Burnet Institute
Medical Research. Practical Action.

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

BELARUS

January 2023

THE GLOBAL FUND

Burnet Institute
Medical Research. Practical Action.

Optima HIV

UNAIDS

BELARUS

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 that progress against the HIV epidemic can continue, it is vital to make cost-effective funding allocation decisions to maximize the impact of HIV programs. An allocative efficiency analysis was conducted in partnership with the Belarus Republican Center for Hygiene, Epidemiology and Public Health, the Global Fund, UNAIDS, Swiss Tropical and Public Health Institute, and the Burnet Institute.

Summary and key recommendations for HIV resource optimization include:

- Belarus has a concentrated HIV epidemic with a high prevalence among people who inject drugs (estimated 23% prevalence in 2020 (2)) and a lower but increasing prevalence among female sex workers and men who have sex with men (estimated 9.7% and 5.8% respectively in 2020 (3)).
- In 2021 an estimated US$14.6M was spent on targeted HIV interventions, with antiretroviral therapy (ART) accounting for 51% of this.
- In a baseline scenario with 2021 spending on programs was maintained, including a fixed annual spending on ART, it was estimated that there would be 12,678 new HIV infections, 5,338 HIV-related deaths and 136,432 HIV-attributable disability-adjusted life years (DALYs) over 2023-2030.
- **Optimizing spending would involve deprioritizing HIV testing among the general population to enable continued scale up of ART for all populations and HIV prevention and testing programs for people who inject drugs.** This optimization prioritizes high impact interventions that address the current treatment gap as well as the high proportion of new HIV infections occurring among people who inject drugs.
- Optimized reallocation of 2021 spending can advance epidemic gains without additional resources and was estimated to avert 2,887 new infections (23%), 456 deaths (9%) and 10,297 DALYs (7%) over 2023-2030 relative to a baseline of continued 2021 spending.
- **With additional resources available, priorities were identified as increased investment in HIV testing services and prevention programs for female sex workers and men who have sex with men, as well as continued scale up of ART and programs for people who inject drugs.** While the epidemic among female sex workers and men who have sex with men is smaller than among people who inject drugs, the prevalence in these groups is rising within the country as well as the region and so HIV prevention programs are critical.
- Moving from the 84-85-82 care cascade modeled in 2021[1] to reach the 95-95-95 targets by 2030 will require progress on all pillars. Meeting the 95% diagnosis target may be possible with optimized allocation of an additional US$4.6M per annum, or a total 132% of 2021 targeted spending. Meeting the 95% treatment and 95% viral suppression targets will require continued expansion of ART coverage through ongoing increases in spending or decreases in procurement costs, and novel programs to improve linkage to care and treatment adherence that are not costed in this analysis.

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

1 Background

In 2021 Belarus had an estimated population size of 9.6 million and an estimated 28,000 people living with HIV (4). Belarus has an HIV epidemic concentrated primarily among people who inject drugs (PWID), with a prevalence of 21% and 26% of males and females who inject drugs in the 2020 Integrated Biological and Behavioral Surveillance Survey (IBBS) (3). Men who have sex with men (MSM) and female sex workers (FSW) are also disproportionately impacted by HIV, with estimated prevalence of 5.8% and 9.7% respectively in the 2020 (3). Further, national data suggest that HIV prevalence is increasing among these groups (5), consistent with other countries in the region (2).

Historically, the HIV response in Belarus has been greatly dependent on international funding organizations, however the Government of Belarus has shown a strong commitment to increase domestic financing for HIV (6). The domestic share of HIV spending increased from 49% to 78% between 2011 and 2017, with most treatment expenditure being government funded (6). In 2021, the total annual spending on HIV programs amounted to US$39.8M derived from the 2021 National AIDS Spending Assessment (NASA) (7), of which the Global Fund contribution was approximately 13.7%.

The national response to the HIV epidemic is guided by Belarus' HIV treatment and prevention program. The government funded antiretroviral therapy (ART) program has been in place since 2012, and treatment coverage has more than doubled over the past five years, from 8,562 people on ART in 2016 to 19,888 people on ART in 2021 (8). Belarus is also committed to scaling up and ensuring the sustainability of harm reduction programs for PWID.

Previous HIV allocative efficiency analyses were conducted in 2014 and 2019 using the Optima HIV model, with support from the World Bank, UNAIDS, the Global Fund, and other partners (9, 10). This is the third Optima HIV analysis in Belarus, 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 Belarus Republican Center for Hygiene, Epidemiology and Public Health. 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 NASA reports, IBBS surveys, national reports and systems were collated. In Belarus, baseline spending was derived from the 2021 NASA (7). 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$14.6M 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. The model was developed by the Optima Consortium for Decision Science in partnership with the World Bank, and a detailed description of the Optima HIV model is available in Kerr et al (11).

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)
    - Males who inject drugs (MWID)
    - Females who inject drugs (FWID)
- General populations
    - Males 0-14 (M0-14)
    - Females 0-14 (F0-14)
    - Males 15-24 (M15-24)
    - Females 15-24 (F15-24)
    - Males 25-49 (M25-49)
    - Females 25-49 (F25-49)
    - 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, including 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 for the general population (HTS)
    - Social and behavior change communication (SBCC)

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 for a given budget 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 Belarus total spending on HIV from domestic and international sources was US$39.8M in 2021, incorporating US$14.6M targeted HIV spending for the programs considered above and US$25.5M non-targeted spending. The majority of targeted spending was for ART (51%), followed by 24% for HTS and 9% for testing and prevention programs for PWID (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, estimated ART coverage among diagnosed people living with HIV was 72%. If ART unit costs (US$375 in 2021) and current coverage of other HIV programs remained constant, annual ART spending would need to increase by US$1.8M (24% of 2021 ART spending) by 2030 to maintain a constant proportion of people who are diagnosed on treatment. 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 on treatment, and specific programs to improve linkage to care or treatment adherence were not modeled or costed in this analysis. Although treatment is available to all diagnosed people living with HIV in Belarus, 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).

