THE REPUBLIC OF TAJIKISTAN

Modelling an Optimised Investment Approach for Tajikistan

Sustainable Financing of National HIV Responses

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Abbreviations

AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral therapy
BCC	Behaviour change communication
CIS	Commonwealth of Independent States
DALY	Disability adjusted life year
GF	Global Fund to Fight AIDS, Tuberculosis and Malaria
GDP	Gross domestic product
HIV	Human immunodeficiency virus
HR	Human resources
HTC	HIV testing and counselling
LM	Labour migrants
LRF	Low risk females
LRM	Low risk males
MDG	Millennium Development Goal
MSM	Men who have sex with men
MTCT	Mother-to-child transmission
NASA	National AIDS spending assessment
NFM	New funding model (of the GF)
NSP	Needle and syringes programme
OI	Opportunistic infection
OST	Opioid substitution therapy
OVC	Orphans and vulnerable children
PI	Prison inmates
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission
PWID	People who inject drugs
QA/QI	Quality assurance/quality improvement
RAC	Republican AIDS Centre
SDG	Sustainable Development Goal
STI	Sexually transmitted infection
SW	Sex workers
VAP	Vulnerable and accessible populations
WTO	World Trade Organisation

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David Wilson and Cliff Kerr developed and ran the mathematical model, and wrote the main body of the technical model descriptions in the Annex of the document.

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Foreword

In order to demonstrate its highest political commitment to the fight against HIV and AIDS and to militate against the harmful socioeconomic impact that communities have been subjected to, the National Program to Fight HIV/AIDS in Tajikistan has requested the donor communities to provide technical assistance for the modeling of an optimized investment approach for Tajikistan in the context of sustainable financing of national HIV responses.

As the world economic landscape changes, so too does the HIV funding landscape. Donor funding has stagnated, and the limited resources available require more emphasis on value for money: funds spent for the greatest impact and in the most efficient way. At the same time, Tajikistan has made some progress on increasing the domestic funding led by H.E the President of Tajikistan who endorsed the establishment of the "National HIV/AIDS Fund" in September 2014.

With joint and concerted efforts of all country partners and stakeholders, the National Program to Fight HIV/AIDS has succeeded to contain the epidemic at a concentrated stage and to reduce the prevalence among key affected populations. More people living with HIV are on treatment and care than ever before, more people know their status and there are indications that the HIV incidence is starting to decline. However, due to scarcity of domestic and donor funding the National Program has to weigh all existing and potential resources in order to continue fighting with this deadly disease and eliminates it ultimately.

Considering the upcoming application to the Global Fund to Fight AIDS, Tuberculosis and Malaria, this document provides the requisite framework for choosing a well-balanced allocation for funding in the quest to optimize impact and serves with its findings and recommendations as a key document to achieve goals and targets of the newly developed National HIV Strategic Plan for 2015-2017.

I wish on behalf of the Ministry of Health and Social Protection of the Republic of Tajikistan to pledge the Government's determination to end the epidemic threat of AIDS. I am convinced that it is achievable if we all get resolved and fight the suffering that this disease continue to inflict on our people and communities in national and international solidarity.

Mr. Nusratullo Salimzoda
Minister, Ministry of Health and Social Protection of the Republic of Tajikistan

Executive summary

- There is one year left to account for final achievements against the MDG6 targets: to halt and begin to reverse the spread of HIV, and to provide universal access to ART to all those in need; there is one year to go until UN member states will agree on the post-2015 agenda and the new SDGs which will most likely re-enforce the UNAIDS Getting-to-Zero Strategy[1] and call for ending the HIV/AIDS epidemic by 2030.
- While considerable progress has been made, Tajikistan is still struggling to reverse the spread of HIV, key populations at higher risk for HIV exposure still face discrimination and criminalization, and ART coverage is well below the MDG6 target.
- As a low-income country with the lowest GDP per capita in the region, Tajikistan's national HIV response is highly dependent on external funding, mainly provided through the Global Fund to Fight AIDS, TB and Malaria (GF). Demands are increasing for higher domestic funding as pre-condition for external support, and while there is a renewed commitment to scale up the HIV response under the new National HIV/AIDS Response Strategy 2015-2017 of the Republic of Tajikistan[2] external funding is rather stagnating at current levels.
- This document aims to contribute to the development of sustainable financing strategies for the national HIV response in the short-, mid-, and long-term perspective by modelling the impact of alternative investment approaches. As part of the short-term contribution, the document provides a rational for improved allocative efficiency that can be used for the GF concept note currently prepared by Tajikistan under the GF New Funding Model (NFM).
- For the modelling, the following key questions of primary relevance for investment decisions related to the national HIV response were identified and addressed through modelling three investment scenarios using 2013 as the reference year:
  - What is the HIV epidemic in Tajikistan likely to look like if the response continues unchanged? And what will be the return on investment by 2020?

Scenario 1: Continue with the current investment allocations and current budget ceiling

  - Can be more achieved with the same amount of resources, and how? What would then be the return on investment by 2020?

Scenario 2: Continue with optimised investment allocations and current budget ceiling

  - Using optimized efficiencies, what would need to be done and how much would it cost to achieve universal coverage of the key prevention and treatment services? What would then be the return on investment by 2020?

Scenario 3: Continue by scaling up to universal coverage of essential HIV prevention and treatment services

  - For all three scenarios, what would be the long-term impact by 2030?

1 Joint United Nations Programme on HIV/AIDS. Getting to Zero: 2011–2015 strategy. Geneva: Joint United Nations Programme on HIV/AIDS; 2010.

2 Republic of Tajikistan. National strategy against the HIV/AIDS epidemic in the Republic of Tajikistan (2015-2017). Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan; 2014.

The model results suggest:

- Maintaining the current investment allocations and budget level should be the absolute minimum target in order not to fall back behind the moderate impact the national HIV response has achieved so far.
- Technical and allocative efficiencies can be improved and recommendations are provided. However, the current budget ceiling is too low to achieve universal coverage of essential HIV services. Due to the resulting service rationalization, only improving efficiencies without addressing the overall budget constraints (scenario 2) will not be sufficient in Tajikistan for 'Getting-to-Zero', achieving MDG6 targets, ending the HIV/AIDS epidemic by 2030 and fulfilling the basic rights for access to essential HIV services for those in need.
- To achieve these goals and targets, and particularly to fulfil the basic right for access to essential HIV services (scenario 3) the overall investment until 2020 would need to be increased by some 25%.
- As return on this investment, around 29,000 new HIV infections would be averted between 2014 and 2030 under scenario 3 using the 'test and treat'[3] approach (around 27,000 using the WHO 2013 ART guideline[4], 26,500 using current national ART guideline). Scenario 2 and 1 avert significantly lower numbers of HIV infections, approximately 20,000 and 16,000, respectively.
- In addition, around 323,000 DALYs would be averted between 2014 and 2030 under scenario 3 using the 'test and treat' approach (314,000 using the WHO 2013 ART guideline, 302,000 using current national ART guideline). Scenario 2 and 1 avert significantly less DALYs, approximately 119,000 and 78,000.
- Detailed information about the mathematical model used is provided in the Annex.

3 Dodd PJ, Garnett GP, Hallett TB. Examining the promise of HIV elimination by 'test and treat' in hyperendemic settings. AIDS. 2010;24(5):729-35.

4 World Health Organisation. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach. Geneva: World Health Organisation; 2013.

The key message of this report:

With a moderate increase of the investment volume until 2020 combined with an optimized investment allocation the national HIV response in Tajikistan can be brought on a trajectory which fulfils the basic rights to access to essential HIV services for those in need and makes ending the epidemic threat of HIV/AIDS in Tajikistan a realistic goal if an environment without stigma and discrimination is provided so that services available will be accepted and used by the affected communities.

1. Why is this document needed?

The HIV response is heavily dependent on international sources

- The Republic of Tajikistan is the only remaining low-income country of the CIS; however, it has seen a GDP per capita growth from $ 139 in 2000 to $ 1,305 in 2013[5,6].
- The Government provides some funding for the HIV/AIDS National Programme from the national budget but expenditures from public funds were mainly spent on recurrent costs, namely human resources and costs of public health care facilities and organisations. Public funds constituted around 24% of the total HIV/AIDS expenditure in Tajikistan in 2013[7].
- Main funding for the national HIV response comes from international sources, particularly the Global Fund to Fight AIDS, Tuberculosis and Malaria (GF).

The current HIV response is insufficient to meet all commitments

- Public sector health care personnel is insufficiently trained and retained in Tajikistan; this is one of the major constraints in scaling up HIV/AIDS care and treatment.
- Insufficient integration of HIV services into primary health care makes a decentralized response and scale-up difficult.
- Considerable benefits could be achieved from scaling up OST for people who inject drugs (PWID), as this group has the highest HIV prevalence in Tajikistan. Failure to control the epidemic among PWID will lead to onward infections in other groups, eventually including low-risk males and females. With this in mind, it is essential that OST moves beyond its pilot phase to being a fully integrated intervention.
- According to a combination of empirical data and model-based estimates, HIV prevalence and incidence in Tajikistan are stabilising or slightly declining.
- The marked labour migration from Tajikistan is largely caused by difficult economic conditions in Tajikistan. Migration to and from areas of higher HIV prevalence increases the risk of HIV infection and makes specific interventions more difficult.
- Overall, the national HIV response faces challenges to fulfil the target of universal coverage of essential HIV prevention and treatment services, and to halt or even substantially reduce the HIV epidemic in Tajikistan.

International aid is unlikely to increase

- The recent global economic crisis has diminished the prospects of growing or even stable international funding for national HIV responses in the region.
- Countries are coming under increased pressure to reduce dependencies on external funding and to transition to domestic financing mechanisms.

5 All financial values in this report, including tables and figures, are expressed in United States dollars.

6 The World Bank. World Development Indicators.

7 Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2012-2013. Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan, Ministry of Health of the Republic of Tajikistan; 2014.

Objectives

- To provide model estimates of future epidemic trajectories in the context of the development of an HIV/AIDS investment case and sustainable financing strategies of the national response for Tajikistan under three scenarios:
  - Scenario 1: Continue with the current investment allocations and current budget ceiling;
  - Scenario 2: Continue with optimised investment allocations and current budget ceiling;
  - Scenario 3: Continue by scaling up to universal coverage of essential HIV prevention and treatment services.

  2013 was used as the reference year.
- To estimate and compare the programme costs and the impact ('return on investment' expressed in new HIV infections averted and DALYs averted) of the three scenarios above in the mid-term (2020) and long-term (2030) perspective under consideration of short-term objectives such as the development of GF concept note under the NFM, and long-term objectives such as the UNAIDS 'Getting to Zero' goals[8], 'Together we will end AIDS' campaign[9] and the proposed target of ending the AIDS epidemic by 2030 under the SDGs[10 11].

8 Joint United Nations Programme on HIV/AIDS. Getting to Zero: 2011–2015 strategy. Geneva: Joint United Nations Programme on HIV/AIDS; 2010.

9 Joint United Nations Programme on HIV/AIDS. Together we will end AIDS campaign.

10 Open Working Group of the General Assembly on Sustainable Development Goals. Introduction and proposed goals and targets on sustainable development for the post 2015 agenda. New York: Opening Working Group; 2014.

11 Joint United Nations Programme on HIV/AIDS. Fast-Track: ending the AIDS epidemic by 2030. Geneva: Joint United Nations Programme on HIV/AIDS; 2014.

2. How much is spent? Where does the money come from?

The national HIV response has been dependent on international aid

- National AIDS Spending Assessments (NASAs) were used to assess HIV/AIDS expenditure in Tajikistan[12,13,14].
- Over the past several years funding for HIV/AIDS in Tajikistan has seen patterns of increase and decrease, with around $ 6.2 million available in 2008, $ 15.4 million in 2011, $ 12.7 million in 2012 and $ 14.1 million in 2013 (figure 1).
- HIV/AIDS funding from the international community has more than doubled since 2008.
- Domestic investments in HIV/AIDS are low compared to what is needed and compared to the international investment.

The national HIV response depends largely on external funding, but Government expenditure is slowly increasing

- GF has been the major donor. For the 2014-2016 period, the GF has recently allocated $ 24.7 million for HIV grants in Tajikistan[15]; the annual average of $ 8.2 million is still lower than the GF investment at its peak in 2010 ($ 9.3 million), but higher than in the previous three years.

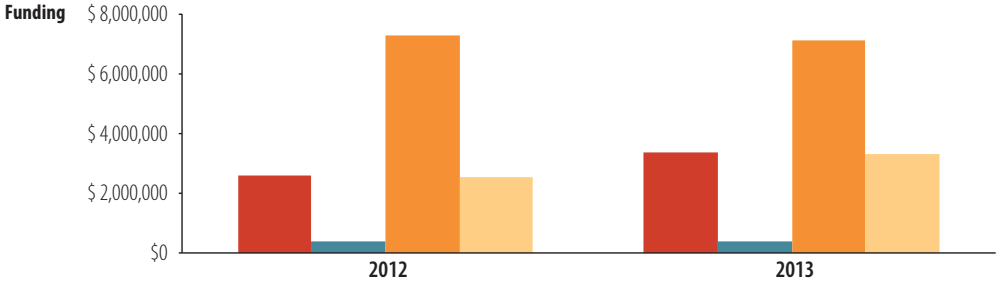
12 Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2008-2009. Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan, Ministry of Health of the Republic of Tajikistan; 2010.

