

Continuum of HIV Care in Rural Mozambique: The Implications of HIV Testing Modality on Linkage and Retention

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Introduction: Context-specific improvements in the continuum of HIV care are needed to achieve the UNAIDS target of 90-90-90. This study aimed to assess the linkage to and retention in HIV care according to different testing modalities in rural southern Mozambique.

Methods: Adults newly diagnosed with HIV from voluntary counseling and testing, provider-initiated counseling and testing, and home-based HIV testing services were prospectively enrolled between 2014 and 2015 at the Manhiça District. Patients were passively followed up through chart examination. Tracing was performed at 12 months to ascertain causes of loss to follow-up.

Fine and Gray competing risk analysis was performed to determine factors associated with the each step of the cascade.

Results: Overall linkage to care as defined by having a CD4 count at 3 months was 43.7% [95% confidence interval (CI): 40.8 to 46.6] and 25.2% of all participants initiated antiretroviral therapy. Factors associated with increased linkage in multivariable analysis included testing at voluntary counseling and testing, older age, having been previously tested for HIV, owning a cell phone, presenting with WHO clinical stages III/IV, self-reported illness-associated disability in the previous month, and later calendar month of participant recruitment. Ascertain deaths and transfers allowed for adjustment of the rate of 12-month retention in treatment from 75.6% (95% CI: 70.2 to 80.5) to 84.2% (95% CI: 79.2 to 88.5).

Conclusions: Home-based HIV testing reached a sociodemographically distinct population from that of clinic-based testing modalities but low linkage to care points to a need for facilitated linkage interventions. Distinguishing between true treatment defaulting and other causes of loss to follow-up can significantly change indicators of retention in care.

Key Words: HIV, linkage, retention, cascade, sub-Saharan Africa, Mozambique

(*J Acquir Immune Defic Syndr* 2018;78:527–535)

Received for publication February 14, 2018; accepted April 20, 2018.

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Supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of CoAg GH000479 (Scaling-up HIV counseling and testing services in a rural population by strengthening the health demographic surveillance system, in Manhiça, Mozambique). The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the CDC. ISGlobal is a member of the CERCA Programme, Generalitat de Catalunya. E.L.-V. is supported by a Rio Hortega doctoral fellowship (Instituto de Salud Carlos III) and a Ramon Areces Foundation fellowship.

Presented at the annual Conference on Retroviruses and Opportunistic Infections (CROI); February 22, 2016; Boston, MA.

The authors have no conflicts of interest to disclose.

D.N. conceived the study; D.N. and E.L.-V. designed the study; E.L.-V., L.F.-S., O.J.A., C.H.S., A.N., E.K., and P.V. acquired the data; E.L.-V., D.N., L.F.-S., and O.J.A. analyzed the data; E.L.-V. and D.N. wrote the first draft. All authors reviewed the manuscript and approved it for submission.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.jaids.com).

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INTRODUCTION

Currently, approximately 30% of people living with HIV (PLWHIV) worldwide do not know their HIV status.¹ Although voluntary counseling and testing (VCT) and clinic-based provider-initiated counseling and testing (PICT) continue to be the most widespread HIV counseling and testing (HCT) strategies worldwide,² other modalities such as home-based HIV testing (HBT) or self-testing strategies are gaining momentum to reach populations that would otherwise be left behind, such as men or young people.¹

Data assessing effectiveness of linkage to HIV care according to testing modalities are often inconclusive, partially due to lack of comparability between studies each assessing 1 or 2 testing modalities under distinct study populations, epidemiologic contexts, HIV program implementation conditions, and outcome definitions.^{3–7} PLWHIV tested through PICT or VCT seem to have higher engagement in care compared with those identified through HBT, who may not show the same motivation

for accessing health services.⁷ In a recent systematic review, linkage to care after HBT was generally low (<33%) but increased (>80%) if additional linkage strategies were used.⁸ Regardless of the testing modality, overall linkage and retention is fraught with obstacles, which contribute to loss to follow-up (LTFU) at different stages of the continuum of care. A systematic review in sub-Saharan Africa estimated that only 59%–78% of PLWHIV diagnosed receive a CD4 result within the first 3 months, 45% of patients are retained in pre-antiretroviral therapy (ART), and 66% of those eligible initiate ART.⁹ Once on ART, a third of patients are reported as LTFU within 3 years.¹⁰ Thus, as countries transition to test and treat, careful monitoring of the linkage and retention rate as well as detailed characterization of LTFU will be essential for appropriate management and evaluation of cascade-wide trends in LTFU.^{11,12}

In Mozambique, it is estimated that only 57% of PLWHIV enroll in care after diagnosis,¹³ and 3-year ART retention is 44%.¹⁴ However, estimates of LTFU may be overestimated due to incomplete ascertainment of outcomes. Active tracing activities to properly identify outcomes such as silent transfers, deaths, and migration are thus essential to improve LTFU estimates. This study aimed to assess the linkage care according to different testing modalities and secondarily evaluate the retention in HIV care and investigate factors associated with uptake across the care cascade in rural southern Mozambique.

