HIV Allocative Efficiency Analysis Guidelines

Methods for improving the efficiency of HIV resource allocation

Volume 1

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Structure of the guidelines

These guidelines are presented in two volumes:

Volume 1 - Methods for improving the efficiency of HIV resource allocation

This volume introduces the approach for conducting **HIV allocative efficiency analyses** and introduces the modelling tool **Optima**. The focus is on improving the efficiency of HIV program responses and increasing the impact of financial resources. This volume includes three main parts:

- **Part 1**: provides an *Introduction to the guidelines*.
- **Part 2**: introduces and describes the procedures required for planning and conducting an *HIV allocative efficiency analyses* and provides details of lessons learnt.
- **Part 3**: introduces *concepts of modelling,* briefly presents the *Optima tool* and provides illustrative examples of the kind of analysis that can be conducted using Optima.

There are several **Appendixes** to Volume 1 including:

- a listing of acronyms and abbreviations used,
- glossary of terms,
- a brief overview of the biology and epidemiology of HIV, and
- other useful references and resources.

Volume 2 – Optima User Guide

This volume provides a detailed step-by-step **User Guide** for using all features of the Optima tool. The guide, also available electronically at http://optimamodel.com/, provides details of:

- the data required to run the analysis,
- how to set parameters for the analysis, and
- how to view and download results.

Provided as an **Appendix** to Volume 2 are technical notes for the Optima software, including:

- explanations of the model structure,
- the various equations used, and
- model assumptions.

Target Audience

These guidelines are aimed at those involved or supporting country teams in conducting an HIV allocative efficiency analysis, and those using Optima. This involves a wide range of users, including:

- Government officials including policy makers, planners, strategic information experts, and budget officers;
- HIV program implementers and evaluators;
- HIV scientists, researchers, and experts;
- International development community and HIV development partners; and
- People living with HIV, and
- other civil society groups.

Certain technical aspects of Optima, included as an Appendix to **Volume 2**, are aimed at mathematical modelers working in the field of HIV, strategic information experts, and HIV researchers.

PART 1. INTRODUCTION

1. Why is efficiency, effectiveness, and sustainability of the HIV RESPONSE more important than ever?

Financial resources for HIV programs substantially increased between 2000 and 2010, but whilst holding steady, have not been increasing at the same rate in more recent years. However, the financial requirements of HIV programs have increased significantly as more people than ever before are eligible to access antiretroviral therapy (ART). In addition, the need to maintain a core set of effective, non-ART based HIV-prevention services remains essential and more important than ever. In this context, there is much discussion on making better use of existing funds, or doing more with less, reallocating funds to the most effective mix of programs for a given epidemiological context, and on increasing domestic HIV financing.

At the same time that HIV programs are expanding in a flat resource environment, a new global set of aspirational HIV goals have been agreed upon by the global HIV community – a global challenge to end the AIDS epidemic by 2030. With all the advances in the understanding of what works in HIV programs, the world has moved closer to this prospect than ever before and in some countries it is within reach. Considering this global vision as well as the ever-expanding HIV service needs on the ground, there is therefore an urgent need to maximize what can be achieved with the available HIV resources. Resources need to be invested wisely on programs where the best scientific evidence demonstrates their effectiveness, to achieve the best possible impact on preventing AIDS-related deaths *and* reducing the number of new HIV infections, as these impact future treatment costs and the risk of onward transmission.

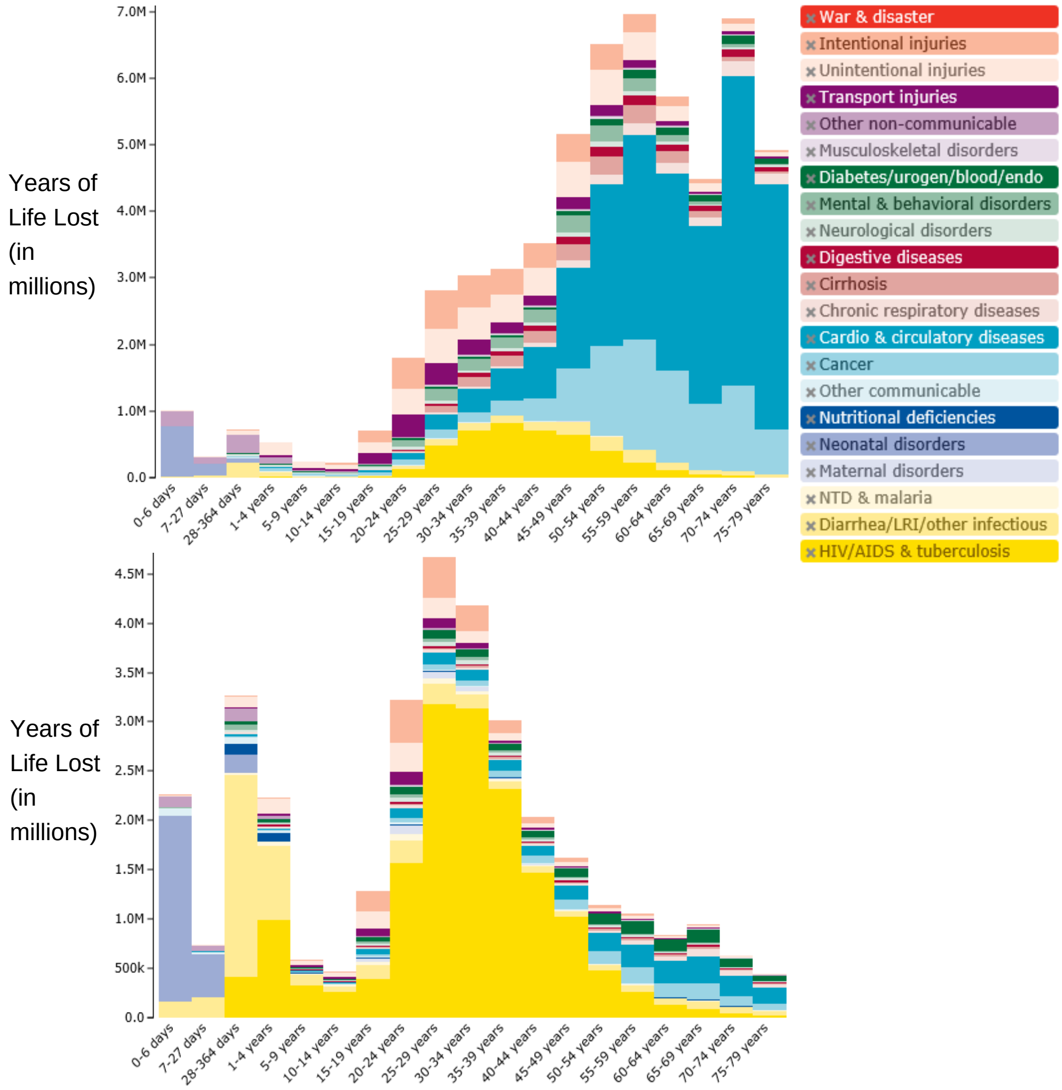
This demand for more effective use of HIV resources is reminiscent of the broader pressure on governments around the world to efficiently manage and spend their scarce health resources. In a context of changing disease patterns, together with the drive to meet ambitious targets like the Millennium Development Goals, and the newly-formulated Sustainable Development Goals (SDGs), better reallocation of resources focusing on the burden of disease in a particular country are critical.

The 2010 Global Burden of Disease (GBD) data provides a comprehensive synthesis of the impact of disease on human wellbeing and thereby offers a basis for comparing investment in health interventions to the relative importance of different health conditions. The GBD data also show the differences in the relative importance of HIV compared to other health conditions in different parts of the world. HIV remains the largest source of years of life lost (YLL) in Southern Africa and parts of Eastern Africa and an important cause of YLL among people of reproductive age in other regions such as Eastern Europe. In regions such as Northern Africa and the Middle East, HIV only accounts for a small portion of the burden of disease. In many countries outside sub-Saharan Africa, the majority of YLL in the population is due to non-communicable diseases. It is essential to consider data on the burden disease for effectively allocating resources between diseases (i.e. inter-disease resource allocation).

The increasing attention on value for money in health is also supported by a stronger focus on implementation research and delivery science. These research fields provide evidence of implementation efficiency through the comparison of outputs from different service delivery solutions.

Even beyond the funding challenges facing HIV programs, the identification and implementation challenge is significant: In 2014, 19 of the 35.3 million of people living with HIV globally still do not know they have been infected with the virus, and more effective service provision for populations at high risk of acquiring and transmitting HIV urgently needs to be strengthened.

Figure 1: Overall burden of disease by age in different regions



Source: Global Burden of Disease Study, 2010

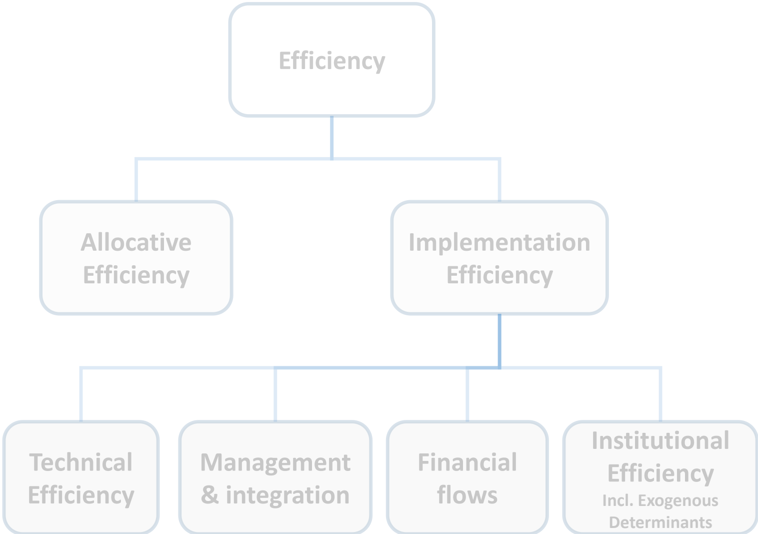
2. Ways Governments can save and BEST USE scarce Health resources

Governments strive to improve the effectiveness, efficiency and sustainability of their HIV responses. What does this mean in terms of Governmental health programming and budgeting efforts?

Effectiveness can be defined as the degree of achievement of a (health) outcome in a real-world setting. Effectiveness of an intervention tends to be lower than its efficacy, since the latter represents the effect of an intervention under 'perfect' conditions in a research trial context. Program effectiveness incorporates evaluations to establish what works, what impacts disease and/or transmission intensity, disseminates proven practice, and improves the efficacy of public health programs. Analysis of program effectiveness entails a combination of program evaluations, empirical studies, meta-analyses, and mathematical modelling efforts. Aiming for maximum effectiveness in health financing would mean aiming for maximum health impact by achieving the best health outcomes for diseases with the highest burden of disease in a given country.

Efficiency can be defined as the achievement of an output with the lowest possible input, without compromi]sing quality. Different types of efficiency exist:

Figure 2: Overview on different aspects of efficiency



Source:

a) **Allocative efficiency** is defined as the distribution of resources among a combination of programs, which are projected to achieve the largest possible effect with available resources and set objectives (see **Volume 1, Part 2**). Allocative efficiency is about allocating available or anticipated additional funds to the right interventions or programs and targeting appropriate groups in such a way that leads to the optimal outcome for the HIV epidemic in a given setting. Allocative efficiency aims to strengthen the understanding of HIV response efforts through disease burden analysis; review of surveillance, survey, policy, program and spending data; and integrative data synthesis to understand the alignment between the epidemic dynamics and HIV spending patterns. It can identify better prioritized, strategic planning with improved allocation of HIV resources among target groups or geographic areas, and intervention priorities and programs.

Where to start?
Allocative Efficiency: Start here if major gains are anticipated from better prioritization of interventions or populations.

Implementation Efficiency: Start here if major gains are anticipated from more efficient implementation measures

b) **Implementation efficiency** describes a set of measures to ensure that programs are implemented to achieve target outputs using the smallest input of resources. In practical terms, improving implementation efficiency means identifying better delivery solutions. This requires improved planning, design of service delivery models, as well as assessing and addressing service delivery obstructions that prevent all clients moving smoothly through the service delivery cascade and reducing wastage of resources. Implementation efficiency will contribute to the improved scale, coverage, and quality of programs. Implementation efficiency includes technical efficiency, program management analysis, health systems integration studies, program expenditure tracking, and cost effectiveness research to improve the flow and use of resources. Implementation efficiency also includes intervention delivery options to promote efficient resource management and program implementation. Implementation efficiency can be further broken down into the following aspects:

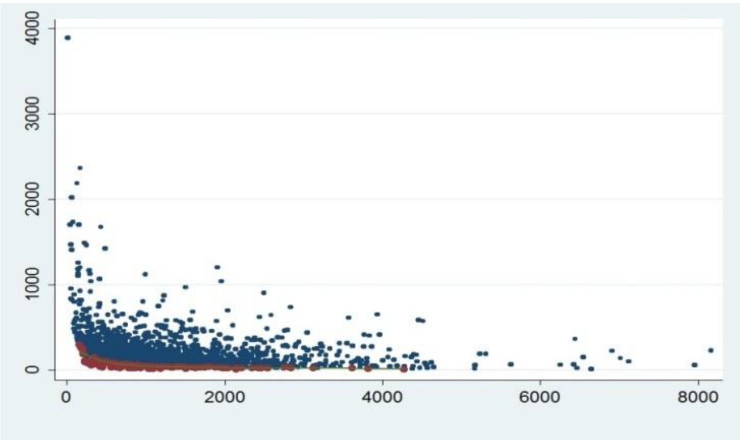
i) Technical Efficiency describes the delivery of a (health) service to produce maximum output at the lowest possible unit cost, while being delivered in accordance with operational quality standards. Technical efficiency analyses are ways in which governments can quantify the relative efficiency of service delivery of health or other services at one facility relative to other facilities. It requires a detailed and sometimes resource-intensive review of service delivery models, practices and associated cost, but will better ensure that funds are well spent. Figure 3 illustrates the large variation in unit cost of treatment services, for the same volume of services delivered between different facilities.

Technical efficiency works hand in hand with allocative efficiency and program effectiveness. If such a technical efficiency analysis exists, estimates of the resulting savings can be used to consider potential gains from re-investing these savings other HIV program costs following the allocative efficiency results.

If programs and responses are technically efficient then allocative efficiency as well as the impact of the program for lowest total cost can be strengthened. Technical efficiency is necessary for allocative efficiency to be achieved; however, allocative efficiency also requires the optimal allocation of resources.

Figure 3: Technical efficiency in service delivery in Kenya

Unit Cost



Number of patients

This example is drawn from a technical efficiency analysis undertaken in Kenya. The graph plots the number of patients (horizontal axis) against unit cost of delivering that service (vertical axis). Each blue dot in the graphic represents a health facility. The red dots represent the efficiency frontier for a given volume of service delivery. The most efficient sites deliver services at the lowest unit cost for the particular number of patients to which they deliver services.

Source: World Bank, HIV Program Efficiency Analysis, Kenya, 2014

ii) Integration and service delivery modalities: through simplified service delivery modalities and better integration of services, services can achieve better economies of scope and scale, reduce waiting times and improve client satisfaction.

iii) Efficiencies in management and integration of services: describe the optimal utilization of management, procurement systems, human resources, and information to support effective and efficient service delivery. As with technical efficiency, efficiency in management and integration can also enhance allocative efficiency, especially if additional funding can be allocated to service delivery rather than management and integration of services.

iv) **Efficiencies in financial flows** describe the timely flow of funds and financial planning information at the national, sub-national, community, and service delivery level.

v) **Institutional efficiencies** describe the degree to which institutions, policy environments, laws and regulations support and enable service delivery to the beneficiary and refer to the ability to reduce transactional costs.

Sustainability of the health sector and HIV responses refers to the ability of government, other funding institutions and households to maintain systems, programs and inputs for the duration required to achieve specific health and HIV goals. This includes different dimensions of sustainability:

i) **Programmatic sustainability** is defined as "the ability to maintain programming, community capacity and health benefits for an extended period of time after major financial, managerial and technical assistance from an external donor is terminated."

ii) **Financial sustainability** refers to the ability of government and its partners to continue spending on a health or HIV outcome for the required duration and to meet any cost of borrowing without compromising the government's financial position (Heller 2006). Sustainability is about reliably knowing and being able to forecast funding sources, maintaining the institutions, management, human resources, service delivery and integrating them better. Financial sustainability analyses assist country teams to project their HIV costs and plan for a transition to sustainable financing.

From the above description of efficiency, effectiveness and sustainability, it should be clear that to *do more with less* or *increase impact with available funding* HIV policy makers, scientists, implementers, and communities need to consider these four concepts in an interlinked manner:

To improve efficiency and effectiveness of HIV responses and funding we need to perform the following:

- Use combinations of inputs wisely (technical and implementation efficiency)
- Invest in the right things that will have the best benefits (allocative efficiency)
- Reliably know or forecast funding sources and integrate them better (financial sustainability)

a) improving what resources are spent on (**allocative efficiency**);

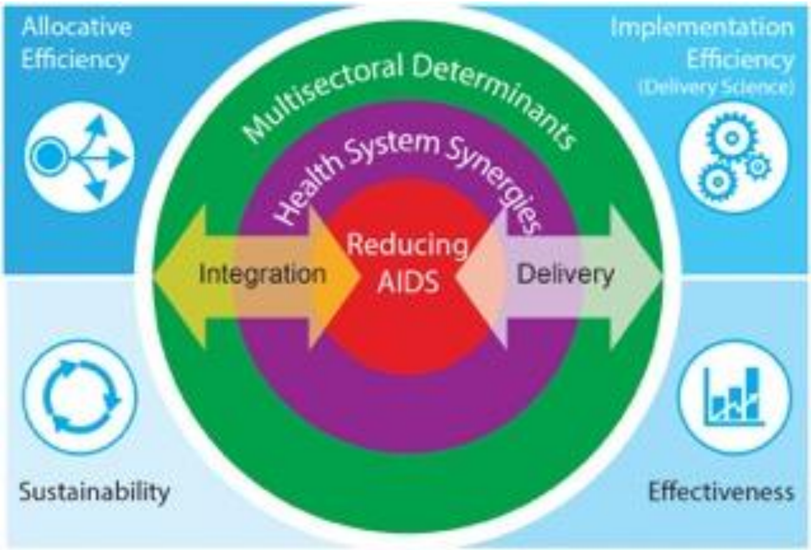
b) how resources are used (improving **implementation and technical efficiency**);

c) **program effectiveness**, and

d) reliably forecasting future volumes of HIV funding needed and better integration of funding sources, as this results in improvements in the longer-term **financial sustainability**.

HIV allocative efficiency analyses are therefore an extremely useful step in better informing ways in which to undertake an HIV response. However, they are best used in conjunction with other components listed above. The World Bank supports Governments in these four focus areas of analytical work which are all on their own, and in combination, able to improve the use of HIV resources and strengthen HIV interventions, towards maximum and sustainable impact.

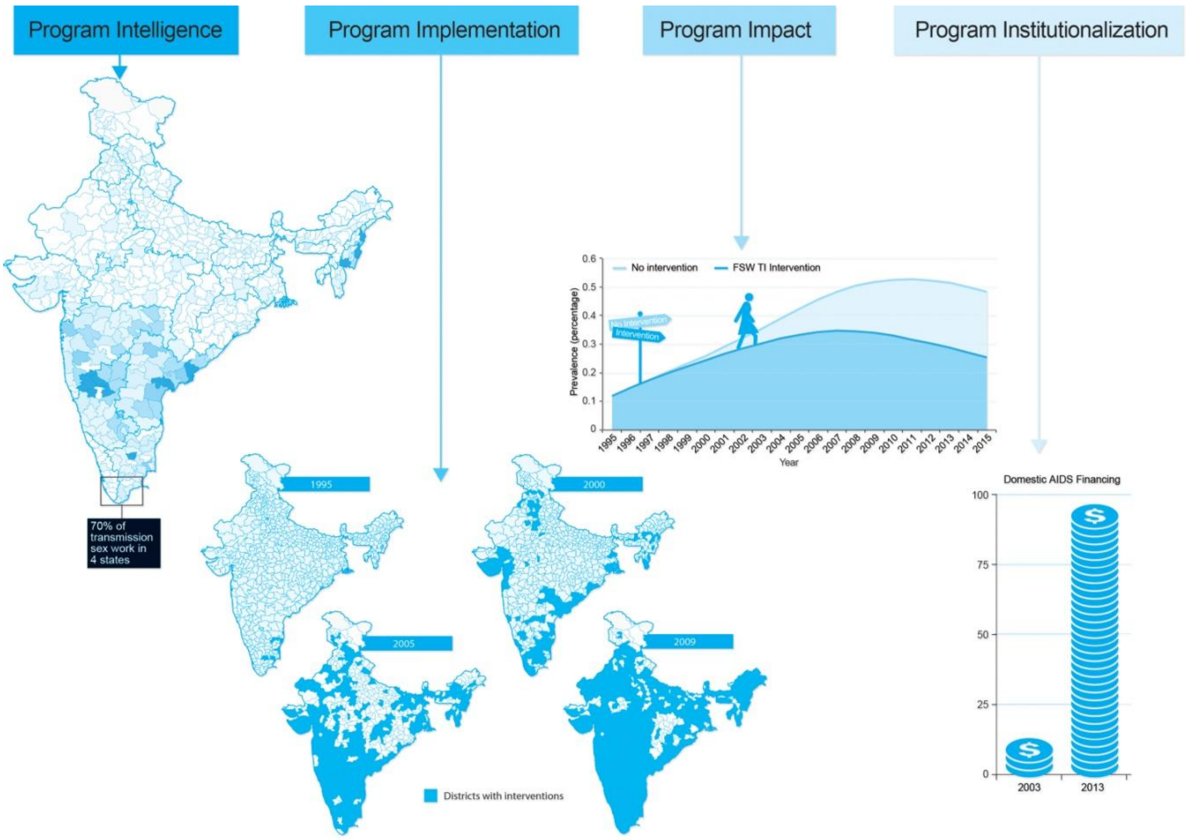
Figure 4: Basis for improving efficiency, effectiveness and sustainability of HIV resources



Source: The World Bank, 2014

The example below, figure 5, shows how different focus areas concentrate on different components to address improving efficiency, effectiveness, integration, and sustainability of the HIV response in India.

Figure 5: Country example of different components to improve efficiency and financial sustainability (India)



Source: The World Bank, 2014

While it is important to look holistically at all focus areas when considering what is to be done to improve efficiency, effectiveness, and sustainability of the HIV response and use of resources, these guidelines focus largely on the **Allocative Efficiency** component, and touch on some aspects of sustainability. These two concepts along with analytical methods with which to tackle them, are described in more detail in **Parts 2 and 3** of these guidelines.

