The Use Of Mhealth In Improving Adherence On Art In Nigeria: A Systematic Review

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Abstract: Introduction: Health is crucial for international development, with Sustainable Development Goal 3 (SDG3) focusing on ensuring healthy lives and promoting well-being globally. One of its targets is the reduction of the AIDS pandemic, achieved through the use of antiretroviral therapy (ART). While ART has significantly extended life expectancy, adherence remains a challenge, particularly in low-income countries like Nigeria. This review examines the effectiveness of mobile health (mHealth) interventions in improving adherence to ART among people living with HIV/AIDS (PLWHA) in Nigeria.

Methodology: A systematic review was conducted following the PEO model (Population, Exposure, Outcome). Relevant studies were sourced from databases including MEDLINE, PubMed, CINAHL, EMBASE, and the Cochrane Library, focusing on those published from 2010 onwards. Inclusion criteria encompassed systematic reviews, meta-analyses, randomized controlled trials, cohort, and cross-sectional studies examining mHealth's impact on ART adherence. Data were extracted and appraised using CASP and AXIS tools.

Findings/Results: Seven studies met the inclusion criteria. Thematic analysis revealed three key themes: (i) Acceptance of mHealth (phone calls, SMS, or apps) as a follow-up tool; (ii) The effect of SMS/text messaging in improving ART adherence; and (iii) Ease of mHealth use. Findings showed high acceptance and effectiveness of mHealth interventions in enhancing ART adherence. Interactive SMS and apps like WelTel and PositiveLinks significantly improved adherence and viral suppression. However, challenges such as language barriers, phone loss, and network issues were noted.

Discussion: mHealth interventions, particularly SMS and phone calls, are effective tools for improving ART adherence among PLWHA in Nigeria. These technologies facilitate patient-provider communication, address adherence barriers, and support viral suppression. Despite their benefits, challenges related to accessibility and literacy in low-income, rural areas must be addressed to maximize mHealth's potential.

Conclusion: mHealth technologies hold promise for enhancing ART adherence in Nigeria, contributing to the global effort to control the AIDS pandemic. Future research should focus on overcoming barriers in rural and low-income settings to ensure broader adoption and effectiveness.

Keywords: mHealth, antiretroviral therapy, ART adherence, HIV/AIDS, Nigeria, mobile health technology, public health, SDG3, viral suppression.

I. INTRODUCTION

Health has been recognized as vital in relation to international development for decades. Pettigrew, L.M., et al. (2015) submit that SDG3 explicitly relates to health, with an aspect of achieving Universal Health Coverage (UHC). Out of the 17 SDGs, goal 3 focuses on ensuring healthy lives and promoting well-being for everyone across all age categories. This goal further has 13 targets, including the reduction of the AIDS pandemic (Singh, 2016).

One of the scientific innovations to fight this pandemic is the development of antiretroviral drugs. Records show that an estimated 14.4 million life-years have been secured worldwide among adults on antiretroviral therapy (ART). However, the

rate of new infections remains very high and still surpasses the number of people starting ART yearly (Williams, Lima, & Gouws, 2011). In addition to the effect of ART, Ortblad et al. (2019) state that ART has both treatment and preventive effects, sufficient to eliminate the risk of HIV transmission among those who have achieved viral suppression through good adherence.

ART adherence thus plays a vital role in achieving the second and third "90s" of the UNAIDS 90-90-90 goals to end the AIDS epidemic. As of the end of 2020, only limited achievements were recorded for the UNAIDS 90-90-90: 84% of people living with HIV knew their status, 87% of people living with HIV who knew their status were accessing antiretroviral therapy, and 90% of people on treatment were virally suppressed (UNAIDS, 2021), indicating that the fight against the pandemic is ongoing. While access to ART continues to expand worldwide, adherence to medication remains a challenge (Haberer et al., 2017).

Adherence to Antiretroviral Therapy (ART) is the degree to which the patient's behavior in taking HIV medications aligns with the recommendations from the health care provider (UNAIDS, 2018, in Abubarka and Haruna, 2021). Conversely, weak adherence to treatment and defaulting on treatment are major challenges of ART programs, especially in resource-limited locations (Kebede et al., 2008, in Uzochukwu et al., 2009).