BELARUS

Allocation of HIV resources towards maximizing the impact of funding

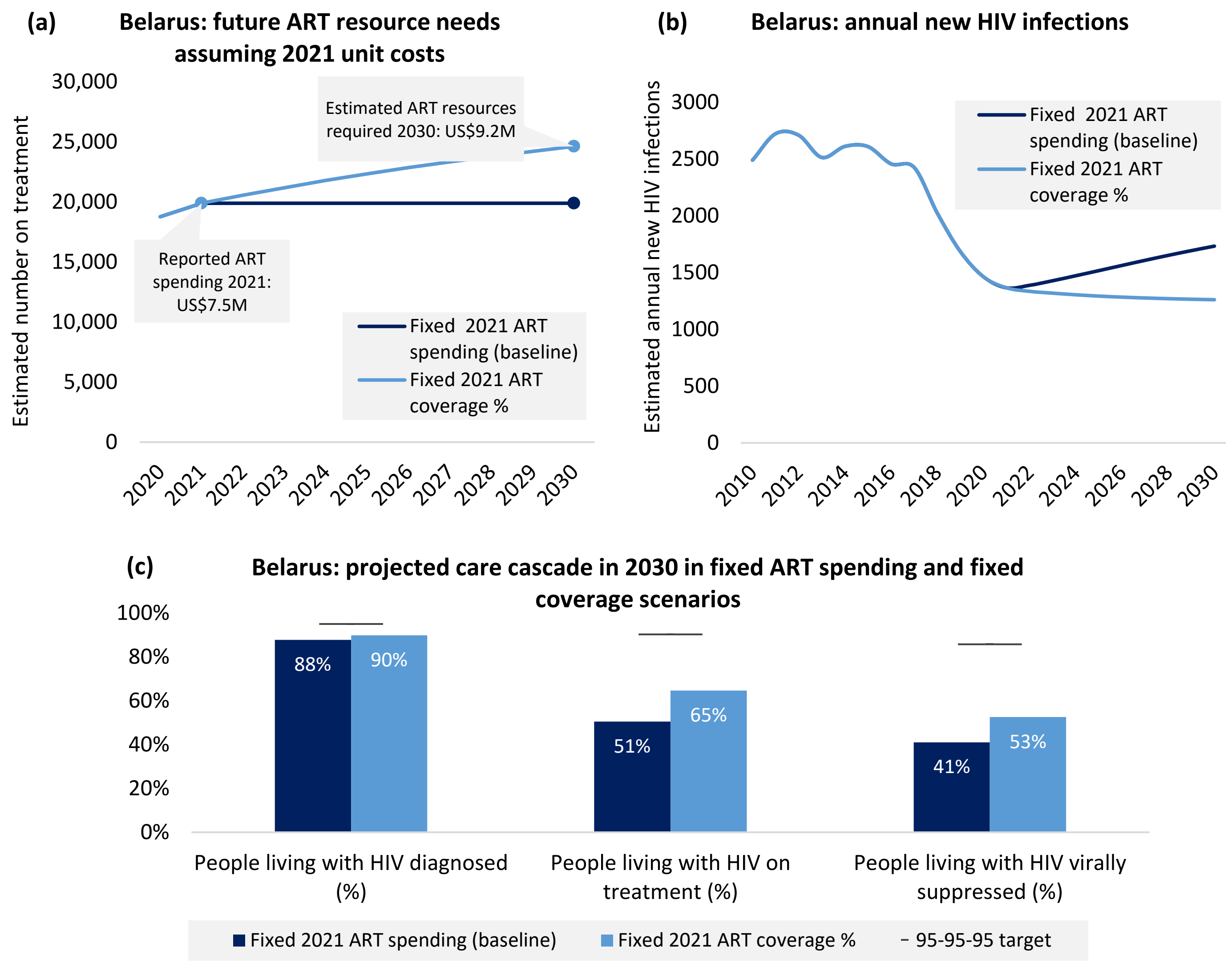


Figure 1. Fixed proportional coverage of people living with HIV on ART compared to fixed ART spending: resource needs and epidemic outcomes by 2030. Panels show (a) Resources required to maintain 2021 proportional coverage of ART among people living with HIV until 2030 if ART unit cost remains constant; (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 12,678 new HIV infections, 5,338 HIV-related deaths and 142,130 HIV-attributable DALYs over 2023-2030 (Table 1). Without additional spending on ART, the HIV care cascade in this scenario was projected to be "88-58-81" in the year 2030 (i.e. 88% people diagnosed, 58% people diagnosed on treatment and 81% people on treatment virally suppressed) (Figure 1c). 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 some generalized HTS spending to enable further scale-up of ART and testing and prevention programs for PWID (Figure 2). Assuming that more people could be accessed for treatment through enhanced linkage to care and adherence programs, then this could reduce mortality as well as new infections through treatment-as-prevention. Maintaining high levels of prevention programs for PWID is also critical, since the prevalence of HIV among PWID is high (over 20% for both males and females (3)) and the model projected that 43% of new HIV infections occurred among PWID. The model deprioritized general population testing to enable greater investment into these higher impact programs, including tested targeted through PWID programs. Although not modeled, delivery approaches and modalities for HTS can also be strategically utilized to better reach undiagnosed people living with HIV even with reduced resources, such as through index testing and social network testing strategies, tailored demand creation, task shifting and HIV self testing, and focused provider-initiated testing (12).

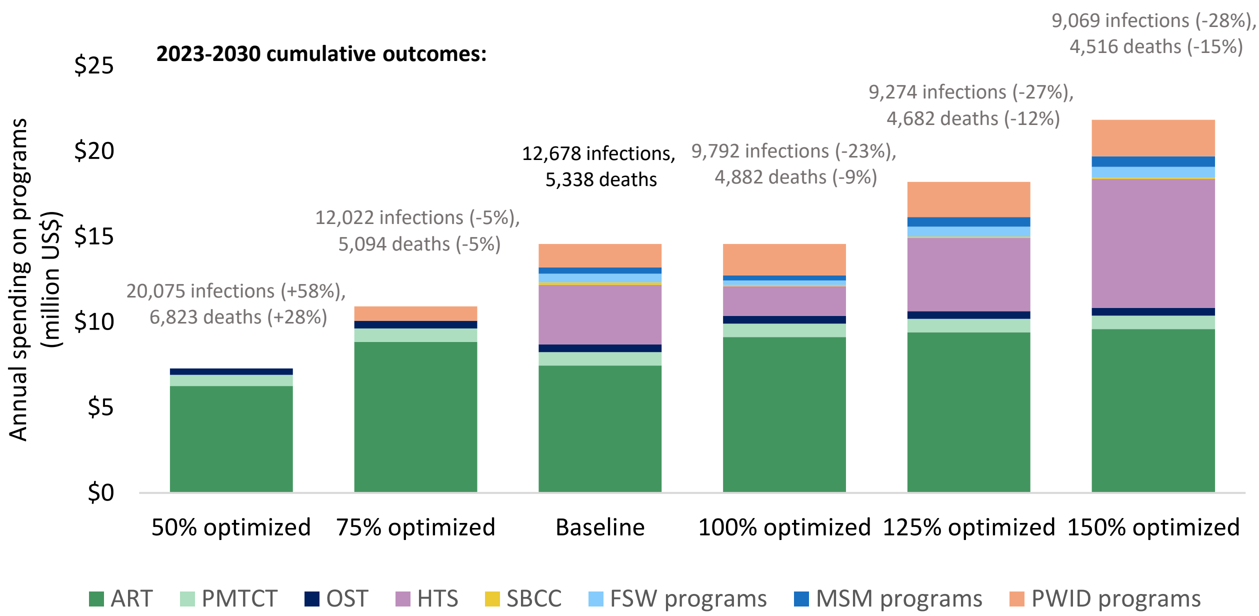


Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2023 to 2030, to minimize new infections and HIV-related deaths by 2030. Percentage optimized refers to the percentage of baseline HIV spending (i.e. 2021 spending). ART, antiretroviral therapy; FSW, female sex worker; HTS, 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; SBCC, social and behavior change communication.

Optimized resource allocation at different budget levels. As the total budget envelope increased, the priorities were identified as continued scale up of ART and programs for PWID, followed by investment in programs for FSW and MSM to curb the rising prevalence among these groups. While HIV infections among FSW and MSM contribute less to the HIV epidemic in Belarus than PWID (model projected 8% and 6% of new infections in 2021 respectively), new infections are increasing among these groups within the country as well as the region, and so HIV prevention programs are also critical.

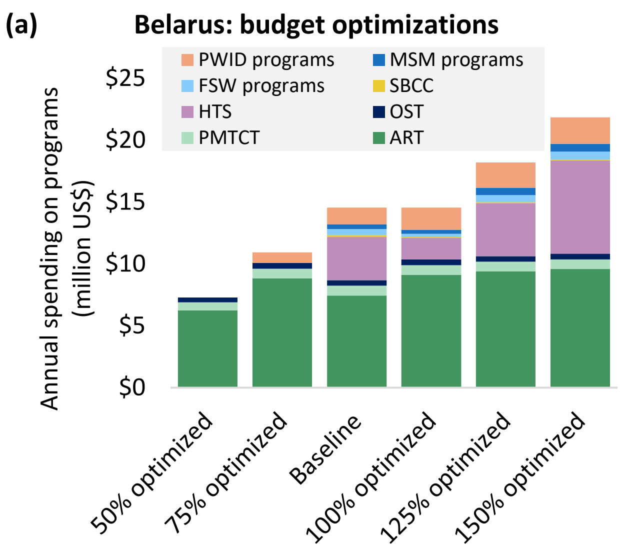
If funding were reduced, maintaining as many people on treatment as possible were prioritized, followed by prevention and NSP programs for PWID.

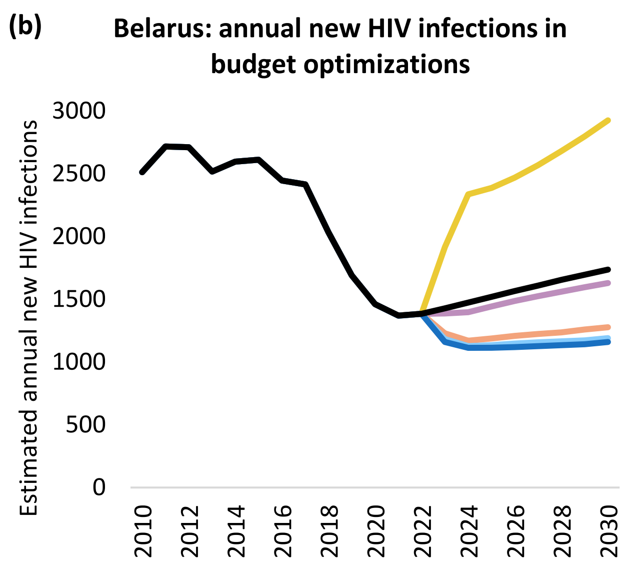
Impact of optimization on HIV epidemic. Compared with the baseline scenario, optimized reallocation of 2021 spending could avert 2,886 new infections (23%), 457 deaths (9%) and 10,297 DALYs (7%) over 2023-2030. This benefit increases to 28% infections, 15% deaths and 13% DALYs averted with an optimized 150% budget (Figure 3;Table 1).

