RETHINKHIV

Perspective Paper

Strengthening Health Systems: Perspectives for economic evaluation

Till Bärnighausen, David Bloom, Salal Humair

COPENHAGEN CONSENSUS CENTER

RUSH
FUNDING DISRUPTIVE IDEAS AGAINST HIV

First published 2011
Copenhagen Consensus Center
Copenhagen, Denmark
Rush Foundation,
Lausanne, Switzerland

ISBN: 978-87-92795-15-1

Perspective Paper

Strengthening Health Systems: Perspectives for economic evaluation

Till Bärnighausen[1,2], David Bloom[1] Salal Humair[1,3]

1 Harvard School of Public Health, Department of Global Health and Population
2 Africa Centre for Health and Population Studies, University of KwaZulu-Natal, South Africa
3 School of Science and Engineering, Lahore University of Management Sciences, Pakistan

RethinkHIV: The Project

2011 marks the 30-year anniversary since the Centers for Disease Control and Prevention introduced the world to the disease that became known as AIDS. Despite 30 years of increasing knowledge about transmission, prevention, and treatment, and current annual spending of $15 billion, every day around 7,000 people are infected with the HIV virus and two million die each year. The HIV/AIDS epidemic has had its most profound impact in sub- Saharan Africa, which accounts for 70 percent of new worldwide infections and 70 percent of HIV-related deaths, 1.8 million new infections in children each year, and has 14 million AIDS orphans.

Humanitarian organizations warn that the fight against HIV/Aids has slowed, amid a funding shortfall and donor fatigue. Yet HIV is still the biggest killer of women of reproductive age in the world, and of men aged 15-59 in sub-Saharan Africa. Time is ripe for a reassessment of current policy and expenditure.

The Rush Foundation has asked the Copenhagen Consensus Center to commission a group of leading health academics to analyze HIV policy choices and identify the most effective ways to tackle the pandemic across sub-Saharan Africa.

RethinkHIV identifies effective interventions in the fight against HIV/Aids across sub-Saharan Africa. It applies cost-benefit analysis to highlight investments and actions that can make a significant difference.

The Copenhagen Consensus Center has commissioned eighteen research papers by teams of top health economists, epidemiologists, and demographers who examine the cost-effectiveness of a range of responses to HIV/AIDS in sub- Saharan Africa under the following topics:

- Efforts to Prevent Sexual Transmission
- Efforts to Prevent Non-Sexual Transmission
- Treatment and Initiatives to Reduce the Impact of the HIV/AIDS Epidemic
- Research and Development Efforts
- Social Policy Levers
- Initiatives to Strengthen Health Systems

A panel of five eminent economists, including recipients of the Nobel Prize, convenes in the fall of 2011 to carefully consider the research and engage with the authors. The Expert Panel is tasked with answering the question:

If we successfully raised an additional US$10 billion over the next 5 years to combat HIV/AIDS in sub-Saharan Africa, how could it best be spent?

After deliberating in a closed-door meeting, the Nobel Laureate Expert Panel provides their answer, highlighting investments and actions that could be most effective avenues for additional funding. Their findings and reasoning are released in the fall of 2011, and published in full alongside all of the research in a collated volume in 2012.

RethinkHIV will generate global discussion regarding responses to HIV/AIDS in sub-Saharan Africa. To participate in a dialogue on the research and findings within sub-Saharan Africa, a Civil Society Conference and forums for youth are held following the Expert Panel meeting in late 2011.

The Civil Society Conference is a means of creating a dialogue with African civil society and to agree on a set of bold new actionable priorities with society politicians, civil society organizations, influential thought-leaders, and others within sub-Saharan Africa.

It is hoped that the project will motivate donors to direct more money to the investments and actions that are demonstrated to be most effective to curtail the pandemic in sub-Saharan Africa.

All of the research papers, and many different perspectives on priorities can be found online at the project's website:
www.rethinkhiv.com

You are invited to join the dialogue and provide your own perspective on priorities for action in Africa.

The Copenhagen Consensus Center

The Copenhagen Consensus Center is a Danish state-funded think- tank that commissions and promotes research highlighting the most effective responses to global challenges. The Center is led by author Bjorn Lomborg, named 'one of the 100 Top Global Thinkers' by Foreign Policy in 2010, 'one of the world's 75 most influential people of the 21st century' by Esquire in 2008, and 'one of the 50 people who could save the planet' by the Guardian in 2008. The Copenhagen Consensus Center is implementing the project, which follows the format of past projects such as Copenhagen Consensus 2004, Consulta de San José in 2007, Copenhagen Consensus 2008, and Copenhagen Consensus on Climate in 2009.
www.copenhagenconsensus.com

The Rush Foundation

The Rush Foundation, based in Lausanne, is dedicated to providing fast, effective funding for innovative thinking addressing the HIV/AIDS epidemic in sub-Saharan Africa. The Rush Foundation is the sponsor of the project. The Rush Foundation was launched in 2010 to fund sustainable projects in sub-Saharan Africa focused on alleviating the pandemic through innovative thinking, and to shake up the status quo in HIV thinking by spearheading thought leadership projects and debates that will help reframe HIV policy. Among other initiatives, the Rush Foundation is currently designing a grant programme with ActionAid in Africa aimed at generating new, sustainable HIV initiatives on the ground.
www.rushfoundation.org

The Papers

The body of research for RethinkHIV comprises 18 research papers. The series of papers is divided into Assessment Papers and Perspective Papers. Each Assessment Paper outlines the costs and benefits of at least three of the most promising responses, interventions, or investments to HIV/AIDS in Sub-Saharan Africa within the respective category. Each Perspective Paper reviews the assumptions and analyses made within the Assessment Paper. In this way, a range of informed perspectives are provided on the topic.

Contents

Introduction

30 years into the HIV epidemic, and in spite of significant progress against the disease in the last decade, HIV still causes enormous human suffering, extracts a huge financial cost, and imposes a daunting challenge for the future—33 million people living with HIV (UN, 2011b), 2.6 million new HIV infections and 1.8 million HIV-related deaths in 2009 (UNAIDS, 2010); annual global spending approximately $16 billion (UNAIDS, 2011a); and resource needs projected at $22 billion/year by 2015 (for the UNAIDS strategic investment priorities (Schwartländer et al., 2011)), or as much as $35 billion/year by 2031 under a different investment trajectory (Hecht et al., 2009).

