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RESEARCH AND EVALUATION REPORT

Impact and Cost of an HIV/AIDS Improvement Intervention in Cote d'Ivoire

SEPTEMBER 2014

This report was prepared by University Research Co., LLC (URC) for review by the United States Agency for International Development (USAID). It was authored by Corrina Moucheraud of Harvard University; Sonia Gbratto-Dobé, Victor Kan Kouassi, and Jean Nguessan of URC; and Thomas Bossert of Harvard University. This study was funded by the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and carried out under the USAID Health Care Improvement Project, which is made possible by the generous support of the American people through USAID.

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DISCLAIMER

The views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Acronyms and Abbreviations

AIDS	Acquired immune deficiency syndrome
ART	Antiretroviral therapy
CD4	Cluster of differentiation 4
HCI	USAID Health Care Improvement Project
HIV	Human Immunodeficiency Virus
IRB	Institutional Review Board
Kg	Kilogram
MOH	Ministry of Health
OLS	Ordinary least squares
PEPFAR	U.S. President's Emergency Plan for AIDS Relief
PMTCT	Prevention of mother-to-child transmission of HIV
URC	University Research Co., LLC

EXECUTIVE SUMMARY

The USAID Health Care Improvement (HCI) Project has been working in Cote d'Ivoire since 2007 to implement improvement interventions at selected HIV treatment facilities. Program results to date have focused on process-level improvements; this analysis aimed to extend this and assess the impact and cost-effectiveness of the HCI interventions via program-attributable changes in patient utilization and morbidity.

The analysis used a retrospective cohort design based on patient records at 26 primary- and secondary-level facilities in Abidjan (public and private) that provide HIV care and treatment. Half were sites where HCI interventions had been implemented, and the other half did not participate in the intervention. Data were abstracted from patient and facility records by trained research assistants. Each facility contributed approximately 45 records from patients who had initiated antiretroviral therapy (ART) on or before March 2013, plus a subset of 10 records for an assessment of data completeness, and facility costs (medicines, laboratory supplies, human resources, plus HCI program expenses). Ethical reviews and approvals were obtained from the URC and Harvard School of Public Health Institutional Review Boards (IRBs) and the National Ethical Committee of Cote d'Ivoire. Utilization was assessed in terms of clinical activities (assessment of CD4 level, and/or examination including patient weight, and/or a change in medication), and health outcomes (CD4 count value, weight value). These were measured as continuous variables and analyzed per 6-month period, from ART initiation until the date of data collection, or until loss to follow-up if sooner. Associations between these outcomes and the HCI program were explored in a series of univariate and multivariate models, the latter with incremental addition of covariates to control for key demographic and clinical factors.

Unadjusted analyses showed that patients in HCI site received better care in the first six months of ART initiation: 46% of patients at HCI sites received follow-up care within six months of initiating ART, versus 40% of patients at non-HCI sites ($p=0.03$). But this difference did not persist for more than the six months. Approximately two-thirds of patients received care at HCI-assisted facilities within the first year of initiating ART regardless of HCI program status (p-value=0.22), and approximately half received care between one and two years of initiating ART ($p= 0.45$). Baseline average CD4 levels were slightly higher for HCI compared to non-HCI sites ($p=0.06$) and were not different by 12 months ($p =0.85$) or two years ($p= 0.29$).

However, the model adjusting for confounders found no such associations in shorter or longer time periods. Patients at HCI sites had about the same odds of care within six months of initiating ART (odds ratio = 1.3-1.4 in models with different sets of covariates, $p>0.05$). On average, patients had a CD4 increase of 158 cells/mm3 and an average weight gain of 6.5 kilograms, with no difference between HCI and non-HCI sites ($p>0.05$).

This lack of a significant program-related effect may be due to the high proportion of missing information. Very few patient records included care after baseline, and although patient records were better for certain items at HCI site records, this was not consistent and the overall prevalence of missing data was still high. For instance, only one-third of records from HCI sites and two-thirds of records from non-HCI sites included baseline CD4 values; and 5% of records from HCI sites and 24% from non-HCI sites reported 6-month exam data. Cost-effectiveness was ultimately not analyzed because a program effect was not found and because of missing data on relevant costs.

The lack of significant program related effect in multivariate analyses results should be interpreted with caution because of missing data. A functioning health information system is necessary for improving patient care, protecting public health, and improving efficiency and transparency for reporting and research. More robust utilization and outcome data are needed to demonstrate the impact of this intervention.

I. INTRODUCTION

Cote d'Ivoire has been greatly affected by the HIV/AIDS epidemic. In 2012, HIV prevalence among adults was estimated to be 3.2%, the highest in West Africa, with approximately 450,000 people in Cote d'Ivoire living with HIV (1, 2).

The health system in Cote d'Ivoire faces many challenges in providing high-quality care including a health worker shortage (1.4 physicians and 4.8 nurses/midwives per 10,000 population (3), versus an average of 2.3 and 10.9, respectively for the African continent (4), and low health expenditures tied to insufficient funding (5). These health system challenges can affect care for patients who qualify for antiretroviral therapy (ART) in Cote d'Ivoire; a PEPFAR-World Bank report found that a coordinated national response to the epidemic has been hampered by "systemic barriers" such as "poorly equipped and under-staffed" health facilities (5).

Deficits in care are likely to negatively impact health outcomes for HIV-infected individuals. A national 2008 assessment of prevention of mother-to-child transmission (PMTCT) and anti-retroviral therapy (ART) services showed significant gaps in quality of care in public and private facilities. In particular, the assessment found that six months after initiating care, 66% of pre-ART and 45% of ART patients were lost to follow-up, only 25% of HIV-positive women were referred for HIV care, and among infants of HIV-positive mothers, only 11% received cotrimoxazole and 9% received HIV testing (6).

A recent study estimated that implementing a portfolio of interventions to reduce loss-to-follow-up in Cote d'Ivoire, including improving care through strengthening provider training, would reduce loss to follow-up and would be cost-effective (using the threshold of three times per-capita gross domestic product), compared to no intervention, if the annual program cost per patient were below USD 22-53 and if the program had 10-25% effectiveness (7). A 2008 analysis in southern Africa found that incorporated clinical indicators such as CD4 count into routine care for patients on ART—moving beyond symptom-based approaches—would result in longer life expectancies and decreased hospitalization costs (8). But there is limited evidence on the costs of improving quality of ART care and their relative cost-effectiveness (9).

Since 2007, the USAID Health Care Improvement (HCI) Project has been implementing quality improvement interventions in facilities that provide HIV services. While previous HCI studies have linked those interventions to improvements in patient chart documentation and reductions in loss to follow-up, the potential impact of HCI interventions on health outcomes, such as adherence to ART, morbidity (CD4 count, viral load, weight, rates of opportunistic infection) and mortality, had not been explored. Recent evaluation literature has emphasized the importance of project evaluation taking this additional step to show that interventions reach their ultimate objectives of not only improving services but also actual health outcomes of patients (10, 11). Further, the costs of such improvement interventions are under-reported. This also is a major interest in current evaluations and a growing concern as funding for HIV/AIDS interventions has begun a secular decline (12-16). Given the resource constraints on providing HIV services in Cote d'Ivoire, understanding the budget impact of improvement interventions and their cost-effectiveness is important for the project and for other HIV activities in Cote d'Ivoire. This study sought to fill that evaluation gap to inform policies for HIV treatment and contribute to the international literature on evaluation of health system interventions to improve HIV care and treatment.

The study sought to address two primary research questions:

1. Did HCI-implemented quality improvement interventions lead to improvements for HIV-related care in Cote d'Ivoire?
2. What is the cost-effectiveness of the improvement interventions?

