International Labour Organization
ILO Regional Office for the Arab States

MAGNET
Migration and Governance Network
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Position Paper on Mandatory HIV Testing in the Arab States

Working paper

Contents

Executive Summary

The International Labour Organization (ILO), together with the United Nations Programme on HIV/AIDS (UNAIDS) and the International Organization for Migration (IOM) take the position that mandatory HIV testing of migrant workers violates their fundamental human rights and is not a cost-effective means of preventing the spread of HIV transmission or mitigating the impacts of the epidemic. Mandatory HIV testing for employment purposes is discriminatory and violates privacy rights protected under international human rights law. First, requiring workers to undergo HIV testing to migrate for employment or to remain in employment is not justified by public health arguments. Second, exclusion of HIV-positive migrant workers from employment due to their HIV status alone is discriminatory. An HIV-positive worker can live with the virus for many years without developing any symptoms of the disease, and without posing any threat of HIV transmission to his or her fellow workers through casual contact. With proper care, support and treatment, she or he can continue to contribute to the workplace and to society, continuing to live a productive, meaningful life for decades.

ILO considers that alternative policy options, such as voluntary HIV testing and counselling should be implemented. This paper examines the societal and economic impacts of mandatory HIV testing and makes recommendations on how countries can respect migrant workers' fundamental rights while preventing HIV transmission and addressing mitigate the impacts of HIV epidemic. The paper sets out alternative policy options to mandatory HIV testing and evidence around their effectiveness based on the relevant literature.

While the paper sets out the issues around mandatory HIV testing and evidence from various countries, it also includes a proposal for the design of a future study aimed at investigating the economic and societal costs and outcomes of mandatory HIV testing and various HIV interventions. This future study would allow researchers to identify what is available and what is missing, and what data is required to perform informative economic analyses for various HIV policy options. The outputs of such a study would provide policy-makers with guidance on how to make informed decisions on prioritisation of limited resources.

1. Background

While the majority of countries worldwide have no restrictions on the entry, stay, and residence of people living with HIV, 38 countries, including the Gulf Cooperation Council (GCC) countries, have such restrictions (UNAIDS, 2014). These restrictions typically reflect the governments' attempts to prevent the spread of HIV and to avoid the possible costs of treatment and care relating to HIV. However, there has been a concern over the practice of mandatory HIV testing and deportation due to positive test results in many countries. In particular, GCC countries require HIV testing for the renewal of migrants' visa. Migrants who test positive for HIV are often deported immediately without being provided with counselling, and their confidential medical information is shared with testing clinics throughout the region, as they are considered to be "unfit" for employment. This results in severe impacts on migrants and their families, members of the society, and the economy. Therefore, it has been argued that mandatory HIV testing is not a cost-effective solution to prevent the spread of HIV . The main arguments in the case against mandatory testing of migrant workers can be classified under three main categories:

1. **The human rights argument:** states that discrimination on the grounds of HIV status in the context of travel regulations, entry requirements, immigration and asylum procedures violate human rights of which:

    - The right to equality before the law;
    - The right to benefit from the highest attainable standard of health (physical and mental health). This includes obligations of the State to provide appropriate HIV-related information, education and support and access to the means of prevention;
    - The right to privacy which encompasses obligations to respect physical privacy (for example, the obligation to seek informed consent to HIV testing) and the need to respect the confidentiality of personal information (for example, information relating to a person's HIV status)
    - The right of every person to access employment. This right is violated when an applicant or employee is required to undergo mandatory testing for HIV and is dismissed or refused employment on the grounds of a positive result.

2. **The public health argument:** mandatory HIV testing does not ensure that those infected get access to healthcare and that HIV is prevented among the general public.

    - There is no evidence that HIV-related restrictions protect the public health or help prevent HIV transmission;
    - Evidence shows that forcing migrants to test is counter-productive, rooted in discrimination; migrant workers or potential migrant workers who test positive for HIV often "go underground", whether they were tested prior to their departure or after they had entered the receiving country; and mandatory HIV testing creates a false sense of security for nationals who are encouraged to think that AIDS is a "foreign" problem.

3. **The economic argument:** mandatory HIV testing is not a cost-effective means of preventing HIV. It is argued that mandatory HIV testing can have a range of negative impacts such as:

    - Loss of qualified workers and increase in unemployment which have negative impact on economic growth;
    - Increase in illegal workforce, which may then result in an increase in the prevalence rate of HIV, if the workers are HIV-positive;
    - Use of national resources for monitoring the migrants periodically;
    - Expenses created by use of testing laboratories, test systems, qualified medical staff for conducting regular HIV tests to migrants who need a visa extension to remain in the host country.

These arguments are mutually-reinforcing, in that promoting respect for human rights also supports public health requirements, and ensuring public health requirements in turn promotes human rights and countries' productivity and economic growth.

In 2010, the ILO adopted Recommendation No.200 concerning HIV and AIDS and the World of Work. The Recommendation states that:

- Workers should not be discriminated against on the basis of their real or perceived HIV status, or the fact that they belong to regions of the world…perceived to be at higher HIV prevalence (para. 3 (c));
- HIV testing should not be required of workers, including migrant workers (para. 25);
- Workers, including migrant workers should not be required by countries of origin, of transit or of destination to disclose HIV-related information (para. 27);
- Migrant workers, or those seeking to migrate for employment, should not be excluded from migration by the countries of origin, of transit or of destination on the basis of their real or perceived HIV status (para.28);
- Measures to ensure access to HIV prevention, treatment, care and support services for migrant workers should be taken by countries of origin, of transit and of destination, and agreements should be concluded among the countries concerned, whenever appropriate (para. 47).

The ILO argues that mandatory HIV testing creates a system of rights, with dignity, integrity and work afforded to those without the virus, and deprivation and exclusion forced upon those living with the virus. An HIV-positive worker can live with the virus for many years without any symptoms of the disease, and without posing any threat of HIV transmission to his or her fellow workers through casual contact. With proper care, support and treatment, she or he can continue to contribute to the workplace and to society, and live a productive, meaningful life for decades.

ILO together with UNAIDS and IOM advocate for voluntary HIV testing –in the context of confidentiality, informed consent and pre- and post-test counselling– as opposed to mandatory testing of workers, whether individuals are seeking work within their countries of origin or abroad.

2. Societal Impact of Mandatory HIV Testing

Millions of migrant workers from Africa (esp. Egypt and Ethiopia) and Asia (esp. Philippines, Nepal, Bangladesh and Sri Lanka) make the journey to the Middle East in search of work opportunities that they are unable to find at home. Upon arrival, they typically take on low-skilled jobs that nationals are unwilling to take, or jobs for which national labor supply is scarce.

