

# **Assessing Factors Associated with Option B+ Initiation, Retention, and Infant Follow Up in Lilongwe, Malawi**

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## **Abstract**

**Background:** Malawi launched Option B+ in July 2011, a program for all pregnant or breastfeeding HIV-positive women to begin lifelong combination antiretroviral therapy (cART). This study characterizes the continuum of care within an antenatal setting in Lilongwe.

**Methods:** Women testing HIV-positive at Bwaila Antenatal Clinic from July 2013 to January 2014 were included. HIV testing and counseling logs were examined, and HIV-infected women were linked to HIV mastercards and infant test records. Logistic regression models were used to analyze relationships between characteristics recorded on the logs and maternal cART initiation, retention, and return for infant testing.

**Results:** During this period, 578 women tested HIV-positive. Of these women, 490 (85%) were linked to an ART initiation record; of these women, 398 (81%) had at least one follow-up record; and of these women, 197 (49%) were retained with full adherence to antiretroviral therapy for three months. Two hundred twenty (38%) were linked to a record of infant testing. Women without an ART record (aOR = 0.19; 95% CI: 0.10, 0.35), women with no follow-up visits (aOR = 0.20; 95% CI: 0.11, 0.36), and women not fully adherent for three months (aOR = 0.56; 95% CI: 0.37, 0.84) were less likely to return for infant testing than women who were retained and adherent for three months.

**Discussion:** Even with a test-and-treat program, many women did not initiate cART, remain in care, or bring their infant for testing. Women lost are at highest risk for transmission and were least likely to bring infants for testing. Facilitating care-seeking at all steps of the continuum remains an important unmet need. Ensuring maternal health has the potential to make major contributions towards maintaining environmental health, thus augmenting the importance of this research.

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## **Introduction**

In July 2011, Malawi launched the Option B+ program in an effort to improve prevention of mother-to-child transmission of HIV, decrease maternal morbidity and mortality, and prevent sexual transmission of HIV. This simple approach calls for all HIV-positive women who are pregnant or breastfeeding to start lifelong combination antiretroviral therapy (cART). Previously, Malawi's guidelines had called for cART initiation based on clinical stage or CD4 count, which led to lower rates of cART initiation, due to challenges or delays in CD4 testing[1]. The initiation of Option B+ precipitated a 748% increase in cART coverage for pregnant women with HIV [1]. In the ensuing years, the WHO began recommending Option B+, and many countries in the region are introducing this program.

The long-term success of Option B+ hinges on retaining women in care throughout the prevention of mother-to-child transmission of HIV (PMTCT) continuum. Following HIV testing at the antenatal clinic, HIV-positive women are given cART and scheduled for a first follow-up visit one month later. Women who start Option B+ during pregnancy have five times the odds of never returning after their first clinic visit compared to women who start ART based on WHO clinical stage and CD4 count guidelines [2]. To maximize the efficacy of Option B+, loss to follow-up (LTF) must be reduced because the long-term success of cART requires continuing adherence to treatment and care-seeking. Maternal LTF can occur at any point along the PMTCT continuum of care, and characterizing the women LTF at each step can facilitate the development of targeted interventions. The continuum has not been detailed in depth in a busy urban setting, and the factors associated with progressing to each step have not been characterized.

Early infant diagnosis is essential to determine which infants are HIV-infected and require treatment. Approximately one third of HIV-exposed infants in sub-Saharan Africa PMTCT programs are lost to follow-up by three months and nearly half are lost after HIV testing[3]. In a study using community health workers to facilitate linkage to care, mother-to-child transmission (MTCT) rates in Lilongwe post-B+ have been documented at 4.1% at first PCR test, with an association between maternal cART and reduced transmission[4]. The proportion of women retained in treatment through delivery in this setting increased significantly from 51.1% to 65% post-B+[4]. Infant retention as well as patient-level data specifically from a district hospital in Lilongwe with a mature Option B+ program has not yet been examined. Correlates with the progress of women along the continuum of care also merit consideration.

In this study, we sought to characterize the full PMTCT continuum of care, including the prevalence of cART initiation, return for a follow-up visit, retention with full adherence for three months, and return for infant testing. We also aim to determine the factors associated with each step. We hypothesize that: 1) substantial LTF will occur at each stage along the continuum; 2) women who undergo HIV testing and counseling (HTC) with their partners will be lost to follow-up at a lower rate than women undergoing individual HTC; 3) women who progress further along the continuum of care will be increasingly likely to return for infant testing.

