Resource optimization to maximize the HIV response in Armenia

Executive summary

In order 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 Armenian 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),** which could lead to increased treatment coverage of people diagnosed with HIV from 71% (status quo) to 83% (optimized) in 2019, with high coverage levels maintained to 2030.
- **Scaling up investment for HIV testing and prevention programs targeting migrants.** At 100% optimized budget, results suggest scaling-up investment in HIV testing and prevention programs targeting migrants, given that over 50% of new HIV infections in Armenia are estimated to have occurred among migrants in 2018. Should additional resources become available, investment in migrants programs should continue to be scaled-up.
- **Maintain some investment for HIV testing and prevention programs targeting men who have sex with men (MSM).** At 100% optimized budget, results suggest maintaining some investment for HIV testing and prevention programs targeting MSM, given that over 15% of new HIV infections in Armenia are estimated to have occurred among MSM in 2018. As additional resources become available, investment in this program should be scaled up.
- **Prioritise investment for HIV testing and prevention programs targeting people who inject drugs (PWID) as additional resources become available.** Given the relatively low number of new HIV infections estimated to have occurred among PWID in 2038, some investment should be maintained for this program and prioritized if over 150% of resources become available.

Given relatively low new HIV infections among the general population, it is **not recommended to prioritize HIV investment towards the general population at the latest reported budget level**, but rather to target limited funds towards key populations at higher-risk of acquiring and transmitting HIV.

Background

In Armenia, HIV prevalence among key populations has remained relatively low. An Integrated biological-behavioural surveillance survey reports published in 2018 showed an estimated HIV prevalence of 1.9% among PWID, 0.6% among FSW, and 1.9% among MSM.[1] While the number of new HIV infections reported among these populations has remained relatively low, nearly 70% of HIV cases registered from 2013 to 2017 were among seasonal labour migrant and their partners,[2] with HIV prevalence among migrants estimated to be 1.2% in 2018.[3]

To build upon the past success of the HIV program in Armenia, the country's 2017–2021 National Programme on the Response to the HIV Epidemic plan aims to achieve the 90–90–90 targets by 2020, to maintain elimination of mother-to-child HIV transmission, and to strengthen their HIV surveillance systems.[4]

Over the 2014-2015 period, an HIV allocative efficiency analysis was conducted using the Optima HIV model with support from the Wold Bank, UNAIDS, the Global Fund, and other partners. Since then, following on recommendations from the 2014-2015 analysis, there have been significant improvements in the adoption of updated HIV testing and treatment protocols, reductions in treatment costs, updated epidemiological values, and improvements in service delivery leading to cost savings. Following on from this initial study, an updated allocative efficacy modeling analysis was conducted to estimate the optimal allocation of HIV resources based on latest reported values with findings described below.

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 Armenia. Epidemiological and program data was provided by the Armenia country team and validated during a regional workshop that was held July 2019 in Kiev, Armenia. 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)
    - Seasonal labour migrants (migrants)
    - Prisoners
- General populations
    - Males 0-14 (M0-14)
    - Females 0-14 (F0-14)
    - Males 15-49 (M15-49)
    - Females 15-49 (F15-49)
    - Males 50+ (M50+)
    - Females 50+ (F50+)

HIV programs considered in this analysis:

- Antiretroviral therapy (ART)
- HIV testing and prevention targeting prisoners
- HIV testing and prevention targeting PWID, including needle-syringe programs (NSP)
- HIV testing and prevention targeting MSM
- HIV testing and prevention targeting migrants
- 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, and OST, can be removed from treatment, unless by natural attrition.

Model weightings

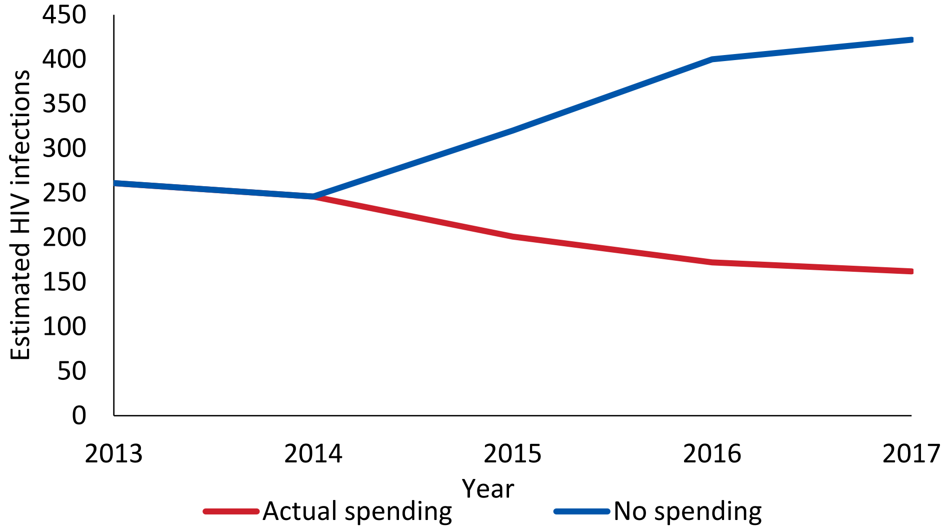
Objective weightings to minimize new HIV infections and HIV-related deaths by 2030 were weighted as 1 to 1 for infections to deaths.

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 Armenia, 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. This is referred to as the baseline scenario.

Results suggests 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 120% more new HIV infections (almost 6,000 more HIV infections) and almost 130% more HIV-related deaths (approximately 4,000 more HIV-related deaths) over this period (figure 1). The total annual spending of the HIV program in 2018 amounted to US$4,732,147, of which the estimated share of Global Fund contribution is 42.9%.



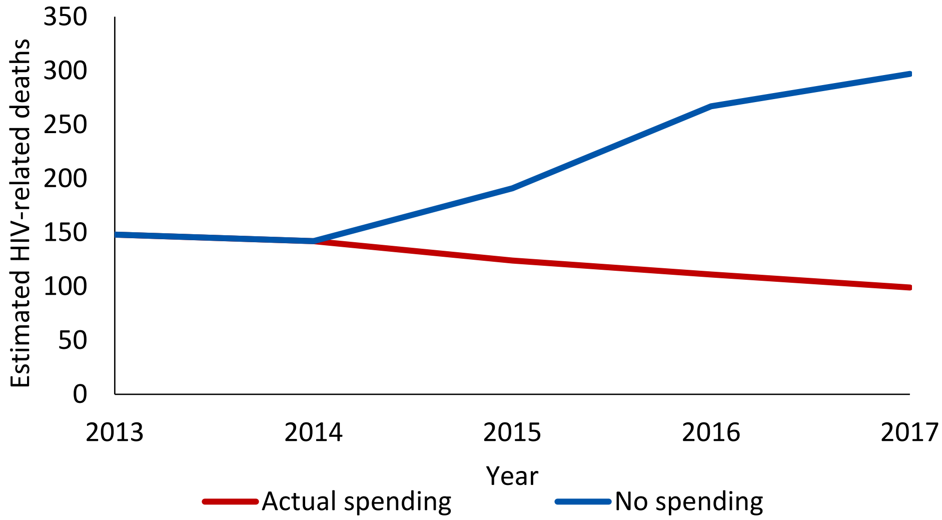


Figure 1. Estimated new HIV infections and HIV-related deaths in the absence of HIV program spending from 2015 to 2017

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

Armenia has a latest reported HIV program budget of US$4.7M in 2018 with approximately 53% of the overall budget invested in non-targeted HIV programs (figures 2 and 3). Optimization results suggest scaling up ART, which could lead to increased treatment coverage from 71% (status quo) to 83% (optimized) in 2019, with high coverage levels maintained to 2030 (figures 2 and 3; table A5).

At 100% optimized budget, results suggest scaling up investment for HIV testing and prevention programs targeting migrants (figures 2 and 3; table A5), given that over 50% of new HIV infections in Armenia are estimated to have occurred among migrants in 2018. Should additional resources become available, investment in migrant HIV programs should continue to be scaled-up (figure 2; table A5). At the 100% budget level, some investment for HIV testing and prevention programs targeting MSM should be maintained, given that 15% of new HIV infections are among MSM in 2018. As additional resources become available, investment in HIV testing and prevention programs targeting MSM should be scaled up (figure 2; table A5). Some investment in PWID programs should be maintained and scaled up as additional resources over 150% of the budget become available.

