CENTER FOR GLOBAL DEVELOPMENT **ESSAY**

The Global AIDS Transition

By Mead Over

May 2010

www.cgdev.org/content/publications/detail/1424143

ABSTRACT

Recognizing the donors' obligation to sustain financing for the millions of AIDS patient who would not be alive today without it, this essay proposes a dynamic paradigm for the struggle with the AIDS epidemic—"the AIDS transition" —and argues that to most rapidly achieve an AIDS transition new funding of AIDS treatment should be tightly linked to dramatically improved and transparently measured prevention of HIV infections.

The Global AIDS Transition:
A feasible objective for AIDS policy

by

Mead Over
Senior Fellow
Center for Global Development

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Executive summary

This essay proposes a new paradigm for combating AIDS and a new objective around which international donors and recipient governments can coordinate their efforts. I call this objective the "AIDS transition."

What exactly is an "AIDS transition"? It is a dynamic process that holds AIDS mortality down—that is, preserves recently achieved mortality reductions—while lowering the number of new infections even further—so that the total number of people living with HIV/AIDS begins to diminish.

An important milestone—when we can say that the transition has been "achieved"—would be the date when the number of new infections in a population first crosses below the number of deaths, so that the number of people living with HIV/AIDS, and the associated cost and dependency, stop growing. Given effective HIV prevention and sustained treatment, this paper shows that a transition could be achieved in Sub-Saharan Africa as a whole as early as 2015 – or as late as 2043.

The AIDS transition paradigm introduces an objective for each donor and at every level of each national HIV/AIDS program. Under this approach, programs cannot be deemed successful unless they provide evidence that they simultaneously suppress AIDS mortality and reduce the growth rate of the number of people living with HIV/AIDS.

At the national or "macro" level, an AIDS transition objective forces donors and governments to plan for AIDS treatment expansion only at the rate that evidence-based prevention programs demonstrate success in reducing the number of new infections, called the incidence of HIV. To the extent that AIDS treatment can be shown, in a given country setting, to directly reduce HIV incidence, donors can offer to increase the rate of AIDS treatment recruitment.

For example, in Sub-Saharan Africa the treatment savings from reducing new infections by 10 percent per year would be worth $43 billion over the next 40 years, an amount that could fund an increase in patient uptake from 15 to 23 percent of unmet need each year. But claims for such a beneficial effect of treatment must be demonstrated with hard data, not just through mathematical models or self-reported behavior changes.

At the sub-national level, policymakers would be asked to show how existing HIV/AIDS treatment programs can be leveraged to improve prevention. For example, treatment programs can be required to either (1) have an HIV prevention arm that extends beyond prevention counseling for the ART patients, reaching out to the local community of uninfected people or (2) form a partnership with an agency specialized in results-based HIV prevention in such a population.

At the level of the individual patient receiving subsidized ART, those whose health enables a return to the labor force can be asked to contribute one day a month to HIV prevention in their community. Treatment programs can require patients to be members of support groups that function not only to help the patient adhere to the ART regime and regain or sustain good health, but also to design and implement evidence-based HIV prevention programs in local communities.

I. Defining an "AIDS transition"

As the third decade of the AIDS epidemic marches on, remarkable successes at extending treatment to millions and a few signs of progress in prevention are overshadowed by a single stark statistic: the number of people infected with HIV in 2008 exceeded by 1.4 million the number of people who initiated AIDS treatment. For every two people placed on treatment there were about five new cases. Thus, the epidemic continues to spread faster than the combined efforts of all donors on prevention and treatment can address it.

In view of the extraordinary rate at which AIDS patients in poor countries have been enrolled in antiretroviral treatment (ART) programs since 2003—from less than 100,000 in 2003 to approximately 4 million at the end of 2009—an optimist might see the continued excess of new infections over new enrollments as a temporary phenomenon. But this view ignores not only the human cost of the increasing numbers of people dependent on a daily drug for survival but also the fiscal implications, which are even less sustainable given the worsened financial environment. For the United States, which provides about half of all donor support to AIDS treatment through its President's Emergency Plan for AID Relief (PEPFAR), the cost of treating all who need it in the 15 target countries would absorb half of U.S. foreign assistance funds by the year 2016Over (2008). Since limited foreign assistance resources in the United States and in other countries will also be needed for other foreign policy objectives, now is the time to reframe the challenge presented by the global AIDS epidemic.

This essay proposes a new paradigm for combating AIDS and a new objective around which international donors can coordinate their efforts. I call this objective the achievement of an "AIDS transition."

What exactly is an "AIDS transition"? It is a dynamic process that holds AIDS mortality down—that is, preserves recently achieved mortality reductions—while lowering the number of new infections even further—so that the total number of people living with HIV/AIDS will begin to diminish.

An important milestone—when we can say that the transition has been "achieved"—would be the date when the number of new infections in a population first crosses below the number of deaths, so that the number of people living with HIV/AIDS and the associated cost and dependency stop growing. At that point, health care personnel in AIDS-affected countries can realistically look forward to the day when enrolling patients on AIDS treatment, providing adherence support, and financing these activities would be routine components of health system functioning. These measures would be used to gauge the quality of health system performance, along with measures such as the quality and accessibility of trauma care, vaccination coverage of children, the ease with which rural malaria patients can acquire artemisinin combination therapy, pre-natal care for pregnant women, and long-term management of diabetes. In any country or region in which this "crossover" occurs, the epidemic will have turned the corner.

But with new infections only slightly less than deaths, the total number of people with AIDS would be falling very slowly. There might also be backsliding on prevention or improved treatment technology that would reverse that situation a year later. ***Sustained effort would be required to keep the number of new infections down for about a decade if we hope to***

substantially decrease the AIDS burden. Only then will the number of people living with HIV/AIDS decline enough so that the disease takes its place among the treatable chronic diseases like diabetes, cancer, or heart disease. And only then can we say that the transition has been "consolidated" —that we are on the road to extinguishing the epidemic.

Of course, the road to an AIDS transition would be dramatically shortened if an effective vaccine were developed and deployed, stopping cold the flow of new infections. But three decades of experience have shown that the human immunodeficiency virus poses an extraordinarily difficult challenge to the immune system and to those who would prepare it to fend off this virus. Time and again the goal of an effective vaccine has appeared within reach, only to vanish like a mirage as we have approached. That said, there is no question that researchers must continue to pursue this elusive goal, and if we are lucky, their findings will also yield biological insights that will benefit other diseases.

For the foreseeable future, however, HIV prevention will depend on solving the social problem caused by the simple fact that for many people, the individual threat of developing AIDS—because it is uncertain and would only occur years later—seems insufficient to counterbalance the immediate rewards from unprotected sexual intercourse and needle-sharing intravenous drug use, which drive the epidemic (See Box 1). These risks taken as individuals impose massive costs on the entire society, in the form of a fiscal burden, medical dependency, and an increased threat of future infection to every sexually maturing young adult—indeed, to all of our children and their children. We all need to work together to

assure an AIDS Transition through social interventions, without depending on a vaccine discovery that may never occur (See Box 2).

Figure 1 helps us try to visualize the history of AIDS so far with a stylized version of the AIDS epidemic in a typical highly affected country. The solid lines in both panels represent the past, and the dashed lines, the hoped-for future. When the epidemic began, the number of new infections (green line, panel a) was greater than the number of deaths of AIDS patients (red line, panel a)—reflecting the fact that it takes many years for the infection to turn into a disease requiring treatment—which led to a rapidly rising number of people with HIV/AIDS (blue line, panel b). As the epidemic matured, the annual number of new infections did not change very much, but the annual number of deaths eventually rose almost as high, slowing the rate of growth of the population living with AIDS.

Then, a few years ago, an increasing proportion of AIDS patients started ART, which began to slow the number of deaths (red line in panel a just before "Today"), although the high incidence of new infections did not decline, presumably because of no step up in prevention efforts. The result was a dramatic rise in the number of people living with HIV/AIDS. If we do not change our approach, the gap between these two flows (AIDS patients dying and new individuals becoming infected) will continue to widen, producing a virtual "population explosion" of AIDS patients in the making.

What can be done? The goal should be twofold: (1) to suppress the annual number of deaths by continued access to effective treatment; and (2) to reduce the annual number of new

infections over the next few years by effective HIV prevention. As Figure 1 shows, when the country succeeds in pushing new infections down below the number of annual deaths, it will succeed in achieving the "AIDS Transition" milestone (vertical lines labeled "Transition Achieved"). And after many years of further efforts to both sustain access to quality treatment and suppress new infections, the total number of people with HIV/AIDS will decline to levels not seen since the beginning of the epidemic. At that point, the country will have "consolidated" its AIDS transition (vertical lines labeled "Transition Consolidation").

Box 1 **A snapshot of AIDS treatment**

For over a decade, the treatment for an HIV-infected patient has been antiretroviral treatment (ART). It is dispensed in the form of a "cocktail," which is a mixture of three different drugs (called "combination therapy" or "triple-drug" therapy)." The price of "first-line" ART has fallen dramatically over the years and is now available in a low-cost generic—heavily subsidized in the developing world by foreign donors. The tricky part of the treatment is that the drugs must be taken every day (sometimes several times a day) for the rest of the patient's life. Failure to adhere closely to the prescribed timing and dosages leads to the patient's development of a drug resistant strain of HIV. At that point, the patient will either die within months or shift to a new and typically much more expensive drug (not available in a generic and not funded by donors), known as "second-line" treatment.

At what point are HIV-infected patients supposed to begin taking ART? In contrast to most other infectious diseases, HIV/AIDS spreads slowly. The time from infection to illness is typically about 8 years, but can vary from 5 up to 12 years or more. Once first-line therapy is begun, the patient can postpone mortality by 4 to 10 years. If first-line fails and second line treatment is available and affordable, mortality is again postponed for another two to ten years.

A key measure of the progression of HIV disease is the number of CD4 cells per microliter of the patient's blood, a count that declines from close to 1,000 for uninfected people to zero as the person's immune system is destroyed by HIV. Until recently, the World Health Organization (WHO) recommended that the threshold for AIDS treatment be 200 cells per microliter, which would be about 8 years after HIV infection. However, in 2009, the WHO revised its guidelines, recommending that treatment begin a year or more earlier, when the CD4 count is 350. The reality is that these guidelines will be very expensive to adopt. Although subsidized AIDS treatment in poor countries, mostly Sub-Saharan Africa, has risen from a few thousand in 2003 to about 4 million in 2009, even at the 200 threshold, about 57 percent of those in need are going untreated; at the 350 threshold, current coverage would drop to a dismal 10-20 percent—a far cry from the global community's goal of "universal" coverage.

