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Review article

How Do Psychosocial Interventions for Adolescents and Young People Living With HIV Improve Adherence and Viral Load? A Realist Review

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A B S T R A C T

Purpose: Psychosocial interventions have the potential to support adolescents and young people living with HIV (AYPLHIV) to achieve better HIV outcomes. However, more evidence is needed to understand which interventions are most effective, and the mechanisms driving how they work in practice.

Methods: We used realist methodologies to generate statements based on evidence from intervention studies and linked evidence included in a systematic review of psychosocial interventions for AYPLHIV. Key data were extracted from available sources to generate cases, including context-mechanism-outcome pathways. Higher level themes were refined iteratively to create a mid-range theory of how these interventions may work.

Results: From 26 resulting cases, 8 statements were crafted, grouped into 3 overarching categories, to describe how these interventions worked. Interventions were overall found to set off mechanisms to improve adherence when (1) responding to individual-level factors to support AYPLHIV (via incorporating agency and empowerment, personalized and/or contextualized approaches, and self-care skills); (2) tailoring delivery strategies to address specific needs (via diverse strategies, longer duration, and digital delivery); and (3) providing supportive resources (via peer and broader support, and structural support and integration into existing services).

IMPLICATIONS AND CONTRIBUTION

Psychosocial interventions for adolescents and young people living with HIV operate through a diverse set of mechanisms to improve antiretroviral adherence and viral load. Understanding how these interventions work in practice, using realist review methods, is critical to shaping responses to support this key population.

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Discussion: A collection of diverse mechanisms may individually or collectively drive improved outcomes for AYPLHIV engaged in psychosocial interventions. Recommendations for integrating our findings into practice are discussed.

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Alongside breakthroughs in clinical and biomedical interventions, behavioral and psychosocial strategies have been essential to improving care and treatment outcomes for people living with HIV [1–3]. Psychosocial interventions utilize psychological, behavioral, and/or social approaches to produce intended outcomes [4]. These interventions vary widely in their content, structure, theoretical underpinnings, and delivery mechanisms; they may target specific behaviors or outcomes, or provide more holistic support to address multiple outcomes simultaneously [5]. Behavioral and psychosocial interventions have been implemented and evaluated extensively among different groups. Among adults living with HIV, these interventions have been found to improve antiretroviral (ART) adherence [6,7] and mental health [8,9], and reduce risk of HIV transmission [10].

However, fewer studies document if and how psychosocial interventions can support adolescents and young people living with HIV (AYPLHIV) between 10 and 24 years in achieving better HIV-related outcomes. Ethical challenges in working with AYPLHIV—a population that may be under the age of consent and otherwise viewed as “vulnerable”—have limited the extent of research conducted with this group [11], with a dearth of implementation science-focused research [12,13]. Furthermore, HIV-focused psychosocial interventions for AYPLHIV are highly heterogeneous in their scope, target population, implementation sites, and outcomes—limiting researchers’ ability to meaningfully compare and draw conclusions about their collective effectiveness [14,15]. Recently, our systematic review and meta-analysis of trials assessing psychosocial interventions for AYPLHIV [16]—which informed the updated World Health Organization (WHO) guidelines on this topic [17]—found that these interventions are, overall, effective in improving ART adherence and reducing viral load.

However, we need to better understand which kinds of psychosocial interventions are most effective, and the mechanisms that drive how they work in practice. This is urgent because AYPLHIV represent a growing proportion of new HIV infections globally, with nearly 500,000 new infections in 2019 [18]. Adolescents also continue to have the poorest HIV outcomes of any age group, with worse retention in care, ART adherence, and viral suppression outcomes [19]. Alternative methods for evaluating existing intervention studies can help us understand AYPLHIV’s specific needs—and how to support them to achieve better adherence outcomes and do so at scale. Realist review methods can be effective in responding to some of these gaps. Although systematic reviews and meta-analyses are generally used to test hypotheses (do interventions work or not?), realist reviews offer opportunities for explanatory analysis (how do they work?). Realist reviews identify potential links among contexts, mechanisms, and outcomes in a complex intervention or set of interventions, to develop, test, and refine theories in an iterative process about how they work [20]. These empirically based qualitative reviews can enable more comprehensive examination of existing interventions in cases where evidence is limited,

especially as they rely upon complementary evidence sources (Box 1).

In this article, we adopted realist methods to analyze psychosocial intervention studies targeting AYPLHIV from our recent systematic review. Considering the context, mechanism, and outcome relationships underpinning psychosocial interventions for AYPLHIV enables us to more clearly consider how these interventions work, for whom, and under which circumstances. We aimed to provide in-depth guidance for public health programs and implementation research efforts focused on AYPLHIV, and inform implementation at scale.

Methods

Inclusion

We included studies from our prior review [16] conducted in collaboration with the WHO’s Adolescent Service Delivery Working Group for the 2020 “Updated recommendations on service delivery for the treatment and care of people living with HIV” [17,22]. Table 1 summarizes the inclusion criteria. Because our meta-analysis found that interventions improved adherence and viral load outcomes, we aimed to probe these effects using a realist methodological approach. Realist approaches facilitate a holistic examination of intervention components in their delivery contexts. In this way, they enable iterative analysis, where researchers identify potential generative mechanisms that might be kicked off by the intervention, and then apply working theories (“candidate” theories) across other similar studies to test them.

Box 1. Key features of realist reviews (adapted from Pawson et al. 2005 [21])

- An inductive approach to developing and testing a mid-range theory of how a complex intervention or set of interventions works
- Aims to identify what works, for whom, in which circumstances, and how
- Results merge theoretical understanding of how interventions work with empirical evidence
- Aims to identify “demi-regularities” or semi-predictable, reoccurring patterns of behavior that drive how interventions work, through context-mechanism-outcome pathways
- Resulting context-mechanism-outcome pathways aim to explain contexts in which interventions are implemented, the mechanisms by which interventions work, and the resulting outcomes
- Realist reviews do not seek to determine intervention effectiveness, but rather influence a richer understanding of how they work in practice

Table 1
Overview of inclusion criteria from prior review

Population focus	Adolescents and young people living with HIV between ages 10 and 24 (or mean age in this range); no restriction on gender, geographic area; interventions engaging additional individuals such as adolescents' caregivers were also eligible
Types of interventions	Behavioral, social and/or psychological interventions or a combination thereof; these could be delivered individually or in groups, and face-to-face or remotely/digitally
Types of studies and comparators	Randomized controlled trials, crossover trials, cluster randomized controlled trials, factorial trials; compared to treatment as usual, time-matched alternative healthcare intervention, or no intervention
Outcomes	Adherence to ART, ART knowledge, retention in care, linkage to care, sexual and reproductive health behaviors, sexual and reproductive health knowledge, viral load, viral suppression, undetectable viral load, improved transitioning to adult services
Other eligibility criteria	Peer-reviewed publications only; no language restrictions; analysis comparing intervention versus comparison group

Evidence identification

We identified studies through structured systematic searches on PubMed, PsycINFO, Scopus, and the Cochrane Library, limited to publications between January 2000 and June 2020 (see [Appendix A](#)). Intervention cases were created for each study, supplemented by linked publications (protocol papers, secondary data analyses, intervention manuals, process evaluations, qualitative studies). Team members identified linked evidence through combing reference lists of included studies and searching linked publications.

