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MOBILE HEALTH FOR ADHERENCE TO ANTIRETROVIRAL THERAPY IN HIV-AIDS: A SYSTEMATIC REVIEW

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ABSTRACT
The prevalence of HIV/AIDS presents a significant global health challenge, impacting populations worldwide. Despite advancements in antiretroviral therapy (ART), adherence to medication remains suboptimal, contributing to increased transmission risks. Objective: This study aims to explore the effectiveness and potential of mobile health (mHealth) technologies in enhancing adherence to ART among individuals living with HIV/AIDS. Method: This study conducted a systematic search across major databases including PubMed, Sage Journals, Scopus, SpringerLink, and ProQuest from 2019 to 2024. The inclusion criteria comprised full-text English articles, randomized controlled trials (RCTs), and studies focusing on mHealth interventions among HIV patients. Results: The utilization of mHealth interventions demonstrated a positive impact on improving knowledge, perception, and social support among PLWHA, thereby enhancing medication adherence. Conclusions: Integrating mHealth technologies into healthcare strategies can significantly improve adherence to ART among individuals with HIV/AIDS. Healthcare providers should embrace these innovations to optimize patient care outcomes and address global HIV/AIDS challenges effectively

Keywords: adherence; HIV patients; mhealth; taking medication

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INTRODUCTION

HIV/AIDS is one of the significant global health challenges affecting millions worldwide. According to data from the World Health Organization (WHO) by the end of 2022, there were 39 million people infected with HIV/AIDS, with an estimated 1.3 million new infections and 630,000 HIV-related deaths. The highest global HIV prevalence is in Africa (25.6 million people), Southeast Asia (3.9 million people), and the Americas (3.8 million people).The medical management of HIV infection involves Antiretroviral Therapy (ART), aimed at reducing HIV transmission rates, lowering morbidity and mortality, improving quality of life, preserving immune function, and suppressing viral replication maximally and continuously (Kementerian Kesehatan Republik Indonesia, 2023). HIV/AIDS treatment and prevention require lifelong routine care and continuous interventions to reduce disease spread and improve treatment outcomes (Adong et al., 2022). In aiming to end the HIV epidemic by 2030, WHO has adopted the 95-95-95 strategy, expected to be achieved by 2025. The 95-95-95 approach signifies that 95% of all people living with HIV know their HIV status, 95% of those diagnosed with HIV are receiving life-saving antiretroviral therapy (ART), and 95% of those on treatment achieve suppressed viral loads to improve individual health and reduce HIV transmission (WHO, 2023).

Despite the availability of antiretroviral therapy (ART), patient adherence to medication among those living with HIV remains low (Adjie, 2019). WHO (2023) reports that 76% of people living with HIV are on treatment, but only 71% have controlled viral loads, far from WHO's targets. Consistent use of antiretroviral therapy (ART) can prevent HIV transmission to others. Individuals living with HIV/AIDS often exhibit medication non-adherence, primarily due to various factors including lack of confirmation, difficulty in adhering to complex medication schedules, stigma, and non-compliance with required medical appointments (Achappa et al., 2013; Adeniyi et al., 2018; Iacob et al., 2017).

Digital health is a powerful and versatile tool that can be utilized to develop high-quality innovative strategies (Cao et al., 2021). With the widespread use of mobile phones in low- and middle-income countries, mobile phone interventions have become popular as efficient communication methods in global health (O'Connor et al., 2022). Mobile phones, offering various functions from text messaging to complex applications, have been recommended by WHO since 2013 to improve patient adherence to antiretroviral therapy (Kanters et al., 2017). The use of mobile applications, text messaging, and other mobile phone services has proven effective in providing support, reminders, education to patients, and facilitating self-monitoring and management of their conditions. Integrating mobile phone technology in HIV/AIDS management can significantly contribute to improving patient adherence to ART. With the ability to provide medication reminders, offer relevant medical information, and support patients in monitoring their health progress, mobile applications and other mobile phone services become valuable tools in efforts to enhance adherence and manage HIV/AIDS (Adong et al., 2022; Agnes et al., 2021; Mao et al., 2018; Ramsey et al., 2019; Ventuneac et al., 2020; Whiteley et al., 2018).

