

BRIEF REPORT

Medication adherence among homeless patients: A pilot study of cell phone effectiveness

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Abstract

Purpose: We examined the feasibility of using cell phones to monitor medication adherence among homeless participants and collected data for research purposes.

Data sources: Ten homeless individuals with a co-occurring substance use and psychiatric disorders who were receiving psychopharmacologic treatment participated in the study. All psychopharmacologic treatment was provided by a psychiatric mental health nurse practitioner. Cell phones were provided to participants with unlimited phone service for 45 days. An automated telephone system was programmed to call participants daily for 30 days. All participant responses were reported to a computer and reviewed by study staff on a daily basis.

Conclusions: The automated calls reached study participants 93% of days and, when reached, participants reported 100% adherence with the prescribed medication regimen. Exit interviews indicated strong support for the usefulness of the phone and the value of the call and survey as reminders to take their medication. No patients dropped out of this study.

Implications for practice: This pilot study establishes the feasibility of using cell phones to monitor and manage medication regimens for hard-to-reach populations, such as the homeless with co-occurring disorders. It also establishes that this technology would work for research data collection.

Medication adherence is as critical to patients with chronic psychiatric disorders as it is to patients with cardiac disease, diabetes, or hypertension. Failure to take medications as prescribed contributes to recidivism and serious medical and social consequences. Without adequate medication, patients with psychiatric disorders often resort to alcohol or other drugs to self-medicate their symptoms. It is estimated that 23% of patients with serious mental illness have co-occurring substance use disorders (Substance Abuse and Mental Health Services Administration, 2004). Therefore, medication adherence is important to all nurse practitioners (NPs).

This study examines the utility of cell phones in collecting self-reported data for monitoring medication adherence among psychiatrically ill homeless patients. Numerous studies have reported that psychiatric patients

have poor medication adherence (Bergen, Hunt, Armitage, & Bashir, 1998; Drake, Osher, & Wallach, 1989; Kampman & Lehtinen, 1999; Kashner et al., 1991; Ncama et al., 2008; Olfson et al., 2000; Owen, Fischer, Booth, & Cuffel, 1996; Weiss et al., 1998). Fewer than 55% of patients adhere to atypical antipsychotic medications, and less than 59% consistently take their mood stabilizers (Colom, Vieta, Tacchi, Sánchez-Moreno, & Scott, 2005; Gilmer et al., 2004; Keck, McElroy, Strakowski, Bourne, & West, 1997). The situation is worse among homeless psychiatrically ill patients, where homelessness further complicates the usual causes of nonadherence (Opler et al., 2001; Wilk et al., 2006). For example, within 2 days of their clinic visits, data indicate that 22% of homeless patients failed to take their medication (Royal et al., 2009).

Investigators have defined medication adherence in different ways. Some authors define adherence based on a specific period of time (e.g., 7 days) when the medication is not used. Others define adherence as having a supply of medication available. For purposes of this study, we define medication adherence as the daily probability of medication use during the follow-up period. This definition corresponds to the recommendation made by Velligan et al. (2006) based on an extensive review of the literature.

This study relied on self-reported medication adherence as the method. There are different methods for assessing medication adherence, including pill counts, serum blood levels, report of significant others, clinician observations, chart reviews, electronic refills, urine tests, and electronic monitoring. Results obtained depend in part on the methods used (Velligan et al., 2006). For example, in one study, patients' self-reported adherence was 15% higher than adherence measured through pill counts (Velligan, Lam, Ereshefsky, & Miller, 2003). Pill counts can be suspect because they relate availability of medication to adherence.

While self-report is an imperfect measure of adherence, it remains the most common method for assessment of medication adherence, and is used in more than 70% of all studies of medication adherence (Velligan et al., 2009). Self-report remains popular because of its ease of use, but it may be the best method when used in a computerized survey. Evidence from multiple studies show that patients are more likely to be truthful in computerized telephone interviews than in face-to-face interviews with clinicians (de Leeuw, 1993; Newman et al., 2002; Perkins & Sanson-Fisher, 1998; Siemiatycki, 1979; Williams et al., 2000). There are many explanations for why patients are more truthful on the phone or to a computer. One explanation is that patients feel uncomfortable talking about deviant behavior (e.g., drug use, suicidal thoughts, and sexual dysfunctions) to another human being. It is also possible that repeated computerized telephone interviews reduce the recall period of data collection and thus make it easier for the patient to be more accurate. Finally, repeated inquiry may make it difficult for patients to maintain the illusion of adherence. Regardless, because patients are more likely to be truthful to computerized telephone interviews, we conclude these tools are ideal for collection of self-reported medication adherence data.

