

The Use of Coaching Sessions and a Mobile Reminder Application to Enhance Medication Adherence in Adults at an Outpatient Psychiatric Clinic

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Abstract

The primary aim of this Clinical Scholarly Project was to assess the effectiveness of coaching sessions and a mobile reminder application to enhance medication adherence in adults at an outpatient psychiatric clinic. Several studies have suggested that patients with chronic health conditions adhere to 50–60% of the prescribed medication regimen. However, up to 80% of patients with psychiatric disorders fail to comply with their medication regimens. This translates into annual costs of \$100–\$300 billion per year for individual patients and healthcare systems, which significantly burdens the current healthcare system. A pre- and post-quasi-experimental time series design was implemented for four months. The group of 15 participants was monitored for the first two months, using traditional care (e.g., presenting at the outpatient psychiatric clinic for evaluation, diagnosing, and medications management). After two months, the same group received the interventions: coaching sessions and a mobile reminder application. To determine whether the aims of the project were met, an independent paired t-test was performed to compare pre- and post-intervention data.

Conclusion: A paired-samples t-test confirmed that the medication adherence rates differed between the two post-intervention months (Times 3 and 4), $t(9) = 6.00, p < .01$.

Introduction

The purpose of this research was to examine the effects of the use of coaching sessions and a mobile reminder application to enhance medication adherence in adults at an outpatient psychiatric clinic at Exodus Recovery, an outpatient adult mental health clinic in downtown Los Angeles. Patients of this clinic frequently do not adhere to their prescribed medication regimen, which can lead to significant health consequences. This pattern is supported by studies that suggest approximately 125,000 deaths per year in the US are linked to medication non-adherence (Osterberg & Blaschke, 2005). These statistics indicate that medication non-adherence has become a public health hazard.

Several studies (Chapman & Horne, 2013; Osterberg & Blaschke, 2005) have suggested that patients with chronic health conditions adhere to 50–60% of the prescribed medication regimen. However, up to 80% of patients with psychiatric disorders fail to comply with their medication regimen (Osterberg & Blaschke, 2005). Osterberg & Blaschke note that this translates into annual costs of \$100–\$300 billion per year for individual patients and healthcare systems, which significantly burdens the current healthcare system. This figure includes costs for emergency-room visits, hospital readmissions, and reordering medications that were never filled or taken. Sometimes, providers are led to believe that a medication change is in order when in reality the patient never took the previous medication or even filled the prescription.

With approximately 3 billion prescriptions written per year in the US alone, the cost of medication has been increasing. It is further estimated that only 50–60% of such medication are consumed as prescribed (Varshney, 2013).

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Reasons for not taking medication as prescribed range from forgetfulness (30%), other priorities (16%), and lack of information (9%). Such non-adherence leads to \$90 billion in additional hospitalizations and procedures every year in the US alone. The current national reformation of the US healthcare system is forcing the healthcare administration to consider innovative methods to address escalating costs while simultaneously delivering competent healthcare. These innovative methods might include interventions to improve patient adherence to medication (Pogoreic, 2012).

A study by DiMatteo, Giordani, Lepper, and Croghan (2002) suggests that adherence to taking medication as prescribed by the provider leads to improved outcomes and reduced healthcare costs. A meta-analysis of 63 studies involving 19,000 patients found that medication adherence resulted in better treatment outcomes by 26% (DiMatteo et al., 2002). Foreman et al. (2012) found that adherence programs resulted in a reduction in hospitalizations and outpatient visits. Approximately 33–69% of medication-related hospital admissions in the US are due to poor adherence or non-adherence (Foreman et al., 2012). The World Health Organization (WHO) (2003) predicted that this problem would only worsen as the number of chronic diseases increases worldwide.

Medication compliance has been defined as the extent to which an individual's behavior coincides with medical advice (DiMatteo et al., 2002). These researchers note that the term "medication compliance" implies a paternalistic relationship between the provider and the patient. It denotes a passive role for the patient and stigmatizes the patient as someone who engages in deviant behavior.

The definition of medication adherence seems to vary. Some studies (Patel & David, 2007; Vervloet et al., 2012) have defined medication adherence as the percentage of "pill-taking behavior", or "pills not taken as prescribed" or "not taken at all". However, medication adherence is also defined as the extent to which the patient acts in accordance with a dosing regimen (Zeber et al., 2013).

The topic of medication non-adherence is important in most aspects of healthcare conversations. In psychiatry, patients often require poly-pharmacy. An example is the patient suffering bipolar disorder, who may need a mood stabilizer, an antidepressant, and an antipsychotic. This regime is in contrast to that used for a patient who is suffering from a urinary tract infection and is treated with a seven-day course of an antibiotic. Thus, the psychiatric provider often faces more complex medication-compliance situations (NCPIE, 2007).

Problem

Significance of the problem within the population

The implementation of the coaching sessions and a mobile reminder application to enhance medication adherence at Exodus Recovery, the clinic where the study was conducted, presented challenges. Exodus Recovery is located in an underserved area of downtown Los Angeles. According to the *Los Angeles Almanac*, approximately 24 % of the Latino population and 49.3% of the African American population is homeless; 20% of the population is mentally ill; and 33–66% of the population has substance abuse problems (September 14, 2013, <http://www.laalmanac.com/social/so14.htm>).

Exodus Recovery serves an average of 1,120 patients each month, with an average of 280 per week. Current data indicates that out of 1,120 patients seen, 62% have missed their appointments and are not refilling or taking their medication as prescribed. This rate of non-adherence results in increased return clinic appointments, an increased burden on case managers, and an increase in the number of psychiatric hospitalizations.

By using a coaching sessions with a mobile reminder application the percentage of non-adherent patients was expected to decrease, as numerous studies have suggested (Velthoven, Brusamento, Majeed, & Car, 2012). Further, support for this study found that other randomized control trials that used mobile phone messages to remind patients to take their anti-retroviral medication resulted in an increase adherence rate of 57% of the intervention group vs. 48% of the control group (Velthoven et al., 2012).

Purpose

The primary aim of this evidenced-based project was to assess the effectiveness of using a mobile application reminder along with coaching sessions to enhance medication adherence in adults at an outpatient psychiatric clinic.

Research Question

The research question was: Does the use of coaching sessions and a mobile reminder application enhance medication adherence in adults at an outpatient psychiatric clinic as compared to usual care?

Literature Review

A comprehensive, systematic review of English language publications from January 2005 through September 2015 was conducted using the following databases: PUBMED/MEDLINE, PsycINFO, and the Cochrane database. Eleven studies that met the inclusion criteria for adherence-enhancement interventions, and that demonstrated significant positive effects, mixed results, or no improvement on adherence, were selected.