To further explore the effectiveness and potential of using mHealth to improve adherence to ART, a systematic review is necessary. This review will investigate various studies and interventions utilizing mHealth technology, whether in the form of mobile applications, text messaging, or other mobile phone services. Its goal is to compile a comprehensive understanding of the impact, barriers, and implications of mHealth use in the context of HIV/AIDS management regarding adherence to ART. Specifically, this study aims to explore the effectiveness and potential of mobile health (mHealth) technologies in enhancing adherence to antiretroviral therapy (ART) among individuals living with HIV/AIDS. Through this systematic review, it is expected to identify the most effective approaches in mHealth use to enhance patient adherence to ART. Thus, this systematic review will provide a strong foundation for developing more efficient and sustainable intervention strategies in addressing HIV/AIDS.

METHOD

In this systematic review study, the authors conducted a search across five major databases: PubMed, Sage Journals, Scopus, SpringerLink, and ProQuest. The authors included articles published between 2019 and 2024. From these databases, a total of 3,376 articles were found available. The keywords used in the search were "HIV Patients AND mHealth AND Adherence Taking Medication". After selecting articles, the authors identified several exclusion criteria divided into three stages. Firstly, articles not available in full text and those not in English were excluded. Furthermore, articles not published within the specified timeframe, not focusing on HIV patient subjects, and not resulting from Randomized Controlled Trials (RCTs) were also excluded. Duplicate articles, RCT protocol articles still in development, and meta-analysis articles of RCTs were also excluded from the analysis.

Selection results of the study can be depicted in the PRISMA flow diagram (Figure 1)