II. METHODOLOGY

A. Study Design

This evaluation used a retrospective study design. Sites where the HCI intervention was implemented are the "exposed" group and, sites that did not participate in the HCI collaborative and where improvement activities had not taken place are the "non-exposed" group. The underlying assumption of this sampling strategy was that, outside of HCI activities, the exposed cohort is comparable to the non-exposed cohort across all characteristics influencing patient outcomes. This allows inference that differences in outcomes between the two groups are attributable to project interventions if there are no unobserved factors that might influence the outcomes.

B. Sampling

This retrospective cohort study was based on patient records at 26 facilities providing HIV prevention and treatment services in Abidjan, Cote d'Ivoire. The facility sampling frame included the 97 primary- and secondary-level facilities offering HIV care and treatment services in the capital city, Abidjan (public and private). A random selection procedure was used to identify study sites, choosing 13 HCI-supported facilities and 13 facilities not supported by HCI.

At each selected facility, trained research assistants reviewed patient and facility records to abstract HIV-related data (see *Data Collection* section, below). The sampling frame consisted of all patients at each facility who initiated ART at least one year prior to the data collection month (i.e., on or before March 2013)[1]. Sample size was calculated using 80% power and 5% alpha with a two-tailed test and making two assumptions. First, an assumption of baseline loss to follow-up of 45%, and a minimum difference of 15% between facilities. Both values were based on loss to follow-up estimates from HIV care programs in Cote d'Ivoire (17), and possible program impact estimates (7). Second, it was assumed that patients from the same health facility would likely be similar to one another in ways that may affect inferences drawn for this study, so an intra-cluster correlation value of 0.05 was used based on the literature (18, 19). The calculated sample size was 520 patients per group, which required 45 records at each of the 13 facilities in each of the two study groups. At facilities where the number of eligible patients exceeded this required sample size, systematic random sampling was used to select records for inclusion. At facilities where the number of eligible patients was too low, records were selected with a longer timeframe, until the required sample size was reached.

In addition, the study collected record-completeness data from a random sample of 10 records from all patients who visited each facility for HIV services during the month prior to data collection. To estimate cost-related measures, data on costs of drugs and laboratory supplies, human resources (including salaries and time spent on HIV care activities), and HCI program activities (where applicable), and facility volume to estimate unit costs were collected at each study site.

Ethical Review

As data were abstracted from patient records, individuals were assigned unique identification numbers that are not traceable to any specific patient. These anonymous (de-identified) data collection sheets are kept in a locked cabinet with access allowed only to project researchers and those they designate. There is no way to link specific patients or providers with the abstracted data.

Ethical review and approval was obtained from the URC and Harvard School of Public Health Institutional Review Boards (IRB) as well as the National Ethical Committee of Cote d'Ivoire.

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[1] The earliest date of ART initiation was in January 2009; but the majority of debut dates occurred in 2012 and beyond.

C. Data Collection

For health outcomes, data were abstracted for patients with existing HIV visit records from the earliest recorded visit until the date of data collection or until the date of death or of loss to follow-up. Data were collected on patient socio-demographic characteristics (age, sex, level of education, employment status), HIV diagnosis (date and place, infection type, counseling provided), clinical visit history (dates, physical exam indicators including weight and pregnancy status, disease progression including CD4 and clinical stage, co-morbidities and other pharmaceuticals), ART history (dates and regimes), and date of death or loss to follow up, where available.

Data completeness was assessed by examining a random subset of 10 records from among the study sample. Completeness of information was measured through a series of binary indicators (recorded/blank) for key patient record components, a subset of the above-mentioned items regarding patient health outcomes (e.g., dates of clinical exams, patient weights, ART regimen types, and date of initiation).

Facility-level information was collected as well, including facility type (level and services offered), location, size and volume; and cost data on expenditures for outpatient and inpatient care, medicines and supplies, wages, and HCI improvement intervention-related costs.

All data collection instruments are presented in Appendix 1. Trained data entry staff entered the results into a data entry program (CSPro v4.1 software).

Variable Definition

"Baseline" was defined for each patient as ART initiation. From this time, care was examined over six-month periods. Standard care practices for patients on ART were examined: CD4 count (date and value), physical examinations (including body weight, CDC stage), and switches in drug regimens. Loss to follow-up (for all reasons) was recorded from the patient record or from the facility-wide per-patient overview file ("TARV"). If a provider noted that a patient had been lost to follow-up, data entry included the date of the final visit and the date of the missed appointment (when available).

ART regimen information was used in two ways: first, to observe differences between HCI and non-HCI sites in choices of drugs; and second, to assess regimen shifting. For the purposes of this analysis, a regimen shift was used only to capture an instance of care, and not as an indicator of care quality. Although high-quality care aims to catch treatment failure early and switch medicines accordingly, exploring such behavior was beyond the scope of this study due to limited information on clinical events that might inform such a choice (e.g., viral load). Instead, since CD4 counts, patient examination data, and regimen types and dates were all recorded in separate spaces on the patient record, these three indicators were used alone and in combination as instances of care utilization.

D. Analysis

Means were statistically tested for significant differences between HCI and non-HCI groups using two-sample t-tests assuming equal variances. Median values were assessed using a Kolmogorov-Smirnov test for equality of distribution functions. Univariate tables report p-values from these tests. In the case of multivariable results, details are given on model specifications and covariates; these models also adjusted for clustering by site. All analyses were conducted using Stata version 12.1 (StataCorp, College Station, Texas).

III. FINDINGS

A. Quality of Care Indicators

The study sample included 553 patient records from 13 HCI sites and 502 patient records from 13 non-HCI sites. The process used to arrive at the study sample is detailed in Appendix 2.

The assumption of baseline cohort comparability was empirically tested, at both patient and facility levels (Table 1 and 2). Underlying differences in individuals could have resulted in non-comparable cohorts that would have experienced different patient outcomes even in the absence of HCI interventions. Additionally, at the facility level, underlying differences between HCI and non-HCI facilities could cause differential quality of care, independent of HCI interventions.

Table 1: Characteristics of patients at baseline, by HCI program status

n	502	553	
Age, Mean	39.05	38.85	0.75
Missing	15.1% (76)	16.5% (91)	0.56
Gender, % female	75.3%	80.7%	0.03
Missing	0.8% (4)	0.5% (3)	0.62
Education level			
No education	30.4%	34.3%	0.20
Primary	33.0%	27.5%	0.06
Secondary	28.5%	28.5%	0.98
Beyond secondary	8.0%	9.7%	0.35
missing	5.8% (29)	7.2% (40)	0.34
Days between HIV test & admission, mean	61.44	89.33	0.05
Missing[2]	62.8% (315)	64.9% (359)	0.46
HIV type			0.02
HIV 1	85.5%	85.2%	
HIV 2	1.4%	4.7%	
Dual	3.0%	2.4%	
Not specified, Missing	10.2%	7.8%	0.18
Entry via PMTCT	20.4%	19.5%	0.74
Missing	17.1% (86)	12.1% (67)	0.02
TB prevalence at entry	10.7%	8.2%	0.22
Missing	27.5% (138)	16.3% (90)	0.001

[2] These are missing largely due to missing information on test date (i.e., date of admission is near-complete).

