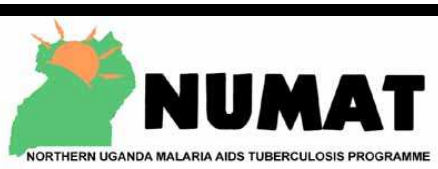

NORTHERN UGANDA MALARIA, AIDS, AND TUBERCULOSIS PROGRAMME (NUMAT)

Providing CD4 Cell Count Tests to Hard-to-reach Communities in Northern Uganda

Programme Reach and Cost-effectiveness of an Outreach Delivery Model

FINAL EVALUATION REPORT
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John Odaga
Charles Okiria

Any correspondences on technical aspects of this report should be addressed to John Odaga
Mobile: +256 772 619 450
e-mails: jodaga@umu.ac.ug or John.Odaga@gmail.com

LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-retrovial Therapy
HIV	Human Immuno-deficiency Virus
IDP	Internally Displaced People
JCRC	Joint Clinical Research Centre
JSI	John Snow Inc
MACA	Multi-sectoral Approach to Control of AIDS
OVC	Orphans ans Vulnerable Children
PMTCT	Prevention of Mother-to-child Transmission
UAC	Uganda AIDS Commision
USAID	United States Agency for International Development
VCT	Voluntary Counselling and Testing

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EXECUTIVE SUMMARY

Background

This evaluation study was commissioned by the Northern Uganda Malaria, AIDS and TB (NUMAT) Project, a USAID funded project designed to respond to the unique health needs in Northern Uganda with respect to HIV/AIDS, TB and Malaria. The project covered all the districts of the Acholi and the Lango sub-regions. The project aimed to improve the coordination of responses to HIV/AIDS, malaria and TB diseases; and to increase access to, and the utilization of the full continuum of these services that are provided in the context of the three diseases.

In order to increase access to quality ART, the project adopted an outreach delivery approach that allows the rural-based HIV positive clients have access to laboratories for CD4 cell count determination. The model assumed a tri-partite, public-private partnership, involving NUMAT as the funder, the district-based peripheral health facilities providing ART, and private third-party laboratories performing the test. Health workers at the designated, rural-based health facilities mobilized clients for the test. NUMAT paid the private laboratories a collection and testing fee for every sample, based on an invoice specifying the number of samples and tests done from each sub-region.

Terms of Reference

The evaluation aimed to compare the NUMAT outreach model with the conventional, referral-hospital-based model of CD4 cell count determination. Specifically, the evaluation aimed to:

1. compare the two models in terms of their coverage and service uptake with respect to laboratories for CD4 cell count measurement
2. measure and compare the extent of user drop-out over time; that is the number of clients who are up-to-date with their follow-up CD4 cell count
3. describe the perception of clients and health workers regarding the two approaches
4. estimate and compare the average cost to the funders, of each delivery model
5. determine which of the two delivery models was more cost-effective,
6. estimate the cost-saving associated with implementing the outreach model
7. describe any lessons learnt, in terms of the challenges related to the achievement of objectives, impact, sustainability of the project and operational issues.

Methods

Measuring coverage (programme reach)

Two indicators were used to measure the coverage/reach of the two models, namely *service uptake/population reach* and *geographical coverage/accessibility/reach.* Service uptake was measured as the number of tests delivered to each eligible client in a year through either of the two delivery models. The numerator for this measure included all CD4 count tests, irrespective of purpose of the test. The denominator ("eligible clients") consisted of HIV+ clients registered at the health facilities in the programme area (Acholi and Lango sub-region). Geographical accessibility/coverage/reach was measured in 2 ways, namely (a) the average distance of the beneficiaries' location from the designated referral hospital (CD4

laboratories) in the region, and (b) the proportion of the beneficiaries within each programme, living within 5 and 10km of the respective hospital in the sub-region.

Measuring cost of a single CD4 cell count test
Cost was determined from the perspective of NUMAT and the Ministry of Health—as funders of the alternative models. The analysis captured only the additional costs (increments) associated with the introduction of the additional service—CD4 cell count measurement—into the existing HIV/AIDS services.

The cost to NUMAT was extracted from the invoices submitted by CYNAPSIS, which covered both the collection and testing fee per sample. We assumed that the fee charged by CYNAPSIS captured the full range of costs suffered in the implementation of the model (including overhead cost and depreciation).

Costing of the hospital-based model entailed identifying, quantifying and monetising all the relevant inputs used in performing a CD4 cell count test. A mixture of bottom-up (ingredient) and top-down methods were used in the analysis. We computed cost of the static model with respect to the actual number of tests performed in the respective CD4 laboratories; in addition, we calculated the "would-be" costs of the respective laboratories, assuming optimal levels of performance—referred to as the expected cost. We calculated the average cost per test (actual and expected) by dividing the total cost associated with CD4 cell count measurement during the year under review, by the total number of tests performed during the year.

Measuring cost-effectiveness
We computed two cost-effectiveness measures, namely average cost-effectiveness ratio (ACER) and incremental cost-effectiveness ratio (ICER). We chose service uptake—the number of times a registered client received a test in a year—as a measure of effectiveness of each model. ACER was calculated by dividing the total cost of each model by the service uptake associated with each model. Therefore, the ACER calculated the cost of testing a client once in a year. We computed average cost-effectiveness of the static model with respect to actual output in Acholi sub-region and the expected optimum output in both sub-regions.

Incremental cost-effectiveness analysis was done by dividing the difference in cost between the two models, by the difference in their effectiveness (service uptake). Differences were computed using the static model as the base case. ICER measures the additional cost incurred by the more effective delivery model to achieve the extra coverage.

Measuring cost-saving to the beneficiaries of the NUMAT model
It was assumed that the outreach programme resulted in increased geographical accessibility to CD4 laboratories, thereby reducing the cost of seeking those services. Thus we calculated the healthcare-seeking cost to a beneficiary of the static laboratory. In addition, we calculated the healthcare-seeking cost that a beneficiary of the outreach programme would have incurred if s/he sought the same services at the designated referral hospital. The amount of cost-saving to the beneficiary of the outreach model was obtained by subtracting the former from the latter. In estimating the health-seeking cost, we considered the cost of travelling, the waiting time at the regional facilities (in relation to CD4 count test), and the cost of an

average meal and accommodation, where applicable. A daily wage rate of 2000/= was applied to the productivity time lost in seeking care.

Assessing Clients' Perception

Using a mixture of focused group discussions and in-depth individual discussions, we assessed clients' perceptions with regard to the two delivery approaches; particularly, the perceived benefits and challenges. In addition, the study assessed the clients' awareness about similar services in the region, and their likelihood of using such alternative services, especially in the absence of the outreach programme. The study subjects consisted of HIV+ beneficiaries of the two delivery models, and the health workers involved in the process of CD4 cell count measurement. We conveniently sampled 4 health facilities offering CD4 count/ART within the outreach programme—two from each sub-region—for this component of the study.

Evaluation Findings

Service Uptake and Geographical coverage

Both the static and outreach models collectively delivered 0.59 CD4 cell count tests to each eligible client in the Acholi sub-region during the year reviewed. However, the number of tests delivered through the outreach model alone was 0.528, nearly 10 times higher than the number delivered through the static model (0.055). Even in a context of optimally functioning static laboratories, the outreach programme would have been far more effective in its reach. Because of data limitation, geographical coverage was assessed for only Acholi subregion. While nearly 2/3rd (65.4%) of the clients in the static programme lived just within 10 km of Gulu hospital, none of the beneficiaries of the outreach programme lived within the same distance. Therefore, the outreach programme had a larger geographical reach, extending coverage mainly to clients who would otherwise have had no or limited access to the services offered at the hospital. Therefore, the NUMAT CD4 outreach model was clearly far more effective and far more equitable in rolling out CD4 cell count test in Northern Uganda than the static model.

The cost of a single CD4 count test: which of the two models was cheaper?

In a context of a suboptimal outputs of the static laboratories, the cost of a CD4 cell count test delivered through the outreach model was found to be significantly lower than the cost of the same test provided through the static model. Calculations based on actual (observed) outputs from Acholi sub-region shows that a single CD4 cell count test in the outreach programme cost 31,500/=, compared to 72,093.62/=, the cost in the same test delivered through the static model in the same sub-region (Gulu hospital-based laboratory). If both static laboratories had performed optimally, the regional cost of providing a single test using the static delivery approach would have been 16,180.87/=, making the outreach model almost twice as costly instead. The cost of providing the test through the static model tended to fall with increase in output, as shown by the hypothetical cost at assumed higher volumes of output. On the other hand, the cost of providing the same test through the outreach model remained constant, irrespective of the volumes of output.

Average cost-effectiveness: which model was more worthwhile?

Cost-effectiveness was calculated per 100 registered clients. Calculations based on actual (observed) outputs from the Acholi sub-region shows that the outreach model was far more cost-effective in the sub-region than the static model. It cost 7,256,862.61 to provide the test

to each of 100 eligible clients once a year using the static model; it cost 3,150,131.79/= to do the same through the outreach model. In an ideal context of optimally functioning static laboratories, the reverse picture could be true, at a regional level; it would have cost 1,618,017.32 /= to provide a single test, once a year, to each of 100 eligible clients in northern Uganda through the static model, compared to 3,149,118.46/=, the cost of achieving the same through the outreach model.

Incremental cost-effectiveness ratio (ICER):
In Acholi Sub-region, the outreach model delivered 0.47 extra tests per person per year, relative to the static model. This was achieved at an extra cost of 1,264,142.14/= per 100 clients per year. Therefore, the outreach model incurred an additional 2,672,604.95/= to purchase each extra test for each of 100 clients in the sub-region per year. In the context of optimal performance of the static labs, the additional cost associated with each extra test per 100 clients in a year would have been 1.5 times higher

Cost-savings to patients
The outreach programme had additional economic benefits to its beneficiaries. By taking services closer to the clients, the outreach model saved the beneficiaries an estimated 50,000/= per client per test (i.e. 80% of the cost they would have incurred to get CD4 count tests from Gulu hospital).

Perception
The introduction of CD4 cell count measurement is believed to have resulted in the rational management of clients in both programmes. However, the outreach programme seemed to have boosted the confidence of peripheral health workers more in clinical decision-making, and has increased client uptake of prophylactic drugs. Nearly all the clients who were on ART in both programmes had reportedly been tested at least once in both models. However, it was not clear whether the introduction of the test had led to a reduction in the use of ART.

Challenges
The biggest challenges related to the outreach programme is the ceiling imposed on the number of test that can be performed per facility, leaving many eligible clients to miss out. This was compounded by the fact that the sample collection process was not fully integrated into the routines of the facilities. The collection team often arrived at, and departed from, some stations too early, leaving out and frustrating some clients who were given appointments for the day.

Conclusion
The NUMAT CD4 outreach model was clearly far more effective (four times more effective) and far more equitable in rolling out CD4 cell count test in Northern Uganda than the static model. Compared with a sub-optimally performing static laboratory, the outreach model was also economically far more attractive. However, the outreach model seemed economically less attractive when compared with static laboratories performing at their ideal capacities. Nevertheless, judgement of the values of the two programmes need to based first and foremost on the objectives of the national health system, which primarily is achieving universal access to quality (CD4 cell count-supported) ART services.

One critical success factor of the current NUMAT model is the presence of the PHA network, which needs to be taken into account, along with other organisational details, if the current achievements of the outreach model are to be replicated.