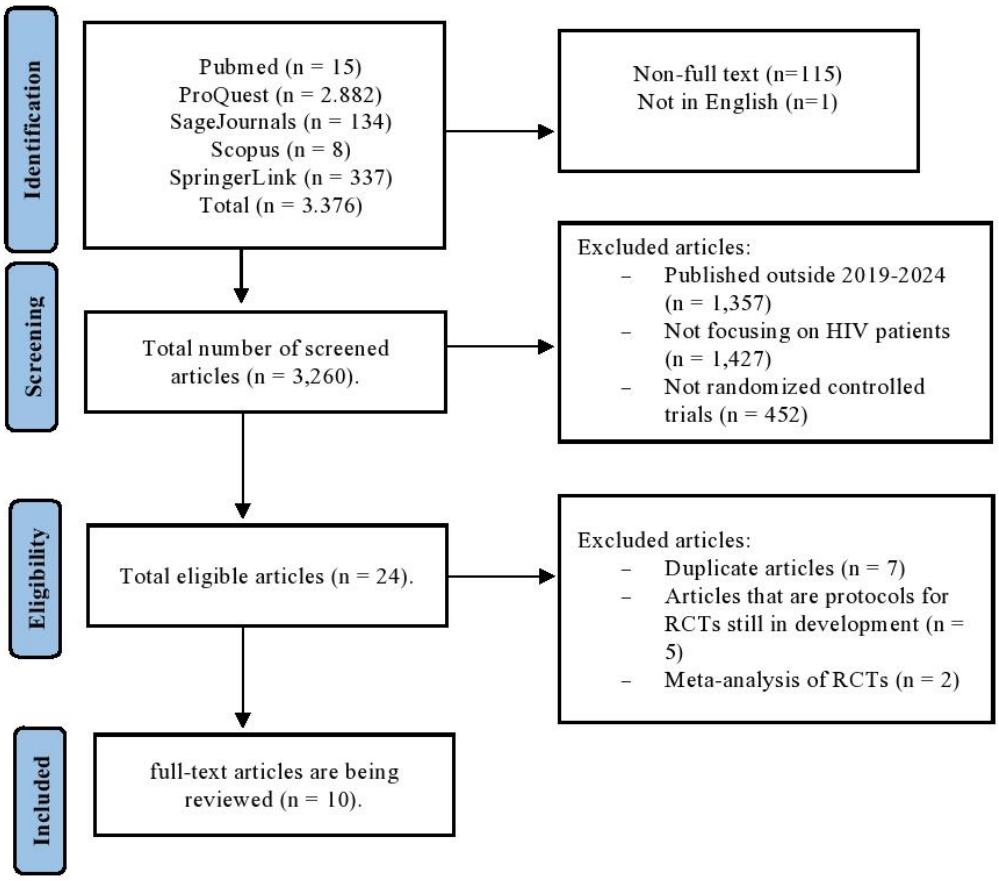

Figure 1. PRISMA diagram of the article search process

RESULTS

Based on the exclusion process, the author identified 24 eligible articles. After reviewing the full texts, 10 articles were selected for inclusion in the author's systematic review. Upon analyzing these ten critically, no articles were found to have a high risk of bias (≤49%), and none showed a moderate risk of bias. All ten articles demonstrated a low risk of bias (>70%) (Rhodes et al., 2023), indicating a strong methodological foundation and reliability for this systematic review. Of the ten articles analyzed using the JBI assessment tool, most met the predefined criteria. While some articles lacked detailed explanations of blinding in their studies, they were still included in this systematic review analysis. The research findings presented across all articles were consistent with the systematic review's objective of evaluating the effectiveness of Mobile Health in improving adherence to antiretroviral therapy (ART) among HIV patients. To assess the methodological quality of the selected articles, researchers used the Joanna Briggs Institute (JBI) instrument. This assessment aimed to identify potential biases in each study, which were then used to evaluate the reliability of the study's findings. Results of the risk of bias assessed using JBI scoring are presented below in JBI scoring results (Figure 2)

