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CENTER FOR GLOBAL DEVELOPMENT **ESSAY**

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**Using Incentives to Prevent HIV Infections**

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By Mead Over

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**ABSTRACT**

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This essay proposes ways to improve the effectiveness of HIV prevention by strengthening incentives for both measurement and achievement. It builds upon a companion essay that proposes an “AIDS Transition”—that is, a gradual reduction in the number of people infected with HIV even as those infected live longer—as a reasonable objective of donor and government AIDS policy.

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# Achieving an AIDS Transition: Preventing Infections to Sustain Treatment

## Essay 2: Using incentives to prevent HIV infections

*This essay proposes ways to improve the effectiveness of HIV prevention by strengthening incentives for both measurement and achievement. It builds upon a companion essay that proposes an “AIDS Transition”—that is, a gradual reduction in the number of people infected with HIV even as those infected live longer—as a reasonable objective of donor and government AIDS policy.*

by

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## Executive summary

After 30 years of grappling with the HIV/AIDS epidemic, the number of people living with HIV continues to soar, reaching 33.4 million in 2008. About 90 percent of those infected reside in the developing world, most of them in Sub-Saharan Africa, where the disease is likely to exacerbate poverty and inequality. It is true that ever greater numbers of AIDS patients are getting antiretroviral treatment (ART), extending lives and slowing the mortality rate. Even so, 2 million people died from AIDS in 2008, bringing the total since 1981 to 25 million people—and leaving Africa with over 14 million AIDS orphans. Moreover, and deeply troubling, for every two persons placed on treatment, there were about five new cases, with young people (aged 15-24) accounting for 40 percent of new HIV infections worldwide.

Enormous sums have been spent over the past decade to try to subdue the epidemic, but at least half of those funds have gone to treatment, not prevention. The problem, as a companion essay points out, is that this strategy has contributed to the ballooning size of the infected population, which over time is creating unsustainable costs. The answer, I argue, lies in an “AIDS Transition,” which will occur only when AIDS mortality is declining and the number of new HIV infections is even smaller and declining at least as fast. (See Box 2.) And for that to happen, the global community needs to simultaneously tackle both treatment and prevention.

The first section of this essay reviews the evidence on the cost-effectiveness of HIV prevention methods and concludes, despite the surprising and shocking weakness of the available research, that HIV prevention can work, provided the critical actors have the proper incentives. The second section explores to what degree “performance based incentives” (PBIs) could strengthen both the measurement of achievements and the achievements themselves. It then looks at six of the most promising prevention interventions and suggests how each could be improved by adding a PBI reward structure. The third section proposes a new approach to HIV prevention—called “Cash on Delivery”—which would give to developing country HIV prevention champions the means to recruit the allies within their own government and civil society that are needed for HIV prevention to finally make headway in stemming the flow of new infections.

## I. With appropriate incentives, HIV prevention can work

It is depressing and even scandalous that after more than 20 years of donor-funded prevention efforts, so few rigorous evaluations have been conducted of HIV prevention interventions (Bertozzi et al., 2010; Wegbreit et al., 2006). So what types of rigorous evaluations have been done? , While some evaluations look only at the costs or only at the health effects of an intervention, the best guidance for resource allocation comes from those that compare the effects to the costs—known as cost-effectiveness studies. Such studies estimate the costs per unit of health benefit obtained, with costs typically measured in dollars, and health benefits measured either in number of HIV cases averted, or the gain in years of additional healthy life, or “disability-adjusted life years” (DALYs).<sup>1</sup>

Recognizing that health service costs depend heavily on the cost of labor and other locally purchased inputs, which vary dramatically by a country’s gross domestic product (GDP) per person, a useful convention is to express the dollar cost per additional DALY gained as a proportion of the GDP per capita of the country in which the intervention has been performed. A recent review of cost-effectiveness studies reports: “[f]irst, all HIV-prevention interventions reviewed here are highly cost effective; that is, the cost per DALY is far less than one GDP per capita; and most interventions in Africa cost less than 30% of one GDP per capita and 40% in other regions. Second, all HIV-prevention interventions reviewed are cost effective when compared to other life saving interventions including HIV treatment, which is consistent with other recent comparative results” (Galarraga et al., 2009). Among the interventions found to be cost-effective are not only a biomedical one, male circumcision, but also broad-based interventions such as sex education classes in schools (Hogan et al., 2005) and a system of rewards for safe behavior and legal sanctions for risky behavior for prostitutes in the Dominican Republic (Sweat et al., 2006).

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<sup>1</sup> The DALY, or disability-adjusted healthy life year was originally developed by the World Bank as a measure of the burden of disease for use in its 1993 World Development Report on health (World Bank, 1993). One DALY is equal to one year of healthy life lost. In cost-effectiveness analysis a reduction in DALYs constitutes an improvement in the population’s health and thus is a measure of effectiveness which can be used to compare interventions across diseases.

Unfortunately, few of these favorable cost-effectiveness findings on HIV prevention are supported by another type of rigorous evaluation, known as randomized controlled studies (RCTs). What exactly are RCTs? To begin with, evaluation experts define the health benefit from an intervention as the difference between the health status of people who have received the intervention and the best estimate of what their health status would have been without the intervention. They apply the term “counterfactual” to the estimated health status of these same people without the intervention, because it refers to a situation that did not actually occur—one in which people who actually received the intervention, did not receive it. For an evaluation study to provide the most reliable guidance to decision-makers, its estimate of the intervention’s benefit must be computed as the improvement with respect to a rigorously estimated counterfactual. And there is widespread agreement that the most reliable and rigorous method for estimating the counterfactual, and thus for computing the improvement caused by the intervention, is to use an RCT.

What do the RCTs that have been carried out on HIV prevention show? Among the 39 interventions evaluated by 37 distinct RCTs for their ability to reduce HIV infection, only five have found a benefit (Padian et al, 2010). Of these, three have produced strong evidence that adult male circumcision reduces the man’s chance of infection by somewhere between 33 to 68 percent, one shows promise for a vaccine, and one, which finds HIV prevention benefits of treating sexually transmitted infection (STI)<sup>2</sup>, is contradicted by other equally rigorous experiments.<sup>3</sup> Promising interventions that have failed to show benefits in RCTs include vaginal microbicide (twelve)<sup>4</sup>; behavioral interventions using counseling, education, and condom distribution (seven); microfinance (one); the diaphragm (one); and pre-exposure prophylaxis (one).

Some conclude from these discouraging results that HIV prevention is a hopeless task. But I believe there is ample evidence that HIV prevention can and will achieve much greater success in the next 10 years than it has

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<sup>2</sup> The treatment of curable STIs is believed to slow the rate of HIV infection, at least in an early stage of the epidemic, because HIV-infected people become more infectious when they also harbor a curable STI and because HIV-negative people with an STI have more CD4 cells in their genital tracts that are potential targets for invading HIV (Over and Piot, 1996).

<sup>3</sup> Since each of the four RCTs of vaccines tested a biologically distinct vaccine, in a sense each RCT is *sui generis*. The failure of three of the vaccine trials does not cast as much doubt on the validity of the one success as is the case for the other success, STI treatment, for which there are 8 failed RCTs. (Padian et al, 2010)

<sup>4</sup> One of these 12 RCTs of vaginal microbicides had to be stopped because accumulating evidence showed women using this product were more likely to become HIV infected than those who did not.

in the last 30. The reason is that the failures of these RCTs to show a lower HIV incidence do not constitute proof that these interventions do not work. After all, to meet the requirements imposed by ethical review boards, the researchers in almost all HIV prevention trials were—and still are—required to provide substantial HIV prevention interventions to those not receiving the tested intervention—in effect, impeding the proper measurement of prevention efforts (see Figure 1).

Take the test of using a diaphragm for HIV prevention. The subjects were randomly allocated to either a “control arm” of the experiment that did not receive a diaphragm or an “experimental arm” that did. The idea was to test whether the rate of new HIV infections would be smaller among patients in the experimental arm than among those in the control arm. A finding that supports the effectiveness of diaphragms would give to policymakers, health workers, and, ultimately, women at risk of HIV an easily used and reusable, relatively inexpensive, female-controlled instrument to protect against infection.

However, the ethical review boards felt that it would be unethical to withhold all HIV prevention from the women who would not receive a diaphragm. They insisted that the researchers provide these women with condom promotion, enhanced diagnosis and treatment of curable STIs (like gonorrhea, syphilis and chlamydia), and risk reduction counseling (see Table 1). Thus, instead of comparing the effectiveness of the diaphragm to the effectiveness of what women in the study area were and would be already doing in their natural milieu, the researchers were obliged to compare the effectiveness of the diaphragm to a package of interventions generally thought to be among the most effective. If the package was sufficiently effective at preventing HIV, there would be no room for the addition of a diaphragm to make any difference. And this might be what happened.

**Table 1. Hard to judge what worked***Control groups always received prevention services so it was tough to isolate if a particular intervention was worthwhile*

(Components of prevention services offered in 36 randomized controlled trials (of 38 interventions) for HIV prevention).

Type of intervention*	No. of trials	No. of trials with prevention services in comparison arms		
		Risk reduction counseling / education	Condom promotion	Enhanced STI services
Behavioral (including risk reduction counseling and condom promotion)	7	5	4	1
Diaphragm	1	1	1	1
Microbicides	12	12	12	12
Pre-exposure Prophylaxis (PrEP)**	1	1	1	0
Male circumcision	4	4	4	4
Treatment of curable sexually transmitted infections	9	7	8	6
Vaccines	4	4	3	2
<b>Total</b>	<b>38</b>	<b>34 (89%)</b>	<b>33 (87%)</b>	<b>26 (68%)</b>

\*One of the 39 interventions reviewed in Padian et al (2010), microfinance (Pronyk 2006) is excluded from this table, because the nature of the prevention services provided to the comparison arm is not reported.

\*\*The intervention PrEP consists of providing antiretroviral medication to uninfected people prior to their exposure, for example through unprotected sex or needle sharing.

Source: Personal communication from McCoy and Padian based on Padian et al (Padian et al, 2010)

The conditions placed by the ethical review boards on the diaphragm experiment were typical of the conditions placed on many of the prevention studies. Behavioral interventions and treatment of curable STIs were used extensively to protect those in the comparison arm. In some cases this protection was so effective that there were hardly any HIV infections in the control arm of the study, making it impossible for the tested intervention to show a benefit. Because of this design feature, the lack of evidence that prevention works might be because the tested interventions, although intrinsically quite useful, have not been sufficiently better than the package of



**Figure 1. Mandated ethical standards**

*(Only 5 percent of 37 rigorous prevention trials compared the tested intervention to a realistic "standard of care," while 66 percent compared the intervention to "exceptional" prevention services)*

(Components of prevention services offered in 37 randomized controlled trials for HIV prevention. (Source: Padian et al, 2010)

services provided to the control group. (See Box 1.) This possibility is supported by the fact that that many of the studies reported informally that risk behavior or HIV incidence had improved in the control group. So the possibility remains that all of these interventions work, although none works perfectly. If this conclusion could be rigorously established through better study design, HIV prevention science and policy would be greatly advanced. Meanwhile, this evidence and the observation that countries like Thailand and Uganda have decreased infection rates encourage us to find ways to improve prevention.

Box 1. Can ethics “blind” attempts to learn how well prevention works?.

*Although randomized controlled studies (RCTs) are indeed the “gold standard” of evaluation—given that they have the best chance of giving an accurate estimate of the health improvement due to an intervention—they can still fail to discover the true impact of a valuable intervention for several reasons. First, the test may be “under-powered.” That means that, for lack of foresight or lack of resources, the researchers collected samples that were so small that the natural variation across intervention sites is large enough to hide the true average benefit in the average site. Second, to meet the requirements imposed by ethical review boards, the researchers in almost all HIV prevention trials are required to provide substantial HIV prevention interventions to those not receiving the tested intervention—in effect, impeding the proper measurement of prevention efforts (see Padian et al, 2010).*

*Figure 1 shows how this might happen. The vertical axis measures the number of new HIV infections that might be observed during the year after the beginning of the trial of a new prevention intervention in four hypothetical groups of randomly allocated villages. The people in the group of villages represented by the vertical bar on the left receive the “standard-of-care” in the national context, which means they only benefit from information that is circulating in the community from the media and word-of-mouth, perhaps augmented by national information and prevention campaigns. In our hypothetical example, the number of new cases declines by 5 percent in the average village in this group, while the error bars extending above and below show the range of variation across all the villages in the group. Typically ethical boards forbid an RCT from collecting data on this group of villages on the grounds that it would be unethical to have any contact with them without offering them prevention interventions. (Box continued on next page.)*

*Box 1. Continued*

*The second bar shows the hypothetical 30 percent average reduction in incidence in the group of villages that receives a package of interventions mandated by the ethical standards of the RCT's ethics panel for everyone contacted by the RCT. The interventions in this group can include intensive counseling about the dangers of HIV infection and "conventional" methods of protection—such as partner reduction and condom use—and they might also include condom distribution and diagnosis and treatment of the curable sexually transmitted infections (see Padian et al, 2010).*

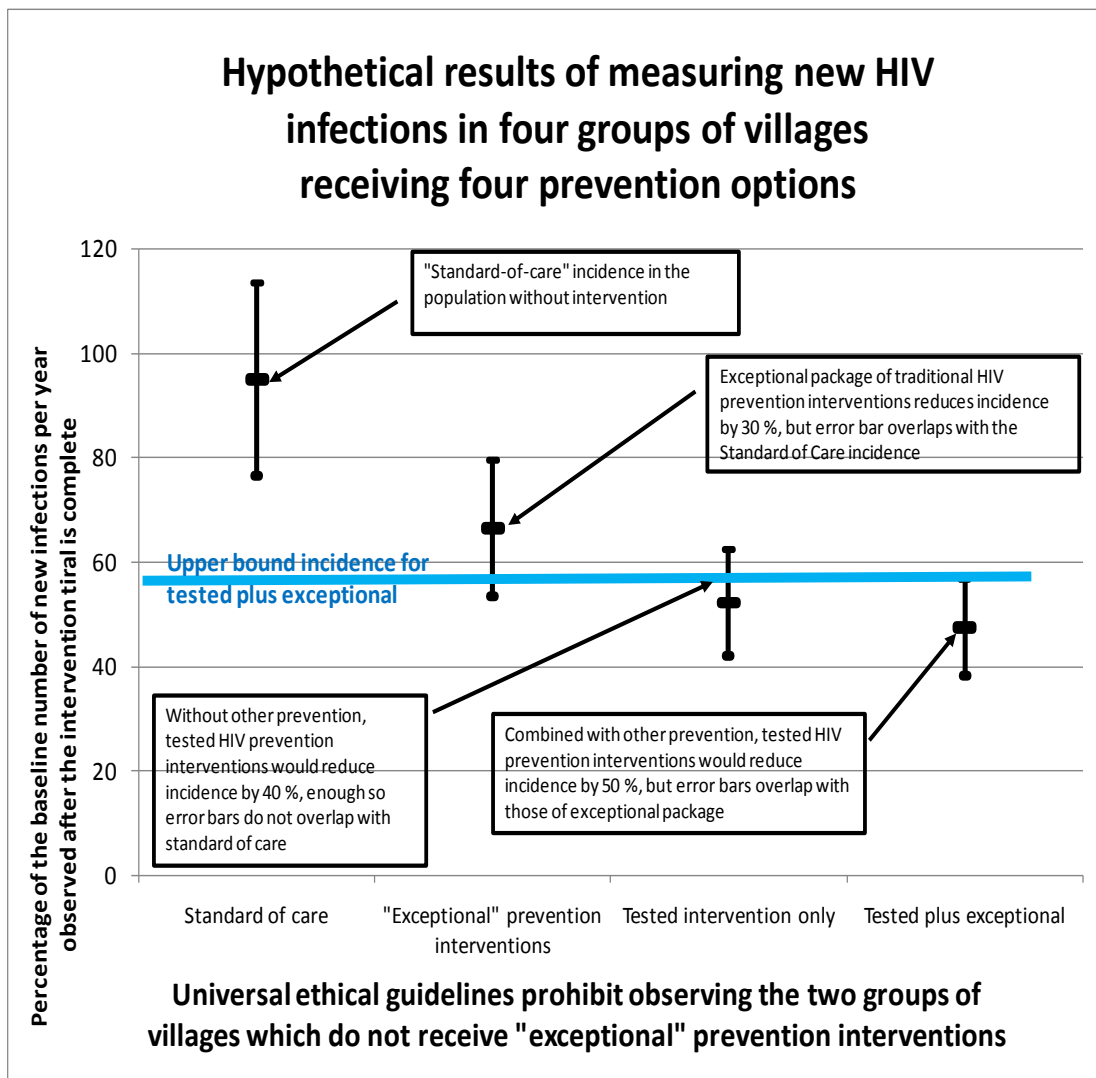
*The third group of villages would receive only the tested intervention, and have an incidence rate that is on average 45 percent lower than the standard of care villages, but the ethical requirements of the RCT prevent these villages from being observed – because of the rule that all contacted villages must receive the minimum package.*