	Non-HCI sites	HCI sites	p-value
Initial ART regimen[3]			
AZT/3TC/NVP	55.2%	39.2%	<0.001
AZT/3TC/EFV	11.2%	10.7%	0.89
TDF/FTC/EFV	3.6%	11.0%	<0.001
D4T/3TC/NVP	7.2%	4.7%	0.15
AZT/3TC/LPV/r	2.4%	2.0%	0.78
TDF/3TC/EFV	1.2%	0.7%	0.50
D4T/3TC/EFV	0.8%	2.7%	0.01
Missing	10.8% (54)	16.6% (92)	0.01

Background characteristics for patients at the HCI and non-HCI sites were similar in terms of age and educational attainment, but there was a significantly higher percentage of women at the HCI sites. Baseline morbidity was quite different across site types: patients at the HCI sites had generally seen more time elapse between initial diagnosis and admission and were more likely to be infected with HIV-2. It should be noted that there were many missing values for these items, so the significant differences should be interpreted with caution. It was equally likely for items to be missing from HCI and non-HCI charts—except whether entry occurred via PMTCT, and baseline tuberculosis, both of which were significantly more likely to be recorded among HCI patient records. Appendix 3 shows the degree of missing data by site, grouped by HCI status. Records were largely missing information on follow-up clinical care (i.e., a second CD4 count or final record date), and crucial baseline information such as date of HIV test, and tuberculosis status at entry was also often missing.

There were differences in choice of initial ART regimen: patients at HCI sites were more likely to begin on TDF/FTC/EFV ($p<0.001$) or D4T/3TC/EFV ($p=0.01$), and were less likely to initiate on AZT/3TC/NVP ($p<0.001$) compared to patients at non-HCI sites.

Tables 2 and 3 present results of the data completeness assessment. Each study facility contributed 10 records to this analysis, and the percentages presented in Table 2 are group averages for HCI sites and non-HCI sites. Demographic information was generally complete (and no more likely to be complete in HCI sites than non-HCI sites), but clinical indicators were largely missing. As shown, not all records included information on events after baseline, such as exams (45-48%) or final visit dates (38-52%). HCI sites generally performed identically to their non-HCI peers on data completeness—except baseline CD4 and month-6 exam information, which were in fact more likely to be missing from patient files at HCI sites. This may be because there were two positive outlier non-HCI sites, with very high proportions of data completeness on these clinical indicators. When these two sites were dropped, baseline CD4 and month-6 exam completeness were no longer significantly different between HCI and non-HCI sites. With such a small sample size (both in number of sites, and in number of records examined per site), it cannot be ruled out that these "positive outliers" represent a data anomaly rather than a true HCI-related difference.

[3] Only most common regimens listed here. Non-listed (and non-missing) regimens complete totals to 100%.

Table 2: Patient record data completeness, by HCI program status

	Non-HCI sites	HCI sites	p-value
Demographic information			
Sex, date of birth	89.5%	98.1%	0.27
Profession, education	85.8%	91.5%	0.48
Clinical history			
HIV test date and result	76.5%	92.3%	0.06
ART antecedents	23.3%	13.8%	0.47
Clinical record			
Physical exam information	47.9%	45.0%	0.84
Baseline CD4	68.1%	37.7%	0.03
6 month exam	23.9%	4.6%	0.03
ART initiation date	68.3%	67.7%	0.96
ART regime	68.7%	68.5%	0.99
Last visit date	37.5%	51.7%	0.33

Table 3 shows more detailed information about clinical care data completeness. On average, patients at HCI sites had 1.92 CD4 count values in their records, which was greater than the 1.76 CD4 values in records of non-HCI patients (p=0.04). Few patients with a first CD4 test date and value had a second such test date and value in their file, although this was more likely among HCI patients (24.8% of study patients in HCI sits versus 14.7% in non-HCI sites; p<0.001). HCI patient files also included, on average, a significantly greater number of exam dates (2.93 versus 2.84 among non-HCI patients, p<0.001)—but there was no significant difference in the frequency of clinical information from these exams such as weight or CDC stage (respectively, p=0.3, 0.77).

Table 3: Data completeness for study sample, by HCI program status

	Non-HCI sites	HCI sites	p-value
CD4 counts			
# of CD4 counts, average	1.76	1.92	0.04
% of patients with first CD4 count + date	92.0%	92.6%	0.74
% of patients with 1 CD4 count + date, who have a second CD4 count + date	14.7%	24.8%	<0.001
Exams			
# of exams, average	2.84	2.93	<0.001
# of weight measures, average	2.55	2.50	0.30
# of CDC stages, average	2.45	2.47	0.77

Patients' care trajectories, as measured by the frequency of different care items over timeframes of follow-up, are shown in Appendix 4.

It was most common for study patients to receive a baseline CD4 count, but no additional CD4 counts thereafter. Less predominant but frequent care trajectories included two CD4 values: at baseline plus another before month 6, at baseline plus between months 6-12, or at baseline and then after month 12. There was a similar pattern for weight measurement: many patients were weighed at baseline and not again, or received two weight values (in descending order of frequency: baseline plus after month 12, baseline plus between months 6-12, and baseline plus between months 0-6). For regimen switching, the majority of patients never had a regimen switch recorded in their patient file. Differences between HCI sites and non-HCI sites were significant for CD4 counts over the first 12 months, and regimen switching between months 0-6—and such differences are explored further below.

Table 4 shows the frequency of service items and results, by care duration (each patient had a unique baseline corresponding to their date of ART initiation).

It was equally likely that patients at HCI and non-HCI sites received a CD4 count and/or weight at baseline ($p > 0.05$). Patients at non-HCI sites were more likely to have qualifying CD4 counts (below 350), and to meet any one of the government's list of criteria for ART initiation ($p < 0.05$).

By month 6, and between months 6 and 12, patients at HCI sites were more likely to have received follow-up care (defined as a CD4 count, and/or a weight measurement, and/or an ART regimen switch) beyond month 12, however, differences between the sites disappeared. A small number of patients received care during this longer timeframe.

Table 4: Follow-up care over time, by HCI program status

	Non-HCI sites	HCI sites	p-value
	502	553	
At baseline (within 7 days of ART initiation)			
CD4	93.8%	94.2%	0.79
Mean value	192	216	0.06
Median value	168	165	0.08
% with CD4≤350	77.9%	72.3%	0.04
Weight measurement	88.0%	85.4%	0.20
Mean value	57.2 kg	58.1 kg	0.32
Median value	56 kg	56 kg	0.51
Qualified to begin ART[4]	86.4%	81.9%	0.06
By month 6			
Any follow-up appointment	39.8%	46.3%	0.03
CD4	28.1%	36.0%	0.006
Mean value[5]	205	215	0.70
Median value	178	174	0.03
Weight measurement	15.5%	13.7%	0.41

[4] Per national guidelines: (1) CDC stage A or B with CD4≤350; (2) CDC stage C (regardless of CD4); (3) CD4<15%; (4) patients with tuberculosis; (5) patients with hepatitis.

[5] Used maximum value per patient if there was more than one over the period.

	Non-HCI sites	HCI sites	p-value
Mean value	55.6 kg	58.0 kg	0.29
Median value	56 kg	55 kg	0.80
Regimen switch	5.0%	7.6%	0.08
Lost to follow-up	13.1%	15.4%	0.30
Between months 6-12			
Any follow-up appointment	33.1%	39.6%	0.03
CD4	27.5%	33.8%	0.03
Mean value	330	297	0.29
Median value	303	254	0.04
Weight measurement	11.4%	10.8%	0.79
Mean value	59.8 kg	57.3 kg	0.32
Median value	59 kg	55 kg	0.50
Regimen switch	2.6%	3.6%	0.34
Lost to follow-up	7.4%	8.9%	0.38
By month 12 (includes the 0-to-6 and 6-to-12 month periods)			
Any follow-up appointment	60.0%	63.7%	0.22
CD4	45.2%	52.1%	0.03
Mean value	284	279	0.85
Median value	242	222	0.05
Weight measurement	26.7%	25.0%	0.44
Mean value	57.3 kg	57.7 kg	0.82
Median value	57 kg	55 kg	0.63
Regimen switch	7.0%	10.8%	0.03
Lost to follow-up	20.5%	24.4%	0.13
Months 12-24[6]			
Any follow-up appointment	45.6%	47.9%	0.45
CD4	30.0%	32.0%	0.50
Mean value	329	300	0.29
Median value	270	284	0.33
Weight measurement	33.5%	37.8%	0.14
Mean value	61.4 kg	61.9 kg	0.69
Median value	61 kg	60 kg	0.95
Regimen switch	2.8%	1.6%	0.20
Lost to follow-up	1.0%	0.2%	0.08

[6] The numbers get very small after this: only 91 CD4s (total for both groups) in the 2-3 year span, for example.