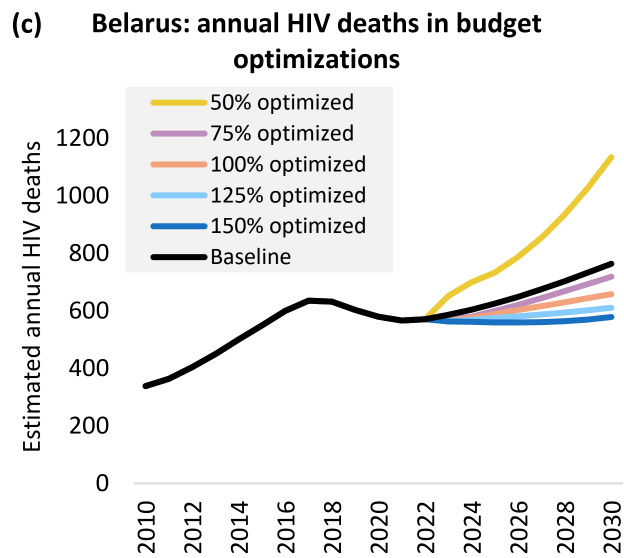
Beyond 150% budget the modeled programs all reached close to their saturation levels, and increased investment had diminishing returns. At this level of spending, the main gap in the care cascade is the loss to follow-up of people who are diagnosed, and hence missed opportunities to receive treatment. 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.

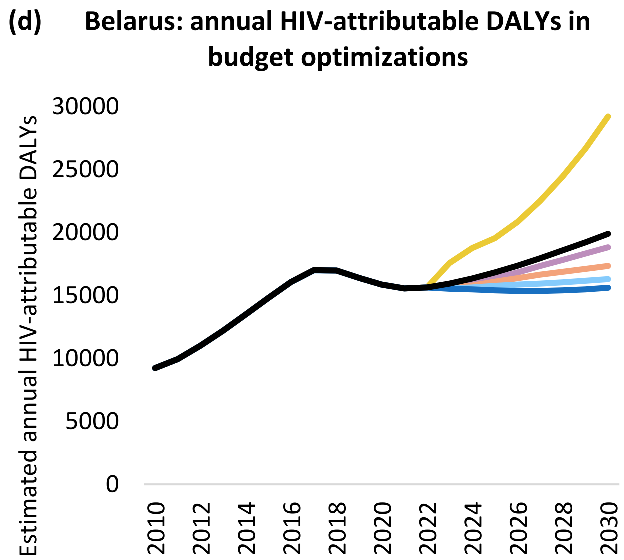
BELARUS

Allocation of HIV resources towards maximizing the impact of funding









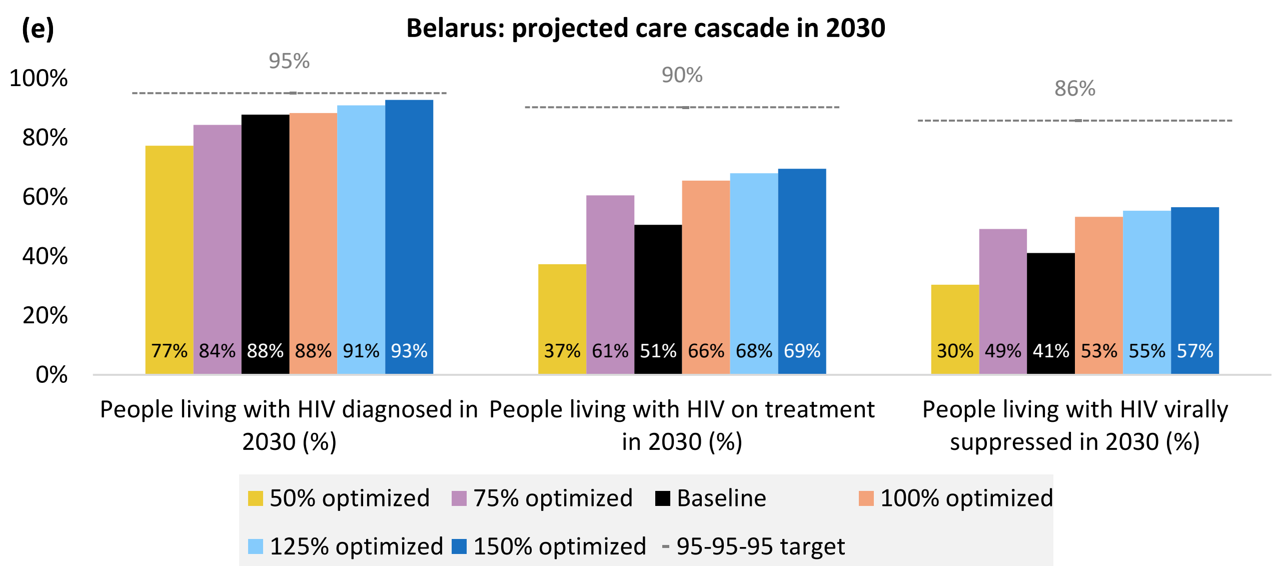


Figure 3. Model outcomes from budget optimization scenarios aiming to minimize infections and deaths. Panels show (a) optimal budget allocations **under varying levels of annual HIV budgets** according to percentage of estimated 2021 spending; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) projected care cascade for the year 2030. ART, antiretroviral therapy; DALY, disability-adjusted life year; 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; SBCC, social and behavior change communication.

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 25,914 (+204%) more new infections, 11,312 (+212%) more deaths and 276,076 (+194%) 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	38,593	16,650	418,206	204%	212%	194%
50% optimized	20,075	6,823	179,509	58%	28%	26%
75% optimized	12,022	5,094	137,069	-5%	-5%	-4%
Baseline	12,678	5,338	142,130			
100% optimized	9,792	4,881	131,833	-23%	-9%	-7%
125% optimized	9,274	4,682	127,259	-27%	-12%	-10%
150% optimized	9,069	4,516	123,591	-28%	-15%	-13%
95-95-95	5,065	2,700	80,879	-60%	-49%	-43%

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, Belarus' 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$4.6M per annum, or a total 132% of 2021 targeted HIV spending, was required over 2023-2030. Additional programs that focus prevention and testing services to 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.

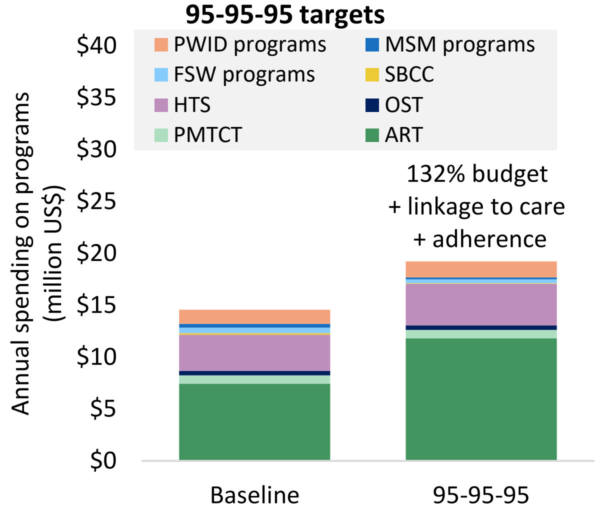
No programs were modeled to improve linkage and retention in treatment, adherence, and viral suppression, and thus the cost of reaching the second and third cascade pillars is unknown. In addition to ART spending, novel programs may be necessary in Belarus to improve linkage to care, treatment adherence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

Achieving the 95-95-95 targets could avert 7,613 (60%) new infections, 2,638 (49%) deaths and 61,997 (45%) DALYs by 2030 compared to the baseline scenario of fixed 2021 spending on programs and no improvements to linkage to care or treatment adherence (Figure 4).

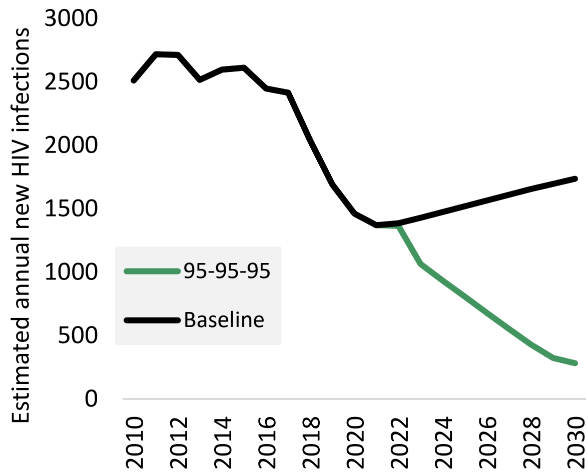
BELARUS

Allocation of HIV resources towards maximizing the impact of funding

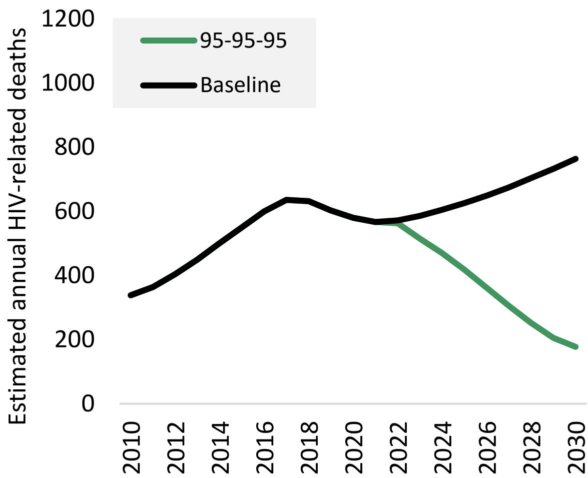
(a) Belarus: optimized budget to reach 95-95-95 targets



