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Allocation of HIV Resources towards Maximizing the Impact of Funding in Selected Eastern European and Central Asian Countries

KYRGYZSTAN

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Allocation of HIV resources towards maximizing the impact of funding

Executive Summary

The Eastern European and Central Asian region continues to have the fastest increasing HIV epidemic in the world (1). The COVID-19 pandemic and the on-going war in Ukraine threaten economic growth and progress towards HIV targets. To ensure progress against the HIV epidemic can continue, it is vital to make cost-effective funding allocations decisions to maximize the impact of HIV programs. An allocative efficiency analysis was conducted in partnership with the Republican AIDS Center of the Ministry of Health of the Kyrgyz Republic, the Global Fund, UNAIDS, Swiss Tropical and Public Health Institute, and the Burnet Institute.

Summary and key recommendations for HIV resource optimization include:

- Kyrgyzstan has a concentrated HIV epidemic with a high prevalence among people who inject drugs (median 16.2% in 2021 (3)) , a lower but increasing prevalence among men who have sex with men (estimated 10.8% in Bishkek 2021 (4)), and a moderate prevalence among female sex workers (estimated 2.0% in 2016)(5).
- In 2021, an estimated US$6.6M was spent on targeted HIV interventions, of which antiretroviral therapy (ART) accounted for 42%.
- In a baseline scenario with 2021 spending allocations maintained, including fixed annual spending on ART, it was estimated that there would be 5,052 new HIV infections, 2,392 HIV-related deaths and 65,298 HIV-attributable DALYs over 2023-2030.
- **Optimizing spending would involve deprioritizing HIV testing for the general population to enable continued scale up of ART and maintain spending for programs for people who inject drugs.** This optimization prioritizes high impact interventions that address the current treatment gap. Continued prioritized investment in HIV testing and prevention programs for people who inject drugs is required to prevent the epidemic expanding.
- Optimized reallocation of 2021 spending can advance epidemic gains without additional resources and was estimated to avert 1,465 new infections (29%), 707 deaths (29%) and 17,902 DALYs (27%) over 2023-2030.
- **With additional resources available, priorities were identified as increasing funding for HIV testing and prevention programs for key populations and HIV testing for the general population as well as the continued scale-up of ART.** Given increasing HIV prevalence among men who have sex with men, HIV prevention and testing programs amongst this group are critical to prevent the epidemic expanding.
- Moving from the 81-56-84 cascade modeled in 2021[1] to reach the 95-95-95 targets by 2030 will require progress on all indicators and is projected to be possible with optimized allocation of an additional US$5.7M per annum, or a total 187% of the estimated 2021 spending. Continued expansion of ART coverage through ongoing increases in spending or decreases in the procurement cost of antiretroviral drugs will support progress toward the 95% treatment target, but novel programs may be necessary to improve linkage to care and treatment adherence.

[1] Fitted through model calibration specifically for this analysis and may slightly differ from reported estimates.

1 Background

In 2021, Kyrgyzstan had an estimated population size of 6.5 million and an estimated 10,000 people living with HIV (6). The HIV epidemic in Kyrgyzstan is primarily concentrated in key populations including people who inject drugs (PWID), female sex workers (FSW), and men who have sex with men (MSM). The estimated HIV prevalence in these populations are median 16.2% among people who inject drugs across five sites (3), 2% in FSW (5) and 10.8% among MSM in Bishkek (4). Historically in Kyrgyzstan, HIV has been spread predominantly amongst men, making up 65% of the registered PLHIV in 2019. However, there has been an increasing trend of new infections in women, with 42% of the new HIV diagnoses among women in 2020-2021 (7).

Similarly, there has been a shift in the dominant method of HIV transmission; from 2009 to 2021, new HIV diagnoses attributed to needle sharing have reduced from 66% to 4% of new diagnoses (7). Programs supporting needle-syringe programs and targeted testing among PWID have contributed to reductions in injecting risks and subsequent reductions in new infections. On the other hand, confirmed infections linked to sexual transmission have increased from 25% to 82% of new diagnoses over the same time period (7).

The national response to the HIV epidemic is guided by Program of the Government of the Kyrgyz Republic to overcome HIV infection in the Kyrgyz Republic. Based on Global AIDS Monitoring, the HIV response in Kyrgyzstan is largely financed by international funding organizations, with approximately 27% of HIV spending from domestic public funding in 2021 (8). Provision of antiretroviral therapy (ART) began in 2005 in Kyrgyzstan and has been steadily scaled up since; coverage of ART has almost doubled over the past five years, from 2,639 people on ART in 2016 to 5,044 people on ART in 2021 (9). Kyrgyzstan is also committed to scaling up and ensuring the sustainability of prevention programs of preventing HIV in key groups of the population with the Kyrgyz government and Republican AIDS Canter working with international funding organizations, local non-governmental organizations (NGOs) and medical centers (10).

Previous HIV allocative efficiency analyses were conducted in Kyrgyzstan in 2014 and 2019 using the Optima HIV model, with support from the World Bank, UNAIDS, the Global Fund, and other partners (11, 12). This is the third Optima HIV analysis in Kyrgyzstan, which was conducted to identify priorities for HIV resources, according to the objectives below, based on the latest demographic, epidemiological and programmatic data.

2 Objectives

Objective 1. What is the **optimized resource allocation** by targeted HIV intervention to minimize HIV infections and deaths by 2030 under five funding scenarios of 50, 75, 100, 125

and 150 percentage of the current HIV funding? What is the expected cascade (gap) under these scenarios?

Objective 2. If national governments do not scale up HIV programs identified for prioritization under optimized allocation for different funding envelopes, what will the impact be on the epidemic by 2030? That is, what is the **opportunity lost to avert HIV infections, deaths** and disability-adjusted life years (DALYs)?

Objective 3. What is the **most efficient HIV resource allocation for best achieving 95-95-95 targets** by 2030, and what is the level of resources required for achieving these targets? What is the number of HIV infections prevented and deaths averted under this scenario?

3 Methodology

An allocative efficacy modeling analysis was undertaken in collaboration with the Republican AIDS Center of the Ministry of Health of the Kyrgyz Republic. Epidemiological and program data were provided by the country team and validated during a regional workshop that was held in September 2022 in Istanbul, Turkey. Country teams were consulted before and after the workshop on data collation and validation, objective and scenario building, and results validation. Demographic, epidemiological, behavioral, programmatic, and expenditure data from various sources including UNAIDS Global AIDS Monitoring and National AIDS Spending Assessment (NASA) reports, IBBS surveys, national reports and systems were collated. Due to incomplete expenditure data available for 2021 at the time of the analysis, 2021 HIV spending in Kyrgyzstan was estimated based on program unit costs in 2020, derived from the 2019-2020 NASA (13), and program coverage values achieved in 2021. Budget optimizations were based on targeted HIV spending for programs with a direct and quantifiable impact on HIV parameters included in the model, represented by US$6.6M of the total annual spending. The 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 detailed description of the Optima HIV model is available in Kerr et al (2).

3.1 Populations and HIV programs

Populations and HIV programs considered in this analysis were:

- Key populations
  - Female sex workers (FSW)
  - Clients of female sex workers (Clients)
  - Men who have sex with men (MSM)
  - Male people who inject drugs (Male PWID)
  - Female people who inject drugs (Female PWID)
  - 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+)
- Targeted HIV programs
  - Antiretroviral therapy (ART)
  - Prevention of mother-to-child transmission (PMTCT)
  - Opioid substitution therapy (OST)
  - HIV testing and prevention programs for PWID and needle-syringe program (PWID programs)
  - HIV testing and prevention programs for FSW (FSW programs)
  - HIV testing and prevention programs for MSM (MSM programs)
  - HIV testing services (HTS) for the general population
  - Prevention programs for prisoners (Prisoner programs)

3.2 Model constraints

Within the optimization analyses, no one on treatment, including ART, PMTCT, or OST, can be removed from treatment, unless by natural attrition. All other programs were constrained to not reduce by more than 50%, unless optimizing a reduced budget.

3.3 Treatment retention parameters

The model did not include any defined HIV programs aimed at improving linkage or retention in treatment, adherence or viral suppression. Objective 1 (optimizing spending across programs to minimize infections and deaths) maintained the most recent values for time to be linked to care, loss-to-follow-up, return to care and viral suppression until 2030. Subsequently, the projected care cascade with optimized spending may underestimate the second and third pillars if additional programs that are not in the model are implemented or scaled-up.

Unlike Objective 1, which maintained most recent values for a number of care parameters, the optimization in Objective 3 (achieving 95-95-95 targets) assumed that the proportion of diagnosed people on treatment and the proportion of people on treatment with viral suppression would linearly increase to reach 95% by 2030. Objective 3 therefore includes the impact of improvements to reach the treatment and viral suppression targets but not the cost of programs required to achieve these gains, which would require further work to quantify.

3.4 Model weightings

Objective 1 weightings to minimize new HIV infections and HIV-related deaths by 2030 were weighted as 1 to 5 for infections to deaths. Objective 3 weightings were to reach 95% diagnosis by 2030 with the minimal possible total spending.

4 Findings

4.1 Objective 1

*What is the **optimized resource allocation** by targeted HIV intervention to minimize HIV infections and deaths by 2030 under five funding scenarios of 50, 75, 100, 125 and 150 percentage of the current HIV funding? What is the expected cascade (gap) under these scenarios?*

2021 HIV spending. In Kyrgyzstan estimated total spending on HIV from domestic and international sources was US$14M in 2021, incorporating US$6.6M targeted HIV spending for the programs considered above and US$7.4M non-targeted spending (non-targeted spending reflects 2020 spending as the latest available data). The majority of targeted spending was for ART (40%), followed by 31% for HTS and 11% for HIV testing and prevention programs for PWID and needle-syringe program (Figure 2; Table A5). Non-targeted spending, which was not included in the optimization analysis, encompassed human resources, management and infrastructure costs, monitoring and evaluation, programs supporting an enabling environment and some HIV care costs (Table A6).

