Resource optimization to maximize the HIV response in Romania

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 Government of Romania, 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 in priority order for HIV resource optimization include:

- **Scaling up HIV testing and prevention programs targeting people who inject drugs and needle-syringe programs** to invest over 40% more of the overall budget from 2019 to 2030 at the latest reported budget level under optimized allocation. Maintaining increased investment should additional budget become available. Since it was estimated that people who inject drugs transmitted 15% of all new HIV infections in Romania in 2018;

- **Scaling up HIV treatment** at the latest reported budget level under optimized allocation, maintaining increased investment up to 125% optimized budget level;

- **Prioritizing HIV testing and prevention programs targeting female sex workers** at 125% optimized budget level and above;

- **Greatly prioritizing HIV services (mainly for the general population)** at 150% optimized budget level and above; and

- **Prioritizing HIV testing and prevention programs targeting men who have sex with men** at 150% optimized budget level and above.

Background

The HIV epidemic in Romania has been stable over the last few years with an estimated <1,000 new HIV infections per year and a resulting HIV incidence of 0.10 (0.07-0.08) and 0.1 HIV prevalence among adults aged 15-49 years (1). It was estimated that there were 18,000 (16,000-20,000) people living with HIV in Romania in 2018. As in the previous years, the main route of transmission was through non-protected heterosexual encounters, followed by those between men who have sex with men (MSM), people who receptively share drug injecting equipment (2). With most new infections occurring among men aged 25-49 years old.

While there is no dedicated AIDS strategy in Romania, related policy objectives are covered within the 2014-2020 National Public Health Strategy developed by the Ministry of Health covering the main strategic objectives from the 2003-2007 National AIDS Strategy, the 2013-2020 National Antidrug Strategy detailing harm reduction and HIV prevention objectives targeting people who inject drugs (PWID) in Romania, and the 2014-2020 National Strategy for Social Inclusion and Poverty Reduction 2014-2020 which was expanded by the Ministry of Labour.

This is the first time that Romania 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 Romania. Epidemiological and program data was provided by the Romania 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 reports, a 2018 HIV surveillance report, 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. (3).

Populations and HIV programs modeled

Key populations considered in this analysis included female sex workers (FSW), clients of female sex workers (clients), men who have sex with men (MSM), and people who inject drugs (PWID). General population groups included males aged 0-14 years (M0-14), females 0-14 (F0-14), males 15-49 (M15-49), females 15-49 (F15-49), males 50 years and older (M50+), and females 50+ (F50+).

HIV programs considered in this analysis included HIV treatment, HIV testing services (HTS) for the general population, HIV testing and prevention targeting FSW, HIV testing and prevention targeting MSM, HIV testing and prevention targeting PWID, and opiate substitution therapy (OST).

Model constraints

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

Model weighting

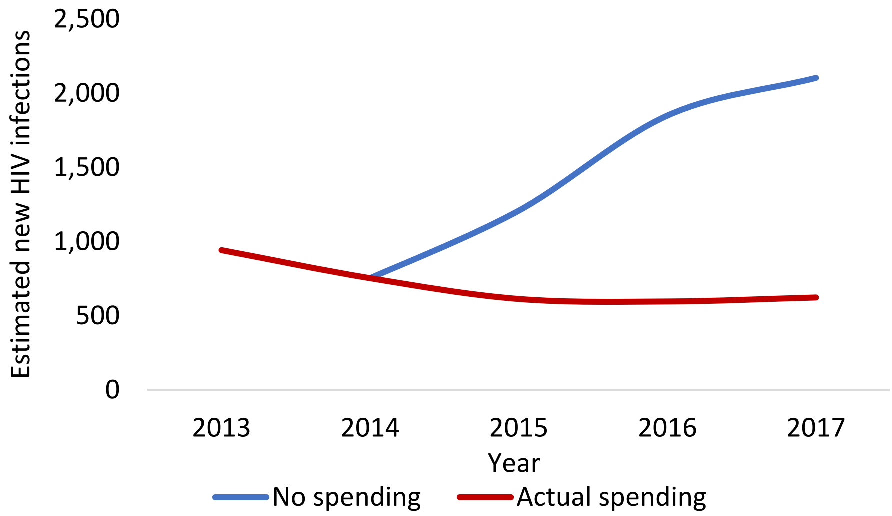
Objective weightings to minimize new HIV infections and HIV-related deaths by 2030 were weighted as 1 to 1 for infections to deaths.

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 Romania, all spending on targeted HIV programs was removed from 2015 to 2017, representing the previous Global Fund funding cycle period and other non-domestic or private funding sources (e.g. Sidaction grants, donations) 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 approximately 180% more new HIV infections (almost 3,300 more infections) and approximately 210% more HIV-related deaths (approximately 1,400 more deaths) over this period (figure 1). Total annual HIV program spending in 2018 amounted to US$76.9M, of which the estimated share of Global Fund and other non-domestic contributions is 0.6%.



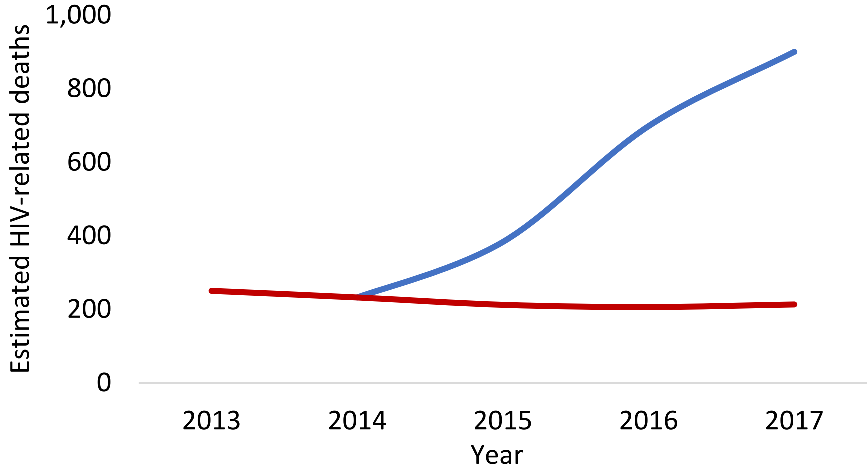


Figure 1. Estimated new HIV infections and HIV-related deaths in the absence of HIV program spending from 2015 to 2017

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

In 2018, Romania reported an HIV program budget of US$76.9M with approximately 99%% of the overall budget invested in non-targeted HIV programs (figures 2 and 3). As non-targeted HIV programs are not considered within the optimization, budgets for these programs are fixed.

In 2018, $75.8M was spent on treatment, representing 98.5% of the total targeted HIV budget of $76.9M. At 100% budget, only 1.5% of the budget could be optimally reallocated, limiting potential gains that could be made through optimization at this budget level. Nevertheless, at 100% budget, optimization results suggest scaling up HIV prevention and testing programs targeting PWID including NSP by over 40%. Scale-up of programs targeting PWIDs is important in the HIV response, as in 2018 it was estimated that PWID were responsible for transmitting 15% of all new HIV infections in Romania (figures 2 and 3; table A4).

Treatment should also be scaled up, by a small percentage of the total budget (0.3% or approximately US$200,000) at 100% budget, with this proportion maintained up to at least 110% budget. At 125% budget and above under optimized allocation it is recommended to prioritize HIV prevention programs including HIV testing and prevention programs targeting FSW, HIV testing and prevention programs targeting PWID and NSP increasing proportional scale-up than at 100% optimized allocation, HIV testing services (mainly for the general population) at 150% optimized budget or above, and HIV testing and prevention programs targeting FSW at 150% optimized budget or above.