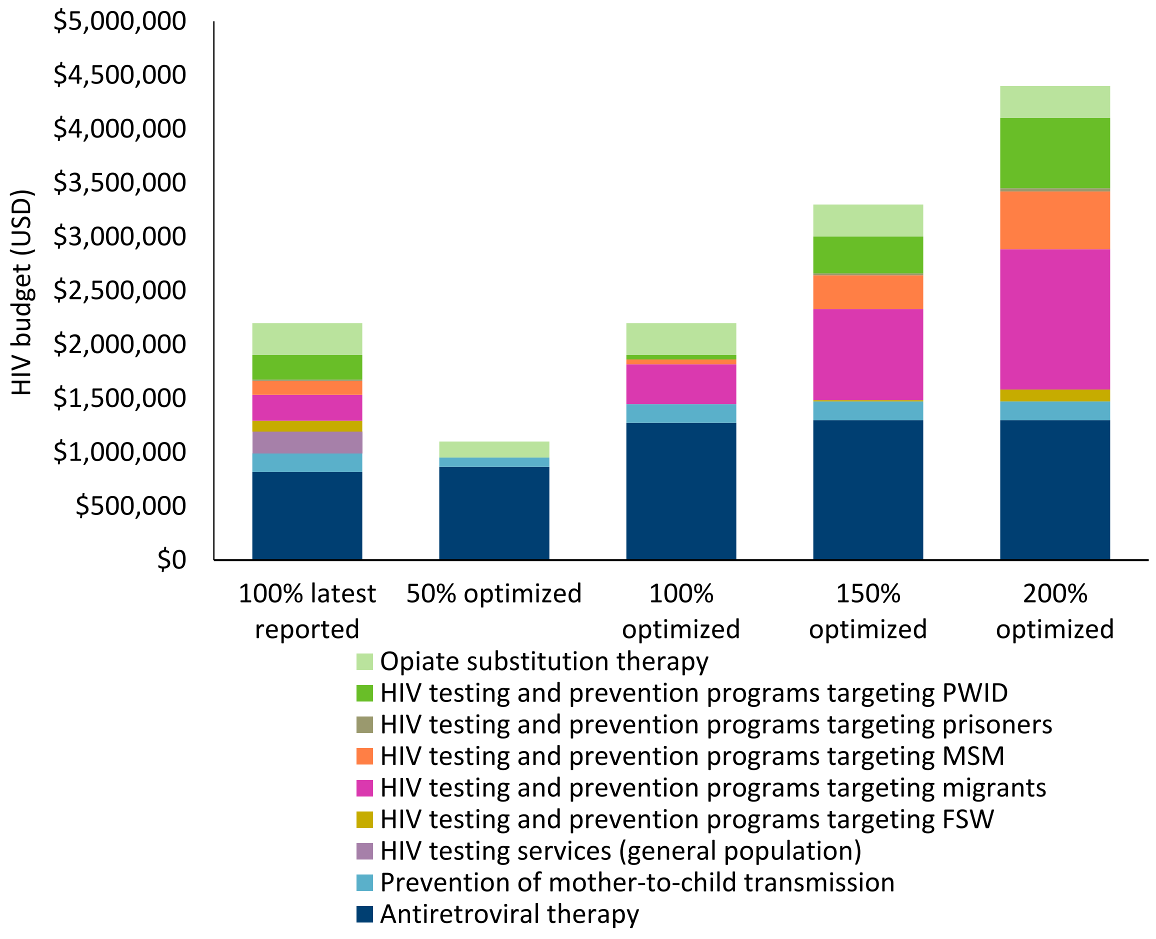


Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2019 to 2030, to minimize new infections and HIV-related deaths by 2030

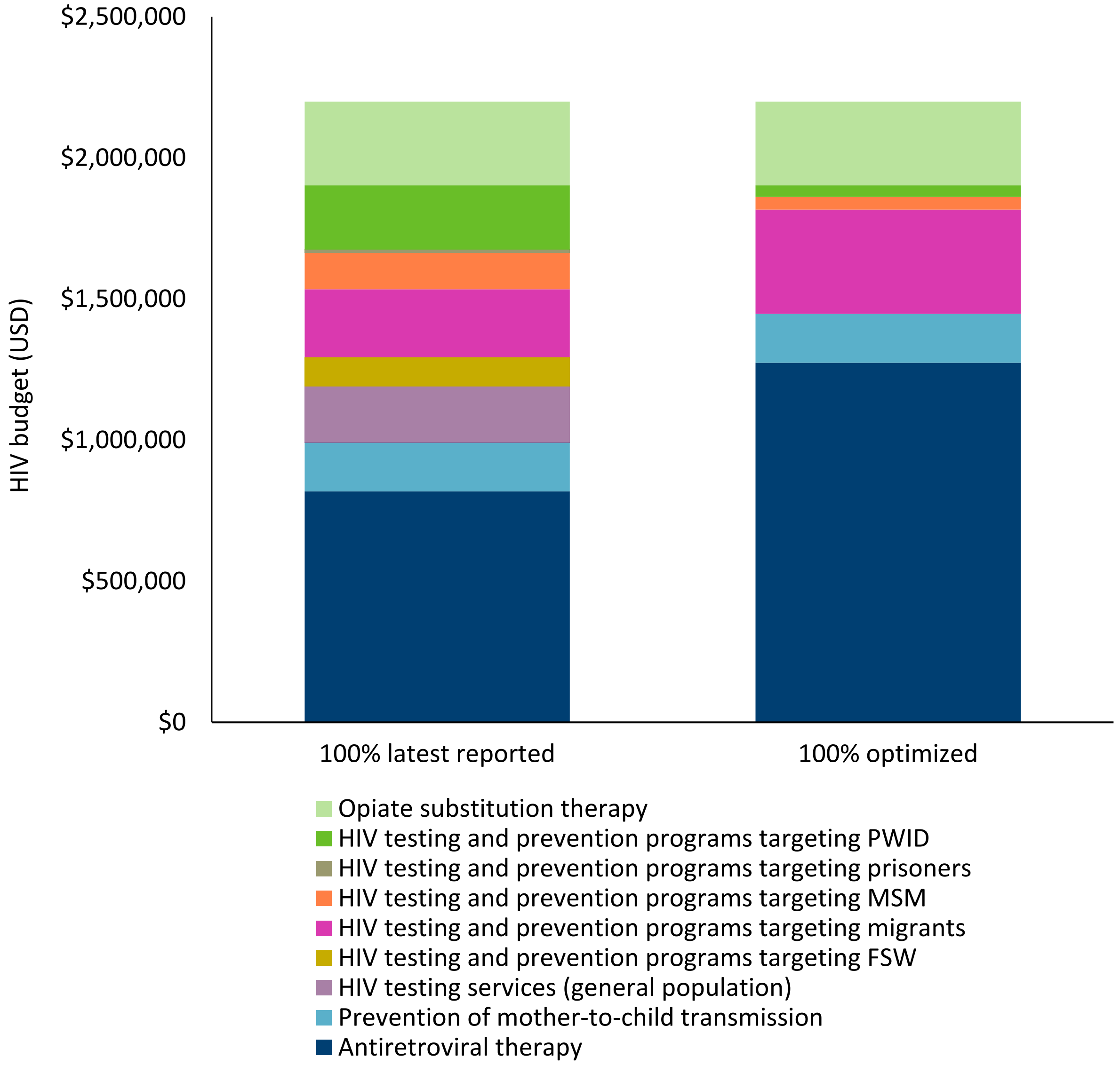


Figure 3. Optimized HIV annual resource allocation for 2019 to 2030 to minimize new infections and HIV-related deaths by 2030

Under 100% optimized annual budgets for 2019 to 2030 to minimize new HIV infections and HIV-related deaths over this period, it is estimated that by 2030 an additional 44% of new HIV infections could be averted (800 more infections averted) and 24% more HIV-related deaths could be averted (150 more deaths averted) compared with the latest reported allocation being maintained over the same period (figure 4). By 2030, an additional 3,200 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 57% (1,000 more infections averted), HIV-related deaths by 33% (200 more deaths averted), and HIV-related DALYs by 30% (4,500 more DALYs averted) compared with the latest reported budget level and allocation (figure 4). It is estimated that optimized investment beyond 350% will have only very marginal impact on reducing HIV infections and deaths given the modeled mix of programs (estimated as 95% of the maximum achievable reduction in infections and deaths in 2030 compared to 2018 levels).

