Measuring patient engagement with HIV care in sub-Saharan Africa: a scoping study

Claire M. Keene1,§, Ayesha Ragunathan1, Jonathan Euvrard2, Mike English1, Jacob McKnight1, Catherine Orrell3 and the InCARE Stakeholder Group*

§Corresponding author: Claire M. Keene, Health Systems Collaborative, Oxford Centre for Global Health Research, Nuffield Department of Medicine, University of Oxford, Oxford, OX1 3SY, United Kingdom. (clairekeene@gmail.com)

*Members are listed in the Supporting Information.

Abstract

Introduction: Engagement with HIV care is a multi-dimensional, dynamic process, critical to maintaining successful treatment outcomes. However, measures of engagement are not standardized nor comprehensive. This undermines our understanding of the scope of challenges with engagement and whether interventions have an impact, complicating patient and programme-level decision-making. This study identified and characterized measures of engagement to support more consistent and comprehensive evaluation.

Methods: We conducted a scoping study to systematically categorize measures the health system could use to evaluate engagement with HIV care for those on antiretroviral treatment. Key terms were used to search literature databases (Embase, PsychINFO, Ovid Global-Health, PubMed, Scopus, CINAHL, Cochrane and the World Health Organization Index Medicus), Google Scholar and stakeholder-identified manuscripts, ultimately including English evidence published from sub-Saharan Africa from 2014 to 2021. Measures were extracted, organized, then reviewed with key stakeholders.

Results and discussion: We screened 14,885 titles/abstracts, included 118 full-texts and identified 110 measures of engagement, categorized into three engagement dimensions ("retention," "adherence" and "active self-management"), a combination category ("multi-dimensional engagement") and "treatment outcomes" category (e.g. viral load as an end-result reflecting that engagement occurred). Retention reflected status in care, continuity of attendance and visit timing. Adherence was assessed by a variety of measures categorized into primary (prescription not filled) and secondary measures (medication not taken as directed). Active self-management reflected involvement in care and self-management. Three overarching use cases were identified: research to make recommendations, routine monitoring for quality improvement and strategic decision-making and assessment of individual patients.

Conclusions: Heterogeneity in conceptualizing engagement with HIV care is reflected by the broad range of measures identified and the lack of consensus on "gold-standard" indicators. This review organized metrics into five categories based on the dimensions of engagement; further work could identify a standardized, minimum set of measures useful for comprehensive evaluation of engagement for different use cases. In the interim, measurement of engagement could be advanced through the assessment of multiple categories for a more thorough evaluation, conducting sensitivity analyses with commonly used measures for more comparable outputs and using longitudinal measures to evaluate engagement patterns. This could improve research, programme evaluation and nuanced assessment of individual patient engagement in HIV care.

Keywords: adherence; engagement; evaluation; measure; retention; self-management

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

1 INTRODUCTION

With the increasing number of people initiated on antiretroviral therapy (ART) through the “universal test-and-treat” strategy, gaps in service provision are likely to shift from access to treatment to long-term engagement with HIV care as the key modifiable mediator of treatment success [1], making the evaluation of engagement crucial to ensuring that the approach to the HIV epidemic is relevant and responds to the realities of people’s experiences.
Methods

Search strategy and selection of the evidence

Study design

A scoping study was conducted to map, summarize and categorize measures of engagement with HIV care (defined as all aspects of care for people who have initiated ART) in sub-Saharan Africa, from a health service delivery perspective (i.e. dimensions that can realistically be measured by the health system). A scoping study was selected to synthesize knowledge as there is a large volume of heterogeneous literature on this topic [34]. It followed the ‘Arksey and O’Malley’ framework [35] with the adaptations proposed by Levac et al. [36], and used the Joanna Briggs Institute guidance on conducting and reporting scoping reviews [37]. The protocol was registered on the Open Science Framework registry [38].
Table 1. Summary of the search parameters and limits as well as the final inclusion and exclusion criteria [35], categorized according to the “population, context, concept” search framework [40]

| Search parameters and limits | Inclusion | Exclusion |
|-----------------------------|-----------|-----------|
| N/A | Published in English | Published in languages other than English |
| N/A | Published between the start of 2014 and when the search was conducted in February 2021 | Published before 2014 |
| N/A | Evidence from sub-Saharan African settings | High-resource settings and countries outside of sub-Saharan Africa |

**Eligibility**

| Literature | Peer-reviewed publications, conference abstracts, guidance documents and reports, and systematic reviews with a pooled estimate | Letters, commentaries, editorials, opinion pieces and case reports |
| Population | Patients on lifelong ART or who have initiated ART previously (includes PMTCT option B+) | Pre-ART initiation or people on pre or post exposure prophylaxis |
| Adults ≥18 years old, including young adults and the elderly | Children and adolescent populations (included if adults 18 years and above are covered as well) |
| Context | Routine primary care or outpatient HIV clinic setting (including within a hospital setting). Includes measurement of engagement with HIV care within a trial setting | Hospital inpatient services or engagement with trials and research specifically |
| Concept | Measurement of engagement | Primary focus on associations of factors with an element of engagement or evaluation of an intervention, without defining the engagement element or explicitly stating how it is measured |
| Engagement | -Retention in services, adherence to treatment and active self-management of care, as outlined by the InCARE framework | Focus on outcomes not related to ART success |
| Measurement | -Primary purpose of the research was to evaluate, validate or compare measures of engagement, report on the performance of metrics or evaluate their association with ART-related outcomes (such as virologic suppression, quality of life or drug resistance) | |
| | -Used more than one metric for engagement and explicitly discussed this, compared them or combined them in a novel measure of engagement | |
| | -Explicitly described, discussed or defined the measure of engagement, discussed proposed adjustments or explained how engagement was measured were included | |
| | A lower threshold for inclusion was used for those that did not evaluate the measure but increased the scope of measures of engagement identified | |

sources that increased the scope of engagement measures identified.

### 2.3 Data extraction, charting and synthesis

The data extracted from each literature source included study information (including the year of publication, country, setting, participant characteristics and methods) and information on the measures of engagement (including information on the measure, such as definition, data collection, calculation and interpretation; evaluation of the measure’s performance in predicting treatment outcomes; and how the measure was used or recommended to be used—Table S3). The extracted data were combined and organized by individual measure and categorized according to the retention, adherence and active self-management dimensions of the InCARE framework (Figure 1) [39].

### 2.4 Stakeholder input

Stakeholder engagement is suggested as useful to add methodological rigour to scoping studies [36], thus the search terms, analysis and interpretation of the results were informed by feedback from the InCARE Stakeholder
Figure 1. Indicators of HIV Care for Antiretroviral Engagement (InCARE) framework, used to direct the search and categorization stages of the scoping study for measures of engagement with HIV care in sub-Saharan Africa [39], drawing from multiple definitions of retention [5, 42, 43], adherence [44, 45], active self-management [24, 46, 47] and treatment outcomes [48–50].

Group: 13 stakeholders, including HIV clinicians, academic researchers, programme implementers and Department of Health managers, with experience in sub-Saharan Africa. The results presented include the stakeholder input.

3 | RESULTS AND DISCUSSION

The main search was conducted on 17 February 2021. The results of the search and the study inclusion process are reported in Figure 2 according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram [54].

3.1 | Characteristics of the evidence sources

After screening, 118 sources were included for analysis (Table S4). Cross-sectional studies (35%) and cohort studies (36% prospective and retrospective combined) were the most commonly represented study types. Case controls, mixed methods, randomized and non-randomized controlled trials, secondary analyses, modelling studies and systematic reviews made up the remaining 29% of sources. Most (69%) of the included studies evaluated the measure in some way, with 50% of the evidence directly evaluating the measure of engagement as the primary focus of the study.

Included evidence reflected research conducted in 19 individual countries in sub-Saharan Africa. Nearly a third of the evidence involved participants from South Africa, with higher proportions from English-speaking countries in southern and east Africa. Four sources had “global” multi-country cohorts, which included sub-Saharan African countries.

3.2 | Identified measures of engagement

In total, 145 measures of engagement were extracted. After categorizing the measures and refining the framing of engagement with stakeholder input, 35 measures were removed as they were not felt to reflect engagement itself but rather factors affecting it (Table S5).

The remaining 110 measures of engagement were categorized by the element of engagement that they most strongly portrayed or were developed to reflect, and subsequently mapped onto the InCARE framework (Table 2). Some measures evaluated multiple dimensions of engagement or treatment outcomes as a summary measure that the engagement process had taken place. A full list of measures with information about their definition, duration and pattern of measurement, data collection, processing and evaluation (strengths, limitations and evidence for association with outcomes or other elements of engagement) can be found in the Tables S6–S10.