Extraordinary commitment, great gains

The past decade has seen the emergence of extraordinary global political commitment for fighting the HIV epidemic, unprecedented increases in donor funding for HIV, and exceptional progress in translating funding into programs and results. The global commitment was manifested in multiple UN General Assembly declarations recognizing HIV/AIDS as a "global crisis"(UN, 2001), resolving to achieve universal access to antiretroviral treatment (ART) by 2010 (UN, 2006), and pledging to intensify efforts to eliminate HIV (UN, 2011b). This global resolve translated to a nearly 10-fold increase in global spending on HIV from 2001 to 2010 (from $1.6 billion to $16 billion), fueled by bilateral donors (e.g. U.S. President's Emergency Plan for AIDS Relief (PEPFAR)), multilateral institutions (e.g. The Global Fund to Fight AIDS, Tuberculosis and Malaria (The Global Fund)), and private philanthropic organizations (e.g. the Bill and Melinda Gates Foundation (BMGF)). The result was a nearly 22-fold increase in the number of people receiving ART from 2001 to 2010 (about 6.6 million by the end of 2010) (UNAIDS, 2011a) and an estimated 17% decline in the number of new infections between 2001 to 2008 (UNAIDS, 2010).

New challenges

But the gains of the last decade are fragile, and barring new technological breakthroughs for fighting HIV, the coming decade could be very different for three reasons: (i) an expanding gap between available treatment resources and stated goals; (ii) flat-lining or declining donor support for global HIV programs; and (iii) the emergence of new demands on the global health community, such as the rise in non-communicable diseases in the developing world. The expanding gap between available and desired treatment resources comes from multiple sources: the new UN goal of achieving universal coverage by 2015 (UN, 2011b); WHO's revised ART eligibility guidelines (from CD4 count<200/µl to CD4 count<350/µl) (WHO, 2010) which have increased the number of people needing ART worldwide from 10 to 15 million (WHO et al., 2010); and the emergence of new evidence that treatment is a highly effective form of prevention (Cohen et al., 2011, Lancet Editorial, 2011), which has led to a chorus of calls for expanding the use of ART for prevention much earlier in the progression of the disease (Economist, 2011, Sidibé, 2011, UNAIDS, 2011a). Flat-lining or declining funding is a direct result of the global financial crisis which began in 2008; and although the UN General Assembly has just pledged to close the $6 billion gap between current funding ($16 billion in 2010) and the estimated need for 2015 (UN 2011), the fulfillment of this pledge remains uncertain as the world economy continues to be buffeted by new crises in Europe, the United States and Japan. The emergence of new demands on the global health community is prominently highlighted by the UN General Assembly's upcoming High-Level Meeting (from September 19-20, 2011) for discussing the prevention and control of non-communicable diseases worldwide with a particular focus on developing countries. Preceded by a UN General Assembly resolution reaffirming commitment to strengthening national health systems (rather than a particular disease like HIV) (UN, 2010), and a preliminary report by the UN secretary general which seeks commitment from member states

to address non-communicable diseases at a priority level compatible with other diseases like HIV (UN, 2011c), this meeting has the potential to shift donor focus and energies away from HIV.

Increasing debates, shifting structures

In this environment, the HIV community is increasingly asking if past strategies for dealing with HIV through stand-alone interventions are still adequate, or if a more sustainable approach is to integrate HIV programs with other health care delivery. Of particular interest is the debate about whether (i) HIV programs should be fully integrated with the primary health care system, (ii) it would be better to move toward "selective integration" of HIV services with other disease-specific programs within the overall health system, (iii) there should be "selective expansion" of current HIV programs to include synergistic HIV-related and –unrelated services (e.g., STI treatment, reproductive health services, treatment of mental disorders), or (iv) HIV funding should be used to spur development in other sectors (e.g., in sex equality, education, and social protection) (Schwartländer et al., 2011).

For example, the Thematic Panel Discussion at the 2011 UN High-Level Meeting on AIDS recently examined how to integrate HIV with TB, sexual and reproductive health, and maternal and child health services (UN, 2011a). And a measure of policy makers' concern is that the resulting UN declaration on HIV from the meeting (UN, 2011b) explicitly commits to redoubling efforts to strengthen health systems in developing countries through several initiatives (e.g. decentralizing HIV programs and/or integrating HIV programs within primary care programs).

In fact, the shift towards health systems strengthening (HSS) is already happening within previously dedicated HIV initiatives. For instance, PEPFAR, which has allocated more than $32 billion since 2004 for bilateral HIV programs (PEPFAR, 2011), and The Global Fund,[4] which has committed approximately $22 billion since 2002 for HIV (The Global Fund, 2011b), have recently started to invest more in HSS as part of their HIV portfolio investments. More specifically, PEPFAR has recognized the need to incorporate a health systems perspective into its programs, and has committed to training 140,000 health care workers, managers, administrators, and planning experts needed for critical functions of the health system (PEPFAR, 2009a). One of its five goals for 2010 through 2014 is to integrate HIV programs with broader global health and development programs (PEPFAR, 2009b). The U.S. Global Health Initiative (GHI), the new umbrella organization for U.S. global health engagements, includes strengthening health systems as a core objective (U.S. Global Health Initiative, 2011b). GHI activities encompass assistance for a broad range of areas, such as improving research and regulatory capacity, improving human resources, and supporting policy changes outside the health sector that can help improve health outcomes (U.S. Global Health Initiative, 2011a). The Global Fund is now seeking proposals for HSS interventions that cut across diseases, e.g. upgrading primary health care facilities, and reinforcing planning and policy-making capacities of health ministries (The Global Fund, 2011a).

4 PEPFAR has also contributed about $6 billion to The Global Fund since 2004, in addition to the $32 billion it allocated for bilateral programs.

Perspectives for evaluating health systems interventions

The growing focus on HSS simultaneously with HIV interventions has the potential to improve the effectiveness, efficiency, and sustainability of HIV programs. But two perspectives need to be kept in mind in setting expectations for (i) when positive impact on HIV programs can be achieved through HSS, and (ii) what interventions can be envisaged within the rubric of HSS, and what challenges they pose for the evaluation of costs and benefits.

Setting expectations: One structure does not fit all

The potential of HSS to improve HIV programs is unlikely to be realized through the undifferentiated integration of HIV programs into countries' general health care systems. It is unlikely that one single structure (e.g., stand-alone HIV programs or HIV care delivered solely through the general primary healthcare systems) is well suited to all contexts, and donors and governments should carefully consider the characteristics of a particular setting to determine which mix of integration will work best there, assessing intervention feasibility and efficiency, as well as the flexibility in adjusting interventions and the ease of evaluating intervention impact (Bärnighausen et al., 2011a).