3. Tools to support allocative efficiency analyses

There are several modelling, simulation, analysis and budgeting tools available to support country governments in improving the efficiency of their HIV resource allocation, HIV program coverage, and for projecting future HIV program costs to meet policy commitments. The following are tools with HIV **epidemic modeling** and **costing** components; therefore, it is these tools that can be used to undertake an **allocative efficiency analysis**:

- AIDS Epidemic Model (AEM)
- Goals
- Optima

The **AIDS Epidemic Model (AEM)** (formerly the Asian Epidemic Model) is a tool reflecting the primary sub-populations and transmission modes driving the HIV epidemics in Asia and more generally in concentrated epidemics, for policy and program analysis in countries. AEM is a deterministic, semi-parametric, population model which allows parameter fitting of several HIV prevalence outputs and epidemiological trends. The model is constructed around behavioral, epidemiological and programmatic data which is usually available in countries. Relevant link: http://www.aidsdatahub.org/sites/default/files/documents/The_Asian_Epidemic_Model_a_process_model_for_exploring_HIV_policy_and_program_alternatives_in_Asia.pdf

The **Goals Model** is a tool to estimate the impact and financial resources required to achieve program targets for HIV prevention, treatment, care and mitigation. It is a compartmental rate-based HIV model in the Spectrum suite. This model is intended to support strategic planning at the national and sub-national level by linking program goals, in the HIV area, and funding. The tool is intended to answer questions related to funding requirements to achieve goals, the effect of alternate patterns of resource allocation on the achievement of program goals, and training requirements for delivery of projected services. The Goals Model has been designed to compare different projection scenarios to assess the impact of diverse HIV intervention programs. Goals can be used to examine the cost-effectiveness of individual interventions or packages of interventions. It is available at: http://www.futuresinstitute.org/spectrum.aspx

Optima is a tool which, in addition to the allocative efficiency analysis and other features, also provides financial commitment analysis. This feature contributes to financial sustainability analysis by providing estimates of future healthcare costs of existing and projected HIV infections. Optima is an example of a software package for modelling HIV epidemics in the light of specific resource allocation levels to address practical policy and program questions encountered by funders, governments, policy makers, health planners, and program implementers. The key feature of this software is its ability to perform resource optimization to meet strategic HIV objectives, set program coverage targets, and conduct HIV-related financial projections in relation to countries' macro-economic contexts. Optima is flexible in terms of which population groups and HIV programs are modelled, the amount of input data used, and the types of outputs generated. Optima has been used in many countries and there is an increasing demand from stakeholders to have a tool such as Optima that can perform HIV epidemic analyses, inform the revision and prioritization of national HIV strategies based on available resources, the setting of HIV program coverage targets, amend HIV program implementation plans, and inform the investment strategies of governments and their funding partners. Optima is a tested and valued tool to support HIV allocative efficiency analysis. The Optima tool is further described in **Part 3** of **Volume 1** of these guidelines, **Volume 2** includes the Optima User Guide and further information is available at: http://optimamodel.com/

There are other tools which are **either epidemic or costing/budgeting** models. Several HIV epidemic models have been used to understand epidemic patterns or program impacts and thereby contribute towards allocative efficiency decisions. These models are, however, not full-fledged allocative efficiency tools, as they do not have an integrated cost analysis component. Among the most frequently used *epidemic models* are:

UNAIDS Modes of Transmission model (MoT) is a tool designed to focus on identifying who is at risk of infection. It is based on risk equations written in Microsoft Excel® and allows estimation of the expected number of incident HIV infections in different exposure groups within the population in a given year, and it calculates the relative contribution of a range of modes of transmission to the total number of new HIV infections. The MoT model is a static model. Modelling of intervention impact is not an outcome of the model, but different scenarios can be assessed by changing model inputs and exploring the effects of changes in service coverage or behavior changes on the distribution of new infections. Available at http://www.unaids.org/en/dataanalysis/datatools/incidencebymodesoftransmission/

HIV Synthesis Transmission model is a tool developed to incorporate much of our understanding of the underlying processes of HIV disease progression and the effect of ART for well-resourced settings. It is a stochastic computer simulation model designed to assess the impacts of ART such as drug resistance, the cost-effectiveness of second-line drugs for ART in settings without virological monitoring, and the epidemiological consequence of a population-based approach to ART with standardized regimens and clinical decision making based on CD4 count, among others. Relevant link: http://www.ncbi.nlm.nih.gov/pubmed/17944687

Epidemic Projections Package (EPP) is a simple HIV model for estimating and projecting adult HIV prevalence and incidence from surveillance data from various sites and years. EPP is used to fit a simple epidemic model to HIV prevalence data from urban and rural sites. The prevalence projection produced by EPP can be transferred to Spectrum to calculate the number of people infected, AIDS cases, AIDS-related deaths, etc.

The **Spectrum Policy Modelling System** consolidates several previous models into an integrated package available at:
http://www.unaids.org/en/dataanalysis/datatools/spectrumepp2013/

A number of planning, costing and budgeting tools can also contribute to the design and costing of HIV responses in the context of allocative efficiency analyses (the Partnership on Maternal, Neonatal and Child Health has also collected information on several such tools http://www.who.int/pmnch/knowledge/publications/costing_tools/en/index8.html). For instance:

Resource Needs Model (RNM) an HIV costing tool in the Spectrum suite, used to estimate overall program costs based on defined unit costs and coverage targets. The RNM calculates the total resources needed for prevention, care, and orphan and vulnerable children support for HIV and AIDS on a national level. The RNM can assist national-level strategic planning efforts by providing a tool and methodology to examine the financial resources needed to implement a variety of prevention interventions, care and treatment programs, and support for orphans and vulnerable children. Available at http://futuresgroup.com/resources/software_models/resource_needs_model

The **HIV Economics Reference Group** has commissioned the completion of an HIV allocative efficiency tools inventory that details where each tool has been used, and how the different modelling tools respond to different HIV policy questions. This inventory will soon be published on the web.

PART 2. HIV ALLOCATIVE EFFICIENCY ANALYSIS

1. Introduction

Given that in **Part 1** of the guidelines, we considered the wider context for allocative efficiency analyses, the focus will now shift to the finer details of allocative efficiency analysis.

1.1. What is an HIV allocative efficiency analysis?

HIV allocative efficiency analyses try to answer the question:
"How can HIV funding be assigned optimally in the most suitable combination of HIV response interventions that will offer the greatest impact or achieve the highest response goals in the areas of HIV prevention, treatment, care and support, in the quickest possible time?"

Allocative efficiency of health or HIV specific interventions is about the right intervention being provided to the right people at the right place in the correct way that health outcomes are maximized. Allocative efficiency analyses integrate epidemic impact with cost and programmatic information for decision-making based on considerations of program cost, impact, scope and coverage. Allocative efficiency is about making wise investments. For this, diverse HIV transmission dynamics and other risk factors must be taken into consideration, as well as individual and population level program effectiveness in order to deliver the most impactful mix of HIV programs to the most relevant target populations in the different geographic areas. These mixes will differ in particular epidemic settings. Through an HIV allocative efficiency analysis all these aspects are considered.

Analytical work on HIV allocative efficiency supports country teams to:

- Review the epidemic dynamics and drivers and the alignment between the transmission situation and expenditure patterns.
- Appraise and better understand the cost components of HIV programs and the national HIV response.
- Assess the best possible or optimal allocations of limited resources for the greatest health impact.
- Evaluate health and financial impacts of policy alternatives and program options in the context of broader health financing.

Through an HIV allocative efficiency analysis, countries gain a better understanding of the course of HIV in their country; they get to review all aspects of their current response, reassess their strategy and prioritized objectives, and improve resource allocation. When doing such an analysis in combination using, at least in part, a mathematical modelling tool such as Optima (see **Part 3** and **Volume 2** of the guidelines), country teams are able to optimize the way in which financial resources are reassigned, and review targets to play out different scenarios until the resources are assigned optimally across the different interventions required.

Allocative Efficiency requires prioritisation of HIV programs and resources.

There are different approaches to an analysis in allocative efficiency that range from heuristic methods, to epidemiologically-focused analyses and intuitive program recommendations, to pragmatic approaches driven by global goals such as the 3 by 5 initiative to rapidly increase access to HIV treatment by 2005. Since the 1990s, there has been increasing attention to national strategic planning and allocating HIV resources to areas where best prevention, treatment and impact mitigation results can be expected. Programmatically early guidance on National Strategic Plans (NSPs) for HIV was gradually complemented with guidance to Know Your Epidemic/Know Your Response (KYE/KYR) epidemiological and program assessments, the AIDS Strategic and Action Planning (ASAP) service, and various other program planning, costing and budgeting tools. In the research community, different mathematical models (some of which were presented earlier) were developed to estimate trends in HIV epidemics and potential impacts of both individual interventions and combinations of interventions. Today, a range of mainstreamed research tools are available to contribute to allocative efficiency analyses. The HIV Modelling Consortium has compiled a useful resource base (http://www.hivmodelling.org/countries/all-models).

Through an allocative efficiency analysis one ensures that, when results are acted upon, scarce resources flow to the programs and areas of intervention that are most likely to produce the best or optimal results. The term, allocative efficiency, refers to the maximization of health outcomes with the least costly, or most beneficial, mix of health interventions.

Part 2 of the guidelines, below, describes the process steps involved in HIV allocative efficiency analysis in detail.

1.2. Transforming HIV allocative efficiency analysis results into action

Translating the analysis results to investment policy and programming is needed to ensure the benefits of the allocative efficiency analyses are actually achieved.

> An **efficiency** agenda is central to the ability of governments to **sustain progress** on their coverages goals.

The analysis is the first step in the process of understanding what will be needed to bring about optimal resource allocation and maximum health outcomes; the real challenge lies in implementing recommendations produced from the analysis results. Such recommendations might require countries to either mobilize additional funding, or change the nature or type of programs that are being implemented, or even stop funding certain programs. This can be challenging due to the multitude of funding sources, the multi-year budgeting cycles and procurement contracts in which countries and donors often find themselves, and the large proportion of HIV funding that is influenced by external funding agendas and allocation criteria.

To have the best chance at success, an allocative efficiency analysis process should be performed keeping in mind that the following is needed:

a) **Operational plan that sets targets and processes for implementing the changes**: Investment and policy recommendations will be most useful when they are accompanied by an operational plan, and with technical support to draw on, so that analysis results find immediate translation into programming.

b) **A local Government champion, with the Government in the driving seat:** The capacity and willingness of governments to allocate resources, in line with the recommendations of an allocative efficiency analysis, is critical. Implementation of the recommendations produced by an allocative efficiency analysis entails the capacity to shift resources from old priorities to new ones, and from less to more effective programs, to make the most of the limited resources. Such shifts in funding may be gradual as program delivery needs to be reoriented and in some cases scaled down, integrated or provided with different delivery modes. Allocative efficiency analysis requires the government to establish and prioritize objectives and assess the actual or expected contribution of public expenditures to those objectives. To allocate efficiently, government must be strategic and evaluative; it must both look ahead and define what it wants to accomplish in a certain time frame, and look back to examine the results and measure the impact. Allocative efficiency analyses assist governments to fulfill these important obligations and consider different scenarios within their own resource envelope and specific epidemic settings.

c) **Realization that it is an incremental process:** Given that resource allocation changes are linked to multi-year budgeting processes and procurement cycles, it is an incremental and extended process of change or shift, rather than a sudden or short-term process with immediate or direct benefits.

1.3. Timing and relevance of an HIV allocative efficiency analysis

Helps guide HIV resourcing decisions: allocative efficiency analyses should be conducted prior to or during important policy or strategy decision-making processes to change, revise or update HIV funding allocations. This provides an opportunity to determine epidemiological or other HIV-related program populations, geographic areas of coverage and program resource allocations and program coverage levels.

Assists with planning functions and funding applications: when allocative efficiency analyses are linked to strategic planning, program evaluations and ongoing budget processes, planning for public resources is made easier. HIV allocative efficiency analysis can assist in the development of prioritized national strategic, operational or implementation plans and will greatly assist in the development of funding applications including Global Fund concept notes. The process undertaken with an allocative efficiency analysis contributes to countries' HIV strategy and planning processes, as well as discussions on HIV service integration and linkage, and strengthens HIV program review. Linking the analysis to the budgeting cycle is also beneficial.

When new data is released: as major, new or improved data becomes available in countries, for example National AIDS Spending Assessment (NASA) or Disease-specific Health Account data (DSA, as part of the system of health accounts), Demographic and Health Survey (DHS) reports, and data from key population surveys. They greatly contribute to a robust allocative efficiency analysis. New data on HIV prevalence and HIV incidence are especially useful for the epidemic modelling component of an allocative efficiency analysis.

When HIV programs are reviewed: given the nature of allocative efficiency analysis, which require country teams to both reflect on results of the past and consider what should be accomplished in future, drawing lessons and applying the knowledge in future strategy discussions are critical. Insights and learning from the past can be used to guide future interventions, but the future is not limited by what happened in the past as innovation needs to be accommodated as well.

To identify priority programs, populations and areas: HIV allocative efficiency analysis helps Governments and development partners to identify which priority populations in which geographic areas and which programs to concentrate their funding efforts on. Also, how HIV service coverage for each of these populations, over time, would need to change, using longer time horizons and analytical approaches to determine where investments should be made and where priorities lie. This also implies a shift from thinking primarily in terms of resource needs (total cost for delivering all relevant HIV programs) towards thinking in terms of value for money (cost for programs that are most cost-effective in achieving impact targets), prioritization, and longer-term investment.

When considering broader health sector resourcing issues and impact: the common metrics of YLL (see Introduction section and Figure 1) and disability-adjusted life year (DALY) assist in gaining an understanding of the comparative burden of different diseases, and most countries can draw on GBD studies. The knowledge of health programs and their individual target populations, services provided and intended benefits help in this broader discussion as well, as HIV programs and their resource base are being reviewed. Allocative efficiency analyses can therefore be used to highlight how resources are being assigned and utilized across different program areas within the health sector. One of the key benefits of an allocative efficiency analysis is that through the analysis country teams are guided on how to make the most of available HIV funding, and think about their wider effects and benefits across health services.

1.4. Limitations of an HIV allocative efficiency analysis

While HIV allocative efficiency analyses have several commendable attributes and outcomes, they also have some limitations that need to be considered.

Data limitations: as with all other evidence-based approaches, HIV allocative efficiency analyses are dependent on the availability, reliability and quality of the data required and used to carry out the analyses. Should there be important data gaps or inconsistencies then the resulting analysis will be affected. Trend analysis is an important aspect of the analysis methodology. If data is not comparable over time this can compromise the analysis conducted. It is recommended that the best available trend data be used for HIV allocative efficiency analyses, both from empirical data sources and modeled trends. Historical program spending data is required for certain aspects of the HIV allocative efficiency analysis. Unfortunately this is one area of limited, scarce or unreliable data. Any effort made to improve this data will add great value to the analysis. It is also accepted that some data are not directly available and need to be derived through calculation and estimation.

Interrelations of programs and sub-populations and accommodating these in the analyses: critical to an HIV allocative efficiency analysis is to determine the impact of certain HIV programs and specifically relating the effects of these programs to the populations they are targeted at. Resource allocation and prioritizing interventions within a mix of HIV programs is a complex issue. It is important that all aspects of budgeting, cost generators, range of interventions and sub-populations affected are included in the analysis. The tools used to facilitate the HIV allocative efficiency analysis should be as refined and comprehensive as possible. If there are limitations as a result of the tools utilized, these should be declared upfront and users are to consider this as they use and interpret the results of the analysis.

Insufficient categorization: as another data issue, in several countries, populations are insufficiently characterized in terms of their HIV risk. Should the data not be available for certain sub-populations, it will result in important segments of the population being omitted from the analysis. As sub-populations which are deemed important in the epidemic are left out from the analysis, the understanding of their role in the current and future epidemic are not explored, and they may be left out in the programmatic resource allocation projections due to not being included in the analysis.

Special effort needed to incorporate health and social benefits beyond HIV: HIV allocative efficiency analysis commonly uses HIV-related metrics such as HIV infections averted, AIDS-related deaths averted, or HIV DALYs. An HIV program may have other beneficial effects beyond these outcomes, such as impacting TB transmission levels, economic participation of HIV infected persons, and social benefits, such as better education effects, improved social cohesion or reduced crime. It is not impossible to measure these benefits but it is very difficult to quantify and attribute these benefits and therefore they are often excluded from the analysis.

Some authors have specifically drawn attention to structural factors like poverty, stigma and discrimination, gender inequality and violence, among others that help drive and sustain the HIV epidemic. Because of their distal nature, such structural drivers cannot easily be included in an allocative efficiency analysis. Remme et al., for example, writes that *“HIV-specific budgeting and priority setting, based on HIV-specific outcomes alone, could lead to the undervaluation of investments in such [structural] interventions”*. The same author proposes the consideration of a co-financing approach across sectors, to leverage disease-specific resources across the development sector and address the underlying root causes of the many health and development problems.

While conducting a HIV allocative efficiency analysis with HIV specific outcomes, it is therefore important to remember the limitations of such an analysis, and discuss the possibility of including other more distal interventions contributing to HIV outcomes in such analyses (provided that relevant data are available).

Similarly, there are non-HIV programs (such as family planning) that have beneficial effects on HIV. These benefits and costs, however, are not fully accounted for or are often excluded from HIV allocative efficiency analysis if not explicitly included in the program choices being made.

Limited to HIV programs: generally, HIV allocative efficiency analyses only consider HIV programs and resource allocations within HIV programs, which is the intra-disease allocation. However, as we already discussed, decision-makers often need to think more broadly. Under the new Global Fund funding model, country teams are faced with dealing with the challenge of resources allocations across specific diseases (HIV, TB, and malaria) as well as health sector strengthening investments. While HIV allocative efficiency analysis is currently focused on HIV programs, efforts are underway to strengthen and further develop tools to review inter-disease allocations.

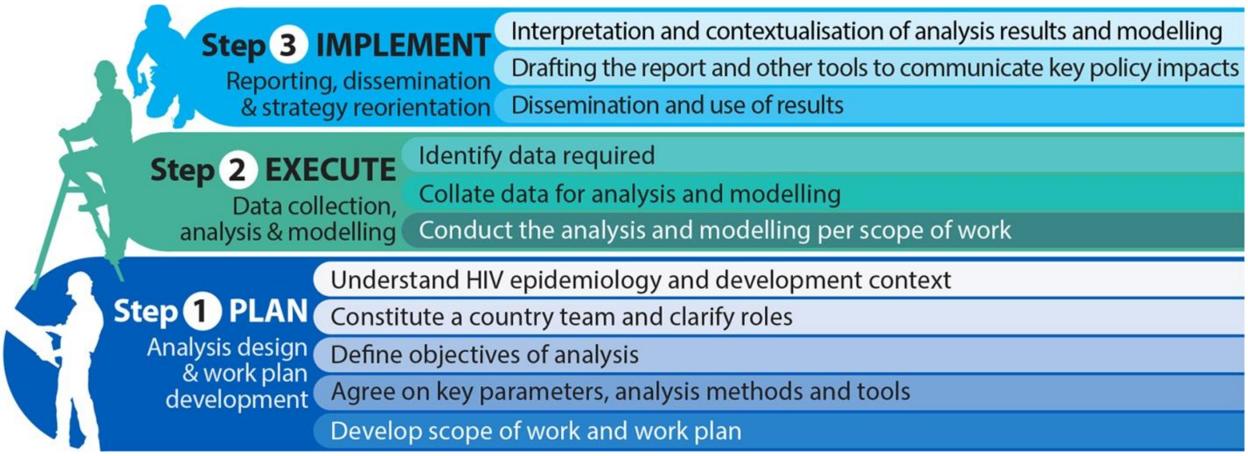
Mathematical modelling limitations: any mathematical model, by sheer design, is a simplification of reality. All modelling tools have limitations. To understand a model's limitations it is important to understand the assumptions and parameters that are used to create scenarios or quantify analyses. There are often limitations of both the modelling methodology and the assumptions. The limitations of Optima will be considered in **Part 3** of these guidelines.

Political economy: decision making is generally influenced by politics. The political economy is important, and needs to be considered as decisions are made. Allocative efficiency analysis can help influence political economy considerations. With the mathematical tools, different scenarios can be built and different options and influences presented for consideration.

2. Steps required to conduct an HIV Allocative Efficiency Analysis

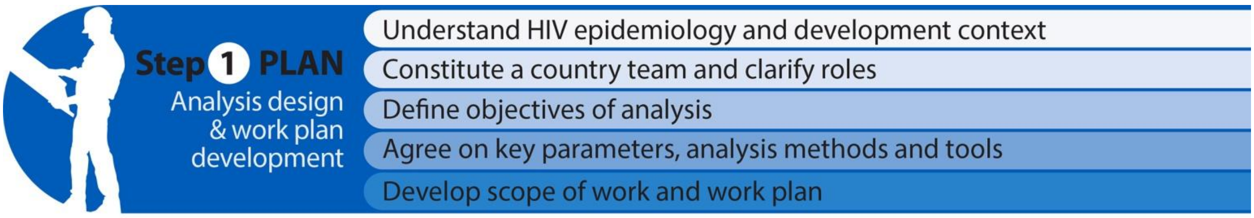
For a detailed understanding of the possible allocative efficiency gains and determining which programs are to be prioritized over others, it is recommended that the following steps be implemented as part of an HIV allocative efficiency analysis:

Figure 6: Outline of process steps of HIV allocative efficiency analysis



Each of these process steps will now be explored further.

2.1. PLAN: Analysis design and work plan development



2.2. Understanding broader HIV epidemiology and development context

Before planning an HIV allocative efficiency analysis, it is important to understand:

- the broader development and health system context,
- the resource flows,
- state of and trends in the HIV epidemic of the country,
- the current HIV response and level of integration in health programs, as well as
- the political economy of HIV decision making in the country.

Furthermore, the funding available for HIV and AIDS and the targets and objectives of the HIV strategy, as well as the operational plan and priorities, also need to be well-understood. It is advantageous to understand the regional contexts especially that of the neighboring countries to better inform the analysis.

a) Understanding trends in the HIV epidemic

It is important that the current state of the HIV epidemic is understood, as far as possible. Consideration is to be given to the historical course and scale of the epidemic, including reviewing the epidemic trend over time by geographic zone, urban and rural areas, sex, different populations, and age bands.

