Hickey et al. Implementation Science (2017) 12:102
DOI 10.1186/s13012-017-0630-8

Implementation Science

SYSTEMATIC REVIEW Open Access

Specification of implementation interventions to address the cascade of HIV care and treatment in resource-limited settings: a systematic review

Matthew D. Hickey[1], Thomas A. Odeny[2], Maya Petersen[3], Torsten B. Neilands[4], Nancy Padian[3], Nathan Ford[5], Zachary Matthay[6], David Hoos[7], Meg Doherty[5], Chris Beryer[8], Stefan Baral[8] and Elvin H. Geng[9*]

Abstract

Background: The global response to HIV has started over 18 million persons on life-saving antiretroviral therapy (ART)—the vast majority in low- and middle-income countries (LMIC)—yet substantial gaps remain: up to 40% of persons living with HIV (PLHIV) know their status, while another 30% of those who enter care are inadequately retained after starting treatment. Identifying strategies to enhance use of treatment is urgently needed, but the conceptualization and specification of implementation interventions is not always complete. We sought to assess the completeness of intervention reporting in research to advance uptake of treatment for HIV globally.

Methods: We carried out a systematic review to identify interventions targeting the adult HIV care cascade in LMIC dating from 1990 to 2017. We identified components of each intervention as "intervention types" to decompose interventions into common components. We grouped "intervention types" into a smaller number of more general "implementation approaches" to aid summarization.
We assessed the reporting of six intervention characteristics adapted from the implementation science literature: the actor, action, action dose, action temporality, action target, and behavioral target in each study.

Findings: In 157 unique studies, we identified 34 intervention "types," which were empirically grouped into six generally understandable "approaches." Overall, 42% of interventions defined the actor, 64% reported the action, 41% specified the intervention "dose," 43% reported action temporality, 61% defined the action target, and 69% reported a target behavior. Average completeness of reporting varied across approaches from a low of 50% to a high of 72%. Dimensions that involved conceptualization of the practices themselves (e.g., actor, dose, temporality) were in general less well specified than consequences (e.g., action target and behavioral target).

Implications: The conceptualization and Reporting of implementation interventions to advance treatment for HIV in LMIC is not always complete. Dissemination of standards for reporting intervention characteristics can potentially promote transparency, reproducibility, and scientific accumulation in the area of implementation science to address HIV in low- and middle-income countries.

Keywords: HIV, Resource-limited settings, Cascade of care, Implementation science, Reporting

* Correspondence: Elvin.Geng@ucsf.edu
[9]Division of ID HIV and Global Medicine, San Francisco General Hospital, Department of Medicine, UCSF, Building 80, 6th Floor, 1001 Potrero Avenue, San Francisco, CA 94110, USA
Full list of author information is available at the end of the article

Background

The global public health response to HIV has made highly efficacious antiretroviral therapy widely available in low- and middle-income countries (LMIC), but vulnerable health systems as well as social and structural barriers to patient engagement have limited full impact. Today, as many as 30% of HIV-infected persons in the more broadly generalized HIV epidemics across sub-Saharan Africa have not been tested: 10%-25%% of those found to be living with HIV have not enrolled in HIV care and an estimated 30% of those who have started treatment are not adequately retained in care [1, 2]. In order to meet the ambitious 90-90-90 targets set by Joint United Nations Programme on HIV and AIDS (UNAIDS) in 2014, there is an urgent need for research to identify implementation interventions to promote uptake and sustained use of antiretroviral treatment [3]. Diverse implementation strategies to enhance uptake of HIV treatment include use of peer and lay healthcare workers, community-based treatment strategies, integration of HIV with maternal health services, and mHealth approaches.

At present, however, consensus about conceptualization and reporting of implementation research does not yet fully exist, potentially undermining the reproducibility, transparency, and generalizability of research in this area. Guidance for how best to specify implementation interventions is emerging, but uptake of these practices among researchers addressing HIV in the global context is unknown [4]. In 2013, Proctor et al. suggested that all implementation interventions should state at a minimum: who carries out the intervention (i.e., the "actors"); the specific activities (i.e., "action"); the timing, frequency, and intensity of those activities (i.e., "dose," "temporality"); the target of the described action (i.e., "action target"); and the targeted behavior on the pathway to a desired outcome (i.e., "implementation outcomes"). In 2014, Pinnock et al. suggested formal Standards for Reporting Implementation Studies of Complex Interventions (STaRI) [5]. Subsequently, a checklist to facilitate reporting titled Template for Intervention Description and Replication (TIDieR) has also been published [6]. Prior reviews of interventions for promoting uptake of HIV treatment have synthesized effects of broad categories of implementation interventions [7–12], but none explicitly address the completeness of intervention specification and reporting.

To appraise the level of reporting the implementation science literature seeking to enhance the use of antiretroviral therapy in LMIC, we carried out a systematic review. We define an implementation intervention as any intervention that seeks to improve uptake or sustained delivery of HIV care and treatment across any step of the HIV cascade of care. We sub-divide antiretroviral therapy implementation into the well-described set of discrete steps known as the HIV "Cascade of Care." While Other reviews have summarized the effects of these interventions, we seek to describing the extent to which reports describe the nature of the intervention being implemented using an approach adapted from Proctor et al. We compared completeness of intervention reporting across different types of implementation interventions (e.g., mHealth, peer support) as well as by outcomes as defined by the particular step in the HIV care cascade (e.g., HIV testing, retention in care) that the intervention addressed.

Methods

Search strategy

We searched for studies of implementation interventions that were evaluated against a comparator and which targeted the adult HIV care cascade in low- and middle-income countries, as defined by the World Bank. The steps in the care and treatment cascade include HIV testing, linkage to care, staging for ART, retention in pre-ART care, initiation of ART, retention on ART, and ART medication adherence [13]. We considered HIV RNA suppression to be a surrogate outcome that combined information from multiple cascade steps, rather than a specific process itself and thus did not include studies that focused solely on HIV RNA suppression as the outcome. We excluded studies that merely evaluated the impact of predictors that are not directly modifiable on outcomes of interest (e.g., impact of gender or socioeconomic status on outcomes). We included prevention of mother to child transmission (PMTCT) studies that focused on maternal cascade outcomes, but to prevent excessive heterogeneity of patient populations, we excluded studies solely focused on infant diagnosis or prevention. Full search criteria can be found in Additional file 1.

We conducted our search within PubMed, Cochrane CENTRAL, WHO Global Health Library, SCOPUS, and Web of Science. Our original search was conducted on March 27, 2014, and included studies from 1996 through that date. We subsequently updated the searches on February 28, 2017, using only PubMed (PubMed yielded 94% of the total articles from the initial search). Our search strategy included four primary search terms linked by "AND": (1) term indicating that study involved a comparator (e.g., randomized trial, cohort, prospective, relative risk); (2) term indicating LMIC; (3) term indicating that study involved HIV; and (4) term indicating that study involved implementation intervention OR cascade of care outcome. Additionally, we reviewed relevant systematic reviews and consulted experts in the field to identify additional articles that were not included (yield of 21 additional studies not identified in the search).

All studies underwent title review by one author (MDH); at which point, clearly irrelevant studies were

screened out—generally because they were duplicate reports, represented basic science work, did not involve any comparison, did not involve a LMIC, or were not addressing an HIV cascade of care outcome. The remaining studies underwent title and abstract review, with full-text consultation when necessary, by two reviewers (MDH and TAO). Studies were included or excluded in the final review by consensus after independent review; discrepancies were resolved by discussion together with a third reviewer (EHG).

Measurements

We captured both coded and unstructured data from each intervention using a Microsoft Access database including identifying information, study design, and level of intervention (e.g., system, organization, individual) (see Additional file 2 for data forms). For practical reasons, we considered each study report as the basic unit of analysis. We recorded the number of patients included in assessment of the cascade outcome of interest in each study. To approximate the frequency of reporting of negative studies, we recorded whether the study reported a positive effect for any of the cascade outcomes included, defined as a statistically significant improvement in any cascade outcome recorded.

We collected information on the "cascade of care" step addressed in each study and assessed for reporting on the behavioral target, action target, actor, action, dose, and temporality of each intervention using a pre-defined protocol (Additional file 3). These characteristics were adapted from the framework proposed by Proctor et al. [4] (Table 1). We perceived the "behavioral target" to be the link between the intervention action and the cascade step. Although the original Proctor framework used "implementation outcomes" in this step, we view many implementation outcomes as either behaviors or immediate antecedents of behavior (e.g., acceptability, adoption, sustainability) and therefore substitute the term "behavioral target" broadly to represent any behavior in health systems, organizations, providers, patients, and community members the intervention was meant to change. In turn, these behavioral targets are in general necessary but usually insufficient component causes of a cascade step.

We next used Susan Michie's Capability, Opportunity, Motivation, and Behavior (COM-B) framework to identify whether an action target was present and whether this action target was the capability, opportunity, or motivation of the agent for whom the intervention attempted to change behavior [14]. Though the original Proctor framework states that an action target should be

Table 1 Intervention components

Intervention component	Description	Example
Actor	People or organization responsible for carrying out the designated intervention action	For example, in a peer support intervention, whether or not the peer is a person living with HIV him or herself is an important aspect of being a peer
Action	The specific set of steps required for carrying out the intervention	For example, a study quantifying the effect of a decentralized system vs a non-decentralized system may not specify how decentralization occurred.
Dose	The frequency with which intervention components are delivered to target population	For example, counseling interventions could vary by the duration of each session, the frequency that sessions are delivered, and the total number of sessions
Temporality	The timing of intervention action as related to other underlying processes	For an intervention to accelerate ART initiation: patients attending an HIV clinic undergo brief counseling and are offered to start ART on the date of the first clinic visit
Action target	The capability, motivation, or opportunity of an individual or organization which the action is intended to modify	HIV testing: First, the government launches a community-based HIV testing campaign. Second, an outreach team attached to the testing campaign offers community members transportation to the campaign on a free bus. Finally, a lottery is being held at the campaign and one person who receives HIV testing will win a bicycle at the health campaign. In this example, the action target of the campaign itself is that the intervention creates an *opportunity* for HIV testing. The action target of the free bus is the patient's *capability* to attend the campaign. The action target of the lottery is the patient's *motivation* to attend the campaign
Behavioral target	The particular behavior the intervention action is intended to elicit as a result of its action on the action target (i.e., modification of capability, motivation, or opportunity of the targeted individual or organization). This may be identical to the cascade outcome or may be an additional behavior proximal to the cascade outcome	ART initiation: an implementation intervention to address this cascade gap could act on a patient behavioral target to encourage them to make a *verbal request of ART* from providers once they know they are eligible. Another intervention could work on a behavioral target in the providers so that they *offer or prescribe* ART more readily

specified according to "conceptual models of implementation," we felt that the COM-B framework provided a sufficiently general definition of the determinants of behavior change that could be broadly applied. We considered an action target to be present if the study authors specified a hypothesized intervention impact on at least one of these domains for the person or entity for whom the intervention is designed to change behavior. We next determined whether the study provided details on the specific actions that were taken in the intervention to achieve the intended behavior change, as well as the frequency and intensity of this action (i.e., dose) and the relation of the timing of the action to underlying events (i.e., temporality). Finally, we assessed whether the study reported who the agent was that carried out the action. For all of the above components, we counted them as "present" if any aspect of the component was mentioned, regardless of the quality or level of detail in reporting of the component in question. For example, an intervention to enhance the cascade step of "ART initiation" might seek to increase health care provider prescription of ART (i.e., the behavioral target) by changing their motivation to do so (i.e., the action target) through opinion-leader (i.e., actor)-led training about the risks of delay (i.e., the action). It might be specified that teaching would be carried out for new providers at the time of hire (i.e., temporality) and reinforced at hour-long sessions quarterly (i.e., dose).