Feasibility

A focus on one particular structure may not be feasible for political or humanitarian reasons. For instance, in Nigeria and Pakistan, vertical polio campaigns almost ground to a halt in the face of religious and political opposition; and against similar opposition, stand-alone HIV programs could also become inaccessible or at best inefficient. On the other hand, in public health emergencies requiring rapid humanitarian responses, such as large unmet need for HIV treatment, stand-alone programs may be the only feasible option since they can be rapidly brought to scale, whereas HSS may take an unacceptably long time.

Technical efficiency

Stand-alone HIV interventions can be efficient for their specific focus but inefficient at the health system level and at the societal level. *Increased* efficiency can result from health workers specializing and adapting their workflow to HIV treatment and prevention. *Decreased* efficiency can result at the level of the overall healthcare system from duplication of functions that are required in providing care for more than one disease, such as drug supply chains, laboratory facilities, and patient-record keeping. Inefficiency at the societal level can result because many HIV-infected patients suffer from diseases that are biologically or behaviorally related to HIV infection or treatment, e.g. opportunistic infections and cardiovascular diseases. HIV-infected patients who must travel between different facilities to receive complete care have to invest more time and money utilizing needed care than patients who can receive all their care in one place.

Flexibility

Stand-alone HIV programs may not be flexible enough for evolving health goals, even though they may be appropriate in the short term. The narrow scope of isolated delivery programs is likely to be especially problematic when a population's health care needs and demands are changing rapidly—for example, in countries undergoing rapid socioeconomic development with changing lifestyles, health risk taking, and care-seeking behavior. In some situations, HIV programs may also draw resources such as health care workers away from general health systems, weakening the delivery of general health care. Furthermore, an excessive HIV focus may distract from long-term planning priorities, such as training an appropriate generalist health care workforce. But a positive

effect from HIV programs is also possible if they can provide the motivation and resources to build specific types of capacity that can benefit the entire health system, as in the PEPFAR-supported USAID|DELIVER PROJECT for drug supply chains.

Evaluation

The emphasis on HSS instead of a narrower focus on HIV programs may also impede rigorous evaluation of program impact. Donor organizations increasingly require evaluation of interventions' impact on population health. Health systems interventions such as building infrastructure, training health care workers, or integrating HIV programs into general health care systems are often difficult to evaluate, because their effects are realized over the medium and long term — and because they affect multiple disease outcomes, they are insufficient on their own to guarantee that effective HIV treatment and care is delivered. The simultaneous trends toward HSS and better evaluation of impact thus run counter to one another, and both donors and governments need to carefully consider the increased difficulty of evaluating impact when shifting focus from HIV programs to HSS (Bärnighausen et al., 2011b).

For these reasons, estimates of the impact of HIV interventions that seek to also strengthen health systems are difficult to obtain, making it difficult to do a comprehensive analysis of their costs and benefits. In the section *Evaluating costs and benefits*, we highlight the kind of issues that arise in doing a cost-benefit analysis for such interventions, by looking at some specific interventions identified by (McGreevey et al., 2011) for the RethinkHIV Project. We highlight both general issues raised when evaluating such interventions, and particular issues that are illustrated by their analyses.

Envisaging interventions: Level and scope of intervention, and issues in evaluation

A framework is needed to guide the debate about HSS interventions, because a wide variety of HSS interventions which entail quite different costs, consequences, risks and implementation challenges are being discussed in the literature (McGreevey et al., 2011, Schwartländer et al., 2011, UN, 2011a). We discuss such a framework below, which can help clarify the goals of particular HSS interventions and thus help understand the issues involved in their evaluation.

Level and scope of interventions

HSS interventions may be envisaged as *HIV focused non-structural (HIVNS)*, *HIV focused structural (HIVS)*, or *general structural (GS)*. *HIVNS* interventions aim towards expanding prevention, diagnosis, treatment or care services for HIV *within* the structure of existing HIV programs, however these programs may be organized. Examples of such interventions include the conditional cash transfer intervention to incentivize people to get tested for HIV and the Cryptococcal Meningitis testing/treatment intervention proposed in (McGreevey et al., 2011). *HIVS* interventions aim to expand HIV services through new structures, or to admit more services within HIV programs, or to integrate HIV programs into general health systems, thus affecting the structure of current HIV programs. Examples of such interventions include the training and deployment of large amounts of community health workers to deliver HIV treatment as proposed in (McGreevey et al., 2011), or addition of HIV-related or –unrelated services to HIV programs as in (Schwartländer et al., 2011). *GS* interventions aim to broadly improve the functioning of the health system, with the hope that such strengthening can lead to improved HIV-related outcomes. Except for the fact that the HSS interventions we are

considering have HIV as their main focus, *GS interventions are similar to horizontal interventions which aim to deliver care for several diseases simultaneously (Bärnighausen et al., 2011a). Examples of GS* interventions include the setting up of an independent fund to incentivize governments in Sub-Saharan Africa to increase their allocations for health, as proposed in (McGreevey et al., 2011).

Evaluating benefits

The focus of HSS interventions is progressively broadened when moving from *HIVNS* to *HIVS* to *GS* interventions, making the evaluation of their benefits increasingly difficult. *HIVNS* interventions focus on narrow sets of health outcomes (e.g., mortality and morbidity in HIV-infected individuals), while *HIVNS* and *GS* interventions are intended to affect a wider range of health outcomes. Full evaluation of *GS* interventions is more difficult than full evaluation of HIVNS interventions because wider populations with a larger set of morbidities and causes of mortality have to be observed. A narrow evaluation of GS interventions that focuses only on HIV-infected persons or a select set of measures (e.g., maternal mortality, or under-5 mortality) is not useful for many decision-making purposes because large components of the total effect might be neglected, e.g. a health worker intervention may save many life-years in diseases not considered.

Evaluating costs

A further complication arises when deciding which costs to include in the evaluation of different interventions. HIV-focused programs are commonly financed exclusively by one agency. Where multiple funders contribute to such programs, the contributions of the different agencies are often clearly visible to all funders. For instance, in South Africa, both PEPFAR and the South African government contribute to the funding of the public-sector ART program (Houlihan et al., 2011). This joint effort is coordinated and both parties can easily obtain information on financial outlays contributed by the other parties (Bärnighausen et al., 2011b). In contrast, in some types of horizontal programs, it may be much more difficult for the primary funder to obtain realistic estimates of the financial contributions of other agencies, because these programs will likely require more diverse sets of inputs and because these inputs will not be utilized exclusively by the horizontal programs. For instance, programs improving the supply chains of medicines to primary care clinics will likely require support by health workers in central pharmacies and by the health workers in the primary care clinics receiving the medicines. However, these health workers will only spend some portion of their time supporting the supply chain intervention. This portion is unlikely to be known without additional research effort, such as time-motion studies or health worker interviews. *GS* interventions are thus likely to imply substantially increased difficulty in determining an intervention's cost-benefit ratio.

