Title

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Authors

Masaki, Emi
Green, Russell
Greig, Fiona
et al.

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Cost-Effectiveness of HIV Interventions for Resource Scarce Countries: Setting Priorities for HIV/AIDS Management

Emiko Masaki, MA, MPH; Russell Green, BA; Fiona Greig, BA; Julia Walsh, MD, MSc; Malcolm Potts, MB, BChir, PhD

Affiliation:
Bay Area International Group
School of Public Health (all authors) and
Department of Economics (R Green)
University of California at Berkeley, USA

Correspondence:
Emiko Masaki
Institute of Human Development
1101 Tolman Hall #1690
University of California at Berkeley
Berkeley, CA 94720-1690
emasaki@uclink.berkeley.edu

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ABSTRACT

Objectives: Despite recent foundation donations and bilateral commitments there are insufficient funds to implement all of the desired interventions for AIDS prevention and treatment. This paper explores one methodto analyze the allocation of limited budgets.

Methods: Based on existing data from African countries, we compare the cost-effectiveness of both HIV prevention and treatment interventions using cost per life-year saved as the outcome measure. We examined five prevention interventions: (1) voluntary counseling and testing; (2) prevention of mother-to-child transmission; (3) STD mass treatment for general population; (4) STD management for sex workers; and (5) blood screening – and four drug price scenarios for antiretroviral treatment for HIV+ patients. In a hypothetical country of one million people and a generalized epidemic, we performed a static budgetary simulation with constrained resources to estimate total life-years gained and number of HIV cases prevented/treated with only prevention or treatment interventions.

Results: Both the cost-effectiveness analysis and the budgetary analysis suggest that HIV prevention interventions are much more cost-effective than ARV treatment. Both blood screening and STD control among sex workers are the most cost-effective preventative interventions at the costs of $3.35 and $3.95 per life-year saved (LYS), respectively. ARV treatment is the least cost-effective, costing $1,317.20 per life-year saved at generic drug prices. In the budgetary simulation scenario with donated drugs, ARV treatment consumes the entire budget saving up to 2,974 life years annually. A portfolio of prevention interventions does not require the entire budget and results in 135,030 life years saved.

Conclusions: Both the cost-effectiveness analysis and the budgetary analysis suggest that HIV prevention interventions should be prioritized if poor countries hope to maximize the scarce resources available for reducing the impact of the AIDS epidemic.

Keywords: AIDS, cost-effectiveness analysis, resource allocation, health policy, Africa

INTRODUCTION

The magnitude of the HIV/AIDS pandemic continues to dwarf the resources committed to contain it. According to the most recent estimate from UNAIDS/WHO 42 million people are now living with HIV, and the total of 5 million people were newly infected with HIV in 2002, and a National Intelligence Council report raises fear of a second wave of the epidemic.(2) (7) The challenges for this ever-growing epidemic ensures that policy making on resource allocation today will have a significant impact on the future course of epidemic.

As of October 2002, $2.14 billion had been committed to the Global Fund to Fight AIDS, Tuberculosis, and Malaria.(1) However, to date the fund has only collected $500 million, and this is far short of the $7 to $10 billion needed annually for HIV/AIDS prevention, treatment, and care programs.(3, 4)

The recent reduction in HIV drug prices and development of the Global Fund has resulted in a renewed push to provide widespread antiretroviral (ARV) treatment to people living with HIV/AIDS in low-income (and some middle-income) countries. Pharmaceutical companies have reduced the prices of some ARV drugs for developing countries by up to 90%. The manufacturing of generic ARVs in Brazil, India, and Thailand has driven down drug prices, and some donations have been made of drugs needed to reduce mother-to-child transmission (MTCT).(5, 6) South Africa, Senegal, Uganda, and Botswana have all initiated HIV/AIDS treatment programs, and Kenya and Nigeria have imported generic HIV drugs.

Ultimately both in the donor community and in governmental and non-governmental accounting, expenditures on prevention and treatment compete with one another within the same budget. Moreover, HIV is most prevalent in resource-scarce countries that face a myriad of

health and other development needs and can least afford both large-scale HIV prevention and treatment campaigns. Therefore the governments of these countries are forced to prioritize their HIV program allocations.

