HHS Public Access

Author manuscript

Psychol Health. Author manuscript; available in PMC 2017 April 01.

Published in final edited form as:

Psychol Health. 2016 April ; 31(4): 383–395. doi:10.1080/08870446.2015.1111371.

Medication Beliefs and Structural barriers to Treatment Adherence Among People Living with HIV Infection

Seth Kalichman, PhD, **Moira O. Kalichman, MSW**, and **Chauncey Cherry, PhD**

University of Connecticut

Abstract

Background—People living in poverty face multiple structural challenges to medication adherence including lack of transportation, inadequate housing, and food insecurity. The degree to which individuals' motivations to remain adherent may overcome structural barriers has received limited attention.

Purpose—To examine whether medication necessity and concerns beliefs predict antiretroviral therapy (ART) adherence over and above structural adherence barriers associated with poverty.

Methods—People living with HIV in a southern US city (N=942) completed computerized interviews, an objective measure of adherence, and HIV viral suppression obtained from medical records. Hierarchical logistic regression models were constructed to examine demographic and illness characteristics, structural barriers, mental health, substance use and medication necessity and concerns beliefs as predictors of ART adherence.

Results—In multivariable models, current drug use and medication necessity and concerns beliefs predicted treatment adherence over and above demographic, health, mental health, and structural factors.

Conclusions—Medication beliefs are proximal and powerful motivating factors that predict adherence. Adherence interventions should directly address medication beliefs in developing strategies to manage barriers facing people with HIV living in poverty.

Keywords

Medication adherence; Medicines necessity-concerns beliefs; Structural barriers; poverty; HIV-AIDS

Antiretroviral therapy has the potential to improve the health and extend the lives of people living with HIV infection. Successful treatment outcomes depend on persistent adherence with even the most forgiving medication regimens requiring as much as 85% of medications be taken as prescribed (Bangsberg, 2006; Bangsberg, Kroetz, & Deeks, 2007; Markowitz et al., 2007). The potential for antiretroviral therapy (ART) to change the course of HIV infection from a life threatening disease to a manageable illness is unfortunately not realized

Correspondence should be addressed to Seth C. Kalichman, Department of Psychology, 406 Babbidge Road, University of Connecticut, Storrs, CT 06269, USA Phone (860) 208-3706 FAX 960 486 8706, seth.k@uconn.edu.

by all those infected. In the United States, only half of people aware of their HIV infection are engaged in medical care, of which three out of four receive ART, with 20% failing to achieve the optimal clinical outcome of complete viral suppression (Gardner, McLees, Steiner, Del Rio, & Burman, 2011).

Studies have identified factors that reliably predict non-adherence to ART including demographic characteristics, illness experiences, social relations, stress, and mood (Fisher, Fisher, Amico, & Harman, 2006). For people living in poverty, there are added structural barriers to adherence including unstable housing (Leaver, Bargh, Dunn, & Hwang, 2007), lack of transportation (Tuller et al., 2010), food insecurity (Weiser et al., 2009), and substance use (Hendershot, Stoner, Pantalone, & Simoni, 2009). Multiple co-occurring structural barriers to adherence may be uniquely related to poor clinical health outcomes in HIV infection (Williams, Amico, Bova, & Womack, 2013). People living in poverty must not only remember to take their medications, they must also overcome adversities such as inadequate housing, food insecurity, and lack of transportation. Beliefs that medications are of greater burden than they are necessary will likely impede motivation to resolve structural barriers to adherence.

While non-adherence can result from factors out of an individual's control, or unintentional non-adherence, motivational factors can substantially contribute to adherence (Horne, 2011; Jonsdottir et al., 2009). Drawing from a cost-benefit approach, Horne has proposed a framework that emphasizes patient beliefs about the necessity of medications – the degree to which medications directly improve health – and concerns about the costs and adverse effects of medications (Horne, Parham, Driscoll, & Robinson, 2009). Studies show that necessity beliefs about medications predict better adherence, while greater medication concerns predict poorer adherence (Horne et al., 2013). Among people living with HIV receiving antiretroviral therapy (ART), believing that their medications are necessary characterizes both individuals who are adherent as well as those who are non-adherent due to circumstances that are out of their control. However, patients who intentionally do not take their medications frequently perceive their medications are unnecessary (Clifford, Barber, Elliott, Hartley, & Horne, 2006).

