RETHINKHIV

Assessment Paper

Social Policy: Going upstream

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COPENHAGEN CONSENSUS CENTER

RUSH

FUNDING DISRUPTIVE IDEAS AGAINST HIV

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

ISBN: 978-87-92795-14-4

Assessment Paper

Social Policy

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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.

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This version of the Assessment Paper was updated in October 2011, after the Georgetown University Conference.

The final version of this paper will be available in the forthcoming volume to be published by Cambridge University Press in 2012.

Introduction

The HIV/AIDS epidemic is now in its thirtieth year. Over the past decade remarkable progress in addressing the consequences of HIV has been made, with nearly 5 million people on antiretroviral treatment. However, prevention efforts have been less successful: globally there are approximately 7,000 infections daily, with the numbers of newly infected outnumbering those newly being put on treatment. Sub-Saharan Africa continues to bear the brunt of the HIV epidemic, with HIV prevalence rates of up to 26% in some countries (UNAIDS, 2010a). Despite these challenges, there are also marked successes, with declines in rates of new HIV infections in many regions globally, including in sub-Saharan Africa. These declines are likely to be the result of large scale HIV prevention efforts, as well as more fundamental changes in sexual behaviour that have evolved as communities respond to the realities of the HIV epidemic and the toll that it is taking.

In sub-Saharan Africa HIV transmission is largely heterosexual, although the role of transmission among men who have sex with men, and among injecting drug users, is also starting to be acknowledged. Established responses to addressing the heterosexual transmission of HIV include behavioural change communication programmes, interventions focused on key at risk populations (such as sex workers and their clients), male circumcision, HIV testing and counselling, condom promotion and the treatment of sexually transmitted infections. Some of these interventions have been considered in other RethinkHIV papers, and are likely to remain central to a comprehensive HIV response. Although the RethinkHIV exercise focuses on sub-Saharan Africa in its entirety, the epidemic varies considerably by setting. In practise the optimal mix of interventions implemented in any setting will vary, and be influenced by the extent to which, at a population level, HIV infection is largely concentrated amongst vulnerable groups such as sex workers, men who have sex with men or injecting drug users (a concentrated HIV epidemic), or more widely generalised in the population (a generalised HIV epidemic).

Over the past decade the HIV prevention landscape has continued to advance. Trial findings showing that male circumcision is protective against HIV infection has led to the widespread scale up of male circumcision in generalised HIV epidemic settings. With recent scientific evidence showing that the early provision of antiretroviral treatment significantly impacts on HIV transmission, the boundaries between HIV treatment and prevention have also become less distinct. Indeed, following the launch of new findings at the Rome International AIDS Conference in July 2011, there is now widespread discussion about the immense promise that anti-retroviral based HIV prevention programming. This includes ART based topical microbicides for women, the early provision of ART treatment for those identified as being HIV infected, and the daily, oral prophylaxis use of ARTs for prevention. Trials to assess the potential impact of a slow release, ART vaginal ring, are also underway.

However, when we review priorities for future HIV/AIDS investment in sub-Saharan Africa, it is important to be sanguine about the challenges. Economic and social factors continue to fuel HIV risk behaviours and undermine proven HIV interventions. Although condoms are highly effective at preventing HIV transmission, women still have very limited options to protect themselves from HIV. Stigma and the fear of the repercussions of finding out one's HIV status make many people reluctant to get tested, so although HIV testing is the cornerstone of all ART based interventions, many fear the social consequences of being diagnosed HIV positive. Weak health systems and cost and capacity constraints continue to make the large scale ongoing delivery of HIV testing and antiretroviral use for both prevention and treatment challenging to scale up and sustain.

Given these challenges above, this paper presents an analysis of the costs and benefits of interventions that seek to address some of underlying social drivers of HIV vulnerability, and the social barriers to achieving a high coverage to proven HIV interventions. Specifically, we consider interventions to address the following four social drivers of HIV vulnerability:

1. Widespread problematic alcohol use that helps fuel men's and women's engagement in risky sexual behaviours, and undermines core HIV prevention messaging. A systematic review of 20 African studies finds that alcohol drinkers had 57% to 70% greater risk of HIV infection than non-drinkers (Fisher et al., 2007).
2. Transactional sex between young girls and older men, that provides one of the main bridges of HIV infection from older sexually active cohorts into uninfected newly sexually active adolescent cohorts. Current HIV prevalence data, for example, shows that eight fold more girls than boys are HIV infected before age 24 in some sub-Saharan African settings (UNAIDS, 2010).
3. Established social norms about gender roles and behaviours, including norms about masculinity that condone multiple sexual partnerships amongst men and permit some forms of domestic violence. These limit women's ability to negotiate or influence the circumstances of sex or address violence in their lives. For example, in South Africa women in violent relationships are at 34% higher risk of incident HIV infection than other women (Jewkes et al., 2010).
4. Stigma and discrimination towards people infected with or affected by HIV, limiting their ability to access or benefit from HIV services, or ensure that HIV programmes and policies are responsive to their needs (Nyblade, 2004; Schwartländer et al. 2011). The active involvement of those most vulnerable to HIV is central to an effective HIV response, with a study in Kenya finding four times higher levels of condom use in communities with strong community mobilization and involvement (Schwartländer et al. 2011).

Aims of analysis and description of policy interventions

Main aims

Our central hypothesis is that there are important social policy interventions that could have significant long-term impact on the HIV epidemic at a comparatively low cost, and that are likely to have both HIV and development related benefits. The focus of these upstream interventions (structural interventions) in particular is on changing the circumstances in which risk behaviours occur. Governments, academia and international development agencies have started to highlight several structural interventions that have the potential to mitigate some of the structural HIV risks through economic empowerment, social protection, financial incentives and transformative processes. (Blankenship et al., 2006; Gupta et al., 2008; Kim et al., 2011; Kim et al., 2008; Padian et al., 2011; Temin, 2010; Cohen et al., 2004).

Drawing upon the growing literature on this issue, detailed analyses that have fed into a global investment plan for HIV (Schwartländer et al. 2011), and the results from several relatively recent intervention studies conducted in sub-Saharan Africa, this paper estimates the costs and benefits of the following 4 interventions:

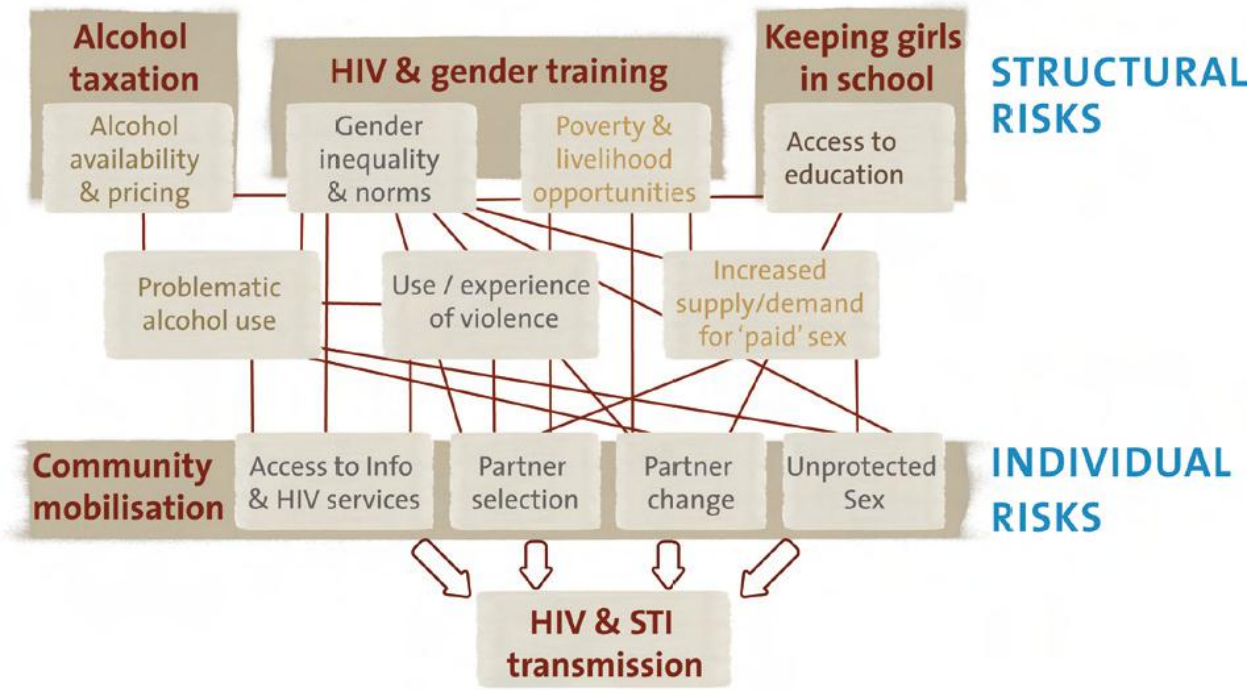
- **Increasing alcohol taxes**, to reduce population levels of problematic alcohol use, with the aim of reducing levels of risky sexual behaviour, in addition other health benefits and

raising tax revenue.

- **Keeping girls in secondary school**, through the use of conditional cash transfers, with the aim of impacting on levels of transactional sex between adolescent girls and older men, as well as generating broader educational related development benefits
- **Adding participatory gender and HIV training to existing microfinance and livelihood programmes** with women and/or men, with the aim of ensuring that the potential synergies between poverty alleviation, gender equity and HIV prevention programmes are effectively realised and lead to reductions in levels of domestic violence against women.
- **Investing in community mobilisation and stigma reduction**, involving those who are most vulnerable to or affected by HIV, to reduce community stigma and discrimination, and support communities to negotiate safer sexual behaviours and access services, including HIV testing and ART.

Figure 1 shows their hypothesized relationship to the more proximal, individual determinants of HIV risk.

Figure 1: Hypothesised relationship between social factors being considered and HIV risk



Rationale for selection of interventions

The interventions were selected following a detailed review of the literature and consultations with HIV experts. As a first step, our review sought to identify the areas of social policy that had the most potential to impact the HIV epidemic. Subsequently, once we had identified the forms of social policy intervention to focus on, we conducted a more detailed literature review of each focal intervention area, to identify the variables to use in our modelling analyses.

The initial round of reviews identified an emerging body of literature on the importance of structural

and social policy interventions, and helped us to map out key dimensions of HIV vulnerability and intervention options. This literature highlighted a consistent, albeit short, list of possible intervention options, with varying levels of evidence about their effectiveness in reducing high-risk sexual behaviours and impacting on the incidence of HIV.

The first area identified was a group of recent innovative experiments using financial incentives to motivate safe sexual behaviours for HIV prevention have received considerable attention. For example, based on the hypothesis that economic instability and poverty drive risk behaviour, conditional cash transfers (CCT) are being provided to adolescent girls to stay in school and to both men and women for remaining STI or HIV-negative in Malawi and Tanzania (Baird et al. 2010; Kohler & Thornton, 2010).

Legislative reform and community focused interventions to reduce HIV related stigma and discrimination and enhance social capital also emerged as being critical to ensuring that communities are able to access and benefit from HIV related services (Schwartländer et al., 2011). We identified a body of literature describing programmatic experience on how to reduce HIV stigma and mobilise communities to generate positive social capital, reduce stigma and discrimination and transform norms around sexual behaviour, and strong examples of situations where widespread shifts in the patterns of sexual behaviour have occurred (Blankenship et al., 2006; Gupta et al., 2008).

We also identified several publications and policy literature describing the importance of social protection policies, to mitigate the impact of HIV on those affected by HIV and AIDS, including households with HIV infected members, orphans and vulnerable children, and elderly caregivers. Although the importance of these policies for reducing future vulnerability to HIV infection was stressed, we found relatively limited data on the likely scale of these impacts (Adato & Bassett, 2009). However, in addition, we found an emerging body of evidence on the impact of different forms of participatory interventions that seek to promote gender-equitable relationships, and reduce levels of physical and sexual violence in relationships, built on the back of broader social protection efforts. In particular, we identified two rigorously conducted cluster randomised controlled intervention trials from South Africa, that demonstrated significant impacts on levels of domestic violence and HIV related risk (Pronyk et al 2004, Jewkes et al 2005).

Although less discussed in the field of structural HIV interventions, there was also a large body of literature focusing on the issue of problematic alcohol use, and potential intervention options. This included detailed reviews of the effectiveness and cost-effectiveness of interventions aimed at reducing the harm caused by alcohol, that considered action in the areas of education and information, the health sector, community action, drink-driving, availability, marketing, pricing, harm reduction, and illegally and informally produced alcohol. This literature, much of which came from outside the field of HIV, included both empirical evaluation studies as well as economic modelling analyses.

From this initial scoping exercise above, cost and outcome data from a limited number of evaluation studies and reviews were repeatedly cited in the literature. These included the results from a randomised controlled trial to assess the impact of a conditional cash transfer intervention to keep girls in school in Malawi, that showed a significant impact on HIV prevalence; and the results from a cluster randomised controlled trial of an enhanced microfinance, HIV and gender training intervention in rural South Africa, that had significant impacts on women's experience of domestic

violence. We also drew upon reviews and secondary analyses of data that explored the effects of adding community mobilisation intervention components to ongoing HIV programmes in India, South Africa, and Tanzania; and meta-analyses that concluded that policies to make alcohol more expensive and less available are highly cost-effective strategies to reduce harmful alcohol use (Anderson et al., 2009), which led us to focus on the intervention of increased alcohol taxation.

As this is an emerging field of work, these studies strongly influenced our choice of social intervention options, as they provided sources of empirical data that could be used in this quantitative modelling analysis. Unfortunately, given the relatively limited body of empirical data that we were able to draw upon, we were not able to also explore the potential merits of different intervention approaches to each social driver – such as, different approaches to keeping adolescent girls in school, or to reducing levels of domestic violence. However, when going through the process of selection we tried to be strategic in our choices, aiming to identify important but relatively neglected opportunities that could be used to help rethink the HIV prevention landscape, to help ensure that future HIV responses more comprehensively respond to the social drivers of HIV infection. It should be noted, for example, that the opportunity and potential scope of benefits associated with each form of intervention considered differs widely:

- Alcohol taxation has the potential to have widespread effect on levels of problematic alcohol use at very low cost;
- Investments to keep girls in secondary school have the potential to not only impact on HIV, but also have multiple important development gains;
- The addition of participatory HIV and gender training to livelihoods programmes adds value to large scale investments and initiatives to reduce poverty and achieve the Millennium Development Goals (MDGs) at potentially low incremental cost; and
- Investment in community mobilisation and stigma reduction will help ensure that communities and those most vulnerable to HIV infection are able to benefit from investments in core HIV programming and service provision, and ensure that these services are responsive to their needs.

It was therefore felt that broadly, this selection of interventions would provide a good illustration of the range of potential interventions possible.