## **Materials and Methods**

### *Study Setting*

This retrospective cohort study examined records from the antenatal and under-five units at Bwaila Hospital in Lilongwe, Malawi. Bwaila is a district-level maternity hospital in Lilongwe, Malawi's capital. The Bwaila Antenatal Clinic (ANC) serves as the initial point of contact with these women, and patients. All patients presenting for their first antenatal visit without a confirmed HIV test undergo opt-out HTC with rapid tests, in which HTC is offered as part of standard treatment but patients can opt-out of receiving that service. Women undergo HTC either alone or with a partner. HIV-positive pregnant women were encouraged to initiate cART on that day in accordance with Malawi's Option B+ guidelines[1]. During the study period, HTC was not a routine component of subsequent antenatal visits. Women who initiate cART are scheduled for an initial follow-up visit in 30 days, with subsequent monthly follow-up visits. Women are told to bring their infants back to Bwaila's Under-Five Clinic for early infant diagnosis six weeks after giving birth in order to test the child for HIV.

### *Study Population*

The study population consisted of women who tested HIV-positive at their first visit to Bwaila ANC during the six-month period from July 19, 2013 to January 18, 2014. HIV-negative women were excluded, as were women who had previously initiated cART.

### *Data Sources, Abstraction, Linkage*

Nurses record HTC information for women and their partners in the HIV Rapid Testing and Counseling Registers (HTC Registers). The HTC Registers also included information about visit date, age, HTC access, previous HIV test results, time since last HIV test, the presence of a male partner, rapid test results, partner HIV status, and risk category. Antiretroviral Therapy



(ART) mastercards contained records of patients' cART initiation and follow-up, including date of ART initiation, birthdate, ART outcome, ART outcome date, and adherence to ART at each visit. Early Infant Diagnosis PCR Test Logs contain HIV test results for infants brought back to Bwaila ANC at six weeks after birth. Early Infant Diagnosis Logs contained information about infant date of birth, reason for HIV testing, HIV test result, cotrimoxazole preventative therapy, date of specimen PCR, date the results were received, and date the result was given to the patient.

Data were abstracted from the paper HTC Registers and Early Infant Detection Logs from May 20, 2014 to June 20, 2014. A Microsoft Access database was constructed to store the information, and data were entered by a trained research assistant. ART mastercard records were abstracted on June 18, 2014 from Baobob, the electronic medical records system (EMRS). In addition to storing records, the EMRS guides healthcare workers through treatment protocols and contains data quality checks. Based on the names and ages of the HIV-positive mothers, as well as dates of presentation, a trained research assistant matched records in the HTC Register with infant records in the Early Infant Detection Logs and maternal ART mastercards.

### *Factors of Interest*

The population of HIV-positive women was characterized on the basis of five-year age categories, last HIV test result, time since last HIV test, partner HIV status, and risk category: high or low. Time since last HIV test was recorded by providers as less than 24 months, greater than or equal to 24 months, or unknown. HTC categories were individual, concordant couple, discordant couple, and unknown. Individual HTC involves group pretest counseling with other individuals, opt-out testing, individual receipt of results, and individual posttest counseling. Couple HTC involves group pretest counseling with other couples, opt-out testing, receipt of

results as a couple, and partner posttest counseling. When there was insufficient information to determine whether a participant who underwent couple HTC was part of a concordant or discordant couple, the HTC category of that participant was considered to be unknown.

### *Outcomes*

Continuum-related outcomes included the presence of an initial cART initiation record (“initiation”), at least one cART follow-up visit (“first follow-up”), and retention in follow-up with full adherence for three months (“three-month adherence”). Full adherence was defined presentation at three monthly visits with at least 90% adherence at each. The three-month period was chosen because almost all women would be expected to have at least three visits before the six week infant testing visit based on the typical timing of first visits to the antenatal clinic. The presence of an infant HIV PCR testing record in the Early Infant Detection Logs (“infant return”) was also examined.

### *Analytical Methods*

Unadjusted and adjusted logistic regression models were used to analyze factors of interest associated with initiation, first follow-up, three-month retention, and infant return. Factors associated with progression to each continuum step were examined only within the group of women who had progressed to the previous step, and factors associated with infant return were examined for all women studied. Missing data were considered as a separate category in each analysis. Analyses were performed using Stata 13.0 (StataCorp).