Beliefs regarding the necessity and concerns about ART predict accepting treatment when offered as well as long-term adherence (Horne, Cooper, Gellaitry, Date, & Fisher, 2007). In one study that included a composite of electronic medication monitoring and self-reported adherence, Gonzalez et al. (2007) found that both necessity and concerns beliefs predicted adherence. While this study included an ethnic and economically diverse sample, social structural barriers to adherence were not included in their model. One study that did attend to structural barriers such as literacy, housing, and substance use only treated these factors as potential covariates in the relationship between ethnicity and adherence (Gunther, Foisy, Houston, Guirguis, & Hughes, 2014). A recent meta-analysis of 207 studies of ART adherence found that medication necessity and concerns beliefs emerged as among the most reliable psychological/motivational factors in predicting adherence, with effect sizes that parallel substance use and depression. Although financial constraints were also associated with poorer adherence, specific structural barriers to adherence were not included in the review (Langebeek et al., 2014). Thus, the degree to which medication necessity and

concerns beliefs predict adherence after accounting for structural barriers has not been tested among people living with HIV.

The purpose of the current study was to test medication necessity and concerns beliefs in predicting ART adherence over and above structural barriers associated with poverty. We examined logistic regression models to predict ART adherence over a six-week period that included multiple individual, social, and structural factors associated with ART adherence. The models were rationally and hierarchically constructed to test whether medication necessity and concerns beliefs predict ART adherence after accounting for demographic, illness, structural factors, mental health and substance use. We tested the hypothesis that medication beliefs would significantly predict ART adherence over and above other individual and structural level predictors of adherence.

Methods

Participants

Participants were 942 men and women being treated for HIV infection. Recruitment occurred between December 2013 and March 2014. The site of the study was Atlanta, Georgia with an annual incidence of 30.3 per 100,000, exceeding the 19.6 per 100,000 population rate of HIV in major US cities. Eligible participants were age 18 or older, HIV positive, and currently receiving ART.

Procedures

Men and women living with HIV were recruited through targeted community sampling with both venue and snowball sampling techniques. Venue recruitment relied on responses to brochures placed in waiting rooms of HIV service providers and infectious disease clinics throughout Atlanta, GA. At an initial office assessment session, participants provided informed consent and completed a computer-assisted interview to collect demographic and health information. We used computerized interviews because they have been shown to increase responses to socially sensitive measures (Gribble et al., 2000; Morrison-Beedy, Carey, & Tu, 2006). Participants were trained to conduct unannounced pill count assessments on the phone. In addition, participants provided a urine sample for drug screening. We also asked participants to obtain their most recent HIV viral load and CD4 cell count results from their medical provider. Participants then completed three unannounced phone-based pill counts to determine ART adherence over the next six weeks. Participants were reimbursed $145 for completing all measures, pill counts, urine specimen collection for drug testing, and returning medical chart information. The University of Connecticut Institutional Review Board approved all procedures.

Measures

Demographic characteristics—Participants were asked their gender, age, years of education, income, ethnicity, and employment status.

Illness experiences—Participants reported the year that they first tested HIV positive to calculate the number of years since they first learned they have HIV infection. A 14-item

scale assessed the number of HIV symptoms experienced from which we calculated a composite score using the summation of all 14 symptoms, alpha = .70 (Kalichman, Rompa, & Cage, 2000). Medication side-effects were measured using 11 common side-effects attributable to current medications, responses made on 4-point scales 0 = Not experiencing, 3 = Severely experiencing, summed to a total score, alpha = .83 (Carrieri, Villes, & 2007).

Structural barriers—Participants reported their experience with structural barriers to medication adherence associated with poverty. We assessed food insecurity with items adapted from the US Food Security Scale that have been validated in past research (Cook & Frank, 2008). Food insecurity indicators were adapted to assess experiences in the past month, dichotomized (*experienced / not experienced*) and summed to create a food insecurity index. Participants who indicated any food insecurity were defined as food insecure for descriptive purposes. We also asked participants if they had stable housing and whether they had reliable transportation over the past month. Specifically, participants reported whether they did not have a place to stay, and whether they were unable to get to a health appointment or were unable to get to where they obtain their food/meals.

