**A systematic review on post-pandemic trends: Does telehealth and mHealth interventions enhance HIV treatment and prevention?**

**Abstract**

**Background:** Despite advancements in antiretroviral therapy (ART) access, with over 30.7 million people on treatment by 2023, challenges in achieving viral suppression persist. Telehealth and mobile health (mHealth) technologies demonstrated efficacy in maintaining HIV care during the COVID-19 pandemic, yet their sustainability and effectiveness in the post-pandemic era, particularly in low-resource settings, remain uncertain.

**Aim:** This systematic review synthesizes evidence on the impact of telehealth and mHealth interventions on HIV treatment adherence, prevention, and patient engagement post-COVID-19**. Objectives**: The primary objective is to evaluate the effectiveness of telehealth and mHealth tools in improving ART adherence and prevention measures, such as pre-exposure prophylaxis (PrEP). Secondary objectives include identifying barriers and facilitators to implementation, examining regional variations, and recommending scalable and sustainable digital intervention strategies. **Methods:** This review follows PRISMA 2020 guidelines to analyze studies published from 2020 onwards. Inclusion criteria focus on peer-reviewed studies assessing telehealth and mHealth interventions for HIV care, with clear outcomes on ART adherence, viral suppression, PrEP uptake, and patient satisfaction. Studies in resource-limited settings, particularly sub-Saharan Africa, are emphasized. The primary outcomes include ART adherence, viral suppression, and PrEP uptake, while secondary outcomes focus on patient satisfaction, stigma reduction, and healthcare accessibility.

**Results:** The findings will highlight the role of telehealth and mHealth in improving adherence and prevention measures, the impact of regional disparities, and factors influencing scalability and sustainability. Insights into the adaptability of these tools post-pandemic will inform policy and strategy to enhance HIV care delivery, particularly for marginalized populations in low-resource settings. Conclusion: This review will provide critical evidence on the effectiveness and scalability of digital interventions for HIV care, guiding their integration into long-term management strategies in resource-constrained contexts.

**Keywords:** Telehealth; mHealth; HIV care; ART adherence; Viral suppression; Pre-exposure prophylaxis (PrEP)

1. **Introduction:**

The number of people receiving antiretroviral therapy (ART) has increased to over 30.7 million by 2023, the size of this epidemic remains a significant public health challenge, with only 77 percent of the global population living with HIV receiving treatment (UNAIDS, 2024, August 2). While there is progress in reducing AIDS-related deaths by 51% from 2010 to date, viral suppression remains a challenge. By 2023, fewer people living with HIV were virally suppressed, and clearly, the trend is on the rise, where one patient dies every minute (UNAIDS, 2024, August 2). In a recent scoping review, Oginga et al. (2024) established that new approaches are required to improve treatment adherence and prevention globally. However, before that happens, it is important to consider limiting aspects like the recent pandemic. The COVID-19 pandemic heightened the need to maintain service to people living with and affected by HIV through innovative solutions (Jiang et al., 2020; Chenneville et al., 2020; Corey et al., 2022; Nguyen Thu et al., 2020; MacNeill et al., 2022; SeyedAlinaghi et al., 2023; Njuguna et al., 2024). Telehealth and mHealth technologies were critical to maintaining access to HIV services at a time when physical interactions were difficult and complex. These digital interventions, such as text messaging, remote patient monitoring, and virtual consultations, improve adherence to ART and HIV prevention measures, including pre-exposure prophylaxis (PrEP) (Esmaeili et al., 2023). The magnitude of engaging in eHealth intervention shows a pooled effect in trials, with participants portraying significantly higher ART adherence (Esmaeili et al., 2023; Saragih et al., 2024). With the world transitioning to a post-pandemic landscape, the sustainability and effectiveness of these digital tools are relatively unknown. The recurring question is how telehealth and mHealth interventions have been sustained and adapted in the post-pandemic era, especially in low-resource settings. Research is needed to find if these remote intervention and monitoring approaches are particularly effective in improving medication adherence and clinical measures in chronic diseases such as HIV. This review aims to synthesize post-pandemic evidence on the effects of telehealth and mHealth interventions on HIV care interventions, focusing on their status on treatment outcomes, patient engagement, and prevention techniques. It explores the scalability and adaptability of these tools, particularly in low-resource settings such as Kenya, to identify regional disparities and assess how they can be optimized to deliver digital healthcare interventions. These findings will guide HIV treatment and prevention policy and strategy and provide important information to promote care for adolescents and other marginalized populations.

