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The LIVE Network: A Music-Based Messaging Program to Promote ART Adherence Self-Management

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Abstract

We developed and pilot-tested the efficacy, acceptability, and feasibility of a music program, The LIVE Network (LN), compared to standard care on outcomes of ART adherence, clinical indicators, and self-efficacy. The study was powered to detect differences at $p < 0.1$. We enrolled and followed 77 participants for 12 weeks (T3). Mean monthly pill counts (PC) declined over time in both groups. Although not significant, the LN had higher PC and a larger proportion had plasma anti-retroviral trough levels within therapeutic range. The LN group did have significantly ($p < 0.1$) increased levels of adherence self-efficacy and decrease in viral loads.

Keywords

HIV/AIDS; Adherence; Antiretroviral therapy; Music program; Self-management

Introduction

Advances in HIV pharmacotherapy and the introduction of antiretroviral therapy (ART) have led to sustained virologic suppression and remarkable reductions in HIV/AIDS associated morbidity and mortality. HIV infection is now widely accepted as a chronic illness with current management strategy directed at complete virologic suppression, optimal CD4 T cell recovery, promotion of ART adherence, and limiting the sequelae of life-long therapy. The need for optimal ART adherence and complete virologic suppression has become more relevant because they are also linked to reduction in the risk of HIV transmission to the uninfected sexual partner [1]. Successful treatment with ART is both a personal and public health priority.

While life-long ART adherence and self-management are essential for the sustenance of the benefits of ART, achieving this goal is complicated by the chronicity of the HIV infection, as well as issues such as substance use, depression, poor social support, and medication side effects. Current ART adherence-promoting behavioral interventions range from

predominately psycho-educational (e.g., to promote self-efficacy), direct observation of drug ingestion, and emerging technological based text-messaging reminders. While these approaches have been effective in certain instances, they have not been universally applicable. Alternative strategies that are culturally relevant with wider appeal and the potential to target diverse groups are needed. Music provides a vehicle for a broad reaching intervention that can be targeted to various cultures depending on the genre(s) chosen. This report provides results of a project to develop and pilot test the efficacy and feasibility of an audio music program to promote adherence self-management for HIV infected persons. Specifically we tested the feasibility and acceptability of the LIVE Network (LN) program and sought to determine whether its use improved adherence to ART (including clinical outcomes) and facilitated medication-related symptom management. Based in Bandura's Social Cognitive Theory, we also explored the effects of the LN program on self-efficacy for adherence. Self-efficacy, belief in one's ability to complete the activities required to perform a specific behavior, has been consistently linked to higher adherence in over the past 10 years of adherence research. In the LN program we incorporated scenarios that enhanced self-efficacy such as vicarious experiences (listening to others experiences in talk segments and scenarios of songs), verbal persuasion for motivation ("you can do it"), physiological cues (information about meaning of CD4 and viral load as indicators, side effects information), personal goal setting (set adherence goals).

Why Music?

Studies have shown that music synchronizes portions of the brain's right and left hemispheres that stimulate emotions, focus attention, and increase motivation [2]. Music has universal appeal and the potential to evoke transformational learning in adults [3]. Music-based messaging can enhance learning, retention, and recall of information [2]. Music provides a medium for disseminating messages in a culturally relevant manner that does not rely on literacy level and helps motivate individuals to initiate and maintain health behaviors through sounds and lyrics. Music-based messaging has been used effectively in several studies on health promotion, behavior, and pain and anxiety reduction. It has also been used in HIV prevention with several populations: teens [4], rural residents in Ghana [5], and in rural African communities [6]. However, we could find no studies that use music to promote ART adherence self-management. In the LN program we provide information, create experiences, and use verbal persuasion and motivation to strengthen self-efficacy for adherence through music and lyrics.

Methods

The project had three phases. First we ascertained the preferred music genres of the target population. We conducted a survey of 135 study site patients (76 % of the participants were between 40 and 59 years, 86 % were African American, and 59 % owned an MP3 or personal CD player) who had been on ART for at least 6 months. The top 10 genres identified were in order: Gospel, Rhythm and Blues (R&B), Oldies, Hip-hop, Motown, Smooth Jazz, Easy Listening, Soul, Blues, and House. Second, we developed the music program and reference manual and conducted three focus groups to determine initial feasibility, likeability, and satisfaction with the LN and manual. These results are published elsewhere [7]. Third, we conducted a pilot randomized controlled clinical trial (RCT) to examine the efficacy of the program compared to standard care (SC). This pilot was designed for 80 % power with alpha of 0.10 to detect moderate-to-large effect sizes. At the end of the pilot phase, we also conducted an evaluation survey regarding feasibility, likeability, and satisfaction. The project was approved by the Institutional Review Board of Emory University on March 28, 2008 and all participants signed informed consent

documents as appropriate for each phase. The results of each phase were integral to the next phase. This report focuses on the results of the third phase.