This study follows Marseille et al. and Creese et al. (10), (11) in proposing the use of cost-effectiveness as a means of prioritization between needs for prevention and treatment. Cost-effectiveness analysis is a very effective tool to determine how to achieve the maximum effects within in a given budget or to achieve a desired effect at the lowest possible cost.(16) The devastating mismatch of needs and resources makes it especially relevant in the context of the HIV epidemic. However, cost-effectiveness is not the only tool to prioritize needs in a resource scarce environment, and policy makers may find many other compelling criteria for resource allocation that are beyond the scope of cost-effectiveness analysis.

In reality, program allocations are influenced by developed world best-practice guidelines, disjointed donor mandates, and political palatability, rather than cost-effectiveness and impact on the epidemic.(8, 9) Policy-makers have received limited guidance in how to prioritize their HIV/AIDS budgets in terms of cost-effectiveness of prevention versus treatment schemes. The Global Fund makes no stipulations regarding how to distribute resources for prevention and treatment. Despite emphatic calls for analyses comparing cost-effectiveness of prevention and treatment programs in resource-scarce settings,(9) dissimilarity between program outcome measures has inhibited comparison.

Several studies have compared the cost-effectiveness among HIV prevention interventions(17-20) or among treatment interventions.(21) Only a few have compared prevention and treatment and usually only in the context of MTCT.(21, 22)

Similar limitations exist in the literature of projecting costs of HIV interventions. Several studies have projected the costs of HIV interventions but compare only prevention schemes or do not consider effectiveness and budget limitations.(3, 21, 23-25) These limitations hinder the applicability of the existing literature to policymakers in resource-scare settings.

This study aims to provide information to policy makers to aid their decision-making on resource allocation in resource scarce settings.

It evaluates the costs and effectiveness of various HIV interventions in developing countries using cost per life year saved as an outcome measure. We then construct a static budgetary simulation that demonstrates the potential impact of various interventions when financially constrained. This allows the cost-effectiveness tradeoff to be viewed in a realistic setting more likely faced by policymakers.

METHODS

We developed two methods of comparison to analyze the impact of policy choices on the HIV epidemic in a resource scarce setting. First, we compared the cost-effectiveness of various HIV interventions, using cost per HIV case averted and cost per life-year saved as our outcome measures. Second, we constructed a simple static budgetary simulation model using a hypothetical country modeled after Kenya to evaluate impacts of allocating the limited budget for prevention or for treatment on the HIV/AIDS epidemic. In this analysis we compare the total LYS when the budget is allocated exclusively to prevention interventions or to treatment.

We use LYS as our measure for comparison between different interventions and the two different budget allocations. This contrasts with a number of studies that use intervention-specific outcome measures such as cost per condom distributed, but also with more comparative

studies that calculate cost per disability-adjusted life years (DALY) saved. By using LYS we assume that a year of treatment for an AIDS patient has the same utility value as a year of life of a person not infected with HIV. This is probably an optimistic assumption in view of the known side effects of the drugs and the delay in resolution of AIDS symptoms after beginning therapy. Very little is known about the quality of life of HIV/AIDS patients in developing countries.

Model 1: cost-effectiveness analysis

We compared the cost-effectiveness of five HIV prevention interventions and one treatment program: (1) voluntary counseling and testing (VCT); (2) prevention of mother-to-child transmission (MTCT); (3) population-wide diagnosis and treatment of STDs; (4) STD management and control program focused on commercial sex workers; (5) blood supply screening; and antiretroviral therapy treatment. We restricted our analysis to these six interventions because of the availability of published cost and effectiveness data from African countries.

In order to estimate the cost-effectiveness of the five prevention interventions, we obtained estimates of cost per HIV case averted from prevention intervention studies conducted in sub-Saharan African countries (see Table 1). These cost estimates included only direct provider costs and were discounted at 3%. We adjusted all cost estimates into year 2000 US dollars. From these cost estimates we calculated the cost-per LYS for each prevention intervention based on the following four assumptions: 1) mean survival time from infection to death for HIV+ infants is 3.5 years; 2) mean survival time from infection to death for HIV+ adults is 10 years; 3) mean age of HIV diagnosis is 27 years old; 4) life expectancy at birth is 52 years, based on Kenya's 1997 life expectancy. We used the actual life expectancy in Kenya,

which includes AIDS-related mortality, to conservatively represent the risk of re-infection outside the scope of the intervention.

