

# Predictors and Interventions to Increase Adherence to Antiretroviral Therapy (Art) In Adolescents on HIV Treatment in Sub-Saharan Africa

Ngwafong Mukere Gladys <sup>1</sup>; Tendongfor Nicolas <sup>2</sup>; Samje Moses <sup>3</sup>; Mary Bi Suh Atanga <sup>4</sup>

## Affiliation

- <sup>1</sup>. Ngwafong Mukere Gladys, BNS, MPH, PhD student, University of Bamenda
- <sup>2</sup>. Tendongfor Nicolas: Head of the Department of Public Health, University of Buea
- <sup>3</sup>. Samje Moses, Senior Lecturer, University of Bamenda
- <sup>4</sup>. Mary Bi-Suh Atanga: Head of Department of Nursing, University of Bamenda

## Abstract:-

### ➤ Introduction

Over the past ten years, access to adequate and affordable antiretroviral medications has expanded globally for people of all ages. Adolescents with HIV, however, have inferior treatment outcomes because of suboptimal adherence, which results in a high viral load and its associated effects, including higher mortality, morbidity, OIs, and HIV medication resistance mutation. This review aims to identify predictors and current strategies to promote ART adherence in adolescents and young people in Sub-Saharan Africa.

### ➤ Method:

We searched databases such as Pub Med and Google Scholar for articles published in English from 2000 to 2024 related to factors affecting ART adherence in adolescents (10-19 years) and interventions to mitigate the challenges and promote ART adherence and treatment outcomes in adolescents living with HIV. Only studies on ART adherence or strategies to enhance ART adherence in adolescents 10-19 years and young people 10-24 years living with HIV in Sub-Sahara Africa were included in the review.

### ➤ Results:

Factors linked to ART adherence and interventions to improve adherence in adolescents and youths were identified at individual client level, family level, health system delivery and healthcare provider level and medication level. Adherence interventions were tailored to mitigate specific level predictors. Individual-level interventions such as memory aids (SMS reminder) and therapeutic education counseling alone were not associated with significantly improved adherence in adolescents and adults. Health service delivery interventions such as age-adapted adolescent support group clinics over the

weekend, after-school services in conjunction with peer support, and single-dose daily medication were associated with an increase in adherence to ART. Financial empowerment of family, adolescents, and HIV treatment literacy were linked to improved adherence. A combination of interventions cutting across multiple levels of interventions appears to be more effective in improving adherence in adolescents.

### ➤ Conclusion:

A combination of directly observed therapy engaging adolescent peer supporters and memory aides in a well-structured health service delivery system is an effective intervention to enhance ART adherence in adolescents. More studies are needed to determine the effects of combination interventions in achieving optimal adherence among adolescents on ART in Sub-Saharan Africa.

**Keywords:-** HIV Treatment, Adherence Interventions, Viral Suppression, Adolescents.

## I. INTRODUCTION

Globally, an estimated 35 million people currently live with HIV, and over 7 million of them are children and youth aged 0- 24 years [1]. A more significant (>85%) percentage of these children and youth with HIV live in nations with poor resources, especially those in sub-Saharan Africa.

Additionally, young women experience disproportionately more significant impacts than their male counterparts, perhaps due to their physiology, economic status, and social/cultural practices in some settings. In children and young adolescents, vertical transmission accounts for more than 90% of HIV infections. Nonetheless, some young people and adolescents contract HIV through sexual contact [2]. Because more children have access to efficient HIV therapy, the survival rate of children living with HIV has

improved. Approximately 54% of children worldwide are using antiretroviral therapy, while 74% of adults with HIV are taking medicine [3]

At every stage of the HIV care cascade, adolescents and young people living with HIV have very poor treatment results relative to adults and children, even though access to antiretroviral medicine has expanded in both high-income and resource-limited settings [4].

Poor adherence to antiretroviral therapy is leading cause of suboptimal treatment success in children and youths. Even among this age group, other subgroups, such as older adolescents 15-19 years, have worsened ART adherence rates [5]. Adherence rates across studies ranged from 16% to 99% [6]. Adherence of approximately 95% is generally regarded as ideal for successful HIV therapy (long-term viral suppression, decreased morbidity, opportunistic infections, mortality, and prevention of HIV medication resistance), even though adherence levels as low as 80% have been linked to treatment success [7].

Adherence to antiretroviral therapy (ART) is a complicated behavior impacted by numerous factors [8]. The purpose of this study was to examine the variables influencing adolescent ART adherence and strategies to reduce low adherence in this demographic.

