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

MOLDOVA

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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 that 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 National AIDS Programme, Hospital of Dermatology and Communicable Diseases, the Global Fund, UNAIDS, Swiss Tropical and Public Health Institute, and the Burnet Institute. The Optima HIV model (2) was applied to estimate the optimized resource allocation across a mix of HIV programs. The analysis was stratified for the Right Bank and Left Bank of Moldova.

Summary and key recommendations for HIV resource optimization include:

RIGHT BANK

- The Right Bank of Moldova has a concentrated HIV epidemic with a high prevalence among people who inject drugs (estimated 10.3% in 2020) and female sex workers (1.9% in 2020) and an increasing prevalence among men who have sex with men (11.4% in 2020).
- In 2021 an estimated US$4.8M was spent on targeted HIV interventions, with antiretroviral therapy (ART) accounting for 44% of this.
- In a baseline scenario where 2021 spending on programs was maintained, including a fixed annual spending on ART, there were estimated to be 3,645 new HIV infections, 2,842 HIV-related deaths and 74,030 HIV-attributable disability-adjusted life years (DALYs) over 2023-2030.
- **Optimizing spending would involve deprioritizing condom promotion and distribution, needle-syringe programs (NSP) and prevention programs for female sex workers, to continue scaling up ART for all populations and HIV programs for men who have sex with men.** This optimization prioritizes high impact interventions that address the current treatment gap as well as the increasing prevalence and high proportion of new HIV infections occurring among men who have sex with men.
- Optimized reallocation of 2021 spending can advance epidemic gains without additional resources and was estimated to avert 734 (20%) new infections, 789 (28%) deaths and 19,329 (26%) of DALYs over 2023-2030 relative to the baseline scenario of continued 2021 spending.
- **With additional resources available, priorities were identified as increased investment in NSP and the continued scale-up of programs for men who have sex with men.**
- Moving from the 62-70-88 care cascade modeled in 2021 to reach the 95-95-95 targets by 2030 in Moldova Right Bank will require progress particularly in diagnosis and treatment. A combination of demographic shifts and HIV programs have resulted in a reduction in estimated new HIV infections, but currently implemented programs have challenges in reaching and diagnosis people with past risk and their partners, who are no longer part of

key populations. The optimized expansion of current programs at 300% of 2021 targeted spending is projected to be insufficient to reach the 95% diagnosis target by 2030. Novel and focused testing strategies are needed to reach these groups more cost-efficiently. 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.

LEFT BANK

- The Left Bank of Moldova has a concentrated HIV epidemic with a high prevalence among people who inject drugs (estimated 20.0% in 2020). Estimates of HIV prevalence among female sex workers and men who have sex with men in the Left Bank are not available and were assumed to be the same as the Right Bank.
- In 2021 an estimated US$1.2M was spent on targeted HIV interventions, with ART accounting for 66% of this.
- In a baseline scenario where 2021 spending on programs was maintained, including a fixed annual spending on ART, there were estimated to be 1,137 new HIV infections, 662 HIV-related deaths and 18,033 HIV-attributable DALYs over 2023-2030.
- **Optimizing spending would involve prioritizing the scale-up of ART benefiting all populations and prevention of mother to child transmission (PMTCT), followed by NSP.** This optimization prioritizes high impact interventions that address the current treatment gap, with the potential to reduce mortality and new infections among all populations. The scale-up of needle syringe programs is prioritized to continue the decreasing prevalence trend among people who inject drugs and prevent epidemic rebound.
- Optimized reallocation of 2021 spending was estimated to avert 236 (21%) new infections, 126 (19%) deaths and 3,184 (18%) of DALYs over 2023-2030 relative to the baseline scenario of continued 2021 spending.
- **With additional resources available, priorities were identified as scaling up HIV testing (all populations) and increased investment in HIV prevention programs for FSW and MSM.**
- Moving from the 75-79-89 care cascade modeled in 2021 to reach the 95-95-95 targets by 2030 in Moldova Left Bank will particularly require progress in diagnosis and treatment. Meeting the 95% diagnosis target may be possible with optimized allocation of an additional US$2.3M per annum, or a total 300% of 2021 targeted spending. More targeted testing to reach undiagnosed people living with HIV may make this objective achievable at a lower cost. 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 Moldova had an estimated total population size of 3.1 million (3) across both banks (with an estimated 465,800 of these residing in the Left Bank in 2020 (4)), with a large wave of immigration from the neighboring Ukraine arriving in 2022. Moldova is a low prevalence HIV country with a concentrated epidemic among people who inject drugs (PWID), men who have sex with men (MSM), and female sex workers (FSW).