Data extraction

Data were extracted from each case to map potential context-mechanism-outcome (CMO) pathways. Data extraction included the following: intervention information (name, country implemented, goal, underlying theory, components); contextual elements (intervention context, broader context where delivered); study outcomes; and implementation factors. Reviewers sought to first identify and extract authors' explanations or descriptions of candidate theories where available, and to infer potential pathways that could account for outcomes from the publication. This process of theory identification, inference, and testing is necessarily speculative and central to the realist process [23].

Three reviewers extracted all case data. To establish consistency, all reviewers extracted the same two cases. Following interactive sessions, where discrepancies in extracted data or CMOs were discussed, cases were extracted individually, with regular team-based discussion and troubleshooting. The first author reviewed all cases and suggested CMO revisions where appropriate.

Although ART adherence and viral load outcomes were considered separately in the original review and data extraction, we elected to bundle them in the model developed, as viral load is often a proxy measure for adherence. In the findings below,

“improved adherence” is used to refer to both improved ART adherence, as well as reduced level of participant viral load.

Evidence synthesis

We generated a master list of CMOs at the study level. Drawing from this master list, we compared CMOs across cases, derived commonalities, and identified reinforcing themes, ultimately reaching saturation of evidence from which no new themes could be derived. We used this evidence to inform the development of mid-range CMOs, tested against study data, comprising the overarching theory of how, for whom, and in which circumstances these interventions work.

Quality appraisal

Study quality was appraised for each included case by the review team. We adapted our quality appraisal from Trickey et al. [24], identifying a description of the underlying theory; alignment of theory and outcomes; description of intervention components; description of intervention content; and attention to how implementation and process may affect outcomes observed. Reviewers rated on a scale of three levels to indicate *absent*, *partially present*, and *satisfactorily present*. All included studies were appraised independently by two team members; discrepancies were resolved through discussion with the broader team as needed.

Results

Study information

Eligible studies were limited to those measuring ART adherence or viral load levels ([Figure 1](#)). Twenty-six cases were identified, from seven countries: the United States (n = 15), Thailand (n = 3), Uganda (n = 3), Zimbabwe (n = 2), Nigeria (n = 1), South Africa (n = 1), and Zambia (n = 1) ([Table 2](#)). Most studies (n = 21, 80.8%) measured ART adherence, and nearly two thirds (n = 16, 61.5%) measured viral load; 11 studies measured both outcomes. Risk of bias, assessed for all studies, is reported elsewhere [16].

Quality appraisals, available in [Table A1](#), deemed study quality to be moderate-to-high; a small number of studies (n = 3) lacked thorough description of intervention theories, alignment of theory and outcomes, and intervention context [52,53,55]. Seven studies (26.9%) scored in the highest-quality range for four of the five domains [31,37,38,41,44,48–50].

Review findings

Eight statements were crafted and organized into three overarching categories to generate a working mid-range theory describing how the interventions work ([Figure 2](#)). Each statement is supported below by evidence from included studies.

Category 1: responding to individual-level factors to support adolescents and young people living with HIV

The first category of statements reflects factors linked to intervention contexts relating to individual-level characteristics that can be leveraged to improve adherence and viral load outcomes. These statements included empowerment, personalized care, and self-care skills.

Table 2
Overview of included studies

Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
The impact of cell phone support on psychosocial outcomes for youth living with HIV nonadherent to antiretroviral therapy	Belzer et al. (2014) [25]/ Sayegh et al. (2018) [26]	United States	Youth living with HIV, mean age 20.4, 37.8% female	To assess the effect of cell-phone support on improved adherence and viral control	Social support	✓	✓	Intervention group had significantly higher level of self-reported adherence compared to the control group at 24 and 48 weeks postintervention ($p = .007$)
The use of cell phone support for non-adherent HIV-infected youth and young adults: an initial randomized and controlled intervention trial								Viral suppression (log ₁₀ HIV viral load) significantly lower at both 24 weeks (2.82 vs. 4.52, $p = .002$) and 48 weeks (3.23 vs. 4.23, $p = .043$)
Does economic strengthening improve viral suppression among adolescents living with HIV? Results from a cluster randomized trial in Uganda	Bermudez et al. (2018) [27]/ Ssewamala et al. (2020) [28]	Uganda	Adolescents living with HIV, families included, mean age 12.5, 56.4% female	To assess the effect of a savings-led economic empowerment intervention on viral suppression among adolescents living with HIV	Asset theory		✓	At 24-months postintervention initiation, the proportion of virally suppressed participants in the intervention cohort increased 10-fold
The long-term effects of a family based economic empowerment intervention (Suubi + Adherence) on suppression of HIV viral loads among adolescents living with HIV in southern Uganda: findings from 5-year cluster randomized trial								In the adjusted model, there was significantly lower odds of intervention participants having a detectable viral load at both 12 (OR 0.424, 95% CI 0.248, 0.723, $p = .002$) and 24 months (OR 0.299, 95% CI 0.161, 0.554, $p < .001$)
Adherence to antiretroviral therapy in HIV-infected pediatric patients improves with home-based intensive nursing intervention	Berrien et al. (2004) [29]	United States	Children and youth living with HIV, caregivers included, mean age 10.5, 51.4% female	To determine if a home-based nursing intervention improves medication adherence	Health Belief Model	✓	✓	Nine of 20 patients in the intervention group maintained or achieved an undetectable viral load, while only 4 patients in the control group achieved this viral load. No statistical differences were found for viral load between the intervention and control group at endline
The VUKA family program: piloting a family-based psychosocial intervention to promote health and mental health among HIV infected early adolescents in South Africa	Bhana et al. (2014) [30]	South Africa	Young adolescents living with HIV, caregivers included, mean age 11.6, 51% female	To assess the development, feasibility, and acceptability of the VUKA family-based program and its short-term impact on a range of psychosocial variables for HIV + preadolescents and their caregivers	Social Action Theory	✓		Youth in the intervention condition reported significantly greater improvements in ART adherence vs. controls postintervention (intervention = 1.10, control = -0.43, $p < .05$)
Effective treatment of depressive disorders in medical clinics for adolescents and young adults living with HIV: a controlled trial	Brown et al. (2016) [31]	United States	Youth living with HIV with diagnoses of clinical depression, mean age 21.5, 31% female	To preliminary test a manualized, measurement-guided treatment for depression for adolescents and young adults in care	Cognitive-behavioral therapy and medication management algorithm		✓	Viral load decreased in both groups; ART adherence did not differ between groups during the study