Mental Health and Substance Use—We administered the 20-item Centers for Epidemiological Studies Depression scale (CESD) to assess symptoms of depression (Van Dam & Earleywine, 2011). Items focused on how often a participant had specific thoughts, feelings and behaviors in the last seven days. Responses were *0 = 0 days, 1 = 1–2 days, 2 = 3–4 days,* or *3 = 5–7 days*. Scores range from 0 to 60 and scores greater than 16 indicate possible depression, alpha = .89. Participants were also asked whether they experienced 18 stressful life events in the previous month (Chesney, Folkman, & Chambers, 1996; Kalichman, DiMarco, Austin, Luke, & DiFonzo, 2003). Stressors reflected social relations (e.g., starting and ending relationships, disclosing HIV status), life circumstances (e.g., financial problems, transportation, having a place to stay), and health concerns (e.g., being hospitalized, experiencing an illness, starting a new medication). Stressors were responded to dichotomously for having occurred (yes/no). We computed a stress index by summing the number of stressors reported. For each stressful event endorsed, participants also rated the amount of distress they attributed to the experience on a 3-point scale, 0 = *no stress*, 1 = *a little stress*, 2 = *a lot of stress.* Mean distress severity scores were computed to create an index of stress experienced, alpha = .75.

To assess current alcohol use we administered the first item on Alcohol Use Disorders Identification Test (AUDIT), which asks about drinking frequency in the previous month (Maisto, Conigliaro, McNeil, Kraemer, & Kelley, 2000; Saunders, Aasland, Babor, DeLaFuente, & Grant, 1993). For other drug use, we performed a multi-panel urine dip-test to detect common illicit drug use. This test strip uses a lateral flow chromatographic immunoassay for qualitative detection of 12 drugs and drug metabolites (Redwood Toxicology Labs - Reditest-12). These tests are U.S. FDA approved and are reliable and valid for initial drug screening.

Medication Beliefs—We used the Beliefs About Medicine Questionnaire to assess participant's views of their medications as necessary and the concerns they may hold about their medications (Horne, 2011; Horne & Weinman, 1999). The medication necessity scale

consists of five items reflecting perceived benefits of medications in direct relation to health; example items include ‘My health, at present, depends on my medicine’, ‘My life would be impossible without my medicine’, and ‘My medicines protect me from becoming worse.’ The five item medication concerns scale reflects potential adverse effects and costs of medications; example items include ‘Having to take my medicines worries me’, ‘My medicines disrupt my life’, and ‘I sometimes worry about the long-term effects of my medicines’. Items were responded to on a 5-point scale, 1 = *Strongly agree,* 5 = *Strongly disagree*. The medication necessity and concerns scales were both internally consistent, alphas = .78 and .81, respectively. As reported in its scale development, the necessity and concerns scales were psychometrically independent in the current sample, r = .01, ns, and were therefore not statistically redundant (Horne & Weinman, 1999).

Medication adherence—Participants consented to three unannounced telephone-based pill counts that occurred over a six-week prospective period. Unannounced pill counts are reliable and valid in assessing medication adherence when performed in homes (Bangsberg, Hecht, Charlebois, Chesney, & Moss, 2001) and on cell-phones (Kalichman et al., 2008; Kalichman et al., 2007). In this study we conducted unannounced cell-phone based pill counts using study-provided free cell phones. Following an office-based interview that included a full accounting of all prescription medications and training in the pill counting procedure, participants were called at three unscheduled times over 12 to 16 day intervals. Participants reached at an inconvenient time or when they were not home were called back at another unannounced time within 48 hours. The first of the three pill counts is used to establish the initial number of pills in possession with the subsequent two pill counts allowing for calculation of adherence, defined as the ratio of pills counted relative to pills prescribed, taking into account the number of pills dispensed. Six-week adherence was calculated as the mean across antiretroviral medications and across pill counts, and adherence was categorically defined by 85% of medications taken as prescribed (Bangsberg, 2006; Bangsberg & Deeks, 2002; Markowitz et al., 2007).

HIV viral load and CD4 cell counts—We used a participant assisted method for collecting chart abstracted viral load and CD4 cell counts from participants' medical records. Participants were given a form that requested their doctor’s office to provide results and dates of their most recent, and not older than 3-months, viral load and CD4 cell counts. These data were therefore obtained directly by the participant from their HIV care provider. The form included a place for the provider's office stamp or signature to assure data authenticity. Participants who were unable to provide chart abstracted data in the 3-month timeframe provided a blood specimen for laboratory testing (n = 30). HIV RNA below detection (i.e., suppression) was defined as less than 100 copies/mL for uniformity across providers.

