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Mental Health Service Users' Mobile Phone Contact Method: Preference and Medication Adherence

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Abstract

Research suggests that medication adherence among individuals with mental health problems is problematic. The issue of medication non-adherence among this population is consistent among the different mental health diagnoses. Numerous factors contribute to medication non-adherence: patient issues, service delivery issues, and issues related to the measurement of medication adherence, which lacks a gold standard. This dissertation is a compendium of three manuscripts that represent three distinct but related studies on medication adherence among individuals with mental health challenges.

The first manuscript is an integrative review that seeks to assess the validity, reliability, and levels of evidence of existing instruments for measuring medication adherence in patients with schizophrenia. The second is another integrative review that examines literature in the past decade (2006-2016) on the use of mobile phone contacts (MPC) in individuals with severe mental illness to improve medication adherence after hospital discharge. The third, a descriptive correlational study, examines mental health services (MHS) users' preferred MPC delivery method when receiving support to increase medication adherence after discharge.

The findings from the first integrative review show the importance of validating medication adherence measures in this population. Findings from the second show the extent to which MPC support the increase of medication adherence in this population. Findings from the third show the importance of identifying patients' preferences for an MPC method when providing support to increase medication adherence in this population. The findings of the two integrative reviews and the descriptive correlational study are integrated at the conclusion of the dissertation.

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Introduction

Medication adherence in patients with mental illness is a major public health concern. Medication nonadherence causes rapid disease progression, increased disease complications, poorer functional outcomes, lower quality of life (Najt, PFusar-Poli, and Brambilla, 2011; Novick et al., 2010), increased violent behavior (Van Dorn, Volavka, and Johnson, 2012), increased suicide attempts (Novick et al., 2010), and earlier/more frequent re-hospitalization (Brown, Bennett, Li, and Bellack, 2011; Najt, PFusar-Poli, and Brambilla, 2011). Social support is noted to be important for patient recovery (Bickley et al., 2013; Sawant and Jethwani 2010); however, challenges that come with mental illnesses disrupt these supportive networks (Green et al., 2002). This lack of support affects the individuals with mental health challenges especially when faced with barriers such as lack of transportation, difficulties in making medical decisions, managing personal health problems, and troubling mental health symptoms (Nath et al., 2012) after discharge. This can lead to poor adherence or non-adherence after discharge from the hospital, causing a revolving door.

One major gap in trying to address medication adherence in this population is the need to find a gold standard to measure medication adherence for these patients. Measuring medication adherence is important to both researchers and clinicians because inaccurately measuring adherence in this population can lead to several potentially costly and dangerous problems (Lam and Fresco, 2015) such as judging an effective treatment as ineffective and using unnecessary expensive diagnostic procedures (Lam and Fresco, 2015). An extensive literature search of studies between 2000 to 2016 regarding the reliability and validity of existing measures for medication adherence identified six

studies that used fourteen instruments specifically measuring medication adherence in this population. Even though these instruments are still relevant in measuring medication adherence for patients with mental illnesses no study serves as a gold standard because the scales reported in each study lacked either validity, reliability or sensitivity.

Studies show that about 50% of individuals with SMI become non-adherent in managing their treatment the first month following discharge from the hospital, which is a major factor influencing acute psychiatric hospital readmission (Tomko et al., 2013). Increased non-adherence to prescribed medications after discharge leads to failure of follow-up care after discharge, failure to achieve the full benefits of treatment (Lee et al., 2015), and higher mental health care costs (Pantalon et al., 2014). Technology has shown potential benefits to persons with mental health challenges (Palmier-Claus et al., 2013; Ho, 2003) especially mobile technology (West, 2012). Telecommunications technology is worldwide (International Telecommunication Union 2013), feasible (Nieuwlaat et al., 2014), and can benefit healthcare (Chen, Mishara, and Liu, 2010; Palmier-Claus et al., 2013).

Mobile phone usage in individuals with mental health challenges is proportionate to the general population's use (70% to 100%) (Miller et al 2015; Ennis et at., 2012), and patients acknowledge its benefits to healthcare delivery (Palmier-Claus et al., 2013). Mobile phone contact is seen as having the potential for increasing medication adherence in individuals with mental health challenges. A thorough literature search between 2006 to 2016 showed only five studies had occurred the use of mobile phone contacts to increase medication adherence in individuals with severe mental illness after discharge.

Although these studies showed that mobile phone contact increases medication adherence in this population (Montes et al., 2012; Beebe, Smith and Phillips 2014; Beebe et al., 2008; Granholm et al., 2012), many limitations with the studies have been identified. Mental health researchers have yet to adequately research the use of mobile phone technology to increase medication adherence in this population; thus, the potential of mobile technology use to improve mental health services among individuals with serious mental illness remains uncertain (Ben-Zeev et al., 2013).

Furthermore, none of the studies reviewed explicitly used a theoretical framework, although the core domains of social support theory are implied. The reviewed studies showed that individuals with SMI were given tangible aid and services, advice, suggestions, and a variety of information including information for self-evaluation, as described by Glanz, Rimer and Viswanath (2008). Using the social support theory to increase medication adherence was important for organizing research design and methods, explaining study results, and placing the findings within the context of science (Mock et al., 2007; Radwin and Fawcett, 2002). This was described in the second manuscript. Social support theory postulates that social support may have positive effects on the physical, mental, and social health of an individual (Glanz, Rimer and Viswanath 2008).

Manuscripts

This dissertation includes three distinct but related manuscripts. The first and second manuscripts are integrative reviews. The first integrative review gives a detailed assessment of the validity, reliability, and levels of evidence for existing instruments that measure medication adherence in patients with schizophrenia. The second integrative

review identifies studies that used text messages and phone calls to increase medication adherence in individuals with mental health challenges. The third manuscript, a descriptive correlational study, identifies mental health service users preferred mobile phone contact method in relation to their medication adherence and demographic and clinical data.

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Manuscript 1

Measuring Medication Adherence in Patients with Schizophrenia: An Integrative Review.

Bright C. E. (2016): Measuring Medication Adherence in Patients with Schizophrenia: An Integrative Review. *Archives of Psychiatric Nursing 31(1).* *doi.org/10.1016/j.apnu.2016.09.003*

Abstract

Purpose

The purpose of this paper is to assess the validity, reliability and levels of evidence of existing instruments for measuring medication adherence in patients with schizophrenia.

Background

Schizophrenia is estimated to affect approximately 7 individuals out of 1000 in their lifetimes, with fifty percent of patients attempting suicide. However, studies have shown that measuring medication adherence in patients with schizophrenia is difficult and no gold standard currently exists. Without reliable and valid instruments to evaluate non-adherence in this population, research into strategies to improve adherence cannot move forward.

Data Sources

This integrative review used the following search terms: assessing, measuring, medication adherence, schizophrenia, medication non-adherence, validity, reliability and measures. Databases searched included CINAHL, PubMed, PsycINFO and Scopus). Studies were included if they were published from 2000 to 2016. Fourteen instruments were identified from six studies and were included in this review.

Results

All the instruments assessed were weak in both validity and reliability coupled with having low levels of evidence. Three instruments (two are fairly new) yielded better validity, reliability and sensitivity; however, they have not been assessed in broad, diverse samples, so their generalizability remains unclear.

Conclusion

This study suggests the need to develop an instrument with adequate validity, reliability, and sensitivity to various patients' characteristics.

Introduction

Nonadherence among patients with severe mental illness has been estimated to be between 30% and 65% (Yang et al., 2012). Non-adherence has substantial impact on disease progression, complications, functional outcomes and quality of life (Najt, Fusar-Poli, & Brambilla, 2011; Novick et al., 2010), leading to relapses, re-hospitalizations (Brown, Bennett, Li, & Bellack, 2011; Lacro, Dunn, Dolder, Leckband, & Jeste, 2002; Leucht & Heres, 2006; Trivedi, Lin, & Katon, 2007), and even death (Meltzer, Anand, & Alphs, 2000). Medication non-adherence poses a formidable challenge to behavioral health clinicians (Glazer, 2010) and increases the economic burden on the healthcare system and society (Brian, 2016; Cloutier et al., 2016; Dilla, Ciudad, & Alvarez, 2013; Insel, Schoenbaum, & Wang, 2009; Mackin, Delucchi, Bennett, & Areán, 2011; Pantalon, Murphy, Barry, Lavery, & Swanson, 2014).

Schizophrenia is chronic and disabling, affecting thinking, feelings, actions and movement (catatonia). Schizophrenia is estimated to affect approximately 7 individuals out of 1000 in their lifetimes (Higashi, Medic, Littlewood, Granström, & Hert, 2013), with increased risk of suicide (Leucht & Heres, 2006; Lindstrom, Eriksson, & Levander, 2012) as fifty percent of patients attempt suicide (Fields, 2011). Anti-psychotic medications are the cornerstone for treatment of schizophrenia (Buchanan et al., 2010;Velligan et al., 2009) but as many as 50% of patients with schizophrenia fail to take their medications as prescribed (Lacro et al., 2002; Stephenson et al., 2012; Velligan et al., 2009) and non-adherence rate accounts for 40% of re-hospitalizations (Knapp, King, Pugner, & Lapuerta, 2004) noted as a significant problem in the treatment of schizophrenia (Leucht & Heres, 2006; Acosta, Hernández, Pereira, Herrera, & Rodríguez,

2012. Barkhof, Meijera, de Sonnevilleb, Linszena, & de Haana, 2011). Unfortunately, studies have shown that measuring medication adherence in patients with schizophrenia is difficult and no gold standard currently exists (Haddad, Brain, & Scott, 2014; Kikkert et al., 2008).

Measuring medication adherence is important to both researchers and clinicians since estimating medication adherence inaccurately can lead to several potentially costly and dangerous problems (Lam & Fresco, 2015). Lam and Fresco (2015) explained that inaccurately measuring medication adherence can cause an effective treatment to be judged ineffective and expensive diagnostic procedures may be unnecessarily used. Currently, two methods are used in measuring medication adherence in patients with schizophrenia; objective and subjective methods. Subjective methods are mostly self-reports, informant ratings and clinician ratings and are frequently used in many studies (Byerly, Nakonezny, & Rush, 2008; Clayton et al., 2010; Kikkert et al., 2011; Ren, Herz, Qian, Smith, & Kazis, 2009; Thompson, Kulkarni, & Sergejew, 2000). Objective methods such as electronic monitoring, pill count, pharmacy refill records and plasma levels are also used in studies (Brain et al., 2014; Byerly et al., 2008; Clayton et al., 2010; Velligan et al., 2009). Moreover, objective measures are the recommended method for measuring medication adherence in this population (Velligan et al., 2009), however, its use is sparse in studies (Brain et al., 2014).

Furthermore, results from both objective and subjective measures of medication adherence in this population are reported to be questionable. Subjective measures are reported to underestimate non-adherence rates (Byerly et al., 2005), while results from objective measures are reported to have possibly been influenced by extraneous factors

(Brain et al., 2014; Hiemke et al., 2011; Sacchetti & Vita, 2014; Velligan et al., 2006, 2007, 2010; Yalcin-Siedentopf et al., 2015). Additionally, irrespective of objective measures being the recommended method for measuring medication adherence in this population (Velligan et al., 2009), varying results have been noted in studies (Velligan, Lam, Ereshefsky, & Miller, 2003; Velligan et al., 2007; Yang et al., 2012).

One important element of a measurement tool is its ability to prove to be valid, reliable, and sensitive to change (Vitolins, Rand, Rapp, Ribisl, & Sevick, 2000). Additionally, these instruments need to prove to be useable and amenable to individual characteristics, aims and resources of the clinical setting (Lam & Fresco, 2015). These characteristics are essential in accurately estimating medication adherence in individuals with schizophrenia. The purpose of this integrative review was to assess current tools for measuring medication adherence in patients with schizophrenia, examining their validity and reliability. This review was to bring to light if any, a reliable and valid measure to evaluate medication adherence in this population. Additionally, this was to help improve strategies to enhance medication adherence in individuals with schizophrenia.

Definitions

Adherence

Medication adherence can be defined as the extent to which a patient's medication-taking matches that agreed with the prescriber (Haddad et al., 2014).

Non-adherence

Nonadherence to medication includes a range of patient behaviors, from treatment refusal to irregular use or partial change of daily medication doses (Higashi et al., 2013).

Measurement

Measurement is the process of assigning numbers to objects to represent the kind and/or number of attributes possessed by objects (Waltz, Strickland, & Lenz, 2010). Medication non-adherence is measured with direct and indirect methods (Karve et al., 2009). Direct methods include: observing patients taking medications direct observation) and measuring drug or metabolite concentrations in the blood or urine (Lavsa, Holzworth, & Ansani, 2011). Indirect methods include: asking patients, checking patient diaries, refill rates, pill counting, monitoring for clinical response, electronic monitoring devices, patient scales or surveys (Lavsa et al., 2011) and the use of administrative database claims (Osterberg & Blaschke, 2005).

Abbreviations have been given to the following measures as follows: pill count (PC), plasma levels (PL): objective and subjective ratings (OSR), medication compliance (MC) and episode-specific approach (ESA). The various publications reviewed are discussed in sequence based on the measurement instrument identified.

Methods

This integrative review assesses instruments to measure medication adherence in patients with schizophrenia. The results from this study may help guide future clinicians seeking to measure medication adherence in this population.

Inclusion and Exclusion Criteria

The primary inclusion criterion was measurement of medication adherence in adult patients with schizophrenia. However, some studies that measured medication adherence in patients with schizophrenia also included patients with schizoaffective disorder, bipolar affective disorder, depression with psychotic features, schizophreniform,

and drug induced psychoses. These studies were also included in this review. Samples that included children, adolescents, geriatric patients and patients with psychiatric conditions other than these were excluded.

Studies reviewed were studies conducted from 2000 to 2016, published in English, with a tool or method to assess or measure medication adherence in patients with schizophrenia that were included. Six studies met the inclusion criteria and are outlined in the integrative review table in the results. Various information from the articles is presented under the following topics: instrument and reference, description of research subjects, instrument description and scoring, method of measurement, validity, reliability, feasibility, and level of evidence.

Databases and Search Terms Used

In consultation with a health science reference librarian search terms were refined, and relevant bibliographic databases identified. The search terms used were: assessing medication adherence, measuring medication adherence, patients with schizophrenia, medication non-adherence measures and validity measures. The following databases were used to search for literature reporting on measures of medication adherence in schizophrenia: Cumulative Index to Nursing and Allied Health Literature (CINAHL), US National Library of Medicine PubMed service (PubMed), PsycINFO, and Scopus.

When search terms were entered into databases, Scopus generated 46 articles, CINAHL generated 60 articles, PubMed nine articles and PsyInfo 157. No additional records were identified from other sources. A total of 272 articles were identified. After duplicates were removed, 210 articles remained, which were screened, and 165 records were excluded because they did not meet the main inclusion criteria.

Thirty-five full-text articles left were assessed, and 29 were excluded with reasons (twelve did not directly deal with measuring medication adherence, three looked at the efficacy of medications therapeutic monitoring), three looked at other tools other than medication adherence tools). One looked at errors in the measurement tools. Three looked at relationship between measurement tools and not specifically measuring medication adherence in individuals. Five articles assessed cognition, one also looked at side effects of medications and one addressed mental illness other than schizophrenia.

Sampling

A total of six studies from CINAHL, PubMed, PsycINFO and Scopus met criteria for inclusion. Subjects from the various articles reviewed were patients with schizophrenia taking various anti-psychotic medications to manage their symptoms. Some studies used direct measurement tools while the others used indirect measurement tools to assess adherence to medications in patients with schizophrenia. In all, fourteen instruments were identified from the articles in the review. The data obtained from the literature reviewed was analyzed based on the validity and reliability of the instruments identified for measuring medication adherence in schizophrenia. The level of evidence of the literature reviewed was also determined. The PRISMA 2009 diagram (Moher et al., 2009) below shows results from search done.

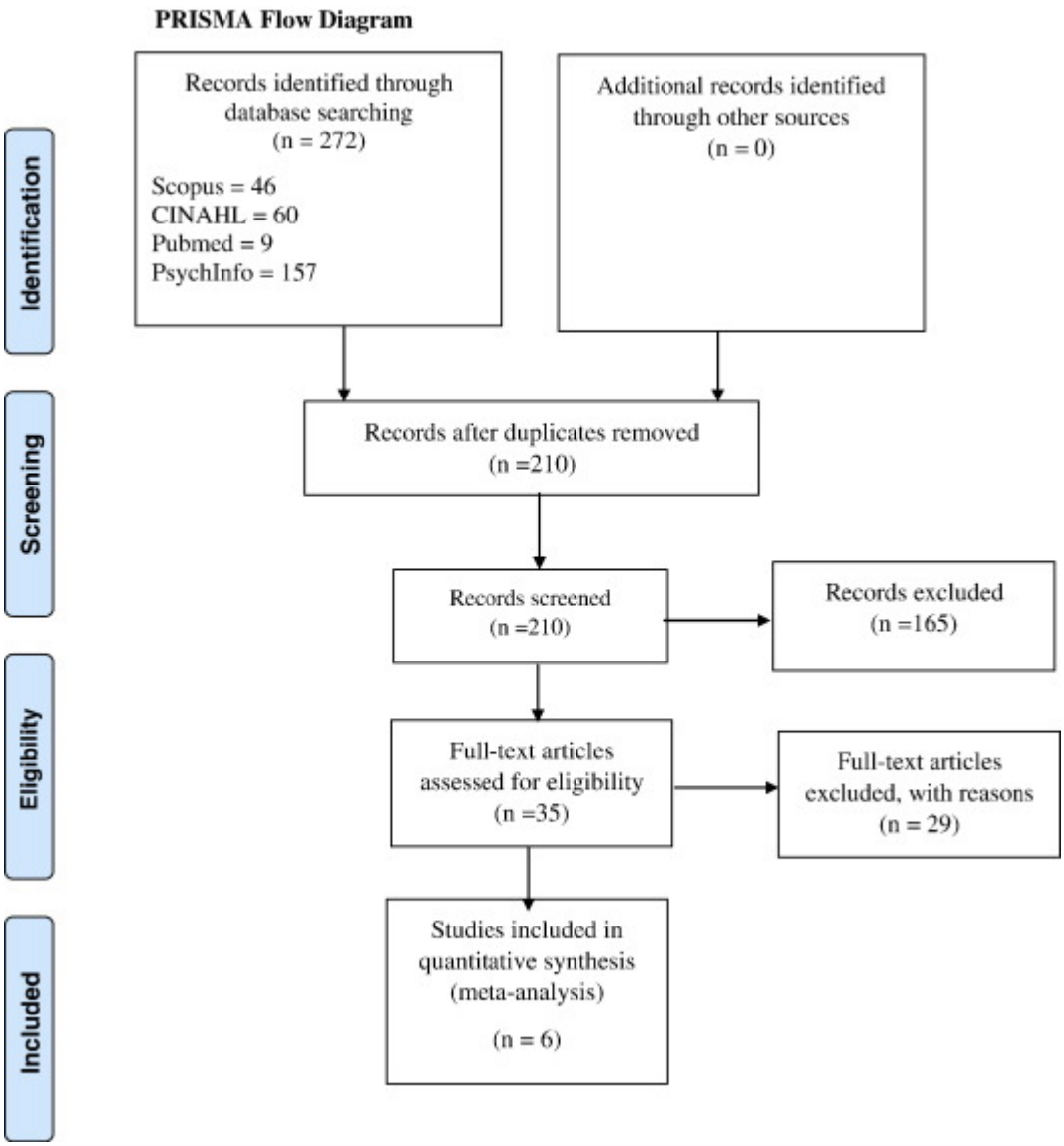

Figure 1. Prisma Flow Diagram

Results

As discussed earlier non-adherence to medications is associated with adverse health conditions, especially in chronic conditions such as schizophrenia. Within the six studies, fourteen instruments for measuring medication adherence in schizophrenia were identified, and their results are presented in this section with focus on their validity,

reliability and sensitivity. The level of evidence of these studies was also evaluated based on the Center for Evidence Based Medicine Levels of Evidence (2009) appraisal format.

Instrument Description

Kikkert et al. (2011) measured medication adherence in patients with schizophrenia by using the Medication Adherence Questionnaire (MAQ), modified Drug Attitude Inventory (DAI), and the Compliance Rating Scale (CRS). Ren et al. (2009) assessed the measurement properties of three commonly used pharmacy-based measures (treatment persistence - TP, medication possession ratio - MPR, and medication compliance - MC) in addition to a new measure - episode-specific approach (ESA) to assess medication adherence with three typical (haloperidol, perphenazine and chlorpromazine) and five atypical (clozapine, olanzapine, quetiapine, risperidone and ziprasidone) antipsychotics. Ren et al. (2009) used a gap of ≥30 days (with no filled index medication) to define discontinuation of treatment as well as the number of times a patient returned to the same index agent after discontinuation of treatment within a 1-year period, which they termed medication "episodes."

Byerly et al. (2008) used the Brief Adherence Rating Scale (BARS), a recently developed instrument using the electronic monitoring (EM) tool as a reference standard to evaluate the BARS' reliability validity, sensitivity, and specificity. BARS took into consideration symptom severity in accordance with the 30-item Positive and Negative Syndrome Scale (PANSS) measure.

Brain et al. (2014) used the Medication Event Monitoring System (MEMS®), Pill Count, Plasma Levels and Subjective and Objective Rating Scale (patient, staff, psychiatrist and close informant ratings) to measure medication adherence in patients

with schizophrenia. They measured the validity of their instruments using the Pearson's $\chi 2$ -method or Fisher's exact test and used kappa ("K") coefficients to describe the agreement between MEMS® and the other measures. Inter-rater reliability for the plasma level was also assessed in the study. Brain et al. (2014) compared relationships between MEMS® adherence and each of the other measures. They also measured inter-rater reliability for the plasma level. Additionally, they analyzed the interrelationships between all measurements using a principal component analysis, with Oblimin rotation.

Thompson et al. (2000) used the Medication Adherence Questionnaire (MAQ) a four-item questionnaire related to medication-taking behaviors of patients; Drug Attitude Inventory (DAI), the most commonly used self-report measure of compliance that includes a 30-item questionnaire - measuring subjective positive attitudes, subjective negative attitudes, health/illness, physician, control, prevention, and harm; and the Medication Adherence Rating Scale (MARS) developed from the DAI and MAQ by applying item response theory (IRT). They tested for reliability with Cronbach's alpha (internal consistency) and test–retest. Parallel-forms chi-square tested for goodness of fit, the construct validity in the MARS was validated using a multitrait–multimethod matrix, carers' estimate of subject compliance, and blood test results.

Finally, Clayton et al. (2010) measured the degree of adherence among patients prescribed antipsychotic medications from existing pharmacy claims data from Medicaid programs in Missouri, Alaska, and Utah for two 12-month periods (January 2006 to December 2006 for Missouri and July 2006 to June 2007 for Alaska and Utah). They first used a clinician-rated structured instrument to assess patients' medication adherence and then used a 12-item scale, the Medication Adherence Assessment Tool (MAAT)

developed by a group of experts using a consensus methodology after review of the adherence literature, as part of a project sponsored by Ortho-McNeil Janssen Scientific Affairs, LLC. They then compared MAAT results with results from indirect measures of treatment adherence derived from pharmacy data, the medication possession ratio (MPR), which they indicated as an already validated tool. Cronbach's alpha was used to check validity of these instruments.

Reliability and Validity of Subjective Measures

Medication Adherence Questionnaire (MAQ)

This instrument was used by both Kikkert et al. (2011) and Thompson et al. (2000). Kikkert et al. (2011) revealed that the MAQ items were directly related to medication intake behavior among the patients and found sensitivity and specificity for time to relapse and admission. At 95% confidence interval using upper and lower boundaries, respectively, logistic regression on the MAQ showed prediction for relapse between 0.345–0.852 and 0.299–0.874 for admission. Furthermore, at 95% confidence interval using lower and upper limits respectively on Cox Regression to predict time to relapse and admission, the MAQ showed time to relapse between 0.537 and 0.874 and 0.443 and 0.950 for time to admission. When checking for relapse, the MAQ had 63.6 sensitivity and 59.7 specificity and for admission, the MAQ had 87.5 sensitivity and 54.5 specificity. The MAQ was both predictive for relapse and for time to relapse. Kikkert et al. (2011) concluded that, 42% of patients who the MAQ rated non-adherent to medications still did not relapse and 35% of the patients the MAQ rated adherent did relapse.

In Thompson et al. (2000), the MAQ had a reliability of 0.76 Cronbach's alpha. When test–retest reliability was assessed after a 2-week interval using the parallel-forms chi-square, it had a goodness of fit of 0.76. When they assessed the internal validity of the MAQ using IRT, the MAQ showed good internal validity but no data or analysis was offered to support this claim. When construct validity of the MAQ was analyzed using a multitrait–multimethod matrix, there was a positive correlation with blood results. See table below for more details.