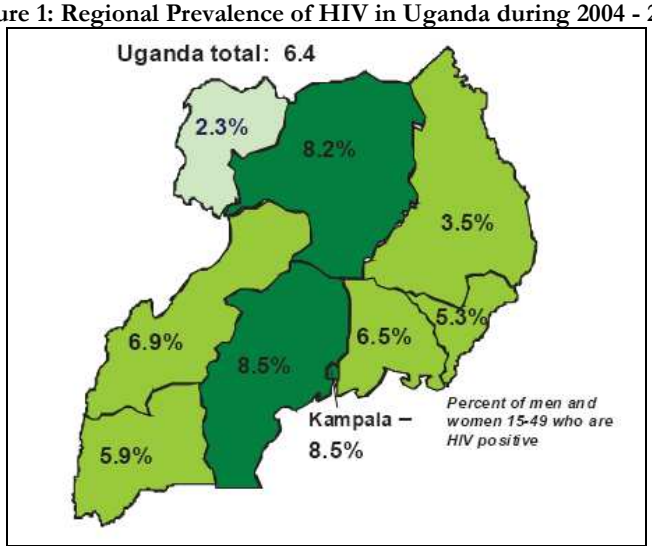
1 INTRODUCTON

1.1 The Burden of HIV/AIDS—in Uganda generally, and in Northern Uganda specifically

Following the occurrence of the first cases in 1982, the prevalence of HIV/AIDS in Uganda rose to a peak of 18% in the early 1990's. Although HIV/AIDS remains a severe disease in Uganda, the prevalence has since fallen to, but stagnated at, a low of 6.4%. Currently, over 1 million people are estimated to be infected with HIV, about 10% of whom are children [1-5].

There is regional variation in the distribution of HIV, with the prevalence in Acholi and Lango sub-regions being one of the highest in the country [1-4]. The prevalence of HIV/AIDS is also higher in men and in urban areas [1-3]

Figure 1: Regional Prevalence of HIV in Uganda during 2004 - 2005



Sources: [1, 3]

1.2 The specific challenge to the health system presented by the conflict in Northern Uganda

Until 2009, the Acholi and Lango Uganda sub-region has witnessed almost a decade of civil war, internally displacing a large section of the population. In Acholi subregion where the conflict was most intense, roughly 90% of the population are thought to have been displaced into internally displaced people's (IDP) camps by 2005 [6]. The civil strife is thought to be partially responsible for the high prevalence of HIV in the region [7]. The conflict further made it difficult to provide adequate services to all segments of the population [8]. Most notably, the IDP camps became the loci of service provision for the majority of the population. Consequently, accessibility to basic health services has been seriously inadequate and inequitable in the two sub-regions. Indeed Chamlia et al found that, during the period of conflict, VCT, PMTCT and ART services in Gulu were clustered mainly in urban areas, leaving most camps and rural areas lacking these services[8].

Because the significance of the IDP camps in service delivery, their closure has been a cause of concern among HIV-positive clients and providers of care alike, who fear that the decommissioning of the camps could result in further inaccessibility to ART, disruption in continuity of care and difficulty in monitoring treatment[9]

1.3 Policy framework and programmatic response to HIV/AIDS in Uganda

A Multi-sectoral Approach to Control of AIDS (MACA) was developed by the Uganda AIDS Commission (UAC) in 1993 to provide an overall framework to guide any national policy and programmatic response to the HIV/AIDS epidemic [10]. The Approach calls for the involvement of all stakeholders, from government to civil society organizations, and from individuals to groups.

In line with the MACA, many policies, plans and guidelines have been developed since, including the draft National AIDS Policy and National HIV&AIDS Strategic Plan (NSP) 2007/08-2011/12. Other specific policies/guidelines that have been developed in the framework of MACA include those for HCT, ART, PMTCT, OVC [3-5].

The NSP emphasizes universal access to an integrated HIV&AIDS prevention, care, treatment and social support services by 2012. More notably, there is emphasis on consolidating and scaling-up access to ART, to even rural health facilities[3-4].

1.4 The challenges associated with scaling up ART

Accordingly, there have been massive efforts to scale up ART in Uganda, alongside prevention, care and social support services [2-3]. ART was formally introduced into the public health system in Uganda about 6 years ago, and has since been progressively scaled up to even rural healthcare settings[2]. By 2009, over 350,000 people were estimated to be in need of ART, more than half of whom (180,973) were reported to be accessing ART already [4].

The National Guideline on ART recommends the initiation of ART only in those who are symptomatic and/or have evidence of significant immuno-suppression[4]. The ART guideline preferentially recommends the use CD4 cell count as the basis for initiating ART, except at facilities where such services are not available, where the WHO clinical staging is recommended instead[4]. Apart from guiding decisions as to whether and/or when to initiate ART, the CD4 cell count is also essential for monitoring the effectiveness of therapy. All HIV positive clients are expected to receive baseline CD4 count; and once therapy is initiated, the test is supposed to be repeated 6-monthly to monitor the effectiveness of ART[4].

Because of the human resource and other technical requirements associated with the administration of ART, the ART guideline recommends the roll-out of ART to HC IV and hospitals only. The human resource and technical constraints associated with CD4 cell count is greater, and so CD4 cell determination has been rolled out to regional referral facilities only. Hence most clients do not have access to laboratories for CD4 cell count determination. The situation has been more grave in the Acholi and Lango subregions because of the protracted civil strife.

Because of the limited accessibility to laboratories capable of performing the CD4 cell counts, ART is initiated presumptively at most clinics. Indeed late initiation of therapy, and the inability to monitor the efficacy and safety of ART in all settings, has been highlighted as some of the main challenges to the effective roll-out of ART[4]. This challenge has been felt the most in the Acholi and Lango subregions, and is set to become even greater with the dissolution of the IDP camps [9]

1.5 The NUMAT project: background, objectives, and scope of activities

The Northern Uganda Malaria, AIDS and TB (NUMAT) Project was designed to respond to the unique situation in Northern Uganda, in supporting expansion of access to and utilization of HIV & AIDS, TB and malaria activities in the region—specifically in the districts of the Acholi sub-region (Gulu, Pader, Amuru, and Kitgum) and the Lango sub-region (Lira, Amolatar, Dokolo, Apac, and Oyam).

The project aimed to improve the coordination of responses to the HIV/AIDS, malaria and TB diseases; and to increase access to, and the utilization of the full continuum of these services.

In order to increase access to ART (and other HIV/AIDS services) to the rural population in the region, the NUMAT project supports the provision of those services to a total of 33 health facilities in the region, comprising HC III, and HC IV and hospitals. In addition, the project adopted, and has been pioneering an outreach delivery model that allows clients in the peripheral facilities to have access to laboratories for CD4 count determination.

1.6 The NUMAT outreach delivery model—the evaluand

The NUMAT outreach approach is a form of tri-partite, public-private partnership, involving NUMAT as the funder, the district-based health facilities providing ART, and private third-party laboratories. Health workers at the designated, rural-based health facilities mobilize the clients to report for sample collection, and other services. Samples are collected fortnightly by CYNAPSIS, a private laboratory, from eligible clients in both sub-regions. The samples from Lango sub-region are tested at CYNAPSIS laboratories while those from the Acholi sub-region are tested at the Joint Clinical Research Centre (JCRC), another private laboratory based at Gulu regional referral hospital. CYNAPSIS delivers results from both laboratories to the respective facilities, and to NUMAT headquarters. The latter pays CYNAPSIS a collection and testing fee for every sample, based on an invoice specifying the number of samples and tests done from each sub-region.

1.7 The conventional model CD4 cell count determination—the base case

Traditionally, CD4 cell count determination is (supposed to be) undertaken at facilities offering ART. As aforementioned, these services are currently available at a few facilities only. As far as the public health system goes, CD4 cell determination has so far been rolled out to the level of regional referral hospitals (serving a number of districts), yet ART provision has been rolled-out further down up to sub district levels. In the NUMAT programme area, the public facilities for CD4 count determination are located at Gulu

regional referral hospital (covering Acholi sub-region) and at Lira regional referral hospital (covering Lango sub-region). Hence clients needing this service from the two sub-regions are expected to travel these facilities for the test.

2 THE PROPOSED EVALUATION

The NUMAT project is in its fifth year of implementation, and comes to an end in August 2010. The project management would like to compare the performance of the outreach model with the traditional approach, with a view of understanding the potentials for sustainability. The evaluation aims to compare the NUMAT outreach model with the conventional, referral-hospital-based model of CD4 cell count. The primary objective of the evaluation was to compare the two models on the basis of their cost-effectiveness.

2.1 Scope or TOR of the evaluation

The consultants were given seven TOR, which essentially was to compare the two delivery approaches along seven variables described below:

1. *Coverage/Reach/access/equity of services:* to compare accessibility to services for CD4 cell count measureent, by the intended beneficiaries, in the context of the two models; in particular to measure the level of service uptake and geographical coverage of the two delivery models
2. *User Retention (drop-out) Rate:* to measure and compare the extent of user drop-out over time (the number of clients who are up-to-date with their follow-up CD4 cell count)
3. *Client and Health workers' Satisfaction:* to describe the perception of clients and health workers regarding the two models of CD4-testing service delivery
4. *Provider Cost:* to estimate and compare the average cost to the funders of each delivery model, of activities associated with CD4 cell count determination;
5. *Cost-effectiveness:* to determine which of the two delivery models is more cost-effective, and to estimate the incremental (added) cost of adopting the NUMAT outreach model over the traditional model
6. *Client Cost (Cost-saving).* To measure and compare the average cost to the client, of accessing the laboratories for CD4 cell count determination in the context of the two models
7. *Lessons learnt:* to describe any lessons learnt, in terms of the challenges related to the achievement of objectives, impact, sustainability of the project and operational issues.

3 METHODOLOGY

3.1 Variables and Measurement

Although comparison of the two delivery models was supposed to be made along 7 variables, the two models were compared along 6 variables instead. Table 1 below gives a summary of how the main variables were measured, the methods of data collection, and the sources of data.

Table 1: Summary of Variables, Data Sources and Methods of Data Collection

Variable	Indicator	Data Collection Methods	Data Source
Coverage (Programme reach)	***Service uptake / Population reach*** The number of tests per client per year	Document Review	a) PHA network database* b) Clients' register at the referral hospital
	Geographical coverage a) Average distance from the designated referral laboratory in the region b) Proportion of clients within 5 km of the referral facility ***c)*** Proportion of clients within 10km of the referral facility	Document Review	a) PHA network database* b) Clients' register at referral the hospital c) Map of Uganda (showing locations of health facilities and distance from referral hospital in km)
Cost to the funder	a) Ave cost/test (intermediate measure)	a) Document Reviews	a) Invoices to NUMAT b) Audited books of accounts from the Gulu & Lira Hosp. c) Inventory books d) Physical inspection and measurement of space and equipment Key Informants (lab. Technicians, administrators
Cost-effectiveness	***Effectiveness parameter*** Proportion of eligible clients who received a test at least once/year (or the number of tests per capita/year	Document Review	a) PHA network database* b) Clients' register at the referral hospital c) Invoices to NUMAT
	Cost-effectiveness ratios a) Average cost-effectiveness ratio (ACER) b) Incremental cost-effectiveness ratio (ICER)	a) Document Reviews b) Observations c) KI interview to clarify	a) Invoices to NUMAT b) Audited books of accounts from the Gulu & Lira Hosp. c) Inventory books d) Physical inspection and measurement of space and equipment e) Key Informants (lab. Technicians, administrators)
Cost and cost-saving to clients	a) The total cost incurred if all clients (including those in the outreach programme) received CD4 count test at the designated referral hospital b) Excess cost or cost-saving to a client in the outreach programme	a) Interviews b) Document Reviews	a) Health workers, clients and a Key Informants at NUMAT head office b) Map of Uganda (showing locations of health facilities and distance from referral hospitals in km)
Client and Providers' Satisfaction	Perceived benefits/disadvantages of both models by the clients and the health workers	a) Clients b) Health Providers	In-depth discussions and Focus Group discussions

*****from the facilities where NUMAT is operational

The quality of the data available could not support a quantitative analysis of the second objective (the degree of clients' compliance with repeat/follow-up tests). Nevertheless, a qualitative assessment of the perceived adequacy of follow-up tests was captured during the perception study.

