East African Medical Journal Vol. 96 No. 2 February 2019

QUALITY IMPROVEMENT APPROACH FOR INCREASING LINKAGE TO HIV CARE AND TREATMENT AMONG NEWLY-DIAGNOSED HIV-INFECTED PERSONS IN KENYAN URBAN INFORMAL SETTLEMENTS DURING 2011–2015

Steve Kegoli, Eastern Deanery AIDS Relief Program, Nairobi, Kenya, Raphael Ondondo, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, P.O. Box 47351 00100 GPO Nairobi, Kenya. Alice Njoroge, Eastern Deanery AIDS Relief Program, Nairobi, Kenya, John Motoku, Eastern Deanery AIDS Relief Program, Nairobi, Kenya, Christopher Muriithi, Eastern Deanery AIDS Relief Program, Nairobi, Kenya, Evelyn Ngugi, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, Nairobi, Kenya, Abraham Katana, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, Nairobi, Kenya, Anthony Waruru, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, Nairobi, Kenya, Herman Weyenga, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, Nairobi, Kenya, Immaculate Mutisya, Division of Global HIV&TB, U.S Centers for Disease Control and Prevention, Nairobi, Kenya

Corresponding author: Steve Kigoli, Eastern Deanery AIDS Relief Program, P.O. Box 47351 00100 GPO Nairobi, Kenya, Email: SteveKegoli@edarp.org

QUALITY IMPROVEMENT APPROACH FOR INCREASING LINKAGE TO HIV CARE AND TREATMENT AMONG NEWLY-DIAGNOSED HIV-INFECTED PERSONS IN KENYAN URBAN INFORMAL SETTLEMENTS DURING 2011–2015

S. Kegoli, R. Ondondo, A. Njoroge, J. Motoku, C. Muriithi, E. Ngugi, A. Katana, A. Waruru, H. Weyanga and I. Mutisya

ABSTRACT

Background: **Pre-enrollment loss to follow-up and delayed linkage to HIV care and treatment (C&T) of newly-diagnosed HIV-infected individuals are associated with increased morbidity and mortality.**

Objective: **To describe quality improvement approach utilized by Eastern Deanery AIDS Relief Program (EDARP) to increase linkage to HIV C&T of newly-diagnosed HIV-infected individuals.**

Design: **Cross-sectional descriptive assessement of a three-phased continuous quality improvement (CQI) project among 20,972 newly diagnosed HIV patients at 14 EDARP health facilities in Nairobi, Kenya. Phase 1 – physically escorting patients to the HIV C&T clinic; Phase 2 – use of linkage registers and timely tracking and tracing individuals who missed appointments; Phase 3 – use of patient HIV literacy materials. Routine patient data collected during the CQI interventions implemented between October 2011 and September 2015 were analyzed.**

Results: **Implementation of the three CQI phases significantly increased linkage to HIV C&T from 60% at baseline in 2011 to 98% in 2015 ($p<0.0001$). Factors associated with decreased linkage to HIV C&T through this CQI intervention**

were: age (adolescents aged 10–19 years), [odds ratio (OR) 0.60, 95% confidence interval (CI): 0.51-7.0]; female sex [OR 0.64, (95% CI: 0.59-0.70)] and unemployement [OR 0.84, (95% CI: 0.77-0.92)]. First time tester [OR 1.9, (95% CI: 1.8-2.1)] and divorcees [OR 2.0, (95% CI: 1.7-2.3)], (p<0.001) had increased likelihood of linkage to HIV C&T.

Conclusion: **Successful linkage to HIV C&T services for newly-diagnosed HIV-infected individuals is achievable through adoption of feasible and low-cost multi-pronged CQI interventions.**

INTRODUCTION

Globally, the Joint United Nations Programme on HIV/AIDS (UNAIDS) has ambitious targets to have 90% of all people living with HIV (PLHIV) know their HIV status, 90% of people diagnosed with HIV infection receiving sustained antiretroviral therapy (ART), and 90% of people receiving ART achieving viral suppression by the year 2020 [1]. Despite a total of 6.4 million people receiving HIV testing annually in Kenya, the Kenya AIDS Indicator Survey 2012 indicated that 54% of PLHIV had never been reached with HIV testing services (HTS) before and thus were unaware of their status [2]. Consequently, Kenya significantly scaled up provision of HTS to achieve the UNAIDS targets, Kenya significantly scaled up HIV testing.

In order to achieve the second and third "90s" of the UNAIDS targets, successful linkage to HIV C&T of the identified HIV-positive people is crucial. Despite high HIV testing coverage, linkage of identified PLHIV to HIV C&T remains a major challenge in Kenya where less than 35% of identified PLHIV were linked and retained in C&T for at least 1 year [3], as well as elsewhere [4, 5]. Efforts to improve health outcomes of PLHIV are hampered by poor access to HIV care and treatment services by newly-identified HIV-positive patients. For example, studies in Kenya reported that only 60% of PLHIV nationally [2] and as low as 15% of newly-identified PLHIV in Western Kenya [6] were linked to HIV care services in 2012 and 2014 respectively. Other studies in rural Kenya documented a 63% linkage to care within 3 months among PLHIV identified through a community-based HIV counseling and testing [7], and only 57% of previously known and newly-diagnosed HIV patients had ever visited an HIV care provider [6]. Similar trends of poor linkage to HIV care have been observed in Tanzania [8] and other Sub-Sahara African countries such as South Africa, where only 63% of people diagnosed with HIV were linked to HIV care [9].

