Published in final edited form as:

J Subst Abuse Treat. 2017 December ; 83: 15–26. doi:10.1016/j.jsat.2017.09.013.

HealthCall delivered via smartphone to reduce co-occurring drug and alcohol use in HIV-infected adults: A randomized pilot trial

Efrat Aharonovich^{a,b,*}, Malka Stohl^b, Daniela Cannizzaro^b, and Deborah Hasin^{a,b,c}

^aDepartment of Psychiatry, Columbia University Medical Center, NY, New York, USA

^bNew York State Psychiatric Institute, NY, New York, USA

^cDepartment of Epidemiology, Mailman School of Public Health, Columbia University, NY, New York, USA

Abstract

Aims—Co-occurrence of drug and alcohol use among people living with HIV is linked to poor medication adherence and lack of viral suppression. HealthCall, a technological enhancement of brief Motivational Interviewing (MI), involves brief daily self-monitoring, positive reinforcement, and personalized feedback. This randomized pilot study among people living with HIV investigated the feasibility and efficacy of reducing non-injection drug and alcohol use with MI + HealthCall as adapted for smartphone technology.

Design—An urban, largely-minority community sample of adults living with HIV were screened for eligibility: last 30 day use of non-injection drugs (4 days of crack/cocaine, methamphetamine, or heroin use) and binge drinking (1 day of 4+ standard drinks). Those eligible were randomized to one of two groups: MI-only (n = 21) and MI + HealthCall-S (n = 21). Trained counselors delivered the brief MI at baseline. Drug and alcohol use assessments were completed at baseline, 30 and 60 days (end of treatment). Primary outcomes derived from a Timeline Follow Back (TLFB) of the past 30 days included (1) total number of days used primary drug (NumDU) (2) total quantity of primary drug used (dollar amount spent per day; QuantU), (3) total number of drinking days (NumDD) and (4) mean number of drinks per day (QuantDD). Feasibility was determined by HealthCall use rates, patient satisfaction questionnaire (1–5 scale, 5 being best), and retention.

Findings—The median daily use rate for HealthCall was 95%, patient satisfaction was excellent (4.5) and retention was high (93%). Both treatment groups reduced drug and alcohol use by end of treatment, with MI+Healthcall-S showing significantly greater reductions than MI-only in QuantU (p=0.01) and NumDU (p=0.046). P-values for reductions in alcohol quantity and frequency in the MI+Healthcall group were 0.09–0.11.

*Corresponding author at: The New York State Psychiatric Institute, 1051 Riverside Drive, Box 123, New York, NY 10032, USA., efrat.aharonovich@nyspi.columbia.edu (E. Aharonovich).

Conflicts of interest

None.

Conclusions—This proof-of-concept randomized trial indicates that HealthCall on the smartphone is a highly feasible intervention in urban, minority individuals with HIV, and suggests efficacy in reducing co-occurring drug and alcohol use. Results suggest opportunities for brief behavioral intervention that may be enhanced through interactive mobile technology to address complex alcohol and drug use patterns that interfere with HIV care, medication adherence and ultimately, viral suppression. A larger randomized trial is warranted to replicate and extend present results.

Keywords

HIV; Smartphone; Co-occurring drug and alcohol use; Motivational Interviewing

1. Introduction

With improved antiretroviral therapy, survival among those with HIV has greatly improved (Antiretroviral Therapy Cohort et al., 2009; Bradley et al., 2016). However, substantial disparities remain (Hall et al., 2013) since African-Americans and Hispanics are at greater risk for HIV infection (Giordano et al., 2010; Harrison, Song, & Zhang, 2010; Siddiqi et al., 2015), and for failure to achieve viral suppression once infected (Castel et al., 2016; Xia, Sun, Wiewel, & Torian, 2017). HIV-infected individuals with alcohol and drug problems are also more likely than others to have poor health behaviors (Crane et al., 2017; Metrik, Caswell, Magill, Monti, & Kahler, 2016; Young, Wood, Dong, Kerr, & Hayashi, 2015), lower engagement in and utilization of HIV care, and lower ART adherence (Gwadz et al., 2016; Lake et al., 2017; Lucas, 2011). Further, the dual use of illicit drugs and alcohol, more than the use of either one alone, is associated with poor quality of HIV care (Dickson-Gomez, Bodnar, Petroll, Johnson, & Glasman, 2015; Korthuis et al., 2012), viral resistance to treatment, and HIV disease progression (Azar et al., 2015; Baum et al., 2009; Lima et al., 2014). Further, 34% to 46% of those with HIV and co-occurring alcohol and drug use are not virally suppressed (Hayashi et al., 2016; Ingersoll et al., 2011; Parsons, Starks, Millar, Boonrai, & Marcotte, 2014). These findings are consistent with a wider, long-standing literature showing that co-occurrence of drug and alcohol use is common (Borges et al., 2015; Grant et al., 2015; Grant et al., 2016; Hasin et al., 2006; Stinson et al., 2005) and associated with increased dependence severity, impairment, health risks, and relapse probability (Arias & Kranzler, 2008; Carroll, Rounsaville, & Bryant, 1993; Heil, Badger, & Higgins, 2001; Macdonald et al., 2014).

Evidence-based treatments for substance use disorders decrease the risk of HIV transmission (Volkow, Baler, & Normand, 2011) and improve the likelihood of initiating ART and achieving viral suppression (Altice et al., 2011). However, intervention trials generally target a single substance rather than dual-substance problems, leaving a smaller literature on dual-focused interventions. Literature reviews of existing studies show promise for such dual-focus interventions (Arias & Kranzler, 2008; Klimas et al., 2014). However, none of these studies included HIV samples, and to our knowledge, no other published trials examined dual drug-and-alcohol-focused interventions in HIV-infected samples. This is concerning, as this population has acute needs due to the risk of poor HIV outcomes. Further, decreases in healthcare funding have led to a need for interventions that require only limited clinical staff

time. Developing effective interventions for HIV-infected individuals targeting co-occurring drug and alcohol use is essential to meeting this urgent public health need, particularly for interventions that (a) can be administered with little staff time; and (b) are acceptable and easily used by disadvantaged minority group members whose rates of HIV infection continue to be high.

Communication-based technologies (e.g., those based on interactive voice response [IVR] or smartphone) offer opportunities to extend patient engagement in very brief interventions (Aharonovich et al., 2006; Justice, 2010; Rollnick, Mason, & Butler, 1999). Our group harnessed communication technology to extend very brief behavioral interventions to reduce alcohol and drug use among HIV-infected individuals, most of whom were socioeconomically disadvantaged African-Americans or Hispanics (Aharonovich et al., 2012; Aharonovich et al., 2017; Hasin, Aharonovich, & Greenstein, 2014). We refer to this intervention as HealthCall. After initial participation in a brief (25 min) motivational interview (MI) (Hettema, Steele, & Miller, 2005; Rollnick et al., 1999), HealthCall serves as a counselor extender, engaging patients in a brief daily intervention that facilitates two theoretically-based, effective components: self-monitoring and personalized feedback (Michie et al., 2012). The self-monitoring component consists of brief (2–5 min) daily interactions with an electronically administered script of questions about substance use, moods, and HIV-related health behaviors. Patients are asked to access HealthCall daily for 60 days, the duration of treatment. The personalized feedback component consists of 30-day graphs of drinking and other responses based on data from patients' daily HealthCall responses, presented to patients and discussed in 10–15 minute meetings with a counselor at 30 and 60 days. We initially used IVR as the HealthCall technology platform (HealthCall-IVR), with a recorded human voice asking the script questions and providing a limited number of reinforcing comments. We then moved HealthCall to a smartphone platform (HealthCall-S) due to its many advantages, including: 1) the ability to use videos with sound of a counselor, as well as other visual presentation of content; 2) immediate availability without requiring telephone or Wi-Fi access (note, HealthCall-S does not involve text messages to participants, which we see as potentially less engaging than the visual and voice presentation of HealthCall). At all stages of development, we made extensive use of formative feedback and input from disadvantaged minority HIV patients, and also from minority bilingual counselors who were highly experienced in working with this patient population. HealthCall has always been offered in English or Spanish.

