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Initiating antiretroviral therapy for HIV at a patient's first clinic visit: A cost-effectiveness analysis of the RapIT randomized controlled trial

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Abstract

Objective—Determine the cost and cost-effectiveness of single-visit (same-day) antiretroviral treatment (ART) initiation compared to standard of care initiation.

Design—Cost-effectiveness analysis of individually randomized (1:1) pragmatic trial of single-visit initiation, which increased viral suppression at 10 months by 26% (relative risk [95% CI] 1.26 [1.05–1.50]).

Setting—Primary health clinic in Johannesburg, South Africa.

Subjects, participants—HIV positive, adult, non-pregnant patients not yet on ART or known to be eligible who presented at the clinic 8 May 2013–29 August 2014.

Intervention—Same-day ART initiation using point-of-care laboratory instruments and accelerated clinic procedures to allow treatment-eligible patients to receive ARVs at the same visit as testing HIV-positive or having an eligible CD4 count. Comparison was to standard of care ART initiation, which typically required 3–5 additional clinic visits.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

Main outcome measure(s)—Average cost per patient enrolled and per patient achieving the primary outcome of initiated ≤90 days and suppressed ≤10 months, and production cost per patient achieving primary outcome (=all costs/primary outcome patients).

Results—The average cost per patient enrolled, per patient achieving the primary outcome, and production cost were $319, $487, and $738 in the standard arm and $451, $505, and $707 in the rapid arm.

Conclusions—Same-day treatment initiation was more effective than standard initiation, more expensive per patient enrolled, and less expensive to produce a patient achieving the primary outcome. Omitting POC tests at initiation and focusing on high volume clinics have the potential to reduce costs substantially and should be evaluated in routine settings.

Keywords

HIV; South Africa; Antiretroviral therapy; Point-of-care systems; Cost; Economic evaluation

INTRODUCTION

For national HIV programs, globally, the loss of patients from clinical care between testing HIV-positive and initiating antiretroviral therapy (ART) remains a major challenge. In South Africa, even among those who have already been found treatment-eligible, loss to care before starting ART has consistently been estimated at a third to a quarter of patients [1–3]. Offering ART to all who test positive regardless of CD4 count, as is now recommended by the World Health Organization [4] and became national policy in South Africa in September 2016 [5], will not achieve the global 90-90-90 targets if those who test positive fail to initiate [6].

One reason for patients' failure to start treatment when it is offered is that in many countries, ART initiation is a burdensome process, requiring multiple clinic visits and long waits between and during visits. A promising strategy for reducing loss of patients before initiation is to shorten the time period, reduce the number of visits, and simplify the steps required before medications are dispensed. The Rapid Initiation of Treatment (RapIT) randomized controlled trial evaluated an intervention that allowed patients in public sector clinics in Johannesburg, South Africa to have treatment eligibility determined, all treatment preparation steps performed, and ARV medications dispensed on the day of their first HIV-related clinic visit. Compared to standard of care, the RapIT intervention increased ART initiation by 36% and viral suppression by 26% [7]. To achieve these outcomes, the intervention used point-of-care laboratory (POC) technologies and altered other inputs, such as staff time, making the RapIT approach potentially more expensive than standard care. Using resource utilization and unit cost data collected during the RapIT trial, we estimated the cost and cost effectiveness of rapid, same day HIV treatment initiation compared to standard care in South Africa.

METHODS

As previously reported [7], RapIT was an unblinded, individually randomized, pragmatic trial offering single-visit antiretroviral treatment initiation to eligible HIV positive adult,

non-pregnant patients. In this analysis, we compare the costs and outcomes of single-visit (same-day) initiation to standard initiation. We focus here on study characteristics necessary to understand the cost-effectiveness analysis (CEA) and on the methods for the CEA itself; further details about the trial are available in the previous report [7].

Study site and population

As most HIV patients are treated by primary health clinics (PHC), the CEA was conducted at the RapIT PHC site which serves a large urban informal settlement on the outskirts of Johannesburg, South Africa. It follows national guidelines for determining ART eligibility and for HIV care and treatment. During the study period, ART eligibility criteria included a CD4 count ≤ 350 cells/mm^3 and/or a WHO Stage III/IV condition [8]. The standard first-line ARV regimen was tenofovir (TDF), emtricitabine (EMT), and efavirenz (EFV). As is typical at PHCs in South Africa, nurses initiated and managed patients on ART, with the help of lay counselors who provided non-clinical services such as HIV counseling and adherence support. Guidelines indicated up to five laboratory tests prior to ART initiation. A CD4 count was used to establish treatment eligibility. Creatinine (Cr), alanine transferase (ALT) and hemoglobin (Hb), were required for confirming a first-line ARV regimen. Finally, TB suspects were asked for a sputum sample for a TB test.

