Original Submission

Adoption of mobile apps for depression and anxiety: Results from a survey on patient interest and barriers to engagement

Jessica M Lipschitz,1,2 Christopher J Miller,2,3 Timothy P Hogan,4,5 Rachel Lippin-Foster,3 Steven R Simon,2,3,6 James F Burgess3

1Department of Psychiatry, Brigham and Women’s Hospital, Boston, MA, USA
2Harvard Medical School, Boston, MA, USA
3Center for Healthcare Organization and Implementation Research, Veterans Affairs Boston Healthcare System, Boston, MA, USA
4Center for Healthcare Organization and Implementation Research, Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA, USA
5Division of Health Informatics and Implementation Science, Department of Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, MA USA
6Geriatrics and Extended Care Service, Veterans Affairs Boston Healthcare System, Boston, MA USA

Corresponding author:
Jessica M. Lipschitz
Department of Psychiatry
Brigham and Women’s Hospital
221 Longwood Avenue
Boston, MA 02115
Telephone: (617) 732-6548
Fax: (617) 975-0828
E-mail: jessica.lipschitz@bwh.harvard.edu.

Acknowledgements:
This study was partially supported by funds made available by the VA Office of Academic Affairs. Additionally, Allen Labonte assisted with pulling recruitment data from the VA Corporate Data Warehouse. Finally, we want to acknowledge that one key study author, James Burgess, passed away before the completion of this manuscript. He was an esteemed colleague and is sorely missed by our community.

Conflicts of Interest: None
Abstract

Background: Emerging research suggests that mobile apps can be used to effectively treat common mental illnesses such as depression and anxiety. Despite promising efficacy results and ease of access to these interventions, adoption of mHealth (mobile device-based) interventions for mental illness has been limited. More insight into patients’ perspectives on mHealth interventions is required to create effective implementation strategies and to adapt existing interventions in ways that facilitate higher rates of adoption.

Objective: The aim of this study was to examine, from the patient perspective, current use and factors that may impact use of mobile apps for mental illness.

Methods: This was a cross-sectional survey study of Veterans who had attended an appointment at a single Veterans Health Administration (VHA) facility in early 2017 that was associated with one of the following mental health concerns: unipolar depression, any anxiety disorder, or post-traumatic stress disorder (PTSD). We used the VA Corporate Data Warehouse (CDW) to create subsets of eligible participants demographically stratified by gender (male/female) and minority status (white/non-white). One hundred participants from each subset (400 total) were selected at random. These individuals were mailed a paper survey with items addressing the following: demographics, technology ownership, technology use, interest in mobile app interventions for mental illness, factors that may impact interest, and depression and anxiety symptom severity.

Results: Of the 400 potential participants, 149 (37.3%) completed and returned a survey. Most participants (79.9%) reported that they owned a smart device and that they use apps in general (71.1%). Most (73.1%) reported interest in using an app for mental illness, but only 10.7% had done so. Paired-samples t-tests indicated that ratings of interest in using an app recommended by a clinician were significantly greater than general interest ratings and even greater when the
recommending clinician was a specialty mental health provider. The most frequent concerns related to using an app for mental illness were lacking proof of efficacy (71.8%), concerns about data privacy (59.1%) and not knowing where to find an app that would help (51.0%).

Participants expressed interest in a number of app features with particularly high interest ratings for context-sensitive apps (85%) and apps focused on the following areas: increasing exercise (75.8%), improving sleep (73.2%), changing negative thinking (70.5%), and increasing involvement in activities (67.1%).

**Conclusions:** Most respondents had access to devices to use mobile apps for mental illness, already used apps for other purposes, and were interested in mobile apps for mental illness. Key factors that may improve adoption include provider endorsement, greater publicity of efficacious apps, and clear messaging around efficacy and privacy of information. Finally, multi-faceted apps that address a range of concerns, from sleep to negative thought patterns, may be best received.

**Keywords:** mHealth, depression, anxiety, mobile apps, engagement, adoption
Adoption of mobile apps for depression and anxiety: Results from a survey on patient interest and barriers to engagement

The majority of the US population owns smartphones (77% in 2016) [1] and the number of mobile applications (apps) for health has grown exponentially over the past decade. A study by the IMS Institute for Healthcare Informatics [2] found that the number of health and wellness apps available to consumers more than doubled between 2013 and 2015 (from 43,000 to over 90,000). While the content and quality of these apps varies widely, the potential public health impact of such tools is enormous. Research suggests that mHealth interventions can have a positive influence on a wide range of health conditions [3, 4]. And, while not a substitute for in-person treatment, these tools offer a treatment option that does not have as many access barriers as in-office treatment (e.g., no transportation is required).