After a successful single-arm proof-of-concept study of HealthCall-IVR to reduce unsafe drinking in HIV primary care patients (Aharonovich et al., 2006), we conducted a 3-arm randomized clinical trial (RCT) comparing MI + HealthCall-IVR, MI-only, and educational control to reduce unsafe drinking in 258 disadvantaged minority HIV primary care patients, of whom 48% were alcohol dependent (Hasin et al., 2013). At end-of-treatment (60 days), MI + HealthCall-IVR was superior to MI-only ($p = 0.03$) and control ($p < 0.01$) for drinking reduction, with results concentrated in the alcohol dependent patients. The average rate of HealthCall-IVR participation in alcohol dependent patients was 63.8% of possible days (not incarcerated or hospitalized); numerous calls were needed to remind patients to continue using HealthCall-IVR. Patient feedback about HealthCall-IVR was generally positive (helpful, easy to use), but many found the IVR repetitive. We therefore re-designed

HealthCall for the smartphone (HealthCall-S), adding video and other colorful visual features, more varied content, and increased feedback and positive reinforcements. In 41 HIV alcohol dependent patients recruited from the same HIV primary care clinic as the 3-arm study, the average rate of HealthCall-S participation was 85.0%, significantly higher ($p < 0.001$) than HealthCall-IVR (Hasin et al., 2014), with few reminder calls needed. Thus, HealthCall-S offered significantly improved patient engagement.

While still working with HealthCall-IVR, we adapted it to target non-injection drug use (NIDU). A pilot RCT in HIV primary care suggested that MI + HealthCall-IVR for NIDU was more effective than MI-only (Aharonovich et al., 2012). We then tested the efficacy of HealthCall-IVR for NIDU in 240 HIV primary care patients, comparing MI + HealthCall-IVR to MI-only and educational control (Aharonovich et al., 2017). In this study, the average daily use of HealthCall-IVR was 64.1%. Participants in all groups reduced drug use, with those receiving MI-only having significantly greater reductions than those in the other groups. Patient feedback again indicated that the IVR component was repetitive. Taken together, the studies indicated that IVR was not a sufficiently engaging technology platform for HealthCall, especially with drug users. Further, although drug and alcohol use often co-occurred in our samples, HealthCall did not address the reality of this common co-occurrence.

Therefore, we utilized the immediate accessibility and multi-media features of smartphone technology to develop a HealthCall-S version targeting co-occurring drug and alcohol use in those with HIV that was designed to be intuitive, user-friendly and engaging, and conducted a preliminary study of this version. The main goals of this study were: (1) to determine the feasibility of HealthCall-S in a largely-minority adult community sample with HIV, and (2) to obtain preliminary evidence for its efficacy in reducing co-occurring non-injection drug and alcohol use. Below, we report the findings from this randomized pilot trial.

2. Material and methods

2.1. Setting and participants

The study was conducted at the New York State Psychiatric Institute. Those eligible were HIV-positive, age 18 years, and, within the past 30 days, had 6 days of non-injection drug use (cocaine, methamphetamine or heroin) and >6 days of binge drinking (1 day of 4 drinks on one occasion). Exclusion criteria included need for alcohol detoxification, active psychosis, suicidality, homicidality, gross cognitive impairment, any injection drug use in the past 6 months, hearing or vision impairment that precluded smartphone use, and plans to leave New York during the study period. Participants provided written informed consent. The New York State Psychiatric Institute Institutional Review Board (IRB) approved all procedures.

2.2. Procedures

Participants were recruited via ads in local free newspapers and pamphlets in waiting rooms of large HIV clinics and community HIV health programs in New York City. The IRB-approved advertisement offered free research-based treatment for those with HIV currently

using drugs and alcohol who wished to cut down. Initially, 841 individuals were pre-screened by telephone. Of these, 173 were screened in-person with the Psychiatric Research Interview for Substance and Mental Disorders for DSM-IV alcohol and drug dependence (PRISM-IV-Computerized Version) (Hasin et al., 2006). Forty-seven were eligible and randomized (Study Consort, Fig. 1). In a parallel two-arm design (1:1 allocation ratio), 47 participants were assigned to Motivational Interviewing-only (MI) (n = 24) or MI + HealthCall (n = 23), with groups stratified on drug use frequency, depression, and unstable housing using urn randomization (Zhao, Weng, Wu, & Palesch, 2012). After completing baseline assessments, participants met with a trained MI counselor for a 25-minute MI session. About 20 min into the session, a study coordinator texted the MI counselors to inform them whether participants were randomly assigned to MI-only or MI + HealthCall-S. For participants assigned to MI + HealthCall-S, counselors then proceeded with the introduction to HealthCall-S. This two-step randomization process kept counselors and participants blinded to participants' randomly assigned treatment conditions until the MI was complete. Participants were compensated for their assessments at each study visit with \$40 worth of gift cards.

2.3. Interventions

2.3.1. Motivational Interviewing (MI)—The individual MI session was administered by master's-level counselors trained in standard MI techniques (Rollnick et al., 1999) by a certified MI trainer. Following guidelines in a manual we created for the study, MI counselors addressed co-occurring non-injection drug and alcohol use using standard MI techniques, e.g., eliciting commitment language to reduce drug and alcohol use, engaging in dialogue about health consequences of participants' drug and alcohol use, exploring ambivalence, and setting up drug and drinking reduction goals for the next 30 days. The total length of the baseline one-time MI session was approximately 25 min. MI quality assurance and prevention of counselor drift was maintained via weekly supervision meetings with EA, and by her review of digitally recorded MI sessions. Participants returned at 30 and 60 days after the baseline session for brief booster sessions (10–15 min) with the study counselor and for their TLFB drug and alcohol assessments conducted by an independent study evaluator. At the end of the 60-day intervention, options for continued alcohol and substance use care were discussed with each participant. Referrals to continued substance use care were offered if requested.

2.3.2. MI-only arm—The baseline MI session targeted both drug and alcohol use, beginning by identifying the participant's primary substance of concern (i.e., drug or alcohol) to discuss first. At the 30 and 60-day visits, counselors delivered a brief booster session (approximately 15 min long) discussing participants' drug use and drinking behaviors during the previous 30 days based on participants' recall. Counselors also reviewed participants' drug and alcohol goals and set new goals if participants wished to do so.

2.3.3. MI + HealthCall-S arm—At baseline, the MI session was delivered exactly as described above. If the text message near the end of the session indicated random assignment of the participant to MI + HealthCall-S, the counselor introduced the participant

to HealthCall, set up the personal drug and alcohol reduction goals, and explained how to use HealthCall on the study smartphone. Under the counselor's guidance, participants then accessed HealthCall and initiated their first HealthCall use. Participants were then asked to continue accessing and using HealthCall daily until their next 30-day visit.

2.3.3.1. HealthCall daily self-monitoring: For thirty days, participants accessed the HealthCall application directly for brief daily use (approximately 3 min) on their study smartphone. HealthCall includes a set of brief self-monitoring questions in English or Spanish (participant's preference) about the previous day (Table 1). Questions covered use of primary drug and the dollar amount spent on it, use of other drugs, drinking patterns (beverage types; number and size of drinks for each type), HIV medication adherence, safe sex practices, and feelings of wellness, stress, and overall quality of the day. The interactive verbal queries asked about 'yesterday' (morning, afternoon, evening) to ensure consistent reporting periods regardless of the time participants accessed HealthCall.