At 200% optimized budget, it is recommended to invest approximately 30% of the HIV budget on prevention and 70% on treatment, including ART, PMTCT, and OST. This compared with at 100% budget at latest reported or optimized allocation 99% was invested on treatment and less than 1% on prevention. At 50% optimized allocation, it is recommended to invest slightly less, 98% on treatment, and 2% on prevention compared to 100% budget. Reducing the budget to 50% under optimized allocation, shows which core programs to continue funding, namely treatment (approximately 97% of the total budget), HIV testing and prevention programs targeting people who inject drugs (PWID) and needle-syringe programs (NSP; approximately 2%), opiate substitutional therapy (approximately 1%), and HIV testing and prevention programs targeting female sex workers (FSW; less than 5% of the total budget).

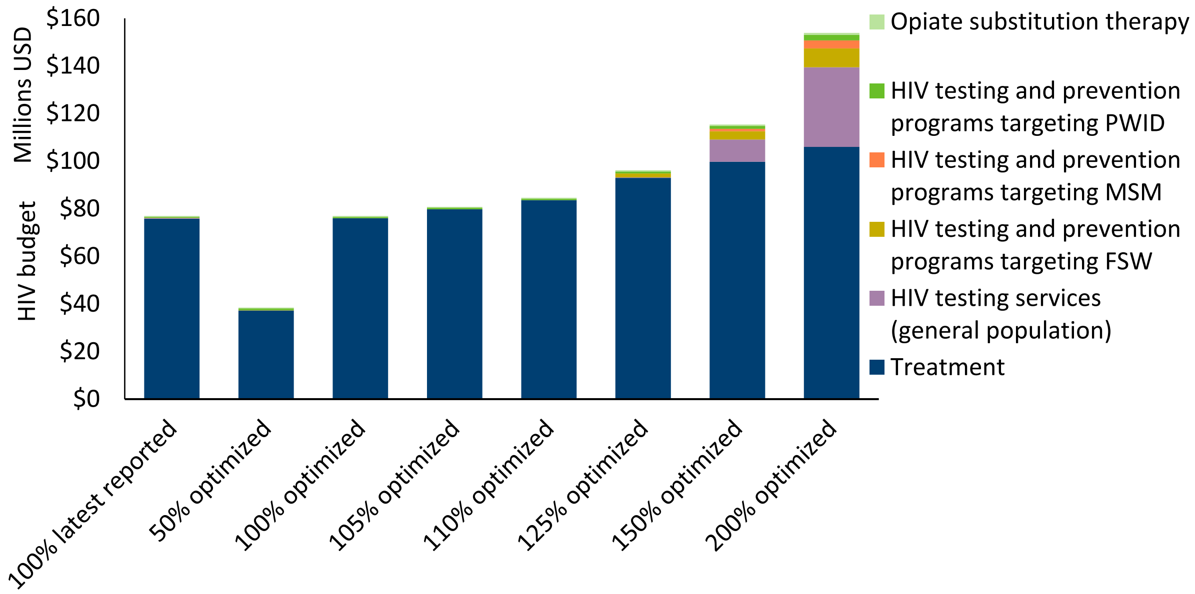


Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2019 to 2030 to minimize new infections and HIV-related deaths by 2030

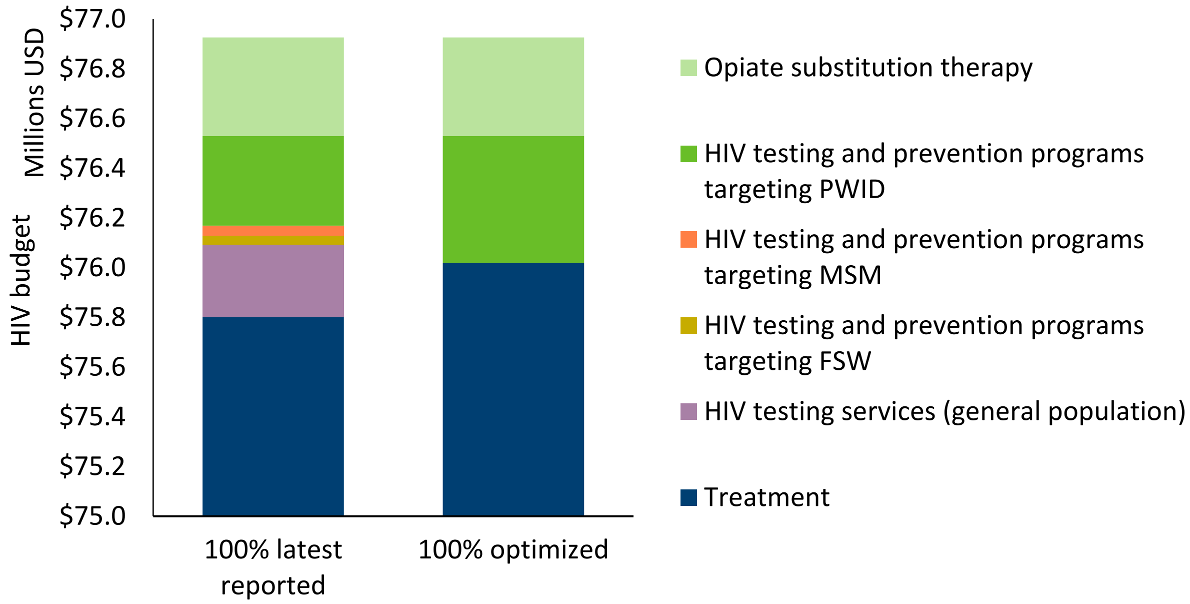
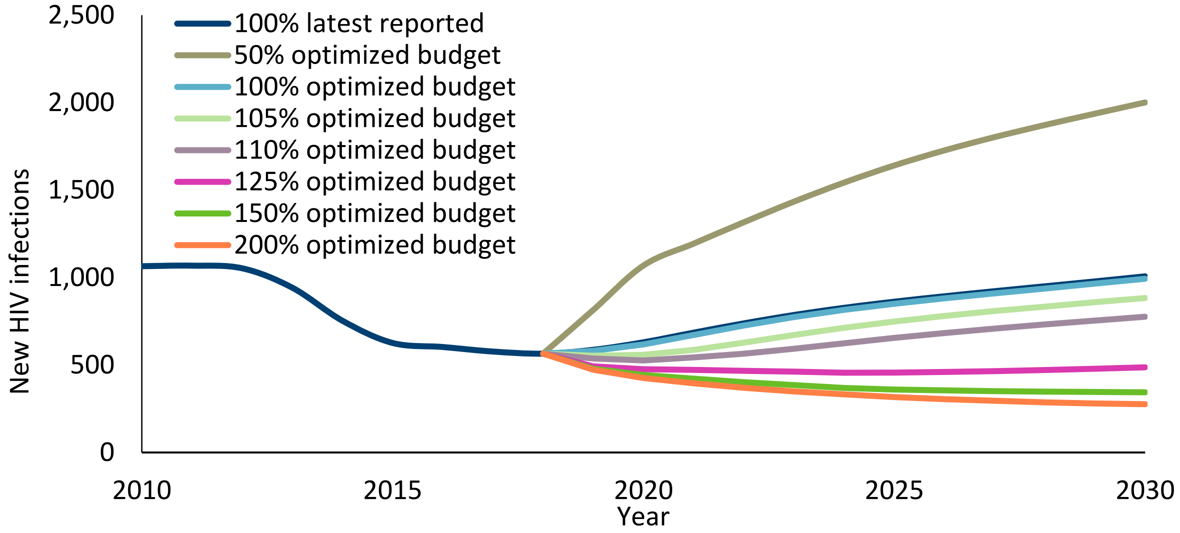


