Statistical Analysis Report:

ART initiation, enrollment and programmatic trends, mortality and retention among HIV infected patients in rural Kwara and Niger states of Nigeria

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1 Introduction

The Vanderbilt University Institute for Global Health (VIGH) and its affiliate Friends in Global Health (FGH) currently supports HIV services in 13 sites in Kwara and Niger States. All 13 sites support HIV testing and counseling (HTC) services and 12 sites support prevention of mother-to-child transmission (PMTCT) of HIV services. Five of the sites provide HIV care and treatment services in addition to HTC and PMTCT services.

In a highly populated, diverse, and decentralized country like Nigeria, the Government of Nigeria, Presidents Emergency Plan for AIDS Relief (PEPFAR), and other programs have made enormous strides in addressing the HIV/AIDS epidemic, but much work remains. While the prevalence of HIV in Nigeria (estimated at 3.6%) is relatively low for sub-Saharan Africa, due to its vast population, Nigeria has the second-largest number of persons living with HIV in the world, estimated at 3,300,000 people (UNAIDS Report on the Global AIDS Epidemic, 2010). Women are disproportionately affected by the epidemic, with a prevalence rate of 2.3% (for ages 15-24 or higher) compared to young men at 0.8%. As of 2008, PEPFAR programs have provided care and support to 1,043,100 Nigerians, only about 40% of those in need (The President's Emergency Plan for AIDS Relief: Sixth Annual Report to Congress).

While PEPFAR has made a solid start in addressing HIV/AIDS in many cities, services are not accessible to all in need, particularly in rural areas. The ability to access care and treatment services beyond larger cities is very limited, underscoring a clear need for significant expansion of services. As of 2009, ARV coverage rate in Nigeria was only 21% with 302,973 individuals receiving treatment, and 1,400,000 in need (WHO/UNAIDS/UNICEF, Towards Universal Access: Scaling Up Priority HIV/AIDS Interventions in the Health Sector, September 2010). With the planned analysis, we will use routinely collected patient monitoring data to describe the program and patient outcomes.

1.1 Research Aims

1.1.1 To describe patients enrolled in HIV care and treatment.

1.1.2 To describe patients who initiate ART among those eligible for ART.

1.1.3 To identify enrollment trends in sex and WHO staging.

1.1.4 To identify missing data trends for CD4 and hemoglobin.

1.1.5 To examine trends from enrollment or ART inintiation of CD4 and hemoglobin.

1.1.6 To estimate all-cause mortality and LTFU during the first year of care and treatment.

1.1.7 To correct mortality for patients on ART.

2 Methods

2.1 Participants

This analysis uses data collected through May 31, 2011 and include HIV-infected patients entering HIV care and treatment programs at aged 15 and older. Only those participants who initiated treatment will be included in the all-cause mortality analysis.

All HIV-infected clients (pre-ART and ART) enrolled into care at VU/FGH-supported clinics receive baseline labs (including CD4, hematology, chemistry), basic care kit (BKC) containing an insecticide treated net, water vessel, and information, educational and communication IEC materials, along with monthly refills of water guard, condoms, and soap. Distribution of the BCK monthly refills encouraged retention into the program. Pre-ART and ART clients are also screened for TB and other opportunistic infections (OIs) and receive treatment as indicated. VU/FGH supports provision of cotrimoxazole prophylaxis per

national guidelines as well as diagnosis and treatment of OIs, including fungal, bacterial and protozoal conditions. Pain is assessed during clinic visits and medication is provided to manage pain as indicated.

2.2 Outcomes

The primary outcome will be ART initiation within 90 days of enrollment among those eligible for ART (as definied below). In all analyses, we plan to use an 'intent-to-continue-treatment' approach and thus ignore subsequent changes to treatment, including treatment interruptions and terminations.

Loss to follow-up (LTFU) is defined as those patients that are not deceased and have not had contact in 180 days prior to database close; this adheres to the Nigerian standard of more than 90 days late to scheduled visit. Because date of missed visit is not captured in the database, we select the missed visit date based on a maximum 3 month window between visits, so as not to overcount LTFU.

Treatment eligibility in Nigeria
Period 1: ART eligibility during June 2009 to May 2010

- WHO stage IV irrespective of CD4 cell count
- WHO stage III if CD4 cell count <350
- WHO Stage I or II if CD4 cell count <200

Period 2: ART eligibility during June 2010 to present:

- CD4 cell count $\leq$ 350 regardless of WHO stage
- CD4 count >350 if WHO stage 3 or 4

2.3 Multiple centers

There are five clinics in two states. Sobi and Lafiagi Hospitals are located in Kwara state. Gawu, Kuta, and Umaru YarAdua Hospitals are located in Niger State.

2.4 Data Sources and Measurements

The data extraction includes all patients enrolled on or before 31 May 2011. For analysis, we will include only those patients enrolled by 28 February 2011. Clinical characteristics collected closest to the date of enrollment up to a 90 day window before or after enrollment are deemed as enrollment status indicators (eg, weight, WHO stage, CD4) with the exception of height which was allowed a 365 day window in either direction.

VU/FGH uses CAREWare to record client level data at all HIV care and treatment sites. VU/FGH performs routine audits of medical records to ensure forms are completed accurately and laboratory data is entered correctly. VU/FGH is in the process of improving data management system for CAREWare to better ensure quality data. A data management plan has been developed and is in the final stage of being fully implemented in the coming months.

Demographic information includes: sex, age, marital status, educational status, occupational status, service entry into the program. Routine clinical data are as follows: weight, height, functional status, WHO stage, TB status. Labs that may be collected include: CD4, hepatitis B, VDRL, pregnancy, hepatitis C, hematocrit, hemoglobin, ALT, creatinine, total cholesterol, HDL, LDL, and triglycerides.

2.4.1 Data Cleaning

Data queries were generated for out of range and missing data. Each site addressed data queries and the clean data was extracted for final analyses.

Along with data query resolution, values of hemoglobin less than 1 (N=46) and greater than 18 (N=60) were imputed as missing. Similarly, values of CD4 count less than 0 (N=0) or greater than 1500 (N=7) were imputed as missing. Creatinine larger than 100 (N=10) and less than 0.1 (N=0) were imputed as missing. If height was recorded less than 100 (N=21) or larger than 220 (N=4), it is imputed as missing. If weight was recorded less than 20 (N=23) or larger than 120 (N=19), it is imputed as missing. BMI is calculated as weight in kilograms divided by the square of height in meters. Extreme BMI records below 10 kg/m^2 (N=11) and above kg/m^2 (N=38) were imputed as missing.

2.5 Statistical methods

1. To describe patients enrolled in HIV care and treatment.
Summary characteristics will be tabulated over total enrollment and by sex.

2. To describe patients who initiate ART among those eligible for ART.
We will subset to those patients who were eligible for ART at enrollment into HIV care and treatment according to Nigerian national guidelines at the date of enrollment. Summary characteristics will be tabulated for patients eligible for ART by ART initiation within 90 days of enrollment and those who did not. A logistic regression may identify whether baseline demographics, lab results, and clinical assessment are predictive of starting therapy or not. Specifically, year of enrollment, age, sex, education level, CD4 count, BMI, hemoglobin, and WHO stage at entry have been identified as predictors of interest. If needed, missing data methods will be considered. Multiple imputation is used to account for missing values of baseline predictors in order to prevent casewise deletion of missing data.