Medication Adherence Rating Scale (MARS)

Thompson et al. (2000) analyzed the MARS for reliability using Cronbach's alpha, which was 0.75. The test–retest reliability assessed after a 2-week interval using the parallel-forms chi-square to test the goodness of fit was 0.72 for the MARS. Thompson et al. (2000) brought to light that, after the internal validity of the MARS was assessed by using IRT, results suggested that it had good internal validity because all the items fit the model. Thompson et al. (2000) stated that the MARS had a high level of validity and appeared to account for the complexity of compliance behavior. They further stated that the MARS was believed to have a greater utility in a number of settings because it is more time and cost-effective than many methods of measuring compliance. They also indicated that the MARS had good convergent or construct validity. Moreover, it appears to be a reliable and valid tool for estimating compliance, with greater validity than the other measures they used in their study.

Objective and Subjective Ratings (OSR)

Regarding OSR, Brain et al. (2014) used a 5-point scale (1 = “0–20%”, 2 = “21–40%”, 3 = “41–60%”, 4 = “61–80%”, and 5 = “81–100%”) to measure adherence. For the

dichotomous adherence variable, category 5 was considered adherent. Results indicated that among the subjective measurements, the highest figure was observed for the self-rated measure (mean adherence 92%) by patients or informants, and the lowest for the clinical staff and prescribing psychiatrists (58%).

Drug Attitude Inventory (DAI)

Kikkert et al. (2011) used the DAI to assess for adherence in schizophrenia. They explained that, the DAI focused on a patient's attitudes toward medication (medication intake behavior). When logistic regression was used at 95% confidence interval using both upper and lower limits, respectively, to predict for relapse and admission, the results showed between 0.721 and 1.091 for relapse and 0.572 and 0.976 for admission DAI. When Cox Regression was used at 95% confidence interval (lower and upper levels, respectively), the results showed between 0.798 and 1.034 for prediction time to relapse and 0.642 and 0.987 for admission DAI. The DAI showed 18.2 for sensitivity and 90.0 specificity for relapse and for admission it showed 20.0 for sensitivity and 87.0 for specificity.

Thompson et al. (2000), revealed that, the DAI had a reliability of 0.77. They also had the test–retest reliability assessed after a 2-week interval using the parallel-forms chi-square, and the DAI had a goodness of fit of 0.60. They concluded that the DAI appeared to have poor internal validity, which may be due to the fact that it may have assessed more than one underlying construct.

Compliance Rating Scale (CRS)

Kikkert et al. (2011) measured adherence with the CRS for prediction of relapse and admission with logistic regression. At a 95% confidence interval, the CRS showed

0.505–0.995 prediction for relapse and 0.277–0.822 for admission. With Cox regression at 95% confidence interval for both lower and upper levels used to predict time to relapse and admission, CRS showed 0.659 (upper) and 0.980 (lower) for relapse and 0.469 (lower) and 0.845 (upper) prediction for admission. Kikkert et al. (2011) further found that CRS showed 34.0 sensitivity and 90.3 specificity for relapse. Kikkert et al. (2011) also found that, for admission, the CRS had 38.5 sensitivity and 81.8 specificity. Kikkert et al. (2011) concluded that the CRS was predictive for time to hospital admission, but the clinical relevance of these effects was, however, limited.

Treatment Persistence (TP)

Ren et al. (2009) used treatment persistence (TP) which defines medication discontinuation based on gap between administrations of ≥30 days. Their results revealed that among the atypical agents, patients who initiated on clozapine were most adherent, whereas patients who were initiated on risperidone were least adherent. Patients on the typical agents who initiated on perphenazine were most adherent and those initiated on haloperidol were least adherent. The results also indicated that initiators of olanzapine and ziprasidone stayed on treatment for the same duration (151 days).

Furthermore, patients who initiated chlorpromazine were reported to have remained on medication treatment slightly longer than initiators of haloperidol (117 vs 110 days, $p < 0.05$). Ren et al. (2009) further stated that TP uses only the first medication episode, which combined the single prescription for patients who had one prescription with the first episodes among patients who had two or three medication episodes. Ren et al. (2009) indicated that results from TP are problematic because it excludes the second episode among patients with two medication episodes and the second and last episodes

among those with three medication episodes. Ren et al. (2009) therefore concluded that results based on the TP approach are likely to be biased.

Medication Possession Ratio (MPR)

Ren et al. (2009) used a gap of ≥30 days to define discontinuation of medication treatment and took into account all medication episodes with the MPR. The study revealed that most patients on atypical agents who initiated clozapine were rated adherent, whereas patients who initiated risperidone were least adherent. With the typical agents, most patients who initiated perphenazine were rated adherent while those initiated on haloperidol were least adherent. However, Ren et al. (2009), stated that initiators of ziprasidone stayed on treatment significantly longer than initiators of olanzapine (269 vs 246 days; $p < 0.001$), and those initiated on ziprasidone remained on treatment slightly longer than initiators of quetiapine (269 vs 266 days are however not statistically significant). Initiators of chlorpromazine remained on medication treatment significantly longer than initiators of haloperidol (234 vs 197 days, $p < 0.001$).

Clayton et al. (2010) revealed that the MPR identified 20% of patients in the sample (58 out of 289) non-adherent to their antipsychotic medications using the threshold of 0.8 for adherence. Looking at these two studies, MPR rated most of the participants in Ren et al. (2009) adherent, but Clayton et al. (2010) found that most of these participants rated non-adherent.

Ren et al. (2009) stated that the MPR lumps together patients with different numbers of medication episodes; hence one would not be able to capture the differences in medication adherence between patients with one medication episode and those with multiple medication episodes. They further indicated that because MPR does not consider

the size of the gap in defining discontinuation of medication treatment, using MPR as a measure for adherence is problematic.

Medication Compliance (MC)

Ren et al. (2009) considered the size of the gap (i.e., ≥30 days) to define discontinuation of medication treatment as indicated on the MC measure. The study revealed that initiators of quetiapine remained on treatment significantly longer than initiators of ziprasidone (191 vs 178 days; $p < 0.05$). Ren et al. (2009) went on to say that, although MC considers all medication episodes, it also lumps together patients with different numbers of medication episodes and one would not be able to capture the differences in medication adherence between patients with one medication episode and those with multiple medication episodes.

Medication Adherence Assessment Tool (MAAT)

According to Clayton et al. (2010), the ability of the MAAT total score to predict adherence as objectively measured by MPR was analyzed using simple linear regression. There was statistical significance with a little less than 5% variability in MPR, which was explained by a patient's total MAAT score. They further state that internal consistency of the MAAT was excellent on Cronbach's [alpha] scores, and inter-rater reliability was excellent ($r = 0.994$ for the total score; with inter-rater reliability on individual items ranging from 0.608 to 1.0). Clayton et al. (2010) shared a concern that, despite these statistically significant findings, clinicians were unable to reliably detect nonadherence among their patients who were prescribed antipsychotic medications using the MAAT since it seemed to be more based on clinicians' subjective ratings.

Episode-Specific Approach (ESA)

Ren et al. (2009), developed a new measure, the ESA, which stratifies the number of medication episodes and compares medication adherence across antipsychotic agents. Findings revealed that the number of days remaining on medication treatment across different antipsychotics tended to vary across different medication episodes. Among the three typical agents, initiators of chlorpromazine had better medication adherence than initiators of haloperidol, but the differences were non-significant among those with one medication episode (131 vs 124 days). Among those with two medication episodes, the difference was moderate (191 vs 171 days; $p < 0.05$). However, among those with three or more medication episodes the difference was strong (195 vs 154 days; $p < 0.001$).

With the five atypical agents, ESA on one hand rated initiators of olanzapine to have stayed significantly longer on treatment than initiators of risperidone when on three or more medication episodes (199 vs 192 days, $p < 0.01$); however, the difference between these two agents was non-significant if the patient was on a first (171 vs 168 days) or second medication episode (198 vs 199 days). On the other hand, ESA rated that initiators of quetiapine and ziprasidone were poorly adherent when on a single medication episode (172 vs 186 days; $p < 0.001$), but more adherent when on a second medication episode (222 vs 210 days; $p < 0.01$).

Brief Adherence Rating Scale (BARS)

Byerly et al. (2008) assessed a recently developed tool (BARS) for reliability, validity, sensitivity, and specificity by using the electronic monitoring (EM) tool as a reference standard every six month and the PANSS score for symptom severity. Their results indicated high internal reliability for the BARS across the six-monthly assessment

periods ($\alpha = 0.92$) and a moderate-to-strong linear relationship between initial monthly BARS adherence and subsequent BARS adherence. For the various initial BARS assessment periods in relation to subsequent BARS adherence, robust regression coefficients ranged from 0.53 to 0.92, and Spearman's correlations (rs) ranged from 0.46 to 0.86. With a mean of ≥71%, the BARS showed adherence among 52.5% (n = 32) of the participants, while 47.5% <71%, (n = 29) were non-adherent. There was a significant inverse relationship with concurrent validity and correlation between BARS adherence and PANSS ($\beta = -0.08$, $p = .007$; $rs = -0.28$, $p = .02$) as lower adherence was associated with more severe positive symptoms.

Byerly et al. (2008) also reported a significant inverse relationship between BARS adherence and PANSS ($\beta = -0.09$, $p = .02$) on the robust regression analysis with no statistical significance in relationship with the Spearman rs ($rs = -0.23$, $p = .07$) but rather a significant inverse relationship ($\beta = -0.40$, $p < .0001$; $rs = -0.39$, $p = .002$). An initial 3-month BARS assessment period with a cutoff of <74% mean adherence (mean of months 0, 1, and 2) had sensitivity of 73.1% and specificity 74.3% in detecting non-adherence. BARS detected 54.1% (n = 33) of the participants adherent, and 45.9% (n = 28) non-adherent. At a cutoff of <71% mean BARS adherence rating for the 6 monthly BARS assessments, 52.5% (n = 32) were adherent, and 47.5% (n = 29) non-adherent with sensitivity (73.1%) and specificity (71.4%).

Reliability and Validity of Objective Measures

Pill Count (PC)

Brain et al. (2014) found that mean adherence as measured by pill count was 82% (95% C.I. 77–87%) across the study period, with a non-significant drop from 86% at baseline to 81% during the last two-month period [F (1, 116) =2.25, p = 0.137].

Plasma Levels (PL)

Brain et al. (2014) found that the samples collected from patients varied. Three blood samples were collected from 51 patients, two samples from 32 patients, and one sample from 15 patients. Results indicated that more than half (56%) of the patients were adherent according to plasma-based measurement. Brain et al. (2014) brought to light that the inter-rater reliability for the plasma level adherence measure was very high (K = 0.92, $p < 0.001$).

Medication Event Monitoring System (MEMS®)

Brain et al. (2014) revealed that the mean adherence for MEMS® across the study period was 84% (95% C.I. 73–88%). Results indicated that MEMS® adherence changed from 85% at baseline to 82% for the final two-month period. This change was, however, not statistically significant [F (1, 116) <1.00, p = 0.475]. Forty-four percent of the patients were differently classified; 31 (32%) were classified as adherent according to MEMS®, and 11 (12%) non-adherent. Similar to MEMS is the electronic monitoring (EM) used in Byerly et al. (2008), which rated participants as adherent from a ≥ 70% mean adherence for a six-month period. The EM rated 57.4% (n = 35) of the participants and the remaining 42.6% of the participants (n = 26) with <70% non-adherent.

Results from the studies reviewed on validity and reliability of measures are summarized on the Table 1 below.

Table 1: Validity and Reliability of Measures

Author/Adherence Measure	Reliability of measure	Validity of measure	Interpretation
Byerly et al. (2008) BARS	Inter-rater reliability Cronbach's coefficient alpha across six monthly assessment periods (α = .92). Robust regression coefficients ranged from 0.53 to 0.92 Spearman's correlations (rs) ranged from 0.46 to 0.86	Concurrent validity assessed with relationship between BARS adherence and PANSS Simple linear robust regression and Spearman rs respectively • BARS adherence and PANSS total score (β = − 0.40, p < .0001; rs = − 0.39, p = .002). • BARS and Positive symptom sub-scale score β = − 0.08, p = .007; rs = − 0.28, p = .02 • BARS adherence and Negative symptom sub-scale score with the robust regression analysis (β = − 0.09, p = .02), Spearman rs (rs = − 0.23, p = .07)	Cronbach alpha revealed very high internal reliability for the BARS across the 6 monthly assessment periods (α = .92) Spearman's rs, revealed a moderate-to-strong linear relationship between initial monthly BARS adherence and subsequent BARS adherence. BARS adherence and PANSS total score revealed a significant inverse relationship. lower adherence was associated with more severe positive symptoms
Brain, et al. (2014) MEMS Pill count (PC) Plasma Level (PL) Patient Informant Staff Psychiatrist	Pearson's $\chi 2$ –method/ Fisher's exact test. MEMS relationship with other measures Results not clearly stated for all adherence measures	Kappa (“K”) coefficients MEMS, K coefficient was 0.72 (p<0.001) MEMS correlation with other measures as follows; Pill count =0.72 Plasma Level =0.05 (p=0.607) Patient =0.30 Informant = 0.46 Staff = 0.30 Psychiatrist=0.31	MEMS highly correlated with pill count with p<0.001 with very low relationship with plasma levels (p=0.607). MEMS K coefficient was reported to be higher than the other measures.

Author/Adherence Measure	Reliability of measure	Validity of measure	Interpretation
Thompson, et al. (2000) MARS MAQ DAI.	Internal consistency (Cronbach's alpha), and parallel-forms Chi-square for goodness of fit test–retest reliability respectively MARS = 0.75, 0.72 MAQ = 0.76, 0.76 DAI. = 0.77, 0.60	Multitrait–multimethod matrix for construct validity with other measures. Quest for Internal validity internal validity using IRT (**p<0.01, *p<0.05) DAI and MAQ = 0.40 DAI and MARS = 0.82 DAI and Carer rating= 0.29 DAI and Bloods Level= 0.65 MAQ and MARS = 0.79 MAQ and Carer rating = −0.32 MAQ and Bloods Level = 0.36 MARS and Carer rating = −0.03 MARS and Bloods Level = 0.60 Carer rating and Bloods Level = 0.57	MARS was significantly correlated with other self-report measures of compliance. Higher correlation was between the MAQ and the MARS than between the DAI and MARS. No relationship between carers' rating and MARS score. Stronger positive correlation was seen with blood results than the MAQ and a slightly lower correlation than the DAI. Supports a good convergent or construct validity for the MARS. MARS and MAQ, had good internal validity. However, DAI had a poor internal validity.
Kikkert, et al. (2011) MAQ DAI CRS	No instrument indicated to measure reliability	Cox Regression model was used to measure validity for relapse and admission. At level of evidence set at and 95% confidence interval respectively. For prediction for relapse MAQ = 0.008 and 0.345-0.852. DAI = 0.255 and 0.721–1.091. CRS = 0.047 and 0.505–0.995 respectively.	MAQ was reported significant predictor for relapse with DAI been poor predictor.

Author/Adherence Measure	Reliability of measure	Validity of measure	Interpretation
		For prediction for admission MAQ = 0.014 and 0.299–0.874 DAI = 0.032 and 0.572–0.976 CRS = 0.008 and 0.277–0.822	CRS was reported significant for admission while DAI was poor predictor.
Clayton et al. (2010) MAAT MPR	MAAT = r0.994 for the total score. MPR = r2 (0.0496) with inter-rater reliability on individual items ranging from 0.608 to 1.0)	Content validity; stepwise fashion using Cronbach's [alpha]. Convergent validity assessed by simple linear regression Spearman and Pearson correlation. Statistical significance set at P<0.05, 2-tailed. Cronbach's [alpha] scores showed. For regression coefficient MAAT = (P<0.001) MPR = (P<0.0073)	MAAT reported excellent Inter-rater reliability (r=0.994 for the total score; with inter-rater reliability on individual items ranging from 0.608 to 1.0) MAAT was reported to be internally valid and significantly predicted adherence. <5% variability in MPR was explained by a patient's total MAAT
Ren, et al. (2009) MPR MC TP ESA	Did not look at reliability of measures used	Did not look at validity of measures used	High reliability reported for ESA Reliability reported for patients on multiple medications for MC Reliability reported for patients on single medication for TP

Comparison of Instruments

Measuring medication adherence is truly difficult when it comes to schizophrenia. Comparing results from various instruments for measuring medication adherence in schizophrenia showed varied results; there is no gold standard. Both the DAI and CRS had high specificity and labeled most patients adherent (86% and 79% respectively); however, both had low sensitivity, with the DAI having the worst predictive validity (Kikkert et al., 2011). Moreover, the DAI appeared to have poor internal validity, likely assessing more than one underlying construct (Thompson et al., 2000). The MAQ was said to be the least problematic predictor for relapse and time to relapse; it had high sensitivity and specificity, with the best sensitivity of all instruments for relapse. It was moderately predictive for admission (Kikkert et al., 2011). There was a strong positive correlation observed between the results of the DAI and MAQ, and a positive relationship (0.60) was observed when correlated with blood levels of lithium and Tegretol. This result was also affirmed by Thompson et al. (2000).

Comparing measures that looked at patients on antipsychotic medications, ratings for medications by these measures were mixed. Both the MPR and the TP rated patients on atypical agents, with those initiated on clozapine most adherent and those initiated on risperidone least adherent (Ren et al., 2009). For typical agents, initiators of perphenazine were most adherent and those initiated on haloperidol least adherent. However, with initiators of ziprasidone, MPR rated them remaining on treatment slightly longer than initiators of quetiapine (269 vs 266 days); this difference was statistically non-significant. This insignificance was similar when comparing quetiapine and olanzapine (269 vs 246 days; $p < 0.001$) (Ren et al., 2009). MC revealed that initiators of quetiapine remained on

treatment significantly longer than initiators of ziprasidone (191 vs 178 days; $p < 0.05$) while TP rated initiators of olanzapine and initiators of ziprasidone staying on treatment for the same duration (151 days). Additionally, both MPR and TP rated initiators of chlorpromazine remained on medication treatment significantly longer than initiators of haloperidol (234 vs 197 days, $p < 0.001$ and 117 vs 110 days, $p < 0.05$ respectively) (Ren et al., 2009).

The MEMS® adherence showed a high correlation with the pill count measurement; although differently classified, different numbers of patients were classified as adherent by the two measures (Brain et al., 2014). The relationship between MEMS® and plasma levels was very low, as plasma levels classified most patients as non-adherent, unlike the MEMS®. These results are said not to be independent, as high loadings (>0.50) were also found between patient and staff ratings, and between MEMS® adherence and pill count (Brain et al., 2014).

When EM and BARS were compared, mixed model repeated measures analysis revealed no significant instrument effect (EM vs. BARS; $F = 0.25$, $df = 1, 92.1$, $p = .61$) and no significant instrument × period interaction ($F = 1.61$, $df = 5, 317$, $p = 0.16$) (Byerly et al., 2008). Further, the test of simple instrument effects (in each period) showed no significant instrument differences on adherence in any of the six prospective months ($F's < 1.16$, $p's > 0.28$). However, there was a significant positive relationship between BARS adherence and EM adherence across the average of the six-monthly assessments ($\beta = 0.98$, $rs = 0.59$, $p < .0001$). BARS could identify patients' oral antipsychotic medication non-adherence vis-à-vis EM adherence in an initial three-month adherence assessment period (Byerly et al., 2008).

Comparing MAQ, DAI, and MARS, the MARS was significantly ($p = -0.03$) correlated with other self-report measures of compliance (observer rating), although the correlation was higher between the MAQ and the MARS than between the DAI and MARS (Thompson et al., 2000). The MARS had good internal validity according to IRT analyses, and after discarding inconsistent items, it produced even greater internal validity and reliability. Analysis of the MARS using Cronbach's alpha was 0.75, compared to 0.76 for the MAQ, and 0.77 for the DAI. MARS had good convergent or construct validity as well as internal validity (Thompson et al., 2000).

When the MAAT was compared with the MPR, the MAAT had good internal reliability, but the scores were not significantly ($p = 0.0073$) correlated with MPR and performed poorly when compared to the MPR (Clayton et al., 2010). Almost half the variability in MAAT score is explained by the clinician's belief about whether the patient was adherent when the relationship between total MAAT score and the clinician's simple assessment of adherence was compared (Clayton et al., 2010). Additional methodological details about these studies is in Table 2 below (instrument/reference, type of study, description of research subjects, instrument description, method of measurement and scoring, validity, reliability, feasibility, and level of evidence).

Table 2: General Overview of Studies Reviewed

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
Medication Event Monitoring System (MEMS®)/ (Brain, et al. 2014)	Longitudinal	N=171 Outpatients DSM-IV diagnosed with schizophrenia or schizophrenia-like psychosis Age = 18–65, prescribed with unsupervised oral antipsychotics	Reference standard (a medication bottle cap equipped with a microprocessor that records the occurrence and time of each bottle opening	Number of bottle opening with cutoff at midnight within 6 months period Continuous measure = 0.00 to 1.00. 1.00 = more than prescribed bottle openings. Adherent = (>0.80) Non-adherent = (≤0.80)	Pearson's $\chi 2$ -method or with Fisher's exact test. Kappa ("K") coefficients describe the agreement between MEMS® and PC, PL OSR,	Reported to be reliable but no instrument was reported to be used.	Inexpensive requires no advanced technical equipment. can be conducted in all health care setting	1a
Pill count (PL)/ (Brain, et al. 2014)	Longitudinal	N=171 Outpatients DSM-IV diagnosed with schizophrenia or schizophrenia-like psychosis Age = 18–65 prescribed with unsupervised	Pills remaining in the MEMS® device at each monitoring were counted prior to refill was counted	Pill count at every monitoring visits with reference to MEMS = 0.00 to 1.00. 1.00 = more than prescribed bottle openings.	Pearson's $\chi 2$ -method or with Fisher's exact test. Kappa ("K")	No instrument was reported to have been used	Inexpensive requires no advanced technical equipment can be used in all health care settings	1a

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
		oral antipsychotics						
Objective and subjective ratings (OSR)/(Brain, et al. 2014)	Longitudinal	N=171 Outpatients DSM-IV diagnosed with schizophrenia or schizophrenia-like psychosis Age = 18–65, prescribed with unsupervised oral antipsychotics	A 5-point scale (1=0–20% 2=21–40%, 3=41–60% 4=61–80%, 5=81–100 %) 5= adherent Rated by Patients, Clinical staff (psychiatrist rated patients' adherence at baseline and endpoint). Close informant	Questionnaire	Pearson's $\chi 2$ -method or with Fisher's exact test. Kappa ("K")	No instrument was reported to have been used.	Not reported	1a
Treatment Persistence (TP)/ (Ren, et al. 2009)	Longitudinal	N = 18,425 Male = 94.3% On any of the eight antipsychotic medications	The length of time a patient was continuously on any antipsychotic agents until a gap of ≥30 days with no filled index agents	Existing data from the Veterans Health Administration (VA), United States from 2000 to2005	No instrument was reported to have been used to measure validity.	Reliability reported for patients on single medication No instrument reported for measuring reliability	Use of a large data base like the VA databases require expertise	4

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
Medication Adherence Questionnaire (MAQ)/ (Kikkert, et al. 2011)	Longitudinal	N=119 Male = 68 (57.1%) With schizophrenia, on antipsychotic treatment for at least one year (at least one hospital admission to mental health setting), indications of clinical instability from relatives, caretakers or clinical team).	Self-report scales with four (4) yes/no questions. Score ≤3 = as non-adherent	Questionnaire	Cox Regression model	No instrument indicated to measure reliability.	Simple four yes/no questions	4
Drug Attitude Inventory (DAI)/ (Kikkert, et al. 2011)	Longitudinal	N=119 Male = 68 (57.1%) With schizophrenia	Self-report 10 yes / no designed from the original 30 DAI-items The sum of the negative items are subtracted from the sum of the positive	Questionnaire	Cox Regression model	No instrument indicated to measure reliability	Simple 10 yes / no statements	4

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
			items. Non-adherent = results = 0					
Compliance Rating Scale (CRS)/ (Kikkert, et al. 2011)	Longitudinal	N=119 Male = 68 (57.1%) With schizophrenia	Seven-point scale scored by key workers. score≤4 = non-adherent Complete refusal = 1 Partial refuse =2 Reluctantly/ passively acceptance = 3,4 or 5 Moderately/active acceptance = 6 or 7	Questionnaire	Cox Regression model	No instrument indicated to measure reliability	Seven-point score 1 to 7	4
Medication Compliance (MC)/ (Ren, et al. 2009)	Longitudinal	N = 18,425 Male = 94.3% On any of the eight antipsychotic medications	The length of time a patient was on any index drugs during the 1-year post-initiation period until a gap of ≥30 days with no	Existing data from the Veterans Health Administration (VA), United States from 2000 to 2005	No instrument was reported to have been used to measure validity.	Reliability reported for patients on multiple medications. No instrument reported for	Use of a large data base like the VA databases require expertise	4

