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Breaking Open the Black Box: Isolating the Most Potent Features of a Web and Mobile Phone-Based Intervention for Depression, Anxiety, and Stress

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Abstract

Background: Internet-delivered mental health (eMental Health) interventions produce treatment effects similar to those observed in face-to-face treatment. However, there is a large degree of variation in treatment effects observed from program to program, and eMental Health interventions remain somewhat of a black box in terms of the mechanisms by which they exert their therapeutic benefit. Trials of eMental Health interventions typically use large sample sizes and therefore provide an ideal context within which to systematically investigate the therapeutic benefit of specific program features. Furthermore, the growth and impact of mobile phone technology within eMental Health interventions provides an opportunity to examine associations between symptom improvement and the use of program features delivered across computer and mobile phone platforms.

Objective: The objective of this study was to identify the patterns of program usage associated with treatment outcome in a randomized controlled trial (RCT) of a fully automated, mobile phone- and Web-based self-help program, "myCompass", for individuals with mild-to-moderate symptoms of depression, anxiety, and/or stress. The core features of the program include interactive psychotherapy modules, a symptom tracking feature, short motivational messages, symptom tracking reminders, and a diary, with many of these features accessible via both computer and mobile phone.

Methods: Patterns of program usage were recorded for 231 participants with mild-to-moderate depression, anxiety, and/or stress, and who were randomly allocated to receive access to myCompass for seven weeks during the RCT. Depression, anxiety, stress, and functional impairment were examined at baseline and at eight weeks.

Results: Log data indicated that the most commonly used components were the short motivational messages (used by 68.4%, 158/231 of participants) and the symptom tracking feature (used by 61.5%, 142/231 of participants). Further, after controlling for baseline symptom severity, increased use of these alert features was associated with significant improvements in anxiety and functional impairment. Associations between use of symptom tracking reminders and improved treatment outcome remained significant after controlling for frequency of symptom tracking. Although correlations were not statistically significant, reminders received via SMS (ie, text message) were more strongly associated with symptom reduction than were reminders received via email.

Conclusions: These findings indicate that alerts may be an especially potent component of eMental Health interventions, both via their association with enhanced program usage, as well as independently. Although there was evidence of a stronger association between symptom improvement and use of alerts via the mobile phone platform, the degree of overlap between use of email and SMS alerts may have precluded identification of alert delivery modalities that were most strongly associated with symptom

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reduction. Future research using random assignment to computer and mobile delivery is needed to fully determine the most ideal platform for delivery of this and other features of online interventions.

Introduction

eMental Health Interventions

When used correctly, Internet-delivered mental health (eMental Health) interventions produce treatment effects similar to those observed in face-to-face treatment [1-4]. However, treatment effects observed vary distinctly across programs [5], and eMental Health interventions still remain somewhat of a black box in terms of our understanding of the mechanisms by which they exert their therapeutic benefit.

Existing frameworks posit a range of features that are most likely to influence program usage and treatment outcome [6], and recent reviews have attempted to isolate the features that mediate intervention outcomes [7]. However, there remains a large degree of variability in the number and types of features included in eMental Health interventions. As these interventions become increasingly more sophisticated, multifaceted, and user-driven, the heterogeneity in patterns of usage, and subsequently, the number of treatment components, also increases. This makes it difficult to identify those features of greatest therapeutic benefit.

Associations Between Patterns of Program Usage and Symptom Reduction

Within trials of eMental Health interventions, examining user log data provide an ideal means of identifying the patterns of program usage that are associated with the greatest therapeutic gain. As such, research has recently turned to focus on how specific patterns of program usage impact on treatment outcome. For example, in a trial of a Web-based intervention for diabetes self-management, use of a self-monitoring feature was associated with improvements in healthy eating, reductions in dietary fat, and increased exercise, but not with medication compliance [8]. Similarly, in a study examining the relationship between use of features of a personally controlled health management record and help-seeking behaviors, Lau et al [9] found that increased use of a diary feature, an Internet poll feature, and an Internet appointment booking feature, correlated with increased help-seeking for emotional well-being as well as overall health service utilization. Studies have also found that specific site usage statistics predict treatment outcome, such as the number of program log-ins [10], the number of psychotherapy module pages accessed [11], the number of activities completed per log-in [12], and use of reminder emails [13]. These finer-grained analyses of the relationship between program use and treatment outcome represent an important first step in developing an understanding of what specific program features impact most on treatment outcome. However, further

studies of multifaceted programs are needed if we are to identify the most potent features of eMental Health interventions.

Incorporation of Mobile Phone Technology

The growth and impact of mobile phone-based interventions provides an opportunity to examine the therapeutic benefits of adding a mobile phone platform to deliver program functions. A particular advantage of mobile phone technology is its capacity to facilitate ecological momentary assessment (EMA); that is, self-monitoring of symptoms and behaviors in real-time and in real-world contexts [14,15]. Self-monitoring of symptoms and behaviors in the context in which they occur helps to promote improved self-awareness of the factors that contribute to depression, stress, and anxiety. Therefore, it is likely that accessing features of an Internet intervention via a mobile phone platform may enhance treatment outcomes. However, no studies to date have examined the therapeutic gains associated with accessing program features via mobile technology.

Current Research

The current study examined associations between patterns of program usage and improvements in symptoms of depression, anxiety, stress, as well as functional impairment, in a randomized controlled trial (RCT) of a Web and mobile phone intervention for individuals with mild-to-moderate mental health symptoms. The current study also examined associations between symptom reduction and use of features across both computer and mobile phone platforms, thereby providing novel insights into the potential benefits of incorporating mobile technology into Web-based interventions.

Known as "myCompass", the program under current consideration is a stand-alone, fully automated self-help program that contains a variety of therapeutic features including interactive psychotherapy modules, self-monitoring, a diary, automated reminders, and motivational messages. The outcomes from the myCompass RCT are described elsewhere [16]. During the RCT, participants who were assigned to receive the myCompass intervention were able to engage with the program in an unrestricted manner, providing us with an ideal opportunity to determine what features were used most often and what were most closely associated with improvements in symptoms and functional impairment. Furthermore, the myCompass program is among the first to incorporate the use of mobile technology. Users could choose to access some of the program features on their computer or mobile phone, and could also choose to receive alerts via email or short message service (SMS; ie, text message). This also provided us with the opportunity to examine whether the addition of a mobile phone platform was associated

with increased use of other program features, as well as improvements in symptoms and functional impairment.

The aims of this study were to describe the site usage patterns of participants who received access to the myCompass program for seven weeks during the RCT, and to identify the program features associated with enhanced program engagement and reductions in depression, anxiety, stress, and functional impairment.

Methods

Participants

In the RCT, participants were randomly allocated to the myCompass intervention, to an attention control condition, or to a waitlist control condition, for seven weeks. The RCT took place between October 2011 and June 2012, during which time usage data were recorded. The usage data presented here are derived from all participants who were randomly allocated to the myCompass intervention condition (n=231).

The myCompass Program

The myCompass program is a fully automated, interactive, stand-alone mobile phone and Internet-delivered intervention designed for the treatment of mild-to-moderate symptoms of depression, anxiety, and stress. Users can access the program through any Internet-enabled device, including smart phones, tablets, laptops, and desktop computers. The program comprises four key features that users can access and engage with in a manner they choose.

Modules

The program contains 12 modules that are based on principles of cognitive behavior therapy, interpersonal psychotherapy, and problem solving approaches. These modules are: (1) Managing Stress and Overload, (2) Communicating Clearly, (3) Problem Solving, (4) Tackling Unhelpful Thinking, (5) Fear and Anxiety, (6) Happiness, (7) Sleep, (8) Relaxation, (9) Taking Charge of Worry, (10) Increasing Pleasurable Activities, (11) Smart Goals, and (12) Managing Loss. Modules are accessed via the Web only on computers (due to the size of the content, they were unavailable on the mobile phone), each module is approximately 10 Web pages in length and is divided into three sections that take approximately 5-10 minutes to complete, with a homework exercise at the end. Users are encouraged to complete one module session per week (with most modules containing 2-3 sessions), with the aim of completing 2 full modules over the course of the intervention. Participants are also encouraged to complete the homework tasks in between sessions. Module sessions are delivered in a tunnelled manner, such that it is necessary to complete a section and enter homework data before moving on to the next section.

Symptom Tracking

A number of predefined tracking dimensions are available for users to select from: (1) anxiety, (2) depression, (3) irritability, (4) restlessness, (5) stress, (6) worry, (7) alcohol, (8) diet, (9) exercise, (10) medication, (11) sleep, (12) smoking, (13) confidence, (14) concentration, (15) energy, and (16) motivation. In addition, users can define their own dimension to track. A

maximum of three dimensions can be tracked at one time. Users can choose to track daily or weekly and to receive tracking reminders via email or SMS. Each time a user enters tracking information, they are also prompted to enter situational information, such as where they are (eg, work, home, commuting), whom they are with (eg, colleagues, friends, alone), and what they doing (eg, working, studying, socializing) in order to help users identify potential triggers to their mood symptoms.

"Snippets"

"Snippets" are brief mental health tips, facts, and motivational messages that a user can elect to receive via SMS or email throughout the intervention. Users can choose the frequency with which they receive snippets, and can turn the feature on or off whenever they choose.

Diary

myCompass also contains a diary feature in which users can make notes about insights they have gained or information they have learned while engaging with the program. For example, users may use the diary to make notes about situational factors that appear to be linked with their mood symptoms on the basis of their symptom tracking data.

Primary Outcome

The Depression, Anxiety, and Stress Scale (DASS-21) [17] is a 21-item self-report scale that was used to measure symptoms of depression, anxiety, and stress. Respondents rate how much they have been bothered by symptoms over the past week on a 4-point Likert scale from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much/most of the time*). The DASS-21 has adequate internal consistency and test-retest reliability [17], and has sound psychometric properties when administered in an Internet format [18]. Total scores range from 0 to 126 and subscale scores range from 0 to 42, with higher scores indicative of more severe symptomatology.

Secondary Outcome

The Work and Social Adjustment Scale (WSAS) [19] is a 5-item self-report scale that was used to assess the degree to which mental health problems interfere with daily functioning. Respondents indicate the degree to which their mental health problems lead to functional impairment in the domains of work, social leisure activities, private leisure activities, home management, and personal relationships, on a 9-point Likert scale from 0 (*Not at all*) to 8 (*Very severely*). The WSAS has been shown to have sound psychometric properties when administered on the Internet [20], and higher scores indicate greater levels of functional impairment.

Demographic information was also collected as part of the baseline questionnaire, and included age, gender, highest level of education attained, and employment status. Frequency with which the participant used mobile phones and computers provided a proxy measure of technology acceptance.

Treatment outcome measures were administered at baseline, 8 weeks after baseline, and at 5 months after baseline. In this paper, we report the relationship between patterns of usage and

treatment outcomes specifically during the intervention period (ie, baseline to 7 weeks).

Usage Outcomes

Data for the following usage variables were obtained: log-ins, modules, symptom tracking, snippets, and diary.

Log-ins was the total number of times a user logged in to the myCompass program.

Modules were the number of modules a user started, the number they completed, and which modules they completed.

Symptom tracking was the number of times a user entered symptom tracking data, the number of tracking reminders a user received (by SMS and email), and the number of times a user tracked a particular symptom. A tracking latency variable was also calculated to determine how long, on average, it took for users to respond to tracking reminders by entering tracking data. This was calculated as the average length of time (in hours) between when a tracking reminder was received and the next instance of entering tracking data.

"Snippets" were the number of "snippets" a user received via SMS and via email.

Diary was the number of diary entries a user made.

Analysis Strategy

First, the sample was divided into two groups, those who used and those who did not use a specific feature. Chi-square tests (for categorical variables) and separate univariate Analyses of Variance (for continuous demographic variables) were then used to test for differences between the two groups on demographics and baseline scores on the DASS subscales and WSAS. Second, for those who used a specific feature, partial correlations were carried out to determine whether frequency of feature use was correlated with post intervention DASS or WSAS scores, after controlling for baseline scores on these measures.

Results

Participants

Of the 720 participants who screened eligible to participate in the myCompass RCT, 242 were randomly allocated to receive the myCompass program for seven weeks. There were eleven participants in this group that withdrew from the RCT, leaving a final sample of 231 for the current analysis. The sample was predominantly female (160/231, 69.3%), university educated (135/231, 58.4%), employed (196/231, 84.8%), married or de facto (133/231, 57.6%), and the mean age was 38.8 years. The majority reported using a computer (225/231, 97.4%) and a mobile phone (223/231, 96.5%) daily.

Patterns of Site Usage

Google Analytics was used to extract site usage data for those in the myCompass group over the course of the RCT, spanning from October 4, 2011 to June 25, 2012. Google Analytics defines visits as the number of times visitors have been to the website. If a visitor is inactive for 30 minutes or more, any future activity is attributed to a new session. Visitors who leave the site and return within the same 30-minute period are counted as part of the same session. During the RCT period, there were a total of 4724 visits to the site, 1182/4724 (25.02%) of which were unique (ie, first time) visits. Across the 266 days, the site recorded 58,296 page views, with an average of 12.34 page views per visit and an average visiting time of 10 minutes and 37 seconds. The bounce rate, which reflects the proportion of visitors who enter the site and leave ("bounce") without viewing other pages within the site, was 19.37%.

Participants were given access to the myCompass program for seven weeks. They were encouraged to track three symptom dimensions and complete two modules of their choice during the intervention period. A little under a third (n=66/231, 28.6%) of the participants never logged in to the program. Those who did use myCompass logged in a total of 2463 times, with the mean number of log-ins per user being 14.9 (SD 16.5), ranging from 1 to 105. The most commonly used feature of the program was the "snippets" feature, used by 158/231 (68.4%) participants. This was followed by the symptom tracking feature, used by 142/231 (61.5%) participants, and 118/231 (51.1%) also used the optional tracking reminder feature. There were 118/231 (51.1%) participants who also used the modules, 57 of whom completed at least one module. The mean number of modules started was 1.2 (SD 1.6) and the mean number completed was 0.6 (SD 1.3). The least commonly used feature was the diary, used by 61/231 (26.4%) participants. Key usage statistics of those who used the program (n=165) are shown in Tables 1-3. Figure 1 shows the use of specific program features over the seven-week intervention period.

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Table 1. Module usage statistics (n=165).

Completion of specific modules	Started (n=118[a])		Completed (n=57[b])	
	n	% sample	n	% sample
Managing stress and overload	63	38.2	33	20.0
Communicating clearly	43	26.1	16	9.7
Problem solving	34	20.6	17	10.3
Tackling unhelpful thinking	26	15.8	13	7.9
Fear and anxiety	25	15.2	9	5.5
Happiness	22	13.3	11	6.7
Sleep	13	7.9	5	3.0
Relaxation	12	7.3	2	1.2
Taking charge of worry	10	6.1	7	4.2
Increasing pleasurable activities	9	5.5	5	3.0
Smart goals	6	3.6	6	3.6
Loss	5	3.0	3	1.8

[a] Indicates the number of users who started at least one module

[b] Indicates the number of users who completed at least one module. Percentages refer to the portion of users who started/completed a module with respect to the total sample of users who logged on at least once, n=165.

Table 2. Symptom tracking usage statistics (n=165).

Symptom tracking		Median	Mean	SD
Instances of tracking		31	49.9	54.2
Reminders				
	Number of email reminders received	0	6.7	15.9
	Number of SMS reminders received	24	25.4	26.2
Frequency of tracking specific dimensions				
	Stress	0	6.2	16.6
	Anxiety	0	5.9	14.9
	Worry	0	5.1	14.0
	Depression	0	4.9	13.4
	Motivation	0	4.9	11.9
	Energy	0	4.3	12.7
	Irritability	0	3.6	10.4
	Confidence	0	3.1	10.5
	Restlessness	0	2.6	10.7
	Sleeping	0	2.4	6.1
	Exercise	0	1.7	4.9
	Concentration	0	0.7	4.4
	Diet	0	0.6	2.5
	Alcohol	0	0.5	2.8
	Smoking	0	0.1	0.5
	Medication	0	0.0	0.1
Latency (hours)		55	9.5	34.9

Table 3. Snippets usage statistics (n=165).

Snippets		Median	Mean	SD
Total				
	Number sent by email	7	7.2	6.9
	Number sent by SMS	0	2.8	10.3
Quick tips				
	By email	1	1.7	4.2
	By SMS	0	1.1	4.9
Fast facts				
	By email	0	0.2	1.0
	By SMS	0	0.1	0.5
Motivational messages				
	By email	5	5.2	2.9
	By SMS	0	1.6	6.3

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Figure 1. Use of program features across the intervention. SMS = short message service; Week = Wk.
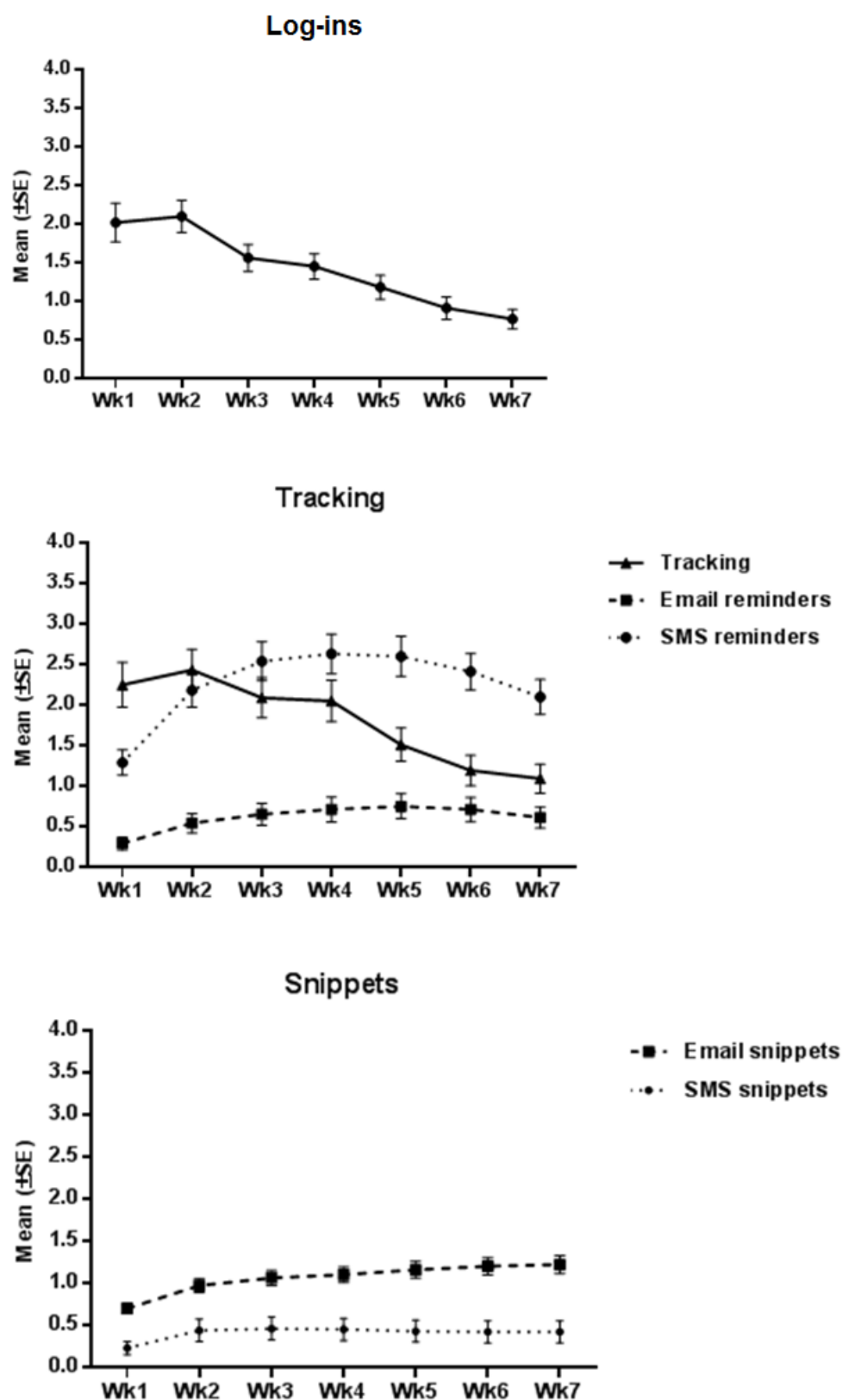
Baseline Predictors of Site Usage

Of the 231 individuals who received access to the myCompass program for 7 weeks during the RCT, 165 individuals logged in at least once. Reasons for nonusage included lack of time, poor motivation, and having intermittent access to the Internet or a computer. There were no significant differences between those who did and did not log in in terms of baseline demographics or clinical symptoms, however, for those who did use the program, log-in frequency (r=.19, P=.02) and total

instances of symptom tracking (r=.18, P=.03) increased with participant age. Baseline demographic and symptom characteristics were not associated with frequency of starting or completing modules. Females chose to receive more "snippets" than males t_{155} = 2.15, P=.03, as did those with lower functional impairment (WSAS score; r=-.21, P=.04), and higher baseline anxiety was associated with a greater number of diary entries (r=.27, P=.04).

Features Associated With Treatment Outcome

Modules

Neither the number of modules started nor the number of modules completed was significantly associated with reductions in depression, anxiety, stress, and functional impairment, after controlling for baseline symptom severity.

Symptom Tracking

Similarly, use of the symptom tracking feature was not associated with reductions in depression, anxiety, stress, or functional impairment, nor was the frequency of symptom tracking. There was also no correlation between symptom tracking latency and symptom improvement.

Symptom Tracking Reminders

After controlling for baseline severity, increased use of the symptom tracking reminders was associated with decreased

functional impairment at post intervention (r=-.28, P=.01), however, there was no association between reminder use and depression, anxiety, or stress. Of those who used tracking reminders, 29 received at least one reminder via email, 97 received at least one reminder via SMS, and 8 subjects received reminders via both modalities. After controlling for baseline severity, frequency of tracking reminders received via email (r=-.27, P=.28), and via SMS (r=-.12, P=.37) were both associated with decreased functional impairment at post intervention, although neither correlation was significant when examined individually.

Bivariate correlations were conducted to determine whether reminders were associated with increased program use. The total number of tracking reminders was positively correlated with the number of program log-ins, as well as the frequency of symptom tracking (Table 4). A greater number of tracking reminders received via email were also associated with increased use and completion of the modules, as well as use of the diary. On each measure, reminders received via email were more strongly correlated with site usage than were reminders received via SMS. Interestingly, the correlation between tracking reminders and functional impairment remained significant even after controlling for frequency of symptom tracking (r=-.28, P=.02), indicating that reminders were associated with improvements in functional impairment independently of any associated increase in symptom tracking.

Table 4. Correlations between usage variables.

Reminders	Total tracking	Tracking latency	Program log-ins	Modules started	Modules completed	Diary entries
	r (P value)	r (P value)	r (P value)	r (P value)	r (P value)	r (P value)
Total	.21 (.02)	-.14 (.15)	.23 (.01)	-.07 (.50)	-.10 (.49)	.11 (.22)
SMS	.03 (.75)	-.12 (.25)	.05 (.65)	-.22 (.05)	-.22 (.20)	.05 (.62)
Email	.28 (.15)	.05 (.82)	.31 (.10)	.40 (<.001)	.40 (.003)	.43 (<.001)

"Snippets"

After controlling for baseline symptom severity, a greater number of snippets received were associated with reduced anxiety at post intervention (r=-.20, P=.04). Increased use of snippets was also associated with nonsignificant reductions in post intervention depression (r=-.09, P=.39), stress (r=-.17, P=.09), and functional impairment (r=-.27, P=.40). Of those who used snippets, 153 received at least one via email and 15 received at least one via SMS. Partial correlations between the number of email snippets received and post intervention scores were nonsignificant, as were partial correlations involving the number of SMS snippets. The lack of difference between the email and SMS delivery modes is possibly due to a high degree of overlap between the two, as 10 of the 15 users who received snippets via SMS also received snippets via email.

Diary

Use of the diary feature was not correlated with treatment outcomes.

Discussion

Aims of the Study

The aims of this study were: (1) to use log data to identify patterns of program use in an RCT of myCompass, a tailored, Web and mobile phone-based intervention for depression, anxiety, and stress; and (2) to determine whether use of certain program features was associated with enhanced program engagement and therapeutic gain. Overall, the results showed that the alert features of the myCompass program were the most commonly used, were associated with increased rates of program engagement, and were associated with the greatest therapeutic gains.

Patterns of Program Use

The average number of log-ins per user over the course of the intervention was 14.9, which is somewhat higher than that reported in other eMental Health interventions (eg, a mean of 6.55 log-ins for individuals in the highest quartile of usage in an Internet intervention for depression) [10]. The bounce rate of 19.37% was also substantially lower than that observed in other interventions (eg, 32.9% in an intervention promoting sexual health, and 56.3% in an intervention promoting

heart-healthy behaviors) [21,22], indicating that the home page was effective at engaging users. Furthermore, Google Analytics data revealed an average site visit duration of 10 minutes and 37 seconds, which is in line with that shown in other trials of Internet-delivered interventions for anxiety and depression that report average site visit durations of between 7 and 13 minutes [23,24], indicating a high level of engagement with the myCompass website. However, as is common in nontherapist-assisted eMental Health interventions [22,25,26], frequency of program use decreased over the course of the intervention, emphasizing the need to identify program features that promote more regular program engagement.

In the RCT, participants were encouraged to complete at least one myCompass module session per week (totalling 2 full modules over the course of the intervention). Log data revealed that module completion rates were lower than expected, with a mean module completion rate of 0.6 modules. This may be partly due to the fact that modules could not be accessed via the mobile phone due to screen size, and reformatting the modules for compatibility with a mobile phone platform is one obvious means of addressing this issue. Low module completion rates may also have arisen because the module sessions were delivered in a tunnelled fashion, whereby subjects were required to complete the module sessions in a predetermined sequence. Although research suggests that a tunnelled format may facilitate greater program engagement (eg, greater number of website pages visited, greater time spent on the website, and greater knowledge gained from the website) [27], subjects were often required to complete the between-session homework tasks before being able to progress to the next session within a module. Making homework tasks optional might be one way to increase module completion, by allowing greater flexibility in the speed with which users proceed through the modules.

The most commonly used feature of myCompass was the "snippets" function. "Snippets" were short motivational messages, quotes or facts, which were sent by email or SMS at a time and frequency chosen by the user. The appeal of the "snippets" may lie in the fact that they are supportive, normalizing, and instill hope, yet demand little of the user in terms of behavior change, attention, or time. The second most commonly used feature was the symptom tracking function. Among the most common symptom dimensions tracked were stress, worry, anxiety, motivation, and depression, indicating that users chose to track symptom dimensions most closely tied to the primary goal of the study, which was to reduce symptoms of depression, anxiety, and stress.

A substantial proportion of participants who used the symptom tracking feature also chose to receive tracking reminders. As expected, increased frequency of tracking reminders was associated with increased frequency of symptom tracking. This finding aligns with those of previous research showing that use of reminders enhances engagement with eMental Health interventions [28]. In particular, one study showed that users who received email reminders made 1.2 times as many visits, viewed 1.58 times as many pages, and spent 1.51 times as many minutes in an Internet intervention for smoking cessation [13], compared to users who did not receive email reminders. The majority of individuals who chose to receive reminders elected

to receive them via SMS. Given that mobile phones are generally carried on the person, this finding may represent the perception that reminders are likely to be received in a more timely fashion if delivered to the mobile phone. It also suggests that program utilization may be enhanced (particularly use of features that involve alerts) via incorporating a mobile phone platform into future eMental Health interventions.

Relationship Between Feature Use and Treatment Outcome

After controlling for baseline symptom severity, participants who chose to use the alert-based features of myCompass, such as the reminders and "snippets", showed significantly greater reductions in post intervention symptoms and functional impairment compared to those who did not use these functions. In particular, there appeared to be a consistent relationship between alerts received via email and reductions in post intervention anxiety and functional impairment. In one respect, this is unsurprising, as self-monitoring is one of the most important components of psychotherapy for anxiety and other mental illnesses [29], and is a key step in helping individuals to change unhelpful cognitions, beliefs, and behaviors [30]. Furthermore, the greater association between email reminders and treatment outcome may be because users who chose to receive alerts via email spend more time on their computer, and as a result, could more easily access the program features that were only available via the computer platform (such as the modules). However, the relationship between email reminders and treatment outcome remained significant even when controlling for frequency of program use and symptom tracking. Although the alert functions of myCompass were primarily intended to enhance program engagement (which they ostensibly did), these data suggest that alerts may also impact treatment outcome independently of their effects on program engagement.

This finding indicates that alerts may serve multiple therapeutic functions and may therefore be an especially potent feature in eMental Health interventions. First, in terms of program usage, alerts act as prompts that enhance program engagement, and so may help to combat the high rates of nonusage attrition common to many Internet interventions [31,32]. Alerts may also be useful for encouraging more ongoing program engagement in users who show a tendency to prematurely disengage from the program once they have begun to achieve symptom remission ("e-attainers"). Second, in terms of treatment outcome, alerts may independently produce therapeutic effects via nonspecific therapeutic processes. Nonspecific variables pertinent to the treatment context, such as encouragement, empathy, and hopefulness of improvement can produce powerful treatment effects in their own right, for a review see [33]. Therefore, receiving regular reminders, motivational messages, and tips may lead to reductions in symptomatology and functional impairment because they regularly and consistently cue the expectation of symptom improvement, create a sense of being continuously supported and encouraged, and remind the user that they are actively taking steps to gain control over their symptoms. Finally, the alert-based functions, such as the "snippets", may provide a means of buffering against or breaking the negative feedback cycles that contribute to the maintenance of many psychiatric conditions. For example,

cognitive models of depression posit that maladaptive responses to negative automatic thoughts (such as rumination and decreased engagement in pleasurable activities) are a primary factor that maintains perceptions of low self-worth and associated depressive symptomatology [34]. Therefore, receipt of motivational messages or normalizing facts may be a means of ensuring that users receive some form of positive reinforcement each day, thereby buffering against the development of a negative cycle.

Interestingly, neither initiation nor completion of the psychotherapy modules was associated with treatment outcome. This finding was unexpected; as we had hypothesized that the core skills taught in the modules would be key to producing symptom reduction. The lack of association may be due to limited variability in use of the modules, as the overall rate of module completion was low. However, ours is not the first study to find a lack of association between module completion and treatment outcome. In a study examining the association between usage metrics and treatment outcome in an RCT of an Internet depression treatment program, Donkin et al [12] found that the proportion of modules completed was not associated with treatment outcome. The authors made two suggestions that warrant further investigation: (1) either the number of modules completed may be a poor indicator of benefit obtained, or (2) that the relationship between module completion and treatment outcome may not be entirely linear, as was originally thought. Indeed, it is possible that rates of module use only within a specific period of the intervention (ie, in the first few weeks) may be more strongly associated with therapeutic gain than total module completion rate. To address this possibility, future studies may wish to examine associations between treatment outcome and feature utilization within discrete stages of the intervention. Another possibility is that user-specific factors, such as the degree of therapeutic alliance with the program, may contribute more strongly to symptom improvement than the actual skills taught in the modules. To investigate this, we have administered self-report questionnaires of therapeutic alliance and have conducted a series of qualitative interviews to determine the degree to which users developed a rapport with the program (paper submitted for publication). Examining reasons for low module use from users who had especially low rates of module completion, or those who did not use the modules at all, will provide further information.

Strengths, Limitations, and Future Directions

The current study examined whether specific patterns of program usage were associated with superior treatment outcomes in an RCT of myCompass, a mobile phone and Web-based self-help intervention for individuals with mild-to-moderate depression, anxiety, and stress. The current findings contribute to our understanding of the mechanisms through which eMental Health interventions exert their therapeutic benefits, by isolating the program features most strongly associated with improvements in symptoms and functional impairment.

Although our findings suggest that alerts are associated with both increased program engagement and greater treatment outcome, this is only a first step, and further research is needed to confirm our findings. Specifically, the current analysis used a correlational design in the single group of individuals who were assigned to receive the active myCompass intervention within the broader RCT. Future studies using random assignment to specific program features is needed in order to reach firm conclusions about the causal relationship between patterns of program usage and reductions in symptoms.

Along similar lines, better information about potential nonlinear relationships between patterns of program use and treatment outcome could be obtained by assessing symptom improvement at more frequent intervals. Assessing symptomatology at each week of the intervention may provide a greater insight into the usage patterns and points of disengagement of those with low rates of adherence, or alternatively, those who may be classified as "e-attainers". This information could then be used to further develop and refine the features that show the strongest associations with symptom reduction, as well as to incorporate prompts at key junctures to assist in reducing rates of program attrition.

In the current study, the rate of module completion was approximately one quarter to one sixth of that expected, which is a limitation, and this may be partly due to the modules being unavailable via mobile phone. However, a lower-than-expected rate of module completion is not an issue that is unique to our intervention. Indeed, many self-paced eMental Health interventions have low rates of module completion, however, there is evidence to suggest that this may not necessarily equate to receiving a lower "dose" of the program. Studies suggest that individuals may derive substantial benefit from symptom tracking alone [35], and it may be that many users prefer this to completion of more in-depth modules. This again points to a need for further research into the most potent components of Internet interventions. If modules turn out to produce the greatest therapeutic benefit, then programs may benefit from evaluating methods of incorporating incentives that drive up rates of module completion. However, if the modules are associated with only marginal improvement compared to other features, it may be more beneficial to consider ways to maximize the potency of other features (eg, using reminders to prompt practice of therapy-based skills).

Finally, the sample used in the current study was predominantly female (160/231, 69.3%), university-educated (135/231, 58.4%), and around 40 years of age. Although sex, education, and age were not found to be strong predictors of program use, it is possible that rates of program engagement, or use of certain features, may differ in other populations. It is possible that rates of program usage may be lower in individuals with poorer literacy, or indeed, those who present with more severe forms of psychopathology.

Conclusions

The current study examined associations between patterns of program usage and symptom improvement in myCompass, a Web and mobile phone-based intervention for mild-to-moderate depression, anxiety, and stress. The alert features of myCompass were most closely associated with symptom improvement, indicating that brief cues that signal self-monitoring or that provide positive reinforcement may be an especially potent feature of eMental Health interventions. Although data

suggested a stronger association between symptom improvement and alerts received via email than via SMS, there was substantial overlap between use of email and SMS reminders. As such, future studies using random assignment to specific program platforms are needed to determine the most therapeutically beneficial platform for delivery of this program component.

Conflicts of Interest

None declared.

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Abbreviations

DASS: Depression, Anxiety, and Stress Scales

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EMA: ecological momentary assessment
RCT: randomized controlled trial
SMS: short message service
WSAS: Work and Social Adjustment Scale

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Original Paper

Feasibility and Perception of Using Text Messages as an Adjunct Therapy for Low-Income, Minority Mothers With Postpartum Depression

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Abstract

Background: Postpartum depression (PPD) is the most common medical problem among new mothers that can have a negative impact on infant health. Traditional treatments are often difficult for low-income mothers to complete, particularly given the numerous barriers families face.

Objective: Among low-income, primarily racial, and ethnic minority mothers with postpartum depression, our aim was to evaluate (1) the feasibility of sending supportive text messages, and (2) the perception of receiving private, supportive text messages for postpartum depression.

Methods: Mothers found to be at risk for postpartum depression received supportive text messages four times weekly for 6 months in addition to receiving access to traditional counseling services based within an academic pediatric office. Feasibility was evaluated along with cellular and text messaging use, access, and perception of the message protocol. Perception of the message protocol was evaluated at study completion via a Likert scale questionnaire and open-ended qualitative survey.

Results: In total, 4158/4790 (86.81%) text messages were successfully delivered to 54 mothers over a 6-month period at a low cost (US $777.60). Among the 96 scripted messages, 37 unique messages (38.54%) allowed for a response. Of all sent messages that allowed for responses, 7.30% (118/1616) were responded to, and 66.1% of those responses requested a call back; 46% (25/54) of mothers responded at least once to a text message. Mothers felt that messages were easily received and read (25/28, 89%) and relevant to them personally (23/28, 82%). Most shared texts with others (21/28, 75%).

Conclusions: Text messaging is feasible, well-accepted, and may serve as a simple, inexpensive adjunct therapy well-suited to cross socioeconomic boundaries and provide private support for at-risk mothers suffering from postpartum depression.

Introduction

Postpartum depression (PPD) is the most common medical problem new mothers face, occurring in 13%-20% of women at some point after birth [1,2]. It has significant effects on children's behavior: higher rates of infant behavioral problems, impaired social development, delayed cognitive development, and insecure attachment patterns [3].

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For low-income and racial and ethnic minority women, the rates of PPD may even be higher [4]. They are also less likely to be diagnosed with, seek out, and/or receive assistance for their symptoms [4]. Traditional barriers to care include a lack of access to medical or counseling services, transportation issues, and a strong stigma against the receipt of mental health therapy [5,6]. For providers, it can be extremely difficult to transcend these barriers and effectively connect with patients.

Short message service (SMS) or text messaging is now a ubiquitous form of communication throughout the world [7]. Texting is inexpensive, and most patients living in poverty have cell phones with texting capability, making it very appealing to underserved minorities [7-9]. Texting requires no transportation and allows patients to receive private, specific messages, which may help reduce the stigma surrounding the receipt of mental health treatment among urban minorities. Daily communication via SMS has the potential to reinforce the therapeutic bond between counseling sessions [10]. Few studies have evaluated using texting as an adjunct therapy for depression. Recently two groups have evaluated the feasibility, patient acceptability, and cost-effectiveness of texting depressed patients, both highlighting the ability of texting to transcend all socioeconomic barriers to care [10,11]. We sought to evaluate the feasibility and patient perception of sending text messages to low-income, primarily African-American mothers with PPD, a previously unstudied patient demographic.

Methods

Participants and Setting

This was a prospective pilot study conducted in a single urban, academic pediatric clinic. Between December 2012 and June 2014, screening for PPD occurred as a standard assessment for all mothers presenting at well-child visits between 7 days and 6 months postpartum. English-speaking mothers (N=143) who lived in the city of St. Louis and scored ≥10 (at risk for PPD) on the Edinburgh Postnatal Depression Scale (EPDS) [12] were approached for enrollment by members of the research team. The research team framed participation as an offer of support

for PPD. All subjects received similar treatment (cognitive behavioral therapy [CBT]) and were offered participation in text messaging as an adjunct. The study did not have Institutional Review Board approval to collect data on those who chose not to participate, so specific reasons for non-participation are not available. Severity of depression was evaluated with the Beck Depression Inventory-II (BDI-II) [13].

Study Procedures

Subjects received 4 text messages per week for 6 months, with each subject receiving the same, non-randomized, message script without any repeats. Message scripting existed in isolation from other support services provided by the research team. That is, while messages were developed with CBT themes in mind, they did not specifically coincide with CBT work in therapeutic sessions. Text messages were developed to be supportive in nature, using principles of postnatal education, motivational interviewing, and CBT (Table 1). Messages were developed by the authors (MB, AL, ER) with input from therapeutic staff. Text messages were automated, sent from a bank of 96 messages, and delivered via the Televox Housecall messaging program. Subjects had the opportunity to opt out of text messaging at any time. Some messages allowed for a response in regards to whether or not a subject would like a follow-up phone call; these responses were limited to either a YES or NO. Prior to receiving text messages, all subjects were provided clear guidance that a team member would return the requested call within 24 hours, but that text responses were not to be used for emergent communications. As text responses were limited in scope (YES or NO), subjects were unable to ask any questions or describe any suicidal content to the project team via a text. To further ensure the safety of subjects, a suicide protocol was developed for the practice to be used in the clinic. The protocol was implemented twice over the course of the project.

CBT, an accepted standard of care for PPD, was the primary form of counseling used during the study, and enrolled subjects had unlimited access to therapeutic services [4,14]. In addition, they had access to social work assistance and telephone support services from clinic staff as part of a comprehensive program entitled Happy Mothers, Healthy Families (HMHF).

Table 1. Example text messages by category.

Category	Example
Informational	A routine is comforting for babies. It helps them know when things, like eating and napping, will happen.
	Children should see the doctor at 2 weeks, 1 month, 2, 4, 6, 9, and 12 months old. Call XXX-XXXX to make an appointment.
	The best seat for your baby is in a car safety seat for every trip in a car, truck, or van. Do u want HMHF to call? YES/NO
	Some symptoms of depression: crying, anger, anxiety, sleep/appetite changes, guilt, helplessness. Want us to call? YES/NO
	Smoking is unhealthy for you, your baby, and other family members. Call for help, call QUIT NOW at 800-784-8669
Motivational / General support	Recognition for what we do for others may be desirable, but it's never guaranteed. Celebrate your own accomplishments, big and small.
	Your happiness depends on what you do; what small thing will you do today to create happiness for yourself?
	Bounce off a loss and onto the next win. Win or lose, HMHF is here, do you want us to call you? YES/NO
	Making a plan and moving forward can be scary; the HMHF team is here to support you. Call XXX-XXXX to schedule an appointment.
	Take the first step, no more and no less, and the next will be revealed (Roberts). We are here to help you take that step. Call XXX-XXXX.
Cognitive behavioral therapy (CBT) / Reflection	Today let's focus on making decisions from the facts not our feelings. What decisions do you have to make?
	We all own responsibility for our feelings; how will you take care of your feelings today? For help making a plan, call XXX-XXXX.
	Focusing on what should be or could be drains energy; focus on what you can achieve. What do you want to achieve? What's the first step?
	You don't have choice in what others say or do; You do have choice in how you respond. Call HMHF to talk to the team.
	No one can make you feel inferior without your consent. (E. Roosevelt) What can you do today to make yourself feel empowered?

Statistical Analysis and Evaluation

In order to define the baseline degree of mobile phone utilization among the study group, cellular and text-messaging use and access were surveyed prior to subjects receiving text messages. Feasibility was defined by the percentage of sent messages successfully received. The perception of the message protocol was evaluated at completion via a Likert scale questionnaire and open-ended qualitative survey. Qualitative comments were pooled. The study was approved by the Saint Louis University Institutional Review Board. Descriptive statistics were used for the evaluation.