Africa has been estimated to have 77% ART medication adherence, with Nigeria ranking third in the burden of HIV infection in sub-Saharan Africa. Ensuring a high rate of adherence to treatment is crucial to avoid the widespread dissemination of resistant strains of HIV. The level of adherence for patients is mostly reported as the percentage of prescribed doses of medication actually taken by the patients over a particular period. It is crucial to have adherence rates exceeding 95% to maximize the benefits of ART, as it plays a vital role in suppressing viral replication, thus preventing the development of transmission (Abubarka and Haruna, 2021).

The majority of the 35 million people living with HIV (PLWH) are found in low-income locations (Haberer et al., 2017), among which Nigeria is well recognized. Nigeria still struggles to attain the global goal of enrolling 90% of people diagnosed with HIV on antiretroviral treatment. Records show that only 33% of all people living with HIV were on ART in 2017 (UNAIDS, 2018, in Abubarka and Haruna, 2021).

Little attention has been given to efforts towards encouraging or promoting adherence to ART through follow-up of clients who are already on ART. Not much is known regarding whether effective follow-up of HIV patients in Nigeria ensures adequate adherence to ART. The innovation of mobile Health (m-health) has been effective in the public health sector and is rapidly growing in developing countries. It has the potential to create a significant impact on healthcare access for a wider proportion of rural populations and an enhanced capacity to meet the demand in low-income countries. The importance of m-health applications to public health using mobile phones has been acknowledged in several areas, including 'collecting community and clinical health data (remote-data-collection)' and rendering health service information to patients, 'direct provision of care', 'disease and epidemic outbreak tracking (public health surveillance)', and

'patients' education and awareness' (Davey & Davey, 2014). With its potential positive effect on public health, m-health can become an effective tool in ensuring adherence to ART among People Living with HIV/AIDS (PLWHA) in Nigeria and other low-income countries.

Therefore, a question arises that necessitates this systematic review: Does the use of m-health improve adherence to ART in Nigeria? The PEO model was adopted to formulate this question, following its acronym where P-Population (People Living with HIV/AIDS), E-Exposure (non-adherence to ART affecting viral suppression), and O-Outcome (Adherence to ART using m-health) were developed.

This systematic review focuses on People Living with HIV/AIDS in Nigeria who are initiated on HIV treatment. The objectives are to determine if the use of m-health as a tool for follow-up improves adherence to ART, to suggest effective ways of ending the AIDS pandemic as targeted by SDG goal 3 by 2030, to provide evidence for policy and decision-making in public health on incorporating m-health technology into HIV/AIDS programming towards achieving ART adherence and viral suppression, and finally, to develop new insights by reanalyzing the results of the included studies.

II. METHODOLOGY

METHODOLOGY

This systematic review aimed to determine whether the use of mHealth technology improves adherence to ART among people living with HIV/AIDS, with the goal of providing evidence for interventions in low-income countries, particularly Nigeria. Various databases were utilized to search for relevant studies, including MEDLINE, PubMed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), EMBASE, and the Cochrane Library.

CRITERIA FOR SELECTING STUDIES FOR REVIEW

The inclusion and exclusion criteria were as follows:
- ✓ *INCLUSION CRITERIA:* Studies with designs of Systematic Reviews, Meta-analyses, Randomized Controlled Trials, Case-Control or Cohort Studies, Cross-Sectional Studies, and Case Studies that examined the effectiveness of mHealth (including mobile phones, text messaging, or specific apps) in improving adherence to ART. Studies published between 2010 and the present were included.
- ✓ *EXCLUSION CRITERIA:* Studies without the specified designs and those published before 2010 were excluded.