3.3 | Identified use cases

The situations in which measures of engagement were used or recommended to be useful were noted for each study (Table S4). The categories of use cases were reviewed with stakeholders and the final categorization is presented in Table 3. It was noted that measures may be useful in an ideal...
3.4 | Overview of results

While it is widely accepted that "engagement in care" is critical to achieve treatment success in ART programmes [154–156], there is little clarity on how best to measure it. This study scoped how health services and researchers measure HIV care engagement in sub-Saharan Africa. It attempts to improve standardization of the measurement of engagement by identifying and collating information on 110 measures reflecting retention in care, medication adherence, active self-management, multi-dimensional engagement and treatment outcomes. In addition, this study categorized the purpose of measurement into three over-arching use cases. Some of the challenges and considerations in measuring engagement encountered in the course of this scoping study are outlined and recommendations on evaluating engagement with this evidence are made.

3.5 | Use cases

Ultimately, the most appropriate measure depends on the intended purpose of the evaluation [22]. The use cases overlap with the dimensions of engagement with HIV care: different measures are suited to provide the depth of knowledge required to answer different questions, justifying varying burdens of data collection and analysis. If the purpose is to evaluate engagement at a population or programme level for quality improvement or to make strategic policy decisions [157], inexact estimates of retention and viral suppression (treatment outcome) may be sufficient to infer credible conclusions, allowing directional decisions to be made [59].

As the gaps in service provision shift from simple treatment availability issues to the complex maintenance of engagement over time [1], more subtle interventions tailoring support to people's specific needs are required [16]. If the purpose of measurement is research to make causal inferences, more in-depth evaluation is needed: to develop nuanced interventions, understand the mechanisms of their impact and make decisions on implementation [20, 21].
Table 2. Identified measures of patient engagement with HIV care, categorised according to the InCARE framework’s dimensions of engagement

| Engagement with services | Engagement with treatment | Engagement with both services and treatment |
|--------------------------|---------------------------|------------------------------------------|
| **Retention (n=18)**     | **Adherence (n=59)**      | **Active self-management (n=18)**          |
| **In care (n=5)**        | Primary adherence (n=5)   | Active involvement (n=4)                    |
| Visit attendance         | (prescription filled)     | Laboratory results (n=5)                    |
| Average retention        | Pharmacy refill (n=5)     | · Viral suppression                         |
| Engagement in care index | · Pharmacy visit compliance/  | · Sustained low level viraemia              |
| Fixed point retention    | crude pharmacy interval   | · CD4 change                                |
| Re-engagement retention  | · Medication possession ratio (MPR) | · CD4 trajectory                           |
| Continuity (n=7)         | · Poor adherence proportion| · Antiretroviral resistance                 |
| · Visit gap/ treatment interruption | · Sustained poor adherence | | |
| · Visit constancy        | · Pharmacy refill gaps    | | |
| · The Health Resources and Services Administration | | | |
| · Continually retained  | | | |
| · Inter-agency Task Team (IATT) definition | | | |
| · Visit pattern          | | | |
| · Retention trajectory   | | | |
| **Timing of retention (n=3)** | | Quality of life and health status (n=3) |
| · Late for visit         | | · HIV mortality                           |
| · Time to loss to follow-up | | · HIV specific quality of life            |
| · Appointment intervals  | | · Self-reported health status             |
| **Composites of retention measures (n=3)** | | | |
| · Point retention and missed visits | | | |
| · Point retention and average retention | | | |
| · On time adherence retention | | | |
| **Laboratory tests (n=5)** | | | |
| · Haemoglobin            | | | |
| · Mean cellular volume (MCV) difference | | | |
| · Bilirubin              | | | |
| · Cathespin              | | | |
| · Resistance detection of intermittent engagement | | | |
| **Healthcare-worker-assessed measures (n=2)** | | | |
| · Clinician-recorded adherence | | | |
| · Directly observed therapy (DOTs) | | | |
| **Pill counts (n=5)**    | | | |
| · Electronic medication event monitoring system (MEMS) | | | |
| · Adherence trajectory by MEMS | | | |
| · Healthcare worker pill counts | | | |
| · Pill count variance    | | | |
| · Over-adherence by pill count | | | |
| **Self-reported quantification of pill-taking through recall (n=13)** | | | |
| · Visual analogue scale (VAS) | | | |
| · Self-reported ART interruption | | | |
| · Weekend recall         | | | |
| · Two-day recall         | | | |
| · Three-day recall       | | | |
| · Four-day recall        | | | |
| · One week recall        | | | |
| · Two week recall        | | | |
| · Combined one to two week self-report | | | |
| · Recall since previous visit | | | |
| · Pill recall and interruption | | | |
| · Swiss HIV Cohort Study Adherence Questionnaire (SHCS-AQ) | | | |
| · Adherence trajectory by self-report | | | |
| **Self-reported timing (n=2)** | | | |
| · ART adherence while drinking pattern questionnaire | | | |
| **Schedule adherence**   | | | |
| · Multidimensional engagement (n=7) (composites of different elements of engagement) | | | |
| · Composite measure of engagement (adherence and retention) | | | |
| · Composite outcome of retention and viral suppression | | | |
| **Composite self-reports (n=13)** | | | |
| · Center for Adherence Support Evaluation (CASE) Index Score | | | |
| · Composite of recall and ability | | | |
| · 3 item self-report composite of ability and recall | | | |
| · South African National Department of Health Adherence Questionnaire | | | |
| · Pattern of adherence by self-report | | | |
| · VAS-SMAQ-FDR | | | |
| · VAS-SHCS-AQ | | | |
| · VAS-SMAQ-ID | | | |
| · Godin’s self-report | | | |
| · Adherence to Refills and Medication Scale (ARMS-7) | | | |
| · Simplified Medication Questionnaire (SMAQ) | | | |
| · Adult AIDS Clinical Trials Group (AACTG) adherence questionnaire | | | |
| · AACTG derivative | | | |
| **Composites of adherence measures (n=8)** | | | |
| · Global adherence | | | |
| · Composite adherence score (CAS) | | | |
| · MPR-pill recall | | | |
| · Composite of antiretroviral concentration and self-report | | | |
| · Behavioural adherence measure | | | |
| · Composite of pharmacy refill measures | | | |
| · CD4 stratified by MCV | | | |
| · On time – pill count | | | |

References for each measure are found in Supplementary material Tables 6-10 with the full information on the measures and the evidence associated with them.
Measures of retention or capture milestones before the point of analysis [6, 158], the pattern of attendance, reflect the continuity of care follow-up” (also termed “attrition”). However, it does not cap-
ture those lost to follow-up [88] without a visit. Different definitions can result in very 
different conclusions and the recall period can change the 
definition of loss to follow-up [6]. The dynamic nature of engage-
ment and the reality of people churning in and out of care are 
important considerations for both routine evaluation and bet-
ter understanding of interventions and individual management 
[66]. In one example, 54–98% were misclassified compared 
to a composite continuity of retention measure, depending on 
the definition of loss to follow-up [6].

Retention measures are also limited as they are gener-
ally calculated retrospectively: data sources poorly distinguish 
between the loss to follow-up and death [158] and often miss “silent transfers” between different facilities [158]. This can 
be addressed by following patients to evaluate alternate out-
comes and adjust estimates: either through tracing a sam-
ple [57], using weights from the literature [27, 134] or using 
national/combined databases to follow patients who move 
between facilities [3, 158]. However, all these approaches 
increase the burden of data collection, linkage and analysis, 
reducing their feasibility in practice.

Different sources of data demonstrated different strengths in estimating retention even within the same population: in 
one study, laboratory data underestimated the proportion 
retained compared with single clinic visit data, but the cen-
tralized system could evaluate retention across facilities to 
detect “silent transfers” [5]. Data can be triangulated to com-
 pense for the weaknesses of individual sources [78]: reten-
tion in care using “any evidence” of engagement (pharmacy, 
clinic visit or laboratory evidence) from all available sources 
was shown to produce a higher estimate of retention than

Table 3. Three overarching use cases and the nine specific applications for each found in the literature and reviewed with stake-
holders

| Overarching use case | Routine monitoring and evaluation of programmesa [2, 5, 13, 15, 22, 49, 55–71] | Individual patient evaluation [71–76] | Research to draw conclusions for recommendations |
|----------------------|-----------------------------------------------------------------|---------------------------------|-------------------------------------------------|
| Specific use case applications: | • Routine evaluation of engagement in patients in facility care [6, 61, 62, 77, 78] | • Rationalize resources, such as expensive genotype [33, 79–82] or viral load [50, 82–87] testing and resources to trace those lost to follow-up [88] | • Understanding the behaviour of people on ART [15, 21, 25, 63, 65, 89–118] |
| | • Routine evaluation of engagement in patients in differentiated service delivery models [49, 119] | • Flag patients early for intervention [57, 120–129] | • Identification of factors on which to intervene [4, 63, 65, 89, 90, 92, 93, 97, 101, 104, 106, 110, 111, 116, 130–133] |
| | • Routine evaluation of engagement in patients who struggle with care [134] | • Support and direct ART management decisions (through initiating conversations with patients or providing healthcare workers with information) [4, 9, 10, 45, 75, 86, 87, 135–139] | • Development and evaluation of interventions to support optimal engagement [24, 32, 133, 140–153] |

aAt facility and population levels for quality improvement and strategic decision-making.