A Kaplan-Meier survival curve was constructed to describe retention in care. Survival was defined as having initiated cART and having a record of still being alive and on treatment at a given time. Women who did not initiate cART were given a treatment failure time of 0 days. Women who were lost to follow-up were given a failure time of the day of their last scheduled

visit. These women were considered to have defaulted 60 days after their last scheduled follow-up visit in accordance with national policy. Women who were retained in care were censored on the day of their last visit or after twelve months of follow-up. Women who died or stopped treatment were given a failure time of the day of the recorded event. For the purpose of constructing the graph, 1 month was calculated as 30.417 days. Women who formally transferred to another clinic (N=12) were not included in this analysis.

#### *Ethical Approvals*

These analyses received approval from the University of North Carolina at Chapel Hill IRB as well as the Malawian National Health Sciences Research Committee. Because all data were routinely collected, the need to obtain informed consent from study subjects was waived.

## Results

Between July 19, 2013 and January 18, 2014, 7574 patients were recorded in the HTC Registers. Of the patients on record, 6771 were women and 803 were male partners. A total of 767 women (11%) attended Bwaila ANC with a partner (Table 1). Thirty-six additional men were listed in the register without a partner. We assumed that these 36 men brought their respective 36 female partners (0.53%) to a follow-up visit at Bwaila ANC. Since those women had already visited Bwaila ANC during their pregnancy, their information would not have been noted a second time in the HTC registers.

Overall, 578 women (8.6%) were HIV-positive. As shown in Table 1, 94 women (16%) were 15 to 20 years old, 179 women (31%) were 20 to 25 years old, 180 women (31%) were 25 to 30 years old, and 125 women (22%) were greater than 30 years old. More than half (325, 56%) of the women had tested HIV-negative previously, 133 (23%) of the women had previously tested HIV-positive, and 120 women (21%) had never been tested for HIV. Of the 458 women previously tested, 421 (92%) reported the time of their most recent HIV test: 169 women (29%) had previously been tested within the past 24 months and 252 women (44%) had tested more than 24 months ago.

Nearly all women (n=570, 99%) stated that they had a current partner; 66 of these women (12%) came with a male partner on their first visit to Bwaila ANC and received couple HTC. Of the women who tested HIV-positive at Bwaila ANC and then received couple's counseling, 36 (55%) were concordant HIV-positive, 22 (33%) were discordant (HIV-negative partner), and 8 (12%) did not know their couple status (Table 1). Though 269 women (46%) did not know their partner's HIV status prior to testing at Bwaila ANC, 190 women (33%) were aware that their partner was HIV-negative and 98 women (17%) knew that their partners were HIV-positive.

Twenty-six women (5%) described their risk exposure to be high over the past three months, while the remaining women classified their risk as low or ongoing.

Of all HIV-infected women, 490 women (85%) initiated cART, while 88 women (15%) did not. Women who underwent HTC as a concordant couple had 0.48 times the odds of initiating cART compared to women who underwent individual HTC (Table 2; 95% CI: 0.21, 1.08). Women who had been tested for HIV less than 24 months ago had 0.43 times the odds of initiating compared to women who had never previously tested (95% CI: 0.14, 1.32). The results of a woman's last HIV test and a woman's age were not associated with the odds of cART initiation.

After initiating cART, 398 initiators (81%) returned for a first follow-up visit. As shown in Table 3, there were no precise associations between first follow-up and couple status, last HIV test result, time since last HIV test, age, or client risk. Women ages 25-30 had 1.91 times the odds of having a first follow-up visit compared to women ages 15-20 (95% CI: 0.89, 4.11). Women who underwent HTC as a concordant couple had 3.24 times the odds of having their first follow-up visit compared to women who underwent individual HTC (95% CI: 0.73, 14.47).

Half of the women with a first follow-up visit (N=197; 50%) had three-month adherence. Three women (1%) of the 241 women with three follow-up visits did not have all adherence data present and were dropped from the analysis. Women who underwent HTC as part of a discordant couple had 3.08 times the odds of exhibiting full adherence at their first three follow-up visits compared to women who underwent individual HTC (Table 4; 95% CI: 1.02, 9.30).

Of the 386 initiators (79%) who were retained at 1 month, 353 (91%) were retained for at least three months of follow-up, representing 75% of all initiators (Figure 1). Of the women with three-month retention, only 197 women (56%) also had three-month adherence. There were 290

initiators (59%) who were considered never to have defaulted in accordance with the national definition.