13 Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2010-2011. Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan, Ministry of Health of the Republic of Tajikistan; 2012.

14 Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2012-2013. Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan, Ministry of Health of the Republic of Tajikistan; 2014.

15 Global Fund to Fight AIDS, Tuberculosis and Malaria. Global Fund Country Allocations: 2014-2016. Geneva: Global Fund to Fight AIDS, Tuberculosis and Malaria; 2014.

Figure 1: HIV funding in Tajikistan in 2012 and 2013 by source*



	2012	2013
Government	2,569,872	3,363,877
Out of pocket	342,288	349,699
Global Fund	7,275,123	7,094,846
Other international	2,528,641	3,269,471
TOTAL	**$ 12,715,924**	**$ 14,077,893**

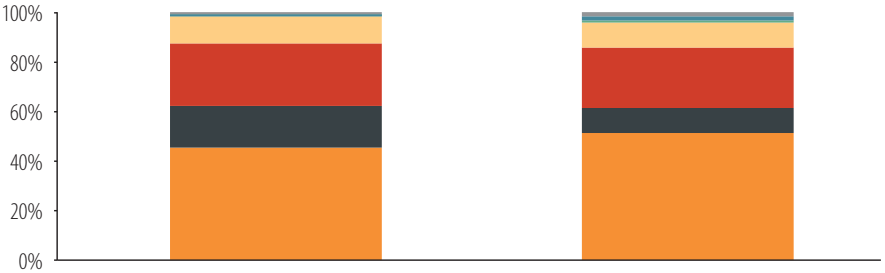
* Source: Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2012-2013. Dushanbe: 2014, and UNDP Tajikistan.

Breakdown of funding by programme components

- Prevention has been the largest funding category, comprising approximately 50% of HIV/AIDS spending in 2012-2013 (figures 2 and 3b).
- 32% of prevention funding was allocated to specific interventions for the three populations at highest risk – PWID, SW, MSM (combined as 'key populations'[16] in figures 3b and 4) – with a 71% increase in 2013.
- Direct programme funding was relatively low for care and treatment, including ART, and decreased by 34% in 2013 (figures 2, 3a, 3c and 4).
- The costs for programme management and human resources were approximately 24.6% and 10.4%, respectively, in 2013; combined, this reflects a 7% increase in 2013 compared to the previous year (figures 2 and 3d).

About 50% of 2012-2013 HIV/AIDS spending went into prevention

Figure 2: HIV/AIDS funding in Tajikistan 2012 and 2013 by programme component*



	2012	2013
HIV-related research	71,541	204,422
Enabling environment	86,888	223,574
Social protection	28,632	111,434
Human resources	1,376,444	1,470,904
Programme management	3,229,888	3,458,515
Care and treatment	2,170,198	1,422,283
Prevention	5,752,333	7,186,761
TOTAL	**$12,715,924**	**$14,077,893**

* NASA classification was used. Please see table A2 in Annex for the details about programme components. $ 2,000 allocated for orphans has been added to the social care component.

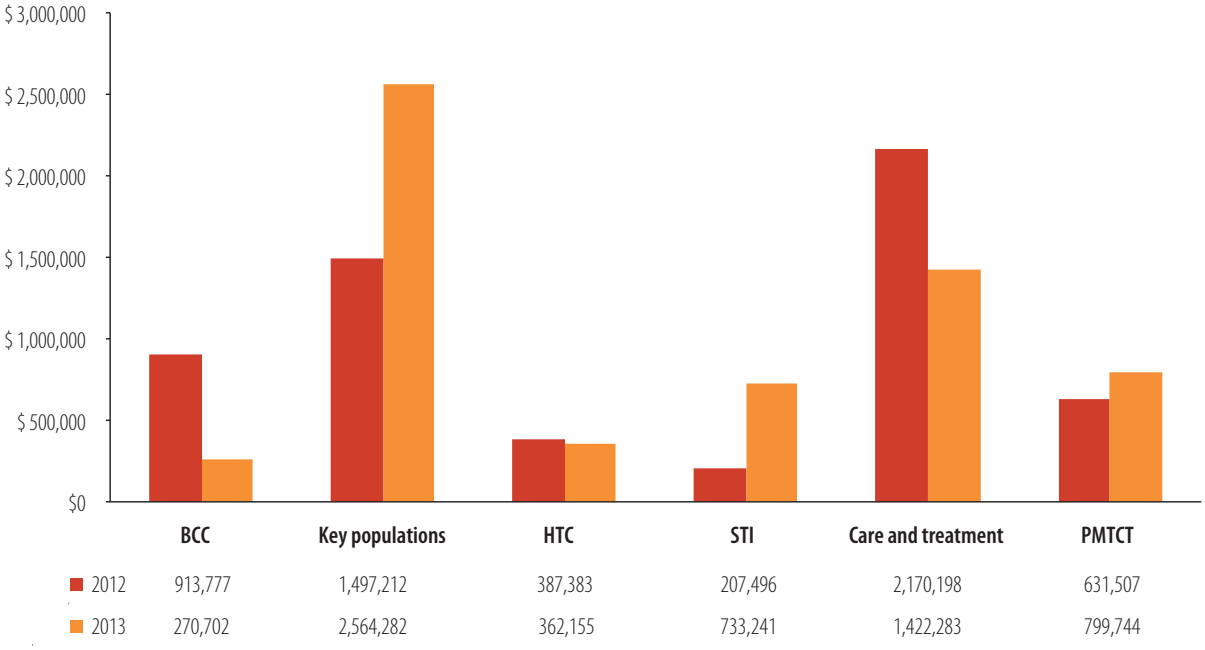
16 The Tajikistan NASA does not provide a further disaggregation of key populations.

Figure 3, a-d: Detailed HIV/AIDS funding allocation in Tajikistan, 2012-2013*, **

* Source: Republic of Tajikistan. Tajikistan National AIDS Spending Assessment: 2012-2013. Dushanbe, 2014.

** 'Key populations' include PWID, MSM and SW. 'VAP' include specific vulnerable groups such as indigenous groups, recruits, truck drivers, prisoners, and migrants.

Figure 4: HIV/AIDS investments in Tajikistan in 2012-2013 by target population and intervention type*



	BCC	Key populations	HTC	STI	Care and treatment	PMTCT
2012	913,777	1,497,212	387,383	207,496	2,170,198	631,507
2013	270,702	2,564,282	362,155	733,241	1,422,283	799,744

* Allocations to key populations in figure 4 are only referring to interventions specific for the respective key population at higher risk for HIV exposure (e.g. specific funding for key populations does not include their treatment or testing costs; on the other hand care and treatment includes care and ART for key populations).

3. What are the results of current investments?

Investments have averted infections

- Modelling of the HIV epidemic in Tajikistan confirms that if the prevention and treatment programmes had not been implemented current HIV prevalence and incidence would have been far greater, especially among PWID.

HIV prevalence seems to stabilise or declining in some populations

- Current HIV prevention policies appear to be keeping HIV prevalence in decline among PWID and stable in most other populations.
- The prevalence of HIV among PWID in 2011 (the most recent year data were available) was 13.5% (23.5% in 2006, 16.3% in 2010); among SW, HIV prevalence was 3.7% in 2011 (3.7% in 2006, 4.4% in 2010). HIV prevalence among MSM in 2011 was 1.5%, but the situation in this population remains unclear. HIV prevalence in prison inmates was 8.4% in 2013 (compared to 8.4% in 2006, 8.5% in 2010).

HIV prevalence is declining among PWID

Late diagnosis is common

- Surveillance data indicate that testing rates have increased in recent years, especially among key populations at higher risk.
- However, the majority (65%) of the estimated number of PLHIV remains unaware of their infection and ability to transmit the virus to others.

The majority (65%) of the estimated number of PLHIV remains unaware of their infection

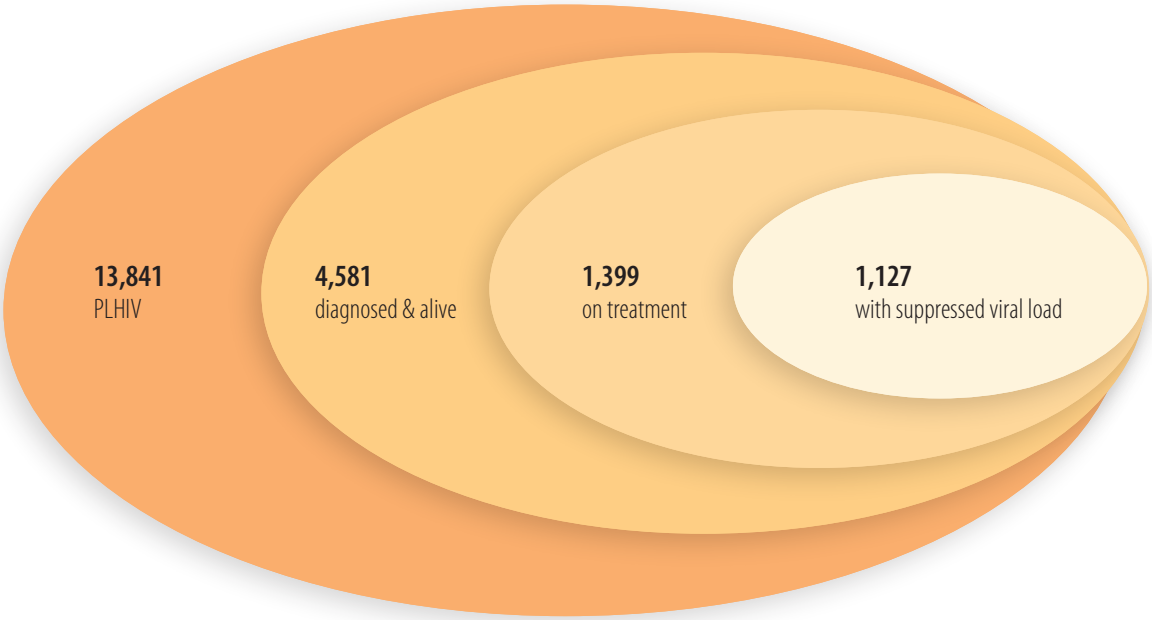
- Late diagnosis also means late initiation of ART, which results in poorer clinical outcomes and a lower impact through treatment as prevention.

Treatment coverage: depending on the way of calculation – but too low

- According to RAC, the estimated number of PLHIV was 13,841 in 2013 of whom 4,581 (33%) had been diagnosed and registered; 1,399 PLHIV (31% of those diagnosed) were on ART at the end of 2013 including an estimated 1,127 with suppressed viral load (figure 5).
- Also in 2013, out of 4,581 PLHIV officially registered, 2,516 PLHIV were eligible for ART under current national guidelines according to RAC. Based on the RAC estimated total number of PLHIV (13,841), the model estimates that 5,200 PLHIV were eligible for ART under the current national guidelines[17]. Estimates for ART coverage, therefore, range from 27% (1,399/5,200) to 56% (1,399/2,516) based on the current national ART guideline, and from 10% (1,399/13,841) to 31% (1,399/4,581) based on the estimated and registered PLHIV, respectively. While treatment greatly improves the quality of life of those who receive it, many PLHIV in need of ART are still not receiving it. Further, the fraction of people on treatment is likely to be too small to have a significant preventive effect on HIV transmission at the population level.

17 The national ART guideline that was used in 2013 was written in 2008 and approved by the Ministry of Health and Social Protection in 2010.

Figure 5: Treatment cascade for Tajikistan in 2013*



* Sources: Estimated number of PLHIV, number of PLHIV diagnosed and alive and number of PLHIV on ART – RAC; number of PLHIV on ART with suppressed viral load – own estimation.

10% of the estimated number of PLHIV was on ART at the end of 2013

Treatment needs continue to rise

- Reported AIDS-related mortality among PLHIV declined slightly in 2013 (63 reported deaths compared to 113 in 2012)[18]. As in other countries, these figures reflect a considerable underreporting[19] due to general challenges of reporting cause-specific mortality, and due to HIV/AIDS specific reporting challenges such as loss to follow-up of diagnosed PLHIV and the high number of undiagnosed PLHIV.
- The number of PLHIV requiring ART outweighs current supply. Demand for treatment, including second-line regimens, is expected to increase further in the near future.
- In 2013, WHO released a new integrated and consolidated ART guideline[20]. The recommendations are based on evidence that treating PLHIV earlier can both keep them healthy and lower the amount of virus in the blood, which reduces the risk of onward transmission. According to the new WHO guideline ART should be initiated in adults living with HIV when their CD4 cell count falls to 500 cells/mm^3 or less regardless of clinical status. This will increase the number of PLHIV eligible for ART considerably compared to the previous WHO guideline and the current national guideline in Tajikistan, which recommends ART initiation at a CD4 of 350 cells/mm^3 or less.