There are to self-reinforcing issues to be considered:

- A general issue of unfair recruitment and treatment of migrant workers: upon arrival, many migrants find themselves subjected to discrimination and unfair treatment from intermediaries involved in the migration process; they often don't know their rights and entitlements and this makes them more vulnerable.
- Issues around specific forms of restriction that target PLHIV: in most Arab States (Bahrain, Egypt, Iraq, Jordan, Saudi Arabia, Kuwait, Lebanon, Oman, Qatar, Syria, Tunisia, UAE and Yemen), migrants are subjected to some form of restriction on entry, stay, or residence related to their HIV-status alone.

- Saudi, Oman and Yemen require declaration of HIV status for entry or for any length of stay and either ban HIV-positive people from entering or apply discretionary measures concerning their entry;

- Egypt, Iraq, Qatar and Tunisia deny applications for entry by HIV positive people for stays beginning as short as 10 days, up to 90 days (and subsequently for longer-term stays and residence). The purposes of such short stays may include personal, business or professional reasons such as tourism, visiting family and/or friends, meetings, conferences or educational events;

- Bahrain, Egypt, Iraq, Jordan, Kuwait, Oman, Qatar, KSA, Syria, UAE and Yemen deport foreigners based on their positive HIV status alone (once their HIV-positive status becomes known);

- Bahrain, Egypt, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, UAE, Tunisia and Yemen have HIV-specific restrictions that are applicable to employment or labour and deny employment visas and/or work permits based on HIV status.

These restrictions represent the governments' attempts to protect public health and to avoid "excessive demands" on health and social services. However, recent studies have shown that the mandatory HIV testing has significant impact on migrants, their families and the society. According to the recent UNAIDS report (UNAIDS, 2014), migrants face various complex obstacles, some of which are the following:

- A lack of access to health care services or social protection (e.g., health insurance, social security benefits),
- Treatment disruption due to detention and/or difficulty in accessing the same treatment regime in their own country,

- Social exclusion and human right abuses,
- Isolation and stress/trauma that may result in migrant workers engaging in risky behaviours (e.g., unsafe sex or drug use),
- A lack of the same entitlements as citizens to insurance schemes that make health care affordable,
- Additional medical treatment costs, transportation costs to reach health care facilities,
- Fear of the loss of income,
- Fear of the being arrested or harassed by the police when travelling, which may result in bribery,
- No or limited access to information on HIV without any consequences of seeking such information.

These issues however have important consequences, and impact society, if they are not addressed. For example, compulsory testing can cause people who know they are infected to go underground, and this may result in further consequences, such as increase in HIV prevalence rate and increase in cost of tackling the epidemic. Some additional consequences include:

1. Mandatory testing is thought to ensure that those infected get access to healthcare.

- Evidence does not convincingly show that mandatory HIV testing leads to greater access to HIV-related services. Anecdotal evidence shows that migrant workers or potential migrant workers who test positive for HIV frequently disappear from the system; furthermore in some cases they are rejected without being informed of their status
- Lack of information and support given to the HIV-positive migrant workers, self-stigma and discrimination by the authorities (in both destination and receiving countries) force the migrant to hide their status and avoid any HIV-related services.

2. Mandatory testing is thought to protect the public by preventing the person living with HIV from spreading the virus to others.

- However, mandatory testing can create a false sense of security:

    - Testing negative can reinforce feelings that one is not at risk and thus, those individuals may not take precautions;
    - Those who are, in fact, HIV-positive but who tested negative because they were in the window period[1] can unknowingly transmit HIV and may not seek medical attention;
    - Restrictions "may encourage nationals to consider HIV a 'foreign problem' that has been dealt with by keeping foreigners outside their borders, so

[1] The most widely available diagnostic test is an antibody test that responds to the presence of certain antibodies that the body has produced in response to HIV. Usually, it takes 12 weeks after infection before there are enough antibodies to be detected through this test. This is called the "window period". By the nature of the antibody test, even if everyone is tested, it will not capture all those who are HIV-infected.

that they feel no need to engage in safe behaviour themselves"[2]. By perpetuating such misperceptions, HIV-related restrictions discourage countries to "know their epidemic" and develop HIV prevention, treatment and support interventions that truly respond to it. HIV-related restrictions on entry misdirect resources into intimidating screening and enforcement activities versus using these resources to expand voluntary HIV counselling and testing, prevention, treatment and care.

- Workers who seek to avoid mandatory testing can become more easily marginalized and poor, and they may feel compelled to turn to irregular, unregulated channels of migration making them less likely to access HIV-related information and services, and, in turn, more vulnerable to infection. The end result of this exclusion may be a worsening of the public health situation.

- Mandatory testing creates increased drug resistance: it pressures HIV-positive people to leave their medicines behind when travelling, with the result that they become ill and/or develop drug resistance.

3. Mandatory testing allegedly provides benefits in-terms of savings on public health expenditure.

- There is an unjustified generalization in terms of assuming that HIV-positive individuals will create excessive demand on health and social services. Automatically subjecting migrant workers to exclusion or deportation instead of conducting individual assessments of actual costs is discriminatory against those who would not place excessive demands on health or social services. In fact, HIV-positive individuals often live long lives, support themselves fully, and contribute productively to society. Demands should only be considered excessive when the expected costs of government services estimated over a short period (of a few years at most) exceed the estimated financial contribution that the applicant will make over the same period.
- Migrants, in fact, often underutilize health services because of lack of health insurance, poverty, fear of being discriminated against, language barriers and cultural exclusion. Accordingly, those migrants that are not included in employer-provided health insurance schemes have to pay out of pocket medical expenses. This restricts their access to primary (cheaper) care, and typically restricts them from seeking care until their health conditions has deteriorated significantly.

3. Economic Impact of Mandatory HIV Testing

Although mandatory HIV testing has been seen as a solution to protect public health by various governments, recent studies have shown that mandatory testing is ineffective, costly, and can have negative consequences (e.g., Coker, 2006). The economic costs associated with mandatory testing outweigh the benefits it can provide by identifying

[2] Joint United Nations Programme on HIV/AIDS (UNAIDS); International Organization for Migration(IOM). 2004. Statement on HIV/AIDS-related travel restrictions (Geneva).

those with HIV and restricting their entry to the country. Myers et al (1998), for example, found that although mandatory testing of pregnant woman for HIV prevents more cases of paediatric HIV than voluntary testing, the economic cost of mandatory testing exceeds the costs of voluntary testing.
The effectiveness of mandatory HIV testing has been also questioned in terms of detecting HIV during the window period of 90 days in which antibodies remain at insignificant levels. Therefore, in fact, an HIV-positive person can test negative. Economically, this results in an ineffective use of limited resources.

The economic costs of mandatory tests range from the direct cost of tests, counselling, and medical expertise to indirect costs, such as psychological stress/trauma and income loss due to the deportation. As the societal and economic impacts of mandatory HIV testing are complex, there is insufficient evidence concerning the cost-effectiveness of mandatory and voluntary HIV tests and interventions. This, once more, emphasizes the need for in-depth economic analysis of mandatory HIV testing against alternative policy options, while taking into account all factors associated with the epidemic. An informative cost-effectiveness analysis (CEA) achieves this by comparing various HIV interventions in terms of both economic and societal costs with health outcomes achieved, such as number of infections prevented.