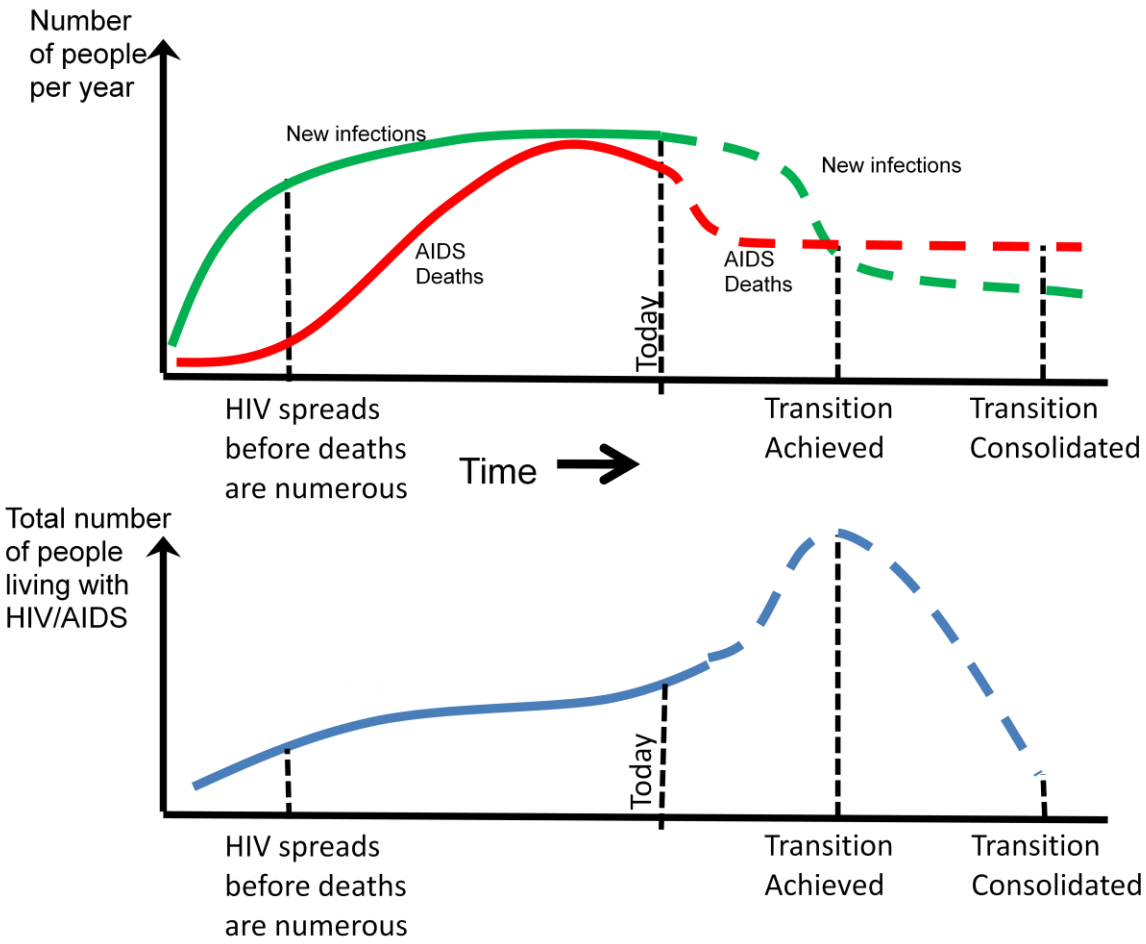

Figure 1. A new policy paradigm for AIDS

*Panel (a) The goal is for the number of new infections to fall below the numbers of deaths of existing patients … Panel (b) … enabling the currently exploding number of people living with HIV/AIDS to fall dramatically***.**

But neither the decades-old origin of the AIDS epidemic nor the decades-in-the-future eventual consolidation of the AIDS Transition are of as much interest to us today as the immediate future. Figure 2 zooms in on that time-slice of Figure 1 starting a few years ago, when effective AIDS treatment began to reduce annual deaths, then extends to only a few years from now, when we reach the attainable milestone of the AIDS Transition. This zoomed-in version emphasizes that, if the AIDS Transition succeeds, the surge currently under way of people living with AIDS will be temporary, slowing when annual numbers of new infections decline. In the year when new infections first fall below the annual number of deaths, the total number of people living with AIDS will have peaked and the focus will turn toward consolidation of the transition.

Box 2 **A snapshot of AIDS prevention**

While researchers have long searched for the elusive vaccine for AIDS and the number of people living with HIV/AIDS has soared, the emphasis in donor circles has been on expanding access to treatment, not preventing new infections. But given that for every two people placed on ART, there are five new infections, this approach is fiscally unsustainable. More money and effort now need to be poured into prevention. However, the reality is that we are only beginning to assemble enough ammunition to try to convince policymakers and donors that they will get more bang for their buck out of prevention than treatment.

The problem is that after more than 20 years of donor-funded prevention efforts, so few rigorous evaluations have been conducted of HIV prevention interventions. The global community now needs to move aggressively on this front, tapping randomized controlled studies (the "gold standard" in medical trials) and other empirical and scientific methods to determine what is effective and under what circumstances. Once we have pinpointed the most promising interventions, the challenge will be figuring out how to scale up their use, especially in the developing world, and motivate implementers to use them. If the prevention campaign succeeds, the fiscal savings will be enormous.

At this point, the most commonly used tool is behavioral interventions—such as risk-reduction counseling, education, and condom distribution. There are also six neglected strategies that show promise technically and politically: targeting HIV hot spots, increasing male circumcision, integrating family planning with AIDS treatment, reorienting HIV testing toward couples, using AIDS treatment for HIV prevention, and mobilizing AIDS patients for HIV prevention.

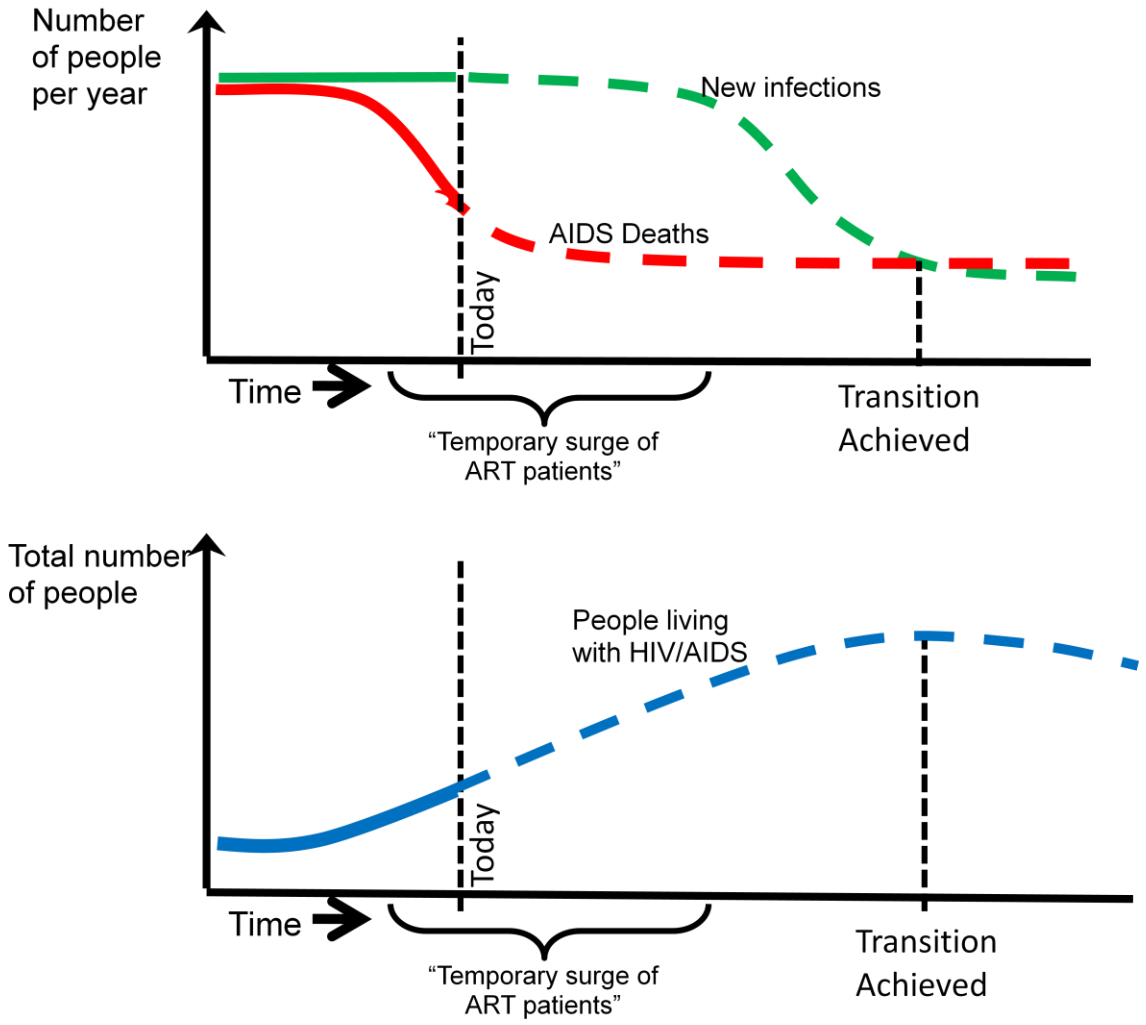

Figure 2. An AIDS progress report
Panel (a) The world's current AIDS population explosion can be temporary …
Panel (b) … if prevention is stepped up to achieve the AIDS transition.
Source: (Over 2004)

A dynamic transition

The AIDS transition has many commonalities with other transitions in the history of public health, especially the demographic transitionCoale (1973); (Hammer, S. M. et al., 2008); Montgomery (2010); (Thompson, 1929)—the shift from a largely rural agrarian society with high fertility and mortality rates to a predominantly urban industrial society with low fertility and mortality rates. They are both dynamic processes with a lot of momentum; they begin

with a threatening "population explosion" because of declining mortality; they require slowing down the trend in the process that adds to the stock of people; and neither one is amenable to a quick fix—a solution to the exploding numbers by simply allowing mortality to rise would have tragic human consequences, which would generate politically unacceptable reputation risks for the donors if not for the governments (Over (2008).

In the AIDS transition, the dynamism is evident at many levels. For the population, risky behaviors that spread HIV ebb and flow in response not only to population dynamics and economic growth patterns but also to the changing perception of the riskiness of those behaviors. In turn, HIV transmission ebbs and flows in response to behavioral cycles. Within each patient, the billions of replicating virus particles surge, then ebb, then surge again as the virus fights a years-long war of attrition with the host's immune system.[1] Even society's responses—including fear, denial, recognition, and policies for preventing, treating, and mitigating the disease's impact—ebb and flow in response to changing political personalities, fluctuating donor fashions, new cohorts of youth coming of age, and the boom and bust of economic cycles.

That said, the AIDS transition and the demographic transition also have many differences. The key one is that some virtuous feedback exists between mortality and fertility in the

[1] According to David Ho, the first to recognize the extraordinary dynamics of HIV in the human body, the total virus production per day is somewhere between 10^{10} and 10^{12} virus particles. On an MIT web page he is quoted as saying, "Half of [the virus particles] in circulation [in the bloodstream of an infected person] is removed in a half-hour, to be replaced by an equal amount of virus." http://mitworld.mit.edu/video/360

demographic transition, while although there may be virtuous feedback in the AIDS transition, there is also perverse feedback.

In the demographic transition, despite our concerns about the pressure that a high birth rate puts on our limited resources, each individual baby is a cause for celebration. Furthermore, the population boom caused a bulge in the age distribution of many countries, which in turn contributed a "demographic gift" in the form of increased savings and faster economic growth when that wave of people entered the labor force (Bloom et al, 1998).

In contrast, no one can rationally celebrate a new case of HIV infection. On top of the pain and suffering, and ultimately premature death that results, there are serious economic consequences. Instead of producing a bulge of healthy fully productive human beings who can add to national savings, each additional AIDS patient treated with subsidized ART, no matter how successfully, will draw down national saving by the amount of his or her treatment subsidy. Even patients who pay for their own care are bidding scarce medical resources away from other competing health needs. All of these costs can be avoided by simply preventing the infection in the first place.

Moreover, in the demographic transition, as adults learn that their children are less likely to die in childhood, they naturally desire fewer children. A decline in desired family size, if supported with family planning information and supplies, leads to a decline in birth rates. This natural tendency for birthrates to fall following a decline in death rates and improved

rates of female education implies that government policy to lower birth rates is to some degree "pushing on an open door."

