How Much Does It Cost to Provide Antiretroviral Therapy for HIV/AIDS in Africa?

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Abstract

Background: Many African countries are rapidly expanding HIV/AIDS treatment programs. Empirical information on the cost of delivering antiretroviral therapy (ART) for HIV/AIDS is needed for program planning and budgeting.

Methods: We searched published and gray sources for estimates of the cost of providing ART in service delivery (non-research) settings in sub-Saharan Africa. Estimates were included if they were based on primary local data for input prices.

Results: 17 eligible cost estimates were found. Of these, 10 were from South Africa. The cost per patient per year ranged from $396 to $2,761. It averaged approximately $850/patient/year in countries outside South Africa and $1,700/patient/year in South Africa. The most recent estimates for South Africa averaged $1,200/patient/year. Specific cost items included in the average cost per patient per year varied, making comparison across studies problematic. All estimates included the cost of antiretroviral drugs and laboratory tests, but many excluded the cost of inpatient care, treatment of opportunistic infections, and/or clinic infrastructure. Antiretroviral drugs comprised an average of one third of the cost of treatment in South Africa and one half to three quarters of the cost in other countries.

Conclusions: There is very little empirical information available about the cost of providing antiretroviral therapy in non-research settings in Africa. Methods for estimating costs are inconsistent, and many estimates combine data drawn from disparate sources. Cost analysis should become a routine part of operational research on the treatment rollout in Africa.

Key words: HIV/AIDS, antiretroviral therapy, Africa, cost

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Introduction

As of June 2006, an estimated 1.04 million people in sub-Saharan Africa were receiving antiretroviral therapy (ART) for HIV/AIDS. This number, while still accounting for fewer than a quarter of those deemed to be in need, represents a ten-fold expansion of treatment services since late 2003. During the first half of 2006, new patients were added at a rate of some 38,000 per month, according to World Health Organization estimates.[1]

Treatment is being paid for by a combination of domestic government budget allocations, patients' own resources, and international donor grants. Since both the maintenance of current service delivery and expansion of access to the remaining three quarters in need will require substantial new investments in the years to come, it is important to know how much the provision of antiretroviral therapy costs. In the absence of prior experience in delivering ART in the public sector, original estimates of the resources needed for treatment were based on models that generally pieced together costs from disparate local sources and/or adjusted cost data collected from other parts of the world.[2,3]

Many countries now have more than two years of experience in providing ART on a large scale in public sector facilities, and longer experience in nongovernmental and private sector facilities. Several reports of clinical outcomes for large patient cohorts at these sites have already been published.[4–9] It is thus reasonable to expect that cost estimates based on actual experience are now available to policy makers and planners and can be used to improve future resource planning. We conducted a review of the published literature, gray literature, and conference abstracts to locate empirical estimates of the costs of providing ART in service delivery (non-research) settings in sub-Saharan Africa.

Methods

Studies were included in the review if they contained estimates of the provider costs of treating adult patients with antiretroviral therapy in a service delivery setting, which we defined as any setting other than that of a clinical trial. Eligible settings thus included public, private, nongovernmental, and workplace facilities. We originally intended to restrict the review to estimates based on primary, retrospective data on resources actually expended for a treated population. Because we found so few of these, we expanded the search to include estimates that used primary local data for input prices but modeled resource use either from expected treatment regimens and schedules of services or from local clinical trial populations, with research-specific costs excluded. We excluded studies that did not indicate the sources of unit cost estimates or used non-local input prices.

Using the terms "antiretroviral," "cost," and "Africa," eligible studies were sought on Medline, the Social Science Citation Index, and Google. Abstracts of the last six international conferences of the International AIDS Society and other relevant national and international conferences and publications archives were also searched, as were the websites of research organizations and international agencies. We also reviewed bibliographies of relevant papers and asked health economists and other researchers working in sub-Saharan Africa for relevant sources. Where possible, authors of conference abstracts were contacted to ask if a full paper, poster, or slide presentation was available; results from the abstract were included if more detailed information was not provided. No effort was made to verify or refine the cost estimates beyond what was included in the source documents.

