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REVIEW

Intervention strategies to improve adherence to treatment for selected chronic conditions in sub-Saharan Africa: a systematic review

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Abstract

Introduction: Evidence-based intervention strategies to improve adherence among individuals living with chronic conditions are critical in ensuring better outcomes. In this systematic review, we assessed the impact of interventions that aimed to promote adherence to treatment for chronic conditions.

Methods: We systematically searched PubMed, Web of Science, Scopus, Google Scholar and CINAHL databases to identify relevant studies published between the years 2000 and 2023 and used the QUIPS assessment tool to assess the quality and risk of bias of each study. We extracted data from eligible studies for study characteristics and description of interventions for the study populations of interest.

Results: Of the 32,698 total studies/records screened, 2814 were eligible for abstract screening and of those, 497 were eligible for full-text screening. A total of 82 studies were subsequently included, describing a total of 58,043 patients. Of the total included studies, 58 (70.7%) were related to antiretroviral therapy for HIV, 6 (7.3%) were anti-hypertensive medication-related, 12 (14.6%) were anti-diabetic medication-related and 6 (7.3%) focused on medication for more than one condition. A total of 54/82 (65.9%) reported improved adherence based on the described study outcomes, 13/82 (15.9%) did not have clear results or defined outcomes, while 15/82 (18.3%) reported no significant difference between studied groups. The 82 publications described 98 unique interventions (some studies described more than one intervention). Among these intervention strategies, 13 (13.3%) were multifaceted (4/13 [30.8%] multi-component health services- and community-based programmes, 6/13 [46.2%] included individual plus group counselling and 3/13 [23.1%] included SMS or alarm reminders plus individual counselling).

Discussion: The interventions described in this review ranged from adherence counselling to more complex interventions such as mobile health (mhealth) interventions. Combined interventions comprised of different components may be more effective than using a single component in isolation. However, the complexity involved in designing and implementing combined interventions often complicates the practicalities of such interventions.

Conclusions: There is substantial evidence that community- and home-based interventions, digital health interventions and adherence counselling interventions can improve adherence to medication for chronic conditions. Future research should answer if existing interventions can be used to develop less complicated multifaceted adherence intervention strategies.

Keywords: adherence; antiretroviral therapy; anti-hypertensive medication; anti-diabetic medication; systematic review; Africa

Additional information may be found under the Supporting Information tab of this article.

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1 | INTRODUCTION

Patients on treatment for chronic conditions face multiple barriers to adherence, and no single intervention is deemed sufficient to ensure that high levels of adherence to treatment are maintained [1]. There remains a need to strengthen and tailor different intervention strategies to different barriers to adherence for chronic conditions [1].

In the efforts to address adherence to treatment for chronic conditions; behavioural and psychological factors, education, integrated care and patient self-management interventions have been explored [2, 3]. This includes behavioural rehabilitation provided by health providers to patients, integration of psychosocial support within health programmes and patients' knowledge about the medication and their overall satisfaction with the treatment [4–6]. Other studies have recommended telephonic counselling and text messaging or reminders (mobile health/mhealth), packaging/medication boxes, home visits, drug-level monitoring and consistent clinical monitoring of patients [4, 6, 7]. Studies focusing on adherence to antiretroviral therapy (ART) for human immunodeficiency virus (HIV) have further emphasized the importance of compliance with standard treatment guidelines (monitoring and reporting of health information [data] to promote appropriate medicine use) [8–10]. Interventions that use mobile technology (mhealth) have the potential to facilitate self-management, education and support, unfortunately, mhealth applications have been limited in sub-Saharan Africa (SSA), and they have had mixed effects on controlling non-communicable diseases (NCDs) [11, 12].

Although numerous reviews have evaluated adherence interventions [12–16], few have undertaken a comparative analysis of adherence to medication for various conditions, notably HIV, hypertension (HPT) and diabetes mellitus (DM). While HIV remains the leading cause of death especially in young and middle-aged adults in SSA, the burden of NCDs, particularly HPT and DM, has increased rapidly in recent years [17–19]. There has been a surge in the burden of NCDs in SSA over the past two decades, rising from 24% in 2000 largely due to challenges in the implementation of preventative and control measures including screening, diagnosis and care [20–22]. Therefore, understanding adherence to related medication is a priority issue. This review assesses treatment adherence interventions for HIV, HPT and DM in SSA, which provides valuable comparisons and context to adherence intervention strategies for chronic conditions in SSA. We sought to understand evidence-based approaches to support adherence to treatment for HIV, HPT and DM.

2 | METHODS

This systematic review has been designed and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [23] (Supplementary Material 1), following the registered protocol on the International Prospective Register of Systematic Reviews (PROSPERO) (registration number: CRD42019127564) [24]. The study used Population (P), Interventions (I), Comparisons (C) and Outcomes (O) (PICO) criteria as the search strategy tool.

2.1 | Eligibility criteria

All studies assessing the impact of adherence interventions for ART, anti-hypertensive medication and anti-diabetic medication in SSA that were conducted or published between 01 January 2000 and 30 November 2022 were considered for inclusion. Studies were excluded if the study setting was not SSA, if papers were written in any other language than English, if the health condition for which adherence to medication was assessed was not HIV, HPT or DM, and if the study was published before the year 2000 (Table 1).

2.2 | Data collection

We conducted a systematic data search using several electronic databases, including PubMed Web of Science, CINAHL, Scopus and Google Scholar, between 01 August 2021 and 29 February 2024 (including the period when the analysis was updated: 08 February 2024–29 February 2024). These dates included repeat searches in case of article publications occurring after the initial search. We also reviewed citations and bibliographies of other related reviews to identify additional relevant material.

The search terms were adjusted to suit the database being searched. An inventory with the database searched, the corresponding search criteria used, the date when the searches were conducted and the results were all maintained (Supplementary Material 2_search term strategy). Two other reviewers (Lisa Noordman and Marit Wiltink) ran the searches separately for comparison. The comparison entailed a number of articles showing as a result of each search (search hits). Small differences were observed and attributed to different dates on which databases were accessed and/or searched by the reviewers. In this case, results from each reviewer were merged and de-duplicated.

Three reviewers (S.B.G., Lisa Noordman and Marit Wiltink) independently conducted title and abstract screening. The screening results were compared for each reviewer to identify any discrepancies. Discrepancies in the screening results were discussed between the three reviewers. In cases where an agreement on inclusion could not be reached, a fourth reviewer (S.T.L.-E.) made the final decision.

From the database search engines, data were imported into the Rayyan electronic tool, a free web-tool designed to help synthesize data for systematic reviews, scoping reviews and literature reviews [25].

2.3 | Study selection

The reviewers performed title and abstract screening using a predefined list of inclusion and exclusion criteria (Table 1 and Figure 1). In case the article was not specific or clear enough, especially in terms of intervention type and outcome measures, screening was discussed by all the reviewers and S.T.L.-E. made the final decision. Multiple studies of the same cohort were included if different outcomes were studied.

2.4 | Data extraction

Data were extracted using a standardized form. The following details were extracted: study title, first author, publication year, type, study duration, country, population, study geographical setting, study design, sample size, intervention description, details on age, sex, condition (HIV, HPT, DM), outcome measures and main results.

Table 1. Methodological aspect of the systematic review

Criteria for study inclusion	Components details
Population (P)	Patients/participants with selected chronic conditions (HIV, HPT, DM) in SSA
Intervention (I)	All interventions listed/described as medication adherence interventions or strategies for the conditions of HIV, HPT, DM
Comparisons (C)	Standard of care and other adherence interventions reported in the relevant study
Outcome (O)	There is no preferred measurement for reporting. For this review, we included studies that reported any quantitative measure of medication adherence including self-reported adherence using a defined threshold, pill count using a defined threshold, change in CD4$^+$ lymphocyte count and HIV-1 RNA (viral load), mean change in systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) measured at certain intervals, retention in care and LTFU, weight, a reduction in HbA1C level, improved specific self-efficacy, mean change in weight, mean waist circumference, mean HbA1c and medication adherence using Morisky Medication Adherence Scale (MMAS-8). Effects on adherence behaviour and the changes in health outcomes.
Setting	All studies from SSA only were considered for the review.
Language	English
Publication date and study duration	The year 2000–2023
Publication status	All the documented studies were considered and included for review. This includes peer-reviewed (i.e. papers, manuscripts and abstracts) and dissertations or theses.