Relevant studies revealed multi-level factors linked to poor adherence to antiretroviral therapy in adolescents living with HIV [1]. There are many factors hindering adherence in adolescents. They can be classified into (i) patient levels, such as gender, age, stigma, non-disclosure, forgetfulness, and knowledge of serostatus; (ii) family structure, such as family dynamic and coherence; and (iii). medication-related hindrances, including the high number of pills and times taken daily, adverse effects, medication flavor and size, and (iv) Health care system and environmental factors such as clinic days/hour appointments, skillful and competent service providers, infrastructure, and rural versus urban location [9].

**Table 1: Patient-Related Factors of ART Adherence in Adolescents.**

<b>I. Client/Patient Factors</b>		
<b>SN</b>	<b>Factors</b>	<b>Description/ explanation.</b>
1	Child's Age	A child's age can significantly impact adherence to various health-related behaviors, especially in adolescents. Adolescents' cognitive capacities advance with age, leading to enhanced problem-solving ability and a greater comprehension of the implications for their health. Increased adherence to prescribed medications or lifestyle modifications may result from this [10-11] It may be difficult for younger adolescents (early teens) to comprehend the long-term effects of non-adherence, which can make following complicated treatment plans difficult.
2.	Mental Illness	Social isolation and a lack of support from family or friends also hinder adherence. Patients may avoid getting care or discussing their problem because to the stigma associated with mental illness, which can cause feelings of shame or embarrassment. Decision-making, memory, and attention can all be negatively impacted by mental diseases such as severe depression, bipolar disorder, or schizophrenia. Patients may, as a result, fail to take their medications as prescribed, misinterpret their treatment plans, or be unable to adhere to complicated care plans. A patient's capacity to work may also be hampered by mental illness, which can make it challenging to pay for therapy, transportation, and prescription drugs. This financial burden may make adherence lower. [12]
3.	Social Support	Adherence may be considerably increased by parents who take an active role in their adolescent's healthcare by reminding them of visits, prescriptions, and lifestyle modifications. Adolescents are more likely to follow their treatment plan when parents are involved and supportive. Adolescents who feel understood, supported, and encouraged by their families tend to have better mental and physical health outcomes. This emotional backing can increase their willingness to follow through with treatments, especially for chronic conditions like diabetes, asthma, or mental health disorders [10].

4.	Poverty	<p>It is sometimes complicated for those who are poor to pay for medical supplies, treatments, or prescription drugs. Co-pays and other out-of-pocket expenses may be debilitating even with insurance, which makes patients skip treatments or dosages.</p> <p>A specific diet is necessary for many therapies, particularly those for long-term ailments like diabetes or heart disease. Such diets can be difficult for those living in poverty to stick to, which lowers treatment efficacy and overall adherence.</p> <p>Healthcare priorities frequently decline when people are preoccupied with meeting their fundamental requirements, such as shelter, food, and bill payment. This may result in delays in getting treatment or medication refills [10].</p>
5.	Frequency of dosing	<p>The frequency of drug delivery significantly influences adolescent medication adherence. Adolescents may struggle to manage duties during their developmental period, such as adhering to medication regimens. Frequent dosage can cause poor adherence, resulting in less-than-ideal treatment outcomes. This can exacerbate the illness being treated and raise the need for healthcare, further complicating the adolescent's view of medicine and adherence. It is more common for adolescents to feel self-conscious about taking their prescriptions, especially in public. If they had to take their meds more than once a day, they might not take them in front of their peers, which would lower their adherence. In conclusion, teenagers who get their medications more frequently tend to be less compliant since it causes disruptions to their routines, raises the possibility that they may forget to take their medications, and exacerbates their psychoses [13].</p>

## II. FAMILY FACTORS

Adolescent adherence can be significantly impacted by the conduct and circumstances of their family, particularly when it comes to things like routine medical care, attending school, or basic behavioral expectations. Family dynamics, parental conduct, and socioeconomic circumstances greatly influence adolescents' ability to follow rules or fulfill obligations.

