The Potential Impact of HIV/AIDS Interventions on the HIV/AIDS Epidemic in Africa: A Simulation Exercise for the World Bank

Lori Bollinger and John Stover
Futures Institute
Glastonbury, CT

March 3, 2007

Introduction

Although some progress has been made against the HIV/AIDS epidemic in sub-Saharan Africa, HIV prevalence remains high. This trend results from a large number of new infections occurring each year and the wider availability of antiretroviral treatment (ART), which results in longer lives for those currently HIV positive.

The World Bank developed its initial Multi-Country AIDS Program (MAP) in 1999, their program to reduce the impact and future path of the HIV/AIDS epidemic in sub-Saharan Africa. Since that time, the landscape surrounding the epidemic has changed dramatically: some countries have successfully reduced HIV incidence, resulting in valuable lessons learned about effective interventions, and more funding has become available through a wider variety of sources, which would allow for higher coverage of these effective interventions.

Given this new information, the World Bank has decided to update its approach regarding the HIV/AIDS epidemic, and write a new strategy plan, Agenda for Action 2007-2011. This background paper will examine some of the important issues and data pertaining to this new strategy, including answering questions such as:

- What is the appropriate level and type of funding for different epidemic profiles in sub-Saharan Africa?
- Which interventions would have the most impact on the HIV/AIDS epidemic?
- What is the impact of increased availability of ART?
- What is the impact of various specific prevention interventions (e.g., condom distribution, STI treatment, programs to prevent mother-to-child transmission)?
- What would be realistic and compelling goals for 2007-2011?

Much of the analysis in this paper is based on results previously obtained for UNAIDS and published in *Science* and by UNAIDS.[1] In addition, the relative cost-effectiveness analysis of specific interventions is based on ten country-level applications of the ***Goals*** model, a model which supports strategic planning at the national level by providing a tool to link program goals and funding.[2]

Current Status of the HIV/AIDS Epidemic[3]

As can be seen in Figure 1 below, HIV/AIDS continues to affect a great number of people in sub-Saharan Africa. At the end of 2005, UNAIDS estimated that over 22 million people were living with the virus in the three regions of sub-Saharan Africa: Southern, East, and Central/West Africa. The majority of these people, about 51 percent,

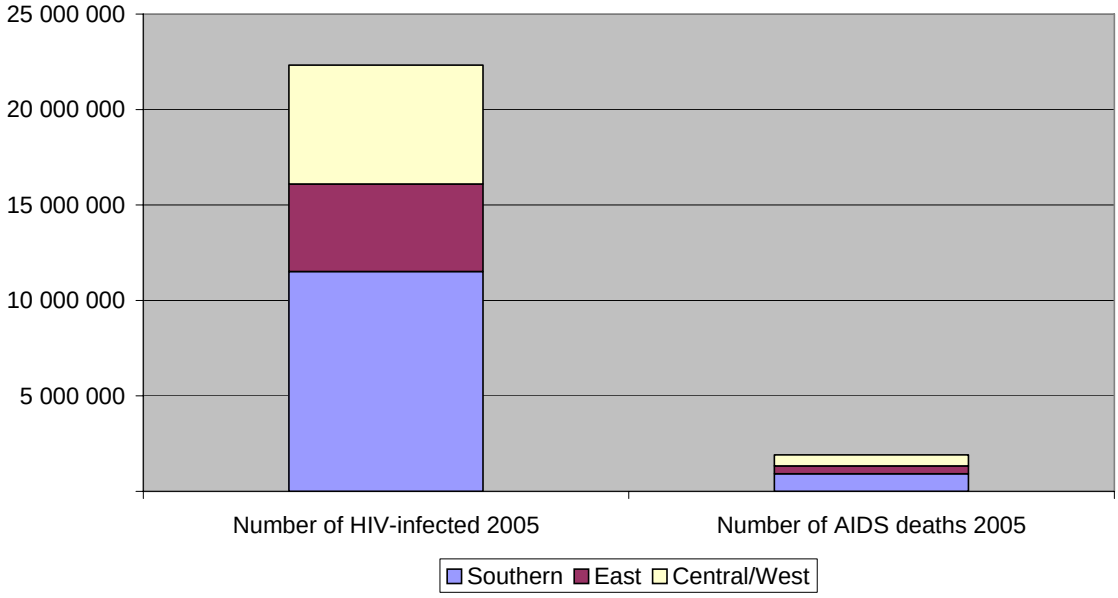
[1] Stover J, Bertozzi S, Gutierrez JP, Walker N, Stanecki KA, Greener R, Gouws E, Hankins C, Garnett GP, Solomon JA, Boerma JT, De Lay P, Ghys PD. The Global Impact of Scaling-Up HIV/AIDS Prevention Programs in Low- and Middle-Income Countries, *Science* 10 March 2006; Vol 311.no.5766, pp. 1474-1476; UNAIDS, "Resource needs for an expanded response to AIDS in low- and middle-income countries" (UNAIDS, Geneva, August 2005).

[2] Futures Group, "Goals model for estimating the effects of resource allocation decisions on the achievement of the goals of the HIV/AIDS strategic plan"(Futures Group, Washington DC, 2005); accessed on November 13, 2006 at http://www.constellafutures.com/Resources.cfm?area=2a&get=GOALS.

[3] Data in this section are from: UNAIDS, 2006 report on the global AIDS epidemic (Geneva, May 2006); accessed on November 13, 2006 at http://www.unaids.org/en/HIV_data/2006GlobalReport/default.asp).

are in Southern Africa, which contains over 11.5 million infected people. The Central/West region accounts for about 21 percent of the total HIV infected population, or over 6 million infections, and East Africa has about 28 percent of the total, approximately 4.5 million infected people.

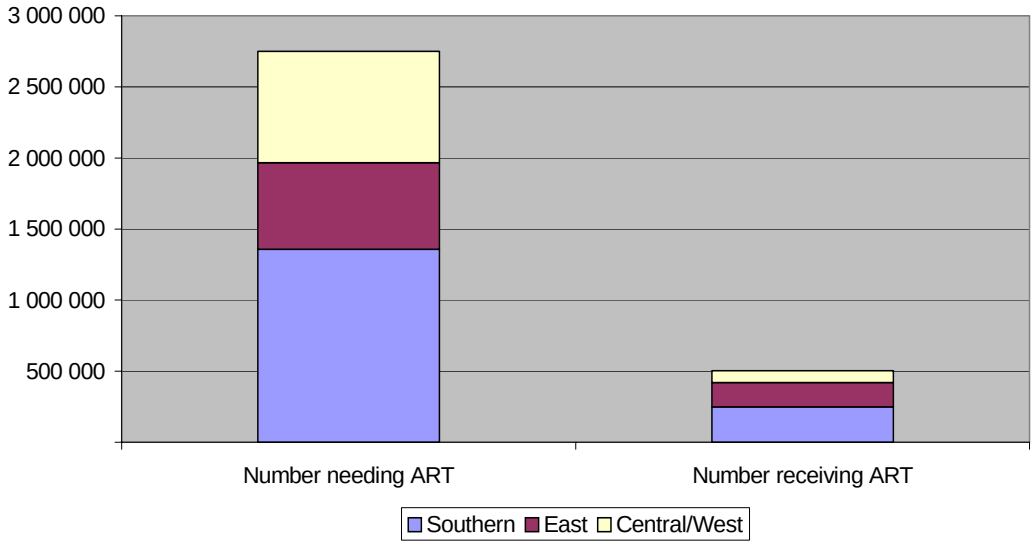
Figure 1
Status of the HIV/AIDS Epidemic in sub-Saharan Africa (2005)



The regional pattern of number of people infected with HIV in sub-Saharan Africa is repeated in the regional pattern of number of AIDS deaths in 2005, also shown in Figure 1. The largest number of deaths, over 900,000 or about 48 percent of the total, was in Southern Africa. There were about 570,000 deaths from AIDS, or 30 percent of the total, in Central/West Africa, while there were about 416,000 AIDS deaths in East Africa, or about 22 percent of the total number of AIDS deaths. Thus in 2005, over 1.9 million people died from AIDS in sub-Saharan Africa.