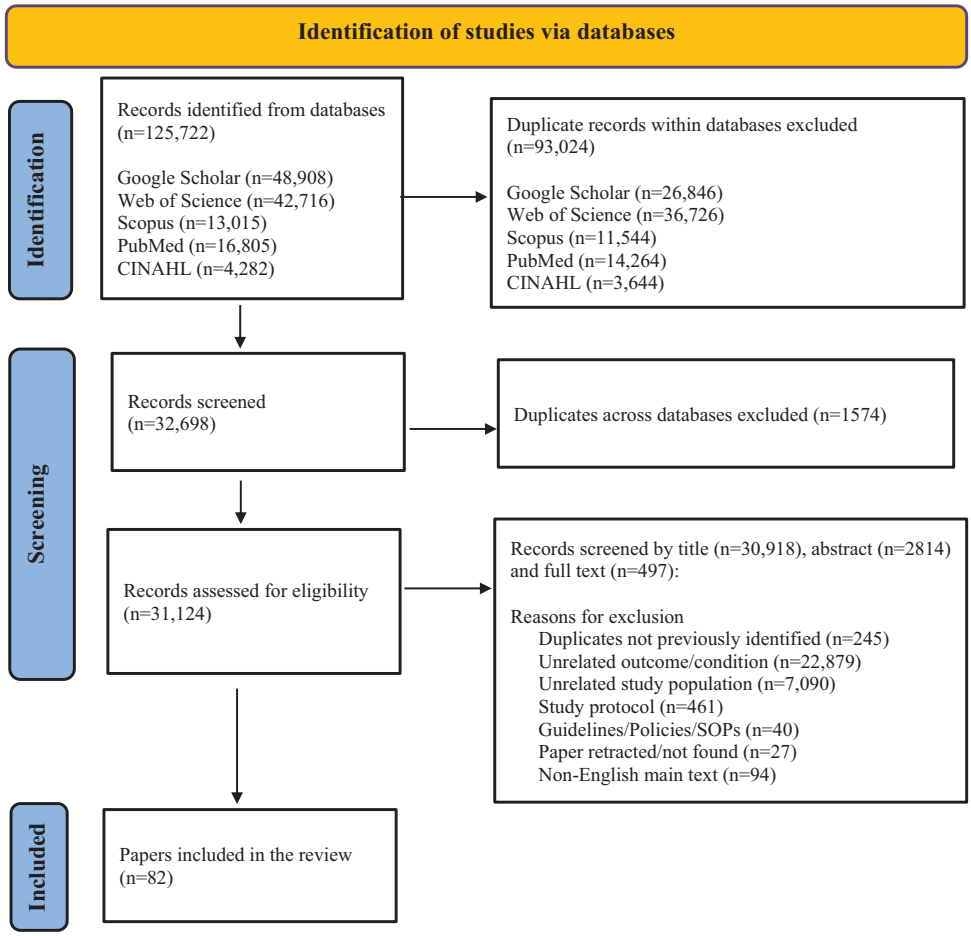


Figure 1. Flow chart—identification of studies via databases.

2.5 | Quality assessment

For all studies in the systematic review, assessments of quality and risk of bias were performed using the Quality in Prognostic Studies (QUIPS) tool (Supplementary Material 3) [26]. The risk of bias was assessed as low risk, moderate risk or high risk for each of the following domains: study design, participant selection, study sample size, descriptions of outcomes and description of interventions.

2.6 | Data analysis

For each study included in the review, the following characteristics were recorded: authors, year of publication, country where the study was conducted, study duration, study design, study site/setting, study population/sample, sample size, sex of participants, age of participants, health condition studied, intervention assessed, outcomes analysed and main findings. Adherence interventions were described according to the type of intervention and implementation setting.

3 | RESULTS

3.1 | Description of included studies

A total of 32,927 records were screened and after the removal of duplicates, a total of 30,918 records remained and their titles and abstracts were screened for inclusion. Of the 30,918 records, 2814 were further screened for inclusion by abstract. The full-text screening of potentially eligible articles was subsequently done in 497 records. The reasons for the exclusion of papers are noted in Figure 1. In total, 82 articles [27–108] were found to be eligible and data were then extracted (Supplementary Material 4).

Of the 82 articles, 74/82 (90.2%) were peer-reviewed journal articles, 7/82 (8.5%) were dissertations and 1/82 (1.2%) were paper abstracts. Fifty-eight papers reported studies of interventions to promote adherence to ART, six were anti-hypertensive medication related, 12 were anti-diabetic medication related and six focused on more than medication for more than one condition. The studies included reported findings on a total of 58,043 participants. The mean sample size was 735 participants (range: 10–10,136). The median age of participant samples was between 30 and 40 years and about two-thirds of the study participants were women. Almost half of the included studies (39/82, 47.6%) were conducted in the southern African region, with a total of 35,849/58,043 participants (61.8%), and East Africa (31/82, 37.8%) with a total of 18,121/58,043 participants (31.2%) (Supplementary Material 4). The remaining 12/82 (14.6%) studies with 4073/58,043 (7.0%) participants were conducted in other parts of the sub-Saharan African region (including West Africa and central Africa).

Of the included papers, 34/82 (41.5%) reported findings of evaluation studies, including randomized controlled trials (31/34, 91.2%) and quasi-experimental studies (3/34, 8.8%), 19/82 (23.2%) reported findings of correlational studies, notably cross-sectional surveys (11/19, 57.9%), and cohort studies (8/19, 42.1%), 17/82 (20.7%) reported findings of qualitative research and 5/82 (6.1%) were mixed method studies. The remaining 8/82 (9.8%) papers included various study designs such as non-described descriptive studies. Data were collected between 2003 and 2023 and the year of study publications ranged from 2006 to 2023.

A total of 54/82 (65.9%) reported improved adherence based on the described study outcomes, 13/82 (15.9%) did not have clear results or defined outcomes and 15/82 (18.3%) reported no significant difference between studied groups.

Of the studies reporting improved medication adherence, 40/54 (74.1%) were related to ART, 2/54 (3.7%) were related to HTN, 9/54 (16.7%) were related to DM and 3/54 (5.6%) were related to more than one health condition. (Supplementary Material 4).

The 82 publications described 98 unique interventions (some studies described more than one intervention). Of the 37 community- and home-based reported interventions, peer treatment supporters (14/37, 37.8%), nutrition support (7/37, 18.9%) and community-based social network support (10/37, 27.4%) were the most described community- and home-based interventions. Of the total mhealth-based interventions, SMS reminders at a regular interval (10/19, 55.6%) was the most described mhealth-based intervention (Table 2).

Other interventions included adherence counselling (29/98, 29.6%), health service interventions (3/98, 3.1%) (which included decentralization of services and health systems strengthening), incentive intervention (voucher) (1/98, 1.0%) and drug optimization (transition in medication) (2/98, 2.0%). Of the 98 unique intervention strategies, 13 (13.3%) were multifaceted (4/13 [30.8%] multi-component health services- and community-based programmes, 6/13 [46.2%] included individual plus group counselling and 3/13 [23.1%] included SMS or alarm reminders plus individual counselling) (Table 2).

3.2 | Risk of bias

Risk of bias was measured using the QUIPS tool (Supplementary Material 3), based on the study design, participant selection, study sample size, descriptions of outcomes and description of interventions. Of the 34 papers (including randomized control trials and quasi-experimental), 28/34 (82.4%) scored a low risk of bias, 4/34 (11.8%) a moderate risk of bias and 2/34 (5.9%) reported a high risk of bias. Out of the 20 correlational papers (cohort and cross-sectional studies), 15/20 (73.7%) scored a low risk of bias and 5/20 (26.3%) scored a moderate risk of bias. From the 17 qualitative studies, only 2/17 (11.8%) scored a low risk of bias, 11/17 (64.7%) scored a moderate risk of bias and 4/17 (23.5%) scored a high risk of bias. From the other study designs (mixed and non-described descriptive methods), 6/11 (54.5%) scored a low risk of bias, 3/11 (27.3%) scored a moderate risk of bias and 2/11 (18.2%) scored a high risk of bias. Overall, 51/82 (62.2%) scored a low risk of bias, 23/82 (28.0%) a moderate risk of bias and 8/82 (9.8%) a high risk of bias. Most papers scored well on participant selection, study design, outcome measurement, intervention measurement, data collection methods and data analyses.