SEARCH STRATEGIES FOR IDENTIFICATION OF STUDIES FOR THE SYSTEMATIC REVIEW

I searched various electronic databases, including MEDLINE, PubMed, CINAHL, EMBASE, and the Cochrane Library, using the following search terms individually and in combination with Boolean commands (OR and AND):
- ✓ Mobile phone OR cell* OR phone*

- ✓ ART OR Antiretroviral AND treatment
- ✓ Adhere*
- ✓ PLWHA* OR people living with HIV/AIDS

A total of 26,899 research studies were identified from the five databases mentioned above in the initial search, without applying the inclusion and exclusion criteria. After a series of screenings using the eligibility criteria and reviewing the abstracts to assess their relevance to the research question, seven studies were finally selected (see Fig. 1 below for the PRISMA schematic representation of the selection process).

The seven selected studies were further appraised using the CASP appraisal tool for cohort, RCT, and qualitative studies, while the AXIS appraisal tool was used for cross-sectional studies to determine their quality and level of evidence. Data were extracted and presented in a datasheet from the seven studies to illustrate their characteristics and key information. More details are presented in the Results/Findings section of the systematic review.
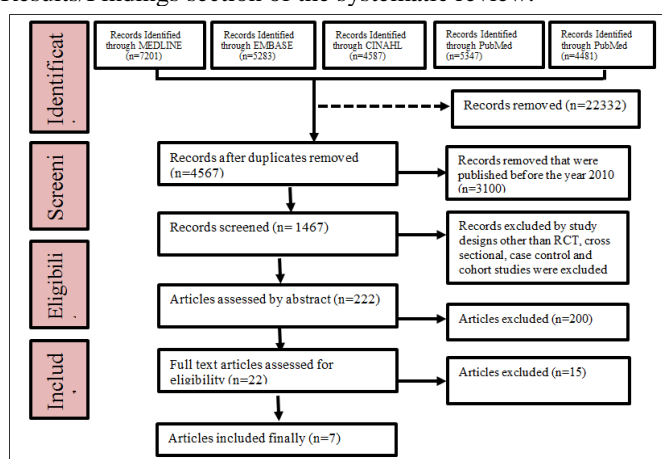
III. FINDINGS/RESULTS

The seven reviewed studies were heterogeneous in their designs and methodologies. A thematic analysis of the studies was conducted under the following themes: (i) Acceptance of mHealth (phone calls, SMS, or text messaging apps) as a follow-up tool for healthcare, (ii) Effect of SMS or text messaging in improving adherence to ART, and (iii) Ease of mHealth use.

ACCEPTANCE OF mHEALTH (PHONE CALLS, SMS, AND TEXT MESSAGING APPS) AS A FOLLOW-UP TOOL FOR HEALTHCARE

Two cohort studies focused on aspects of mHealth technology designed to improve adherence to ART, such as WeltelKenya1 (which involved patient-provider communication, creating an interactive avenue between the patient and the healthcare provider) and PositiveLinks (an app that enables patient engagement in care). Both interventions aimed to have people living with HIV/AIDS directly engage in the services they receive. Extensive use of PositiveLinks (PL) was associated with a greater likelihood of maintaining viral suppression; a 10% increase in response rate to daily queries was associated with a 2.1% increase in the number of days

suppressed (incident rate ratio = 1.02, 95% CI 0.96–1.09) (Canan et al., 2020). Another trial study by Shar et al. (2019) highlighted that interactive text messages utilizing three Behavioral Change Techniques (BCTs) significantly improved adherence.

EFFECT OF SMS OR TEXT MESSAGING IN IMPROVING ADHERENCE TO ART

Six studies reported findings on the effect of SMS in improving adherence to ART. The use of reminder devices (Smillie et al., 2014) and mobile text messaging on a weekly basis enhanced adherence to ART (Horvath et al., 2012), with 90% adherence achieved by 63% of the group that received weekly reminders. Evidence shows that automated text message reminders have the potential to improve adherence among PLWHA who are initiated on ART (Pop-Eleches et al., 2013). Interventions delivered via mobile phone calls were shown to reduce HIV viral load (Shar et al., 2019). Young and adult PLWHA comfortably disclosed their status and affirmed that SMS aids adherence to ART (Endebu, 2019). A larger proportion of literate phone users mentioned that SMS reminders are the most relevant factor influencing their adherence to drugs (Kim et al., 2015).