Eight randomized control trials indicated that mobile messaging, electronic reminders, or text messaging could improve medication adherence. Two systematic reviews of literature studies also indicated that factors associated with adherence were multi-factorial and provided mixed results. The studies indicated that adherence improved with patient-targeted changes, noting that mobile technology was worth exploring and finding an association between the use of text messaging and an increase in adherence rates in anti-retroviral therapy (ART). One pilot study showed that using the mobile phone was an effective way of communicating with homeless people and was considered to have great potential in healthcare.

Improving medication adherence is a continuous process. A poor match between patient readiness and any interventions can compromise medication adherence. A WHO (2003) study reported that electronic reminders play a supportive role in enhancing medication adherence and WHO has prioritized the use of new technologies to assist health delivery in underserved areas.

A systematic review of mobile phone messaging to improve adherence noted that mobile phone applications are worth exploring (Wise & Operario, 2008). Mbuagbaw et al. (2011) found that mobile phone technology could help address medication non-adherence and open communication channels between patients and providers. Electronic reminders, which work by prompting the patient to self-administer their medication, come in many forms, including beepers, pagers, mobile phones, and pill box alarms.

A randomized clinical trial conducted by Wolever et al. (2010) evaluated the effectiveness of integrated health coaching on psychosocial factors, behavior change, and glycemic control. Fifty-six patients with type-2 diabetes were randomly assigned to a six-month coaching program. Statistical analysis was performed using the software package SPSS version 17 and independent sample t-tests. Medication adherence improved in the coaching group ($Z = -2.862$; $p = .004$). The study also indicated that single-based interventions were sufficient.

Cocosila, Archer, Haynes, and Yuang (2009) conducted a randomized control trial of 102 subjects. Subjects were randomized using a JavaScript program. A multivariate analysis of variance (MANOVA) omnibus test, an analysis of variance (ANOVA) analysis, and a two-tailed t-test revealed that adherence was increased (246% for the intervention group vs. 131% for the control group) by the use of wireless text messaging. The study revealed a significant correlation (coefficient = -0.352, sig. +0.01) between the average number of text messaging acknowledgements sent by the intervention group participants and the number of pills they reported missed during the last week of the trial.

Another randomized control trial was conducted by Shapiro et al. (2012) to evaluate whether daily text messaging was effective in enhancing weight-loss interventions in a randomly selected group of 117 obese subjects. Group differences in weight loss were tested using mixed models. An "intent to treat" (ITT) approach was utilized. Missing data were first input via multivariate imputation by chain equations (MICE). The results indicated that text messaging had a moderately strong effect (69% I vs. 60% C) on weight-loss interventions and could be a useful adjunct to weight-loss treatments.

A randomized controlled trial by Pop-Eleches et al. (2011) tested the efficacy of short message service (SMS) reminders to improve adherence to ART in 431 adult patients who had initiated ART within the previous three months. These patients were enrolled and randomly assigned to a control group or one of the four intervention groups.

Participants in each of the intervention groups received daily and/or weekly reminders. Adherence was measured using an electronic medication-monitoring system. Differences between the intervention groups and the control group were compared using Pearson's chi-squared test. Two level analyses were conducted: a summary analysis and a subgroup analysis. All analyses were conducted using the statistical software package STATA (version 10.0). The ITT analysis results showed that 53% of the participants who received weekly SMS reminders achieved adherence of at least 90% during the 48 weeks of the study, compared with 40% of the participants in the control group ($P=0.03$). Participants who received weekly reminders were also significantly less likely to experience treatment interruptions exceeding 48 hours during the 48-week follow-up period than participants in the control group (81 vs. 90%, $P = 0.03$).

The effectiveness of mobile technology-based behavior change or disease-management interventions for healthcare consumers was evaluated via a systematic review conducted by Free et al. (2013). Search strategies identified 26,211 electronic records, which were screened for eligibility; 334 potentially eligible reports were obtained. Seventy-five trials were identified. Fifty-nine trials investigated the use of mobile technology and determined that text-messaging interventions increased adherence to ART.

Sheppard et al. (2013) conducted a randomized control of women's non-adherence to mammograms, to study the effectiveness of brief telephone-coaching adherence interventions. Fifty-four women participated: 17 in the intervention group and 31 in the control group. A mixed-method descriptive design was used, interventionists were blinded, and descriptive statistics (including means and standard deviations) were used. After the intervention, most of the women who had missed appointments (94.5%) rescheduled them. More women in the intervention group kept their appointments (54%) than those in the usual care group (46%).

Burda, Haack, Duarte, and Alemi (2012) conducted a study on the effectiveness of using mobile phones to communicate with homeless people. Ten homeless individuals were selected and provided with mobile phones. The phones were programmed into an automated telephone system for 30 days. Participant responses were reported to a computer. Participants were administered MINI, CES-D and ASI-Lite before the phone protocol was initiated, electronic surveys were administered daily, and Voxio's interactive response system was used. Data was analyzed using probability charts, reporting the percentage of patients who responded. The intervention reached 90% of the participants, confirming that mobile phones were a valuable and effective method of reaching homeless patients.

Vervloet et al. (2012) conducted a randomized controlled trial to assess the effectiveness of interventions that used electronic reminders to improve adherence to chronic medication. Data was collected for 104 type-2 diabetes patients with suboptimal adherence to oral anti-diabetics. Fifty-six patients were randomized to receive SMS reminders to take their medication, while 48 patients received no reminders. The results indicated that patients who received SMS reminders took significantly more doses within a predefined time window (one hour) than patients who received no reminders: 50% vs. 39% ($p = 0.03$). Reminded patients tended to miss doses less frequently than patients who were not reminded (15% vs. 19%, $p = 0.065$).

Velligan et al. (2013) conducted a randomized controlled study that compared the effectiveness of in-person and electronic reminders for improving adherence to oral medication in patients with schizophrenia. Repeated measured ANOVA for mixed models indicated that adherence to medication was significantly better in both active conditions than in the "treatment as usual" (TAU) group (both $p < 0.0001$). In active treatments, adherence ranged from 90% to 92%, compared to 73% in treatments based on electronic monitoring.

Interian, Fernandez-Lewis, Gara, and Escobar (2013) used a randomized controlled trial to examine the efficacy of motivational interviewing for improving antidepressant adherence among Latinos with a depressive disorder. Participants were randomized to receive usual care (UC) or Motivational Enhancement Therapy for Antidepressants (META). After adjusting for covariates, the META participants showed significantly higher antidepressant adherence than the UC participants (72% vs. 42%, respectively, $p < 0.01$).

Theoretical Framework

The Health Belief Model (HBM) was used as the theoretical framework for this study's implementation of the mobile reminder application project at an adult outpatient psychiatric clinic. The HBM was developed in the early 1950s by a group of psychologists at the US Public Health Service, in an attempt to understand the failure of the public to accept preventive measures and/or early tests for detection of asymptomatic disease (Janz & Becker, 1984). The HBM is a value-expectancy theory that considers the value an individual places on maintaining their well-being or seeking out treatment. HBM emphasizes that an individual's beliefs are a predictor of the likelihood that they will take action. The notion of value-expectancy is derived from cognitive theorists such as Kurt Lewin (Gipson & King, 2012).

