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# Feasibility and Acceptability of a Mobile Intervention to Improve Treatment Adherence in Bipolar Disorder: A Pilot Study

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## Abstract

We evaluated the feasibility and acceptability of a two week-long ecological momentary intervention (EMI), delivered via personal digital assistants (PDAs), to improve treatment adherence in bipolar disorder. EMIs use mobile technology to deliver treatment as clients engage in their typical daily routines, in their usual settings. Overall, participants ($N$ = 14) stated that EMI sessions were helpful, user-friendly, and engaging, and reported satisfaction with the timing and burden of sessions, as well as the method of delivery. All participants completed the study and all PDAs were returned undamaged. On average, participants completed 92% of EMI sessions. Although this study was not designed to assess efficacy, depression scores decreased significantly over the study period and data suggest relatively high rates of treatment adherence; missed medication was reported 3% of the time and 3 participants reported missing a total of 6 mental health appointments. Negative feedback largely involved technical and logistical issues, many of which are easily addressable. These preliminary findings add to the growing body of literature indicating that mobile technology-assisted interventions are feasible to implement and acceptable to patients with serious mental illnesses.

### Keywords

bipolar disorder; ecological momentary intervention; mobile health; adherence

## Introduction

Non-adherence is a major concern in the treatment of bipolar disorder (BD; Colom et al., 2000; Lingam & Scott, 2002). In one recent study, for example, 77.8% of participants with BD were classified as medication non-adherent (de Souza, Vedana, Mercedes, & Miasso, 2013) according to published criteria (Morisky, Levine, Green, & Smith, 1982). In another recent report, 48% of participants missed medication in the previous week and 51.4% missed medication in the previous month (Sajatovic et al., 2012). Earlier studies suggest that one in three individuals with BD fails to take at least 30% of their prescribed medication (Scott & Pope, 2002a & b). Similar problems appear to exist with respect to non-adherence

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with psychotherapeutic treatment (Busby & Sajatovic, 2010; Gaudiano, Weinstock, & Miller, 2008).

Treatment non-adherence in BD predicts a range of serious negative outcomes, such as relapse, hospitalization, functional impairment, and suicidality (Gonzalez-Pinto et al., 2006; Keck et al., 1998; Strakowski et al., 1998). Non-adherence is also costly in financial terms. Hospital costs are nearly six times higher for patients with BD who use medication irregularly than for those who are regular users (Svarstad, Shireman, & Sweeney, 2001) and, over the course of 6 years, cost of care for a non-adherent individual with BD will equal that for 13 individuals who are adherent (Durrenberger, Rogers, Walker, & de Leon, 1999).

Although many studies have examined predictors of non-adherence or have explored outcomes related to non-adherence in BD, very few published studies have assessed the effects of interventions designed specifically to enhance treatment adherence in this population. The results of those pilot studies that have tested such interventions are encouraging and suggest that cognitive-behavioral (Cochran, 1984; Scott & Tacchi, 2002), psychoeducational (Dogan & Sabanciogullari, 2003; Harvey & Peet, 1991), values-based (Gaudiano, Weinstock, & Miller, 2011), skills training (Depp, Lebowitz, Patterson, Lacro, & Jeste, 2007), and needs-based approaches (Sajatovic et al., 2012) can all increase adherence. Given these positive findings, as well as evidence that adjunctive psychosocial treatment for BD is cost-effective and results in a range of significantly improved outcomes (Miklowitz, 2008; Sachs, 2008), it is surprising that more attention has not been paid to developing such interventions.