In summary, given the relative infancy of this field, the main purpose our section and subsequent analysis is to explore the potential importance of different forms of social policy interventions to impact HIV, by examining a set of illustrative interventions, based on where the evidence currently exists. For this reason, our conclusions should be seen as exploratory, rather than providing definitive conclusions on the economically optimal mix of social interventions possible.

Evidence on effectiveness, cost-effectiveness and cost benefit analysis of each intervention

Reduced problematic alcohol use through increased taxation

There is consistent evidence that alcohol consumption, and in particular problematic alcohol use, is

associated with higher HIV prevalence, unprotected sex and poor medication adherence, as well as biological factors that may synergistically increase HIV acquisition and onward transmission (Hahn et al., 2011). This association is substantiated in sub-Saharan Africa, where a systematic review found that drinkers had 57%-70% greater chance of being HIV positive than non drinkers in bivariate and multivariate analyses, controlling for confounders (Fisher et al., 2007).

However, as much of the data on association between alcohol and HIV comes from cross-sectional data, it has proven more difficult to establish causality (Cook & Clark, 2005, Kalichman et al. 2007, Fisher et al., 2007), with some suggesting that any association reported could be due to confounding. In particular, it has been argued that personality types could lead to an association between alcohol and HIV, with people who naturally have sensation/risk-seeking tendencies being more prone to both excessive alcohol consumption and risky sexual behaviour (Rashad & Kaestner, 2004, Kalichman et al. 2008, Shuper et al., 2010).

Stronger evidence of causality may be obtained from prospective longitudinal data that demonstrates that problematic alcohol consumption precedes HIV risk behaviours or infection, and from experimental studies, that show that reductions (or increases) in alcohol use do in turn lead to reductions (or increases) in HIV risk (Leigh & Stall, 1993, Halpern-Felsher et al., 1996, Weinhardt & Cary, 2008, Woolf-King & Maisto, 2011). Moreover, evidence of a plausible causal pathway, and of a dose-response relationship (so that those who drink more are at greater HIV risk than those who only drink a little) are also important criteria used to establish causality (Shuper et al., 2010). There is good evidence of a dose-response relationship, with heavy or symptomatic drinkers having higher odds of HIV infection than less heavy drinkers (Fisher et al., 2007). This is supported by a coherent theoretical pathway that has also been empirically established, with evidence of the direct pharmacological and psychological dis-inhibitory behavioural impact of alcohol consumption (Crowe & George, 1989, Steele & Josephs, 1990).

There is also some data suggesting that alcohol consumption (the cause) does indeed precede risky sex and HIV incidence (the effect). For example, Baliunas et al. (2009) reviewed African studies with incident HIV as an outcome, thereby making temporality a precondition for inclusion. This study found that those who drank before or during sexual intercourse were at an 87% increased risk for HIV infection. However, event-level methods that analyse diary entries and control for personality factors tend to show more equivocal results (Weinhardt & Carey, 2000, Woolf-King & Maisto, 2011).

Lastly, a causal relationship is supported by the evidence from the US that changes in the cause leads to changes in effects – in this case, that interventions that impact on alcohol use do lead to reductions in HIV or other sexually transmitted infections (Shuper et al., 2010). In particular, Chesson et al. (2000) presents evidence from the United States indicating that rates of sexually transmitted diseases (STDs) were responsive to alcohol regulation, with a beer tax increase of $0.20 per six-pack (accompanied by similar increases in wine and liquor taxes) being associated with an 8.9% reduction in gonorrhoea and a 32.7% reduction in syphilis.

Given these findings, a potentially important but untapped area of intervention for HIV are efforts to reduce problematic alcohol use. Despite the evidence from industrialised countries that shows that pricing and taxation policies can have a significant impact on problematic alcohol use, these forms of intervention have not been considered in SSA for HIV prevention. To date, evaluation studies of

interventions that seek to directly influence the behaviours of drinkers or providers in sub-Saharan Africa do not appear promising, with trials of educational interventions targeted at drinkers through drinking establishments having no effect at all in Zimbabwe (Fritz et al., 2011) and weak and non-durable effects on the heaviest drinkers in South Africa (Kalichman et al., 2008).

In contrast structural interventions, such as regulating the availability, price and advertising of alcohol seem to have potential. Indeed, a detailed analysis by World Health Organisation (WHO) concluded that regulating financial accessibility to alcohol through taxation can be a highly cost-effective policy intervention (Chisholm et al., 2004; WHO, 2005). Later work also highlights the potential of taxation to have a strong impact on problematic drinking in the longer rather than shorter run, and to delay the start of drinking and finally to prolong the progression of young people towards drinking larger amounts (Anderson et al., 2008). Overall, in Africa sub-region E[1], Chisholm et al. find that the health effect of taxation was high, with 1,506 to 1,688 DALYs averted per 1 million people and thus cost-effectiveness also high at $87 to $97 per DALY averted. A cost-effectiveness analysis of HIV prevention interventions in the United States concluded that alcohol taxation was one of the most cost-effective and under-utilised interventions, with an estimated cost-effectiveness ratio of $1,500 per infection averted (Cohen et al., 2004).

Global cost-effectiveness analysis found that such interventions led to a greater averted disease burden in the male population, as approximately two thirds of the total population-level health gain from interventions was among men (Chisholm et al., 2004). Importantly for our analysis, only the direct effects of alcohol use on morbidity and mortality were taken into account. If HIV infections averted were considered, the cost per DALY averted may have been even lower, particularly in sub-region E, which also happens to include some of the countries with the highest HIV related adult mortality rates.

In addition to cost-effectiveness evidence, negative externalities of hazardous alcohol use represent a market failure, which is a central justification for government intervention. Excise taxes are levied on so-called 'sin' goods, such as alcohol, are therefore set to reflect external costs associated with hazardous consumption. Moreover, the relative ease of taxing alcoholic drinks and the inelastic demand for them in most developing countries, make excise taxes a popular source of tax revenue. A recent study has found that in Europe, alcohol excises are typically set too low, since the external costs far exceed the effective excise level (Cnossen, 2006). A related analysis in South Africa compared alcohol-related excise and VAT revenues to public spending to deal with the consequences of alcohol abuse and conservatively estimated shortfall of 1.1 billion ZAR (about USD 138 million) (Budlender, 2009). Another study in South Africa estimated the economic costs of problem drinking to be in excess of $1.7 billion per year (2% of GNP), roughly three times the amount of revenue generated by excise taxes (Parry, 2000). Thus, there appears to be scope for increasing these excises to better reflect actual external costs in SSA (Volkerink, 2009).

However, health, revenues and economic impact is likely to be strongly influenced by current high

[1] WHO's Global Burden of Disease Africa sub-region E includes the following countries: Côte d'Ivoire, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe

levels of unrecorded consumption, and the ability to substitute taxed for untaxed alcohol consumption (which may also be toxic) in SSA. With a widespread availability of substitutes, in some countries there may be a heightened 'Laffer curve' effect, where at high prices, overall tax revenues may fall, as consumers switch to unregulated sources of alcohol. Moreover, the global analysis described above also found that in Africa sub-region D[2], taxation had a limited effect on hazardous alcohol consumption, with 64 to 99 DALYs averted per 1 million population, and that this was largely due to high current levels of unrecorded consumption. The concomitant cost effectiveness ratios ranged from $1,719 to $2,662 per DALY averted, which can only be considered cost-effective in a limited number of African countries. (Chisholm et al., 2004).

Studies from Tanzania and Kenya find a high degree of substitutability within the beverage industry (Osoro et al., 2001; Okello, 2001). In Tanzania, a 1% increase in the price of commercial beer is accompanied by a 2.7% increase in the quantity of local brew demanded. Although this does indicate high cross price elasticity of demand between beverages, a shift to the local brews, may represent shifting to beverages with lower alcohol content. The health risks of substitution will occur in countries where there is a more significant supply of home-made spirits and adulterated industrial alcohol, although there is only anecdotal evidence of the severity of such cases, and little data available. Moreover, current trends in alcohol consumption suggest that in sub-Saharan Africa there is a distinct shift away from traditional home-brews to market beers, with the consumption of market beers being associated with a higher social status (Parry et al, 2005; Bird & Wallace, 2010). This may mitigate this substitution effect.

A number of analysts have also explored where different African countries lie on this so-called Laffer curve for excise taxation, in order to determine whether there is still scope to increase excise rates, without reducing tax yields. Studies in Tanzania and Kenya find inelastic price elasticities of demand for most alcoholic beverages considered, particularly beer (with the exception of Guinness in Kenya). Higher excise rates on these goods would therefore be expected to optimise tax revenue. According to the study in Tanzania and simulations based on its findings in other SSA countries, the revenue-maximising tax rate has not yet been reached (Bird & Wallace, 2010). Data from Kenya, however, suggests that taxes on market beer were along the downward slope of the Laffer curve and would need to be reduced to 62.5% in order to optimise tax revenue (Karingi et al., 2001). The different situations in Kenya and Tanzania in part are likely to reflect (or may cause, differing levels of unrecorded consumption, at 60% and 30% respectively.

Work by Anderson et al., (2008) suggests several potential interventions for countries with high levels of unrecorded consumption, such as tax enforcement. These were found to be highly cost-effective, although the analysis only covers the Americas, Europe and western Pacific regions. Others point to the possibilities of differential pricing of more alcohol beverages (Bird & Wallace, 2010). However, while acknowledging the potential of these additional interventions, where unrecorded consumption and substitution may be issues, some economists remain sceptical about their feasibility of implementing them in some African contexts (Bird & Wallace, 2010).

Finally, it is important to consider the distributive effects of any taxation. In general, evidence

[2] WHO's Global Burden of Disease Africa sub-region D includes the following countries: Angola, Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Mauritius, Niger, Nigeria, Senegal, Sierra Leone, Togo

suggests that lower-income urban individuals are likely to be bare a relatively larger share of the tax burden, making such taxes regressive (Bird & Wallace, 2010). However, the more heavy drinkers within this group are disproportionately affected and they appear the apparent relationship between socioeconomic status and an increased risk of alcohol-related problems suggests that lower-income persons suffer more from alcohol problems and their consequences (Parry et al., 2005). By inference, although the poor will bear more of the costs, they are also likely to reap a larger share of the benefits of reduced problem drinking, that may neutralises the regressive nature of increased alcohol taxes. Nevertheless, the distributional aspect of alcohol taxation needs to be considered, and particular care needs to be taken to mitigate any higher levels of substitution in lower income groups.

Keeping girls in school using conditional cash transfers

The primary constraint to female school attendance in sub-Saharan Africa is the high cost of schooling, including school fees, uniforms and text books (Pettifor et al., 2008). Young women are also more often taken out of school to contribute financially to the household or care for siblings and sick family members. Successful interventions to address these economic barriers would need to reduce the financial cost of schooling, as well as the opportunity costs to households. Such interventions have been implemented, including waiving secondary school fees for girls, providing free uniforms and other supplies, or introducing unconditional cash transfers for the poorest households, resulting in increased enrolment, reduced drop-out rates and even reduced marriage and pregnancy rates among girls in certain cases (Adato & Bassett, 2009; Duflo et al., 2006; Hallfors et al., 2011).

Proven successful in Latin America, conditional cash transfers are also being experimented with in sub-Saharan Africa as a demand-side intervention to reduce the opportunity costs to parents of sending girls to school. By virtue of their conditionality, such transfers directly compensate households for these opportunity costs and increase the "price" of risky sex for schoolgirls, as pregnancy could lead to school expulsion and loss of the cash transfer. This partially serves to counter the effect of time discounting, by bringing the rewards of risk reduction closer to the present, rather than avoiding AIDS many years in the future. The income effect also appears to have a more direct impact on sexual behaviour by reducing the girls' reliance on age-disparate relationships for economic support (Baird et al., 2010a).

A conditional cash transfer (CCT) intervention in Malawi paid girls to stay in school and resulted in girls in the cash group being 60% less likely to be HIV infected after 18 months, with the effect being attributed to reductions in transactional sex with older men. Importantly, there was no difference in effects between girls receiving conditional and non-conditional grants. However, there was a dose response effect with payment size, suggesting that poverty was an important motivation for transactional sex, and that the impact on HIV incidence was achieved through the reduction in poverty. Baird et al (2010b) calculate a cost per HIV infection averted through the conditional cash transfer scheme in Malawi of US$ 3,750.

In terms of the use of CCT to prevent HIV through other pathways (with less evidence), a randomised trial in Tanzania suggested that men and women receiving financial incentives had a 25% lower incidence of STIs than controls, while another scheme in Malawi that paid men and women to

maintain their HIV-negative status for 1 year, noted no effect (Kohler & Thornton, 2010). Given that these are preliminary results, we focus on the more promising CCT to keep girls in school, which is also supported by evidence on gender income inequality being a structural driver. For example, a cost-benefit analysis of female secondary education in Tanzania concluded that the net benefit of investing in keeping girls in secondary school was between 1.3 and 2.9, based on HIV infections averted and increased earnings (Brent, 2009). Similarly, a study in Uganda found that there were substantial additional returns to schooling through its effects on HIV prevention in particular. The labour market rate of return to education alone was estimated at 10.23%, while the additional rate of return from reduced HIV prevalence was found to be between 1.31% and 3.51% (De Walque, 2002).

Finally, it should also be noted that in a 2008 Copenhagen Consensus Challenge paper, female education through conditional cash transfers was proposed as a key intervention for promoting women's empowerment and gender equality more broadly. It found a net benefit ranging from 3.0 to 26.1, which did not incorporate any HIV benefit (King et al. 2007).

Adding gender and HIV training onto livelihood programmes

A range of interventions have been implemented to promote women's economic empowerment in sub-Saharan Africa and thereby potentially trigger a positive income effect on HIV (Blankenship et al., 2006; Kim et al., 2008). However, although microfinance, agricultural extension and subsidised agricultural inputs have had positive effects on poverty and food security, unfortunately we found no evidence that these interventions alone have influenced sexual behaviour and HIV transmission (Davis et al., 2010; Denning et al., 2009; Pronyk, Hargreaves & Morduch, 2007).

The best documented intervention in SSA, which sought to combine an economic empowerment component with an HIV prevention component, is the Intervention with Microfinance for AIDS and Gender Equity (IMAGE) in South Africa. IMAGE added a ten session participatory training curricular onto existing microfinance activities, with the sessions being conducted prior to the microfinance loan group meetings.

This combined approach significantly reduced levels of intimate partner violence and improved household wellbeing, social capital and gender equity (Pronyk et al 2004; Kim et al., 2009). Younger participants also reported reduced HIV risk behaviours, and an increased uptake of HIV testing. In contrast to stand-alone HIV or gender training intervention, IMAGE was able to access and maintain a sustained contact with intervention participants for over a year, thanks to its concurrent concern for addressing the immediate economic priorities of participants. Moreover, detailed analyses of the findings suggest that the impacts achieved were primarily as a result of the combined benefits of the micro-finance and training components of the intervention. This illustrates how such livelihood programmes provide a critical opportunity to add further gender and HIV related intervention activities, which are able to engage with participants over an extended period of time (Kim et al., 2009).