Data Analyses

We first examined the descriptive characteristics of the sample by comparing participants with adherence above and below 85% of medications taken during the prospective 6-week assessment period. Comparisons were made using contingency table chi-square tests for categorical variables and independent t-tests for continuous variables. The main study

hypotheses were tested using multiple logistic regression analyses. Bivariate regression models were first examined for all factors in relation to adherence. We then used multivariable logistic regression models for adherence defined as 85% of medications taken, with sensitivity analyses using 75% and 95% adherence. We constructed hierarchical models to test demographic characteristics, illness experiences, structural barriers, mental health and substance use, and medication beliefs as predictors of antiretroviral adherence. The regression models were rationally constructed to account for demographic characteristics, illness experiences, structural barriers, mental health, and substance use in relation to adherence, with medication beliefs tested in a final block. Regression analyses therefore tested the hypothesis that medication beliefs would significantly predict ART adherence over and above demographics, illness experiences, mental health, substance use, and structural factors. We report overall model X^2 tests and odds ratios with 95% confidence intervals, with statistical significance defined as $p < .05$ for all analyses.

Results

Descriptive analyses showed that participants who were less than 85% adherent to ART demonstrated significantly poorer health than individuals with greater adherence in terms of HIV-related symptoms, medication side-effects, HIV viral load and CD4 cell counts. (see Table 1) In addition, poorer adherence was related to food insecurity and lack of transportation. Analyses also confirmed that non-adherent participants experienced more symptoms of depression, greater alcohol use, and were significantly more likely to screen positive for illicit drug use. Finally, participants with poorer adherence endorsed more concerns beliefs regarding their medications and endorsed fewer beliefs that taking their medications are necessary for their health. These descriptive results support the internal validity of the study measures.

Predictors of Antiretroviral Adherence

Bivariate logistic regressions for each predictor variable and HIV treatment adherence are shown in Table 2. Results indicated that all three structural barriers, specifically unstable housing, food insecurity and lack of transportation predicted adherence less than 85%. In addition, depression scores and drug use were related to poorer adherence as were greater medication concerns beliefs and lower medication necessity beliefs.

The multivariable hierarchical logistic regression models predicting ART adherence are shown in Table 3. In the first block (Model 1) demographic characteristics and illness experiences did not significantly predict ART adherence. In the second block (Model 2), structural barriers added to the predictive model, which was significant. However, no single factor emerged as a significant independent predictor. In the third block (Model 3), current drug use significantly predicted non-adherence and the overall model was again significant. Finally Model 4 remained significant with medication necessity and concerns beliefs, along with current drug use, entering as significant predictors of adherence.

Sensitivity Analyses

Sensitivity analyses were conducted using lower (75%) and upper (95%) bound thresholds for treatment adherence. A total of 206 (22%) participants were less than 75% adherent in the six-week observation period. The multivariable model with demographics, illness experience, structural, mental health, substance use and medication beliefs predicting adherence was significant, X^2 (df = 15) = 40.46, p < .01. Significant predictors were lack of transportation (adj. OR = 0.61, p < .01, 95%CI 0.41–0.91), current drug use (adj. OR = 0.56, p < .01, 95%CI 0.39–0.78), and medication necessity beliefs (adj. OR = 1.06, p < .01, 95%CI 1.01–1.11). Medication concerns beliefs were not significant in predicting adherence below 75%.

For 95% of pills taken used to define the upper bound of adherence, there were 541 (59%) participants below this threshold. The multivariable model was again significant, X^2 (df = 15) = 39.6, p < .01. Significant predictors of 95% adherence were current drug use (adj. OR = 0.63, p < .01, 95%CI 0.48–0.85), medication concerns beliefs (adj. OR = 0.95, p < .01, 95%CI 0.92–0.98), and medication necessity beliefs (adj. OR = 1.04, p < .05, 95%CI 1.01–1.07). Results therefore held at the upper boundary of adherence and partially at the lower boundary.

Discussion

The current study extends past research to show that structural barriers, mental health, substance use, and medication beliefs predict ART adherence. In multivariable models, we found that medication beliefs predict ART adherence over and above demographic characteristics, illness experiences, structural barriers, mental health and substance use factors in a sample of people living with HIV. In a final hierarchical model, poorer ART adherence was predicted by current drug use, holding greater medication concerns and fewer medication necessity beliefs. Sensitivity analyses showed that both medication necessity and concerns beliefs predicted the upper boundary of adherence (95% pills taken), while medication necessity beliefs predicted the lower boundary of adherence (75%). Medication necessity beliefs therefore predicted adherence at all levels, while concerns beliefs predicted 85% and 95% adherence. These findings support our hypothesis that medication beliefs significantly predict ART adherence over and above structural barriers to adherence.