Results

Demographic and Cellular Use Characteristics

Among the 58 mothers who enrolled (Table 2), 69% (40/58) were between the ages of 20-29 and 83% (48/58) were of non-Hispanic African-American race. The majority (38/47, 81%) had an annual income of <US $25,000 per year. The mean EPDS was 13.57 +/- 3.14 (scores ≥10 indicative of risk for PPD) and the BDI-II was 24.24 +/- 9.73, with scores in the range of 16-25 indicative of moderate depression.

Fifty-four (93%) subjects received text messages. The majority of mothers (98%, 54/55) with cellular phone and texting capability elected to receive text messages while 3 subjects did not have text messaging capability, though each commented that they would have liked to receive messages. Thirty-four (63%) subjects had a smartphone.

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Table 2. Demographic characteristics of HMHF subjects.

Characteristic	HMHF Moms, n (%)
Age, years	
15-19	5 (8.6)
20-29	40 (69.0)
30-39	13 (22.4)
Race/Ethnicity	
Non-Hispanic white	8 (13.8)
African American	48 (82.8)
Mixed-Race	2 (3.4)
Education level (n=48)	
Less than high school	12 (25.0)
High school graduate	10 (20.8)
Some college	19 (39.6)
Associate's	4 (8.3)
Bachelor's and above	3 (6.3)
Income, USD (n=47)	
Less than $10,000	25 (53.2)
$10,000-$14,999	5 (10.6)
$15,000-$24,999	8 (17.0)
$25,000-$34,999	3 (6.4)
Greater than $35,000	6 (12.8)

Feasibility

A total of 4158 texts were sent successfully with 13.81% (666/4824) experiencing delivery failure. Of those messages not received, 532/666 (79.9%) had a receiver error and 134/666 (20.1%) had a sender error. Among receiver errors, 478/532 (89.8%) were individual carrier (participant) errors (eg, lapse in service, changed number, texting plan did not support short code messages), and 54/532 (10.2%) were opt-in errors, which resulted when a participant accidentally opted out and did not recognize it. Among the sender errors, 44/134 (32.8%) messages were not sent due to Televox stopping those messages prior to completion of the message schedule, and 90/134 (67.2%) messages were marked for future delivery by Televox, denoting that the message may or may not have been sent after the scheduled time (Figure 1).

Among the 96 scripted messages, 26% (25/96) included a call-back number, and 39% (37/96) included a YES/NO prompt to text whether the recipient would like a follow-up call. Of the messages that allowed for responses, 7.30% (118/1616) were responded to, and 66.1% of those responses requested a call back; 46.3% (25/54) of mothers responded at least once to a text message. Total cost for sending all messages during the project was US $777.60 ($14.40/subject; 54 subjects). This cost was based on the price per message sent ($0.15/message; 96 messages).

Figure 1. Text messaging feasibility.
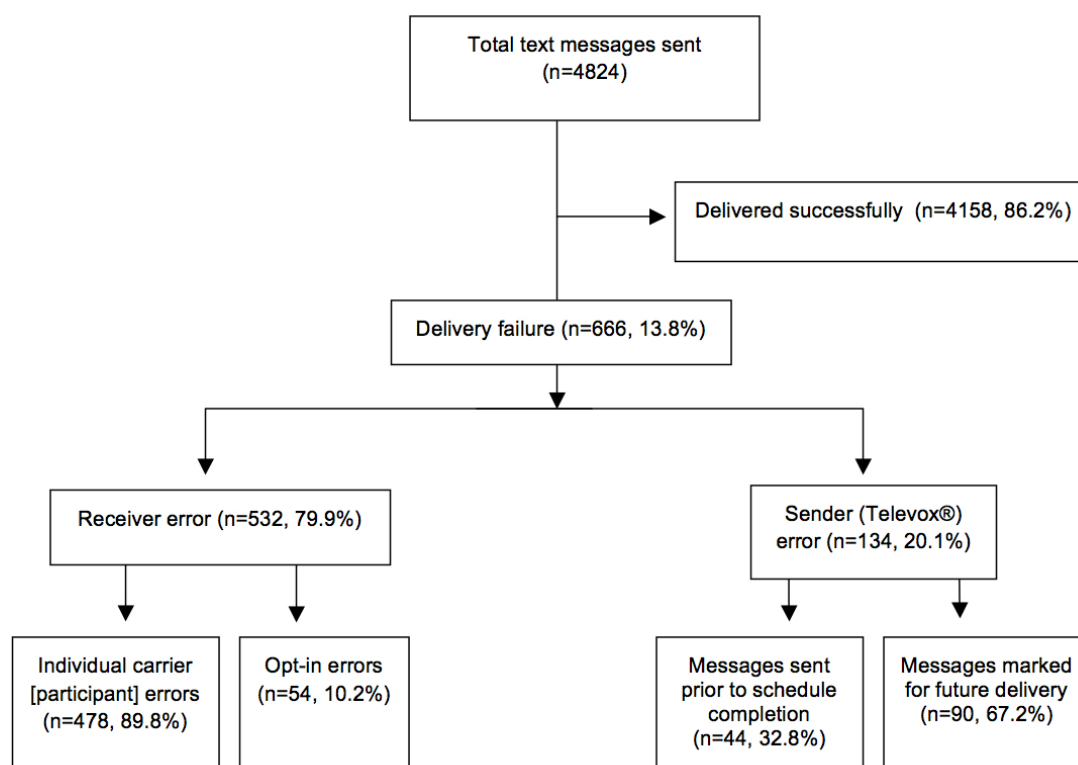
Survey Data

Through June 2014, 28 subjects had completed both 6 months of enrollment in addition to an exit survey. Two subjects opted out of text messaging during the 6-month message cycle while the remaining 28 either elected not to fill out an exit survey (n=12), had not yet completed 6 months of study participation (n=8), or withdrew (project team unable to contact after completing message protocol) from the study (n=8). Of those who completed an exit survey (Table 3), the majority agreed (25/28, 89%) that texts were a positive influence on their motivation to change and on their symptoms of depression. Patients felt that messages were easily received and read (25/28,

89%) and relevant to them personally (23/28, 82%). Most mothers shared the texts with others (21/28, 75%).

Regarding qualitative responses, Table 4 details all individual responses for each open-ended question from the exit survey. When asked the best thing about the text messages, the majority of respondents indicated it was their ability to motivate and recalibrate. Subjects appreciated that the messages were positive and encouraging, serving as a call to action, or a reminder of the capability to handle their PPD. By extension, subjects used the messages as a boost in challenging themselves to deal with their depression. The majority of subjects indicated that they would not change anything about the messages, but some subjects wanted the messages to be more customizable both in content and timing.

Table 3. Patient perception of messages based on exit survey.

Quantitative survey responses[a]	Average; % agree (n)
Overall, I enjoyed receiving text messages from the Project Team.	4.32; 79% (22)
It was easy to receive and read the text messages from the Project Team.	4.50; 89% (25)
I feel that the text messages made a positive change in my symptoms of depression.	4.32; 82% (23)
I thought the messages were very relevant to me personally.	4.29; 82% (23)
I feel that the text messages were a positive influence on my motivation to change.	4.50; 89% (25)
I liked having the option for an HMHF Project Team member to call me back.	4.52; 89% (25)
I shared the text messages with others.	4.19; 75% (21)

[a]All measured on a 1-5 Likert scale where 1=strongly disagree and 5=strongly agree.

Table 4. Qualitative responses from exit survey.

Survey question	Responses
What was the best thing about receiving text messages from the HMHF Project Team? (n=27)	The encouragement (4)
	The most fantastic part about receiving the text messages was that it gave me something to dwell on after a bad situation; it made me think positive (3)
	Knowing that someone was there for me and that [the team] cared (3)
	If I was down, it helped me through the day; they always cheer me up (3)
	Positive messages (3)
	They always seemed to come when I needed them most (2)
	They help (2)
	I liked that they came in the morning to help set the "tone" for the day (2
	The reminded me every day, even just by their presence, that I had tools, resources, and thoughts that improve my depression
	I didn't like them; they need to be more positive
	You can reply [to the messages] for help
	Receiving the calls
	Too few [messages]
How did you use the messages sent by the HMHF Project Team? (n=26)	Encouraging myself to do better for my child and I (5)
	I would try to make sure I incorporated it into my day (5)
	As a confidence booster and to cheer up. I also shared them with friends and family members (3)
	I would use the message to motivate me (3)
	To gain hope and strength (2)
	I just read them (2)
	I used the messages as an inspiration (2)
	I will reread over it again sometimes
	I started to see it like my daily horoscope; not all days was it completely relevant, but the days it was spot on were awesome
	It [kept] me knowing people care
	I used them as little prayers for me something to look up to
What would you change; what would have been more helpful? (n=26/16)	Nothing (23)
	More inspirational quotes (5)
	The messages that have been helpful are those that apply to "moving forward" in life, paying attention to yourself, having focus (4)
	Not so many (2)
	Anything positive (2)
	It would have been more helpful to choose a topic for the week and relate it to my situation
	I particularly liked the quotes. Perhaps more fact-based messages would have been helpful, only because I tend to respond to statistics and research
	I would send more
	I wish [the messages] came at a specific time of day that I selected
	I wish I [could] still receive them
	I don't know

XSL•FO
RenderX

Discussion

Principal Results

Feasibility

Messages were received with a high level of success (86.8% of those sent), and program cost was considerably less than anticipated indicating feasibility. Among low-income populations, consistent cellular service (eg, changes in phone number, plan) can be a significant barrier. However, given the open communication and consistent access to care offered with this project, reliable contact via SMS was not a major issue. Some subjects changed phone numbers during the program; however, based on the frequent clinical interactions at maternal counseling and infant well-child visits, the project team was able to quickly update contact information for the texting program as a team member checked in with subjects at all visits to the clinic. Many subjects who changed phone numbers contacted the project team directly to update their new number so that they would continue to receive text messages without any disruption to the texting program. The desire of subjects to quickly alert the project team to changes in their contact information underscores how much they enjoyed the program and the text messages they received.

Perception

Mothers clearly felt comfortable receiving the text messages, thought they were informative and appropriate to them as individuals, and were perceived to make a difference in their depressive symptoms. Many mothers noted that they would have liked to receive more individual, patient-specific information via the messages. The possibility for such a program exists; most securely, it would require mothers to own a smartphone with a password-protected messaging app to minimize the possibility of someone recognizing that the phone's owner was receiving treatment. Alternatively, patients could sign a Health Insurance Portability and Accountability Act (HIPAA) waiver consenting to the receipt of individualized text messages from their medical provider. Given the stigma and sensitivity surrounding treatment for mental illness, programs interested in detailing specific information about depression or anxiety to recipients should strongly consider password protection via an app or utilizing a screen-lock on the phone.

The willingness to share messages about one's mental health suggests that recipients were engaged in the messaging process, used the messages as a tool to reach out for help, and may be willing to work against the stigma associated with mental health treatment. This is particularly relevant given the noted disparities in mental health care and access among racial and ethnic minority populations, coupled with the strong, often community-specific stigma regarding the receipt of counseling or support services. Based on the qualitative responses in Table 4, this population of African-American women preferred motivational and inspirational messages and noted a preference to receive more individualized messages. Texting may be an avenue to improve engagement with at-risk mothers and families regarding mental health concerns, which traditionally have been taboo.

The mobile, asynchronous nature of texting offers a notable opportunity to bridge traditional barriers to care (poverty, stigma, transportation, and access) [5,15]. The possibility of combining text messaging and traditional CBT as a new treatment model could easily be adopted in primary care, postnatal, and mental health care settings.

Comparison With Prior Work

These findings correlate with previous studies suggesting that text messaging is a feasible method of communication in health care and an acceptable tool for behavioral change [16-20]. This research is singular given the study population, study duration, and the underlying disease process. Previous authors have described study strength in the investigation of urban, low-income, African-American mothers, noting the high-risk nature and prevalence of PPD within this demographic [21]. Despite this, no studies have evaluated the feasibility or acceptability of text messaging among urban, low-income predominantly African-American mothers with PPD. Although a few studies have evaluated the use of text messaging as an adjunctive tool for depression and mental illness [10,11,22,23], the authors are unaware of any research evaluating text messaging among women with PPD, particularly over a 6-month period. More notably, there is no published data on whether our study population would even use this potential treatment option for PPD. The impact of PPD on a mother spans beyond what accompanies depression alone, as it has a direct impact on infant care, maternal-newborn attachment, and future child development and behavior [24]. Our findings also acknowledge the importance of considering cultural differences when choosing content for a text messaging program [22], something that has not been evaluated in all texting studies [23]. Given the relevance to maternal and child mental health, the evaluation of an underserved population, and the demonstrated acceptance of receiving and sharing messages about a traditionally highly sensitive disease (PPD), many possibilities for further study remain.

Limitations

The purpose of the evaluation was to assess feasibility and perceptions regarding message content. Because this study did not evaluate text messaging as an intervention for PPD, our findings underscore the need for a larger, controlled study evaluating the clinical efficacy of using text messages as an adjunct therapy for PPD among low-income African-American women.

Not all subjects completed exit surveys, which affected the overall number of responses in the qualitative survey. As a result, a formal qualitative analysis of the comments was not performed given the limited number of responses.

Conclusions

Increasing access to mental health services via mobile technology has the opportunity to positively impact infant developmental, behavioral, and attachment outcomes that are linked to PPD. The minimal cost of executing a text messaging

protocol creates a viable, scalable, and fiscally responsible option for providing adjunctive support towards the treatment of PPD. As traditional treatments are often unavailable or difficult for low-income mothers to complete, text messaging may serve as a simple, inexpensive adjunct therapy well-suited to cross socioeconomic boundaries and provide private support for at-risk mothers suffering from postpartum depression.

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Abbreviations

CBT: cognitive behavioral therapy
EPDS: Edinburgh Postnatal Depression Scale
HMHF: Happy Mothers, Healthy Families
PPD: postpartum depression

<u>Original Paper</u>

Evaluation of an Online Campaign for Promoting Help-Seeking Attitudes for Depression Using a Facebook Advertisement: An Online Randomized Controlled Experiment

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Abstract

Background: A depression-awareness campaign delivered through the Internet has been recommended as a public health approach that would enhance mental health literacy and encourage help-seeking attitudes. However, the outcomes of such a campaign remain understudied.

Objective: The main aim of this study was to evaluate the effectiveness of an online depression awareness campaign, which was informed by the theory of planned behavior, to encourage help-seeking attitudes for depression and to enhance mental health literacy in Hong Kong. The second aim was to examine click-through behaviors by varying the affective facial expressions of people in the Facebook advertisements.

Methods: Potential participants were recruited through Facebook advertisements, using either a happy or sad face illustration. Volunteer participants registered for the study by clicking on the advertisement and were invited to leave their personal email addresses to receive educational content about depression. The participants were randomly assigned into two groups (campaign or control), and over a four consecutive week period, received either the campaign material or official information developed by the Hospital Authority in Hong Kong. Pretests and posttests were conducted before and after the campaign to measure the differences in help-seeking attitudes and mental health literacy among the campaign and control groups.

Results: Of the 199 participants that registered and completed the pretest, 116 (55 campaign and 62 control) completed the campaign and the posttest. At the posttest, we found no significant changes in help-seeking attitudes between the campaign and control groups, but the campaign group participants demonstrated a statistically significant improvement in mental health literacy (P=.031) and a higher willingness to access additional information (P<.001) than the control group. Moreover, the happy face Facebook advertisement attracted more click-throughs by users into the website than did the sad face advertisement (P=.03).

Conclusions: The present study provides evidence that an online campaign can enhance people's mental health literacy. It also demonstrates the practicality and effectiveness of an online depression awareness campaign using a Facebook-based recruitment strategy and distribution of educational materials through emails. It is important for future studies to take advantage of the popularity of online social media and conduct evaluative research on mental health promotion campaigns.

Introduction

Mental illness is a substantial contributor to the global burden of disease [1]. However, mental illness remains underdiagnosed in many people, and many of them receive minimal to no treatment for their illnesses [2]. From the health policy perspective, one way to tackle the underdiagnosis problem is to deliver mental health campaigns for promoting acceptance, enhancing knowledge, and encouraging help-seeking behavior [3]. According to the World Health Organization, selective preventive intervention programs targeted at specific groups, such as school children, adolescents, and elderly persons can help reduce depression [4]. Some campaigns have been developed to address stigma or cultivate positive attitudes toward depression and its treatments [5,6], but their effects on encouraging help-seeking intention has yet to be measured [6].

Along the same line, some research findings suggest that an increase in mental health literacy can affect one's help-seeking intention [7-9]. According to the findings of a systematic review of 22 studies [10], mental health literacy is listed as one of the important factors for strengthening help-seeking intentions for mental disorders among adolescents.

Health promotion campaigns delivered through the Internet have become increasingly more common recently [11,12]. The Internet is one of the major platforms for the public to seek health information and resources because of its convenience and anonymous nature [13]. Online campaigns, through the use of websites, online forums, and social media in particular, enable reaching diverse populations and providing motivation through reminders and feedback to the participants [14]. They can also mimic interpersonal communication to advocate health-related behavioral changes [15]. In a meta-analysis of 85 online intervention studies, online campaigns were found to be helpful for physical health behavior changes with statistically significant effects, especially when grounded in theory of behavioral change like the theory of planned behavior (TPB) [12,16].

Nevertheless, a systematic review revealed that there were very few effectiveness studies of online campaigns intended to encourage young people's help-seeking for mental health, and indeed most demonstrated no statistically significant impacts [17]. The authors also found that most studies in the review were of low quality, suggesting further research was needed to evaluate the studies properly [17].

This study aims to evaluate the effectiveness of an online campaign targeted at enhancing help-seeking attitudes for depression in Hong Kong. Specifically, the study seeks to examine whether such a campaign can promote participants' help-seeking attitudes for depression and mental health literacy. This study is the final stage of a multiple-phase, mixed-method research project aimed at developing a universal media campaign to encourage a help-seeking attitude for depression in Hong Kong. Hong Kong is a business-centric and fast-changing city with dynamic economic development and wide income gaps. These modern city characteristics have marked implications for the population's mental health status [18]. However, very little research has been done to measure the prevalence of clinical mental disorders among the general

public in the city [19]. Campaigns that promote awareness and anti-stigmatization for depression have arisen in the recent decades, but virtually no study has been rigorously conducted to evaluate the effectiveness of these campaigns in Hong Kong.

Methods

Study Background

Theoretical models are needed to guide campaign development and strategies [12]. Formative research, including a series of semi-structural interviews, was conducted to formulate and validate a theoretical framework for help-seeking in depression in Hong Kong and the results have been reported elsewhere [20]. The research made reference to the TPB and the McGill Illness Narrative Interview (MINI) to allow theoretical, contextual, and cultural understandings of how various factors interweave and of the way in which an individual's help-seeking attitude and behavior is influenced [20]. As a study outcome, a model was built with factors that explain how help-seeking intentions can be targeted for media campaigns. The model includes attitudes toward help-seeking, subjective norms, and perceived behavioral controls as suggested by the TPB, as well as the following three additional factors (1) attitude toward treatment, (2) perceived barriers and individual actions, and (3) perceived responses if a family member or friend experiences depression [21].

In addition, the quality of the campaign material was examined. One central question was how to design visual material for online display that can draw the largest extent of viewers' attention to the material? Previous studies have demonstrated that people with depression have an attentional bias against negative and sad facial expressions [22,23]. As such, the second objective of this study is to examine click-through behaviors by varying the attractiveness of two affective photographs showing either sad or happy facial expressions in online advertisements.

The study protocols were approved by the Human Research Ethics Committee for Non-Clinical Faculties, The University of Hong Kong. Trial registration for this kind of health attitude research is not required. We followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) for reporting the development and findings of online surveys [24].

Participants and Procedures

Participants who identified themselves as Hong Kong residents using traditional Chinese language and aged 18-59 years old in their Facebook profiles were recruited through paid advertisements on Facebook. Facebook has more than 845 million users around the world [25]. Facebook is an especially appealing medium to young adults [26-28] and is found to be particularly useful for follow-up research due to users' frequent or daily usage [28]. Health-related research has successfully deployed online participant recruitments to reach out to larger audiences or specific demographics like young women or smokers, or for interventions in areas like HIV prevention [26,29,30]. As one of the most popular social networking websites, Facebook offers recruitment advertisements that can be arranged to be shown only to the targeted population through

users' age and location indicated on their profile or their Internet Protocol (IP) address [26,31]. Facebook identified and estimated a total of 1.3 million users as our target audience using the criteria of being a Hong Kong resident, 18-59 years of age, and Cantonese speaking.

With reference to the recruitment procedure of the previous studies, the cost-per-click advertising model was used [26,31]. This payment model goes along with a bidding system employing the bidding price range suggested by Facebook, which is the cost per click of the advertisements. Advertisements with lower prices for bids are less likely to be displayed. Also, limits can be set in order to control the cost for per day or for the entire campaign. When the limit is reached, Facebook stops showing the advertisement [26,31].

Two Facebook advertisements were posted during the period from January 29, 2013 to March 3, 2013, with more than 26 million prevalence of impressions representing the incidence of appearance on Facebook (ie, people may see multiple impressions of the same advertisement). A total of HK $17,887.87 (roughly US $2300) was spent on both advertisements that gained a total of 5405 clicks. The main advertisement copy was posted with the headline "Say no to depression" in Chinese. On the side, there was a short paragraph asking:

> *What would you do if you discovered that your friend might have depression? Click here and we will provide you with four episodes of electronic material related to depression for free.*

With the same copy, two versions of the advertisements were made with the following attached pictures (1) a depressed woman covering her face (sad face), and (2) three cheerful young ladies (happy face) (Figure 1).

The Facebook advertisement (Figure 2) was linked to the introductory page of an online survey supported by SurveyMonkey [32]. The page provides explanation for the study purpose, introduces the flow of the campaign, and requests the user's participation and consent to join the campaign. Participants can click the "Agree" button to give consent and then enter an email address for receiving future campaign material. We checked the email registration and the IP address collected by the system to avoid duplication of participants. Before the campaign, the user interface of the online survey was pilot tested and then modified to enhance usability.

The study's internal validity was one of our concerns as participant recruitment and campaign execution were carried out completely on the Internet. In order to take into account possible duplications and to minimize the number of fake accounts or registrations, which are widespread concerns for online surveys and campaigns, participants were required to manually input the email registration after clicking into the Facebook advertisements. This email registration process and the following steps of sending questionnaires and campaign material through email helped minimize the chances of false identities and accounts. The IP addresses were also tracked to minimize duplication [33]. However, the process compromises the user convenience of simply doing a web-based survey where duplication and fake responses are inevitable. A pretest and posttest design was used to conduct the surveys. Drawing on the TPB's three factors (1) attitude toward help-seeking, (2) subjective norm, and (3) perceived behavior control, the pretest and posttest were identical and aimed to measure the changes in the participant's value and view of depression after the campaign. The items used as primary outcomes were derived from the help-seeking theoretical model as developed in the formative research stage. Secondary outcome measures included changes in mental health literacy [34], attitudes toward seeking professional help [35], and supplementary factors including action and view toward family and friends with depression, perceived barriers, and attitudes toward treatment. The Depression Anxiety Stress Scale (DASS) in Chinese was also used to measure the respondents' depressive episode [36].

Using Cronbach's alpha and confirmatory factor analysis, the reliability and validity in the measurements of the items were tested in a separate study that was reported elsewhere [37]. The Cronbach's coefficients for attitude, subjective norm, and perceived behavior control were 0.77, 0.77, and 0.82, respectively. Confirmatory factor analysis showed an acceptable fit of the model.

The duration of the campaign was six weeks. Participant registration, which was also the end of the posting period for the Facebook advertisement, was due on March 3, 2013. The web link of the pretest was then sent out for all registered participants' email accounts. The cut-off date for completion of the pretest was March 18, 2013, with prompt reminders sent beforehand. Those who failed to fill in the pretest were considered as dropouts from the campaign.

Every Monday for the following four weeks, a short paragraph of campaign material on depression was sent out in email format to participants. Participants had been randomly assigned to two groups that received either originally developed material for this campaign or the official mental health material prepared by the Hong Kong Hospital Authority, which was used as a control comparison. Participants were not aware of which group they belonged to. The full set of online questionnaires is provided (Multimedia Appendix 1).

Figure 1. The happy and sad face images and their targeted Facebook users.
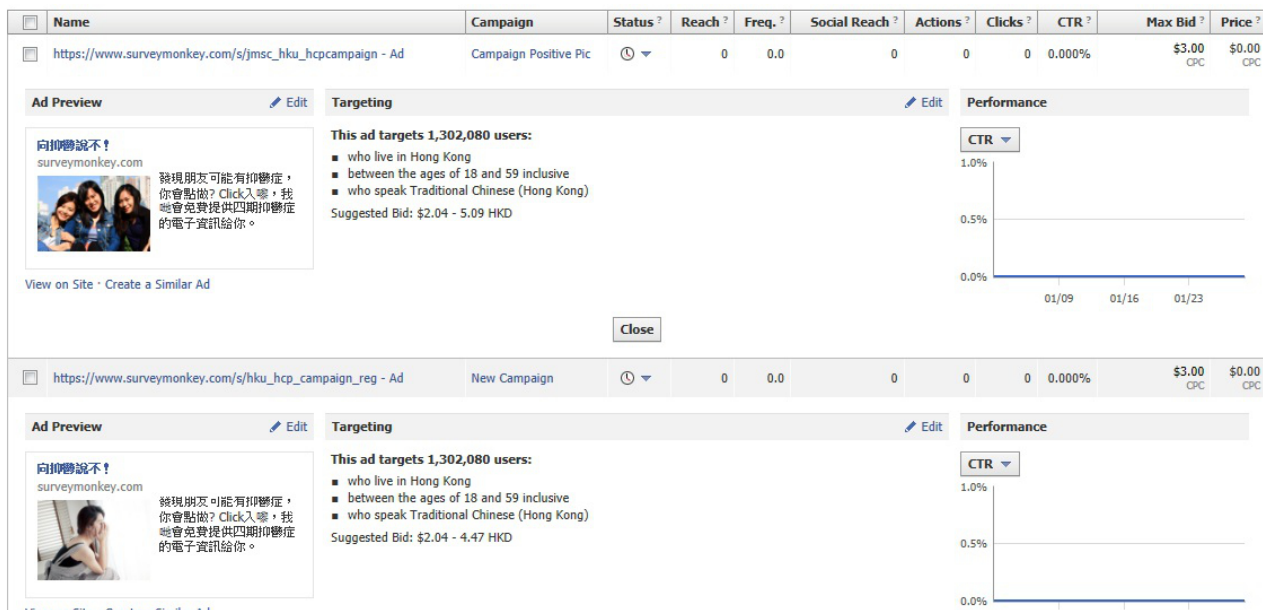
Figure 2. Example of the Facebook advertisement.

Campaign Material

The campaign material was originally designed by the first author, who has a bachelor's degree in journalism and has received mental health first-aid training, and was reviewed by the second author, who is a clinical psychologist and mental health researcher. All campaign material was written in Chinese. Four episodes of campaign messages were created with reference to the factors in the help-seeking theoretical model with each week featuring a background of depression, attitudes toward help-seeking, subjective norms, and perceived behavioral control [21]. The four email scripts were based on a story that was developed originally to incorporate the above factors. The story depicts a sister who suspects her brother has depression, and in turn portrays the progression of events as the sister and brother seek information and care (Multimedia Appendix 2).

An external web link was printed at the end of the email body for optional further reading, which provided additional information related to the week's message. The additional information was adopted from existing health information sourced from the World Health Organization, Hong Kong Hospital Authority, and academic studies related to depression

[38,39] and posted on the online survey page with a normal web page layout. In order to monitor who clicks into the further readings, the page starts with a question that asks whether the participant has read any other depression-related information during the week. The next page has the actual further reading information and ends with a question asking whether the information was helpful. The two-step process of answering questions and clicking "Next" and "Done" helped measure which participants clicked into the halfway point and which ones completed the further reading.

On the Monday of the sixth week, a link to the posttest was sent out in email format to all participants. In the final email, participants were advised to fill in the posttest only after they had finished reading the previous four weeks' material. Participants were given a week to fill in the posttest. The posttest was due at the end of week 6. Both pretest and posttest were voluntary surveys without incentive. Participants who did not complete the questionnaires or did not fill in the required material were considered to be dropout participants.

The chi-square test was used to test the differences between campaign and control groups for the variables described in Table 1. The Fisher's exact test was used if any cell frequency was

fewer than five. The t test was deployed to test the mean difference between groups. The campaign outcomes were assessed by the analysis of variance (ANOVA) model in the statistical software package SPSS 21.0. P value was set as .05.

Results

Of the 383 Facebook users who had consented and registered with their personal email address to join the campaign, 197

(51/100, 51.0%) completed the pretest and were included in the campaign. They were randomly assigned into one of the two groups with 98 in the campaign group and 99 in the control group. After receiving four weeks of electronic campaign material, of the 116 participants that completed the posttest, 54 (55/100, 55.0%) were in the campaign and 62 (63/100, 63.0%) in the control group. The participants' flow of this study is shown in Figure 3.

Figure 3. Flow chart of the study.
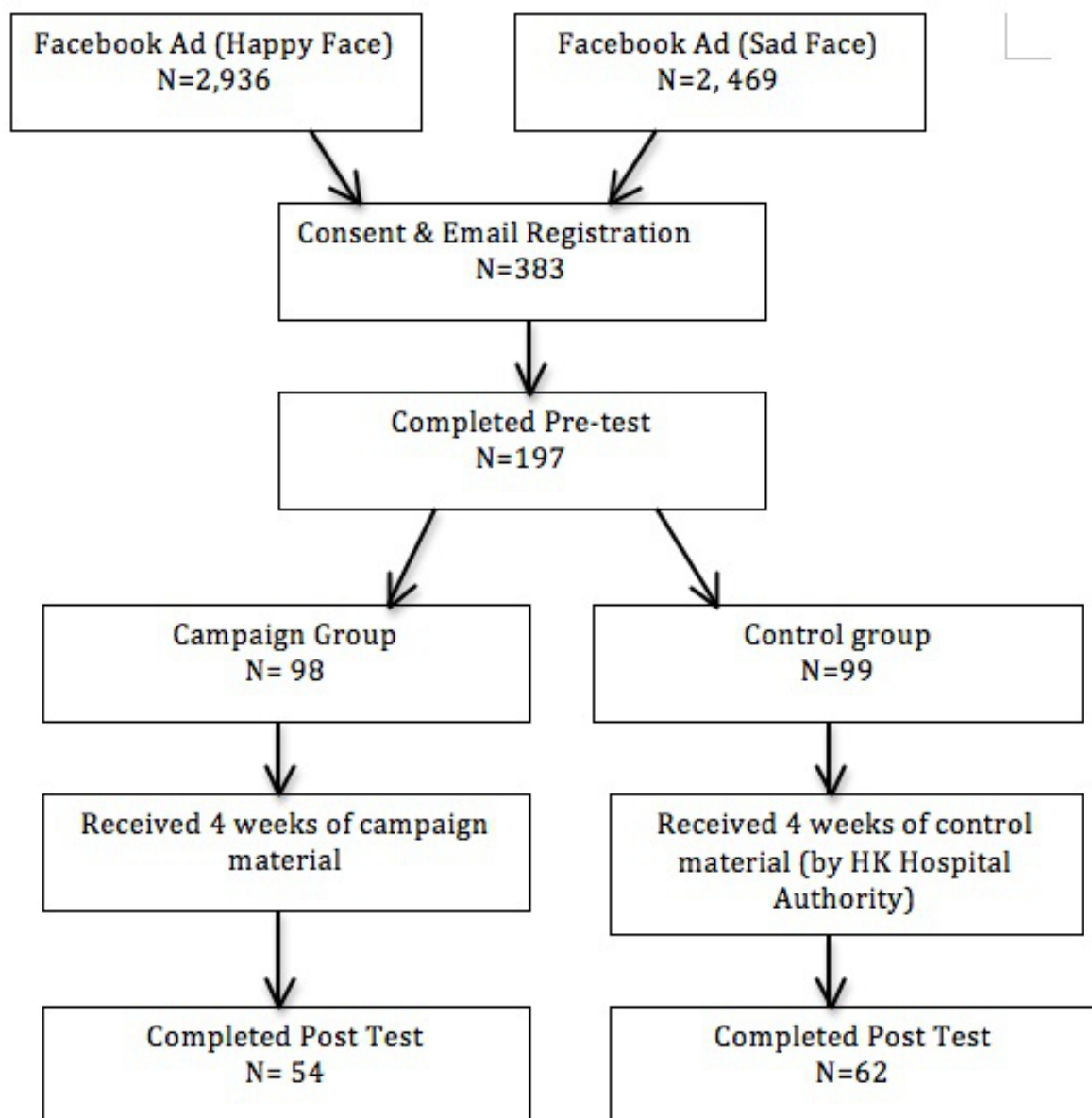
No significant difference in demographic characteristics was found between the two groups (Table 1).

Participants were mainly young adults, 18-29 years old, who represent the most frequent Internet and social media users.

Over 50% of them had attained the secondary school education level. Also, about 30% of the participants reported that they had received a diagnosis of depression before. More than 70% of the participants reported suffering from mild to extremely severe depressive symptoms.

Table 1. Demographic characteristics of participants of the campaign and control groups.

Demographic characteristics		Campaign (N=55) n (%)	Control (N=62) n (%)	Difference (%)	*P* values
Gender					0.13
	Male	23 (43)	17 (27)	16	
	Female	31 (57)	45 (73)	-16	
Age					0.84
	18-29	24 (44)	22 (35)	9	
	30-39	6 (11)	8 (13)	-2	
	40-49	10 (19)	11 (18)	1	
	50-59	12 (22)	19 (31)	-9	
	60 or above	2 (4)	2 (3)	1	
Education level					0.35
	Primary school	0 (0)	4 (6)	-6	
	Secondary school	30 (56)	32 (52)	4	
	Undergraduate	19 (35)	21 (34)	1	
	Postgraduate	5 (9)	5 (8)	1	
Ever been diagnosed with depression?					0.26
	Yes	13 (24)	22 (35)	-11	
	No	41 (76)	40 (65)	11	
Ever sought professional help?					0.70
	Yes	25 (46)	32 (52)	-6	
	No	29 (54)	30 (48)	6	
Friends or family members who had a diagnosis of having depression?					0.88
	Yes	33 (61)	36 (58)	3	
	No	21 (39)	26 (42)	-3	
Depression anxiety stress scale (DASS) level					0.36
	Normal	13 (24)	15 (24)	0	
	Mild	3 (6)	6 (10)	-4	
	Moderate	12 (22)	16 (26)	-4	
	Severe	10 (19)	4 (6)	13	
	Extremely severe	16 (30)	21 (34)	-4	

While comparing the click-through rate to the optional further readings between groups, 69 participants from the campaign group (70%, 70/100) clicked through at least once during the four weeks, whereas only 40 participants from the control group (40%, 40/100) clicked through, suggesting that the participants in the campaign group were more willing to read further information than those of the control group (χ^2_1=16.7, *P*<.001).

The primary and secondary outcome measures in the help-seeking model are presented in Table 2. The analysis showed that changes in all primary outcomes including attitude, subjective norm, perceived behavioral control, and intention for help-seeking of depression, which were adapted from the core variables of the TPB, were found to be statistically insignificant. However, significant changes were found in mental health literacy between the two groups. In other words, the campaign group participants were more likely to recognize that the character portrayed in the vignette was experiencing depression than did respondents in the control group. In the campaign group, the percentage of participants who were able to recognize depressive symptoms in the vignette increased from 40%-68%, whereas a decrease was found in the control group from 59.7%-53 % (χ^2_1=4.5, *P*=.034).

Table 2. Posttest scores of the primary and secondary outcome measures of the help-seeking models in the campaign and control groups.

Outcome measure		Campaign (N=54)	Control (N=62)
		Mean (SD)	Mean (SD)
Primary			
	Attitude	[a]2.05 (0.46)	2.07 (0.55)
	Subjective norm	2.84 (1.46)	2.56 (1.61)
	Perceived behavioral control	2.49 (1.31)	2.29 (1.33)
	Intention	3.01 (1.48)	2.73 (1.58)
Secondary			
	Perceived barrier	4.35 (1.48)	4.26 (1.69)
	Attitude toward treatment	2.58 (1.11)	2.47 (1.21)
	Action and view toward family and friends with depression	3.40 (1.10)	2.73 (1.58)

[a]1 is the highest likelihood to seek help, and 7 is the lowest

We also tested which picture, happy- or sad-looking, received more clicks to join the campaign. The advertisement with the happy face gained 2936 clicks with 12,591,361 impressions, representing a 0.023% (0.023/100) click-through rate into the advertisement and HK $3.05 (US $0.39) per click. The sad face advertisement gained 2469 clicks out of 13,412,509 impressions, amounting to a 0.018% (0.018/100) click-through rate and HK $3.62 (US $0.46) per click. The total spending of the happy and sad face advertisements was HK $8,942.89 (US $1,146.50) and HK $8,944.98 (US $1,146.80), respectively. The click-through rate of the happy face picture was statistically significantly higher than the one of the sad face ($\chi^2_1 = 75.1$, $P<.001$). Among those completing the pretest, no significant difference in demographics was found between those who clicked into the two advertisements. However, there were significantly more pretest completers who had a diagnosis of depression among those who clicked into the happy face advertisement than those who clicked into the sad face (chi-square test with Yates' continuity correction, $P=.03$).

Discussion

Principal Findings

This study demonstrated the possibility of delivering an online mental health campaign that promotes help-seeking for depression. Although no significant change was detected in the primary outcomes of the campaign, which were designed to closely following the TPB, the increase of mental health literacy in the intervention group provides supportive evidence in the educational value of such campaigns. The result is consistent with a similar campaign evaluation study that found that social media campaigns can improve mental health literacy but have limited impact on attitudinal outcomes [40]. Previous research has also supported the effectiveness of improving mental health literacy in public campaigns as it could help encourage early identification and intervention for mental disorders [41,42].

It is important to note that our campaign was particularity attractive to individuals with mild to severe depressive symptoms, irrespective of who were or were not receiving treatment. We found that 30% (30/100) of the participants had

a diagnosis of depression, and more than 70% of participants reported that they were mildly or severely depressed. This might reflect that participants who were suffering from depressive episodes were particularly attracted to the depression-related advertisement on Facebook and campaign material. Since nearly half of the participants have sought professional help for their depressive episodes, their help-seeking intention might have been shaped by their own personal illnesses and treatment experiences. This may partly explain the non-significant changes in the primary outcomes of the help-seeking intention but rather significant improvement in media literacy [43,44]. Hence, we argue that the insignificance of some of the results of this study cannot reject the importance of this theory-based campaign and the usefulness of theories like TPB, but further research is needed. Indeed, some participants left messages at the end of the campaign noting that they had experienced or were experiencing depression and hoped that their participation in the study would be helpful for research on depression and help-seeking.

Another interesting finding concerns the different responses by those receiving the two pictures in the Facebook advertisement. The Facebook advertisement with a happy face picture gained more clicks than did the one with a sad face. According to our analysis, no significant difference in demographics was found between those who had clicked through the two advertisements. However, we found more people who had a diagnosis of depression among those who clicked into the happy face advertisement than those who clicked into the sad face, which runs contrary to previous laboratory findings of depressive patient's differential attention to emotional pattern [22,23]. This finding has practical implications for informing campaign developers in that they should pay attention to content design and use appropriate material for the campaign, especially when the campaign is customized for those people with a history of mental health problems.

Facebook is increasingly being used for participant recruitment for research, especially targeting specific groups like adolescents, groups with specific health needs, patients, and caregivers [26,45]. Psychological research has also started to move online to explore more potential benefits of online research

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including lowering the cost of collecting data [3,25,45], conducting large scale observational [46], and experimental studies [47]. Research finds that Facebook is also very helpful in accessing the hard-to-reach populations due to its massive number of users worldwide and by recruiting participants through snowball sampling [48]. As our study topic , mental illness, is a socially stigmatized subject, we can specifically choose the target audience we want our advertisements to reach (ie, Chinese-speaking Hong Kong adult residents). It is also convenient for the participant to be recruited, and participate in the online campaign and surveys at their convenience and in their own space, as long as they have access to the Internet via phone or computer [45,49]. Since an individual's online presence can be impersonal, research has found that it is sometimes easier for sensitive topics to be researched and communicated through the Internet as participants can remain anonymous when accessing the health information resources or participating in the campaigns [25,45,50]. Recent research has found that Facebook is a favorable health resource platform for groups with specific health needs to communicate, share information on the health problem and treatment experiences, provide emotional support, and communicate with medical workers [45,50]. Moreover, there is a lot of potential for analyzing Facebook or other social media platforms for big data health research [51].

Limitations

The following are limitations worth noting. The recruited subjects may be biased toward certain characteristics (ie, relatively more female respondents and depressed patients). The dropout rate of the campaign can be considered high, which is not uncommon in online subject recruitment. The results might not represent those who dropped out from the email registration and the pretest. Due to the complications of reading campaign material and receiving pretest and posttest data through email, the dropout rate was higher than expected, but duplicated and fake responses were minimized since each registration and all email content was accomplished by a unique link and email message, which can ensure good data quality.

The loss of samples resulted in lower statistical power and might partly account for some of the non-significant statistical tests. In an online setting, there is no simple way to ensure that the subject has read and fully comprehended the material. But this factor should not alter the final results because both intervention and control groups should have the same impact, if any. Although it is acknowledged that help-seeking intentions may not directly lead to actual help-seeking behavior, effective preventive measures are essential in response to the prevalent reluctance regarding help-seeking for depression [52].

With the small sample size of our study, the conclusions may not be optimally representative to the public's view of help-seeking and depression. However, using a theory-driven and culturally-specific campaign design strategy is recommended because it enables systematic understanding of public knowledge and allows room for the development of audience-oriented material. Although the change in help-seeking intentions was not significant in the current study, future studies can build upon our findings to replicate the study, revise the model, or carry out tests with a larger and more representative sample size.

Conclusions

Under the backdrop that clinical depression is projected to become a major global disease burden in the future, encouraging help-seeking for depression should be an essential aspect for health service development. Online media can help reach large numbers of participants and get help-seeking messages across to a population. In this study, an online media campaign, with the support of a theory-driven approach and customized campaign material, was used as an innovative and practical platform for a mental health campaign to encourage help-seeking for depression and to increase the individual's media literacy. Further research is needed to confirm the results.