*The fourth group of villages (on the far right of the figure) receives both the exceptional package received by the second group and also the tested intervention that would be received by the third group. In this hypothetical example, the fourth group experiences the most benefit, with the average village having an incidence fully 50 percent lower than it would have been without the package of interventions.*

*In this situation, when the RCT is only allowed to collect data on the second and fourth groups of villages, the RCT will fail to find a statistically significant benefit of the tested intervention. This failure is represented in the figure by the horizontal blue line labeled "upper bound incidence for tested plus exceptional." Rigorous application of statistical analysis will note that, despite the difference in the average incidence between the second and fourth groups, the variation around the averages in the two groups, which is captured by the overlapping error bars in the figure, means that the difference in the averages might be due only to chance.*

*Box 1. Continued*

*Despite the rigor of the methods, the RCT would in this case be reaching a false conclusion. If the researchers had been able to compare either of the two groups that include the tested intervention to the first group, the villages receiving only the local standard of care, they would have found that prevention works. Because they have been “blinded” by ethical constraints, they have not been able to measure the true benefits of the interventions.*



**Box Figure 1. A conundrum for evaluators**

*Ethical constraints interfere with measuring prevention options*

## II. Using performance based incentives for HIV prevention

How can the most promising existing interventions be scaled up and how can the implementers be best motivated? Part of the answer may lie in a relatively new policy instrument for the health sector—the application of performance based incentives (PBIs) to increase the productivity or improve the quality of health care. What exactly are PBIs? Rena Eichler and Ruth Levine define them to be “the transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target”(Eichler et al, 2009). They include “incentives on both the demand and the supply sides, at both individual and collective levels, [which operate at] the interface between provider and patient” (ibid.). But they exclude “the conditional payments that donor agencies offer to national [or sub-national] governments” (ibid.).

The main purpose of PBIs — also known as “pay for performance” — is to adjust individual agents’ incentives to better align with the interests of the community and the country. On the demand side, they should heighten the interest of individual clients. On the supply side, they should motivate service providers to try harder.

Whether they can improve day-to-day HIV prevention operations or AIDS treatment remains to be sufficiently explored—so far, there has been little rigorous evaluation of them—but results from studies reviewed in Eichler and Levine are promising.

In rural Malawi, for example, Rebecca Thornton studied a demand-side PBI by randomizing the distribution of vouchers to clients worth up to a day’s wage, redeemable upon submission to an HIV test and receipt of their results at a nearby voluntary counseling and texting (VCT) clinic. She found that while there was substantial demand for HIV testing even in the absence of cash incentive, any positive amount nearly doubled uptake of HIV testing. She also found that HIV-positive respondents who learned their test results were significantly more likely to purchase condoms in follow-up interviews. She concludes that even small cash incentives might be

useful in overcoming inertia or stigma-related costs in learning HIV status, and may even be marginally useful in condom uptake, thereby averting further infections (Thornton, 2005).<sup>5</sup>

Also in Malawi, Baird, Chirwa, McIntosh, and Ozler (2009)<sup>6</sup> randomized a conditional cash transfer that sought to estimate the effect of receiving a small cash payment conditional on girls' school attendance. Some girls received the cash regardless of whether they went to school, others only if they went to school, and others received nothing. The authors found that one year after the intervention, cash transfers led not only to increases in self-reported school attendance but also to declines in early marriage, pregnancy, sexual activity, risky sexual behavior, and coital frequency for the sexually active. Girls who received cash were more likely to attend school regardless of whether the cash was conditional on attendance. To explain how cash and improved school attendance might have reduced the girls' sexual activity, the authors suggest that attendance at school made the girls less available for sexual liaisons or possibly that the cash transfer relieved girls of the need to trade sex for school expenses. They caution that a longer study would be required to estimate how long the benefits persist (Baird et al, 2009).

As for using conditional cash transfers for HIV prevention, Medlin and de Walque (2008), after surveying the literature, suggest that the best proxy on which to condition transfers might be new infections with STIs—which are transmitted by similar risk behavior as HIV, but are easier to observe and, unlike HIV, are curable. By conditioning the transfer on a reversible event (STI infection), instead of an irreversible one (HIV infection), a conditional transfer program can continue to provide rewards for safe behavior to people who have previously failed the condition, a group of particular interest for curbing the epidemic. Thus, HIV positive people can

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<sup>5</sup> Preliminary results from a follow-up study by Thornton in Malawi suggest that offering a payment to HIV-negative people if they will remain negative is not a sufficient—or a sufficiently plausible—prevention incentive.

<sup>6</sup> "The results of this randomized trial are encouraging in another respect: They refute the assertion that is sometimes made that poor African women have little or no physical control over their own sexual risk. In another randomized study that demonstrates how much control women can have even in the absence of an income transfer, Dupas has shown that the information that older men are more likely to be HIV infected has led young poor African women to reduce the frequency with which they have sex with older men. (Dupas, 2010) "

continue to get rewards for safe behavior, for which they would be forever ineligible if the condition were HIV-negative status.<sup>7</sup>

In this essay, I suggest that future HIV/AIDS prevention efforts be focused on six neglected strategies that show promise technically and politically: improved targeting of HIV prevention even in countries with generalized epidemics; the mobilization for HIV prevention of the people who receive U.S.-funded AIDS treatment; the expansion of access to male circumcision; the integration of family planning services into HIV testing and AIDS treatment facilities, the use of AIDS treatment to suppress transmission to existing partners; and the re-orientation of HIV testing toward in-home services for couples, partially as a substitute for facility-based testing of individuals. Moreover, each of these efforts should be improved by the addition of a PBI reward structure.

### ***A. Incentives to target HIV hot spots***

The first step in a successful prevention campaign is to gather the epidemiological data to discern where and among whom HIV infections are spreading most rapidly. This is no longer a controversial approach. The epidemiological case for controlling STIs among high-risk populations as a matter of public health was made with mathematic rigor 35 years ago by Hethcote & Yorke (Hethcote et al, 1984). Initially, UNAIDS resisted the arguments made at the World Bank (Ainsworth et al, 1997) and elsewhere for prioritizing high-risk groups—believing that population-wide approaches would be more effective and, especially, less stigmatizing. But beginning in about 2007 the tide began to turn and UNAIDS embraced the new slogan “Know your epidemic – Know your response.” (UNAIDS, 2009; Wilson and Halperin, 2008). Economists are also on board because of the beneficial spillover effects for people outside the high-risk groups from prevention among those with high risk (Over and Aral, 2006). Recent evidence from the Avahan project in India provides support for these spillover effects by showing a correlation between HIV prevalence rates at ante-natal clinics, which serve

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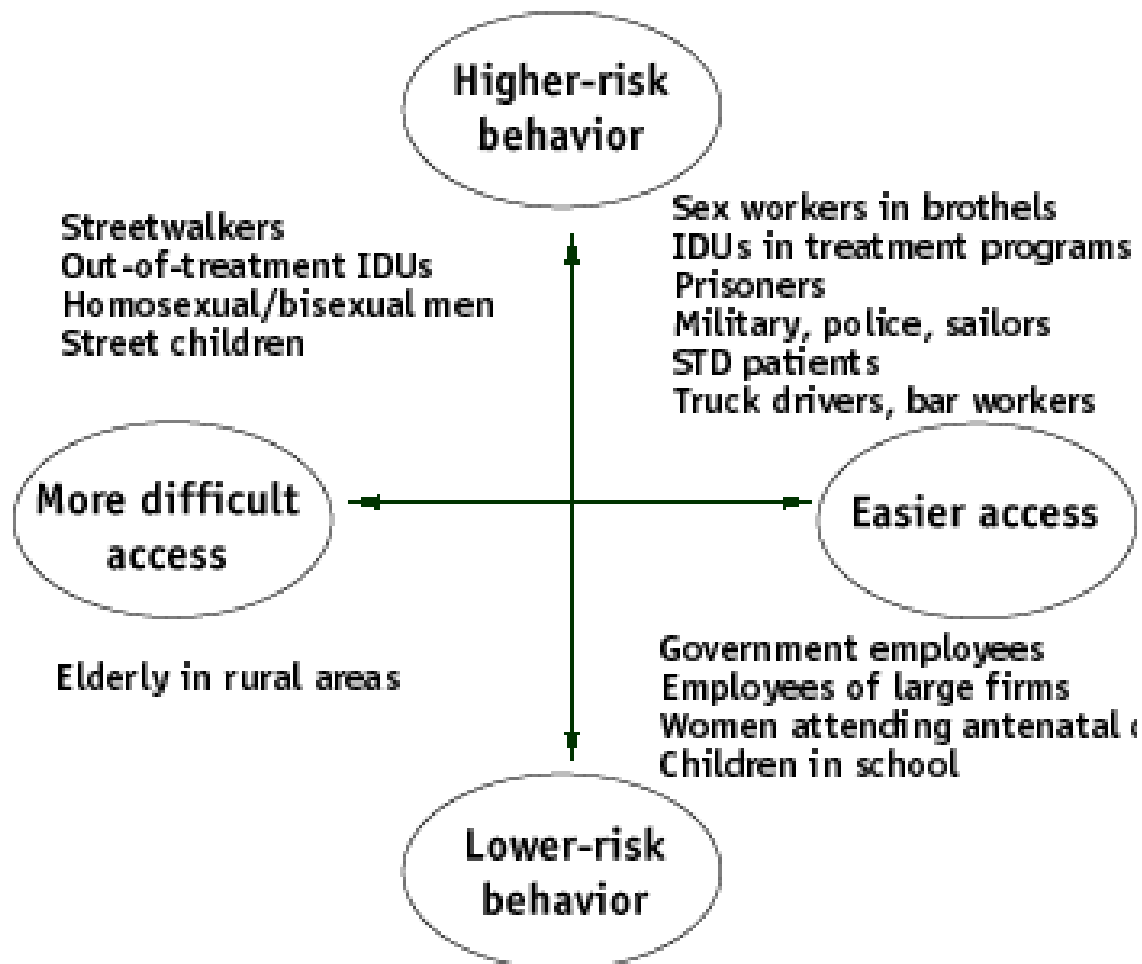
<sup>7</sup> A trial with this design is under way in Tanzania as described at <http://clinicaltrials.gov/ct2/show/NCT00922038?term=william+dow&rank=1>

the general population, and HIV prevalence rates among female sex workers in the same district. (Alary et al., 2010)

However, the major actors in the donor field—such as PEPFAR—have yet to do their homework to facilitate this approach. As the Institute of Medicine notes in its 2007 assessment of PEPFAR’s implementation, the agency has never done the basic survey work that would be required to monitor its own progress on prevention. The report adds that “PEPFAR and other U.S. government-funded programs before it have supported the collection, analysis and appropriate application of both sentinel and behavioral surveillance data in many of the focus countries. ... However, only a few of the countries have conducted behavioral surveys focused specifically on high-risk populations. Without behavioral data on these populations it is difficult for countries and donors to know what specific factors are driving each epidemic and what particular interventions would be the most successful for each country in preventing further spread of HIV.” (Institute of Medicine, 2007) p. 133)



# Classification of Groups by Riskiness of Their Behavior and Their Accessibility



**Figure 2. Setting prevention priorities**  
*High-risk groups that are relatively easy to access are worth targeting first*  
 (Source: (Ainsworth et al, 1997), Figure 3.4, p. 147)

Moreover, some high-risk groups are harder to reach than others. In these instances, economic logic supports placing the highest priority on the high-risk groups that are relatively easy to access. Figure 2 shows how the various groups of the population can be organized by both risk and accessibility. Governments with low coverage of all of these groups can start by assuring coverage of the groups in the northeast corner of the diagram, which might include, depending on the country or on the place within the country, sex workers in brothels, intravenous drug users in treatment programs, organized and identified men who have sex with men. In countries where HIV prevalence is low in the general population, virtually universal coverage of all high-

risk groups might be enough to reverse the course of the epidemic and accomplish the AIDS transition. (See Box 2.) In countries with more generalized epidemics, universal coverage of all high-risk groups is necessary, but not sufficient, meaning that interventions must actively reach out to the general population, in particular through widespread scale-up of male circumcision and testing and counseling couples.

Unfortunately many countries do not understand where these high-risk groups can be found or how to contact them without intimidation. A technique called the “PLACE Method” was developed in the last ten years to address this problem especially in African epidemiological contexts (Weir et al., 2002; Weir et al., 2003; Weir et al., 2004). The method uses interviewers’ contacts with taxi drivers, market women, and other people on the street to identify the “hot spots” in town, where people gather to look for a date. Although the formative research to develop this technique and field test it in a dozen African cities was funded by USAID, neither that agency nor PEPFAR has attempted to evaluate the technique using rigorous impact evaluation methods or scale up its implementation to saturate even a single city or small pilot region of any African country with prevention messages and condoms. In addition, there are a variety of other techniques for reaching high-risk populations with the needed interventions, which promote and distribute condoms and train people in their effective use. Unfortunately few of these techniques benefit from the rigorous impact evaluation that has been exercised on biomedical prevention techniques or treatment interventions (Bertozi, S. M., Padian, N., and Martz, T. E., 2010; Lagakos and Gable, 2008; Wegbreit, J., Bertozi, Stefano, DeMaria, L. M., and Padian, N. S., 2006) .

