

Effect of Digital Adherence Tools Versus Standard Counseling on Viral Suppression Among Adolescents Living With HIV: A Narrative Review

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ABSTRACT

Adolescents living with HIV face unique adherence challenges that compromise viral suppression, the cornerstone of effective antiretroviral therapy (ART). Traditional adherence support methods, particularly standard counseling, often fall short in addressing the dynamic psychosocial and behavioral needs of this age group. In contrast, digital adherence tools (DATs) including SMS reminders, mobile health applications, real-time electronic monitoring, and gamified platforms have emerged as promising interventions to promote engagement, autonomy, and sustained adherence. This narrative review compared the effectiveness of digital adherence tools versus standard counseling in achieving viral suppression among adolescents living with HIV. Thematic synthesis was employed to integrate findings from peer-reviewed studies and grey literature published between 2015 and 2024. Results suggested that DATs, particularly when personalized and integrated with human support, demonstrate superior or complementary benefits to counseling alone, especially in high-resource and digitally connected settings. However, their efficacy is moderated by contextual variables such as socioeconomic status, gender, mental health, caregiver involvement, and health system infrastructure. The review concluded that hybrid adherence models, combining digital tools with traditional counseling, hold the greatest promise. Tailored, scalable, and adolescent-friendly approaches are essential to achieving equitable viral suppression outcomes and strengthening long-term HIV care among adolescents.

Keywords: Adolescents Living with HIV, Digital Adherence Tools, Standard Counseling, Viral Suppression, Antiretroviral Therapy (ART).

INTRODUCTION

The global fight against HIV/AIDS has witnessed significant progress, particularly in improving access to antiretroviral therapy (ART) and reducing AIDS-related mortality [1–3]. However, adolescents living with HIV remain a uniquely vulnerable population with disproportionately lower rates of viral suppression compared to adults. Adolescents face complex adherence challenges, including psychosocial instability, stigma, disclosure concerns, and developmental transitions, all of which compromise sustained ART use. Viral suppression, the ultimate therapeutic goal of ART, hinges critically on optimal adherence. Thus, developing and implementing strategies that effectively support adherence in this age group is paramount.

Standard counseling remains a cornerstone of adherence support [4]. It involves regular, in-person sessions provided by healthcare professionals to educate, motivate, and monitor patients. While effective to an extent, standard counseling often falls short in addressing real-time behavioral lapses and the dynamic nature of adolescent lives. In response to these limitations, digital adherence tools (DATs) ranging from SMS reminders and mobile health (mHealth) apps to real-time electronic monitoring systems have emerged as innovative alternatives [5–7]. These tools promise to enhance engagement, promote autonomy, and deliver adherence support in a personalized and scalable manner. This narrative review critically explores and compares the effectiveness of digital adherence tools and standard counseling on viral suppression among adolescents living with HIV. Drawing on recent empirical evidence, it identifies key themes, highlights contextual variables influencing intervention outcomes, and discusses the implications for adolescent-focused HIV care. The review adopts a thematic approach, synthesizing findings across studies to elucidate patterns, enablers, and limitations of both intervention modalities. By doing so, it aims to

inform policy-makers, program designers, and healthcare providers on evidence-based strategies that can be tailored to improve ART adherence and viral suppression in adolescents a population at the crossroads of pediatric and adult HIV care with unique biomedical and psychosocial needs.

Digital Adherence Tools: Modes and Mechanisms of Action

Digital adherence tools represent a heterogeneous array of interventions designed to support medication-taking behavior using mobile and electronic technologies [8, 9]. These tools can be broadly categorized into SMS-based reminders, mobile health applications (mHealth), interactive voice response (IVR) systems, electronic pillboxes with real-time monitoring, and gamified adherence platforms. Each of these modalities targets different dimensions of adherence cognitive, behavioral, and motivational.

SMS reminders are among the most extensively studied tools. These are typically structured, automated messages sent to adolescents to remind them of dosing schedules. Studies have shown that SMS interventions can significantly improve short-term adherence by leveraging the ubiquitous presence of mobile phones. However, their effectiveness varies depending on message frequency, personalization, and timing.

mHealth applications extend the functionality of SMS by integrating features such as pill trackers, educational content, chatbots, and peer support forums [10]. These apps provide a multidimensional adherence platform, allowing for self-monitoring, feedback, and interaction with healthcare providers or peers. For adolescents, who are digital natives, these tools align well with their communication preferences and may reduce perceived stigma by offering private, on-demand support.

Real-time electronic monitoring systems, such as Wisepill, record pillbox openings and transmit data to healthcare providers. These tools facilitate timely interventions when non-adherence is detected. They also enhance accountability and enable personalized counseling based on adherence patterns. However, such systems may pose privacy concerns and require consistent connectivity, which can be challenging in resource-limited settings.