Intervention

The LIVE (pronounced “liv”) Network (LN) is a 70 min pre-recorded audio music program that uses a simulated DJ talk show format to educate and motivate persons living with HIV/AIDS to adhere to ART and manage medication-related symptoms and side effects. It is designed to enhance self-efficacy (self-confidence), outcome expectancy (attitudes), and personal goals for adherence and self-management of medication-related symptoms and side effects. The DJ refers questions and comments from “callers” to three experts: an infectious disease physician and HIV researcher (IO), a nurse practitioner HIV provider and researcher (MH) and a nurse educator (the project research nurse). The experts incorporate motivational interviewing (MI) techniques when responding to the callers; they provide information and suggest strategies to enhance adherence and self-management skills. Throughout the program, the DJ plays ten original songs written and produced by Positive Records, Inc. (SL), in conjunction with the project investigators. The songs synthesize and summarize the content using the top genres from our music survey. The program is in MP3 format and can be re-played in whole or parts as often as desired to increase learning and motivation. The dramatic setting of the music and narrative lends itself to a vicarious experience, and the believability and relevance of the situation fosters identification with the material. The music is of very high quality, promoting listening and the desire to share it with others, as we learned from the focus groups. The vernacular presentation of medically correct information makes it more attractive and easy to listen to. The audio program contains 23 tracks: four jingles (brief music interludes), eight radio talk interludes, ten songs, and an Outro (goodbye) segment. Most of the LN songs last from 3.5 to 5 min. Consistent with Social Cognitive Theory, the primary persuasive messages conveyed throughout the songs are “you can do it” (self-efficacy) and “take every dose every day” (adherence).

There is an accompanying manual that contains song lyrics, listening diary, and supplementary content on the topics brought up in each song. Chapters in the manual include the song lyrics and a log for recording lab results, effects of adherence on lab results, symptoms and side effects, need for support, motivation, values, overcoming adherence barriers, goal setting, stress and depression, and disclosure. Several chapters contain exercises using MI techniques such as confidence rulers, goal setting, and values clarification, whereby participants work through overcoming barriers to adherence, increasing self-confidence and motivation to adhere and deal with symptoms, and developing goals for self-management of their HIV. We also activated an 800 number that participants could call with questions. Development of the program and materials took place between July 25 and Dec 7, 2008.

Procedures

Setting and Recruitment

The entire project took place at a large urban infectious disease clinic located in the Southeastern US. This site serves over 5,000 HIV infected men, women, and children. About 25 % of the clients are women, about 78 % are African American, and 17 % are Caucasian. The clinic receives Ryan White funding and provides comprehensive care. The SC for all patients who begin or change ART at the site is that they receive at least one visit with a nurse educator prior to starting medications. At that visit, the nurse provides medication education, assistance with developing a dose schedule, and side effect recognition and management.

The pilot RCT was conducted from January to December 2009. Potential participants were recruited using fliers, referrals from providers and staff, and self-referral. Eligibility criteria included: HIV infected; started or changed ART regimen in the past 6 months; 18 years of age or older; English speaking; mentally stable as determined by a screening assessment [mini-mental status exam (MMSE) and Brief Symptom Inventory (BSI)]; and willing to participate in study activities, assessments, monthly pill counts, and be randomly assigned to either condition. Potential participants were excluded if they had a history of or self-identified bilateral hearing loss, severe cognitive impairment based on the cut score of 24 (after adjustment for low literacy levels) on the MMSE, or current evidence of severe depression or suicidal ideations (based on responses to 11 key items on the BSI related to suicidal ideations, severe depression and psychotic behaviors). The latter individuals were immediately referred for counseling and were eligible to re-screen after treatment. Eligible participants were randomized 2:1 to LN or SC after the baseline assessment. Those randomized to LN were scheduled for a supervised listening session where they were given and instructed in use of a MP3 player (with ear buds) containing the LN pre-loaded. The supervised listening session occurred on-site and participants listened to the complete 70 min program using their MP3 player with ear buds. They were encouraged and reminded to listen to the program regularly at each follow-up session throughout the entire 12 weeks study however we did not ‘prescribe’ a listening frequency.

