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High levels of retention in care with streamlined care and universal test-and-treat in East Africa

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Abstract

Objective—We sought to measure retention in care and identify predictors of non-retention among patients receiving ART with streamlined delivery during the first year of the ongoing SEARCH “test-and-treat” trial (NCT 01864603) in rural Uganda and Kenya.

Design—Prospective cohort of patients in the intervention arm of the SEARCH Study.

Methods—We measured retention in care at 12 months among HIV-infected adults who linked to care and were offered ART regardless of CD4 cell count, following community-wide HIV-testing. Kaplan-Meier estimates and Cox proportional hazards modeling were used to calculate the probability of retention at one year and identify predictors of non-retention.

Results—Among 5,683 adults (age ≥ 15) who linked to care, 95.5% (95% CI: 92.9 – 98.1%) were retained in care at 12 months. The overall probability of retention at one year was 89.3% (95% CI: 87.6 – 90.7%) among patients newly linking to care and 96.4% (95% CI: 95.8 – 97.0%)

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among patients previously in care. Younger age and pre-ART CD4 below country treatment initiation guidelines were predictors of non-retention among all patients. Among those newly linking, taking more than 30 days to link to care after HIV diagnosis was additionally associated with non-retention at one year. HIV viral load suppression at 12 months was observed in 4,227/4736 (89%) of patients retained with valid viral load results.

Conclusion—High retention in care and viral suppression after 1 year were achieved in a streamlined HIV care delivery system in the context of a universal test-and-treat intervention.

Keywords

HIV; Africa; Antiretroviral therapy; Healthcare; Retention in care

Introduction

Antiretroviral therapy (ART) reduces morbidity and mortality in patients with all CD4+ Tcell count levels[1, 2] and decreases the probability of HIV transmission to uninfected partners[3]. In order to realize these individual and public health benefits, in 2015 the WHO guidelines were updated to recommend ART for all HIV infected individuals, regardless of CD4 count[4] (universal treatment). Retention in care will be critical to the success of universal test-and-treat strategies, and treatment programs will be challenged to extend ART treatment to the newly eligible patients while supporting retention in care in an expanded patient population. Retention in care will also be essential to realizing the UNAIDS target of 90-90-90, particularly the final goal that 90% of the population on ART is virally suppressed.

Significant questions remain about whether high retention in a universal test-and-treat system is possible in the setting of increasing patient volumes, an increasing proportion of asymptomatic patients, and known barriers to retention. Current estimates of retention in sub-Saharan Africa are widely variable and the estimated regional average 12-month retention of 76% (range 65% – 89%) is insufficient to achieve these targets [5]. In addition, current retention estimates are likely biased due to incomplete ascertainment of outcomes and do not reflect retention under universal treatment. Individual factors including younger age[6–13], male gender[8–18], lower education[16], occupation[11, 17], and mobility[19] have all been associated with lower levels of retention in ART care and could affect retention under the test-and-treat paradigm. Additionally, clinic factors contributing to disengagement in care, including long wait times, negative staff attitudes and frequent visits[9, 20–22] could be exacerbated as ART access is expanded.

With the advent of large scale efficacy trials of the universal test-and-treat strategy being conducted in sub-Saharan Africa[23, 24], new research is needed to bridge existing clinical and implementation science knowledge gaps around retention in care in these ambitious universal treatment strategies. The intervention arm of the ongoing Sustainable East Africa Research on Community Health (SEARCH) test-and-treat trial (NCT01864603) provides ART within a streamlined care delivery system, which was designed to offer patient-centered and efficiently delivered care to minimize many of the traditional barriers to retention. We sought to characterize predictors and barriers to retention in care in the

intervention arm of the SEARCH trial during the first year of implementation of universal testing and treatment utilizing a streamlined model of ART care.

Methods

SEARCH Study Design

The SEARCH HIV test-and-treat study is a community cluster-randomized controlled trial in 32 communities in three regions: western Kenya, southwestern Uganda, and eastern Uganda. All communities received a community census and population-wide HIV testing at baseline in 2013 – 2014. These are rural communities composed of geopolitical units just above the village level (termed a 'parish' in Uganda and a 'sublocation' in Kenya) with a population of about 10,000 people each, within the catchment area of a government supported ART clinic(s). Using a hybrid mobile HIV testing approach in which 2-week multi-disease community health campaigns (CHCs) are followed by home-based testing (HBT) of CHC non-participants, 89% of the population was tested at baseline[25]. In the 16 SEARCH intervention communities, all HIV-infected individuals were referred immediately upon HIV diagnosis to HIV care and then offered immediate ART initiation or continuation of ART therapy at the clinic within a streamlined model of care.

Streamlined care

The streamlined care model was developed using the PRECEDE framework[26] and was designed to reduce patient barriers to care. It featured ART start at first linkage to clinic, visits with reduced wait time [27], quarterly (as opposed to monthly) follow-up visits for stable patients, a patient-centered approach to care in which staff were trained to provide care in a welcoming and empathetic environment, a telephone hotline for patients with medical questions and appointment scheduling concerns, appointment reminders by phone or SMS, and provision of viral load results through a structured viral load counseling protocol [28, 29]. Patients who missed a clinic visit were tracked using a "tiered" approach performed by nurses in Uganda and community health workers in Kenya. Under the "tiered" tracking approach the patient was called after the first missed visit to determine the reason for the missed visit and reschedule the appointment. If the patient also missed the rescheduled appointment, or the patient was not reached by phone, a tracker visited the patient at home or an alternative location of their choice. In some communities the patient was offered ART in an alternative location of the patient's choosing. All patients initiating ART at CD4 T- cell counts above country-treatment guidelines who missed a clinic visit were tracked from the beginning of the study; retention tracking was expanded to include all patients starting in March 2014 in Uganda and in June 2014 in Kenya. No financial incentives for retention in care were provided.