In mental illness – where stigma and self-reliance beliefs are additional barriers to treatment seeking and engagement [5] – mHealth offers even greater potential. Common mental health disorders like depression and anxiety impact nearly a third of the US population and most of those who need treatment do not receive it [6, 7]. The sheer number of people affected makes providing adequate treatment in traditional clinic settings prohibitive in terms of availability of trained providers. Studies indicate that mHealth interventions can improve functioning and symptoms in those with depression and/or anxiety [8-11], and also that technology offers some advantages over in-person treatments. Specifically, mHealth interventions offer 24/7 support because mobile devices are often kept with users throughout the day. Additionally, patients may be more likely to report severe symptoms on technology platforms than in person [12] and patients value the autonomy and empowerment that can be offered by such platforms [13].
Unfortunately, adoption of mHealth interventions for common mental illnesses like depression and anxiety remains low. To date, mHealth is not a routine part of mental healthcare offerings in the US, nor has any one mHealth platform for mental illness been widely adopted by consumers in the US. These patterns are particularly noteworthy in systems like the Veteran Health Administration (VHA), which has invested substantially in building and evaluating several free behavioral health apps specifically designed for mental health concerns of Veterans. At present, it is unclear what the best approaches may be to encourage patient adoption of these technologies.

Research on patient adoption of technology in treatment of mental illness suggests that interest outpaces adoption. Specifically, studies of patients with depression, anxiety and PTSD suggest that interest varies widely based on the type of technology in question, but most patients are interested in using some kinds of technology in treatment [14, 15]. With regard to mHealth specifically, Erbes et al. [16] found that over half of a sample of patients with PTSD expressed interest in mHealth programs for PTSD, but less than 10% were currently using these platforms to help manage their symptoms.

Given high interest and low adoption, there is a need to build a stronger understanding of the factors that may affect adoption at the system level. Research on other patient-facing technologies suggests that how such technologies are integrated into the healthcare system may impact patient adoption. For example, findings from studies focused on adoption of online portals indicate that provider endorsement can improve rates of adoption [17]. It remains to be determined whether this is the case for mHealth interventions.

There is also a need to build a stronger understanding of factors that may affect adoption at the patient level. A large national survey of health app use in the general population indicated
lack of interest, cost, and concern about data privacy were key barriers to adoption [18]. These findings have been reinforced in other studies focused on mental health apps. Specifically one study focused on mHealth interventions for depression found that cost, concerns about privacy, concerns over intervention efficacy and misfit of intervention features to needs (i.e., personalization) were key barriers to adoption of depression apps [19]. Another study focused on health and mental health apps found that efficacy and privacy are key barriers to adoption as well as not knowing where to find an app or knowing which app to download [20]. However these studies were conducted using only partially clinical samples, that is, presence of clinically significant symptoms (on self-report or via medical record diagnosis) was either not an eligibility criterion or not assessed.

Stronger understanding of patient perspectives on mHealth interventions in relevant clinical samples is required to support the development of targeted implementation strategies and platform modifications that will ultimately promote adoption. The aim of the current study was to characterize mHealth interest, concerns and preferences in a sample of patients with an active diagnosis of depression, anxiety and/or PTSD. Specifically, we sought to: (1) identify patients’ degree of interest in mHealth interventions for mental health; (2) identify whether provider endorsement would impact degree of interest; (3) determine reasons for nonuse of mHealth interventions for mental health; and (4) identify what mHealth content or features are of most interest to patients.

**Methods**

**Recruitment**

We used the VA Corporate Data Warehouse (CDW) to identify individuals meeting eligibility criteria, and to extract contact and diagnostic information for those individuals.
Eligibility criteria were as follows: (a) US military Veteran enrolled in care at the VA Boston Healthcare System, (b) receiving VA primary care, as indicated by having at least one encounter in the local primary care clinic between 1/1/2016 and 7/1/2016, (c) age 18 years or older, (d) attended a VA medical appointment between 1/1/2016 and 7/1/2016 in which an anxiety disorder (including obsessive-compulsive disorder), unipolar depressive disorder or posttraumatic stress disorder (PTSD) was documented as one of the conditions treated in the appointment. ICD-10 codes for visits associated with unipolar depression included F32-F34. ICD-10 codes for visits associated with anxiety and PTSD included F40-F43. The decision to include patients with any or all of these diagnoses in the sample was based on high comorbidity rates between these diagnoses and the similarity of pharmacological and psychotherapeutic treatments for these disorders [21-26].