We did not attempt to evaluate the quality of reporting within each domain due to the inherent subjectivity of such an assessment and lack of clear framework for rating such quality. Full description of our measurement approach can be found in the study protocol in Additional file 2, and further examples can be seen in Table 2. It should be noted that though the initial Proctor framework also included "justification" of the approach chosen as a key factor that should be reported, we excluded this from our assessment due to the inherent subjectivity in qualitatively assessing whether or not appropriate justification was provided.

Analysis

Classification of interventions: intervention types and approaches

Implementation interventions reported in these studies were grouped in order to reduce the dimensionality of the data and facilitate summarization. The grouping was complicated by two facts: first, no two studies examined the exact same intervention and, second, many interventions were composed of multiple components, each with different actions. We attempted to summarize the types of interventions included in these studies using a two-step process. We first empirically classified each intervention using generally recognizable "prototypes" based largely on the action, agreed upon through iterative evaluation by three of the authors who work in the HIV field (MDH, TAO, EHG). We initially generated a list of all intervention types that these three authors had encountered in literature in the field. Subsequently, the above three authors independently extracted data from ten studies and, through discussion, developed consensus about classification of each study and intervention types included. Discussion of these articles led to additions to our list, after which we developed operational definitions for all intervention types included (Table 2). This list and set of definitions was used for full data extraction of all included articles. For example, we considered "counseling" to be an intervention type and defined this in accordance with common practice as "Interpersonal assistance or guidance to address individual personal, social or psychological problems." Table 2 contains a full list intervention types utilized. Under this approach, a single intervention presented in a study report could be composed of multiple intervention types. For example, an intervention providing peer counseling with short message service (SMS) follow-up messages could be classified as "mHealth," "counseling," and "peer support." Once we developed a full list of intervention types, the above authors empirically combined these interventions into six general groupings based on generally recognizable groupings of interventions. These more general groupings are referred to as "intervention approaches" (Table 2). The intervention types and approaches listed in Table 2 represent our best attempt at characterizing interventions, though it should be emphasized that misclassification is possible and reproducibility by others outside our group is not known.

Completeness of implementation intervention specification

We assessed the prevalence of reporting of the six characteristics adapted from Proctor overall, in each intervention approach, as well as for each step in the HIV cascade of care. We generated a suggested "score" from 0 to 6 for each study by summing the presence of reporting for each characteristic of interest. We then applied univariable linear regression to evaluate the association between study design, year of publication, intervention approach, and cascade step addressed on reporting completeness. We used robust standard errors to account for clustering within studies. To evaluate for nonlinear contributions of year of publication, we also fit restricted cubic splines and included them in an additional model.

Results

Search results and study characteristics

Our initial search yielded 13,744 articles (Fig. 1). Review of references from recent systematic reviews and

Table 2 Frequency of intervention approaches and intervention types

Intervention approaches	*n*	%	Intervention type	*n*	%	Definition
Service delivery	81	52	Outreach	23	15	Contact with the patient by the facility to encourage a health care behavior which is typically not a part of a longitudinal relationship
			Decentralization	16	10	Expansion of services to lower-level health delivery units
			Mobile testing	14	9	HIV testing delivery that involve mobile units
			Point-of-care	10	6	Use diagnostic materials that can be used at the interface between system or provider and patient and which yield results in near real time
			DOT	7	4	Observation of drug ingestion
			Navigator	7	4	A health worker who engages in a long-term guidance, whether psychosocial or logistical, with a patient, which is at least in part in the community
			Service expansion	7	4	Provision of a new or expanded health services
			Integration	6	4	Colocation of health services
			Home-based care	4	3	Any health care activities taken in the community or home of the patient
			Adjunctive services	3	2	Services provided that are not for HIV care but which are meant to facilitate update of HIV care
			Community-based care	2	1	
Infrastructure/management	43	27	Task shifting	25	16	Distribution of health care activities to lower cadres of health workers
			Guidelines	12	8	Normative technical guidance
			Health worker training	9	6	Skills or motivational development in health care workers
			Management	8	5	Organization and control of human and material resources
			Leadership	3	2	Development of capabilities of managers and health workers to organize and execute objectives in the health delivery environment
			QI	3	2	Application of an established methodology to harness organizational capacity for practice change
Counseling	37	24	Counseling	35	22	Interpersonal assistance or guidance to address individual personal, social, or psychological problems
			Patient skill development	13	8	Development of habits, knowledge, and efficacy of patients
Social/behavioral	34	22	Social support (non-peer)	18	11	Use of social support but from individuals not necessarily in the target patient's social groups (for example, male involvement in pMTCT)
			Peer support (community-based)	15	10	Use of individuals from similar social groups to support health behavior where interactions are predominantly in the community
			Peer support (facility-based)	6	4	Use of individuals from similar social groups to support health behavior and where interactions are in the health care facility only
			Male involvement	1	1	Engagement of men in health where primary target of health outcome is woman or child
Technology	29	18	Reminder	22	14	Use of reminders to prompt action on the part of patients or providers
			mHealth	14	9	Actions to influence health behavior through use of a cell phone technology
			Technology	13	8	Use of electronic or other novel devices or processes other than phones
			Data management	4	3	Use of data summarization, display, or analysis to guide action
Demand creation	27	17	Incentives	13	8	Provision of material inducements, whether conditional or not, to promote a health behavior
			Community mobilization	8	5	Activities to motivate individuals to engaging the larger, geographically defined social network
			Food supplementation	7	4	Disbursement of food
			Behavioral economics	3	2	Interventions addressing principles in behavioral economics
			Demand creation	3	2	Interventions that market the HIV cascade interventions through promoting awareness and reach
			Health campaign	3	2	Event or series of events designed to promote uptake of or engagement in healthcare services
			Marketing/mass communication	2	1	Use of communications and mass media, such as radio, to promote a health activity

consulting with experts in the field yielded an additional 21 articles that were included, resulting in 13,765 articles reviewed. Twelve thousand seven hundred seventy-one were excluded based on the titles (excluded if the title clearly suggested that the study was not LIMC, HIV-related, addressing a cascade of care outcome, or lacked a comparator group), and 642 were duplicate reports. Abstracts and, where necessary, full text of 352 articles was examined by both reviewers. Of these, 157 were included in the final analysis [15–171]. Eighty-eight percent of included interventions took place across sub-Saharan Africa (Table 3). The most common study designs were retrospective cohort studies (25%) and individual randomized controlled trials (25%), followed by before-and-after design (17%). Most interventions sought to influence individual patient behavior (63%, e.g., impact of peer-delivered directly observed therapy on individual patient adherence [133]) and non-patient community members (15%, e.g., encouraging community members to be tested for HIV [153]). The remaining studies addressed healthcare worker behavior (10%, e.g., task shifting intervention to allow nurses to initiate and refill ART [53]) and organizational behavior (13%, e.g., impact of guidelines on health center adherence to ART initiation within 8 weeks of TB treatment initiation [41]). The median sample size of included studies was 955 participants (IQR 400–4903).

Identification of intervention types and approaches

In the 157 studies, we identified a total of 34 intervention types (Table 2). The most common intervention type was counseling (22%), followed by task shifting (16%), outreach (15%), and reminders (14%). Most studies examined multi-faceted interventions. For example, Franke [60] reported on an "accompaniment" intervention in Rwanda where a community health worker made daily visits to the patients' homes and provided social support, adverse event evaluation, directly observed therapy, and dispensed food supplementation. The intervention types therefore included actions of "counseling," "social support (non-peer)," "directly observed therapy," "food supplementation," and "incentive." As a point of contrast, Igumbor [77] studied a "patient advocate" intervention in South Africa in which facility-based staff made home visits, assessed barriers to adherence, counseled about adherence, and planned adherence support services. Therefore, this study included "counseling" and