Results from multivariable models are shown in Table 5. For the full table, the independent variable is whether the patient was from an HCI site or from a non-HCI site (yes/no). Care outcomes were modeled as binary yes/no variables, while clinical outcomes were modeled as continuous variables. The binary outcomes are presented as an odds ratio resulting from a logistic regression model. Within each outcome variable, each row represents a sequential addition of sets of covariates. The included demographic covariates were patient sex (male, female) and education level (by category). Age was not included due to widespread missing data for this variable. Unless noted otherwise, the clinical covariates were HIV type (categorical), CD4 level at baseline (continuous), weight at baseline (continuous). Entry via PMTCT, and tuberculosis status at entry, were not included due to the high proportion of missing data. For outcomes of largest CD4 change and largest weight gain, this was only among patients with at least two measurements of each type; in such cases, these were calculated as the difference between the largest and smallest CD4 value (and weight value, accordingly) recorded in the time after ART initiation.

Multivariate analyses did not reveal any significant association between the intervention and key outcomes in the first six months or over longer timeframes. There was no statistically significant association between any health status improvements and HCI site: patients at non-HCI programs saw an average maximum CD4 change of 158cells/mm3 and an average weight gain of 6.5 kilograms, with no significant difference in these values for patients at HCI sites (p-values of 0.4 and 0.7, respectively).

Table 5: Multivariable models

Outcome 1: Any care within 6 months (Yes/No)				
	Odds ratio	p-value	n	
No covariates	1.30	0.39	1055	
With demographic covariates	1.28	0.42	979	
With clinical covariates	1.44	0.29	750	
With demographic + clinical covariates	1.42	0.31	699	
Outcome 2: Any care within 12 months (Yes/No)				
	Odds ratio	p-value	n	
No covariates	1.17	0.66	1055	
With demographic covariates	1.10	0.79	979	
With clinical covariates	1.22	0.62	750	
With demographic + clinical covariates	1.19	0.68	699	
Outcome 3: Difference in maximum CD4 value over first 6 months				
	OLS coefficient	p-value	Constant	n
No covariates	9.41	0.82	205.30	276
With demographic covariates	12.06	0.76	216.94	257
Outcome 4: Difference in maximum CD4 value over first 12 months				
	OLS coefficient	p-value	Constant	n
No covariates	-4.45	0.93	283.48	426
With demographic covariates	-3.02	0.95	323.74	400

Outcome 5: Largest CD4 change per patient				
	OLS coefficient	p-value	Constant	n
No covariates	-30.96	0.43	158.29	488
With demographic covariates	-24.66	0.52	171.34	456
With clinical covariates†	-22.93	0.58	144.95	454
With demographic + clinical covariates	-13.38	0.74	128.32	426
Outcome 6: Largest weight gain per patient				
	OLS coefficient	p-value	Constant	n
No covariates	-0.33	0.72	6.53	930
With demographic covariates	-0.14	0.89	5.95	869
With clinical covariates††	-0.37	0.69	13.19	847
With demographic + clinical covariates	-0.09	0.93	14.87	791

† Clinical covariates here are HIV type and minimum CD4 level.

†† Clinical covariates here are HIV type and minimum weight level.

B. Cost Analyses

Cost-effectiveness of the HCI intervention was not assessed because of the lack of a robust finding on the impact of the intervention. Also, the cost information received from sites was variable in quality and completeness

Data on HCI program costs are presented in Table 6. These data were not available from all HCI sites; four sites reported no program activities during the preceding year. For sites that did provide HCI program costs, they reported on two key activities: learning sessions and coaching visits. The cost of a learning session included: room rental (10,000 per participant), refreshments (14,750 per participant for coffee break and 20,650 for lunch), and participant transport (20,000 each). Of the sites that provided these costs, they all participated in the same learning session during the target period (13-14 November 2012). The cost of a coaching visit is comprised of transportation for the coach (20,000 per site); there were four sites with a coaching visit during the study period.

Table 6: HCI program costs

Activity	Unit cost	Number of participants (per site)	Total amount (across all sites)
Learning sessions	65,400 per participant	5 sites: 1 participant 3 sites: 2 participants	719,400
Coaching visits	20,000 per coach	4 sites: 1 visit	80,000
Total			799,400

IV. DISCUSSION

Unadjusted analyses indicated that patients at HCI sites saw a higher likelihood of receiving care during the 6 months after initiating ART—as indicated by having a CD4 count taken and/or of having their drug regimen switched. But no longer-term care effect was found, nor any robust evidence of health status improvements. In addition, all effects disappeared in the multivariable models. The lack of effect in the multivariate analyses should be interpreted with caution due to the high proportion of missing data which reduced the power of the study to detect differences.

This study found that nearly all patients who initiated ART also received a baseline CD4 count and/or weight at that point at both HCI and non-HCI sites. Additionally, between 80-90% of patients beginning ART had documentation indicating they were qualified to do so per national guidelines. Among these ART initiators, however, most charts did not indicate a follow-up visit by month 6: only 40-46% of patients had an instance of clinical care (defined as CD4 count, recorded weight, or regimen switch) recorded within this 6-month post-initiation period (this was more common at HCI sites than non in univariate models). Documented loss to follow-up was less than 15% over this period. If a longer timeframe is used to assess this initial follow-up appointment, approximately two-thirds of ART initiators returned for care within one year, and one-quarter were classified as lost to follow-up.

These results correspond with others found in the literature: another study of HCI and non-HCI sites in Abidjan found that 45% of patients were lost to follow-up within 6 months of initiating ART (17); and others in Cote d'Ivoire found that only one-third of charts for adults who initiated ART included information on a follow-up visit within 6 months (6), or 6-month loss to follow-up rates of 5-40% (7). One difference between these findings and others is the type of care received. In this study, patients returning during the one-year period were more likely to receive a CD4 count, whereas patients in the study by Lin et al were more likely to have a follow-up weights recorded. The magnitude of changes in these health states were similar across the two studies: over the first 12 months, this analysis found an average CD4 change of approximately 150 cells/mm3 and an average weight gain of 6.5 kilograms (without a significant difference between HCI and non-HCI sites), versus the respective values from Lin et al of 170 cells/mm3 and 3 kilograms.

More broadly, the literature has been challenged in finding consistent effects for quality intervention programs, particularly around chronic care, including HIV, and in terms of outcome versus process measures (20-25). There is renewed interest in understanding how contextual factors outside a particular quality intervention may in fact be differentially affecting outcomes (26, 27), and in studying how best to adapt effect quality interventions for resource-poor settings (28).

Overall, the findings from this study underscore the urgency to invest in strengthening data quality at the study facilities, and based on findings elsewhere in the literature (6, 17) more broadly in Cote d'Ivoire. Patient records assessed for this analysis had many data gaps, with dwindling completeness after the 6-month mark especially. Possible explanations include high rates of patient attrition and high patient-to-provider ratios that may limit time for recordkeeping. In either case, however, there is a great need to institutionalize robust and sustainable data collection systems. This may entail training both on the system and its role and importance, and incentives for its use including support from management, clear linkages with clinical duties that result in tangible improvements in workload and/or patient care, feedback and modification mechanisms, and embedded data collection mechanisms to document and demonstrate system use and effectiveness. Other health system inputs will also be required, such as monetary allocations to build and support these systems, and additional health worker inputs (data clerks and/or increasing staffing of clinical workers), and patient-level considerations such as informed consent and confidentiality (29-32). The importance of improving data quality in Cote d'Ivoire should be prioritized in the future.