MATERIALS AND METHODS

Study Setting and Procedures

The study was performed in the area covered by the health and demographic surveillance system (HDSS) located in the Manhiça District, a semirural area with a high HIV burden of disease in Mozambique.^{15,16} Further study area details are provided in the supplemental digital content.

This prospective cohort study consecutively enrolled patients with a new HIV diagnosis after HCT from trained counselors through VCT, outpatient PICT, and HBT between May 2014 and June 2015, before test and treat.¹⁷ The cohort inclusion criteria were adults older than 18 years willing to participate, resident in the Manhiça District Hospital (MDH) catchment area, and receiving a first HIV-positive result. Pregnant and TB co-infected patients who were diagnosed with HIV at the antenatal clinic or at the TB clinic, followed a specific model of integrated care and were thus excluded. Individuals tested through VCT and PICT were screened for eligibility after receiving an HIV-positive result, whereas in HBT, patients were screened before testing. For the purpose of this study, PICT was implemented at the MDH adult triage clinic as an opt-out strategy. HBT was performed using a list of adults randomly selected among the residents recorded in the HDSS. Three attempts were made to contact each individual before defining the status as absent and replacement was used when household residents could not be found.

All participants with a new HIV diagnosis were referred to the MDH for enrollment in HIV care. The study procedures did not influence the linkage to care beyond the HCT and

facility-based guidance to the MDH reception. At 12 months after diagnosis, patients defaulting at any stage were contacted by field counselors for active tracing to ascertain outcomes: migration, silent transfer, death, and LTFU.

Data Collection

This study included several data sources: (1) basic sociodemographic variables and information regarding HCT were recorded in study-specific forms at the time of testing and enrollment; and (2) passive follow-up clinical data were obtained from the MDH HIV electronic patient tracking system (ePTS).¹⁸ The charts of those patients who were identified as defaulting at any stage of the cascade were reviewed manually for quality check. For those not enrolled, we certified the absence of enrollment by matching the study database to the ePTS based on probabilistic matching methods¹⁹; (3) vital status was extracted from the HDSS; and (4) 12-month tracing of outcomes were recorded in study-specific forms at the time of home visits to patients defaulting at any stage according to data from ePTS and clinical charts.

Outcome Definitions and Statistical Considerations

The primary outcome was linkage to care, a binary variable defined as having a first CD4 count available within 3 months of diagnosis. For the purpose of the study and assuming a 50% linkage to care rate in VCT, a sample size of 408 HIV-positive individuals in each testing group was estimated to be necessary to detect a difference of 10% in linkage to care by PICT or HBT as compared with VCT with 80% power.

Self-reported knowledge of HIV was framed as a yes/no question as whether the participant knew what HIV was. Intention to disclose HIV status to partner was also asked as a yes/no question. Self-reported disability due to illness was defined as being unable to perform daily activities at least once in the past month due to illness. Occupation was categorized as: services, farming, and other, which included unremunerated activities such as domestic, unemployed, students, and no information. The history of a previous negative HIV testing at any time was collected.

The uptake of each of the following steps of the cascade was measured: (1) enrollment in care, defined as registering at the MDH and receiving a hospital identification number; (2) first clinical consultation; (3) linkage to care; and (4) ART initiation. The study used a 3-month cut-off from diagnosis to steps 1–3. For step 4, the 3-month cut-off was applied from the date of ART eligibility to initiation. For the purpose of this analysis, we only considered ART eligibility and initiation based on the criteria determined at first clinical visit. Twelve-month retention on ART was defined as having a clinical visit in the previous 180 days according to a proposed conservative universal definition of LTFU in HIV treatment programs, which corresponds to being at least 90 days late for a clinical visit.^{20,21} The definition of LTFU was thus specific for every step and included patients not uptaking first steps of the cascade plus those LTFU in ART.

We compared descriptive characteristics using χ^2 tests for categorical variables. We used the Fine and Gray competing risk model, with death being the main competing event, to estimate the impact of testing modality on each specific step of the cascade conditioned on the completion of the previous step. The hazard ratio of the subdistribution was used as a measure of association together with the corresponding 95% confidence interval (95% CI). Time was calculated from diagnosis to date when each step was reached, or date of death. Variables listed in Table 1 were entered into the models through a backward stepwise elimination procedure using Wald test *P*-values of *P* < 0.2 for addition and *P* > 0.1 for removal from the model. The final multivariable models were adjusted for age, sex, testing modality, as well as later month of study enrollment, defined as the number of months elapsed between study initiation and participant recruitment. We found no multicollinearity between variables or interactions between sex, age, and testing modality.