The economic consequences of mandatory HIV testing should be assessed in four main areas:

1. **The impact on demographics:**

- Mandatory HIV testing may result in migrants going "underground"., In turn, this could increase HIV infections in the country, both among migrant workers and the general population;
- A increase in the mortality rate among the migrant population may result in an increase in the number of orphans (Haacker, 2002).

2. **The impact on the public sector and on the health sector:**

    - Loss of qualified workers, resulting in a negative impact on economic growth;
    - Increase in unemployment among HIV-positive migrants
    - Disruption in public services
    - Government revenues will decline due to declined tax collection rates;
    - Increase in the number of irregular migrants, which may then result in an increase in the HIV infections, if the workers are HIV-positive;
    - Need for extra resources for monitoring the migrants periodically;
    - Need for trained health personnel;
    - Rapid increase in the demand for testing laboratories, test systems, qualified medical staff for conducting regular HIV tests to migrants who need a visa extension to remain in the host country.

3. **The impact on companies:**

    - Disruption of the production process due to deportation;
    - Cost of replacing workers and increased cost of training;

- Loss of productivity;
- Medical care, funerals cost and attendance;
- Higher insurance premiums

In the IMF Working Paper, based on various case studies, Haacker (2002) estimated that for a company with one per cent of AIDS cases among employees, direct costs might increase by 1-2 per cent of the company's wage bill. If the company bears the costs of disability or death, this would increase by 0.5-4 per cent of the wage bill. These additional costs may also have impacts on the migrant workers and the public, such as s reduction in medical benefits, shifting costs and risks to the public sector and its employees.

4. The impact on economic growth

- Disruption of production has an adverse impact on productivity, and declines in the rate of growth of the labour force, and thus, decline in GDP growth;
- Prioritisation of mandatory HIV testing, and thus allocating funds towards this may crowd out other expenditures in public sector, such as education, transportation (e.g., Arndt & Lewis, 2000; Roy, 2014).

Although the governments and organisations requesting the mandatory HIV testing in place expect to reduce the impacts of HIV, the societal impacts, along with economic impacts, do not guarantee these expectations. In fact, as discussed before, there is no evidence on the effectiveness of mandatory HIV testing. On the contrary, mandatory HIV testing may cause migrant workers to go underground or leave them with additional costs that they cannot deal with.
However, ILO considers that providing voluntary testing and necessary treatment to people living with HIV brings economic gains to a society through improved health and productivity of the labour force, including the migrant labour force.

4. How Can Countries Make a Difference to Migrants?

There are a number of guidelines and recommendations available on HIV and AIDS and the workplace (e.g., 2001 ILO Code of Practice; UKAID, 2011; UNAIDS, 2014). Central to these recommendations and guidelines is the need to reduce inequality, promote public health, and advice on how to prevent HIV epidemic and mitigate its impact on people.

In line with the UNAIDS Gap Report (UNAIDS, 2014) this paper highlights some key elements of migrant's access to health services and HIV services, which should be considered and weighed against the cost and impact of mandatory HIV testing:

- Lifting all restrictions on the entry, stay and residence of people living with HIV.
- Ending all mandatory HIV testing practices and, instead, offering routine HIV counseling and testing without the potential for negative consequences related to migration decisions.
- Ensuring that all people on the move—citizens and non-citizens alike— have access to essential HIV services.

- Enforcing national non-discrimination laws and policy frameworks that specify protections for people living with HIV and guarantee access to health and other services.
- Expanding access to HIV treatment and other health services to cover migrants, ensuring that services are delivered through a rights-based approach.
- Recognizing the increased vulnerability of migrants in national AIDS strategies and including programmes to reach mobile populations with effective HIV prevention, treatment, care and support services.
- Ensuring that resources are directed to those migrant populations and communities that are most vulnerable to HIV.
- Designing programmes that are responsive to migrants' different backgrounds and needs.
- Designing and disseminating HIV information in languages and accessible formats that migrants can understand so that they can make informed decisions about their health and personal behavior.
- Implementing and coordinating cross-border initiatives so that protective measures can have an optimal impact that transcends borders, increasing access to services, including voluntary testing and treatment.
- Mobilizing communities by engaging people from within migrant and ethnic minority populations to ensure that their needs are being met and that programmes are culturally appropriate and take gender concerns into account.
- Protecting all people from sexual and labor exploitation.
- Strengthening civil society leadership to counter stigma and social exclusion.
- Meaningfully including migrants, as well as members of their families, in community health programmes at the local level.
- Ensure consultations on health and development frameworks and programmes at the national level.

As mentioned before, HIV issues are complex and there is a need to assess the impact of these issues and the manner in which they may intersect. . While some of the actions taken by some organisations or governmental institutions shed light on HIV issues and on the effectiveness and efficiency of the manner in which these issues are being handled, there still needs to be a better understanding of the issues in general and in-country specific settings. Table 1 presents some examples of actions taken by a number of countries to mitigate HIV and AIDS and its impact on people.

Table 1. Some country-specific examples of alternative interventions to mitigate the impact of HIV and AIDS.

Country	Action(s) Taken
UK	UK made antiretroviral therapy available to all people living with HIV in the country at no cost regardless of their immigration status
Thailand and Cambodia	Thai and Cambodian authorities have collaborated on a scheme that allows Cambodian migrants living with HIV to return to their home country every three

	months to obtain their upply of antiretroviral medicines.
South Africa	The South African National AIDS Council is establishing a multi-stakeholder advisory committee on providing mobile men and women with advice about comprehensive programmes to reduce the risk of HIV transmission.
US	Banned mandatory HIV testing for immigrants in 2009.
Egypt, Iran, Lebanon, Morocco, Palestine and Tunisia	Implemented anonymous HIV testing and counselling.

ILO considers that mandatory HIV testing is not an effective policy option. Instead, promoting voluntary testing and access to primary care and prevention services would avoid high health care costs for the country and also reconcile public health interests with human rights obligations.

5. Alternative Options to Mandatory HIV Testing and Evidence on Their Cost-Effectiveness?

Although there are various alternative options to mandatory HIV testing, one of the reasons why implementation of effective HIV interventions is not occurring is because of insufficient evidence of the cost-effectiveness of such prevention interventions and programs (Bertozzi SM, 2006).

Following recent systematic reviews on HIV prevention, we can classify HIV interventions under three main categories: behavioural, biomedical, and structural.

- **Behavioural change interventions:** aim to reduce the risk of HIV through modification of sexual and addiction-related behaviour. Voluntary counselling, school-based interventions, and treatments for addictions are some examples of this category.

- **Biomedical interventions:** use technology to target biological and physiological processes that are responsible for HIV and its transmission harness. These include interventions like male/female condoms, blood screening, treatment of STIs, pre- or post-exposure antiretroviral therapy (ART), prevention of mother-to-child transmission (PMTCT), male circumcision, microbicides, and vaccines.