A total of 2,840 Veterans in the CDW met the above criteria. Within this sample, we divided records into four strata (white men, non-white men, white women, non-white women) and randomly sampled 100 records from each stratum to achieve a gender- and minority-balanced set of potential participants. These randomly selected 400 individuals were actively recruited for participation via mailed surveys and accompanying study information. While electronic medical record diagnostic codes were used to define our corporate data warehouse search parameters and establish a set of eligible participants, these codes were not extracted for use in our dataset. This decision was made to protect patient’s privacy, especially those patients who chose not to participate. The only information extracted from patient’s charts were name and mailing address.

We used a modified Dillman method for recruitment [27]. The 400 Veterans identified as potential participants were sent a series of three mailings, each including a letter inviting the
Veteran to participate, a study fact sheet, the survey, a postage-marked opt out postcard and a postage-marked return envelope. Additionally, the first mailing contained a $10 patron coupon for use at the local VA facility cafeteria and general store. The study invitation letter informed Veterans that they may keep this coupon regardless of their decision to participate in this research. Participants who returned either the survey or opt out postcard were not included in successive mailings.

All recruitment and study procedures were approved by the VA Boston Healthcare System’s Institutional Review Board.

Survey

Survey items were a combination of validated measures and newly developed questions based on the literature on technology use and adoption. Key areas addressed were as follows.

**Sociodemographics.** Age, sex, race, education level, marital status and income were assessed using standard items.

**Overall health.** Participants were asked the first question of the Short Form 36 (SF36) quality of life instrument: “Would you say your health is:” [Excellent, Very good, Good, Fair, Poor]. This brief measure has been found to be predictive of overall health status [28, 29].

**Mental/Behavioral Health.** Participants were asked to self-report “Do you currently have any of the following health conditions?” Depression [Yes/No], Anxiety [Yes/No], PTSD [Yes/No], Alcohol Problems [Yes/No], Drug Problems [Yes/No], Difficulty Sleeping [Yes/No], Overweight [Yes/No], Stress [Yes/No], Diabetes [Yes/No], Smoking [Yes/No], Chronic Pain [Yes/No].
Severity of depressive symptoms was measured using the Patient Health Questionnaire (PHQ-8), which is the PHQ-9 [30] without the item related to suicide/self-harm. The PHQ-8 has been found to have equivalent validity to the PHQ-9 [31] and was selected for this study because the delay inherent in a mailed response form would not have allowed adequate clinical response to high ratings of suicidality.

Severity of anxiety was measured using the Generalized Anxiety Disorder-7 (GAD-7) [32]. Initially developed to diagnose generalized anxiety disorder, this scale has been found to be a reliable and valid tool for measuring overall anxiety severity in the general population [33, 34].

**Technology Use.** Mobile device ownership was assessed by asking participants two questions: “Do you have a smartphone?” [Yes/No] and “Do you have a tablet?” [Yes/No]. Definitions of smartphone and tablet were provided for participant reference.

Device use was assessed by asking participants “Do you ever use apps on your smartphone or tablet?” [Yes/No]. Participants were instructed to check “no” if they did not own a smartphone or tablet. A definition of “apps” was provided for participant reference. Participants were asked to further detail device use via the following question: “Do you use your phone or tablet for any of the following?” (1) Texting [Yes/No], (2) Email [Yes/No], (3) Driving/walking directions [Yes/No], (4) Searching the internet [Yes/No], (5) Camera functions (to take pictures or record videos) [Yes/No], (6) Social media (like Facebook, Instagram or Twitter) [Yes/No], (7) Checking the weather forecast [Yes/No].