The benefits associated with engaging, in a participatory and ongoing manner, is also supported by the findings from a somewhat similar gender training programme, Stepping Stones. Stepping Stones has been implemented in over 40 countries since the mid-nineties, targeting both men and women, as a 50-hour participatory HIV prevention stand-alone programme that aims to improve sexual health

through building more equitable gender relationships. A randomised controlled trial of this intervention showed significant impacts on herpes (HSV-2) over two years (Jewkes et al., 2008), as well as significant reductions in the reported levels of intimate partner violence perpetrated by men. In this case, where women had received the gender training, but there had been no economic component, the intervention did not impact significantly on their experience of partner violence.

Given the complex relationship between income and HIV incidence and the lack of evidence on the impact of economic empowerment and livelihood interventions alone on sexual behaviour and HIV transmission, we build our analysis upon the IMAGE model in South Africa, drawing also from the impact findings for Stepping Stones with men. In detail, the microfinance component of the IMAGE intervention identified women above 18 years and living in the poorest households as eligible loan recipients and control participants. Loan centres of about 40 women met fortnightly to repay loans, apply for additional credit and discuss business plans. These meetings served as avenues for introducing the Sister-for-Life participatory learning programme to address HIV infection and intimate partner violence (Kim et al. 2007). In a first phase, ten 1-hour training sessions were conducted, covering topics such as gender roles, communication, domestic violence and HIV infection. In the second phase, women recognised as "natural leaders" by their peers undertook another week of training and then worked with their centres to address priority issues, through wider community mobilisation engaging both youths and men in the intervention communities. The training curriculum was delivered alongside microfinance services over a 12-month period (Kim et al. 2007).

We therefore model combining 'piggy-backing' training focusing on HIV and gender relationships onto livelihood interventions that have an income effect, considering both the addition of the training to women (as in IMAGE) and with men (extrapolating from Stepping Stones about the benefits of working with men). For men, the underlying assumption is that the livelihoods activity provides a framework within which issues of gender and HIV can be explored, and that the combination of reduced household economic stress and gender training will impact on their perpetration of intimate partner violence. For women, our assumption in this approach is that a livelihood intervention that increases women's income can be expected to have a similar impact on intimate partner violence (IPV) as the IMAGE intervention, if administered with a gender and HIV training curriculum.

As with keeping girls in school, it should be noted that more broadly livelihood interventions have also shown to have multiple economic benefits. Although there is relatively limited data specific to Africa, impact assessments of microfinance schemes in Uganda and South Africa have found an enhanced household capacity to meet basic needs (including food) and to accumulate valuable assets (Barnes et al., 2001; Kim et al., 2009). Other successful income generating models in SSA are largely agriculture-based, as more often than not agriculture represents the mainstay of the economy and rural livelihoods. Low yields and high food prices over the past few years have further exacerbated food insecurity and left 239 million people undernourished (FAO, 2010). Limited access to improved agriculture technologies, inputs, credit and extension are the key barriers to a Green Revolution in Africa (Denning et al., 2009) and women are particularly disadvantaged.

The Farmer Field School (FFS) is an innovative, participatory and interactive agricultural extension model, initiated in Asia and subsequently replicated across the world (Braun et al., 2006). Based on hands-on farmer experimentation sessions and non-formal training (Anandajayasekeram et al. 2007), the approach has expanded its crops focus to include a wide range of topics such as livestock, community forestry, water conservation, food security, health and HIV. An impact evaluation

conducted in Kenya, Uganda and Tanzania revealed a 61% increase in agricultural income and a more substantial impact among female-headed households (187%), compared to a non-participating control group.

Agricultural productivity in SSA is being further compromised by poor access by smallholder farmers to improved seed and fertiliser, in tandem with declining soil fertility. Based on this reality, there has been a return to government subsidies as an effective policy instrument for promoting food security, as evidenced by Malawi's internationally acclaimed Farm Input Subsidy Programme, which has transformed Malawi from a net importer to a net exporter of maize (Dorward & Chirwa 2011; Sanchez et al. 2007). Based on the same principles, NGOs have also been providing agricultural inputs to beneficiaries, as part of integrated rural livelihood programmes, such as the Millennium Village Project (MVP) (Sanchez et al., 2007). In Kenya, Ethiopia and Malawi, each household in the Millennium Villages received improved seed (primarily for maize) and fertiliser inputs for a typical smallholder farm size, as well as complementary extension training. In Kenya, the Sauri village experienced a 3.9 fold increase in maize production, enabling the village to satisfy 166% of its food needs from own production, compared to 43% before the intervention (Denning et al., 2009). Similarly, this so-called caloric food requirement index went from 0.13 to 1.10 in Ethiopia, and from 0.56 to 8.46 in Malawi (Sanchez et al., 2007).

The training component of the IMAGE programme was found to have an estimated cost per DALY gained of US$8,764 (2010) for the trial phase and US$2,630 (2010) for the initial scale-up phase – but this only took into account DALY gain from reductions in intimate partner violence. Studies of the underlying economic interventions, such as the Millennium Village Project, found a benefit-cost ratio of between 2.3 and 3.5 in just six to nine months (Denning et al., 2009), while the external evaluation of Malawi's 2006–2007 farm input subsidy programme estimated a modest benefit-cost ratio of 0.76 to 1.36 in terms of increased maize yields (Dorward & Chirwa, 2011), excluding indirect benefits accrued through improved food security, health or education outcomes.

Community mobilisation and stigma reduction

Although still somewhat ill-defined, there is growing evidence that community mobilisation and stigma reduction can be enablers of other core HIV prevention interventions. Effective programmes need to be conducted in partnership with the communities in which interventions are being implemented, and engage with those most affected by HIV. Indeed intervention delivery is highly dependent upon the support and involvement of community members and volunteers, and without these forms of partnership services may struggle to reach key populations. For these reasons community engagement and mobilisation activities, aimed at creating a supportive, enabling and empowering environment are recognized by UNAIDS as an essential component of all HIV programmes (Schwartländer et al., 2011). In addition, these forms of activity can support changes in community norms, that can change the environmental context in which people make decisions related to HIV risk (Khumalo-Sakutukwa et al., 2008).

Current evidence points towards this enabling virtue, particularly for interventions targeting youths and delivered through existing community-based organisations or centres that have been found to have more positive results (Maticka-Tyndale & Brouillard-Coylea, 2006). Moreover, a study in Kenya found that individuals were four times more likely to report consistent condom use if living in areas

with good engagement of CBOs (Schwartländer et al., 2011). Furthermore, a multi-country study in Tanzania, Zimbabwe and South Africa reported a four-fold increased uptake of voluntary counselling and testing (VCT), when provided at the community-level, compared to facility-based VCT provision (Khumalo-Sakutukwa et al., 2008). Another study in Ghana found a significant negative interaction between risky sexual behaviours and community stigma (Adjusted odds ratio (AOR) = 0.44; 95% confidence intervals = 0.19-0.67), indicating that the generally positive effect of risky sex on HIV testing is attenuated among women from communities with high levels of stigma (Koku, 2011).

A review of the literature on stigma and HIV/AIDS by Mahajan et al. (2008) quotes studies from South Africa, China and France, which reported increased unsafe sex and non-disclosure among PLHIV holding stigmatising attitudes or experiencing HIV-related discrimination. Results from interventions to reduce stigma through community-, work- and group-based approaches with information, peer education and counselling activities in Uganda, Tanzania and Zimbabwe documented increased HIV/AIDS knowledge and awareness, reported desire to change behaviour, better coping skills for PLHIV, reduced stigma and discrimination of PLHIV, empowered to negotiate safe sex and increased demand for condoms and VCT (Brown et al., 2003). Hence, it is concluded that community mobilisation intervention with a stigma reduction component can increase the uptake of VCT, adherence to ART and help prevent mother-to-child-transmission, as well as the effective targeting of social support to the most affected (Mahajan et al., 2008; Temin, 2010).

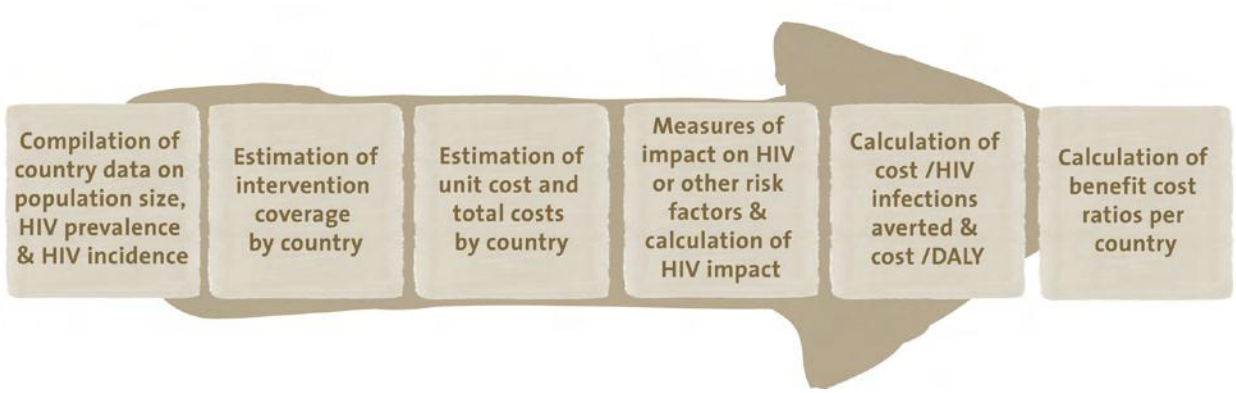
Finally, the International HIV/AIDS Alliance piloted the participatory Social Return On Investment (SROI) methodology to determine the value for money of its community mobilisation support in India and Zambia, as perceived and monetised by the beneficiaries themselves. The SROI study of the CHAHA programme in the Maharashtra and Andhra Pradesh states in India, reported that for every US$ 1 invested, an additional US$ 4 were generated in social, health and financial value. This programme targeted 64,000 children affected by HIV/AIDS through its outreach workers with nutritional, psycho-social, educational and household support. It aimed to create an enabling environment through community mobilisation in all settings (health, social and legal) for stigma reduction. Most of the value created by the intervention was related to improved livelihoods (income), resulting from the decrease in stigma experienced by HIV-positive parents or caregivers, encouraging them to seek paid employment. The outcome area in which the second largest value was created according to stakeholders was improved health status, largely through improved child nutrition, which avoided considerable costs of travel, health support and medicine (Biswas et al. 2010). A SROI study in Zambia also estimated similar benefits (International HIV/AIDS Alliance, 2011).

Methodology

We present here both cost-effectiveness and cost–benefit analyses of the four interventions identified above based on the guidelines issued by RethinkHIV. To estimate cost-effectiveness, for each intervention option we calculate the incremental cost per Disability Adjusted Life Year (DALYs) – which gives a measure that reflects the health related benefits of each intervention considered. To conduct cost-benefit analysis, which evaluates the cost of an intervention relative to monetised outcomes, we represent both the health benefit in terms of monetised DALYs, additional economic benefits for those who are targeted by the intervention, and, in a very few cases, benefits from positive externalities associated with the intervention.

The time period for our analysis is the five year period in which the intervention is carried out for the costs, with any benefits that derived from the five year investment that accrued up until the target group dies included (although in some cases we only describe potential longer term benefits as the data was not available to quantify them). Our broad approach can be seen in Figure 2.

Figure 2: Steps in analysis



It is important to note that for this analysis, wherever possible, we took a country by country approach, and disaggregated population related data by sex. We only generalised across countries when there was no other option. We sought to incorporate this level as detail, as we recognise that a range of contextual factors will influence the relative benefit-cost ratios obtained. As well as there being substantial variability in the levels and distribution of HIV infection between countries in sub-Saharan Africa, there is also substantial variation in the size of the different sub-populations being targeted by each intervention, the costs of each intervention and the degree to which the intervention is effective, both in the short and long term. While data constraints made it difficult to incorporate all these factors – we attempted to ensure our calculations were made and presented on a country by country basis, as can be seen in the Appendix to this report.

From the outset we recognised that our approach is limited in many ways. As well as the challenges of parameterisation, in our modelling we focus on estimating the provider costs and the impacts on recipients of these specific interventions. This is a gross over-simplification of the potential value of social policy interventions, as using this perspective we fail to capture the potential longer term and broader impact of achieving widespread societal change. It is now well recognised that HIV/AIDS is a long wave event, and that resource decisions need to consider both the short and long term implications of different policy choices. Particularly, we were not able to model the potential longer term social implications of reductions in levels of problematic alcohol use, shifts towards less inequitable gender roles and norms and reductions in intimate partner violence; and the implications of achieving reductions in levels of stigma and discrimination against very marginalised groups and communities. A study by Brent et al. (2009) for example shows that the longer term impact of education on HIV is likely to be up to four fold its direct impact[3]. If this holds true (even at a lesser extent) for each of the strategies that we are considering, we would underestimate both the cost-effectiveness and benefit cost ratios of these interventions considered by factors of four or more.

The first stage in our approach was to compile country data on population size and HIV epidemiology

[3] **However, we could not model this, as our definition of direct and indirect impact was different than in Brent et al. (2009)**

and use this to estimate intervention coverage. For several of the interventions this estimate took into account the existing coverage of complementary interventions and factors like those groups who are living below the poverty line. We then estimated the unit costs for each intervention, in some cases using a combination of the literature and a GDP adjustment, as recommended by RethinkHIV. Next, we estimated HIV infections and DALYs, taking into account the current degree of ART coverage. We also included cost savings from the prevention of future ART provision. Finally, we added in any additional economic benefits to arrive at our final benefit cost ratios.

Detailed methods on costs, effectiveness and benefit estimation for each intervention are presented below.

Determining coverage - compilation of country data on population size, HIV prevalence and HIV incidence

A detailed spreadsheet was developed, that compiles country specific data on the size of the adolescent and adult population, and population HIV prevalence and incidence, for all countries in sub-Saharan Africa (listed in Appendix 1). This data came largely from different UN agencies, including UNDESA, UNAIDS, and UNDP.

Broadly our modelling assumes an immediate scale-up of the interventions to the target coverage level, rather than a gradual one – in order to illustrate the costs and benefits of these interventions when 'up and running'. However, we have tried to remain conservative when setting coverage targets, i.e. 20% of microfinance and livelihood programme beneficiaries per year; 30% increase in current coverage of community mobilisation; and only schoolgirls living under the poverty line to be provided with conditional cash transfers. For alcohol taxation, we do not assume a high end effect, but instead use conservative estimates of the prevalence of problematic alcohol use among men and women in each country, and then estimated how reductions in problematic use may lead to reductions in HIV incidence. When doing this, we recognize that the regulatory capacity of countries will vary widely, and so we correct our estimate of effect, using country specific measures of the levels of unrecorded alcohol consumption. Details of the key literature used and the methods used for each intervention are provided below.