*Box 2. A snapshot of the AIDS transition*

*The global community hovers at the dangerous point where new HIV infections continue to outnumber AIDS deaths, resulting in a growing number of people living with HIV/AIDS. Already, the fiscal burden of AIDS is enormous and AIDS funding has flatlined. Yet donors have an obligation to sustain financing for the millions of AIDS patients who would not be alive today without it. Against that backdrop, we are proposing a dynamic paradigm for the struggle with the AIDS epidemic—the “AIDS transition”—and a new objective around which international donors and recipient governments can coordinate their efforts.*

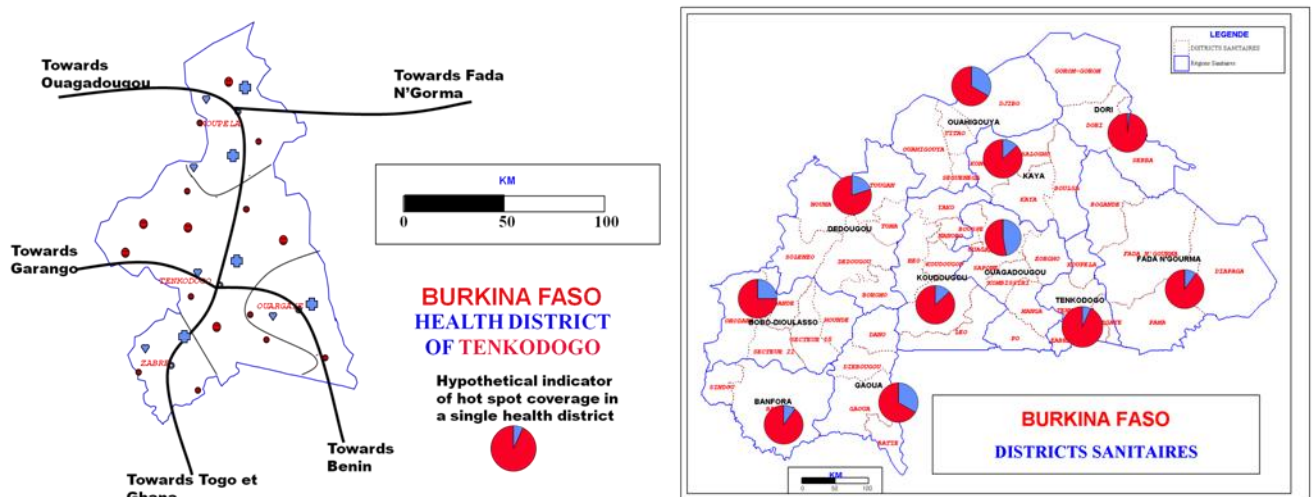
*What exactly is an “AIDS transition”? It is a dynamic process that holds AIDS mortality down—that is, preserves recently achieved mortality reductions—while lowering the number of new infections even further—so that the total number of people living with AIDS will begin to fall.*

*Our goal should be to reach—as early as 2015, or as late as 2043, depending on how forcefully we step up effective HIV intervention and sustain antiretroviral treatment (ART)—the point when we can say that the AIDS transition has been “achieved.” That milestone will occur when the number of new infections in a population first crosses below the number of deaths.*

*The most rapid way to reach this milestone will be to tightly link new funding of AIDS treatment to dramatically improved and transparently measured prevention of HIV infections. That is why the AIDS transition paradigm specifies that programs will not be deemed successful unless they can demonstrate with hard data that they simultaneously suppress AIDS mortality and reduce the growth rate of the HIV/AIDS population. If they are deemed successful, donors can offer to increase the rate at which HIV-infected individuals are recruited for ART. And patients who are healthy enough to rejoin the labor force can be asked to contribute one day a month to HIV prevention in their community.*

*Moreover, success will translate into fiscal savings. For Sub-Saharan Africa, the most heavily hit continent, 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. (See Essay 1 in this series and (Over, 2004) for more on the AIDS transition.)*

How could PBIs be introduced in an African country where most risky sex occurs outside narrowly defined brothels? A starting point would be to delegate the job of conducting “PLACE-style” surveys to district and municipal governments throughout the country. Figure 3 illustrates how a country could assemble a unified portrayal of the degree to which its HIV transmission “hot spots” are covered by prevention interventions by charging each district of the country with mapping its hot spots and reporting monthly on the proportion that are covered. The left panel of the figure shows all the identified hot spots in a district, distinguishing those without prevention coverage by the color red while those with HIV prevention coverage are colored blue. The right panel shows the percentage of hot spots with prevention coverage as a blue slice, here suggesting coverage is very poor. National level AIDS programming authorities can assemble these reports into a nationwide map like the one in the right panel of Figure 3 and be held accountable for improvements, indicated by expanding blue slices, by their superiors in the Ministry of Health or Prime Minister’s office.



**Figure 3. Targeting hot spots**  
*Engaging health districts to pinpoint hot spots for prevention interventions*

(Hypothetical application of performance indicators to improve the coverage of HIV transmission "hot spots" in a district and the entire country of Burkina Faso. A dot is colored red if it has been identified, but not yet reached by HIV prevention activities, and then changed to blue if prevention activities are in place. Source: Author's construction)

Although the mathematics and the intervention techniques for helping those at highest risk to protect themselves and others from HIV infection have been known for decades—and exemplified in Thailand<sup>8</sup>, Brazil, and a few other places—most governments and donors have been reluctant to fully implement these programs even in the southern cone of Africa, where the epidemic has infected a quarter of the adult population. People on the left of the political spectrum are rightfully concerned to protect people with high-risk behavior from human rights abuses by government or nongovernment actors. They point out that driving high-risk groups underground will make it much harder to help alter risky behavior. People on the right of the spectrum oppose providing any government interventions to groups whose behavior they disapprove of. Observers who know and understand the social contexts of these target populations note that only part of any given risk group is likely to fall into the high- risk high accessibility category in the northeast of Figure 2, the rest being harder to reach, and thus in the northwest of the figure.

Critics are correct to point out that the mathematical models that demonstrate the superior cost-effectiveness of interventions with high-risk groups typically assume that an intervention can accurately reach a specific risk group and change its behavior by a given amount. To claim such accurate targeting would be as unrealistic as it would be for a telephone marketing firm to assure its client that every phone call will reach a potential user of the client's product. In reality, people with high-risk behavior are dispersed among more general populations and can only be reached by going through an "access channel." Finding that channel, however, is difficult. Table 2 shows a hypothetical cross-tabulation of some of the epidemiologically important high- risk groups arrayed against a set of hypothetical access channels. Table entries give the "coverage" and "concentration" of each access channel for each risk group. For example, suppose one would like to target prostitutes. The proportion of all prostitutes reached or "covered" by such messages may be "low" if most prostitutes in a country are illiterate or without access to radio or television, And clearly in relation to the entire audience of mass media, prostitutes would be a small percentage, giving a score of "low" for their "concentration" in that access channel. However, an intervention that operates using the PLACE method by accessing its audience

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<sup>8</sup> The great success of Thailand's 100 percent condom program in the 1980s was predicated on the existence of brothels that were active and easily identifiable foci for an effective prevention campaign (Ainsworth and Over, 1997).

through bars and dance venues should score a “high” on coverage, while still only getting a “low” on concentration.

Real world prevention interventions, such as the Avahan initiative in India, take for granted that they must pass through the appropriate channel to access their clients.<sup>9</sup> However, prevention organizations have typically focused on a single channel, thus failing to provide financiers with evidence of the effectiveness of various channels, or of different channel mixes, at achieving prevention goals in a given target population. One way to ameliorate this would be to introduce PBIs. Using population-based surveys, true coverage of the intended target group could be measured so that PBIs could be designed at the level of the target group rather than at the level of the channel. With incentives conditional on prevention programs reaching the target group, prevention agencies would be motivated to find the most effective mix of channels for reaching that group.<sup>10</sup>

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<sup>9</sup> The Avahan initiative is aimed at reducing the spread of HIV in India through targeted HIV prevention programs in the six Indian states with the highest HIV prevalence, and along the nation’s major trucking routes. ([http://www.gatesfoundation.org/avahan/Documents/Avahan\\_HIVPrevention.pdf](http://www.gatesfoundation.org/avahan/Documents/Avahan_HIVPrevention.pdf), (Bertozzi, S. M., Padian, N., and Martz, T. E., 2010))

<sup>10</sup> The challenge for the modelers, on the other hand, is to incorporate the concept of channels in their models in order to test the robustness of their cost-effectiveness results in this more realistic framework. When modelers are able to calibrate the parameters of channel effectiveness from the data collected by prevention implementers, quantitative prediction of future HIV infection rates will be able to support an AIDS transition strategy.

**Table 2. Getting out the message. Better prevention requires using the right channels to reach the right risk groups.**

<i>Target group</i>		<i>Access Group</i>					
<i>Group</i>	<i>Size</i>	<i>Audience of mass media</i>	<i>Prisoners, soldiers, students, or workers in prisons, barracks, schools or work sites</i>	<i>Sexually active adults at bars</i>	<i>Patients at general health care clinics</i>	<i>clients and workers at family planning and STD clinics</i>	<i>Residents of a neighborhood</i>
<i>Groups at risk</i>							
<i>From sex</i>							
Prostitutes	20	Low/Low	Low/Low	High/Low	Medium/Low	High/Low	Medium/Medium
Clients of prostitutes	100	Medium/Low	High/Low	High/Low	Medium/Low	High/Low	Low/Low
Sexually active adolescents	2,000	Low/Low	Medium/Low	Low/Low	Medium/Low	Medium/Low	Low/Low
Adults with multiple partners	2,000	High/Medium	High/Medium	High/High	Medium/Low	Medium/High	High/Low
From transfusions	10,000	Medium/High	Medium/High	Low/Medium	High/High	Low/Medium	High/High
From needles	5	High/Low	Low/Low	Medium/Low	High/Medium	High/High	Low/Low
<i>Group Controlling risk</i>							
Health Care Providers	5	High/Low	Low/Low	Medium/Low	High/Medium	High/High	Low/Low
Government Officials	5	High/Low	High/Medium	Medium/Low	Low/Low	Low/Low	Medium/Low

*Note:* Coverage is defined as the proportion of the target group reached by a message. Concentration is the proportion of those reached who are in the target group. “High” is defined as greater than two-thirds; “Medium” is defined as one-third to two-thirds; “low” is defined as less than one-third. The estimated coverage precedes the estimated concentration; thus, the notation “high/low” means that using the indicated access group to target the indicated target group will have a high coverage but a low concentration. In the language of epidemiology, an access channel with high coverage/concentration of a risk group has high “sensitivity”/“specificity” vis-a- vis that risk group. The corresponding concepts in statistics are Type I and Type II error. (source: (Over and Piot, 1993)

## ***B. Incentives to increase male circumcision***

The evidence that male circumcision (MC) protects men from HIV infection has accumulated now from both observational and experimental studies. The first observational study was the cross-country regression by Bongaarts and co-authors (Bongaarts et al., 1989), which showed a remarkable association between MC prevalence and HIV prevalence. But skeptics expressed doubt about a causal link because MC prevalence was correlated with religious affiliation, which might be directly responsible for differences in HIV prevalence given religious differences in sexual mores. In support of that stance, one cross-section study of HIV prevalence did not find a correlation with MC prevalence, when percent-Muslim and seven other socioeconomic variables were controlled for (Over, 1998).

In the last few years, however, randomized controlled trials in Uganda (Gray et al., 2007), South Africa (Auvert et al., 2005), and Kenya (Bailey et al., 2007) have confirmed that the association between MC and HIV is indeed causal. In fact, the ethical review process halted the Kenyan trial after observing that 22 of the 1,391 circumcised men became HIV infected compared to 47 among the 1,393 uncircumcised group. Because the risk of becoming infected during the trial period was 53 percent smaller for the circumcised, the researchers concluded that MC is comparable to a 50 percent effective vaccination. Circumcision seemed to be equally protective in Uganda (a 51 percent reduction in risk) and perhaps more so in South Africa (a 60 percent reduction in risk).<sup>11</sup> Furthermore, none of the studies was able to find evidence that circumcised men might be “disinhibited,” increasing their risky behavior and thereby offsetting some of the advantage of the circumcision.

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<sup>11</sup> In a February 1, 2010 comment on my January 26 blog post, Ron Gray says, “We are conducting a post-trial surveillance study as well as evaluation of circumcision services [in Uganda]. After four years follow up, HIV incidence in men who were circumcised is 0.67 per hundred person-years, and in men who chose not to be circumcised incidence is 2.67 per hundred person-years.” A 75 percent reduction in risk is quite striking and greater than the upper bound of the Cochrane Collaboration metaanalysis of the circumcision studies. It would be interesting to know if apparently improved results over a longer follow-up period are because of some kind of attrition/selection bias or if circumcision’s benefits for any individual improve over time. (<http://blogs.cgdev.org/globalhealth/2010/01/adult-male-circumcision-as-an-hiv-prevention-tool-should-the-scale-up-of-an-efficacious-intervention-be-evaluated.php> )



As the encouraging results on MC have accumulated<sup>12</sup>, researchers have increasingly turned from the question of efficacy to those of feasibility and field effectiveness. Small scale non-random studies have generally supported the feasibility of scaling up MC access to the general population in Africa. Building on these research results, PEPFAR should now allocate a substantial portion of its discretionary resources to making clean and safe circumcision at least as easily accessible to men as ART in all the PEPFAR countries.

The fact that male circumcision is still somewhat controversial in some countries limits the role of both demand- and supply-side PBIs. For example, a donor sponsored policy of offering individual men payments to accept circumcision might engender invidious charges of imperial plots against African men. On the supply side, the same considerations would prevent using PBIs to increase uptake. However, incentives could be designed to motivate providers to maintain the quality of their service (by rewarding user satisfaction) and to perform efficiently (keeping waiting lines short and unit costs to a minimum).

### ***C. Incentives to integrate family planning with AIDS treatment***

Another key strategy to prevent infections, which has not been sufficiently deployed, is family planning. While programs to prevent mother to child transmission of HIV are having increased success, they are still difficult and complicated. Every child that is infected despite these efforts will be costly to treat for his or her entire life. Furthermore, such children stand a greater than average chance of becoming orphans, despite the efficacy and increased availability of AIDS treatment.

In view of the private and social cost incurred for each HIV infected child, AIDS treatment programs and family planning programs should join forces to assure that every HIV-positive woman has free and easy access to the birth control method of her choice, without fear of stigmatization. Unfortunately, owing to the lack of integration of family planning and AIDS treatment, there appears to be substantial unmet need for contraception among HIV positive women. As early as 1993 a study found that 60 percent of HIV positive

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<sup>12</sup> See (Potts et al., 2008) for a brief review of recent MC studies.

women would prefer not to have more children (Allen et al., 1993). Medical intervention to prevent mother to child transmission of HIV once pregnancy has occurred has been found to be less or equally cost-effective than family planning in several studies (Reynolds et al., 2006; (Stover et al.) (2003); Sweat et al., 2004). In a letter to the editor, three of the authors of these studies point out that the existing low levels of contraception in sub-Saharan Africa have probably prevented 173,000 HIV infected births each recent year and that provision of family planning services to the those with unmet need can avert an additional 160,000 HIV positive births every year (Reynolds et al., 2005).

How can PBIs be used to strengthen this approach? One way is to design them to reward clinics for offering family planning services to HIV-infected pregnant clients. These rewards can be based on client satisfaction with the counseling they receive and the freedom of choice they report, rather than on uptake of new ART patients.