An understanding of how HIV is distributed in the various geographic locations and population sub-groups of the country and which key populations have elevated HIV prevalence will assist with the analysis. Population-based survey reports such as DHS (Demographic Health Survey) and AIS (AIDS Indicator Survey) Reports, as well as HIV prevalence data from antenatal clinic clients should be consulted to obtain the necessary information. There is an increasing availability of spatially mapped HIV data. Examples of some sub-national estimates and maps from 12 countries are available at
http://www.unaids.org/en/dataanalysis/knowyourepidemic/epidemiologypublications

Such data could also be used to conduct sub-national allocative efficiency analyses. This could be done using a mathematical model, but since not all parameters may be available for all sub-national regions, it may be more feasible to conduct such analyses outside the model. For example, the model may suggest that a core program like PMTCT or condom distribution for the general population is not cost-effective in a country with a concentrated epidemic, but there may be additional information on geographical hotspots or patterns, which could inform recommendations for geographical or other targeting of programs – or different levels of intensity for providing services in different locations (e.g. only scale up HTC for pregnant women, but use fewer referral sites for delivering full PMTCT services for the very few HIV positive women identified in low-prevalence areas).

b) Taking stock of the current response including funding available and the national targets

In gaining an understanding of the country's current response to HIV it is important to consider efforts of the past, current efforts and what is planned. The HIV specific response is also to be viewed in the light of the broader health sector issues including finance, services and programs, as well as national targets and objectives.

Consideration is to be given as to how the HIV response is financed and what has been spent on different HIV services and programs. Next to reflect on is what HIV services and programs have been scaled up and to what level of coverage of the target populations. These services and programs could include condom promotion and distribution, prevention of mother-to-child transmission, HIV counselling and testing, provision of ART, and SBCC, amongst other key programs.

The HIV strategy or HIV implementation plan should be reviewed. Of special interest for the Analysis is the focus of the programs and planned interventions, the targets countries are working towards and if the plan is costed, the source and extent of funding required, as well as unit costs.

c) Understanding broader development, health, and political contexts

The analysis to be undertaken should be viewed in the light of relevant major trends in the economic and human development context within the country. The macroeconomic situation needs to be considered along with potential for economic growth and the sectors that contribute to the country's economy. An understanding of the administrative landscape is also valuable.

Basic human development factors are to be considered. These include an awareness of the composition of the population and reviewing key indicators such as population growth rate, fertility index, birth rates, life expectancy, per capita income, poverty levels, living conditions, standards of housing and living, human development index, HIV indicators, education and literacy levels. Where possible, indicator values between rural and urban areas should be compared. Issues of food security within the country and means and modes of successful communication should also be considered.

Any plans or legislative frameworks developed to guide the future investment strategy, especially HIV investments, or broader social sector development should be reviewed. These could include a Poverty Reduction Plan, Economic and Social Development plan or Growth and Rejuvenation Strategies. The national Health Development Plan would be another important document to review and consider the objectives identified to improve the population's health status and attainment of the health MDGs. Other factors to consider include country commitments to universal health coverage and political commitments to meet health targets utilizing approaches such as a rights-based approach.

Political economy considerations:

- Develop partner profiles
- Identify groups who want the analysis done
- Consider for whom it is important
- Consider who the champion of the analysis will be
- Identify who does not support the analysis. Consider how to involve and include them
- Consider how results will be used and shared
- Who will be interested in monitoring the implementation of recommendations?

There needs to be a very specific and direct focus of the health sector. Consideration is to be given to what portion of the GDP is spent on the provision of health services and source of funding. The health priorities and challenges, including the burden of disease are to be reviewed, along with the provision and reach of health services. Wherever possible, potential differences between urban and rural areas and possible gender differentials in the levels of the above indicators should be noted.

The purpose of reviewing these documentation and trends is to obtain a better sense of the key development challenges in the country, and how the HIV responses need to be implemented within that context.

d) Identifying stakeholders involved in the analysis and a local champion

Finally, it is also important to understand the political economy in the country, specifically in terms of health and HIV policy making, financing and implementation. Questions to consider include: who are the key stakeholders, what are their motivations, and how are they linked to the HIV response? It is helpful to speak with local HIV stakeholders to get a sense of the political economy, and to identify a local champion who will both be involved in the study and champion the implementation of recommendations.

Kusek, Görgens, and Hamilton (2014) summarize it as follows:

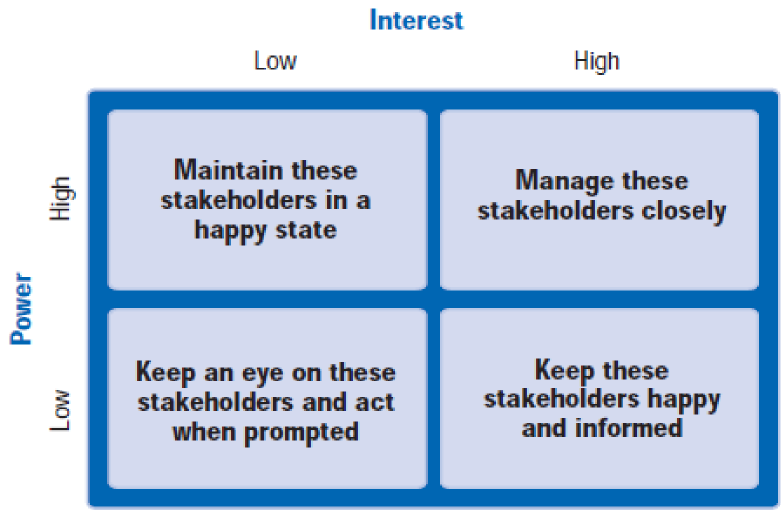
"Avoiding failure means understanding the importance of managing key stakeholders, both those in favor and those opposed to the effort. If senior management is not behind the effort, it likely will not succeed. Several studies—from Young and Jordan (2008) to Rondinelli (1993) and Bryde (2008) for example—have concurred that senior management support is essential for project success".

"Bryde (2008) went further to say that a project champion matters most, that such a project champion needs to have an internal and external function, and the managerial skills of project champions—not their technical prowess in a specific field—are most important. Senior management plays a game-changing role in determining project success or failure, irrespective

of the organization involved. However, those not in favor of the project's moving forward, or the critics, can play just as important a role in whether or not the project fails. Failure to recognize the role played by people who have both a positive and a negative viewpoint about project implementation will result in disaster."[1]

It may be useful to think of different types of stakeholders as follows (Figure 7) and to plan for the involvement of the stakeholders with high power and high interest in the allocative efficiency analysis.

Figure 7: Power-Interest Matrix in terms of types of stakeholders involved in the analysis



Source: Chinyio and Olomolaiye, 2010

2.3. Constitute the country team

The value of conducting an HIV allocative efficiency analysis also lies in the diagnostic and consultative processes that guide you through the analysis process and finally lead to the development of the different resource allocation scenarios and policy recommendations. Once the stakeholder analysis, including informal engagement, and political economy analysis have been undertaken, a country team can be established.

It is suggested that the country team established to work on the HIV allocative efficiency analysis includes a technical study leader, who should be experienced in doing these types of analyses and who will be a champion for the work in-country. The team should draw on members in relevant technical working groups (TWGs) such as the M&E TWG. Typically, the following persons are included in the study team

- Representatives of the Ministry of Health who deal with HIV programs,
- Ministry of Finance officials involved in financing and budgeting for HIV programs,
- Technical personnel of the National AIDS Commission,
- Other developmental partners supporting HIV programs and initiatives, and

[1] Kusek, J., Gorgens, M., and Hamilton. B. 2014. Failsafe management: Five rules to avoid program failure. World Bank: Washington DC. Available at: https://publications.worldbank.org/index.php?main_page=product_info&cPath=0&products_id=24547&wbid=c6f2040024cad40fb2f35c2e56585400

- Epidemiologist and HIV monitoring and evaluation (M&E) officers. Epidemiologists generally have a thorough understanding of the nature of the country epidemic and the M&E officer will generally have a good working knowledge of data availability, HIV programs and spending patterns.

The technical study leader should be someone who is very familiar with all the technical aspects of the analysis required, be very experienced and skilled in conducting HIV allocative efficiency analysis and particularly practiced in using the selected tool. The technical study leader is usually a technical assistant assigned to the task. Generally, the focal point is an in-country representative, who is well-informed about the National response, is knowledgeable about the status of the epidemic and well aware of the data that is available. Usually the head of M&E at NAC takes on the role of focal point, however, this is not always the case and one needs to consider country nuance. In-country or regional representatives of the development partners are usually also available to work with the teams, and they should be drawn into the process as early as possible.

2.4. Define objectives of analysis

Through developing a Scope of Work document the country study team can achieve the following:

a) Define HIV policy questions that the Government wishes to answer

It is important to agree on the core policy questions that the allocative efficiency analysis seeks to answer (see box below for illustrative examples). The policy objectives need to be specific about the funding levels for which resource allocations should be done, clear about the health outcomes that the country wishes to achieve, time-bound, and specific about the measures of success that will be used. There is a need for simple but precise questions.

During the development of the objectives, it is important to discuss the timing and substance of key upcoming policy and funding decisions the country needs to take. Examples include the context of revising a national strategy, preparing a concept note for the Global Fund or building an HIV investment case to mobilize domestic public sector resources.

EXAMPLE of four HIV policy questions defined for a country HIV allocative efficiency analysis

1. How can the country best allocate available HIV funding for maximum HIV impact up to 2030?
2. What is the least amount of money needed to achieve the targets of the National HIV Strategy over the next 5 years?
3. What is the return on investment of specified HIV investments over the next 5 years?
4. What are the health and financial impacts of implementing a different HIV treatment initiation policy over the next 5 years?

b) Develop analysis questions and identifying sub-analyses required

HIV allocative efficiency analyses need to be responsive to countries' needs and priorities. While all countries will follow similar processes in conducting an allocative efficiency analysis, the components to include and targets they are working towards will differ due to the unique situation and analysis needs of each country. Therefore, once the HIV policy questions are defined, these need to be translated into specific analysis and modelling questions. Specific sub-analyses to further unpack the HIV policy question might also need to be specified. The questions need to be specific, time referenced, where applicable target certain sub-populations, and be measurable.

When developing the question, country teams need to consider:

- What is the health outcome that the country seeks to achieve,
- for which group (or perhaps within which geographic area),
- within which time frame, and
- what resources does the country have access to, or will it require?

The second level of questioning, which will result from the allocative analyses itself, could include:

- To what extent will HIV prevalence, incidence and deaths be minimized?
- To what extent will the reach (or coverage) of programs be extended?
- How does this relate to the national targets?
- How do resources have to be assigned to programs to achieve this?

An illustrative example of a well-structured research question indicating the required sub-analyses is provided below:

EXAMPLE
Defining specific analysis questions surrounding the HIV policy question, "How can a country best allocate available HIV funding for maximum HIV impact up to 2030?"

This analysis will be an epidemiological projection and comparison of outcomes with current and optimized allocation of resources. The focus will be to determine how the country can best allocate the available and anticipated domestic and international HIV resources to achieve maximum HIV response impact (HIV infections and AIDS related deaths averted)? This will entail the following specific questions:

a. How many new HIV infections and AIDS-related deaths will be averted over the next XX years, and how close will this get the country to the national strategic plan's disease-related targets:
(i) With the current volume of funding, allocated according to current expenditure?
(ii) If anticipated program coverage targets in the NSP are achieved?
(iii) With the current volume of funding, allocated optimally?

b. What is the volume of funding needed to achieve the country's HIV national strategy outcome goals over the life of the strategy (or over a longer time horizon):
(i) According to current program implementation practices and costs?
(ii) If efficiency gains (lower unit costs, less money on management, etc.) and different service delivery models are plausibly identified with a justification for how the efficiencies may be achieved?

c. What are the long-term HIV-related financial implications of continuing current HIV expenditure patterns compared with (i) optimally allocating resources over the NSP period (as defined above); (ii) increasing spending to meet national strategy targets; (iii) changing ART eligibility criteria; and/or (iv) any other program scenario that the country would like to compare it to?

2.5. Agree on analysis methods, key parameters, and tools

a) Selection of analysis method

It is at this stage that country groups need to agree on what approach they will utilize for the analysis. They need to consider which **analytical method** is going to best suit the needs of their analysis. Generally an HIV allocative efficiency analysis can:

- be based on the data provided, and objectives posed with different response and financing scenarios created; or
- consider the alignment between the current epidemic dynamics (transmitting and receiving populations) and the current targeting and reach of the interventions and misalignment between these identified. In optimization analysis, current resource allocation can be 'optimized' to explore what could be achieved if investment was directed in the most impactful way. Here, considerations on programmatic efficiency and potential savings for re-investment elsewhere can also be made with a fixed budget or anticipated increases; and how resources can be re-allocated to improve efficiency; and what level of resourcing is required to achieve expected outcomes in a given timeframe.

What all allocative efficiency tools have in common is that they have an epidemic model underpinning them, which establishes epidemic trends and projects them into the future thereby creating a baseline scenario assuming "business as usual" (at current coverage of programs or stable HIV investment). There are different approaches to finding resource allocation options, which can be more effective than "business as usual". Mainly three approaches are used, summarized below:

i) Epidemiological analytical method (no quantification of resources needed), with conceptual recommendations: While some allocative efficiency analyses can be done without a mathematical model, the analysis and options it produces will be limited (heuristic and not analytical). Some countries have completed some basic analyses using tools such as a mapping approach (see below), or Microsoft Excel® to explore allocative efficiency questions and mapping policy, programs and funding allocation to explore allocative efficiency choices. These recommendations are made based on epidemiological data and 'gut feel', and does not involve quantification of the allocative efficiency decisions derived via simulation or analysis.

Figure 8: Example of mapping and heuristic approach used to explore allocative efficiency analysis

HIV Prevention policy areas	Evidence for effect on HIV incidence	Policies responding to which drivers of the epidemic	HIV prevention program implemented	Funding for HIV prevention (as % of total HIV prevention funding)
Needle and syringe exchange program	Yes	Sharing of non-sterile injecting equipment	Implemented on a small scale	3% of prevention funding
HIV awareness program	No	Age disparate sex	Yes, through TV only	5% of prevention funding
HIV peer education for the youth	Yes	Early sexual debut Low condom use	Yes, in urban areas only	10% of prevention funding
PMTCT	Yes	Vertical transmission	Yes, All ANC clinics, integrated	5% of prevention funding
VCT	No	Access to care and support	Yes, capital city only	42% of prevention funding
Life skills education in schools	No	Early sexual debut Low condom use	Yes, in 40% of secondary schools	2% of prevention funding
Male circumcision practices	Yes	Lack of male circumcision	Not implemented	No funding
Social change communication	Research needs to be done	Multiple concurrent partnerships	Not implemented	No funding
Gender based violence	Conflicting evidence	Gender inequality	In all prisons across the country	33% of prevention funding

Source: The World Bank, Epidemic, response and policy synthesis process used in country assessments, 2008

ii) Scenario analysis: This type of allocative efficiency analysis can be conducted using tools such as GOALS, Optima or AEM. Different scenarios of coverage levels of core HIV programs are assumed and then mathematical modelling is carried out to assess the impact of such investments. One example for such an analysis would be to compare the impact of reaching 80per cent ART coverage only, versus reach 80 per cent coverage of ART along with core prevention interventions. Scenarios can also be run for different impact targets to determine the cost of achieving specific reductions in incidence and deaths. Different scenarios are then compared and discussed to determine which scenario is most appropriate in the country context.

iii) Optimization analysis: A different approach to establishing an allocatively efficient mix of programs, is through mathematical optimization (currently available in Optima): This analysis focuses on how best, with certain levels of resourcing, programs should best be implemented to minimize HIV incidence, minimize DALYs resulting from AIDS and minimize AIDS-related deaths. In optimization analysis, a large range of program mix options are mathematically tested and compared until the most effective combination of interventions is established.

Scenario Analysis	Optimization Analysis
Compares different settings, but won't look for the optimal	Looks for the optimal mix achieving an objective
Typically tied to different coverage or allocation scenarios, e.g., different coverage targets e.g., 80 per cent coverage of VMMC, FSW, MSM	Always tied to an overarching goal, e.g., minimize new infections

Much of the scope of the analysis is determined by the methodology employed or tools utilized. Some tools or models that support this type of analysis are focused on specific aspects, and country teams need to ensure that the accepted methodology or applied tool meets their needs for the allocative efficiency analysis. See **Part 1, section 3**, for a brief overview of some of the different tools and models available to countries.

Once a decision is made on the tools to be used, a crucial step for country teams is to reach agreement on the key parameters or important areas of consideration for the analysis.

b) Agreement on key parameters to the analysis

Country teams need to agree on which **populations, HIV programs** and **HIV expenditure categories** they are to focus on in the analysis. There are four aspects that need to be considered to guide whether the populations or programs should be included:

- Does the population or sub-populations make a significant contribution to HIV prevalence figures within the country, or is it at least a sizable population and hence should be included?
- Does the HIV program make a significant contribution to HIV national intervention or is a sizeable part of the HIV program budget assigned to this program?
- Is there reliable, current and quality demographic data available on the sub-populations of interest?
- Is there reliable, current and quality expenditure, coverage and reach data available for the specific HIV program?

Considering these issues, the country study team needs to decide which **populations** to include in the analysis. This is based on the population's size, role and importance in the epidemic and quality of data on the population and required sub-populations (see below for choice of **HIV programs** and **HIV expenditure categories)**. It should be noted that some tools do not allow flexibility in the selection of populations to include in the analysis. In these cases, the analysis is conducted with set population data.

> In a recent Allocative Efficiency Analysis conducted in Sudan, local stakeholders suggested that prisoners, populations of humanitarian concern, migrants, and people who inject drugs should be considered in the modelling analysis, in addition to FSW, their clients and MSM. Stakeholders felt that these populations may play an important role in the epidemic. However, there were very few data on these four populations which could be used, and it was agreed that there should first be an effort to improve data availability on these populations for strengthening the understanding of their role as sources of new HIV infections.

Country teams would need to work with their own agencies that collect and process population data from the national censuses and size estimation studies conducted at various intervals. These agencies can support the country study team with population estimates and projections, as they understand best the variables that impact on fertility, mortality and population growth. Some population projections do include the impact of HIV on population growth, by including mortality assumptions, including AIDS. For the purposes of this analysis it is better to work with population estimates that ***exclude*** HIV and AIDS impact, as this will be done as part of the data analysis. However, if the projected population data is only provided with HIV and AIDS impact estimates included, it is critical for countries to understand how the HIV impact has been included into the population projections. For countries that do not have their own population or census data, they can refer to the UN population datasets available at http://esa.un.org/wpp/unpp/panel_indicators.html, to draw down population datasets It is important to note that as of 2012, the UN Population Division (UNPD) no longer publish a "no-AIDS" scenario that excludes HIV and AIDS impact.

Population data from censuses and projections are generally provided by sex and within 5-year age bands. For the purposes of the HIV allocative efficiency analysis, the age bands only become critical when there are important and large scale HIV programs that specifically target an age band, such as the youth or 15 to 24 year olds, or if epidemic parameters differ greatly across ages. It is critical to ensure that if age bands are being used, the different groups do tally to the original total population figures provided. For the analysis it is important to use population data for the base year of the analysis, and to include estimates and projections throughout the time period under analysis. Population numbers of future years, or projected population numbers, are for instance used in program coverage estimations (population size as denominator), or in program costs (population size being associated with service volume and program cost).

In addition to the general population data, by sex and age, it is important that population data is provided for the different population sub-groups that HIV programs or interventions target. Amongst these, the following key populations at increased HIV risk should generally be considered in all types of HIV epidemics:

FSW	Female sex workers
MSM	Men who have sex with men
PWID	People who inject drugs (male and female)
SWC	Clients of sex workers

Some population members could, based on their multiple risk behaviors, be allocated to more than one population, for example, some MSM may also engage in injecting behavior. Usually, such individuals are assigned in such analyses to a population based on their dominant risk (using available knowledge on transmission probabilities of intravenous drug injection with a contaminated needle-syringe, penile-vaginal or penile-anal intercourse, and mother-to-child).
In addition to the key populations listed above, depending on country specific HIV epidemic drivers, countries may want to include – for instance - “Migrants” and “Prisoners” (numbers by sex), should they be considered to be populations at increased risk of HIV infection, should there be substantive programs targeting them and should minimal demographic, epidemiological and behavioral data be available.

Country teams should try and avoid falling into the trap of accommodating too many different sub-populations, as this might weaken the analysis due to limited knowledge on population size, risk behaviors, relationship patterns and biological variables like HIV and STIs (sexually transmitted infections). Sub-populations should only be included if there is a minimum amount of data (like an approximate population size and HIV prevalence), or if they are targeted in a significant manner through a focused program, or if they are considered to meaningfully contribute to HIV incidence and transmission in the country.

The country team will also need to decide, which **national HIV programs** to include in the analysis, and similar criteria apply as on selecting the sub-populations. Generally, the common core HIV programs will be included in the country National Strategic Plan, and HIV program tracking or reporting systems are good data sources. Equally, financial reporting systems, such as the NAC Financial Management systems, the National Health Accounts, System of Health Accounts (SHA) or the NASA (National AIDS Spending Assessment) resource tracking highlight key HIV programs. Where HIV indicator systems have been introduced in country, these could provide data on the range and reach of the critical HIV programs. The following core HIV programs are generally considered in an HIV allocative efficiency analyses:

ART	Antiretroviral treatment
Condom	Condom programs
FSW	Female sex worker programs
HCT/VTC	HIV counselling & testing Voluntary testing & counselling
MSM	Men who have sex with men programs
NSP	Needle-syringe programs
OST	Opioid/Opiate substitution therapy
PMTCT	Prevention of mother-to-child transmission
PrEP	Pre-Exposure Prophylaxis
SBCC	**Social and behavior change communication**
VMMC	Voluntary medical male circumcision

However, one can also include new and innovative programs in an analysis of this nature to estimate what the impact of these interventions will be.

When selecting programs to include, it is relevant to consider the link or impact that different programs may have on each other (e.g. ART requires HCT to identify who needs ART) and also how the relationship between expenditure and effect differs across programs.

- **SBCC programs** might not have an epidemiological impact in and of themselves, but, if designed well and implemented at a certain scale, are thought to affect the uptake of other HIV programs (for example, an ART adherence promotion program can affect ART uptake rates, and a condom promotion program could affect condom uptake and use).

- **PMTCT programs** may consume funding over a period of time as they are delivered to individual HIV-positive pregnant women over a few months (different for option B+, where an HIV positive pregnant woman upon diagnosis, with HIV infection, is immediately put on lifelong HIV treatment). The epidemiological impact of investment in PMTCT is slightly different to other investments, as HIV transmissions to infants are mostly dead-end and only long-term survivors of MTCT are at risk of onward transmission.

- **VMMC programs** also have their specificities, as the actual intervention is a "one-off" with funds spent just for the VMMC counselling, procedure and short after-care - yet the intervention permanently reduces the man's risk of getting HIV infected over the remaining years of sexual activity. If VMMC is carried out at a young age (in infancy, childhood or early adolescence), then the full epidemiological impact of the intervention can be delayed for several years or even 2-3 decades – but, the cumulative effect of circumcision at a young age is higher because more sexual acts are protected.

- Regarding **ART**, once a person is initiated on the treatment, there is an obligation to continue to provide the service as long as the person needs it. This has very significant resource implications and can extend over a long period of time.