The HBM theorizes that health-related actions depend on the following factors (Janz & Becker, 1984):

1. Perceived susceptibility: There must be sufficient motivation or concern about health to make the health issues relevant. For example, a patient diagnosed with depression must believe in the diagnosis, their susceptibility to the illness, and that the illness may be contracted.
2. Perceived severity: This is the belief that one is vulnerable to the sequelae of the condition suffered. There must be a perceived threat. Patients must feel that if their condition is left untreated, they risk disability, pain, social consequences, and/or death.
3. Perceived benefits: This is the belief that following a particular recommendation or action plan would be advantageous, and that the barriers and costs can be overcome. In the proposed project coaching sessions, pharmaco-education and use of the mobile reminder application are recommended actions that may reduce the disease threat.
4. Perceived barriers: The patient must weigh the proposed action's effectiveness against the perception that the medication and/or interventions may be dangerous (e.g., side effects), unpleasant, painful and/or time consuming.

Study Design and Methodology

Project Design

A pre- and post-quasi-experimental time series design was implemented for four months. The group of 15 participants was monitored for the first two months using traditional care (e.g., presenting at the outpatient psychiatric clinic for evaluation, diagnosing, and medications management). After two months, the same group received the intervention's coaching sessions and a mobile reminder application. Adherence percentage rates were collected at the end of the first, second, third, and fourth month. To determine whether the aims of the project were met, a paired samples t-test was performed to compare pre and post data.

Setting and Sample

Study participants were selected from an adult outpatient psychiatric medication clinic located in East Los Angeles, California. Inclusion criteria were as follows: both genders, all ethnicities, aged 18 or older, Axis I Diagnosis of Depression, and patients who had missed two consecutive medication follow-up appointments, possessed an iPhone or Android phone, lived in a home/apartment, and who were full-time residents of Los Angeles, California. Exclusion criteria were as follows: aged less than 18 years, Dual Diagnosis, Axis I other than that stated in the inclusion criteria, and patients who had no cell phone and were homeless.

Procedures

Fifteen adults aged 18–65 were randomly selected from the Affinity Information System (AIS). The list of participants was not in any alphabetical order. Recruitment took place by contacting participants by personal phone, followed by a face-to-face confidential screening for each participant. The researcher followed the Initial Patient Questionnaire (see Appendix F) to ensure consistency of information discussed with each participant. Informed consent was obtained, with full disclosure of the research expectations of participants. Participants were able to opt out at any time during the study. A unique identifier number was used to protect patient information, with any information collected put into a data source that was coded with a numbering system. Study data were kept in a locked file located in the clinic's medical records unit.

The researcher screened the charts for pre-implementation data, using a retrospective review of mental health charts for age, gender, psychiatric diagnosis, current diagnosis, and current compliance rate. Compliance with the US Department of Health and Human Services 45 C.F.R. 164.316 was followed for accessing records and for documentation and reporting purposes. A convenience sample of 15 patients was obtained from the pre-implementation data of patients who had missed two or more appointments. The potential non-adherent patients were monitored for the first and second month. A monthly pill count was conducted on the first and second month, utilizing the medication possession ratio (MPR). This is a calculation that is commonly used in health research and is supported by the International Society for Pharmaceutical and Outcomes Research (Fortney, Pyne, Edlund, & Mittal, 2010; Hoch & Dewa, 2008; Rolnick, Pawloski, Brita, Asche, & Bruzek, 2013). As recommended by Kozma, Dickson, Phillips, and Meletiche (2013), medication adherence for this study was calculated by dividing the total number of days the patient was on a medication and the number of days the patient reported taking the medication or a monthly pill count.

The 15 patients in this study who were identified as having poor medication adherence were given monthly coaching sessions (see Appendix G), of 10 minutes' duration, at the beginning of the third and fourth month and provided with instructions on how to use the mobile reminder application, Dosecast (see Appendix H). The coaching sessions centered in a process to discuss factors associated with medication non-adherence, to facilitate healthy, sustainable behavior change by challenging a client to listen to their inner wisdom, identify their values, and transform their goals into action.

The researcher entered all medication information (name of medication, dose, and frequency) into Dosecast. At the end of the fourth month, the participants emailed the mobile reminder application data to the researcher. The mobile reminder application data were downloaded and the adherence rates were obtained utilizing the MPR. All data were recorded on a locally developed data collection tool (see Appendix E) and the information was then entered into SPSS Statistics Grad Pack 22.0 program for statistical data analysis.

Dosecast was selected as the mobile application for this study because of the expectation that it would enhance medication adherence. According to the software, it is "a flexible, easy-to-use medication management application that is available free of charge for Apple, Android, and Amazon devices" (Arya, 2014). Dosecast offered the following features (Arya, 2014):

- Reliably sent dose reminders whether or not the subject had an internet connection.
- Tracked the subject's time zone and adjusted reminders accordingly.
- Enabled doses to be skipped before or after their scheduled time.
- Displayed the drug name, dosage information, and directions in the reminders for each dose.

Post-implementation data collection on compliance outcomes was undertaken at the end of the fourth month, to determine whether the aims of the project had been met. To assess this, a paired sample t-test was performed, comparing baseline compliance data with data collected after the program implementation.

Protection of Human Subjects

The captured data was stored according to Human Subject Protection laws with a copy stored in a double-locked site with keys held only by the principal investigator.

Data Analysis

Patient medication adherence data were collected at 30 and 60 days (called Times 1 and 2) before the coaching sessions and the use of the mobile reminder application. The group was then given monthly coaching sessions and the use of the mobile reminder application for a period of 60 days. Medication adherence data was obtained again during the 3rd and 4th month of the study, after the coaching sessions and the use of the mobile reminder application (called Times 3 and 4). Medical adherence was calculated based on the number of days a patient received a given medication vs. the number of days the patient reported taking the medication.

First, descriptive statistics were calculated to understand the demographic characteristics of the sample. Next, pre-adherence rates were examined to test if rates differed in the two months prior to the intervention, using a paired-samples t-test. Demographic characteristics were examined at all of the time points to see if there were any demographic differences in adherence rates prior to the intervention. If the demographic data was continuous (e.g., education and age) then correlations were conducted. If the demographic data was categorical (e.g., race and gender) one-way ANOVAs were conducted. Post-adherence rates were then compared to see if the rates for the two months after intervention were different, using a paired-samples t-test. Finally, to test the hypothesis of whether the intervention increased adherence rates, paired-samples t-tests were conducted comparing pre-and post-intervention adherence.