4 | DISCUSSION

There has been a significant increase in the number of studies implementing and evaluating interventions aimed at

Table 2. Description of adherence intervention types

Intervention type	Definition	ART	Anti-hypertensive medication	Anti-diabetic medication
Community- and home-based interventions				
Community based-adherence support (CBAS) with home visits	Provision of adherence support through home visits by a community health worker or peer volunteer. Home visitors are involved in a variety of activities such as food ration provision basic clinical assessments and patient referrals, ART delivery, and providing DOT and pill counts.	2	0	0
Multi-component health services- and community-based programme	Interventions involve a facility-designated health worker who connects patients to facility-level services. Responsibilities of the worker have included home visits, patient monitoring and tracing, and counselling.	4	0	0
Peer treatment supporters	Involving other persons within a patient's social circle in assisting that patient with their treatment. Examples of responsibilities of the treatment supporter include providing Direct Observed Therapy (DOT) service, social support, bonding, bridging or linking social networks, clinical site mediation, and providing regular follow-up reminders for the next appointment attendance.	9	2	3
Community-based social network support	Support at the community level is designed to be delivered to a group. Includes interventions involving a patient's extended social network in the patient's treatment.	6	2	2
Nutrition support	Providing supplementary nutritional support either at the individual or household level. Can come in the form of food rations or nutrition education.	7	0	0
Total		**28**	**4**	**5**
Digital health/mhealth/ehealth interventions				
SMS reminders sent at regular intervals	Regular delivery of SMS messages aimed at directly or indirectly reminding patients to adhere to their medication.	8	1	1
SMS reminders triggered by adherence monitors	SMS messages were sent if an electronic adherence monitoring device was not opened within 30 minutes of the scheduled dose time.	1	0	0
IVR or phone calls for reminders	Interactive voice response or regular phone calls delivering messages on medication adherence and other HIV/ART-related topics, as well as appointment reminders. Some also sent non-interactive, SMS picture messages to remind patients of dosage adherence.	1	0	0
Smartphone application	Medication reminders and adherence tracking, refill and appointment reminders, leaderboard and adherence points, social support through discussion forms, peer-to-peer support and community-based resources list	2	0	0
eHealth: adherence monitor device	A device enabling healthcare professionals or researchers to interpret activities of the patient/participant in the context of adherence and inform better decision-making and as an intervention and tool for the patient to aid self-management and improve adherence.	2	0	0
Total		**14**	**1**	**1**

(*Continued*)

Table 2. (Continued)

Intervention type	Definition	ART	Anti-hypertensive medication	Anti-diabetic medication
Adherence counselling				
Individual counselling	Adherence to educational and/or counselling interventions delivered in a one-on-one setting. Sessions are often led by trained health professionals or lay counsellors (including direct social support).	7	2	5
Group counselling	Adherence to educational and/or counselling interventions delivered in a group setting. Includes social support groups. Sessions are often led by trained professionals or lay counsellors and delivered through a set curriculum or informed by a psychosocial theory/practice.	5	1	0
Individual plus group counselling	Interventions with both individual and group counselling components (including educational and/or counselling delivered in a one-on-one or group setting)	6	0	0
Adherence counselling: SMS or alarm reminders plus individual counselling	Individual adherence counselling combined with regular reminders. Reminders could come in the form of either an alarm device programmed around dosage times or regular SMS messages, sent at times independent of the dosage schedule.	3	0	0
Total		**21**	**3**	**5**
Health service interventions				
Decentralization: decentralized medication delivery (DMD)	Decentralization comprises clinically stable ART patients who meet at facilities or community locations in groups of up to 30 every 2–3 months to receive group counselling, have a brief symptom screen and receive pre-packed medications. DMD comprises prepacking and distribution of medications to pick-up points, which are at locations other than the clinic pharmacy. Patients only need to come to the clinic on a 6-monthly basis for a clinical exam and rescripting.	1	0	0
Health system strengthening programme	A well-functioning health system working in harmony is built on having trained and motivated health workers, a well-maintained infrastructure, and a reliable supply of medicines and technologies, backed by adequate funding, strong health plans and evidence-based policies.	1	0	0
Integration of services	Provision of integrated care with standard vertical care delivered separately for people with HIV, diabetes or hypertension.	1	1	1
Total		**3**	**1**	**1**
Incentive intervention (behaviour change mechanism)				
Voucher	Vouchers are cash or gifts with a definitive value provided to study participants. The voucher incentive interventions are offered and designed by the researchers or investigators to reward participants/patients for achieving a certain goal and encourage team members to exceed their goals.	1	0	0
Total		**1**	**0**	**0**

(*Continued*)

Table 2. (Continued)

Intervention type	Definition	ART	Anti-hypertensive medication	Anti-diabetic medication
Drug optimization				
Transition in medication	The adoption of better drug regimens to improve treatment adherence, viral suppression and quality of life of people living with the specified condition. These benefits could reduce pressures on health systems as lower rates of viral failure on new treatments could reduce the risk of HIV drug resistance (HIVDR) and HIV transmission. In addition, the transition to new lower-cost antiretroviral (ARV) drugs could provide significant savings for national health budgets worldwide.	2	0	0
Total		**2**	**0**	**0**
Educational intervention				
Active visualization device	A device that delivers or provides health information that could be particularly useful in educating patients about the specific condition or related treatment.	1	0	0
Health education/knowledge	Any combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes.	1	1	2
Health literacy	The achievement of a level of knowledge, personal skills and confidence to take action to improve personal and community health by changing personal lifestyles and living conditions.	0	0	1
Total		**2**	**1**	**3**
Other				
Intervention counting pills	Monthly clinic-based pill counts	1	0	0
The food intervention programme: food by prescription	A programme that provides food and nutritional care to malnourished HIV-positive individuals as a therapeutic and supplementary feeding package at health facilities.	1	0	0
Total		**2**	**0**	**0**
Overall total		**73**	**10**	**15**

Note: The categorization of interventions was adapted from a study by Ridgeway et al. [13].

promoting adherence to chronic conditions. This systematic review combines the available evidence from a large number of studies to identify a range of adherence interventions aimed at promoting adherence to ART among people living with HIV, anti-hypertensive medication and anti-diabetic medication. The majority of adherence interventions described in this review were ART-related. This is consistent with health programmes in most sub-Saharan African countries that have placed more focus on HIV programmes as compared to HPT and DM-related programmes, but different to most high-income countries whose focus has been balanced across the three chronic conditions [8, 109–111].

Individual-related characteristics described in the reviewed studies demonstrated that almost two-thirds were females and of middle age (30–40 years). The individual-specific characteristics identified may represent the demographic profile of patients in chronic treatment programmes, particularly those receiving HIV care in the SSA [112, 113].

The community-based adherence interventions highlighted an important link between primary healthcare facilities or services and the communities, demonstrated integration of treatment and patient care, and decentralization of chronic care to the communities [114, 115]. Community- and home-based adherence interventions such as peer treatment support meet the rising need associated with overall chronic care, where due to the real shortage of healthcare workers and the growing caseload of people needing care, professional workers' roles are increasingly limited to medical and nursing tasks in health facilities [116]. This review provides evidence of the efficacy of community- and home-based adherence support strategies, but more focus should be on their acceptability and cost-effectiveness.

Mobile health is increasingly being explored for health promotion [117] and was also used in adherence-promoting interventions identified in this review, to deliver educational and behavioural components, either singly or in combination. The majority of mhealth-related medication adherence interventions described in this review reported improved adherence using specified outcome measurements. Most mobile health interventions were used to educate, remind or provide advice to patients. These technologies enabled the collection and transfer of patient-specific data/information across to different professionals, who could then deliver tailored feedback and reminders to the patients. The increasing advancement in technology and related benefits received by patients from healthcare providers without presenting at a health facility is an appealing prospect. Furthermore, mhealth interventions could have a greater reach, and better adoption and implementation; thus having a greater positive heath impact [117, 118]. However, more research is needed to establish the sustainability of such interventions and to evaluate how mhealth interventions can be useful in the short and long term in promoting adherence to medications.

The interventions described in this review were primarily directed at patients and ranged from adherence counselling including both individual and group counselling to more complex interventions such as mhealth interventions which took into consideration patients' abilities to use digital technology and preferences in addition to educating and aiding them to adhere to medication. Some of the interventions employed a combination of interventions, for example adherence intervention consisting of a combination of educational, behavioural or affective strategies. Behavioural and effective strategies, which are increasingly being used in adherence support interventions, range from adherence aids (such as medication administration aids), to motivational interviewing [119, 120].