#### ***D. Incentives to re-orient HIV testing toward couples***

As a supplement to provider-initiated testing, donors—such as PEPFAR—should evaluate the feasibility and effectiveness of wide scale couple counseling in the home. While couple counseling has been found to be effective with couples in which one is HIV infected) (Allen,S et al., 1992a; Allen,S et al., 1992b; Allen, S., Serufilira, A., Gruber, V., Kegeles, S., Van de, Perre P., Carael, M., and Coates, T. J., 1993; Padian et al., 1993; Roth et al., 2001), it has an even more promising role for couples in which neither person is yet infected. Furthermore, a few studies suggest that people are more likely to accept couple counseling in their home than at health care facilities (Farquhar et al., 2004; Matovu et al., 2002; Were et al., 2003). When couples learn each others' HIV status as well as their own, and receive counseling about the dangers of unprotected sex outside the couple, such knowledge might not only increase condom use with other partners but also reduce the frequency of such partners. Thus, couple counseling, especially in the couple's home, might be the intervention that would achieve Helen Epstein's elusive "invisible cure," by discouraging the practice of multiple concurrent partnerships, which is thought to be a major contributor to the epidemic (Epstein, 2007; Halperin and Epstein, 2004; Morris and Kretzschmar, 1997).

As for PBIs, a country with the resources and the motivation to push HIV prevention efforts beyond those at highest risk can expand door-to-door couple counseling using the techniques of agricultural extension or house-to-house residual spraying for malaria. Rewards can be offered to those doing the counseling based on the number of households reached and measures of the quality of counseling interventions. With appropriate quality controls and social audits, AIDS control programs can sub-contract couple counseling to nongovernmental organizations, with rewards based on both quantity and quality of population coverage.

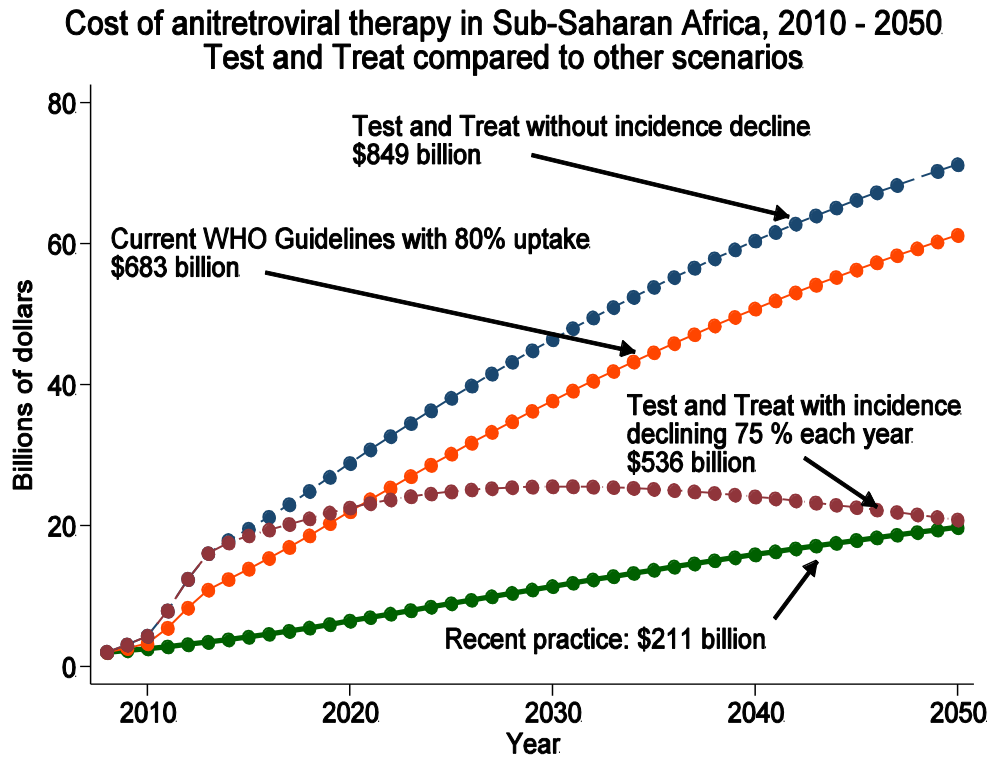
### ***E. Incentives to use AIDS treatment as HIV prevention***

Because effective AIDS treatment reduces the amount of HIV in the blood stream to undetectable levels, it has long been argued that AIDS treatment might itself constitute an effective HIV prevention tool. Recently a group of authors based at WHO have published an article proposing a new “test-and-treat” (TNT) policy that amounts to testing every adult in a population and immediately beginning treatment on all who test positive, regardless of their CD4 count (Granich et al., 2009). The authors conclude that not only would a TNT approach reverse the epidemic but it would also do so at lower cost than would universal treatment initiated years later relative to each patient’s disease progression, at conventional CD4 thresholds. They base this conclusion on mathematical modeling using strong assumptions regarding the patients’ adherence to medication for decades despite having never been sick and on the degree to which infectiousness is suppressed by ART,

How much would the TNT approach cost? As expected, it would be very expensive to implement. One way to show this is by juxtaposing TNT scenarios to other ART scenarios in Sub-Saharan Africa, as Figure 4 does.

Let us begin with the future cost to donors and governments of continuing on the recent trend, which in Africa as a whole has enrolled 15 percent of those needing treatment each year—which the WHO’s 2009 guidelines define as those with at least CD4 counts of 350 cells per microliter. As the green curve shows, the cost of this ART policy would rise from about \$4 billion in 2010 to almost \$20 billion in 2050, with a present value of \$211 billion through 2050 for AIDS treatment alone, without even considering the costs of HIV prevention or care. But what happens if the newly proposed WHO guidelines are followed, which recommend that those needing treatment include all HIV-infected patients with CD4 counts less than a higher threshold of 350 cells per

microliter. And suppose we boost the uptake from the current 15 percent to a much larger amount of need, say 80 percent. As the orange curve (second from the top) shows, the annual cost of expanding AIDS treatment would soar to \$20 billion by 2020, and the present value of the stream of costs through 2050 would hit \$683 billion.



**Figure 4. Too costly?**  
*A proposed “test and treat” policy might not be a bargain*  
 ( (Source: Authors calculations)

Now let us cost out the TNT scenarios. The blue curve presents the projected cost of treating 80 percent of all HIV-infected people as soon as they become infected under the pessimistic assumption that such a policy would not actually reduce the incidence of new infections as intended. The brown curve (second from bottom) projects the cost of treating 80 percent of all the HIV-infected under the optimistic assumption that with this much coverage the rate of new infections would decline precipitously by 75 percent per year so that there are no more new infections in Africa after the year 2020. These two curves together establish upper and lower bounds on the possible future costs of the TNT policy option, with the true future costs lying somewhere in between.

We find that at least in the first decade of its implementation, the TNT scenario would be even more expensive than a policy of 80 percent coverage at WHO's new guidelines. Under either the optimistic or the pessimistic version of the TNT option, annual treatment costs rise to \$20 billion in the middle of the next decade, and aggregate discounted costs over the next 40 years rise to between \$536 and \$849 billion. Thus, the TNT option is between two-and-a-half and four times more expensive than the continuation of the recent trend of treatment expansion.

Moreover, the TNT approach may fail in expensive ways. For example recent meta-analysis has found that for people on ART the number of infections per thousand person-years is about 5, not very different from the infectivity of people *not* on ART during the decade or so interval beginning 6 to 10 weeks after infection until the year before death (Attia et al., 2009). Those infections that do occur under TNT would transmit a drug resistant form of HIV which will be more expensive to treat than existing viruses. While most resistant viruses are less fit than "wild" or "naïve" HIV that has not been exposed to ART, the wide scale implementation of the TNT policy creates the opportunity for the virus to attempt trillions of additional "experiments" with alternative strategies for resistance, and it is plausible that one or more of these experiments could lead to a resistant HIV that will be more virulent than the HIV-1 virus which currently infects more than 33 million people worldwide (Dodd et al., 2010).<sup>13</sup> That said, given the large number of African couples in which only one partner is HIV-infected, the costs and benefits of early ART initiation in preventing or postponing the spouse's infection still deserve to be explored.

Although this analysis leads to skepticism about the feasibility and affordability of the TNT policy option as a contributor to an AIDS transition, AIDS treatment may contribute to slowing HIV transmission in more modest ways. (See Box 2 on the AIDS transition.) For example, given the large number of African couples in which only one partner is HIV-infected, the costs and benefits of early ART initiation in preventing or postponing the

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<sup>13</sup> These points and others suggesting the fragility of the Granich et al results were made at a workshop sponsored at WHO on November 9, 2009.

[http://www.who.int/hiv/topics/artforprevention/modelling\\_meeting/en/index.html](http://www.who.int/hiv/topics/artforprevention/modelling_meeting/en/index.html)

spouse's infection still deserve to be explored. PBIs that are used to reward patient adherence also serve the prevention objective in this way.

## ***F. Incentives to mobilize AIDS patients for HIV prevention***

It is easy to misunderstand the intent of the suggestion that AIDS patients be mobilized for prevention. Doctors will tell you that they are already counseling their patients in safe-sex and they support strong patient counseling programs wherever ART is provided. After all, they know the value of safe-sex. A study on ART patients in Cote d'Ivoire who were counseled to maintain safe behavior showed no increase in self-reported risk behavior (Katzenstein et al., 2003). And a recent study in Rwanda (Dunkle et al., 2008) finds the same encouraging result using biological markers for unprotected sex. That said, we know from biological studies that patients who are effectively adhering to ART are in any case less likely to transmit infection during unprotected sex. .

What is needed is to mobilize these patients—who thanks to their precise adherence to their medication regime, are in good health—to become a vital channel for reaching out to the much larger population of people whose risk behavior places them in danger of infection. With proper training, motivation, and monitoring, patients can work to assure that AIDS treatment does not engender complacency and disinhibition among non-patients, but instead encourages reductions in risk behavior.

One way to leverage such patients into enhanced HIV prevention in the community would be to apply PBIs to the adherence support organizations, rather than to individual patients. When multiple adherence support organizations exist in a community, they can be judged against one another not only by their success at maintaining adherence among their members but also on their efforts to reach out to non-members with HIV prevention interventions. Organizations that do well only on adherence would not lose their funding; reducing their funding might disrupt the treatment of their members. But neither would such poor performers receive funding to enroll additional members. However, organizations that excel at both adherence support and outreach prevention would be rewarded with funding for additional members. In this way, through a process of muted

competition among treatment support organizations, treatment subsidies would also be leveraging prevention efforts in the places that need both.

### **III.Counting the saved: A “Cash-on-Delivery” approach to HIV/AIDS assistance**

After thirty years and billions of dollars spent combating the AIDS epidemic, the rate of new infections remains higher than the rate at which new patients are placed on treatment and, in countries where incidence has declined, it is still difficult to attribute any of the decline to government or donor-funded interventions (Bongaarts, J., Reining, P., Way, P., and Conant, F., 1989; Institute of Medicine, 2007). While funding for AIDS treatment and prevention have reached unprecedented levels, dwarfing those for any other disease condition (England, 2007), complaints abound that much of this funding is wasted due to excessive earmarking ((Oomman, Bernstein, and Rosenzweig) (2007)) or to insufficient health system capacity to support the expenditure (Over, 2004; Shiffman, 2008). Vertical AIDS programs funded by the U.S. PEPFAR program, the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), and other donors have the advantage of facilitating accountability for simple indicators of AIDS program execution, but the disadvantage of constructing funding “silos” that are isolated from the rest of host country health systems (Institute of Medicine, 2007; Over, 2009). In the language of Bill Easterly, current programs are designed to employ and promote “planners” who implement top-down approaches to AIDS control rather than the innovative “seekers,” who would should be searching for ways to most effectively combat AIDS (Easterly, 2006). The externally driven specification of program details belies the purported objective of PEPFAR and other donor programs to eventually be assumed by national governments and populations.

The combination of high rates of new infection and increasing numbers of people on lifetime treatment means that successful donor programs like PEPFAR have been increasing the total number of people with HIV. There is no attempt to use the demand for treatment as an incentive to local governments and other relevant collectives to leverage improved effort on, and effectiveness of, their HIV prevention activities. Reducing the rate of new infections below the lowered death rate of people living with HIV/AIDS, although essential to the achievement

of an “AIDS transition” comparable to the “demographic transition” of recent decades, is absent from donor targets (See Box 2 on the AIDS transition.) Adopting such a goal would require much more profound integration of HIV prevention with AIDS treatment than is typically attempted.<sup>14</sup> The treatment part of donor programs places excessive emphasis on the number of people receiving treatment, with too little emphasis on whether those people adhere to treatment and to the quality of their treatment. The prevention side of donor-supported AIDS programs suffers similarly from imprecise measurement of prevention objectives and achievements.<sup>15</sup>

Since the earliest days of the effort to contain the AIDS epidemic, public health experts have stressed that leadership of HIV prevention efforts must come from those who are at the top of a country’s political and social structure. In those countries where highly placed leaders, such as the president, have forcibly and unabashedly addressed the AIDS epidemic, HIV infection rates have frequently fallen. Examples include Thailand, Brazil, Mexico, and Uganda. Yet the leaders of many countries with severe epidemics have turned their backs on the HIV/AIDS control efforts, preferring to use their prestige in support of other goals. In other countries, national leadership has been to no avail because state and local leaders have refused to follow. The question then arises whether there exist any legitimate and effective tools that donors can deploy to influence national leaders to initiate and sustain HIV/AIDS prevention objectives and to help those national leaders motivate state and local leaders to do the same.

PBIs like those already discussed are managerial tools that can be used by good managers to improve the day-to-day performance of their staff or the compliance or adherence of their patients. However, these incentives do not typically address the constraints under which providers and their manager operate. Managers of health facilities may be unable to serve more patients because of interruptions in their supply chains. Or the managers

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<sup>14</sup> There have been few examples of integration beyond the provision of prevention counseling for patients receiving ART.

<sup>15</sup> Instead of being measured, the number of new cases of infection is typically modeled based on reported prevention activities. Furthermore, existing prevention targets are unclear regarding how many times a prevented infection can be counted if the same person is protected for twelve months as compared to the situation where twelve persons are all protected for one month. Prevention targets should instead be stated as a given percent reduction of directly measured incident cases. To do that, it will be necessary to measure new infection with enough precision to effectively target prevention interventions to the locations and key populations that generate the most new infections.



of the supply chain, if offered a PBI for improved logistical support to health facilities, may be unable to respond because of problems with the national customs agency or lack of functional roads during the rainy season. Furthermore, even at the level of the provider-patient encounter, sometimes the reasons for poor results lie outside the control of individual providers or their managers. The hierarchical superiors of the providers may lack the authority, the skills, the resources, or the motivation to review provider performance. Or the superiors may have all of these attributes, but be frustrated by a lack of coordination from other parts of government. In these situations, there is a need for improved and sustained motivation at a higher level.

A recent review of the PBIs currently deployed by the three major AIDS donors compares publicly available information on their use of such incentives. (Oomman et al, 2010). As Table 3 from that study shows, while all of the donors express concern about performance, none of them publishes quantitative performance measures specific to the many HIV prevention programs they support that would enable citizens of the recipient or donor countries to judge the contractor's achievement of HIV prevention objectives. And none of them explicitly sets quantitative targets and then rewards individual implementers for achievement by a pre-agreed formula. Since at the aggregate level, the most concrete indicator is the number of individuals receiving ART, all three donors bias their reporting against HIV prevention relative to treatment, and none of them explicitly addresses the problem of insufficient leadership for HIV prevention at the top levels of government. Thus, the three largest donors are largely missing the opportunity to apply PBIs to HIV prevention programs at the lower levels, where they can affect the efficiency of individual facility or program managers and their employees, or at the highest levels, where they might help to align the incentives of government decision-makers with HIV prevention objectives.