Similarly, directing individual management needs a much more refined understanding of who has, or is likely to have, trouble engaging, in order to make good decisions about which intervention to implement for a particular patient [50].

3.6 Measures of retention

Retention measures reflected interactions with health ser-
wartens, evaluating whether a person was in care, the contin-
ynuity of the retention or the timing of the visit (lateness relative to a scheduled/expected visit). Retention measures can be derived from routine data [88] and simple mea-
sures like average retention (proportion of kept/expected vis-
its attended) make the evaluation of retention a pragmatic 
option to monitor HIV programmes [5]. Most retention mea-
sures were discussed in multiple sources, but multiple thresh-
olds within each measure reduced standardization as differ-
ent papers used different definitions of “retained” versus “not 
retained”/“lost to follow-up” (from 9 weeks [88] to 180 days 
[49] without a visit). Different definitions can result in very 
different conclusions and the recall period can change the 
measure of success, worsening the outcomes of more recent 
time periods [5]; highlighting the importance of being inten-
tional about how we measure retention for specific purposes 
[22].

Fixed point retention was one of the most ubiquitously 
used measures to consider people as “retained” or “lost to 
follow-up” (also termed “attrition”). However, it does not cap-
ture the pattern of attendance, reflect the continuity of care 
or capture milestones before the point of analysis [6, 158], 

the individual sources alone [5, 146]. Advancement and merging of electronic databases may facilitate the use of combined data sources and improve the quality of estimates of retention (and other measures of engagement) [6, 157], but require investment and thought to address issues around the protection of personal information.

3.7 | Measures of adherence

Measures of adherence made up more than half the identified metrics. These measures reflected primary (prescription filled) and secondary adherence (medication taken as directed) [55]. Assessing adherence is useful in research to understand engagement behaviour [160] and for individual management: particularly identifying the need for and directing interventions before virological failure is established [161], and for rationalizing expensive genotypic resistance testing for people failing second-line ART [79, 150]. These measures need to be conducted specifically to evaluate adherence, making them less suited to routine programme monitoring.

Many studies attempted to find or evaluate “more objective” measures of adherence to overcome the social desirability and recall biases associated with self-reported measures [4, 82, 93, 136], which may result in overestimation of adherence [10, 72, 84]. Some measures were considered more objective than self-reports [55, 62, 75, 79, 159], but even these remain indirect measures of behaviour taking place outside the facility [55]: laboratory tests use changes associated with ART as proxies [81, 87], pill counts measure whether pills were removed from the bottle rather than if they were taken [55] and pharmacy refills reflect a maximum possible level of adherence through ART on hand, leading to possible overestimation of “true” adherence [2, 93]. Antiretroviral concentrations were considered to quantify adherence independent of other influences such as resistance [10] and were often used as an “objective” gold standard to compare other measures of adherence against [160]. However, they were not consistently associated with viral outcomes [67, 72, 135].

The generally poor ability of adherence measures to detect viral non-suppression was demonstrated in a recent Cochrane review, which found a wide variation in sensitivity and specificity across measures [161]. Adherence measures can also be influenced by the particular drug [137], body weight, genetics, metabolism [75, 76] and “white coat adherence” (temporary influence by the particular drug [137], body weight, genetics, metabolism [75, 76] and “white coat adherence” (temporary influence by the particular drug [137], body weight, genetics, metabolism [75, 76] and “white coat adherence” (temporary influence by the particular drug [137], body weight, genetics, metabolism [75, 76] and “white coat adherence” [61], especially useful for individual patient evaluation to direct the management plan.

3.8 | Measures of active self-management

Measures of active self-management fell into two main categories: (1) items that measure action-oriented health-related behaviours and active involvement in the treatment plan [165], and (2) items that reflect whether people are managing the treatment plan themselves. This encompassed self-care, self-monitoring, symptom management, management of other activities that maintain their health [166] and self-management: medical management, the management of their new role as a patient and maintaining emotional health [46]. The active self-management measures are not currently part of routine care, making them less suitable for programmatic monitoring, but potentially valuable for evaluating individual engagement issues to direct care, and researching more refined interventions to support engagement.

The goals of success are slowly shifting from simply providing access to ART, to the complex task of keeping people on treatment lifelong [1] regardless of changes in the health system, people’s personal lives and the interplay between the two [3, 167]. We hypothesize that this aspect of engagement will be increasingly important in ensuring retention and adherence over time to maintain long-term successful treatment outcomes. However, because the measurement of this dimension has not been a priority in sub-Saharan Africa [121], there is currently little evidence to support this. Despite making up the same proportion of the identified measures as retention, there was little overlap in active self-management with only one measure (Adolescent HIV Self-management scale) discussed in more than one source (though both by the same author [96, 168]). If concepts are not measured, there is little evidence to justify that they matter and to promote their subsequent routine measurement: creating a difficult loop to break. Further evaluation of active self-management measures is needed to support their wider adoption into practice. This study provides a starting point: an organized list of options that have been implemented in sub-Saharan Africa and could be used and evaluated more widely.

3.9 | Multi-dimensional engagement

Some measures combined dimensions of engagement, such as adherence and retention [57, 142] or retention and treatment outcomes [77, 122, 144, 146, 149], where people categorized as “engaged” met the criteria for all components [122]. Adherence and retention trajectories were combined to identify an additional group of people who had consistent retention but early non-adherence (measured by medication possession ratio) that was not identified when each
dimension was evaluated separately [57]. Measuring multiple dimensions of engagement can help to evaluate engagement more comprehensively, and may offer a simple approach to flag issues with engagement; if engagement is not optimal, individual dimensions can then be evaluated.

These measures, however, require the collection of multiple pieces of information, are more complex to calculate, may obscure issues with individual engagement dimensions when combining them and may not always improve the accuracy of the measurement [161]. Thus, the actual additional benefit needs to be balanced with complexity and feasibility when evaluating multiple dimensions in a single measure.

3.10 Treatment outcomes as a measure of engagement

The retention, adherence and active self-management dimensions categorize engagement behaviour, which in turn drives the success or failure of antiretroviral treatment. Treatment outcomes are thus a consequence of engagement and represent a summary of whether the engagement process has taken place. For example, an individual must have consistently managed their appointments and taken pills over time to have a viral load (VL) test result and be virologically suppressed [49]. In this study, the identified measures of engagement were often evaluated against treatment outcomes, with those showing stronger associations deemed more accurate reflections of retention [5], adherence [75, 120, 139] and active self-management [175]. Virologic suppression, in particular, was often cited as the “gold standard” of treatment success [63, 169, 183].

Identified measures of treatment outcomes included VL, immunological outcomes, antiretroviral resistance, mortality, health status and HIV-specific quality of life, which could be used to broaden the definition of treatment success beyond the narrow focus on virologic suppression [48]. Disability-adjusted life years (DALYs) and quality-adjusted life years (QALYs) are used extensively in modeling studies and evaluations of other chronic diseases [170], but they have not found a routine place in HIV evaluation: no included sources mentioned DALYs or QALYs. These are metrics that the HIV community could adopt to increase the comparability of evaluations.

While engagement is necessary to achieve sustained treatment success, outcomes are also influenced by factors, such as ART resistance, drug–drug interactions or suboptimal pharmacokinetics [50]. Therefore, outcomes cannot discriminate between poor engagement or deterioration due to other reasons [137]. The delayed effect between suboptimal engagement and a change in outcomes (e.g. VL [120]) makes outcomes poor indicators of early engagement issues when intervention could avert the need to switch regimens to less tolerable second- or third-line options. VLs are also relatively expensive and are not always available for routine monitoring [50, 82]: at best, they are conducted infrequently (e.g. yearly), intermittently or at worst not at all [62]. Additionally, most programmes only begin monitoring VL from 4 to 6 months after initiation [171, 172], missing a high-risk period for disengagement [155].