Resource needs to maintain 2021 ART coverage. In 2021, ART coverage among diagnosed people living with HIV was 56%. If ART unit costs remain constant (US$538 in 2021), ART spending would need to increase by US$0.6M (23% of 2021 ART spending) from 2021 to 2030 to maintain a constant proportion of diagnosed people living with HIV on treatment given current epidemic trends, including current coverage of other HIV programs. Maintaining the "status quo" proportion of diagnosed people living with HIV on treatment will require additional future investment in HIV (Figure 1a), further reductions in ART unit costs, or reallocation of resources from other HIV programs.

To compare scenarios with optimized allocation of resources within a fixed budget envelope, a counterfactual "Baseline" of fixed annual spending on ART was used. This would result in different epidemic projections to maintaining fixed coverage (Figure 1b) but means that optimizations consider how the needs for additional treatment can be met.

Comprehensive strategic information was not available to define the combination of factors leading to people not being retained in care and treatment, and specific programs to improve linkage to care or adherence were not modelled or costed in this analysis. Although treatment is available to all diagnosed people living with HIV in Kyrgyzstan, there is a gap in strategic information where some diagnosed people living with HIV are neither reported to be on treatment nor lost to follow-up. It was assumed that additional spending on ART would be able to return these people to treatment, but further exploration of the limitations in achieving higher coverage of treatment may be necessary (including migration and acceptability of treatment regimens).

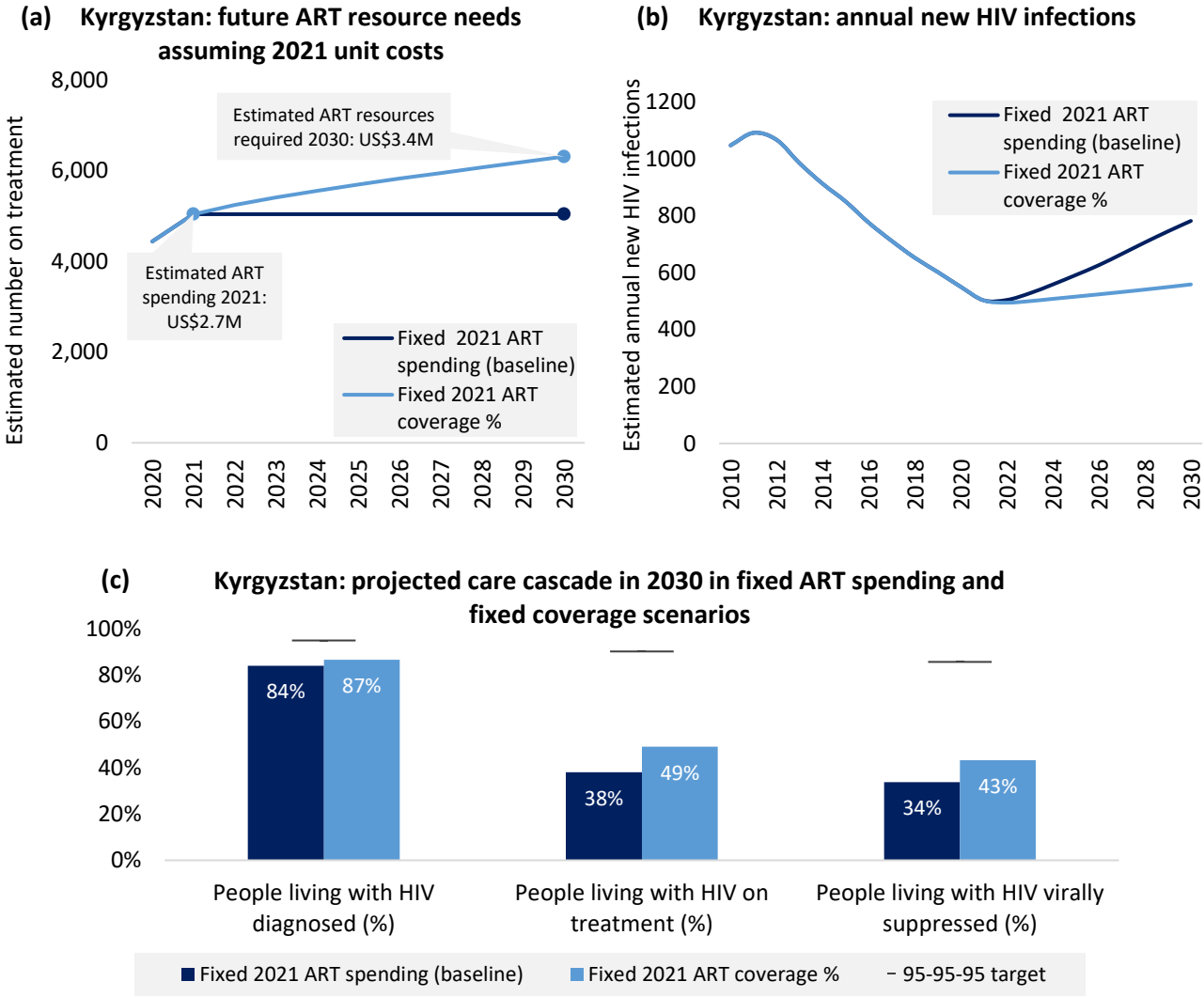

Figure 1. Fixed proportional coverage of people living with HIV on ART compared to fixed ART spending: resource needs and epidemic outcomes by 2030. Panels show (a) Resources required to maintain 2021 proportional coverage of ART among people living with HIV until 2030 if ART unit cost remains constant; (b) Estimated number of annual new HIV infections if ART spending is fixed until 2030 (baseline) compared to if ART proportional coverage is fixed; and (c) Projected HIV care cascade among all people living with HIV if ART spending is fixed at 2021 values compared to if ART coverage is fixed at 2021 values. ART, antiretroviral therapy.

Baseline scenario. In the baseline scenario maintaining 2021 spending on programs with fixed allocations, the model projects that there would be 5,052 new HIV infections, 2,392 HIV-related deaths and 65,298 HIV-attributable DALYs over 2023-2030. The HIV care cascade in this scenario was projected to be "84-46-88" in the year 2030 (i.e. 84% people diagnosed, 46% people diagnosed on treatment and 88% people on treatment virally suppressed) (Figure 1c; Table 1). The low proportion of people on treatment in 2030 reflects that ART spending

will need to increase over time just to maintain constant percentage treatment coverage, since more people will continue to be diagnosed.

Optimized resource allocation of 2021 spending. Optimization of 2021 spending identified that additional impact may be possible by reallocating HTS spending to enable further scale-up of ART (Figure 2). Assuming that more people could be accessed for treatment through enhanced linkage to care and adherence programs, then closing the treatment gap through increased investment in ART could reduce mortality as well as new infections through treatment-as-prevention. Similarly, the optimization also suggests funding of PMTCT should be increased by 13%, as this prevents not only mother-to-child transmission, which made up approximately 3% of new diagnoses in 2021, but also provides mothers with ART, reducing their risk of further transmitting HIV. The optimization maintains spending in HIV testing and prevention programs for PWID and needle-syringe programs. Reducing spending in these programs could lead to an increase in risky needle sharing and increased risky sexual behavior amongst people who inject drugs, leading to a resurgence in new infections in these populations.

HTS programs and testing and prevention programs were deprioritized in the theoretical optimization at 100% budget not because they are not effective or important, but because of the high impact and cost-effectiveness of ART at preventing mortality and new infections among all populations. At this budget level prevention and testing programs for MSM and FSW are relatively less impactful compared to ART and programs for PWID because HIV diagnosis rates among FSW and MSM are estimated to be already high, modeled at 92% and 90% respectively in 2021. Furthermore, condom use appears to be normalized in these populations, with 97% of FSW and 88% of MSM reporting using a condom at last commercial act with clients and last casual act, respectively (4, 5). The model predicts that in the absence of any programs, condom use would remain relatively high in these groups given normalized use and availability through alternative channels (see Table A4).

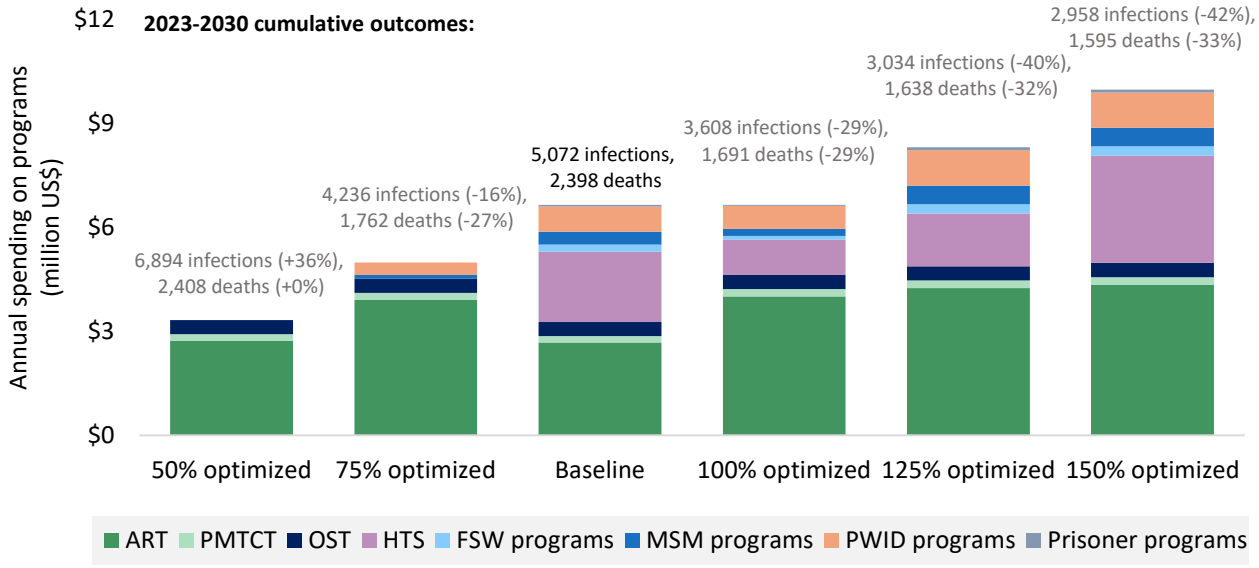

Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2023 to 2030, to minimize new infections and HIV-related deaths by 2030. Percentage optimized refers to the percentage of baseline HIV funding at a given budget level. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

Optimized resource allocation at different budget levels. As the total budget increased, the priorities were identified as increased investment in prevention and testing programs for prisoners, MSM, FSW and PWID and HTS for the general population, as well as continued scale up of ART and PMTCT. In the 2021 budget, the MSM, FSW and PWID programs already have high coverage of their respective populations, which is increased to near saturation in the optimized allocation of 125% budget (Table A3). Subsequently there is little additional allocation to these programs at 150% budget optimization. To increase the saturation point of these programs and enable higher coverage gains, additional programs that address factors such as stigma and geographical barriers would be needed.