3.2 Measuring Coverage (Programme Reach)

In the context of this evaluation, 'coverage' describes the extent to which the models under evaluation reached the intended targets. It was assumed that both of the models targeted the same pool of potential beneficiaries. Therefore, the word "coverage" is used here synonymously with "programme reach".

The study used two indicators to measure the coverage/programme reach of the two models:

a) the number of tests delivered to each eligible client in a year through either of the two delivery models, otherwise referred to as *service intake or population reach.*
b) the average distance between the designated static laboratories and the addresses of the beneficiaries in either delivery model, also referred to as *geographical coverage or accessibility.*

3.2.1 Service Uptake (Population reach)

Service uptake was measured with respect to HIV+ clients registered in the programme area (Acholi and Lango sub-region). The clients were those described as having received at least one clinical care. A clinical care consisted of any clinical act, including counselling, routine prophylactic treatment and ART. Relevant datasets were obtained from the register of PHA network, an association of people living with HIV/AIDS (PHA) found in the entire operational areas of NUMAT. Obviously, not all PHA in the region were registered in the PHA network registers. However, the registers provided the most reliable and quickly accessible data regarding the total number of HIV positive people in the region under study (in Acholi and Lango sub-regions).

We assumed that each registered client qualified for a CD4 count test, at least once. We divided the total number of tests administered through each model, with the total number of eligible clients. The numerator included all CD4 count tests, irrespective of purpose. That is, we included, in the numerator, tests done on

a) clients in preparation for ART
b) clients who were already on ART, but who were still sick and needed help in planning clinical care
c) clients were already on ART, but who had never been tested for CD4 count before
d) clients who were already on ART and in need of a follow-up test
e) Pregnant mothers

The data for the NUMAT programme were extracted from the invoices submitted to NUMAT by CYNAPSIS. The number of tests done in the hospitals was extracted from the respective outpatient registeres.

3.2.2 Geographical accessibility or reach

Geographical accessibility was measured as the average distance, from the beneficiaries' location, to the regional referral hospital in the sub-region. The decision to measure distance

from the clients' addresses to the referral hospitals stems from the logic that, in the absence of the outreach model, all the clients in the sub-region would have been expected to travel to those hospitals for CD4 count determination. Therefore, this measure is also an indication of the *geographical reach* of each approach.

For clients tested through the outreach programme, the facilities from which they were tested were considered to be their addresses. For the static model, clients' actual addresses were used; however, these were available at Gulu hospital only.

The geographical reach of the outreach programme was measured by means of a map (of the Northern Uganda) showing the location of the various health facilities in the sub-region, and the distance between major towns/trading centres[1].

Therefore, in the context of the outreach programme, geographical reach implies the distance the beneficiaries in the outreach programme would have been required to travel if they had to seek the test in question from the designated laboratories. For the clients tested through the static model, geographical reach refers to the actual distance travelled by the clients to the referral facilities.

3.3 Measuring Cost-Effectiveness

Cost-effectiveness was computed using three basic steps. The first was to calculate the average cost of delivering a single CD4 count test using each model. The second was to compute the degree of effectiveness for each model. The third step was to compute cost-effectiveness ratios for each model.

3.3.1 Measuring the cost of a CD4 count test

Perspective, Method and Scope

Cost was determined from the perspective of NUMAT and the Ministry of Health—as funders of the alternative models.

Incremental costing, rather full costing, was undertaken. Incremental costing only focuses on the analysis of additional costs (increments), cost that are directly or indirectly associated with the introduction of a new service into the existing system—in this case the introduction of CD4 cell count measurement into the existing HIV/AIDS related services. Incremental costing methods would normally exclude costs that would nevertheless be incurred in the absence of the new programme.

Time Horizon

Initially, the study intended to capture cost and outputs of the two delivery approaches over a 5–year period. The aim was to provide a trend, and an average, of cost and effectiveness spanning a wider time horizon[2]. However, the performance of the hospital-based laboratories was erratic because of frequent equipment breakdowns, except for the financial year 2008/09. Besides, at the time of the study, the NUMAT programme had run for only 1 – 2 years in most areas. Therefore, there was insufficient data to support an analysis that

[1] Nelles Map (Uganda), Camerapix Publishers International, Nairobi (sales@camerapix.co.uk)
[2] The cost and effectiveness of a programme may vary inversely as time progresses

covers a longer time horizon. The analysis was therefore based on the 2008/09 financial year. The NUMAT financial year ran from October 2008 to September 2009; the Government financial year ran from July 2008 to June 2009. The performance of the Gulu hospital-based CD4 laboratory was intermittent even during 2008/09 financial year; however, we were able to capture output over 9 successive months. The annual output for the financial year was then extrapolated from the monthly average[3] calculated over the 9 months period.

Measuring the cost of a CD4 count test in the outreach model

The NUMAT outreach programme was implemented by a private contractor, which charged a fee per client, consisting of a collection fee and a testing fee for each sample. Therefore, the average cost (per test) was extracted from the invoices submitted by the contractor (CYNAPSIS) to NUMAT. It is presumed that the fees charged fully captured the cost of all the activities/inputs associated with the whole process of getting a client tested, including maintenance and depreciation costs.

Measuring the cost of a CD4 count test in the static model

Costing the conventional, hospital-based approach entailed identifying, quantifying and monetising the various inputs used in the process of CD4 count determination. A mixture of bottom-up (ingredient) and top-down approaches was applied. Ingredient costing involved identifying, quantifying and valuing specific resource inputs used in providing the test to each client. Examples of resources costed as such include the testing kits and related medical sundries (such as gloves and cotton wools), and staff time. Staff time was captured where the CD4 laboratories had staff dedicated specifically for the test, or where existing staff had to divert their time away from other routine activities to CD4 count-related tasks.

Top-down costing was undertaken where CD4 count related costs were incurred at other departments (e.g. administration, and other clinical support departments); or where costs were incurred at the level of CD4 laboratories, but, because of the accounting procedures, were reflected as overhead (administrative) costs. Such expenditures were normally shared between different departments. Therefore, global expenditures were extracted from records and then appropriate shares were allocated (stepped-down) to the CD4 laboratories using appropriate allocation statistics as described below. Where resources were used for more than one activity (e.g. to perform other laboratory examinations, ARV delivery, TB-related activities, etc) the share attributable to CD4 level determination was apportioned using appropriate allocation statistics.

Identifying, quantifying and valuing various inputs

a) Personnel cost

Personnel cost consisted of salaries and, where applicable, the monetary values of all fringe benefits. There were no records of any allowances paid for CD4 count determination, or for shared activities. Salaries were considered for staff fully dedicated to the CD4 laboratory; or for staff normally working in other centres (e.g. outpatients department, main laboratories) but who were also involved in tasks associated with CD4 count determination. In such cases, the value of their time dedicated to CD4 count determination was considered if the latter activities were deemed to have diverted the staff away from the other activities in the

[3] There wasn't wide variation in the monthly outputs during the time when the laboratory was functional

relevant departments. Information regarding shared staff time was obtained by interviewing. The actual amount of time dedicated to CD4 count-related activities was estimated by way of a time-motion questionnaire completed by the relevant staff. The time motion questionnaire administered covered a period of one month. We assumed that the schedule of work and the motion pattern for the month during which the study was conducted was, on average, the same for all the months of the year under review, since there were no reported major changes in schedule. Volunteer time (especially those involved in counselling and sample selection) was valued at the local market rates for nursing assistants. Where the staff were provided accommodation on top of their salaries, the local rental rates were applied[4]

b) Fixed Assets (Equipment and Buildings)

All fixed assets (with economical lifespan of more than one year) used for service delivery in the CD4 laboratory and in the ancillary centres (OPD and main laboratory) during the period under study were considered as part of the direct costs for those cost centres. Those which came into use after the study period (such as new equipment and buildings) were excluded. Assets were included if they were acquired solely for CD4 count determination; or where CD4 count measurement was one of a number of activities for which the asset was acquired. Assets were considered for costing if they were not for resale.

To obtain the actual value of a fixed asset used for the period of study, its current replacement value was annualized using standard annualisation tables at an interest rate of 3% to allow for comparison with other costing studies. Only annualized costs were used in the cost analysis to compute the annual contribution of each asset to CD4 count determination in the year under study. Permanent buildings were assumed to have a useful life span of thirty (30) years. Vehicles and small medical and non medical equipment were assumed to have a useful life of five (5) years. CD4 count machine were assumed to have a useful life of ten (10) years.

The replacement value for buildings was obtained by multiplying the ground area of the buildings with the unit cost of building a square metre of concrete structure in that area. Most of the buildings in the studied units had standard architectural plans and so their ground areas could easily be obtained. For those whose plans we could not obtain from the management, their ground areas were physically measured by the research team. The unit cost of constructing buildings in each area was obtained from the Government/ Ministry of Health Infrastructure Division. It was estimated to be Uganda Shillings 1,000,000/m^2 for storey houses, 860,000/m^2 for ordinary houses. The replacement cost for a brick fences was estimated at Shs 50,000/m^2 (Average Exchange rate was 1820/USD).

For other fixed assets like furniture and electronics, the inventories were first updated. The replacement values of each asset were determined basing on prevailing market prices and rates stipulated by either the Ministry of Health's National Advisory Committee on Medical Equipment (NACME), or by use of National Medical Store (NMS) and Joint Medical Store (JMS) equipment price catalogues of 2009 and local market rates in accordance to Shepard and colleagues [11].

[4] A 3-bedroom house for a staff on a salary scale of U1 to U3; a 2-bedroom house for one on scale of U4-U6; a 1-bedroom house for one on a scale of U7 and below

We did not come across any donated assets that were used for CD4 count determination.

c) Medical Supplies (testing kits, syringes, gloves, safety boxes, etc)
The number of testing kits and gloves was estimated from the number of tests administered. The health workers reportedly used one pair of gloves during each of the processes requiring gloving of the hands. The number of safety boxes used was computed from the volume of the common boxes and the number (volume) of the common syringes/vacutainers used. The values of the supplies consumed was calculated using the *National or Joint Medical Stores Catalogue and Price Indicator, 2008/09*.

d) Maintenance, Utilities and Other Supplies
The costs of utilities (cleaning, water, electricity, telephone and currier), fuel, lubricants, stationery and maintenance were obtained from final accounts and assigned to the administration because it was difficult to determine the consumption of individual service units. The costs of utilities, maintenance and other supplies allocated to the main laboratory by a factor of 3%, based on previous studies [12-13].

The cost of maintaining medical equipment other than the CD4 equipment was obtained and allocated to the main laboratory in a similar manner.

e) Start-up costs
We set off to include the cost of start-up activities, such as training, planning meetings, and social mobilization for the static laboratories. Start-up costs were supposed to be annualised. However, such costs were thought to be negligible and were excluded.

Calculating the total cost of CD4 laboratories—considering various combination of inputs
The total cost associated with CD4 determination during the year was computed for various input combinations[5]—firstly for various combinations of *direct* inputs only and, secondly for various combinations of both *direct* and *indirect/overhead* inputs. Direct costs refer to costs that were attributed to resource usage *within* the CD4 laboratories. They consist of the cost of the test kits and related supplies, the cost of personnel and maintenance. Overhead/indirect costs consist of costs incurred at the level of administration or clinical support services, but which are partially dependent on the outputs in the CD4 laboratories. Examples include the cost of cleaning, the cost of utilities (water and electricity), and the cost of maintaining medical equipment other than the CD4 machines themselves (e.g. fridges).