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
			filled index agent.			measuring reliability		
Episode-Specific Approach (ESA)/ (Ren, et al. 2009)	Longitudinal	N = 18,425 Male = 94.3% On any of the eight antipsychotic medications	The length of time a patient was on any index drugs during the 1-year post-initiation period until a gap of ≥30 days with no filled index agent.	Existing data from the Veterans Health Administration (VA), United States from 2000 to 2005	No instrument was reported to have been used to measure validity.	High reliability reported. But did No instrument reported for measuring reliability	Use of a large data base like the VA databases require expertise	4
Medication Adherence Assessment Tool (MAAT)/ Clayton et al. (2010)	Longitudinal	N= 359 diagnosed with schizophrenia prescribed with antipsychotic medications	12-item survey Items filled based on clinicians watching videotapes of patient interviews	Existing pharmacy claims data from Medicaid programs in Missouri, Alaska, and Utah	Stepwise fashion using Cronbach's alpha. Spearman and Pearson correlation between pairs of questions to identify redundant items. Convergent validity) with simple linear regression for	Inter-rater reliability was excellent (r=0.994 for the total score; with inter-rater reliability on individual items ranging from 0.608 to 1.0)	Only 12-items	1b

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
					relationship between MAAT and MPR scores			
Electronic Monitoring (EM)/Byerly, et al. (2008)	Prospective	N= 61 schizophrenia= 35 schizoaffective = 26 26 ≥18 years of age currently taking a single oral antipsychotic	Electronically recorded Medication vial cap. With date and time of bottle opening. Score based on bottle opening. Excessive opening not counted and lack of opening considered adherent or non-adherent based on reasons given by staff	Questionnaire	Linear robust regression, Simple linear robust regression, and the Spearman rs. $p \leq .05$ level of significance	Spearman rank-order correlation coefficient Robust regression simple linear robust regression Robust regression and Spearman's rs	Not stated. Based on bottle opening and pill count records	1a
Medication Adherence Assessment Tool (MAAT)/Clayton et al. (2010)	Longitudinal	N= 289 of the patients with schizophrenia prescribed with antipsychotic	Scores derived from electronic data from Medicaid claims Calculated as the days of medication supply that patients received during a fixed	Survey	The relationship between MPR score and MAAT (convergent validity) was assessed by simple linear regression	Not indicated	Low-cost, minimally intrusive, effective way to improve clinician assessment of patient adherence.	1a

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
			time period divided by the number of days in that period					
Medication Adherence Rating Scale (MARS)/ (Thompson, et al. 2000)	Longitudinal	N=66 Women = 51 Men = 15 Inpatients = 29 Outpatients = 36 Schizophrenia = 32 Bipolar affective disorder = 14 Depression with psychotic features = 4 Schizoaffective disorder = 4 Schizophreniform or drug-induced psychosis = 12	Medication Adherence Rating Scale (MARS) based on the DAI and MAQ.	Questionnaire Laboratory investigations (lithium levels) Non-compliance = 0 compliant attitude or behavior = 1	Construct validity (Multitra-multimethod matrix, The Carers' estimate of subject compliance, Blood results. Internal validity (Quest)	Cronbach's alpha, and test–retest using parallel-forms Chi-square Cronbach's alpha results: MARS=0.75 MAQ =0.76 DAI = 0.77 Test-retest results; MARS= 0.72 MAQ = 0.76 DAI = 0.60	Questionnaire is Quick and simple 10 questions requiring Yes or No answer.	1a

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
Brief Adherence Rating Scale (BARS)/ Byerly, et al. (2008)	Prospective	N= 61 schizophrenia= 35 schizoaffective = 26 26 ≥18 years of age currently taking a single oral antipsychotic	4 items: 3 questions and an overall visual analog rating scale. Method of scoring was not clearly indicated but Based on 0%–100% proportion of doses taken by the patient in the past month	Questionnaire adapted from the CATIE trial	Linear robust regression, Simple linear robust regression Spearman rs. $p \leq .05$ level of significance concurrent validity ($\beta = -0.40$; rs = − 0.39, p = 0.002) on PANSS and ($\beta = -0.08$, p = .007; rs = − 0.28, p = .02) on Positive Symptom Sub-Scale Scores	Cronbach's coefficient alpha test–retest Spearman rank-order correlation coefficient Robust regression simple linear robust regression Spearman's rs Cronbach's coefficient alpha ($\alpha = 0.92$). test–retest (β 0.53 to 0.92 and rs (0.46 to 0.86)	4 items on the questionnaire makes it simple and easy to administer	1b
Plasma levels (PL)/ (Brain, et al. 2014)	Longitudinal	N=131 Outpatients DSM-IV diagnosed with	Laboratory plasma levels of antipsychotic	Plasma levels of medication.	Pearson's $\chi 2$ -method or with Fisher's	Inter-rater reliability for the plasma	A simple yes or no and 0-3 was used in rating.	5

Instrument/ Reference	Type of study	Description of Research Subjects	Instrument Description	Method of Measurement/ Scoring	Validity Measure	Reliability Measure	Feasibility	Level of Evidence
		schizophrenia or schizophrenia-like psychosis Age = 18–65, prescribed with unsupervised oral antipsychotics	drugs and their metabolites	Adequate levels = 0–3 Adherence = 3 Inadequately low plasma levels at any of the three lab visits and/or two missed laboratory visits = non-adherence. Questionnaire, sample Plasma levels rated Yes or No by two independent senior psychiatrists	exact test. Kappa (“K”)	level adherence measure was very high (K=0.92, p<0.001). plasma. samples are probably not true reflections of adherence	Patients visit hospital lab for blood draw	

Discussion

Subjective measures such as the OSR, MAQ, DAI, and MAAT, although convenient to both patient and informants, stand a greater chance of being biased. All the measures that were subjective showed higher ratings of self-ratings (the patient rating) and mixed results for informant ratings (clinicians and family/friend). Many factors can cause these biases. Subjective assessments are likely to be inaccurate and tend to overestimate levels of adherence (Velligan et al., 2010). For example, most patients are likely to rate themselves as adherent and would not want clinicians to think that they do not take their medications. Another bias is by informants, such as family, who may rate patient's adherent where clinicians may rate them as non-adherent. There have also been reports of physician frequently underestimating the degree of nonadherence of their patients (Sacchetti & Vita, 2014). Results analyzed indicate that neither physician report nor patient self-report accurately identified adherence when compared with data from electronic monitoring or pill counts (Velligan et al., 2007).

Another issue is that, two or more clinicians may not rate independently, and rating may be based on previous knowledge of patients' medication taking behavior. A typical example is the MAAT scores about which Clayton et al. (2010) observed good internal reliability, yet clinicians were unable to reliably detect nonadherence among their patients who were prescribed antipsychotics because results were highly correlated with the physician's belief about whether the patient was adherent, not with the objective measure of adherence. Additionally, data from health management organizations, or single service payment systems such as Medicaid/Medicare, could be potentially flawed,

since filling a prescription by no means insures that the medication was ingested, and it is important to look at prescription refills over time (Kane, Kishimoto, & Correll, 2013).

This makes objective and subjective measures' validity and reliability questionable. Objective measures such as the MEMS®, EM and PC, seem to be an easy way to measure adherence but unreliable as they are not able to actually measure pill discarding and whether or not all pills were actually ingested by the patient. Patients may take more than one dose out of the bottle at a time, not take any pills out at all, or fail to replace the cap, or may fill prescriptions in locations where there is no record, resulting in missing data (Velligan et al., 2010). Another issue is that it is easy for a patient to discard some pills or transfer them to another bottle (Kane et al., 2013). Samples or old medications are also noted to compromise the results obtained using pill counts and pharmacy refill records (Velligan et al., 2010). These electronic monitoring devices; MEMS pill bottle caps, although common, are costly (Davies et al., 2010).

Plasma level (PL) instruments used to measure medication adherence may be questionable and not a reliable measure. It is very possible that false negative (medication not in blood) or positive (adequate medication in blood) results will be obtained from blood samples. For example, individual variations, such as fast or poor metabolisms (Yalcin-Siedentopf et al., 2015), can cause an individual to be falsely rated adherent or non-adherent. Additionally, patients knowing they are in a research study may take loading doses prior to laboratory blood sample draws and may wrongly be rated adherent. Similarly, misinterpretation in laboratory values, increases in dosage of medications, switching, and even the prescription of additional medications could affect these results (Sacchetti & Vita, 2014). These inter-individual pharmacokinetic differences can be

attributed to age, concurrent diseases, concomitant medication, genetics, lifestyle activities (i.e. smoking and caffeine use) and can affect plasma levels of medications (Hiemke et al., 2011; Velligan et al., 2007).

For these reasons, it is very important to interpret results from PL with caution (Yalcin-Siedentopf et al., 2015). Furthermore, blood sample collection represents a snapshot in time (Mattson, 1995), meaning the results might not be a true reflection of adherence behavior of a patient. Another issue with PL as a measure is that patient refusal to do blood draws could be rated as non-adherent but it may be avoidance of the pain of needle. All these factors do not make the PL measure reliable or a valid measure. This suggests that PL is not a very reliable way of measuring adherence. These objective measures are said to be associated with significant errors (Velligan et al., 2006).

Treatment persistence (TP), medication possession ratio (MPR), medication compliance (MC), and the episode-specific approach (ESA) were used to assess medication adherence with the typical and atypical antipsychotics. Results varied, and no two instruments gave the same ratings for all medications across the study period. Apart from the ESA, all the others did not consider the uniqueness of each patient to rate their medication adherence behaviors; some considered only one medication. Those that considered two or more medications ended up lumping together patients with different numbers of medications. In the treatment of schizophrenia, there can be a lot of medication switching and multiple medication prescription, especially in complicated (Ren et al., 2009) and acute cases. It is always important to consider the acuity of the patient's symptoms since stable patients are more likely to adhere to medications than patients with acute symptoms. If these factors are not considered, patients will be rated

non-adherent unfairly; due to this fact, these measures are not reliable for all cases of schizophrenia.

ESA accounted for the medication episodes, level of patient's recovery and number of days remaining on the medication treatment. It therefore provides a fair comparison of medication adherence across antipsychotic agents by avoiding potential bias against those patients on multiple medication episodes (Ren et al., 2009). This approach seems promising although the instrument has not been thoroughly analyzed. Another important finding from this review is that some studies (Brain et al., 2014) reported conducting the study on patients who were high functioning and might already be adherent to their medications; this makes results from such studies not generalizable. Futures studies should ensure generalizable representations of the population to ensure true comparisons of adherence measures.

It is of importance to consider the following factors when measuring adherence to medication in schizophrenia: the number of medications the patient is taking, the level of the patient's recovery (symptom severity), and the number of days of a patient's treatment. Patients with schizophrenia take different medications for different reasons, and the prescribed medication may change due to switches among antipsychotic agents and adherence behaviors (Ren et al., 2009). Recognizing the number of medications, a patient is on and determining the type of measure to use is very important but attempts by current measures to do this have proven futile.

At least three limitations were noted to be associated with this review. Some studies gave values for significant results obtained from the measures used and others did not. Additionally, some studies gave values for validity and reliability of measures while

others did not. Furthermore, the length of study periods varied widely among the studies reviewed. This made it somewhat difficult to compare results of the instrument from various studies to make conclusions. However, irrespective of these limitations, the findings of this review were not affected.

This review found that, based on the ratings of the Oxford Centre for Evidence-based Medicine Levels of Evidence (2009), there were wide variations in the levels of evidence of the reviewed instruments. MEMS®, PC, and OSR have level one-a evidence, because they were used across different populations. The MARS has a level three-b evidence since it has been used on limited populations, and further generalization is needed. BARS and ESA are supported by one-b and three-b levels of evidence since they have been validated across single and limited populations. Both need further studies for generalizability. The remaining measures (MAQ, DAI, CRS, TP, MPR and MC) are supported by level four evidence since they lack sensitivity. Also, PL has a level of evidence of five because it is based on physiological results.

Clearly, the conventional approaches to measure medication adherence among those with schizophrenia are inadequate. Subjective methods like self-reports and physician reports are most commonly used in measuring adherence (Velligan et al., 2009), but they have issues with validity and reliability. On the other hand, objective instruments such as electronic medication monitoring, pill count or pharmacy-based measures, may enhance the chance of detecting adherence problems (Kikkert et al., 2011), but may not reflect the dosage actually ingested by the patient (Yalcin-Siedentopf et al., 2015).

In this review, only three instruments had some validity, reliability and sensitivity: the ESA, the BARS and the MARS. However, these recently developed instruments need greater generalizability in order to yield better validity and reliability in measuring medication adherence in this population.

In conclusion, these findings highlight a challenge to researchers to develop an adherence instrument that takes into account the number of medications the patient is taking, the level of the patient's recovery, and the number of days of a patient's treatment for the instrument to yield validity, reliability and sensitivity with a better level of evidence.

Conclusion

Measuring medication adherence in patients with schizophrenia is important as medication non-adherence rates in this population continue to be alarmingly high, and therefore of public health concern. Results from assessing current instruments demonstrate that additional evidence is needed to measure medication adherence in patients with schizophrenia; no gold standard currently exists. Existing conventional instruments, in addition to having inadequate validity and reliability, did not consider patients' special characteristics and had low levels of evidence due to a lack of generalizability. Two recently developed instruments (MAR and ESA) formulated by modifying some existing conventional instruments and the BARS seem promising, as they had better validity and demonstrated adequate sensitivity to the unique characteristics of patients. These new instruments, however, require generalizability and further studies are required to ascertain the adequacy of their validity and reliability.

In conclusion, this integrative review validates that better instruments to measure medication adherence in patients with schizophrenia are needed because current instruments either lack sensitivity, well established validity or generalizability. When researchers respond to this urgent call to formulate an instrument that has validity, reliability and sensitivity in measuring medication adherence in patients with schizophrenia, clinicians will be better able to address issues of non-adherence to medications in this population.

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Manuscript 2

Integrative Review of Mobile Phone Contacts and Medication Adherence in Severe Mental Illness

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Abstract

BACKGROUND: Poor medication adherence is a significant problem in individuals with severe mental illness (SMI). About 50% of people with SMI become nonadherent to treatment in the first month following discharge from the hospital.

OBJECTIVE: This study examined literature in the past decade (2006-2016) on the use of mobile phone contacts in individuals with SMI to improve medication adherence post hospital discharge.

DESIGN: This integrative review used the search terms texting, text messaging, SMS, cell/mobile phone, medication adherence, medication compliance, and mental illness. Databases (CINAHL, PubMed, PsycINFO, and Scopus) and manual searching of reference lists were done. The main inclusion criteria were the use of mobile phone contacts on medication adherence in individuals with SMI. Adults 18 years and older, studies conducted from 2006 to 2016, and studies conducted in English were also criteria for inclusion. Only five studies met criteria for inclusion.

RESULTS: Outcomes from the review showed that mobile phone contacts have been used to improve medication adherence in individuals with SMI and able to provide the four types of social support (instrumental, informational, emotional, and, appraisal). When phone contacts especially text messaging was used as an adjunct to other interventions, it yielded better medication adherence than when used alone. However, results on medication adherence rates were mixed in participants on both psychiatric and non-psychiatric medications.

CONCLUSION: Although mobile phone contacts are a promising tool to enhance medication adherence after hospital discharge, its effectiveness to increase medication adherence in this population remains inconclusive.

Introduction

Poor medication adherence is a significant problem in individuals with severe mental illness (SMI). Medication nonadherence has been linked to more rapid disease progression, increased disease complications, poorer functional outcomes, lower quality of life (Najt, Fusar-Poli, & Brambilla, 2011; Novick et al., 2010), increased violent behavior (Van Dorn, Volavka, & Johnson, 2012), increased suicide attempts (Novick et al., 2010), and earlier/more frequent rehospitalization (Brown, Bennett, Li, & Bellack, 2011; Najt et al., 2011). Studies have shown that in the first month following discharge from the hospital, about 50% of individuals with SMI become nonadherent in managing their treatment, a major factor influencing acute psychiatric hospital readmission (Tomko et al., 2013). Increased nonadherence to prescribed medications after discharge has been linked to failure of follow-up care after discharge, resulting in failure to achieve the full benefits of treatment (Lee et al., 2015) and higher mental health care cost (Pantalon, Murphy, Barry, Lavery, & Swanson, 2014; American Pharmacist Association 2013).

When patients are due for discharge, providers, caregivers and patients may perceive that they can take care of themselves, but they need support despite apparent recovery (Bickley et al., 2013). All patients may require some support; however, support is essential for individuals with SMI. In all individuals, the core network for support (friends and family members) closest to the individual (Perry, 2011) is most likely to provide emotional, social, and economic support through communicating, controlling emotions and behaviors, problem solving, and positive coping behaviors (Sawant & Jethwani, 2010). However, mental health problems can cause changes in this network's composition, potentially disrupting these otherwise supportive relationships, (Green et

al., 2002) sometimes irreversibly. This lack of support from a core social network can cause challenges for individuals with SMI, especially after hospital discharge when they are faced with barriers such as lack of transportation, difficulties in making medical decisions, managing personal health problems, and troubling mental health symptoms (Nath, Wong, Marcus, & Solomon, 2012).

Additionally, other social connections such as coworkers, neighbors, acquaintances, extended kin, and friendships with limited contact may be peripheral with weak and unstable ties (Perry, 2011). Many of these peripheral network relationships become strained because symptoms associated with SMI can provoke fear and discomfort (Perry, 2011). A strain in both core network and peripheral ties can therefore lead to a lack of social support for these individuals. For example, one study found that individuals who seek mental health support begin treatment with larger and more broadly functioning social networks, but the size of their social network decreases over time (Perry & Pescosolido, 2015).

An additional important source of support for individuals with SMI are mental health practitioners who provide greater support to patients at both admission and discharge. Since mental health practitioners are highly involved with individuals with SMI, assisting them to identify sources of support, build social skills, develop friendships, discover new programs, and find community services, they may be a strong source of social support for these individuals (Sirin et al., 2013), even after hospital discharge. Identifying a person whom the patient perceives provides them with social support (Sawant & Jethwani, 2010) is necessary for continuity of care and recovery from SMI after discharge. For the health care practitioner to be able to give support to

individuals with SMI, there is a need to make this process less cumbersome to both the health care practitioner and the individuals with SMI, to ensure that adequate social support, encouragement, and treatment (Sawant & Jethwani, 2010) are provided.

One method that health care professionals have used to provide support to individuals with SMI to improve medication adherence post discharge is the use of technology. Technology has shown to increase patients' levels of perceived control, autonomy, self-esteem, participation in social activities (Palmier-Claus et al., 2013), self-monitoring strategies, opportunities to directly modify behavior, and engagement in informal support (Ho, 2003). Furthermore, mobile technology can reduce the number of patients visiting a health care facility, prioritizing care for those requiring more detailed medical assistance (West, 2012). Additionally, mobile technology has proven to reduce the burden of health care workers travelling to hard-to-reach areas to deliver care, making it possible to extend service to underserved areas, improve health outcomes, and promote medical system efficacy (West, 2012). This further helps contribute to decreased burnout in health care workers, as they will have fewer patients to care for during health care visits.

A mobile technology with nearly 6.8 billion users is telecommunications. Indeed, phone contact alone is nearing 100% worldwide penetration (International Telecommunication Union, 2013). Telephone messages in particular are low-cost, quick method of intervention and are accessible and feasible even in areas where more intensive follow-up is not practical or available (Chen, Mishara, & Liu, 2010). Many patients are conscious of the benefits mobile phone assessment could bring to clinical care, as well as its successful integration into everyday routines (Palmier-Claus et al.,

2013). Moreover, telephone messages are simple to leave and retrieve, making them feasible for both the patient and his/her support persons (Nieuwlaat et al., 2014). Furthermore, telephone calls and text messages are potential avenues to meet the need for community-based, problem-solving interventions that are accessible to patients at a low cost when compared to face-to-face interventions (Beebe, Smith, & Phillips, 2014). This shows that mobile phone contacts have great potential in providing social support to patients with SMI and will be beneficial for treatment adherence.

A very high medication adherence rate was reported in patients who received services in which their medications were delivered directly to them daily by a treatment staff (Beebeet al., 2014) as well as patients who received support from a staff in assisted living settings when compared to those living independently (Granholm, Ben-Zeev, Link, Bradshaw, & Holden, 2012). This supports the social support theory, which posits that social support may have positive effects on the physical, mental, and social health of an individual (Glanz, Rimer, & Viswanath, 2008).

The primary objective of this integrative review was to examine literature in the past decade (2006-2016) on the use of mobile phone text messaging and phone calls in providing support to individuals with SMI with respect to increasing medication adherence after discharge from the hospital. Secondarily, with the social support theory as a guide, this review assessed social support provided to individuals with SMI through mobile phone contacts for core elements of the four types of social support: instrumental, informational, emotional, and appraisal (Glanz et al., 2008). This integrative review therefore answered the following questions: (1) Do text messages and/or phone calls

increase medication adherence in individuals with SMI after hospital discharge? (2) What type of social support does mobile phone contacts provide to individuals with SMI?

Methods

The Whittemore and Knafl (2005) integrative review framework was used for this review. With the guide of a reference librarian, the search terms, texting, text messaging, SMS, cell/mobile phone, medication adherence, medication compliance, and mental illness were entered into the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the U.S. National Library of Medicine PubMed service (PubMed), PsycINFO, and Scopus databases to search for literature reporting on the use of mobile phone text messages and phone calls in medication adherence in individuals with SMI. Boolean operators were used to combine terms, and limiters set were humans, 2006 to 2016, and abstracts.

When search terms were entered into databases, Scopus generated 72 articles, CINAHL generated 172 articles, PubMed 122 articles, and PsyInfo 168. Additional records identified from manual searching of reference lists numbered 120 articles, making a total of 654 articles. After duplicates were removed, 338 articles remained, which were screened, and 260 records were excluded because they did not meet the main inclusion criteria. Afterward, the 78 full-text articles left were assessed, and 73 were excluded with reasons (32 did not address issues of medication adherence, 26 addressed conditions other than SMI, 15 were about substance use and eating disorders, and 1 on epilepsy). The main inclusion criteria were a focus of the study on the use of mobile phone text messages and phone calls on medication adherence in individuals with SMI. Adults 18 years and older with SMI, studies conducted from 2006 to 2016, and in English

were also criteria for inclusion. Studies excluded were ones on children, adolescents, geriatric patients, patients with eating disorders, and patients with substance use disorders, as well as studies with primary focus on physical conditions. A total of five articles were included in the review. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses; http://www.prisma-statement.org) flow diagram of the search done is shown in Figure 1 below.

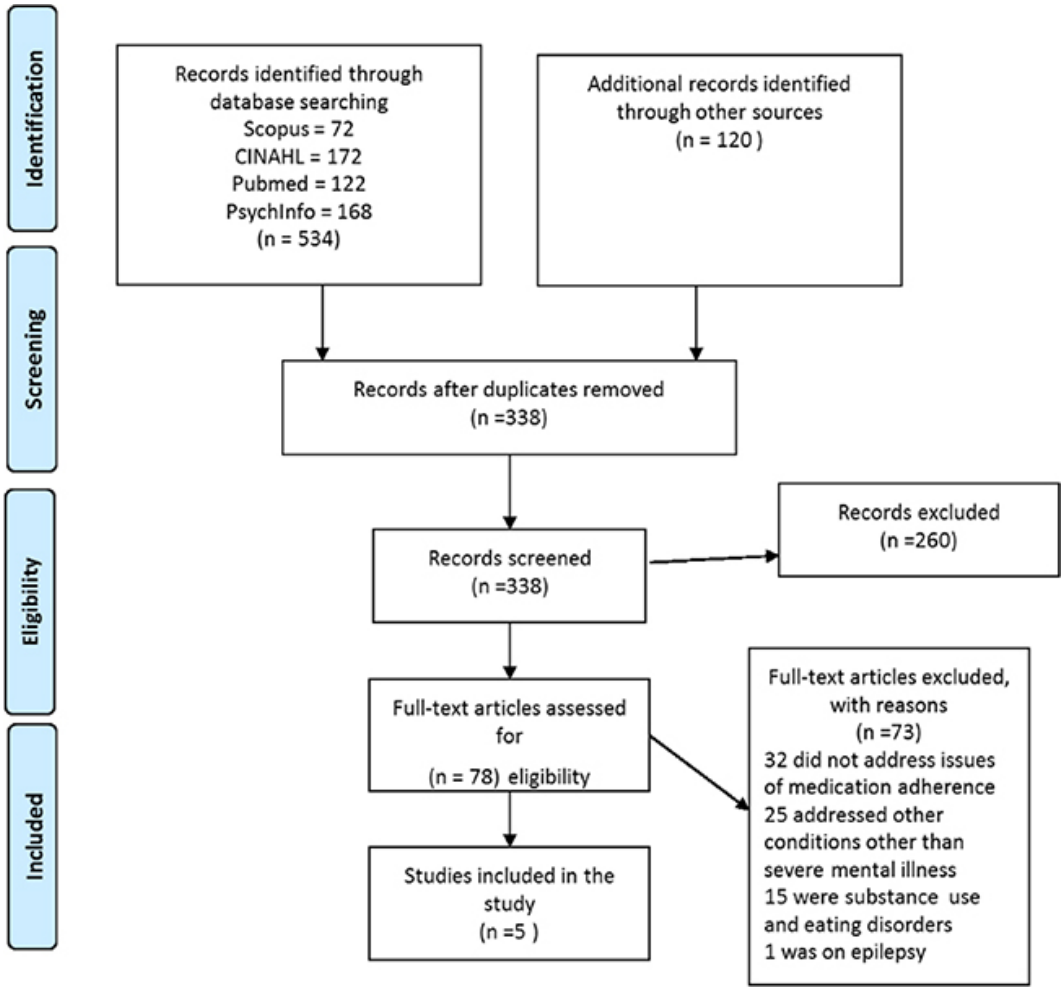

Figure 1. PRISMA diagram.
Note. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Further, this review is informed by the four types of social support: instrumental support, informational support, emotional support, and appraisal support (Glanz et al., 2008). Instrumental support is explained as tangible aid and services; informational support as advice, suggestions, and information; emotional support as expression of empathy, love, trust, and care; and appraisal support as information that is useful for self-evaluation (Glanz et al., 2008). An account of how researchers used mobile phone contacts to provide the four types of social support to individuals with SMI has been elaborated.