Alcohol Taxation

Regulating the financial accessibility of alcohol through taxation is the most cost-effective yet most politically sensitive policy intervention to reduce problematic alcohol consumption (Chisholm et al. 2004; WHO 2005; Wagenaar et al. 2009). Increasing taxation is likely to meet strong resistance from the beverage industry, and in settings where there is a preponderance of homemade alcohol, there is the risk that consumers will switch their consumption to homemade alcohol.

Based on the approach adopted in a cost-effectiveness analysis undertaken by WHO's CHOICE (CHOosing Interventions that are Cost-Effective) exercise, we model a 25% increase of the current alcohol excise tax for all alcoholic beverages per country (not a 25% increase in price, as was assumed by one commentor on this paper). This includes excise taxes on all regulated alcohol sales of homebrewed alcohol, as well as larger commercially available brands of beers and spirits.

Target population: Given the nature of the intervention, we assumed the intervention will affect all

consumers of regulated alcohol. However, through this blanket tax increase, we aim to reach our specific target, i.e. heavy drinkers, in order to curtail their hazardous drinking as a means of reducing their associated risky sexual behaviours and susceptibility to HIV infection. We extracted the most recent data on the prevalence of heavy episodic drinking among adult men and women per country from WHO's Global Information System on Alcohol and Health (2003-2008), which is defined as the proportion of adult men and women (15+ years) who have had at least 60 grammes or more of pure alcohol on at least one occasion weekly. This allows us to estimate the number of male and female heavy drinkers to be reached, given the total adult population (15-49 years) per country.

Coverage: The cost-effectiveness analysis of interventions to prevent hazardous alcohol use determined that taxation was the most cost-effective in populations with moderate to high levels of drinking (above 5% prevalence) and lower unrecorded consumption (below 50%) (Chisholm et al., 2004). In SSA, this corresponds to countries in WHO's Africa sub-region E, characterised by their high child mortality and very high adult mortality. In countries with high amounts of unrecorded production and consumption, increasing the proportion of alcohol that is taxed could be a more effective way of influencing pricing than a simple increase in tax (Anderson et al., 2009). In some countries prices may be at the top of the Laffer curve, and the focus may be on tax enforcement. However, as we were focusing on HIV, and this was not included in the previous analyses, in the first instance we estimated cost-effectiveness for all countries in SSA. Moreover, in practise, given the country-specificity of the potential degree and severity of substitution, we did not feel we had sufficient data to on this to justify excluding countries from our analysis in the first instance.

With a 25% tax increase, we assume a distortionary effect leading to a 10% increase in unrecorded consumption, as proposed in Chisholm et al (2004), assuming that the proportion of unrecorded consumption is equivalent to the proportion of consumers drinking unregulated alcohol. We used country specific estimates on the current unrecorded alcohol consumption levels from WHO's database, and thereby excluded unrecorded consumption, plus the 10% increase, from our effective coverage.

Sources of data used on current coverage of interventions / risk factors		
Intervention	**Coverage / incidence**	**Source**
Increasing alcohol taxes	Prevalence of heavy episodic drinking among men and women by country	WHO Global Information System on Alcohol and Health, most recent data from 2003-2008

Keeping Girls in Secondary School

The World Bank CCT study was implemented in Malawi from 2008 to 2009 as an individually randomised controlled trial providing monthly cash transfers to 3,796 unmarried schoolgirls and young women, on the condition that they stay in (or return to) school. This trial was the first to evaluate and establish the impact of a conditional cash transfer programme on HIV prevalence, sexual behaviour, based on detailed behavioural and STI biomarker data. Given its rigorous design and positive HIV outcomes, we chose to model this intervention for other countries in SSA.

Target population: The Malawi intervention targeted all unmarried girls between 13 and 22 in the targeted geographical area, because it represents the period during which school dropout coincides with the onset of sexual activity. Due to data availability, with population data stratified by 5 year age cohorts (10-14; 15-19; 20-24), we focus on girls between 15 and 19. According to UNESCO data, this age group corresponds roughly to the normal secondary school age in most countries in the region, which is generally between 12 and 18 (ranging from 10-17 in Angola to 14-20 in Tanzania). We choose to target girls already in secondary school, as the effectiveness of the intervention has only been demonstrated for this group, and not for girls who had already dropped out but were incentivised to return to school.

Coverage: In order to estimate the size of the target group, we consider net attendance ratios, defined as the percentage of girls of secondary school age attending secondary school or higher. Current ratios for each country were sourced from UNICEF's online database, containing the most recent figures from 2005 to 2009. In 44 SSA countries, female net secondary school attendance ranges from 5% in Rwanda to 63% in Namibia, with a median of 22%. By default, these attendance ratios are used to determine the number of girls between 15 and 19 currently attending school. It is however clear that the total number of girls of secondary school age attending secondary school is likely to be higher than our estimates, given the wider age range in the definition (12-18 years). Nevertheless, we model a conditional cash transfer scheme that would target the 100% poorest girls in these populations (living under US$1.25 a day), with a focus on keeping girls in secondary school for an additional two years. We do this as the evidence suggests that the income effect is most likely to drive the reduction in risk behaviour amongst girls of this age – and thus assume that this group would benefit most from the intervention.

Sources of data used on current coverage of interventions / prevalence of risk factors		
Intervention	**Coverage**	**Source**
Keeping girls in secondary school	Levels of net secondary school attendance of girls by country	UNICEF, State of the World's Children 2011, most recent data from 2005-2009

Adding HIV and gender training to livelihood programmes

Target population: We target the adult population that is currently enrolled in ongoing microfinance and livelihood programmes with this incremental investment. We include women, as this is where the IMAGE intervention showed effect, as well as men, as the findings from the Stepping Stones Trial show that gender training activities with men can impact on their perpetration of violence, as well as on HSV-2.

Coverage: In order to estimate the size of this target population, we estimate current coverage levels of existing microfinance and livelihood schemes. In 2010, nearly 500 microfinance institutions reported providing services to over 8 million people in SSA through the Mix Market platform[4]. Since

[4] **The MIX MARKET™ is a global, Web-based microfinance information platform that was launched by the UN Conference on Trade and Development and expanded by the Consultative Group to Assist the Poor (CGAP).**

not all institutions report, this is likely to be an underestimate, but we use the reported figures per country as current coverage levels. For countries without data, we assume a coverage equivalent to the regional mean of 1.7% of the adult population. The coverage of other livelihood interventions is estimated from the few documented experiences, i.e. the FFS and the Millenium Villages, based on the ratio of their total beneficiaries (Braun et al., 2006) to the total adult population. These average ratios for countries with data are then extrapolated to countries without data. For each country, we then determine a low estimate of coverage based on the intervention with the most beneficiaries. As a realistic scale up plan, we target 20% of these current beneficiaries with an add-on training component.

Sources of data used on current coverage of interventions / risk factors		
Intervention	**Coverage / incidence**	**Source**
Adding participatory gender and HIV training to existing microfinance and livelihood programmes	Coverage of microfinance and livelihood programmes	Microfinance Information eXchange (MIX market), 2009 data Millennium Villages Project website Farmer Field Schools review (Braun et al., 2006)

Community mobilisation

Community mobilisation as an intervention is complex and wide-ranging, but can broadly be divided into three categories: outreach and engagement activities; support activities; and advocacy, transparency and accountability activities. Activities such as peer education, group discussions, community forums and establishing community networks come to mind (Schwartländer et al., 2011). It is particularly important to marginalised groups, who tend to be excluded from wider community processes, such as young people, women, sex workers, men who have sex with men and people who inject drugs, as well as those affected by HIV. These groups are also particularly susceptible to HIV infection and stand to benefit from collectivisation among themselves. Several have made use of community mobilisation in the prevention and mitigation of HIV and AIDS, by means of peer outreach and the promotion of HIV testing. Support groups of sex workers, for example, have generally combined one-on-one or small group behaviour change communication with access to commodities and services, including condoms, STI care and VCT (Dandona et al., 2005; Schwartländer et al., 2011). We use the Futures Institute's online Goals Express[5] to model this intervention.

Target population: The modelled community mobilisation intervention targets the general adult population (15-49).

Coverage: We model an increase of 30% from the current coverage of community mobilisation for the 19 SSA countries contained in the Goals Express model. Information on current levels of coverage of community mobilisation is already programmed into the Goals Express model, and was also used for the investment framework presented in Schwartländer et al. (2011). This input came from information provided by national programmes during UNAIDS resource needs workshops, and ranges from 0% in Burkina Faso to 60% in Benin. The Goals model assumes a relatively low coverage

[5] **http://policytools.futuresinstitute.org/goals.html**

of 4% for countries where there were no specific data.

Sources of data used on current coverage of interventions / risk factors		
Intervention	**Coverage / incidence**	**Source**
Investing in community mobilisation activities	Current coverage of community mobilisation activities	Schwartländer et al. (2011)

Estimation of total and unit costs

The costs of any social intervention are likely to be highly context specific. Due to data scarcity, our approach has been to source setting-specific costs and adjust them for other countries using GDP per capita, as recommended by RethinkHIV. Moreover, although we would have preferred to capture total societal costs per intervention, the data sources tended to concentrate on provider costs. This implies that the total costs of each intervention are likely to be underestimated in our analysis, as the various financial costs incurred by beneficiaries and their households to attend school, training sessions or community mobilisation events are largely omitted, as well as the associated opportunity costs. Finally, for most of the proposed interventions, economies of scale are likely to be achieved, even in the short to medium run, bringing unit costs down. We have currently made no adjustment for scale-effect on costs. However, in order to partially take this into account, we have incorporated unit costs at scale rather than those incurred during the more capital-intensive start-up phases, where distinct cost data was available in the literature.

In general unit costs were extracted from peer-reviewed literature, publications from reliable development institutions and the Futures Institute's online unit cost database, which was also utilised in the strategic investment framework proposed by Schwartländer et al. (2011). All costs are expressed in 2010 US$, where necessary using OECD/DAC US$ deflators.

Alcohol taxation

Chisholm et al. (2004) estimates that the incremental costs of an increase in the excise tax on alcohol for a population of 1 million at $150,000 (2004 international dollars) in WHO Africa region E countries, is equivalent to a unit cost of $0.17 in 2010 US$. For Africa sub-region D, these unit costs were slightly higher, at $0.19. The costs relate to legislation activities, as well as the administration and enforcement of the tax policy once passed (Chisholm et al., 2004). The cost of the intervention is likely to be higher in the first year on account of the required change in legislation, followed by lower unit costs for the rest of the policy life. However, as we did not have data to inform this, we assume a flat cost function.

Unit costs used in calculation of policy interventions				
Intervention	**Unit cost used**	**Key intervention activities**	**Range from other sources**	**Source**
Increasing alcohol taxes	$ 0.17 – 0.19	Policy/legislative change, tax collection, administration and enforcement	0.45 in US (Cohen et al., 2004)	Chisholm et al. (2004)

Keeping girls in school

The conditional cash transfer programme in Malawi consisted of an average payment of US$10 per girl per month (for 10 months of school a year), of which 30% on average went directly to the girl. Additional costs include the direct payment of secondary school fees, and programme administration costs. It is estimated that the average annual costs for each schoolgirl were approximately $100 in cash transfers, $20 in school fees and $50 in administrative costs (Baird et al., 2010a; Baird et al., 2010b). The total financial cost per schoolgirl of US$ 173 (adjusted to 2010 US$) represents 56% of Malawi's GDP per capita.

The cash transfer of $10 per month represented around 15% of total monthly household consumption in the sample households at baseline, placing the programme in the middle-to-high end of the range of relative transfer sizes for conditional cash transfer programmes. For similar programmes in Cambodia and Mexico, the cash transfers have ranged from as little as 2% to over 20% of total monthly household consumption (Baird et al. 2010). Relative to GDP per capita, however, Mexico's Progresa transfer was only about 6%, excluding administrative costs (King et al. 2007). In comparison, the more common unconditional cash transfer schemes in SSA represent between 24% and 52% of per capita income (Adato & Bassett, 2008).

On the basis of this, we generalised the US$20 and US$70 for annual school fees and administrative costs to other settings adjusting by GDP capita. However, since our target population were those living on less than US$1.25 per day (and this is 74% of Malawi's population (WB figures)), we did not adjust the transfer amount by GDP per capita. Instead, we assumed that US$ 100 reported for Malawi would be sufficient in other countries to generate the same effect. In reality however this is likely to be highly context specific, and therefore we conducted a sensitivity analysis this.

Source unit costs used in calculation of policy interventions				
Intervention	**Unit cost used**	**Key intervention activities**	**Range from other sources**	**Source**
Keeping girls in secondary school	$ 173 (Malawi: 56% of GDP per capita)	Beneficiary identification, monitoring of school attendance, cash transfers, payment of school fees	$ 200 – 1,662 (per household for unconditional cash transfers)	Baird et al. (2010a)

Adding participatory gender and HIV training to livelihood programmes

An economic evaluation was conducted for the IMAGE training component to determine its incremental cost-effectiveness (Jan et al., 2010). The costing adopted a provider perspective, excluding costs to participants and families (e.g. travel and opportunity costs of attending meetings). During the two-year start-up phase, costs were estimated at US$ 23.9 per participant per year (in 2010 US$). The two-year scale-up phase registered an annual cost of US$ 12.88 per participant. Old programme cost data of a Stepping Stones intervention in Mozambique in the late nineties indicates an average cost per training participant of $0.40 (in 2010 US$) (World Bank, 2003). Although this is not rigorous costing data, it suggests that lower unit costs could be achieved, prompting us to model unit costs based on the IMAGE training in its scale-up phase. However, as we source our effect data from the IMAGE study, we assumed the cost as reported by Jan et al (2010) still to be the most relevant estimate. As these costs represent about 1.1% of the South African GDP per capita, we used this proportion to estimate costs for the other SSA countries.

Unit costs used in calculation of policy interventions				
Intervention	**Unit cost used**	**Key intervention activities**	**Range from other sources**	**Source**
Adding participatory gender and HIV training to existing microfinance and livelihood programmes	$ 12.88 (South Africa: 1.1% of GDP per capita)	Development of materials, training of trainers and training of beneficiaries	$ 0.4 (Stepping Stones training, Mozambique)	Jan et al. (2010) World Bank (2003)

Community mobilisation and stigma reduction

Costing studies were found for the Masaka intervention in Uganda and the “Mema kwa Vijana” youth intervention in Tanzania. For the Ugandan case, the average unit cost of the community IEC component of the intervention was $1.92 per person reached in 2010 US$ (Terris-Prestholt et al. 2006). For the Tanzanian case, the community mobilisation component was estimated to account for 12.3% of total programme cost, at an estimated cost per targeted adolescent of $2.93 (Terris-Prestholt, Kumaranayake, Obasi, et al., 2006).