Since HealthCall serves primarily as a counselor extender, video clips showed a female bilingual 'counselor' (actually an actress) greeting participants, instructing participants on how to use each of the screens, and reinforcing a wide range of behaviors, including: (1) accessing and using HealthCall (e.g., "Thank you for using HealthCall"), (2) meeting or not meeting reduction goals (e.g., "Great! You met your goal today", "Even though you did not meet your goal today, we are glad to hear from you"), and (3) achieving abstinence (e.g., "You met your abstinence goal today. Great job!"). To prevent repetitiousness, a variety of welcome and goodbye statements were used daily. For example, participants were wished a good weekend after using the app on Fridays (e.g., "Thanks very much for checking in! We hope that you have a great weekend! Please don't forget to use HealthCall on both Saturday and Sunday").

At the end of the script, and before saying goodbye, participants saw a video clip of the counselor providing a daily tip on maintaining drug and alcohol abstinence. Participants could save daily tips into a 'tip bank' so that they could be accessed again later. (Fig. 2 shows examples of HealthCall screen content). Participants navigated between the application screens at their pace. A notification icon appeared on top of the smartphone screen if HealthCall was not used for >24 h. Additional details about the content of HealthCall-S are presented in Table 1.

2.3.3.2. HealthCall goal attainment and personalized feedback at 30-day: Data that participants entered into HealthCall were automatically transmitted to a secure server, compiled, and used to produce personalized graphs, which were viewed and discussed with participants at the 30 and 60-day booster sessions. The personalized graphs showed the participant's drug and alcohol reduction goals, his/her reported daily amount spent on drugs, and the number of standard drinks drank on each day. The participant's reported HIV medication adherence, as well as a summary of his/her goals, were presented as a summary below the graph (Fig. 3).

At the 30-day visit, the counselor presented the personalized graphs to the participant, which served as the basis for a brief 10–15-minute discussion of the participant's drug and alcohol

use, mood, other health-related behaviors, and overall well-being. If participants decided to revise their drug or alcohol reduction goals, the counselor entered the new goal into the HealthCall application. Participants were then asked to continue using HealthCall for another 30 days. At the 60-day visit, a similar session was conducted, using the personalized graph of the 31–60-day period as the basis for feedback and discussion. At the end of the 60-day session, options for continued alcohol and substance abuse care were discussed, and referrals offered if requested.

2.3.4. Provision of HealthCall smartphone—Participants assigned to HealthCall received a study smartphone (Motorola G) with the HealthCall application and a pre-paid calling and data plan installed. (HealthCall was not loaded onto participants' own smartphone if they had one to standardize its administration). The manufacture's instruction booklet on how to use the smartphone was provided. At the 30-day visit, the pre-paid plan was renewed for another 30 days. Participants assigned to MI-Only received a study smartphone or the equivalent value in gift cards at their 60-day visit to equalize compensation across the two conditions.

2.4. Assessments

Assessments included an interviewer-administered Computer-Assisted Personal Interview (CAPI), and an Audio Computer-Assisted Self Interview (A-CASI) administered at baseline prior to randomization, and at 30-day and 60-day visits. A trained research evaluator administered the CAPI, which was used to assess demographic characteristics, DSM-IV substance and psychiatric disorders, and other medical and HIV-related health variables. Alcohol withdrawal was assessed by a study interviewer prior to enrollment, and at 30-day and 60-day visits using the Clinical Institute Withdrawal Assessment of Alcohol Scale, Revised (CIWA-Ar) (Sullivan, Sykora, Schneiderman, Naranjo, & Sellers, 1989). Individuals were referred to detoxification if they received scores above 10 on the CIAW-Ar and experienced two or more withdrawal symptoms around the same time in the past 30 days.

The A-CASI assessed drug and alcohol use in the past 30 days. MI counselors were blind to the A-CASI assessment results, and participants were informed of this. Drug and alcohol use was also assessed at baseline, 30 and 60 days with a 30-day timeline-follow-back (TLFB), which uses a calendar and memory aids to reconstruct estimates of drug and alcohol use levels (Sobell & Sobell, 1995). To calculate standard drinks, participants were shown the National Institute on Alcohol and Alcoholism “What's a Standard Drink” conversion chart with drink types and glass sizes (National Institute on Alcohol Abuse and Alcoholism, 2017). If a participant missed a 30-day assessment but returned at 60 days, a retrospective TLFB was administered to cover the missed time periods, as prior studies showed that this retrospective method captured data with good reliability (Delker, Aharonovich, & Hasin, 2016; Robinson, Sobell, Sobell, & Leo, 2014). Drug use reports were confirmed with rapid urine screens (iScreens® panel for cocaine, amphetamine, methamphetamine, THC, opiates, PCP, barbiturates and benzodiazepines) at each assessment. Alcohol use reports were validated with breathalyzers. Agreement between the TLFB and confirmatory drug screen was 95.35% for those reporting drug use in the past 3 days and 63.89% for those reporting

abstinence in the past 3 days on all time points. This concordance rate is consistent with the accuracy and use of TLFB data for alcohol and drug in other studies (Aharonovich et al., 2017; Dillon, Turner, Robbins, & Szapocznik, 2005; Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000).

2.5. Feasibility and efficacy outcomes

2.5.1. Feasibility—We used three measures of feasibility. The first was engagement in HealthCall, indicated by proportion of days used out of the total number of possible days the participant could have used HealthCall (e.g., not incarcerated or hospitalized; range 1–60 days). The second was satisfaction with HealthCall use, assessed at the end of the 60-day intervention with a 7-item, 5 point Likert-like scale (1 = low; 5 = high). Examples of items were “Was HealthCall easy to use?”; “Did you find HealthCall engaging?”; “How much did you like the graphs for your drug and alcohol use?” “How helpful were the tips and tip bank” etc.) The third was completion of treatment, defined as attending the final treatment visit at 60 days. Qualitative data were also collected to obtain additional details about the specific aspects of HealthCall that participants found helpful. These data were gathered by conducting in-person interviews at the 60 day visit, during which study staff assessors asked participants open ended questions about HealthCall and recorded their responses verbatim.

2.5.2. Efficacy—Primary efficacy outcomes included (1) total number of days used primary drug (NumDU); (2) total quantity of primary drug used (dollar amount spent per day; QuantU), (3) total number of drinking days (NumDD) and (4) mean number of standard drinks per day (QuantDD). Drug and alcohol outcomes were assessed with the TLFB of the past 30 days at all time points.

2.6. Data analysis

Baseline characteristics (e.g., demographic characteristics, drug and alcohol use prior to baseline, and psychiatric disorders) were examined descriptively. Differences in continuous variables by treatment group (MI-only vs. MI + HealthCall-S) were tested using *t*-tests for normally distributed variables, and non-parametric Wilcoxon tests for other variables. Treatment group differences in categorical variables were examined using Chi-square tests.

Change in drug and alcohol use outcomes among participants was analyzed using TLFB data from the 30 and 60-day assessments (HealthCall data were not used since these data were only available from the group assigned to MI + HealthCall-S). Generalized estimating equations (GEE) were used to model the effects of time, treatment and the interaction of time x treatment on each outcome (SAS PROC GENMOD). GEE takes into account the within-subject correlations of the repeated measures. Each model controlled for baseline levels of drug or alcohol use and uses the outcome distribution with the best fit (negative binomial, Poisson) since distributional characteristics of different substance use outcomes may vary (Wagner, Riggs, & Mikulich-Gilbertson, 2015). All tests were 2-tailed, with $p < 0.05$ indicating significance and $p = 0.05$ – 0.09 indicating a trend towards significance. Effect sizes are represented with Incident Rate Ratios (IRR) and associated confidence intervals, suitable for non-normally distributed variables. IRRs reflect the ratio of expected count, or

rate, of the outcome in the MI + HealthCall group compared to the MI-only group by the end of treatment.

