ALLOCATING HIV FUNDING EFFICIENTLY IN MYANMAR

Analyses using the Optima HIV Model

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February 2017

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ACRONYMS AND ABBREVIATIONS

3DF	Three Diseases Fund
3MDG	Three Millennium Development Goals Fund
AEM	AIDS Epidemic Model
AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral therapy
BSS	Behavioural Surveillance Survey
DALY	Disability-adjusted life year
EPP	Estimation Projection Package
FESR	Framework for Economic and Social Reform
FSW	Female sex workers
GARPR	Global AIDS Response Progress Report
Global Fund	Global Fund to Fight AIDS, Tuberculosis and Malaria
GNI	Gross national income
HTC	HIV testing and counselling
HDI	Human Development Index
HIV	Human immunodeficiency virus
HSS	HIV Sentinel Sero-surveillance Survey
IBBS	Integrated Biological and Behavioural Surveillance Survey
KP	Key population
LRI	Lower respiratory infection
MSM	Men who have sex with men
NASA	National AIDS Spending Assessment
NCDP	National Comprehensive Development Plan
NGO	Nongovernmental organization
NHP	National Health Plan
NS	Needle and syringe programme
NSP	National Strategic Plan
OST	Opiate substitution therapy
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission of HIV
PWID	People who inject drugs

STI	Sexually transmitted infection
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNOPS	United Nations Office for Project Services
UNSW	University of New South Wales

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KEY POLICY RECOMMENDATIONS

1. **Antiretroviral therapy** should have the **highest priority among interventions. ART coverage should further be increased** from current level.

2. **Funding for prevention and testing programmes** targeting **female sex workers, men having sex with men** and **people who inject drugs** (PWID) should be **kept close to their current level.**

3. **Funding allocated for PWID** should be shifted from general testing and primary prevention towards **needle and syringe programmes,** as well as **treating more patients diagnosed with HIV. Prisoner programmes** can also reach many current and former PWID and **should be scaled up substantially.**

4. It is essential to assure that **total available annual funding will not be less than the critical level of between US$ 50 million and US$ 60 million.** Funding below this level combined with **no considerable improvements in programme efficiency would lead to a catastrophic situation** which must be avoided at all cost.

5. In addition to allocative efficiency, **technical efficiency of HIV programmes** should be **reviewed and improved where necessary. Programme management should also be made more efficient,** reducing the currently high management costs through **greater use of Government or alternative systems in service delivery. Reducing the unit cost** of each direct and indirect programme could produce the **SAME EFFECT AS INCREASING THE TOTAL BUDGET**, thus averting more new infections and HIV-related deaths.

6. While beyond the scope of this report, it must be emphasized that available data shows that Myanmar is spending too little on health for its income category. Myanmar should look at the overall burden of disease, its policy priorities, and **decide options for increased fiscal space for health, including HIV/AIDS.**

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EXECUTIVE SUMMARY

Background

This report summarizes the findings of an allocative efficiency analysis of Myanmar's national HIV epidemic and response. At the request of the Government of Myanmar, the World Bank and UNAIDS led an analysis of the allocation of resources used in the HIV response, to consider whether a different allocation could prevent more HIV-related deaths and new infections. This analysis has contributed to the decision-making processes around policy, programmatic and resource needs to be defined in Myanmar's third National Strategic Plan (2016–2020; NSP III) and Myanmar's HIV Concept Note, which was submitted to the Global Fund to Fight AIDS, Tuberculosis and Malaria in June 2016.

The Government has for the first time allocated domestic funding for the provision of antiretroviral therapy for people living with HIV (PLHIV) and opioid substitution therapy for PWID.

Myanmar has a concentrated HIV epidemic. The overall HIV prevalence among adults aged 15–49 years is estimated at 0.76% in 2015, but prevalence among certain subgroups (e.g., female sex workers (FSW), men who have sex with men (MSM), people who inject drugs (PWID)) is considerably higher. Myanmar's HIV response focuses on the key populations. The HIV-related programmes are mainly funded by international donors, and managed through government and non-governmental organizations and international development partners.

It is important to note that recently the Government has for the first time allocated domestic funding for the provision of antiretroviral therapy for people living with HIV (PLHIV) and opioid substitution therapy for PWID. This follows a shift towards increased public-sector ownership and management of the HIV programmes, particularly HIV treatment. Chapter 3 shows a detailed summary of the trends in HIV funding over the period 2007–2015. The analysis uses as baseline the resource allocation level of 2014, when the total available budget for HIV was US$ 68.9 million.

Methodology

The analysis was conducted using Optima HIV, a software package and decision tool designed to conduct allocative efficiency analyses. The objective of the analysis was to identify how to allocate resources across different HIV programmes in order to achieve the minimum sum of new HIV infection and HIV-related deaths over the period 2016–2020. This analysis was done with a range of total budget constraints, covering 65%, 80%, 100%, 125%, or 150% of total amount available for direct programmes in the 2014 fiscal year. Optima HIV and the methodology are presented in detail in Section 4.

The results of the main analysis are presented in Chapter 5 of this report. Secondary analyses, including optimizations for a longer time period (2016–2030) and to minimize new infections only or deaths only, as well as a range of scenario analyses, are presented in Annexes 2 and 3.

Key findings

The key findings of the main analysis are as follows:

if the current budget were better targeted through optimal allocation of resources to the right programmes targeting the right populations, annual new infections would be expected to decrease by around 1,000 and deaths by around 700.

1. It is expected that with the current HIV response efforts (2014 level, US$ 68.9 million), approximately 8,400 new HIV infections and 8,100 HIV-related deaths will occur each year between 2016 and 2020 in Myanmar. However, even without additional resources, if the current budget were better targeted through optimal allocation of resources to the right programmes targeting the right populations, annual new infections would be expected to decrease by around 1,000 and deaths by around 700. If resources remain at the 2014 level the following recommendation should be considered:

    - Total spending on prevention programmes targeting key populations (FSW, MSM, PWID)[1] should be secured at current level, although necessary decrease in general testing and prevention programmes for PWID may be unavoidable.

    - Among programmes targeting PWID, the needle/syringe programme should be prioritized. Opiate substitution therapy (OST), due to a number of factors specific to Myanmar context,[2] is recommended to continue to be funded as an essential programme not only for prevention of HIV and other blood-borne viruses but for the many other health and social benefits. In addition, prison programmes should receive greater resources as there is significant overlap between prison and PWID population.

    - More resources are needed to continue to scale up coverage of antiretroviral therapy. Provided there is reduction in funding for PWID needles/syringes and OST programmes, the portion of PWID funds which currently covers general testing and general prevention programmes might be used to contribute to ART scale-up. In a resource constrained, concentrated epidemic setting, it is recommended that priority be given to ensuring that people diagnosed

[1] Prevention programmes targeting key populations (FSW, MSM, PWID) do not include any ART programmes, although ART can also be considered as prevention ("treatment as prevention").

[2] OST has not been determined to be effective in reducing drug injecting behaviour and needle/syringe sharing: it has high costs, and its coverage has not reached a level to have impact in reducing HIV transmission among people who inject drugs. However, it has other benefits such as supporting ARV treatment adherence and treatment and harm reduction for drug users.

with HIV are quickly put on antiretroviral treatment. While there remain PLHIV not on ART, programmes for general HIV testing, counselling and other programmes for general population (who are at lower risk for HIV infection) such as condom distribution and behaviour change promotion should receive less priority and resources, until resource level increases.

2. If the total funding were to drop below a critical level (about 75%–85% of the 2014 budget(US$ 68.9 million)), the HIV response may no longer be able to maintain the current ART coverage and effectively prevent new infections. All efforts must be made to keep the funding above this critical level.

3. If the total HIV budget were to increase (by at least 20% compared with 2014 level) then scaling up HTC for all populations becomes important to facilitate uptake of ART among those currently undiagnosed and not in care. This can be interpreted as the introduction of a "test and treat" approach.

4. In order to sustain coverage level in a decreasing resource situation, it is advised to pay attention to programme unit costs and ensure that the unit costs are at reasonable level where programmes can operate effectively and efficiently. The costs of management and administration increased six-fold between 2011 and 2012 (a one-year period). Reducing management costs would free up resources that could be channelled into direct programmes for greater impact. Furthermore, there are opportunities for improved efficiency from better integration with other programs and front line service delivery, and the government should continue and expand these efforts (existing efforts include the integration of PMTCT and with maternal and child health services; TB/HIV; Hepatitis C and other co-infections services; national laboratory strengthening and harmonization of information management systems and supply chain systems).

Conclusion

Under current resource allocation levels, Myanmar's HIV response focuses on provision of ART and HIV services for key populations (FSW, MSM, PWID) while funding other general population programmes. With this funding allocation, the number of new infections and HIV-related deaths is expected to continue to decline at a moderate pace.

However a slight shift of resources without changing the current focus on key populations can achieve additional gains. Re-allocating resources from general population programmes to add to the ART scale-up programme can result in an additional 1,000 new infections and 700 HIV-related deaths averted each year.

Should the funding situation change and more resources become available, then HTC efforts among all populations would become more important to enable future uptake of ART.

At this phase in the Myanmar's HIV response given tremendous progress achieved in a relatively short time, a moderate increase in total funding, together with improved technical efficiency of all direct and indirect programmes, could potentially allow Myanmar to extend targeted HIV services to new population groups, and start to move towards "test and treat" to achieve more substantial reductions in the epidemic burden.

1 INTRODUCTION

United Nations Member States have committed to implementing a bold agenda to end the AIDS epidemic by 2030 during the United Nations General Assembly High-Level Meeting on Ending AIDS, held in New York, United States of America, from 8 to 10 June 2016. The progressive, new and actionable Political Declaration includes a set of specific, time-bound targets and actions that must be achieved by 2020 if the world is to get on the Fast-Track and end the AIDS epidemic by 2030 within the framework of the Sustainable Development Goals.[3]

Focused and efficient HIV programme design and delivery is essential to ensure that programmes can do more with the available resources—even more urgent if resources are declining.

In the past, HIV responses in many countries around the world provided a wide range of services using many different approaches. In a time of increasing resource envelopes, this was useful in order to learn from testing different interventions and delivery modalities. However, it also led to fragmentation of responses and limited focus on scaling up the highest-impact programmes. Today, in an increasingly resource-constrained environment, HIV responses are faced with the double challenge of scaling up targeted but comprehensive HIV services that reduce the risk of transmission of HIV and treating a larger number of people living with HIV than ever before. Focused and efficient HIV programme design and delivery is essential to ensure that programmes can **do more with the available resources—even more urgent if resources are declining**.

1.1 Allocative efficiency and HIV health

The concept of allocative efficiency takes health interventions (including services, health product commodities, and other activities, the primary intention of which is to improve health) as inputs and the health of the population as an output.[4] It aims to **use available resources to achieve the best possible health outcomes with the least costly mix of health interventions**. It is about the right interventions being provided to the right people at the right place in such a way that health outcomes are maximized.

HIV allocative efficiency studies attempt to answer the question *"How can HIV funding be optimally allocated to the combination of HIV response interventions that will yield the highest impact (achieve HIV response goals in HIV prevention, treatment, care and support) in the shortest period of time?"*

3 UN General Assembly (2016). Political Declaration on HIV and AIDS: On the Fast Track to Accelerate the Fight against HIV and to End the AIDS Epidemic by 2030

4 Liu X/World Health Organization (2003). Policy tools for allocative efficiency of health services.

The dialogue around HIV financing has been changing in recent years, from estimating the total resources needed to comprehensively finance universal access, to identification of the **high-impact interventions that should be prioritized within the constraints of a realistic resource envelope that a country is likely to have available**. In connection with this, the following developments can also be highlighted:

- Shared interest in more predictable levels of HIV funding support for countries;
- Promoting better alignment between HIV investment decisions and "need", informed by disease burden and ability to pay;
- The concept of shared responsibility or "fair share", calling on governments to contribute public sector funds to the HIV response;
- The stabilization of most HIV epidemics globally, resulting in a change from HIV's special disease status to a condition with long-term treatment needs similar to some non-communicable diseases in many settings;
- The move from vertical HIV interventions to more integrated HIV and health service provision with strong linkages to TB and sexual and reproductive health services and the management of chronic conditions;
- The change from an HIV spending approach towards an investment approach, using longer time horizons, and analytical approaches to determine where investments should be made.

Experience and lessons learned have led to consensus that **better outcomes could be achieved if HIV resources were optimally allocated – on the most cost-efficient interventions that contribute to the greatest impact. In some settings, perhaps even more results could be achieved with less resources if these were managed strategically.**

One way to determine the optimal HIV resource allocation is to use mathematical modelling. One such HIV allocative efficiency modelling tool, Optima HIV, is designed to provide investment guidance. Ultimately, in addition to data and analytical evidence, national policies, priorities and the amount of available resources will influence allocation of resources across different programmes.

The Optima HIV tool:

- Produces estimates of HIV incidence, mortality, disability-adjusted life years (DALYs) and prevalence under the current pattern of investment;
- Provides a formal method of optimization that quantitatively and objectively determines optimal allocations of HIV resources across numerous prevention and treatment programmes to address multiple policy objectives;

- Estimates the impact of different interventions, cost-effectiveness and return-on-investment;
- Provides analysis of the longer-term financial consequences of HIV infections and HIV investments.

1.2 Rationale for an HIV allocative efficiency analysis in Myanmar

HIV prevalence among adults in Myanmar is about 0.76%, ranking third in the Asia Pacific region after Thailand and Papua New Guinea.[5] The country's HIV epidemic is concentrated, with prevalence varying substantially across different population groups and geographical regions. Funding for Myanmar's HIV response mainly comes from external sources. The Global Fund to Fight AIDS, Tuberculosis and Malaria (Global Fund), a major donor supporting HIV programmes in low- and middle-income countries around the world, withdrew from Myanmar in 2005[6] but returned in 2012 and currently covers 50% of the total HIV funding.[7] Myanmar is shifting towards increased public-sector ownership and management of the HIV programmes, particularly HIV treatment. Recognizing that the level of resources for HIV and health is declining globally, the Government of Myanmar in dialogue with UNAIDS and the World Bank requested support to analyse the allocation of resources for different HIV interventions in Myanmar's HIV response. The World Bank and UNAIDS agreed to jointly support the National AIDS Programme to conduct a Resource Allocative Efficiency Analysis, building on HIV modelling work using the AIDS Epidemic Model (AEM) and Investment Case Analysis for the HIV Response.

Myanmar is shifting towards increased public-sector ownership and management of the HIV programmes, particularly HIV treatment.

It was agreed that the findings from this analysis would contribute to decision-making processes around policy, programmatic and resource needs to be defined in Myanmar's third National Strategic Plan on HIV/AIDS (2016–20; NSP III). Furthermore, the analysis has already been used to provide key analytical inputs to Myanmar's HIV Concept Note submitted to the Global Fund in June 2016.

In particular, the recommendations from this allocative efficiency study are designed to help address the following questions:

a. How could the existing HIV budget envelope be allocated more efficiently?

b. Which programmes should be prioritized if (i) more funding becomes available; or (ii) the total budget decreases?

The allocative efficiency analysis was conducted by the University of Bern, Switzerland, using the mathematical model Optima HIV, in collaboration with the

[5] UNAIDS (2016): AIDSInfo Online Database.

[6] Parry J (2005): Bull World Health Org 83(10), pp. 724–5.

[7] UNAIDS (2015): National AIDS Spending Assessment in Myanmar 2012–2013.

Optima development team at University of New South Wales (UNSW), Burnet Institute and Optima Consortium for Decision Science.

1.3 Objectives of the analysis

This project consists of two sets of analyses. In the **optimization analyses**, the aim is to identify the optimal allocation of funding across different HIV-related programmes in order to minimize the sum of new HIV infections and HIV-related deaths over a given time period. The following time periods were applied:

- 2016–20: Third National Strategic Plan period (NSP III; see Section 3.2)
- 2016–30

The study team investigated different total budget levels because there is uncertainty as to future level of funding. 2014 was chosen as the baseline funding level, since it was the last year with detailed cost and programme coverage data available. In addition to the main analysis assuming 2014 level of spending, the team also investigated the optimal allocation if the budget available for direct programmes decreased by 20% or 35%, or increased by 25% or 50%.

The five-year NSP III time period was chosen for the primary analysis after discussions with the country stakeholders. The longer time period was included in a secondary analysis: due to uncertainties in the long-term financing, it was thought more plausible to set short-term targets, but the longer time period analysis would provide insights on how the optimal allocation would change if the long-term benefits were considered.

In the primary analysis, averted HIV infections and averted HIV-related deaths were given the same weight. The team also conducted secondary analyses in which the aim was to minimize only new infections or only deaths. The findings from the main analyses are presented in Chapter 5, and the secondary analyses in Annex 2.

The second set of analyses—**scenario analyses**—aimed to answer the question: how many new HIV infections and HIV-related deaths can be expected, and how much will the total HIV-related costs be, in a given period under the following separate conditions:

- If, due to decreased funding, all risk-related behaviour among key populations increases by 50%
- If programme coverage is gradually increased so that the NSP III targets are met by 2020 (either for the entire population, or at least the key populations)
- If Myanmar were to implement a “test and treat” policy

Scenario analyses do not aim to optimize resource allocation; they simply show how the epidemic is expected to develop under a given scenario, where the impact-related parameters are varied directly. Since such analyses have already been conducted in large scale using the AEM model, the results of the scenario analyses are only presented in Annex 3.

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2 COUNTRY CONTEXT

2.1 Economy

Myanmar is bordered by Bangladesh, China, India, Laos and Thailand, and has an area of 677,000 km^2. The total population was 51.4 million in the 2014 census.[8] The country gained independence from British rule in 1948, and was governed by a military government between 1962 and 2011, and then replaced with civilian parliamentary democracy.

Myanmar is the fastest growing economy in Asia, with the annual growth rate of 8.5% in 2015.

Measured by gross national income (GNI), Myanmar is a lower middle income country. Myanmar is the fastest growing economy in Asia, with the annual growth rate of 8.5% in 2015. The country's per-capita GNI was US$ 1,280 (Atlas method) in 2014.[9] The country's major natural resources include gemstones, oil and gas, as well as agricultural products (mainly rice). Myanmar is the world's second-largest opium producer, after Afghanistan, producing about 25% of the world's opium. Myanmar's economy was seriously affected by the sanctions placed by the United States and many European countries, which began to be lifted in 2012 when the country started the process towards democracy.

2.2 Human development

Human development is usually measured by the Human Development Index (HDI), which includes three basic dimensions of human development: 1) a long and healthy life; 2) access to knowledge and 3) standard of living.

In 2014, Myanmar had an HDI of 0.536, ranking it 148th out of 188 in the world, among countries classified as having low human development.[10] This is also clearly below the East Asia and Pacific Region average (0.710). Myanmar's HDI has increased gradually from 0.35 in 1990, and remained relatively stable during the last five years (Fig. 2.1).