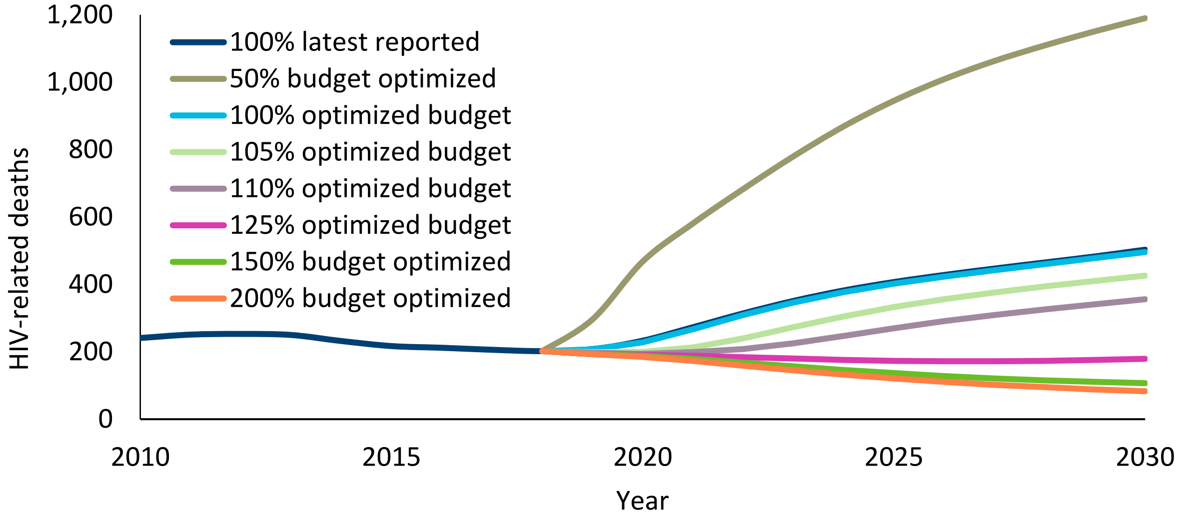
Figure 3. Optimized HIV annual resource allocation for 2019 to 2030 to minimize new infections and HIV-related deaths by 2030

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 1% of new HIV infections could be averted (approximately 150 more infections averted) and 1% more HIV-related deaths could be averted (approximately 60 more deaths averted) compared with the latest reported allocation being maintained over the same period (figure 4). By 2030, an additional 15,00 DALYs could be averted under optimized budget allocation, 1% more. Once again since only 1.5% of the budget at 100% budget could be optimally reallocated, the potential gains that could be made through optimization at this budget level are limited.

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 60% approximately (5,800 more infections averted), HIV-related deaths by 65% (2,900 more deaths averted), and HIV-related DALYs by 60% (70,500 more

DALYs averted) compared with the latest reported budget level and allocation (figure 4). However, it is estimated that investment beyond approximately 280% 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) (Table A5).





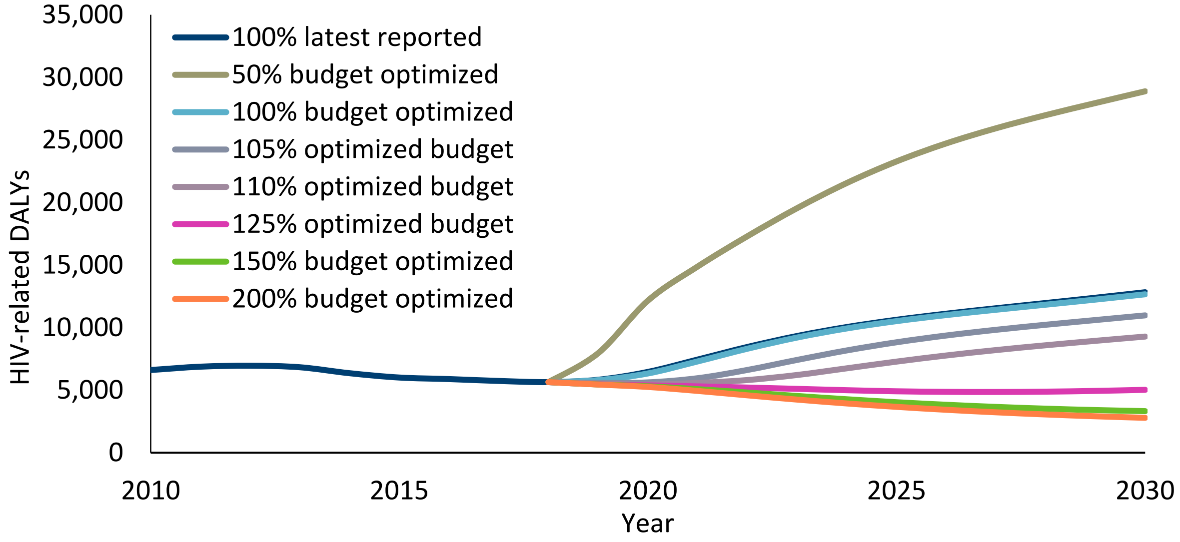


Figure 4. Estimated new HIV infections, HIV-related deaths, and HIV-related DALYs under optimized varying annual budget levels for 2019 to 2030 to minimize infections and deaths by 2030

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, 79% of people living with HIV will be diagnosed, 87% of those diagnosed will receive treatment, and 90% of those on treatment will achieve viral suppression. 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 140% of the latest reported budget level and to optimize with prioritized scale-up of treatment and HIV testing services mainly intended for the general population, to increase percent diagnosed and successfully treated towards 95-95-95, since over 80% of new HIV infections in 2018 were estimated to be among the general population including clients of sex workers (figures 5 and 6).

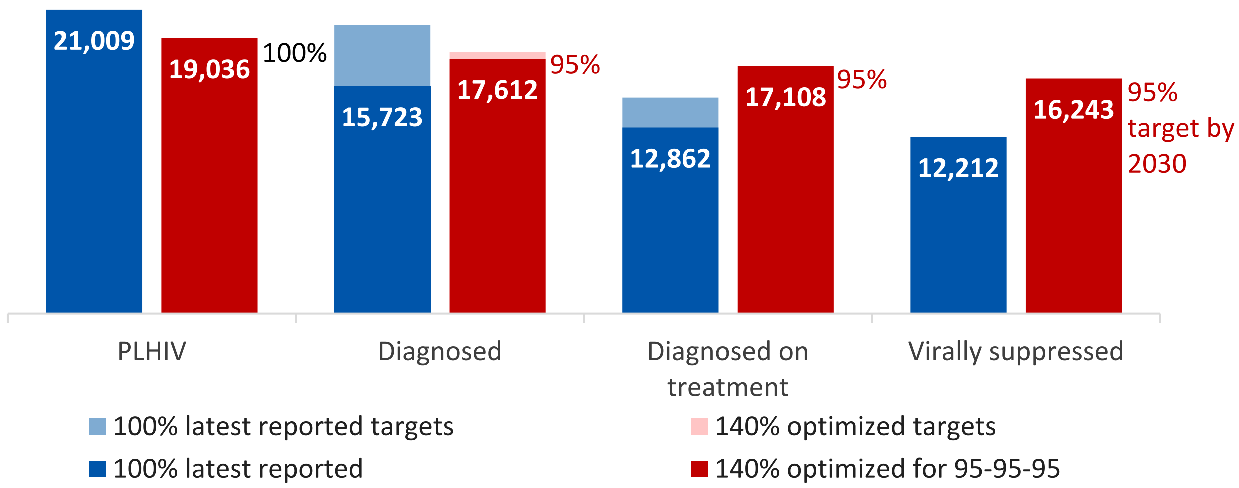


Figure 5. HIV cascade under optimized resource allocation to best achieve 95-95-95 targets by 2030. Dark blue bars represent progress towards 95-95-95 targets under 100% latest reported budget, with light blue bars showing the gap to achieving targets. Red bars represent progress towards 95-95-95 targets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