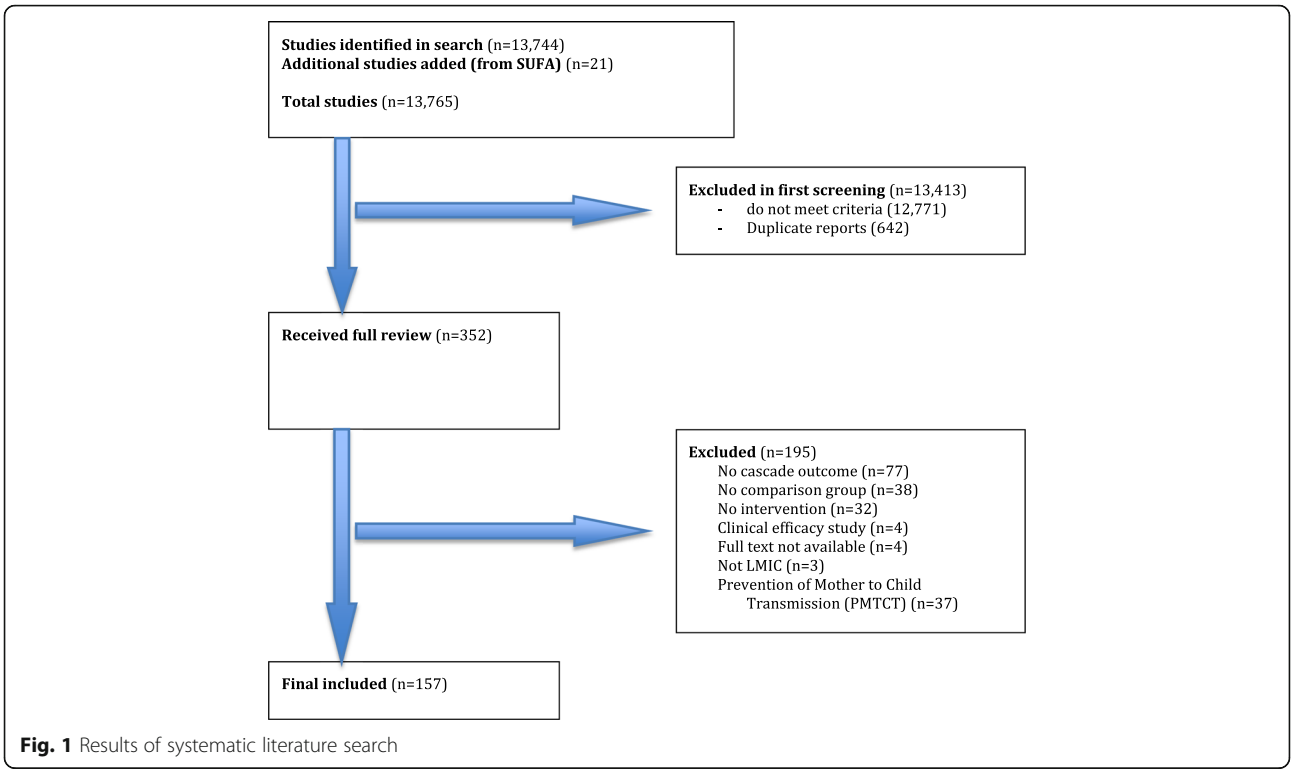

Fig. 1 Results of systematic literature search

"peer support (community-based)" intervention types, but would not include "directly observed therapy" or "food supplementation."

Overall reporting of implementation interventions

Across all studies, the number of Proctor-based intervention dimensions reported was normally distributed with a median of three out of a maximum of six (Fig. 2). Ten percent (16/157) of studies reported zero of the six dimensions, and 19% (30/157) reported all six. In general, across all studies, the intervention dimensions that were closer to the cascade step of interest tended to be more completely reported than "upstream" components of the intervention (such as the actor, dose, and temporality): 69% of studies reported a "behavioral target" and 61% reported an "action target" of the intervention, whereas 64% reported the "action," and 42% described "the actor" of the action (Additional file 4). Only 41% of studies reported the action "dose" and 43% reported "temporality." In unadjusted linear regression, publication year was not associated with completeness of reporting (0.09 points per year, 95% CI −0.03 to 0.20, p = 0.14). Use of restricted cubic splines to model effect of publication year did not reveal any non-linear trend in reporting completeness either. Study design was associated with completeness of reporting. Compared to retrospective cohort studies (n = 40), most other study designs were associated with improved reporting completeness, with before-and-after design (n = 27, +1.7, 95% CI 0.82–2.7), individual randomized controlled trials (RCT) (n = 40, +2.0, 95% CI 1.1–2.8), and cluster RCTs (n = 23, +1.7, 95% CI 0.79–2.7) all reaching statistical significance, and quasi-experimental designs approaching significance (n = 7, +1.9, 95% CI −0.19 to 3.9).

Intervention reporting by intervention approach

Overall, across six intervention approaches, the mean number of implementation dimensions reported ranged from 3.0 to 4.2 out of 6 (Table 4). Approaches that scored less well included service delivery (3.0), healthcare infrastructure/management (3.3), and social/behavioral (3.3). Technology interventions scored the highest (4.2). Examining the completeness of reporting of each Proctor dimension separately in each intervention approach provided additional resolution (Table 4). The actor was reported less than 50% of the time for demand creation, infrastructure/management, service delivery, and social/behavioral interventions. Dose and temporality were generally not well reported, with the exception of interventions using technology. Action target was also most frequently reported for technology interventions. The behavioral target was reported in more than 75% of the studies for four out of the six approaches. In a regression model, demand creation (+0.99, 95% CI 0.15–1.82) and technology interventions (1.42, 95% CI 0.69–2.15) were associated with more complete reporting (Table 5).

Table 3 Study characteristics (n = 157)

	n (median where specified)	% (IQR where specified)
Study design		
Retrospective cohort	40	25
Individual RCT	40	25
Before-and-after	27	17
Cluster RCT	23	15
Prospective cohort	16	10
Quasi-experimental	7	4
Cross-sectional	2	1
Case-control	2	1
Region[a]		
Africa	138	87
Asia	13	8
Americas	7	4
Level of behavioral target[b]		
Individuals—patients	75	62
Individuals—community members	18	15
Organizations	15	12
Individuals—healthcare workers	12	10
Study reported a positive effect		
No	46	29
Yes	111	71
Year of publication		
2004	1	1
2005	0	0
2006	2	1
2007	4	3
2008	6	4
2009	7	4
2010	18	11
2011	17	11
2012	29	18
2013	18	11
2014	8	5
2015	15	10
2016	24	15
2017[c]	8	5
Sample size[d] (median, IQR)	955	400 to 4903

[a]One study included sites in both Africa and Asia
[b]Limited to studies reporting a behavioral target (n = 120)
[c]Through 28 February 2017
[d]Sample size was determined by the number of individuals (patients or community members) included in the study, regardless of study design. Thus, sample size for cluster randomized controlled trials was recorded as the number of individuals, rather than the number of clusters

Intervention reporting by cascade target

Reporting of intervention dimensions ranged from a low of 2.7 out of 6 (n = 56) for retention on ART to a high of 4.3 out of 6 for those targeting staging (n = 12) (Table 6). Actor and temporality was most infrequently reported in testing, retention on ART, and adherence interventions. Infrequent reporting of dose was also common for testing and retention on ART interventions, as well as initiation interventions. Interventions targeting post-ART retention showed the most incomplete reporting—less than 50% in four of the six dimensions. Adherence interventions reported the actor and temporality less than 50% but had similar reporting frequency to other cascade steps for the remaining categories. A behavioral target was reported in over 75% of studies for all cascade steps except for retention on ART. In linear regression of reporting completeness (on a scale of zero to six total Proctor-based dimensions) by cascade step as a categorical variable, interventions targeting adherence had a trend toward more complete reporting (+0.78, 95% CI −0.02 to 1.57, p = 0.06) (Table 7).

Discussion

In this review, we found 157 studies that sought to improve uptake of HIV care and treatment in LMIC. We identified 34 intervention *types*, which we grouped into six general *approaches*. Overall, we found that implementation interventions addressing adult HIV care and treatment are often incompletely specified across dimensions that are important for fully characterizing a given intervention. A behavioral target for implementation interventions (the particular behavior that an intervention is intended to change) was specified with the greatest frequency, but even this dimension was reported in only two thirds of the studies, falling substantially short of universal coverage. Reporting of the "dose" and "temporality" of the particular intervention action were the least commonly reported.

We observed more complete reporting in certain types of interventions. Technological interventions, many of which were SMS-based interventions in this review, reported action, dose, temporality, and action target more consistently than other intervention approaches—a finding likely explained by the computerized, automated, and pre-programmed nature of systems to deliver SMS interventions. Despite increased frequency in reporting these domains, technology interventions reported a behavioral target with approximately the same frequency as other intervention approaches. The importance of identifying a behavioral target in an otherwise well-specified technology intervention is exemplified by a study in Kenya, which found that a weekly two-way SMS messaging system [102] improved virologic outcomes. However, the study did not report the intended

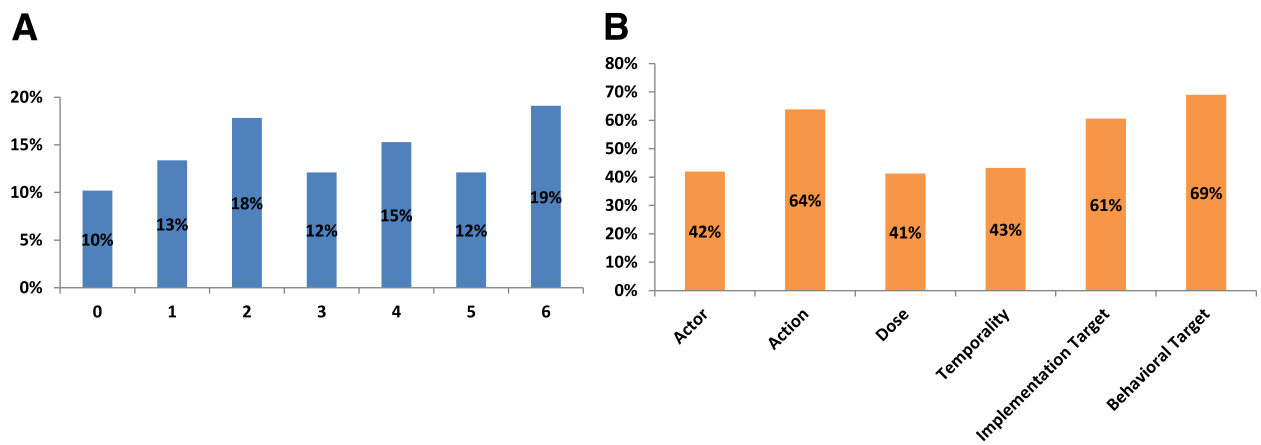

Fig. 2 **a** Number of implementation parameters reported in each study (max 6, *N* = 157). **b** Prevalence of reporting of each implementation parameter in each study (*N* = 157)

behavioral or intervention targets, which could potentially help explain observed effects in both this and other subsequent studies of SMS, not all of which showed positive effects.

Although multiple groups have issued reporting guidelines for implementation research [6], here, we extend the current scientific discourse on reporting through empiric quantification of the reporting gap in a specific topical area—care and treatment of HIV in LMIC. These findings suggest that implementation research targeting HIV treatment is an emerging area where standard reporting practices have not completely diffused into day-to-day scientific practice. Of concern, over the 13 years covered in this study, the average completeness of reporting has not changed.