	<i>The U.S. President's Emergency Plan for AIDS Relief (PEPFAR)</i>	<i>The Global Fund to Fight AIDS, Tuberculosis and Malaria</i>	<i>The World Bank's Multi-Country HIV/AIDS Program for Africa (the MAP)</i>
<i>How is performance defined?</i>	At the global and country levels, by progress made against global targets set centrally and apportioned among individual countries. At the recipient level, by progress against output targets as set out in the grant agreement.	By the ability of primary recipients to meet targets established in the grant agreement.	In principle, by the ability of recipients to achieve set program targets—but for funding decisions primarily by other measures, such as disbursement rates and timeliness in meeting expenditure goals.
<i>How does performance affect the selection of recipient organizations?</i>	PEPFAR has primarily chosen recipients with proven programmatic and financial capacity and ability to adhere to U.S. government requirements.	Capacity and past performance of primary recipients are assessed as part of the grant application. Primary recipients have their own procedures for selecting subrecipients.	Past performance has a limited role in the selection of primary recipients (which are usually government entities). In the selection of subrecipients, past performance is not a primary determinant.
<i>How are performance targets set?</i>	Country-level targets are derived from global targets. Targets for individual grants—negotiated between a primary recipient and PEPFAR country team—are based on performance measures outlined in each request for proposals and grant proposal.	Targets are negotiated between the Global Fund and each grant recipient, based on objectives in the countries' grant proposals.	Recipients and subrecipients set their own targets with the approval of the World Bank preparatory team.
<i>How are performance data collected and used?</i>	Performance data are collected directly from primary recipients, except in Uganda, where recipients report to Monitoring and Evaluation of Emergency Plan Progress (MEEPP). Performance is measured by comparing outputs achieved against output targets set out in each grant agreement.	Recipients report to the Global Fund, usually using special reporting formats; data are checked by the Local Fund Agent. Primary recipients collect and verify data from subrecipients, with spot checks from Local Fund Agents.	Primary recipients report to the World Bank on financial and programmatic indicators quarterly; subrecipients report to primary recipients monthly. Data are verified by independent data audits and used to assess performance against targets.
<i>What is the role of performance in decisions about continued funding?</i>	The role of performance is not clearly defined. Good performance can lead to increased funding, but poor performance has no clear consequences.	Performance is the primary, but not the only, factor in individual disbursement decisions. Phase 2 renewal depends largely on performance, though contextual factors are also considered. A Rolling Continuation Channel to extend well-performing grants beyond five years creates an incentive for good performance in Phase 2.	Performance against output targets is one factor in disbursement decisions. Other important factors include disbursement rates and timeliness in meeting expenditure goals.
<i>How does a performance focus affect the distribution of donor resources?</i>	Most funding goes to organizations with existing high capacity and a history of working with the U.S. government. Some evidence points to recipients replacing holistic programming with a narrower focus.	None found.	Recipients with higher capacity, especially for meeting expenditure goals, are favored.
<i>How are performance policies coordinated with host country governments?</i>	No systematic strategy links performance criteria or reporting to national systems and priorities.	Governments sit on Country Coordinating Mechanisms. Grant objectives tend to be aligned with national AIDS plans.	Performance indicators are drawn from each country's National Strategic Framework. Reporting requirements are partly aligned with national monitoring and evaluation systems.

**Table 3. In need of better performance targets**

*Donors worry about performance but fail to set quantitative performance measures for prevention (Oomman et al, 2010)*

### ***A. What COD payments would do***

To address this overarching problem—which manifests not only in HIV/AIDS but in every sector of foreign assistance—Birdsall and coauthors (Barder and Birdsall, 2006; Birdsall et al, 2010) have proposed the “Cash-on-Delivery” (COD) approach to foreign aid. It applies incentives to the top levels of governmental organization, such as the state, the province, or the nation. And it recognizes that the leaders of national and state governments in recipient countries must constantly balance the demands from a long list of constituencies and clients. In this dynamic and often chaotic political environment, agreements made several years earlier to sustain an HIV prevention effort may become less urgent than the concerns of the day. The COD approach aims to help donors facilitate longer-term commitments to sustained effort on a particular objective by establishing a reward mechanism that provides payments for the achievement of specific objectives, payments that governments can use to motivate actors and their constituencies at every level.

The payment provided by a COD contract is quite explicitly a reward or a prize that the country or state has won because of its achievement of a challenging, worthwhile, internationally recognized social objective. Take the true story of an island in the South Pacific that used the power of economic incentives in motivating widespread and persistent popular participation in a disease control effort—in this case, for malaria control (see Box 3). Although malaria is different from HIV in many respects, both diseases spread because each individual in the population perceives the private benefits of preventive behavior to be insufficient compared to the immediate discomfort, cost, or inconvenience they entail. Furthermore, effective prevention of both diseases requires the coordination of many government and non-government agents throughout society. If the promise of cruise ship spending could change this balance of incentives in favor of disease control, perhaps a COD approach could work a similar miracle for HIV prevention.

The COD approach has been developed and proposed for application in other sectors in response to four intellectual currents in the field of foreign assistance in general and HIV prevention in particular.

- First, there is a trend toward results-based foreign assistance, which is exemplified by the U.S. government’s Millennium Challenge Corporation (Radelet, 2003) and the Global Alliance for

Vaccines and Immunization at the national level and the PBI movement at the level of the individual social service facility (Eichler et al, 2009).

- Second, there is a growing belief among some observers that in the field of development the foreign “planners” who have traditionally led the design and implementation of development assistance, have less pertinent knowledge and are less important for success than the local “seekers” who, if properly motivated, could best solve the problems of making schools or health clinics work on the ground (Easterly, 2006).
- Third, following the work of Filmer and Pritchett (Filmer and Pritchett, 1999), an increasing number of observers have wondered whether the poor results achieved by public service delivery in poor countries can be partly attributed to insufficient motivation at higher as well as lower levels of public service delivery institutions (Filmer, D. and Pritchett, L., 1999).
- Fourth, in the domain of HIV prevention, data on the cost of service delivery reveals enormous unexplained variation in unit costs for the delivery of the same service within as well as across countries, suggesting substantial scope for enhanced incentives to improve the prevention results obtained from available prevention resources (Bautista-Arredondo et al., 2008; Dandona, L et al., 2005a; Dandona, L et al., 2005b; Dandona, L et al., 2005c; Guinness et al., 2005; Marseille et al., 2004; Marseille et al., 2007)

How would COD payments work? There are five key features, as Table 4 shows. The first is that a donor (bilateral, multilateral, or philanthropic) and recipient (national or state government) enter into an agreement or “contract” in which the donor agrees to reward the recipient country if it achieves, or proportional to its achievement of, a certain development outcome. In “development-speak,” outcomes are a fundamental dimension of peoples’ well-being such as poverty reduction, nutritional status, cognitive development, educational achievement, and health status. Thus, as distinct from financing budget support, inputs, or activities, the COD approach pays only for evidence that development itself has been advanced.

The COD payment would *not* substitute for traditional input-based foreign assistance. Nor would the payment be conditional on any government policy decisions or enacted legislation or implemented regulation, as has

often been the case with loans or grants from multilateral donors. For example, suppose an HIV prevention effort involves the ministries of health, education, and civil society. A typical National AIDS Control Program would include a detailed list of activities that each ministry would perform (“outputs”) and would budget the vehicles, materials, training, and logistical support (the “inputs”) that each would “require” to produce these outputs. Such a plan might mention a reduction in new HIV infections as an aspiration or even as an objective. But the ministries in charge of executing the plan would only be held accountable for the specified inputs and outputs.

In contrast, the COD approach eschews any detailed programming of the outputs or activities of the individual government agencies, and it is unable to hold the separate agencies accountable for their activities or outputs or to attribute any changes in the outcome to any individual or institutional actors. It also would not specify how any prize would be distributed among the local actors who have contributed to winning it. A recipient government might best leverage a COD agreement into HIV prevention achievements by openly discussing the prize distribution with constituent local governments and civil society groups—which would encourage buy-in at the community level. Depending on the recipient’s perception of where incentives would do the most good, the recipient might offer to distribute portions of the prize to local government health officials, NGOs, mayors, or even individual citizens.

The other four features include “hands-off” administration of the program, independent verification, transparency, and complementarity with other aid programs. In this context, “hands off” means that the COD agreement *per se* would never provide technical assistance, advice, training, oversight, or any other input to program execution. Host country governments and their existing advisors would be free to seek any of the inputs they deem useful to obtaining the contractually agreed improvements but no additional budget would be available from the COD process for this assistance. And most importantly, the recipient government would not be required to spend COD payments from the donor on the program, or even the sector, on which the payments are conditioned. That means the government could use the extra resources from a COD program on HIV prevention to build roads or to train its national soccer team.

**Table 4. A snapshot of the COD approach**

*The emphasis would be on outputs and a hands-off administrative policy*

**Key Features**

- Rewards improvements in “outcomes:” i.e. fundamental dimensions of human well-being
- Hands-off (i.e. donor does not prescribe *how* outcomes are to be achieved)
- Independent verification
- Transparency (to assure that donor and recipient constituencies have enough information to judge whether the outcomes have been achieved.)
- Complementarity with other aid programs

**Basic Steps**

- Two parties (typically a donor or donor consortium and a recipient government) negotiate and sign a medium-term (e.g. five-year) contract specifying output performance goals
- Recipient government collects and reports output data using mutually agreed sampling methods<sup>16</sup>
- Donor does independent audit of measured output (ideally, annually)
- Donor pays recipient according to achievement of previously negotiated output performance goals (e.g. six months after each performance audit)
- Operational or impact evaluation research is optional, potentially funded by a third party

Source: Author’s adaptation of Figure 3 from (Birdsall et al, 2010)

There are also five basic steps involved in the COD approach (see Table 4). It is the fifth one—the absence of a requirement that there be a carefully monitored “control group” of the population that does not receive the intervention—that clearly distinguishes the COD performance audits from formal impact evaluation. While the objective of impact evaluation is to determine whether a specific intervention has improved a development index relative to a “counterfactual” state of the world in which that intervention was not implemented, the more modest objective of the COD approach is to simply determine whether improvement has occurred relative to a benchmark and, if so, to estimate the magnitude of the improvement.

By comparing the future value of a development index to a benchmark and agreeing to pay for every unit by which the index is better than the benchmark, the COD approach provides an incentive to exert effort toward improving the index regardless of whether the selected benchmark accurately represents the counterfactual of what would have happened in the absence of the COD. The COD approach is thus available in contexts where

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<sup>16</sup> The agreement must specify at least the population to be sampled, the sampling frame, the clustering method, the sample size and distribution across clusters and the timing of the baseline and of successive follow-up surveys.

impact evaluation would be either politically or technically infeasible. For example, impact evaluation is notoriously handicapped when a development index is affected by many contextual variables, only some of which are under the control of the evaluators and some of which cannot even be measured (Deaton et al, ). The COD program has no such handicap because it rewards based on outcome improvements, whatever the cause of those improvements. Impact evaluation typically requires that interventions be applied to a random sample of subjects or communities and withheld from a matched comparator group that does not receive the intervention. The COD approach requires only that the index whose improvement is to be rewarded be measured at least twice, once at the baseline to establish a benchmark and once in a follow-up survey.

Although the COD approach eschews a research perspective, it may indirectly encourage research.<sup>17</sup> To the extent that the COD approach motivates the recipient government to learn what works best to achieve the COD-determined improvement objectives, the government and its partners are free to conduct research to that end. Indeed, being motivated to improve the COD outcomes, the government may pay new attention to relevant previously completed research and show new interest in eliciting relevant operational research from the academic community.

## ***B. Advantages of COD assistance***

How do the PBI approach and the COD approach differ? They differ on the *level* and the *time-frame* of the outcomes to be rewarded and on the degree to which funders keep their “hands off” of the actual day-to-day production process. Whereas PBI rewards relatively short-term (for example, monthly or quarterly) improvements in patient-level or facility-level outcomes, the COD approach rewards medium-term (for example, annual or multi-year) improvements in the average outcome for an entire state or national population. Because the PBI approach integrates with the day-to-day management of individual interventions, the donor typically becomes involved in selecting the actual inputs, outputs, or activities to be monitored and rewarded. In

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<sup>17</sup> After Argentina entered into World Bank funded, performance-based contracts with its provinces in 2004 regarding 10 indicators of maternal and child health, a study found that the provinces actively sought “technical assistance to improve information systems, expand enrollment, and contract and pay providers.” (Eichler and Glassman, 2008)

contrast, the COD approach stands well back of the process and indeed is agnostic regarding the contribution to the outcome of individual interventions.

COD foreign assistance, as proposed by Birdsall and coauthors (Barder, O. and Birdsall, Nancy, 2006; Birdsall et al, 2010), at first augments, but could eventually replace existing program-specific bilateral and multilateral funding. The COD approach entails a written contract between the donor and the host country government that, at the end of a set period of time, would provide the recipient government with additional financial resources that bear a specified relationship to the country's progress toward the achievement of one or more specific development objectives.

For example, the authors suggest that a payment of \$200 per child be made to the recipient government for every additional child enrolled above those that were enrolled at the beginning of the period (Birdsall et al, 2010) p. 55). To assure host country agreement with the COD contract, all donors would agree that the payments would be over and above the existing education assistance funding in the country, not a substitute for it. The COD contract requires that audited measures of the specified outcomes be made prior to the contract's start and then periodically to establish the gains to be rewarded.



*Box 3. An island takes on malaria, and wins*

*From time immemorial the inhabitants of Aneityum, an island of the South Pacific nation of Vanuatu, tolerated endemic malaria, with its periodic bouts of fever and occasional childhood deaths. In the 1980s, their island lifestyle was sustained by fishing and enriched by biannual visits of a cruise ship and its free-spending tourists. Then in 1990, two tourists contracted malaria. According to Kevin Palmer of the World Health Organization, “I talked to the captain who confirmed that passengers had gotten sick with malaria after visiting Vanuatu. It wasn’t certain whether they were infected during the Aneityum visit or not, but regardless [the cruise ship captain] demanded that the island be declared malaria free or the ship wouldn’t stop anymore. This is why the islanders came to WHO and the malaria program people in Port Vila [their country’s capital city] to ask for help.”<sup>a</sup> Journal articles document how the extraordinary community-level motivation and participation of the Aneityum population led to the successful elimination of malaria on the island.<sup>b</sup> Palmer notes, “The happy ending to the story is that Aneityum is now a popular tour destination known as Mystery Island so the people on Aneityum are economically secure thanks to what they accomplished.”<sup>a</sup>*

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<sup>a</sup>Kevin Palmer, Personal communication, 2010.

<sup>b</sup> See (Atkinson et al. 2010; Kaneko et al. 2000; Kaneko 2010)

## 1. COD for HIV prevention<sup>18</sup>

So how would we design a COD contract for HIV prevention? The reality is that it would not be easy for several reasons. First, the subject population for HIV prevention is potentially quite large, consisting of everyone whose behavior places them at risk of infection or of infecting someone else. This means we will have to pay the COD rewards based on a sample of the relevant population rather than on the kind of comprehensive administrative data that could be used in a COD for AIDS treatment program (which would have a relatively smaller cohort) or in a COD program applied to other sectors.