A small clinic room was allocated for enrolling patients, determining treatment eligibility, conducting POC tests, and offering rapid treatment initiation. The study nurse and study counselor who conducted the study procedures described below had similar training to clinic staff who provide routine ART initiation.

The study population consisted of all HIV positive, adult (≥18), non-pregnant patients who presented at the clinic between 8 May 2013 and 29 August 2014, were not yet on ART, and did not already have a CD4 count result indicating that they were treatment-eligible. Enrolled patients were randomized 1:1 to rapid treatment initiation (rapid arm) or standard of care treatment initiation (standard arm).

Study procedures

Supplementary Figure 1 illustrates study procedures. After randomization, standard arm patients who did not have a treatment-eligible CD4 count result had a blood sample taken following standard procedures. Following the blood draw, standard arm patients followed standard ART initiation procedures with no further study team interaction. An additional 3–5 clinic visits were typically required before ARVs were dispensed, for counseling and education, the laboratory tests mentioned above, which were performed by the regular laboratory and a physical examination.

Patients randomized to the rapid arm who did not already have a CD4 count result available were offered a POC CD4 count to determine treatment eligibility. As in the standard arm, those not ART eligible were withdrawn from the study. Those ART eligible who had TB symptoms were offered a POC TB test; TB-positive patients were referred to the clinic's TB nurse to initiate TB treatment. All rapid arm patients were offered POC pre-initiation blood tests (Hb, Cr, and ALT). The study nurse and study counselor also provided education,

counseling, and a physical examination during that same visit. An initial ARV supply was dispensed at the end of the visit.

After completion of study procedures, follow up for resource utilization and outcomes was by record review only. Patients whose CD4 counts made them ineligible for ART were withdrawn and excluded as soon as the results were available.

Outcomes

The primary trial outcome was viral load suppression by 10 months after study enrolment, which we used as our measure of effectiveness for the CEA. This study-specific health outcome was chosen because it has clinical significance in the treatment of HIV. For the CEA, we chose to retain the primary trial outcome, as there are not sufficient data to model the lifetime benefits and costs associated with the intervention. For patients who did not achieve suppression, we defined two other endpoints: in care but with an unsuppressed or missing viral load, or not in care. Not in care included patients who were lost to follow up or died at any time in the 10-month study period, regardless of ART initiation. Loss was defined as being more than three months late for the last scheduled visit. The three outcomes were mutually exclusive.

Costs

Costs were estimated from the provider perspective over the 10-month study period. Previously described micro-costing methods were used to cost all resources for care and treatment [9, 10]. We used case report forms (CRFs) and routine patient records to estimate resource utilization for each patient over the study period. We then multiplied the resource usage by the unit cost.

Details of costing methods are presented in Box 1 [11, 12]. Resources captured included drugs, laboratory tests, clinical staff time, buildings, equipment, general supplies, and other shared services, such as non-clinical staff. Trial-specific costs that would not be incurred in routine practice (i.e. screening, informed consent, study-specific data collection) were excluded. All costs were collected in or adjusted to 2015 South African Rand (ZAR). The costs are reported in United States Dollars (USD) using the average 2015 exchange rate of 12.74.

Box 1

Methods for estimating unit costs

Resource	Method for estimating cost
Drugs	Antiretroviral and other drugs dispensed per subject during the study period were extracted from the individual subject's CRF and clinic record. The published national drug unit costs were applied to determine total drug cost per subject [11].
Laboratory tests —Point of care	Point of care tests for rapid arm subjects were extracted from CRFs. A unit cost for each test was estimated using a previously described methodology [10] [17]. We included the cost of equipment, reagents, staff time, quality assurance, maintenance, building space, and utilities. In the baseline scenario the patient volume was assumed to be the total number of patients enrolled in both arms of the study at the