Individual and group counselling adherence interventions could be regarded as being more patient-centred; however, their impact depends on the extent to which patients' or individuals' psychosocial needs are taken into consideration. This includes attitudes towards the health condition, cultural barriers, social concerns (such as perceived stigma) and cognitive abilities. These needs have been recognized in recent years as important predictors of optimal adherence to treatment and should be considered in any development of adherence interventions for chronic conditions [121].

The role of healthcare service-related interventions on medication adherence has been emphasized, particularly in cases of chronic diseases [122], though their impact is difficult to measure and has often been found to lack consistency [122, 123]. More adherence interventions have also addressed healthcare services-related factors impacting adherence, as was seen in this review. These include patient-related, condition-related and medication-related factors. For example, this review reported that adopting and using better ART drug treatment improved adherence to medication. In addition, greater emphasis on task-shifting and decentralization of services improved medication adherence and is, therefore, worthy of further investigation.

This review also reported improved medication adherence and retention in care for participants who received cash vouchers during the study period. The early effects on adherence and retention were sustained in the cash groups after the intervention was complete. Although this intervention improved adherence, the effect of such interventions should be considered along with other tested interventions as part of a comprehensive package of support during the treatment journey. A larger-scale impact evaluation to determine the effectiveness of cash support on cost-effectiveness, and issues related to sustainability, also needs consideration.

Overall, any intervention designed to influence human behaviour, such as modifying medication adherence in patients with chronic conditions, would be more successful if multiple factors that aid the change in human behaviour are addressed. Combined interventions comprise different components, which may act both independently and inter-dependently, to address the changes needed, and may be more effective than using a single component in isolation [124]. However, the complexity involved in designing, implementation and replicating combined interventions often complicates the practicalities of such interventions [124]. Therefore, interventions involving a single component may be preferred as they are easier to design, implement and replicate, and oftentimes are successful in influencing a behaviour change [124].

4.1 | Limitations of the reviewed studies

The quality of the studies included in our review varied; almost two-thirds of the studies reviewed had a low risk of bias, while fewer than one-tenth of all studies had a high risk of bias. While most studies reviewed had a low risk of bias, our assessment of a study's quality was limited for some studies due to a failure to report critical information related to study methodologies, such as study designs, or participant inclusion criteria, or to adequately describe outcome measures. Based on the small number of studies or interventions reviewed for HPT and DM, there may have been challenges in searching and including these conditions or related interventions. In addition, one in five of the total reviewed studies did not have clearly defined outcome measures. Therefore, future studies assessing adherence to treatment should use validated adherence measures, to report reliable findings or make strong conclusions.

More rigorous research in this field is critical, as is a replication of studies with positive findings in other settings. Furthermore, some of the studies described in this review were multifaceted, with some delivering multiple intervention components and others providing adherence support as a part of a broader package of services; this makes it impossible to discern the relative effect of each intervention component or identify which aspects are most impactful on adherence. Another limitation of these studies, and adherence research in general, remains with the challenge of accurately measuring medication adherence and in the variety of methodologies utilized [13].

The exclusion of data from studies conducted in North Africa may have led to the exclusion of potentially informative studies; however, NCDs are increasingly becoming the main cause of mortality in SSA, where the diseases were responsible for 37% of deaths in 2019 [20–22].

This review was limited to studies written in English only due to authors' or reviewers' challenges in reviewing studies written in other languages. Therefore, we may have potentially excluded relevant articles written in other languages besides English. Importantly, non-English speaking countries based in SSA may provide different but useful knowledge or evidence on intervention strategies to improve adherence to treatment. Additionally, while we feel that the search terms or strings we used were able to remove irrelevant articles, it is possible that the search strings we used were not comprehensive enough.

5 | CONCLUSIONS

Our study found substantial evidence of interventions to improve adherence among adults living with chronic conditions in SSA. There is more evidence that community- and home-based, mhealth and adherence counselling interventions can improve adherence to chronic conditions. These tested and evaluated adherences enhancing interventions should increasingly be considered for routine implementation in health programmes. However, rigorous ongoing evaluation of the impact and performance of these interventions will be necessary. Multifaceted adherence intervention strategies that include reliable adherence measures such as drug exposure testing and socio-economic support components such as cash vouchers provided to patients may be more effective than using a single-component intervention strategy. Therefore, evidence gaps in adherence-enhancing interventions need to be closed, including on cost-effectiveness and long-term effectiveness. Future research should seek to answer if existing intervention strategies can be successfully adapted for all chronic conditions assessed in this review. Our findings support testing more interventions and the need to develop a gold standard (or uniform measures) for adherence outcome ascertainment.

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COMPETING INTERESTS

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AUTHORS' CONTRIBUTIONS

SBG, STL-E and JBFDW contributed to the conception and design of the study. SBG organized the database and performed the analysis. SBG wrote the first draft of the manuscript. SBG, JBFDW, WDFV, AMJW and STL-E wrote sections of the manuscript. All authors contributed to the manuscript revision, read and approved the submitted version.

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DISCLAIMER

The statements and views made in this article are solely the responsibility of the authors and do not necessarily represent the official views of the National Institutes of Health.

DATA AVAILABILITY STATEMENT

The datasets used or analysed for the current study are available from the corresponding author on reasonable request.

REFERENCES

1. Shubber Z, Mills EJ, Nachega JB, Vreeman R, Freitas M, Bock P, et al. Patient-reported barriers to adherence to antiretroviral therapy: a systematic review and meta-analysis. PLoS Med. 2016;13(11):1–14. https://doi.org/10.1371/journal.pmed.1002183
2. Cochrane MG, Bala MV, Downs KE, Mauskopf J, Ben-Joseph RH. Inhaled corticosteroids for asthma therapy: patient compliance, devices, and inhalation technique. Chest. 2000;117:542–50. https://doi.org/10.1378/chest.117.2.542
3. Hampson SE, Skinner TC, Hart J, Storey L, Gage H, Foxcroft D, et al. Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review. Health Technol Assess. 2001;5(10):1–79. https://doi.org/10.3310/hta5100
4. Costa E, Giardini A, Savin M, Menditto E, Lehane E, Laosa O, et al. Interventional tools to improve medication adherence: review of literature. Patient Prefer Adherence. 2015;9:1303–14. https://doi.org/10.2147/PPA.S87551
5. Topp SM, Chipukuma JM, Giganti M, Mwango LK, Chiko LM, Tambatamba-Chapula B, et al. Strengthening health systems at facility-level: feasibility of integrating antiretroviral therapy into primary health care services in Lusaka, Zambia. PLoS One. 2010;5(7):e11522. https://doi.org/10.1371/journal.pone.0011522

