Communication between patients, peers, and care providers through a mobile health intervention supporting medication-assisted treatment for opioid use disorder

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ABSTRACT

Introduction: Our team developed the HOPE app as a clinic-based platform to support patients receiving medication assisted treatment (MAT) for opioid use disorder. We investigated the app's two communication features: an anonymous community message board (CMB) and secure messaging between patients and their clinic team.
Methods: The HOPE (Heal Overcome Persist Endure) app was piloted with patients and MAT providers. Text from the CMB and messaging were downloaded and de-identified. Content analysis was performed using iteratively developed codebooks with team consensus.
Results: The pilot study enrolled 28 participants; 25 were "members" (patients) and 3 were providers (physician, nurse, social worker). Of member-generated CMB posts, 45% described the poster's state of mind, including positive and negative emotions, 47% conveyed support and 8% asked for support. Members' secure messages to the team included 52% medical, 45% app-related, and 8% social topics. Provider's messages contained information exchange (90%) and relationship-building (36%).
Discussion: Through the CMB, members shared emotions and social support with their peers. Through secure messaging, members addressed medical and social needs with their care team, used primarily for information exchange but also relationship-building.
Practice implications: The HOPE app addresses communication needs for patients in MAT and can support them in recovery.

1. Introduction

The ongoing opioid epidemic has taken a massive toll in the United States, emphasizing the need for safe and effective therapies for opioid use disorder (OUD) [1]. OUD refers to a problematic pattern of opioid use that causes significant impairment or distress, based on diagnostic criteria that include unsuccessful attempts to control use and use resulting in negative social consequences [2]. Medication assisted treatment (MAT) with methadone or buprenorphine in addition to

evidence-based counseling improves OUD patient outcomes by combining medication to prevent withdrawal symptoms and behavior-focused therapy to support behavior change [3]. However, patients in nonurban communities continue to face significant barriers to accessing care, such as scarcity of providers and long distance to travel to clinics [4,5].

Mobile technology interventions for patients with chronic diseases have shown promise in improving outcomes and helping patients remain engaged in care, particularly for vulnerable populations [6–8].

Mobile health (mHealth) platforms including use of telemedicine and smartphone applications designed for people with substance use disorders have demonstrated improvements in patient engagement in care and prevention of relapse, particularly for patients with alcohol use disorder [9–11]. There are fewer mHealth interventions designed for patients with OUD, and this population remains a high priority [12–15]. Although there has been a rise in app development related to OUD in recent years, most have been designed for clinicians only, without interactive communication features [16]. Patient-facing apps have offered tools for finding service providers, setting reminders, accessing educational resources, or tracking personal progress towards goals, but lacked integration of multi-component interventions [16]. Barriers to mHealth adoption have included concerns about privacy and security [17] and mismatch between apps and user needs and preferences [18]. Commercially available apps may be distrusted due to possibility of users' information being shared with third parties [19].

Direct message exchange between patients and clinicians via patient portals allows communication outside of regular appointments. Patients with access to portals have reported satisfaction with their ability to ask questions manage appointments and medications, and access test results which leads to improved chronic disease management [20,21]. For patients living in nonurban communities where they might have to travel long distances to clinic, the ability to readily communicate outside of appointments offers significant benefit. While patients and providers primarily use direct messaging to convey logistical information, direct messaging also contains opportunities for relationship-building [22–24]. Despite the potential benefits of patient portals, their use tends to be higher among groups with higher socioeconomic status [25]. Patients in disadvantaged groups may face barriers to use of these portals [26], demonstrating a need for communication tools that are more usable and accessible.

While the patient-provider relationship can be crucial for OUD recovery, peer support can also be an important component. With the rise of social media, individuals with chronic conditions have turned increasingly to online platforms as a source of peer connection and support [27–29]. People with OUD may find the anonymity of online support groups particularly empowering given ongoing stigma and desire to form online communities while preserving privacy. However, most openly accessible online communities are not monitored or moderated by healthcare teams, which poses a risk of misinformation and inappropriate interactions [30]. Negative or incorrect postings can undermine the help provided by such groups. Furthermore, the impact of digital support services on patient outcomes remains an area of ongoing investigation [31–33].