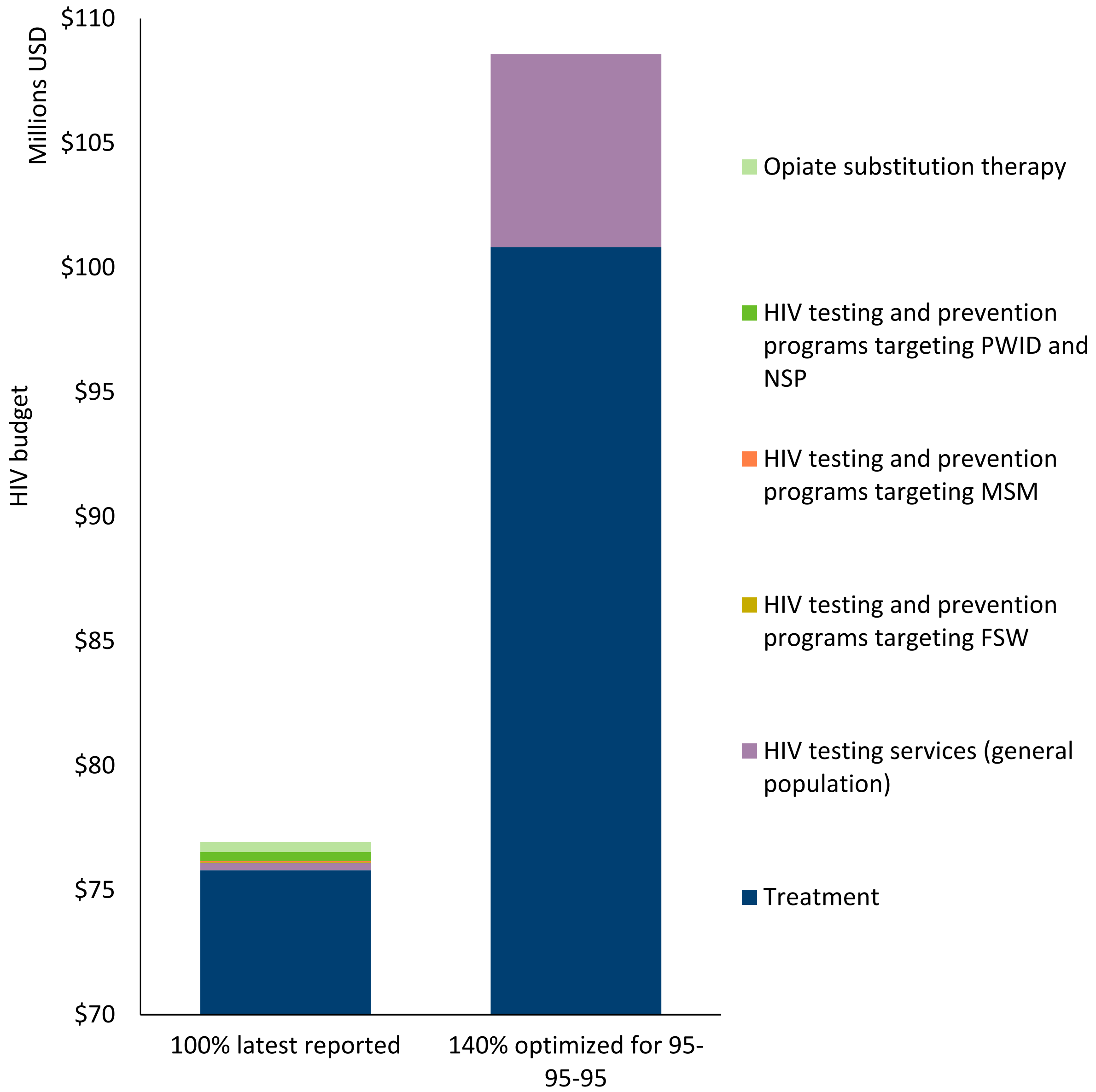


Figure 6. Optimized HIV budget level and allocation to best achieve 95-95-95 targets by 2030

Compared with latest reported 100% budget allocation, by 2030 under optimized allocation of 140% budget towards achieving 95-95-95 targets it is estimated that almost 60% more new HIV infections could be averted (approximately 5,000 more infections averted) and 65% more HIV-related deaths could be averted (approximately 2,800 more deaths averted) over the 2019 to 2030 period (figure 7).

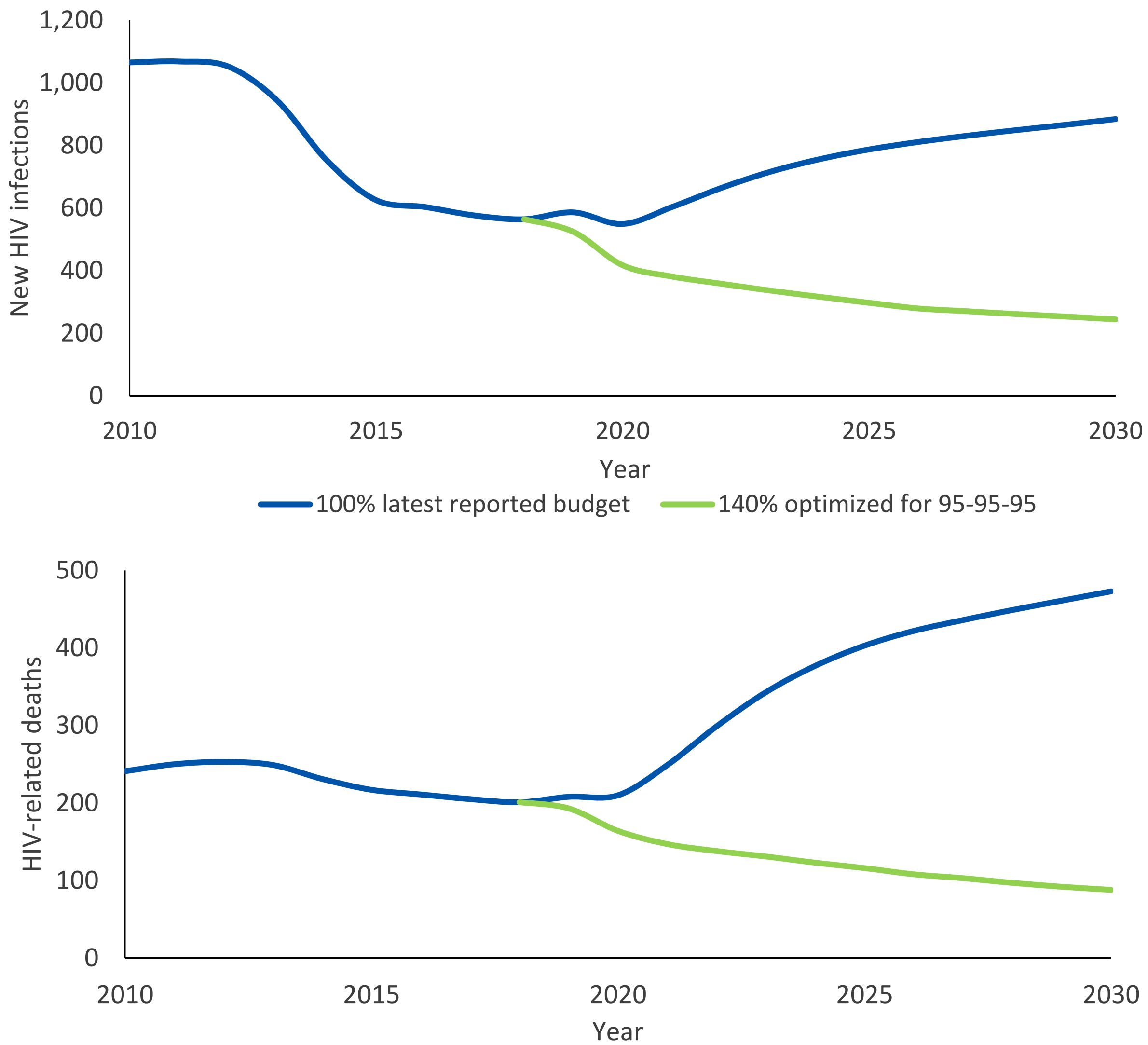


Figure 7. Estimated new HIV infections and HIV-related deaths under optimized allocation towards best achieving 95-95-95 targets by 2030

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.