Measures

Patient demographics were obtained during a baseline home-to-home census enumeration. Patients with a Ministry of Health HIV medical record at the time of the baseline CHC were considered previously linked to care, and those with an ART start date indicated on their medical record were classified as prescribed ART at baseline. A viral load was obtained at least 6 months after the start of streamlined care, either during follow-up year 1 hybrid

mobile testing (CHC or HBT one year after baseline testing) or in clinic. Plasma HIV-1 RNA viral load was measured from finger-prick capillary[30] or venous blood collection by commercial real-time PCR assays at multiple reference laboratories.

Retention in care was defined as not more than 90 days late to a scheduled 12-month follow-up. Patients were considered out of care (non-retention) if they were found alive, in the community and not enrolled in HIV care, moved out of the community without a documented transfer, or were lost to follow-up. Patients with a documented transfer and patients who died were censored in time-to-event analysis. Patients were considered virally suppressed if their HIV viral load was < 500 copies/ml at the time of follow-up year 1 hybrid testing or, if none available, clinic viral load performed closest in time to 12 months.

Gender, age, education, occupation, mobility, access to a mobile phone, and HIV testing location (CHC versus home-based testing) were obtained during the baseline year. Education was categorized as no school, any primary or completed primary school, and any secondary or further education. The 13 individuals who answered “don’t know/refused” on the baseline census were considered to have attended no school in the analysis. The 20 occupational categories at baseline were further classified as formal (student, teacher, government worker, military worker, health worker, factory worker), informal-high risk (fisherman, bar owner, bar worker, truck/taxi/motorcycle/bike/boat driver, or tourism), informal-low risk (farmer, shopkeeper, market vendor, hotel worker, household worker, construction worker), no job (unemployed, disabled), or other. Individuals were considered a stable resident if they reported having resided within the community for at least 6 months out of the 12 months prior to census enumeration.

Statistical Analysis

The objective of this analysis was to describe 12-month retention in care and predictors of non-retention among adults who linked to care in a SEARCH intervention community during the first year of the intervention. The analysis was thus restricted to adults (≥ 15 years) who had at least one clinic visit after baseline hybrid testing. Individuals whose first clinic visit occurred <12 months before database closure date were also excluded. For the time-to-event analysis, patients entered the risk group (T_0) at their first clinic visit after baseline hybrid testing. Time to attrition was calculated as the time between T_0 and a patient’s last scheduled clinic visit. Kaplan Meier survival estimates were used to calculate probability of retention at one year. Hazard ratios for non-retention were also computed using Cox proportional hazards modeling. Follow up continued until attrition, censoring due to death or transfer, or 365 days after linkage. A secondary analysis in which death was treated as a competing risk was also performed. The proportional hazards assumption was assessed graphically and with Schoenfeld residuals. To evaluate predictors of requiring enhanced retention support in order to stay in care, we used logistic regression to evaluate adjusted predictors of the need for retention tracking after the date all patients became eligible for retention tracking (i.e. after March 1, 2014 in Uganda and after June 1, 2014 in Kenya). Multivariate models included region, sex, and age based on *a priori* determination. Covariates that were significant in univariate analysis were added in stepwise progression and included in the model if they contributed significantly to the fit of the model using a

likelihood ratio test with p<0.1. In the proportional hazards model, age was stratified into three categories: 15–24, 25–29, and >30 years (because retention was homogenous within these categories and did not violate the proportional hazards assumption). Community was included as a fixed effect in all models and cluster-robust standard errors with household as the unit of independence were used to control for clustering by community and household. All analyses were stratified by care status at the time of baseline hybrid testing (previously in care vs. newly linking). Stata v14 (College Station, Texas) was used for analysis.

Ethics

The Makerere University School of Medicine Research and Ethics Committee (Uganda), the Ugandan National Council on Science and Technology (Uganda), the Kenya Medical Research Institute Ethical Review Committee (Kenya), and the University of California San Francisco Committee on Human Research (USA) approved the study protocol including the consent procedures. All participants provided verbal informed consent in their preferred language with fingerprint biometric confirmation of agreement.

Results

Study population

Between April 2, 2013 and June 8, 2014, 89,431 adults (≥ 15 years) were enumerated in the 16 intervention communities[25]. Among the 7,132 (8%) who were found to be HIV-infected at the time of baseline hybrid mobile testing, 6,128 (86%) had at least one clinic visit after the baseline CHC and before follow-up year one CHC. An additional 448 (6%) were excluded because their first visit occurred <12 months before database closure date resulting in 5,683 (80%) included in analysis. At baseline, 4,082 (72%) had a history of HIV care and 3,458 (61%) had ever been prescribed ART, while 1602 (28%) were linking to care for the first time [Figure 1].

Demographics

Of the 5,683 patients who linked to HIV care, 3,703 (65.2%) were from Kenya, 1,306 (23.0%) were from western Uganda, and 674 (11.9%) were from eastern Uganda; 3,820 (67.2%) were female; 603 (10.6%) were between 15–24 years of age and 1,494 (26.3%) were under age 30; and almost all were stable residents (5,544, 97.5%). One thousand two hundred fifty seven (22.1%) had a pre-ART CD4 above country treatment guidelines at the time of ART start. Four thousand three hundred eight two (77.1%) had tested at the CHC vs. 23.9% at HBT. Regional differences were seen; Kenyan participants were more likely to be younger, have lower levels of education, work in the fishing industry, and to have tested during home-based testing (vs. at CHCs). Kenyans were also more likely to have a history of previous HIV care and ART [Table 1].