- Other programs like **ART, NSPs, OST, PrEP,** and **condom programs** are effective, but require continual funding to sustain their effectiveness. Their cumulative effect on reducing HIV transmission is far more immediate compared to early VMMC.

In addition to the HIV programs listed above, depending on country specific HIV epidemic drivers country teams may want to include other programs. These can be substantive programs funded from the HIV budget such as "cash transfers for young girls", (where for example young girls are provided cash incentives for attending and remaining in school,) and there should be reliable, current data available about program costs and effectiveness.

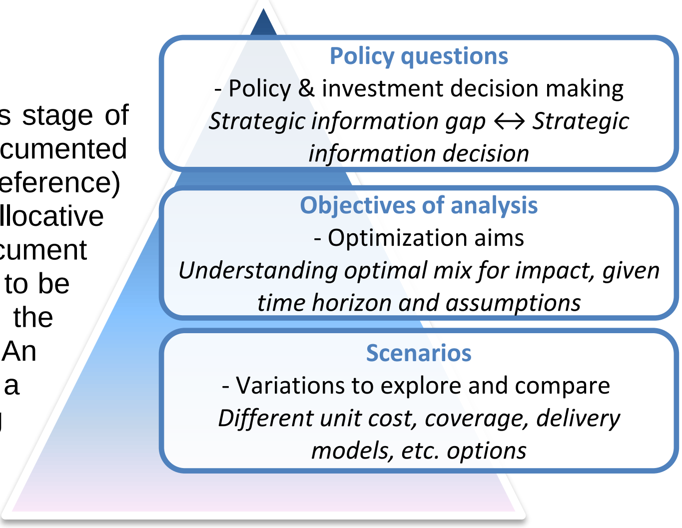
In addition there are some aspects of programs that enable other programs, or cut across all programs (sometimes called critical enablers and synergies). While it is important to consider these programs, as they form part of the HIV resource allocation process, they may be treated differently in the allocative efficiency analysis as they may not have a *direct* and measurable effect on HIV incidence or AIDS-related deaths. An example of some of these programs include: governance, management and coordination, strategic information, capacity building, infrastructure and impact mitigation.

Other interventions, like universal precautions, medical waste management and safe blood provision are health system interventions and should not necessarily be funded from HIV-specific resources, but rather broader health resources.

2.6. Develop Scope of Work and Work Plan

a) Develop a Scope of Work

Typically, the agreements reached during this stage of the HIV allocative efficiency analysis are documented in a Scope of Work (or a Terms of reference) document to outline the cornerstones of the allocative efficiency analysis. The Scope of Work document guides country teams through all the aspects to be covered in the discussion about the methodological approach and design. An illustrative example of a Scope of Work for a country using Optima as a tool for conducting an HIV allocative efficiency analysis is provided in **Appendix 3** of **Volume 1** of these guidelines.



b) Agree on responsibilities and timelines in a Work Plan

It is suggested that a Work Plan, or schedule of activities, be developed to guide the HIV allocative efficiency analysis. This schedule is usually included in the Scope of Work document.

The Work Plan should guide all aspects of the HIV allocative efficiency analysis and would typically include discrete activities and their timeframes and should identify the lead responsibility that team members will carry along with definite due dates. Timeframes should be realistic, as missed deadlines will have a knock-on effect and delay the analysis. Timeframes should also consider critical milestones or important dates in the HIV calendar, such as submission for funding applications (may need to "work backwards"), or disseminating results at scheduled public events.

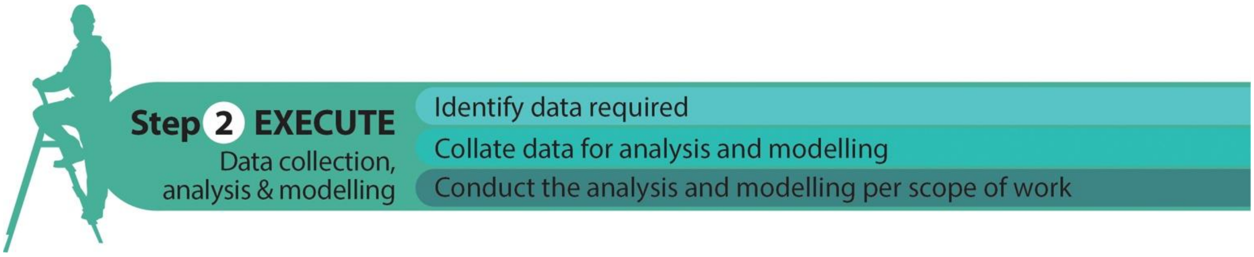
EXAMPLE: Possible activities to be considered in the schedule of activities are:

- Identification of
    - study objectives or research questions,
    - available data sources for epidemiological, behavioral, program and cost data over time
    - programs and sub-populations to be included in the analyses, and

- financial analysis objectives
- Development or finalization of Scope of Work document
- Review of the relevant published and un-published literature
- Collating the required epidemiological, behavioral, program and cost data
- Populating any data template or data entry screens for selected modelling software
- Data analysis including mathematical modelling
- Drafting the various results sections and recommendations for the report
- Preparing policy brief and slide collection
- Developing action points for translation of allocative efficiency analysis recommendations into policy and programming

Each team member is to be clear about what is expected of him or her and how s/he will collaborate with others over the course of the HIV allocative efficiency analysis.

2.7. EXECUTE: Data collation, analysis, and modelling



2.8. Identify data required

The set policy objectives and research questions posed will influence the sub-populations and HIV programs to include in the analysis. Cost or expenditure data will be required and these need to be linked to the HIV programs. As indicated in the previous section, data availability is a critical issue when considering the populations and programs to include in the analysis. It is acknowledged that no country will have all data, for a range of years, for all populations and programs. It is important to ensure that the methodology engaged in the HIV allocative efficiency analysis adequately deals with the data gaps; however it is acknowledged the more data available the more precise the analysis will be.

Different models will require different data. Data required for an Optima analysis is described in **Volume 2** of these guidelines.

Typically the data elements that will be needed are described below but these population data can be amended as needed for the particular analysis and are not cast in stone:

Example of population data

- Children 0-14 years
- Females 15-49 years
- Males 15-49 years
- Females 50+ years
- Males 50+ years
- Female sex workers (FSW)
- Clients of FSW (Clients)
- Men having sex with men (MSM)
- Women who inject drugs (WWID)
- Men who inject drugs (MWID)

Any other populations important for country epidemic dynamics (e.g. migrants, prisoners) and for which reliable data is available could also be included.

Data requirements and data sources

Area	Data requirements	Possible data sources
Population data	• Population size estimates for key populations (FSW, CSW, MSM, men and women who inject drugs, any other key populations relevant to country epidemics), • Any data on overlaps between key populations (e.g., WWID and FSW), • Any recent census or other demographic data, which supersedes 2010 UN population projections (if available).	• Reports on population size estimates for key populations • Any recent census files (if 2010 UN data is not in line with latest national data)
HIV and STI prevalence	• HIV prevalence in the different sub-populations at different points in time, • STI prevalence (or percentage of population reporting STI symptoms) for the different sub-populations.	• Reports on HIV and STI surveillance, DHS, MICS (multiple indicator cluster surveys) • Any special studies

Sexual behavior data	• Behavioral surveillance and other study data for the different study populations on
	  ○ numbers of sexual partners for regular, casual and paid sex
	  ○ sexual frequency (number of acts) for regular, casual and paid sex
	  ○ condom use at last sex (as a proxy for proportion of acts protected) for regular, casual and paid sex
	• Information on population sexual mixing and transitions (entry and exit into specific populations such as FSW, PWID)
		• Reports and behavioral surveillance for different populations
		• Any special studies

Drug injecting behaviors	• Behavioral surveillance and other study data on
	  ○ Frequency of injections,
	  ○ Types of injections (opioids, amphetamine, mixed),
	  ○ Percentage of injections that use shared needles,
	  ○ Percentage of reused syringes that are cleaned,
	  ○ Number of people on OST (Opioid Substitution Therapy).	

HTC, ART, PMTCT	• Survey data (or projection from routine data) for the different sub-populations on
	  ○ Proportion of population tested for HIV during the past 12 months and received their results;
	  ○ Proportion of PLHIV on ART;
		• Reports and behavioral surveillance for different populations

Area	Data requirements	Possible data sources
	○ HIV prevalence among pregnant women; ○ Crude birth rate or births per woman; ○ Percentage of women breastfeeding (disaggregated by HIV status). • Routine data on ○ Number of HIV tests conducted, ○ Number of new HIV diagnoses, ○ Number of people on ART (disaggregated by first line and second line); ○ Number of births per year, ○ Number/percentage of pregnant women tested for HIV; ○ Number/percentage of HIV positive pregnant women /babies receiving ARV prophylaxis;	• DHS, MICS • Program annual reports • Any special studies and evaluations • Program annual reports • GARPR • Global Fund concept notes/ reports, • National AIDS Spending Assessment (NASA) reports • National strategic plan (NSP) on HIV • Results framework of NSP • Operational plan for NSP • NSP costing files
Program packages and coverage	• Information on program packages available for ○ Prevention programs for FSW ○ Prevention programs for MSM ○ Prevention programs for PWID ○ Prevention programs for clients of FSW (if any) (CSW) ○ Prevention programs for the general population ○ HIV testing and counselling ○ Condom promotion and distribution ○ ART ○ Care and Support ○ PMTCT • Information on targets for the different program areas and current coverage (number and/or percentage of target population reached) with the different packages; • Total expenditure per program component • Total cost per person reached with a specific service component.	

2.9. Collate data for analysis and modelling

It is important that the data required for the analysis and modelling, which stems from the populations and programs to be included in the analysis, is carefully collated. When collating the data it is advised that a record of kept of the source of data, including the year of that data source and format of the original data. As some data required for the analysis and modelling may need manipulation, in the form of indicators being calculated, or totals and the mean being determined, it is important that the data collation keeps track of all the calculations made and formulae applied. Any assumptions used at any stage should be carefully considered and when agreed to, documented. It is acknowledged there will be data gaps and it is important that these are recognized.

Should there be multiple data sources for the same data required, it is important to capture all the data, including details of the different data sources. Country teams are to work through the data and agree on which is the most reliable data source to be used for the intended analysis.

When collating the data for the analysis it is important that country teams are clear on what data is required, along with the required format. As some indicator data may be required for the analysis it is critical that the indicator definitions and method of calculation of the derived indicator is standardized.

The data collation step, along with capturing all the background information to collecting and preparing the data for analysis is critical for the report writing stage, as the report is to detail issues of data, assumptions used and what data manipulations were required.

It is beneficial to review all the input data with the country team to ensure data reliability and accuracy. It is particularly beneficial to discuss data assumptions where data is not available and come to agreement with the country team on the chosen values.

2.10. Conduct the analysis and modelling as per Scope of Work

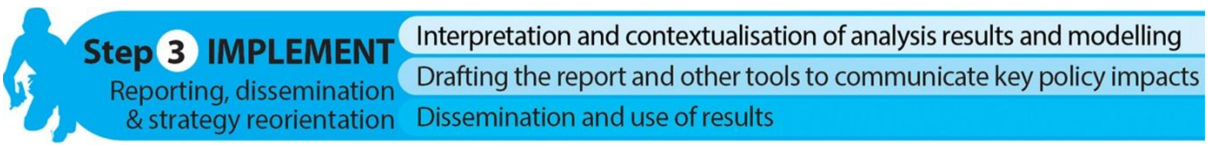
It is acknowledged that there are many factors that influence the rate at which people become infected with HIV, become diagnosed, move onto treatment, and die of AIDS-related causes. HIV responses consist of programs that attempt to alter these rates. Through different HIV responses and programs, efforts are made to change the predicted course of HIV, by:

- decreasing the HIV transmission rate,
- decreasing the AIDS death rate (most notably through treatment, care and support programs), and/or
- decreasing morbidity and disability as a result of HIV, typically measured in DALYs or QALYs.

If one of the analytical methods described earlier in 2.1.4 (c) are used, then, through an HIV allocative efficiency analysis, the expenditure on HIV programs is related to transmission and death rates, and where appropriate DALYs.

The specific analytic steps will be determined by the analysis method chosen. In **Part 3** of these guidelines, the specific focus is on determining how the Optima tool is used to perform this type of analysis.

2.11. IMPLEMENT: Reporting, dissemination, and strategy reorientation



2.12. Interpretation and contextualization of analysis results and modelling

After completing the rigorous phases required of an HIV allocative efficiency analysis, the results, findings and interpretations should be clearly and objectively framed for the required parties to consider, absorb and internalize in terms of their policy implications.

In understanding and interpreting the analysis, it should be linked to the original policy or research questions posed. Try to answer each analysis question with the modelling and other analysis data collected – including the data collected during the contextualization step (see 2.1.1). Depending on the methodology employed for the analysis, should the results be presented graphically, statistically or in a tabular format, it is best to 'interpret' these and describe them narratively for whichever medium used to share the result, either in a PowerPoint presentation or a written piece. These results should be presented to the country team to be verified before policy option recommendations are derived.

In **Part 3 and Volume 2** of the guidelines, practical guidance is given on how to interpret and present the outcomes of the HIV allocative efficiency analysis using Optima and the specific output that Optima generates.

2.13. Drafting the report and other tools to communicate key policy impacts

a) Developing the report

It is recommended that the report on the HIV allocative efficiency analysis be developed as the Analysis unfolds. Prior to the detailed Analysis commencing, the framework and structure of the report should be agreed to, along with identifying team members who will contribute different sections to the development of the report. A lead writer should be identified to ensure that the sections are submitted as required. A suggested template for the report is provided as an Appendix 4.

b) Developing a policy brief with key analysis interpretations and key policy messages

For a wide spectrum of users to gain the full benefit of the HIV allocative efficiency analysis, the results of the analysis need to be packaged and provided in a user-friendly manner. This might require that the results of the analysis be carefully considered, and agreement reached on how to interpret and present them to the general user or specific groups. It is important that not only the methodology and approach of the Analysis, including assumptions and constraints, but the actual findings, results and recommendations are subject to rigorous peer review.

It has been found that the best way to share the results is to link them to policy options for further consideration or clear recommendations for the Ministry and relevant partners and stakeholders to consider. Policy options can be presented in a succinct policy brief that focuses on a specific policy issue or recommendation.

Some guidelines for writing a policy brief

What is a policy brief? A policy brief is a short document that presents the findings and recommendation of a research project. It is considered to be a medium for exploring a particular issue, highlighting lessons learned from the research and is a vehicle for providing policy advice.

Writing for your audience: a policy brief is a short, stand-alone document that is focused on one issue.

When drafting a policy brief consider:

- Who am I writing this brief for?
- What are the reader's interests and concerns? What questions need answers?
- How knowledgeable are the readers about the topic?
- How open are the readers to the message?

Choosing your content : Apply a laser focus

Remember these tips:

- Focus on a single topic
- Define your purpose
- Identify salient points that support the aim
- Distil points to essential information
- Base your conclusions on results
- Ensure that your policy recommendations are relevant, credible and feasible

Putting the Brief Together – **A Policy Brief Template**

1. **Executive Summary**
    - Lead with a short statement or pertinent question
    - Distil the essence of the brief
    - Provide an overview for busy readers
    - Entice readers to go further

2. **Introduction**
    - Answers the question "why"
    - Explains the significance/urgency of the issue
    - Describes research objective
    - Gives overview of findings, conclusions
    - Creates curiosity for rest of brief

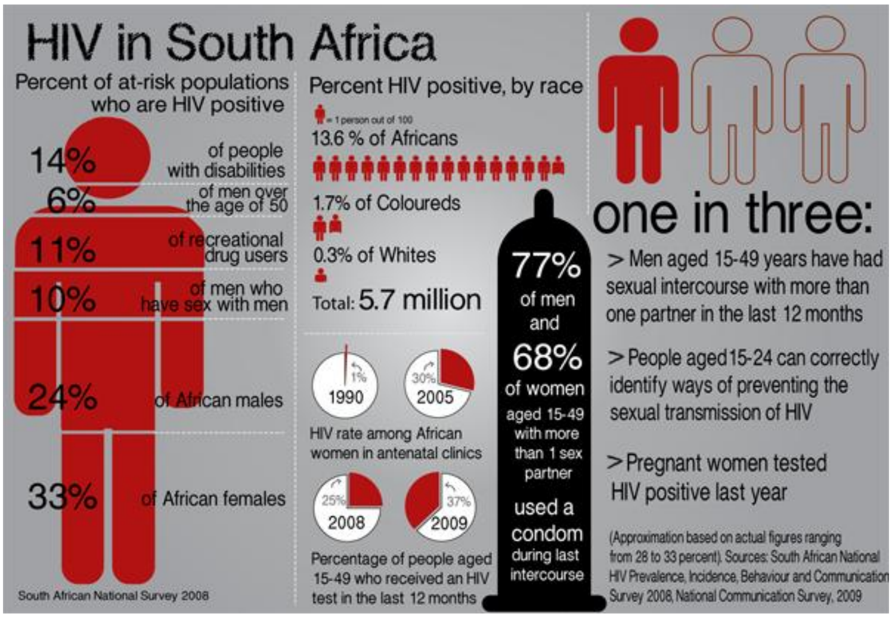
3. **Approaches and Results**
    - Provides summary of the facts
    - Describes issue and context
    - Describes research and analysis
    - Should not be overly technical
    - Explains how research was conducted
    - Results: What Did We Learn?
        - Make content easy to follow
        - Start by painting a general picture
        - Move from general to specific
        - Base conclusions on results

4. **Conclusion** (what does it mean?)
    - Use section to interpret data
    - Aim for concrete conclusions
    - Express ideas using strong assertions
    - Ensure ideas are balanced and defensible

5. **Implications and Recommendations**
    - Implications are what could happen and recommendations are what should happen
    - Both flow from conclusions
    - Both must be supported by evidence
        - Implications: If…Then…
            - Describe what will be the consequences
            - Less direct than recommendations
            - Useful when advice not requested
            - Softer approach but still can be persuasive
        - *Recommendations: Call to Action*
            - Describe clearly what should happen next
            - State as precise steps
        - Ensure they are relevant, credible and feasible

c) The use of infographics to communicate analysis findings and policy implications

Another tool in presenting data or the findings of the analysis, and growing in popularity, is the use of infographics. These are usually very eye-catching and useful for on-line publication or if posters or graphic presentations (such as PowerPoint or Prezi) are to be developed.



Information graphics or infographics are graphic visual representations of information, data or knowledge intended to present complex information quickly and clearly. They can improve cognition by utilizing graphics to enhance ability to see patterns and trends.

Infographics enable one to condense large amounts of information into a form that is attention-grabbing and where it will be more easily absorbed by the reader. In his 1983 The Visual Display of Quantitative Information, Edward Tufte indicates that 'graphical displays' should:

- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production, or something else
- avoid distorting what the data have to say
- present many numbers in a small space
- make large datasets coherent
- encourage comparison different pieces of data by eye
- reveal the data at several levels of detail, from a broad overview to the fine structure.
- serve a reasonably clear purpose: description, exploration, tabulation or decoration.
- be closely integrated with the statistical and verbal descriptions of a dataset.

Graphics reveal data. Indeed graphics can be more precise and revealing than conventional statistical computations.

Source: http://en.wikipedia.org/wiki/Infographic (adapted)

2.14. Dissemination and use of results

a) Dissemination of results

A dissemination strategy is to be developed to ensure that the results of the analysis and the report and other products of the analysis are shared widely. It is important that the dissemination strategy include processes to ensure that the report or products are carefully checked and signed off by relevant parties, prior to dissemination. Dissemination activities could be conducted through in-country workshops, round table dialogues, national and international conferences and seminars as permissible under the data ownership and use agreement. Key findings may be posted on the websites of key Government and Development Partners and relevant social media channels could be utilized to share findings.

b) Use of results to influence policy, resource allocations and programs

As stated previously, the use of results to influence policy, resource allocations and programming, is why the study is undertaken. Specific steps should therefore be taken to increase the chances that the analysis results will be used:

a) Working closely with a local champion identified as critical to the analysis. This may involve engaging with multiple interest groups

b) Ensuring that results communicate necessary changes in program coverage levels

c) Conducting the analysis at a time when results will be used to affect target program coverage levels. i.e. ensuring that the analysis results are available when policy decisions about priority programs in priority geographic locations for priority populations are made

d) Realizing and communicating that change will be incremental

e) Identifying low hanging fruit – early wins, quick changes that can easily be implemented

f) Making use of procurement cycles and government's medium term expenditure budgeting to bring about change

g) Developing an action plan with defined timelines and responsibilities to ensure that implementation takes place

h) Tracking resources allocations over time, by making optimized resource allocation a standing agenda item in annual HIV review and planning meetings, so that the country can measure incremental progress in changes in resource allocations

i) Making recommendations within the reality of development partner budgets and funding priorities, such as minimum funding earmarks for HIV treatment that form part of the authorization and re-authorization of PEPFAR

j) Supporting country teams to report to senior HIV and health structures, to ensure accountability beyond the analysis period and to ensure that recommendations remain center stage, even after the term of the country team has ended.

2. Lessons learnt

A number of international agencies and research institutions have conducted HIV allocative efficiency analysis, to support HIV decision making and planning in several countries across Africa, Asia, Latin America and Eastern Europe. Certain important lessons have been learnt along the way, and these are shared in this section of these guidelines.

2.15. Need to understand the epidemic as a core starting point

A critical lesson learnt is that to gain the most from an HIV allocative efficiency analysis, country teams need to understand the dynamics of HIV transmission and have access to data on the course and scale of the epidemic. The better the understanding of the dynamics of HIV transmission and how these play out in the country, the greater the value of the resulting analysis. Also, by conducting the analysis the country teams will improve their own understanding of the dynamics of HIV transmission within the country, different groups and locations.

Not only is it important to understand general HIV transmission patterns but to also recognize the contrasting transmission dynamics between concentrated, generalized or mixed epidemics. Through an understanding of the most at risk populations and HIV transmission dynamics, resources can be better targeted at interventions where needed and with the biggest impact. Key populations at higher risk need to be understood as heterogeneous with a variety of risk profile. For instance, among FSW, there may be women with additional risks due to illegal residency status, drug injecting, or very young age. Among MSM, there are low risk men in stable relationships, but also men with very high partner acquisition rates due to commercial sex experiencing additional risks. The understandings of risk profiles and dynamics of HIV transmission need to be included in the analysis to the extent possible.

It is important to compare relative risks and incidence rates (percentage or per 1,000) between sub-populations, <u>not</u> the total number of incident infections across sub-populations, as prevention efforts need to be guided by relative differences in HIV acquisition and onward transmission.

2.16. Need to understand expenditure data and how they impact incidence and mortality

Experience has shown there is a need to gain an improved understanding of how interventions relate to each other. There is a need to appreciate the interdependence and synergies of interventions and recognize whether they directly prevent infection and/or death, or indirectly and how and why. The process of conducting the allocative efficiency analysis and reflecting on the results assists to broaden this understanding.

