Mobile Health Interventions for Schizophrenia and Bipolar Disorder: A Review of Randomized Controlled Trials

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Abstract

Over the last several years, mobile health (mHealth) has become an increasingly popular method for delivering health interventions. mHealth has been utilized especially for mental health interventions. However, the literature on interventions for people with serious mental illness, specifically schizophrenia and bipolar disorder, is limited. Prior research has noted the importance of conducting clinical trials to better determine the impact of mHealth interventions on people with schizophrenia and bipolar disorder. This review identifies 6 clinical trials of mHealth interventions that aim to improve clinical outcomes of people with schizophrenia and bipolar disorder. The results of the review show that there is moderate evidence that mHealth interventions are beneficial to people with schizophrenia and bipolar disorder. However, further research is needed to identify with models of mHealth interventions are most effective, and for which clinical outcomes.

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1.0 Introduction

Mental illness is a serious public health issue. Severe mental illness (SMI) is a subgroup defined by the National Institute of Mental Health as "mental, behavioral, or emotional disorder resulting in serious functional impairment, which substantially interferes with or limits one or more major life activities". Schizophrenia and bipolar disorder typically fall into the category of severe mental illness due to their characteristics (Eack et al., 2013). Symptoms of both disorders have a large impact on one's day to day functioning. Schizophrenia symptoms include delusions, hallucinations, disorganized speech, and lack of motivation. Bipolar disorder is marked by periods of depression and mania (Eack et al., 2013). Bipolar disorder affects 0.7% of people worldwide (Ferrari et al.), and schizophrenia impacts 0.4% (McGrath et al., 2008). The costs on the healthcare system for these disorders is large (Desai et al., 2013) Additionally, there are indirect costs to the individual as well as caregivers, including inability to work, loss of productivity in work, and premature mortality. (Desai et al., 2013). Clinical outcomes for people with schizophrenia and bipolar disorder are poor. People with schizophrenia in particular are at higher risk of mortality and suicide (McGrath et al., 2008). People with bipolar disorder have been shown to have lower self-reported quality of life, especially during depressive episodes (Khafif et al., 2021). Both groups have difficulty with medication compliance and self-management of their illness (Garcia et al., 2016).

Over the last several years, mobile health (mHealth), or "the use of mobile communications for health information and services" (Nacinovich, 2011) have become increasingly popular. Due to the widespread use of smartphone devices, these interventions have become more feasible to implement (Clough et al., 2011 & Torous et al., 2014). mHealth offers flexibility, convenience,

and in the case of mental health-focused mHealth programs, suggestions or motivation for behavior change. People with schizophrenia and bipolar disorder may experience particular benefits from mHealth interventions. With treatment adherence being an issue in this subgroup, mHealth may be a helpful tool for offering reminders as well as managing symptoms.

The COVID-19 pandemic has also increased the uptake of and shown the benefits of telehealth and telemental health services (Smith et al., 2020). mHealth interventions have shown effectiveness for a number of health issues, including general mental health, smoking cessation, and medication adherence broadly (Rathbone et al., 2017). For mental health specifically, mHealth interventions have been found to be effective for reducing anxiety (Rathbone et al., 2017). mHealth interventions have also demonstrated effectiveness for improving treatment adherence, symptom monitoring, and appointment attendance for mental health related issues generally (Berrouiguet et al., 2016). One study found that SMS texting services were effective for communicating psychoeducational content (Rathbone et al., 2017).

Despite the increase in mHealth interventions, this area is relatively new in targeting individuals with SMI. Currently, most of the literature in this area focuses on the feasibility and acceptability of mHealth interventions among this group. Generally, these studies show that mHealth interventions for people with SMI are feasible and acceptable (Firth et al., 2017). However, there have been a few randomized clinical trials that have studied the impact of mHealth on clinical outcomes in those with SMI. The interventions that do exist focus on multiple dimensions of clinical outcomes, such as symptom management, medication adherence, quality of life, and self-management. There are also a number of modalities for implementing mHealth – SMS texting, phone calls, app-based, or a combination. Randomized controlled trials are important to help determine what mechanism provides benefit or behavior change (if any) to participants.

In the feasibility study done by Rathbone et al., they noted the importance of conducting trials with a randomized design in this area to eliminate bias. Many people with SMI are engaged in some form of treatment already. Additionally, those who self-select to be part of a mHealth intervention may differ at baseline from those that choose not to participate. To further this area of research and the development of mHealth interventions for people with SMI, it is important to isolate the effect of the interventions.