EASE OF MHEALTH TECHNOLOGY USE

mHealth can only be effective if the target population has access to and is comfortable using it. Findings related to ease of use include loss of phones, difficulty in understanding SMS messages in English, issues with network coverage, and the process of learning to text (Smillie et al., 2014). PLWHA with higher utilization of PositiveLinks (PL) had a higher chance of achieving the Health Resources and Services Administration's benchmarks (Canan et al., 2020).

STRENGTHS AND WEAKNESSES OF THE REVIEWED STUDIES

The overall review of studies has some notable strengths and weaknesses:

- ✓ *Smillie et al. (2014):* This study adopted a qualitative method and a prospective cohort design, which was relevant for researching the use of Weltel as a model in designing Short Message Service in Canada, especially by understanding PLWHA opinions. However, the small-scale population may lack representativeness, and there is a potential bias in participant selection by health workers, limiting external validity.
- ✓ *Horvath et al. (2012):* This systematic review of RCTs provided quality evidence that mobile text messaging is effective in improving adherence. However, the total population of these trials is unknown, and it is unclear how participants were selected. Additionally, participants were not blinded, and the study did not capture the adolescent group or consider culturally specific text messages, weakening external validity and limiting generalizability.

- ✓ *Shar et al. (2019):* This systematic review included 19 trials with a total of 2,650 participants. The synthesis of study findings was thematically analyzed with relevance to the research question.
- ✓ *Canan et al. (2020):* This study used a quantitative method and a prospective cohort design appropriate for the research question and objectives. The study was clear in its aims and objectives, and data were collected at appropriate intervals. However, generalizability is limited because it was conducted only in a clinic.

- ✓ *Kim et al. (2015):* This study used a quantitative method and a cross-sectional design, recruiting 895 rural participants. While the evidence is robust for generalizability and findings can be applied in similar locations, the study population might be a limitation due to potential difficulties in comparing characteristics with other HIV patients in rural Africa.
- ✓ *Pop-Eleches et al. (2013):* The research lacks elements of reproducibility and generalizability, although the data were adequately described, and a clear thematic analysis was conducted, presenting robust evidence of the beneficial effects of mobile phone technology for HIV/AIDS care delivery.

Author and Date	Title of study	Aims	Study Designs	Methods	Study participants	Main findings	Critical appraisal performed	Study Strengths	Study Weaknesses
Smillie, K. et al. 2014	Qualitative Study Investigating the Use of a Mobile Phone Short Message Service Designed to Improve HIV Adherence and Retention in Care in Canada (WelTel BC1)*	1. To understand • Attitudes of people living with HIV who faced multiple barriers to engagement in HIV care. • Their experiences using theWel-Tel intervention as a tool to help manage their care. 2. To adapt the WelTel intervention to the Canadian context and to test the acceptability and feasibility of the intervention in a Canadian HIV clinic setting.	Cohort study: Prospective pilot study	Qualitative method	25 participants were recruited into the prospective study.	1. Attitudes towards engaging in HIV care: • *Medication adherence*: taking medication was important. • *Attending appointments*: majority of participants stated that attending appointments was a priority. • *Experiences with care*: participants reported that being treated with respect and kindness influenced their access to care. • *Support from friends and family*: support from family and friends in form of reminders and care encourage adherence. • *Ease of use*: Lost of phones, poor network coverage, and difficulty in understanding SMS in English language. 2. Usefulness of WelTel	Critical Appraisal Skills Programme (CASP) tool for qualitative research was used to appraised the study	1. The study clearly stated the aims of the research. 2. The research methodology (Cohort: prospective) was appropriate as the study sought to interpret and illuminate the actions of research participants 3. The recruitment of study participants were appropriate – HIV patients selected from a clinic using eligibility criteria.	1. The research used a small scale population for the study which may lack some representative elements. 2. There is bias of participants' selection because they were selected by the Health care providers based on their feelings. 3. The intervention of WelTel lacks some elements of external validity thus generalization and sustainability is insufficient.