The Futures Group presents additional unit cost data of community mobilisation interventions for HIV in its online database, based on an unpublished analysis of the cost of PEPFAR-funded interventions in Ethiopia, South Africa and Uganda, focusing on abstinence, “be faithful” and community mobilisation approaches. These unit costs range from $0.40 to $12.90, with a median of $1.05. The remaining unit costs were sourced from the strategic investment framework model presented in Schwartländer et al (2011), based on UNAIDS resource needs workshops. These estimates are based on data from community health worker programmes in generalised epidemics.

Here the median cost per person was slightly lower at around US$ 0.88 (mean: US$ 2.06). Since community mobilisation is not clearly defined as an intervention, we tried to adopt unit costs for different settings as far as possible. Where there was no country specific data, the South African cost that was assumed in the Goals Express model (and Schwartländer et al., 2011) was adjusted by GDP.

Unit costs used in calculation of policy interventions				
Intervention	**Unit cost used**	**Key intervention activities**	**Range from other sources**	**Source**
Investing in community mobilisation	$ 0.33 – $37.10 (South African cost then adjusted by GDP for countries with data gaps)	Outreach, support, advocacy	0.40-12.90 (Ethiopia, South Africa PEPFAR and Terris-Presholt et al. 2006a and 2006b)	Schwartländer et al. (2011)

Approach to modelling HIV infections averted/ HIV impact

Estimating the potential benefits of each form of HIV intervention is complex for several key reasons. Firstly, as described above, there is limited effectiveness evidence available in the area of social policy interventions on HIV impact, due to the relatively new interest in this area. Secondly, as with costs, even where evidence is available we face a particular problem in terms of estimating incremental effectiveness. For example, while we have good evidence on the combined cost-effectiveness of interventions that provide both community mobilisation and HIV prevention services to high risk groups, it is difficult to identify how much of this effectiveness is attributable to the community mobilisation component alone.

In addition, ideally, for each intervention being considered we would have used country specific behavioural and epidemiological data, in combination with intervention specific data about the effect of each intervention on patterns of sexual behaviour and networking, to estimate the impact of the intervention on temporal trends in HIV transmission.

In practice, this form of evidence was not available. Because of this, we estimated the numbers of HIV infections averted by each form of intervention by first estimating the proportion of the sexually active population that could potentially be reached in each country; using national population and prevalence data to estimate the proportion of these people who are HIV uninfected, and then using evidence about the degree to which each factor is associated with HIV risk, to estimate how the annual incidence of HIV infection in this sub-group could potentially be reduced.

Mathematically, we adopted the following approach to estimate how reductions in risk may reduce HIV incidence:

If S people in a population of size N at need are not HIV infected at time t, if there is an annual incidence i, after 1 year S(1-i) will remain uninfected. Similarly, after t years $S(1 - i)^t$ will not be HIV

infected, and $N - S(1 - i)^t$ will be HIV infected .

If an intervention leads to M HIV-uninfected people reducing their HIV risk behaviours, so that their annual risk of HIV infection is reduced by a factor a (< 1), the annual HIV incidence will be ai rather than i, and after t years $M(1 - ai)^t$ will not be HIV infected and $M(1 - (1 - ai)^t)$ will be HIV infected.

Estimates of the cumulative number of HIV infections averted after time t can thus be obtained by subtracting the estimates of the cumulative numbers HIV infected with and without the intervention.

In each case, for each of these calculations the proportional reduction in the HIV incidence measure was estimated using available epidemiological evidence about either the effect size of the specific intervention on the prevalence of risk in the populations, and/or the strength of association between the exposure and HIV prevalence or incidence.

For the conditional cash transfer intervention we used the direct measure of the impact of the intervention on HIV incidence. For alcohol taxation we estimated how the levels of problematic alcohol use among women and men would decrease as a result of taxation, and the subsequent reduction in HIV incidence among these beneficiaries; for interventions to keep girls in secondary school we estimated the numbers of HIV infections averted by a 40% reduction in HIV incidence among the beneficiaries of this intervention; to model the effect of adding gender and HIV training to livelihood programmes we estimated the effect of the intervention on ongoing levels of intimate partner violence, and then used data on the strength of association between exposures to violence and incident HIV to estimate the potential HIV benefits of this reduction. In practice for both the alcohol taxation and livelihoods training programme we had to use measures of the strength of association between prevalent phenomena (e.g. intimate partner violence and problematic alcohol use and HIV) to estimate the potential reduction in incident risk. This estimation is likely to hold best in stable HIV epidemic settings.

The one exception to the modelling approach used was the community mobilisation strategy. Here, we used the impact matrix developed as part of the Futures Institute's Goals Express model (Bollinger, 2008), which specifies the forms of behaviour change that result from exposure to community collectivisation. These default parameters relate to a slight reduction in the age of first sex, and modest increases in condom use. The Goals Express model was then used to estimate how these increases in the age of sexual debut and levels of condom use translate into reductions in HIV incidence.

Although our literature review suggested that in practise the benefits of community collectivisation may be much broader than solely increasing condom use and age of first sex, it was not possible to adjust this parameterisation in any way. Furthermore, as it was only possible to use the Goals Express Model in a limited number of countries where there was data input, we used a very crude method to extrapolate the estimate of impact to other countries - by applying the median value of the ratio of the number of HIV infections averted / person reached across the countries modelled to the other countries.

Alcohol taxation

A global systematic review of 112 studies concluded that a 10% increase in alcohol prices resulted in

a 5% reduction in drinking (Wagenaar et al. 2010). However, the price elasticity among heavy drinkers is expectedly lower, approximately -0.28 according to another review (Wagenaar et al. 2009). Chisholm et al. (2004) estimate that in Africa sub-region E, a 25% increase in taxation combined with a subsequent 10% increase in unrecorded consumption, would result in an 8.1% reduction in the incidence of hazardous alcohol use, considering the existing prevalence of 3 preferred beverages and their respective price elasticities.

A systematic review and meta-analysis of African studies on the association between alcohol use and HIV infection, found that when compared to non drinkers, problem drinkers had a 77% higher odds of being HIV positive than non-problem drinkers (2.04 vs 1.57) (Fisher et al. 2007). Similarly, another global meta-analysis that restricted its selection criteria to incident HIV infection found that alcohol consumers were at 77% higher risk of HIV infection compared to non drinkers (Baliunas et al., 2010) preceding alcohol consumption. For our analysis we modelled a 77% reduction in annual HIV incidence for problem drinkers who become non-problem drinkers.

Given that alcohol affects the immune system and contributes to a worsened course of HIV/AIDS, there are more HIV-related benefits of reduced alcohol consumption through delayed disease progression, increased support seeking behaviour and treatment adherence (Shuper et al., 2010). We model these additional benefits in terms of DALYs saved based on an estimation method that found that the percentage of AIDS deaths that can be attributed to alcohol consumption range from 0.03% to 0.34% for men and 0% to 0.17% for women (Gmel et al 2011). Other morbidity and mortality benefits from reducing alcohol use through taxation were documented by Wagenaar et al. (2010), who find that doubling tax levels would reduce alcohol-related mortality by an average of 35%, traffic crash deaths by 11%, sexually transmitted disease by 6%, violence by 2%, and crime by 1.4%. These benefits were not included in our analysis.

Key inputs used to estimate the impact of increases in taxation on HIV incidence

Policy intervention	Intermediate effects	Impact on HIV	Source
Increasing alcohol taxes	8.1% reduction in problem drinking, as a result of a 25% increase in alcohol taxation	77% reduction in annual HIV incidence among male and female problem drinkers who become non-problem drinkers	Chisholm et al, 2004 Fisher et al, 2007

Keeping girls in secondary school

We model a 60% annual reduction in HIV incidence among the target group, in line with the findings from the Malawi trial, that found that eighteen months into the World Bank programme, HIV prevalence was 60% lower and HSV-2 prevalence 75% lower among girls receiving the cash transfers that were already in school at the start of the intervention, compared to the control group. There is currently insufficient evidence to ascertain whether this short-term impact is likely to be sustained and therefore represent an infection averted for life or merely delay infection to after the invention. Long-term post-intervention impact will be evaluated in 2012 (World Bank, 2011).

At the intermediate level, the conditional cash transfer appears to have led to sexual behaviour change, as evidenced by the delayed sexual debut, reduced number of sexual partners and a lower frequency of sexual activity, but no effect on condom use. However, these reported changes in sexual behaviour explain less than half of the programme's impact on HIV prevalence. The change in the risk profiles of the girls' sexual partners accounts for the rest of the variation, with simulations revealing that the HIV prevalence among the male sexual partners of treatment girls was about 50% less than among partners of the control group girls. The causal pathway most supported by this intervention study is that girls in school are empowered to make safer choices of younger partners, resorting less to transactional and intergenerational sex. The study noted a dose response effect with payment size, suggesting that poverty was an important motivation for transactional sex (World Bank, 2011).

The extent to which such an intervention is merely shifting the demand from older high-risk men towards the girls that are out-of-school, and thus increasing their susceptibility to HIV infection, remains to be determined. At the population level, this could mean a zero net benefit from the intervention. It would be important to determine what degree of coverage of keeping girls in school would be necessary to overcome this displacement effect and therefore alter the course of the epidemic.

Adding gender and HIV training to livelihood programmes

The IMAGE programme impact was assessed by comparing IMAGE clients in intervention communities with a control group of non-clients in matched non-intervention communities. The cluster randomized controlled trial showed a 55% decrease in past year intimate partner violence within 2 years (Pronyk et al., 2006, Kim et al., 2007). A randomised trial of the Stepping Stones model found a 48% reduction in IPV perpetration by targeted men after 2 years (AOR= 0.48, 0.38 to 1.01) (Jewkes et al. 2008). Despite these impacts, over the relatively short durations of the trials neither IMAGE nor the Stepping Stones interventions were found to impact significantly on community levels of HIV incidence, although significant reductions in HSV-2 were documented among men in the Stepping Stones trial.

In our analysis, we model the potential influence of reductions in intimate partner violence (and the underlying issue of gender inequality) on subsequent HIV transmission. We focus on this link as a recent longitudinal analysis in South Africa found that HIV incidence was higher among women who reported more than one episode of intimate partner violence in the past year or had low equity in their relationship. Gender inequalities and intimate partner violence are both associated with a 32-34% increased risk of incident HIV infection over two years (Jewkes et al., 2010).

Drawing upon these research findings, we model the impact of an intervention that leads to a 50% reduction in violence, assuming a conservative estimate of the past year prevalence of IPV of 20% in all sub-Saharan countries (WHO, 2008). We then estimate that among those who are in relationships where violence has ceased, the annual incidence of HIV infection would be reduced by 20%.

This approach to the modelling, where we consider the indirect benefits of gender training on levels of partner violence may be conservative. Although initially there appeared to be no generalized impact of IMAGE on sexual behaviour and HIV incidence (Pronyk et al., 2006), a subsequent analysis focusing on a subset of young female beneficiaries (14-35 years), found that they were more likely to have accessed VCT and less likely to have had unprotected sex at last intercourse with a non spousal

partner (Pronyk et al. 2008).

The Stepping Stones intervention trial results found a 33% reduction in the incidence of HSV-2. Furthermore, it was found to significantly reduce certain risk behaviours in men, such as transactional sex and problem drinking. Interestingly however, in the Stepping Stones trial women's sexual behaviour and risk of violence did not change (Jewkes et al., 2008), underscoring the potentially critical role of the income effect from the microfinance component on women's sexual behaviour and risk of violence.

Key inputs used to estimate the impact of adding HIV and gender training onto livelihood programmes			
Policy intervention	**Intermediate effects**	**Impact on HIV**	**Sources**
Adding participatory gender and HIV training to existing microfinance and livelihood programmes	55% reduction in incidence of Intimate Partner Violence (IPV)	Assume 20% reduction in annual HIV incidence, given reduction in IPV	Pronyk et al, 2006
Stepping Stones gender training for women and men	48% reduction in IPV perpetration by targeted men after 2 years		Jewkes et al, 2010

Community mobilisation

Few intervention studies to date have rigorously assessed the impact of community mobilisation on HIV infection, but a number have determined its effects on intermediate indicators of sexual behaviour, namely reported sexual debut and condom use. A review by Bollinger et al estimated that community mobilisation as an intervention has a negative effect as it decreases age at first sex by 0.3 years, but also reduces condom non-use by 10% among medium risk groups (i.e. men and women with more than one sexual partner in the previous year, excluding sex workers and their clients) and by 2.5% among low risk groups (i.e. men and women with one partner only in the previous year) (Bollinger, 2008). The consequent impact on HIV transmission is based on the Goals Express model discussed earlier.

It is worth noting, however, that the inputs used by Goals Express appear to underestimate the potential impact of this intervention, if evidence from other parts of the world can be considered applicable. Studies in India, for example, have found that female sex workers exposed to a community mobilisation intervention were 41% to 109% more likely to report consistent condom use, than those receiving a standard care package (Halli et al., 2006; Blankenship et al., 2008; Swendeman et al., 2009). Additionally, those who were both exposed to the intervention and had high levels of collective agency were 2.5 times more likely to report consistent condom use than other female sex workers. Although this is specific to high risk groups, it does suggest, at the very least, that community mobilisation can have a more significant impact among these groups and in countries with more concentrated epidemics. Based upon our review, and emerging evidence on the potential importance of community mobilization activities as part of a targeted intervention approach, we feel that these effects are likely to severely underestimate the effects of community mobilisation.

Key inputs used to estimate the impact of community mobilisation			
Policy intervention	**Intermediate effects**	**Impact on HIV**	**Source**
Investing in community mobilisation	10% reduction in condom non-use for medium-risk groups 2.5% reduction in condom non-use for low-risk groups 0.3 reduction in age at first sex	Modelled effects by country using the Goals Express Model	Bollinger, 2008

Estimating cost-effectiveness and benefit-cost ratios

Cost-effectiveness

We estimated the incremental cost per DALY of each intervention, but contained this to costs and DALYs directly related to HIV. The following broad formula was used: incremental cost per DALY = (Incremental costs of the intervention - cost savings from reduced ART treatment)/ DALYs from HIV infections averted.

Costs and HIV infections averted within the five year period were included. We estimated DALYs averted from these HIV infections averted using standard formulae and disability weights. DALYs were calculated using the following assumptions. Those on ART have a longer life expectancy than those without, and require different disability weights. We assumed that the proportion of those on ART remained the same as in 2010 when estimating the overall DALYs averted. Our calculations were made for both a 3% and 5% discount rate as recommended by RethinkHIV.