Table 1. A mixed bag
Pros and cons of biological and behavioral effects of ART on rate of new HIV infections

	Effects that might slow transmission	**Effects that might speed transmission**
Biological	* Reduces viral load in the HIV-infected person, which reduces infectivity per contact	* Lengthens duration of infectivity, which increases number of contacts * Selects for resistant strains of HIV, which can be transmitted despite the presence of antiretroviral drugs
Behavioral	* Motivates HIV testing, but testing has an ambiguous impact on transmission * Promotes solidarity and reduces the stigma associated with HIV/AIDS, which might facilitate prevention campaigns in some settings	* Reduces perceived danger of unsafe behavior, potentially leading to the "disinhibition" of risk behavior.

Source: Over et al. (2004)

But in the AIDS transition, the impact on new infections of AIDS treatment access and the consequently smaller number of deaths is more complicated and less clearly desirable. As Table 1 shows, there are various positive and negative behavioral and biological effects. Just as awareness of lower childhood mortality has reduced peoples' fear that their children would die and thus allowed them to plan fewer children, awareness of lower AIDS mortality has reduced peoples' fear of knowing their HIV infection status and thus allowed them to seek testing and treatment at an earlier stage of the disease. And effective treatment reduces

new infections by lowering the number of virus particles in bodily fluids, thereby reducing the rate of transmission associated with potential exposures.[2]

Unfortunately, pernicious effects in both the biological and the behavioral dimensions offset the desirable effects of treatment on the number of new infections. In the biological dimension, ART can select resistant strains of HIV, which can replicate in, and be spread by, ART patients (Bangsberg et al, 2003); (Friedland et al, 1999). And because treatment lengthens patients' lives, it obviously lengthens the time during which these patients can infect others.

On the behavioral side, the increased HIV testing because of wider treatment access has been a mixed blessing for HIV prevention. People who have learned that they are HIV positive subsequently report altruistically reducing their risky contacts. However, since they are aware that society expects them to reduce their risky contacts, their self-reported behavior may be unreliable and might in fact hide a less altruistic change in behavior in the other direction. On the other hand, people who test negative actually report an increase in risky behavior, especially if they have tested negative several times(Sherr, L. et al., 2007).[3]

[2] For example, there is evidence that among the HIV negative spouses of ART patients, HIV infection rates are much smaller than among the HIV negative spouses of HIV infected people not on ART (Attia, S. et al., 2009); (Granich, R. M. et al., 2009).

[3] One possible explanation for increased risky behavior by people who have tested negative presumes that many of them know that they have previously had risky sexual contacts. Because public health messages rarely reveal that the probability of HIV transmission on a single sexual contact is less than 1 in 20, the person testing negative experiences so-called "cognitive dissonance" between his or her belief that transmission is highly probable and his infection status. While one might resolve this dissonance by doubting the accuracy of a single negative test, after several negative tests the person might logically conclude instead

Footnote continued on next page

Furthermore, the very effectiveness and accessibility of AIDS treatment naturally reduce peoples' fear of the disease. Given that risky sex and intravenous drug use, the two behaviors that transmit most HIV, are inherently appealing, people are rational to increase those behaviors in response to the perception that the consequences are less dangerous. Perverse effects of this sort have occurred in association with AIDS treatment in various settings around the world, including Nairobi, Kenya, and several American and European cities (Katz, M. H. et al., 2002); (Miller et al, 2000). To quote UNAIDS, "HIV incidence appears to be either stable or on the rise in numerous countries where antiretroviral therapy has long been widely available (UNAIDS, 2009)(page 18).

Another way that the two transitions differ is whether economic development helps or hinders. Although the demographic transition is not yet complete in all parts of the world, population death rates have generally remained low, and birth rates have continued to decline. As countries urbanize, educate their girls, and improve the availability of family planning information and supplies, people seem to want to reduce their fertility rates to approximately replacement level. The momentum of development is clearly reinforcing government policy in the direction of a successful demographic transition.

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that he or she is, for some unknown reason, immune to HIV infection. Believing oneself to be immune then can logically justify increased sexual activity. Another possible explanation for increased risky behavior after a negative test result is that the person who can claim such a result has more success in attracting partners.

In contrast, there is no perceptible development-related momentum for the AIDS transition in severely affected countries. Although significantly suppressed by vigorous government- and donor-supported AIDS treatment programs in many low- and middle-income countries, AIDS mortality would bounce back again within months if these subsidized programs were removed. And in poor countries, the number of HIV infections show no sign of declining "naturally" in response to expanded access to AIDS treatment (UNAIDS, op cit.).

Many ways to fail

What are the chances of success with the AIDS transition? Sadly, uncertain at best. Granted, the spread of AIDS treatment has launched the AIDS transition in many countries, but the transition can fail just as ignobly as did the last century's plan to eradicate malaria. Remember that in 1955, the World Health Organization (WHO) announced a worldwide Global Malaria Eradication Program in 1955, only to admit defeat in 1969(Tanner et al, 2008). Some 40 years later, the Global Roll Back Malaria Program is gaining momentum, but notably without the word "eradication" in its title.

So what form might failure take? Three possible scenarios stand out—one involving treatment failure and all involving prevention failure (see Figure 3). They all lead to ever faster accumulations of the population undergoing treatment with ART until, by the arithmetic of compound interest, keeping them alive requires an ever-growing portion of the total resources of the health sector and then of society as a whole.

In the first scenario (panel a) donors and governments not only fail to reduce the number of newly infected individuals (green line) but also fail to sustain the quality and the number of people recruited as new ART patients, which, in turn, will influence the number of AIDS deaths (red line). As a result, the current surge in the number living with HIV/AIDS initially slows but then continues to grow (blue line). While the growth rate in the total number of people with HIV would be slowest with this type of transition failure, the resurgence in AIDS mortality that would occur would remind the world of the resurgence of malaria deaths throughout Sub-Saharan Africa and Asia after the Global Malaria Eradication effort was

terminated in 1969(Packard, R. M., 1997). It would be a depressing and even humiliating failure of the development effort and would discredit all involved with the effort to widen access to AIDS treatment.

In the second scenario (panel b), donors and governments sustain the quality and the number of people recruited as new ART patients (red line stays down), but fail to slow the incidence of new infections (green line stays up). In this case, the continued "success" of treatment must lead inevitably to a disastrous backlash as donors and governments become overwhelmed with the burden of maintaining constantly growing numbers of people on treatment (blue line bends up) to the exclusion of all other social expenditure.

In the third scenario (panel c), donors and governments again sustain the quality and the number of people recruited as new ART patients, but fail so miserably on the prevention front that the incidence of new infections actually rises. Among the three types of AIDS transition failure, this one leads to the most explosive growth of people living with HIV/AIDS. It would occur if the net impact of AIDS treatment on HIV transmission turns out to be pernicious instead of desirable.

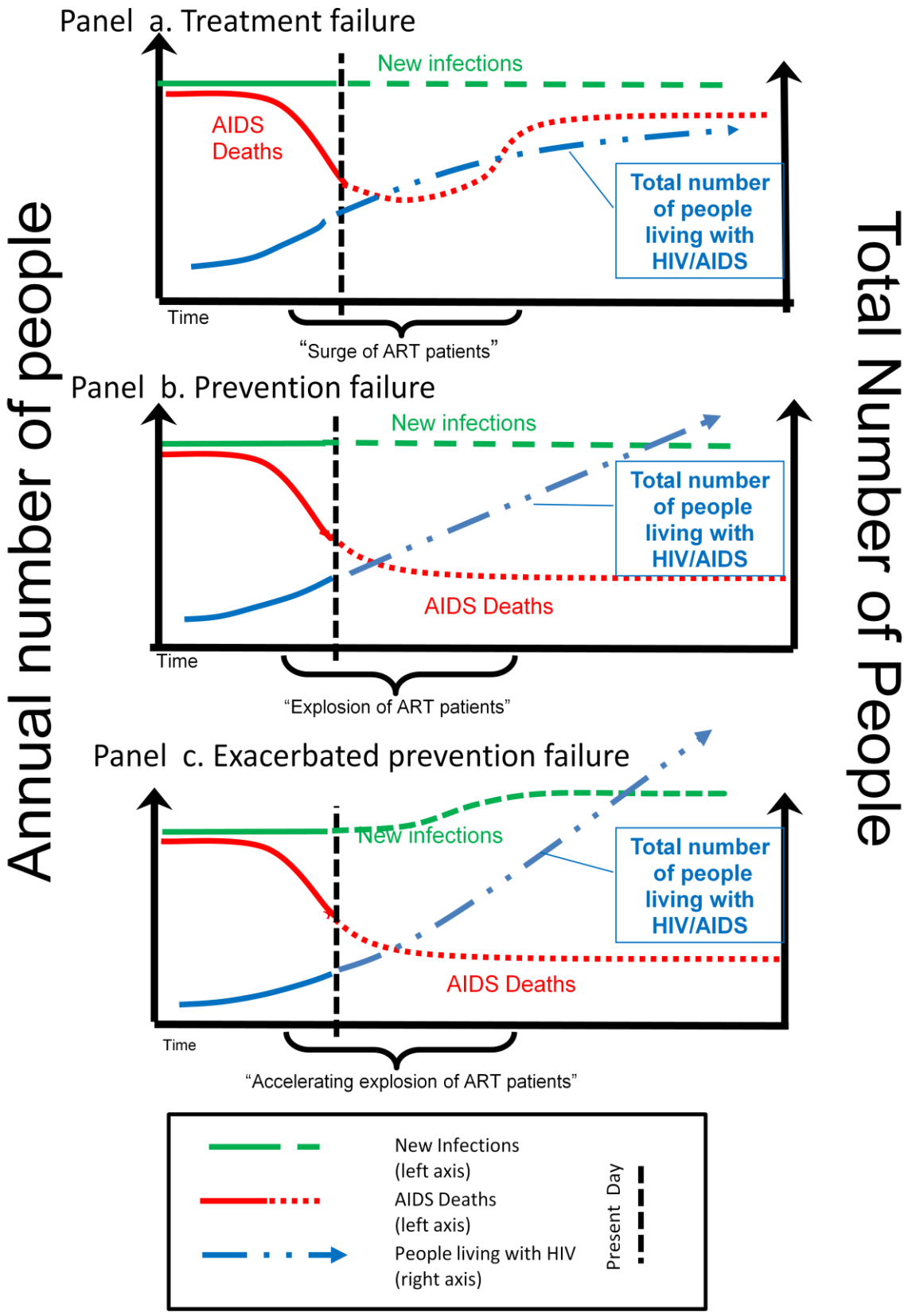


Figure 1. Three ways the AIDS transition can fail . Source (Author's construction based on Over (2004)

Which of these scenarios is most likely to occur? Given the current slowdown in the availability of funding for AIDS treatment and the lack of evidence for effective HIV prevention, the most likely pattern of transition failure is that shown in panel a. If AIDS deaths eventually swing back up—which would reflect a lowering of treatment standards—we can expect AIDS treatment providers, beneficiaries, and advocates to loudly blame one another and the rest of the foreign assistance community for this reversal. In the minds of tax-paying constituents in donor countries, the ensuing acrimony is likely to tarnish the entire AIDS-assistance enterprise, reducing AIDS donors' ability to fund AIDS treatment or prevention. Indeed, public disappointment with the reversal of the much celebrated mortality reductions to date might engender the feeling that *any* kind of foreign assistance is ultimately hopeless and thus lead to a loss of public support for foreign assistance funding in general. For these reasons, the AIDS community and the entire community of foreign assistance donors and recipients need a feasible objective for AIDS policy. The AIDS transition is just such a feasible objective.

A new policy tool

Just adopting a new paradigm, by itself, is no magic bullet for the AIDS epidemic. The litmus test of the paradigm will be whether it enables policymakers at every level—from national leaders down to the municipal authorities and from heads of donor agencies down to those who negotiate and implement project agreements—to integrate the twin goals of reducing mortality through sustained access to treatment and better preventing new infections.