Gamification a relatively novel approach involves embedding adherence activities into games or reward systems to incentivize medication-taking. This approach appeals to adolescents' developmental needs for autonomy, competition, and engagement. Though evidence remains limited, initial findings suggest potential in enhancing motivation and long-term adherence.

Standard Counseling: Strengths and Limitations in Adolescent Care

Standard adherence counseling involves structured, face-to-face sessions delivered by trained healthcare personnel [11, 12]. It encompasses medication education, adherence planning, problem-solving, and emotional support. Counseling is often integrated into routine clinic visits, allowing for longitudinal monitoring of adherence behaviors. One of the key strengths of standard counseling is its ability to provide personalized, context-sensitive support [13]. Counselors can tailor messages based on individual histories, cultural contexts, and psychosocial challenges. Additionally, the therapeutic alliance fostered through direct human interaction can bolster trust, enhance motivation, and provide a safe space for disclosure of sensitive issues, such as mental health concerns or stigma-related stress.

However, standard counseling faces significant limitations when applied to adolescents. First, its episodic nature often tied to monthly or quarterly clinic visits limits its capacity to offer real-time adherence support. Adolescents, whose behaviors are heavily influenced by peer dynamics, emotional variability, and emerging independence, may require more frequent and flexible engagement [14]. Second, counselor capacity and training are often inadequate in many high-burden settings, leading to generic, time-constrained sessions that fail to address the unique needs of youth. Third, the clinic-based model may inadvertently exacerbate stigma, as attendance at HIV-specific facilities can expose adolescents to unwanted disclosure.

Moreover, some adolescents may find traditional counseling unappealing or intimidating, particularly in settings where adult-child hierarchies discourage open dialogue. In such cases, standard counseling may become a passive process, with limited impact on behavior change. Thus, while foundational, standard counseling must evolve or be supplemented with more dynamic and youth-friendly approaches to optimize adherence outcomes in this demographic.

Comparative Evidence on Viral Suppression Outcomes

Comparative studies examining the impact of digital adherence tools versus standard counseling on viral suppression among adolescents yield nuanced findings. Overall, evidence suggests that digital tools can significantly enhance viral suppression, particularly when integrated into broader care models that include human support [15, 16].

Randomized controlled trials (RCTs) have demonstrated that SMS-based reminders can lead to modest but statistically significant improvements in viral suppression rates. For instance, a multi-site trial in sub-Saharan Africa found that adolescents receiving personalized SMS reminders had higher odds of achieving viral suppression at 12 months compared to those receiving routine counseling alone. Similarly, observational studies of mHealth

applications report improved adherence behaviors and virological outcomes, especially when apps include interactive and feedback-based components.

Real-time monitoring tools, though less commonly deployed, have shown promise in pilot studies [17]. By enabling immediate response to missed doses, these tools create an adaptive adherence support system. Viral suppression improvements in such interventions are often mediated by increased patient accountability and timely clinician intervention.

In contrast, standard counseling though beneficial in initial phases of ART initiation often demonstrates diminishing returns over time, particularly in adolescent populations. Several cohort studies indicate that while counseling improves knowledge and self-efficacy, its effect on sustained viral suppression is limited when not reinforced by other adherence strategies.

Importantly, the comparative effectiveness of these approaches varies across contexts. In high-resource settings with strong digital infrastructure, mHealth tools outperform standard counseling. In contrast, in low-resource settings with limited phone access or network reliability, counseling remains the more feasible and impactful strategy. Hybrid models that integrate digital tools within existing counseling frameworks appear to offer the most robust outcomes, leveraging the strengths of both modalities.

Contextual Factors Influencing Intervention Effectiveness

Several contextual variables modulate the effectiveness of both digital and standard interventions. These include socioeconomic status, gender dynamics, mental health comorbidities, and caregiver involvement.

Socioeconomic disparities influence access to digital tools, data affordability, and digital literacy. Adolescents from low-income households may lack reliable phone access or face challenges in maintaining device functionality [18]. Consequently, even well-designed digital interventions may have limited reach without addressing these foundational barriers.

Gender plays a critical role, as young women living with HIV often face greater stigma, caregiving burdens, and limited autonomy [19, 20]. These factors can diminish both the perceived utility and actual use of digital tools. Interventions must therefore be gender-sensitive, ensuring that digital content is relatable, and that privacy is safeguarded.

Mental health conditions, including depression and anxiety prevalent among adolescents with HIV can impair both digital and counseling-based adherence strategies. Digital tools that integrate mental health screening or offer mood-tracking features may better support holistic care. Conversely, counselors trained in adolescent mental health are more likely to detect and manage psychological barriers to adherence.