### Overview and Hypotheses

We sought to develop and pilot test a handheld computer-delivered intervention designed to improve treatment adherence in BD (“Improving Adherence in Bipolar Disorder” [IABD]). Participants completed two weeks of brief, twice-daily assessments about symptoms and other potential momentary risk factors for non-adherence on personal digital assistants (PDAs) and received automated, semi-individualized feedback based on their responses. In the present study, we were primarily interested in establishing the feasibility and acceptability of using mobile technology to target adherence in this population; this study represents the pilot phase of a larger, ongoing investigation (see Discussion). Consistent with previous work (Depp et al., 2010), we hypothesized that: (1) All PDAs would be returned; (2) Participants would complete at least 75% of the momentary sessions; and (3) Average ratings of perceived helpfulness, ease of use, and overall satisfaction would be at least 4 on 1 to 5 Likert-type scales. We gathered pre-post data on depression and mania for exploratory purposes but given the study’s modest sample and scope, we did not have any a priori hypotheses about symptom reduction or other clinical changes.

## Method

### Participants

Fourteen individuals with bipolar-spectrum disorders were recruited from inpatient, partial hospital, and outpatient settings at a private psychiatric hospital. Participants were recruited

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via chart review and referral. For the purposes of this pilot study, diagnoses were recorded from electronic records and confirmed by chart review (structured diagnostic interviews were not used). Inclusion criteria included: 1) current treatment associated with BD; 2) age between 18–65 years; 3) absence of current alcohol or substance dependence; 4) ability to read and write well enough to complete the research protocol; and 5) verbal report of comfort using the PDAs employed in the study.

## Procedure

The Butler Hospital Institutional Review Board approved all study procedures. Patients who appeared to meet inclusion criteria, based on review of their hospital charts, were approached, given a brief verbal overview of the study, and invited to participate. Informed consent was obtained from those who expressed interest. Study visit 1 was scheduled for as soon as possible thereafter (within one week for outpatients, and within one week of discharge for inpatients/partial hospital patients). During this visit, participants completed a demographics questionnaire and measures of manic and depressive symptoms (see "Measures"), and also provided information about their current treatment. Finally, participants were familiarized with the PDA, guided through a practice session, and provided with an opportunity to ask questions. Participants received a short, printed guidebook that reviewed instructions for PDA use. We used Palm Zire 31 PDAs and the Experience Sampling Program (ESP) to deliver IABD. ESP is an open-source software package for running questionnaires on Palm Pilots or compatible PDAs. Data are stored on the device until they are uploaded to a computer for analysis.

For the next 14 days, participants were prompted twice daily via the PDA alarm to complete electronic treatment sessions (see "Intervention for Treatment Adherence") at 10AM and 5PM, for a total of 28 momentary sessions. These specific alarm times were necessary due to limitations in ESP software configurability. However, they suited our purposes, since we wanted to assess scheduled treatment (appointments and medication) each morning and actual adherence behaviors (appointments attended and medication ingested) each evening. Additional daily sessions were not included so as to minimize participant burden. In an attempt to standardize assessment times and the speed with which participants moved through sessions, participants had a maximum of 1 hour to initiate a session and a maximum of 2 minutes to respond to each question. We called participants after 7 days to allow them a chance to report any problems with the PDAs and ask any questions. In order to minimize PDA malfunction and software errors, we selected an option in the ESP program that prevented participants from exiting the program and, therefore, from using the PDAs for purposes other than completing IABD.

At the end of this 2-week period, participants came back to the laboratory, returned the PDAs, received reimbursement, and again completed measures of manic and depressive symptoms. We interviewed participants to gather data on acceptability of the study procedures and also provided them with an anonymous form, through which they could provide additional feedback. The anonymous forms were sealed, stored separately from study data, and were not read until all participants completed the study. Participants were

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compensated $40 for the in-person visits and an additional $1 for each of the 28 momentary sessions they completed.