Additionally, treatment outcomes do not differentiate between the dimensions of engagement. VL has been used specifically as a measure of adherence [4, 86, 173], but this too is subject to misclassification bias [70], and a missing VL may reflect healthcare worker error, resource constraints or poor retention rather than adherence. Relying on a primary outcome of virologic suppression for evaluation in research could misrepresent the efficacy of new interventions, which may improve a dimension of engagement but not be sufficient alone to improve treatment outcomes [174].

VL continues to be a valuable measure at multiple levels of the system and the WHO supports the expansion of regular VL monitoring [175]. However, this needs to be interpreted within its limitations and supplemented with measures of individual dimensions to comprehensively evaluate engagement. In the absence of a single best measure of engagement, we recommend the evaluation of more than one dimension from the InCARE framework to measure engagement more comprehensively. This could help better understand engagement behaviour, develop appropriate interventions and make better decisions about individual patient management.

3.11 Alternative approaches to current measures of engagement

Combining measures has been proposed as an alternative to a single best measure of engagement. For example, a comparison of short- and long-term measures of adherence can identify intermittent or “white coat” adherence [137], and composite retention measures capture visit consistency, are more stringent and have lower misclassification than fixed point retention [6]. While combinations improved sensitivity in some cases, this did not substantially improve the association with outcomes, adding complexity without fully overcoming individual measures’ limitations [16, 122]. This was also demonstrated by a recent Cochrane review that found that the sensitivity of composite measures of adherence ranged from 10% to 100%, and specificity from 49% to 100% [161]. It may be most feasible to use simple measures with moderate association with outcomes and interpret them within their limitations [4].

Adherence measures were widely evaluated as an alternative to costly VL monitoring, but generally, the association was not strong enough to replace it with confidence. Associations varied with the threshold used for “good” adherence, changing the clinical interpretation when making decisions [50, 139]. In addition, newer adherence measures, such as electronic medication event monitoring systems and therapeutic drug monitoring, can be more expensive than VL, with complicated logistics (e.g. sample storage at –80°C [137, 160]) and requirements for complex equipment [15, 55, 135, 137, 160] that reduce their feasibility in practice.

Cross-sectional measurements fail to identify the gaps in the treatment journey when the health service could intervene to improve engagement [42, 57]. Longer periods of evaluation capture more of the subtlety of engagement, are more strongly associated with outcomes [139, 160] and can facilitate the evaluation of patterns of engagement. Measuring patterns avoids obscuring the individual differences in engagement over time that occurs with single time-point
measures [57, 60], potentially useful in understanding engagement dynamics [49, 58]. Evaluation of individual-level longitudinal trajectories of engagement can also uncover “behavioural phenotypes” that identify high-risk individuals in high-risk periods of their treatment journey [57, 123], offering a novel opportunity to direct interventions to behavioural patterns rather than the demographic categories we traditionally use to target differentiated services (often with poor success) [57]. These prospects make these measures worth the required longer follow-up [6], adjustments to data collection to track patients and link data from different sources [157] and the added computational complexity [5]. Investments in routine databases could support better measurement both for clinical patient management and routine programme monitoring, and provide data for research analyses [176].

3.12 | The “elusive gold standard”

Considering the number of sources this study screened, it is surprising that no standard definitions of an engagement or consistently used measures (even for retention [42] or adherence [50]) were identified. While VL is considered the gold standard for monitoring treatment response [50], the mixed evidence means no measure perfectly reflects successful engagement or its dimensions. Measures are chosen to prioritize sensitivity or specificity in predicting outcomes, resulting in a trade-off between missing people in need of support or over-intervening and wasting resources [125].

There is a demand for specific recommendations on standardized measures to measure engagement consistently and comparably [14, 177, 178]. In large ART programmes in sub-Saharan Africa, measurement choice is restricted by practicality [50, 121]. Thus, consideration of feasibility (specifically cost, complexity and time burden) is paramount for practical integration into routine health monitoring systems [136]. Until more specific recommendations are produced, we recommend conducting sensitivity analyses using multiple common definitions of retention (such as visit gaps and fixed-point retention), adherence (medication possession ratio, electronic pill count, self-report and antiretroviral concentration) and active self-management (patient activation and self-management assessment) to increase the comparability of evaluations of engagement. The use of multiple measures could also explore the implications of different measures on the conclusions drawn, particularly for the dimension of active self-management, for which there is less evidence [121].

While the search for a unifying measure reflective of engagement was unsuccessful, this indicates the complexity of the concept [17]. Engagement is multi-dimensional, with retention, adherence and active self-management all crucial to longitudinal, sustained treatment success [39]. Particularly for the purposes of making decisions on individual patient care and research to develop and test new interventions, evaluating all dimensions may be more valuable than hiding the heterogeneity with summary measures.

3.13 | Strengths and limitations

This study focused specifically on engagement with HIV care, but the findings could inform the evaluation of other chronic diseases requiring lifelong engagement with care. Strengths of this study also include a broad search of the literature across multiple databases and the review of a large number of sources. This study drew on the experience of the research team in clinical HIV management and differentiated service development in low-resource, contextually challenging settings, grounding this work in the practical realities of patient care and programme management. Eligibility criteria, data extraction, and analysis results were continually reviewed throughout the scoping process to reduce bias, both with the second reader and stakeholder engagement as suggested by scoping study guidance [35, 36].

The research question was very broad, both in the concept of engagement and the number of papers identified: a recognized drawback of scoping studies [36]. This study did not attempt to evaluate the quality of sources and whether they reflected the underlying construct. Some useful measures may have been missed through the focus on sub-Saharan Africa, and measures from high-income or other low-income settings could inform the measurement of engagement in sub-Saharan Africa. As literature was reviewed, terms that described engagement behaviour were identified that had not been included in the original search, and the Gwet’s AC1 for the studies included was “fair,” with 68% observed agreement, reflecting the lack of clarity in the definition of engagement. In addition, due to the English language limit in the search, most evidence was from English-speaking countries in southern and east Africa. However, restricting the search to “English” only reduced the volume of evidence by a small amount (e.g., by 0.6% for PubMed), which may reflect that English is the main language for scientific publication [179], or that countries with a prevalence above 10% are all anglophone [180]. Surprisingly, the two sub-Saharan African countries with the highest HIV prevalence in the world, Eswatini and Lesotho [180], did not produce literature that was identified in this search, despite being searched for by name.

Of the 145 measures of engagement identified in this study, 35 were removed from the final list as they were judged to reflect factors that affect engagement rather than engagement behaviour itself. These included contextual factors (e.g., measures of the reasons for non-adherence), reflections of the health system (e.g., ART coverage) and personal factors (e.g., the ability to engage, including information, motivation and behavioural skills). The line between engagement behaviour and the factors affecting it was a persistent tension in discussions throughout screening and stakeholder engagement. The ambiguity in the definition of the measures of engagement dimensions meant that the process of refining the categorization of identified measures was iterative.

4 | CONCLUSIONS

Heterogeneity in conceptualizing HIV care engagement is reflected by the broad range of measures identified and the lack of consensus on the best indicators of each dimension. The purpose of evaluation should direct the choice of measurement: research, programme evaluation and patient
assessment could all be advanced through measurement of multiple dimensions for a more comprehensive evaluation, conducting sensitivity analyses with commonly used measures for more comparable outputs and using longitudinal measures to evaluate patterns of engagement. Improvements to data collection and management could also facilitate better routine measurement of these engagement dimensions to facilitate improved individual patient management, programme monitoring and research to explore the impact of interventions on engagement and treatment outcomes.

This review categorized the wide variety of measures used to evaluate engagement with HIV care in sub-Saharan Africa into a usable reference list. It could help make choices on measuring engagement for different use cases, and provides options for the less commonly evaluated dimension of “active self-management.” However, specific recommendations could not be made from the available evidence as no measures were obviously superior—for engagement overall, for individual dimensions or to replace virological outcome monitoring. Further work could make evidenced recommendations on a standardized, minimum set of measures to comprehensively evaluate engagement with care for different use cases. This study could also support further work to explore the importance of the active self-management dimension, unpacking the underlying mechanisms of poor engagement and differentiating those who are unwilling to engage from those who are unable to remain engaged due to complex individual, social and health system factors. An improved understanding of the mechanisms driving disengagement and how to evaluate engagement comprehensively could support the implementation of more nuanced interventions to improve it. It could also inform the understanding and measurement of engagement for other chronic diseases.