Differing time-lags and levels of certainty

HIVNS interventions will commonly generate health impacts more quickly than horizontal ones. This occurs because interventions solely focused on benefiting HIV-infected populations generally need to be in place before an *HIVNS* intervention (e.g. ART delivery) can begin. By contrast, HSS interventions such as *GS* interventions require years of investment before the end results are visible, because, e.g., an investment into medical or nursing education will require many years before doctors and nurses become available to deliver ART. Similarly, the establishment of an electronic patient record system may require procurement of laptops, development of software, health worker training, and field testing before it can contribute to the quality or efficiency of ART delivery and improve health outcomes in patients. The longer the time lags between intervention and outcomes, the more complicated it will be to determine the costs and benefits of the intervention.

Even if *GS* can be rigorously evaluated, we may learn less from the evaluation results than in the case of the evaluation of *HIVNS* interventions, because GS interventions are commonly mediated through longer causal chains than HIVNS ones, and the number of factors that can modify intervention effects will likely increase. Take, for instance, a training program to increase the capacity of district health managers to plan the delivery of HIV programs. For this GS intervention to have an effect on population health, it will be necessary for district health managers to be trained and acquire new skills, and be willing to use their new skills. The impact on health outcomes will then further depend on the ability of the manager to effect changes in the actual delivery of ART. It is this actual delivery, on the other hand, which is usually the starting point for the evaluation of *HIVNS* programs such as ART programs. Thus, the mediating steps from the district health worker intervention to a health impact are many more than those from the ART program to health impact, and contextual factors influencing district health managers' capacity to use newly acquired skills will likely increase the heterogeneity of effects across settings (Bärnighausen et al., 2011b).

Differences in mediating factors will lead to heterogeneity in estimated impacts across settings. The larger the number of mediating factors between the intervention and the outcome, the more resources will be required to either observe or control for all mediating factors. As the number of mediating factors will commonly increase as the intervention structure changes from *HIVNS* to *GS*, it is likely that impact evaluation that can shed light on the effects of programs across settings or populations will be more complex and require more resources for GS than for HIVNS interventions.

Evaluating costs and benefits

(McGreevey et al., 2011) was commissioned by RethinkHIV to assess the costs and benefits of viable HIV interventions that also strengthen general health systems, under the assumption that an additional $2 billion per year can be spent on these interventions for the next five years in sub-Saharan Africa. The authors discuss four specific interventions and the magnitude of resources required for each:

- Conditional cash transfers (CCT) to motivate adults to seek HIV testing, and thus reduce the number of HIV+ people unaware of their status. The cost is estimated at $2 billion—to test 400 million adults using a $5 voucher per person. The main benefit considered is a reduction in new infections by about 0.25 million annually.
- Deploy a large number of rural of community health workers (CHW) for HIV testing, diagnosis and early stage treatment, as well as for delivering other basic health services, such as unmet need for family planning among rural women (particularly those tested to be HIV+). The cost is estimated at $640 million. The main benefit considered is a reduction in maternal deaths by about 0.3 million annually, and a reduction in infant mortality by 0.1 million lives annually (through reduction in infant HIV infections).
- Test HIV+ people for Cryptococcal Meningitis (CM), an opportunistic infection associated with HIV, and treat those found to have CM. The cost is estimated at $1.3 billion. The benefits considered are an increase in life expectancy of people infected with CM by an average of 9.6 years.
- Provide cash on delivery (COD) to governments to increase the share of health spending in their overall public spending so they meet the Abuja goals (15% of public spending on health), with the hope that strengthened health systems will also lead to better HIV treatment results. The benefits considered include under-5, maternal, HIV and TB deaths averted, and a decrease in fertility rate.

For each intervention, the authors provide a qualitative discussion and calculate a cost-benefit ratio under at least one central assumption—e.g., if CCTs can reduce annual infections by 250,000 annually, or if 90% of the unmet need for family planning could be eliminated among women living with HIV. They then use available estimates about the number of lives saved, infections averted, etc., and the value of life and disability-adjusted life years (DALY) suggested by RethinkHIV, to compute a benefit-cost ratio. The paper highlights considerable variation in the benefit-cost ratios of the interventions, but concludes by noting that the benefits collectively outweigh the costs.

General issues

As the authors note, these interventions involve unequal effort, target different population segments (e.g., all vs. women only), and affect different aspects of HIV (e.g., prevention vs. treatment), which makes it difficult to compare their cost-benefit ratio. In addition, the exact impact of such interventions, i.e. which specific aspects of the health system will be strengthened and by how much, is difficult to gauge. For instance, two of the interventions are explicitly focused on the demand side of HIV programs (CCTs and CM testing), and it is hard to be exact about how much they will strengthen general health systems. The two other interventions (training CHWs and COD) are focused on HSS, but are at very different levels, (CHW focused only on HIV, and COD focused on the entire health system), making their impact on the HIV epidemic hard to quantify.

Unintended consequences

Even if we could account for some consequences, the other difficulty in doing a cost-benefit analysis is that interventions for HSS could have a range of unintended consequences that may be difficult to identify and to quantify. Foreseeable consequences could include excessive resources required to manage the demand generated by the CCTs, or the negative social and political costs if enough resources are not made available to treat people who discover their HIV+ status, or an open-ended financial commitment to keep offering incentives for coming years.
Unintended consequences may arise if CCTs lose their effectiveness over time or "spoil the well", i.e. lead to reduced willingness to act. For example, if we incentivize some behaviors that people should adhere to attain better health, people may come to expect financial incentives for other behaviors that benefit their health; or if funds get exhausted, people may wait to seek testing or care in the hope of future financial incentives; or if we do end up with the desired policy outcome of putting more people on treatment, it may increase sexual risk-taking and reduce the effectiveness of the intervention (e.g. (Walque et al., 2011)). The net effect, benefit or harm, of individual-level financial incentives for health-seeking behavior in HIV is continuing (AIDSTAR-One, 2011), as is the debate about government-level financial incentives (Over, 2010).

Scale of intervention and implementation time

The other challenge in doing cost-benefit analysis of the proposed interventions is the different scales of their implementation. The scale at which an intervention is implemented (e.g. offering CCT to everyone or 80% of those in need of testing) affects its cost benefit calculations, if either the effectiveness of an intervention is a non-linear function of the resources allocated to the intervention, or the costs are non-linearly increasing in the scale of the intervention. In such cases, the cost-benefit calculation will produce different values for the same intervention delivered at different scales. While the debate about how to account for issues of scale in cost-benefit and cost-effectiveness analyses for HIV interventions continues (Committee, 2008, Kumaranayake, 2008, Moatti et al., 2008), it is prudent to compare multiple cost-benefit values at differing scales of a given intervention to provide better guidance to policymakers.