As noted in the introduction, there has been increasing coverage of ART in sub-Saharan Africa over the last several years. At the end of 2005, over 2.5 million people were in need of ART, as defined by UNAIDS, where about half of these people were in Southern Africa (1.3 million people), about 28 percent were in Central/West Africa (780,000 people), and approximately 22 percent were in East Africa (600,000 people) (see Figure 2). The number of those receiving ART varied from a high of about 250,000 in Southern Africa to 170,000 in East Africa to a low of 84,000 in Central/West Africa.[4] Because of the higher burden of disease in Southern Africa, however, the number of people in need of ART who were actually receiving it translates into coverage rates ranging from a low of 10 percent in Central/West Africa, to Southern Africa at 18 percent, to a high of 28 percent in East Africa.

Figure 2
Current Status of Coverage of Antiretroviral Treatment in sub-Saharan Africa
(2005)



[4] South Africa announced on November 13, 2006 that 235,378 patients are receiving ART, up from 178,000 at the end of June. Catherine Maddux, "Quarter Million South Africans Getting Free AIDS Drugs" Voice of America News (11.13.06).

Coverage of other key interventions for sub-Saharan Africa in 2005 is shown in Table 1. Coverage ranges from a low of 2 percent for adults receiving VCT services, to a high of 89 percent of primary school children receiving HIV/AIDS education in their schools. Note that not all countries report having interventions, so that the figure of 59 percent for IDU harm reduction programs and 18 percent for MSM outreach programs are likely to be overstated.

Table 1
Coverage of key interventions for sub-Saharan Africa in 2005

Intervention	*Coverage (Weighted average)*	*Number of Countries Reporting*
Voluntary Testing and Counseling	2%	27
Women offered PMTCT services	10%	27
Risky sex acts protected by publicly distributed condoms	21%	35
SW covered by outreach programs	23%	49
MSM covered by outreach programs	18%	10
Male prisoners covered by programs	46%	27
Street children covered by programs	15%	26
AIDS education in primary schools	89%	28
AIDS education in secondary schools	78%	27
Home-based care	15%	24
Cotrimoxazole prophylaxis against opportunistic infections for adults	29%	15
Cotrimoxazole prophylaxis against opportunistic infections for children	2%	11

Source: J Stover and M Fahnestock, "Coverage of selected services for HIV/AIDS prevention, care and treatment in low- and middle-income countries in 2005," Constella Futures, July 2006.

Description of Scenarios

There are three different scenarios that are used in this paper: Base, Prevention, and Treatment. The ***Base*** scenario assumes that the coverage levels of prevention and treatment interventions that existed in 2005[5] remain at the same level throughout the projection time period. Based on this assumption, HIV prevalence is then projected for 44 sub-Saharan African countries using country-specific models that were developed by UNAIDS and WHO.[6] The number of new infections and other variables such as deaths from AIDS were then calculated using the Spectrum software package.[7]

The ***Treatment*** scenario consists of increasing coverage from the current levels that are in the ***Base*** scenario to reach universal access by 2010. Universal access is defined as covering 80% of adults and children in need of ART, and covering 80% of children in need of cotrimoxazole prophylaxis. Annual costs of care and treatment are based on data from Khayelitsha, South Africa, including data on costs of and progression to first-line and second-line therapies, incidence and treatment of opportunistic infections, and configuration of palliative care.[8] Costs of ART are based on the assumption that, on average, each person receives 7.5 years of ART.

Various assumptions are then added to the ***Treatment*** scenario to derive the ***Prevention*** scenario. This scenario assumes that prevention interventions are scaled-up in a linear fashion from the existing 2005 levels to coverage levels of 80-100 percent by

[5] USAID, UNAIDS, WHO, UNICEF, POLICY Project, "Coverage of selected services for HIV/AIDS prevention , care and support in low and middle income countries in 2003" (POLICY Project, Washington DC, June 2004).
[6] The Estimates and Projection Package (EPP) was used in countries with generalized epidemics, and the Workbook method was used in countries with concentrated epidemics. See www.unaids.org for a complete description of the models, and to download the models.
[7] Available at www.futuresgroup.com.
[8] S Cleary and A Boulle "Methodological Issues: The ART of extrapolation," paper presented at "HIV/AIDS Interventions in Developing Countries: Using Cost Benefit and Cost Effectiveness Analysis to Help Guide Policy and Action," Harvard AIDS Institute, Boston, MA, September 13-15, 2006.

2010, and that they remain at these 2010 levels through 2011. The prevention interventions that are included, along with their maximum scaled-up coverage levels that are reached beginning in 2010, are shown in Table 2 below.

Table 2. Intervention Coverage Reached in 2010 by Type of Epidemic

	Percent of the target population reached	
Intervention	**Concentrated**	**Generalized**
Vulnerable populations		
AIDS education for primary/secondary students	45%	100%
Programs focused on out-of-school youth (6-15)	20%	50%
Programs focused on sex workers and clients	80%	80%
Programs focused on MSMs	80%	80%
Programs focused on IDUs	80%	80%
Prevention for people living with HIV	80%	80%
Workplace prevention	3%	50%
General populations		
Percent of adults reached through community mobilization	0%	70%
Number of mass media campaigns per year	4	5
% of adult population accessing VCT each year	1%	5%
% of casual sex acts covered with condoms	80%	80%
% of married people with casual partners using condoms in marital sex	30%	30%
Medical services		
% of need for post-exposure prophylaxis that is met	100%	100%
Safe blood (% of units screened for HIV)	100%	100%
Safe medical injections	92%	99%
Universal precautions	92%	99%
STI treatment	75%	100%
PMTCT (coverage among women attending ANC)	80%	80%

The impact of this increase in coverage of prevention interventions on HIV infections averted is then calculated by: (1) predicting the change in behavior that is due to this increased coverage; (2) estimating the impact of this behavior change on HIV

incidence; and finally (3) examining the consequences of the changes in incidence on variables such as number of people infected with HIV and deaths from AIDS. Changes in behavior are predicted based on an impact matrix that estimates the effect of the various prevention interventions on specific behaviors: condom use, number of partners, STI treatment-seeking behavior, and age at first sex.[9] These behavior changes are then fed through an HIV/STI transmission equation to calculate new HIV infections, via the ***Goals*** model, described above. Finally, the Spectrum model is used to relate the changes in HIV incidence to other variables of interest, such as number of HIV-infected people and deaths from AIDS.

The number of HIV infections averted is combined with the costs of the prevention interventions to calculate cost-effectiveness ratios, or cost per HIV infection averted. The costs of the expanded prevention program are derived from the global resource requirements that were estimated by UNAIDS in 2005.[10] These resource requirements were calculated at the country level for 125 low- and middle-income countries with different assumptions depending on the type of epidemic; the 44 countries from sub-Saharan Africa are included here. Constant returns to scale are assumed in the scaling-up of the prevention interventions. Note that the expenditures do not include program costs for items such as administration, management, research, monitoring and evaluation, or advocacy that add about 7 percent to overall costs, as these are costs that are general to the program, and not specific to prevention interventions only. Also,

[9] L Bollinger, K Cooper-Arnold, J Stover. "Where are the Gaps?" *Studies in Family Planning*, **35**, 27-38 (2004). More detail regarding the various assumptions used is available in the supplemental materials associated with: Stover J, Bertozzi S, Gutierrez JP, Walker N, Stanecki KA, Greener R, Gouws E, Hankins C, Garnett GP, Solomon JA, Boerma JT, De Lay P, Ghys PD. The Global Impact of Scaling-Up HIV/AIDS Prevention Programs in Low- and Middle-Income Countries, *Science* 10 March 2006; Vol 311.no.5766, pp. 1474-1476.