We estimated the costs of ARV treatment based on flat program costs for administering the treatment and four drug price scenarios for the triple combination therapy, consisting of zidovudine (AZT), didanosine, and nevirapine, a standard protocol for symptomatic HIV treatment. We considered the following four drug price scenarios: (1) average full prices available as of June 2000 in African countries;(26) (2) reduced prices negotiated for Uganda through the UNAIDS/Ministry of Health HIV/AIDS Drug Access Initiative;(27) (3) proposed prices for generic drugs from the Indian pharmaceutical firm Cipla;(28) and (4) drugs donated free of charge. We considered the scenario in which drugs are provided at no charge based on the recommendation of the Harvard Consensus that HIV/AIDS treatment be funded by international donations[1].

The program costs for provision of ARV treatment in developing country settings ranges from $350 per patient from Brazil's national treatment program to $1,123 per patient, according to the Harvard Consensus Report. Other analysts suggest using program cost estimates of tuberculosis directly observed therapy (DOT), as it has been suggested as a proxy for ARV therapy program costs.(30) The program cost of tuberculosis treatment in South Africa range from $672 for DOT to $1,897 for conventionally delivered treatment.(31) We used $672 as a middle range estimate of the flat cost to administer and monitor the ARV treatment therapy. Because there is no data on the effect of HAART treatment on life expectancy, we assumed with continued treatment, recipients would live out to Kenya's life expectancy of 66 years without

[1] Labeling drugs as free depends on point of view. Clearly they are not free to donors, who face their own budgetary trade-offs, but this paper is concerned with the point of view of individual countries.29. Babiker A, Darbyshire JH, Gill ON, Johnson AM, Phillips AN, Porter K, et al. How soon after HIV seroconversion is antiretroviral therapy initiated? Aids 1999;13(10):1241-1247.

AIDS mortality instead of Kenya's current life expectancy of 52 years. We assumed that compliance with the drug regimen would be 100% and that treatment starts upon diagnosis. The treatment start time is based on the finding that HIV carriers in the United States and in sub-Saharan Africa do not get tested until they become symptomatic,(32, 33) which occurs approximately two years after seroconversion in sub-Saharan Africa[2]. Because an untreated HIV+ person would live for 10 years after infection, ARV treatment allows an HIV+ person to live an additional 29 years. Program costs and assumptions for calculating cost-effectiveness of ARV treatment are presented in Table 2.

Model 2: Budgetary Simulation Analysis

Results from Model 1 were used to construct the budgetary simulation analysis for a hypothetical country with a population of one million. We modeled our hypothetical country with socioeconomic, demographic, and epidemiological indicators that are similar to Kenya's. We chose Kenya as our model country because it is a high prevalence country with low budgetary resource that faces the critical choices exemplary of the analysis we hope to perform. Secondly, the depth of published research in Kenya and its immediate neighbors facilitates the accurate assignment of parameters in our model.

The hypothetical country has a population of one million with 48% aged 15 to 45 and crude birth and death rates of 35 and 13 per 1000 persons. It has a slowly rising adult HIV prevalence rate of 15%(35) with heterosexual transmission of 90%,(36) blood transmission of 7%(37, 38), and mother to child transmission of 3% as the major means of HIV transmission.

[2] In the United Kingdom the time between seroconversion and treatment initiation averaged between 6 months and 5 years depending on year of infection and availability of treatment.34. Morgan D, Mahe C, Mayanja B, Whitworth JA. Progression to symptomatic disease in people infected with HIV-1 in rural Uganda: prospective cohort study. Bmj 2002;324(7331):193-6.