## Measures

We assessed symptoms of depression with the Quick Inventory of Depressive Symptoms (QIDS; Rush et al., 2003), a 16-item, interview-based measure. We assessed symptoms of mania with the Clinician-Administered Rating Scale for Mania (CARS-M; Altman, Hedeker, Janicak, & Peterson, 1994), a 15-item, interview-based measure. Total scores can range from 0 to 27 for the QIDS and 0 to 74 for the CARS-M, with higher scores reflecting more severe symptoms. All assessments were conducted by a PhD-level psychologist (SJW). Five-point Likert-type scales were developed for this study and used to assess overall satisfaction with IABD (1 = *very dissatisfied*, 5 = *very satisfied*), perceived helpfulness of the intervention (1 = *not at all helpful*, 5 = *extremely helpful*), and ease of use (1 = *not at all user-friendly*, 5 = *extremely user-friendly*).

## Intervention for Treatment Adherence: Rationale & Design

We used an ecological momentary intervention (EMI) framework to develop IABD. EMIs entail the use of mobile technology to deliver clinical recommendations and treatments as clients engage in their typical daily routines, in their usual settings (Heron & Smyth, 2010). Potential clinical advantages of EMIs include the provision of extra support between provider visits, the possibility for the content of momentary sessions to be tailored based on patient needs or assessment responses, and the chance for clients to practice new skills and apply new behaviors in vivo. Further, EMIs could constitute a low-cost, easily-disseminable way to increase frequency and duration of therapeutic contact. These are particularly important considerations in BD; literature suggests that more frequent therapeutic contact may foster higher adherence in this disorder (Zeber et al., 2008), yet individuals with BD see an outpatient mental health treatment provider on average only 14 times per year (Narrow, Regier, Rae, Manderscheid, & Locke, 1993; Regier et al., 1993). Thus, we felt that an EMI paradigm was well-matched to the unique treatment needs of this population and the goals of this intervention.

Recent reviews of the literature reveal that psychoeducational (PE) and cognitive-behavioral (CB) interventions have been most successful in improving adherence rates in BD (Gaudiano et al., 2008; Sajatovic, Davies, & Hrouda, 2004). Thus these were the orientations from which we drew in designing IABD. The PE component targeted gaps in knowledge that serve as risk factors for non-adherence (e.g., assuming one does not need treatment when one is feeling well). The CB component targeted maladaptive beliefs about illness and treatment that serve as risk factors for non-adherence (e.g., believing that one "should" be able to do without medication). The overarching goal of IABD was to assess potential momentary risk factors for non-adherence (e.g., symptoms, attitudes toward treatment, simple forgetting) and deliver brief intervention messages *before* a patient skipped a medication dose or missed an appointment. In other words, we aimed to neutralize risk factors for non-adherence as they occurred, rather than after a potentially lengthy delay (i.e., at the patient's next appointment with a provider).

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It would be impossible to address all potential risk factors for non-adherence in any intervention, particularly a mobile technology-based treatment; limitations such as screen size, maximum character display, and tradeoffs between protocol length/complexity, participant burden, and software processing speed necessarily impact treatment design. Thus, we elected to target risk factors that: (1) are potentially malleable; (2) have been identified as major determinants of treatment adherence in BD (for a review, see Leclerc, Mansur, & Brietzke, 2013); (3) might be expected to change on a day-to-day basis; and (4) could be assessed and at least partially addressed via an EMI paradigm. The areas that IABD therefore targeted were knowledge about daily appointments and medications (AM only), adherence behaviors (PM only), treatment alliance, doubt over need for treatment when one is feeling well, concern over side effects, feeling that one "should" be able to do without medication, trouble remembering appointments/medication, and doubt that treatment is helpful. These items were assessed at each EMI session via individual questions and "Yes/No" checkboxes. Feedback was provided if participants indicated a problem/concern. For example, if a participant answered "Yes" to the question "Do you have concerns about your treatment alliance or relationship with your treatment provider(s)?" she received the following message:

> "If you feel like this relationship could be better than it is, you're encouraged to discuss this with your provider at your next appointment. You might find it helpful to bring in a list of suggestions for ways each of you could work to improve the relationship, or things that he or she could be doing that you might find more helpful. Also, be sure to ask any questions or express any concerns you might have about your treatment."