The purpose of this literature synthesis is to identify randomized controlled trials worldwide that tested an mHealth design to improve clinical outcomes for people with schizophrenia and/or bipolar disorder and to determine if mHealth interventions improve clinical outcomes for this population.

2.0 Methods

2.1 Literature Review

PubMed was the primary database used for the search. We used the advanced search feature with the terms “severe mental illness” and “mobile health intervention”. This search yielded 1,109 results, and when narrowed to randomized controlled trials only, it yielded 226. We also searched PsycInfo and the Health and Psychosocial Instruments journal using the same search terms and criteria, which yielded 44 results. Titles were scanned for relevance, and those selected were read in depth and outlined.

2.2 Inclusion Criteria

To be included in this synthesis, articles had to target adults (age 18 and older) with a diagnosis of schizophrenia, bipolar, or related disorders. If the articles targeted people with SMI generally, inclusion of individuals with schizophrenia and bipolar disorder must be explicitly stated in the inclusion criteria. The intended outcomes had to be to improve clinical outcomes for the participants. This could be in a variety of ways – through medication compliance, reducing rates of hospitalization, or improving symptom management. If it was a feasibility study or evaluation, these outcomes still had to be tested. Articles were included in this synthesis if they were a randomized controlled trial or an evaluation of a randomized controlled trial. Due to the limited literature and lack of interventions in this area in the United States, we included

interventions from other countries. To be included, each intervention had to have a mobile or web-based component. This could be in the form of an app, texting, or phone call service. We included only those published in 2015 or beyond, but it's important to note this did not exclude many articles. 2015 was chosen as the cut-off year based on findings from a mobile phone and smartphone ownership study (Firth et al., 2015). With the literature review method plus these inclusion criteria, this yielded a total of 6 articles.