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2. Romania Country Progress Report on AIDS Reporting period January 2016 – December 2016. Bucharest, Romania: Ministry of Health; 2017.
3. 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. Journal of acquired immune deficiency syndromes (1999). 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	0.11%
	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)	0.24
	CD4 (500) to CD4 (350-500)	0.95
	CD4 (350-500) to CD4 (200-350)	3.00
	CD4 (200-350) to CD4 (50-200)	3.74
	CD4 (50-200) to CD4 (<50)	1.50
Changes in transmissibility (%)		
	Condom use	95%
	Circumcision	58%
	Diagnosis behavior change	0%
	STI cofactor increase	265%
	Opiate substitution therapy	54%
	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

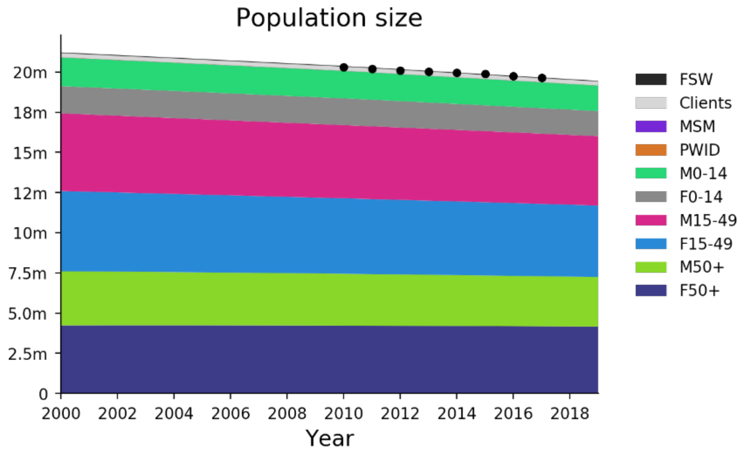
Source: Optima HIV User Guide Volume VI Parameter Data Sources

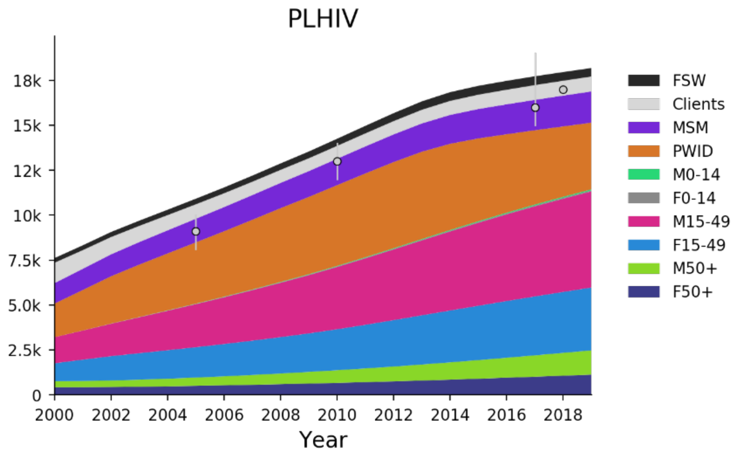
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

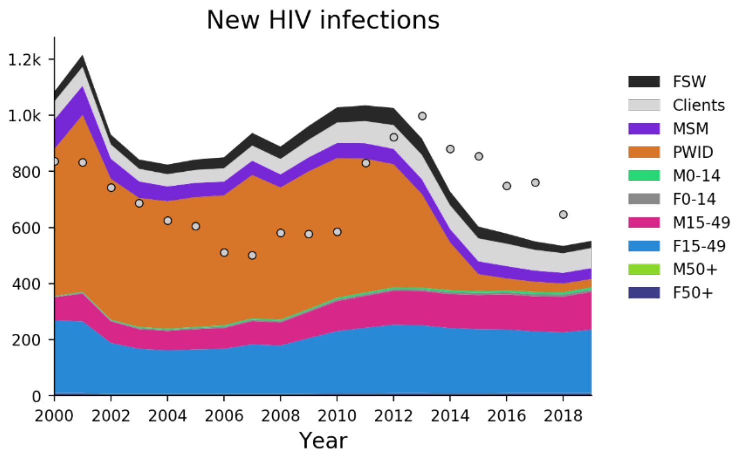
Treatment recovery due to suppressive ART (average years to move)		
	CD4 (350-500) to CD4 (>500)	2.20
	CD4 (200-350) to CD4 (350-500)	1.42
	CD4 (50-200) to CD4 (200-350)	2.14
	CD4 (<50) to CD4 (50-200)	0.66
	Time after initiating ART to achieve viral suppression (years)	0.20
	Number of VL tests recommended 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)	6%
	CD4 (<50)	32%
	Relative death rate on suppressive ART	30%
	Relative death rate on non-suppressive ART	57%
	Tuberculosis cofactor	217%

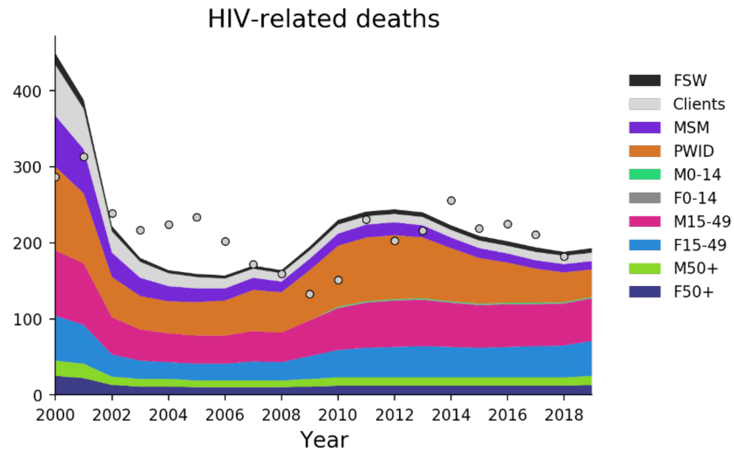
Source: Optima HIV User Guide Volume VI Parameter Data Sources