Any program that accomplishes one of the goals without reference to the other must be called to account. Only programs that work on both—and can show results on both—should be eligible for funding.

II. Harbingers of an AIDS transition

How far along is the global community on the AIDS transition? The answer is that the world as a whole—and Sub-Saharan Africa in particular—are only in the initial stages.

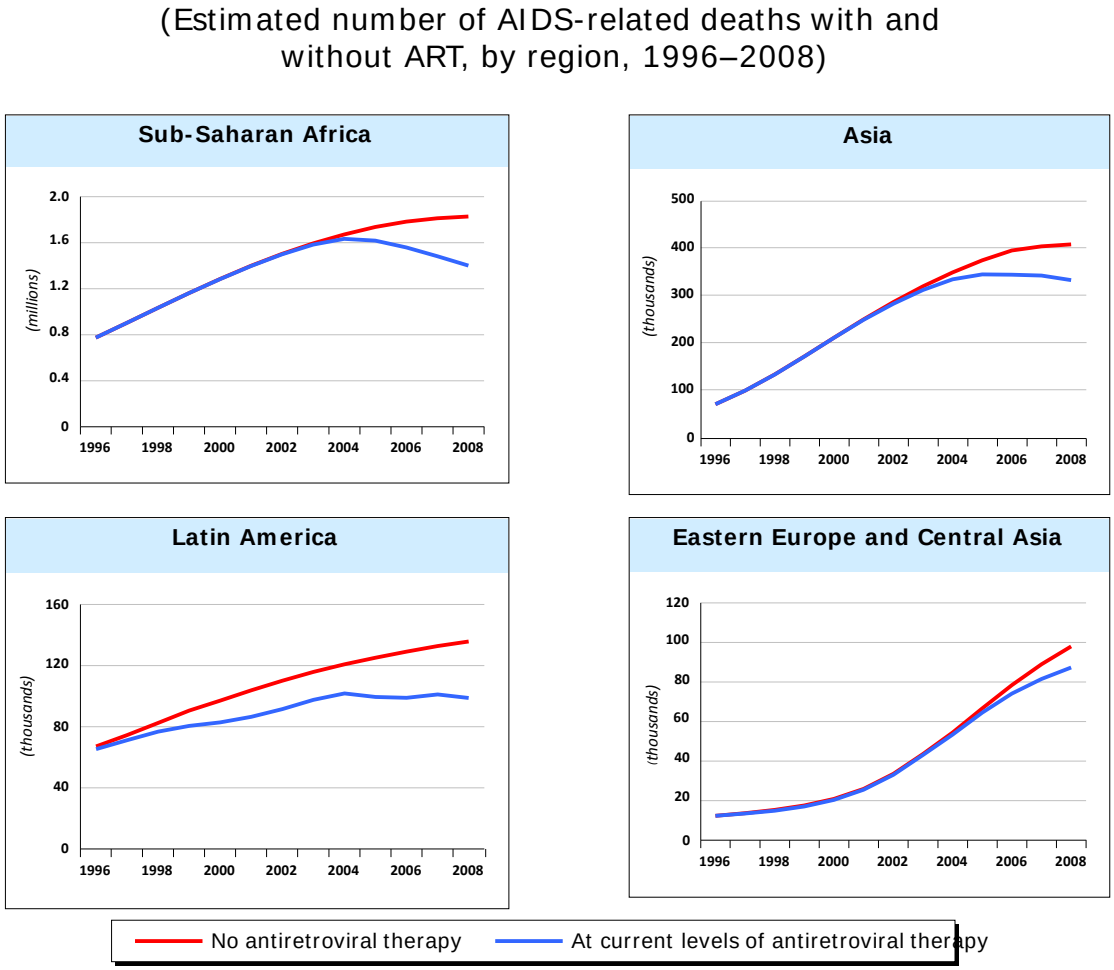


Figure 4. A promising start for some
In the four most heavily affected regions, Sub-Saharan Africa and Asia are leading the way on the AIDS transition.
(Source:(UNAIDS, 2009))

The Africa region, as Figure 4 shows, has the most marked evidence of a mortality reduction—characteristic of the beginning of an AIDS transition—with annual deaths declining from 1.6 million in 2005 to 1.4 million in 2008, a drop of 4.5 percent per year.

This continent-wide average hides even greater declines in some countries. Between 2002 and 2006, AIDS mortality in Kenya fell by 29 percent, or at an annual rate of 7 percent per year (National AIDS Control Program, 2007, as cited in UNAIDS, 2009).

The mortality trend for Asia also looks hopeful, suggesting that mortality is declining there, too, as India, the country with the most AIDS cases, continues to emulate Thailand by rolling out AIDS treatment to an increasingly large percentage of those who need it. However, the annual number of AIDS deaths has not yet begun to decline in Latin America and continues to rise in Eastern Europe and Central Asia. Although a few countries in these regions, like Brazil, Argentina, and Poland, have taken great strides toward mortality reduction, the regions in aggregate have not yet achieved the mortality reductions that are the harbinger of the first stage of an AIDS transition.

Too little prevention

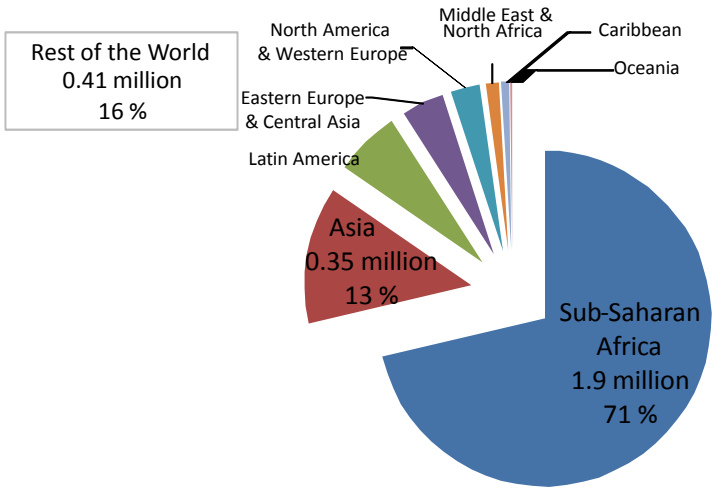
But the other half of the transition story is the rate of new HIV infections, and Sub-Saharan Africa and Asia together accounted for 83 percent of the roughly 2.7 million new infections in 2008 (see Figure 5). Moreover, as Figure 6 and Table 2 show, in most developing countries—about 86 percent of the 97 countries for which we have data—new HIV infections continue to exceed the number of deaths from AIDS. In other words, these countries are only in the initial phase of an AIDS transition. The worry is whether and how quickly they will proceed to the next stage. The problem is that countries like Brazil and Thailand have achieved wide treatment coverage but little on the prevention front, resulting in an "explosion" of people living with HIV/AIDS. Other countries like South Africa and

Zambia have achieved heroic expansion of ART access from 2007-2008, and are continuing to expand, but there is little evidence of better prevention.

Figure 5. AIDS heavyweights

New infections are concentrated in Sub-Saharan Africa and Asia

(Regional distribution of 2.7 million estimated new HIV infections in 2008)



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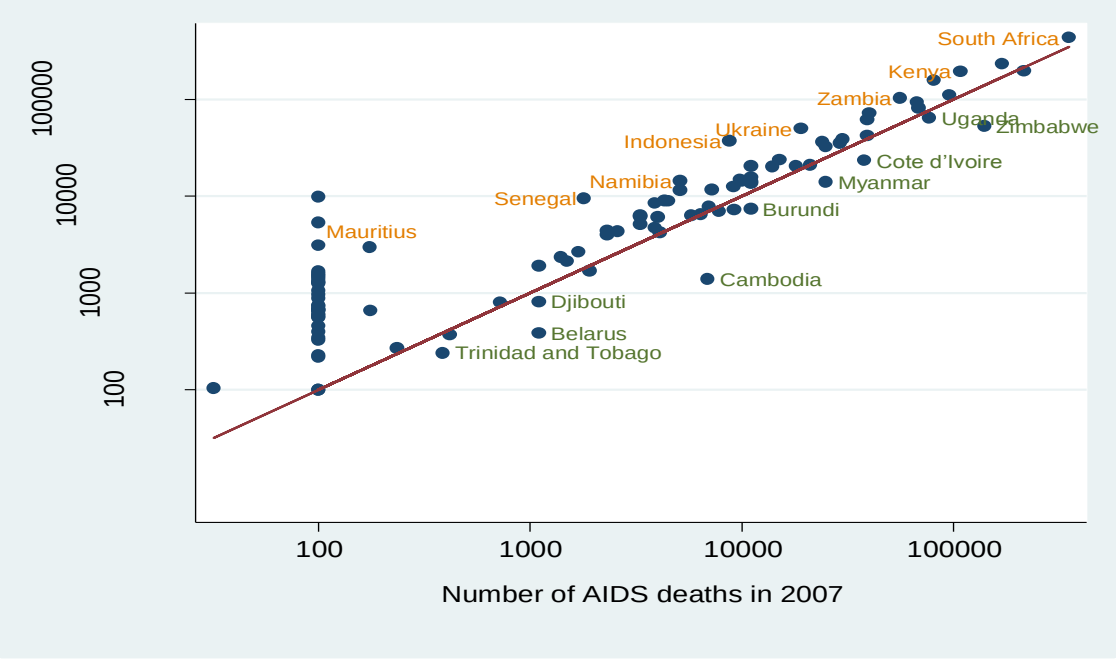

Figure 2. On the wrong side of the line
***The number of new HIV infections exceeds the number of AIDS deaths in all but 15 developing countries*. (Source: (eART-linc, 2008); (UNAIDS, 2008) and author's estimates)**

Table 2. A trend to reverse
New infections outnumber deaths in most developing countries as ART coverage grows

(Estimated new infections, AIDS deaths, and patients on ART in selected countries where new infections exceed deaths, 2007-2008)

	Estimated HIV incidence 2007*	Deaths in 2007	Percentage by which incidence exceeds deaths	Patients on ART in 2008	Percentage increase in ART 2007 to 2008	Estimated percentage coverage in 2008
South Africa	432,857	350,000	23.7%	701,000	52.4%	39.3%
Nigeria	231,428	170,000	36.1%	239,000	20.7%	29.5%
Kenya	195,000	107,500	81.4%	243,000	37.3%	43.6%
Zambia	103,500	56,000	84.8%	226,000	49.7%	59.9%
Ethiopia	93,642	67,000	39.8%	132,000	46.7%	39.2%
Thailand	39,071	30,000	30.2%	180,000	17.6%	69.5%
Vietnam	36,614	24,000	52.6%	27,100	59.4%	34.0%
Brazil	23,857	15,000	59.0%	190,000	5.0%	79.5%
Angola	20,635	11,000	87.6%	13,000	8.3%	23.0%
Colombia	14,828	9,800	51.3%	23,100	10.0%	39.1%
Namibia	14,528	5,100	184.9%	59,000	13.5%	82.5%
Swaziland	14,500	10,000	45.0%	32,700	30.8%	51.5%
Botswana	14,200	11,000	29.1%	117,000	25.8%	95.0%
Haiti	11,707	7,200	62.6%	19,300	28.7%	47.6%

Sources: Columns with deaths and patients on ART are from(World Health Organization, 2009)(UNAIDS, 2008); (UNAIDS, 2009). Estimates of incidence are computed by the author from UNAIDS and WHO time-series data on prevalence, deaths, and treatment rollout by country. Estimated coverage in 2008 is defined as the ratio of the number of 2008 ART patients to the sum of 2008 ART patients and need in 2007, according to UNAIDS' 2007 methodology. Selected countries have a ratio of estimated incidence to deaths greater than 1.2, a ratio of enrolled ART patients to the total number needing ART in 2007 greater than 0.25 and an estimated number of incident cases greater than 5,000. (gen cvg8 = a2008/(a2007-d2007+i2007);gen r = i2007/d2007; list nation i2007 d2007 r a2008 inc cvg8 if ((cvg>.25 & r > 1.2) | (code=="ZAF":code)) & i2007>10000 & i2007~=.)