Retention in care outcomes

Of the 5,683 adults who linked to care during the eligible period, 5,058 (88.6%) were retained at their original clinic and 260 (4.6%) had a documented transfer to an alternative site. Sixty (1.1%) patients died, 108 (1.9%) were known to be alive and in the community, and 64 (1.1%) moved out of the community without a documented transfer [Appendix 1]. Of

the 60 deaths, 15 were due to illness, 1 was due to an accident, and 44 were unknown. The overall probability of retention at one year, adjusted for out-transfers and deaths, was 95.5% (95% CI: 92.9 – 98.1%). The probability of retention at one year was 89.3% (95% confidence interval (CI) 87.6 – 90.7%) among patients newly linking to care and 96.4% (95% CI 95.8 – 97.0%) among patients previously in care. Probability of retention at one year was higher among those previously in care compared to those newly linking across all subgroups. The lowest observed retention (76.3%; 95% CI 70.9 – 81.7%) was among adults age 15–24 linking to care for the first time [Figure 2].

Virologic Outcomes

Overall, at follow-up viral load testing 4,455/5,683 (78.5%) had a suppressed viral load, 621/5,683 (10.9%) had a viral load > 500 copies/ml, and 610/5,683 (10.7%) did not have viral load results. Patients with viral load results available were more likely to be retained in care ($p<0.001$), live in East Uganda ($p = 0.002$), be age 30 years or older ($p < 0.001$), and have a pre-ART CD4 count above country treatment guidelines ($p<0.001$). Among the 5,058 retained in care, follow-up viral load data were available for 4,736 (93.6%); of these, 4,227 (89%) were suppressed.

Predictors of retention

Among both those newly linking to care and those previously in care, there was no significant association between non-retention and sex, education level, occupation, mobility, or whether HIV testing was completed at the CHC or in HBT. Non-retention was significantly more likely among younger patients, with those age 15–24 years being the least likely to be retained in care at 12 months among those newly linking to care (aHR 3.78, 95% CI 2.48 – 5.76) and those previously in care (aHR 2.70, 95% CI 1.70 – 4.29). Additionally, among patients newly linking to care, non-retention was more likely among residents of eastern Uganda (aHR 2.52, 95% CI 1.04 – 6.12) and those who took more than 30 days to link to care (aHR 1.41, 95% CI 1.03 – 1.95). In addition to young age, not having access to a mobile phone (aHR 1.94, 95% CI 1.36 – 2.77) was the only other predictor associated with increased risk of non-retention in multivariate analysis among patients who had a history of HIV care [Table 2]. Results were similar when death was treated as a competing risk rather than censoring event [Appendix 2].

Predictors of retention tracking

Patients newly linking to care were more likely to require retention tracking to stay in care compared to those previously in care (31.1% vs. 9.3%, $p<0.001$). Patients who lived in Uganda, younger patients, men, and those with a pre-ART CD4 count above country treatment guidelines were more likely to require retention tracking to stay in care. Testing site (CHC vs. HBT) and time to link were not associated with retention tracking [Table 3].

Discussion

In one of the first evaluations of retention in HIV care in the setting of a universal test-and-treat program, we found 95% of patients who linked to care were still in care one year after introducing universal ART delivered via streamlined care in two country public health

systems. This included demographic groups who have historically demonstrated lower retention, such as men, those with lower educational levels, and persons who work in high-risk occupations (e.g. fisherfolk). In contrast to concerns about retention among those with high CD4 counts (patients who will increasingly be initiating ART under new universal ART guidelines), these patients demonstrated high retention with 91% of patients newly linking patients and 97% of those previously in care retained in care at one year.

The streamlined model of care employed in the SEARCH-supported clinics might have contributed to the high levels of observed retention, as it addresses many of the traditional barriers to retention, such as negative staff attitudes, frequent clinic visits, and long waiting times. Staff were trained to deliver care in a warm and welcoming environment and to support adherence and retention in an empathetic manner with patients[29]. Decreased wait times and decreased frequency of visits from monthly to every three months increases the clinic capacity to see more patients, which will be critical for treatment programs to scale-up under universal test-and-treat[28]. Reducing wait times may mitigate stigma associated with queuing outside HIV clinics for some patients. Also, the provision of viral load results and structured viral load counseling provided a tool for adherence assessment and retention support.

Active outreach, especially immediately after or within one week of missed appointments, is known to improve retention [31–33]. Retention tracking that was initiated immediately following a missed visit was part of the streamlined care package, and used a tiered approach to adapt to the resources and needs of the communities as well as the individual patients. Patients in Uganda, men, younger patients, and those newly linking to care were more likely to require retention tracking to stay in care, possibly reflecting a higher risk of attrition among these groups. Although mobility has been associated with lower retention[19], unstable residents who were retained in care had a lower probability of requiring retention tracking. It may be that the unstable residents who successfully link to care are highly motivated to stay in care. While patients with high CD4 were also more likely to have been tracked, early during the study follow up period only high CD4 patients were eligible for tracking and may have continued to be prioritized throughout the follow-up period even after all patients became eligible.

In contrast to other settings in sub-Saharan Africa in which men have lower retention rates than women[7–10, 12, 13, 17, 18, 34], we did not observe any significant gender disparity. The streamlined care system employed by the clinics, which decreased the frequency and improved the efficiency of visits, could have particularly benefited men by reducing any disruption to employment or other work. In these communities in rural East Africa a large proportion of the men work as farmers or fishermen, which requires them to be away from their communities for extended periods, and has been a demonstrated to deter men from to facility-based testing[35]. Men did require additional effort through retention tracking to stay in care, and may have benefited from this individualized outreach.

These data also highlight the challenges adolescents and young adults face in remaining in care. Younger adults not only required more effort through retention tracking to stay in care, but those under age 30 also had significantly lower retention than older age groups. This age

group faces high levels of stigma in their home environment and at school, which negatively affects retention[36]. In addition, younger adults are more likely to be mobile, traveling for education or employment. In our population, 5% of the youth (age 15–24) are mobile compared to 2.5% of the overall population. These mobile youth demonstrated the lowest overall retention, with only 81% still in care at 12 months. Retention support that addresses this vulnerable population will be required as our streamlined care model evolves. Alternative treatment sites, such as school-based treatment, longer intervals between refills to accommodate those who attend school outside of the community, and alternative methods of antiretroviral therapy, including long-acting methods, may be needed to support this population.