Infant return to Bwaila ANC constitutes the final aspect of the examined continuum of care. Based on the Early Infant Detection Logs, 220 women (38%) had an infant record present, while 358 women (62%) did not. Compared to women who were retained and adherent for three months, non-initiators (aOR=0.19; 95% CI: 0.10, 0.35), non-returners (aOR=0.20; 95% CI: 0.11, 0.36), and non-adherers (aOR=0.56; 95% CI: 0.37, 0.84) were significantly less likely to exhibit infant return (Table 5).

Among the 220 infants with an infant return record, only two infants tested HIV positive. Both infants were born to mothers who had tested HIV negative less than 24 months prior to the first test and who underwent individual HTC. The mothers both had partners who they believed were HIV negative, and neither reported engaging in high-risk behavior within the past three months. One of these mothers had no record of cART initiation, while the other initiated and then defaulted after four months of follow-up. She reported perfect adherence at her first visit, but did not have perfect adherence throughout the next three months.

## Discussion

The vast majority of women who tested HIV-positive at Bwaila ANC could be linked to a cART initiation record. Of the women who initiated cART, most returned for a follow-up visit. Only half of these women with a follow-up visit were retained with full adherence for three months, representing about a third of the total study population. Fewer than half of all women who tested HIV-positive returned to Bwaila for infant testing. Women lost at each step of the continuum were much less likely to have an infant testing record.

To our knowledge, this study is the first to link HTC records to ART records on a patient level. Previous investigations conducted throughout Malawi following the initiation of Option B+ noted loss up to 24% within the first six months at facilities large enough to use the EMRS, with most of this loss occurring within the first three months[2]. We observed a similar retention rate, but given that similar retention was observed over only three months, six-month LTF within this study population is likely higher. LTF has been noted to vary between 0% and 58% depending on the healthcare facility, with urban, Ministry of Health-managed, central hospitals using EMRS having the highest proportions of six-month LTF[2]. As a large, urban facility managed by the Ministry of Health, Bwaila would be expected to have LTF figures on the upper end of the spectrum. HTC practices at Bwaila may be responsible for LTF figures that are lower than this literature model predicts. Bwaila ANC nurses emphasize that patients may choose to opt out of HIV testing, which may prevent LTF to some extent since perceived coercion into receiving an HIV test has been noted as a reason that women in PMTCT programs discontinue treatment[5-7].

We observed lower retention than other studies in Malawi. Overall 12-month Option B+ retention within the entire country has been recorded at 77%, and retention in this study falls

short of that metric even at three months[1]. However, 12-month retention defined by clinic attendance alone may not account for missed visits or inconsistent attendance, and these measures may have a more significant impact on whether a patient meets the threshold for three-month retention[8]. Prior to Option B+, women who failed to enroll in PMTCT resulted in the greatest loss along the continuum of care[9]. Our study supports the finding that, following the introduction of Option B+, LTF enters the continuum of care at later steps but remains prevalent[9]. However, considering that proper cART initiation requires at least one follow-up visit, a substantial proportion of women still fail to properly start treatment.

A statistically significant group of women initiate cART, adhere to treatment, and return for infant testing. Similar findings have been noted in other parts of sub-Saharan Africa, but never in an Option B+ setting or at an urban referral hospital[10-12]. Mothers adherent to a cART regimen are more likely to be virally suppressed, which decreases their likelihood of transmitting HIV to their child[13]. By engaging in the entire continuum of care, these women derive maximum benefit from the Option B+ PMTCT program. This group merits further characterization to evaluate causality in order to optimize treatment protocols.

Healthcare professionals in this setting are likely not seeing the infants at highest risk of acquiring HIV. These infants have mothers who are not adherent to cART and who are consequently less likely to be virally suppressed. Interventions are needed to engage women who do not initiate cART in care beyond antenatal clinic visits. Failure to retain high-risk infants in care likely correlates with low rates of infant HIV seropositivity at first PCR test. This is the first study in the Option B+ era to examine associations of each step in the continuum with exposed infants returning. Additionally, the finding that the same group of women who initiates cART is significantly more likely to seek infant testing has not previously been reported.



Women may have sought care elsewhere rather than discontinuing care-seeking altogether. Formal transfer events were recorded in the EMRS, but they were notably low. Informal transfer may have occurred, and this would account for some of the perceived LTF. Research indicates that women transfer to other clinics to continue ART more commonly than clinic records show, implying that PMTCT retention may be higher than single center data suggest[14]. A centralized EMRS, system-wide unique identifier, or a more thorough system of recording transfers would be required to evaluate the continued follow-up of these transfer patients.