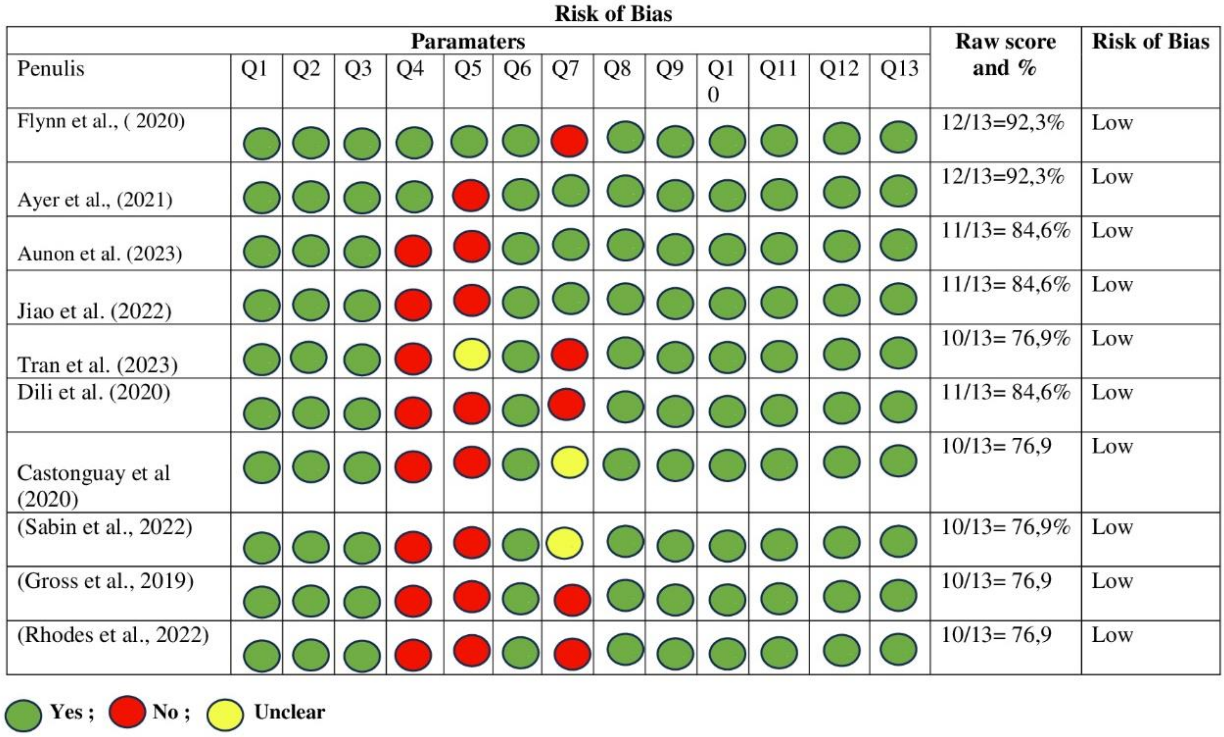

Figure 2. Joanna Briggs Institute (JBI) Scoring

Here's a summary analysis article (table 1).

Table 1.
Journal Analysis

Author (year), Method	Intervention type, Country, Number of participants and Duration	Objective	Measurement tool	Outcome
Protocol of the randomized control trial: the WiseApp trial for improving health outcomes in PLWH (WiseApp) (Flynn et al., 2020) Method: RCT	mHealth application, WiseApp, in United States, involving 200 participants (100 in the intervention group and 100 in the control group), with a duration of 6 months.	To test the effect of WiseApp on ARV adherence.	ARV adherence is assessed using the CleverCap pill dispenser, CASE Adherence Index, and monitoring CD4 and viral load test results..	The intervention using mobile health (mHealth) applications successfully improved adherence to antiretroviral therapy (ART) and the quality of life of patients living with HIV/AIDS.
Nurse-Led Mobile Phone Voice Call Reminder and On-Time Antiretroviral Pills Pick-Up in Nepal (Ayer et al., 2021) Method : RCT	Phone call led by nurses, in Nepal. 468 HIV-positive individuals. Intervention group: 234 individuals, and the control group is 234 individuals. Duration: 6 months.	Improving clinic attendance and adherence to ARV medication.	Clinic attendance for on-time ARV pill pick-up, measured using WHO's definition of timely ARV medication collection.	The intervention of nurse-led phone call reminders significantly increased clinic attendance for on-time ARV pill pick-up among HIV-positive individuals in Nepal. Participants in the intervention

				group were more likely to attend the clinic regularly.
Randomized controlled trial of a theory-informed mHealth intervention to support ART adherence and viral suppression among women with HIV in Mombasa, Kenya: preliminary efficacy and participant-level feasibility and acceptability (Aunon et al., 2023) Method: RCT	mHealth application "Motivation Matters!" in Kenya, involving 210 participants (105 in the intervention group and 105 in the control group), with a duration of 6 months.	Improving HIV viral suppression and ART adherence among commercial sex workers.	Viral suppression and ART adherence are assessed using the LifeWindows Information-Motivation-Behavioral Skills ART Adherence Questionnaire (LW-IMB-AAQ).	The mHealth intervention "Motivation Matters!" has a positive impact on viral suppression and adherence to antiretroviral treatment (ART) among HIV-positive women engaged in sex work in Mombasa, Kenya.
A diferentiated digital intervention to improve antiretroviral therapy adherence among men who have sex with men living with HIV in China (Jiao et al., 2022) Method: RCT	Mini-program WeChat in China, involving 570 participants, with 288 individuals in the intervention group and 288 in the control group. Duration: 8 months.	Evaluating the effectiveness of various digital interventions on ART adherence among people living with HIV (PLWH).	Using self-assessment and adherence measures to evaluate adherence to antiretroviral therapy (ART).	The research findings indicate that digital interventions significantly improve adherence to antiretroviral therapy (ART) compared to one-on-one instant messaging with multimedia technology. This intervention is effective in enhancing adherence and can be integrated into HIV management in middle-income countries. Instant messaging and social media have been proven effective in improving ARV adherence.
A Social Media–Based Support Group for Youth Living With HIV in Nigeria (SMART Connections): Randomized Controlled Trial (Dulli, Ridgeway, Packer, Murray, Plourde, et al., 2020) Method: RCT	Facebook-based support group, in Nigeria. Involving 324 participants (163 in the intervention group and 161 in the control group), with a duration of 9 months.	Improving HIV care retention and ART adherence.	HIV treatment adherence is measured using AACTG, social isolation with PROMIS Social Isolation, depression with PHQ-8, and HIV stigma with the short HIV Stigma Scale.	The SMART Connections intervention improves HIV knowledge and is considered beneficial but does not significantly impact HIV care retention among youth in Nigeria.
Efficacy of a Mobile Phone-Based Intervention on Health Behaviors and	Smartphone application, in Vietnam, involving 524 participants (238 in	Improving medication adherence	Visual Analog Scale (VAS) for ART adherence,	The intervention using theory-based mobile health