Advancing reporting standards in research targeting implementation interventions is aligned with a broader movement in social and behavioral sciences to enhance transparency and bolster reproducibility [172]. One aspect of this movement is to ensure open access to materials that would be needed to reproduce the study; adequate specification of the details of the intervention is clearly critical to achieving such an objective. Specification also enables researchers seeking to evaluate the intervention in a new setting and implementers to scale up the intervention (perhaps with adaptations). For example, peer-based interventions where persons living with HIV and experienced with treatment offer knowledge, support, and care to those newly starting therapy are popular, but over 40% of such studies did not specify the selection, training, or remuneration of the peer educators under evaluation. Variation in the delivery of peer-based interventions along with the variable reporting are perhaps the two reasons that despite tremendous enthusiasm about their potential, some see peer-based interventions as nebulous and unconvincing.

Transportability—or the ability to use results from one setting to infer effects in another—takes a heightened

Table 4 Completeness of reporting of Proctor-based intervention dimensions overall and by intervention approach

	Counseling	Demand creation	Infrastructure/management	Service delivery	Social/behavioral	Technology
Actor	54%	37%	49%	42%	35%	55%
Action	76%	78%	65%	59%	68%	83%
Dose	41%	52%	40%	36%	41%	62%
Temporality	49%	37%	60%	36%	32%	62%
Implementation target	68%	70%	53%	60%	71%	86%
Behavioral target	78%	89%	67%	63%	79%	76%
Mean score	3.6	3.6	3.3	3.0	3.3	4.2
Total *n* by column	37	27	43	81	34	29

Cells in which reporting is less than 50% are dark red. Cells in which reporting is between 50 and 75% are pink. Cells in which reporting is above 75% are white. Totals are mean score out of total possible score of 6

Table 5 Association between implementation approach and interventions reporting

Implementation approach	Coefficient	95% CI		*p* value
Counseling	0.53	−0.14	−1.20	0.12
Demand creation	0.99	0.15	−1.82	0.02
Healthcare infrastructure/management	0.59	−0.21	−1.38	0.15
Service delivery	−0.17	−0.79	−0.45	0.58
Social/behavioral	−0.03	−0.74	−0.68	0.94
Technology	1.42	0.69	−2.15	<0.001

We used linear regression to assess change in a scale of one to six intervention dimensions reported on ten intervention approaches. Regression coefficients are interpreted as the change in score associated with the implementation approach

importance for implementation interventions because contextual diversity in implementation environments is the rule. Work by Pearl et al. underscores the critical role of hypothesizing about and measuring the mechanisms of effect to make inferences about anticipated effects in another [173, 174]. For example, one included study of an opinion leader-led coaching intervention in Uganda sought to accelerate uptake of ART through influencing frontline healthcare workers (e.g., clinical officers, nurses) [20]. Qualitative work, however, revealed that healthcare workers (HCWs) in turn influenced peer health workers, who prepared patients for ART initiation in the community even before encountering formal HCW, thus catalyzing the ART initiation process through a mechanism outside of the original design. Understanding this mechanism suggests that this intervention might have diminished effects in settings without peer health workers and might be improved with formal incorporation of this cadre into the intervention design where peers do exist.

There are several limitations with the search protocol and analytic approaches reported here. First, there is no single search term that will consistently identify implementation interventions. In HIV care and treatment, however, there is a widely excepted heuristic (i.e., the "cascade of care") for the macroscopic steps in public health activities (e.g., testing, linkage, retention, and adherence) that facilitated our search. Second, many interventions are composed of a "package" of different activities. We were unable to separate out intervention dimensions for each sub-component even though such an analysis might be revealing. Third, we grouped interventions into types and approaches that, by consensus of the authors, were understandable to public health practitioners; however, this grouping may be subject to debate and may not be comprehensive or reproducible. Fourth, deciding whether studies reported a particular characteristics of the implementation intervention is somewhat subjective, and therefore our assessments may be imperfectly reproducible.

Conclusions

Although intervention specification is critically important for pragmatic research, reporting of key intervention characteristics in studies targeting the HIV treatment cascade is not optimal. Poorly specified interventions present challenges to other researchers or to implementers who might seek to reproduce results or scale up the intervention, thus potentially undermining both

Table 6 Completeness of reporting of Proctor-based intervention dimensions overall and by HIV care cascade step

	Testing	Linkage	Staging	Initiation	Pre-ART retention	Retention on ART	Adherence
Actor	47%	64%	58%	52%	64%	44%	39%
Action	74%	79%	75%	61%	73%	51%	73%
Dose	37%	57%	58%	35%	64%	33%	57%
Temporality	34%	64%	75%	61%	64%	42%	47%
Implementation target	55%	64%	75%	58%	55%	56%	67%
Behavioral target	87%	86%	92%	81%	73%	45%	76%
Total score	3.3	4.1	4.3	3.5	3.9	2.7	3.6
Total *n* by column	38	14	12	31	11	55	49

Cells in which reporting is less than 50% are purple. Cells in which reporting is between 50 and 75% are pink. Cells in which reporting is above 75% are white

Table 7 Univariate regression of sum of six intervention reporting dimensions on each step in the cascade of care

Cascade step	Coefficient	95% CI		*p* value
Testing	0.32	−0.54	−1.18	0.47
Linkage to care	0.83	−0.37	−2.03	0.18
Staging	1.03	−0.23	−2.28	0.11
ART initiation	−0.02	−0.94	−0.90	0.96
Pre-ART retention in care	0.89	−0.63	−2.42	0.25
Retention in care on ART	−0.32	−1.09	−0.45	0.41
Adherence to ART	0.78	−0.02	−1.57	0.06

scientific progress as well as real-world utility. Inadequately specified interventions also complicate informal as well as formal knowledge accumulation through meta-analyses, which hold great promise as a tool to extend comparative effectiveness research [175, 176]. There is a movement in the social sciences to promote transparency, yet incompletely specified interventions are, by definition, opaque. Improving specification of implementation interventions represents a core component of the process toward achieving sustained viral suppression for all those living with HIV to improve clinical outcomes and prevent onward HIV transmission.

Additional files

Additional file 1: Search criteria. (DOCX 25 kb)
Additional file 2: Data entry form. (PDF 146 kb)
Additional file 3: Protocol. (DOCX 29 kb)
Additional file 4: Emblematic studies. (DOCX 15 kb)

Abbreviations

ART: Antiretroviral therapy; COM-B: Capability, Opportunity, Motivation, and Behavior framework; HCW: Healthcare workers; HIV: Human immunodeficiency virus; LMIC: Low- and middle-income countries; PMTCT: Prevention of mother to child transmission; RNA: Ribonucleic acid; SMS: Short message service; STaRI: Standards for Reporting Implementation Studies of Complex Interventions; TIDieR: Template for Intervention Description and Replication; UNAIDS: Joint United Nations Programme on HIV and AIDS; WHO: World Health Organization

Acknowledgements

The authors would like to thank Hacsi Horvath for assistance with setting up and executing the searches.

Funding

There are no funding sources to report for this study.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

MDH, TAO, and EHG designed the review and wrote the initial study protocol. MDH, TAO, ZM, and EHG collected the data. MDH and EHG analyzed the data and wrote the first draft of the manuscript. All authors contributed to the interpretation of the data and critical revision of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Author details

[1]Division of General Internal Medicine, San Francisco General Hospital, Department of Medicine, University of California, San Francisco (UCSF), San Francisco, CA, USA. [2]Kenya Medical Research Institute, Nairobi, Kenya. [3]Department of Biostatistics and Epidemiology, School of Public Health, University of California, Berkeley, CA, USA. [4]Center for AIDS Prevention Studies, Department of Medicine, UCSF, San Francisco, CA, USA. [5]Department of HIV/AIDS, World Health Organization, Geneva, Switzerland. [6]School of Medicine, UCSF, San Francisco, CA, USA. [7]Mailman School of Public Health, Columbia University, New York, NY, USA. [8]Center for Public Health and Human Rights, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA. [9]Division of ID HIV and Global Medicine, San Francisco General Hospital, Department of Medicine, UCSF, Building 80, 6th Floor, 1001 Potrero Avenue, San Francisco, CA 94110, USA.

Received: 26 October 2016 Accepted: 17 July 2017
Published online: 08 August 2017

References

1. Fox MP, Rosen S. Retention of adult patients on antiretroviral therapy in low- and middle-income countries: systematic review and meta-analysis 2008-2013. J Acquir Immune Defic Syndr. 2015;69:98–108.
2. Rosen S, Fox MP. Retention in HIV care between testing and treatment in sub-Saharan Africa: a systematic review. PLoS Med. 2011;8:e1001056.
3. UNAIDS. Ambitious treatment targets: writing the final chapter on the AIDS epidemic. In. Geneva: Joint United Nations Programme on HIV/AIDS; 2014.
4. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. Implement Sci. 2013;8:139.
5. Pinnock H, Epiphaniou E, Sheikh A, Griffiths C, Eldridge S, Craig P, et al. Developing standards for reporting implementation studies of complex interventions (StaRI): a systematic review and e-Delphi. Implement Sci. 2015; 10:42.
6. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ. 2014;348:g1687.
7. Barnighausen T, Tanser F, Dabis F, Newell ML. Interventions to improve the performance of HIV health systems for treatment-as-prevention in sub-Saharan Africa: the experimental evidence. Curr Opin HIV AIDS. 2012;7:140–50.
8. Glasgow RE, Eckstein ET, Elzarrad MK. Implementation science perspectives and opportunities for HIV/AIDS research: integrating science, practice, and policy. J Acquir Immune Defic Syndr. 2013;63(Suppl 1):S26–31.
9. Govindasamy D, Ford N, Kranzer K. Risk factors, barriers and facilitators for linkage to antiretroviral therapy care: a systematic review. AIDS. 2012;26: 2059–67.
10. Padian NS, Holmes CB, McCoy SI, Lyerla R, Bouey PD, Goosby EP. Implementation science for the US President's Emergency Plan for AIDS Relief (PEPFAR). J Acquir Immune Defic Syndr. 2011;56:199–203.
11. Schackman BR. Implementation science for the prevention and treatment of HIV/AIDS. J Acquir Immune Defic Syndr. 2010;55(Suppl 1):S27–31.
12. Suthar AB, Hoos D, Beqiri A, Lorenz-Dehne K, McClure C, Duncombe C. Integrating antiretroviral therapy into antenatal care and maternal and child health settings: a systematic review and meta-analysis. Bull World Health Organ. 2013;91:46–56.
13. Gardner EM, Young B. The HIV care cascade through time. Lancet Infect Dis. 2014;14:5–6.

14. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci. 2011;6:42.
15. Abas M, Nyamayaro P, Bere T, Saruchera E, Mothobi N, Simms V, et al. Feasibility and acceptability of a task-shifted intervention to enhance adherence to HIV medication and improve depression in people living with hiv in Zimbabwe, a low income country in sub-Saharan Africa. AIDS Behav. 2017. [epub ahead of print].
16. Abdool Karim SS, Naidoo K, Grobler A, Padayatchi N, Baxter C, Gray AL, et al. Integration of antiretroviral therapy with tuberculosis treatment. N Engl J Med. 2011;365:1492–501.
17. Achieng L, Musangi H, Billingsley K, Onguit S, Ombegoh E, Bryant L, et al. The use of pill counts as a facilitator of adherence with antiretroviral therapy in resource limited settings. PLoS One. 2013;8:e67259.
18. Aderemi-Williams RI, Tayo F, Sagoe A, Zachariah MP. Effect of 2 models of care and factors predicting patients' adherence to doctor's appointment attendance in Lagos State University Teaching Hospital, Ikeja, Lagos, Nigeria. J Int Assoc Provid AIDS Care. 2017;16:296–302.
19. Alamo ST, Wagner GJ, Sunday P, Wanyenze RK, Ouma J, Kamya M, et al. Electronic medical records and same day patient tracing improves clinic efficiency and adherence to appointments in a community based HIV/AIDS care program, in Uganda. AIDS Behav. 2012;16:368–74.
20. Amanyire G, Semitala FC, Namusobya J, Katuramu R, Kampiire L, Wallenta J, et al. Effects of a multicomponent intervention to streamline initiation of antiretroviral therapy in Africa: a stepped-wedge cluster-randomised trial. Lancet HIV. 2016;3:e539–48.
21. Arrive E, Dicko F, Amghar H, Aka AE, Dior H, Bouah B, et al. HIV status disclosure and retention in care in HIV-infected adolescents on antiretroviral therapy (ART) in West Africa. PLoS One. 2012;7:e33690.
22. Auld AF, Nuwagaba-Biribonwoha H, Azih C, Kamiru H, Baughman AL, Agolory S, et al. Decentralizing access to antiretroviral therapy for children living with HIV in Swaziland. Pediatr Infect Dis J. 2016;35:886–93.
23. Aung PP, Ryan C, Bajracharya A, Pasricha N, Thein ZW, Agius PA, et al. Effectiveness of an integrated community- and clinic-based intervention on HIV testing, HIV knowledge, and sexual risk behavior of young men who have sex with men in Myanmar. J Adolesc Health. 2017;60:S45–53.
24. Balcha TT, Jeppsson A. Outcomes of antiretroviral treatment: a comparison between hospitals and health centers in Ethiopia. J Int Assoc Physicians AIDS Care (Chic). 2010;9:318–24.
25. Bango F, Ashmore J, Wilkinson L, van Cutsem G, Cleary S. Adherence clubs for long-term provision of antiretroviral therapy: cost-effectiveness and access analysis from Khayelitsha, South Africa. Tropical Med Int Health. 2016; 21:1115–23.
26. Barton GR, Fairall L, Bachmann MO, Uebel K, Timmerman V, Lombard C, et al. Cost-effectiveness of nurse-led versus doctor-led antiretroviral treatment in South Africa: pragmatic cluster randomised trial. Tropical Med Int Health. 2013;18:769–77.
27. Bassett IV, Coleman SM, Giddy J, Bogart LM, Chaisson CE, Ross D, et al. Sizanani: a randomized trial of health system navigators to improve linkage to HIV and TB care in South Africa. J Acquir Immune Defic Syndr. 2016;73:154–60.
28. Bassett IV, Regan S, Luthuli P, Mbonambi H, Bearnot B, Pendleton A, et al. Linkage to care following community-based mobile HIV testing compared with clinic-based testing in Umlazi Township, Durban, South Africa. HIV Med. 2014;15:367–72.
29. Batavia AS, Balaji K, Houle E, Parisaboina S, Ganesh AK, Mayer KH, et al. Adherence to antiretroviral therapy in patients participating in a graduated cost recovery program at an HIV care center in South India. AIDS Behav. 2010;14:794–8.
30. Bedelu M, Ford N, Hilderbrand K, Reuter H. Implementing antiretroviral therapy in rural communities: the Lusikisiki model of decentralized HIV/AIDS care. J Infect Dis. 2007;196(Suppl 3):S464–8.
31. Bock P, Boulle A, White C, Osler M, Eley B. Provision of antiretroviral therapy to children within the public sector of South Africa. Trans R Soc Trop Med Hyg. 2008;102:905–11.
32. Braitstein P, Siika A, Hogan J, Kosgei R, Sang E, Sidle J, et al. A clinician-nurse model to reduce early mortality and increase clinic retention among high-risk HIV-infected patients initiating combination antiretroviral treatment. J Int AIDS Soc. 2012;15:7.
33. Brennan AT, Long L, Maskew M, Sanne I, Jaffray I, MacPhail P, et al. Outcomes of stable HIV-positive patients down-referred from a doctor-managed antiretroviral therapy clinic to a nurse-managed primary health clinic for monitoring and treatment. AIDS. 2011;25:2027–36.
34. Brunie A, Wamala-Mucheri P, Akol A, Mercer S, Chen M. Expanding HIV testing and counselling into communities: feasibility, acceptability, and effects of an integrated family planning/HTC service delivery model by Village Health Teams in Uganda. Health Policy Plan. 2016;31:1050–7.
35. Byamugisha R, Astrom AN, Ndeezi G, Karamagi CA, Tylleskar T, Tumwine JK. Male partner antenatal attendance and HIV testing in eastern Uganda: a randomized facility-based intervention trial. J Int AIDS Soc. 2011;14:43.
36. Cantrell RA, Sinkala M, Megazinni K, Lawson-Marriott S, Washington S, Chi BH, et al. A pilot study of food supplementation to improve adherence to antiretroviral therapy among food-insecure adults in Lusaka, Zambia. J Acquir Immune Defic Syndr. 2008;49:190–5.
37. Chan AK, Mateyu G, Jahn A, Schouten E, Arora P, Mlotha W, et al. Outcome assessment of decentralization of antiretroviral therapy provision in a rural district of Malawi using an integrated primary care model. Tropical Med Int Health. 2010;15(Suppl 1):90–7.
38. Chang LW, Kagaayi J, Arem H, Nakigozi G, Ssempijja V, Serwadda D, et al. Impact of a mHealth intervention for peer health workers on AIDS care in rural Uganda: a mixed methods evaluation of a cluster-randomized trial. AIDS Behav. 2011;15:1776–84.
39. Chang LW, Kagaayi J, Nakigozi G, Ssempijja V, Packer AH, Serwadda D, et al. Effect of peer health workers on AIDS care in Rakai, Uganda: a cluster-randomized trial. *PLoS One*. 2010;5:e10923.
40. Chang LW, Nakigozi G, Billioux VG, Gray RH, Serwadda D, Quinn TC, et al. Effectiveness of peer support on care engagement and preventive care intervention utilization among pre-antiretroviral therapy, HIV-infected adults in Rakai, Uganda: a randomized trial. AIDS Behav. 2015;19:1742–51.
41. Choun K, Pe R, Thai S, Lorent N, Lynen L, van Griensven J. Timing of antiretroviral therapy in Cambodian hospital after diagnosis of tuberculosis: impact of revised WHO guidelines. Bull World Health Organ. 2013;91:195–206.
42. Chung MH, Richardson BA, Tapia K, Benki-Nugent S, Kiarie JN, Simoni JM, et al. A randomized controlled trial comparing the effects of counseling and alarm device on HAART adherence and virologic outcomes. PLoS Med. 2011;8:e1000422.
43. Corbett EL, Dauya E, Matambo R, Cheung YB, Makamure B, Bassett MT, et al. Uptake of workplace HIV counselling and testing: a cluster-randomised trial in Zimbabwe. PLoS Med. 2006;3:e238.
44. Costa TM, Barbosa BJ, Gomes e Costa DA, Sigulem D, Fátima Marin H, Filho AC, et al. Results of a randomized controlled trial to assess the effects of a mobile SMS-based intervention on treatment adherence in HIV/AIDS-infected Brazilian women and impressions and satisfaction with respect to incoming messages. Int J Med Inform 2012,81:257-269.
45. Dalal S, Lee CW, Farirai T, Schilsky A, Goldman T, Moore J, et al. Provider-initiated HIV testing and counseling: increased uptake in two public community health centers in South Africa and implications for scale-up. PLoS One. 2011;6:e27293.
46. Das S, Carmone A, Franke MF, Frank D, Kiromat H, Kaima P, et al. Retention among ART patients in the Highlands of Papua New Guinea: evaluating the PAPUA model. J Acquir Immune Defic Syndr. 2014;65:e67–73.
47. de Tolly K, Skinner D, Nembaware V, Benjamin P. Investigation into the use of short message services to expand uptake of human immunodeficiency virus testing, and whether content and dosage have impact. Telemed J E Health. 2012;18:18–23.
48. de Walque D, Gertler PJ, Bautista-Arredondo S, Kwan A, Vermeersch C, de Dieu BJ, et al. Using provider performance incentives to increase HIV testing and counseling services in Rwanda. J Health Econ. 2015;40:1–9.
49. Etienne M, Burrows L, Osotimehin B, Macharia T, Hossain B, Redfield RR, et al. Situational analysis of varying models of adherence support and loss to follow up rates; findings from 27 treatment facilities in eight resource limited countries. Tropical Med Int Health. 2010;15(Suppl 1):76–81.
50. Ezeanolue EE, Obiefune MC, Ezeanolue CO, Ehiri JE, Osuji A, Ogidi AG, et al. Effect of a congregation-based intervention on uptake of HIV testing and linkage to care in pregnant women in Nigeria (Baby Shower): a cluster randomised trial. Lancet Glob Health. 2015;3:e692–700.
51. Ezeanolue EE, Obiefune MC, Yang W, Ezeanolue CO, Pharr J, Osuji A, et al. What do you need to get male partners of pregnant women tested for HIV in resource limited settings? The baby shower cluster randomized trial. AIDS Behav. 2017;21:587–96.
52. Faal M, Naidoo N, Glencross DK, Venter WD, Osih R. Providing immediate CD4 count results at HIV testing improves ART initiation. J Acquir Immune Defic Syndr. 2011;58:e54–9.