3. Results

3.1. Sample characteristics

Of the 47 participants (Table 2), 77% were male, 79% were African American, and 17% were Hispanic. Most (72%) were single or divorced, and 93% were unemployed, disabled, or on public assistance. The mean age of the participants was 51 years (range: 34 to 63 years). The mean number of years of HIV infection was 18.59 (SD = 7.9). All participants were prescribed HIV medication.

Twenty-four participants were randomized to MI-only and twenty-three to MI + HealthCall-S. There were no significant differences by treatment condition on any of the baseline characteristics reported in Table 2. Three participants assigned to MI-only entered inpatient alcohol detoxification immediately after randomization due to acute worsening of their drinking, and were therefore not exposed to any protocol intervention. Two participants assigned to MI + HealthCall-S reported their study smartphone lost (n = 1) or stolen (n = 1) within <48 h and were therefore not exposed to the intervention and did not contribute to the HealthCall feasibility data.

3.2. Feasibility

3.2.1. HealthCall-S: engagement and satisfaction—Of the 21 participants in the MI + HealthCall-S arm, the median rate of HealthCall-S use was 95% (range, 68.7% to 100%) of the possible 60 days, a very high engagement rate. Participants spent an average 3.09 min per day using HealthCall-S.

Participants evaluated their satisfaction with HealthCall on 7 items using 5-point Likert-like scale ratings (1 = low satisfaction; 5 = high satisfaction). The mean rating of the 7 patient satisfaction items was 4.5 (SD 0.8) out of a possible high score of 5.0, indicating high satisfaction with HealthCall. One of the primary reasons participants found HealthCall engaging was the video counselor's guidance and reinforcing qualities (e.g., “it was “comforting and soothing”, “she was encouraging”, “pleasant voice and face”, “nice to see a human face”).

3.2.2. Intervention implementation, retention and data availability by condition

—Overall treatment retention and implementation was very high for both treatments. Of the 44 individuals who received the allocated treatments, 42 (95%) completed the study (n = 21 in MI + HealthCall-S, and n = 21 in MI-Only). Levels of exposure to the counselor sessions were also comparable in both groups, with those assigned to MI-Only attending an average of 2.90 sessions and those assigned to MI + HealthCall-S attending an average of 2.95 sessions, indicating that the extra effort involved in using HealthCall did not discourage study participation. All treatment completers provided TLFB end-of-treatment data. Hence, analyses for the primary substance and alcohol use outcomes were not constrained by differential rates of attrition or data availability.

3.2.2.1. Feasibility concerns

3.2.2.1.1. Reported loss of smartphone: A feasibility concern was that participants might lose or sell the study smartphone. Of participants assigned to MI + HealthCall-S, 21 (91.3%) retained the study smartphone to the end of treatment. The two who did not reported the phone as lost ($n = 1$) or stolen ($n = 1$) within 48 h of treatment initiation, leaving them essentially unexposed to HealthCall-S.

3.2.2.1.2. Time required to train participants on HealthCall use: Of participants in the MI + HealthCall-S arm, mean minutes required for training, including the first use of HealthCall, was 5.4 min ($SD = 1.4$). For experienced users ($n = 7$), this mean was 4.3 min ($SD = 1.9$), for naïve users ($n = 10$), 5.9 min ($SD = 1.4$) and those whose smartphone experience was unknown ($n = 4$), 6.0 min ($SD = 2.9$).

3.3. Efficacy outcomes

3.3.1. Drug use

3.3.1.1. Number of days used (NumDU): Overall, the whole sample reduced the number of days of primary drug use. In the MI + Healthcall-S group, the mean number of days used primary drug in the prior 30 days was 12.8 ($SD = 4.4$) at baseline, 6.4 ($SD = 5.5$) at 30 days, and 5.0 ($SD = 4.7$) at 60 days. In the MI-only group, the mean number of days used was 15.3 ($SD = 7.3$) at baseline, 8.2 ($SD = 6.3$) at 30 days, and 8.5 ($SD = 6.1$) at 60 days (Fig. 4). NumDU was best fit using the negative binomial distribution; the GEE models showed a significantly greater reduction in NumDU in the MI + Healthcall-S group than in the MI only group at the end of treatment ($p = 0.04$) (see Table 3). Incidence Rate Ratios indicate that the MI + Healthcall-S group used on average 41% fewer days than the MI-only group ($IRR = 0.59$, 95% $CI = 0.35$ – 0.99).

3.3.1.2. Primary drug dollars spent (QuantU): In the MI + Healthcall-S group, the mean amount spent per day on drugs was \$25.2 ($SD = 16.7$) at baseline, \$11.6 ($SD = 20.2$) at 30 days, and \$7.1 ($SD = 9.0$) at end of treatment (Fig. 5). The mean amount spent in the MI group was \$28.5 ($SD = 16.6$) at baseline, \$15.3 ($SD = 14.4$) at 30 days, and \$14.6 ($SD = 12.7$) at the end of treatment. QuantU was best fit with the negative binomial distribution and the GEE models showed a significantly greater reduction in QuantU in the MI + Healthcall-S group than in the MI only group ($p = 0.01$). IRRs indicate that the MI + Healthcall-S group spent on average 50% less per day on drugs than the MI-only group ($IRR = 0.50$, 95% $CI = 0.29$ – 0.87).

3.3.2. Alcohol use

3.3.2.1. Number of days drank (NumDD): In the MI + Healthcall-S group, the mean number of days drank in the prior 30 days was 14.2 ($SD = 7.3$) at baseline, 8.1 ($SD = 8.7$) at 30 days, and 7.0 ($SD = 7.6$) at 60 days. In the MI only group, the mean number of days drank was 13.7 ($SD = 6.3$) at baseline, 6.5 ($SD = 6.6$) at 30 days, and 8.1 ($SD = 5.7$) at 60 days (Fig. 6). NumDD was best fit with the Poisson distribution and the GEE showed a trend-level greater reduction in NumDD in the MI + Healthcall-S group than the MI-Only

group at the end of treatment ($p = 0.09$) (see Table 3). The MI + Healthcall-S group drank on average 33% fewer days than the MI-only group (IRR = 0.67, 95% CI = 0.41–1.07).

3.3.2.2. Number of standard drinks per day (QuantDD): Overall, the mean number of standard drinks per day during the prior 30 days decreased in both treatment groups. In the MI + Healthcall-S group, mean drinks per day in the prior 30 days was 3.2 (SD = 2.4) at baseline, 1.2 (SD = 1.4) at 30 days, and 0.9 (SD = 1.0) at end of treatment. In the MI-only group, mean drinks per day was 2.7 (SD = 2.0) at baseline, 1.4 (SD = 2.0) at 30 days, and 1.3 (SD = 1.1) at 60 days (Fig. 7). The negative binominal distribution was the best fit for the QuantDD and the GEE model showed no significant group effect at the end of treatment ($p = 0.10$). However, the IRRs indicate a greater reduction in QuantDD, (37% fewer drinks per day) in the MI + Healthcall group than the MI-only group (IRR = 0.63 (95% CI = 0.36–1.11).

4. Discussion

In this randomized clinical trial pilot, we adapted and assessed the feasibility and preliminary efficacy evidence of brief Motivational Interviewing + HealthCall administered on a smartphone (MI + HealthCall-S) versus MI-only to reduce co-occurring alcohol and non-injection drug use in a community sample of HIV-infected adults. Participants who received MI + HealthCall-S reported significantly fewer days of drug use and significant greater drug quantity reduction at the end of the 60-day treatment. Participants in the MI + HealthCall-S also reported fewer days drinking days than participants in MI-only. Overall retention (93%) in both groups was excellent. Participant engagement in and satisfaction with HealthCall-S showed that delivery of HealthCall on a smartphone in this urban minority community sample was highly feasible. To our knowledge, this is the first randomized pilot trial evaluating the feasibility and efficacy of a smartphone-based intervention for the co-occurrence of drug and alcohol use in adult HIV infected individuals.