Based on a projection from HIV sentinel surveillance data(35) and levels of current prevention efforts, we assumed that there would be 10,690 new infections each year in the absence of any prevention efforts. We assumed that our hypothetical country has a moderate health infrastructure and a number of limited HIV/AIDS prevention interventions already in place. The hypothetical country has a $2.00 per capita AIDS budget or a total of $2 million to spend on HIV/AIDS interventions. This assumption is consistent with current per capita expenditures in sub-Saharan African countries of about $1.57.

In the budgetary analysis we estimated the maximum number of people that could benefit from each prevention program based on the means of transmission, the size of the target population, and participation rate in each program. In order to adjust for overlap between interventions of target populations, we reduced the affected population for each intervention by 10%. As an example of overlap, an individual might prevent infection through participation in both a VCT program and an STD management program, but the infection prevention should not be counted twice. This level was chosen as a rough estimate in the absence of any data or model for guidance. We present the parameters for each intervention below.

Blood Screening Program: A total of 3000 units of blood was assumed to be donated each year(39) at a unit cost of $14.87.(40) The HIV prevalence among donors and recipients is assumed to be 6.4% and 15% respectively,(41) and the average number of units transfused per patient is assumed to be 1.23.(40) Based on the HIV prevalence rate, 192 units of donated blood is assumed to be infected with HIV.

Voluntary Counseling and Testing Program: The entire population aged 15 to 49 is assumed to be the target of the VCT program. Five percent of them, totaling 24,499 people, are assumed to enroll in the VCT program at a cost of $28 per person in the target population.(42)

Population-wide STD Treatment: We assume the entire population aged 15 to 49 is targeted for population-wide STD treatment. We used the total cost of intervention from the Mwanza study in Tanzania, assuming that STD prevalence rates of these two countries are similar[3]. The program costs is $0.96 per person aged 15 to 49 years.

STD Management for Sex Workers:

The STD management program specifically targets sex workers in urban areas,(47) and we assumed that 3% of the total urban population aged 15-49 years in our hypothetical country is involved in sex work.(48-50) We assumed that 25% of sex workers participate in the STD management program at a cost of $101.45 per person participating.

Mother to Child Transmission Prevention Program: In Model 1 we examined the cost effectiveness of use of both AZT and Nevirapine for prevention of mother to child transmission.(51, 52) However, for the budgetary analysis we assumed the MTCT prevention

[3] The Rakai study was not selected because the study population's STD rates were low. 43. Wawer MJ, Gray RH, Sewankambo NK, Serwadda D, Paxton L, Berkley S, et al. A randomized, community trial of intensive sexually transmitted disease control for AIDS prevention, Rakai, Uganda. Aids 1998;12(10):1211-25, 44. Over AM, Piot P. HIV infection and sexually transmitted diseases. Washington, D.C.: Population Health and Nutrition Division Population and Human Resources Dept. World Bank; 1991, 45. Grosskurth H, Mosha F, Todd J, Mwijarubi E, Klokke A, Senkoro K, et al. Impact of improved treatment of sexually transmitted diseases on HIV infection in rural Tanzania: randomised controlled trial. Lancet 1995;346(8974):530-6. Syphilis rates are lower in Kenya than in Mwanza, but gonorrhoeae and chlamydia rates are higher, so overall curable STD rates are comparable to Mwanza. Although Kenyan HIV prevalence is somewhere between that of Rakai and Mwanza, the growth of the prevalence rate is more similar to Mwanza.46. US Census Bureau. HIV/AIDS Profiles: Kenya; 2000 June 2000.

intervention would use AZT because of its more widespread use[4].(52) Because AZT is much more expensive than Nevirapine, our results provide a higher estimate of the cost per HIV infection averted. With a crude birth rate of 35 per 1,000 persons, we estimated that 35,000 babies would be born each year. Based on sentinel surveillance of pregnant women in Kenya, we assumed that 14.4% of pregnant women would be HIV+. We assumed that 25% of all pregnant women would participate in the VCT program, and 75% of those identified as HIV-positive would participate in the MTCT prevention program at a cost of $372.1 per person.

ARV Treatment for HIV+ Patients: Results from the four ARV drug price scenarios from our first model are used to calculate the total intervention costs assuming 50% of the HIV+ population participates. Based on these four ARV intervention costs we also estimated the number of HIV+ people that could be covered within the AIDS budget constraint.