Results

We located 15 studies that met the criteria for the review. One of these estimated treatment costs at three types of sites, giving us a total of 17 cost estimates. The studies are listed in Table 1. Study reference numbers in Table 1 will be used to refer to individual studies in the remainder of the paper.

Table 1. Studies Included in the Review

Study reference number	Source	Country and location	Setting	Type of facility	No. facilities included in costing	Population treated	No. study subjects included in costing	Year of cost data
B1	[10]	Benin, Cotonou	Urban	Nongovernmental clinic	1	Assumed general adults	237	2005
C1	[11-13]	Cote d'Ivoire, Abidjan	Urban	Community clinics	5	Clinical trial participants (adults)	270	Unclear, probably 2000
E1	[14]	Ethiopia, various locations	Unspec.	Public hospitals	6	Assumed general adults	n.a.	Unclear, probably 2003
N1	[15]	Nigeria, various locations	Unspec.	Various	5	Assumed general adults	n.a.	2001-2004
R1	[16]	Rwanda, various locations	Unspec.	Reference hospitals, district hospitals, and health centers	9	Assumed general adults	109	2005
SA1	[17]	South Africa, Cape Town	Urban	Teaching hospital	1	Clinical trial participants (adults)	27	2004
SA2	[18]	South Africa, various locations	Various settings (mining areas)	Hospitals	Many	Mine employees and dependents	Unspec.	Unclear, probably 2002-2005
SA3	[18]	South Africa, various locations	Various settings (mining areas)	Occupational clinics	Many	Mine employees and dependents	Unspec.	Unclear, probably 2002-2005
SA4	[18]	South Africa, various locations	Various settings (mining areas)	General practitioners' offices	Many	Mine employees and dependents	Unspec.	Unclear, probably 2002-2005
SA5	[19]	South Africa Cape Town	Urban	Nongovernmental clinics	3	Assumed general adults	1729	2000-2005
SA6	[20]	South Africa, various locations	Various settings (workforces)	Managed care scheme	Many	Employed persons and dependents	Unspec.	2002
SA7	[21]	South Africa, Durban	Urban	Hospitals	2	Healthcare workers	41	2004
SA8	[22]	South Africa, Cape Town	Urban	Public dedicated HIV clinic	1	Assumed general adults	212	Unspec., probably 2005
SA9	[23,24]	South Africa, Soweto	Urban	Nongovernmental clinic	1	General adults	980	2004-2005
SA10	[25]	South Africa, Johannesburg	Urban	Public hospital	1	General adults	100	2005
U1	[26]	Uganda, Unspec.	Unspec.	Various	Unspec.	Assumed general adults	Unspec.	2004
ZI	[27]	Zambia, Unspec.	Unspec.	No individual facilities	n.a.	Assumed general adults	n.a.	2002-2003

Unspec: Unspecified.

Cost estimates from the studies are shown in Table 2 and Figure 1. From each study, we extracted or calculated an average annual cost per patient for the first year of treatment. Whenever possible, this covered a full twelve months on antiretroviral therapy for all patients included in the cost estimate. A few studies, however, included some patients not yet on ART in the average cost estimate, and others were ambiguous on this point. Almost all of the studies looked only at patients still on ART at the end of the costing period, thereby excluding the costs of mortality and loss to follow up of patients who initiated therapy. Finally, some studies considered only patients on first-line ARVs, while others included actual or estimated costs for patients who switched to second-line drugs during the year. Table 2 notes these issues for each study.