This analysis is subject to several limitations. These high retention rates should be interpreted in the context of the 86% who linked to care within one year. Those with delayed linkage may experience higher rates of non-retention, and those with the greatest challenges to linkage are those who are also likely to experience challenges staying in care. While the majority of patient outcomes at one year were ascertained, there were likely silent transfers that were not accounted for among those who moved out of the study community without a documented transfer or among those with missing outcomes[9, 37]. In addition, the care outcomes of the patients with an official transfer are unknown. However, data on patients transferring care in the region indicates almost all patients with an official transfer are linked to care at their destination facility within 3 months[38]. Only retention in the first year is captured so longer follow-up will be necessary to evaluate durability of retention in care. Finally, the viral suppression in this population could be underestimated, as almost 10% patients were missing viral load data at 12 months. We anticipate the completeness of viral load results will increase as viral load monitoring is expanded in East Africa.

To our knowledge, these are the first data on retention in care in a universal test-and-treat setting and demonstrate that high levels of retention in care are achievable when some of the known barriers to retention have been targeted. As universal test-and-treat is expanded, these barriers will need to be continually addressed to ensure durable retention, especially as patients' ages, and life factors change. Specific targeted interventions to retain young adults will also be crucial to the success of test-and-treat programs, as will strengthening timely linkage to care and retention for new diagnoses, and supporting those accessing care for the first time.

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Appendix 1. Outcomes at 12 months among adults in SEARCH intervention communities who accessed care after baseline CHC and before follow-up year one CHC (N = 5683)

	Accessed care after baseline CHC [N]	Retained in care at original site [n (%)]	Documented transfer [n (%)]	Died [n(%)]	Alive & in the community [n(%)]	Moved out of community [n(%)]	Missing [n(%)]
Total	5683	5058 (89.0%)	260 (4.6%)	60 (1.1%)	108 (1.9%)	64 (1.1%)	134 (2.4%)
New to care							
Total	1601	1329 (83.0%)	83 (5.2%)	25 (1.6%)	86 (5.4%)	45 (2.8%)	33 (2.0%)
Uganda-East	278	227 (81.7%)	6 (2.2%)	10 (3.6%)	22 (7.9%)	11 (4.0%)	2 (0.7%)
Uganda-West	563	465 (82.6%)	27 (4.8%)	6 (1.1%)	35 (6.2%)	22 (3.9%)	8 (1.4%)
Kenya	760	637 (83.8%)	50 (6.6%)	9 (1.2%)	29 (3.8%)	12 (1.6%)	31 (4.0%)
Men	642	547 (85.2%)	22 (3.4%)	9 (1.4%)	44 (6.9%)	11 (1.7%)	9 (1.5%)
Women	959	782 (81.5%)	61 (6.4%)	16 (1.7%)	42 (4.4%)	34 (3.6%)	24 (2.5%)
Age 15–24	257	173 (67.3%)	23 (9.0%)	6 (2.3%)	24 (9.3%)	24 (9.3%)	7 (2.7%)
Age 25–29	308	247 (80.2%)	13 (4.2%)	5 (1.6%)	23 (7.5%)	10 (3.3%)	10 (3.2%)
Age >= 30	1036	909 (87.7%)	47 (4.5%)	14 (1.4%)	39 (3.8%)	11 (1.1%)	16 (1.5%)
Low CD4	766	595 (77.7%)	59 (7.7%)	20 (2.6%)	39 (5.1%)	26 (3.4%)	27 (3.5%)
High CD4	835	734 (87.9%)	24 (2.9%)	5 (0.6%)	47 (5.6%)	19 (2.3%)	6 (0.7%)

	Accessed care after baseline CHC [N]	Retained in care at original site [n (%)]	Documented transfer [n (%)]	Died [n(%)]	Alive & in the community [n(%)]	Moved out of community [n(%)]	Missing [n(%)]
Stable resident	1548	1288 (83.2%)	81 (5.2%)	24 (1.6%)	82 (1.6%)	42 (2.7%)	25 (1.6%)
Not stable resident	53	41 (77.4%)	2 (3.8%)	1 (1.9%)	4 (7.6%)	3 (5.7%)	1 (1.9%)
Tested at CHC	1173	965 (82.5%)	63 (5.4%)	21 (1.8%)	64 (5.5%)	33 (2.8%)	27 (2.3%)
Tested in HBT	428	364 (85.1%)	20 (4.7%)	4 (0.9%)	22 (5.1%)	12 (2.8%)	6 (1.4%)
<= 30 days to link	960	817 (85.1%)	43 (4.5%)	17 (1.8%)	38 (4.0%)	28 (2.9%)	17 (1.8%)
> 30 days to link	641	512 (79.9%)	40 (6.2%)	8 (1.3%)	48 (7.5%)	17 (2.7%)	16 (2.5%)
Previously in care							
Total	4082	3729 (91.4%)	177 (4.3%)	35 (0.9%)	22 (0.5%)	18 (0.4%)	101 (2.5%)
Uganda-East	396	356 (89.9%)	16 (4.0%)	9 (2.3%)	7 (1.8%)	5 (1.3%)	3 (0.8%)
Uganda-West	743	653 (87.9%)	78 (10.5%)	4 (0.5%)	1 (0.1%)	3 (0.4%)	4 (0.5%)
Kenya	2943	2720 (92.4%)	83 (2.8%)	22 (0.8%)	14 (0.5%)	10 (0.3%)	94 (3.2%)
Men	1221	1119 (91.7%)	46 (3.8%)	14 (1.2%)	12 (1.0%)	4 (0.3%)	26 (2.2%)
Women	2861	2610 (91.2%)	131 (4.6%)	21 (0.7%)	10 (0.4%)	14 (0.5%)	75 (2.6%)
Age 15–24	346	300 (86.7%)	18 (5.2%)	4 (1.2%)	4 (1.2%)	3 (0.9%)	17 (4.9%)
Age 25–29	583	525 (90.1%)	24 (4.1%)	8 (1.4%)	5 (22.7%)	6 (1.0%)	15 (2.5%)
Age >= 30	3153	2904 (92.1%)	135 (4.3%)	23 (0.7%)	13 (0.4%)	9 (0.3%)	69 (2.2%)
Low CD4	3660	3330 (91.0%)	166 (4.5%)	34 (0.9%)	15 (0.4%)	15 (0.4%)	100 (2.7%)
High CD4	422	399 (94.6%)	11 (2.6%)	1 (0.2%)	7 (1.7%)	3 (0.7%)	1 (0.2%)
Stable resident	3996	3651 (91.4%)	172 (4.3%)	34 (0.9%)	21 (0.5%)	17 (0.4%)	101 (2.5%)
Not stable resident	86	78 (90.7%)	5 (5.8%)	1 (1.2%)	1 (1.2%)	1 (1.2%)	0
Tested at CHC	3213	2945 (91.7%)	134 (4.2%)	29 (0.9%)	17 (0.5%)	13 (0.4%)	86 (2.7%)
Tested in HBT	858	784 (91.4%)	43 (5.0%)	6 (0.7%)	5 (0.6%)	5 (0.6%)	15 (1.7%)