						• *Communicating with Health Care providers:* Participants were satisfied with their ability to contact HCPs via text messages and calls, although some preferred physical contact. All participants (20/20) opted to recommend the program to their friends. That it was beneficial in managing their care such as appointment scheduling (16/20), appointment reminders (15/20), blood test results (14/20). • *Engaging in care:* Many participants said the text messages reminded them that "somebody" cares.			
Horvath, T. et al, 2012	Mobile phone text messaging for promoting adherence to antiretroviral therapy in patients with HIV infection	To determine whether mobile phone text-messaging is efficacious in enhancing adherence to ART in patients with HIV infection.	Systematic Review	Systematic Selection of 4 RCTs studies through electronic databases.	1. 4 RCT reviewed 2. Total number of participants not clearly stated.	1. There is quality evidence from the trials that mobile text-messaging is efficacious in enhancing adherence. 2. One trial proves high quality evidence that mobile phone text-messaging at weekly intervals is effective in enhancing HIV viral load suppression. Another shows a low evidence of	Critical Appraisal Skills Programme (CASP) tool for Randomized Controlled Trial (RCT) was used to appraised the study	1. The study was clear on outcomes, and focused intervention 2. The trials in the review were of high quality evidence on text messages effectiveness in enhancing adherence to ART.	1. The review did not clearly state how participants were selected and randomized. 2. Participants were not blinded 3. The RCT did not capture the adolescent populations. 4. The RCT did not consider culture specific data message content and length.

						text-messaging on a daily basis is no more effective than standard care in promoting adherence to ART.			
Canan, C.E. et al. 2020	Long term impact of *PositiveLinks*: Clinicdeployed mobile technology to improve engagement with HIV care	to evaluate the impact of up to 24 months of PL use on HIV viral suppression and engagement in care and to examine whether greater PL use was associated with improved outcomes.	Prospective Cohort study	Quantitative method	127 patients at a university-based Ryan White HIV clinic.	• Greater PL use was associated with a greater likelihood of maintaining viral suppression in unadjusted analyses, with each 10% increase in response rate to daily queries associated with a 2.1% increase in number of days suppressed (incident rate ratio = 1.02, 95% CI 0.96–1.09). • Members with high PL use were approximately twice as likely to achieve viral suppression compared to those with low PL use (HR = 2.09, 95% CI 0.64–6.88). • Members with high PL use (>48% response rate) were more likely to achieve the Health Resource and Service Administration (HRSA) metric than those with low PL use • The estimated association between PL use and engagement in care, after adjusting for gender, education, and income, was 1.52	Critical Appraisal Skills Programme (CASP)	1. Research was clear on the aims and objective. 2. Research data was collected at baseline and at 6 months interval according to the period the PL App impact could be tested in order to address the issue of improving HIV care.	1. The generalizability is limited because it was a clinic deployed intervention. 2. All participants were Positive link (PL) users; making it difficult to compare with non-PL users. 3. Inadequate information and app usage.

		.				(95% CI 0.89–2.57).			
Kim, J. et al 2015.	Feasibility and acceptability of mobile phone short message service as a support for patients receiving antiretroviral therapy in rural Uganda: a cross-sectional study	To determine the proportion of people living with HIV who are literate and also use mobile phones in a rural setting in Uganda	Cross-sectional study	Quantitative method.	895 participants were enrolled.	• 84.2% of literate phone users reported good ART adherence. • Reminders as the most important factor influencing adherence to drugs (36.5% vs. 22.3% for others, pB0.001),. • Those in waged/salaried employment (AOR=2.35; 95% CI 1.23_4.49), crafts/trade work (AOR_2.38; 95% CI 1.11_5.12) and petty trade (AOR_1.85; 95% CI 1.09_3.13) were more likely to be literate phone users in comparison to those with no income. • Those with access to a mobile phone were also more likely to report sub-optimal drug adherence (AOR=1.76; 95% CI 1.12-2.77).	AXIS tool was used to appraise the study.	The study establish an evidence that meet the generalizability, thus its findings can be applied in other similar location settings. The author's discussions and conclusions were based on the results and findings, e.g. one must not necessary be literate to use text messaging	Study participants were difficult to know in comparison with other HIV patients in Africa who reside in rural areas. It is also unclear whether the participants would have preferred SMS for ART reminders, health status checks or both;
Pop-Eleches, C. et al. 2013	Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders	Objective was to test the efficacy of short messages on adherence to adherence on ART	Randomized Controlled Trial (RCT).	Quantitative method	720 participants enrolled in the trials.	Among participants who were retained in care at 48 weeks, the fraction who achieved at least 90% adherence was 63% for the group that received weekly reminders. The two groups receiving short reminders and retained in care for 48	Critical Appraisal Skills Programme (CASP)	Presentation of a robust evidence of beneficial effects of mobile phone technology for HIV/AIDS care delivery, also known as mHealth. The study clearly shows a thematic analysis based on data collection relevant to the research question.	Research lacks reproducibility and generalizability of findings. No HIV-RNA determinations - difficult to measure adherence and viral suppression.