**Table 2: Family-Related Factors of ART Adherence in adolescents.**

SN	Factors	Description
1.	Behavior and life situation of the family.	Adolescents with parents who are interested in their lives tend to stick to medical recommendations, attend school regularly, and behave in ways that are expected of them. Parents who are supportive offer direction, assist with scheduling activities such as studying or taking prescriptions and set an example of responsibility and discipline. Adolescents who grow up in stable households are more likely to feel secure and follow routines. On the other hand, family instability brought on by divorce, repeated moves, or disagreement can cause stress, worry, and a lack of structure, which can lower adherence [14].
2.	Parental Support and Involvement	Parents who support their teenagers with scheduling, reminders, and medication management improve adherence. Practical participation in daily activities, such as scheduling medicine or going to appointments with them, also improves adherence. If parents provide them with emotional support, adolescents are more likely to stick with their treatment plan. This entails supporting them, paying attention to their thoughts and worries, and actively listening to them [15].
3.	Parental Monitoring	Perfect adherence is typically observed by parents who appropriately monitor their adolescent's adherence behaviors, such as reminding them of scheduled medical visits or checking to see if their prescription is taken. But to avoid creating resistance, this monitoring must be fair and not unduly dominating [16]
4.	Parental Health Literacy	Parents' knowledge of Health Information. Parents with a high degree of health literacy are better equipped to help their adolescents realize how important adherence is. Understanding medical instructions, therapies, and the long-term advantages of adherence may create a supportive atmosphere for teenagers [17].

5.	Parental Attitudes and beliefs	Adolescent adherence can be significantly impacted by parental views on the gravity of a problem, the need for treatment, or the efficacy of a health regimen. If parents stress the value of finishing therapy, children can develop a sense of responsibility. Parental views towards alternative therapies, conventional medicine, or mistrust of healthcare institutions may also impact adherence. Adherence to the recommended therapy may be improved by cultural ideas that support it, while those that do not may make it more difficult [15,17]
----	--------------------------------	--

### III. MEDICATION FACTORS

Adolescent adherence to medication is significantly influenced by its formulation. Administration's shape, flavor, and convenience might positively or negatively impact a young person's desire and capacity to take their prescription regularly.

**Table 3: Medication –Related Factors to ART Adherence in Adolescents**

SN	Factors	Explanation
1.	Taste and Palatability	Like younger children, adolescents are frequently more sensitive to the taste of prescription drugs. They are less inclined to take a drug regularly if it feels harsh or disagreeable. Adolescents are more likely to accept liquid formulations, chewables, or pills with a pleasant flavor, especially if the drug is taken regularly or over an extended length of time [18-19].
2.	Size and Appearance	Adolescents who find it daunting or challenging to swallow significant medications may neglect to take them as prescribed or miss doses. Chewable pills, smaller tablets, or patches may increase adherence. Adherence to medicine can be enhanced by discretely administered medications (e.g., patches or single tablets), particularly in social contexts when teenagers may feel uncomfortable taking their medicines in front of their peers[18,20]
3.	Delivery Method (Patch, Oral, Nasal, etc.	For adolescents who might find it challenging to take injections or oral drugs, they provide an option. Since patches are usually worn for a longer amount of time—a day or even a week—they need less administrations, which improves adherence [19].
4.	Fixed-Dose Combinations	Multiple drugs are necessary for certain illnesses, including HIV or hypertension. By lowering the number of tablets required for the regimen, fixed-dose combination pills that combine multiple medications into one dosage can facilitate adherence [18].
5.	Dosage Form	Adolescents who have trouble swallowing pills or capsules may not stick to their regimen well. Dissolvable pills or liquid formulations are frequently simpler to swallow and may increase adherence. For chronic conditions like asthma (inhalers) or diabetes (insulin injections), the form of medication can significantly impact adherence. Injections are generally seen as more intrusive and may lower adherence unless essential [20].

**Table 4: HealthCare Delivery System Related- factors of ART Adherence in Adolescents.**

SN	Factors	Explanation
1.	Accessibility and Availability of Services	Teens in underprivileged or rural locations could find it challenging to go to clinics or hospitals. Adolescents may become disinclined to attend follow-up sessions due to lengthy wait periods, unavailable appointment schedules, or awkward hours [14].
2.	Provider-Patient Relationship	Adolescents may experience miscommunication or intimidation from medical staff, which may cause them to lose faith in themselves or their desire to heed advice. Adherence may be impacted by providers' failure to communicate instructions or treatments in a way that teenagers may comprehend [14].
3.	Confidentiality and Privacy	Suppose adolescents believe their health information may not be kept private from parents or guardians. In that case, they may be reluctant to fully participate in healthcare services, particularly when it comes to

	Concerns	issues like substance abuse, mental health issues, or sexual health. Fear of being judged is a common reason adolescents avoid addressing delicate topics with healthcare practitioners, making treatment adherence more difficult [14].
4.	Technology and Digital Health	If their healthcare systems do not offer adequate education or access to dependable digital health technologies, adolescents may turn to dubious sources of health-related information. They may find it more difficult to participate and remain devoted to healthcare systems that do not use technology, such as telemedicine, online appointment scheduling, or reminder systems [14].
5.	Continuity of Care	If their care is not well coordinated, teens may see several healthcare professionals, which might lead to uncertainty about the recommended therapies or drugs. Adherence to adult healthcare services may be impacted by adolescents' feelings of disconnection from their new physicians [14]

