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## Costs of Providing Care for HIV-infected Adults in an Urban, HIV Clinic in Soweto, South Africa

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### Abstract

**Background**—As access to antiretroviral therapy (ART) in sub-Saharan Africa expands, estimates of the costs of initiating and maintaining patients on antiretroviral therapy are important to program planning, budgeting, and cost-effectiveness analyses.

**Methods**—Total costs of providing HIV care, including ART, in an urban, non-governmental, adult clinic in Soweto, South Africa were estimated from October 2004 through March 2005. Personnel costs were estimated using individuals' work time and salary, and for across-organization services (e.g. information technology), a proportion of entire annual costs was applied. Utilisation of medications, labs, and radiographic tests were estimated by a random sample of patient charts (10%) and applied to the entire cohort.

**Results**—966 adult patients received care during the study period (75% female, median age 34 years, median CD4 count at ART initiation: 109 cells/mm<sup>3</sup>). 17% were stable on ART at entry, 61% initiated ART, and 22% did not receive ART over the course of the study. Mean cost of the entire program (in US\$) was \$92,388/month, and mean per patient cost of care - regardless of ART treatment status - was \$98.1/month. Among adults on ART, costs were lowest for those already on ART (\$119.0/month) and highest for those initiating ART (\$209.7/month) in the first month and \$130.0 the following month. Human resources and antiretrovirals each accounted for one-third of overall costs.

**Conclusions**—The monthly cost of treating HIV-infected patients in an urban South African clinic was highest in the month of initiation and lower for stable patients, with costs driven predominantly by antiretrovirals and personnel.

### Keywords

Costs; antiretroviral therapy; PEPFAR; HIV; South Africa

## INTRODUCTION

South Africa has the greatest number of HIV-infected people in the world; prevalence at antenatal clinics varies from 15% to 39% depending on the province.<sup>1</sup> With antiretroviral

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coverage rates of about 28% in 2007 and an incidence rate of at least 2% per annum in adults, demand for effective HIV therapy will grow for the foreseeable future.<sup>2,3,4</sup>

Funding for the scale-up effort in South Africa and other sub-Saharan African countries comes from multiple sources and care is delivered through a variety of models in diverse settings.<sup>5</sup> Data on the actual costs of providing comprehensive care to HIV-infected people is needed to assist governments and external funders in planning, identify cost drivers and areas of potential savings and allow the setting of achievable targets. The US Government's PEPFAR program in South Africa has an annual budget of more than \$500 million and supports numerous South African HIV treatment facilities in the public, private and non-governmental sectors. PEPFAR supports an HIV treatment service located in a large research unit clinic in urban Soweto serving over 1,000 HIV-infected people with comprehensive care and treatment. Our objectives were to report: the total costs of providing care in this setting, the monthly costs of care categorized by antiretroviral therapy (ART) status and, in those who initiated ART, the costs in the months prior to, the month of, and the month after initiating ART.

## METHODS

### Study Setting

The Perinatal HIV Research Unit (PHRU) is a research organization located on the campus of the Chris Hani Baragwanath Hospital (CHBH) in Soweto. The PHRU started initiating patients at its free-of-charge ART service at CHBH in March 2004. Despite being co-located with CHBH, management, staffing and all costs of care are borne by the PHRU and apart from the collection of operational data for monitoring and evaluation, patients do not participate in clinical research. Although no rent is paid, the PHRU was solely responsible for refurbishment and for ongoing maintenance of the clinic where the ART service is rendered. Patients are referred from other programs in the PHRU or self-refer and are started on ART based on South African treatment guidelines.<sup>6</sup> Pre-ART visits include baseline CD4, viral load, liver function and hematology tests and symptom-based screening for TB. Once on ART, CD4 cell count and viral load are measured every six months, hematology and liver function tests every three months. Other tests, such as lactate, are ordered when necessary.

### Health Services Utilization and Cost

This retrospective cohort study was conducted over a 6-month period from October 1, 2004 through March 30, 2005. Costs were ascertained from a provider's perspective and included costs of personnel, capital, medications and tests, and other miscellaneous costs during the study period. The PHRU finance department operates all its projects as self contained cost-centers thus all salaries, invoices and indirect costs can be accurately allocated to the project incurring expenditure. This study included only those costs that could be clearly linked to the operations of the PEPFAR funded HIV treatment service.