1. **Objectives**
	1. **Primary Objective**

To examine the effectiveness of telehealth and mHealth interventions in improving HIV treatment adherence and prevention outcomes post-COVID-19. The main goal of this systematic review is to outline the continued efficacy of digital interventions such as telehealth consultations, mobile health apps, or remote monitoring instruments (Manby et al., 2022; Ezelote et al., 2024) in supporting HIV patients' adherence to treatment and curtailment of the spread of the virus by promoting the use of prevention measures such as pre-exposure prophylaxis (PrEP) in the post-pandemic era. These tools were first used during the pandemic (Queiroz ET AL., 2021; Patel et al., 2022; Goldstein et al., 2023), but do they represent the potential for sustained use to strengthen individual and public health impacts on outcomes for people living with HIV? By focusing on this objective, the review will provide insights into how these interventions have adapted to new challenges and if their effectiveness has been maintained as the pandemic subsides.

* 1. **Secondary Objectives**
1. Identify barriers and facilitators to implementing telehealth and mHealth interventions. This objective will focus on what factors will be important to the success of telehealth and mHealth tools in delivering HIV care. Barriers exist whenever there are technological challenges, lack of access to mobile devices or internet connectivity, privacy concerns, or resistance from patients or healthcare providers (Haleem et al., 2021; Iyanna et al., 2022; Borges do Nascimento et al., 2023). In contrast, the emergence of facilitators, such as robust digital infrastructure, policy support, and positive patient experience, will also be examined. The knowledge of these elements will help integrate the intervention into routine healthcare delivery.
2. Examine regional variation, focusing on sub-Saharan Africa and other resource-limited regions. Sub-Saharan Africa continues to bear a disproportionately high HIV burden (Oginga et al., 2024a; Oginga et al., 2024b; UNAIDS, 2024, August 2), and resource constraints frequently impede effective treatment and prevention interventions. The review will identify these regional differences, which will help pinpoint tailored strategies for optimal HIV care in resource-constrained contexts like Kenya.
3. Provide recommendations for the scalability and sustainability of these interventions. The final secondary objective is to develop actionable recommendations for scaling and sustaining telehealth and mHealth interventions in HIV care (Crentsil, 2022; Olang, 2024). As digital solutions become increasingly important post-pandemic, stakeholders need to consider how these interventions can be expanded and integrated as part of long-term HIV management strategies. Conscious decisions will be made to ensure these interventions' sustainability and broad adoption, such as cost-effectiveness, accessibility, patient engagement, and structural capacity to meet the global healthcare workforce.
4. **Methodology**
	1. **Study Design**

This systematic review will consolidate and critically analyze studies published between 2017 and the present, adhering to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines to ensure methodological rigor (Page et al., 2021; Sarkis-Onofre et al., 2021). Due to the fast incorporation of medical technology during the COVID-19 pandemic, this review offers a comprehensive study that will evaluate the impact of telehealth and mHealth interventions on HIV care regarding adherence, prevention approaches, and patient engagement.

* 1. **Inclusion and Exclusion Criteria**
		1. **Inclusion Criteria** – 1)English-language peer-reviewed articles: The articles will only be from reputable academic publishers or journals with high scientific rigor and validity. 2) Telehealth and mHealth studies of HIV treatment and prevention interventions: In particular, this review will examine how telehealth (e.g., virtual consultations, telemonitoring, etc.) and mHealth (mobile apps, digital reminders, etc.) have contributed to the progression of HIV care in the full range of ART, PrEP prevention, and other health educational and behavioral actions, such as mental health support. 3) Studies with high specificity of outcome measures: Articles must report quantitative or qualitative measures of ART adherence rate, degree of viral suppression uptake of PrEP, or patient satisfaction. We will be able to measure the evidence that the interventions were working toward increasing the good outcomes of HIV care.
		2. **Exclusion Criteria** – 1)Studies that are not HIV specific: To focus on HIV care, exclusions will include telehealth and mHealth research and interventions about non-HIV diseases. 2) Non-peer-reviewed articles: Articles with no primary data that do not meet these evidence standards to qualify for this review will not be included. 3) Studies needing clear outcome measures: Articles that present or report measurable outcomes and descriptive data supported by inferential analysis will be excluded, but not articles that present or report measurable outcomes of general interest.
	2. **Population and Interventions**

Population: This review will consider studies in HIV-positive people or at high HIV infection risk, in particular studies in key populations such as men who have sex with men, sex workers, intravenous drug users, and adolescents. Demographic factors, including age, gender, and sexual orientation, will be subgroups analyzed in regions of high HIV prevalence, such as sub-Saharan Africa (Oginga et al., 2024a; Oginga et al., 2024b). Understanding how different subgroups respond to telehealth and mHealth interventions is critical for addressing health inequities and tailoring digital interventions to the needs of different subgroups.