AUTHORS’ AFFILIATIONS

1Health Systems Collaborative, Oxford Centre for Global Health Research, Nuffield Department of Medicine, University of Oxford, Oxford, United Kingdom; 2Centre for Infectious Disease Epidemiology and Research, School of Public Health and Family Medicine, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa; 3Department of Medicine, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa

COMPETING INTERESTS

There are no relevant financial or non-financial competing interests to report.

AUTHORS’ CONTRIBUTIONS

Conceptualization: CMK, ME, JMK and CO.
Methodology: CMK, AR, JE, ME, JMK and CO.
Data curation: CMK.
Analysis: CMK, AR, JE, ME, JMK, CO, InCARE Stakeholder Group: AG, BH, Evdh, IEW, IK, KA, KRA, LB, MM, TC and TP.
Funding acquisition: N/A.
Writing—original draft: CMK.
Writing—review and editing: CMK, JE, AR, ME, JMK, CO, InCARE Stakeholder Group: AG, IEW, IK, KA, KRA, LB, MM and TP.

ACKNOWLEDGEMENTS

We would like to thank Eli Harriss for help developing the search strategy and to the Health Systems Collaborative team for the support, thoughts and reflections. The InCARE Stakeholder Group members are listed in the Supporting Information.

FUNDING

This research was conducted as part of a PhD undertaken by CK at the University of Oxford. It was supported through a scholarship from the Clarendon Fund and St John’s College Kendrew Clarendon Award, in partnership with the Nuffield Department of Clinical Medicine.

DATA AVAILABILITY STATEMENT

Data are available on request.

REFERENCES

1. Skazawe I, Eshun-Willson I, Sikombe K, Czaicki N, Somwe P, Mody A, et al. Retention and viral suppression in a cohort of HIV patients on antiretroviral therapy in Zambia: regionally representative estimates using a multistage-sampling-based approach. PLoS Med. 2019;16(5):1–17.
2. Denison JA, Koole O, Tsiu S, Menten J, Torkey K, van Praag E, et al. Incomplete adherence among treatment-experienced adults on antiretroviral therapy in Tanzania, Uganda and Zambia. AIDS. 2015;29(3):361–71.
3. Clouse K, Vermund SH, Maskew M, Lerie MN, MacLeod W, Malete G, et al. Mobility and clinic switching among postpartum women considered lost to HIV care in South Africa. J Acquir Immune Defic Syndr. 2017;74(4):383–9.
4. Atanga PN, Ndetei HT, Fon PN, Meriki HD, Muffih TP, Achidi EA, et al. Using a composite adherence tool to assess ART response and risk factors of poor adherence in pregnant and breastfeeding HIV-positive Cameroonian women at 6 and 12 months after initiating option B+. BMC Pregnancy Childbirth. 2018;18(1):418.
5. Phillips TK, Orrell C, Brittain K, Zeber A, Abrams EI, Myer L. Measuring retention in HIV care: the impact of data sources and definitions using routine data. AIDS. 2020;34(5):749–59.
6. Ahoua L, Arikawa S, Tiendrebeogo T, Lauherta M, Aly D, Becquet R, et al. Measuring retention in care for HIV-positive pregnant women in Prevention of Mother-to-Child Transmission of HIV (PMTCT) option B+ programs: the Mozambique experience. BMC Public Health. 2020;20(1):522.
7. Phillips AN, Cambiano V, Nakagawa F, Bans-Matharu L, Sow PS, Ehrenkranz P, et al. Cost effectiveness of potential ART adherence monitoring interventions in sub-Saharan Africa. PLoS One. 2016;11(12):e0167654.
8. Klein DJ, Bershteyn A, Eckhoff PA. Dropout and re-enrollment: implications for epidemiological projections of treatment programs. AIDS. 2014;28(SUPPL. 1):S47–59.
9. Tabb ZI, Mmbaga BT, Gandhi M, Louie A, Kuncze K, Okochi H, et al. Antiretroviral drug concentrations in hair are associated with virologic outcomes among young people living with HIV in Tanzania. AIDS. 2018;32(9):1115–23.
10. Chawana TD, Nhachi CFB, Nathoo K, Ngara B, Okochi H, Louie A, et al. Higher tenofovir concentrations in hair are associated with decreases in viral load and not self-reported adherence in HIV-infected adolescents with second line virological treatment failure. AIDS Res Hum Retroviruses. 2021;37(10):748–50.
11. Maguero MJ, Westfall AO, Zimski A, Jessica D, Mari-Lynn, D. Gardner LJ, et al. Measuring retention in HIV care: the elusive gold standard. J Acquir Immune Defic Syndr. 2012;61(5):574–80.
12. Craker L, Tarantino N, Whiteley L, Brown L. Measuring antiretroviral adherence among young people living with HIV: observations from a real-time monitoring device versus self-report. AIDS Behav. 2019;23(8):2138–45.
13. Fox MP, Bor J, Brennan AT, Macleod WB, Maskew M, Stevens WS, et al. Estimating retention in HIV care accounting for patient transfers: a national laboratory cohort study in South Africa. PLoS Med. 2018;15(6):e1002589.
14. Mugglin C, Kläger D, Gueler A, Vanobberghen F, Rice B, Egger M. The HIV care cascade in sub-Saharan Africa: systematic review of published criteria and definitions. J Int AIDS Soc. 2021;24(7):1–14.
15. Abdulrahman SA, Ganasegeran K, Rampil L, Martins OF. HIV treatment adherence—a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
16. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
17. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
18. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
19. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
20. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
21. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
22. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
23. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
24. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
25. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
26. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
27. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
28. Ford N, Eshun-wilson I, Ameyan W, Newman M, Vojnov L, Doherty M, et al. Antiretroviral adherence— a shared burden for patients, health-care providers, and other stakeholders. AIDS Res Rev. 2019;21(1):28–39.
40. Czacki NL. Understanding and informing interventions to improve antiretroviral adherence: three papers on antiretroviral adherence in sub-Saharan Africa. PhD Thesis, University of California. 2016;1–61.

41. Műnene E, Ekman B. Association between patient engagement in HIV care and antiretroviral therapy medication adherence: cross-sectional evidence from a regional HIV care center in Kenya. AIDS Care. 2015;27(3):378–86.

42. Font H, Rollins N, Essajee S, Becquet R, Foster G, Mangwi AO, et al. Retention-in-care in the PMTCT cascade: definitions matter! Analyses from the INSPIRE projects in Malawi, Nigeria and Zimbabwe. J Int AIDS Soc. 2020;23(10):e25609.

43. The World Health Organization. WHO Africa: HIV/AIDS. 2020 [cited 2021 Feb 12]. Available from: https://www.afr.who.int/health-topics/hiv/aids

44. Angwenyi V, Bunders-Aelen J, Criel B, Lazarus JV, Aantjes C. An evaluation of self-management outcomes among chronic care patients in community home-based care programs in rural Malawi: a 12-month follow-up study. Health Soc Care Community. 2020;29(2):353–68.

45. Poles G, Li M, Sirl H, Mhulu A, Hawkins C, Kaaya S, et al. Factors associated with different patterns of nonadherence to HIV care in Dar es Salaam, Tanzania. J Int Assoc Provid AIDS Care. 2014;13(1):78–84.

46. Mills EJ, Nachega JB, Buchan I, Orbinski J, Attaran A, Singh S, et al. Adherence to antiretroviral therapy in sub-Saharan Africa and North America: a meta-analysis. J Am Med Assoc. 2006;296(6):679–90.

47. Haas AD, Zanievski E, Anderegg N, Ford N, Fox MP, Vinkoor M, et al. Retention and mortality on antiretroviral therapy in sub-Saharan Africa: collaborative analyses of HIV treatment programmes. J Int AIDS Soc. 2018;21(2):e25084.

48. Hajizadeh M, Sia D, Heymann SJ, Nandi A. Socioeconomic inequalities in HIV/AIDS prevalence in sub-Saharan African countries: evidence from the Demographic Health Surveys. Int J Equity Health. 2014;13(18):1–22.

49. Nyindo M. Complementary factors contributing to the rapid spread of HIV-I in sub-Saharan Africa: a review. East Afr Med J. 2005;82(1):40–6.

50. Avert. HIV and AIDS in East and Southern Africa: Regional Overview. Global information and education on HIV and AIDS. 2020 [cited 2022 Mar 16]. Available from: https://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/

51. Kharasny ABM, Karim QA. HIV infection and AIDS in sub-Saharan Africa: current status, challenges and opportunities. Open AIDS J. 2016;10:334–48.