HIV/AIDS Treatment Management (Tran et al., 2023) Method: RCT	the intervention group and 286 in the control group), with a duration of 3 months.	and health behaviors among HIV/AIDS patients.	HIV/AIDS Self-Efficacy Scale (HIV-ASES), and Symptom Management Self-Efficacy Scale for HIV.	(mHealth) applications is effective in improving medication adherence and self-efficacy in managing HIV/AIDS symptoms among HIV patients in Vietnam.
The Implementation of a Text Messaging Intervention to Improve HIV Continuum of Care Outcomes Among Persons Recently Released From Correctional Facilities (Castonguay et al., 2020) Method: RCT	Text messaging (SMS), in United States, involving 112 participants (57 in the intervention group and 55 in the control group), with a duration of 6 months.	Improving HIV Continuum of Care outcomes among individuals newly released from prison.	ARV medication adherence, viral load outcomes, and CD4 results.	This research shows that SMS text message interventions sent to individuals recently released from prison facilities can improve HIV Continuum of Care outcomes.
Real-time Feedback to Improve HIV Treatment Adherence in Pregnant and Postpartum Women in Uganda (Sabin et al., 2022) Method: RCT	Real-time Feedback, in Uganda, involving 131 participants (68 in the intervention group and 63 in the control group), with a duration of 3 months.	Improving ART adherence in pregnant and postpartum women.	WisePill Technologies device, text message reminders, and counseling sessions.	There is a significant decrease in antiretroviral therapy (ART) adherence between the pregnancy and postpartum periods.
Two-way mobile phone intervention compared with standard-of-care adherence support after second-line antiretroviral therapy failure (Gross et al., 2019) Method: RCT	Two-way mobile phone intervention compared with standard-of-care adherence support. In Kenya, South Africa, Brazil, and the United States. 257 intervention, 264 control participants. Duration: 12 months.	Supporting adherence in individuals experiencing treatment failure on second-line ART.	Viral suppression, CD4 count changes, ART adherence, and adverse events.	Mobile-based intervention to support adherence in individuals with treatment failure on second-line ART in low- and middle-income countries did not show significant benefits in viral suppression rates at 48 weeks. Despite high self-reported adherence rates, the intervention proved challenging to implement.
Outcomes From a Randomized Trial of a Bilingual mHealth Social Media Intervention to Increase Care Engagement Among Young Gay, Bisexual, and Other Men Who Have Sex With Men and Transgender Women With HIV (Rhodes et al., 2023) Method: RCT	Mobile health in the form of WeCare bilingual (English and Spanish) in rural areas covering 40 counties in North Carolina, Virginia, West Virginia, and Tennessee. Involving 98 participants (100 intervention, 98 control). Duration: 12 months.	Supporting engagement in HIV care.	Medication adherence and viral load levels, HIV Stigma Scale, Medical Outcomes Study for mental health, and instruments to assess HIV care barriers.	The weCare intervention successfully increased engagement in HIV care.