Valid data collection can improve the quality and efficiency of care, aid public health in reducing drug resistance and early detection of epidemics and other health problems, and enable more rapid and transparent reporting for monitoring and evaluation. Health information systems are a key building block of a health system (33), and are likely a good investment for Cote d'Ivoire. Care improvement programs such as HCI are important, but good data are necessary to measure their impacts well and to ensure maximum impact as supported by good recordkeeping and patient tracking. Improvement interventions such as HCI are strengthened by documentation and information systems (34-36)—for example to reduce care duplication, to improve organization (e.g., facilitate task shifting and coordination across care), and to follow guidelines for care, as well as to target follow-up for patients who have been non-adherent or lost to follow-up (6). Additionally, as donors increase their demands for sophisticated program evaluation to justify additional funding, data systems and information to demonstrate effectiveness of quality improvement become essential elements of accountability. Better data are necessary to demonstrate this and to ensure continued support for quality HIV/AIDS care and treatment programs.

Appendix 1: Data Collection Forms

REPUBLIQUE DE CÔTE D'IVOIRE

Union Discipline Travail

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MINISTERE DE LA SANTE ET DE LA LUTTE CONTRE LE SIDA

ETUDE SUR L'ANALYSE COUT-EFFICACITE DES INTERVENTIONS D'AMELIORATION DE LA QUALITE VIH/sida EN COTE D'IVOIRE

FEVRIER-MARS 2014

OUTIL DE COLLECTE DES DONNEES SUR LE PATIENT

QI. INFORMATIONS SUR LE PATIENT

001—Enquêteur 1……..…/___/___/___/

002—Enquêteur 2……..…/___/___/___/

003—Superviseur……......./___/___/

004—Date de passage ……../___/___/2014/

Heure de début :…… Heure de fin :……

005—Région sanitaire.……/___/___/

006—District Sanitaire……..……/___/___/

007—Site……...…..……..…../___/___/

008—Identifiant:……..../___/___/___/___/___/___/

Les renseignements contenus dans ce questionnaire sont confidentiels. Ils sont couverts par le secret statistique et ne peuvent être publiés que sous forme anonyme conformément à la loi du 7 juin 1951 sur l'obligation de répondre et le secret statistique.

Site……...…..……..…./___/___/

001—Numéro de la fiche :……..…….. ……/___/___/___/

002—Identifiant :……..../___/___/___/___/___/___/

003—Date d'admission……/____/____/_____/

I - IDENTITE ET DONNEES SOCIODEMOGRAPHIQUES	
101. Sexe : 1. ❒ *Masculin* 2. ❒ *Féminin* 102. Date de naissance : _____/_____/_____ **103. Profession** : _____ 1. ❒ En activité 2. ❒ Au chomage 3. ❒ A la retraite	104. Niveau d'instruction : _____ 1. ❒ *Non scolarisé(e)* 2. ❒ *Primaire* 3. ❒*Secondaire* 4. ❒*Supérieur* 105. Situation matrimoniale : _____ 1. ❒ *Vie en couple* 2. ❒ *Veuf (ve)* 3. ❒ *Divorcé(e)* 4. ❒ *Célibataire*

II - TEST VIH/SIDA
201. Date du test VIH : _____/_____/_____
202. Lieu du test: _____
203. Laboratoire : _____
204. Résultat: 1. ❒VIH 1 2. ❒VIH 2 3. ❒VIH dual 4. ❒ VIH type Non précisé
205. Information reçue: 1. ❒ *Oui* 2. ❒ *Non* 3. ❒ *Ne sait pas*

III - POINT D'ENTREE POUR LES SOINS	
301. ❒CDV	**307.** ❒Hospitalisation
302. ❒PTME	**308.** ❒Auto référence
303. ❒Médecine	**309.** ❒OBC (Organisation à base communautaire)
304. ❒Pédiatrie	**310**. ❒Toxicologie
305. ❒CAT (Ct anti-tuberc) ou CDT (Ct dépis-t)	**311.** ❒Autres:_____
306. ❒IST	
312. ❒ Transfert avec dossier **312a. Date de transfert** ____/____/_____ **312b. Centre d'origine** : _____	**313.** ❒ Transfert sans dossier **313a**. **Date de transfert** ____/____/_____ **313b. Centre d'origine** : _____

IV - ANTECEDENTS ARV
401. ARV : 1. ❒*Oui* 2. ❒*Non*
401a. Si Oui, date de démarrage : _____/_____/_____
401b. Régime (abréviation) : _____
402. **Traitement en cours** : 1. ❒*Oui* 2. ❒*Non*
402a. Si Non, date d'arrêt : ____/____/_____

403. (Femme) A bénéficié d'une PTME : 1. ❒ *Oui* 2. ❒ *Non* 3. ❒ *Ne sait pas* 4. ❒ *Non Applicable*

403a. Si Oui : 1. ❒ *AZT seul* 2. ❒ *Névirapine seule* 3. ❒ *AZT + Névirapine*

4. ❒ *Multi thérapie : Régime* :_____

V - AUTRES ANTECEDENTS

501. Contraception: 1. ❒ *Oui* 2. ❒ *Non* 3. ❒ *NA* **501a. Si oui**, méthode utilisée : _____

502. Cotrimoxazole : 1. ❒*Oui* 2. ❒ *Non*

502a. Si Oui, date de début: _____/_____/_____

503. Traitement en cours : 1. ❒*Oui* 2. ❒ *Non*

503a. Si Non, date d'arrêt : ____/____/_____

504. Fluconazole : 1.❒ *Oui* 2.❒ *Non*

504a. Si Oui, date de début:____/_____/_____

505. Tuberculose : 1. ❒ *Oui* 2. ❒ *Non*

505a. Si Oui, date dernier épisode :

_____/_____/_____

511. Transfusion sanguine : 1. ❒ *Oui* 2. ❒ *Non*

511a. Si Oui, Nombre /_____/_____/

511b. Date de la dernière ____/_____/_____

	1. Oui	2. Non	3. NSP
506. Zona			
507. Maladie de Kaposi			
508. Méningite à cryptocoque			
509. Toxoplasmose cérébrale			
510. Hépatite virale B/C			

VI - EXAMEN PHYSIQUE

601. Date : ____/____/_____ **602. Poids:** /_____/ *Kg* **603. Catégorie CDC:** /_____/

604. Grossesse en cours : 1. ❒*Oui* 2. ❒*Non* 3. ❒ *Non Applicable*

604a. Si oui, date probable d'accouchement : _____/____/_____

605. Etat fonctionnel : 1. ❒ *Valide* 2.❒ *Ambulatoire* 3. ❒ *Alité*

606. Conduite à tenir : **1.** ❒ Ambulatoire 2. ❒ Hospitalisation 3. ❒ Consultation autre service

607. Si Hospitalisation ou Consultation autre service, préciser le service_____

601bis. Date: ____/____/_____ **602bis**. **Poids:** /_____/ *Kg* **603bis**. **Catégorie CDC:** /_____/

604bis. Grossesse en cours : 1. ❒*Oui* 2. ❒*Non* 3. ❒ *Non Applicable*

604abis. Si oui, date probable d'accouchement : _____/____/_____

601ter. Date : ____/____/_____ **602ter**. **Poids:** /_____/ *Kg* **603ter**. **Catégorie CDC:** /_____/