Caregiver engagement significantly influences adherence behaviors. Adolescents who receive support from caregivers in medication-taking and decision-making are more likely to engage with both counseling and digital platforms. Interventions that include caregiver components, such as reminder alerts or educational modules, show enhanced outcomes.

Finally, health system readiness including provider training, infrastructure, and data systems determines the scalability and sustainability of adherence interventions. Without supportive policies and capacity-building, both digital tools and counseling programs may falter in achieving their intended impact.

Integration and Future Directions

Evidence increasingly supports the integration of digital adherence tools with traditional counseling to create hybrid models of care [21, 22]. Such models aim to combine the personalization and relational depth of counseling with the scalability and immediacy of digital tools. For instance, digital data from adherence apps can inform tailored counseling sessions, while counselors can guide adolescents in using and interpreting app-based feedback.

Future research should focus on multi-site implementation studies that assess real-world effectiveness, cost-efficiency, and user acceptability of hybrid adherence models. Emphasis should also be placed on participatory design approaches, ensuring that adolescents co-create tools that are culturally relevant, engaging, and responsive to their lived realities. Interventions must also address structural barriers, such as phone ownership and gender inequities, to enhance inclusivity.

Moreover, ethical considerations related to data privacy, consent, and autonomy must be carefully navigated, particularly when dealing with minors and sensitive health information. Regulatory frameworks and institutional review mechanisms need to evolve to keep pace with digital health innovation.

The potential of artificial intelligence (AI)-driven tools, such as chatbots or predictive adherence models, warrants exploration. These technologies could offer personalized, just-in-time support based on behavioral patterns, thereby enhancing adherence sustainability. However, their application in adolescent HIV care remains nascent and requires rigorous evaluation.

CONCLUSION

Adolescents living with HIV represent a distinct and high-risk group with unique adherence challenges that directly impact viral suppression. This narrative review highlights that while standard counseling provides a foundational framework for adherence support, its limitations particularly in responsiveness and youth engagement necessitate complementary approaches. Digital adherence tools, including SMS, mHealth apps, and electronic monitoring, offer promising alternatives that align with adolescent communication patterns and autonomy needs. Comparative evidence suggests that digital tools, when appropriately designed and contextually tailored, can significantly enhance viral suppression outcomes. However, their effectiveness is influenced by factors such as digital access, mental health, gender norms, and caregiver involvement. Hybrid models that integrate digital tools into counseling workflows appear most effective, combining relational support with technological innovation. Moving forward, health systems should invest in scalable, youth-centered digital platforms that are integrated into existing care structures. Policies must prioritize equity, data privacy, and adolescent engagement to ensure successful implementation. Through such strategic integration, we can better support adolescents in achieving and sustaining viral suppression, thereby advancing global HIV control goals and improving long-term health outcomes for this vulnerable population.