						weeks were marginally more likely to be adherent than the control group (59 vs. 47%, P= 0.07) - automated text message reminders may improve adherence among patients initiating ART in resource-limited settings.		The data was adequately described.	
Shah, R. et al. 2019	A systematic review and meta-analysis in the effectiveness of mobile phone interventions used to improve adherence to antiretroviral therapy in HIV infection	to provide an updated synthesis of RCTs of interventions designed to increase adherence to ART medication delivered to patients via mobile phone to describe the effectiveness of interventions which employ different delivery mechanism (SMS, voice calls, application software) and different intervention content or frequencies of contact (weekly, daily contact).	Systematic Review and meta-analysis of RCTs	Quantitative method	19 trials with a total of 2650 participants	Intervention delivered by mobile phone call showed by one trial that it causes reduction in HIV viral load. Interventions by mobile phone imagery showed by one trial that there is a statistically significant improvement in HIV viral load. It was not clear if the delivery system (daily, weekly, scheduled or triggered mechanism in text messages) had an effect, since the results had individual mixed statistical significance. Text messages described as interactive with the use of more than 3 Behavioral Change Techniques (BCTs) all indicated improvements in adherence.	Critical Appraisal Skills Programme (CASP)	The synthesis of study findings were thematically analyzed with adequate relevance to the research question. Outcomes were explicitly stated The objective of the study was clearly stated. Results/findings were analyzed in line with the study objectives.	Participants were not blinded, Lack of established adherence measures made analysis of outcomes inadequate.
Endebu, T. et al. 2019	Acceptability and feasibility of short message service to improve ART medicatio	To examine the feasibility and acceptability of SMS to improve ART adherence and	Cross-sectional survey	Quantitative Method	420 participants	Majority of the patients were willing to accept SMS in order to improve their medication adherence.	AXIS tool was used to appraise the study	The study design - cross-sectional was appropriate for the aim of the research which was through examination.	The outcomes of the study were not stated. The study failed to discuss limitations that should be looked into by

| Endebu, T. et al. 2019 | Acceptability and feasibility of short message service to improve ART medication adherence among people living with HIV/AIDS receiving antiretroviral treatment at Adama hospital medical college, Central Ethiopia | To examine the feasibility and acceptability of SMS to improve ART adherence and exploring associated factors among HIV Positive people receiving ART in central Ethiopia. | Cross-sectional survey | Quantitative Method | 420 participants | Majority of the patients were willing to accept SMS in order to improve their medication adherence. Young and early adult patients easily disclosed their status and admitted that SMS aid adherence 91% were willing to accept SMS on ART treatment from ART Clinic and about 81.5% of them perceived that SMS would aid medication adherence. Respondents, having cell phone always were 2.95 times more likely to accept short message service as compared to those having a cell phone not always [AOR = 2.95, 95%CI (1.03–8.40)]. | AXIS tool was used to appraise the study | The study design - cross-sectional was appropriate for the aim of the research which was through examination. The study subjects/participants were the representative of reference population under research Ethical consideration were fully put in place. | The outcomes of the study were not stated. The study failed to discuss limitations that should be looked into by future researchers. |

IV. DISCUSSION

Following the thematic analysis in the findings, mHealth technologies like WelTel and PositiveLinks are accepted by people living with HIV/AIDS (PLWHA) as follow-up tools to support ART adherence. Short Message Service (SMS) and phone calls have been proven effective as reminder tools for patients on ART, facilitating interaction with healthcare providers, addressing challenges, and maintaining adherence to care and treatment. The goal of viral suppression can be achieved if SMS and phone calls are effectively utilized.