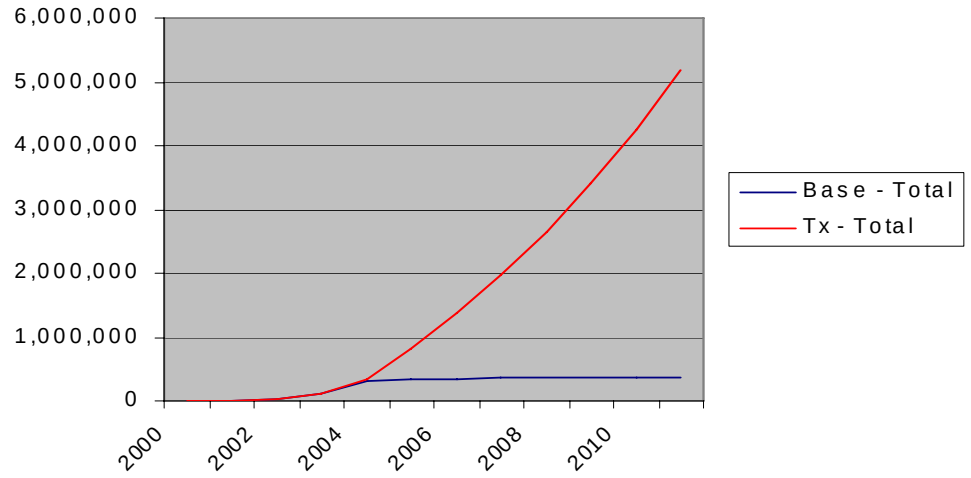
[10] UNAIDS, "Resource needs for an expanded response to AIDS in low- and middle-income countries" (UNAIDS, Geneva, August 2005).

mitigation costs for orphans and vulnerable children are displayed in a separate section below.

Results for the Treatment Scenario

As described above, the ***Treatment*** scenario begins with the existing coverage levels of ART for adults and children and cotrimoxazole prophylaxis for children in 2005, and increases these initial coverage rates to achieve universal access by 2010, defined as reaching 80 percent of those in need. This scaling-up results in a very large increase in the number of people on ART, so that over 5 million people in need of treatment are receiving it by 2011 (see Figure 3). Note that, if the scaling-up does not occur, only about 300,000 people in need of treatment would receive it in 2011.

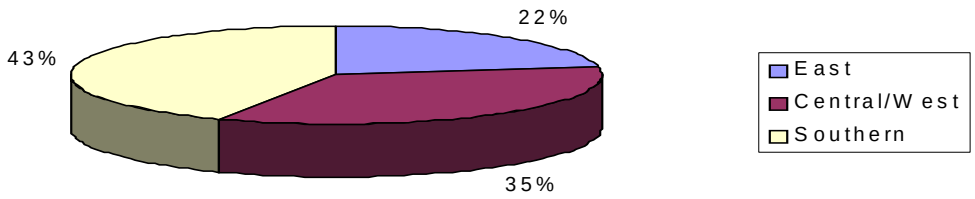
Figure 3
Impact of Universal Access on Number of People on ART in sub-Saharan Africa to 2011



If the ***Treatment*** scenario does occur, i.e. universal access is reached, of the 5 million people receiving treatment by 2011, 43 percent of them will be in Southern

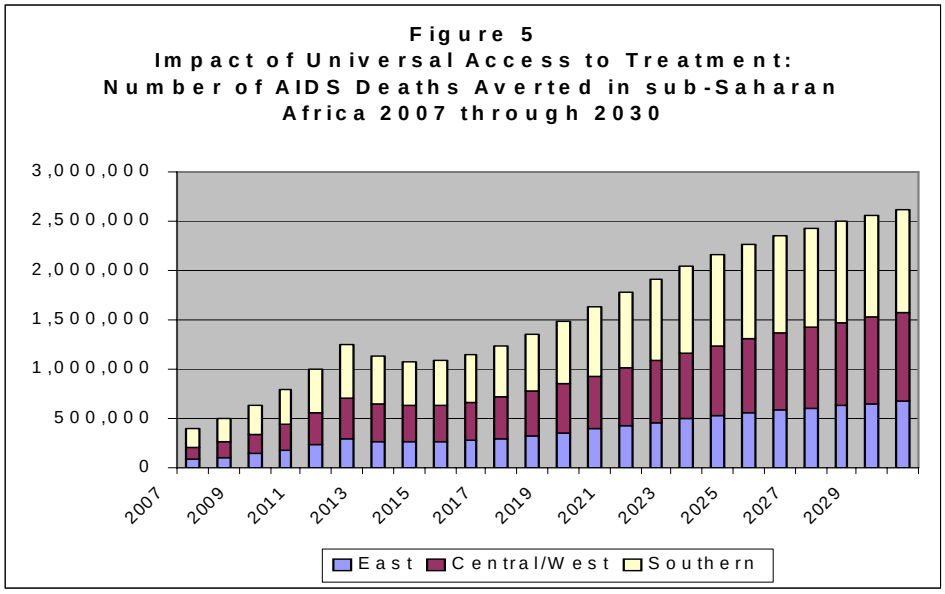
Africa, 35 percent will reside in Central/West Africa, and 22 percent will live in East Africa (see Figure 4).

Figure 4
Relative Share of People Receiving ART by Region in sub-Saharan Africa in 2011

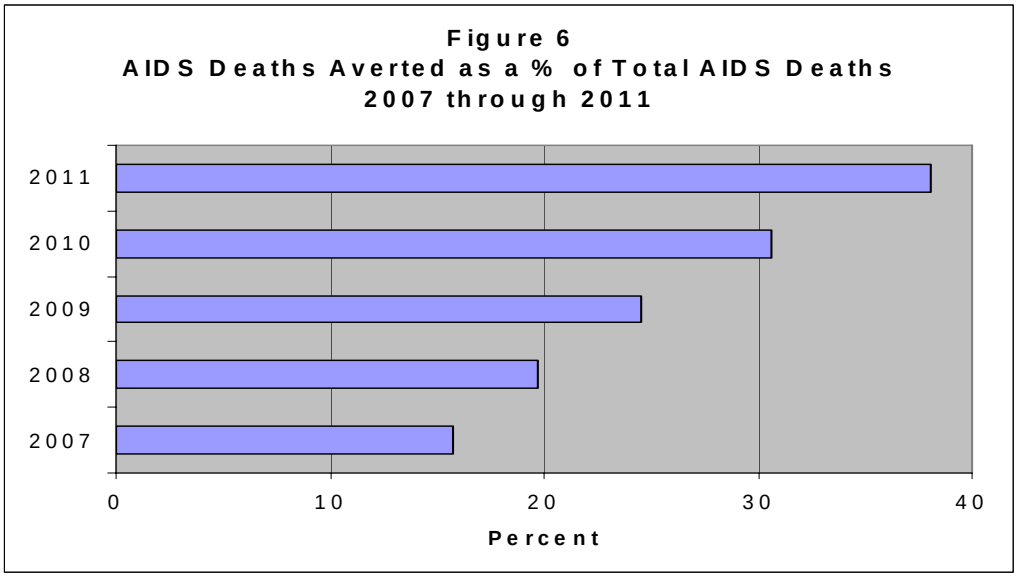


One important benefit of increasing access to treatment is a significant increase in the number of deaths due to AIDS and AIDS-related causes that are averted. In Figure 5 below, the number of AIDS deaths averted increases dramatically. There is an immediate impact of expanding ART coverage, with a total of about 400,000 AIDS deaths averted in 2007 alone. By 2030, the number of AIDS deaths averted each year rises to over 2.5 million. Note that the initial increase in AIDS deaths averted during the first several years is due to the achievement of universal access; after a slight slowdown, the number of AIDS deaths averted continues to grow throughout the time horizon. In total, the chart illustrates that over 37 million AIDS deaths are averted between 2007 and 2030.