Ethical Approval

This study was approved by the Mozambican National Bioethics Committee, Institutional Review Boards at the Centers for Disease Control and Prevention, Barcelona Institute of

Global Health, and Centro de Investigaçao em Saude de Manhica. All participants provided written informed consent.

RESULTS

Study Profile and Population Characteristics

During the study period, 1955 adults tested positive for HIV at the MDH (VCT and PICT) were approached to determine their eligibility for the study. Over half did not meet inclusion criteria and among those eligible, the acceptance rate was 86.6% and 91.4% in VCT and PICT, respectively (Figs. 1A, B). Of 11,793 individuals randomly selected and confirmed to reside in the HDSS, 10,897 home visits were performed and 75% (n = 8192) of individuals were found and were screened for eligibility; among them, 16.3% had a previous HIV diagnosis (n = 1335) and 1.5% (n = 121) were pregnant and therefore not eligible (Fig. 1C). A total of 82.2% (n = 6736) of the home visits fulfilled inclusion criteria and the acceptance rate was 76.0%, significantly lower than in the clinic modalities (*P* < 0.001). Among those tested, 7.2% had a positive HIV result (n = 369). No prevalent TB cases were identified at the time of recruitment in any of the three testing modalities.

TABLE 1. Characteristics of Study Population According to Testing Modality

	Testing Modality (n, %)			Total	Global <i>P</i>
	VCT	PICT	HBT		
No. enrolled, n	330	423	369	1122	
Median age in years (IQR)	32.1 (25.5–40.7)	32.2 (25.7–39.4)	36.2 (28.3–46.1)	33.2 (26.4–42.9)	<0.001
Sex					
Male	129 (39.1)	196 (46.3)	168 (45.5)	493 (43.9)	0.105
Female	201 (60.9)	227 (53.7)	201 (54.5)	629 (56.1)	
Occupation					<0.001
Services	117 (35.5)	155 (36.6)	165 (44.7)	437 (39.0)	
Farming	37 (11.2)	70 (16.6)	104 (28.2)	211 (18.8)	
Other	176 (53.3)	198 (46.8)	100 (27.1)	474 (42.2)	
Self-reported knowledge of HIV					<0.001
No	24 (7.3)	24 (5.7)	73 (19.8)	121 (10.8)	
Yes	306 (92.7)	399 (94.3)	296 (80.2)	1001 (89.2)	
Previous HIV-negative test					0.538
No	187 (56.7)	243 (57.5)	198 (53.7)	628 (56.0)	
Yes	143 (43.3)	180 (42.6)	171 (46.3)	494 (44.0)	
Intention to disclose partner					0.002
Has no partner	89 (27.0)	78 (18.4)	57 (15.4)	224 (20.0)	
Intention to disclose partner	216 (64.4)	314 (74.2)	257 (69.6)	787 (70.1)	
No intention to disclose partner	25 (7.6)	31 (7.3)	55 (14.9)	111 (9.9)	
Testing type					<0.001
Individual	271 (82.1)	402 (95.0)	340 (92.1)	1013 (90.3)	
Nonindividual	59 (17.9)	21 (5.0)	29 (7.9)	109 (9.7)	
Disability in previous month					0.010
No	306 (92.7)	409 (96.7)	339 (91.9)	1054 (93.9)	
Yes	24 (7.3)	14 (3.3)	30 (8.1)	68 (6.1)	
Has cell phone					0.004
No	66 (20.0)	122 (28.8)	112 (30.4)	300 (26.7)	
Yes	264 (80.0)	301 (71.2)	257 (69.6)	822 (73.3)	

