Positive Strategies to Enhance Problem-Solving Skills (STEPS): A Pilot Randomized, Controlled Trial of a Multicomponent, Technology-Enhanced, Customizable Antiretroviral Adherence Intervention for HIV-Infected Adolescents and Young Adults

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Abstract

Adolescents are disproportionately impacted by HIV in the United States. Optimal effects from antiretroviral therapy (ART) can be achieved through stringent adherence to a daily medication regimen; for adolescents, this may be interrupted due to complex barriers unique to this age group. We previously conducted formative qualitative interviews with HIV-infected adolescents to identify key barriers facing adolescents regarding ART adherence and potential strategies to address these barriers. These data were used to inform an ART adherence intervention designed to overcome difficulties unique to HIV-infected adolescents (e.g., internalized stigma and HIV-related shame, disclosure to sexual partners, social life, and extracurricular activities at school, etc.). The resulting intervention—“Positive Strategies To Enhance Problem-solving Skills (Positive STEPS)” —combines five individual counseling sessions with daily text message reminders. We conducted a pilot randomized controlled trial of the intervention against a standard of care control and report on the feasibility of procedures and participant acceptability of the intervention in terms of content, structure, and format. ART adherence was measured in both arms through Medication Event Monitoring System pill caps and self-report. Feasibility and acceptability of the Positive STEPS intervention was evidenced by 90% retention for the intervention sessions; 100% completion of the four-month assessment; and positive responses on postintervention evaluation forms (all intervention participants rated Positive STEPS as “acceptable” or “very acceptable”) and brief exit interviews. At the 4-month assessment visit, the change in ART adherence among the intervention group [mean change score = 13%, standard deviation (SD) = 29.5] was significantly higher compared with the standard of care group (mean change score = -26%, SD = 26.0; Cohen’s *d* effect size = 1.43, confidence interval = 0.17–2.49, *p* = 0.02). Future testing of the intervention in a fully powered randomized controlled trial to determine efficacy is warranted.

Keywords: adolescents, HIV, ART, adherence, technology, text messaging

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Introduction

IN 2015, YOUTH 13–24 years of age accounted for over 22% of all new HIV infections, despite representing less than 17% of the US population. That year, persons 20–24 years of age experienced the second highest rate of new HIV diagnoses of any age group, just behind persons 25–29 years of age.¹ Recent advances in antiretroviral therapy (ART) allow HIV-infected adolescents and young adults to manage their HIV as a chronic disease; however, high levels of ART adherence are essential for maintaining viral suppression, as well as for reducing HIV transmission to uninfected sexual partners.^{2,3}

Consistent, long-term, ART adherence can be challenging for youth with barriers to adherence, including, but not limited to, forgetting, HIV-related stigma, mood, and substance use.⁴ In addition, a recent study suggests that the clinic social environment may play an important supportive role for adolescents with HIV infection, influencing health outcomes.⁵ Additionally, recent studies have examined barriers unique to perinatally infected versus behaviorally infected adolescents.^{6,7} Distinct among perinatally infected adolescents were fatigue from chronicity of HIV; regimen complication and frequent medication changes due to development of drug-resistant HIV; transition to independent HIV care management from parental/guardian management; and complicated disclosure patterns due to parental HIV status and secrecy in the family. Among behaviorally infected adolescents, distinct barriers included: self-blame (i.e., internalized stigma) for infection; greater control over starting medications; and stigma associated with HIV risk-taking behaviors. Notably, across 22 published studies, ART adherence among adolescents ranged from 28% to 69%,⁸ much lower than the 85–95% required to optimize treatment gain.⁹ However, to the best of our knowledge, there are no published efficacious interventions to improve ART adherence in this population.

Methods

Intervention development and theoretical underpinnings

Through formative qualitative work with this population,⁷ we developed an adolescent-focused multicomponent intervention that incorporated technological aspects (e.g., short message service text messages and video vignettes)—“Positive Strategies To Enhance Problem-solving Skills (Positive STEPS)” —which was guided by an evidence-based adult HIV medication adherence intervention, Life-Steps.^{10,11} The intervention is grounded in the social-cognitive and contextual realities (e.g., participants’ living circumstances, parental support, school situation) of HIV-infected adolescents and is informed by social cognitive theory¹² and based on principles of cognitive-behavioral therapy,^{13,14} motivational interviewing,¹⁵ and problem solving.^{16,17} The intervention, previously described,¹⁸ addresses 11 informational, problem-solving, and cognitive-behavioral steps, targeted over five, in-person intervention sessions with a master’s-level counselor. During each of the five customizable sessions, the participant and the counselor define the problem impacting adherence, generate alternative solutions, make decisions about the alternatives, and collaboratively decide on a plan regarding how to implement the solutions.

Study design and sample

We conducted a pilot randomized controlled trial of the Positive STEPS intervention compared with a standard of care control (SOC) group. HIV-infected youth were recruited from hospitals and community health centers in the greater Boston, Massachusetts area. Eligible individuals were between 16 and 24 years of age and self-reported difficulties adhering to their ART medications (i.e., missing at least one dose in the past week or at least three doses in the past month; <90% adherence). Participants ($N=14$) were equally randomized across two study conditions.

ART adherence monitoring

Improvement in ART adherence was the primary outcome; this was electronically monitored in both arms through Medication Event Monitoring System (MEMS) pill caps. As was done in past studies from our group, we included a two-week monitoring period of adherence, using MEMS cap data, as part of the baseline evaluation to have a comparison point for pre–post analyses.¹⁹

Quantitative assessment

Participants completed a quantitative assessment administered through an Audio Computer-Assisted Self-Interview (ACASI) system at baseline and at 4 months postbaseline.