Low CD4 = Pre-ART CD4 below Country treatment guidelines

High CD4 = Pre-ART CD4 above Country treatment guidelines

CHC = Community Health Campaign

HBT = Home-based Testing

Appendix 2. Predictors of non-retention at 12 months in adult residents of SEARCH intervention communities who linked to HIV care after baseline CHC and before follow-up year 1 CHC with death as a competing risk (N = 5683)

	Newly Linking to care (N = 1601)				Previously in Care (N = 4082)			
Predictor	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**
Region								
Kenya	ref		ref		ref		ref	

	Newly Linking to care (N = 1601)				Previously in Care (N = 4082)			
Predictor	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**
Uganda-East	1.90	0.82 – 4.42	2.51	1.04 – 6.07	0.95	0.47–1.91	0.84	0.47 – 1.50
Uganda-West	0.96	0.36 – 2.54	0.89	0.32 – 2.43	0.28	0.13–0.61	0.25	0.12 – 0.52
Sex								
Male	ref		ref		ref		ref	
Female	1.07	0.79 – 1.43	0.75	0.53 – 1.05	1.01	0.72–1.43	0.83	0.58 – 1.20
Age								
15–24	3.88	2.69 – 5.60	3.72	2.44 – 5.68	2.48	1.57 – 3.91	2.78	1.76 – 4.39
25–29	2.37	1.60 – 3.52	2.50	1.67 – 3.76	1.49	0.95 – 2.32	1.64	1.04 – 2.58
>= 30	ref		ref		ref		ref	
Education								
No School	0.53	0.30 – 0.95	0.79	0.44 – 1.42	0.84	0.43 – 1.61		
Primary	ref		ref		ref			
Any secondary or further	0.88	0.50 – 1.24	0.77	0.49 – 1.22	0.88	0.48 – 1.61		
Occupation								
Formal	ref				ref			
Informal – high risk	1.72	0.37 – 7.91	1.40	0.28 – 6.84	0.73	0.22 – 2.38		
Informal – low risk	2.14	0.66 – 6.95	1.78	0.51 – 6.23	0.92	0.33 – 2.58		
No job	4.59	1.29 – 16.27	2.80	0.73 – 10.8	2.13	0.70 – 6.44		
Other	2.32	0.58 – 9.17	1.77	0.42 – 7.53	0.61	0.11 – 3.35		
Access to a mobile phone								
Yes	ref				ref		ref	
No	1.27	0.92 – 1.75			1.93	1.35 – 2.76	1.92	1.35 – 2.74
Mobility								
Stable resident	ref				ref			
Not stable resident	1.76	0.86 – 3.58			0.82	0.20 – 3.40		
Pre-ART CD4								
Below country treatment guidelines	ref		ref		ref		ref	
Above country treatment guidelines	0.69	0.50 – 0.94	0.63	0.46 – 0.86	0.75	0.41–1.39	0.63	0.34 – 1.15
Site of testing								
CHC	ref				ref			
HBT	0.93	0.62 – 1.40			0.82	0.55–1.22		
Time to link								
<= 30 days	ref		ref					
> 30 days	1.53	1.11 – 2.11	1.43	1.04 – 1.98				

Abbreviations: CI = Confidence Interval; CHC = Community Health Campaign; HBT = Home-based testing