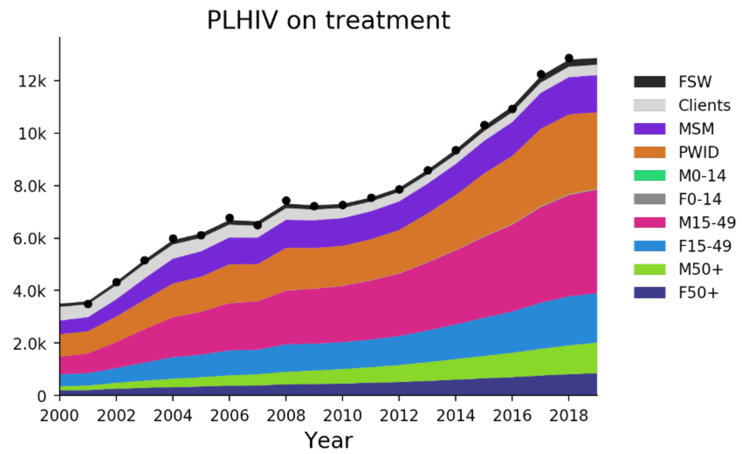
Appendix 2. Model calibration

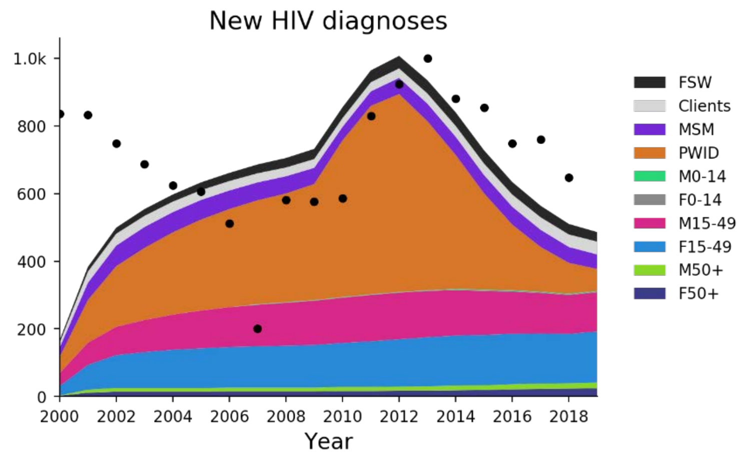


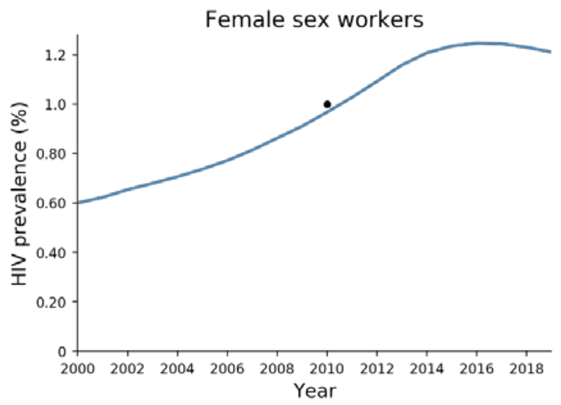


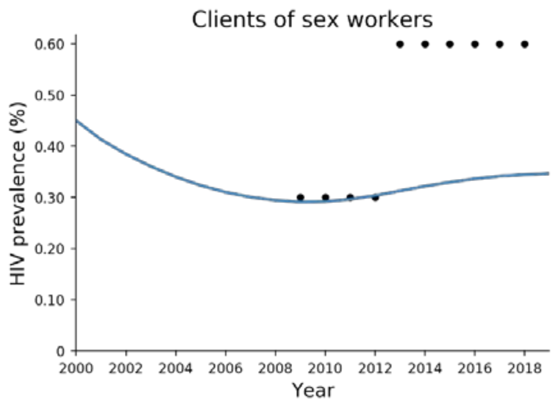


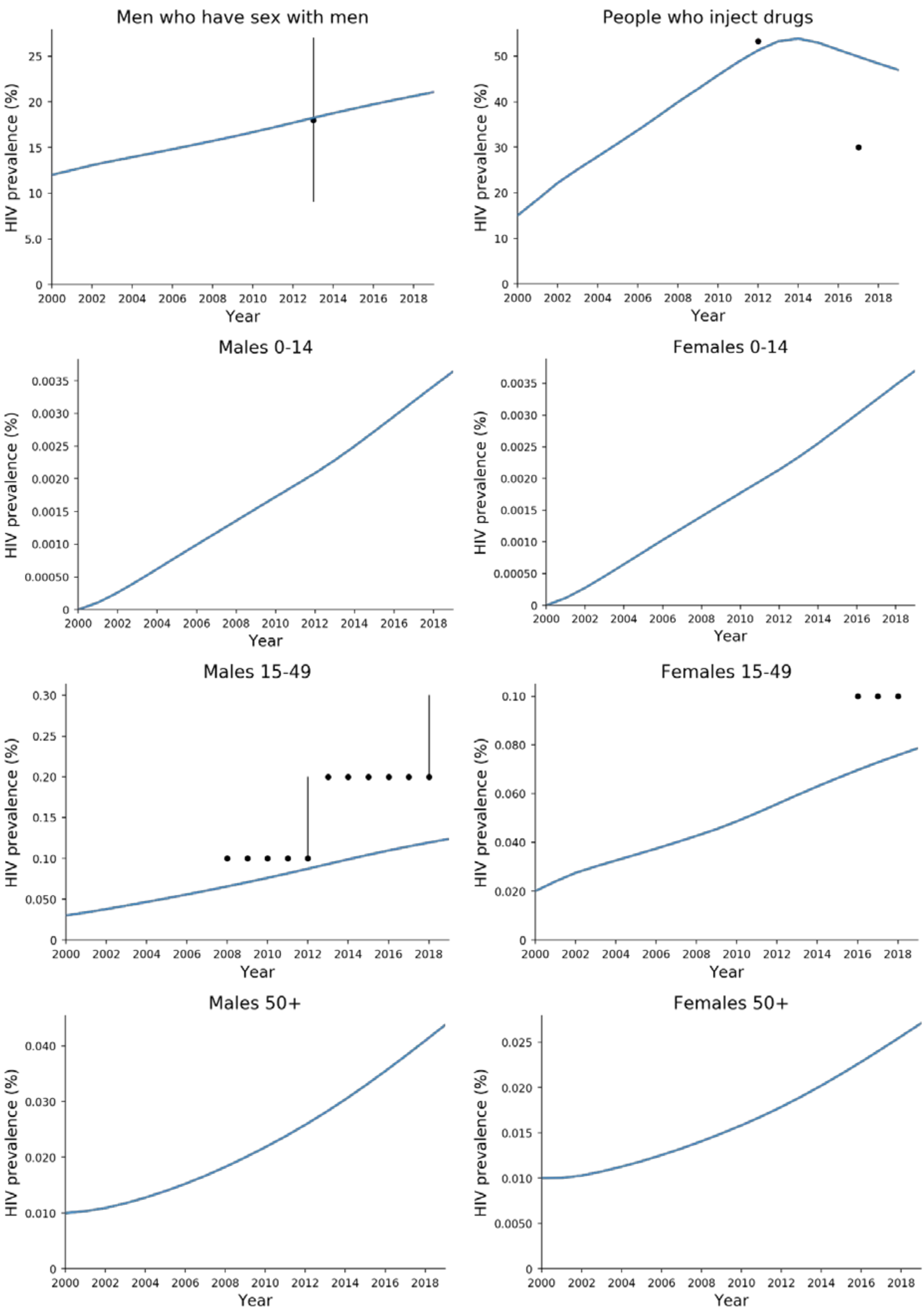

HIV-related deaths
400
300
200
100
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


PLHIV on treatment
12k
10k
8.0k
6.0k
4.0k
2.0k
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


New HIV diagnoses
1.0k
800
600
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year
FSW
Clients
MSM
PWID
M0-14
F0-14
M15-49
F15-49
M50+
F50+


Female sex workers
HIV prevalence (%)
1.2
1.0
0.80
0.60
0.40
0.20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year


Clients of sex workers
HIV prevalence (%)
0.60
0.50
0.40
0.30
0.20
0.10
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year