This randomized pilot study adds to the existing literature on the implementation of technology-based delivery of HealthCall as feasible and effective for alcohol dependence and non-injection drug use (Aharonovich et al., 2012; Hasin et al., 2013; Hasin et al., 2014). HealthCall-S for the co-occurrence of alcohol and drug use was rated by participants as highly engaging, which was consistent with the high engagement rate (95% of possible days of use). This rate was substantially higher than the rate found in our study of HealthCall-IVR (64%) in non-injection HIV-infected drug users (Aharonovich et al., 2017), and similar to the high engagement rate found in our pilot study of HealthCall-S for alcohol in alcohol dependent HIV patients (Hasin et al., 2014). This high engagement rate has several positive clinical implications that could result in improved treatment outcome. HealthCall enhances participants' daily self-monitoring, which has been shown to be an important active ingredient in the mechanisms that promote behavior change (Garnett, Crane, West, Brown, & Michie, 2015; Michie et al., 2012). As we found in earlier HealthCall trials with alcohol (Hasin et al., 2013; Hasin et al., 2014) or drug use alone (Aharonovich et al., 2012; Aharonovich et al., 2017) the continued decline in drug use from days 31 to 60 may be related to use of the personalized graphs and feedback. Compared to the 30 and 60-days sessions that rely on participants' memory of their substance use in the prior 30 days in the

MI-only group, the graphs may provide participants with more accurate feedback on progress towards their goals and solutions for barriers impeding progress. Our findings are consistent with other smartphone research suggesting that providing feedback related to goal achievement is important in reducing alcohol use (Garnett et al., 2015).

HealthCall's mechanisms of change are hypothesized to include the following: (1) increased awareness of the target behavior through self-monitoring; (2) improved accuracy about change through personalized feedback; (3) goal setting and attainment; (4) increased participant commitment to change (Aharonovich, Stohl, Ellis, Amrhein, & Hasin, 2014), and (5) improved self-efficacy (Gause et al., 2016). HealthCall-S satisfaction ratings and end of treatment debriefing indicated that participants positively endorsed these components. Future studies are needed to test whether HealthCall effects are mediated through these components and to provide empirical evidence for HealthCall's mechanism of change.

A feasibility concern was whether participants who had never owned smartphones could successfully use and engage with HealthCall-S. Our findings suggested that for such individuals, the design of the application in conjunction with the simple audio and visual instructions made navigating HealthCall-S intuitive and easy. During open-ended debriefing interviews at the end of the study, participants described the HealthCall app in the following ways: “clear and to the point”, “straight forward and uncomplicated”, “push one button and it does the rest”. There were no differences between naïve and experienced smartphone users in the time needed to learn to use HealthCall-S.

Study limitations are noted. First, the study did not include post-treatment follow-up. Previous HealthCall-IVR randomized trials included 12 months of follow-up. These studies showed long term effects in drinking reduction (Hasin et al., 2013) but did not show significant effects in the reduction of non-injection drug use (Aharonovich et al., 2017). A trial of HealthCall-S to reduce co-occurring drug and alcohol would provide information about whether the higher HealthCall-S than HealthCall-IVR engagement rate (95% vs 63%) could produce significantly better long-term outcomes for non-injection drug use and alcohol. Second, our main outcome measures for drug use (prior 30 days) did not correspond exactly with the time frame ordinarily captured by urine drug toxicology screens (prior 2–4 days). However, a sensitivity analysis showed that of the MI-only and MI + HealthCall-S participants, 14.3% and 23.8%, respectively, had negative toxicology screens at 60 days. While this difference was not significant and among heavy users, cocaine can remain detectable in urine during much longer periods of abstinence (National Institutes of Health, 2017), the results still favored the MI + HealthCall-S arm. A third limitation is that the pilot study did not include measures of HIV viral load. Thus, information about treatment effects on viral suppression was not available. However, viral load changes would generally not be detectable by 60 days (8 weeks), the duration of the present trial. Future studies should examine this in long-term follow-up. Fourth, the sample was too small to examine co-occurring mental health issues, but these should be examined in future, larger studies. Fifth, we did not test HealthCall feasibility and efficacy in a sample of physically healthy youth, but this would make an interesting and worthwhile future study goal. Sixth, the sample was too small to examine whether years with HIV, HIV medication status, tobacco use or access to different types of healthcare were associated with the outcomes, but future studies should

do this as well. Finally, we did not test a version of HealthCall-S without brief in-person counseling because we see HealthCall-S as a clinician-extender rather than as a stand-alone intervention. While a stand-alone version of HealthCall-S could be envisioned, it would require considerable additional development and would serve a different purpose than the purpose for which HealthCall-S was designed.

Our study also had several notable strengths. The design included the random assignment of a heterogeneous community sample to treatment conditions. The sample had a high proportion of disadvantaged minority participants (96%), a group of considerable health disparity concern in the HIV epidemic. Further, despite the small sample ($n = 21$ per condition), significant differences were detected between the two interventions. HealthCall-S was highly successful in engaging participants, with an engagement rate of 95%. The study had an excellent retention for those exposed to treatment (42/44; 95%) and comparable levels of data availability in both conditions.

5. Conclusions

This randomized pilot was designed to provide information on the feasibility and promise of a smartphone-based HealthCall intervention targeting co-occurring drug and alcohol use. Using smartphone technology, the MI + HealthCall-S intervention was highly feasible, and the results suggested its efficacy at reducing co-occurring drug and alcohol use compared to MI-only at the end of the 60-day treatment. The promising results from this study combined with the way that the HealthCall intervention appears to impact alcohol and substance use outcomes also suggest that HealthCall-S could be offered to diverse substance using populations rather than only those with HIV. Furthermore, because the components of HealthCall-S are theory-based and general to behavior change, HealthCall-S could be further developed and tested to target additional health behaviors, enabling staff without specialized training or technical knowledge to deliver an extended brief intervention, expanding the dissemination potential of HealthCall. As new technical developments emerge, they can be incorporated to strengthen the intervention further. With HIV now a chronic disease, those of greatest concern are vulnerable sub-populations such as individuals with alcohol and drug problems who are not virally suppressed (Hayashi et al., 2016; Ingersoll et al., 2011; Parsons et al., 2014), often members of ethnic minority groups. We suggest that the next step to expand our understanding of the utility of HealthCall in these vulnerable populations is to conduct a large randomized trial in a community sample of HIV-infected individuals with co-occurring drug and alcohol use, following them post-treatment and determining their viral loads. Success on such a next step could offer a means to improve the chances of those with HIV to sustain a meaningful and healthy recovery.

Acknowledgments

Role of funding source

This work was supported by the National Institutes of Health [grant numbers R01DA024606-S, R01AA014323]. The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