Resource	Method for estimating cost
	study site (as all were potentially eligible for the intervention). The equipment was assumed to have a life span of five years and was discounted at 5%.
Laboratory tests—Centralized (regular)	All laboratory tests in the standard arm and monitoring tests after ART initiation in the rapid arm were performed off site by the National Health Laboratory Service. The actual number of tests performed per subject during the study period was extracted from the individual subject's clinic record as well as the NHLS database. The published unit cost per test was applied to determine the laboratory cost per subject [12].
Clinical staff time for patient care	Clinical staff time was defined as including any doctor, nurse, and HIV lay counselor time spent with the patient. For the rapid arm, the trial CRF recorded the actual time in minutes used by the study nurse and study counselor for the rapid initiation process, and average salaries for each cadre used to estimate an average unit cost per rapid arm enrolment visit. For all other visits (standard and rapid arm) the clinical staff time cost was calculated by taking the total ART clinical staff cost per month and dividing it by the total ART visits to the clinic per month to get the average clinical staff cost per visit. Clinical staff salaries (standard and rapid arm) were obtained from the published list of public sector salaries for that cadre.
Buildings and equipment	The total floor space allocated to the HIV program was calculated by measuring the HIV care and treatment floor space and adding on a proportion of floor space shared by different services (i.e. waiting rooms). A market related average rental cost per square meter was applied to estimate the cost of the building. Electricity costs were obtained for the facility and applied by square meter. Water and effluent costs were not available for the facility and cost per square meter was estimated based on a similar building. The replacement cost of equipment was obtained and a working life of 5 years applied to obtain a cost per month. All HIV specific equipment was included and a proportion of equipment from shared spaces was included. The building and equipment costs were apportioned to each subject based on a per-visit cost.
Management and administration costs, including staff not providing direct patient care to individual patients and non-medical supplies	All staff members who did not provide direct patient care but provided some support to the HIV program (i.e. clinic manager, data clerks) were included. Staff salaries were obtained from published public sector salaries for that cadre. The cost of all general supplies (i.e. not related to a particular service) was obtained from facility financial reports. Management and administration costs were apportioned to each subject based on a per visit cost. All costs for management and administration incurred at the site level (i.e. the primary health clinic) were included. Costs incurred above the level of the site were excluded.

Data collection and analysis

Patient-level data for the CEA were drawn from CRFs and patients' medical records. Patients' medical records included hard copy patient files, hard copy patient registers, and other electronic data sources, including the national electronic laboratory database maintained by the National Health Laboratory Service. All of these data sources were routinely collected and not specific to the study. These provided individual resource utilization (i.e. number of clinic visits, services provided, medications dispensed, laboratory tests performed). Facility-level data pertaining to resource usage not attributable to individual patients were extracted from clinic registers, management reports and financial records. Unit costs were obtained from tender documents, state price lists, public salary scales, invoices, quotes or other relevant financial documents.

We first described baseline characteristics and outcomes of the two study arms. We then estimated average patient resource utilization over the study period. Next, we estimated average cost per patient by study arm and outcome and disaggregated by cost category. We then estimated the "production cost," a calculation that takes the costs of offering the intervention to all patients and divides it by only those achieving the primary outcome [9].

Sensitivity analysis

In sensitivity analysis, we first tested the assumption that all missing viral loads among retained patients were suppressed. We then varied three parameters that affect the costs of rapid initiation. First, we looked at patient volume, which determined the number of tests done per day. Test volume has been found to be a major factor in the cost-effectiveness of POC tests [13, 14]. The baseline scenario used the total number of patients enrolled in both arms as the volume. For the sensitivity analysis, we estimated results for a "low volume/high cost" scenario, in which the volume of patients was equal to those who enrolled in the rapid arm only, and a "high volume/low cost" in which the volume of patients was equal to the total ART initiates at the site.

Because the POC TB test was the most expensive component of the rapid strategy and was required for only a few patients, we also considered a scenario in which TB suspects were excluded. In routine care, these patients could be offered a standard TB test and initiated only after receiving the test results. This would allow the large majority of patients, who are not TB suspects, to be initiated on the same day without incurring the cost of a POC TB instrument.