53. Fairall L, Bachmann MO, Lombard C, Timmerman V, Uebel K, Zwarenstein M, et al. Task shifting of antiretroviral treatment from doctors to primary-care nurses in South Africa (STRETCH): a pragmatic, parallel, cluster-randomised trial. Lancet. 2012;380:889–98.
54. Fatti G, Grimwood A, Bock P. Better antiretroviral therapy outcomes at primary healthcare facilities: an evaluation of three tiers of ART services in four South African provinces. PLoS One. 2010;5:e12888.
55. Fatti G, Meintjes G, Shea J, Eley B, Grimwood A. Improved survival and antiretroviral treatment outcomes in adults receiving community-based adherence support: 5-year results from a multicentre cohort study in South Africa. J Acquir Immune Defic Syndr. 2012;61:e50–8.
56. Fatti G, Mothibi E, Shaikh N, Grimwood A. Improved long-term antiretroviral treatment outcomes amongst patients receiving community-based adherence support in South Africa. AIDS Care. 2016;28:1365–72.
57. Fayorsey RN, Saito S, Carter RJ, Gusmao E, Frederix K, Koech-Keter E, et al. Decentralization of pediatric HIV care and treatment in five sub-Saharan African countries. J Acquir Immune Defic Syndr. 2013;62:e124–30.
58. Ferrand RA, Meghji J, Kidia K, Dauya E, Bandason T, Mujuru H, et al. Implementation and operational research: the effectiveness of routine opt-out HIV testing for children in Harare, Zimbabwe. J Acquir Immune Defic Syndr. 2016;71:e24–9.
59. Fiori K, Schechter J, Dey M, Braganza S, Rhatigan J, Houndenou S, et al. Closing the delivery gaps in pediatric HIV care in Togo, West Africa: using the care delivery value chain framework to direct quality improvement. AIDS Care. 2016;28(Suppl 2):29–33.
60. Franke MF, Kaigamba F, Socci AR, Hakizamungu M, Patel A, Bagiruwigize E, et al. Improved retention associated with community-based accompaniment for antiretroviral therapy delivery in rural Rwanda. Clin Infect Dis. 2013;56:1319–26.
61. Fylkesnes K, Sandoy IF, Jurgensen M, Chipimo PJ, Mwangala S, Michelo C. Strong effects of home-based voluntary HIV counselling and testing on acceptance and equity: a cluster randomised trial in Zambia. Soc Sci Med. 2013;86:9–16.
62. Fylkesnes K, Siziya S. A randomized trial on acceptability of voluntary HIV counselling and testing. Tropical Med Int Health. 2004;9:566–72.
63. Georgette N, Siedner MJ, Petty CR, Zanoni BC, Carpenter S, Haberer JE. Impact of a clinical program using weekly short message service (SMS) on antiretroviral therapy adherence support in South Africa: a retrospective cohort study. BMC Med Inform Decis Mak. 2017;17:18.
64. Gimbel-Sherr SO, Micek MA, Gimbel-Sherr KH, Koepsell T, Hughes JP, Thomas KK, et al. Using nurses to identify HAART eligible patients in the Republic of Mozambique: results of a time series analysis. Hum Resour Health. 2007;5:7.
65. Grabbe KL, Menzies N, Taegtmeyer M, Emukule G, Angala P, Mwega I, et al. Increasing access to HIV counseling and testing through mobile services in Kenya: strategies, utilization, and cost-effectiveness. J Acquir Immune Defic Syndr. 2010;54:317–23.
66. Grimsrud A, Kaplan R, Bekker LG, Myer L. Outcomes of a nurse-managed service for stable HIV-positive patients in a large South African public sector antiretroviral therapy programme. Tropical Med Int Health. 2014;19:1029–39.
67. Grimsrud A, Lesosky M, Kalombo C, Bekker LG, Myer L. Implementation and operational research: 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:e16–23.
68. Grimwood A, Fatti G, Mothibi E, Malahlela M, Shea J, Eley B. Community adherence support improves programme retention in children on antiretroviral treatment: a multicentre cohort study in South Africa. J Int AIDS Soc. 2012;15:17381.
69. Gross R, Zheng L, La Rosa A, Sun X, Rosenkranz SL, Cardoso SW, et al. Partner-based adherence intervention for second-line antiretroviral therapy (ACTG A5234): a multinational randomised trial. Lancet HIV. 2015;2:e12–9.
70. 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;30:1295–300.
71. Haskew J, Ro G, Turner K, Kimanga D, Sirengo M, Sharif S. Implementation of a cloud-based electronic medical record to reduce gaps in the HIV treatment continuum in rural Kenya. PLoS One. 2015;10:e0135361.
72. Hatcher AM, Turan JM, Leslie HH, Kanya LW, Kwena Z, Johnson MO, et al. Predictors of linkage to care following community-based HIV counseling and testing in rural Kenya. AIDS Behav. 2012;16:1295–307.
73. Hermans SM, Castelnuovo B, Katabira C, Mbidde P, Lange JM, Hoepelman AI, et al. Integration of HIV and TB services results in improved TB treatment outcomes and earlier prioritized ART initiation in a large urban HIV clinic in Uganda. J Acquir Immune Defic Syndr. 2012;60:e29–35.
74. Hershow R, Gannett K, Merrill J, Kaufman BE, Barkley C, DeCelles J, et al. Using soccer to build confidence and increase HCT uptake among adolescent girls: a mixed-methods study of an HIV prevention programme in South Africa. Sport Soc. 2015;18:1009–22.
75. Hewett PC, Nalubamba M, Bozzani F, Digitale J, Vu L, Yam E, et al. Randomized evaluation and cost-effectiveness of HIV and sexual and reproductive health service referral and linkage models in Zambia. BMC Public Health. 2016;16:785.
76. Himmich H, Ouarsas L, Hajouji FZ, Lions C, Roux P, Carrieri P. Scaling up combined community-based HIV prevention interventions targeting truck drivers in Morocco: effectiveness on HIV testing and counseling. BMC Infect Dis. 2015;15:208.
77. Igumbor JO, Scheepers E, Ebrahim R, Jason A, Grimwood A. An evaluation of the impact of a community-based adherence support programme on ART outcomes in selected government HIV treatment sites in South Africa. AIDS Care. 2011;23:231–6.
78. Ikeda JM, Tellez CA, Hudes ES, Page K, Evans J, Racancoj O, et al. Impact of integrating HIV and TB care and treatment in a regional tuberculosis hospital in rural Guatemala. AIDS Behav. 2014;18(Suppl 1):S96–103.
79. Iwuji CC, Orne-Gliemann J, Larmarange J, Okesola N, Tanser F, Thiebaut R, et al. Uptake of home-based HIV testing, linkage to care, and community attitudes about ART in rural KwaZulu-Natal, South Africa: descriptive results from the first phase of the ANRS 12249 TasP cluster-randomised trial. PLoS Med. 2016;13:e1002107.
80. Jaffar S, Amuron B, Foster S, Birungi J, Levin J, Namara G, et al. Rates of virological failure in patients treated in a home-based versus a facility-based HIV-care model in Jinja, southeast Uganda: a cluster-randomised equivalence trial. Lancet. 2009;374:2080–9.
81. Jani IV, Sitoe NE, Alfai ER, Chongo PL, Quevedo JI, Rocha BM, et al. Effect of point-of-care CD4 cell count tests on retention of patients and rates of antiretroviral therapy initiation in primary health clinics: an observational cohort study. Lancet. 2011;378:1572–9.
82. Jobarteh K, Shiraishi RW, Malimane I, Samo Gudo P, Decroo T, Auld AF, et al. Community ART support groups in Mozambique: the potential of patients as partners in care. PLoS One. 2016;11:e0166444.
83. Joseph Davey D, Nhavoto JA, Augusto O, Ponce W, Traca D, Nguimfack A, et al. SMSaude: evaluating mobile phone text reminders to improve retention in HIV care for patients on antiretroviral therapy in Mozambique. J Acquir Immune Defic Syndr. 2016;73:e23–30.
84. Kabore I, Bloem J, Etheredge G, Obiero W, Wanless S, Doykos P, et al. The effect of community-based support services on clinical efficacy and health-related quality of life in HIV/AIDS patients in resource-limited settings in sub-Saharan Africa. AIDS Patient Care STDs. 2010;24:581–94.
85. Kadede K, Ruel T, Kabami J, Ssemmondo E, Sang N, Kwarisiima D, et al. Increased adolescent HIV testing with a hybrid mobile strategy in Uganda and Kenya. AIDS. 2016;30:2121–6.
86. Khachani I, Harmouche H, Ammouri W, Rhoufrani F, Zerouali L, Abouqal R, et al. Impact of a psychoeducative intervention on adherence to HAART among low-literacy patients in a resource-limited setting: the case of an Arab country—Morocco. J Int Assoc Physicians AIDS Care (Chic). 2012;11:47–56.
87. Kipp W, Konde-Lule J, Saunders LD, Alibhai A, Houston S, Rubaale T, et al. Antiretroviral treatment for HIV in rural Uganda: two-year treatment outcomes of a prospective health centre/community-based and hospital-based cohort. PLoS One. 2012;7:e40902.
88. Kiragga AN, Nalintya E, Morawski BM, Kigozi J, Park BJ, Kaplan JE, et al. Implementation and operational research: impact of nurse-targeted care on HIV outcomes among immunocompromised persons: a before-after study in Uganda. J Acquir Immune Defic Syndr. 2016;72:e32–6.
89. Kiweewa FM, Wabwire D, Nakibuuka J, Mubiru M, Bagenda D, Musoke P, et al. Noninferiority of a task-shifting HIV care and treatment model using peer counselors and nurses among Ugandan women initiated on ART: evidence from a randomized trial. J Acquir Immune Defic Syndr. 2013;63:e125–32.
90. Kliner M, Knight A, Mamvura C, Wright J, Walley J. Using no-cost mobile phone reminders to improve attendance for HIV test results: a pilot study in rural Swaziland. Infect Dis Poverty. 2013;2:12.
91. Kohler PK, Chung MH, McGrath CJ, Benki-Nugent SF, Thiga JW, John-Stewart GC. Implementation of free cotrimoxazole prophylaxis improves clinic retention among antiretroviral therapy-ineligible clients in Kenya. AIDS. 2011;25:1657–61.