In one study, Alemi et al. (1994) used telephones to monitor patients discharged from substance abuse treatment programs. Since then, telephone monitoring has been used in many different settings (Des Jarlais et al., 1999; Piette, Weinberger, & McPhee, 2000; Vincent, Reinharz, Deaudelin, Garceau, & Talbot, 2006). Moni-

toring medication adherence among homeless psychiatrically ill patients is novel. In this study, we report our successful experience.

Methods

Design

This pilot study explored the feasibility of daily monitoring medication adherence among homeless psychiatrically ill patients through program-provided cell phones. The study design and procedures were approved by the University of Maryland Institutional Review Board. Patients who met study eligibility requirements were provided with a cell phone and free service for personal local and long distance phone calls for 45 days. A total of 10 participants were recruited and followed for 30 days, during which participants received daily phone calls from the system. No control group was included in this quasi-experimental, prospective pilot study.

Sample

Participants were recruited from Health Care for the Homeless in Baltimore City. Participants were the patients of a psychiatric mental health NP (PMHNP) who prescribed and managed the psychotropic medications.

To be eligible, participants were required to meet the following criteria:

- Age 21–64;
- diagnosis of substance use disorder (DSM-IV-TR Checklist);
- co-morbid axis I DSM-IV-TR diagnosis (Schizophrenia, Bipolar disorder, Major depression, Anxiety disorder);
- English speaking;
- live within Baltimore City limits;
- homeless or at risk of being homeless, based on clinical interview data;
- prescribed psychotropic medication(s);
- willing to receive telephone contact during study call hours;
- demonstrated ability to press telephone buttons with dexterity.

The following participants were excluded from the study:

- Recent history of violence;
- unwilling to give contact information for relative or friend;
- unable to follow directions to press phone buttons in response to questions.

Potential participants who expressed an interest in the study were referred by their PMHNP. Study staff invited patients who met eligibility criteria to participate (100% of referred patients met eligibility criteria). Potential participants signed consents to participate in the study, were interviewed using study instruments, and were trained in the use of the phones. All potential participants consented to participate in the study and completed both baseline and exit interviews.

Instrumentation

Voxeo's Interactive Voice Response system was used to program the survey that would be distributed to the participants each day. The expert consensus guideline series for adherence problems among psychiatrically ill patients presented a number of recommendations regarding what to ask and how often to ask about adherence (Velligan et al., 2009). The panel argued that it is best to ask about medication intake directly rather than ask about attitudes toward medication. They recommended nine questions to assess attitudes of the patient toward the medication, six questions to assess symptom severity, five questions about demographics, nine questions about environmental factors, five questions on cognitive impairment, two questions on medication-related side effects, seven questions on relationship factors, and four questions about assessing service delivery-related barriers. While these domains of inquiry are all appropriate, daily telephone interviews need to be short to improve a likelihood of response. We developed a two-item survey that asked about self-reported intake of medication and side effects:

- Since your last call, did you take your medication as prescribed? If you have taken your medication as prescribed, press 1; if you have changed the amount or timing of any of your medications press 9.
- Are you having any difficulty or side effects with your medications? If yes press 1, if no press 9.

Our survey is similar to the Brief Adherence Rating Scale (BARS), a reliable and valid instrument for assessment of medication adherence (Byerly, Nakonezny, & Rush, 2008). The BARS verifies the number of pills that the patient should take and the number of days over the last month that the medication was not taken or was taken partially. Clinicians visually rate their perceptions of patients' medication adherence. We adapted this instrument for daily use.

In addition to the above two questions, the system verified that the appropriate person was reached. The system warned the participants not to assume that information

provided would be reviewed by their PMHNP immediately and in case of emergency to call their PMHNP directly. Additionally, the system provided appropriate salutations and comments at start and exit (e.g., "We are glad to hear that you are not having any side effects").