An even more persuasive statistic can be seen in Figure 6 below, which displays the number of AIDS deaths averted in sub-Saharan Africa as a percentage of total deaths from AIDS, if universal access to ART is achieved. In 2007, about 16 percent of total



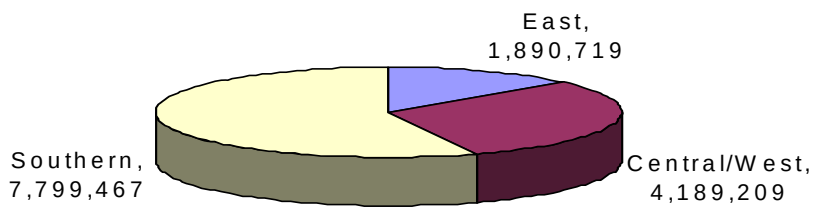
deaths from AIDS are averted because of the ramp-up in ART coverage. This percentage increases steadily throughout the time period, reaching a high of 38 percent by 2011. Thus not only does the absolute number of AIDS deaths averted increase over time, as seen in Figure 5 above, but the relative number of AIDS deaths averted does, as well.



In fact, the number of AIDS deaths averted as a percentage of total AIDS deaths more than doubles due to achieving universal access to ART.

Another way of examining the impact of increasing ART coverage is to calculate the number of life years gained relative to the ***Base*** scenario.[11] As is shown in Figure 7 below, between 2007 and 2011, almost 14 million life years are gained if coverage of ART is scaled-up to reach universal access by 2010, and maintained in 2011. Over half of these life years are gained in Southern Africa, while 30 percent of the total life years gained occurs in Central/West Africa, and about 13 percent of the gain is in East Africa.

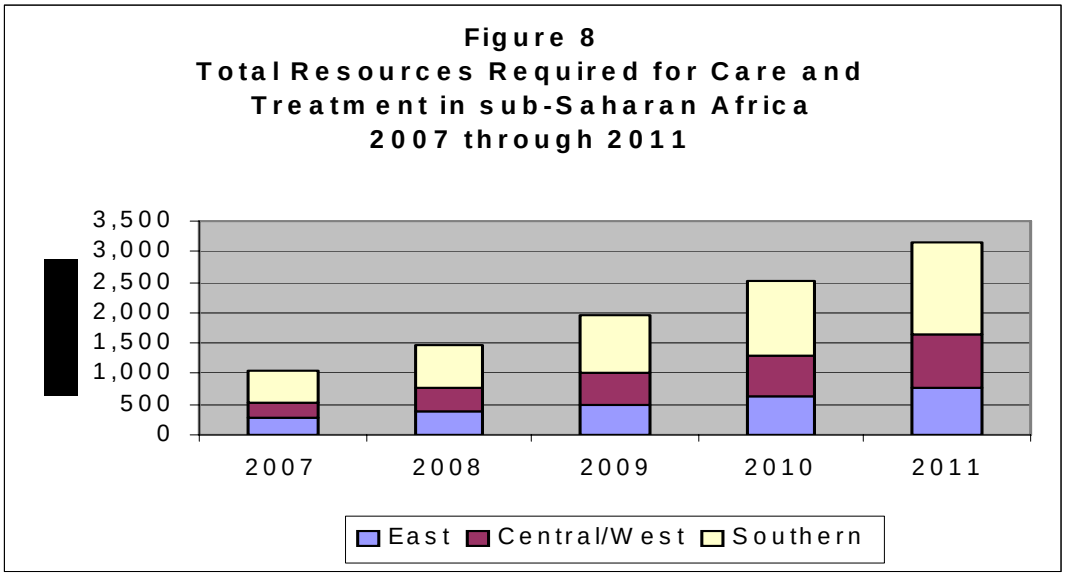
Figure 7
Impact of Universal Access to Treatment:
Cumulative Number of Life Years Gained in sub-Saharan Africa 2007 through 2011



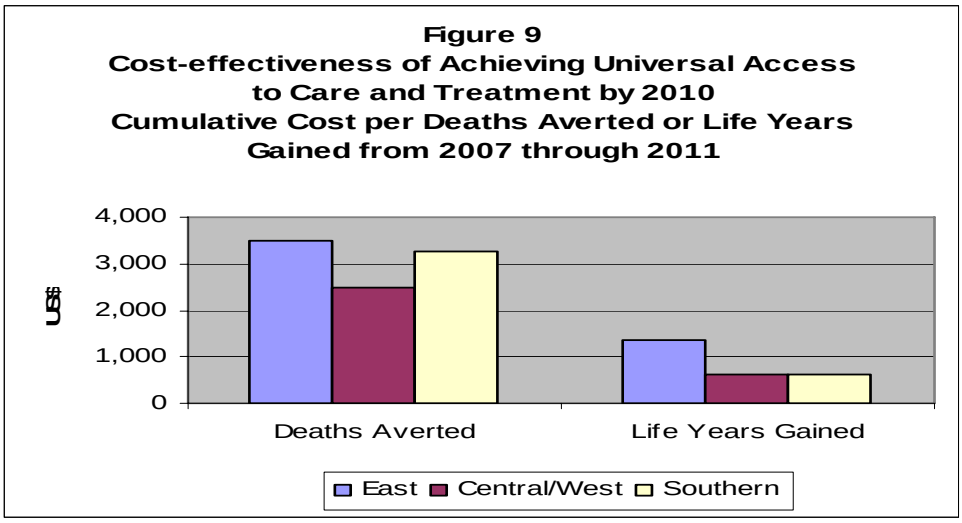
What is the total cost for scaling-up access to ART to achieve universal access in sub-Saharan Africa by 2010, and maintaining that universal access through 2011? Figure 8 below shows that the resources required to meet this target start at about US$1 billion in 2007, as coverage begins to increase, rises to US$2.5 billion by 2010, when universal access is achieved, and reaches US$3.2 billion in 2011. Note that this is about 71 percent

[11] Life years gained is calculated as the sum of the difference between the total population in each year from 2007-2011 in the base scenario and the total population in each year from 2007-2011 in the prevention scenario. Recall that the prevention scenario builds on the treatment scenario, so that the effect of increasing treatment is also included in this calculation.

of the cost of achieving universal access in prevention expenditures, which reach US$4.5 billion in 2011 (see Figure 15 below).



Finally, an initial cost-effectiveness analysis can be performed by dividing the additional expenditures for care and treatment between 2007 and 2011 by both the cumulative number of AIDS deaths averted between 2007 and 2011, and the cumulative number of life years gained between 2007 and 2011. These results can be seen in Figure 9. Overall, the cost of averting one AIDS deaths varies by region between US$2,500 and

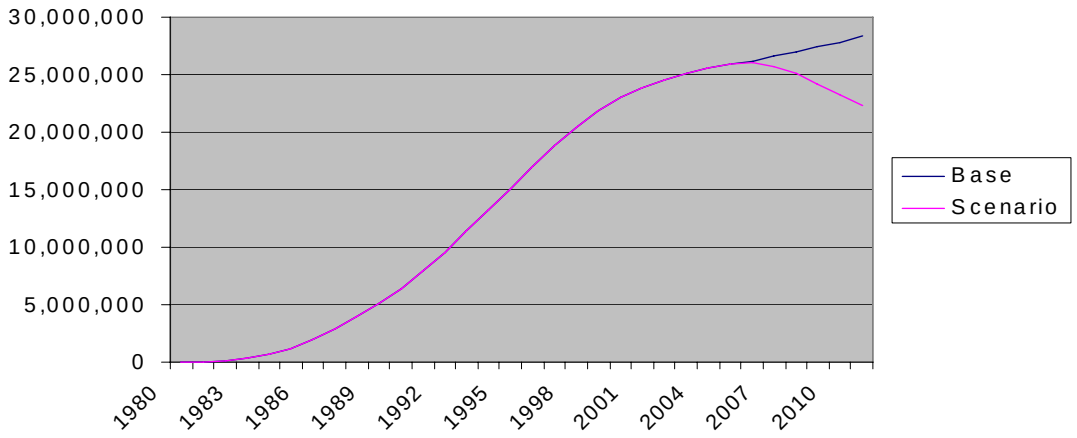


US$3,500, while the cost per life year gained is approximately US$1,400 in East and Africa, and about US$600 in Central/West and Southern Africa.

