many cases, recoveree and coach needs were complementary. Recoverees wanted a better, faster way to communicate with their coaches; coaches wanted a stable point of contact so that they could reliably connect with their recoverees without the wasted time of dealing with outdated contact information or unstable phone connections. Recoverees and coaches both wanted a convenient way to access and share resources.

Tensions between the needs of coaches and recoverees also emerged, however, as illustrated in Table 6. These tensions surfaced because our methodology incorporated stakeholders from both user groups during all stages of the design process. This addresses a weakness in past research on technology-assisted interventions for SUD, which has tended to overly focus on the healthcare provider perspective [76]. Incorporating stakeholders from all groups during the design process means that designers had to navigate between the desires of recoverees, healthcare professionals, a healthcare system, and what the designers could realistically achieve [29, 32].

One important example of this is the norms around urgent messaging. The option to send a message as urgent was one of the recoverees' favorite features in communication, but some of them said they would expect a very fast turnaround time for a response (5-10 minutes). Coaches liked that their recoverees would be able to better communicate when they were in crisis, but worried that the expectation of a fast response would put an additional strain on their workflow that they could not realistically meet, especially if they knew they would not be available during extended periods of time. The app prototype proposed a solution: the ability to assign a "substitute coach" to recoverees while their coach is unavailable. Coaches were enthusiastic about this option; however, recoverees were more reluctant. Though all the recoverees in the usability study said that a substitute coach would be acceptable in times of emergency, they also said that their history and trust with their primary coach was very important to them. This tension is an example of the challenges of translating tensions into design requirements for PMA.

Tensions surfaced between user needs in the evaluation of other app components as well. Recoverees and coaches both liked having access to a centralized list of resources, but coaches were concerned with the increased workload of building and maintaining the resource list. In this particular case, the healthcare system is employing someone to maintain this list, but future designs should be aware of coaches' sensitivity to an increased workload, even if it leads to a more efficient workflow in the long term.

The application prototype did not include any integration with the health system's EHR because of recoverees' concerns, even though coaches in the focus groups prioritized EHR integration. Responses from recoverees in Focus Group A and the usability study indicated that integration with EHR would cause privacy concerns related to varying levels of trust in the health system and various providers within the system. For example, recoverees were comfortable with their coach and coach manager being able to see their information in PMA, but were less comfortable with their primary care physician being able to access their data and not at all comfortable with emergency room nurses having access. This is likely due in part to fear of stigma if providers knew they had a substance use disorder, as previous research has shown that individuals with SUD are treated differently by healthcare providers [86]. Integration with EHR, or even recoveree perception that their data may be shared, is likely to have a chilling effect on recoveree adoption of PMA, especially in early recovery when trust in outside individuals and institutions can be very low.

Lastly, multiple recoverees requested new features that would help them build a community with other recoverees: sharing stories, discussing which resources worked best for them, and providing other support to each other. This type of support is recognized as being important in the recovery journey, but adding features that enable recoveree-to-recoveree communication creates complications for the health system related to privacy and security. For example, there can be no risk

of recoverees' names being exposed to other recoverees. While some form of recoveree-to-recoveree support may be implemented in future iterations of PMA, design choices must be made carefully.

9.2 Lessons Learned from Engaging People Recovering from Substance Use

There were several challenges in recruiting patients for these research engagements. Consistent communication with participants during enrollment was challenging due to issues such as inconsistent mobile phone access (e.g. running out of minutes) and temporary places of residence. This is unsurprising given that this was one of the challenges PMA was designed to address.

Transportation was also a challenge. Multiple participants were no-shows, and several others were late, because they did not own cars and had to rely on others to drive them or use public transportation, which was not reliably on time. To address this issue, the peer recovery program offered participants free bus passes to get to the location where stakeholder engagements took place, about ten miles outside of the city center. The location of the interviews could not be changed to be more accommodating to recoverees because of IRB constraints.

Several recoverees were concerned about their participation in this research being known. They were worried about the possibility of being outed as a person in recovery from SUD. Additionally, the focus groups and usability study sessions were videotaped, and several participants wanted reassurance that the videos would only be accessible to the research team. Prioritizing participants' privacy in the research design and clearly communicating those privacy protections are particularly important for this population so that they can make informed choices about their participation.