The Mini-International Neuropsychiatric Interview (MINI), a short valid and reliable structured diagnostic interview, was used to confirm *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR) diagnoses (American Psychiatric Association, 2000). The DSM-IV-TR is the official psychiatric diagnosis coding system in the United States. DSM-IV-TR criteria support multiaxial evaluations: AXIS I consists of psychiatric clinical disorders; AXIS II consists of personality disorders and mental retardation; AXIS III lists physical disorders or medical conditions; AXIS IV lists psychosocial and environmental stressors; and AXIS V provides an assessment of overall level of functioning. The MINI is a structured research tool that was developed jointly by psychiatrists and clinicians in the United States and Europe, for DSM-IV-TR and ICD-10 psychiatric disorders (Sheehan et al., 1998). Structured psychiatric research tools are designed to improve interrater reliability for diagnostic purposes.

Depression symptoms were measured by the Center for Epidemiologic Studies Depression Scale (CES-D), a widely used scale to determine the severity of depression symptomatology. Reliability and validity is widely established in the literature (Wong, 2000).

Substance use was measured by the Addiction Severity Index-Lite (ASI-Lite), a research tool used to measure the severity of alcohol and drug use and its consequences. Reliability and validity is well established in the research literature (McLellan, Cacciola, Alterman, Rikoon, & Carise, 2006).

At the exit interview, participants were asked the following questions: "What were your general impressions of the study? What did you like or not like? How did the phones make a difference in your day-to-day life?"

Data collection

Participants were administered the MINI, the CES-D, and the ASI-Lite before the phone protocol was initiated to corroborate the PMHNPs clinical diagnoses with valid and reliable research instruments.

The electronic survey was administered each day via the cell phone. Figure 1 provides the details of the call flow, which included verification that the participant was available to respond to the questions, assessment of whether the medication was taken as prescribed (if not, why not?), assessment of side effects, and transfer of call in case of side effects.