3. To identify enrollment trends in sex and WHO staging.
The relationship between sex and enrollment may be modeled using a logistic regression with sex as the outcome and date of enrollment as a predictor. Similarly, the relationship between staging and enrollment may be modeled using proportional odds (ordinal logistic regression) with stage as the outcome and date of enrollment as a predictor. Figures depicting proportion of female and proportions of WHO staged I, II, III, or IV participants by quarter of enrollment will summarize any trend.

4. To identify data collection trends in CD4 and hemoglobin.
It is expected that as the program matured and more laboratory/data collection resources were provided for that collection of CD4 and hemoglobin improved. The relationship between presence of lab value and enrollment may be modeled using a logistic regression with missingness as the outcome and date of enrollment as a predictor. Figures depicting proportion of CD4 and proportions of hemoglobin collected by quarter of enrollment will also summarize any trend.

5. To examine trends from enrollment or ART initiation of CD4 and hemoglobin.
The trajectory of CD4 count and hemoglobin will be depicted using spaghetti plots overlaid with a lowess curve for two groups of patients: entire cohort (time since enrollment) and ART initiators (time since initiation). No formal comparisons are planned as this is a big picture summary and will not address issues of timely initiation and patient dropout.

6. To estimate all-cause mortality and LTFU during the first year of ART.
Kaplan-Meier estimates will be used to compute mortality and mortality/LTFU during the first 12 months on ART. We will estimate the cumulative incidence of LTFU treating death as a competing risk during the

first 12 months. These estimates will include 95% confidence intervals and they will be calculated only for those patients who initiated ART.

7. To correct mortality for patients on ART.
A PLoS Medicine article recently published[1] attempts to correct for mortality not observed in those lost to follow-up. The mortality observed among patients remaining in care can be multiplied by a correction factor C to obtain an estimate of program-level mortality that takes death among patients lost to follow-up into account. This correction factor is obtained from a nomogram. This method applies only to one year estimates and for patients who have initiated ART.

R-software 2.13.1 (www.r-project.org) will be used for data analyses.

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List of Figures

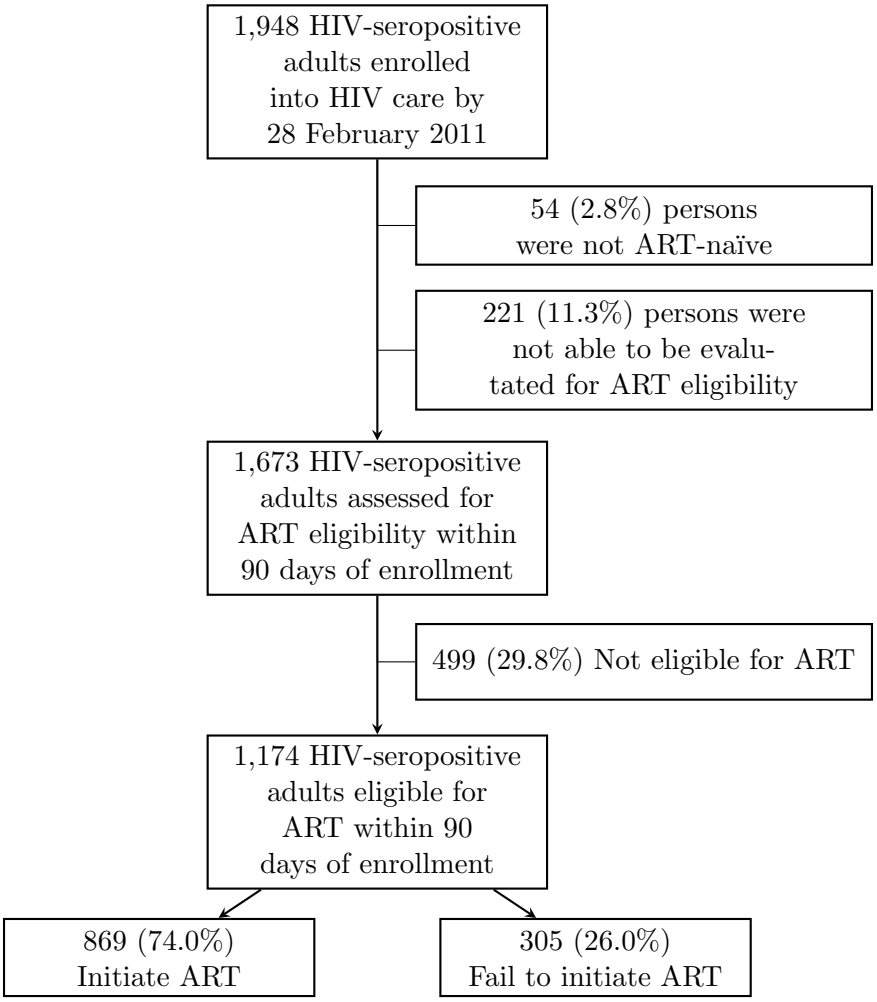
[1] Egger M, Spycher BD, Sidle J, Weigel R, Geng EH, et al. (2011) Correcting Mortality for Loss to Follow-Up: A Nomogram Applied to Antiretroviral Treatment Programmes in Sub-Saharan Africa. PLoS Med 8(1): e1000390.

3 Results

Data include all patients enrolled into care on or before 28 February 2011.

3.1 Cohort profile

Figure 1: Flowchart of enrollment and ART eligibility



Because patients with WHO stage IV (and III after June 2010) are eligible for treatment regardless of CD4 count, there may be some bias in concluding that 70.2% of patients were ART eligible. This could be an overestimate; it is owing to the fact that we cannot determine eligibility for patients missing CD4 count with WHO stage I and II (and III before June 2010).

Table 1: Summary of Patient Demographics by Sex

	Female (n=1288)	Male (n=660)	Combined (n=1948)	P-value[b]
Clinic, n(%)				0.004
GBRH	654 (50.8%)	358 (54.2%)	1012 (52.0%)	
Kuta	107 (8.3%)	79 (12.0%)	186 (9.5%)	
LGH	196 (15.2%)	69 (10.5%)	265 (13.6%)	
SBSH	249 (19.3%)	115 (17.4%)	364 (18.7%)	
UMYMH	82 (6.4%)	39 (5.9%)	121 (6.2%)	
Age[a]	30 (25, 36)	38 (32, 45)	32 (27, 40)	<0.001
Education, n(%)				<0.001
Missing	474 (36.8%)	259 (39.2%)	733 (37.6%)	
None	353 (43.4%)	110 (27.4%)	463 (38.1%)	
Started primary	52 (6.4%)	15 (3.7%)	67 (5.5%)	
Completed primary	111 (13.6%)	63 (15.7%)	174 (14.3%)	
Secondary	176 (21.6%)	135 (33.7%)	311 (25.6%)	
Post secondary	54 (6.6%)	50 (12.5%)	104 (8.6%)	
Qur'anic	68 (8.4%)	28 (7.0%)	96 (7.9%)	
Marital status, n(%)				<0.001
Missing	430 (33.4%)	240 (36.4%)	670 (34.4%)	
Divorced	22 (2.6%)	2 (0.5%)	24 (1.9%)	
Married	652 (76.0%)	359 (85.5%)	1011 (79.1%)	
Separated	42 (4.9%)	15 (3.6%)	57 (4.5%)	
Single	66 (7.7%)	30 (7.1%)	96 (7.5%)	
Widowed	76 (8.9%)	14 (3.3%)	90 (7.0%)	
Occupation, n(%)				<0.001
Missing	460 (35.7%)	248 (37.6%)	708 (36.3%)	
Employed	165 (19.9%)	157 (38.1%)	322 (26.0%)	
Other	122 (14.7%)	53 (12.9%)	175 (14.1%)	
Retired	1 (0.1%)	9 (2.2%)	10 (0.8%)	
Student	17 (2.1%)	10 (2.4%)	27 (2.2%)	
Unemployed	523 (63.2%)	183 (44.4%)	706 (56.9%)	
Referral type, n(%)				<0.001
Missing	728 (56.5%)	345 (52.3%)	1073 (55.1%)	
In-patient	1 (0.2%)	0 (0.0%)	1 (0.1%)	
Other	3 (0.5%)	2 (0.6%)	5 (0.6%)	
Outside clinic/provider	1 (0.2%)	0 (0.0%)	1 (0.1%)	
PMTCT	61 (10.9%)	5 (1.6%)	66 (7.5%)	
VCT	494 (88.2%)	308 (97.8%)	802 (91.7%)	
Pregnant (enrollment)	124 (9.6%)	0 (0.0%)	124 (6.4%)	