If she answered "No," the software presented the next potential area of treatment concern.

In addition, each session assessed symptoms (mood, mood change, sleep disturbance [AM only], psychomotor agitation/retardation, anxiety, perceptual disturbances) that are common prodromes in BD (Lam & Wong, 2005), with the rationale that symptom exacerbation can spur doubt over the effectiveness of treatment and, thus, contribute to non-adherence. All symptoms were assessed via individual questions and, with the exception of mood, mood change, and sleep disturbance, with "Yes/No" checkboxes. These three questions asked for additional information to clarify the problem and inform appropriate feedback. For example, mood was assessed via the question, "Please rate your current mood" and the following scale: 1=most depressed ever, 2, 3, 4=neutral, 5, 6, 7=on top of the world. Based on the response, the program branched to the following feedback:

> *1* or *2*: "You're encouraged to talk to someone you trust, do something you enjoy, or get in touch with your provider. Remember to take your medications as prescribed and don't forget about any appointments you may have. Keeping up with your treatment helps keep your mood from getting worse. If you experience any serious thoughts of hurting yourself contact a mental health specialist or go to the nearest emergency room."
>
> *3 – 6*: "It sounds like you're feeling fair to pretty good right now. That's great. Remember to continue taking your medications as prescribed and attend your

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scheduled mental health appointments. Part of the reason you're feeling good is because of your ongoing treatment."

*7*: "It sounds like you're feeling pretty happy right now. That's good, but sometimes people with bipolar disorder find that their mood can get TOO high. This is often an early sign that something is wrong. Pay attention to your mood. If you continue to feel "on top of the world," contact your treatment provider. Make sure that you are taking your medications as prescribed and attending all scheduled appointments."

Finally, assessment of suicidal ideation and provision of appropriate instructions occurred at each EMI session. Participants indicated whether they had thought about hurting themselves since the last assessment ("yes" or "no") and, if so, whether they had a plan to kill themselves ("I have no plan," "I have a vague plan," "I have a clear plan," or "I know exactly how to do it"). If they chose one of the latter two options they were presented with instructions to contact a mental health provider immediately or go to the nearest emergency room. If they chose one of the former two options, other coping strategies were suggested (e.g., talking to someone they trust).

For all questions, feedback messages were developed based on clinical expertise of the research team (within the PE and CB framework of IABD), while also considering the previously-mentioned practical limitations of an EMI treatment delivery paradigm (i.e., messages were as streamlined and concise as possible). As exemplified by the "mood" item described above, feedback was semi-individualized; a set list of feedback messages and branching rules were programmed into the software, such that participants could receive the same or different feedback from one EMI session to the next, based on their responses.

### Overview of Analyses

All analyses were conducted using SPSS 20.0 and HLM 6.01. We used hierarchical linear modeling to estimate means and standard deviations of momentary (level-1) variables (e.g., latency of response to alarms, mood) and change in momentary variables over time (level-2), in order to account for the nested structure of our data (Bryk & Raudenbush, 1992). Although we would generally apply family-wise error correction to account for multiple analyses, we chose not to do so in the present study, given its modest scope and sample size.

## Results

### Descriptive Statistics

Baseline clinical and demographic characteristics are presented in Table 1. On average, participants took 5.00 minutes ($SD$ = 4.13) to respond to alarms and spent 1.85 minutes ($SD$ = 0.78) on EMI sessions. As the study period progressed, participants took longer to respond to alarms ($b_{10}$ = .20, $SE$ = .07, $p$ < .01) and spent less time on EMI sessions ($b_{10}$ = −.05, $SE$ = .01, $p$ < .001), but were no more likely to miss sessions ($b_{10}$ = .00, $SE$ = .00, $p$ = .68).