Medication beliefs play a significant role in intentional aspects of non-adherence including altering medication schedules and not prioritizing medications among health behaviors. Beliefs about medicines have been shown to predict intentionally missing medications. For example, studies show that concerns about the risks of mixing alcohol and other drugs with antiretroviral medications are robust predictors of intentional non-adherence even after accounting for the relationship between substance use itself with adherence (Kalichman et al., 2012; Sankar, Wunderlich, Neufeld, & Luborsky, 2007). Believing that medications are less necessary and harboring greater concerns about medications in the current study predicted poorer adherence over and above structural barriers.

Studies of medication necessity and concerns beliefs have previously found similar patterns of association with antiretroviral adherence (Horne et al., 2013). However, most studies have

relied on self-reported adherence and cross-sectional designs. In a meta-analysis, Horne et al. (Horne et al., 2013) identified nine studies that tested the association between necessity-concerns beliefs and medication adherence in people living with HIV infection, most of which relied on self-reported measures of adherence. One study that did include electronic monitoring of medication adherence experienced significant missing data and therefore combined electronic monitoring data with a self-report measure to construct a latent class variable (Gonzalez et al., 2007). The limitations of self-reported adherence are well known, especially in terms of socially desirable responding and limitations of memory when recalling missed medications (Pearson, Simoni, Hoff, Kurth, & Martin, 2007). Our study used an objective measure of adherence and therefore builds confidence in the results of previous research.

These results should be interpreted in light of the study limitations. First, we relied on a convenience sample from a city in the southeastern U.S. that cannot be considered representative of people living with HIV infection. The sample also came from a wide-range of providers that likely varied in their prescription practices. We also used self-report measures to assess individual and structural level barriers, including behaviors and circumstances that are subject to under-reporting. In addition, while unannounced pill counts provide an objective measure of adherence and participants counted their pills twice, we were unable to externally verify the accuracy of pills counted. Our study did not use an experimental design and cannot lead to any directional or causal inferences. In addition, the magnitude of the observed associations where relatively small and may represent findings of limited clinical significance. The importance of medication beliefs as a target for adherence interventions may therefore lie in larger scale interventions that can have a significant public health impact. Recognizing these limitations, we conclude that our results have implications for advancing HIV treatment adherence interventions.

Unlike structural barriers such as food insecurity and unstable housing, motivational beliefs and notions about the relative value of medications are aspects of adherence that are amenable to available interventions (Clifford et al., 2006). Counseling patients about the role antiretrovirals play in suppressing HIV and restoring immune functions can bolster a sense that treatment is necessary for improving health. In addition, patient concerns about adverse effects and costs of medicines can be addressed in social and clinical services (Horne et al., 2013). Thus, the objectives of medication beliefs counseling should at least in part be a perceived cost-benefit analysis where the necessities of medications are weighed against concerns, and concerns are directly addressed. Existing approaches to medication adherence counseling with added attention to medication beliefs offer a viable framework for improving adherence in clinical settings (Miller & Rollnick, 2012). Research is therefore needed to test the effects of integrating motivational counseling to address medication beliefs within broader behavioral self-management approaches that can be brought to scale to improve medication adherence.

References

Bangsberg DR. Less than 95% adherence to nonnucleoside reverse-transcriptase inhibitor therapy can lead to viral suppression. Clinical Infectious Diseases. 2006; 43(7):939–941. [PubMed: 16941380]

Bangsberg DR, Deeks SG. Is average adherence to HIV antiretroviral therapy enough? Journal of General Internal Medicine. 2002; 17(10):812–813. [PubMed: 12390559]

Bangsberg DR, Hecht FM, Charlebois ED, Chesney M, Moss A. Comparing objective measures of adherence to HIV antiretroviral therapy: Electronic medication monitors and unannounced pill counts. AIDS and Behavior. 2001; 5:275–281.

Bangsberg DR, Kroetz DL, Deeks SG. Adherence-resistance relationships to combination HIV antiretroviral therapy. Current HIV/AIDS Reports. 2007; 4(2):65–72. [PubMed: 17547827]

Carrieri MP, Villes V, et al. Self-reported side-effects of anti-retroviral treatment among IDUs: a 7-year longitudinal study. International Journal of Drug Policy. 2007; 18(4):288–295. [PubMed: 17689377]

Chesney M, Folkman S, Chambers D. Coping effectiveness training for men living with HIV: preliminary findings. International Journal of STD and AIDS. 1996; 7(Suppl 2):75–82. [PubMed: 8799801]

Clifford S, Barber N, Elliott R, Hartley E, Horne R. Patient-centred advice is effective in improving adherence to medicines. Pharmaceutical World Science. 2006; 28(3):165–170.