If funding were reduced, the priority is maintaining as many people on treatment as possible, followed by maintaining spending for prevention and NSP programs for PWID and lastly maintaining prevention programs for MSM.

Impact of optimization on HIV epidemic. Compared with the baseline scenario, optimized reallocation of 2021 spending could avert 1,465 new infections (29%), 707 deaths (29%) and 17,902 DALYs (27%) over 2023-2030. This benefit increases to 42% infections, 33% deaths and 31% DALYs averted with an optimized 150% budget (Figure 3, Table 1).

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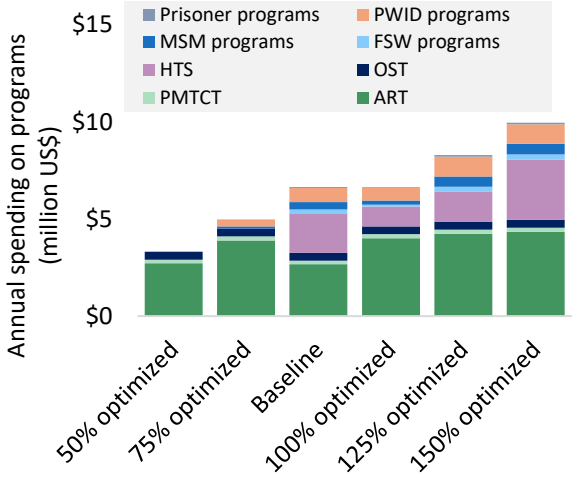
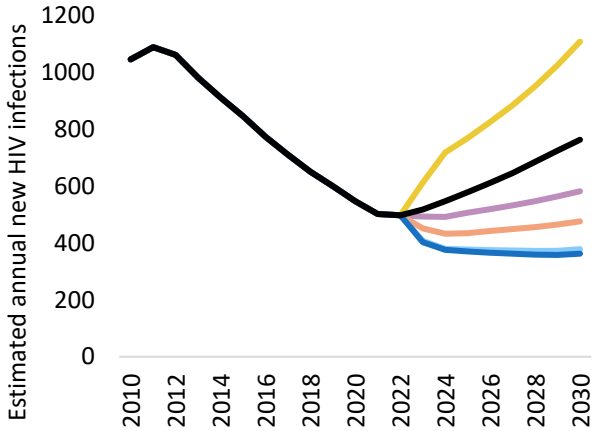
Allocation of HIV resources towards maximizing the impact of funding

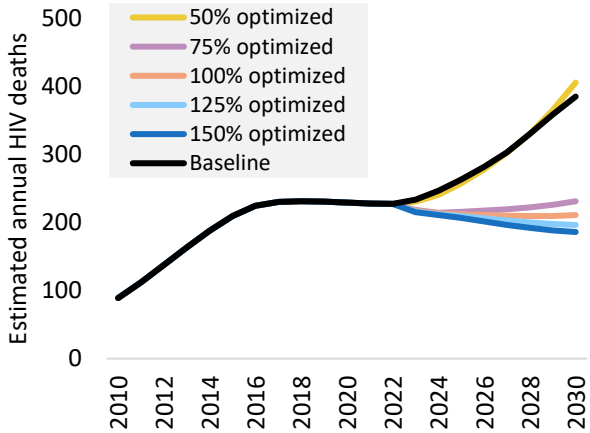
(a) **Kyrgyzstan: budget optimizations**



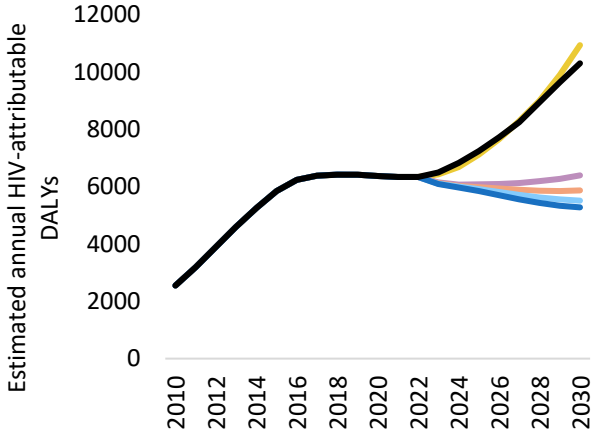
(b) **Kyrgyzstan: annual new HIV infections in budget optimizations**



(c) **Kyrgyzstan: annual HIV deaths in budget optimizations**



(d) **Kyrgyzstan: annual HIV-attributable DALYs in budget optimizations**



(e) **Kyrgyzstan: projected care cascade in 2030**

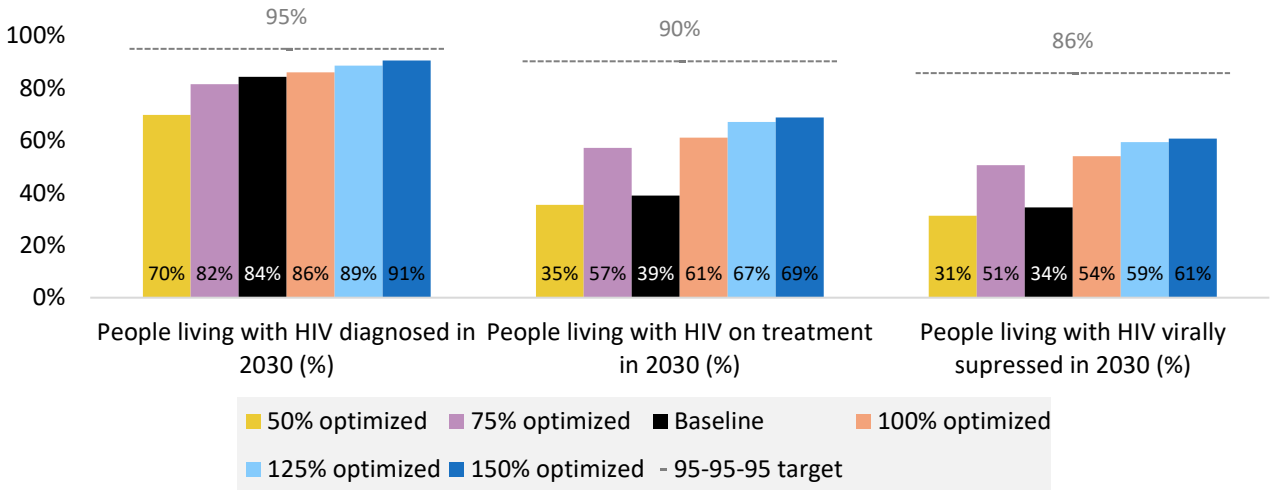


Figure 3. Model outcomes from budget optimization scenarios aiming to minimize infections and deaths. Panels show (a) optimal budget allocations under varying levels of annual HIV budgets according to percentage of current HIV funding; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) projected care cascade for the year 2030 among all people living with HIV. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

Due to the reasons discussed above regarding near saturation of programs for key populations, increasing the budget from 125% to 150% produces only a modest 2-3% decrease in new infections, deaths and DALYs. At this level of spending, the main gap in the care cascade is people who are diagnosed but lost to follow up, and hence miss opportunities to receive treatment. Approaches to reach those not accessible by current services, for example interventions to support diagnosed people to receive treatment and stay in care, as well as to reduce treatment failure rate, would be needed.

4.2 Objective 2

*If national governments do not scale up HIV programs identified for prioritization under optimized allocation for different funding envelopes, what will the impact be on the epidemic by 2030? That is, what is the **opportunity lost to avert HIV infections, deaths** and DALYs?*

Zero HIV spending. The continued investment in HIV programs is essential to avoid epidemic rebound. In a scenario with no HIV spending from 2023, the model estimates that there would be 10,014 (+197%) more new infections, 3,663 (+153%) more deaths and 94,342(+144%) more DALYs over 2023-2030 compared to the baseline scenario of fixed annual spending on programs (Table 1).

Table 1. Cumulative new HIV infections, HIV-related deaths, HIV-related DALYs between 2023-2030 under different scenarios, and differences in impacts compared to the baseline scenario of fixed 2021 spending on programs.

	Cumulative new HIV infections 2023-2030	*Cumulative HIV deaths 2023-2030*	*Cumulative HIV DALYs 2023-2030*	*Difference in infections from baseline*	*Difference in deaths from baseline*	*Difference in DALYs from baseline*
No HIV spending from 2023	15087	6062	159783	197%	153%	144%
50% optimized	6894	2408	66015	36%	0%	1%
75% optimized	4236	1762	49380	-16%	-27%	-25%
Baseline	5072	2398	65441			
100% optimized	3608	1691	47539	-29%	-29%	-27%
125% optimized	3034	1638	46244	-40%	-32%	-29%
150% optimized	2958	1595	45218	-42%	-33%	-31%
95-95-95	1935	1030	31124	-62%	-57%	-52%

Percentage optimized refers to percentage of baseline spending.

4.3 Objective 3

*What is the **most efficient HIV resource allocation for best achieving 95-95-95 targets** by 2030, and what is the level of resources required for achieving these targets? What is the number of HIV infections prevented and deaths averted under this scenario?*

Based on both baseline and 100% optimized spending, Kyrgyzstan's care cascade is not projected to reach 95-95-95 targets by 2030 (equivalent to 95-90-86 of all people living with HIV) (Figure 3e).