Health app use was evaluated by asking participants “Have you ever used an app to help you manage stress, depression, anxiety or PTSD?” [Yes/No]. Participants were also asked “Have you ever used an app to help you track or complete the following activities: (1) Daily Steps
PATIENT INTEREST IN MHEALTH AND BARRIERS TO ENGAGEMENT

[Yes/No], (2) Diet (to track your calories or what you eat) [Yes/No], (3) Weight [Yes/No], (4) Mindfulness exercises [Yes/No], (5) Sleep [Yes/No].”

**Interest in Mobile Apps for Mental Health.** Participants were asked the following questions regarding interest in use of mobile apps for mental health: (1) “How interested are you in using an app to help you manage stress, depression, anxiety or PTSD?” (2) “How willing would you be to use an app to help you manage stress, depression anxiety or PTSD if your primary care provider recommended the app?” and (3) “How willing would you be to use an app to help you manage stress, depression, anxiety or PTSD if your mental health provider (therapist or psychiatrist) recommended the app?” Participants were asked to rate each question on a Likert scale ranging from ‘1 = Not at all’ to ‘5 = Completely.’

Participants were asked about interest in mental health apps with context-sensing capabilities. The term context sensing is used here to refer to apps that use passive sensors to provide context-sensitive feedback. Participants were asked about context-sensing capabilities via the following question: How interested would you be in an app that could respond to physical (e.g., heart rate) or behavioral changes to know when you might be experiencing symptoms of stress, anxiety, depression or PTSD and suggest ways to manage symptoms?” Participants were asked to rate this question on a Likert scale ranging from “1 = Not at all” to “5 = Completely.”

Perceived reasons for using or not using mobile apps for mental health were also assessed. Participants were asked to select “reasons that are true for you.” See Table 2 for a list of discrete reasons included on the survey.
Interest in specific app content/features was assessed by asking: Would you be interested in an app that allowed you to do any of the following? [Yes/No for each feature]. See Table 3 for a list of features included on the survey.

**Data Analysis**

We aggregated descriptive data on the following: demographic and health characteristics, devices owned, current technology use, and level of interest in mHealth interventions and in context-sensitive mHealth interventions.

We used paired sample t-tests to evaluate the degree to which provider endorsement impacted participants’ level of interest in use of mHealth interventions for mental illness. Specifically, t-tests compared participants’ general interest ratings with those provided when asked how interested they would be in using a mobile app for mental illness if their primary care provider (PCP) recommended it. A similar comparison was conducted between general interest ratings and those provided when asked how interested they would be in using a mobile app for mental illness if their mental health provider recommended the app. Finally, we used t-tests to compare interest ratings associated with PCP recommendation with those associated with mental health provider recommendation.

We also compiled aggregate descriptive data on the following: reasons endorsed for using/not using mobile apps for mental health, and interest in specific app features/content.

**Results**

**Participants**

A total of 149 surveys were returned (response rate of 37.3%). The resulting sample was fairly balanced on demographic characteristics (see Table 1) as would be expected by the demographically stratified recruitment methodology. For clarity and because no item or scale had
missing data for more than 8.1% of respondents, all results are reported as percentages of the full sample.

The mean PHQ-8 score was 11.25 (SD = 6.62) and the majority of the sample (65.8%, n=98) reported symptoms that met the PHQ-8 cutoff score of 8 indicating clinically significant depressive symptoms [35]. The mean GAD-7 score was 9.65 (SD = 6.02) and more than half of the sample (56.4%, n=84) reported symptoms that met the GAD-7 cutoff score of 8 for clinically significant anxiety symptoms [34]. Self-reported mental health conditions were collected and are detailed in Table 1.