[4] Marseille et al. (1999) showed that Nevirapine is more cost effective than AZT costing only $11.69 per person for targeted treatment. As a result, countries are starting to use Nevirapine rather than AZT for MTCT prevention.

RESULTS

Results from the cost-effectiveness analysis indicate that all of the prevention interventions are more cost-effective than ARV treatment, even when drugs are donated (Table 3). Among the prevention programs, blood screening and STD control for sex workers are the most cost-effective preventative interventions, costing $3.35 and $3.95 per LYS. The least cost-effective prevention program is prevention of MTCT through AZT, which costs $213.66 per LYS. However, it is four times more cost-effective than ARV treatment using donated drugs, which costs $857.95 per LYS. At the average price for ARV drugs in African countries in 2000, ARV treatment costs more than $10,000 per LYS. Securing access to generic drugs would make ARV treatment even more cost-effective, costing $1,317.26 per LYS.

Results of the budgetary simulation analysis are summarized in Table 4. The most notable finding from this analysis is that the five prevention interventions could avert 8,855 new HIV infections, costing only $1,806,931, which represents 90% of the total $2 million AIDS budget. The most cost-effective intervention, STD control and management for sex workers, can prevent 4,789 HIV infections, representing 21% of the AIDS budget. The VCT program is the largest budget item, preventing 2,360 HIV cases and taking up 34% of the AIDS budget (see Figure 1). Since not all infections can be averted through this portfolio of interventions, the remaining 10% of the AIDS budget could be used for other interventions such as education, condom distribution, or treatment and care.

The results from the budgetary analysis indicate that given an adult HIV prevalence of 15%, an AIDS budget of $2 million is insufficient to treat every HIV+ person. If the entire budget were allocated to treatment, between 238 and 2,974 people could be treated depending on the price of the ARV drugs. This represents between only 0.32% and 4.1% respectively of the

total adult HIV+ population. If, on the other hand, the hypothetical country attempted to treat 50% of its adult HIV+ population (this may be ambitious given so few know their HIV sero-status), it would require a budget almost 12 times larger using donated drugs or 154 times larger paying the full price for drugs.

The most dramatic difference between prevention and treatment interventions is in LYS. The least cost effective prevention program (MTCT) saves as many life years as the most cost effective ARV drug price scenario. The full set of prevention interventions would save roughly 45 times as many life years as ARV therapy with donated drugs.

This study demonstrates the importance of doing cost-effectiveness analyses in ways that are useful to policy and decision-makers. Applying budget constraints to cost projections tangibly illustrates the impact of policy decisions on the lives of people facing the threat of HIV/AIDS. Because of the difference in cost effectiveness between strategies, future funding decisions can have dramatic effects on the impact of the AIDS epidemic in poor countries.

DISCUSSION

Since the governments have a strong incentive to control the epidemic as early as possible, it is important to prioritize interventions in order to achieve the maximum effect within a given budget. When resources are limited and the epidemic is at an early stage, HIV prevention efforts have a much greater impact on the epidemic than public provision of a comprehensive ARV treatment. Cost-effectiveness analysis is one of the most useful tools in deciding among alternative interventions when resources are scarce. However the nature of cost-effectiveness analysis on interventions in sub-Saharan Africa is that necessary information is never complete or uniform. In order to estimate cost-effectiveness we used the best published data on program

costs of the six interventions we compared. However, due to differences in time, location, and costing methods, these estimates may not be exactly comparable.

Cost-effectiveness analyses should take into consideration secondary infections and the timing of interventions relative to the stage of the epidemic. Because it is difficult to measure the effects of interventions on secondary infections, however, almost no cost studies, except ones based on simulation, have assessed the effects of interventions on secondary infections, and neither does this study. . Our cost-effectiveness figures, especially for interventions that prevent infections in high-risk groups, are therefore somewhat underestimated. It is widely documented that prevention is most effective at earlier stages of the epidemic.(24) Although Kenya is not in the early stage of its epidemic, the prevalence rates continue to grow in rural areas.(46)

This analysis has modeled simultaneous implementation of several interventions in a simple way. We have included a rough measure of overlap among target populations, which reduces cost effectiveness, but have ignored the potential cost savings of integrating interventions, e.g. running STD management and VCT from the same clinic. Overlap and participation rates had the most influence on the results of all assumptions made. The results were linearly dependent on these assumptions, so that a 10% increase in overlap results in a 10% decline in number of cases averted with no effect on cost. A simple sensitivity analysis(53) showed, however, the general order of magnitude of the results is robust to wide variation in these assumptions.