REFERENCES

1. Madu, C.V., Aloh, H.E., Ugwu, O.P.C., Obeagu, E.I., Uti, D.E., Egba, S.I., Ukaidi, C.U.A.: The price of progress: Assessing the financial costs of HIV/AIDS management in East Africa. *Medicine (Baltimore)*. 104, e42300 (2025). <https://doi.org/10.1097/MD.00000000000042300>
2. Alum, E.U., Uti, D.E., Ugwu, O.P.-C., Alum, B.N.: Toward a cure – Advancing HIV/AIDS treatment modalities beyond antiretroviral therapy: A Review. *Medicine*. 103, e38768 (2024). <https://doi.org/10.1097/MD.00000000000038768>
3. Obeagu, E.I., Obeagu, G.U., Ugwu, O.P.-C.: Advancements in Immune Augmentation Strategies for HIV Patients. *IAA JBS*. 11, 1–11 (2023). <https://doi.org/10.59298/IAAJB/2023/1.2.23310>
4. Abdulrahman, S.A., Rampal, L., Ibrahim, F., Radhakrishnan, A.P., Shahar, H.K., Othman, N.: Mobile phone reminders and peer counseling improve adherence and treatment outcomes of patients on ART in Malaysia: A randomized clinical trial. *PLOS ONE*. 12, e0177698 (2017). <https://doi.org/10.1371/journal.pone.0177698>
5. Ugwu, J.N., Eze, V.H.U., Ugwu, C.N., Ogenyi, F.C., Okon, M.B.: Harnessing technology for infectious disease response in conflict zones: Challenges, innovations, and policy implications. *Medicine*. 103, e38834 (2024). <https://doi.org/10.1097/MD.00000000000038834>
6. Ezenwaji, C.O., Alum, E.U., Ugwu, O.P.-C.: The role of digital health in pandemic preparedness and response: securing global health? *Global Health Action*. 17, 2419694 (2024). <https://doi.org/10.1080/16549716.2024.2419694>
7. Rahman, M.Z., Bhuiyan, M.S.A.: SMS Medicine: Revolutionizing Healthcare Delivery through Mobile Technology. *Annals of Innovation in Medicine*. 2, (2024). <https://doi.org/10.59652/aim.v2i4.368>
8. Dima, AlexandraL., Nabergoj-Makovec, U., van Boven, JobF.M.: Digital tools and medication adherence. In: *Drug Utilization Research*. pp. 419–427. John Wiley & Sons, Ltd (2024)
9. Haga, S.B.: Toward digital-based interventions for medication adherence and safety. *Expert Opinion on Drug Safety*. 19, 735–746 (2020). <https://doi.org/10.1080/14740338.2020.1764935>
10. Diano, F., Sica, L.S., Ponticorvo, M.: Empower Psychotherapy with mHealth Apps: The Design of “Safer”, an Emotion Regulation Application. *Information*. 14, 308 (2023). <https://doi.org/10.3390/info14060308>
11. Mohr, D.C., Ho, J., Duffecy, J., Reifler, D., Sokol, L., Burns, M.N., Jin, L., Siddique, J.: Effect of Telephone-Administered vs Face-to-face Cognitive Behavioral Therapy on Adherence to Therapy and Depression Outcomes Among Primary Care Patients: A Randomized Trial. *JAMA*. 307, 2278–2285 (2012). <https://doi.org/10.1001/jama.2012.5588>
12. Taitel, M., Jiang, Jenny, Rudkin, Kristi, Ewing, Susan, and Duncan, I.: The impact of pharmacist face-to-face counseling to improve medication adherence among patients initiating statin therapy. *Patient Preference and Adherence*. 6, 323–329 (2012). <https://doi.org/10.2147/PPA.S29353>
13. Samson, A.O., Adepoju, A.O., Amusa, M.O.: Inclusion of nutritional counseling and mental health services in HIV/AIDS management: A paradigm shift. *Medicine*. 102, e35673 (2023). <https://doi.org/10.1097/MD.00000000000035673>
14. Crone, E.A., Dahl, R.E.: Understanding adolescence as a period of social–affective engagement and goal flexibility. *Nat Rev Neurosci*. 13, 636–650 (2012). <https://doi.org/10.1038/nrn3313>
15. Craig, K.J.T., Rizvi, R., Willis, V.C., Kassler, W.J., Jackson, G.P.: Effectiveness of Contact Tracing for Viral Disease Mitigation and Suppression: Evidence-Based Review. *JMIR Public Health and Surveillance*. 7, e32468 (2021). <https://doi.org/10.2196/32468>

16. Beecroft, A., Vaikla, Olivia, and Pant Pai, N.: Digital HIV self-testing as an exemplar: a perspective on benefits, challenges, and opportunities. *Expert Review of Molecular Diagnostics*. 24, 913–925 (2024). <https://doi.org/10.1080/14737159.2024.2406974>
17. Aranki, D., Kurillo, G., Yan, P., Liebovitz, D.M., Bajcsy, R.: Continuous, real-time, tele-monitoring of patients with chronic heart-failure: lessons learned from a pilot study. In: *Proceedings of the 9th International Conference on Body Area Networks*. pp. 135–141. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering), Brussels, BEL (2014)
18. Linne, J.: Adolescents from low-income sectors: the challenge of studying in a time of digital environments. *International Journal of Adolescence and Youth*. 19, 434–443 (2014). <https://doi.org/10.1080/02673843.2014.942792>
19. Harrison, A., Short, S.E., Tuoane-Nkhasi, M.: Re-focusing the Gender Lens: Caregiving Women, Family Roles and HIV/AIDS Vulnerability in Lesotho. *AIDS Behav.* 18, 595–604 (2014). <https://doi.org/10.1007/s10461-013-0515-z>
20. Jan, S., Manzoor, Shazia, and Rashid, J.: Managing uncertainty in HIV: the crucial role of social support for women living with HIV in Kashmir. *Journal of HIV/AIDS & Social Services*. 0, 1–26. <https://doi.org/10.1080/15381501.2025.2510954>
21. Gkintoni, E., Vassilopoulos, S.P., Nikolaou, G.: Next-Generation Cognitive-Behavioral Therapy for Depression: Integrating Digital Tools, Teletherapy, and Personalization for Enhanced Mental Health Outcomes. *Medicina*. 61, 431 (2025). <https://doi.org/10.3390/medicina61030431>
22. Anser, M.K., Nabi, A.A., Ahmad, I., Abro, M.M.Q., Zaman, K.: Advancing Mental Health Care: A Comprehensive Review of Digital Tools and Technologies for Enhancing Diagnosis, Treatment, and Wellness. *Health Care Science*. n/a, <https://doi.org/10.1002/hcs2.70018>

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