**Table 5: HealthCare Providers Related-factors of ART Adherence in Adolescents**

SN	Factors	Explanation
1.	Involvement in decision-making	Some healthcare providers don't seek the consent of some adolescents when making decisions that concern them [17]
2.	Positive reinforcement	Providers who support and acknowledge little accomplishments might inspire teenagers to follow treatment regimens. Those who don't admit it may tend to discourage adolescents [14].
3.	Understanding of Adolescent Development	Providers knowledgeable about the developmental stage of adolescence and its challenges are better equipped to engage with their patients effectively [ 19 ]
4.	Educational Efforts	Higher adherence rates are predicted for providers who take the time to educate adolescents about their problems and the value of therapy [(15)]
5.	Follow-Up Support	Consistent follow-up and assistance from healthcare experts can help promote adherence and resolve any issues adolescents may experience [ 15]

#### IV. STRATEGIES TO IMPROVE ADHERENCE TO ANTIRETROVIRAL THERAPY IN ADOLESCENTS.

Given the various factors contributing to poor ART adherence, efficient interventions must be found to reduce ART adherence barriers in adolescents who exhibit particular risk-taking traits and a limited capacity for making wise and healthful decisions that advance their well-being.

There are several ways to improve adherence, including proper management of mental health issues, fostering strong relationships, tailoring the treatment plan if feasible, empowering the adolescent to handle adherence issues, supplying information, guaranteeing peer and family support, and boosting motivation [21]

##### ➤ *Individual Client-Level Strategies:*

Individual client-level interventions employ a cognitive or behavior approach, attempting to modify behaviors through memory aids and therapeutic education strategies. These programs use strategies like financial incentives, adherence support devices, directly witnessed therapy, and teaching and counseling [22].

**Table 6: Individual Client-Level interventions to improve adherence to ART in adolescents.**

SN	Intervention	Approach
1	Education and counseling	Cognitive and behavioral model. Individual and group therapeutic education strategies such as counseling cards, charts, and peer-led education should be used [15]. This approach attempts to modify behaviors through the use of a memory aid
2	Observational strategies	<ul style="list-style-type: none"> <li>Swallowing of medication by the child is observed by the caregiver, healthcare providers, community worker, or medication buddy. The use of pill boxes. A medication event monitoring system monitors medication pick-up from the clinic and counts the number of pills swallowed at home and during clinic visits by healthcare providers [16]. Healthcare providers should build a trusted relationship with adolescents and caregivers and engage them in discussions about potential barriers to adherence and strategies to overcome them.</li> </ul>
3	Reminder system /memory aide	Mobile phone text messages, alarms, medication buddies/partners, and reminder calls for medication pick-up were some reminder strategies to improve adherence [22, 23].
4	Psychosocial support	Individual need-based counseling and education, group counseling and therapeutic education during adherence club meetings, and peer-led adherence support /counseling [14].
5	Financial incentive/literacy	Payment of transportation and school fees, as well as setting up small businesses for economic empowerment to caregivers [22, 24]

**Table 7: Family Interventions for HIV-positive Adolescents to Improve Adherence**

SN	intervention	Approach	Description of intervention
1.	Parental support and involvement, parental literacy	Educational empowerment/mentorship Nutritional and cash support to facilitate feeding and transportation.	Involving the family in the adolescent's care facilitates the development of a support network. Regular meetings to review health status and issues might be held to keep everyone informed and active. Roles and obligations may be made clear by creating contracts that specify expectations for adherence and family support. Adherence can be facilitated by creating regular regimens for taking medications or engaging in health-related activities [18] Adolescents might be motivated by rewarding and encouraging adherence behaviors. Education on a child's condition and the significance of adherence can better equip parents to help their children. Increasing family awareness of health concerns might help create a more encouraging atmosphere for adherence [25].
2.	Parental Monitoring	Communication skills and building trust	Cooperation and trust may be increased by teaching parents to listen to their children actively and to acknowledge their feelings [18, 21]
3.	Economic empowerment	Financial training /mentorship on income generation and saving. Setting up of small businesses.	Financial literacy, financial support for starting a business, financial planning mentoring, school fees, and food assistance were among the economic empowerment interventions provided to families of adolescents living with HIV. These interventions also addressed financial planning, business development, and the establishment of both short- and long-term goals [24,26,27].