Acknowledgments

Conflicts of Interest

None declared.

Multimedia Appendix 1

Full set of online questionnaires.

[PDF File (Adobe PDF File), 39KB - mental_v2i1e5_app1.pdf]

Multimedia Appendix 2

Campaign Material (Originally in Chinese).

[PDF File (Adobe PDF File), 8KB - mental_v2i1e5_app2.pdf]

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Abbreviations

DASS: depression anxiety stress scale
IP: Internet Protocol
TPB: theory of planned behavior

<u>Original Paper</u>

Utilizing a Personal Smartphone Custom App to Assess the Patient Health Questionnaire-9 (PHQ-9) Depressive Symptoms in Patients With Major Depressive Disorder

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Abstract

Background: Accurate reporting of patient symptoms is critical for diagnosis and therapeutic monitoring in psychiatry. Smartphones offer an accessible, low-cost means to collect patient symptoms in real time and aid in care.

Objective: To investigate adherence among psychiatric outpatients diagnosed with major depressive disorder in utilizing their personal smartphones to run a custom app to monitor Patient Health Questionnaire-9 (PHQ-9) depression symptoms, as well as to examine the correlation of these scores to traditionally administered (paper-and-pencil) PHQ-9 scores.

Methods: A total of 13 patients with major depressive disorder, referred by their clinicians, received standard outpatient treatment and, in addition, utilized their personal smartphones to run the study app to monitor their symptoms. Subjects downloaded and used the Mindful Moods app on their personal smartphone to complete up to three survey sessions per day, during which a randomized subset of PHQ-9 symptoms of major depressive disorder were assessed on a Likert scale. The study lasted 29 or 30 days without additional follow-up. Outcome measures included adherence, measured by the percentage of completed survey sessions, and estimates of daily PHQ-9 scores collected from the smartphone app, as well as from the traditionally administered PHQ-9.

Results: Overall adherence was 77.78% (903/1161) and varied with time of day. PHQ-9 estimates collected from the app strongly correlated (r=.84) with traditionally administered PHQ-9 scores, but app-collected scores were 3.02 (SD 2.25) points higher on average. More subjects reported suicidal ideation using the app than they did on the traditionally administered PHQ-9.

Conclusions: Patients with major depressive disorder are able to utilize an app on their personal smartphones to self-assess their symptoms of major depressive disorder with high levels of adherence. These app-collected results correlate with the traditionally administered PHQ-9. Scores recorded from the app may potentially be more sensitive and better able to capture suicidality than the traditional PHQ-9.

KEYWORDS

Introduction

Depression is a highly prevalent illness, both in the United States and worldwide, with a tremendous psychiatric, medical, and economic burden [1].Recently, there has been increased appreciation of the dynamic nature of depression, with several studies suggesting the clinical importance of temporal fluctuations of symptoms, including suicidal ideation [2,3]. However, the majority of clinical assessment tools for depressive symptoms are administered at fixed time points and subject to retrospective recall. Customized smartphone apps are a novel, low-cost means of conducting ecological momentary assessment to capture the temporal dynamics of depression.

The Patient Health Questionnaire-9 (PHQ-9) is a validated depression rating scale frequently utilized both in primary care [4] and psychiatry clinics. It assesses symptoms of depression over the preceding 2 weeks and is used for screening, diagnosing, and monitoring [5]. Numerous studies have demonstrated its utility in influencing clinical decision making [6,7], and meta-analyses have concluded that it has good diagnostic properties compared to longer screening tools [8]. However, like many scales, it is subject to patient retrospective recall, which may be especially biased in psychiatric illnesses [9].

Ecological momentary assessment (EMA) strives to complement static rating scales by offering *real-time* and *real-world* measurements of symptoms. In the past, this has often been conducted by asking patients to maintain paper-and-pencil mood logs. However, the labor-intensive and intrusive nature of paper-and-pencil EMA has limited its clinical applicability [10] and underscores the concern that data can be backfilled by patients [11]. Smartphones offer a potential solution by enabling EMA through apps designed to prompt, collect, time-stamp, and securely transfer patient data. EMA studies have been, and often still are, conducted on other devices such as Palm Pilots. Moving forward, we believe that conducting studies on smartphones is important because smartphone use may reduce bias in the form of the Hawthorne effect. This may occur if patients use their own devices, if devices are increasingly owned and used by mental health patients [12], and if the devices are both clinically applicable and scalable with today's technology.

Although recent studies have demonstrated interest and ability of psychiatric patients to use smartphone apps for monitoring their mental health, there is currently no data on patients' use of personal smartphones for depression EMA. In the general population, nearly 58% of US adults owned a smartphone in January 2014 [13] and this rate is expected to continue to increase. Recent evidence suggests that in patients with severe and persistent mental illness, personal smartphone ownership may be substantial [14]. In outpatient clinics, the percentage of patients with smartphones may even exceed the national average [15]. Feasibility and interest in utilizing smartphone apps to monitor mental illness has already been demonstrated in nearly all major diagnostic categories of psychiatric illness [16]. The proliferation of nearly 40,000 health apps in the iTunes and Android app stores suggests a strong interest among patients [17].

Patient adherence and patterns of daily use of smartphone apps by psychiatric patients is largely unknown. Efforts to assess rates of survey adherence include one depression study reporting that 68% of patients completed 75% of surveys [18]. A recent review of psychiatry-related mobile apps reported generally high adherence rates, notably higher than similar Internet-based interventions [16]. There is even less data on the daily patterns of use for these apps. One study of adolescents using a cognitive behavioral therapy (CBT) app to treat anxiety noted that the number of completed entries initially decreased during the first 3 weeks but then appeared to stabilize and remain fairly constant after week 4 [19].

Despite the ability of smartphone apps to now capture data in real time, there is still little known about how the symptoms of depression may vary in real time. Of particular interest is the potential of smartphone apps to be able to detect suicidal thoughts and offer new tools to better assess and understand suicidality.

While there is a burgeoning literature on smartphone apps and psychiatric illnesses, nearly all of these studies involve apps that are not available or accessible to all patients using the Android platform Google Play and Apple platform app stores. This may introduce unintended selection bias into studies. As noted in a recent study, patients refused to participate if the app was not able to run on their phone [20]. Although many studies of smartphone apps provide subjects with smartphones for the duration of the study, there is early evidence to suggest that patients may use their personal phone in a different manner than a loaned study phone [21].

We developed an iOS and Android smartphone app that assessed, three times a day, a randomized subset of three questions from the PHQ-9 questionnaire, including suicidality (see Methods for details). We chose to have the questions sampled from the PHQ-9 due to its broad applicability and demonstrated validity across numerous technologies, including touch screen computers [22], telephones [23], interactive voice technologies [24], and smartphones [25].

We hypothesized that psychiatric outpatients would be able to download the app to their personal smartphone and use it for 30 days. We further hypothesized that the smartphone-based EMA implementation would increase ease and convenience of data collection, as well as enable us to capture day-to-day variability in depressive symptoms and accurately represent intraindividual symptoms and their variation.

Methods

Design of Study and Smartphone App

Subjects were recruited from the outpatient psychiatry clinics at Beth Israel Deaconess Medical Center and the Massachusetts Mental Health Center, both located in Boston, Massachusetts. Inclusion criteria were a current diagnosis of major depressive disorder, current involvement in psychiatric treatment, and ownership of an iPhone or Android smartphone with the capacity to download and run the study app (ie, the subject was able to log in to the relevant app store, install the app on their own phone, and run the app). Further inclusion criteria were the

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agreement of the patient's current mental health care provider that participation would not be harmful, and that they would review data collected from the app with the patient at the conclusion of the study. Exclusion criteria included patient refusal to participate or the psychiatric clinician's concern that the subject was not appropriate for this study. The study duration was 29 or 30 days, depending on patient availability for a follow-up visit. On each day the subjects were asked to complete three short surveys delivered by the customized smartphone app. Subjects were notified that their responses on the app would not be monitored and would only be shared and reviewed when they met with their mental health providers after 29 or 30 days. In addition, each subject was asked to take the standard, paper-based PHQ-9 survey both at the beginning and at the end of the study period. The study protocol was approved by the Institutional Review Board (IRB) of Beth Israel Deaconess Medical Center and the Massachusetts Department of Mental Health. All participants signed an informed consent form.

Subjects were directed to download the app, Mindful Moods, onto their personal smartphone from either the Apple iTunes or Android Google Play store. The app alerted subjects that a survey was available three times per day at the following times: mornings between 10 AM and noon, afternoons between 1 PM and 3 PM, and evenings between 5 PM and 7 PM. Once alerted, subjects had a 2-hour time window to respond to the survey, after which time the survey was closed. In each survey session, subjects were asked to respond to three questions from the PHQ-9 questionnaire sampled without replacement and using a Likert scale (see Figure 1). Each survey session drew an independent sample of three questions from the PHQ-9 questionnaire, such that some questions were likely asked more than once and others not at all on a given day. Subjects were asked to reply to each question based on their experiences during the last day or 24-hour period. In order to increase patient engagement, assess response validity, and avoid survey fatigue, questions incorporated slight variations in wording, for example, if the subjects *were* feeling depressed or *were not* feeling depressed during different instances of the survey.

Subjects using the app had regular contact with their psychiatric clinicians, although neither they nor their clinicians had access to the patient mood data until the conclusion of the study. Although subjects were provided with contact information regarding questions about the app, no subject took advantage of such information. Subjects were compensated US $50 for completing at least 70% of survey sessions offered by the app.

Figure 1. Screenshot of the Mindful Moods app. The app consisted only of a log-in screen and this survey screen on which randomized PHQ-9 questions were assessed at each survey session, three times a day.
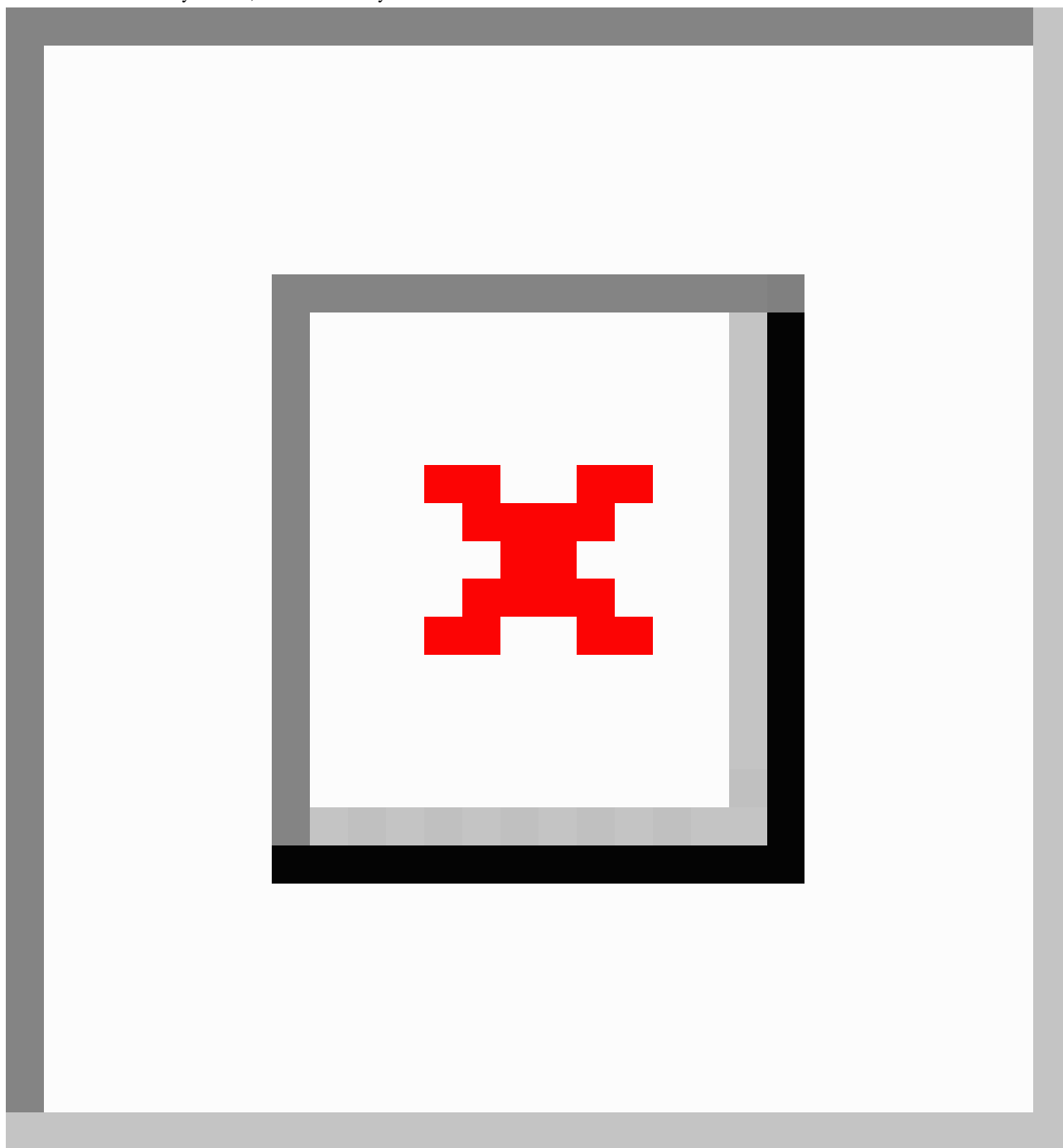
Statistical Estimation of Daily Patient Health Questionnaire-9 Scores

The PHQ-9 is usually administered on paper in a clinical setting, where patients are required to answer every question item. In this design, patients using the app might miss some questions over time. The app itself also incorporates randomness in the questions presented to increase response rates and potentially allow the estimation of additional survey features, such as within-day correlations between questions. These considerations invite novel estimation procedures for PHQ-9 scores.

A simple estimate of a patient's PHQ-9 score is the sum of their daily responses, possibly weighted to adjust for data

missingness. This naïve approach may be problematic as patients respond differently to various PHQ-9 questions, which are asked and/or answered at different rates, introducing bias. We, therefore, proposed a simple estimation strategy that incorporated question sampling and missingness by using information from the subject's recent responses. The development of a more sophisticated statistical approach is part of our ongoing work.

We began by predicting the response of each question per day, which we estimated as the average response to that question over the last 2 weeks. Thus, before using any information from a given day itself, we obtained a prediction for the PHQ-9 score of a subject as the sum of predicted question responses. We

then estimated a patient's daily PHQ-9 score as this prediction *plus* the sum of differences between the predictions and the actual responses obtained throughout the day. This estimate had the desirable property of recovering the standard PHQ-9 score in the case that each PHQ-9 item happened to be asked and answered in a given day. Deviations from this standard yielded an estimate that borrowed information from past responses.

This method also admitted a natural estimate for the daily variance in PHQ-9 scores. For a given day, the variation in each question was estimated as the empirical variation in that question's responses over the last 2 weeks. The variation in a daily PHQ-9 score was thereby estimated as the sum of the variances of the responses obtained for that day. From this estimate we were able to find confidence intervals for the predicted PHQ-9 score, yielding a statistical method for detecting if a daily score was significantly higher or lower than that predicted from previous variation. A more detailed description is given in Multimedia Appendix 1.

Results

Out of a total of 14 patients who were offered the opportunity to participate, 13 (93%) enrolled in the study. The 13 subjects consisted of 3 males (23%) and 10 females (77%), with mean ages of 48 (SD 16) and 35 (SD 13), respectively. These 13 subjects took the initial in-office, paper-and-pencil PHQ-9 before downloading the app and their average PHQ-9 score was 8.62 (SD 4.56). We did not collect any data on the cognitive status and treatment course of any individual patient—all patients were currently diagnosed with, and in treatment for, major depressive disorder as confirmed by their mental health care providers.

We began with an assessment of the patient cohort adherence to the study protocol. Of the 13 subjects, 10 (77%) used the app for 30 days and 3 (23%) used the app for 29 days. Subjects were expected to respond to three short surveys per day, resulting in a total of 90 surveys per subject. A total of 903 of the 1161 short surveys administered to the cohort were completed, yielding an overall adherence of 77.78%. Adherence differed slightly with time of survey administration. The percentages of surveys completed were 75.5% (292/387) in the morning, 84.2% (326/387) in the afternoon, and 75.5% (292/387) in the evening. Analysis of variance showed a statistically significant difference in these adherence rates. Adherence remained strong throughout the study. As shown in Figure 2, adherence appeared to increase

after a few days, decrease, and ultimately stabilize after about 2 weeks.

A more detailed summary of adherence by patient, survey time, and day is shown in Figure 3. Although there is some variability in adherence across subjects, all subjects display surprisingly high adherence to the study protocol. The figure also suggests that there might be some subject-specific response patterns. For example, the pattern of missing surveys seems to vary from person to person—Subject 4 appears to be more likely to miss morning surveys than evening surveys, whereas Subject 8 is the opposite, appearing more likely to miss evening than morning surveys. In the figure, gray cells represent lack of data for patients who completed the study in 29 days—adherence was not calculated for these time points.

As detailed in the Methods, the smartphone app presented the subjects with a sample of three PHQ-9 questions three times per day, where each sample was drawn with replacement from the nine questions of the PHQ-9 questionnaire. This approach was chosen to minimize subject fatigue by introducing variation in the questions asked. As a consequence of the study design, it was unlikely that each of the PHQ-9 questions would actually be asked on any given day, making it hard to reconstruct the PHQ-9 score from observed daily data alone. We reconstructed the PHQ-9 score using the statistical estimation approach described in the Methods. Figure 4 displays the daily PHQ-9 score prediction, confidence interval, and proposed estimate for Subject 1. Also indicated in the plot days is when the subject reported significant suicidal ideation, defined here as scoring 2 or 3 on Question 9 on suicidality.

A composite of information across patients is displayed in Figure 5, summarizing the PHQ-9 scores over time for each subject by plotting their score predictions. This plot illustrates the dynamic nature of PHQ-9 depression symptoms that can be captured with an app run on a subject's personal smartphone.

Each patient also took a standard, paper-based PHQ-9. Those scores, taken at the beginning and end of the study, are also shown in Figure 4 (green squares). Returning to Subject 1, we see that the paper scores were lower than the app scores. This is generally true of patients in our study. Average paper and app scores for each subject are presented in Figure 6.

We found that the app scores were on average 3.02 (SD 2.25) points higher than paper scores. The two scores were fairly strongly correlated, yielding a Pearson correlation coefficient of .84 (95% CI .55-.95).

Figure 2. Average adherence to surveys delivered by the customized smartphone app over time (days). Responses were pooled from the three daily surveys: morning, afternoon, and evening. The gray band represents a 95% prediction interval.
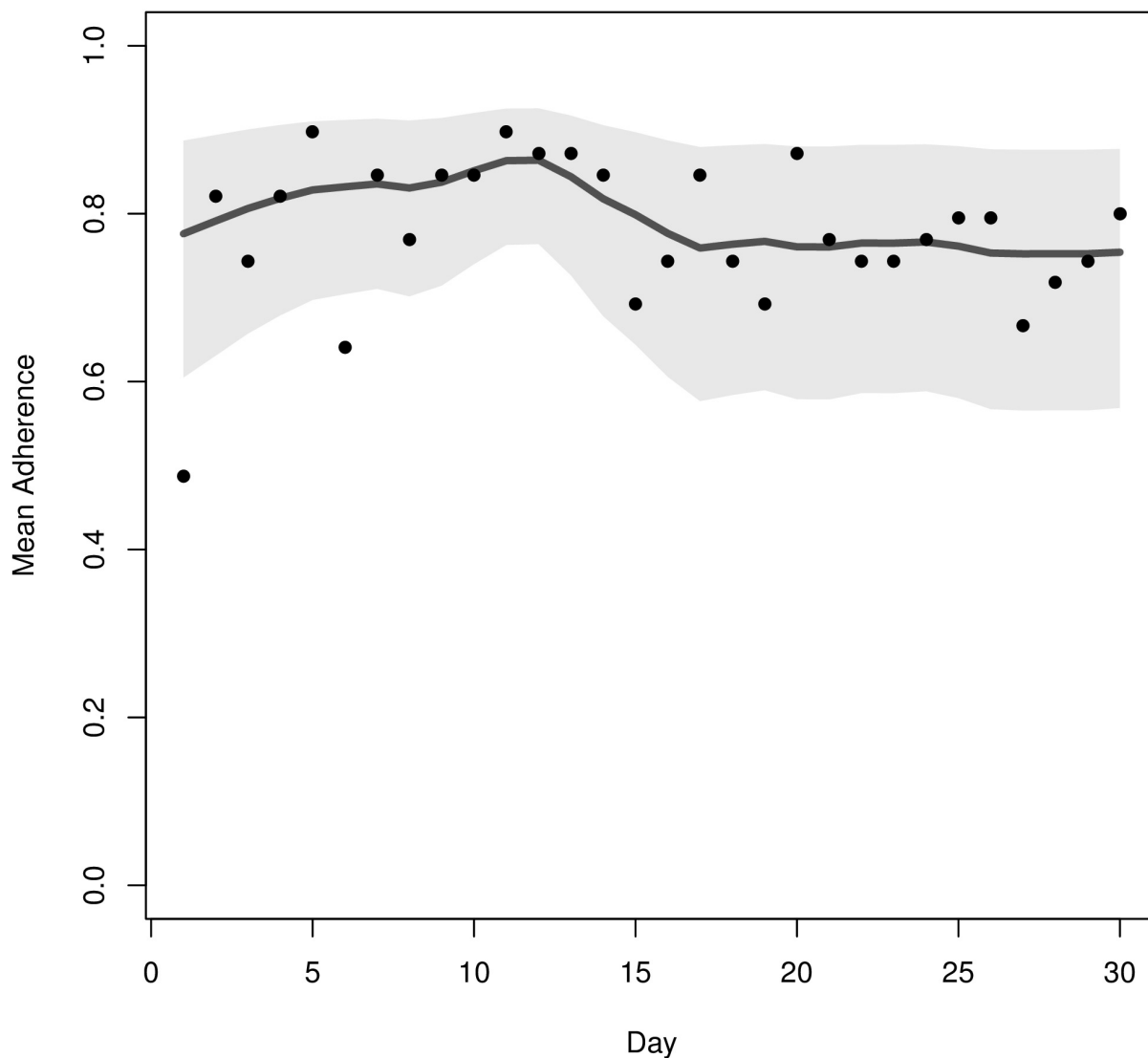
Figure 3. Adherence by patient, survey time, and day. Within patient rows, survey times are presented in columns of three, ordered as morning, afternoon, and evening from top to bottom, respectively.
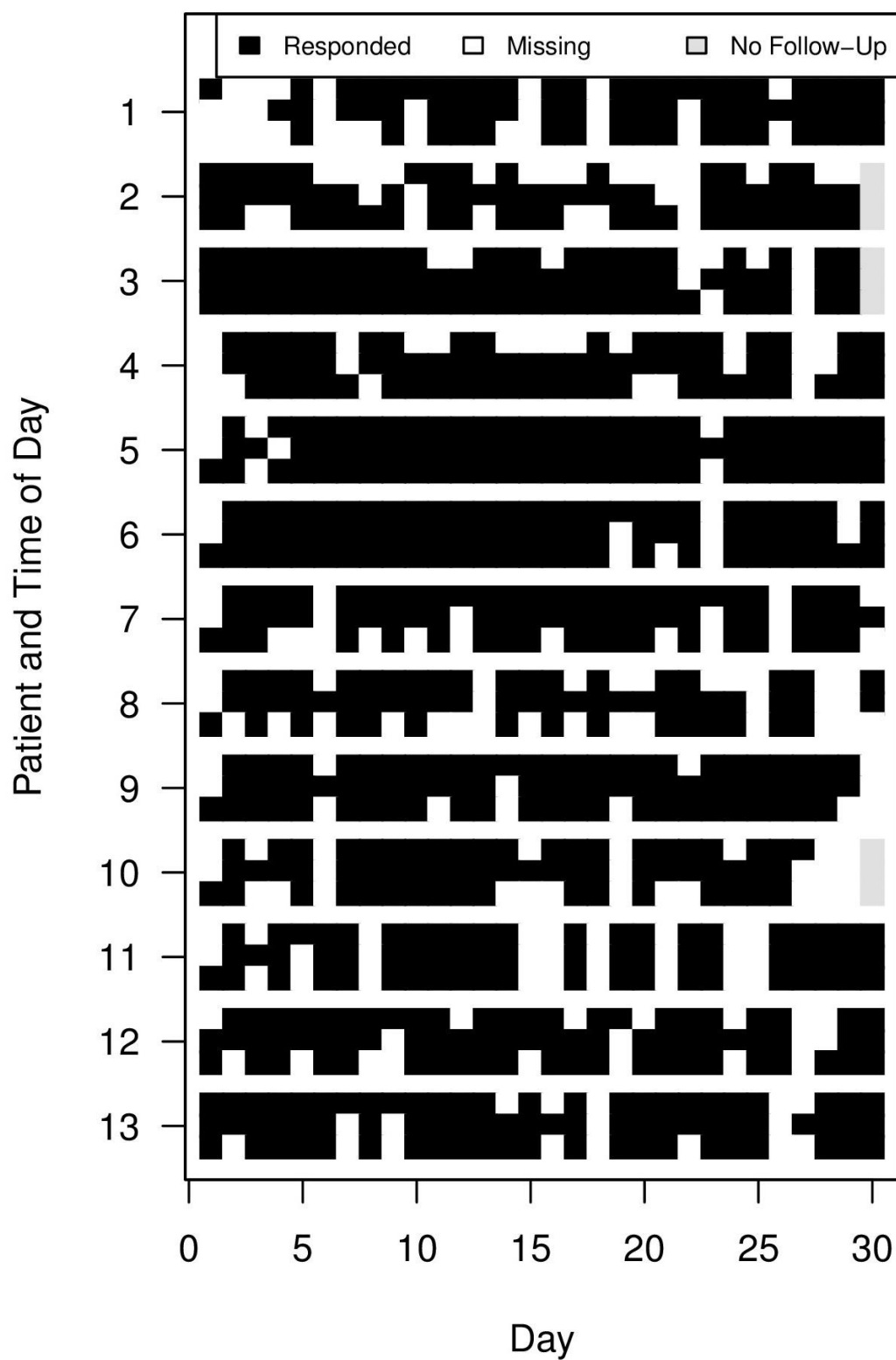
Figure 4. PHQ-9 estimates, reported suicidal thoughts, predictions, confidence intervals, naïve scores, and paper scores for Subject 1. Significant suicidal thoughts (Likert score >1) are shown as red diamonds. The green squares correspond to paper-based PHQ-9 scores. A horizontal line is included after the first 2 weeks.
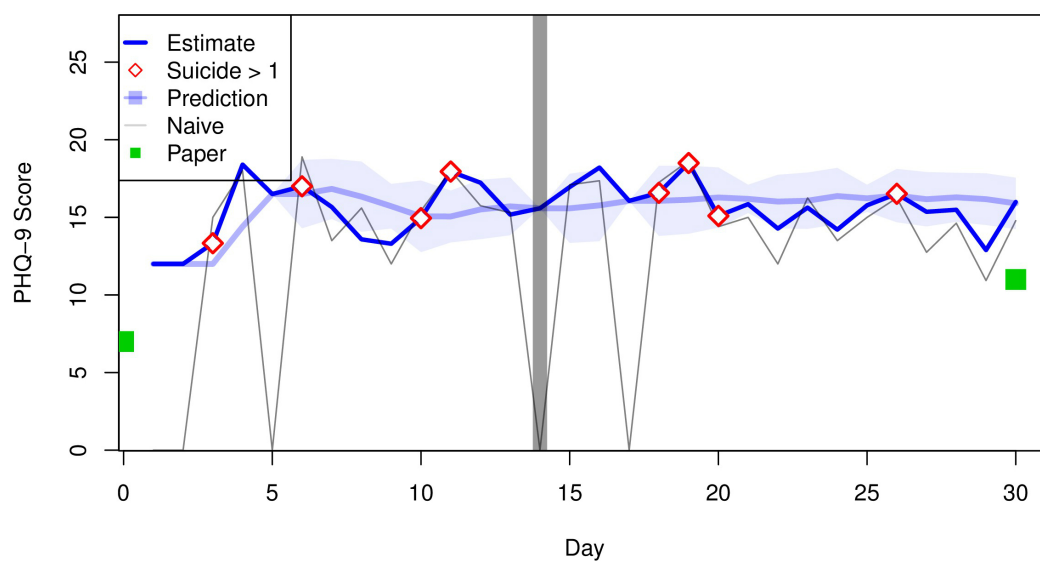
Figure 5. A composite plot of daily PHQ-9 score predictions. As weighted averages of recent scores, these predictions are much smoother than the estimates themselves.
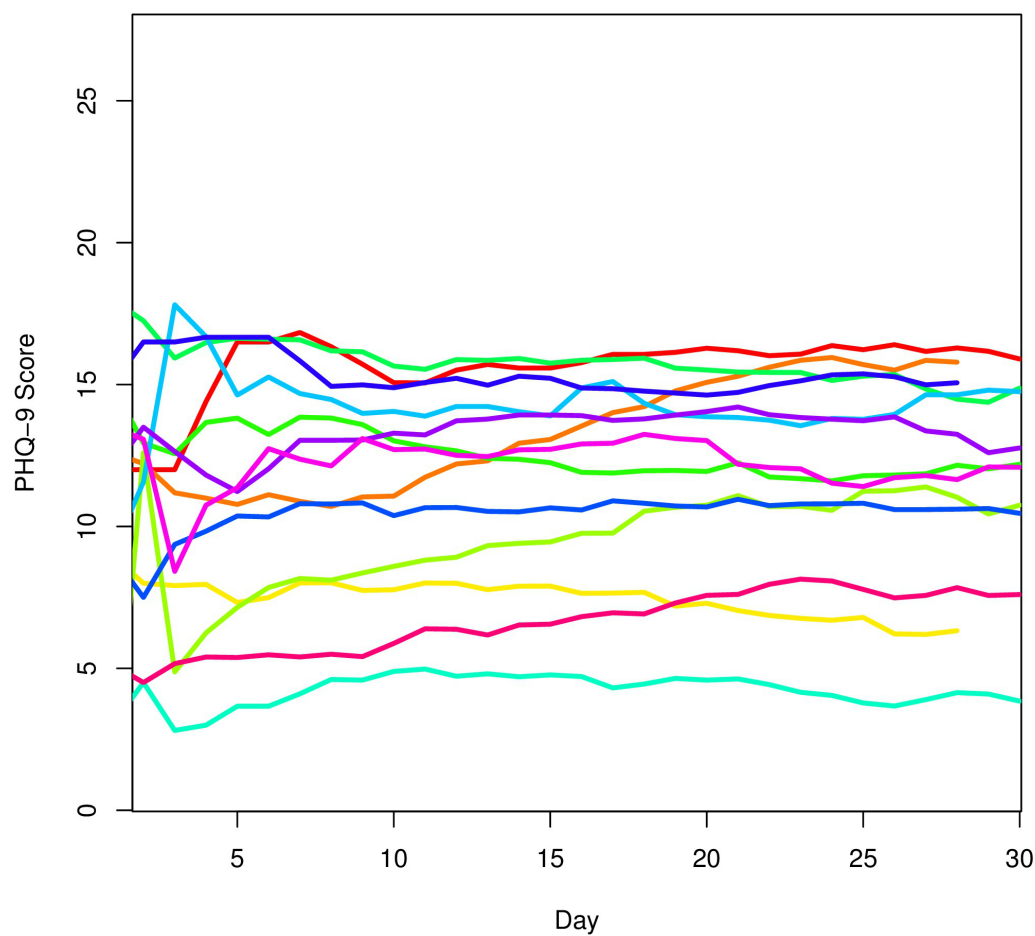
Figure 6. A plot of average paper and app PHQ-9 scores by patient (Pearson correlation coefficient, r=.84). Identical scores would lie on the added line.
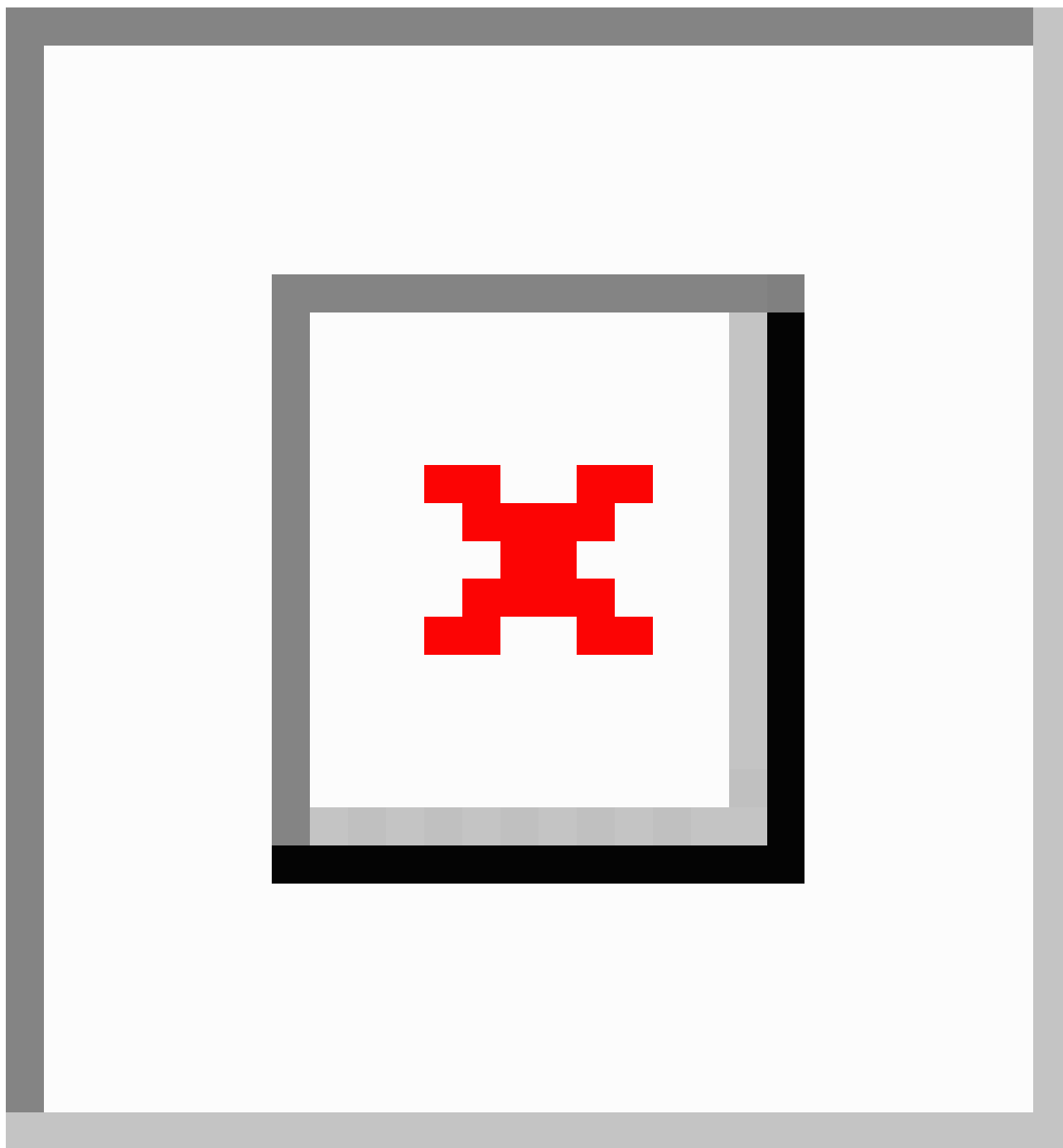
Discussion

Principal Findings

Our results suggest that it is feasible to monitor depressive symptoms in an outpatient setting utilizing a smartphone app running on a patient's own phone. While prior studies have demonstrated similar results comparing paper and app PHQ-9 scores within a 2-hour time frame [26], our study employed three daily survey sessions in a 30-day period for a total of 90 survey sessions per subject. Other studies using apps to assess depressive symptoms have employed rating scales that included either single-point measurements with no follow-up [27,28], combined assessment with personalized feedback [25], or

enhanced treatment [18,29]. These study designs have rendered it more difficult to understand the nature of depressive symptoms over an extended period of time independent of the study intervention.

While both the paper and app scores were strongly related, average PHQ-9 scores reported from the app were consistently higher. These results suggest that subjects with major depressive disorder may report a higher severity of symptoms with smartphones than to clinical providers. Potential explanations for this include the impact of retrospective recollection, patient desire to avoid embarrassment or disappointing their providers, or fear that reporting a higher burden of symptoms may lead to unwanted treatment changes or forced hospitalization. While

our present data cannot address these hypotheses, we note that while no patient reported suicidality at a level of 2 or 3 on the paper-based PHQ-9, a total of 9 of the 13 subjects (69%) reported suicidal ideation on the app at these levels. The ability of the app to capture the presence of suicidal thoughts is an important result, suggesting that electronic monitoring may offer providers a more accurate method to record and understand suicidal ideation, as well as provide a means to prompt patients to call 911 if they report elevated suicidal scores. This ability of smartphones and related technologies to offer the mental health field a new tool in the detection, and in the potential prevention, of suicide is an important area for future study and development.

Our results provide novel information regarding psychiatric patients' adherence with smartphone apps. The stability of the adherence rates over time suggests that patients are able to use smartphone apps for symptom collection over extended periods of time of at least 1 month. This corroborates the results of another study, in which adherence rates stabilized for the use a smartphone app to assess anxiety disorder [19]. Our data affords the opportunity to study adherence throughout the day. Adherence was shown to be higher in the afternoon compared to mornings and evenings, which indicates that afternoons might be the most opportune time to gather these kinds of data.

We did not provide novel monitoring devices or phones to patients, but rather utilized patients' own smartphones. To the best of our knowledge, no prior study has enabled patients to use their personal smartphones, either Apple or Android models, to monitor their psychiatric symptoms. We believe that the high level of survey completion and lack of patient difficulty with the app may, in part, reflect the ease of app use on their personal phone instead of a study device. This suggests that future research efforts could enable patients to utilize their own smartphones, with substantial cost-saving for future research and clinical implementation.

Our results are also important as they underscore the utility of using only within-subject data to provide symptom scores, in this case the PHQ-9 estimates, which negates the need for large numbers of subjects in order to achieve statistical efficiency. As smartphones continue to develop with the addition of more sophisticated sensors, understanding the clinical uses and validating the clinical correlations of such data will likely become increasingly important.

Limitations

There are several limitations to our study. While the sample size of 13 is small, it is comparable to similar and earlier pilot studies on this topic [25]. Patients in this study were not excluded due to comorbidity of additional illnesses. Our adherence rates are similar to other studies on mobile apps for patients with mental illness, however, it must be noted that subjects in this study might have been motivated, at least in part, by the US $50 that was contingent upon completing at least 70% of survey sessions. We also did not collect information on what type of treatment study subjects were receiving. In addition, our study lacked a control group, and it is possible that subject underreporting on the paper-and-pencil PHQ-9 might also have been a function of interacting with a clinician. Another potential confounder is the fact that subjects understood that their responses to the app would not be monitored, while reporting symptoms in the clinic on the paper scale received immediate mental health clinician review and attention.

Conclusions

Our study demonstrates that subjects with a major depressive disorder are able to use a PHQ-9-based self-monitoring app on their personal smartphone, and that these results are correlated with traditional (paper-based) PHQ-9 scores. In addition, data collected through an app may potentially be both more sensitive to the symptoms of a major depressive disorder and better able to detect suicidal ideation. Finally, adherence with app use appears to be high, both throughout the day and over a 4-week time frame. These advantages suggest that digital monitoring of symptoms is feasible and provides an engaging, real-time, and low-cost supplement to the maintenance of mental health.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Additional methods.

[PDF File (Adobe PDF File), 167KB - mental_v2i1e8_app1.pdf]

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Abbreviations

CBT: cognitive behavioral therapy
EMA: ecological momentary assessment
IRB: Institutional Review Board
PHQ-9: Patient Health Questionnaire-9

Original Paper

Client Perceptions of the Mental Health Engagement Network: A Secondary Analysis of an Intervention Using Smartphones and Desktop Devices for Individuals Experiencing Mood or Psychotic Disorders in Canada

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Abstract

Background: The use of innovative technologies in mental health care has the potential to improve system efficiency, enhance quality of care, and increase patient engagement. The Mental Health Engagement Network (MHEN) project developed, delivered, and evaluated an interactive Web-based personal health record, the Lawson SMART Record (LSR), to assist mental health clients in managing their care and connecting with their care providers. This paper presents a secondary analysis of data collected in the MHEN project regarding clients' perceptions of technology and the use of these technologies in their care.

Objective: We aimed to answer six questions: (1) What is the level of comfort with technology within a sample of individuals experiencing mood or psychotic disorders? (2) How easy to use and helpful are the MHEN technologies from the perspective of individuals experiencing a mental illness? (3) Are there differences in how helpful or useful individuals find the smartphone compared to the LSR? (4) Are there specific functions of MHEN technologies (eg, reminders for medications or appointments) that are more valued than others? (5) What are the other ways that individuals are using MHEN technologies in their daily lives? (6) How likely are individuals to be able to retain and maintain their smartphone?

Methods: Mental health clients aged 18-80 (N=400) and diagnosed with a mood or psychotic disorder were provided with a smartphone (iPhone 4S) and participating care providers (n=52) were provided with a tablet (iPad) in order to access and engage with the LSR. A delayed implementation design with mixed methods was used. Survey and interview data were collected over the course of 18 months through semistructured interviews conducted by experienced research assistants every 6 months post-implementation of the intervention. Paired *t* tests were used to determine differences between 6 and 12-month data for perceptions of the MHEN technologies. A paired *t* test was used to examine whether differences existed between perceptions of the smartphone and the LSR at 12 months post-implementation.

Results: Due to dropout or loss of contact, 394 out of 400 individuals completed the study. At the end of the study, 52 devices were lost or unusable. Prior to the intervention, participants reported being comfortable using technology. Perceptions of the MHEN technologies and their functions were generally positive. Positive perceptions of the smartphone increased over time (P=.002), while positive perceptions of the LSR decreased over time (P<.001).