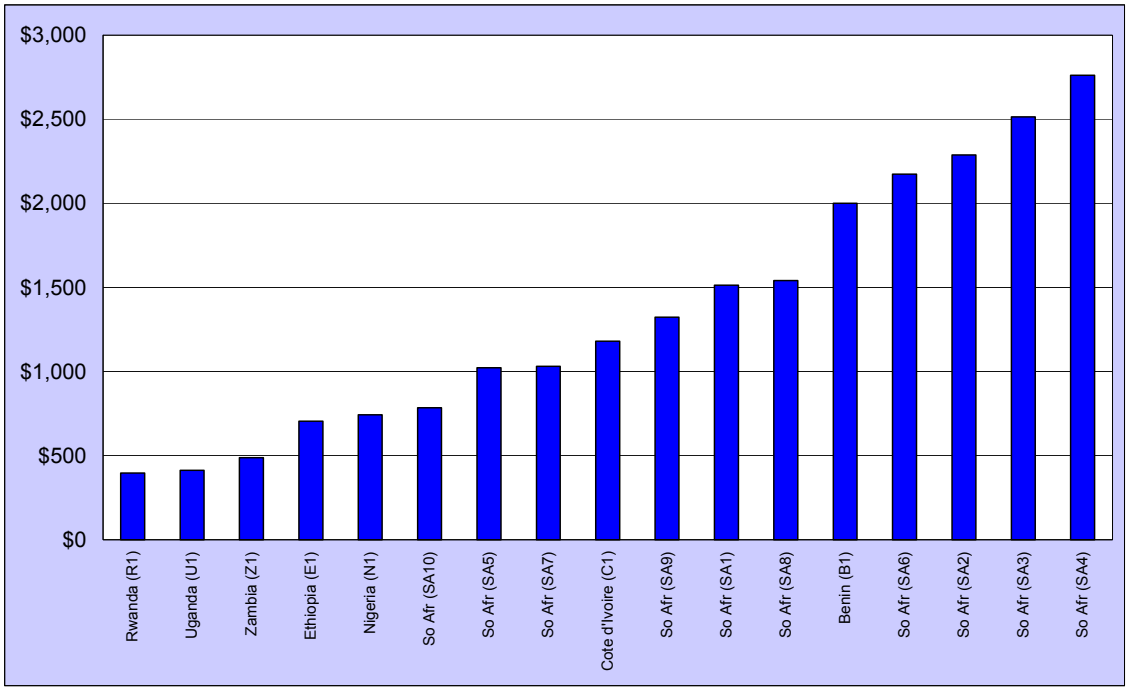
Table 2. Cost Estimates

Study reference number	Average cost/ patient/ year (USD)	USD year	Costing methods	Costs included	Major costs excluded	Inclusion of 2nd-line ARV regimen
B1	$2,000	N.A.	Average cost per ART patient based on patient and site records.	ARVs, lab, OI treatment, inpatient care, personnel.	Infrastructure unclear.	Unspecified
C1	$1,180	2002	Disease progression data from local clinical trial combined with local regimen and input prices.[a]	ARVs, lab, OI treatment , inpatient care, personnel, infrastructure.		1st line only.
E1	$705	2003	Local regimen and input prices, modeled with AIDSTreatCost	ARVs, lab, personnel.	OI treatment, inpatient care, infrastructure.	1st line only.
N1	$742	2004	Local regimen and input prices, modeled with AIDSTreatCost.	ARVs, lab, personnel. ARV and lab costs increased by 15% to account for wastage.	OI treatment, inpatient care, infrastructure.	1st line only.
R1	$396	2005	Average cost per ART patient based on patient and site records.	ARVs, lab, OI treatment, inpatient care, personnel.	Infrastructure unclear.	Unspecified
SA1	$1,513	2004	Resource use data from local clinical trial combined with current input prices.	ARVs, lab, OI treatment, inpatient care, personnel. Includes TB treatment.	Infrastructure.	Unspecified
SA2	$2,287	2005	Average cost per ART patient based on patient and site records.	ARVs, lab, personnel, infrastructure, management	OI treatment and inpatient care unclear.	2% of subjects switched to 2nd line ARVs over costing period.
SA3	$2,514	2005	Average cost per ART patient based on patient and site records.	ARVs, lab, personnel, infrastructure, management	OI treatment and inpatient care unclear.	2% of subjects switched to 2nd line over costing period.
SA4	$2,761	2005	Average cost per ART patient based on patient and site records.	ARVs, lab, personnel, infrastructure, management	OI treatment and inpatient care unclear.	2% of subjects switched to 2nd line over costing period.
SA5	$1,023	2003	Resource use and cost data from local cohort; modeled annual cost.[b]	ARVs, lab, OI treatment, inpatient care, personnel, infrastructure. Includes TB treatment.		0.48% of subjects switched to 2nd line after 6 months.