**Table 8: Healthcare system strengthening interventions To Improve ART adherence in Adolescents.**

SN	Intervention	Approach/Description
1.	Differentiated service delivery (DSD) models.	Age-adapted adolescents-centered differentiated service delivery (DSD) incorporates structured adolescent-focused groups, adherence, adherence counseling, and social activities into clinic visits—typically on the weekends or after school hours [ 28]. Additionally, a systematic study found a moderate relationship with increased adherence in adolescents and young people with counseling and education (individual, family, and group interdisciplinary with adolescents or caregivers) [22]. Peer assistance at the community level is tailored to be responsive to the needs of each adolescent.
	Supply of single-dose HIV treatment	The regular supply of single-tablet-dose treatment is easy to swallow. Eliminating the difficulty of swallowing many tablets improves treatment adherence.
	Health facility–level interventions.	Adequate infrastructure provides weekend and after-school services to meet individualized care needs. A policy that allows healthcare providers to be trained regularly empowers them with the skills and knowledge to build trusted relationships with adolescents. The policy of free Healthcare services promotes the availability of medication to all adolescents living with HIV, irrespective of their economic status [22]. Among measures for maximizing adherence in adolescents are principles such as discussing improvement strategies with the adolescent before initiating treatment and at each treatment visit, using adherence monitoring measures, and maintaining a nonjudgmental and supportive provider-patient relationship [18].

## V. DISCUSSIONS

This scoping review exposed multiple-level characteristics or factors that are either barriers or facilitators of adherence to antiretroviral treatment in adolescents living with HIV in sub-Saharan Africa. Many studies conducted across countries in Sub-Saharan Africa identified adolescent-level factors such as age, HIV awareness, HIV treatment literacy, and health status of the patient. Adolescents who have minimal understanding of their HIV status interrupt medication intake easily [10]. Medication characteristics, such as the number of pills, the number of times to swallow the medicine, and the taste, size, and adverse effect of the antiretroviral therapy, can positively or negatively impact adherence to ART in adolescents. The adolescents also suffered from medication fatigue due to the lifelong nature of the ART [6, 18-19]. Family characteristics linked to good adherence were family support, family unity, family cohesion, and the disclosure of the adolescent's HIV status to other members of the family who can also provide psychosocial support to both the adolescent and her caregiver [9]. The organization of the healthcare delivery system and healthcare providers' characteristics also influence adherence to ART in adolescents [9, 5]. Healthcare delivery systems that have adapted clinic hours and services to the needs of adolescents enhance adolescents' medication possession and adherence to ART [18]. Trusted and friendly provider-patient relationships allow for sincere conversation and identification of barriers

and facilitators to develop an individualized care plan to promote adherence to ART [29].

Given the multidimensional factors linked to adherence to antiretroviral therapy, effective adherence interventions or strategies must address more than one dimension. Using cognitive, health beliefs, and behavioral theories, interventions directed to adolescents, caregivers, healthcare delivery systems, and healthcare providers demonstrate a higher probability of promoting good adherence in adolescents on ART [18, 30, 24]

Education-focused strategies promoting health literacy regarding HIV and ART may modify medication-taking behavior in adolescents. Adherence behavior may also be improved by directly including adolescents in their personal HIV treatment choices and plans [31]. Interventions that address patients' practical medication management skills accompanied by knowledge and support from caregivers, peers, and non-judgmental healthcare providers over a minimum time will promote good adherence in the target population [12].

Additionally, affective-based intervention techniques include psychotherapy or antidepressant drugs that provide emotional support to enhance ART adherence [29]. Common strategies include "treatment partners," peer support/counseling, and facility—or community-based support group meetings [24]. A combination of techniques, including

group instruction, counseling, and educational pamphlets, is linked to better adherence rates [32]

Economic empowerment or incentive-based strategies for caregivers and adolescents include rewards for suppressed viral load, food support, financial support for transportation for medication pick-up, and medical bills to promote good health and adherence [31]. Treatment for children must be provided in conjunction with caregivers rather than by themselves to strengthen follow-up [30]. Medication-related strategies include the supply of a once-daily single-tablet regimen to eliminate the medication pill burden [15,11]. Combining text messaging and individual and group counseling in sessions accompanied by routine adherence assessment methods increases the need-based counseling rate and ART adherence [32,22].

Intensive individual adherence counseling, family-based economic empowerment, community—and facility-based peer-led differentiated service delivery (DSD), and psychosocial/therapeutic education were some effective strategies for promoting adherence in adolescents [31].