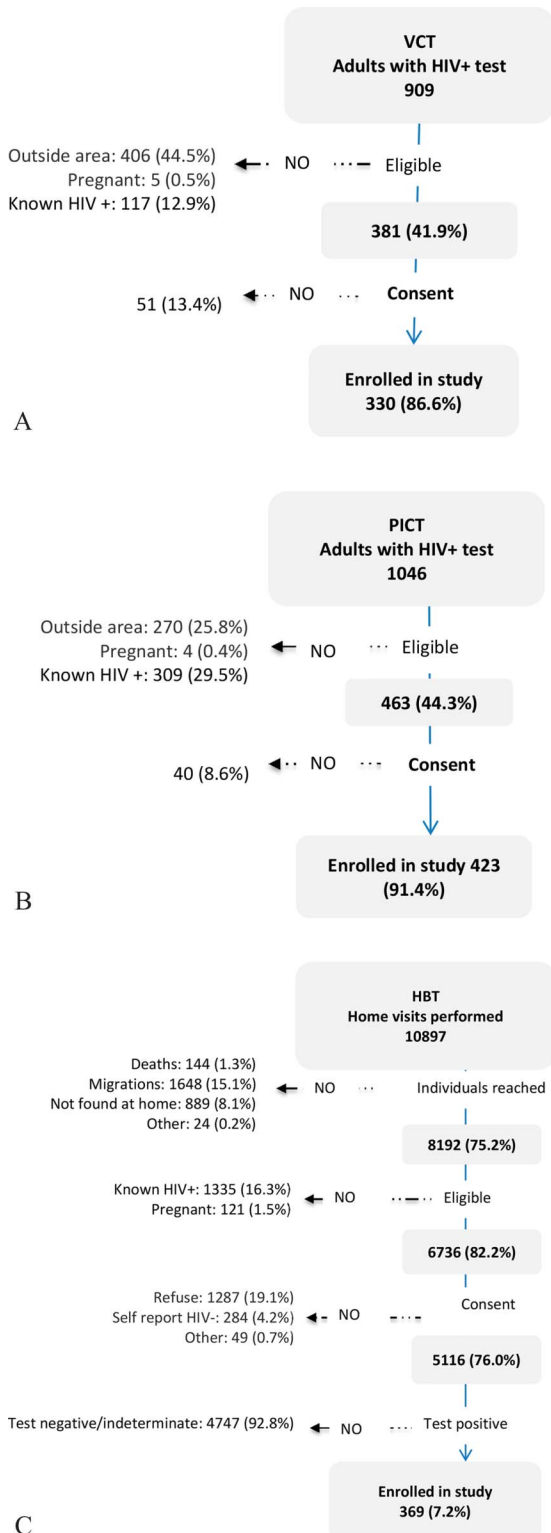


FIGURE 1. Study profile for patients enrolled in the study through different testing modalities: (A) VCT, (B) PICT, and (C) HBT. Percentages are calculated over the previous step.

Overall, a total of 1122 adults with a new HIV-positive result were enrolled from the 3 HIV testing modalities: VCT (n = 330), PICT (n = 423), and HBT (n = 369). Fifty-six percent were female and the median age at the time of enrollment was 33 years (Table 1). Baseline characteristics differed between testing modalities in all variables except for sex ($P = 0.105$) and history of negative HIV previous test year ($P = 0.538$) (Table 1). Regardless of testing modality, less than half the participants reported a previous HIV negative test. HBT participants were slightly older, more likely to be farmers, and fewer self-reported knowledge on HIV as compared with VCT and PICT (Table 1). Through VCT, nonindividual testing was significantly more frequent and participants were more likely to have a cell phone than in the other modalities. PICT patients were less likely to report disability in the previous year.

Three-Month Uptake of Care

Individuals in the HBT group showed significantly lower uptake of enrollment in care [35.5% (95% CI: 30.6 to 40.6)] compared with the clinic-based testing modalities {[98.5% (95% CI: 96.5 to 99.5)] and [90.8% (95% CI: 87.6 to 93.4)] in VCT and PICT, respectively, $P < 0.001$ } (Fig. 2). Overall linkage to care as defined by having a CD4 count (see methods) was 43.7% (95% CI: 40.8 to 46.6), and 25.2% of all participants initiated ART.

The cascade of care conditioned on completion of the previous step showed that a total of 69.0% of patients linked (n = 338) were eligible for ART at the initial evaluation visit according to national guidelines (see Figure 1, Supplemental Digital Content, <http://links.lww.com/QAI/B164>). Of those eligible, 83.7% initiated ART within the following 3 months, with a median time from diagnosis to ART initiation of 46 days [interquartile range (IQR): 31–78]. Testing modality was not associated with WHO stage ($P = 0.204$), ART eligibility among linked patients ($P = 0.429$), or proportion of patients initiating ART among those eligible ($P = 0.124$) (see Figure 1, Supplemental Digital Content, <http://links.lww.com/QAI/B164>). Of those linked, median initial CD4 cell count was 291 cells/mm³ (IQR: 173–450), with no significant differences across groups [VCT: 282 (IQR: 170–427), PICT: 294 (IQR: 155–458), and HBT: 315 (IQR: 178–506), $P = 0.570$]. Fifteen percent of participants had CD4 <100 cells/mm³, and 5.8% of participants had an advanced WHO stage III/IV at first visit.

Twelve-Month Uptake of Care

We then explored the linkage and retention indicators conditioned on the previous step of the cascade over the 12 months after diagnosis. Most uptake of enrollment in care and first clinical visit occurred in the first 3 months after diagnosis, with only an additional 3.7% and 6.2% subjects with delayed enrollment or clinical visit, respectively. However, among individuals with a clinical visit, 20.2% had a delayed linkage between 3 and 12 months after diagnosis and 16.6% did not link at all during the first year.