HIV prevalence among PWID has decreased in the Right Bank from 12.6% in 2016 (5) to 10.3% in 2020 (6); in the Left Bank prevalence among PWID is still very high but has decreased from 25.8% in 2016 (5) to 20.0% in 2020 (6). In the Right Bank, HIV prevalence has decreased among FSW from 6.10% in 2016 to 1.9% in 2020 and increased among MSM from 7.7% in 2016 to 11.4% in 2020 (5, 6). Prevalence estimates are limited for the Left Bank, but it is estimated that the HIV prevalence of the general population (0.62% in 2020 (7)) is considerably higher than that of the Right Bank (0.24% in 2020 (7)).

The introduction of the National Strategy for HIV Prevention in 2000 saw a sharp decline in new infections among PWID in the early 2000s. Now the primary source of HIV transmission is through heterosexual contact, accounting for over 88.5% of new cases in 2019 (7). HIV spending was based on the National Program for the prevention and control of HIV/AIDS infection and sexually transmitted infections for the years 2022-2025, with the Global Fund providing funding to reach the NAP targets. The domestic share of HIV spending increased from 30% to 54% between 2013 and 2017 (8).

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 Moldova, 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 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 National HIV program of Moldova, stratified by the Left Bank and Right Bank of Moldova. 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 (GAM) and National AIDS Spending Assessment reports, integrated bio-behavioral surveillance surveys, national reports and systems were collated. In Moldova, baseline spending was derived from program data. Budget optimizations were based on targeted HIV spending for programs with a direct and quantifiable impact on HIV parameters included in the model. 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 has been published by 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)
  - Males who inject drugs (MWID)
  - Females who inject drugs (FWID)
- General populations
  - Male 0-14 (M0-14)
  - Female 0-14 (F0-14)
  - Male 15-49 (M15-49)
  - Female 15-49 (F15-49)
  - Male 50+ (M50+)
  - Female 50+ (F50+)
- Targeted HIV programs
  - Antiretroviral therapy (ART)
  - Prevention of mother-to-child transmission (PMTCT)
  - Prevention of mother-to-child transmission testing (PMTCT test)
  - HIV testing services (HTS), all populations

- HIV testing and prevention programs for FSW (FSW programs)
- HIV testing and prevention programs for MSM (MSM programs)
- Needle-syringe programs (NSP)
- Opioid substitution therapy (OST) [Right Bank only]
- Condom promotion and distribution, including social and behavior change communication (Condoms)

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. HTS was constrained to maintain at least current spending at all budget levels. 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 – Right Bank

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 Moldova Right Bank total spending on HIV from domestic and international sources was US$7.7M in 2021, incorporating US$4.8M targeted HIV spending for the programs considered above and US$2.9M non-targeted spending. The largest portion of targeted spending was for ART (44%), followed by 16% for NSP, and 10% HTS (Figure 2; Table A5a). Non-targeted spending, which was not included in the optimization analysis, encompassed human resources, management, infrastructure costs, monitoring and evaluation as well as 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 70%. If ART unit costs remain constant (US$432 in 2021), ART spending would need to increase by US$110,000 (5% 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, including meeting the needs for additional treatment, a counterfactual "Baseline" of fixed annual spending on ART was used, although this would result in slightly different epidemic projections (Figure 1b).

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 Moldova Right Bank, 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).