Cook JT, Frank DA. Food security, poverty, and human development in the United States. Annals of New Yourk Academy of Sciences. 2008; 1136:193–209.

Fisher J, Fisher W, Amico R, Harman J. An information-motivation-behavioral skills model of adherence to antiretroviral therapy. Health Psychology. 2006; 25:462–473. [PubMed: 16846321]

Gardner EM, McLees MP, Steiner JF, Del Rio C, Burman WJ. The spectrum of engagement in HIV care and its relevance to test-and-treat strategies for prevention of HIV infection. Clinical Infectious Diseases. 2011; 52(6):793–800. [PubMed: 21367734]

Gonzalez JS, Penedo FJ, Llabre MM, Duran RE, Antoni MH, Schneiderman N, Horne R. Physical symptoms, beliefs about medications, negative mood, and long-term HIV medication adherence. Annals of Behavioral Medicine. 2007; 34(1):46–55. [PubMed: 17688396]

Gribble JN, Miller HG, Cooley PC, Catania JA, Pollack L, Turner CF. The impact of T-ACASI interviewing on reported drug use among men who have sex with men. Subst Use Misuse. 2000; 35(6–8):869–890. [PubMed: 10847215]

Gunther M, Foisy M, Houston S, Guirguis L, Hughes C. Treatment beliefs, illness perceptions, and non-adherence to antiretroviral therapy in an ethnically diverse patient population. International Journal of Clinical Pharmocology. 2014; 36(1):105–111.

Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. Journal of Acquired Immune Deficiency Syndromes. 2009; 52(2):180–202. [PubMed: 19668086]

Horne R. Adherence to asthma medication: a question of ability? Primary Care Respiratory Journal. 2011; 20(2):118–119.

Horne R, Chapman SC, Parham R, Freemantle N, Forbes A, Cooper V. Understanding patients' adherence-related beliefs about medicines prescribed for long-term conditions: a meta-analytic review of the Necessity-Concerns Framework. PLoS ONE. 2013; 8(12):e80633. [PubMed: 24312488]

Horne R, Cooper V, Gellaitry G, Date HL, Fisher M. Patients' perceptions of highly active antiretroviral therapy in relation to treatment uptake and adherence: the utility of the necessity-concerns framework. Journal of Acquired Immune Deficiency Syndromes. 2007; 45(3):334–341. [PubMed: 17514019]

Horne R, Parham R, Driscoll R, Robinson A. Patients' attitudes to medicines and adherence to maintenance treatment in inflammatory bowel disease. Inflammatory Bowel Disease. 2009; 15(6): 837–844.

Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. Journal of Psychosomatic Research. 1999; 47(6):555–567. [PubMed: 10661603]

Jonsdottir H, Friis S, Horne R, Pettersen KI, Reikvam A, Andreassen OA. Beliefs about medications: measurement and relationship to adherence in patients with severe mental disorders. Acta Psychiatrica Scandanavia. 2009; 119(1):78–84.

Kalichman S, DiMarco M, Austin J, Luke W, DiFonzo K. Stress, social support, and HIV-status disclosure to family and friends among HIV-positive men and women. Journal of Behavioral Medicine. 2003; 26(4):315–332. [PubMed: 12921006]

Kalichman SC, Amaral CM, Cherry C, Flanagan JA, Pope H, Eaton L, … Schinazi R. Monitoring Antiretroviral adherence by unannounced pill counts conducted by telephone: Reliability and criterion-related validity. HIV Clinical Trials. 2008; 9:298–308. [PubMed: 18977718]

Kalichman SC, Amaral CM, Stearns HL, White D, Flanagan JA, Pope H, … Kalichman MO. Adherence to antiretroviral therapy assessed by unannounced pill counts conducted by telephone. Journal of General Internal Medicine. 2007; 22:1003–1006. [PubMed: 17390095]

Kalichman SC, Amaral CM, White D, Swetsze C, Kalichman MO, Cherry C, Eaton L. Alcohol and Adherence to Antiretroviral Medications: Interactive Toxicity Beliefs Among People Living With HIV. Journal of the Association of Nurses in AIDS Care. 2012