Table 2
Continued

Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
Improving health outcomes for youth living with the human immunodeficiency virus: a multisite randomized trial of a motivational intervention targeting multiple risk behaviors A clinic-based motivational intervention improves condom use among subgroups of youth living with HIV	Chen et al. (2011) [32]/Naar-King et al. (2009) [33]	United States	Youth living with HIV, mean age 20.5, 47.3% female	To explore the effects of a motivational interviewing-based multirisk reduction intervention, “Healthy Choices” in improving motivation, depression, viral load, and condom use in youth living with HIV	Motivational interviewing, Motivational Enhancement Therapy	✓	✓	Participants in the intervention arm showed significant decline in viral load at 6 months postintervention compared to control group ($d = -0.36$, $t = -2.15$, $p = .03$), with no significant differences remaining at 9-month follow-up
Crystal clear with active visualization: understanding medication adherence among youth living with HIV	Christodoulou et al. (2020) [34]	United States	Youth living with HIV, mean age 24, 7.7% female	To pilot an adapted active visualization device that demonstrates how ART works in the body	Multisensory learning theory	✓	✓	Intervention youth had lower viral loads and reported less difficulty in adhering to ART than standard care at follow-up. Of participants with detectable viral loads (>20 copies/mL) at baseline, three intervention group patients reached undetectable viral loads (<20 copies/mL) at follow-up, while no standard group patients reached the undetectable level. Regarding ART adherence, 2/10 in the intervention group reported missing a dose in the past 3 months compared to 7/9 in the standard care group
Project YES! Youth engaging for success: a randomized controlled trial assessing the impact of a clinic-based peer mentoring program on viral suppression, adherence and internalized stigma among HIV-positive youth (15–24 years) in Ndola, Zambia	Denison et al. (2020) [35]	Zambia	Adolescents and youth living with HIV, mean age 19.1, 59.3% female	To examine the effects of Project YES! on improving viral suppression and reducing stigma among HIV-positive adolescents and young adults in sub-Saharan Africa	Social cognitive theory, positive youth development constructs		✓	Viral suppression improved in both the intervention and control groups, with baseline values of 63.5% and 63.7% respectively to 73.0% and 71.3% at midline. There were no differences in ART adherence
A social media-based support group for youth living with HIV in Nigeria (SMART Connections): randomized controlled trial	Dulli et al. (2020) [36]	Nigeria	Youth living with HIV, mean age 21.2, 87.7% female	To test the effectiveness of a structured support group intervention, Social Media to promote Adherence and Retention in Treatment (SMART) Connections, delivered through a social media platform	Not specified	✓		No statistically significant differences were found for ART adherence among the intervention and control group

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Table 2
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Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
A randomized controlled trial of personalized text message reminders to promote medication adherence among HIV-positive adolescents and young adults	Garofalo et al. (2016) [37]	United States	Youth living with HIV with poor adherence, mean age 24.1, 18.1% female	To examine the effect of a personalized two-way, daily text messaging intervention to improve adherence to antiretroviral therapy (ART) among poorly adherent HIV-positive adolescents and young adults	Social cognitive theory	✓	✓	No significant difference in either log viral load or viral suppression between the two arms at either 3- or 6-month follow-up. Intervention arm participants were more than 2.6 times likelier than those in the control to report $\geq 90\%$ adherence at 3 months
Project ACCEPT: evaluation of a group-based intervention to improve engagement in care for youth newly diagnosed with HIV	Hosek et al. (2018) [38]	United States	Youth living with HIV and diagnosed within the past 12 months, mean age 20.2, 19.4% female	To test the efficacy of ACCEPT at addressing factors that impact engagement in care for youth newly diagnosed with HIV, including stigma, disclosure, healthy relationships, substance use, and future life planning	Social cognitive theory, information-motivation behavioral (IMB) skills model	✓	✓	Intervention participants had improved medication adherence; they were 2.33 times more likely to take their ART over time compared to controls (95% CI 1.29, 4.21, $p = .005$). The intervention group saw significant decline in viral load over time compared to the control group (95% $-0.14, 0.07, p = .041$)
Effect of an empowerment intervention on antiretroviral drug adherence in Thai youth	Kaihin et al. (2015) [39]	Thailand	Youth living with HIV, mean age 18.8, 56.5% female	To determine the effects of an empowerment intervention on antiretroviral therapy (ART)	Empowerment-based approach	✓		At endline assessment, 82.6% of the experimental group had adherence $\geq 95\%$, compared to 21.7% of the control group.
Text messaging for improving antiretroviral therapy adherence: no effects after 1 year in a randomized controlled trial among adolescents and young adults	Linnemayr et al. (2017) [40]	Uganda	Youth living with HIV, mean age 18.3, 63% female	To assess the effectiveness of Short Message Service (SMS) reminder messages on antiretroviral and cotrimoxazole prophylaxis adherence, as well as the relative effectiveness of SMS with and without a response option	Not specified	✓		There were no statistically significant difference in adherence outcomes between the intervention groups compared with the control group over the 48-week period by intention-to-treat or by complete case analysis