Results for the Prevention Scenario

If prevention interventions are scaled up to reach universal access to prevention, as defined by UNAIDS, then the number of HIV positive people could drop by over 20 percent, to approximately 22 million in 2011 as compared to over 28 million (see Figure 10).

Figure 10
Effect of Prevention Interventions on Number of HIV+ People in sub-Saharan Africa through 2011



This impact is even more startling when examined for new infections alone; if prevention interventions are scaled-up to achieve universal access, the number of annual new infections begins to decline immediately, and by 2011 is reduced by about two-thirds, from over 3.5 million to approximately 1.25 million (see Figure 11):

Figure 11
Effect of Prevention Interventions on New HIV Infections in sub-Saharan Africa through 2011

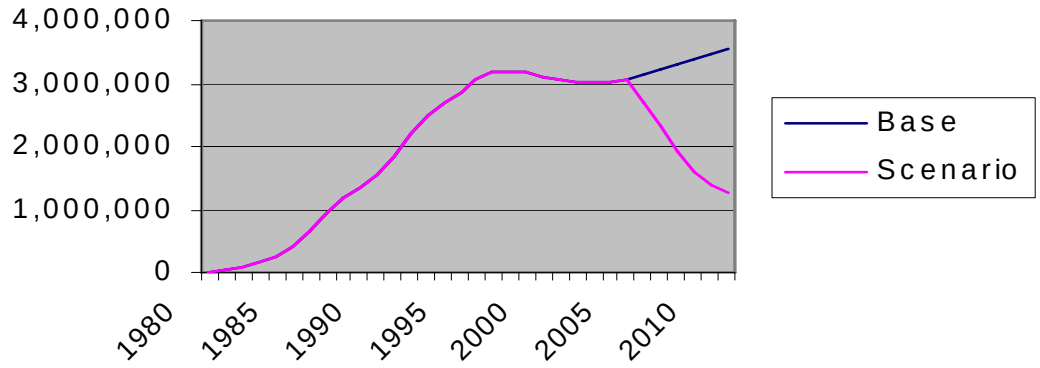


Figure 12
Infections Averted as a % of Total New Infections 2007-2011

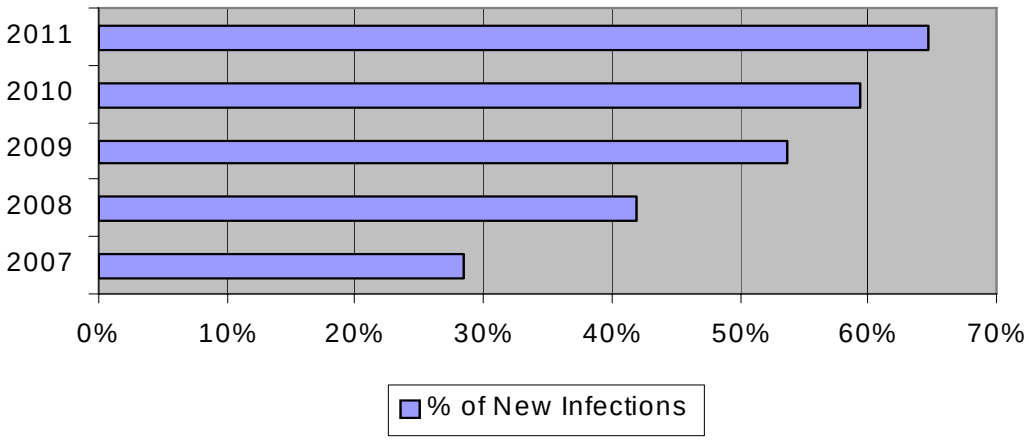
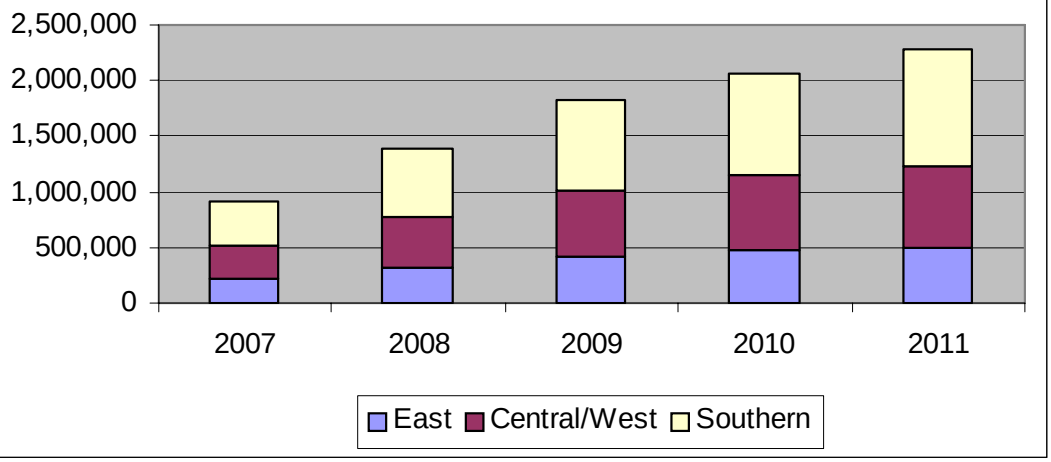


Figure 12 above shows this result in another way; between 2007 and 2011, a ramped-up prevention program results in a substantial reduction in the percentage of new infections (relative to total new infections). The number of infections averted as a

percentage of total new infections decreases from approximately 28 percent in 2007 to about 65 percent by 2011. Thus the impact of prevention interventions grows over time.

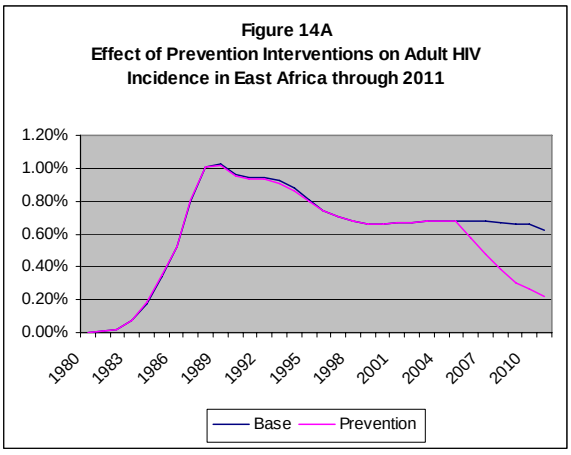
Finally, the regional distribution of new HIV infections averted can be seen in Figure 13 below. The largest absolute number of new infections averted is in Southern Africa, about twice the magnitude of the number averted in Central/West Africa, with an intermediate number averted in East Africa. Since the disease burden is greatest in Southern Africa, of course the majority of averted infections are there as well.