Kalichman SC, Rompa D, Cage M. Distinguishing between overlapping somatic symptoms of depression and HIV disease in people living with HIV/AIDS. Journal of Nervous and Mental Disease. 2000; 188:662–670. [PubMed: 11048815]

Langebeek N, Gisolf EH, Reiss P, Vervoort SC, Hafsteinsdottir TB, Richter C, … Nieuwkerk PT. Predictors and correlates of adherence to combination antiretroviral therapy (ART) for chronic HIV infection: a meta-analysis. BMC Medicine. 2014; 12:142. [PubMed: 25145556]

Leaver CA, Bargh G, Dunn JR, Hwang SW. The effects of housing status on health-related outcomes in people living with HIV: a systematic review of the literature. AIDS and Behavior. 2007; 11(6 Suppl):85–100. [PubMed: 17682940]

Maisto SA, Conigliaro J, McNeil M, Kraemer K, Kelley ME. An empirical investigation of the factor structure of the AUDIT. Psychoogicall Assessment. 2000; 12(3):346–353.

Markowitz M, Slater LN, Schwartz R, Kazanjian PH, Hathaway B, Wheeler D, … McCallister S. Long-term efficacy and safety of tipranavir boosted with ritonavir in HIV-1-infected patients failing multiple protease inhibitor regimens: 80-week data from a phase 2 study. Journal of Acquired Immune Deficiency Syndromes. 2007; 45(4):401–410. [PubMed: 17554217]

Miller WR, Rollnick S. Meeting in the middle: motivational interviewing and self- determination theory. International Journal of Behavioral Nutrition. 2012; 9:25.

Morrison-Beedy D, Carey MP, Tu X. Accuracy of audio computer-assisted self-interviewing (ACASI) and self-administered questionnaires for the assessment of sexual behavior. AIDS and Behavior. 2006; 10(5):541–552. [PubMed: 16721506]

Pearson CR, Simoni JM, Hoff P, Kurth AE, Martin DP. Assessing antiretroviral adherence via electronic drug monitoring and self-report: an examination of key methodological issues. AIDS and Behavior. 2007; 11(2):161–173. [PubMed: 16804749]

Sankar A, Wunderlich T, Neufeld S, Luborsky M. Sero-positive African Americans' beliefs about alcohol and their impact on anti-retroviral adherence. AIDS and Behavior. 2007; 11(2):195–203. [PubMed: 16799842]

Saunders JB, Aasland OG, Babor TF, DeLaFuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption II. Addictions. 1993; 88(6):791–804.

Tuller DM, Bangsberg DR, Senkungu J, Ware NC, Emenyonu N, Weiser SD. Transportation costs impede sustained adherence and access to HAART in a clinic population in southwestern Uganda: a qualitative study. AIDS and Behavior. 2010; 14(4):778–784. [PubMed: 19283464]

Van Dam NT, Earleywine M. Validation of the Center for Epidemiologic Studies Depression Scale--Revised (CESD-R): pragmatic depression assessment in the general population. Psychiatry Research. 2011; 186(1):128–132. [PubMed: 20843557]

Weiser SD, Bangsberg DR, Kegeles S, Ragland K, Kushel MB, Frongillo EA. Food Insecurity Among Homeless and Marginally Housed Individuals Living with HIV/AIDS in San Francisco. AIDS and Behavior. 2009; 13:841–848. [PubMed: 19644748]

Williams AB, Amico KR, Bova C, Womack JA. A proposal for quality standards for measuring medication adherence in research. AIDS and Behavior. 2013; 17(1):284–297. [PubMed: 22407465]

Table 1

Sample characteristics of people who were ART non-adherent and adherent over the six-week observation period.