We estimated the incremental costs of each intervention by multiplying coverage with the unit costs described above. However it is important to note that for the interventions of gender training and community mobilisation activities, incremental costs related to HIV impact can be distinguished. In contrast, in the case of alcohol taxation and keeping girls in school – the separate costs that contribute to HIV reduction cannot be distinguished. In the latter case, we therefore had to include the entire cost of the intervention in the cost-effectiveness ratio.

Table 1: DALY parameters

Parameters	Value	Source
Age weight	0.04	GBD 2004
Disability weight pre- AIDS	0.135	GBD 2004
Disability weight AIDS	0.505	GBD 2004
Disability weight ART	0.167	GBD 2004
Duration pre-AIDS	8 years	Creese et al 2004
Duration ART	13 years	Cleary 2004
Duration AIDS (no ART)	3 years	Creese et al 2004
Age specific life expectancy	Country specific	WHO life tables
Age of onset of HIV		
Keeping girls in school	17 years	
Alcohol taxation	20 years	
Economic empowerment and gender training	25 years	
Community mobilisation	20 years	

We estimated cost savings from HIV infections averted assuming that the proportion of those who would get access to ART would remain similar to that in 2010 (WHO, 2010). The estimate of lifetime cost was taken from Cleary et al. (2006). At a 3% discount rate this is estimated to be US $9,426 and at a 5% discount rate US$ 8,225 for South Africa (2010 US$). Based on the detailed cost breakdown presented in Cleary et al. (2006) this was then adjusted to other countries assuming that the prices of drugs and other international supplies remain the same between countries (approximately 50% of expenditures) and the other 50% was adjusted by GDP per capita (as recommended by RethinkHIV).

Benefit cost ratios

For all interventions, we estimated the benefits of DALYs averted by converting DALYs using the amounts of US$ 1,000 and US$ 5,000 as recommended by RethinkHIV. For community mobilisation and gender training, we conservatively assumed no additional DALY or further economic gain beyond those gained from reductions in HIV infections, due to the lack of data in this area. For keeping girls and alcohol taxation in school we made a number of adjustments for additional health benefits, economic benefit and costs beyond those to HIV. These are described in detail below.

Keeping girls in school

Our literature review found a number of other health benefits of keeping girls in school including lower fertility, improved maternal health and improved child nutrition. Moreover schooling has an economic benefit in terms of higher labour market productivity and future earnings. One conservative estimate of these well-documented benefits suggests that a 1% increase in years of female schooling is associated with 0.37% increase in per capita income (Knowles et al. 2002). We add both these non-HIV benefits into the model, by referring to previous work done for the Copenhagen Consensus Centre (King et al 2007). These estimate a benefit cost ratio of conditional cash transfers for girls including the effect on income and on under-five mortality. We use here the most conservative estimates from that report. These assume that an extra 0.7 year of schooling is achieved for one year of CCT funding, but no direct mortality effect is included. It should however be noted that these effects are achieved at a lower cost than our estimates of the level of cost of conditional cash transfers required to achieve an HIV impact. However, for simplicity, we have conservatively assumed that any extra payment in the out intervention will result in no additional benefits.

Scenario	**BCR of keeping girls in school, excluding HIV impact**
Low discount, low DALY	6.9
Low discount, high DALY	18.28
High discount, low DALY	3.49
High discount, high DALY	9.24

Alcohol taxation

A recent review of the effectiveness and cost-effectiveness of policies and programmes to reduce the harm caused by alcohol highlights the complex interaction between alcohol and health (Anderson et al., 2009). Beyond this, there are likely to be a wide range of economic costs and benefits of changes in alcohol consumption. Given the complexity of these relationships, we consider only two issues here. The first is we include the additional benefits in terms of DALYs gained as reported by Chisholm et al. (2004). These exclude the impact on HIV infection and only examine the direct impact on morbidity and mortality. As stated above, Chisholm et al. estimate that with a 25% increase in alcohol taxation it costs US$ 92 to avert a DALY in sub-region E in Africa. This reflects a gain of 1,589 DALYs averted per 1 million population per year. We applied this gain in DALYs averted to our model respectively, and then valued DALYs as RethinkHIV recommends, at US$1,000 and US$5,000.

We also included the dead weight (welfare) loss associated with tax distortions in our analysis. We estimate this using standard formula. We modelled the loss for 500ml discount beer, assuming a price elasticity of demand of -0.3. Retail prices and sales figures were sourced from WHO's global data

repository. Where we had data gaps we filled them with regional averages. Table 2 shows the parameters used in our calculations below.

Table 2 – Parameters used in estimates of dead weight loss for alcohol tax

Location	500 ml discount beer						
	Current				With 25% increase in excise tax		
	Price (US$)	Excise tax (as % of retail price)	Sales in 1000 hectolitres	Sales in 500 ml (million)	New excise tax	Change in sales (PED= -0.3)	DWL (US$)
Angola	1.5	0.22	5,695	1,139.0	0.28	-25,922,069	-1,494,541
Benin	0.8	0.1	622	124.4	0.13	-1,066,286	-12,491
Botswana	1.1	0.3	561	112.2	0.38	-4,039,200	-270,809
Burkina Faso	0.9	0.25	718	143.6	0.31	-3,916,364	-156,655
Burundi	0.5	0.35	1,348	269.6	0.44	-12,454,088	-450,662
Cameroon	0.7	0.22	5,054	1,010.8	0.28	-23,004,414	-645,710
Central African Republic	1.1	0.22	156	31.2	0.28	-710,069	-29,358
Chad	1.3	0.22	335	67.0	0.28	-1,524,828	-72,298
Comoros	2.9	0.22	1	0.2	0.28	-4,552	-502
Congo	0.9	0.22	1,324	264.8	0.28	-6,026,483	-212,589
Côte d'Ivoire	0.9	0.12	1,388	277.6	0.15	-3,026,127	-51,131
Democratic Republic of the Congo	1	0.1	3,476	695.2	0.13	-5,958,857	-85,127
Equatorial Guinea	1.3	0.22	205	41.0	0.28	-933,103	-46,012
Eritrea	3.3	0.2	3	0.6	0.25	-12,000	-1,332
Ethiopia	1	0.22	2,649	529.8	0.28	-12,057,517	-448,207
Gabon	1.1	0.22	1,131	226.2	0.28	-5,148,000	-218,197
Gambia	2.4	0.11	30	6.0	0.14	-59,214	-2,367
Ghana	1.1	0.2	2,046	409.2	0.25	-8,184,000	-304,832
Guinea	0.8	0.22	200	40.0	0.28	-910,345	-28,660
Guinea-Bissau	0.8	0.17	45	9.0	0.21	-142,464	-3,157
Kenya	0.8	0.22	4,682	936.4	0.28	-21,311,172	-622,433

Lesotho	1.2	0.18	328	65.6	0.23	-1,142,710	-38,152
Liberia	0.9	0.03	140	28.0	0.04	-65,455	-235
Madagascar	1.1	0.16	832	166.4	0.2	-2,457,121	-66,518
Malawi	1.1	0.22	191	38.2	0.28	-869,379	-36,849
Mali	0.2	0.22	103	20.6	0.28	-468,828	-3,912
Mauritius	1.1	0.22	298	59.6	0.28	-1,356,414	-57,491
Mozambique	0.6	0.4	1,461	292.2	0.5	-17,532,000	-1,086,984
Namibia	1.1	0.22	914	182.8	0.28	-4,160,276	-176,333
Niger	0.7	0.08	80	16.0	0.1	-106,667	-865
Nigeria	1.1	0.22	11,114	2,222.8	0.28	-50,587,862	-2,144,160
Rwanda	0.7	0.61	650	130.0	0.76	-25,042,105	-5,788,680
Senegal	1.6	0.22	242	48.4	0.28	-1,101,517	-65,179
Sierra Leone	1.6	0.03	276	55.2	0.03	-106,839	-538
South Africa	1.1	0.33	26,526	5,305.2	0.41	-223,495,660	-17,534,822
Swaziland	1.1	0.22	193	38.6	0.28	-878,483	-37,234
Togo	0.8	0.09	461	92.2	0.12	-718,847	-7,753
Uganda	0.8	0.22	1,735	347.0	0.28	-7,897,241	-230,654
United Republic of Tanzania	1.1	0.26	3,930	786.0	0.32	-22,577,523	-1,221,398
Zambia	0.3	0.6	639	127.8	0.75	-23,004,000	-2,139,372
Zimbabwe	1.1	0.4	523	104.6	0.5	-6,276,000	-701,292

Other benefits that are excluded from our analysis

Apart from the specific issues above, there are two key types of benefits that are omitted from our analysis, reflecting our general approach, but need to be taken into account when interpreting our findings:

- Our findings exclude most externalities. For example we do not account for any impact from those girls in school on other girls who may not receive conditional cash transfers. This could work in two ways. In a positive way, other girls may decide to also attend school encouraged by their peers. On the other hand, men who are seeking young girls as

partners, may focus on other groups. We also do not include any consequences on orphans or others impacted by the loss of someone with HIV. Moreover, as stated above our findings include only the short term effect. This also applies to externalities. For example a study by Brent et al (2009) highlights the fact that in the longer run there may be additional externalities from education, such as other members in a household becoming educated and healthier – that may translate in longer term productivity gains for all. For example, King et al (2008) estimates that including these benefits may increase the low discount, low DALY BCR of 6.90 to 8.45.

- We have applied no equity weight to our results. While there are those who argue that efficiency analyses should include distributional weights – by excluding them we are assuming an equal value of welfare independent of income level. Yet, our interventions are primarily focused on those groups who may be more vulnerable and/or poorer than those who are recipients of alternative HIV interventions. For many, this provides additional value to the social interventions we consider.

Results

Table 3 shows the findings on the unit cost, annual cost and total cost of each intervention modeled, using the coverage figures specified above.

Table 3 – Unit cost (mean/min/max), annual cost and total cost (3%/5%) US$2010

	Mean Unit Cost (US$2010)	Min Unit Cost (US$2010)	Max Unit Cost (US$2010)	Annual Coverage (Million Persons)	Annual Cost (US$2010)	Total Cost (discounted 3%) (US$2010)	Total Cost (discounted 5%) (US$2010)
Alcohol Taxation	0.18	0.17	0.19	408.3	72,770,600	343,266,081	330,811,546
Keeping Girls in school	434.01	161.62	2,867.71	5.8	1,876,176,436	8,850,108,871	8,529,005,216
Gender and HIV Training on Livelihood Programmes	3.77	0.36	34.27	1.7	4,508,099	21,265,144	20,493,593
Community Mobilisation	3.56	0.33	37.1	17.9	60,758,486	286,603,756	276,205,069

The mean unit cost of the alcohol taxation was US$0.17 per capita. At this cost, when summed, the

total discounted costs of implementing the intervention across sub-Saharan Africa was around $343 million ($330 million using a 5% discount rate). For community mobilisation, the mean unit cost was US$3.6 per recipient, with a range of US$ 0.33 to US$ 37.10 between countries. When summed, the total discounted cost was $286 million using a 3% discount rate ($276 using a 5% discount rate). The average unit costs for keeping girls in school was much higher - $434 per recipient, with a range of US$ 161 to US$ 2,867 between countries. When summed, the total discounted cost was almost $8,850 million using a 3% discount rate ($8,859 million using a 5% discount rate). This reflects the high unit costs and high coverage assumptions used for this scenario. Gender/HIV training has a mean cost of US$3.77 and the total costs would be around US$21 million. In total, we estimate that these intervention scenarios would cost $9.5 billion (with a 3% discount rate) to implement – with the keeping girls in school taking up the vast majority of the funding available.

Table 4 – Infections averted, DALYs averted and cost savings (US$2010)

	Cumulative infections averted by year 5	Cumulative DALYS averted by year 5 (3%)	Cumulative DALYS averted by year 5 (5%)	Cost savings ART from infections averted by year 5 (3%) (US$ 2010)	Cost savings ART from infections averted year 5 (5%) (US$ 2010)
Alcohol Taxation	29,764	361,945	348,958	88,820,287	76,932,062
Keeping Girls in school	35,430	445,194	429,141	104,361,680	90,393,304
Gender and HIV Training on Livelihood Programmes	13,865	162,009	156,188	44,102,031	38,199,158
Community Mobilisation	7,086	87,756	84,572	26,307,689	19,084,100

Table 4 shows the infections and DALYs averted and the cost savings from reductions in ART costs from the infection averted. For the coverage scenarios considered in our analyses, the highest number of infections averted is generated from keeping girls in school (this covers all of those with an income under US$1.25 per day), with alcohol tax also making a substantial contribution. As the gender/HIV training and community mobilisation have been constrained by the number of current participants in livelihood interventions they make a relatively small contribution to overall infections averted. It is estimated that over time total ART cost savings from this package of intervention would amount to US$ 263 million at a 3% discount rate (US$ 224 million at a 5% discount rate).

Table 5 – Total cost, cost savings, incremental cost per DALY (US$2010) and DALYs averted

	Total Cost (discounted 3%)	Total Cost (discounted 5%)	Cost savings ART (3%)	Cost savings ART (5%)	Total DALYS averted (3%)	Total DALYS averted (5%)	Incremental Cost per DALY	Incremental Cost per DALY
Alcohol Taxation	343,266,081	330,811,546	88,820,287	76,932,062	361,945	348,958	703	728
Keeping Girls in School	8,850,108,871	8,529,005,216	104,361,680	90,393,304	445,194	429,141	19,645	19,664
Gender and HIV Training on Livelihood Programmes	21,265,144	20,493,593	44,102,031	38,199,158	162,009	156,188	-141	-113
Community Mobilisation	286,603,756	276,205,069	26,307,689	19,084,100	87,756	84,572	2,966	3,040

Table 6 shows our results for the incremental cost per DALY for each intervention. It should be noted that these costs include any cost savings from reductions in ART. The cost per DALY for all interventions, bar the training programmes appears high compared to other well known health interventions. However, it should be noted that this is an artefact of the methods used. As we could not separate out the incremental costs of alcohol taxation and keeping girls in school in any meaningful way (the health impact would not be achieved without the full expenditure) the costs appear high when only compared to the DALY averted gain.

Table 6 – Mean, minimum and maximum incremental cost and cost per DALY per intervention (US$2010)

	Mean Incremental Cost per DALY (3%)	Min of Incremental Cost per DALY (3%)	Max of Incremental Cost per DALY (3%)	Mean Incremental cost per DALY (5%)	Min of Incremental cost per DALY (5%)	Max of Incremental cost per DALY (5%)
Alcohol Taxation	18,412	-603	262,874	18,435	-511	262,872
Keeping Girls in School	113,627	3,695	1,142,031	113,647	3,724	1,142,050
Gender and HIV Training on Livelihood Programmes	461	-660	14,603	487	-561	14,615
Community Mobilisation	2,347	-817	22,982	2,489	-552	23,127

In the case of community mobilisation and stigma reduction our estimates are also high. In practise our analyses rely heavily on the findings from the country specific coverage and effect measured used for this analysis, that were drawn from previous modelling and resource projection activities on this issue, and the approach that we used to extrapolate the findings from the countries where we were able to use the GOALs express model to project impact on HIV, and the other countries.