Results

General Overview of Studies Reviewed

Five articles identified and included in this review were longitudinal studies of different durations, with only one (Granholm et al., 2012) being a pilot study. Most of the studies reviewed had participants randomly assigned to either a control or an intervention group (Beebe et al., 2008; Montes, Maurino, Diez, & Saiz-Ruiz, 2010; Montes, Medina, Gomez-Beneyto, & Maurino, 2012), with the remaining (Beebe et al., 2014; Granholm et al., 2012) not having a control group. Two studies used SMS only (Granholm et al., 2012; Montes et al., 2012), one study used phone call only (Beebe et al., 2008), and one used both text messaging and phone calls in addition to another intervention (Beebe et al., 2014).

The times for text messaging/phone calls as a reminder to take medications varied among studies and were based on either participants' own preferred times (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2012) or focus group feedback (Granholm et al., 2012). The studies used various numbers of times to contact participants and assessed a

variety of issues. Most of the studies did an assessment of medication adherence at baseline at the beginning of each study and at different times in the study period (Beebe et al., 2008; Beebe et al., 2014). Medication adherence was measured with a variety of validated tools (shown in a later table).

Among the studies reviewed, most of the participants were recruited from outpatient facilities. Only one study (Montes et al., 2012) recruited participants ready for discharge from an inpatient facility. The majority of the participants were on antipsychotic medication (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2010). Others were on antidepressant medications or mood stabilizers (Granholm et al., 2012). Some studies also reported that some of the participants were on non-psychiatric medications (Beebe et al., 2008; Beebe et al., 2014). Additionally, most of the participants from the various studies reviewed were diagnosed with schizophrenia (any type), and others with affective disorder, neurotic, stress-related, somatoform disorder, delusional disorder, personality disorder, and behavioral disorders due to psychoactive substance use. Only two studies reported comorbidity with physical ailments and treatments given (Beebe et al., 2008; Beebe et al., 2014).

Most of the studies reviewed addressed issues about taking medication (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2010), with others giving an account of participants' symptoms, (Beebe et al., 2014; Granholm et al., 2012), appointment/clinic attendance (Beebe et al., 2014), abstaining from alcohol and other drugs (Beebe et al., 2014), and getting along with others/socialization (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012). Additionally, coping alternatives, medication adherence barriers such as forgetfulness or lack of knowledge about prescribed medications,

episodes of missed doses, or incomplete adherence among participants were also addressed (Beebe et al., 2008; Montes et al., 2010; Montes et al., 2012). Furthermore, the effectiveness of coping efforts (Beebe et al., 2008) and quality of life (Montes et al., 2012) were also addressed. Moreover, one study, compared the effect of telephone calls only, text messages only, and both telephone calls and text messages on participants' medication adherence (Beebe et al., 2014).

Mobile Phone Contact and Medication Adherence

Mobile phone contacts as reminders were effective in enhancing medication adherence in individuals with SMI (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012), with the majority of participants demonstrating improved medication adherence compared to baseline (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012) although Montes et al. (2010) reported nonsignificant differences (88.2% and 90%, respectively) in medication adherence rate among treatment and control groups at baseline. SMS/phone call reminders also showed improved medication adherence among participants in intervention groups compared to those who received routine clinical care in Montes et al.'s (2010) study as follows: 8.5% increase in intervention group and only 1.1% increase in control group at the end of the study period, resulting in 25.7% (n = 109) improved adherence to treatment compared to 16.8% (n = 74) in the control group. Results from this study showed significant differences in adherence among the groups (96.7% of participants in the intervention group were adherent to treatment compared to 91.2% in the control group).

In one study (Beebe et al. 2008), the majority of its participants lived alone (n = 10) and were unemployed (n = 22). Moreover, in another study, participants living independently were initially less likely to report medication adherence because of higher probability of forgetting to take medication at baseline and showed high medication nonadherence rates compared to those in assisted living setting (Granholm et al., 2012). However, with the introduction of mobile phone contacts, the probability of reporting forgetting to take medications in participants living independently diminished over time. In the study, daily text messages sent as reminders to participants living independently to take medications increased medication adherence rate at baseline considerably when compared to those in assisted living where participants had support from staff and already showed better medication adherence rate (Granholm et al., 2012). Furthermore, higher medication adherence rates have also been noted in participants who had their medication delivered directly to them daily by treatment staff (Beebe et al., 2014). Moreover, from all the studies reviewed, mobile phone contacts used as reminders to take medications increased medication adherence at initial assessment and remained high over time for almost all participants.

The only study (Beebe et al., 2014) comparing medication adherence among the three mobile phone contact methods (phone call only [Telephone Intervention Problem Solving], text message only, and text message plus phone calls) reported the percentage and mean standard deviation for psychiatric medication adherence scores in the first, second, and third month consecutively as follows: phone call only, 72 (20.1), 83.9 (18.0), and 80.9 (16.3); text only, 72 (33.7), 70.1 (33.2), and 71.5 (26.6); and phone call plus text, 84.2 (22.4), 87.5 (13.0), and, 81.1 (25.5), respectively. Although this study

explained that the mean psychiatric adherence scores were high in both phone call only (by an average of 5.3%) and the text only groups (by an average of 13%) for the three consecutive months, these differences in medication adherence were reported to be nonsignificant. Furthermore, in one study (Montes et al., 2012), there were decreases in medication adherences rate and high numbers of hospitalizations when SMS was stopped in a study period.

Mobile Phone Contact and Social Support

With the guide of the four types of social support—instrumental support (tangible aid and services), informational support (advice, suggestions, and information), emotional support (expression of empathy, love, trust, and caring), and appraisal support (information that is useful for self-evaluation), as depicted by the social support theory (Glanz et al., 2008)—researchers used mobile phone contacts to provide social support to individuals with SMI as follows.

Instrumental Support

Regarding instrumental support, two studies (Beebe et al., 2014; Granholm et al., 2012) provided participants with mobile phones and in the other three studies participants used their own mobile phones. In the studies reviewed all participants were sent text messages/SMS only (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2012), phone call only (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2010), or SMS plus phone call (Beebe et al., 2014) as reminders by nurses/researchers to take their medications, with one study providing additional materials (Beebe et al., 2014) to enhance medication adherence. Participants were sent daily text messages or phone calls

(Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2012), weekly phone calls (Beebe et al., 2008; Beebe et al., 2014), monthly phone call (Montes et al., 2010), or both daily text messages and weekly telephone calls (Beebe et al., 2014) as means of providing instrumental support.

Informational Support

Using mobile phone contacts, researchers provided participants with education on how to use a mobile phone to receive calls, read text messages, and send text messages (Granholm et al., 2012) through mobile phone contacts. The text message/phone calls information received by participants focused on medications (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010), symptoms/mental illness (Beebe et al., 2008; Granholm et al., 2012; Montes et al., 2012), participant attitude/perception of medication (Granholm et al., 2012; Montes et al., 2012), coping strategies (Beebe et al., 2008; Beebe et al., 2014), clinic appointment/attendance (Beebe et al., 2014; Granholm et al., 2012), and socialization skills (Granholm et al., 2012). Participants had the opportunity to ask researchers questions or advice on problems concerning health care services or their illnesses, which were addressed immediately through advice by the researcher (Beebe et al., 2014). Additionally, participants received information on how to evaluate their medication adherence as well as symptoms severity with various validated instruments (Granholm et al., 2012; Montes et al., 2012).

Emotional Support

Researchers had the opportunity to listen to participants' concerns, perceptions, awareness, understanding, and attitudes toward their mental illness and medications. Researchers then provided advice and gave referrals as needed through mobile phone

contacts (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2012). Some studies (Beebe et al., 2008; Beebe et al., 2014) discussed participants' ability to socialize and how participants got along with others in society. These same studies provided participants with answers to any questions they had and guided participants to problem-solve difficulties encountered by generating solutions and choosing a solution. The researchers then followed up with participants at the next mobile phone contact to assess the effectiveness of the chosen solution (Beebe et al., 2008; Beebe et al., 2014).

Appraisal Support

Through the use of mobile phone contacts, studies reviewed (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012) measured participants' medication adherence behaviors. In addition to medication adherence, researchers assessed participants' symptoms severity (Granholm et al., 2012); perception, awareness, understanding, and attitudes toward mental illness/treatment (Montes et al., 2012), and after-care/appointment attendance (Beebe et al., 2014; Granholm et al., 2012). Participants' ability to socialize (Granholm et al., 2012), their coping strategies (Beebe et al., 2008), and their use of alcohol and other drugs (Beebe et al., 2014) were also evaluated. The evaluation was done either by the support person or by the participants with either direct or indirect validated measures; some of these measures are shown in table 1.

Benefit of Using Mobile Phone Contacts in Providing Social Support

The results from the studies reviewed showed that mobile phone contacts provided numerous benefits in addition to being effective in enhancing medication adherence in individuals with SMI (Beebe et al., 2008; Beebe et al., 2014; Granholm et

al., 2012; Montes et al., 2010; Montes et al., 2012). Improved medication adherence was demonstrated in most study participants when compared to baseline (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012). When text messages were used as reminders to take medications, medication adherence increased in all study participants across the studies reviewed and especially in participants living independently when compared to those in assisted living settings (Granholm et al., 2012).

There was improvement in medication adherence among participants in intervention groups receiving mobile phone contacts as reminders compared to those in the control group receiving routine clinical care (Beebe et al., 2008; Montes et al., 2012). Moreover, consistent with this result was a progressive increase in medication adherence noted in an intervention group in a 3-month study (Montes et al., 2010) after each telephone contact when these reminders were used. One study (Beebe et al., 2014) comparing the effect of telephone calls only, text messages only, and telephone calls plus text messages on individuals' symptoms and medication adherence reported high medication adherence over a 3-month period. The study reported that those who received a combination of both phone call and text messages had better medication adherence than participants who received phone call only or text message only, although nonsignificant (Beebe et al., 2014). When Beebe et al. (2010) compared providing information to participants through text messaging and conventional writing materials, the use of SMS was noted to be acceptable, feasible, convenient, fast, and simple and a flexible method of enhancing medication adherence in this population. They also stated that using text

message as an adjunct to phone call should be considered in the treatment of patients with schizophrenia.

Apart from mobile phone contacts increasing adherence to psychiatric medications, participants in the intervention groups with comorbidities who received text messages as reminders to take their medications showed better medication adherence for non-psychiatric medications when compared to the control group at baseline (Beebe et al., 2008; Beebe et al., 2014). However, one study had discrepant findings and showed nonsignificant changes in non-psychiatric medications adherence from baseline (Beebe et al., 2008).

In some studies, other participants issues that were affected by medication adherence were assessed, and it was observed that when medication adherence improved, participants' symptoms (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010), awareness of mental illness (Granholm et al., 2012), attitude/perception of the benefits of medication adherence (Granholm et al., 2012; Montes et al., 2012), appointment attendance (Beebe et al., 2014; Granholm et al., 2012), and socialization skills also improved (Granholm et al., 2012) among individuals with SMI.

Table 1 includes general characteristics of studies reviewed: author, country of study, type of study/duration, diagnoses, type of treatment facility, sample characteristics/ size, measure of adherence, and major findings of the studies.

Table 1. *General Characteristics of Study Reviewed*

Author	Country of study	Type of study/duration	Diagnoses	Type of treatment facility	Sample characteristics/size	Measure of adherence	Major findings
Beebe, Smith, and Phillips (2014)	Southeastern United States	Longitudinal 3-month study No control group	Schizophrenia spectrum disorder Schizophrenia (any subtype) or schizoaffective disorder	Outpatients community mental health center	*N* = 30 19 females 11 males Age 21-68 years	Pill count	Both psychiatric and non-psychiatric medication adherence was higher in the phone call (TIPS) plus text group than both the phone call only and the text only groups, but these differences were not significant in psychiatric medication adherence.
Granholm, Ben-Zeev, Link, Bradshaw, and Holden (2012)	San Diego County, United States	Longitudinal study 12-week No control group	Schizophrenia or Schizoaffective disorder	Outpatient residential and treatment settings	*N* = 55 Age > 18 years Schizophrenia; paranoid = 32, undifferentiated = 10, disorganized = 2, schizoaffective disorders = 11	Medication Adherence Questionnaire	There was better improvement in medication adherence in participants and significantly in participants living independently when compared to those in assisted living facilities.
Montes, Maurino, Diez, and Saiz-Ruiz (2010)	Spain	Prospective, randomized, comparative, (intervention and control groups); 4-month study (October 2006-November 2007)	Schizophrenia	Outpatients in community mental health centers	*N* = 865 Control group = 441 Intervention group = 424 ≥18 years old Clinically stable outpatient	Register of Adherence to Treatment	There were significantly higher patients followed up with phone calls being adherent to medications than those in the control group, with significant improvement in adherence in antipsychotic medications.
Beebe et al. (2008)	Southeastern United States	Experimental longitudinal 3-month study	Schizophrenia	Outpatient community-dwelling persons from community	*N* = 25 13= control 12 = intervention Age 25-69	Pill count home electronic monitoring system; record review for intramuscular	Persons receiving phone calls (TIPS) had significantly higher adherence to psychiatric medications throughout the study period compared to

Author	Country of study	Type of study/duration	Diagnoses	Type of treatment facility	Sample characteristics/size	Measure of adherence	Major findings
				mental health center		antipsychotic medication	those receiving usual care. Phone calls should be used as adjunct to face to face appointments.
Montes, Medina, Gomez-Beneyto, and Maurino (2012)	Spain	Prospective study; randomized, open-label, controlled, 6-month study (intervention and control groups)	Schizophrenia	Outpatient psychiatric centers	*N* = 254 18-65 years of age Clinically stable, a single oral antipsychotic medication	Medication Adherence Questionnaire	There was significantly greater improvement in adherence among patients receiving text messages compared to the control group from baseline.

Note. TIPS = Telephone Intervention Problem Solving

Discussion

A key finding of this review was that mobile phone contacts (text messaging/phone calls) have been used to promote medication adherence in individuals with SMI, and the studies reviewed showed that mobile phone contacts, especially text messages, were effective in reminding study participants to take their medications (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012). These results were noted in similar studies (Kunigiri, Gajebasia, & Sallah, 2014; Montes, Maurino, Diez, & Saiz-Ruiz, 2011; Van Gent & Knoppert Van Der Klein, 2010). Moreover, for all the studies reviewed, the use of mobile phone contacts achieved higher medication adherence rates across all the studies. This result is supported by similar studies (Stentzel et al., 2015; Vervloet et al., 2012). One other cardinal observation noted in this review was the high medication adherence rate shown when text messages were used as an adjunct to other interventions. This typically included a combination of the following: phone call, text message, or conventional material (printed material; Beebe et al., 2014). The results showed greater increase in medication adherence rates in individuals with SMI when a combination of multiple interventions occurred compared to any method used independently.

Furthermore, one study showed that text messages are noncumbersome and inexpensive in providing support for individuals with SMI (Beebe et al., 2014). The study also proved text messages/SMS to be accessible, feasible/convenient, low-cost, fast, simple, quick, and more effective in providing information on medication adherence when compared to traditional/conventional printed materials. These findings are consistent with other similar studies (Depp et al., 2010; Ehrenreich, Righter, Rocke,

Dixon, & Himelhoch, 2011; Granholm, Loh, & Swendsen, 2008; Harrison et al., 2011; Johnson et al., 2009; Mäkelä, Paavola, & Stenman, 2010; Patrick, Griswold, Raab, & Intille, 2008; Pijnenborg et al., 2010; Spaniel et al., 2008; Van den Berg, Graba, Freyberger, & Hoffmann, 2011). Also, considering that the researchers were able to continue following up with most participants through the study period, Beebe et al.'s (2014) assertion that mobile phone contacts are acceptable to both the support person and the participant is laudable.

Additionally, studies reviewed showed that individuals on psychiatric medication treatments with comorbidities requiring and taking both psychiatric and non-psychiatric medications had mixed results: High medication adherence was noted for psychiatric medications but nonsignificant adherence results for non-psychiatric medications (Beebe et al., 2014). Comparable results were noted in Patrick et al. (2008) and Smith and Schatz (2010) studies but incongruent with results of Pratt et al. (2006) and Dolder, Lacro, and Jeste (2003) study where high medication adherence rate were noted for both psychiatric and non-psychiatric medications. Moreover, when patients' medication adherence is monitored, the expectation is that all medications would have been adhered to. Considering that participants had better adherence with psychiatric medications but low adherence to non-psychiatric medications makes it a cause for concern. The question is, were participants adhering to the psychiatric medications because they knew they were being evaluated purposely on psychiatric medications and not non-psychiatric medications? The reason for this unusual low adherence rate needs further study.

Regarding the core domains of the social support theory, studies reviewed showed that mobile phone contacts give individuals more benefits in addition to helping increase

medication adherence. The social support mobile phone contacts provide to individuals with SMI, especially the use of text messages, should not be underestimated. Studies reviewed showed that individuals with SMI were given tangible aid and services, advice, suggestions, and a variety of information including information for self-evaluation as described by Glanz et al. (2008). Even though the use of the social support theory was not mentioned explicitly in the studies reviewed, the account given by these studies is consistent with the theory's core domains. Mobile phone contacts proved to promote autonomy, which is one of the important fundamentals of mental health treatment.

Instrumental Support

Participants in the studies reviewed received tangible aid and services such as mobile phones (Beebe et al., 2014; Granholm et al., 2012) and reminders through text messages or phone calls. In addition, participants received reminders based on their own preferred times (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2012) or from focus group feedback (Granholm et al. 2012). This sort of assistance can be seen as "perceived control" noted in the social support theory (Glanz et al., 2008).

Informational Support

Individuals with SMI were given advice, suggestions, and information through mobile phone contacts. From the studies reviewed, a support person had the opportunity to address questions or other problems participants were facing (Beebe et al., 2008; Beebe et al., 2014). The person providing support identified participants' reasons for the nonadherence and immediately provided advice and referrals necessary (Beebe et al., 2008; Beebe et al., 2014), which could be the reason participants stayed in the study.

Considering what has been discussed so far, participants got the help they needed, and rehospitalization was prevented, which is consistent with the aims of the social support theory. The social support theory confirms that when people experience stressors, enhanced individual/community resources increase the likelihood that the stressors will be handled/coped with in a way that reduces the long-term or short-term adverse health consequences (Glanz et al., 2008). Indeed, providing social support to individuals with SMI is recommended for continuing treatment since individuals with SMI will not left alone to go through challenges, which can lead to medication nonadherence, increased symptoms, and rehospitalizations.

Another goal of the social support theory that was addressed is reduction in uncertainty or unpredictability and production of desired outcomes (Glanz et al., 2008). Noted in the studies reviewed, individuals with SMI were provided with advice and referrals through mobile phone contacts, resulting in reduction in severity of participants' symptoms, reduction in rehospitalization, and increase in medication adherence outcomes, which is consistent with the goal of the social support theory. To further emphasize the importance of using mobile phone contacts in providing social support to individuals with SMI, one undesirable outcome noted in this review was a decrease in medication adherences rate and high numbers of hospitalizations when text messages were stopped in a study period (Montes et al. 2012). These findings therefore support the view that mobile devices increase medication adherence across diverse health and mental health problems (Heron & Smyth 2010; Kunigiri et al., 2014; Van den Berg, Grabe, Baumeister, Freyberger, & Hoffmann, 2015; Vervloet et al., 2012).

Emotional Support

Researchers could express empathy, love, trust, and care to individuals with SMI through mobile phone contacts. Participants' concerns, perceptions, awareness, understanding, and attitudes toward their mental illness and medications were addressed by the researchers (Beebe et al., 2008; Beebe et al., 2014). Additionally, the participants' ability to socialize and get along with others were assessed (Beebe et al., 2008; Beebe et al., 2014). Researchers guided participants to problem-solve difficulties encountered and assess the effectiveness of the solution (Beebe et al., 2008; Beebe et al., 2014). This confirms that the availability of enhanced individual/community resources promotes the likelihood that people experiencing stressors will cope in a way that adverse health consequences will be decreased or prevented (Glanz et al., 2008).

Appraisal Support

All the studies reviewed (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012) used assessment tools that are well known in mental health research for measuring medication adherence (Brain et al., 2014; Byerly et al., 2008; Kikkert et al., 2011; Thompson, Kulkarni, & Sergejew, 2000). In some studies, participants were taught how to assess their own medication adherence and symptom severity (Beebe et al., 2008; Beebe et al., 2014). This method increased participants' autonomy in that they could identify where they were in their recovery process and were more willing to adhere to treatment. This finding supports Palmier-Claus et al.'s (2013), Kunigiri et al.'s (2014), Vervloet et al.'s (2012), and Stentzel et al.'s (2015) assertion that mobile phone contacts promote patient autonomy.

Additionally, when participants' medication adherence rates improved using mobile phone contacts, their symptoms, attitude, and perception toward medication adherence, appointment attendance, and socialization also improved (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012). These findings support similar studies (Car, Gurol-Urganci, de Jongh, Vodopivec-Jamsek, & Atun, 2012; Fortney et al., 2013; Van den Berg et al., 2015) as well as the social support theory (Glanz et al., 2008).

The Effect of Mobile Phone Contact Support and Medication Adherence in SMI

It is important to note that all studies reviewed elaborate the beneficial effect of mobile phone contacts in providing support to individuals with SMI by increasing participants' medication adherence, improving symptoms, improving ability to socialize, and developing better attitude toward mental health. To support this finding better, it was seen that there was decrease in medication adherences rate and high numbers of hospitalizations when text messages were stopped in a study period (Montes et al., 2012). However, looking closely at the studies reviewed, most of the study participants were recruited from outpatient settings, with only one study (Montes et al., 2012) recruiting participants ready for discharge from an inpatient facility, which may increase medication nonadherence if the patient had not had support after discharge.

Waiting to contact patients at their outpatient facilities may not address issues of medication adherence in all patients discharged from the hospital. This is because some patients discharged who are confused about their medications may end up nonadherent and may be re-hospitalized before their first outpatient appointment since immediate support was not provided. Additionally, studies have shown that patients may be at risk

for discontinuing their therapy due to frequent long waiting periods for consecutive appointments in the ambulatory care system (Van den Berg et al., 2015). It is therefore imperative for mental health professionals to recognize that issues of medication nonadherence in individuals with SMI should be addressed immediately following hospital discharge.

Also noted in this review is that some participants were already receiving support either by having their medications directly delivered to them or by living in assisted settings (Beebe et al., 2014; Granholm et al., 2012), and the intervention may have only served as a buffer to their medication adherence behavior. For this reason, it should be noted that even though there is high medication nonadherence rate in individuals with SMI, there is the likelihood that most patients with mental issues would adhere to their medications if given the necessary support. To support this statement, El-Mallakh and Findlay (2015) brought to light that lack of family support for adherence, or having no family, further contributes to nonadherence in patients with mental illness. This makes it very important to identify a person whom the patient perceives as a social support (Sawant & Jethwani, 2010) when the individual is admitted to an inpatient setting before discharge. This allows continuity of care and recovery through early identification of problems and the application of solutions to address any problems the patient may encounter immediately after discharge.

However, considering studies reviewed, it is difficult to attribute the increase in medication adherence to the support provided through mobile phone contacts intervention to study participants who already had support and were adherent to their medications.

There is, therefore, the need to apply this support intervention to patients who are known to be nonadherent to their medications and/or have no structured support.