2.17. Need to use the appropriate supporting tools in allocative efficiency analysis

There is a range of tools available to country teams to facilitate allocative efficiency analysis (see **Part 1** for a listing of some of these tools). The importance of using dynamic models (not static) which can project the investment impact over time, as epidemic impacts evolve over time through downstream effects, and by averting secondary transmission, should not be overlooked. Country teams need to carefully select the tool(s) used to facilitate their analysis.

2.18. Lessons in improving allocative efficiency

With past experience, there are certain lessons that have been learnt regarding how to achieve allocative efficiency and these include the importance of 'getting the mix right':

- Need to correct imbalance between epidemiological importance of specific populations and allocated resources.

- Need to correct imbalance between epidemic spread across country's administrative regions and resources allocated to these regions

- Need to correct insufficient resource allocation to high-impact interventions and targeted sub-populations.

Consideration to be given to interventions such as VMMC or PMTCT, that are amongst programs that have wide reaching effects or interventions that target marginalized populations such as PWID, MSM/MSW, TG, and FSW.

2.19. Improved outcomes with available resources

Allocative efficiency analyses can demonstrate that better outcomes can be achieved with fixed resources, or specific outcomes can be achieved with less money should resources be distributed optimally. However, efficient allocations critically require that desired outcomes are clearly defined.

It is found that the optimization of resource allocations is sensitive to the restraints used (in modelling), the time horizon selected for the impact to develop, and whether the interventions programs have multiple outcomes included in the analysis - such as preventing AIDS-related deaths *and* reduce HIV transmission (or even non-HIV effects like condoms may have on teen pregnancy and STIs).

2.20. Improving data and reporting

When working with country teams in facilitating HIV allocative efficiency analysis it is found that there is a renewed interest in improving data and reporting on programs. When country teams see how the data is used in the Analysis, and the importance of accurate and complete data is demonstrated to them, the need to 'get the data right' is rekindled. Country teams tend to make a concerted effort to improve the data for HIV planning and this has a wide range of benefits on HIV initiatives.

2.21. Allocative Efficiency Analysis includes considerations for technical efficiency

Through a structured HIV allocative efficiency analysis, country teams are shown how reductions in the unit and marginal cost of delivering some HIV services, or aspects of HIV programs, may free up resources that can be redistributed to other health or social sector priorities. Allocative efficiency analyses could therefore also be used to point to areas that require further investigation in terms of technical and implementation efficiency.

Consideration should be given to conducting technical and implementation efficiency and allocative efficiency analysis in conjunction with each other. A key strategy in improving technical and implementation efficiency is reducing unit costs, often through improved utilization of human resources (no idle time e.g. through demand creation in certain times of year), using different cadre and allowing task shifting or improved integration which implies using staff for multiple purposes, etc. Also, reducing indirect costs (e.g. leader management) include for example combining low-volume places into larger service points with good referral, or reducing bottlenecks like HCT in week before VMMC provision, and reducing costs of medications and consumables through pooled purchasing or tender on open market, good supply chain planning to prevent emergency and small orders which are more costly.

Some links and references on technical and implementation efficiency include:

- Benin - http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4003579/
- Columbia - http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-6182
- India - http://www.resource-allocation.com/content/13/1/5

2.22. Importance of political economy and a local champion

Allocating resources according to historical budgets when determined mainly by existing supply and its use, perpetuates and reinforces existing inequities. But directly measuring need for health care is nearly impossible technically. The *absolute* level of resource need is usually determined politically, when the overall health care budget is fixed, or economically, through different population groups' ability to pay.

"Resource allocation conflicts are characterized by multiple constituencies, complex relationships, and myriad benefits and harms—which may or may not be apparent. All of these factors make resolving ethics conflicts related to scarce resources in rural settings both difficult and emotionally troubling." [2] For this reason, understanding the political economy and keeping the already-identified local champion on board, is one of the most important steps that the country team can take to ensure that the results of the analysis influence real-life program allocations on the ground.

2.23. Challenges of defunding programs

In a resource constrained environment, making HIV allocative efficiency decisions inevitably means that some programs may receive less funding than in the past. This is a complex issue and poses some ethical dilemmas. As Maddox et al (2004) summarized:

"*Perhaps the impact of the array of problems, issues, and the myriad difficult decisions that policymakers and managers make may be softened by imaginative and rational strategies to finance, organize, and deliver health care when resources are scarce. Decisions related to scarce resource allocations must be made in consideration of the ethical principles of autonomy, beneficence, and especially justice. Ethical issues related to scarce resource allocation are likely to become increasingly complex in the future. Thus, it is imperative that health care leaders diligently and ethically continue to explore these issues*."

For programs that are identified for defunding, clear transition plans – of staff, equipment, infrastructure and processes – and proper change management processes should be put in place to ensure that transitions happen with the least amount of disruption possible.

2.24. Invest in proven interventions and target specific groups or areas

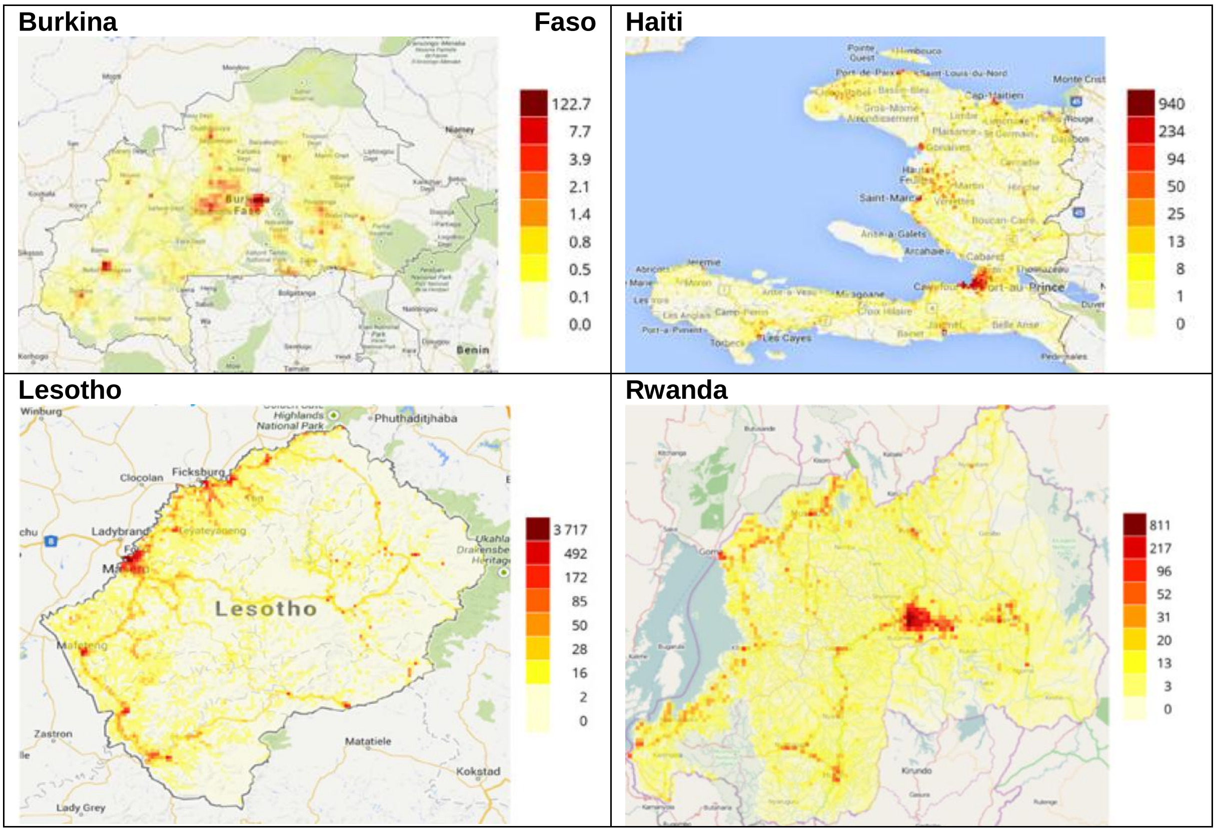
There is an increasing body of knowledge about the effectiveness of HIV interventions in certain epidemic settings or in specific populations.

[2] Gardent and Reeves, 2009. https://geiselmed.dartmouth.edu/cfm/resources/ethics/chapter-09.pdf

For example in concentrated and low-level epidemics the following targeted interventions for FSW, MSM and PWID are found to be most effective: condom promotion and NSPs, tailored sexual health services, OST provision, HIV diagnosis and treatment, oral Pre-exposure prophylaxis (PrEP, emerging evidence), solidarity and group empowerment and supportive local and national legal environments. In contrast, in generalized epidemics the proven approaches include: PMTCT, VMMC, ART based prevention and where affordable cash transfers, and targeted SBCC programs. It should also be considered that even within generalized epidemics there may be segments of concentrated epidemic transmission in SW settings, among MSM and PWID, where proven interventions from concentrated epidemics should be applied.

In a study in Kenya, (Anderson, 2014) researchers demonstrated that instead of distributing resources for HIV prevention and clinical programs uniformly, targeting specific areas and groups at greater risk is more effective. Explicit outcomes can be achieved, if resources are distributed optimally. Targeting locations or hotspots and specific groups or key populations is critical to maximize the investment made.

Figure 9: Estimated spatial distribution of people living with HIV aged 15+ years / km2 (Spectrum application)



Source: UNAIDS, 2014

PART 3. INTRODUCTION TO MODELLING AND THE OPTIMA TOOL

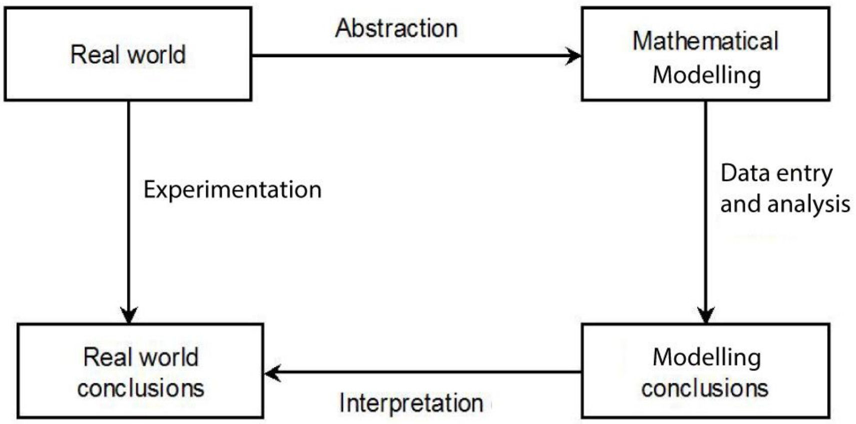
3. Introduction to modelling

3.1. Modelling as a tool

A model is a computer system designed to demonstrate the probable effect of two or more variables that might be brought to bear on an outcome. Models can reduce the effort required to manipulate these factors and present the results in an accessible format. They are used to imitate real-life situations; a mathematical epidemiological model uses equations to represent an epidemiological context, with its population groups and programs. In assisting to understand the past trends, mathematical models can be used to assess the present and predict future trends. Generally, they help to understand a system and to study the effects of different components or conditions, and to make predictions. It is important to acknowledge that modelling is an activity that requires one to think about how objects behave or interact as well as the process involved in reaching an outcome.

A mathematical model comprises a system of mathematical equations to describe the key processes, aspects and behaviors within the real-life scenario of interest. It helps to visualize patterns and connections that cannot be directly observed. Since most of the interacting systems in the real world are far too complicated to measure and describe, it becomes essential to identify the most important parts of the system and these are included within the mathematical model (Fowkes and Mahony, 1994). The role that mathematical modelling could play in understanding a system is illustrated by the figure below.

Figure 10: Role of mathematical modelling in system description

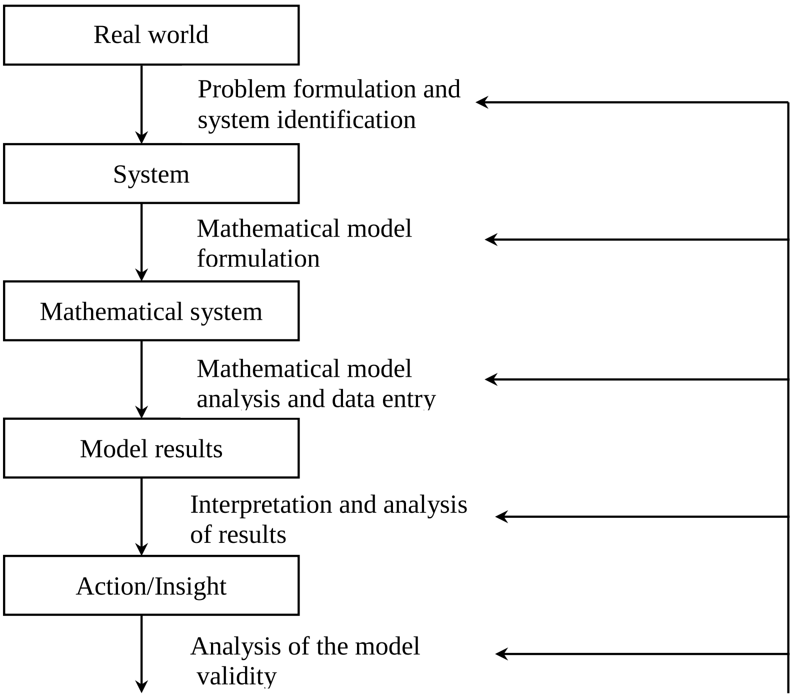


Source: Fowkes N.D. and Mahony J.J., 1994

The modelling process begins with some observations and interpretation about the real world. It becomes desirable to make some conclusions or predictions about these observations. One way to proceed is to conduct experiments and record the results. However, sometimes these could be too expensive, too difficult or unethical to conduct. An alternative is to produce a 'framework' which replicates the reality and the observations within. This is performed through the mathematical model, which contains some of the essential features of the real world, translated into a system of mathematical equations. Analyzing the model mathematically and computationally can produce results. Through using logical argument to interpret the model results, mathematical conclusions can be derived. These conclusions are able to then be translated to real-life interpretations and predictions about the real world.

Creating a model requires a series of steps. The figure below illustrates the common steps in building a mathematical model to describe a system of interest. The process starts by specifying the general elements and relationships of the system to be modelled. Data requirements and their availability are then assessed. Then, the model is formulated and the parameters of the model are estimated. Once the model is built, it should be tested to establish its validity. . This testing of the model or 'calibration' process allows for alignment of the known real-life aspects to those generated by the model. The closer the model is aligned to the data, the better the model is at mimicking real-life.

Figure 11: Modelling process



Source: Beroggi, 1998

In the study of infectious diseases in particular, mathematical modelling has become an important tool for understanding the mechanisms controlling the spread and distribution of infections in a given population. Mathematical modelling provides an explicit framework to develop and communicate our understanding of the transmission dynamics of an infectious disease. The mathematical description of the typical course of an infection and the mechanisms of the transmission between individuals have begun to provide a scientific framework to aid decision makers in predicting the potential outcome of different interventions programs.

In epidemiology, mathematical modelling can serve a number of specific purposes:

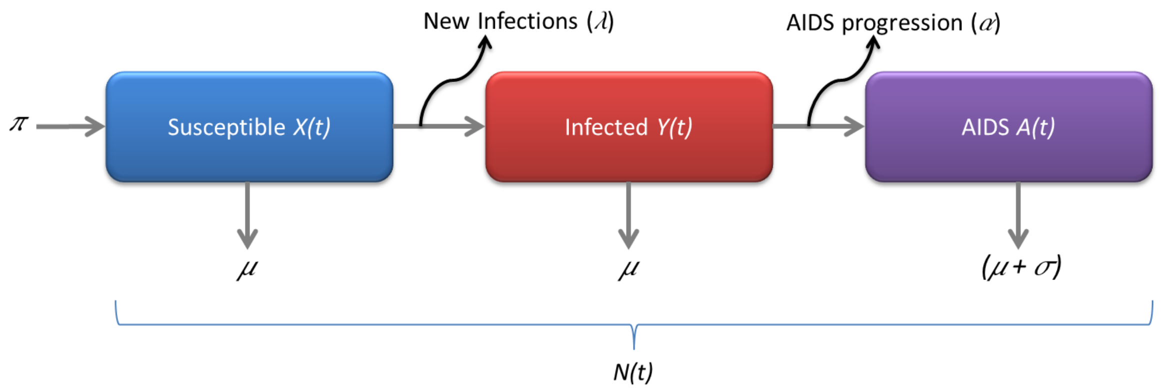
- In the absence of reliable data, mathematical modelling can be used to help formulate and test hypotheses, and inform data collection strategies.
- Mathematical modelling can delineate the basic mechanisms and processes underlying transmission.
- It can help estimate temporal changes in disease burden and assess treatment needs.

- It could help to determine what needs to be measured to interpret epidemiological patterns and assess the impact of potential interventions.
- It could play an important role in the design and evaluation of different intervention programs and their related costs, including power calculations for prospective evaluation designs.

The dynamics of an infectious disease can be complex, and the impact of control programs can be difficult to predict. The goal using mathematical modelling is to disentangle the underlying patterns of an epidemic and identify rules that could enable this behavior to be predicted. Once the transmission dynamics of an infectious disease are appropriately described with a mathematical model, the potential impact of different intervention programs could be assessed. Using the mathematical model developed, it would become possible to make predictions regarding the impacts of changes in patterns of behavior or biology in the dynamics of the epidemic derived from proposed interventions. Therefore, mathematical modelling has become a tool to assist in the identification and the role or ability of a potential intervention program to deliver public health benefits (Garnett, 2002).

Mathematical models of transmission dynamics need to incorporate in their framework the appropriate epidemiological, biological and demographic characteristics of the infection of interest and the studied population (Boily and Mâsse, 1996). The structure of such models is typically illustrated as compartments representing the flow of individuals from one infection state to another. In Figure 12 the compartmental structure of a simple model of HIV transmission in a homogeneous population is illustrated. This model represents the flow of individuals through the different stages of HIV infection.

Figure 12: A basic schematic model of the dynamics of HIV infection in a given population



The three compartments illustrated represent the three infection states: susceptible, HIV infected, and the development of AIDS. Here, $X(t)$, $Y(t)$, and $A(t)$ represent at time t the number of individuals in each disease state ($N(t) = X(t) + Y(t) + A(t)$). The transition from the susceptible to infected group occurs at a rate $\lambda(t)$, which is also called the force of infection, and is given by:

$$\lambda(t) = m\beta Y(t)/N(t)$$

where m represents the mean rate of partner change per unit time, β is the HIV transmission probability per partnership, and $Y(t)/N(t)$ the prevalence of HIV infection in the population at time t.

The constant β captures the likelihood of transmission based on the distribution of sex acts within a partnership. Assuming a binomial probability distribution in which the infection is transmitted or not from an infected to an uninfected person during a sex act, then the probability of transmission within a sexual partnership (β) could be expressed as:

$\beta = 1 - (1 - \gamma)^n$

where γ is the probability of transmission during a single act, and n is the number of sex acts per unit of time. Hence this calculation could be translated as: 1 – (probability of not getting infected by an HIV- positive partner)^(number of sex acts).

Using the previous definitions, the dynamics of the infection can be expressed in terms of a very basic mathematical model using differential equations as follow:

$$\frac{dX}{dt} = \eta - X[\lambda(t) + \mu]$$

$$\frac{dY}{dt} = X\lambda(t) - Y(\mu + \alpha)$$

$$\frac{dA}{dt} = Y\alpha - A(\mu + \sigma)$$

Where η is the rate of individuals entering the sexual active population per time, μ is the background mortality rate, α is the AIDS progression, and σ is the AIDS mortality.
Such simple models, along with their expansions to capture more complex interactions and the nonlinear nature of the dynamics of infectious diseases, could be used to identify and explain counter-intuitive results, which then can be implemented for the interpretation of observed trends. It would help to delineate the basic principles and processes underlying the transmission of the virus, as well as to help design and evaluate interventions, and determine what needs to be measure to assess the impact of such interventions (Anderson and Garnett 2000).

3.2. Value and limitations of a model

As mentioned above, mathematical models can play an important role in policy analysis. They become a powerful analytical tool that can add clarity and insights to many policy questions. Scenarios, as a product of modelling, can be beneficial as they help stakeholders and policy makers consider possible futures and build awareness of different options.

The appropriate use of a mathematical model, however, is strongly influenced by the understanding of their limitations and ensuring that such limitations are well documented, and considered in the interpretation of the model outcomes, analysis or scenarios. Delva et al. (Plos Med 2012) indicate that "it is not uncommon for different models addressing very similar questions to produce—or appear to produce—widely different estimates, and thus a model's validity and ability to inform an important public health decision can be questioned."

Since information about a real world system becomes less precise or difficult to measure, more assumptions have to be made. Assumptions and estimates are made almost in every step of the process described in Figure 12. These assumptions are generally based on prior knowledge or experience and the fact that this judgment is necessary and is an inherent limitation of a mathematical model. Therefore, the user of a model must understand the assumptions associated with the formulation of the model, and how these assumptions would influence the model outcome.

Models are abstraction of reality but should try to capture the critical elements of the real-world system. However, it becomes virtually impossible to capture all the essential components of a system, and therefore a further inherent limitation of a model is the components that are left out or inadequately treated in the model. However, still remembering, the purpose of the model is not to capture the complex reality, but to represent the essential elements of that reality which are necessary and sufficient for addressing a specific question.

Mathematical models are dependent on the data available: the model is often said to be as good as the data it includes. The extent and quality of these data can be variable. The data might be incomplete and are usually estimates. Uncertainty around the values of variables that have been measured in the field might substantially affect the model output. However, you can incorporate uncertainty into the model and report uncertainty in the results.

Given that modelling does have limitations, it is important that the analysis is viewed in light of the limitations, and where appropriate these limitations are acknowledged upfront. This should go along with a general presentation of the model structure, parametrization, and application of any outputs based on the chosen inputs. If well designed and conceptualized, the model, software and mathematical equations, can deal adequately with some of these limitations, resulting in high levels of confidence in the analyses and results.

Modelling remains a valuable tool that can assist to play out different scenarios in the most effective manner and provide analysis to assist in planning, policy dialogue and formulation, advocacy and when considering which targets are achievable within given limitations, be it time or resources. Modelling also provides additional benefits, such as leading to improved data collection and systems strengthening.

4. Optima and its applications

4.1. Introduction to Optima

Optima is an optimization and analysis tool that assists country teams in determining the optimal allocation of HIV resources and coverage levels across programs in specific HIV epidemic settings. The optimization and analysis tool helps decision makers and HIV program managers reach maximum impact with the country's HIV epidemic response, by facilitating an integrated analysis of epidemic, program and cost data to determine an optimal distribution of investments to best serve their country's needs. **Optima** can improve country HIV and health-policy decision-making through informing domestic and international HIV funding allocations and target program coverage levels.