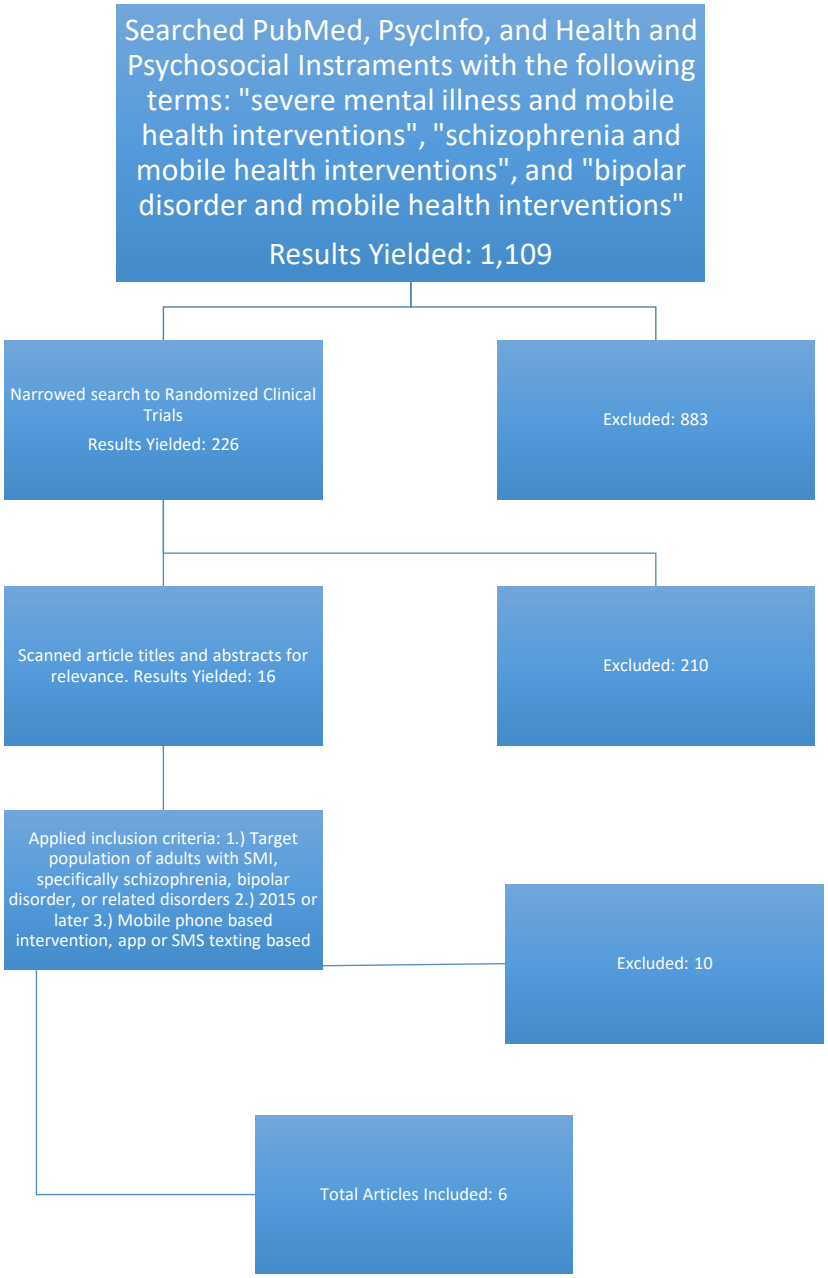

Figure 1 Literature Review

3.0 Results

The search yielded 6 total interventions to be included in this synthesis. The interventions took place in several different countries, and ranged in publication date from 2018 to 2021. While reading the articles, common themes emerged amongst the interventions. While the articles may have differed on outcomes in some cases, the common themes that emerged were: medication compliance, symptom improvement, quality of life, and self-management.

3.1 Overview of Interventions

Table 1 provides an overview of the articles chosen for this review. Articles are compared based target population, where the study took place, inclusion criteria, primary outcomes, the type of mHealth intervention, the results, and the author's recommendations for future research. Section 3.2 will provide further description of each intervention in the context of their respective theme.

Table 1 Intervention Characteristics

	Hanssen et al. (2020)	**Ben-Zeev et al. (2018)**	**Cai et al. (2020)**	**Krzystanek et al. (2018)**	**Röhricht et al. (2021)**	**Schulze et al. 2019**
Target Population	64 individuals with a schizophrenia diagnosis	160 adults with SMI	277 adults with schizophrenia	291 adults with paranoid schizophrenia	Adults with SMI, specifically schizophrenia, schizoaffective disorder, or bipolar disorder	120 adults with schizophrenia or bipolar disorder
Location	Amsterdam	Midwestern United States	China	Poland	London, United Kingdom	Germany
Inclusion Criteria	Schizophrenia diagnosis confirmed by the DSM-5, between the ages of 18-60 year old, an IQ of above 70, able to read and understand dutch, the ability and willingness to sign informed consent	Diagnosis of schizophrenia, schizoaffective disorder,	Community dwelling adults in one of the 9 townships of the Human Province of China, with a primary diagnosis of schizophrenia and taking antipsychotic medications	Between the ages of 18-45, paranoid schizophrenia diagnosed in the last 10 years, in remission at the time of enrollment, and access to a high speed internet connection	Adults ages 18-65, have a diagnosis of schizophrenia, schizoaffective, or bipolar disorder with an illness duration of at least one year, and receiving care through the Care Program approach	18 years or older with a schizophrenia or bipolar diagnosis
Primary Outcomes	Momentary symptoms and social functioning as assessed by ESM questionnaires	Engagement, Satisfaction, and Clinical outcomes (primarily general psychopathology, but also depression, psychosis, anxiety, and quality of life)	Antipsychotic medication adherence (measured using unannounced, at home pill counts)	Symptom improvement by improving the clinical condition between baseline, 6 months, and 12 months (PANSS, Calgary Scale, and Clinical Global Expression Scale)	Patient satisfaction on quality of life measurements	Medication adherence (MARS-D)

Table 1 (continued)

mHealth Intervention	SMARTapp: schizophrenia mobile assessment and real-time feedback application): imac	FOCUS intervention: Completion of daily self assessments, access to on-demand content related to self management, plus weekly calls from an mHealth support specialist.	e-Platform with access to mobile texting with a lay health supporter and educational messaging	The MONEO Platform: Received a study cell phone that sent two reminders per day to take medication, with the option to schedule a cognitive training twice a week or schedule a telehealth appointment with a provider	Florence Telehealth System: 4 reminder texts per day regarding medications, appointments, and well-being indicators. Well-being indicators were related to sleep, anxiety, and voice hearing (rated on a scale from 0-2). Tailored messaging was sent based on wellbeing indicators, with the option to request support from a provider.	Daily phone call from trained nurses asking about medication intake, adherence issues, and side effects, with time to discuss topics of the participant's choice. Receiving follow-up text messages was an optional part of the intervention.
Results	Psychotic symptoms decreased in the treatment group, while the control showed no change. Both groups showed a decrease in loneliness, but did not impact other social engagement measures. Feasibility of the SMARTapp was highly rated amongst participants.	Clinical outcomes of the FOCUS intervention were comparable to those in the WRAP group	Medication adherence increased significantly from the control period to the intervention period	Participants in the intervention group showed a significant reduction in affective symptoms and clinical symptom subscales. The improvement in clinical status was not significant.	No significant difference found between the intervention and control groups	The intervention group was more likely to be medication compliant at 6 months than the control group
Limitations	Small sample, short intervention, and no treatment as usual group	No treatment as usual comparison	Not a systemic approach to understanding relapse, collecting data via lay health supporters is not objective	Small sample from some study sites, no data on participant's medication history	This sample was already more stable/high-scoring on quality of life measures	MARS-D is a self-reported measure

Table 1 (continued)

Author's Recommendations	Examine the feasibility of integrating mHealth interventions with personalized feedbacked into existing in-person interventions	Ensure that future mHealth interventions in this area are ethical and implemented responsibly	Consider frequency and timing of texting to reduce participant fatigue and the cost, feasibility, and acceptability of more complex texting or app based interventions	Comparison to users of the MONEO platform to a treatment as usual control	Include participants with a higher level of need, a long-term trial to determine long term effects and adverse effects	Focus on more comprehensive measures of medication adherence

3.2 Medication Compliance

There were two interventions that focused specifically on improving medication compliance amongst their participants. The first, the LEAN trial (Cai et al., 2020), was part of a larger community health intervention called the 686 program, which was designed to address serious mental illness, specifically amongst those with psychotic disorders, in rural communities in China. The 686 program, which has nearly 6 million participants across China, aims to improve management and intervention for psychotic disorders by providing free medication to low-income individuals (Good et al., 2012). The intervention recruited participants in 9 rural townships in the Hunan Province of China. Participants were selected randomly from the 686 program registry.

The intervention included 1. lay health supporters, 2. Access to an e-platform with mobile texting and educational messaging, 3. A token gift for demonstrated behavior change and, 4. Participation in the 686 program, as usual. While not directly stated, we can assume that participants and lay health supporters were given or had access to a cell phone for the intervention,

because they were taught how to use cell phones. Participants in the intervention received via text 1 medication reminder per day, educational reminders every day, and relapse monitoring messaging once every month. The Lay health supporters, who were generally family members, completed a training course on how to respond to text messages and how to recognize signs of relapse.

This randomized-controlled trial utilized a stepped-wedge design with a waitlist control group. The intervention was split into three, 6 month phases. In phase 1, one cohort of the participants received the intervention. The other cohort received the 686 program as usual, without the lay health supporter and texting component. In phase two, the group that received the intervention first received just the 686 program, while the other group received the intervention. In phase 3, both groups received the intervention at the same time. The model allowed for a control group, while also allowing all participants to potentially benefit from the program.

The primary outcome for the LEAN trial was antipsychotic medication adherence, which was measured by unannounced at-home pill counts by research staff. The secondary outcome was severity of symptoms, as measured regularly in the 686 program. The participant's frequency of engagement with the texting system was also tested.

The majority of participants were female (55.4%) with an average age of 46 years old The results showed that the intervention increased medication adherence (p=.004). Those with better adherence but poorer functioning at baseline showed a greater increase in adherence. The results also showed a reduction in symptoms (p=.002) and hospitalizations. It did not have a significant impact on functioning, as measured by the World Health Organization Disability Assessment Schedule (WHO DAS). The results also showed that phase 3 did not lead to any additional increase

in adherence for those who received the intervention in phase 1. However, there was an improvement in symptoms for this group in phase 3.

The second intervention by Shultze et al. (2019) used the Medication Adherence Support Scale (MARS-D) to measure the primary outcome of medication adherence amongst individuals with schizophrenia or bipolar disorder. The intervention consisted of participants receiving a phone call from trained nurses every month for 6 months. In these phone calls, the nurses asked participants about medication intake, side effects, and issues with adherence. If there were any issues, participants were encouraged to see their doctor. There was also a portion of the call dedicated to addressing "personal topics" the participant wanted to address. There was also an optional part of the intervention where participants could receive text messages regarding topics that came up during the phone call. Those that opted in to this received short messages weekly. Those that did not answer for a week were no longer contacted via text.

Participants were randomized to mHealth intervention or a care as usual control group. The mean age of the participants was 43 and 42% of participants were female. The results of this intervention showed that the intervention group was more likely to be medication compliant at the six month follow up than the control group. This result was controlled for age, sex, and medication compliance at baseline. Adjusting for diagnosis, number of meds taken, and social desirability had no effect. This effect was not seen at the three month follow up.

3.3 Quality of Life

The Florence Telehealth System (Rohricht et al., 2021) aimed to improve quality of life for people with serious mental illness and enhance community treatment. This intervention was carried out by community mental health teams in London.

Florence was an existing Telehealth system adapted specifically for this intervention by clinicians and patients. There were three main elements that were adapted: medication/well-being reminders, a well-being indicator, and a request support option. Participants received four text messages per day from the Florence system: two were reminders about medication/appointments, and two were reminders to submit their well-being indicators. The participants got to choose what time they received these messages. The well-being indicators were rated each day by participants on a scale from 0-2 (0=having problems, 1=minor problems, 2=no issues). The well-being indicators were focused on the areas of sleep, anxiety, and voice hearing. Depending on the scores, participants received automated messages back from the Florence system. Participants also had the option to request support. A care coordinator would then follow up with them to get more information about their needs.

The primary outcome was patient satisfaction on quality of life measurements. The secondary outcomes were intervention adherence, treatment adherence, satisfaction with treatment, and factors leading to effective self-management. This feasibility study was two-armed, with an intervention group receiving usual community care plus the adapted Florence intervention, and a control group only receiving standard community care. The intervention lasted a total of 6 months. Outcome measures were collected at baseline and six months.

The mean age of participants was 35 years old, and consisted of 34 females and 31 males. The results of this intervention did not show any significant benefit for the adapted Florence

intervention over time. In other words, there was no significant difference found between the treatment and control group. It's important to note that this group of participants was already high scoring on all outcome measures, and results may differ amongst those with a higher burden of disease.

3.4 Symptom Improvement

The MONEO trial (Krzystanek et al., 2018) aimed to improve the clinical condition of individuals with paranoid schizophrenia. Secondary outcomes were whether or not the MONEO platform improved the stability of the clinical condition, rates of hospitalization, or visits to an outpatient clinic.

After enrollment, participants were randomized to either the MONEO (intervention) group or the control group. Both groups received a cell phone, but the control group received an inactive version of the MONEO software.

Those in the intervention group with the MONEO platform received two reminders per day on the cell phone to take their medication. Participants provided feedback on these alerts, which provided measures for medication adherence. Participants in the intervention group also had the option for cognitive training twice a week through the MONEO platform, scheduled at their own convenience. They also had the ability to request telehealth visits with a provider through the app. The inactive version of the platform provided to the control group only allowed for a monthly assessment from an investigator. They measured performance of cognitive training at the beginning of the trial, 6 months, and 12 months, instead of the twice a week option provided to the intervention group.

Outcomes were measured through improvements in the percentage change in the scale measures (The PANSS, The Calgary Scale for Affective Symptoms, and the Clinical Global Impression Scale for severity) between baseline, six, and 12 months. Number of hospitalizations and outpatient clinic attendance was also collected through the MONEO platform.

The majority of participants in the trial were male (60%) and had a mean age of 32 years old. After 12 months, the participants in the intervention group showed a significant reduction in affective symptoms ($p<.01$) and those measured by the PANSS ($p<.05$). Improvement in clinical status (as measured by the CGI-S scale) was not significant. The intervention group also showed a significant decrease in clinical symptom subscales. The placebo group showed a significant decrease in symptoms only when assessing the Calgary scale. The number of hospitalizations and outpatient visits was similar between the two groups.

A trial by Hanssen et al. (2020) aimed to test whether an mHealth intervention with personalized feedback would improve symptoms and social functioning of people with schizophrenia spectrum disorders more than just an mHealth app with no personalized feedback. The SMARTapp (Schizophrenia Mobile Assessment and RealTime feedback application) was developed based upon the Experience Sampling Method (ESM), which is used to constantly monitor experiences and behaviors. The SMARTapp consisted of questionnaires customized to this trial that participants completed 6 times per day for three weeks, plus an additional questionnaire before bed each day. In this trial, participants were randomized to either the SMARTapp with personalized feedback to the questionnaire responses, or the SMARTapp with no personalized feedback to questionnaires. The personalized feedback consisted of messaging related to possible behavior changes or activities that participants could engage in.

Outcomes were measured at baseline and a post-intervention session. The majority of participants were male with an average age of 38 in the feedback group and 40 in the no feedback group. The results showed that psychotic symptoms decreased in the feedback group ($p=.02$) from week 1 to week 3. Loneliness decreased significantly in both groups from weeks 1 to 3 ($p=.01$). Both groups showed decreased symptoms after 3 weeks ($p<.01$)

3.5 Self-Management

One trial conducted in the Midwest of the United States focused on self-management of mental illness and measured primary outcomes of improvement of clinical symptoms, quality of life, and recovery (Ben-Zeev et al., 2018). They also measured satisfaction and engagement with the intervention. For this trial, the FOCUS mHealth intervention was compared to a control group receiving WRAP (Wellness Action Recovery Plan), which is a widely used in-person group intervention for individuals with serious mental illness.

The FOCUS intervention was administered through a smart phone app. It also contained a platform for clinicians, as well as an mHealth support specialist to help with the use of the app. Each day, participants complete a self-assessment through the app. Participants also had access to on-demand content related to self-management of their illness. The topics included coping with voice hearing, mood, sleep, social functioning, and medication.

The majority of participants in this trial were male (59%) and African American (65%). Schizophrenia and schizoaffective disorder were the most common diagnoses among the sample (48%), but participants diagnosed with bipolar disorder and major depressive disorder were also included. Participants were assessed on outcomes at baseline, 6 weeks, and 12 weeks. Results

showed that FOCUS participants were significantly more like to engage in at least 8 weeks of treatment (p=.03) than WRAP participants, but there was no significant difference in the groups in engaging in all 12 weeks of treatment. Ratings of satisfaction were similar between both groups (p=.76). The groups also did not differ on any clinical outcomes after 12 weeks. However, within group analyses showed that both groups improved on general psychopathology and depression.

4.0 Discussion

Overall, these six randomized controlled trials show promising evidence that mHealth could be effective for people with serious mental illness, specifically schizophrenia and bipolar disorder. The SMARTapp and MONEO platforms demonstrated an improvement in symptoms, while the LEAN trial and the medication adherence trial from Schultze et al. showed that mHealth interventions can promote medication adherence. The Florence telehealth system, however, was not found to have an effect on patient quality of life and clinical outcomes. While the FOCUS intervention did have an effect, was not more impactful than the in-person WRAP intervention.

4.1 Limitations

Each trial had limitations that are important for consideration when interpreting results, but also for designing future mHealth studies in this population. First, it is important to consider the samples used in each of these interventions. The MONEO intervention, for example, excluded participants with co-existing psychiatric conditions, and who were mentally and/or physically unwell. This is a problem in this population, because it is not uncommon for people with SMI to have co-occurring disorders. This also excludes individuals with more serious illness or those experiencing a psychotic/manic/depressive episode. While this is an issue, the characteristics of schizophrenia and bipolar disorder would make it difficult to implement an intervention in the midst of an episode. Regardless, it is important to see what effect (if any) mHealth can make for more serious illness. For those individuals with more serious illness, timing these interventions to

focus on prevention of future episodes may be the best strategy. Similarly, in the SMARTapp trial, participants in the feedback (intervention) group, had less serious illness than those in the control group. This is important to take into consideration due to the decrease shown in psychotic symptoms amongst this group.

The 6 interventions differed in the way that they implemented mHealth. The variety of app-based, SMS texting, and phone call interventions makes it difficult to synthesize the results and identify which type of mHealth intervention was most effective. This is complicated further because some interventions showed improvement on certain outcomes, but not all.

Despite the research that most individuals with schizophrenia or bipolar disorder have access to a smartphone, or a mobile phone of some kind, it cannot be ignored that interventions such as these present accessibility issues for some participants – such as those who do not know how to use technology like this, or cannot afford it. While randomized clinical trials are important for getting at the effects of these interventions, they typically provide participants with the equipment (and training, if necessary). While this is possible for a grant funded research study, it is important to consider how mHealth can be implemented into everyday life and usual care. With the results of the FOCUS intervention showing that the effects of the mHealth program were the same as the in-person intervention, it raises the question of where can mHealth actually be useful, and where is it just being used as a complicated replacement for something that already works and doesn't require special knowledge and financial resources from participants.

4.2 Implications

While these results show varying effects of mHealth interventions for people with schizophrenia and bipolar disorder, the public health implications of this research area are important. For schizophrenia and bipolar disorder, many interventions (medication, therapy, peer support, etc.) are used together to produce the best outcomes for patients (Stepnicki et al., (2018), Tan et al., (2018) & Duckworth at al., (2014)). mHealth has the potential to be another tool used alongside these more conventional treatments. With technology and personal devices becoming more involved in health and mental healthcare, plus mHealth's demonstrated effectiveness and extensive literature in other areas, there is the opportunity to add another dimension to the treatment of schizophrenia and bipolar disorder.

4.3 Future Directions

With only six trials being eligible for inclusion in this synthesis, this is still a new area being explored by randomized clinical trials. However, each provides important insight on where research can go from here. First, researchers should look into how some of the positive components of mHealth can be implemented into existing, in person interventions. Namely, the SMARTapp found that personalized feedback was helpful for participants in reducing symptoms, and they suggest incorporating feedback into in-person interventions. Both the SMARTapp and LEAN trials make a case for considering participant burden when it comes to mHealth. Interventions that involve frequent notifications, texting, or other alerts may be disruptive or upsetting to participants. Future mHealth interventions should examine what threshold is least disruptive to participants,

while still producing an effect. When it comes to medication adherence, more comprehensive measures of adherence should be used. The MARS-D is a self-reported instrument. The unannounced home pill counts used in the LEAN trial leave room for error as well, and may raise questions about ethics in future interventions. As more interventions in this area are done, future reviews should focus on specific types of mHealth interventions (app-based, texting, phone calls) to determine which modality is most effective for this population.

5.0 Conclusion

In conclusion, there is moderate evidence that mHealth interventions may be beneficial for people with schizophrenia and bipolar disorder. More randomized controlled trials should be designed to further identify the mechanisms that make mHealth beneficial for this population. Additionally, future evaluations should look at what types of mHealth interventions are most effective amongst this group.

Bibliography

Addington, D., Addington, J., & Schissel, B. (1990). A depression rating scale for schizophrenics. Schizophrenia Research, *3*(4), 247-251. https://doi.org/10.1016/0920-9964(90)90005-R.

Beentjes TAA, Goossens PJJ, Vermeulen H, Teerenstra S, Nijhuis-van der Sanden MWG, van Gaal BGI. E-IMR: e-health added to face-to-face delivery of Illness Management & Recovery programme for people with severe mental illness, an exploratory clustered randomized controlled trial. BMC Health Serv Res. 2018 Dec 12;18(1):962. doi: 10.1186/s12913-018-3767-5. PMID: 30541536; PMCID: PMC6292084.

Berrouiguet, Baca-García, E., Brandt, S., Walter, M., & Courtet, P. (2016). Fundamentals for Future Mobile-Health (mHealth): A Systematic Review of Mobile Phone and Web-Based Text Messaging in Mental Health. *Journal of Medical Internet Research*, *18*(6), e135–e135. https://doi.org/10.2196/jmir.5066.

Busner J, Targum SD. The clinical global impressions scale: applying a research tool in clinical practice. Psychiatry (Edgmont). 2007 Jul;4(7):28-37.

Cai Y, Gong W, He H, Hughes JP, Simoni J, Xiao S, Gloyd S, Lin M, Deng X, Liang Z, He W, Dai B, Liao J, Hao Y, Xu DR. Mobile Texting and Lay Health Supporters to Improve Schizophrenia Care in a Resource-Poor Community in Rural China (LEAN Trial): Randomized Controlled Trial Extended Implementation. J Med Internet Res. 2020 Dec 1;22(12):e22631. doi: 10.2196/22631. PMID: 33258788; PMCID: PMC7738261.

Carpenter-Song E, Jonathan G, Brian R, Ben-Zeev D. Perspectives on Mobile Health Versus Clinic-Based Group Interventions for People With Serious Mental Illnesses: A Qualitative Study. Psychiatr Serv. 2020 Jan 1;71(1):49-56. doi: 10.1176/appi.ps.201900110. Epub 2019 Oct 16. PMID: 31615368.

Desai, Pooja R et al. Estimating the Direct and Indirect Costs for Community-Dwelling Patients with Schizophrenia. Journal of pharmaceutical health services research 4.4 (2013): 187–194. Web.

Duckworth K, Halpern L. Peer support and peer-led family support for persons living with schizophrenia. Curr Opin Psychiatry. 2014 May;27(3):216-21. doi: 10.1097/YCO.0000000000000051. PMID: 24662961.

Eack, S., Anderson, C., & Greeno, C. (2013). Identifying and managing the symptoms of severe mental illness. In Mental health case management (pp. 35-48). SAGE Publications, Inc.,

Ferrari AJ, Stockings E, Khoo JP, Erskine HE, Degenhardt L, Vos T, Whiteford HA. The prevalence and burden of bipolar disorder: findings from the Global Burden of Disease

Study 2013. Bipolar Disord. 2016 Aug;18(5):440-50. doi: 10.1111/bdi.12423. PMID: 27566286.

Firth J, Cotter J, Torous J, Bucci S, Firth JA, Yung AR. Mobile Phone Ownership and Endorsement of "mHealth" Among People With Psychosis: A Meta-analysis of Cross-sectional Studies. Schizophr Bull. 2016 Mar;42(2):448-55. doi: 10.1093/schbul/sbv132. Epub 2015 Sep 22. PMID: 26400871; PMCID: PMC4753601.

García S, Martínez-Cengotitabengoa M, López-Zurbano S, Zorrilla I, López P, Vieta E, González-Pinto A. Adherence to Antipsychotic Medication in Bipolar Disorder and Schizophrenic Patients: A Systematic Review. J Clin Psychopharmacol. 2016 Aug;36(4):355-71. doi: 10.1097/JCP.0000000000000523. PMID: 27307187; PMCID: PMC4932152.

Good BJ, Good MD. Significance of the 686 Program for China and for global mental health. Shanghai Arch Psychiatry. 2012 Jun;24(3):175–7. doi: 10.3969/j.issn.1002-0829.2012.03.008. http://europepmc.org/abstract/MED/25324623.

Guy W (ed). ECDEU Assessment Manual for Psychopharmacology. Rockville, MD: US Department of Heath,Education, and Welfare Public Health Service Alcohol, Drug Abuse, and Mental Health Administration, 1976.

Kay, S. R., Opler, L. A., & Lindenmayer, J.-P. (1989). The Positive and Negative Syndrome Scale (PANSS): Rationale and standardisation. *The British Journal of Psychiatry, 155*(Suppl 7), 59–65.

Khafif TC, Belizario GO, Silva M, Gomes BC, Lafer B. Quality of life and clinical outcomes in bipolar disorder: An 8-year longitudinal study. J Affect Disord. 2021 Jan 1;278:239-243. doi: 10.1016/j.jad.2020.09.061. Epub 2020 Sep 15. PMID: 32971316.

Krzystanek M, Borkowski M, Skałacka K, Krysta K. A telemedicine platform to improve clinical parameters in paranoid schizophrenia patients: Results of a one-year randomized study. Schizophr Res. 2019 Feb;204:389-396. doi: 10.1016/j.schres.2018.08.016. Epub 2018 Aug 25. PMID: 30154027.

Lewis S, Ainsworth J, Sanders C, Stockton-Powdrell C, Machin M, Whelan P, Hopkins R, He Z, Applegate E, Drake R, Bamford C, Roberts C, Wykes T. Smartphone-Enhanced Symptom Management In Psychosis: Open, Randomized Controlled Trial. J Med Internet Res. 2020 Aug 13;22(8):e17019. doi: 10.2196/17019. PMID: 32788150; PMCID: PMC7453320.

Mahler C, Hermann K, Horne R, et al: Assessing reported adherence to pharmacological treatment recommendations: translation and evaluation of the Medication Adherence Report Scale (MARS) in Germany. J Eval Clin Pract 2010; 16:574–579.

McGrath J, Saha S, Chant D, Welham J. Schizophrenia: a concise overview of incidence, prevalence, and mortality. Epidemiol Rev. 2008;30:67-76. doi: 10.1093/epirev/mxn001. Epub 2008 May 14. PMID: 18480098.

Nacinovich. (2011). Defining mHealth. Journal of Communication in Healthcare, 4(1), 1–3. https://doi.org/10.1179/175380611X12950033990296

Rathbone AL, Prescott J. The Use of Mobile Apps and SMS Messaging as Physical and Mental Health Interventions: Systematic Review. J Med Internet Res. 2017 Aug 24;19(8):e295. doi: 10.2196/jmir.7740. PMID: 28838887; PMCID: PMC5590007.

Röhricht F, Padmanabhan R, Binfield P, Mavji D, Barlow S. Simple Mobile technology health management tool for people with severe mental illness: a randomised controlled feasibility trial. BMC Psychiatry. 2021 Jul 16;21(1):357. doi: 10.1186/s12888-021-03359-z. PMID: 34271902; PMCID: PMC8283992.

Schulze LN, Stentzel U, Leipert J, Schulte J, Langosch J, Freyberger HJ, Hoffmann W, Grabe HJ, van den Berg N. Improving Medication Adherence With Telemedicine for Adults With Severe Mental Illness. Psychiatr Serv. 2019 Mar 1;70(3):225-228. doi: 10.1176/appi.ps.201800286. Epub 2019 Jan 17. PMID: 30651059.

Stępnicki P, Kondej M, Kaczor AA. Current Concepts and Treatments of Schizophrenia. Molecules. 2018 Aug 20;23(8):2087. doi: 10.3390/molecules23082087. PMID: 30127324; PMCID: PMC6222385.

Tan BL, Lee SA, Lee J. Social cognitive interventions for people with schizophrenia: A systematic review. Asian J Psychiatr. 2018 Jun;35:115-131. doi: 10.1016/j.ajp.2016.06.013. Epub 2016 Sep 23. PMID: 27670776.

Üstün TB, ed. Measuring health and disability: manual for WHO disability assessment schedule WHODAS 2.0. World Health Organization, 2010.