52. Tique JA, Howard LM, Gaveta S, Sidat M, Rothman RL, Vermund SH, et al. Measuring health literacy among adults with HIV infection in Mozambique: development and validation of the HIV literacy test. Aids Behav. 2017;21(3):822–32.

53. Hickey MD, Salmen CR, Tessler RA, Omollo D, Baccetti P, Magerenge R, et al. Antiretroviral concentrations in small hair samples as a feasible marker of adherence in sub-Saharan Kenya. J Acquir Immune Defic Syndr. 2014;66(3):311–5.

54. Tricco AC, Lillie E, Zarin W, O’Brien K, Colquhoun H, Kastner M, et al. A scoping review on the conduct and reporting of scoping reviews. BMC Med Res Methodol. 2016;16(1):1–10.

55. Arksey H, O’Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Method. 2005;8(1):19–32.

56. Levac D, Colquhoun H, O’Brien K. Scoping studies: advancing the methodology. Implement Sci. 2010;5(1):1–9.

57. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance on extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467–73.

58. World Health Organization. HIV test–treat–retain cascade analysis: guide and tools. Geneva. 2017.

59. Gachara G, Mavhandu LG, Rogasik ET, Manhaeve C, Besong PO. Evaluating adherence to antiretroviral therapy using pharmacy refill records in a rural treatment site in South Africa. AIDS Res Treat. 2017;2017:6476219.

60. Jackson IL, Umoj SS, Erah PO. Medication adherence and health status in HIV positive patients in Akwa Ibom State, Nigeria. Trop J Pharma Res. 2020;19(10):2197–204.

61. Kapiamba G, Masango T, Mphuthi D. Antiretroviral adherence and virological outcomes in HIV-positive patients in Ugu district, KwaZulu-Natal, South Africa. J AIDS Res. 2016;15(3):195–201.

62. Mbenge MA, Sarr SO, Diop A, Ndour CT, Ndiaye B, Mbaye S. Prevalence of defaulters and determinants of adherence to antiretroviral treatment among HIV patients on first-line regimen: a cross-sectional study in Dakar, Senegal. Pan Afr Med J. 2019;33:95.

63. Meresse M, March L, Kouandack C, Bonono RC, Boyer S, Laborde-Balen G, et al. Patterns of adherence to antiretroviral therapy and HIV drug resistance over time in the Stratall ANRS 12110/ESTHER trial in Cameroon. HIV Med. 2014;15(8):478–87.

64. Areesgba HO, Adeoye IA. Self-efficacy and antiretroviral therapy adherence among HIV positive pregnant women in South-West Nigeria: a mixed methods study. Trop J AIDS Res. 2016;9(2):756.

65. Aregbesola OH, Adeoye IA. Self-efficacy and antiretroviral therapy adherence among HIV positive pregnant women in South-West Nigeria: a mixed methods study. Trop J AIDS Res. 2016;9(2):756.

66. Johnson LF, Estill J, Keiser O, Cornell M, Moolla H, Schomaker M, et al. Consensus statement on the role of health systems in advancing the long-term well-being of people living with HIV. Nat Commun. 2021;12(1):3–7.

67. Agaba PA, Genberg BL, Sagay AS, Agbaji OO, Meloni ST, Danem NY, et al. Retention in differentiated care: multiple measures analysis for a decentralized HIV care and treatment program in North Central Nigeria. J AIDS Clin Res. 2018;9(2):756.
69. Rhead R, Masimirembwa C, Cooke G, Takaruzu A, Nyamukapa C, Mutsumi C, et al. Might ART adherence estimates be improved by combining biomarker and self-report data? PLoS One. 2016;11(12):e0167852.

70. Grabowski MK, Reynolds SJ, Kagaiy J, Gray RH, Clarke W, Chang LW, et al. The validity of self-reported antiretroviral use in persons living with HIV: a population-based study. AIDS. 2018;32(3):363–9.

71. Orrell C, Cohen-K, Leisegang R, Bangser DR, Wood R, Maartens G. Comparison of six methods to estimate adherence in an ART-naive cohort in a resource-poor setting: which best predicts virological and resistance outcomes? AIDS Res Ther. 2017;14(1):20.

72. Erb S, Letang E, Glass TR, Natamatomugiro A, Mnzava D, Mapesi H, et al. A simple visual analog scale is a valuable tool to assess self-reported adherence in HIV-infected patients on antiretroviral treatment in a resource-limited setting. J AIDS Clin Res. 2017;8(9):731.

73. Abah IO, Ojej V, Missa J, Ugugwa P, Agaba PA, Abagyi O, et al. Clinical utility of pharmacy-based adherence measurement in predicting virologic outcomes in an adult HIV-infected cohort in Jos, North Central Nigeria. J Int Assoc Provid AIDS Care. 2016;15(1):77–83.

74. George L, Muro EP, Notari A, Dolmans W, Burger DM, Kivangura ER. Nevirapine concentrations in saliva measured by thin layer chromatography and self-reported adherence in patients on antiretroviral therapy at Kilimanjaro Christian Medical Centre, Tanzania. Ther Drug Monit. 2014;36(3):366–70.

75. Kimulwo MJ, Okendo J, Aman RA, Ogotu BR, Lokwor GO, Ochijg DJ, et al. Plasma nevirapine concentrations predict virological and adherence failure in Kenyan HIV-1 infected patients with extensive antiretroviral treatment exposure. PLoS One. 2017;12(2):e0172960.

76. Ndirwapi Z, Chawana TD, Stray-Pedersen B, Nkachi CF, Rusanganiko S. A population pharmacokinetic model is beneficial in quantifying hair concentrations of ritonavir-boosted atazanavir: a study of HIV-infected Zimbabwean adolescents. BMC Pharmacol Toxicol. 2020;21(58):1–9.

77. Drain P. Simplifying treatment and monitoring for HIV (STREAM HIV) trials. ClinicalTrials.gov. 2020.

78. Anjo C, Agu KA, Oladele EA, Badru T, Adekunle O, Oqula D, et al. Adherence to on-time ART drug pick-up and its association with CD4 changes and clinical outcomes among HIV positive adults on first-line antiretroviral therapy in Nigerian hospitals. AIDS Behav. 2017;21(2):386–92.

79. Hermans LE, Steegen K, Ter Heine R, Schuurman R, Tempelman HA, Moraba R, et al. Drug level testing as a strategy to determine eligibility for drug resistance testing after failure of ART: a retrospective analysis of South African patients on second-line ART. J Int AIDS Soc. 2020;23(6):e25501.

80. Court R, Leisegang R, Stewart A, Sunpath H, Murphy R, Winterheimer P, et al. Short term adherence tool predicts failure on second line protease inhibitor-based antiretroviral therapy: an observational cohort study. BMC Infect Dis. 2014;14(1):664.

81. Onugbo DM, Lim R, Twywa H, Stanley CC, Tenpo B, Broadhurst R, et al. A cross-sectional study to evaluate second line virological failure and elevated biliru- bin as a surrogate for adherence to atazanavir/ritonavir in two urban HIV clinics in Lilongwe, Malawi. BMC Infect Dis. 2017;17(1):461.

82. Sangeda RZ, Mosha F, Prosperi M, Aboud S, Vercauteren J, Camacho RJ, et al. Longitudinal ART adherence trajectories and sociodemographic and psychoso- cial predictors among ART initiators in Cape Town, South Africa. Int J Adherence 2019 Conference. Miami, FL: International Association of Providers of AIDS Care; 2019.

83. Barchi F, Winter SC, Ramaphane P, Dougherty D. The role of self-efficacy in women's health-seeking behaviors in northwestern Botswana. J Health Care Poor Underserved. 2019;30(2):653–67.

84. Jennings L, Kellerman T, Spinelli M, Ntants Z, Cogli D, Van Schalkwyk M, et al. Drug resistance, rather than low tenofovir levels in blood or urine, is associated with tenofovir, entecavir, and efavirenz failure in resource-limited settings. AIDS Res Hum Retroviruses. 2022;38(6):455–62.

85. Tsegaye E, Delis A, Wondimu F, Boursa D, Bourn C, Mawah S, et al. Factors influencing self-management of adults living with HIV/AIDS in a rural area (Koula-Moutou) in East Gabon. Afr J AIDS Res. 2019;18(1):51–7.

86. Guira O, Kaboré DSRR, Dao G, Zagré N, Zohoncon TM, Pietra V, et al. The modalities of nonadherence to highly active antiretroviral therapy and the associ- ated factors related to patients' sociodemographic characteristics and their care- giving perceptions in Ouagadougou (Burkina Faso). J Int Assoc Provid AIDS Care. 2019;18(5):254–60.