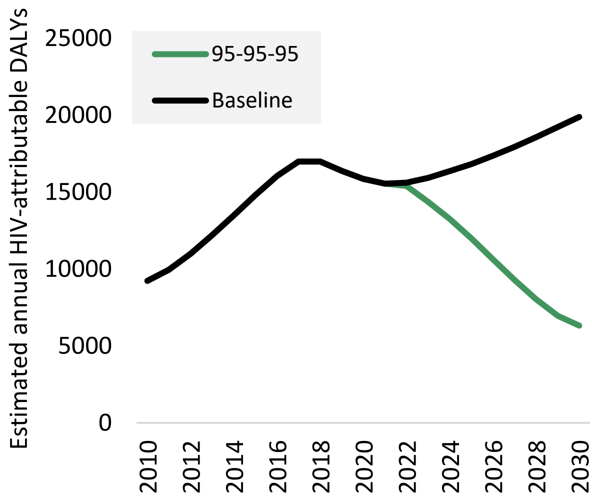
(b) Belarus: annual new HIV infections in 95-95-95 scenario



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



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



(e) Belarus: projected care cascade

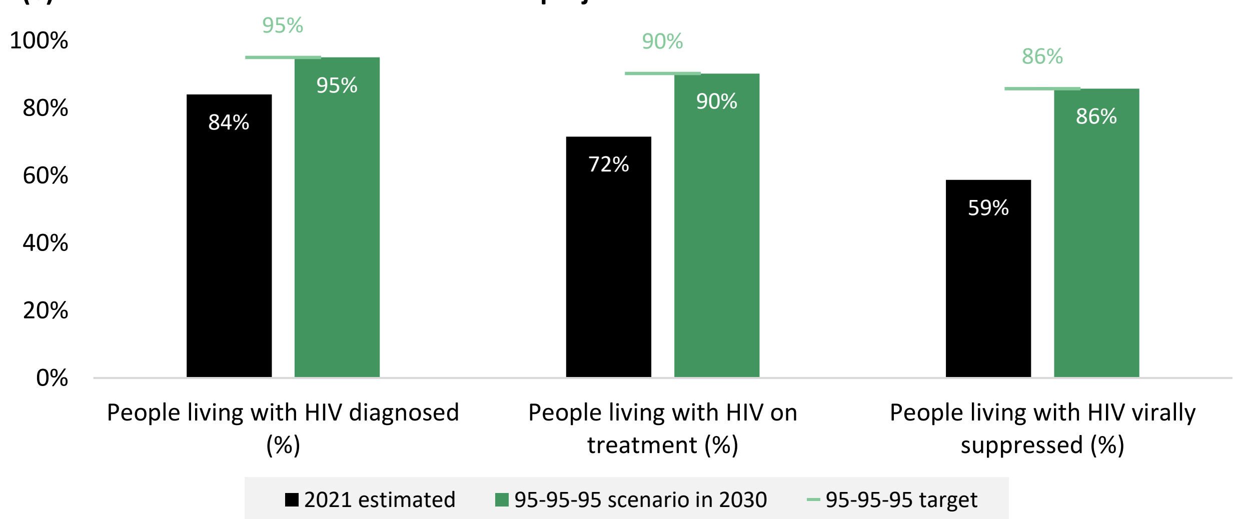


Figure 4. Optimized HIV budget level and allocation to achieve 95-95-95 targets by 2030. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) estimated care cascade in baseline year 2021 and projected for the year 2030 as a proportion of all people living with HIV. ART, antiretroviral therapy; DALY, disability-adjusted life year; 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; SBCC, social and behavior change communication.

5 Comparison with past spending

Spending on targeted HIV programs has increased over time, from US$9.5M in 2013 to US$14.6M in 2021 (Figure 5). There has been an increase in spending on ART, both in total and as a proportion of the overall spending. Alongside a reduction in ART unit costs between 2013 (US$576) and 2021 (US$378), this reflects the large scale-up of treatment that has occurred, which had likely played an important role in reducing both new infections and deaths. There has also been a shift in spending across other programs, with increased emphasis on HIV testing and prevention programs focusing on PWID, FSW and MSM, and decreased emphasis on PMTCT, OST and SBCC. These changes are consistent with recommendations from previous allocative efficiency analyses and would likely have improved the cost-effectiveness and impact of investment.

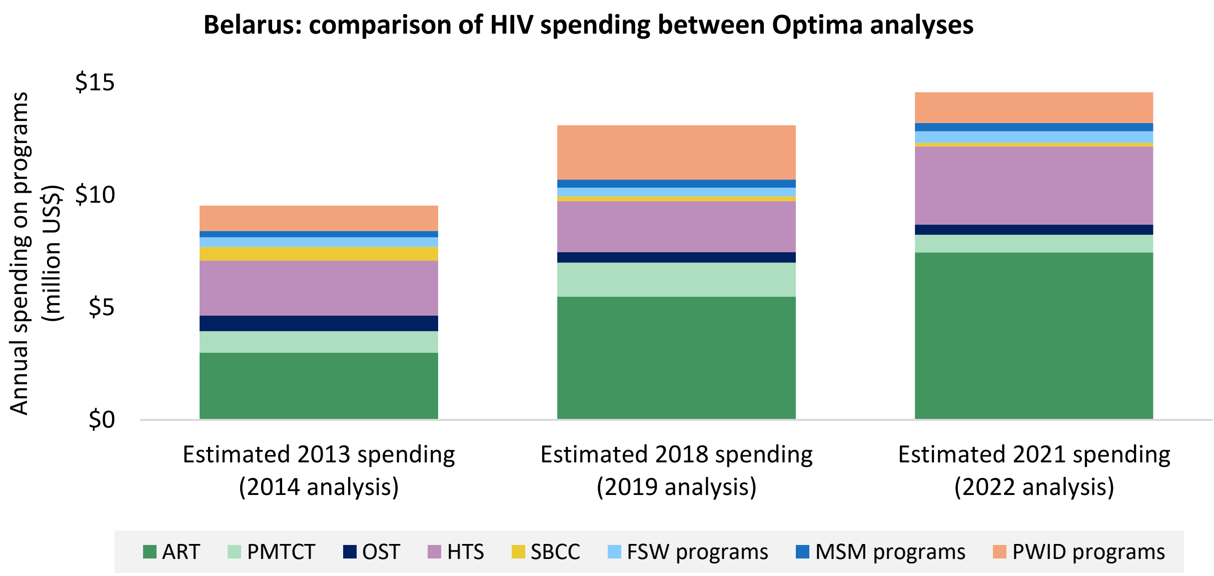


Figure 5. Estimated budget allocations from 2014, 2019 and 2022 Optima analyses. (N.B. spending on PWID programs in 2014 analysis reflects spending on needle-syringe program; spending on PWID programs in 2019 and 2022 analysis reflects spending on needle-syringe program and HIV testing, prevention programs targeting PWID.) 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; SBCC, social and behavior change communication.

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. Specifically, in Belarus, it was noticed condom use rate in reality may be lower than reported since people may be coerced into reporting they use condoms.
- **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.

7 Conclusions

This modeling analysis evaluated the allocative efficiency of direct HIV programs in Belarus, 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 and testing and prevention program coverage among PWID, followed by programs for MSM and FSW. 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 Belarus country team and international partners.

Country team: Alexander Atamanchuk and Svetlana Sergeenko, Belarus Republican Center for Hygiene, Epidemiology and Public Health.

Burnet Institute: Anna Bowring, Debra ten Brink, Kelvin Burke, Nick Scott, Nisaa Wulan, Rowan Martin-Hughes, Tom Tidhar, Thomas Walsh, Yinzong Xiao

Global Fund: Corina Maxim, Shufang Zhang

Swiss Tropical and Public Health Institute: Andrew Shattock, Sherrie Kelly

University College London: Tom Palmer

UNAIDS: Eleanora Hvazdziova

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

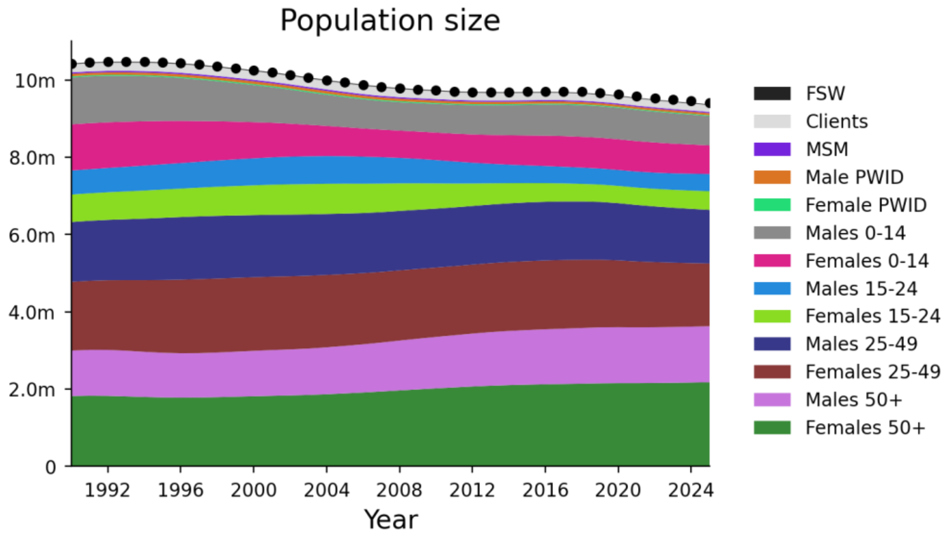
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