Study reference number	Average cost/ patient/ year (USD)	USD year	Costing methods	Costs included	Major costs excluded	Inclusion of 2nd-line ARV regimen
SA6	$2,173	2002	Average cost of claims reimbursed per patient-year in 2002 for patients registered on program in 1999 with starting CD4 count 100-200.	All claims to the managed care scheme (inpatient care, outpatient care, ARVs, lab).	Unclear. Not all subjects on ART for full year.	Unspecified.
SA7	$1,031	2004	Local regimen and input prices, modeled costs.	ARVs, lab, personnel, infrastructure	OI treatment, inpatient care.	1st line only.
SA8	$1,541	N.A.	Resource use and cost data from local cohort; modeled annual cost.[c]	ARVs, lab, OI treatment, inpatient care, personnel, infrastructure.		Unspecified.
SA9	$1,322	2005	Average cost of treatment per patient based on patient and clinic records.[d]	ARVs, lab, OI treatment, personnel, infrastructure.	Inpatient care.	Unclear, probably 1st line only.
SA10	$784	2005	Average cost per patient in the 12 months following medical eligibility for ART.	ARVs, lab, OI treatment, personnel, infrastructure. Cost of subjects who discontinued treatment included.	Inpatient care. Most subjects on ART for < 12 months.	14% of subjects received at least one 2nd line drug during costing period.
U1	$412	2003	Local regimen and input prices, modeled with AIDSTreatCost.	ARVs, lab, personnel.	Inpatient care, OI treatment, infrastructure	10% of patients assumed to be on 2nd line regimen.
Z1	$488	2003	Local regimen and input prices, modeled with AIDSTreatCost.	ARVs, lab. ARV and lab costs increased by 15% to account for wastage.	OI treatment, inpatient care, personnel, infrastructure.	1st line only.

N.A. = not available
[a] Cost shown is base case cost per life year gained, discounted 3%.
[b] Cost shown is average cost/life year gained, undiscounted.
[c] Cost shown is average cost/life year gained, discounted 3%
[d] Cost shown is cost is for month 1 + month 2 + average cost/month x 10

Figure 1. Average Cost per Patient per Year, in Ascending Cost Order



The specific items included in the cost estimates also vary. All of the estimates included the cost of ARVs and laboratory tests. The most complete estimates also included treatment of opportunistic infections, inpatient care, personnel (staffing) for outpatient care, and infrastructure. Some also accounted for the cost of program management. In most cases, treatment of opportunistic infections excluded tuberculosis, which is often treated at a separate facility. In some studies, small cost items were lumped together under an "other" category. To the extent possible, we indicate in Table 2 which items are included in or excluded from the total provided.

Finally, for studies that provided this information, the breakdown of the annual average cost into its main components is shown in Table 3.

Table 3. Distribution of Total Cost per Patient per Year in the Reviewed Studies

Study reference number	ARVs	lab	personnel	infrastructure	other
B1	77%	(other)	(other)	(other)	23%
C1	25%	(other)	(other)	(other)	75%
E1	67%	29%	2%	excluded	3%
N1	50%	23%	22%	excluded	6%
R1	75%	(other)	(other)	(other)	25%
SA1	48%	(other)	(other)	(other)	52%
SA2	30%[a]	28%	18%	1%	23%[d]
SA3	26%[a]	15%	29%	5%	26%[d]
SA4	29%[a]	28%	25%	1%	17%[d]
SA5	33%[b]	9%	17%	41%[c]	0%
SA7	44%	24%	23%	2%	7%
SA9	34%	18%	33%	9%	5%
SA10	53%[b]	19%	18%	9%	0%
U1	78%	18%	4%	excluded	0%
ZI	57%	36%	excluded	excluded	7%

[a]May include non-ARV drugs
[b]Includes non-ARV drugs
[c]Includes non-clinical personnel costs
[d]Primarily program management

Discussion

This review of the cost of providing antiretroviral therapy for HIV/AIDS in sub-Saharan Africa has three main limitations, beyond the small number of studies available for review. First, the cost estimates included here were drawn from a range of verified and unverified sources of variable quality. In several cases, only conference abstracts or slides or project reports were available. Abstracts rarely provide sufficient detail about methods or sources of data to allow for quality appraisal. While there is no reason to believe that the information provided is not an accurate reflection of costs at the time of the studies, many of the estimates were never scrutinized by external reviewers. They should thus be interpreted with caution.