87. Ketchaji A, Assah F, Fokam J, Tanoue EA, Monebenimp F, Ngowe MN, Predictors of non-adherence to antiretroviral therapy among adolescents living with HIV in the Centre Region of Cameroon. Am J Public Health Res. 2019;7(4):126–36.

88. Kikoni MT, Pertet AM. Factors contributing to antiretroviral drug adherence among adults living with HIV or AIDS in a Kenyan rural community. Afr J Prim Health Care Fam Med. 2017;9(1):e1–7.

89. Magidson JF, Saal W, Nel A, Remmert JE, Kagee A. Relationship between patient-related factors and medication adherence among South African patients taking highly active anti-retroviral therapy. Afr Heal Sci. 2017;17(3):738–45.

90. Davis A, Narcini-Pala A, Nguyen N, Robbins R, Mellins CA, Joska J, et al. Relationship between drug adherence and antiretroviral therapy among adults living with HIV/AIDS in a rural area (Koula-Moutou) in East Gabon. Afr J AIDS Res. 2019;18(1):51–7.

91. Nguo A, Kabore DSRR, Dao G, Zacré N, Zohoncon TM, Pietra V, et al. The modalities of nonadherence to highly active antiretroviral therapy and the associ- ated factors related to patients’ sociodemographic characteristics and their care- giving perceptions in Ouagadougou (Burkina Faso). J Int Assoc Provid AIDS Care. 2019;18(5):254–60.

92. Ketchaji A, Assah F, Fokam J, Tanoue EA, Monebenimp F, Ngowe MN, Predictors of non-adherence to antiretroviral therapy among adolescents living with HIV in the Centre Region of Cameroon. Am J Public Health Res. 2019;7(4):126–36.

93. Kikoni MT, Pertet AM. Factors contributing to antiretroviral drug adherence among adults living with HIV or AIDS in a Kenyan rural community. Afr J Prim Health Care Fam Med. 2017;9(1):e1–7.

94. Magidson JF, Saal W, Nel A, Remmert JE, Kagee A. Relationship between patient-related factors and medication adherence among South African patients taking highly active anti-retroviral therapy. Afr Heal Sci. 2017;17(3):738–45.

95. Davis A, Narcini-Pala A, Nguyen N, Robbins R, Mellins CA, Joska J, et al. Relationship between drug adherence and antiretroviral therapy among adults living with HIV/AIDS in a rural area (Koula-Moutou) in East Gabon. Afr J AIDS Res. 2019;18(1):51–7.

96. Guira O, Kaboré DSRR, Dao G, Zagré N, Zohoncon TM, Pietra V, et al. The modalities of nonadherence to highly active antiretroviral therapy and the associ- ated factors related to patients’ sociodemographic characteristics and their care- giving perceptions in Ouagadougou (Burkina Faso). J Int Assoc Provid AIDS Care. 2019;18(5):254–60.

97. Ketchaji A, Assah F, Fokam J, Tanoue EA, Monebenimp F, Ngowe MN, Predictors of non-adherence to antiretroviral therapy among adolescents living with HIV in the Centre Region of Cameroon. Am J Public Health Res. 2019;7(4):126–36.

98. Kikoni MT, Pertet AM. Factors contributing to antiretroviral drug adherence among adults living with HIV or AIDS in a Kenyan rural community. Afr J Prim Health Care Fam Med. 2017;9(1):e1–7.

99. Magidson JF, Saal W, Nel A, Remmert JE, Kagee A. Relationship between patient-related factors and medication adherence among South African patients taking highly active anti-retroviral therapy. Afr Heal Sci. 2017;17(3):738–45.
longitudinal HIV treatment adherence among youth living with HIV transitioning into young adulthood in Southern Uganda. BMC Public Health. 2021;21(1):179.

109. McKinney O, Modeste NN, Lee JW, Gleason PC. Predicting Malawian women's intention to adhere to antiretroviral therapy. J Public Health Res. 2015;4(2):17–20.

110. Adefolalu A, Nikosi Z, Olorunuyan S, Masemola P. Self-efficacy, medication beliefs and adherence to antiretroviral therapy by patients attending a health facility in Pretoria. South Afr Fam Pract. 2014;56(5):281–5.

111. Dewing S, Mathews C, Lurie M, Kagge A, Padayachee T, Lombard C. Predictors of poor adherence among people on antiretroviral treatment in Cape Town, South Africa: a case–control study. AIDS Care. 2015;27(3):342–9.

112. Beres LK, Schwartz S, Simbeza S, McGready J, Eshun-Wilson I, Mwamba C, et al. Patterns and predictors of incident return to HIV care among traced, disengaged patients in Zambia: analysis of a prospective cohort. J Acquir Immune Defic Syndr. 2021;86(3):513–22.

113. Okoronkwo I. Assessing self care practices of people living with AIDS attending antiretroviral clinic Kafanchan, Kaduna State, Nigeria. J AIDS Clin Res. 2015;6(12):1–6.

114. Boussari O, Subiti F, Genolini C, Bastard M, Iwaz J, Fonton N, et al. Impact of variability in adherence to HIV antiretroviral therapy on the immunovirological response and mortality. BMC Med Res Methodol. 2015;15(10):1–8.

115. Byabene AK, Fortes-Dégéoumonvo L, Niang K, Manga MN, Bulubalu ANH, Nachega JB, et al. Optimal antiretroviral therapy adherence as evaluated by CASE index score tool is associated with virological suppression in HIV-infected adults in Dakar, Senegal. Trop Med Int Health. 2017;22(6):776–82.

116. Kelemwele CT, Mokhulukhi N. Patterns and predictors of antiretroviral therapy use among alcohol drinkers at HIV clinics in Tshwane, South Africa. AIDS Care. 2014;26(Suppl 1):578–82.

117. Murnane PM, Bacchetti P, Currier JS, Brummel S, Okochi H, Phung N, et al. Tenofvir concentrations in hair strongly predict virologic suppression in breastfeeding women. AIDS. 2019;33(10):1657–62.

118. Wachira J, Middlestadt S, Reece M, Peng CYJ, Braitstein P. Physician counseling within Malawi's Option B+ program. AIDS Care. 2015;27(Suppl 1):S78–82.

119. Phillips TK, Simon A, Abbott M, Malima B, Schneeweiss AE, Sikkema K, et al. Improving AIDS Care After Trauma (ImpACT): pilot outcomes of a coping intervention among HIV-infected women with sexual trauma in South Africa. AIDS Behav. 2018;22(3):1039–52.

120. Wesevich A, Hosseinipour MC, Golik CE, McGrath N, Tsidya M, Chimndozi L, et al. The Video intervention to Inspire Treatment Adherence for Life (VITAL Start) protocol for a multisite randomized controlled trial of a brief video-based intervention to improve antiretroviral adherence and retention among HIV-infected pregnant women in Malawi. Trials. 2020;21(1):207.

121. Maclachtlan EW, Shepard-Perry MG, Ingo P, Uusiku J, Mushirima R, Simwanza R, et al. Evaluating the effectiveness of patient education and empowerment to improve patient–provider interactions in antiretroviral therapy clinics in Namibia. AIDS Care. 2016;28(5):620–7.

122. Myer L, Phillips TK, Zerbe A, Brittain K, Lesosky M, Hsiao NY, et al. Evaluation of caregiver adherence to antiretroviral therapy for HIV-infected children in South Africa: a randomised controlled trial. PLoS Med. 2019;16(5):e1002547.

123. Chattclawi HC, Greif M, Temane QM, Ellis S. Changeover-time in psychosocial well-being of people living with HIV and their partners close to them after an HIV stigma reduction and wellness enhancement community intervention. Afr J AIDS Res. 2015;14(1):1–12.

124. Chattclawi HC, Greif M, Temane QM. Health behaviour change of people living with HIV after a comprehensive community-based HIV stigma reduction intervention in North-West Province in South Africa. SAHARA J. 2014;11(1):222–32.

125. Zerbe A, Brittain K, Phillips TK, Iyun VO, Allerton J, Nofemela A, et al. Community-based adherence clubs for postpartum women on antiretroviral therapy use among alcohol drinkers at HIV clinics in Tshwane, South Africa. AIDS Care. 2014;26(Suppl 1):578–82.

126. Peterson K, Menten J, Peterson I, Togun T, Okomo U, Oko F, et al. Patterns and predictors of incident return to HIV care among traced, disengaged patients in Zambia: analysis of a prospective cohort. J Acquir Immune Defic Syndr. 2021;86(3):513–22.