18 Republic of Tajikistan. Country report on progress in fighting HIV epidemic in 2014. Dushanbe:2014.

19 Smith CJ, Ryom L, Weber R, Morlat P, Pradier C, Reiss P, et al. Trends in underlying causes of death in people with HIV from 1999 to 2011: a multicohort collaboration. The Lancet. 2014; 384(9939):241-8.

20 World Health Organisation. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach. Geneva: World Health Organisation; 2013.

4. Scenario 1: Maintaining the current investment allocations and budget level, what will the HIV epidemic look like by 2020?

This chapter summarises key model outputs for the following questions: What is the HIV epidemic in Tajikistan likely to look like if the response continues unchanged? And what will be the return on investment by 2020, expressed in new HIV infections and DALYs averted?

Scenario 1: 'Maintaining the 2013 investment allocations and budget level'

HIV incidence is expected to decrease slowly

- The first HIV case in Tajikistan was recorded in 1991. However, before the early-to-mid 2000s, there was little known about HIV in Tajikistan. By the end of 2006 there had been a cumulative of 707 people diagnosed with HIV and officially registered which then increased to 5,550 (of which 4,581 were still alive) at the end of 2013.
- For the future projection, the model-estimated annual HIV incidence shows a moderate decline from approximately 1,450 in 2013 to around 1,150 in 2,020.
- The projected declining incidence is mainly driven by key populations at higher risk of HIV exposure; in SW incidence is projected to decline by 28%, in PWID by 27%, in prison inmates by 27%, in MSM by 20%, and in labour migrants by 20%. The model also projects spill over effects for lower risk adult females and males with incidences declining by 13% and 6%, respectively.

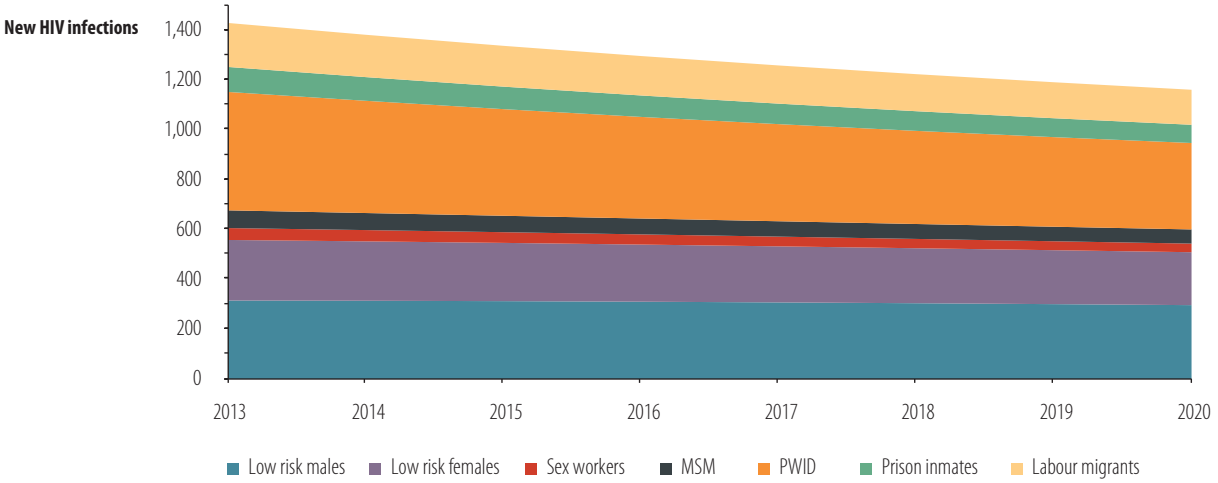
HIV transmission mode with little changes

- In 2013, 57.5% of newly diagnosed HIV infections were transmitted sexually, 27.3% through injecting drug use and 5.4% from mother to child[21]. Sexual transmission and injecting drug use have long contributed to HIV transmissions in Tajikistan. HIV will continue to be transmitted among PWID in Tajikistan but the trend towards a larger share of sexual transmissions will progress (figure 6).

57.5% of newly diagnosed infections in 2013 were transmitted sexually

21 For 9.8% of newly diagnosed HIV infection in 2013 mode of transmission was unknown.

Figure 6: Model-estimated trend in HIV incidence under Scenario 1 ('maintaining the 2013 investment allocations and budget level')*



* Please see Annexes 1 and 2 for the assumptions underlying the model.

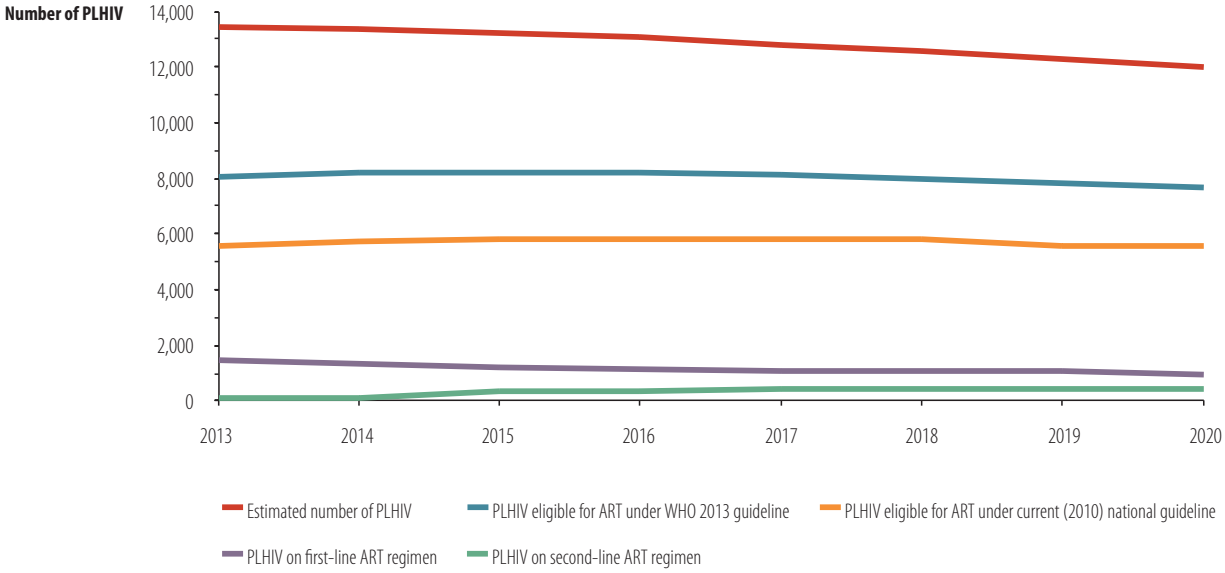
Number of PLHIV eligible for ART is expected to increase with guideline update

- Current coverage of ART is low even when the eligibility is based on the current national guideline (see section 3).
- Proceeding with the existing investment allocations at the current budget level, the estimated number of PLHIV is projected to slightly decrease from approximately 13,000 in 2013 to 12,000 in 2020 (figure 7).
- The number of PLHIV eligible for ART based on the current national ART guideline is expected to slightly increase to 5,600, but will increase to 8,200 in 2015 and only moderately decrease to 7,700 in 2020 if the WHO 2013 guideline are adopted in 2015.

Under scenario 1, 5,600 PLHIV will be eligible for ART by 2020 and 7,700 if the WHO 2013 guideline is adopted

- Approximately 950 PLHIV will be on first-line ART regimen and the number of PLHIV on second-line ART regimen will increase to about 400 in 2020.
- If testing rates are not increased, only 3,300 out of the estimated 12,000 PLHIV will know their HIV status.
- Since the total number of PLHIV on ART would slightly decrease because of budget constraints and the increasing number of second line ART, and since the model predicts the number of PLHIV to only slightly decrease, ART coverage in 2020 would remain low between 11% and 41%: 11% of the estimated number of PLHIV (1,350/12,000), 18% of PLHIV eligible for ART according to WHO 2013 guidelines (1,350/7,700), 24% of PLHIV eligible for ART according to the current national guidelines (1,350/5,600), 41% of PLHIV registered (1,350/3,300). Following the current national guidelines (the WHO 2013 guideline) around 4,250 (6,350) of the PLHIV would be eligible but without ART; 1,950 of them would know their status and be on a waiting list for ART.

Figure 7: Estimated numbers of PLHIV, of PLHIV eligible for ART and of PLHIV on ART (Scenario 1 – 'maintaining the 2013 investment allocations and budget level')



Return on investment – Scenario 1: 'Maintaining the 2013 investment allocations and budget level'

- Compared to the counterfactual scenario of no HIV/AIDS programmes at all, 'maintaining current investment allocations and budget ceiling' would avert around 3,100 new HIV infections and 5,000 DALYs by the end of 2020 at a total programme cost of $ 98.5 million (not accounting for inflation).

5. Scenario 2: What can be improved by optimising efficiencies under the current budget envelope?

This chapter summarises key model outputs for the following questions: Can more be achieved with the same amount of resources, how can this be achieved and what would be the return on investment by 2020?

Scenario 2 – 'optimising the investment allocations at the 2013 budget level'

More value for money through technical efficiency

- With the need to achieve more, it is important to consider how unit costs can be reduced. If unit costs are reduced, more can be done with the same resources.
- Overall management and administration costs appear to be high compared with direct programme costs and other countries in the region.
- It is understood that a substantial part of the HR costs are used for salary top-ups for service providers using external funding sources. It is not clear how this will be sustained in the future.

Programme management and human resources costs are higher than in other countries of the region

- Room for additional technical efficiency may exist when considering the most efficient models of service delivery and removing existing structural barriers that limit the effectiveness and efficiency of current service delivery.
- On the other hand, the recent WTO accession is expected to result in higher procurement costs for some ARVs still under patent. In addition, some savings will be needed to invest in improved QA/QI processes of programme implementation, among them adequate management of healthcare waste generated by programme interventions[22].

More value for money through allocative efficiency

Background for allocative efficiency

- The resource allocation in Tajikistan must take into account the disease burden, the distribution among sub-populations and the potential for impact. There is an important opportunity to further improve the resource allocation to programme components and sub-populations in such a way that the greatest impact can be achieved.
- Allocative efficiency can be considered the allocation of resources in the best combination across various programme components that leads to optimal outcomes and impact **within a defined budget envelope**. As such, modelling allocative efficiency is not sufficient to determine the overall budget envelope needed to achieve defined targets, In addition, allocative efficiency is assessed here

22 Kühling JG. Rapid assessment: Healthcare waste component of Global Fund HIV, TB and Malaria projects in Tajikistan. Istanbul: United Nations Development Programme Istanbul Regional Centre for Europe and Central Asia; 2014.

from the perspective of an individual disease programme, and not across the health sector or beyond.

Allocative efficiency is considered here as an optimal allocation mix within a defined budget envelope

Methods for allocative efficiency

- A formal mathematical optimisation procedure surrounded an epidemiological transmission model to calculate the allocation of resources across HIV programme components which is likely to result in the least number of new HIV infections and DALYs over the 2014-2020 period; it uses the 2013 investment allocations as a starting point and keeps the budget constant on 2013 amounts (see table A2 in Annex for more details). The model was informed by available epidemiological, behavioural and clinical data, as well as likely programme outputs and other outcomes associated with possible funding combinations over all programmes.
- For the model, two alternative options were considered:

Option A: Improving allocative efficiency for the prevention and the care and treatment programme components, comprising about 60% of the total budget in 2013; the programme management and HR components were left constant.

Option B: Improving allocative efficiency for the prevention and the care and treatment programme components, but reducing allocations for programme management and HR by 20% (which equals approximately $ 1 million) and using the savings to further improve the allocative efficiency for the prevention and the care and treatment components.

- For both options, prevention of HIV transmission aimed for PLHIV, blood safety, and 'other prevention' (prevention of the HIV transmission at the workplace, post-exposure prophylaxis), provider initiated HIV testing, and 'other' programme components (orphans and vulnerable children, social protection, enabling environment, and HIV-related research) were kept constant
- For option B, savings in programme management / HR were partially used to continue services which are essential components of the national HIV programme but were set to zero or substantially reduced under option A due to their assumed lower effectiveness in the overall context of service rationalization.
- The most cost-effective interventions are those that have proven effectiveness in reducing risk behaviours and/or biological transmissibility, or improving survival and health, and are targeted to groups of people at greatest risk of acquiring or transmitting HIV. The optimisation procedure automatically factors these considerations into the calculation of ideal allocations taking into account costs and the level of effectiveness to meet a given objective.
- There will be different optimal allocations for different objectives. For example, objectives could include: minimising the number of new infections with current resources; minimising the number of deaths with current resources; or minimising the amount of money required to achieve a certain percentage decline in new infections or to meet the targets of the national strategic plan, such as providing universal coverage for prevention and treatment services.
- Here, the objective reflected the UNAIDS 'Getting to Zero'[23] vision by minimising both DALYs (accounting for disease progression and death) and new HIV infections by 2020 **with current** (2013) **resources**. Each additional infection was considered equivalent to 20 DALYs, a value which takes into account both DALYs outside the window of the intervention period as well as the effect of subsequent infections. While the model is optimised for the period until 2030, the outputs

23 The UNAIDS 'Getting to zero' strategy for 2011-2015 has three components: to get to zero new infections, zero AIDS-related deaths and zero discrimination.

are discussed in this chapter for the short- and mid-term period until 2020 to focus on the current programming needs under the GF new funding model in Tajikistan.