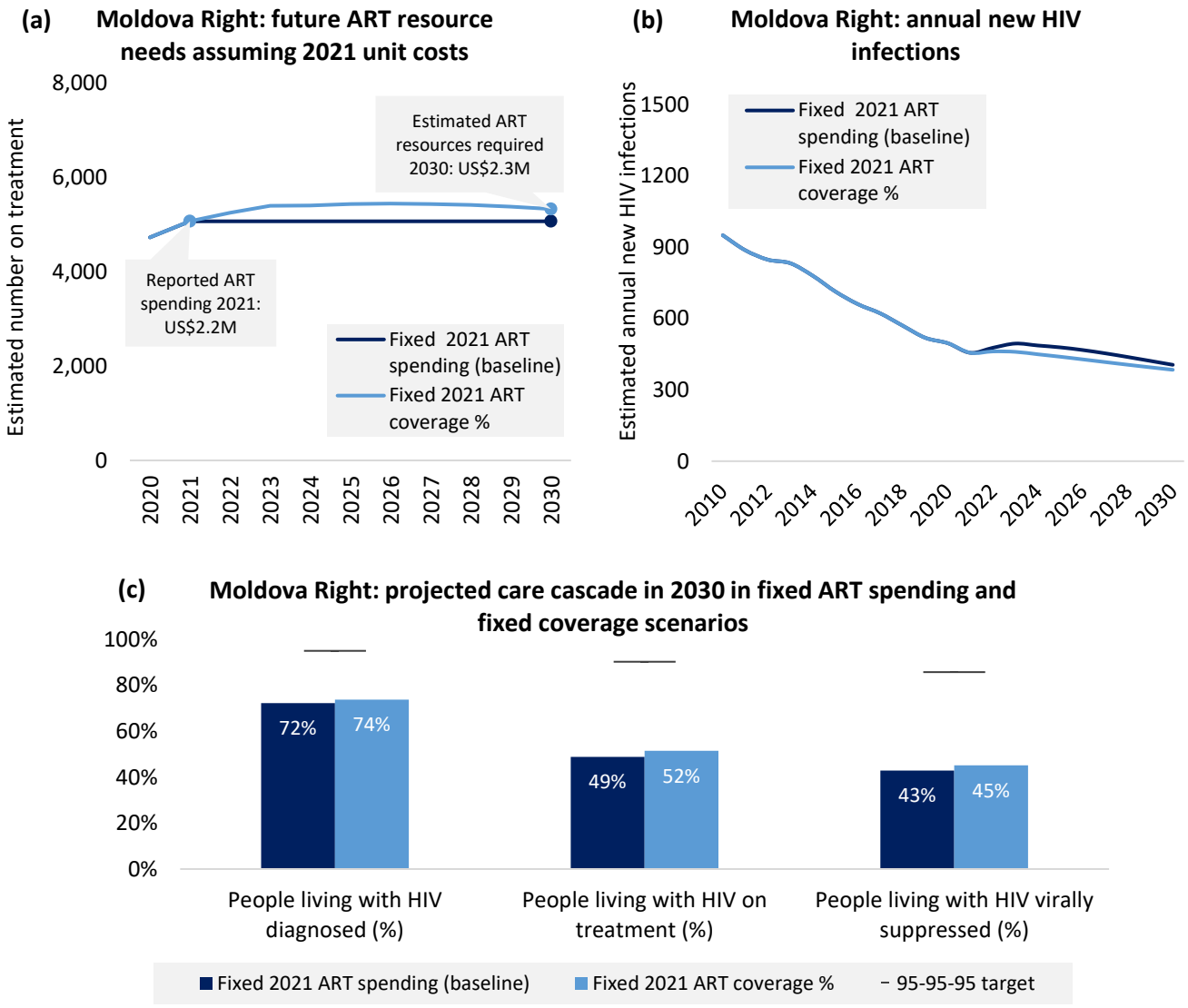

Figure 1. Fixed proportional coverage of people living with HIV on ART compared to fixed ART spending: resource needs and epidemic outcomes by 2030. Panels show (a) Resources required to maintain 2021 proportional coverage of ART among people living with HIV until 2030 if ART unit cost remains constant; (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 3,645 new HIV infections, 2,842 HIV-related deaths and 74,030 HIV-attributable DALYs over 2023-2030. Without additional spending on ART, the HIV care cascade in this scenario was projected to be "72-68-88" in the year 2030 (i.e. 72% of people diagnosed, 68% of diagnosed people on treatment and 88% of people on treatment virally suppressed) (Figure 1c; Table 1). The low proportion of people on

treatment in 2030 reflects that ART spending will actually need to increase over time to maintain a constant percentage coverage, since more people will continue to be diagnosed.