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## Feasibility and Acceptability

All participants completed the study and all PDAs were returned undamaged. Thirteen participants (92.86%) returned their PDAs on time. Participants completed an average of 25.64 (*SD* = 1.82; range = 22–28) EMI sessions (91.57%). Number of sessions completed was not associated with initial manic symptoms ($r(12) = .09$, $p = .77$). A trend emerged for a positive association with depressive symptoms ($r(12) = .52$, $p = .06$). On the 5-point Likert-type scales, the average rating was 4.29 for overall satisfaction (*SD* = 0.70, range = 3 – 5), 4.25 for helpfulness (*SD* = 0.89, range = 3 – 5), and 4.46 for ease of use (SD = 0.80, range = 3 – 5). Initial depressive symptoms were unrelated to any of these ratings and initial manic symptoms were unrelated to overall satisfaction and ease of use (all $p > .10$). A trend emerged for a positive association between initial manic symptoms and perceived helpfulness ($r(12) = .51$, $p = .07$).

In general, qualitative feedback was very positive (see Table 2). Participants indicated that the sessions were useful in a number of ways, including as a means to learn more about their moods and other symptoms, as a way to improve treatment adherence, and as encouragement to contact their providers when it was clinically appropriate to do so. Negative feedback largely related to the structure and administration of the EMI sessions. Importantly, several participants suggested that sessions would be improved by adding questions (i.e., making sessions longer).

## Preliminary Evidence for Efficacy

Although evaluating feasibility and acceptability were our primary goals for this study, we also explored preliminary evidence for IABD's efficacy. For example, we examined average levels of relevant momentary outcomes and whether these outcomes changed over the course of the study. The average momentary mood rating was 3.95 (*SD* = 0.33) and the average number of treatment-related concerns was 0.48 (*SD* = 0.80). Mood ratings and number of treatment-related concerns did not change over the course of the study period ($b_{10} = -.01$, *SE* = .01, $p = .44$ and $b_{10} = -.00$, *SE* = .01, $p = .58$, respectively). During morning assessments, participants reported knowing what medications to take for that day, at what doses, and at what times 98% of the time (*SD* = 2%). This did not change over the course of the study ($b_{10} = -.00$, *SE* = .00, $p = .47$). They reported knowing what appointments they had and at what times 100% of the time. During evening assessments, they reported having missed medications for that day 3% of the time (*SD* = 4%). This did not change over the course of the study ($b_{10} = -.00$, *SE* = .00, $p = .16$).

Missed provider appointments occurred so infrequently that HLM analyses could not generate a reliable estimate of the within-person average. Therefore, we examined these data qualitatively. Three participants reported missing a mental health appointment over the course of the study; two missed 1 appointment each and one missed 4 appointments. Incidence of missed appointments did not change over the course of the study period ($b_{10} = .00$, *SE* = .00, $p = .84$).

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Finally, we examined whether manic or depressive symptoms changed from study visit 1 to 2. CARS-M scores did not change significantly ($t(26) = 0.26$, $p = .80$). However, QIDS scores decreased significantly over the study period ($t(26) = 2.06$, $p = .05$).

## Discussion

In this pilot study we sought to evaluate the feasibility and acceptability of an EMI to improve treatment adherence in BD. Overall, participants voiced satisfaction with study procedures and with the timing, burden, content, and method of delivery of momentary sessions. Adherence with EMI sessions was high, and all PDAs were returned undamaged. Participants indicated that IABD was helpful in ways that were both expected (e.g., helping them remember appointments and medications, facilitating conversations about the therapeutic relationship with providers) and unexpected (e.g., instilling routine into their days, fostering a feeling that they were doing something active and positive for their health). Although we did not design or power this study to assess efficacy, symptoms of depression decreased significantly from study visit 1 to 2 and data suggest high rates of treatment adherence during the study period. Negative feedback largely involved technical and logistical issues, many of which are easily addressable.