Finally, we considered the effect on costs of having rapid initiation partially delivered by an enrolled nurse instead of a public health care nurse (PHCN). Although the study was implemented by a PHCN, which is the most highly trained cadre of South African nurses, many of the procedures could be performed by more junior nurses, at lower cost. We estimated results if an enrolled nurse replaced the PHCN for half the time per treatment initiation visit. We then combined all three cost-reduction scenarios described above to estimate a "cost minimization scenario".

Ethics approval

Written informed consent was obtained from each study participant. The study was approved by the Institutional Review Boards of the University of the Witwatersrand and Boston University and registered at ClinicalTrials.gov (NCT01710397) and the South African National Clinical Trials Register (DOH-27-0213-4177).

RESULTS

Sample characteristics and outcomes

The PHC site enrolled a total of 213 study- and treatment-eligible patients, including 108 in the standard arm and 105 in the rapid arm (Table 1). There were no important differences between the arms.

Trial outcomes for the PHC site are reported in the lower half of Table 1 [7]. Significantly more patients in the rapid arm (63%) than the standard arm (43%) achieved viral suppression by 10 months, an outcome that serves as a proxy for viral suppression at the time of the routine six-month viral load. Of those not reaching the primary outcome, nearly equal proportions (16% standard arm, 17% rapid arm) were retained in care but unsuppressed or missing a viral load. In contrast, substantially more patients in the standard arm (42%) were lost to follow up compared to the rapid arm (20%).

Resource utilization and unit costs

Average resource utilization by study arm for patients who achieved the primary outcome is shown in Table 2. As might be expected, patients in the rapid arm spent more time on ART during the study period, since most initiated sooner than the standard arm patients. Rapid arm patients made an average of three fewer clinic visits than standard arm patients during the study period. Standard arm patients had slightly fewer laboratory tests, which likely reflects the shorter time that standard arm patients were on ART during the study period. The laboratory test utilization per month after ART initiation for retained patients was identical between arms. Fewer viral load tests were done in the standard arm due to the larger number of patients lost to care in this arm before reaching the routine six-month viral load. The small number of TB tests performed in both arms reflects the relatively low TB symptom burden in the study population.

As shown in Table 3, all the point-of-care laboratory tests in the rapid arm were substantially more expensive per test performed than the regular tests in the standard arm under the baseline scenario. The POC TB test was exceptionally expensive. The right-hand columns of Table 3, used in the sensitivity analysis below, reveal the importance of patient volume in determining cost per test. In the low-cost scenario, in which fixed equipment and shared costs were spread over the total number of ART initiates at the study site, as might happen if POC tests were routine, the cost per baseline panel was almost 82% lower. In the high-cost scenario, in which fixed equipment and shared costs were spread over only the tests actually conducted in the study (i.e. the rapid arm), the cost per baseline panel was 8% higher.

There was also a large difference between arms in the ART initiation visit cost, which was much more expensive in the rapid arm. This reflected both the longer time required for a rapid initiation visit and the use of a PHCN for all clinical steps. If the rapid initiation intervention were adopted for routine care, more junior nurses could perform some of the steps, potentially reducing staff costs, a scenario that we explore in sensitivity analysis. There were no differences in unit costs for any of the other resources required during the study period. The standard first-line ARV regimen of TDF/EMT/EFV cost $97/year during the study period.

Total costs and cost-effectiveness

The average cost per patient by study arm and patient outcome is reported in Table 4. Independent of outcome, the cost per patient enrolled was 41% more ($132) in the rapid arm than in the standard arm. When outcomes are taken into account, however, this difference

diminishes: for patients achieving viral suppression, rapid arm patients cost only 4% more than standard arm patients, or a difference of $18 per virally suppressed patient.

Drug costs per patient were slightly higher in the rapid arm, as expected, due to the slightly longer period on ART. The high cost of the POC tests in the rapid arm accounts for the majority of the difference between arms for virally suppressed patients. Although standard arm patients made an average of three more clinic visits than did those in the rapid arm, the savings in terms of clinical staff time and fixed costs was offset by the higher use of these resources during the rapid arm initiation visit.

Sensitivity analyses

Table 5 provides the results of our sensitivity analyses, in which we varied patient volume, TB testing procedures, and staff cadre in the rapid arm of the study and used the baseline values and sensitivity analysis unit costs from Table 3.