Optimized resource allocation of 2021 spending. Optimization of 2021 spending in Moldova Right Bank identified that additional impact may be possible by reallocating spending from condom programs, and prevention programs for PWID (NSP) and FSW to enable further scale-up of ART for all populations and testing and prevention programs for MSM (Figure 2). The Optima model suggests that only 70% of diagnosed people living with HIV were on treatment in 2021. Assuming that more people could be accessed for treatment through enhanced linkage to care and adherence programs, then closing this treatment gap through increased investment in ART could reduce mortality as well as new infections through treatment-as-prevention. We estimate that 26% of new HIV infections occurred among MSM in 2021, and therefore prioritizing investment in HIV testing and prevention programs for MSM is required to prevent the epidemic expanding in this key population. NSP, programs for FSW, and condom programs were deprioritized in the theoretical optimization 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.

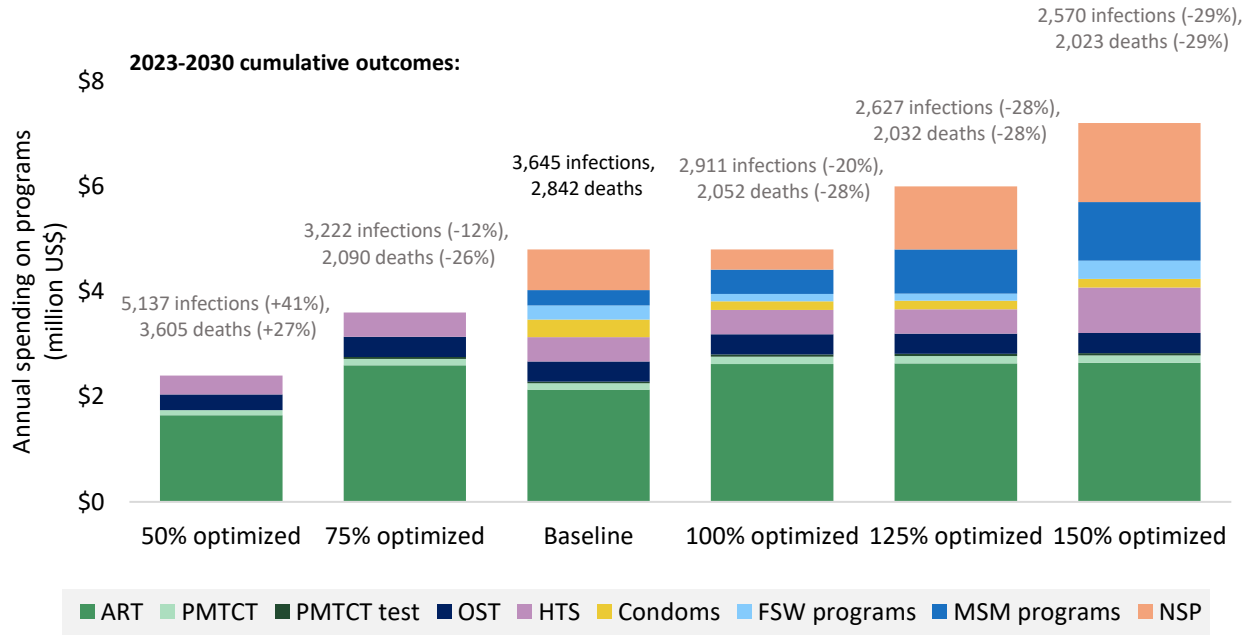

Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2023 to 2030, to minimize new infections and HIV-related deaths by 2030: Moldova Right Bank. Percentage optimized refers to the percentage of baseline HIV funding at a given budget level. ART, antiretroviral therapy; FSW,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

Optimized resource allocation at different budget levels. As the total budget envelope increased, the priorities were identified as investment in programs for people who inject drugs (NSP) as well as the continued scale up of prevention programs for MSM, followed by further investment in HIV testing. The epidemic among MSM is rising within the country as well as the region and so prevention programs are critical.