[a] Continuous variables are reported as medians (interquartile range).

[b] To compare the distribution of study characteristics for participants by sex, we employ chi-square tests. Similarly, we use a Wilcoxon rank sum test for continuous variables by sex.

Table 2: Summary of Patient Clinical Characteristics by Sex

	Female (n=1288)	Male (n=660)	Combined (n=1948)	P-value[b]
Height (cm)[ac]	159 (155, 164)	168 (163, 172)	162 (156, 167)	<0.001
Missing height (cm), n(%)	306 (23.8%)	161 (24.4%)	467 (24.0%)	
Weight (kg)[ac]	52 (46, 60)	58 (51, 65)	54 (48, 62)	<0.001
Missing weight (kg), n(%)	85 (6.6%)	57 (8.6%)	142 (7.3%)	
BMI (kg/m^2)[ac]	20.7 (18.6, 23.5)	20.7 (18.7, 22.6)	20.7 (18.7, 23.1)	0.638
Missing BMI (kg/m^2), n(%)	328 (25.5%)	166 (25.2%)	494 (25.4%)	
Functional status, n(%)				0.893
Missing	38 (3.0%)	22 (3.3%)	60 (3.1%)	
Bedridden	18 (1.4%)	11 (1.7%)	29 (1.5%)	
Ambulatory	91 (7.3%)	46 (7.2%)	137 (7.3%)	
Working	1141 (91.3%)	581 (91.1%)	1722 (91.2%)	
CD4 count[a]	262 (130, 438)	181 (89.2, 318.2)	237 (114.5, 392)	<0.001
Missing CD4 count, n(%)	191 (14.8%)	142 (21.5%)	333 (17.1%)	
CD4 count category, n(%)				
Missing	191 (14.8%)	142 (21.5%)	333 (17.1%)	
<50	90 (8.2%)	58 (11.2%)	148 (9.2%)	
51-200	333 (30.4%)	218 (42.1%)	551 (34.1%)	
201-350	283 (25.8%)	143 (27.6%)	426 (26.4%)	
>350	391 (35.6%)	99 (19.1%)	490 (30.3%)	
Hemoglobin[a]	10.2 (9.1, 11.4)	11.3 (9.7, 12.8)	10.6 (9.2, 11.8)	<0.001
Missing hemoglobin, n(%)	323 (25.1%)	202 (30.6%)	525 (27.0%)	
Hemoglobin category, n(%)				
Missing	323 (25.1%)	202 (30.6%)	525 (27.0%)	
<8	112 (11.6%)	42 (9.2%)	154 (10.8%)	
8-10	320 (33.2%)	92 (20.1%)	412 (29.0%)	
>10	533 (55.2%)	324 (70.7%)	857 (60.2%)	
Creatinine[a]	0.7 (0.6, 0.9)	1 (0.8, 1.2)	0.8 (0.6, 1.1)	<0.001
Missing creatinine, n(%)	857 (66.5%)	476 (72.1%)	1333 (68.4%)	
WHO stage, n(%)				<0.001
Missing	42 (3.3%)	23 (3.5%)	65 (3.3%)	
I	439 (35.2%)	157 (24.6%)	596 (31.7%)	
II	259 (20.8%)	142 (22.3%)	401 (21.3%)	
III	510 (40.9%)	314 (49.3%)	824 (43.8%)	
IV	38 (3.0%)	24 (3.8%)	62 (3.3%)	
HAART status, n(%)				0.710
HAART > 90 days from enrollment	131 (10.2%)	58 (8.8%)	189 (9.7%)	
HAART in 90 days from enrollment	773 (60.0%)	394 (59.7%)	1167 (59.9%)	
No HAART	350 (27.2%)	188 (28.5%)	538 (27.6%)	
Not ART-naive	34 (2.6%)	20 (3.0%)	54 (2.8%)	
Death in 12 months (enrollment)	23 (1.8%)	31 (4.7%)	54 (2.8%)	<0.001
Lost in 12 months (enrollment)	417 (32.4%)	228 (34.5%)	645 (33.1%)	0.362

[a] Continuous variables are reported as medians (interquartile range).

[b] To compare the distribution of study characteristics for participants by sex, we employ chi-square tests. Similarly, we use a Wilcoxon rank sum test for continuous variables by sex.

[c] Weight, height, functional status, CD4, hemoglobin, creatinine, WHO stage are collected at enrollment. Enrollment data is collected in a window of ± 90 days from date of enrollment.

3.2 ART initiation among ART eligible

Table 3: Summary of Patient Demographics by HAART Initiation among those eligible to start HAART