- **Structural interventions:** aim to change the underlying determinants of risk, vulnerability or disease itself. These interventions are also called "environmental", "ecological", or "upstream" interventions (Galárraga et al., 2009). Structural interventions include changes in laws, prices and/or taxes, subsidies, vouchers, housing, income-generating activities, women empowerment etc. (Gupta et al., 2008).

The evidence around the effectiveness of HIV interventions show variations due to various factors, such as the assumptions used in effectiveness analyses, availability of the data, scale of the study, and country-specific settings. Thus, the available literature does not offer a comparison of the effectiveness of various interventions that can be used as an alternative to mandatory HIV testing. However, these studies shed light into the methodology and data requirement for an informative economic analysis that can be used in decision-making.

The evidence on effectiveness of HIV interventions varies, as seen in Table 5. However, most of the cost-effectiveness studies seem to be on biomedical interventions. It is also difficult to differentiate with certainty which intervention type (behavioural, biomedical, or structural) is the most cost-effective intervention. This is due to various factors, including different base case scenarios used in CEA, uncertainties and unknowns associated with variables used in CEA. Nevertheless, comprehensive literature reviews for developing countries (e.g., Fernandez et al., 2005; Kirby et al., 2007) show that behavioural interventions, such as school-level interventions can have a positive impact on attitudes and knowledge of HIV and AIDS.

6. Suggestions for Future Studies on Economic Evaluation of Mandatory HIV Testing

Economic evaluation methods can help decision-makers allocate limited resources efficiently and define priorities among a range of interventions. It involves the identification of costs and outcomes (impact, results, effects, benefits, health gains) of an intervention such that meaningful comparisons across various interventions can be made using the same measure – cost to outcome ratio.

A major criticism in the literature has been on the identification of both direct and indirect costs of HIV interventions and the outcome achieved by these interventions, such as the number of cases prevented (Galárraga et al., 2009). More specifically, economic analyses suffer from the following issues that make them incomparable between each other:

- Unclear and untested assumptions used in economic models;
- Incomplete cost components of analyses, such as indirect cost like productivity loss;
- Difficulty in measuring intervention outcomes;
- Lack of multiple intervention comparisons in economic evaluation studies;
- Different country setting;
- Different target population (e.g., migrant workers, general public, pregnant women, etc.);
- Complexity in the way interventions are implemented and how they are bundled with each other;
- Uncertainty in how to achieve sufficiently large scale major impact due to the adoption of HIV interventions;
- Non-linear relationship between unit cost and scale, which may result in different cost-effectiveness at different scales of implementation;
- Non-linear effectiveness with scale, such as relationship between behaviour change and epidemic behaviour (Morris et al., 2004).

- Lack of information in terms of how to interpret results in terms of thresholds;
- Lack of information on budgetary constraints;
- Difficulty in generalizability of results to other settings.

Due to the factors mentioned above, many economic evaluation studies can be quite speculative and not informative in policy decision-making. Thus, a critical analysis of such studies is needed before utilising their findings in policy decision-making. This should involve a comprehensive review of literature on economic analysis of HIV interventions, regardless of any search restrictions (e.g., region, target population, age, or intervention type). More specifically, this comprehensive research should include the following steps:

- Identification of unit cost/effect data used in the economic analysis.
- Assumptions for obtaining unit costs/effects, as well as their reasoning, should be questioned.
- Most importantly, the current economic models used to estimate the impacts of HIV testing on public sector (e.g., education, public health), companies, demographics, and economic growth should be critically investigated.

These steps in the future research will allow researchers to identify available and missing information, as well as required data, and thus, will help them shape the future economic analysis with more in-depth. This will then provide policy-makers with guidance on how to make informed decisions in prioritisation of resources.

Alongside the use of economic criteria (e.g., cost-effectiveness, cost-utility), other factors, such as ease of implementation, acceptability of an intervention among the targeted population and the public, and political acceptability are also used in the prioritisation of competing interventions. Recently, health systems have sought to incorporate public preferences in priority setting and investment decisions (e.g., The UK Health and Social Care Bill, 2011; Public Involvement Framework, Health Canada, 2005). In the context of mandatory HIV testing, eliciting individual's views and preferences for various HIV interventions would help understand the willingness of the these people with HIV to accept such interventions. For example, in the case of voluntary HIV testing, what proportion of migrant workers would like to be tested? Such preference elicitation studies also investigate how preferences vary with individuals' socio-demographic characteristics to shed light into the type of individuals who are more likely to adopt a particular intervention. This would help understand not only the impacts of mandatory HIV testing on migrant workers, but also the acceptability (or uptake) of alternative policy options by them, which in turn may help control the HIV epidemic.

1.1. Techniques for Economic Evaluation of Mandatory HIV Testing

The methodological techniques that can be used in future economic analysis depend on the depth of this analysis. Due to the barriers/factors mentioned above, the current studies, generally focus on a simple comparison of a limited number of HIV interventions using cost-effectiveness analysis (CEA), cost-benefit analysis (CBA), or cost-utility analysis (CUA). Although they all compare the consequences of health care

programmes with their costs, the main difference between them is the measurement of these consequences.

In CBA, the effects of HIV programmes are measured in monetary units, such as willingness-to-pay. In CEA, the consequences of a health care program are measured in natural units, such as cases prevented, life-years gained, disability days saved. In CUA, the outcomes incorporate the notion of value by considering the quality of life-years saved from an intervention, as well as the quantity – i.e., quality-adjusted life years (QALYs) or disability-adjusted life years (DALYs).[3]

The main decision rule in CBA is to undertake an activity if the sum of the benefits are greater than the sum of the costs or, similarly, if the net benefit is positive. If only one activity with a positive net benefit can be undertaken (for example, due to there being limited available funds), then the appropriate rule is to choose the activity with the highest net benefit. The main decision rule in CEA is to compare the CE ratio with predefined or accepted CE thresholds obtained from other accepted and rejected interventions (e.g., against leagues tables). The decision rule in CUA is similar to the one in CEA as CUA is a special case of CEA where the effects (outcomes/benefits) incorporate the notion of "value".

Each of these economic evaluation techniques has strengths and limitations, as described in Table 2. The future research should take into account these strengths and limitations and collect the required data accordingly.

Table 2. Summary of economic evaluation techniques

Method	Strengths	Limitations
CBA	• It is broader in scope than CEA/CUA. Because CBA converts all costs and benefits to money it is not restricted to comparing programmes within health care but can be used to inform resource allocation decisions both within and between sectors. • It adopts a broad societal perspective (or It allows quantification of a broad range of effects, such as total societal willingness-to-pay for a new mitigation strategy to reduce HIV epidemic) • It can assess whether the budget	• It may not be easy to measure all costs and benefits, especially for those that are intangible and difficult to value (e.g., some environmental impacts, pain and suffering) • It may be difficult to attach money values to some health outcomes.