604ter. Grossesse en cours : 1. ❒*Oui* 2. ❒*Non* 3. ❒ *Non Applicable*

604ater. Si oui, date probable d'accouchement : _____/____/_____

VII - BILANS										
	a. J0	b. J15	c. M6	d. M12	e. M18	f. M24	g. M30	h. M36	i. M42	j. M48
701. Date										
702. CD4										
703. Charge virale										

VIII - TRAITEMENT ANTI RETROVIRAL	
Dates :	Substitution dans le schéma de 2ème ligne
801. ____ /___/_____ Eligible	814. 1ére substitution
801a. **Stade CDC** /___/	**814a**. ___ /___/_____ Date
801b. **Motif**: 1. ❒Clinique uniquement	**814b**. Nouveau Régime _____

2. ❒ CD4 (Nb ou %) /_____/

802. ___ /___/_____ Eligible et prêt pour le traitement ARV

803. ___ /___/_____ **803a**. Transféré de_____

804. ___ /___/_____ Début du traitement ARV

Traitement 1ère ligne

805. ___ /___/_____ Date début du traitement

806. Régime**:**_____

807. Poids /_____/ Kg

808. Score de Karnofsky /_____/

1. Valide**:** ❒ 2. Ambulatoire**:** ❒ 3. Alité: ❒

Substitution dans le cadre du schéma thérapeutique de 1ère ligne:

809. 1ére substitution

809a. ___ /___/_____ Date

809b. Nouveau Régime _____

809c. Motif_____

810. 2ème substitution

810a. ___ /___/_____ Date

810b. Nouveau Régime_____

810c. Motif _____

Traitement 2ème ligne

Passage au schéma thérapeutique de 2nd ligne

811. ___ /___/_____ Date début du traitement

812. Régime _____

813. Motif_____

814c. Motif _____

815. 2ème substitution

815a. ___ /___/_____ Date

815b. Nouveau Régime _____

815c. Motif_____

Traitement 3ème ligne

Passage au schéma thérapeutique de 3ème ligne

816. ___ /___/_____ Date

817. Nouveau Régime _____

818. Motif_____

Substitution dans le schéma de 3ème ligne

819. 1ére substitution

819a. ___ /___/_____ Date

819b. Nouveau Régime_____

819c. Motif _____

820. 2ème substitution

820a. ___ /___/_____ Date

820b. Nouveau Régime _____

820c. Motif_____

IX - PERDU DE VUE	
A PARTIR DU DOSSIER PATIENT : **1.** Perdu de vue selon le dossier patient ? ❒ 1. *Oui* ❒ 2. *Non* ❒ 3. Non disponible 2. Si oui, date du dernier RDV _____/____/_____ 3. Date du RV non-respecté _____/____/_____	A PARTIR DU REGISTRE TARV: 4. Perdu de vue selon le registre TARV ❒ 1. *Oui* ❒ 2. *Non* ❒ 3. Non disponible 5. Si oui, date du dernier RV: _____/____/_____ 6. Date du RV non-respecté _____/____/_____

REPUBLIQUE DE CÔTE D'IVOIRE

Union Discipline Travail

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MINISTERE DE LA SANTE ET DE LA LUTTE CONTRE LE SIDA

ETUDE SUR L'ANALYSE COUT-EFFICACITE DES INTERVENTIONS D'AMELIORATION DE LA QUALITE VIH/sidaEN COTE D'IVOIRE

FEVRIER-MARS2014

OUTIL DE COLLECTE DES DONNEES SUR LE PATIENT

Q2. INFORMATIONS SUR LA QUALITE DU DOSSIER PATIENT

001—Enquêteur 1……...…/___/___/___/

002—Enquêteur 2……...…/___/___/___/

003—Superviseur……......./___/___/

004—Date de passage ……../___/___/2014/

Heure de début :…… Heure de fin :……

005—Région sanitaire.……/___/___/

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Le dossier client inclus-t-il…	Numéro de dossier (Marquer O si l'item est inclus dans le dossier; marquer N si non et NA si non applicable)									
	1	2	3	4	5	6	7	8	9	10
Identifiant (Inscrire l'identifiant)										
101. Numéro dossier patient										
102. Sexe										
103. Date de naissance ou âge										
104. Profession										
105. Niveau d'instruction										
106. Lieu d'habitation										
107. Contact Téléphonique										
108. Personne de soutien (à contacter)										
109. Région sanitaire										
110. Nom de l'établissement										
111. Nom du service										
112. Test VIH/SIDA : Date du test VIH										
113. Test VIH/SIDA :Résultat										
114. Antécédents ARV et ou PTME : ARV date de démarrage										
115. Antécédents ARV et ou PTME : ARV Régime										
116. Autres antécédents										
117. Examen Physique : Date										
118. Examen Physique : Poids										

Le dossier client inclus-t-il…	Numéro de dossier (Marquer O si l'item est inclus dans le dossier; marquer N si non et NA si non applicable)									
	1	2	3	4	5	6	7	8	9	10
119. Examen Physique : T°										
120. Examen Physique : TA										
121. Examen Physique : Catégorie CDC										
122. Examen Physique : Etat fonctionnel ou score de karnofsky										
123. J0 – bilan Initial : CD4										
124. M6 – tous bilans										
125. Début du traitement ARV – Date										
126. Traitement anti rétroviral : régime										
127. Ligne de suivi thérapeutique du mois										
128. Prochain RDV										

REPUBLIQUE DE CÔTE D'IVOIRE

Union Discipline Travail

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MINISTERE DE LA SANTE ET DE LA LUTTE CONTRE LE SIDA

ETUDE SUR L'ANALYSE COUT-EFFICACITE DES INTERVENTIONS D'AMELIORATION DE LA QUALITE VIH/sidaEN COTE D'IVOIRE

FEVRIER-MARS2014

OUTIL DE COLLECTE DES DONNEES SUR LES COÛTS

001—Enquêteur 1……..……/_____/___/___/

002—Enquêteur 2……..../_____/___/___/

003—Superviseur……......./___/___/

004—Date de passage ……../___/___/2014/

Heure de début :…… Heure de fin :……

005—Région sanitaire.……./___/___/

006—District Sanitaire……..……/___/___/

007—Site……...…..……./___/___/

008—Numéro de la fiche :……..…….. ……/___/___/___/

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	I - INDICATEURS											
	Octobre 2012 - Septembre 2013											
	a. Oct	b. Nov	c. Déc	d. Jan	e. Fev	f. Mars	g. Avril	h. Mai	i. Juin	j. Juil	k. Aout	l. Sept
101. Nombre de patients VIH+ ayant reçule CDV et effectué le test de dépistage												
102. Nombre de patients VIH+ ayant effectué le bilan initial												
103. Nombre de patients VIH+ ayant initié le traitement ARV												
104. Nombre de patients VIH+ ayant effectué le bilan de suivi												
105. Nombre de tests VIH réalisés												
106. Nombre de tests de CD4 réalisés												
107. Nombre de tests de charge virage réalisés												
108. Nombre de patients VIH-1+ ayant reçu le traitement de 1ère ligne												
109. Nombre de patients VIH-1+ ayant reçu le traitement de 2ème ligne												
110. Nombre de patients VIH-2+ ayant reçu le traitement de 1ère ligne												

II –INTRANTS (Registre de Dispensation des ARV)				
Médicaments (combinaisons et/ou composantes)	a. Quantité	b. Coût unitaire	c. Coût total	Observations
Atazanavir 300/Ritonavir100 mg				
Darunavir 300 mg				
Efavirenz 600 mg				
Lamivudine 150/ Zidovudine 300 mg				

Lamivudine150/ Zidovudine 300/ Nevirapine 200 g				
Lopinavir Ritonavir200/50 mg				
Raltégravir 400 mg				
Ritonavir100 mg				
Tenofovir300 mg				
tenofovir 300/emtricitabine 200mg				
Tenofovir 300/Lamivudine 300mg				
Tenofovir 300/ Emtricitabine 200 mg/Efavirenz 600 mg				
Tenofovir 300/Lamivudine 300/Efavirenz 600mg				

III - LABORATOIRE				
Désignation	a. Allocation pour le site	b. Coût unitaire	c. Coût total	Observations
301. Test de VIH				
302. Test de CD4				
303. Test de charge virale				

		III - PERSONNEL			
	Type d'employé : vacataire ou permanent	Grade ou catégorie	a. Nombre de travailleur	b. Rémunération de base	c. Temps alloué à la prise en charge VIH par semaine
401. Staff position 1 Administrateur de l'hopital					
402. Staff position 2 Médecins cliniciens					
402a. Staff position 2 Médecins cliniciens					
402b. Staff position 2 Médecins cliniciens					

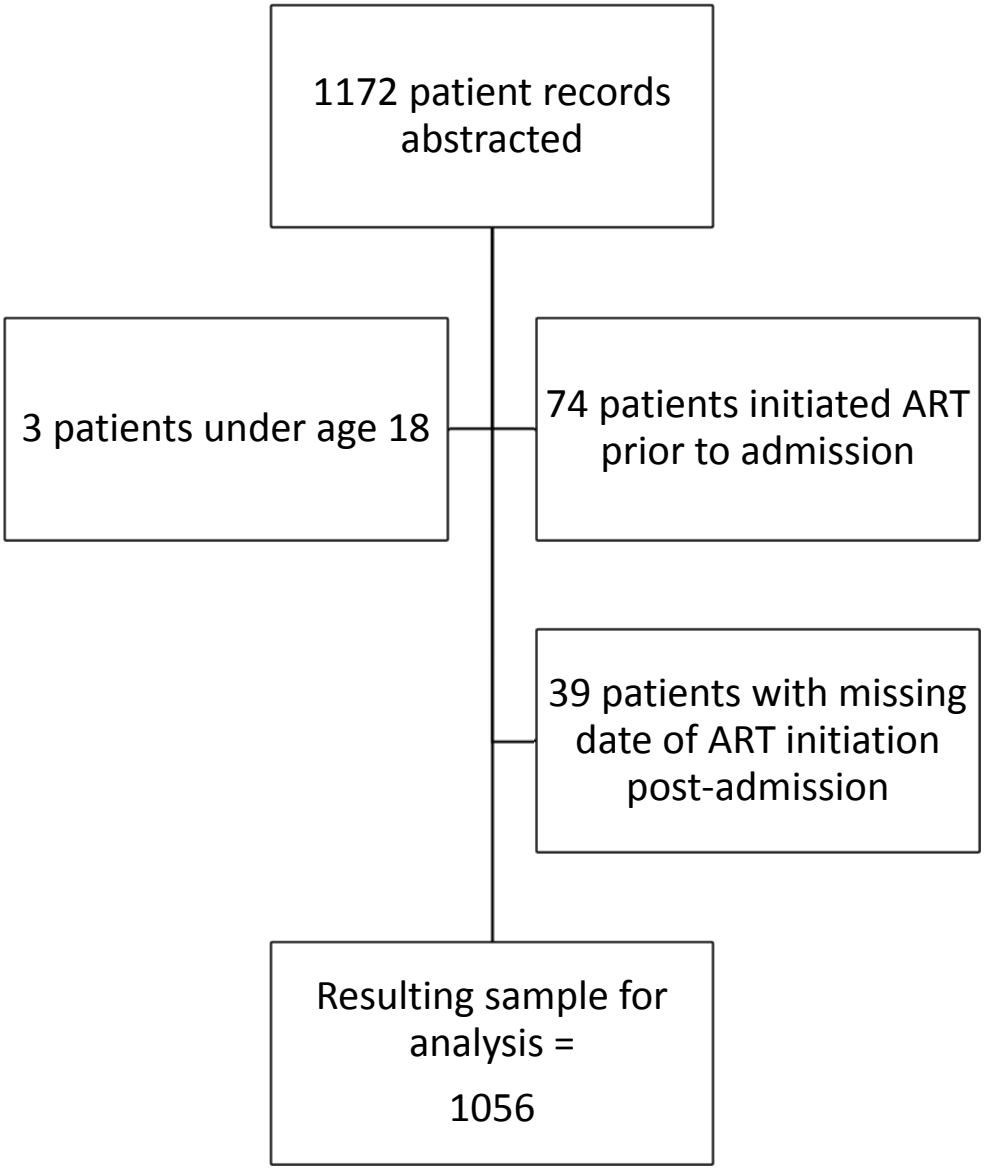
403c. Staff position 2 Médecins cliniciens					
404c. Staff position 2 Médecins cliniciens					
403. Staff position 3 Pharmaciens					
403a. Staff position 3 Pharmaciens					
403b. Staff position 3 Pharmaciens					
403c. Staff position 3 Pharmaciens					
403d. Staff position 3 Pharmaciens					
404. Staff position 4 Infirmiers					
404a. Staff position 4 Infirmiers					
404b. Staff position 4 Infirmiers					
404c. Staff position 4 Infirmiers					
404d. Staff position 4 Infirmiers					
405. Staff position 5 Sages-femmes					
405a. Staff position 5 Sages-femmes					
405b. Staff position 5 Sages-femmes					
405c. Staff position 5 Sages-femmes					
405d. Staff position 5 Sages-femmes					
406. Staff position 6Techniciens de labo					
406a. Staff position 6Techniciens de labo					
406b**.** Staff position 6Techniciens de labo					
406c. Staff position 6Techniciens de labo					
406d. Staff position 6Techniciens de labo					
407. Staff position 7 Assistants sociaux					
407a. Staff position 7 Assistants sociaux					
407b. Staff position 7 Assistants sociaux					
407c. Staff position 7 Assistants sociaux					

407d. Staff position 7 Assistants sociaux					
408. Staff position 8 Préparateur Gestionnaire en Pharmacie					
408a. Staff position 8 Préparateur Gestionnaire en Pharmacie					
408b. Staff position 8 Préparateur Gestionnaire en Pharmacie					
408c. Staff position 8 Préparateur Gestionnaire en Pharmacie					
408d. Staff position 8 Préparateur Gestionnaire en Pharmacie					
409. Staff position 9 Conseillers communautaires					
409a. Staff position 9 Conseillers communautaires					
409b. Staff position 9 Conseillers communautaires					
409c. Staff position 9 Conseillers communautaires					
409d. Staff position 9 Conseillers communautaires					
410. Staff position 10 Auxiliaires en pharmacie					
410a. Staff position 10 Auxiliaires en pharmacie					
410b. Staff position 10 Auxiliaires en pharmacie					
410c. Staff position 10 Auxiliaires en pharmacie					

410d. Staff position 10 Auxiliaires en pharmacie					

	IV - DEPENSES ADDITIONNELLES / HCI											
	Octobre 2012-Septembre 2013											
	a. No. 1	**b. No. 2**	**c. No. 3**	**d. No. 4**	**e. No. 5**	**f. No. 6**	**g. No. 7**	**h. No. 8**	**i. No. 9**	**j. No. 10**	**k.No. 11**	**l. No. 12**
Sessions d'apprentissage												
501. Date												
502. Coûts												
Visites de coaching												
503. Date												
504. Coûts												
Collaboration												
505. Date												
506. Coûts												

Appendix 2: Sample Selection Details



Appendix 3: Missing Data

NON-HCI SITES													
Site number	5	6	8	14	16	17	18	19	20	21	22	23	24
Baseline													
Age	0	33%	13%	44%	2%	63%	11%	24%	10%	0	3%	24%	2%
Gender	10%	0	1%	0	0	0	0	0	5%	0	0	0	0
Education	0	14%	4%	0	7%	25%	6%	8%	5%	11%	0	4%	2%
HIV test date	50%	51%	63%	61%	51%	38%	67%	65%	90%	69%	55%	62%	49%
Admit date	0	0	8%	0	4%	0	3%	0	14%	0	19%	0	0
HIV type	0	9%	3%	6%	0	0	6%	3%	36%	7%	45%	7%	11%
Entry via PMTCT	100%	9%	52%	3%	0	0	17%	14%	7%	0	3%	0	33%
TB at entry	10%	53%	15%	3%	18%	75%	8%	92%	12%	7%	61%	49%	2%
Clinical care													
2nd CD4 date[7]	80%	81%	77%	75%	53%	88%	75%	81%	90%	87%	81%	89%	89%
Final date	40%	40%	61%	61%	64%	25%	72%	57%	71%	40%	68%	64%	49%
HCI SITES													
Site number	1	2	3	4	7	9	10	11	12	13	15	25	26
Baseline													
Age	0	80%	1%	13%	0	30%	28%	2%	8%	21%	9%	0	32%
Gender	0	0	0	0	0	0	0	0	0	0	0	2%	5%

[7] Almost all records included a first CD4 count date, so these data focus on follow-up events.

Education	5%	7%	0	8%	9%	0	13%	5%	16%	28%	0	2%	8%
HIV test date	71%	68%	60%	54%	74%	50%	67%	74%	63%	54%	76%	73%	51%
Admit date	0	0	1%	3%	0	5%	2%	2%	11%	3%	0	0	3%
HIV type	21%	10%	6%	3%	3%	8%	2%	21%	0	3%	0	15%	8%
Entry via PMTCT	2%	12%	6%	10%	43%	10%	13%	2%	0	36%	12%	12%	8%
TB at entry	10%	5%	4%	5%	3%	70%	15%	5%	21%	36%	15%	7%	30%
Clinical care													
2nd CD4 date	83%	100%	68%	97%	3%	53%	63%	86%	68%	62%	79%	98%	100%
Final date	60%	54%	71%	21%	89%	48%	61%	49%	34%	38%	71%	68%	11%

Red highlighting indicates that more than half of records from the site were missing data for that variable; orange highlighting indicates a missing prevalence of one-third.

Appendix 4: Patient Care Trajectories

Note: Qualifying care items for this analysis were: CD4 count, weight, and regimen switch. The leftmost column presents the overall frequency of these events at HCI sites and at non-HCI sites. All other values in the tables combine HCI and non-HCI figures; and cell highlighting indicates the most probable trajectory result.

CD4 at baseline (within 1 week of ART initiation) (93.8% in non-HCI, 94.2% in HCI, p-value 0.80)	Yes = 992								No = 63							
CD4 between 0-6 months of ART initiation (28.1% in non-HCI, 36.0% in HCI, p-value 0.006)	Yes = 308				No = 684				Yes = 33				No = 30			
CD4 between 6-12 months of ART initiation (27.5% in non-HCI, 33.8% in HCI, p-value 0.03)	Yes = 135		No = 173		Yes = 163		No = 521		Yes = 15		No = 18		Yes = 12		No = 18	
CD4 beyond 12 months of ART initiation (37.3% in non-HCI, 34.7% in HCI, p-value 0.4)	Y = 72	N = 63	Y = 74	N = 99	Y = 72	N = 91	Y = 128	N = 393	Y = 10	N = 5	Y = 10	N = 8	Y = 5	N = 7	Y = 8	N = 10

Weight at baseline (within 1 week of ART initiation) (88.0% in non-HCI, 85.4% in HCI, p-value 0.2)	Yes = 914				No = 141			
Weight between 0-6 months of ART initiation (15.6% in non-HCI, 13.7% in HCI, p-value 0.4)	Yes = 132			No = 782	Yes = 22			No = 119

Weight between 6-12 months of ART initiation (11.4% in non-HCI, 10.8% in HCI, p-value 0.8)	Yes = 0		No = 132		Yes = 102		No = 680		Yes = 1		No = 21		Yes = 14		No = 105	
Weight beyond 12 months of ART initiation (51.4% in non-HCI, 47.0% in HCI, p-value 0.2)	--	--	Y = 10	N = 122	Y = 12	N = 90	Y = 444	N = 236	Y = 1	N = 0	Y = 9	N = 12	Y = 5	N = 9	Y = 37	N = 68

Regime switch between 0-6 months of ART initiation (5.0% in non-HCI, 7.6% in HCI, p-value 0.08)	Yes = 67				No = 989			
Regime switch between 6-12 months of ART initiation (2.6% in non-HCI, 3.6% in HCI, p-value 0.3)	Yes = 5		No = 62		Yes = 28		No = 961	
Regime switch beyond 12 months of ART initiation (3.4% in non-HCI, 2.2% in HCI, p-value 0.2)	Yes = 0	No = 5	Yes = 5	No = 57	Yes = 3	No = 25	Yes = 21	No = 940

Regime switch types:

Regime 1	Regime switch 1a	Regime switch 1b	Regime switch 2	Regime switch 2a	Regime switch 3	Regime switch 3a
AZT/3TC/NVP (494)	AZT/3TC/EFV: 6	TDF/3TC/LPV/r: 1	AZT/3TC/NVP: 6	--	AZT/3TC/NVP: 4	--
	AZT/3TC/LPV/r: 2	--	AZT/3TC/EFV: 4	--	TDF/3TC/LPV/r: 1	TDF/FTC/EFV: 1
	TDF/3TC/EFV: 1	--	TDF/FTC/EFV: 3	--	TDF/FTC/EFV: 1	--
	TDF/FTC/EFV: 3	--	TDF/FTC/LPV/r: 1	TDF/3TC/LPV/r: 1		
	D4T/3TC/NVP: 4	D4T/3TC/NVP: 1				
		Other: 1				

	D4T/3TC/EFV: 1	AZT/3TC/EFV: 1				
AZT/3TC/EFV (116)	AZT/3TC/NVP: 3	--	AZT/3TC/LPV/r: 1	--	--	--
	AZT/3TC/EFV: 1	--				
	AZT/3TC/LPV/r: 5	AZT/3TC/EFV: 1				
	TDF/3TC/EFV: 1	--				
	TDF/FTC/EFV: 2	--				
TDF/FTC/EFV (79)	AZT/3TC/EFV: 2 ABC/3TC/EFV: 1	--	--	--	TDF/FTC/EFV: 1	--
D4T/3TC/NVP (62)	AZT/3TC/NVP: 9	AZT/3TC/LPV/r: 1 ABC/3TC/NVP: 1	AZT/3TC/LPV/r: 1	--	--	--
	AZT/3TC/EFV: 2	--	TDF/FTC/EFV: 1			
	TDF/3TC/EFV: 1	--	Other: 3			
	TDF/FTC/EFV: 2	--				
	Other: 4	TDF/FTC/EFV: 2				
AZT/3TC/LPV/r (23)	AZT/3TC/NVP: 1 AZT/3TC/LPV/r: 1	--	--	--	--	--
TDF/3TC/EFV (10)	--	--	--	--	--	--
D4T/3TC/EFV (19)	AZT/3TC/NVP: 1 AZT/3TC/EFV: 4 TDF/FTC/EFV: 1	--	TDF/FTC/EFV: 2	--	--	--

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