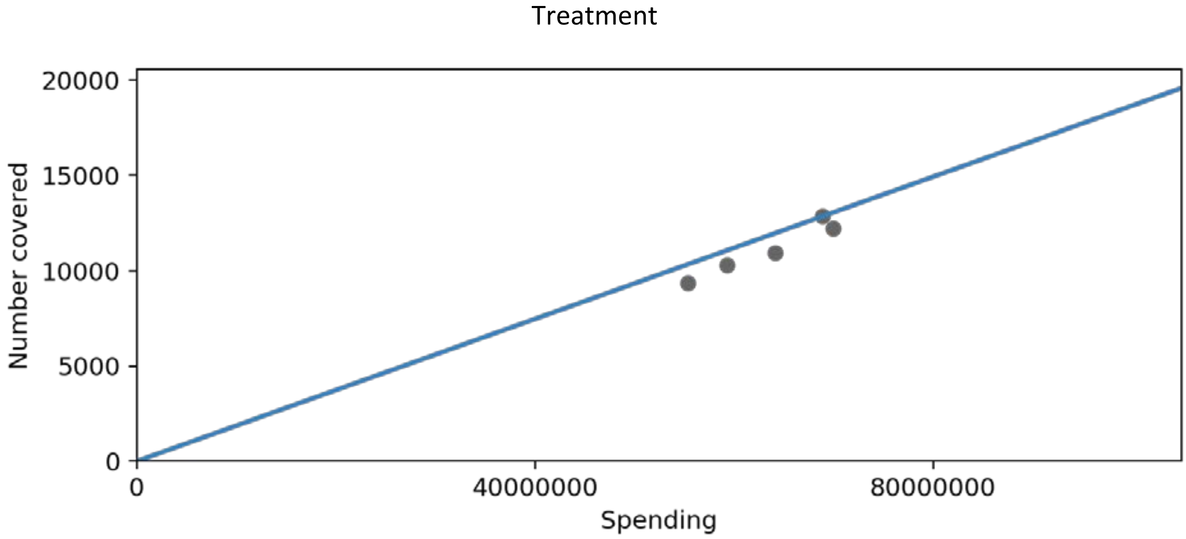

Men who have sex with men
HIV prevalence (%)
0
5.0
10
15
20
25
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
People who inject drugs
HIV prevalence (%)
0
10
20
30
40
50
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Males 0-14
HIV prevalence (%)
0
0.00050
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Females 0-14
HIV prevalence (%)
0
0.00050
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Males 15-49
HIV prevalence (%)
0
0.050
0.10
0.15
0.20
0.25
0.30
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Females 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
0.010
0.020
0.030
0.040
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year
Females 50+
HIV prevalence (%)
0
0.0050
0.010
0.015
0.020
0.025
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Year

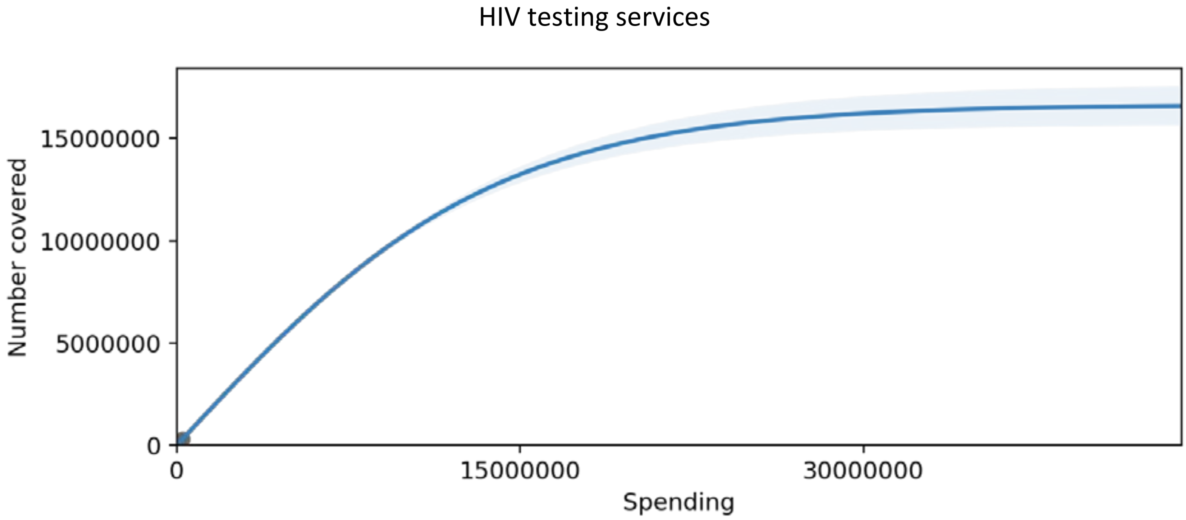
Appendix 3. HIV program costing

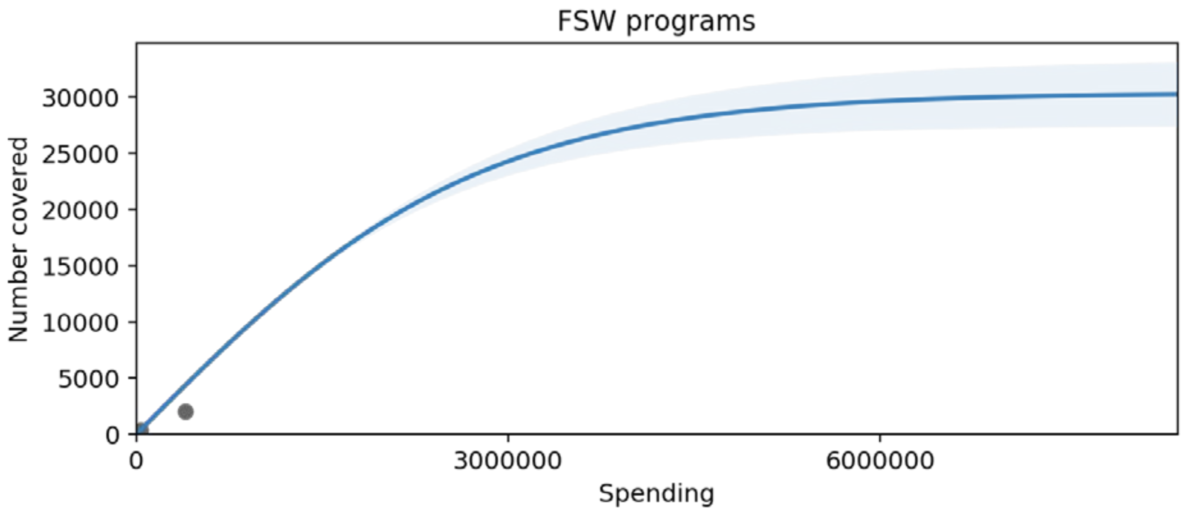
Table A3. HIV program unit costs and saturation values