5 Apart from the perspective of the study, the cost of a given intervention depends on the range of inputs included in the calculation,

Table 2: Description of Cost Inputs Associated with the Static CD4 cell Count Laboaratories

ONLY DIRECT COST INPUTS INCLUDED	
a	***Direct Cost - laboratory consumables only*** e.g. the cost of test kits, gloves, cotton wool, antiseptic, etc)
b	***Direct Cost - all recurrent cost***: included the cost of all consumables ((a) above); the cost of personnel (involved in the process of carrying out CD4 tests, from sample collection in the OPD to actual testing in the CD4 laboratories); and the cost of maintaining the CD4 test machines.
c	***Direct cost - all recurrent and equipment depreciation*** (CD4 laboratory): included (a) and (b) above and the annualised cost of the CD4 test machines. We assumed a constant depreciation rate, whether the equipment was used optimally or not.
d	***Total direct cost:*** comprising the cost of all inputs consumed at the level of the CD4 laboratory. In addition to all the above, it included the annualised cost of the laboratory building.
BOTH DIRECT & OVERHEAD COST INPUTS INCLUDED	
e	***Total recurrent cost of the CD4 laboratory*** (direct and overhead recurrent costs): this included all the recurrent costs incurred at the level of the CD4 laboratory ((b) above) and the recurrent costs allocated from overhead centres (cost of cleaning, equipment maintenance and utilities). The overhead recurrent cost represents costs relevant to the CD4 laboratory, but which were incurred/captured at the overhead centres. The recurrent overhead costs allocated to the CD4 laboratory include the cost of utilities, cleaning and medical equipment maintenance (other than the CD4 test machines themselves). *Therefore, the total recurrent cost represents the true operational costs of the CD4 laboratory*; being indicative of the short-term sustainability potential of the static model.
f	***Total incremental cost of the CD4 laboratory***: this scenario included the total recurrent cost of the CD4 laboratory ((e) above), and the annualised cost of assets at the level of the CD4 laboratories (CD4 machines and buildings). *Realistically speaking, this is the scenario that represents the full cost of the test*, because it includes costs that can only be attributed to the introduction of the CD4 laboratory. It excludes recurrent and depreciation costs that would nevertheless have been incurred if the CD4 laboratories had not been established in the hospitals in question. It was prudent to include the cost of buildings (of the CD4 laboratories) in this scenario because the CD4 laboratories operate in rooms dedicated solely for such purposes.
g	***Total (full) cost of the CD4 laboratory*** represents the cost when all overhead costs are allocated to the direct costs of the CD4 laboratory, including costs that would, arguably have been incurred in the absence of the CD4 laboratories.

Calculating the total cost of CD4 laboratories—considering varying operational capacities

We also computed the total cost of the static CD4 laboratories with respect to the prevailing operational capacity of the CD4 laboratories; in addition, we calculated the "would-be" costs of the respective laboratories, assuming optimal levels of performance. For the purpose of this presentation, the former scenario is referred to as the *observed cost*, while the latter, the *expected cost*. In Gulu referral hospital, the reported number of tests done was far below par; therefore, the "observed cost" in Gulu hospital refers to the cost calculated as per the actual suboptimal (26%) level of operation. The number of tests reported in Lira hospital during 2008/09 was the same as (or nearly exceeded) the expected/optimal level. Therefore, the observed total cost of the CD4 laboratory in Lira hospital was considered to be the same as the expected total cost.

Thus in addition to considering various input combinations, we computed the following cost scenarios corresponding to the different operational capacities of the CD4 laboratories in the region.

Table 3: Description of Various Cost Scenarios in the Static delivery Model

Gulu regional referral Hospital
1. Observed cost: the cost calculated in relation to the actual number of tests carried out in Gulu hospital during 2008/09.
2. Expected cost: the estimated cost per test if the CD4 laboratory operated at the optimal capacity (10 tests per day, per 4 days per week)
Lira regional referral hospital
3. Observed cost: the cost calculated in relation to the actual number of tests carried out in Lira hospital during 2008/09. It is noteworthy that the CD4 laboratory in Lira hospital operated at the optimal level, each time the machine was functional. Therefore, the 'observed' cost is also the 'expected' cost.
Overall cost of both static laboratories in the region
4. Observed cost: the average cost, considering the actual combined coverage of both regional referral hospitals during 2008/09
5. Expected: the average cost considering the combined coverage of the two referral hospital, if Gulu hospital CD4 laboratory had operated at an optimal level as well.

Calculating the average cost of the CD4 laboratories

Average costs were calculated by dividing the total cost associated with CD4 count measurement during the year under review, by the total number of tests performed during the year. Accordingly, various average cost scenarios were generated.

3.3.2 Deriving the Cost-Effectiveness of the Two Models

In order to portray the true benefits of the two models we calculated two types of cost-effectiveness ratios—average cost-effectiveness ratio (ACER) and incremental cost-effectiveness ratio (ICER).

Computing average cost-effectiveness ratios (ACER) of the two models

Average cost-effectiveness ratio (ACER) is a measure of value for money. It was calculated by dividing the total cost of each model with the effectiveness (or outcome) achieved by the respective model.

We chose service uptake (population reach) achieved by each model as a measure of effectiveness. Hence effectiveness was defined as the number of the average number of times a registered client received the CD4 cell count test during the year reviewed. Therefore, the ACER calculated gives the cost of testing a client once in a year. We computed ACERs associated with the static models with respect to the observed coverage in Acholi sub-region and the expected coverage in both sub-regions.

Computing incremental cost-effectiveness (ICER) of the Outreach model

Incremental cost-effectiveness analysis was done by dividing the difference in cost of the two models, by the difference in their effectiveness (coverage). Differences were computed using the static model as the base case.

Thus ICER was defined,

$$\text{ICER (outreach)} = \frac{\text{cost of the outreach programme} - \text{cost of the static model}}{\text{Service uptake in the outreach programme} - \text{Service uptake coverage of the static model}}$$

Incremental cost-effectiveness was analysed under the presumption that the cost of the outreach model covered the full range of the cost suffered by the implementers of the model.

3.4 Measuring Client Cost and Cost-Savings

This study aimed to measure the cost saving to a client in the outreach programme. It was assumed that the outreach programme resulted in increased geographical accessibility to CD4 laboratories, thereby reducing the cost of seeking those services. Thus we calculated the healthcare-seeking cost to a beneficiary of the static laboratory. In addition, we calculated the healthcare-seeking cost a beneficiary of the outreach programme would have incurred if s/he were to seek the same services at the designated referral hospital. The amount of cost-saving was calculated as the difference between the cost incurred by the beneficiary of the static model and the would-be cost to the beneficiary of the outreach model, if s/he had travelled to the regional laboratory for the same test.

In each sub-region, we selected 2 health centres, one located at about 20 km from the static laboratory, and the other at 60 – 70 km from the same referral hospital in the region. The distances corresponded to the average geographical reach of the static and outreach models respectively (refer to measurement of geographical reach in the results section). From each sampled health facility, we asked both the clients and the health workers to estimate the cost of travelling the stated distances above, the waiting time at the regional facilities (in relation to CD4 count test), and the cost of an average meal and accommodation, where applicable.

We put the same questions to the key informant at NUMAT head office regarding a client located at the average geographical reach of the static (17 km) and outreach (65 km) models.

There was agreement between all informants, on the out-of-pocket expenditures on different items costed. A daily wage rate of 2000/= was applied to the productivity time lost in seeking care.

3.5 Clients' Perception, Challenges, Lessons Learnt

A qualitative assessment was made of the clients' perception of the two programmes. The 'clients' consisted of HIV+ beneficiaries of the two delivery models, the health workers working in the clinics, the "expert clients", and the laboratory technicians. Expert clients consisted of HIV+ patients who were trained to offer clinical and administrative support services along the established staff of the facilities. As already stated, we chose 4 health facilities offering CD4 count/ART within the outreach programme—two from each sub-region. Three of the facilities within the outreach programme were health centres, of referral level III (HC III), and one was a hospital. From each sub-region, we sampled a facility located about 20 km of the referral facility, and the other, 60 – 70 km away. The facilities were sampled conveniently, basing on the clinic days and logistical considerations. In addition, both referral hospitals were also purposefully included in the samples.

In most cases, we conducted in-depth discussions with individual clients. In some circumstances, we conducted focused group discussions with some of the health workers and expert clients, and individual discussions with other health workers or clients. The mode of data collection was dictated by the availability of the study participants.

The study subjects were asked about their general perception of the two delivery approaches, in particular their perceived benefits and challenges. In addition, the study sought to establish the clients' awareness of similar services in the region, their likelihood of using such alternative services, especially in the absence of the outreach programme.

4 EVALUATION FINDINGS

4.1 General Information on performance of the static models

The number of tests expected from Gulu-based static CD4 laboratory during 2080/09 was 2080, if the laboratory had performed at the expected capacity of 10 tests per day, in 4 days/week, in 52 weeks/year. However, only 541 tests were done in this laboratory during the year, thus, performing at only 26% of the expected capacity during the year under review. This figure (541 tests) was extrapolated from data collected over 9 consecutive months during which the machine was in normal operations[6]. Therefore, the figure represents a normal operational capacity of the laboratory during the period—a capacity not directly constrained by equipment breakdown.

The Lira hospital, the CD4 cell count machine was reported to have last worked during the 2004/05 financial year. During 2009, samples were collected from registered clients at the hospital, but were transported and tested at the JCRC laboratory in Gulu. Therefore, the delivery model implemented at Lira hospital during the review period was sort of a hybrid between the traditional and the outreach models. The total number of samples (2595 samples) tested during this period corresponded to the annual optimal output—the number of tests expected if the laboratory had operated at its recommended capacity, without any constraints. Therefore, the coverage reported for the Lira-based laboratory represents what would have been expected in a more ideal context.

Therefore, the study presents the *actual* performance of the static laboratories with respect to the Acholi sub-region only. However, it also describes the would-be (*expected*) performance of the both laboratories in an ideal context. Consequently, in the following sections, we compare the two models at two levels:

a) The *actual* performance of the static laboratory in Gulu hospital with that of the outreach model in Acholi sub-region.
b) The *expected* performance of both static laboratories (in Gulu and Lira hospitals) with the overall performance of the outreach model in the entire northern region

4.2 Coverage of the Static and Outreach Model

The study used two indicators to measure the coverage/programme reach of the two models:

a) the number of tests delivered to each eligible client through either of the two delivery models, otherwise referred to as *service intake or population reach.*
b) the average distance between the designated static laboratories and the addresses of the beneficiaries in either delivery model, also referred to as *geographical coverage or accessibility.*

4.2.1 Service intake (population reach)

Table 4 below shows the per capita number of CD4 cell count tests delivered through each of the models evaluated during the review period. As previously explained, the table compares the actual performance of the static laboratory in the Acholi sub-region with that

[6] As mentioned before, there wasn't much variation in the monthly number of tests done during the period observed

of the outreach model in the same sub-region. It also compares the ideal outputs that could have been achieved through the static model in the entire northern region, with the overall achievement (output) of the outreach model in the entire northern region.