Conclusions: Quantitative and qualitative findings from this analysis demonstrated that these technologies positively impacted the lives of individuals experiencing severe mental illnesses and dispeled some of the myths regarding retention of technology among marginalized populations. This secondary analysis supported the acceptability of using mental health technologies within this population and provided considerations for future development.

Introduction

Background

Health care systems and agencies have increasingly invested in information technology to improve the quality and efficiency of service delivery [1,2]. This trend has extended into mental health care, where the implementation of Electronic Mental Health (e-mental health) has demonstrated positive outcomes [3-5]. The Mental Health Commission of Canada introduced a briefing document outlining the vital role that technology plays in advancing the care of clients within the mental health system [6]. In this document, e-mental health is defined as "mental health services and information delivered or enhanced through the Internet and related technologies" [7]. This broad definition includes the use of diverse technologies such as video conferencing, Web-based interventions, virtual reality platforms, and interventions using mobile devices [6].

The Mental Health Engagement Network (MHEN) used Web and mobile technologies to distribute and evaluate the use of a personal health record (PHR) to assist mental health clients in their care [8-10]. Using a Web-based PHR, an individual can manage and share their health information electronically in a private and secure way. PHRs can be connected to electronic health records (EHRs), which are records of client-related information managed by health care providers. When tethered, EHRs and PHRs create an integrated record of client care that can be used by providers and clients to access information about conditions, medications, test results, and appointments, and to communicate electronically [11]. This paper presents a secondary analysis of data from the MHEN project. The purpose of this secondary analysis is to investigate the perceptions of individuals diagnosed with mental illnesses regarding the use of these technologies in their care.

Literature Review

Research regarding electronic applications for treatment and maintenance of physical health are increasingly common, but the body of e-mental health work is comparatively less developed [12]. Much of the focus of mental health research using information technology is on the efficacy of specific interventions [13]. For example, studies have shown that mobile and Web-based interventions can effectively deliver cognitive behavioral therapy for depression [14], enhance psychosocial functioning in depressed individuals [15], and decrease psychological distress for individuals experiencing anxiety disorders [16]. As this literature demonstrates, using technology to improve mental health service delivery is promising; however, this is based on assumptions that individuals are comfortable and able to use the technology in regular care. If using technology to manage mental health is unappealing or difficult

for clients, the usefulness of these interventions is minimal. Though this literature is growing, research more often focuses on the presence or absence of psychopathology following an intervention, rather than the individuals' experience using the intervention itself.

Some research, however, is beginning to focus on the use of technology in mental health care from the clients' perspective [17-20]. Rotondi et al, for example, examined the features of Web-based interventions that enhance usability for mental health clients, including reducing the need to think abstractly or filter out distracting content [20]. Another study conducted online surveys (N=525) to examine community attitudes toward using mobile phones for management of mental health issues [12]. Survey results demonstrated that a majority of participants (76%) were interested in managing mood, anxiety, or health on their mobile devices. Similarly, individuals in the United States living with severe mental illnesses (ie, mood disorders, schizophrenia, or schizoaffective disorder; N=1568) were surveyed regarding their use of mobile technologies and interest in future services. Again, when asked about whether or not they would be interested in receiving mental health services through mobile technologies, 81% of respondents who owned a mobile device and 62% of respondents who did not, responded positively [21]. These findings suggest that technologies can be created so that they are usable by individuals with mental illness and that e-mental health is generally perceived positively by individuals with mental health issues.

However, even clients who express interest in using technology in health management may have difficulty navigating and performing tasks involving technology; thus, it is important to establish the acceptability and usability of technology in addition to client interest [22]. A study that examined an electronic intervention for individuals with schizophrenia or schizoaffective disorder demonstrated that 90% of participants found the intervention to be acceptable and easy to use [23]. Conversely, studies have shown that certain populations may experience significant difficulties in using technology for health management [24]. The roles of cognitive abilities and age in using a simulated PHR for health management activities (eg, health maintenance and medication management) were examined, and the study found that both middle-aged (40-59 years) and older adults (60-85 years) had substantial difficulty in performing health management tasks electronically. Performance was significantly predicted by level of education, Internet experience, cognitive abilities, numeracy skills, and older age [24]. Still, another study found that while individuals with severe mental illness (SMI) and a co-occurring substance use disorder are less likely to use the Internet, there were no significant differences between those who did and did not access the Internet with respect to literacy skills, typing ability, lack

of knowledge, or fear of technology. The most common barrier to accessing the Internet was cost [25]. While some research provides evidence suggesting clients perceive an online intervention using a mobile device as an effective way to manage mental health issues, further research into the feasibility of using information technology in mental health care is warranted.

Importantly, none of this research, specifically the studies involving mobile phones, was implemented in Canada. The cost of mobile phone services varies widely between countries, with Canada having some of the highest rates when compared to Australia, the United States, the United Kingdom, France, Germany, Italy, and Japan [26]. Due to this international variation in cost, it is possible that client perceptions regarding use of mobile technology in mental health care may also vary widely between countries. Therefore, further research investigating client perceptions of mobile and Internet-based interventions for mental illness should be carried out in diverse national contexts.

Integrating new technologies into usual health care is dependent on further investigation into what works well for clients and what does not. Research shows that individuals experiencing mental illness are interested in using technology in their mental health care [12]; however, barriers to use and facilitators of adoption of technology in care are not well understood [24,25]. PHRs provide an example of a health care technology that receives significant positive attention while remaining separate from routine service provision. Despite the potential benefits of using PHRs, several barriers to adopting this technology into usual care are apparent: active participation of relevant professionals, data security, cost, and most relevant to this paper, client ability to use the technology [2,11,27,28]. It is not yet fully understood how these barriers influence the use of health care technologies by people with varying levels of cognitive ability, severity of illness, and different geographical locations. It is important, then, to investigate the use of innovative technologies in care with individuals experiencing some of the most severe mental health issues (ie, mood and psychotic disorders) in locations where these services are some of the most expensive in the world (ie, Canada). Findings from such research will significantly contribute to the literature regarding the adoption and use of e-mental health technology in community-based mental health care.

The Primary Study

The MHEN project sought to deliver and evaluate the use of online resources and mobile technologies in mental health service delivery using a PHR. The project began in September 2011 and was completed in March 2014 in London, Ontario, Canada, and the surrounding area. It used a client-centered intervention designed by an interdisciplinary group of health care providers, researchers, health information technology experts, and mental health clients. Client participants in the project received a smartphone (iPhone 4S), a TELUS health space account, and a Lawson SMART record (LSR). Smartphones were not only communication devices with calling and texting capabilities but also had Internet functionality through data plans and Wi-Fi access. Participating care providers

received an LSR account and a tablet (iPad). TELUS health space is powered by Microsoft Health Vault and is a platform on which health information can be gathered, stored, and shared. The LSR is a PHR, that is, a Web-based application, which sits on the TELUS health space platform. Information from EHRs was uploaded on a daily basis to the LSR. This information included an active list of medications, family medical history, immunization records, allergies, mental health care professionals' contact information, care plans, and crisis plans. The LSR also allowed individuals to input information and included several tools and functionalities: a mood monitor to track, store, and share moods with their participating health care professional; health journal notes to log subjective thoughts and reminders; prompts and reminders to assist in daily living; the ability to track physiological measures (eg, blood pressure, blood glucose, weight); and secure messaging with their mental health care professional. The intervention as well as its adoption by clients and providers has previously been reported in greater detail [8-10].

The Study

This study is a secondary analysis of data from the MHEN project, which assessed client participants' perceptions regarding use of the MHEN technologies (ie, the smartphone and the LSR). This investigation will elaborate on the little that is known about how individuals experiencing mental illness use health care technology. It is necessary to assess factors that influence client adoption so that the implementation of health care technologies can be feasible. In order to further understand factors affecting the use of technology in mental health care, this study addressed several research questions:

1. What is the level of comfort with technology within a sample of individuals experiencing mood or psychotic disorders?
2. How easy to use and helpful are the MHEN technologies from the perspective of individuals experiencing a mental illness?
3. Are there differences in how helpful or useful individuals find the smartphone compared to the LSR?
4. Are there specific functions of the MHEN technologies (eg, prompts and reminders for medications or appointments, being able to connect with their care provider, ability to share information with other providers) that are more valued than others?
5. What are the other ways these individuals are using the MHEN technologies in their daily lives?
6. How likely are individuals to be able to retain and maintain their phone (eg, lose or break it)?

This is an essential initiative given the current emphasis on developing information technology to enhance health care service delivery and the potential benefits for consumers of using these technologies in regular care [6].

Methods

Design

The current study is a secondary analysis of the information obtained through Demographics and Perception of SMART

Technology questionnaires, both of which were designed by the research team. Data collected through these forms was used to assess a baseline comfort with technology and feelings towards the technologies used in the MHEN project.

The MHEN project was based on a delayed implementation design and employed a mixed methods approach. Community-based individuals from the caseloads of participating mental health care professionals were randomized into two groups: individuals in Group A (early intervention group) received the smart technology intervention first, while those in Group B (delayed intervention group) acted as a control for the first 6 months and thus received the intervention 6 months after Group A. Surveys were used to assess demographics, empowerment, health status, health and social services use, quality of life, and perceptions of SMART technology. Experienced research assistants administered questionnaires every 6 months for a total of 18 months, resulting in four interview points. Interviews occurred in a location of the client's choosing, including the research office, the individual's home, or a community setting such as a coffee shop. Qualitative data were obtained through focus group sessions that occurred throughout the study, in addition to open-ended questions answered during the survey administration. Maximum variation sampling was used to identify potential participants for focus groups.

Individuals in the study received CAN $20 for their participation in each interview and focus group. Participants gave informed consent prior to receiving the intervention and before each interview. Ethics approval was obtained from the university research ethics board in December 2011. See Multimedia Appendix 1 for the CONSORT E-HEALTH checklist [29].

Sample

In total, 400 community-based participants were recruited from the caseloads of 54 mental health care professionals in London, Ontario, and the surrounding area. The health care providers were members of one of four community mental health agencies. Participating care providers asked clients on their caseloads if they would be interested in participating in the study. Interested clients contacted the research team directly to indicate their interest and schedule a time for registration. Eligible clients were between the ages of 18 and 80, had been diagnosed with either a mood or psychotic disorder, and were able to read and understand English. As a result of dropouts and loss of contact with participants, the analysis presented here is based on 394 individuals who completed the study. Group A consisted of 192 individuals, and Group B consisted of 202 individuals.

Measures

Assessment focused on participants' perceptions and self-reports of their experiences using the software, smartphone, and desktop computer interfaces in the context of the project. Usability testing of the devices or software was not conducted.

Baseline level of comfort with technology was assessed through three questions asking how comfortable the participant felt with computers, the smartphone, and technology generally. Responses ranged from 1 (extremely comfortable) to 7 (extremely uncomfortable). As the more extreme categories contained fewer individuals than the more central categories, responses were collapsed into three categories: comfortable, mixed, and uncomfortable.

Participants were asked to think only of their smartphone without their health record and indicate how easy it was to use, how helpful it was, how simple it was to use, and how much independence it afforded. They were then asked to think only of the LSR and indicate the same. Initially, responses were scored from 1 to 7, with 1 representing negative feelings in some cases (ie, extremely hard to use, extremely unhelpful) and positive in other cases (ie, extremely simple to use, gives extremely more independence). For the analysis, these were rescored so 1 represented extremely negative feelings (ie, hard to use, unhelpful, confusing, less independence) and 7 represented extremely positive feelings (ie, easy to use, helpful, simple, more independence).

Individuals were asked to indicate how they felt about each specific feature of the smartphone and health record on a scale from 1 (terrible) to 7 (delighted). These features included having their own PHR, receiving medication prompts, receiving appointment/schedule prompts, connecting with their care provider using the smartphone, connecting with their care provider using the LSR, having access to their personal crisis plan, and being able to share their health information with other health care providers.

Participants were asked specifically whether or not they used the LSR, and whether or not they used the smartphone in order to determine utilization rates. They were also asked to indicate what they used the smartphone for. The list of possible uses included accessing the LSR, contacting their care provider, use of social media (eg, Facebook, Twitter), texting, emailing, playing games, listening to music, watching videos, or other. If they indicated "other", they were asked to give specific details of use. For the current analysis, these details were examined and additional categories created. Each participant could indicate multiple items.

Most items from the Perception of SMART Technology questionnaire were collected at the 6, 12, and 18-month interviews. The exceptions were the questions on feelings about connecting with their care provider through their health record, questions on utilization of the smartphone and LSR, and what participants were using their smartphones for. This information was only collected at the 12 and 18-month interviews.

Analysis

As there were no significant differences between the two intervention groups post-randomization, they were collapsed into one group for purposes of the current analysis. To account for the delayed implementation design, data were analyzed from an intervention time perspective instead of an interview time perspective. To achieve this, data from Group A (early intervention group) remained unchanged while data from Group B (delayed intervention group) were shifted back (Figure 1).

Frequencies and percentages were calculated for all categorical data (eg, sample characteristics, baseline comfort with technology, utilization of the smart technologies), and means and standard deviations were calculated for all scale variables

(eg, feelings towards the technologies in general and the specific features of each).

Paired *t* tests were used to determine differences between 6 and 12-month post-intervention data for perceptions of the smartphone and LSR regarding ease of use, helpfulness, simplicity, and independence they afforded. Perceptions about specific features of the smartphone and LSR were also compared. Additionally, a paired *t* test was used to examine whether differences existed between perceptions of the smartphone and the health record at 12 months post-intervention. Each specific analysis was conducted on a complete case basis,

and all data analyses were done using Statistical Package for Social Sciences (SPSS) 22.0.

Qualitative data from focus groups and open-ended questions were thematically analyzed, and supporting quotations were captured to further understand quantitative results. Focus group discussions were audio recorded and subsequently transcribed verbatim. Transcripts were read by the research assistant and principal investigator, and themes were established using a matrix approach [30]. Analysis was guided by Leininger's approach to qualitative analysis [31]. Discussion of initial themes occurred at team meetings, and transcripts were subsequently re-read in order to further refine themes.

Figure 1. Study design for the MHEN intervention identifying post-intervention and post-implementation time points for each treatment group.
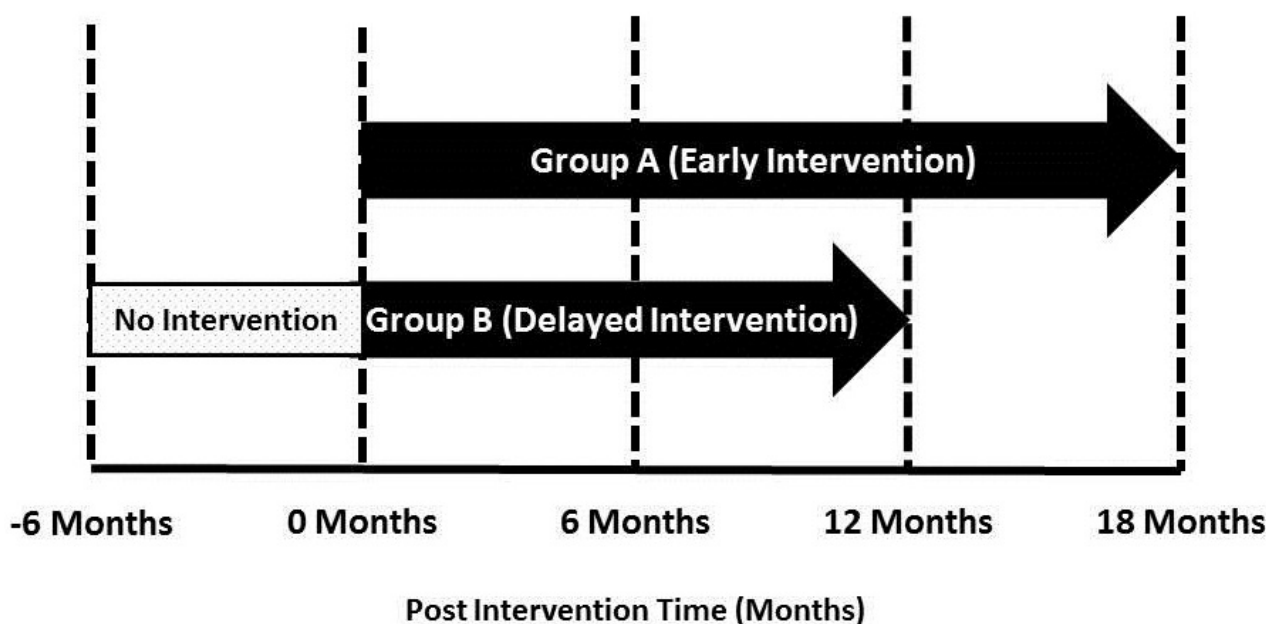
Results

Sample Characteristics

The average age of MHEN participants was 37.6 years, and the majority of participants were male (239/394, 60.7%) and/or single and had never been married (276/394, 70.1%). Just under half (177/394, 45.0%) of the individuals in the study had graduated high school, and almost a quarter (97/394, 24.6%)

had completed post-secondary schooling. The most prevalent psychiatric diagnosis in the sample was a psychotic disorder (234/394, 59.4%) followed closely by a mood disorder (226/394, 57.4%). The least prevalent diagnoses were personality disorder (24/394, 6.1%), disorder of childhood/adolescence (22/394, 5.6%), and other/organic/unknown type (19/349, 4.8%). No significant differences between the early intervention group and delayed intervention were found on any baseline demographics (Table 1).

Table 1. Sample characteristics (N=394) of MHEN study participants.

Characteristics	Early intervention group, n (%)	Delayed intervention group, n (%)	Total sample, n (%)
Age in years, mean (SD)	38.2 (14.6)	37.1 (12.9)	37.6 (13.8)
Sex			
Male	125 (65.1)	114 (56.4)	239 (60.7)
Female	67 (34.9)	88 (43.6)	155 (39.3)
Marital status			
Single, never married	140 (72.9)	136 (67.3)	276 (70.1)
Married/Common-law	18 (9.4)	15 (7.4)	33 (8.4)
Separated/Divorced	32 (16.7)	50 (24.8)	82 (20.8)
Widowed	2 (1.0)	1 (0.5)	3 (0.8)
Highest level of education			
Grade school	52 (27.1)	66 (32.8)	119 (30.3)
High school	93 (48.4)	84 (41.8)	177 (45.0)
Community college/ University	46 (24.0)	51 (25.4)	97 (24.6)
Currently employed	47 (24.5)	50 (24.8)	97 (24.6)
Psychiatric diagnoses [a]			
Psychotic disorder	111 (57.8)	123 (60.9)	234 (59.4)
Mood disorder	119 (62.0)	107 (53.0)	226 (57.4)
Anxiety disorder	60 (31.2)	64 (31.7)	124 (31.5)
Substance related disorder	30 (15.6)	20 (9.9)	50 (12.7)
Personality disorder	12 (6.2)	12 (5.9)	24 (6.1)
Disorder of childhood/ adolescence	9 (4.7)	13 (6.4)	22 (5.6)
Other/organic/unknown	8 (4.0)	11 (5.5)	19 (4.8)

[a]Individuals could have multiple diagnoses and therefore be counted in more than one group. Diagnosis groups do not add to 100%.

Comfort With Technology Prior to Intervention

At the outset of the study, the majority of participants felt comfortable with all of the technologies that were investigated (computers, phone, and technology in general; Figure 2). Almost the entire sample (362/394, 91.9%) felt comfortable with phones, and approximately two-thirds felt comfortable with computers (267/394, 68.2%) and technology in general (277/394, 70.3%). Alternatively, only a small fraction (16/394, 4.1%) felt uncomfortable with phones, and less than one-fifth of the sample felt uncomfortable with computers (70/392, 17.9%) or technology in general (55/394, 14.0%).

Figure 2. Level of comfort with technology in general, computers, and phones at baseline.
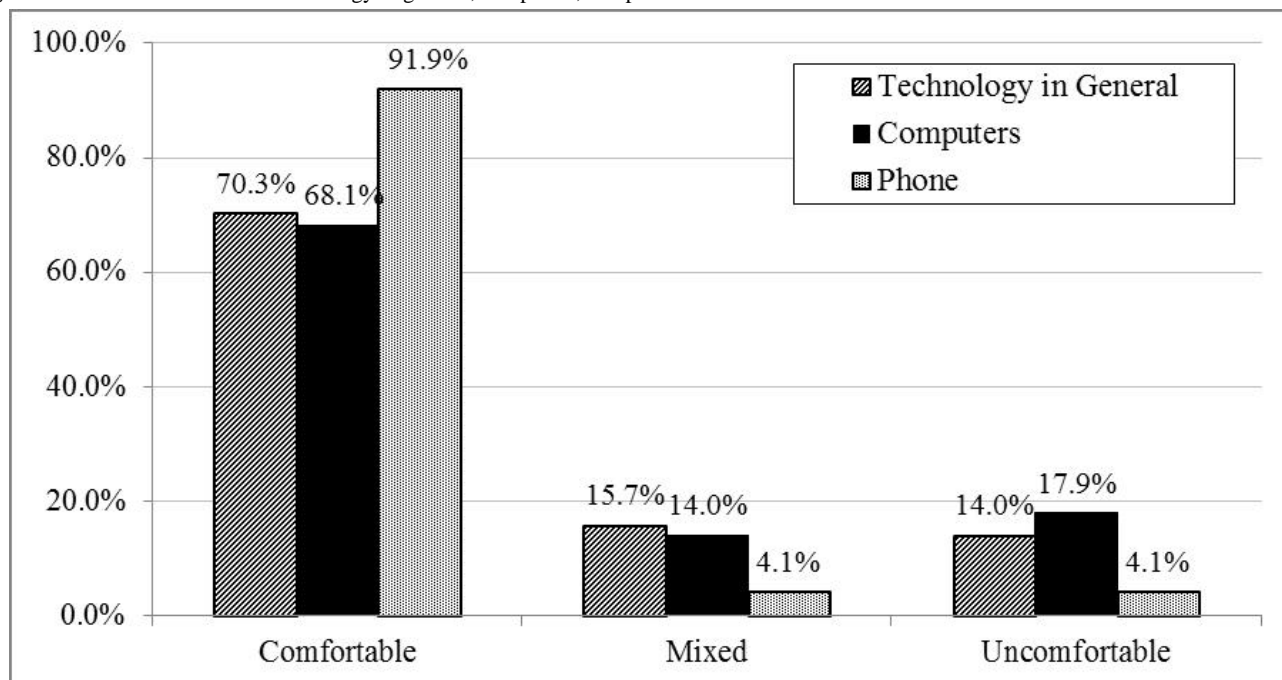
Perceptions of the Smartphone and Lawson SMART Record

Given a neutral score of four (half way between the extreme negative and positive scores), it appears perceptions of ease of use, helpfulness, simplicity, and provision of independence for both the smartphone and the LSR were generally positive as all averaged scores ranged from 4.83 to 6.29 (Table 2). Only two aspects significantly changed over time: positive perceptions towards the smartphone's ease of use increased between 6 and 12 months post-intervention (t_{311}=-3.112, P=.002), while positive perceptions towards the LSR's helpfulness decreased (t_{219}=4.443, P<.001).

Table 2. Client perception scores regarding ease of use, helpfulness, simplicity, and provision of independence of the smartphone and Lawson SMART Record over time.

	n	6 months post-intervention	12 months post-intervention	18 months post-intervention[a]	P [b]
Smartphone					
Ease of use	312	5.32 (1.71)	5.61 (1.67)	5.65 (1.68)	.002
Helpfulness	310	6.29 (1.05)	6.28 (1.11)	6.24 (1.09)	.93
Simplicity	311	5.26 (1.80)	5.24 (1.80)	5.27 (1.82)	.83
Independence	310	5.84 (1.32)	5.76 (1.48)	5.84 (1.49)	.41
Lawson SMART Record					
Ease of use	218	4.91 (1.87)	4.83 (1.94)	4.92 (1.84)	.55
Helpfulness	220	5.80 (1.11)	5.35 (1.60)	5.15 (1.59)	<.001
Simplicity	220	5.00 (1.75)	4.88 (1.79)	5.07 (1.70)	.36
Independence	221	5.26 (1.43)	5.10 (1.46)	5.16 (1.35)	.14

[a]Data from Group A only. Due to the delayed implementation design Group B did not have 18-month post-intervention data.

[b]P value reflects difference between 6 and 12 months post-intervention.

These findings mirror the qualitative data from the focus groups. With respect to ease of use of the phone, a number of individuals mentioned how much easier they were finding the phone to use over time:

I'm able to use the phone a little bit easier than I could at first…because I'm learning more about certain apps that I have and if I think of something, the people in my family that are more tech savvy, I can get them to help me… it was new for me when I first got it, but more and more as I kind of work on my phone, 'cause I got a few games that I'm learning to use the apps a little bit easier.

Well um, I know how to text now, I know how to um use the smartphone itself and umm how to dial the numbers that I need and just push a button and you

can find what number you want and just contacts. Yeah, it's a lot easier now.

One of the other themes that emerged through open-ended questions, in support of the quantitative findings above, was the decrease in use of the smart record over time due to an improved mental health status, or recovery. This could explain why individuals were finding the record less useful over time. For example, when asked at the 12-month post-intervention point whether they still used the LSR, one participant noted "I'm not really using it right now. I'm doing well right now and so I don't want to be reminded of my mental health problems," and another stated, "I haven't had any mental health issues lately. So I haven't had a need to use it". At 18 months post-intervention, another participant stated they were not using the smart record because "I kind of became more stable since the study began so it didn't seem as necessary."

When comparing the smartphone and LSR at 12 months post-intervention, individuals consistently rated the smartphone higher than the LSR. The difference in average scores between the two technologies ranged from 0.56 (simplicity) to 1.01 (ease

of use), depending on the utility being examined, and were all significant (all $P<.001$; Table 3).

Some of the best examples in the difference between perceptions of the smartphone and LSR come from the medication and appointment prompts and reminders. Individuals often felt the phone outperformed the record in reliability and helpfulness and subsequently began using the applications native to the phone for reminders and alarms in place of the record's prompts:

Um, I had some problems with the TELUS health space part because I would enter times for medication and instead of sending one email it would send me three or four. So if you're taking medication a couple times a day, that's almost a dozen emails. Um, so I stopped using that part of the TELUS and I've programmed it into the reminders and alerts on the phone.

I find that, unfortunately, I rely more on the calendar for reminders than the [Lawson SMART Record] app because they are very correct, like it's 7, it's coming on at 7.

Table 3. Scores for comparison of feelings towards the smartphone and Lawson SMART Record regarding ease of use, helpfulness, simplicity, and independence they afford at 12 months post-intervention.

	Smartphone	Lawson SMART Record	*P* value
Ease of use	5.71 (1.64)	4.70 (1.98)	<.001
Helpfulness	6.24 (1.17)	5.33 (1.60)	<.001
Simplicity	5.33 (1.76)	4.77 (1.86)	<.001
Independence	5.72 (1.49)	5.05 (1.46)	<.001

Value of the Smartphone and Lawson SMART Record Functions

Again, perceptions of specific functions of the smartphone and the LSR tended to be positive overall, with scores ranging from

4.97 to 5.90 (Table 4). Over time there was a significant decrease in the positivity of perceptions towards having the LSR (difference of 0.24, $P=.002$) and having access to a personal crisis plan (difference of 0.29, $P=.009$). No other significant changes were found.

Table 4. Scores for perceptions about specific functions of the smartphone and Lawson SMART Record over time.

	n	6 months post-intervention	12 months post-intervention	18 months post-intervention[a]	*P* [b]
Having own PHR	286	5.76 (1.09)	5.52 (1.23)	5.41 (1.27)	.002
Medication prompts	44	5.50 (1.41)	5.57 (1.17)	5.89 (0.60)	.78
Appointment/Schedule prompts	95	5.64 (1.25)	5.66 (1.32)	5.67 (1.18)	.89
Connecting with care provider using smartphone	250	5.75 (1.20)	5.65 (1.29)	5.45 (1.63)	.31
Connecting with care provider using PHR	90	5.34 (1.52)[c]	5.14 (1.43)[c]	4.97 (1.69)	.20[c]
Having access to personal crisis plan	119	5.90 (0.97)	5.61 (1.14)	5.45 (1.42)	.009
Ability to share health information with other care providers	270	5.65 (1.21)	5.54 (1.25)	5.35 (1.33)	.24

[a]Data from Group A only. Due to the delayed implementation design, Group B did not have 18-month post-intervention data.

[b]*P* value reflects difference between 6 and 12 months post-intervention.

[c]Reflects Group B only due to design and timing of questionnaire.

Use of the Smartphone and Lawson SMART Record

At 12 months post-intervention, 311 (93.4%) of the participants who answered questions (N=335) about use of the smartphone and PHR indicated they were currently using the smartphone. In contrast, 151 (45.3%) indicated they were currently using the LSR. The five most common uses of the smartphone were related to communication (Table 5). Of those who indicated they were currently using the smartphone, 247 (79.4%) indicated they were using it to send and receive text messages, 240 (77.2%) indicated they were using it to contact their care provider, and 205 (65.9%) indicated they were using it to send and receive email messages. Accessing the LSR was the seventh most common activity with 145 (46.6%) of those reporting on the use of the smartphone.

From the focus group data, the theme of being able to reach out and contact someone was identified: "I can text my sister in [British Columbia]and she can phone me back…it makes me feel better that I can actually use something like type something and she can receive it. It gives me more confidence", "Yeah actually, I text. I text my older brother or call my friends, texting away, call them, keeps me in contact with everybody", and:

> *Also just, like, the phone is right there like, if I really want to talk to somebody it's a lot easier for me, instead of writing down, to just go and call my worker, or call support, or call a crisis line. It just seems a lot easier. Or you know, um texting people if I'm in crisis, I'll text my step daughter or my mom.*

Table 5. Most common uses of the smartphone.

Rank	Uses	12 months post-intervention, n (%)
1	Texting	247 (79.4)
2	Contacting care provider	240 (77.2)
3	Listening to music	210 (67.5)
4	Email	205 (65.9)
5	Watching videos	174 (55.9)
6	Social media	166 (53.4)
7	Accessing the Lawson SMART Record	145 (46.6)
8	Games	141 (45.3)
9	Social phone calls/Communication	35 (11.3)
10	Internet browsing	20 (6.4)
11	Alarms/Calendar	16 (5.1)
12	Camera/Photography	13 (4.2)
13	Checking weather	10 (3.2)
14	Other[a]	9 (2.9)
15	Banking	6 (1.9)
16	Reading/Studying	6 (1.9)
17	Notes	5 (1.6)
18	Apps in general	5 (1.6)
19	GPS/Maps	3 (1.0)

[a]Includes unspecified, making/recording music, guitar tuning, checking stocks, job searching, organization.

Maintenance of Smartphones

At the study's completion, a total of 62 devices had been lost, sold, broken, stolen, or permanently locked at some point during the study. Of the 30 devices that had been lost, 10 were later found by participants, resulting in a total of 52 unusable or misplaced devices. Of these, 20 (38.5%) had been lost, 17 (32.7%) had been stolen, 8 (15.3%) had been broken, 6 (11.5%) had been sold, and 1 (1.9%) had been permanently locked due to the security features of the operating system.

Discussion

Principal Results

The MHEN project used mobile phones and Web-based technologies to support the care of individuals experiencing mental illness [8-10]. The purpose of this secondary analysis was to determine how participants in the study perceived the use of the smartphone and the PHR in their mental health care and in their lives generally. There is early evidence supporting the notion that mobile and Web-based technologies are viable methods of improving mental health care service delivery and research [32-34]; yet, little is known about how adults with mood and psychotic disorders use technology in their lives or

their ability to use these technologies in their care. This secondary analysis of data from the MHEN project provided insight into client perceptions of these technologies and supported the feasibility of implementing similar technologies into the wider system of mental health care.

At baseline, individuals indicated that they were generally comfortable using technology. This is an important finding given the severity of illness experienced by the research participants; for example, individuals in this study had an average of 7-8 psychiatric hospitalizations in their lifetimes. These findings suggest that the decreased likelihood of owning a mobile device and using the Internet for those diagnosed with mental illnesses, as compared to the general population [21,35], is not likely due to discomfort in using technology. Perhaps, given the resources required to own and use mobile devices, the digital divide between those experiencing mental illness and the general population would disappear. Further, these initial ratings of comfort with technology are consistent with previous research [36] and support the feasibility of implementing new technologies into the care of those with SMIs.

When evaluating the use of technologies in mental health care, it is important to consider perceptions of the specific technologies involved. Participants perceived the LSR and mobile devices used in this intervention positively in terms of ease of use, helpfulness, simplicity, and the independence they afforded. Interestingly, the positivity of perceptions of the smartphone increased over time, while the positivity of perceptions of the LSR decreased over time. The increase in participants' positive perceptions of the smartphone over time could be a result of increased familiarity with the device and ability to navigate its functions. This finding supports the idea that individuals with SMIs are able to learn and adapt to using complex technologies. The decrease in participants' positive perceptions of the LSR over time may be indicative of an improvement in mental health status over the course of the study. If participants' symptoms of mental illness were improving and they felt less in need of intensive treatment, it follows that the LSR would be perceived as being less helpful over time. Another possible explanation of this decrease in LSR use could be related to issues of the LSR's functionality. An onerous login process, for example, could have increasingly deterred clients from accessing the LSR over time. Both explanations correspond to participants consistently rating the smartphone more positively than the PHR at the conclusion of the study.

Overall, participants rated specific functions of the technologies, such as appointment reminders, as being perceived positively. Participants' perceptions of having a PHR and having access to a personal crisis plan decreased over time. Other functions, such as medication and appointment reminders, proved to be important to many participants. However, participants often found these functions within the LSR to be lacking and consequently used functions native to the smartphone, such as the calendar, for these purposes. These findings suggest that while the smartphone and its functions appear to be helpful, the LSR will benefit from further modification. In addition, these findings point to the programming capabilities of individuals who are experiencing SMIs as evidenced by participant

modification of the smartphone functions to meet their individual care needs.

Consistent with previous research findings [12], participants most commonly reported using the smartphone for communication. Many individuals suggested that a prominent benefit of the intervention was simply being able to stay connected with friends and family and easily contact a care provider when in crisis. Sending and receiving text messages were reported as the most common uses of the phone. Future interventions should be developed with this observation in mind and leverage client comfort with text-based communication.

A concern at the outset of the study was maintenance and retention of devices. The small percentage of devices that were lost, stolen, broken, or inactive at the completion of the study provides evidence that individuals diagnosed with SMIs are accountable to manage and maintain devices for personal and health management purposes. With the aim of integrating mental health technologies into usual care, it is important to consider the feasibility of providing large numbers of individuals with costly devices. Even if only 13% of clients are unable to retain or maintain their devices, as was found in the present study, replacing these devices would be a substantial additional cost to service providers. For this reason, future research should investigate the use of interventions that do not require the use of costly smartphones with data plans, such as those that are text message–based.

Limitations

Several limitations of this research should be considered when evaluating client perceptions of this intervention and when planning similar interventions in the future. For example, since the LSR is often accessed using the smartphone, it is difficult to evaluate the phone and the record as separate entities. While questions about the phone were separated from questions about the LSR, clients may not have completely separated the two components in their perceptions. Additionally, the LSR is available in both desktop computer and mobile phone versions, and so it is possible that clients were using their smartphones to access the version of the LSR designed for use on desktop computers. It is important to understand how individuals prefer to access their information and what characteristics make a function appealing and usable. Fully understanding user preferences may not be possible without knowing the way that individuals accessed the LSR, but this was not probed in this study. Another possible limitation is the link between a client's perception of the intervention and their care provider's willingness or ability to use the intervention. The intervention examined in the MHEN study involved two-way input from clients and care providers. In order for clients to perceive the intervention positively, care providers must be able to support clients in the technical aspects of the intervention and also be actively engaged in the intervention themselves [37]. Unfortunately, active care provider participation was not always present and for this reason, some clients may have perceived the LSR negatively. These factors should be considered in the design and implementation of future research in order to assist in understanding the perceptions of individuals experiencing mental illness regarding the use of smartphones, desktop

computers, and health management software in their mental health care.

Conclusions

The implementation of innovative technologies to improve the quality and efficiency of care for individuals experiencing mental illness is a promising avenue for system improvement.

Though future research is needed to elaborate on factors that make technological interventions acceptable, usable, and cost-effective, this secondary analysis of data from an e-mental health intervention study has provided evidence supporting the applicability of mental health technologies in the care of individuals with severe mental illnesses.

Conflicts of Interest

None declared.

Multimedia Appendix 1

CONSORT-EHEALTH checklist V1.6.2 [37].

[PDF File (Adobe PDF File), 997KB - mental_v2i1e1_app1.pdf]

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Abbreviations

EHR: electronic health record
LSR: Lawson SMART Record
MHEN: Mental Health Engagement Network
PHR: personal health record
SMI: severe mental illness

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Original Paper

A Virtual Mental Health Clinic for University Students: A Qualitative Study of End-User Service Needs and Priorities

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Abstract

Background: Help seeking for mental health problems among university students is low, and Internet-based interventions such as virtual clinics have the potential to provide private, streamlined, and high quality care to this vulnerable group.

Objective: The objective of this study was to conduct focus groups with university students to obtain input on potential functions and features of a university-specific virtual clinic for mental health.

Methods: Participants were 19 undergraduate students from an Australian university between 19 and 24 years of age. Focus group discussion was structured by questions that addressed the following topics: (1) the utility and acceptability of a virtual mental health clinic for students, and (2) potential features of a virtual mental health clinic.

Results: Participants viewed the concept of a virtual clinic for university students favorably, despite expressing concerns about privacy of personal information. Participants expressed a desire to connect with professionals through the virtual clinic, for the clinic to provide information tailored to issues faced by students, and for the clinic to enable peer-to-peer interaction.

Conclusions: Overall, results of the study suggest the potential for virtual clinics to play a positive role in providing students with access to mental health support.

Introduction

Mental Health Problems and University Students

There is growing recognition of the high rates of mental health problems experienced by young adults attending universities. University students experience higher rates of psychological distress and mental disorders than their nonstudent peers [1-3]. Among US college students, approximately 50% will experience a mental disorder during a 12-month period [4].

However, help seeking by university students for mental health problems is very low. In a large US study, only 18% of students with a past-year mental disorder received treatment [4].

Identified barriers to help seeking for mental health problems in students are varied and include stigma [5,6]; lack of knowledge about services and their location [6,7]; failure to perceive themselves as in need of mental health support [8]; and lack of time [8]. Despite the provision of free short-term counseling at most university campuses, uptake of these services is far lower than would be expected on the basis of need. A US study found that only 12.7% of students with a mental health problem sought help from university campus services [9]. Moreover, many counseling services have resourcing constraints that limit the numbers of students that they can see, which may result in long waiting lists for the students who do seek assistance from these services [10].

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Web-Based Interventions

Evidence-based programs delivered via the Internet have the potential to broadly disseminate interventions to at-risk groups [11]. Several reviews and meta-analyses have demonstrated that Web-based interventions are effective in reducing symptoms of depression and anxiety in both adults [12,13] and university students [14]. Web-based interventions offer several advantages over face-to-face interventions, including 24-hour accessibility, anonymity, and a number are provided to end-users without the requirement for clinician support. These features may be particularly appealing to young people who face time pressures [15], fear stigma [16], and already have a high rate of engagement with the Internet [17].

Virtual clinics have been proposed as a model for providing streamlined, continuity of care for chronic physical and mental health conditions [18,19]. Virtual clinic models emphasise self-management, place the user at the center of their own care, and often incorporate several elements such as information, peer-to-peer support, facilitated access to professionals, and symptom screening and monitoring tools. In its role as a partner in the Australian Government funded Young and Well Cooperative Research Centre, the National Institute for Mental Health Research is currently developing a university virtual clinic, a comprehensive, Internet service targeting mental disorders in tertiary students. The present study was conducted as an initial phase of a larger user-centered development process to design, develop, and evaluate the university virtual clinic. Consulting end-users in the development of interventions allows appropriate tailoring of services to the target population and fosters a sense of empowerment and ownership that may improve uptake of and engagement with services [20]. Qualitative methods such as focus groups have been used in health services research to access the perspectives of consumers and end-users. Focus groups are particularly suited to assessing health needs and generating data to plan and develop effective interventions [21]. The aim of the present study was to conduct focus groups with university students to obtain input on potential functions and features of a university virtual clinic.

Methods

The Focus Groups

There were four focus groups that were conducted with students from the Australian National University (ANU) in November and December 2012. Each focus group consisted of four or five participants (n=5, 5, 4, 5) with a total of 19 participants. There were three groups that were conducted on the ANU campus, and one group was conducted at an off-campus university residential hall. Ethics approval was granted by the Australian National University Human Research Ethics Committee (2012/520). Cinema vouchers were offered to participants in recognition of their time and involvement in the focus groups.

Participant Recruitment

Several methods were used to recruit participants. First, email invitations for a focus group on "student mental health and online programs" were sent to a list of students who had previously expressed interest in participating in a mental health

research initiative and provided their contact details to the researchers at a mental health awareness event. Participants were also encouraged to invite other students to participate. Second, the researchers contacted the senior resident of a university residential hall for assistance in advertising the focus group to their students. The method of recruiting through the residential hall was most effective because the focus groups were directly and actively targeted to a captive group of students by someone who had a preexisting relationship with them. Recruitment of new participants was discontinued when consistencies emerged in the data. Following the fourth focus group, the facilitators met to review the notes taken during the groups by one of the facilitators, and to discuss the data obtained. The facilitators mutually agreed that data saturation had been achieved following the fourth focus group.

Development of Focus Group Questions and Procedure

Focus group questions were developed by the researchers to investigate broad and specific issues relevant to the development of a virtual mental health clinic. A full list of the questions asked during the focus groups is provided in Multimedia Appendix 1; however, only a subset of these questions is the subject of this paper. Participants were asked to imagine the concept of a comprehensive Internet resource for mental health and to discuss their attitudes toward this resource, and what content it should contain. This was designed to elicit spontaneous ideas about the potential functions and features of a virtual clinic. Screenshots of other Internet resources were provided to students to provide a context for the discussion. Next, specific prompting questions were asked about the potential functions and features discussed by the participants (eg, "How do you think students would want to connect with other students?"). Focus group questions also addressed other issues including participants' preferences for help seeking, and their ideas about usage, engagement, and dissemination of the virtual clinic. These data are reported elsewhere.