Preferred terminology in this disease space is complex and preferences can vary between individuals. For example, during Focus Group A, several participants said the term "addiction" was not preferred and requested that "disease" be used instead. The facilitator opened this up to a larger discussion with the group about preferred terminology, which produced a range of opinions within the group. We found that having this discussion early on helped "break the ice" with participants, who were empowered to offer suggestions, and corrections to terminology and assumptions through the session. Researchers should also be aware of terms to be used only by members within the community; for example, several of our participants referred to themselves as "addicts" or "junkies," terms that should not be used by outsiders as they are recognized as potentially stigmatizing language [61].

9.3 UCD Challenges

Using UCD we discovered unmet needs from both coaches and recoverees and designed a solution serving both populations. Existing approaches to designing mHealth technology supporting substance use recovery tend to promote either clinician or recoveree inputs, but rarely both at the same time [76]. Our application of UCD to the design of PMA was different from these approaches; as a unit within a larger healthcare system, we had to deliver a practical and implementable solution serving both our coworkers and our patients. We therefore equally prioritized coach and recoveree involvement in all UCD stages, striving to make coaches' workflows more efficient while meeting recoveree needs for access to various types of support. The positive feedback for the prototype received from both coaches and recoverees shows the benefits of such an approach.

We nonetheless encountered some of the UCD challenges for mHealth solutions reported in previous research [32]. In particular, we had to address designer's assumptions and biases about the end users, consider the input of multiple stakeholders while attempting to innovate, and limit the number of design-evaluation iterations.

Not all members of our three-person design team were present during the focus groups; one designer had had no contact with coaches and recoverees until the usability study [48, 51]. The design effort behind the PMA tool started several months after the last focus group; recollection of

focus group experiences were thus more difficult and potentially biased by more frequent input from our clinical domain experts. The designers were also sometimes conflicted between including features recoverees *wanted*, such as creating private groups between recoverees (see focus group B), that entail liability and safety concerns; versus what coaches *needed*, such as EHR integration (focus groups, usability study), but that recoverees rejected.

This tension between designers, clinicians, and end-users, mentioned in previous research [29, 32], can also be extended to the health system our designers were serving. Our team constantly questioned the feasibility of implementing PMA in the recovery program run by our healthcare system and had to be especially mindful of norms surrounding health technologies, e.g. the US Health Insurance Portability and Accountability Act (HIPAA). These considerations have inhibited some ideas that could have been viable for a substance use recovery app, such as integrating a "recovery community" as suggested by recoveree participants in the usability study [32], or smartphone passive sensing to predict and prevent substance use [24, 31, 58].

Our process would have benefited from additional iterations on the design and evaluation phases to be truer to the UCD paradigm. While we had several formative research and design iterations (see Figure 2), we were unable to redesign the prototype with feedback received in the usability study due to resource constraints, a problem common to other mHealth projects following UCD methodology [32]. Despite this, triangulation of results from focus groups and usability data, as well as further discussion with our clinical domain experts, allowed us to be confident in revised design requirements for PMA's implementation within our healthcare system [39].

10 LIMITATIONS AND ETHICAL CONSIDERATIONS

10.1 Limitations

This research had several limitations. We conducted our preliminary research and tested our prototype within a single health system. Because most of the research participants were affiliated with our health system as coworkers or patients, PMA's specifications may be too tailored to our workflows and client population that our health system serves. However, preliminary discussion with stakeholders from other healthcare systems have shown potential for adaptability to other environments.

The recoverees in the usability study were mostly young adults (our oldest participant was 35 years old, and all others were under 30), which excludes middle aged and older adults for whom recovery can be very different [25]. Additionally, participants of our usability study were all smartphone users and familiar with the Internet, most were at least high school or college-educated, and all had transportation means to travel to the research facility. In our snowball sampling used during Focus Group A we probably missed recoverees of lower socio-economic status.