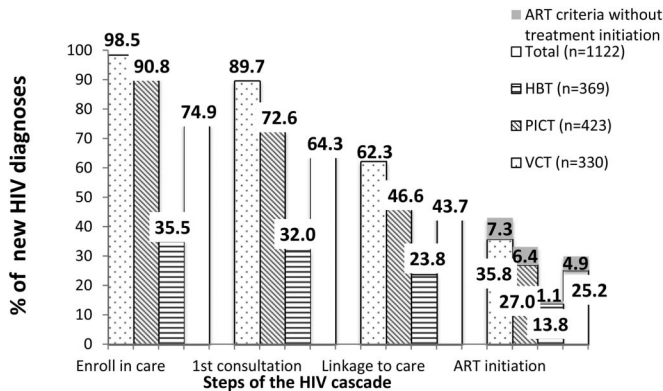


FIGURE 2. Three-month uptake of the initial steps of the HIV care cascade for all new HIV diagnoses according to testing modality. Uptake of each step is defined at 3 months after diagnosis for the first 3 steps (enrollment, consultation, and linkage to care) and 3 months after ART eligibility for the final step of ART initiation. Each bar represents the proportion of the total number of individuals recruited (N = 1122).

Patient home visits were conducted at 12 months, among patients LTFU at different steps of the cascade. Of those who had never linked to care, 41.7% were indeed not in care, whereas of those eligible for ART who had never initiated, 25% had discontinued and 17.5% had died (Fig. 2). Among those LTFU in ART, the proportion of deaths reached 21.7%. Thus, the proportion of those with confirmed discontinuation decreased along the cascade, whereas the proportion of deaths increased ($P < 0.001$) (Fig. 3). Of those who initiated ART, the 12-month retention was 75.6% (95% CI: 70.2 to 80.5). Patient tracing allowed for adjustment of the estimate of patients retained on ART at 12 months, taking into account death and both documented plus silent transfers. Removing these from the denominators adjusted the estimate of 12-month retention to 84.2% (95% CI: 79.2 to 88.5).

Determinants of Early Uptake at Each Step of the Cascade of Care

We identified factors associated with timely uptake of each step of the cascade. Multivariable analysis showed that older age, self-reported disability in the previous month due to illness, having a cell phone, and later calendar month of participant recruitment were positively associated with enrollment in care at 3 months (Table 2). However, testing modality (PICT or HBT) as well as self-reported knowledge of HIV were negatively associated with enrollment in care (Table 2). The participants from the 3 testing modalities differed in most of the covariates (Table 1). Confounding of covariates by testing modality was confirmed using bivariate analysis and stratified analysis (see Tables 1 and 2, Supplemental Digital Content, <http://links.lww.com/QAI/B164>), and only adjusted values are shown in Table 2.

Among patients who enrolled in HIV care, older age (≥ 45 compared with < 25 years) and later calendar month of participant recruitment were positively associated with having a first clinical consultation (Table 2). However, PICT and

HBT as compared with VCT were predictors of not having a clinical consultation (Fig. 3).

Among patients with a clinical visit, older age, having a previous negative HIV test, advanced WHO stage, self-reported disability, having a cell phone, and later calendar month of participant recruitment were positively associated with linkage to care at 3 months. Similarly to previous steps in the cascade, PICT and HBT were both associated with decreased linkage in multivariate analysis (Table 2).

We did not identify any factors significantly associated with initiating ART among those eligible (Table 2).

DISCUSSION

These results provide comprehensive estimates from Mozambique of early engagement in care after HIV diagnosis using various common testing strategies. Although HBT was 3-fold less efficient at linking patients in care than were the VCT and PICT modalities, mostly due to a significant block in the enrollment in HIV care stage, HBT reached a slightly older population with less self-reported knowledge of HIV. A home-based tracing study at 12 months allowed for adjustment of estimates of ART retention at 12 months. After elimination of deaths and transfers misclassified as suspected LTFU, the estimate of ART retention at 12 months increased from 75.6% to 84.2%.