References

- Aharonovich E, Greenstein E, O'Leary A, Johnston B, Seol SG, Hasin DS. HealthCall: Technology-based extension of motivational interviewing to reduce non-injection drug use in HIV primary care patients - A pilot study. *AIDS Care*. 2012; 24(12):1461–1469. <https://doi.org/10.1080/09540121.2012.663882>. [PubMed: 22428809]
- Aharonovich E, Hatzenbuehler ML, Johnston B, O'Leary A, Morgenstern J, Wainberg ML, ... Hasin DS. A low-cost, sustainable intervention for drinking reduction in the HIV primary care setting. *AIDS Care*. 2006; 18(6):561–568. <https://doi.org/10.1080/09540120500264134>. [PubMed: 16831783]
- Aharonovich E, Sarvet A, Stohl M, DesJarlais D, Tross S, Hurst T, ... Hasin D. Reducing non-injection drug use in HIV primary care: A randomized trial of brief motivational interviewing, with and without HealthCall, a technology-based enhancement. *Journal of Substance Abuse Treatment*. 2017; 74:71–79. <https://doi.org/10.1016/j.jsat.2016.12.009>. [PubMed: 28132704]
- Aharonovich E, Stohl M, Ellis J, Amrhein P, Hasin D. Commitment strength, alcohol dependence and HealthCall participation: Effects on drinking reduction in HIV patients. *Drug and Alcohol Dependence*. 2014; 135:112–118. <https://doi.org/10.1016/j.drugalcdep.2013.11.015>. [PubMed: 24332577]
- Altice FL, Bruce RD, Lucas GM, Lum PJ, Korthuis PT, Flanigan TP, ... Collaborative B. HIV treatment outcomes among HIV-infected, opioid-dependent patients receiving buprenorphine/naloxone treatment within HIV clinical care settings: Results from a multisite study. *Journal of Acquired Immune Deficiency Syndromes*. 2011; 56(Suppl 1):S22–32. <https://doi.org/10.1097/QAI.0b013e318209751e>. [PubMed: 21317590]
- Zwahlen M, Harris R, May M, Hogg R, Costagliola D, ... Egger M. Antiretroviral Therapy Cohort C. Mortality of HIV-infected patients starting potent antiretroviral therapy: Comparison with the general population in nine industrialized countries. *International Journal of Epidemiology*. 2009; 38(6):1624–1633. <https://doi.org/10.1093/ije/dyp306>. [PubMed: 19820106]
- Arias AJ, Kranzler HR. Treatment of co-occurring alcohol and other drug use disorders. *Alcohol Research & Health: The Journal of the National Institute on Alcohol Abuse and Alcoholism*. 2008; 31(2):155–167. [PubMed: 23584817]
- Azar P, Wood E, Nguyen P, Luma M, Montaner J, Kerr T, Milloy MJ. Drug use patterns associated with risk of non-adherence to antiretroviral therapy among HIV-positive illicit drug users in a Canadian setting: A longitudinal analysis. *BMC Infectious Diseases*. 2015; 15:193. <https://doi.org/10.1186/s12879-015-0913-0>. [PubMed: 25927573]
- Baum MK, Rafie C, Lai S, Sales S, Page B, Campa A. Crack-cocaine use accelerates HIV disease progression in a cohort of HIV-positive drug users. *Journal of Acquired Immune Deficiency Syndromes*. 2009; 50(1):93–99. <https://doi.org/10.1097/QAI.0b013e3181900129>. [PubMed: 19295339]
- Borges G, Zemore S, Orozco R, Cherpitel CJ, Ye Y, Bond J, ... Wallisch L. Co-occurrence of alcohol, drug use, DSM-5 alcohol use disorder, and symptoms of drug use disorder on both sides of the U.S.-Mexico border. *Alcoholism, Clinical and Experimental Research*. 2015; 39(4):679–687. <https://doi.org/10.1111/acer.12672>.
- Bradley H, Mattson CL, Beer L, Huang P, Shouse RL, Medical Monitoring P. Increased antiretroviral therapy prescription and HIV viral suppression among persons receiving clinical care for HIV infection. *AIDS*. 2016; 30(13):2117–2124. <https://doi.org/10.1097/QAD.0000000000001164>. [PubMed: 27465279]
- Carroll KM, Rounsaville BJ, Bryant KJ. Alcoholism in treatment-seeking cocaine abusers: Clinical and prognostic significance. *Journal of Studies on Alcohol*. 1993; 54(2):199–208. [PubMed: 8459714]
- Castel AD, Kalmin MM, Hart RL, Young HA, Hays H, Benator D, ... Greenberg AE. Disparities in achieving and sustaining viral suppression among a large cohort of HIV-infected persons in care - Washington, DC. *AIDS Care*. 2016; 28(11):1355–1364. <https://doi.org/10.1080/09540121.2016.1189496>. [PubMed: 27297952]
- Crane HM, McCaul ME, Chander G, Hutton H, Nance RM, Delaney JAC, ... Kitahata MM. Prevalence and factors associated with hazardous alcohol use among persons living with HIV

- across the US in the current era of antiretroviral treatment. *AIDS and Behavior*. 2017; 21(7):1914–1925. <https://doi.org/10.1007/s10461-017-1740-7>. [PubMed: 28285434]
- Delker E, Aharonovich E, Hasin D. Interviewer-administered TLFB vs. self-administered computerized (A-CASI) drug use frequency questions: A comparison in HIV-infected drug users. *Drug and Alcohol Dependence*. 2016; 161:29–35. <https://doi.org/10.1016/j.drugalcdep.2016.01.007>. [PubMed: 26880593]
- Dickson-Gomez J, Bodnar G, Petroll A, Johnson K, Glasman L. HIV treatment for alcohol and non-injection drug users in El Salvador. *Qualitative Health Research*. 2015; 25(12):1719–1732. <https://doi.org/10.1177/1049732314568322>. [PubMed: 25595149]
- Dillon FR, Turner CW, Robbins MS, Szapocznik J. Concordance among biological, interview, and self-report measures of drug use among African American and Hispanic adolescents referred for drug abuse treatment. *Psychology of Addictive Behaviors*. 2005; 19(4):404–413. <https://doi.org/10.1037/0893-164X.19.4.404>. [PubMed: 16366812]
- Fals-Stewart W, O'Farrell TJ, Freitas TT, McFarlin SK, Rutigliano P. The timeline followback reports of psychoactive substance use by drug-abusing patients: Psychometric properties. *Journal of Consulting and Clinical Psychology*. 2000; 68(1):134–144. [PubMed: 10710848]
- Garnett C, Crane D, West R, Brown J, Michie S. Identification of behavior change techniques and engagement strategies to design a smartphone app to reduce alcohol consumption using a formal consensus method. *JMIR Mhealth Uhealth*. 2015; 3(2):e73. <https://doi.org/10.2196/mhealth.3895>. [PubMed: 26123578]
- Gause, NK., Elliott, JC., Delker, E., Stohl, M., Hasin, D., Aharonovich, E. Association between change in self-efficacy to resist drinking and drinking behaviors among an HIV-infected sample: Results from a large randomized controlled trial. *Journal of Health Psychology*. 2016. <https://doi.org/10.1177/1359105316664127>
- Giordano TP, Bartsch G, Zhang Y, Tedaldi E, Absalon J, Mannheimer S, ... MacArthur RD. Disparities in outcomes for African American and Latino subjects in the Flexible Initial Retrovirus Suppressive Therapies (FIRST) trial. *AIDS Patient Care and STDs*. 2010; 24(5):287–295. <https://doi.org/10.1089/apc.2009.0332>. [PubMed: 20438378]
- Grant BF, Goldstein RB, Saha TD, Chou SP, Jung J, Zhang H, ... Hasin DS. Epidemiology of DSM-5 alcohol use disorder: Results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry*. 2015; 72(8):757–766. <https://doi.org/10.1001/jamapsychiatry.2015.0584>. [PubMed: 26039070]
- Grant BF, Saha TD, Ruan WJ, Goldstein RB, Chou SP, Jung J, ... Hasin DS. Epidemiology of DSM-5 drug use disorder: Results From the National Epidemiologic Survey on Alcohol and Related Conditions-III. *JAMA Psychiatry*. 2016; 73(1):39–47. <https://doi.org/10.1001/jamapsychiatry.2015.2132>. [PubMed: 26580136]
- Gwadz M, de Guzman R, Freeman R, Kutnick A, Silverman E, Leonard NR, ... Honig S. Exploring how substance use impedes engagement along the HIV care continuum: A qualitative study. *Frontiers in Public Health*. 2016; 4:62. <https://doi.org/10.3389/fpubh.2016.00062>. [PubMed: 27092300]
- Hall HI, Frazier EL, Rhodes P, Holtgrave DR, Furlow-Parmley C, Tang T, ... Skarbinski J. Differences in human immunodeficiency virus care and treatment among subpopulations in the United States. *JAMA Internal Medicine*. 2013; 173(14):1337–1344. <https://doi.org/10.1001/jamainternmed.2013.6841>. [PubMed: 23780395]
- Harrison KM, Song R, Zhang X. Life expectancy after HIV diagnosis based on national HIV surveillance data from 25 states, United States. *Journal of Acquired Immune Deficiency Syndromes*. 2010; 53(1):124–130. <https://doi.org/10.1097/QAI.0b013e3181b563e7>. [PubMed: 19730109]
- Hasin D, Samet S, Nunes E, Meydan J, Matseoane K, Waxman R. Diagnosis of comorbid psychiatric disorders in substance users assessed with the Psychiatric Research Interview for Substance and Mental Disorders for DSM-IV. *The American Journal of Psychiatry*. 2006; 163(4):689–696. <https://doi.org/10.1176/ajp.2006.163.4.689>. [PubMed: 16585445]
- Hasin DS, Aharonovich E, Greenstein E. HealthCall for the smartphone: Technology enhancement of brief intervention in HIV alcohol dependent patients. *Addiction Science & Clinical Practice*. 2014; 9:5. <https://doi.org/10.1186/1940-0640-9-5>. [PubMed: 24533631]