Allocative efficiency is considered here as an optimal allocation mix to reach the objectives of minimizing new HIV infections and DALYs

- The model takes into account the dual impact of ART: 'treatment as prevention'[24]. It could be assumed that treatment reduces transmission risk by as much as 96% based on the HPTN-052 clinical trial setting[25], but this may be an overestimation. In an observational cohort study of serodiscordant couples in China it was shown that HIV transmission was reduced by only 26% due to ART[26]. Based on a large review of literature we conducted across many settings, adherence to ART was estimated as 75% for the model; at 92-96% efficacy for full adherence, this weights to approximately 70% efficacy of ART in reducing infectiousness when accounting for observed adherence patterns. Therefore, we assumed that ART reduces transmission by 70%[27].

The model assumes that ART reduces the probability of HIV transmission by 70%

Modelling results for allocative efficiency

- Current resource allocations strike a compromise between an optimal HIV incidence-reduction strategy and an optimal DALY-reduction strategy.
- It was identified that overall the current (2013) budget envelope is insufficient to scale up all essential and effective standard interventions to universal coverage. Therefore, the results for an optimised allocative efficiency under the current budget ceiling (i.e. for the currently underfunded programme) must be interpreted with caution in the context of service rationalisation. This is especially true when considering competing effectiveness of essential key interventions aimed at reducing infections, disease burden and death.

The current budget is insufficient to scale up essential HIV interventions to universal coverage, even under optimized efficiencies

- With these constraints in mind, the model suggests an optimised resource allocation under the 2013 budget constraints by shifting resources from BCC, community mobilisation, prevention for 'vulnerable and accessible' populations and youth towards key populations at higher risk for HIV infection, and for option A from HTC towards treatment given the low treatment rates which mean, under the model assumptions, relative limited benefits from diagnosing additional people (figure 8, table 1).

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24 World Health Organisation. Antiretroviral treatment as prevention (TASP) of HIV and TB. Geneva: World Health Organisation; 2012.

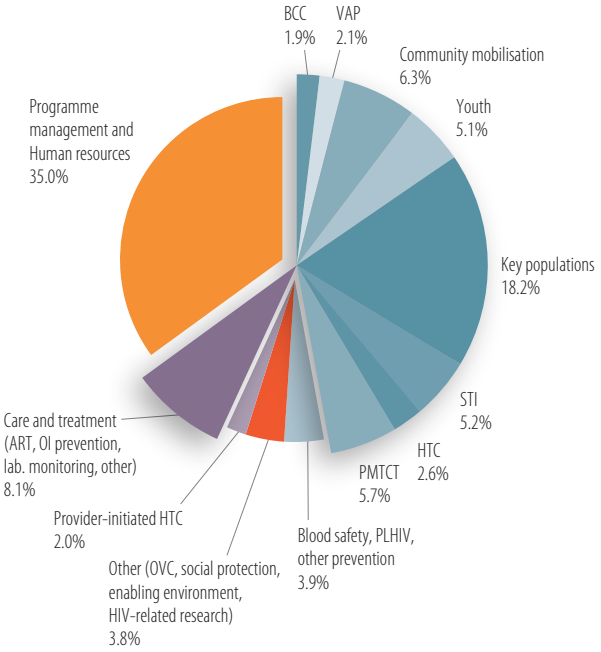
25 Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. N Engl J Med. 2011;365:493–505.

26 Jia Z, Mao Y, Zhang F, Ruan Y, Ma Y, Li J, et al. Antiretroviral therapy to prevent HIV transmission in serodiscordant couples in China (2003-11): a national observational cohort study. Lancet. 2013;382:1195–203.

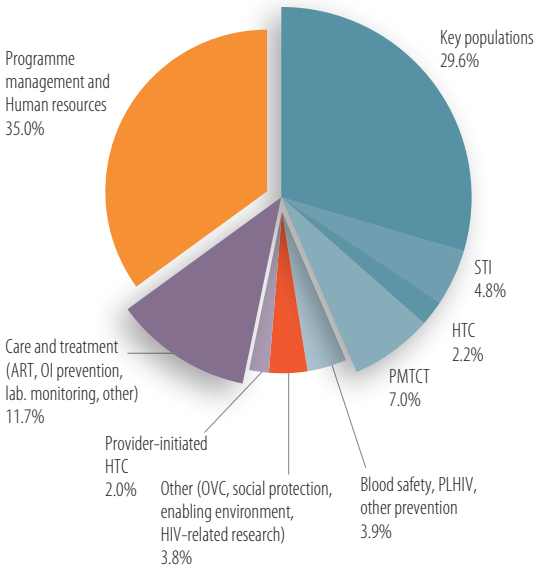
27 Regional studies on the impact of ART on preventing HIV transmissions in key populations at higher risk are not available; such studies would be useful to improve investment decisions.

Figure 8, a-c: Comparison of budget allocations under the current (2013) budget envelope; a) current (2013) allocations, b) optimised allocations option A, and c) optimised allocations option B*,**

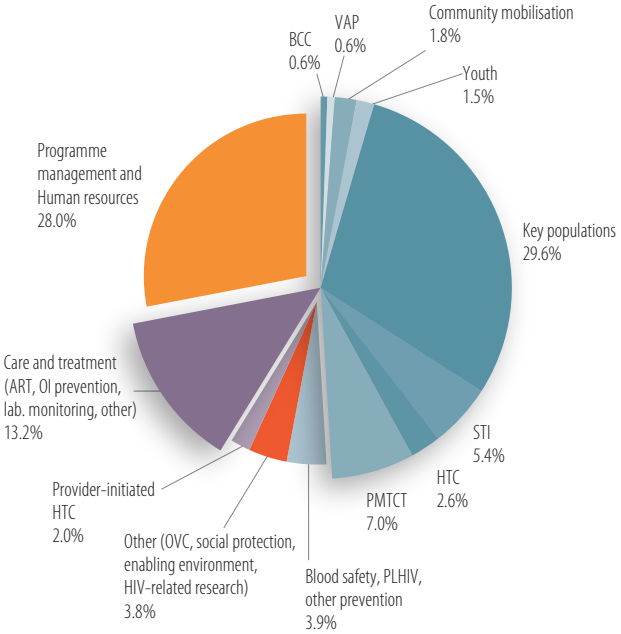
a) Current



b) Optimised (option A)



c) Optimised (option B)



* See narrative for further explanation of option A and B.

** Based on NASA clasification, 'VAP' category includes includes specific vulnerable groups such as indigenous groups, recruits, truck drivers, prisoners, and migrants.

Table 1: Comparison of budget allocations under the current (2013) budget envelope: current (2013) allocation mix, optimised allocation option A and optimised allocation option B*,**

	Budget allocation in $		
	a) current (2013) allocation	**b) optimised allocation, option A**	**c) optimized allocation, option B**
HIV spending TOTAL	**14,077,893**	**14,077,893**	**14,077,893**
Prevention SUBTOTAL	**7,186,761**	**6,682,225**	**7,458,762**
Prevention – blood safety, PLHIV, other	555,040	555,040	555,040
Communication for social and behaviour change (BCC)	270,702	0	79,331
Community mobilization	886,404	0	259,830
HIV testing and counselling (HTC)	362,155	307,433	362,155
Programmatic interventions for vulnerable and accessible population	295,655	0	86,653
Prevention – youth in school	362,977	0	106,390
Prevention – youth out-of-school	356,561	0	104,480
Prevention programmes for key target populations (PWID, SWs, MSM)	2,564,282	4,162,560	4,162,560
Prevention, diagnosis and treatment of STI for general population	733,241	670,850	755,981
PMTCT not disaggregated by intervention	799,744	986,342	986,342
Care and Treatment SUBTOTAL	1,422,283	1,926,819	2,136,166
Provider initiated testing and counselling	277,130	277,130	277,130
Care and treatment – ART, OI prevention, lab. monitoring, other	1,145,153	1,649,689	1,859,036
Programme management and Human resources SUBTOTAL	**4,929,419**	**4,929,419**	**3,943,535**
Others – OVC, social protection, enabling environment, HIV-related research SUBTOTAL	**539,430**	**539,430**	**539,430**

* Allocations to key populations in table 1 are only referring to interventions specific for the respective key population at higher risk for HIV infection (e.g. specific funding for key populations does not include their treatment or testing costs; on the other hand care and treatment includes care and ART for key populations).

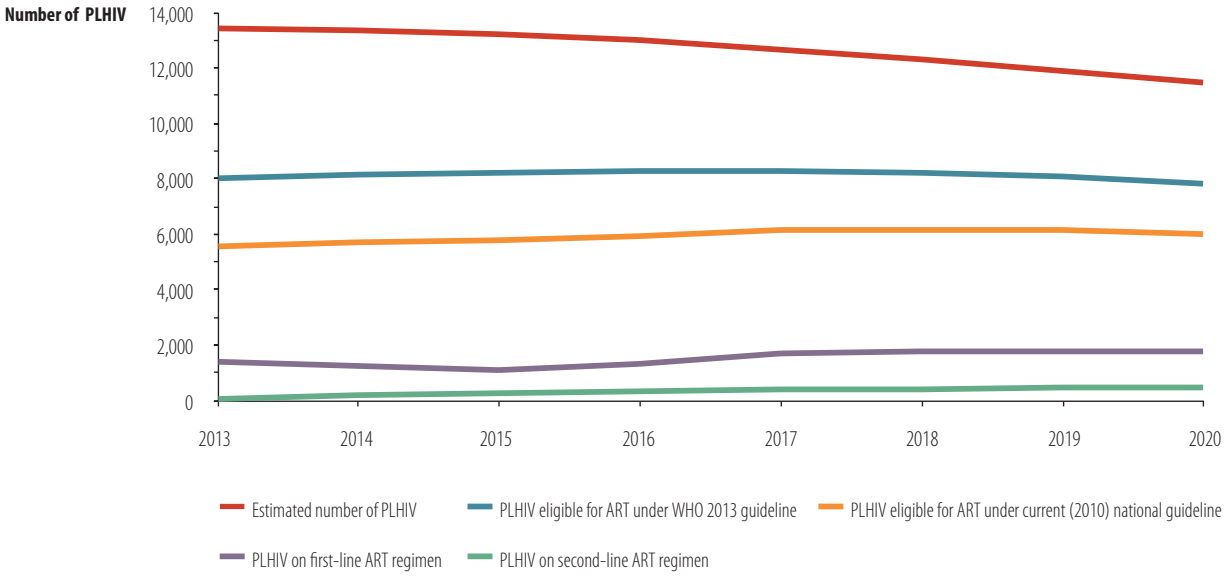
** See narrative for further explanation of option A and B.

Improved impact – but still insufficient service coverage

- Modelling allocative efficiency (figure 9) results by 2020 in[28]:
  - an estimated 11,500 PLHIV;
  - an estimated 6,000 PLHIV eligible for ART in 2020 based on the current national ART guideline, and 7,900 if the WHO 2013 guideline are adopted in 2015;
  - around 1,800 PLHIV will be on first-line ART regimen and 500 PLHIV will be on second-line regimen in 2020;
  - an estimated ART coverage of 20% to 96%: 20% among estimated number of PLHIV (2,300/11,500); 29% among PLHIV eligible for ART according to WHO 2013 guidelines (2,300/7,900); 38% among PLHIV eligible for ART according to the current national guidelines (2,300/6,000); and 96% registered PLHIV (2,300/2,400).

28 Outcomes are shown only for the optimized budget allocation with 20% reduction of programme management and HR allocations (option B).

Figure 9: Estimated numbers of PLHIV, of PLHIV eligible for ART and of PLHIV on ART (Scenario 2 – 'optimising the investment allocations at the 2013 budget level' using option B)*



* See narrative for further explanation of option B.

Return on investment – Scenario 2: 'Optimising the investment allocations under 2013 budget level'

- Compared to the counterfactual scenario of no HIV/AIDS programmes at all, 'optimising the investment allocations under the current budget level' would avert around 4,400 (4,200)[29] new HIV infections and 15,600 (12,500)[30] DALYs by the end of 2020 at a total programme cost of $ 98.5 million.