	No HAART[d] (n=305)	HAART in 90 days (n=869)	Combined (n=1174)	P-value[b]
Clinic, n(%)				<0.001
GBRH	132 (43.3%)	545 (62.7%)	677 (57.7%)	
Kuta	42 (13.8%)	22 (2.5%)	64 (5.5%)	
LGH	28 (9.2%)	104 (12.0%)	132 (11.2%)	
SBSH	86 (28.2%)	153 (17.6%)	239 (20.4%)	
UMYMH	17 (5.6%)	45 (5.2%)	62 (5.3%)	
Age[a]	34 (28, 42)	34 (28, 40)	34 (28, 40)	0.292
Female	178 (58.4%)	555 (63.9%)	733 (62.4%)	0.101
Education, n(%)				0.141
Missing	91 (29.8%)	291 (33.5%)	382 (32.5%)	
None	71 (33.2%)	233 (40.3%)	304 (38.4%)	
Started primary	11 (5.1%)	27 (4.7%)	38 (4.8%)	
Completed primary	35 (16.4%)	77 (13.3%)	112 (14.1%)	
Secondary	56 (26.2%)	149 (25.8%)	205 (25.9%)	
Post secondary	24 (11.2%)	37 (6.4%)	61 (7.7%)	
Qur'anic	17 (7.9%)	55 (9.5%)	72 (9.1%)	
Marital status, n(%)				0.251
Missing	71 (23.3%)	271 (31.2%)	342 (29.1%)	
Divorced	6 (2.6%)	13 (2.2%)	19 (2.3%)	
Married	174 (74.4%)	474 (79.3%)	648 (77.9%)	
Separated	8 (3.4%)	29 (4.8%)	37 (4.4%)	
Single	22 (9.4%)	37 (6.2%)	59 (7.1%)	
Widowed	24 (10.3%)	45 (7.5%)	69 (8.3%)	
Occupation, n(%)				0.012
Missing	75 (24.6%)	286 (32.9%)	361 (30.7%)	
Employed	75 (32.6%)	151 (25.9%)	226 (27.8%)	
Other	23 (10.0%)	90 (15.4%)	113 (13.9%)	
Retired	4 (1.7%)	2 (0.3%)	6 (0.7%)	
Student	9 (3.9%)	13 (2.2%)	22 (2.7%)	
Unemployed	119 (51.7%)	327 (56.1%)	446 (54.9%)	
Referral type, n(%)				0.054
Missing	151 (49.5%)	450 (51.8%)	601 (51.2%)	
In-patient	1 (0.6%)	0 (0.0%)	1 (0.2%)	
Other	0 (0.0%)	2 (0.5%)	2 (0.3%)	
PMTCT	5 (3.2%)	34 (8.1%)	39 (6.8%)	
VCT	148 (96.1%)	383 (91.4%)	531 (92.7%)	
Pregnant (enrollment)	10 (3.3%)	56 (6.4%)	66 (5.6%)	0.055

[a] Continuous variables are reported as medians (interquartile range).

[b] To compare the distribution of study characteristics for participants by ART initiation in 90 days, we employ chi-square tests. Similarly, we use a Wilcoxon rank sum test for continuous variables by ART initiation in 90 days.

[d] Includes 256 patients not initiating treatment prior to database cut date, and 49 initiating >90 days from enrollment.

Table 4: Summary of Patient Clinical Characteristics by HAART Initiation among those eligible to start HAART

	No HAART[d] (n=305)	HAART in 90 days (n=869)	Combined (n=1174)	P-value[b]
Height (cm)[ac]	162 (156, 169)	162 (156, 167)	162 (156, 167)	0.575
Missing height (cm), n(%)	110 (36.1%)	197 (22.7%)	307 (26.1%)	
Weight (kg)[ac]	51 (45, 60)	53 (47, 60)	52 (46, 60)	0.062
Missing weight (kg), n(%)	38 (12.5%)	25 (2.9%)	63 (5.4%)	
BMI (kg/m^2)[ac]	19.3 (17.1, 21.9)	20.3 (18.3, 22.5)	20.1 (18.1, 22.4)	0.001
Missing BMI (kg/m^2), n(%)	114 (37.4%)	201 (23.1%)	315 (26.8%)	
Functional status, n(%)				<0.001
Missing	15 (4.9%)	6 (0.7%)	21 (1.8%)	
Bedridden	14 (4.8%)	13 (1.5%)	27 (2.3%)	
Ambulatory	39 (13.4%)	72 (8.3%)	111 (9.6%)	
Working	237 (81.7%)	778 (90.2%)	1015 (88.0%)	
CD4 count[a]	149 (68.5, 282)	159 (86, 250)	156 (81, 257)	0.859
Missing CD4 count, n(%)	58 (19.0%)	39 (4.5%)	97 (8.3%)	
CD4 count category, n(%)				
Missing	58 (19.0%)	39 (4.5%)	97 (8.3%)	
<50	45 (18.2%)	99 (11.9%)	144 (13.4%)	
51-200	104 (42.1%)	430 (51.8%)	534 (49.6%)	
201-350	71 (28.7%)	243 (29.3%)	314 (29.2%)	
>350	27 (10.9%)	58 (7.0%)	85 (7.9%)	
Hemoglobin[a]	10.2 (8.8, 11.8)	10.3 (9, 11.7)	10.2 (9, 11.7)	0.621
Missing hemoglobin, n(%)	108 (35.4%)	93 (10.7%)	201 (17.1%)	
Hemoglobin category, n(%)				
Missing	108 (35.4%)	93 (10.7%)	201 (17.1%)	
<8	31 (15.7%)	98 (12.6%)	129 (13.3%)	
8-10	63 (32.0%)	248 (32.0%)	311 (32.0%)	
>10	103 (52.3%)	430 (55.4%)	533 (54.8%)	
Creatinine[a]	0.8 (0.6, 1.2)	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)	0.706
Missing creatinine, n(%)	186 (61.0%)	596 (68.6%)	782 (66.6%)	
WHO stage, n(%)				0.003
Missing	11 (3.6%)	4 (0.5%)	15 (1.3%)	
I	37 (12.6%)	162 (18.7%)	199 (17.2%)	
II	39 (13.3%)	140 (16.2%)	179 (15.4%)	
III	194 (66.0%)	527 (60.9%)	721 (62.2%)	
IV	24 (8.2%)	36 (4.2%)	60 (5.2%)	
Death in 12 months (enrollment)	21 (6.9%)	25 (2.9%)	46 (3.9%)	0.003
Lost in 12 months (enrollment)	119 (39.0%)	249 (28.7%)	368 (31.3%)	0.001

[a] Continuous variables are reported as medians (interquartile range).

[b] To compare the distribution of study characteristics for participants by ART initiation in 90 days, we employ chi-square tests. Similarly, we use a Wilcoxon rank sum test for continuous variables by ART initiation in 90 days.

[c] Weight, height, functional status, CD4, hemoglobin, creatinine, WHO stage are collected at enrollment. Enrollment data is collected in a window of ± 90 days from date of enrollment.

[d] Includes 256 patients not initiating treatment prior to database cut date, and 49 initiating >90 days from enrollment.

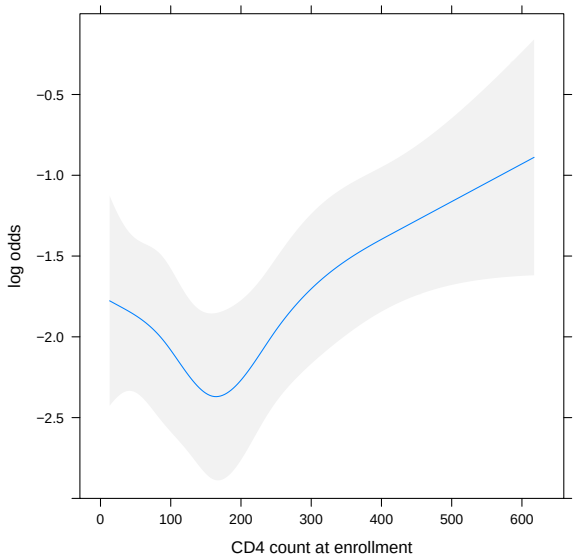
Table 5: Logistic Regression: Failure to initiate HAART in 90 days among those eligible to start HAART