92. Kompala T, Moll AP, Mtungwa N, Brooks RP, Friedland GH, Shenoi SV. Impact of nurse-delivered community-based CD4 services on facilitating pre-ART care in rural South Africa. BMC Health Serv Res. 2016;16:374.
93. Kranzer K, Zeinecker J, Ginsberg P, Orrell C, Kalawe NN, Lawn SD, et al. Linkage to HIV care and antiretroviral therapy in Cape Town, South Africa. *PLoS One*. 2010;5:e13801.
94. Kundu CK, Samanta M, Sarkar M, Bhattacharyya S, Chatterjee S. Food supplementation as an incentive to improve pre-antiretroviral therapy clinic adherence in HIV-positive children—experience from eastern India. J Trop Pediatr. 2012;58:31–7.
95. 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;15:1795–802.
96. Kunutsor S, Walley J, Muchuro S, Katabira E, Balidawa H, Namagala E, et al. Improving adherence to antiretroviral therapy in sub-Saharan African HIV-positive populations: an enhanced adherence package. AIDS Care. 2012;24:1308–15.
97. Labhardt ND, Motlomelo M, Cerutti B, Pfeiffer K, Kamele M, Hobbins MA, et al. Home-based versus mobile clinic HIV testing and counseling in rural Lesotho: a cluster-randomized trial. PLoS Med. 2014;11:e1001768.
98. LaCourse SM, Chester FM, Matoga M, Munthali C, Nsona D, Haac B, et al. Implementation and operational research: implementation of routine counselor-initiated opt-out HIV testing on the adult medical ward at Kamuzu Central Hospital, Lilongwe, Malawi. J Acquir Immune Defic Syndr. 2015;69:e31–5.
99. Lambdin BH, Micek MA, Sherr K, Gimbel S, Karagianis M, Lara J, et al. Integration of HIV care and treatment in primary health care centers and patient retention in central Mozambique: a retrospective cohort study. J Acquir Immune Defic Syndr. 2013;62:e146–52.
100. Larson BA, Schnippel K, Brennan A, Long L, Xulu T, Maotoe T, et al. Same-day CD4 testing to improve uptake of HIV care and treatment in South Africa: point-of-care is not enough. AIDS Res Treat. 2013;2013:941493.
101. Larson BA, Schnippel K, Ndibongo B, Xulu T, Brennan A, Long L, et al. Rapid point-of-care CD4 testing at mobile HIV testing sites to increase linkage to care: an evaluation of a pilot program in South Africa. J Acquir Immune Defic Syndr. 2012;61:e13–7.
102. Lester RT, Ritvo P, Mills EJ, Kariri A, Karanja S, Chung MH, et al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. Lancet. 2010;376:1838–45.
103. Linnemayr S, Stecher C, Mukasa B. Behavioral economic incentives to improve adherence to antiretroviral medication. AIDS. 2017;31:719–26.
104. Long L, Brennan A, Fox MP, Ndibongo B, Jaffray I, Sanne I, et al. Treatment outcomes and cost-effectiveness of shifting management of stable ART patients to nurses in South Africa: an observational cohort. PLoS Med. 2011;8:e1001055.
105. Louwagie G, Girdler-Brown B, Odendaal R, Rossouw T, Johnson S, Van der Walt M. Missed opportunities for accessing HIV care among Tshwane tuberculosis patients under different models of care. Int J Tuberc Lung Dis. 2012;16:1052–8.
106. Lubega M, Tumwesigye NM, Kadobera D, Marrone G, Wabwire-Mangen F, Peterson S, et al. Effect of community support agents on retention of people living with HIV in pre-antiretroviral care: a randomized controlled trial in Eastern Uganda. J Acquir Immune Defic Syndr. 2015;70:e36–43.
107. Lugada E, Levin J, Abang B, Mermin J, Mugalanzi E, Namara G, et al. Comparison of home and clinic-based HIV testing among household members of persons taking antiretroviral therapy in Uganda: results from a randomized trial. J Acquir Immune Defic Syndr. 2010;55:245–52.
108. Luque-Fernandez MA, Van Cutsem G, Goemaere E, Hilderbrand K, Schomaker M, Mantangana N, et al. Effectiveness of patient adherence groups as a model of care for stable patients on antiretroviral therapy in Khayelitsha, Cape Town, South Africa. PLoS One. 2013;8:e56088.
109. MacPherson P, Lalloo DG, Webb EL, Maheswaran H, Choko AT, Makombe SD, et al. Effect of optional home initiation of HIV care following HIV self-testing on antiretroviral therapy initiation among adults in Malawi: a randomized clinical trial. JAMA. 2014;312:372–9.
110. Maduka O, Tobin-West CI. Adherence counseling and reminder text messages improve uptake of antiretroviral therapy in a tertiary hospital in Nigeria. Niger J Clin Pract. 2013;16:302–8.
111. Maheswaran H, Thulare H, Stanistreet D, Tanser F, Newell ML. Starting a home and mobile HIV testing service in a rural area of South Africa. J Acquir Immune Defic Syndr. 2012;59:e43–6.
112. Massaquoi M, Zachariah R, Manzi M, Pasulani O, Misindi D, Mwagomba B, et al. Patient retention and attrition on antiretroviral treatment at district level in rural Malawi. Trans R Soc Trop Med Hyg. 2009;103:594–600.
113. Matovu JK, Todd J, Wanyenze RK, Kairania R, Serwadda D, Wabwire-Mangen F. Evaluation of a demand-creation intervention for couples' HIV testing services among married or cohabiting individuals in Rakai, Uganda: a cluster-randomized intervention trial. BMC Infect Dis. 2016;16:379.
114. 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:e46909.
115. 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;31:815–25.
116. McGuire M, Ben Farhat J, Pedrono G, Szumilin E, Heinzelmann A, Chinyumba YN, et al. Task-sharing of HIV care and ART initiation: evaluation of a mixed-care non-physician provider model for ART delivery in rural Malawi. PLoS One. 2013;8:e74090.
117. McGuire M, Pinoges L, Kanapathipillai R, Munyenyembe T, Huckabee M, Makombe S, et al. Treatment initiation, program attrition and patient treatment outcomes associated with scale-up and decentralization of HIV care in rural Malawi. PLoS One. 2012;7:e38044.
118. McLaughlin MM, Franke MF, Munoz M, Nelson AK, Saldana O, Cruz JS, et al. Community-based accompaniment with supervised antiretrovirals for hiv-positive adults in Peru: a cluster-randomized trial. AIDS Behav. 2017. [epub ahead of print].
119. McNaghten AD, Schilsky Mneimneh A, Farirai T, Wamai N, Ntiro M, Sabatier J, et al. Implementation and operational research: strengthening HIV test access and treatment uptake study (Project STATUS): a randomized trial of HIV testing and counseling interventions. J Acquir Immune Defic Syndr. 2015;70:e140–6.
120. Menzies N, Abang B, Wanyenze R, Nuwaha F, Mugisha B, Coutinho A, et al. The costs and effectiveness of four HIV counseling and testing strategies in Uganda. AIDS. 2009;23:395–401.
121. Mugusi F, Mugusi S, Bakari M, Hejdemann B, Josiah R, Janabi M, et al. Enhancing adherence to antiretroviral therapy at the HIV clinic in resource constrained countries; the Tanzanian experience. Tropical Med Int Health. 2009;14:1226–32.
122. Muhamadi L, Tumwesigye NM, Kadobera D, Marrone G, Wabwire-Mangen F, Pariyo G, et al. A single-blind randomized controlled trial to evaluate the effect of extended counseling on uptake of pre-antiretroviral care in Eastern Uganda. Trials. 2011;12:184.
123. Munoz M, Finnegan K, Zeladita J, Caldas A, Sanchez E, Callacna M, et al. Community-based DOT-HAART accompaniment in an urban resource-poor setting. AIDS Behav. 2010;14:721–30.
124. Nachega JB, Chaisson RE, Goliath R, Efron A, Chaudhary MA, Ram M, et al. Randomized controlled trial of trained patient-nominated treatment supporters providing partial directly observed antiretroviral therapy. AIDS. 2010;24:1273–80.
125. Ndekha MJ, van Oosterhout JJ, Zijlstra EE, Manary M, Saloojee H, Manary MJ. Supplementary feeding with either ready-to-use fortified spread or corn-soy blend in wasted adults starting antiretroviral therapy in Malawi: randomised, investigator blinded, controlled trial. BMJ. 2009;338:b1867.
126. Nglazi MD, van Schaik N, Kranzer K, Lawn SD, Wood R, Bekker LG. An incentivized HIV counseling and testing program targeting hard-to-reach unemployed men in Cape Town, South Africa. J Acquir Immune Defic Syndr. 2012;59:e28–34.
127. Ngo AD, Ha TH, Rule J, Dang CV. Peer-based education and the integration of HIV and sexual and reproductive health services for young people in Vietnam: evidence from a project evaluation. PLoS One. 2013;8:e80951.
128. Nyasulu JC, Muchiri E, Mazwi SL, Ratshefola M. NIMART rollout to primary healthcare facilities increases access to antiretrovirals in Johannesburg: an interrupted time series analysis. S Afr Med J. 2013;103:232–6.
129. Obua C, Kayiwa J, Waako P, Tomson G, Balidawa H, Chalker J, et al. Improving adherence to antiretroviral treatment in Uganda with a low-resource facility-based intervention. Glob Health Action. 2014;7:24198.
130. Odafe S, Torpey K, Khamofu H, Ogbanufe O, Oladele EA, Kuti O, et al. The pattern of attrition from an antiretroviral treatment program in Nigeria. PLoS One. 2012;7:e51254.
131. Oluoch T, Kwaro D, Ssempijja V, Katana A, Langat P, Okeyo N, et al. Better adherence to pre-antiretroviral therapy guidelines after implementing an electronic medical record system in rural Kenyan HIV clinics: a multicenter pre-post study. Int J Infect Dis. 2015;33:109–13.
132. Patten GE, Wilkinson L, Conradie K, Isaakidis P, Harries AD, Edginton ME, et al. Impact on ART initiation of point-of-care CD4 testing at HIV diagnosis among HIV-positive youth in Khayelitsha, South Africa. *J Int AIDS Soc*. 2013;16:18518.