Infant follow-up may also have occurred at different facility, but little attempt is made to capture this data. It is plausible that women attend Bwaila ANC in order to give birth at Bwaila since it is a large district hospital, but they receive cART and have their infants tested at other clinics. Efforts to routinely capture this data are essential to determining whether the association between maternal retention in care and infant return implies a catastrophic, undocumented failure of PMTCT efforts within the group that is not retained in care. Interventions focused on retaining mothers and infants at a single institution are crucial to evaluating PMTCT efficacy.

Linking records presented a significant challenge. Each HTC record was linked by hand to the corresponding ART mastercard and Early Infant Detection record. No consistent unique identifier was present across all three sources, so linkage was made on the basis of the mothers' names. As HTC records are handwritten, name clarity and spelling varied throughout. The records identified as linked in this study were matched with a high degree of confidence. However, other records may have been created for the same woman but could not be linked with confidence. EMRS data entry issues also may have contributed to linkage difficulties. Data abstraction in real-time could reduce some of the errors resulting from retrospective review. A

total of 655 women have records of initiating cART under Option B+ in Lilongwe during the relevant time period, but 165 of these women did not have corresponding HTC records at Bwaila ANC. Some of these women may have tested HIV-positive previously but were not on cART at presentation. In addition, 88 women with HTC records were not linked an ART mastercard.

Women who underwent HTC with a partner and learned that they were discordant were more likely to be retained with full adherence for three months than women who underwent individual HTC. Indeed, there was a trend towards women in discordant couples being initiated, having their first follow-up visit, and exhibiting three-month adherence. This may be the result of partner support. Understanding of treatment as prevention could also contribute to this trend[15]. More research is needed to clarify causal factors. This finding indicates that interventions to bring partners to HTC could help with overall retention.

Women who underwent HTC with a partner and learned that they were concordant were less likely to initiate cART. This finding contradicts previous research on this topic[16-18]. One possible hypothesis is that these women may have been tested previously, and merely brought their partners for disclosure of their own status and testing of the partner's status so that both could openly begin cART if indicated. The fact that women who underwent HTC as a concordant couple had 3.24 times the odds of women who underwent individual HTC to have a first follow-up visit supports this hypothesis. These women may also have been in care elsewhere.

A significant proportion of women are lost to follow up along each step of the continuum of care. In light of this finding, interventions to help transition women between subsequent steps are urgently needed. Various studied interventions have the potential to reduce loss to follow up at each point in the continuum[19-22]. Additionally, interventions are needed to encourage

mothers to bring their infants back for testing at six weeks. Engaging women in a return to the healthcare facility may also serve to improve their cART retention. Each step in the continuum of care provides an opportunity for a targeted intervention, and further studies are needed to discern the most effective techniques for each step.

Reducing vertical transmission of HIV offers the promise of a lower burden of disease on a population level. Developing nations with high HIV prevalence, such as Malawi, tend to emphasize caring for individuals with HIV over environmental protection. This societal strain has been shown to increase demand for resources controlled by women, including firewood, water, and medicinal plants[23]. As compared to PMTCT approaches focused solely on infant treatment, Option B+ offers more immediate potential to remedy the environmental damage resulting from societal focus on combating HIV because this approach begins by ensuring maternal health. This in combination with the demonstrated efficacy of Option B+ in preventing vertical transmission provides a strong basis for continuing to optimize this protocol in order to facilitate the widespread scale-up of an even more effective version of the program.

The population growth rate in Malawi ranks among the highest in the world at 2.8% per year[24]. This explosive growth places a considerable energy burden on a nation that has already endured rampant deforestation[24]. Malawi also faces endemic malaria and schistosomiasis, among other infectious vector-borne diseases and zoonoses, and the landscape changes required to support population growth have the potential to increase human exposure to these diseases[25]. Additionally, the 65% of Malawians who live below the national poverty line are at increased risk of susceptibility to natural disasters and man-made pollution[24]. Without spacing and limiting births, the issues associated with rapid population growth will continue to intensify in coming years. Family planning constitutes a major aim of PMTCT, and these programs have

the potential to increase access to the resources required to control population growth[13].