DISCUSSION

mHealth interventions have proven effective in enhancing adherence to antiretroviral therapy (ART) among HIV/AIDS patients (Aunon et al., 2023; Ayer et al., 2021; Castonguay et al., 2020; Dulli, Ridgeway, Packer, Murray, Mumuni, et al., 2020; Jiao et al., 2022; Pagan-ortiz et al., 2019; Rhodes et al., 2023; Tran et al., 2023). These interventions vary widely in their approaches. For instance, some, like the WiseApp and other general smartphone apps, focus on providing medication reminders, educational content, health tracking, and social support to enhance adherence (Flynn et al., 2020). On the other hand, nurse-led phone calls and interactive mobile phone interventions offer personalized support by facilitating direct communication between patients and healthcare professionals, which can effectively address individual needs and improve treatment adherence (Ayer et al., 2021).Despite their advantages, research by Gross et al. (2019) showed differing results where mobile phone-based interventions to support adherence among individuals failing second-line ART in low- and middle-income countries did not demonstrate significant benefits in viral suppression at 48 weeks. Despite self-reported high adherence rates, these interventions proved challenging to implement. Participants with a history of prior non-adherence presented significant barriers to intervention success Gross et al. (2019). Additionally, mobile phone technology for health interventions may face implementation difficulties in low- and middle-income countries due to logistical issues such as inadequate electricity infrastructure and cellular network coverage (Osei & Mashamba-Thompson, 2021).

mHealth programs like "Motivation Matters!" and SMS messaging share similarities in using motivational strategies to encourage patient adherence (Aunon et al., 2023; Castonguay et al., 2020). While SMS primarily serves as reminders, "Motivation Matters!" offers more varied and complex motivational content. WeChat mini-programs and smartphone apps also enhance medication adherence by providing reminders, dosage tracking, and educational resources, with WeChat integrated into China's popular messaging app. mHealth provides an accessible solution to common barriers in ART adherence, such as forgetfulness and lack of social support (Ramsey et al., 2019). Well-designed apps offer daily reminders, medication tracking, and options to contact medical professionals for assistance (Peng et al., 2020). Facebook-based support groups (Dulli, Ridgeway, Packer, Murray, Mumuni, et al., 2020) facilitate social and emotional support among patients, reducing isolation, increasing engagement, and promoting shared responsibility in treatment adherence.The use of mHealth to enhance adherence to ARV medication among HIV/AIDS patients shows promising results. Interventions combining reminder features, social support, and real-time monitoring are particularly effective. Success depends on personalization, accessibility, and the social support provided. Integrating mHealth into healthcare systems improves medication adherence and quality of life through holistic approaches including personal, educational, and motivational elements. These interventions are adaptable across cultural and economic contexts, especially beneficial in low- and middle-income countries due to low cost and wide accessibility. For example, WeChat mini-programs in China and nurse-led voice calls in Nepal provide crucial support in areas with limited healthcare access.These studies highlight how mHealth interventions enhance knowledge, adherence, social support, and perception of HIV. To summarize these findings, the author developed the mnemonic "KASIH" (Knowledge, Adherence, Social support, Perception of HIV).

Knowledge

Research by Rhodes et al. (2022) and Aunon et al.(2023) shows that mHealth interventions, including those using social media, enhance knowledge, motivation, and behavioral skills among individuals living with HIV. These interventions not only provide accurate health

information but also foster supportive social interactions, empowering participants to feel connected and motivated in adhering to their treatments. Increased HIV knowledge through such interventions helps individuals understand the importance of therapy adherence and improves overall care. This knowledge also contributes to reducing HIV stigma and promoting a positive perception of people living with HIV, ultimately enhancing their quality of life (Andersson et al., 2020; Letshwenyo-Maruatona et al., 2019). By delivering accessible information and building social support networks, mHealth interventions influence attitudes and behaviors towards HIV treatment. They play a crucial role in improving HIV/AIDS management, particularly by enhancing ART adherence and potentially reducing new infection rates. Implementing these evidence-based strategies is vital in global public health efforts to combat HIV/AIDS effectively.