To reach the 95% diagnosis target, a minimal additional US$5.7M per annum, or a total 187% of the estimated 2021 targeted HIV spending, was required over 2023-2030. The total US$12.4M was optimized by achieving high coverage of treatment (46% of spending allocated to ART), full scale-up of prevention programs for PWID as in the 125% and 150% budgets, and expanding HTS (39% of spending). Expanded coverage of PWID and general population testing is projected to be enough to reach the 95% diagnosis target, but additional programs that provide prevention and testing services to other people at high past or present risk (e.g. former sex workers or people with a history of injecting drug use) may make it possible to reach the 95% diagnosis target more cost-efficiently. Continued expansion of ART coverage through ongoing increases in spending or decreases in the procurement cost of antiretroviral drugs will support progress toward the 95% treatment target, but novel programs may be necessary in Kyrgyzstan to improve linkage to care, treatment adherence and retention to achieve 95% treatment coverage and 95% viral suppression.

No programs were modeled to improve linkage and retention in treatment, adherence, and viral suppression, and thus the cost of reaching the second and third cascade pillars is unknown. In addition to ART spending, novel programs may be necessary in Kyrgyzstan to improve linkage to care, treatment adherence and retention to achieve 95% treatment coverage and 95% viral suppression.

Achieving the 95-95-95 targets could avert 3137 (62%) new infections, 1368 (57%) deaths and 34317 (52%) DALYs compared to the baseline scenario of fixed 2021 spending on programs and no improvements to linkage to care or treatment adherence (Figure 4).

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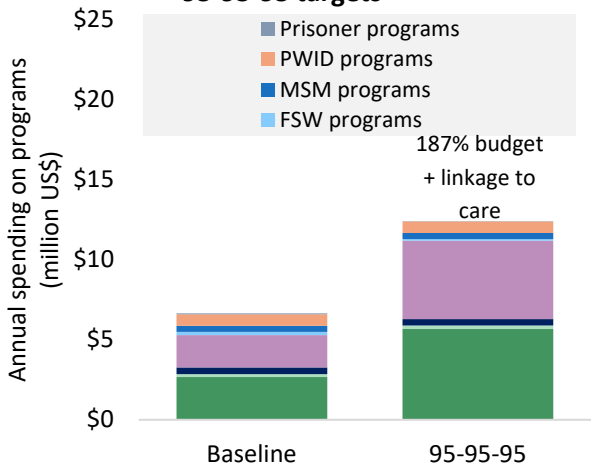
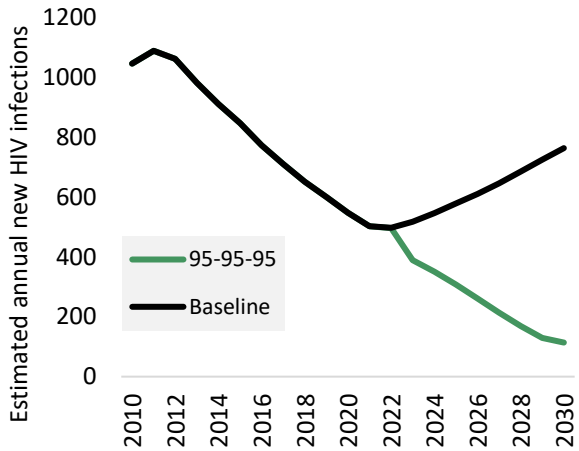
Allocation of HIV resources towards maximizing the impact of funding

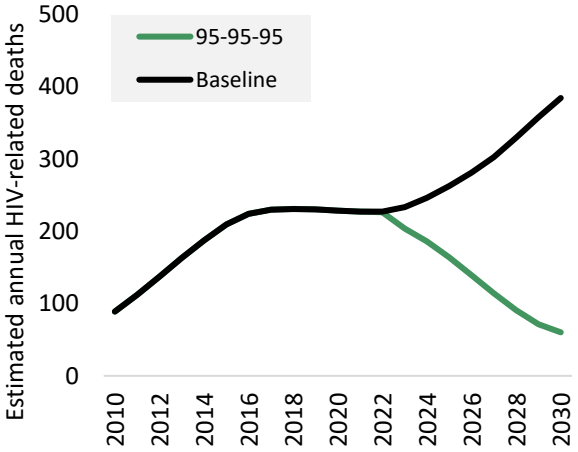
(a) Kyrgyzstan: optimized budget to reach 95-95-95 targets



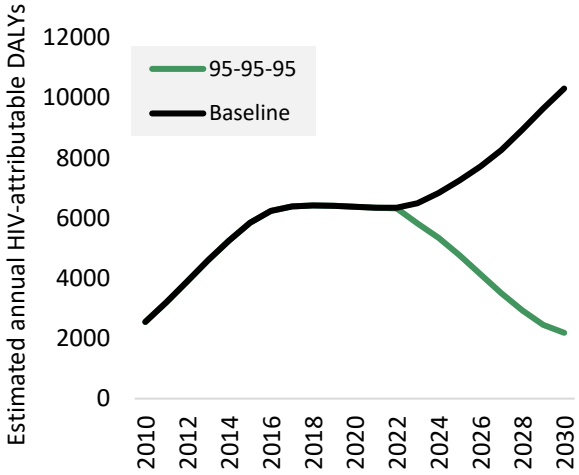
(b) Kyrgyzstan: annual new HIV infections in 95-95-95 scenario



(c) Kyrgyzstan: annual HIV deaths in 95-95-95 scenario



(d) Kyrgyzstan: annual HIV-attributable DALYs in 95-95-95 scenario



(e) Kyrgyzstan: projected care cascade

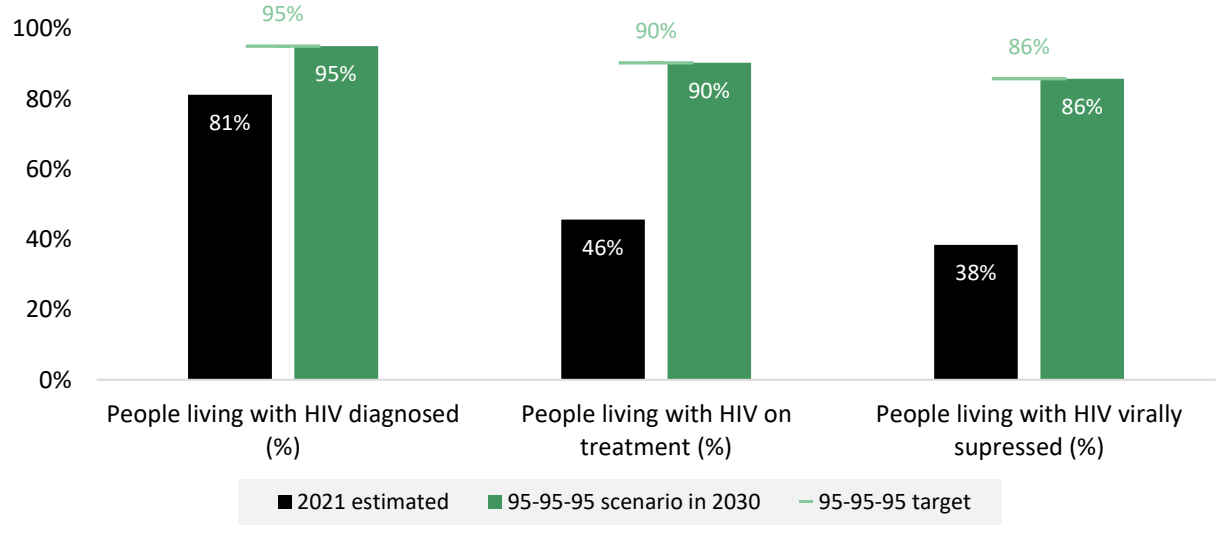


Figure 4. Optimized HIV budget level and allocation to achieve 95-95-95 targets by 2030. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) estimated care cascade in baseline year 2021 and projected for the year 2030 as a proportion of all people living with HIV. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

5 Comparison with past spending

Spending on targeted HIV programs has increased by 36% since 2018, from US$4.9M to estimated US$6.6M in 2021. In line with previous recommendations, investment changes have included increased absolute and relative spending on ART, enabling increased treatment coverage despite an increase in ART unit cost from $423 in 2018 to $538 in 2020. Contrary to recommendations from the 2019 analysis to expand investment in testing and prevention programs for PWID as additional funds become available, spending on these programs has decreased since 2018. This may be due to reduced need, with fewer people injecting drugs, and lower frequency of injection for those that do. Program coverage among MSM increased from 2018 (9,803 men reached) to 2021 (10,811 men reached) despite lower overall spending. However, it is not clear whether this was due to efficiency gains or changes in the package of services offered.

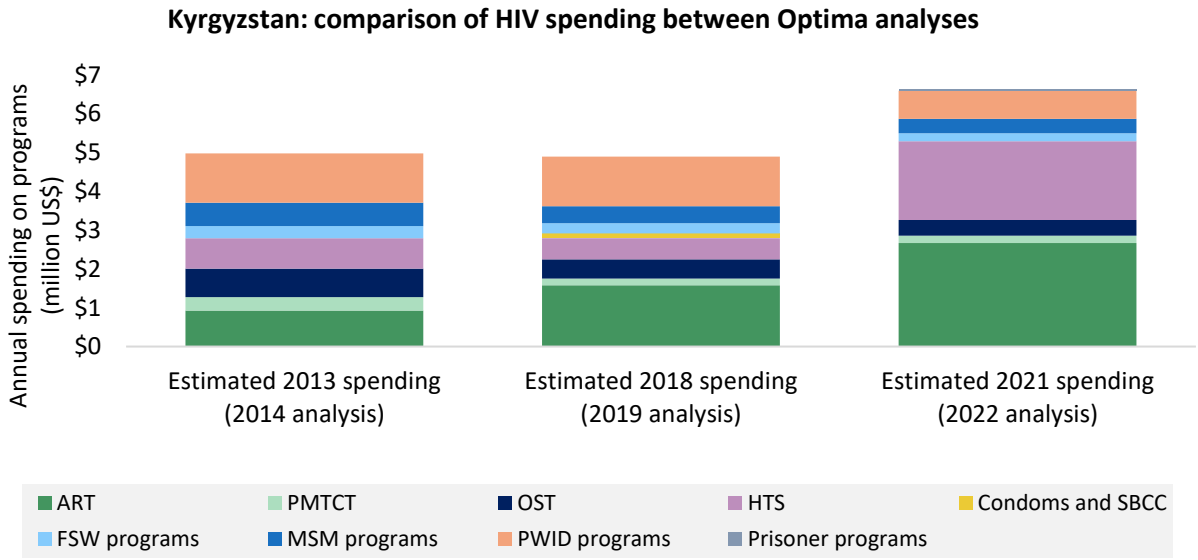


Figure 5. Estimated budget allocations from 2014, 2019 and 2022 Optima analyses. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

6 Study limitations

As with any modeling study, there are limitations that should be considered when interpreting results and recommendations from this analysis.