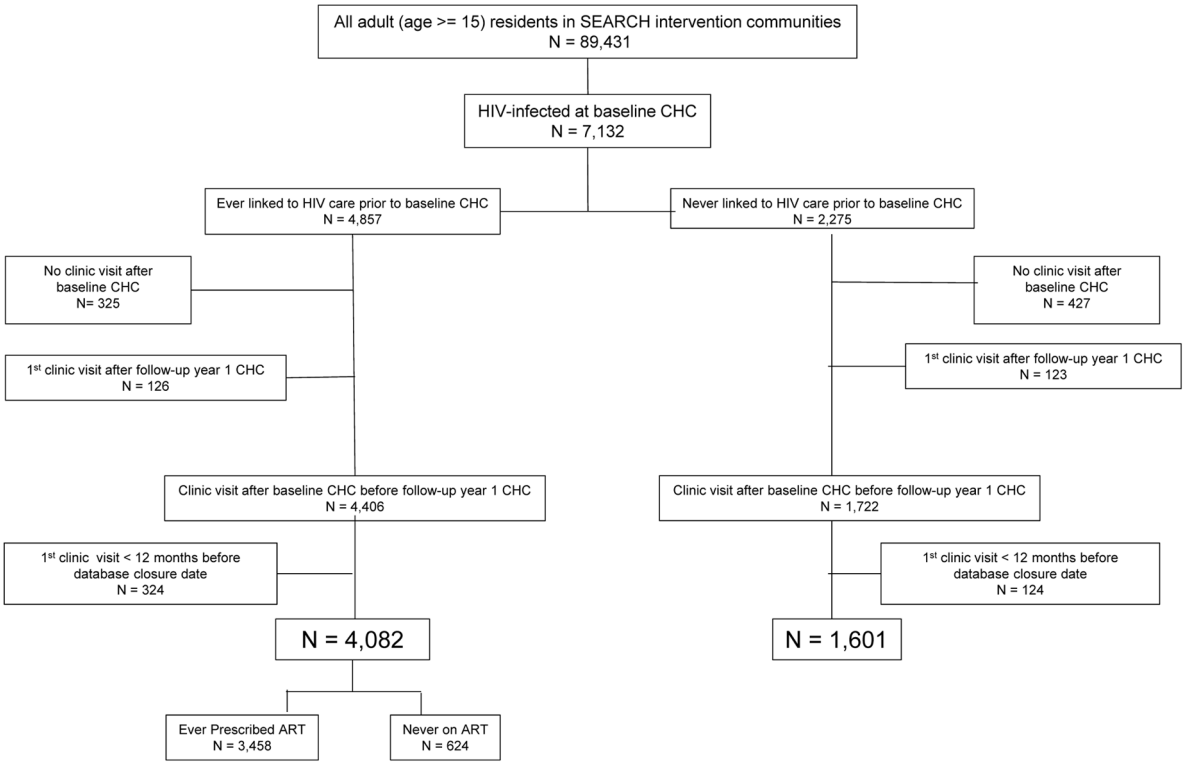

Figure 1.
Study population

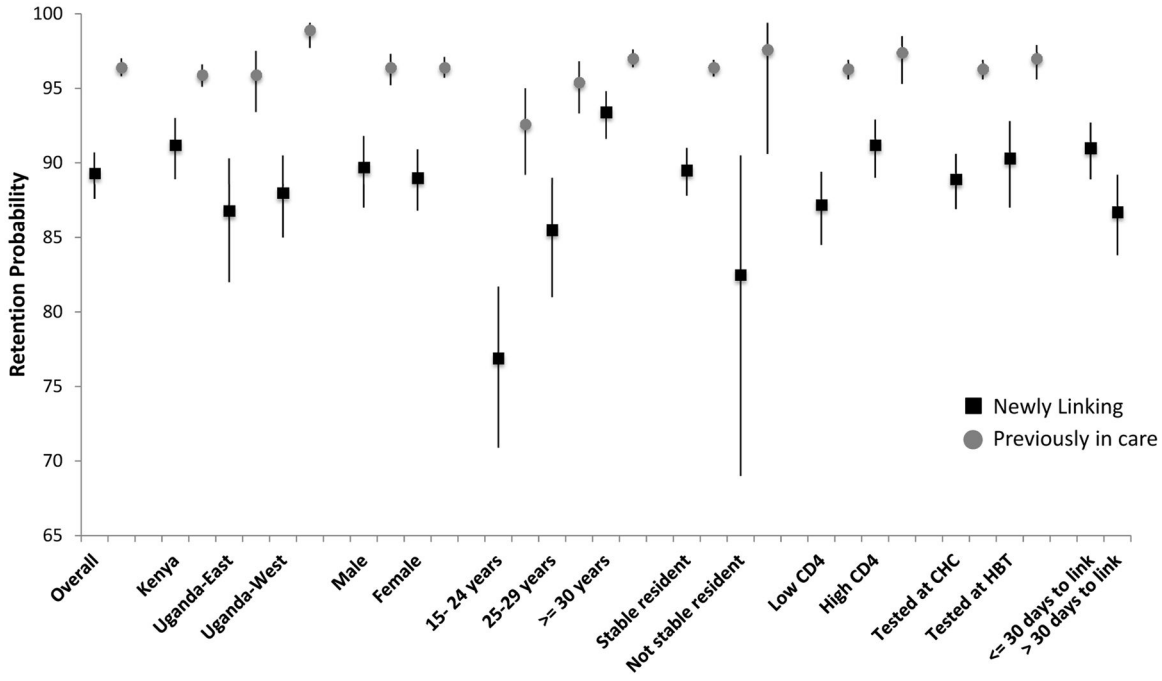

Figure 2.

Probability and 95% confidence intervals of being retained in care at one year among patients previously in care and newly linking to care in SEARCH intervention communities, overall and by subgroup

Low CD4 = pre-ART CD4 less than country treatment guidelines

High CD4 = pre-ART CD4 above country treatment guidelines

CHC = Community Health Campaign

HBT = Home-based testing

Table 1

Baseline characteristics among adult (age ≥ 15 years) residents of SEARCH intervention communities who linked to care after baseline CHC and before follow-up year 1 CHC (N = 5683)