The results of the t-test comparing Times 3 and 4 were significant, indicating that it is not possible to combine or average the post-intervention data together (i.e., each post-intervention month has to be compared separately with the pre-intervention data). Therefore, four separate paired-samples t-tests were conducted to test the research hypothesis, as follows:

- Post-intervention first month vs. pre-intervention first month (Time 3 vs. Time 1)
- Post-intervention first month vs. pre-intervention second month (Time 3 vs. Time 2)
- Post-intervention second month vs. pre-intervention first month (Time 4 vs. Time 1)
- Post-intervention second month vs. pre-intervention second month (Time 4 vs. Time 2).

Results

Description of Sample

A total of 15 participants took part in the study. Gender was almost evenly split in the sample, with eight males and seven females. Ethnicity was also fairly balanced, with four Caucasian participants, 6 Hispanic/Latino participants, and five African American participants. The education level of the sample was low: 73% of the sample had never earned a high school degree; two participants (13.3%) graduated from high school; one participant earned an Associate's Degree; and one participant earned a Bachelor's Degree. The ages ranged from 22 to 66 years, with the average age being 44.53 ($SD = 14.58$). See Table 1 for demographic characteristics of the sample.

Medication Adherence

At Time 1 (before any intervention) the average medication adherence rate of the 15 participants was 53.10% (see Figure 1), with adherence rates ranging from 30.00% to 73.33%. One participant did not provide any medical adherence data at Time 1 and was dropped from all further analyses. At Time 1, females had better adherence to their medication regimen ($M = 62.22\%$, $SD = 10.03\%$) than males ($M = 46.25\%$, $SD = 11.05\%$). The difference between male and female adherence at Time 1 was tested using an independent-samples t-test and was found to be significant, $t(12) = 2.78$, $p = .02$ (see Figure 2). As participants' age was not correlated to adherence rates at Time 1 ($r = -.04$, $p = .88$) it was clear that adherence rates did not differ by the participant's age. Education was also not related to adherence rates at Time 1 ($r = -.26$, $p = .37$), and nor was ethnicity (Caucasian $M = 44.44\%$, $SD = 7.62\%$; Hispanic/Latino $M = 53.89\%$, $SD = 5.39\%$; African American $M = 57.33\%$, $SD = 5.90\%$, $p = .43$ — see Figure 3). At Time 2 (one month after Time 1, but still with no interventions), the average adherence rate was 51.02%, with rates ranging from 33.33% to 70.00% (see Figure 1).

One participant's data was not available at Time 2. A paired-samples t-test confirmed that adherence rates did not differ between the two pre-intervention months (Times 1 and 2), $t(12) = 1.33$, $p = .208$. At Time 2, females still had better adherence to their medication regimen ($M = 60.00\%$, $SD = 10.32\%$) than males ($M = 43.33\%$, $SD = 8.16\%$) (see Figure 2). The difference between male and female adherence rates at Time 2 was tested and was found to be significant, $t(11) = 3.25$, $p < .05$. As participants' age was not correlated to adherence rates at Time 2 ($r = -.22$, $p = .46$), it was clear that adherence rates did not differ by the participant's age. Education was also not related to adherence rates at Time 2 ($r = -.21$, $p = .50$) and nor was ethnicity (Caucasian $M = 43.33\%$, $SD = 7.21\%$; Hispanic/Latino $M = 51.33\%$, $SD = 5.58\%$; African American $M = 55.33\%$, $SD = 5.58\%$, $p = .44$ — see Figure 3).

Time 3 was the first post-intervention month. The average adherence rate for the sample was 58.88%, with adherence rates ranging from 36.67% to 76.67%. Two participants' data were not available at Time 3 (see Figure 1). At Time 3, females still had better adherence to their medication regimen ($M = 68.33\%$, $SD = 8.26\%$) than males ($M = 49.45\%$, $SD = 9.28\%$) (see Figure 2). The difference between male and female adherence at Time 3 was tested and was found to be significant, $t(10) = 3.70$, $p < .01$.

As participants' age was not correlated to adherence rates at Time 3 ($r = -.08, p = .82$), it was clear that adherence rates did not differ by the participants' age. Education was also not related to adherence rates at Time 3 ($r = -.21, p = .50$) and nor was ethnicity (Caucasian $M = 53.33\%$, $SD = 9.77\%$; Hispanic/Latino $M = 57.33\%$, $SD = 6.16\%$; African American $M = 62.66\%$, $SD = 6.16\%$, $p = .69$ — see Figure 3).

Two months after the intervention (Time 4), the average adherence rate was 72.66%, with adherence rates ranging from 63.33% to 83.33%. Four participants' data was not available at Time 4 (see Figure 1). At Time 4, females had better adherence to their medication regimen ($M = 77.33\%$, $SD = 7.22\%$) than males ($M = 67.99\%$, $SD = 5.05\%$), $t(8) = 2.36, p = .045$ (see Figure 2). As participants' age was not related to adherence rates at Time 4 ($r = -.24, p = .50$), it was clear that post-intervention adherence rates did not differ by the participants' age. Education was also not related to adherence rates at Time 4 ($r = .04, p = .91$) and nor was ethnicity (Caucasian $M = 70.00\%$, $SD = 4.71\%$; Hispanic/Latino $M = 74.99\%$, $SD = 8.81\%$; African American $M = 71.66\%$, $SD = 8.81\%$, $p = .76$ — see Figure 3). A paired-samples t-test confirmed that adherence rates did differ between the two post-intervention months (Times 3 and 4), $t(9) = 6.00, p < .01$. Adherence rates at Time 4 (two months post-intervention) were significantly higher than adherence rates at Time 3 (one month post-intervention).

Testing the Success of the Intervention

Paired-samples t-tests were conducted to test the success of the intervention (the main analysis to test the research hypothesis). Pre-intervention adherence rates at Times 1 and 2 were compared with the post-intervention adherence rates at Time 3 and 4. Paired-samples t-tests were conducted to see if adherence rates significantly increased between pairs of time before and after the intervention, as follows:

Adherence rates at Time 3 (58.89%) were significantly higher than adherence rates at Time 1 (53.33%). The paired-samples t-test confirmed this, $t(11) = 5.38, p < .01$.

Adherence rates at Time 3 (58.89%) were significantly higher than adherence rates at Time 2 (51.67%). The paired-samples t-test confirmed this, $t(11) = 8.99, p < .01$.

Adherence rates at Time 4 (72.67%) were significantly higher than adherence rates at Time 1. The paired-samples t-test confirmed this, $t(9) = 10.37, p < .01$.

Adherence rates at Time 4 (72.67%) were significantly higher than adherence rates at Time 2. The paired-samples t-test confirmed this, $t(9) = 9.47, p < .01$.

Thus, it can be concluded that the intervention successfully increased adherence rates.