- **Population sizes:** There is uncertainty in population size estimates; for key populations stigma may lead to underestimation of population size, and for total populations there is instability in migration patterns due to the war in Ukraine. This may influence estimates of people living with HIV and subsequently, service and funding needs for each key population.
- **Epidemiological indicators** come from population surveys or programmatic data that have varying degrees and types of biases. Uncertainty in these indicators combined with uncertainty in population sizes can lead to uncertainty in model calibration and projected baseline outcomes and subsequently, service and funding needs for each key population.
- **Effect (i.e. impact) sizes for interventions** are taken from global literature (e.g. the effectiveness of condom use for preventing infections). Actual program impacts may vary depending on context or quality of implementation.
- **Geographical heterogeneity** is not modeled, and outcomes represent national averages. There may be opportunities for additional efficiency gains through appropriate geographical targeting.
- **Cost functions for each program** are a key driver of model optimizations. Cost functions determine how program coverage will change if funding is reallocated, as well as maximum achievable program coverage. There is uncertainty in the shapes of these cost functions, values which could influence how easily or how high programs could be scaled up.
- **Retention in care:** This analysis did not consider programs that could improve linkage and retention in care for people diagnosed, or viral suppression for people on treatment. These programs will be essential to achieving the 95-95-95 targets and future analyses should focus on quantifying the spending and impacts of relevant programs.
- **Other efficiency gains** such as improving technical or implementation efficiency were not considered in this analysis.
- **Equity** in program coverage or HIV outcomes was not captured in the model but should be a key consideration in program implementation. 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, and technical or implementation efficiency gains. In addition, prevention programs may have benefits outside of HIV, such as for sexually transmitted infections, hepatitis C, and community empowerment. These were not considered in the optimization but should be factored into programmatic and budgeting decisions.

- **Currency:** The COVID-19 pandemic, war in Ukraine and global economic crises have led to instability in currencies over the past few years. Spending is reported in US$, but what this value represents in local currency may change over time in unknown ways.
- **Migration** of people, especially people living with HIV was not considered. Migrants with HIV can sometimes explain changes in the numbers of people living with HIV or can affect the number of new HIV infections.

7 Conclusions

This modeling analysis evaluated the allocative efficiency of direct HIV programs in Kyrgyzstan, finding that an optimized resource allocation can have an impact on reducing infections and deaths. Program priorities were identified as increased treatment scale-up where possible, maintenance of funding towards testing and prevention programs for people who inject drugs, and scale-up of key population programs as budget becomes available. New or scaled-up programs focusing on supporting linkage to care, adherence and retention in treatment are needed to reach care cascade targets by 2030, and the cost of these programs will require future exploration.

Acknowledgements

This Optima HIV modeling analysis was conducted as a collaboration between the Kyrgyzstan country team and international partners.

Country team: Aibek Bekbolotov, Lyutsia Yanbukhtina, and Ulan Sarymsakov, the Republican AIDS Center of the Ministry of Health of the Kyrgyz Republic.

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University College London: Tom Palmer

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8 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%
	Opioid substitution therapy	54%
	PMTCT	90%
	ARV-based pre-exposure prophylaxis	95%
	ARV-based post-exposure prophylaxis	73%
	ART not achieving viral suppression	50%
	ART achieving viral suppression	100%
Disutility weights		
	Untreated HIV, acute	0.18
	Untreated HIV, CD4 (>500)	0.01
	Untreated HIV, CD4 (350-500)	0.03
	Untreated HIV, CD4 (200-350)	0.08
	Untreated HIV, CD4 (50-200)	0.29
	Untreated HIV, CD4 (<50)	0.58
	Treated HIV	0.08

Source: Optima HIV User Guide Volume VI Parameter Data Sources

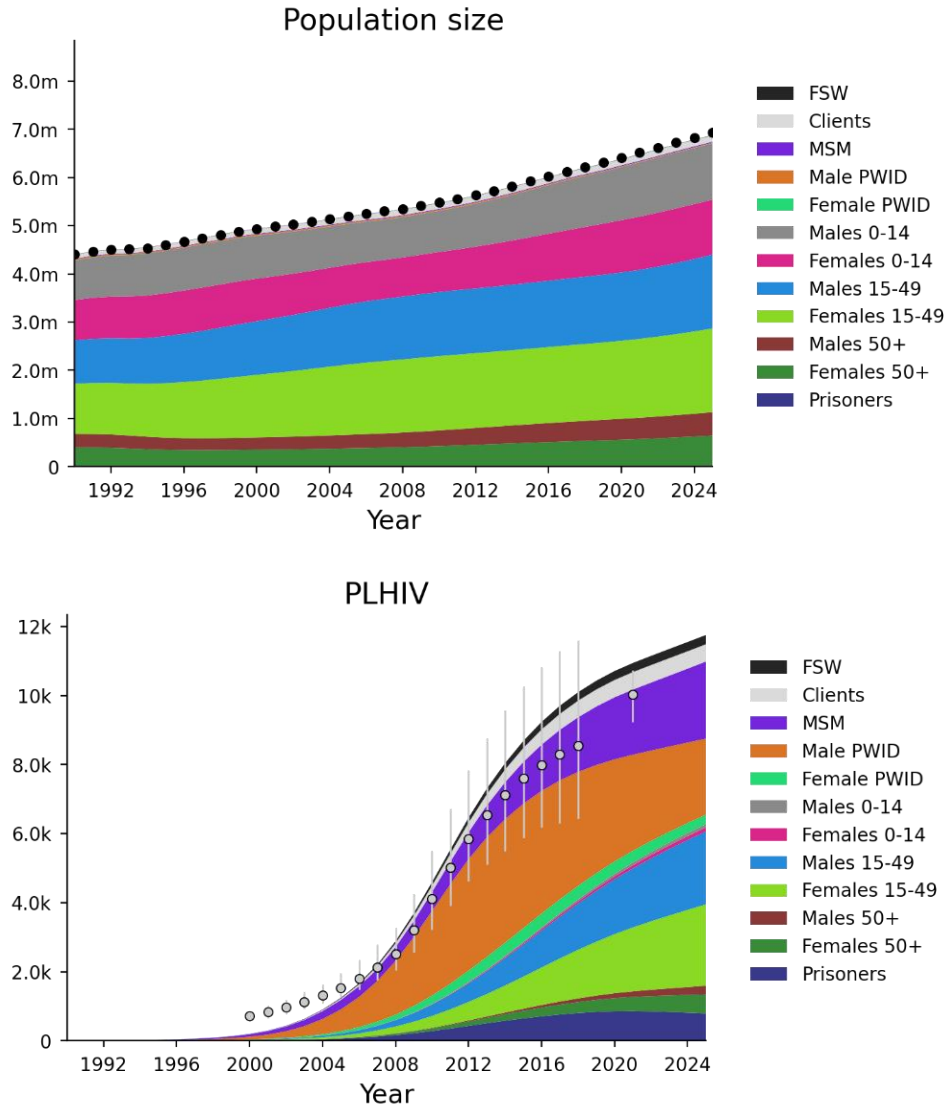
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

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
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 (% HIV-related 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 ART achieving viral suppression	23%
	Relative death rate on ART not achieving viral suppression	49%
	Tuberculosis cofactor	217%

Source: Optima HIV User Guide Volume VI Parameter Data Sources

Appendix 2. Model calibration

Figure A1. Calibration outputs. Dots represent official country estimates based on World Population Prospects, Spectrum model, surveillance surveys, program data and UNAIDS.