However, phone calls and SMS messages may be less effective if they are not designed in a language that PLWHA can easily understand. The reviewed studies suggest that the ease of use and widespread adoption of mHealth technology significantly influence adherence to HIV care and treatment.

This systematic review has several limitations that should be considered for future research. The most significant gap is the broad scope of the study, which encompasses a wide range of PLWHA. While studies on various aspects of mHealth technology in improving adherence have been conducted,

adopting mHealth often requires financial resources that patients may lack. For PLWHA in low-income countries like Nigeria, particularly in rural areas where mHealth adoption might be challenging due to factors like income and literacy, there is a lack of research. Understanding the challenges and potential of mHealth in rural populations is crucial for effective HIV/AIDS programming.

Another limitation is the heterogeneity of study designs, including RCTs, cohort studies, and cross-sectional studies. This variation complicates the analysis of the strengths and weaknesses of the reviewed studies concerning mHealth technology in improving ART adherence.

The implications of the results/findings from this systematic review suggest that the utilization of mHealth should be accessible to all PLWHA, including those in rural areas. However, despite advancements in telecommunications, rural locations often lag behind, significantly impacting access to critical health information and telehealth services (RHIhub, 2022).

To control the HIV/AIDS epidemic in line with the United Nations' vision, Nigeria must reach and provide effective care to groups of positive clients who face barriers to accessing treatment. Nigeria is among six nations with a high burden of HIV, low ART coverage, low decline in new infections, and poor viral suppression. Approximately 3.8 million Nigerians are estimated to be living with HIV, contributing significantly to new infections in Sub-Saharan Africa (Katbi et al., 2019). Despite efforts to place people living with HIV on ART, only 34% of adult patients are accessing treatment, far from achieving HIV control goals. Progress in ART coverage will remain limited if the disease is concentrated in areas with poor access and service provision (WHO, 2017).

To expand ART access and ensure adherence as a holistic approach towards achieving SDG goal 3 by 2030, research and policy development on the effectiveness of mHealth technology in rural areas should be prioritized. The Nigerian government should initiate programs that promote the acceptability and affordability of mHealth technologies as follow-up tools for ART adherence for all PLWHA, including those in rural areas.

V. CONCLUSION

Health is universally recognized as a critical component of international development, with significant efforts directed towards its improvement. One such effort is the Sustainable Development Goals (SDGs), particularly SDG 3, which focuses on ensuring healthy lives and promoting well-being for all. Adherence to antiretroviral therapy (ART) has been a pivotal innovation in combating HIV. Various strategies have been implemented to enhance ART adherence.

This systematic review of seven studies reveals that mHealth technologies can significantly impact ART adherence. These technologies, including SMS and phone calls, have shown promise in improving communication between patients and healthcare providers, thus supporting better adherence to treatment. However, there are still areas that require further research and development, particularly the application of mHealth in rural areas.

The lack of research and resources directed towards the implementation of mHealth in rural settings is a significant gap. These areas often face challenges such as limited access to healthcare services and lower literacy rates, which can affect the adoption and effectiveness of mHealth solutions. Therefore, it is crucial to allocate resources and conduct more research to explore the potential of mHealth technologies in rural regions. This approach will help ensure that all people living with HIV, regardless of their location, can benefit from advancements in healthcare technology and move closer to achieving the global health targets set by SDG 3.

By addressing these gaps, we can strengthen the impact of mHealth technologies and enhance adherence to ART, ultimately contributing to the global effort to combat HIV and improve health outcomes worldwide.

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