Table 1: Demographic Characteristics of the Sample

	N	M (SD)
Age	15	44.53 (14.58)
Gender		
Male	8	
Female	7	
Race/Ethnicity		
Caucasian	4	
Hispanic/Latino	6	
African American	5	
Education		
Less than high school	11	
High school graduate	2	
Associate's Degree	1	
Bachelor's Degree	1	

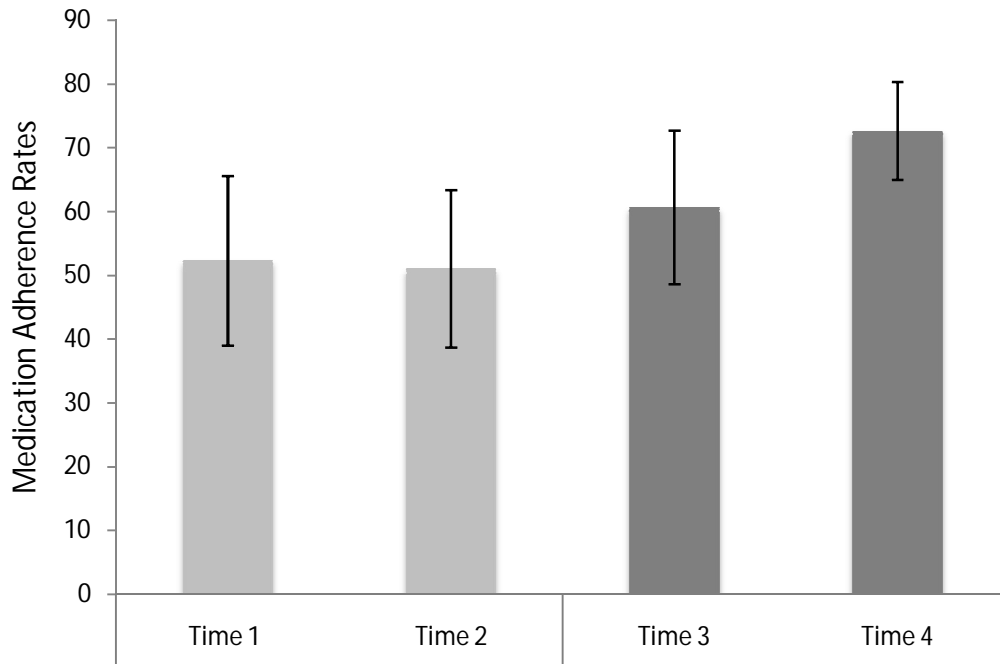


Figure 1: Adherence rates by month of the study

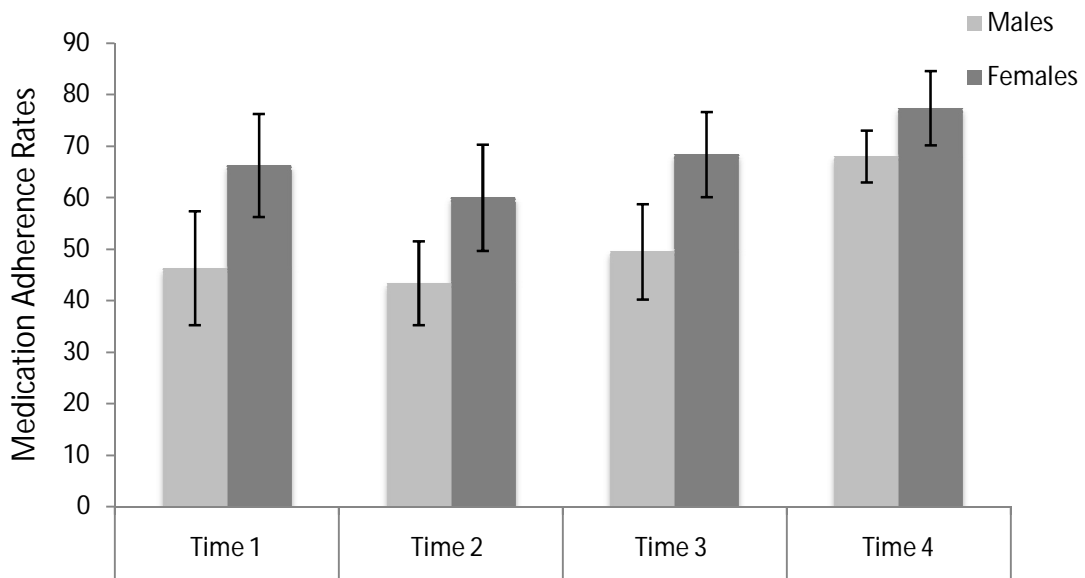


Figure 2: Medication adherence rates by gender and month of the study

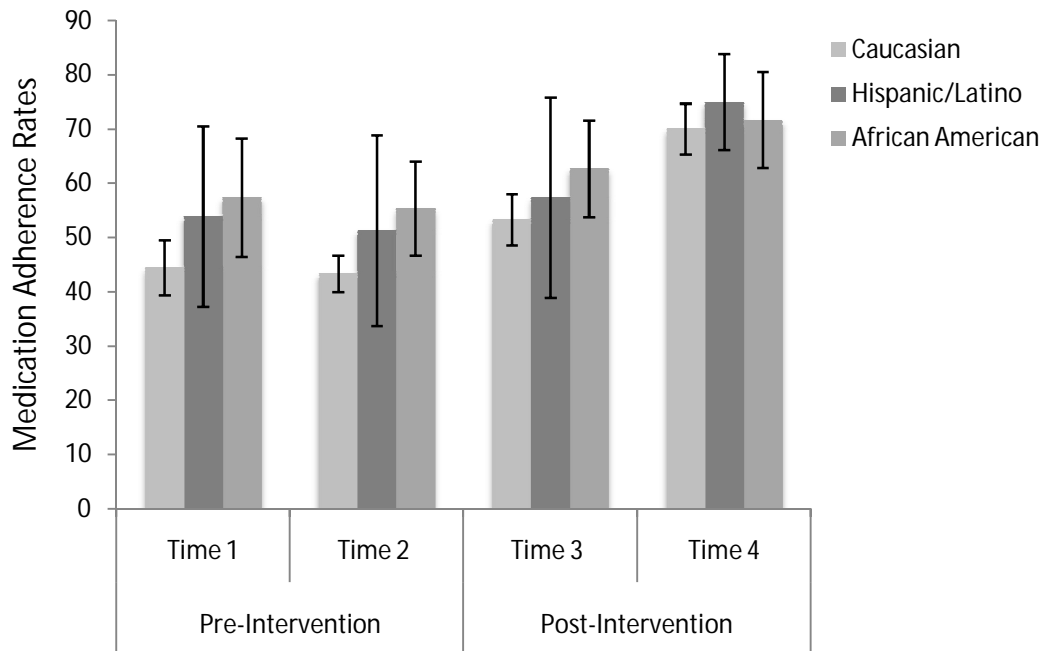


Figure 3: Medication adherence rates by ethnicity and month of the study

Discussion

Race, gender, and educational level have been studied in the US as factors in non-adherence to medication. Some studies have indicated that Caucasians are believed to have good compliance (Jin, Grant, Vernon, & Shu, 2008). Studies by Rahul, Balkrishnan, Camacho, Whitmire; Roger (2006) and Adams et al. (2008) revealed that African Americans’ adherence to a medication regimen is lower than that of Caucasians whites. A study conducted by Shiah et al. (2014) revealed that male patients adhere more effectively to a medication regimen than females patients do. Manteuffel, William, Verbrugge, Pittman, and Steinkellner (2014) also found that women are less likely than men to have good adherence in their use of chronic medication and are less likely to receive the medication treatment and recommended monitoring. Although no studies could be found regarding a link between education level and adhering to a medication regimen, a study by Alkatheri and Albekairy (2013) found that a higher educational level positively affects level of medication knowledge.