The proposed interventions also have very different times for implementation. These differing time-horizons can lead to two kinds of problems in cost-benefit calculations. First, the longer time period for health systems interventions to take effect means that discounted future benefits are likely to assess HSS interventions unfavorably against solely HIV-focused interventions. Second, accumulating benefits over time requires that we accommodate positive and negative feedback loops created by the interventions themselves.

Feedback

For instance, we know that provision of ART at a moderate to high coverage level produces a positive feedback loop that significantly increases future resources required for increasing coverage (Barnighausen et al., 2007, Bärnighausen et al., 2009, Bärnighausen et al., 2010c). This feedback can be substantial, and models that do not account for it can significantly misestimate the costs and benefits of the interventions. Figures 1 and 2 in the Appendix show the magnitude of the effect feedback has on human resource requirements for ART, due to the mortality reduction effects of ART. Similar feedback loops may occur in other forms, e.g. the feedback from ART to reduction in future HIV infections, or from changes in behavior due to prevention interventions to future infections (Bärnighausen et al., 2010b, Bärnighausen et al., 2010a).

Such difficulties raise the need for models more sophisticated than static cost-benefit calculations, for capturing time varying intervention effects of HSS interventions. These models will have to be more powerful than the already existing tools at the HIV community's disposal. For instance, while a range of models specific to HIV are available for estimating time varying effects of HIV interventions, they only consider a limited set of AIDS-related outputs (mortality, new infections etc.)—e.g. epidemiological models, micro-simulations, and system dynamics models (Brown et al., 2010, Dangerfield et al., 2001, Stover et al., 2010a), and the freely available UNAIDS Spectrum modeling tools (Stover et al., 2010b, UNAIDS, 2011b). Extending them to consider a broader range of outputs affected by HSS interventions offers an opportunity for productive original research.

Specific issues

In spite of such difficulties, McGreevey et al. (2011) present a cost-benefit ratio for each intervention under transparent assumptions. For example, for CCTs, they assume providing a $5 voucher to 400 million people to get tested will reduce infections by 0.25 million annually; for CHW training, they assume spending $640 million can eliminate 90% of the unmet need for family planning; for CODs, they calculate benefits assuming a $1 billion endowment fund can be used to incentivize governments in Sub-Saharan Africa to spend up to $52 billion on health.

Some of these assumptions appear optimistic, such as being able to meet 90% of the family planning need in HIV+ women through CHWs immediately, assuming that CHWs can also deliver ART, or that we can incentivize governments to spend $52 billion on health using an endowment fund of $1 billion. For comparison, (schwartländer et al., 2011) assume 80% ART coverage as a measure of widespread treatment, and assume that 86% ART coverage can be reached universally at the end of ten years. Since ART coverage and family are closely tied in the CHW intervention, family planning coverage could follow a similar trajectory, and maintaining this coverage could require a long time horizon. Similarly, for the endowment fund, it might be useful to do a historical comparative study on how far external donor flows have increased country allocations to specific or general health priorities. In general, at this stage the evidence base for the impact of HSS interventions is not strong, and cost-benefit calculations must rely on assumptions, some more

optimistic than others. One way to work around this problem is to do a sensitivity analysis of cost-benefits around the assumptions. But such sensitivity analysis is typically useful only when there are non-linear, dynamic, or feedback effects (i.e. either the effects or the costs are non-linear as a function of the scale of implementation, or across time), otherwise both costs and effects are simply linear and sensitivity analysis does not give much insight.

The proposed interventions also illustrate how one needs to consider the effects of interventions more broadly when reasoning about the impact on health systems. For instance, for CCTs, it is not clear how the reduction in infections by 0.25 million will occur. Presumably that will require some other form of prevention intervention or treatment with its attendant costs, since there is hardly any evidence that simply being aware of HIV status can reduce new infections significantly. Those extra costs will affect the cost-benefit calculations significantly. It is also not clear how the demand for testing generated by the vouchers will be handled, which, e.g., will differ if access to testing services is already available, or if testing services will need to be expanded to accommodate the 400 million people who are willing to be tested, with attendant costs. The consideration of broad impacts is essential in evaluating an intervention that is aimed at HSS interventions.

For long-lasting interventions, such as creation of the Abuja Fund, focusing only on direct recurring costs of the interventions (as opposed to other administrative or capital costs) may be dictated by necessity at this stage, but other costs will need to be considered at least qualitatively to determine if a proposed intervention is realistic in a given country. For instance, a country with a very high degree of corruption would offer a difficult challenge in monitoring the use of resources disbursed under the Abuja Fund, and may require the setting up of costly independent monitoring and evaluation structures.

Finally, the cost-benefit ratio alone is not sufficient to distinguish between interventions, without considering other factors. For instance, CM testing will benefit a small minority of people who are HIV+, so its cost-benefit ratio alone is not a good indicator for comparison with other interventions, that are said to benefit many people.

Conclusions

The motivation for, and trends in, the recent shift towards HSS from previously stand-alone HIV interventions have the potential to increase the effectiveness, efficiency, and sustainability of HIV programs. But several issues arise when considering when and how to mix HSS interventions with HIV-focused programs, and how to evaluate their costs and benefits. First, the mix needs to be designed taking into account each country's circumstances. Second, HSS interventions can have very different scopes, and different scopes raise different challenges for evluation of their costs and benefits. Finally, even after costs and benefits are determined, a full evaluation of an intervention needs to take into account more than static cost-benefit analysis. Issues such as feedback resulting from effect of interventions, and unintended consequences of broad interventions, that can have major implications for the cost-benefit analyses of broad interventions such as those presented in (McGreevey et al. 2011), are overlooked in static analyses. Dynamic models which incorporate unintended consequences and feedback are essential for a proper cost-benefit accounting of HSS interventions.

Appendix

Figure 1: Difference in resource requirements estimated by a model that does not incorporate feedback due to reduced mortality because of ART (top) and a model that does (below).
Time is in years from left to right. The population needing ART is represented by the thickness of the main flow– if we consider the thickness of the starting flow from the left as 100% then about 30% more people are added to the pool requiring ART each year (these figures reflect approximately the 9 million needing ART globally, to which about 2.7 million new people needing ART are added each year, WHO 2009). In the top figure (non-feedback case), mortality (red outflow) is assumed to be unaffected by ART and is assumed to be 23% of the population pool each year; the population needing ART increases to 122% at the end of year 5. In the bottom figure (the feedback case), of the potentially 23% that can be lost to mortality each year, most are saved due to universal ART coverage (the light blue), so only a fraction leave the system; the population needing ART grows to 213% at the end of year 5. (Source: Authors' rendition).