Table 2
Continued

Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
A randomized controlled trial study of the acceptability, feasibility, and preliminary impact of SITA (SMS as an Incentive To Adhere): a mobile technology-based intervention informed by behavioural economics to improve ART adherence among youth in Uganda	MacCarthy et al. (2020) [41]	Uganda	Youth living with HIV between ages 15 and 24	To examine the effect of a text-based intervention providing weekly real-time antiretroviral adherence feedback, based on information from a smart pill box	Behavioral economics	✓		Accounting for baseline adherence levels, the intervention arm focused on individual adherence feedback had 3.8% lower adherence compared to the control group, while the intervention arm focused on individual + peer adherence feedback had 2.4% higher adherence than the control group at endline, and 9% higher in the final weeks of the study
Effect of a differentiated service delivery model on virological failure in adolescents with HIV in Zimbabwe (Zvandiri): a cluster-randomised controlled trial	Mavhu et al. (2020) [42]	Zimbabwe	Adolescents living with HIV, ages 13–19 years, 52% female	To evaluate a peer-led differentiated service delivery intervention on HIV clinical and psychosocial outcomes	Peer mentor model	✓	✓	Virological failure (viral load >1,000 copies per mL) or death at endline was less common in the intervention group than in the control group (adjusted prevalence ratio 0.58, 95% CI 0.36, 0.94, $p = .03$)
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	Mimiaga et al. (2019) [43]	United States	Youth living with HIV, mean age 19, 40% female	To examine the feasibility of procedures and participant acceptability of the intervention in terms of content, structure, and format	Social cognitive theory, cognitive-behavioral therapy, motivational interviewing, problem solving	✓		At the 4-month evaluation, the change in ART adherence detected was among the intervention group (mean change score 13%, SD = 29.5) was significantly higher compared with the standard care group (mean change score = -26%, SD = 26.0; Cohen's $d = 1.43$, CI = 0.17, 2.49, $p = .02$)
Motivational Enhancement System for Adherence (MESA): pilot randomized trial of a brief computer-delivered prevention intervention for youth initiating antiretroviral treatment	Naar-King et al. (2013) [44]	United States	Youth living with HIV and newly initiated on ART, mean age 20.3, 19.7% female	To pilot test a two-session computer-delivered motivational intervention to facilitate adherence among youth with HIV newly prescribed antiretroviral treatment (ART)	Computer-based motivational interviewing	✓	✓	The viral suppression rate in the intervention group was larger in magnitude when compared with control group (Cohen's $d = 0.09$ at 3 months; $d = 0.28$ at 6 months). The intervention group reported greater adherence than the control group on 2 of 3 adherence measures at 6 months ($d = 0.49$ for 7-day adherence, $p < .05$; $d = 0.66$ for weekend adherence, $p < .01$)
Healthy choices: motivational enhancement therapy for health risk behaviors in HIV-positive youth	Naar-King et al. (2006) [45]	United States	Youth living with HIV, mean age 21, 49% female	To pilot a brief individual motivational intervention targeting multiple health risk behaviors	Motivational interviewing, Motivational Enhancement Therapy		✓	The intervention group showed significantly greater reductions in log viral load (-0.67) compared with control (-0.01, $t = 2.36$, $p < .05$)

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Table 2
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Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
Brief report: maintenance of effects of motivational enhancement therapy to improve risk behaviors and HIV-related health in a randomized controlled trial of youth living with HIV	Naar-King et al. (2008) [46]	United States	Youth living with HIV, mean age 21.1, 47.7% female	To examine the maintenance of effects of Motivational Enhancement Therapy (MET) shown to improve risk behaviors and viral load immediately posttreatment	Motivational interviewing, Motivational Enhancement Therapy		✓	The treatment group had greater reductions in viral load from baseline to 6 months (−1.23, 2.43) than did the control group (−0.003, 1.93, $p = .03$)
CHAMP + Thailand: pilot randomized control trial of a family-based psychosocial intervention for perinatally HIV-infected early adolescents	Nestadt et al. (2019) [47]	Thailand	Young adolescents with perinatal HIV transmission, caregivers included, mean age 12.3, 49% female	To evaluate the intervention CHAMP + on reducing mental health and psychosocial challenges and improving treatment adherence	Social Action Theory	✓		The intervention group showed significant improvement in adherence, with most improvements sustained at the 9-month assessment mark. The intervention group showed a greater improvement in viral load reduction at 1-month assessment (−4,626.6) compared to control (−685.1)
Motivational interviewing targeting risk behaviors for youth living with HIV in Thailand Motivational interviewing targeting risky sex in HIV-positive young Thai men who have sex with men	Rongkavilit et al. (2013, 2014) [48, 49]	Thailand	Young people living with HIV, mean age 21.7, 18.5% female (2013) Young men who have sex with men, mean age 22.5 (2014)	To assess the effect of Healthy Choices intervention on reducing risky sexual behaviors	Motivational interviewing	✓	✓	No effect of the intervention was observed in regard to ART adherence or plasma HIV viral loads
Prevention for substance-using HIV-positive young people: telephone and in-person delivery	Rotheram-Borus (2004) [50]	United States	Youth living with HIV, median age 23, 22% female	To examine the effects of a preventive intervention on HIV risky behaviors and health practices	Not specified	✓		Adherence to ART medication was similar among both intervention conditions over time compared to controls
Using technology to improve adherence to HIV medications in transitional age youth: research reviewed, methods tried, lessons learned	Spratt (2017) [51]	United States	Adolescents living with HIV who are non-adherent to ART, mean age 17.1, 75% female	To test the feasibility of a MedMinder electronic pillbox and cell phone texting with personalized motivational interviewing strategies to improve medication adherence	Motivational interviewing	✓		Participants from both intervention groups showed improvements over the study period, with Group A (alarm signals off) demonstrating slightly higher medication adherence (mean 40.1%) compared to Group B (34.7%) (alarm signals on)

Table 2
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Title	Author and year	Country	Study population description	Program intent	Underlying theory/model	Measured viral load and/or viral suppression	Measured adherence	Outcomes
Mindfulness instruction for HIV-infected youth: a randomized controlled trial	Webb et al. (2018) [52]	United States	Youth living with HIV, mean age 18.7, 47.2% female	To assess the effect of a mindfulness-based stress reduction (MBSR) program compared to an active control group on psychological symptoms and HIV disease management	Mindfulness-based stress reduction	✓	✓	Participants in the experimental study arm were more likely to have or maintain reductions in viral load at 3-month follow-up than those in the control group ($p = .04$)
Enhancing health among youth living with HIV using an iPhone game	Whiteley et al. (2018) [53]	United States	Youth living with HIV, mean age 22.4, 21.3% female	To examine the preliminary effects of an iPhone game/app on ART adherence, viral load, and relevant knowledge and attitudes	Information-motivation-behavioral skills model	✓	✓	No significant differences were found between intervention and control groups overall. Among participants newly starting ART, participants in the intervention had improved adherence (71% vs. 48% adherence at post-test; effect size difference of 1.18, $F = 3.20$, $p = .05$) and decreased viral load (0.96 log greater decrease in viral load; effect size difference of -2.21 , $F = 4.33$, $p = .04$) compared to control
Effectiveness of community adolescent treatment supporters (CATS) interventions in improving linkage and retention in care, adherence to ART and psychosocial well-being: a randomised trial among adolescents living with HIV in rural Zimbabwe	Willis et al. (2019) [54]	Zimbabwe	Adolescents living with HIV between 13 and 19 years of age, 61.7% female	To determine the effectiveness of peer support services on improving linkage to services and retention in care, adherence, and psychosocial well-being	Peer mentor model	✓		The intervention group showed statistically significant improvement in adherence to ART from 44.2% at baseline to 71.8% at end line ($p = .008$). Participants in the intervention group were 3.9 times more likely to adhere to treatment compared to control (OR = 3.934)

ART = antiretroviral; CI = confidence interval; OR = odds ratio; SD= standard deviation.