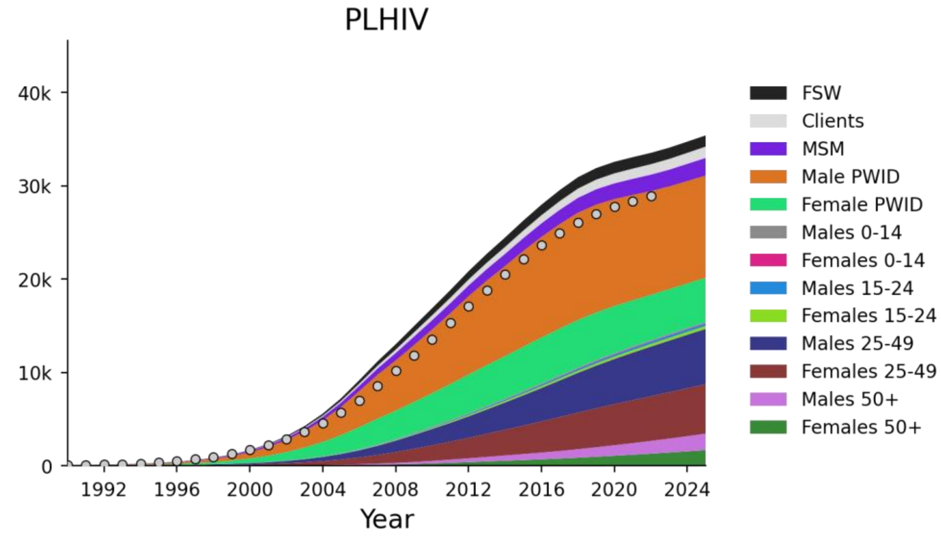
Treatment recovery due to suppressive ART (average years to move)		
	CD4 (350-500) to CD4 (>500)	2.20
	CD4 (200-350) to CD4 (350-500)	1.42
	CD4 (50-200) to CD4 (200-350)	2.14
	CD4 (<50) to CD4 (50-200)	0.66
	Time after initiating ART to achieve viral suppression (years)	0.20
CD4 change due to non-suppressive 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

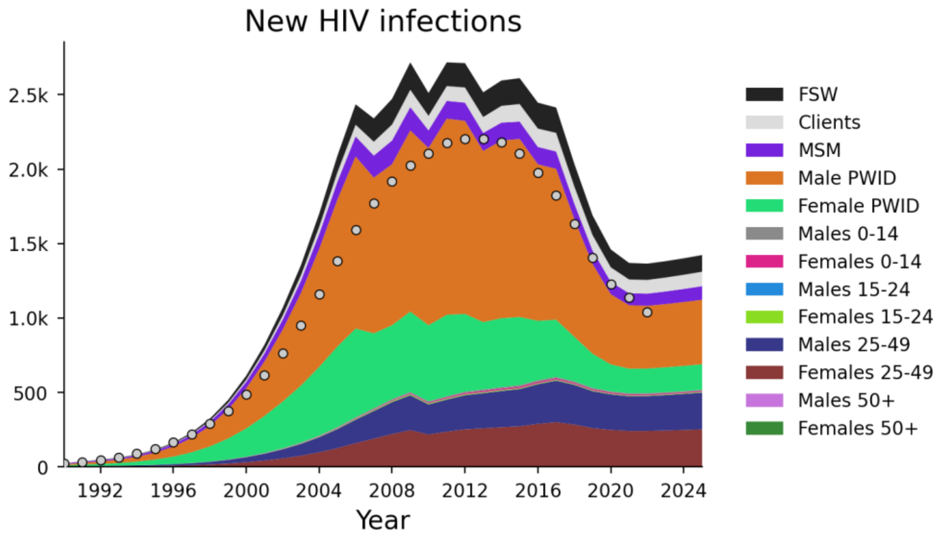
Figure A1. Calibration outputs. Dots represent official country estimates based on World Population Prospects, Spectrum model, surveillance surveys, program data and UNAIDS.