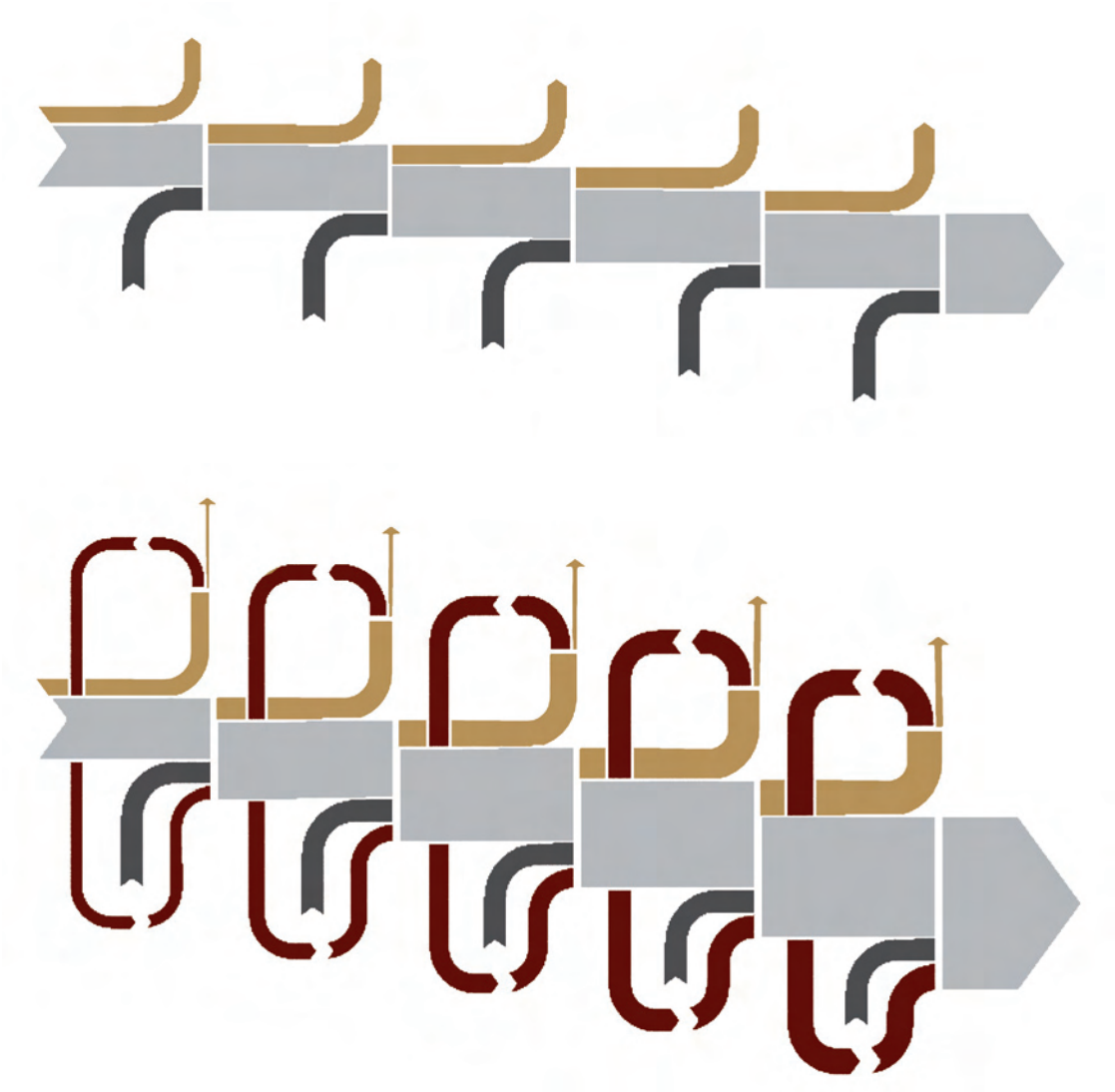
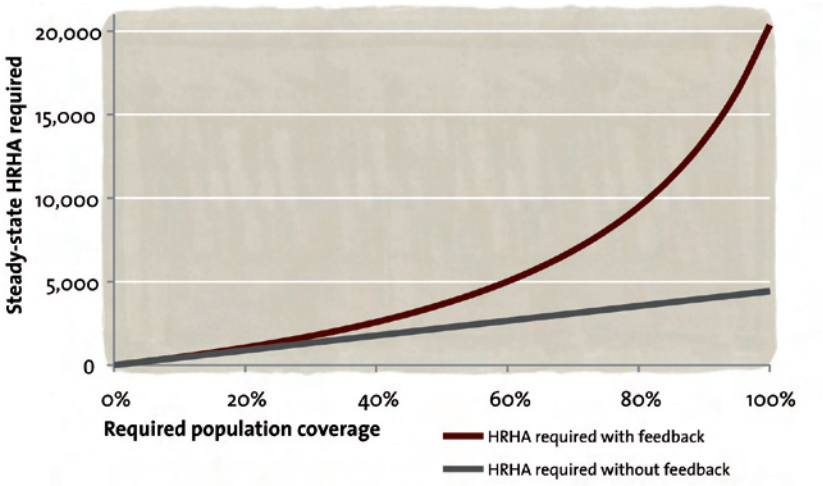


Figure 2: Human resources required to provide universal ART coverage for SSA, expressed as a function of population ART coverage.
Resource requirements shown for a model that does not account for feedback due to ART between time periods, and one that does.



(Source: (Bärnighausen et al., 2009)

Table 1: A framework for thinking about HSS interventions and the challenges they raise for cost benefit analyses.