The primary facilitator (LF) was a female researcher and registered psychologist at the National Institute for Mental Health Research. There were two research assistants (AG and JC) that were present to provide assistance and take field notes during the focus groups. The focus groups were also audio recorded. On arrival, participants were provided with an information sheet to read and a consent form to sign, as well as a short demographic questionnaire (age, gender, number of years of study, study discipline, and domestic versus international student status). At the beginning of each focus group session, the primary facilitator provided a brief introduction to the study and information about the purpose of the focus groups, confidentiality, and voluntary participation. The duration of each session was approximately 1.5 hours.

Analysis Strategy

Data were analyzed using thematic analysis in NVivo 10 by the first (LF) and third (JC) authors. Participants' statements in response to each question were coded using a grounded theory approach [22], whereby similar concepts were grouped together into themes. The themes that emerged during discussion of each question are described below under each predetermined topic, and are ordered by relative importance, as determined by the

number of comments, as well as the volume and quality of discussion associated with each theme. Direct quotes are used to illustrate the emergent themes and participants are identified by a number and their gender (eg, 1F = Female, participant number 1).

Results

Participants

Of the 19 university students who participated in the focus groups, 10 were female. The mean age of the sample was 21.6 years (range 19-24 years) and the mean duration of their tertiary education was 3.1 years (range 1-5 years). Most participants were domestic students (12/19, 63%) from a range of study disciplines (arts, law, commerce, engineering, science, music, and combined degrees from those faculties). Participants were not recruited based on mental health status; nor were they asked to discuss their own mental health during the focus groups. No participant dropped out of the focus groups, although one student left a group early due to personal commitments.

Topic 1, the Utility and Acceptability of a Virtual Mental Health Clinic for Students

Question, What do you think about the idea of a space online which offers pretty much anything students might need for their mental health?

There were four main themes that emerged during discussion of this question: (1) the virtual clinic as a centralized help source, (2) the desire for professional/human input in the virtual clinic, (3) concerns regarding privacy and uptake, and (4) restriction of the virtual clinic to the university student population.

Virtual Clinic as a Centralized Source of Help

Participants viewed the virtual clinic as an ideal solution to the problem of widely dispersed, decentralized mental health resources on the Internet,

> *Everything's scattered at the moment and if you had something that was bad enough that you knew to go there and then it catered for everything...I think something like that would be so good.* [1F]

Participants believed that a virtual clinic would make it easier and more convenient for students to find existing resources and help for mental health problems,

> *Just finding out what services are available for you can be really time-consuming.* [2F]

> *[A virtual clinic would be] so convenient as well because you don't have to go to every place for different little informations (sic). You can just do it in one place.* [9F]

They also believed that a virtual clinic would be a good first point of call for students to seek help without fear of being stigmatized,

> *Like for someone who is, I don't know, needs help but...because of stigma, then, and if you go to website*

that pretty much has everything covered, it's, it's a good place to start for them. [3F]

The Desire for Professional/Human Input

Some participants commented that an Internet clinic may encourage self-diagnosis (which could be inaccurate and potentially dangerous) and believed that it was necessary for professionals to be involved in the clinic to provide personalized feedback and support,

> *You might think you present with like, one set of symptoms but then like a psychiatrist or like a psychologist might look at you and say like, "well actually you have this type of anxiety or you've got these things". So yeah, you need a professional to help you...* [2F]

Several participants indicated that they preferred to talk to someone rather than write about their problems on the Internet,

> *I find with things that sort of have strong emotional content, I much prefer talking than like, writing.* [2M]

This preference was mainly due to concerns about not being understood or difficulties in communicating via text when other nonverbal information is absent,

> *I actually get quite anxious when I write about it and I think "oh what if that person doesn't understand", whereas talking, you know, there's sort of a lot more cues and things you can go on.* [2M]

Concerns Regarding Privacy and Uptake

Some participants indicated that they would be hesitant to disclose personal information when using a virtual clinic, especially if the service was linked to the university,

> *If it was something student-based at a university that provided like everything, I'm not sure how much information I'd want to be giving.* [4F]

Additionally, some participants expressed concerns about the ongoing utility of a university virtual clinic,

> *Well, you'd go there once and it's really helpful but you won't keep going back.* [3M]

Participants indicated that user-friendly language, regular content updates, interactivity, and easy navigability would be key features to promote the, "stickiness" [4M] or repeated usage by students of a virtual clinic. Several participants indicated that videos could be used to engage students,

> *I find that students nowadays enjoy watching videos as opposed to reading long paragraphs of text.* [1F]

Restriction of the Virtual Clinic to University Students

Some participants were concerned that restricting the virtual clinic to university students may ignore the broader contexts in which students operate (eg, as men, women, young adults),

> *A lot of people struggle with these issues, you know, at university and elsewhere.* [2M]

A participant felt that a university-focused virtual clinic might promote the idea that mental illness is exclusively associated with being a student,

You know, I think it'd be more normalizing for mental illness to say "Hey, it's not just students who experience this, everyone has it". [1M]

Topic 2, Potential Features of a Virtual Mental Health Clinic

Question, What should be in this space and what should it offer participants?

There were three themes that emerged from discussion of this question: (1) information, (2) access to professionals, and (3) peer-to-peer interaction.

Information

Provision of information was suggested as an important feature of the virtual clinic. Several subthemes emerged during this discussion: (1) well-being tips, (2) tailored information, (3) information about symptoms, and (4) information about how to help friends.

Well-Being Tips

Participants felt that the virtual clinic should not only focus on treating mental illness, but also on providing information about how to prevent illness and maintain mental well-being,

Maybe not just an emphasis on treating existing conditions but general well-being. [2F]

Participants also wanted information about how to maintain a balanced lifestyle as a student,

Information about balancing lifestyle, about balancing your study with your life. [5M]

Motivational messages, especially those that provide positive reinforcement for help seeking, and stories of recovery from people with experience of mental health problems were also viewed as beneficial and reassuring.

Tailored Information

It was important to participants that the information was tailored to their needs; for example, their area of study, gender, and sexual orientation. A participant felt that the virtual clinic should offer information about issues that are of specific relevance to the university population, such as exam stress, homesickness, and university processes for offering academic adjustments to students experiencing mental health problems,

Information...for issues, that specifically affect uni students would be good. [5F]

Symptom Information

Participants wanted the virtual clinic to contain information about how to recognize if they were experiencing a mental health problem, as well as the causes and symptoms of common mental disorders,

I think basically all the symptoms you would have to look out for...and information on, about, each illness. [6F]

Participants also wanted "technical literature" [2M] (ie, scientific studies) on symptoms, consumer experiences, and treatment.

How to Help Friends

It was important to some participants that they received information regarding how to help friends and family with mental health problems. In their experience, someone experiencing a mental health problem would typically speak to their friends first, and therefore, some participants felt it necessary to know how to respond to these situations,

So that in a way we're more aware of, sort of like, we make sure that we look after our friends as well. [6M]

Access to Professionals

Access to mental health professionals was considered by many participants to be a necessary component of the virtual clinic. To prompt discussion, participants were specifically asked: "Who would these professionals be?" and "How do you think students would want to access help from a professional?".

Types of Professionals

Psychologists, counselors, and youth workers were the most preferred types of mental health professional. Other suggested professionals included social workers and psychiatrists. Participants generally felt that psychiatrists and general practitioners/primary care physicians were not well suited to provide help on the Internet, as they are more focused on prescribing medication and writing referrals, respectively. Participants also felt that it was important to provide options to students in terms of access to different types of professionals,

Good to have a variety of options, for example if you have a bad experience...you want to have that other option as well. [7M]

and,

Because you have different degrees of mental illnesses and they can help in different ways. [7M]

Additionally, participants felt that it was important for professionals involved with the virtual clinic to receive training to manage issues that are relevant to specific groups (eg, sexual identity in young people).

Methods of Connection With Professionals

The ability to use the virtual clinic to make appointments to see a mental health professional, either face-to-face or online, was viewed favorably. However, participants varied in their preferences regarding methods of connection with professionals. Online chat, phone, video-calling (eg, through Skype), email, "query boxes", and forums were suggested by participants as possible options. Some participants viewed these methods as less confronting than connecting with professionals face-to-face,

I think that's a good idea, instead of going to the counseling center in person, you could do it online so you feel more comfortable sharing details that way. [7F]

However, the ability to speak face-to-face with a professional was also viewed positively by participants, even if this contact was initiated by online communication,

It would be nice to kind of have an email or something first to know who I'm communicating with before I meet them face-to-face. [1M]

Many participants felt that video-calling could be too intrusive,

It'd be a little bit overwhelming to actually see someone like talking on a screen. [6M]

It would be weird because it's like inside your home. [6F]

and,

Yeah, it's like your personal space. [2F]

Although offering access to professionals was seen to enhance the credibility of the virtual clinic, participants had reservations about the effectiveness of providing therapy online compared to in-person,

Would an hour counseling someone online be as effective for them as an hour spent counseling someone in-person? [1M]

Peer-to-Peer Interaction

Participants suggested the capability for peer-to-peer interaction as a useful component of the virtual clinic. There were two major themes that emerged during this discussion: (1) perceived benefits, and (2) privacy issues.

Perceived Benefits

Participants felt that online peer-to-peer support could be beneficial in a number of ways. For example, it could reduce stigma through discussion of mental illness, foster a sense of community among students, and allow students to share personal stories of recovery, which was viewed as having a positive effect on those who experience mental health problems. The ability to connect with other students who have had similar experiences was viewed favorably,

I think like it's a really good idea, um, having...like-minded kind of people, getting to see their stories and then it's "oh ok, it's not just me", things like that. [8F]

Incorporating a social, peer-led element into the virtual clinic was seen as necessary to promote engagement with the service,

I guess socializing helps keep it active and I guess you want it to be a much more active than passive space. [3M]

The ability to organize or advertise group activities, such as meditation or relaxation groups through the virtual clinic was also noted as a helpful way for students to cope with stressful events like exams.

Privacy and Security Issues

Participants highlighted security of information as a priority in their discussion of peer-to-peer interaction,

I think knowing that your information isn't going to feedback elsewhere–whether it's to academics or family–like knowing that your information you shared is secure. [1F]

Participants were also concerned that other students could recognize them. The use of anonymous usernames was suggested by participants as a potential approach to enabling privacy. However, a participant felt that students should be given the option to be anonymous,

I feel like there should be an option rather than only being anonymous. I feel like some people are quite comfortable talking about mental health issues and they don't mind putting their name out there. [1F]

There were three additional questions that were asked to prompt further discussion: (1) "How do you think students would want to connect with other students?", (2) "What do you think about having moderators to manage the peer support component and who should they be?", and (3) "How do you think discussion of suicide should be handled?".

Methods for Peer-to-Peer Interaction

Participants suggested that a range of options for peer-to-peer contact should be provided in the virtual clinic, including chat rooms, forums, a "question and answer" function, the ability to comment on videos, and providing a space for users to share positive messages or posts. Most participants preferred forums due to their ability to benefit those who read as well as those who comment, and their efficiency in generating multiple perspectives on a single issue or problem. With moderation, forums were perceived by participants to be safer than private chats in which monitoring could be impractical or unfeasible. Conversely, as forums are not synchronous, some participants felt that users may lose interest in them or not access the help they need in a timely manner,

People might just lose interest or not think that their issue's going to be solved as quickly as they need. [8F]

Moderation Issues

The presence of a moderator to monitor discussions between participants was seen as vital to ensure safety within the peer-to-peer component of the virtual clinic. Participants expressed concern about the potential for online bullying, exacerbation of distress, or encouragement of unhealthy behavior in forums. Trigger labels, allowing users to "flag" posts containing distressing content, and the ability to report abuse were suggested as helpful solutions. Participants were also largely in favor of,

clear, well-established [3M]

and,

concrete [3M]

guidelines for use of the forum,

I think having a moderator who has set up these rules and is willing to implement sanctions if people contravene those rules is very important. [4M]

When discussing who they would consider to be appropriate moderators, participants preferred either mental health professionals or those who have had a significant amount of experience using the forum (eg, senior members).

Discussion of Suicide

While participants recognized that there may be dangers associated with discussion of this topic, they felt that banning discussion of suicide would be isolating, stigmatizing, and may act as a barrier to help seeking,

> *If it wasn't allowed then it would be quite a deafening silence.* [8M]

However, participants noted that discussions about suicide should be,

> *very heavily moderated* [4F]

supportive, focused on help seeking, and nonjudgemental,

> *That people aren't...being stigmatized or whatever for...contemplating suicide or something like that.* [4M]

Participants believed that discussion of suicide would need to be closely monitored, and that,

> *any posts that are potentially dangerous to other users [should] be deleted.* [4M]

Discussion

Principal Findings

Overall, participants viewed the concept of a virtual clinic favorably as an additional option for the provision of mental health services. It was seen as a particularly suitable platform for consolidating online mental health resources and providing help to students who may be reluctant to access other services due to stigma. A previous survey of university students found that the availability of vast amounts of information and the ability to seek help without fear of embarrassment were among their top reasons for using the Internet for mental health support [23]. Participants expressed a clear desire for a virtual clinic to involve human support in some capacity, primarily for credibility and safety reasons. Some students expressed a preference for access to professionals because they were concerned about their ability to communicate their feelings through writing. Similar views were reported in a study asking students to contrast Internet (nonhuman) and face-to-face mental health care [23]. Commonly cited reasons for preferring face-to-face care in this study included the perception that it is more personal, reliable, and conducive to building mutual understanding.

Participants also expressed concerns about the privacy of their personal information and who would have access to it. This may be related to high rates of perceived stigma among university students [6], or fear among students that disclosure of having experienced a mental disorder may be linked to their academic records [24].

When asked about the potential features of a virtual clinic, participants expressed a clear desire for the availability of centralized information, access to professionals, and peer-to-peer support. Participants expressed a strong need for mental health information, which is unsurprising given that reading informational websites is one of the most highly utilized and preferred methods of accessing mental health support on the Internet among university students [25]. Regarding participants' preferred topics for information, they expressed a preference for information about general well-being, symptoms of mental disorders, how to help friends, and issues related specifically to university students, such as homesickness and study stress. Similarly, work-life balance, time and stress management, coping skills, and anxiety were among the top rated topics of interest reported in a survey that assessed the views of university students toward an online mental health intervention [26].

In terms of the types of professionals that participants wanted to access, participants preferred psychologists and counselors, particularly those with skills and experience relevant to the university student population. Participants also wanted the ability to make appointments with professionals through the virtual clinic, and suggested several methods of connecting with professionals, including by chat, email, forums, and telephone. Use of video-calling or Skype was not rated favorably by some participants because it was considered to be too intrusive. It appeared from the discussion that although participants expressed a strong preference for connecting with professionals, they wanted to do so on their own terms, using methods that they perceived as less confronting.

Participants discussed peer-to-peer interaction positively, as a method for enabling social support and sharing of personal stories of recovery. Similar views have been expressed by young people in a case study of the development of an online community forum for young people [27,28]. A previous study of an online forum for university students found that users benefitted from being able to identify with the experiences of others, which helped them to cope with feelings of loneliness [29]. The majority of participants indicated a desire to remain anonymous, which has been previously found to be extremely important to users of online mental health forums [30]. A frequently raised issue during the discussion of forums was the importance of ensuring the safety and privacy of participants. Participants expressed concern about the possibility of bullying or exacerbation of distress in forums, and that this could be circumvented by providing a clear set of rules governing use of the forum and the presence of an experienced moderator. Higher levels of moderation may be required to ensure the safety of users, in light of evidence suggesting that lower levels of moderation were associated with higher levels of depressive symptoms and symptom contagion effects among users of an online self-harm support group [31]. Participants believed that banning discussion of suicide could be stigmatizing. However, they acknowledged that discussion of suicide would require close monitoring and should focus on help seeking. In practice, balancing concerns about distress and safety issues with concerns about the perpetuation of stigma is likely to prove highly challenging.

Limitations

There are several limitations associated with the current research that require consideration. Participants were not selected on the basis of current or previous experience of a mental disorder, and their mental health status was not assessed. It is unclear to what extent the views of students without mental health problems are applicable to those of students experiencing a

mental illness. However, several participants disclosed having previously experienced mental health problems during the focus groups and framed their responses to the questions in terms of their own experiences. Moreover, although the virtual clinic is designed to target mental health, its purpose is to be disseminated universally to the entire student population, to assist not only those with current mental health problems, but to provide prevention tools to students without symptoms. Given that participants self-selected to participate and this study was conducted in one university setting, the views expressed may not represent the views of ANU students generally, or students from other universities. However, it is arguable that reasonable diversity in terms of gender, domestic and international student status, and discipline of study was obtained in the sample to represent the wider student body. Finally, we did not ensure that participants who invited other students to attend were allocated to different groups, as composition of the groups was based purely on when participants were available to attend. Preexisting relationships between group members may have potentially biased the discussion.

In addition, these focus groups were conducted in the first, exploratory stage of the design and development of a virtual clinic, and some participants found it hard to conceptualize what a virtual clinic would actually involve. Later stages of the project will include further student involvement through testing and discussion of functional and nonfunctional prototypes. It may be that these feedback mechanisms, which offer greater context, will generate additional, differing, or expanded student perspectives.

Implications

The results of this study suggest that although university students are generally in favor of a virtual clinic, they have reservations about privacy, trustworthiness, and the ability of online interventions to deliver the same quality of care as other services. Thus, online services targeting university students should be built on evidence-based principles, and streamline or simplify the help seeking process for students. Moreover, increased awareness of the effectiveness of online mental health interventions is needed among students to increase their confidence in this form of treatment. Privacy concerns and stigma are also major issues for university students, who fear that disclosure of, or seeking help for, a mental health problem may negatively affect their success at university or their subsequent career opportunities. Providing the capability for students to access help privately online may go some way to address this issue. It is also important to ensure that information about privacy and models of information sharing are made explicit to service users and are within their control.

Although participants in this study feared that tailoring a virtual clinic to university students might be stigmatizing, they expressed a clear desire for the functions and content of the virtual clinic to address the issues commonly experienced by university students. Arguably, tailored, relevant content will increase the appeal and likelihood of uptake of an online service for students, and indeed this has been identified as an important priority among end-users of virtual clinics for other chronic health conditions such as diabetes [32]. Moreover, uptake of a service like this within a university environment will require cooperation and buy-in from all levels within the university, including the executive, health and student services, student organizations, heads of faculties and departments, residential halls, and teaching staff. A possible strategy to encourage awareness and uptake among students would be to universally disseminate the virtual clinic as a prevention and treatment tool to students during their orientation to the university, at the start of each semester, and during stressful times throughout the academic year such as exam periods.

Participants also expressed a desire to connect with mental health professionals through the virtual clinic. This raises important issues regarding resourcing and the implementation of university-based virtual clinics over time and in different settings. A balance is needed between the competing demands of making online services scalable, widely implementable, and cost-effective, while meeting the needs and expectations of users for professional human involvement. Models for human involvement need to be flexible and responsive to the availability of professionals in different university environments. Groups within the university such as trained lay-students, consumers, and clinical psychology trainees could provide support, moderation, or clinical services to users, which may reduce the level of mental health professional involvement required.

This paper presents the first step in a larger user-centered design process being undertaken to develop the virtual clinic. The data obtained in this study will be used to develop and build prototypes for testing with students and other stakeholder groups. Feedback from testing sessions will be used to refine the prototypes for further testing and finalize the functionality that will comprise the virtual clinic. Thus, the findings of this research have direct implications for the development of online interventions to improve the mental health of university students. Despite the impact that untreated mental health problems can have in emerging adulthood, mental health problems still remain undertreated in this vulnerable group. A university-specific virtual clinic may address some of the help seeking barriers that students experience, and allow universities to improve rates of help seeking among their students.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Focus group questions.

[PDF File (Adobe PDF File), 40KB - mental_v2i1e2_app1.pdf]

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Abbreviations

ANU: Australian National University
CRC: Cooperative Research Centre

<u>Viewpoint</u>

Clinical Practice Models for the Use of E-Mental Health Resources in Primary Health Care by Health Professionals and Peer Workers: A Conceptual Framework

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Abstract

Background: Research into e-mental health technologies has developed rapidly in the last 15 years. Applications such as Internet-delivered cognitive behavioral therapy interventions have accumulated considerable evidence of efficacy and some evidence of effectiveness. These programs have achieved similar outcomes to face-to-face therapy, while requiring much less clinician time. There is now burgeoning interest in integrating e-mental health resources with the broader mental health delivery system, particularly in primary care. The Australian government has supported the development and deployment of e-mental health resources, including websites that provide information, peer-to-peer support, automated self-help, and guided interventions. An ambitious national project has been commissioned to promote key resources to clinicians, to provide training in their use, and to evaluate the impact of promotion and training upon clinical practice. Previous initiatives have trained clinicians to use a single e-mental health program or a suite of related programs. In contrast, the current initiative will support community-based service providers to access a diverse array of resources developed and provided by many different groups.

Objective: The objective of this paper was to develop a conceptual framework to support the use of e-mental health resources in routine primary health care. In particular, models of clinical practice are required to guide the use of the resources by diverse service providers and to inform professional training, promotional, and evaluation activities.

Methods: Information about service providers' use of e-mental health resources was synthesized from a nonsystematic overview of published literature and the authors' experience of training primary care service providers.

Results: Five emerging clinical practice models are proposed: (1) promotion; (2) case management; (3) coaching; (4) symptom-focused treatment; and (5) comprehensive therapy. We also consider the service provider skills required for each model and the ways that e-mental health resources might be used by general practice doctors and nurses, pharmacists, psychologists, social workers, occupational therapists, counselors, and peer workers

Conclusions: The models proposed in the current paper provide a conceptual framework for policy-makers, researchers and clinicians interested in integrating e-mental health resources into primary care. Research is needed to establish the safety and effectiveness of the models in routine care and the best ways to support their implementation.

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KEYWORDS

translational medical research; professional practice; primary health care; treatment of mental disorders; Internet; health care technology; health promotion; case management; psychotherapy

Introduction

Background

Over the past 15 years, there has been a rapidly burgeoning interest in the use of electronic communications to deliver psychological therapies. This has been driven by recognition of the high prevalence of mental health problems and the relatively low treatment rates. For example, up to half of those living in English-speaking developed countries will experience a mental disorder in their lifetime [1-3]. Accordingly, most will directly experience a mental disorder or be in a close relationship with a person who does. Unfortunately, only a minority of people with mental health problems receives treatment. In Australia, treatment rates improved following the introduction of subsidized psychological therapies but still remain substantially lower than those achieved for comparable physical conditions [4].

E-mental health resources offer a potential means for addressing this treatment gap. Of the different resources, online symptom-focused programs have been the most thoroughly researched. These programs have typically drawn on cognitive behavior therapy (CBT) and involve online modules with interactive components such as symptom questionnaires, multimedia content that can be downloaded, and exercises in which service users practice skills. Programs that incorporate some human support and guidance are referred to as iCBT. Others are designed for use as self-guided, fully automated interventions.

Numerous research trials have shown that Internet-delivered CBT programs can be efficacious and cost effective. A few such programs have accumulated enough evidence to be listed by national review bodies such as the National Institute for Health and Care Excellence (NICE) in the UK and the National Registry of Evidence-based Programs and Practices (NREPP) in the USA. For example, e-mental health programs listed by NREPP include Beating the Blues [5], MoodGYM [6], and the Co-ordinated Anxiety Learning and Management Tools (CALM) program [7].

Further, a recent systematic review found that for three disorders (depression, social phobia, and panic disorder), the evidence for iCBT was sufficient to meet the American Psychological Association's criteria for an "established" therapy [8]. iCBT interventions have achieved similar outcomes to individually administered face-to-face CBT while requiring much less therapist time [8,9].

While the initial research effort has focused on programs that draw on standard forms of CBT, programs based on other types of therapy can also be efficacious. These include Internet-delivered programs drawing on interpersonal therapy [10], psychodynamic therapy [11], and structured writing techniques [12].

Other technology-based interventions are also accumulating evidence of positive outcomes. Online psycho-education has been shown to improve attitudes to help seeking [13,14] and may be associated with symptom reduction [6]. Information websites can help address the large unmet needs for information, although quality continues to be variable [15,16]. Relapse prevention interventions are also showing promise across service users with diverse diagnostic [17] and/or treatment histories [18].

Other applications include peer-to-peer support [19], game-based interventions [20], mobile apps [21], online chat [22], and video-conferenced therapy [23].

Implementation in Routine Care

Interest is now turning to the question of how e-mental health resources can be incorporated into traditional systems of care. Primary health care systems are of particular interest because they are typically the first point of contact and provide the bulk of mental health care to individuals, at least in developed countries. In Australia for example, the primary health care system is comprehensive and includes general medical practices, allied health, indigenous health workers, pharmacists, and other services [24]. Incorporating e-mental health services into primary health care could improve treatment rates for common mental disorders, especially for people who are unable or unwilling to access traditional services. It may also generate efficiencies and allow clinicians time to provide more intense care to those who require it [25].

To this end some studies have explored implementation of iCBT in primary health care settings. More research is needed in this area, but positive outcomes have been found for programs designed to treat depression and a range of anxiety disorders [26-28].

In an innovative initiative, the Australian Government has funded the e-Mental Health in Practice (eMHPrac) service to promote key e-mental health resources among primary health care service providers and to train them to use these resources in routine practice [25,29]. These providers include: general medical practitioners; primary care and mental health nurses; indigenous health workers; psychologists; social workers; occupational therapists; counselors; community health workers; and peer support workers.

There are two routes by which e-mental health resources can be incorporated into primary health care (cf [30]).

The best-researched route involves the delivery of iCBT to service users referred to centralized online clinics from community-based service providers. These clinics typically provide some in-house therapist support to service users as they work through programs. Online clinics of this type may receive public health funding to provide free treatment, such as those in Holland and Australia [31,32].

The current paper will focus on the second route, in which community-based service providers incorporate a broad range of e-mental health resources into their practice. This requires clearly differentiated models of practice that are sufficiently flexible and diverse to be relevant to practitioners operating in different contexts and with varying levels of mental health training. Such models must take into account the perspectives and real-life challenges faced by service providers and users in community-based care settings.

Although previous work has considered ways that community-based therapists can use e-mental health resources such as iCBT [33-36], there has been little systematic consideration of models by which diverse providers can incorporate a broad range of e-mental health resources into their practice.

Accordingly, the current paper proposes practice models by which e-mental health resources can be comprehensively incorporated into primary health care systems. The proposed models draw on a nonsystematic overview of published literature

and the authors' experience of training primary care service providers to use e-mental health resources. Our aim in presenting these models is to stimulate discussion, to provide a conceptual framework for future research and to assist clinicians who wish to explore the use of e-mental health resources in their practice.

Models of Delivery in Primary Health Care

Broad Approaches

We identify five broad approaches to the use of e-mental health resources, which require varying levels of service provider knowledge and engagement. The five models are: (1) promotion; (2) case management; (3) coaching; (4) symptom-focused treatment; and (5) comprehensive therapy.

Table 1 describes these models, detailing the role of the provider, the role of the e-mental health resource and the contact between the service user and provider. Table 2 shows the workers for whom the models are most relevant and the knowledge required to implement each model.

Table 1. Roles of service providers and e-MH resources in each practice model.

Model	Worker provides	Role of e-MH resource	Usual type of contact with worker
Promotion	Information about resources	User decides – can be information, support or treatment	Informal if passive promotion, formal if promotion occurs during a consultation
Case-management	Pre/post assessment, referral to e-resource, crisis support and alternative referral(s) where required	Resource is primary intervention, worker's role is mainly referral	Pre and post assessments scheduled, service user may initiate additional contact
Coaching	Support to help the person use the e-program Assessment and crisis support may be provided directly by worker or by associated services	Resource is primary intervention, worker's role is to assist user to engage with and complete program	Assessments, program support likely to be scheduled, service user may initiate additional contact
Integrated into symptom-focused therapy	Individual assessment and formulation Plan and deliver focused therapy incorporating e-MH and human-delivered therapeutic activities.	e-resource enhances /extends the work of the therapist in a discrete, symptom-focused intervention e-MH programs may also function as a guide for therapists	Ongoing and scheduled, service user may initiate additional contact
Integrated into comprehensive treatment	Comprehensive multi-dimensional clinical assessment and individualized formulation. Plan and deliver comprehensive intervention incorporating e-MH and traditional therapies. Therapist activities that relate to the e-MH resource may resemble those described in Models 1-4.	e-resource is used flexibly as one part of comprehensive, mixed methods intervention.	Ongoing and scheduled, service user may initiate additional contact.

Table 2. Service providers most likely to use each practice model and required knowledge.

Model	Likely to suit	Existing practice	Knowledge about e-MH
Promotion	Any worker in a clinical role; workers in non-clinical roles who are supervised by clinicians	Select and provide information about mental health services	Relevant e-MH portals and key information sites
Case management	Any worker in a clinical role that involves screening and referral for mental health concerns	Able to provide screening assessment, alternative referrals and crisis support	Familiar with key e-MH resources and ethical issues relating to e-therapies; able to refer and follow-up appropriately
Coaching	Workers in clinical roles able to assess mental health, refer and support service users' self-help activity.	As above plus capacity to maintain appropriate and focused coaching relationship.	Familiar with relevant e-MH programs and coaching protocols where they exist, capacity to develop or adapt coaching protocols; familiar with ethical issues relating to e-therapies.
Integrated into symptom-focused therapy	Therapists already providing discrete symptom/ disorder focused therapies such as CBT	Can provide individualized assessment/formulation, deliver symptom-focused therapy in traditional formats (e.g., face to face) and provide access to alternative referrals and crisis support	Familiar with relevant resources and ethical issues
			Able to flexibly integrate e-MH resources into intervention
Integrated into comprehensive therapy	Therapists already providing comprehensive individualized psychological assessment and therapies	Advanced therapy training, capacity to formulate and treat complex problems and use multi-modal approaches	Familiar with available online resources; specific knowledge of e-MH resources and ethical issues relevant to their area of practice

Referral Models

Overview

In the first three models, the e-mental health resource is the main intervention. The role of the community-based provider is to refer the service user to the resource and to provide varying degrees of support.

Advantages for service providers using these models include access to free high quality psycho-educational resources and increased referral options. Use of these models may potentially reduce practice costs and increase effectiveness and efficiency.

1) Promotion

What is the Promotion Model?

In this model, information is provided to service users to guide them towards high quality resources. At a minimum, providers can promote credible portal websites, which direct service users to relevant, evidence-based resources [37]. Providers can also become familiar with and promote the resources most relevant to their service - including information sites, symptom-focused treatment programs and online sources of emotional support.

Which Providers Are Most Likely to Use the Promotion Model?

Most primary health care providers can promote e-mental health resources. Those in non-clinical roles such as practice managers and administrators can arrange for promotional material to be displayed to service users in waiting rooms or on websites run by the practice. Providers in clinical roles may engage in more active forms of promotion such as briefly describing relevant resources to service users. This may occur in the course of general health consultations as well as in response to service users' requests for mental health assistance.

For example, general practice nurses have regular contact with people experiencing chronic physical conditions, to whom they provide information, monitoring and treatment. Given the high comorbidity of these conditions with mental health problems, practice nurses are well placed to promote awareness in this at risk group, to detect changes in life circumstances that may increase risk of mental health problems and to respond to the development of symptoms in these service users [38]. Similarly, service providers such as physiotherapists, exercise physiologists, and dietitians treat conditions that are highly comorbid with mental health concerns and can provide information about e-mental health services as appropriate.

There is also enormous potential for promotion by those who provide ancillary services to people experiencing mental health concerns. Community pharmacists are highly accessible and have regular contact with people who are using psychotropic medications. Relationships with pharmacists may be particularly important for people who lack continuity of care in their relationships with other professionals. This may be critical where service users obtain repeat medication prescriptions from different doctors in walk-in clinics.

There have been calls to extend pharmacists' role in recovery-oriented mental health care [39] and the promotion of e-mental health resources through pharmacies could be one means of facilitating this development. Pharmacists can encourage service users to explore appropriate e-mental health resources in addition to using medication. People interested in self-help interventions may also seek information about supplements such as St John's Wort. In addition to advice provided directly by the pharmacist, these customers can be encouraged to visit sites that provide evidence-based information about supplements and other interventions.

What Knowledge is Required to Use the Promotional Model?

Service providers working in clinical roles will have pre-existing knowledge about mental health, face-to-face care options, and referral processes. These providers would at least need to be familiar with key mental health portals and may also choose to learn about specific resources most relevant to their practice.

Where workers in non-clinical roles engage in promotion activities, it is expected that the clinicians employing them would oversee the selection of resources and the manner in which they were promoted.

Current Status of the Promotion Model

This approach requires little specialist knowledge or change to existing practice. In Australia, there is anecdotal evidence that e-mental health resources are already being promoted by mental health service providers and by general health workers in clinical and non-clinical roles including general practice nurses, practice managers, community health outreach workers, physiotherapists, pharmacists, and osteopaths.

2) Case Management

What is the Case Management Model?

In this model, the practitioner provides an initial assessment, referral to an e-mental health resource and a follow-up assessment. Referrals are most commonly made to iCBT or self-guided symptom-focused programs, but can also be made to e-mental health support groups and other resources.

Prior to referral, an initial assessment is required to determine the most suitable intervention. E-mental health programs typically use automated screening tools to help guide the service user in their intervention choices. These vary in complexity, but are often focused on the symptoms treated by the particular program. In community-based practice where the service user has approached a service provider for assistance, more comprehensive assessments are required (eg, [40]). These require a relatively high level of skill and service providers engaging in assessment should be appropriately qualified. Assessment will generally occur during face-to-face or possibly video-conferenced consultations [41], although information from e-mental health tools may be incorporated into the assessment.

Once the service user has engaged with the e-mental health program, the provider is not expected to assist them to work through it. However, the provider is expected to provide additional assessment, support, and alternative referrals if the service user does not find the e-mental health program to be helpful, and/or if their condition or situation deteriorates.

When used as an intervention in the case management model, the e-mental health resource is the main psychological treatment for at least one area of concern. It may be provided as a stand-alone intervention used in addition to other interventions. For example, a general practitioner might prescribe psychotropic medication and refer the service user to an iCBT program. Similarly, a person experiencing pain and depression might be referred to a physiotherapist as well as to an e-mental health depression treatment program. E-mental health resources can also be combined with human delivered psychological treatments (see Models 4 and 5 in this paper).

Which Providers Are Most Likely to Use the Case Management Model?

This approach is particularly suitable for practitioners who provide non-specialist mental health assessment and referral such as general medical practitioners. It is also used by mental health professionals such as those working as injury / rehabilitation consultants and in community outreach services.

In the case management approach, e-mental health services are considered as referral destinations where appropriate (eg, [40]). This can be particularly useful where specialist assistance is not available in a timely manner or not available at all. For example, we are aware of a public sector mental health team that encourages general medical practitioners to consider this approach for people who have undergone specialist assessment but whose symptoms are not sufficiently acute or severe to meet specialist service admission criteria.

This approach is useful where service users have been accepted into a service but cannot immediately access face-to-face support or psychological therapy, for example where there are waiting lists (eg, [42]). This is highly relevant to services that have existing triage, internal referral, and case management processes such those catering for a particular demographic group (such as young people) or disorder (such as substance use). Workers who already provide assessment and case management in these systems such as youth workers, substance abuse counselors and community health workers, can incorporate e-mental health resources into their work with some additional training.

The case management approach can also be used to introduce e-mental health resources as post-treatment booster or relapse prevention interventions. Anecdotal reports from service users indicate that although they may delay returning to face-to-face therapy until symptoms are relatively severe, they may access e-mental health resources when symptoms are still mild.

What Knowledge is Required to Use the Case Management Model?

Service providers using this model will already have clinical roles and relevant skills in assessment and referral. To refer to e-mental health resources, they would also need to be able to locate and evaluate relevant resources and have detailed knowledge of specific resources most relevant to their practice area.

Engaging in active follow-up assessments is critical in this model to enhance safety by ensuring that services are matched to clinical need and by providing access to alternative care as required. It also helps providers to understand how service users in their particular setting respond to e-mental health resources. If outcomes and adherence are disappointing, this should be investigated so that local service users' preferences can be understood and referral practices can be modified. However, it should be noted that people who do not complete online programs are not necessarily dissatisfied with the program (eg, [43-46]).

Current Status of the Case Management Model

This model is currently promoted and supported by a range of online services. For example, Australian online clinics support referrals and case management by offering clinicians' resources such as an online referral facility [32] and online decision-making tools and guides [45,47,48].

Some online providers have developed referral aids in the style of prescription or referral pads and distributed them to clinicians so they can direct service users to their particular programs. These aids have been distributed in printed format and in an electronic format that can be incorporated into medical practice software (eg, [47,48]).

As part of the eMHPrac project in Australia [29], referral aids have been developed to raise practitioner awareness of multiple resources. These aids are currently incorporated into a software application embedded within clinical information software, and it is hoped in the future that they will be incorporated directly into the most frequently used clinical information software packages (Personal communication by J Proudfoot and J Tennant, 2014).

3) Coaching

What is the Coaching Model?

In the coaching model, human support is added to a symptom-focused e-mental health program. The treatment team thus has three components—the service user, the human service provider and the e-mental health program. The online program is the primary intervention and provides the content and structure for the treatment. The coach supports the self-therapeutic activities undertaken by the service user and helps them engage with and complete the program [49].

Coaching combines the benefits of human support and Internet-delivered content. Online formats can reliably deliver material with high fidelity and may enhance learning and retention of critical material compared to traditionally delivered CBT [50,51]. On the other hand, human coaches may improve the match between service user and intervention through assessment and tailoring; support users to complete the program and enhance users' understanding and application of program material [41,52]. Coaching may be used to reduce the amount of clinician time required to deliver an intervention, improve fidelity and support non-expert workers to deliver basic interventions.

Which Providers Are Most Likely to Use the Coaching Model?

The provision of coaching by community-based providers raises critical questions about qualifications, training, and supervision. Requirements will depend upon the service users involved, the programs used, and the degree of therapeutic skill required by particular coaching protocols.

In community-based primary health care settings, coaching is most likely to be delivered by providers with an existing clinical role. For example, in Australia, coaching is likely to be delivered by health professionals but in other countries such as the United Kingdom, coaching is likely to be delivered by para-professional workers such as the IAPT's Psychological Wellbeing Practitioners [53].

Effectiveness studies of individual programs have demonstrated that, with appropriate training and supervision, a wide range of people can provide coaching. In one study, coaches were drawn from a mixed group of clinicians (general medical practitioners, psychologists, medical specialists, nurses, and other allied health practitioners) [45]. Other studies have included coaches who were: general medical practitioners with additional mental health training [54,55]; primary care nurses and social workers [7]; psychologists working in private practice [44] and in a non-government mental health organization [56]; community-based psychologists and social workers [46]; paraprofessional graduate mental health workers [57]; peer workers [58], and administrative staff [59].

There is great interest in incorporating the perspectives of people with lived experience of mental disorders into symptom-focused e-mental health programs. In addition to developing direct coaching roles, programs have included service user narratives in the automated content and/or hosted online peer forums within the program [59,60]. We are also aware of projects in which peer workers and advocates have developed their own coaching procedures for freely available Internet-delivered programs, in order to offer services to people living in areas that lack mental health treatment services.

What Knowledge is Required to Use the Coaching Model?

Providers already in clinical roles will have mental health knowledge and skills appropriate to their role and are able to provide mental health assessment, support, and referrals. Coaching that requires psychotherapeutic skills is likely to be delivered by providers who have therapy qualifications and already provide psychological services. In addition, they will need sufficient familiarity with e-mental health programs to match them with individual service users and skills relevant to providing coaching for the particular programs they use.

Coaches will also need to use their existing clinical skills, their understanding of particular programs, and service user preferences to decide whether to offer a coached intervention to an individual service user. Many protocols have excluded people who are psychotic, acutely suicidal, engaging in substance abuse, or have other conditions that may impair learning. Other factors to be considered include service users' Internet access; comfort and proficiency in using text-based material and computer programs, and their capacity to work independently [61-63].

Current Status of the Coaching Model

Overview

Coaching protocols have been developed for specific programs and suites of related programs. They have largely been applied in relatively controlled settings such as research trials, centralized online clinics and university or hospital-based clinics (eg, [31,52,60,64]).

Compared to providers in these settings, community-based providers have more diverse qualifications, work in more diverse service settings and provide services to more diverse users.

Rather than using a single program or programs from a single provider, they may wish to access a broad range of programs from various online providers for service users with diverse concerns and demographics.

Accordingly, examples of coaching protocols in the literature will often not, by themselves, be sufficient to guide providers in routine primary care settings. Rather, flexible protocols and clinical guides are required that can be tailored to the requirements of particular service users, the programs most relevant to those service users and the expertise of the service provider.

Community-based service providers who wish to participate in coaching activities can currently access protocols in two ways. First, some online services actively support community-based providers to coach users through the particular programs offered by that service. Resources available vary across programs but may include coaching guidance or manuals (eg, [47,52,65]). Training may be available for service providers to help them become familiar with the program, its coaching protocol, online communication techniques, and relevant ethical, legal, and technical issues [52,63].

Some e-mental health resources are explicitly designed to guide both the therapist and the service user to work on the material together during sessions. These do not necessarily reduce the amount of time required of service providers. Instead, they are designed to improve intervention quality and support a wider range of non-expert providers to deliver basic psychological interventions. For example, the Calm Tools for Living program guides the delivery of multi-diagnostic CBT treatment in primary care by health workers such as nurses and social workers [7]. Other examples include the StayStrong iPad app, which is designed for use with Australian Indigenous service users. It supports a wide range of workers to deliver a culturally appropriate structured mental health and substance abuse intervention [66].

Second, existing protocols (for example, those used in research) can be adapted to suit community-based providers and the service users they work with most frequently. The following draws on the research literature to illustrate the ways in which coaching can be implemented.

a) The Scope and Intensity of Coaching

Basic coaching activities include monitoring/ supervision, emotional and technical support, and encouragement to complete the program. Other coaching activities require psychotherapeutic skills, although the online program remains the primary focus. These include tailoring the program in response to individual service users' progress (for example by controlling the release of new content) and helping them to complete critical tasks such as exposure, which they might otherwise avoid [67-69]. In the CALM program, coaches also demonstrate skills such as controlled breathing [7].