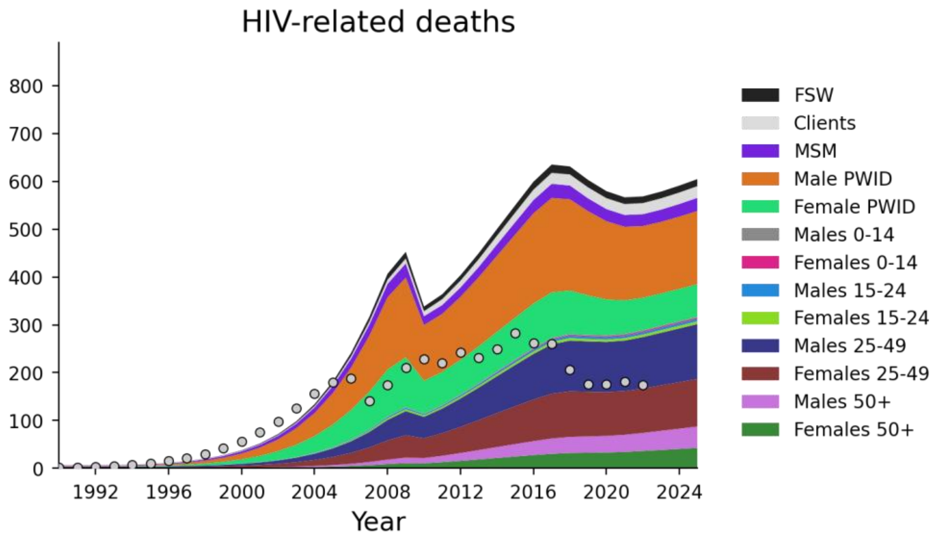


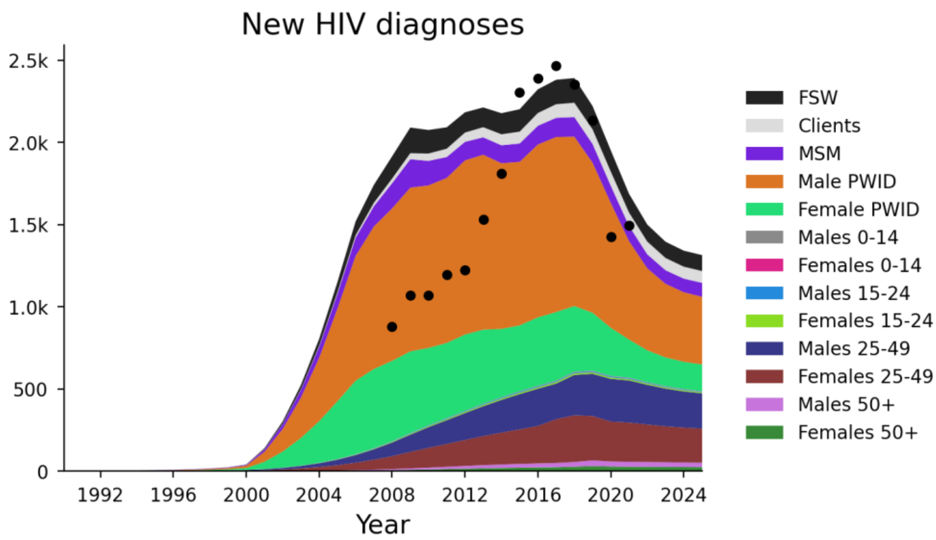


BELARUS

Allocation of HIV resources towards maximizing the impact of funding

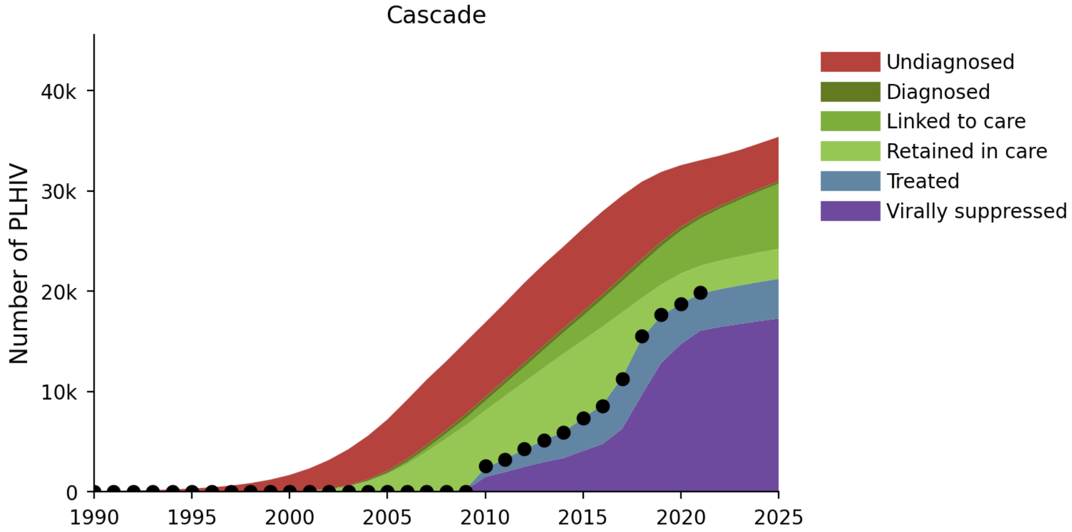


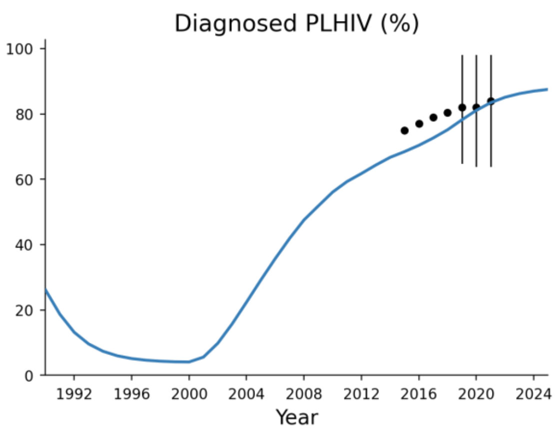


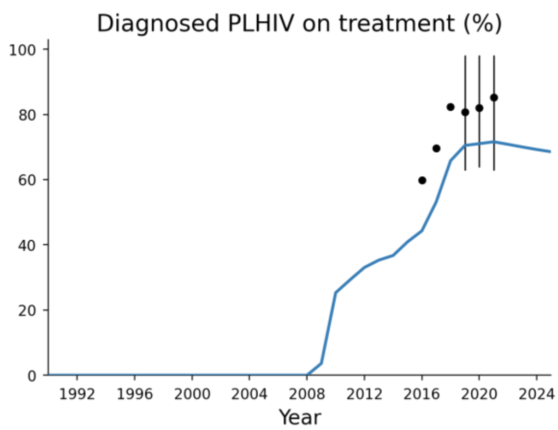


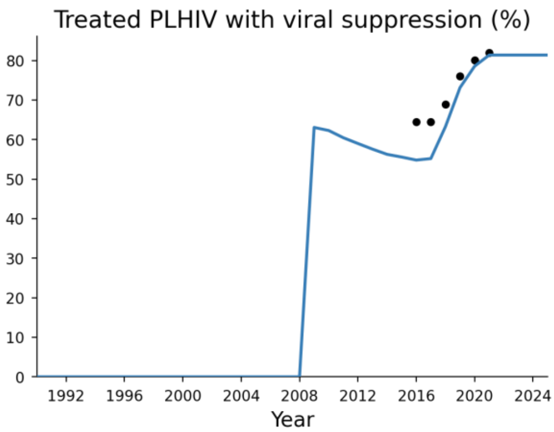
BELARUS

Allocation of HIV resources towards maximizing the impact of funding



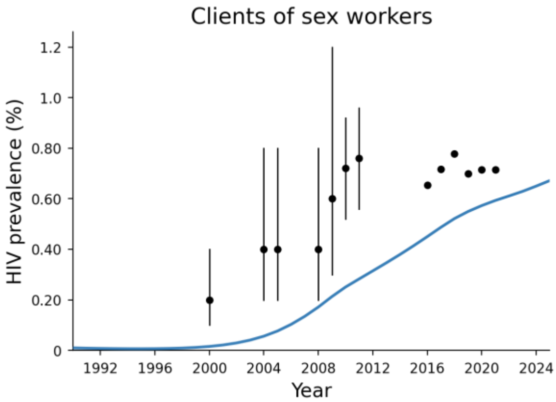


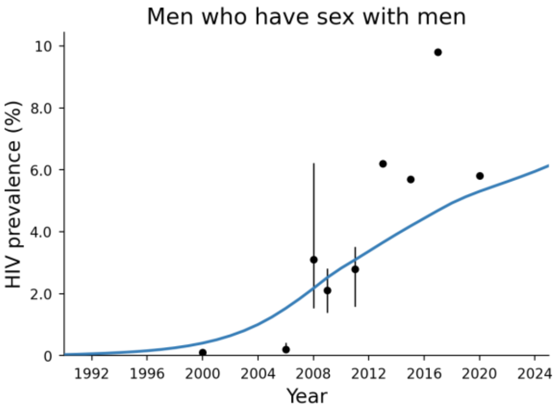


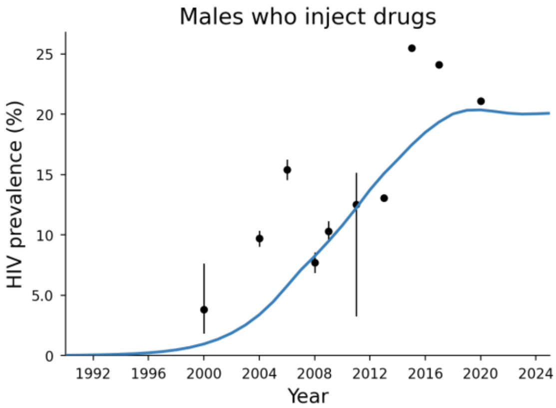


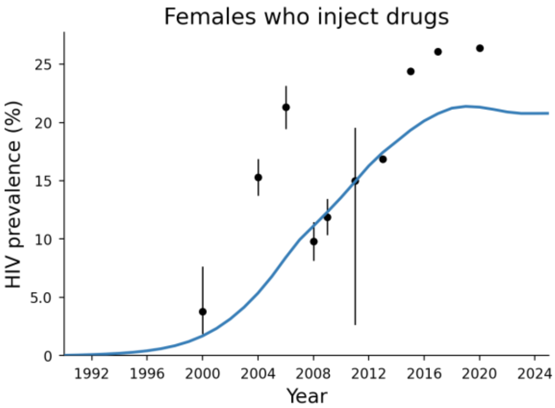
BELARUS

Allocation of HIV resources towards maximizing the impact of funding



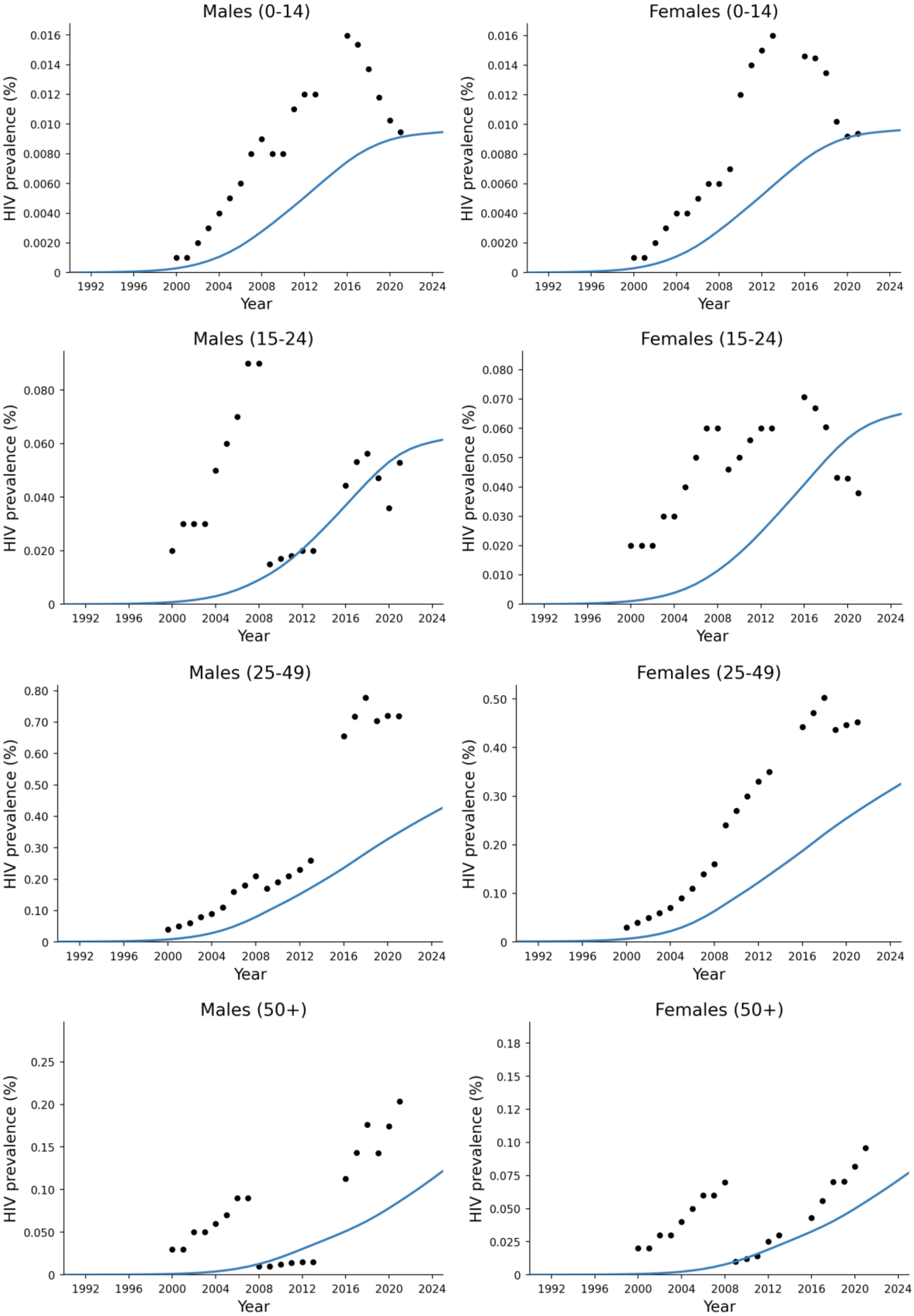






BELARUS

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	$374.74	90%	95%
HIV testing and prevention programs for FSW	$50.28	50%	70%
HIV testing and prevention programs for MSM	$25.12	50%	70%
HIV testing and prevention programs for PWID	$23.74	55%	85%
HIV testing services (general population)	$2.09	60%	85%
Opioid substitution therapy	$630.84	0%	10%
Prevention of mother-to-child transmission	$3,705.79	95%	100%
Social and behavior change communication (general population)	$0.07	20%	80%

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; SBCC, social and behavior change communication.

Table A4. Data inputs of impact of programs

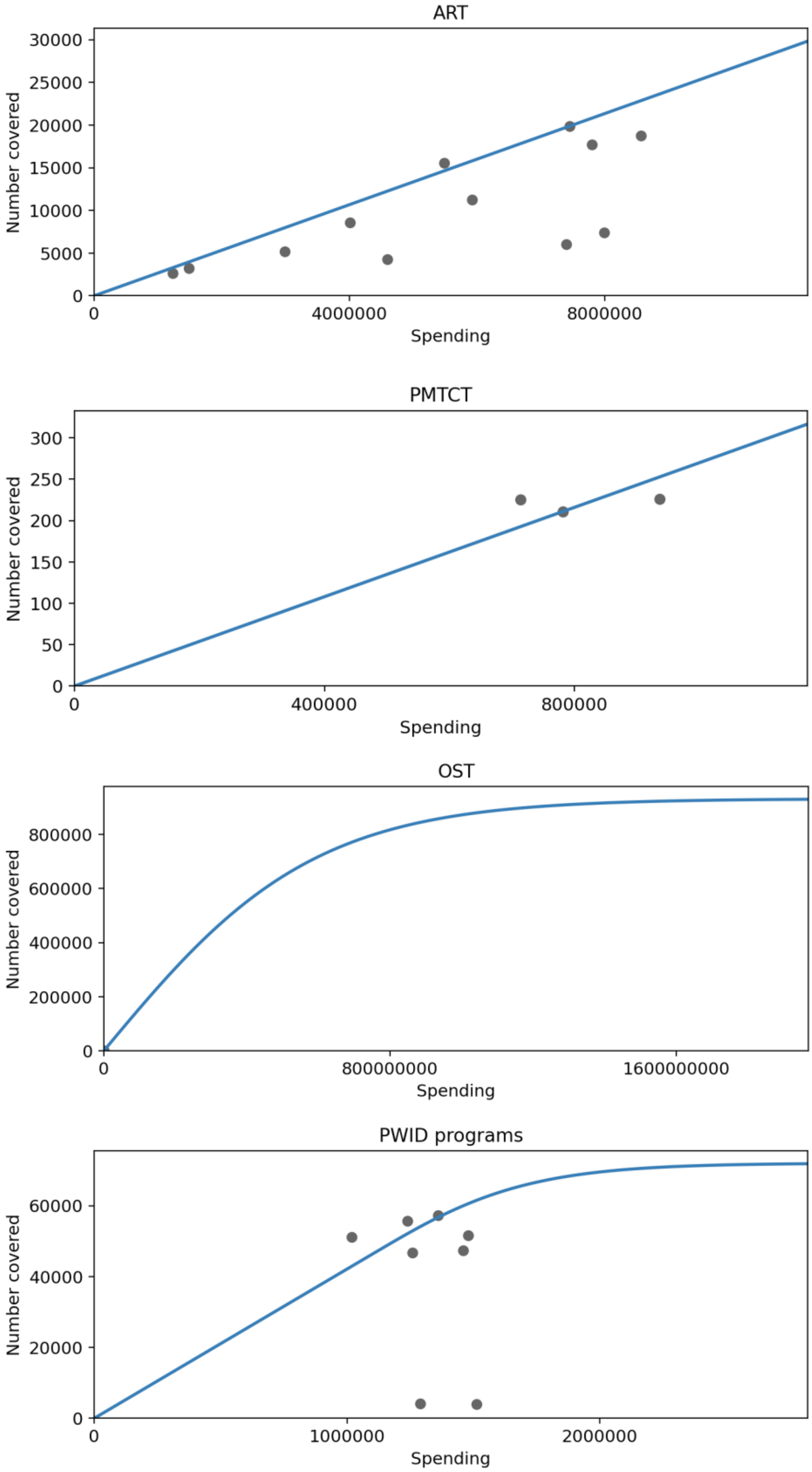
HIV program	Parameter	Population interactions or population	In absence of any programs		For each individual reached by this program	
			Low	High	Low	High
MSM programs	Condom use for casual acts	MSM, MSM	62%	62%	80%	80%
PWID programs	Condom use for casual acts	Clients, Female PWID	38%	38%	70%	70%
PWID programs	Condom use for casual acts	Male PWID, Female PWID	55%	60%	58%	65%
PWID programs	Condom use for casual acts	Male PWID, Females 15-24	59%	59%	67%	69%
PWID programs	Condom use for casual acts	Male PWID, Females 25-49	55%	55%	60%	65%
PWID programs	Condom use for casual acts	Males 15-24, Female PWID	61%	61%	66%	75%
PWID programs	Condom use for casual acts	Males 25-49, Female PWID	55%	55%	60%	65%