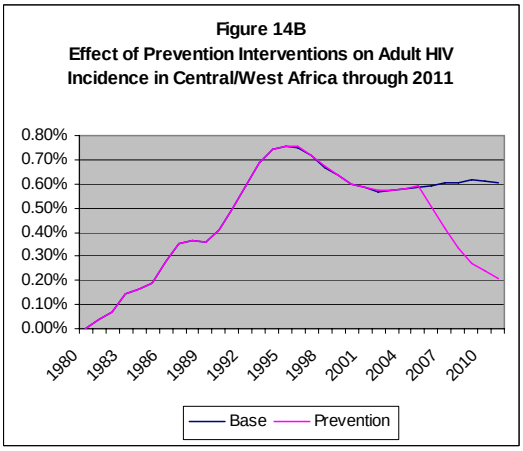
Figure 13
Infections Averted due to Prevention Interventions in sub-Saharan Africa 2007-2011

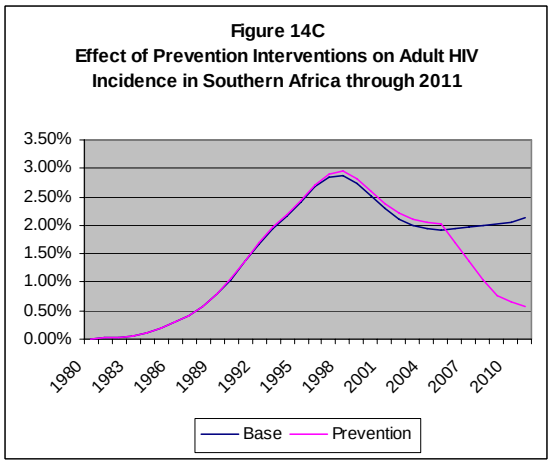


Another way to examine the impact of scaled-up prevention interventions on new infections is to display the impact on HIV incidence (see Figures 14A – 14C, below). Viewed on this proportional basis, it is clear that the impact of increased prevention on HIV incidence is substantial in each region. In East and Central/West Africa, in the absence of any increase in prevention efforts, HIV incidence would reach levels of approximately 0.6 percent by 2011. The impact of the increase in prevention results in a

drop by more than half in each region, with incidence dropping to 0.21 percent and 0.22 percent, respectively. The impact is even greater for Southern Africa, with a drop of almost 75 percent, from over 2 percent to about 0.5 percent by 2011.







What will be the total resources required to scale-up prevention interventions to universal access by 2010? In Figure 15 below, the total resources required for each of the three regions in sub-Saharan Africa are shown for the years 2007 through 2011, in millions of US dollars. In 2007, the total for all three regions is about US$2.7 billion, increasing to US$4.7 billion by 2011. Recall that these figures do not include costs for

orphans and vulnerable children; the results for mitigation costs are discussed in a separate section, below.

Figure 15
Total Resources Required for Prevention Interventions in sub-Saharan Africa, 2007-2011

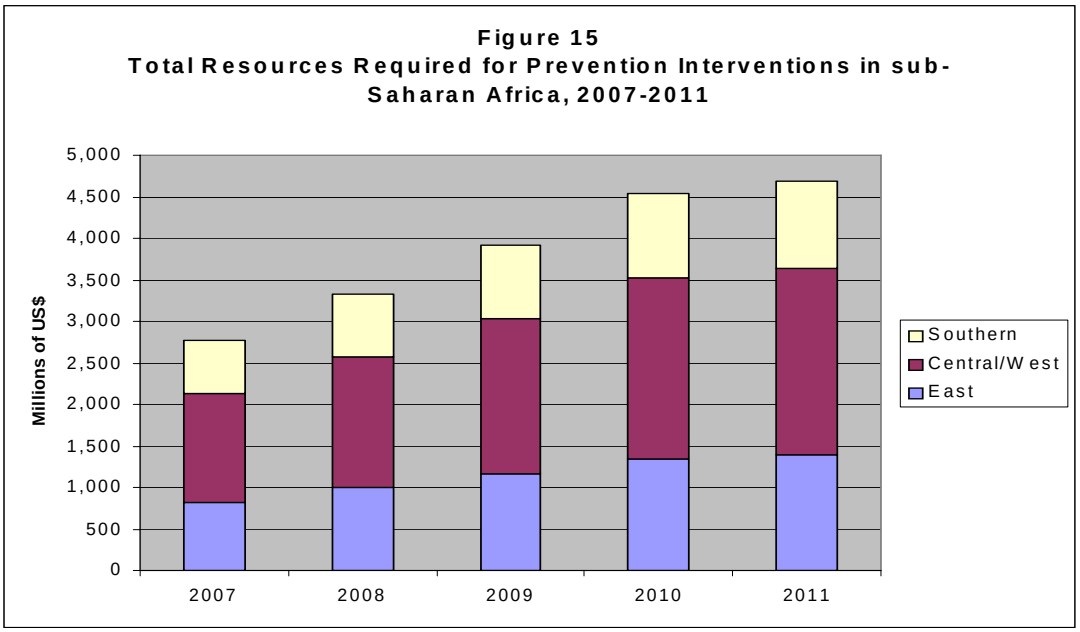
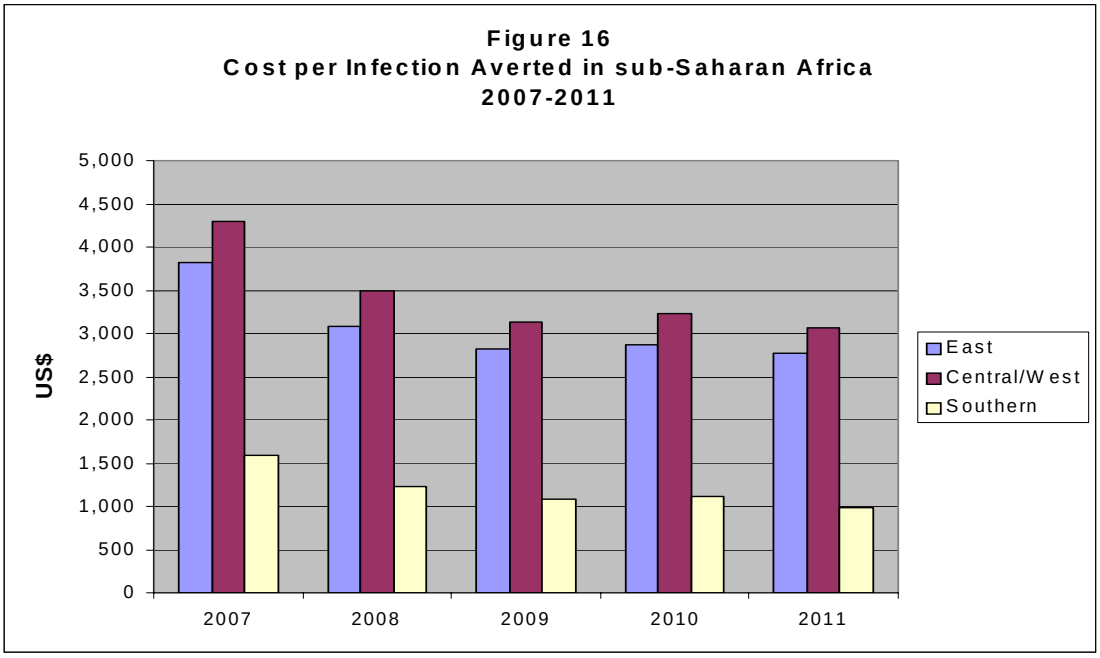


Figure 16 below summarizes all of the information presented above, displaying the calculation of cost per HIV infection averted in US dollars. There are a couple of interesting observations to make about this chart. First, the cost per infection averted decreases significantly for each of the three regions between 2007 and 2011. The greatest decline is in the Southern Africa region, where the cost per HIV infection averted drops by 38 percent, from US$1,588 in 2007 to US$990 by 2011. Overall, the average cost per HIV infection averted in sub-Saharan Africa drops from about US$3,000 in 2007 to about US$2,000 by 2011. This decrease is due primarily to increasing numbers of infections averted, as overall costs increase over that time period. The second observation is that the cost per infection averted is significantly lower in Southern Africa than in the other two regions; this is due, of course, to the higher disease burden there, and thus the higher number of new infections that can potentially be averted.