Conversely, this current study found that females had better adherence to their medication regimen (M = 77.33%, SD = 7.22%) than males (M = 67.99%, SD = 5.05%, $t(8) = 2.36, p = .045$). There were also no differences in adherence rates at Time 4 by ethnicity: Caucasian (M = 70.00%, SD = 4.71%), Hispanic/Latino (M = 74.99%, SD = 8.81%), African American (M = 71.66%, SD = 8.81%), $p = .76$ (see Figure 3). Additionally, education level was not related to adherence rates at Time 4, $r = .04, p = .91$.

The overall goal of this study, which is believed to be the first to investigate this topic, was to address non-adherence to medication regimens in an adult psychiatric outpatient clinic by implementing monthly coaching sessions coupled with the use of a mobile reminder application. A number of small studies have previously documented increased medication adherence through the use of SMS, telephone call reminders, and educational and motivational interviewing. The findings of this current study have supported those results, and suggest that coaching sessions and the use of a mobile reminder application can significantly improve medication adherence.

These results are promising because increased medication adherence is associated with better health outcomes, including reduced relapses and fewer hospitalizations (Braithwaite, Shirkhorshidian, Jone, & Johnsrud, 2013).

Application to Practice

The evidence strongly suggests that patients' medication adherence rates improve with the use of mobile reminder applications. As noted by former Surgeon General C. Everett Koop (Institute for Nurse Practitioner Excellence, n.d.), "... drugs don't work in patients who don't take them." Providers must remain cognizant that medication non-adherence contributes to suboptimal clinical benefits. Poor medication adherence translates into increased use of healthcare, such as hospitalizations, which are more costly and time consuming than medications management (Braithwaite et al., 2013). That is, when patients do not adhere to medication regimen they require more expensive services. In fact, medication non-adherence is involved in more than one-third of medication-related hospitalizations (Braithwaite et al., 2013). The raw data regarding medication non-adherence at Exodus Recovery's adult outpatient clinic was approximately 62%. The literature suggests that utilizing text message reminders alone could improve medication adherence by 8–90% (Burda et al., 2012; Cocosila et al., 2009; Sheppard et al., 2013). This current project utilized two interventions to reduce medication non-adherence rates: a mobile reminder application and coaching sessions. As anticipated, medication adherence rates increased. Implementing this medication adherence program would allow for a collaborative change in practice standards to increase the quality of care that Exodus Recovery providers can deliver to patients. Also, by reducing the economic burden of emergency-room and acute hospital stays, along with the co-morbidities of poorly controlled depression, a higher quality of life may be realized for patients.

Research suggests that patients who have an understanding of medication adherence and non-adherence realize that their behaviors can directly affect their treatment and quality of life; however, more research is needed to address critical issues in this area (DiMatteo et al., 2002; Sheppard et al., 2013; Wolever et al., 2010). Future studies regarding medication adherence should use other methods to help identify the specific non-adherence issues involved (e.g., primary non-adherence, execution of medication regimen, lack of patient education, and socioeconomic factors) because each of these may require a different intervention. Additional research is required to increase understanding of the relationships between adherence, outcomes, and healthcare costs.

Lack of medication adherence is a well-known and well-documented problem. The National Council on Patient Information and Education (NCPIE, 2007) notes that poor medication adherence has been a problem for many decades but has received few systemic interventions. Medication non-adherence is a crisis in the US and worldwide, and requires a coordinated approach to find solutions. To suggest that medication adherence is the fault of the patient is uninformed, counter-productive, and a perspective best abandoned. Implementing improvements in economic and health outcomes is a serious challenge for the health industry. In light of the Affordable Care Act, requiring policymakers to find new methods of improving healthcare outcomes. Mechanisms to encourage patients to adhere to medication regimens are now a national focus (Castellano, Copeland-Halperin, & Fuster, 2013).

Limitations

The initial time involved in coaching the client and setting up the mobile reminder application may discourage some providers. Further, patients must possess an iPhone and/or an Android phone, potentially limiting the number of patients able to be included. This project focused only on Axis I Diagnoses of Depression and did not include children or the homeless. Depending on the outcomes of further studies, recommendations could be made to insurance companies to provide incentives to both providers and patients in the form of adherence tools and educational coaching sessions that improve medication adherence. These incentives could include reduced co-pay rates for patients with good adherence to their medicine regimens and free mobile phone applications to remind patients to take their medications as prescribed.

Summary

The objective of this study was to determine whether the medication adherence rates of patients at the Exodus Recovery clinic improved after the implementation of a mobile reminder application accompanied by scheduled coaching sessions. The study included an analysis of pre- and post-adherence rates. The study's results were clinically significant, showing an increased medication adherence rate. The study also had limitations of sample size and study time.

Therefore, a study that utilizes better study methods, and has more participants over a longer period, may show significant, measurable differences. Once interventions can be tailored to meet a patient needs, rather than offering the same intervention to all patients, better health outcomes will be possible.

Conclusions

Previous research has found that patients who have an understanding of medication adherence and non-adherence realize that their behaviors can directly affect their treatment and quality of life as it relates to their illness. However, further research is required to increase understanding of the association between adherence, outcomes, and healthcare costs.

Although adherence interventions appear to have improved medication adherence rates in studies that included two or more interventions with patient-targeted changes, knowledge gaps remain. Medication adherence consists of a combination of a patient–provider relationship, socioeconomic factors, and education. Healthcare decision makers should avoid taking an *à la carte* approach to medication non-adherence.

Declaration of Interest

The author of this research project reports no conflicts of interest and is responsible for the content and writing of this paper. The project was executed without external funding.

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Appendices

Appendix A: Institutional Review Board (IRB) Approval

June 7, 2014

George Smith
Chair, Institutional Review Board
Brandman University
16355 Laguna Canyon Road
Irvine, CA 92618

As the Senior Vice President of Clinical Affairs at Exodus Recovery, Inc., it is my responsibility to assure the quality of care in the Exodus clinic. I have discussed Jorge Trujillo's proposed Doctor of Nursing Practice project to utilize coaching sessions and a mobile reminder application to enhance medication adherence and believe that it can be completed in this clinic without risk to our patients or compromise of their confidentiality.