Further research is needed to identify which coaching activities are critical but some key considerations have been identified.

Qualitative interview data has underlined the importance of interpersonal relatedness for maintaining engagement with iCBT

[70]. With regards to the coach/ service user relationship, the Supportive Accountability model is an overall model for optimizing human support in e-mental health interventions. It was proposed to aid research, but is a useful conceptual aid for practitioners entering this area [71].

Examples of coaching behaviors are available from analyses of emails sent by coaches to service users. In one study of an online program for Generalised Anxiety Disorder, the most frequently-coded therapist behaviors involved prompting and reinforcing task completion, and real-life application of program material. Reinforcement of task completion was significantly correlated with better outcomes. Poorer outcomes were associated with therapists being more flexible about program deadlines, but the direction of causality was not clear [72].

Similar themes were found in an analysis of therapist communications in a case study of iCBT for depression. Additional disorder-specific therapist communications were found, such as email content intended to increase hope and normalize the client's experience [62].

b) The Amount of Time Required

Program protocols usually indicate the coaching time required but this may be minimal once the service user has begun working through the program (eg, [59,73]). Indeed, many coaching functions can be at least partially automated, for example reminders to complete tasks, feedback about symptom quizzes, and prompts to seek professional advice [56,59,68,74-76].

Providers should carefully monitor service users' satisfaction with the time provided. Users may feel isolated and unmotivated if the coaching is too brief [70,77], although increasing amounts of therapist time may not necessarily improve outcomes [78]. Generally, however, more time will be required for coaching that involves therapeutic activity and coaching time in community settings will need to respond to the needs of individual service users [7,62,70].

c) Contact Arrangements

Service users can access online programs from locations of their own choice or from spaces provided by the coach (eg, [7,58]). Most symptom-focused programs require users to register an account. Some can be completed anonymously while others require users to provide personally identifying information.

In many protocols, contact between coaches and service users is asynchronous and conducted via emails, but may also occur through face-to-face meetings and telephone calls (eg, [44-46, 52, 54-56,64,66,79]). The use of text-based media such as email and chat requires additional training to ensure that the coach is competent in the clinical use of the media as well as secure online spaces in which to communicate with service users [26,46,80]. Coaching protocols usually provide email templates that coaches can personalize for individual service users (eg, [26,63,80]).

Most protocols specify deadlines for service users to complete tasks and schedules for contact between service users and providers, although service users may initiate additional contact [44-46]. Additional automated or human contact may be initiated

at critical times, such as when users have not made contact within a specified time period, if coaches are concerned about users' engagement with the program or their clinical status and when service users begin or complete key tasks [12,45-47,54,56].

Most programs provide service users with feedback as they work through the intervention, for example via symptom quizzes and other interactive exercises. Service users can print out this feedback and bring it to sessions or email it to their coach. Some programs provide information about user progress and clinical status directly to coaches [45,47,56,60,61].

Integrative Models

Overview

In the previous three referral models, the e-mental health program is the main intervention and the content and structure of the intervention is determined by the e-mental health resource. Models 4 and 5 are integrative models, where the therapist determines the content and structure of the assessment and overall intervention.

e-mental health resources can be integrated into any part of the therapy process. During assessment, therapists may incorporate information from online assessments, which are available as stand-alone tools or embedded within information sites or symptom-focused programs [81,82]. These resources can also be used to help improve therapy readiness and engagement. Service users can be encouraged to access particular sites and to talk with the therapist about the sites they have visited. This may help normalize and destigmatize service users' internal experiences, assist them to reflect upon and describe their internal experiences, help form optimistic and realistic expectations about therapy, and assist the transition into intervention. Anecdotal data indicates that the pre-therapy use of e-mental health resources may be particularly helpful with young people. Once a service user is engaged in treatment, providers may integrate e-mental health resources into their work to maximize the effectiveness of face-to-face sessions.

Two integrative models are described below. The first relates to integration of e-mental health resources with symptom-focused treatment, and the second refers to complex interventions.

4) Integrated into Symptom-Focused Treatment

What is the Symptom-Focused Model?

In this model, the therapist provides an individualized assessment, formulation, and intervention that incorporates traditional therapeutic activities as well as e-mental health resources.

The relative contributions of electronic resources and traditional therapy will vary across therapists and service users. E-mental health resources can be used to assist with standard therapeutic tasks such as assessment, psycho-education, self-monitoring, cognitive restructuring and the development of skills such as relaxation and mindfulness. Online peer groups can provide opportunities for behavioral experiments and social skills practice exercises.

Symptom focused programs can also be incorporated into therapy by presenting material in both electronic and face-to-face formats. In one study, participants received face-to-face CBT therapy in the first half of the sessions and worked independently through an online program in the second half. Outcomes for anxiety, distress, and depression in the combined (face-to-face and online) intervention were as good or better than outcomes in the traditionally delivered (face-to-face only) intervention [83]. The combined intervention thus reduced therapist time and maintained or improved outcomes.

e-mental health and therapist-delivered material can also be delivered sequentially. For example, a service user could meet with a therapist for a series of face-to-face sessions and then complete a symptom-focused e-program before returning to the therapist for a follow-up assessment (cf [34]).

There is also potential to develop symptom-focused group therapy interventions using e-mental health programs. This could occur in a similar manner to that reported for a primary-care mood-disorders group based on a computerized (but not Internet-delivered) CBT program [84]. This group was hosted by a general medical practice that provided a meeting room and a computer for each participant. The facilitators set a module for each session and in the first part of the session each participant used their computer to work through the module. After a tea break, facilitators led a group session on the topic of the module that had been completed by the group members.

Which Providers Are Most Likely to Use the Symptom Focused Model?

This model is likely to be used by therapists already providing discrete symptom-focused psychological interventions such as manual-based CBT to relieve specific symptoms and disorders. In the Australian primary health care system for example, this model is particularly relevant to providers delivering Focused Psychological Strategies interventions under the Medicare Better Access program [85]. These providers include psychologists, social workers, occupational therapists, and general medical practitioners with relevant therapy training. It would also be relevant to mental health nurses and other mental health workers delivering therapy in other primary care services.

What Knowledge is Required to Use the Symptom-Focused Model?

In order to use the symptom-focused model, providers require existing qualifications and experience in providing face-to-face symptom-focused therapies. In addition, they would need to be sufficiently familiar with specific e-mental health resources to choose relevant elements and integrate them into bespoke interventions for individual service users.

Current Status of the Symptom-Focused Integration Model

Although there are anecdotal reports of this model's use and some promising research data, more ecologically valid research is needed to evaluate whether it delivers improved effectiveness and efficiency in routine care.

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5) Integrated Into Comprehensive Therapy

What is the Comprehensive Therapy Model?

In this practice model, e-mental health resources are used in a comprehensive intervention designed and structured by the human therapist. The e-mental health resource is one element of a multi-modal approach that uses a range of interventions to treat a presenting problem or simultaneously addresses a number of presenting problems.

The therapist's role will include both traditional therapeutic activities and activities related to the service users' interaction with e-mental health resources. Therapists' roles in relation to e-mental health will vary from case to case and may resemble activities in described Models 2, 3, or 4. Thus the therapist may encourage the service user to use an information site, online support group or symptom-focused program in a relatively independent manner and monitor the service users' response to the resource. In other cases, the therapist will be more directly involved in supporting the service user's interaction with the electronic resource. For example, they may provide some coaching for an online CBT program or integrate the program into a symptom-focused intervention.

This integrated comprehensive model can be used where multiple therapeutic approaches are required to tackle one presenting problem, particularly where first line interventions have been unsuccessful or where some components of therapy require an emphasis on interpersonal processes occurring in the therapeutic relationship. For example, the early stages of treating complex trauma may require a strong focus on building the therapeutic relationship and engagement. Concurrent use of e-mental health programs at this stage could help lay the foundation for challenging activities such as exposure work. For example, working through a symptom-focused program could help provide some initial symptom relief, improve skills for managing arousal and enhance stability and resilience.

This approach can also be helpful where there is more than one presenting problem, or where there are comorbidities and secondary disorders that require treatment. Given that the number of funded sessions is likely to be limited, augmenting human delivered therapy with e-mental health resources may reduce the risks associated with incomplete or inadequate treatment of complex issues.

Which Providers Are Most Likely to Use This Model?

This model will be most relevant to therapists who already provide comprehensive individualized therapies in their existing practice. In the Australian primary care system for example, this would include clinical psychologists providing psychological therapies under the Medicare Better Access program and other therapists whose work involves tackling complex problems. It would also be relevant to providers whose primary role is to treat very specific concerns and who may need an additional resource to tackle comorbid problems such as anxiety, depression, and substance abuse. For example, in relationship interventions where one or more of the participants is experiencing a high prevalence disorder such as depression, the therapist can focus on interpersonal processes during

sessions and refer the symptomatic partner(s) to an online service that treats depression.

What Knowledge is Required to Use the Comprehensive Model?

Service providers who are engaging in comprehensive individualized assessment and therapy will already have extensive knowledge of psychological processes and diverse therapies as well as skills in developing multi-modal assessment and treatment plans. Those who provide therapy for specific issues such as relationship problems will have existing skills in screening for comorbid problems that require treatment. In addition, providers need to have familiarity with the e-mental health resources they intend to integrate into their therapies.

Current Status of the Comprehensive Therapy Model

At this stage, individual therapists are integrating e-mental health idiosyncratically into comprehensive therapies. Anecdotal evidence indicates that uptake of this model may be aided by its conceptual similarity to the use of face to face delivered CBT-based skills groups traditionally provided alongside individual specialist therapy in secondary care psychiatric services.

Discussion

Community-based service providers are developing innovative ways of incorporating e-mental health resources into their practice. The models described here are intended to help researchers, policy-makers, and service providers conceptualize the ways in which e-mental health resources can be incorporated into existing systems of health delivery.

These practice models can also be integrated into innovative service delivery models that improve the delivery of mental health services in primary health care. For example, stepped care and stratified care models are distinguished from usual care partly by the systematic inclusion of less specialist and lower intensity psychological interventions [86-88]. The promotion, case management and coaching models can be used to deliver psycho-education, support, and symptom-focused interventions in low intensity interventions [89]. The integrative models described here can be incorporated into higher intensity interventions.

Similarly, collaborative care models for severe depression typically include case management or care coordination roles and systematically support service user self- management. Access to psychological interventions within collaborative care models is associated with better outcome [90]. Clearly, the incorporation of e-mental health resources could support this work, for example through the promotion of high quality online self-help material and case management referrals to iCBT.

The models described here are also compatible with emerging enhancements to service delivery systems. For example, virtual clinic environments are currently being developed that will offer a range of e-mental health resources within a defined online environment. They will provide a framework within which service providers and users can choose interventions of known quality and may allow the automation of some activities

currently undertaken by humans, including aspects of promotion, case management, assessment, and coaching.

e-mental health resources support self-management and service user expertise and are thus also compatible with emerging recovery-focused, person-centered approaches. One example is the support facilitation approach currently being developed in Australia for people with complex, severe and persistent mental illness [91]. Support facilitation workers assist service users to engage with a range of services and the referral models (promotion, case management, and coaching) described in the current paper are highly relevant to these roles.

Future Research

Outcome Research

The current paper has demonstrated how e-mental health resources can be incorporated into routine care and some of the potential advantages of doing so. However, research into community providers' use of e-mental health resources is at an early stage and it is not yet possible to determine the optimal ways for providers to interact with the resources. There is an urgent need for research to evaluate the effectiveness, safety, and efficiency of the clinical practice models described in this paper.

As an initial step, a systematic synthesis of existing literature is needed to identify gaps in the literature and inform clinical practice. The current paper is based on a narrative review in which the most visible body of e-mental health outcome research involved coaching, but a more systematic approach may identify additional bodies of evidence that relate to other practice models.

As outcome research develops in this area, it will be critical to use research methodologies that optimize ecological validity as well as scientific rigor. These should include practice-based methodologies that balance the need to retain intervention fidelity and the need for flexibility that allows interventions to be adapted for use in routine care settings [92]. It will also be important to actively involve practitioners in developing practice-based procedures to guide implementation and evaluation (eg, [56,93]).

Research Into Providers' Use of E-Mental Health Resources

Anecdotal reports and existing literature suggests that practitioners most commonly interact with e-mental health resources by recommending websites to service users. For example, nearly 90% of an Australian sample of general medical practitioners reported that they recommended websites to service users, and a mental health information site was included amongst the three most frequently recommended sites [94].

Other studies have investigated the uptake of iCBT amongst service providers and have reported low rates of use [61,95-97]. Providers seem to prefer the idea of adding iCBT to existing clinical practice rather than using it as a replacement. This preference has been reported in various provider groups including CBT therapists [97], youth workers [98], and rural health care practitioners [99].

Taken together, these studies suggest that community-based practitioners may be most likely to use online resources in ways that are most consistent with the promotion, case management, and integrative models described in the current paper. Unfortunately, as noted above, there is less research on these models than on the coaching model.

In order to assess the degree to which e-mental health resources are being integrated into health delivery systems, it will also be important to continue measuring uptake by provider groups. Some studies thus far have been limited by small sample sizes and a focus on measuring practitioner attitudes and intentions with less focus on quantifying actual behavior. Furthermore, the lack of clearly defined provider roles and behaviors in the use of e-mental health resources has meant that the meaning of "practitioner use" is at times unclear or variable across studies.

Future studies can be improved by the use of adequate samples and using the models proposed in the current paper to more clearly conceptualize and define the outcomes of interest.

Research Into Factors That Influence Provider Behavior

Successful dissemination will require a good understanding of the factors that can hinder and facilitate provider engagement with online resources.

Existing surveys on practitioner attitudes to iCBT and have found that they are generally open to the concept of using iCBT, particularly for people with less severe or complex symptoms and where some clinical support is provided (eg, [98-102]). Factors related to technological proficiency and access do not seem to be major obstacles to uptake in general but are perceived to affect the viability of using e-mental health resources with specific clients, therapists, and settings [97,100,101].

Commonly cited barriers include providers' lack of accurate knowledge about the resources, lack of training in their use, and concerns about their effectiveness, safety and clinical responsibility [97,98,100-105].

The Promotion Model requires relatively little change to providers' usual practice, particularly if they already provide psycho-educational materials such as printed handouts. Practitioners who wish to use the other models described in this paper will need to gain new knowledge, engage more deeply with e-mental health resources, and make some conceptual changes to their practice.

Obstacles to acquiring relevant knowledge include having the time to review resources and lack of access to training [99]. Even where time and training is available, providers are unlikely to prioritize learning about e-mental health resources unless they perceive it to be beneficial. In the absence of direct financial incentives, potential benefits may include reduced expenses associated with preparing and printing psycho-educational material (promotion model), access to additional referral destinations (case management model), the possibility of achieving more within the same number of sessions (integrative models) and being able to meet the expectations of service users.

In Australia, evaluation activities associated with the eMHPrac project will contribute to future research. Data will be collected on the ways that providers use e-mental health resources and on the proportion of e-mental health service users who have accessed key websites as result of a recommendation from a provider. Annual surveys and evaluation of eMHPrac provider training interventions will provide data on factors that influence practitioner engagement with and use of online resources.

health care. The current paper has described five clinical practice models to help researchers, policy-makers, and service providers conceptualize the ways in which e-mental health resources can be incorporated into existing and emerging systems of health delivery. Further research is urgently needed to identify the best procedures for implementing the various practice models, the best means of supporting practitioner uptake and to establish the effectiveness and safety of each practice model when applied in community-based routine care settings.

Conclusions

e-mental health resources can be incorporated into the routine practice of diverse service providers and settings in primary

Conflicts of Interest

The authors are responsible for delivering ANU's e-hub Mental Health suite of online programs. These programs are promoted along with other services by the eMHPrac project.

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<u>Viewpoint</u>

Mental Health Mobile Apps: From Infusion to Diffusion in the Mental Health Social System

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Abstract

The roles of mental health educators and professionals in the diffusion of mental health mobile apps are addressed in this viewpoint article. Mental health mobile apps are emerging technologies that fit under the broad heading of mobile health (mHealth). mHealth, encompassed within electronic health (eHealth), reflects the use of mobile devices for the practice of public health. Well-designed mental health mobile apps that present content in interactive, engaging, and stimulating ways can promote cognitive learning, personal growth, and mental health enhancement. As key influencers in the mental health social system, counselor educators and professional associations may either help or hinder diffusion of beneficial mHealth technologies. As mental health mobile apps move towards ubiquity, research will continue to be conducted. The studies published thus far, combined with the potential of mental health mobile apps for learning and personal growth, offer enough evidence to compel mental health professionals to infuse these technologies into education and practice. Counselor educators and professional associations must use their influential leadership roles to train students and practitioners in how to research, evaluate, and integrate mental health mobile apps into practice. The objectives of this article are to (1) increase awareness of mHealth and mental health mobile apps, (2) demonstrate the potential for continued growth in mental health mobile apps based on technology use and acceptance theory, mHealth organizational initiatives, and evidence about how humans learn, (3) discuss evidence-based benefits of mental health mobile apps, (4) examine the current state of mHealth diffusion in the mental health profession, and (5) offer solutions for impelling innovation diffusion by infusing mental health mobile apps into education, training, and clinical settings. This discussion has implications for counselor educators, mental health practitioners, associations, continuing education providers, and app developers.

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Introduction

This article addresses the roles of mental health educators and professionals in the diffusion of mental health mobile apps. These emerging technologies fit under the broad heading of mobile health (mHealth), where mHealth, encompassed within electronic health (eHealth), reflects the use of mobile devices for the practice of public health. The objectives are to (1) increase awareness of mHealth and mental health mobile apps, (2) demonstrate the potential for continued growth in mental health mobile apps based on technology use and acceptance theory, mHealth organizational initiatives, and evidence about how humans learn, (3) discuss evidence-based benefits of mental health mobile apps, (4) examine the current state of mHealth diffusion in the mental health profession, and (5) offer solutions

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for impelling innovation diffusion by infusing mental health mobile apps into education, training, and clinical settings. This discussion has implications for counselor educators, mental health practitioners, associations, continuing education providers, and app developers.

The Mobile Health Explosion

Overview

Nascent digital technologies blazed the trail for the explosion of mHealth and mobile health apps (Figure 1). In 2012, 75% of American households used the Internet within the home [1], and 79% of Americans accessed the Internet during the prior month [2]. Some form of broadband is available to almost 99% of the US population [1]. Cellular phone subscribers grew from approximately 5 million Americans in 1990 to over 326 million in 2012 [3]. As of October 2012, 88% of Americans ages 25 and older used mobile phones [1].

According to ABI Research, 9 billion apps were downloaded worldwide to mobile phones in 2010. In 2011, there were roughly 17,000 health-related applications for iPhones, Android-based devices, and other mobile phones and tablets [4]. Of the 9,000 consumer health apps available in 2011, approximately 6% related to mental health, 11% to stress management, 4% to sleep, and 2% to smoking cessation [5]. International Data Corporation had forecasted 76.9 billion global app downloads for 2014 [6], where the mHealth market accounted for nearly $9 billion [7]. By 2017, it is estimated that half of the 3.4 billion mobile phone or tablet users worldwide will be using mHealth apps [8].

Potential for Mental Health Mobile Apps Growth

Evaluating mental health mobile app development and use through the lens of the unified theory of acceptance and use of technology (UTAUT) provides insight into the prospective continued growth of mHealth technologies. In 2012, Venkatesh and colleagues applied UTAUT to consumers and developed UTAUT2 (Figure 2) [9]. As app developers apply the findings from this comprehensive technology use and acceptance theory that pulled together decades of research, it follows that numbers of apps and the number of app users will continue to increase. The constructs identified in UTAUT2 may be applied specifically to a consumer's behavioral intention to use mental health mobile apps.

Figure 1. Digital technologies blazed the trail for the mHealth explosion.
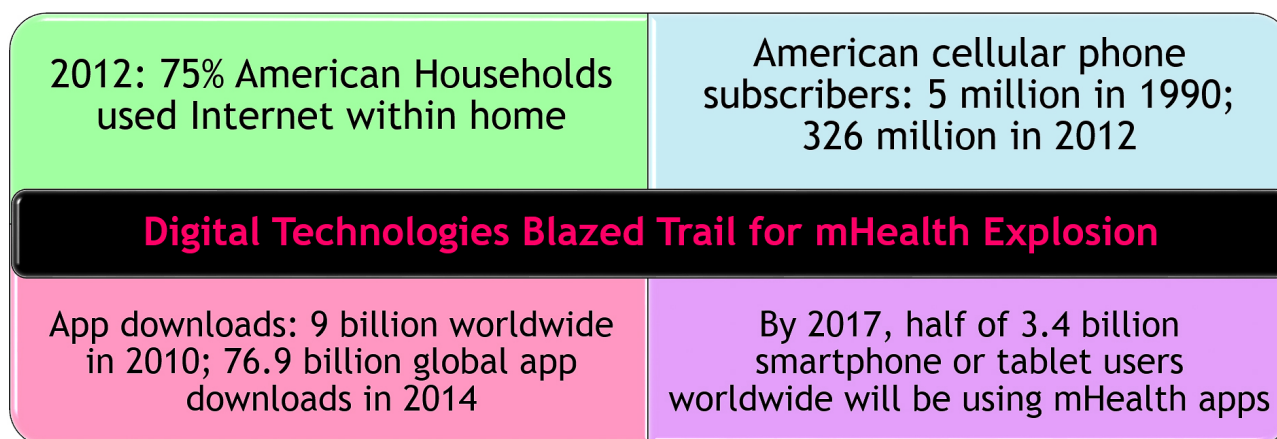
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Figure 2. Potential for diffusion of mental health mobile apps based on the unified theory of use & acceptance 2 (UTAUT2). © 2012, Regents of the University of Minnesota, used with permission.
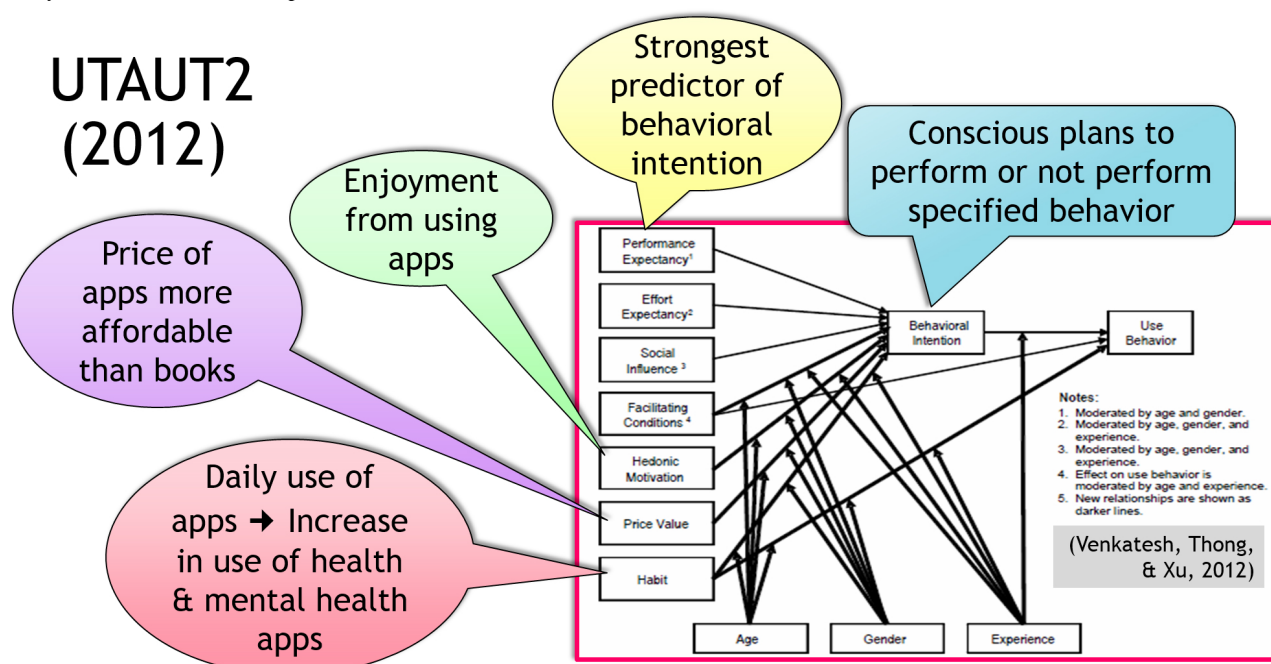
Performance Expectancy

Performance expectancy is the degree to which a mental health mobile health app will provide benefits to consumers performing certain activities. According to Venkatesh et al, this construct has been shown to be the strongest predictor of behavioral intention [9]. When mental health providers endorse and encourage the use of particular apps, consumer performance expectancy is heightened, increasing the likelihood that patients will use provider-recommended apps.

Effort Expectancy

Effort expectancy is the degree of ease associated with consumers' use of mental health mobile apps. With the passage of time, consumers become more experienced with mobile apps and understand how easy it is to use a personal phone to interact with mental health information. Consumers and practitioners will soon learn that very little effort and time is required to benefit from using mental health mobile apps.

Social Influence

Social influence is the extent to which consumers perceive that family and friends believe mental health mobile apps should be used. As the number of app downloads increases, so too will the social influence on even more people to use mental health mobile apps. Mental health professionals may also exert social influence on colleagues and patients to use mental health mobile apps.

Facilitating Conditions

Facilitating conditions refers to consumers' perceptions of the resources and support available to perform a behavior. As consumers become adept in using mobile phone features and interacting with apps, the ability to connect to the Internet becomes more ubiquitous, and as app developers offer more user-friendly, evidence-based apps and technical support, conditions will be facilitated to increase app use.

Hedonic Motivation

Hedonic motivation, enjoyment from using apps, is also a predictor of intention to use apps. Using mobile apps to access and interact with mental health information can be much more engaging and stimulating than sources of mental health information used in the past.

Price Value

Price value is an important factor as consumers have to bear the costs associated with purchasing mobile apps. Many mental health mobile apps are less than $5.00 and many are free. The price value of apps is much more affordable than the price of many books or workbooks.

Habit

Habit is the extent to which people tend to perform behaviors automatically because of learning. "Habit is a perpetual construct that reflects the results of prior experiences" (p161) [9]. As people increasingly use a variety of apps as a daily habit, this will increase the likelihood that people will also use mental health mobile apps.

National and Global Mobile Health Initiatives

Overview

Grasping the potential of mHealth, national and global level organizations are also lighting the way with initiatives for a healthcare paradigm shift and the mHealth explosion (Figure 3). In 2013, the US Department of Health and Human Services Office of the National Coordinator for Health Information Technology released the National Action Plan to Support

Consumer Engagement via eHealth [10]. The goal is to increase eHealth information access, support the development of related digital tools, and shift attitudes from traditional patient-provider roles to patient-centered care.

The World Health Organization (WHO) stated that mobile technologies have "potential to transform the face of health service delivery across the globe." (p1) [11] WHO's mHealth report indicates applications of mobile phone technologies in maternal and child health, diseases, access to emergency and general health services, and treatment enhancement. The WHO mHealth report also noted the United Nations included mHealth as a key innovation for advancing the Global Strategy for Women's and Children's Health, launched in New York in 2010 [11]. Another report by the WHO, the Mental Health Action Plan 2013-2020, includes a goal to promote self-care through the use of mobile health technologies [12].

In addition, the US Food and Drug Administration (FDA) features a mobile medical apps page on its website and states "the widespread adoption and use of mobile technologies is opening new and innovative ways to improve health and health care delivery" and "these tools are being adopted almost as quickly as they can be developed." The FDA website indicates the agency encourages development of mobile medical apps that improve health care and provide health information [13].

Capabilities of Mental Health Mobile Apps

In his book, *Brain Rules, 12 Principles for Surviving and Thriving at Work, Home, and School,* molecular biologist John Medina conveyed scientific evidence about how brains learn and work [14]. The studies that formed a basis for Medina's *12 Brain Rules* (Figure 4) were published in peer-reviewed journals and successfully replicated. Some of Medina's brain rules relate well to the capabilities of mental health mobile apps to enhance mental health intervention and treatment.

Figure 3. National and global electronic and mobile health initiatives.
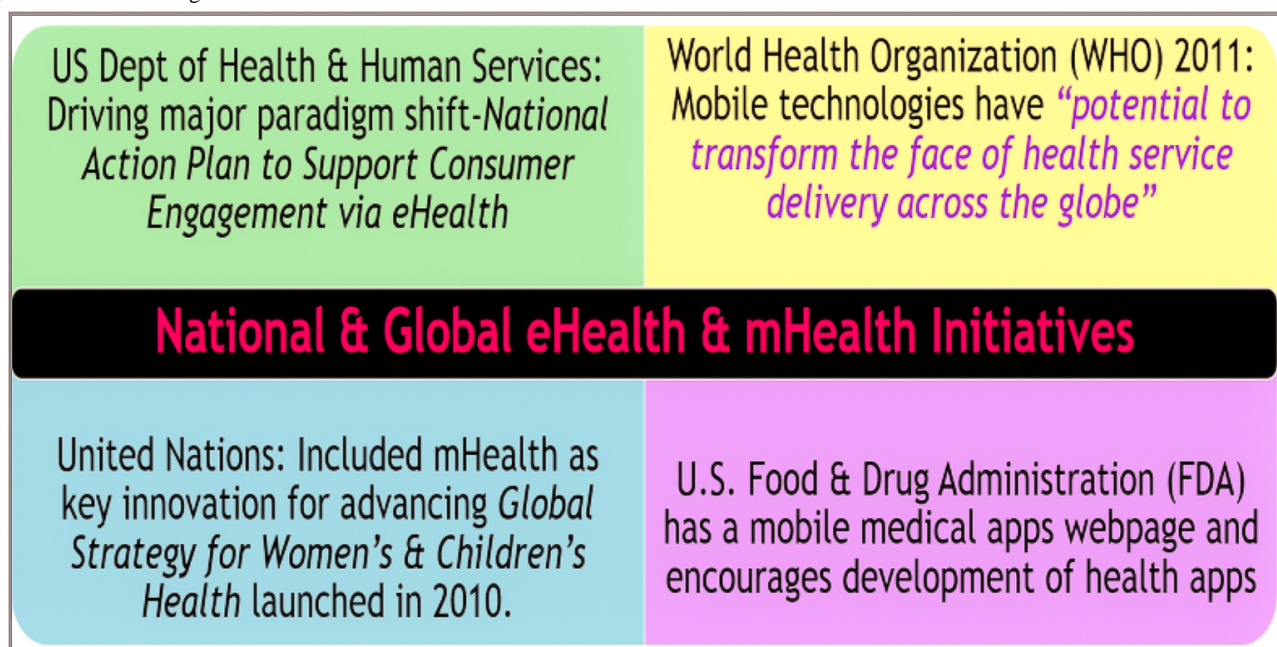
Figure 4. Six of Medina's 12 Brain Rules that relate well to the potential of mental health mobile apps to enhance learning and personal growth. From Brain Rules, by John Medina. Copyright ©2008 by John Medina, used with permission.

Medina's 12 Brain Rules

1. **Survival:** The human brain evolved too
2. **Exercise:** Exercise boosts brain power
3. **Sleep:** Sleep well, think well
4. **Stress:** Stressed brains don't learn the same way
5. **Wiring:** Every brain is wired differently
6. **Attention:** We don't pay attention to boring things
7. **Memory:** Repeat to remember
8. **Sensory Integration:** Stimulate more of the senses
9. **Vision:** Vision trumps all the other senses
10. **Music:** Study or listen to boost cognition
11. **Gender:** Male and female brains are different
12. **Exploration:** We are powerful & natural explorers

Rule #1 Survival: the Human Brain Evolved Too

With technology interaction, the human brain evolves. Former homework tools such as handouts and workbooks are outdated. As people continue to embrace mobile phone technologies, people will likely be less interested in writing on handouts.

Rule #6 Attention: We Don't Pay Attention to Boring Things

Well-designed mobile apps are much more interesting than black words on a white sheet of paper. App designers apply research about colors, fonts, backgrounds, and learning activities. Applying this research to app content helps engage attention and maintain the interests of users.

Rule #7 Memory: Repeat to remember

Working memory, also known as short-term memory, is limited in capacity. mHealth apps can help people learn new information to improve mental health. It is easy to tap and slide on a mobile phone screen. The built-in features of mobile apps permit frequent repeating of information; repeating facts engages the transfer of information to long-term memory. In addition, mobile phones with app capabilities permit users to access limitless sources of information on the Internet in a readily-accessible personal handheld device, enhancing the abilities of users to learn and apply health information.

Rule #8 Sensory Integration: Stimulate more of the senses

With colorful graphics, videos, music, audio, and kinesthetic interaction, well-designed apps simultaneously engage several senses; this enhances the learning experience. The study on deep breathing apps by Chittaro and Sioni is an example of sensory integration in a mental health mobile app [15] where the integration of visualization with an historically auditory intervention improved the effectiveness of deep breathing training.

Rule #9 Vision: Vision Trumps All the Other Senses

Being able to view graphics, diagrams, charts, and videos on mobile phones offers varied learning experiences. Visual explanations of mental health information provide users with the opportunity to deepen their understanding of mental health concerns in an engaging manner.

Rule #12 Exploration: We Are Powerful and Natural Explorers

Well-designed mental health mobile apps permit users to engage in interactive exploration. Medina notes that humans learn by observing, testing, and experimenting.

Mental health mobile apps offer a framework for implementing what Medina's research revealed about how to help people learn. Well-designed mental health mobile apps that present content in interactive, engaging, and multisensory approaches can promote cognitive learning, personal growth, and mental health enhancement.

Evidence-Based Benefits of Mental Health Mobile Apps

Because mental health professionals have an ethical duty to use evidence-based interventions [16-19], it is necessary to evaluate research evidence. Studies regarding efficacy evidence of mental health mobile apps are appearing in journals. Research may be found regarding apps to support treatment for anxiety, depression, social phobia, obsessive compulsive disorder, and posttraumatic stress disorder. Treatments such as cognitive behavior therapy, dialectical behavior therapy, and prolonged exposure therapy are being assimilated into apps that supplement the therapy process. Apps are being used to assist with social work, client monitoring, and psychoeducation.

Luxton et al [20] provided an overview of mobile phone use in behavioral health care. The researchers presented a table of behavioral health apps based on clinical area, platform, and purpose. It is clear from this review that mobile phones are being used to deliver treatment inventions, psychoeducation, audio-recording of sessions, and virtual coaching. The researchers note:

> The rapid growth in the use of smartphones has opened a new world of opportunities for use in behavioral health care. Mobile phone software applications (apps) are available for a variety of useful tasks to include symptom assessment, psychoeducation, resource location, and tracking of treatment progress. The latest two-way communication functionality of smartphones also brings new capabilities for telemental health. [p505, [20]]

The Luxton et al overview indicates the potential of mental health mobile apps for consumer empowerment, reduction of stigma associated with seeking mental health treatment, self-monitoring, improved patient/provider communication, and enhancement of psychological services (Figure 5). They also highlighted another promising use of mobile phones in behavioral health: external hardware devices such as biofeedback sensors may be connected to mobile phones. Such external devices combined with mobile phone capabilities and app features may be used to improve mental health. In projecting the future of behavioral health digital technology, Luxton et al note:

> Future widespread use of smartphone technology in the behavioral health field can be expected. Our increasingly mobile, tech-savvy, and health conscious society will demand care delivery solutions that expand beyond traditional office-based requirements to better fit diverse needs and lifestyles. [p510, [20]]

Georgia State University researchers Jabeley and colleagues researched an augmented version of SafeCare, as an in-home child safety mobile phone app intervention [21]. Parents were trained to use a mobile phone (iPhone) to video rooms in their homes to assist in identifying child safety hazards and toxins. The parents shared the videos with an observer in a graduate public health education program and both the observer and the parents used mobile phones to communicate feedback, logistics, and safety content. The researchers found that hazards were reduced across rooms and across participants. As well, the face-to-face time of the home observers was progressively reduced and replaced by video data collection. This study suggests that mobile phones with app capabilities are promising for data collection and for augmenting face-to-face interactions.

In Finland, Lappalainen et al conducted a pilot study to assess the feasibility of the P4Well intervention in treatment of stress-related psychological problems in males [22]. P4Well is a novel intervention which combines modern psychotherapy, cognitive behavioral therapy, and acceptance and commitment therapy, with personal health technologies to deliver the intervention via multiple channels. The intervention includes group meetings, an internet portal, mobile phone applications, and personal monitoring devices.

> Our results confirm the feasibility of the intervention and suggest that it had positive effects on psychological symptoms, self-rated health, and self-rated working ability. The intervention seemed to have a positive impact on certain aspects of burnout and job strain, such as cynicism and over-commitment. (p1) [22]

Mobile mind mapping apps can support counseling frameworks, such as rational emotive behavior therapy (REBT) as discussed by Warren [23]. A major goal of REBT is to encourage clients to become their own therapists. Clients may use mobile mind mapping apps to implement REBT principles during or immediately after adverse situations, and may use it daily for storing and readily accessing a database of rational thoughts.

Several mobile apps are available to guide users through deep breathing exercises, a technique often used to reduce stress, anxiety, and depression. Audio breathing guides have been the status quo. Mobile apps, however, have presented the ability to add a visual element to deep breathing guides. Chittaro and Sioni conducted an analysis of three approaches to deep breathing training [15]. One employed a traditional audio method, and the other two employed different types of visualizations used together with audio instruction. The researchers analyzed participants' physiological reactions and subjective perceptions and their findings indicate that visualization can contribute to the effectiveness of breathing training apps.

In addition to the benefits offered by mental health mobile apps, it is evident that target populations are interested in using their

phones to monitor and improve their mental health. For example, a study by Torous and colleagues indicated psychiatric outpatients are interested in using their mobile phones to monitor their mental health [24]. The researchers surveyed 320 psychiatric outpatients from clinics in four states and found that about 70% of patients were interested in using mobile phones to monitor symptoms. Based on their results, the researchers concluded there may be fewer patient obstacles to mobile phone application-based clinical monitoring and treatment protocols than commonly thought.

Figure 5. Benefits and uses of mental health mobile apps.
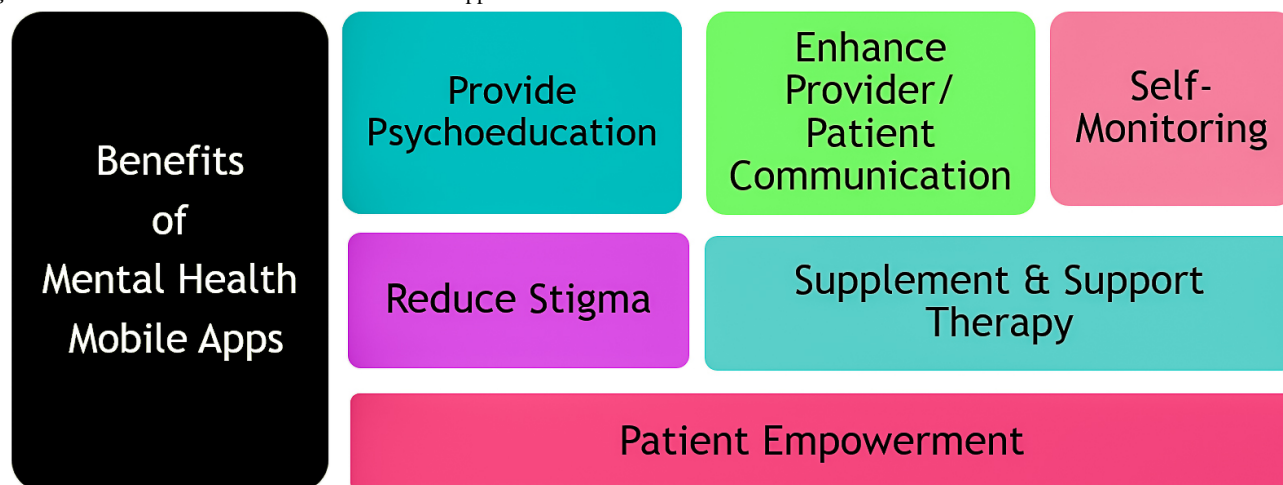
The Diffusion of Mental Health Mobile Apps in the Mental Health Profession

Overview

Rogers described innovation diffusion as the process of communicating an innovation over time among members of a social system [25]. Counselor educators and professional associations are key influencers of the diffusion or lack of diffusion of mHealth throughout the mental health social system. Counselor educators and associations must consider the importance of their roles in providing instruction regarding mental health mobile apps and their roles in the innovation diffusion process.

Counselor Education

Counselor educators are to provide instruction on the most current knowledge, empirically based techniques, procedures, and modalities. In addition, counselor educators are obligated to heed accreditation standards that require education programs to produce evidence of the use and infusion of technology [18]. A technology-infused learning environment is one in which technology permeates the educational setting and the curriculum. Counseling professionals are to actively pursue understanding of how to use technology resources to better serve clients [16,18,19]. Based on these ethical mandates and standards, it is clear that counselor educators are directed to learn about and teach students how to integrate evidence-based mental health mobile apps into practice.

The mental health profession, however, has lagged in technology adoption for counselor education and treatment interventions [20,26]. In an article on the use of social media in counselor education, for example, Tilman and colleagues indicate "The digital age marches on with or without counselor education programs being prepared." (p1) [27]

Professional Association Conferences

Continuing education for mental health professionals is to reflect current knowledge and emerging developments [17,19], and counselors are to be open to and obtain training on new procedures [16]. Educators and practicing mental health professionals often rely on professional conferences to obtain required continuing education credits. The authors of this article conducted a content analysis in early February 2015 to identify mental health technology-related topics offered at conferences (Table 1).

Thousands of mental health mobile apps are currently available in app stores. However, out of 4,404 session topics at the 12 conferences included in the content analysis, 4.1% (179/4,404) were technology-related topics. Only 0.3% (14/4,404) of topics specifically addressed mental health mobile apps. This analysis of professional association conference topics indicates training is lagging behind development. There is room to include more mental health technology topics at professional conferences. Mental health associations have a timely opportunity to encourage and offer more research and training regarding the use of mental health mobile apps and other mental health technologies.