Based upon our review of the literature we feel that it is very likely these modelled projections fail to adequately capture the benefits of community mobilisation intervention activities focused on key vulnerable groups. However, using the Goals Express model we were not able to alter the community mobilisation model inputs, to enable us to obtain estimates of these effects. Moreover, the approach that we used to extrapolate the country specific modelled projections to other sub-Saharan African countries was also very limited. Our choice of applying the median ratio of the reduction in HIV incidence per beneficiary was pragmatic, chosen in the absence of other viable alternatives.

The low cost per DALY for gender and HIV programmes, are much lower than the work presented by Jan et al. (2010). This is because these previous estimates only took into account the DALY gain from the prevention of Intimate Partner Violence. Adding the HIV impact, when dealing with such a low cost intervention, results in cost savings, due to long term cost savings from ART treatment averted.

The table below illustrates how our results on incremental cost per DALY vary by setting – here the mean, minimum and maximum are provided (across countries). This illustrates that variation across settings is significant. For example for alcohol taxation the incremental cost per DALY ranges from US$ 262,874 to a negative value. The full results by country are presented in Appendix 1.

Table 7 shows the average costs, benefits and benefit cost ratios at a 3% discount rate. The net health benefit includes both the benefit derived from DALYs averted and the cost savings from ART. Other benefits are added in the case of alcohol taxation and keeping girls in school.

It can be seen that in comparison to cost-effectiveness figures presented above, both alcohol taxation and keeping girls in school start to fare better, once the additional economic benefits of each policy are added. As no additional benefits were added to community mobilisation, and it had a relatively low cost-effectiveness result, this has the lowest benefit cost ratio at around unity. Training as part of livelihood programmes has the highest benefit cost ratio. The economic benefits of alcohol taxation and keeping girls in school considerably outweigh the health benefit. In the case of keeping girls in school the broader economic benefits are so substantial that the added benefit from HIV infections averted makes little difference to the earlier results found by King et al. (2007).

Table 7: Total cost, net health benefit and benefit cost ratio by intervention, using a 3% discount rate (US$2010)

	Total Cost (discounted 3%)	Net benefit HIV only (US$1000) (3%)	Net benefit HIV only (US$5000) (3%)	Net benefit (US$1000) (3%)	Net benefit (US$5000) (3%)	BCR (US$1000) (3%)	BCR (US$5000) (3%)
Alcohol Taxation	343,266,081	450,765,138	1,898,544,541	2,066,902,856	10,125,215,099	6.02	29.50
Keeping Girls in School	8,850,108,871	549,555,902	2,330,332,791	61,615,307,110	162,329,546,058	6.96	18.34
Gender and HIV Training on Livelihood Programmes	21,265,144	206,110,555	854,144,652	206,110,555	854,144,652	9.69	40.17
Community Mobilisation	286,603,756	114,064,109	465,089,790	114,064,109	465,089,790	0.40	1.62

Table 8 shows the same results but for a 5% discount rate. This highlights the fact that the benefits from keeping girls in school are longer term and hence are highly sensitive to the discount rate being applied.

Table 8: Total cost, net health benefit and benefit cost ratio by intervention, 5% discount rate (US$2010)

	Total Cost (discounted 5%)	Net benefit health only (US$1000) (5%)	Net benefit health only (US$5000) (5%)	Net benefit (US$1000) (5%)	Net benefit (US$5000) (5%)	BCR (US$1000) (5%)	BCR (US$5000) (5%)
Alcohol Taxation	330,811,546	425,889,586	1,821,719,681	1,890,481,643	9,290,661,936	5.71	28.08
Keeping Girls in School	8,529,005,216	519,534,677	2,236,100,168	31,436,435,861	82,324,561,867	3.69	9.65
Gender and HIV Training on Livelihood Programmes	20,493,593	194,386,888	819,137,806	194,386,888	819,137,806	9.49	39.97
Community Mobilisation	276,205,069	103,656,502	441,946,110	103,656,502	441,946,110	0.38	1.60

Given that our results vary substantially by country, we also present one example here (alcohol taxation) that illustrates how our results may be applied. Examining the drivers of our cost-effectiveness and benefit- cost ratios for alcohol taxation, as anticipated, cost-effectiveness is strongly influenced by the current levels of unrecorded consumption and HIV prevalence. As mentioned above unrecorded consumption provides an indication of the probable levels of substitution from taxed to unrecorded consumption of alcohol, and as such will determine overall health and fiscal impact. Similarly, those countries with much higher levels of HIV prevalence will benefit considerably more than those with lower levels of HIV prevalence. Table 9 below therefore provides a list of countries for which our analysis suggests alcohol taxation may be most beneficial in terms of reducing HIV, without substantially impeding taxation or creating broader health concerns.

Table 9 _ List of countries where unrecorded consumption<50%, BCR>1, and (HIV) CE threshold< 3x GDP/cap

Country	Average of Incremental Cost per DALY	Sum of BCR 1000 (3%)	Unrecorded consumption	Prevalence of hazardous drinking (%)	GDP per capita	CE threshold (3 x GDP/cap)
Botswana	-603	14.6	38%	12.7	6,064	18,192
Gabon	796	1.19	21%	5.7	7,502	22,506
Malawi	902	1.48	29%	3.3	310	930
Mauritius	7,276	0.44	27%	4.0	6,735	20,205
Mozambique	-9	15.31	34%	18.6	428	1,284
Namibia	850	9.45	39%	7.3	4,267	12,801
Nigeria	559	1.96	20%	11.3	1,118	3,354
South Africa	-203	14.07	26%	11.2	5,786	17,358
Swaziland	33	11.11	0%	2.4	2,533	7,599
Uganda	147	12.21	8%	10.4	490	1,470
United Republic of Tanzania	1,031	9.45	30%	5.7	503	1,509
Zambia	173	10.42	39%	7.0	990	2,970
Zimbabwe	520	10.07	20%	5.4	449	1,347

Sensitivity analyses

Although not presented here, we also explored the potential sensitivity of the findings to the various assumptions about the effect of the intervention on HIV incidence. Specifically, for alcohol taxation we explored the effect of using assumption of how moving from problematic to non-problematic alcohol use impacts on HIV incidence compared to more moderate drinkers (low 38.5%, high 90%). For community mobilisation, we varied the method used to extrapolate the impact projections across settings, with the low estimate using the minimum value of the ratio of the infections averted per person reached across the settings modelled, and the high estimate coming from the maximum of these values. For interventions to keep girls in school, the low estimate used an assumption of a 30% reduction in annual HIV incidence, and the high estimate used an assumption of a 90% reduction in annual HIV incidence per beneficiary. This high upper range was used to capture the possible long term benefits of education on HIV as reported in the study by Brent et al. (2009). For the gender/HIV training intervention, our low estimate considered a 25% reduction in intimate partner violence, with a 10% reduction in annual HIV incidence among beneficiaries. The high effect estimate was obtained using an estimate of a 75% reduction in intimate partner violence, and a resulting 30% reduction in risk of HIV infection.

The analyses highlighted that the findings that are most sensitive to changes in inputs are those that rely most on the estimates of HIV impact to generate benefit – ie community mobilisation and training on livelihoods. As would be expected, the projected benefit cost ratios are much higher for the higher effect assumptions, with increases in the effect assumptions near enough proportionally increasing the BCR. Given the uncertainty around the input values used in our analyses, and in particular, our concern over the robustness of our modelling of the impact of community mobilization, an important research priority is to generate better evidence of impact in different sub-Saharan African settings. However, for keeping girls in school and alcohol taxation the impact of changing the HIV effect assumptions was more muted, as they contribute to such a small proportion of the overall benefits.

Discussion and conclusion

In our analyses we have sought to model, country by country, the benefit/cost ratios of four very varied forms of social policy intervention, drawing upon existing empirical cost and effects data, and linking this with country specific economic, epidemiological, behavioural and demographic data. This was challenging, both given the relative paucity of rigorous economic or impact evaluation data, and because we were forced to take an individual perspective on structural forms of interventions that may have much broader longer term societal impact. A further limitation of our work has been the difficulty in distinguishing which costs to include and exclude. We were very pragmatic in our approach. If the HIV impact could be achieved by 'piggy-backing' then we estimate the incremental cost of doing so. However, where this could not be achieved – we decided to fund the entire cost of the intervention. In reality HIV funds are unlikely to be used this way. A much higher cost-effectiveness and benefit cost ratio is likely to be achieved by partnering with those involved in livelihoods improvement, community development and education expansion.

Our findings suggest that alcohol taxation potentially promising, even when only include HIV related

consequences and we have not factored in the broader economic and social effects. Although this form of intervention is potentially politically sensitive, we nevertheless sought to model its potential costs and benefits, given strong evidence on the price elasticity of alcohol consumption, good evidence of the relationship between problematic alcohol use and incident HIV infection, and demonstrated evidence of the impacts of alcohol taxation of levels of STI infection in the US. Although the practical and political challenges of such a policy should not be underestimated, we feel that it is important that HIV impact evidence is used to inform future policy discussions on this topic.

Our analyses of the potential benefit cost ratios associated with paying girls to stay in secondary school support previous CCC analyses of the benefit of these forms of intervention. In practise we found that the lowest cost/HIV infection ratios were in low GDP, high HIV prevalence countries, with the HIV benefits generally improving already high BCRs. These findings suggest that in these settings it would be appropriate for HIV programmes to finance some (albeit a percentage) of the total costs investments to keep girls in school.

Our modelling of the amounts of investments in community mobilization & gender and HIV training was limited by the scope of evidence available on each form of intervention. Our findings suggest that both forms of intervention are relatively low cost. Comparing the findings across countries, our BCR estimates range from < 1 to over 70, with the ratios being greatest in settings where HIV prevalence is high. These findings suggest that these forms of intervention are likely to be most cost-effective in countries or among sub-populations where the interventions are focused on sub-populations or communities where interventions are targeted.

Although in our analyses we presented the findings from four specific intervention options, it is important to resist the temptation to devise a standard list of structural interventions across very different contexts and epidemic settings in SSA. Whilst, in this analysis, we have considered a relatively fixed intervention model, implemented in each sub-Saharan African country, in practice it is likely that specific adaptations to different settings would need to be made. For example, initiatives to keep girls in secondary school may or may not require a conditionality component, and community mobilisation and stigma reduction interventions are likely to take different forms in different settings. Indeed, it has been strongly argued that structural approaches do not work the same way or have the same effect in all populations and settings. Specific details of both the people and the settings that make particular programme or policy inputs relevant and effective must be established and analysed (Gupta et al., 2008). These differences may have a fundamental impact on our results, both in terms of the effect size, but also which interventions are more cost-effective in which setting.

We must also caution, at this early stage in the field, of making too many direct comparisons between the four strategies considered, or between the evidence presented here and the more biomedical intervention options presented in other papers. Whilst we have attempted to accurately incorporate the cost inputs and broad range of intervention benefits, the analysis of each of the interventions have their specific strengths and limitations. Although we were able to include many of the benefits of keeping girls in school, we were not able to adequately estimate the longer term impact of income on HIV, nor many of the externalities that it may bring. Similarly, although we tried to estimate the benefits of reduced problematic alcohol use on HIV, we were not able to sufficiently value the other economic and well-being effects of this change. As discussed above, although we recognise that structural interventions – by their very nature – seek to achieve widespread societal change, in general we were not able to fully quantify the potential long term, or wider societal benefits of each of

the interventions being modelled.

Finally, despite these challenges, our findings point to the untapped potential of each of these forms of intervention considered in different countries in sub-Saharan Africa. Unfortunately there is still much uncertainty in our analyses. Despite a growing body of program experience in each of the fields considered, we were able to draw upon only a handful of evaluation studies of a limited range of intervention options. This is a reflection on the research and donor priorities of the HIV/AIDS field. Whilst millions have been invested into the development and testing of new biomedical prevention options, limited resources have gone into structural intervention research. As part of the CCC agenda, the ambition is to promote innovative thinking on how to strengthen the HIV response in sub-Saharan Africa. Although it is too early to compare our findings with those from more researched areas of HIV intervention presented in other papers, it would be wrong to conclude that a lack of evidence equates with a lack of effect. If anything, we hope that our findings demonstrate the potential value of moving beyond the more biomedical and health service intervention paradigms and that the current failure to invest in the implementation and evaluation of structural interventions is an important omission. We need to collect greater evidence on the costs of different social policy options, and to support rigorous evidence on the short and long term benefits of different social interventions.