Several studies have documented barriers to timely linkage to and sustained retention in HIV C&T, which are broadly classified into three main categories: structural barriers, health system barriers, and behavioral barriers [10, 11]. For example, the clinical layout and the quality of posttest counseling were barriers to linkage to HIV C&T in western Kenya (structural and health system barriers respectively) [12]. Additionally, behavioral or health system barriers associated with decreased linkage to HIV C&T include: younger age (15–24 years), being unsure of the HIV test result, living with two or more adults, lack of time to seek

health care, believing ART can make you sick, and taking alcohol decrease linkage to care and treatment (behavioral or health system barriers) [13]. Although these barriers to linkage to HIV C&T have been well documented, few studies have evaluated integrated approaches as interventions targeted at improving linkage of identified PLHIV to HIV care and treatment [14, 15]. Previously described linkage to C&T approaches include: escorting patients from testing point to the HIV care and treatment service point [14, 15], enhancing patient support by improving ART knowledge among clients, tracking for missed visits, facilitating disclosure, reducing stigma, and making phone call appointment reminders [13-15]. This paper describes the outcome of implementation of a systematic continuous quality improvement (CQI) package in Eastern Deanery AIDS relief program (EDARP) clinics as part of the Kenya HIV Quality Improvement Framework (KHQIF) guidance towards increasing and sustaining high linkage rates of newly-diagnosed HIV clients to care and treatment [16].

METHODS

A non-randomized three-phased CQI intervention program was implemented in 14 EDARP ART comprehensive care clinics (CCC) located in urban informal settlements within Nairobi city, with each phase lasting 9 months. A retrospective review of routinely-collected patient data from these 14 EDARP clinics was performed. Electronic medical records of newly-diagnosed HIV-positive patients between 1st October 2011 and 30th September 2015 were assessed for successful linkage to HIV C&T. We defined successful linkage to HIV C&T as a documented first visit and assigned a CCC enrolment number for HIV C&T within a period of zero days to 3 months after HIV diagnosis. Newly-identified HIV-positive patients who chose to be linked to non-EDARP sites were documented but excluded from the final analysis. Information was collected using Ministry of Health HIV Testing and Counselling Registers, Linkage Register, and EDARP electronic medical records systems. Upon HIV diagnosis, locator information of the patient (phone contacts, patient address and landmarks near where they lived) was captured on the locator form. This information was used to trace newly diagnosed HIV infected patients for subsequent follow-up visits to facilitate linkage to HIV C&T.

Quality Improvement Intervention Cycles

CQI activities were performed in three plan-do-study-act (PDSA) cycles as detailed below.

PDSA Cycle 1- October 2011 to June 2012: Patient escort, task shifting, and fast tracking

The first CQI set of interventions instituted in Phase 1 of the project (change package) was aimed at reducing the waiting time (at all service delivery points in the clinic) to ensure successful linkage of newly-identified HIV-positive patients by physically escorting and fast tracking the patients, as well as task shifting to expedite the provision of HIV C&T services implemented in all the 14 EDARP facilities. During this PDSA Cycle 1, the HIV testing service (HTS) provider physically escorted the newly-identified HIV-positive client from the HTS testing point to clinical ART point to initiate process of accessing HIV C&T services. To ensure the client took the shortest time possible at the clinic waiting area, the clients were fast-tracked to receive service(s) regardless of number of persons waiting to see the clinician. Additionally, the collection of vital signs such as body temperature, blood pressure, and pulse rate

were task-shifted to the HTS providers after an induction training. These interventions enhanced coordination between the HIV testing points and the HIV C&T clinics. This was aimed at reducing the waiting times as patients navigate through the clinic service points and increasing efficiency of HIV C&T service delivery. The performance of the CQI package was reviewed monthly using achieved linkage rates.

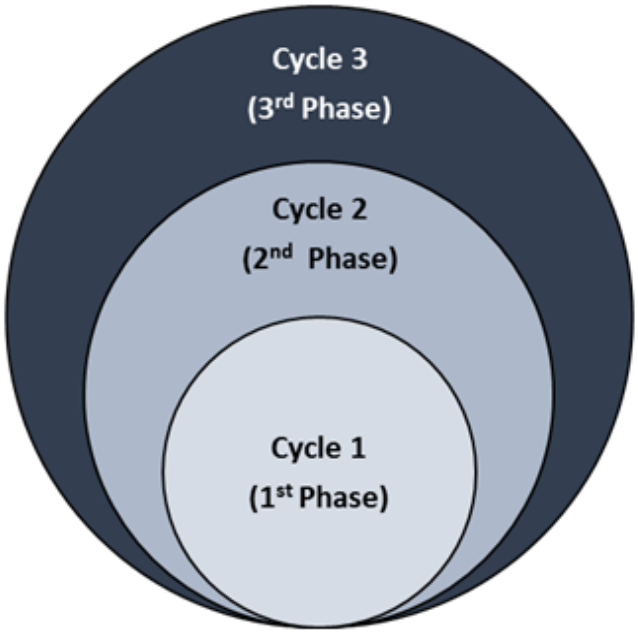
PDSA Cycle 2 (July 2012 to March 2013): Patient escort, task shifting, fast tracking, and aggressive tracking and tracing