Table 3. The exceptions
A minority of developing countries have managed to bring new infections below deaths

(Estimated new HIV infections, AIDS deaths, and patients on ART in all countries where deaths exceed new infections, 2007-2008)

	Estimated HIV incidence 2007*	Deaths in 2007	Percentage by which incidence exceeds deaths*	Patients on ART in 2008	Percentage increase in ART 2007 to 2008	Estimated coverage in 2008
India	196,733	213,677	-7.9%	235,000	48.7%	30.0%
Uganda	64,357	77,000	-16.4%	164,000	42.6%	48.6%
Zimbabwe	53,571	140,000	-61.7%	148,000	51.0%	30.6%
Cote d'Ivoire	23,357	38,000	-38.5%	52,000	0.0%	29.7%
Myanmar	14,000	25,000	-44.0%	15,200	38.2%	23.4%
Burundi	7,428	11,000	-32.5%	14,000	27.3%	32.2%
Burkina Faso	7,257	9,200	-21.1%	21,100	24.1%	45.8%
Rwanda	6,985	7,800	-10.4%	63,000	28.6%	93.8%
Honduras	1,700	1,900	-10.5%	6,300	12.5%	53.4%
Cambodia	1,400	6,900	-79.7%	32,000	18.5%	92.8%
Djibouti	814	1,100	-26.0%	999	42.7%	23.7%
Belarus	385	1,100	-65.0%	1,200	33.3%	33.5%
Gambia	370	401	-7.7%	999	100.2%	44.0%

Sources: Columns with deaths and patients on ART are from UNAIDS 2008, 2009, and WHO 2009. Estimates of incidence are computed by the author from UNAIDS and WHO time-series data on prevalence, deaths, and treatment rollout by country. See the notes to Table 2. *Negative numbers in column 3 indicate that deaths exceed new infections. (list nation i2007 d2007 r a2008 inc cvg8 if r<1)

As for the exceptions—those 15 percent of developing countries where AIDS deaths exceed new infections—their story is worth noting (see Table 3). Rwanda and Cambodia, with low death rates owing to estimated treatment coverage above 90 percent, and with even lower rates of new infection, are in the forefront of the AIDS transition. If they can sustain high treatment coverage and hold incidence rates below lowered death rates, they may be the first countries to consolidate the transition. India, Uganda, Zimbabwe, and Burkina Faso also seem to be on the way to consolidating the AIDS transition, partly because they have made

impressive reductions in incidence from previously much higher levels and partly because they have not expanded AIDS treatment as much as some others. It is critical that the incidence reductions be sustained as they strive to expand treatment coverage. In Uganda, the most frequently cited example of successful prevention, there is already worrisome evidence that risk-behavior and HIV infection rates in ante-natal clinics are rising (Opio et al.,2008, Wabwire-Mangen, 2009 as cited in UNAIDS, 2009). As for Cote d'Ivoire, Myanmar, and Burundi, their AIDS treatment coverage is so low (under one third) that their AIDS deaths have not yet fallen below the rate of new infections. As they work to expand treatment coverage, they can prevent the surge in the total number of people living with HIV/AIDS by simultaneously improving prevention effectiveness. In this way they can move more directly and immediately to consolidate an AIDS transition.

Uneasy early victories

Another way to track progress on the AIDS transition is to step back and look at the time paths of new HIV infections since 1980. At first glance, the news from Sub-Saharan Africa and Asia seems promising given that the number of new infections appears to be slightly declining (see Figure 7). For the period 2001 through 2008, when accuracy might be highest, UNAIDS estimates that the declines in the number of new infections have been at the annual rate of 2.7 percent per year in Africa and 1.9 percent in Asia. Perhaps if these trends are simply sustained, the number of new infections will eventually fall below the number of annual deaths and the number of people living with HIV/AIDS will begin to decline.

Figure 7. A promising start

Africa and Asia need to keep up the momentum in reducing new infections

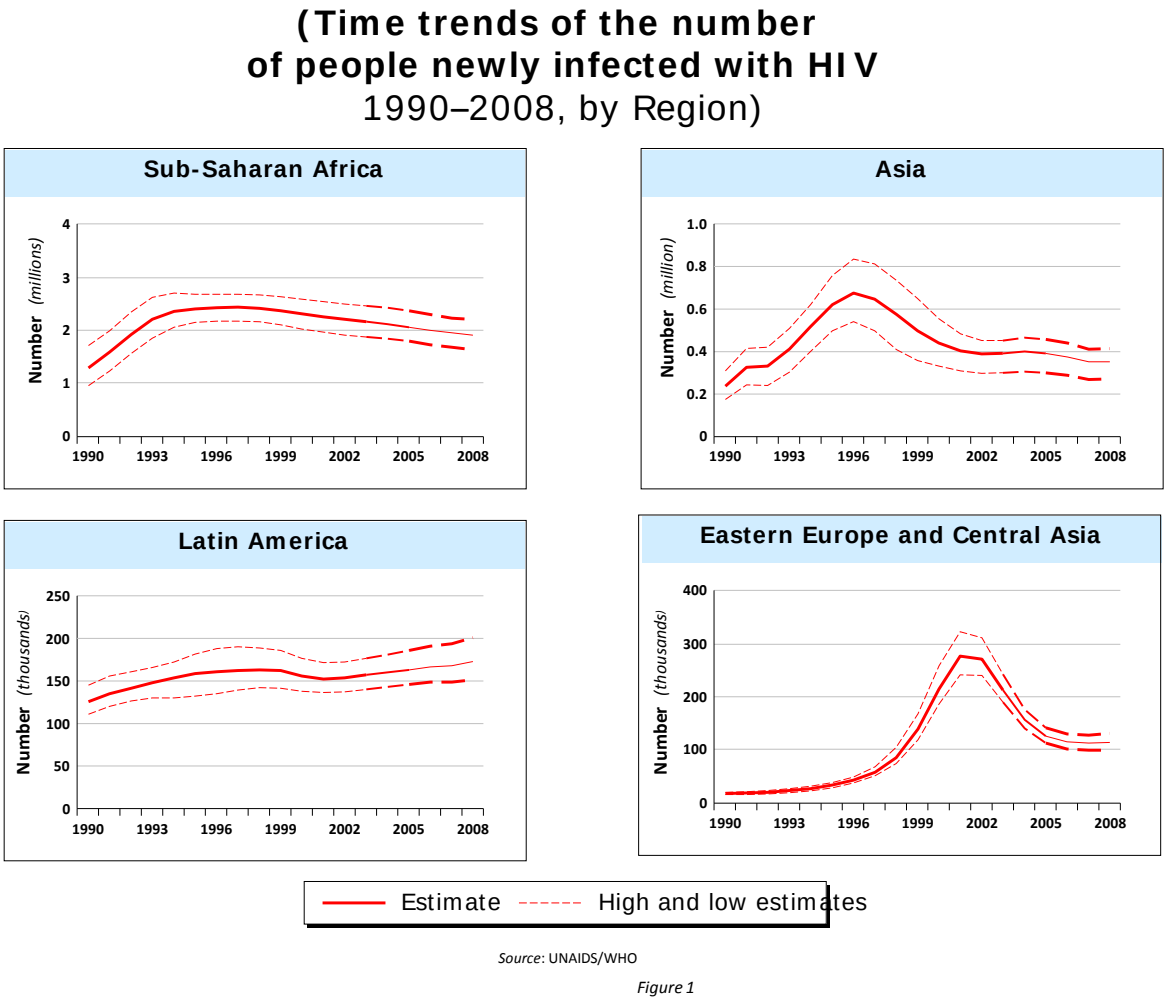

Figure 7. Annual incidence of new HIV infections by region as estimated by UNAIDS in 2009 Source: UNAIDS (2009)

If Asian countries simply sustain their current rate of decline of AIDS mortality, without aggressively expanding AIDS treatment, and incidence continues to fall at 1.9 percent per

year, the number of people living with HIV/AIDS in Asia would begin declining in 2015. But given the continued dramatic expansion of ART in India, China, and Vietnam—and the likelihood that Thailand and Cambodia will sustain or even further expand treatment access—AIDS mortality is likely to fall even faster. If the gap between new cases and mortality starts to widen in this way, the region's need of an AIDS transition strategy will be apparent. However, by taking preemptive action on HIV prevention, the region can avoid the explosion of people living with HIV/AIDS, moving more quickly to the consolidation stage in which AIDS is a manageable rarely infectious, chronic disease.

In Sub-Saharan Africa, while HIV incidence has been declining quickly, AIDS mortality has been falling much faster, at 4.5 percent per year, creating a population explosion of people living with HIV/AIDS. Moreover, there is evidence that the incidence decline has slowed and perhaps even stabilized. Determining what will happen next is difficult, given that there is an ongoing debate over how much of the incidence decline has been thanks to changes in risk behavior, perhaps caused by government- and donor-funded prevention interventions, and how much would have occurred anyway owing to the natural evolutionary pattern of any infectious disease epidemic. For example, the massive expenditures of the PEPFAR program in Africa since 2003, while coinciding with the downward bend in the mortality rate on that continent in Figure 4, do not seem to have been associated with any visible downward inflection in new HIV infections in Figure 7. While hardly strong evidence against the effectiveness of PEPFAR prevention efforts, this observation suggests that recent declines in HIV incidence might be cyclical and subject to reversal.

A recent study by Hallett and co-authors lends credence to the cyclical theory. Using detailed HIV surveillance data on specific countries, they extracted the estimated natural cyclical movement of the HIV epidemic in Zimbabwe, Kenya, and Haiti and showed that in those countries, an additional reduction in incidence had occurred on top of the reduction stemming from the natural course of HIV(Hallett, T. B. et al., 2006). However, recent data from Uganda, the African country to first report success at reducing the prevalence of HIV—where treatment coverage had expanded to 115,000 patients in 2007—suggests that both risk behavior and HIV prevalence rates are rising ((Opio, A. et al., 2008) as cited in UNAIDS, 2009). Thus, it is necessary to consider the discouraging possibility that Africa's incidence would stabilize at its current level, or even rise, as well as more optimistic futures in which it will continue to decline at 3 percent or more per year.

III.The timing and costs of an AIDS transition in Africa

In contrast to most other infectious diseases, HIV/AIDS spreads slowly and deliberately, but with seemingly inexorable momentum. The time from infection to illness is typically about 8 years, with individual durations varying from 5 up to 12 or more. In the absence of AIDS treatment, this long lag time means that preventing an HIV infection only generates a benefit in the form of an averted death after a median time of about 8 years. Since first-line AIDS treatment postpones mortality by 4 to 10 years, its wide availability increases the lag between HIV prevention and mortality benefits by this same number of years. When much more expensive second-line AIDS treatment is available for patients whose first-line therapy no longer works, mortality is postponed again.