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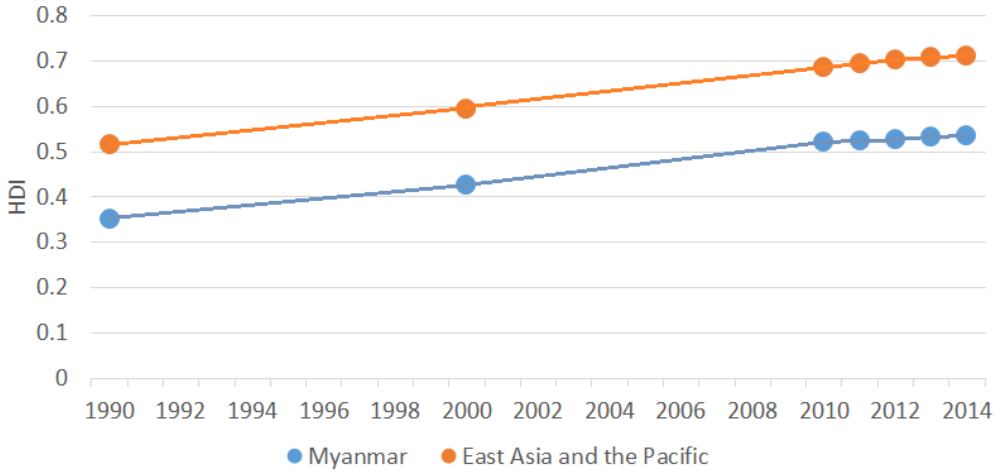
8 Myanmar Ministry of Immigration and Population (2015): The 2014 Myanmar Population and Housing Census.

9 World Bank (2016): World Bank open data.

10 United Nations Development Programme (2016): Human Development Data 1980–2015.

Figure 2.1 Human Development Index (HDI) in Myanmar and East Asia/Pacific 1990–2014



Source: United Nations Development Programme (Human Development Data).

Life expectancy at birth was 65.9 years (women 68 years, men 64 years), ranking 141st in the world in 2014. The expected years of schooling were 8.6, and the mean years of schooling 4.1. Eight per cent of females and five per cent of males were illiterate.

2.3 Burden of disease

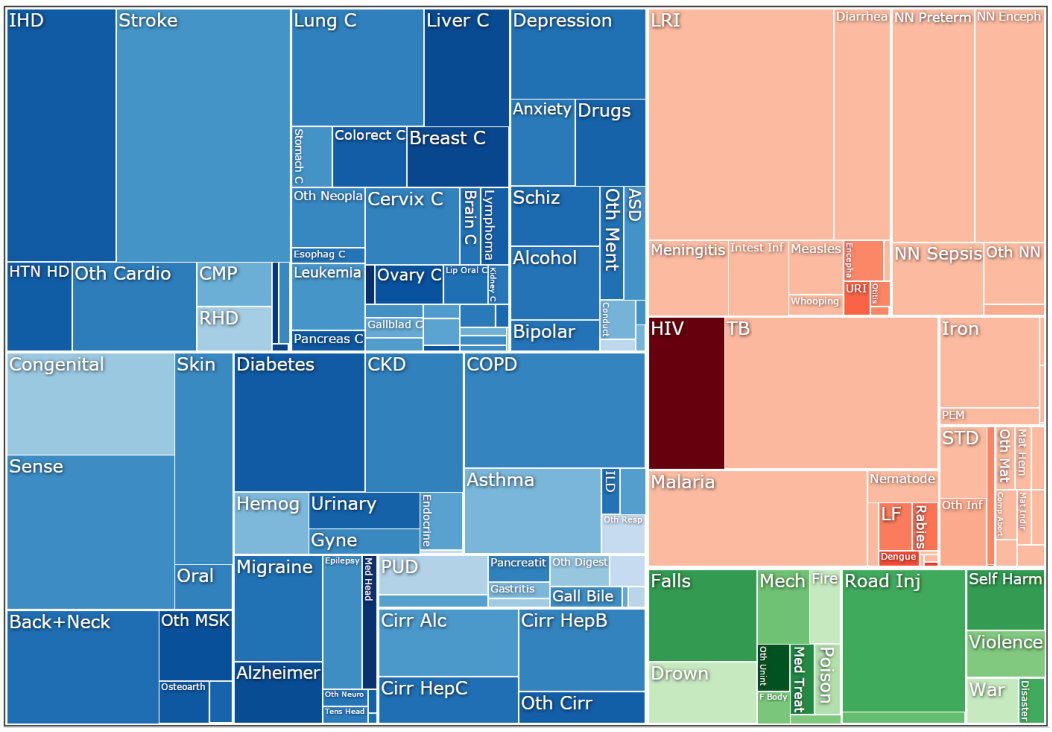
The number of DALYs attributable to HIV has increased on average by 13% every year since 1990, and it is the most rapidly growing individual cause of DALYs in Myanmar.

Burden of disease is commonly measured in disability-adjusted life years (DALYs). This takes into account the years lost to premature death and years lived with ill-health or disability, which are weighted according to the severity of the condition. In 2012, Myanmar's total DALYs were 23.1 million, of which 11.9 million (52%) were attributable to non-communicable diseases, 8.3 million (36%) to communicable, maternal, perinatal and nutritional diseases, and 2.8 million (12%) to injuries (Figure 2.2: 2013 situation).[11,12] The situation has changed considerably since 1990, when most DALYs were still attributable to communicable diseases, especially lower respiratory infections (LRI), diarrhoea, malaria and tuberculosis. In 2012, cardiovascular diseases were the most common individual cause of DALYs, whereas among communicable diseases, LRI, tuberculosis and malaria were most common. The number of DALYs attributable to HIV has increased on average by 13% every year since 1990, and it is the most rapidly growing individual cause of DALYs in Myanmar. Some 628,000 DALYs were attributed to HIV, which is 7.6% of the DALYs caused by communicable diseases, and 2.7% of all DALYs.

[11] World Health Organization (2014): Estimated DALYs by cause, sex and WHO Member State, 2012.

[12] Institute for Health Metrics and Evaluation (2016): Global Burden of Disease data tool.

Figure 2.2 Disability-adjusted life-years (DALYs) in Myanmar (2013, all ages)



Source: Institute for Health Metrics and Evaluation (Data visualizations).

Notes: Blue area shows non-communicable diseases; red area communicable diseases and green area injuries. The darkness of each box shows the relative change between 1990 and 2013 (dark boxes: increase in DALYs; light boxes: decrease in DALYs).

The Government is committed to improving access to and quality of health as a part of its reform agenda aimed at raising the level of social and economic development in the country.

2.4 Health system and financing

2.4.1 Health care system in Myanmar

The health care system in Myanmar is organized and provided by public and private providers. The main provider of health services in the public sector is the Ministry of Health and Sports, under which the Department of Medical Services is responsible for service delivery in public hospitals, from station hospitals to general hospitals, while the Department of Public Health is responsible for disease prevention and primary care provided below station hospitals, which includes, amongst others, rural health centres and maternal and child health centres. Other ministries also provide health services, mainly for their employees. Private for-profit care mainly focuses on ambulatory care, although some institutional health services also exist. Nongovernmental non-profit organizations (NGOs) also have their role in the provision of health care.[13]

Myanmar's health care services are undergoing major changes. The Government is committed to improving access to and quality of health as a part of its reform agenda aimed at raising the level of social and economic development in the country. The Ministry of Health and Sports recently completed a new, more inclusive, National

[13] Myanmar Ministry of Health (2014): Health in Myanmar 2014: Myanmar Health Care System.

Health Plan 2017–21 (NHP), that sets forth a direction to strengthening the health system and set the foundations for the country's long-term vision of reaching Universal Health Coverage by 2030. NHP aims to achieve universal access to basic essential package of health services delivered at the primary health care level.

2.4.2 Financing of health care

The Government's budget, private household spending, social security systems, community contributions and external aid are the major source for financing health care services in Myanmar. A considerable part of the health financing comes from out-of-pocket spending. The Government's spending on health care has increased rapidly over the last few years, from less than US$ 7 million in the fiscal year 2000–01 to US$ 556 million in 2014–15. The relative share of the health care budget has also increased: in 2010, government health expenditures were 1.8% of general government expenditure and 0.3% of the GDP, whereas in 2014, the corresponding percentages were 3.6% and 1.0%. These are lower than in the region on average: the share of health expenditure from total government budget in 2014 was for example in Thailand 5.6%, in Vietnam 3.8% and in Cambodia 1.3%. Myanmar also has a social security scheme, which obliges all employers (including public/government-owned, private, international, or joint ventures) with five or more employees to provide insurance to their employees. The insurance is financed together by the Government (in the form of capital investment), the employer and employee. However, this scheme covers only a small proportion of Myanmar's total population.

3 HIV IN MYANMAR

3.1 HIV epidemic in Myanmar

Myanmar's HIV epidemic is concentrated among key populations, which include people who inject drugs (PWID), female sex workers (FSW) and their clients, men who have sex with men (MSM), and other priority populations.

Myanmar has the third-highest HIV prevalence in the Asia-Pacific region. According to the Estimates and Projections Package (EPP)/Spectrum model, the adult (15–49) prevalence in Myanmar increased from 0.05% in 1990 to 0.93% in 2005. Since then, the prevalence has declined and stabilized at 0.76% in 2015, corresponding to about 225,000 PLHIV.[14] Myanmar's HIV epidemic is concentrated among key populations, which include people who inject drugs (PWID), female sex workers (FSW) and their clients, men who have sex with men (MSM), and other priority populations referenced in the National Strategic Plan on HIV/AIDS such as prisoners, and migrants and mobile populations.

Among the key populations, the HIV prevalence is estimated to be substantially higher. Prevalence estimates among certain population groups are available annually since 1992 from the HIV Sentinel Sero-surveillance Surveys (HSS), as well as the Behavioural Surveillance Surveys (BSS, 2007–08) and Integrated Biological and Behavioural Surveys (IBBS, 2014–15).[15,16,17] Among **people who inject drugs,** the prevalence estimated by HSS stayed above 50% until 2000, after which it decreased; however, after reaching a minimum of 18% in 2012, it has started to increase slightly again.

HIV prevalence among **female sex workers** was increasing during the 1990s, and stayed at around 30% between 2000 and 2006. From 2007, the prevalence has been decreasing, and the 2014 HSS estimated it to be 6.3% (Fig. 3.1a). However, the estimates from the IBBS suggest that it may be higher, up to 16%.

Men who have sex with men have been included in the HSS since 2007, when the HIV prevalence was estimated at 29% (Fig. 3.1a). This has also decreased, and was 6.6% in 2014; again, however, the IBBS suggested a higher value at 11.6%. **Male clients of STI clinics**, who may be seen as a proxy for high risk men (e.g., clients of sex workers) in general, have had a slowly decreasing trend in HIV prevalence, starting from 9% in 1992 and stabilizing around 5% from 2005 onwards (Fig. 3.1a).

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14 UNAIDS (2016): AIDSInfo Online Database.

15 Myanmar Ministry of Health, National AIDS Programme (2015): HIV Sentinel Sero-surveillance Survey 2014.

16 Myanmar Ministry of Health, National AIDS Programme (2009): National Behavioural Surveillance Survey 2007–2008 Report on Injecting Drug Users and Female Sex Workers.

17 Myanmar Ministry of Health, National AIDS Programme (2014): Integrated Biological and Behavioural Surveillance Survey and Population Size Estimates among People who Inject Drugs.

Among "low-risk" populations included in the HSS (blood donors, pregnant women and military recruits), prevalence estimates have varied across time: among pregnant women and military recruits, who as young and sexually active may have an increased risk of HIV, prevalence data have occasionally gone above 2.5%, although on average it has stayed around 1%. Prevalence among blood donors increased until reaching 1.2% in 2002, and decreased between then and 2012, after which it increased again (Fig. 3.1b). However, it should be noted that HSS is based on small samples and is therefore not representative of the entire population.

Figure 3.1a Observed HIV prevalence in the HIV Sentinel Surveys 1992–2014: most-at-risk populations

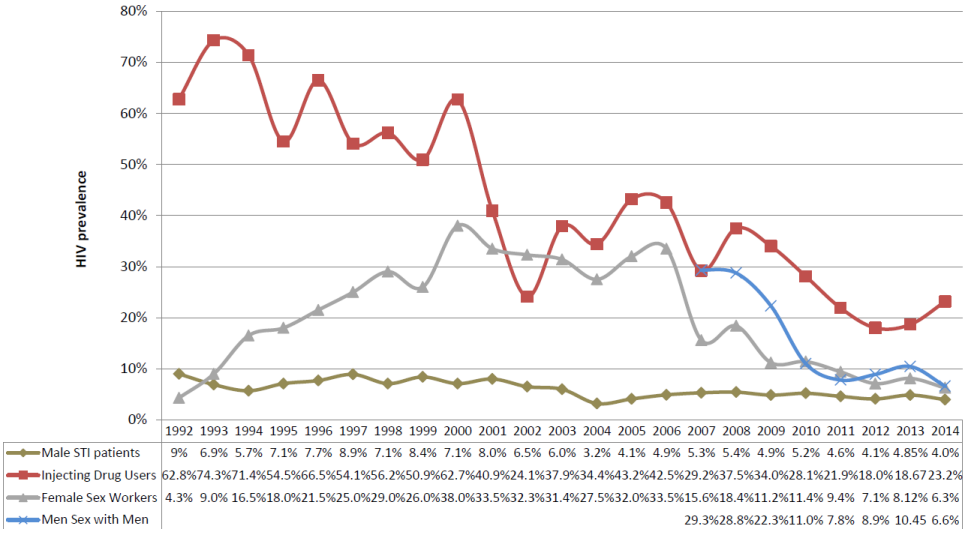
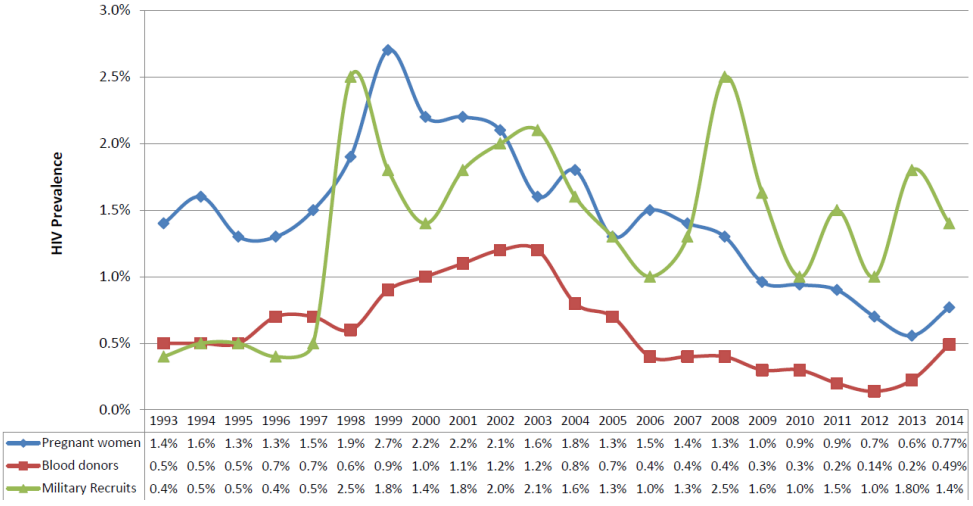


Figure 3.1b Low-risk populations



Source: Myanmar Ministry of Health (2014 HIV Sentinel Sero-surveillance Survey).

3.2 National response to HIV

Myanmar's national response to the HIV epidemic began in the mid-1980s. In 1989, AIDS was ranked a priority disease on the basis of public health, political importance and potential socio-economic impact. In the same year, a multisectoral National AIDS Committee was established, and a short-term plan to prevent HIV transmission was launched.[18]

The three objectives to reach this goal include reduction of HIV incidence among priority populations and their partners, facilitating and ensuring viral suppression for all people living with HIV, and improving the enabling environment to support the response.

The country's first National Strategic Plan (NSP) on HIV and AIDS covered the period 2006–10. This was followed by NSP II for 2011–15, which after its mid-term review was extended to 2016. Currently, the country has started its third National Strategic Plan (NSP III), which covers the period 2016–20.[19] The long-term vision of NSP III is to end HIV as a public health threat by 2030 by fast-tracking access to a continuum of integrated and high-quality services. The goal of NSP III is to reduce HIV transmission as well as HIV-related mortality, morbidity, disability and social and economic impact. The three objectives to reach this goal include **reduction of HIV incidence** among priority populations and their partners, facilitating and ensuring **viral suppression** for all people living with HIV, and improving the **enabling environment** to support the response. The following five milestones were set:

- 90% of all people living with HIV (PLHIV) in Myanmar should be aware of their status;
- 90% of all PLHIV who are diagnosed should be receiving antiretroviral therapy (ART);
- 90% of people receiving ART should have achieved viral suppression;
- 90% of all most-at-risk key populations including sex workers, men who have sex with men, people who inject drugs, prisoners, and migrants, should have access to combination prevention services;
- 90% of people living with or affected by HIV should report no discrimination, especially in health, education and workplace settings.

The first three milestones listed correspond to the global "90–90–90" targets, which were launched by UNAIDS in 2014, aiming to reduce the annual number of new HIV infections worldwide to below 500,000 by 2020.

[18] Myanmar Ministry of Health (2014): Myanmar National Strategic Plan on HIV and AIDS 2011–16. Full version, revised 2014.

[19] Myanmar Ministry of Health: National Strategic Plan on HIV and AIDS 2016–20.

3.3 HIV financing

3.3.1 HIV financing by source

Myanmar, like many other low- and middle-income countries, relies heavily on external resources to finance its HIV response. Since 2005, there have been a number of significant changes in the HIV financial landscape in Myanmar. In 2005, the Global Fund withdrew funding for all three diseases (AIDS, TB and malaria) from Myanmar. A pooled donor fund called the Three Diseases Fund (3DF) was established to support AIDS, TB and malaria in the interim to provide continuity to the three programmes. When Myanmar's political transformation occurred in 2012, the Global Fund reinstated funding to the country. The Three Diseases Fund was then replaced by the Three Millennium Development Goals Fund (3MDG), which resulted in a significant reduction in non-Global Fund resources for the three diseases.