These preliminary findings add to a growing body of literature indicating that mobile technology-delivered or –assisted interventions are feasible to implement and acceptable to patients with a wide range of diagnoses (e.g., Kenardy et al., 2003; Weitzel, Bernhardt, Usdan, Mays, & Glanz, 2007; Norton, Wonderlich, Myers, Mitchell, & Crosby, 2003; Brendryen & Kraft, 2008; Burns et al., 2011), and that they can be useful for increasing treatment adherence (Granholm, Ben-Zeev, Link, Bradshaw, & Holden, 2012; Lewis et al., 2013; Mulvaney, Anders, Smith, Pittel, & Johnson, 2012). As far as we are aware, this is only the second published study of an EMI in BD (Depp et al., 2010). Understandably, some skepticism may exist that individuals with BD and other serious mental illnesses (SMIs) would be able or willing to adhere to treatment procedures for this (intensive) type of intervention (i.e., answering questions and reading feedback via multiple electronic sessions on a handheld computer over the course of many days). One might expect that distractibility, amotivation, lack of insight, or other symptoms would negatively impact adherence or otherwise interfere with treatment engagement. However, we found a considerably *higher* rate of session completion in this study than in some of our previous EMA work with non-clinical populations (e.g., Wenze, Gunthert, & German, 2012; Wenze, Gunthert, & Forand, 2007). Further, the observed rate of session completion is consistent with a previous report on an EMI for BD (Depp et al., 2010), with studies that have used ecological momentary *assessment* (EMA) in populations with BD (e.g., Myin-Germeys et al., 2003), and with a study that used EMA to augment in-person psychosocial treatment for BD (Miklowitz et al., 2012). The current findings are therefore in accord with literature suggesting that EMIs are feasible and acceptable to individuals with SMI (Depp et al., 2010; Granholm et al., 2012), and that they may be efficacious in reducing depressive symptoms (Depp et al., 2010) and increasing medication adherence (Granholm et al., 2012).

These results are encouraging for many reasons. In the typically lengthy interval between mental health treatment provider visits among individuals with BD (Narrow et al., 1993;

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Regier et al., 1993), mobile technology-based interventions could provide patients with support and feedback on goals, symptoms, and homework. With specific respect to treatment adherence, EMIs hold the potential to evaluate and identify precursors to non-adherence on a momentary, ongoing basis (something that could probably not be achieved even if the frequency of face-to-face provider visits was increased), and to intervene before the non-adherence actually occurs. Importantly, mobile technologies might be a cost-effective way to achieve these goals; investment in a (re-usable) PDA or smartphone is cheaper and more practical than providing multiple additional face-to-face sessions and requires less therapist time. For example, studies of the use of technology-assisted treatments for anxiety disorders have estimated a savings of up to $540–630 per client, compared with traditional individual CBT (Newman, Consoli, & Taylor, 1999; Newman, Kenardy, Herman, & Taylor, 1997). Lastly, EMIs could be a highly disseminable way to improve adherence; although we anticipate that mobile-technology-delivered interventions will be most efficacious when used to augment and extend face-to-face therapy, as tested in the current study IABD requires no additional provider support and could therefore be implemented via a range of settings.

A final point that deserves consideration is the self-reported (high) rates of medication adherence and appointment attendance in this study. Although IABD may have contributed to these outcomes, other factors might also have been at play. Some participants might have been untruthful. Others might have forgotten about medications prior to an EMI session but, having been reminded, taken the medications at the time of the session and, thus, reported adherence. Our sample might have included participants who were fairly adherent at baseline. Indeed, we observed high adherence *with IABD* (i.e., completing 92% of sessions), and a study designed to increase adherence is probably most appealing to individuals who value their treatment and are motivated to improve their adherence. Finally, there is wide variability in how non-adherence is defined in the literature (Colom, Vieta, Tacchi, Sánchez-Moreno, & Scott, 2005). We may have observed different rates of non-adherence if we had used different methods or definitions.