Interventions:Telehealth encompasses a range of digital platforms for delivering virtual healthcare by telephone or video with healthcare providers, remote clinical management, or telemonitoring of viral loads or ART adherence (Crentsil, 2022; Olang, 2024). It will review how these interventions have maintained or enhanced treatment adherence and clinical outcomes, especially in resource-limited settings. mHealth interventions include using mobile apps to facilitate patient education, sending reminders for ART adherence, providing virtual counseling, and self-monitoring health metrics. In particular, there is interest in apps with artificial intelligence supporting personalized care (Bohr & Memarzadeh, 2020), which demonstrate promise at increasing engagement and outcomes by providing advice specifically to each patient based on that person's data.

* 1. **Results and Discussion**

**Primary Outcomes:**

* ART Adherence Rates: The core outcomes of this review are on how telehealth and mHealth interventions impact ART adherence in people living with HIV, and it is crucial to viral suppression and global health outcomes. Priorities will be placed on studies of groups, such as areas of historically poor adherence rates in care.
* Viral Suppression: Studying studies that report changing viral load as a measure of clinical effect will be explored in the short-term as well as long-term experiences with digital interventions and achieving viral suppression.
* Uptake of HIV Prevention Tools (PrEP): How digital interventions affect the uptake and retention of PrEP use among high-risk populations as an HIV prevention strategy will be another critical outcome.

**Secondary Outcomes:**

* Patient Satisfaction and Engagement: Given the importance of patient-centered care, this review will assess how telehealth and mHealth can enhance patient engagement and satisfaction through ease of access, the degree of patient comfort with technology, and trust in the patient-provider use of telehealth.
* Reduction in Stigma: Digital health interventions may uniquely enable HIV-related stigma reduction by intervening in more private, nonjudgmental health spaces that are outside of direct observation. This review will evaluate to what extent patients' experiences of stigma and willingness to participate in HIV care are influenced by these technologies.
* Healthcare Accessibility and Utilization Rate: The review will determine whether telehealth and mHealth interventions increase access to care, especially in remote or underserved populations lacking physical access. They also cover utilization rates for preventive services, follow-up care, and routine monitoring.
1. **Search Strategy**
	1. **Data Sources**

To ensure comprehensive coverage and the inclusion of high-quality studies, the following electronic databases will be used for the literature search: PubMed: A leading medical and life sciences literature database relevant to HIV treatment and prevention. Google Scholar: Provides a robust selection of clinical research studies and health-related literature, especially for mHealth and telehealth interventions. Cochrane Library: This library offers systematic reviews and high-quality randomized controlled trials, which are vital for evaluating intervention effectiveness. CINAHL: Covers nursing and allied health literature, including studies on patient adherence and digital health tools. Manual reference searches will also be conducted to identify potentially relevant studies that the database search may not capture. This will include reviewing the reference lists of key articles and existing systematic reviews on telehealth or mHealth interventions for HIV care.

* 1. **Keywords and Search Terms**

The following keywords and terms will guide the search process to identify relevant studies: Telehealth; mHealth; HIV treatment; HIV prevention; ART adherence; PrEP uptake; Post-pandemic trends

A combination of these keywords will be used in various configurations to ensure that studies covering both HIV care and digital interventions are captured. Boolean operators such as AND, OR, and NOT will be employed to refine the search results. For example, a search query might look like ("Telehealth" OR "mHealth") AND ("HIV treatment" OR "ART adherence") AND ("Post-pandemic trends").

* 1. **Search Process**

The search process will be carried out in the following steps:

1. Initial Database Search: Databases will be searched for articles published between 2020 and the present. The search will be refined by language (English) and article type (peer-reviewed studies).
2. Title/Abstract Screening: Two independent reviewers will assess the relevance of the studies by reviewing titles and abstracts. Studies that meet the inclusion criteria will be shortlisted for full-text review.
3. Full-text Review: Eligible studies will undergo a thorough full-text review conducted independently by two reviewers to ensure compliance with the inclusion criteria. Reviewer discrepancies will be resolved through consensus or consultation with a third reviewer.
4. **Data Extraction and Quality Assessment**
	1. **Data Extraction**

Data will be extracted from the selected studies based on the following criteria: Study Characteristics: Information such as the author, year of publication, country, study design, and sample size will be collected to understand the study context and design. Intervention Details: The type of telehealth or mHealth intervention used, including its duration, features, and delivery method (e.g., video consultations and mobile app features), will be extracted to categorize the interventions and assess their applicability. Outcomes: Outcome measures such as ART adherence rates, uptake of HIV prevention tools like PrEP, patient satisfaction, barriers to implementation, and other patient-reported outcomes (e.g., mental health support, stigma reduction) will be compiled.