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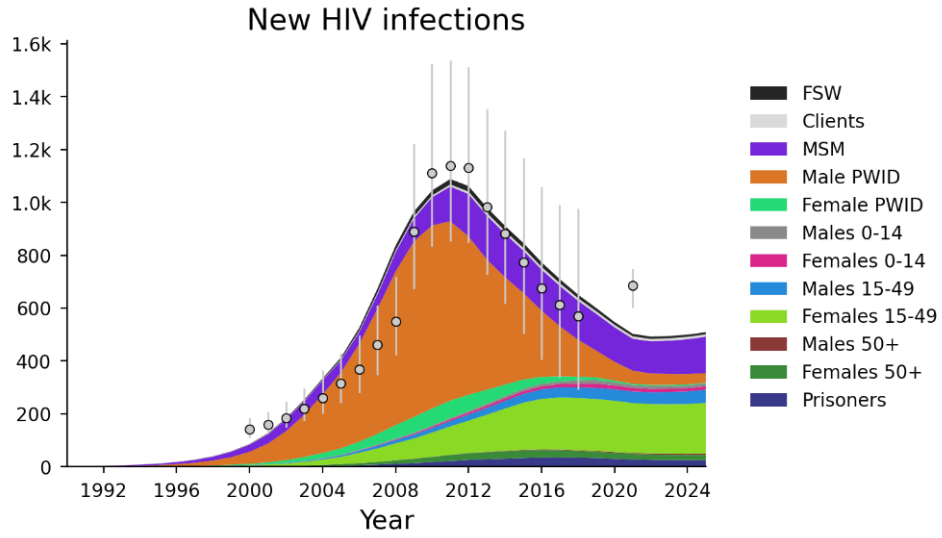
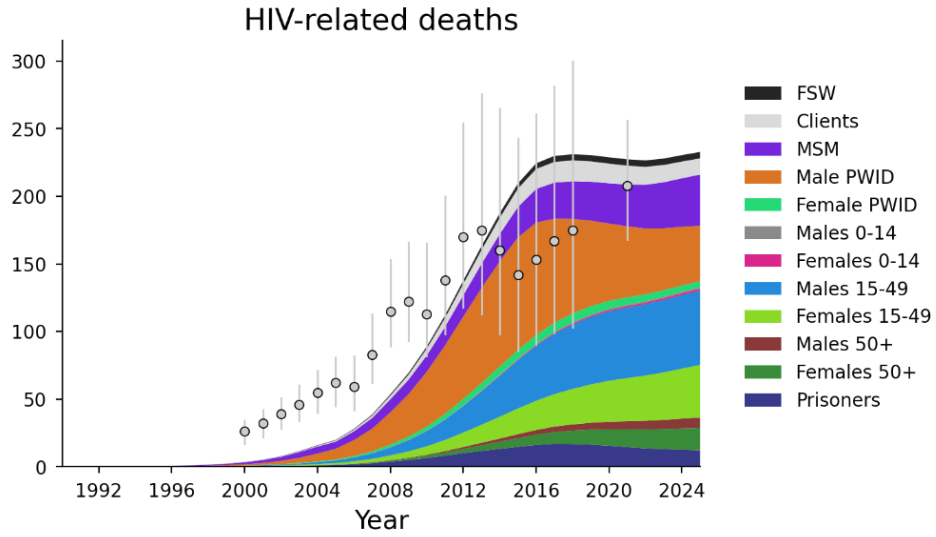
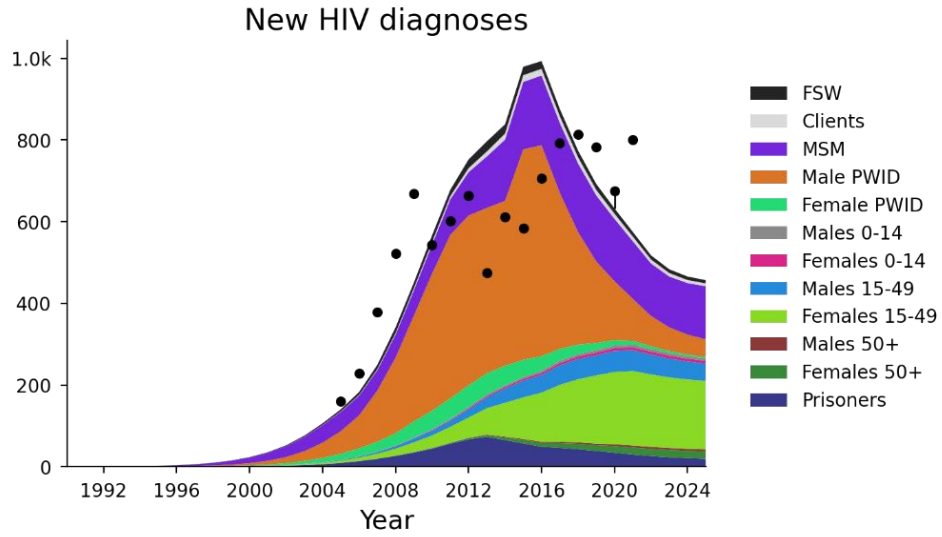
Allocation of HIV resources towards maximizing the impact of funding







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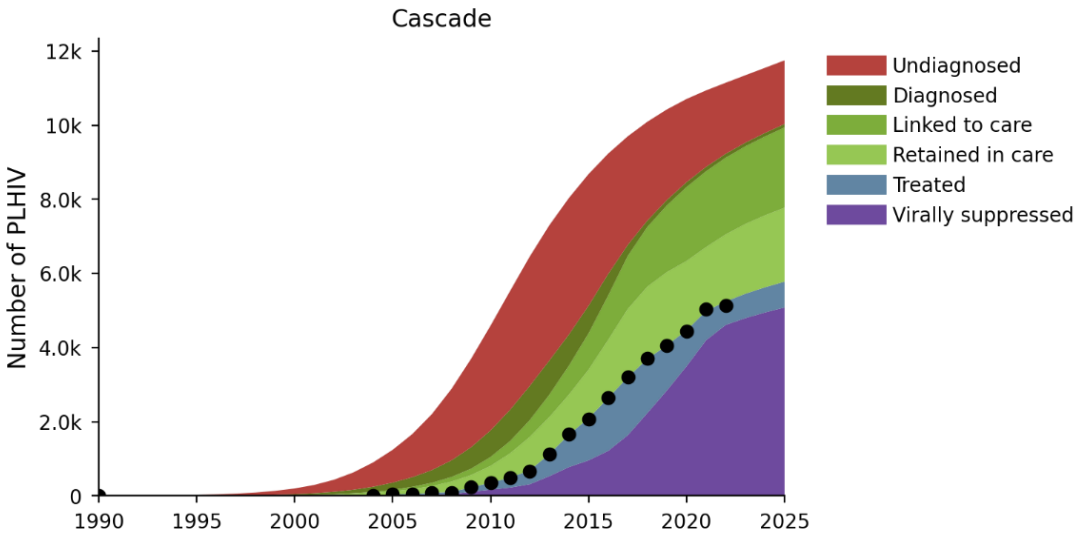
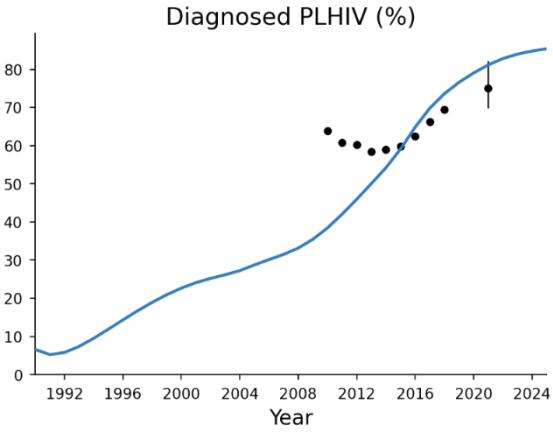
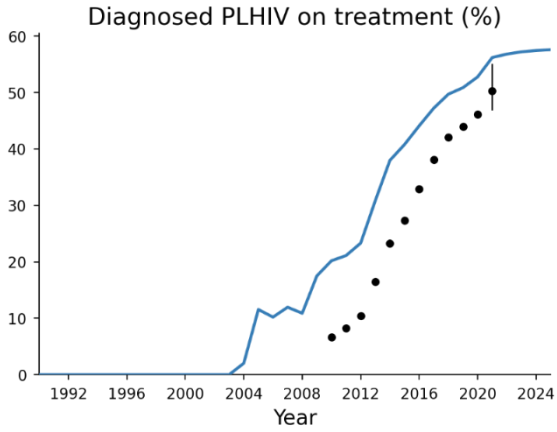
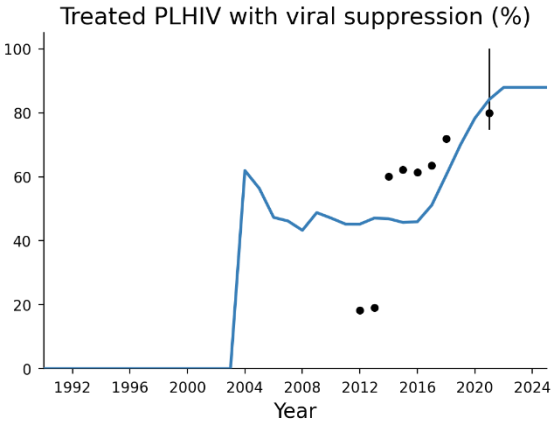
Allocation of HIV resources towards maximizing the impact of funding









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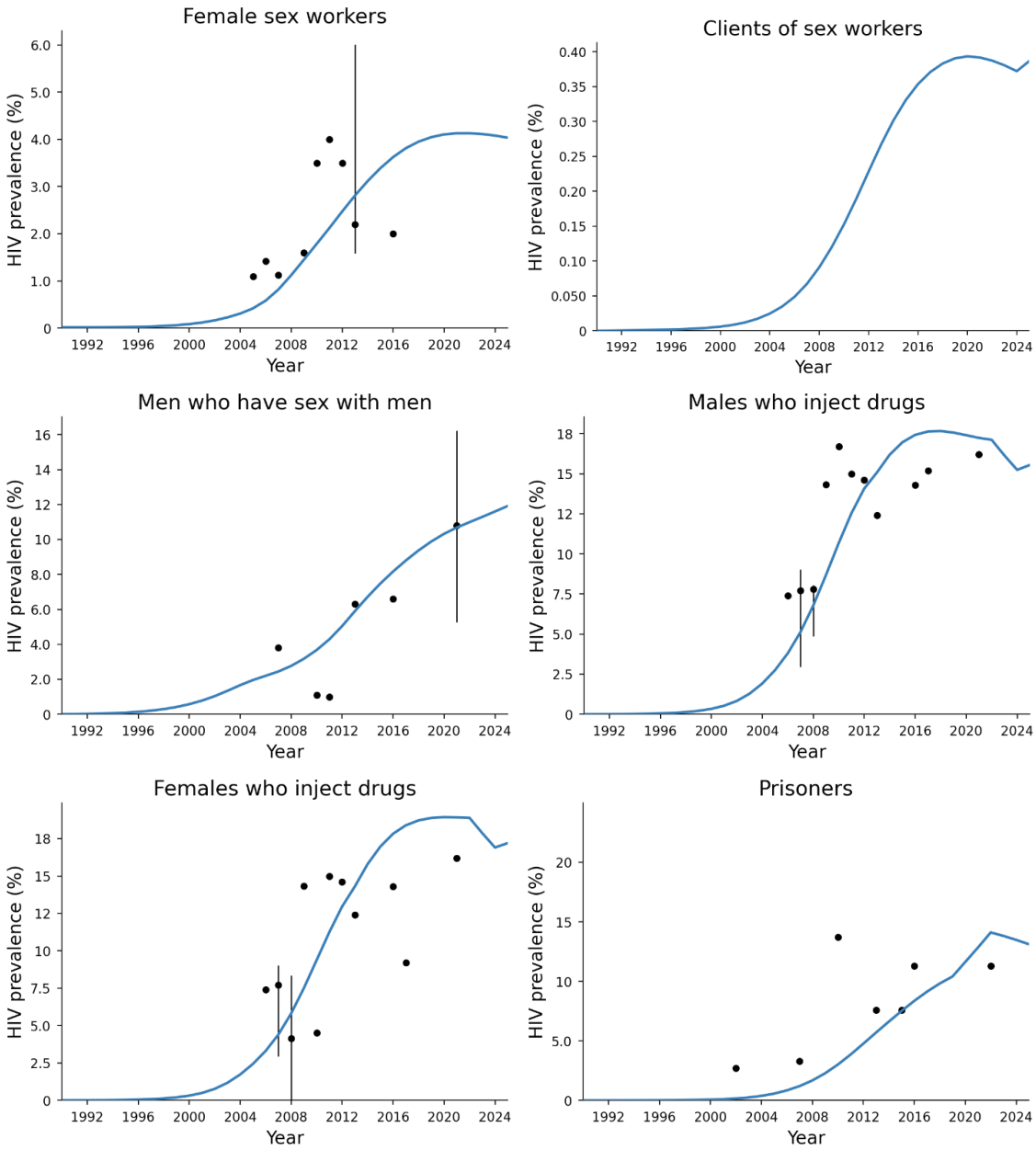