	Odds Ratio (95% CI)	P-value
Clinic		<0.001
GBRH (ref)	1	
Kuta	5.70 (2.99, 10.89)	
LGH	1.45 (0.86, 2.46)	
SBSH	2.46 (1.58, 3.85)	
UMYMH	0.84 (0.40, 1.76)	
Age (per 5 yrs)	1.01 (0.94, 1.09)	0.785
Sex and pregnancy		0.122
Female (ref)	1	
Male	1.32 (0.94, 1.87)	
Pregnant Female	0.65 (0.31, 1.38)	
Education		0.369
None (ref)	1	
Started primary	1.29 (0.59, 2.81)	
Completed primary	1.56 (0.91, 2.68)	
Secondary	1.43 (0.88, 2.33)	
Post secondary	2.08 (1.03, 4.20)	
Qur'anic	1.11 (0.58, 2.12)	
Marital status		0.708
Married (ref)	1	
Divorced	1.25 (0.43, 3.66)	
Separated	0.79 (0.33, 1.88)	
Single	1.31 (0.68, 2.54)	
Widowed	1.36 (0.78, 2.39)	
Occupation		0.742
Employed (ref)	1	
Other	0.98 (0.52, 1.82)	
Student	1.71 (0.61, 4.81)	
Unemployed	1.08 (0.66, 1.76)	
BMI (per 1 kg/m^2)	0.93 (0.88, 0.98)	0.008
Functional status		0.002
Working (ref)	1	
Ambulatory	1.92 (1.15, 3.18)	
Bedridden	4.17 (1.63, 10.67)	
CD4 count		0.003
50	1.49 (0.93, 2.39)	
350	2.10 (1.31, 3.35)	
200 (ref)	1	
500	3.02 (1.69, 5.39)	
Hemoglobin (per 1 g/dL)	1.00 (0.91, 1.10)	0.957
WHO stage		0.964
I (ref)	1	
II	1.05 (0.60, 1.82)	
III	1.12 (0.70, 1.81)	
IV	1.16 (0.50, 2.71)	
Month of enrollment		0.001
June 2009 (ref)	1	
December 2009	1.01 (0.68, 1.48)	
June 2010	1.18 (0.64, 2.19)	
December 2010	2.13 (1.19, 3.81)	

[a] There is evidence that the association between the log-odds of delayed HAART initiation is non-linear with CD4 count (p=0.021) and date of enrollment (p=0.082).

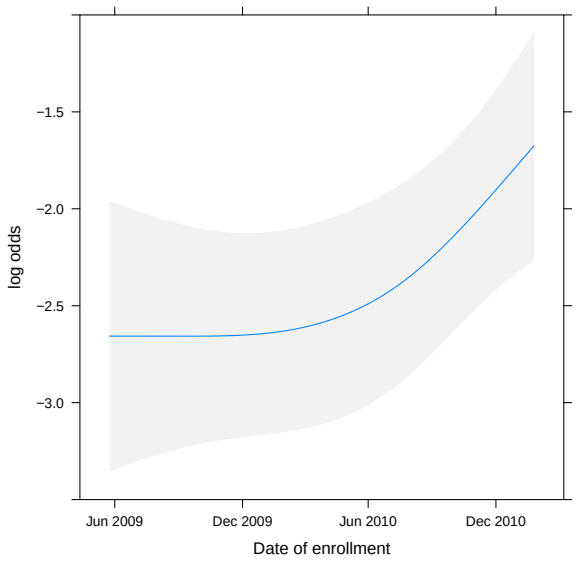
[b] There are 1174 patients included in this model. Missing values of baseline predictors are accounted for using multiple imputation.

Figure 2: Predicted Log Odds: Failure to initiate HAART in 90 days by CD4 count among those eligible to start HAART



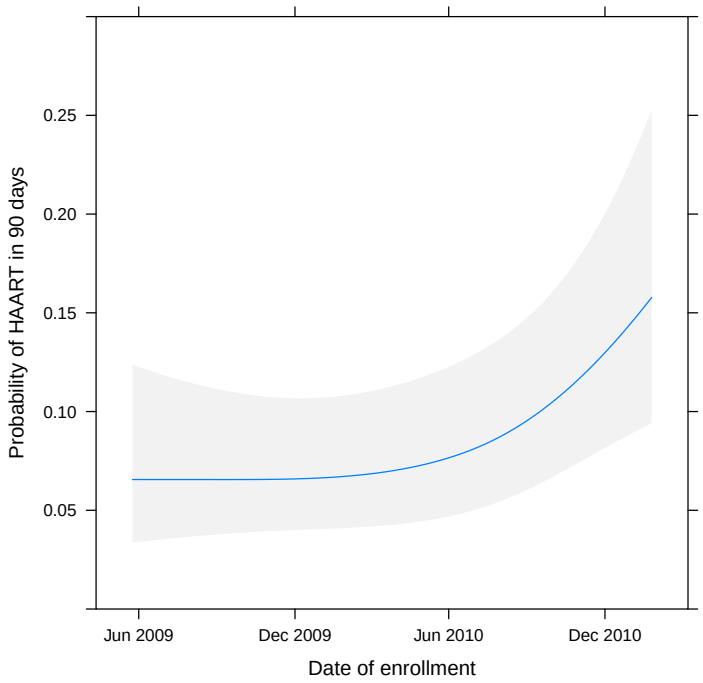
Adjusted to: clinic=GBRH age=34 sexandpreg=Female ph_pt_edu=None ph_mrtl_stt=Married ph_pt_occp=Unemployed enbmi=20.1 enfs=Working enhem=10.2 enwho=3 enroll_dt=2010-08-24

Figure 3: Predicted Log Odds: Failure to initiate HAART in 90 days by date of enrollment among those eligible to start HAART



Adjusted to: clinic=GBRH age=34 sexandpreg=Female ph_pt_edu=None ph_mrtl_stt=Married ph_pt_occp=Unemployed enbmi=20.1 enfs=Working encd4=156 enhem=10.2 enwho=3

Figure 4: Predicted Probability: Failure to initiate HAART in 90 days by date of enrollment among those eligible to start HAART



Adjusted to: clinic=GBRH age=34 sexandpreg=Female ph_pt_edu=None ph_mrtl_stt=Married ph_pt_occp=Unemployed enbmi=20.1 enfs=Working encd4=156 enhem=10.2 enwho=3

Table 6: Predicted Probability: Failure to initiate HAART in 90 days among those eligible to start HAART

	Probability (95% CI)
Jun 2009	0.07 (0.03, 0.12)
August 2009	0.07 (0.04, 0.11)
October 2009	0.07 (0.04, 0.11)
Dec 2009	0.07 (0.04, 0.11)
Feb 2010	0.07 (0.04, 0.11)
Apr 2010	0.07 (0.04, 0.11)
Jun 2010	0.08 (0.05, 0.12)
August 2010	0.09 (0.05, 0.14)
October 2010	0.11 (0.07, 0.16)
Dec 2010	0.13 (0.08, 0.20)
Feb 2011	0.16 (0.09, 0.26)

Adjusted to: clinic=GBRH age=34 sexandpreg=Female ph_pt_edu=None ph_mrtl_stt=Married ph_pt_occp=Unemployed enbmi=20.1 enfs=Working encd4=156 enhem=10.2 enwho=3