[3] In literature, CUA and CEA are sometimes used interchangeably due to the similarity in their outcome measurement.

Method	Strengths	Limitations
	should be expanded to accommodate the new programme.	
CEA	• Less time- and resource-intensive • Easier to understand • Compares different programmes with identical objectives	• It cannot be used to make comparisons across a broad set of programmes/interventions/strategies because effectiveness measure used in CEA assumed to be the same for these interventions. • It cannot typically address the opportunity cost of funding a new programme/intervention/strategy due to re-allocation funds • There may be more than one outcome of proposed programme, such as life-extension, side effects, and short or long-term quality of life changes. As CEA uses a particular outcome measure that must be common among the programmes, its value is limited. • Some outcomes may be more important than others, but under CEA, all outcomes have the same weight.
CUA	• It enables a broad range of outcomes to be included, and thus allows the comparisons across widely differing programs. • It attaches value to the outcomes so the more important outcomes are weighted more heavily. • Uses standardised utility (outcome) instruments, such as QALY, EQ-5D, DALY (can be also strength –depends on the argument).	• It is not easy to assess outcomes • Uses standardised utility (outcome) instruments, such as QALY, EQ-5D, DALY (can be also limitation –depends on the argument) • In CUA, societal benefits and costs are often not taken into account.

Resources to fund HIV interventions and programs are limited and must be used judiciously to maximise the number of HIV infections averted. In addition, prioritisation

decisions are complex, and therefore HIV intervention prioritisation decisions should be based on multiple criteria, rather than basing them on economic criteria alone. Therefore, future studies should also take societal perspectives (e.g., social costs and benefits for receiving countries) into the prioritisation decision-making, as in CBA. The willingness of the society (or of a target population – e.g., migrant population) to accept an HIV intervention, alternative to mandatory HIV testing, influences the uptake of such alternative interventions (e.g., voluntary testing) and helps in the reduction of (societal and economic) impacts of the epidemic. More importantly, it helps understand how HIV-positive people and the general public feel about potential choices made on their behalf.

Discrete Choice Experiment (DCE) is one of the stated preference elicitation techniques used widely in various fields of economics, including health economics. Specifically, DCE involves asking people to choose between competing (hypothetical) HIV interventions or programmes, presented as scenarios, using a series of defined characteristics (e.g., cost) represented at various levels (e.g., $10, $20). The collected data from DCE surveys is then estimated using probabilistic choice models to explain the relative importance of specific, plausible scenarios and the values attached to their constituent parts (i.e., willingness-to-pay). DCE allows us to study a wide range of innovations and programmes sharing the same characteristics (e.g., cost), but at different levels (e.g., $10, $20), without specifying exactly what these innovations are. Using this broader framework, we can help policy-makers in prioritising the HIV intervention investment choices available to them.

1.2. Data Requirement

An informative economic evaluation requires data that includes all relevant information. The type of required data depends on the purpose of an investigation, as well as the focus. If the aim is to investigate the impact of HIV interventions from a broader perspective, then the data should include, *inter alia*, the factors listed in Table 3. Although some of these factors may be country-specific and may not necessarily be applicable to certain situations, we encourage researchers to take these into account for informative analyses. However, if the aim is to evaluate HIV interventions options by taking into account their costs and outcomes, then one may need to explore some of the factors listed in Table 3 at an intervention level. Table 4 presents some examples of costs and outcomes associated with various interventions.

Table 3. Costs to companies, public sector, individuals, and economy

Companies	Public sector	Individuals	Economic growth
- Sick leave - Medical cost - Recruitment and travel cost of replacement workers - Productivity loss - Workplace HIV	- HIV/AIDS care - Social security system - Education - Disruption of public services - Increase in HIV prevalence due to	- Additional cost of testing and medical treatments - Loss of salary - Insecurity of finding a job (unemployment)	- Increase in unemployment - Loss of qualified workers - Reduced government revenues from declined tax

prevention and HIV testing	possible increase in illegal workforce - Additional trained health personnel - Extra resources to monitor workers periodically - Extra testing laboratories		collection rates

Table 4. Examples of intervention specific costs and outcomes

Intervention	Costs	Outcomes
Behavioural Interventions		
HIV training	Training materials Brochures and hand-outs Training of trainers Salary of trainers Transport and food cost Rent and utilities	Number of HIV averted; behavioural change, such as increase in the use of condoms.
School-based interventions	Teaching training cost	
Voluntary counselling	Salary of counsellor Rent and utilities	
Biomedical interventions		
Voluntary testing	Cost of tests Salary of medical staff Medical laboratories	Number of HIV prevented Reduction in HIV prevalence rate
Antiretroviral therapy (ART)	Cost of confirmatory tests Pre-test counselling cost	Number of cell counts
Prevention of mother-to-child transmission	Cost of family planning strategies Pediatric ART	Number of HIV-positive births prevented Number of HIV-infected children treated Number of cell counts
Male circumcision	Cost of treatment	
HIV self-testing	Cost of test Cost of confirmatory tests Cost of distribution	Number of HIV infections averted
Structural Interventions		

Condom use and communication campaigns	Cost of campaigns Salary of staff recruited	DALYs Number of HIV infections averted Reduction in
Mass media	Cost of advertising Salary of staff recruited	prevalence rate
Peer education and condom distribution	Wholesale price of condoms distributed Training of peers Rent and utilities Materials used	Increase in condom use Number of HIV infections averted

Addition to the abovementioned aspects, there are other factors affecting the economic evaluation of an HIV intervention:

- HIV incidence rate (Waters et al., 2011),
- HIV prevalence rate (Venkatesh et al., 2013),
- prevalence of undiagnosed HIV infections (Paltiel et al., 2005),
- whether key populations were targeted (Yazdanpanah et al., 2010),
- rate of acceptance of HIV interventions (e.g., tests) (Yazdanpanah et al., 2010),
- availability of confirmatory tests and post-test counseling (Yazdanpanah et al., 2010), and
- patient health status and treatment regimen (Meyer-Rath and Over, 2012).

1.3. Model Check and Validity

Building a model requires an understanding of how an intervention works and the identification of the parameters needed and can be estimated from the data. The parameters associated with high levels of uncertainty should be checked in sensitivity analysis to understand how they affect the results and therefore what the impact might be of a wrong assumption.

Furthermore, the mathematical models should be dynamic and consider including HIV positive and negative people, level of sexual risk behaviors, acceptability (and uptake) of HIV interventions, socio-demographic characteristics, and individuals' general view of testing (e.g., resistance to testing) that may influence their willingness to use the intervention (Cambiano et al., 2014).

7. REFERENCES

Arndt, C., & Lewis, J. D. (2000). The Macroimplications of HIV/AIDS in South Africa: A Prelimianry Assessment *South African Journal of Economics*.