Patient volume affected costs in two ways: by altering the unit cost per POC test performed, as shown in Table 3, and by changing the fixed costs per clinic visit, as fixed costs are estimated as cost/patient served. When we assumed that all treatment-eligible patients presenting at the clinic received the intervention (high volume), cost per patient treated fell sharply, and the cost per virally suppressed patient was less in the rapid arm compared to the standard arm.

The POC TB test was exceptionally expensive because of the small number of TB suspects identified and correspondingly low volume of tuberculosis tests performed. In sensitivity analysis, we estimated costs under which TB suspects were excluded and assumed to be offered a non-POC TB test and standard initiation separately, as could readily be done in routine care. When TB suspects were excluded the cost per virally suppressed patient in the rapid and standard arms were identical, and the production cost in the rapid arm was substantially lower.

The last parameter we varied was the nurse cadre required to carry out rapid initiation procedures. When an enrolled nurse replaced the PHCN used in the study for 50% of the rapid initiation visit, the cost per virally suppressed patient was less than 1% higher in the rapid arm than in the standard arm, with similar production costs. Finally, to estimate a minimum cost at which the intervention might reasonably be carried out, we combined all three cost reduction scenarios: exclusion of TB suspects, high patient volume, and implementation by a lower cadre nurse. As shown in the last row of Table 5, this resulted in a cost per virally suppressed patient that was substantially lower in the rapid arm than in the standard arm, as well as a much lower production cost.

DISCUSSION

The RapIT trial demonstrated that offering patients the opportunity to start ART on the same day as their first HIV-related clinic visit has the potential to increase ART uptake and viral suppression. Loss to care was higher after treatment initiation among those offered same-day initiation than among those in standard care, suggesting that for some patients, attrition from

care was shifted from before ART initiation to after. The increase in treatment uptake more than offset the post-initiation losses, however, leading to an overall benefit to patients enrolled in the intervention arm of the study. Although effective, same-day initiation will not be a feasible strategy for routine care, however, if it is too expensive to implement. In this analysis, we estimated the cost per patient and production cost of same-day initiation using the RapIT strategy of accelerated procedures and POC laboratory tests. We found that for all patients participating at the PHC site, this strategy cost an average of 41% more than under standard care during the study period. For virally suppressed patients, however, rapid initiation cost only 4% more than standard initiation. When costs incurred by all patients in each arm were allocated only to patients achieving viral suppression (the production cost estimate) there was little cost difference between the strategies. We also note that these cost estimates are from the perspective of the provider only. They do not reflect the potential benefits which might accrue to the patient or society as a result of this intervention. One clear example of such benefits to patients is the smaller number of clinic visits required to initiate treatment, which potentially translates into lower transport costs and a reduction in lost wages. Earlier treatment initiation is also associated with improved health outcomes for the patient and a reduction in the likelihood of HIV transmission.

In the sensitivity analyses reported above, we considered whether feasible changes to the study strategy would increase its cost-effectiveness. The easiest to implement is the omission of TB testing at point of care, as TB suspects could simply be managed separately and not started on ART until TB test results were returned from a centralized laboratory. This step alone would cut costs sharply. The other changes we examined, to staff cadre and patient volume, also led to large cost reductions. We note, however, that these changes could also affect patient outcomes. The results of the sensitivity analyses should thus be interpreted as illustrative examples of how to make same-day initiation affordable.

South Africa and many neighboring countries have recently adopted the WHO's 2015 recommendation for offering ART to all HIV-positive individuals, regardless of CD4 counts. Though South Africa has not yet issued detailed procedural guidelines, other countries in the region have advised that ART initiation should not be dependent on laboratory results[15] [16]. In such settings, it may be possible to utilize RapIT's accelerated procedures without requiring POC instruments. The breakdown of costs in Table 4 suggests that if the rapid arm's laboratory costs were the same as those in the standard arm, same-day initiation would become cost-saving.

In this study, we did not have the data required to account directly for the effect of same-day initiation on either clinic crowding or the efficiency of staff time allocation. As reported in Table 3, rapid arm patients made three fewer clinic visits than did standard arm patients. For clinics, this meant lower visit costs (i.e. waiting space, locating patient files, taking vital signs, data entry). On the other hand, the intervention did require that a nurse spend substantially more time on the initiation visit than happens under standard care, potentially interrupting the delivery of other services. Shifting some tasks to lesser-trained cadres, as is done in the sensitivity analysis reported above, may help address this challenge, but adoption of the intervention for a clinic as whole would likely require deliberate changes in staff allocation to accommodate a single, long visit rather than multiple shorter ones. For patients,

same-day initiation meant three fewer investments of travel time and costs and time spent waiting in clinic queues, potentially substantial benefits that are not captured in the CEA. In sum, same-day initiation will almost certainly result in less clinic crowding and reduce costs to patients; the effect on clinic efficiency for its overall service delivery responsibilities is uncertain.