During subsequent routine data evaluation meetings, continued gaps were noted despite implementation of PDSA cycle 1. It was found that a number of clients were not initiated on the same day as per the CQI package, leading to unsuccessful linkage to HIV C&. To address these gaps, aggressive tracking of clients not linked to care on the same day was introduced as part of change process in PDSA Cycle 2. This intervention involved tracking patients using their patient locator information, phone calls, as well as tracing by community health volunteers (CHVs), and was implemented alongside the already adopted strategies of physically escorting patients, fast tracking and task shifting, in PDSA Cycle 1. A standard protocol was developed to trace clients by phone (one day after the missed appointment), and if unsuccessful (after three attempts in 2 days), physical tracing was done by the HTS provider or CHV using the locator information. Detailed outcome of these aggressive patient follow-up were documented in Patient Tracking/Tracing Register. This strategy provided follow up of clients who were not successfully linked to HIV C&T using PDSA Cycle 1 strategies or clients who chose to enroll for HIV C&T at a later date but did not attend.

PDSA Cycle 3 (April 2013 to September 2015): Patient escort, task shifting, fast tracking, aggressive tracking and tracing, and comprehensive patient literacy

After implementation of PDSA Cycle 2 (Patient escort, task shifting, fast tracking and aggressive tracking and tracing) linkage to HIV care and treatment of newly-identified HIV-positive patients was still below the UNAIDS second 90 target. Using routine performance data, and carrying out a root cause analysis, disparities in linkage across various facilities and HIV testing providers were noted. It was further observed that clients did not have adequate information on the importance of initiating HIV C&T, potentially leading to lack of motivation to promptly enroll for HIV C&T services. Therefore, in Cycle 3, a comprehensive patient literacy was added to the Cycle 2 CQI package.

In PDSA Cycle 3, comprehensive patient literacy was implemented in addition to PSDA Cycles 1&2. As part of achieving standard patient literacy, all providers (QI team) carrying out HIV testing received a standardized training to communicate consistent and accurate information to patients on the importance of early initiation of HIV C&T. The training included a refresher on HTS, effective communication skills building, stages of HIV disease progression, and on the importance of prompt linkage to HIV C&T. Further, HTS providers achieving higher linkage rates were identified to mentor low-performing HTS providers using a peer-to-peer on-the-job training model. Therefore, CQI interventions aligned to KHQIF (MOH, 2014) were implemented in three phases: Phase 1 (PDSA Cycle 1), Phase 2 (PDSA Cycle 2) and Phase 3 (PDSA Cycle 3) as summarized in Figure 1.



Cycle 1 (Oct 2011 – Jun 2012): Patient escort, task shifting and fast tracking

Cycle 2 (Jul 2012 – Mar 2013): Patient escort, task shifting, fast tracking, and aggressive tracking and tracing

Cycle 3 (Apr 2013 – Sep 2015: Patient escort, task shifting, fast tracking, aggressive tracking and tracing, and training of QI team on provision of comprehensive patient literacy

Figure 1: Cycles of CQI packages implemented in three phases to improve PLHIV linkage to HIV care: October 2011–September 2015

Statistical Methods

Descriptive statistics were presented as proportions and classified into different patient strata. Chi square tests were used to assess changes in proportions for different factors that may influence the linkage of PLHIV to HIV C&T and presented using odds ratios (OR) with 95% confidence interval (CI).STATA Version 12 (*Stata Statistical Software: Release 12.* College Station, TX: StataCorp LP.) was used for analyses.

Ethical approval

This study was approved by the University of Nairobi, Kenyatta National Hospital Ethics Review Committee and the US Centers for Disease Control and Prevention (CDC).

RESULTS

Trends of improvement in linkage by PDSA cycle

The overall linkage to HIV C&T of newly-identified HIV-positive clients increased significantly from 67.5% (95% CI: 65.8-69.1) in October 2011 to 98.4% (95% CI: 97.6-98.7) in September 2015 (p<0.0001) after implementation of the three cycles of QI (Figure 2). PDSA Cycle 1 resulted in a significant increase in linkage to HIV C&T of newly-identified HIV-positive clients from 67.5% (95% CI: 65.8-69.1) to 77.3% (95% CI: 75.9-78.6). Interventions performed during Cycle 2 significantly increased linkage from 77.3% (95% CI: 75.9-78.6) to 86.7% (95% CI: 85.1-87.9) and in Cycle 3, linkage to care increased significantly from 86.7% (95% CI: 85.1-87.9) to 98.2% (95% CI: 97.6-98.7).