Bertozzi SM, P. N., Wegbreit J, DeMaria LM, Feldman B, Gayle H, Gold J, Grant R, Isbell MT. (2006). *HIV/AIDS Prevention and Treatment* (Vol. 2): New York; Washington, DC: Oxford University Press; World Bank.

Cambiano, V., Mavedzenge, SN, Phillips, A. (2014). Modelling the Potential Population Impact and Cost-Effectiveness of Self-Testing for HIV: Evaluation of Data Requirements. *AIDS Behaviour*, 18: S450 - S458.

Coker, R. (2006). *Migration, public health and compulsory screening for TB and HIV*. London: Institute for Public Policy Research: IPPR.

Dowdy, D. W., Sweat, M. D., & Holtgrave, D. R. (2006). Country-wide distribution of the nitrile female condom (FC2) in Brazil and South Africa: a cost-effectiveness analysis. *Aids, 20*(16), 2091-2098.

Fernandez, M., Kelly, J., Stevenson, L., Sitzler, C., Hurtado, J., Valdez, C., Benotsch, E. (2005). HIV prevention programs of nongovernmental organizations in Latin America and the Caribbean: the Global AIDS Intervention Network project. *Rev Panam Salud Publica, 17*(3), 154 - 162.

Fung, I. C., Guinness, L., Vickerman, P., Watts, C., Vannela, G., Vadhvana, J., . . . Jani, G. (2007). Modelling the impact and cost-effectiveness of the HIV intervention programme amongst commercial sex workers in Ahmedabad, Gujarat, India. *BMC Public Health, 7*, 195.

Galárraga, O., M Arantxa Colchero, Richard G Wamai, & Bertozzi, S. M. (2009). HIV prevention cost-effectiveness: a systematic review. *BMC Public Health 2009, 9*(1), S5.

Gray, R. H., Li, X., Kigozi, G., Serwadda, D., Nalugoda, F., Watya, S., . . . Wawer, M. (2007). The impact of male circumcision on HIV incidence and cost per infection prevented: a stochastic simulation model from Rakai, Uganda. *Aids, 21*(7), 845-850.

Grosskurth, H., Mosha, F., Todd, J., Mwijarubi, E., Klokke, A., Senkoro, K., . . . et al. (1995). Impact of improved treatment of sexually transmitted diseases on HIV infection in rural Tanzania: randomised controlled trial. *Lancet, 346*(8974), 530-536.

Gupta, G. R., Parkhurst, J. O., Ogden, J. A., Aggleton, P., & Mahal, A. (2008). Structural approaches to HIV prevention. *Lancet, 372*(9640), 764-775. doi: 10.1016/s0140-6736(08)60887-9

Haacker, M. (2002). *The Economic Consequences of HIV/AIDS in South Africa*. IMF Working Paper. IMF.

Hausler, H., Sinanovic, E., Kumaranayake, L., Naidoo, P., Schoeman, H., Karpakis, B., & Godfrey-Faussett, P. (2006). Costs of measures to control tuberculosis/HIV in public primary care facilities in Cape Town, South Africa. *Bull World Health Organ, 84*(7), 528 - 536.

Health Canada. (2005). *Public Involvement Framework*.

Hogan, D., Baltussen, R., Hayashi, C., Lauer, J., & Salomon, J. (2005). Cost-effectiveness analysis of strategies to combat HIV/AIDS in developing countries. *BMJ, 331*(7530), 1431 - 1437.

Hogan, D. R., Baltussen, R., Hayashi, C., Lauer, J. A., & Salomon, J. A. (2005). Cost effectiveness analysis of strategies to combat HIV/AIDS in developing countries. *Bmj, 331*(7530), 1431-1437.

John, F. N., Farquhar, C., Kiarie, J. N., Kabura, M. N., & John-Stewart, G. C. (2008). Cost effectiveness of couple counselling to enhance infant HIV-1 prevention. *Int J STD AIDS, 19*(6), 406-409.

Kahn, J. G., Marseille, E., & Auvert, B. (2006). Cost-effectiveness of male circumcision for HIV prevention in a South African setting. *PLoS Med, 3*(12), e517.

Kirby, D., Laris, B., & Rolleri, L. (2007). Sex and HIV education programs: their impact on sexual behaviors of young people throughout the world. *J Adolesc Health, 40*(3), 206 - 217.

Maclean, C. C., & Stringer, J. S. (2005). Potential cost-effectiveness of maternal and infant antiretroviral interventions to prevent mother-to-child transmission during breast-feeding. *J Acquir Immune Defic Syndr, 38*(5), 570-577.

Martin, G., Bollinger, L., Pandit-Rajani, T., Nkambula, R., & Stover, J. (2007b). Costing Male Circumcision in Swaziland and Implications for the Cost Effectiveness of Circumcision as an HIV Intervention (pp. 50). Washington, D.C.: USAID: Health Policy Initiative.

Martin, G., Bollinger, L., Pandit-Rajani, T., Tshehlo, R., & Stover, J. (2007a). Costing Male Circumcision in Lesotho and Implications for the Cost Effectiveness of Circumcision as an HIV Intervention (pp. 50). Washington, D.C.: USAID: Health Policy Initiative.

Meyer-Rath, G and Over, M. (2012). HIV Treatment as Prevention: Modelling the Cost of Antiretroviral Treatment—State of the Art and Future Directions. *Plos Medicine*, 9(7), 1-10.

Myers, E. R., Thompson, J. W., & Simpson, K. (1998). Cost-Effectiveness of Mandatory Compared With Voluntary Screening for Human Immunodeficiency Virus in Pregnancy. *Obstetrics & Gynecology, 91*(2), 174-181.

Oster, E. (2005). Sexually Transmitted Infections, Sexual Behavior, and the HIV/AIDS Epidemic. *Quarterly Journal of Economics, 120*(2), 467-515.

Over, M., Marseille, E., Sudhakar, K., Gold, J., Gupta, I., Indrayan, A., . . . Heywood, P. (2006). Antiretroviral therapy and HIV prevention in India: modeling costs and consequences of policy options. *Sex Transm Dis, 33*(10 Suppl), S145-152.

Paltiel AD, Weinstein MC, Kimmel AD, Seage GR, Losina E, Zhang H, et al. Expanded screening for HIV in the United States—an analysis of cost-effectiveness. (2005). *N Engl J Med,* 352(6):586–95.

Price, M. A., Stewart, S. R., Miller, W. C., Behets, F., Dow, W. H., Martinson, F. E., . . . Cohen, M. S. (2006). The cost-effectiveness of treating male trichomoniasis to avert HIV transmission in men seeking sexually transmitted disease care in Malawi. *J Acquir Immune Defic Syndr, 43*(2), 202-209.

Reynolds, H. W., Janowitz, B., Homan, R., & Johnson, L. (2006). The value of contraception to prevent perinatal HIV transmission. *Sex Transm Dis, 33*(6), 350-356.

Roy, S. (2014). The effects of HIV/AIDS on economic growths and human capitals: a panel study evidence from Asian countries. *AIDS care, 26*(12), 1568-1575.