Thus, HIV prevention programs implemented in the next few years generate most of their benefits beginning 20 years in the future. Any analysis that extends only 20 years from now will miss those benefits and thus undervalue HIV prevention. Other policy interventions with long-term impacts include changing the rate of uptake of new AIDS patients or the criteria for AIDS treatment eligibility. In this essay, in an effort to capture the benefits of HIV prevention and of other AIDS policies with long-duration, we use a planning horizon of 2050.[4]

A. Quick, slow, or not at all

When might an AIDS transition occur in Sub-Saharan Africa? By projecting forward to the year 2050 the annual numbers of new HIV infections and AIDS deaths, we can estimate the number of years until an AIDS transition as a function of plausible rates of incidence decline and ART uptake. We look at three cases with differing levels of incidence—from the number of new infections staying constant to a decline of 10 percent per year. In each of these cases, we also examine four possible future treatment uptake scenarios. The uptake assumption—defined as the percentage of unmet need at the beginning of any year that is met during that year —varies from zero to 80 percent.

In case 1, we examine what would happen if governments and donors respect only the entitlements of those currently on treatment but add no future patients to the treatment rolls (Figure 8, panel a). That is, we assume that the annual number of new cases stabilizes at the recent estimate, rather than declines.[5] This case reproduces for Africa the treatment failure depicted in Figure 3 panel a, where incidence remains high and mortality reverts gradually back to the levels it attained prior to 2003, before the expansion of treatment access. The fact that AIDS mortality rises to eventually equal the number of new cases means that the explosive growth of the number of people living with HIV/AIDS will slow and then eventually reverse. But this "solution" to the problems currently posed by treatment success amounts to surrender of the gains made to date. It would be akin to solving the problem of

[5] The computer model used for these projections is open source and freely available for download, so that readers can construct their own scenarios within the current structure of the program – or modify the program as desired. McCarthy and Over (2009)

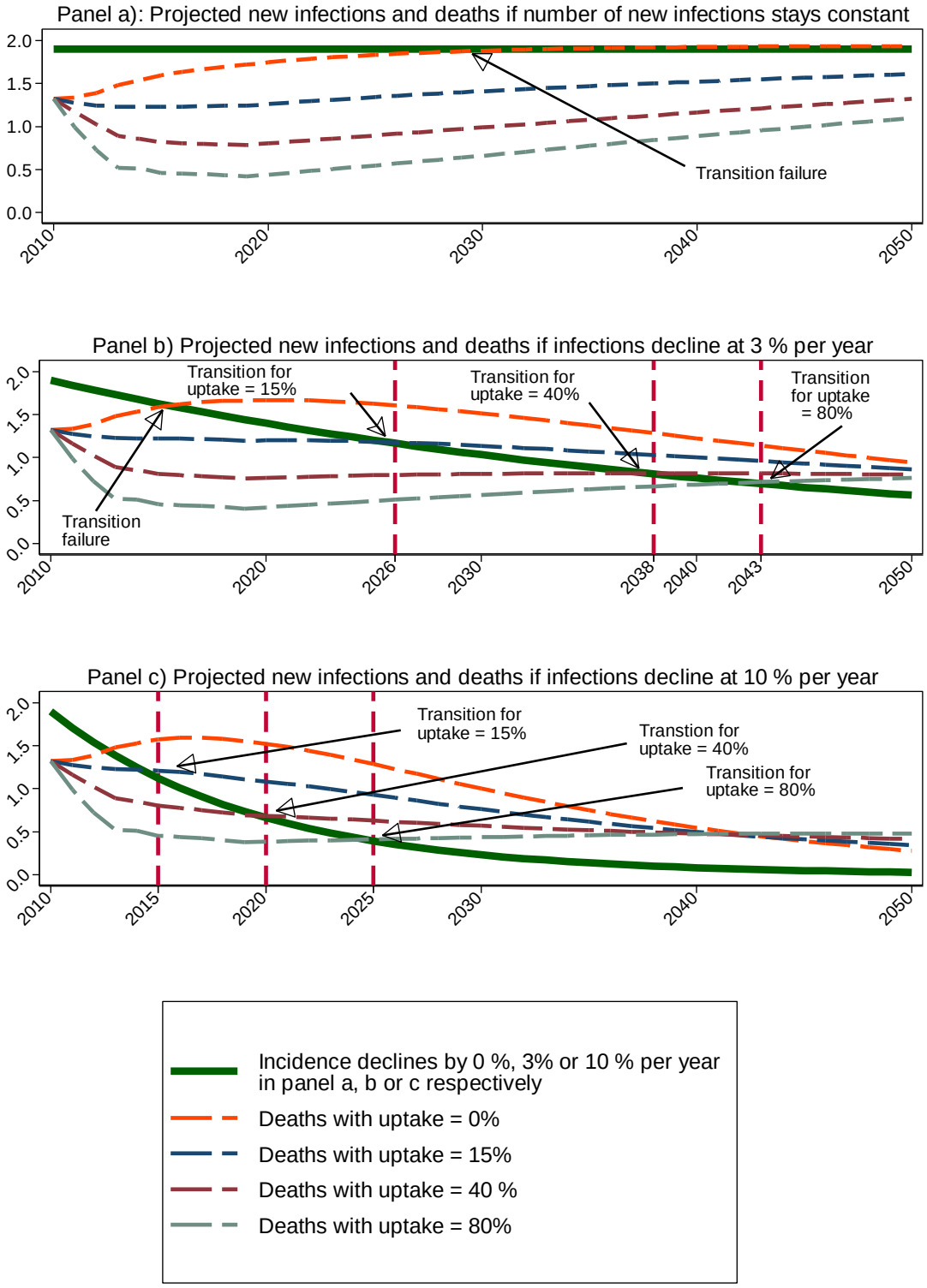

Figure 8. The timing of the AIDS transtion depends on both prevention success and treatment uptake. ***Depending on the rate of decline of new infections, the AIDS***

transition might never be achieved in Sub-Saharan Africa (panel a), be achieved in the year 2026 (panel b) or be achieved as early as 2015 (panel c) **(Source: Author's computations)**

exploding population growth not with family planning to facilitate a demographic transition, but by deliberately deploying the four horsemen of the apocalypse.

In case two, we take a more positive approach, assuming that the decline in incidence rates observed for the last seven years continues at the same rate of about 3 percent per year (Figure 8 panel b). If there is a zero decline in incidence (as in Figure 8 panel a), a policy of stopping all future patient enrollment leads to a convergence of mortality and incidence—an outcome we define as a "transition failure" because it does not meet the condition of sustaining the reduction in AIDS mortality. But if there is a treatment uptake rate of 15 percent per year, AIDS mortality continues to be held down to roughly the level to which it has been forced by successful treatment expansion. Under this rate of continued treatment expansion, the continent will attain an AIDS transition in the year 2026. With more vigorous ART expansion at 40 percent or 80 percent, the AIDS transition will be attained in 2038 or 2043 respectively. The year 2026 seems too long to wait before turning the corner on the AIDS epidemic, especially when considering that decades of further expenditures on AIDS treatment would lie ahead and an uptake rate of 15 percent would leave 85 percent of patients without recourse in any year throughout this period.

In case 3, we examine the much more optimistic situation that would be attainable if the incidence rate of new cases declines at 10 percent per year (Figure 8 panel c). With much more successful prevention and the current African uptake rate of 15 percent, the AIDS transition could be attained in 2015, only five years from now. Even with much more

ambitious uptake rates such as 40 or 80 percent, the transition could be achieved by 2020 or 2025.

Keep in mind that for any decline in incidence, the transition would be postponed by further expansions of access to treatment (panels b and c). Thus, while further treatment expansion postpones death for millions, by also postponing the AIDS transition, it greatly increases future costs and dependency levels. Donors and governments must carefully weigh the consequences when they expand treatment.

B. How to make the money go further

How much would the AIDS transition in Africa cost? We set out to answer that question by putting together a model that would allow us to look at many possible scenarios. Our key assumptions include a projection horizon set at the year 2050, which captures most of the benefits of prevention occurring in the next decade, and a conventional social discount rate of 3 percent. [6] We estimate the future fiscal burden of a government or donor commitment to any given level of recruitment by making assumptions about such determinants as the unit cost of treatment in each country, the potential economies of scale as treatment numbers expand, the success rate of treatment, and the proportion of patients moving from first- to second-line treatment. And because we are examining Sub-Saharan Africa, we adopt the perspective of the international public sector (which includes both donor governments and the national governments of affected countries, but excludes out-of pocket and third-party

[6] One might argue that the planning horizon should be shorter because of technological uncertainty and myopic political decision-making or even longer to capture even more of the prevention benefits. Our choice of a 40-year horizon is an admittedly arbitrary compromise between these views. Similarly, choosing too high a rate at which to discount future costs and benefits biases the analysis against prevention.

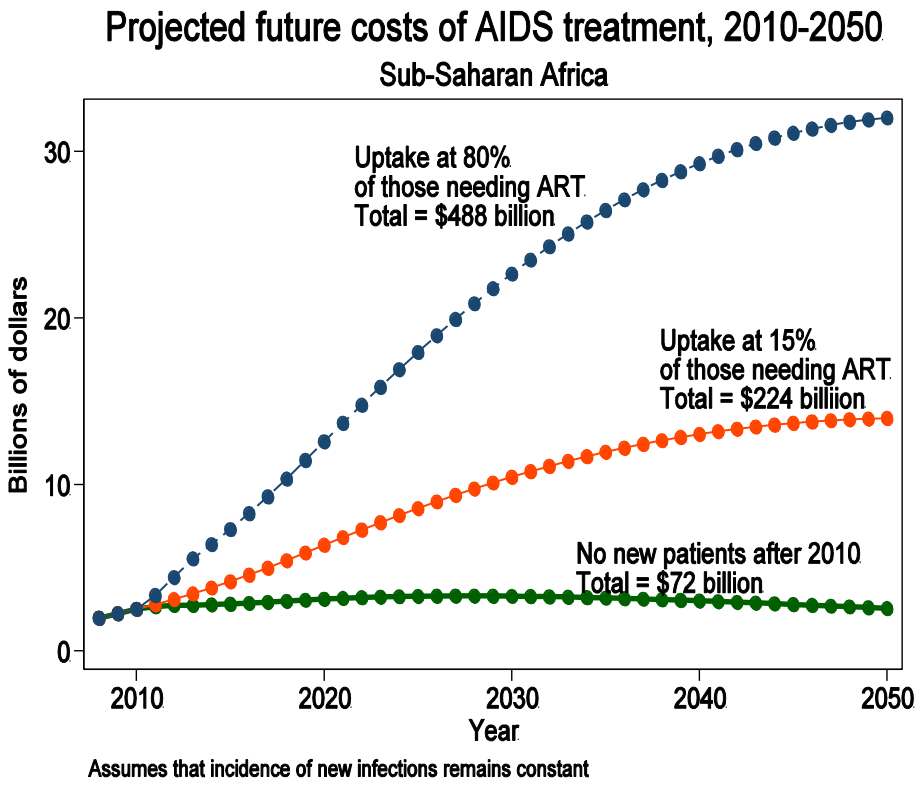

Figure 3. The cost of saving lives
As ART treatment expands, so will fiscal costs **(Source: Author's calculations.)**

payments). In other words, we estimate the total cost of subsidized AIDS treatment in the region—and the impact on these costs and on total cumulated AIDS deaths—knowing that in almost all of the countries in the region most of these costs are currently borne by external funders.

Our study shows that the answer to costs lies in the uptake rate. An uptake percent of zero would mean that those underwriting the treatment subsidies respect the entitlement of patients who have started subsidized treatment up to the present, but assume no financial

responsibility for additional patients in the future.[7] Using available data on the mortality of AIDS patients on treatment, and assuming that second-line treatment scales up to 95 percent coverage of the recruited patients who fail first-line treatment by the year 2020, about half of the 3.4 million patients currently on subsidized treatment will still be alive in 2050, two thirds of whom will be on second-line therapy. As Figure 9 shows, the annual cost of this existing cohort starts at $2.5 billion in 2010, rises to $3.3 billion in 2028 as more patients switch to second-line therapy before declining to $2.5 billion again in 2050 as mortality thins out the number of patients at the end of the projection period. Cumulating this annual cost over the 40 years at a 3 percent discount rate gives the endowment equivalent present value of a 40-year commitment as $72 billion 2009 dollars.[8] At a 3 percent interest rate, the annualized cost of this commitment would be $3 billion per year.