Optima is an HIV mathematical model. As a modelling tool, **Optima** is fairly unique in that it has been developed into a specialized toolkit to support analyses in HIV allocative efficiency and financial commitment and can be used to inform HIV investment choices in the short-, medium- and long-term. Given that all national HIV responses are aimed at minimizing new HIV infections, the burden of the disease and AIDS-related deaths, **Optima** is a valuable tool as it allows for comparison of current investments with optimal investments for these different objectives. **Optima** requires demographic, HIV prevalence, behavioral, HIV service use and expenditure data, which are commonly available from national review and reporting routines. As a policy dialogue tool, **Optima** assists country teams to allocate resources optimally, so that impact of the investment is maximized and costs minimized.

Optima supports exploring answers to the following questions:

- Which HIV programs should we prioritize given funding availability?

- What resources are needed to reach coverage targets and epidemiological objectives?
- What HIV intervention mix is most cost-effective for a country's HIV epidemic?
- Which investment, allocation and coverage levels are best for minimizing HIV incidence, HIV-related mortality, or both?
- What are the future treatment costs for people already living with HIV?
- How can long-term costs be minimized by optimal investment decisions today?
- How many HIV infections and deaths have been averted through past HIV investments?

The **Optima** optimization and analysis tool was developed by the Kirby Institute of the University of New South Wales (Australia) with conceptual inputs from some of the World Bank staff.

4.2. Why use Optima in your country?

As **Optima** is a mathematical model of HIV transmission and disease progression integrated with an economic and financial analysis framework, it assists country teams to provide analysis to facilitate policy dialogue. Some of the areas to focus this dialogue around, amongst others, are, critical areas to guide HIV interventions, the course of HIV within a country, financial consequences of AIDS on different sub-populations, financial commitments required to achieve targets, program investment options, options for minimizing costs, and achieving the maximum effect or most suitable outcome of an integrated HIV program with the same level of funding.

Optima provides country teams with the following support and benefits:

- **Epidemic dynamics:** Through its epidemic modelling capacity, **Optima** strengthens a country's understanding of which populations transmit and acquire the most new infections and how these patterns evolve over time.

- **Priority allocations:** By providing an investment cascade, highlighting which programs should be funded first, given limited resources, **Optima** grows a country's understanding of where to invest at times of low or stagnant funding availability, and how to broaden HIV investment as funding improves.

- **Value for money:** Through its optimization process, **Optima** can guide a country's HIV programming decisions, by showing which mix of HIV programs at which coverage levels provide the most suitable HIV outcomes.

- **Long-term financial implications of AIDS:** By assessing future HIV treatment and care costs of existing HIV infections, **Optima** can help country teams to advocate for further HIV prevention investment to minimize future costs.

4.3. Using Optima to understand your epidemic and optimize investment decisions

Optima provides the necessary analysis to understand the HIV epidemic in country and guide investment options to optimize the benefits in a number of ways. Illustrative examples of this analysis are discussed in this section of the guidelines.

4.4. Using Optima to explore HIV epidemic dynamics

Optima *can be used to evaluate past epidemic dynamics and predict future trends*

- Define your sub-populations and understand how they drive the epidemic
- Define your timeframes and link them to national strategies and plans
- Define spending amounts per year based on expected resource availability
- Understand the epidemiological impact of past and future intervention programs

Figure 13: Illustrative example of using Optima to explore HIV epidemic dynamics

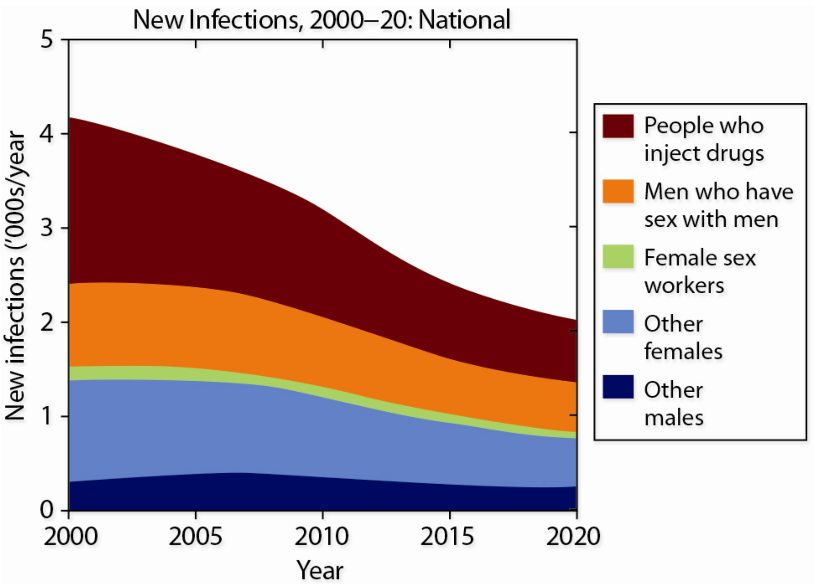
Source: UNSW & World Bank

4.5. Using Optima to understand optimal resource allocations

Optima *uses mathematical modelling to determine the optimal HIV investment mix of existing resources and future financial resources needs.*

- Define your key interventions, such as condom programs, needle-syringe programs, and antiretroviral treatment (ART)
- Choose specific objectives, such as reducing HIV incidence, AIDS-related deaths, disability-adjusted life years, or provide a combination thereof
- Choose different time horizons to contrast short- and medium-term scenarios
- Discover which investment combinations provide best value-for-money

Figure 14: Illustrative example of using Optima to understand optimal resource allocations



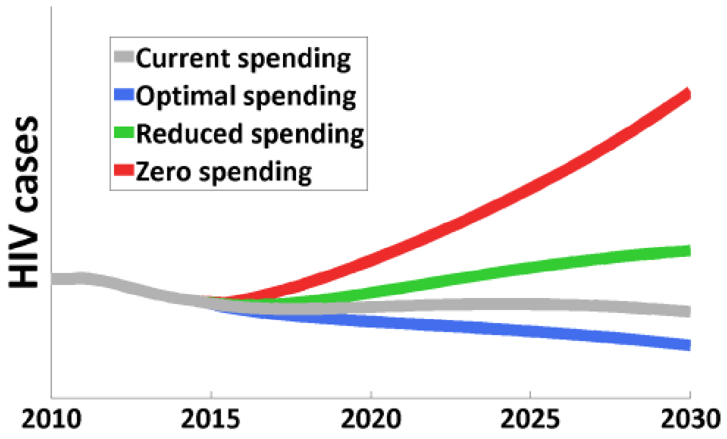
Source: UNSW & World Bank

4.6. Using Optima to evaluate financial and epidemiological impacts of investments

Optima *runs impact and cost-effectiveness analyses of HIV investments*

- Understand the epidemiological gains of different HIV interventions and investment mixes
- Calculate the return on investment of past programs

Figure 15: Illustrative example of using Optima to evaluate financial and epidemiological impacts of investments



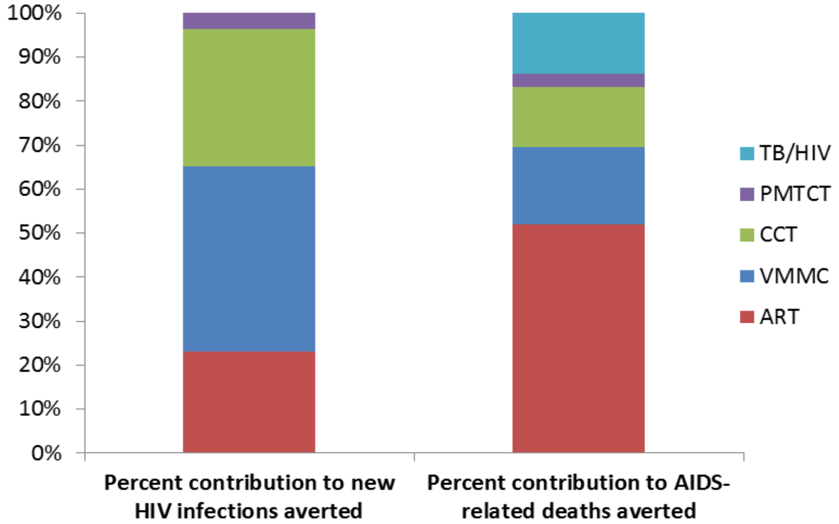
Source: UNSW & World Bank

4.7. Using Optima to assess the impact of scale-up scenarios of a set of defined core interventions

Optima *runs impact analyses of scenarios of sets of core interventions:*

- Understand the relative impacts of core interventions, and their cost contributions
- Calculate impact and incremental cost-effectiveness ratios of core interventions, delivered separately or in combination

Figure 16: Illustrative example of using Optima to estimate contribution of scaled-up core interventions in reducing new HIV infections and AIDS-related deaths

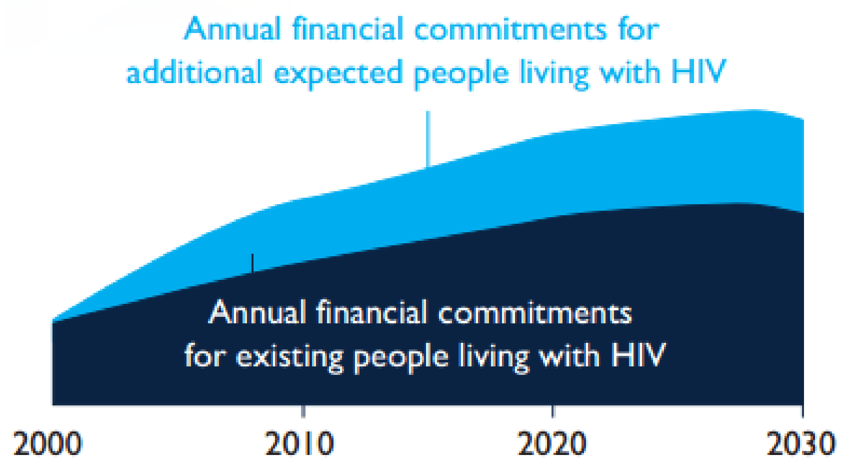


Source: UNSW & World Bank

4.8. Using Optima to understand the financial implications of the HIV response

Optima *can provide an analysis to understand the financial implications of HIV response: (a)* Understand the long-term financial implications of the HIV program (including financial commitments of care and treatment for people living with HIV; and *(b)* Determine the costs associated with a single new HIV infection or all people currently living with HIV.

Figure 17: Illustrative example of using Optima to understand the financial commitment for people living with HIV



Source: UNSW & World Bank

4.9. How does Optima work?

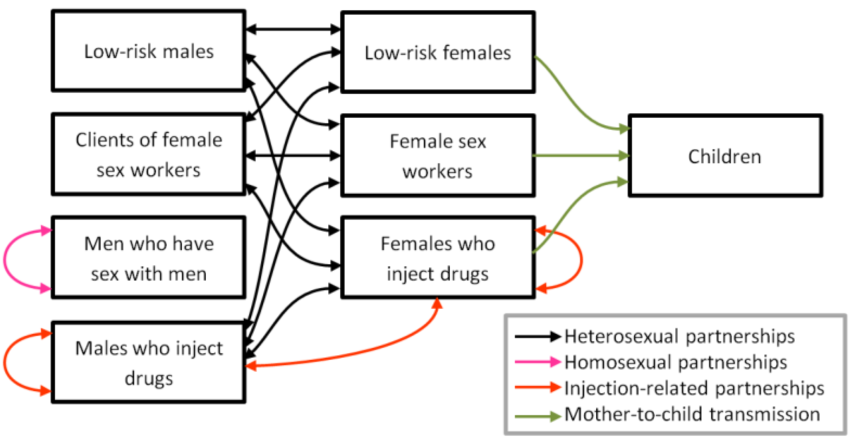
Volume 2 of the guidelines provides a detailed step-by-step User Guide on how to use the **Optima** software. The section below will focus on how **Optima** functions by providing a brief overview of the logic and processes followed by the modelling software. A more technical description of **Optima** is provided as an appendix in **Volume 2**.

Optima is a mathematical model of HIV transmission and disease progression integrated with an economic and financial analysis framework. Its structure is highly flexible and can accommodate HIV interventions and sub-populations specific to each country. Optima's only fixed aspect is its basic disease progression model, which makes it an HIV model instead of a universal epidemic model.

Optima divides the general population into sub-groups, based on:

- Geographical region,
- population type (risk and age based),
- HIV infection status,
- HIV diagnosis status,
- CD4 count and
- treatment status.

Figure 18: Example populations and HIV transmission related interaction in Optima

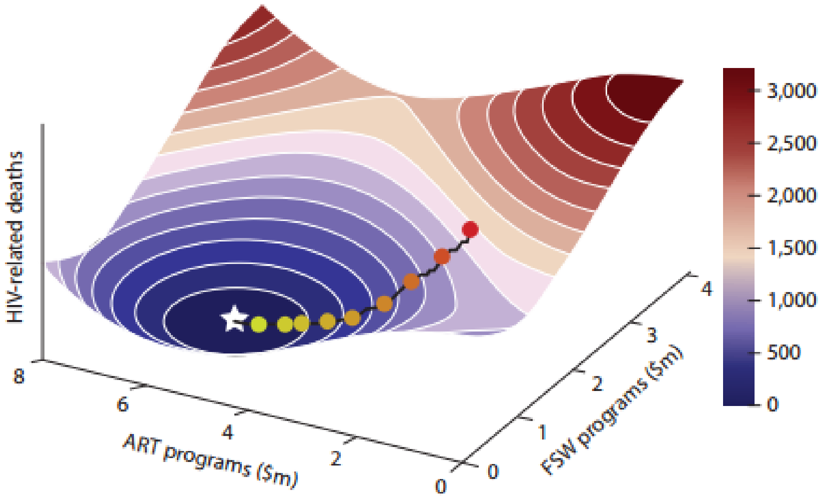


In contrast to most other HIV models, the populations are not fixed; user-defined populations may be used, including different risk groups (for example sex workers, drug users) and age groups (for example children, young adults). The user enters demographic, epidemiological, behavioral, clinical, and financial data via a spreadsheet generated specifically for the project. Data entry is flexible and the model can handle missing data points, although, the more data points, the more precise the calibration of the model and the subsequent analyses.

Optima input parameters			
	Biological parameters	**Behavioral parameters**	**Other parameters**
Population parameters	Natural mortality rate		Size of sub-populations
HIV parameters	Sexual HIV transmissibility STI-related transmissibility increase Disease-related transmissibility Condom efficacy Circumcision efficacy HIV health state progression rates HIV-related death rates	Number of sexual partners Number of acts per partner Condom usage probability Circumcision probability	HIV prevalence STI prevalence
Mother-to-child transmission parameters	Mother-to-child transmission probability	Birth rate PMTCT access rate	
Injection-related parameters	Injecting HIV transmissibility Syringe cleaning efficacy Drug-related death rate	Number of injections Syringe sharing probability Syringe cleaning probability Opium substitute therapy	
Treatment parameters	ART efficacy ART failure rates	HIV testing rates	Number of people on ART
HIV program parameters	Coverage of past implementation Total cost of past program implementation, by year		

The unique feature of **Optima** is its **optimization function**. For each program area (for example ART, prevention of mother to child transmission, condom promotion etc.), the relationships between program cost, coverage and outcomes are established using country-specific data. A mathematical optimization function is used to calculate the **optimal allocation of resources** to different program areas to maximize the reduction in new infections, deaths or disability-adjusted life years, given fixed costs or to minimize costs while achieving specific targets with these objectives. The fully calibrated, or aligned, model combined with these cost-coverage-outcome relationships also provides results on epidemic dynamics, evaluations of past spending, cost-effectiveness of investments, and projected costs and financial commitments.

Figure 19: Schematic illustration of mathematical optimization processes used in Optima



Source: UNSW (2015)

4.10. The limitations of Optima

While section 1.2 (above) describes the general limitations of modelling tools, provided below is a description of some of the limitations specific to **Optima.**

- **Optima** is designed to facilitate allocations within HIV, but is not designed for determining inter-disease allocations (i.e. between different diseases, for example HIV versus tuberculosis).
- Despite its economic analysis capacity, **Optima** is not a costing or budgeting tool, **Optima** can inform investments, but actual budgeting for implementation requires other tools.
- **Optima** is designed to provide rigorous analysis to guide decision-making processes. This will not always be in line with every stakeholder's expectations and, hence, other equity or political considerations will need to be addressed outside the tool.

The appropriate use of models and their output can contribute to effective dialogues and policymaking, but misuse of models or misinterpretation of their output can mislead decision making.

4.11. Optima requirements, processes and analysis

When using **Optima** for an analysis, the user is required to make a number of important choices at the outset:

- At the beginning of a new analysis project, **Optima** requires the user to define programs and populations to be included in the analysis.
- Based on the user's choice **Optima** generates a data entry workbook in Microsoft Excel® (referred to as 'data entry spreadsheet') to provide data for these populations and programs.
- In the data entry spreadsheet the user enters data in MS-Excel format and thereafter uploads the created workbook into **Optima**.

This section describes the preparatory steps, which will help users in making good decisions. For these preparations users will require a basic understanding of the country's

HIV epidemic, relevant sub-populations, HIV programs, costs associated with the programs and available data sources.

4.12. Populations

The first critical decision when using **Optima** is which sub-populations to include in an analysis. The following criteria can guide this decision:

- the population plays a **substantial role in the country's epidemic**;
- the population can be **clearly defined**;
- the population is currently or could be **targeted with HIV programs**;
- there is a minimum amount of **data** or reliable estimates for this population, most critically **on population size and HIV prevalence**;
- the population does not have substantial overlaps with other populations, for which there is insufficient data to track the overlap (e.g. TB patients are a group, which cut across different other populations, but the proportion of TB patients coming from different groups may be hard to establish, i.e. in this case TB patients would be hard to include as a separate population).

Optima offers the user the following default populations:	
• Female sex workers	• Children (1-14 years)
• Clients of sex workers	• Infants (below 1 year)
• Men who have sex with men	• Other males (15-49 years)
• Transgender individuals	• Other females (15-49 years)
• People who inject drugs	• Other males [enter age]
• Males who inject drugs	• Other females [enter age]
• Females who inject drugs	

The user does not have to include all these populations in the analysis and should consider the following:

- The user can decide on whether to disaggregate certain populations by gender or not depending on data availability (for example if over 95per cent of migrants or PWID are male, there may not be need for a separate female migrant or females who inject drugs population).

- In most epidemics, certain key populations like female sex workers, their clients and men who have sex with men play a critical role and should be included.

- Users are encouraged to include the categories of *Other males* and *Other females* to ensure that the country's total population is reflected in the analysis. This will allow for checking the total population of the country against other demographic data and projections. It will also make the **Optima** analysis more comparable to other national HIV estimates, which are based on the country's total population in specific age groups.

Based on the country's epidemic type the **Optima** user can add more populations, while considering that including more populations will also make the results of the analysis more complex and will require specific data on these populations.

The total sub-groups of populations should reflect the total population numbers as reflected in the general census reports or population and demographic studies.

4.13. Choosing populations in concentrated epidemics

In concentrated epidemic settings specific other key populations may play important roles. Such populations could include:

- Female partners of MSM,
- Female partners of sex work clients,
- Sexual partners of people who inject drugs,
- Migrants,
- Uniformed services personnel,
- Other specific professional groups,
- Prisoners, and
- Others.

What will determine their inclusion as a separate population is their contribution to the epidemic, and whether in the country context these populations are identifiable for delivery of HIV programs. For example, female partners of sex work clients account for a substantial portion of new data availability infections in many settings, but are difficult to distinguish programmatically from other women aged 15-49 years and there are few data on this group in most settings, their inclusion therefore may not be essential.

4.14. Choosing populations in generalized and mixed epidemics

In generalized and mixed epidemics, it could be relevant to further divide the general population of males and females. This could be done by age, preferably using age definitions, which are relevant to the epidemic and for which other data will be available, for example:

- Males 15-24 years
- Males 25-49 years
- Males 50+ years
- Females 15-24 years
- Females 25-49 years
- Females 50+ years

The default options for including children in **Optima** is to divide them into infants (0-1 years) and children (2-14 years). However, it is also possible to include one population of children 0-14 years. If the country would like to specifically analyze new infections, number of HIV-positive infants and deaths among infants, it will be useful to separate the two populations. Otherwise, one population of children may also be sufficient, as it would be assumed that the majority of HIV infections among children would relate to earlier MTCT.

Optima users could also apply definitions, which they know from other epidemic models, for example by HIV risk: people who are not sexually active ("no risk"), people in a "stable relationship", people with casual partners. However, there may be overlaps between such categories and others and data may not be consistently available for such definitions. Therefore it will be preferable to use definitions, which are supported by most standard DHS reports like disaggregation by age or marital status.

In principle, **Optima** is sufficiently flexible to include any number of different populations. For example, in some generalized epidemics specific geographical areas, settings like mines, migrants or even groups like long-term sero-discordant couples could be included. In most countries, this would, however, require secondary analysis of DHS or other data to come up with HIV prevalence, behavior and service use data for such user-defined populations.

4.15. Choosing sub-national populations

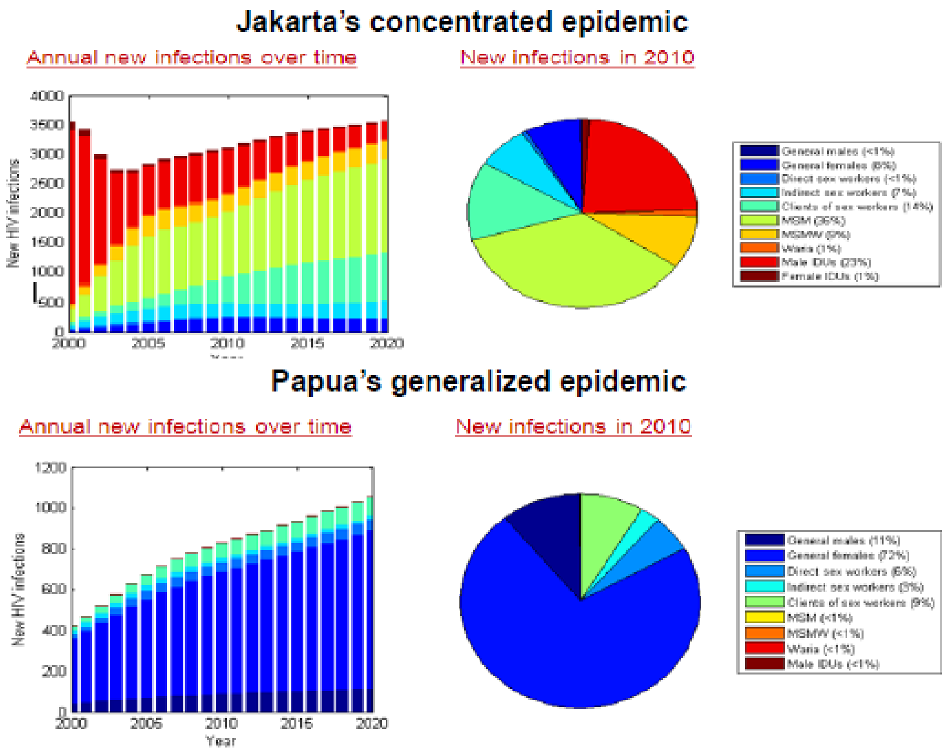
Optima can also be used to conduct sub-national HIV epidemic analysis, which can be particularly relevant in countries with large epidemics and countries with relatively heterogeneous epidemics such as geographically mixed epidemics (like Nigeria, Indonesia, Kenya, Tanzania, Mozambique and many others). In such cases, the user does not have to define all populations for each region of the country, but could focus on key populations in specific geographical regions.