All participants were assessed at baseline (T1), 6 weeks (T2), and 12 weeks (T3) using ACASI computer administered surveys, and had a blood test for antiretroviral plasma trough level at T3. Each participant also had monthly in-person or telephone pill counts. Data collectors were not blinded to intervention arms. All participants received monetary incentives for completion of the assessments and pill counts as well as snacks and transportation reimbursement. Childcare was provided at the site if needed. The LN group could keep the MP3 player and manual and those in the SC received the MP3 player with LN and program manual at the end of the study to promote study retention.

Measures

Adherence—We conducted *pill counts* (PC) of each antiretroviral medication at the screening visit and then at baseline and monthly for 12 weeks (3 months) of the study. We collected blood for *plasma ARV trough levels* for the primary antiretroviral medication (PI or NNRTI based on our preestablished protocol) at T3. Due to cost constraints, we were only able to collect these at T3. Collection of the sample was timed to correspond to just before the next dose of the target medication (plus or minus 1 h). Participants were asked not to take their medication on the day of the blood test until after the blood was drawn. Drug levels were measured by high performance liquid chromatography and UV-detection in the pharmacology laboratory at the University of Alabama—Birmingham using standardized procedures.

Clinical Outcomes—*CD4 count and viral load levels* are clinical indicators of adherence. All results available during the 12 weeks of the study were extracted from each participant's medical records. Results below viral load log of 1.88 were considered below the level of detection (correspond to <40 copies/ml).

Symptoms and symptom distress were assessed using the ACTG Symptom Distress Module (ASDM) [8]. It asks if the respondent experienced any of the 20 common symptoms in the past 4 weeks and the level of distress each symptom causes (“it doesn't bother me” to “it bothers me a lot”). Cronbach's alpha for this scale was 0.91. *Depression*, commonly associated with poor adherence, was measured using the Center for Epidemiologic Studies

Depression Scale (CES-D) [9] with an alpha reliability of 0.87. Scores of 16 correspond to clinical depression.

Self-Efficacy—We measured self-efficacy for both adherence and symptom management. The *adherence self-efficacy* instrument is a 19 item scale based on Bandura's conceptualization of self-efficacy. Items are rated on an 11 point scale from 0 (I cannot do at all) to 10 (Sure I can do). Cronbach's alpha for this scale was 0.92. We used a visual analogue scale to measure *self-efficacy for managing symptoms*[10].

Process Measures—To determine feasibility, use, likeability, and satisfaction we conducted an end of study evaluation of the LN. Participants rated songs and manual chapters on a scale of 0 (hated it) to 10 (loved it) and provided feedback on how often they listened to the program and used the manual and 800 number, as well as suggestions for improvements.

Analyses

Data were analyzed using SPSS, v.20 (IBM Corporation © 2011). Descriptive statistics were computed to summarize the measures for the overall sample and subgroups as well as evaluate the underlying distributions and extent of any missing data over time. Parametric and non-parametric methods such as *t* tests, Mann–Whitney, Wilcoxon Rank Sum test, Chi square and Fisher's Exact tests (FET) (when more than 20 % of the cells had expected counts <5) were used as indicated for normally distributed and skewed variables as well as dichotomized and categorical variables. Internal consistency reliability coefficients were computed on instruments by calculating Chronbach's alpha. The original design was planned for 80 % power with alpha set at 0.10 to detect moderate-to-large effect sizes (ES) (e.g. Cohen's $d > 0.50$) for an expected enrollment sample size of 72 (using a 2:1 allocation ratio) with anticipated attrition rate of 17 % yielding 60 subjects completing the study. Thus, statistical tests were considered significant for $p < 0.10$. Multilevel mixed models (MLM) was used to compare viral load (inverse of log transform) and CD4 percents between groups and over time. Repeated measures analysis of variance (RM-ANOVA) and non-parametric Friedman's ANOVA were conducted to examine changes in PC between and within groups over time. A χ^2 test was used to compare the proportion of persons in each group at or above antiretroviral therapeutic drug levels at T3. Logistic regression was used to calculate the odds ratio of increased depressive symptoms on adherence (drug trough levels).