Table 1. Demographic Characteristics of the Sample (N=149)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years, mean (SD)</td>
<td>57.5 (13.9)</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>67 (45.0%)</td>
</tr>
<tr>
<td>Male</td>
<td>77 (51.7%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>5 (3.4%)</td>
</tr>
<tr>
<td>Race/ethnicity, n (%)</td>
<td></td>
</tr>
<tr>
<td>African American/Black</td>
<td>44 (29.5%)</td>
</tr>
<tr>
<td>Asian</td>
<td>6 (4.0%)</td>
</tr>
<tr>
<td>Caucasian/White</td>
<td>67 (45.0%)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>9 (6.0%)</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>American Indian, Alaskan Native</td>
<td>4 (2.7%)</td>
</tr>
<tr>
<td>Other</td>
<td>11 (7.4%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>7 (4.7%)</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
</tr>
<tr>
<td>Middle school (7th-8th)</td>
<td>1 (0.7%)</td>
</tr>
<tr>
<td>High school (9th-12th)</td>
<td>24 (16.1%)</td>
</tr>
<tr>
<td>Some college/vocational school</td>
<td>41 (27.5%)</td>
</tr>
<tr>
<td>Associates degree (2-year college)</td>
<td>16 (10.7%)</td>
</tr>
<tr>
<td>Bachelor’s degree (4-year college or university)</td>
<td>36 (24.2%)</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>27 (18.1%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>4 (2.7%)</td>
</tr>
<tr>
<td>English as first language, n (%)</td>
<td>134 (89.9%)</td>
</tr>
<tr>
<td>Marital Status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Single, never married</td>
<td>39 (26.2%)</td>
</tr>
<tr>
<td>Married</td>
<td>46 (30.9%)</td>
</tr>
</tbody>
</table>
### Divorced/separated
- 49 (32.9%)

### Widowed
- 11 (7.4%)

### Not reported
- 4 (2.7%)

<table>
<thead>
<tr>
<th>Annual Household Income</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $20,000</td>
<td>36 (24.2%)</td>
</tr>
<tr>
<td>$20,000 to $34,999</td>
<td>21 (14.1%)</td>
</tr>
<tr>
<td>$35,000 to $49,999</td>
<td>35 (23.5%)</td>
</tr>
<tr>
<td>$50,000 to $74,999</td>
<td>20 (13.4%)</td>
</tr>
<tr>
<td>$75,000 to $99,999</td>
<td>15 (10.1%)</td>
</tr>
<tr>
<td>$100,000 to $149,999</td>
<td>8 (5.4%)</td>
</tr>
<tr>
<td>$150,000 or more</td>
<td>2 (1.3%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>12 (8.1%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health (SF-1)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>3 (2.0%)</td>
</tr>
<tr>
<td>Very good</td>
<td>21 (14.1%)</td>
</tr>
<tr>
<td>Good</td>
<td>56 (37.6%)</td>
</tr>
<tr>
<td>Fair</td>
<td>51 (34.2%)</td>
</tr>
<tr>
<td>Poor</td>
<td>11 (7.4%)</td>
</tr>
<tr>
<td>Not reported</td>
<td>6 (4.0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Self-Reported Behavioral Health Conditions</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>107 (71.8%)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>96 (64.4%)</td>
</tr>
<tr>
<td>PTSD</td>
<td>91 (61.1%)</td>
</tr>
<tr>
<td>Alcohol use disorder</td>
<td>14 (9.4%)</td>
</tr>
<tr>
<td>Substance use disorder (not alcohol)</td>
<td>15 (10.1%)</td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td>93 (62.4%)</td>
</tr>
<tr>
<td>Overweight</td>
<td>76 (51.0%)</td>
</tr>
<tr>
<td>Stress</td>
<td>97 (65.1%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>26 (17.4%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>32 (21.5%)</td>
</tr>
<tr>
<td>Chronic Pain</td>
<td>88 (59.1%)</td>
</tr>
</tbody>
</table>

### Technology Ownership & Use

The majority of the sample reported owning a smartphone (75.8%, n=113) and a smaller portion reported owning a tablet (45.6%, n=68). Together a total of 119 participants (79.9%) reported owning a smart device that could be used to run a mental health app. In terms of technology use, the majority of the sample reported that they use their phone or tablet for apps (71.1%, n=106), texting (79.2%, n=118), taking pictures/camera (77.9%, n=116), searching the
internet (69.8%, n=104), checking the weather forecast (69.1%, n=103), email (67.8%, n=101),
driving/walking directions (63.8%, n=95) and social media (55.7%, n=83).

Of the health-related app functions, participant endorsement of using daily steps was the
most common (28.2%, n=42), followed by tracking calories (22.8%, n=34), mindfulness
exercises (20.8%, n=31), weight management (20.1%, n=30), and sleep (18.8%, n=28). Only
10.7% (n=16) reported that they had engaged with apps to help manage mental illness.

**Interest in Apps for Mental Illness**

When asked how interested they would be in using an app for mental illness, 73.1%
reported some level of interest. Specifically, 12.8% (n=19) indicated that they would be
completely interested, 22.1% (n=33) indicated that they would be very interested, 22.8% (n=34)
indicated that they would be moderately interested, and 15.4% (n=23) indicated that they would
be a little interested. When the sample was limited to only those who owned a smart device, the
percentage of individuals with some level of interest in using an app for mental illness was
slightly higher (77.3%, n=92).