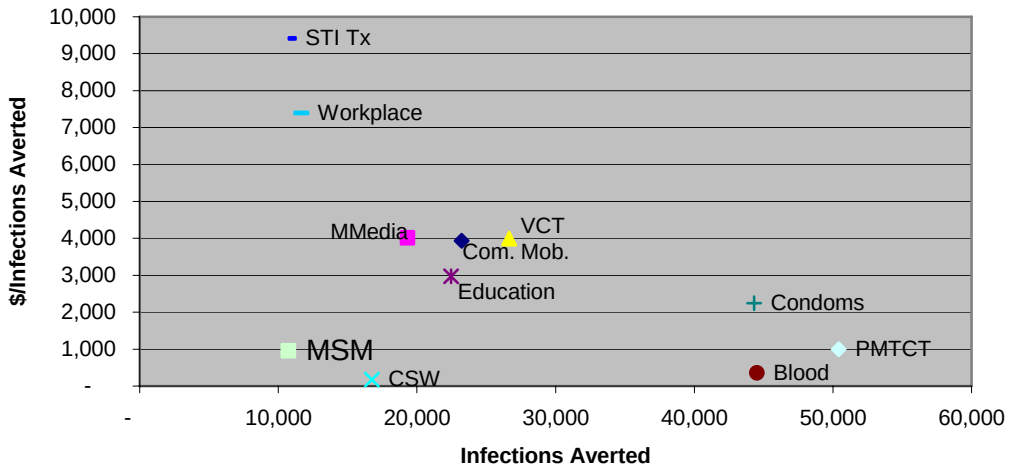


One final question to ask in the ***Prevention*** scenario is, although scaling-up prevention interventions appears to be very effective, given that countries will have limited resources, which specific interventions should be scaled-up first? That is, which interventions are relatively the most cost-effective?

Figure 17 below displays a partial answer to this question, using a slightly different methodology than that used by the other graphs in this section. Here, results from ten different country-specific applications of the ***Goals*** model were used to calculate (unweighted) average impacts for ten different interventions: community mobilization, mass media, voluntary counseling and testing (VCT), interventions for commercial sex workers (CSW), interventions for men who have sex with men (MSM), in-school youth programs (Education), blood safety, condom distribution, STI treatment, workplace programs, and programs to prevent mother-to-child transmission (PMTCT). These interventions were selected because they have the most robust results when calculating

their impact coefficients. For each country, the full program of prevention interventions was scaled-up to reach universal access targets by 2010, with the resulting number of total HIV infections averted calculated. After this, the funding was taken away from each of the ten interventions listed one at a time (and subsequently replaced), so that the marginal impact of the intervention could be measured, in terms of both funding required and the number of HIV infections averted. These two results were then combined to calculate the cost per HIV infection averted. Figure 17 shows the total number of HIV infections averted for each intervention individually on the x-axis, and the cost per

Figure 17
Number of Infections Averted and Cost-Effectiveness Ratio by Prevention Intervention



infection averted by intervention on the y-axis.

Interventions that are closest to the x-axis are the most cost-effective, that is, they have the lowest cost per number of HIV infections averted. Interventions that have a cost-effectiveness ratio of less than US$1,000 per infection averted are: blood safety and

PMTCT programs, and interventions reaching CSW and MSM. The next tier of cost-effective interventions have cost-effectiveness ratios of between US$1,000 and US$4,000 per infection averted, and include youth education programs, general condom distribution, mass media, community mobilization and voluntary counseling and testing (VCT). The reasons behind these low cost-effectiveness ratios vary; for example, mass media programs are relatively less effective, yet because they reach a large number of people and are relatively less expensive, they have a relatively low cost-effective ratio. Interventions for CSWs, on the other hand, have a much smaller target population group, yet because the HIV prevalence rate in that group is usually quite high, a large number of infections can be averted (about 18,000).

The other two interventions have higher cost-effectiveness ratios, ranging between US$7,000-US$9,500 per infection averted, and include workplace programs and STI treatment programs. Each averted approximately 10,000 HIV infections.

Another way of presenting these data is by using categories, shown below in Table 3A (East and Southern Africa) and Table 3B (Central and West Africa), as the epidemic is quite different in Central/West Africa and cost-effectiveness ratios vary accordingly. These tables classify interventions by their relative cost-effectiveness ratios, as well as by their relative impact, or percentage of total infections averted. The relative impact is presented because population sizes vary among the various countries, and so a relative impact is a more accurate representation of the impact. There are three categories of cost per infection averted: Low (<US$1,000), Medium (US$1,000 – US$3,000), and High ((>US$3,000), and three categories for impact: Low (0-10% of total infections

averted), Medium (10-20% of total infections averted), and High (>20% of total infections averted).

Table 3A
Cross-classification of Interventions by Cost-effectiveness and Impact
For East/Southern Africa

	Impact (% of infections averted)		
Cost per infection averted	*Low (0-10%)*	*Medium (10-20%)*	*High (>20%)*
Low (< $1,000)	CSW MSM	PMTCT	Blood
Medium ($1,000 - $3,000)	Comm. Mobilization VCT Education	Condom Dbn	
High (> $3,000)	Mass Media STI Treatment Workplace		

Table 3B
Cross-classification of Interventions by Cost-effectiveness and Impact
For Central/West Africa

	Impact (% of infections averted)		
Cost per infection averted	*Low (0-10%)*	*Medium (10-20%)*	*High (>20%)*
Low (< $1,000)	MSM	CSW	
Medium ($1,000 - $10,000)	Blood Condom Dbn	PMTCT Workplace	
High (> $10,000)	Comm. Mobilization Mass Media STI Treatment Education		

Both tables indicate that interventions targeting CSW and MSM across all of sub-Saharan Africa are very cost-effective, with costs per infection averted of less than US$1,000. In addition, PMTCT and blood safety programs are also very cost-effective in East/Southern Africa, where HIV prevalence rates are higher, and also have a substantial impact on the number of total infections averted. In Central/West Africa, these two interventions are classified in the Medium cost per infection averted category, and PMTCT contributes a substantial proportion of all infections averted. In East/Southern Africa, the interventions in the Medium cost per infection category are Community Mobilization, Voluntary Counseling and Testing, Education for youth, and general

Condom Distribution programs. The latter program, general Condom Distribution, has the largest relative impact, at between 10-20% of total infections averted. In Central/West Africa, the interventions with a Medium cost per infection averted includes PMTCT and Blood safety programs, as discussed above, as well as general Condom Distribution programs and Workplace programs. Finally, those interventions with the highest cost per infection averted in East/Southern Africa are Mass Media, STI Treatment, and Workplace programs, while the corresponding interventions in Central/West Africa are Community Mobilization, Mass Media, STI Treatment, and Education for youth.

Orphans and Vulnerable Children[12]

As of 2006, there were about 43 million children under the age of 18 in sub-Saharan Africa who are either single or double orphans due to parental deaths from AIDS or other causes. Different coping mechanisms have arisen to provide support for these orphans, including from immediate family members, governments, and non-governmental organizations, including faith-based organizations. As the number of orphans increases, however, the resulting financial demands are placing an increasing burden on the ability of these groups to cope with the resources required.

Figure 18 below illustrates the impact of HIV/AIDS on the number of orphans and vulnerable children in sub-Saharan Africa, as well as a projection of those in need of assistance. The population in need is defined as all double orphans and vulnerable children, along with half of single orphans, who live in households under the poverty

[12] Information in this section is derived from J Stover, L Bollinger, N Walker, R Monasch, "Resource needs to support orphans and vulnerable children in sub-Saharan Africa," *Health Policy and Planning* 2007 **22**:21 -27.

line. As can be seen, there has been a huge increase in the number of orphans and vulnerable children due to HIV/AIDS; from zero in 1985 to just under 20 million by 2011, with approximately half of those children in need of assistance.