Results

The study flow diagram is depicted in Fig. 1. We screened 109 potential participants and enrolled 77 persons who started or changed ART within the previous 6 months. Participants were randomized 2:1 to LN ($n = 51$) or SC ($n = 26$) at baseline (T1). Sixty-nine (LN = 45; SC = 24) completed the 6 weeks (T2) and 64 (LN = 42; SC = 22) completed the 12 weeks (T3) assessments, which was an 83 % retention rate as was expected in the original proposed study design. One LN subject withdrew due to illness. Attrition was not significantly different by group at either time point (T2 FET $p = 0.710$ and at T3 FET $p = 1.000$).

Mean age was 44.7 years; 65 % ($n = 50$) were male, and 88 % ($n = 68$) were African American (AA). About 58 % ($n = 45$) self-identified as heterosexual, 26 % ($n = 20$) as gay/homosexual, and 8.7 % ($n = 6$) as bisexual. Participants were HIV infected for 9.6 years (median). Median monthly income was \$674. Both groups were equivalent in all variables except for a borderline difference in race: 94 % of LN was AA versus 77 % of SC (FET, $p = 0.054$) (Table 1). Study outcomes are displayed in Table 2.

Adherence

At T3, mean adherence rates (measured by PC) had declined over time for both groups. However, the drop was greater for the SC compared to the LN group: 67 % (14 of 21) of SC but only 52 % (22 of 42) of LN subjects dropped below their baseline adherence rates

($\chi^2_{(1)}=1.167, p=0.280, n=63$). While not statistically significant, mean monthly PCs adherence rates were higher at T3 for LN participants (77.8 % vs. 70.6 %). Also at T3, 80.5 % of LN participants versus 72.7 % of SC had ARV plasma trough levels at or above the DHHS guidelines recommended therapeutic range [11] ($FET, p=0.534, n=63$).

CD4 percent (%) and viral load (VL) (inverse of log transform) were analyzed using multilevel mixed (MLM) models (SPSS MIXED). Sixty-two subjects had one or more lab samples (CD4 and viral load) taken once a month between 1 month prior to enrollment through 12 weeks. Due to attrition and intermittent missing lab samples, 98 total CD4 %'s and 116 viral loads were available for analysis. Of these 62 subjects, only 33 had CD4 %'s in the month prior to enrollment and 41 had "baseline" viral loads. The MLM model for viral loads was fit for the inverse of the log transform of the viral loads (to adjust for skewness) for group, time, and group-by-time effects with random intercept and slope. The equations for the fitted lines were back-transformed for the plots (Fig. 2) of viral load log across time per group. There was a negative slope (the desired direction) for the LN group whereas the SC showed a positive slope over time (increasing viral loads). There was a significant ($p < 0.10$) group-by-time interaction effect ($F_{(1,33.6)} = 3.572, p = 0.067$, moderate-to-large effect size (ES) = 0.65). No significant group-by-time differences were seen for CD4 % ($F_{(1,32.8)} = 0.213, p = 0.648$).

Adherence self-efficacy scores improved in the LN group from T1 to T3 (Friedman's ANOVA $\chi^2_{(2)}=5.1, p=0.080$). No significant changes were seen for the control group (Friedman's ANOVA $\chi^2_{(2)}=2.6, p=0.273$). Wilcoxon pairwise post hoc tests using Bonferroni corrected alpha = 0.033 indicated significant differences for the LN group between both T1 and T3 ($Z = -2.39, p = 0.017$) and T2 and T3 ($Z = -2.39, p = 0.017$). While the Wilcoxon paired rank tests yielded the same test statistics for the differences for the LN group from T1 to T3 and T2 to T3, the largest improvement was between T1 and T3 where ART adherence self-efficacy scores increased by 6.05 (SD = 12.97) yielding a moderate ES (Cohen's d) of 0.47.

There were no differences between or within groups in numbers of *symptoms or symptom distress*. However, *self-efficacy for symptom management* scores declined from T2 to T3 in the SC group (from 89.2 at T2 to 87.0 at T3; with only 33.3 % of the SC subjects improved) and increased in the LN group (from 87.8 at T2 to 92.3 at T3; with 44.4 % of the LN subjects improved) ($\chi^2_{(1)}=0.614, p=0.433$). Participants with higher CES-D scores (*depressive symptoms*) at T1 were 1.08 times more likely to have drug trough levels below the therapeutic level at T3 (per one point increased in CES-D scores) (*logistic regression CES-D depression coefficient* $B = 0.072, SE = 0.033, Wald test statistic = 4.767, df = 1, p = 0.029$). Those with drug trough levels below the therapeutic level had an average CES-D score of 17.2 (SD 12.4) which is consistent with depression and was 7.0 points higher than the participants at or above therapeutic drug trough levels (CES-D mean 10.3, SD 8.0) ($t_{(58)} = 2.45, p = 0.017$, moderate-to-large $ES = 0.64$).