29 Scenario 2 option B (scenario 2 option A).
30 Scenario 2 option B (scenario 2 option A).

6. Scenario 3: Fulfilling the commitments for people in need – the rights-based investment case

This chapter summarizes key model outputs for the questions: Using optimized efficiencies, how much would it take to achieve universal coverage for the key prevention and treatment services, and what would then be the return on investment by 2020?

Scenario 3 – 'scaling up to universal coverage by 2020'

Shortfalls of the current and optimised investment case under the current budget ceiling

- The modelling results of scenario 1 and 2 clearly demonstrate the limitations of the current budget level: too many PLHIV will remain undiagnosed and without essential services, even under optimised allocative efficiency and reduced programme management and HR costs; the impact on HIV incidence and DALYs remains limited.

Keeping the current budget envelope means: too many PLHIV will remain undiagnosed and without essential services

- 'Doing more and better with less' is an important call for continuous quality improvement and efficiency gains, but there is clearly a threshold below which a budget simply becomes insufficient to fully meet the objectives.
- The current epidemic indicators, service coverage and the modelling forecast show that overall the HIV response is underfunded in Tajikistan in order to meet its objectives of 'Getting to Zero' and of fulfilling the commitments for universal coverage of essential HIV services.

Modelling the scale-up to universal coverage of essential HIV services

Background on universal coverage

- Commitment to universal coverage of HIV service in Europe and Central Asia is reflected in a number of declarations, including the 2004 'Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia'[31], the 2004 'Vilnius Declaration on Measures to Strengthen Responses to HIV/AIDS in the European Union and in Neighbouring Countries'[32], and the 2007 'Bremen Declaration on Responsibility and Partnership – Together Against HIV/AIDS'[33]. Tajikistan is one

31 Dublin Declaration on Partnership to fight HIV/AIDS in Europe and Central Asia. Breaking the Barriers – Partnership to fight HIV/AIDS in Europe and Central Asia Conference; 2004, Feb 23-24; Dublin, Ireland.

32 Vilnius Declaration on Measures to Strengthen Responses to HIV/AIDS in the European Union and in Neighbouring Countries. Europe and HIV/AIDS – New Challenges, New Opportunities Conference; 2004, Sept 17; Vilnius, Lithuania.

33 Bremen Declaration on Responsibility and Partnership – Together Against HIV/AIDS. 'Responsibility and Partnership -Together Against HIV/AIDS' Conference; 2007, Mar 12-13; Bremen, Germany.

of 55 countries included in the monitoring of progress against the commitments of the Dublin declaration[34].

- In accordance with the MDG6, the main goal of the National AIDS Programme of Tajikistan is to halt and begin to reverse the spread of HIV through universal access to prevention, treatment, care and support[35]; this is reconfirmed in the new National HIV/AIDS response strategy (2015-2017) of the Republic of Tajikistan[36].
- Universal health coverage is being considered as one of the targets under the proposed Sustainable Development Goal for health and it plays a key role in the positioning of health in the post-2015 development agenda[37].

Without universal coverage of essential HIV services, ending the epidemic of AIDS by 2030 will be unrealistic

- Without universal coverage of key prevention and treatment services, the target of ending the epidemic of HIV/AIDS by 2030 as recently proposed by the Open Working Group[38] will be unrealistic.

Methods for modelling universal coverage of essential HIV prevention, treatment and care services

- Using the same model structure as described in the previous chapter and detailed in the Annex, the objective of a rights-based investment approach is to reach universal coverage of essential HIV prevention services and ART by 2020.
- Starting at the current (2013) estimated service coverage for HTC, ART, PMTCT and special interventions for key populations, the model assumed an approximately linear increase over time to reach universal coverage for the key prevention and ART services by 2020.
- For ART services, the model investigated alternatively the following three options to determine universal coverage:

Option A: 95 percent of diagnosed PLHIV and eligible for ART under the current national ART guideline;

Option B: 95 percent of diagnosed PLHIV and eligible for ART under the WHO 2013 guideline;

Option C: 95 percent of all diagnosed PLHIV ('test and treat' concept[39]).

- For PMTCT, the objective of the modelling was to achieve 95% coverage; for harm reduction specific to PWID and special preventive service for other key populations 80% coverage of estimated need was used. For HTC the objective was that 80% of key populations at higher risk would know their status.

34 European Centre for Disease Prevention and Control. Thematic report: Combined reporting – Monitoring implementation of the Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia: 2012 progress. Stockholm: European Centre for Disease Prevention and Control; 2013.

35 The Government of Tajikistan. Programme on the response to the epidemic of HIV/AIDS in the Republic of Tajikistan for the period 2011-2015. Dushanbe: the Government; 2010.

36 Republic of Tajikistan. National HIV/AIDS response strategy (2015-2017) in Republic of Tajikistan. Dushanbe: National Coordination Committee to Combat HIV/AIDS, Tuberculosis and Malaria in the Republic of Tajikistan; 2014.

37 World Health Organisation. Positioning Health in the Post-2015 Development Agenda – WHO Discussion Paper; 2012.

38 Open Working Group of the General Assembly on Sustainable Development Goals. Introduction and proposed goals and targets on sustainable development for the post 2015 agenda. New York: Opening Working Group; 2014.

39 Dodd PJ, Garnett GP, Hallett TB. Examining the promise of HIV elimination by 'test and treat' in hyperendemic settings. AIDS. 2010;24(5):729-35.

Modelling results for a rights-based investment case approach

- To achieve universal treatment access under scenario 3 option C ('test and treat') the number of PLHIV on ART would need to reach around 9,700, for option B (WHO 2013 guideline) approximately 9,000 and for option A (current national guideline) about 8,200 by 2020. This reflects a 6- to 7-fold increase to 2013 ART figures.
- The number of people tested during the last 12 months will be 9% higher in 2020 than in 2013.
- Since the coverage rate for PMTCT is already high, it would see only a modest increase by 2020.
- NSP/OST coverage of PWID will increase substantially to reach at least 20,000 PWID by 2020.

With a rights-based investment approach the number of PLHIV on ART would increase 6- to 7-fold

Return on investment – Scenario 3: 'Scaling up to universal coverage by 2020'

- Under the assumption of the universal coverage for key preventive and treatment interventions, the epidemic impact would depend on the applied criteria for ART eligibility, as shown in table 2.

Table 2: Projected estimated epidemiological impact and programme costs* (point estimates) using three options for ART eligibility criteria for Scenario 3: 'Scaling up to universal coverage by 2020'**

	Universal ART coverage		
By 2020	**Option A**	**Option B**	**Option C**
Estimated PLHIV	13,670	13,660	12,700
Estimated new HIV infections averted***	7,000	7,150	8,360
Estimated DALYs averted***	95,400	100,000	101,700
Total programme costs 2014-2020	$ 123.3 million	$ 126.6 million	$ 129.0 million

* Not accounting for inflation.
** See narrative for further explanation of option A, B and C.
*** Compared to the counterfactual scenario of no HIV/AIDS programmes at all.

7. Rights-based investment today – the highest impact now and in the future

This chapter summarises and compares key model outputs for the short- and long-term impact of scenario 1 ('maintaining the 2013 investment allocations and budget level'), scenario 2 ('optimising the investment allocations at the 2013 budget level') and scenario 3 ('scaling up to universal coverage').

The rights-based investment approach – highest impact on HIV infections and DALYs in the short-term

- In the previous chapters, model predictions showed the highest impact for scenario 3 'scaling up to universal coverage' in terms of averting new HIV infections and DALYs by 2020; this is also the only scenario fulfilling international commitments made and key goals of the National AIDS Programme. Comparisons of projected impact and costs are summarized in table 3.

The rights-based investment approach – highest impact on HIV infections and DALYs also in the long-term

- The long-term impact of scenario 3 until 2030 is even more impressive; figure 10 shows the comparison of all scenarios.
- Under scenario 3, the estimated number of PLHIV would be around 13,500 by 2030 using current national treatment guidelines, approximately 13,700 using the WHO 2013 treatment guideline, and about 12,300 using the 'test and treat' approach. This compares to an estimated 9,000 PLHIV for scenario 2[40] and 10,700 for scenario 1 (figure 10a). Differences can be explained by long-term dynamics of differences in averted HIV infections and averted HIV-related deaths.
- An estimated cumulative total of around 29,000 new HIV infections would be averted between 2014

40 Using the optimized budget allocation with 20% reduction of programme management and HR allocations (option B).

Table 3: Point estimates of cumulative new HIV infections averted, cumulative DALYs averted and total programme costs under the three different scenarios (2014-2020)

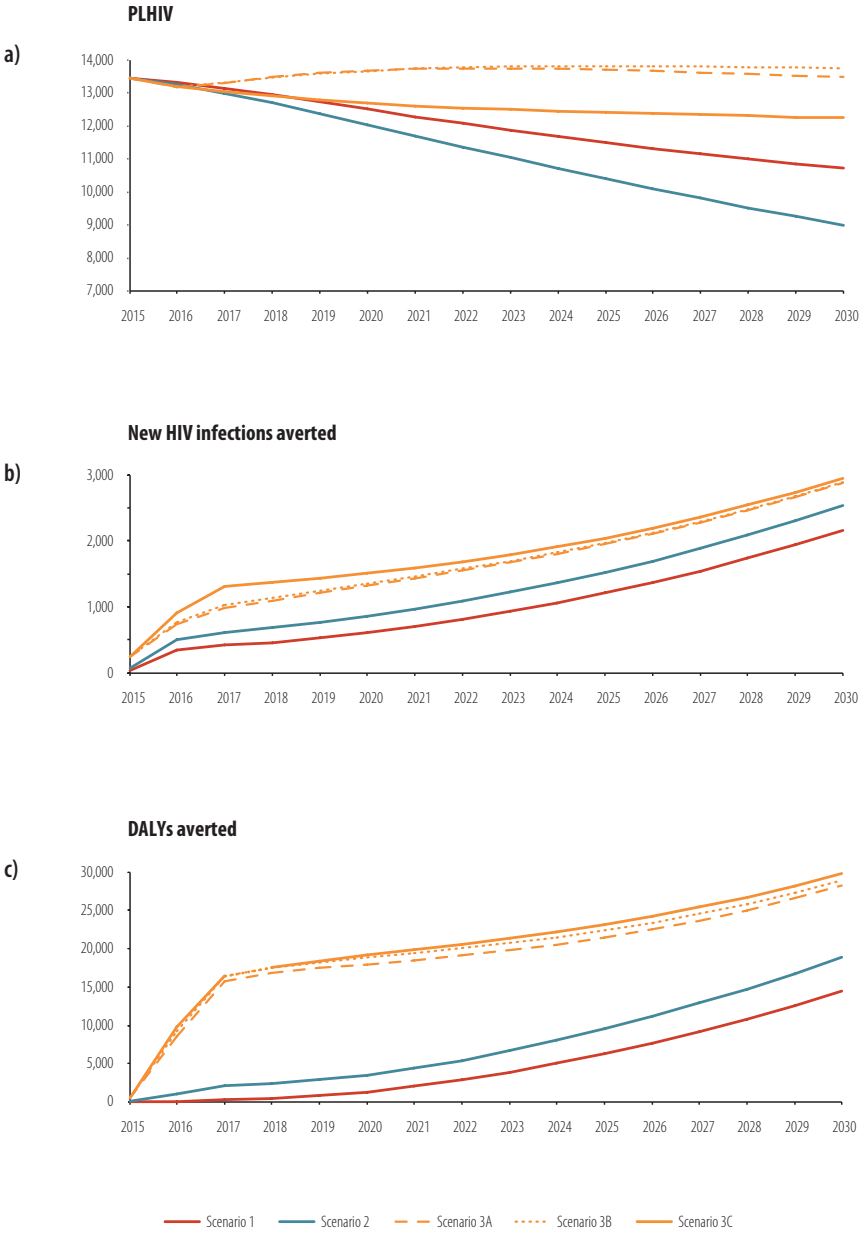
	Scenario 1	**Scenario 2**	**Scenario 3** Option A*	**Scenario 3** Option B*	**Scenario 3** Option C*
New HIV infections averted	3,100	4,400	7,000	7,150	8,360
DALYs averted	5,100	15,600	95,400	100,000	101,700
Total programme costs	$ 98.5 million	$ 98.5 million	$ 123.3 million	$ 126.6 million	$ 129.0 million

* Option A: 95% of diagnosed AND eligible PLHIV by 2020, current national guideline; option B: 95% of diagnosed AND eligible PLHIV by 2020, WHO 2013 guideline; option C: 95% of all diagnosed PLHIV by 2020 ('test and treat').

and 2030 under scenario 3 using the 'test and treat' approach (around 27,000 using the WHO 2013 guideline, around 26,500 using current national guidelines). Scenario 2 and 1 achieve significantly lower numbers of averted new HIV infections, approximately 20,000 and 16,000 respectively (figure 10b).