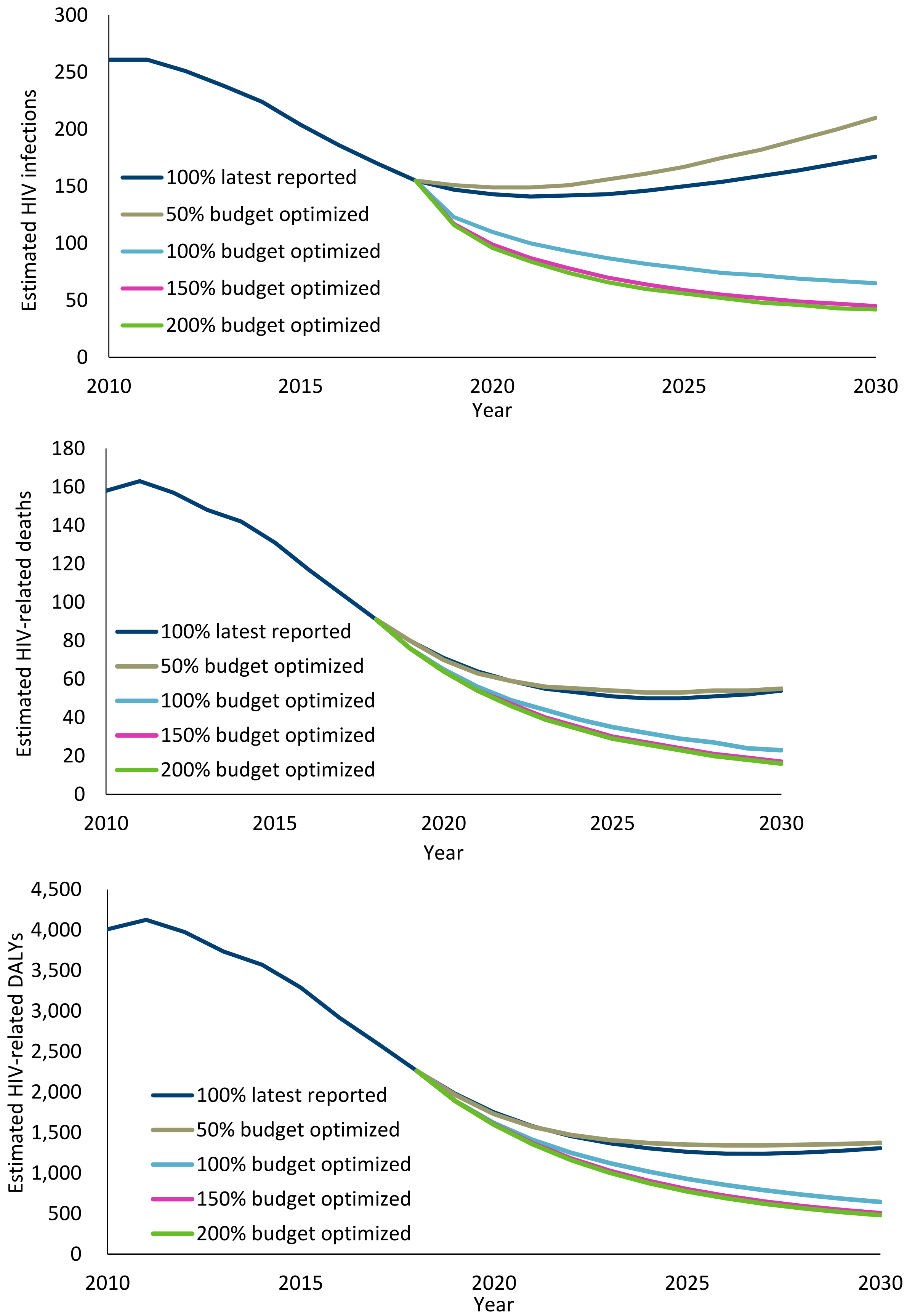


Figure 4. Estimated new HIV infections, HIV-related deaths, and HIV-related DALYs under optimized varying annual budget levels 2019 to 2030 to minimize infections and deaths by 2030

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 conditions, it is estimated that by 2020 84% of people living with HIV will be diagnosed, 55% of those diagnosed will receive treatment, and 90% of those on treatment will achieve viral suppression (figure 5). Even with an increased budget, optimization results suggests 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 140% of the latest reported budget level (an additional $1M annually) and optimized to prioritize antiretroviral therapy (ART), HIV testing and prevention programs targeting migrants, and HIV testing and prevention programs targeting MSM (figure 6). By 2030, this could allow Armenia to have 94% of people living with HIV be aware of their status, 95% of those diagnosed on treatment, and 95% of those on treatment to have achieved viral suppression (figure 5).

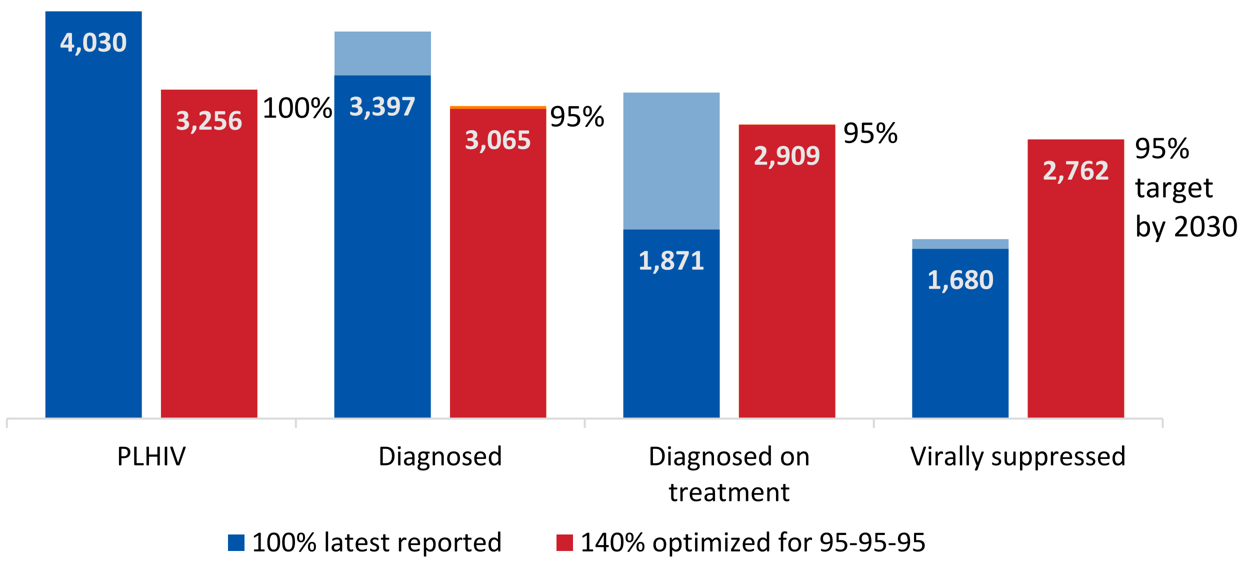


Figure 5. HIV cascade under optimized resource allocation to best achieve 95-95-95 targets by 2030. Dark blue bars represent progress towards 95-95-95 targets under 100% latest reported budget, with light blue bars showing the gap to achieving targets. Red bars represent progress towards 95-95-95 targets under 140% optimized resource allocation to best achieve 95-95-95 targets, with light red bars showing the gap to achieving targets.