	< 85% Adherent N = 325		≥85% Adherent N = 617		
Characteristics	**N**	**%**	**N**	**%**	**X^2**
Male	236	73	441	72	
Female	89	27	176	29	0.13
African American	307	95	554	90	
Caucasian	11	3	45	7	
Other ethnicities	7	2	13	3	9.26
Unemployed	88	27	167	27	0.01
Income < $10,000	217	67	390	63	1.36
Viral load Detectable	96	30	114	19	15.27**
CD4 < 200 cell/mL	71	23	84	14	11.15**
Unstable housing	142	44	244	40	5.56+
Food insecure	230	71	387	63	13.69**
Lacks reliable transportation	174	53	266	43	9.42**
Alcohol use	214	67	300	49	34.39**
Drug use	199	63	304	50	14.33**
	M	SD	M	SD	t
Age	43.4	9.7	47.4	9.5	6.02**
Years of education	12.6	1.9	12.6	1.8	0.49
Years since HIV diagnosis	13.0	7.6	13.8	8.2	1.45
HIV symptoms	4.1	3.5	3.5	3.4	2.57**
ART side effects	0.5	0.5	0.4	0.4	1.95*
CD4 cell count	440.4	288.7	532.8	370.8	3.83**
Depression (CESD)	14.2	8.9	12.7	8.6	2.43**
Stress experience	3.2	3.9	2.9	3.6	1.08

Characteristics	< 85% Adherent N = 325		≥85% Adherent N = 617		X^2
	N	%	N	%	
Medication concerns	14.3	4.6	13.3	4.5	3.33**
Medication necessity	20.7	4.0	21.5	3.7	2.78**

Note:

+ p < .10,

* p < .05,

** p < .01

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Table 2

Bivariate logistic regression models for factors associated with HIV treatment adherence.

	≥ 85% Adherent	
Characteristics	**OR**	**95% CI**
Demographics		
Education	1.01	0.94–1.09
Employment	1.00	0.74–1.36
Income	1.08	0.91–1.29
Illness Experiences		
Years since diagnosis	1.01	0.99–1.03
HIV symptoms	0.95	0.91–0.96
ART side-effects	0.75 +	0.56–1.00
Structural Barriers		
Unstable housing	0.84 *	0.70–0.99
Food insecure	0.82 **	0.73–0.91
Lacks reliable transportation	0.65 **	0.50–0.85
Mental Health & Substance Use		
Depression (CESD)	0.98 **	0.96–0.99
Stress experienced	0.98	0.94–1.01
Alcohol use	0.95	0.88–1.02
Drug use	0.25 **	0.44–0.77
Medication Beliefs		
Medication Concerns	0.95 **	0.92–0.98
Medication Necessity	1.05 **	1.01–1.08

Note:

+ p < .10,

* p < .05,

** p < .01;

adherence coded 0 = < 85% adherent, 1 = ≥ Adherent.

Psychol Health. Author manuscript; available in PMC 2017 April 01.

Table 3

Regression models predicting antiretroviral adherence (> 85% Medications taken) over a six-week period.

	Model 1		Model 2		Model 3		Model 4	
	Adj OR	**95%CI**	**Adj OR**	**95%CI**	**Adj OR**	**95%CI**	**Adj OR**	**95%CI**
Demographics								
Education	1.03	.95–1.11	1.02	0.94–1.11	1.00	0.93–1.09	1.01	0.93–1.10
Employment	.95	.68–1.33	0.93	0.66–1.31	0.95	0.68–1.34	0.96	0.68–1.35
Income	1.08	.88–1.32	1.04	0.85–1.28	1.04	0.85–1.28	1.05	0.85–1.29
Illness Experiences								
Years since diagnosis	1.00	.99–1.02	1.00	0.98–1.02	1.00	0.98–1.02	1.01	0.98–1.02
HIV symptoms	.96	.92–1.01	0.97	0.92–1.01	0.97	0.92–1.01	0.96	0.92–1.01
ART side effects	.94	.66–1.35	1.04	0.72–1.50	0.96	0.64–1.46	1.05	0.69–1.60
Structural Barriers								
Unstable housing			1.03	0.82–1.27	1.04	0.82–1.31	1.04	0.82–1.31
Food insecurity			0.87	0.76–1.00	0.88	0.76–1.02	0.88	0.76–1.02
Lacks transportation			0.82	0.58–1.14	0.82	0.58–1.15	0.88	0.62–1.24
Mental Health & Substance Use								
Depression (CESD)					0.99	0.97–1.01	1.00	0.98–1.02
Stress experienced					1.02	0.98–1.07	1.02	0.98–1.07
Alcohol use					0.95	0.95–1.03	0.96	0.88–1.04
Drug use					0.63**	0.47–0.84	0.62**	0.45–0.82
Medication Beliefs								
Medication Concerns							0.95**	0.92–0.99
Medication Necessity							1.06**	1.02–1.09
Model X^2	7.4		15.3**		27.7**		40.8**	

Note:

* p < .05.

** p < .01,

adherence coded as 0 = < 85% adherent, 1 = ≥ 85% adherent.