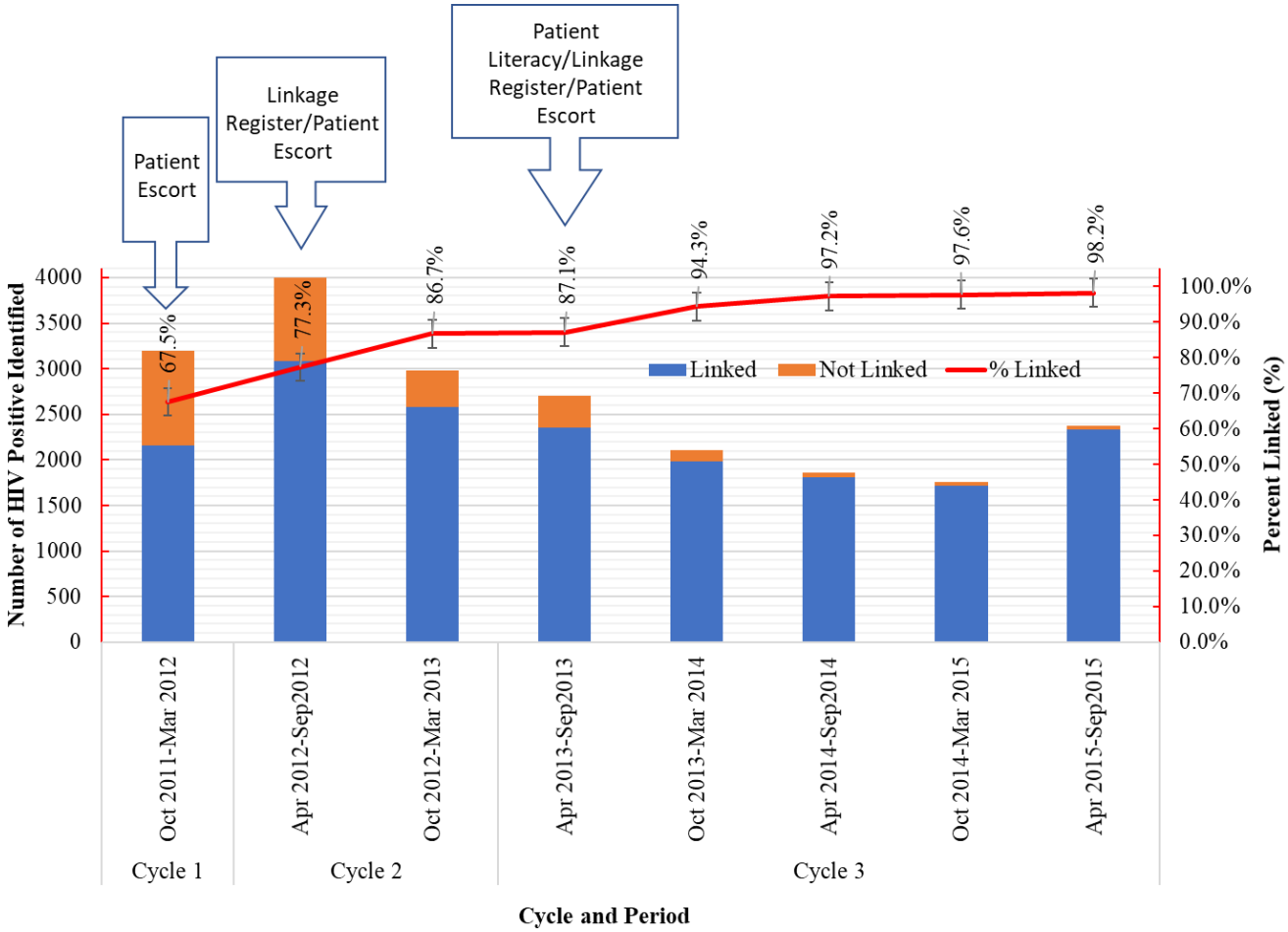


Figure 2: Trends of improved linkage to care among newly-diagnosed HIV-infected persons during October 2011-September 2015

Sociodemographic characteristics

A total of 20,972 newly-diagnosed HIV-infected individuals identified between October 2011 and September 2015 were included in this analysis. Of these, the majority 13,464 (64%) were females (Table 1). Children 0–9 years were 696 (3%), adolescents

10–19 years were 993 (5%), and adults (≥20 years of age) were 19,283 (92%). Among the adult population, 10,698 (51%) were married, 6,289 (30%) single, 2,491 (12 %) divorced, and 781 (4%) widowed. Repeat HIV testers accounted for 12,920 (62%). During the 4-year period, 18,018 (86%) of newly-diagnosed HIV-positive patients were successfully linked to HIV care.