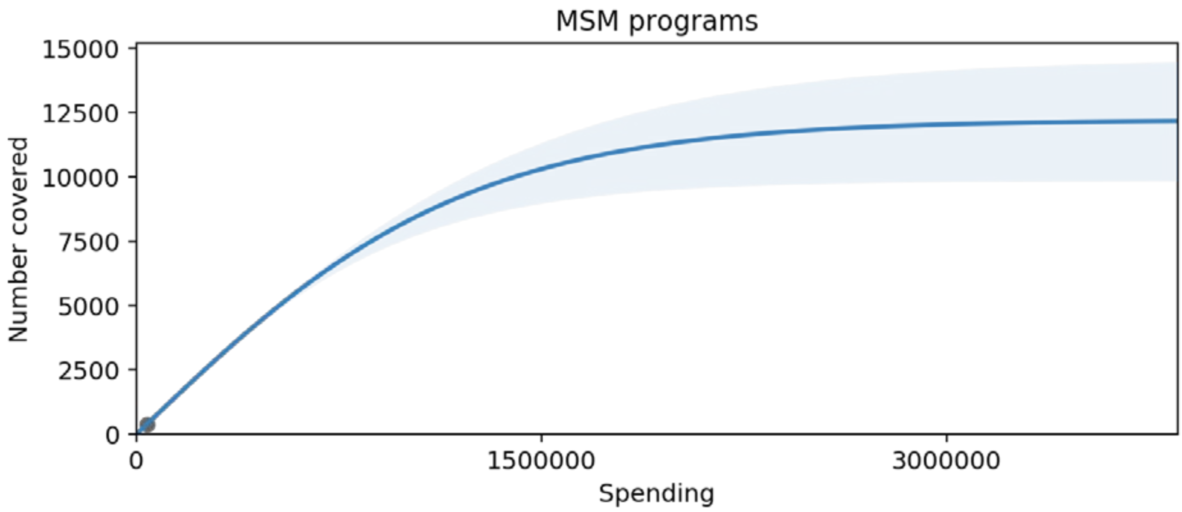
HIV program	Unit cost (USD)	Saturation (low)	Saturation (high)
HIV treatment	$5,893.00	85%	95%
HIV testing services (general population)	$0.91	80%	90%
HIV testing and prevention targeting FSW	$90.00	70%	85%
HIV testing and prevention targeting MSM	$99.51	60%	89%
HIV testing and prevention targeting PWID and NSP	$109.46	70%	85%
Opioid substitution therapy (OST)	$229.81	10%	25%

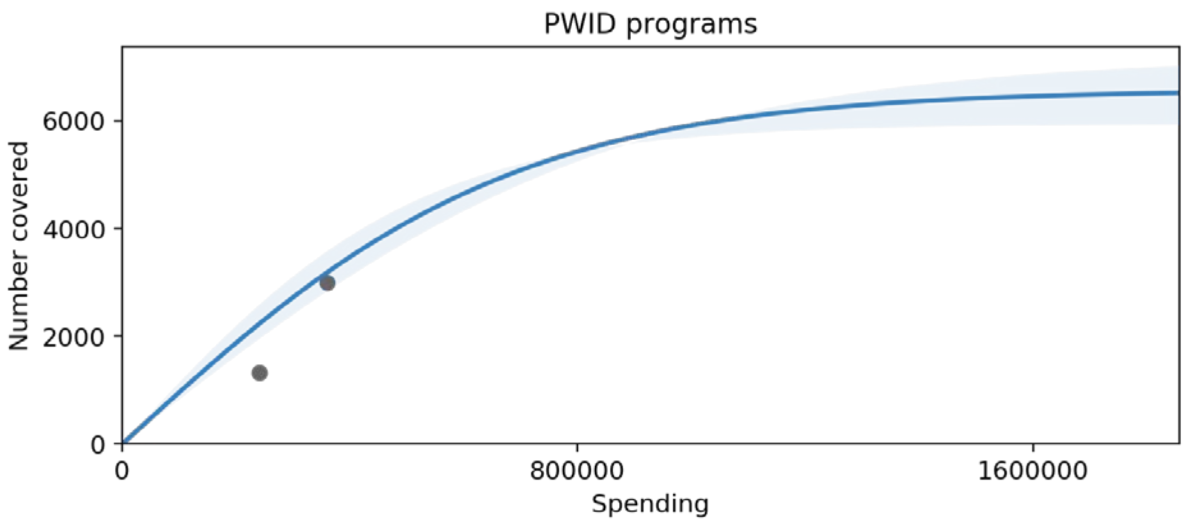
Appendix 4. Cost functions

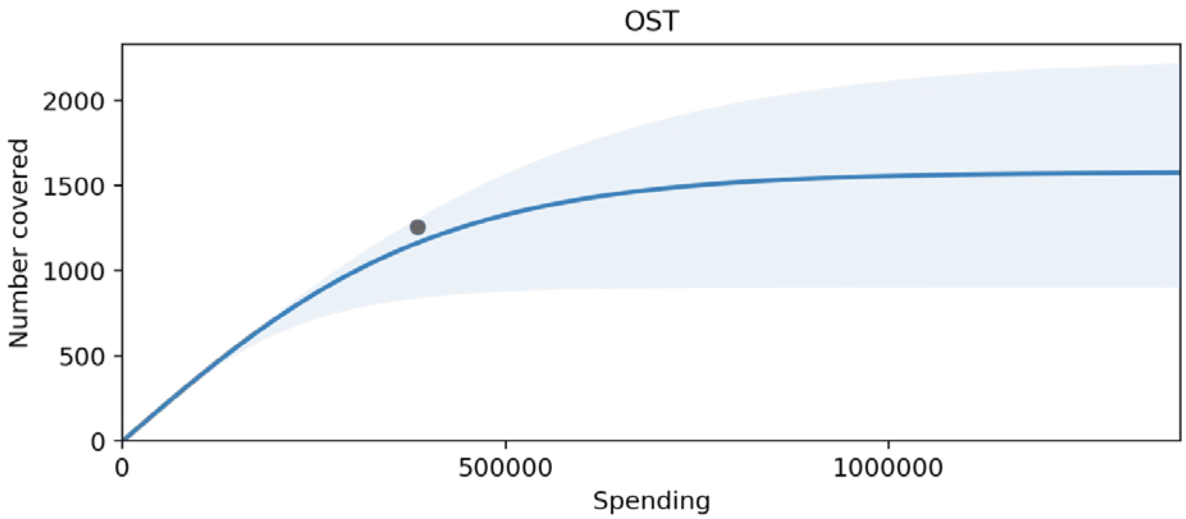





FSW programs
Number covered
30000
25000
20000
15000
10000
5000
0
0
3000000
6000000
Spending


MSM programs
Number covered
15000
12500
10000
7500
5000
2500
0
0
1500000
3000000
Spending


PWID programs
Number covered
6000
4000
2000
0
0
800000
1600000
Spending


OST
Number covered
Spending
0
500
1000
1500
2000
0
500000
1000000

Appendix 5. Annual HIV budget allocations at varying budgets

Table A4. Annual HIV budget allocations at varying budgets for 2019 to 2030

	100% latest reported (2018)	50% optimized	100% optimized	105% optimized	110% optimized	125% optimized	150% optimized	200% optimized
Targeted HIV program								
Treatment*	$75,800,476	$37,260,717	$76,019,018	$79,801,265	$83,574,341	$92,971,282	$99,748,247	$105,956,422
HIV testing (gen pop)	$292,859	$0	$0	$0	$0	$146,016	$9,304,217	$33,450,406
FSW programs	$35,370	$145,069	$0	$0	$0	$1,714,833	$3,476,293	$7,955,772
MSM programs	$40,401	$0	$0	$0	$0	$0	$1,066,464	$3,345,041
PWID programs and NSP	$360,000	$725,547	$510,088	$554,296	$607,675	$829,251	$1,198,438	$2,350,569
OST*	$396,890	$331,664	$396,890	$416,734	$436,579	$496,112	$595,335	$793,780
Non-targeted HIV program								
Management	$63,975 (2016)							
Total targeted HIV program budget	**$76,925,995**	**$38,462,998**	**$76,925,995**	**$80,772,295**	**$84,618,595**	**$96,157,494**	**$115,388,993**	**$153,851,991**

*Constrained so cannot be defunded below latest reported percent of total budget

Table A5. 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
283%	15% (87)	18% (36)	89% (3,739)	93% (2,190)

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.