133. Pearson CR, Micek MA, Simoni JM, Hoff PD, Matediana E, Martin DP, et al. Randomized control trial of peer-delivered, modified directly observed therapy for HAART in Mozambique. J Acquir Immune Defic Syndr. 2007;46:238–44.
134. Peltzer K, Ramlagan S, Jones D, Weiss SM, Fomundam H, Chanetsa L. Efficacy of a lay health worker led group antiretroviral medication adherence training among non-adherent HIV-positive patients in KwaZulu-Natal, South Africa: results from a randomized trial. SAHARA J. 2012;9:218–26.
135. Pham LT, Kitamura A, Do HM, Lai KA, Le NT, Nguyen VT, et al. Retrospective analysis of antiretroviral therapy uptake and retention of male clients receiving methadone maintenance therapy in two provinces in Vietnam: potential synergy of the two therapies. Harm Reduct J. 2017;14:12.
136. Plazy M, Dabis F, Naidu K, Orne-Gliemann J, Barnighausen T, Dray-Spira R. Change of treatment guidelines and evolution of ART initiation in rural South Africa: data of a large HIV care and treatment programme. BMC Infect Dis. 2015;15:452.
137. 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;25:825–34.
138. Pope DS, Deluca AN, Kali P, Hausler H, Sheard C, Hoosain E, et al. A cluster-randomized trial of provider-initiated (opt-out) HIV counseling and testing of tuberculosis patients in South Africa. J Acquir Immune Defic Syndr. 2008; 48:190–5.
139. Rosen S, Long L, Sanne I. The outcomes and outpatient costs of different models of antiretroviral treatment delivery in South Africa. Tropical Med Int Health. 2008;13:1005–15.
140. Rosen S, Maskew M, Fox MP, Nyoni C, Mongwenyana C, Malete G, et al. Initiating antiretroviral therapy for HIV at a patient's first clinic visit: the RapIT randomized controlled trial. PLoS Med. 2016;13:e1002015.
141. Sabin LL, DeSilva MB, Hamer DH, Xu K, Zhang J, Li T, et al. Using electronic drug monitor feedback to improve adherence to antiretroviral therapy among HIV-positive patients in China. AIDS Behav. 2010;14:580–9.
142. Sanne I, Orrell C, Fox MP, Conradie F, Ive P, Zeinecker J, et al. Nurse versus doctor management of HIV-infected patients receiving antiretroviral therapy (CIPRA-SA): a randomised non-inferiority trial. Lancet. 2010;376:33–40.
143. 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;48:611–9.
144. Schulz SA, Draper HR, Naidoo P. A comparative study of tuberculosis patients initiated on ART and receiving different models of TB-HIV care. Int J Tuberc Lung Dis. 2013;17:1558–63.
145. Sherr KH, Micek MA, Gimbel SO, Gloyd SS, Hughes JP, John-Stewart GC, et al. Quality of HIV care provided by non-physician clinicians and physicians in Mozambique: a retrospective cohort study. AIDS. 2010;24(Suppl 1):S59–66.
146. Siedner MJ, Lankowski A, Haberer JE, Kembabazi A, Emenyonu N, Tsai AC, et al. Rethinking the "pre" in pre-therapy counseling: no benefit of additional visits prior to therapy on adherence or viremia in Ugandans initiating ARVs. PLoS One. 2012;7:e39894.
147. Siedner MJ, Santorino D, Lankowski AJ, Kanyesigye M, Bwana MB, Haberer JE, et al. A combination SMS and transportation reimbursement intervention to improve HIV care following abnormal CD4 test results in rural Uganda: a prospective observational cohort study. BMC Med. 2015;13:160.
148. Simoni JM, Chen WT, Huh D, Fredriksen-Goldsen KI, Pearson C, Zhao H, et al. A preliminary randomized controlled trial of a nurse-delivered medication adherence intervention among HIV-positive outpatients initiating antiretroviral therapy in Beijing, China. AIDS Behav. 2011;15:919–29.
149. Stubbs BA, Micek MA, Pfeiffer JT, Montoya P, Gloyd S. Treatment partners and adherence to HAART in Central Mozambique. AIDS Care. 2009;21:1412–9.
150. Sweat M, Morin S, Celentano D, Mulawa M, Singh B, Mbwambo J, et al. Community-based intervention to increase HIV testing and case detection in people aged 16-32 years in Tanzania, Zimbabwe, and Thailand (NIMH Project Accept, HPTN 043): a randomised study. Lancet Infect Dis. 2011;11:525–32.
151. Taiwo BO, Idoko JA, Welty LJ, Otoh I, Job G, Iyaji PG, et al. Assessing the viorologic and adherence benefits of patient-selected HIV treatment partners in a resource-limited setting. J Acquir Immune Defic Syndr. 2010;54:85–92.
152. Talisuna-Alamo S, Colebunders R, Ouma J, Sunday P, Ekoru K, Laga M, et al. Socioeconomic support reduces nonretention in a comprehensive, community-based antiretroviral therapy program in Uganda. J Acquir Immune Defic Syndr. 2012;59:e52–9.
153. Thielman NM, Chu HY, Ostermann J, Itemba DK, Mgonja A, Mtweve S, et al. Cost-effectiveness of free HIV voluntary counseling and testing through a community-based AIDS service organization in Northern Tanzania. Am J Public Health. 2006;96:114–9.
154. Thurman TR, Luckett B, Taylor T, Carnay M. Promoting uptake of child HIV testing: an evaluation of the role of a home visiting program for orphans and vulnerable children in South Africa. AIDS Care. 2016;28(Suppl 2):7–13.
155. 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;3:171.
156. Topp SM, Li MS, Chipukuma JM, Chiko MM, Matongo E, Bolton-Moore C, et al. Does provider-initiated counselling and testing (PITC) strengthen early diagnosis and treatment initiation? Results from an analysis of an urban cohort of HIV-positive patients in Lusaka, Zambia. *J Int AIDS Soc*. 2012;15: 17352.
157. Torpey KE, Kabaso ME, Mutale LN, Kamanga MK, Mwango AJ, Simpungwe J, et al. Adherence support workers: a way to address human resource constraints in antiretroviral treatment programs in the public health setting in Zambia. PLoS One. 2008;3:e2204.
158. Uzma Q, Emmanuel F, Ather U, Zaman S. Efficacy of interventions for improving antiretroviral therapy adherence in HIV/AIDS cases at PIMS, Islamabad. J Int Assoc Physicians AIDS Care (Chic). 2011;10:373–83.
159. 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;19:145–56.
160. Wang H, Zhou J, Huang L, Li X, Fennie KP, Williams AB. Effects of nurse-delivered home visits combined with telephone calls on medication adherence and quality of life in HIV-infected heroin users in Hunan of China. J Clin Nurs. 2010;19:380–8.
161. Wanyenze RK, Hahn JA, Liechty CA, Ragland K, Ronald A, Mayanja-Kizza H, et al. Linkage to HIV care and survival following inpatient HIV counseling and testing. AIDS Behav. 2011;15:751–60.
162. Wanyenze RK, Kamya MR, Fatch R, Mayanja-Kizza H, Baveewo S, Szekeres G, et al. Abbreviated HIV counselling and testing and enhanced referral to care in Uganda: a factorial randomised controlled trial. Lancet Glob Health. 2013; 1:E137–e145.
163. Webster PD, Sibanyoni M, Malekutu D, Mate KS, Venter WD, Barker PM, et al. Using quality improvement to accelerate highly active antiretroviral treatment coverage in South Africa. BMJ Qual Saf. 2012;21:315–24.
164. Winter MC, Halpern M, Brozovich A, Neu N. Evaluation of an HIV adherence counseling program in La Romana, Dominican Republic. J Int Assoc Provid AIDS Care. 2014;13:361–5.
165. Wouters E, Van Damme W, Van Loon F, van Rensburg D, Meulemans H. Public-sector ART in the Free State Province, South Africa: community support as an important determinant of outcome. Soc Sci Med. 2009;69: 1177–85.
166. Yassi A, Adu PA, Nophale L, Zungu M. Learning from a cluster randomized controlled trial to improve healthcare workers' access to prevention and care for tuberculosis and HIV in Free State, South Africa: the pivotal role of information systems. Glob Health Action. 2016;9:30528.
167. Yende-Zuma N, Naidoo K. The effect of timing of initiation of antiretroviral therapy on loss to follow-up in HIV-tuberculosis coinfected patients in South Africa: an open-label, randomized, controlled trial. J Acquir Immune Defic Syndr. 2016;72:430–6.
168. Young SD, Cumberland WG, Nianogo R, Menacho LA, Galea JT, Coates T. The HOPE social media intervention for global HIV prevention in Peru: a cluster randomised controlled trial. Lancet HIV. 2015;2:e27–32.
169. Zachariah R, Teck R, Buhendwa L, Fitzerland M, Labana S, Chinji C, et al. Community support is associated with better antiretroviral treatment outcomes in a resource-limited rural district in Malawi. Trans R Soc Trop Med Hyg. 2007;101:79–84.
170. Zelaya CE, Le Minh N, Lau B, Latkin CA, Viet Ha T, Minh Quan V, et al. The effect of a multi-level intervention on the initiation of antiretroviral therapy (ART) among HIV-infected men who inject drugs and were diagnosed late in Thai Nguyen, Vietnam. PLoS One. 2016;11:e0161718.
171. Zeng W, Rwiyereka AK, Amico PR, Avila-Figueroa C, Shepard DS. Efficiency of HIV/AIDS health centers and effect of community-based health insurance

and performance-based financing on HIV/AIDS service delivery in Rwanda. Am J Trop Med Hyg. 2014;90:740–6.
172. Miguel E, Camerer C, Casey K, Cohen J, Esterling KM, Gerber A, et al. Social science. Promoting transparency in social science research. Science. 2014; 343:30–1.
173. Bareinboim E, Pearl J. Meta-transportability of causal effects: a formal approach. In: Proceedings of the 16th International Conference on Artificial Intelligence and Statistics (AISTATS); 2013. p. 135–43.
174. Pearl J, Bareinboim E. Transportability across studies: a formal approach. DTIC Document. Los Angeles: University of California; 2011. pp. 1-19.
175. 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. JAMA. 2006;296:679–90.
176. Mills EJ, Thorlund K, Ioannidis JP. Demystifying trial networks and network meta-analysis. BMJ. 2013;346:f2914.