Adherence taking Medication

mHealth interventions have emerged as critical tools in enhancing medication adherence among HIV/AIDS patients. Research by Tran et al. (2023) confirms that mobile phone-based interventions effectively improve adherence by overcoming barriers like forgetfulness and access challenges to clinics. Ayer et al. (2021) underscore the efficacy of nurse-led voice calls in enhancing ARV uptake timeliness, addressing accessibility issues and improving medication literacy. Rhodes et al. (2022) and (Castonguay et al., 2020) highlight the positive impact of social media and text messages in fostering healthcare engagement and providing practical reminders, respectively. Additionally, Twimukye et al. (2021) demonstrate that voice call interventions in Uganda effectively enhance adherence among young populations, leveraging social support and improving medication literacy.These studies collectively demonstrate that mHealth interventions, including mobile phones, text messages, and voice calls, play a crucial role in improving ARV adherence and overall HIV/AIDS care management. By addressing barriers and enhancing patient engagement, these interventions contribute significantly to global efforts in improving health outcomes and quality of life for individuals living with HIV/AIDS.

Social Support

Individuals living with HIV/AIDS not only need effective treatment for physical discomfort but also rely on social support to manage life challenges and ease psychological stress (Li et al., 2021). Research by Mao et al. (2018) and Twimukye et al. (2021) shows that social support significantly influences adherence to antiretroviral therapy (ART). This underscores the effectiveness of interventions like SMS text messaging and social media platforms in providing crucial support to people with HIV/AIDS.Social support offers motivation, information, and a supportive environment where individuals can share experiences and resources related to HIV management and ART (Knight & Schatz, 2022). It fosters connection and emotional well-being among those living with HIV (Shacham et al., 2017), reducing feelings of loneliness and isolation. Feeling supported by their community encourages individuals to stay committed to their treatment plans, enhancing their overall health and well-being. Research by Tran et al. (2023) confirms that interventions using social support technologies, such as SMS or social media, effectively improve medication adherence among HIV-positive individuals. These interventions provide not only practical benefits but also emotional and psychological support, highlighting the importance of online platforms in managing HIV/AIDS effectively.

Perception of HIV

Individuals living with HIV often face concerns about stigma and its repercussions, such as potential job loss Connor et al. (2022). This stigma can lead to dissatisfaction with appearance

and emotional distress, impacting their overall quality of life Mao et al. (2018). Positive attitudes towards HIV treatment can enhance adherence to antiretroviral therapy (ART) (Pagan-ortiz et al., 2019). However, perceptions of HIV vary widely; some view it as a manageable condition with access to effective therapy, while others encounter barriers to treatment (Flynn et al., 2020).Research by Jiao et al. (2022) demonstrates that digital interventions, including text messages, instant messaging, and social media, can influence perceptions and adherence to ART among men who have sex with men living with HIV in China. These interventions provide information, reminders, and support, significantly improving adherence compared to control groups. The study reports that 82.9% of participants in the intervention group achieved optimal adherence, compared to 71.1% in the control group. This underscores the potential of digital approaches to enhance HIV treatment adherence, particularly among vulnerable populations like men who have sex with men. By offering accessible support through digital platforms, these interventions can effectively enhance long-term health and quality of life for individuals living with HIV.

CONCLUSION

Integrating mHealth technology into healthcare systems helps HIV/AIDS patients stick to their medication schedules and improve their quality of life. By using apps, text messages, and other tools, healthcare providers can offer personalized support, making it easier for patients to manage their health. Studies show that these digital tools effectively boost adherence to HIV medication. While some interventions for patients on second-line treatment didn't improve viral suppression, they did increase adherence. Overall, mHealth is flexible and can be adapted to different needs and local contexts, making it a valuable tool in global HIV/AIDS care.This approach emphasizes "KASIH" - Knowledge, Adherence to medication, Social support, and Perception of HIV - as key elements in enhancing HIV/AIDS management through mHealth interventions. By strengthening knowledge, improving adherence, providing social support, and enhancing perceptions about HIV, mHealth interventions can effectively improve long-term quality of life and health outcomes for individuals living with HIV/AIDS.

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