Figure 18
Number of Orphans and Vulnerable Children due to HIV/AIDS in sub-Saharan Africa through 2011

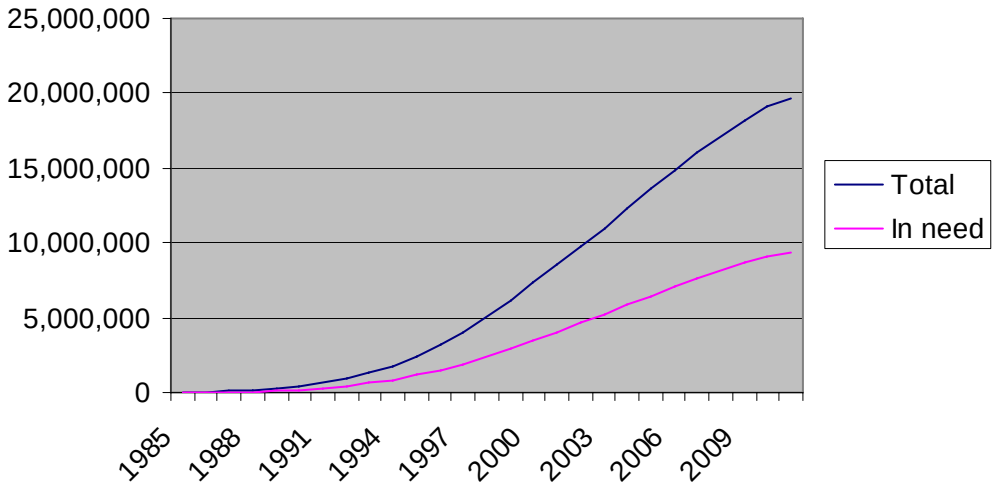
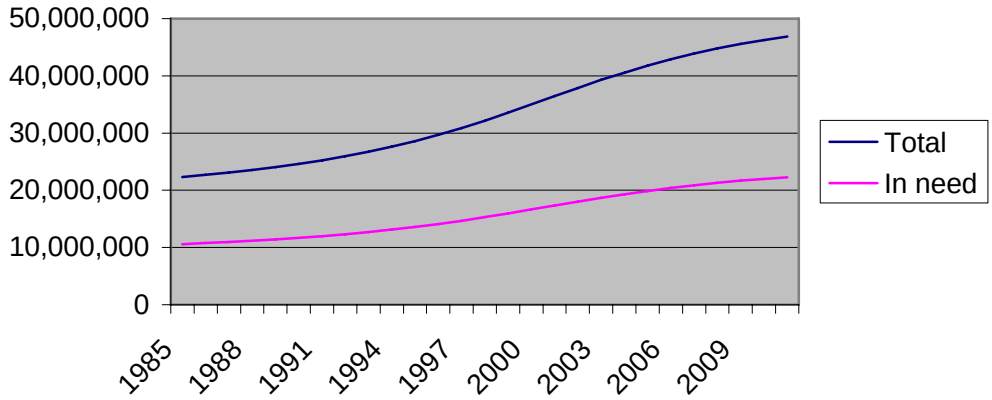


Figure 19 displays the total number of orphans and vulnerable children in sub-Saharan Africa through 2011, which forms the basis for calculating the resources required for their support, as the consensus is that, for sub-Saharan Africa, all orphans and vulnerable children should be supported, to mitigate against any stigma that might develop otherwise. This chart shows that the number of orphans and vulnerable children increases from approximately 43 million in 2006 to over 45 million in 2011, while the number in need increases from about 20 million in 2006 to over 22 million in 2011. Thus the number of orphans and vulnerable children has basically doubled since 1985, imposing an enormous strain on the system.

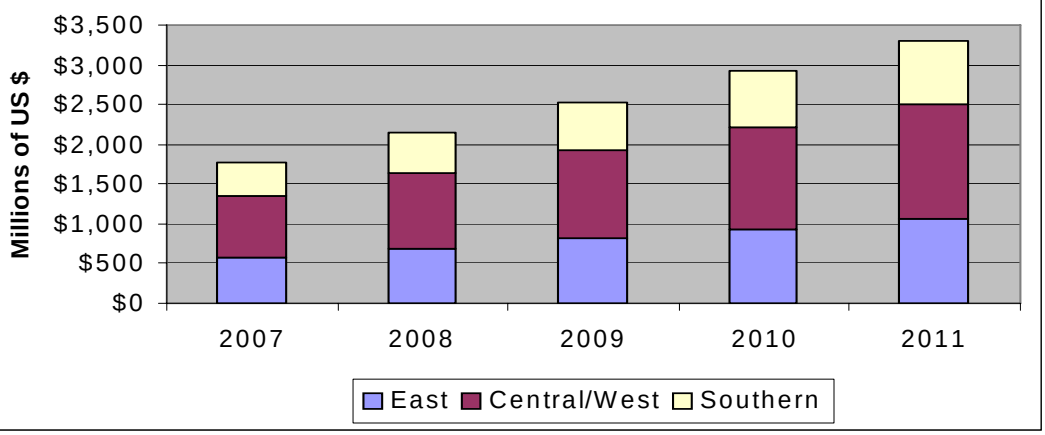
Figure 19
Number of Orphans and Vulnerable Children in sub-Saharan Africa through 2011



The resources that would be required to care for these children, based on scaling-up the existing resources that were available in 2003, are presented in Figure 20 by region. The final amount of resources required in 2011 includes increasing returns to scale for costs during the scaling-up period, and covers all orphans and vulnerable children who are in need of support.

By 2011, if all orphans and vulnerable children in need of support receive it, total resources required would be about US$3.3 billion, with the greatest amount required in Central/West Africa, followed by East Africa and finally Southern Africa. Note that the total amount needed to support orphans and vulnerable children is about the same amount that would be required to provide universal access to treatment in 2011.

Figure 20
Total Resources Required for Orphans and Vulnerable Children in sub-Saharan Africa 2007 to 2011



Conclusions and Recommendations

The HIV/AIDS epidemic continues to affect countries in sub-Saharan Africa adversely, with over 22 million people infected with HIV at the end of 2005. Since the beginning of the epidemic, lessons have been learned about the effectiveness of prevention interventions, costs of anti-retroviral treatment have decreased substantially, and more funding has become available. The World Bank was interested in examining the impact of HIV/AIDS in sub-Saharan Africa, given this new information, and applying these results to their new strategy plan, Agenda for Action 2007-2011.

The results presented here suggest three possible ways in which the World Bank might have a comparative advantage in having an impact on the HIV/AIDS epidemic:

1. *Fully fund highly cost-effective interventions.* This paper has shown that there are four highly cost-effective preventions for sub-Saharan Africa: PMTCT, Blood

safety programs, and outreach programs for commercial sex workers (CSW) and men who have sex with men (MSM). Most of these interventions are not fully funded; for example, the most recent statistics show that only 10% of women are offered PMTCT services (see Table 1 above). In addition, although national blood transfusion services report testing rates of near 100%, it is unclear whether donations outside these services test at the same high rates. Finally, Some other funding sources, including national governments, are less interested in funding outreach programs for CSW and MSM, yet these are highly cost-effective. The World Bank could play a valuable role in filling these funding gaps.

2. *Assist in health systems strengthening to derive the benefit of increasing ART coverage.* The results here show that there is a tremendous benefit to the countries of sub-Saharan Africa in increasing the coverage of ART. Difficulties with systemic issues in the health systems, however, have hindered a faster scaling-up of the delivery of ART. The World Bank could play an important role in strengthening health systems in order that the countries can deliver this treatment, particularly in view of the complementarities that might exist with other World Bank health system strengthening efforts.
3. *Increase support for orphans and vulnerable children, particularly in the education sector.* This paper has shown that there is an enormous need for support for orphans and vulnerable children in sub-Saharan Africa, and that this need will increase substantially in future years. Given the focus on increasing education levels that currently exists at the World Bank, complementarities between that

policy and providing support for orphans and vulnerable children in the form of school fees, uniforms, etc might exist.

These three areas are possible areas where the World Bank might have a comparative advantage in providing funding, both in terms of funders' willingness to undertake the interventions, and synergies with existing World Bank programs and priorities.