6. Munro S, Lewin S, Swart T, Volmink J. A review of health behaviour theories: how useful are these for developing interventions to promote long-term medication adherence for TB and HIV/AIDS? BMC Public Health. 2007;7:1–16. https://doi.org/10.1186/1471-2458-7-104
7. Pinto SL, Gangan N, Gangal N, Shah S. Tools used to improve medication adherence: a systematic review. Value Health. 2013;16(3):A42–43. https://doi.org/10.1016/j.jval.2013.03.240
8. Mills EJ, Lester R, Thorlund K, Lorenzi M, Muldoon K, Kanters S, et al. Interventions to promote adherence to antiretroviral therapy in Africa: a network meta-analysis. Lancet HIV. 2014;1(3):e104–11. https://doi.org/10.1016/S2352-3018(14)00003-4
9. Moyo F, Chasela C, Brennan AT, Ebrahim O, Sanne IM, Long L, et al. Treatment outcomes of HIV-positive patients on first-line antiretroviral therapy in private versus public HIV clinics in Johannesburg, South Africa. Clin Epidemiol. 2016;8:37–47. https://doi.org/10.2147/CLEP.S93014
10. Evans D, Berhanu R, Moyo F, Nguweneza A, Long L, Fox MP. Can short-term use of electronic patient adherence monitoring devices improve adherence in patients failing second-line antiretroviral therapy? Evidence from a pilot study in Johannesburg, South Africa. AIDS Behav. 2016;20(11):2717–28. https://doi.org/10.1007/s10461-016-1417-7
11. Betjeman TJ, Soghoian SE, Foran MP. mHealth in sub-Saharan Africa. Int J Telemed Appl. 2013;2013:1–7. https://doi.org/10.1155/2013/482324
12. Devan H, Farmery D, Peebles L, Grainger R. Evaluation of self-management support functions in apps for people with persistent pain: systematic review. JMIR Mhealth Uhealth. 2019;7:e13080. https://doi.org/10.2196/13080
13. Ridgeway K, Dulli LS, Murray KR, Silverstein H, Santo LD, Olsen P, et al. Interventions to improve antiretroviral therapy adherence among adolescents in low- and middle-income countries: a systematic review of the literature. PLoS One. 2018;13:e0189770. https://doi.org/10.1371/journal.pone.0189770
14. Stephani V, Opoku D, Beran D. Self-management of diabetes in sub-Saharan Africa: a systematic review. BMC Public Health. 2018;18(1):1148. https://doi.org/10.1186/s12889-018-6050-0
15. Rahmawati R, Bajorek BV. Self-medication among people living with hypertension: a review. Fam Pract. 2017;34:cmw137. https://doi.org/10.1093/fampra/cmw137
16. Pedrosa VM, Abrantes AV. The role of mHealth in chronic disease management in sub-Saharan Africa. Eur J Public Health. 2020;30:532 (Supplement_5). https://doi.org/10.1093/eurpub/ckaa166.009
17. Adeloye D, Basquill C. Estimating the prevalence and awareness rates of hypertension in Africa: a systematic analysis. PLoS One. 2014;9(8):e104300. https://doi.org/10.1371/journal.pone.0104300
18. Atun R, Davies JI, Gale EAM, Bärnighausen T, Beran D, Kengne AP, et al. Diabetes in sub-Saharan Africa: from clinical care to health policy. Lancet Diabetes Endocrinol. 2017;5:622–67. https://doi.org/10.1016/S2213-8587(17)30181-X
19. Remais JV, Zeng G, Li G, Tian L, Engelgau MM. Convergence of non-communicable and infectious diseases in low- and middle-income countries. Int J Epidemiol. 2013;42(1):221–27. https://doi.org/10.1093/ije/dys135
20. World Health Organization (WHO). Cardiovascular diseases [Internet]. [cited 2023 Apr 24]. Available from: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1
21. Bigna JJ, Noubiap JJ. The rising burden of non-communicable diseases in sub-Saharan Africa. Lancet Glob Health. 2019;7:e1295–96. https://doi.org/10.1016/S2214-109X(19)30370-5
22. Africa CDC. Africa CDC Non Communicable Diseases, Injuries Prevention and Control and Mental Health Promotion Strategy (2022–26) [Internet]. 2023. [cited 2023 Mar 24]. Available from: https://africacdc.org/download/africa-cdc-non-communicable-diseases-injuries-prevention-and-control-and-mental-health-promotion-strategy-2022-26/
23. Moher D, Liberati A, Tetzlaff J, Altman DG, Altman D, Antes G, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6:e1000097. https://doi.org/10.1371/journal.pmed.1000097
24. Gumede S, De JB, Venter WF, Lalla-Edward ST. Adherence strategies and interventions for selected chronic conditions in sub-Saharan Africa: a systematic review and meta-analysis 2. PROSPERO International prospective register of systematic reviews PROSPERO. 2019. [Cited 2023 Feb 11]. Available from: https://www.crd.york.ac.uk/prospero/#searchadvanced https://www.crd.york.ac.uk/prospero/#recordDetails
25. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210. https://doi.org/10.1186/s13643-016-0384-4
26. Roqué M, Martínez-García L, Solà I, Alonso-Coello P, Bonfill X, Zamora J. Toolkit of methodological resources to conduct systematic reviews. F1000Res. 2020;9:82. doi 10.12688/f1000research.22032.2
27. Jones D, Cook R, Spence A, Weiss SM, Chitalu N. Antiretroviral therapy in Zambia: do partners on ART enhance adherence? J Int Assoc Provid AIDS Care. 2014;13(6):497–500. https://doi.org/10.1177/2325957414553843
28. Maduka O, Obin-West CI. Adherence counseling and reminder text messages improve uptake of antiretroviral therapy in a tertiary hospital in Nigeria. Niger J Clin Pract. 2013;16(3):302. https://doi.org/10.4103/1119-3077.113451
29. Foster SD, Nakamanya S, Kyomuhangi R, Amurwon J, Namara G, Amuron B, et al. The experience of "medicine companions" to support adherence to antiretroviral therapy: quantitative and qualitative data from a trial population in Uganda. AIDS Care. 2010;22(Suppl. 1):35–43. https://doi.org/10.1080/09540120903500027
30. Posse M, Tirivayi N, Saha UR, Baltussen R. The effect of food assistance on adherence to antiretroviral therapy among HIV/AIDS patients in Sofala province, in Mozambique: a retrospective study. J AIDS Clin Res. 2013;4(3):198. https://doi.org/10.4172/2155-6113.1000198
31. Mbuagbaw L, Thabane L, Ongolo-Zogo P, Lester RT, Mills EJ, Smieja M, et al. The Cameroon Mobile Phone SMS (CAMPS) trial: a randomized trial of text messaging versus usual care for adherence to antiretroviral therapy. PLoS One. 2012;7(12):e46909. https://doi.org/10.1371/journal.pone.0046909
32. Haberer JE, Musiimenta A, Atukunda EC, Musinguzi N, Wyatt MA, Ware NC, et al. Short message service (SMS) reminders and real-time adherence monitoring improve antiretroviral therapy adherence in rural Uganda. AIDS. 2016;30(8):1295–99. https://doi.org/10.1097/QAD.0000000000001021
33. Haberer JE, Musinguzi N, Tsai AC, Boum Y, Bwana BM, Muzoora C, et al. Real-time electronic adherence monitoring plus follow-up improves adherence compared with standard electronic adherence monitoring. AIDS. 2017;31(1):169–71. https://doi.org/10.1097/QAD.0000000000001310
34. Bobrow K, Farmer AJ, Springer D, Shanyinde M, Yu LM, Brennan T, et al. Mobile phone text messages to support treatment adherence in adults with high blood pressure (SMS-Text Adherence Support [StAR]): a single-blind, randomized trial. Circulation. 2016;133(6):592–600. https://doi.org/10.1161/CIRCULATIONAHA.115.017530
35. Pop-Eleches C, Thirumurthy H, Habyarimana JP, Zivin JG, Goldstein MP, De Walque D, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. AIDS. 2011;25(6):825–34. https://doi.org/10.1097/QAD.0b013e32834380c1
36. Czaicki NL, Mnyippembe A, Blodgett M, Njau P, McCoy SI. It helps me live, sends my children to school, and feeds me: a qualitative study of how food and cash incentives may improve adherence to treatment and care among adults living with HIV in Tanzania. AIDS Care. 2017;29(7):876–84. https://doi.org/10.1080/09540121.2017.1287340
37. Leon N, Surender R, Bobrow K, Muller J, Farmer A. Improving treatment adherence for blood pressure lowering via mobile phone SMS-messages in South Africa: a qualitative evaluation of the SMS-text Adherence SuppoRt (StAR) trial service organization, utilization, and delivery of care. BMC Fam Pract. 2015;16(1):80. https://doi.org/10.1186/s12875-015-0289-7
38. Sarna A, Luchters S, Geibel S, Chersich MF, Munyao P, Kaai S, et al. Short- and long-term efficacy of modified directly observed antiretroviral treatment in Mombasa, Kenya: a randomized trial. J Acquir Immune Defic Syndr. 2008;48(5):611–19. https://doi.org/10.1097/QAI.0b013e3181806bf1
39. Fox MP, Pascoe S, Huber AN, Murphy J, Phokojoe M, Gorgens M, et al. Adherence clubs and decentralized medication delivery to support patient retention and sustained viral suppression in care: results from a cluster-randomized evaluation of differentiated ART delivery models in South Africa. PLoS Med. 2019;16(7):e1002874. https://doi.org/10.1371/journal.pmed.1002874
40. Muchiri JW, Gericke GJ, Rheeder P. Effect of a nutrition education programme on clinical status and dietary behaviours of adults with type 2 diabetes in a resource-limited setting in South Africa: a randomised controlled trial. Public Health Nutr. 2016;19(1):142–55. https://doi.org/10.1017/S1368980015000956
41. Suru KU. Effectiveness of mobile phone reminders in improving adherence and treatment outcomes of patients on ART in Adamawa State, Nigeria: a randomized controlled trail. Texila Int J Public Health. 2021;9(1):197–211. doi 10.21522/tijph.2013.09.01.art020
42. Ndhlovu CE, Kouamou V, Nyamayaro P, Dougherty L, Willis N, Ojikutu BO, et al. The transient effect of a peer support intervention to improve adherence among adolescents and young adults failing antiretroviral therapy in Harare, Zimbabwe: a randomized control trial. AIDS Res Ther. 2021;18(1):1-11. https://doi.org/10.1186/s12981-021-00356-w
43. Ahonkhai AA, Pierce LJ, Mbugua S, Wasula B, Owino S, Nmoh A, et al. PEERNaija: a gamified mhealth behavioral intervention to improve adherence to antiretroviral treatment among adolescents and young adults in Nigeria. Front Reprod Health. 2021;3:1-14. https://doi.org/10.3389/frph.2021.656507