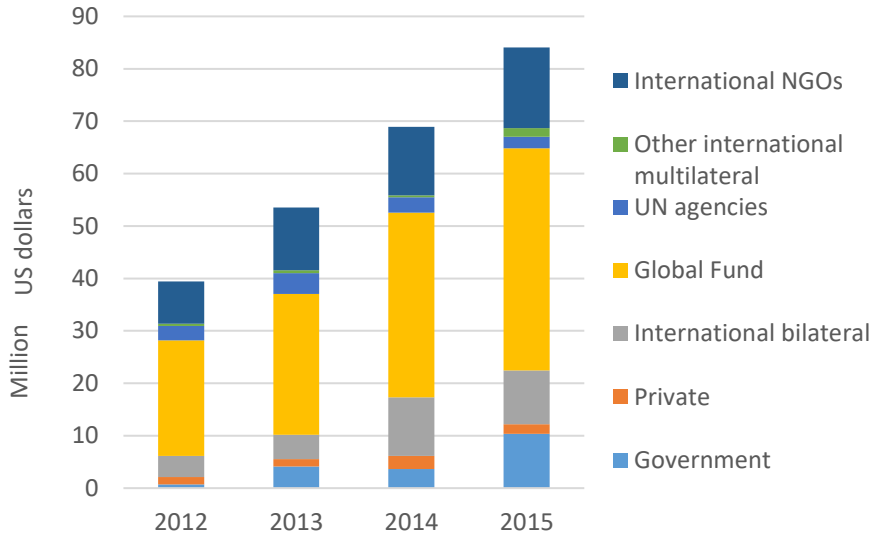
The total available annual funding increased from US$ 32.8 million in 2007 to US$ 84.1 million in 2015.[20,21,22] The increase was fairly moderate until 2011 with a decrease in 2012, after which the funding increased rapidly. Figure 3.2 shows funding by source from 2012 to 2015. The most significant contributor is the Global Fund, contributing about 50% of the annual HIV resources in Myanmar since 2012. The increase in total funding thus mainly reflects increased funding from the Global Fund, which is also the largest contributor to the HIV response globally. Domestic funding from the Myanmar Government has increased substantially: from about US$ 700,000 in 2012 to over US$ 10 million in 2015. The proportion of the total health budget is thus less than 2%, compared with the 2.7% share of HIV among all DALYs. Other major funders include international NGOs and bilateral donors. The total HIV funding in 2015 corresponds to US$ 381 per PLHIV. The spending per PLHIV in Asia and the Pacific ranges from less than 100 to over 2000 US dollars across the countries. Myanmar's spending was comparable, but still lower than in nearby countries such as Vietnam (US$ 381), Thailand (US$ 644) and Cambodia (US$ 669).

[20] UNAIDS (2015): National AIDS Spending Assessment in Myanmar 2012–13.

[21] UNAIDS (2016): National AIDS Spending Assessment in Myanmar 2014–15.

[22] UNAIDS, UNICEF, World Health Organization and Asian Development Bank (2016): HIV and AIDS Data Hub for Asia-Pacific.

Figure 3.2 Sources of HIV funding in Myanmar 2012–15



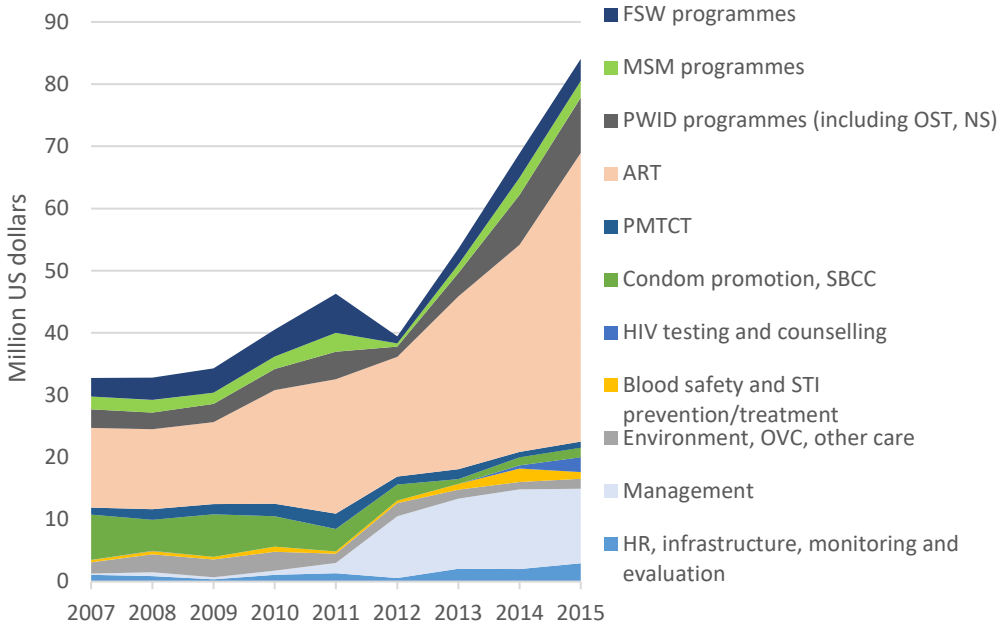
Source: UNAIDS (National AIDS Spending Assessments 2012–13 and 2014–15).

3.3.2 HIV spending by programme

As the total budget increased, the allocation across programmes has also changed (Fig. 3.3). In 2007, over half of the total budget was spent on primary prevention services, and of this funding, about half went to FSW, MSM and PWID, and half to other populations. ART received about 40% of the total funding. The situation stayed about the same until 2009, after which the total budget started to increase, mainly because of increased funding for ART. The most significant change happened between 2011 and 2012: there was a drop in the total budget, but funding for project management increased almost six-fold from US$ 1.7 million to US$ 9.9 million. Funding for primary prevention programmes decreased by 64% from US$ 17.4 million to US$ 5.8 million. This occurred at the time when the Global Fund returned and 3DF ended, so a possible explanation is the different reporting principles and costs associated with the start-up of the Global Fund programme. However, it is clear that prevention programmes took a major hit in that period.

Between 2012 and 2015, management costs remained relatively stable. Most of the increase in total budget is attributable to ART costs, which increased from about US$ 13 million between 2007 and 2009 to US$ 47.3 million in 2015. Spending for primary prevention programmes increased (but by far less).

Figure 3.3 Spending to different HIV programmes in Myanmar 2007–15



Source: UNAIDS (National AIDS Spending Assessments 2012–2013 and 2014–15; HIV and AIDS Data Hub for Asia-Pacific).

4 METHODOLOGY

To assess HIV epidemic trends, the epidemic modelling module of the Optima HIV tool was used, which consists of a compartmental population-based model of HIV transmission and disease progression. The model incorporates evidence on biological transmission probabilities, detailed infection progression, sexual mixing patterns and drug injection behaviour and is calibrated to HIV prevalence data points available from the different subpopulations, as well as to data points on the number of people on ART.

The three objectives to reach this goal include reduction of HIV incidence among priority populations and their partners, facilitating and ensuring viral suppression for all people living with HIV, and improving the enabling environment to support the response.

To assess how incremental changes in spending affect the HIV epidemic and determine the optimal funding allocation, the model establishes weighted relationships between the cost of HIV intervention programmes, the coverage level attained by these programmes, and the resulting outcomes. These relationships are specific to the country, population and programme being considered.

Using the relationships between cost, coverage and outcome in combination with Optima's epidemic model, it is possible to calculate how incremental changes in the level of funding allocated to each programme will impact overall epidemic outcomes. Furthermore, by using a mathematical optimization algorithm, Optima is able to determine the "optimal" allocation of funding across different HIV programmes; that is, an allocation that brings the greatest benefit in health outcomes. Further details about Optima HIV can be found on the website http://www.optimamodel.com.

4.1 Analytical framework

The first step of the modelling procedure was to select the input parameters for the model. These include the population groups, expenditure areas, baseline scenario and funding. Expenditure areas can either be included in the optimization, or have fixed costs.

The HIV epidemic has already been modelled in detail using the AIDS Epidemic Model (AEM),[23] which has several similarities with the epidemic component of Optima HIV. The same key input parameters already extracted for calibration of AEM were used whenever possible. The final set of inputs was agreed upon after discussions with all involved parties.

[23] Brown T & Peerapatanapokin W (2016): HIV Resource Allocations using AEM.

4.1.1 Populations

The study team divided the total population into the following subgroups: female sex workers, men who have sex with men, people who inject drugs, clients of sex workers, prisoners, other males aged 15–49, other females aged 15–49, other males aged 50 and above, other females aged 50 and above, and children aged 0–14. The population of prisoners was further disaggregated into prisoners with and without drug use history, and children into girls and boys. However, to keep it simple, these distinctions will not be shown explicitly. Other simplifying assumptions were also made regarding the key populations: all PWID and prisoners were assumed to be male, and the population size estimates were adjusted accordingly. Male sex workers and transgender persons were included in the MSM population and not modelled separately.

Table 4.1 Population groups included in Optima HIV

Population group	Population in 2015	Notes
Female sex workers (FSW)	66 000	Assumed to be aged 15–49
Clients of sex workers	1 124 000	Assumed to be aged 15–49
Men who have sex with men (MSM)	253 000	Assumed to be aged 15–49
People who inject drugs (PWID)	56 000	Assumed to be male, aged 15–49 (excludes PWID who are currently in prison)
Prisoners	50 000	Assumed to be male; split into those with and without drug use history
Other males aged 15–49	12 879 000	Excluding FSW clients, MSM, PWID and prisoners
Other females aged 15–49	14 706 000	Excluding FSW
Other males aged 50 and above	4 511 000	—
Other females aged 50 and above	5 415 000	—
Children aged 0–14	14 849 000	Split into girls and boys

Source: Authors.

4.1.2 Programmes included in the model

The programmes included in the model are presented in Table 4.2. Table 4.2a shows the "direct" programmes, which are expected to have a direct impact on HIV transmission and/or HIV-related deaths. The programmes in Table 4.2b are indirect programmes: they may be essential for the overall response or included for ethical reasons, but scaling these programmes up or down would not have a direct impact on HIV transmission or mortality. In the optimization, money can be allocated freely between the direct programmes (taking into account possible constraints for minimum or maximum change compared with current situation), but the spending on indirect programmes stays constant at the baseline level.

Direct programmes include antiretroviral therapy, prevention of mother-to-child transmission (PMTCT), HIV testing and counselling (HTC), condom promotion and social and behaviour change communication, general prevention programmes targeting FSW and their clients, MSM, PWID, and prisoners, needle/syringe (NS) programme and opiate substitution therapy (OST). ART covers all population groups. FSW, MSM, PWID and prisoner general prevention programmes include condom promotion and distribution, promotion of low-risk behaviour, and HIV testing and counselling for the population in question. NS and OST were included as separate programmes from PWID prevention, although in particular the provision of NS has a prevention impact and rationale. General prevention for PWID includes HIV testing and counselling, distribution and promotion of condoms, and communication about behaviour. The NS programme was defined using the estimated unit costs, which cover the syringes themselves and their distribution. HTC and condom promotion and social and behaviour change communication targeted only populations that were not covered by one of the key population programmes. HTC included both provider-initiated and voluntary testing, and it is assumed that the only ways to be tested for HIV are through HTC, PMTCT, or one of the key population prevention programmes. Condom and social and behaviour change programmes included condom promotion and distribution and behaviour interventions not targeting any particular population, as well as prevention programmes for certain vulnerable and priority populations (migrants or mobile populations).

Indirect programmes include overall programme management, human resources and infrastructure, enabling environment, as well as programmes for blood safety, and treatment and care of sexually transmitted infections. Programme management, coordination and administration are usually necessary to run the direct programmes. Improving efficient use of the budget for these indirect programmes can free up resources for direct programmes. For the purposes of this study, all management- and infrastructure-related costs that are related to a specific programme were included along with the other costs of that particular programme. For example, the management costs of ART clinics and ART provision are included in ART and thus taken into account in the optimization.

Table 4.2a Programmes included in Optima HIV: direct programmes (included in the optimization)

Direct programmes	Budget in 2014 (us$)	Notes
Programmes for FSW and their clients	3 912 000	Testing, counselling, condom/behavioural promotion (excludes ART, PMTCT)
Programmes for MSM	2 799 000	Testing, counselling, condom/behavioural promotion (excludes ART)
Programmes for PWID	2 312 000	Testing, counselling, condom/behavioural promotion (excludes ART, NS, OST)
Programmes for prisoners	48 000	Testing, counselling, condom/behavioural promotion (excludes ART)
Condom promotion and social and behaviour change communication	1 206 000	"Other" populations only (excludes FSW, clients, MSM, PWID, prisoners)
HIV testing and counselling (HTC)	537 000	"Other" populations only (excludes FSW, clients, MSM, PWID, prisoners)
Needle/syringe programme (NS)	4 282 000	
Opiate substitution therapy (OST)	1 441 000	
Antiretroviral therapy (ART)	33 573 000	For all population groups
Prevention of mother-to-child transmission (PMTCT)	885 000	For all pregnant and breastfeeding women

Many programmes that are currently funded from the HIV budget have substantial benefits beyond HIV care.

Table 4.2b Indirect programmes (assumed fixed costs)

Indirect programmes	Budget in 2014 (US$)	Notes
Management	12 839 000	—
Human resources	484 000	—
Enabling environment	1 169 000	—
Monitoring and evaluation	1 242 000	—
Prevention and care of sexually transmitted infections (STIs)	38 000	—
Blood safety	2 130 000	—

Source: Authors.

Many programmes that are currently funded from the HIV budget have substantial benefits beyond HIV care. The preferred way to deal with programmes with additional benefits in other sectors is to calculate the share of the benefits that is attributable to each sector, and arrange the required funding from each of the sectors accordingly.[24] This however needs coordination of the response across programmes and will only work if each sector is committed to providing their share of the

[24] Remme M et al (2014): AIDS 28(3), pp. 425–34.

spending. In practice, however, this is not always possible. For example, the main benefits of OST are outside of HIV prevention. If only the benefits for HIV are taken into account, the programme is not efficient due to a number of reasons in the Myanmar context, and would be recommended to be defunded in an HIV-focusing optimization. Using the principles presented by Remme *et* al, the study team calculated that about 20% of OST benefits should be attributed to HIV prevention, and thus it would be appropriate to fund 20% of the unit costs from the HIV budget and the remaining 80% from elsewhere. However, as it seems unlikely that presently the 80% share could be covered from any other budget than the health sector's HIV budget, and OST is seen as a priority programme, the team included OST in the model with full unit costs, along with a constraint that OST should not be defunded. In addition to reducing injection frequency, OST may also have other HIV related benefits that were not included in the model.

FSW, MSM and PWID HIV prevalence estimates were derived from the annual HIV Sentinel Sero-surveillance Surveys (HSS), as well as the Integrated Biological and Behavioural Surveillance Survey (IBBS) in 2014–15.

In variable budget scenarios, the funding for OST was constrained to at least its current share of the budget (e.g. 50% increase in total direct-programme funding corresponding to at least 50% increase in OST funding). In a similar way, PMTCT was constrained not to be defunded: PMTCT may not appear to be an efficient intervention within a short-term timeframe, but is considered important for ethical reasons and may influence the epidemic in the long term. The PMTCT constraint was not set above current level even with higher funding, as the coverage is already relatively high (at least 80%). Blood safety and care of sexually transmitted infections were fixed at their current cost levels. Although these programmes also benefit the HIV response, they are needed in the country regardless of the HIV epidemic, and estimating the direct benefit of such programmes on HIV incidence or mortality would be difficult. Under ideal conditions, programmes with multi-sectoral benefits would be co-financed by the different budgets in accordance with the share of the expected benefit, but in practice such an approach is often not realistic to implement.

4.2 Model calibration

Model calibration refers to the process of adjusting a subset of model parameters in order to better match observed data. In Myanmar, estimates of HIV prevalence for all modelled subpopulations were available. As noted earlier, the study used the same prevalence estimates as the AEM whenever possible. FSW, MSM and PWID HIV prevalence estimates were derived from the annual HIV Sentinel Sero-surveillance Surveys (HSS), as well as the Integrated Biological and Behavioural Surveillance Survey (IBBS) in 2014–15. For other populations, proxies were used: for clients of FSW, the HSS data on male patients of sexually transmitted infection (STI) clinics were used; and for other males and females aged 15–49, data from blood donors were used for the lower limit and data from new military recruits or pregnant women for the upper limit, with the average of the low and high as the final data reference. The model parameters that were adjusted included the HIV prevalence in each

subpopulation in 2000 (the year that the model was initiated) and the relative force of infection in each population group. The results of the calibration were subjected to review by local experts with knowledge of the epidemiological situation in Myanmar, and were also compared with those from the AEM. For example, the early high prevalence estimates for MSM and for females aged 15–49 were considered outliers: the prevalence estimates were clearly not in line with the overall trend, and the team estimated (in line with the later data, and also the AEM) that the prevalence has been slowly increasing over time. The HSS data had also limitations that should be considered: surveys from the earliest years included less sites, meaning that high-risk settings may be overrepresented. Surveyed samples of low-risk populations may also include individuals from high-risk populations.

Figure 4.1 Model calibration: Modelled (curves) and observed (dots) prevalence in different population groups

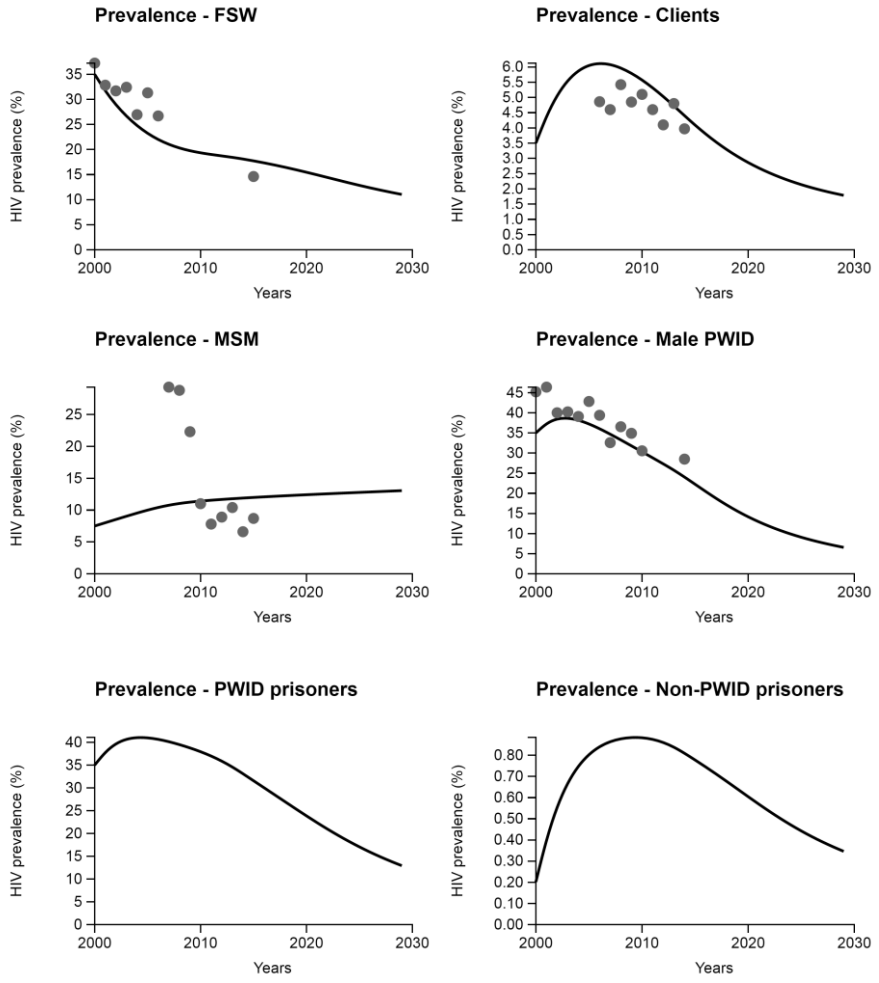
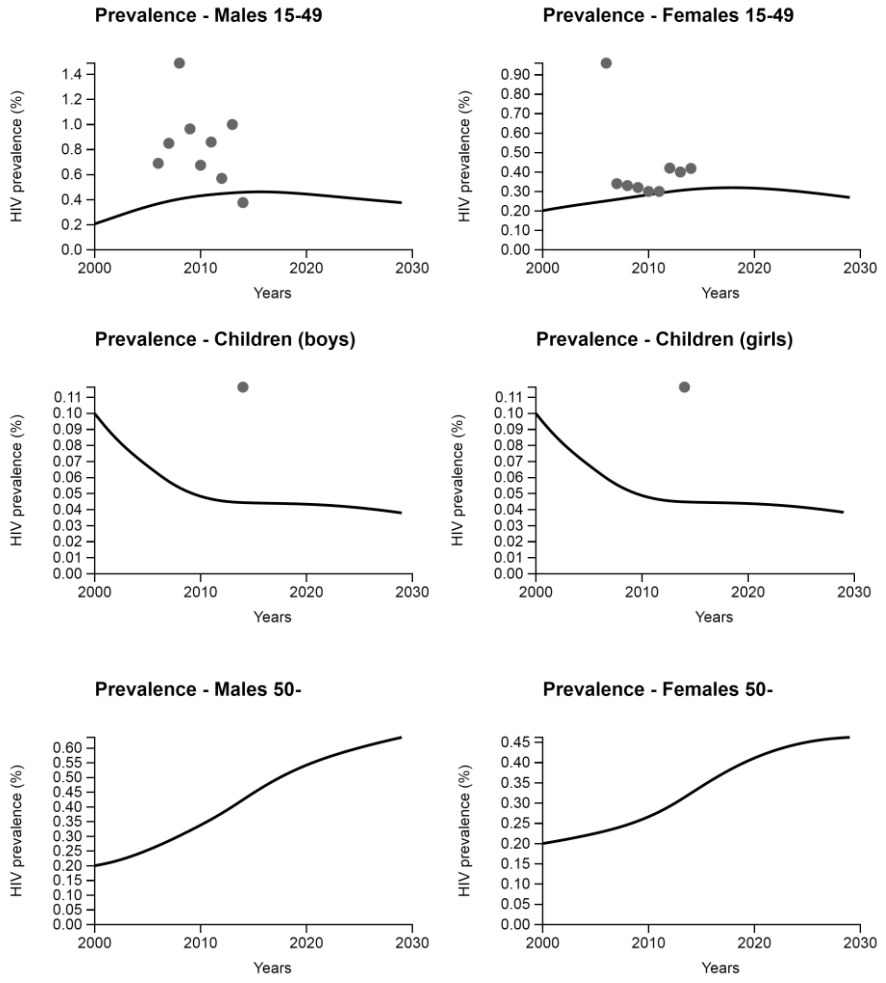


Figure 4.1 Model calibration: Modelled (curves) and observed (dots) prevalence in different population groups (continued)



Source: Authors.