I believe that the data Jorge collects during the project will allow us to make informed decisions about potential improvements in our clinical practice.

Although, I believe a review of health records is a straightforward quality improvement project, our clinic does not have an Institutional Review Board; your review will serve as an independent review of the safety of human subjects.

Thank you for your assistance in this matter.

Sincerely,



Kathy Shoemaker, RN
Senior Vice President of Clinical Affairs
Exodus Recovery, Inc.

Appendix B: National Institutes of Health (NIH) Certificate



Appendix C: Clinical Clearance Letter



BRANDMAN UNIVERSITY INSTITUTIONAL REVIEW BOARD
IRB Application Action – Approval

Date _____

Name of Investigator/Researcher: Jorge Luis Trujillo
 Faculty or Student ID Number: 00444123

Title of Research Project:
Implementing a Medication Adherence Program at an Adult Psychiatric Outpatient Clinic

Project Type: New Continuation Resubmission

- Category that applies to your research:
- Doctoral Dissertation
 - DNP Clinical Project
 - Masters' Thesis
 - Course Project
 - Faculty Professional/Academic Research
 - Other:

Funded: No Yes _____

Funding Agency; type of funding; grant number

Project Duration: (cannot exceed 1 year) 4 months

Principal Investigator's Address: 1920 Marengo St.
Los Angeles, CA 90601

Email Address: jtrujil1@mail.brandman.edu Telephone Number: 562-715-7756

Faculty Advisor/Sponsor/Chair Name: Dr. Kim Moreno

Email Address: kmoreno1@mail.brandman.edu Telephone Number: 619-316-8940

Category of Review:
 Exempt Review Expedited Review Standard Review

<input checked="" type="checkbox"/>	I have completed the NIH Certification and included a copy with this proposal
<input type="checkbox"/>	NIH Certificate currently on file in the office of the IRB Chair or Department Office

Signature of Principal Investigator Jorge L. Trujillo Digitally signed by Jorge L. Trujillo
DN: cn=Jorge L. Trujillo, ou=Brandman University, ou=ONP
Student, email=trujilj@mail.brandman.edu, c=US
Date: 2014.06.18 14:12:59 -0700' Date 6/18/14

Signature of Faculty Advisor/Sponsor/Dissertation Chair GPS Signing for Chairperson Digitally signed by GPS Signing for Chairperson
DN: cn=GPS Signing for Chairperson,
University: ou=MSNSIP,
email=gsip@brandman.edu, c=US
Date: 2014.06.21 23:19:27 -0400' Date 6/21/2014

The proposed project has been reviewed in accordance with the University's BUIRB policies related to the protection of human subjects and the institutional assurance to BUIRB. Comments and recommendations are provided for determining action on the IRB application.

**BRANDMAN UNIVERSITY INSTITUTIONAL REVIEW BOARD
IRB APPLICATION ACTION – APPROVAL
COMPLETED BY BUIRB**

IRB ACTION/APPROVAL

Name of Investigator/Researcher: _____

- Returned without review. Insufficient detail to adequately assess risks, protections and benefits.
- Approved/Certified as Exempt form IRB Review.
- Approved as submitted.
- Approved, contingent on minor revisions (see attached). Must resubmit with revisions
- Requires significant modifications of the protocol before approval. Research must resubmit with modifications (see attached)
- Researcher must contact IRB member and discuss revisions to research proposal and protocol.

Level of Risk: No Risk Minimal Risk More than Minimal Risk

Comments and Recommendations:

IRB Reviewer: Dr. Jalin A. Brooks Johnson

Telephone: 909.481.1481

Email: jbrooks@brandman.edu

IRB Certification Number: 06181401

Date: 6/25/2014

Revised IRB Application **Approved** **Returned**

IRB Reviewer: _____

Telephone: _____

Email: _____

Date: _____

Appendix D: Informed Consent

INFORMATION ABOUT: Implementing a Medication Adherence Program at an Adult Psychiatric Outpatient Clinic

BRANDMAN UNIVERSITY
16355 LAGUNA CANYON ROAD
IRVINE, CA 92618

RESPONSIBLE INVESTIGATORS: Jorge Luis Trujillo and Dr. Kim Moreno

PURPOSE OF STUDY: Medication non-adherence rates at the outpatient clinic where the project is to be implemented is at approximately 62%. Consequences of medication non-adherence include worsening condition, increased comorbid diseases, increased healthcare costs, and death. Medication non-adherence results from many causes; therefore, no easy solutions exist (Chisholm-Burns & Spivey, n.d.). The first step to addressing non-adherence is to recognize that collaboration must occur between healthcare practitioners and patients to increase adherence, with the goal of achieving optimal health outcomes. This project will utilize two interventions in an attempt to reduce medication non-adherence rates: a mobile reminder application and coaching sessions.

I agree to utilize the mobile reminder application (Dosecast) to record when I have taken my scheduled medications. Medication adherence rates will be obtained from patients receiving the intervention. Adherence rates will be determined by the number of days a patient was on medication vs. the number of days the patient reported taking the medication (medication possession per number of days reported taking the medication). I agree to have periodic coaching sessions with regards to the importance of medication adherence and the use of the mobile reminder application.

I understand that:

- a) There are no foreseeable risks associated with this study.
- b) The possible benefits of this study to me are enhancing medication adherence and thus have a better treatment response.
- c) Any questions I have concerning my participation in this study will be answered by Jorge Luis Trujillo, Doctorate of Nursing Practice (Office Tel # 323-276-6400) Mr. Trujillo will be available to answer questions between Monday through Thursday 08:00am-4pm.
- d) I understand that I may refuse to participate or may withdraw from this study at any time without any negative consequences. Also, the Investigator may stop the study at any time.
- e) I also understand that no information that identifies me will be released without my separate consent and that all identifiable information will be protected to the limits allowed by law. If the study design or the use of the data is to be changed, I will be so informed and my consent re-obtained. I understand that if I have any questions, comments, or concerns about the study or the informed consent process, I may write or call the Office of the Executive Vice Chancellor of Academic Affairs, Brandman University, and 16355 Laguna Canyon Road, Irvine, CA 92618, (949) 341-7641.

I acknowledge that I have received a copy of this form and the Research participant's Bill of Rights. I have read the above and understand it and hereby consent to the procedure(s) set forth.