Below is an example how this could be addressed in a large country with three epidemic sub-regions including one with drug injecting practices and one with an epidemic among mine workers:

Female sex workers, Region A	Female sex workers, Region B	Female sex workers, Region C
Clients of sex workers, Region A	Clients of sex workers, Region B	Clients of sex workers, Region C
Men who have sex w. men, Region A	Men who have sex with men, Region B	Men who have sex w men, Region C
People who inject drugs, Region A		
Other males (15-49), Region A	Other males (15-49), Region B	Other males (15-49), Region C
Other females (15-49), Region A	Other females (15-49), Region B	Other females (15-49), Region C
	Mine workers, male, Region B	
Infants (below 1), Region A	Infants (below 1), Region B	Infants (below 1), Region C
Children (1-14), Region A	Children (1-14), Region B	Children (1-14), Region C
Other males 50+, Region A	Other males 50+, Region B	Other males 50+, Region C
Other females 50+, Region A	Other females 50+, Region B	Other females 50+, Region C

Provided below is an example of **Optima** analyses prepared for sub-national groups in Indonesia. Below is an example how this could be addressed in a large country with two epidemics.

Figure 20: Country example of sub-national analysis: HIV epidemic (and allocative) diversity in Indonesia



Source: UNSW

Such an approach would also require you to define sub-national programs along the same lines.

4.16. How to deal with population 'overlaps'

In many cases there will be overlaps between different populations, for example females who use drugs and who also sell sex or migrants who are also sex work clients. There are different options how to handle such overlaps:

- *Define a specific group (for example female sex workers who inject drugs):* This should only be done if the group is key for understanding the epidemic, if the overlap between the two groups is substantial and if sufficient data are available. Although this may be an ideal solution in terms of precision, data may not be available or require time-consuming secondary analysis and from a programmatic perspective it may not be essential to have such detailed information for an additional sub-group.

- *Assign populations as per their dominant risk:* This will be the most common solution. If in our example the dominant risk is through drug injecting behaviors, all FSW who inject drugs could best be defined as women who inject drugs (WWID). **Optima** will allow for entering commercial (paid) sex acts as a behavioral parameter for women who inject drugs.

Technical note: Although this second solution is preferable because of simplicity, it comes with a limitation: The behavioral and HIV service data from standard country IBBS reports for female sex workers will still include those FSW who inject drugs; although in the model FSW would exclude those who inject drugs by definition as they are part of WWID. If there is a large overlap in population size or difference in HIV prevalence between FSW who inject and those who do not inject drugs, this could warrant calculating HIV prevalence and other parameters manually for FSW who do not inject drugs. If the overlap or difference in HIV prevalence is small, it could be simpler to just use existing survey data and acknowledge this as a limitation.

4.17. HIV Programs

The second critical choice users need to make is on the HIV programs to include in an **Optima** analysis. The following criteria should be used for dividing the national HIV response into specific programs:

- the program plays an important **role in the national HIV response**;
- there is historical program **coverage information** for the program if it is a 'direct' program targeting a population (or in case of new programs at least an understanding of potential coverage targets);
- past **expenditure data** (or budget allocation data) are easily accessible for the program (for example: the program corresponds to a standard category in the National AIDS Spending Assessment);
- there is research **evidence** on the efficacy or effectiveness of a HIV program for a specific population.

Just as for populations, an important consideration is to keep the number of programs manageable, for the resulting analysis to be robust.

Other programs should be included in categories defined in **Optima** such that the entire budget can be assessed.

Optima offers a range of default programs to the user:

HIV Prevention, Care & Support	HIV testing and counselling
Condom promotion and distribution	Antiretroviral therapy
Social and behavior change communication	Prevention of mother-to-child transmission
Diagnosis and treatment of STIs	Other HIV care
Voluntary medical male circumcision	Orphans and vulnerable children
Cash transfers for HIV risk reduction	
Programs for female sex workers and clients	***Enablers and synergies***
Programs for men who have sex with men	Management
Programs for people who inject drugs	HR and training
Opiate substitution therapy	Enabling environment
Needle-syringe program	Social protection
Pre-exposure prophylaxis	M&E, surveillance, and research
Post-exposure prophylaxis	Health infrastructure

There are two types of programs included in **Optima**: HIV prevention, care and support programs and enablers and synergies. Some expenditure categories are directly linked to the impact metrics and have a direct effect on incidence, AIDS-related deaths, or DALY, while for other categories, included within enablers and synergies, there is either limited cost data or no known direct effect, for instance coordination expenditures, or M&E spend.

In principle all programs can be linked to a specific parameter in the model. For example, condom promotion and distribution would be linked to the percentage condom use in casual sexual acts. However, not all programs have to be linked to a specific outcome. Some cost categories, in particular enablers or synergies will not have a specific measurable effect on an impact metric in the model – such as HIV incidence or AIDS-related deaths - and will need to be treated as fixed costs. Fixed costs could be reduced through technical efficiency assumptions.

The choice of programs should correspond to the choice of populations included in the **Optima** analysis. Therefore if there is an FSW and an MSM population it will be useful to model FSW and MSM focused programs. This could also be useful, if such programs are not yet in place, as the **Optima** analysis could then be used to assess the potential impact of such a program. **Optima** can also model the effect of new programs like oral Pre-Exposure Prophylaxis based on cost estimates and efficacy data from Randomized Control Trials (RCTs), along with assumed adherence levels.

With **Optima**, it is also possible to add user-defined programs as required, for example programs for user-defined populations such as prisoners, migrants or others. In concentrated epidemics, these may include particularly intensive outreach programs for a key population or a program targeted at a specific population like prisoners. In generalized epidemics, these may include a particularly intensive multi-pronged program for young women and their male partners, which would be expected to have higher efficacy than general SBC spending. For adding any such additional programs, it will be important to consider whether information on program effects is available from studies or from evaluations.

The total group of programs should reflect the total national HIV spending as reflected under a NASA (past spending) or a National Strategic Plan (future budgets). If there is a group of small expenditure items which do not fit under any of the categories, there could be room to include them under a separate category like “Other HIV programs”. Such a category should ideally not exceed 5per cent of the HIV spending.

4.18. Cost information for an Optima analysis

Although information on cost and coverage does not have to be entered in **Optima** immediately, it is useful to review available data at an early stage as this might inform the choice of programs in the model. **Optima** uses cost-coverage-outcome curves to determine the interactions between spending and effect (see **Volume 2** of these guidelines to learn more about cost-coverage-outcome-curves).

to produce these curves **Optima** can use multiple data points on cost and coverage, and while not ideal, with Optima, the curves could be produced from a single data point as well.

4.19. Using National AIDS Spending Assessments (NASA) in an Optima analysis

The standard approach in **Optima** is to use actual HIV spending data from NASA or comparable reports produced for Global AIDS Progress Reporting for determining program costs. In an appendix to **Volume 2** of the guidelines there is a list matching all NASA spending categories to programs in **Optima**.

The quickest way to get from NASA data to the actual spending data required in **Optima** will be to do the following:

- Add a column to a NASA/GARPR expenditure table,
- Enter in this column a code (example short name) for each program the user selected in **Optima**,
- Calculate the totals for each **Optima** program category,
- Check that all spending in the NASA/GARPR is assigned to a program in **Optima**.

In some cases, the country team will have additional knowledge on how to classify specific expenditure items. The user will also be required to enter specific coverage information for each program, **Optima** will establish relationships between cost and coverage.

4.20. Using data from National Strategic Plans or other costing exercises

In some cases, past expenditure data will not give a true reflection of what future costs will look like. For example the package of services may change; or past cost may only reflect an inception phase and actual unit cost could be substantially lower. **Optima**, therefore, also provides an option for the user to enter future costs. These could come from a costed operational plan under a National Strategy (NSP) or a costing study.

The process for translating NSP costs into total program costs in **Optima** will be the same as described above for NASA. The total costs of an NSP could be divided using the names of the specific programs in **Optima**. In addition, the coverage targets associated with these programs will need to be available for **Optima** to develop cost-coverage relationships. This will be particularly relevant for new programs (like PrEP) where no past spending data is available.

4.21. Focus of the Optima analysis

Different Objectives → Different Allocations or different results

The focus of **Optima** analysis, and the output of **Optima**, is aimed at assisting country teams to determine whether their HIV program is achieving maximum impact. Measuring the impact is linked to what objective is desired. Should the objective be to:

- minimize new HIV infections,
  - all efforts and resources will be aimed at those interventions which prevent HIV transmission and HIV acquisition

- minimize AIDS-related deaths or the burden of the disease,
  - all efforts and resources will primarily be aimed at saving lives and hence strengthening or expanding the most effective HIV diagnosis, treatment and care interventions in the short-term and prevention programs such that longer-term disease burdens will be averted

- or a combination of reducing HIV infections and minimizing AIDS related deaths or DALYs.

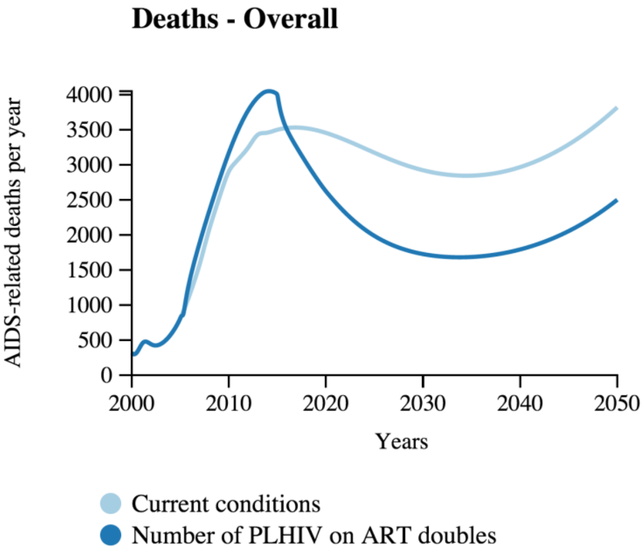
Generally countries strive for a mix of these objectives and have additional context-specific priorities which would lead to additional objectives for their HIV interventions. The results of the analysis are provided, through **Optima**, to be used to guide discussion around the achievement of targeted objectives.

Optima analysis results are aligned to the needs of an HIV allocative efficiency analysis. Provided below are some illustrative examples of analysis results provided by **Optima**.

Examples	**Illustrative Optima result**	**Brief indication of how a country can use the analysis**
1. Scenario analyses		
a. What the epidemic would look like if there were twice as many PLHIV on ART? b. What would it look like if condom use in sex workers were to increase to 90 per cent?	Optima can answer questions such as these through the scenario analysis functionality. Users have the option to change the parameters that influence the epidemic over different time frames. All of the standard Optima results (prevalence, infections, deaths, DALYs, number of people of treatment, projected costs of HIV response and financial commitments) can then be viewed for each scenario. Multiple scenarios can be compared simultaneously. *See Figure 21*	The scenario analysis results can be used in a number of different settings. Firstly, this type of analysis is useful for countries in the *planning phase*. Modelling the impact of different strategies is an invaluable tool for supporting well-informed and effective National Strategic Plans. Secondly, this type of analysis can be useful in the *assessment phase*, when evaluating the effect of already-implemented programs. Thirdly, this analysis can support advocacy, by demonstrating the effect on the epidemic of reduced program reach.
2. Optimization analysis, single budget		
a. Given a fixed funding envelope, how should this be allocated across different programs to result in the minimum number of new infections? b. What would the reduction in infections be that would result from reallocating funding in this way?	Optima can answer questions such as these by using the optimization analysis feature. Users have the option to define different objectives (for example, to minimize infections, deaths, DALYs or financial commitments over a given time period), and different constraints. The constraints reflect the types of real-world issues that are encountered when allocating program funding across multiple	The optimization results can be used in the planning phase of programming, when deciding how to allocate resources. They can be used to support applications for funding from external agencies, such as the Global Fund, and as well as for domestic advocacy purposes.

Examples	**Illustrative Optima result**	**Brief indication of how a country can use the analysis**
	years. All of the standard Optima results (prevalence, infections, deaths, DALYs, number of people of treatment, projected costs of HIV response, and financial commitments) can then be viewed for each optimization. Multiple different optimizations can be compared simultaneously. *See Figure 22*	
3. Optimization analysis, multiple budgets		
a. Supposing that the amount of funding available were to increase, what programs should be scaled up first? b. Conversely, if the amount of funding available were to decrease, what programs should be retained and what programs should be defunded?	Optima's optimization analysis feature allows you to compare and optimize multiple budgets at once. *See Figure 23*	These results can be used to design minimal service packages in the event of heavily reduced funding availability, to inform prioritization planning, and for advocacy purposes. They can support cost-effectiveness analyses and assist in evaluation exercises.
4. Optimization analysis to meet epidemic targets		
a. What is the minimal amount of funding required to achieve multiple objectives, such as reducing new infections and deaths? b. What savings would result from optimizing the allocation of funding, compared to simply scaling up?	Optima can answer questions such as these by using the optimization analysis feature. This feature supports optimizations with the objective of minimizing the amount of money spent.	These results can be used to show the cost savings that would result from allocating funding in the most efficient way, rather than simply scaling up expenditure and retaining the existing funding allocation. This type of analysis is useful for countries who wish to estimate how much funding will be required to meet certain epidemic targets, such as the UNAIDS 2030 targets or the targets specified in a National Strategic Plan.
5. Optimization analysis combined with efficiency gains		
Supposing that an improvement in management techniques meant that management costs could be reduced by 20per cent. How could the money saved from this efficiency improvement best be reinvested in core programming?	This is similar to Question 3a above: Optima allows users to see which programs should be scaled up first if more program funding becomes available.	These results can be used to advocate for improved implementation efficiency, to and to support cost-effectiveness analyses and assist in evaluation exercises.

Figure 21: Examples of scenario analysis



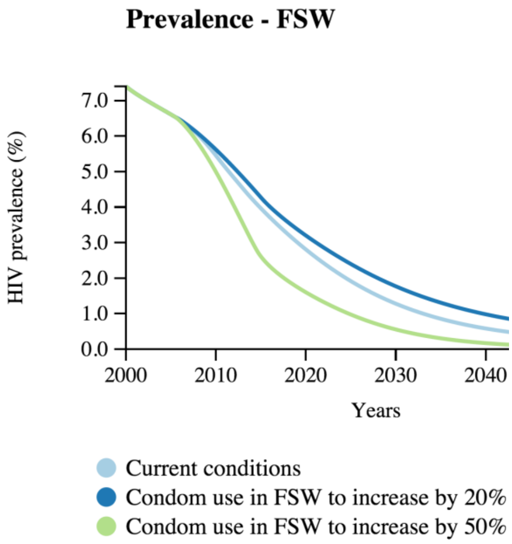
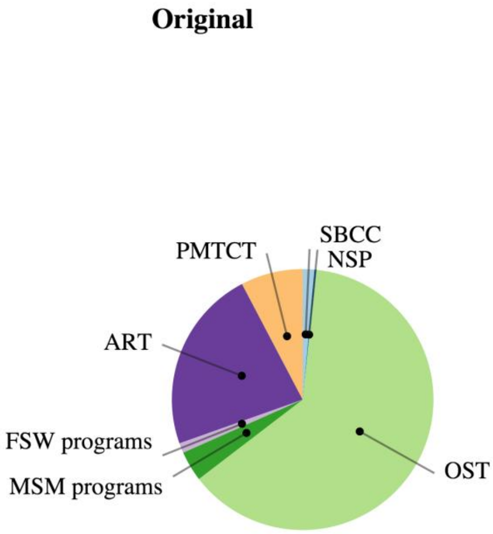


Figure 21a: Comparing the number of deaths under current conditions and a scenario in which the number of PLHIV on ART doubles

Figure 21b: Comparing the number of deaths under current conditions and a scenario in which condom use in FSW increases by 20per cent and by 50per cent

Figure 22: Examples of optimization analyses with a single budget



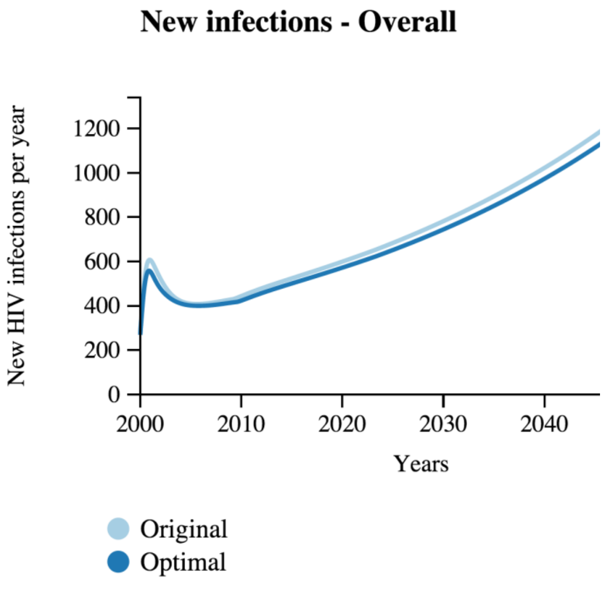
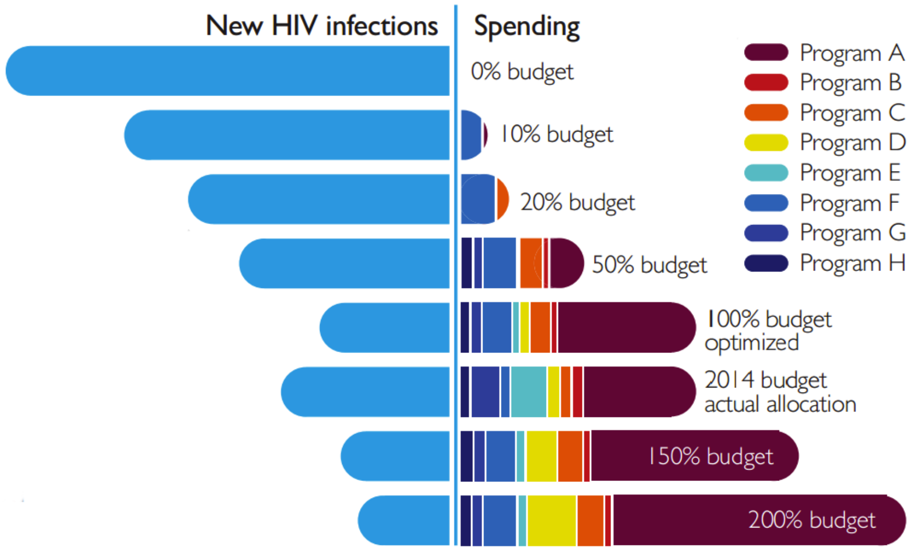


Figure 22a: Pie chart indicating the optimal allocation of funding to different programs. The objective in this example was to minimize infections to 2030.

Figure 27b: Comparing the number of total infections under the original and optimal funding allocations.

Source: UNSW/The World Bank: Optima analysis

Figure 23: Examples of optimization analyses with multiple budget envelopes



The total number of new infections (left) resulting from each allocation (right). The objective in this example was to minimize infections to 2030.

Source: UNSW/The World Bank: Optima analysis

Volume 2 of the guidelines will provide a detailed step-by-step guide to making the most of the **Optima** software.

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APPENDIX

1. Acronyms and abbreviations

AEM	Asian Epidemic Model
AEM	The Asian Epidemic Model
AIDS	Acquired immunodeficiency syndrome
AIS	AIDS indicator survey
ART	Antiretroviral therapy
BOD	Burden of disease
CPI	Consumer Price Index
CSW	Commercial sex workers
DALY	Disability-adjusted life year
DHS	Demographic health survey
DSA	Disease specific (health) accounts
eMTCT	Elimination of mother-to-child transmission
EPP	Epidemic Projections Package
FAD	Female Adults (15 years or older)
FELD	Females aged 50+
FSW	Female Sex Workers
FYTH	Female Youth
GARPR	Global AIDS response progress reporting
GBD	Global Burden of Disease Study
GDP	Gross domestic product
GNI	Gross national income
GP c	General Population Condom use
HAPSAT	HIV and AIDS program sustainability analysis tool
HDI	Human development index
HIV	Human immunodeficiency virus
HTC	HIV Testing and Counselling
IBBS	Integrated bio-behavioral survey
IEC	Information education communication
IGO	Inter-Governmental Organization
KP	Key population
KYE/KYR	Know your Epidemic, Know your Response
M&E	Monitoring and Evaluation
MAD	Male Adults (15 years or older)
MDG	Millennium Development Goal
MELD	Males aged 50+
MoT	Modes of Transmission
MSM	Men who have sex with Men
MSW	Male sex workers
MWID	Men who inject drugs
MYTH	Male Youth
NAC	National AIDS council/commission/committee
NASA	National AIDS spending Assessment

NGO	Non-governmental organization
NHA	National health accounts
NSP	National strategic plan
NSP	Needle and Syringe exchange Program; National Strategic Plan
OST	Opioid/Opiate substitution therapy
PLHIV	People Living with HIV
PMTCT	Prevention of Mother-To-Child Transmission
PrEP	Pre-Exposure Prophylaxis
PWID	People Who Inject Drugs
PWID c	People Who Inject Drugs condom use
QALY	Quality adjusted life year
RNM	Resource Needs Model
SBBC	Social and behavior change communication
STI/D	Sexually transmitted infections/diseases
SWC	Sex Worker Clients (Clients of Sex Workers)
TB	Tuberculous
TG	Trans-gender
TWG	Technical working group
UNAIDS	Joint United Nations Program on HIV and AIDS
UNSW	University of New South Wales
VCT	Voluntary counselling and testing
VMMC	Voluntary medical male circumcision
WHO	World Health Organization
WWID	Women Who Inject Drugs
YLL	Years of life lost

2. Glossary of terms

Please note that **Volume 2** has another glossary, containing terms relating to modelling and more specifically Optima.