Appendix 1 – Country level results

Table A1 – Coverage by country (persons)

	Alcohol Taxation	Community Mobilisation	Keeping Girls in School	Gender and HIV Training on Livelihood Programmes
Angola	8,868,000	177,360	112,292	3,547
Benin	4,336,000	780,480	60,918	28,695
Botswana	1,080,000	21,600	22,867	3,672
Burkina Faso	7,522,000	150,440	74,834	30,547
Burundi	4,437,000	88,740	23,805	2,822
Cameroon	9,706,000	194,120	42,842	41,023
Central African Republic	2,176,000	43,520	15,072	870
Chad	5,188,000	103,760	25,955	4,656
Comoros	356,000	7,120	1,724	1,210
Congo	1,844,000	36,880	44,362	15,007
Côte d'Ivoire	10,307,000	206,140	56,339	9,482
Democratic Republic of the Congo	30,519,000	610,380	516,319	15,036
Djibouti	466,000	9,320	3,478	1,584
Equatorial Guinea	332,000	6,640	3,742	1,129
Eritrea	2,627,000	52,540	27,086	8,932
Ethiopia	39,765,000	4,771,800	431,995	462,482
Gabon	776,000	15,520	1,481	310
Gambia	827,000	16,540	11,079	2,658
Ghana	12,298,000	245,960	157,626	71,743
Guinea	4,829,000	96,580	38,645	14,163
Guinea-Bissau	754,000	15,080	2,767	332
Kenya	19,757,000	2,370,840	177,891	294,234
Lesotho	1,017,000	20,340	15,233	3,458
Liberia	1,940,000	38,800	30,584	5,694
Madagascar	9,577,000	191,540	160,747	13,119

Malawi	7,018,000	1,052,700	79,738	23,877
Mali	6,356,000	127,120	70,254	34,447
Mauritania		34,240	6,487	5,821
Mauritius	716,000	14,320	5,197	2,434
Mozambique	10,761,000	215,220	149,280	18,052
Namibia	1,155,000	23,100	38,099	646
Niger	6,663,000	133,260	31,342	9,779
Nigeria	75,181,000	1,503,620	2,224,221	100,639
Rwanda	5,026,000	100,520	20,621	9,114
Senegal	6,227,000	373,620	36,716	49,929
Sierra Leone	2,805,000	56,100	28,414	7,489
Somalia	4,262,000	85,240	11,032	14,491
South Africa	27,470,000	2,472,300	207,881	173,896
Sudan	21,534,000	430,680	234,075	73,216
Swaziland	611,000	12,220	19,600	909
Togo	3,368,000	67,360	41,115	19,249
Uganda	14,874,000	297,480	79,470	86,385
Tanzania	20,627,000	412,540	128,141	46,668
Zambia	5,940,000	118,800	157,085	6,268
Zimbabwe	6,368,000	127,360	165,370	2,555
Grand Total	**408,266,000**	**17,929,840**	**5,793,823**	**1,722,271**

Table A2 – Infections averted and DALYs by country (3%)

	Alcohol Taxation		Community Mobilisation		Keeping Girls in School		Gender and HIV Training on Livelihood Programmes	
	Culm, Inf Avert 5yrs	Total DALYS (3%)	Culm Inf Avert Yr5	Total DALYS (3%)	Sum of Inf Avert Yr5	Sum of Total DALYS (3%)	Sum of Inf Avert Yr5	Sum of Total DALYS (3%)
Angola	228	2,859	101	1,324	359	4,756	15	182
Benin	19	213	91	1,024	85	986	57	598
Botswana	300	2,899	51	499	536	5,406	83	743
Burkina Faso	15	178	86	1,013	120	1,443	6	67
Burundi	88	1,165	51	696	100	1,385	9	120
Cameroon	305	3,793	111	1,428	333	4,359	407	4,923
Central African Republic	31	396	25	334	66	900	3	35
Chad	13	148	59	714	130	1,593	13	151
Comoros	0	1	4	57	0	5	2	32
Congo	35	462	21	288	230	3,184	81	1,029
Côte d'Ivoire	111	1,420	55	744	169	2,306	20	251
Democratic Republic of the Congo	885	11,577	348	4,620	103	1,387	38	494
Djibouti	6	76	5	76	1	10	3	46
Equatorial Guinea	11	141	4	49	37	492	5	60
Eritrea	7	91	30	377	22	277	9	105
Ethiopia	131	1,775	343	4,832	86	1,226	1,933	25,790
Gabon	44	500	9	103	10	123	3	27
Gambia	21	286	9	131	53	744	11	143
Ghana	42	542	21	278	410	5,561	211	2,674
Guinea	29	345	55	672	70	864	28	320
Guinea-Bissau	19	230	9	107	11	140	1	16

Kenya	454	5,139	894	10,345	1,455	17,215	2,885	31,194
Lesotho	115	1,225	39	422	429	4,829	128	1,292
Liberia	23	324	22	321	43	624	11	154
Madagascar	68	1,011	109	1,699	32	501	26	388
Malawi	425	4,839	715	8,340	1,080	12,875	395	4,301
Mali	5	51	72	822	70	816	68	716
Mauritania	NA	NA	20	256	4	52	12	143
Mauritius	6	85	8	111	2	29	5	62
Mozambique	4,182	50,401	441	5,511	2,555	32,453	369	4,315
Namibia	59	577	13	130	441	4,492	5	44
Niger	31	402	76	1,021	31	425	0	2
Nigeria	7,653	97,762	203	2,708	12,880	173,677	731	9,145
Rwanda	108	1,033	14	137	78	781	32	279
Senegal	3	32	67	750	51	588	99	1,027
Sierra Leone	47	611	32	431	85	1,158	21	260
Somalia	47	667	49	719	2	33	29	402
South Africa	8,329	97,374	1,748	21,017	5,610	68,779	4,110	46,220
Sudan	238	3,470	245	3,737	47	714	144	2,093
Swaziland	84	833	21	207	606	6,282	34	307
Togo	78	921	38	507	181	2,414	100	1,147
Uganda	3,001	37,506	209	2,555	761	9,483	1,174	14,282
United Republic of Tanzania	1,087	13,911	259	3,347	997	13,048	392	4,901
Zambia	772	7,619	185	1,848	2,782	28,828	123	1,127
Zimbabwe	607	7,057	120	1,449	2,273	27,952	36	404
Grand Total	29,764	361,945	7,086	87,756	35,430	445,194	13,865	162,009

Table A3 - Unit and total costs by country (US$ 2010)

	Alcohol Taxation		Community Mobilisation		Keeping Girls in School		Gender and HIV Training on Livelihood Programmes	
	Sum of Unit Cost	Sum of Total Cost (discounted 3%)	Sum of Unit Cost	Sum of Total Cost (discounted 3%)	Sum of Unit Cost	Sum of Total Cost (discounted 3%)	Sum of Unit Cost	Sum of Total Cost (discounted 3%)
Angola	0.19	7,947,933	9.83	8,225,865	858	454,470,082	9.08	152,007
Benin	0.19	3,886,134	1.62	5,951,922	266	76,296,106	1.66	224,475
Botswana	0.17	866,059	1.25	127,362	1,210	130,535,891	13.50	233,816
Burkina Faso	0.19	6,741,583	5.00	3,548,201	225	79,431,895	1.15	165,834
Burundi	0.17	3,558,060	0.39	161,361	162	18,147,671	0.36	4,742
Cameroon	0.19	8,698,990	1.62	1,480,354	335	67,691,040	2.53	489,353
Central African Republic	0.17	1,744,949	1.09	224,545	214	15,202,509	1.01	4,149
Chad	0.19	4,649,738	1.62	791,271	242	29,571,429	1.36	29,825
Comoros	0.17	285,479	1.96	65,705	277	2,256,168	1.81	10,320
Congo	0.17	1,478,716	9.00	1,565,699	595	124,538,446	2.46	174,288
Côte d'Ivoire	0.17	8,265,253	1.62	1,575,260	330	87,600,741	0.36	15,930
Democratic Republic of the Congo	0.17	24,473,391	0.39	1,109,889	162	393,620,004	5.79	410,657
Djibouti	0.17	373,689	2.92	128,586	349	5,722,542	2.70	20,197
Equatorial Guinea	0.19	297,555	37.10	1,161,886	2,868	50,617,358	34.27	182,501
Eritrea	0.17	2,106,609	0.89	220,331	199	25,391,858	0.82	34,608
Ethiopia	0.17	31,887,821	0.33	7,427,987	194	395,926,108	0.77	1,670,572
Gabon	0.19	695,489	6.00	439,256	1,466	10,238,678	16.70	24,452
Gambia	0.19	741,198	1.04	80,828	210	10,952,078	0.96	12,001
Ghana	0.19	11,022,066	1.62	1,875,685	328	244,032,528	2.44	827,174
Guinea	0.19	4,327,985	1.62	736,517	205	37,458,241	0.91	60,531
Guinea-Bissau	0.19	675,772	1.25	88,946	225	2,941,592	1.16	1,812

Kenya	0.17	15,843,271	3.36	37,576,512	264	221,755,707	1.64	2,280,139
Lesotho	0.17	815,539	1.57	150,635	269	19,321,490	1.70	27,740
Liberia	0.19	1,738,722	0.53	97,891	173	24,904,519	0.49	13,274
Madagascar	0.19	8,583,374	1.62	1,460,679	211	159,984,264	0.98	60,338
Malawi	0.17	5,627,781	2.90	14,400,500	188	70,809,193	0.69	77,724
Mali	0.19	5,696,557	1.62	969,414	256	84,810,567	1.54	249,942
Mauritania			2.21	357,609	296	9,070,506	2.05	56,171
Mauritius	0.19	641,714	16.23	1,096,074	1,329	32,588,692	14.99	172,164
Mozambique	0.17	8,629,318	1.62	1,641,263	209	147,321,053	0.95	81,128
Namibia	0.17	926,202	4.49	489,085	891	160,131,609	9.50	28,954
Niger	0.19	5,971,705	1.62	1,016,238	196	28,935,476	0.78	36,144
Nigeria	0.19	67,380,873	1.62	11,466,570	332	3,480,749,682	2.49	1,181,466
Rwanda	0.17	4,030,383	1.62	766,563	226	21,974,071	1.16	49,958
Senegal	0.19	5,580,941	1.62	2,849,217	315	54,535,838	2.28	536,341
Sierra Leone	0.19	2,513,978	1.62	427,817	194	25,970,312	0.76	26,814
Somalia	0.17	3,417,726	0.53	215,058	173	8,983,294	0.49	33,780
South Africa	0.17	22,028,378	13.94	162,569,428	1,161	1,138,270,088	12.88	10,565,253
Sudan	0.17	17,268,259	1.62	3,284,355	173	190,607,409	0.49	170,675
Swaziland	0.17	489,965	1.62	93,382	583	53,905,971	5.64	24,172
Togo	0.19	3,018,566	1.04	329,943	210	40,678,677	1.09	99,040
Uganda	0.17	11,927,561	1.07	1,501,469	220	82,555,200	1.12	456,268
United Republic of Tanzania	0.17	16,540,930	1.62	3,152,507	223	134,510,650	0.96	211,208
Zambia	0.17	4,763,326	2.00	1,120,783	309	228,982,127	2.20	65,159
Zimbabwe	0.17	5,106,542	4.30	2,583,310	213	166,109,507	1.00	12,048
Grand Total		**343,266,081**		**286,603,756**		**8,850,108,871**		**21,265,144**

Table A4. Incremental cost per DALY by country (US$2010)

	Alcohol Taxation		Community Mobilisation		Keeping Girls in School		Gender and HIV Training on Livelihood Programmes	
	Average of Incremental Cost per DALY	Sum of BCR 1000 (3%)	Average of Incremental Cost per DALY	Sum of BCR 1000 (3%)	Average of Incremental Cost per DALY	Sum of BCR 1000 (3%)	Average of Incremental Cost per DALY	Sum of BCR 1000 (3%)
Angola	2,567.00	0.60	5,968.00	0.20	95,349.00	6.91	618.00	1.46
Benin	17,882.00	0.43	5,426.00	0.24	77,101.00	6.92	31.00	3.58
Botswana	-603.00	14.60	-817.00	8.12	23,282.00	6.98	-660.00	6.27
Burkina Faso	37,652.00	0.37	0.00	0.00	54,813.00	6.92	2,225.00	0.51
Burundi	2,959.00	8.78	124.00	4.78	13,010.00	6.98	-56.00	27.69
Cameroon	2,117.00	0.80	834.00	1.16	15,361.00	6.98	-82.00	11.89
Central African Republic	4,302.00	8.78	552.00	1.67	16,790.00	6.97	10.00	9.46
Chad	31,209.00	0.38	849.00	1.14	18,345.00	6.97	-36.00	6.26
Comoros	262,874.00	8.55	1,024.00	0.98	461,126.00	6.90	209.00	3.48
Congo	3,067.00	8.76	5,290.00	0.21	38,998.00	6.93	31.00	6.72
Côte d'Ivoire	5,681.00	8.74	1,962.00	0.55	37,859.00	6.93	-80.00	17.99
Democratic Republic of the Congo	1,990.00	9.07	79.00	4.83	283,719.00	6.90	706.00	1.35
Djibouti	4,808.00	8.77	1,593.00	0.65	570,289.00	6.90	358.00	2.45
Equatorial Guinea	1,604.00	0.92	22,982.00	0.07	102,372.00	6.91	2,521.00	0.50
Eritrea	23,001.00	8.60	354.00	2.10	91,599.00	6.91	125.00	3.65
Ethiopia	17,874.00	8.59	1,437.00	0.72	322,862.00	6.90	-24.00	16.81
Gabon	796.00	1.19	3,566.00	0.40	82,566.00	6.92	272.00	1.81
Gambia	2,495.00	0.78	501.00	1.81	14,616.00	6.97	-19.00	13.16
Ghana	20,204.00	0.38	6,567.00	0.17	43,741.00	6.93	158.00	3.72
Guinea	12,329.00	0.45	833.00	1.15	43,127.00	6.93	-45.00	6.52
Guinea-Bissau	2,750.00	0.76	616.00	1.46	20,873.00	6.96	-78.00	10.36
Kenya	2,792.00	8.93	3,294.00	0.37	12,604.00	7.00	-231.00	17.84

Lesotho	342.00	10.49	-19.00	3.86	3,695.00	7.23	-321.00	62.53
Liberia	5,295.00	0.55	229.00	3.53	39,854.00	6.93	19.00	12.39
Madagascar	8,475.00	0.47	845.00	1.18	319,491.00	6.90	143.00	6.51
Malawi	902.00	1.48	1,422.00	0.76	5,250.00	7.13	-255.00	70.45
Mali	112,426.00	0.37	836.00	1.14	103,689.00	6.91	39.00	3.75
Mauritania	NA	NA	1,202.00	0.86	175,284.00	6.91	221.00	2.98
Mauritius	7,276.00	0.44	9,559.00	0.13	1,142,031.00	6.90	2,488.00	0.46
Mozambique	-9.00	15.31	91.00	4.05	4,369.00	7.16	-167.00	63.05
Namibia	850.00	9.45	2,878.00	0.50	34,924.00	6.95	-147.00	2.72
Niger	14,749.00	0.43	856.00	1.14	67,921.00	6.92	14,603.00	0.08
Nigeria	559.00	1.96	4,086.00	0.27	19,919.00	6.96	-3.00	8.76
Rwanda	3,416.00	7.49	5,017.00	0.28	27,666.00	6.95	-349.00	8.53
Senegal	176,660.00	0.35	3,395.00	0.37	92,417.00	6.91	157.00	2.61
Sierra Leone	4,009.00	0.62	871.00	1.13	22,326.00	6.95	-6.00	10.74
Somalia	5,096.00	8.75	265.00	3.46	274,247.00	6.90	54.00	12.25
South Africa	-203.00	14.07	7,237.00	0.19	16,140.00	6.99	-218.00	6.33
Sudan	4,951.00	8.75	850.00	1.17	266,916.00	6.90	56.00	12.58
Swaziland	33.00	11.11	-203.00	3.67	8,053.00	7.08	-521.00	20.34
Togo	3,060.00	0.72	468.00	1.82	16,697.00	6.97	-138.00	14.18
Uganda	147.00	12.21	337.00	2.13	8,499.00	7.04	-144.00	36.82
United Republic of Tanzania	1,031.00	9.45	744.00	1.27	10,145.00	7.01	-119.00	26.96
Zambia	173.00	10.42	74.00	2.53	7,512.00	7.08	-431.00	25.75
Zimbabwe	520.00	10.07	1,549.00	0.69	5,750.00	7.10	-181.00	40.60

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