Figure 5: ART initiation during the first 90 days after enrollment by sex

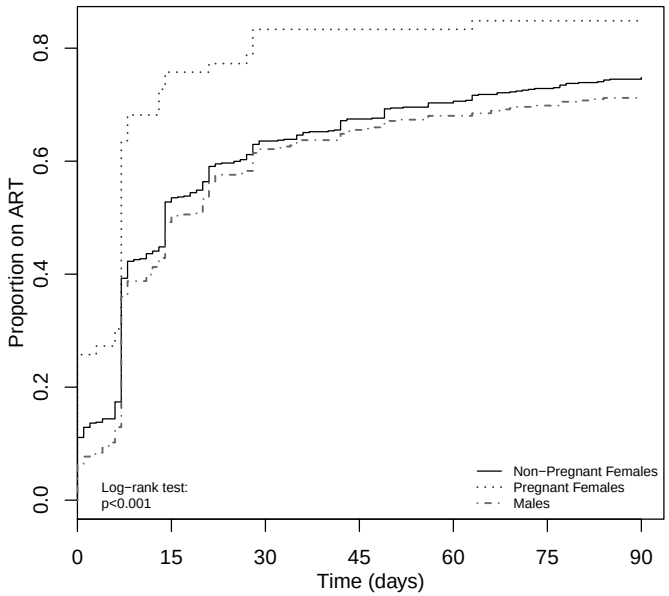


Figure 6: ART initiation during the first 90 days after enrollment by clinic

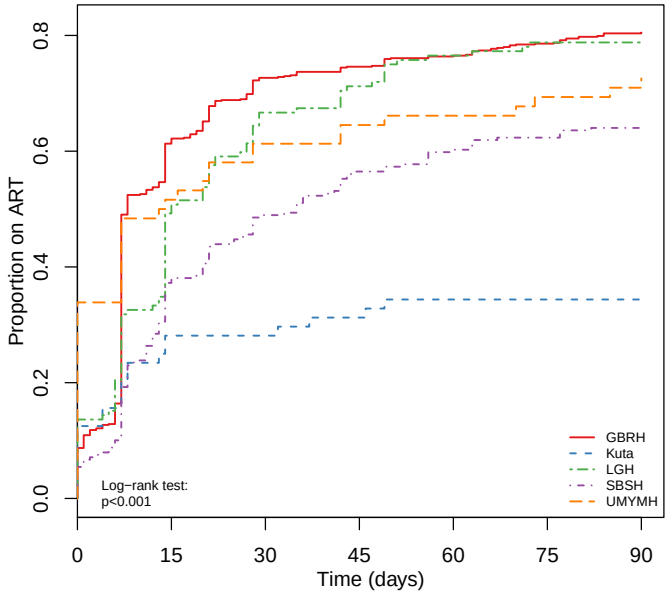


Table 7: Quarterly Key Indicators

	Q1 (n=211)	Q2 (n=276)	Q3 (n=265)	Q4 (n=482)	Q5 (n=461)	Q6 (n=253)	Combined (n=1948)
Cumulative enrollment	211	487	752	1234	1695	1948	
Female	128 (60.7%)	187 (67.8%)	180 (67.9%)	329 (68.3%)	309 (67.0%)	155 (61.3%)	1288 (66.1%)
WHO stage, n(%)							
I	75 (36.4%)	96 (36.1%)	80 (30.4%)	130 (28.9%)	115 (25.4%)	100 (40.7%)	596 (31.7%)
II	36 (17.5%)	52 (19.5%)	55 (20.9%)	112 (24.9%)	76 (16.8%)	70 (28.5%)	401 (21.3%)
III	78 (37.9%)	109 (41.0%)	119 (45.2%)	193 (42.9%)	252 (55.8%)	73 (29.7%)	824 (43.8%)
IV	17 (8.3%)	9 (3.4%)	9 (3.4%)	15 (3.3%)	9 (2.0%)	3 (1.2%)	62 (3.3%)
CD4 count[a]	241 (114, 391)	264 (128.5, 403.5)	236 (123.5, 388.8)	237 (108.5, 408.5)	214 (101, 373)	261 (142, 471.5)	237 (114.5, 392)
Missing cd4 count, n(%)	14 (6.6%)	37 (13.4%)	19 (7.2%)	56 (11.6%)	96 (20.8%)	111 (43.9%)	333 (17.1%)
CD4 data collection	197 (93.4%)	239 (86.6%)	246 (92.8%)	426 (88.4%)	365 (79.2%)	142 (56.1%)	1615 (82.9%)
Hemoglobin data collection	171 (81.0%)	204 (73.9%)	202 (76.2%)	363 (75.3%)	347 (75.3%)	136 (53.8%)	1423 (73.0%)

[a] Continuous variables are reported as medians (interquartile range).

3.3 Enrollment trends

Figure 7: Proportion of Female Enrollees by Quarter

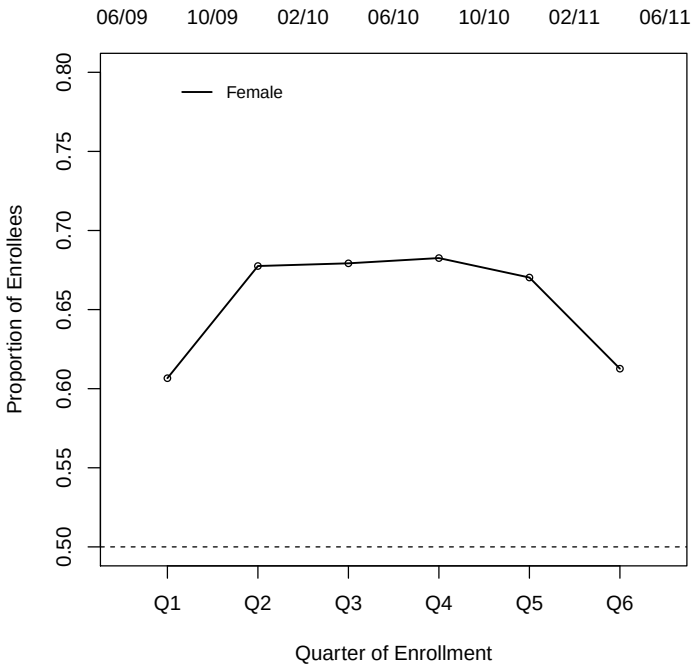
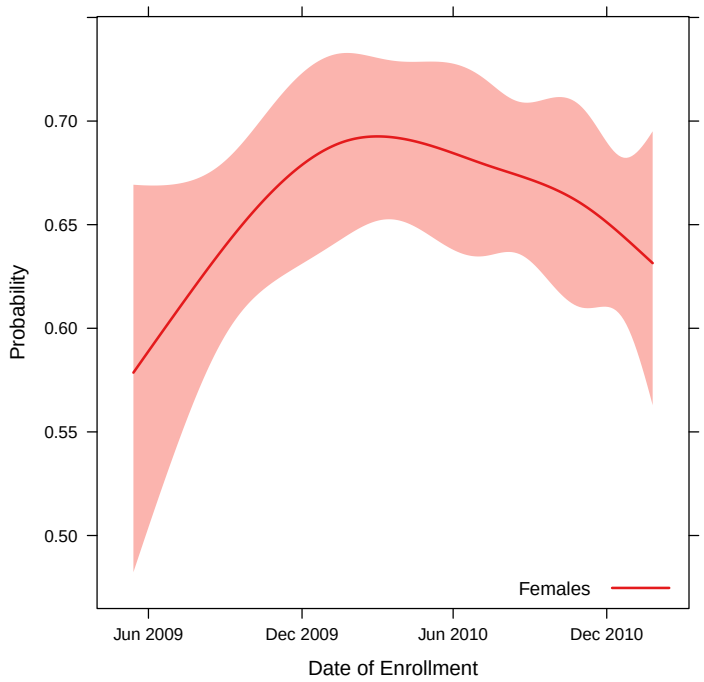


Figure 8: Predicted Probability: Female enrollment by date of enrollment



Test of association between date of enrollment and odds of female enrollee: p=0.233.