Table 4: Proportion of the Eligible Clients Tested in the Static and Outreach Model

PARAMETERS	Acholi	Lango	Total
NUMBER OF ELIGIBLE CLIENTS*	9778	19442	29220
NUMBER OF TESTS DONE			
Outreach model	5163	6697	11860
Static model			
Observed	541	-	-
Expected (ideal context)	2080	2595	4675
POPULATION COVERAGE (No of tests per eligible client per year)			
Outreach model	0.53	0.34	0.41
Static model			
Observed	0.06	-	-
Expected (ideal context)	0.21	0.13	0.16

**Source = PHA network register*

The table shows that, on average, both the static model and the outreach model collectively delivered 0.59 CD4 cell count tests to each eligible client in the Acholi sub-region during the year reviewed. However, the number of tests delivered through the outreach model alone was 0.528, nearly 10 times higher than the number delivered through the static model (0.055).

If both static laboratories had performed to their expected optimum capacities, they would have collectively delivered the test 0.16 times to each client in the entire region (0.21 per capita in Acholi and 0.13 per capita in Lango). The outreach model could have delivered an average of 0.41 tests per client per year in the entire northern region (0.528 tests/client/year in Acholi; and 0.34 tests/client/year in Lango). Therefore, even if both static laboratories had performed to their best capacities, the number of tests delivered through the outreach model in the entire northern region would have still been 2.5 times higher.

4.2.2 Geographical accessibility or geographical reach

Geographical coverage or reach was measured by means of two indicators, namely

a) the average distance covered by each delivery model, measured from one reference point (the referral CD4 laboratory in the sub-region), and
b) the proportion of each group of beneficiaries within walking distance (5km and 10km) of the same reference point (the referral CD4 laboratory in the sub-region).

The respective static laboratories were used as the reference points on the premise that the all beneficiaries would have been expected to use those laboratories in the absence of the outreach or/and other programmes. Table 5 below summarises the geographical reach of each model, in terms of the distance covered and the proportion of the respective beneficiaries who are near the referral laboratories. As stated before, client addresses were not available for Lira hospital.

Table 5: Clients' Location from the Referral Hospital in the Region

	ACHOLI SUB-REGION		LANGO SUBREGION		Overall geographical accessibility of the outreach model,
	Static model	Outreach model	Static model	Outreach model	
Mean distance of clients' location from referral Hospital (km) in the sub-region	17	68	-	63	65
Proportion of tested clients living within 5 KM of the referral hospital in the region	53.8%	0%	-	0%	0%
Proportion tested clients living within 10 KM of the referral hospital in the region	65.4%	0%	-	0%	0%

The table shows that, in Acholi sub-region, the clients tested at Gulu referral hospital typically lived 17 km away; on the other hand, the outreach programme covered clients located farther away, typically 68 km from Gulu hospital. Furthermore, while nearly 2/3rd (65.4%) of the clients from Gulu hospital lived just within 10 km of the hospital, none of the beneficiaries of the outreach programme lived within the same distance. Therefore, the outreach programme had a larger geographical reach, extending coverage mainly to clients who would otherwise have had no or limited access to the services offered at the hospital.

4.3 Average Cost of a CD4 Cell Count Test

We computed the average cost of a single CD4 count test in each of the delivery models. The cost of the static model was captured, and is presented, by its constituent inputs; while that of the outreach approach was available by activities types, rather than by input types[7]. Hence it is not possible to compare the two models, inputs with inputs, to identify the major cost-driving inputs. In any case, this level of comparison was outside the scope of this study.

4.3.1 The cost of a test in the outreach model

Table 6 shows the unit cost of the NUMAT outreach programme.

Table 6: The Average Cost (UGX) of a Single CD4 Cell Count -- Outreach Model

DESCRIPTION	RATE UGX)
Samples collection fee	20,000
Charge per CD4 test	11,500
Total average cost (charge per test)	**31,500**

The table shows that it cost NUMAT 31,500/= for each CD4 count test administered to a client under the outreach model; 63.5% of which was the cost of collection. This cost reportedly covers the full range of costs suffered by the contractors, including the cost of inventory management, the cost of maintenance and depreciation of assets, and a profit margin.

4.3.2 The cost of a test in the static model

For the static model, we computed cost as per the prevailing operational capacity of the CD4 laboratory in Gulu hospital (Acholi sub-region). In addition, we calculated the "would-be"

[7] The cost data for the outreach programme were not disaggregated by inputs.

unit costs of the respective laboratories, if they all had operated at the expected optimal levels. For the purpose of this presentation, the former scenario is referred to as the *observed cost*, while the latter, the *expected cost*.

The consultants computed various cost scenarios for the static model, representing various combinations of inputs considered. Having different cost scenarios allows policy makers and readers to compare our results with other cost estimates that may have included different input combinations. In addition, the different cost scenarios have different policy/sustainability implications. Table 7 describes the different cost scenarios for the static model.

Table 7: The Average Cost per CD4 cell count Test in a Static Model, by Different Inputs Combinations

		GULU regional hospital		LIRA regional hospital	Overall cost of the static model
		Observed cost	Expected cost	Expected cost	Expected cost
DIRECT COST INPUTS ONLY		1	2	3	4
a	Laboratory consumables only	4,689.42	4,689.42	3,758.77	4,172.83
b	Total recurrent cost *(consumables +personnel+ maintenance)*	35,911.70	12,810.22	7,982.27	10,130.32
c	Total recurrent+equipment depreciation cost	55,935.98	18,018.46	12,262.04	14,823.18
d	Total direct cost *(consumables+personnel+equi+buildings)*	55,976.92	18,059.39	12,352.02	14,891.34
DIRECT & OVERHEAD COST INPUTS					
e	Recurrent costs only *(direct: consumables, personnel; OH: cleaning, utilities, transport)*	52,072.83	17,013.66	11,490.78	13,948.02
f	Total direct cost + recurrent overhead cost	72,138.04	21,919.93	11,580.77	16,180.87
g	Full cost: all relevant inputs included	91,938.90	27,412.96	20,208.19	23,413.74

4.3.3 Which of the two models is cheaper?

The input scenario chosen the as the appropriate comparator

To be able to appropriately compare the costs of the two approaches, one needs to know the range of costs included in the outreach model. It was assumed that the cost suffered by NUMAT to fund the outreach programme covered the full range of activities and inputs associated with its implementation, including any profit margin. Basing on this assumption, therefore, the total incremental cost (scenario (f)) is the appropriate comparator for the outreach model.

From this point onwards, the cost and cost-effectiveness measures associated with the outreach model will be compared with the equivalent measures derived from the total incremental cost of the static model.

Observed and expected scenarios

Because the two static CD4 laboratories evaluated are currently designated to serve the whole of the Northern region (Acholi and Lango sub-regions), just as the NUMAT outreach programme does, it is desirable to compare economic performance of the two models at the level of the whole northern region. As afore mentioned, actual the cost and cost-effectiveness measures associated the static model were computed for the Acholi sub-region

only. In Lango sub-region, actual cost and cost-effectiveness measures could not be computed for the static model due to data limitation. Therefore, the study compares the region-wide economic performance of the outreach model with the would-be, region-wide economic performance of the static laboratories, assuming an optimal operational capacity of the latter. The relevant findings are summarised in Table 8 below.

Table 8: The Observed and Expected Costs (UGX) of the Static Model Compared with the Cost of the Outreach Model during 2008/09

1	**Performance in Acholi sub-region**	**Total Cost**	**Output (no of tests)**	**Ave. Cost per Test**
a	Static (Gulu Hospital only) based on actual outputs	39,026,681.43	541	72,093.62
b	Outreach (based on actual outputs)	162,634,500.00	5,163	31,500.00
2	**Region-wide performance (both sub-regions)**			
a	Both Static Labs. (Gulu & Lira referral hospitals), based on ideal outputs	75,645,545.80	4675	16,180.87
b	Outreach (both sub-regions), actual outputs	373,590,000.00	11,860	31,500.00

Calculations based on the actual (observed) outputs from Acholi sub-region shows that a single test in the outreach programme cost less than ½ the cost in the static (Gulu hospital-based) laboratory in the sub-region (31,500/=, compared to 72,093.62/=). If both static laboratories had performed optimally, the regional cost of providing a single test using the static delivery approach would have been 16,180.87/=, making the outreach model almost twice as costly instead.

4.4 Cost-Effectiveness of the Outreach vs. Static Model

In order to portray the true benefits of the two models we calculated two types of cost-effectiveness ratios—average cost-effectiveness ratio (ACER) and incremental cost-effectiveness ratio (ICER).

4.4.1 Average Cost-effectiveness Ratio (ACER)

Average cost-effectiveness ratio (ACER) is a measure of value for money. It was calculated by dividing the total cost of each model with the effectiveness (or outcome) achieved by the model. We chose population reach, or the level of service uptake associated with each model, as the measure of effectiveness. Hence the average cost-effectiveness ratio gives the cost of testing each eligible client once per year. Table 9 summarises the CER of the two models.

Table 9: Average Cost-effectiveness Ratios of the Static and Outreach Models, 2008/09

1	Performance in Acholi sub-region	Total Cost per 100 registered clients (UGX)	Effectiveness (tests/client/yr)	Cost (UGX) of testing each of 100 clients once/yr
a	Static (Gulu Hospital only) based on actual outputs	399,127.44	0.055	7,256,862.61
b	Outreach (based on actual outputs)	1,663,269.58	0.528	3,150,131.79
2	**Region-wide performance (both sub-regions)**			
a	Both Static Labs. (Gulu & Lira referral hospitals), based on expected outputs	258,882.77	0.16	1,618,017.32
b	Outreach (both sub-regions), actual outputs	1,278,542.09	0.406	3,149,118.46

Cost-effectiveness was calculated per 100 registered clients. The scenario based on actual (observed) outputs from the Acholi sub-region shows that the outreach model was far more cost-effective in the sub-region than the static model. If each of 100 eligible clients received the test once a year using the static model, the cost of achieving that would be 7,256,862.61 per year, compared with 3,150,131.79/= which would be incurred for providing the same number of tests per capita per year through the outreach model; that is, the cost of delivering the same one test to each client per year was two times higher in the static model as it was in the outreach model. In an ideal context of optimally functioning static laboratories, the reverse picture could be true, at a regional level. If both static laboratories had achieved their expected optimal outputs, it could have cost 1,618,017.32 /= to provide a single test to each of 100 eligible clients in the northern region through this model, compared to 3,149,118.46/=, the cost of achieving the same through the outreach model.

4.4.2 Incremental Cost-effectiveness Ratio (ICER)

Incremental cost-effectiveness analysis was calculated by dividing the difference in the cost of the two models by the difference in their effectiveness. Differences were computed using the static model as the base case. Hence the incremental cost-effectiveness ratio measures the additional cost incurred by the outreach model (the more effective programme) to purchase the extra result (number of tests delivered)

Table 10: Incremental Cost-effectiveness Ratio of the Outreach Model

1	**Incremental cost-effectiveness (based on actual outputs in Acholi sub-region only)**	
a	Additional cost accrued by the outreach programme per 100 clients	1,264,142.14
b	Extra tests delivered through the outreach model per client per year	0.473
c	Additional cost per each extra test delivered to 100 clients through the outreach model	2,672,604.95
2	**Incremental cost-effectiveness (in the context of optimal performance of the static laboratories in the both sub-regions)**	
d	Expected Incremental cost of the outreach programme per 100 clients	1,019,659.32
e	Incremental coverage of the outreach model	0.246
f	Additional cost per each extra test delivered to 100 clients through the outreach model	4,144,956.60

In Acholi Sub-region, the outreach model delivered 0.47 extra tests per person per year, relative to the static model. This was achieved at an extra cost of 1,264,142.14/= per 100 clients per year. Therefore, the outreach model incurred an additional 2,672,604.95/= to purchase each extra test for each of 100 clients per year. In the context of optimal performance of the static labs, the additional cost associated with each extra test per 100 clients in a year would have been much higher, nearly 1.5 times higher

4.5 Estimated Cost-Saving to the Clients

During the clients' perception study (summarised in the following sections) we asked the health workers to estimate the average distance travelled by most of the HIV positive clients registered at their facilities. We assumed that the distance travelled by the HIV+ clients was the same as the distance travelled by the beneficiaries of the CD4 count tests. In each sub-region, we selected 2 health centres, one located at about 20 km and the other, at 60 – 70 km from the referral hospital in the region. We also asked both the clients and the health workers to estimate the cost of travelling the stated distances, the waiting time at the facilities (in relation to CD4 count test), and the cost of an average meal and accommodation, where applicable.