Second, while the donor is paying to avert a bad outcome—an HIV infection—these infections are a relatively rare event compared, for example, to unsatisfactory AIDS treatment outcomes. Whereas the risk of HIV infection in a general population is typically less than 1 percent per year and almost never more than 2 percent per year, as many as 10 or 20 percent of those initiating treatment in a given year might either fail treatment (in the sense that their drugs stop working) or be lost to follow-up (meaning that they fail to return for their scheduled appointment and cannot subsequently be located). While rarity of new infections is exactly what we would like to achieve, the challenge is that the rarer the event the larger the sample size necessary to detect a reduction in its frequency, and a larger sample size means greater cost and more possibility for mistakes or even opportunistic manipulation of the measurements by interested participants.

Third, it may be tough in the case of HIV infection to know what constitutes a commendable outcome. For AIDS treatment, sustaining the subjects in the program is already a successful result and is worthy of reward for its own sake. However, in the case of HIV infection, we want to commend and reward the recipient for averting HIV infections. This implies that we want to reward the recipient country to the extent that HIV incidence is smaller than it would have been in some other state of the world (the counterfactual) than the one we actually observe. HIV infections averted can be defined only in reference to a “counterfactual” state of the world in which they would have occurred. Specifically, HIV infections averted is defined as the arithmetic difference

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<sup>18</sup> This section of this essay draws heavily on (Hallett and Over, 2010).

obtained by subtracting the number of new HIV infections that have actually occurred over a certain period of time in a certain population, say 50,000, from the number that would have occurred in the same period and the same population, but in the counterfactual state of the world, say 75,000. The difference, in this case 25,000, would be the estimate of HIV infections averted.

The COD philosophy is to reward any improvement (that is, any reduction in new infections) beyond some specified threshold without regard to why that improvement occurred or whether it would have occurred in the absence of the COD program. This philosophy could be characterized as the adoption of a naïve counterfactual that no change would have occurred without the COD program, or simply as the recognition that the donor values the improvement for its own sake and is willing to reward the country for the achievement whatever the cause. Adopting this philosophy for an infectious disease is complicated by the fact that for any infectious disease the “incidence rate” —that is, the fraction of an uninfected population that becomes infected over a given interval, typically a year—varies substantially over time even in the absence of intervention. Typically the incidence rate is high in the early stages of the epidemic when the entire population is susceptible. It then declines as the, “prevalence rate”—that is, the fraction of a given population that is infected at a given point in time—of the disease rises and the formerly susceptible population is saturated with infection. The incidence rate can then increase again as new cohorts of susceptibles enter the population. The time scale of these cycles varies from weeks for influenza to years for HIV.<sup>19</sup>

The advent of effective accessible ART for AIDS adds another difficulty to the interpretation of trends in the prevalence rate, given that those whose lives are sustained by treatment raise the proportion of the population that is infected, even in the absence of new infections. Clearly it could be logically contradictory to reward a country for both extending the lives of AIDS patients—as we propose to do with a COD program for AIDS treatment— while simultaneously, in the name of HIV prevention, rewarding it for reducing the proportion of its population living with HIV/AIDS.

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<sup>19</sup> The terms “prevalence” and “incidence” as used by epidemiologists correspond to what economists would call the “*stock* of current infections” and the “*flow* of new infections.” Economists use the term “incidence” in an entirely different way to describe the distribution of a benefit or a cost across social groups as in the expression “the incidence of a tobacco tax is higher on the poor, because they are more likely to smoke.” In this essay, we adopt the epidemiologist’s usage of the term “incidence”.

Because of these complications, using the COD approach for HIV prevention requires more attention to defining the benchmark than would be the case when the COD approach is applied to other indices of development, including AIDS treatment. This third characteristic of HIV prevention is the most challenging impediment to operating a COD for HIV prevention program. But it too is surmountable if the donor and recipient can agree at the outset on the use of the statistical, modeling, and auditing methods that will enable the donor to confidently pay a reward commensurate with the recipient's real achievements in HIV prevention.

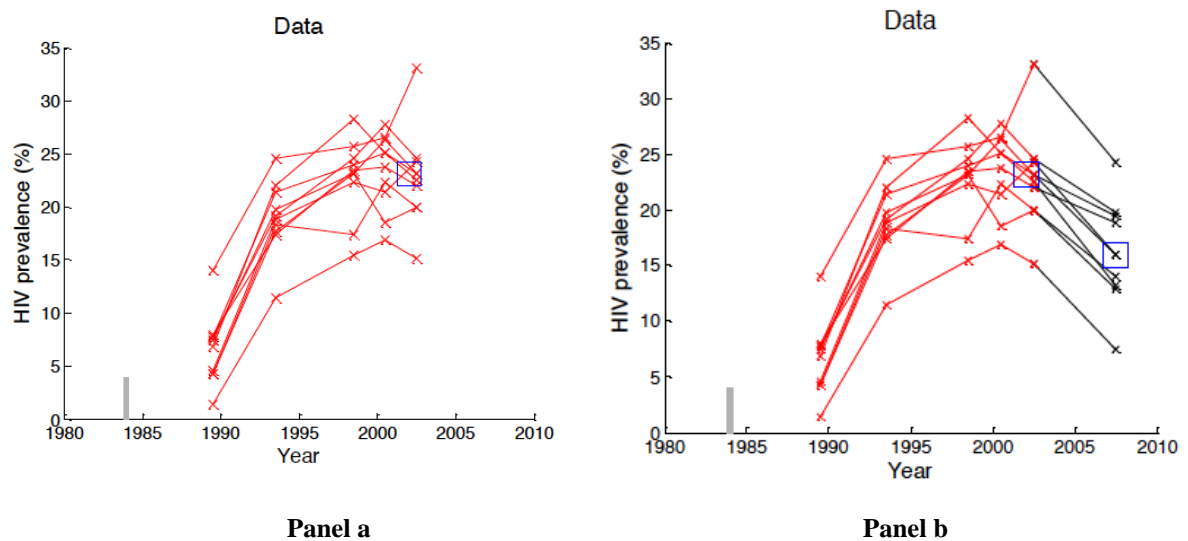
There are two feasible approaches to defining a plausible counterfactual against which to measure HIV infections averted: the prevalence modeling approach and the test of recent infection (TIR) approach.

***The prevalence modeling approach.*** The first approach involves measuring the prevalence rate in two surveys of the general population—one before the intervention is begun and the other after the agreed time for the intervention has lapsed—supplemented by prevalence data from earlier years, convenience samples at antenatal clinics and data on the number receiving ART, and coupled with a detailed model of the epidemic. Together, this data is used to infer both the actual rate of new infections in the interval and in the counterfactual (the rate of new infections that would have occurred in the absence of behavioral change). The difference between these two estimated incidence rates as a proportion of the population provides an estimate of the number of HIV infections averted.

Let us take an example, as laid out by Hallett and others (Hallett et al., 2009). Supposing that in a hypothetical country with a high HIV prevalence rate, surveillance has been conducted at nine antenatal clinics since 1989, and a baseline survey of HIV infection in 8,000 households was conducted in 2002. The data might look like the nine trend lines in panel (a) of Figure 5, with the household survey result indicated by the small rectangle. Based on this data and on expert opinion regarding the earlier history of the epidemic, a model would predict a leveling off or a slight reduction in HIV prevalence in the absence of any change in risk behavior or increase in AIDS treatment. Such a leveling off is owing to the natural evolution of an epidemic of infectious disease, as

the most susceptible people in the population become infected and some of the infected die. This prediction becomes the counterfactual against which the country's prevention performance will be measured.

Now suppose that the country signs a COD contract with a donor in 2002, in which the donor agrees to reward the recipient country the amount of \$10 for every HIV infection averted by 2007. Panel (b) shows the subsequent data on seroprevalence in the nine clinics and, in the second small square, the estimates from the 2007 follow-up household survey. Using the 2007 clinic and survey data and known rates of AIDS treatment, the prevalence modeling method allows the estimation of the number of HIV infections that may have been averted because of changes in risk behavior. The good news is that this hypothetical country achieves a probable reduction in HIV prevalence much greater than would be expected with no change in behavior. Comparing the path of HIV prevalence without behavior change to the path with the change, the authors estimate the number of HIV infections averted in 2007 as between 140,000 and 270,000 –with the best estimate being 210,000 averted (see Figure 6). At \$10 per averted infection, the donor would pay the country \$2.1 million.

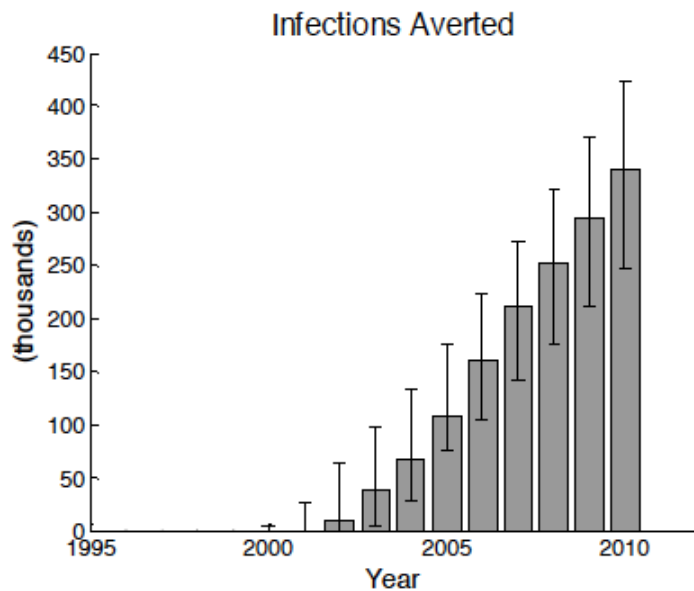


**Figure 5. The prevalence modeling approach**  
*Using HIV prevalence data at antenatal clinics to design a COD agreement*

**Note:** Panel (a) shows HIV prevalence trends in 9 antenatal clinics as segmented lines and the 2002 household survey result as a small square. Panel (b) shows the additional data through 2007 including a second rectangle giving the prevalence estimate from the 2007 household survey.

**Source:** (Hallett, T. B., Gregson, S., Gonese, E., Mugurungi, O., and Garnett, G. P., 2009)

The question arises whether the payout should be diminished because of the large uncertainty around the 210,000 point estimate. To the degree that the uncertainty is a result of the donor's having been unwilling to finance larger samples for the household surveys, the recipient government should not be held accountable for the lack of precision. But in this example the uncertainty is increased by the fact that the prevalence rates vary from one antenatal clinic to another (Panel b). To reward countries for greater precision in the follow-up prevalence estimate, the payout function could be revised to deduct for imprecision. For example, the original agreement could be to pay \$15 per infection averted less \$5 for the difference between the upper and lower limits on the 95 percent confidence limits. In this example, the recipient government would receive \$3.15 million less \$650,000 for a net payment of \$2.5 million.



**Figure 6. How much progress?**

*Policymakers can design a financial reward based on HIV infections averted*

(Estimated HIV infections averted and 95 percent confidence interval by year, using model projections from data on prevalence in 2002 and 2007 and in 10 antenatal clinics.) Source: (Hallett and Over, 2010)

This prevalence modeling approach has the advantage of feasibility with existing HIV testing and survey methods, but has several disadvantages. The main one is the complexity of the process needed to construct a counterfactual and to use it to interpret trends in prevalence. The mathematical modeling method can be adjusted to be conservative, so that the threshold for finding evidence for behavior change affecting the course of the epidemic is raised, or alternatively, the model can be adjusted to be more generous by doing the opposite, opening the calculation of HIV infections to dispute. Another disadvantage is the strong influence on the conclusions drawn by experts from the information entered about HIV prevalence early in the epidemic before the surveillance system was established. This makes the analysis vulnerable to gaming. In addition, the increasing availability of ART that sustains HIV prevalence in the population requires additional complex adjustments to the prevalence modeling<sup>20</sup>. These disadvantages could be addressed in the original COD agreement by establishing an objective expert panel to which both the donor and the recipient would agree to defer and perhaps a binding arbitration mechanism in case of subsequent disagreements. Indeed the establishment of such mechanisms might be advisable for any COD agreement. Nevertheless, an alternative approach that depends less on modeling and more on direct measurement would be desirable.

***The “test-of-recent-infections” approach.*** The second approach makes use of blood tests that detect whether an HIV infected person has become infected within a specific recent period of time, such as six months. After a decade of research, these “Tests of Recent Infection” (TRI) are on the verge of gaining approval for wider use. By using such a test to measure HIV incidence directly, instead of inferring incidence from a change in prevalence, a COD program for HIV prevention can conform more closely to the COD norm by simply paying for any measured reduction in incidence.

The original TRI method used a so-called detuned assay to judge whether an HIV infected person was newly infected. The idea of this assay was to apply both a more and less sensitive test to the same blood specimen.

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<sup>20</sup> For example, according to UNAIDS only about three-quarters of patients who enroll in ART are retained for two years in the same program (UNAIDS, 2009). The larger the number of these disappearing patients who successfully re-enroll elsewhere, rather than succumbing to the disease, the greater will be the prevalence of HIV in the population in the counterfactual – and vice-versa. A higher counterfactual prevalence, when compared to any observed prevalence, will lead to a larger estimate of prevalence reduction and thus a greater cash-on-delivery payout. Thus, modelers will be under pressure from the recipient government to assume that most disappearing patients successfully find new treatment options, when that may not be true.

On the theory that the reactivity of the test to the blood sample increases with the length of time the person has been infected, the researchers would use the number of people who scored HIV-positive on the more sensitive test, but negative on the less sensitive one, as a measure of those newly infected. The newer TRI method is to gauge the time since infection by measuring the opacity of a single blood test result. While both of these methods show promise, they suffer from the same problem when used alone: some people who have been infected a long time appear on the test to be recently infected, thus biasing upward the measured rate of HIV incidence.<sup>21</sup> Furthermore, the proportion of such people turns out to vary from one epidemiologic setting to another. Recently researchers have shown that these problems can be addressed by using several tests in conjunction on the same blood sample.<sup>22</sup> This use of “combination-testing” opens the way to the routine application of TRI to the measurement of HIV incidence and to the use of TRI to reward countries for reducing HIV incidence.

By delinking rewards for HIV prevention from prevalence measurement, the TRI approach shields COD for HIV prevention from the charge that it could discourage countries from prolonging the lives of people living with HIV/AIDS. Because it is direct, the TRI approach reduces the dependence of any COD payout function on complex epidemiologic modeling.<sup>23</sup> While application of the TRI approach might occasionally lead to the donor paying a recipient for incidence reductions that are part of the natural epidemic cycle, this problem is generic to the COD approach and can be addressed through the appropriate design of the payout function.

The one problem that is aggravated by the TRI approach in comparison to the prevalence modeling approach is the requirement for a large sample or a long period between the baseline and follow-up surveys. In the prevalence modeling example discussed above, when prevalence has in fact declined by 20 percent, two samples of 8,000 each at a five-year interval are sufficient to reject the hypothesis that prevalence is unchanged

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<sup>21</sup> Evidence suggests that these tests can misclassify two types of people as recently infected: those whose immune systems are greatly impaired and those whose immune systems have effectively suppressed the infection for years.

<sup>22</sup> Tests similar to those used to track a patient’s immune system during ART can be used to determine whether an individual who scores positively on a TRI might be misclassified owing to either a disabled immune system or an exceptionally effective one.

<sup>23</sup> Some modeling might still be necessary to best arrive at an incidence measurement after combining the information from several tests.



on 80 percent of repetitions.<sup>24</sup> However, with the TRI approach, because the proportion of the population that is newly infected (the incidence rate) is much smaller than the total proportion infected (the prevalence rate), either the sample size or the number of years between surveys must be larger in order to detect any given improvement.