Self-report adherence supplemented the electronic monitoring data at baseline and 4 months postbaseline. The optimal period and response task for self-reported ART adherence using electronic monitoring data as the standard for predictive validity,²⁰ found that longer time periods (e.g., 30 days vs. 4 days) were accurate at assessing adherence. As per our prior trials, we used the 2-week period because 1 month would be too long to be sensitive to adherence in the acute study.

The assessment also included questions on sociodemographic characteristics (e.g., age, race/ethnicity, route of HIV infection) as well as scales to assess the hypothesized mediators of the intervention effect (per our conceptual model above), including adherence-readiness,²¹ motivators,²² adherence self-efficacy,²³ social support,²⁴ and skills building.^{25,26}

Randomization

All participants completed a MEMS “run-in” period 2 weeks following their baseline visit and then a randomization visit at the end of this period. At this visit, participants were randomized to one of the two study conditions. Block randomization, with blocks of four, were used for allocation at each site, with randomization assignment generated by a computer. Block randomization ensured balanced representation in the two study conditions at each site, with half of the sample randomized to the Positive STEPS intervention and half randomized to the SOC.

Statistical analysis

While this was a small pilot RCT and we were not powered to statistically examine an intervention effect, we compared changes from baseline to follow-up in adherence using MEMS data (i.e., last 2 weeks’ adherence). For four participants who did not have MEMS data at follow-up, we used self-reported adherence in the past month (i.e., percentage of

days taking all doses). Chi-squared and *t*-tests were used to determine if key variables significantly differed between study conditions (i.e., to assess whether or not randomization was successful). To estimate the effect size,²⁷ we calculated Cohen's *d* and reported the standardized difference between groups in the change scores. All statistical tests determined significance with $\alpha=0.05$. To reduce the threat of bias, the intent-to-treat principle was followed, where cases are analyzed according to the condition that they were randomized to.

Exit interviews

Lastly, participants in the intervention group completed a brief qualitative exit interview to evaluate participant acceptability (what they liked, anything they did not like, or anything they felt should be added) of the intervention in terms of content, structure, and format. They were also asked to rate the intervention on a 4-point Likert-scale [ranging from (1) very acceptable to (2) acceptable to (3) somewhat acceptable to (4) not acceptable].

Results

Sample characteristics

Participants' mean age was 19 years [standard deviation (SD)=1.2]; the majority were male (60%) and most identified as a racial/ethnic minority (64%). Furthermore, most (82%) were infected with HIV through sexual contact versus perinatally infected. Aggregate mean baseline medication adherence scores were 74% (SD=35.3). Both the intervention and control groups did not significantly differ with respect to baseline sociodemographics and adherence scores.

Feasibility and acceptability

Feasibility and acceptability of the program was evidenced by 90.0% retention for the intervention sessions; 100% completion of the 4-month assessment; and positive responses on evaluation forms (all intervention participants rated Positive STEPS as "acceptable" or "very acceptable") and during qualitative exit interviews (reported below).

Preliminary efficacy

At the 4-month assessment visit, the change in ART adherence among the intervention group (mean change score = 13%, SD=29.5) was significantly higher compared with the standard of care group (mean change score = -26%, SD=26.0; Cohen's *d* effect size = 1.43, confidence interval = 0.17–2.49, $p=0.02$). While not powered to detect a statistically significant improvement, the hypothesized mediators such as adherence readiness, motivators, adherence self-efficacy, social support, and skills building all moved in the expected direction.

Exit interviews on acceptability of the Positive STEPS intervention

Exit Interviews among participants randomized to the Positive STEPS intervention indicated that the individual counseling, use of MEMS pill caps, and personalized text messages were well received. During exit interviews, participants identified "creating a medication schedule (e.g.,

setting weekly goals, daily alarms)" as "the most useful component of the Positive STEPS intervention," which one respondent described as "helping [you] learn how to fall into an easy and regular regimen." Text message reminders were regarded favorably, aiding participants to mediate their impulsivity, as reported by providing a "safeguard," particularly during social interactions. Participants highlighted the importance of creating their own text messages, suggesting it made them feel "empowered," and valued the visual intervention content (i.e., videos and diagrams), which "put things in perspective" and "demonstrated real-world implications." Upon program completion, several participants indicated that they had implemented strategies discussed during the intervention to address personal barriers, such as developing contingency plans for travel or more effectually communicating with their care team.

Discussion

Clinical practice guidelines for HIV-infected youth must consider the influence that adolescent development has on engagement in medical care so that ART adherence interventions can be tailored to address their unique barriers. Using qualitative interviews with adolescents,⁷ we developed a youth-specific, manualized intervention to optimize ART adherence, which was adapted from an analogous, evidence-based, adult intervention (i.e., Life-Steps).^{10,11} This pilot randomized controlled trial demonstrated high participant acceptability, feasibility of recruitment and intervention delivery, and initial evidence for participant improvement in ART adherence for those randomized to the Positive STEPS intervention group versus the SOC. These findings justify future efficacy testing of Positive STEPS in a fully powered, randomized, controlled efficacy trial.

Acknowledgments

This work was supported by a Harvard University Center for AIDS Research (CFAR) grant P30 AI060354 (PI: M.J.M.), a Boston Children's Hospital Aerosmith Endowment Fund grant 94874 (PI: L.M.B.), and a National Institute of Mental Health grant R34 MH090790 (PI: L.M.B.). The authors would also like to thank Jessica Ratner, Caroline Hu, Madeline Wachman, and Michael Garber for their contributions to this study.

Author Disclosure Statement

No competing financial interests exist.

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