Traditional HCT approaches based solely on VCT run the risk of missing populations who present specific linkage challenges. HBT reached an older population that was distinct to the clinic population in all tested variables except for sex and previous HIV-negative testing history. HBT had an acceptability rate of 76% and provided a 7.2% yield of identification of new HIV diagnoses, thus representing an effective strategy for reaching PLWHIV in a setting of hyperendemic HIV. However, without additional strategies that facilitate linkage, 65.5% of patients tested through HBT were lost at the initial steps of the cascade, similar to observations in neighboring countries.^{4,6,22} Being solicited through a non-client-initiated approach such as HBT when individuals are healthy could lead to lower motivation to seek care as opposed to when the same individual voluntarily seeks contact with the health services and/or feels ill.^{5,23,24} A recent model has suggested that facilitated linkage interventions will be crucial for cost-effectiveness of test and treat particularly as a larger number of healthier patients initiates treatment.²⁵

In addition to individual factors, health system-driven variations in patient flow may impact linkage from different testing modalities. In Manhiça, the VCT occurs early in the day, allowing for completion of the first 2 steps of enrollment and clinical visit within the same day. However, in the case of outpatient PICT, a high volume of patients often leads to delaying the specific HIV clinical visit until the next day, thus increasing defaulters at the first step similar to that observed for HBT. Thus, operational particulars such as simplifying or collapsing the cascade²⁶ according to HCT modality, streamlined or accelerated initiation of ART coupled with community ART initiation, and/or patient-centered differentiated care¹¹ will be key to successful implementation of test and treat.

TABLE 2. Multivariate Analysis of Factors Associated With Each Step of the Cascade

	A. Enrollment in Care				B. Clinical Consultation			
	n (%)	aSHR	95% CI	P	n (%)	aSHR	95% CI	P
Test modality								
VCT	325 (98.5)	Reference		<0.001	296 (91.1)	Reference		<0.001
PICT	384 (90.8)	0.81‡	(0.74 to 0.87)		307 (80.0)	0.65‡	(0.55 to 0.76)	
HBT	131 (35.5)	0.13‡	(0.11 to 0.16)		118 (90.1)	0.47‡	(0.40 to 0.55)	
Age category								
18–24	175 (75.8)	Reference		<0.001	145 (82.9)	Reference		0.107
25–34	297 (75.0)	1.05	(0.92 to 1.20)		256 (86.2)	1.14	(0.94 to 1.39)	
35–44	188 (72.9)	1.16*	(1.01 to 1.34)		161 (85.6)	1.18	(0.95 to 1.45)	
45–	180 (75.9)	1.33‡	(1.17 to 1.53)		159 (88.3)	1.30*	(1.05 to 1.60)	
Sex								
Male	363 (73.6)	Reference			305 (84.0)	Reference		
Female	477 (75.8)	1.07	(0.97 to 1.18)		416 (87.2)	1.07	(0.94 to 1.23)	
Months from study initiation to participant recruitment, median (IQR)	5.9 (3.5–9.0)	1.01*	(1.00 to 1.03)		6.2 (3.6–9.0)	1.07‡	(1.04 to 1.09)	
Occupation								
Services	319 (73.0)	Reference		0.032	273 (85.6)			
Farming	149 (70.6)	1.08	(0.95 to 1.23)		126 (84.6)			
Other	372 (78.5)	0.92	(0.83 to 1.02)		322 (86.6)			
Self-reported knowledge of HIV								
No	80 (66.1)	Reference			67 (83.8)			
Yes	760 (75.9)	0.83*	(0.70 to 0.98)		654 (86.1)			
Previous HIV-negative test								
No	484 (77.1)				415 (85.7)			
Yes	356 (72.1)				306 (86.0)			
Intention to disclose partner								
No partner	185 (82.6)				163 (88.1)			
Intention	587 (74.6)				494 (84.2)			
No intention	68 (61.3)				64 (94.1)			
Testing type								
Individual	748 (73.8)				641 (85.7)			
Nonindividual	92 (84.4)				80 (87.0)			
Disability previous month								
No	787 (74.7)	Reference			673 (86.5)			
Yes	53 (77.9)	1.18*	(1.01 to 1.37)		48 (90.6)			
Has cell phone								
No	205 (68.3)	Reference			169 (82.4)			
Yes	635 (77.3)	1.15*	(1.03 to 1.28)		552 (86.9)			
	C. Linkage				D. ART Initiation			
	n (%)	aSHR	95% CI	P	n (%)	aSHR	95% CI	P
Test modality								
VCT	205 (69.3)	Reference		0.002	117 (83.0)	Reference		0.115
PICT	197 (64.2)	0.76*	(0.61 to 0.94)		111 (80.4)	0.86	(0.66 to 1.12)	
HBT	88 (74.6)	0.62‡	(0.47 to 0.83)		51 (92.7)	1.19	(0.87 to 1.62)	
Age category								
18–24	86 (59.3)	Reference		<0.001	38 (79.2)	Reference		0.329
25–34	173 (67.6)	1.64‡	(1.19 to 2.26)		99 (80.5)	1.20	(0.82 to 1.76)	
35–44	122 (75.8)	2.17‡	(1.56 to 3.01)		76 (85.4)	1.30	(0.89 to 1.91)	
45–	109 (68.6)	2.22‡	(1.57 to 3.14)		66 (89.2)	1.43	(0.96 to 2.13)	
Sex								
Male	209 (68.5)	Reference			125 (81.2)	Reference		
Female	281 (67.6)	1.21	(0.97 to 1.50)		154 (85.6)	1.13	(0.90 to 1.43)	
Months from study initiation to participant recruitment, median (IQR)	7.6 (5.0–9.6)	1.26‡	(1.22 to 1.31)		7.6 (5.0–9.6)	1.00	(0.97 to 1.04)	