## Limitations and Future Directions

The current study has a number of limitations that are important to consider. Our sample size was small and demographically homogeneous. Due to limitations of the ESP software, we were not able to personalize the timing of assessments; the designated times (10AM and 5PM) might not have been convenient for all participants or ideal for data collection. Given the modest scope of this pilot trial, diagnosis was made by chart review only and some participants were relatively asymptomatic during their participation. On a related note, we were not able to ascertain whether participants met current criteria for a bipolar episode and, if so, the polarity of the episode. It is possible that some participants (especially those with a “BD-NOS” diagnosis) may not have met full criteria for BD, that we would see different results in a more diverse or severely symptomatic sample, or that findings might differ depending on polarity of episode at baseline. Importantly, we had no baseline measures of adherence, adherence during the study period was assessed via self-report only, and we did not follow participants prospectively, so we do not know whether IABD impacted adherence. Future (larger-scale, longitudinal, randomized, controlled) studies will address

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this question. It is also conceivable that some of the ways in which we set up the PDAs may have impacted our findings. For example, if participants had been allowed more than an hour to respond to a prompt, more than 2 minutes to respond to an individual question, or had been permitted to use the device for other purposes, rate of EMI session completion or subjective feelings of engagement might have been higher. Finally, as this intervention is in the early stages of development, we compensated participants for completing EMI sessions. It remains to be seen whether similarly high rates of completion will be observed when participants are not monetarily reimbursed for doing so.

Since this pilot study was completed, we have further developed IABD and we are testing this expanded version of the intervention ("My Treatment [MyT]") in a larger-scale, randomized, controlled study. MyT involves EMI sessions as well as 6 in-person sessions and spans 3 months. In an effort to address some of the technological and programming issues identified by participants, MyT is delivered via smartphones, using the MyExperience open-source software. Adherence is assessed in a multimodal manner (via momentary and retrospective self-report, pill counts, and provider contact) and is evaluated on an ongoing basis, for a year after study enrollment, thus allowing us to examine longer-term effects of the intervention.

Future studies might make use of additional ways to measure adherence (e.g., serum drug levels, pharmacy records, electronic medication bottle caps) and capitalize on rapidly-advancing capabilities of smartphones and other devices, including GPS functions, motion sensors, and physiological monitors (Armey, 2012; Intille, 2004). Passive sensors (e.g., ingestibles, epidermal/external/wearable sensors) could also be incorporated (Sarasohn-Kahn, 2013). Given participant feedback in this study, assessing subjective levels of engagement at momentary sessions is recommended. Finally, dismantling studies and cost-effectiveness research will be important to determine which aspects of mobile technology-assisted interventions are most efficacious and the total savings that these interventions yield. Such data will also inform questions about whether these interventions should be targeted towards those with demonstrated problems with adherence, or whether all individuals with BD could derive benefit.

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## Biography

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**Table 1**

Baseline Clinical and Demographic Variables

| Variable | *M*(*SD*) | *N*(%) |
|---|---|---|
| Age | 40.86(12.15) | |
| Sex (female) | | 10(71.43%) |
| Ethnicity (Hispanic) | | 1(7.14%) |
| Recruitment Site | | |
| Inpatient | | 3(21.43%) |
| Partial Hospital | | 2(14.29%) |
| Outpatient | | 9(64.29%) |
| Diagnosis | | |
| Bipolar I Disorder | | 5(35.71%) |
| Bipolar II Disorder | | 5(35.71%) |
| Bipolar Disorder NOS | | 4(28.57%) |
| Course of illness | | |
| Age of BD onset | 16.00(7.32) | |
| Number of psychiatric hospitalizations | 5.21(4.12) | |
| Lifetime depressive episodes | 62.79(72.32) | |
| Lifetime (hypo)manic episodes | 49.59(72.63) | |
| History of suicide attempt(s) | | 9(64.29%) |
| Number of suicide attempts | 2.07(3.12) | |
| Treatment | | |
| Number of daily psychiatric medications | 3.21(1.42) | |
| Times per day taking psychiatric medications | 2.79(1.93) | |
| Medication treatment only | | 6(42.86%) |
| Frequency of provider visits (weekly or more) | | 5(35.71%) |
| Symptoms | | |
| QIDS | 12.50[a](3.96) | |
| CARS-M | 9.93[b](8.74) | |