For both approaches, the sample size and survey interval requirements for capturing an annual reduction in incidence depend on several factors that vary across countries and epidemiological contexts. Suppose the COD criterion is that a reward be paid if the second incidence survey yields an estimated incidence that is statistically smaller than the incidence in the baseline survey. In this situation, Figure 7 depicts the tradeoff between sample size and survey interval to allow a COD reward to be paid. The curved lines depict the level sets of equal statistical power with lines to the northeast indicating higher statistical power for rejecting the hypothesis of equal incidence as either sample size or the time between surveys gets larger.

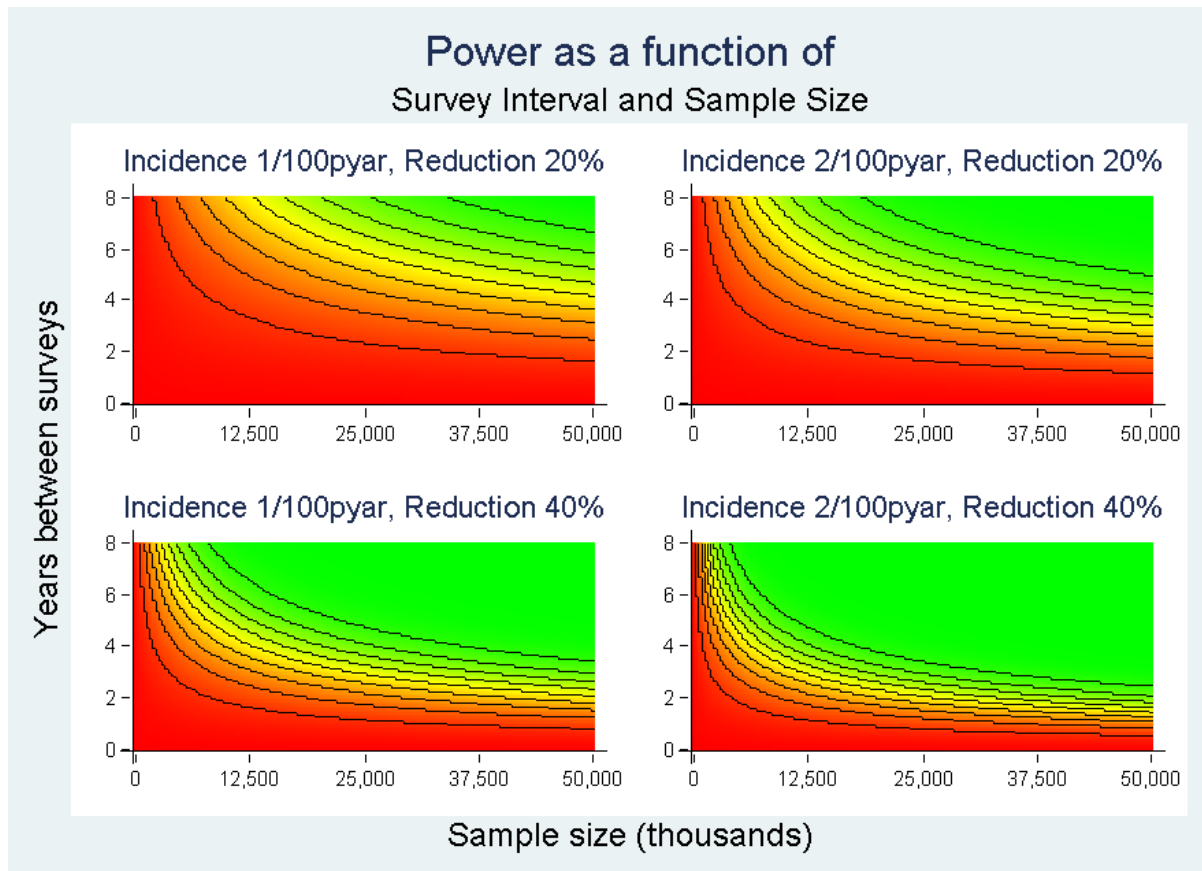
When the starting incidence is relatively high at 2 new infections per hundred person-years and the actual decline is rather large at 40 percent per year, as depicted in the lower right panel, a powerful test can be achieved with a relatively small sample of 25,000 individuals and a relatively short interval between surveys of 4 years.<sup>25</sup> But when the starting incidence is relatively low at only 1 new infection per hundred person-years and the true reduction is rather small at only 20 percent, as depicted in the upper left panel, a relatively large sample of 50,000 and a relatively long interval between surveys of 6 years would be required to obtain the same statistical power. Of course, a larger sample and a longer interval would be more costly, but this could be alleviated to some extent by choosing a payout rule that increases the payout smoothly with increases in the estimated number of HIV infections averted. Thus, even if sampling error leads to an underestimate of the country's reduction in HIV incidence, the probability exists of some payout. Furthermore, with a smoothly

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<sup>24</sup> In other words, two samples of 8,000 yield a statistical power of 80 percent for the test that prevalence has declined in this hypothetical model. A test of this hypothesis with this power would ordinarily require only that the two samples be of 730 persons each. The requirements of the prevalence modeling approach, however, push the sample size requirement up to 8,000.

<sup>25</sup> The same power could be attained with two samples of only 12,500 each if the interval between surveys increases to 6 years.

increasing payout function, the recipient country planners will be motivated to reduce prevalence as much as they can.



**Figure 7. Finding the right mix**

*Policymakers need to juggle sample size and years between surveys to best determine if HIV incidence has declined*

(Statistical power to reject the hypothesis that incidence has not declined as a function of sample size, years between surveys, by starting incidence per 100 person-years and annual percentage reduction in incidence.)

Source: (Hallett and Over, 2010).

### **Payout functions**

Whether averted HIV infections are estimated using the prevalence modeling approach or the “TRI” approach, the payout itself can be a smoothly increasing function of the total number of HIV infections averted. Under the discussion of the prevalence modeling approach, we suggested that payout could be \$15 dollars for every

averted infection, less a \$5 penalty for every unit difference between the high and low estimate boundaries of the 95 percent confidence interval.

Instead of a penalty for imprecision, the payout might include a bonus for precision. Table 5 lists four possible payout functions that could be used to reward countries for progress in reducing HIV incidence, while Figure 8 graphs their expected performance as a function of the true incidence reduction the recipient manages to achieve. The graph is constructed by averaging the payouts over many replications at each of a range of actual changes in the HIV incidence rate when the baseline and follow-up surveys both include 20,000 subjects, the starting incidence is 2 new cases per 100 person-years (or 2 percent), and the interval between surveys is 5 years. The horizontal axis measures improvement with the right of the axis representing up to a 50 percent reduction in incidence, while the left of the axis represents a worsening of the situation with incidence being larger at the follow-up survey than it had been at the baseline. The vertical dashed line at a zero change in incidence represents no change in incidence between the surveys.

Since sample surveys by their nature do not count everyone, even a sample as large as 20,000 can by chance be unrepresentative and yield an estimated decline in incidence when incidence has not truly declined. All of the payout functions contain that possibility as represented by the fact that expected, or average, payouts are greater than zero even when the actual change in incidence is zero or positive. Choice of a payout rule to include in a COD agreement requires that the danger of over-payment be weighed against the danger of under-payment, the latter situation occurring when the country has actually achieved an incidence reduction of, say, 40 percent, but the reduction measured by an unlucky sample is only 30 percent—and payout correspondingly less. The possibility of over- or under-payment is inescapable in the context of a one-time COD program, but becomes less important if the COD program is repeated with the same recipient. For example, suppose that a particular sample is unlucky in the direction of over-estimating incidence leading to a reduction in the payout. The next time a survey is conducted, it is unlikely to be unlucky in the same direction. If it is more accurate, the difference in incidence between the preceding survey and this new one will be biased upward. Thus the payout foregone on the first iteration of the COD program would be made up by an over-payment on the second

iteration. As the iterations of the program accumulate, the law of large numbers guarantees that the total accumulated payment will converge to the amount that properly rewards the actual accomplishment.

Rule 1 is a simple linear function of the incidence reduction that reaches its maximum when incidence is reduced by half. The rationale for this maximum is that reducing incidence by half is a prodigious accomplishment for which donors would want to offer their maximum reward. But if the donor is willing to risk larger payouts, the threshold at which payout reaches its maximum could be adjusted to a 75 percent reduction or even a 100 percent reduction without reducing the reward for a 50 percent reduction. Figure 8 shows that this payout function, labeled Rule 1, entails only a small danger of a payout when the recipient has not really reduced incidence (the region to the left of the vertical dashed line) and then increases the recipient's expected reward in a roughly linear way up to the maximum of 50 percent.

Rule 2 differs from Rule 1 only by offering the recipient a bonus for achieving a statistically significant reduction in incidence. Statistical significance could be improved at any given level of incidence reduction by either increasing the sample size—a decision that would be taken jointly by donor and recipient and presumably funded by the donor—or by improving the consistency of HIV prevention across the regions where incidence is measured. By reducing the variance in incidence reduction, the recipient government can improve the precision with which any given reduction is measured, thereby increasing the chance that it will win the precision bonus. The other way to improve the chance that the reduction will be statistically significant is for the reduction to be as large as possible, an additional incentive to the recipient to excel at HIV prevention. Figure 8 shows the effect of the bonus is to make the payout function steeper up until an inflection point at about 20 percent reduction. Thus each incremental percentage point of reduction receives a greater reward under Rule 2 than Rule 1. The donor's expected cost is correspondingly greater.

Rule 3 is a modification of Rule 2 designed to make the payout function even steeper over the range of small improvements. This rule will be useful in encouraging performance in contexts where any reduction is extremely difficult. However, note that it entails the disadvantage of providing an expected payout of 20 percent of the maximum when there has been no actual reduction in incidence. And more than Rules 1 or 2 it

entails a substantial risk of payout when the true change in incidence has been an increase, rather than a decrease.

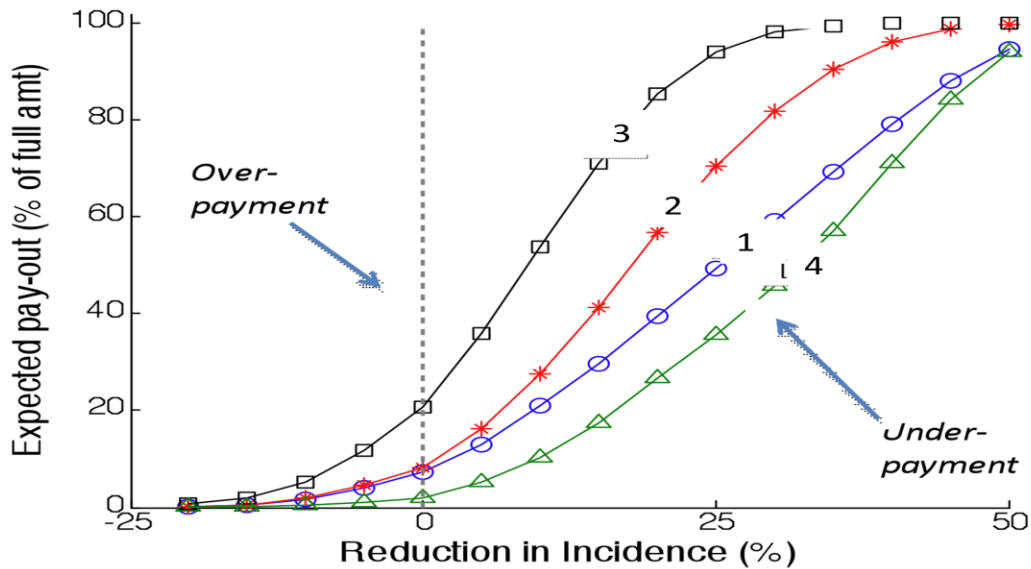
Rule 4 is included to demonstrate the possibility that the payout rule could be adjusted to be less steep for small improvements and correspondingly steeper for large improvements if this is deemed desirable in a specific context. For example, suppose the donor and the recipient remain engaged in a succession of repeated COD programs for the same population. Perhaps in the early years a very steep and forgiving payout rule like Rule 3 would be best to motivate the recipient as it launches its enhanced HIV prevention program. But then subsequent contracts could be more demanding, looking more like Rule 2, Rule 1 or even Rule 4 to shift the steepest part of the payout function to the more ambitious levels of incidence reduction.

1.	Pay-out linearly in proportion to the reduction in incidence (up to a reduction by half).
2.	Pay-out linearly in proportion to the reduction in incidence (up to a reduction by half), with a bonus if the reduction reaches statistical significance at $p=0.05$ .
3.	Pay-out convexly (faster return at smaller reductions) in proportion to the reduction in incidence (up to a reduction by half), with a bonus if the reduction reaches statistical significance at $p=0.05$ .
4.	Pay-out concavely (faster increase in return at larger reductions) in proportion to the reduction in incidence (up to a reduction by half), with a bonus if the reduction reaches statistical significance at $p=0.05$ .

**Table 5. Constructing the reward**

*Four alternative payout functions could be used to reward a country for reducing HIV incidence*

Source: Hallett & Over (2010).



**Figure 8. Too little or too much**

*There are risks of under-payment and over-payment in all of these payout functions*

**(Relationship between true reduction in incidence and the expected payout under a range of “continuous payout functions” when the sample size for both the baseline and the follow-up survey is 20,000.)**

Source: Hallett and Over (2009)

## 2. Synergy between HIV prevention and AIDS treatment

A COD program for HIV prevention would be an even larger improvement over current donor practice than would be true for a COD program in AIDS treatment—which is elaborated in a companion essay on treatment.

Typical prevention programs measure only the inputs of the HIV prevention programs they fund, like the number of condoms distributed or man-hours of outreach time. Even the crudest measures of the national coverage of prevention programs are being reported to the UN General Assembly for the first time in 2008. The COD approach would break new ground both in rewarding prevention outcomes and in providing HIV prevention program managers with recent data on HIV incidence, an indicator of prevention success.

Furthermore, the still contentious debate over the relative benefits of different mixes of prevention programs would pass from the donor’s responsibility to that of the recipient government. Here also, COD would reward “seekers” rather than “planners” (Easterly, 2006).

That said, there is enormous scope for taking advantage of the synergy between HIV prevention and AIDS treatment. HIV prevention costs money and effort today, but only saves money on AIDS treatment years in the future, when the person whose infection has been averted would otherwise have become ill. This fact biases myopic governments away from effective HIV prevention. The weight actually assigned to prevention in the COD reward function will be subject to negotiation between donors and a given country recipient and may vary from country to country. But *any* positive weight given to prevention offers the recipient country a chance to reap immediate financial rewards for prevention accomplishments instead of having to wait for that reward until the infected person would have become sick.

The COD approach has an additional advantage over programmatic funding of giving the recipient country the incentive to seek out ways to increase the synergy between prevention and treatment. After all, if the country can more effectively leverage treatment efforts to motivate prevention, it increases its reward without having to spend more on prevention. Or if investing in improved roads has knock-on benefits on both prevention and treatment, again the country wins.

Once a group of donors has negotiated a COD contract covering both treatment and prevention—with the AIDS transition objective of a declining death rate and a declining new infections rates—all parties might agree to allow excluded donors to buy into the arrangement by adding to the unit payout for prevention or for treatment. Effectively these additional donors would “bid upward” the price or reward for either prevention or treatment or both. This kind of simulated market would reveal donors’ preferences between these two interventions, while adding to the recipient’s incentive to do both.<sup>26</sup>

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<sup>26</sup> Some observers might see such a market mechanism as threatening to change the incentive ratio between the options away from the relative weighting those observers would have preferred. But recognizing donors’ “right” to select which of multiple gifts they prefer to give is a plausible alternative principle – and might elicit a greater total amount of donor financing.