Due to lack of data on effectiveness measured in terms of LYS, this study did not include prevention interventions such as education programs, population-wide condom distribution, or potential future interventions such as male circumcision and promotion of vaginal microbicides or female condoms programs. These interventions are likely to be as cost-effective as those

included in this study. If this were the case, they could be implemented using the surplus from the prevention scenario in the budgetary analysis.

This study highlights the need to include a diversified portfolio of interventions, because many programs complement each other and target specific, exhaustible populations; a government cannot efficiently spend its entire HIV/AIDS budget on MTCT program because there are a limited number of HIV+ pregnant women. Different programs, such example of education, condom distribution, and STD control, may act synergistically, although unfortunately we lack the evidence-based tools needed to evaluate the optimal allocation of money to these interventions.

Because the program costs of DOT ARV treatment are high, treatment cannot be as cost effective as prevention. However, even if we were to adopt the program costs of the Brazilian AIDS treatment program ($350), ARV treatment would still be less cost-effective than the least cost-effective prevention program (MTCT prevention with AZT). In addition, we have assumed that treatment would be initiated upon diagnosis. If treatment were delayed one additional year after infection, cost per life year save would decrease by 3%.

Taking into account the limitations of the data, even under the most conservative assumptions about every possible variable HIV prevention has a much greater impact on the epidemic and uses far fewer resources than treatment. If impact on the epidemic is our primary concern, we need to use cost-effectiveness as our primary decision-making tool.

We recognize that in reality cost-effectiveness is not the only criterion on which resource allocation is based. Other considerations include the predominant means of HIV transmission, the amenability to change with regards to behaviors and social norms, along with a myriad of ethical and political factors.(20) For example, countries must consider AIDS interventions such

as orphanage care, home-based care, and treatment of opportunistic diseases in their budget allocations. In 2001 Malawi allocated approximately 9% of its AIDS budget to AIDS care activities.(54) However, to date patients have been mostly responsible for their treatment costs, and this is likely to continue. Furthermore, allocating all resources to prevention, would not eradicate the disease. In our first budget allocation scenario – HIV prevention programs only – 83% of the assumed new infections annually would be averted, and even an ideal prevention campaign may not be able to fully contain the disease.

Treatment has been advocated using several arguments not considered in this study. First, the availability of treatment may create an incentive to get tested for HIV by reducing the stigma against people living with HIV/AIDS and improving the prospects of life with HIV/AIDS, thus making prevention more effective.(25), (55), (56)

Secondly, treatment reduces the viral load in HIV+ individuals, thereby reducing the probability of HIV transmission to others.(25) However, some studies indicates that the availability of treatment has been positively correlated with an increase in risky behavior among homosexual men in some developed countries.(43, 57, 58) As to date, there is no data to indicate the ambiguities to repute nor dispute the correlating effects of viral load treatment to risk behavior.

Thirdly, countries with higher prevalence rates consider HIV treatment necessary to reduce the economic and social burden of disease, which in the short run prevention alone cannot do.(25) However, it is unlikely that this burden will be alleviated if budgetary limitations restrict treatment to only 3% of HIV+ individuals.

Human Rights and Ethics:

Finally, the human rights perspective assigns a moral imperative to treatment. This perspective should motivate a strong commitment from the international community to finance a comprehensive HIV/AIDS response that includes treatment. Until sufficient resources are mobilized, a cost-effectiveness analysis takes moral precedence, insofar as treating one HIV-infected individual denies program funding which would prevent the infection of between 5 and 42 individuals, depending on price scenarios.