*Notes*. QIDS = Quick Inventory of Depressive Symptoms; CARS-M = Clinician-Administered Rating Scale for Mania;

[a] "Moderate" depressive symptoms;

[b] "Mild" manic symptoms.

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**Table 2**

Qualitative Feedback About the Intervention

| Theme | Examples of Positive Feedback |
|---|---|
| Insight/awareness | "I learned a lot. My mood fluctuates a lot and I didn't realize that. Also, if I get aggravated about something it stays with me. (It) made me more aware of my mood and my mood-sleep connection."<br>"I sort of know it, but this really highlighted that I'm worse in the afternoons." |
| Adherence | "(It) made me more aware of when I had appointments, more conscious of it when I didn't go to one. I felt badly when I missed one and it prompted me to call to reschedule. …I missed fewer appointments because of it."<br>"There were 2 occasions where I hadn't taken my meds. It reminded me." |
| Help-seeking/coping | "I called my doctor because it reminded me that something wasn't right with my mood. That was helpful."<br>"One day I felt bad and got a different prompt: 'You're encouraged to do something you enjoy.' I did and it helped. I've been told this before but it's hard to remember in the moment." |
| Therapeutic alliance | "I actually had a conversation about my treatment with my provider due to this question (about concerns over treatment alliance) being raised."<br>"I'm having a problem (with a provider) and I've thought about this before but reading (the messages) again and again, I realize this is very important and I will do it (speak with my provider)." |
| Routine | "It made me more aware of the time of day. (It) instilled regularity."<br>"I'm considering setting my cell to beep me at 10AM and 5PM so I keep checking in with myself at those times."[a] |
| Active role in care | "It felt like I was *doing* something for myself."<br>"Made me stop a couple of times a day and think about how I feel. Usually I just go, go, go and this made me stop and think." |
| Encouragement | "I liked the positive feedback and I always read it. (It was like) reassurance. Even when I knew what feedback I'd get."<br>"Felt like someone was actually there, checking on me." |
| Other | "I liked that it also commented on feeling too good."<br>"I ate better, cooked for myself, exercised more. I was more compliant with my other health routines, too. Physical therapy and stuff." |
| | Examples of Negative Feedback |
| Session structure and delivery | "It would've been more helpful if it was more tailored."<br>"Would've been great to have a comments section."<br>"Would be good if the questions changed over time."<br>"Maybe randomize the order for the questions?"<br>"Have it run on your own smartphone."<br>"I'd suggest having the number of beeps based on the number of times per day that a person takes meds." |
| Technical problems[c] | "It took me out of the survey and reset itself to zero (responses)."[b]<br>"The beep should be louder."<br>"I felt like it didn't always give me an hour-long window (to respond)." |
| Expanding session content or frequency | "Maybe allow more leeway in the mood reports. Like, I might be depressed but also angry."<br>"Maybe add some questions… about stressors."<br>"Maybe also ask about alcohol or drug consumption."<br>"The yes/no questions didn't leave a lot of room for nuance."<br>"I would prefer (doing sessions) 3 times per day. More insight that way." |
| Other | "After the first few days it became rote."<br>"What this should look like would differ depending on whether you're new to treatment, just out of an episode, et cetera." |

[a] Three participants indicated they were considering this type of strategy.

[b] No data were lost for this participant.

[c] Four participants noted technical problems with the device (e.g., being alerted 3 times a day or at the wrong times, being taken out of the ESP program).