44. Xiong S, Peoples N, Østbye T, Olsen M, Zhong X, Wainaina C, et al. Family support and medication adherence among residents with hypertension in informal settlements of Nairobi, Kenya: a mixed-method study. J Hum Hypertens. 2022;37(1):74–79. https://doi.org/10.1038/s41371-022-00656-2
45. Jackson IL, Okonta JM, Ukwe CV. HIV- and hypertension-related knowledge and medication adherence in HIV seropositive persons with hypertension. J Public Health. 2022;44(1):e79–e87. https://doi.org/10.1093/pubmed/fdaa221
46. Geneti Y, Wondwossen K, Adimasu M, Deressa D, Lami FAM, Abdisa L, et al. Adherence to diabetes self-management and its associated factors among adolescents living with type 1 diabetes at public hospitals in Addis Ababa, Ethiopia: a cross-sectional study. Diabetes Metab Syndr Obes. 2022;15:659–70. https://doi.org/10.2147/DMSO.S350168
47. Olagbemide OJ, Omosanya OE, Ayodapo AO, Agboola SM, Adeagbo AO, Olukokun TA. Family support and medication adherence among adult type 2 diabetes: any meeting point? Ann Afr Med. 2021;20(4):282-287. https://doi.org/10.4103/aam.aam_62_20
48. Agidew E, Wale MZ, Kerebih H, Yirsaw MT, Zewdie TH, Girma M, et al. Adherence to diabetes self-care management and associated factors among people with diabetes in Gamo Gofa Zone public health hospitals. SAGE Open Med. 2021;9:205031212110539. https://doi.org/10.1177/20503121211053953
49. Tusubira AK, Nalwadda CK, Akiteng AR, Hsieh E, Ngaruiya C, Rabin TL, et al. Social support for self-care: patient strategies for managing diabetes and hypertension in rural Uganda. Ann Glob Health. 2021;87(1):86. https://doi.org/10.5334/aogh.3308
50. Booysen F, de Walque D, Over M, Hashimoto S, de Reuck C. A randomized control trial of a peer adherence and nutritional support program for public sector antiretroviral patients. 2016. https://doi.org/10.1596/1813-9450-7760
51. Vedanthan R, Kamano JH, Chrysanthopoulou SA, Mugo R, Andama B, Bloomfield GS, et al. Group medical visit and microfinance intervention for patients with diabetes or hypertension in Kenya. J Am Coll Cardiol. 2021;77(16):2007–18. https://doi.org/10.1016/j.jacc.2021.03.002
52. Masupe T, Onagbiye S, Puoane T, Pilvikki A, Alvesson HM, Delobelle P. Diabetes self-management: a qualitative study on challenges and solutions from the perspective of South African patients and health care providers. Glob Health Action. 2022;15(1):2090098. https://doi.org/10.1080/16549716.2022.2090098
53. Steward WT, Agnew E, de Kadt J, Ratlhagana MJ, Sumitani J, Gilmore HJ, et al. Impact of SMS and peer navigation on retention in HIV care among adults in South Africa: results of a three-arm cluster randomized controlled trial. J Int AIDS Soc. 2021;24(8):e25774. https://doi.org/10.1002/jia2.25774
54. Sunpath H, Pillay S, Hatlen TJ, Murphy RA, Marconi VC, Moosa MYS, et al. A nurse-led intervention to improve management of virological failure in public sector HIV clinics in Durban, South Africa: a pre- and post-implementation evaluation. S Afr Med J. 2021;111(4):299. https://doi.org/10.7196/SAMJ.2021.v111i4.15432
55. Hoffman RM, Moyo C, Balakasi KT, Siwale Z, Hubbard J, Bardon A, et al. Multimonth dispensing of up to 6 months of antiretroviral therapy in Malawi and Zambia (INTERVAL): a cluster-randomised, non-blinded, non-inferiority trial. Lancet Glob Health. 2021;9(5):e628–38. https://doi.org/10.1016/S2214-109X(21)00039-5
56. Leon N, Namadingo H, Bobrow K, Cooper S, Crampin A, Pauly B, et al. Intervention development of a brief messaging intervention for a randomised controlled trial to improve diabetes treatment adherence in sub-Saharan Africa. BMC Public Health. 2021;21(1):147. https://doi.org/10.1186/s12889-020-10089-6
57. Bor J, Kluberg SA, Lavalley MP, Evans D, Hirasen K, Maskew M, et al. One pill, once a day: simplified treatment regimens and retention in HIV care. Am J Epidemiol. 2022;191(6):999–1008. https://doi.org/10.1093/aje/kwac006
58. Rattine-Flaherty E, Burton S. The role of pharmacy personnel in promoting adherence to antiretroviral therapy in the Eastern Cape: communication barriers and breakthroughs. Afr J AIDS Res. 2021;20(2):165–71. https://doi.org/10.2989/16085906.2021.1925310
59. Sonday F, Bheekie A, van Huyssteen M. Pharmacist-led medication therapy management of diabetes club patients at a primary healthcare clinic in Cape Town, South Africa: a retrospective and prospective audit. S Afr Med J. 2022;12(6):437–45. https://doi.org/10.7196/SAMJ.2022.v112i6.16247
60. Fatti G, Ngorima-Mabhena N, Tiam A, Tukei BB, Kasu T, Muzenda T, et al. Community-based differentiated service delivery models incorporating multimonth dispensing of antiretroviral treatment for newly stable people living with HIV receiving single annual clinical visits: a pooled analysis of two cluster-randomized trials in southern Africa. J Int AIDS Soc. 2021;24(S6):e25819. https://doi.org/10.1002/jia2.25819
61. Grimsrud A, Lesosky M, Kalombo C, Bekker LG, Myer L. Community-based adherence clubs for the management of stable antiretroviral therapy patients in Cape Town, South Africa: a cohort study. J Acquir Immune Defic Syndr. 2016;71(1):e16–e23. https://doi.org/10.1097/QAI.0000000000000863
62. Swartz A, Maughan-Brown B, Perera S, Harrison A, Kuo C, Lurie MN, et al. "The Money, It's OK but It's not OK": patients' and providers' perceptions of the acceptability of cash incentives for HIV treatment initiation in Cape Town, South Africa. AIDS Behav. 2022;26(1):116–22. https://doi.org/10.1007/s10461-021-03355-0
63. Lopes J, Grimwood A, Ngorima-Mabhena N, Tiam A, Tukei BB, Kasu T, et al. Out-of-facility multimonth dispensing of antiretroviral treatment: a pooled analysis using individual patient data from cluster-randomized trials in Southern Africa. J Acquir Immune Defic Syndr. 2021;88(5):477–86. https://doi.org/10.1097/QAI.0000000000002797
64. Rencken CA, Harrison AD, Mtukushe B, Bergam S, Pather A, Sher R, et al. "Those people motivate and inspire me to take my treatment." Peer support for adolescents living with HIV in Cape Town, South Africa. J Int Assoc Provid AIDS Care. 2021;20:232595822110005. https://doi.org/10.1177/23259582211000525
65. Katz IT, Bogart LM, Fitzmaurice GM, Staggs VS, Gwadz MV, Bassett IV, et al. The Treatment Ambassador Program: a highly acceptable and feasible community-based peer intervention for South Africans living with HIV who delay or discontinue antiretroviral therapy. AIDS Behav. 2021;25(4):1129–43. https://doi.org/10.1007/s10461-020-03063-1
66. Gilbert HN, Wyatt MA, Pisarski EE, Asiimwe S, van Rooyen H, Seeley J, et al. How community ART delivery may improve HIV treatment outcomes: qualitative inquiry into mechanisms of effect in a randomized trial of community-based ART initiation, monitoring and re-supply (DO ART) in South Africa and Uganda. J Int AIDS Soc. 2021;24(10):e25821. https://doi.org/10.1002/jia2.25821
67. van Loggerenberg F, Grant AD, Naidoo K, Murrman M, Gengiah S, Gengiah TN, et al. Individualised motivational counselling to enhance adherence to antiretroviral therapy is not superior to didactic counselling in South African patients: findings of the CAPRISA 058 randomised controlled trial. AIDS Behav. 2015;19(1):145–56. https://doi.org/10.1007/s10461-014-0763-6
68. McCoy SI, Njau PF, Fahey C, Kapologwe N, Kadiyala S, Jewell NP, et al. Cash vs. food assistance to improve adherence to antiretroviral therapy among HIV-infected adults in Tanzania. AIDS. 2017;31(6):815–25. https://doi.org/10.1097/QAD.0000000000001406
69. Affusim C, Francis E. The influence of family/social support on adherence to diabetic therapy. Int J Adv Sci Res Eng. 2018;4(5):71–80. doi 10.31695/ijasre.2018.32712
70. Venables E, Edwards JK, Baert S, Etienne W, Khabala K, Bygrave H. "They just come, pick and go." The acceptability of integrated medication adherence clubs for HIV and non communicable disease (NCD) patients in Kibera, Kenya. PLoS One. 2016;11(10):e0164634. https://doi.org/10.1371/journal.pone.0164634
71. Olowookere AJ, Olowookere SA, Talabi AO, Etonyeaku A, Adeleke OE, Akinboboye OO. Perceived family support and factors influencing medication adherence among hypertensive patients attending a Nigerian tertiary hospital. Ann Trop Med Public Health. 2015;8(6):241. https://doi.org/10.4103/1755-6783.162668
72. Tirivayi N, Koethe JR, Groot W. Clinic-based food assistance is associated with increased medication adherence among HIV-infected adults on long-term antiretroviral therapy in Zambia. J AIDS Clin Res. 2012;3(7):171. https://doi.org/10.4172/2155-6113.1000171
73. Adedigba S, Dankyau M. Role of family support in medication adherence in type 2 diabetes mellitus patients at an outpatient setting in Nigeria: a prospective cohort study. Int J Med Surg Sci. 2019;5(3):100–105. doi 10.32457/ijmss.2018.025
74. Iloh GP, Amadi A. Family support, medication adherence and glycaemic control among ambulatory type 2 diabetic Nigerians in a primary care clinic in Eastern Nigeria. J Health Res Rev. 2018;5(2):71. https://doi.org/10.4103/jhrr.jhrr_121_16
75. Nachega JB, Knowlton AR, Deluca A, Schoeman JH, Watkinson L, Efron A, et al. Treatment supporter to improve adherence to antiretroviral therapy in HIV-infected South African adults: a qualitative study. J Acquir Immune Defic Syndr. 2006;43(SUPPL. 1):S127–33. https://doi.org/10.1097/01.qai.0000248349.25630.3d
76. Stubbs BA, Micek MA, Pfeiffer JT, Montoya P, Gloyd S. Treatment partners and adherence to HAART in Central Mozambique. AIDS Care. 2009;21(11):1412–19. https://doi.org/10.1080/09540120902814395
77. Nnodimele Onuigbo ATULOMAH. Effects of two health education interventions on adherence to antihypertensive medication and on blood pressure in selected tertiary health facilities in Southwestern Nigeria. University of Ibadan; 2014.
78. Olorunfemi O, Chukwurah MN, Agbo David I. Effect of health literacy on medication adherence among diabetic patients. Int J Med Health Sci. 2018;7(3):130-33.