4.3 Cost–coverage–outcome relations for programmes

In Optima HIV, the effect of each direct programme is defined using a relation of total cost, programme coverage, and the impact(s). The relationship between costs and programme coverage were defined using a top-down approach. First, the total costs were extracted for each programme from the GARPR and NASA data, which were available between 2007 and 2015 (see section 3.3.2). Coverage was estimated mainly from progress reports (available until 2014).[25] Depending on the programme, coverage was defined either as the total number of patients accessing the programme (ART, PMTCT, OST), or the proportion of the target population that was covered by

[25] Myanmar Ministry of Health (2015): Progress Report 2014.

the programme. Cost–coverage curves (i.e. showing the programme coverage as a function of total cost) were defined manually by fitting to the available data. The relation did not need to be linear: a saturation effect was allowed, representing the fact that the programmes usually first cover the easily accessible subpopulations before attempting to find the hard-to-reach individuals. The cost–coverage data could be used to estimate unit costs, which were compared with the unit cost estimates given by the National AIDS Programme. The second step estimated the relationship between programme coverage and the actual outcome(s), such as the proportion of sex acts protected by condom, proportion of injections using a shared needle, or proportion of a target population having an HIV test. The coverage–outcome relationship was assumed to be linear, assuming that the outcome of a programme is, on average, the same for each person who is effectively reached by the programme regardless of the order in which the person is reached. ART, PMTCT and OST coverage–outcome relationships were predefined in Optima HIV. Other outcome estimates were derived mainly from the annual progress reports published by the Ministry of Health.

All cost–coverage–outcome relations are shown in Annex 1.

4.4 Optimization analyses

The aim of the optimization analyses is to find the spending allocation mix across different direct programmes that yields the greatest benefit in averted new HIV infections and averted HIV-related deaths over a given time period.

The aim of the optimization analyses is to find the spending allocation mix across different direct programmes that yields the greatest benefit in averted new HIV infections and averted HIV-related deaths over a given time period.

The study considered two time horizons: 2016–20 and 2016–30. The first period is the NSP III timeframe, and was chosen as the main analysis. The five-year time window may, however, exclude some potential long-term benefits, and the longer time period was used in a secondary analysis.

In the main analysis, averted new HIV infections and averted HIV-related deaths were given the same weight. This means that the optimal allocation was defined as the allocation that minimizes the sum of new infections and HIV-related deaths happening over the time period (2016–20 or 2016–30). The study also considered sensitivity analyses where only new infections or only deaths were minimized. These analyses indicate how to prioritize programmes depending on the objectives.

The main analysis considered the spending level of 2014. This was the last year for which both cost and coverage data were available for most programmes. Although cost data were also available for 2015, programme coverage data were not available for that year. The total budget for 2015 was 22% higher than for 2014. This possibly indicates an underestimation of resource availability in the future. In addition to the current level budget analysis, the team conducted an “investment cascade” analysis to examine the optimal allocation at varying budget levels. The following levels of direct-

programme budget were included: 65%, 80%, 125% and 150%. The percentages apply to the total spending allocated to direct programmes in 2014. The spending for indirect programmes was kept constant across all budget levels. When this is included, the percentages presented above correspond to a total budget of 74%, 85%, 119% and 137% of the total budget in 2014.

4.5 Scenario analyses

Optima HIV's scenario analyses aim to project the development of the epidemic (new HIV infections, HIV-related deaths, prevalence) as well as the total HIV-related costs, under given scenarios and timeframes. These analyses does not attempt to optimize the allocation: it is assumed that the programme coverage will remain at the baseline level (2014), unless it is defined to change according to the scenario. HIV-related costs include programmatic costs as well as indirect costs – in other words, those costs associated with HIV directly or indirectly – such as care of HIV-related illness, or social mitigation. Efficient prevention and treatment of HIV can save money indirectly in the long term.

The following scenario analyses were conducted, in addition to the baseline scenario (maintaining 2014 spending levels):

- Defunding of programmes targeting key populations: What would happen if programmes targeting key populations (FSW, MSM and PWID) were defunded by 50%, resulting in a corresponding decrease in condom use, decrease in testing rates, and increase in needle sharing among the respective key populations?
- Achieving the National Strategic Plan III targets: What would happen if HIV testing, ART and programmes targeting key populations were scaled up so that the NSP III targets are achieved by 2020?
- Implementation of "test and treat": What would happen if HIV testing was scaled up substantially and ART eligibility was extended to include all PLHIV regardless of CD4 count?

The NSP III targets are presented in Section 3.2, and consist of the global "90–90–90" targets and two additional "90%" targets (access to combination prevention programmes for key populations, and lack of discrimination). Due to the limitations of the model, the target of viral suppression was replaced by increased coverage of ART, and discrimination/stigmatization was not modelled. Since Myanmar has a concentrated epidemic, an alternative NSP III scenario was also modelled, where the targets were explicitly set to be fulfilled only among the key populations.

As mentioned earlier, related work on HIV estimates and projections of the HIV epidemic in Myanmar has been carried out extensively using the AEM tool. The final outputs of the Optima HIV analysis for Myanmar are very similar to the AEM outputs.

In order to avoid duplication, the detailed scenario analyses are not presented here but can be found in Annex 3 of this document.

4.6 Optimization

The mathematical optimization provided by the Optima model uses a formal and scientific way to determine the "best" allocation of resources and spending to achieve different objectives (e.g. minimizing HIV incidence; minimizing HIV-related deaths; or minimizing a weighted sum of these two). The model determines the allocation of resources that best meets the objective.

5 RESULTS

5.1 HIV transmission dynamics

According to the Optima model, there were 8,056 new infections and 7,363 HIV-related deaths in Myanmar in 2015. This is lower than predicted by EPP/Spectrum (11,763 new infections and 9,675 HIV-related deaths). These differences, in particular for new infections, are likely due to differences in internal structures of the models, choice and definition of population groups, and calibration.

Over half (55%) of the new HIV infections occurred among the key populations: FSW, their clients, MSM, PWID and prisoners.

Over half (55%) of the new HIV infections occurred among the key populations: FSW, their clients, MSM, PWID and prisoners (Fig. 5.1). The projected number of new infections has been constantly decreasing since 2000, when about 26,000 people were estimated to have acquired HIV. The proportion of new infections among key populations has also been slowly decreasing over time. In 2000, 84% of all new infections were among key populations, about half of these among clients of sex workers and almost one-third among PWID. Over the years, the number of new infections among clients of FSW, PWID and prisoners has dropped substantially (from about 19,000 in 2000 to about 4,000 in 2014 among these three population groups), whereas the incidence among other populations has remained relatively stable (about 7,000 new infections in 2000 , and 5,000 in 2014).

According to Optima HIV, the number of HIV-related deaths remained stable at around 11,000 deaths per year from 2000 until 2009, after which this started to decrease (Fig. 8). This is likely due to the increasing number of people receiving ART: the number of people on ART has grown rapidly over the last years, from about 20,000 (6% of all PLHIV) in 2009 to 85,000 in 2014 (about one third of all PLHIV). In 2000, almost two-thirds of the deaths were among key populations: 8% among FSW, 15% among their clients, 11% among MSM, 13% among PWID, and 16% among prisoners. Deaths among the low-risk general population were approximately equally distributed between males and females. Over the first decade of the century, deaths among FSW decreased rapidly, while the number of deaths among males in the general population increased. The decrease after 2010 has been most rapid among PWID: in 2000, about 1,400 PWID were estimated to have died of HIV-related causes, whereas in 2014 this number had dropped to 400. Both new infections and HIV-related deaths are expected to continue to decline slowly if the coverage of all treatment and prevention programmes remains at the 2014 level. We also note that the trend in HIV related deaths by Optima differs in the earliest years from the results of the Spectrum model: whereas Optima suggests that the deaths remained stable at around 11,000 during the years 2000–10, Spectrum shows an increase peaking in

2006–07, followed by a decrease. There were also differences in the absolute numbers of HIV related deaths between the models: the estimates of Optima were higher than those of Spectrum in years 2000–2001, and lower thereafter.

Figure 5.1 Projected new HIV infections in Myanmar: 2000–30

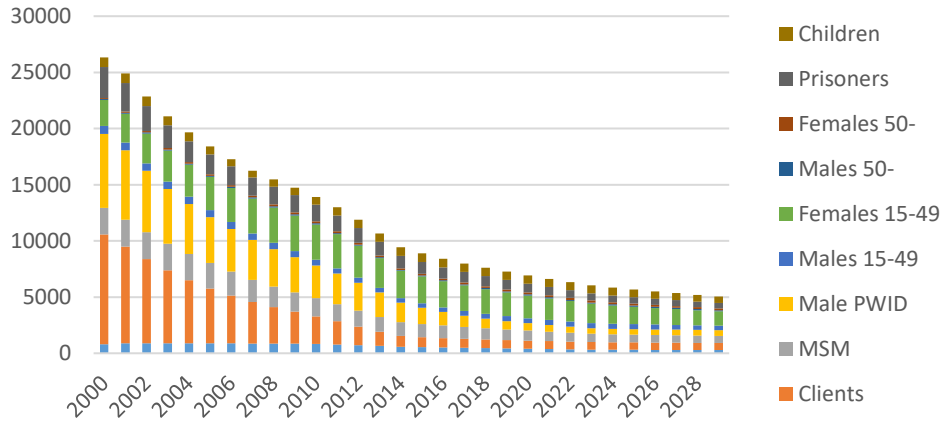
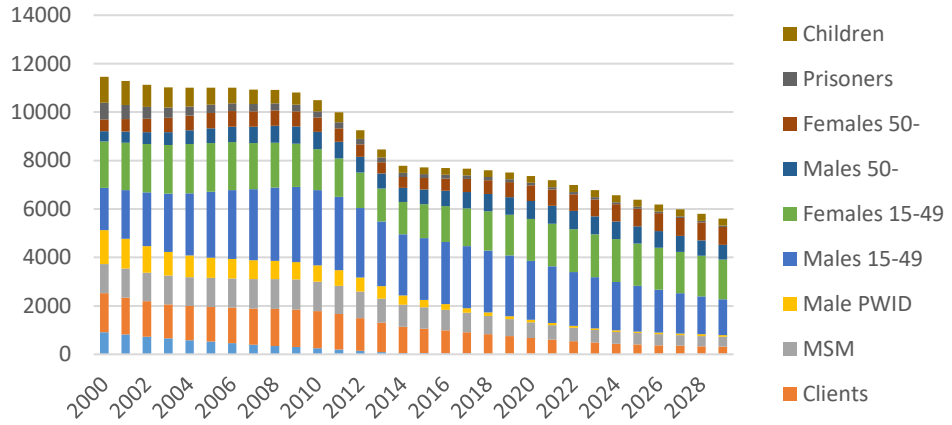


Figure 5.2 Projected HIV-related deaths in Myanmar: 2000–30



5.2 Optimal resource allocation with 2014 level budget: 2016–20

Of the total budget of US$ 68.9 million spent in 2014, US$ 51.0 million were allocated for the direct programmes, which have clearly defined intended associations with factors to influence epidemic outcomes. The potential impact that may be achievable through reallocation of this funding among these direct programmes was considered. According to the optimization analyses, if the amount of resources available stays the same as in 2014, these should be reallocated for greater epidemiological impact. Spending for ART should be increased by 15% from US$ 33.6 million to US$ 38.7 million (Table 5.1). Spending for PMTCT and OST, which both were constrained not to be defunded, should stay at the current level. Funding for primary prevention

programmes targeting FSW and their clients, MSM and PWID should be only marginally decreased. To make way for the resource increase needs for ART and other priority areas, funding should be made available from programmes that currently do not have greatest priority in this epidemic and resource context; these lower priority programmes include general testing for other than key populations and condom and behavioural interventions (85% decrease).

The optimization did not considerably change the allocation of resources across different population groups (Figure 5.3). Among all population groups, ART received more money than before and primary prevention programmes less.

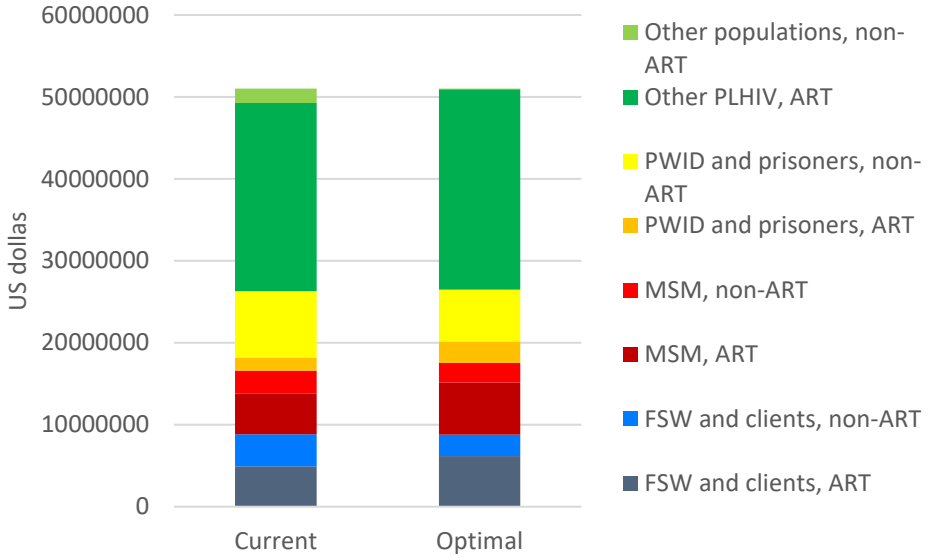
Table 5.1 Current (2014) and optimal allocation of the 2014 HIV budget (US$ 68.9 million) among different programmes

Programme	2014 allocation	Optimal allocation	Change
FSW programmes	3 912 000 (5.7%)	2 639 000 (3.8%)	-33%
MSM programmes	2 799 000 (4.1%)	2 369 000 (3.4%)	-15%
Non-NS PWID programmes	2 312 000 (3.4%)	340 000 (0.5%)	-85%
Prisoner programmes	48 000 (0.1%)	186 000 (0.3%)	+289%
Condom promotion and social and behaviour change communication	1 206 000 (1.7%)	5000 (<0.1%)	<-99%
HIV testing and counselling	537 000 (0.8%)	35 000 (0.1%)	-93%
Needle/syringe programmes	4 282 000 (6.2%)	4 370 000 (6.3%)	+2%
Opiate substitution therapy	1 441 000 (2.1%)	1 441 000 (2.1%)	*
Antiretroviral therapy	33 573 000 (48.7%)	38 727 000 (56.2%)	+15%
PMTCT	885 000 (1.3%)	885 000 (1.3%)	*
Indirect programmes	17 902 000 (26.0%)	17 902 000 (26.0%)	**

Source: Authors.

Note: *=Opiate substitution therapy and PMTCT were constrained not to be defunded; **=Indirect-programme costs were assumed to stay constant.

Figure 5.3 Distribution of the 2014 HIV budget (US$ 68.9 million) among different population groups with the 2014 budget or optimal allocation



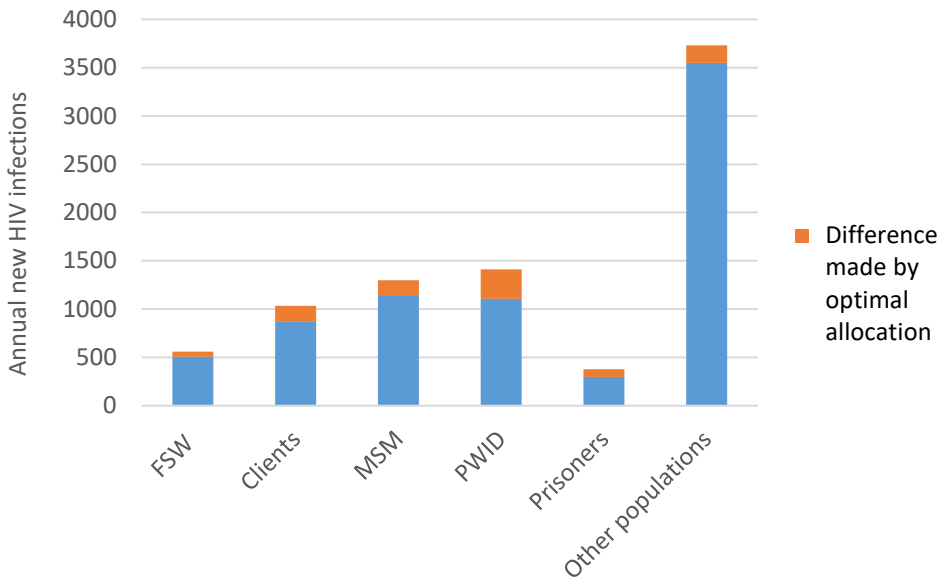
Source: Authors.