- Hasin DS, Aharonovich E, O'Leary A, Greenstein E, Pavlicova M, Arunajadai S, ... Johnston B. Reducing heavy drinking in HIV primary care: A randomized trial of brief intervention, with and without technological enhancement. *Addiction*. 2013; 108(7):1230–1240. <https://doi.org/10.1111/add.12127>. [PubMed: 23432593]
- Hayashi K, Wood E, Kerr T, Dong H, Nguyen P, Puskas CM, ... Milloy MJ. Factors associated with optimal pharmacy refill adherence for antiretroviral medications and plasma HIV RNA non-detectability among HIV-positive crack cocaine users: A prospective cohort study. *BMC Infectious Diseases*. 2016; 16(1):455. <https://doi.org/10.1186/s12879-016-1749-y>. [PubMed: 27568002]
- Heil SH, Badger GJ, Higgins ST. Alcohol dependence among cocaine-dependent outpatients: Demographics, drug use, treatment outcome and other characteristics. *Journal of Studies on Alcohol*. 2001; 62(1):14–22. [PubMed: 11271960]
- Hettema J, Steele J, Miller WR. Motivational interviewing. *Annual Review of Clinical Psychology*. 2005; 1:91–111. <https://doi.org/10.1146/annurev.clinpsy.1.102803.143833>.
- Ingersoll KS, Farrell-Carnahan L, Cohen-Filipic J, Heckman CJ, Ceperich SD, Hettema J, Marzani-Nissen G. A pilot randomized clinical trial of two medication adherence and drug use interventions for HIV+ crack cocaine users. *Drug and Alcohol Dependence*. 2011; 116(1–3):177–187. <https://doi.org/10.1016/j.drugalcdep.2010.12.016>. [PubMed: 21306837]
- Justice AC. HIV and aging: Time for a new paradigm. *Current HIV/AIDS Reports*. 2010; 7(2):69–76. <https://doi.org/10.1007/s11904-010-0041-9>. [PubMed: 20425560]
- Klimas J, Tobin H, Field CA, O'Gorman CS, Glynn LG, Keenan E, ... Cullen W. Psychosocial interventions to reduce alcohol consumption in concurrent problem alcohol and illicit drug users. *Cochrane Database of Systematic Reviews*. 2014; 12:CD009269. <https://doi.org/10.1002/14651858.CD009269.pub3>.
- Korthuis PT, Fiellin DA, McGinnis KA, Skanderson M, Justice AC, Gordon AJ, ... Kraemer KL. Unhealthy alcohol and illicit drug use are associated with decreased quality of HIV care. *Journal of Acquired Immune Deficiency Syndromes*. 2012; 61(2):171–178. <https://doi.org/10.1097/QAI.0b013e31826741aa>. [PubMed: 22820808]
- Lake S, Kerr T, Capler R, Shoveller J, Montaner J, Milloy MJ. High-intensity cannabis use and HIV clinical outcomes among HIV-positive people who use illicit drugs in Vancouver, Canada. *The International Journal on Drug Policy*. 2017; 42:63–70. <https://doi.org/10.1016/j.drugpo.2017.02.009>. [PubMed: 28336000]
- Lima VD, Kerr T, Wood E, Kozai T, Salters KA, Hogg RS, Montaner JS. The effect of history of injection drug use and alcoholism on HIV disease progression. *AIDS Care*. 2014; 26(1):123–129. <https://doi.org/10.1080/09540121.2013.804900>. [PubMed: 23767757]
- Lucas GM. Substance abuse, adherence with antiretroviral therapy, and clinical outcomes among HIV-infected individuals. *Life Sciences*. 2011; 88(21–22):948–952. <https://doi.org/10.1016/j.lfs.2010.09.025>. [PubMed: 20888839]
- Macdonald S, Pakula B, Martin G, Wells S, Borges G, Roth E, ... Callaghan RC. Health profiles of clients in substance abuse treatment: A comparison of clients dependent on alcohol or cocaine with those concurrently dependent. *Substance Use & Misuse*. 2014; 49(14):1899–1907. <https://doi.org/10.3109/10826084.2014.935791>. [PubMed: 25099309]
- Metrik J, Caswell AJ, Magill M, Monti PM, Kahler CW. Sexual risk behavior and heavy drinking among weekly marijuana users. *Journal of Studies on Alcohol and Drugs*. 2016; 77(1):104–112. [PubMed: 26751360]
- Michie S, Whittington C, Hamoudi Z, Zarnani F, Tober G, West R. Identification of behaviour change techniques to reduce excessive alcohol consumption. *Addiction*. 2012; 107(8):1431–1440. <https://doi.org/10.1111/j.1360-0443.2012.03845.x>. [PubMed: 22340523]
- National Institute on Alcohol Abuse and Alcoholism. What is a standard drink?. 2017. Retrieved July 27, 2017, from <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/what-standard-drink>
- National Institutes of Health. Toxicology screen. U.S. National Library of Medicine; 2017. <https://medlineplus.gov/ency/article/003578.htm>
- Parsons JT, Starks TJ, Millar BM, Boonrai K, Marcotte D. Patterns of substance use among HIV-positive adults over 50: Implications for treatment and medication adherence. *Drug and Alcohol*