Effective scale-up of PMTCT will reduce both the risk of MTCT among HIV-infected women and the pressure facing Malawi as a result of rapid population expansion. This would ultimately reduce the number of women incorporated into future Option B+ cohorts, thereby minimizing the resources required for PMTCT efforts.

## **Conclusion**

Although Option B+ has been very effective at PMTCT, further interventions are required to ensure optimal protection of infants. There appears to be a group of mothers who are retained with full adherence and who return for infant testing, and transmission rates are extremely low among these individuals. However, this finding implies the existence of a non-compliant group of mothers whose infants go untested. Interventions along the continuum of care are needed to ensure optimal PMTCT. Current efforts appear to have succeeded in educating discordant couples about the importance of cART, so there is much hope that new interventions will be able to prevent HIV transmission with even greater efficacy. Achieving PMTCT goals also includes increasing maternal access to family planning resources, and this has the potential to yield enormous environmental benefit in light of Malawi's explosive population growth. Further investigations designed to optimize PMTCT protocols and evaluate the efficacy of existing programs within sub-Saharan Africa therefore serve a dual purpose of reducing the burden of disease and minimizing the strain placed on the fragile environments of developing nations.

**Table 1. Female Baseline Characteristics**

	Total (N=578)	
	N	(%)
HTC Category*		
Individual HTC	512	89%
Concordant cHTC	34	6%
Discordant cHTC	26	5%
Last HIV Test		
Never	120	21%
Negative	325	56%
Positive	133	23%
Time Since Last HIV Test		
Never Tested	120	21%
<24 months	169	29%
12-24 months	252	44%
≥24 months	37	6%
Age (#)		
15-20	94	16%
20-25	179	31%
25-30	180	31%
>30	125	22%
Mean	26.2±0.2	
Client Risk		
Low or Ongoing	552	96%
High Last 3 Mo.	26	5%
Partner HIV Status		
No Partner	12	2%
Unknown	269	46%
Negative	190	33%
Positive	98	17%
Missing	10	2%

Table 1 shows female characteristics recorded in the HTC records during a visit to Bwaila ANC.

\*Covariate totals may not add up to the total study population due to missing data.

**Table 2. Factors Associated with the Presence of a cART Record among All HIV-Positive Women**

	N (%)	cART Record Present (N=578)			
		Unadjusted		Adjusted	
		OR	(95% CI)	OR	(95% CI)
HTC Category*					
Individual HTC	512 (89%)	1		1	
Concordant cHTC	34 (6%)	0.41	(0.19, 0.88)	0.48	(0.21, 1.08)
Discordant cHTC	26 (5%)	0.93	(0.31, 2.77)	1.23	(0.38, 4.01)
Last HIV Test					
Never	120 (21%)	1		1	
Negative	325 (56%)	0.97	(0.54, 1.74)	1.48	(0.44, 4.96)
Positive	133 (23%)	1.00	(0.50, 1.99)	1.45	(0.43, 4.86)
Time Since Last HIV Test					
Never Tested	120 (21%)	1		1	
<24 months	169 (29%)	0.61	(0.33, 1.13)	0.43	(0.14, 1.32)
≥ 24 months	252 (44%)	1.41	(0.75, 2.67)	0.95	(0.30, 2.94)
Unknown	37 (6%)	1.46	(0.46, 4.61)	1.46	(0.45, 4.73)
Age					
15-20	94 (16%)	1		1	
20-25	179 (31%)	0.80	(0.41, 1.59)	0.79	(0.38, 1.62)
25-30	180 (31%)	1.40	(0.67, 2.92)	1.32	(0.61, 2.87)
>30	125 (22%)	0.82	(0.39, 1.70)	0.76	(0.35, 1.63)
Risk					
Other	552 (96%)	1		1	
High	26 (4%)	0.58	(0.23, 1.49)	0.63	(0.22, 1.79)

Table 2 shows the association of different covariates with the presence of a cART record within the entire study sample. \*Covariate totals may not add up to the total study population due to missing data.