Note: "Other populations" include also former representatives of key populations, after ending their high-risk behaviour.

Despite the substantial decrease in funding to programmes targeting other than the most affected key populations, these population groups also benefit from the optimization: for example infections among partners of high-risk individuals can be prevented.

Optimal allocation of the 2014 level budget was predicted to avert on average an additional 943 new HIV infections and 644 HIV-related deaths per year during the period 2016–20 (Figure. 5.5 and 5.6). This corresponds to 11% and 8% annual reductions in the number of new HIV infections and HIV-related deaths respectively that were expected during the same period with the current resource allocation level. Both new infections and deaths were averted in all population groups. The greatest relative reduction in new infections was among current PWID (22%, from 1,411 with current allocation to 1,106 with optimized allocation). Reductions in deaths were approximately equally distributed across the population groups. Despite the substantial decrease in funding to programmes targeting other than the most affected key populations, these population groups also benefit from the optimization: for example infections among partners of high-risk individuals can be prevented. It should however be noted that although the great majority of HIV related deaths are among the other (non-key) populations, these include also former sex workers and their clients, and former PWID: most individuals from these key populations are expected to end their high-risk behaviour and return to the low-risk population before developing AIDS.

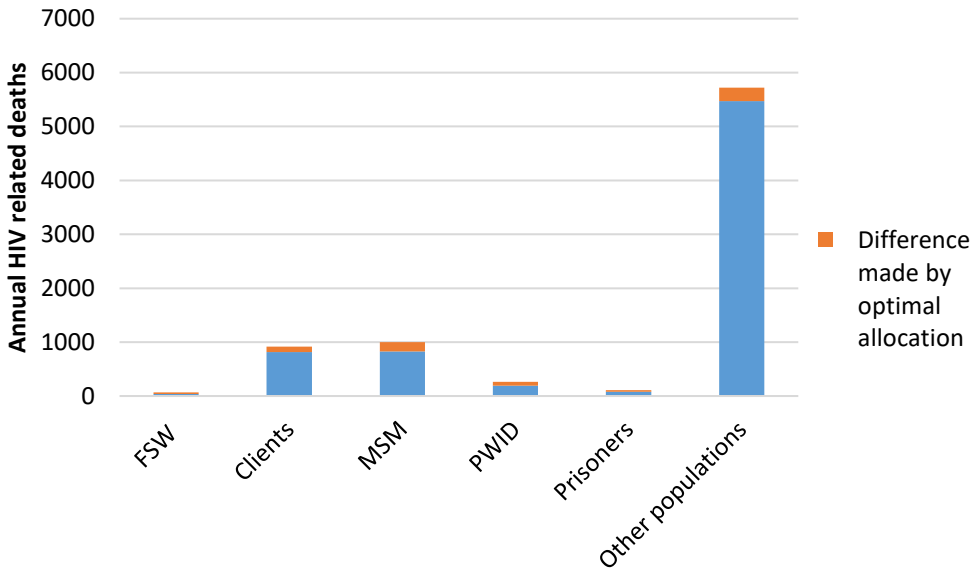
Figure 5.4 Expected average annual new HIV infections in Myanmar between 2016 and 2020



Source: Authors.

Notes: Blue=new infections expected with optimal allocation; orange=difference made by optimal allocation (new infections expected with continuation of the 2014 allocation); "Other populations" include also former representatives of key populations, after ending their high-risk behaviour.

Figure 5.5 Expected average annual HIV-related deaths in Myanmar between 2016 and 2020



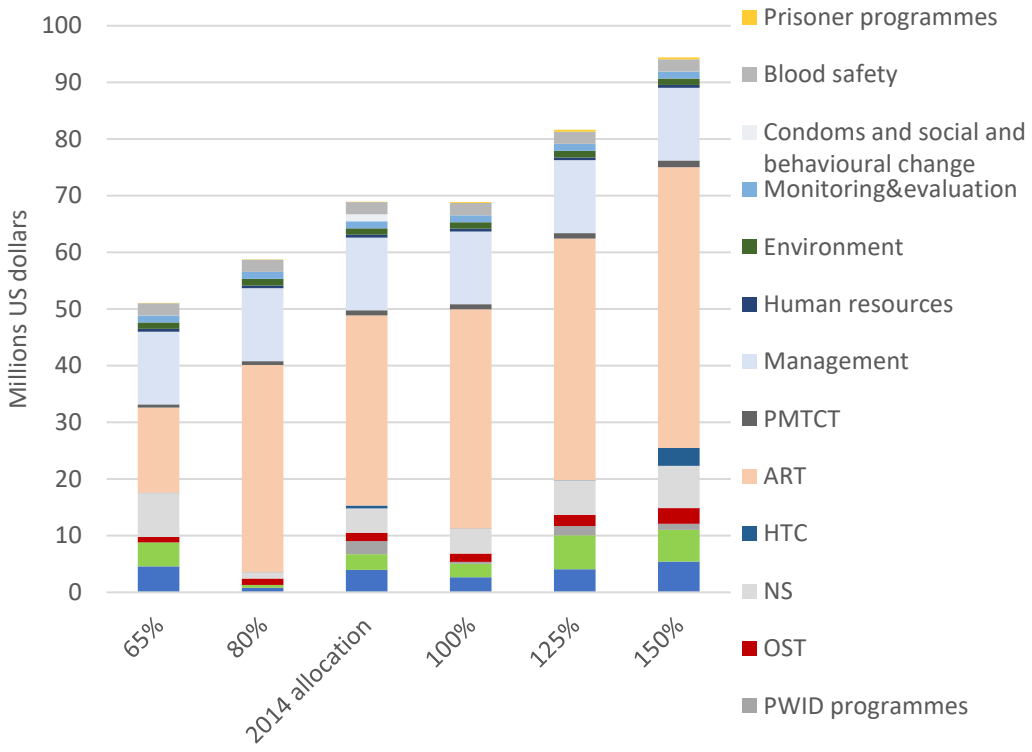
Source: Authors.

Notes: Blue=deaths expected with optimal allocation; orange=difference made by optimal allocation (deaths expected with continuation of the 2014 allocation); "Other populations" include also former representatives of key populations, after ending their high-risk behaviour.

5.3 Optimal HIV allocation at different resource levels: 2016–20

Figure 5.6 shows the optimal allocation among programmes at different investment levels, ranging from 65% to 150% of the 2014 direct-programme budget plus indirect programmes. The results show that with moderate cuts in total funding, ART should have the greatest priority: if the direct-programme spending is reduced to 80% of the 2014 level, the optimization suggests allocating almost 90% of the direct-programme spending (62% of total budget) to ART. However, if the cut is larger, the results change substantially: in this situation, over half of the direct-programme funding should be for FSW and MSM programmes and needle/syringe programmes. If more funding were available than in 2014, prevention for key populations should be scaled up: in particular, funding for MSM programmes should be doubled if the available direct-programme funding increased by 25%. With a larger increase, HTC for other than key populations should also be scaled up.

Figure 5.6 Optimal allocation of HIV funding with variable budgets.

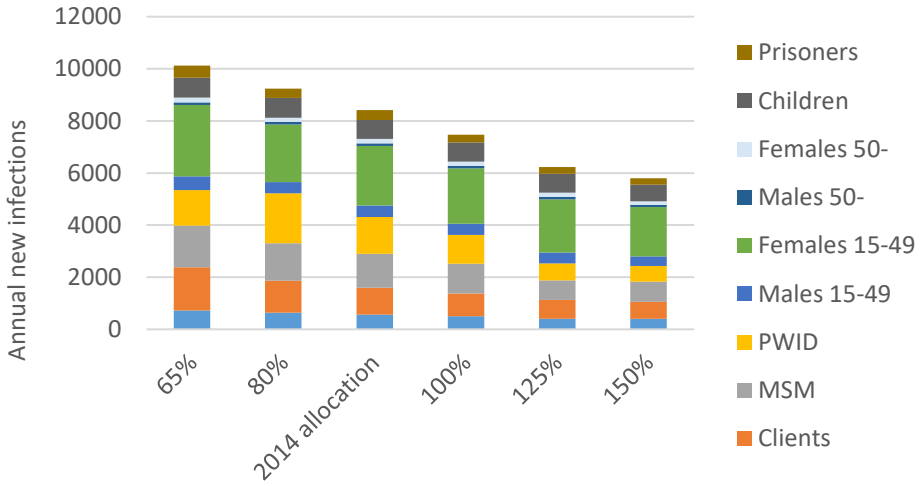


Source: Authors.
Note: The percentages refer to the direct-programme funding available in 2014.

The annual number of new HIV infections can be expected to vary according to the level of funding (Figure 5.8). Almost 1,000 additional new infections every year can be expected if only 80% of the 2014 total for direct-programme funding is available, even if it is allocated optimally. On the other hand, a 25% increase in the 2014 total

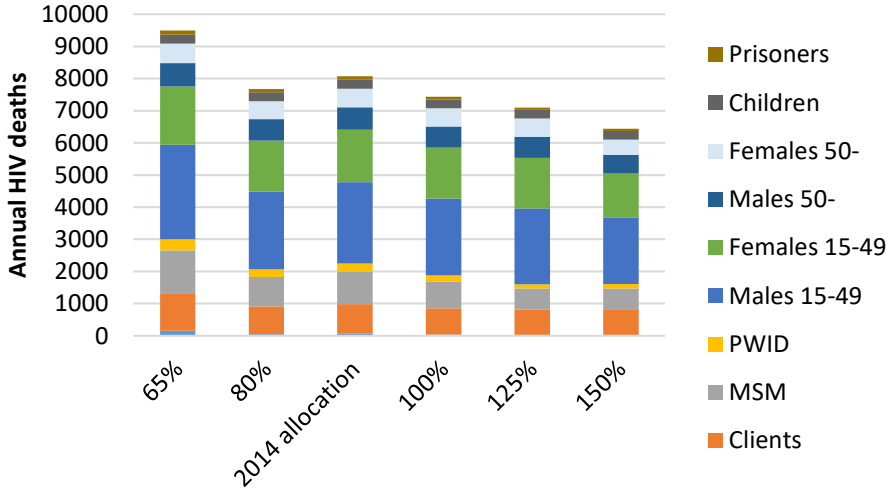
for direct-programme funding could – together with optimal allocation —avert over 2,000 additional new HIV infections every year. The number of deaths is also sensitive to the funding level (Figure 5.9). About 500 more deaths could be averted every year compared to the current situation with only 80% of the total direct-programme funding available in 2014, if the resources were optimally allocated (to expand ART). However, a larger cut would lead to a substantial increase in deaths: if only 65% of the 2014 direct-programme funding were available, the number of expected deaths would increase from the current 8,000 to about 9,500.

Figure 5.7 Average annual new HIV infections in Myanmar between 2016 and 2020 with variable budgets, assuming the resources are optimally allocated



Source: Authors.
Note: The percentages refer to the direct-programme funding available in 2014.

Figure 5.8 Average annual HIV related deaths in Myanmar between 2016 and 2020 with variable budgets, assuming the resources are optimally allocated



Source: Authors.
Note: The percentages refer to the direct-programme funding available in 2014.

5.4 Other analyses

Annex 2 shows the results from the secondary optimization analyses that were conducted.

6 DISCUSSION

6.1 Epidemic trends

Myanmar has a concentrated HIV epidemic. About half of all new infections are in key populations at higher risk, although these key populations account only for a small proportion of the total population. The number of new infections has been gradually decreasing since 2000, in particular among clients of FSW and PWID, who in 2000 still accounted for two-thirds of all new infections. However, the level of new HIV infections has stayed stable among FSW and MSM, as well as among women from the general population, who are considered low risk as they themselves are not engaging in any high risk behaviour, but nonetheless are at risk through the behaviour of their partners.

Despite the overall trend of decreasing HIV incidence, annually about 8,400 people are expected to become newly infected with HIV, and 8,100 people are expected to die from HIV-related illness, over the next five years.

Despite the concentrated nature of the epidemic, about half of the new infections are expected to occur outside the key populations at higher risk.

If the total amount of resources available in 2014 were annually available and were allocated optimally among the programmes (see Section 6.3 for further discussion), the **annual new infections could be reduced from the current 8,400** to about **7,400**, and **HIV-related deaths from 8,100** to **7,400**, each year. Furthermore, combining optimal resource allocation and an increase of one-third of the 2014 level of HIV funding, these numbers could be reduced further down to **6,400** new infections and **5,800** HIV-related deaths each year. Despite the concentrated nature of the epidemic, about half of the new infections are expected to occur outside the key populations at higher risk. This is mainly due to the small population size of the key population groups, bridge populations linking the key populations with general population (e.g. clients of sex workers), as well as the fact that some additional populations at higher risk were not explicitly modelled, either because of insufficient data on population size and prevalence, or the difficulty of determining the population exactly and distinguishing it from others (e.g. migrants). However, new HIV infections are decreasing, and the results do not indicate that the epidemic would develop into a generalized one. At this stage, the Myanmar HIV response and the focus of the NSP III is on further reducing new infections along with scaling up ART for all those who need it and sustaining the programmatic progress that has been achieved.

6.2 HIV funding

As part of the overall transition that Myanmar is experiencing, health and HIV financing are undergoing changes. There is a shift underway towards increased Government ownership and accountability to provide comprehensive health care for the public. It is hoped that the increasing trend of domestic contribution for health and HIV continue into the future to reduce dependency on external contribution from donors.

As pointed out in Chapter 3.3, the Global Fund provides the largest proportion of funds for the HIV response in Myanmar. The Government has also increased domestic spending, which currently stands at around 12% of total HIV resources.

Despite the current increase, future funding is uncertain, meaning that the country should be prepared to have strategies in place for different scenarios of total available funding. Several potential issues may lead to a continuing increase in funding available for direct HIV programmes. Management costs in 2012 were six times higher than in 2011, and these have continued to increase slowly. A return to a lower level could free resources for direct programmes.

Currently, much of the HIV response is managed by international NGOs. The eventual transition to a Government-managed HIV response would potentially reduce programme management costs and make the NSP budget more cost-efficient.

6.3 Optimal allocation of the resources

However, by further reallocating the resources, more new infections and HIV-related deaths could be averted, even without increasing the budget.

Myanmar's current HIV response already focuses on the key populations at higher risk: female sex workers, their clients, men who have sex with men, and people who inject drugs. Moreover, the coverage of ART has been continuously increasing over recent years. However, by further reallocating the resources, more new infections and HIV-related deaths could be averted, even without increasing the budget. The study also showed that the optimal allocation depends on the available budget level, and that the appropriate allocation pattern differs substantially among the following three scenarios.

6.3.1 Substantial decrease in the available funding

If the total available budget were **substantially lower than in 2014**, this would lead to a catastrophic situation where a formal optimisation loses its meaning. In theory, the lowest number of new infections and HIV related deaths in this situation would be gained by prioritizing prevention programmes for key populations, even if it meant reducing funding to ART, including stopping treatment for some patients (in practice, restricting ART again to the patients in most advanced disease stage). However, this would be an inappropriate solution in several ways, causing ethical problems and

further serious issues. The standard assumption and constraint in the analyses was that no patient who has started ART should be taken off treatment, except through natural attrition. This principle cannot however be held if the total budget does not allow to keep everyone one ART. The analysis also has other limitations. For example, the Optima HIV model does not account for drug resistance development. Taking people off ART could lead to massive increase in the prevalence of drug-resistant virus subtypes, and these strains could be further transmitted. This could have serious consequences for the effectiveness of ART and lead to substantially increased treatment costs in the future. As a conclusion, this shows that **a minimum funding level** corresponding to about 74% to 85% of the 2014 budget level (or about **US$ 50–60 million**) is essential to maintain a stable programme. This is also the minimum funding level, above which results from this analysis should be considered for policy recommendations. The study strongly recommends that Myanmar consider every avenue to keep the total budget to at least this level.

6.3.2 Moderate decrease or increase from the 2014 level

ART has the highest priority, and funding for it should be increased by about 15% from the current level.

If the available funding stays within a range of about US$ 55–85 million (i.e., **close to the 2014 budget level**), the study findings suggest the following sequence of prioritization: ART has the highest priority, and funding for it should be increased by about 15% from the current level. This means that if less funding than in 2014 were available, almost all direct-programme spending should be allocated to ART. The next programmes in the priority sequence are prevention programmes targeting the key populations at highest risk. If the total budget were to stay at least at the 2014 level, then programmes for FSW, MSM and PWID should be maintained with spending that is not decreased by more than about one-third. If the total budget were to increase, MSM programmes should receive more funding. Funding for PWID should focus on needle and syringe programmes. Opiate substitution therapy (which was constrained not to be defunded from the current level, as it has important benefits beyond HIV prevention) may be considered for scale-up if the total budget were to increase. Prisoner programmes should also receive more funding: the optimization results suggest a four-fold increase on the current budget, which would nonetheless correspond to a relatively small increase in absolute terms. It is suggested that programmes not targeting key populations (including testing and condom/behaviour promotion interventions) be almost completely defunded. These results demonstrate that, unless there were a substantial change in the budget, the response should continue to focus on **ART** and **prevention programmes targeting key populations**. However, it must be noted that there may be other key or vulnerable populations—such as young people, migrants, and the regular partners of individuals from key populations, which were not modelled explicitly but would also benefit from targeted prevention interventions. Although the model suggests defunding all programmes targeting the "other" populations (which now include the low-risk general population, but also some high-risk or vulnerable population groups), each specific programme

should be considered on a case-by-case basis before any decisions of defunding are made.

6.3.3 Substantial increase in the available funding

"Test and treat" consists of two components: intensive screening of the entire population to diagnose all PLHIV as soon as possible; and immediate ART regardless of disease stage.

If the total budget were **substantially** increased, the results suggest that the scale-up of ART and key population prevention programmes should take priority. In addition to this, HTC for other populations should also be scaled up. The scenario could be seen as a moderate version of a "test and treat" strategy. "Test and treat" consists of two components: intensive screening of the entire population to diagnose all PLHIV as soon as possible; and immediate ART regardless of disease stage. Global guidelines over recent years have progressively promoted earlier start of ART and increasing ART eligibility to new population groups, with most recent guidelines promoting initiation of ART regardless of CD4 count.[26] Once all or most people diagnosed with HIV are initiated and successfully maintained on ART, testing becomes the main challenge in implementing "test and treat". The scenario presented here with the highest budget suggests increasing the funding for all key population programmes (which also include HIV testing and counselling), as well as more funding (US$ 3 million annually) for HTC of other population groups, which was almost defunded with all lower budgets. This probably would be closest to a "test and treat" scenario. Myanmar has a concentrated epidemic, and a testing intervention that tries to screen the entire population would be inefficient—both expensive and time-consuming. As a suggestion, the US$ 3 million for HTC could be used to extend active HIV testing for other populations with higher HIV risk or vulnerability (such as migrant workers) and to develop HIV testing and counselling for members of the general population (e.g. those who have symptoms or feel they have been at risk). As a conclusion, the Optima modelling exercise has shown that if the total budget could be increased by 37% (or even slightly less; corresponding to about **US$ 90–95 million per year**), a **"test and treat"** approach could be considered: the focus of prevention should still be kept on the key populations at higher risk, but some of the additionally gained funding could also be allocated to trying to identify those who are HIV-positive in other population groups.