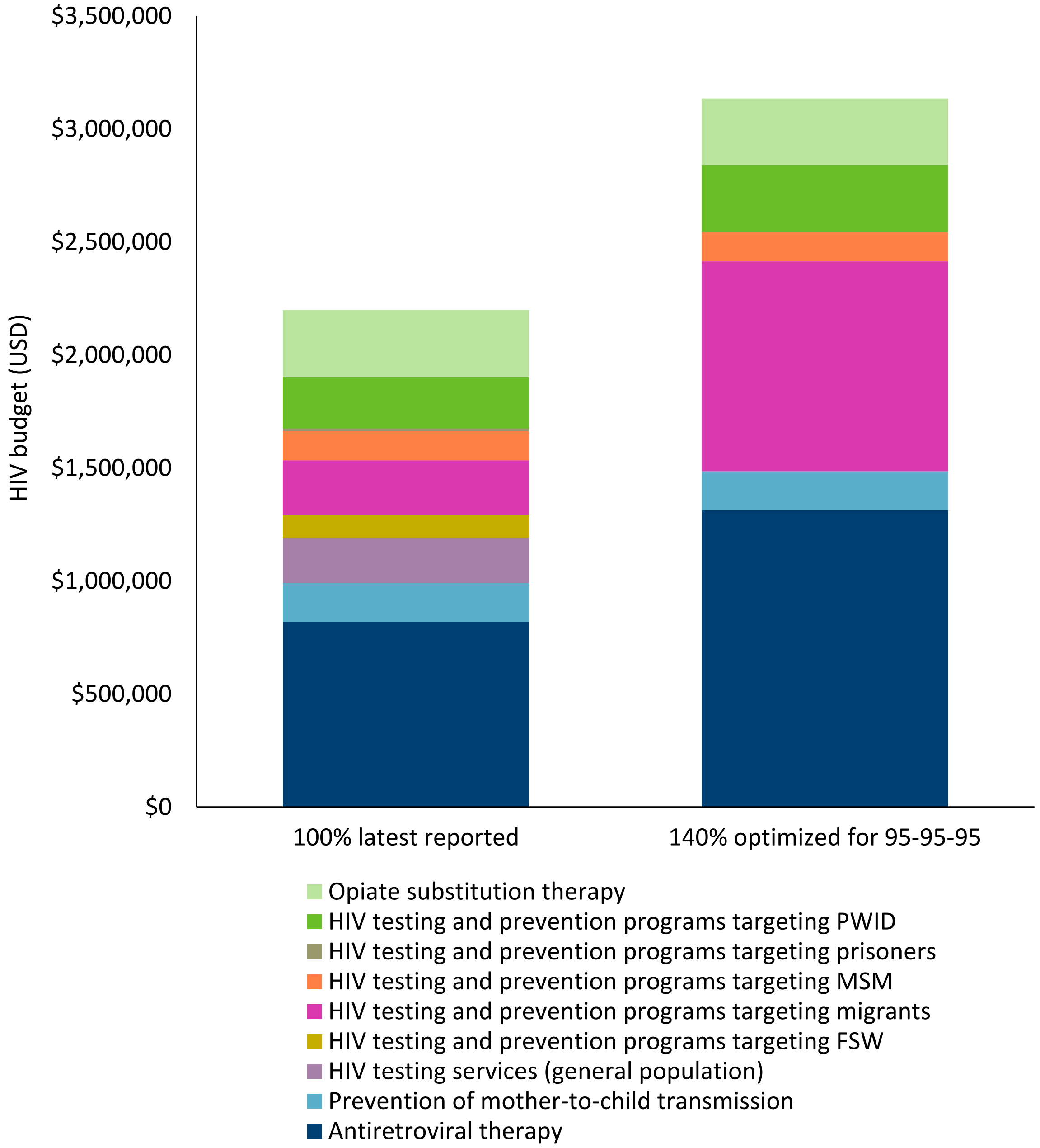


Figure 6. Optimized HIV budget level and allocation to best achieve 95-95-95 targets by 2030

Compared with latest reported 100% budget allocation, by 2030 under optimized allocation of 140% budget towards achieving 95-95-95 targets it is estimated that an additional 60% of new HIV infections could be averted (approximately 1,100 more infections averted) and 30% of HIV-related deaths could be averted (approximately 200 more deaths averted) (figure 7).

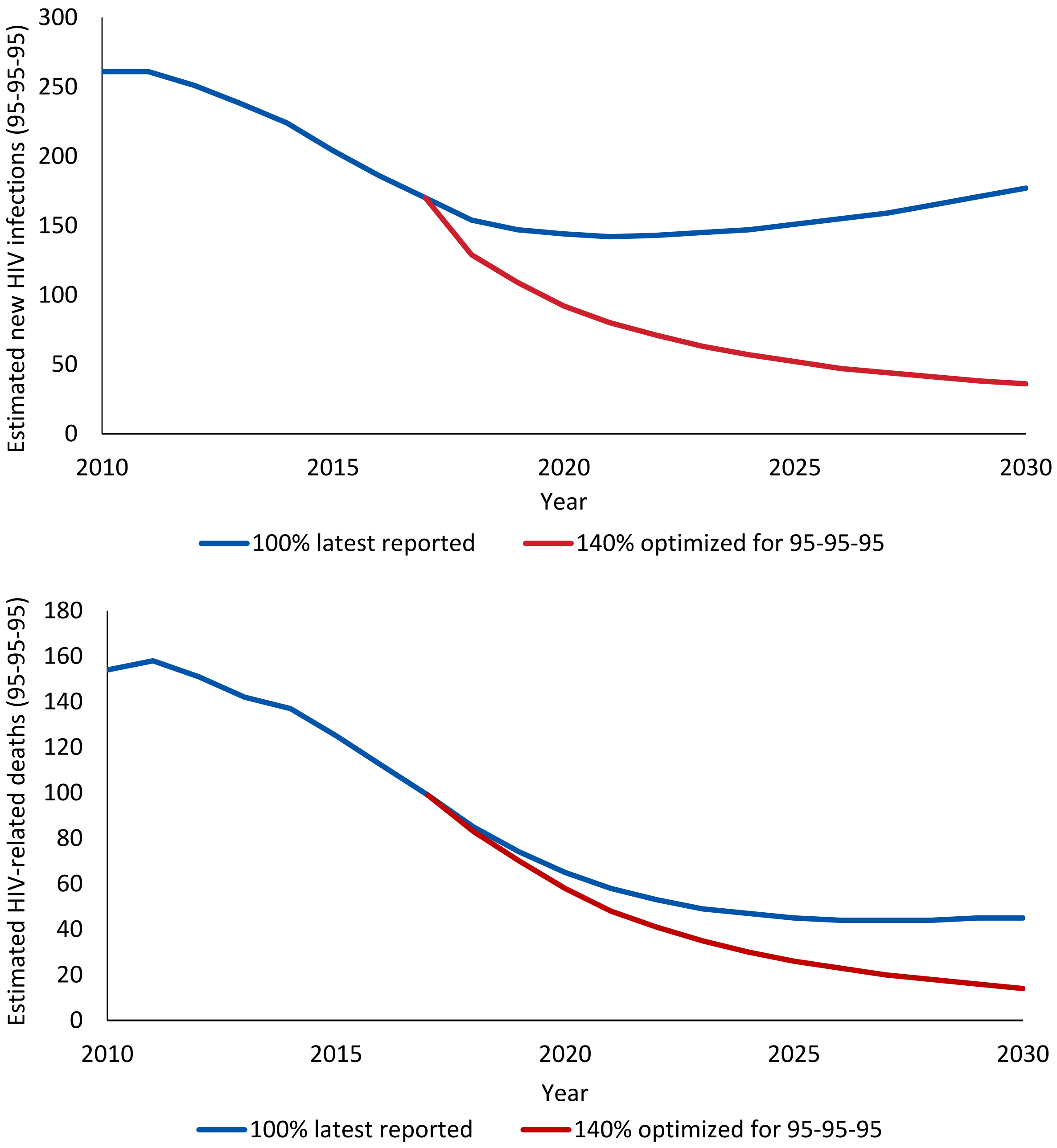


Figure 7. Estimated new HIV infections and HIV-related deaths under optimized allocation towards best achieving 95-95-95 targets by 2030

Study limitations

As with any modelling study, there are limitations that should be taken into account when considering 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.

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 biological-behavioral surveillance survey among people who inject drugs, female sex workers, men who have sex with men and transgender persons, National Center for AIDS Prevention of Ministry of Health of Armenia (NCAP), 2018.
2. Annual report. HIV epidemiological surveillance in the Republic of Armenia, National Center for AIDS Prevention of Ministry of Health of Armenia (NCAP), 2018
3. Biological and Behavioral Surveillance Survey on Armenian, Male, Seasonal Labor Migrants in Urban Communities in Armenia, National Center for AIDS Prevention of Ministry of Health of Armenia (NCAP), 2018.
4. Armenia progress report, 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%
	Pre-exposure prophylaxis	73%
	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

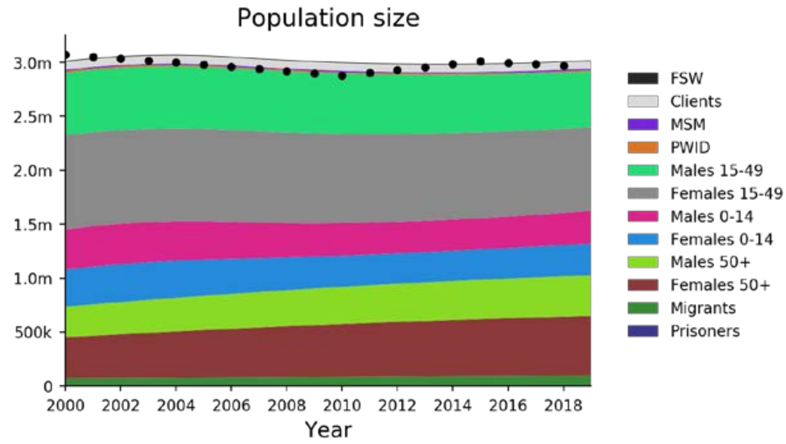
Source: Optima HIV User Guide Volume VI Parameter Data Sources

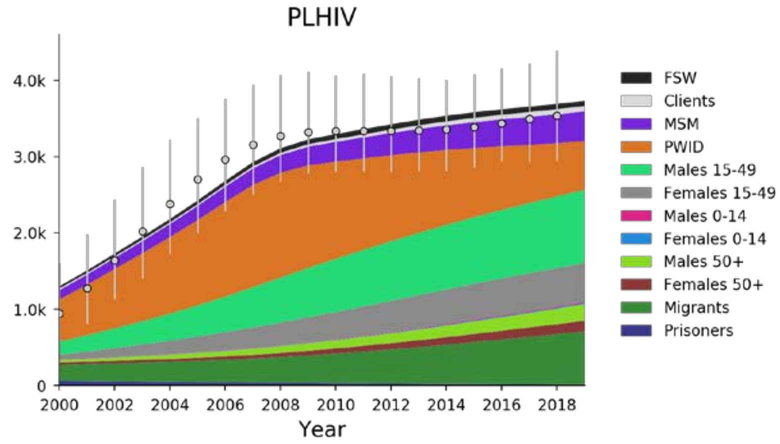
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