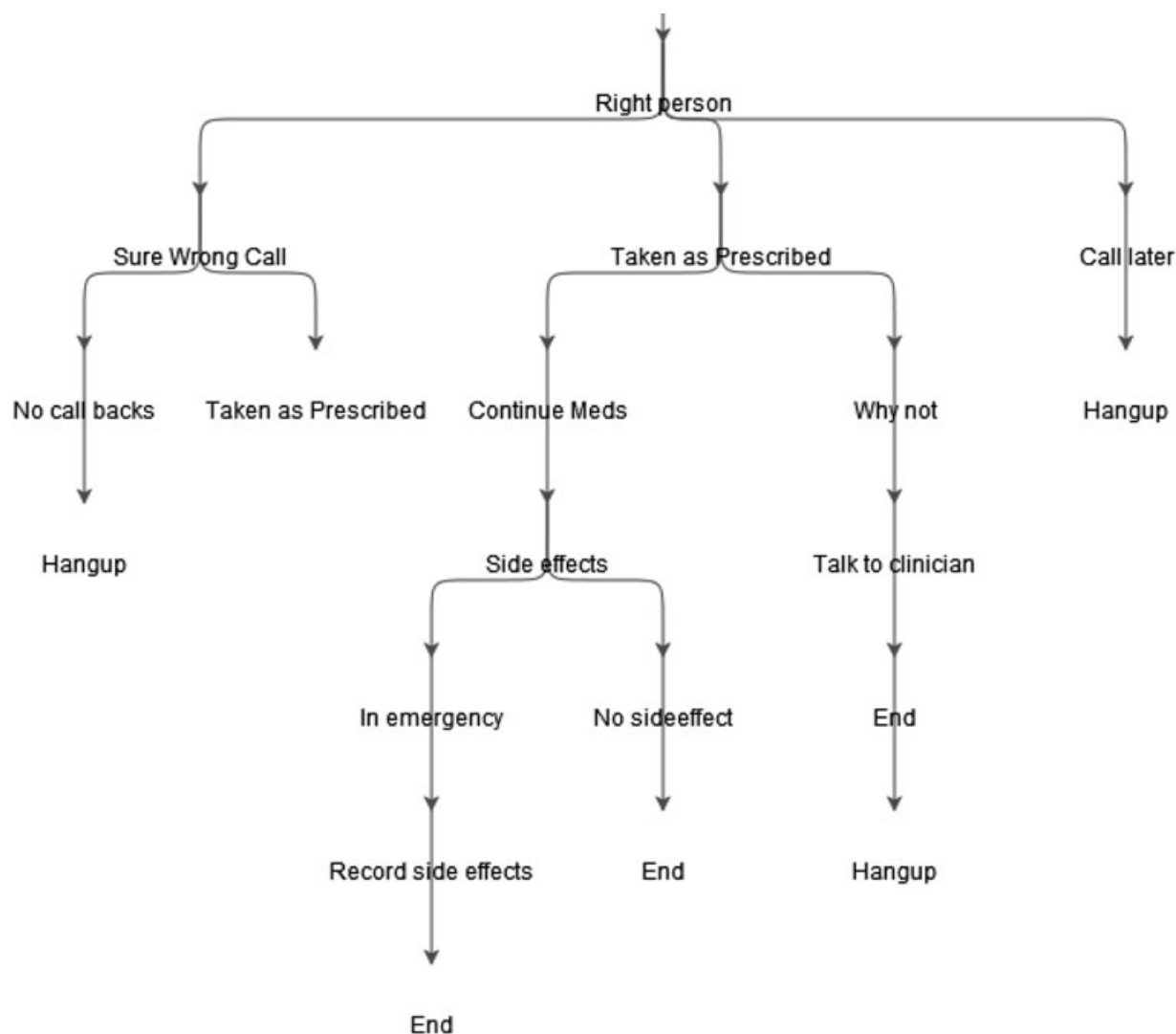


Figure 1 Flow of the survey.

The survey was performed using Voxeo's Interactive Voice Response systems. Questions were asked in English and were recorded using a female voice. The system can be reviewed by calling 202-684-2293 or using Skype to connect to +99000936 9992001912. We will maintain the system for at least 1 year after publication of this article so that readers can examine the system. This system is in the public domain, and use of it in clinical practice and research studies is encouraged.

Data analysis

Descriptive analyses of the survey data included frequencies and percentages. Data over time were analyzed using probability charts, reporting the percent of patients

who had responded daily. In these charts, the control limits for variations in percent of patients reached were calculated as:

$$\text{Control Limit} = p \pm 3\sqrt{p(1-p)/n}.$$

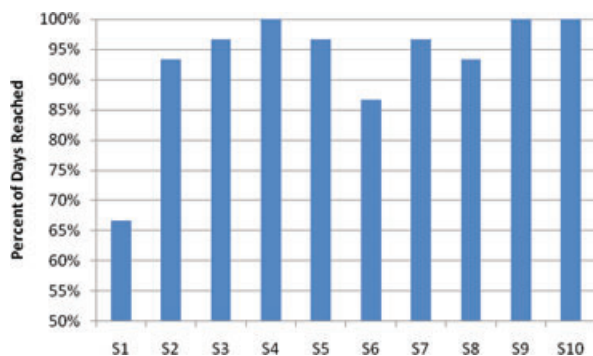
where p is the average daily probability of being reached and n is the number of patients monitored.

Results

There were no drop outs among the recruited participants in this study. Likewise, the phones were not lost, stolen, or bartered. At the end of the study, participants were allowed to keep the phones but service was discontinued. Table 1 shows the characteristics of the study

Table 1 Characteristics of 10 participants

Characteristic of participant	Mean/percent	Standard deviation
Percent male	0.80	0.16
Percent black	0.80	0.16
Percent white	0.20	0.16
Average age	46.90	8.80
Modified MINI	12.60	3.17
CES-D	29.70	10.95
Lifetime years of cocaine use	10.95	9.45
Lifetime years of heroin use	6.20	7.90
Lifetime years of alcohol use at more than three times/week	23.60	9.43

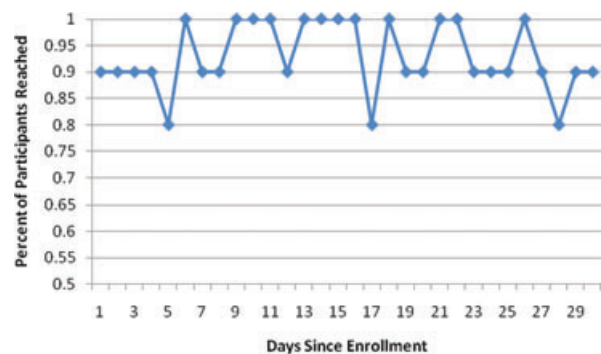
**Figure 2** Percentages of participants' daily response. S = subject number.

participants. Most participants were African-American men with a mean age of 47. Because of the eligibility criteria, all participants who participated had mental health problems; this is also reflected in average MINI scores in excess of 12 (mean [M] = 12.60, standard deviation [SD] = 3.17). Participants' depression scores were also high (M = 29.70, SD = 10.95). All participants enrolled were required to have a history of co-morbid substance use problems. This was validated via the ASI-Lite, demonstrating the high number of average years of addiction to heroin (more than 6 years), cocaine (more than 10 years), and alcohol (more than 23 years).