The second limitation involves the age of the cost estimates. Antiretroviral drugs comprise the largest share of the total cost per patient in most studies, and the price of ARVs has fallen dramatically in the past three years. Prices for some laboratory tests, such as CD4 counts, have also come down. The older studies included in the review may therefore overestimate the current cost of providing ART.

Finally, the inconsistency in costing methods make comparison across studies hazardous. Each of the studies reviewed here used a different methodology for selecting costs to include, identifying resource utilization patterns, and assigning unit costs. Some presented only a discounted average cost per life year gained, others a marginal cost per patient-year added. Many excluded potentially major cost items, such as infrastructure, on the grounds that clinics and hospitals already exist and therefore do not contribute to the incremental cost of providing ART.

Despite these limitations, the studies reviewed in Table 2 do offer a ballpark indication of the cost of providing antiretroviral therapy in service delivery settings. This cost has so far averaged roughly $850/patient/year in countries outside South Africa and about $1,700/patient/year in South Africa. In both cases, median costs are slightly lower, at roughly $700/patient/year in non-South Africa countries and $1,500/patient/year in South Africa. The apparently higher costs in South Africa probably reflect both higher input prices and more complete cost estimates. If only the four South African studies that used recent cost data from public or nongovernmental sites (SA5, SA8, SA9, and SA10) are included, the average cost/patient/year is just under $1,200. This may represent a more accurate estimate of recent costs in South Africa. For non-South African countries, the mean cost is heavily influenced by the four estimates made with the AIDSTreatCost model (E1, N1, U1, and Z1), each of which excluded several major cost items.

Of the 17 cost estimates found, 10 come from a single country, South Africa. While it is not surprising that more research is being conducted in South Africa than in other countries, the generalizability of South African data to other countries in sub-Saharan Africa is uncertain. Labor costs are substantially higher in South Africa than elsewhere on the continent; on the other hand, transport and procurement systems are better developed and volumes of patients larger, which may bring costs down.

Across all the studies, ARV medications comprise a large proportion of the total cost per patient, but this proportion varies widely. In South Africa, ARVs account for, on average, just over one third of the total cost/patient, while in other countries, one half to three quarters of the total is attributable to ARVs. This likely reflects the higher cost of non-ARV inputs in South Africa, particularly labor and inpatient care. Some but not all of the studies reflect the low negotiated prices for ARVs that have been available in developing countries since 2004.

Perhaps the most striking finding of this review is the sheer dearth of high quality data available on the cost of providing antiretroviral therapy for HIV/AIDS in service delivery settings in Africa. While this may be an artifact of timing—it may simply be too soon for cost estimates from ART rollouts to have been published—the publication of clinical data from at least half a dozen national programs in multiple countries suggests otherwise. The absence of cost estimates is almost certainly also a reflection of the lack of attention to economic aspects of national programs among researchers and research funders. Costing is the simplest form of economic analysis, and among health economists, costing of service delivery interventions is often of less interest than modeling the cost effectiveness of potential interventions. Given the importance of accurate cost information to the sustainability of the treatment effort, however, generating this information, from a wide range of countries and settings, should be given high priority in the coming months.

The studies reviewed here provide little guidance to policy makers and program planners about the variation in costs associated with the location, scale, or sector (government,

nongovernmental, private) of facilities and programs,[3] the characteristics of the patient population, or the age of the treatment programs and concomitant average patient duration on ART. Now that large scale rollouts are underway, each of these issues can and should be investigated through operational research.

A second general finding of this review is the need for more consistent costing methods across countries and sites. Accepted methods for cost analysis and presentation of cost information do exist.[28] While no specific methodology can be imposed on researchers, wider use of standard costing methods and greater clarity in stating assumptions and approaches would greatly improve the quality of available data.

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Author Contributions

Both authors contributed to identifying and interpreting the studies reviewed in this paper and edited the manuscript. S Rosen drafted the manuscript.

Competing Interests

The authors declare that they have no competing interests.

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