- Dependence. 2014; 139:33–40. <https://doi.org/10.1016/j.drugalcdep.2014.02.704>. [PubMed: 24745475]
- Robinson SM, Sobell LC, Sobell MB, Leo GI. Reliability of the Timeline Followback for cocaine, cannabis, and cigarette use. *Psychology of Addictive Behaviors*. 2014; 28(1):154–162. <https://doi.org/10.1037/a0030992>. [PubMed: 23276315]
- Rollnick, S., Mason, P., Butler, CC. *Health behavior change: A guide for practitioners*. London, UK: Churchill Livingstone; 1999.
- Siddiqi AE, Hu X, Hall HI. Centers for Disease C & Prevention. Mortality among blacks or African Americans with HIV infection–United States, 2008–2012. *MMWR. Morbidity and Mortality Weekly Report*. 2015; 64(4):81–86. [PubMed: 25654607]
- Sobell, LC., Sobell, MB. Alcohol consumption measures. In: Allen, JP., Columbus, M., editors. *Assessing alcohol problems: A guide for clinicians and researchers*. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; 1995. p. 55-73.
- Stinson FS, Grant BF, Dawson DA, Ruan WJ, Huang B, Saha T. Comor-bidity between DSM-IV alcohol and specific drug use disorders in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Drug and Alcohol Dependence*. 2005; 80(1):105–116. <https://doi.org/10.1016/j.drugalcdep.2005.03.009>. [PubMed: 16157233]
- Sullivan JT, Sykora K, Schneiderman J, Naranjo CA, Sellers EM. Assessment of alcohol withdrawal: The revised clinical institute withdrawal assessment for alcohol scale (CIWA-Ar). *British Journal of Addiction*. 1989; 84(11):1353–1357. [PubMed: 2597811]
- Volkow ND, Baler RD, Normand JL. The unrealized potential of addiction science in curbing the HIV epidemic. *Current HIV Research*. 2011; 9(6):393–395. [PubMed: 21999774]
- Wagner B, Riggs P, Mikulich-Gilbertson S. The importance of distribution-choice in modeling substance use data: A comparison of negative binomial, beta binomial, and zero-inflated distributions. *The American Journal of Drug and Alcohol Abuse*. 2015; 41(6):489–497. <https://doi.org/10.3109/00952990.2015.1056447>. [PubMed: 26154448]
- Xia Q, Sun X, Wiewel EW, Torian LV. Brief report: HIV prevalence and the prevalence of unsuppressed HIV in New York City, 2010–2014. *Journal of Acquired Immune Deficiency Syndromes*. 2017; 75(2):143–147. <https://doi.org/10.1097/QAI.0000000000001311>. [PubMed: 28207429]
- Young, S., Wood, E., Dong, H., Kerr, T., Hayashi, K. Daily alcohol use as an independent risk factor for HIV seroconversion among people who inject drugs. *Addiction*. 2015. <https://doi.org/10.1111/add.13256>
- Zhao W, Weng Y, Wu Q, Palesch Y. Quantitative comparison of randomization designs in sequential clinical trials based on treatment balance and allocation randomness. *Pharmaceutical Statistics*. 2012; 11(1):39–48. <https://doi.org/10.1002/pst.493>. [PubMed: 21544929]

Fig. 1.
CONSORT diagram of participant flow into the study June 2015–December 2015.

Fig. 2.
HealthCall's screens (sample).

Fig. 3.
The 30-day personalized HealthCall report (sample).

Fig. 4.
Reduction in frequency of drug use (NumDU) by treatment group.

Fig. 5.
Reduction in quantity of drug use (QuantU) by treatment group.

Fig. 6.
Reduction in frequency of days drank alcohol (NumDD) by treatment group.

Fig. 7.
Reduction in quantity of drinks per drinking day (QuantDD) by treatment group.

Table 1

HealthCall daily smartphone content.

HealthCall daily smartphone main queries and statements*	Purpose
1. Varied welcome greeting	Reinforce calling, add variety
2. Primary drug frequency: number of times used?	Self-monitor
3. Primary drug quantity: dollar amount used?	Self-monitor
4. Level of desire to use primary drug?	Self-monitor
5. Level of commitment to reduce primary drug use?	Strengthen commitment
6. Thought about primary drug goal?	Reminder of goal
7. Reasons for using primary drug?	For 30- and 60-day meetings
8. Reasons for not using prim drug?	Build self-efficacy
9. Offer of 7-day primary drug use graph	Self-monitor progress
10. Reinforce drug abstinence, goals, using the app	Build self-efficacy, add variety
11. Alcohol quantity: wine/beer/liquor?	Self-monitor
12. Level of desire to drink?	Self-monitor
13. Level of commitment to reduce drinking?	Strengthen commitment
14. Thought about alcohol goal?	Reminder of goal
15. Reasons for drinking?	For 30- and 60-day meetings
16. Reasons for not drinking?	Build self-efficacy
17. Offer of 7-day alcohol graph	Self-monitor progress
18. Reinforce alcohol abstinence, goals, using the app	Build self-efficacy, add variety
19. Other (non-primary) illicit drug use	Self-monitor
20. If on HAART, all HIV meds taken?	Self-monitor
21. Reasons for taking HIV meds?	Build self-efficacy
22. Reasons for not taking HIV meds?	For 30- and 60-day meetings
23. If had sex, was protected?	Self-monitor
24. Mood? Stress? Wellness?	Identify drug or alcohol triggers, patterns
25. Dally "tip"	Skills to cut down
26. Offer to call counselor re: drug and alcohol use	Provide assistance if wished

primary drug use

alcohol use

other

both primary drug and alcohol use

* reminds participants that questions pertain to "yesterday" (e.g. morning, afternoon, evening, and night)

Table 2

Baseline Characteristics of Mobile HealthCall Study Participants

	MI Only n = 24	MI + Healthcall n = 23	Full Sample N = 47	
		Prevalence (%)		p-value ^b
Female	20.83	26.09	23.40	0.67
Ethnicity				
African American	79.17	78.26	78.72	0.28
Hispanic	12.50	21.74	17.02	
Other	8.33	0.00	4.26	
High school education	79.17	82.61	80.85	0.76
Married / stable relationship	25.00	30.43	27.66	0.67
Employed	4.17	8.70	6.38	0.52
On probation or parole	4.17	0.00	2.13	0.32
DSM IV diagnoses, from PRISM interviews				
Lifetime DSM-IV drug dependence	100	100	100	1.00
Current DSM-IV drug dependence ^a	100	100	100	1.00
Lifetime alcohol dependence	91.67	82.61	87.23	0.35
Current DSM-IV alcohol dependence ^a	79.17	82.61	80.85	0.76
Any lifetime major depressive disorder	12.50	30.43	21.28	0.13
Borderline personality disorder	29.17	39.13	34.04	0.47
Antisocial personality disorder	25.00	4.35	14.89	0.05
Primary drug type				0.27
Crack	95.83	86.96	91.49	
Cocaine	4.17	13.04	8.51	
		Mean (SD)		p-value ^c
Age, years	50.92 (7.21)	51.00 (7.02)	50.96 (7.04)	0.99
Years since HIV diagnosis	19.94 (7.59)	18.23 (7.88)	18.59 (7.66)	0.67
Number of days used past 30 days				
Primary drug	13.96 (7.95)	13.17 (4.87)	13.57 (6.57)	0.99
Alcohol	13.08 (7.26)	14.48 (7.34)	13.77 (7.25)	0.60
Quantity used per day past 30 days				
Mean \$ amount Primary drug	26.96 (17.63)	27.68 (19.77)	27.31 (18.51)	0.88
Mean standard drinks	2.51 (2.06)	3.45 (2.62)	2.97 (2.37)	0.18

MI = motivational interviewing; SD = standard deviation.

^aDSM-IV diagnosis based on 30 days prior to baseline.

^bChi-square test for significant differences between treatment groups for indicated baseline characteristic.

^cWilcoxon test for significant differences between treatment groups for indicated baseline characteristic.

Table 3

Treatment effect on drug and alcohol use outcomes at 30 and 60 days from generalized estimating equation (GEE) model.^a

Drug outcomes	MI + HealthCall versus MI-only ^f	
	Incidence Risk Ratio (IRR) (95% confidence interval)	p-Value
NumDU ^b		
30 days	0.88 (0.55–1.39)	0.57
60 days	0.59 (0.35–0.99)	0.04
QuantU ^c		
30 days	0.72 (0.40–1.30)	0.27
60 days	0.50 (0.29–0.87)	0.01
Alcohol outcomes	MI + HealthCall versus MI-only	
	Incidence Risk Ratio (IRR) (95% confidence interval)	p-Value
NumDD ^d		
30 days	0.98 (0.56–1.74)	0.95
60 days	0.67 (0.41–1.07)	0.09
QuantDD ^e		
30 days	0.76 (0.35–1.64)	0.48
60 days	0.63 (0.36–1.11)	0.11

^a All models control for baseline level of use (drug or alcohol).

^b NumDU = mean number of days used primary drug 30 days prior to study visit.

^c QuantU = mean dollar amount per day used over 30 days prior to study visit.

^d NumDD = mean number of days drank during 30 days prior to study visit.

^e QuantDD = mean number of drinks per day during the 30 days prior to study visit.

^f MI-only = reference group.