The study had several other limitations. Although we aimed to make trial procedures as realistic as possible, the intervention was likely both more effective and more expensive than it would be if implemented in routine care. It is unlikely, for example, that a busy nurse at a crowded clinic would invest as much time per patient as the study nurses did; reducing the length of the initiation visit would cut costs but may affect outcomes. We lacked data on the costs of different types of non-study clinic visits and so used an average cost per visit that may have masked cost variations among patients. Although we designed the study to reflect as closely as possible the conditions of routine clinical care in South Africa, generalizability of results to other locations in South Africa, or to other countries, is unclear. We report average costs incurred in the study; marginal costs for initiating difficult-to-access patients may differ from our results. Finally, our study population was limited to ART-eligible patients during the study period, when a threshold of a CD4 count < 350 cells/mm^3 was applied; new guidelines under which all HIV-positive patients are eligible for ART may affect both the costs and effectiveness of the RapIT intervention.

The results of the trial and of the cost-effectiveness analysis suggest that using the RapIT strategy—including POC instruments—is both more effective and modestly more expensive than standard care. They also indicate that there may be variations on the strategy that would reduce costs substantially and may not lessen effectiveness. As countries adopt “treat all” guidelines and no longer require a baseline CD4 count to establish treatment eligibility, the need for POC instruments will diminish, making same-day initiation clearly affordable. For countries considering how to increase uptake of ART—particularly under new guidelines in which all HIV-positive individuals are eligible for treatment—RapIT offers a potentially valuable addition to the set of effective interventions available.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Baseline characteristics, trial outcomes

Variable	Standard arm N=108	Rapid arm N=105	Crude risk difference (95% CI)	Crude relative risk (95% CI)
Baseline characteristics				
Age in years, median (IQR)	34 (29–42)	35 (29–40)		
Female, %	57%	51%		
CD4 count, median cells/mm^3 (IQR)	162 (90–253)	183 (108–274)		
Reason for clinic visit, n (%)				
Have HIV test	31 (29%)	32 (30%)		
Provide blood sample for CD4 count	3 (3%)	2 (2%)		
Receive CD4 count results	73 (68%)	71 (68%)		
Other	1 (0%)	0 (0%)		
Outcomes				
Viral suppression by 10 months (primary outcome)	46 (43%)	67 (63%)	21% (8–34%)	1.50 (1.15–1.95)
Unsuppressed or not reported	17 (16%)	17 (16%)	0% (−9–10%)	1.03 (0.56–1.90)
Lost to follow up	45 (42%)	21 (20%)	−22% (−34%–10%)	0.48 (0.31–0.75)
Of patients not achieving primary outcome:				
Not initiated on ART	28 (26%)	3 (3%)	−23% (−14–31%)	0.11 (0.03–0.35)
Initiated and retained, viral load unsuppressed	9 (8%)	7 (7%)	−1% (−9%–5%)	0.80 (0.31–2.07)
Initiated and retained, viral load not reported	8 (7%)	10 (10%)	2% (−5%–9%)	1.29 (0.53–3.13)
Initiated but not retained	17 (16%)	18 (17%)	1% (−9%–11%)	1.09 (0.59–2.00)

Table 2

Average resource utilization per patient achieving the primary outcome and difference between initiation strategies

Resource	Standard arm	Rapid arm	Difference (rapid-standard)
N	46	66	20
Time in care, median mo (IQR)	10.0 (10-10)	10.0 (10-10)	0.0
Time on ART after initiation, median mo (IQR)	9.5 (9.3–9.6)	10.0 (10-10)	−0.5
Pre-ART visits	2.9	1.0	1.9
Total visits (pre-ART + ART)	9.9	6.9	3.0
CD4 count	0.4	0.5	0.1
Viral load	0.9	1.0	0.1
TB tests	0.2	0.4	0.2

Table 3

Estimated unit cost in US dollars (USD)

Laboratory tests	USD cost/test		POC low volume/high cost scenario	POC high volume/low cost scenario
	Standard (NHLS) tests	POC baseline scenario		
CD4 count	4.51	41.19	75.03	14.89
TB test	13.03	286.90	539.65	81.06
Creatinine	2.06	17.63	30.05	7.39
ALT	3.08	17.63	30.05	7.39
Hemoglobin	1.22	17.63	30.05	7.39
Full baseline panel (CD4, TB, Cr, ALT, Hb)	23.91	380.99	704.83	118.11
Viral load	23.04	n/a *		
Clinic visits	**USD cost/visit**			
Standard clinic visit (average for all types of HIV-related visits)	15.45			
Rapid initiation visit (rapid arm only)				
Baseline scenario (public health nurse only)	60.31			
Sensitivity analysis (enrolled nurse for 50% of visit)	45.53			
Other visit resources	20.66			
Staff (support)	16.71			
Buildings	2.88			
Equipment	0.96			
Supplies	0.12			

* All viral load tests, which were routine monitoring tests done 6 months after initiation rather than as part of the initiation process, were conducted by the NHLS.

Table 4

Cost per patient in US dollars (USD)

Cost per patient by outcome category	**USD cost (95% Confidence Interval)**				
	N	**Standard**	**N**	**Rapid**	**Difference**
All patients	108	319.08 (278.82 – 359.33)	105	451.19 (403.74 – 498.65)	132.12 (83.20 – 181.03)
Viral suppression by 10 months (primary outcome)	46	487.45 (465.95 – 508.95)	67	505.42 (481.17 – 529.67)	17.97 (−16.69 – 52.62)
Unsuppressed or not reported	17	431.61 (375.70 – 487.53)	17	478.94 (398.56 – 559.32)	47.33 (−54.43 – 149.09)
Lost to follow up	45	104.45 (74.96 – 133.93)	21	255.73 (207.15 – 304.31)	151.28 (95.82 – 206.74)

Cost breakdown for patients achieving primary outcome	**USD cost (%)**	
	Standard	Rapid
Drugs	86.66 (18%)	93.56 (19%)
Lab tests	44.43 (9%)	116.95 (23%)
Clinical staff visit cost	152.43 (31%)	151.81 (30%)
Fixed costs (buildings, equipment, management, admin)	203.92 (42%)	143.09 (28%)
Total per patient achieving primary outcome	487.44 (100%)	505.42 (100%)

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Table 5

Sensitivity analyses

Parameter varied in rapid arm	Per patient enrolled		Per patient achieving primary outcome		Production cost*
	Cost	Difference from standard arm (%)	Cost	Difference from standard arm (%)	
Baseline scenario - actual volume and staffing					
Standard arm, for comparison	319.08	0.00 (0%)	487.45	0.00 (0%)	738.16
Rapid arm	451.19	132.12 (41%)	505.42	17.97 (4%)	707.09
Patient volume set equal to full patient load of clinic (high volume) **					
Standard arm, for comparison	319.08	0.00 (0%)	487.45	0.00 (0%)	738.16
Rapid arm	389.42	70.34 (22%)	451.99	−35.46 (−7%)	610.28
Some tasks shifted from primary health nurse to enrolled nurse **					
Standard arm, for comparison	319.08	0.00 (0%)	487.45	0.00 (0%)	738.16
Rapid arm	436.42	117.34 (37%)	490.64	3.19 (1%)	683.94
Assume missing viral loads were suppressed					
Standard arm, for comparison	319.08	0.00 (0%)	466.74	0.00 (0%)	638.15
Rapid arm	451.19	132.12 (41%)	490.83	24.09 (5%)	615.26
Assume TB suspects excluded; no POC TB tests **					
Standard arm, for comparison	309.41	0.00 (0%)	481.14	0.00 (0%)	760.99
Rapid arm	423.38	113.97 (37%)	482.29	1.15 (0%)	635.07
Minimum cost scenario: excluded TB suspects + high patient volume + enrolled nurse					
Standard arm, for comparison	309.41	0.00 (0%)	481.14	0.00 (0%)	760.99
Rapid arm	370.09	60.68 (20%)	429.64	−51.51 (−11%)	555.14

*Production cost=total cost for all patients in arm/number of patients in arm achieving primary outcome

**Included in minimum cost scenario