## VI. CONCLUSIONS

Multiple factors at different levels (patient, family, health system, and medication) affect adolescent adherence to ART. Hence, numerous interventions tailored to mitigate challenges at various levels were employed to improve adherence to ART in adolescents. Interventions implemented at the individual patient level included SMS reminders, Directly observed therapy, therapeutic education, counseling, Psychosocial supports, and health system level interventions included peer support and adolescent-focused support groups, age-adapted adolescent-centered differentiated service delivery (DSD), individual and group adherence counseling. In contrast, family-level interventions included economic empowerment, therapeutic education, mentorship in business, and psychosocial /food support. Family support is critical in identifying adolescent adherence barriers and providing needed assistance to prevent adherence obstacles. A combination of several level interventions shows promise in improving adherence to ART and viral suppression among adolescents in Sub-Saharan Africa, even if a single-level intervention may help improve adherence in the adult population.

## RECOMMENDATIONS

To improve ART adherence in adolescents, more study is required to understand better the various combination intervention experiences of adolescents living with HIV/AIDS in sub-Saharan Africa. This information will help build culturally appropriate interventions that are well-tailored.

Further study is needed to test effective adolescent-level interventions to achieve optimal adherence and sustain viral suppression.

## REFERENCES

- [1]. Wei HH, Tsai LP, Wu PS (2016) : Adolescent onset of vertically transmitted untreated AIDS: A report of one case.. 4, s.l. : Tzu Chi Med J. , 2016, Vol. 28. PMC5442908..
- [2]. WHO (2022). <https://www.who.int/news/item/16-07-2021-new-findings-from-the-odyssey-trial-confirm-superiority-of-dolutegravir-based-art-in-young-children>. New findings from the ODYSSEY trial confirm superiority of dolutegravir-based ART in young children. [Online] WHO, July 16, 2021. [Cited: October 11, 2022.]
- [3]. Hlophe LD, Tamuzi JL, Shumba CS, Nyasulu PS (2023): Barriers and facilitators to anti-retroviral therapy adherence among adolescents aged 10 to 19 years living with HIV in sub-Saharan Africa: A mixed-methods systematic review and meta-analysis.. 5, s.l. : PLoS One. 2023 May , 2023, Vol. 18. e0276411. .
- [4]. Adejumo OA, Malee KM, Ryscavage P, Hunter SJ, Taiwo BO (2018). 1Contemporary issues on the epidemiology and antiretroviral adherence of HIV-infected adolescents in sub-Saharan Africa: a narrative review. ., s.l. : J Int AIDS Soc, 2015, Vol. 18. 20049. doi: 10.7448/IAS.18.1.20049. PMID: 26385853; PMCID: PMC4575412..
- [5]. Cluver, Carly Hudelson & Lucie ( 2015): Factors associated with adherence to antiretroviral therapy among adolescents living with HIV/AIDS in low- and middle-income countries: a systematic review. AIDS Care, , pp. 805-816, DOI: 10.1080/09540121.2015.1011073.
- [6]. Byrd KK, Hou JG, Hazen R, Kirkham H, Suzuki S, Clay PG, Bush T, Camp NM, Weidle PJ, Delpino A (2019).Patient-Centered HIV Care Model Team. Antiretroviral Adherence Level Necessary for HIV Viral Suppression Using Real-World Data. . 3, s.l. : J Acquir Immune Defic Syndr, 2019, Vol. 82. doi: 10.1097/QAI.0000000000002142. PMID: 31343455; PMCID: PMC6854523..
- [7]. Villiera JB, Katsabola H, Bvumbwe M, Mhango J, Khosa J, Silverstein A, Nyondo-Mipando AL (2022): Factors associated with antiretroviral therapy adherence among adolescents living with HIV in the era of isoniazid preventive therapy as part of HIV care.: PLOS Glob Public Health. , 2022, Vol. 2. e0000418. .
- [8]. Ammon, N., Mason, S. and Corkery, J.M (2018) : Factors impacting antiretroviral therapy adherence among human immunodeficiency virus–positive adolescents in Sub-Saharan Africa: a systematic review.: Public Health ELSEVIER, 2018, Vol. 157. pages 20-31.
- [9]. Chesney, Margaret A ( 2000) : Factors Affecting Adherence to Antiretroviral Therapy. Vol. 30.