 Signature of Participant or Responsible Party

 Signature of Witness (if appropriate)

 Signature of Principal Investigator
 Brandman University IRB April 2010

 Date

Appendix F: Initial Patient Contact Questionnaire

The following questions and/or information will be provided to potential participants of the coaching session/mobile reminder project to enhance medication adherence:

1. The principal researcher will identify self.
2. The principal researcher will do the following:
 - a) Greet participant (good morning/good afternoon).
 - b) Proceed to explain to the participant by verbalizing the following: "The principal researcher is conducting a study to improve medication adherence. The primary aim of this evidenced-based project is to assess the effectiveness of a mobile application reminder along with coaching sessions in increasing medication adherence at an adult psychiatric outpatient clinic. I am requesting your VOLUNTARY participation on this project to help us determine if the project is effective in enhancing medications adherence." Ask the participant if he/she is interested in participating and if the participant agrees, proceed to ask if the participant owns an iPhone or Android phone. If no, proceed to thank the participant for his time.
 - c) If the participant owns an Android/iPhone and agrees to participate, make an appointment for the participant to come to the clinic for a medication evaluation and to explain the use of the mobile reminder application. The principal researcher will download the Dosecast application to the participants' mobile phone and will enter medication data into the mobile application.
 - d) The participant will have the process explained to him and will be provided with the consent form for his signature.

Appendix G: Script for Coaching Sessions

If it is ok with you, I would like to talk with you about taking your medication.

A) *I would like to begin our conversation today by asking a few questions about how you are doing with taking your medication. I see that you are taking (name of medication). Tell me about how taking your medication is going.*

B) *Can you describe your medicine routine during the past two weeks—would you say that your adherence to (name of medication) has increased, decreased or remained the same? (Adherence means taking your medication as prescribed, every day and every dose.)*

Reflect

C) *If the patient missed the medication, say: Could you tell me the reason you missed your medication?*

Reflect

D) *If adherence has declined, say: Tell me about problems, if any, that you are having with taking your medicine.*

Reflect

E) *If patient has taken ALL his/her medications, go to PART A.*

F) *If patient has MISSED medications, go to PART B.*

Part A

If patient has taken ALL of his/her medications or has maintained an 80% adherence rate within the past 30 days, say: It is great that you have taken your (name of medication) exactly as ordered. You have not missed a single dose in the past 30 days, or you have been at least 80% adherent. It seems like you have made efforts to take this medication as it was prescribed. Tell me about your methods/routines that helped you to do this.

Use reflective listening and paraphrasing. Reinforce efforts. REFLECT on things that helped.

B) *Describe some of the benefits that you now experience from taking your medicine exactly as ordered.*

Reflect

Part B

If the patient has missed a dose of his/her medication or taken it incorrectly within the last 2 weeks, say:

- i) *You said that you missed ...#... doses of ...(medication). You also said that you missed taking (name of medication) because (reason).*
- ii) *To help me better understand how you feel about taking (name of medication), I'd like to ask you a couple questions. Is that okay with you? If permission is granted, continue.*
- iii) *What are some problems you are having with taking the medication (i.e. side effects, forgetfulness)?*
- iv) *Can you tell me about some specific examples of when/why this happened?*
- v) *What are some possible ways to deal with this problem?*
- vi) *Tell me about what you have tried in the past to deal with this problem.*

Discuss and highlight the following issues for the participant

Pros of medication adherence:

1. Able to control your own health
2. Have more energy
3. Avoid hospitalizations
4. Have peace of mind
5. Make significant others happy

Cons of medication non-adherence:

1. Decreased energy
2. Lack of motivation
3. Apathy
4. Feelings of sadness
5. Suicidal ideation
6. Loss of interest
7. Too much sleep or not enough sleep
8. Eating too much or not eating enough

Appendix H: About Dosecast



Dosecast is the most flexible and easy-to-use medication management app available for Apple, Android, and Amazon devices. With Dosecast, you'll remember to take **the right medication, the right way, at the right time – every time!**

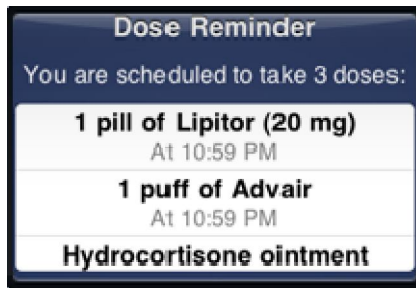
Featured in:

About.com
FierceMobile
Healthcare

REAL SIMPLE
The New York Times

Reader's
Digest

How Dosecast Works



- Simply enter basic information about each medication you take, such as the name, dosage, and how and when you take it.
- You can set up reminders on a daily/weekly/monthly schedule, every few days or weeks, or for a pre-set number of hours or days after the last dose.
- Dosecast adjusts to your changing day, enabling you to take a dose early or postpone it as long as you need.
- As you take doses, Dosecast tracks remaining quantities, sends refill reminders, and logs medication adherence.



Copyright © 2013 Montuno Software, LLC | P.O. Box 541591, Waltham MA, 02454-1591



Dosecast Features

Dosecast is available in both a free and premium edition.

Free Edition Features

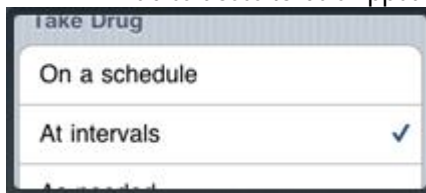
The free edition includes the following features:

Reliable Notifications

- Reliably sends dose reminders with or without an internet connection.
- Tracks the time zone you are in and adjusts reminders accordingly, so you get notified at the right time no matter where you are.
- Optionally schedules backup reminders for a configurable period later (e.g. 5 minutes) in case the original reminder isn't noticed.

Flexible Scheduling

- Schedules doses on a daily/weekly/monthly schedule, every few days or weeks, or after a pre-set number of hours or days since the last dose.
- Tracks the maximum number of doses allowed per day or per 24 hours.
- Enables doses to be logged later (in case you forgot your device at the time the dose was due).
- Enables doses to be skipped before or after their scheduled time.



Customizable Dose Amounts and Instructions

- Tracks the drug name, dosage information, and directions, which are displayed in the reminders for each dose.
- Tracks notes for each drug, such as what the drug is for and what side effects to watch out for.

Pills per Dose	1 >
Pill Strength	20 mg >
For	Me >

Postpone-able Reminders

- Enables reminders to be postponed by a custom duration before or after they appear.
- Multiple overdue doses may be postponed as a group or individually.

	15 mins
0 hours	20 mins
1 hour	25 mins

Smart Silencing

- Tracks start and end of bedtime and start and end of each treatment so there are no unwanted alarms.
- Notifications may be switched off or drugs archived during pauses in the treatment.

drugs taken on a schedule.	
Bedtime Starts	10:00 PM >
Bedtime Ends	6:00 AM >

Privacy and Security

- No personally identifiable information is collected.
- All drug information is encrypted at rest and when in transit, making the app safe when used from a public access point.

Appendix I: Acronyms and Abbreviations

AIS	Affinity Information System
ART	anti-retroviral therapy
HBM	Health Belief Model
ITT	intent to treat
META	Motivational Enhancement Therapy for Antidepressants
MICE	multivariate imputation by chain equations
MPR	medication possession ratio
NCPIE	National Council on Patient Information and Education
SMS	short message service
TAU	treatment as usual
UC	usual care
WHO	World Health Organization