Figure 9: Proportion of WHO Stages by Quarter

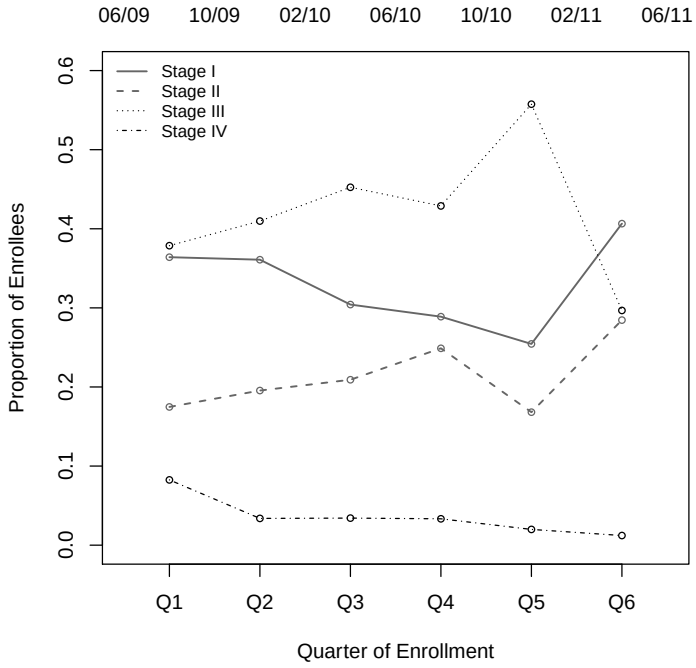
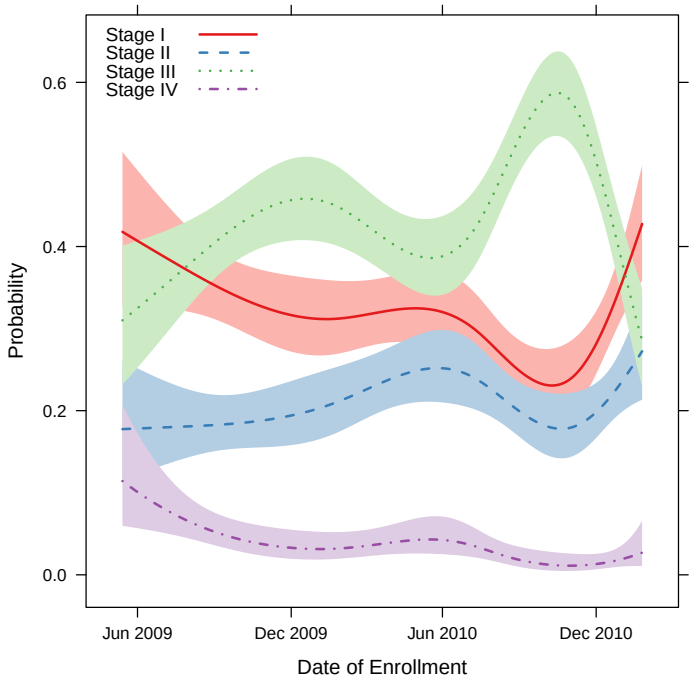


Figure 10: Predicted Probability: WHO staging by date of enrollment



Test of association between date of enrollment and proprtional odds of higher staged enrollee: p<0.001.

3.4 Lab collection and trajectory

Figure 11: Proportion of patients with enrollment CD4 or hemoglobin by Quarter

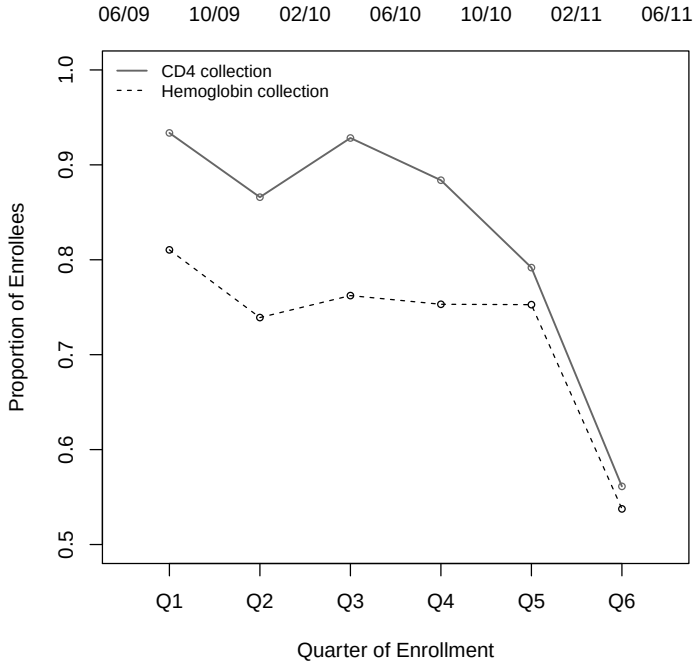
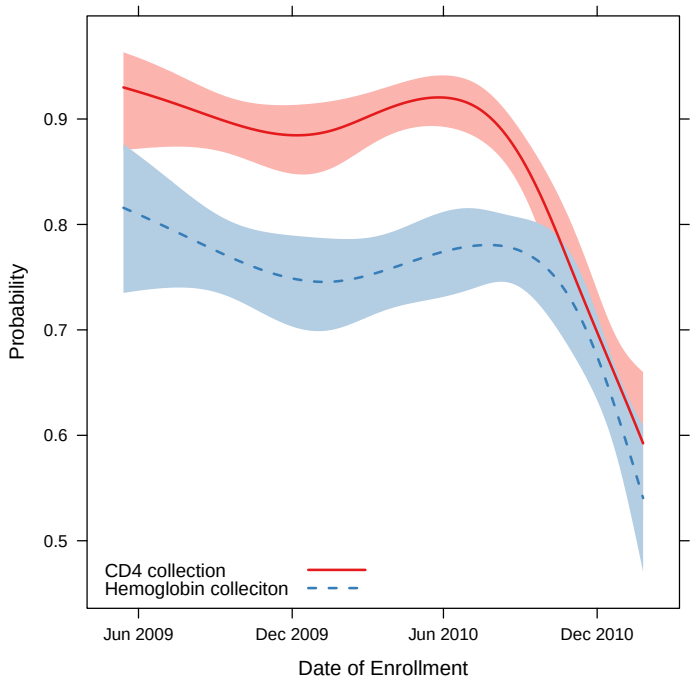
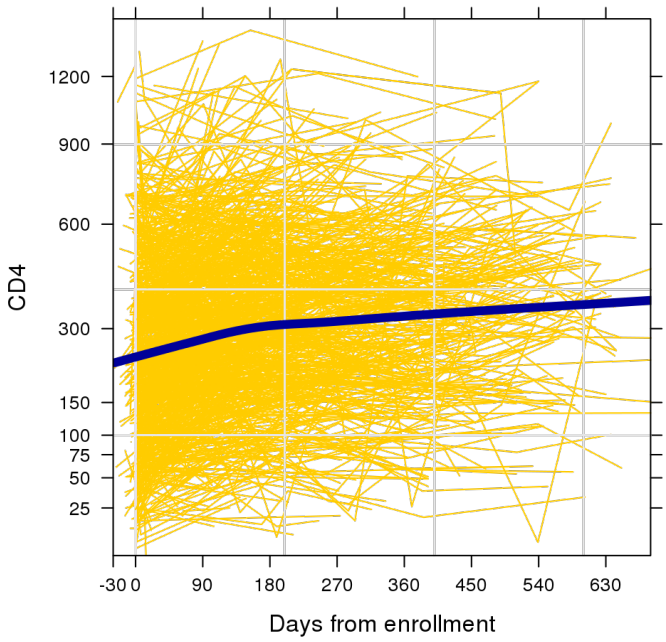