Table 1

Sociodemographic Characteristics of PLHIV Assessed for Improvement in Linkage to HIV Care between 2011 and 2015

Category	Sub Category	Totals	Linked	Not Linked	Odds ratio	P
Sex	Male	7,508	6,698 (89%)	810 (11%)	Ref	
	Female	13,464	11,320 (84%)	2,144 (16%)	0.64 (0.59-0.70)	<0.001
Age Group	20+ yrs.	19,283	16,593 (86%)	2,690 (14%)	Ref	
	10–19 yrs.	993	782 (79%)	211 (21%)	0.60 (0.51-0.70)	<0.001
	0–9 yrs.	696	643 (92%)	53 (8%)	1.97 (1.48-2.62)	<0.001
Type of testing status	Repeat testers	12,920	10,745 (83%)	2,175 (17%)	Ref	
	First time testers	7,168	6,489 (91%)	679 (9%)	1.93 (1.77-2.12)	<0.001
	Missing Info	884	784 (89%)	100 (11%)	excluded	
Employment status	Employed	11,680	10,403 (89%)	1,277 (11%)	Ref	
	Unemployed	8,154	7,114 (87%)	1,040 (13%)	0.84 (0.77-0.92)	<0.001
	Missing Info	1,138	501 (44%)	637 (66%)	excluded	
Education level	≥Secondary	8035	7528 (94%)	507 (6%)	Ref	
	≤Primary	10,105	9,419 (93%)	686 (7%)	0.92 (0.82-1.04)	0.207
	Missing Info	2,832	1,071 (38%)	1,761 (62%)	excluded	
Marital Status	Married	10,698	9,289 (87%)	1,409 (13%)	Ref	
	Single	6,289	5,484 (87%)	805 (13%)	1.03 (0.94-1.13)	0.503
	Divorced	2,491	2,313 (93%)	178 (7%)	1.97 (1.68-2.32)	<0.001
	Widowed	781	695 (89%)	86 (11%)	1.23 (0.97-1.54)	0.094
	Missing Info	713	237 (33%)	476 (67%)	excluded	

Overall, 84% of the women were linked compared to 89% of the men. Women were significantly less likely to be linked compared to men OR=0.6 [(95% CI: 0.59-0.70); p<0.001]. Children 0–9 years had a significantly higher likelihood of being linked compared to adults ≥ 20 years OR=1.97 (95% CI: 1.48-2.62); p<0.001 and the reverse was true for

adolescents who had significantly lower likelihood for being linked into care OR=0.6 [(95% CI: 0.5-0.7); p<0.001)]. Unlike level of education, first time testers [OR=1.93 (1.77-2.12)] and divorcees [OR=1.97 (95% CI: 1.68-2.32)] were significantly at increased odds of being linked to care, while unemployment [OR=0.84 (95% CI: 0.77-0.92)] was associated with reduced odds of linkage to C&T (Table 1). In multivariate analysis, sex, age, type of testing and marital status (divorced) remained independent significant predictors of linkage into C&T of newly-identified HIV positive individuals (p<0.01).

Improvement in linkage by sex

Overall, the QI strategies implemented resulted in a significant (p<0.001) improvement in linkages to HIV C&T among men 79% (95% CI: 77.3-80.6) to 98% (95% CI: 97.2-98.7) and women from 70% (95% CI: 68.7-71.3) to 98% (95% CI:97.4-98.5) at Cycle 1 to post cycle 3 respectively. Linkage by sex was significantly difference during Cycle 1 and 2 but diminished during Cycle 3 implementation and post Cycle 3, which registered equal odds of linkage to C&T among males and females (Table 2).

Improvement in linkage by age

The QI interventions implemented over the four years led to significant increases in linkage to HIV C&T across all age groups of newly-identified HIV positives individuals. Children aged 0–9 years improved from 86.9% (95% CI: 81.4-90.9) to 97.3% (95% CI: 92.9-99.1), p< 0.0001; adolescents (10–19 years) improved from 60.9% (95% CI: 55.8-65.9) to 94.9% (95% CI: 90.8-97.3), p<0.0001; and adults ≥20 years improved from 73.0% (95% CI: 71.9-74.1) to 98.0% (95% CI: 97.5-98.4), p<0.0001: at Cycle 1 to post Cycle 3 respectively (Table 2). In Cycle 1, the 0 to 9 years age band was associated with increased likelihood of being linked to HIV C&T, OR=2.4 (95% CI: 1.6-3.7); p<0.0001, while adolescents (10–19 years) were significantly less likely to be linked [OR 0.6 (95% CI: 0.5-0.7); p<0.0001], compared to adults ≥20 years (Table 2). Although age-related differences in linkage for children aged 0 to 9 years compared to adults diminished by Cycle 3 QI implementation, the differences for adolescents (10–19 years) persisted post Cycle 3 (OR=0.4; 95% CI: 0.2-0.7); p<0.01 (Table 2). Therefore, although the greatest margin of improvement in linkage to HIV C&T was observed among adolescents in whom linkage increased from 61% at Cycle 1 to 95% post Cycle 3, there seem to be barriers to linkage in this age band that require interventions to diminish age-related difference in linkage for this group.