LN Program Evaluation

Most (47 of 51) LN participants completed an end-line evaluation, rating satisfaction, likability, and usage, and providing suggestions for improvement. In general, responses were overwhelmingly positive. Combining "agree" and "strongly agree" responses, we found that

respondents: liked the DJ segments (85 %), liked the music styles (81 %), and found the lyrics easy to understand (85 %). Similarly, they found the manual easy to use (89 %), felt it was understandable (89 %), and liked and found it helpful (87 %). Participants listened to the songs frequently (17 % reported listening to the songs 6–10 times, and 43 % reported listening >10 times in the prior 3 months). They also listened repeatedly to the DJ segments (43 % reported listening 1–5 times, 21 % listened 6–10 times, and 30 % listened >10 times). Overall the manual was used less than the songs: 11 % reported not using the manual at all; 38 % used it 1–5 times; 28 % used it 6–10 times, and only 23 % used it >10 times in the prior 3 months. Participants rated each song and manual section on a 0 (hated it) to 10 (loved it) scale. Every song and all but one manual section received mean ratings over 8.5. Fifty-four percent ($n = 25$) of participants reported using the 800 number and majority of those ($n = 18$) used it only 1–5 times during the 12 weeks. We suspect many did not use the 800 number because the clinic was easily accessible and patients preferred to come in-person, provide feedback at the follow-up sessions, or call the study office with questions. Feedback we received from all venues included questions about or problems with MP3 player, comments on the songs, and suggestions for future enhancements. Participants would often remark that they were unsure about the program when they started the study, but really liked it once they listened. One man called to ask if he could share the program with his wife so she can better understand his depression. One caller suggested producing accompanying music videos. In the end-line evaluation, only a few participants made suggestions for changes to the LN. One person wanted more jazz, two wanted more songs, one said the music style was too young, and two felt the manual was too large.

Discussion

This article reports on an innovative project. We believe we are the first to use music to promote antiretroviral adherence and medication-related symptom self-management. The LN music program was well liked and listened to regularly and repeatedly by the participants. As noted in HIV prevention studies in low resource countries, music-based messaging may work well for low literacy groups, and our future work will include literacy variables. Measuring adherence using therapeutic drug levels in plasma was also innovative; the measure was easy to collect, and doing so enhanced the objectivity of the findings.

Due to its pilot nature, the study was powered to detect changes at an alpha of 0.1 or less with a moderate-to-large effect size. Adherence declined over time, which has been noted in in other adherence studies. Although not statistically significant, the LN had higher PC and a larger proportion had plasma antiretroviral trough levels within therapeutic range. There were significant changes ($p < 0.1$) in viral load and adherence self-efficacy and the effect sizes were in the moderate-to-large range. Results provide encouragement for revision of the program and more comprehensive study. One of the main goals of the LN was to improve self-efficacy for adherence, an important mediator for adherence and its positive consequences. We demonstrated an improvement in this variable. The largest and statistically significant improvement in self-efficacy occurred between T1 and T3, suggesting that a longer study might show sustainable improvements. Numerous studies have validated self-efficacy to be a consistent mediator of ART adherence. It is also a key variable needed to attain and maintain health behavior as noted by its inclusion in behavioral theories such as Social Cognitive Theory (our framework), The Information, Motivation and Behavior Skills Theory, and Health Belief Model. Research has shown that high/low levels of self-efficacy are associated with high/low adherence. Revisions to strengthen the self-efficacy component are warranted. If we can increase and sustain self-efficacy, through continued use of the LN program, there is theoretical and research data that support adherence could be increased.

We also saw a non-significant trend toward improvement in self-efficacy for symptom self-management in the LN group, but there were no significant differences between groups in the numbers or the perceived distress of symptoms. Newer antiretroviral medications have improved side effect profiles. Whether a person will develop symptoms or side effects cannot be predicted or changed, but it may be possible to alter the person's response to these symptoms. Therefore it may be more realistic for future studies to address how one copes with symptoms in order to promote adherence rather than to expect that an intervention can reduce symptoms and/or side effects [12]. Both the song and manual section about symptoms and side effects were rated low by the participants. We intend to revise and reframe these in hopes to improve self-efficacy for self-management of symptoms.