The HOPE app is a clinic-based mobile health platform developed for patients with OUD receiving MAT [34]. HOPE (Heal Overcome Persist Endure) was created through an iterative formative phase that included patient and provider interviews and feedback on prototypes. App features were adapted from our team's prior work on PositiveLinks, a mobile platform developed for people with HIV that improved outcomes including engagement in care and viral suppression [35]. The HOPE app was developed with many similar features, such as self-monitoring of medication adherence and mood, and some features specific to OUD recovery, such as tracking substance use and "triggering" or recovery-encouraging experiences.

Two communication features were adapted from PositiveLinks: direct messaging and a community message board (CMB). Through the messaging feature, patients send and receive secure messages to providers and administrative staff to improve connection to care and address concerns between appointments. The CMB allows patients to interact with each other, for the intended purpose of peer connection and support. The messaging and CMB features were the app components that facilitated communication with others. In contrast, the app's other features were designed primarily for self-monitoring. The aims of this study were to investigate the secure messaging and CMB features of the HOPE app and to assess how these communication features have been utilized by pilot study participants.

2. Methods

The HOPE app was piloted from October 2019 through July 2020 with patients and providers at the University of Virginia MAT clinic, the same site where the formative phase of the app development was conducted. The study was approved by the Institutional Review Board, and informed consent was obtained from all participants. Enrolled patients were referred to as 'members'. All members and providers who enrolled were trained by study staff on the use of the HOPE platform, accessed either by the app installed on their phones (for members) or through a web portal (for providers).

Patient study eligibility criteria were: (1) receiving care for OUD at University of Virginia MAT clinic, (2) 18 years or older, (3) ability to read and speak English. Prisoners and persons with cognitive impairment were not eligible due to inability to give informed consent. Eligible providers included physicians, nurses, and social workers on the MAT team. Patients were referred by clinic providers who identified them as high risk for disengagement from care (for example, high risk substance use history, social challenges such as unstable housing, or mental health concerns). Patients were offered enrollment during their routine outpatient visits at the clinic. None of the patients who were offered enrollment declined to participate. Enrollment was performed by study team members not involved in patient's clinical care.

Members completed baseline assessments that included demographic information and substance use history. Members without smartphones were given Android smartphones with a $50 prepaid account for unlimited data, text messaging and phone calls. For members who already had smartphones, the app was installed on their own phone and monthly payment codes were provided for their preexisting accounts. Costs of cellular phone service were subsidized for up to 6 months while participants were enrolled in study.

The study team downloaded text from the CMB and secure messaging, and the text was de-identified for analysis. In all quotations below, the original spelling and punctuation of the text is unedited, in order to preserve participant voice. A qualitative study was performed to evaluate the content of the text and characterize the themes emerging in conversations conducted between members and between members and providers. Frequencies of content categories were calculated to assess the most common themes.

2.1. CMB analysis

On the CMB, members could post new conversations or reply to each other's posts. Members were identified only by self-selected user names to preserve anonymity. Posts were visible to all enrolled members and the administrator but not to providers. The HOPE administrators (Admin) monitored for any content that violated community board guidelines, such as offensive posts or disclosure of potentially identifying information, and Admins could delete posts if needed. Inspirational messages were posted weekly by Admin. The content of the CMB was downloaded into an Excel database for analysis. Two study team members (JH and TF) reviewed the posts and generated themes for categorization of posts, using a content analysis methodology. A final codebook was generated by consensus and applied to the entire dataset so that theme frequencies could be determined. These methods were informed by our team's prior work on analysis of online community interactions [36].

2.2. Secure messaging analysis

The secure messaging feature allowed members to exchange messages with Admin and with clinic providers. Messages could only be viewed by the designated sender and recipient and by the Admin who monitored for any messages not addressed to ensure that any member

concerns were handled in a timely manner. A codebook was developed iteratively by three study team members (AT, JH, and TF) until thematic saturation and coding reliability were achieved, similar to methods in our team's prior analyses of messaging in mobile health interventions [22].