127. Okoronkwo I. Assessing self care practices of people living with AIDS attending antiretroviral clinic Kafanchan, Kaduna State, Nigeria. J AIDS Clin Res. 2015;6(12):1–6.

128. Boussari O, Subiti F, Genolini C, Bastard M, Iwaz J, Fonton N, et al. Impact of variability in adherence to HIV antiretroviral therapy on the immunovirological response and mortality. BMC Med Res Methodol. 2015;15(10):1–8.

129. Genn L, Chapman J, O'Keefe T, Abell N, Marukutira T, Tshume O, et al. Pharmacy refill data are poor predictors of virologic treatment outcomes in adolescents with HIV in Botswana. AIDS Behav. 2019;23(8):2130–7.

130. Magidson JF, Sall W, Nel A, Remmert JE, Kagge A. Relationship between depressive symptoms, alcohol use, and antiretroviral therapy adherence among HIV-infected, clinic-attending patients in South Africa. J Health Psychol. 2017;22(1):1426–32.

131. McKinney O, Modeste NN, Lee JW, Gleason PC. Predicting Malawian women’s intention to adhere to antiretroviral therapy. J Public Health Res. 2015;4(2):17–20.
therapy (ART) in Cape Town, South Africa: a pilot study. BMC Health Serv Res. 2020;20(1):621.

150. Chawana TD, Gandhi M, Nathoo K, Ngara B, Louie A, Horig H, et al. Defining a cutoff for atazanavir in hair samples associated with virological failure among adolescents failing second-line antiretroviral treatment. J Acquir Immune Defic Syndr. 2017;76(1):S5–9.

151. Friedland BA, Gottes A, Hows J, Baral SD, Sprague L, Nyblade L, et al. The People Living with HIV Stigma Index 2.0: generating critical evidence for worldwide. AIDS. 2020;34(Suppl 1):S5–18.

152. Nawar E. Longitudinal analysis of interruptions in HIV care and treatment among HIV-positive pregnant women engaged in clinical care in Kigali, Rwanda. DSc Thesis. Tulane University, New Orleans. 2020;1–92.

153. Jackson IL, Okonta JM, Ukwve CV. Development and psychometric evaluation of the patient’s HIV knowledge questionnaire (PHKQ). Int J Clin Pharm. 2020;42(2):695–702.

154. Mugavero MJ, Davila JA, Nevin CR, Giordano TP. From access to engagement: measuring retention in outpatient HIV clinical care. AIDS Patient Care STDS. 2010;24(10):607–13.

155. Grimsrud A, Wilkinson L, Eshun-Wilson I, Holmes C, Sikazwe I, Katz IT. Understanding engagement in HIV programmes: how health services can adapt to ensure no one is left behind. Curr HIV/AIDS Rep. 2020;17(5):458–66.

156. Johnson MO, Neillands TB, Koester KA, Wood T, Saxceja JA, Dilworth SE, et al. Detecting disengagement from HIV care before it’s too late: development and preliminary validation of a novel index of engagement in HIV care in South Africa. J Acquir Immune Defic Syndr. 2019;91(2):145–52.

157. World Health Organization. Consolidated HIV strategic information guidelines: driving impact through programme monitoring and management. Geneva; 2020.

158. Fox MP, Bor J, Brennan AT, MacLeod WB, Maskew M, Stevens W, et al. Estimating retention in HIV care accounting for patient transfers: a national laboratory cohort study in South Africa. PLoS Med. 2018;15(6):e1002589.

159. Eby J, Chapman J, Marukutira T, Anabwani G, Tshume O, Lepodisi O, et al. The adherence–outcome relationship is not altered by diary-driven adjustments of microelectronic monitor data. Pharmacoeconomic Drug Saf. 2015;24(12):1513–20.

160. Alcaide ML, Ramlagan S, Rodriguez VJ, Cook R, Pelzer K, Weiss SM, et al. Self-report and dry blood spot measurement of antiretroviral medications as markers of adherence in pregnant women in rural South Africa. AIDS Behav. 2017;21(7):2135–40.

161. Smith R, Villanueva G, Probyn K, Shussaero Y, Ford N, Orrell C, et al. Accuracy of measures for antiretroviral adherence in people living with HIV. Cochrane Database Syst Rev. 2022;7(7):CD013080.

162. Jennings L, Robbins RN, Nguyen N, Ferraris C, Leu CS, Dolezal C, et al. Tenofivir diphosphate in dried blood spots predicts future viremia in persons with HIV taking antiretroviral therapy in South Africa. AIDS. 2022;36(7):933–40.

163. Bardon AR, Simon JM, Layman LM, Steiker JD, Drain PK. Perspectives on the utility and interest in a point-of-care urine tenofovir test for adherence to HIV pre-exposure prophylaxis and antiretroviral therapy: an exploratory qualitative assessment among U.S. clients and providers. AIDS Res Ther. 2020;17(1):1–10.

164. Garfield S, Clifford S, Eliasson L, Barber N, Willson A. Suitability of measures for antiretroviral adherence in people living with HIV. Cochrane Database Syst Rev. 2020;20(4):998–1022.

166. Richard AA, Shea K. Delineation of self-care and associated concepts. J Nurs Scholarsh. 2011;43(3):255–64.

167. Topp SM, Mwamba C, Sharma A, Mukamba N, Beres LK, Geng E, et al. Rethinking retention: mapping interactions between multiple factors that influence long-term engagement in HIV care. PLoS One. 2018;13(3):e0193641.

168. Crowley T, Van der Merwe A, Kidd M, Skinner D. Measuring adolescents failing second-line antiretroviral treatment in a public sector HIV clinic in Johannesburg, South Africa. Clin Epidemiol. 2018;10:17–29.

169. Hine P, Smith R, Eshun-Wilson I, Orrell C, Cohen K, Leeflang MMG, et al. Measures of antiretroviral adherence for detecting viral non-suppression in people living with HIV. Cochrane Database Syst Rev. 2018.

170. GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396:1204–22.

171. World Health Organization. Policy Brief: consolidated guidelines on the use of antiretroviral therapy and preventing HIV infection. What’s new. WHO guidelines. 2015.

172. Western Cape Government Department of Health. The Western Cape Consolidated Guidelines for HIV Treatment: Prevention of Mother-to-Child Transmission of HIV (PMTCT), Children, Adolescents and Adults. Cape Town; 2020:1–76.

173. Hirasen K, Evans D, Maskew M, Sanne IM, Shearer K, Govathson C, et al. The right combination – treatment outcomes among HIV-positive patients initiating first-line fixed-dose antiretroviral therapy in a public sector HIV clinic in Johannesburg, South Africa. Clin Epidemiol. 2018;10:79–80.

175. The World Health Organization. Update of recommendations on first- and second-line antiretroviral regimens. Geneva; 2019.

176. Boule A, Hekees A, Tiffin N, Smith M, Mutemarina T, Zinyakatira N, et al. Data Centre Profile: The Provincial Health Data Centre of the Western Cape. Int J Popul Data Sci. 2019;4(2):06.

177. Heestermans T, Browne JL, Aitken SC, Vervoort SC, Klipstein-Grobusch K. Determinants of adherence to antiretroviral therapy among HIV-positive adults in sub-Saharan Africa: a systematic review. BMJ Glob Health. 2016;1(4):e000125.

178. Kaplan S, Nteso KS, Ford N, Boule A, Meintjes G. Loss to follow-up from antiretroviral therapy clinics: a systematic review and meta-analysis of published studies in South Africa from 2011 to 2015. South Afr J HIV Med. 2019;20(1):984.

179. Kamadjeu R. English: the lingua franca of scientific research. Lancet Glob Health. 2019;7(9):e1174.

180. HIV/AIDS - adult prevalence rate. The World Factbook. 2021 [cited 2021 Aug 4]. Available from: https://www.cia.gov/the-world-factbook/field/hiv-aids/adult-prevalence-rate/country-comparison

SUPPORTING INFORMATION

Additional information may be found under the Supporting Information tab for this article:

Additional files
Table S1: Example search strategy for the PubMed database.
Table S2: Justification for the search parameters, search limits and eligibility criteria for inclusion of sources in the scoping study.
Table S3: Data extracted from the included sources identified in the search.
Table S4: List of included sources.
Table S5: List of measures removed during analysis.
Table S6: Measures of retention with detailed information on their use.
Table S7: Measures of adherence with detailed information on their use.
Table S8: Measures of active self-management with detailed information on their use.
Table S9: Measures of multi-dimensional engagement with detailed information on their use.
Table S10: Measures of treatment outcome with detailed information on their use.

File S1: Members of the InCARE Stakeholder Group.