- [10]. Lee C, Sapasap J, LaRochelle J, Smith RO, Badowski ME (2021) : Antiretroviral Therapy in Children and Adolescents: A Look Into Modern Single Tablet Regimens. s.l. : J Pediatr Pharmacol Ther., 2021, Vol. 26. PMID: 34790067; PMCID: PMC8591998..
- [11]. Dean AJ, Walters J, Hall A. (2010) : A systematic review of interventions to enhance medication adherence in children and adolescents with chronic illness.: Arch Dis Child, 2010, Vol. 95. PMID: 20522463..
- [12]. Cruz ML, Cardoso CA, Darmont MQ, Souza E, Andrade SD, D'Al Fabbro MM, Fonseca R, Bellido JG, Monteiro SS, Bastos FI (2014) : Viral suppression and adherence among HIV-infected children and adolescents on antiretroviral therapy: results of a multicenter study. 6, s.l. : J Pediatr (Rio J), 2014, Vol. 90. PMID: 24953723..
- [13]. Nasaba, Rosemary, Denis Tindyebwa, Victor Musiime, Robert Iriso, Resty Ingabire, Denis Nansera, Monica Etima-Kizito, Joseyee Kasule, and Malia Duffy (2018): Handbook on Counselling and Psychosocial Care for Children and Adolescents Living with and Affected by HIV in Africa. Kampala : ANECCA, 2018.
- [14]. Backes C, Moyano C, Rimaud C, Bienvenu C, Schneider MP (2021) Digital Medication Adherence Support. s.l. : Front Med Technol, 2021, Vol. 2. PMID: 35047896; PMCID: PMC8757821.
- [15]. Tobin NH, Aldrovandi GM (2013): Immunology of pediatric HIV infection.. s.l. : Immunol Rev, 2013. PMID: 23772619; PMCID: PMC3737605.
- [16]. Nichols JS, Kyriakides TC, Antwi S, Renner L, Lartey M, Seaneke OA, Obeng R, Catlin AC, Gan G, Reynolds NR, Paintsil E (2019 ) : High prevalence of non-adherence to antiretroviral therapy among undisclosed HIV-infected children in Ghana. AIDS Care, Vol. 1. PMID: 30235940; PMCID: PMC6288009.
- [17]. CDC, HIV.gov.(2022): Guidelines for the Use of Antiretroviral Agents in. s.l. : clinical info, 2022.
- [18]. Schlatter AF, Deathe AR, Vreeman RC (2016) The Need for Pediatric Formulations to Treat Children with HIV. s.l. : AIDS Res Treat, 2016. PMID: 27413548; PMCID: PMC4927993.
- [19]. WHO (2021): Consolidated guidelines on HIV prevention, testing, treatment, service delivery and monitoring: recommendations for a public health approach. s.l. : WHO, 2021.
- [20]. Taddeo D, Egedy M, Frappier JY (2008) : Adherence to treatment in adolescents. . 1, s.l. : Paediatr Child Health, 2008, Vol. 13. doi: 10.1093/pch/13.1.19. PMID: 19119348; PMCID: PMC2528818..
- [21]. MacPherson P, Munthali C, Ferguson J, Armstrong A, Kranzer K, Ferrand RA, Ross DA (2015) : Service delivery interventions to improve adolescents' linkage, retention and adherence to antiretroviral therapy and HIV care: Trop Med Int Health. , 2015, Vol. 20. PMC457954.
- [22]. Sumari-de Boer IM, Ngowi KM, Sonda TB, Pima FM, Masika Bpharm LV, Sprangers MAG, Reiss P, Mmbaga BT, Nieuwkerk PT, Aarnoutse RE (2021) : Effect of Digital Adherence Tools on Adherence to Antiretroviral Treatment Among Adults Living With HIV in Kilimanjaro, Tanzania: A Randomized Controlled Trial J Acquir Immune Defic Syndr. , 2021, Vol. 87. PMC8263131.
- [23]. Kizito S, Namuwonge F, Brathwaite R, Neilands TB, Nabunya P, Bahar OS, Damulira C, Mwebembezi A, Mellins C, McKay MM, Ssewamala FM (2022) : Monitoring adherence to antiretroviral therapy among adolescents in Southern Uganda: comparing Wisepill to Self-report in predicting viral suppression in a cluster-randomized trial. s.l. : J Int AIDS Soc. , 2022, Vol. 25. e25990.
- [24]. . Reif LK, Abrams EJ, Arpadi S, Elul B, McNairy ML, Fitzgerald DW, Kuhn L (2015) : Interventions to Improve Antiretroviral Therapy Adherence Among Adolescents and Youth in Low- and Middle-Income Countries: A Systematic Review 2015-2019, s.l. : AIDS Behav., 2020, Vol. 24. PMC7223708.
- [25]. Ekwunife OI, Anetoh MU, Kalu SO, Ele PU, Eleje GU (2018) .:, Conditional economic incentives and motivational interviewing to improve adolescents' retention in HIV care and adherence to antiretroviral therapy in Southeast Nigeria: study protocol for a cluster randomised trial. Trials. s.l. : Trial, BMC, 2018, Vol. 19. PMC6311063.
- [26]. Ekwunife OI, Anetoh MU, Kalu SO, Ele PU, Egbewale BE, Eleje GU (2022) : Impact of conditional economic incentives and motivational interviewing on health outcomes of adolescents living with HIV in Anambra State, Nigeria: A cluster-randomised trial.. s.l. : Contemp Clin Trials Commun., 2022. PMC9486535..
- [27]. Mogoba P, Lesosky M, Zerbe A, Falcao J, Mellins CA, Desmond C, Arnaldo C, Kapogiannis B, Myer L, Abrams EJ (2021): The CombinADO study to assess the impact of a combination intervention strategy on viral suppression, antiretroviral therapy adherence, and retention in HIV care among adolescents and young people living with HIV: protocol for a cluster-randomized control., s.l. : Erratum in: Trials., 2021, Vol. 22. s13063-021-05943-w.
- [28]. Ameyan W, Melendez-Torres GJ, Kara T, Brand A, Chideya Y, Abrahams N, Bradshaw M, Page DT, Ford N, Sam-Agudu NA, Mark D, Vitoria M, Penazzato M, Willis N, Armstrong A, Skeen S (2022): Psychosocial interventions for improving engagement in care and health and behavioural outcomes for adolescents and young people living with HIV: a systematic review and meta-analysis. Laurenzi CA, du Toit S., 8, s.l. : J Int AIDS Soc., J Int AIDS Soc. 2021 Aug;24(8):e25741. doi: 10.1002/jia2.25741. Erratum in: 2022 Sep;25(9):e26014. , Vol. 24. PMID: 34338417; PMCID: PMC8327356..
- [29]. . Hart JE, Jeon CY, Ivers LC, Behforouz HL, Caldas A, Drobac PC, Shin SS (2011) : Effect of directly observed therapy for highly active antiretroviral therapy on