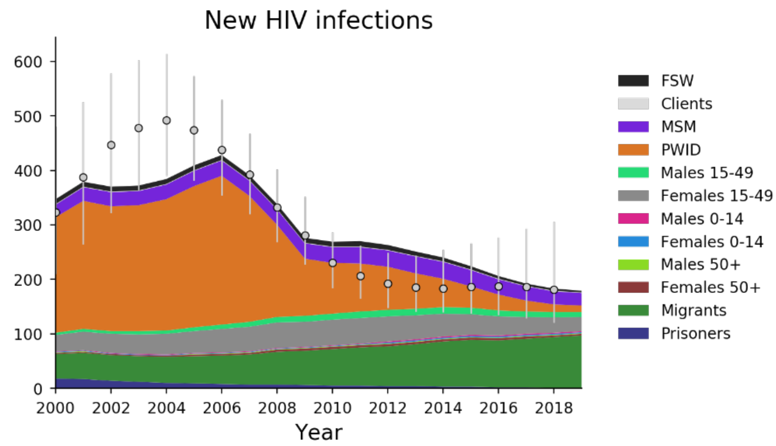
Treatment recovery due to suppressive ART (average years to move)		
	CD4 (350-500) to CD4 (>500)	2.20
	CD4 (200-350) to CD4 (350-500)	1.42
	CD4 (50-200) to CD4 (200-350)	2.14
	CD4 (<50) to CD4 (50-200)	0.66
	Time after initiating ART to achieve viral suppression (years)	0.20
	Number of VL tests recommended 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%

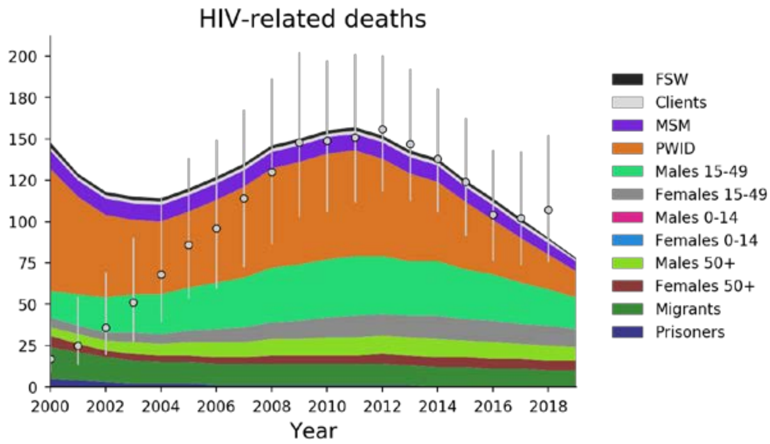
Source: Optima HIV User Guide Volume VI Parameter Data Sources

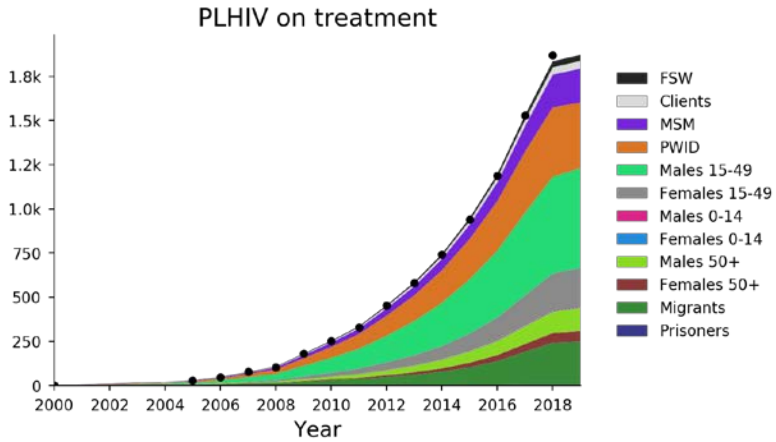
Appendix 2. Model calibration

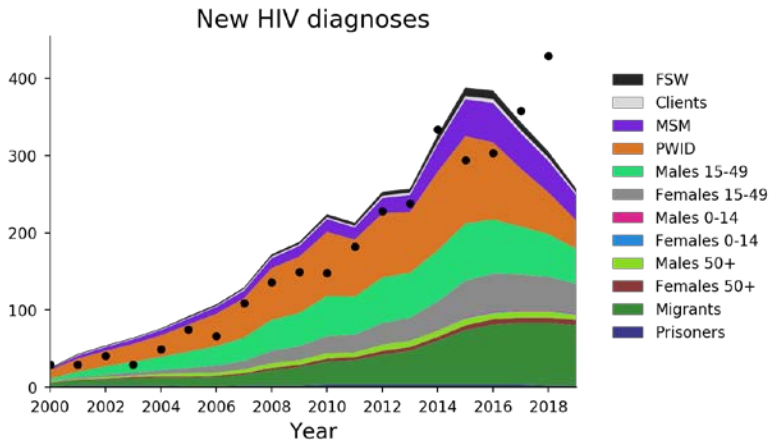


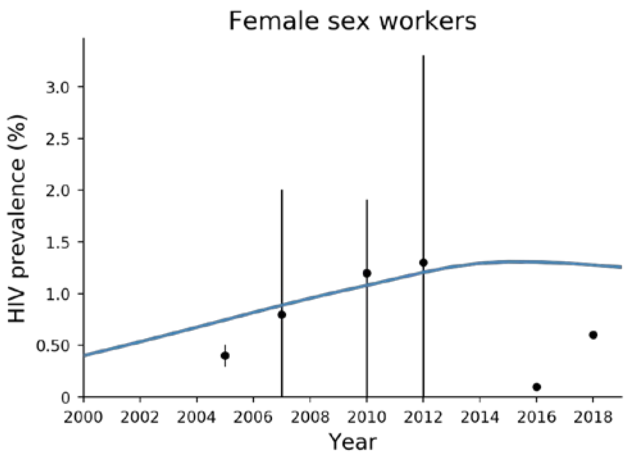


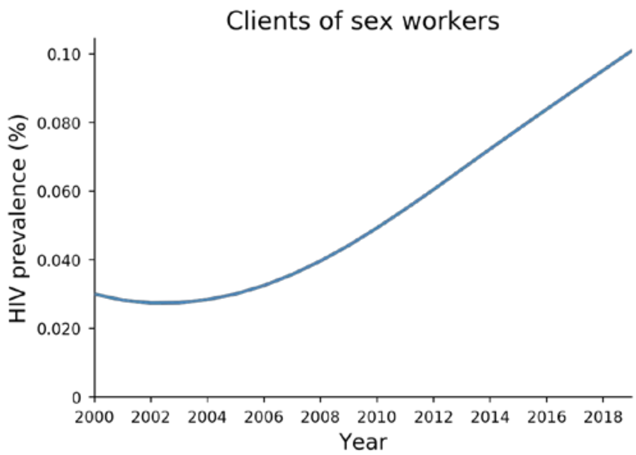


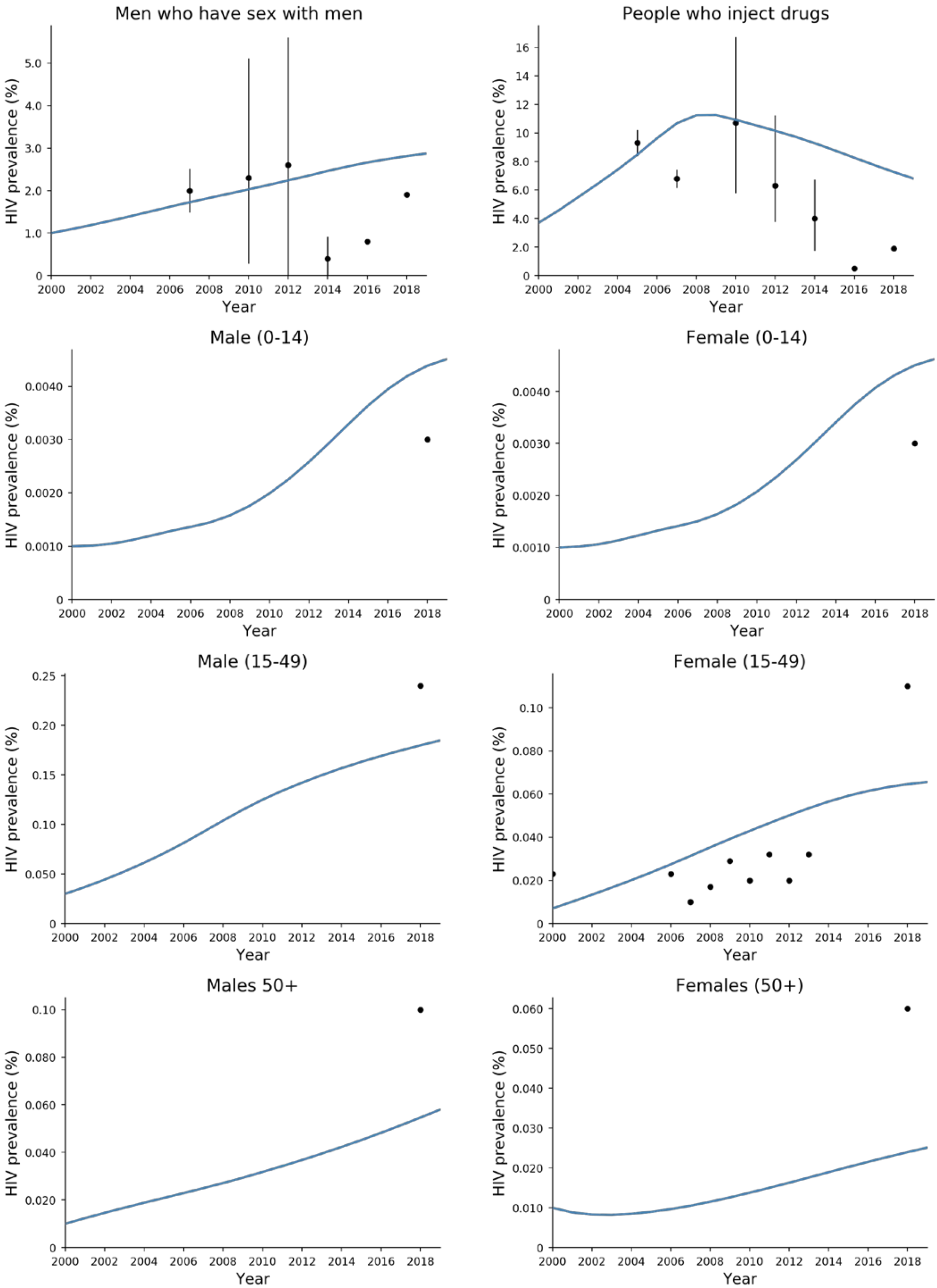

HIV-related deaths
Year
FSW
Clients
MSM
PWID
Males 15-49
Females 15-49
Males 0-14
Females 0-14
Males 50+
Females 50+
Migrants
Prisoners

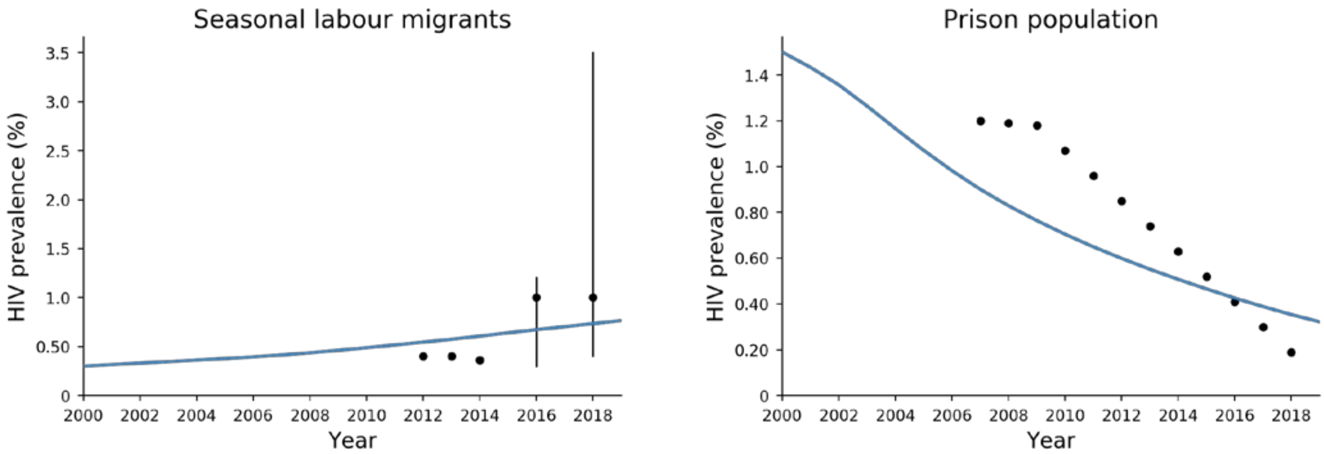

PLHIV on treatment
Year
FSW
Clients
MSM
PWID
Males 15-49
Females 15-49
Males 0-14
Females 0-14
Males 50+
Females 50+
Migrants
Prisoners


New HIV diagnoses
Year
FSW
Clients
MSM
PWID
Males 15-49
Females 15-49
Males 0-14
Females 0-14
Males 50+
Females 50+
Migrants
Prisoners


Female sex workers
HIV prevalence (%)
Year


Clients of sex workers
HIV prevalence (%)
Year


Men who have sex with men
HIV prevalence (%)
0
1.0
2.0
3.0
4.0
5.0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
People who inject drugs
HIV prevalence (%)
0
2.0
4.0
6.0
8.0
10
12
14
16
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Male (0-14)
HIV prevalence (%)
0
0.0010
0.0020
0.0030
0.0040
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Female (0-14)
HIV prevalence (%)
0
0.0010
0.0020
0.0030
0.0040
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Male (15-49)
HIV prevalence (%)
0
0.050
0.10
0.15
0.20
0.25
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Female (15-49)
HIV prevalence (%)
0
0.020
0.040
0.060
0.080
0.10
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Males 50+
HIV prevalence (%)
0
0.020
0.040
0.060
0.080
0.10
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Females (50+)
HIV prevalence (%)
0
0.010
0.020
0.030
0.040
0.050
0.060
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year



Note: The HIV prevalence for 2018 for seasonal labour migrants was subsequently revised to 1.2% as noted on page 2 of this report.

Appendix 3. HIV program costing

Table A3. HIV program unit costs and saturation values

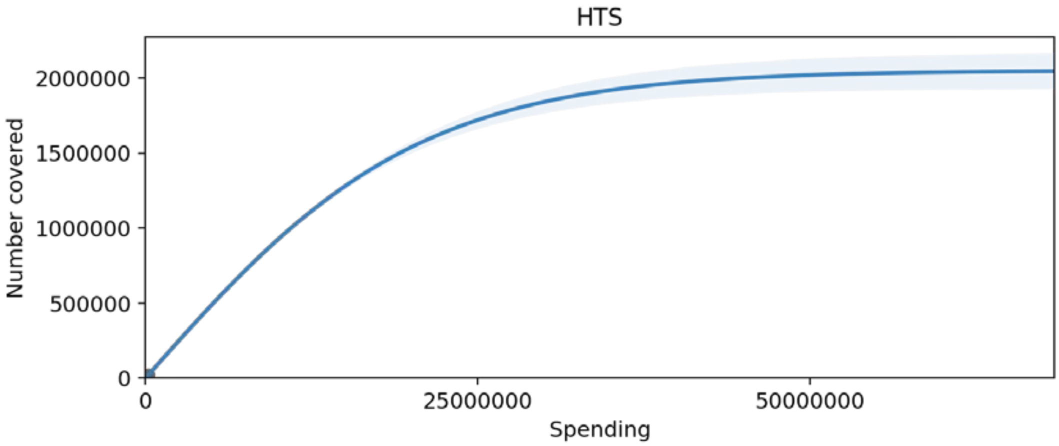
HIV programs	Unit cost (USD)	Saturation (low)	Saturation (high)
HIV testing services (HTS) (general population)	$10.00	80%	90%
Antiretroviral therapy (ART)	$437.40	85%	95%
HIV testing and prevention programs targeting migrants	$11.60	55%	60%
HIV testing and prevention programs targeting PWID	$56.50	60%	70%
Prevention of mother-to-child transmission (PMTCT)	$3,769.10	99%	100%
HIV testing and prevention programs targeting prisoners	$4.80	97%	100%
HIV testing and prevention programs targeting FSW	$34.00	60%	70%
HIV testing and prevention programs targeting MSM	$34.90	60%	70%
Opiate substitution therapy (OST)	$608.40	10%	20%

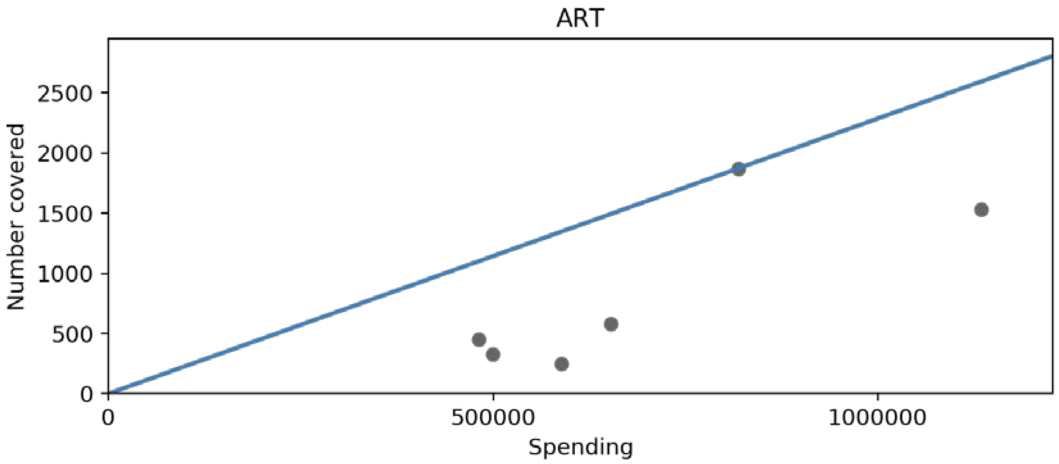
Table A4.Values used to inform HIV program cost functions

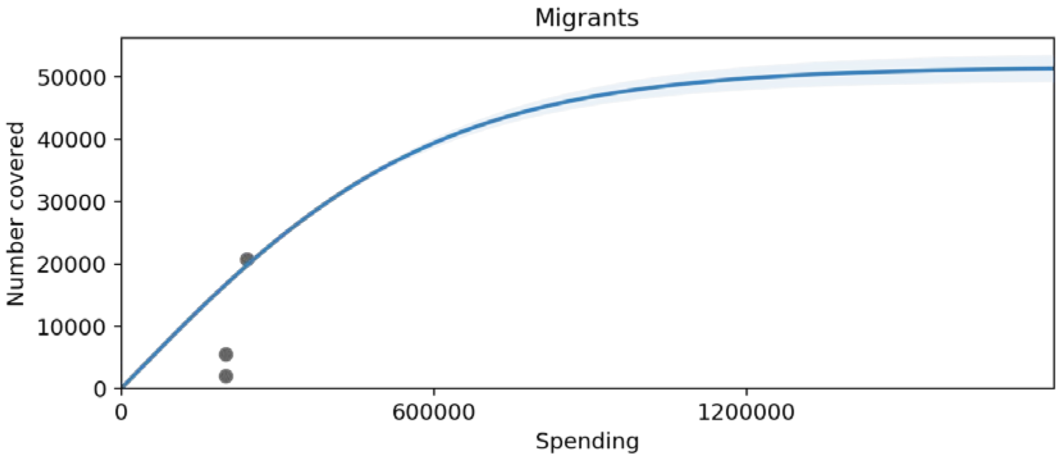
HIV programs	Parameters	Population interactions or populations	In absence of any programs		At max attainable coverage	
			low	high	low	high
MSM programs	Condom use (casual acts)	('MSM', 'MSM')	84%	84%	98%	98%
NSP & PWID	Condom use (casual acts)	('PWID', 'PWID')	52%	52%	97%	97%
NSP & PWID	Condom use (casual acts)	('PWID', 'Females 15-49')	31%	31%	65%	65%
Migrants	Condom use (casual acts)	('Migrants', 'Females 15-49')	38%	38%	71%	71%
Migrants	Condom use (casual acts)	('Migrants', 'Migrants')	65%	65%	98%	98%
Prisoners	Condom use (casual acts)	('Prisoners', 'Females 15-49')	34%	34%	57%	57%
Prisoners	Condom use (casual acts)	('Prisoners', 'Prisoners')	57%	57%	90%	90%
FSW programs	Condom use (commercial acts)	('Clients', 'FSW')	96%	96%	98%	98%
FSW programs	HIV testing rate	FSW	14%	14%	63%	63%
HTS	HIV testing rate	Clients	15%	15%	70%	70%
MSM programs	HIV testing rate	MSM	8%	8%	77%	77%
NSP & PWID	HIV testing rate	PWID	5%	5%	65%	65%
HTS	HIV testing rate	Males 15-49	15%	15%	64%	64%
HTS	HIV testing rate	Females 15-49	15%	15%	64%	64%
HTS	HIV testing rate	Males 50+	4%	4%	14%	14%
HTS	HIV testing rate	Females 50+	4%	4%	14%	14%

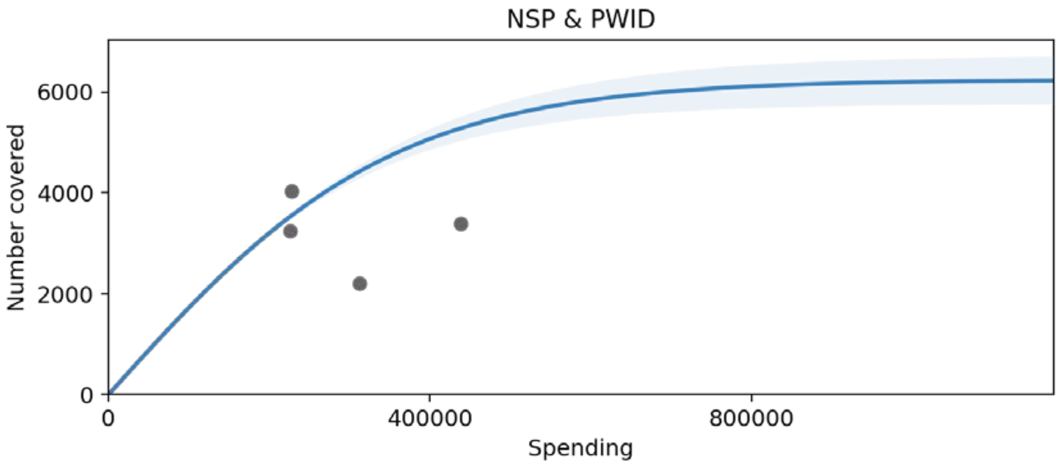
HIV programs	Parameters	Population interactions or populations	In absence of any programs		At max attainable coverage	
			low	high	low	high
Migrants	HIV testing rate	Migrants	13%	13%	60%	60%
Prisoners	HIV testing rate	Prisoners	10%	10%	61%	61%
NSP & PWID	Needle sharing	PWID	23%	23%	1%	1%

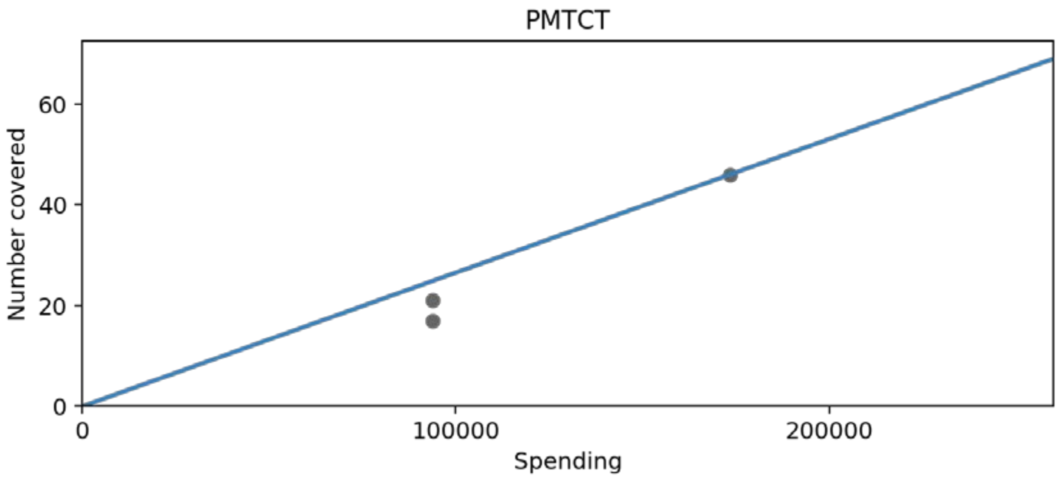
Appendix 4. Cost functions

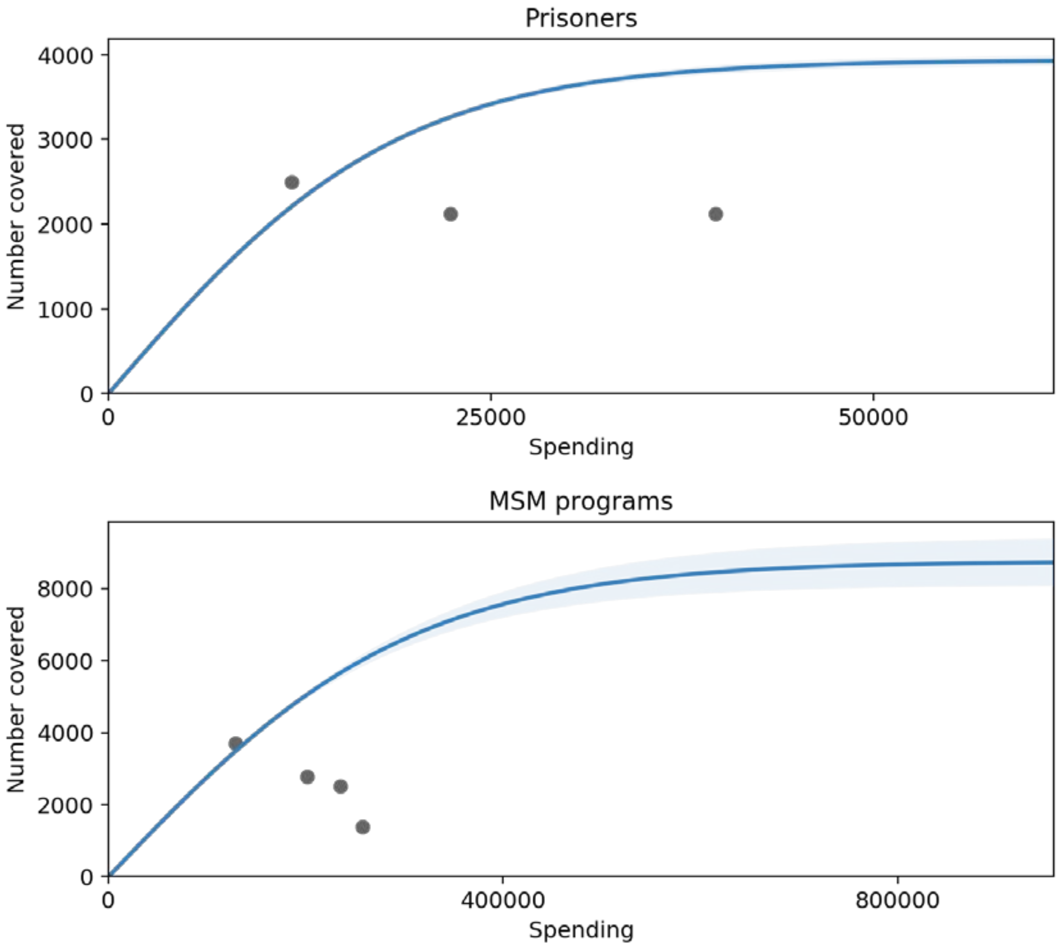


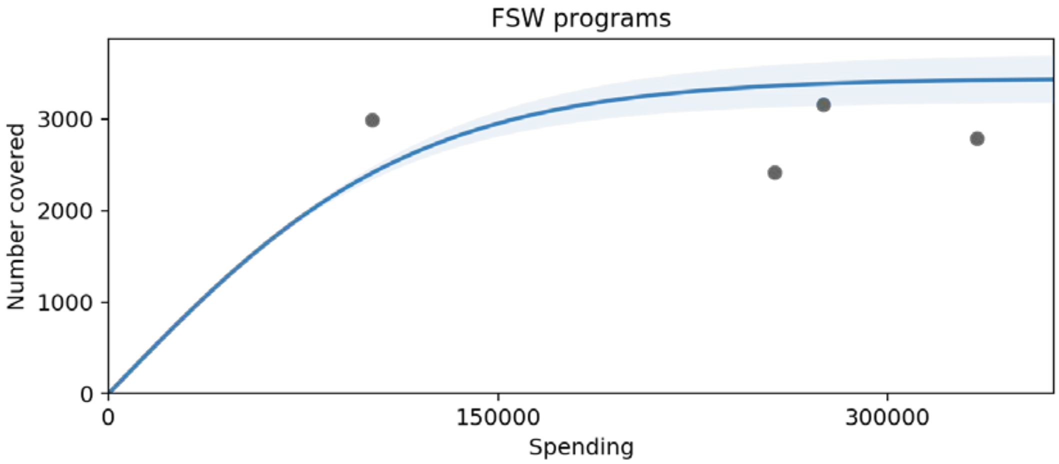


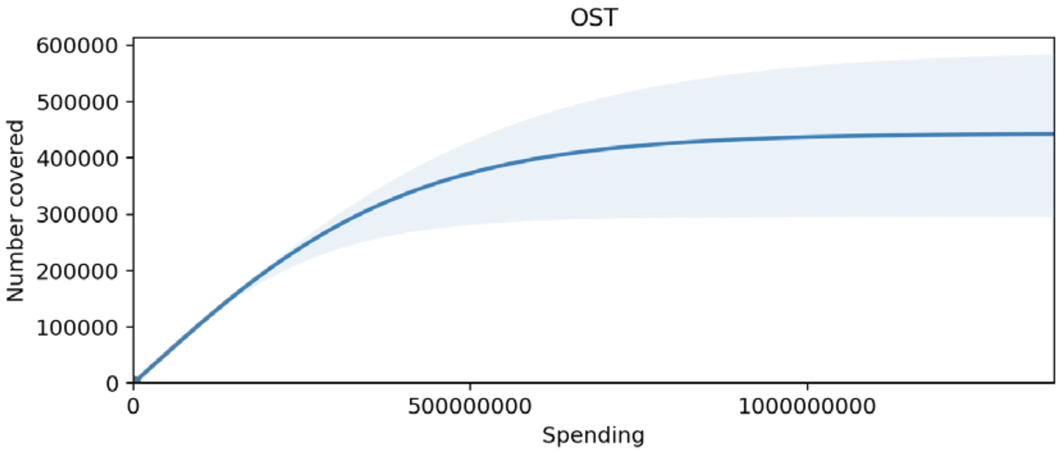

Migrants
Number covered
50000
40000
30000
20000
10000
0
0
600000
1200000
Spending


NSP & PWID
Number covered
6000
4000
2000
0
0
400000
800000
Spending


PMTCT
Number covered
60
40
20
0
0
100000
200000
Spending


Prisoners
Number covered
4000
3000
2000
1000
0
0
25000
50000
Spending
MSM programs
Number covered
8000
6000
4000
2000
0
0
400000
800000
Spending


FSW programs
Number covered
3000
2000
1000
0
0
150000
300000
Spending


OST
Number covered
600000
500000
400000
300000
200000
100000
0
0
500000000
1000000000
Spending

Appendix 5. HIV budget allocations

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

	100% latest reported (2018)	**50% optimized**	**100% optimized**	**150% optimized**	**200% optimized**
Targeted HIV program					
Antiretroviral therapy (ART)	$818,387	$864,841	$1,274,242	$1,299,444	$1,299,772
Prevention of mother-to-child transmission (PMTCT)	$173,379	$86,690	$173,379	$173,379	$173,379
HIV testing services (general population)	$200,000	$0	$0	$0	$0
HIV testing and prevention programs targeting FSW	$101,592	$0	$0	$11,674	$108,911
HIV testing and prevention programs targeting migrants	$240,865	$0	$369,564	$845,412	$1,303,043
HIV testing and prevention programs targeting MSM	$128,982	$0	$44,498	$312,588	$535,173
HIV testing and prevention programs targeting prisoners	$11,972	$0	$0	$17,446	$30,660
HIV testing and prevention programs targeting PWID	$227,885	$0	$41,379	$342,794	$651,474
Opiate substitution therapy (OST)	$296,288	$148,144	$296,288	$296,288	$296,288
Total targeted HIV program	$2,199,350	$1,099,675	$2,199,350	$3,299,025	$4,398,700
Total non-targeted HIV program	$2,532,797		$2,532,797		
Total HIV program budget	$4,732,147		$4,732,147		

Table A6. Maximum estimated impact HIV budget to minimize new HIV infections and HIV-related deaths by 95% in 2030 compared with 2018 or 2010 levels

Maximum impact budget	Percent reduction in HIV infections in 2030 compared with 2018 (number reduced)	Percent reduction in HIV-related deaths in 2030 compared with 2018 (number reduced)	Percent reduction in HIV infections in 2030 compared with 2010 (number reduced)	Percent reduction in HIV-related deaths in 2030 compared with 2010 (number reduced)
350%	72% (100)	84% (70)	83% (200)	92% (150)

It is estimated that optimized investment beyond 350% budget will have only very marginal impact on reducing 95% of new HIV infections and HIV-related deaths in 2030 compared to 2018 or 2010. This is given the modeled mix of programs delivered with modeled program impacts, as programs will reach set saturation levels if resources above 350% were invested even with optimized allocation. Additional reductions in infections and deaths could be realized if the modelled programs could be delivered more cost-efficiently or additional targeted HIV programs were to be implemented.