We acknowledge that cost-effectiveness approach is not the only or the most desirable criteria for the resource allocation on AIDS in the grounds of ethical and human rights perspective. The actual fund allocation and budgeting are often under the political control, and rational economic criteria are least employed in such settings. Generally, treatment is more politically appealing than prevention. Effects of treatment are immediate, while effects of prevention are often much slower to occur. In addition, people living with HIV/AIDS are much more visible constituents than people who are at the risk of HIV infection. Thus, there are clear interests among people who are affected with HIV/AIDS to lobby politicians and governments to improve access to treatment whereas not as much as efforts are made for preventative interventions to protect their health from future infections. Ideal policy measures is to meet both needs of prevention and treatment - controlling the epidemic as effective as possible while providing all necessary care and support for people who are affected with the disease. When countries are not able to make the best and most desirable policy, policy makers of the countries still need to be well informed about the alternative options and their expected outcomes in order to make the second best decision.

In order to better inform the policy makers about these policy choices and prioritization among interventions, consistent monitoring and evaluation of the interventions are essential to

accurately measure the effectiveness as well as the costs. As both costs and effectiveness vary at the settings and at the stages of epidemic, more studies should be conducted in developing countries, where the majority of infections occur and resources are extremely constrained, in order to provide informative representation for policy makers in making decisions.

Table 1. Comparison of Cost Effectiveness of HIV interventions measured as cost per HIV case averted

Activity	Cost per HIV infection averted	Location
Blood screening for HIV (40)	$39.98	Zambia
Voluntary counseling and testing (VCT)(42)	$263.05	Kenya
STD management for sex workers (47)	$15.73	Kenya
STD mass treatment for general population (36)	$267.10	Tanzania
Short course ARV treatment for pregnant women (51)	$5423.77	Sub-Saharan Africa
Single-dose Nevirapine (ARV) for pregnant women (52)	$285.23	Sub-Saharan Africa

Table 2. Costs of ARV treatment per patients per year with various price scenarios

Assumption	Full Price	UNAIDS negotiated price	Proposed price for generic drugs	Donated Drugs
Monthly cost of drugs	$643.3	$80.0	$30.0	$0
Annual cost of drugs	$7,719.6	$960.0	$360.0	$0
Life Expectancy	66	66	66	66
Mean age of infection	27	27	27	27
Time to initiate treatment after diagnosis	2	2	2	2
Average survival time	10	10	10	10
Life years gained by treatment	29	29	29	29
Total survival time with treatment	37	37	37	37
Lifetime cost of drugs	$285,625. 2	$35,520.0	$13,320.0	$0
Annual program cost per patient	$672.5	$672.5	$672.5	$672.5
Total cost per treatment	$310,505.7	$60,400.5	$38,200.5	$24,880.5
Annual cost per patient	$8,392.1	$1,632.5	$1,032.5	$672.5