Improvement in linkage by type of testing status (first or repeat testers)

During the implementation period there was significant increase in linkage to HIV C&T of newly-identified HIV positive- for both first testers (clients who were testing for the first time) from 77.0% (95% CI: 75.1-78.9) to 98.0% (95% CI: 97.1-98.6), p<0.0001; and repeat testers from 67.0% (95% CI: 65.6-68.4) to 98.0% (95% CI: 97.4-98.5), p<0.0001 at Cycle 1 to post Cycle 3 respectively. In Cycle 1, first time testers were 1.7 times more likely to be linked to HIV C&T compared to repeat testers [OR 1.7 (95% CI: 1.5-2.9); p<0.0001], similar trend was also observed at Cycle 2 where first time testers were 1.9 times more likely to be linked to HIV C&T than repeat testers (Table 2). In Cycle 3 and post Cycle 3 QI implementation, there were no significant difference in linkage between first-time testers and repeat testers (Table 2).

Improvement in linkage by marital status

Across different marital status, the QI strategies from Cycle 1 to Cycle 3 led to significant increases in linkage to care of

newly-identified HIV positive people. For the married, linkage increased from 72.0% (95% CI: 70.5-73.4) at Cycle 1 to 98.0% (95% CI: 97.3-98.5) post Cycle 3. Linkage increased from 76.0% (95% CI: 74.2-77.7) to 98.0% (95% CI: 97.0-98.7), 78.1% (95% CI: 74.6-81.1) to 99.1% (95% CI: 97.7-99.7) and 68.1% (95% CI: 61.2-74.3) to 98.2% (95% CI: 95.1-99.4) among single, divorced and widowed individuals, at Cycle 1 to post Cycle 3, respectively (Table 2). Unlike among widowed individuals [OR=0.8 (0.6-1.1), p=0.258], single people [OR=1.2 (95% CI: 1.1-1.4), p<0.001] and divorcees [OR=1.4 (95% CI: 1.1-1.7), p<0.01] had increased likelihood of being linked to HIV C&T in Cycle 1 of QI implementation compared to their married counterparts. These differences in linkage persisted during Cycle 2 and Cycle 3 among divorcees but diminished altogether post Cycle 3 (Table 2).

Table 2

Factors associated with linkage to HIV care by Cycle of continuous quality improvement: October 2011 – September 2015

Characteristic		Cycle 1			Cycle 2			Cycle 3			Post-Cycle 3		
		Linked	Not Linked	OR (95% CI); p-value	Linked	Not Linked	OR (95% CI); p-value	Linked	Not Linked	OR (95% CI); p-value	Linked	Not Linked	OR (95% CI); p-value
Sex	Male	1989	529	Ref	1862	207	Ref	1404	59	Ref	1443	29	Ref
	Female	3253	1394	0.6 (0.6-0.7); p<0.0001	3071	542	0.6 (0.5-0.8); p<0.0001	2370	99	1.0 (0.7-1.4); p=1.000	2606	53	1.0 (0.6-1.6); p=1.000
Age	20+	4826	1785	Ref	4617	690	Ref	3450	144	Ref	3700	76	Ref
	10-19	231	148	0.6 (0.5-0.7); p<0.0001	194	43	0.8 (0.5-0.9); p<0.05	153	13	0.49 (0.3-0.9); p<0.05	204	11	0.4 (0.2-0.7); p<0.01
	0-9	185	28	2.4 (1.6-3.7); p<0.0001	142	11	1.93 (1.1-3.6); p<0.05	171	9	0.8 (0.4-1.6); p=0.641	145	4	0.7 (0.3-2.1); p=0.784
Type of testing	Retester	2990	1473	0.6 (0.5-0.7); p<0.0001	3024	576	0.52 (0.4-0.6); p<0.0001	2198	116	0.8 (0.6-1.1); p<0.164	2533	52	1.0 (0.6-1.5); p=0.976
	First time	1468	438	1.7 (1.5-1.9); p<0.0001	1929	191	1.9 (1.6-2.3); p<0.0001	1576	66	1.3 (0.9-1.7); p=0.164	1516	31	1.0 (0.7-1.6); p=0.976
Marital	Married	2698	1049	Ref	2581	224	Ref	1922	80	Ref	2088	43	Ref
	Single	1733	547	1.2 (1.1-1.4); p<0.001	1408	156	0.8 (0.6-0.9); p<0.05	1117	47	1.0 (0.7-1.4); p=1.000	1226	25	1.0 (0.6-1.7); p=1.000
	Divorced	512	144	1.4 (1.1-1.7); p<0.01	714	22	2.8 (1.8-4.4); p<0.0001	567	6	3.9 (1.1-9.1); p<0.001	520	5	2.1 (0.8-5.0); p=0.145
	Widowed	141	66	0.8 (0.6-1.1); p=0.258	171	9	1.7 (0.8-3.3); p=0.192	168	5	1.4 (0.6-3.5); p=0.606	215	4	1.1 (0.4-3.1); p=1.000