Soorapanth, S., Sansom, S., Bulterys, M., Besser, M., Theron, G., & Fowler, M. G. (2006). Cost-effectiveness of HIV rescreening during late pregnancy to prevent mother-to-child HIV transmission in South Africa and other resource-limited settings. *J Acquir Immune Defic Syndr, 42*(2), 213-221.

Sweat, M., Kerrigan, D., Moreno, L., Rosario, S., Gomez, B., Jerez, H., . . . Barrington, C. (2006). Cost-effectiveness of environmental-structural communication interventions for HIV prevention in the female sex industry in the Dominican Republic. *J Health Commun, 11 Suppl 2*, 123-142.

Teerawattananon, Y., Vos, T., Tangcharoensathien, V., & Mugford, M. (2005). Cost-effectiveness of models for prevention of vertical HIV transmission - voluntary counseling and testing and choices of drug regimen. *Cost Eff Resour Alloc, 3*, 7.

The UK House of Commons. (2011). *Health and Social Care Bill*.

UNAIDS. (2014). Welcome. *UNAIDS/Resources/Infographi.* Retrieved October, 2014, from http://www.unaids.org/en/resources/infographics/20120514travel/

UNAIDS Inter-agency Task Team on Young People. (2006). Preventing HIV/AIDS in Young People: Evidence from Developing Countries. In David A. Ross, B. Dick & J. Ferguson (Eds.). Geneva: WHO.

Venkatesh KK, Becker JE, Kumarasamy N, Nakamura YM, Mayer KH, Losina E, et al. (2013). Clinical impact and cost-effectiveness of expanded voluntary HIV testing in India. *PLoS ONE*, 8(5):e64604.

Vickerman, P., Kumaranayake, L., Balakireva, O., Guinness, L., Artyukh, O., Semikop, T., . . . Watts, C. (2006). The cost-effectiveness of expanding harm reduction activities for injecting drug users in Odessa, Ukraine. *Sex Transm Dis, 33*(10 Suppl), S89-102.

Vickerman, P., Terris-Prestholt, F., Delany, S., Kumaranayake, L., Rees, H., & Watts, C. (2006). Are targeted HIV prevention activities cost-effective in high prevalence settings? Results from a sexually transmitted infection treatment project for sex workers in Johannesburg, South Africa. *Sex Transm Dis, 33*(10 Suppl), S122-132.

Waters RC, Ostermann J, Reeves TD, Masnick MF, Thielman NM, Bartlett JA, et al. (2011). A cost-effectiveness analysis of alternative HIV retesting strategies in sub-Saharan Africa. *Jaids-J Acquir Immune Defic Syndr,* 56(5):443–52.

White, R. G., Glynn, J. R., Orroth, K. K., Freeman, E. E., Bakker, R., Weiss, H. A., . . . Hayes, R. J. (2008). Male circumcision for HIV prevention in sub-Saharan Africa: who, what and when? *Aids, 22*(14), 1841-1850.

White, R. G., Orroth, K. K., Glynn, J. R., Freeman, E. E., Bakker, R., Habbema, J. D., . . . Hayes, R. J. (2008). Treating curable sexually transmitted infections to prevent HIV in Africa: still an effective control strategy? *J Acquir Immune Defic Syndr, 47*(3), 346-353.

Yazdanpanah Y, Sloan CE, Charlois-Ou C, Le Vu S, Semaille C, Costagliola D, et al. (2010). Routine HIV screening in France: clinical impact and cost-effectiveness. *PLoS One,* 5(10):e13132.

8. APPENDIX

Table 5. Studies investigating cost-effectiveness of HIV interventions.

Citation/setting	Intervention type	Target population / issue addressed	Epidemic profile	Main results
BEHAVIOR CHANGE INTERVENTIONS				
Hausler et al., 2006 Cape Town, South Africa	VCT	Self-presenting and antenatal clients as well as TB and STI patients; retrospective annual cost data in 3 care facilities.	Generalized high-level	ProTEST intervention CE range: US$ 67 per HIV infection averted (HIA) in the STI clinic to US$ 112 in the community health clinic.
D. Hogan et al., 2005 Sub-Saharan Africa & South East Asia	VCT, School-based education, etc.	Youth aged 10-18 years. Regular sessions to all students. Costs include teacher training.	Generalized high-level & Concentrated	US$ 6704 per HIA or US$ 376 per DALY (assumes 95% coverage).
John et al., 2008 Nairobi, Kenya	VCT	Couple counseling for PMTCT; data on time and costs of pregnant women and couple counseling.	Generalized low-level	Infant HIA for US$ 483 using any of the two VCT options explored in the study: individual vs. couple counseling.
Vickerman, Kumaranayake, et al., 2006. Odessa, Ukraine	Treatment of addictions	Injecting drug users (IDUs). Economic costs by coverage and IDU HIV prevalence rate.	Concentrated	792 HIA at US$ 97 per HIV infection (at 20-38% service coverage and IDU HIV prevalence of 54%).
BIOMEDICAL INTERVENTIONS				
Over et al., 2006. India	ARTs	Modeling of 3 ART policy options to predict course of the epidemic in the absence of expanded ART availability: improved adherence to therapy; treatment for PMTCT including husbands; and subsidies for ART for people living below the poverty line.	Concentrated	Cost per life year saved compared with baseline scenario is US$ 146 for ADHERE, US$ 199 for MTCT+, US$ 286 for below poverty line (BPL).

Citation/setting	Intervention type	Target population / issue addressed	Epidemic profile	Main results
Reynolds et al., 2006. Sub-Saharan Africa	PMTCT	Contraception as a strategy to prevent perinatal HIV transmission through decreasing unintended pregnancies that prevents HIV-positive births. Health system perspective with hypothetical sub-population during 1 year.	Generalized high-level	US$ 663 per HIV-positive birth averted (for the family planning strategy) vs. US$ 857 per HIV-positive birth averted (with single-dose nevirapine regime).
Soorapanth et al., 2006. South Africa	PMTCT	Cohort of 100,000 women tested at 28, 34 and 36 weeks of pregnancy with different combinations of prenatal prophylactic and pediatric ART regimens.	Generalized high-level	HIV rescreening would prevent additional infant infections and result in net savings when zidovudine plus single-dose nevirapine or single-dose nevirapine is used for perinatal HIV prevention, and ART was available to treat perinatally HIV-infected children.
Maclean & Stringer, 2005. Sub-Saharan Africa	PMTCT	Hypothetical cohort of 40,000 pregnant women. BF for 6 months with daily infant nevirapine (NVP) prophylaxis; maternal combination ART during pregnancy and for 6 months of BF; and maternal combination ART only for women who meet CD4 criteria. Each was compared to: BF for 12 months; BF for 6 months; and formula feeding for 12 months.	Generalized high-level	Providing daily infant NVP cost an additional 93,638 dollars and generated 1183 additional QALYs: ICER=US$ 79/QALY Maternal combination ART was potentially very effective but too costly for most resource-poor settings (ICER: US$ 87/QALY).
Teerawattananon et al., 2005. Thailand	PMTCT	Modeling of hypothetical cohort of 100,000 pregnancies. Decision model assessed CE of 4 ART regimens given in addition to VCT	Generalized low-level	One VCT session with AZT+NVP averts 337 cases of infection at US$ 556 per case averted, while two VCT with the same drug regimen averts 16 additional