SBCC	Condom use for casual acts	Clients, Females 15-24	58%	58%	79%	84%
SBCC	Condom use for casual acts	Clients, Females 25-49	52%	52%	74%	79%
SBCC	Condom use for casual acts	Clients, Females 50+	38%	38%	60%	60%
SBCC	Condom use for casual acts	Males 15-24, Females 15-24	71%	73%	73%	75%
SBCC	Condom use for casual acts	Males 15-24, Females 25-49	66%	67%	70%	71%

SBCC	Condom use for casual acts	Males 25-49, Females 15-24	64%	64%	67%	68%
SBCC	Condom use for casual acts	Males 25-49, Females 25-49	59%	59%	62%	63%
SBCC	Condom use for casual acts	Males 25-49, Females 50+	43%	45%	46%	48%
SBCC	Condom use for casual acts	Males 50+, Females 25-49	43%	45%	46%	48%
FSW programs	Condom use for commercial acts	Clients, FSW	50%	50%	68%	68%
PWID programs	Probability of needle sharing (per injection)	Male PWID	9%	9%	4%	4%
PWID programs	Probability of needle sharing (per injection)	Female PWID	9%	9%	4%	4%
FSW programs	HIV testing rate (average tests per year)	FSW	0.50	0.55	1.1	1.17
MSM programs	HIV testing rate (average tests per year)	MSM	0.50	0.52	1.26	1.30
PWID programs	HIV testing rate (average tests per year)	Male PWID	0.50	0.50	0.84	0.84
PWID programs	HIV testing rate (average tests per year)	Female PWID	0.50	0.50	0.84	0.84
HTS	HIV testing rate (average tests per year)	Clients	0.08	0.09	0.97	0.97
HTS	HIV testing rate (average tests per year)	Males 0-14	0.00	0.00	0.04	0.04
HTS	HIV testing rate (average tests per year)	Females 0-14	0.00	0.00	0.05	0.05
HTS	HIV testing rate (average tests per year)	Males 15-24	0.12	0.15	0.82	0.85
HTS	HIV testing rate (average tests per year)	Females 15-24	0.13	0.15	0.82	0.85
HTS	HIV testing rate (average tests per year)	Males 25-49	0.12	0.15	0.87	0.88
HTS	HIV testing rate (average tests per year)	Females 25-49	0.14	0.15	0.87	0.88
HTS	HIV testing rate (average tests per year)	Males 50+	0.03	0.03	0.48	0.50
HTS	HIV testing rate (average tests per year)	Females 50+	0.03	0.03	0.40	0.42
PMTCT	Number of people on PMTCT	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; SBCC, social and behavior change communication.