The system called the participants daily over a 1-month period. On any day, if the participant could not receive the call, the system would attempt to reach the client with one additional phone call.

Figure 2 shows the percent of participants who responded to the telephone surveys. On an average day, 93% of participants were reached (upper limit = 100%, lower limit = 69%).

Participants differed in the frequency with which they could be reached. Participant 1 had numerous difficulties with the initial use of the system and was not able to respond before the call went to voice mail. However, after repeated instruction and support, she was able to partici-

**Figure 3** Percent of participants reached within 30 days.

pate fully in the study. Participant 6 responded to calls on 87% of days. All remaining participants were reached at least 90% of days; three participants were reached every day (Figure 3).

When participants were reached, they reported that they had taken their medication as prescribed 100% of the time. On one occasion, a client recorded a symptom, which upon further investigation was discovered not to be related to the psychopharmacologic medication.

The exit interviews, which occurred after the 30-day period of the study, supported the possibility that computer calls might have reminded patients to take their medication. The following themes were reflected in the responses to the questions "What were your general impressions of the study?" and "What did you like or not like?" Phone calls helped to structure the day and to remember to take the medication:

It would wake me up and if I overslept it let me know... [to take] my medicine. So I liked... the phone... by it being convenient. [Staff: so you liked the fact that it would wake you up?] Yeah.

[W]hat I liked about the study is how it put you on a general schedule and helped... in your medication taking... [I]t gave me a feeling that someone actually cared about what I'm doing, and that I'm getting through what I'm getting through. There's not really much I didn't like about the study.

Exit interviews also showed that the availability of the phones had broader ramifications for the participants. Many reported that the phones helped to improve communications with their family members and their clinicians. The following is a typical response to the exit question "How did the phones make a difference in your day-to-day life?"

... I haven't talked to my daughters in five years and with the use of the phone and the computer I now have contact with my daughters, and my son. I have three grandkids, too! (patient laughs)... [S]o it helped me out a lot, it really

did. And I've been on my meds every day. I feel better, too, when I take them. I haven't had as many "blues-y" days.

Discussion

This pilot shows that it is possible to reach homeless psychiatrically ill clients on cell phones over an extended period. The majority of participants were available every day to respond to the system. One of the participants had difficulty using the system because she was not able to press the keys on the telephone keypad with sufficient force to respond to the questions. In future implementation, we encourage systems that would allow participants to respond by either pressing a key or by speaking into the phone. In addition, we had restricted calls to no more than two calls per day to the same client. Often the system had to leave a message for the client. In the future, it would be helpful if the system would allow participants to call in and report their medication intake, if they were not previously reached.

Overall, participants were reached on 93% of days. This was a very high level of participation for homeless patients with co-occurring psychiatric and substance use disorders. Even more surprising was the finding that all of the participants reported that they had taken their medication as prescribed. Our finding exceeded the rates of adherence reported in the literature. It is possible, though unlikely, that the participants reported they were adherent even though they had not taken their medication. However, numerous studies reviewed earlier have shown that patients are more likely to report deviant behavior to a computerized telephone interview than to their clinician. Another possible explanation is that the daily calls are therapeutic and do improve adherence. Participants reported that they felt cared for and thus made additional efforts to maintain their medication regimen.

This pilot study has established that homeless patients can be easily reached through cell phone technology. Additional research is needed to explain the high medication adherence rates observed in this study. Medication adherence is only one clinical objective. Using this technology, over an extended time would determine if it also leads to improved health outcomes. All NPs struggle to enhance medication compliance, especially in chronically ill populations. This pilot study has the potential for broad-based application. Future research is needed to explore how technology can be used to improve all health and mental outcomes for psychiatrically ill homeless patients.

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