Statement 1: Engaging with interventions that focus on empowerment (C), AYPLHIV may experience more agency and improved self-management, and become more active in pursuing healthy behaviors (M), leading to better adherence (O).

AYPLHIV may experience overlapping challenges linked to their HIV status or socioeconomic status. Internalized and social stigma, and fear of the future, may present specific barriers to adherence as adolescents and young people (AYP) transition into adulthood [25,26,38]. As adolescence is characterized by increased social awareness and potential self-consciousness, interventions focusing on empowering approaches are important for AYP. These interventions may involve principles of motivational interviewing, where AYPLHIV are able to set personal goals for improving adherence or other healthy behaviors [48,49]. This choice could also be reflected more creatively, for example with AYPLHIV able to create their own avatars through a digital game [44]. These approaches may involve more active interactions—such as open, group-based engagement where AYP are invited to share adherence challenges and find support in hearing others' strategies [39], or role-plays to troubleshoot discussing difficult topics with a clinician [43]. Furthermore, these approaches may be reflected in structural decisions about intervention delivery—such as holding specific separate sessions for AYP and caregivers who are jointly enrolled in a program [47].

AYPLHIV may be further empowered through accessible, relatable intervention content; this might include culturally specific references or characters [30] and/or co-developing the intervention with AYPLHIV themselves [53]. These approaches, together, may improve buy-in among AYP and contribute positively to identifying widely suitable approaches to boost adherence. Overall, increases in youth agency and investment may improve AYPLHIV's confidence and self-efficacy, and strengthen intervention engagement, leading to opportunities for improved adherence.

Statement 2. AYPLHIV may benefit from accessing personalized and tailored approaches (C), allowing them to identify ways to address their individual needs and concerns linked to adherence (M), reducing barriers to good adherence (O).

Studies revealed the importance of personalized and/or tailored approaches in effectively reaching AYPLHIV, who comprise a heterogeneous group. Structured ART regimens and national and global guidelines may provide a reasonable standard of care, but neglect more individualized and personal reasons for poor adherence. Diverse populations of AYP may require differentiated approaches to clinical care, and interventions supporting AYP to build personalized adherence strategies may be more effective in responding to specific barriers [39]. Motivational interviewing-based interventions may tackle concurrent risk behaviors that compromise adherence, encouraging problem-solving approaches linked to specific goals and providing personalized feedback [46]. For AYP recently diagnosed with HIV, cognitive behavioral therapy-based approaches that help identify and modify unhelpful thinking patterns may decrease internalized stigma related to an HIV-positive status and promote pill-taking [43]. However, personalized approaches may also be resource-intensive and infeasible at health facilities with limited dedicated personnel and funds for continual engagement [51].

Statement 3: Given multiple psychosocial barriers to adherence, interventions including self-care skills and/or

strategies (C) may support AYPLHIV to be better able to prioritize their own health and needs and improve their capability to engage in care (M), thus improving adherence (O).

AYPLHIV may be managing mental health and psychosocial challenges related, or in addition, to their HIV-positive status. These burdens may be layered with other social, familial, or financial difficulties, which can affect their ability to adhere and engage in care. Although most intervention studies were not explicitly tied to improving mental health, many incorporated self-care strategies to support AYPLHIV's health behaviors more holistically. In some cases, self-care components can be more practical, encompassing daily adherence reminders [25,26,37], especially for at-risk subgroups of AYPLHIV [42], or more comprehensive information about HIV knowledge and treatment plans [38]. Other interventions involving self-care may be oriented around complementary practices (such as mindfulness-based stress reduction [52] or taught through vignettes [47]. For AYP diagnosed with and being treated for major depressive disorder, however, interventions may require higher level professional care, and/or more intensive efforts—such as in one study that identified improvements in depressive symptoms through a combined pharmacological-psychosocial approach, but not adherence outcomes [31].

Category 2: tailored delivery strategies

The second category of statements reflects factors linked to broader intervention delivery contexts, identifying strategies for delivery that support better uptake and improve adherence. These statements include diverse delivery strategies, longer duration interventions, and digital delivery.

Statement 4: As AYPLHIV experience complex challenges that interfere with adherence (C), diversifying delivery strategies can support engagement with intervention content (M), and improve adherence (O).

AYPLHIV may benefit from interventions that present diverse delivery strategies to boost engagement and successful outcomes. In group-based settings, where participants may be facing distinct barriers to adherence from one another, interventions can employ multiple delivery techniques—including activities, role plays, and didactic sessions—to engage AYP with different approaches to learning, supporting AYP to improve healthy behaviors [38]. Hybrid delivery models (i.e., group and individual sessions) may also be effective, enabling both social cohesion and learning, and individual attention [35,38,42]. These layered approaches may provide mutually reinforcing opportunities for intervention uptake, or present information and teach skills in diverse ways, allowing adolescents to engage with content in the way works best for them [50]. One caveat is that when these interventions employ highly flexible approaches, it may be harder to monitor intervention fidelity.

Statement 5: AYPLHIV across contexts who are encouraged to engage with longer duration interventions (C) may internalize new skills and have more opportunities to practice skills (M), improving outcomes (O).