The actual future level of funding will depend on allocations from international donors and ability to mobilize more domestic resources. It must be noted that at the same time, investments in other fields of health care are also urgently needed. The HIV budget should not be increased at the cost of other health care sectors, in particular when the overall low (1.0% of GDP) contribution of public financing on health is taken into account. However, Myanmar should systematically look at its burden of disease, its policy priorities, and decide optimal allocation. Overall, Myanmar is spending too little on health from the level that the country should be

[26] World Health Organization (2015): Guideline on When to Start Antiretroviral Therapy and on Pre-exposure Prophylaxis for HIV.

able to afford as an economy, and Myanmar should look for options for increased fiscal space for health, including HIV/AIDS. The benefits achieved will also depend on the technical efficiency of the direct and indirect programmes. The sums mentioned above assume that the efficiency of all expenditure areas (both direct programmes, and expenditures such as management) will stay constant in the future. However, this may change over the coming years (see Box). Another factor influencing the amount of money that can be allocated to direct programmes is the sum spent on indirect programmes. The almost six-fold increase in the costs for management and administration in 2012 suggests that the **programmes could be managed more efficiently, and that the savings could be used to scale up direct programmes**. Finally, the preliminary NASA results from 2015 suggest that the total funding has further increased, from US$ 69 million in 2014 to US$ 84 million. This does not imply any further increase in the future, but shows that the use of the 2014 funding level is likely a conservative assumption, and may underestimate the actual average level of future funding. However, it also remains to be seen whether Myanmar will be able to continue to attract external resources for HIV at a similar level as currently.

Box 6.1 Technical efficiency of programmes: potential for future improvement

This study assesses allocative efficiency, i.e., how resources should be allocated between programmes. In addition, substantial benefits could be gained by **improving technical efficiency: essentially by reducing unit costs of programmes.** In the near future, several issues may be able to make programmes more efficient:

- **Shifting the management from international NGOs to** Government and local entities
- **New more efficient** service delivery and outreach models
- Integrating **HIV response more with** other health care sectors
- **Strengthening of national** laboratory capacities
- **Improved technical efficiency will have an impact on the optimal allocation:**
- **For example, total budget on 2014 level** but 20% reduction in unit costs **would mean that the optimal allocation and associated benefits are** equivalent to the analysis with 25% increase **in direct-programme budget**
- **Different efficiency gains in different programmes may lead to differences in optimal allocation**

Source: Authors

The preventive effect of ART suggests that the HIV response should move away from a strict distinction between "treatment" and "prevention" interventions: ART can be very efficient in both.

In addition to improving the health of people living with HIV, it is proven that **ART effectively prevents onward transmission of HIV**.[27] Concepts such as "treatment as prevention" and "test and treat" have gained a lot of prominence. The preventive effect of ART suggests that the HIV response should move away from a strict distinction between "treatment" and "prevention" interventions: ART can be very efficient in both. The study results are in line with these findings: it was shown that **allocating more resources to ART will eventually prevent more new infections** than investments in other prevention activities such as condom and behaviour promotion. However, the study also showed that ART requires a critical level of coverage before it can be considered an efficient method for prevention. This highlights that although small or short-term funding shortages may not threaten the overall HIV response, there is a certain threshold funding level below which ART will become inefficient for prevention. This is also related to the fact that the increasing number of patients already on ART means that while new patients need to start treatment**, enough resources must also be available to maintain those already on ART on treatment**. The study estimates that around US$ 50 to 60 million every year is the minimum level to maintain an effective response to the HIV epidemic in Myanmar. Of this, at least US$ 35 million are needed for ART. This is about the level of the 2013 budget, and considerably more than was available before (between US$ 30 and 45 million annually).

Comprehensive packages of primary prevention services targeted at key populations mainly consist of distribution and promotion of condoms, provision of HIV testing and counselling services, and promotion of safer behaviour practices. In addition, needle and syringe provision plays an important role in the response targeting people who inject drugs. The study results showed the **importance of continuing to invest in these programmes, despite the growing coverage of ART**. Among programmes targeting PWID, the results highlighted the role of the **needle and syringe programme**. The exact reallocation of resources between NS and other PWID programmes should be interpreted with caution, since in practice it may be difficult to separate NS from the other PWID interventions. The fact that drug use is illegal and punished means that programmes targeting PWID may need to be seen as a general combined service, rather than as separate interventions: the main challenge of implementing any programmes targeting PWID is reaching the target population. The team also had limited cost data on NS programmes, which were based on the coverage and assumed unit cost, and deducted from the total costs of PWID programmes.

Opiate substitution therapy (OST) and prevention of mother-to-child transmission (PMTCT) were constrained in this study not to be defunded. OST in itself was not found to be an efficient programme to prevent HIV, but it has considerable benefits beyond HIV care. It should be recognized that in the context of Myanmar, multi-

[27] Cohen M et al (2011): N Engl J Med 365(6), pp. 493–505.

PMTCT has been one of the great successes of HIV care worldwide and has virtually eliminated vertical transmission in many settings. This target could also be achievable in Myanmar, if the coverage of PMTCT can be kept high enough.

sectoral funding of OST according to the share of benefits across the sectors is currently not likely to be feasible, and at the moment the continuation of OST will require funding from the HIV budget. PMTCT may also often not appear as efficient in such analyses with short-term time windows. Nevertheless, it is clear that PMTCT should be maintained with high coverage. PMTCT has been one of the great successes of HIV care worldwide and has virtually eliminated vertical transmission in many settings. This target could also be achievable in Myanmar, if the coverage of PMTCT can be kept high enough.

In the optimization analyses, **prisoner programmes regularly received more funding**. This is easy to understand: prisoners are a population easy to reach, leading to lower unit costs than, for example, PWID programmes, which often have severe and costly challenges in finding and reaching their target population. Furthermore, after being released from prison, the former prisoners will return to the general population and will also contribute to the HIV epidemic. No information was available on the average length of prison sentences, which results in some uncertainty around these findings.

As expected for a concentrated epidemic, the optimization results showed that prevention programmes targeting other than key populations were very inefficient. However, it should be noted that "other populations" in the analyses does not necessarily mean the low-risk general population. Other populations include, for example, partners of PLHIV, partners of key populations at higher risk, migrants, and other smaller subpopulations that may have a considerably higher risk of acquiring HIV than the general population. These populations are, however, often hard to distinguish from the general population. Myanmar does not at the moment have any prevention activities that would solely focus on the low-risk general population and due to the "concentrated" nature of the epidemic among key populations this makes sense. The "Condoms and Social and Behaviour Change Communication" programme, which was included in this analysis, combines several programmes that target population groups that are either at high risk (e.g., migrants), vulnerable (e.g., out-of-school young people), or can be easily accessed (e.g., young people in school, people in the workplace). The team assumed that increased spending in this combined programmatic area would lead to increased condom use in casual relationships, however this assumption was based only on scarce observations with very high uncertainty. Therefore, the results should be interpreted with caution. **Some prevention programmes,** targeting specific populations, but included in this analysis in the condom and behaviour change programme category, **may in fact be efficient**, and some interventions may also be considered important for ethical or policy reasons. Quantitative studies may help to identify such programmes.

Testing programmes targeting other than key populations were also defunded in the analysis with 2014 budget level. The concerns discussed above for prevention programmes are valid also for testing: the target population may include subgroups

with high prevalence. Overall, over half of all PLHIV are outside the separately modelled key populations, and in the long term, efforts must also be test wider population groups efficiently. It is essential to develop testing strategies that can identify the maximal number of cases without the need to massively scale up the outreach. The optimisation analysis suggests to fund HTC outside the most affected key populations if the total budget can be sufficiently increased, but new testing strategies could potentially be considered even with lower budgets, if their efficiency can be made close to that of existing key population programmes.

Optima HIV is a recognized mathematical model, which has been used in over 50 countries to study the allocative efficiency of the HIV response.

The analysis has several limitations that should be understood and considered when policy decisions are made. This exercise was based on mathematical modelling, and all models are simplifications and estimations of reality. Although modelling is a useful tool that can use limited observational data to help generate long-term epidemiological and financial predictions and evaluate the impact and cost-effectiveness of different interventions, the findings of models are subject to uncertainty, and the correct interpretation of the results requires in-depth understanding of the limitations and restrictions in the models' assumptions and available data. The reliability of the model's results depends on the accuracy of its inputs. Optima HIV is a recognized mathematical model, which has been used in over 50 countries to study the allocative efficiency of the HIV response. We explicitly included the key population groups that are expected to contribute most to the epidemic, and calibrated the model to prevalence data that were available in some cases annually. The model and data however have several limitations that may influence the results. Some of the limitations have already been mentioned in the paragraphs above. In addition, for example, we assumed that the allocation, once optimized, will stay constant over time. Although further gains in efficiency could be achieved by varying the allocation between programmes over time, these gains would be expected to be negligible in the context of a concentrated epidemic and relatively short time window. We advise to re-evaluate the allocation in the next review phase of the National Strategic Plan. The analysis also did not attempt to assess the optimal allocation of resources within the defined programmes. Some indirect effects, such as the impact of HIV testing on reducing high-risk behaviour, could also not be included. When policy changes are made on the basis of this or other mathematical modelling analyses, the entire context should be understood. For example, as mentioned under the scenario in which total funding decreases substantially, the allocation that theoretically brings the greatest benefit may not be ethically acceptable and may have serious long-term consequences that may not be captured by the current analysis.

7 CONCLUSION

Myanmar has developed an appropriate response to the HIV epidemic through investing in the scale-up of ART as well as prevention interventions targeting the key population groups that have the most significant impact on the development of the epidemic. The total funding has increased substantially over the years, and especially the number of patients on ART has grown exponentially over the last few years. The optimization analyses have several key messages that should be considered in policy-making.

There is "no way back" regarding HIV funding: due especially to the high number of patients already on ART, it must be assured in the future that a budget no less than the current spending level is available.

First, there is "no way back" regarding HIV funding: due especially to the high number of patients already on ART, it **must be assured in the future that a budget no less than the current spending level is available**. Going back to the level of funding before 2014 could lead to an emergency situation where access to ART needs to be prioritized and not all in need may receive it. The long-term consequences of such a scenario are hard to predict. If cuts in budget are expected, it will be essential to focus on the technical efficiency and management-related costs, to ensure that the coverage of direct programmes can be maintained.

Second, **ART is clearly a priority programme**, and the results suggest to accelerate its scale-up if possible. This is in line with the current global policies, promoting the earlier initiation of ART, not only to treat infected individuals, but also to prevent onward transmission and to weaken the epidemic.

Third, **prevention and testing programmes that target the key populations at higher risk also are high priority programmes**. With the current total budget, funding for all key population programmes should be kept close to current level, and prisoner programmes should be scaled up considerably. Among programmes targeting people who inject drugs, the needle and syringe programme in particular should be promoted, whereas the resources currently spent on testing and condom and behavioural promotion could be shifted towards treating more patients.

Fourth, testing and prevention for other than the modelled key populations were not found efficient, and the resources from these programmes could be moved towards increasing the number of people on ART. However, **if the budget continues to increase, active testing could be expanded to new population groups**, and the country could start to move towards "test and treat". Developing alternative, more efficient, testing and screening strategies could help to identify more HIV infected people also outside the most affected key populations.

Finally, apart from allocating the resources more efficiently across programmes, **there should also be focus on technical efficiency**, in particular the currently very high management costs. Reducing the unit costs of each direct and indirect programme could result in the same effect as increasing the total budget, and avert more new infections and HIV-related deaths.

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9 ANNEXURE

ANNEX 1 COST–COVERAGE–OUTCOME RELATIONS

This annex shows the plots of cost–coverage–outcome relations that were used in the analysis. For each programme, *cost* refers to the total spent on the programme within one year, including all components that are necessary to provide the programme. *Coverage* can be defined in two ways: either as the number of people accessing the programme (used for ART, PMTCT and OST), or the proportion of the target population that is reached by the programme (used for all other programmes). The proportion is assumed to be the same across all target populations. *Outcome* refers to the impact the programme has on behaviour or other factors that influence the transmission of HIV and/or mortality.

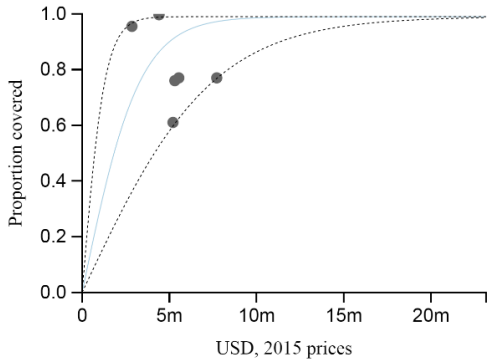
For each programme, the first plot presents the achieved coverage as a function of the cost. The relationship is not linear: we assume a saturation effect, where the coverage will approach the assumed maximum coverage asymptotically. This represents the fact that most programmes will first be able to cover certain subpopulations that are easy to reach. As more funding becomes available, the programme will aim to find the harder-to-reach subpopulations, among which the unit costs will be higher.

The further plots show for each assumed outcome the outcome as a function of the coverage (left panel), or as a function of the total cost (right panel). The coverage–outcome relationship is assumed to be linear. The cost–outcome relationship is calculated by combining the cost–coverage and coverage–outcome relations.

In all plots, the dots show the available data, the curves also reflect the assumptions made for the model, which were gained by fitting the appropriate mathematical formula manually to the data. For ART, PMTCT and OST, the outcome is defined using the Optima HIV default parameters (see user documentation on www.optimamodel.com), without the need to define specific coverage–outcome curves.

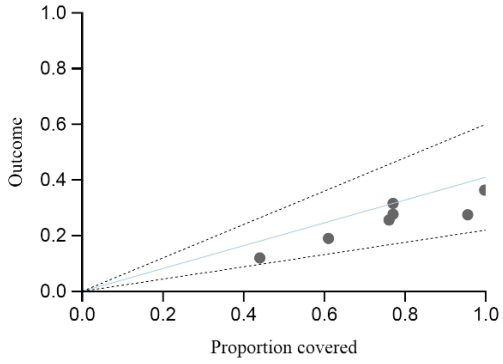
A1.1 FSW programmes

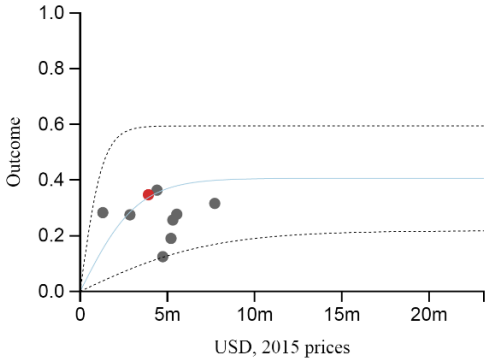
Cost–coverage relation



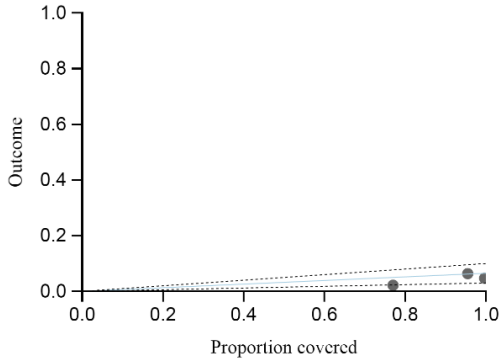
Coverage–outcome and cost–outcome relations

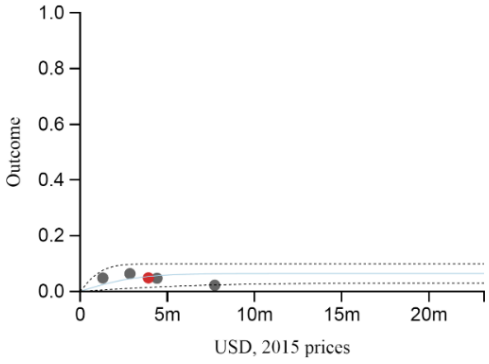
A1.1.1 Proportion of people tested: FSW



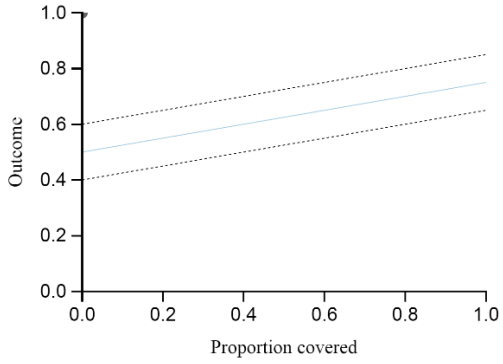


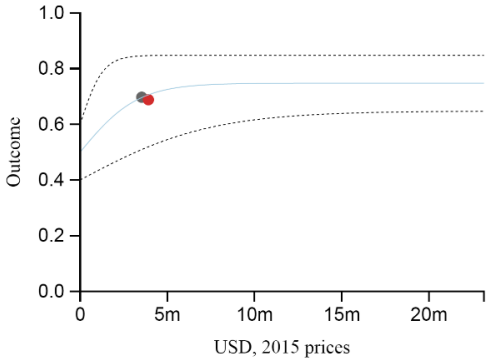
A1.1.2 Proportion of people tested: clients





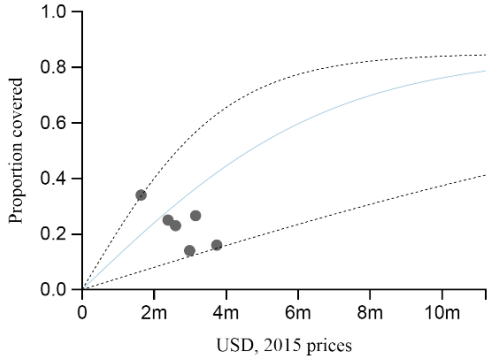
A1.1.3 Proportion of commercial sexual acts between FSW and clients where condom is used