Allocative Efficiency	Allocative efficiency of health or HIV specific interventions is about the right intervention being provided to the right people at the right place in the correct way that health outcomes are maximized. It is defined as the distribution of resources among a combination of programs, which are projected to achieve the largest possible effect with available resources and set objectives.
Behavioral intervention	Behavioral interventions discourage risky behaviors and reinforce protective ones, typically by addressing knowledge, attitudes, skills, and beliefs.
Biomedical intervention	Biomedical HIV intervention strategies use medical and public health approaches to block infection, decrease infectiousness, and reduce susceptibility.
Bottom-up	Costing method that involves identifying all of the resources that are used to provide a service and assigning a value to each of those resources. These values are summed and linked to a unit of activity to derive a total unit cost.
Cost-effectiveness analysis (CEA)	A form of economic analysis that compares the relative costs and outcomes (effects) of two or more courses of action.
Directly Observed Treatment Strategy (DOTS)	The name given to the TB control strategy recommended by the WHO in which the drug taking of the patient is supervised by a person instructed to do so.
Effectiveness	Effectiveness can be defined as the degree of achievement of a (health) outcome in a real-world setting.
Efficiency	Efficiency can be defined as the achievement of an output with the lowest possible input without compromising quality.
Financial Sustainability	Financial sustainability refers to the ability of government and its partners to continue spending on a health or HIV outcome for the required duration and to meet any cost of borrowing without compromising the government's financial position
HIV incidence	The estimated total number of new (total number of diagnosed and undiagnosed) HIV infections in a given period.
HIV prevalence	The percentage of people aged 15-49 who are infected with HIV.
Implementation efficiency	Implementation efficiency describes a set of measures to ensure that programs are implemented to achieve target outputs using the smallest input of resources. In practical terms, improving implementation efficiency means

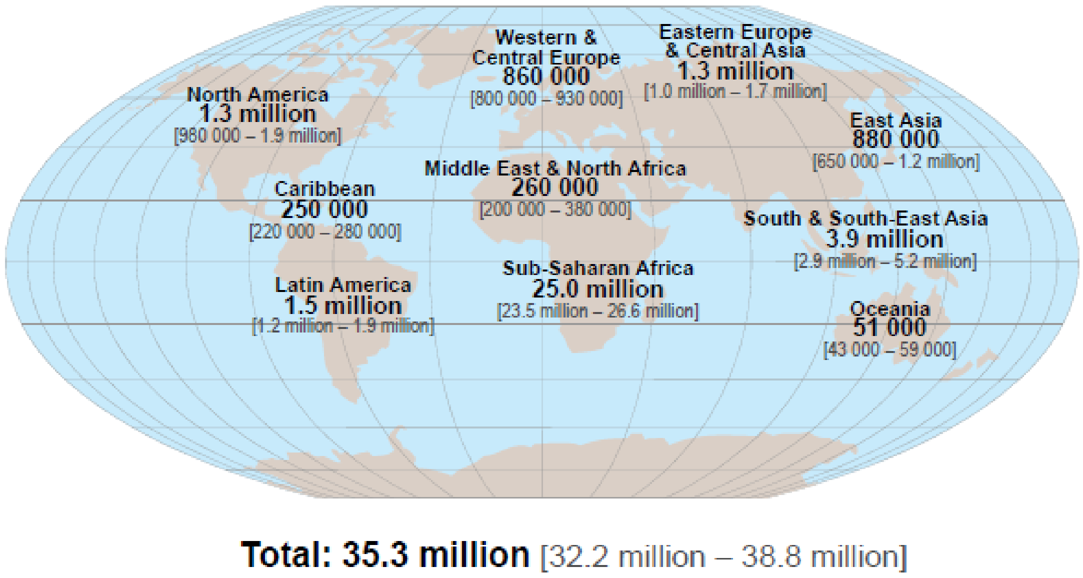
	identifying better delivery solutions. This requires improved planning, design of service delivery models, as well as assessing and addressing service delivery obstructions that prevent all clients moving smoothly through the service delivery cascade and reducing wastage of resources. Implementation efficiency will contribute to the improved scale, coverage, and quality of programs.
Incremental cost-effectiveness ratio (ICER)	An equation used commonly in health economics to provide a practical approach to decision making regarding health interventions. ICER is the ratio of the change in costs to incremental benefits of a therapeutic intervention or treatment.
Model	Computer system designed to demonstrate the probable effect of two or more variables that might be brought to bear on an outcome. Models can reduce the effort required to manipulate these factors and present the results in an accessible format.
Opioid substitution therapy (OST)	The medical procedure of replacing an illegal opioid, such as heroin, with a longer acting but less euphoric opioid; methadone or buprenorphine are typically used and the drug is taken under medical supervision.
Opportunistic Infection Prophylaxis (OI Prophylaxis)	Treatment given to HIV-infected individuals to prevent either a first episode of an OI (primary prophylaxis) or the recurrence of infection (secondary prophylaxis).
Pre-exposure prophylaxis (PrEP)	A way for people who do not have HIV but who are at substantial risk of getting it to prevent HIV infection by taking a pill every day.
Program Effectiveness	Program Effectiveness incorporates evaluations, empirical studies, meta-analyses, and mathematical modelling efforts to establish what works and provides impact on disease and/or transmission intensity, disseminating proven practice and improve the public health results of programs
Program sustainability	Program sustainability refers to the ability to maintain programming, community capacity and health benefits for an extended period of time after major financial, managerial and technical assistance from an external donor is terminated It refers to the ability of a health sector or HIV response to maintain the institutions, management, human resources, service delivery and demand generation components of a national response until impact goals have been achieved and maintained over time as intended by the strategy.
Reference Case (RC)	A standard set of principles and specifications that an analyst should follow in performing cost-effectiveness analysis - adapted from Culyer (2013), Gold (1996).
Return on investments (ROI)	A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment; the result is expressed as a

	percentage or a ratio.
Sustainability	Sustainability of the health sector and HIV responses refers to the ability of government, other funding institutions and households to maintain systems, programs and inputs for the duration required to achieve specific health and HIV goals. It is about reliably knowing and being able to forecast funding sources and integrating them better. Financial sustainability analyses assist country teams to project their HIV and AIDS costs and to plan for a transition to sustainable financing.
Technical efficiency	Technical Efficiency describes the delivery of a (health) service to produce maximum output at the lowest possible unit cost, while being delivered in accordance with operational quality standards.
Top-down	A costing method that divides total expenditure (quantum of funding available) for a given area or policy by total units of activity (e.g. patients served) to derive a unit cost.

3. A brief overview of the Biology and epidemiology of HIV

Acquired immune deficiency syndrome (AIDS) was first described in 1981 in homosexual men in North America (Gottlieb 1981) followed by the first report in patients from Central Africa in 1983 (Clumech 1983). Three years later it was evident that the human immunodeficiency virus (HIV), the virus responsible for the development of AIDS, had spread into populations of many countries around the world and had become an enormous public health problem (Quinn 1986).

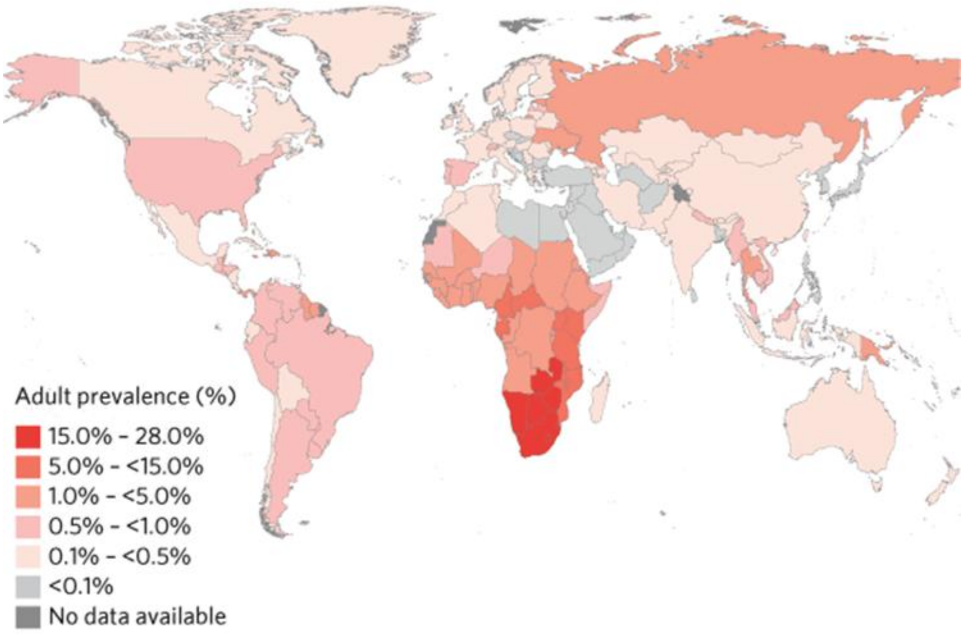
Figure 24: Adults and children estimated to be living with HIV (2012)



Source: UNAIDS & WHO (Available at http://www.unaids.org/sites/default/files/en/media/unaids/contentassets/documents/epidemiology/2013/gr2013/201309_epi_core_en.pdf, accessed 24 May 2015)

Routes of transmission of HIV and the demographic distribution of the virus vary around the world. Sub-Saharan Africa suffers the most severe epidemic, with about 22.5 million adults and children living with the infection (68 percent of the global HIV population). Unprotected heterosexual intercourse along with the transmission of HIV to newborns and breast-fed babies (mother-to-child transmission) are the dominants mode of transmission worldwide, accounting for about 85per cent of all HIV infections (Simon, Ho et al. 2006). The HIV epidemic in Asia and Eastern Europe is largely dominated by injection drug use (PWID), sex workers and their clients, and men who have sex with men (MSM). In the Caribbean, the primary route of transmission is hypothesized to be commercial sex. A large portion of the burden of disease in Central and South America, as well as in North America and western and central Europe is concentrated in the MSM population. Other significant modes of transmission in these regions include PWID and commercial sex. In the Middle East and North Africa, the prevalence of HIV infection is relatively low.

Figure 25: The distribution of people living with HIV infection globally



The darker shades represent higher prevalence of HIV infection.

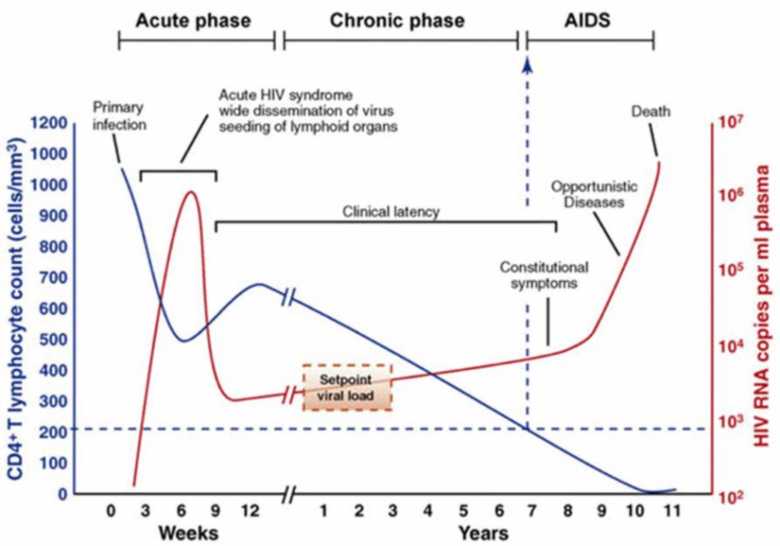
Source: WHO/UNAIDS 2008. Available at http://www.who.int/hiv/data/global_data/en/ Accessed March 17, 2015

HIV is a member of the lentivirus subfamily of retroviruses that produces chronic infections in the host and gradually degenerates the host's immune system (Fauci 1988). Retroviruses such as HIV use a reverse transcriptase enzyme to produce DNA from the virus's RNA template. The resulting double retroviral HIV-DNA then moves into the nucleus where it inserts into the host DNA and becomes a provirus, step in which the infection of the cell becomes permanent (Greene 1993).

HIV infection is characterized by a progressive loss of the CD4+ helper lymphocytes. The loss of T cells leads to severe damage to immune function and consequently permits opportunistic infections and neurological complications that would not occur in persons with intact immune system (Ho 1987). The pattern of disease progression can be subdivided into three phases. The primary or acute phase, that comprises the first weeks after infection, in which the infected individual usually develops a high virus load and CD4 cell concentration transiently falls, followed by a partial recovery in the number of cells. At the end of this phase there is a decrease of viral load to the set point level, and then the infection enters to the second (chronic) phase characterized by the lack of any symptomatic signs (Hutchinson 2001).

Although during the chronic phase the infection is largely asymptomatic, the virus continues its replication and CD4 cell concentration falls progressively. There is great variation in the length of the asymptomatic phase, ranging from few months to many years. The final phase of the disease is characterized by the development of AIDS, where CD4 cell concentrations fall below 200 per µl and opportunistic infections begin to appear (Hutchinson 2001). (More information could be found in: Simon, Ho, and Karim; HIV/AIDS epidemiology, pathogenesis, prevention, and treatment, The Lancet 2006, 368:9534)

Figure 26: Natural history of HIV infection in the absence of therapy in a hypothetical patient



Source: O'Brien and Hendrickson: Host genomic influences on HIV/AIDS; Genome Biology 2013, 14:201

4. Scope of Work for HIV analyses using Optima

Introduction

In a resource-constrained environment, today's HIV responses are faced with the need to scale-up targeted but comprehensive HIV services that reduce the transmission of HIV and treat and care for a larger number of people living with HIV than ever before. Focused HIV responses and efficiency in program delivery are essential to ensure that programs can **do more with less funding**. The concept of allocative efficiency refers to the **maximization of health outcomes using the most cost-effective mix of health interventions**.

There are different tools with which to address this policy topic. One such tool is Optima. **Optima** is a mathematical model of HIV transmission and disease progression that uses an integrated analysis of epidemic, program, and cost data to determine an optimal distribution of investment at different funding levels to better serve the needs of HIV and health decision-makers and planners. This document specifies a set of typical questions addressed by Optima for selection in an analysis.

A. What is the country context of these analyses?

Discuss the motivations for performing Optima analyses (e.g., inform a Global Fund concept note application; advocacy for increased domestic health budget).

B. What is the current National Strategic Plan?

National Strategic Plan Period
e.g. 2015-2020

HIV Health Impact Targets in the National Strategic Plan					
Indicator	Reduce by	Reduce / maintain to less than	Among which population group(s)? (normally all)	Year of data for comparing outcomes	
				Baseline year	End year
Annual new HIV infections	e.g. 40%		e.g. All	e.g. 2015	e.g. 2020
Annual AIDS-related deaths	e.g. 50%		e.g. All		
HIV prevalence (not recommended)		e.g. 10%	e.g. MSM		
…add / delete rows as needed					

Note: if the National Strategic Plan does not contain epidemiological targets a default recommendation is to reduce both annual new HIV infections and AIDS-related deaths by 50%.

C. What priority policy questions can Optima help answer?

Typically an Optima analysis is focused around objectives of a national strategic plan. However, analyses can be conducted at sub-national levels, particularly when there is epidemic heterogeneity by location.

In developing the scope of work for an HIV allocative efficiency study, the team should consider the policy and country context and then make a decision as to which of the policy questions below is a priority for the country to answer. The particular HIV allocative efficiency question for the country is then shaped around the policy question(s) that need to be answered.

Analyses can consider resources allocated across (i) broad program areas at the national level or; (ii) programs by sub-national geographical region and/or (iii) different HIV service delivery models. For all analyses, results will include projected prevalence, number of people living with HIV, number of new HIV infections, number of people on treatment, number of HIV-related deaths, and the long-term financial implications of HIV (including both costs and commitments).

C1. How close are we to National Strategic Plan targets under current funding?

Over the National Strategic Plan period, how close will the country get to their National Strategic Plan's disease-related targets:

a) With the current volume of funding, allocated according to current expenditure?
b) With the current volume of funding, allocated optimally?

C2. How much funding is required to achieve the National Strategic Plan targets?

Over the National Strategic Plan period (or over a longer time period), according to current program implementation practices and costs:

a) How much total funding is requird to meet the National Strategic Plan targets?
b) How is this funding optimally allocated between programs?

C3: What benefits can be achieved via implementation efficiency gains?

How do the results of C1 and C2 change according to the following plausibly identified implementation efficiency gains?

Program	Total / unit costs reduced by
e.g. Management	e.g. 20%
e.g. OST	e.g. 25%
e.g. Mobile clinics	e.g. 15% lower unit cost but 20% less coverage (up to 65% of population)
…add / delete rows as needed	

Note: All allocation scenarios can be expressed in terms of volume of funding, and changes in program coverage levels and intensity over time. Change in potential reach (maximum coverage) should also be specified for different service delivery models.

D. What other questions can Optima help answer?

In addition to the key questions listed above, Optima can help answer specific analysis questions.

D1. What have been the impacts of past program implementation?

Retrospectively, how would the country's HIV epidemic trajectories have changed had investment not occurred in different programs and what is the estimated cost-effectiveness of the past response?

Program	Period
e.g. PWID programs (needle and syringe programs and OST)	e.g. 2006-2012
e.g. Total programmatic spend over all components	

D2. What is the expected future impact of policy or program implementaton scenarios?

What is the projected future trajectory of the country's HIV epidemic with and without investment in specific programs, or with/without attaining program-specific targets?

Reference year for expenditure
e.g. 2015

Baseline projection assumptions
e.g. Coverage remains the same as 20XX levels for all programs (this year could be the last year of available confirmed funding or levels prior to the start, or end, of NSP funding); No PLHIV who initiates ART is to stop receiving ART, except through natural attrition

Scenario	Parameter assumptions	Scale-up/down period	Analysis period
e.g. Prevention programs for all PWID and MSM defunded	e.g. Condom use among MSM with casual partners declines from 80% to 65% e.g. Needle sharing among PWID increases to 20% of injections	e.g. From 2016	e.g. 2016-2025
e.g. Adherence to ART	e.g. Viral suppression increased to 80%	e.g. by 2018	e.g. 2016-2030
e.g. ART coverage	e.g. ART coverage increased to 85% among diagnosed PLHIV	e.g. by 2020	e.g. 2016-2025
e.g. Voluntary medical male circumcision	e.g. VMMC coverage increases to 75% in males 10-34 years	e.g. by 2020	e.g. 2016-2030
e.g. Voluntary medical male circumcision	e.g. VMMC funding increases by 20% per year	e.g. Between 2016 and 2020	e.g. 2016-2030
… add / delete rows as needed			

E. Modeling specifications

E1. Constraints for the optimal allocations

Changes in funding to achieve optimal allocations will be constrained by the following conditions:

Program	Constraint
e.g. ART	No one who initiates ART is to stop receiving ART, except through natural attrition
e.g. OST	No one who initiates OST is to stop receiving OST, except through natural attrition
e.g. Key population prevention	e.g. Funding cannot change by more than 30% per year
… add / delete rows as needed	

E2: Population groups and programs to be included in the model

The following population sub-groups will be included in analyses:

Geographical region	Populations
e.g. Province 1; Province 2	e.g. for each province: males & females in age groups (0-2, 3-14, 15-24, etc.), FSWs, …

The following programs will be included in analyses:

Program	Service delivery model
Direct programs	
e.g. for each province: HCT	e.g. HCT sites, point of care mobile outreach clinic, public hospitals
e.g. FSW programs	e.g. peer outreach
… add rows as needed	
Indirect programs	
…add rows as needed	

F. From Analysis to Implementation

Once analysis is completed, it is important to monitor if policy recommendations resulting from the analysis are translated into the real policy changes and budget allocations. The follow-up analysis should be conducted to measure the impact of policy and budget allocation changes on key outcome indicators, such as HIV infections, death, DALY. Depending on the country specific context, the additional analysis can be conducted when (i) new funding allocation for Global Fund Grants are approved; (ii) budget is appropriated for the national AIDS program; (iii) the budget is executed and the program expenditures are recorded.

G. Study timelines and deliverables

The following timeframe is proposed for the analytical support:

Deliverable	Responsible	Due date
Teleconference / meeting on generating an Optima project and defining populations and program parameters		
Teleconference / meeting on data entry workbook		
Provision of a zero draft Optima data workbook for quality assurance		
Provision of a first draft Optima data workbook		
Provision of a revised draft Optima data workbook for quality assurance		

Deliverable	Responsible	Due date
Preliminary (test) model calibration and cost-coverage outcome relations		
In-country mission for stakeholder engagement, final data review, calibration and cost-coverage outcome inputs and preliminary results		
Team review and revise Optima model results		
Consolidate results in a short summary report		
Develop full draft allocative efficiency analysis report		
Feedback on full report including World Bank peer review		
Consolidating the final report		
Prepare a short policy brief		
Layout and publishing as required		
Dissemination meeting		
Follow-up analysis to measure the impact of program/policy changes		

Once agreement is reach on this Scope of Work document, the timeframe is considered firm and team members will rely on timely availability of each interim deliverable, as per the above schedule.

5. A suggested framework for the Country report on an HIV allocative efficiency analysis

Example 1:

Executive summary
Background
Methods
Key findings
Conclusions

1 Introduction
- 1.1 Allocative efficiency in HIV and health
- 1.2 Objectives of the analysis

2 COUNTRY A's human development, health and financing context
- 2.1 Human development
- 2.2 Burden of disease
- 2.3 Health and HIV financing

3 Methodology
- 3.1 Analytical framework
- 3.2 Epidemic calibration
- 3.4 Cost-coverage-outcome relationships
- 3.5 Limitations of analysis

4 Results
- 4.1 HIV transmission dynamics
- 4.2 Optimized allocations for improved health impact
  - 4.2.1 Optimized allocations to minimize HIV incidence and HIV-attributable deaths
  - 4.2.2 Program coverage and outcomes with optimized allocations
  - 4.2.3 Optimized allocations for different levels of available funding
- 4.3. Cost to achieve targets
  - 4.3.1 Cost to achieve national strategy targets
  - 4.3.2 Cost to achieve long-term response targets
- 4.4 Return on investment of optimized allocations
  - 4.4.1 Financial savings up to 20xx
  - 4.4.2 Costs per HIV infection or death averted
- 4.5 Health and financial impacts of implementing different ART guidelines
  - 4.5.1 Impact of different ART eligibility scenarios
  - 4.5.2 Cost implications and financial impact of different ART eligibility scenarios
- 4.6 Long-term costs and financial commitments for HIV services for PLHIV

5 Discussion
- 5.1 Epidemic spread and potential for new HIV infections
- 5.2 Funding for health and HIV interventions
- 5.3 Optimal HIV resource allocation for impact and sustainability
- 5.4 Linkages to technical efficiency: Potential areas for research & improved implementation

6 Conclusions and recommendations

Information or documents to include in the annexure:
- Technical information regarding the modelling tool used
- Data tables including:
  - Calibration figures, cost and coverage data or cost-coverage-outcome-curves and economic and cost data

Example 2: