Resource optimization to maximize the HIV response in Azerbaijan

Executive summary

To maintain the HIV response in Eastern Europe and Central Asia it is imperative to ensure that national HIV programs continue to be sustainably financed. Continued commitment by national governments to finance the HIV the response is critical. Moreover, with planned transition away from donor support, there will be increased demand on domestic fiscal investment. As such it is vital to make cost-effective funding allocations decisions to maximize impact. An allocative efficiency modeling analysis was conducted through partnership with the Azerbaijani Government, the Global Fund, UNAIDS, and the Burnet Institute. The Optima HIV model was applied to estimate the optimized resource allocation across a mix of HIV programs. It is anticipated that recommendations from this analysis, as summarized below, will inform subsequent National Strategic Plans and Global Fund funding applications.

Key recommendations for HIV resource optimization include:

- **Scaling up antiretroviral therapy (ART)**, by focusing on enrolling those newly diagnosed with HIV and maintaining those already on treatment, treatment coverage can be brought up from 62% (status quo) to 91% (optimized) in 2019, with high coverage levels maintained to 2030.
- **Reinvest resources from HIV testing programs targeting the general population towards HIV testing and prevention programs targeting key populations.** Spending on HIV testing programs targeting the general population represented over 40% of Azerbaijan's HIV budget in 2018. Given that 86% of new HIV infections were estimated to have occurred among key populations, investment in HIV prevention programs targeted at these groups should be prioritized.
- **Scaling up investment for HIV testing and prevention programs targeting people who inject drugs (PWID)**. Given that 40% of new HIV infections occur among people who inject drugs, HIV testing and prevention programs targeting this group should be scaled up at the 100% budget, with continued scale up as additional resources become available.
- **Scaling up investment for HIV testing and prevention programs targeting men who have sex with men (MSM)**. Given that 22% of new HIV infections occur among men who have sex with men, HIV testing and prevention programs targeting this group should be scaled up at the 100% budget, with continued scale up as additional resources become available.
- **Scaling up investment for HIV testing and prevention programs targeting female sex workers (FSW)**. Given that 24% of new HIV infections occur among female sex workers, HIV testing and prevention programs targeting this group should be scaled up at the 100% budget, with continued scale up as additional resources become available.
- **To achieve 95-95-95 targets by 2030**, the latest reported annual HIV budget should be optimized with prioritized scale-up of treatment from 38% of the total targeted HIV program budget to 67% in 2019 and maintained to 2030. Similarly, to increase funding for key population programs including for PWID, MSM, and FSW from 20% of the total budget to 33%.

Background

The HIV epidemic in Azerbaijan continues to be concentrated among key populations, including people who inject drugs (PWID), female sex workers (FSW) and men who have sex with men (MSM). HIV prevalence is estimated to have increased from 2.0% in 2011 to 2.2% in 2015[1] among MSM and from 0.7% in 2011 to 2.3% in 2015 among FSW.[2] HIV prevalence among PWID has decreased from 9.5% in 2011 to 8.6% in 2015.[3] Despite this decline in prevalence, the majority of new HIV infections are still occurring among injecting drug users, with of 45% of reported infections in 2016-2017 in this group.[4]

In response to the HIV epidemic in the country, the government of Azerbaijan adopted the 2016-2020 National Strategic Plan with continued focus on HIV prevention among key populations, as well as scaling up treatment for all people living with HIV.[4] This is the first time that Azerbaijan conducts an allocative efficacy modeling analysis to estimate the optimal allocation of HIV resources based on latest reported values with findings described below. This analysis is expected to inform upcoming strategic planning for the HIV program.

Objectives

1. Given 2015-2017 resource allocation, how many new HIV infections, HIV-related deaths, and HIV-related DALYs (comparable to QALYs saved) are estimated to have been averted through HIV program implementation?
2. What is the optimized resource allocation to minimize HIV infections and HIV-related deaths by 2030 under optimized varying budget levels?
3. What is the optimized HIV resource allocation for best achieving the 90-90-90 and 95-95-95 targets by 2020 and by 2030, respectively, and what are the minimum levels of resources required for best achieving these targets?

Methodology

An allocative efficacy modeling analysis was undertaken in collaboration with the HIV program of Azerbaijan. Epidemiological and program data was provided by the Azerbaijan country team and validated during a regional workshop that was held July 2019 in Kiev, Ukraine. Country teams were consulted before and after the workshop on data collation and validation, objective and scenario building, and results validation. Demographic, epidemiological, behavioural, programmatic, and expenditure data from various sources including UNAIDS Global AIDS Monitoring and National AIDS Spending Assessment reports, Integrated bio-behavioural surveillance surveys, national reports and systems, as well as from other sources were collated. This allocative efficacy analysis was conducted using Optima HIV, an epidemiological model of HIV transmission overlayed with a programmatic component and a resource optimization algorithm. A more detailed description of the Optima HIV model has been published by Kerr et al.[5]

Populations and HIV programs modeled

Populations considered in this analysis were:

- Key populations
    - Female sex workers (FSW)
    - Clients of female sex workers (Clients)
    - Men who have sex with men (MSM)
    - People who inject drugs (PWID)
- General populations

    - Males 0-14 (M0-14)
    - Females 0-14 (F0-14)
    - Males 15-49 (M15-49)
    - Females 15-49 (F14-49)
    - Males 50+ (M50+)
    - Females 50+ (F50+)

HIV programs considered in this analysis:

- Antiretroviral therapy (ART)
- HIV testing and prevention targeting PWID
- HIV testing and prevention targeting MSM
- HIV testing and prevention targeting FSW
- HIV testing services (HTS) for the general population
- Prevention of mother-to-child transmission (PMTCT)
- Opiate substitution therapy (OST)

Model constraints

Within the optimization analyses, no one on treatment, including ART, PMTCT, or OST, can be removed from treatment, unless by natural attrition.

Model weightings

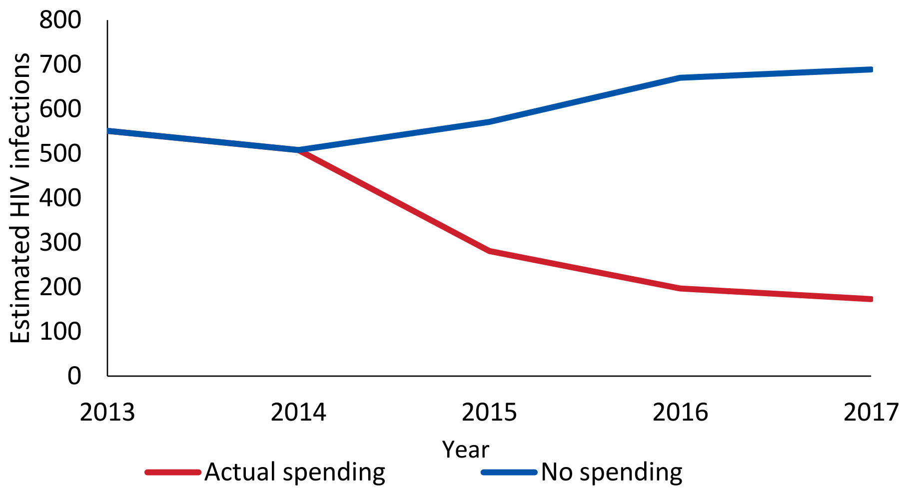
Objective weightings to minimize new HIV infections and HIV-related deaths by 2030 were weighted as 1 to 1 for infections to deaths.

Findings

Objective 1. Given 2015-2017 resource allocation, how many new HIV infections, HIV-related deaths, and HIV-related DALYs are estimated to have been averted through HIV program implementation?

To estimate the impact of past HIV spending on the status of HIV in Azerbaijan, all spending on targeted HIV programs was removed from 2015 to 2017, representing the previous Global Fund funding cycle period. This was compared with actual program spending over the same period, referred to as the baseline scenario.

Results suggest that past investments have had an important impact on the HIV response. Had the HIV program not been implemented from 2015 to 2017, by 2018 it is estimated that there could have been almost 200% more new HIV infections (almost 1,300 more infections) and over 150% more HIV-related deaths (approximately 1,200 more deaths) over this period (figure 1). In 2018, US$8.3 million was spent on targeted HIV programs in Azerbaijan.



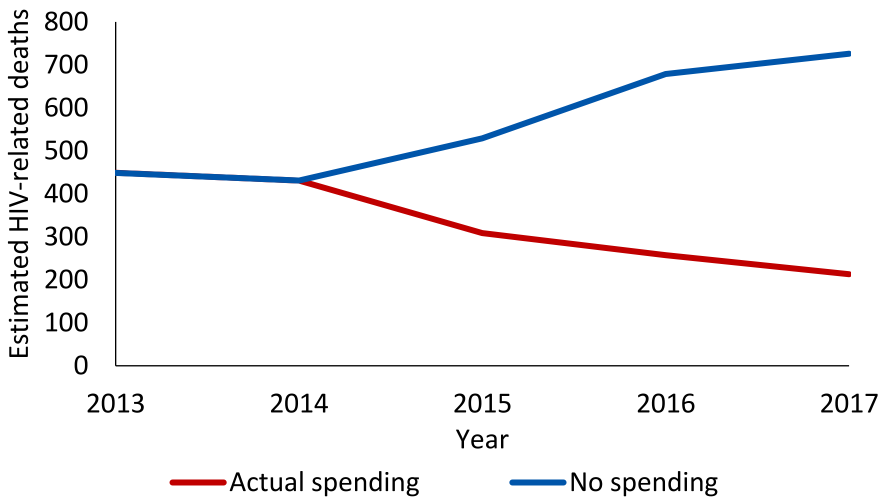


Figure 1. Estimated new HIV infections and HIV-related deaths in the absence of HIV program spending from 2015 to 2017

Objective 2. What is the optimized resource allocation to minimize HIV infections and HIV-related deaths by 2030 under varying budget levels?

Azerbaijan reported spending US$8.3M on targeted HIV programs in 2018 (figures 2 and 3). Spending for non-targeted HIV programs was not reported, nor is spending for these programs considered within the optimization. Optimization results suggest scaling up ART and PMTCT, which could lead to increased treatment coverage from 62% (status quo) to 91% (optimized) in 2019 with high coverage levels maintained to 2030 (figures 2 and 3; table A5).

At 100% optimized budget, results suggest shifting investment from HIV testing programs targeting the general population towards HIV testing and prevention programs targeting key populations (figures 2 and 3; table A5). Given that it is estimated that 86% of new HIV infections in Azerbaijan occurred among key populations, 40% in PWID, 22% in MSM and 24% FSW in 2018, programs targeting these group should be scaled up (figure 2; table A5). Spending on HIV testing programs for the general population represented over 40% of Azerbaijan's in 2018. By reinvesting resources from HIV testing programs for the general population to testing targeting PWID, MSM and FSW, while scaling up treatment, Azerbaijan could increase the number of people living with HIV who are diagnosed and those who receive treatment.

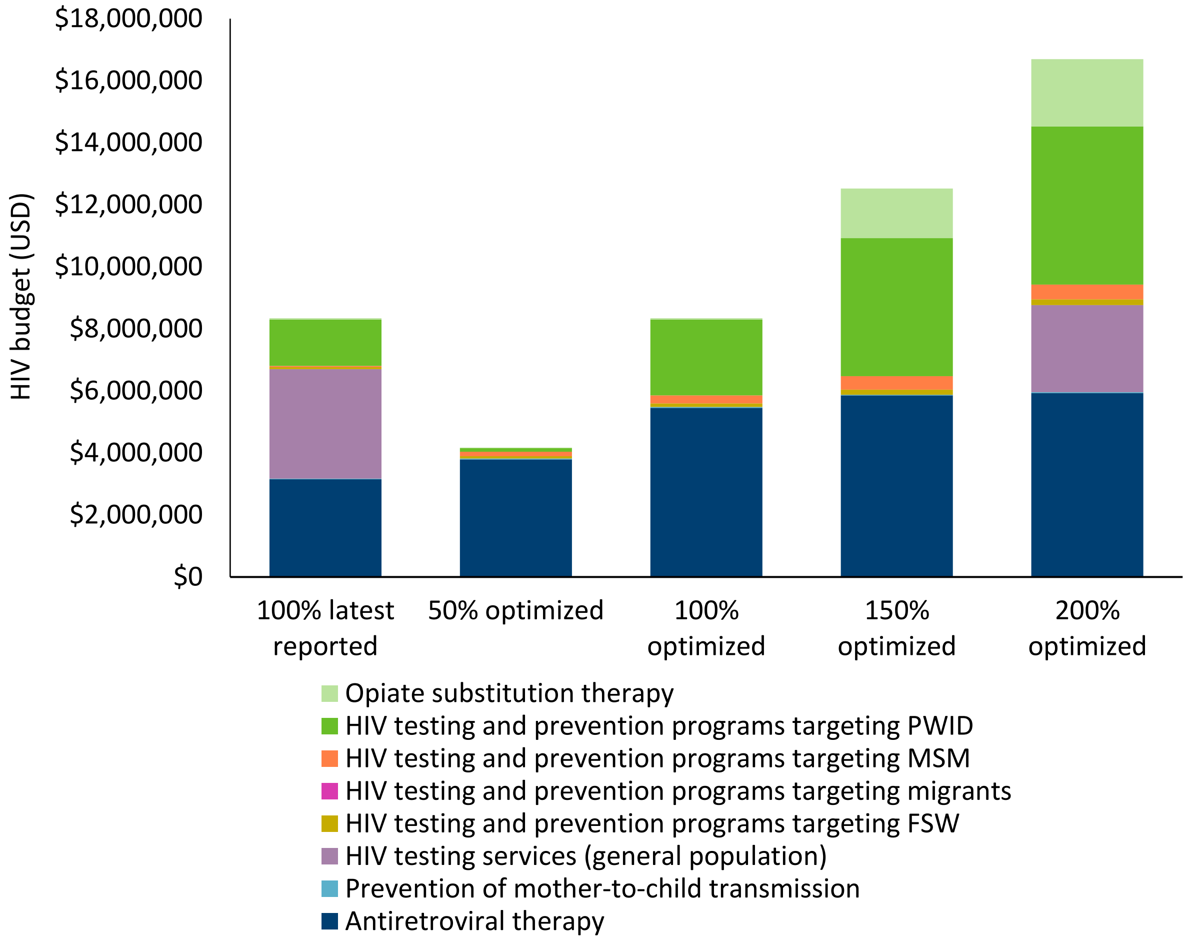


Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2019 to 2030 to minimize new infections and HIV-related deaths by 2030

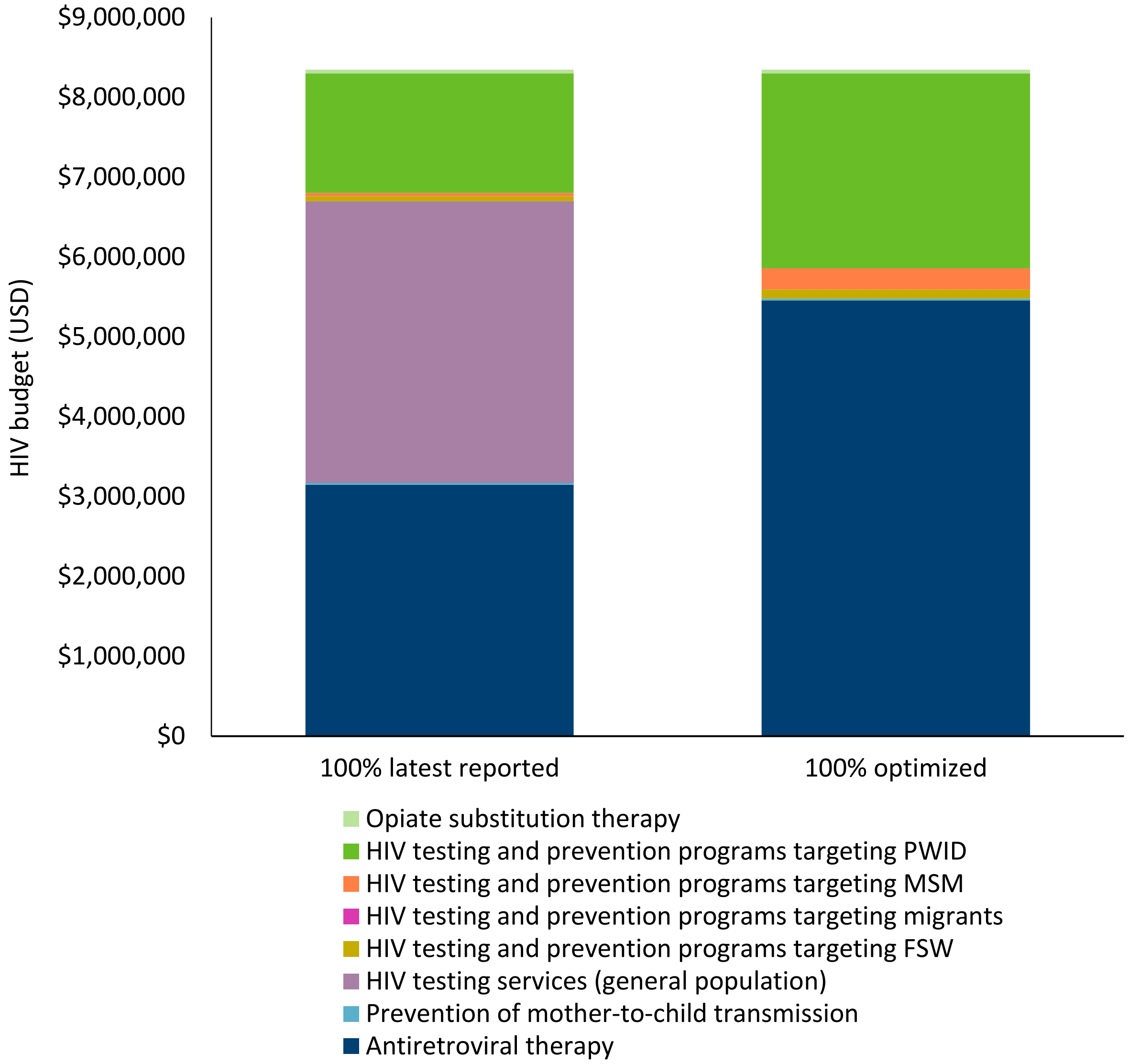


Figure 3. Optimized HIV annual resource allocation for 2019 to 2030 to minimize new infections and HIV-related deaths by 2030

Under 100% optimized annual budget to minimize new HIV infections and HIV-related deaths from 2019 to 2030, it is estimated that by 2030 an additional 50% of new HIV infections could be averted (1,200 more infections averted) and 30% more HIV-related deaths could be averted (600 more deaths averted) compared with the latest reported allocation being maintained over the same period (figure 4). By 2030, an additional 15,000 DALYs could be averted under optimized budget allocation.

If the budget were doubled to 200% and the allocation optimized, it is estimated that by 2030 new HIV infections could be reduced by an additional 65% (1,500 more infections averted), HIV-related deaths by 40% (900 more deaths averted), and HIV-related DALYs by 40% (22,000 more DALYs averted) compared with the latest reported budget level and allocation (figure 4). It is estimated that investment beyond 250% will only have very marginal impact on reducing HIV infections and deaths given the current mix of programs, as programs will reach set saturation levels (calculated as 95% of the maximum achievable reduction in infections and deaths in 2030 compared to 2018 levels).

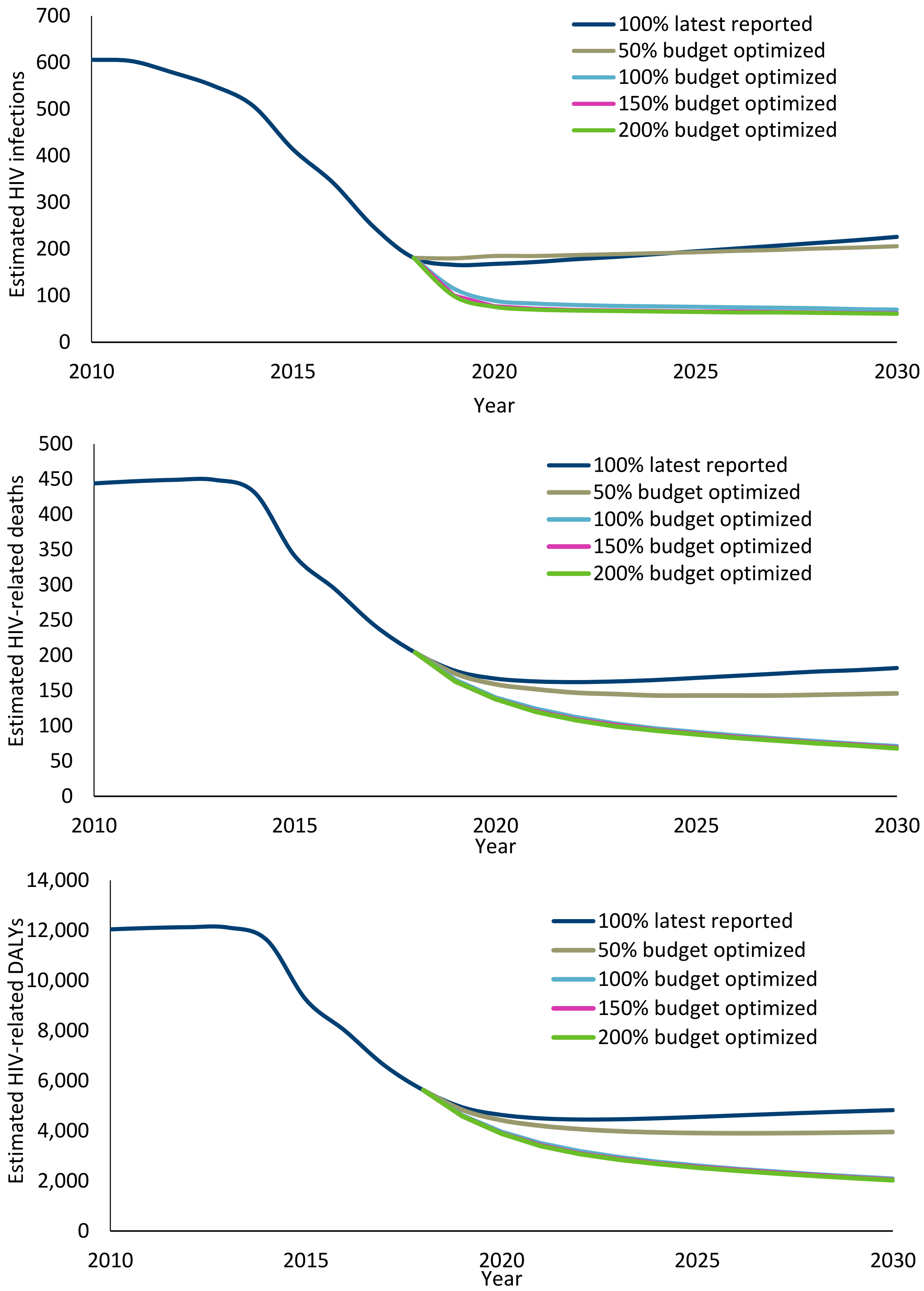


Figure 4. Estimated new HIV infections, HIV-related deaths, and HIV-related DALYs under optimized varying annual budget levels for 2019 to 2030 to minimize infections and deaths by 2030

Objective 3. What is the optimized HIV resource allocation for best achieving the 90-90-90 and 95-95-95 targets by 2020 and 2030, respectively, and what are the minimum levels of resources required for best achieving these targets?

Under latest reported budget, it is estimated that by 2020, 87% of people living with HIV will be diagnosed, 59% of those diagnosed will receive treatment, and 71% of those on treatment will achieve viral suppression (figure 5). Even with an increased budget, optimization results suggest that 90-90-90 targets will not be met by 2020, as this is such a short timeframe.

To approach 95-95-95 targets, it is estimated that the annual HIV program budget from 2019 to 2030 should be increased to 100% of the latest reported budget level and optimized with prioritization of antiretroviral therapy (ART), HIV testing and prevention programs targeting PWID, HIV testing and prevention programs targeting MSM and HIV testing and prevention programs targeting FSW (figure 6). By 2030, this could allow Azerbaijan to have 93% of people living with HIV be aware of their status, 97% of those diagnosed on treatment, and 95% of those on treatment to have achieved viral suppression (figure 5).

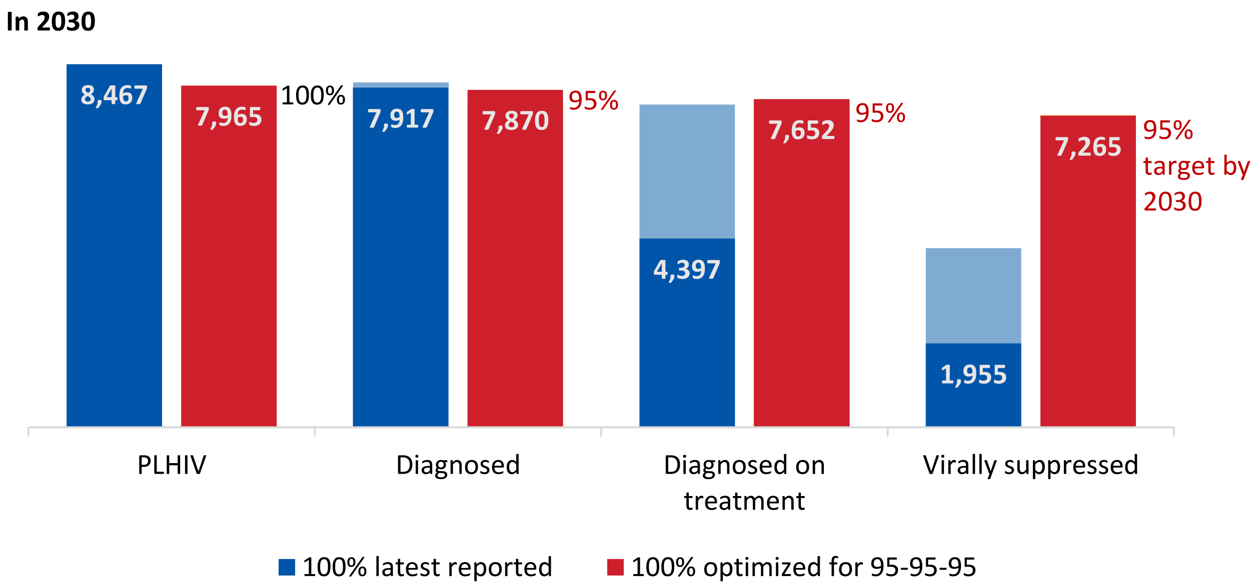


Figure 5. HIV cascade under optimized resource allocation to best achieve 95-95-95 targets by 2030. Dark blue bars represent progress towards 95-95-95 targets under 100% latest reported budget, with light blue bars showing the gap to achieving targets. Red bars represent progress towards 95-95-95 targets under 100% optimized resource allocation to best achieve 95-95-95 targets, with light red bars showing the gap to achieving targets.

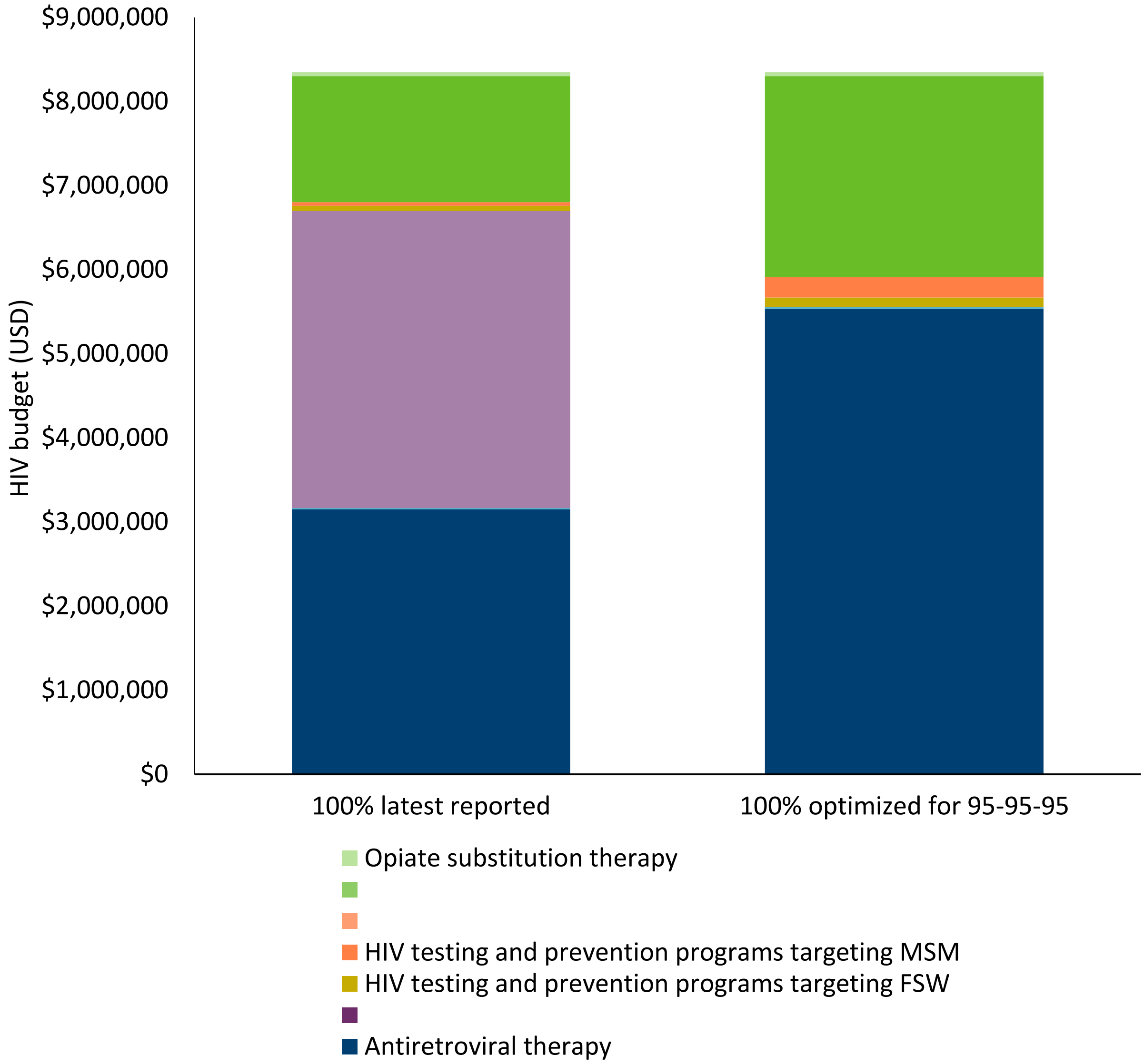
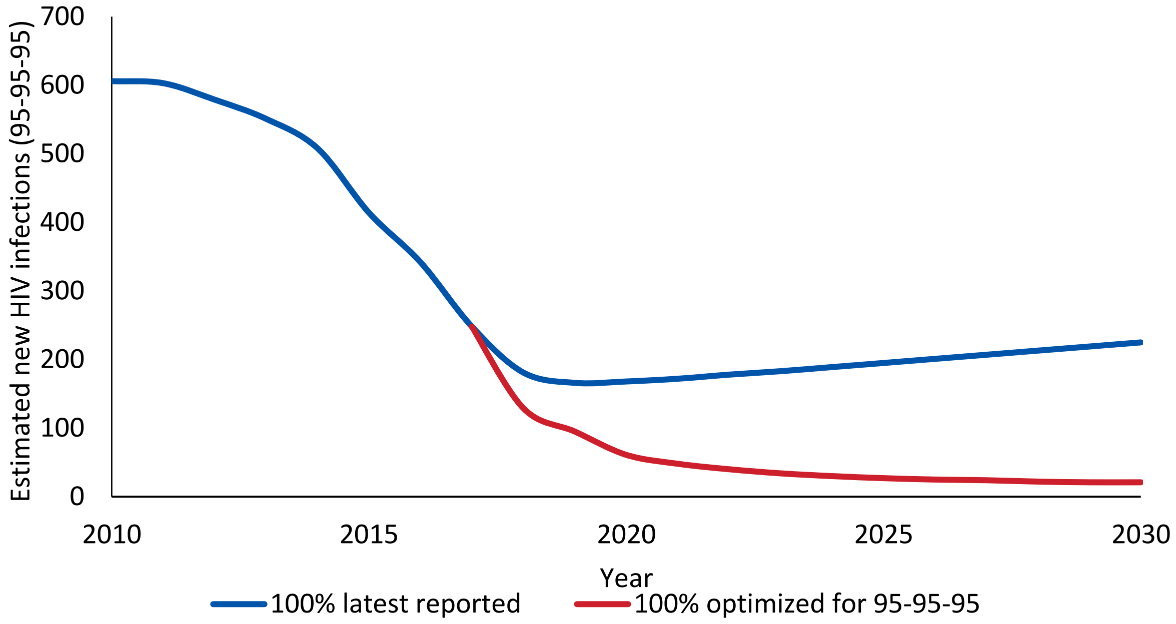


Figure 6. Optimized HIV budget level and allocation to best achieve 95-95-95 targets by 2030

Compared with latest reported 100% budget allocation, by 2030 under optimized allocation of 170% budget towards achieving 95-95-95 targets it is estimated that an additional 80% of new HIV infections could be averted (approximately 1,900 more infections averted) and 70% of HIV-related deaths could be averted (approximately 1,400 more deaths averted) (figure 7).



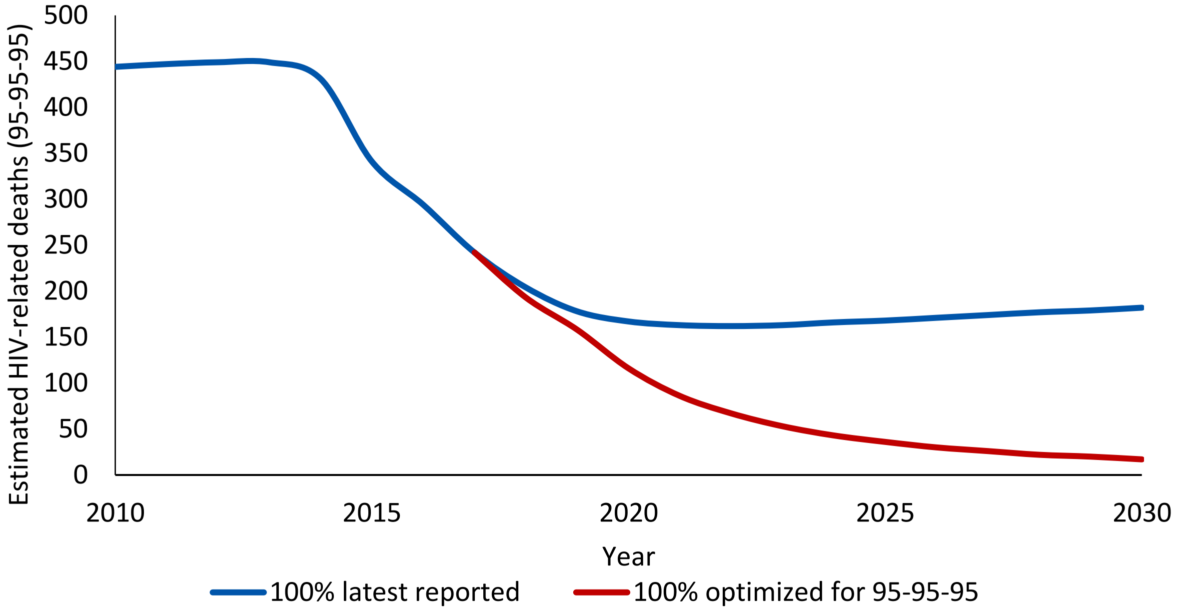


Figure 7. Estimated new HIV infections and HIV-related deaths under optimized allocation towards best achieving 95-95-95 targets by 2030

Study limitations

As with any modelling study, there are limitations that should be considered when interpreting results and recommendations from this analysis. First, limitations in data availability and reliability can lead to uncertainty surrounding projected results. Although the model optimization algorithm accounts for inherent uncertainty, it might not be possible to account for all aspects of uncertainty because of poor quality or insufficient data, particularly for cost and coverage values informing cost functions. Coupled with epidemic trends, cost functions are a primary factor in modeling optimized resource allocations. Second, we used contextual values and expert opinion where available, otherwise evidence from systematic reviews of clinical and research studies were used to inform model assumptions. Lastly, we did not capture the effects of migration of on the HIV epidemic.

Conclusions

The results of this allocative efficiency modeling analysis demonstrate the impact that an optimized resource allocation across a mix of HIV programs can have on reducing infections and deaths. The purpose of this modelling analysis was to evaluate the allocative efficiency of core HIV programs. However, additional gains could be achieved through improving technical or implementation efficiency. In addition, policy makers and funders are encouraged to consider resources required to improve equity, such as through investment in social enablers to remove human rights-based barriers to health. These elements have not been explicitly dealt with in this analysis.

References

1. Integrated Bio-behavioral surveillance and population size estimation survey among men who have sex with men in Azerbaijan, 2015.

2. Integrated Bio-behavioral surveillance and population size estimation survey among Female sex workers in Azerbaijan, 2015.

3. Integrated Bio-behavioral surveillance and population size estimation survey among people who inject drugs in Azerbaijan, 2015.

4. Country progress report – Azerbaijan, Global AIDS Monitoring 2018. UNAIDS, 2018.

5. Kerr CC, Stuart RM, Gray RT, Shattock AJ, Fraser-Hurt N, Benedikt C, et al. Optima: A model for HIV epidemic analysis, program prioritization, and resource optimization. JAIDS, 2015;69(3):365-76.

Appendices

Appendix 1. Model parameters

Table A1. Model parameters: transmissibility, disease progression, and disutility weights

Interaction-related transmissibility (% per act)	
Insertive penile-vaginal intercourse	0.04%
Receptive penile-vaginal intercourse	0.08%
Insertive penile-anal intercourse	0.09%
Receptive penile-anal intercourse	1.38%
Intravenous injection	0.80%
Mother-to-child (breastfeeding)	36.70%
Mother-to-child (non-breastfeeding)	20.50%
Relative disease-related transmissibility	
Acute infection	5.60
CD4 (>500)	1.00
CD4 (500) to CD4 (350-500)	1.00
CD4 (200-350)	1.00
CD4 (50-200)	3.49
CD4 (<50)	7.17
Disease progression (average years to move)	
Acute to CD4 (>500)	0.30
CD4 (500) to CD4 (350-500)	1.11
CD4 (350-500) to CD4 (200-350)	3.10
CD4 (200-350) to CD4 (50-200)	3.90
CD4 (50-200) to CD4 (<50)	1.90
Changes in transmissibility (%)	
Condom use	95%
Circumcision	58%
Diagnosis behavior change	0%
STI cofactor increase	265%
Opiate substitution therapy	54%
PMTCT	90%
Unsuppressive ART	50%
Suppressive ART	92%
Disutility weights	
Untreated HIV, acute	0.15
Untreated HIV, CD4 (>500)	0.01
Untreated HIV, CD4 (350-500)	0.02
Untreated HIV, CD4 (200-350)	0.07
Untreated HIV, CD4 (50-200)	0.27
Untreated HIV, CD4 (<50)	0.55
Treated HIV	0.05

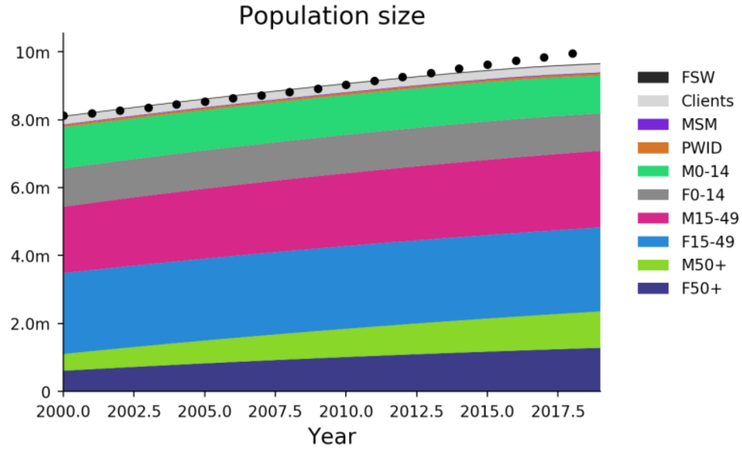
Source: Optima HIV User Guide Volume VI Parameter Data Sources

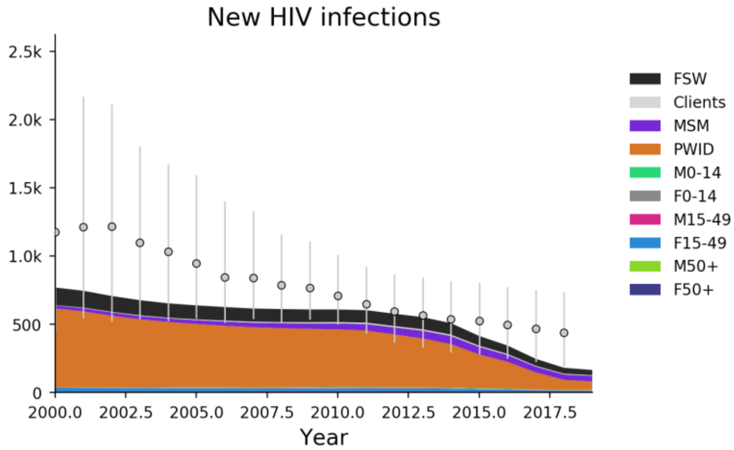
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

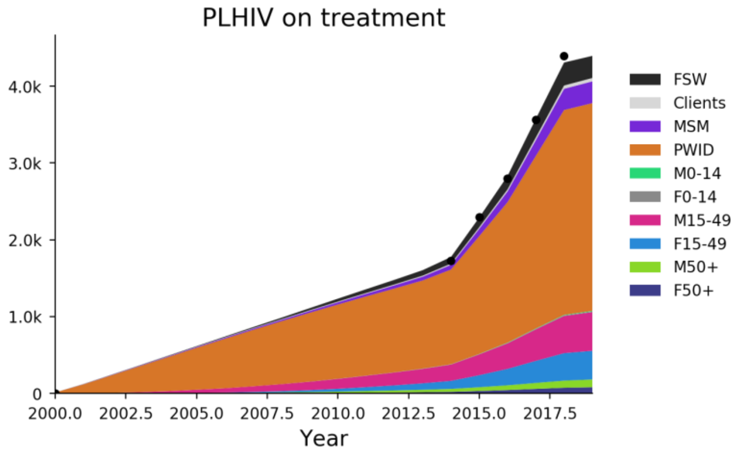
Treatment recovery due to suppressive ART (average years to move)	
CD4 (350-500) to CD4 (>500)	2.20
CD4 (200-350) to CD4 (350-500)	1.42
CD4 (50-200) to CD4 (200-350)	2.14
CD4 (<50) to CD4 (50-200)	0.66
Time after initiating ART to achieve viral suppression (years)	0.20
Number of VL tests recommended per person per year	2.00
CD4 change due to non-suppressive ART (%/year)	
CD4 (500) to CD4 (350-500)	3%
CD4 (350-500) to CD4 (>500)	15%
CD4 (350-500) to CD4 (200-350)	10%
CD4 (200-350) to CD4 (350-500)	5%
CD4 (200-350) to CD4 (50-200)	16%
CD4 (50-200) to CD4 (200-350)	12%
CD4 (50-200) to CD4 (<50)	9%
CD4 (<50) to CD4 (50-200)	11%
Death rate (% mortality per year)	
Acute infection	0%
CD4 (>500)	0%
CD4 (350-500)	1%
CD4 (200-350)	1%
CD4 (50-200)	8%
CD4 (<50)	43%
Relative death rate on suppressive ART	30%
Relative death rate on non-suppressive ART	70%
Tuberculosis cofactor	217%

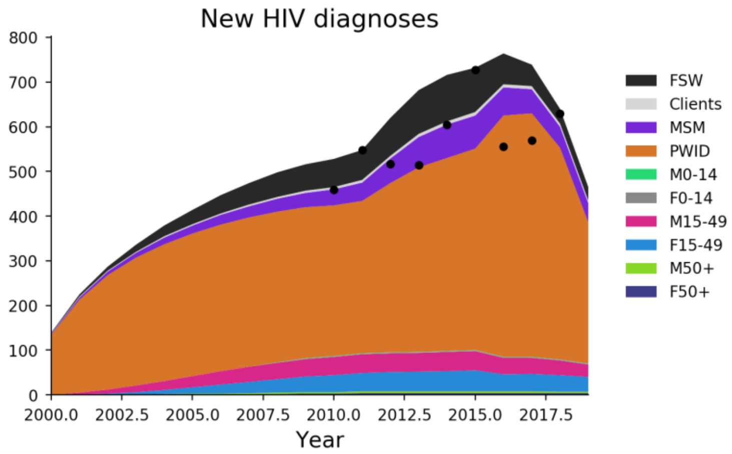
Source: Optima HIV User Guide Volume VI Parameter Data Sources

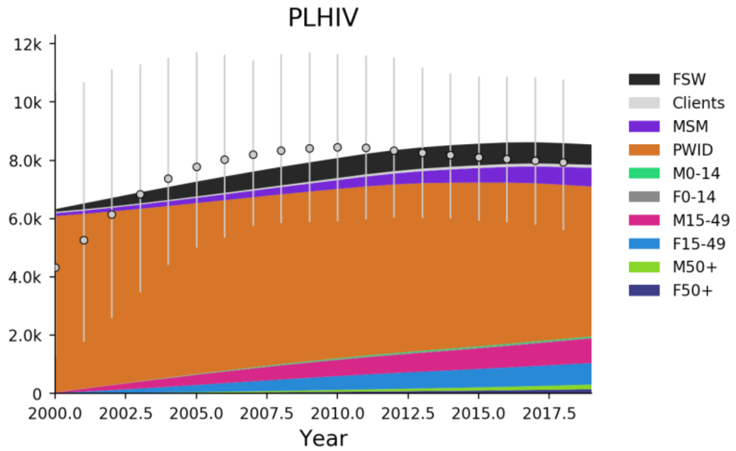
Appendix 2. Model calibration

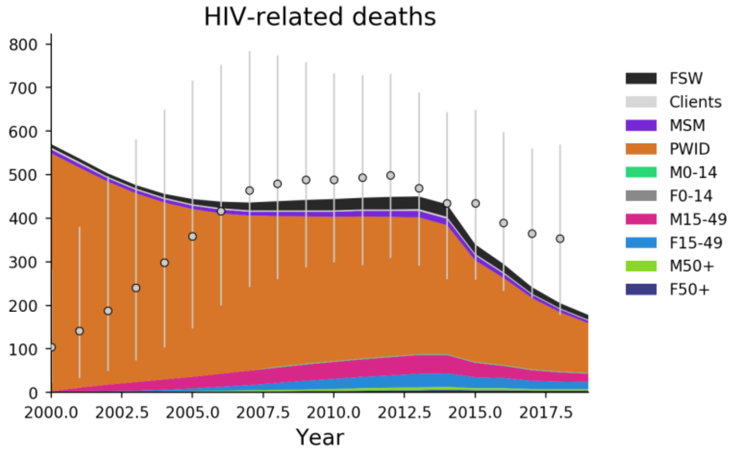




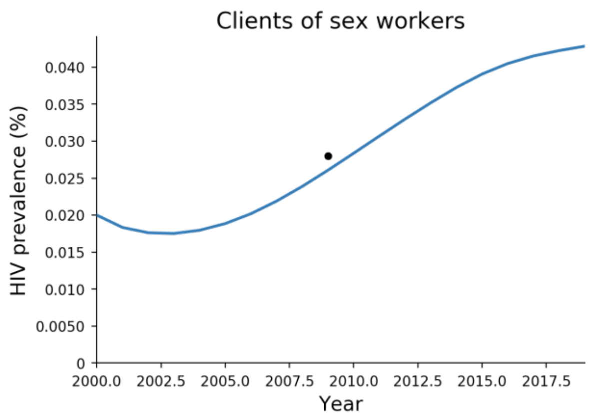


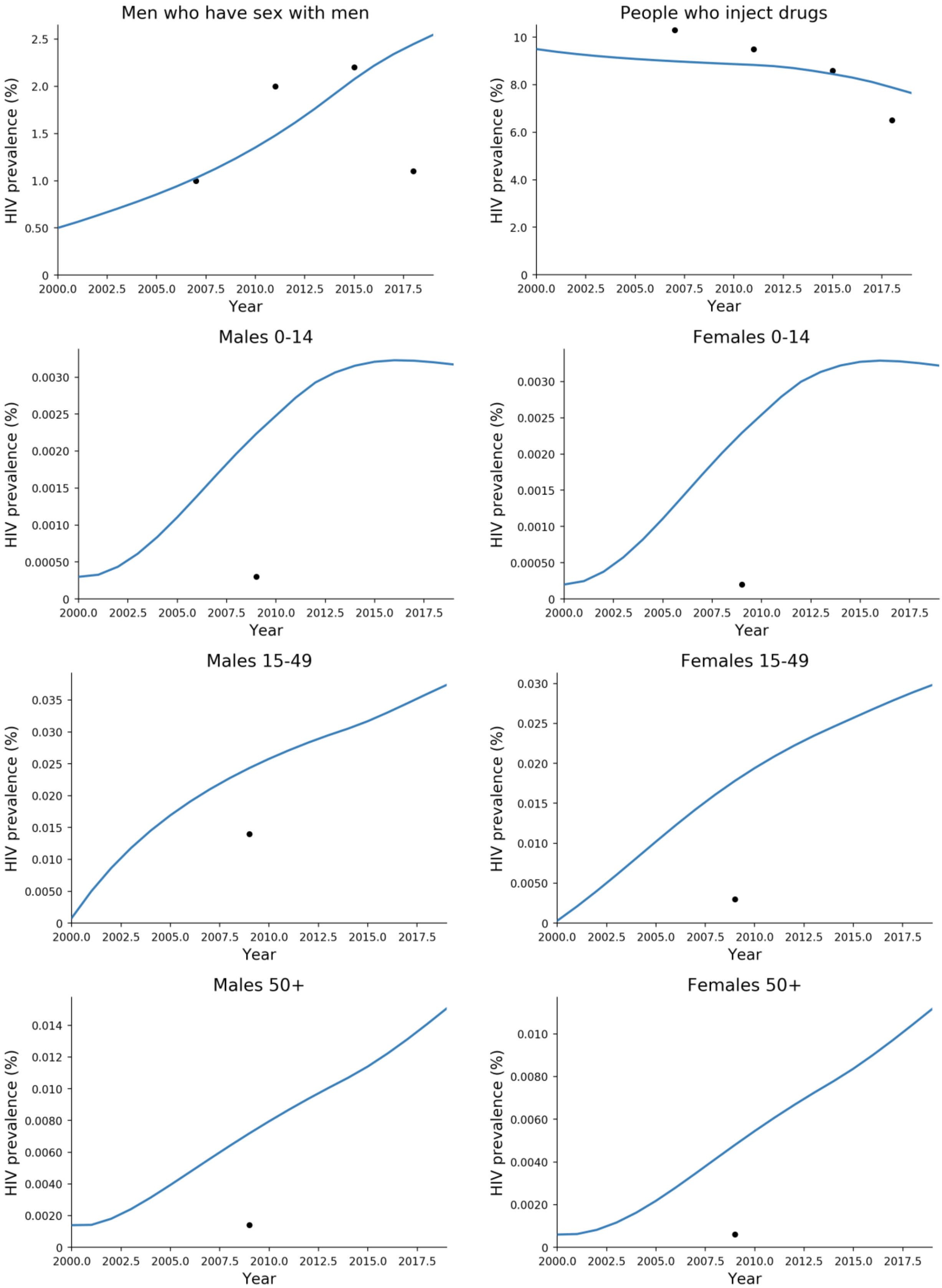

New HIV diagnoses
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


PLHIV
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


HIV-related deaths
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


Female sex workers
HIV prevalence (%)
Year


Clients of sex workers
HIV prevalence (%)
Year


Men who have sex with men
People who inject drugs
Males 0-14
Females 0-14
Males 15-49
Females 15-49
Males 50+
Females 50+
HIV prevalence (%)
Year
2000.0
2002.5
2005.0
2007.5
2010.0
2012.5
2015.0
2017.5

Appendix 3. HIV program costing

Table A3. HIV program unit costs and saturation values

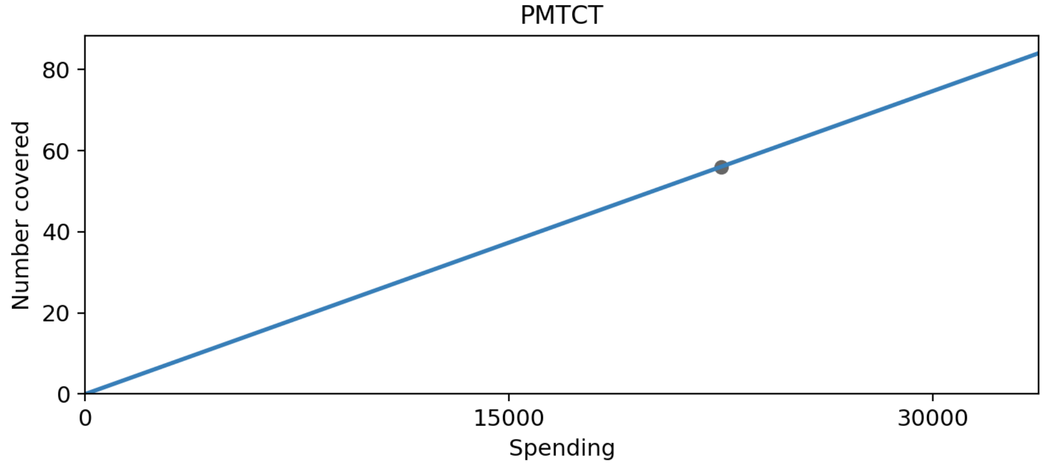
HIV program	Unit cost (USD)	Saturation (low)	Saturation (high)
Antiretroviral therapy (ART)	$716.15	85%	95%
HIV testing services (general population)	$4.20	80%	90%
HIV testing and prevention targeting FSW	$2.74	70%	80%
HIV testing and prevention targeting MSM	$8.10	65%	85%
HIV testing and prevention targeting PWID	$41.03	70%	80%
Opioid substitution therapy (OST)	$139.43	5%	10%
Prevention of mother-to-child transmission (PMTCT)	$401.97	98%	100%

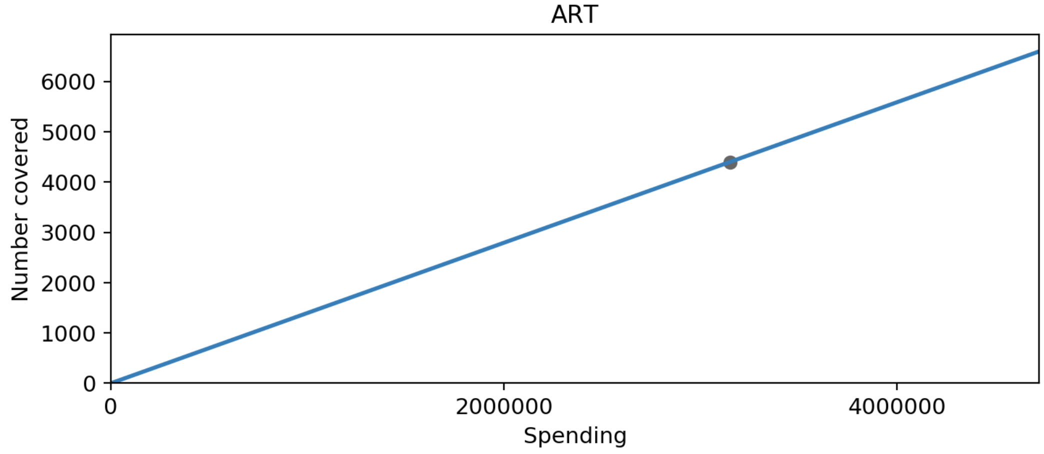
Table A4. Values used to inform HIV program cost functions

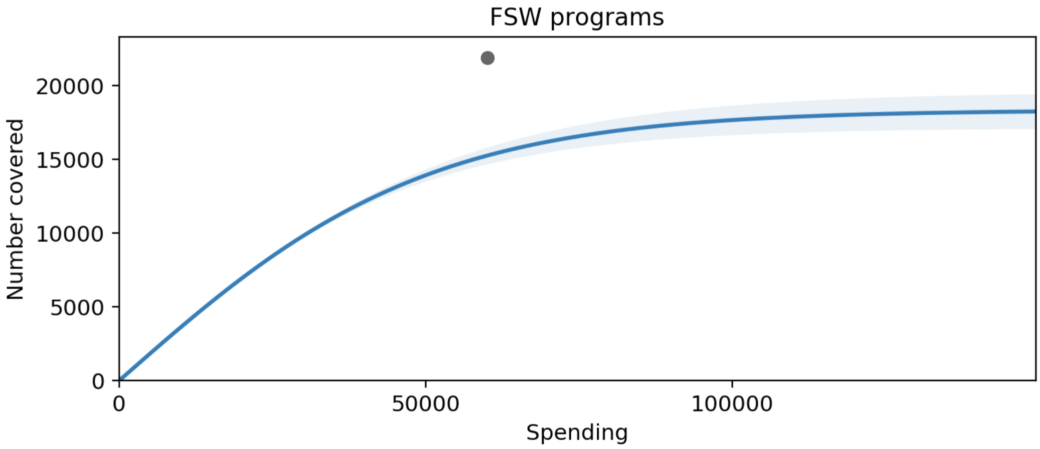
HIV program	Parameter	Population interactions or populations	In absence of any programs		At max attainable coverage	
			low	high	low	high
MSM programs	condom use (casual acts)	MSM, MSM	65%	75%	90%	95%
FSW programs	condom use (casual acts)	Clients, FSW	24%	27%	70%	80%
FSW programs	condom use (casual acts)	PWID, FSW	17%	20%	55%	55%
PWID programs	condom use (casual acts)	PWID, FSW	17%	20%	50%	55%
FSW programs	condom use (casual acts)	M15-49, FSW	25%	25%	65%	75%
FSW programs	condom use (casual acts)	M50+, FSW	25%	25%	65%	75%
PWID programs	condom use (casual acts)	PWID, F15-49	10%	15%	40%	55%
MSM programs	HIV testing rate	MSM	40%	60%	150%	150%
HTS	HIV testing rate	MSM	40%	60%	70%	70%
FSW programs	HIV testing rate	FSW	0%	2%	20%	30%
HTS	HIV testing rate	FSW	0%	2%	10%	10%
PWID programs	HIV testing rate	PWID	4%	4%	80%	85%
HTS	HIV testing rate	PWID	4%	4%	25%	25%
HTS	HIV testing rate	Clients	10%	10%	40%	50%
HTS	HIV testing rate	M0-14	2%	2%	25%	25%
HTS	HIV testing rate	F0-14	2%	2%	25%	25%
HTS	HIV testing rate	M15-49	15%	15%	50%	60%
HTS	HIV testing rate	F15-49	15%	15%	50%	60%
HTS	HIV testing rate	M50+	2%	2%	15%	15%

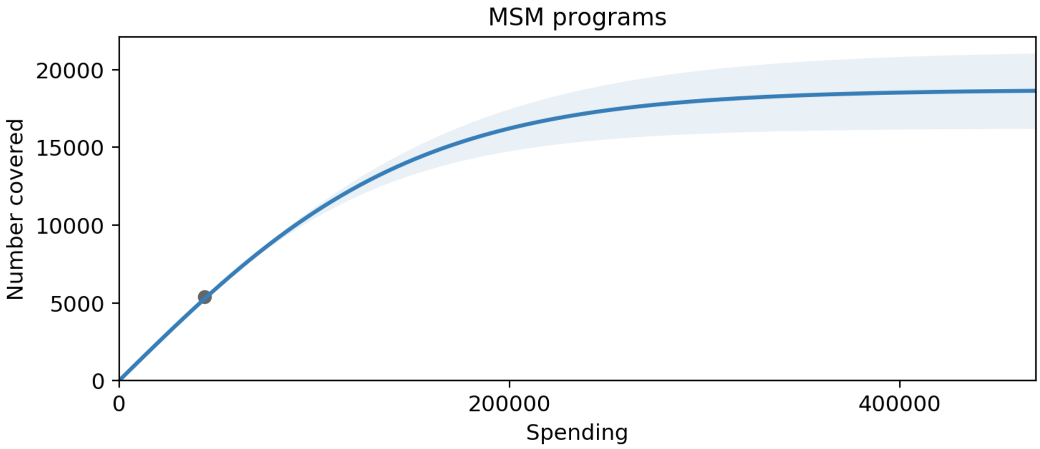
HIV program	Parameter	Population interactions or populations	In absence of any programs		At max attainable coverage	
			low	high	low	high
HTS	HIV testing rate	F50+	2%	2%	25%	25%
FSW programs	condom use (commercial acts)	('Clients', 'FSW')	50%	50%	85%	90%
FSW programs	condom use (commercial acts)	('PWID', 'FSW')	10%	10%	40%	50%
PWID programs	needle sharing	PWID	35%	35%	2%	2%

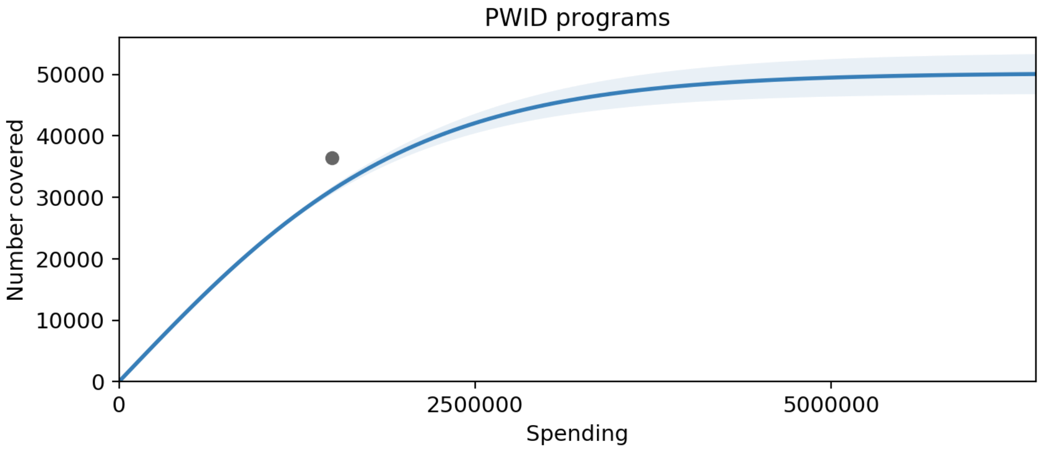
Appendix 4. Cost functions

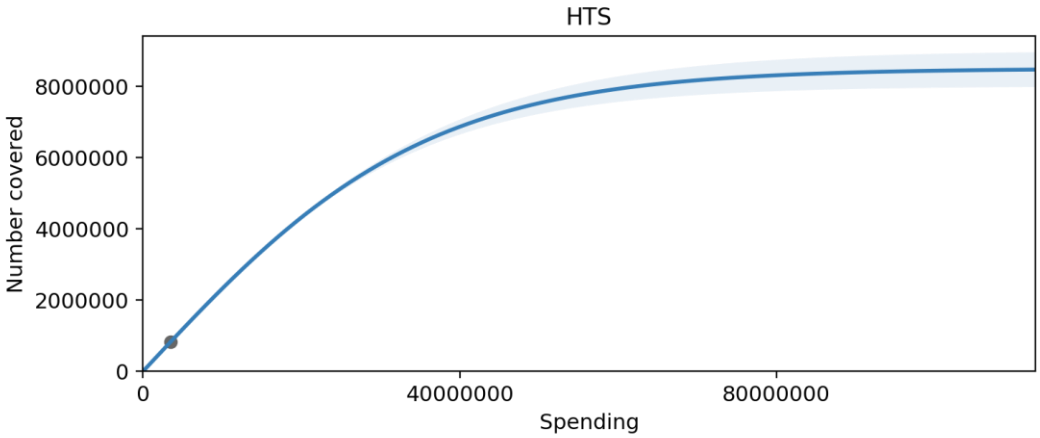





FSW programs
Number covered
20000
15000
10000
5000
0
50000
100000
Spending


MSM programs
Number covered
20000
15000
10000
5000
0
200000
400000
Spending


PWID programs
Number covered
50000
40000
30000
20000
10000
0
2500000
5000000
Spending


HTS
Number covered
8000000
6000000
4000000
2000000
0
40000000
80000000
Spending

Appendix 5. Annual HIV budget allocations at varying budgets

Table A5. Annual HIV budget allocations at varying budgets for 2019 to 2030

Targeted HIV programs	**100% latest reported (2018)**	**50% optimized**	**100% optimized**	**150% optimized**	**200% optimized**
HIV testing and prevention programs targeting FSW	$60,067	$78,151	$115,083	$167,486	$184,941
HIV testing and prevention programs targeting MSM	$43,902	$147,838	$263,969	$426,405	$475,482
HIV testing and prevention programs targeting PWID	$1,496,719	$106,912	$2,440,487	$4,451,552	$5,096,207
HIV testing services (general population)	$3,527,835	$0	$0	$0	$2,811,318
Opiate substitution therapy (OST)	$47,128	$23,564	$47,128	$1,596,606	$2,169,719
Prevention of mother-to-child transmission (PMTCT)	$22,510	$25,382	$25,005	$25,106	$25,277
Antiretroviral therapy (ART)	$3,148,930	$3,791,698	$5,455,420	$5,853,481	$5,931,238
Total targeted **HIV program budget**	$8,347,091	$4,173,546	$8,347,092	$12,520,637	$16,694,182

Table A6. Maximum estimated achievable HIV budget to minimize new HIV infections and HIV-related deaths by 95% under optimized allocation

Maximum impact budget	Reduction in HIV infections in 2030 compared with 2018	Reduction in HIV-related deaths in 2030 compared with 2018	Reduction in HIV infections in 2030 compared with 2010	Reduction in HIV-related deaths in 2030 compared with 2010
250%	67% (122)	67% (136)	90% (550)	85% (376)

Estimated as the budget required to achieve 95% of the maximum reduction in infections and deaths achievable. This is the maximum reduction in infections and deaths with the current mix of programs, delivered with the current program impacts. Additional reductions in infections and deaths could be realized if the current programs could be delivered more cost-efficiently or additional targeted HIV programs were to be implemented.