- virologic, immunologic, and adherence outcomes: a meta-analysis and systematic review. *J Acquir Immune Defic Syndr.* , 2011, Vol. 56. e37-8. PMID: 20375848.
- [30]. Munyayi FK, van Wyk B, Mayman Y (2022) : Interventions to Improve Treatment Outcomes among Adolescents on Antiretroviral Therapy with Unsuppressed Viral Loads: A Systematic Review 7, s.l. : *Int J Environ Res Public Health.* , 2022, Vol. 19. [jerph19073940](https://doi.org/10.3390/ijerph19073940).
- [31]. Mimiaga MJ, Bogart LM, Thurston IB, Santostefano CM, Closson EF, Skeer MR, Biello KB, Safren SA (2019): 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. .. 1, s.l. : *AIDS Patient Care STDS.*, 2019, Vol. 33. [PMC6338456](https://pubmed.ncbi.nlm.nih.gov/338456/)..
- [32]. Enane, Leslie A. 1, Vreeman, Rachel C. 2 and Foster, Caroline (2018): Retention and adherence: global challenges for the long-term care of adolescents and young adults living with HIV. 3, s.l. : Wolters Kluwer, 2018, Vol. 13. DOI: <https://doi.org/10.1097/COH.0000000000000459>.
- [33]. Olurotimi A Adejumo, Kathleen M Malee, Patrick Ryscavage, Scott J Hunter, Babafemi O Taiwo(2015) : Contemporary issues on the epidemiology and antiretroviral adherence of HIV-infected adolescents in sub-Saharan Africa: a narrative review. 1, s.l. : *JIAS*, 2015, Vol. 18. <https://doi.org/10.7448/IAS.18.1.20049>.
- [34]. Dow DE, O'Donnell KE, Mkumba L, Gallis JA, Turner EL, Boshe J, Shayo AM, Cunningham CK, Mmbaga BT. Sauti ya Vijana (SYV(2022): The Voice of Youth): Longitudinal Outcomes of an Individually Randomized Group Treatment Pilot Trial for Young People Living with HIV in Tanzania.. 6, s.l. : *AIDS Behav.* , 2022, Vol. 26. [PMC8784208](https://pubmed.ncbi.nlm.nih.gov/38784208/)..
- [35]. Mukherjee TI, Zerbe A, Falcao J, Carey S, Iaccarino A, Kolada B, Olmedo B, Shadwick C, Singhal H, Weinstein L, Vitale M, De Gusmao EP, Abrams EJ( 2022): Human-Centered Design for Public Health Innovation: Codesigning a Multicomponent Intervention to Support Youth Across the HIV Care Continuum in Mozambique.. 2, s.l. : *Glob Health Sci Pract.* 2022, , Vol. 10. [e2100664](https://doi.org/10.1016/j.ghs.2022.100664).