Longer duration, or increased contact, may improve outcomes linked to adherence for AYPLHIV. This may involve high frequency of routine meetings, and/or sessions sustained over a longer period of time. For participants in face-to-face interventions, increased contact may encourage stronger relationship-building and enable AYPLHIV to build rapport—

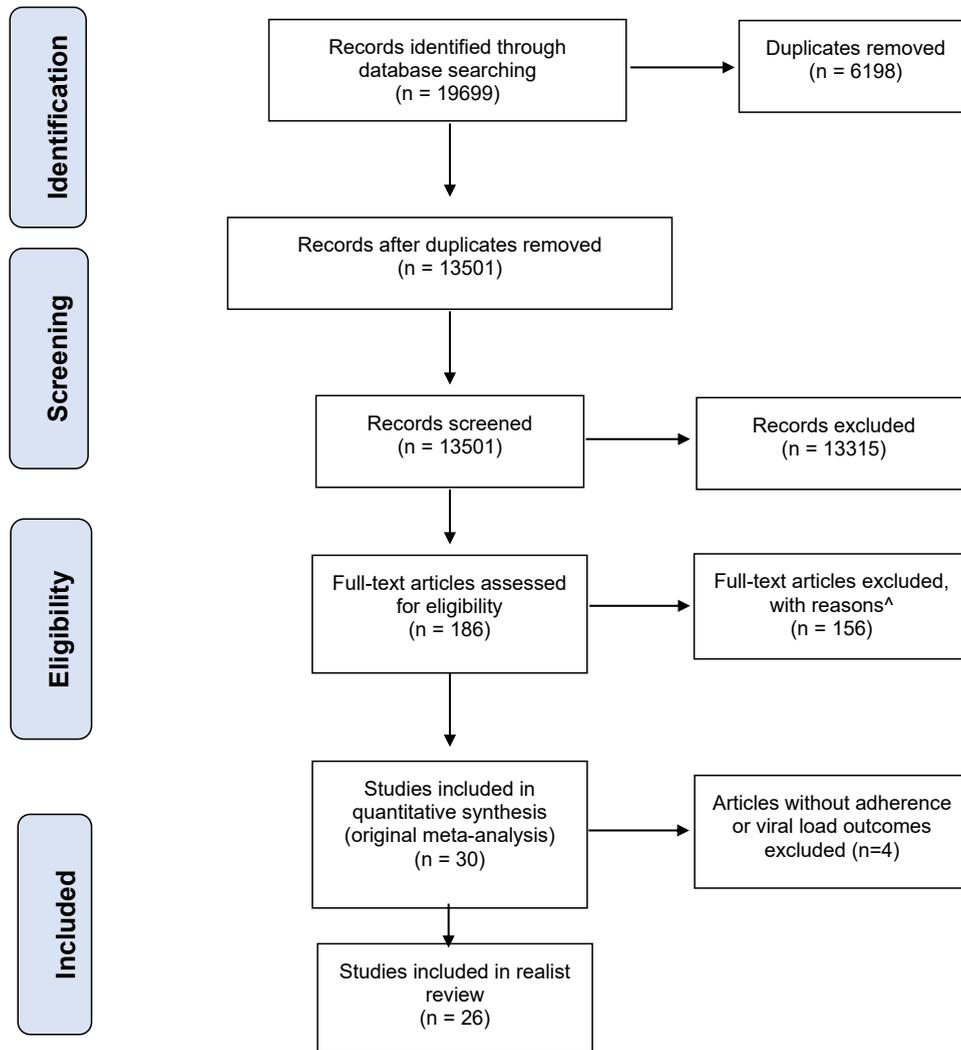


Figure 1. PRISMA flow chart of included studies.

both with peers in group-based settings, as well as with facilitators across all settings [42]. Contact may be particularly important for AYPLHIV, who are likely to experience internalized and externalized stigma linked to their status [48]. For adherence especially, more contact time might allow for behavior change processes to better take hold [50]. Perinatally infected AYP often experience shifts in their model of care when transitioning to adult services, and so additional time to practice self-care strategies for adherence is critical [39]. Extra contact or support time is also valuable for newly diagnosed individuals [38,53].

For interventions with higher risk of attrition, limited contact may inhibit adherence reminders and hinder positive outcomes [51]. In cases where intervention sessions have been reduced from earlier iterations, effects on adherence may not be as substantial [38]. Importantly, longer duration interventions should carefully integrate adolescent-friendly messaging, communication, and other appropriate incentives, to sustain interest and boost buy-in over longer timeframes.

Statement 6: AYPLHIV across a diverse range of settings (C) are likely to find digitally delivered interventions appealing, convenient, and confidential (M), leading to improved engagement (M) and better adherence (O).

For AYPLHIV in high-income and low-income settings alike, digitally delivered interventions are likely to be acceptable, especially when catered toward youth preferences. Digital or remote-based interventions can increase AYPLHIV's accessibility to important content and enable contact outside of traditional intervention spaces, which is key for individuals who are hard-to-reach due to geographic or other reasons [51,53]. Furthermore, digitally based interventions enable better confidentiality, even on group-based platforms, which may appeal to AYPLHIV experiencing stigma or lacking confidence to participate in an in-person intervention [36]. Remote interventions can be streamlined in nature, such as those that engage AYPLHIV through phone calls [25] or use daily SMS reminders about adherence, which may be more effective if individualized [37,40,42] (see Statement 2). Alternate forms of technology such as smart pillboxes may also be valuable add-ons for prompting participant engagement [41].