* 1. **Quality Assessment**

The methodological quality of the included studies will be assessed using the Critical Appraisal Skills Programme (CASP) checklists. These checklists are widely used to assess the quality of clinical studies, including randomized controlled trials, cohort studies, and qualitative research. The CASP tool will help evaluate aspects such as: Study design validity; Sample size adequacy; Risk of bias; Data collection and analysis methods

Studies will be rated as high, moderate, or low quality, and only those with moderate to high quality will be included in the final analysis to ensure the reliability of the systematic review’s conclusions.

1. **Data Synthesis**
	1. **Qualitative Synthesis**

A thematic analysis of the qualitative synthesis will be performed to identify common barriers, facilitators, and regional disparities identified in the included studies. The aim will be to identify themes concerning telehealth and mHealth intervention implementation and effectiveness for HIV care. These themes may include barriers. Factors such as technological limitations (i.e., technological limitations [e.g., poor internet access], patient-related issues [e.g., low health literacy, stigma], and healthcare system issues [e.g., lack of provider training]) that deter uptake or success of these interventions. Facilitators include positive factors for telehealth and mHealth, including healthcare provider engagement, patient motivation, supportive policy laws, and technological advancements enhancing the scalability of adoption and effectiveness of intended solutions. Regional disparities encompass analyses of how these interventions were implemented in diverse geographical areas (e.g., SSA, Sub-Saharan Africa, and Southeast Asia). It will explore how different regions in healthcare infrastructure, digital literacy, and socio-economic context may influence the outcomes of telehealth and mHealth interventions.

A narrative synthesis will summarize the effectiveness of various interventions. This will detail and describe how telehealth and mHealth technology have affected HIV treatment adherence, prevention (e.g., PrEP uptake), and viral suppression in post-pandemic settings. The results of this synthesis will be categorized by intervention type, patient demographic, and contextual factor, providing insights into the general effectiveness of these digital interventions.

* 1. **Quantitative Synthesis**

For cases where data may consist, a descriptive analysis of the resulting results will be conducted to provide an overview of the study's outcome. This analysis will involve aggregating key findings such as: ART adherence rates: Examining telehealth and mHealth interventions that influence adherence to antiretroviral therapy. Viral suppression: Assessing the effect of these interventions on viral load reduction and sustained viral suppression in persons living with HIV. PrEP uptake: Examining how digital interventions help PrEP uptake.

Additionally, the prevalence of success across various interventions will be displayed proportionally. That could involve computing the number of studies reporting positive ART adherence, viral suppression, and PrEP uptake results. This allows researchers to see where these outcomes are distributed across different contexts and which interventions are more likely to result in the highest overall outcomes. Both qualitative and quantitative synthesis will be combined to fully comprehend the state of ART in telehealth and mHealth interventions aimed at HIV treatment and prevention in the post-pandemic world.

1. **Dissemination Plan**

The findings will be shared through: Peer-reviewed publications targeting journals in public health and HIV research. Presentations at global conferences such as AIDS 2024 or International AIDS Society events. Simplified summaries are shared on LinkedIn to engage practitioners and policymakers.

1. **Timeline (3 Months)**
* Week 1: Finalize protocol and search strategy and start literature search.
* Weeks 2-3: Screen studies and assess for eligibility.
* Weeks 4-5: Get some data, quality check it and start to analyze.
* Week 6: The draft cycle of a manuscript based on synthesized findings.
* Week 7: Revise and finalize the manuscript.
* Week 8: Submit the manuscript for publication and disseminate it.
1. **Conclusions**

This review will present evidence to guide the design and deployment of telehealth, and mHealth approaches to HIV care in this review. This review aims to help translate trends post-pandemic so policymakers can scale these interventions up to the global level in settings as low-resource as Kenya.

**ABBREVIATION**

HIV: Human Immunodeficiency Virus

mHealth: Mobile Health

RCT: Randomized Controlled Trial

PrEP: Pre-Exposure Prophylaxis

ART: Antiretroviral Therapy

PLHIV: People Living with HIV

WHO: World Health Organization

UNAIDS: Joint United Nations Programme on HIV/AIDS

COVID-19: Coronavirus Disease 2019

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2

QoL: Quality of Life

OR: Odds Ratio

**Disclaimer (Artificial intelligence)**

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

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