Since a complete cessation of treatment recruitment seems unlikely and would allow AIDS mortality to rise and thus constitute failure of the AIDS transition[9], Figure 9 presents the timeline of costs for two other scenarios, each of which is defined by a constant uptake percentage. The middle line presents the future cost stream associated with a commitment by funders to continue recruiting at about the same rate as they have in the past, which for the

[7] The model assumes subsidized cases in each country would converge to the target uptake rate over 3 years. The implication of this assumption is that, with a zero uptake rate, an additional 1 million new patients would be added in 2011-2013 and no patients thereafter. This assumption is consistent with PEPFAR's stated objective of reaching 4 million patients by the year 2014.

[8] The total present value of the commitment is the amount of an endowment which, if established today, would just cover the costs of this commitment and be exhausted at the end of the 40 year period, assuming an interest rate of three percent over the period.

[9] See the topmost of the dashed lines in the three panels of **Error! Reference source not found.** (deaths with uptake = 0%).

average African country has been about 15 percent of those needing treatment in any year. Since a few African countries have done much better than that, while most have done worse, a commitment to this objective might be met by reallocating treatment subsidies away from countries which have recruited higher percentages and toward those that have done worse. Under this recruitment policy, and assuming that HIV incidence remains unchanged, Figure 9 shows that annual treatment costs for the continent would rise from $3.3 billion now to about $12 billion by the year 2050 and the total present value (or the endowment equivalent) of the commitment would be $224 billion.[10] At a 3 percent interest rate, the annualized cost of this commitment would be $10 billion per year.

Of course, a much more generous commitment to provide subsidized treatment for 80 percent of those who need it each year would be close to the humanitarian ideal of universal coverage for AIDS treatment. Under the same assumptions as before regarding treatment success, HIV incidence and passage to second-line, but allowing for some economies of scale as treatment numbers scale up in individual countries, the annual cost of this commitment would rise to above $30 billion in the year 2050 and the total value (or endowment equivalent) of the 40 year commitment would be $488 billion.[11] At a 3 percent interest rate, the annualized cost of this commitment would be $21 billion per year.

[10] See note 8.
[11] See note 8.

Lowering costs through prevention

What happens if better prevention helps bring down the rate of new infections? Will that reduce costs? The answer is absolutely. As Figure 10 panel a shows, the present value (or the endowment equivalent) of uptake commitments in the zero to 80 percent range is extremely sensitive to the effectiveness of HIV prevention on the continent. If the rate of new HIV infections remains unchanged, at an 80 percent uptake, costs would drop from $488 billion to

$439 billion for a 40-year saving of $49 billion or an annualized saving of $2.1 billion.

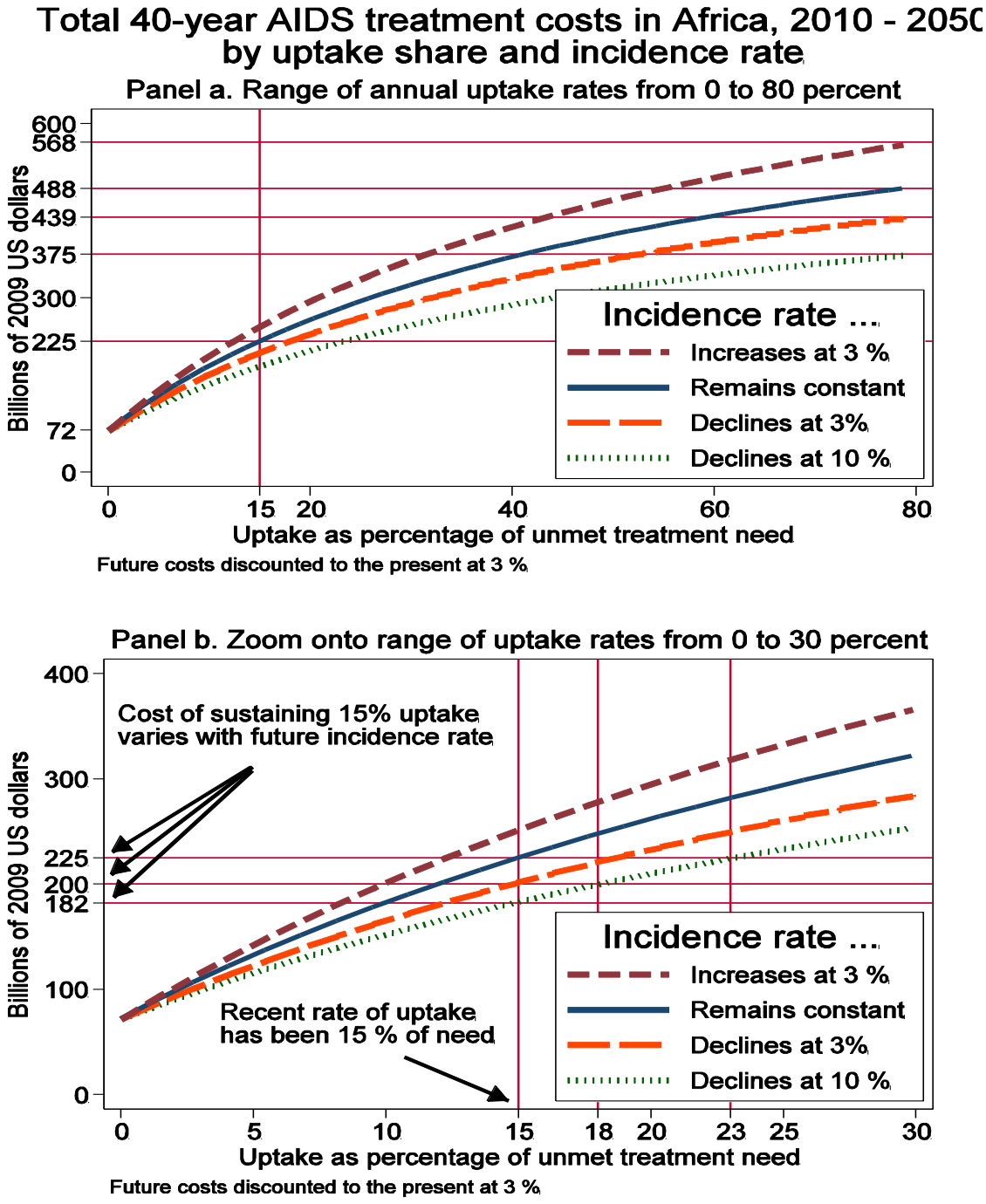

Figure 10. A fiscal case for better prevention ***As policymakers weigh by how much to increase the percentage of the HIV/AIDS population on ART, the fiscal burden would be lightened by a drop in the incidence of new infections.***
(Source: Author's calculations)

Furthermore, while the AIDS transition would be unattainable within 40 years if HIV incidence is constant (Figure 8 panel a), a 3 percent decline in incidence together with an 80 percent uptake would lead to an AIDS transition in the year 2043 (see panel b of Figure 8). At a 15 percent uptake, the AIDS transition would occur four years earlier in 2039.

If incidence falls by 10 percent per year, the savings at an 80 percent uptake amounts to $113 billion, which brings the annualized cost of almost universal coverage down to $16.11 billion per year. A glance at Figure 8 panel c reminds us that even with the 80 percent uptake, the AIDS transition would in this case occur in 2025, while at a 15 percent uptake the AIDS transition would be even earlier in 2020.

In contrast to these optimistic scenarios, however, is the pessimistic case in which the incidence rises by 3 percent year. The endowment equivalent of the costs over 40 years for an 80 percent uptake scenario would rise to $568 billion--$80 billion more than if incidence remains constant and $193 billion more than if incidence declines by 10 percent over the period. Moreover, the AIDS transition would have failed, as in panel c of Figure 3.

Given that the maximum uptake percentage that prodigious donor effort has been able to achieve since 2003 has averaged about 15 percent for the Sub-Saharan African region, it is worthwhile to focus more closely on uptake rates in that vicinity—which Figure 10 panel b does by zooming in on Figure 10 panel a to show the details in the neighborhood of uptake rates around 15 percent of and the associated costs.

Suppose the financiers of AIDS treatment subsidies in Africa were to commit to meeting 15 percent of treatment need over the next 40 years. At constant incidence, this would amount to an endowment equivalent commitment of $225 billion. But as it turns out, the same commitment would cost only $200 billion if the number of new HIV cases declines at 3 percent per year and only $182 billion if the decline is at 10 percent per year. On the other hand, if incidence increases by 3 percent per year, the total cost of this commitment would be $252 billion. These calculations underscore how a commitment by underwriters to finance a given percentage of need (here 15 percent) increases their financial stake in HIV prevention outcomes. Furthermore, the larger the share of future need that underwriters commit to funding, the larger will be their stake in future prevention effectiveness.

IV. Rethinking AIDS assistance policies to facilitate an AIDS transition

So how does the global community incorporate the objective of an AIDS transition into foreign aid policies? The good news is that there are numerous trends in today's global HIV/AIDS policy environment that should facilitate this endeavor. These include:

- increasing recognition that donor support of AIDS treatment in poor countries constitutes not only an unusually poignant and appealing way in which the richer countries can help the poorer ones but also an international entitlement from which donors and governments can only escape over the long term by assuring HIV prevention;

- increasing acceptance of donors that the eventual social development of the poorest countries depends upon a long-term commitment to support their education and health sector spending at levels consistent with an international humanitarian standard;

- increasing acceptance by donors and recipient countries that taxpayer and philanthropic support for social services in poor countries will increasingly be dependent on the transparency of the measurement of the results these services are intended to deliver;

- slower increase in the availability of AIDS funding than in the recent past;

- increasing international impatience with poor HIV prevention performance excused by issues of stigma or cultural barriers;

- improving technology for measuring the incidence of new HIV infections at the population level;

- recognition by the international AIDS community that male circumcision is not only effective at reducing a man's risk of infection but may also be acceptable among adult male populations in Africa; and

- tentative acceptance by the international AIDS community that behavioral HIV prevention can be effective following, for example, the management intensive Avahan model from India, but the "best practices" are highly context specific and thus must be developed and tested afresh in each national context.

The challenge for the international health community is now to build on these trends to design a new "AIDS transition strategy." The key to that strategy will be to leverage the political and economic support for providing ART to the largest possible number of patients to assure not only sustained support for continued uptake of new ART patients at close to the historical global rate of 15 percent per year but also a dramatic deceleration in the rate of new HIV infections.

Changing policy at every level

The AIDS transition paradigm introduces an objective for each donor and national HIV/AIDS program. Programs will not be deemed successful unless they simultaneously suppress AIDS mortality and reduce the growth rate of the HIV/AIDS population. This objective will change policy and practice at every level.

At the national or "macro" level, an AIDS transition objective forces donors and governments to plan for AIDS treatment expansion only at the rate that evidence-based prevention programs demonstrate success in reducing incidence. The AIDS transition objective generates a demand for improved HIV incidence measurement that will immediately expand the resources devoted to this essential task and over the medium term elicit entrepreneurial energy and biological breakthroughs to improve the technology for incidence measurement. To the extent that AIDS treatment can be shown, in a given country setting, to directly reduce HIV incidence, the scope for AIDS treatment would be expanded.

But claims for such a beneficial effect of treatment must be demonstrated with hard data, not just through mathematical models or self-reported behavioral change.