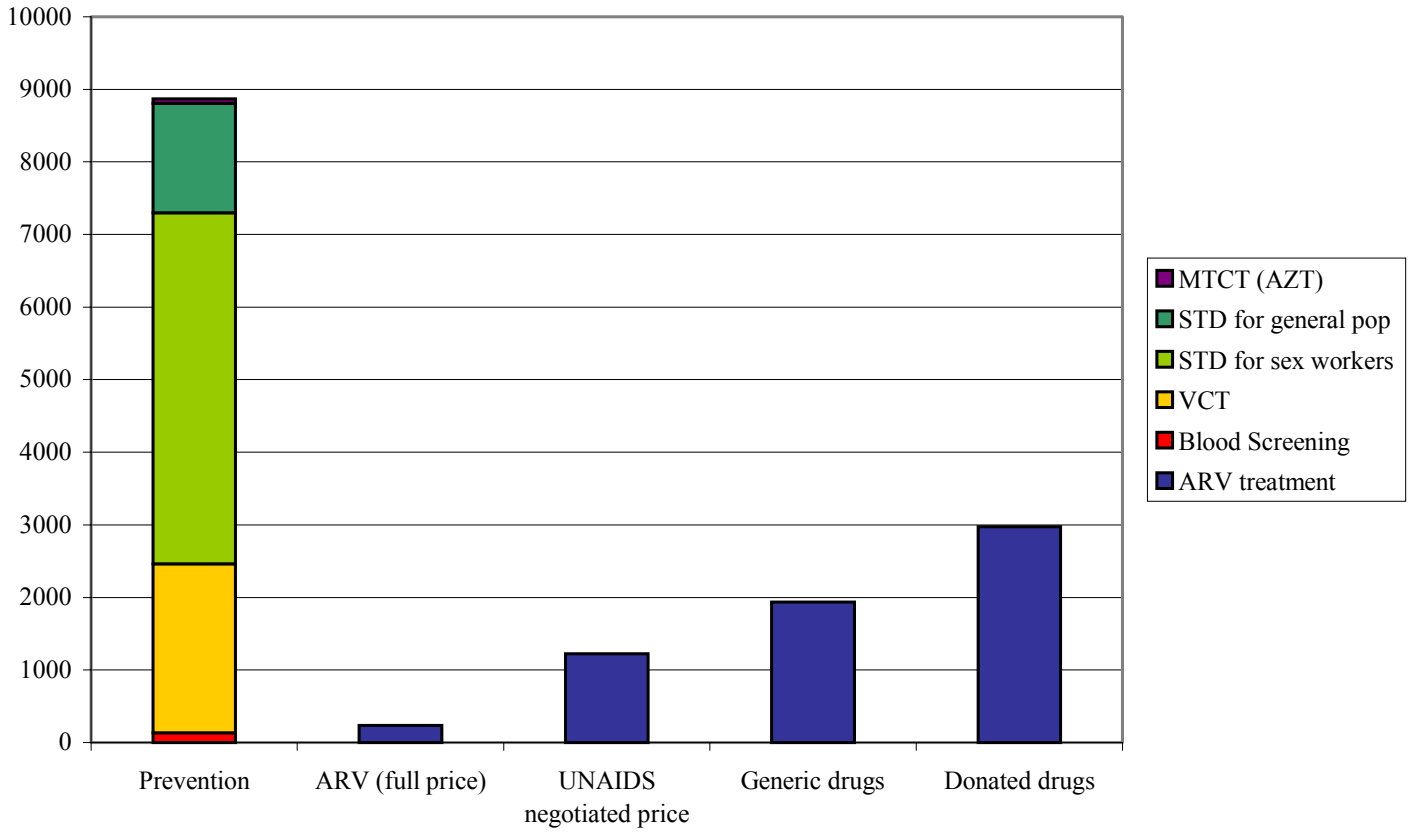
Table 3. Comparison of Cost-Effectiveness of HIV interventions measured in cost per life year saved

	Intervention	Cost per life year saved
Prevention	Blood screening for HIV	$3.35
	STD control and management for sex workers	$3.95
	Single-dose Nevirapine for pregnant women	$11.24
	Voluntary counseling and testing (VCT)	$22.03
	STD mass treatment for general population	$22.32
	Short course ARV treatment for pregnant women (AZT)	$213.66
ARV treatment	Donated drugs	**$857.95**
	Proposed price for generic drugs	**$1,317.26**
	UNAIDS negotiated price	**$2,028.78**
	Full price in 2000	**$10,707.09**

Table 4. Budgetary Simulation Analysis

Interventions	Budget required	% AIDS budget	Cases averted/treated	Life years saved	% annual infections averted	% infections treated
Total Prevention	$1,809,468	90%	8,903	135,602	83%	
Blood Screening	$44,610	2%	133	1,995	1%	
VCT	$689,649	34%	2,360	35,394	22%	
STD for sex workers	$251,089	13%	4,789	71,837	45%	
STD for general pop	$469,210	23%	1512	22,680	14%	
MTCT using AZT	$352,373	18%	61	2,971	1%	
ARV (full price)	**$2,000,000**	**100%**	**238**	**238**		**0.3%**
UNAIDS negotiated price	**$2,000,000**	**100%**	**1,225**	**1,225**		**1.7%**
Generic Drugs	**$2,000,000**	**100%**	**1,937**	**1,937**		**2.6%**
Donated Drugs	**$2,000,000**	**100%**	**2,974**	**2,974**		**4.4%**

Figure 1. Number of cases averted vs. treated within the budget



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