We put the same questions to the key informant at NUMAT head office regarding a client located at the average distance covered by the static and outreach models respectively. The estimates are summarised in the table below, and are used to calculate the cost-saving to the clients, accruing from the improved accessibility due to the outreach model.

Table 11: The Cost of Seeking a CD4 cell count Test at Gulu Hospital, and the Cost Saved by receiving the Same Service through the Outreach programme

		LOCATION OF THE CLIENT FROM GULU HOSPITAL	
COST INPUTS		Beneficiary of the static model	Beneficiary of the outreach model
a)	Mean distance to referral Hospital (km)	17	68
b)	Estimated cost of a round trip to Gulu referral hospital	8000/=	30000/=
c)	Productivity time lost (travelling and waiting Time)/days	1	2
d)	Wage rate/day	2000/=	2000/=
e)	Income lost in travelling and waiting time	2000/=	4000/=
f)	Accommodation	-	20000/=
g)	Meals	2500/=	7500/=
h)	Total cost (a+b+e+f+g)	12500/=	61500/=
i)	Cost saving by clients in the outreach model	-	49000/=

The table above shows an estimate of cost to a client located at the typical geographical coverage of each model, if both groups of clients in the Acholi sub-region used Gulu hospital for their CD4 count examination. The estimated cost incurred by a client located 17 km away from Gulu hospital (the typical coverage of the static laboratory in the Acholi sub-region) was 10,500/=, compared to 61,500/= that would have been incurred by a client located 68 km away (the typical coverage of the outreach model), if such a client had to

travel all the way to Gulu hospital to for a CD4 count test. Therefore, by taking services closer to the clients, the outreach model saves the beneficiaries an estimated 50,000/= per client per test (i.e. they saved 80% of the cost they would have incurred to get CD4 count tests from Gulu hospital.

4.6 Clients' Perceptions and Lessons Learnt

A qualitative assessment was made of the clients' perception of the two programmes. The 'clients' consisted of HIV+ beneficiaries of the two delivery models, the health workers working in the clinics, the expert clients, and the laboratory technicians. The expert clients consisted of HIV+ patients who have been trained to offer basic clinical services along the established staff of the facilities. The study subjects were asked about their general perception of the programmes, in particular the perceived benefits and challenges. In addition, the study sought to establish their awareness of similar services in the region, their likelihood of using such alternative services, especially in the absence of the outreach programme.

The perceptions of the clients are summarised below.

4.6.1 Perceived benefits

There was unanimity among the health workers and the "expert clients" that the CD4 count test has been very helpful in planning clinical care. Presumptive treatment was noted to have been misleading; the CD4 test has been helpful in rationalising clinical care.
"… most clients would normally like to be started on ART immediately even when we still consider them to be in good clinical status". I/C of a health centre.

"On the other hand, some patients who normally look clinically okay turn out to have a low CD4 count; some times patients in good clinical status are also tested" I/C of a health centre.

In addition, the test is thought have helped in counselling such patients, and to have improved the acceptability of septrin, saving ART for those who need them only.

Furthermore, it is believed that the test has generally speeded up the process of evaluating clients, such that ART is now initiated early. The health status of clients on chronic care is thought to have generally improved after the introduction of the test. *"Mortality and morbidity have declined because treatment is initiated at the right time."* (the officer incharge of one of the ART clinics)

Whereas there was agreement that introduction of the CD4 count test had improved the rational use of ART, opinions were divided on the change in the consumption level of anti-retroviral drugs. Only one respondent reported that the *"requirement for drugs has fallen drastically, as clients are now started on ART on the basis of the CD4 count";* most of the health workers and expert clients interviewed believed that the use of ART had increased because the number of clients put on ART had increased, following the introduction of CD4 test.

4.6.2 Coverage

Most of the clients on chronic care in the outreach programme were reported to have received CD4 count test at least once. It was difficult to establish this fact at Gulu and Lira

hospitals since the clients on chronic care had mixed registration—with the majority registered with Joint Clinical Research Centre (JCRC). However, at all the sampled facilities (both static and outreached-based), it was reported that all the clients who were on ARVs had received CD4 count test at least once, either as a baseline, in preparation for ART, while planning further clinical management for someone already on ART, or for monitoring. It was further noted that most of the clients in the outreach programme were up to date with their follow-up tests, courtesy of the reminder system which is part of the programme. The respondents at Gulu and Lira hospitals were not sure if clients registered under the hospital-run programmes were up-to-date with their follow-up tests.

Most clients in the outreach programmes were not even aware of the existence of the testing services anywhere else in the regions. Besides, nearly all the clients conceded that they probably wouldn't have been able to go for the test at the hospitals or the private laboratories in town, had the NUMAT outreach programme not been introduced, for because of their poor health status, associated cost and time lost; and as noted by one of the PHA network leaders, *"it is better to have all the services under one roof; it is inconveniencing to have treatment initiated at one centre, and CD4 the test for planning and monitoring treatment done in yet another centre."*

4.6.3 Perceived challenges

The main challenges highlighted with the hospital-based services were the frequent equipment breakdown. Furthermore, the introduction of the test has meant an increased workload to the existing staff in the laboratories. Coupled with the fact that there is only one machine per hospital, this means the demand for the service exceeds the supply by far. Most respondents reported long queues and long waiting time in relation to the hospital-based services.

A couple of challenges were also identified with regard to the outreach programme. The first one was the policy of putting a ceiling on the number of tests that can be done per facility. Hence priority is said to be given to pregnant mothers, children and *"weak"* clients, leaving out many would-be eligible clients, who miss out. The second was a short-coming associated with the organisational set-up of the outreach programme. It was widely reported that the collection team often arrive too early at the stations and leaves the station before all the prioritised clients have arrived. This is because they normally have a string of facilities to cover during each scheduled day. Hence

> *"clients who happen to be there get tested in an effort to raise the quota for the facility … some of the prioritised clients are even left out after they have been mobilised to come for the test, leaving them frustrated, and reluctant to come for the test on subsequent occasions"* [one in-charge of a health centre].

It was acknowledged that, currently the demand for the test in the outreach programme far exceeds the available supply, justifying the ceiling imposed. However, some of the health workers interviewed strongly felt that the shortage in supply was being compounded by what they perceived as another organisational short-coming, whereby the whole process—from sample collection, through transportation, testing and giving results—is controlled by third parties, with limited participation of the staff of the concerned facilities. They contend that if

the kits were kept at the facilities, and the local health workers collected and transported the samples, they could mainstream the testing activities into their own routine schedules. They further emphasized that this arrangement could

a) enable them to take care of all eligible clients
b) give them a sense of ownership and participation
c) be less costly
d) build capacity at the facility level, and
e) address issues of geographical access, since the NUMAT team tends to test clients who live nearby the facilities only

Concerns for quality were also raised at one of the health facilities. As noted by a laboratory technician at the facility: *"We are concerned about quality control … where sample collection and transportation has been privatized, as we are not sure of the adequacy of quality control measures",* who went on to add that a quality check initiated from their laboratory had detected a discrepancy in the result of one of the samples, and that two further quality checks had been undertaken and were awaiting the results.

4.6.4 Lessons Learnt—Critical success factors

There was consensus that the PHA network, especially the presence of the expert clients, was a vital mobilisation tool without which most of the achievements of the outreach programme may not have been realised.

"The expert clintes are very helpful; they make our work easy, although we take all the credit" [the in-charge of one health centre]

It was reported that samples were normally collected every 2 weeks; and that clients who required the tests were normally informed, either through the PHA leaders who are part of the treatment support team (expert clients). It was further noted that, although clients were normally given appointments for the sample collection at the clinics, some of them often forgot about the appointments; yet others are sometimes reluctant to turn up for the appointments for various reasons. Such clients are normally reminded and/or encouraged to the honour their appointment by the expert clients during home visits.

5 DISCUSSION OF THE MAIN FINDINGS

5.1 Coverage and perceived benefits of the outreach model

The National HIV/AIDS Strategic Plan (NSP) and the National ART guideline advocate for a universal access to integrated HIV&AIDS, emphasizing the scaling-up of ART to all segments of the population, using simple public health approaches that deliver services at the population level[4-5]. ART therapy is notably more effective when based on CD4 cell count than when given presumptively. Besides, CD4 cell count-supported ART therapy can lead to a more rational management of HIV positive clients. Hence rolling-out CD4 cell count measurement to all centres offering ART is one way of increasing access to *quality* ART services.

The NUMAT CD4 outreach model achieved a greater population and geographical reach than the conventional static model. Furthermore, the outreach programme was notably more equitable in rolling-out the CD4 cell count test than the static model. In fact, it almost exclusively extended services to the rural population who probably might not have accessed the services based at the two referral hospitals. By achieving a greater and more equitable population and geographical coverage than the traditional model, the NUMAT CD4 delivery model made a greater contribution in achieving the objectives of the National HIV/AIDS Strategic Plan.

Although not obviously tangible, the CD4 outreach programme was also of economic benefit on the demand side. By extending access to the rural population in northern Uganda, the outreach programme did essentially extend coverage to a population that is very poor; a population that admitted that they wouldn't have had the means, the time and the strength to travel to the designated hospitals for the tests. The outreach programme saved the rural clients substantial amounts of money and time—assuming all of them would have gone for the test at the regional hospital in the outreach programme.

5.2 The cost of a single CD4 count test: which of the two models was cheaper?

The analysis of cost was first undertaken in a context of actual operational capacity of the static laboratory, using data from Acholi sub-region only. The analysis was also repeated in a context of an optimum operational capacity of both static laboratories. We considered the total cost of implementing either programme.

The evaluation found that, in a context of a suboptimal operation of the static laboratories, the cost of a providing the test through the outreach model was significantly lower (by more than half) than the cost of providing the same test through the static model. However, the cost of providing the test through the static model tended to fall with increase in output, as shown by the cost at more the most optimum volumes of output. On the other hand, the cost of providing the same test through the outreach model remained constant, irrespective of the volume of output. We are of the view that this was because the outreach programme operated on a pre-agreed price, which has remained constant over the years. The potential area of cost-saving in the outreach programme is the sample transportation component. The underlying assumption here is that transportation cost is arguably semi-variable (or semi-

fixed), especially if new health centres are included into the programme randomly such that the effect of geographical expansion on cost is cancelled. If this assumption holds, then the average transportation cost would be expected to fall with increase in output [14].

However, it is noteworthy that average costs values per se are not useful for judging the worth of a programme. They are useful mainly for planning, budgeting purposes and fund-raising [11].

5.3 Cost-effectiveness ratios (CERs)

Choosing between alternative programmes entails considering both their cost and effectiveness. Cost-effectiveness ratios (CERs) are measures that take into account both the cost and effectiveness of a programme, and are therefore more useful in judging a programme worth. Cost-effectiveness ratios (CERs) show the value for money of alternative programmes; in this case, the worth of the two delivery models. They are useful for answering the question as to which programme is better, when both cost and effectiveness are considered.