Coding included sender and recipient roles (Admin, member or provider), message topic and message function. Topic codes categorized messages as app-related, medical-related or social-related. Function codes categorized messages by whether they served a purpose of information exchange or relationship-building. Due to the size and complexity of the data set, coding and analyses were performed using Dedoose (Dedoose Version 8.0.35, (2018); Los Angeles, CA: Socio-CulturalResearchConsultants, LLC www.dedoose.com).

3. Results

The HOPE pilot study enrolled 25 patients (members) and 3 providers. Table 1 shows the demographic characteristics of the members. The mean age was 33.7 years (SD 8.1). Thirteen identified as male (52%), twelve as female (48%). Twenty-one patients identified as white (84%), two as African-American (8%), and two as other (multiple race, American Indian/Alaska Native) (8%). The demographics of enrolled patients were representative of the overall populations of patients served by this MAT clinic. Provider roles were 1 physician, 1 nurse, and 1 social worker.

Overall, 22 (88%) members used the messaging feature during the first month after enrollment, decreasing to 13 (52%) in the sixth month. There was lower initial uptake and more attrition in CMB use with 9 (36%) members using the CMB in their first month and 1 (4%) in their sixth month. At 6 months post-enrollment, 14 (56%) members were retained in care at the clinic. Of the 11 lost to follow-up at the clinic, 4 continued to use the messaging after their last documented clinic visit. The participants were unable to keep using the app after the conclusion of the study because it was closed to preserve data security.

3.1. CMB results

The CMB contained 78 posts; 29 were from Admin and 49 were from members. Table 2 shows categories of member posts with examples and frequencies. Among member-generated posts, the most frequent type expressed the poster's emotional state, including positive emotions (45%) such as optimism and gratitude, or negative emotions (29%) such as anger, frustration or anxiety. In 8% of members' posts, members asked for support from others and in 47%, posts conveyed support for others. Posts describing stressors included issues around substance use (18%), relationships (6%), and finances or work (4%). Posts could contain more than one code, for example, multiple stressors or a stressor

Table 1
Member Characteristics.

	N (%) or Mean (SD)
Age	33.7 (8.1)
Gender, male	13 (52%)
Race/Ethnicity	
White, non-Hispanic	21 (84%)
Black, non-Hispanic	2 (8%)
Other race	2 (8%)
Education	
Less than high school	5 (20%)
High school or GED	12 (48%)
Some college	7 (28%)
College graduate	1 (4%)
Employment	
Employed full time	3 (12%)
Employed part-time	7 (28%)
Disabled	4 (16%)
Unemployed	11 (44%)

Table 2
Community Message Board post types with examples and frequencies.

Category and Definition	Example	% of member posts, (n)
Community chat: includes posts about current events and holidays	"happy New Year hope everyone enjoys the fresh start to a new year"	12.2% (6)
Social support		
Seeking support: post expressed need for support	"I need extra support right now. Please reach out to give me some hope!"	8.1% (4)
Providing support: member offers encouragement, condolences, or inspirational statements	"if your reading this your blessed even if your having a bad day or stressed or going threw something just remember your blessed you woke up and yhats a blessing every day"	46.9% (23)
Emotional state		
Negative emotions: describes feelings such as anger, frustration, grief, or anxiety	"why does it have to be a battle every day cant just 1 day a week be great ugh"	28.6% (14)
Positive emotions: describes feelings of optimism, perseverance, gratefulness, or an achievement	"slow progress is still progress!"	44.9% (22)
Stressors		
Drug use: describes substance use, sobriety or medication treatment	"they want to take the meds away or reduce them that keep someone sober"	18.4% (9)
Financial and work stress: conveys stress about working, including work relationships or job search process	"I've been looking for a job. I applied to get my old job back. I kept going and going to the place…"	4.1% (2)
Relationship stress: includes stress due to family, healthcare providers, or partners	"i couldn't understand why i couldn't make her happy.it was because 5 other guys were.and like a idiot, im beating myself up over it…"	6.1% (3)

and an emotion. Admin-generated posts included announcements and inspirational quotes.

Members responded to each other's posts, usually by offering support or encouragement. For example, a member posted "I'm having a hard time moving forward lately. please send some prayers". A second member responded with "prayers" and a third member replied "one foot two foot is my motto sending you healing light & love" with emojis of a heart and smiley face. In another conversation, one member posted "Sobriety is not just quitting drugs its a total lifestyle change". Another member replied with "no doubt. people think that just because theyre sober that theyre better people. unfortunately that is not the case. ignorance must be blissful." Others chimed in with "so true" and "I agree". Only one post was deleted by Admin, due to the member stating their name, which was removed in order to maintain anonymity on the CMB. No posts had to be removed for negative or inappropriate content.

3.2. Secure messaging results

The secure messaging log contained 2103 messages, with 44% sent by members, 21% by providers, and 35% by Admin. Messages sent by providers and Admin were mostly directed to member recipients. Messages from members were sent to providers (52.3%) and Admin (47.7%). Table 3 shows message categories by sender type with examples and frequencies.

The topics of messages were categorized as (1) app-related, which included technical questions or coordinating phone credits, (2) medical, which included content about appointments, medications and questions regarding care, or (3) social which included content about housing, finances, insurance, and transportation. Coding showed that 55% of messages contained app-related content, 43% were medical and 6%

Table 3
Message categories by sender type with frequencies and examples.

		Sender			Example
		Member (N = 921)	Provider (N = 434)	Admin (N = 748)	
Topic	App-related	45.2% (416)	4.4% (19)	97.6% (730)	"Maybe we can try to trouble shoot this issue over the phone."
	Medical	52.0% (478)	90.6% (393)	3.3% (25)	"Can you give me a call when you get a chance, I will be out of medicine after tomorrow"
	Social	8.3% (76)	8.3% (36)	1.3% (10)	"Hopefully by the time you need it again, [name] will have figured out the financial aid."
Function	Information Exchange	85.3% (786)	90.3% (392)	92.8% (694)	"I need to reschedule my appointment. I cannot make it today."
	Relationship-building	37.2% (343)	36.4% (158)	49.2% (368)	"It's tough but it sounds like you're doing the best you can and putting in the work."

social. Of messages sent by Admin, 98% were app-related, the majority being messages sent each month to coordinate payment of phone credit with members. Messages sent by providers were primarily medical (91%) and those sent by members were 52% medical, 45% app-related and 8% social. Messages exchanged between providers and Admin were primarily conferring about members who had not been heard from recently, coordinating study activities with clinic appointments, or sharing information, such as medical concerns that members had shared with Admin but that should be addressed to the medical provider.

The function of messages was categorized as (1) information exchange, which described utilitarian messages conveying facts, or (2) relationship-building, which encompassed messages that expressed emotion or enhanced rapport. Most messages contained information exchange (93% Admin-sent messages, 90% provider-sent messages, and 85% member-sent messages), and many also contained relationship-building, such as "Thanks, I hope you have a great day." Of Admin-sent messages, 49% contained relationship-building, as did 36% of provider-sent messages and 37% of member-sent messages.

Each message was assigned at least one topic code and at least one function code but could have more than one if relevant. Within the category of medical messages, subcategories were coordinating appointments, coordinating medications, discussion of medications (e.g. possible side effects), managing medication adherence (e.g. discussion of pill boxes or other strategies), addressing withdrawal, and discussion of physical or mental health concerns. Within the category of social messages, subcategories were coordinating social needs (e.g. housing, transportation, insurance issues), discussion of life events, outreach (e.g. provider checking on patient who missed appointment), and affirmation (e.g. general positive or encouraging statements). Many member concerns intersected both medical and social issues, such as transportation difficulty impacting appointment attendance. For example, a member-to-provider message stated "Hey I can't make my appt today I don't have a ride and I'm in the country what time can I come tomorrow?"

Issues with insurance also impacted appointment attendance and medication access, as a member alerted their provider, "i was seeing how I could get more suboxone because i only have one left and i dont have insurance to be seen but im afraid of not having them". Members reached out to their care team when facing difficulty in managing emotions and finding ways to cope without opioid use. For example, a member stated "Im really struggling with things im overwelmed with thoughts of using and having a hard time dealing with my anger".

Providers responded to member messages with both practical advice and emotional support. For example, a provider replied to a distressed member stating "I'm sorry you are struggling right now. I think it is gonna help you coming back to see us on a weekly basis. Don't forget to bring your meds tomorrow so we can fill a medication box for you". Providers offered affirmation to members doing well and encouragement to those facing difficulty, such as "So proud of you & how well you are doing!!" and "it's tough but it sounds like you're doing the best you can and putting in the work." Providers used the messaging to coordinate appointments and medication refills, address withdrawal symptoms, and help address social concerns. Providers also initiated conversations, such as outreach to members who had missed appointments, "you didn't show for your apt this morning. Hope you are OK? I left a message on your voice mail as well." One member used the app to get reengaged in care, sending their provider a message, "How can i go about getting back into the clinic?", to which the provider responded with instructions for reestablishing care and welcoming the member back.

The COVID-19 pandemic began during the HOPE pilot study period. In Virginia, the Executive Order issued on March 12 2020 declared a state of emergency and began a period of closure for schools and businesses [37]. During this time, medical centers canceled non-urgent ambulatory visits, which were postponed or transitioned to telemedicine services. Continuity of care and consistent access to medications are particularly important for patients receiving MAT due to risks of withdrawal symptoms or relapse. The uncertainty and stress of the pandemic also presented a challenge for patients with OUD, especially those with mental health conditions. An increase in use of the secure messaging was noted from an average of 4.1 (standard deviation 5.0) messages per participant in the month prior to the lockdown order to an average of 5.9 (6.4) messages per participant in the month after. Usage is per user per month, averaged across the cohort. There was no change in the rates of CMB posting.

Examination of the messaging content that occurred during the COVID-19 pandemic showed that this feature was used to coordinate telemedicine appointments and maintain continuity of care. For example, a provider-to-member message stated, "this is a unique time though we want to make sure you still get care and your needs met!" Messages also addressed social concerns, such as a member-to-provider message that said "because of the coronavirus do not want to bring the baby into the hospital and school being out I have my son". Possible COVID exposures and testing were also discussed, such as a member-to-provider message: "I was in er all day yesterday my covid test results should be in sometime tomorrow". In addition to information exchange, providers used the messaging to give reassurance, for example, "You don't have to worry about running out". Members also expressed concern for providers, such as "I understand it's crazy right now. Hope your doing good. I wish you and your loved ones the best through this sad time." The messaging allowed members and their care team to remain connected despite disruptions to in-person care.

4. Discussion and conclusion

4.1. Discussion

Through HOPE, a clinic-affiliated smartphone app for patients with OUD receiving MAT, members had the ability to communicate through an anonymous community message board and secure messaging. We

found that the secure messaging feature was used by members, providers, and administrative staff to discuss topics on medical care, social issues, and app function and served both to exchange information and to build relationships. The CMB was used by members primarily as an opportunity to share their emotions, and to ask for and provide support to other members. The current study analyzing the content of these communication features provides insight into how participants used HOPE in their engagement with MAT care, both through peer support and connection to their care team.

The ability to message providers directly gave members the ability to notify their care team of urgent issues, allowing providers to address problems in a timely manner as they arose. At the start of the COVID-19 pandemic, the ability to relay information between providers and members easily was especially crucial given the disruptions to patient care and the need to shift from in-person appointments to telehealth visits. The importance of secure low-barrier messaging has been similarly demonstrated to maintain continuity of care during the pandemic in other treatment settings for vulnerable populations [38].

While information exchange characterized the majority of messages, relationship-building remained a significant component. The direct messaging and CMB features of the HOPE app are novel among MAT-specific mHealth apps [13–15] and may be particularly important for fostering rapport and decreasing mistrust. Trusting therapeutic relationships are especially critical for patients who have faced stigma and other barriers to care [39,40]. Prior studies of messaging between patients and providers over apps or patient portals indicates that messaging can serve not only as a vehicle for efficient communication but also as a means of furthering the therapeutic relationship between patient and provider [22–24]. The majority of messages exchanged between members and administrative staff were related to routine function of the app, such as information regarding phone credit payments, but it also allowed for prompt resolution of technical difficulties.

Although messaging with clinic teams is available through patient portals linked to electronic medical records systems, these portals tend to have poor uptake among disadvantaged populations and patients with lower health literacy [25,26]. The HOPE app was developed in collaboration with patients with lived experience of OUD and achieved high scores on the System Usability Scale during development [34]. Despite socioeconomic disadvantage in our pilot study population, patients were able to use the HOPE app for messaging and address their medical and social needs. Usability interviews with both patients and providers showed positive experiences with the app overall and specifically with the messaging as an effective means to improve connection to care and patient-provider communication [34]. Texting is another option for reaching the clinic team which is favored over phone calls especially by younger patients [41]. However, texting is generally discouraged by healthcare providers due to lack of compliance with privacy and security standards. In contrast, the HOPE app was developed to meet these standards and protect privacy while also facilitating communication [34].

Members used the CMB to express positive or negative emotions, stressors, and support. There was a focus on psychosocial content over biomedical content. A limitation of this study was the small sample size. In particular, the CMB had relatively low uptake compared to the secure messaging feature, which may be attributed to the small cohort size of the pilot study. Participants in the formative work for HOPE app development had expressed desire for a supportive community of peers [34], but may need a larger pool of participants for robust activity in the group. Additional limitations of this study include lack of follow-up interviews to elicit app feedback, perceptions of app usefulness in real-world settings, and barriers to sustained engagement. Further follow-up would be needed to assess sustainability of implementing HOPE at MAT clinics and impact of app engagement on clinical outcomes.

Additionally, the disruption of the COVID-19 pandemic on patient care necessitated fewer in-person appointments and potentially increased reliance on messaging between members and providers as a means of communication as face-to-face contact was limited. As such, the patterns of usage observed may be difficult to generalize as clinics return to pre-pandemic levels of care. However, mHealth can still play a crucial role in helping patients overcome preexisting barriers to care, especially in nonurban areas where lack of transportation and other challenges limit access to in-person appointments.

Participants were provided with a smartphone if needed and payment of their phone bill during the study period; therefore, lack of a smartphone was not a factor in recruitment of participants. HOPE was developed in collaboration with patients with OUD and designed to be usable at low literacy levels [34]. However there still remains a potential bias as participants who agree to be part of the study represent those who are comfortable enough with technology to test a novel intervention. This may need to be taken into account in consideration of program expansion or implementation at other sites.

4.2. Conclusion

The HOPE app offers a useful adjunct to MAT care for patients with OUD and providers who are open to mHealth participation. In order to better understand usage patterns, replication with a larger sample would be useful. Implementing HOPE as a part of an MAT program will require buy-in both from patients being treated for OUD and MAT providers willing to use the mobile application.

4.3. Practice implications

Patients receiving MAT for OUD can benefit from support from their peers going through similar experiences and from healthcare providers. mHealth offers a means to achieve support in a way that meets patients where they are and overcomes potential barriers to in-person contact, including transportation challenges and, in recent times, isolation imposed by pandemic restrictions. Patient-provider communication can extend beyond the clinic setting to help address patient needs, exchange information, and build relationships. Further development and implementation of mHealth tools in practice should include ongoing collaboration with patients and providers to encourage engagement in care.

CRediT authorship contribution statement

Tabor E. Flickinger: Funding acquisition, Investigation, Data analysis, Writing – original draft, Writing – review & editing. **Marika Waselewski:** Funding acquisition, Data curation, Data analysis. **Alexa Tabackmanc:** Data analysis. **Jacqueline Huynh:** Data analysis. **Jacqueline Hodges:** Data curation. **Kori Otero:** Project administration. **Kelly Schorling:** Project administration. **Karen Ingersoll:** Study conceptualization, Funding acquisition, Supervision. **Nassima Ait-Daoud Tiouririne:** Funding acquisition, Project administration. **Rebecca Dillingham:** Study conceptualization, Funding acquisition, Supervision. All authors contributed to manuscript review and editing and final approval.

Presentation

A preliminary version of this analysis was presented at the International Conference on Communication in Healthcare in October 2021.

Declaration of Competing Interest

Authors Dillingham and Ingersoll have active consulting agreements with Warm Health Technology, Inc. Author Waselewski had a consulting agreement with Warm Health Technology while contributing to this work. For all other authors, there are no declarations.

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Identifiers

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

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