- Between 2014 and 2030 nearly 323,000 DALYs would be averted under scenario 3 using the 'test and treat' approach (314,000 using the WHO 2013 guideline, 302,000 using current national guidelines). Scenario 2 (119,000) and scenario 1 (78,000) avert less than half the number of DALYs (figure 10c).

Figure 10 a-c: Long term comparisons (2013-2030) of the epidemiological impact of scenario 1, 2 and 3; a) estimated number of PLHIV, b) estimated annual number of new HIV infections averted, and c) estimated annual number of DALYs averted*,**



* For scenario 2 option B was used. For more details see chapter 5.
** For figures 10b and 10c these analysed figures reflect the 12 month period before the each year.

8. Remarks

All mathematical models have their limitations and results should therefore be interpreted with the necessary caution.

- All model forecasts are subject to uncertainty. Therefore, point-estimates indicate trends rather than exact figures.
- The model calibration depends as much on the quality of input data as on the quality of the model itself. The country and study teams including the RAC paid much attention to assure data quality. However, there is room for improvement in further studies, both in terms of data quality and model structures.
- The best model calibration will rarely achieve an exact match of historical data, but mirror as closely as possible the key trends of them.
- Modelling the optimization of allocative efficiencies depends critically on the availability of evidence-based parameter estimates of the effectiveness and cost-efficiency of individual interventions.
- Particularly interventions related to the so-called critical enablers[41] such as interventions against punitive laws and discrimination, community mobilization, but also interventions related to health systems strengthening often lack 'hard' effectiveness data in relation to the key impact indicators such as new HIV infections or DALYs averted. Under resource constraints like in scenario 2, the model will therefore suggest to reduce or even stop such interventions which requires to set model restrictions like fixing allocations at certain minimum amounts.
- Even for clinical interventions, the effectiveness in general but particularly in a specific country or population setting is less clear than commonly thought. Assumptions need therefore to be made in a transparent way so that they can be reviewed. One of the critical assumptions – the effectiveness of ART on HIV prevention – has been presented in detail, others are referred to in the Annex.
- The model operates largely with current unit costs. Although the effect of increases or decreases of unit costs can be estimated with the model, the model itself cannot suggest what unit cost is adequate to achieve a defined standard of service quality or even what the defined standard should be. There is very little information about service quality and its contextual effect on impact available for Tajikistan or for the region. This is an area which deserves much greater attention particularly in times in which funding mechanisms such as the new funding model of the GF structurally incentivise reduction of unit costs without having adequate quality monitoring measures in place.
- Finally, no allocative efficiency optimization within a budget framework that is not sufficient to meet the needs for essential health services can replace the rights for basic health services. On the other hand, waste of resources under conditions of global resource constraints, low service coverage and inequities in service access make the fulfilment of these basic rights even more difficult. The key message of this document is therefore: With a moderate increase of the investment volume until 2020 combined with an optimized investment allocation the national HIV response in Tajikistan can be brought on a trajectory which fulfils the basic rights to access to essential HIV services for those in need and makes ending the epidemic threat of HIV/AIDS in Tajikistan a realistic goal if an environment without stigma and discrimination is provided so that services available will be accepted and used by the affected communities.

41 UNDP, UNAIDS. Understanding and acting on critical enablers and development synergies for strategic investments. New York: UNDP; 2012.

Annex

Annex 1. Model description

Overview of analytical methods

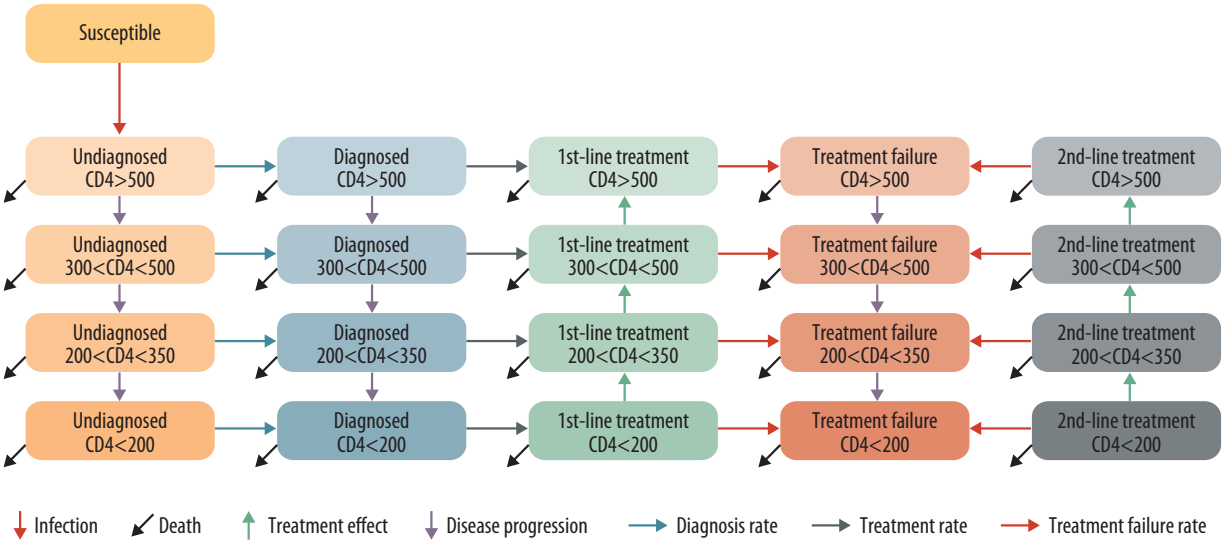
To assess HIV epidemic trends, resource needs, the cost-effectiveness of past programmes, and the impact of potential future programmes, we developed a detailed mathematical model of HIV transmission and disease progression, called the Projection and Evaluation Tool (Prevtool).

Prevtool is a flexible population-based HIV model. The basic disease progression implemented in the model is shown in figure A1. This is the only aspect of the model structure that is fixed, and specifies it as being an HIV model instead of a universal epidemic model.

In contrast to most other HIV models, the population groups used in Prevtool are not fixed. Instead, up to 14 user-defined population groups may be used. A typical example for a concentrated HIV epidemic, such as used in Tajikistan, is shown in figure A2. Here, seven population groups are used, including low-risk ('general') males and females, SWs and their clients, male and female PWID, and MSM.

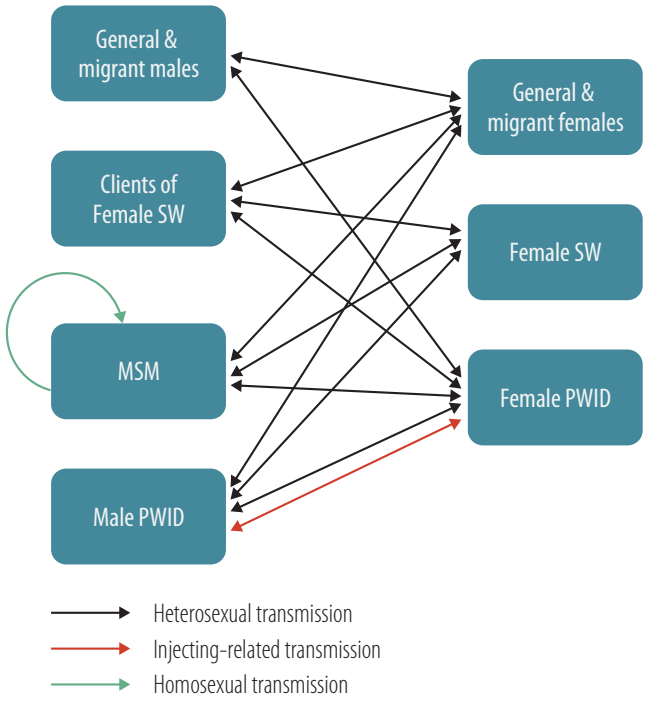
Data are entered into Prevtool by means of an Excel spreadsheet, as shown in figure A3. Data entry is flexible, allowing everything from a separate data point for every population for each year, or a single data point for all populations over the entire time period.

Figure A1: Schematic diagram of model structure*



* Each compartment represents a single population group with the specified health state, while each arrow represents the movement of individuals between health states. All compartments except for 'Susceptible' represent individuals living with HIV. 'Death' includes all causes of death.

Figure A2: Population groups and interactions in Prevtool, example



The model uses a coupled system of ordinary differential equations to track the movement of people between health states. The overall population is partitioned in two ways: by group and by health state. Individuals are assigned to a given population based on their dominant risk; however, to capture important cross-modal types of transmission (e.g., SW becoming infected via injecting drug use), relevant behavioural parameters can be set to small but nonzero values (e.g., male PWID occasionally engage in commercial sex; MSM occasionally inject drugs).

The rate at which uninfected individuals in each population group become infected is determined by the force-of-infection for that population. This depends on the number of risk events an individual is exposed to in a given period of time and the infection probability of each event. Sexual transmission risk depends on the number of people in each HIV-infected stage (that is, the prevalence of infection in the population of partners), the average number of casual, regular, and commercial homosexual and heterosexual partnerships per person, the average frequency of sexual acts per

Figure A3: Example of data entry spreadsheet for a concentrated epidemic (in this case, Tajikistan)*

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
HIV prevalence (percent)	LRM	(0.05)											
	LRF	(0.05)					0.5	0.1	0.3	0.06	0.04	0.04	0.05
	SW	(2.2)					0.7	3.7	1.8	2.8	2.7	4.4	3.7
	MSM	(1.2)											1.5
	PWID	(18)					15.8	23.5	19.4	17.6	17.3	16.3	13.5
	PI	(8)					6.2	8.4	6.8	7.8	8.8	8.5	
	LM	(2)						2.2		0.5			
STI prevalence (percent)	LRM						(0.5)						
	LRF						0.5	0.8	1	1.2			
	SW									10.5	11.5	9.6	14.6
	MSM												5.1
	PWID						11.6	18	10.6	7.7	9.6	7.1	7.4
	PI						15.6	13.7	9.4	11.4	10.1	9	
	LM							0.5		1.7			

* In addition to best-estimate data, upper and lower bounds are provided (or estimated) for each point.

partnership, the proportion of these acts in which condoms are used, the efficacy of condoms, the extent of male circumcision, and the prevalence levels of STIs (which increase transmission probability) and HIV.

The stage of infection (chronic, AIDS-related illness/late stage, or on treatment) for the HIV-positive partner in a serodiscordant couple also influences transmission risk due to different levels of infectiousness in each infection stage. Intravenous transmission risk depends on the number of injecting partners per person per year, frequency of injecting per year, frequency of sharing injecting equipment and %age of shared syringes that are cleaned before re-use and the efficacy of cleaning.

Mathematically, the force-of-infection is given by:

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

where λ is the force-of-infection, β is the transmission probability of each event, and n is the effective number of at-risk events (thus n gives the average number interaction events with infected people where HIV transmission may occur). The value of the transmission probability β is based n average viral load of people in different stages of infection and transmissibility differs by mode of transmission (intravenous drug injection, heterosexual intercourse, and homosexual intercourse), and may be modified by behavioural interventions (for example, condom use or circumcision). The number of events n not only incorporates the total number of events, but also other factors that moderate the possibility that these events are capable of transmitting infection, such as condom use or circumcision. There is one force-of-infection term for each type of interaction (for example, casual sexual relationships between low-risk males and indirect female sex workers), and the force-of-infection for a given population will be the sum of overall interaction types.

In addition to the force-of-infection rate, in which individuals move from uninfected to infected states, there are seven other means by which individuals may move between health states. First, individuals may die, either due to the background death rate (which affects all populations equally), due to injecting behaviour, or due to HIV/AIDS (which depends on CD4 count). Second, in the absence of intervention, individuals progress from higher to lower CD4 counts. Third, individuals can move from undiagnosed to diagnosed states based on their HIV testing rate, which is a function of CD4 count (for example, people with AIDS symptoms have a higher testing rate) and population type (for example, SW usually get tested more frequently than low-risk males). Fourth, diagnosed individuals may move onto treatment, at a rate which is dependent on CD4 count. Fifth, individuals may move from treatment to treatment failure, and sixth, from treatment failure onto second-line treatment. Finally, while on successful first- or second-line treatment, individuals may progress from lower to higher CD4 count and they will have reduced infectiousness.

In total, the model can accommodate up to 294 compartments (14 populations each with 21 health states), and the change in the number of people in each compartment is determined by the sum over the relevant rates described above multiplied by the compartments on which they act. For example, the number of individuals in the compartment corresponding to undiagnosed female SW with a CD4 count between 200 and 350 cells/μL changes according to the following equation:

$$\frac{dU_{SW200-350}}{dt} = U_{SW350-500}\tau_{350-500} - U_{SW200-350}(\mu_{200-350} + \tau_{200-350} + \eta_{SW350-500})$$

where $U_{SW350-500}$ is the current population size of people with undiagnosed HIV and with a CD4 count between 350 and 500 cells/μL, $U_{SW200-350}$ is the population size of the compartment with lower CD4 count (200-350 cells/μL), τ is the disease progression rate for the given CD4 count, μ is the death rate, and η is the HIV testing rate. (Note: this example does not consider movement between populations, such as female SW returning to the low-risk female population and vice versa.) Each compartment (figure A1, boxes) corresponds to a single differential equation in the model, and each rate (figure A1, arrows) corresponds to a single term in that equation.