**Table 3. Factors Associated with Having At Least One Follow-Up Visit among Women with a cART Record Present**

		At Least 1 Follow-Up Visit Among Women with a cART Record Present (N=490)				
		N(%)	Unadjusted		Fully Adjusted	
			OR	(95% CI)	OR	(95% CI)
HTC Category*						
	Individual HTC	438 (90%)	1		1	
	Concordant cHTC	24 (5%)	2.69	(0.62, 11.65)	3.24	(0.73, 14.47)
	Discordant cHTC	22 (5%)	1.10	(0.36, 3.33)	1.53	(0.45, 5.13)
Last HIV Test						
	Never	102 (21%)	1		1	
	Negative	275 (56%)	1.53	(0.88, 2.67)	1.57	(0.53, 4.62)
	Positive	113 (23%)	1.27	(0.66, 2.44)	1.22	(0.43, 3.49)
Time Since Last HIV Test						
	Never Tested	102 (21%)	1		1	
	<24 months	131 (27%)	1.13	(0.61, 2.10)	0.74	(0.27, 2.05)
	≥ 24 months	224 (46%)	1.72	(0.96, 3.09)	1.13	(0.41, 3.07)
	Unknown	33 (7%)	1.38	(0.51, 3.75)	1.36	(0.49, 3.76)
Age						
	15-20	80 (16%)	1		1	
	20-25	147 (30%)	0.77	(0.40, 1.50)	0.76	(0.38, 1.53)
	25-30	160 (33%)	1.86	(0.90, 3.84)	1.91	(0.89, 4.11)
	>30	103 (21%)	0.98	(0.47, 2.02)	1.04	(0.48, 2.22)
Risk						
	Other	470 (96%)	1		1	
	High	20 (4%)	0.68	(0.24, 1.93)	0.51	(0.16, 1.64)

Table 3 shows the association of different covariates with having at least one follow-up visit record among women with a record of initiating cART. \*Covariate totals may not add up to the total study population due to missing data.



**Table 4. Factors Associated with Retention in Care with Full Adherence for Three Months among Women With At Least One Follow-Up Visit**

		Retained and Adherent after 3 Months of Follow-Up Among Women with At Least One Follow-Up Visit (N=398)				
		N(%)	Unadjusted		Fully Adjusted	
			OR	(95% CI)	OR	(95% CI)
HTC Category*						
	Individual HTC	352 (90%)	1		1	
	Concordant cHTC	22 (6%)	1.31	(0.55, 3.12)	1.42	(0.58, 3.50)
	Discordant cHTC	18 (4%)	2.85	(0.99, 8.16)	3.08	(1.02, 9.30)
Last HIV Test						
	Never	78 (20%)	1		1	
	Negative	229 (58%)	0.85	(0.51, 1.42)	0.61	(0.23, 1.60)
	Positive	91 (23%)	0.88	(0.48, 1.62)	0.64	(0.25, 1.68)
Time Since Last HIV Test						
	Never Tested	78 (20%)	1		1	
	<24 months	103 (26%)	0.65	(0.36, 1.17)	0.97	(0.39, 2.41)
	≥ 24 months	190 (48%)	1.02	(0.60, 1.74)	1.68	(0.70, 4.03)
	Unknown	27 (7%)	0.72	(0.30, 1.74)	0.62	(0.25, 1.58)
Age						
	15-20	64 (16%)	1		1	
	20-25	111 (28%)	0.9	(0.48, 1.66)	1.02	(0.53, 1.98)
	25-30	141 (35%)	1.40	(0.78, 2.54)	1.56	(0.82, 2.95)
	>30	82 (21%)	1.08	(0.56, 2.08)	1.16	(0.58, 2.32)
Risk						
	Other	383 (96%)	1		1	
	High	15 (4%)	1.56	(0.54, 4.46)	1.26	(0.39, 4.02)

Table 4 shows the association of different covariates with retention in care with full adherence after three months of follow-up among women with at least one follow-up visit. \*Covariate totals may not add up to the total study population due to missing data.