HSS Interventions Framework					Impacts on evaluation and cost-benefit analysis		
Acronym	**Type of intervention**	**Main aim**	**Examples**		**Benefits**	**Costs**	**Time lag and uncertainty**
HIVNS	HIV non-structural interventions	Expand prevention, diagnosis, treatment or care services for HIV within the structure of existing HIV programs	Conditional cash transfer intervention to incentivize people to get tested for HIV (McGreevey et al., 2011), Cryptococcal Meningitis testing/treatment (McGreevey et al., 2011)	→	Limited in number, easier to evaluate (AIDS-related mortality etc.)	Limited number of sources of cost information and more control over cost information because of funding structure, costs incurred closer to program delivery	Causal chains from intervention to ultimate effects short
HIVS	HIV structural interventions	Expand HIV services through new structures, or to include more services within HIV programs, or to integrate HIV programs into general health systems, thus affecting the structure of current HIV programs	Training, deployment of community health workers to deliver HIV treatment (McGreevey et al., 2011), addition of HIV-related or -unrelated services to HIV programs (Schwartländer et al., 2011)	→	Some benefits easier to evaluate (AIDS-related mortality etc.), others difficult (counseling for STI, how much benefit displaced from other STI interventions)	Some costs easier to measure, others difficult	Causal chains from intervention to some effects short, other effects long
GS	General structural interventions	Broadly improve the functioning of the health system, with the hope that such strengthening can lead to improved HIV-related outcomes	Setting up an independent fund to incentivize governments in Sub-Saharan Africa to increase their allocations for health (McGreevey et al., 2011), creating a health insurance system	→	Most benefits difficult to evaluate (prevention and treatment across many diseases, long-term behavioral change at both individual and population level)	Costs often difficult to identify conceptually, measure because of many different contributors, and attribute to different causes (training of doctors as a case)	Causal chains from intervention to ultimate effects long

References

AIDSTAR-ONE 2011. Debate Five: The Ethics of Material Incentives for HIV Prevention. *Emerging Issues in Today's HIV Response Debate Series (available at http://www.aidstar-one.com/events/emerging_issues_todays_hiv_response_debate_series/ethics_material_incentives_hiv_prevention). AIDSTAR-One, John Snow, Inc. for USAID.*

BÄRNIGHAUSEN, T., BLOOM, D. & HUMAIR, S. 2009. A mathematical model for estimating the number of health workers for universal antiretroviral treatment. *National Bureau of Economic Research (NBER) Working Paper #15517.*

BÄRNIGHAUSEN, T., BLOOM, D. & HUMAIR, S. 2010a. Assessing the impact of the global financial crisis on ART programs: a behavioural feedback model. *Oral presentation at the11th International Congress of Behavioral Medicine (ICBM), 4-7 August 2010.* Washington, DC, USA.

BÄRNIGHAUSEN, T., BLOOM, D. & HUMAIR, S. 2010b. The sustainability of antiretroviral treatment: the case of South Africa. *Oral presentation at International AIDS and Economics Network, 16-17 August 2010.* Vienna, Austria.

BARNIGHAUSEN, T., BLOOM, D. E. & HUMAIR, S. 2007. Human resources for treating HIV/AIDS: needs, capacities, and gaps. *AIDS Patient Care STDS,* 21**,** 799-812.

BÄRNIGHAUSEN, T., BLOOM, D. E. & HUMAIR, S. 2010c. Universal antiretroviral treatment: the challenge of human resources. *Bull World Health Organ,* 88**,** 951-2.

BÄRNIGHAUSEN, T., BLOOM, D. E. & HUMAIR, S. 2011a. Going Horizontal — Shifts in Funding of Global Health Interventions. *New England Journal of Medicine,* 364**,** 2181-2183.

BÄRNIGHAUSEN, T., BLOOM, D. E. & HUMAIR, S. 2011b. Health systems and HIV treatment in Sub-Saharan Africa: Matching intervention and program evaluation strategies. *Sex Transm Infect,* [Submitted].

BROWN, T., BAO, L., RAFTERY, A. E., SALOMON, J. A., BAGGALEY, R. F., STOVER, J. & GERLAND, P. 2010. Modelling HIV epidemics in the antiretroviral era: the UNAIDS Estimation and Projection package 2009. *Sexually Transmitted Infections,* 86**,** ii3-ii10.

COHEN, M. S., CHEN, Y. Q., MCCAULEY, M., GAMBLE, T., HOSSEINIPOUR, M. C., KUMARASAMY, N., HAKIM, J. G., KUMWENDA, J., GRINSZTEJN, B., PILOTTO, J. H. S., GODBOLE, S. V., MEHENDALE, S., CHARIYALERTSAK, S., SANTOS, B. R., MAYER, K. H., HOFFMAN, I. F., ESHLEMAN, S. H., PIWOWAR-MANNING, E., WANG, L., MAKHEMA, J., MILLS, L. A., DE BRUYN, G., SANNE, I., ERON, J., GALLANT, J., HAVLIR, D., SWINDELLS, S., RIBAUDO, H., ELHARRAR, V., BURNS, D., TAHA, T. E., NIELSEN-SAINES, K., CELENTANO, D., ESSEX, M. & FLEMING, T. R. 2011. Prevention of HIV-1 Infection with Early Antiretroviral Therapy. *New England Journal of Medicine,* 0.

COMMITTEE, E.S. 2008. Informing scale-up and resource alloction: the use of economic analysis. *AIDS, 22, S5-S6 10.1097/01.ids.0000327617.93737.82.*

DANGERFIELD, B. C., FANG, Y. & ROBERTS, C. A. 2001. Model-based scenarios for the epidemiology of HIV/AIDS: the consequences of highly active antiretroviral therapy. *System Dynamics Review,* 17**,** 119-150.

ECONOMIST 2011. AIDS: The 30 years war. *The Economist (June 2, 2011).*

HECHT, R., BOLLINGER, L., STOVER, J., MCGREEVEY, W., MUHIB, F., MADAVO, C. E. & DE FERRANTI, D. 2009. Critical choices in financing the response to the global HIV/AIDS pandemic. *Health Aff (Millwood),* 28**,** 1591-605.

HOULIHAN, C. F., BLAND, R. M., MUTEVEDZI, P. C., LESSELLS, R. J., NDIRANGU, J., THULARE, H. & NEWELL, M.-L. 2011. Cohort Profile: Hlabisa HIV Treatment and Care Programme. *International Journal of Epidemiology,* 40**,** 318-326.

KUMARANAYAKE, L. 2008. The economics of scling up: cost estimation for HIV/AIDS interventions. *AIDS, 22, S23-S33 10.1097/01.aids.0000327620.47103.1d.*

LANCET EDITORIAL 2011. HIV treatment as prevention-it works. *The Lancet,* 377**,** 1719.

MCGREEVEY, W., AVILA, C. & PUNCHAK, M. 2011. Strengthening health systems for HIV/AIDS in sub-Saharan Africa: Preliminary note for Copenhagen Consensus Center. Copenhagen Consensus Center.

MOATTI, J. P., MARLINK, R., LUCHINI, S. & KAZATCHKINE, M. 2008. Universal access to HIV treatment in developing countries: going beyond the misinterpretations of the 'cost-effectiveness' algorythm. *AIDS, 22, S59-S66 10.1097/01.aids.0000327624.69974.41.*

OVER, M. 2010. Using Incentives to Prevent HIV Infections. *Center for Global Development Working Paper Series.* Washington, DC: Center for Global Development.