### ***C. Potential flaws and possible remedies of a COD approach for AIDS***

The COD approach has several potential weaknesses that must be addressed and remedied in any application. However, before considering these features individually, we must remember that all existing forms of foreign assistance in general, and HIV/AIDS assistance policies, in particular share these four features.

***Negotiation costs.*** COD requires that donors and recipients agree in advance on a precisely defined reward structure or payout function. In most countries, nongovernmental stakeholders must also be involved in this process to increase the chance that some of the rewards from the payout function will pass through the government to those who are implementing the program and to assure that those stakeholders with the most to contribute to HIV prevention can negotiate their share of the COD reward. The recipient government is likely to be most successful in maximizing its COD receipts if it uses the prospective receipts to achieve buy-in from these stakeholders. Negotiating these agreements will thus be a costly process, but perhaps no more so than in the case of conventional assistance programs. Given the prospect of these domestic transaction costs, the government that accepts a donor's offer to negotiate a COD agreement will likely be one that is strongly motivated to reduce incidence and views the sharing of COD rewards with other stakeholders as a useful inducement to their energetic participation toward the common HIV prevention goal. Other governments need not apply.

***Rewards measured outcomes.*** Because of the measurement requirement, the COD approach is not able to reward unmeasured improvements in population well-being, and is thus biased against such unmeasured outcomes. For example, the payout functions described above omit consideration of the degree of stigma that the recipient government allows to fall on those practicing risky sexual behaviors. A recent flurry of reports of governmental persecution of men who have sex with men in African countries give credence to the possibility that even now, twenty-five years after the early spread of HIV and Jonathan Mann's warnings about how the disease tends to locate and exacerbate the fault lines of intolerance in a society, each new cohort of government parliamentarians and policymakers is susceptible to the misconception that AIDS can be controlled by punishing those with high-risk behavior (Tarantola et al, 2006).



Donors concerned that a country that enters into a contract designed to reward a reduction in the number of new infections might, in its zeal to win the COD prize, carry out prevention programs that would infringe the human rights of its population can impose eligibility requirements on recipient countries, such as human rights ombudsmen or civil society watchdogs. Furthermore, they can include in the contract a provision that overtly discriminatory or stigmatizing behavior toward the HIV-infected or the most at-risk populations, certified by a third party, will annul the offer of the COD payment.

To a greater degree than with other COD applications—such as improving school completion or reducing infant mortality for example—donors and recipients will need to agree to monitor HIV prevention activities for human rights abuses.<sup>27</sup> The COD contract must clearly stipulate that credible evidence of the abuse of the human rights of those with high-risk behavior or with HIV will be cause for abrogation of the agreement. Another tactic available to donors to reduce the possibility of unintended consequences is to keep the size of the reward small in relation to the domestically borne costs of the activities that the recipient is most likely to undertake to achieve the agreed results and in relation to the largest other financing flows into the country. The trick will be to choose a magnitude that is large enough to motivate people who attach intrinsic value to achieving the designated goal but not so large that it can attract the rent-seekers from other more remunerative targets or elicit stigmatizing reactions toward those perceived as transmission risks.

***Big country bias.*** To the extent that improved implementation of AIDS treatment and prevention programs requires learning what works and what does not work in each country, a big country might be better at improving. Natural variation of the program over its larger number of districts would produce more extremes of performance in both directions. A large country would have more skilled operations research personnel who could investigate these good and bad performers and help disseminate lessons from the good ones. And big countries will generally have more incentive to invest in knowledge, because they have larger populations to whom these public good benefits will extend. These biases in favor of big countries can be compensated by

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<sup>27</sup> Although their model application is to primary school completion, an area where human rights abuses seem less likely, Birdsall and Savedoff discuss the possibility of incorporating a “social audit” into their model COD contract as protection against unintended consequences. (Birdsall et al, 2010)

parallel investments in small country capacity and perhaps by rewarding small countries even more for every unit improvement in either the treatment or the prevention dimension.

***Vulnerable to dishonest data collection and analysis.*** The parties to a COD contract must agree on an arrangement to measure the key outcomes that will determine the payment. Because all COD contracts will reward achievement, they will create incentives for biased data collection and analysis. After the exacerbation of human rights abuses, one of the worst possible unintended consequences of implementing COD would be the corruption of the national statistics institutions. The exercise of due diligence to assure that the COD outcomes are honestly measured is the most important responsibility of those designing the COD contract.

Several safeguards should be built in to protect the integrity of the COD outcome measurement process. The COD contract can include the provision that surveys and data collection and analysis be performed either exclusively by accredited international statistics organizations or in partnership with external agencies and local partners. Household surveys can collect data not only on HIV incidence but also on individual characteristics and on program variables such as the local presence of HIV prevention activities. These surveys can be used to guard against cheating in two ways. First, statisticians can confirm that the baseline and the follow-up samples contain similar distributions by age, sex, geographical location, and profession to be sure that any measured changes in incidence are not simply owing to a biased selection of one of the samples. Second, statisticians can confirm that correlations among the individual and program variables on the first survey are either unchanged in the second survey or are changed in plausible ways that can be confirmed by an auditor who revisits a few of the sampled villages. The security of blood samples can be guarded with particular care, and DNA testing can be used to assure that surveyors are not taking the shortcut of multiple re-sampling of the same blood. In addition, the survey data can include codes to individually identify which survey employees administered, supervised, and keypunched each individual survey. In the history of household surveys, this last precaution has proved important in uncovering survey anomalies that have been introduced by individual incompetence or corruption.<sup>28</sup>

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<sup>28</sup> Analysis of the interviewer codes recorded in the data from a household seroprevalence survey in Namibia revealed the strong probability that a single interviewer had provided samples of his own blood in lieu of  
Footnote continued on next page

Building in the proper safeguards at the time of COD contract negotiation may seem onerous, unnecessary, and even embarrassing. But the prospect of unintended consequences from the COD agreement – or even of the suspicion that COD outcome measurement has been suborned, should be sufficient to convince all parties of the need for these legalistic procedures. The objective is to assure that the COD program, and the HIV treatment and prevention programs it will reward, repel those individuals in any society who are most adept at falsifying data to achieve an illusory success, and attract and ultimately reward those people in that same society who are most competent at, and passionately committed to, strengthening AIDS treatment and averting HIV infections.

#### ***D. Piloting a COD AIDS assistance program***

If the idea of using a COD reward for HIV incidence reduction catches the imagination of one or more donors—and if countries where many of the HIV prevention input and activity budgets are already financed are interested in reaching for this prize—then there would be much to gain from piloting this idea in a country, or perhaps in a region of a country. The regional focus has the advantage of allowing comparisons with other regions that do not yet have a COD program. Unless the selection of regions to include in the pilot is entirely random, the comparison would have to be done by matching regions that receive the pilot to those that do not.

If a COD program is piloted in a region, those negotiating the COD contract should agree on a payout function that rewards both national and regional stakeholders. With some rewards going to national stakeholders, national decision makers will have more incentive to focus the best expertise available nationwide on the problem of improving results in the specific pilot region. Since measurement is likely to be challenging for any COD program, piloting in a region would enable the country and the donors to test the selected independent measurement agency to see if its performance is adequate and if it can remain immune to the temptation to exaggerate improvements. An important aspect of the pilot would be to test the feasibility and desirability of a specific reward rule or payout function. After several years of successful implementation in pilot regions, the program could then be extended to the entire country.

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visiting and taking blood from members of the households that were the object of research (Janssens,W et al, 2009a; Janssens,W et al, 2009b).

## IV. Potential fiscal savings from better prevention

In the various countries of the world, the fiscal burden associated with lifetime AIDS treatment of an additional HIV infected person, discounted at a social discount rate of 3 percent to the date of HIV infection, ranges from \$5,000 in the poorest countries to more than \$50,000 in the middle-income countries.<sup>29</sup> So preventing a person from becoming HIV infected during his or her lifetime is worth at least this much. If we recognize that each averted infection prevents that person from infecting others and if we believe that an additional year of an adult's life averts orphanhood years, increases economic productivity and lowers risk of social unrest, then these dollar estimates are lower bounds for the value of averting an infection. Furthermore, a high rate of HIV infection is a "public bad," which casts an ominous shadow over the maturation of all the youth in the country, weakens the labor force and worsens the investment climate by threatening potential foreign investors with high health care expenditures. Universal access to government-financed AIDS treatment, as is available in Botswana and Thailand, only partially mitigates this depressing effect. Effective HIV prevention, in contrast to universal treatment access, can prevent this disheartening future altogether.

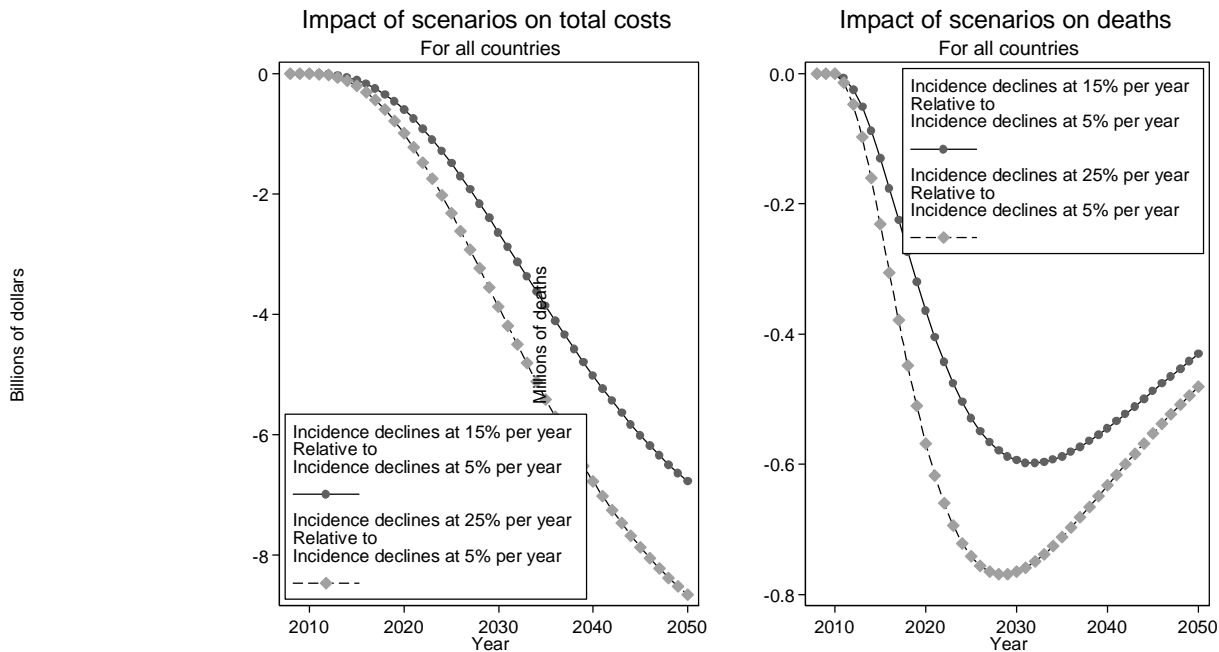
Take the case of Thailand. During the 1990s Thailand spent a total of about \$434 million on its HIV prevention and treatment program, most of which was on prevention (Over et al., 2007; Revenga et al, 2006). During this time period, HIV infection slowed substantially from its previous rate of spread. By 2002, when Thailand introduced universal AIDS treatment, the total number of HIV infected people in Thailand was 14 times smaller than it would have been without the behavioral changes. As a result, the cost to treat all of Thailand's AIDS patients in the subsequent decade would be \$18.6 billion less than without the behavioral changes. By spending \$434 million to save \$18.6 billion, Thailand achieved a benefit cost ratio of 43 to one, perhaps one of the highest ever computed for a government investment. In a world that has been spending \$18 billion a year for

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<sup>29</sup> Economists use a discount rate to "discount" or reduce the value of future costs and benefits compared to current ones. For example, at a discount rate of 100 percent, only the current year's treatment cost would matter to a decision-maker, all future costs being "discounted.. In the belief that a responsible government "should" plan responsibly for the future, even weighing the well-being of the unborn in its current calculations, economists typically recommend a low discount rate to government decision-makers. The rate of 3 percent was adopted by the World Bank for evaluating future health benefits and losses in its 1993 *World Development Report* and has since become conventional in the analysis of future health benefits and their associated costs. An even lower discount rate would yield larger estimates of the present value of a stream of future treatment costs. (World Bank, 1993)

AIDS treatment in poor countries, donors would be irrational not to spend a few million to achieve measurable reductions in the rates of new HIV infections and thereby reduce the future need for treatment.

## Impact of reduced HIV incidence on costs on deaths



**Figure 9. A slam dunk**  
*Effective HIV prevention dramatically reduces costs and deaths independently of other policies.*  
 (Source: Author's calculations)

As Figure 9 shows, by 2030, reducing incidence by 15 percent annually will save \$2.6 billion in treatment costs a year, enough to finance treatment for at least 3 million additional AIDS patients. Reducing incidence by a much more dramatic 25 percent per year will save \$3.8 billion by 2030, increasing to \$8.5 billion a year by 2050. These two prevention scenarios also avert 600,000 and 800,000 deaths, respectively, with more averted from now to 2030 when the number of deaths would otherwise have crested than later when people on treatment eventually succumb to the illness.

On a regional basis, Table 6 shows that the benefits will be widely spread with Sub-Saharan Africa—the hardest-hit region—measuring the biggest gains if the rate of new cases could be slowed from the current rate of

decline of 5 percent per year to 15 percent or even 25 percent. Of the total cost saving of \$2.6 billion from the more modest achievement, more than \$1.9 billion would be saved in Sub-Saharan Africa. Of the averted deaths, 427,000 out of 594,000 would be saved in Sub-Saharan Africa.

**Table 6. A must for Sub-Saharan Africa**

*By 2030, Sub-Saharan Africa would reap a huge benefit—in terms of lower costs and fewer deaths—from better prevention* (Source: Author's calculations)

Region	Reduce incidence by 15 % per year compared to 5% per year in baseline scenario		Reduce incidence by 25 % per year compared to 5 % per year in baseline scenario	
	Costs (Thousands)	Deaths	Costs (Thousands)	Deaths
East-Asia & Pacific	-214,762	-51,128	-314,470	-65,994
Europe & Central Asia	-131,985	-35,340	-194,024	-45,592
Latin America & the Caribbean	-172,588	-23,270	-252,660	-29,936
Middle East and North Africa	-7,734	-3,987	-11,357	-5,158
South Asia	-146,831	-53,568	-215,891	-69,005
Sub-Saharan Africa	-1,963,796	-426,911	-2,879,985	-549,312
Total	-2,637,696	-594,204	-3,868,387	-764,997

Source: Author's calculations.

Of course these incidence reductions are easy to assume in a mathematical model but a lot harder to achieve in practice. However, the evidence of success with male circumcision and the success of well-established prevention techniques in the control groups of randomized controlled trials suggest that with sufficient effort and in the absence of political impediments, rates of incidence reduction of 15 percent or more are possible in Africa. Achieving incidence reductions of this magnitude can create fiscal space so that donors can contemplate expanding treatment access to a larger share of those in need.

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