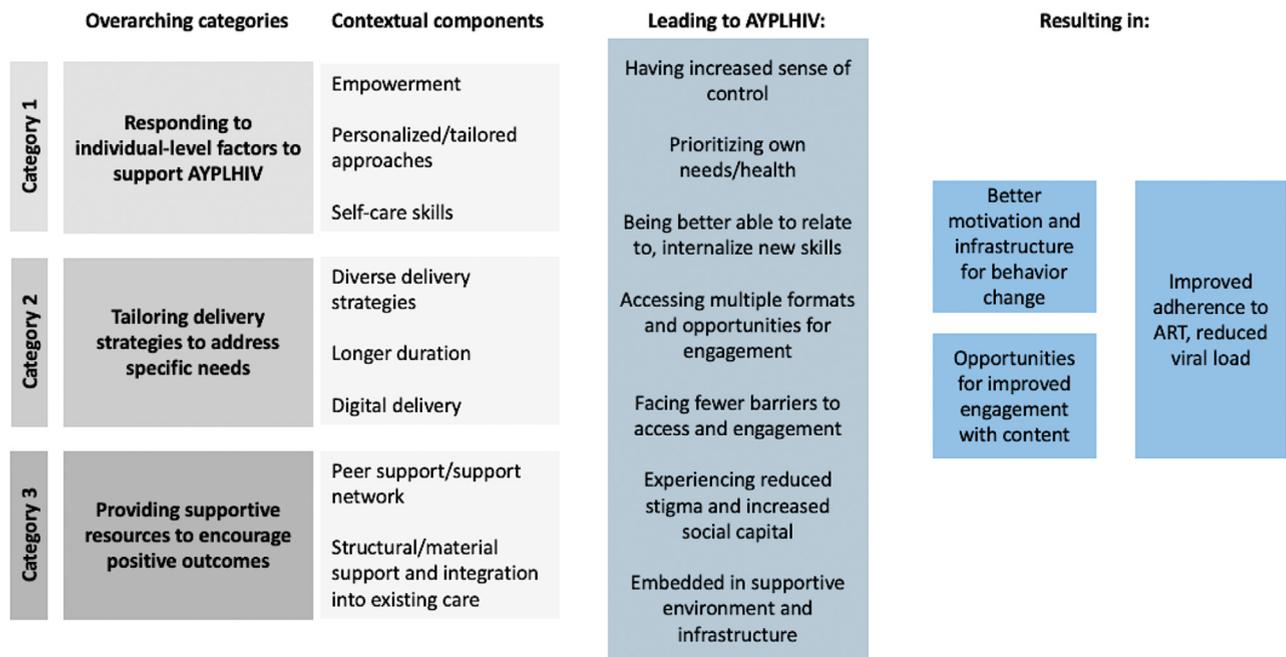


Figure 2. Theorized pathways to effectiveness.

Higher levels of engagement are, in turn, associated with better uptake of intervention content and improved adherence.

Importantly, there are logistical challenges to implementing digital interventions effectively, especially given considerable socioeconomic inequity among AYPLHIV. Risk of attrition is, by nature, higher for digital interventions; these interventions should be interactive, utilizing personalized approaches to boost engagement and retention [44]. Accessibility is another significant challenge: despite high levels of mobile phone ownership, even in low-income settings, AYPLHIV may lack access to their own phone (or rely on caregivers' phones), posing challenges when digital interventions rely on smartphone apps. This barrier may be addressed by providing smartphones or other technology [51] to support adherence, and/or by covering mobile costs for participants' phones for the duration of the intervention [26]. Issues linked to internet connectivity or electricity for phone-charging may complicate real-time feedback on adherence progress and goals [51]. As safeguarding is a primary concern for remote-based participants, good practice standards such as allowing participants to select pseudonyms, and establishing mutually respectful ground rules for group engagement, should be adopted for digitally based interventions to ensure privacy and confidentiality and reduce risk of unplanned disclosure. Ultimately, in some settings (especially low-income settings), digitally delivered interventions may be infeasible for much of the target AYP population.

Category 3: providing supportive resources to encourage positive outcomes

The final category reflects on supportive environmental or structural resources that can provide reinforcement for healthy behaviors and promote adherence.

Statement 7: Given complex support needs for AYPLHIV (C), access to peer-delivered interventions and interventions

drawing on broader support networks may help decrease stigma, boost motivation, and teach coping skills (M), improving adherence (O).

AYPLHIV may face stigma and uncertainties about navigating living with HIV. Access to peer-delivered interventions may improve AYPLHIV's social capital. Peer mentors may offer active role-modeling and problem-solving, supporting AYP self-confidence and self-acceptance to adopt adherence-promoting behaviors [35]. They may also support AYPLHIV with addressing internalized stigma, by identifying and relating to various challenges, sharing coping skills, and broadly leveraging their shared HIV status to navigate social challenges [42,54]. Close attention to peer mentor characteristics (e.g. exemplary adherence, experience with HIV treatment, interpersonal skills) should inform the selection process. Furthermore, these interventions should prioritize training and supervision for peer implementers, and engage co-delivery approaches where suitable, to ensure they have adequate support and manage issues of confidentiality appropriately [35].

Interventions drawing across AYPLHIV's broader support networks, including parents and/or primary caregivers, may be similarly valuable—especially for younger adolescents who rely on caregivers for continued support [29,30]. These interventions may focus on equipping caregivers to be more responsive and accommodating to AYP's autonomy in self-care, and/or to improve AYP-caregiver communication to create adherence-promoting environments [30,42,47]. They may also involve joint peer-parent sessions [27].

Statement 8: Among AYPLHIV exposed to multidimensional poverty in resource-limited communities (C), interventions that incorporate structural/material support to integrate provisions into existing care (M) can help ease structural barriers to participation and adherence (M), improving adherence (O).

Many AYPLHIVs are socioeconomically disadvantaged, encountering practical, material, and structural challenges when both engaging in interventions and accessing ART [28,30]. These challenges include transport costs to clinics to access ART and time trade-offs between earning an income and accessing care. Consequently, AYPLHIV may benefit from partaking in interventions integrating structural and material support. Interventions that involve cash transfers, incentivized savings accounts, or other asset-based approaches can build family and individual resilience and future orientation, especially in low-income settings [27,28]. These socioeconomic interventions may also increase agency, facilitating improved HIV-related outcomes. Importantly, these interventions, and their effects, may be difficult to implement or sustain over a long period without significant financial investments.

Integrating innovative strategies into routine care may be a more feasible, and sustainable, solution for reaching AYPLHIV effectively. Aligning intervention sessions with medical appointments decreases effort required for participation, and also promotes engagement in health services, increasing the likelihood of reinforcing messages [44]. Unless structural clinic-level changes are made to accommodate these alignments, these approaches may not be sustainable, and will work best for brief interventions only [48,49].

Discussion

This realist review provides a working mid-range theory of how psychosocial interventions for AYPLHIV operate across multiple contexts and in diverse circumstances to improve ART adherence and reduce viral load.

In theorizing effective pathways for improving adherence among AYPLHIV, we identified three broad categories—individual-level engagement, delivery approaches, and supportive resources—by which interventions can set off mechanisms against contextual factors to produce positive outcomes. Our findings mirror those from existing reviews on adherence-focused interventions for AYPLHIV populations, recent global consultations with country representatives [56] and from AYP themselves [22,57]. These pathways also add new insight. Importantly, the theorizing embedded within realist reviews points to areas for further refinement as psychosocial interventions are developed and improved.