PEPFAR 2009a. The U.S. President's Emergency Plan for AIDS Relief: Five-Year Strategy, Annex: PEPFAR's Contributions to the Global Health Initiative (December 2009). Washington, DC: The U.S. President's Emergency Plan for AIDS Relief.

PEPFAR 2009b. The U.S. President's Emergency Plan for AIDS Relief: Five-Year Strategy, Executive Summary of PEPFAR's Strategy (December 2009). Washington, DC: The U.S. President's Emergency Plan for AIDS Relief.

PEPFAR. 2011. *Making a Difference: Funding (Updated February 2011)* [Online]. Available: http://www.pepfar.gov/press/80064.htm [Accessed March 21 2011].

SCHWARTLÄNDER, B., STOVER, J., HALLETT, T., ATUN, R., AVILA, C., GOUWS, E., BARTOS, M., GHYS, P. D., OPUNI, M., BARR, D., ALSALLAQ, R., BOLLINGER, L., DE FREITAS, M., GARNETT, G., HOLMES, C., LEGINS, K., PILLAY, Y., STANCIOLE, A. E., MCCLURE, C., HIRNSCHALL, G., LAGA, M. & PADIAN, N. 2011. Towards an improved investment approach for an effective response to HIV/AIDS. *The Lancet,* 377**,** 2031-2041.

SIDIBÉ, M. 2011. The 4th decade of AIDS: What is needed to reshape the response. *UN Chronicle,* Vol. XLVII No. 1, 2011 (15.05.2011).

STOVER, J., JOHNSON, P., HALLETT, T., MARSTON, M., BECQUET, R. & TIMAEUS, I. M. 2010a. The Spectrum projection package: improvements in estimating incidence by age and sex, mother-to-child transmission, HIV progression in children and double orphans. *Sexually Transmitted Infections,* 86**,** ii16-ii21.

STOVER, J., MCKINNON, R. & WINFREY, B. 2010b. Spectrum: a model platform for linking maternal and child survival interventions with AIDS, family planning and demographic projections. *International Journal of Epidemiology,* 39, i7-i10.

THE GLOBAL FUND 2011a. The Global Fund's Approach to Health Systems Strengthening (HSS): Information Note. Geneva, Switzerland: The Global Fund to Fight AIDS, Tuberculosis and Malaria.

THE GLOBAL FUND 2011b. Making a Difference: Global Fund Results Report 2011. Geneva, Switzerland: The Global Fund to Fight AIDS, Tuberculosis and Malaria.

U.S. GLOBAL HEALTH INITIATIVE. 2011a. *GHI: Building on and Expanding Existing Platforms* [Online]. U.S. Global Health Initiative. Available : http://www.ghi.gov/what/platforms/index.htm [Accessed 23 August 2011].

U.S. GLOBAL HEALTH INITIATIVE. 2011b. *The Plan* [Online]. U.S. Global Health Initiative. Available: http://www.ghi.gov/about/ghi/index.htm [Accessed 23 August 2011].

UN 2001. Declaration of Commitment on HIV/AIDS. New York: United Nations General Assembly Special Session on HIV/AIDS, 25-27 June 2001.

UN 2006. Declaration of Political Commitment on HIV/AIDS. New York: United Nations General Assembly High Level Meeting on HIV/AIDS, 31 May-2 June 2006.

UN 2010. Resolution 64/265: Prevention and control of non-communicable diseases. New York: United Nations General Assembly Sixty-Fourth, Agenda Item: 114, 20 May 2001.

UN 2011a. Panel 5: Integrating the AIDS response with broader health and development agendas, moderated by Laurie Garrett. New York: United Nations 2011 High Level Meeting on AIDS, 10 June 2011.

UN 2011b. Political declaration on HIV/AIDS: Intensifying our efforts to eliminate HIV/AIDS. New York: United Nations General Assembly High Level Meeting on HIV/AIDS, 8-10 June 2011.

UN 2011c. Report of the Secretary General: Prevention and control of non-communicable diseases, 19 May 2011. New York: United Nations General Assembly Sixty-Sixth Session, Item 119 of the preliminary list, 19-20 September 2011.

UNAIDS 2010. Getting to zero: 2011-2015 strategy Joint United Nations Programme on HIV/AIDS (UNAIDS). Geneva, Switzerland: Joint United Nations Programme on HIV/AIDS (UNAIDS).

UNAIDS 2011a. AIDS at 30: Nations at the crossroads. Geneva, Switzerland: Joint United Nations Programme on HIV/AIDS (UNAIDS).

UNAIDS. 2011b. *Spectrum/EPP 2011* [Online]. Joint United Nations Programme on HIV/AIDS (UNAIDS). Available: http://www.unaids.org/en/dataanalysis/tools/spectrumepp2011/ [Accessed 15 September 2011].

WALQUE, D. D., KAZIANGA, H. & OVER, M. 2011. Antiretroviral Therapy Awareness and Risky Sexual Behaviors: Evidence from Mozambique. *Center for Global Development Working Paper Series, Working Paper 239*. Washington, DC: Center for Global Development.

WHO 2010. Antiretroviral therapy for HIV infection in adults and adolescents: recommendations for a public health approach– 2010 rev. Geneva, Switzerland: World Health Organization.

WHO, UNAIDS & UNICEF 2010. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector: progress report 2010. Geneva, Switzerland: World Health Organization.

RethinkHIV RESEARCH PAPERS

Prevention of Sexual Transmission

Assessment Paper: Jere Behrman, Hans-Peter Kohler

Perspective Paper: Damien de Walque

Perspective Paper: Alan Whiteside

Prevention of Non-sexual Transmission

Assessment Paper: Lori Bollinger

Perspective Paper: Rob Baltussen, Jan Hontelez

Perspective Paper: Mira Johri

Treatment

Assessment Paper: Mead Over, Geoffrey Garnett

Perspective Paper: Robert J Brent

Perspective Paper: John Stover

Vaccine Research and Development

Assessment Paper: Dean Jamison, Robert Hecht, with Jared Augenstein, Gabrielle Partridge, and Kira Thorien

Perspective Paper: Steven S. Forsythe

Perspective Paper: Joshua Salomon

Social Policy

Assessment Paper: Anna Vassall, Michelle Remme, Charlotte Watts

Perspective Paper: Tony Barnett

Perspective Paper: Harounan Kazianga

Strengthening Health Systems

Assessment Paper: William McGreevey, with Carlos Avila, Mary Punchak

Perspective Paper: Till Bärnighausen, David E. Bloom, and Salal Humair

Perspective Paper: Nicoli Nattrass