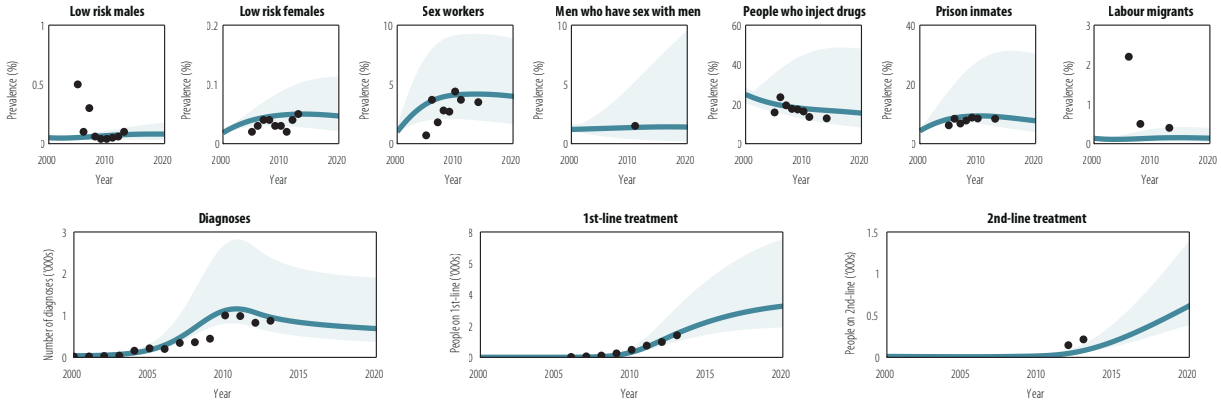
Most of the parameters in the model are related to calculating the force-of-infection; a list of model parameters is provided in table A1. Empirical estimates for model parameter values can be interpreted in Bayesian terms as prior distributions. The model must then be calibrated, which is the process of finding

Table A1: Input parameters of the model

	Biological parameters	Behavioural parameters	Epidemiological parameters
Population parameters	Background death rate		Population sizes (TP)
HIV-related parameters	Sexual HIV transmissibilities* (H) STI-related transmissibility increase* Condom efficacy* Circumcision efficacy* HIV health state progression rates (H) HIV-related death rates (H)	Number of sexual partners* (TPS) Number of acts per partner* (S) Condom usage probability* (TP) Circumcision probability* (T)	HIV prevalence (TP) STI prevalence (TP)
MTCT parameters	Mother-to-child transmission probability	Birth rate PMTCT access rate (T)	
Injection-related parameters	Injecting HIV transmissibility* Syringe cleaning efficacy* Drug-related death rate	Number of injections* (T) Syringe sharing probability* (T) Syringe cleaning probability* Methadone treatment probability (T)	
Treatment parameters	ART efficacy* ART failure rates	HIV testing rates (TPH)	Number of people on ART (T)

Key: T = parameter value changes over time; P = parameter value depends on population group; H = parameter depends on health state; S = parameter depends on sexual partnership type; * = parameter is used to calculate the force-of-infection.

Figure A4: Calibration of Prevtool to Tajikistan epidemic data*



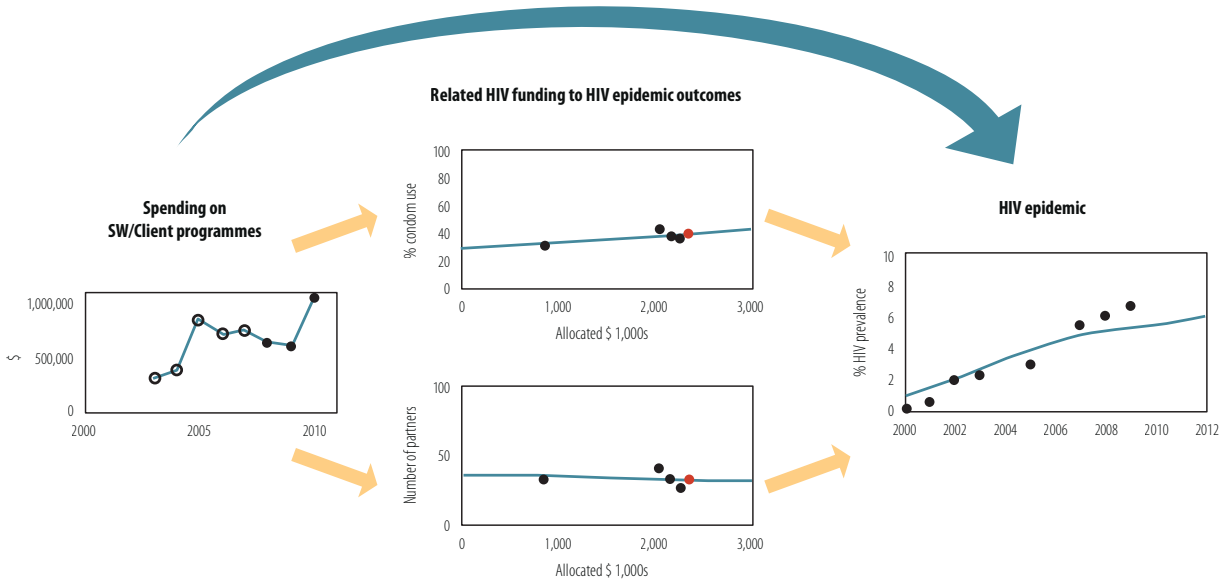
* Dots show data; lines show model outputs; shaded regions are 95% confidence intervals.

posterior distributions of the model parameter values such that the model generates accurate prevalence estimates. Given the challenges inherent in quantifying all known constraints on the epidemic, initial calibration is performed manually, with oversight by and collaboration with in-country stakeholders where possible. This prior distribution is then used in a Monte Carlo Markov chain algorithm, which uses both epidemiological and behavioural data to calculate the log-likelihood for a given set of model parameters. The distribution of parameter values produced by the Monte Carlo Markov chain is the posterior, which is then used for all epidemiological and economic analyses. An example calibration is shown in figure A4.

Relationships between spending and risk behaviours

In our analysis, we use a logistic/sigmoid function to describe the relationships between a behavioural parameter affected by a HIV prevention programme and the level of spending on that programme. Using this function with assumed uncertainties bounds, we obtain logistic curve fits to available datasets for overall programme spending and associated behaviours. Indirect costs have no direct impact on HIV transmission parameters; but changes to HIV programmes may affect these costs to supply additional condoms, clean syringes, and methadone, for example. Using these relationships, any change in HIV programme funding directly affects risk behaviours and changes to the HIV epidemic; an example of this is demonstrated in figure A5. The fitted logistic relationships will represent the change in behaviours with spending.

Figure A5: Example of the relationship between spending on SW/client programmes and the HIV epidemic*



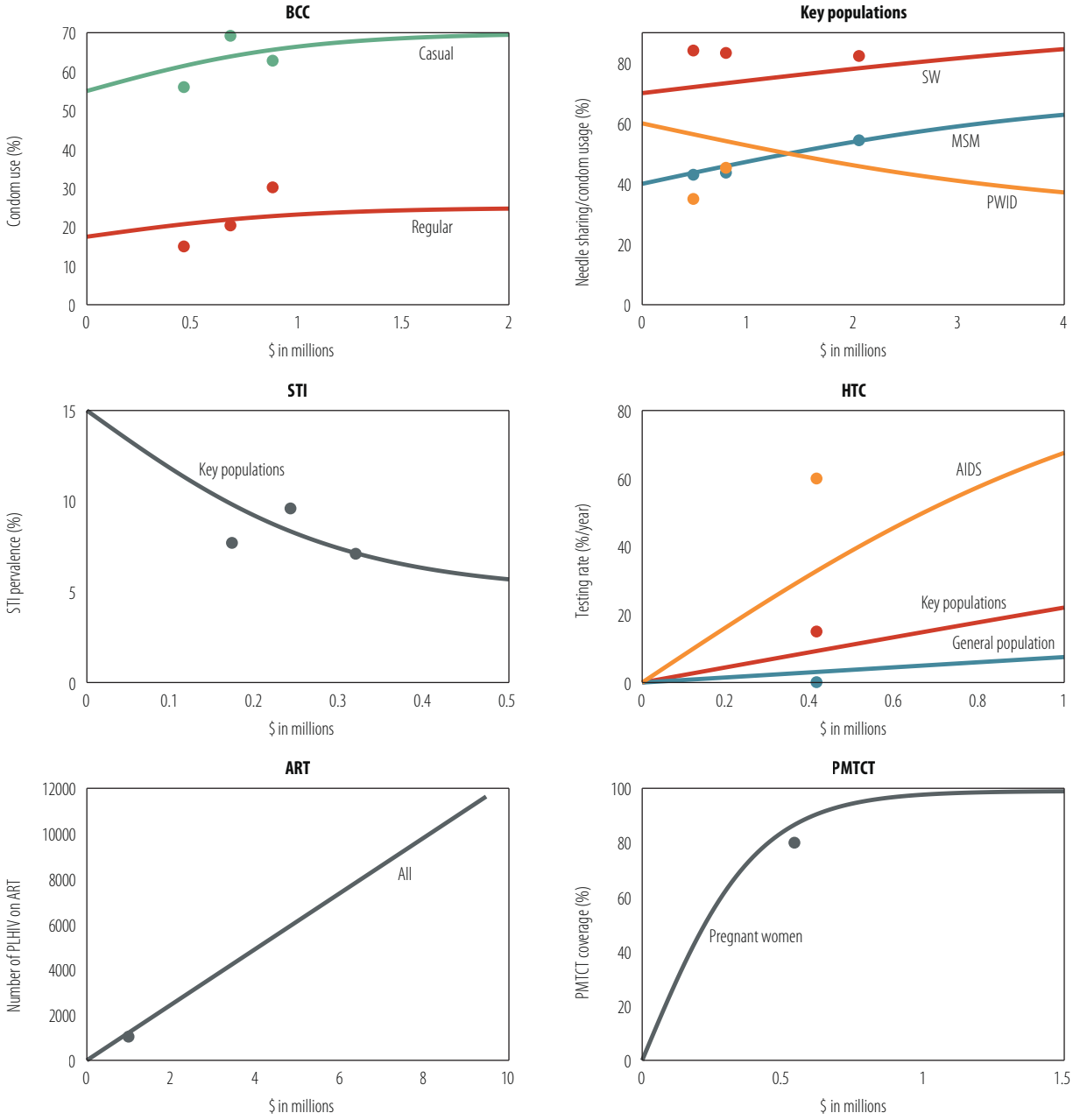
* Numerical values are for illustrative purposes only.

Counterfactual scenarios

Prevtool calculates the cost-effectiveness of past HIV programmes by comparing the expected number of new infections and HIV/AIDS related deaths according to current and past conditions with the estimated numbers under counterfactual scenarios in the absence of funding for specific programmes.

We simulate counterfactual scenarios using Prevtool based on the assumed effect of the removal or enhancement of specific programmes. The calibrated simulations with the programmes in place represent the baseline scenario. For each prioritised population, we develop counterfactual scenarios for the behavioural parameters affected by prevention programmes prioritising that population — with the parameters for the other populations remaining at their values obtained through the calibration process. Specific counterfactual scenarios used depend on the implementation and characteristics of HIV prevention programmes and the data available. We fit a logistic function to behavioural parameters affected by prevention programmes; figure A6 shows some example logistic functions for Tajikistan.

Figure A6: Example logistic curves



Cost-effectiveness calculations for past evaluations

For each counterfactual scenario, we measure the health benefits of a specific HIV intervention programme in terms of HIV infections averted as well as life years and DALYs saved compared to the baseline scenario. We calculate incremental cost-effectiveness ratios to estimate the cost-effectiveness of each programme. These are calculated based on the counterfactual scenarios and comparing the spending of each programme (discounted annually), as well as estimated annual healthcare costs incurred/saved

(using unit health costs and utilities for each country obtained from our data synthesis), with the estimated effectiveness of the programmes. Determining whether a past HIV programme is cost-effective is dependent on country-specific thresholds. Appropriate thresholds for each country were determined after consultation with in-country stakeholders.

Future impact of HIV programmes and optimal allocation of resources

To investigate the potential impact of future HIV prevention programmes we run model projections for each scenario. Specific programme options are investigated but are based on core prevention methods (harm reduction), along with programmes based on using antiretroviral treatment as prevention in combination with other programmes. We then compare projections where parameters and funding remain at current values and calculate the annual incidence, the number of infections averted, and the total cost required for each scenario.