On an individual level, we found that psychosocial interventions can improve adherence when they are able to equip AYPLHIV with skills for self-care, that is, improve self-efficacy; are individually or AYP-tailored; and use empowerment-centered approaches to improve agency. Other studies have identified similar, overlapping strategies and skillsets that promote adherence, including empowerment [3], self-monitoring [58], and self-management strategies that encompass stigma reduction and future orientation [59]. We also identified diverse tailored approaches to psychosocial intervention delivery that support better uptake of strategies for adherence: a recent review by Casale et al. [60] showed that multifaceted interventions extending beyond clinical settings were important for AYPLHIV. Finally, in examining broader contextual elements that facilitate supportive resources for better adherence, we found that peer mentors, broader support networks, and material and structural support may ease barriers to access. Other research has identified the importance of these specific components, both independently and together; Cluver et al.'s [61] work on “cash plus care”

reiterates how social protection and supportive care can improve AYP adherence and linked behaviors. Furthermore, AYP themselves have been found to approve conditional economic incentives to ease adherence barriers [62]. Psychosocial support delivered through peer counselling and support [58], social relationships [3], and family-based services [63] are important for improving adherence among AYPLHIV; however, flexible approaches and high-quality implementer training are needed. Sustainability is an ongoing area of concern for interventions that are time-bound [64]; identifying pathways for continued provision of social protection is critical to ensure that intervention effects do not fade after programs end.

Although we paid special attention to level of engagement and outcome differences among participants, this review did not uncover significant differences in mechanisms by gender. Some interventions were more attuned to participant age in their design and implementation, for example, by including caregivers to support younger adolescents, or engaging older groups independently to foster autonomy. Mode of HIV transmission has also been identified as a potentially important factor in AYPLHIV-targeted interventions [65]. We identified only a small number of studies examining mode of transmission among newly diagnosed youth, men who have sex with men, and younger AYP with perinatal HIV. This highlights the need for interventional studies evaluating adherence interventions tailored to mode of transmission.

Integrating these findings into practice

We have identified a number of linked recommendations to consider how to take these statements into practice.

First, although our review's findings stem from observed CMO pathways, implementation considerations are closely linked to how practical these statements may be and how feasible the relevant actions are in low-resource contexts. We suggest a close consideration of context-specific factors, as well as additional support while implementing psychosocial interventions for AYPLHIV in novel spaces. Relevant examples include peer-driven programming, digital delivery, and personalized strategies. Although peer mentors have been widely employed across multiple contexts [66], it is critical that they receive supervision and mentorship support: both to support their own health and wellbeing as they navigate similar challenges, and to facilitate their professional development as young peer health workers [42,67]. Similarly, digitally based interventions continue to be readily adopted to reach remote populations of AYPLHIV, despite inherent challenges that often accompany their implementation. Challenges may include accessibility of equipment, network connectivity, and electricity, as well as sustained engagement over time. Researchers and practitioners should assess contextual factors that might support or inhibit digital interventions ahead of and during implementation. Finally, in settings where prevailing norms restrict individual agency—for example, among adolescent and young women, and with younger adolescents—personalized strategies requiring a level of agency beyond that allowed for some AYPLHIV may have poor uptake and/or impact [68].

Second, although large-scale research studies can provide robust evidence on intervention effectiveness, learning from ongoing programming is essential to broaden the evidence base and respond in nimble, contextually appropriate ways. Program practitioners implementing psychosocial interventions for

AYPLHIV should aim to enhance routine monitoring and evaluation practices to gather comprehensive data. Both researchers and practitioners should prioritize streamlined reporting to support implementation and generate better-quality evidence to improve HIV outcomes. It is also important to align standardized indicators and tools, to enable cross-programmatic learning and maintain a high quality of programmatic evidence [69,70].

Third, interventions should be designed, implemented, and evaluated with an early focus on scale-up and sustainability. Integrating interventions with existing community- and facility-based approaches, as explored in Statement 8, may increase policy buy-in. This approach may also drive interest among AYP themselves, especially when paired with adolescent- and youth-friendly health services. From a sustainability perspective, policymakers may also be more likely to take up interventions that have been field-tested and adequately evidence-based, as has happened in Zimbabwe with the Zvandiri intervention [42]. Additionally, interventions should be accompanied by economic evaluations.

Finally, interventions designed to reach AYPLHIV should be responsive to the evolving COVID-19 pandemic and its direct and indirect impacts. Responsiveness should include careful assessment of how COVID-19-related public health measures, surges in SARS-CoV-2 infection, and effects on HIV service delivery may affect young people's engagement in HIV care and reachability. Such considerations include new or adapted facility and community strategies—as well as how social, economic, and demographic effects may alter the contexts in which AYPLHIV live, and the kinds of interventions they need. Youth-focused interventions that employ digital modalities, integrate economic empowerment strategies, and/or support task-shifting to peers may be particularly important in maintaining a flexible, yet attentive, HIV response [71].

Limitations

This review has some limitations. It draws from a subset of a previously identified group of randomized controlled trials; while we endeavored to include additional linked publications from these trials in our dataset, we may have omitted other qualitative or mixed-methods research that could provide more nuance to these findings. Additionally, as this study relies on results from a 2020 search, it is possible that more recently published studies are missing from this analysis. We were unable to access intervention manuals for the majority of studies, and relied on authors' reporting of intervention components and contexts in the studies and linked evidence. Although this reporting was overall adequate, there may be gaps in our theory development due to inconsistent reporting quality. Similarly, reviewed studies did not include evidence from longer term follow-ups, which may have limited the conclusions we are able to draw from the available evidence.

Considering viral load as a proxy for adherence was logical for the purposes of our review; however, we acknowledge that this approach has clinical limitations and may overlook the possibility of resistance mutations. We also focused our outcomes around ART adherence and viral load, which are only part of the HIV care continuum; some mechanisms we identified may require further bolstering to effectively initiate AYPLHIV in care, for example.

Finally, realist reviews may offer insights about complex interventions and their implementation through identifying and

testing theories as part of an iterative, generative process; their purpose is not to identify what works in all situations, but rather to generate a mid-range theory that explains reoccurring patterns of behavior in a given set of circumstances. The findings of this review should be interpreted with this in mind.

Conclusion

Psychosocial interventions are a critical means of engaging and supporting AYPLHIV, and work through a diverse set of mechanisms to improve adherence and reduce viral load. Through a focus on individual-level skills, delivery approaches, and supportive resources, psychosocial interventions may be able to be further refined and improved to reach new groups of AYPLHIV, or address other related HIV outcomes. Our recommendations—focusing on implementation quality, integrating robust monitoring into ongoing programming, prioritizing sustainability and scale-up considerations, and remaining responsive to COVID-19 disruptions—may strengthen existing efforts to support AYPLHIV at a critical life stage.

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Supplementary Data

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