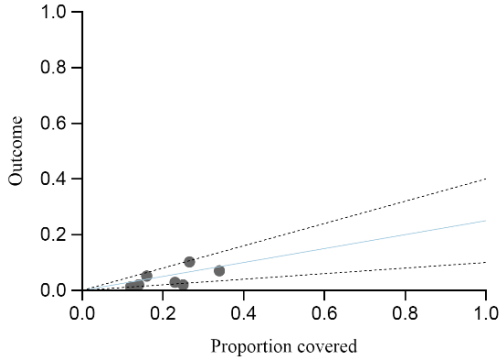
A1.2 MSM programmes

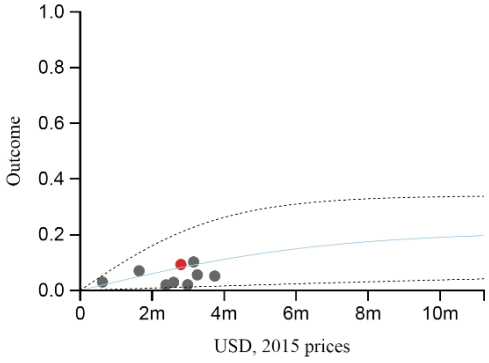
Cost–coverage relation



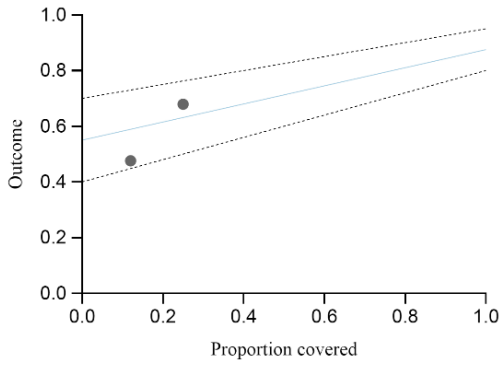
Coverage–outcome and cost–outcome relations

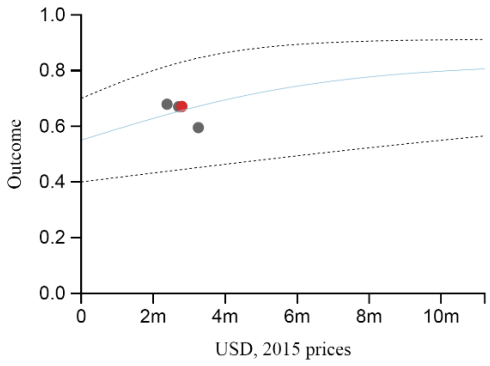
A1.2.1 Proportion of people tested: MSM





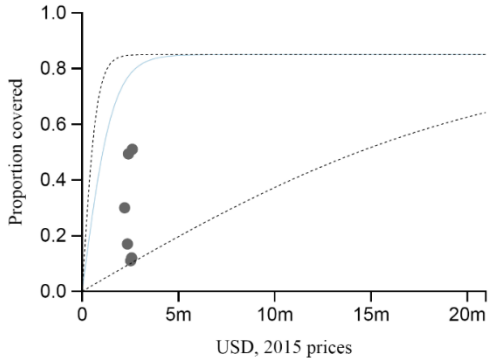
A1.2.2 Proportion of casual sexual acts in which condoms are used: MSM





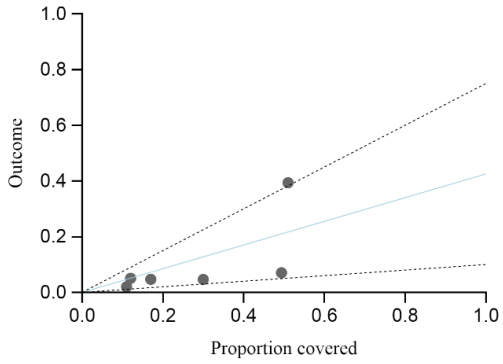
A1.3 PWID programmes

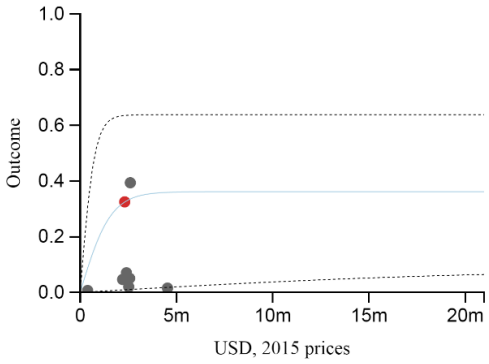
Cost–coverage relation



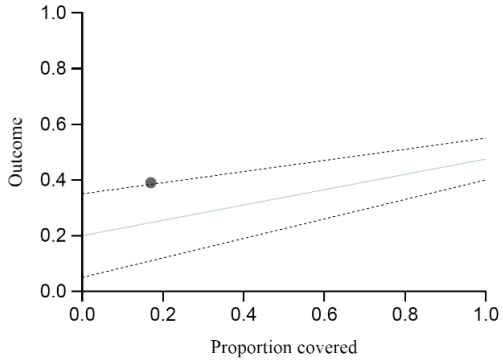
Coverage–outcome and cost–outcome relations

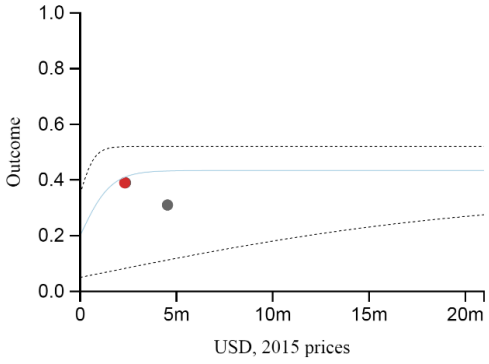
A1.3.1 Proportion of people tested: PWID





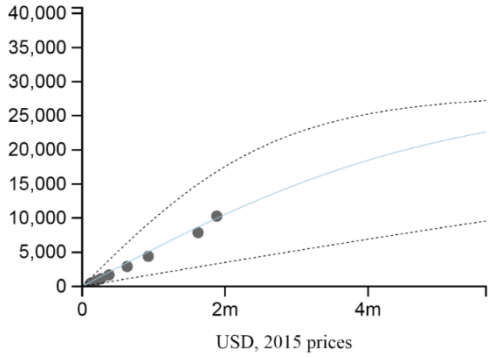
A1.3.2 Proportion of casual sexual acts in which condoms are used: PWID





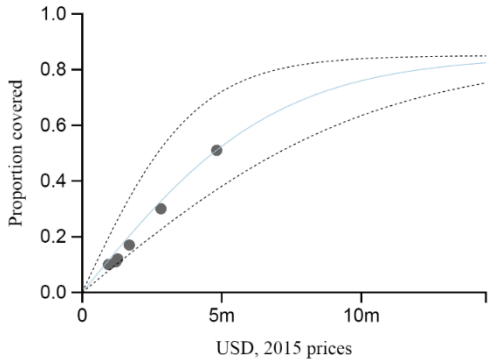
A1.4 Opiate substitution therapy

Cost–coverage relation



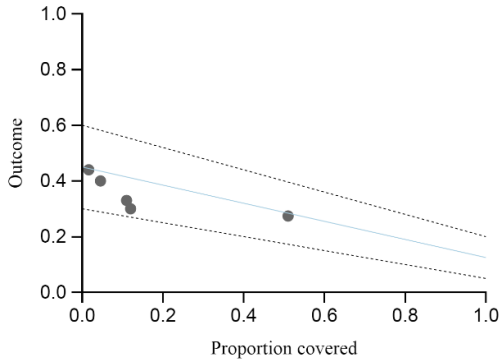
A1.5 Needle and syringe programme

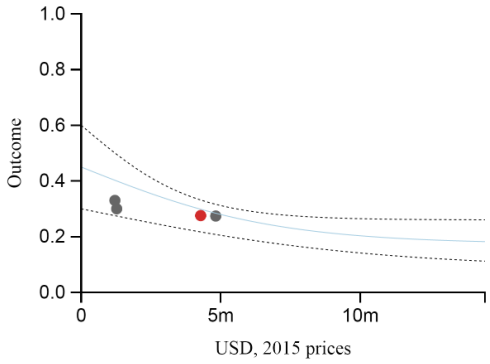
Cost–coverage relation



Coverage–outcome and cost–outcome relations

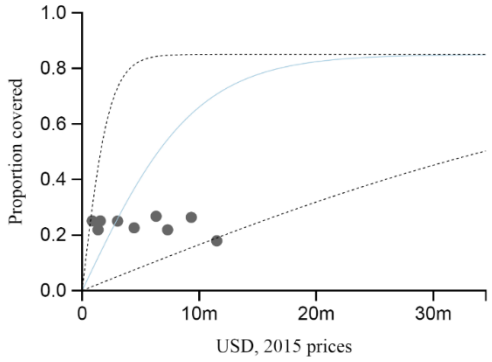
A1.5.1 Proportion of injections using receptively shared needles: PWID





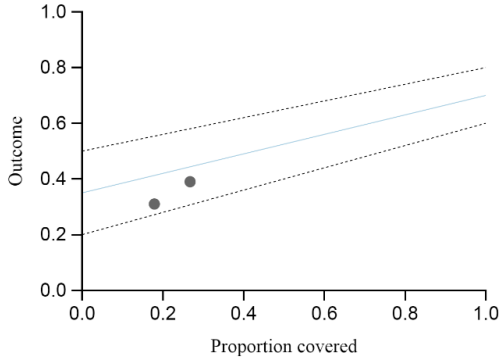
A1.6 Condoms and social and behaviour change communication

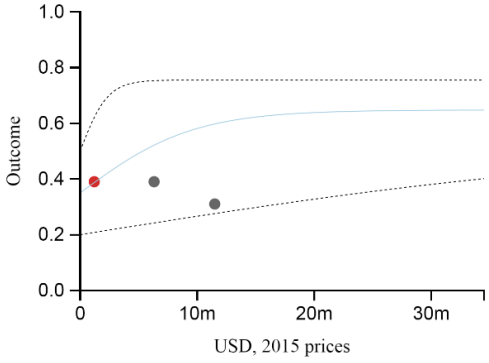
Cost–coverage relation



Coverage–outcome and cost–outcome relations

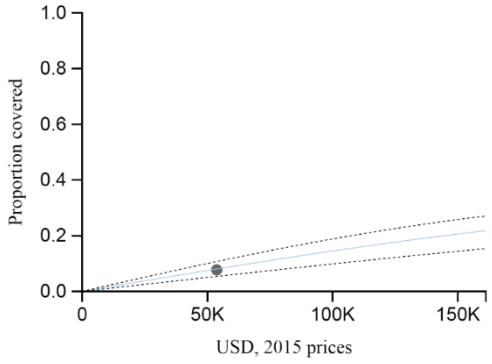
A1.6.1 Proportion of casual sex acts in which condoms are used: Other populations (men and women aged 15 and above)





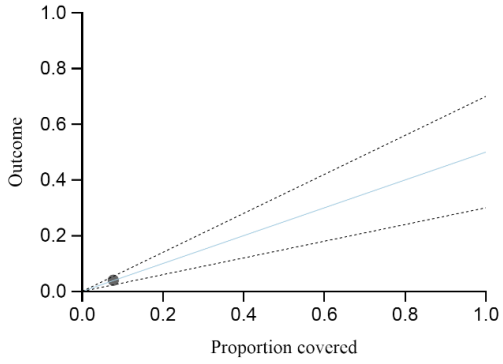
A1.7 Prisoner programmes

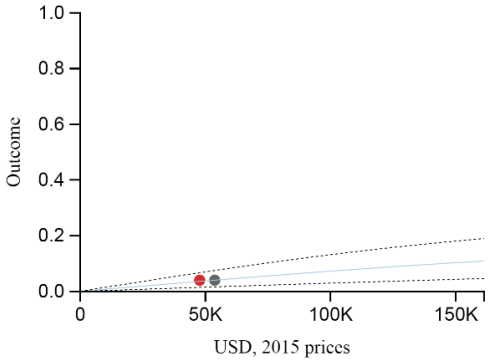
Cost–coverage relation



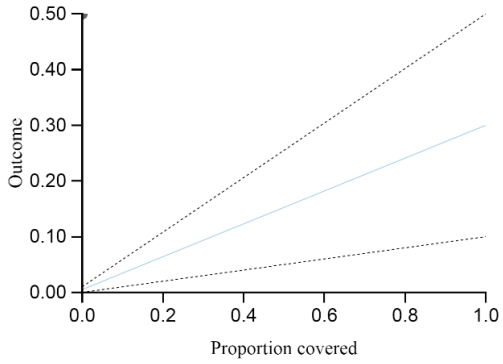
Coverage–outcome and cost–outcome relations

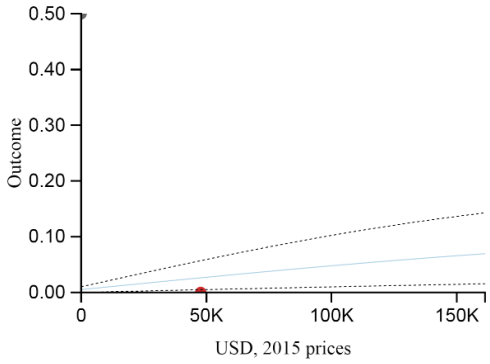
A1.7.1 Proportion of people tested: Prisoners





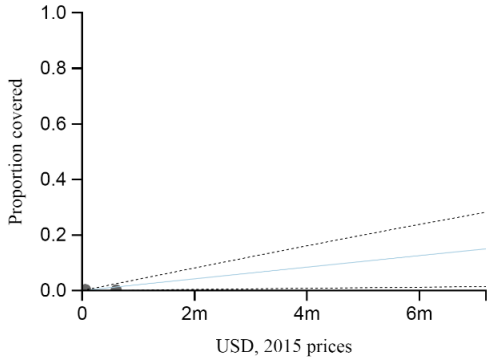
A1.7.2 Proportion of casual sex acts in which condoms are used: Prisoners





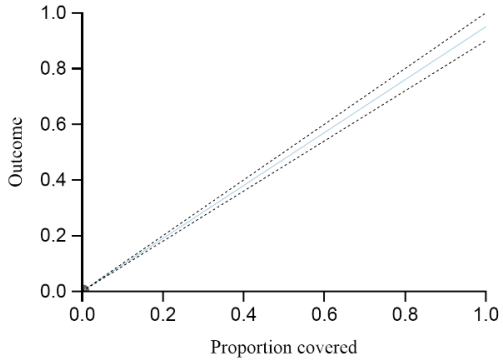
A1.8 HIV testing and counselling

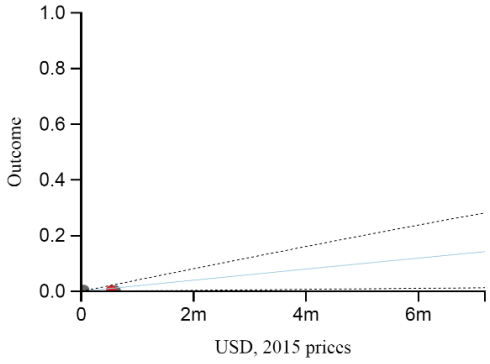
Cost–coverage relation



Coverage–outcome and cost–outcome relations

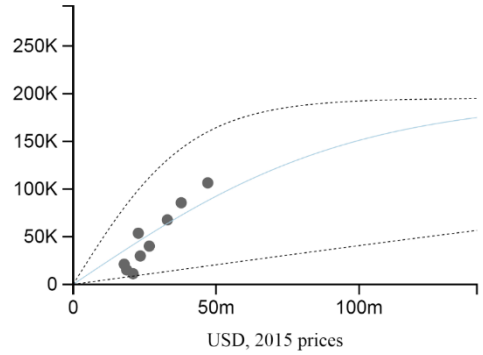
A1.8.1 Proportion of people tested: Other populations (men and women age 15 and above)





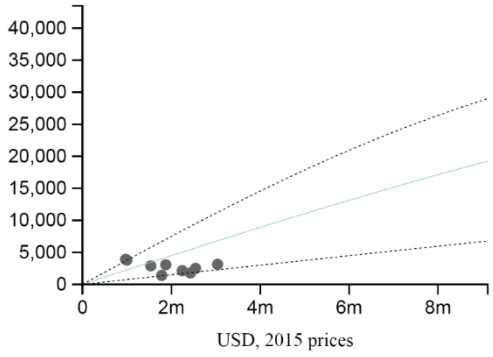
A1.9 Antiretroviral therapy

Cost–coverage relation



A1.10 Prevention of mother-to-child transmission

Cost–coverage relation



ANNEX 2 Additional optimization analyses

A2.1 Optimization with longer (2016–30) time window

Our main optimization analysis considered a five-year time window (2016–2020). This was chosen since there are significant uncertainties in the future long-term funding and other factors. This is also the timeframe of the new National Strategic Plan. However, ideally, the aim of the HIV response would also be to gain substantial benefits in the long term, leading ultimately to the eradication of the HIV epidemic. We therefore conducted a secondary analysis for the time period 2016–2030. The aims and targets were otherwise the same as in the main analysis: we wanted to find the allocation of resources that would minimize the sum of new HIV infections and HIV-related deaths over the period 2016–2030.

The results of the analysis with 2014 budget level were similar to those of the shorter time period (Table A2.1). The major differences included the following:

- Funding for antiretroviral therapy increased even more (25%)
- Correspondingly, funding for prevention programmes for key populations had to be decreased more
- Prisoner programmes received even more funding (seven-fold increase)
- Among PWID, resources were focused on general prevention/testing instead of needle and syringe programmes

Table A2.1 Current (2014) and optimal allocation of the 2014 HIV budget (US$ 68.9 million) among different programmes

Programme	Current allocation	Optimal allocation	Change
FSW programmes	3 912 000 (5.7%)	1 859 000 (2.7%)	-52%
MSM programmes	2 799 000 (4.1%)	2 223 000 (3.2%)	-21%
PWID programmes	2 312 000 (3.4%)	1 025 000 (1.5%)	-56%
Prisoner programmes	48 000 (0.1%)	346 000 (0.5%)	+626%
Condom promotion and social and behavioural change communication	1 206 000 (1.7%)	49 000 (0.1%)	-96%
HIV testing and counselling	537 000 (0.8%)	17 000 (<0.1%)	-97%
Needle/syringe programme	4 282 000 (6.2%)	965 000 (1.4%)	-77%
Opiate substitution therapy	1 441 000 (2.1%)	1 441 000 (2.1%)	*
Antiretroviral therapy	33 573 000 (48.7%)	42 187 000 (61.2%)	+26%
PMTCT	885 000 (1.3%)	885 000 (1.3%)	*
Indirect programmes	17 902 000 (26.0%)	17 902 000 (26.0%)	**

Source: Authors.
Notes: The optimization minimizes the sum of new HIV infections and HIV-related deaths over the period 2016–30; *=Opiate substitution therapy and PMTCT were constrained not to be defunded; **=Indirect-programme costs were assumed to stay constant.

These findings are understandable. Optima assumes that the allocation will remain constant across the years. With the 15-year time window, resources allocated to ART must also be scaled up accordingly, to meet the increased long-term need. Prisoner programmes can be also expected to be more efficient when the long-term impact is taken into account: within the five-year period, many prisoners will remain imprisoned and thus cannot contribute to the epidemic outside prison. An extension of the time window will lead to most prisoners returning to the free population (either PWID, or other males). The shift from needle/syringe programme to general prevention among PWID likely reflects the increased need for testing to identify those living with HIV so they can start ART.