**Personnel Costs**—Care and treatment in the PEPFAR funded HIV service is provided exclusively by employees of the PHRU and includes primary healthcare nurses (equivalent to a nurse practitioner), medical officers, social workers and adherence counselors. Personnel costs for clinical and managerial staff working in this HIV service were calculated using estimates of personnel time spent on the program. Effort estimates were obtained from project personnel, their immediate superior and then verified by the program director (LM) and then multiplied by their total cost-to-company salary for each month of the study. Actual clinic visits for the period covering the costing were obtained from clinic staff. At the time of the study, the HIV treatment service was charged an amount of \$10 per patient visit

which was the estimate of the costs of: non-HIV treatment project clinic personnel (cleaners, receptionists, clinic manager, etc), clinic consumables (files, syringes, gloves, medical waste disposal, cleaning materials, etc) and furniture, fittings and equipment used by patients but outside of the consulting rooms.

For non-clinical support services that contribute to numerous projects across the PHRU such as finance, human resources (HR), information technology and legal support, overall annual costs for each service were obtained from budgets and then apportioned on a pro rata basis to the project on the basis of managers estimates of usage of each service by the treatment program. As an example, HR costs were allocated using as a denominator the total salary bill of the PHRU and as the numerator the salary costs of people in the PEPFAR funded ART service. Recruitment costs for hiring and replacing personnel, bank charges, postage and courier and subscriptions for insurance against claims for medical malpractice were also included based on actual charges to the project.

**Capital Costs**—Capital costs were charged to the project on a monthly basis based on a depreciated amount as per South African Revenue Services wear and tear allowances. HIV treatment service staff estimated the average number of consulting rooms used by the project per working day then costs of equipment and furniture in existing consulting rooms was estimated by requesting quotes for a standard consulting room from suppliers which was depreciated over 5 years apportioned by time of the study. Similarly, capital expenses on furniture and computers and office equipment used exclusively by the service were costed to the study. A motor vehicle was used to trace patients and was costed based on its use by the service; annual maintenance, repairs and fuel were averaged per month.

A market related rental cost for clinic space was obtained and then apportioned to the HIV treatment service based on the total square metres of clinic and office space used. Nine landlines and a mobile phone were required to support the program and average actual charges were added to a pro rata cost of purchasing and maintaining the PHRU's telephone switchboard. Printing and stationery costs included actual general stationery requirements of the HIV treatment service. Other direct costs were calculated by either applying a pro rata to each item based on proportional utilisation by the service and total actual expenditure by the organization on that item where the actual service costs could not be obtained, or by applying the actual service cost where such cost could be easily determined.

**Utilisation and Costs of Laboratory Tests, Antiretroviral Drugs and Other Medications**—A random sample of 10% of patients' clinical records was systematically reviewed to assess individual utilisation over the study period. The dates of initiation and discontinuation of each individual antiretroviral agent and other pharmaceuticals were abstracted. Individual laboratory and radiological investigations performed each month were recorded. All outpatient investigations were performed at the clinic and there is no evidence that patients were undergoing investigations elsewhere. Costs of each pharmaceutical agent, laboratory and radiological investigation were obtained from invoices.

Patients were divided into three groups: those who initiated ART prior to the study period and remained on ART at study entry, those who initiated ART during the study period, and those not receiving ART during the study period. The costs of pharmaceuticals, laboratory and radiological investigations calculated for the randomly selected 10% sample were then applied, by group, to the entire cohort of adult patients according to their ART status during the study.

## Outcomes

Total cost per month for the entire HIV treatment service was calculated by summing each allocated cost. To estimate monthly costs per-person in care, the total monthly program cost was divided by the total number of patients on treatment at the end of each month and averaged. For those on antiretroviral therapy, this calculation was performed for the month prior to initiation of treatment, the month of treatment initiation and the month following treatment initiation. All costs were actuals or estimates in South African Rand (ZAR) for the study period and were standardized to 2004 prices then converted to United States Dollars (\$) using average exchange rates for the period.<sup>7</sup>

## RESULTS

966 patients received care in the HIV treatment service during the study period; median age 34 years, 67% female, median CD4 count of 104, and median viral load of 61,500 copies/ml. Seventeen percent of patients entered the study period already on ART, whereas 61% initiated ART during the study period and 22% did not receive ART during the study period.