It should, however, be pointed out that in choosing alternative programmes, the effectiveness takes precedence over cost. A programme which is less effective may be more cost-effective because it is much less costly. Normally, such a programme would not be considered as an alternative option to the status quo. Once a new programme is significantly more effective than the status-quo, then it is worth considering. The next question then becomes whether it presents better value for money, and whether its implementation could be afforded.

We calculated two CERs, average cost-effectiveness ratio (ACER) and incremental cost-effectiveness ratio (ICER). ACER is a direct measure of the value of a programme, while ICER gives an indication as to whether choosing the more effective programme is associated with a cost-saving; or whether, and how much, additional cost is incurred to implement it.

5.4 Average cost-effectiveness ratio: which delivery model was worthwhile?

Average cost-effectiveness ratio (ACER) seeks to answer the question whether the same level of outputs/outcome can be achieved with fewer resources, or whether a higher level of output can be achieved with the same resource or less. In this context ACER was measured as the cost of testing each eligible client once in a year, with both models targeting the same pool of registered clients.

Basing on data from the Acholi sub-region, it was evident that, in a context of a suboptimal performance of the static laboratories, the outreach programme was significantly more cost-effective than the static model. This came about because the outreach model was more effective and less costly at the same time. Although this observation was made for Acholi sub-region only, it is logical to assume that this finding holds for Lango sub-region as well given the similarity in contexts. However, if both static laboratories in the region had performed optimally, the outreach model could have been less cost-effective, a fact that can partly be explained by the low cost of the test in the static model at higher volumes of output.

5.5 Incremental cost-effectiveness ratio: does choosing the more cost-effective model result in cost-saving?

Average cost-effectiveness ratios (ACERs) are normally sufficient in deciding which option presents better value for money. However, choosing a more cost-effective intervention is often not merely a technical efficiency decision alone; it may also entail making allocative efficiency decisions. For example, decision makers may need to know whether, by choosing a more cost effective programme over the status-quo, additional cost will be incurred to implement it, or whether it will be associated with cost-saving. If additional budget will be required, where will the money come from? Is there slack cash, or will there be need to shift resources from one/more programme(s) in order to fund the new programme. In the latter case, is the benefit forgone by shifting resources away from one or more programmes worth the benefit gained by adopting the new more cost-effective programme? *Incremental cost-effectiveness ratios (ICERs)* help to answer such allocative efficiency questions.

Incremental cost-effectiveness ratio (ICER) shows the extra benefit achieved by the more effective model, in this case the outreach model, and the extra cost or cost-saving associated with each extra unit of the effect/outcome/benefit.

This study shows that the outreach programme delivered more tests per capita per year but at extra cost. However, the extra coverage achieved by the outreach model was far greater than the extra cost associated with the test, therefore realising better value for money (being more cost effective). The ICER associated with the outreach programme in Acholi sub-region was 2,672,604.95/= per 100 registered clients in the sub-region. This means that by choosing the outreach programme over the static model in this region, the Ministry of health incurs an extra cost of 2,672,604.95/= for each extra test the outreach model provides to each of 100 registered clients per year. In the context of optimally functioning static laboratories, the additional cost associated with each extra test to 100 clients per year through the outreach delivery model would be twice as much.

Therefore, choosing the outreach model is not merely a technical efficiency consideration. Because choosing the outreach model over the static model requires additional investment, allocative efficiency decisions are called into play. Allocative efficiency decisions are normally politically charged. This is especially true in a context of budget ceilings, such as the one currently prevailing in Uganda, whereby additional funding for a particular programme can only be realised by shifting resources from another programme. Policy makers have to consider whether the benefit forgone by shifting resources from one programme (e.g. malaria programme) is worth the increased extra coverage of the outreach CD4 count delivery model. Otherwise they have to consider whether they can afford to provide additional budget to the current healthcare budget, in order to accommodate the outreach delivery model without crowding out other programmes.

Although the evaluation sought to determine which delivery model was more cost-effective, it is also important to note that the two models are not mutually exclusive; they could be implemented complementarily if sufficient can be made available.

5.6 Implications of the cost and effectiveness findings for rolling out the outreach model

Classical diffusion theories and empirical evidence from implementation research all strongly suggest that the feature of an innovation with the most powerful influence on the decision of potential adopters is the perceived relative advantage over the standard practice [15-21]. That is to say, the extent and rate of adoption of a new innovation is heavily influenced by how policy makers, practitioners, and clients perceive its benefits relative to the standard practice. Demonstrating the effectiveness and cost-effectiveness of a new innovation is a crucial and significant step in influencing a change in policy and practice [15-21]. Therefore, the empirical and perceived benefits of the outreach model provide a fertile ground for its introduction into the health system on a large scale, if the government chooses to introduce it alongside, or instead of the static module.

It should be noted that if the government of Uganda were to implement the outreach programme, the calculated ACER and ICER would apply only if the programme is organised and implemented according to the current NUMAT format. One critical success factor of the current NUMAT model is the presence of the PHA network, which has a life of its own, requiring additional technical and logistical support[8]. However, by paying attention to some constraints highlighted below, organisational improvements could be made to the current setup of the outreach programme, which can make the model even more cost-effective.

We further wish to point out that the outreach delivery model appears more cost-effective than the static approach only in a context of a sub-optimal performance of the latter. The static delivery model appears more cost-effective at higher volumes of output. For this reason, policy makers could be cautious in considering the outreach model. We wish to underline further that the fundamental consideration in choosing between alternative programmes is not is not the cost-effectiveness ration; rather it is the programme's effectiveness of the programme.

Another equally important consideration is the overall objective of the health system (which may reflect the value system of that particular society). As previously mentioned, the primary objective of the Ugandan HIV/AIDS policies and plans is equity—universal access to quality (RDT-supported) ART [4-5]. Therefore, even if the static model appears to be more cost-effective under ideal context, that would be a secondary consideration. The major short-coming of the static model, besides economic considerations, is its limited population and geographical reach. Besides, it is unlikely that the static models could achieve optimum outputs because of institutional constraints. The evidence from Gulu laboratory suggests that even when equipment is running normally, the laboratories are still unable to achieve their optimum targets, partly because of human resource constraints.

5.7 Challenges associated with rolling out CD4 cell count laboratories

There were two main challenges reported in relation to the outreach programme. The first was the ceiling imposed on the number of test that can be performed per facility, leaving

[8] In fact the costing of the NUMAT outreach model did not include the cost of sustaining the PHA network (although this cost was found to be trivial)

many eligible clients to miss out. A question for the programme managers to consider is whether it would be more prudent to undertake further expansion by widening geographical coverage (spreading the benefit more widely but thinly); or whether it would be better to (first) raise the ceiling such that more people get tested from the current set of facilities. The advantage with the latter consideration is that it could cut the transportation cost, making the programme more cost effective.

Secondly, it appears that sample collection is not (yet) fully mainstreamed in the schedules of the facilities; and that health workers at the facilities are presently passive participants in the whole process. Perhaps consideration could be made of the suggestion that the collection, specimen transportation and collection of results could be mainstreamed into the activities of the beneficiary facilities, and getting the health workers actively involved. It would also be a way of building capacity for the future, for a time when the project is no more. Obviously some other considerations might need to be made before taking up this suggestion, key among which would be the human resource capacity at the facilities.

6 CONCLUSIONS

The evaluation compared the NUMAT outreach approach to delivering CD4 cell count to eligible clients in northern Uganda, with the traditional hospital-based approach where clients have to travel all the way to the static laboratories. Presently the government-funded static laboratories have been rolled out to regional referral laboratories only.

The evaluation reveals that the NUMAT CD4 outreach model was clearly far more effective and more equitable in rolling out CD4 cell count test in Northern Uganda than the static model. Even in a context of optimally functioning static laboratories, the outreach programme would have been far more effective in its reach. Therefore, by adopting this model, NUMAT made a greater contribution to the objectives of the National HIV/AIDS Strategic Plan (NSP), of achieving a universal access to quality ART, than the contribution made by the conventional referral-hospital-based approach.

Furthermore, the outreach programme seemed to have boosted the confidence of health workers in clinical decision-making, and increased client uptake of prophylactic drugs. Because of its equity-orientation it saved the rural clients substantial amounts of money and time, which they would have spent if they had to go for the same tests at the regional hospital in the outreach programme.

Compared with a sub-optimally performing static laboratory, the outreach model was economically far more attractive. It was cheaper to provide the CD4 cell test through the outreach model, costing less than 50% of the cost of delivery through the static model. Although this was true for Acholi sub-region, it is logical to assume the same for the whole northern region because of the similarity in context. Additionally, it was far more cost-effective to reach the clients through the outreach model than through the static model. The outreach model seemed economically less attractive when compared with static laboratories performing at the ideal capacity. However, judgement of the values of the two programmes need to based first and foremost on the of objectives of the national health system, which primarily is achieving universal access to quality (CD4 cell count-supported) ART services.

Because the extra coverage achieved by the outreach model came at an extra cost to NUMAT, choosing this model is not merely a technical efficiency decision but also an allocative efficiency matter. Policy maker have to decide whether the outreach model can be afforded without crowding out other programmes.

Although through out the evaluation the two models were adjudged as alternative options, it is also important to note that the two models are not necessarily mutually exclusive, and could be implemented complementarily.

One critical success factor of the current NUMAT model is the presence of the PHA network, which needs to be taken into account, along with other organisational details, if the current achievements of the outreach model are to be replicated.

A question for the programme managers to consider is whether it would be more prudent to undertake further expansion by widening geographical coverage; or whether they would rather raise the ceiling on the number of tests done per facility such that more clients can get

tested from the current set of facilities. Furthermore, could consider mainstreaming the sample collection process more into the activities of the beneficiary facilities, and getting the health workers more actively involved in the process. This could help in building capacity for the future.

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Appendices

Appendix 1: Summary of Cost Scenarios—Gulu Hospital

OBSERVED COST (AT ESTIMATED OUTPUT OF 541 PER YEAR)

	DIRECT COST INPUTS ONLY				DIRECT & OVERHEAD COST INPUTS		
Cost	Laboratory consumables only	Total recurrent cost (consumables+personnel)	Total recurrent+equipment depreciation cost	Total direct cost (consumables+personnel+equi+buildings)	Recurrent costs only (direct:consumables, personnel; OH: cleaning, utilities, maitenence)	Total direct cost+recurrent overhead cost	Full cost: all relevants inputs included
Direct cost	2,536,977.88	19,428,229.88	30,261,365.48	30,283,511.43	19,428,229.88	30,283,511.43	30,283,511.43
Overhead & intermediate co	-	-	-	-	8,743,170.00	8,743,170.00	19,455,433.65
Total accrued at Lab	2,536,977.88	19,428,229.88	30,261,365.48	30,283,511.43	28,171,399.88	39,026,681.43	49,738,945.07
	-	-	-	-	-	-	-
Workload	-	-	-	-	-	-	-
Total output	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00
CD4 test observed)	541.00	541.00	541.00	541.00	541.00	541.00	541.00
CD4 test (expected)	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00
	-	-	-	-	-	-	-
Unit cost (observed)	**4,689.42**	**35,911.70**	**55,935.98**	**55,976.92**	**52,072.83**	**72,138.04**	**91,938.90**