Table 1. Content analysis of mental health professional conferences 2013-2015: technology-related session topics.

Conference	Year[a]	Technology-related topics[b], n	Total sessions[c], n	Technology - related topics[d], %	Mental health mobile app topics[e], n
American Association for Marriage & Family Therapy	2013	5	161	3.0%	0
American Association for Marriage & Family Therapy	2014	3	77	3.8%	0
American Board of Professional Psychology	2014	0	26	0.0%	0
American Board of Professional Psychology	2015	0	19	0.0%	0
American Counseling Association	2014	20	361	5.5%	0
American Counseling Association	2015	17	457	3.7%	1
American Mental Health Counselors Association	2013	3	82	4.0%	0
American Psychiatric Association	2013	11	512	2.1%	2
American Psychiatric Association	2014	18	597	3.0%	1
American Psychological Association	2013	54	990	5.5%	7
American Psychological Association	2014	43	983	4.4%	3
National Association of Social Workers	2014	5	139	3.5%	0
Total, N or mean (%)		179	4,404	4.1%	14

[a] This content analysis was completed in early February 2014. Only two conferences had complete conference programs available for 2015 at that time.

[b] Search terms used: app/apps, blog/blogging, digital, distance, eHealth/e-Health, ethics, games/gaming, innovative/innovation, internet, mHealth/m-Health, mobile, online, psychotechnology, social media, technology, telecoaching, teleconsulting, telehealth, telepsychology, twitter, virtual/virtual reality, and web/website/web-based

[c] Included were conference program courses, case conferences, advances, symposia, lectures, reports, workshops, and forums. Poster sessions were not included due to overlap with other sessions.

[d] Calculated by dividing technology-related topics by total session number.

[e] Included in technology-related topics

Solutions for Impelling Diffusion of Mental Health Mobile Apps

Overview

Mental health mobile apps are considered to be emerging technologies. As mental health mobile apps move toward ubiquity, research will continue to be conducted. The studies published thus far, combined with the potential of mental health mobile apps for learning and personal growth, offer enough evidence to compel mental health professionals to integrate these technologies into education and practice. Counselor educators and professional associations must use their influential leadership roles to train students and practitioners in how to research, evaluate, and integrate mental health mobile apps into practice.

The ultimate guide for using or teaching any therapeutic intervention or mental health technology is to only do what is good for patients and not harm patients. These principles of beneficence and non-maleficence guide ethical codes, laws, and daily practices. In recommending particular mental health mobile apps to patients, professionals must carefully consider issues such as privacy, informed consent, security of confidential data, and potential harm. Since ethical concerns are highly relevant and are not to be ignored, the goal of mental health professionals should be to exercise ethical prudence while simultaneously embracing the benefits of mental health mobile apps (Figure 6).

Promoting Technological Literacy

Promoting technological literacy will assist counselor educators and professional associations in diffusing the innovation of mental health mobile apps throughout the mental health social system. In the book *Using Technology to Improve Counseling Practice, A Primer for the 21st Century,* Tyler and Sabella synthesized several explanations of technological literacy into the following definition:

Technological literacy is the intellectual processes, abilities, and dispositions needed for counselors to understand the link among technology, themselves, their clients, and a diverse society so that they may extend human abilities to satisfy human needs and wants for themselves and others. (p5)[28]

Although Tyler and Sabella's definition was written a decade ago, well before the emergence of mental health mobile apps, it continues to be a useful definition. The authors further define the abilities of technically literate health professionals which are summarized in Figure 7.

Figure 6. Mental health professionals are to balance ethical concerns with the benefits of mental health mobile apps.
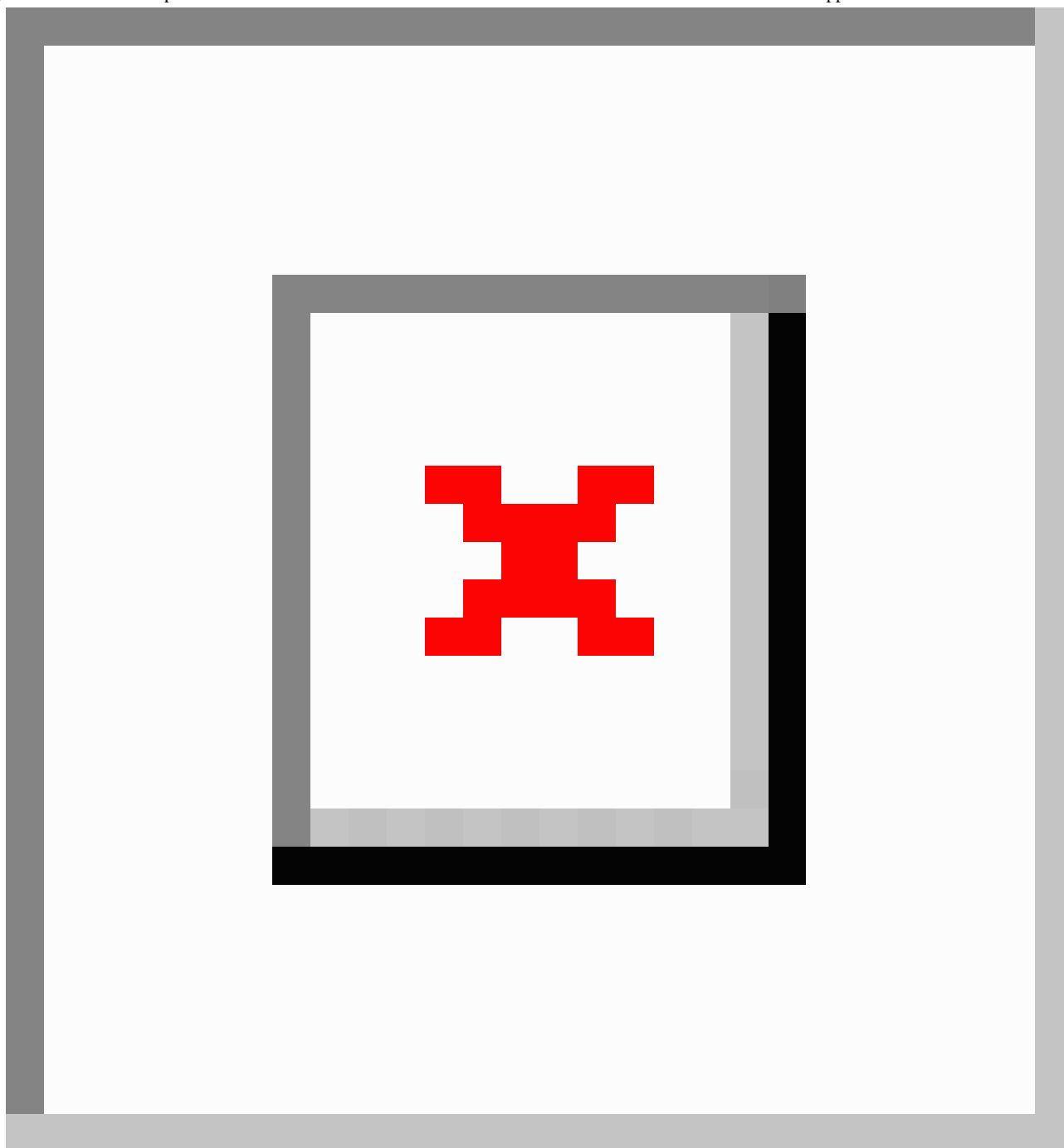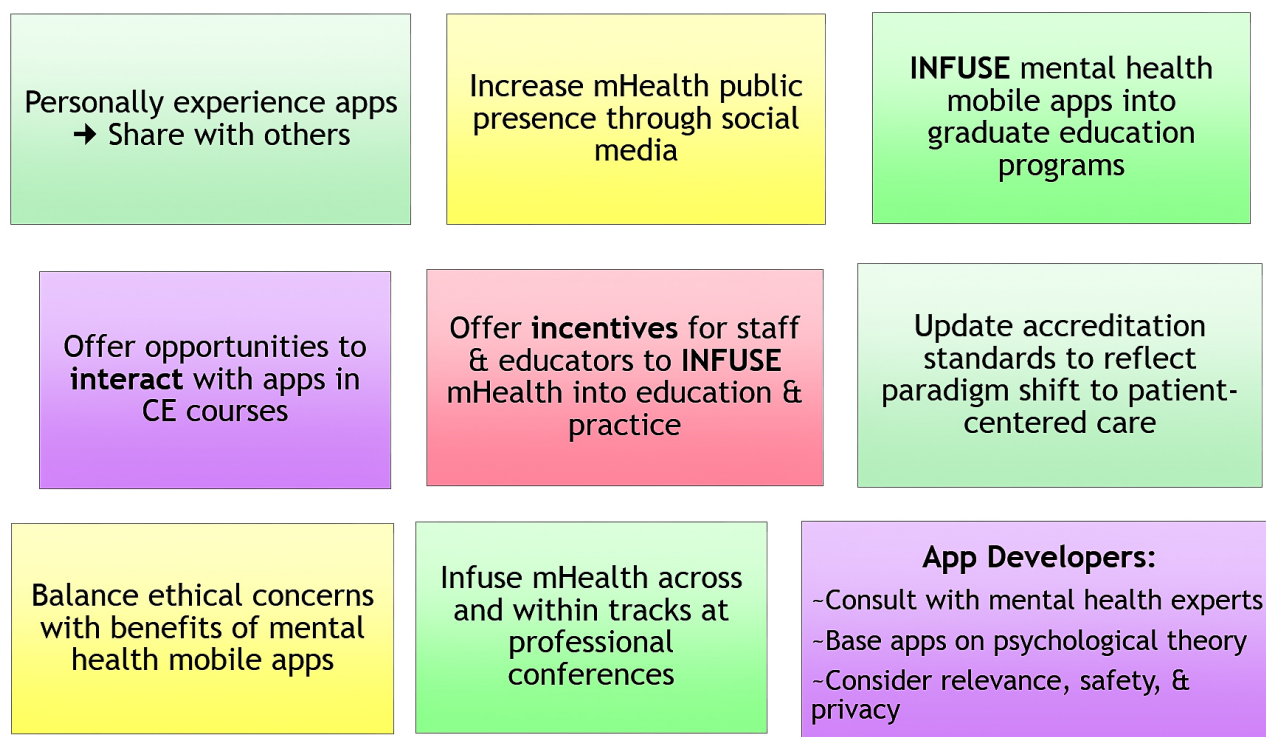

Figure 7. Abilities of technically literate health professionals. From Using Technology to Improve Counseling Practice, A Primer for the 21st Century [29].

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Figure 8. Solutions for impelling diffusion of mental health mobile apps.

Personally experience apps ➜ Share with others	Increase mHealth public presence through social media	**INFUSE** mental health mobile apps into graduate education programs
Offer opportunities to **interact** with apps in CE courses	Offer **incentives** for staff & educators to **INFUSE** mHealth into education & practice	Update accreditation standards to reflect paradigm shift to patient-centered care
Balance ethical concerns with benefits of mental health mobile apps	Infuse mHealth across and within tracks at professional conferences	**App Developers:** ~Consult with mental health experts ~Base apps on psychological theory ~Consider relevance, safety, & privacy

Personally Use Apps

A relevant 14th century proverb is *the proof of the pudding is in the eating.* In innovation diffusion theory, trialability [25] means one must personally experience an innovation in order to fully test that innovation. Professionals may enhance their personal lives with evidence-based exercise and fitness apps, relaxation apps, sleep apps, burnout prevention apps, and continuing education tracking apps. As mental health professionals become more adept in personally using apps, they will be more likely to socially influence colleagues and students to use apps. Together, this will contribute to the diffusion of mental health mobile apps throughout the mental health social system.

Raise Awareness of Evidence-Based Apps

Practitioners may aim to increase the awareness of mental health mobile apps through social media channels. Websites may be updated to include links to research regarding evidenced-based apps and to include tips for using particular apps. Blogging, micro-blogging (eg, Twitter), and posting on Facebook are means of establishing an online presence regarding evidence-based mental health mobile apps. To increase personal mHealth awareness, practitioners will benefit from following the blogs and postings of other mHealth organizations and professionals.

Infuse Mental Health Mobile Apps into Graduate Counselor Education

Infusing educational content with mental health mobile apps across and within courses is required in order to develop technologically competent, culturally-relevant mental health professionals. However, accomplishing infusion will be a challenge considering so many university faculty members are digital immigrants [29] who may be reluctant to embrace new technologies [26]. To overcome this problem, counseling departments need to offer professional development workshops regarding mental health mobile apps. These classes need to include hands-on interactivity (trialability) with apps and guidance for infusing these technologies into educational and clinical settings. Offering incentives to encourage effective infusion of mHealth into curricula will enhance technology adoption [25]. A few typically-required graduate-level counseling courses and ideas for learning activities offered for each course are listed in Textbox 1.

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Textbox 1. Course and learning activities for infusing mental health mobile apps into graduate level counselor education courses.

Counseling skills

- Identify and review apps for recognizing and rating intensity of feelings.

- Use a free app builder program to create a counseling skills educational app on a topic such as basic attending skills, empathy, transference and countertransference, stages of counseling interviews, confrontation, interpretation, or multicultural perspectives.

Counseling theories and techniques

- Identify and review apps that indicate a particular theoretical foundation. Write a paper discussing the degree to which the app aligns with that theory.

- Work in groups and assess selected apps in view of multicultural awareness.

Ethics

- Identify ethics codes that are pertinent to the design, development, and therapeutic integration of mental health mobile apps.

- Establish a class webpage for app reviews, and require students to post reviews of a designated number of mental health mobile apps in regards to potential ethical issues.

Individual analysis

- Identify apps with built-in assessments and rating scales, and review and report on the efficacy evidence of these assessments.

- Use a free app builder to design a psychoeducational app on a particular mental health condition.

Life span development

- Identify and review apps that are useful for various developmental stages such as pregnancy, parenting skills, child mental disorders, career development, relationships, disabilities, and mental health enhancement for people who are elderly.

- Work in a group and create a gaming app using a free gaming app creator, and target a particular age group and developmental issue.

Professional issues

- Critique apps promoting an inpatient program and an outpatient counseling center, and describe the strengths and indicate any needs for improvement.

- Create a hypothetical informational app for a counseling center. Address boundaries, confidentiality, abuse reporting, records, fees, roles and responsibilities, referrals, and termination.

Psychological change strategies

- Use a cognitive behavior therapy app throughout the semester, and give a presentation that reflects impressions of the app and how it may be used in therapy.

- Present a hypothetical case study report outlining the integration of an app into the therapeutic process.

Research methods

- Write a research paper critiquing the efficacy evidence for two apps that are promoted as interventions for a particular mental health condition.

- Create a class website for app research. Throughout the semester, require students to post links to topics such as app standards, public safety, efficacy evidence, journals that publish mental health app research, sources of continuing education such as podcasts, webinars and conferences, app creator links, and app development and design information.

- Select a research study about a new mental health app, and create a flow chart depicting the design, development, testing, and research process that was used in the development of the app. Critique the research design and process.

Substance abuse

- Create a table in Google Docs for students to share links to evidence-based substance abuse apps.

- Write and present a report on the efficacy evidence of a substance abuse app that is designed for self-monitoring and relapse prevention.

Disseminate Information During Clinical Staff Meetings

Staff meetings are an appropriate venue for discussing mental health mobile apps. Staff members may regularly present research evidence, app strengths and limitations, and suggestions for integrating particular apps into clinical practice. It will be useful to create an online document that permits staff to add and edit app information and provide links to research evidence. Staff members may also be invited to discuss experiences with using apps to support treatment.

Integrate Apps Into Therapy

In order to integrate mental health mobile apps into therapy, it is necessary to collect information regarding patients' mobile phones and their willingness to download and use mental health mobile apps. Relevant questions may be incorporated into intake forms. It is important to not give patients the impression that owning a mobile phone or a data plan is a requirement for therapy. Also, not all mobile phones have app capabilities, there may not be enough memory on some mobile phones to add apps, data plans may be limited, and some people may have privacy concerns related to storing sensitive data on their phones. When patients desire to use apps, practitioners must then make informed decisions about recommending appropriate apps. This decision making process is similar to that used in recommending books, workbooks, or other homework assignments.

The goal in recommending apps to individual clients is *purposeful alignment* of evidence-based apps with client needs and abilities. In order to best align particular apps with particular clients, professionals need to first interact with and test the apps themselves. One method of testing an app is to fictitiously assume symptoms of a related condition or mental disorder, while thinking through that app's alignment with research and theory, ethics and privacy issues, relevance, benefits, consumer ease of use, engagement factors, and price value [9]. Apps need to be aligned with treatment goals, cultural backgrounds, and cognitive abilities. Practitioners may assign appropriate app activities such as homework, and then follow-up in subsequent visits. For example, if a patient has been directed to use a mood tracker app to monitor medication effectiveness, at subsequent sessions, the practitioner may review the data collected to assist with medication decisions.

Practitioners may also conduct surveys to monitor patient attitudes and effectiveness of mental health mobile apps. One method of monitoring patient attitudes is discussed by McGillicuddy et al [30]. After a demonstration of a prototype mobile phone-based monitoring system, renal transplant recipients completed a 10-item questionnaire regarding perceptions of the technology. They also completed a perceived stress scale and a medication adherence scale. Data collected through similar types of questionnaires will assist practitioners in making informed decisions about clinically integrating mental health mobile apps.

Professional Association Conferences and Publications

The content analysis conducted by the authors of this article indicated the need for more technology-related topics at mental health professional conferences since technology-related and mental health mobile app topics averaged only 4% and 1%, respectively. While some professional association conferences offer technology-related sessions in technology tracks, reflecting an effort to include training in emerging technologies, grouping technology training into one track may delay the innovation diffusion process. Designated technology tracks tend to draw professionals who are innovators or early technology adopters and may fail to entice professionals in need of increased awareness and increased comfort levels with respect to mental health mobile apps and other technologies. Infusing emerging technologies across and within other tracks is likely to better assist in the diffusion process. As such, presenters need to share evidence-based technologies, provide demonstrations, include hands-on interaction, and deliver concrete suggestions for incorporating technologies into educational training and clinical practice.

App Developers

Mental health mobile app developers need to consult with mental health experts to ensure that apps are based on sound psychological theory. Developers need to follow research protocols in producing app efficacy evidence. Attention to relevance and benefits [31], along with ethical, privacy, and security issues must guide app development. In addition, app developers need to create apps that will accentuate practitioner-patient collaborations in order to impel mHealth diffusion within the new health care paradigm [10].

Conclusions

Evidence-based mental health mobile apps are relevant and beneficial for psychoeducation, patient empowerment, and for helping patients reach therapeutic goals. However, training on how to incorporate mental health mobile apps is lagging behind the rapid development of these mHealth technologies. As key influencers, counselor educators and professional associations have an ethical responsibility to learn about and to educate students and practitioners. To avoid or delay infusing mental health mobile apps into training and practice may even be considered by some to be professionally irresponsible. If the key leaders in the counseling field impede the diffusion of mental health mobile apps, patients and practitioners will be hindered from reaping the benefits of these technologies. Therefore, infusing mental health mobile apps into education and practice will help bring about diffusion of these innovations throughout the mental health social system.

Conflicts of Interest

None declared.

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Abbreviations

eHealth: electronic health
mHealth: mobile health
REBT: rational emotive behavior therapy
UTAUT: Unified Theory of Acceptance and Use of Technology
UTAUT2: Unified Theory of Acceptance and Use of Technology-2
WHO: World Health Organization

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Original Paper

Privacy Issues in the Development of a Virtual Mental Health Clinic for University Students: A Qualitative Study

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Abstract

Background: There is a growing need to develop online services for university students with the capacity to complement existing services and efficiently address student mental health problems. Previous research examining the development and acceptability of online interventions has revealed that issues such as privacy critically impact user willingness to engage with these services.

Objective: To explore university student perspectives on privacy issues related to using an online mental health service within the context of the development of an online, university-based virtual mental health clinic.

Methods: There were two stages of data collection. The first stage consisted of four 1.5-hour focus groups conducted with university students (n=19; 10 female, 9 male, mean age = 21.6 years) to determine their ideas about the virtual clinic including privacy issues. The second stage comprised three 1-hour prototype testing sessions conducted with university students (n=6; 3 male, 3 female, mean age = 21.2 years) using participatory design methods to develop and refine a service model for the virtual clinic and determine student views on privacy within this context.

Results: The students raised a number of issues related to privacy in relation to the development of the university virtual clinic. Major topics included the types of personal information they would be willing to provide (minimal information and optional mental health data), concern about potential access to their personal data by the university, the perceived stigma associated with registering for the service, and privacy and anonymity concerns related to online forums contained within the virtual clinic.

Conclusions: Students would be more comfortable providing personal information and engaging with the virtual clinic if they trust the privacy and security of the service. Implications of this study include building the clinic in a flexible way to accommodate user preferences.

Introduction

Mental disorders are at their peak in young people aged 16 to 25 years [1], a time when many young people are enrolled in university [2]. University life can expose students to additional stressors [3], which may impact negatively on their mental health. Mental disorders are responsible for a significant disability burden in university students [4], with a recent US

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study reporting a 12-month mental disorder prevalence level of almost 50% in university students [5]. Mental disorders can have severe consequences if untreated, including disability [6,7], suicide [8], lowered quality of life [9], and, for students, a greater risk of dropout from their education [10]. Despite this, less than one-fifth of students with mental health problems use mental health services [5].

The tertiary education setting is a unique environment in which to provide both large-scale preventive and treatment interventions for mental health problems [11]. Mental health services in a university setting tend to be delivered face-to-face [12], which may limit their cost-effectiveness and scalability. In addition, the high clinical load often experienced by staff at university health clinics and economic burden on the university [13] restrict the number of students who can access face-to-face care. Technology-based interventions show promise for treating common mental disorders such as depression and anxiety in university students [14]. Interventions delivered via the internet can be continuously available, accessed anonymously, cost-effective [15,16], scalable, and broadly disseminated [17,18]. University students use the internet frequently and are highly likely to search for information about mental health online [19]. Moreover, Internet interventions may be viewed as less stigmatizing than traditional approaches to care [20,21], with university students being concerned with perceived stigma associated with accessing on-campus counseling services [22]. Therefore, there is a potential role for a university-based online service that has the capacity to complement traditional services to more effectively and efficiently address student mental health problems.

A key issue in the development of an online health service (and indeed, any health service) is the user's experience of privacy [23,24]. Research outside the university setting has investigated privacy issues relating to the security of user personal information [25], predominantly in the context of consumer portals in medical settings [26-31]. One study examined consumer attitudes towards privacy when provided with online access to their medical records [29]; another explored concerns about privacy in the development of personal health records for veterans [30]. All studies identified privacy as a significant concern for users of these services. Although these studies have focused on adults in the community, it is possible that privacy is an even greater concern for students, particularly those studying certain disciplines like law or medicine [32,33]. For example, students may fear being labeled with a mental health condition or being discontinued from their course by the university [34]. Little qualitative research has been conducted to investigate privacy issues among university students or the types of personal information that students are comfortable providing with respect to their mental health. This study seeks to address the gap in knowledge.

Methods

Overview

This study was conducted within a larger project involving the development of a university-specific virtual mental health clinic designed to provide support to students across the mental health intervention spectrum (from awareness and prevention to treatment and relapse prevention). Participatory design methods attempt to involve all stakeholders (eg, end-users, employees, administrators) in coproducing a service [35]. In this project to date, these methods have included focus groups and prototype sessions which were used to engage students (end-users) in the development of the virtual clinic. Using participatory design methods may increase uptake of the service among students and foster a sense of empowerment and ownership of the service [36].

This research is taken from the first two stages of the project. The first stage comprised qualitative focus groups, which broadly examined the topic of mental health help-seeking online, and the second stage consisted of iterative prototyping of model versions of the clinic and feedback cycles conducted with students. The focus groups and prototype testing sessions were structured and based on predetermined questions to aid the development of the virtual clinic while allowing for other topics to be discussed as they arose. A list of questions for the focus groups and prototype sessions is provided in Multimedia Appendix 1.

Study Sample

The overall sample for focus groups and prototype sessions consisted of 25 students (13 female, 52%) from The Australian National University (ANU). The mean age was 21.5 years (range 18-24).

Focus Group Sessions

This project stage involved conducting four focus groups with 19 university students (10 females, 9 males; n=5, 5, 5, 4) to determine their views on online help-seeking for mental health problems and ideas about components of the virtual clinic and how it might function. The mean age of the focus group sample was 21.6 years (range 19-24). Each group lasted approximately 1.5 hours. Detail on the methods for the focus groups have been published previously [36].

Prototype Sessions

This stage of the research involved conducting three 1-hour prototype testing sessions with 6 university students (3 females, 3 males; *n*=1, 2, 3) to engage students in the development and refinement of a service model for the virtual clinic. During these sessions, participants provided feedback on a prototype version of the virtual clinic, developed by the research team based on the previously conducted focus groups; relevant literature; and clinical, empirical, and information technology best practices. The prototype presented to the participants depicted a student, how the student may encounter and use the clinic, as well as example features of the clinic and how the clinic may interact with service providers (eg, a university counseling center). This process was iterative and each session contained a new prototype for testing, which took into account input from participants in previous sessions and further elements to be tested as determined by the researchers. The mean age of the prototypes sample was 21.2 years (range 18-23).

All groups were facilitated by LF with note-taking by either AG or JC and were conducted onsite at the National Institute

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for Mental Health Research at ANU with the exception of one focus group which was held in a meeting room at a student hall of residence. The researchers mutually agreed that data saturation (no new themes emerging) had been reached after four focus groups and three prototype sessions. Students were recruited for both stages via email invitations sent to a list of students who provided their name and email address at previously held mental health awareness events. In addition, a snowball sample was implemented whereby potential participants were encouraged to invite other students to participate. Finally, the researchers also contacted a senior resident at a student residential hall for assistance in advertising the focus group to other residents.

Ethics

All participants provided written consent after reading an information sheet. A cinema pass was supplied to students on completion of the focus group in appreciation for their time. Ethical approval for both stages of the research was granted by the ANU Human Research Ethics Committee (focus groups, 2012/520; prototype sessions, 2013/491). Ethical issues that were addressed in these submissions included protecting participant privacy by instructing participants to maintain confidentiality of the content discussed, ensuring any distress that occurred during groups was appropriately managed by a trained psychologist, and protecting individually identifiable data. No problems related to these issues arose. All focus groups and prototype sessions were audiotaped and transcribed verbatim.

Analyses

Two researchers (AG and JG) identified and coded quotes that were relevant to the topic of privacy. Subsequently, thematic analysis [37] was broadly used by the first author (AG) to classify participant statements and ideas into themes using grounded codes [38]. The number of comments and ideas in the discussion created on each topic during the focus groups and prototype sessions was used to determine the major themes and subthemes in the data. In the findings below, the quotes that best represented each theme are reported and the participants are identified by gender, participant number, and group type (ie, $F1\_FG$ = female participant number 1, focus groups; M2_P = male participant number 2, prototype sessions).

Results

Student Perspectives

Figure 1 presents a concept map of the privacy themes raised in relation to the virtual clinic, including (1) what personal information participants would be willing to provide, (2) concern about the university's access to information or personal data, (3) stigma associated with registration, and (4) privacy issues related to online forums within the virtual clinic. The results below present the data according to major and minor themes. Each theme is ordered by its relative importance as judged by the number of comments and ideas generated for each topic across the focus group and prototype session discussions.

Figure 1. Privacy themes raised in relation to the virtual clinic by students. Larger shape indicates a greater volume of discussion generated in the topic.
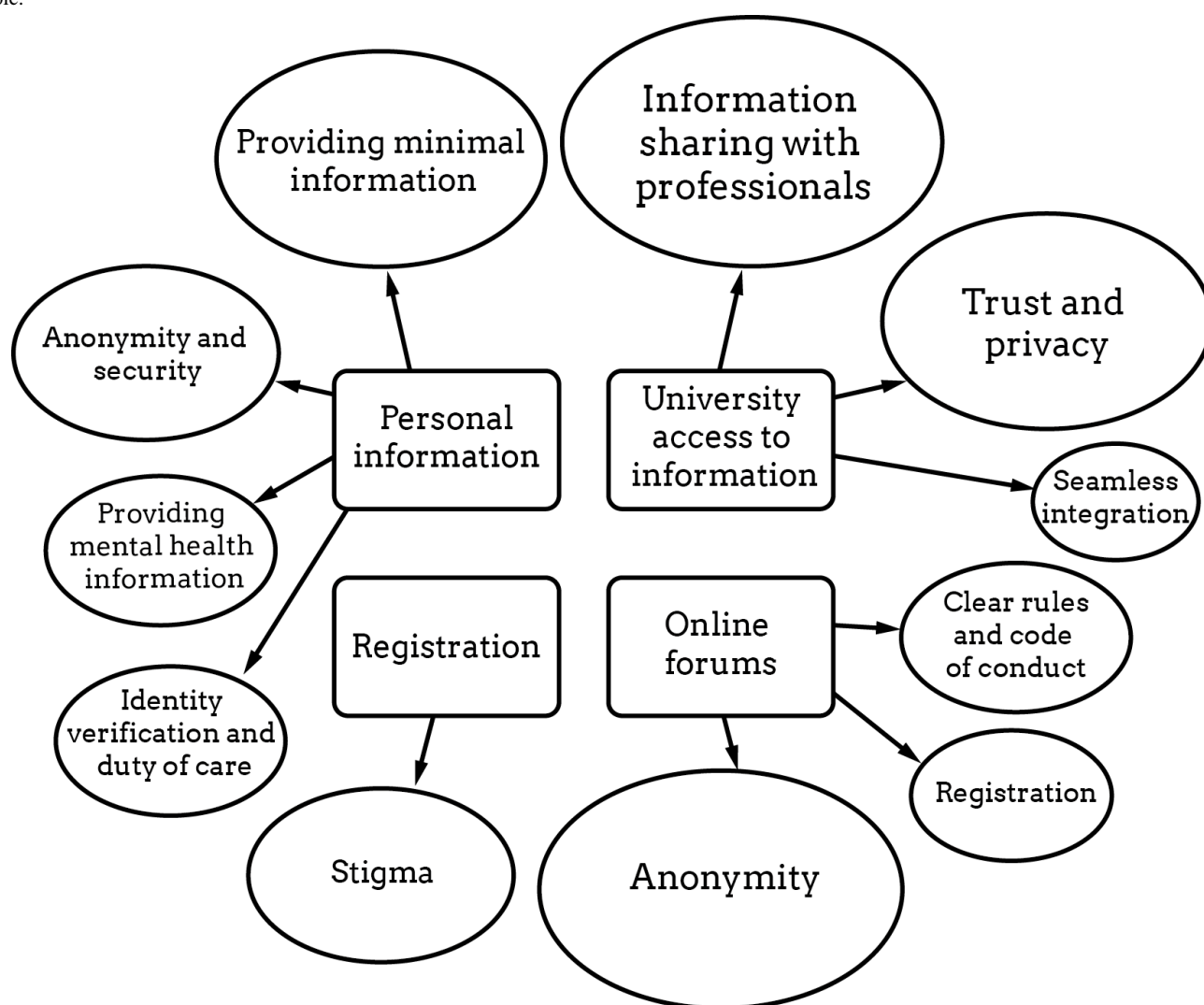
Personal Information

Providing Minimal Information

Participants considered the types of personal information required to create an account to be very important. They believed that providing minimal demographic information for a service such as a virtual clinic would be acceptable (eg, age range, gender, international/domestic student status, study load status, on- or off-campus residence). Overall, participants felt it was important that the information was relevant to the service and, most importantly, that it was collected for a reason: "Things that may not be relevant shouldn't be asked." [M1_FG] Because of this, they found it acceptable for the virtual clinic to ask for information that would enable content to be more tailored to their experience and emphasized that the site should justify to the user why the information is needed,

> *[Explaining] why we're giving that information, so if it is like those type of things that can help…target, like, the site or something to you, and instead of registering your account it's just…help us target it for you.* [F1_P]

However, this did not extend to any personally identifying information such as age or birth date: "I just don't think people would want to come to it with a birth date and, identifying themselves." [F1_P] Additionally, some participants were happy to provide area of study, whereas others felt that would be too identifying. Overall, they felt it was extremely important that all information provided should not be compulsory: "What personal information you should be able to be comfortable providing…most of the things should be optional." [M2_FG]

Anonymity and Security

In general, the participants believed that they would be more likely to provide information anonymously: "The more anonymous it is, I think, the more information people are willing to give." [M3_FG]

Participants also indicated that they would be more likely to share information if they trusted the security of the website,

> *I mean it depends on who gets to see what and on whether I trust the security of the site or not. Um, because, I'd sort of be quite happy to put, you know, most personal information, like client details and*

personal information…if I, you know, trusted that control to work. [M4_FG]

I'm actually more than willing to put in every single thing as long as I know that the whole system is safe. [M1_FG]

In general, even though the participants knew confidentiality and security measures were taken, they still had concerns that generally, "the Internet just seems kind of insecure." [F2_FG]

Identity Verification and Duty of Care

Participants indicated that it was important that the system could verify that a user was entitled to register for the virtual clinic (ie, being a student) to ensure user safety: "So you're not talking to some creepy person." [F3_FG]) They also thought that it was important that users could be contacted (via email) by the providers of the virtual clinic site. Thus, they considered that being able to be identified in some way was necessary: "I guess other, really other than name…pretty much a valid email… you shouldn't have to provide much more information than that." [M2_FG] Additionally, they recognized that duty of care issues for the providers of the clinic were important and that users may need to be contacted in emergency situations,

If they're in crisis, maybe…with their permission passing on a phone number or something to the CAT [Crisis and Assessment] team and getting them to give them a call. [F3_FG]

However, they acknowledged that if users did not want to provide information then perhaps "the best you can do is say like…'we'd love it if you called this CAT team number'…they never have to give away their information online." [M5_FG]

Providing Mental Health Information

Participants felt that quizzes about mental health were acceptable. However, again they made it clear that such quizzes should be optional,

I think if you could have like a pop-up quiz…'we'd like to invite you to fill in this short quiz–it's entirely up to you whether to fill it in or not,' because I think that matter of choice is important. Don't shove it down their throat. [M6_FG]

University and Other Access to Personal Information

Information Sharing With Professionals

The participants felt that it was important to accommodate personal preference for information sharing between organizations. For example, some students would want mental health professionals to have access to their account: "If you could connect with a specific psychologist using this site and then they can actually review your material directly through this space. That could be useful." [M3_FG] Others felt this access for their psychologist might save time in their counseling sessions: "The counseling center makes you go on a computer anyway…and fill out some kind of form…it could just do this as well." [M7_P]

Although participants were generally supportive of information sharing with professionals, they were concerned about the security of this data,

If you have information on there that has been looked at in one way by professionals or something, you probably don't want that information being put out there for all the other users on the site to see. [F4_FG]

The participants agreed that no information should be available without a person's consent and that taking into account personal preference was important: "If the user…intends to keep their information private, private or confidential from those professionals…it would be important if you consider the concerns of the user first before you offer any kind of solution or suggestion." [F5_FG]

Trust and Privacy

The participants raised several concerns about other university staff being able to access their personal information. They felt that a perceived lack of privacy had the potential to deter students from using the virtual clinic: "Fears about the lack of privacy is going to be a huge issue." [M3_FG] Because of this, they felt it was extremely important that the virtual clinic website was trustworthy and that any information shared was kept confidential: "Knowing that your information isn't going to feedback elsewhere—whether it's to like academics or family…knowing that the information you shared is secure." [F6_FG] They also believed that the virtual clinic needed to be transparent in communicating where this information could potentially be shared: "I guess it depends. I think just communicating…where it's going to go is really important." [F6_FG] It was also considered important that the list of terms and conditions that explained where their information would go was brief and easy to understand: "Short and succinct… not too lengthy, 'cause as soon as it becomes more than like a paragraph, no one reads it." [F2_FG]

An idea that arose repeatedly across groups was that students would want to the ability to set and maintain their own privacy settings for different groups (eg, clinicians, friends, other users),

Different levels of accessibility to information. You can set what information you show to certain people. So you can make it entirely public, you share all your information with anybody and everybody or you can restrict access so only certain people can see. [M6_FG]

In relation to this idea, the concept of requiring a password to gain additional access to their virtual clinic accounts also emerged: "You could customise different levels. You know, when do I need a password?" [M7_P]

Seamless Integration

The participants suggested that registering their own account for the virtual clinic (with an anonymous username and password) would minimize the need for their account to be linked to any identifying details. Conversely, some participants considered that creating a new account was onerous and would prefer it to be generated using their existing log-in information for their online student account. They also noted that there could be seamless log-in across all university services as they found it "irritating when you have to swap from [one online university service to another]" [F7_FG] and that they were already exposed to "a lot of integrated stuff" [M7_P] (eg, student email, other

online student services). However, participants noted that they often allowed their peers to log in to their online student accounts to access printing and other services, so they felt this could compromise the privacy of their personal information contained within the virtual clinic: "My friends and I, like, when you run out of print quota…you give someone else your login so…if they had a different password for this thing, I would feel more comfortable." [F8_P] The idea of a guest account or non–signed-in access was suggested as a potential way of allowing students to access material with which they may not otherwise engage,

> I think it's important to have your username account but also a guest account so if you don't want to do something which someone else can see, you can use the private guest account, which won't record your information. [M8_FG]

Stigma of Registration

The participants felt that actively registering for the service could increase their sensitivity to stigma as it indicated that they identify as having a mental health problem,

> I think it's the fear of like, again like people have that stigma attached, like if you register people are going to like, somehow you're going to be…identified as a person who has a problem...it's like saying 'I need help.' [M10_P]

The participants felt that one way of overcoming this was to seamlessly integrate the virtual clinic with other university services, as mentioned above. This would involve all students having an automatically registered account with the virtual clinic, alongside other freely available online student services that students already access (eg, course administration interfaces) so that "every student can have an account" [F9_P] and "you don't have to use them, no one's saying you have to, it just means every student is on the system." [F1_P] Participants suggested that they could create an account name so that any activity on the virtual clinic would not be identifiable by other users of the website: "you log in with your uni ID but when you make an account, it will make sure you make an anonymous profile name." [M1_FG]

The participants indicated that being able to hide their visibility on the site was paramount: "You don't want other people to see, 'Oh this person is online—she must be going through something.'" [M8_FG] Because of this, some participants felt that parts of the virtual clinic should be visible at all times (eg, general information), whereas other sections should be restricted to registered users (eg, people's profiles). Other participants thought that all virtual clinic content should be available without having to register: "I'd want to have the option of being able to explore it without signing up." [F9_P]

Online Forums

Anonymity

The participants thought that a forum would be an important element component of a virtual clinic for university students. Some students, as with registration, felt that it was important to have an anonymous username in forums: "To post on forums

you need some kind of a username. If that could not be attached to your student number, then that would create that kind of sense of privacy." [F1_P] However, other participants felt that certain students would prefer to not be anonymous: "Some people are quite comfortable talking about mental health issues and they don't mind putting their name out there." [F6_FG] Some participants felt that it was important for the system to be capable of doing both,

> I guess that's when you need the option to use it as anonymously as a tool for yourself, for your personal needs or as a networking device like I think it needs to do both. [M3_FG]

The ability to disclose your identity to specific people was suggested by participants ("Do you want to share your details with this person?" [M10_P]), in order to enable users to meet up in person with larger groups of other students: "We can get together and talk about that, like over coffee, and then people can, yeah, disclose who they are online if they want." [F1_P] However, participants acknowledged that there was a difficult balance between ensuring the privacy and security of personal information and providing an avenue for social interaction outside the clinic.

Clear Rules and Code of Conduct

The participants felt it was very important that the rules of the forum were clearly stated, including basic etiquette and what would happen if members posted any content about harming themselves or others,

> Perhaps including something about that in the code of conduct like 'we will contact you if you xyz.' [M3_FG]

> Cause you don't want it to be out of surprise but if I know you'll be contacting me then [that's ok]. [M8_FG]

Some participants also liked the idea of private instant messaging between members within the forums but recognized that this could also be potentially unsafe: "Cause that would be the easiest way to bully someone—message them privately." [F2_FG]

Registration

As with the clinic itself, the participants believed that the forums should be accessible to view content without registration particularly because "people don't want to join forums unless they've seen what's in them first." [F1_P] However, participants agreed that students would have to have an account if they wanted to post: "You can't interact with it unless you register." [M8_FG] Participants believed that most students would be more likely to read posts than to post themselves and "you still want that information to be available because it's useful for someone who doesn't register." [M8_FG]

Discussion

Principal Findings

Overall, one of the major themes that emerged from the current research related to the provision and treatment of personal

information. The students in this study expressed the view that in most cases it should not be mandatory to provide personal information, particularly in the case of the most identifying or sensitive information, including mental health data. Previous research has demonstrated that students are very concerned about disclosing mental health information with university staff because they fear being identified as having a mental health problem [34]. However, the students in this study felt that it could be a barrier to use if it were not clear that the requested information was relevant to use of the service and being collected for a reason. Tailoring the site to the user was seen as an acceptable reason for requesting personal information. However, the students felt that the virtual clinic needed to explicitly demonstrate to the user the advantages of collecting such information. This is consistent with previous research that suggests users are more comfortable providing health information online when they can see clear benefits in doing so [27].

Some of the students in this study supported a model that reduced privacy in which users would be more identifiable to the university in exchange for the convenience of the integration of the virtual clinic with other online student services. Previous research has also found that easy access to health information can outweigh user concerns about privacy [29]. The students in this study felt that seamless integration, where they were provided with automatic access to an account linked across university services, could be highly desirable, particularly as it would avoid the stigma associated with actively signing up for a mental health service. Similarly, perceived stigma associated with disclosing mental health problems has been discussed previously as a barrier to face-to-face help-seeking from counseling centers by students [39].

A model whereby students were provided with access to services by the university would necessarily require that students were identifiable to the university on some level. Identification of users (via email at a minimum) would be necessary in the case of a student in crisis, as the university has duty of care for students [40]. In general, students were relatively comfortable with this model if they were convinced that the information could be kept secure and not provided to wider university staff not involved in running the clinic (ie, teaching staff) or to other people such as friends and family.