	Uganda-West (N = 1306)	Uganda-East (N = 674)	Kenya (N = 3703)	Total (N = 5683)
Sex				
Male [n (%)]	219 (32.5%)	219 (32.5%)	1163 (31.4%)	1863 (32.8%)
Female [n (%)]	455 (67.5%)	455 (67.5%)	2540 (68.6%)	3820 (67.2%)
Age [years, median (IQR)]	36 (29–44)	39 (31–46)	37 (29–46)	
15–19 years	42 (3.2%)	20 (3.0%)	75 (2.0%)	137 (2.4%)
20–24 years	130 (10.0%)	43 (6.4%)	293 (7.9%)	466 (8.2%)
25–29 years	189 (14.5%)	83 (12.3%)	619 (16.7%)	891 (15.7%)
30–34 years	232 (17.8%)	91 (13.5%)	604 (16.3%)	927 (16.3%)
35–39 years	207 (15.9%)	118 (17.5%)	617 (16.7%)	942 (16.6%)
40–44 years	187 (14.3%)	125 (18.6%)	447 (12.1%)	759 (13.4%)
> 45 years	319 (24.4%)	194 (28.8%)	1048 (28.3%)	1561 (27.5%)
Education				
No School	230 (17.6%)	123 (18.3%)	184 (5%)	537 (9.5%)
Primary or less	794 (60.8%)	405 (60.1%)	3214 (86.8%)	4413 (77.7%)
Any Secondary or further	282 (21.6%)	144 (21.4%)	293 (7.9%)	313 (5.5%)
Don’t know/refused to answer	0	1 (0.2%)	12 (0.3%)	13 (0.2%)
Occupation				
Farming	858 (65.7%)	485 (72.0%)	2118 (57.2%)	3461 (65.7%)
Fishing	1 (0.1%)	3 (0.5%)	417 (11.3%)	421 (7.4%)
Shopkeeper/Vendor	103 (7.9%)	30 (4.5%)	425 (11.5%)	558 (9.8%)
Household worker	50 (3.8%)	30 (4.5%)	175 (4.7%)	255 (4.5%)
Transport worker	26 (2.0%)	13 (1.9%)	33 (0.9%)	72 (1.3%)
Student	18 (1.4%)	12 (1.8%)	42 (1.1%)	72 (1.3%)
Other	194 (14.9%)	78 (11.6%)	299 (8.1%)	571 (10.1%)
No Job	56 (4.3%)	23 (3.4%)	194 (5.2%)	273 (4.8%)
Mobility status				
Stable n(%)	1258 (96.3%)	658 (97.6%)	3628 (98%)	5544 (97.5%)
Mobile n(%)	48 (3.7%)	16 (2.4%)	75 (2.0%)	139 (2.5%)
Access to mobile phone [n (%)]	758 (58.0%)	306 (45.4%)	2657 (71.8%)	3721 (65.5%)
CD4 at baseline CHC				
<50 cells/mm^3	10 (0.8%)	8 (1.2%)	24 (0.7%)	42 (0.7%)
50–200 cells/mm^3	93 (7.1%)	59 (8.8%)	188 (5.1%)	340 (6.0%)
200–350 cells/mm^3	231 (17.7%)	127 (18.8%)	543 (14.4%)	892 (15.7%)
350–500 cells/mm^3	326 (25.0%)	166 (24.6%)	783 (21.1%)	1275 (22.4%)
>500 cells/mm^3	588 (45.0%)	281 (41.7%)	1827 (49.3%)	2696 (47.4%)
Missing baseline CD4	58 (4.4%)	33 (4.9%)	347 (9.4%)	438 (7.7%)
Pre-ART CD4 above country treatment guidelines[§]	408 (31.2%)	196 (29.1%)	653 (17.6%)	1257 (22.1%)

	Uganda-West (N = 1306)	Uganda-East (N = 674)	Kenya (N = 3703)	Total (N = 5683)
HIV RNA < 500 copies/ml	431 (33.0%)	190 (28.2%)	1656 (44.7%)	2277 (40.1%)
Missing baseline viral load	381 (29.2%)	193 (28.6%)	873 (23.6%)	1245 (21.9%)
Previous linkage to care [n (%)]	743 (56.9%)	396 (58.8%)	2943 (79.5%)	4082 (71.8%)
On ART before baseline CHC [n (%)]	585 (44.8%)	318 (47.2%)	2359 (63.7%)	3262 (57.4%)
HIV Testing Location				
CHC*	1075 (82.3%)	606 (89.9%)	2701 (72.9%)	4382 (77.1%)
HBT**	228 (17.5%)	60 (8.9%)	998 (26.7%)	1286 (22.6%)
Missing	3 (0.2%)	8 (1.2%)	4 (0.1%)	15 (0.3%)

*CHC = Community Health Campaign

**HBT = Home Based Testing

§Country guidelines for treatment were to initiate ART at CD4 < 350 cells/ml until December 2013 in Uganda and until June 2014 in Kenya, after which country treatment guidelines were changed to reflect the 2013 WHO guidelines of ART initiation at CD4 < 500 cells/ml

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Table 2

Predictors of non-retention at 12 months in adult residents of SEARCH intervention communities who linked to HIV care after baseline CHC and before follow-up year 1 CHC (N =5683)

	Newly Linking to care (N = 1601)				Previously in Care (N = 4082)			
Predictor	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**
Region								
Kenya	ref		ref		ref		ref	
Uganda-East	1.90	0.82–4.43	2.52	1.04–6.12	0.64	0.15–2.79	0.53	0.12–2.32
Uganda-West	0.95	0.36–2.51	0.88	0.32–2.42	0.28	0.13–0.60	0.25	0.12–0.52
Sex								
Male	ref		ref		ref		ref	
Female	1.08	0.80–1.47	0.76	0.54–1.06	1.01	0.71–1.43	0.84	0.59–1.21
Age								
15–24	3.94	2.72–5.70	3.78	2.48–5.76	2.48	1.57–3.90	2.70	1.70–4.29
25–29	2.39	1.61–3.55	2.51	1.67–3.77	1.48	0.95–2.32	1.59	1.01–2.51
>= 30	ref		ref		ref		ref	
Education								
No School	0.53	0.30–0.94	0.78	0.44 – 1.40	0.83	0.43–1.60		
Primary	ref		ref		ref			
Any secondary or further	0.78	0.50–1.23	0.76	0.48 – 1.21	0.88	0.48–1.61		
Occupation								
Formal	ref		ref		ref			
Informal – high risk	1.71	0.37–7.86	1.37	0.28 – 6.73	1.01	0.29–3.49		
Informal – low risk	2.16	0.67–7.01	1.79	0.51 – 6.28	1.10	0.44–2.80		
No job	4.61	1.30–16.4	2.79	0.72 – 10.7	2.41	0.83–6.94		
Other	2.32	0.59–9.2	1.79	0.42 – 7.58	0.68	0.18–2.59		
Access to a mobile phone								
Yes	ref				ref		ref	
No	1.27	0.92–1.76			1.94	1.35–2.77	1.94	1.36 – 2.77
Mobility								
Stable resident	ref				ref			