Figure 12: Predicted Probability: CD4 and hemoglobin collection by date of enrollment

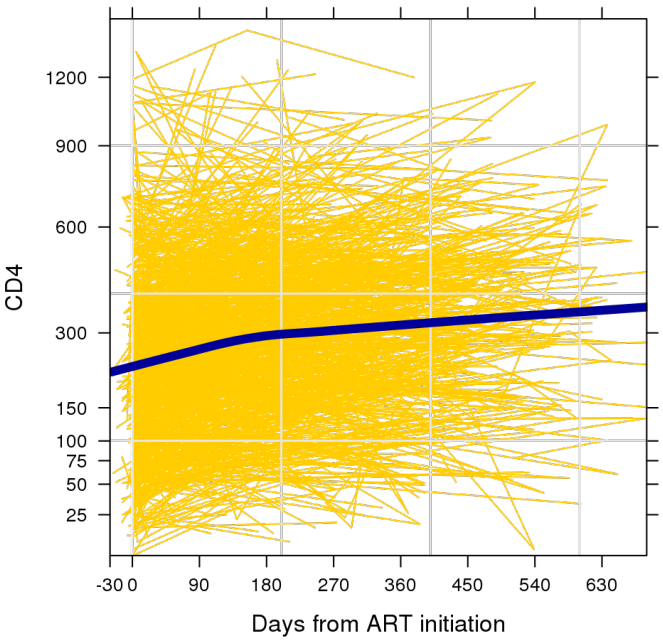


Test of association between date of enrollment and probability of CD4 and hemoglobin collection, respectively: $p<0.001$ and $p<0.001$.

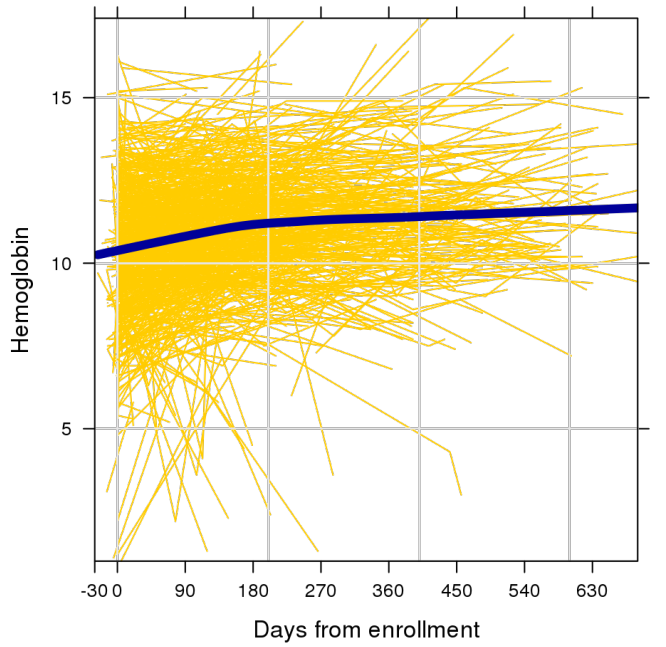
Figure 13: CD4 and hemoglobin trajectories



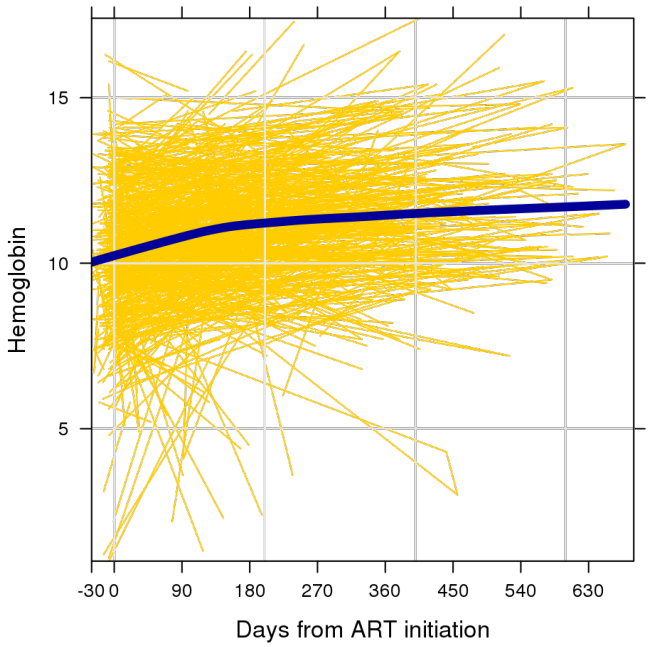
(a) CD4, entire cohort



(b) CD4, ART initiators



(c) Hemoglobin, entire cohort



(d) Hemoglobin, ART initiators

3.5 Mortality and loss to follow-up on patient on ART

Table 8: Kaplan-Meier estimates of Mortality/LTFU

Event type	Treatment duration	Rate	(95% CI)
Mortality	90 days	1.8%	(2.6%, 1.0%)
	180 days	2.3%	(3.3%, 1.3%)
	365 days	5.9%	(8.1%, 3.6%)
Mortality/LTFU	90 days	21.8%	(24.2%, 19.5%)
	180 days	28.6%	(31.3%, 25.9%)
	365 days	44.7%	(48.3%, 40.9%)
LTFU[a]	90 days	20.3%	(18.1%, 22.7%)
	180 days	26.7%	(24.2%, 29.5%)
	365 days	40.6%	(37.1%, 44.3%)

[a] Deaths are censored at date of death; thus, deceased patients are no longer included in the risk set for LTFU.

3.6 Correcting for mortality in LTFU

A PLoS Medicine article recently published[1] attempts to correct for mortality not observed in those lost to follow-up. The mortality observed among patients remaining in care can be multiplied by a correction factor C to obtain an estimate of program-level mortality that takes death among patients lost to follow-up into account. This correction factor is obtained from a nomogram. This method applies only to one year estimates and for patients who have initiated ART.

Among all patients who initiated ART, the numbers at risk and lost to follow-up are 1410 and 380, respectively. The Kaplan-Meier (95% CI) estimate for mortality at 1 year of patients NOT lost to follow-up is 6.7% (4.2% to 9.1%). The overall estimate (95% CI) of program-level mortality at 1 year is 15.3% (8.6% to 23.5%).

[1] Egger M, Spycher BD, Sidle J, Weigel R, Geng EH, et al. (2011) Correcting Mortality for Loss to Follow-Up: A Nomogram Applied to Antiretroviral Treatment Programmes in Sub-Saharan Africa. PLoS Med 8(1): e1000390.