The privacy and security of personal information within the virtual clinic was considered an important issue for students. As noted by Vodicka et al [29] there are two separate risks involved: the privacy risks of having an online mental health account (ie, breaches of university security) and the risks of accessing these accounts online (ie, sharing university services passwords). The students maintained that this may not be a barrier to use if they were provided with a clear set of rules explaining the virtual clinic's privacy and confidentiality processes. This is consistent with previous research examining electronic health portals which identified the need for clear explanations of consent, privacy ,and security processes to users [28,31]. Additionally, the need for privacy to be assured in order to feel comfortable using online services is consistent with other

studies examining the development of health record resources [25,27].

The students' views on many topics were not unified. However, one point they all agreed on was that personal choice was paramount in all aspects of the virtual clinic including anonymity in forums, release of personal information to the university, and sharing of information with professionals. Diversity in perspectives about privacy and releasing personal information has been found in previous qualitative research investigating health portals where some participants were more comfortable sharing information than others [27]. However, all participants in this study wanted assurance that no information would be released without their consent and even then that it would only be released to those who are central to their treatment on a need to know basis, similar to views expressed by community members in previous research [31].

Limitations

There are two primary limitations that need to be considered for the current research. First, the aim of the two stages of this study was not specifically to collect data on privacy alone. Questions targeting privacy were asked within the context of a broader purpose of determining the content and functionality of the virtual mental health clinic, and the data were analysed ad hoc. It is possible that some aspects of privacy relating to the development of the virtual clinic were missed by using this method. Second, a relatively small self-selected group of students participated in the two stages of data collection. Therefore, the sample may not be representative other students at ANU or of the wider university student population.

Conclusions

Privacy considerations are vital in the development of an online mental health virtual clinic for university students. Overall, the students believed that potential users of a university mental health clinic would be more comfortable providing data as long as they trusted the privacy and security of the website, particularly that their personal data will not be shared without their knowledge or consent.

This study highlights the potential difficulties of balancing user preferences with the requirements of the service provider. First, there are considerable challenges in implementing an online clinic that can integrate efficiently with other existing university services including student course accounts and connections to counseling centers or psychologists. Moreover, the expressed desire for personal choice in all aspects of the clinic (eg, preference to identify self on forums) also presents challenges and may not be able to be implemented due to safety or other concerns. Finally, the students occasionally held views that conflicted, for example, preferring to have an account set up by the university but desiring to be unidentifiable to the university. Overall, implications of this study suggest that the virtual clinic will need to be built flexibly to accommodate varying user preferences for levels of engagement and the provision of information and that privacy of user information will need to be balanced against other potential capabilities of the clinic.

Acknowledgments

Conflicts of Interest

None declared.

Multimedia Appendix 1

Focus group and prototype session questions.

[PDF File (Adobe PDF File), 48KB - mental_v2i1e9_app1.pdf]

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Original Paper

mHealth in the Wild: Using Novel Data to Examine the Reach, Use, and Impact of PTSD Coach

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Abstract

Background: A majority of Americans (58%) now use smartphones, making it possible for mobile mental health apps to reach large numbers of those who are living with untreated, or under-treated, mental health symptoms. Although early trials suggest positive effects for mobile health (mHealth) interventions, little is known about the potential public health impact of mobile mental health apps.

Objective: The purpose of this study was to characterize reach, use, and impact of "PTSD Coach", a free, broadly disseminated mental health app for managing posttraumatic stress disorder (PTSD) symptoms.

Methods: Using a mixed-methods approach, aggregate mobile analytics data from 153,834 downloads of PTSD Coach were analyzed in conjunction with 156 user reviews.

Results: Over 60% of users engaged with PTSD Coach on multiple occasions (mean=6.3 sessions). User reviews reflected gratitude for the availability of the app and being able to use the app specifically during moments of need. PTSD Coach users reported relatively high levels of trauma symptoms (mean PTSD Checklist Score=57.2, SD=15.7). For users who chose to use a symptom management tool, distress declined significantly for both first-time users (mean=1.6 points, SD=2.6 on the 10-point distress thermometer) and return-visit users (mean=2.0, SD=2.3). Analysis of app session data identified common points of attrition, with only 80% of first-time users reaching the app's home screen and 37% accessing one of the app's primary content areas.

Conclusions: These findings suggest that PTSD Coach has achieved substantial and sustained reach in the population, is being used as intended, and has been favorably received. PTSD Coach is a unique platform for the delivery of mobile mental health education and treatment, and continuing evaluation and improvement of the app could further strengthen its public health impact.

KEYWORDS

PTSD; trauma; mHealth; mental heatlh; mobile app; public health; self-management

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Introduction

Smart mobile devices are increasingly ubiquitous, discreet (ie, can be used in public spaces without attracting attention), convenient (ie, carried at all times, immediate access to services), capable of running powerful software applications or "apps" that collect data and respond to user actions, and are highly functional allowing users to easily access services, such as banking, getting directions, and connecting with friends. Approximately 55% of adults in the United States own mobile phones, and 42% own tablets [1]. The use of apps among mobile device owners has increased from 22% in 2009 to 50% in 2013; increasing at a rate that parallels the early rapid growth of Internet use [1]. In 2014, accessing the Internet via mobile devices surpassed Internet access via personal computers (47% compared to 45%).

Mobile health (mHealth) refers to an interdisciplinary branch of eHealth, focused on utilizing mobile technologies for health improvement initiatives [2,3]. Because of the widespread adoption of mobile devices, mHealth technologies have the potential to reach large numbers of individuals in the general population, including those who are living with untreated mental health concerns and as a supplement to those already in care [4]. Because many of those with posttraumatic stress disorder (PTSD) do not receive evidence-based treatment [5], PTSD is an important candidate for testing mobile mental health technologies. In the United States, the lifetime prevalence of PTSD is estimated to be between 7 and 12% of the population, and between 5 and 7 million adults are living with PTSD in any given year [6]. Despite the high prevalence of PTSD, seeking mental health treatment, particularly among veteran populations, is stigmatized [7,8]. Mobile mental health apps have the potential to provide mental health support that overcomes barriers posed by stigma, and technological interventions for PTSD may provide helpful resources to individuals who would not otherwise seek traditional face-to-face care.

Emerging research on the usability, feasibility, and efficacy of mHealth interventions demonstrates promise [3,9]. However, extant mHealth studies have been constrained by small sample sizes, use of private research versions of apps that are generally unavailable to the public, use of reimbursement to incentivize participation, and limited evaluation of user experiences with the technology. In contrast, few mHealth apps that have been successfully disseminated to the general public have also undergone scientific evaluation. To our knowledge, there are no studies that have evaluated mobile mental health technologies deployed in real-world settings. Thus, little is known about natural patterns of engagement, optimal design features, user experiences, and the most effective applications of mobile phone technologies. Maximizing the efficacy of mHealth interventions for PTSD will require a better, more ecologically valid understanding of how apps for mental health are used by the general population.

Preliminary research on the utility of mHealth for PTSD suggests that a mobile intervention would be well-received by veterans and useful for managing symptoms such as anxiety and sleeplessness or during periods of intense stress [10]. To meet this need, the United States Department of Veterans Affairs (VA), in collaboration with the Department of Defense, developed PTSD Coach, a mobile mental health app for PSTD, for both iOS and Android operating systems [11,12]. The app is designed for veterans, service members, and civilian trauma survivors who may be experiencing symptoms of PTSD, as well as for their family members and others desiring to learn about posttraumatic stress. The design of PTSD Coach was informed both by subject matter experts in evidence-based treatment of PTSD and Veterans and others living with PTSD [10]. The app provides authoritative information about PTSD and professional care, a self-assessment for PTSD symptoms, opportunities to find support, and cognitive-behavior therapy (CBT) based interactive tools to help users manage PTSD symptoms (see Figure 1).

Since its release in early 2011, PTSD Coach has been widely available to the general public [11,12], thereby providing a unique opportunity to evaluate the potential public health impact of a mobile mental health app for PTSD. Two sources of data shed some light on how PTSD Coach has been received in the general population. First, aggregate and fully de-identified data are available to describe how users in the general population interact with PTSD Coach. Aggregate app usage data can be very useful for understanding patterns of attrition and how users interact with key content or features. Such information is crucial for optimizing user experiences and tailoring the delivery of evidence-based intervention components of the app. Second, many users provide thoughtful written reviews of the app, and a detailed qualitative analysis has the potential to greatly inform developers about how users engage with mobile mental health apps and opportunities for further enhancing their efficacy.

By combining quantitative and qualitative data sources, mixed methods has the potential to increase both the breadth and depth of our understanding of mHealth interventions being delivered in uncontrolled, real-world settings [13]. Qualitative data allow for a richer understanding of the processes by which an intervention may exert its effects [14], and are particularly valuable for understanding how interventions are perceived by users, whether they are used as intended, and what underlying, unmeasured factors might influence adoption and use. Mixed methods also provide a means for app users to have a voice in informing the development of the population-based mobile mental health apps.

The current study characterizes reach, use, and impact of PTSD Coach in the general population using a mixed-methods approach. Two distinct types of data were analyzed: aggregate population-level app engagement data and qualitative data from user reviews in the two major app marketplaces: Apple's App Store and Google's Play Store. The study had three aims: (1) to examine the reach of PTSD Coach over time; (2) to characterize how users engaged with the app; and (3) to describe the reception and impact of the PTSD Coach mobile app among users in the general population. We also sought to investigate potential differences between iOS (Apple) and Android versions of PTSD Coach.

Figure 1. Screenshot of the PTSD Coach mobile phone application: (A) home screen and primary content areas: Education (Learn), Self-Assessment, Manage Symptoms (Tools), and Support; (B) Distress Thermometer (ie, subjective units of distress, measured before and after use of a symptom management tools).

Methods

Data Sources

Data were derived from two sources. First, we included mobile analytics data from all unique downloads of PTSD Coach in the three-year period between March 2011 and February 2014 (N=153,834). Detailed session event logs from March 2014 through June 2014 were also available (N=3462 first-time sessions; N=12,449 return visit sessions). Second, we included written reviews from all PTSD Coach users (N=156) who provided reviews of the app on either the App Store (Apple) or the Play Store (Google).

Procedures

Mobile Analytics

User engagement with the app was measured using Flurry Analytics. The Flurry software development kit (SDK), with a restricted feature set to ensure de-identification, was integrated into the iOS and Android versions of PTSD Coach prior to their public release in order to be able to make administrative decisions about how to deploy the app for the most public health impact while simultaneously ensuring user privacy and confidentiality. To accomplish this balance, VA opted to use Flurry Analytics to obtain de-identified, aggregate data about how users interact with PTSD Coach. No identifying information of any kind was available for any user of the app, and information across sessions could not be tracked. Flurry was used to securely capture aggregate usage data and retention information across time, as well as to capture key app-related events (eg, agreeing to end user license agreement or EULA,

viewing home page, visiting app content). All usage measures were stored in aggregated, anonymized data files and were available separately for the iOS and Android versions of the app.

User Reviews and Ratings

All user reviews provided for PTSD Coach between April 8, 2011 and February 10, 2014 were obtained from the App Store (Apple) and Play Store (Google), where they are publically available. Two autotranslated and unintelligible user reviews from the Play Store were removed from the sample. The final sample consisted of 156 user reviews (App Store, n=53; Play Store, n=103). In order to write reviews in the App Store, users are first required to download the app. For the Play Store, users can review an app without downloading it. Reviews are not required, nor does PTSD Coach prompt users to write reviews.

In addition to user reviews, star ratings were also captured. All app users were provided with the option to rate PTSD Coach using a 5-star ratings system that is common across platforms (ranging from 1 to 5, with 1 being the most negative rating, and 5 being most positive). Users may leave a "star" rating for the app without providing a written review. All star ratings were analyzed, regardless of whether the user left an app review or not (n_{iOS}=80, $n_{Android}$=329). User reviews and ratings were imported into SPSS 21 for analysis.

Measures

Mobile Analytics

For each platform (iOS or Android), we captured basic user engagement measures (ie, number of downloads, active users,

session length, number of sessions, etc across time) in addition to two primary measures of retention across time. Retention was first measured using *rolling retention,* which is the ratio of the number of users whose last day of app use was some time after a given time point to the total number of users who downloaded the app. Because rolling retention does not account for the frequency of use and may overestimate actual usage, we also measured retention using *return rate,* which captures the proportion of users who returned to use the app during specific intervals of time (eg, one day after download, the first week after download, one month later, etc). Finally the Flurry mobile analytics package also allowed us to capture *fully de-identified* click stream data. Click streams, which documented users' navigation through the content pages of the app across time, were parsed using the Perl programming language to identify first-time users (those who accepted the EULA) and returning users. Each session began with the launch of the app and was classified as either a first-time use or a return visit on the basis of whether the EULA was displayed at launch or not. For each session type (first time use versus return visit), specific usage events were tracked, including completing set-up of the app, navigation from the home screen to one of the four primary content areas (learn, manage symptoms, find support, or self-assessment) and navigation from one content area to another. Click streams were only available for the iOS version of the app. Given the high volume of click stream data, we analyzed a representative subset from the most recent three month of app use, which comprised over 650,000 rows of data.

The PTSD Coach app was also able to capture self-report data on PTSD symptoms and momentary distress. PTSD symptoms were measured using the PTSD Checklist-Civilian version, or PCL-C [15]. The PCL-C is a widely-used 17-item self-report measure of PTSD symptoms that has strong reliability and validity [16,17]. Upon visiting the self-monitoring section of the app, participants were prompted to complete the PCL by rating each of the 17 PTSD symptoms on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely), with total scores ranging from 17 to 85. Momentary distress was measured using a one-item Subjective Units of Distress Scale (SUDS, or distress thermometer [18]), anchored at 0 (no distress) and 10 (worst distress you can imagine). This measure has been widely used in PTSD research and validated against more extensive measures of mood disturbance in a variety of populations [19].

Qualitative Codes From User Reviews

In order to characterize users' personal experiences with the app, a phenomenological approach to qualitative analysis was utilized. Three domains of interest, based on our primary research questions, were identified for qualitative coding: app reach (eg, characteristics of individual app users), usage (eg, how and when users interacted with the app), and reception (eg, perceived outcomes associated with using the app and the overall valence of users' impressions of the app). Separate coders (J Owen & B Jaworski) categorized each user review for the presence or absence of each broad coding domain. Consistent with an inductive approach to qualitative analysis, coders identified specific themes within each domain, and careful coding rules were used to create a codebook (available from the authors) to characterize each of these themes. User reviews

were then coded independently by the two coders, and inter-coder reliability demonstrated substantial to near-perfect agreement (kappas=.65-.93, mean=0.77; [20]). All coding disagreements were resolved by consensus coding. Overall, user reviews were brief with a mean value of 32.8 words (SD 32), averaging just over two assigned codes per review with a mean of 2.2 (SD 2.0). iOS user reviews were longer with a mean value of 53.2 words for iOS versus 44.3 for Android ($t_{60.6}$ =4.87, $P<.001$), and were assigned more codes than were Android reviews, with a mean of 3.6 for iOS versus 1.5 for Android ($t_{66.8}$=6.37, $P<.001$).

Analyses

To examine the reach of PTSD Coach, we calculated descriptive statistics and proportions for all basic user engagement metrics from the Flurry mobile analytics package. For some aggregate metrics, standard deviations could not be estimated when individual data points were not available for analysis (eg, session length, number of total sessions using the app). Qualitatively identified characteristics of users who left app reviews were also summarized. To characterize usage of the app, we tested differences between iOS and Android users with respect to completing key app-related tasks (ie, completing EULA, engaging in app set-up, viewing one of the four primary content areas on the app, and viewing multiple content areas). Differences between platforms were tested using chi-square analyses. Differences in app ratings between platforms were tested using an independent samples *t* test. To evaluate reception, proportions of iOS and Android users expressing each qualitatively identified code or valence were compared using chi-square analyses. To evaluate impact, change scores for momentary distress were calculated and tested, using a one-sample *t* test against no change. All analyses were conducted using SPSS 21.

## *Results*

Reach of PTSD Coach

Since its launch in the spring of 2011, PTSD Coach has been downloaded 153,834 times, and 64% of these downloads were on the iOS platform. The number of new downloads has been relatively stable across time, with over 55,000 in 2012 and nearly 54,000 in 2013. There was an average of over 10,600 unique active users in any given month (ie, used at least once during the month) since the release of the app. Figure 2 displays number of downloads and active users for the previous two years (ie, June 2012 – May 2014). As of September 2014, PTSD Coach has been downloaded in 86 countries, with non-US downloads constituting 12% of the total and 10-15% of each month's new users.

PTSD Coach was intended for a wide range of individuals impacted by trauma, not just those who have served in the military. Qualitative results suggest that PTSD Coach is reaching veterans and civilians, as well as family members and mental health providers. Personal characteristics, such as military service, PTSD diagnosis, and psychotherapy attendance, were mentioned in 39 (25%) of the reviews. Among those who disclosed military status (n=22), 73% self-identified as current

service members or veterans, compared with 27% who self-identified as being civilians. Of those who mentioned trauma characteristics (n=19), all users reported trauma exposure or a specific PTSD diagnosis (eg, "I suffer from PTSD"). A minority of user reviews (n=9) mentioned being connected to someone who had experienced trauma, such as family members (eg, "My spouse has PTSD") and mental health service providers (eg, "I'm a counselor who hopes to use this app with clients").

PTSD Coach also captured self-reported PTSD symptoms (using the PCL) for 10.3% of first-time users' sessions and 20.9% of returning users' sessions. Mean PCL scores, in first-time sessions was 57.2 (SD 15.7) and in return sessions was 55.1 (SD 16.6), which were well-above the National Center for PTSD's recommended probable PTSD diagnosis cut point for use in VA or civilian specialty mental health clinics [21].

Figure 2. Downloads and active users of PTSD Coach between June 2012 and May 2014.
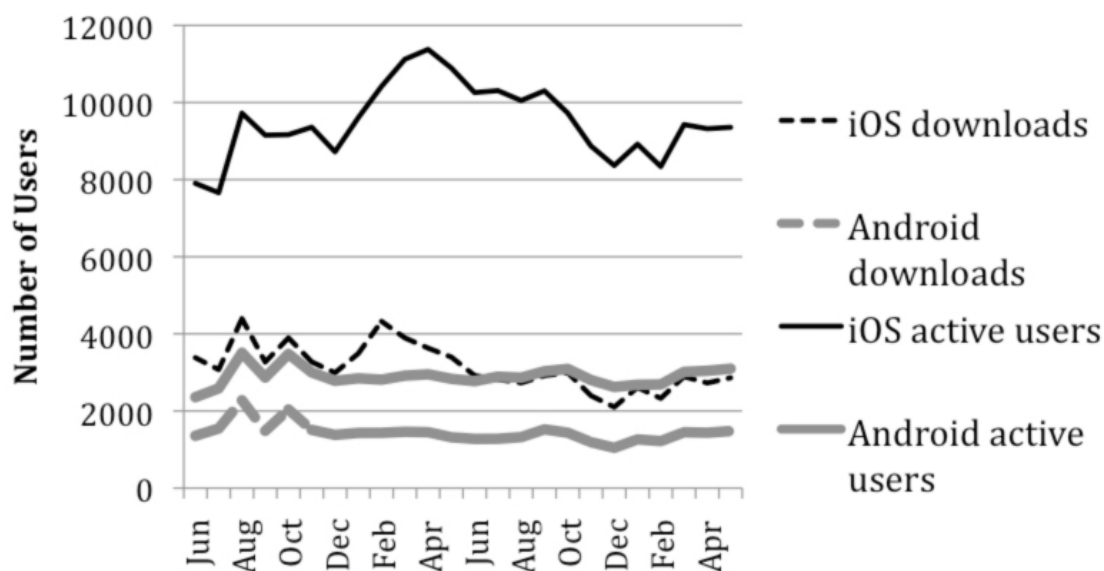
Use of PTSD Coach

Retention of Users

Mobile analytics data were used to identify patterns of app use across time. First, we examined rolling retention rates which describe the proportion of users who continued active application use across time. Among those who downloaded PTSD Coach (n=153,834), 61.1% returned to use the app after the first day it was installed. Over half of users (52.1%) continued to use the app, or used it at least one time beyond the first week of download. Usage declined over time, with 41.6% continuing to use the app 1 month after installation, 28.6% using the app after 3 months, 19.4% using the app after 6 months, and 10.6% using the app a full year post-installation. Patterns of user retention varied based on operating system, with iOS users maintaining both a higher number and proportion of users across time.

Because rolling retention metrics include users who may use the app infrequently or sporadically across time, we also identified actual app usage per user during specific time periods post-download (see Figure 3). Use of PTSD Coach during the day and week after initial download were quite similar for iOS and Android, averaging 14% of users who opened the app one day after download and 15.6% of users who opened the app sometime within the first week after the initial download. By one month after initial download, iOS and Android return rates began to differ, with 25.2% of iOS and 18.9% of Android downloaders returning to use the app sometime within that first month. During the third month after download, 15.2% of iOS

and 9.3% of Android users returned to use the app. By one year post-download, 5.5% of iOS and 1.9% of Android users returned to use the app.

Analysis of user reviews identified few mentions of use patterns or habits (n=15) but suggested discrete subsets of users: those who used PTSD Coach only once or a few times and those who used PTSD much more extensively. Overall, 6.4% (n=10) of user reviews reported that they used the app during moments of crisis or described the app as being available exactly when it was needed. Another 4.5% (n=7) of reviews described adoption of the app into the user's daily routine (eg, "I have used this app at least once a week") and long-term use (eg, "I have used this for at least a year now"). Self-reported momentary distress levels, reported by 12.7% of those in a first-time session and 20.2% of those in a return-visit session, were consistent with qualitative findings suggesting use during moments of need. Distress levels in both first-time (mean 6.7 [SD 2.1]) and return-visit sessions (mean 7.0 [SD 2.1]) were quite high, and return-visit users exhibited higher momentary distress levels than first-time users, t_{2956}=2.76 , P=.0057.

Characterizing App Sessions

Most app usage occurred between 8am and 10pm (of the user's time zone), with an average of 30.2 users per hour over a 24-hour period, peaking at 1pm (with a mean value of 43 users/hour) and declining steadily until 10pm (with a mean value of 32 users/hour). Usage between the hours of 11pm and 6am averaged nearly 19 users per hour. The median number of sessions per user was 1.7 per day, 1.9 per week, and 2.5 per month. On average, users opened PTSD Coach (ie, began a new

session) 6.3 times before discontinuing use. Median time spent using PTSD Coach during each session was just over 47 seconds, and total time spent using PTSD Coach averaged approximately 5 minutes (see Table 1 for details, by platform). The app was used throughout the day, including times outside typical clinic business hours. User reviews complement these findings and highlight the strength of mHealth solutions for providing in-the-moment access. For example, one review described how the app helped during difficult times, stating that

It helps get me through those rough patches, and when you're really messed up it will advise you to call someone in your support line.

Another user highlighted the availability of the app's resources, commenting that

[it was] great to be able to carry all this around in my pocket. When I can't sleep or I feel like I'm going to lose it, I can't always wait to see a counselor.

Table 1. Aggregate Flurry measures of app usage and App Store satisfaction ratings by platform.

Flurry measures	iOS	Android	Total
Mean # of sessions per user (mean)	6.8	5.2	6.3
Median time per session (seconds)	47.8[a]	47.6[b]	47.7
Mean total time of use (seconds)	325	250	301
Mean App Store rating[a]	4.5	3.9	4.3

[a]App store ratings are based on a 5-star system where 5 stars is the highest possible rating that can be assigned; app ratings represent only a subset of total downloads with n=80 for iOS and n=329 for Android; Total app rating is weighted by number of downloads.

[a]Average for all health & fitness mobile apps tracked by Flurry for iOS=39.9 seconds

[b]Average for all health & fitness mobile apps tracked by Flurry for Android=31.7 seconds

Click stream data were analyzed for the most recent three months of user sessions with PTSD Coach in order to provide more detailed information on differing usage patterns between first time and returning users (see Table 2). When first using PTSD Coach, the app requires users to agree to the EULA, and then users may complete an optional brief set-up to customize the app with personal data and media from their phone (eg, music, photos, contacts). Users who opt to skip this set-up go directly to the app's home screen which presents the four main content areas of the app (see Figure 1). After the app was opened, the majority of first-time users arrived at the home screen (79.8%) and 37% visited a content area. In contrast, among returning users, 63.3% navigated to at least one content area. Among first-time users who made it to a content area (n=1275), 32.5% accessed one content area, 43.6% accessed two or three of the content areas, and 24.7% accessed all four content areas of the app. The majority of returning users navigated directly to the assessment (61.7%) or symptom management (53.4%) sections of the app, and only 44.5% of those who viewed content visited more than one content area.

Figure 3. PTSD Coach use and maintenance up to one year after initial download.
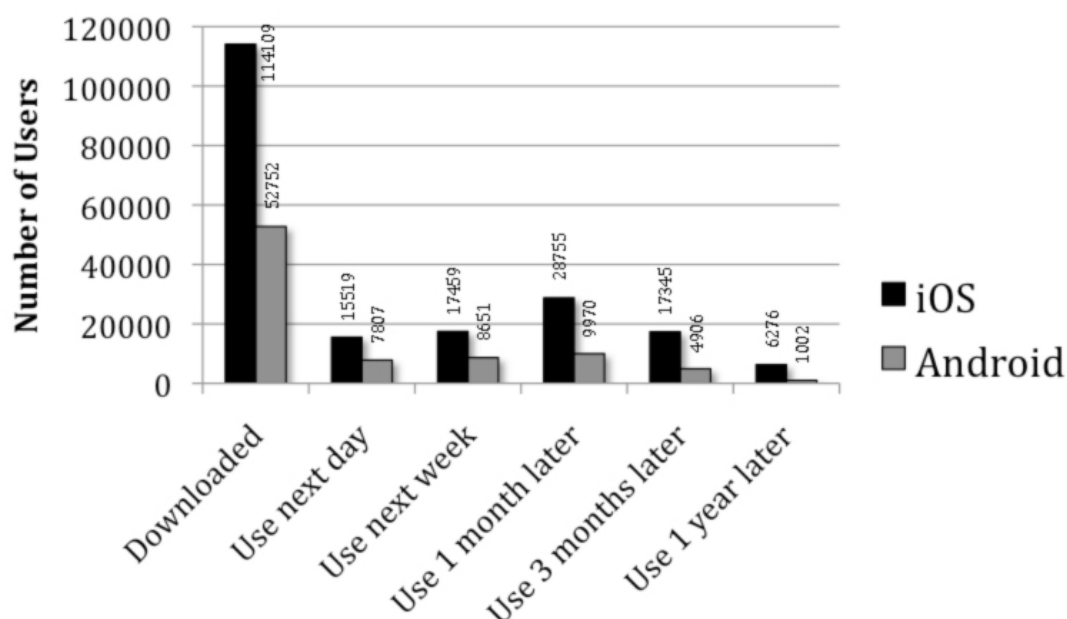
Table 2. Detailed session analysis for PTSD Coach (iOS) by first time users and returning users: March 5, 2014 through June 14, 2014.

Session analysis	First time users (n=3462 sessions)	Returning users (n=12,449 sessions)	Between-group differences (*P* value)
Number of events within session, mean (SD)	31.2 (42.0)	29.4 (36.8)	.01
Consented to license agreement, n (%)	3383 (97.7%)	-	
Entered app set-up, n (%)	1879 (54.3%)	1187 (9.5%)	<.001
Made it to home screen, n (%)	2762 (79.8%)	12,418 (99.8%)	<.001
Made it to any content area, n (%)	1285 (37.1%)	7882 (63.3%)	<.001
First content area visited [a], n (%)			<.001
Learn about PTSD	437 (34.0%)	1185 (15.0%)	
Self-assessment	409 (31.8%)	3597 (45.6%)	
Manage symptoms	266 (20.7%)	2399 (30.4%)	
Get support	173 (13.5%)	701 (8.9%)	
Each content area visited within session [a], n (%)			
Learn about PTSD	773 (60.2%)	2308 (29.3%)	<.001
Self-assessment	870 (67.7%)	4860 (61.7%)	<.001
Manage symptoms	821 (63.9%)	4210 (53.4%)	<.001
Get support	590 (45.9%)	2534 (32.1%)	<.001
Number of content areas visited [b], n (%)			<.001
0	1477 (53.5%)	4536 (36.5%)	
1	414 (15.0%)	4368 (35.2%)	
2	288 (10.4%)	1779 (14.3%)	
3	268 (9.7%)	954 (7.6%)	
4	315 (11.4%)	781 (6.3%)	

[a]denominator=all those who made it to at least one content area on the app; [b]denominator=all those who made it to the app's home screen.

Qualitative data provided additional information about users' likes and dislikes associated with each of the app's main components. Across all reviews, 27.6% (n=43) described one or more specific features of the app that they particularly liked. Largely consistent with the mobile analytics findings, users most commonly reported liking the manage symptoms tools (13%), followed by self-assessment (9%), learn (6%), and find support (<1%). Fewer than 10% (n=15) described specific dislikes, and those dislikes centered on personal preferences about the manage symptom tools and self-assessment. For example, one user did not like the pace of the breathing tool, noting "I'd like to breathe slowly, not hyperventilate" and another user indicated that the self-assessment did not capture data over a sufficient length of time stating:

> *been using [this app] for over a year now to take self-assessments, but can't view history of those over this longer span of time.*

However, 33.3% (n=52) reported at least one technical problem. Android users noted a high prevalence of technical problems (46.6%) relative to iOS users (7.5%; χ^2_1(N=156)=24.0, *P*<.001). Over 15% (n=24) of reviews mentioned a specific suggestion

for improvement, such as providing a feature for social networking with other users, creating specific web and tablet versions of the app, providing an ability to journal on the app, and providing features that would be used in conjunction with a professional therapist.

Reception and Impact of PTSD Coach

Reviews were predominately classified as having a positive valence (58.3%, n=91), having a negative valence (25.6%, n=40), or being coded as ambivalent between positive and negative (16.0%, n=25). Valence of reviews differed significantly between iOS and Android platforms, χ^2_2(N=156)=31.2, *P*<.001, with 89% of iOS reviews classified as entirely positive compared with 42.7% of Android reviews. Similar to the valence of the written reviews, star ratings among those who provided a review indicated favorable views of the app, with an average of 3.6 stars across both platforms, with significant differences between iOS (mean=4.6, SD=0.9) and Android (mean=3.1, SD=1.7; t_{154}=7.6, *P*<.001).

From the qualitative analysis, seven categories of perceived meaningful outcomes were identified and coded (see Table 3). The majority of reviews indicated that PTSD Coach has a

Table 3. Perceptions of meaningful outcomes associated with use of the PTSD Coach mobile app from user reviews.

Reported outcomes associated with app use	Example review comments
General helpfulness or usefulness of the app	*"This is very effective & helpful.";* *"If you had to deal with trauma this is exactly what you want. To be able to help yourself deal with things better"*
Gratitude for the app	*"Thank you for all your efforts in providing such a supportive app";* *"I am thankful to have it"*
Gratitude or appreciation specifically toward the VA	*"Thanks to the workers at the VA for trying so hard to help us";* *"Really great that the VA made available a mobile app to assist with treatment of PTSD"*
Meaningful personal difference	*"This app took me from severe to moderate PTSD!";* *"Instead, I was able to use a tool on the app for relaxation. The flashback subsided and I was able to get right back to sleep."*
Life-changing or life-saving impact	*"This app just might save a few lives. I know it saved mine";* *"This has changed how I deal in private and a god send"*
Increasing or reinforcing face-to-face PTSD treatment or serving as a primary tool for self-management	*"I found out it's useful for them in tailoring you treatment";* *"Reminding me of the skills I know, awesome!"*
Adverse or negative experiences	*"Frustrating";* *"Stresses me out!"*

positive impact on its users. Nearly one-third of reviews (n=48) explicitly described the app as being helpful (50.9% of iOS users, 20.4% of Android users). Nearly 15% (n=23) of reviews expressed direct gratitude for the app (30.2% of iOS user reviews and 6.8% of Android user reviews), and 12.2% (n=19) reported that the app made a meaningful personal difference or had a life-changing impact (26.4% for iOS users, 4.9% for Android users). Only one user indicated feelings of increased stress or anxiety, which was attributed to technical difficulties using the Android version of the app.

For both first-time and return-visit sessions, 21% of users who provided a momentary distress rating also went on to use a suggested symptom management tool and then re-rated their distress. Momentary distress scores decreased an average of 1.6 points (SD=2.6; 95% CI=1.07–2.14) points for first-time users, which was statistically significant, t_{92}=5.0, P<.001 (see Table 4). Among return users, distress decreased an average of 2.0 points (SD=2.3; 95% CI=1.81–2.19), which also was statistically significant, t_{547}= 20.4, P<.001. For the Android platform, n=6125 sessions were available for analysis, and of these SUDS change scores were available for 20.6% (n=1262) of sessions. Average SUDS reduction was 1.14 points (SD=2.35; 95% CI=1.011–1.27), a statistically significant decrease, t_{1261}=17.2, P<.001. SUDS change scores were significantly higher for first-time iOS users than for Android users, t_{4722}=5.5, P<.001.

Table 4. Trauma symptoms, momentary distress, and distress reduction associated with use of symptom management tools in PTSD Coach.

	First-time sessions (N=3462 unique users)	Return-visit sessions (N=12,449 sessions aggregated across users)	Between-group differences (*P*value)
Trauma symptoms (PCL)			
Mean (SD)	57.2 (15.7)	55.1 (16.6)	.024
n (%)	359 (10.3%)	2599 (20.9%)	
Momentary distress (SUDS)			
Mean (SD)	6.7 (2.1)	7.0 (2.1)	.005
n (%)	440 (12.7%)	2518 (20.2%)	
Reduction in distress (SUDS) after use of symptom management tool			
Mean reduction (SD)	1.6 (2.6)	2.0 (2.3)	.13
n (%)	93 (21.1%)[a]	548 (21.8%)[a]	

[a]denominator=all those who provided at least one momentary distress rating; Time frame: March 5, 2014 through June 14, 2014. n=proportion of users who entered self-report data; SUDS=Subjective Units of Distress.

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Discussion

The public health impact of an intervention can generally be characterized as a function of its reach and efficacy [22]. With respect to reach, PTSD Coach has been broadly disseminated, and based on user reviews it appears that a substantial proportion of the users represent its target audience of veterans and civilians in the general population living with PTSD symptoms. Remarkably, in spite of the lack of marketing to promote app use, the reach of the PTSD Coach app has been consistent across time-with more than 50,000 downloads per year in each of the 3 years since its release with a growing international reach. Given its success, the Veterans Affairs departments of Australia and Canada have published their own versions of PTSD Coach, and a Danish version is in production. These numbers demonstrate the potential of PTSD Coach and other mobile apps for reaching a number of specific target populations across the globe, including family members, those with diverse types of trauma-related stressors, those working with and without a therapist, and veterans and civilians. Mobile mental health apps have substantial potential to expand the reach of mental health support services, and PTSD Coach is successfully reaching many with high levels of PTSD symptoms.

Estimates of the use of PTSD Coach provide useful indicators of the app's potential efficacy by helping us to characterize whether users are engaging with intervention content in a manner that is consistent with its intended use. PTSD Coach was explicitly designed to be used as-needed, during moments of distress, and distress data clearly demonstrate that many users of PTSD Coach were moderately to highly distressed at the time they chose to use a symptom management tool. App use patterns, as identified through both qualitative and quantitative data, were strongly consistent with this design and demonstrate relatively strong use over time, with users averaging just over 6 sessions with the app. First-time and return users also engaged with the app very differently, with return users more readily accessing evidence-based content, such as the self-management tools and self-monitoring intervention.

Additionally, these are among the first data to provide usage and attrition data from a publically available and widely disseminated mHealth application and offer a useful benchmark for evaluating other mobile mental health apps. As with many eHealth technologies [23], developers of mHealth applications must contend with considerable attrition across time. There were subsets of users, identified by both mobile analytics and user reviews, who endorsed sustained, long-term use of the app. In Web-based interventions, greater doses of intervention are associated with stronger effects [24,25], but very little is known about engagement with mHealth tools. Understanding the relationship between engagement and effectiveness of mHealth applications, and how these factors interact with individual characteristics of the user, is a critical next step. It may be that a few well-timed doses of PTSD Coach, accessed when needed most, may be sufficient to have an impact on PTSD-related symptomatology.

Detailed mixed-method analyses of session visits and user experiences also allowed us to identify a number of ways the app could be improved. Importantly, over half of first-time users who made it to the app's home screen abandoned their sessions before visiting any of the primary content on the app. Among developers, this is a fairly well-known use pattern (downloading an app and quickly scanning it to determine its personal relevance), and many of these users will establish more familiarity with the app by returning for subsequent sessions and continuing to use the app on an ongoing or as-needed basis. For those users who may only open the app a single time, there is only a brief opportunity to capture their interest. Identifying interventions that are carefully tailored to specific subsets of users, such as first-time or infrequent users, could increase immediate adoption and promote sustained, appropriate use of the app. A/B or multivariant testing, whereby two or more versions of the same app are made available to test one specific change to the app (eg, modifying the welcome sequence to encourage rapid access to app content), could be particularly valuable, for example, by helping first-time users successfully navigate to at least one evidence-based content area of the app [3]. Although we have now received detailed qualitative feedback from a face-to-face group of inpatient veterans [10] and online user reviews of the app, additional detailed qualitative interviews, with specific target audiences such as PTSD Coach users with trauma who are not already connected with mental health care or survivors of military or other sexual traumas, could also be used to further strengthen the efficacy and impact of the app for these important subgroups. Additionally, the self-assessment and manage symptom domains were the most heavily used content areas of the app, and efforts to personalize and tailor content to specific user characteristics (eg, trauma severity, distress level, or history of use of the app), could promote repeated or sustained use of the app among those in need [26].

With respect to impact of PTSD Coach, qualitative evaluations of the app were predominately positive, and the perceived helpfulness of the app was among the most commonly identified themes in the study. A substantial number of users reported life-altering benefits, and we observed no reports of any adverse events. Satisfaction ratings were also very strong, particularly among iPhone users. These results highlight that PTSD Coach is well-tolerated and delivers meaningful personal benefits to a number of users. Both first-time and return-visit users who used a symptom management tool and reported momentary distress levels before and after exhibited a significant, modest reduction in distress–approximately 2 full points on the 0-10 scale. The symptom management tools were equally beneficial for first-time and return-visit users. Whether the app can be shown to provide benefit greater compared to passage of time or an active placebo control condition remains an open question.

Platform-related differences in users' experiences with PTSD Coach (ie, iOS vs Android) may be of particular interest to other mHealth researchers and developers, given the challenges and costs of developing apps for two distinct platforms. As described in many user reviews, the Android version of the app provided a qualitatively different user experience than did the iOS version, and Android users did not experience as much distress reduction from symptom management tools as did iOS users. Because Android is used by 28% of all mobile phone users (compared

with 25% for iPhones; [1]) it has the potential to reach a substantial number of those living with PTSD symptoms. However, the costs of developing for Android will be higher because of the need to accommodate the diversity of the Android ecosystem, including multiple devices with widely divergent characteristics and various current and former versions of the operating system itself [27]. For mHealth researchers and developers, it is important to recognize that the choice of platform is critical given the substantial investment of time, energy, and capital required for startup, development, and maintenance of mobile mental health interventions. Some degree of platform specialization may be necessary for the field until better cross-platform mobile development tools become available, particularly those that can satisfy broad dissemination requirements (eg, full compliance with Americans with Disabilities Act accessibility standards).

There are a number of study limitations that must be considered. First, use of the Flurry mobile analytics package did not allow us to identify users at the individual level, and results could only be evaluated in aggregate. This aggregation could actually lead to less accurate estimates of engagement, because mobile analytics overestimate the number of unique downloads by including those who download the app multiple times or on multiple devices. Aggregation also resulted in a potential underestimate of app usage by return users in particular, because interrupted interactions with PTSD Coach (eg, switching back and forth between apps) could not be linked together. Consequently, many such return-visit sessions were not available for analysis. Future studies of PTSD Coach in controlled trials will be required to evaluate how specific users engage with the application over time and how individual differences in PTSD-related factors might impact use. Second, qualitative results were limited to those who chose to leave a user review on one of the app stores, and little is known about whether such reviews are representative of all those who have downloaded and tried the app. Previous research [28] has suggested that earlier reviews may be more positive than later reviews, or that

those with more neutral attitudes may be less likely to leave reviews. However we did not observe any time effects associated with valence of the reviews. Additionally, star ratings for PTSD Coach did not differ between those who left reviews and those who did not. Given the potential for bias in the user reviews, additional sources of phenomenological data (eg, detailed qualitative interviews) may be helpful for triangulating the present findings.

PTSD Coach has clearly been helpful to a number of users, and many of those who use the symptom management tools report significant reductions in distress. A subset of users report high levels of use of PTSD Coach and/or life-changing impacts, whereas for others the app appears to meet expectations but is used only a handful of times before being discontinued. Whether the app is able to exert a meaningful effect after only a few sessions is a question that we are currently investigating in controlled studies. This study is among the first to provide such a highly detailed examination of reach, use, and reception associated with a free and publically available mHealth app, and results may serve as a useful benchmark for the evaluation of subsequent apps for mental health. These benchmarks could provide useful targets for effectively improving mobile mental health apps, for example, by reducing next-day or next-week attrition, increasing the proportion of those who access key content during the initial session with the app, and identifying ideal minimum exposures to specific content areas that would be considered necessary to exert a beneficial effect. Given the broad dissemination of PTSD Coach, even minor efforts to further refine the usability and utility of the app may ultimately increase the number of those with traumatic stress symptoms who receive a minimum exposure to evidence-informed PTSD treatment recommendations. Mobile mental health apps, particularly those that are able to achieve such widespread reach, have unprecedented potential for improving quality of life and public health outcomes for those living with PTSD symptoms and other mental health conditions.

Conflicts of Interest

None declared.

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Abbreviations

CBT: cognitive-behavior therapy
EULA: end user license agreement
PCL: PTSD check list
PTSD: posttraumatic stress disorder
SDK: software development kit
VA: Department of Veterans Affairs

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