In addition, most of these recoverees were in a stable point in their recovery and had higher levels of trust for the program and the larger healthcare system. Recoverees were asked to imagine how they might feel about the prototype when they were early in their recovery journey; several commented on how low trust would have changed their response to the prototype. It is likely that the results underplay the concerns of privacy and trust that recoverees might have when they first engage with the program. Additionally, because they were at a more stable point in their recovery, recall to times of less stability is potentially an issue. Until a fully=integrated tool is assessed, gaining a wide array of insights for those in the very recent stages of recovery is unlikely due to recruitment issues associated with the points outlined in this section and throughout the paper.

10.2 Ethical Considerations

It was of the utmost importance to the research team that all recoverees felt safe as they shared aspects of their substance use disorder and recovery. We held the focus groups and usability study in a research facility not connected to anywhere healthcare services are delivered. During the introduction to the focus groups, the facilitators took additional care to explain their lack of personal experience with SUD. They also requested that participants speak up if inappropriate terminology was mistakenly used. As discussed in a previous section, a participant did ask us to use different terminology and it opened a line of discussion in focus group.

All co-authors/members of the research team are QPR certified. QPR (Question.Persuade.Refer) is a program that teaches an individual how to recognize when people are in the beginning stages of a crisis and how to react to the situation [45]. Having this type of training and certification was also shown to be an important ethical consideration for qualitative work with other stigmatized populations [68]. Additionally, we created a resource list for recoverees to take with them at the end of the focus groups in the event that talking about their past substance use had a delayed negative impact.

As mentioned in the discussion, one serious ethical consideration for the development of this tool is that recoverees would be sharing personally identifiable information and data considered sensitive under HIPAA through PMA. Both functional and non-functional design elements related to the protections of user data were taken into consideration during the design of the prototype. Unimplemented design elements associated with security and privacy, especially with regard to alerts generated from the app, need to be tested with users.

11 FUTURE WORK

The initial designs and prototype have been tested with both Parkview peer recovery coaches and recoverees. Future work includes building out PMA into a stable production-ready tool for the health system. At that point, a randomized clinical trial would allow us to test the effectiveness of this tool within the peer recovery support program setting and further investigate the tensions uncovered in the initial research. Furthermore, extending PMA to other types of peer recovery programs (e.g. SUD navigation) would test the generalizability and extensibility of its design. Previous HCI research has demonstrated the benefits of mHealth technologies similar to PMA within other health system navigation settings [46].

12 CONCLUSION

Treatment for SUD is complex. A growing body of work has shown the efficacy of integrating non-clinical support into the clinical context of SUD treatment: treating not just the underlying healthcare issue but also associated behaviors. Peer recovery coaches play a vital role in our health system's approach to addressing the opioid and substance use epidemic. They provide non-clinical support to the recoverees in addition to being connected to the health system where clinical care is provided. Technology has the potential to play a key role in supporting recoverees during the recovery journey. The UCD design and evaluation of the application highlight the potential for mobile apps like PMA to support the momentary needs of recoverees in addition to providing coaches tools to support their workflows. By including non-clinical treatment efforts like peer recovery programs alongside clinical treatments, our health system has taken a more holistic approach to treating SUD, offering better long-term prospects for people in their recovery journey.

Abbreviation	Full Text
SUD	Substance Use Disorder
OUD	Opioid Use Disorder
HCI	Human Computer Interaction
UCD	User-centered Design
mHealth	Mobile Health
PMA	Peer Mobile Application
DSM-5	Diagnostic and Statistical Manual of Mental Disorders-5
SAMHSA	Substance Abuse and Mental Health Services Administration
FDA	Food and Drug Administration
GPS	Global Positioning System
AA	Alcoholics Anonymous
NA	Narcotics Anonymous
MAT	Medically Assisted Treatment
IRB	Institutional Review Board
EHR	Electronic Health Record
SUS	System Usability Scale
QPR	Question.Persuade.Refer
HIPAA	Health Insurance Portability and Accountability Act

Table 7. Abbreviations and Definitions

13 ACKNOWLEDGEMENTS

14 ABBREVIATIONS

Table 7 defines all abbreviations used in this manuscript.

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