DISCUSSION

In this assessment of a three-phased CQI intervention, we document a significant increase in linkage of newly-diagnosed HIV-positive patients to HIV C&T services. Implementation of patient escort, task shifting, and fast-tracking (Cycle 1) increased linkage by 10%. Incorporating aggressive tracking and patient tracing to the package (Cycle 2) increased linkage for an additional 10%. The addition of comprehensive patient literacy to Cycles 1 and 2 packages (Cycle 3) increased linkage by another 11%. The comprehensive package of all three cycles increased linkage by an aggregate of 31%. These data suggest that implementation of interventions with a multi-component approach can effectively increase the linkage of newly-diagnosed HIV-positive patients to care and treatment services. Similar to findings from our study, Elul and colleagues (2017) observed that fast-tracking patients and aggressively tracking/tracing using phone reminders significantly increased linkage by 1.6-fold within 1 month of HIV diagnosis [15]. Additionally, another study found that phone reminders significantly increased linkage to care among adolescents [13], suggesting that continuous support to HIV-positive patients may aid in overcoming some of the barriers affecting linkage to care. In contrast, a study by McNairy and colleagues (2017) found no effect of phone reminders (aggressive tracking) on linkage but attributed these negative results to a concurrent national linkage campaign that might have diluted the effect of this intervention during the study [14].

In our study, age was observed to be an important factor for linkage, with adolescents experiencing the lowest rates of linkage to HIV care. These results were in agreement with findings from other studies [13-15]. Although these interventions increased linkage across all age bands, younger children (0–9 years) compared to adults (≥20 years) patients demonstrated higher likelihood of linkage. Conversely, adolescents (10-19 years) had decreased odds of being linked compared to adults, despite the greatest increase in linkage being documented among adolescents. These results emphasize the existence of unique challenges as barriers to accessing HIV C&T among adolescents that span beyond interventions implemented in this study. Other studies using combined strategies to improve linkage have documented similar results among 18–24-year-old patients [14, 15]. These corroborated the effectiveness of multipronged intervention approaches in addressing linkage challenges faced by adolescents and young adults.

Sex and marital status were identified as key patient characteristics that affect linkage of PLHIV to HIV C&T, similar findings were documented elsewhere [17-19]. For these two factors, interventions in Cycles 1 and 2 yielded the most significant outcome on linkage to HIV C&T, with Cycle 3 having little additional effect on linkage. In addition to male sex having poor health-seeking behaviour [18, 19], repeat testers are often in denial of their 1st HIV test result status [17, 19, 20]. Similar to sex, where males experienced the greatest increase in linkage due to this CQI intervention compared to females, PLHIV who reported being repeat testers had the most significant increase in linkage from 67% to 98%. Therefore, results posted by this study and elsewhere [14] have demonstrated that combined intervention implemented in Cycles 1 and 2 were sufficient to address barriers to linkage to HIV C&T among these unique sub-populations of PLHIV (males and repeat testers).

In this study, being male, aged 0 to 9 years or ≥20 years, first time testers, and divorcees were significantly associated with increased linkage to care services within the first two years of CQI implementation, suggesting that Cycles 1 and 2 CQI packages were the most impactful for these specific groups. Although, combined intervention (Cycles 1 through 3) showed significant improvement in linkage to HIV C&T across different demographic characteristics when comparing before and after (Table 1), significant stepwise increase in linkage across the 4 years was only consistently observed among older patients (≥20 years) and divorcees (Table 2). This suggested that patient support services emphasizing comprehensive patient literacy was an important addition to interventions addressing barriers to linkage to HIV C&T that were unique to divorced or older PLHIV.

CONCLUSION

This study demonstrated significant improvement in linkage of PLHIV to HIV C&T services through implementation of feasible and low-cost CQI interventions of patient escort, fast tracking, aggressive tracing, task shifting and improved comprehensive patient literacy. Among newly-identified PLHIV, multiple interventions may be required to address barriers to linkage to HIV C&T services. Therefore, strategies embracing multipronged interventions have increased likelihood of linking newly-identified PLHIV to HIV C&T services, towards achieving the second 90 of the UNAIDS targets.

ACKNOWLEDGEMENTS

We would like to thank all clients included in this analysis and all EDARP health care providers for making this project a success.

Attribution of Support:
This publication was made possible by financial support from the President's Emergency Plan for AIDS Relief (PEPFAR) through the U.S. Centers for Disease Control and Prevention (CDC), under the terms of cooperative agreements PS-09-991-PS-002053.

Disclaimer:
The findings and conclusions in this publication are those of the authors and do not necessarily represent the official position of the funding agency.

REFERENCES

1. UNAIDS. (2014). An ambitious 90-90-90 treatment target to help end the AIDS epidemic," United Nations. Retrieved from https://www.unaids.org/sites/default/files/media_asset/90-90-90_en.pdf.
2. National AIDS and STI Control Program (NASCOP), Ministry of Public Health and Sanitation, Kenya. (2014). Kenya AIDS Indicator Survey 2012: Final Report. *J. Acquir. Immune Defic. Syndr., 66* (Suppl 1), 1–530.
3. Ng'ang'a, A., Waruiru, W., Ngare, C., Ssempijja, V., Gachuki, T., Njoroge, I., *et al*. (2014). The status of HIV testing and counseling in Kenya: results from a nationally representative population-based survey. *Journal of acquired immune deficiency syndromes (1999), 66*(Suppl 1), S27–S36.
4. Gerdts, S. E., Wagenaar, B. H., Micek, M. A., Farquhar, C., Kariaganis, M., Amos, J., *et al*. (2014). Linkage to HIV care and antiretroviral therapy by HIV testing service type in Central Mozambique: a retrospective cohort study. *Journal of acquired immune deficiency syndromes (1999), 66*(2), e37–e44.
5. Rosen, S., & Fox, M. P. (2011). Retention in HIV care between testing and treatment in sub-Saharan Africa: a systematic review. *PLoS medicine, 8*(7), e1001056.
6. Genberg, B. L., Naanyu, V., Wachira, J., Hogan, J. W., Sang, E., Nyambura, M., *et al*. (2015). Linkage to and engagement in HIV care in western Kenya: an observational study using