79. Kaguiri CE. Role of social support on adherence to antiretroviral therapy among patients attending AMPATH clinic at Moi Teaching and Referral Hospital, Eldoret, Kenya. Moi University; 2014.
80. Audet CM, Salato J, Vermund SH, Amico KR. Adapting an adherence support workers intervention: engaging traditional healers as adherence partners for persons enrolled in HIV care and treatment in rural Mozambique. Implement Sci. 2017;12(1):50. https://doi.org/10.1186/s13012-017-0582-z
81. Kamau TM, Olsen VG, Zipp GP, Clark M. The effectiveness of social resource intervention to promote adherence to HIV medication in a multidisciplinary care setting in Kenya. Int J STD AIDS. 2012;23(12):843–48. https://doi.org/10.1258/ijsa.2012.011472
82. Ouansafi I, Chibanda D, Munetsi E, Simms V. Impact of Friendship Bench problem-solving therapy on adherence to ART in young people living with HIV in Zimbabwe: a qualitative study. PLoS One. 2021;16:e0250074. https://doi.org/10.1371/journal.pone.0250074
83. Jones ASK, Coetzee B, Kagee A, Fernandez J, Cleveland E, Thomas M, et al. The use of a brief, active visualisation intervention to improve adherence to antiretroviral therapy in non-adherent patients in South Africa. AIDS Behav. 2019;23(8):2121–29. https://doi.org/10.1007/s10461-018-2292-1
84. Abdalla A. Effect of health education intervention in the management of type-II diabetes mellitus among adults attending Garissa County Referral Hospital, Kenya. Kenyatta University; 2022.
85. Ajuna N, Tumusiime B, Amanya J, Awori S, Rukundo GZ, Asiimwe JB. Social networks and barriers to ART adherence among young adults (18–24 years) living with HIV at selected primary health facilities of southwestern Uganda: a qualitative study. HIV/AIDS—Res Palliat Care. 2021;13:939–58. https://doi.org/10.2147/HIV.S328643
86. Mash RJ, Rhode H, Zwarenstein M, Rollnick S, Lombard C, Levitt N, et al. Research: educational and psychological issues effectiveness of a group diabetes education programme in under-served communities in South Africa: a pragmatic cluster randomized controlled trial. Diabet Med. 2014;31:987–93.
87. Tirivayi N, Koethe JR, Groot W. Food assistance and its effect on the antiretroviral therapy adherence, weight and immune recovery of HIV infected adults: evidence from Zambia. 2010. [Cited 2023 Apr 17]. Available from: https://www.academia.edu/386688/Food_Assistance_and_its_effect_on_the_Antiretroviral_Therapy_Adherence_Weight_and_Immune_Recovery_of_HIV_Infected_Adults_Evidence_from_Zambia
88. O'Laughlin KN, Wyatt MA, Kaaya S, Bangsberg DR, Ware NC. How treatment partners help: social analysis of an African adherence support intervention. AIDS Behav. 2012;16(5):1308–15. https://doi.org/10.1007/s10461-011-0038-4
89. Ivanova O, Wambua S, Mwaisaka J, Bossier T, Thiongo M, Michielsen K, et al. Evaluation of the ELIMIKA pilot project: improving ART adherence among HIV positive youth using an eHealth intervention in Mombasa, Kenya. Afr J Reprod Health. 2019;23(1):100–110. doi 10.29063/AJRH2019/V23I1.10
90. Kunutsor S, Walley J, Katabira E, Muchuro S, Balidawa H, Namagala E, et al. Improving clinic attendance and adherence to antiretroviral therapy through a treatment supporter intervention in Uganda: a randomized controlled trial. AIDS Behav. 2011;15(8):1795–802. https://doi.org/10.1007/s10461-011-9927-9
91. Dzansi G. Integrated mobile phone interventions for adherence to antiretroviral treatment in clients with HIV infection in Accra, Ghana. University of the Western Cape; 2017.
92. Fox MP, Berhanu R, Steegen K, Firnhaber C, Ive P, Spencer D, et al. Intensive adherence counselling for HIV-infected individuals failing second-line antiretroviral therapy in Johannesburg, South Africa. Trop Med Int Health. 2016;21(9):1131–37. https://doi.org/10.1111/tmi.12741
93. Kinyua FM. Internet and cell phone as tools to support antiretroviral therapy adherence among HIV infected patients aged above 18 years attending Kenyatta National Hospital. Jomo Kenyatta University of Agriculture and Technology; 2015.
94. Rouhani SA, O'Laughlin KN, Faustin ZM, Tsai AC, Kasozi J, Ware NC. The role of social support on HIV testing and treatment adherence: a qualitative study of HIV-infected refugees in southwestern Uganda. Glob Public Health. 2017;12(8):1051–64. https://doi.org/10.1080/17441692.2015.1132472
95. Sarna AS, Luchters S, Geibel P, Munyao S, Kaai K, Shikely K, et al. Promoting adherence through a directly administered antiretroviral therapy strategy in Mombasa, Kenya [Internet]. Horizons Research Update. 2005. [Cited 2023 Apr 17]. Available from: https://pdf.usaid.gov/pdf_docs/PNADE941.pdf
96. Maduka O. The effect of adherence counselling and short message sending (SMS) reminders on adherence to treatment in clients on highly active antiretroviral therapy in Rivers State. National Postgraduate Medical College; 2011.
97. Mwale OG, Kamera H. The effect of home follow up visit in enhancing antiretroviral therapy adherence among HIV and AIDS patient in a rural setting, Malawi; an operational evaluation quantitative descriptive study. J Prev Treat HIV/AIDS. 2016;1(1):21311
98. Xiong S. The relationship between family support and medication adherence among hypertensive patients in Kenya. Duke Kunshan University and Duke University; 2018.
99. Wouters E, Masquillier C, Ponnet K, le Roux Booysen F. A peer adherence support intervention to improve the antiretroviral treatment outcomes of HIV patients in South Africa: the moderating role of family dynamics. Soc Sci Med. 2014;113:145–53. https://doi.org/10.1016/j.socscimed.2014.05.020
100. Orrell C, Cohen K, Mauff K, Bangsberg DR, Maartens G, Wood R. A randomized controlled trial of real-time electronic adherence monitoring with text message dosing reminders in people starting first-line antiretroviral therapy. J Acquir Immune Defic Syndr. 2015;70(5):495–502.
101. Moyer E. Peer mentors, mobile phone and pills: collective monitoring and adherence in Kenyatta National Hospital's HIV treatment programme. Anthropol Med. 2014;21(2):149–61. https://doi.org/10.1080/13648470.2014.925083
102. Tadesse H, Toma A. Nutritional treatment outcomes of therapeutic feeding program and its predictors among HIV patients at Hawassa University Comprehensive Specialized Hospital, Hawassa City, Sidama, Southern Ethiopia: a retrospective cohort study. HIV/AIDS—Res Palliat Care. 2023;15:83–93. https://doi.org/10.2147/HIV.S395936
103. Kivuyo S, Birungi J, Okebe J, Wang D, Ramaiya K, Ainan S, et al. Integrated management of HIV, diabetes, and hypertension in sub-Saharan Africa (INTE-AFRICA): a pragmatic cluster-randomised, controlled trial. Lancet. 2023;402(10409):1241–50. https://doi.org/10.1016/S0140-6736(23)01573-8
104. Mulawa MI, Mtukushe B, Knippler ET, Matiwane M, Al-Mujtaba M, Muessig KE, et al. Supporting adolescents with HIV in South Africa through an adherence-supporting app: mixed methods beta-testing study. JMIR Form Res. 2023;7:e47575. https://doi.org/10.2196/47575
105. Ware NC, Pisarski EE, Tam M, Wyatt MA, Atukunda E, Musiimenta A, et al. The meanings in the messages: how SMS reminders and real-time adherence monitoring improve antiretroviral therapy adherence in rural Uganda. AIDS. 2016;30(8):1287–93. https://doi.org/10.1097/QAD.0000000000001035
106. Kizito S, Nabayinda J, Neilands TB, Kiyingi J, Namuwonge F, Damulira C, et al. A structural equation model of the impact of a family-based economic intervention on antiretroviral therapy adherence among adolescents living with HIV in Uganda. J Adolesc Health. 2023;72(5):S41–S50. https://doi.org/10.1016/j.jadohealth.2022.12.012
107. Haas AD, Kunzekwenyika C, Manzero J, Hossmann S, Limacher A, Van Dijk JH, et al. Effect of the Friendship Bench intervention on antiretroviral therapy outcomes and mental health symptoms in rural Zimbabwe: a cluster randomized trial. JAMA Netw Open. 2023;6(7):e2323205. https://doi.org/10.1001/jamanetworkopen.2023.23205
108. Hanrahan CF, Schwartz SR, Mudavanhu M, West NS, Mutunga L, Keyser V, et al. The impact of community- versus clinic-based adherence clubs on loss from care and viral suppression for antiretroviral therapy patients: findings from a pragmatic randomized controlled trial in South Africa. PLoS Med. 2019;16(5):e1002808. https://doi.org/10.1371/journal.pmed.1002808
109. Sapkota S, Brien JA, Greenfield J, Aslani P. A systematic review of interventions addressing adherence to anti-diabetic medications in patients with type 2 diabetes—impact on adherence. PLoS One. 2015;10:e0118296. https://doi.org/10.1371/journal.pone.0118296
110. Ogungbe O, Byiringiro S, Adedokun-Afolayan A, Seal SM, Himmelfarb CRD, Davidson PM, et al. Medication adherence interventions for cardiovascular disease in low- and middle-income countries: a systematic review. Patient Prefer Adherence. 2021;15:885–97. https://doi.org/10.2147/PPA.S296280
111. Yew SQ, Zulkifley NH, Mohd Nazan AIN. A review of the effectiveness of interventions on medication adherence among hypertension patients. Malaysian J Med Health Sci. 2020;16:325-32.
112. Kharsany ABM, Karim QA. HIV infection and AIDS in sub-Saharan Africa: current status, challenges and opportunities. Open AIDS J. 2016;10(1):34–48. https://doi.org/10.2174/1874613601610010034
113. Yuyun MF, Sliwa K, Kengne AP, Mocumbi AO, Bukhman G. Cardiovascular diseases in sub-Saharan Africa compared to high-income countries: an epidemiological perspective. Glob Heart. 2020;15(1):15. https://doi.org/10.5334/GH.403
114. Scanlon ML, Vreeman RC. Current strategies for improving access and adherence to antiretroviral therapies in resource-limited settings. HIV/AIDS—Res Palliat Care. 2013;5:1–17. https://doi.org/10.2147/HIV.S28912
115. Otiso L, McCollum R, Mireku M, Karuga R, De Koning K, Taegtmeyer M. Decentralising and integrating HIV services in community-based health systems: a qualitative study of perceptions at macro, meso and micro levels of the health system. BMJ Glob Health. 2017;2(1):e000107. https://doi.org/10.1136/bmjgh-2016-000107
116. Denton M, Brookman C, Zeytinoglu I, Plenderleith J, Barken R. Task shifting in the provision of home and social care in Ontario, Canada: implications for qual-