	Newly Linking to care (N = 1601)				Previously in Care (N = 4082)			
Predictor	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**	**Hazard Ratio**	**95% CI**	**Adj Hazard Ratio**	**95% CI**
Not stable resident	1.77	0.87–3.60			0.82	0.20–3.39		
Pre-ART CD4								
Below country treatment guidelines	ref		ref		ref		ref	
Above country treatment guidelines	0.68	0.50–0.93	0.62	0.45–0.84	0.75	0.40–1.38	0.63	0.34–1.17
Site of testing								
CHC	ref				ref			
HBT	0.93	0.61–1.40			0.90	0.56–1.42		
Time to link								
<= 30 days	ref		ref					
> 30 days	1.52	1.11–2.10	1.41	1.03–1.95				

Abbreviations: CI = Confidence Interval; CHC = Community Health Campaign; HBT = Home-based Testing

Country guidelines for treatment were to initiate ART at CD4 < 350 cells/ml until December 2013 in Uganda and until June 2014 in Kenya, after which country treatment guidelines were changed to reflect the 2013 WHO guidelines of ART initiation at CD4 < 500 cells/ml

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Table 3

Predictors of requiring tracking for retention support among patients retained in care at one year (N = 5318)

	Newly Linking to care (N = 1412)				Previously in Care (N = 3906)			
Predictor	**OR**	**95% CI**	**Adj OR**	**95% CI**	**OR**	**95% CI**	**Adj OR**	**95% CI**
Region								
Kenya	ref		ref		ref		ref	
Uganda-East	4.76	2.89 – 7.85	12.0	4.80 – 30.1	8.15	3.39 – 19.6	6.85	2.82 – 16.7
Uganda-West	1.51	0.84 – 2.71	1.25	0.50 – 3.15	2.0	1.51 – 2.66	0.75	0.30 – 1.85
Sex								
Male	ref		ref		ref		ref	
Female	0.85	0.66 – 1.08	0.68	0.52 – 0.89	0.98	0.76 – 1.27	0.70	0.52 – 0.95
Age								
15–24 years	1.97	1.27 – 3.03	2.55	1.59 – 4.10	2.76	1.77 – 4.31	2.39	1.46 – 3.91
25–29 years	1.84	1.24 – 2.75	2.00	1.30 – 3.07	2.05	1.38 – 3.07	1.90	1.21 – 2.99
30–34 years	1.28	0.85 – 1.92	1.40	0.90 – 2.16	1.88	1.28 – 2.77	1.85	1.22 – 2.81
35–39 years	1.35	0.90 – 2.05	1.44	0.93 – 2.24	1.28	0.87 – 1.89	1.25	0.81 – 1.92
40–44 years	0.96	0.61 – 1.52	1.09	0.67 – 1.78	1.08	0.71 – 1.64	1.06	0.67 – 1.66
> 45 years	ref		ref		ref		ref	
Education								
No School	0.87	0.60 – 1.28	1.18	0.76 – 1.82	1.02	0.69 – 1.49	1.24	0.80 – 1.92
Primary	ref		ref		ref		ref	
Any secondary or further	0.92	0.65 – 1.32	0.97	0.65 – 1.42	0.84	0.58 – 1.22	0.99	0.66 – 1.47
Occupation								
Formal	ref				ref			
Informal – high risk	1.22	0.54 – 2.75			1.64	0.75 – 3.58		
Informal – low risk	0.96	0.50 – 1.84			1.43	0.73 – 2.82		
No job	1.27	0.58 – 2.78			1.70	0.75 – 3.87		
Other	0.58	0.22 – 1.55			1.64	0.63 – 4.27		
Own a mobile phone								
Yes	ref		ref		ref		ref	
No	1.26	0.97 – 1.63	1.17	0.89 – 1.55	1.25	0.97 – 1.62	1.30	0.98 – 1.73

	Newly Linking to care (N = 1412)				Previously in Care (N = 3906)			
Predictor	**OR**	**95% CI**	**Adj OR**	**95% CI**	**OR**	**95% CI**	**Adj OR**	**95% CI**
Mobility								
Stable resident	ref		ref		ref		ref	
Not stable resident	0.34	0.12 – 0.93	0.33	0.13 – 0.84	0.76	0.29 – 1.97	0.83	0.26 – 2.63
Pre-ART CD4								
Below country treatment guidelines	ref		ref		ref		ref	
Above country treatment guidelines	3.19	2.43 – 4.19	3.16	2.39 – 4.18	10.1	7.49 – 13.6	9.52	7.00 – 12.9
Site of testing								
CHC	ref		ref		ref		ref	
HBT	0.85	0.63 – 1.15	0.87	0.62 – 1.20	1.13	0.82 – 1.55	1.08	0.77 – 1.53
Time to link								
<= 30 days	ref		ref					
> 30 days	1.28	0.99 – 1.66	1.25	0.95 – 1.64				

Abbreviations: CI = Confidence Interval; CHC = Community Health Campaign; HBT = Home-based Testing

Country guidelines for treatment were to initiate ART at CD4 < 350 cells/ml until December 2013 in Uganda and until June 2014 in Kenya, after which country treatment guidelines were changed to reflect the 2013 WHO guidelines of ART initiation at CD4 < 500 cells/ml