Additionally, when asked about interest in apps that could deliver context-sensitive
feedback (i.e., utilizing passive sensors to respond to physical or behavioral changes), the
majority of the sample (84.0%, n=125) reported some interest. Specifically, 28.9% (n=43)
reported that they would be completely interested, 26.2% (n=39) reported that they would be
very interested, 16.1% (n=24) reported that they would be moderately interested, and 12.8%
(n=19) reported that they would be a little interested. When the sample was limited to only those
who owned a smart device, the percentage of individuals interested in an app that delivered
context-sensitive feedback was only slightly higher (86.6%, n=103).

**Relationship Between Interest in Apps for Mental Illness & Provider Endorsement**
Paired-sample t-tests were used to determine whether provider endorsement would impact interest levels. Participants rated global interest independent of provider endorsement (M=2.81, SD=1.38) significantly lower than interest in the context of PCP endorsement (M=3.13, SD=1.38, t(147)=-5.65, \(P<.001\), d=.23). Similarly, participants rated global interest independent of provider endorsement (M=2.81, SD=1.38) significantly lower than interest in the context of mental health provider endorsement (M=3.30, SD=1.36, t(145)=-4.05, \(P<.001\), d=.36). Finally, participants rated interest in the context of PCP endorsement (M=3.13, SD=1.38) significantly lower than interest in the context of mental health provider endorsement (M=3.30, SD=1.36, t(145)=-3.37, \(P<.001\), d=.12). When the sample was limited to only those who owned smart devices (n=119), these comparisons remained significant at the \(p<.001\) level in the same directions.

**Reason for Not Using Apps for Mental Illness**

Table 2 displays the frequency with which participants endorsed specific reasons for not using mental health apps. The most commonly endorsed reasons were not having proof that the app would work, concerns about privacy, and not knowing where to find such an app. These were the most commonly endorsed reasons both when the full sample was considered and when the sample was limited to only those participants who owned smart devices.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Smart Device Owners (N=119) n (%) endorsed</th>
<th>Full sample (N=149) n (%) endorsed</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>I might use an app for these problems if I saw proof that it worked.</em></td>
<td>92 (77.3%)</td>
<td>107 (71.8%)</td>
</tr>
<tr>
<td><em>I am concerned about protecting my privacy with having my information in an</em></td>
<td>73 (61.3%)</td>
<td>88 (59.1%)</td>
</tr>
</tbody>
</table>
app like this.

I don’t know how to find an app that would help.  
61 (51.3%)  
76 (51.0%)

I don’t think an app can help me to get better.  
44 (37.0%)  
55 (36.9%)

I am already in treatment for stress, depression, anxiety or PTSD and don’t see the need for an app.  
43 (36.1%)  
52 (34.9%)

It would be embarrassing to have an app like this on my phone.  
31 (26.1%)  
39 (26.2%)

I don’t use apps at all.  
13 (10.9%)  
29 (19.5%)

I tried an app like this before and did not like it because it was not personalized enough.  
13 (10.9%)  
14 (9.4%)

I don’t think I have a problem with stress, depression, anxiety or PTSD.  
12 (10.1%)  
21 (14.1%)

I tried an app like this before and it did not help.  
11 (9.2%)  
11 (7.4%)

I tried an app like this before and did not like it because it was difficult to use.  
10 (8.4%)  
12 (8.1%)

### Popular Features for Apps for Mental Illness

Table 3 displays the frequency with which participants endorsed interest in features of mental health apps. The features with the highest interest ratings related to increasing exercise, getting better sleep, cognitive restructuring (changing negative/self-critical thinking), and behavioral activation (getting involved in more activities). These features were the most frequently endorsed both when the full sample was considered and when the sample was limited to only those participants who owned smart devices.