ity of care. Health Soc Care Community. 2015;23(5):485–92. https://doi.org/10.1111/hsc.12168
117. Mahmood A, Kedia S, Wyant DK, Ahn SN, Bhuyan SS. Use of mobile health applications for health-promoting behavior among individuals with chronic medical conditions. Digit Health. 2019;5:205520761988218. https://doi.org/10.1177/2055207619882181
118. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. Lancet Glob Health. 2018;6:e1196–252 https://doi.org/10.1016/S2214-109X(18)30386-3
119. Damulak PP, Ismail S, Manaf RA, Said SM, Agbaji O. Interventions to improve adherence to antiretroviral therapy (ART) in sub-Saharan Africa: an updated systematic review. Int J Environ Res Public Health. 2021;18:2477. https://doi.org/10.3390/ijerph18052477
120. Knight L, Mukumbang FC, Schatz E. Behavioral and cognitive interventions to improve treatment adherence and access to HIV care among older adults in sub-Saharan Africa: an updated systematic review. Syst Rev. 2018;7(1):114.
121. Conn VS, Ruppar TM, Enriquez M, Cooper PS. Patient-centered outcomes of medication adherence interventions: systematic review and meta-analysis. Value Health. 2016;19:277–85. https://doi.org/10.1016/j.jval.2015.12.001
122. Fernandez-Lazaro CI, García-González JM, Adams DP, Fernandez-Lazaro D, Mielgo-Ayuso J, Caballero-Garcia A, et al. Adherence to treatment and related factors among patients with chronic conditions in primary care: a cross-sectional study. BMC Fam Pract. 2019;20(1). https://doi.org/10.1186/s12875-019-1019-3
123. Danielson E, Melin-Johansso C, Modanloo M. Adherence to treatment in patients with chronic diseases: from alertness to persistence. Int J Community Based Nurs Midwifery. 2019;7(4):248-57. doi 10.30476/IJCBNM.2019.81303.0
124. McEvoy CT, Moore SE, Appleton KM, Cupples ME, Erwin C, Kee F, et al. Development of a peer support intervention to encourage dietary behaviour change towards a Mediterranean diet in adults at high cardiovascular risk. BMC Public Health. 2018;18(1). https://doi.org/10.1186/s12889-018-6108-z

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