Citation/setting	Intervention type	Target population / issue addressed	Epidemic profile	Main results
		for PMTCT: a) Zidovudine (AZT); b) Nevirapine (NVP); c) a combination of AZT for early antenatal attenders and NVP for late arrivals; and d) combined administration of AZT and NVP and to assess the incremental CE of adding a second VCT session in late pregnancy.		cases at cost of US$ 1266 per infection averted. The incremental CE ratio of moving from 1VCT, AZT+NVP to 2VCT, AZT+NVP is US$ 16,000 per additional averted case, which is much lower than the recommended threshold value for HIV infection averted in Thailand.
Vickerman, Terris-Prestholt, et al., 2006. South Africa, Johannesburg	Treatment of STIs	Female sex workers (FSW); mathematical model, fitted to epidemiological data, to estimate HIV & STI cases prevented. CE of intervention with and without periodic presumptive treatment (PPT).	Generalized high-level	US$ 2093 per HIA or US$ 78 per DALY; US$ 85 per DALY if FSW treated w/ syndromic management; incremental cost of adding PPT was US$ 31 per DALY.
Price et al., 2006. Malawi, Lilongwe	Treatment of STIs	Male clinic attendees with urethritis and genital ulcer disease (GUD) were randomized to receive treatment for trichomoniasis or placebo in addition to the standard of care.	Generalized high-level	Expanding STI services to include trichomoniasis represents an excess cost of US$ 350.2 and prevents 22.7 cases of HIV in comparison to the status quo; this is equivalent to an ICER of US$ 15.43.
Oster, 2005. Africa	Treatment of STIs	Modeling based on decreasing transmission rates, involves treating other untreated (bacterial) sexually transmitted infections. Intervention modeled on the Mwanza, Tanzania Grosskurth et al., 1995.	Generalized	Intervention would save 291 million life years with 13 million HIA. Achieved at a cost of US$ 3.67 per life year, and around US $ 78 per infection. Sexual behavior intervention slightly less effective, preventing 6 million infections at a cost of US$ 16.82 per life year and US$ 436 per HIA.

Citation/setting	Intervention type	Target population / issue addressed	Epidemic profile	Main results
White, Orroth, et al., 2008. East and West Africa	Treatment of STIs	STI simulation model fitted to four HIV epidemics to estimate population-attributable fractions of incident HIV attributable to STIs. Cost per HIA compared with lifetime HIV treatment costs (US $3500).	Generalized low- and high-level	Cost per HIA range: US$ 321-1665. Curable STI interventions remain cost-saving when compared to lifetime HIV treatment costs in generalized HIV epidemics, populations with high-risk behaviors & low male circumcision rates.
Kahn et al., 2006. South Africa, Gauteng Province	Male circumcision (MC)	General adult male population. 1000 newly circumcised adult men followed dynamically over 20 years to estimate HIV incidence reduction.	Generalized high-level	US$181 per HIA (at 25.6% adult HIV prevalence). US$ 551 per HIA (at 8.4% adult prevalence).
Gray et al., 2007. Uganda, Rakai	MC	MC for males with impact on HIV incidence reduction for both males and females aged 15+. Efficacy (40-60%) and coverage rates (25-100%) varied.	Generalized high-level	19-58 surgeries per infection averted over 10 years; US$ 1269-3911 per HIA based on (40-60%) efficacy of circumcision and 75% service coverage.
Martin et al., 2007b; Martin et al., 2007a Lesotho & Swaziland	MC	Adult population. Country-wide CE of scaling up MC among males (ages 15 49) to 57.5 percent coverage (i.e., to reduce number of uncircumcised men by half) between 2008 and 2020.	Generalized high-level	US$ 292 per HIA in Lesotho; one HIV infection would be averted for every 6.1 MCs. US$176 per HIA in Swaziland; one HIV infection would be averted for every 4.1 circumcisions.
White, Glynn, et al., 2008. Sub-Saharan Africa	MC	Individual-based model fitted to the characteristics of illustrative high-HIV-prevalence population in sub-Saharan Africa The CE was calculated over 2-50 years. Future costs and effects discounted and compared with present value of	Generalized high-level	The cost per HIA by the default intervention targeted at 15–49 year olds, over 5, 10, 20, 30, 40 and 50 years, was US$ 974 (691–1964), 431 (308–842), 195 (143–356), 132 (100–232), 104 (81–179), and 89 (71–150) respectively.

Citation/setting	Intervention type	Target population / issue addressed	Epidemic profile	Main results
		lifetime HIV treatment costs (US$ 4043).		
Dowdy et al., 2006. Brazil & South Africa	Female condom	Country-wide distribution of nitrile female condoms (FC2). Estimation of costs and impact of a female condom at different volumes of distribution.	Generalized high-level / concentrated	Brazil: US$ 20,683 per HIA. South Africa: US$ 985 per HIA or US$ 18 per DALY.
STRUCTURAL / ENVIRONMENTAL INTERVENTIONS				
Sweat et al., 2006. Dominican Republic; Santo Domingo and Puerto Plata	100% Condom plus communication campaign plus law changes	CSWs and clients in 41 sex establishments. One intervention includes: community mobilization, promotional media and interpersonal communication and counseling. A second intervention adds enhanced STI clinical services, monitoring and evaluation system with graduated sanctions on sex establishment's owners.	Generalized low-level / concentrated	US$ 10,856 per HIA and US$ 457 per DALY in Puerto Plata (structural approach with law changes); versus US$ 28,208 per HIA and US$ 1,186 per DALY saved in Santo Domingo (traditional IEC)
Fung et al., 2007. India, Ahmedabad	Empowerment / Social / Peer-based programs	CSW strategies with peer educators: increase knowledge of HIV/AIDS and STIs, improve STI treatment of CSW and clients, increase safer practices, environment improvement. Compared with no intervention.	Low-level	Cost per HIA is US$ 59.3 (33.7-133.4) (peer educator valued as financial cost) and US$ 97.7 (55.6-128.5) (peer educator valued as economic cost). US$ 3.1 (1.9-7.5) to 5.5 (3.1-12.3) per DALY.
D. R. Hogan et al., 2005. Sub-Saharan Africa	Mass media	General population. TV and radio episodes and inserts in key newspapers, repeated every two years. Effectiveness: proportion of population exposed to campaign.	Generalized high-level	Mass media US$ 58 per HIA or US$ 3 per DALY (ICER compared to no intervention).

Source: Galárraga et al., 2009.