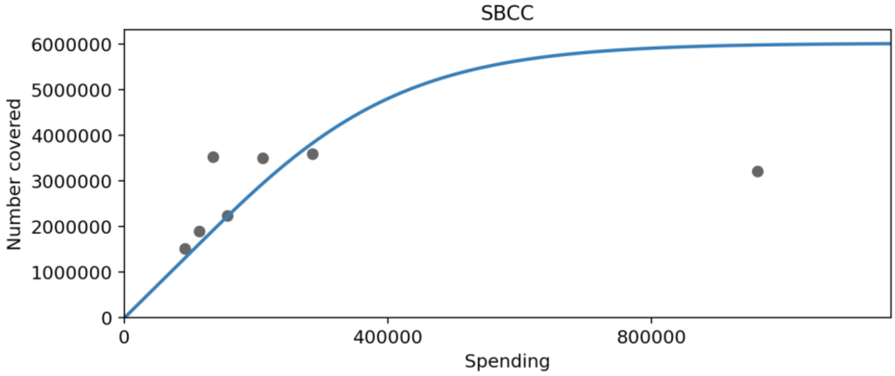
- The number of people modeled as receiving ART, PMTCT and OST is equal to the coverage of the respective programs.

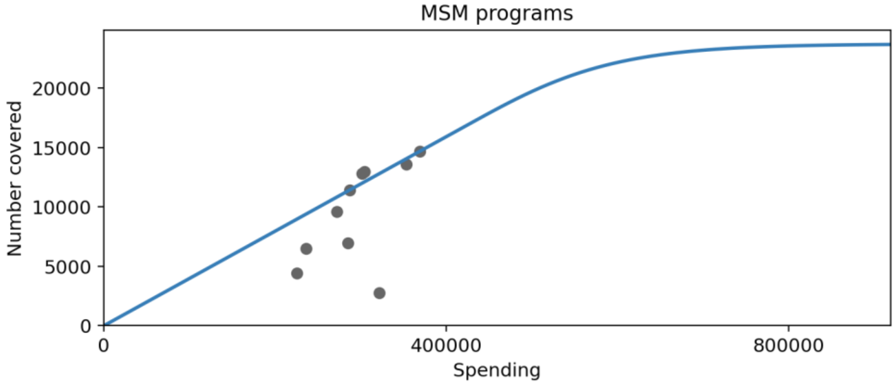
Figure A2. Cost functions. Figures show relationship between total spending and number covered among targeting population of each program.

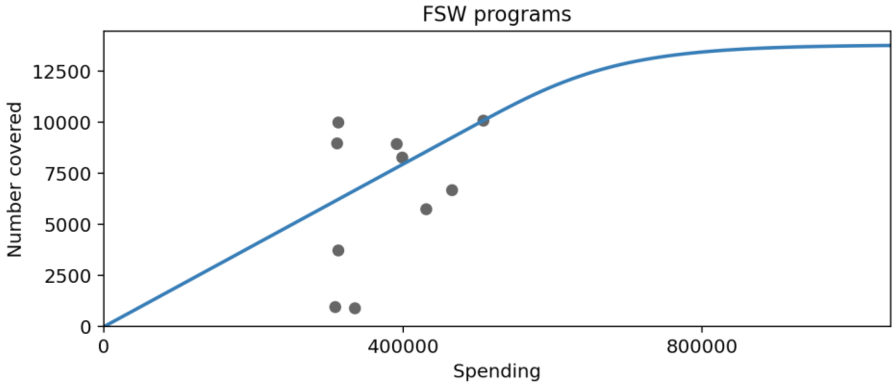


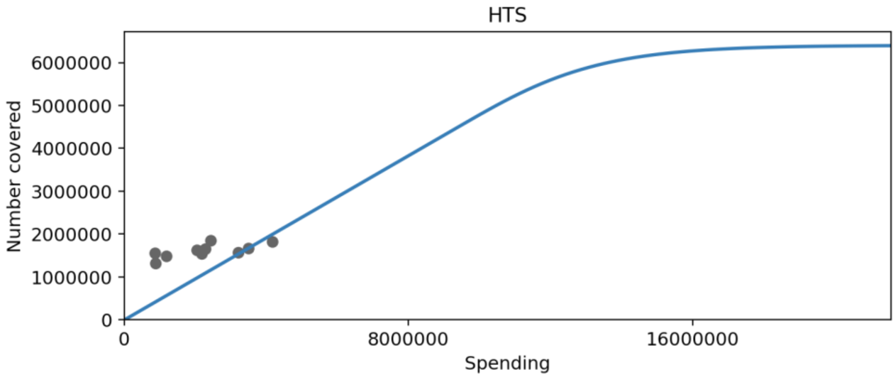
BELARUS

Allocation of HIV resources towards maximizing the impact of funding









Appendix 4. Annual HIV budget allocations at varying budgets

Table A5. Annual HIV budget (US$) allocations among targeted HIV programs at varying budgets for 2023 to 2030

	100% latest reported (2021)	50% optimized	75% optimized	100% optimized	125% optimized	150% optimized
Antiretroviral therapy	7,452,863	6,250,345	8,838,462	9,129,006	9,399,532	9,592,640
HIV testing and prevention programs for FSW	507,312	-	-	253,656	579,837	634,827
HIV testing and prevention programs for MSM	369,347	-	-	301,000	569,901	627,250
HIV testing and prevention programs for PWID and NSP	1,361,286	-	854,499	1,828,803	2,060,221	2,141,483
HIV testing services (general population)	3,486,704	-	-	1,743,352	4,287,487	7,541,938
Opiate substitution therapy	448,530	376,160	448,530	448,530	448,530	448,530
Prevention of mother-to-child transmission	781,992	655,818	781,992	781,992	781,992	781,992
Social and behavior change communication	156,610	-	-	78,305	78,305	78,305
Total targeted HIV program budget	14,564,644	7,282,322	10,923,483	14,564,644	18,205,805	21,846,966

FSW, female sex worker; MSM, men who have sex with men; NSP, needle-syringe program; PWID, people who inject drugs

Table A6. Latest reported budget of non-targeted HIV programs, 2021

	Latest reported budget (2021)
Enabling environment	$26,947
Human resources	$106,349
Infrastructure	$447,787
Monitoring and evaluation	$256,153
Management	$1,298,827
Other HIV care	$2,727,909
Other HIV costs	$20,216,579
Orphans and vulnerable children (OVC)	$378,093
Total non-targeted HIV program budget	$25,458,644

Note: in Belarus, HIV care costs used to include opportunistic costs for other diseases, such as tuberculosis, but were lower in recent years as tuberculosis is now covered as part of another national program. Other HIV costs have increased in the latest reported budget as they now include PCR tests.

9 References

1. UNAIDS. In Danger: Global AIDS Update. Geneva, Switzerland: UNAIDS; 2022.
2. UNAIDS. The key Population Atlas 2022 [Available from: https://kpatlas.unaids.org/dashboard.
3. Belarus Integrated Biological and Behavioural Surveillance Survey 2020.
4. Spectrum. HIV epidemic estimates. 2022.
5. Lundgren J, Raben D. HIV/AIDS treatment and care in Belarus: Evaluation report. WHO Collaborating Centre on HIV and Viral Hepatitis; 2014. Available from: https://www.euro.who.int/__data/assets/pdf_file/0008/246617/ENG-Belarus_report_Final-for-web-with-cover.pdf.
6. UNAIDS HIV Financial Dashboard 2022 [updated July 2022; cited 2022 25 Oct]. Data source: Global AIDS Monitoring, GARPR reports]. Available from: https://hivfinancial.unaids.org/hivfinancialdashboards.html.
7. National AIDS Spending Assessment: Belarus2021.
8. AIDSinfo Global data on HIV epidemiology and response. 2022.
9. Optimizing Investments in Belarus for the National HIV Response: World Bank; 2016 [Available from: https://doi.org/10.1596/25395.
10. Resource optimization to maximize the HIV response in Belarus 2019 [Available from: http://optimamodel.com/pubs/Belarus_2020.pdf.
11. Kerr CC, Stuart RM, Gray RT, Shattock AJ, Fraser N, Benedikt C, et al. Optima: a model for HIV epidemic analysis, program prioritization, and resource optimization. Journal of Acquired Immune Deficiency Syndromes. 2015;69(3):365–76.
12. Consolidated guidelines on HIV testing services, 2019. Geneva: World Health Organization; 2020 [cited 2022 November 24]. Available from: https://www.who.int/publications/i/item/978-92-4-155058-1.