TABLE 2. (Continued) Multivariate Analysis of Factors Associated With Each Step of the Cascade

	C. Linkage				D. ART Initiation			
	n (%)	aSHR	95% CI	P	n (%)	aSHR	95% CI	P
Occupation								
Services	198 (72.5)	Reference		0.162	112 (85.5)			
Farming	79 (62.7)	0.75	(0.56 to 1.01)		45 (83.3)			
Other	213 (66.2)	0.90	(0.71 to 1.14)		122 (81.9)			
Self-reported knowledge of HIV								
No	42 (62.7)				22 (88)			
Yes	448 (68.5)				257 (83.2)			
Previous HIV-negative test								
No	257 (61.9)	Reference			155 (83.8)			
Yes	233 (76.1)	1.43‡	(1.16 to 1.76)		124 (83.2)			
Intention to disclose partner								
No partner	115 (70.6)				64 (86.5)			
Intention	340 (68.8)				194 (82.2)			
No intention	35 (54.7)				21 (87.5)			
Testing type								
Individual	427 (66.6)				246 (84.3)			
Nonindividual	63 (78.8)				33 (78.6)			
Disability previous month								
No	456 (67.8)	Reference			259 (83.6)			
Yes	34 (70.8)	1.52†	(1.12 to 2.07)		20 (83.3)			
Has cell phone								
No	109 (64.5)	Reference			67 (81.7)			
Yes	381 (69.0)	1.44†	(1.13 to 1.84)		212 (84.1)			
WHO stage								
I–II	415 (66.4)	Reference			212 (83.5)			
III–IV	75 (78.9)	1.46†	(1.14 to 1.87)		67 (83.8)			

Fine and Gray competing risk model analysis estimating determinants of: (A) enrolling in care at 3 months (n = 840) among all participants (n = 1122); (B) having a first clinical consultation at 3 months (n = 721) among individuals enrolled in care (n = 840); (C) linkage to care at 3 months (n = 490) among individuals with a first clinical visit (n = 721); and (D) initiating ART 3 months after eligibility (n = 279) among individuals ART-eligible (n = 334).

n (%): number of individuals with uptake of the corresponding step of the cascade and % of the individuals from each category who enroll in care (A), have a first clinical consultation (B), link to care (C), and initiate ART (D).

Variables included in the multivariable analyses are listed in Table 1, plus WHO Stage. Only aHR for variables retained in the final model are shown.

*Point estimate *P*-values are shown as *P* < 0.05.

†Point estimate *P*-values are shown as *P* < 0.01.

‡Point estimate *P*-values are shown as *P* < 0.001.

aSHR, adjusted subdistribution hazard ratio.

We observed that completion of all steps of the cascade occurred during the first 3 months after diagnosis, with the exception of linkage. Although having a CD4 count before ART initiation will no longer be a criterion for ART initiation in a test-and-treat approach, CD4 results remain a pillar for management of patients with advanced HIV disease to prioritize cotrimoxazole prophylaxis and screening for cryptococcal antigen and TB.^{27,28} At the first clinical assessment, over two-thirds of patients were ART-eligible based on CD4 criteria and 15% had CD4 counts under 100/mm³. This population is susceptible to increased mortality in the first months of ART due to undiagnosed TB, cryptococcus, and other bacterial infections that can be prevented through adequate screening and prophylaxis. A delay or absence of CD4 results at the time of ART initiation jeopardizes successful treatment of these patients in advanced disease. A rapid qualitative test for CD4 levels discriminating advanced HIV could be very useful in these settings.