**Table 5. Covariates Associated with the Presence of an Infant PCR Testing Record among All HIV-Positive Women**

	N (%)	Infant Record Present (N=578)			
		Unadjusted		Fully Adjusted	
		OR	(95% CI)	OR	(95% CI)
HTC Category*					
Individual HTC	512 (89%)	1		1	
Concordant cHTC	34 (6%)	1.12	(0.55, 2.27)	1.23	(0.57, 2.65)
Discordant cHTC	26 (5%)	0.59	(0.24, 1.43)	0.51	(0.19, 1.34)
Last HIV Test					
Never	120 (21%)	1		1	
Negative	325 (56%)	1.40	(0.90, 2.18)	1.22	(0.52, 2.88)
Positive	133 (23%)	1.06	(0.63, 1.78)	0.84	(0.36, 2.00)
Time Since Last HIV Test					
Never Tested	120 (21%)			1	
<24 months	169 (29%)	0.96	(0.59, 1.59)	0.92	(0.41, 2.07)
≥ 24 months	252 (44%)	1.60	(1.02, 2.52)	1.24	(0.57, 2.69)
Unknown	37 (6%)	1.08	(0.50, 2.35)	1.01	(0.44, 2.32)
Age					
15-20	94 (16%)	1		1	
20-25	179 (31%)	0.98	(0.58, 1.66)	1.12	(0.63, 1.99)
25-30	180 (31%)	1.35	(0.80, 2.27)	1.19	(0.67, 2.12)
>30	125 (22%)	1.47	(0.85, 2.57)	1.64	(0.89, 3.02)
Risk					
Other	552 (96%)	1		1	
High	26 (4%)	0.86	(0.37, 1.95)	1.18	(0.45, 3.09)
Maternal Continuum of Care					
Retained and adherent for 3 mos.	197 (34%)	1		1	
Follow-up but not adherent at 3 mos.	201 (35%)	0.56	(0.37, 0.83)	0.56	(0.37, 0.84)
Linked but no follow-up	92 (16%)	0.19	(0.11, 0.35)	0.20	(0.11, 0.36)
Not linked	88 (15%)	0.19	(0.10, 0.34)	0.19	(0.10, 0.35)

Table 5 shows the association of different covariates with the presence of an infant PCR test record within the entire study sample. \*Covariate totals may not add up to the total study population due to missing data.

**Figure 1. Kaplan-Meier Survival Curve Showing Retention in Care among All HIV-Positive Women Who Initiated cART**

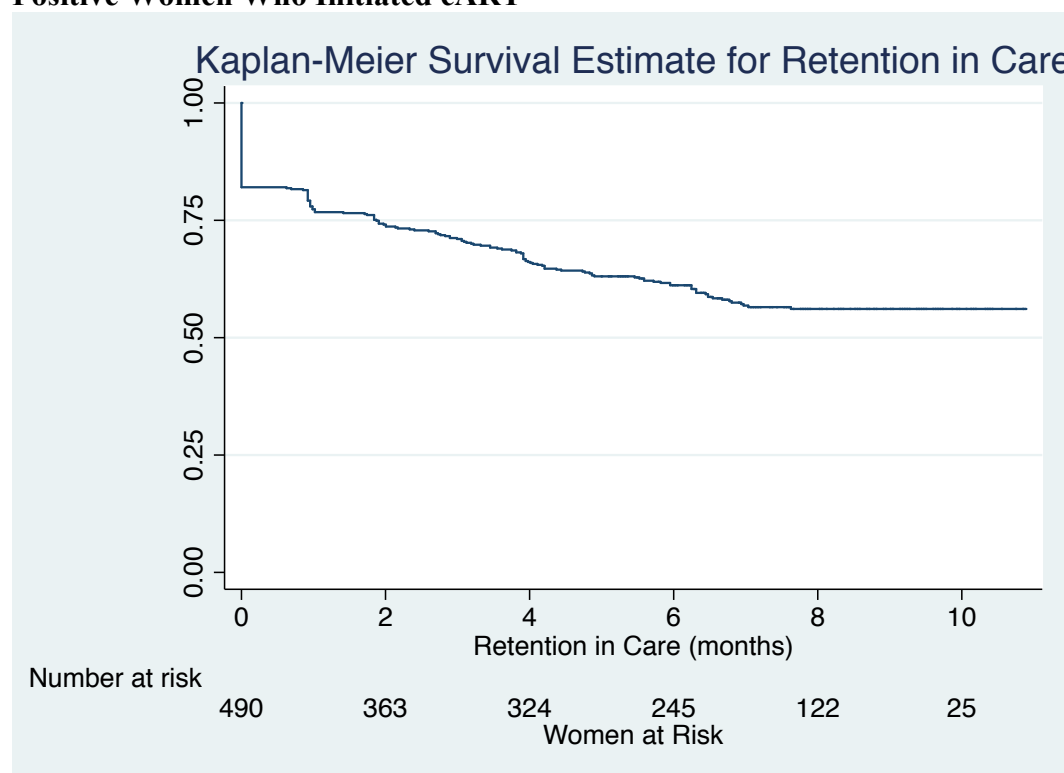


Figure 1 depicts the Kaplan-Meier survival curve showing retention in care for all women in the study. Women at risk after a given length of retention in care is defined as the number of women still recorded to be in care at that point. This graph reflects all abstracted follow-up data.

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