### Personnel Utilization and Cost

The staffing complement required to support the treatment service at enrolment of 1000 patients included the following positions (% full-time equivalent): Project Director (50%), Other investigators/Senior staff (28.7%), Project Manager (100%), Other administration (17.5%), Medical Officers (105%), Primary Health Care Nurses (300%), Pharmacist (200%), Pharmacy Assistant (70%), Social Worker (25%), Counselors (150%), Data Capturer (100%) and a Driver (25%). The monthly cost to the service for selected positions is shown in Table 1. The mean total monthly cost of personnel-related expenses, weighted by their effort on the program was \$30,255.

### Medications, Laboratories and Capital and Clinic Costs

The most frequently initiated antiretroviral regimen during the study period consisted of d4T, 3TC and nevirapine, consistent with South African National Treatment Guidelines. The mean costs of this regimen including taxes, delivery and pre-packaging fees are shown in Table 1, and total \$83 per month. The mean costs of non-antiretroviral medications ranged from \$0.90 per month for co-trimoxazole prophylaxis to \$3.1 for a course of nystatin suspension for oral candidiasis (Table 1).

Total estimated cost of the service for the 6-month period of the study was \$552,959, a mean monthly cost of \$92,160 and the monthly cost per patient was \$98.1. Personnel and ART costs each made up about one third of the total cost of the service for the overall cohort, whereas laboratory, capital and clinic infrastructure costs each accounted for about half of the remaining costs (Table 2). Among patients not receiving ART during the study period, the average monthly cost of care was \$62.8, of which 51% was attributable to the cost of personnel.

Among patients receiving ART during the study period, mean monthly costs are reported separately for patients who 1) entered the study period already on ART and 2) initiated ART during the study period (Table 2). For the latter group, costs are reported monthly for the month prior to ART initiation, the month of ART initiation and the following month. Costs were lowest for those entering on stable ART (\$119.0/month) and highest for those initiating ART (\$209.7 in the first month). The high costs for ART initiation were driven by the costs of baseline laboratory tests including CD4 cell counts and viral loads.

## DISCUSSION

The overall mean monthly cost of care per-person in our cohort of 966 HIV-infected adults was \$98.1, of which antiretroviral drugs and personnel each accounted for one-third, and the remainder was evenly split between laboratory and radiological studies and capital costs. Of those on ART, costs were lowest for those entering the study on therapy and were highest in the patients initiating therapy, driven primarily by the laboratory costs prior to and during ARV initiation.

Patients entering this study were typical of patients in HIV treatment cohorts in sub-Saharan Africa, including a higher proportion of women and low baseline CD4 cell count.<sup>8</sup> However, this study is one of few available cost studies from the region and is consistent with and extends the work of costing studies reported from public clinics in South Africa.<sup>9-10-11</sup> A study of a public ART facility in Gugulethu reported an average cost of \$1,186 per outpatient year for HIV care including ART, similar to our monthly average cost of \$98.1 (\$1,177 extrapolated to one year), and \$119.0 for patients stable on ART (\$1,428 for one year).<sup>9</sup> Investigators in KwaZulu-Natal reported similar costs of ART for HIV-infected healthcare workers in two state-subsidised hospitals from about ZAR5,697 to ZAR8,762 (about \$950-\$1348).<sup>10</sup> Lastly, a study of public clinics serving patients from Khayaletsha that used a less expensive source of antiretroviral drugs, reported lower yearly costs from \$853 to \$897 depending on baseline CD4 cell count and excluding inpatient care.<sup>11</sup>

Controlling costs will be critical as South Africa plans further expansion of ART to greater numbers of those not currently covered. We anticipate that personnel costs per patient will decline over time as provider expertise grows and task shifting to less expensive cadres of health care personnel occurs. Likewise, clinic and capital costs that are fixed despite increasing numbers of patients along with further integration of HIV services into primary healthcare settings will further reduce per-patient costs. Laboratory costs will likely remain elevated until greater numbers of competing CD4 and viral load technologies become available. In the meantime, further work needs to be done to determine efficient, yet safe and effective monitoring algorithms for those on ART in limited-resource countries.