Prevtool is used to determine the optimal allocation of funding using an adaptive stochastic linear gradient-descent optimisation method. This calculates the allocation of funding to programmes with the minimum total infections, minimum prevalence, minimum AIDS-related deaths, or maximum DALYs saved. It is also possible to invert this analysis and calculate the minimum spend required to achieve a particular target in terms of one of those quantities.

Annex 2. Data inputs[42]

Summary of costs and unit costs

National spending on AIDS in Tajikistan was examined by major funding sources with the use of national statistics, sector reports, and data reported by public health service institutions for the years between 2008 and 2013. Standard accountancy estimation methods were used to generate a complete dataset of national spending on AIDS. Costs were broken down by financing sources, agents, service providers, AIDS spending categories, and beneficiary populations using functional NASA classifications and definitions. Data collection covered spending on AIDS response funded from domestic public and international funding sources.

42 All data presented were verified by the RAC.

Table A2: Budget for the national HIV programme by programme components

	2012 budget in $	2013 budget in $
HIV spending TOTAL	**12,715,924**	**14,077,893**
Prevention SUBTOTAL	**5,752,333**	**7,186,761**
Communication for social and behaviour change (BCC)	913,777	270,702
Community mobilization	856,309	886,404
HIV testing and counselling (HTC)	387,383	362,155
Programmatic interventions for vulnerable and accessible population	181,923	295,655
Prevention – youth in school	298,843	362,977
Prevention – youth out-of-school	186,713	356,561
Prevention of HIV transmission aimed at PLHIV	47,222	69,954
Prevention programmes for key target populations (PWID, SW, MSM)	1,497,212	2,564,282
Prevention of HIV transmission at the workplace	139,872	8,711
Prevention, diagnosis and treatment of STI for general population	207,496	733,241
PMTCT not disaggregated by intervention	631,507	799,744
Blood safety	404,076	459,549
Post-exposure prophylaxis	0	16,826
Care and Treatment SUBTOTAL	**2,170,198**	**1,422,283**
Provider initiated testing and counselling	177,351	277,130
OI prophylaxis and treatment	319,368	56,298
ART not disaggregated neither by age nor by line of treatment	716,681	909,788
Specific HIV-related lab monitoring	295,165	110,167
Care and treatment not disaggregated by intervention	661,633	68,900
Programme management SUBTOTAL	**3,229,888**	**3,458,515**
Planning, coordination and programme management	1,275,059	1,286,787
Administration and transaction costs associated with managing and disbursing funds	263,316	362,731
Monitoring and evaluation	180,649	204,827

Table A2: Budget for the national HIV programme by programme components (cont.)		
Serological surveillance	383,308	487,073
Upgrading and construction of infrastructure	356,932	362,496
Programme management and admin not disaggregated by intervention	770,624	754,601
Human resources SUBTOTAL	**1,376,444**	**1,470,904**
Monetary incentives for HR not broken by staff	943,695	1,033,037
Training	393,417	298,035
'Human resources', not disaggregated by type	39,332	139,832
Orphans and vulnerable children (OVC)	**0**	**2,000**
OVC, not broken down by type	0	2,000
Social protection SUBTOTAL	**28,632**	**109,434**
Social protection through in-kind benefits	28,632	109,434
Enabling environment SUBTOTAL	**86,888**	**223,574**
Advocacy	17,528	42,511
Human rights programmes	28,581	52,791
AIDS-specific institutional development	25,000	35,923
AIDS-specific programmes focused on women	8,500	0
Programmes to reduce gender-based violence	3,958	0
Activity on enabling environment not elsewhere classified	3,321	92,349
HIV-related research SUBTOTAL	**71,541**	**204,422**
Clinical research	5,837	9,292
Behavioural research	29,037	165,130
HIV and AIDS related research not disaggregated by type	36,667	30,000

Table A3: Population size

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LRM	3.2 mil.	2.5 mil.	3.3 mil.	2.5 mil.	2.6 mil.	2.6 mil.	2.7 mil.	2.8 mil.	2.7 mil.	2.7 mil.	3.3 mil.	2.4 mil.	2.0 mil.	
LRF	3.1 mil.	3.1 mil.	3.2 mil.	3.3 mil.	3.3 mil.	3.4 mil.	3.5 mil.	3.5 mil.	3.5 mil.	3.7 mil.	3.8 mil.	3.9 mil.	4.0 mil.	
SW	(37,746)			8,000						12,500		46,600		
MSM	(22,251)											17,000 (Dushanbe)		
PWID	(25,000)		34,000							25,000				
PI	(8,000)					12,500	8,500	8,000	9,100	8,000	9,300	10,000		
LM			750,000						1,000,000	1,000,000	1,500,000	2,000,000	2,000,000	

LRM = low-risk males; LRF = low-risk females; SW = sex workers; MSM = men who have sex with men; PWID = injecting drug users; PI = prison inmates; LM = labour migrants. Brackets are used to indicate estimates as opposed to observed data; applies to all following figures.

Table A4: HIV prevalence (%)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LRM	(0.1)													
LRF	(0.1)					0.5	0.1	0.3	0.06	0.04	0.04	0.05	0.06	0.1
SW	(2.2)					0.7	3.7	1.8	2.8	2.7	4.4	3.7		
MSM	(1.2)											1.5		
PWID	(18.0)					15.8	23.5	19.4	17.6	17.3	16.3	13.5		
PI	(8.0)					6.2	8.4	6.8	7.8	8.8	8.5			8.4
LM	(2.0)						2.2		0.5					0.4

Table A5: STI prevalence (%)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
LRM						(0.5)								
LRF						0.5	0.8	1.0	1.2					3.0
SW									10.5	11.5	9.6	14.6		
MSM												5.1		
PWID						11.6	18.0	10.6	7.7	9.6	7.1	7.4		
PI						15.6	13.7	9.4	11.4	10.1	9.0			13.1
LM							0.5		1.7					

Table A6: Testing rates

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Testing rate per year (%)	LRM														
	LRF														
	SW												57.6		
	MSM												40.8		
	PWID								25.0	35.9	27.3	47.0	36.4		
	PI								7.0	8.0	9.0	9.0			8.4
	LM														
	AIDS stage														(50)

Table A7: Treatment rates

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Treatment rate per year (%)	CD4 (500)							0 .0	2.0	3.0	9.0	4.0	6.0	5.0	10.0
	CD4 (350-499)							0.0	2.0	2.0	9.0	3.0	8.0	16.0	20.0
	CD4 (200-349)							4.0	4.0	5.0	14.0	15.0	13.0	21.0	30.0
	CD4 (<200)							4.0	9.0	13.0	10.0	19.0	28.0	33.0	40.0
	Treatment failure												2.0	4.0	2.0

Table A8: Mother-to-child transmission

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mother-to-child transmission	Birth rate (births/ woman/yr)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	
	Pregnant women covered (%)						2.0	4.0	9.0	22.0	27.0	47.0	63.0	64.0	91.5

Table A9: HIV diagnoses

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
No. HIV diagnoses	Total	18	22	33	42	159	217	202	346	363	437	1004	989	828	876

Table A10: Patients on ART

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
No. patients on ART	1st-line														1,377
	2nd-line														22
	Total							24	67	117	255	483	751	983	1,399

Table A11: Sexual acts per person per year and condom use, and circumcision probability

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average no. regular sexual acts	LRM														(60)
	LRF														(60)
	SW														(20)
	MSM														0
	PWID														(40)
	PI														(40)
	LM									42					42
Average no. casual sexual acts	LRM														(10)
	LRF														(10)
	SW							36	67	114	52	109	62		
	MSM														(60)
	PWID							88	68	42	42	42			
	PI														(20)
	LM									16					26

Table A11: Sexual acts per person per year and condom use, and circumcision probability (cont.)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average no. other sexual acts (e.g. commercial)	LRM														
	LRF														
	SW							728	572	494	728	676	770	884	624
	MSM												18		
	PWID						161	177	73	42	26	21	31		
	PI														(16)
	LM									16					16
Condom use % for regular acts	LRM														(1.0)
	LRF							7.6	0.8	0.5					
	SW						26.7	26.0	31.0	31.8	22.3	23.0	25.8		
	MSM												41.1		
	PWID						20.4	21.0	18.0	13.0	19.7	27.0	30.2		
	PI														
	LM							14.0							21.5
Condom use % for casual acts	LRM														(20.0)
	LRF														(20.0)
	SW						24.0	16.7	33.3	56.0	69.2	43.1	30.6		
	MSM												67.8		
	PWID						25.0	66.0	24.9	17.6	21.7				
	PI														(20.0)
	LM														(20.0)

Table A11: Sexual acts per person per year and condom use, and circumcision probability (cont.)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Condom use % for other acts	LRM														
	LRF														
	SW						69.0	74.7	69.2	84.1	83.3	85.9	81.1		
	MSM												54.4		
	PWID						55.5	57.9	20.4	13.2	8.7	11.9	59.7		
	PI														(60.0)
	LM									59.7					
Circumcision probability	LRM														(5.0)
	LRF														
	SW														
	MSM														(5.0)
	PWID														(5.0)
	PI														(5.0)
	LM														(5.0)

Table A12: Injecting drug use parameters

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Average no. injections/ person/yr	LRM														
	LRF														
	SW														
	MSM														
	PWID						679	723	796	796	821	865	883		
	PI														(10)
	LM														
Drug use parameters	% shared injections						57.0	45.0	37.0	35.0	45.3	70.2			
	% PWID on methadone											0.3	1.2	1.2	0.6
	% reused syringes that are cleaned						24.0	45.0	54.0	63.2	84.1	69	93.5		

Table A13: Biological constants

Interaction-related transmissibility (% per act):	Male & female (insertive)	0.06 (0.01-0.5)
	Male & female (receptive)	0.09 (0.05-1.00)
	Male & male (insertive)	0.06 ((0.015-1.5)
	Male & male (receptive)	0.1 (0.048-2.9)
	Injecting	0.4 (0.03-5.0)
	Mother-to-child	35 (20-50)
Disease-related transmissibility	CD4(500)	4.0 (1.2-5.0)
	CD4(350,499)	1.0 (0.8-1.2)
	CD4(200,349)	1.0 (0.8-1.2)
	CD4(<200)	3.8 (3.6-4.0)
	Treatment	0.2 (0.02-0.5)
Disease progression rate: (% per year)	CD4 (500) to CD4 (350,499)	24.5 (22.6-26.4)
	CD4 (350,499) to CD4 (200,349)	51.0 (47.0-55.0)
	CD4 (200,349) to CD4 (<200)	51.0 (47.0-55.0)
Treatment recovery rate: (% per year)	CD4 (350,500) to CD4 (>500)	45.0 (14.0-93.0)
	CD4(200,349) to CD4 (350,500)	70.0 (29.0-111.0)
	CD4 (<200) to CD4 (200,349)	36.0 (28.0-43.0)
Death rate: (% mortality per year)	Background	1.4 (0.9-2.0)
	Injecting	1.0 (0.7-1.2)
	CD4 (500)	0.052 (0.035-0.068)
	CD4 (350,500)	0.128 (0.092-0.164)
	CD4 (200,349)	1.1 (0.2-2.0)
	CD4 (<200)	50.0 (40.0-66.0)
	Treatment (CD4<200)	4.00 (1.0-10.0)
Treatment failure rate: (% per year)	1st-line	4.5 (3.0-6.0)
	2nd-line	4.5 (3.0-6.0)
Efficacy/change in transmissibility due to:	Condom (%)	80.0 (60.0-99.0)
	Circumcision (%)	60.0 (50.0-65.0)
	Diagnosis (%)	1.0 (0.0-60.0)
	STI cofactor increase (%)	700.0 (100.0-1000.0)
	Syringe cleaning (%)	75.0 (70.0-80.0)
	Methadone (%)	95.0 (90.0-99.0)
	PMTCT (%)	78.0 (40.0-99.0)
	Treatment risk compensation (%)	100.0 (95.0-200.0)

Table A14: Partnerships

		LRM	LRF	SW	MSM	PWID	PI	LM
Regular sexual interactions	LRM		1					
	LRF	1						
	SW							
	MSM				1			
	PWID		1	1				
	PI		1	1				
	LM		1	1				
		LRM	LRF	SW	MSM	PWID	PI	LM
Casual sexual interactions	LRM		1	1				
	LRF							
	SW							
	MSM							
	PWID		1	1				
	PI		1	1				
	LM		1	1				
		LRM	LRF	SW	MSM	PWID	PI	LM
Other sexual interactions	LRM			1				
	LRF							
	SW							
	MSM				1			
	PWID			1				
	PI			1				
	LM			1				
		LRM	LRF	SW	MSM	PWID	PI	LM
Injecting interactions	LRM							
	LRF							
	SW							
	MSM							
	PWID					1	1	
	PI					1	1	
	LM							


Get to
Get to zero
new HIV infections
End the epidemic
threat of AIDS
Universal access
to HIV services
Get to zero
discrimination
Get to zero
AIDS-related deaths
Get to zero
discrimination
Get to zero
new HIV infection