Table 3. Interest in Specific Features of Mental Health Apps
<table>
<thead>
<tr>
<th>Item wording (intervention label)</th>
<th>Smart Device Owners (N=119) n (%) endorsed</th>
<th>Full sample (N=149) n (%) endorsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase your physical activity or exercise (physical activity)</td>
<td>95 (79.8%)</td>
<td>113 (75.8%)</td>
</tr>
<tr>
<td>Help you learn to get better sleep (CBTi)</td>
<td>87 (73.1%)</td>
<td>109 (73.2%)</td>
</tr>
<tr>
<td>Learn how to change negative/self-critical thinking (cognitive restructuring)</td>
<td>86 (72.3%)</td>
<td>105 (70.5%)</td>
</tr>
<tr>
<td>Get involved in more activities (behavioral activation)</td>
<td>86 (72.3%)</td>
<td>100 (67.1%)</td>
</tr>
<tr>
<td>Track mood/stress/anxiety/PTSD symptoms. (progress monitoring)</td>
<td>80 (67.2%)</td>
<td>95 (63.8%)</td>
</tr>
<tr>
<td>Speak with a health coach when your symptoms are bad. (professional support)</td>
<td>79 (66.4%)</td>
<td>98 (65.8%)</td>
</tr>
<tr>
<td>Learn more about your mental health condition. (psychoeducation)</td>
<td>77 (64.7%)</td>
<td>92 (61.7%)</td>
</tr>
<tr>
<td>Help improve your social skills (social skills training)</td>
<td>75 (63.0%)</td>
<td>92 (61.7%)</td>
</tr>
<tr>
<td>Remind you to take your medications. (medication adherence)</td>
<td>73 (61.3%)</td>
<td>91 (61.1%)</td>
</tr>
<tr>
<td>Connect with a community of people with similar mental health problems (social support)</td>
<td>61 (51.3%)</td>
<td>72 (48.3%)</td>
</tr>
</tbody>
</table>

**Discussion**

**Principal Findings**

Results from this study indicate that access and interest in mobile apps for mental illness outpace actual use. Specifically, we found that access to devices and use of apps in general was high: nearly 80% of our sample reported owning smart devices and of those with smart devices nearly 90% reported that they use apps. Interest in using mobile apps for mental illness was also high: over 70% of the sample indicated that they have some level of interest. Despite owning the
requisite devices, having active and relevant diagnoses (as indicated by PHQ-8 and GAD-7 scores) and expressing interest, use of mobile apps for mental illness was low: only one in ten participants used apps for mental illness. These findings could be interpreted as indicating that most participants wanted to use mHealth interventions for mental illness and had the device and technology knowledge to do so.

Findings also provide some guidance into factors that may impact adoption. First, the highest-rated reasons for not using apps for mental health were related to not having proof of efficacy, concerns about whether these apps could keep mental health information adequately private, and not knowing where to find such an app. These findings suggest that public dissemination of information on efficacy of apps for mental illness (for example, in doctors’ offices or on public transportation) could improve adoption. Additionally, informing users how information within the app is protected (for example, in the introductory screens of the app) may increase adoption. Concerns related to efficacy and privacy are supported by earlier studies [18, 19, 36], but until recently [20] lack of information on where to find evidence-based apps has not been clearly articulated as a barrier to adoption. With regard to barriers to adoption, it is important to specifically note that the present study did not evaluate cost as a barrier to adoption for two reasons. First, within VA, cost concerns of medical care are different than outside VA. Second, VA has developed a number of mobile apps for mental illness that are freely available to the public and relevant for the Veterans recruited in this study.

Provider endorsement also appears to be one promising avenue for increasing adoption of mHealth for mental illness. Participants provided significantly higher interest ratings in the context of provider endorsement than when asked more generally about interest in using such apps. These findings are consistent with existing literature on the impact of provider
endorsement in patient adoption of other patient-facing technologies (e.g., patient portals that offer messaging and other features) [17]. These findings go beyond the existing literature, however, by showing that the type of provider endorsing the intervention may matter because interest ratings were greater in the context of mental health provider endorsement than primary care provider endorsement. Provider recommendation is not currently the norm: recent research suggests that individuals are more likely to hear about mental health apps through social media, web searches or friends than through medical providers [20]. Findings from our study underscore that providers could potentially play a key role in increasing adoption. Findings also raise questions about who among providers should be endorsing mHealth interventions to maximize the chances of adoption.

Findings also provide insight into what features/content of apps patients with depression, anxiety and/or PTSD may find most useful. Over 70% of participants with smart devices reported interest in using apps that facilitate core functions of cognitive behavioral therapy like cognitive restructuring and behavioral activation. Over 73% of participants with smart devices reported interest in features that would promote wellness in areas of behavioral health such as sleep difficulties and inactivity. These findings suggest that this population may be best served by individual apps or suites of apps that target depression and anxiety from multiple angles [10]. Additionally, interest in context-sensing mobile app interventions was high: 85% of participants indicated some level of interest in this type of intervention. This finding contrasts with other research where participants endorsed skepticism and concern over context sensing [36]. Interest in context-sensing mobile app interventions may indicate an interest in personalization. Along these lines, Table 2 shows that the majority of those who reported having used an app for mental health also endorsed that they did not like it because it was not sufficiently personalized. This finding should be interpreted with caution because we do not
know which apps these participants used and it is difficult to draw conclusions based on such a small subsample (only 10.7% of the full sample had used apps for mental illness). However, other research corroborates that patient reports of insufficient personalization is a perceived barrier to using mobile treatment apps for depression [19].

Also of note, while participants endorsed interest in apps that offered the option of speaking to a health coach, five other features were endorsed more frequently than this one. There has been a lot of emphasis on the integration of health coaching into app platforms both as a way to enhance engagement and as a way to produce higher levels of change [37, 38]. On the other side of this debate, some research indicates that integrating health coaching does not necessarily ensure engagement in technology-based interventions for depression as users can simply ignore calls from coaches [39]. Findings from this study contribute to this debate and indicate that health coaching capabilities may not be essential for user interest and/or engagement.

**Strengths and Limitations**

Key strengths of this study include engagement of a racially diverse, clinical sample and proactive recruitment methods. By mailing paper surveys to patients identified as eligible, we expect to have captured data from individuals who may not have responded to more passive recruitment approaches (e.g., flyers in waiting rooms). However, our proactively-mailed survey methodology also introduces some bias as it is also possible that those who were less interested in use of technology were less likely to respond to the survey. Nevertheless, it is our expectation that the clinical nature of our sample was appropriate for our research questions and that our recruitment method introduced less bias than studies recruiting online or via social media, which essentially make technology proficiency a condition for entry into the study.
PATIENT INTEREST IN MHEALTH AND BARRIERS TO ENGAGEMENT

The sample in this study consisted entirely of Veterans receiving services at a single VA hospital in a metropolitan area in the northeastern United States. Generalizability of findings to non-Veteran samples and samples collected in other geographical areas is unknown. Additionally, given the scope and funding level of this study, the presence of diagnoses required for eligibility was based on patients’ medical records and not verified by study staff independently through a structured clinical interview.

Finally, this study evaluates stated preferences and interests. Moving forward, however, it will be necessary to evaluate whether these self-reported findings hold up behaviorally. That is, future research will need to assess whether implementation strategies and platforms consistent with observed preferences and interests are associated with positive impact on adoption and engagement.

Conclusions and Future Directions

Mobile apps are a new and promising adjunctive, and possibly even stand-alone, treatment option for patients with depression and anxiety disorders. They are technologies that can reach patients beyond the confines of traditional brick-and-mortar clinic visits and engage them directly, in the context of their daily lives. For these reasons, mobile apps are also a unique treatment option to implement, one that requires a thorough understanding of patient perspectives and preferences if effective implementation strategies are to be designed. As reinforced in this study, smart devices are ubiquitous and patients are interested in using this technology. Findings from this study offer several key takeaway points. First, in this sample of individuals with clinically-significant mood and/or anxiety symptoms, most were interested in using mobile apps as part of treatment, but few were doing so. Second, participant interest ratings suggest that provider endorsement may positively influence adoption of these
technologies. Third, integration of wearables and passive data to direct interventional content, interventions to improve self-care around sleep and inactivity, and common cognitive-behavioral therapy interventions such as cognitive restructuring and behavioral activation were all perceived as valuable by patients. Finally, messaging around these technologies should increase awareness of mobile apps available for this population, relay what is known around efficacy, and address privacy concerns.

Evaluating the generalizability of these findings in a non-Veteran sample and determining whether preferences observed here translate to actual behaviors will be critical moving forward. Adjusting messaging and implementation strategies in ways that reflect these findings and evaluating patient adoption and engagement are essential next steps. Additionally, evaluating whether preferences endorsed translate to preferential use of specific app features in real-world settings could direct attention of app developers toward the features that patients most value.
References