This study has several limitations. First, limited study budget led to the use of a relatively small sample on which to base individual patient utilisation in each group, although this sample had the benefit of being randomly selected. Additionally, the PHRU is a research site and may have higher health worker per-patient ratios and perform more investigations than public sector sites but the PHRU lends itself to a study of this nature as virtually all costs are borne by the institution and are therefore easily quantifiable. However, the FTE of 405% medical officers and primary health care nurses for nearly 1,000 patients is similar to staffing levels reported from public, private and non-governmental sectors.<sup>12</sup> Also, the sponsor requires that generic antiretroviral drugs be approved or tentatively approved by the US Food and Drug Administration (FDA) and at the time of the study few FDA-approved generic formulations were available so the high antiretroviral prices used in this analysis reflect the purchase of brand-name drugs (including taxes and dispensing and packaging fees). The costs of first-line ARVs available in PEPFAR-funded programs have declined since this analysis was conducted as more generic antiretrovirals are approved by the FDA. The proportion of overall costs attributable to ART has also likely fallen, although may rise over time as patients transition to more expensive second-line regimens.

In conclusion, this study provides the actual costs of providing comprehensive HIV care and treatment for patients in Soweto, South Africa and demonstrated the high costs of human resources, ART, and laboratories (the latter costs are high at ART initiation) as a proportion of overall care costs. Along with further reductions in ART prices, we posit that integration

of HIV care into primary healthcare services combined with task-shifting from doctors could optimise the limited human resources available and possibly assist in improving access to ART in South Africa.

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**Table 1**

Selected Input Costs of the ART program in Soweto for the period October 2004 through March 2005

	Cost (\$)
<b>Personnel (per month)</b>	
Primary Healthcare Nurse	2,069.0
Pharmacist	2,786.0
Medical Officer	3,880.0
<b>Medications- non ART</b>	
Co-trimoxazole 80/400mg (60 tabs)	0.9
Metronidazole 400mg (21 tabs)	0.4
Nystatin oral suspension (20ml)	3.1
Amoxicillin 250mg (15 tabs)	0.6
Doxycillin 200mg (14 tabs)	0.7
<b>Medications- ARVs (month supply)</b>	
Stavudine 40mg	6.3
Didanosine 100mg	16.9
Lamivudine 150mg	16.4
Zidovudine 300mg	46.8
Combivir 300/150mg	53.5
Efavirenz 600mg	31.7
Nevirapine 200mg	60.0
Lopinavir/ritonavir 133.3/33.3mg	45.8
<b>Laboratory and Radiographic Tests</b>	
Full blood count	14.0
AST and ALT	12.0
CD4 cell count	20.9
Viral Load	93.6
Sputum smear for tuberculosis	5.4
<b>Capital Costs (per month)</b>	
Printing/Stationary	225.0
Computers	439.8
Rent/utilities	480.0
Communications	508.3

**Table 2**

Mean Per Patient Costs for the Overall Cohort and stratified by ART Status

	Overall cohort (n=966), \$ (%)	Patients not on ART (n=208), \$ (%)	Patients on ART at study initiation (n=167), \$ (%)		Patients initiating ART during study (n=591), \$ (%)		
			Month prior to ART initiation	Month of ART initiation*	Month prior to ART initiation	Month of ART initiation*	Month after ART initiation
Non-antiretroviral Medications	6.1 (6.2)	6.9 (11.1)	5.5 (4.6)	6.0 (2.9)	6.9 (6.5)	5.3 (4.1)	70.4 (54.1)
Antiretrovirals	29.0 (29.6)	0	50.7 (42.6)	70.4 (33.6)	0	70.4 (33.6)	8.4 (6.5)
Laboratory and Radiographic Tests	17.0 (17.3)	9.9 (15.8)	16.8 (14.1)	86.3 (41.2)	54.1 (50.6)	86.3 (41.2)	32.0 (24.6)
Personnel	32.0 (32.6)	32.0 (51.0)	32.0 (26.9)	32.0 (15.3)	32.0 (29.9)	32.0 (15.3)	14.0 (10.8)
Capital and Clinic	14.0 (14.3)	14.0 (22.3)	14.0 (11.8)	14.0 (6.7)	14.0 (13.1)	14.0 (6.7)	130.1
<b>Mean Total Costs per Month per-Patient</b>	<b>98.1</b>	<b>62.8</b>	<b>119.0</b>	<b>209.7</b>	<b>107.0</b>	<b>209.7</b>	<b>130.1</b>