Another finding that warrants discussion is that those who had more depressive symptoms at baseline had significantly lower therapeutic drug levels at the end of the study. Depression has been another very consistent predictor of poor adherence. Our program was not intended to “improve” depression, but rather to encourage recognition of its symptoms and when to seek help. Unfortunately, the song and manual section focused on depressive symptoms were among the lower rated. We are currently revising both to enhance information about the symptoms, seeking help, and the relationship between depression and ART adherence.

It is not surprising that the LN manual was not used much. Its length (175 pages) was daunting and some participants complained of this in the program evaluation. We plan to considerably reduce the manual size, providing more concise, ‘fact sheet’-type supplementary information. Although over half of the participants report using the 800 number in the end-line evaluation, the majority reported infrequent use. Most participants were regular patients at the clinic site and felt comfortable stopping by the office or called the office number if they had questions. The expense of the phone line and personnel to man it make it difficult to justify in future “one-site” local studies. We are developing creative ways for participants to provide feedback in future projects.

There are limitations to this pilot project. All measures of adherence were subject to bias: patients can dump pills prior to PC, as well as “load” medications prior to therapeutic blood level testing. The fact that pill counts declined over time leads us to infer that these behaviors did not occur regularly. Our budget limited how many times therapeutic drug levels could be drawn. Thus, the ‘post-test only’ design for this variable does not allow us to compare changes within groups. Although not statistically significant, it is encouraging that a higher proportion of those in the LN group had drug levels in the therapeutic range.

Another limitation is that we were unable to identify an ideal “dose” of the program. The end-line evaluation that was completed by most participants did contain usage data as noted earlier, but was collected as part of an anonymous evaluation, so no usage data can be linked to adherence outcomes. We can say that 60 % listened over six times in the 3 months study period. We did ask all participants to keep a monthly listening frequency diary (included in the manual), but only 19 of the 51 LN (37 %) returned their diaries, seven of these had no entries, nine had missing entries for one or more months, and only five had useable data. Future projects will incorporate ways to more accurately capture usage information.

Conclusions

The LN employs a creative and overall enjoyable use of music and music-based messaging to educate and motivate HIV infected persons for adherence self-management. We feel the findings reflect encouraging trends in adherence, and in particular adherence self-efficacy and clinical outcome of lower viral loads. These results provide support for the continued study of music-based messaging to promote ART adherence and self-efficacy for adherence

self-management. The LIVE Network is an innovative educational and motivational and culturally relevant adherence self-management program using the power of music-based messaging to enhance learning and recall and self-efficacy to follow ART treatment regimen. Our findings show promise for future long term study of the efficacy of the program after appropriate revisions has been completed.

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Fig. 1. CONSORT flow diagram

Fig. 2. Viral load (log) over time in LN (treatment, *stars*) and SC (control, *black circles*) groups. Model fit lines for each group shown (LN *dashed line*, SC *solid black line*). Model fit lines were obtained from a MLM fit for the inverse of the log transform of the viral loads for group, time and group-by-time effects with random intercept and slope. The equations for the fitted lines were back-transformed for the plot above of log (viral loads) across time per group