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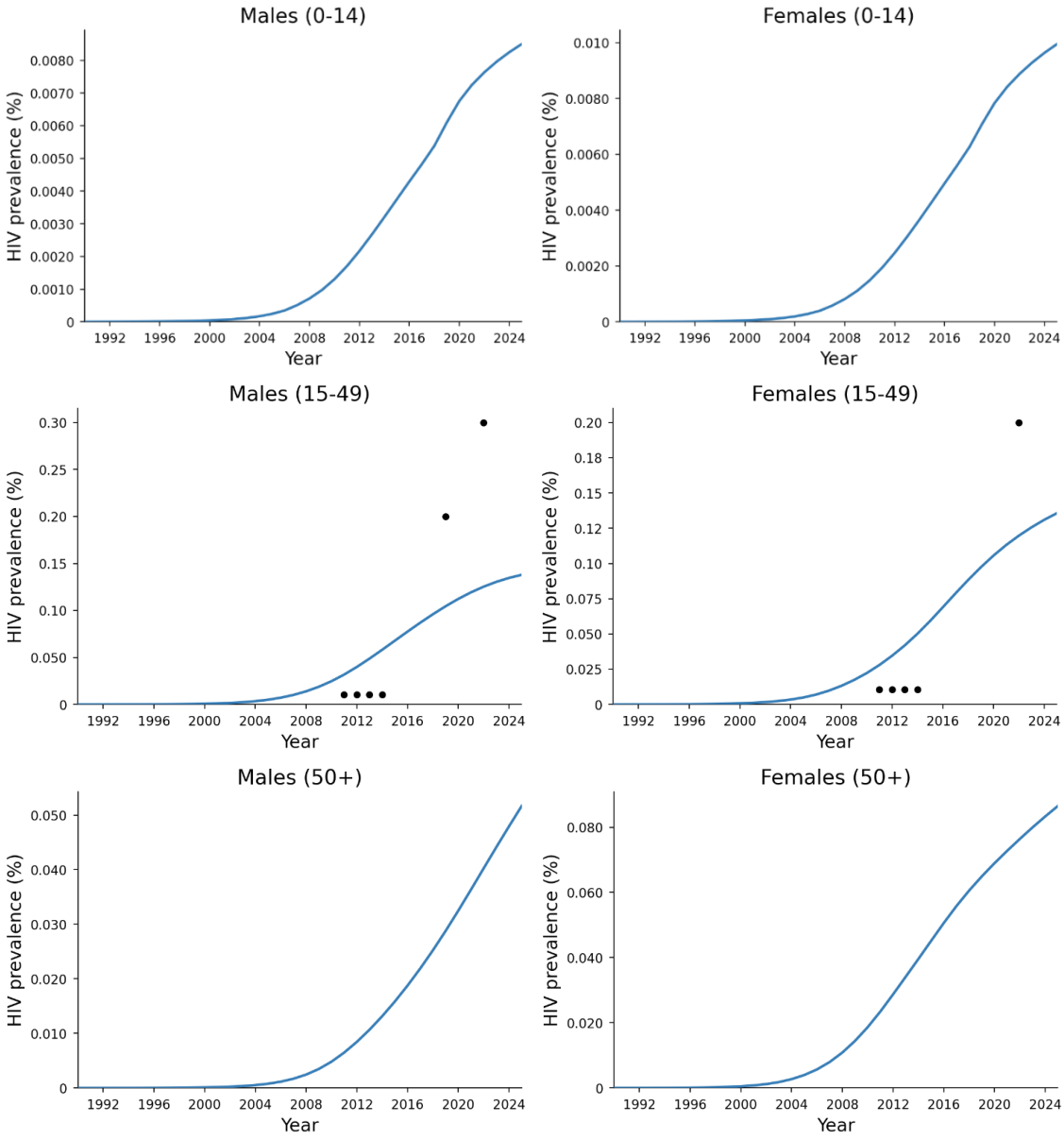
Allocation of HIV resources towards maximizing the impact of funding



Appendix 3. HIV program costing and impacts

Table A3. HIV program unit costs and saturation values

HIV program	Unit cost (USD)*	Saturation (low)	Saturation (high)
Antiretroviral therapy	$537.65	95%	95%
HIV testing and prevention programs for FSW	$58.00	50%	70%
HIV testing and prevention programs for MSM	$34.00	55%	76%
HIV testing and prevention programs for PWID	$67.00	60%	85%
Prevention programs for prisoners	$30.00	30%	40%
HIV testing services (general population)	$3.70	30%	70%
Opioid substitution therapy	$484.33	0%	15%
PMTCT	$1079.39	95%	95%

FSW, female sex worker; MSM, men who have sex with men; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.
* Due to incomplete data in 2021, unit costs reflect 2020 spending with the exception of prisoner programs

Table A4. Data inputs of impact of programs

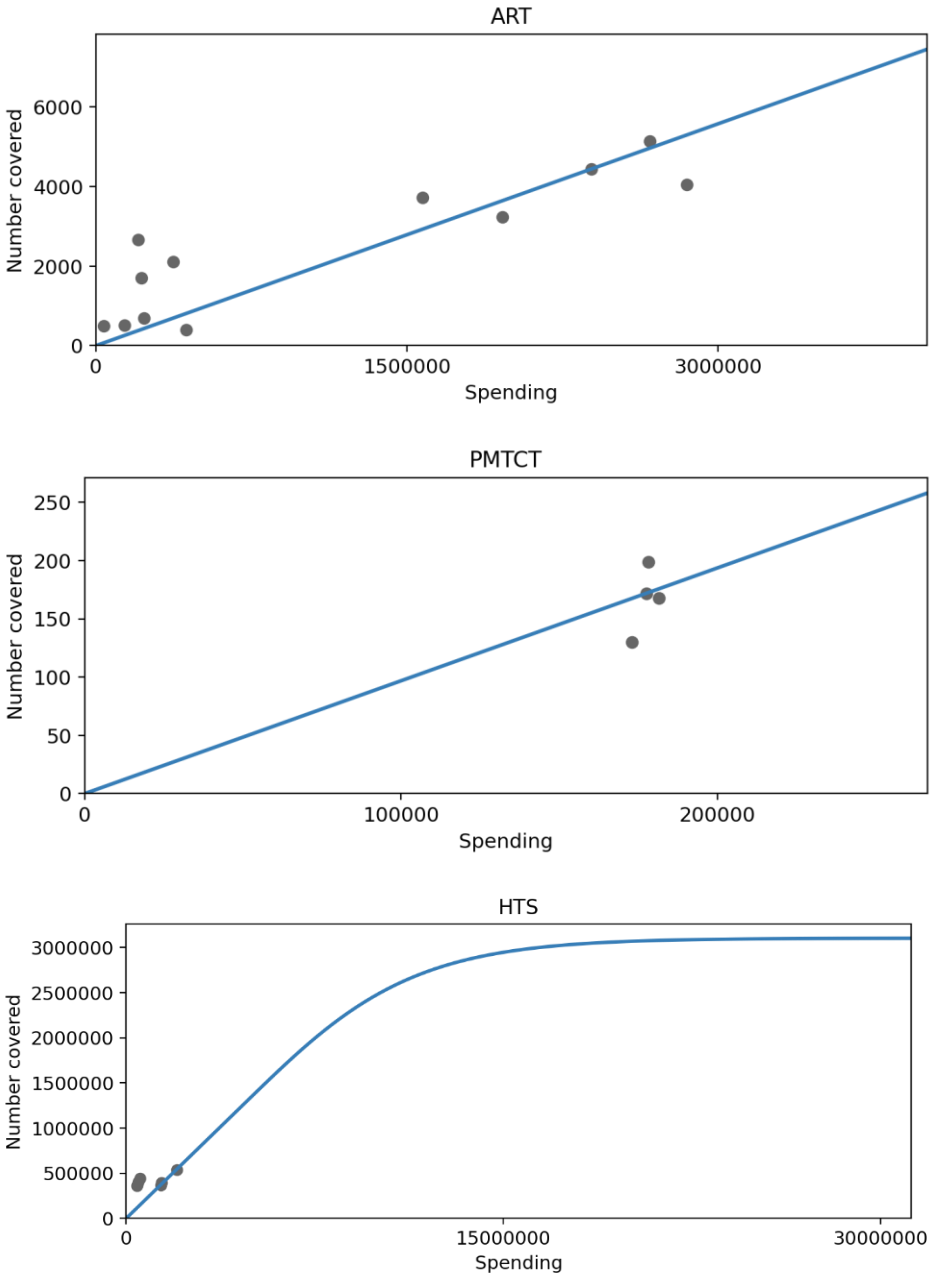
HIV program	Parameter	Population interactions or population	In absence of any programs		For each individual reached by this program	
			Low	High	Low	High
FSW programs	Condom use for commercial acts	Clients, FSW	92%	92%	99%	99%
FSW programs	Condom use for commercial acts	Male PWID, FSW	60%	60%	98%	98%
PWID programs	Condom use for commercial acts	Clients, Female PWID	75%	80%	90%	97%
PWID programs	Condom use for commercial acts	Male PWID, FSW	60%	60%	80%	90%
PWID programs	Condom use for commercial acts	Male PWID, Female PWID	60%	60%	85%	95%
FSW programs	Condom use for casual acts	Males 15-49, FSW	60%	60%	93%	93%
MSM programs	Condom use for casual acts	MSM, MSM	72%	72%	99%	99%
PWID programs	Condom use for casual acts	Male PWID, Female PWID	43%	50%	80%	87%
PWID programs	Condom use for casual acts	Male PWID, Females 15-49	32%	40%	70%	83%
PWID programs	Condom use for casual acts	Males 15-49, Female PWID	50%	55%	83%	97%