Enrollment and linkage to care outcomes shared similar predictors including testing modality, age, disability due to illness, cell phone ownership, and months between study initiation and individual patient enrollment. Owning a cell phone was independently associated with increased enrollment in care and may behave as a proxy of socioeconomic status.²⁹ Self-reported disability due to illness in the previous month was positively associated with enrollment and linkage, likely due to an increased perceived association of illness with HIV. The number of months elapsed between study initiation and individual patient enrollment also positively impacted linkage. This is likely due to improvements in patient flow occurring progressively over time, particularly in the case of PICT, which experienced a gradual transition toward same-day clinic visit and CD4 results. Having a previous HIV-negative test, self-reported disability due to illness, or later WHO stage likely reflected an individual’s higher engagement with the health system and/or illness prompting

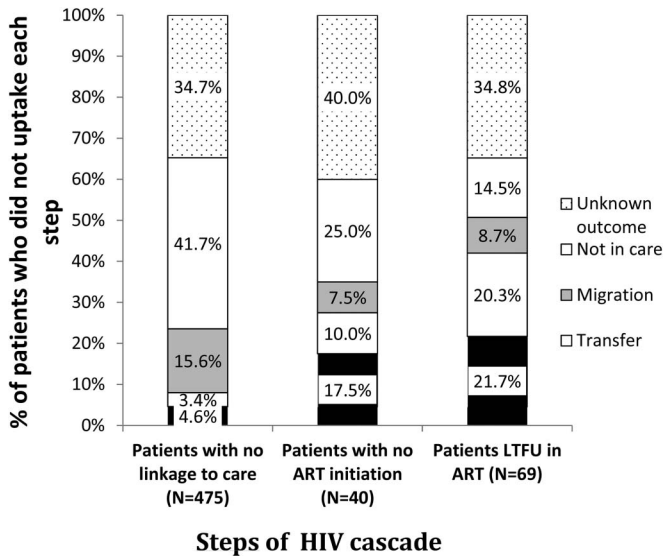


FIGURE 3. Outcomes after patient tracing of individuals who did not uptake or were LTFU in the HIV cascade. Each step was estimated at: 12 months after diagnosis for linkage in care, 12 months after ART eligibility for ART initiation, and 12 months after ART initiation for ART treatment. Transfers included both documented plus silent transfers identified during the 12-month tracing home visit.

increased health-seeking. PICT and HBT testing modalities showed poorer outcomes than VCT in all steps of the cascade.

Other studies have shown clinic^{30,31} as well as individual factors including young age,^{30,32–34} male sex,^{35–37} occupation,^{33,37} and absence of cell phone³⁴ to be associated with lower completion of each step of the cascade. Once linked to care, 83.7% of those eligible initiated ART within 3 months with a 75.6% 12-month ART retention. These results fall within the average estimates of ART retention in Southern Africa, which hover at 76%–65% at 1 and 3 years, respectively.^{10,38} However, there is great heterogeneity in retention rates between African subregions^{39–42} and most estimates suffer from biases due to incomplete ascertainment of outcomes. The few published patient-tracing studies estimate that 20%–60% of patients considered LTFU after ART initiation are likely to have died.^{12,43} We observed a steady increase in proportion of LTFU attributable to deaths, which could be due to a longer accrual of person-time between steps later in the cascade and highlights the importance of ascertainment of outcomes. Half the patients considered LTFU in ART care were either deaths, transfers, or migrations. Ascertaining the cause of LTFU allowed for an adjustment of the estimated proportion of 12-month retention from 75.6% to 84.2%. Precision in LTFU, retention, and mortality indicators is key for appropriate forecasting and resource allocation in ART scale-up efforts.¹²

Implementation research suffers from several limitations. First, linkage to care is based on available electronic patient data, which may overestimate attrition due to poor record keeping, even in the context of previous validation of the accuracy of the databases.^{5,42,44} We attempted to mitigate this bias by reviewing paper-based charts and conducting

home visits for patients considered LTFU. Second, although we only performed the study in the catchment area of the MDH, it is possible that certain patients prefer to seek for care at an outside health unit, potentially underestimating the uptake of care. This is unlikely because the 5% transfer rate detected through the 12-month visit among participants not linking to care suggests very little usage of other health facilities. Third, this study evaluated factors potentially associated with the uptake of each step. However, we cannot rule out a residual effect due to potential confounders such as distance from health care facility, education, marital status, comorbidities, or other facility-level factors that were not assessed. Moreover, the framing of the baseline question “self-reported knowledge of HIV” did not allow us to draw conclusions on the gaps in understanding of HIV-related topics in the community and the heterogeneity in occupation categories did not allow us to draw conclusions. Finally, we did not detect factors associated with ART initiation, but due to high participant defaulting before this step, we did not have the statistical power to detect minor to moderate associations.

CONCLUSIONS

HBT reached a sociodemographically distinct population in need of facilitated linkage interventions such as SMS reminders or patient navigators. Regardless of testing modality, there is a considerable block in various steps of the early cascade of care leading to low rates of ART initiation among newly diagnosed patients, which could potentially limit the public health benefits of a universal testing and treatment approach. In addition, weaknesses in distinguishing LTFU from migrations and silent transfers may cloud accurate estimations of programmatic indicators.

ACKNOWLEDGMENTS

The authors thank the Ministry of Health of Mozambique, our research team, collaborators, and especially, all communities and participants involved.

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