EXPECTED COST (AT OUTPUT OF 2080 TESTS PER YEAR

	DIRECT COST INPUTS ONLY				DIRECT & OVERHEAD COST INPUTS		
Cost	Laboratory consumables only	Total recurrent cost (consumables+personnel)	Total recurrent+equipment depreciation cost	Total direct cost (consumables+personnel+equi+buildings)	Recurrent costs only (direct:consumables, personnel; OH: cleaning, utilities, maitenence)	Total direct cost+recurrent overhead cost	Full cost: all relevants inputs included
Direct cost	9,754,000.00	26,645,252.00	37,478,387.59	37,563,532.84	26,645,252.00	35,963,532.84	37,563,532.84
Overhead & intermediate co	-	-	-	-	8,743,170.00	9,629,924.97	19,455,433.65
Total accrued at Lab	9,754,000.00	26,645,252.00	37,478,387.59	37,563,532.84	35,388,422.00	45,593,457.81	57,018,966.49
-	-	-	-	-	-	-	-
Workload	-	-	-	-	-	-	-
Total output	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00
CD4 test observed)	541.00	541.00	541.00	541.00	541.00	541.00	541.00
CD4 test (expected)	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00
-	-	-	-	-	-	-	-
Unit cost (expected)	**4,689.42**	**12,810.22**	**18,018.46**	**18,059.39**	**17,013.66**	**21,919.93**	**27,412.96**

Appendix 2: Lira Hospital—Summary of Cost Scenarios

	DIRECT COST INPUTS ONLY				DIRECT & OVERHEAD COST INPUTS		
Cost	Laboratory consumables only	Total recurrent cost (consumables+personnel)	Total recurrent+equipment depreciation cost	Total direct cost (consumables+personnel+equi+buildings)	Recurrent costs only (direct:consumables, personnel; OH: cleaning, utilities, maitenence)	Total direct cost+recurrent overhead cost	Full cost: all relevants inputs included
Direct cost	9,754,000.00	20,714,000.00	31,819,983.00	32,053,498.56	20,714,000.00	20,947,515.56	32,053,498.56
Overhead & intermediate cost	-	-	-	-	9,104,572.44	9,104,572.44	20,386,756.96
Total accrued at Lab	9,754,000.00	20,714,000.00	31,819,983.00	32,053,498.56	29,818,572.44	30,052,088.00	52,440,255.52
Workload							
Total output	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00
CD4 test (observed)	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00
Unit cost (observed)	**3,758.77**	**7,982.27**	**12,262.04**	**12,352.02**	**11,490.78**	**11,580.77**	**20,208.19**

Appendix 3: Summary of cost scenarios for both Gulu and Lira Hospital

		DIRECT COST INPUTS ONLY				DIRECT & OVERHEAD COST INPUTS		
COST PARAMETERS		Laboratory consumables only	Total recurrent cost (consumables+personnel)	Total recurrent+equipment depreciation cost	Total direct cost (consumables+personnel+equi+buildings)	Recurrent costs only (direct:consumables, personnel; OH: cleaning, utilities, maitenence)	Total direct cost+recurrent overhead cost	Full cost: all relevants inputs included
Total Hosp-specific cost	LRRH (O)	9,754,000.00	20,714,000.00	31,819,983.00	32,053,498.56	29,818,572.44	30,052,088.00	52,440,255.52
	GRRH (O)	2,536,977.88	19,428,229.88	30,261,365.48	30,283,511.43	28,171,399.88	39,026,681.43	49,738,945.07
	GULU (E)	9,754,000.00	26,645,252.00	37,478,387.59	37,563,532.84	35,388,422.00	45,593,457.81	57,018,966.49
Overall cost of the static model	Observed*	12,290,977.88	40,142,229.88	62,081,348.48	62,337,009.99	57,989,972.32	69,078,769.43	102,179,200.59
	Expected**	19,508,000.00	47,359,252.00	69,298,370.59	69,617,031.40	65,206,994.44	75,645,545.80	109,459,222.00
LAB OUTPUTS - GRRH								
GRRH								
Total output		30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00	30,040.00
CD4 test	Observed*	541.00	541.00	541.00	541.00	541.00	541.00	541.00
CD4 test	Expected**	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00	2,080.00
LRRH								
Total output	Observed*	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00	27,723.00
CD4 test observed)	Expected**	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00	2,595.00
BOTH RRH								
Total output		57,763.00	57,763.00	57,763.00	57,763.00	57,763.00	57,763.00	57,763.00
CD4 test	Observed*	3,136.00	3,136.00	3,136.00	3,136.00	3,136.00	3,136.00	3,136.00
CD4 test	Expected**	4,675.00	4,675.00	4,675.00	4,675.00	4,675.00	4,675.00	4,675.00
TOTAL AVERAGE COST	Observed*	3,919.32	12,800.46	19,796.35	19,877.87	18,491.70	22,027.67	32,582.65
	Expected**	4,172.83	10,130.32	14,823.18	14,891.34	13,948.02	16,180.87	23,413.74

Appendix 4: List of People Interviewed

Names	Organisation	Designation
Dr. Andrew Ocero	NUMAT H/Q	Main contact person for the research
Dr. Luigi Cicció	NUMAT H/Q	Monitoring and Evaluation Officer
Akello Lucy	Koch Goma HC III	Clinical Officer
Odokonyero Mark	Koch Goma HC III	I/C VCT & ART clinic
Ochola Raphael	Koch Goma HC III	Network Support Agent/V/chairman PHA
Ajok Molly	Koch Goma HC III	PHA network support agent
Adong Grace	Koch Goma HC III	Client
Dominica B.	Lira Hospital	Laboratory Assistant
Betty Apio	Lira Hospital	Laboratory Technichian
Eunice	Lira Hospital	Director, Lira Infectious Disease Control
Bernard Amunye	Lira Hospital	I/C Laboratory Technician
Wigale	Lira Hospital	Hospital Administrator
Omach Luciano	Ogur HC III	I/C ART Clinic
Akech Florence	Ogur HC III	PHA network agent
Obong Alfred	Ogur HC III	PHA network agent
Ayela Wilbert	Ogur HC III	Client
Omara Jenifer	Aboke HC III	I/C ART clinic
Peter Aga	Aboke HC III	PHA Network agent
Beatrice Nyana	Aboke HC III	PHA Network agent
Dories Ayena	Aboke HC III	PHA Network agent
Okello A. Denis	Aboke HC III	PHA Network agent
Ojok Buni	Aboke HC III	Volunteer
Obong Sam Kizito	Aboke HC III	Enrolled Comprehensive Nurse
Jane Arina	Aboke HC III	Laboratory Technichian
Ochom David	Aboke HC III	HSD focal person for HIV/AIDS
Dr. Vincent Owiny	Oyam District Health Office	District Health Officer
Olanya Consolate	Anaka Hospital	Senior Nursing Officer
Obal Stanley	Anaka Hospital	Enrolled Nurse, ART clinic
Okech John	Anaka Hospital	Network Support Agent
Sr. Obur	Gulu Hospital	Nursing Officer, ART clinic
Dan	Gulu Hospital	Data officer
Ogwal Tom	Gulu Hospital	Senior Laboratory Technician
Aliyi Walimbwa	Gulu Hospital	Senior Hospital Administrator

Appendix 5: Interview guide for clients who have had at least one CD4 count test

Date _____ Organisation _____
Interviewer _____ Title of the respondent _____

Introduction, explanation of the purpose of the research, and obtaining verbal consent

1. How many times have you received a CD4 count test?
2. When the test(s) was/were performed on you, did they specify the purpose?
3. Can you tell us where such services (CD4 count tests) are available in this region (the possible places a client could go to for such a service in the region).
4. Please can you mention where the test you received was done from, (the facility, which organisation, etc)
5. In the absence of the NUMAT outreach model, what is the likelihood that you would have received this test from elsewhere?
6. What is your view regarding the performance of the NUMAT outreach model as opposed to the static (hospital-based) model? … *(probe about perceived benefits/disadvantages of the models; affordability)*

7. Any lessons learnt from implementing the outreach model; and the static model?

8. Will you, please, give us an estimate of the following?

	To this facility	From this facility to the relevant referral hospital (GRRH/LRRH)
Average distance (KM) travelled by clients		
Estimated cost of a round trip		
Travelling and waiting time		
Accommodation cost		
Meals (cost)		

9. Any final comments?

Thank you for your time

Appendix 6: Interview guide for the DHO and the NUMAT focal person

Date _____ Organisation NUMAT H/Q
Interviewer _____ Title of the respondent _____

Introduction, explanation of the purpose of the research, and obtaining verbal consent

9. Confirm the coverage of NUMAT program (number and proportion of facilities, number and proportion of sub-counties covered)

10. Enquire about the availability of a programme document or any other documents (e.g. reports) that describe the objectives and detailed activities of NUMAT, particularly the CD4 count outreach programme.

11. Some clarification from **NUMAT**… the term *"clients who have received at least one clinical service"* vs. *"clients on cotrimoxazole"* from the datasets obtained from PHA

12. Can you please estimate the proportion of registered HIV+ clients who would normally be considered eligible for CD4 count test (in Northern Uganda, or in Uganda as a whole)

13. Can you estimate the proportion of eligible clients who have received CD4 count test at least once during the 2008/09 financial year or the most recent financial year?

14. What is your view regarding the performance of the NUMAT outreach model as opposed to the static (hospital-based) model? … *(probe about perceived benefits/disadvantages of the models; affordability; coverage—location of clients from the facilities; sustainability; main constraints)*

15. What would be your comments regarding the possibility of adopting of the outreach model as a policy in Uganda? … *(probe about the approach of where the two models are combined)*

16. Any lessons learnt from implementing the outreach model; and the static model?

17. Will you, please, give us an estimate of the following?

	ACHOLI		LANGO			Overall NUMAT
	GRRH	NUMAT	LRRH	NUMAT		
For a client living at mean distance to referral Hospital (km)	17	68	-	63		65
Estimated cost of a round trip						
Travelling and waiting time						
Accommodation						
Meals						
Total cost						
Cost saving	-		-	-		-

Thank you for your time

Appendix 7: Interview guide for the officer in-charge of Health Facility and PHA network leader

Date _____ Organisation _____
Interviewer _____ Title of the respondent _____

Introduction, explanation of the purpose of the research, and obtaining verbal consent

18. We would like to know the number of HIV positive clients who were registered at this facility during the 2008/09 financial year, and the number who were eligible for ART, during the same year … *(ask to see records if easily retrievable; or ask to give estimates for the most recent financial year)*

19. Can you please estimate the proportion of registered HIV+ clients who would normally be considered eligible for CD4 count test (in Northern Uganda, or in Uganda as a whole)

20. Can you estimate the proportion of eligible clients who have received CD4 count test at least once during the 2008/09 financial year or the most recent financial year?

21. Can you tell us where such services (CD4 count tests) are available in this region (the possible places a client could go to for such a service in the region).

22. Please can you briefly describe arrangement under which some of your clients have had access to CD4 count tests … *(probe about client selection, purpose of the tests in the majority of cases, average number of tests per person)*

23. In the absence of the NUMAT outreach model, what is the likelihood a client from this catchmet area would have received this test from elsewhere?

24. What is your view regarding the performance of the outreach model as opposed to the static (hospital-based) model? … *(probe about perceived benefits/disadvantages of the models; affordability; coverage—location of clients from the facilities; sustainability; main constraints)*

25. What would be your comments regarding the possibility of adopting of the outreach model as a policy in Uganda? … *(probe about the approach of where the two models are combined)*

26. Any lessons learnt from implementing the outreach model; and the static model?
27. Will you, please, give us an estimate of the following?

	To this facility	From this facility to the relevant referral hospital (GRRH/LRRH)
Average distance (KM) travelled by clients		
Estimated cost of a round trip		
Travelling and waiting time		
Accommodation cost		
Meals (cost)		

Thank you for your time