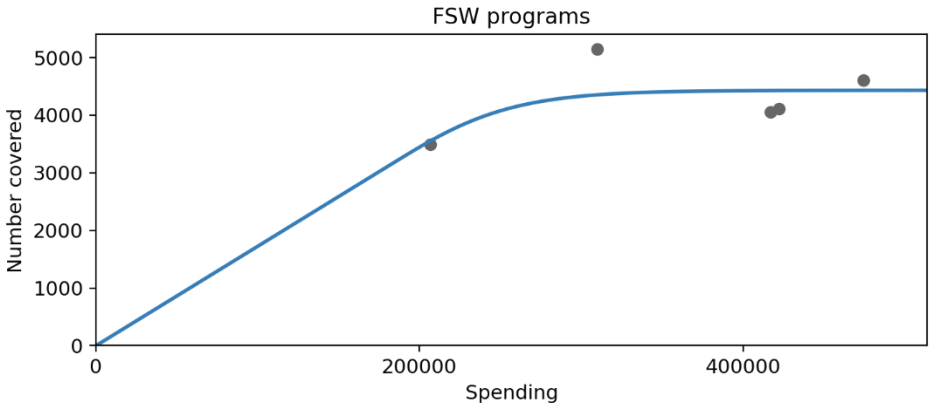
FSW programs	HIV testing rate (average tests per year)	FSW	0.10	0.16	0.72	0.85
MSM programs	HIV testing rate (average tests per year)	MSM	0.10	0.16	1.00	1.22
PWID programs	HIV testing rate (average tests per year)	Male PWID	0.00	0.10	0.65	0.74
PWID programs	HIV testing rate (average tests per year)	Female PWID	0.00	0.10	0.60	0.70
HTS	HIV testing rate (average tests per year)	Clients	0.00	0.00	0.55	0.55
HTS	HIV testing rate (average tests per year)	Males 15-49	0.00	0.00	0.55	0.55
HTS	HIV testing rate (average tests per year)	Females 15-49	0.15	0.18	0.95	0.95
HTS	HIV testing rate (average tests per year)	Males 50+	0.00	0.00	0.25	0.25
HTS	HIV testing rate (average tests per year)	Females 50+	0.00	0.00	0.25	0.25
PWID programs	Probability of needle sharing (per injection)	Male PWID	12%	12%	1%	1%
PWID programs	Probability of needle sharing (per injection)	Female PWID	8%	8%	1%	1%
Prisoner programs	Probability of needle sharing (per injection)	Prisoners	86%	87%	20%	20%
PMTCT	Number of people on PMTCT	Total	0	0	-	-
PMTCT	Number of people on treatment	Total	0	0	-	-
ART	Number of people on treatment	Total	0	0	-	-
OST	Number of PWID on OST	Total	0	0	-	-

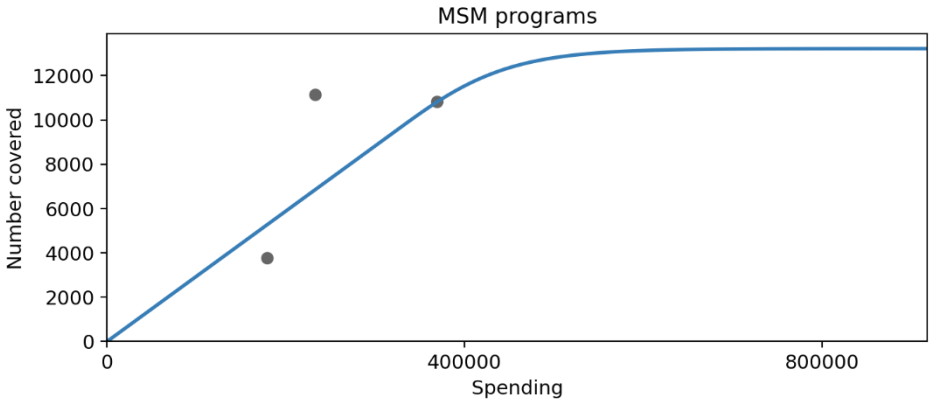
ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

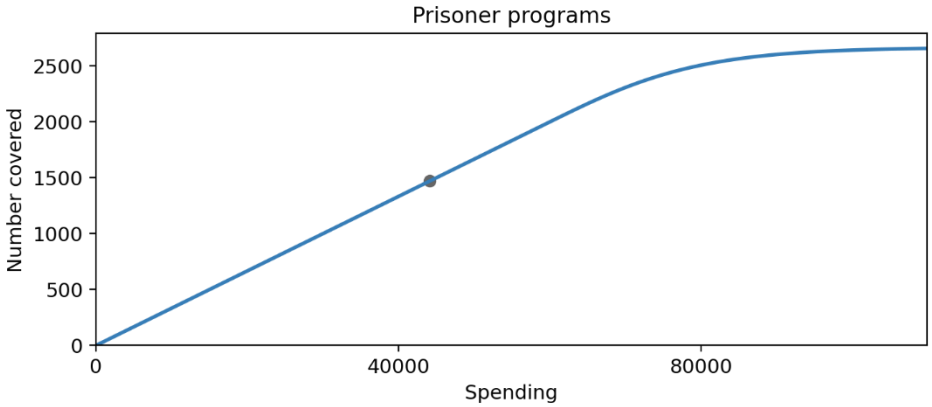
- The number of people modeled as receiving ART, PMTCT and OST is equal to the coverage of the respective programs.

Figure A2. Cost functions




FSW programs
Number covered
0
1000
2000
3000
4000
5000
0
200000
400000
Spending


MSM programs
Number covered
0
2000
4000
6000
8000
10000
12000
0
400000
800000
Spending


Prisoner programs
Number covered
0
500
1000
1500
2000
2500
0
40000
80000
Spending

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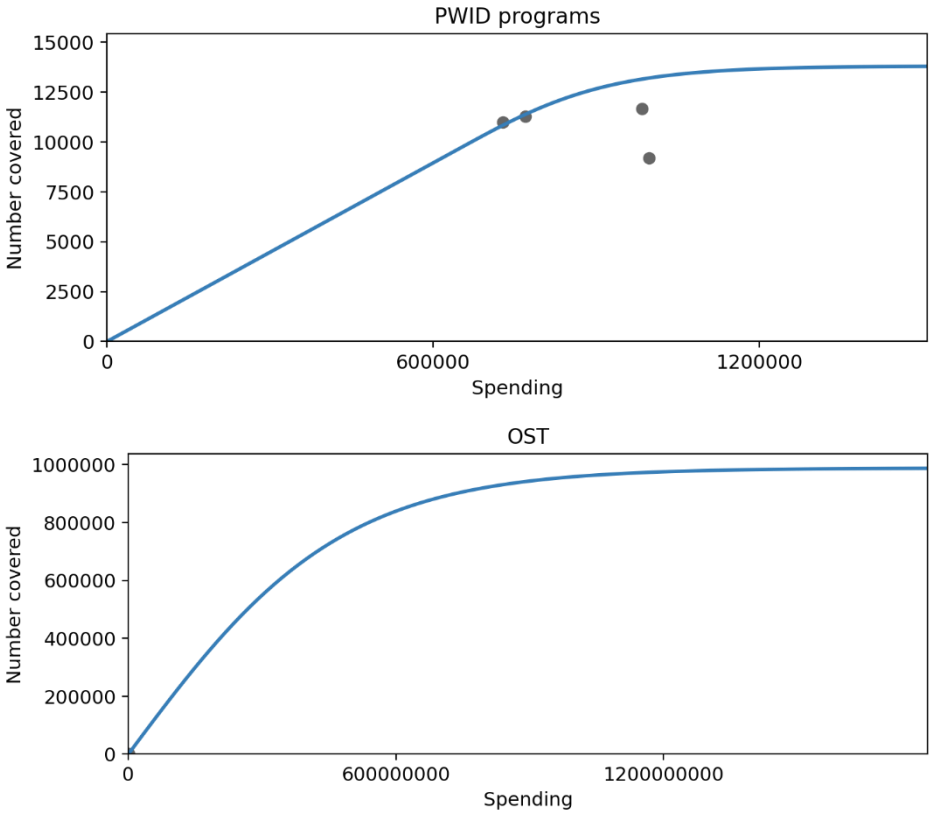

Appendix 4. Annual HIV budget allocations at varying budgets

Table A5. Annual HIV budget allocations at varying budgets for 2022 to 2030

	100% latest (estimated 2021)#	50% optimized	75% optimized	100% optimized	125% optimized	150% optimized
Antiretroviral therapy (ART)	2,671,583	2,726,014	3,899,942	4,008,089	4,243,401	4,333,751
FSW programs*	206,518	0	0	103,259	265,688	265,213
MSM programs*	368,968	0	106,829	210,376	533,104	537,962
PWID programs*	727,825	0	360,182	663,978	1,022,788	1,011,988
Prevention programs for prisoners	44,160	0	0	22,080	82,596	82,721
HIV testing services for general population	2,026,920	0	0	1,013,460	1,524,476	3,092,287
PMTCT	185,656	185,656	204,696	210,389	219,557	227,666
Opioid substitution therapy	408,290	408,290	408,290	408,290	408,290	408,290
Total targeted HIV program budget	6,639,920	3,319,960	4,979,940	6,639,920	8,299,900	9,959,880

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services targeting general population; MSM, men who have sex with men; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission; SBCC, social and behavior change communication.
Due to incomplete data, 2021 spending estimated based on unit cost in 2020 and program coverage achieved in 2021.
* Incorporates HIV testing and prevention services.

Table A6. Latest reported budget of non-targeted HIV programs, 2020

	Latest reported budget (2020*)
Enabling environment	$1,251,121
Infrastructure	$110,361
Monitoring and evaluation	$564,492
Management	$3,077,374
Other HIV care	$377,836
Other HIV costs	$1,951,582
Orphans and vulnerable children	$106,857
Total non-targeted HIV program budget	$7,439,623

* Non-targeted HIV spending not available for 2021 at the time of analysis

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