Table 1

Baseline characteristics of full sample and by group

Statistics		All	SC	LN	Test for group differences
Age	N	77	26	51	$t_{(75)} = -0.500, p = 0.619$
	Mean (SD)	44.7 (8.7)	44.0 (9.6)	45.1 (8.3)	
	Median	45.0	44.5	45.1	
	Range	[24–66]	[27–60]	[24–66]	
Monthly income	N	73	24	49	$\alpha_Z = -0.289, p = 0.773$
	Mean (SD)	\$2,044 (\$11,022)	\$4,889 (\$19,163)	\$484 (\$69)	
	Median	\$674	\$649	\$674	
	Range	[\$0–\$94,371]	[\$0–\$94,371]	[\$2–\$2,000]	
Years with HIV	N	76	26	50	$\alpha_Z = -0.197, p = 0.844$
	Mean (SD)	7.2	10.2 (7.1)	10.6 (7.3)	
	Median	9.6	9.6	9.9	
	Range	0.4–29.2	0.4–24.1	0.4–29.2	
Depression (CES-D score)	N	74	25	49	$\alpha_Z = -0.229, p = 0.819$
	Mean (SD)	11.9 (9.7)	12.6 (11.3)	11.5 (9.0)	
	Median	9.0	9.0	9.0	
	Range	[3.8–19.0]	[3.0–17.5]	[4.0–19.0]	
CD4 counts ^d	N	33	10	23	$\alpha_Z = -0.235, p = 0.814$
	Mean (SD)	333.8 (304.2)	293.4 (133.1)	351.4 (355.3)	
	Median	279	280.5	270.0	
	Range	[2–1,592]	[87–571]	[2–1,592]	
CD4 % ^d	N	33	10	23	$\alpha_Z = 0.000, p = 1.000$
	Mean (SD)	17.4 (10.3)	17.4 (7.9)	17.4 (11.3)	
	Median	18.0	18.5	13.0	
	Range	[0–44]	[6–28]	[0–44]	
Viral loads (log) ^d	N	41	15	26	$\alpha_Z = -0.772, p = 0.440$
	Mean (SD)	2.2 (0.8)	2.2 (0.7)	2.1 (0.8)	
	Median	1.9	1.9	1.9	

Statistics		All	SC	LN	Test for group differences
Range		[1.6–4.8]	[1.6–3.9]	[1.6–4.8]	
Category		N (%)	N (%)	N (%)	
Gender	Male	50 (64.9)	15 (57.7)	35 (68.6)	$\chi^2_{(1)} = 0.904$, $p = 0.342$
	Female	27 (35.1)	11 (42.3)	16 (31.4)	
Race	African American	68 (88.3)	20 (76.9)	48 (94.1)	$b_{FET} p = 0.054$
	White, hispanic, other	9 (11.7)	6 (23.1)	3 (5.9)	
Sexual identity	Heterosexual	45 (58.4)	15 (57.7)	30 (58.8)	$\chi^2_{(1)} = 0.009$, $p = 0.924$ $c_{\text{Heterosexual vs. other}}$
	Homosexual	20 (26.0)	7 (26.9)	13 (25.5)	
	Bisexual	6 (7.8)	1 (3.8)	5 (9.8)	
	None of above, unsure	6 (7.8)	3 (11.5)	3 (5.9)	

^aMann–Whitney test performed

^bFisher's Exact test (FET) performed

^cHomosexual, bisexual, none of above and unsure merged together

^dCD4 counts and percents and log-viral loads at “baseline” were obtained up to 30 days prior to enrollment

Table 2

Results for study variables at assessment points

N	Mean (SD)	[T1] Baseline	4 weeks	[T2] 6 weeks	8 weeks	[T3] 12 weeks
Pill counts <i>n</i> % pills taken (SD)						
All		76	70		67	64
		82.8 (25.8)	77.9 (30.9)		75.4 (32.6)	75.4 (31.3)
SC		25	25		23	22
		77.4 (31.8)	80.5 (29.5)		78.9 (28.2)	70.6 (31.1)
LN		51	45		44	42
		85.4 (22.2)	76.4 (31.9)		73.5 (34.8)	77.8 (31.5)
Adherence self-efficacy <i>n</i> score (SD)						
All		77		69		63
		172.1 (22.0)		173.4 (25.0)		179.5 (11.7)
SC		26		24		21
		170.5 (24.3)		171.8 (26.4)		176.5 (16.1)
LN		51		45		42
		172.9 (21.0)		174.2 (24.5)		181.0 (8.6)
Symptom distress <i>n</i> score (SD)						
All		77		69		64
		7.5 (5.8)		7.4 (6.0)		7.0 (6.0)
SC		26		24		22
		7.4 (5.6)		6.7 (6.0)		6.9 (5.9)
LN		51		45		42
Self-efficacy for symptom management <i>n</i> score (SD)						
All				61		64
				88.3 (18.1)		90.5 (16.8)
SC				21		22
				89.2 (19.7)		87.0 (20.1)
LN				40		42
				87.8 (17.4)		92.3 (14.8)
Drug trough levels (<i>n</i> , %)						

N	Mean (SD)	[T1] Baseline	4 weeks	[T2] 6 weeks	8 weeks	[T3] 12 weeks
All						14 (22.2) < therap. level
						49 (77.8) therap. level
SC						6 (27.3) <Therap. level
						16 (72.7) therap. level
LN						8 (19.5) < therap. level
						33 (80.5) therap. level