The average annual number of new HIV infections between 2016 and 2029 was 8,162 with current allocation, and 6,846 with the optimal allocation. The optimal allocation could avert on average about 1,300 more new infections every year over the longer time window, corresponding to 16% of all new infections. The optimal allocation would prevent about 1,000 more HIV-related deaths every year (from 7,843 with current allocation to 6,814 with optimal allocation), equivalent to a reduction of about 13%. The average annual additional number of averted new infections over the next five years was about 200, and averted deaths about 700. This shows that the optimization that aims to minimize new infections and deaths over a 15-year time period does not perform all that much better in the short term in averting new infections, but averts more deaths than the optimization that considers only the short-term impacts. The reason is that the long-term optimization allocates more resources for ART, which can avert death efficiently also in the short term, but requires more time to influence incidence.

One limitation of the current Optima HIV model is that the allocation is assumed to stay constant over the optimization period. In practice, the most efficient strategy may be to change the allocation of resources over time. Combining the results of the short- and long-term optimizations shows that an allocation that brings the greatest benefit in the long term is not very efficient in the short term in preventing new infections. This suggests that the best strategy may be to first increase ART only moderately, and continue to invest substantially in prevention programmes targeting key populations: providing condoms and behavioural counselling for FSW and MSM, and needle/syringe provision for PWID. After a few years, the allocation could be changed towards more rapid scale-up of ART, including moving the focus in key population programmes from prevention to testing.

A2.2 Optimization to minimize new HIV infections only, or HIV-related deaths only

The aim in the main analysis was to minimize both new HIV infections and HIV-related deaths over the given period, with equal weight. This means in practice minimizing the sum of new infections and deaths, without prioritizing either one over the other. This takes into account both the health of the current PLHIV, as well as avoiding more people becoming infected, to slow down the spread of the epidemic. Concentrating on only one of these targets would be problematic. The aim to minimize only new infections would easily lead to allocations that might indeed control the

epidemic, but ignore the wellbeing of people already living with HIV. In the extreme case, the allocation could even suggest not to treat people with ART. On the other hand, an optimization to minimize HIV-related deaths only would likely focus on treating as many PLHIV in the advanced stage of infection as possible (prevention interventions do very little to prevent deaths in the short term): together with the relatively short time window, this could lead to an increase in incidence. Therefore, an analysis using only one of these as endpoints is not appropriate. A comparison of these analyses may however provide valuable information on how the allocations should be modified under policies that give more weight on either preventing new infections or preventing the deaths among currently infected people.

However, we conducted two sensitivity analyses – minimizing either only new infections, or only deaths – to probe the expected changes in the optimal allocation if policymakers chose to favour preventing deaths or preventing new infections.

If the aim is only to minimize new HIV infections between 2016 and 2020, the optimization results are very similar to the main analysis (Table A2.2). ART received slightly more money (16% increase compared to current allocation), and correspondingly MSM programmes and needle/syringe provision received less money than in the main analysis.

The results of the analysis aiming to minimize deaths only differed substantially from the main analysis. ART funding was increased by 25%, and funding for HTC for other than key populations increased more than six-fold. FSW programmes and needle/syringe provision were almost completely defunded; MSM and other PWID programmes were moderately defunded and prisoner programmes were funded more. The reason for this is mainly that HIV testing is integrated into the key population programmes. FSW already have a high coverage of testing, unlike MSM, PWID and prisoners.

Optimizing new infections only led to approximately similar reductions in new infections and deaths as the main analysis: the average new infections per year decreased by about 1,000 (11%) from 8,412 to 7,455, and the HIV-related deaths by about 700 (8%) to 7,407. This shows that minimizing new infections will also help to avert HIV-related deaths: this is probably mainly due to the use of ART as prevention. With the sole objective of minimizing deaths, the number of expected deaths every year with optimized allocation was 7,056, which is equivalent to averting about 1,000 more (13%) of HIV-related deaths. However, annual new infections increased by 300 to 8,750 per year. This reflects the contradiction in focusing on deaths only: the related defunding of most prevention activities will cause new infections, which may accelerate the epidemic and lead to potentially more deaths in future, as well as an increased disease burden and increased demand for funding in the long term.

Table A2.2 Current (2014) and optimal allocation of the 2014 HIV budget (US$ 68.9 million) among different programmes

Programme	Current allocation	Minimizing new infections–Optimal allocation: change		Minimizing HIV/AIDS deaths–Optimal allocation: change	
FSW programmes	3 912 000 (5.7%)	2 745 000 (4.0%)	-30%	113 000 (0.2%)	-97%
MSM programmes	2 799 000 (4.1%)	2 052 000 (3.0%)	-27%	1 960 000 (2.8%)	-30%
PWID programmes	2 312 000 (3.4%)	747 000 (1.1%)	-68%	911 000 (1.3%)	-61%
Prisoner programmes	48 000 (0.1%)	250 000 (0.4%)	+425%	137 000 (0.2%)	+188%
Condom promotion and social and behavioural change communication	1 206 000 (1.7%)	4000 (<0.1%)	<-99%	4000 (<0.1%)	<-99%
HIV testing and counselling	537 000 (0.8%)	27 000 (<0.1%)	-95%	3 460 000 (5.0%)	+544%
Needle/syringe programme	4 282 000 (6.2%)	3 768 000 (5.5%)	-12%	57 000 (0.1%)	-99%
Opiate substitution therapy	1 441 000 (2.1%)	1 441 000 (2.1%)	*	1 441 000 (2.1%)	*
Antiretroviral therapy	33 573 000 (48.7%)	39 079 000 (56.7%)	+16%	42 029 000 (61.0%)	+25%
PMTCT	885 000 (1.3%)	885 000 (1.3%)	*	885 000 (1.3%)	*
Indirect programmes	17 902 000 (26.0%)	17 902 000 (26.0%)	**	17 902 000 (26.0%)	**

Source: Authors.
Notes: The optimization minimizes the new infections or HIV-related deaths over the time period 2016–20; *Opiate substitution therapy and PMTCT were constrained not to be defunded; **Indirect-programme costs were assumed to stay constant.

As a consequence, we showed that the optimal allocation that aims to minimize the sum of new infections and deaths also averts as many infections as possible with any allocation. This adds evidence to the choice of equal weighting between the outcomes. Aiming to avert deaths only would lead to an allocation that would not be plausible for ethical reasons nor give the best long-term impact. However, if the Government were to aim to give more weight to averting HIV-related deaths in the near future, these results indicate that more resources should be given to ART and programmes that include testing (in particular MSM and PWID programmes, and also HTC). However, this should be done within the frames of the original optimization, and depending on the available funding: funding must also be secured for FSW programmes and needle/syringe provision, which are essential for preventing onward transmission.

ANNEX 3 Scenario analyses

In addition to the optimization analysis for studying allocative efficiency, the Optima HIV model has the option of conducting scenario analyses, where the epidemiological indicators (new HIV infections, HIV-related deaths) as well as total costs (including programmatic costs, but also other costs for related healthcare and social mitigation) are estimated for a given scenario. In this annex, we present five scenario analyses conducted using Optima: (1) current conditions; (2) defunding key population programmes; (3) achieving NSP III targets for all populations; (4) achieving NSP III targets for key populations; and (5) a "test and treat" strategy.

A3.1 Assumptions

With **current conditions,** we assume that the situation stays on the baseline (2014) level until 2020.

In the scenario where **key population programmes were defunded,** we made the following assumptions:

- Use of condoms in commercial sex between FSW and clients, and in casual sex involving MSM and PWID, will decrease gradually between 2016 and 2020, corresponding to a 50% decrease in funding for the relevant programme (according to the cost–coverage–outcome relations defined for the optimization analysis)
- Sharing of needles will increase gradually between 2016 and 2020, corresponding to a 50% decrease in funding for NS programmes
- Testing among FSW, clients, MSM, PWID and prisoners will drop to half of the current level by 2020

In the scenario where **NSP III targets were reached,** the following assumptions were made:

- Annual proportions of people tested for HIV will increase from the current level to 80% (among FSW, MSM, PWID and prisoners) or 70% (among all other populations) by 2020
- Number of people on ART will increase between 2016 and 2020 to correspond to 72% viral suppression among all PLHIV
- Condom use in commercial sex between FSW and clients, and in casual sex involving MSM and PWID, will increase from the current level to a level corresponding to 90% coverage of the relevant programme by 2020
- Needle sharing will decrease to a level corresponding to a 90% coverage of NS programmes by 2020

In the scenario where **NSP III targets were reached among key populations only,** we made all the above assumptions, except the increase in proportion of testing for HIV among populations other than FSW, clients, MSM, PWID and prisoners.

In the **test and treat** scenario, the following assumptions were made:

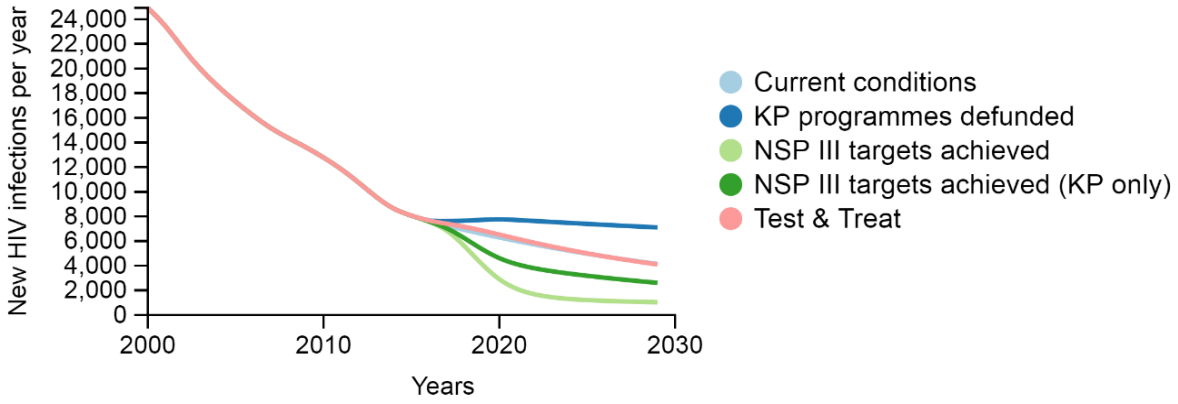
- Proportions of FSW, their clients, MSM, PWID and prisoners testing annually for HIV will double by 2020;
- Number of people on ART will increase to the maximum level (as in the NSP III scenario); the true number of people on ART will however be restricted by the availability of testing.

In all scenarios, we modelled the epidemic between 2016 and 2030, but focused on the results within the NSP III period (2016–2020). We present the number of new infections, number of HIV-related deaths and annual HIV-related costs across this time period.

A3.2 Results and discussion

The number of new infections is expected to continue decreasing under current conditions, from 8,056 in 2015 to 6,286 in 2020 (Fig. A3.1, Table A3.1), and to 4,141 in 2029. Of the new infections in 2020, 2,958 (47%) were among the key populations (FSW, their clients, MSM, PWID, prisoners). A "test and treat" intervention does not influence new infections: the results were very close to the current conditions scenario (which makes the latter difficult to see in Figure A3.1). Defunding the key population programmes would stop the decreasing trend: in this scenario, the number is expected to start to increase in 2016, and reach 7,782 in 2020. From 2020, the number of new infections would decrease minimally again, reaching 7,106 in 2029. If the country can achieve the NSP III targets by 2020, this would cause a massive drop in new infections: to 2,812 infections expected in 2020, and continuing to decrease to 1,034 in 2029. If the NSP III targets were achieved only among key populations, 4,566 infections are expected in 2020 and 2,605 in 2029.

Figure A3.1 Annual number of new HIV infections in Myanmar under the modelled scenarios between 2000 and 2030.

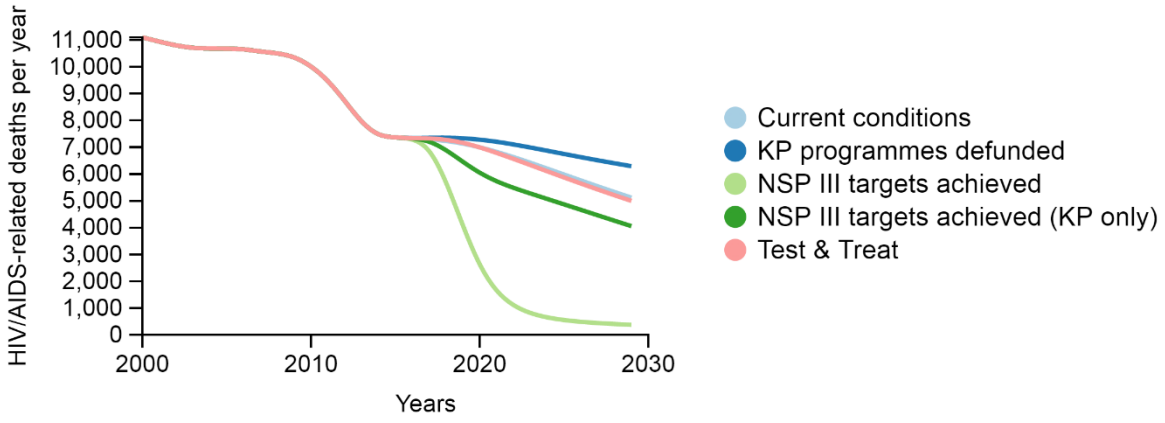


Source: Authors.

In regard to deaths, there were also no major differences between the current conditions and "test and treat". The number of HIV-related deaths was 7,363 in 2015, which decreased to 7,002 by 2020, and 5,117 by 2029 (Figure A3.2, Table A3.1): the number of HIV-related deaths is expected to continue decreasing with the current conditions. Of the 7,002 deaths in 2020, 1,454 (21%) were

among the key populations. Defunding the key population programmes would result in 7,287 deaths in 2020, and 6,292 in 2029. Achieving the NSP III targets would substantially avert deaths: 2540 HIV-related deaths would be expected in 2020, and only 371 in 2029. If the targets were met only among the key populations, the corresponding numbers would be 6,032 and 4,054.

Figure A3.2 Annual number of HIV-related deaths in Myanmar under the modelled scenarios between 2000 and 2030.



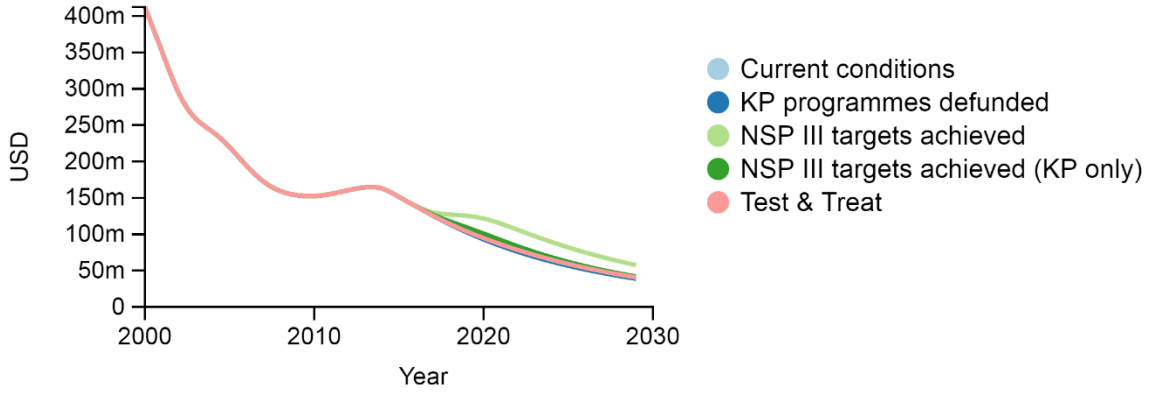
Source: Authors.

According to the scenario analyses, the total cost related to the HIV epidemic in 2015 was US$ 151.2 million. This includes all direct and indirect costs associated with HIV, including all prevention, treatment and other HIV programmes and their management; approximate costs of other care of HIV infected patients according to CD4 cell count; and approximate costs related to social mitigation. Continuing with the current conditions would lead to a decrease in the annual cost, to US$ 94.5 million in 2020 and US$ 39.7 million in 2030 (Fig. A3.3, Table A3.1). Defunding the key population programmes would result in a total cost of US$ 92.6 million in 2020 and US$ 38.7 million in 2029. If the NSP III targets were achieved by 2020, the annual cost in 2020 would be US$ 122.1 million, and in 2030, US$ 57.5 million. Achieving these targets among key populations only would result in costs of US$ 100.9 and 41.7 million, and "test and treat" in costs of US$ 94.5 and 40.6 million in 2020 and 2029 respectively. In other words, achieving the NSP III targets in the entire population would be expected to cost about US$ 53 million more than continuing with the current conditions (Table A3.1).

The scenario analyses demonstrate that achieving the NSP III targets would lead to massive reductions in new infections and HIV-related deaths. It would cost society over US$ 50 million more over the next five years, which may not be completely unrealistic to realize. Nevertheless, it might be a challenge to achieve the high coverage of testing in particular. In a concentrated epidemic such as that in Myanmar, the epidemic can be controlled by interventions that mainly focus on the key populations at higher risk. However, about half of all new infections and almost 80% of HIV-related deaths still happen among the "other" populations. If the individuals at higher risk among the "other" populations can be identified (such as the regular and casual partners of people belonging to the key populations), it may be plausible to achieve a high enough testing

coverage also among these groups. However, if this cannot be done, it is unlikely that the NSP targets could be achieved for the entire population: in practice, an intervention aiming to test large numbers of people randomly selected from the general population would not be plausible in the context of Myanmar. Achieving the NSP III targets among the key populations only (i.e. ignoring the aim that 90% of patients outside the key populations are aware of their status) would be more realistic, but would not lead to the same level of benefit.

Figure A3.3 Annual HIV-related costs in Myanmar under the modelled scenarios between 2000 and 2030



Source: Authors.

The "test and treat" scenario in the model showed almost identical results with the current conditions. This is likely due to the way we defined it. The usual way to define "test and treat" is a policy where (i) efforts are made to identify individuals living with HIV as soon as possible; and (ii) all PLHIV are eligible for ART and enrolled in care immediately after diagnosis. Our interpretation for the first condition was to double the rates of testing among key populations: for the above-mentioned reasons, a testing campaign targeting the low-risk population would not be realistic. To make a difference in the epidemic, "test and treat" should therefore aim not only to scale up testing, but to start by reaching universal coverage at least among the key populations, and also try to identify the groups at higher risk that currently are counted within the low-risk other populations.

Table A3.1 Results of the five conducted scenario analyses in years 2020 and 2029

Scenario:	Current conditions	KP programmes defunded	NSP III targets achieved	NSP III targets achieved (KP only)	Test & Treat
In 2020					
New infections	6 286	7 782	2 812	4 566	6 525
HIV deaths	7 002	7 287	2 540	6 032	7 000
Annual costs, US$	94 493 000	92 630 000	122 137 000	100 936 000	94 497 000
Cumulative costs, US$ (2016-2020)	599 983 000	595 030 000	652 667 000	612 262 000	598 189 000
In 2029					
New infections	4 141	7 106	1 034	2 605	4 099
HIV deaths	5 117	6 292	371	4 054	4 996
Annual costs, US$	39 704 000	38 732 000	57 469 000	41 748 000	40 559 000
Cumulative costs, US$ (2016-2029)	1 161 515 000	1 142 508 000	1 431 456 000	1 210 743 000	1 166 367 000

Source: Authors.