Authors of studies reviewed noticed some limitations of the studies. Some studies reviewed made it known that the use of small sample sizes in their studies prevents generalization of study results (Beebe et al., 2008; Beebe et al., 2014). One study noticed a possibility of a Type II error as smaller than expected increases in medication adherence resulted in power less than 35% to detect significant differences in adherence (Beebe et al., 2014). Furthermore, the inability to identify significant relationships in the intervention given and outcome due to lack of power was addressed (Beebe et al., 2008). However, other studies used larger sample sizes and obtained remarkable results (Montes et al., 2010; Montes et al., 2012).

A possible selection bias was raised in studies reviewed as most participants included in the studies were clinically stable (Granholm et al., 2012; Montes et al., 2012), taking antipsychotic medications, and adherent (Beebe et al., 2008; Granholm et al., 2012; Montes et al., 2012) at baseline. To be more explicit, some participants who were already on depot medications (Beebe et al., 2014) and those with less clinical symptoms (low severity of voices and multiple social interactions) at baseline were included in the studies (Granholm et al., 2012). Excluded from some studies were less stable or unstable patients with symptoms of severe paranoid delusions or hallucinations (Montes et al., 2012). Moreover, some researchers believed that the exclusion was necessary because participants could be unwilling to participate or the intervention (SMS reminders) could even worsen their clinical status (Montes et al., 2012). This aligns with Beebe et al.'s (2008) assumption that the 50% participants' reluctance/refusal rate in their study may be

due to instability. This is congruent with the report of some studies that most nonadherent patients were reluctant to participate in the studies because recruitment methods used leaned toward more adherent patients (Beebe et al., 2008; Montes et al., 2012).

Moreover, such exclusions are noted to be a threat to the internal validity of a study (Beebe et al., 2008), and inclusion of less stable/unstable patients at baseline could show greater improvements in outcome (Granholm et al., 2012). Furthermore, the use of one-size-fit-all timing of the application of the intervention is noted in one study to be problematic. Participants who take medications outside of the scheduled intervention time may not benefit due to the fixed scheduling (Montes et al., 2012). Furthermore, nonblinding of researchers applying an intervention could have led to high rating of greater improvement in adherence and symptoms severity (Montes et al., 2012).

Authors raised concerns about the reliability of measures used to assess medication adherence that is both objective and subjective. Challenges reported regarding subjective measures such as self-rated scales was the tendency of participants inflating/overestimating self-report of medication adherence (Granholm et al., 2012; Montes et al., 2012). This inflation is attributed to either social desirability of the participants or rater expectations (Montes et al., 2012). Objective measures such as pill counts' inability to confirm/guarantee that missing medications were truly ingested (Beebe et al., 2008; Beebe et al., 2014) is problematic even though it is noted to be acceptable to patients (Beebe et al., 2008) and seen as a more objective measure (Granholm et al., 2012).

Some variables noted to be essential for medication adherence or nonadherence were not assessed in some studies. Factors such as participants' insight, poor alliance

with therapist or clinician, less outpatient contact (Montes et al., 2010), as well as participants' prior experiences with antipsychotic treatments and side effects were not assessed (Montes et al., 2012). Similarly, the effects of the intervention (mobile phone contact) on participants' specific beliefs about medications, socialization, and auditory hallucinations were not assessed in one study (Granholm et al., 2012). Even though some studies (Beebe et al., 2008 Montes et al., 2012) noticed greater improvement in medication adherence in the intervention group when compared with control group receiving routine clinical care, one study lacked a comparison group (Granholm et al., 2012) and recommends comparison groups in mobile phone contact interventions. Granholm et al. (2012) acknowledge that the use of incentive for responding to an intervention is not feasible in the real world.

From studies reviewed, authors made the following important recommendations to improve future text messages and phone calls intervention research to improve medication adherence: (a) assessment of participants' insight and environmental factors of nonadherence to establish the benefit of the intervention in patients at risk (Montes et al., 2010), (b) the use of time-lagged analyses to examine the relationships between mobile interventions and specific patient beliefs in a larger population (Granholm et al., 2012), (c) the use of both objective and subjective methods to assess medication adherence (Granholm et al., 2012; Montes et al., 2012), and (d) the need to determine text messaging response rates and medication adherence without incentives (Granholm et al., 2012).

Readers are warned by some authors (Beebe et al., 2008; Granholm et al., 2012) to view or interpret study results with caution due to their limitations.

Furthermore, there is a need for further studies to identify reasons for nonsignificant differences in medication adherence rates even though there are significant improvement in symptoms in one study that compared the mobile phone contact methods (call, text, and call plus text). Additionally, more studies on patients who are recruited and followed from inpatient settings should be done. Furthermore, the population of SMI was disproportionately studied as majority of participates in this review had schizophrenia. There is the need for more studies on the use of mobile phone contacts for improving medication adherence in patients with SMI with diagnoses other than schizophrenia.

A study on the comparison of mobile phone contacts use on medication adherence in individuals with SMI from inpatient settings and those from outpatient settings is needed as this will help determine whether time is a crucial factor in the introduction of the intervention in enhancing medication adherence in individuals with SMI.

Last, slight differences exist in variables measured apart from medication adherence in studies reviewed. Beebe et al. (2008) while applying their text messages and phone calls intervention also provided participants with advice and problem-solving guide and measured symptoms. Montes et al. (2010) targeted participants' symptoms severity and quality of life in addition to medication adherence. Granholm et al. (2012) on one hand sort participants' socialization skills, auditory hallucinations, and medication adherence. Montes et al. (2012) on the other hand looked at participants' attitude toward medication, insight into illness, clinical severity, and health-related quality of life after the application of the intervention. Beebe et al. (2014) mainly studied participant symptoms and medication adherence. One common variable measured in the studies

reviewed apart from medication adherence was participants' symptom severity. Considering study results showing improvement in these variables, a combination of into one intervention research will be beneficial in increasing medication adherence in individuals with SMI.

This integrative review has some important limitations. First, although a comprehensive literature search was done, only five studies relating to mobile phone contacts and medication adherence in individuals with SMI were identified. This was true considering that mobile technology use to improve mental health services among individuals with serious mental illness remains doubtful (Ben-Zeev, Davis, Kaiser, Krzsos, & Drake, 2013). Second, this review did not take into consideration the level/severity of participants' mental illness prior to participating in the respective studies. Last, this review lumped together the social support provided by all the mobile phone contact methods to increase medication adherence in individuals with SMI to draw conclusions on the four types of social support. Furthermore, this review did not consider individual mobile phone contact method (text message only, phone call only, or text message plus phone call) for the core elements of the four types of social support described by Glanz et al. (2008). This will be done comprehensively in a future study.

Conclusion

Notwithstanding the gaps in literature reviewed, the use/benefit of mobile phone contacts, especially SMS, as means of providing social support for individuals with SMI is notable. This review illustrates the positive effects of social support on the physical, mental, and social health of individuals with SMI as depicted by the four types of social support: instrumental, informational, emotional, and appraisal (Glanz et al., 2008).

Mobile phone contacts use to provide social support proved to be acceptable to both the individual and support persons because of its feasibility, convenience, speed, simplicity, and flexibility.

The key factor noted to have enhanced mobile phone contacts to increase medication adherence in individuals with SMI was autonomy. Participants had a say in the intervention by choosing the time they wanted the intervention to occur. It is possible that adherence to medications was increased partly because participants had autonomy and felt part of their treatment. Additionally, with the convenience and acceptability of mobile phone contacts, mental health professionals will be able to provide individuals with SMI support after hospital discharge by providing education (awareness) and assessment (medication adherence, symptom severity, appointment attendance, means of socializing), as well as providing referrals when appropriate especially in individuals living independently. Also, it was mentioned in studies reviewed that mobile phone contacts especially text messaging provides a better means to communicate health information to individuals with SMI than the conventional means (print). Additionally, text messages could be used as an adjunct to other interventions to improve medication adherence in this population.

In conclusion, although the studies reviewed showed increases in medication adherence rate of study participants when mobile phone contacts were used to provide support, the total number of participants (sample size) used in the five studies reviewed is not enough to provide conclusive evidence about the effectiveness of mobile phone contact in increasing medication adherence in this population. Therefore, there is the need for further studies on larger population sample. Future research should also focus on the

optimal timing of the use of SMS (e.g., immediately after discharge) as well as issues of dosing and the comparative effectiveness of the different mobile phone contact delivery methods (calls only, text messages only, and calls plus text messages) in providing support to individuals with SMI.

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Manuscript 3

A Descriptive Correlational Study: Mental Health Service Users Mobile Phone Contact Method Preference and Medication Adherence.

Abstract

INTRODUCTION: Medication non-adherence in mental health service users has been attributed to both intentional and unintentional causes. Mobile phone contact (MPC) can potentially increase medication adherence and improve overall health outcomes. However, lack of data exists regarding participants' preferred mobile phone contact method (phone calls only, text messages only or text message plus phone calls) and its relationship with medication adherence.

METHODS: This descriptive correlational study used a survey approach (interview) to collect data from participants receiving mental health services at an outpatient mental health facility. Convenience sampling was used to enroll 41 study participants.

RESULTS: Text messaging was the preferred method of contact by participants with 70.7% choosing this method. Reasons for this choice included; convenience, less time consuming, less distractive, and simple to use. No relationship was noted in MPC preference with medication adherence or participants' demographic/clinical data except ethnicity.

CONCLUSION: This study suggests that participants receiving mental health services that receive mobile phone contact (MPC), prefer text messaging when receiving support to increase medication adherence after discharge. This preferred method of MPC may improve medication adherence but further work is needed to elucidate a change in clinical outcomes.

Introduction and Background

Mental illnesses and substance-related/addictive disorders are chronic conditions that substantially impact public health (Lee et al., 2015; SAMSHA, 2017). The use of medications continues to be an important element in the treatment of mental illnesses (Buchanan et al., 2010; Velligan et al., 2009) and substance use disorders (Lee et al., 2015). When medications are taken as prescribed medicine can reduce the severity of mental illness and improve outcomes (Velligan, Sajatovic, Hatch, Kramata, & Docherty, 2017). Benefits of medication use in substance/alcohol use disorders include: (a) reduction in substance use, (b) prevention of overdose, (c) medical management of withdrawal or detoxification, (d) relapse prevention, and (e) maintenance of remission (Lee et al., 2015).

Although the use of medicine aids with reducing substance/alcohol use disorders, medication nonadherence is a concern and frequently occurs shortly after hospital discharge (Tomko et al., 2013; Van Dorn et al., 2012). Furthermore, medication nonadherence leads to negative consequences such as poorer treatment outcomes (Lee et al., 2015; Spaniel et al., 2008), substantial negative impact on patients' health and functioning (Higashi, 2013; Nath, 2012; Tomko et al., 2013), higher hospitalization rates (Najt, 2011; Uhlmann, Kaehler, & Harris, 2014), and increased cost (Morken, Widen, & Grawe, 2008; Van den Berg et al., 2015; SAMSHA, 2017).

Causes of Medication Non-adherence

Medication nonadherence has been attributed to both intentional and unintentional causes (Velligan et al., 2017). The intentional causes of medication nonadherence include (a) poor insight, (b) negative attitude towards medications, (c) medication side effects, (d)

symptom severity, (e) stigma, and (f) negative therapeutic alliance (Lam et al., 2013; Novick et al., 2010; Wong et al., 2015). However, reasons such as cognitive impairments (Alene et al., 2012; Ascher-Svanum et al., 2006; Sajatovic et al., 2011), substance use (Alene et al., 2012; Eticha et al., 2015; Jonsdottir et al., 2013; Zeber et al. 2011;), severe depression/antidepressant use (Ascher-Svanum et al., 2006; Na et al., 2015;), poor family/social support (Morken, Grawe, & Widen, 2007; Rabinovitch et al., 2009), inactive social functioning and independent housing (Elbogen et al., 2005; Novick et al., 2010), as well as poor access to mental health care (McCann et al., 2008; Zeber et al., 2011) have been attributed to unintentional causes of non-adherence.

Mental Health and Support

When patients are discharged from the hospital, they need support despite apparent recovery (Bickley et al., 2013). The numerous barriers encountered by individuals after discharge such as transportation, difficulties in making medical decisions, managing personal health problems, and troubling mental health symptoms (Nath, Wong, Marcus, & Solomon, 2012) make providing support for these individuals in real time essential. Research has shown that individuals with mental health problems often receive support from a core social network of family and friends as well as coworkers, neighbors, acquaintances, extended kin, and friendships (Perry, 2011). Yet, if an individual's mental health problems provoke fear and discomfort (Green et al., 2002, Perry, 2011) a person can become potentially burdensome to these otherwise supportive networks.

This burden can strain social connections leading to lack of social support (Bright, 2018), which can lead to relapse and re-hospitalization. Perry and Pescosolido (2015)

suggested that individuals who seek mental health support begin treatment with larger and more broadly functioning social networks, but the size of a social network decreases over time. However, support is important to mitigate the many barriers faced by individuals with mental health problems.

Indispensable Nature of Support in Mental Health Treatment

Continuous long-term medication treatment with close monitoring and real-time symptom assessment for early and immediate intervention is beneficial for individuals with mental health challenges (Ainsworth, Palmier-Claus, Machin, & Barrowclough, 2013). Moreover, discharge planning is essential to achieve continuous long-term medication treatment. Additionally, discharge planning has numerous benefits that include: (a) increases in medication adherence after discharge, (b) decreases in clinical symptoms, and (c) reduction in the frequency of hospitalizations (Hamann et al., 2014; Khaleghparast et al., 2004; Pantalon et al., 2014). Furthermore, effective discharge planning increases outpatient treatment and continuity of care, reduces readmission rates, and overall improves mental health outcomes and quality of life for patients (Schulz, Gray, & Spiekermann, 2013). Because the support network in this population decreased with time, healthcare professionals might include readily available telecommunication systems in discharge planning to provide support and potentially enhance medication adherence.

Mobile Phone Contacts and Support

Telecommunication technology has over 6.8 billion users nearing 100% worldwide penetration (Chen, Mishara & Liu, 2010; International Telecommunication Union, 2013). Further, the usage of mobile phone technology in individuals with mental

health problems is estimated to be between 73% to almost 100% (Ennis, Rose, & Denis, 2012) with cell phone ownership comparable with ownership among a nationally representative sample in the United States (Campbell, Caine, Connelly, Doub, & Bragg, 2015). Studies indicate that support provided through cell phone/ mobile phone contacts (MPC) is feasible and inexpensive for enhancing medication adherence in this population. In addition, support through MPC provided frequent long-term treatment and close monitoring of mental health service users (Chen, Mishara, & Lui, 2010; Klasnja & Pratt, 2012; National Institute of Mental Health, 2015), which is needed to enhance medication adherence in this population. MPC can include phone calls (PC) or text messages (TM). TM is noted to be usually quick and accessible to patients even in areas where more intensive follow-up is not practical or available (Chen et al., 2010). Moreover, TM is not limited by the model or make of an individual's phone (Klasnja & Pratt, 2012).

MPC and Medication Adherence in Mental Health

Studies that used MPC to increase medication adherence in individuals with mental health challenges examined three delivery methods: phone call only (PC), text messages only (TM); or a combination of phone call plus text messages (TMPC) individually and in combination (Beebe, Smith, & Philip, 2014; Beebe et al., 2010; Granholm, Ben-Zeev, Link, Bradshaw, & Holden, 2012; Montes, Maurino, Diez, & Saiz-Ruiz, 2011,2010) with other materials. Investigators found increases in medication adherence when individuals with mental illness (MI) received reminders, education, and support after discharge (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2011).

This result was also noted in individuals living independently as well as those previously noted to be non-adherent to their medications (Granholm et al., 2012).

With support through MPC, increases in medication adherence improved participants' symptoms, increased appointment/clinic attendance, improved the ability to socialize, and reduced hospital readmissions (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2011; Najt, 2011; Uhlmannet et al., 2014). Further, barriers to medication adherence such as forgetfulness, lack of knowledge about prescribed medications (Beebe et al., 2010; Montes et al., 2010), missed doses or incomplete adherence (Montes et al., 2011) after discharge were addressed. Additionally, TM alone extensively improved medication adherence (Agyapong, Milnes, & McLoughlin, 2013; Branson, Clemmey, & Mukherjee, 2013; Foreman et al., 2012; Granholm et al., 2012; Harrison et al., 2011), especially in reminding patients about medications (Kunigiri, Gajebasia, & Sallah, 2014). Moreover, when TM was stopped in one study the participants' medication adherence rates decreased and hospitalizations increased (Montes et al., 2010).

Identified Gap in Research

Even though MPC is a promising tool in providing support to increase medication adherence in individuals with mental health problems, limited studies exist evaluating the use of this tool. The few studies (Beebe et al. (2008) and Beebe et al. (2014) and Granholm et al. (2012) and Montes et al. (2010), and Montes et al. (2012) that used MPC to provide support to increase medication adherence in this population had limitations needing further research. One limitation is that, even though participants chose preferred times for receiving MPC, lack of evidence exists on whether participants preferred the MPC method used (Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2011).

Likewise, in one study Beebe et al. (2014) comparing the three methods of MPC showing increases in medication adherence in the group receiving TMPC, there was no evidence that the participants actually preferred that method. However, studies show that considering patients preferences in mental health improved clinical outcomes (Raue, Schulberg, Heo, Klimstra, & Bruce, 2009; Kocsis, Leon, & Markowitz, 2009; Gelhorn, Sexton, & Classi, 2011) and thus identifying preferences for MPC method may lead to further improvement in medication adherence.

The main objective of this study was to identify the MPC delivery method MHS users prefer when receiving support to increase medication adherence after discharge. Further, this study explored the relationship among MHS users' preferred MPC delivery method, demographic/illness characteristics, medication adherence rate, and the overall acceptability of MPC as a method for receiving support to increase medication adherence after discharge.

Methods

Theoretical framework

Social support theory postulates that social support has a positive impact on the physical, mental, and social health of individuals (Glanz, Rimer, & Viswanath, 2008). There are four types of social support: instrumental (tangible aid and services), informational (advice, suggestions and information), emotional (expression of empathy, love, trust, and caring), and appraisal (information that is useful for self-evaluation) (Glanz et al., 2008).

Bright, (2018) noted how researchers who used MPC provided participants with one or more types of social support. Instrumental support was provided when participants

received mobile phones (Beebe et al., 2014; Granholm et al., 2012) and text messages and/or phone calls reminders (Beebe, et al., 2008; Montes et al., 2012). Informational support was provided by addressing questions and problems participants were facing (Beebe et al., 2008; Beebe et al., 2014). Emotional support was provided to participants when concerns, perceptions, awareness, understanding, and attitudes toward their mental illness and medications as well as the ability to socialize with others as suggested by (Beebe et al., 2008; Beebe et al., 2014). In addition, appraisal support was provided when participants were given the opportunity to assess their medication adherence and compare the adherence to real time medication adherence with well-known medication adherence assessment measures (Beebe et al., 2008; Beebe et al., 2014; Granholm et al., 2012; Montes et al., 2010; Montes et al., 2012).

However, lack of evidence exists regarding MPC method preference among individuals receiving MHS. Moreover, the need to identify patients' preferences cannot be over emphasized in mental health treatment. Integrating patient preferences into treatment is an expectation (Papakostas, 2009; Sobczak, 2009), because integration provides a positive relationship with treatment initiation and adherence (Raue, Schulberg, Heo, Klimstra, & Bruce, 2009). Further, understanding a patient's preferences is noted to result in favorable outcomes (Gelhorn, Sexton, & Classi, 2011). For example, in a depression study, patients receiving treatment based upon preferred intervention had lower outcome depression scores compared to those who did not (Kocsis, Leon, & Markowitz, 2009). This study suggests the importance of assessing participants' preference in MPC methods when receiving support to increase medication adherence after discharge.

Design

This descriptive correlational study utilized a survey approach with cross-sectional design to examine the perceptions of participants receiving mental health services on the value of MPC use to enhance medication adherence. A convenience sample was used to recruit study participants 18 years of age and older. All clients at an outpatient facility located in Virginia were given the opportunity to participate in the study to ensure appropriate representation of all ages, races, and diagnoses. Participants' demographic information were reported in the analysis. Moreover, the clinic director, program coordinator, and counselors disseminated the study information to potential participants.

Study site

The mental health facility located in Virginia provides both inpatient and outpatient services to adolescents and adults with mental health and substance abuse diagnoses. The facility's outpatient services include intensive outpatient services, partial hospitalization, and outpatient services. Study participants were recruited from the outpatient service.

Participants

In this study, participants were recruited who had a diagnosis of a mental illness (MI) including schizophrenia (any type), bipolar disorder, major depression disorder, schizoaffective disorder, obsessive-compulsive disorder, panic disorder, post-traumatic stress disorder, and substance use disorder as specified by Diagnostic and Statistical Manual of Mental Disorders (DSM–5). Further, participants were between the ages of 18

years and 70 years, able to communicate in English, and taking at least one type of psychiatric medication. Every potential participant who presented at the outpatient facility for treatment during the data collection period was given the opportunity to participate in the study, ensuring the inclusion of participants of all racial and gender backgrounds.

Procedures for Data Collection

After reviewing charts, individuals who met inclusion criteria were identified as potential participants. One of the individual's treatment team members (either director, counselor, or program manager) introduced the researcher to the eligible individual. Eligible individuals were informed about the purpose of the study and were provided with contact information and informed that participation in the study was voluntary as well as they had the right to withdraw from the study at any time without an impact on treatment in any way.

Once consented, the researcher scheduled at least 20 minutes for each interview and audio-taped the interview. The researcher conducted the interviews in a private comfortable room provided by the outpatient facility. During this time the researcher administered the demographic questionnaire, medication adherence questionnaire, and structured interview guide.

The PI assessed participants' medication adherence with the medication adherence questionnaire (MAQ). The PI then asked participants about MPC method preferences, the reason for this choice, and perceptions of the benefits and problems with MPC. Participants were also asked to choose a second and third MPC delivery method and provide reasons for the choices. The PI asked participants about problems they

foresee arising when receiving support through MPC and how to avoid or overcome these perceived problems. In addition, the researcher read the questions, answer choices to participants, and recorded any other comments the participants had verbatim on the interview guide. The PI also recorded the participants' demographic information from the participants' chart. Recruitment and interviews were conducted from December 2017 through January 2018. Recruitment was concluded after all the potential participants were approached.

Sample size

The researcher contacted 76 prospective participants, 35 prospective participants were not enrolled in the study, 19 out of the 35 did not meet criteria for inclusion, and the remaining 16 refused to participate in the study. Reasons for not meeting inclusion criteria and refusal to participate in the study are elaborated in a flow chart in the analysis section. A total of 41 participants were enrolled in the study.

Outcome measures

Outcomes measured in this study included participants' medication adherence, participants' MPC preference, and the overall acceptability of MPC. The PI assessed participants' medication adherence with the medication adherence questionnaire (MAQ). The MAQ is a 4-item self-administered medication adherence scale that has been used as a medication adherence measure since 1986 (Morisky, Greene, & Levine, 1986). The MAQ requires a simple yes or no answer to measure medication adherence. Questions asked on this scale included: do you ever forget to take your medicine? Are you careless at times about taking your medicine? When you feel better do you sometimes stop taking your medicine? and Sometimes if you feel worse when you take the medicine, do you

stop taking it? The score ranges from zero to four and was interpreted as follows: 0= Highest adherence, 1 and 2 = medium adherence, and 3 and 4 = low adherence. Zero depicted the highest adherence levels and four the lowest adherence.

Participants' MPC method preference was assessed along with overall acceptability, mobile phone ownership/possession, current use of MPC reminders to take medications (if receiving reminders through which means and if preferred), willingness to receive support through MPC, problems foreseen with receiving MPC intervention and solution to these problems.

Ethics

The Institutional Review Board at the Medical University of South Carolina (MUSC) approved this study. Institutional approval also was given by the outpatient facility. The researcher conducted the interviews in a designated private and comfortable room provided by the facility. The researcher explained details of the study including, medication adherence assessment, obtaining of demographic information, and interview requirements (including audio recording and verbatim hand recording on interview guide) to participants. Additionally, the PI made participants aware of the need for written informed consent and Health Insurance Portability and Accountability Act of 1996 (HIPAA) authorization forms. The PI made participants aware of the right to withdraw from the study at any time and that any treatment received will not be affected in any way. Furthermore, participants were assured of the confidentiality of the information.

All data collected, which included demographic information questionnaires, medication adherence questionnaire, informed consent documents, HIPAA documents, audio recordings, and interview guides, were code linked and secured in locked storage

compartments, then transferred electronically immediately to a password protected Research Electronic Data Capture (REDcap) environment. REDcap is a secure web-based application designed to support data capture for research studies (Harris et al., 2009), provided by MUSC. Further, the code-linked data was transferred and stored in Box (an electronic file sharing and storage system) approved by MUSC, which has similar features as explained above.

Data analyses

To make the analysis more meaningful, participants' medications were grouped under broad categories. According to Ren, Herz, Qian, Smith, and Kazis (2009) and Montes et al. (2012), and Granholm et al. (2012), the use of categories of medication such as antidepressants and antipsychotics to report participant medication is an acceptable technique for conducting research. SPSS version 24 was used for the statistical analyses. Descriptive statistics were used to describe and summarize the participants' demographic/clinical data and MAQ data. Chi-Square Test of Independence, Point Biserial Correlation, Pearson Correlation and analysis of variance (ANOVA) were used to identify any significant differences between participants' demographic/illness data and MAQ data. Ninety-five percent (95%) confidence interval (CI) was used for this analysis.

Correlational analysis and chi-square test were used to identify the relationships between the participants:

- Primary psychiatric diagnoses and medication adherence
- Duration of primary psychiatric illness and medication adherence
- Use of polypharmacy and medication adherence

- Receipt of MPC reminders and medication adherence
- Multiple diagnoses and medication adherence
- Number of psychiatric hospitalizations and medication adherence.

Other relationships explored were the participants:

- Primary psychiatric diagnosis and MPC method preference
- Gender and MPC method preference
- Age and MPC method preference
- Receipt of MPC reminders and medication adherence.
- Overall acceptability of MPC (willingness to receive MPC, current use of reminders and mobile phone ownership) and medication adherence.

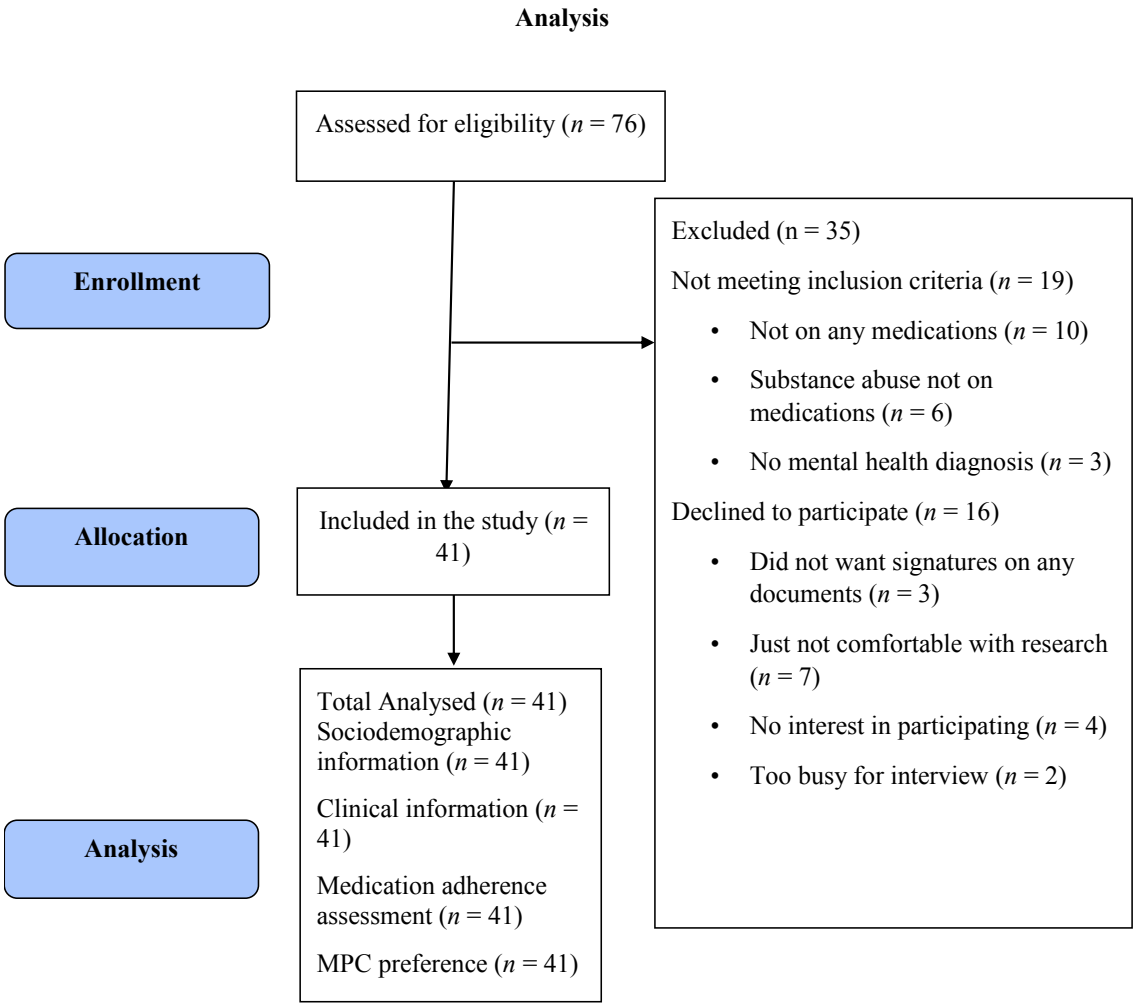

Figure 1. Participants Enrollment

Sociodemographic information

Participants' ages ranged between 18 and 70 (M = 37.7). Gender was disproportionately presented in this study with 68.29% (n = 28) being male and 31.71% (n = 13) being females. Caucasians represented the majority 60.981% (n = 25) followed by African American 31.71% (n = 13). Most of participants 39.2% (n = 16) had some college education/vocational training. Table 1 below gives details about the participants' demographic information.

Table 1: *Frequency for Demographic Information*

Variable	*n*	*%*
Gender		
Female	13	31.71
Male	28	68.29
Age Range		
18-20	5	12.20
21-30	10	24.39
31-40	9	21.95
41-50	7	17.07
51+	10	24.39
Ethnicity		
African American	13	31.71
Caucasian	25	60.98
Other	3	7.32
Education		
Elementary	1	2.44
High school	14	34.15
Some college/vocational	16	39.02
Bachelors	9	21.95
Postgraduate	1	2.44

Note. Due to rounding errors, percentages may not equal 100%.

Varied sources of income were identified with employment being the major source of income reported by 41.46% (n = 17) of participants. Concerning source of support after discharge, the majority of participants 85.37% (n = 35) reported having family support (M = 0.85, SD = .358). Only 12.0% (n = 5) participants reported receiving support from healthcare providers. The majority 80.5% (n = 33) of participants reported only one source of support, 17.07% (n = 7) of participants reported 2 sources of support, and 2.44% (n = 1) of participants reported support from three sources (family, healthcare provider, and friends/coworkers) after discharge. Mobile phone ownership in this population was 90.24% (n = 37) with all these mobile phones solely owned by participants. When the participants' willingness to receive reminders to take medications through MPC was assessed, the majority 92.24% (n = 38) wanted reminders, indicating

some participants who did not own mobile phones yet, wanted reminders. Table 2 below gives details about participants' source of income, support after discharge, mobile phone ownership, and willingness to receive reminders to take medications.

Table 2: *Frequency for Sociodemographic Information*

Variable	*n*	*%*
Source of support after discharge		
Family	35	85.37
Friends	7	17.07
Healthcare	5	12.20
Social group	1	2.44
Self	1	2.44
Missing	0	0.00
Source of income		
Employment	17	41.46
Social security	8	19.51
Family/friends	16	39.02
Retirement	2	4.88
Mobile phone ownership/possession		
No	4	9.76
Yes	37	90.24
Sole usage	37	90.24
Shared		
Problems taking medications at home		
No	27	65.85
Yes	14	34.15
Currently receiving reminders	0	0.00
Would you like reminders		
No	3	7.32
Yes	38	92.68

Note. Due to rounding errors, percentages may not equal 100%.

Psychiatric History

Primary Mental Health Diagnosis

In examining mental health diagnosis, alcohol/substance use/dependence was the primary diagnosis of many of the participants representing 34.15% (n = 14) of the total population. Schizophrenia/schizophrenia-like disorders were the minority with 7.32% (n = 2). Moreover, it is important to note that 14.6% (n = 6) of participants had multiple

primary psychiatric diagnoses. The mean number of primary diagnoses in this population was 1.19 (*SD* = .510). Table 3 below gives the total number of participants with a particular primary diagnosis and related characteristics.

Table 3: *Frequency for Primary Psychiatric Diagnosis*

Variable	*n*	*%*
Primary diagnosis		
Alcohol/Substance Use Disorder	14	34.15
ADHD	3	7.32
Bipolar Disorder	3	7.32
Generalized Anxiety Disorder	5	12.20
Major Depressive Disorder	12	29.27
Schizophrenia/Schizophrenia-Like	2	4.88
Other	2	4.88
Other related characteristics		
One primary diagnosis	35	85.4
Multiple primary diagnoses	6	14.6
Two primary diagnosis	4	9.8
Three primary diagnosis	2	4.9

Note. Due to rounding errors, percentages may not equal 100%.

Comorbidity and Polypharmacy

When participants were assessed for other mental health diagnoses, the results indicated that, alcohol/substance use/sedative/stimulant/anxiolytic/hypnotic abuse/disorder/dependence was the highest 85.37% (*n* = 35), which is comparable to the 92.68% (*n* = 38) of participants' report of history of substance use. These disorders were then followed by generalized anxiety disorder and ADHD/ADD with comparable results 21.95% (*n* = 9 each). Table 4 below provides the total number of participants with types of mental health diagnoses and history of substance use.

Table 4: *Frequency for Other Psychiatric Diagnosis*

Variable	*n*	*%*
Other mental health diagnosis/substance use		
Generalized anxiety disorder	9	21.95
Major depressive disorder	7	17.07
ADHD	9	21.95
Bipolar disorder	5	12.20
Alcohol/substance and other drug abuses	35	85.37
History of substance use		
No	3	7.32
Yes	38	92.68

Note. Due to rounding errors, percentages may not equal 100%.

Participants were on various medications to treat mental health issues. The results indicate 43.90% (*n* = 18) participants were on antidepressants, followed by medications to treat Opioid/Alcohol dependence 34.15% (n=14). Further, Table 5 below depicts the psychiatric medication participants were taking.

Table 5: *Frequency for Psychiatric Medications*

Variable	*n*	*%*
Psychiatric medications		
Anticonvulsant	9	21.95
Antidepressants	18	43.90
Antipsychotic	7	17.07
SSRI	14	34.15
Stimulants	6	14.63
Opioids Dependence Treatment/Alcohol Relapse Medications	14	34.15
Gabapentin	5	12.20
Sedatives	8	19.51
Other	5	12.20

Note. Due to rounding errors, percentages may not equal 100%.

Comorbidity was noted when the participants' primary psychiatric diagnosis and other mental health diagnoses were combined. The majority of participants 97.56 (n=40) had two or more diagnosis, with most of these participants having two diagnoses (53.66, n=22). The mean number of mental health diagnosis in this population was 3.6 (*SD* = 1.245). As comorbidity was prevalent in this population, so was polypharmacy in

managing mental illnesses. Many participants were on two or more medications, with the minimum 43.90% (*n* = 18) on only one psychiatric medications (*M* =2.80, *SD* = 1.503). Table 6 and 7 provides details on the total number of psychiatric diagnoses and total number of psychiatric medications taken by participants.

Table 6: *Frequency for Psychiatric Comorbidity and Polypharmacy*

Variable	*n*	*%*
Total number of psychiatric diagnosis		
1	1	2.44
2	22	53.66
3	12	29.27
4	5	12.20
5	1	2.44
Total number of psychiatric medications		
1	18	43.90
2	8	19.51
3	9	21.95
4	5	12.20
5	1	2.44

Note. Due to rounding errors, percentages may not equal 100%.

Table 7: *Summary Statistics for Psychiatric Comorbidity and Polypharmacy*

Variable	*M*	*SD*
Psychiatric diagnosis	2.59	0.84
Number of medications	2.10	1.18

Note. '-' denotes the sample size is too small to calculate statistic.

Chronicity of Mental Illness

To ascertain chronicity of mental illness, the duration of the participants' primary psychiatric diagnoses and history of inpatient hospitalizations were examined. The duration of the participants' primary psychiatric diagnosis ranged from less than a year to 38 years. The majority of participants 51.2% (*n* = 21) had a primary diagnosis between 0-5 years. The results indicated (*M* = 8.36, *SD* = 8.56) for the duration of primary psychiatric illness. Psychiatric hospitalizations ranged from 0-10, with 65.85% (*n* = 27)

of the population never having been hospitalized. The results indicated (M = 0.88, SD = 2.14) of psychiatric hospitalization. Table 8 and 9 below provides more details on these characteristics.

Table 8: *Frequency for Chronicity of Mental Illness*

Variable	*n*	*%*
Duration of primary diagnosis in years		
0-5	21	51.2
6-10	9	22
11- 15	3	7.3
16-20	5	12.2
21- 38	2	4.9
Number of psychiatric hospitalizations		
0	27	65.85
1	9	21.95
2	2	4.88
4	1	2.44
9	1	2.44
10	1	2.44

Note. Due to rounding errors, percentages may not equal 100%.

Table 9: *Summary Statistics for Chronicity of Mental Illness*

Variable	*M*	*SD*
Duration of primary psychiatric diagnosis in years	8.36	8.56
Number of psychiatric hospitalizations	0.88	2.14

Note. '-' denotes the sample size is too small to calculate statistic.

Physical Health Challenges

In addition to mental health co-morbidities, participants had physical illnesses. Hypertension/cardiac disease was the highest reported by 34.15% (n = 14) of participants, reflected in comparable results with anti-hypertensive/cardiac medications taken by 31.71% (n = 13) of participants. Details on participants' physical health challenges are noted in table 10 below.

Table 10: *Frequency for Physical Health Challenges and Medications*

Variable	*n*	*%*
Medical diagnosis		
Hypertension/Cardiac Diseases	14	34.15
Diabetes	2	4.88
Asthma	3	7.32
Hepatitis	3	7.32
Other	11	26.83
Medical medication		
Antihypertensive/Cardiac Medications	13	31.71
Antidiabetics	1	2.44
Sedatives	3	7.32
Anti-Asthmatics	3	7.32
Other	10	24.39

Note. Due to rounding errors, percentages may not equal 100%.

Total Health Challenges

When participants' total diagnoses (both medical and psychiatric comorbidities) were comprehensively considered, the total number of psychiatric diagnoses had an average of 2.59 (*SD* = 0.84) and the total number of medical diagnoses had an average of 0.80 (*SD* = 0.90) and participants are taking medications for both medical and psychiatric conditions. Table 11 provides the details.

Table 11: *Summary Statistics for Total Number of Psychiatric and Medical Diagnoses*

Variable	*M*	*SD*
Total Number of Psychiatric Diagnoses	2.59	0.84
Total Number of Medical Diagnoses	0.80	0.90

Medication Adherence Assessment

Results of participants' medication adherence using the MAQ indicated that 36.59% (*n* = 15) of the participants scored one (1), indicating a medium adherence rate. Only 19.51% (*n* = 8) scored Zero (0) on the MAQ, indicating highest medication adherence, whereas 12.20% (*n* = 5) had the lowest adherence rate with a score of four (4).

The results indicate the medication adherence rate in this population (M = 1.66, SD = 1.32). Table 12 and 13 below provides details on participants' medication adherence scores.

Table 12: *Frequency for MAQ Scores*

Variable	*n*	*%*
MAQ		
0.00	8	19.51
1.00	15	36.59
2.00	6	14.63
3.00	7	17.07
4.00	5	12.20

Note. Due to rounding errors, percentages may not equal 100%.

Table 13: *Summary Statistics for MAQ Scores*

Variable	*M*	*SD*
MAQ	1.66	1.32

The relationships were determined for medication adherence (using the MAQ) and participants demographic/clinical information (gender, ethnicity, mobile phone ownership, willingness to receive MPC, primary psychiatric diagnosis, the number of medications taken, the number diagnoses, and the number of psychiatric hospitalizations). Furthermore, MAQ was the dependent variable.

For strength of relationship between gender, ethnicity, mobile phone ownership, willingness to receive MPC and MAQ, a point biserial correlation, a special case of the Pearson correlation aided with determining this relationship. Cohen's standard was used to evaluate the strength of the relationship, where coefficients between .10 and .29 represented a small effect size, coefficients between .30 and .49 represented a moderate effect size, and coefficients above .50 indicate a large effect size (Cohen, 1988). The other category of Ethnicity was removed from the variable because of only 3

observations, allowing comparisons between the two major ethnic groups, Caucasians and African Americans. There was a significant negative correlation between Ethnicity and MAQ (r_{pb} = -0.53, p < .001). The correlation coefficient between Ethnicity and MAQ was -0.53 indicating a large effect size, which suggests that compared to African American, Caucasian are associated with a lower MAQ score. Therefore, Caucasians tend to have a higher level of medication adherence. However, no relationship was found between gender and MAQ (r_{pb} = -0.30, p < .057), mobile phone ownership and MAQ (r_{pb} = -0.23, p < .148), and willingness to receive MPC and MAQ (r_{pb} = -0.21, p < .178). Table 14 presents the results of the correlation.

Table 14: *Point Biserial Correlations for Demographic Information and MAQ*

Comparison	*n*	r_{pb}	95% CI	*p*
Gender-MAQ	41	-0.30	[-0.56, 0.01]	.057
Ethnicity_-MAQ	38	-0.53	[-0.73, -0.25]	< .001
Mobile phone ownership/possession –MAQ	41	0.23	[-0.08, 0.50]	.148
Would you like reminders –MAQ	41	0.21	[-0.10, 0.49]	.178

Note. The critical values are 0.31, 0.40, and 0.50 for significance levels .05, .01, and .001 respectively.

To determine significant differences in MAQ scores and age, ANOVA was conducted and showed no relationship existed. Further, descriptive analysis indicated, there was better medication adherence in participants aged 51 and above (M = 1.4, SD = 1.24) than the remaining age group. However, this is at a medium adherence level. Table 15 shows ANOVA scores and Table 16 provides the details of the descriptive statistics on MAQ and age.

Table 15: *Analysis of Variance for MAQ by Age*

Term	*SS*	*df*	*F*	*p*	η_p^2
Age	3.16	4	0.43	.785	0.05
Residuals	66.06	36			

Table 16: *Means, Standard Deviations, and Sample Size for MAQ by Age Range*

Combination	*M*	*SD*	*n*
18-20	1.8	0.84	5
21-30	2	1.49	10
31-40	1.33	1.41	9
41-50	1.86	1.46	7
51+	1.4	1.26	10

Note. - indicate sample size was too small to calculate statistic.

Also explored were the relationships between medication adherence and the type of psychiatric diagnosis, number of psychiatric hospitalizations and duration of primary psychiatric diagnosis. MAQ was the dependent variable.

Descriptive analyses indicate participants with generalized anxiety disorder had the best adherence with (M = 0.8, SD = 1.3) yet it was in the medium adherence range because the value of the mean was above zero. Moreover, 50% (n = 4) of participants diagnosed with generalized anxiety disorder had the highest adherence score (0). Participants with bipolar disorder had the least adherence rate (M = 2.67, SD = 1.530) indicating a low adherence level. No participant diagnosed with generalized anxiety disorder had the highest level of adherence. Table 17 and 10 below provides details about participants' medication adherence and primary psychiatric diagnosis.

Table 17: *Means, Standard Deviations, and Sample Size for MAQ by Primary Diagnosis*

Combination	*M*	*SD*	*n*
Alcohol/Substance Abuse	1.86	1.35	14
ADHD	1.67	1.53	3
Bipolar Disorder	2.67	1.53	3
Generalized Anxiety Disorder	0.8	1.3	5
Major Depressive Disorder	1.58	1.31	12
Other	1.5	1	4

Note. - indicate sample size was too small to calculate statistic.

Table 18: *Frequency for Primary Psychiatric Diagnosis*

Variable	0	1	2	3	4
Primary Psychiatric Diagnosis					
Anxiety Disorder	4 (50%)	2 (13%)	0 (0%)	3 (43%)	0 (0%)
Major Depressive disorder	2 (25%)	4 (27%)	1 (17%)	0 (0%)	0 (0%)
ADHD	4 (50%)	2 (13%)	1 (17%)	1 (14%)	1 (20%)
Bipolar disorder	0 (0%)	1 (7%)	1 (17%)	1 (14%)	2 (40%)
Alcohol/substance use disorder	7 (88%)	12 (80%)	4 (67%)	7 (100%)	5 (100%)

Note. Due to rounding errors, column wise percentages may not equal 100.

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in MAQ based on primary psychiatric diagnosis. Schizophrenia was merged into the other category of primary psychiatric diagnosis, since there were only 2 participants with Schizophrenia as their primary psychiatric diagnosis. The results of the ANOVA were not significant, F (5, 35) = 0.84, p = .527, indicating the differences in MAQ among the levels of primary psychiatric diagnosis were all similar (Table 19).

Table 19: *Analysis of Variance for MAQ by Primary Psychiatric Diagnosis*

Term	*SS*	*df*	*F*	*p*	η_p^2
Primary psychiatric diagnosis	7.46	5	0.84	.527	0.11
Residuals	61.76	35			

Pearson correlations were conducted between MAQ and participants psychiatric history (duration of primary psychiatric diagnosis, number of diagnoses, number of medications, and number of hospitalizations) to establish strength of relationship. Cohen's standard was used to evaluate the strength of the relationship, where coefficients between .10 and .29 represent a small effect size, coefficients between .30 and .49

represent a moderate effect size, and coefficients above .50 indicate a large effect size (Cohen, 1988).

There was no significant correlation between MAQ and duration of primary psychiatric diagnosis, r_p = 0.00, p = 1.00. Therefore, there was no relationship between MAQ and duration of primary psychiatric diagnosis. To establish strength of association between MAQ and the total number of psychiatric diagnoses, Pearson correlations conducted, showed no significant correlation between MAQ and total number of psychiatric diagnoses, r_p = -0.11, p = .500. This implies that no relationship exists between MAQ and total number of psychiatric diagnoses. To find a relationship between MAQ and the number of psychiatric medications, Pearson correlations were conducted; they showed no significant correlation between MAQ and number of psychiatric medications, r_p = 0.07, p = .660. Further, the strength of the relationship between MAQ and the number of psychiatric hospitalizations examined by Pearson correlation indicated that no significant correlation existed between MAQ and number of psychiatric hospitalizations, r_p = 0.06, p = .730 (Table 26). See Table 20 below for more details.

Table 20: Pearson Correlation Matrix between MAQ and Participants Psychiatric History

Variable	r_p	p
1. MAQ-Duration of Primary Psychiatric Diagnosis	0.00	1.00
2. MAQ-Total Number of Psychiatric Diagnosis	-0.11	.500
3. MAQ-Number of Psychiatric Medications	0.07	.660
4. MAQ-Number of Psychiatric Hospitalizations	0.06	.730

However, interesting results were fund when descriptive statistics of medication adherence and the duration of primary psychiatric diagnosis, number of diagnoses, number of medications, and number of hospitalizations of participants was conducted.

Descriptive statistics of medication adherence across the number of psychiatric diagnosis of participants showed that, the highest medication adherence with participant with one psychiatric diagnosis was 2, which is medium adherence level. The highest medication adherence level (0) was noted in participants with two or more diagnosis. Most participants 15 (36.56%) scored one and two (1 and 2) on the MAQ scale indicating medium adherence level. Moreover, participants (n = 5) who had the lowest adherence rate also had two or three diagnoses. See Table 21 for the percentages of MAQ across diagnosis.

Table 21: *Frequency Table for MAQ and Total Psychiatric Diagnoses*

Variable	0	1	2	3	4
Total Psychiatric Diagnoses					
1	0 (0%)	0 (0%)	1 (17%)	0 (0%)	0 (0%)
2	2 (25%)	11 (73%)	4 (67%)	3 (43%)	2 (40%)
3	4 (50%)	2 (13%)	0 (0%)	3 (43%)	3 (60%)
4	1 (12%)	2 (13%)	1 (17%)	1 (14%)	0 (0%)
5	1 (12%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Note. Due to rounding errors, column wise percentages may not equal 100

Descriptive statistics showed that, the levels of MAQ was spread across the different types of psychiatric medications taken. Fifty percent of participants (50%, n=4) on antipsychotic medications had highest level of adherence (0). Table 22 shows participants percentages of MAQ Across the type of Psychiatric medications.

Table 22: *Frequency for Psychiatric Medications*

Variable	0	1	2	3	4
Psychiatric medications					
Anticonvulsant	2 (25%)	3 (20%)	1 (17%)	1 (14%)	2 (40%)
Antidepressants	2 (25%)	6 (40%)	3 (50%)	4 (57%)	3 (60%)
Antipsychotic	4 (50%)	1 (7%)	0 (0%)	1 (14%)	1 (20%)
SSRI	3 (38%)	7 (47%)	2 (33%)	1 (14%)	1 (20%)
Stimulants	3 (38%)	1 (7%)	0 (0%)	2 (29%)	0 (0%)
Opioids/alcohol medications	2 (25%)	5 (33%)	1 (17%)	4 (57%)	2 (40%)
Gabapentin	1 (12%)	1 (7%)	1 (17%)	2 (29%)	0 (0%)
Sedatives	1 (12%)	1 (7%)	1 (17%)	5 (71%)	0 (0%)
Other	1 (12%)	2 (13%)	1 (17%)	0 (0%)	1 (20%)

Note. Due to rounding errors, column wise percentages may not equal 100%.

Moreover, descriptive statistics showed that, the highest medication adherence reported in participants was 38% (n=3) among those taking only one medication with Zero (0) score on the MAQ. Similarly, highest medication adherence was noted in 12.5% (*n* = 1) participant who was on two medications, 25% (n = 2) on three medications and 25% (n=2) on four medications. The highest mediation adherence in participants on five (5) medications was 3 indicating low medication adherence. Table 23 provides the details of these results.

Table 23: *Frequency for MAQ and Number of Psychiatric Medications*

Variable	0	1	2	3	4
Number of Psychiatric Medications					
1	3 (38%)	9 (60%)	3 (50%)	2 (29%)	1 (20%)
2	1 (12%)	2 (13%)	2 (33%)	0 (0%)	3 (60%)
3	2 (25%)	2 (13%)	1 (17%)	3 (43%)	1 (20%)
4	2 (25%)	2 (13%)	0 (0%)	1 (14%)	0 (0%)
5	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)

Note. Due to rounding errors, column wise percentages may not equal 100%.

However, descriptive statistics shows that participants with 0-2 number of hospitalizations had better medication adherence rate than participants with more than

two hospitalizations. For duration of primary psychiatric diagnosis, medication adherence scores varied. Table 24 gives details of this results.

Table 24: *Frequency for MAQ and Duration of Primary Psychiatric Diagnosis and Number of Psychiatric Hospitalization*

Variable	0	1	2	3	4
Duration of primary psychiatric diagnosis in years					
0-5	3(36%)	6 (45%)	4 (68%)	4 (57%)	2 (40%)
6-10	2(24%)	4 (27%)	1 (17%)	1 (14%)	1 (20%)
11- 15	0 (0%)	0 (0%)	1 (17%)	1 (14%)	1 (20%)
16-20	2 (25%)	3 (21%)	0 (0%)	0 (0%)	0 (0%)
21- 38	1 (12%)	0 (0%)	0 (0%)	1 (14%)	1 (20%)
Number of psychiatric hospitalization					
0	5 (62%)	10 (67%)	5 (83%)	4 (57%)	3 (60%)
1	1 (12%)	4 (27%)	1 (17%)	1 (14%)	2 (40%)
2	2 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
4	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)
9	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)
10	0 (0%)	1 (7%)	0 (0%)	0 (0%)	0 (0%)

Note. Due to rounding errors, column wise percentages may not equal 100%.

Assessment of MPC

Perceived advantages and disadvantages of receiving MPC as a supportive intervention for medication adherence.

The ability to remember to take medications is reported to be the main reason participants want MPC as a supportive intervention for medication adherence, as 92.68% (n = 38) of participants chose that reason. Being dependent on reminders and not remembering to take medications if the phone turns off or is destroyed as well as not getting the reminders at all were noted by 46.34% (n = 19) of the participants as a disadvantage of receiving MPC to support medication adherence (see Table 25).

Table 25: *Frequency for Perceived Advantages and Disadvantages of Receiving MPC*

Variable	*n*	*%*
Perceived Advantages/Benefits		
Able to remember to take medications.	38	92.68
Able to receive advice if cannot remember details about my medications.	28	68.29
Able to ask questions about treatment.	22	53.66
Able stay on medications and not just stop taking them.	25	60.98
Will know someone cares about him/her.	18	43.90
Will be more responsible since will constantly be reminded to take medications	27	65.85
Will not have to worry about tracking the time to take medications	22	53.66
It will save time	14	34.15
Perceived Disadvantages/Problems		
It will distract me.	7	17.07
Will feel controlled	6	14.63
Will not have any privacy	5	12.20
Will cause people around to know I take medications	4	9.76
Will be dependent on reminders and not remember to take medications if phone turns off, gets destroyed or if I do not get the reminders	19	46.34

MPC Method Preference

The preferred method of MPC was TM (*n* = 29, 70.73%). Moreover, PC was noted to be the least preferred method by the majority 56.10% (n=23) of participants but was chosen by 39.02% (n=16) as a second choice. TMPC was also chosen by 41.46% (n=17) as second choice, which is comparable to the number of participants who chose PC as second choice. Frequencies and percentages are presented in Table 26.

Table 26: *Frequency for MPC Choices*

Variable	*n*	*%*
Preference		
TM	29	70.73
PC	3	7.32
TMPC	9	21.95
Second choice		
TM	8	19.51
PC	16	39.02
TMPC	17	41.46
Third choice		
TM	3	7.32
PC	23	56.10
TMPC	15	36.59

Note. Due to rounding errors, percentages may not equal 100%.

Reasons for a preferred MPC method

Convenience was the main reason for participants (n = 25, 68.29%) choosing TM as a preferred MPC method. Similarly, convenience and simple to use were the two major reasons participants chose TMPC as a second preferred method (n = 6, 14.63 and n = 6, 14.63). However, 41.46% (n = 17) of participants chose PC as third choice for being more distracting. Tables 27, 28, and 29 gives details about participants' MPC choices, reasons for choices, and p-values obtained.

Table 27: *Frequency for MPC Method Chosen as Preferred/First Choice*

Variable	*n*	*%*
TM reason		
Convenience	28	68.29
Simple to use	24	58.54
Less distractive	22	53.66
Requires less time.	22	53.66
Provide privacy	11	26.83
Receive advice	13	31.71
Get someone to talk to about medications	5	12.20
Get someone to talk to about symptoms	4	9.76

Variable	*n*	*%*
PC reasons		
Convenience	3	7.32
Simple to use	3	7.32
Less distractive	0	0.00
Requires less time.	1	2.44
Provide privacy	2	4.88
Receive advice	3	7.32
Get someone to talk to about medications	2	4.88
Get someone to talk to about symptoms	2	4.88
TMPC reasons		
Convenience	6	14.63
Simple to use	6	14.63
Less distractive	2	4.88
Requires less time.	3	7.32
Provide privacy	3	7.32
Receive advice	6	14.63
Get someone to talk to about medications	5	12.20
Get someone to talk to about symptoms	6	14.63

Note. Due to rounding errors, percentages may not equal 100%.

Table 28: *Frequency for MPC Method Chosen as Second Choice*

Variable	*n*	*%*
TM reason		
Convenience	6	14.63
Simple to use	5	12.20
Less distractive	4	9.76
Requires less time.	5	12.20
Provide privacy	6	14.63
Receive advice	3	7.32
Get someone to talk to about medications	1	2.44
Get someone to talk to about symptoms	2	4.88
PC reasons		
Convenience	6	14.63
Simple to use	7	17.07
Less distractive	2	4.88
Requires less time.	1	2.44
Provide privacy	4	9.76
Receive advice	11	26.83
Get someone to talk to about medications	9	21.95
Get someone to talk to about symptoms	8	19.51
TMPC reasons		
Convenience	10	24.39
Simple to use	5	12.20

Variable	*n*	*%*
Less distractive	6	14.63
Requires less time.	4	9.76
Provide privacy	9	21.95
Receive advice	4	9.76
Get someone to talk to about medications	8	19.51
Get someone to talk to about symptoms	10	24.39

Note. Due to rounding errors, percentages may not equal 100%.

Table 29: *Frequency for MPC Method Chosen as Third Choice*

Variable	*n*	*%*
TM reason for being third		
Less Convenience	1	2.44
Not Simple to use	1	2.44
More distractive	1	2.44
Requires more time.	0	0.00
Provides less privacy	1	2.44
Cannot Receive advice	3	7.32
Cannot Get someone to talk to about medications	3	7.32
Cannot Get someone to talk to about symptoms	3	7.32
PC reasons		
Less Convenience	12	29.27
Not Simple to use	2	4.88
More distractive	17	41.46
Requires more time.	11	26.83
Provides less privacy	9	21.95
Cannot Receive advice	2	4.88
Cannot Get someone to talk to about medications	0	0.00
Cannot Get someone to talk to about symptoms	0	0.00
TMPC reasons		
Less Convenience	3	7.32
Not Simple to use	1	2.44
More distractive	10	24.39
Requires more time.	9	21.95
Provides less privacy	6	14.63
Cannot Receive advice	0	0.00
Cannot Get someone to talk to about medications	0	0.00
Cannot Get someone to talk to about symptoms	0	0.00

Note. Due to rounding errors, percentages may not equal 100%.

Conducting a Chi-Square Test of Independence aided with examining the relationship with preference and reasons given. The three levels of preference (TM, PC,

and TMPC). There was significant between Preference and convenience ($\chi^2(2) = 28.30$, $p < .001$); Preference and simple to use ($\chi2(2) = 17.73$, $p < .001$); preference and destruction ($\chi2(2) = 14.13$, $p < .001$); preference and less time ($\chi2(2) = 14.13$, $p < .001$); preference and receiving advice ($\chi^2(2) = 24.99$, $p < .001$); and preference and talking about medications ($\chi^2(2) = 20.25$, $p < .001$). However, there was non-significant relationship between preference getting more privacy $\chi2(2)$ and talking about symptoms ($\chi2(2) = 3.10$, $p = .212$ and $\chi2(2) = 0.35$, $p = .838$ respectively). Table 30 and 31 gives the observed and expected frequencies for relationship between the type of MPC preferred and reasons given for choice made.

Table 30: *Frequencies for Reasons for MPC Method Preferred*

	Convenience		Simple to Use		Less Distractive		Requires Less Time	
Preference	0	1	0	1	0	1	0	1
PC	3[0.95]	0[2.05]	3[1.24]	0[1.76]	3[1.39]	0[1.61]	3[1.39]	0[1.61]
TMPC	8[2.85]	1[6.15]	8[3.73]	1[5.27]	8[4.17]	1[4.83]	8[4.17]	1[4.83]
TM	2[9.20]	27[19.80]	6[12.02]	23[16.98]	8[13.44]	21[15.56]	8[13.44]	21[15.56]

Note. Values formatted as Observed[Expected].

Table 31: *Frequencies for Reasons for MPC Method Preferred*

	Receive advice		Talk About Medications		More Privacy		Talk About Symptoms	
Preference	0	1	0	1	0	1	0	1
PC	3[2.56]	0[0.44]	3[2.63]	0[0.37]	3[2.20]	0[0.80]	3[2.71]	0[0.29]
TMPC	3[7.68]	6[1.32]	4[7.90]	5[1.10]	8[6.59]	1[2.41]	8[8.12]	1[0.88]
TM	29[24.76]	0[4.24]	29[25.46]	0[3.54]	19[21.22]	10[7.78]	26[26.17]	3[2.83]

Note. Values formatted as Observed [Expected]

Relationship or differences between MPC Preference and Demographic/Clinical Information

Interesting results were found when the relationship between participants' MPC preference was examined with regards to demographic/clinical information, medication

adherence, medication adherence, and MHS users' overall acceptance of MPC as a method of providing support to increase medication adherence after discharge. MPC preference was the dependent variable.

Frequencies and percentages were calculated for MPC preference split by primary psychiatric diagnosis. For alcohol/substance abuse (n = 9, 64%), ADHD (n = 2, 67%), bipolar disorder (n = 3, 100%), generalized anxiety (n = 5, 100%), major depressive disorder (n = 8, 67%), and other psychiatric diagnoses (n = 2, 100%), the preferred method was TM. For schizophrenia, the preferred method was TMPC (n = 2, 100%). Frequencies and percentages are presented in Table 32.

Table 32: *Frequency for MPC Preference and Primary Psychiatric Diagnosis*

Variable	Alcohol /Substance Abuse	ADHD	Bipolar	Generalized Anxiety	Major Depression	Schizophrenia	Other
PC	1 (7%)	1 (33%)	0 (0%)	0 (0%)	1 (8%)	0 (0%)	0 (0%)
TMPC	4 (29%)	0 (0%)	0 (0%)	0 (0%)	3 (25%)	2 (100%)	0 (0%)
TM	9 (64%)	2 (67%)	3 (100%)	5 (100%)	8 (67%)	0 (0%)	2 (100%)

Note. Due to rounding errors, column wise percentages may not equal 100%.

Chi-Square Tests of Independence were conducted to examine whether MPC had a relationship with gender or age. There were 2 levels in Gender: Female and Male. There were 5 levels in Age: 18-20, 21-30, 31-40, 41-50, and 51+. There were 3 levels in MPC Preference: PC, TMPC, and TM. Prior to conducting the analysis, the assumption of adequate cell size was assessed, which requires all cells to have expected values greater than one, and 80% of cells to have expected values of at least five (McHugh, 2013).

For gender the expected value (in square brackets), females who chose PC as their MPC preference had an expected value of .95 and 50% (less than 80%) of the expected

values for each cell were greater than 5 as seen in Table 26. These violate the assumptions of the Chi-Square Test for Independence, so the results are to be interpreted with caution. The results of the Chi-Square test were not significant, $\chi^2(2) = 2.07$, $p = .355$, suggesting that Gender and MPC preference are not related to one another. This implies that the observed frequencies were not significantly different than the expected frequencies. Table 33 presents the results of the test.

Table 33: *Frequencies for Gender and MPC*

	MPC		
Gender	PC	TMPC	TM
Female	0[0.95]	4[2.85]	9[9.20]
Male	3[2.05]	5[6.15]	20[19.80]

Note. Values formatted as Observed[Expected].

In examining the relationship between age and MPC preference, some of the cells had expected values less than 1, and only 20% (less than 80%) of the cells had expected frequencies of at least 5 as shown in Table 4. These violate the assumptions of the Chi-Square Test for Independence, so the results must be interpreted with caution. The results of the Chi-Square test were not significant, $\chi^2(8) = 6.15$, $p = .631$, suggesting that Age and MPC preference are not related to one another. This implies that the observed frequencies were not significantly different than the expected frequencies. Table 34 presents the results.

Table 34: *Frequencies for Age and MPC*

	MPC		
Age	PC	TMPC	TM
18-20	1[0.37]	2[1.10]	2[3.54]
21-30	1[0.73]	1[2.20]	8[7.07]
31-40	0[0.66]	1[1.98]	8[6.37]
41-50	0[0.51]	2[1.54]	5[4.95]
51+	1[0.73]	3[2.20]	6[7.07]

Note. Values formatted as Observed[Expected].

A Chi-Square Test of Independence was conducted to examine whether MPC preference and Ethnicity were independent. There were 3 levels in MPC preference: PC, TMPC, and TM. There were 3 levels in Ethnicity: Other, African American, and Caucasian. Prior to conducting the analysis, the assumption of adequate cell size was assessed, which requires all cells to have expected values greater than zero, and 80% of cells to have expected values of at least five (McHugh, 2013). A total of 3 cells had expected frequencies less than 1, indicating the first condition was violated. A total of only 33.33% (less than 80%) of the cells had expected frequencies of at least five, indicating the second condition was not met. Thus, the results should be interpreted with caution. The results of the Chi-Square test were significant, $\chi^2(4) = 13.99$, $p = .007$, suggesting that MPC preference and Ethnicity are related to one another. The following level combinations observed values that were greater than the expected values: PC: other, PC: African American, TMPC: African American, and TM: Caucasian. The following level combinations observed values that were less than the expected values: TMPC: other, TM: other, TM: African American, PC: Caucasian and TMPC: Caucasian. Table 35 presents the results of the Chi-Square test.

Table 35: *Frequencies for MPC and Ethnicity*

	Ethnicity		
MPC	African American	Caucasian	Other
PC	2[0.95]	0[1.83]	1[0.22]
TMPC	6[2.85]	3[5.49]	0[0.66]
TM	5[9.20]	22[17.68]	2[2.12]

Note. Values formatted as Observed[Expected].

To examine whether MAQ and Preference were independent, a Chi-Square Test of Independence was conducted. The results were not significant, $\chi^2(8) = 9.64$, $p = .292$, suggesting that MAQ and Preference could be independent of one another. This implies

that the observed frequencies were not significantly different than the expected frequencies. Table 36 presents the results of the Chi-Square test.

Table 36: *Frequencies for MPC Preference and MAQ*

	Preference		
MAQ	PC preference	TMPC preference	TM preference
0	0[0.59]	1[1.76]	7[5.66]
1	0[1.10]	3[3.29]	12[10.61]
2	1[0.44]	2[1.32]	3[4.24]
3	2[0.51]	2[1.54]	3[4.95]
4	0[0.37]	1[1.10]	4[3.54]

Values formatted as Observed[Expected].

Overall acceptability Assessment

Lastly, the MHS users' overall acceptability of MPC was examined, and the association between medication adherence and mobile phone ownership as well as liking reminders were assessed.

Problems Foreseen When Receiving MPC Intervention and Solution

Problems participants anticipated with receiving MPC varied and included (a) the inability to receive the message/call due to network issues, (b) mobile phone battery running down, (c) distraction, and (d) inability to retrieve messages. Table 37 gives details about this information.

Table 37: *Frequency Table for Problems Foreseen with MPC*

Variable	*N*	*%*
Problems participants foreseen		
Inability to read and write in English.	2	4.88
Not be able to understand the message I receive.	5	12.20
Not receiving the message/call due to network issues	24	58.54
Not able to retrieve message/text.	10	24.39
May not be able to read text message if the letter characters are too small.	4	9.76
Lack of skills using mobile phone for the purpose of receiving reminders.	2	4.88

Variable	*N*	*%*
Feeling discomfort with typing response.	2	4.88
Inability to pay for the extra charge for receiving mobile phone contact.	5	12.20
Mobile phone battery may run down.	15	36.59
Distractions	12	29.27

With regards to overcoming the problems with receiving MPC intervention, 70.7% (*n* = 29) mentioned that the MPC message should be clear, simple and understandable. Additionally, MPC should be simple, clear and understandable, receiving MPC in an understood language, receiving MPC at preferred times, and ensuring that the mobile phone is charged were also chosen by participants 70.73 (*n* = 29), 39.02% (*n* = 16), 36.59 (*n* = 15), and 34.15% (*n* = 14), respectively. Other reasons given were comparable. Table 38 below provides details about problems foreseen as well as solutions to problems related to receiving the MPC intervention.

Table 38

Frequency Table for Overcoming the Problems

Variable	*n*	*%*
How to overcome these problems		
Prefer to receive text and phone calls in the language understood	16	39.02
Prefer the message be sent to caregiver if cannot read and write	1	2.44
The messages should be clear, simple and understandable.	29	70.73
Use soft key options for responding to mobile phone contacts.	7	17.07
Use on-screen number options for responding to mobile phone contacts.	12	29.27
Receiving demonstration on how to retrieve the text message/calls	4	9.76
Making sure phone bills are paid to get network all the time	12	29.27
The letters of the text message should be in big sizes for me to read easily.	6	14.63
Prefer to receive phone calls options due to discomfort with typing	4	9.76
Prefer to receive prepaid mobile phone contact	8	19.51
Want to receive the mobile phone contact based on preferred times	15	36.59
Ensuring mobile phone is charged at all times.	14	34.15

Note. Due to rounding errors, percentages may not equal 100%.

Concerning mobile phone ownership, 90.2% (n = 37) of participants owned a mobile phone, but no one (0%) was currently receiving MPC reminders to take medications. However, 92.2% of participants wanted to receive MPC reminders. Given that no participants responded that they currently receive reminders, this variable was not included in the chi-square analysis. Most participants, 92% (n = 34), both owed mobile phones and wanted reminders, while 8% (n = 3) of participants who owned mobile phone did not want reminders, and 9.76% (n=4) of participants who did not have mobile phones wanted reminders. Table 39 depicts this information.

Table 39: *Frequency Table for Mobile Phone Ownership and Liking Reminders*

Variable	No	Yes
Would you like reminders		
No	0 (0%)	3 (8%)
Yes	4 (9.76%)	34 (92%)

Note. Due to rounding errors, column wise percentages may not equal 100%.

Conducting a point biserial correlation analysis for MAQ aiding with examining if the participants liked reminders and mobile phone ownership. A point biserial correlation is a special case of the Pearson correlation. Cohen's standard was used to evaluate the strength of the relationship, where coefficients between .10 and .29 represent a small effect size, coefficients between .30 and .49 represent a moderate effect size, and coefficients above .50 indicate a large effect size (Cohen, 1988). There was no significant correlation between MAQ and liking reminders, $r_{pb} = 0.21$, $p = .178$. This suggests that no relationship exists between MAQ and liking reminders. For relationship between MAQ and mobile phone ownership, there was no significant correlation between MAQ and mobile phone ownership, rpb = 0.23, $p = .148$. This indicates that there is no

relationship between MAQ and mobile phone ownership. Table 40 presents the results of the correlation.

Table 40: *Point Biserial Correlations for Liking Reminders, Mobile Phone Ownership and MAQ*

Comparison	*n*	r_{pb}	95% CI	*p*
MAQ-Liking Reminders	41	0.21	[-0.10, 0.49]	.178
MAQ-Mobile Phone Ownership	41	0.23	[-0.08, 0.50]	.148

Discussion

The results of this study revealed some interesting findings about MPC preferences in mental health service users. The results suggest that mobile phone ownership (90.2%) is common in this population, similar to findings from other studies (Ennis et al., 2012; Miller et al., 2015) and comparable to the national average as noted by Campbell et al., (2015). However, the result of the study suggests the need for clinicians to provide patients who do not own mobile phones with mobile phones when considering incorporating MPC into routine clinical care to enhance medication adherence in all mental health service users. Furthermore, the need for reminders to take medications cannot be overestimated and seems to be an expectation when ensuring medication adherence in this population, taking into account that 92.2% of the participants expressed interest in such reminders. Comparatively, 90.2% of participants owned a mobile phone and 92.7% of the participants' expressed interest in receiving reminders, which suggests that even though some participants did not own mobile phones, they still wanted reminders. The results suggest the need for reminders in this population an expectation that should not be underestimated by mental health practitioners in the quest for solutions to medication non-adherence.

Moreover, there is reason for concern due to participants' medication adherence scores on the MAQ, 51.2% having medium adherence (1 and 2), 29.3% having low adherence to medications ratings (3-4), and only 19.5% having the highest medication adherence rate (0). It is important to note that participants with medium and low medications adherence rates are the majority (80.5%), which may explain why 92.7% of the participants expressed interest in receiving reminders to take medications. Suggesting that some participants with the highest medication adherence rating and those who did not own mobile phones still wanted reminders to take medications. The medication adherence rate in this population is (M = 1.66), suggesting medium adherence according to the MAQ scores, confirming the continued challenge in medication adherence in this population as evidenced in mental health research (Tomko et al., 2013).

Medication adherence was also compared with the participants' demographic/clinical information, and interesting results were found. It was noted that the type of primary psychiatric diagnosis had no relationship with medication adherence (p = .527), nor did the total number of primary psychiatric diagnoses (p = .500), nor did the duration of primary psychiatric diagnosis (p = 1.00). Even though a non-significant relationship was found between MAQ and primary psychiatric diagnosis (p = .527) of participants, a closer look at individual numbers of diagnosis, and medication gave us some idea about trends in medication adherence in this population. Of the total population, the eight participants with the highest medication adherence (MAQ = 0) had only one psychiatric diagnosis. However, the five participants who had the lowest medication adherence rating (MAQ = 4) had one diagnosis.

Similarly, no significant relationship (p = .660) was found with medication adherence and number of medications taken. However, for trends in adherence, four participants forming 50% of participants with the highest adherence rate (MAQ = 0) were on only one medication. Moreover, no participants taking five medications had the lowest adherence rating. Likewise, no significance was found between medication adherence and the number of psychiatric hospitalization (p = .730). The variation in medication adherence scores across the numbers and types of psychiatric diagnosis or medications indicate that — although no statistically significant difference existed in medication adherence, type/number of diagnosis, and type/number of medications taken — descriptive statistics of individual trends in the type and number of medications taken suggest otherwise, indicating the need for further studies to confirm study results.

Participants' medication adherence was significant for ethnicity (p < .001). Caucasians were noted to have low MAQ scores compared to African Americans and other ethnicities. Also, the non-significance noted in participants MAQ scores and participants mobile phone ownership and liking reminders should be looked at closely (p = .148, p = .178 respectively). The results suggest that mental health providers should not assume that any of these factors could increase or decrease medication adherence in this population when applying an intervention to increase medication adherence.

Reasons for or not wanting reminders

Even though non-significant results were noted for most of the participants' medication adherence and demographic/clinical data when compared, it is important to remember that, 80.5% participants who fell below the highest medication adherence score and 92.2% of all participants wanted reminders to take medications. Participants

expressed knowledge about the benefits of receiving reminders to take medications. Among these benefits, at least 50% of participants expressed remembering to take my medications, receiving advice about details of medications, ability to ask questions about treatment, ability to stay on medications and not just stop taking it, knowing someone cares, being more responsible because of constant reminders to take medications, and not worrying about tracking the time to take medications confirming participants' awareness of the benefits MPC could bring to mental health treatment (Palmer-Claus et al., 2013).

Furthermore, the results indicated that participants are aware of the four types of social support MPC might provide as each of these benefits falls under a social support category (instruments [remembering to take medications due to constant reminders], informational [receiving advice and asking questions about treatment], emotional [knowing someone cares; not worrying about tracking the time], and valuation [being more responsible]). The results also confirmed the potential importance of continuous support to ensure continuous long-term treatment with close monitoring (Ainsworth et al., 2013; Bright, 2018; Palmier-Claus et al., 2013). The 92.7% expressing that remembering to take medications was the benefit of MPC confirms that participants are aware of the benefits MPC brings to mental health care as noted in similar study (Granholm et al., 2012).

However, participants also noted that receiving MPC is not without some sort of risk. The disadvantages participants expressed about receiving MPC included distraction, feeling controlled, lack of privacy, causing people around to know participants are taking medications, being dependent on reminders, and not remembering to take medications if the phone turns off or if reminders are not received were. For risks such as lack of

privacy, distraction, and feelings of being controlled can be reduced or avoided if participants can choose preferred times to take medication as noted in similar studies (Beebe et al., 2008; Beebe et al., 2014; Montes et al., 2012). The disadvantages expressed by participants about receiving MPC demonstrates that autonomy is important in every treatment intervention which aligns with the social support theory (Glanz et al., 2008).

Identification of preferences

After participants expressed value in receiving MPC, preferences for a MPC method was assessed. The results indicate 70.7% of participants preferred the TM method. However, in similar study that did not indicate participants MPC method preference, showed increases in medication adherence in participants receiving TMPC when compared to TM and PC (Beebe et al., 2014). This study therefore seeks to inform clinicians that even though a high medication adherence rate was noted in participants receiving TMPC in Beebe et al., (2014) study, TMPC might not be a preferred method. Moreover, research has shown that, when patients do not receive the preferred treatment method, the decision not to initiate or complete treatment could be associated with disappointment or dissatisfaction with the treatment offered by the clinician (Raue et al., 2009). Hence, taking patients' preferences into consideration when applying MPC may be important to increasing medication adherence in this population because reduction in adhering to TMPC could have occurred with time.

In prospective, MPC trial taking into account participant preferences would add to the knowledge of whether patient preference with MPC would enhance medication adherence about randomized MPC.

Reasons for choosing preferred MPC method

Participants' reasons for choosing a preferred MPC method was evaluated, and results showed that 70.7% of the participants were aware that TM is convenient, simple to use, less distractive and requires less time compared to PC and TMPC. The relationship between participants' reasons for choosing a MPC method as preferred was highly significant ($p < .001$) for convenience, simple to use, less distractive, required less time, receiving advice, and talking about medications.

However, 29.3% of participants saw PC as less convenient, 41.5% saw PC as more distractive and 26.8% saw PC as more time consuming, which could explain why only 7.32% ($n = 3$) chose PC as a preferred method.

Relationship between MPC method preference and participants' characteristics

In exploring participants' preferred MPC method and demographic/clinical data, interesting results were found. There was no relationship between MPC preference and age ($p = .631$) even though the age ranged from 18-70 years. Non-significant relationship ($p = .355$) was also found for gender and MPC preference. However, preference was significant with ethnicity ($p = .007$). African Americans preferred TMPC (2.85%) while Caucasians preferred TM (17.68%) suggesting that providers should consider ethnicity of participants when applying the MPC intervention. However, because PC and TMPC were combined into one group, the results of this study did not clearly indicate which of the two methods (PC or TMPC) was most preferred by African Americans.

Considering psychiatric diagnoses, participants preferred TM, except all those (100%) diagnosed with schizophrenia, who preferred TMPC confirming Beebe et al.'s (2010) recommendation to consider using text messages as an adjunct to phone calls

when applying MPC in treatment of patients with schizophrenia. Another interesting finding was participants diagnosed with ADHD did not want TMPC. The reason for this result should be investigated in future studies. Further, mixed results were found for all three MPC preferences with participants diagnosed with major depressive disorder and alcohol/substance use disorder/dependence. However, these results cannot be generalized in this population due to the small sample size. There is therefore a need for further studies with larger sample sizes to produce generalizable results and to identify any statistical significance.

When participants MPC preference was compared to medication adherence scores, non-significant differences were found (p =.292), suggesting that MPC preference and medications adherence are independent. However, this non-significant relationship between medication adherence and MPC is not conclusive since this is not an intervention study and does not predict a relationship between MPC preference and medication adherence. Furthermore, subjective measures were used to assess medication adherence in this population (self-report) which was noted to be unreliable and susceptible to social desirability and memory biases causing overestimate in medication regimens. The disadvantages of using a subjective measure in this study suggest the need for an intervention study and the use of objective medication adherence measures such as pill count and plasma levels. The use of objective measures in medication adherence assessment for individuals with mental challenges has been highly recommended (Ren et al., 2009).

Overall acceptability

Finally, the participants' impression of receiving MPC was evaluated by assessing the overall acceptability of MPC, which included MPC preference, mobile phone ownership, willingness to receive reminders, problems foreseen with MPC, and solutions for these problems. A network issue was one major concern of participants when receiving MPC intervention. Further, the numerous solutions participants reported for overcoming problems arising from receiving MPC intervention included receiving MPC in language understood, clarity, simplicity and understandability of MPC intervention. Receiving MPC at preferred times, prepaid contacts and use of soft key should be strongly considered for successfully implementing MPC intervention. Differences in language are noted to be one of the barriers to effective communication (Schyve, 2007). Therefore, ensuring MPC is done in language patients understand is important for MPC to be effective in this population. Additionally, paying for extra charges with MPC will be a challenge in this population, considering that 58.5% of participants depend on social security/disability funds, retirement funds, or family and friends with 39.0% of income from family and friends. One solution to problems with receiving MPC was making sure phone bills are paid to maintain service all the time, which implies that if MPC is to be included in standard of care, bill assistance and financial guidance should be considered.

Moreover, the non-significant relationship identified between medication adherence and mobile phone ownership as well as liking reminders (p = .148 and p = .178 respectively) should be further explored further through an intervention study to accurately predict association.

Limitations and Recommendations

This study has several limitations. The first limitation is results of this study are not generalizable given its small sample size, and there is consequently a need for replication in a larger population. The second limitation is to accurately predict a relationship between MPC method preference and participants' demographic/clinical information as used in this study. There is a need for an intervention study to compare participants who had the opportunity to choose a preferred MPC method and those who did not. The third limitation is an intervention study is needed to establish a relationship between medication adherence and MPC preferences. Finally, a follow up study of participants from an inpatient psychiatric setting to an outpatient setting should be done to identify relationships based on the time of application of the MPC intervention.

Conclusion

This study reported information about MPC preferences to enhance medication adherence after discharge for mental health service users. Providers should not underestimate the need for reminders to take medications in this population, considering that the majority of participants fell within the moderate to low medication adherence ratings. Further, participants' willingness for MPC reminders to take medications confirms a struggle with medication adherence and the need for mental health providers to continue support even after discharge to increase medication adherence.

The need to identify preferences in MPC method should be a priority when providers apply an MPC intervention to increase medication adherence. Based on the results, providers should not overlook the participants' expressions of autonomy by indicating a preferred MPC method and giving significant reasons for the choice made.

Similarly, participants preferred time for applying MPC intervention is likely to reduce lack of privacy, distraction, and feelings of being controlled expressed by participants. It is important to note that in this study, MPC was significant for relationship with ethnicity and preferences although not significant statistically with diagnosis or number of medications. In conclusion, identifying MPC preference in mental health service users is as essential as applying the MPC intervention itself in increasing medication adherence after discharge. There is a need for larger intervention studies to explore this issue.

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Summary and Conclusion

This dissertation contains two integrative reviews and a descriptive correlational study. The first review is on the validity and reliability of instruments used to measure medication adherence in patients with schizophrenia. The second integrative review reports on the use of mobile phone contact to increase medication adherence in patients with severe mental illness. The descriptive correlational study identifies the mobile phone contact method preferred by individuals to increase medication adherence after discharge.

Results from the three studies shed new light on medication adherence in individuals with mental illness. Information presented from the first manuscript showed that available measurement instruments, while still relevant for measuring medication adherence, are limited; new measures are needed because all available instruments lack either validity, reliability, or sensitivity, and a gold standard for measuring medication adherence in patients has yet to be established. The second manuscript provides information on the use of mobile phone contact to support increased medication adherence in patients with severe mental illness. Results indicate that some promising data are emerging on mobile phone contact use to increase medication adherence in individuals with severe mental but limited data exist on its use. Hence, there is a need for more studies to produce conclusive results.

The third manuscript, a descriptive correlational study, provides information on mobile phone contact method preferences among mental health service users for supporting increased medication adherence after discharge. The results from the study indicate that reminders are essential to ensure medication adherence, as demonstrated by participants' interest in reminders and high level of mobile phone ownership. Medication

adherence in this population was a mean of 1.66, indicating medium to moderate medication adherence rate on the MAQ scale. MPC preference was significant for some demographic data such as ethnicity, and TM was the most preferred MPC method. Participants reported it was convenient to use required less time and involved the fewest distractions. The relationship among participants' MPC preference and medication adherence yielded inconclusive results, thus reinforcing the need for further studies.

However, this dissertation has some limitations that should be addressed in future studies. The first manuscript could not effectively make conclusions because the reviewed studies reported varying research timeframes and differences regarding significance of results and validity and reliability of measures. The second manuscript did not consider the level/severity of participants' mental illness prior to their participating in the respective studies, and the conclusions about mobile phone contact providing all four types of social support were determined by assessing all the mobile phone contact methods as a single category. Further, individual mobile phone contact method (text message only, phone call only, or text message plus phone call) was not assessed for the core elements of the four types of social support described by Glanz et al. (2008). Also, results from the third manuscript cannot be generalized in this population because of the small sample size used. Thus, results obtained for the relationship between MPC method preference and medication adherence are not predictive. An intervention study is needed for generalizability and accurate predictability of the relationship between MPC method preference and medication adherence. However, none of these limitations affected the main findings of the dissertation regarding the usefulness of MPC methods for this population and the need for more research in this area.

Many lessons have been learned from this dissertation. To address medication non-adherence in this population, it is necessary to identify a tool that is sensitive to each patient's unique needs and has validity and reliability, to accurately measure medication adherence in this population since there is no gold standard. Further, mobile phone contacts were noted to be one readily available technology that is feasible for both the support person and the individual with mental health challenges. Of the three methods, text messaging (TM) is simple to use, convenient, and inexpensive, and its use as an intervention to increase medication adherence in this population seems especially promising. Moreover, to effectively implement MPC, it is necessary to consider identifying participants' preference for an MPC method. Moreover, patient involvement in treatment planning and choice of an intervention helps with initiation and adherence to the intervention, implying that making patient preference a priority is as important as application of the intervention itself when seeking to support increased medication adherence in this population. Further, the importance of language use and cost/billing of MPC should not be overlooked. This dissertation seeks to inform stakeholders, especially policy makers, healthcare providers, and caregivers about the continual need of an effective means to improve medication adherence in this population.

Future studies

From the gaps identified in this dissertation (both integrative reviews, and the descriptive correlational study), there is a continual need for interventions that work to address the medication non-adherence menace in this population. The need for improvement in interventions to increase medication adherence. as well as instruments to measure medication adherence in this population, cannot be underestimated. Further,

even though some new measures are discovered. and MPC is noted to be promising in increasing medication adherence, limited studies exist for their generalizability. Therefore, future studies should focus on developing new generalizable medication adherence instruments that have validity, reliability. and sensitivity (Bright, 2016). Further, attention should be given to the extent to which each mobile phone contact method can provide social support in this population using the social support theory as a reference.

This dissertation serves as a platform for the next stage of research: An intervention study on MPC preferences and medication adherence in mental health service users. This will include a sufficiently large sample size to accurately predict the relationship between MPC preferences and medication adherence in this population. Also, the extent to which each MPC method provides the four types of social support will be considered in this future research.

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Appendix A

Institutional Review Board for Human Research (IRB)

Office of Research Integrity (ORI)

Medical University of South Carolina

Harborview Office Tower

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Charleston, SC 29425-8570

Federal Wide Assurance # 1888

APPROVAL:

This is to certify that the research proposal **Pro00072581** entitled:

A Descriptive Correlational Study: Mental Health Services Users' Mobile Phone Contact Method Preference and Medication Adherence.

Submitted by: **Cordellia Bright**

Department: **Medical University of South Carolina**

for consideration has been reviewed by **IRB-I - Medical University of South Carolina** and approved with respect to the study of human subjects as adequately protecting the rights and welfare of the individuals involved, employing adequate methods of securing informed consent from these individuals and not involving undue risk in the light of potential benefits to be derived therefrom. No IRB member who has a conflicting interest was involved in the review or approval of this study, except to provide information as requested by the IRB.

Original Approval Date: **12/6/2017**

Approval Expiration: **12/5/2018**

Type: **Expedited**

Chair, **IRB-I - Medical University of South Carolina**

Mark Hamner*

Statement of Principal Investigator:

As previously signed and certified, I understand that approval of this research involving human subjects is contingent upon my agreement:

1. To report to the Institutional Review Board for Human Research (IRB) any adverse events or research related injuries which might occur in relation to the human research. I have read and will comply with IRB reporting requirements for adverse events.
2. To submit in writing for prior IRB approval any alterations to the plan of human research.
3. To submit timely continuing review reports of this research as requested by the IRB.
4. To maintain copies of all pertinent information related to the research activities in this project, including copies of informed consent agreements obtained from all participants.
5. To notify the IRB immediately upon the termination of this project, and/or the departure of the principal investigator from this Institution and the project.

∗***Electronic Signature****: This document has been electronically signed by the IRB Chairman through the HSSC eIRB Submission System authorizing IRB approval for this study as described in this letter.*

Appendix B.

200 N Glebe Rd Ste 703 Arlington, VA 22203
www.phoenixhouse.org
November 17, 2017
T 703 841 0703
F 571 297 9809

Phoenix House
Rising Above Addiction

CC: The Institutional Review Board

Dear Ms. Cordellia Bright,

This letter is in support of MUSC College of Nursing Doctoral candidate, Cordellia Bright, conducting her research study with voluntarily participants of Phoenix House Mid-Atlantic's outpatient substance abuse and mental health program.

Phoenix House Mid-Atlantic provides inpatient and outpatient substance abuse and mental health services to adolescents and adults in Arlington, Virginia.

After reviewing Ms. Bright's proposal, we at Phoenix House Mid-Atlantic are giving clients the option to voluntarily participate in her study at his/her own discretion.

If you have any further questions, please feel free to contact me at the number listed below.

Sincerely,

Patricia Schneeman LSATP
Clinical Director (703)
867-8410
pschneeman@phoenixhouse.org

Appendix C

From: DONALD MORISKY [dmorisky@ucla.edu]
Sent: Tuesday, August 29, 2017 2:46 AM
To: Bright, Cordellia
Subject: Re: Request for Permission to use medication adherence tool

CAUTION: External

Greetings Cordellia, and this is my first publication of my doctoral paper published in 1986. The Morisky, Green and Levine Medication Adherence Scale has been cited in the medical literature over 3000 times. It is in the public domain and can be translated by you with no license requirement. You can do a search of this article on PubMed and see how many investigators are still using this scale. Please keep me appraised of your adherence research.

I wish you the very best of success in your adherence research.

Sincerely,

Donald Morisky, ScD, ScM, MSPH
Research Professor
UCLA Fielding School of Public Health

On Mon, Aug 28, 2017 at 5:51 PM, Bright, Cordellia <brightco@musc.edu> wrote:

This message was sent securely by MUSC

Good afternoon Dr. Morisky,

Thank you so much for your response. I contacted my school and was informed the school is unable to purchase the Morisky Widget MMAS License at this time. Moreover, the Morisky, Green and Levine Medication Adherence Scale will work perfectly for my study. I will be grateful if you grant me permission to use the Morisky, Green and Levine Medication Adherence Scale as you suggested.

I am looking forward to a favorable response.

Thank you.

Cordellia Bright
PhD candidate
MUSC College of Nursing

From: DONALD MORISKY [dmorisky@ucla.edu]
Sent: Sunday, August 27, 2017 3:00 PM
To: Bright, Cordellia
Subject: Re: Request for Permission to use medication adherence tool

Thank you, Cordellia, for your interest in using my copyrighted intellectual property. All MMAS-8 and MMAS-4 licenses are administered through the Morisky Widget. Beginning in 2017, I only license the MMAS-8 to organizations and universities, not individuals. If your University is interested in obtaining a Morisky Widget MMAS License, please have them contact me, otherwise, you are forbidden from using the MMAS-8., only universities and large health institutions are able to purchase a license. Individual licenses are no longer available.

You will need a license to use my intellectual property (IP) and licenses are only provided to universities and large health institutions. If you wish to use my IP, please have your university send me a note wishing to purchase a lifetime MMAS license to have access to all diagnostic assessment instruments including The MMAS-4 (a screening adherence survey), the MMAS-8 (a diagnostic assessment of medication taking behavior and WHY the patient is nonadherent), the depression scale, the anxiety scale, and a substance abuse scale. **You can visit my website to see how the Morisky**

Widget works at morisky.org. All MMAS-8 and MMAS-4 licenses are administered through the Morisky Widget.

If you cannot get your university to purchase a lifetime Morisky Widget to be used by all students, faculty, and staff in your university, I will give you permission to use the Morisky, Green and Levine Medication Adherence Scale. This is my first publication of my doctoral paper published in 1986. The Morisky, Green and Levine Medication Adherence Scale has been cited in the medical literature over 3000 times. It is in the public domain and can be translated by you with no license requirement. You can do a search of this article on PubMed and see how many investigators are still using this scale. Please let me know if you are interested in receiving this research article.

I wish you the very best of success in your adherence research.

Sincerely,

Donald Morisky, ScD, ScM, MSPH
Research Professor
UCLA Fielding School of Public Health

On Wed, Aug 23, 2017 at 7:18 PM, Bright, Cordellia <brightco@musc.edu> wrote:

Dear Dr. Morisky,

I am a doctoral student at the Medical University of South Carolina and I am planning my dissertation study involving assessment of medication adherence in individuals receiving mental health services.

I am writing to seek your permission to use the **eight item medication adherence scale** you used in your study "Morisky, D. E., Ang, A., Krousel-Wood, M., Ward, H J. (2008). Predictive validity of a medication adherence measure in an outpatient setting. J Clin Hypertens (Greenwich) 10(5): 348–354".
I hope to start my data collection by September 2017 and will be grateful if you grant me permission to use your tool.

Thank you in advance for your consideration.
Cordellia Bright
PhD Candidate
MUSC College of Nursing

Appendix D.

Data collection instruments for demographic/clinical data

Study ID# ----------

DEMOGRAPHIC INFORMATION FROM CHART REVEIW

Socio-demographic characteristics

1. Age
---
2. Gender
   a. Male
   b. Female
   c. Other

Please specify ----------
3. Cultural origin

Treatment information

4. Primary psychiatric diagnosis
---
5. Other mental health diagnoses

---
6. Medical diagnoses

---
7. History of substance use
   i. Yes
   ii. No

8. Duration of primary psychiatric illness
---
9. Number of psychiatric hospitalizations
---
10. Psychiatric medications prescribed

---
11. Other medications prescribed

QUESTIONNAIRE FOR DEMOGRAPHIC INFORMATION

Study ID ----------

1. Education/highest grade completed

---

2. Source of Income

---

3. Who is available to support you after discharge?

---

4. Do you have problems taking medications at home?
   i. Yes
   ii. No
5. Do you own/possess a mobile phone?
   i. Yes
   ii. No

If Yes, do you use the mobile phone solely by yourself or you share use of your mobile phone with someone?

   i. Sole usage
   ii. Shared usage

6. Are you currently receiving reminders through mobile phone contacts to take your medications?
   i. Yes
   ii. No

If yes, through which means?

   i. Text messages
   ii. Phone calls
   iii. Text messages plus phone calls

Do you like receiving mobile phone contacts as reminders through your current method?

   i. Yes
   ii. No

7. Would you like to be contacted by a service provider through mobile phone to provide you with support after discharge?

   i. Yes
   ii. No

Appendix E.

Medication adherence assessment tool

Study ID# ----------

MORISKY, GREEN AND LEVINE MEDICATION ADHERENCE SCALE – MAQ

(Morisky, Green and Levene 1986)

Table 1.

MAQ

Question	No = 0	Yes= 1
1. Do you ever forget to take your medicine?		
2. Are you careless at times about taking your medicine?		
3. When you feel better do you sometimes stop taking your medicine?		
4. Sometimes if you feel worse when you take the medicine, do you stop taking it?		

Appendix F.

Interview guide

Study ID ----------

Interview Questions

Many patients have trouble taking their medications at home. I want to talk to you about how we might be able to help you remember to take your medications at home. Remember, there are three mobile phone contacts delivery methods;

i. **TEXT MESSAGES**
ii. **PHONE CALLS**
iii. **TEXT MESSAGES PLUS PHONE CALLS.**

Please choose the options that best answers the question in your view by circling them. You can choose more than one answer and write in your views if they are not reflected in the answer choices below each question.

1. What might be the benefits of receiving support through a mobile phone contact to remind you to take your medication? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'I'.***
    a. I will be able to remember to take my medications.
    b. I will be able to receive advice if I cannot remember details about my medications.
    c. I will be able to ask questions about my treatment.
    d. I will be able stay on my medications and not just stop taking them.
    e. I will know someone cares about me.
    f. I will be more responsible since I will constantly be reminded to take my medications.
    g. I will not have to worry about tracking the time to take my medications.
    h. It will save me time.

i. Other

please specify

---

2. What might be the problems with receiving support through a mobile phone contact to remind you to take your medication? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'f'.***
   a. It will distract me.
   b. I will feel controlled.
   c. I will not have any privacy.
   d. It will cause people around me to know I am taking medications.
   e. I will be dependent on reminders and not remember to take my medications if my phone turns off, gets destroyed or if I do not get the reminders.
   f. Other

      please specify

      ---

3. If a health care provider contacts you by mobile phone, which mobile phone contact method would you ***prefer*** to be used?

   ---

4. Why did you choose this mobile phone contact method? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'I'.***
   a. It is convenient
   b. It is simple to use.
   c. It is less distractive.
   d. It will require less of my time.
   e. It will provide me with more privacy.
   f. I can receive advice if I am confused about my medications.

g. I will get someone to talk to about my problems.
h. I will get someone to talk to about my symptoms.
i. Other

   Please specify

   ---

5. Which method would be your ***second choice***?

   ---

6. Why would this be your second choice? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'I'.***
   a. It is convenient
   b. It is simple to use.
   c. It is less distractive.
   d. It will require less of my time.
   e. It will provide me with more privacy
   f. I can receive advice if I am confused about my medications.
   g. I will get someone to talk to about my problems.
   h. I will get someone to talk to about my symptoms.
   i. Other

      Please specify

      ---

7. Which method would be your ***last choice***?

   ---

8. Why would this be your last choice? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'I'.***
   a. It is less convenient

b. It is not simple to use.
c. It is more distractive.
d. It will require too much of my time.
e. It will provide me with less privacy.
f. I will not be able to receive advice if I am confused about my medications.
g. I will not get someone to talk to about my problems.
h. I will not get someone to talk to about my symptoms.
i. Other

   Please specify

   ---

9. What ***problems*** do you think might arise if you receive support through your mobile phone to remind you to take your medication? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'k'.***
   a. I cannot read and write in English.
   b. I may not be able to understand the message I receive.
   c. I may not receive the message/call due to network issues.
   d. I may not be able to retrieve message/text.
   e. I may not be able to read text message if the letter characters are too small.
   f. I may lack the skills of using mobile phone for the purpose of receiving reminders.
   g. I may feel discomfort with typing response.
   h. I will not be able to pay for the extra charge from receiving mobile phone contact.
   i. My mobile phone battery may run down.
   j. It will distract me.
   k. Other

      Please specify

      ---

10. How can these problems be avoided or overcome? ***Please circle the answer that best reflect your views and specify any that is not listed below in option 'M'.***
    a. I want to receive text and phone calls in the language I understand.
    b. I would prefer the message be sent to my caregiver since I cannot read and write.
    c. The messages should be clear, simple and understandable.
    d. Use soft key options for responding to mobile phone contacts.
    e. Use on-screen number options for responding to mobile phone contacts.
    f. I would like to receive a demonstration on how to retrieve the text message/calls.
    g. I will make sure I pay my bills to get network all the time.
    h. The letters of the text message should be in big sizes for me to read easily.
    i. I would prefer to receive phone calls options since I may feel discomfort with typing.
    j. I would prefer to receive prepaid mobile phone contact.
    k. I want to receive the mobile phone contact based on my own preferred times.
    l. I will ensure I charge my mobile phone at all times.
    m. Other

       Please specify

       ---

11. What other suggestions or recommendations do you want to make regarding this topic?

    Please specify