population-based estimates from home-based counselling and testing. *The lancet. HIV, 2*(1), e20–e26.

7. Hatcher, A. M., Turan, J. M., Leslie, H. H., Kanya, L. W., Kwena, Z., Johnson, M. O., *et al*. (2012). Predictors of linkage to care following community-based HIV counseling and testing in rural Kenya. *AIDS and behavior, 16*(5), 1295–1307. doi:10.1007/s10461-011-0065-1.
8. Sanga, E. S., Lerebo, W., Mushi, A. K., Clowes, P., Olomi, W., Maboko, L., & Zarowsky, C. (2017). Linkage into care among newly diagnosed HIV-positive individuals tested through outreach and facility-based HIV testing models in Mbeya, Tanzania: a prospective mixed-method cohort study. *BMJ open, 7*(4), e013733.
9. Kranzer, K., Zeinecker, J., Ginsberg, P., Orrell, C., Kalawe, N. N., Lawn, S. D., *et al*. (2010). Linkage to HIV care and antiretroviral therapy in Cape Town, South Africa. *PloS one, 5*(11), e13801.
10. Lankowski, A. J., Siedner, M. J., Bangsberg, D. R., & Tsai, A. C. (2014). Impact of geographic and transportation-related barriers on HIV outcomes in sub-Saharan Africa: a systematic review. *AIDS and behavior, 18*(7), 1199–1223.
11. Govindasamy, D., Meghij, J., Kebede Negussi, E., Clare Baggaley, R., Ford, N., & Kranzer, K. (2014). Interventions to improve or facilitate linkage to or retention in pre-ART (HIV) care and initiation of ART in low- and middle-income settings--a systematic review. *Journal of the International AIDS Society, 17*(1), 19032. doi:10.7448/IAS.17.1.19032
12. Wachira, J., Naanyu, V., Genberg, B., Koech, B., Akinyi, J., Kamene, R., *et al*. (2014). Health facility barriers to HIV linkage and retention in Western Kenya. *BMC health services research,* 14, 646.
13. Naik, R., Doherty, T., Jackson, D., Tabana, H., Swanevelder, S., Thea, D. M., *et al*. (2015). Linkage to care following a home-based HIV counselling and testing intervention in rural South Africa. *Journal of the International AIDS Society, 18*(1), 19843.
14. McNairy, M. L., Lamb, M. R., Gachuhi, A. B., Nuwagaba-Biribonwoha, H., Burke, S., Mazibuko, S., *et al*. (2017). Effectiveness of a combination strategy for linkage and retention in adult HIV care & treatment in Swaziland: The Link4Health cluster randomized trial. *PLoS medicine, 14*(11), e1002420.
15. Elul, B., Lamb, M. R., Lahuerta, M., Abacassamo, F., Ahoua, L., Kujawski, S. A., *et al*. (2017). A combination intervention strategy to improve linkage to and retention in HIV care & treatment following diagnosis in Mozambique: A cluster-randomized study. *PLoS medicine, 14*(11), e1002433.
16. Ministry of Health (MOH). (2014). Kenya HIV Quality Improvement Framework Operational Manual.pp. 1–6. Retrieved from https://www.chskenya.org/wp-content/uploads/2017/09/01-KHQIF_final.pdf
17. Conserve, D., Sevilla, L., Mbwambo, J., & King, G. (2013). Determinants of Previous HIV Testing and Knowledge of Partner's HIV Status Among Men Attending a Voluntary Counseling and Testing Clinic in Dar es Salaam, Tanzania. *Am. J. Mens. Health, 7*(6): 450–460.
18. Galdas, P. M., Cheater, F., & Marshall, P. (2005). Men and health help-seeking behaviour. *J. Adv. Nurs., 49*(6), 616–623.
19. Jenness, S. M., Myers, J. E., Neaigus, A., Lulek, J., Navejas, M., & Raj-Singh, S. (2012). Delayed entry into HIV medical care after HIV diagnosis: Risk factors and research methods. *AIDS Care, 24*(10), 1240–1248.
20. Kulkarni, S., Tymejczyk, O., Gadisa, T., Lahuerta, M., Remien, R. H., Melaku, Z., *et al*. (2017). 'Testing, Testing': Multiple HIV-Positive Tests among Patients Initiating Antiretroviral Therapy in Ethiopia. *J. Int. Assoc. Provid. AIDS Care. 16*(6):546-554.