At the sub-national level, policymakers would be asked to show how existing HIV/AIDS treatment programs can be leveraged to improve prevention. For example, treatment programs can be required to either (1) have an HIV prevention arm that extends beyond prevention counseling for the ART patients, reaching out to the local community of uninfected people or (2) form a partnership with an agency specialized in results-based HIV prevention in such a population. Since budgetary constraints for supporting AIDS patients are typically national, there would be scope for "trade" in AIDS treatment slots, so that sub-national districts, provinces, or programs that effectively demonstrate prevention success can "sell" that success to less successful regions that have more demand for treatment. Such an internal "market" would reallocate resources to treatment/prevention efforts that effectively reduce incidence until the AIDS transition objective is satisfied.[12]

At the level of the individual patient receiving subsidized ART, those whose health enables a return to the labor force can be asked to contribute one day a month to HIV prevention in their community. Treatment programs can require patients to be members of support groups that function not only to help the patient adhere to the ART regime and regain or sustain

[12] There is an analogy here with the "cap and trade" proposals for limiting the growth of carbon-dioxide emissions. Treatment programs that wish to recruit new patients could be asked to purchase a certain number of prevented HIV infections for every new treatment slot to be subsidized by the government or donors.

good health, but also to design and implement evidence-based HIV prevention programs in local communities.

People suffering from AIDS and their advocates may object to the AIDS transition paradigm because it conditions AIDS treatment expenditures on measured prevention success, thereby holding AIDS patients hostage to the performance of HIV prevention programs and ultimately to the risk behavior in the community. The moral weight of this argument would be compelling if financial and manpower resources were sufficient to treat an unlimited number of patients. However, in the current environment, with budget shortfalls and belt-tightening everywhere, it is clear that AIDS treatment resources will be rationed whether or not we like it. More than ever before, AIDS treatment programs are being asked to demonstrate their efficiency. AIDS treatment advocates can increase the resources allocated to AIDS treatment if they concede the need to assure a net decline in people living with HIV/AIDs and work actively to measure and publicize their progress toward this objective.

How PEPFAR fits in

The U.S. 2008 PEPFAR reauthorization bill contains an example of exactly this kind of bargain—in the form of a requirement on the PEPFAR program. The bill mandates that the U.S. administration (that is, the PEPFAR program) report by September 30, 2008, and annually thereafter, the unit costs of AIDS treatment over time. It further specifies that the number of people on treatment must be increased commensurate with the decline in the unit cost of treatment, so that the authorized treatment budget could be spread over more and more patients. The language of the bill says: "the treatment goal…shall be increased…by the

same percentage that the average U.S. Government cost per patient…has decreased …" [Sec 403(3)(d)(3)] This may be the first time in history that any government has mandated performance targets based on estimates of the unit costs of meeting those targets.[13]

Because U.S. authorization legislation sets an upper limit on the amount that subsequent appropriation bills can allocate to a program, the bill's authors were constrained to seek efficiency through unit cost reductions. The language of the bill gives AIDS treatment advocates an incentive to innovate in the management of treatment delivery systems in search of lower unit costs.

An alternative procedure more in keeping with the AIDS transition objective would be for a donor to "authorize" its agents not only to continue to treat current patients but also to recruit a specified share of all those who need treatment in each future year through, for example, 2050. This authorization would effectively guarantee an entitlement to the existing patients and also to that donor's share of all new patients. From the point of view of treatment advocates, it would be better for the donor to include a share of future patients in the entitlement than to only commit to continued treatment for existing patients.

In its December 2009 strategy document, the United States committed to such an expansion of the number of AIDS patients who will receive U.S.-funded ART, promising to boost the

[13] See Over and Wendt, "PEPFAR Reauthorization IV: Target Formula May Unintentionally Prevent Improvements in PEPFAR Implementation," August 4, 2008, http://blogs.cgdev.org/globalhealth/2008/08/pepfar-reauthorization-iv-targ.php

total number supported by the U.S. government from 2.4 to at least 4 million patients by the year 2014. At the same time it promised to put greater emphasis on HIV prevention and, specifically, prevent 12 million infections.[14] However, it would have been preferable to make the treatment commitment in the form of a specific *percentage* share of treatment need, rather than as a specific *number* of patients, because that way, the donor and its agents could not only share the burden of future patients but also share the fiscal saving from effective prevention.[15]

Once it becomes apparent that the donor shares the gains from effective prevention, the donor can offer the recipient government an intertemporal trade. Under the specified assumptions on unit costs and the incidence of new infections, the future stream of these treatment costs can be estimated. For Sub-Saharan Africa, as Figure 10 panels a and b show, the total cost of that commitment will be a great deal less if HIV incidence is reduced. This reduction will save resources in the future, but those resources are not currently available to expand treatment rolls. A valuable role for donors is to solve this time-inconsistency problem by making a contract with the recipient country. As hard evidence is presented that HIV incidence is declining, the present value of the consequent savings in treatment costs can be used immediately to increase the *current* expansion of treatment access.

[14] http://www.pepfar.gov/documents/organization/133035.pdf

[15] A more detailed consideration of this option is contained in an annex to this essay entitled "Should donors and governments commit to treat a number of cases or a percentage of need?"

In the U.S. case, Congress can mandate an increase in the uptake of new patients that will hold constant the U.S. total long-term financial commitment to treatment. Such a mandate would, first, force PEPFAR and recipient governments to measure incidence much more rigorously than it has yet done, and second, channel some of the political pressure for faster ART uptake toward achieving measurable reductions of HIV incidence on the ground in developing countries.

The troublesome aspect of the new PEPFAR strategy is that it announced its treatment and prevention objectives as two separate objectives. It is true that both of them would contribute to the achievement of the AIDS transition. But by failing to link them, the United States has missed a strategic opportunity to structure its AIDS assistance in a way that would more effectively motivate PEPFAR agents—who number in the thousands, from in-country program staff and civil servants to contractors and NGOs—to work toward an AIDS transition. The same advice would go for other major bilateral and international donors and programs, like the Global Fund to Fight AIDS, Tuberculosis and Malaria.

The essence of the AIDS transition strategy proposed here is for donors to leverage the support for AIDS treatment to improve the effectiveness of HIV prevention and assure that mortality reductions are sustained while incidence falls below mortality over time. An accompanying essay discusses options for improving the incentives for prevention, including the possibility of "Cash on Delivery" for HIV incidence reduction. Another accompanying essay forecasts the fiscal burden of AIDS treatment under a wider range of policy options and considers the role of performance-based reward systems in assuring the quality of ART

as well as the contribution of AIDS treatment groups to effective prevention in the wider community. Only through effective HIV prevention combined with sustained treatment can the world eventually move beyond the AIDS transition to a future when AIDS is a relatively rare and manageable chronic disease.

V. Annex. Commit to treat a number of cases or a percentage of need?

The debate over how much to expand and improve access to AIDS treatment usually revolves around whether the objective should be the enrollment of a given number of patients by a given future year, or a guarantee of "universal access" —where "universal access" is defined as serving 100 percent of those whose HIV sickness reaches a specified degree of severity in every future year. An alternative, which is akin to the latter but recognizes the infeasibility of universal access, is to define treatment performance as expanding enrollment each year so as to serve a given percentage between zero and 100 of those whose sickness reaches the specified degree of severity and have not yet received treatment. I call this annual percentage of unmet need served through enrollment expansion the "uptake rate" of a treatment program[16].

Defining a government or donor uptake policy as a public commitment to treat a proportion of those who need it, as we do in Figure 8, assures that the funders' future cost burden will be smaller if HIV prevention is more effective. In contrast to a commitment to fund a given *number* of new patients each year, the commitment to fund a given *percentage* of new patients gives the underwriting parties a financial stake in prevention outcomes and, therefore, a justifiable and legitimate concern with the proper measurement and forecasting of the number of current and future eligible patients. More than a commitment to treat a specified

[16] The uptake rate is a "flow" concept and will typically be different than the "coverage rate," which is a "stock" concept. For example, in a given year a country may be treating 45 percent of all who need treatment (its coverage), but may only be able to expand enrollment fast enough to serve 15 percent of unmet need that year (the uptake rate).

number of new patients each year, a percentage commitment signals to the recipient country that the donor is willing to share the fiscal risks if prevention results turn out poorly, in exchange for the opportunity to share the fiscal benefits when prevention succeeds. In countries where immediate political exigency overshadows long-term concerns to such a degree that HIV prevention receives too little public attention, the donor's financial as well as moral interest in prevention can help well-intentioned national politicians to maintain focus on this long-term public good.

A key choice parameter in my analysis is the uptake percentage, or the percentage of total unmet treatment need met through new patient recruitment each year. The narrative assumes that any chosen uptake percentage is the result of the aggregate commitments of all governments and donors on the African continent. However, a valid alternative perspective is to think of the uptake percentage as the share of the continent's annual unmet need for treatment assumed by a specific donor, such as PEPFAR. To the extent that ART delivery can be scaled up at constant unit costs, a second donor (for example, the Global Fund for AIDS, Tuberculosis and Malaria) could fund an additional uptake percentage, increasing the overall percentage of met need while committing to a commensurate share of treatment costs. The analysis of treatment uptake and its consequences for the time and cost until the achievement of an AIDS transition are thus largely additive.[17]

[17] Depending on how treatment is organized, the addition of a second contributor's funds could enable the entire treatment program to reduce unit costs through economies of scale in purchasing or service delivery. The cost estimates below incorporate such an assumption.

The same cannot be said for the impact of the rate of new HIV infections on the fiscal burdens of separate contributors to the AIDS transition within a given population. Under the rule that individual governments or donors each commit to a percentage of a country's total treatment need, the reduced treatment need resulting from the HIV prevention investments of any one government or donor will reduce the treatment costs to all the participants in AIDS treatment finance. Not only does the time until an AIDS transition become shorter for all participants but the future cost of a commitment to any given uptake percentage is also reduced for all. In this sense, investments in reducing the incidence of new infections are a pure public good and, like all public goods, suffer from the free rider problem. An individual government or donor that commits to a specific uptake percentage in a country or on the continent as a whole will have a greater financial stake in HIV prevention when there are few or no other financing entities committing to treatment in the same population.

An incentive compatible arrangement of AIDS responsibilities would be for each financial entity to focus on a population wherein as much as possible of the cost saving from HIV prevention effectiveness can accrue directly to that financing entity. Such an allocation of treatment financing responsibilities will tend to solve the free-rider problem and enhance the financial incentive for prevention. The alternative approach, wherein all donors tend to collaborate in all countries or all parts of a single country, dilutes the incentives for prevention and thus acts against the best interests of the recipient countries, which as a result will receive less effective prevention. Furthermore, if this free-rider problem reduces the incentives to invest in effective HIV prevention for all treatment contributors, then all will incur greater costs or be forced to renege on their treatment commitments.

An obvious possible impediment to donors committing to support a percentage of treatment need is the requirement that the donor and recipient governments, as well as other stakeholders, agree on a measurement of the denominator, the number of people needing treatment each year, but not receiving it. Since this number is difficult to estimate even in a rich country and depends on key technical decisions such as the threshold CD4 count at which a patient becomes eligible for subsidized treatment, some may object that it would be impractical for funders to commit to fund treatment slots for a percentage of need rather than for a number of patients.

One possible solution to this difficulty would be an expensive and unwieldy policy of universal annual testing to determine who needs treatment. An alternative, more practical possible solution would be to ask patients to enroll at treatment centers and then hold a transparent lottery to select those who win treatment slots. The donor would award treatment slots as a percentage of those registering for the lottery. Numbered biometrically coded identity cards could prevent individuals from entering the lottery multiple times, perhaps at different sites. A third alternative would be to use an agreed-upon third party to generate estimates of the total number needing treatment based on HIV surveillance data and projection models. See the accompanying essay on HIV prevention for more discussion of such a modeling approach.

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