If funding were reduced, based on program constraints priorities were identified as maintaining as many people on treatment as possible, HTS, OST and PMTCT.

Impact of optimization on HIV epidemic. Compared with the baseline scenario, optimized reallocation of 2021 spending could avert 734 new infections (20%), 789 deaths (28%) and 19,329 DALYs (26%) over 2023-2030 (Figure 3; Table 1).This benefit increases to 29% infections, 29% deaths and 27% DALYs averted with an optimized 150% budget (Figure 3; Table 1).

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

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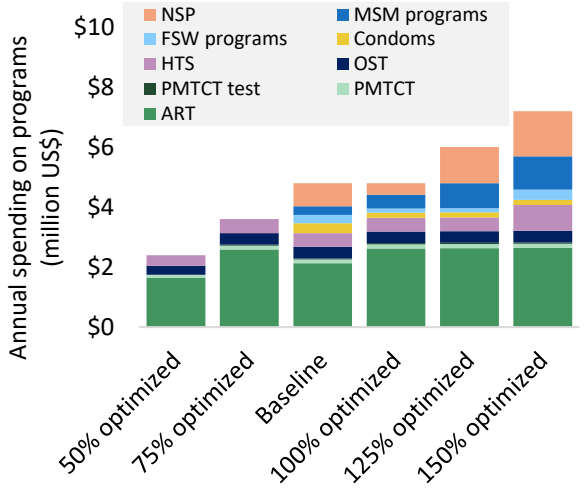
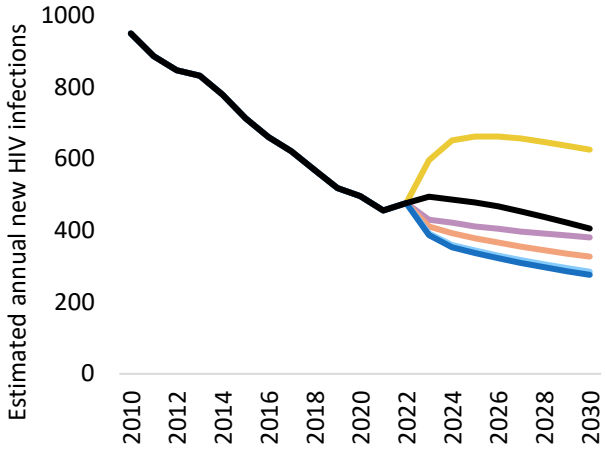
Allocation of HIV resources towards maximizing the impact of funding

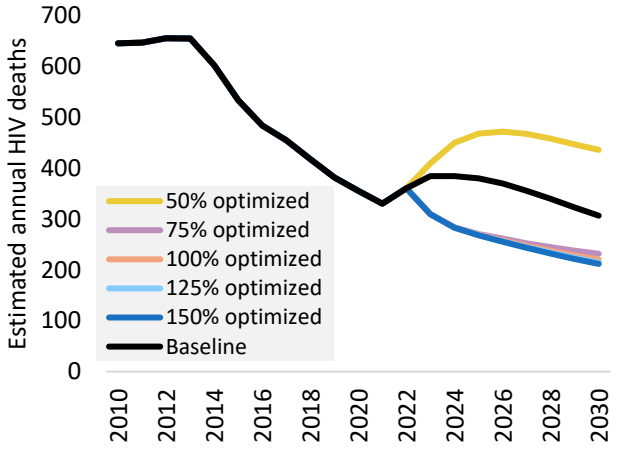
(a) Moldova Right: budget optimizations



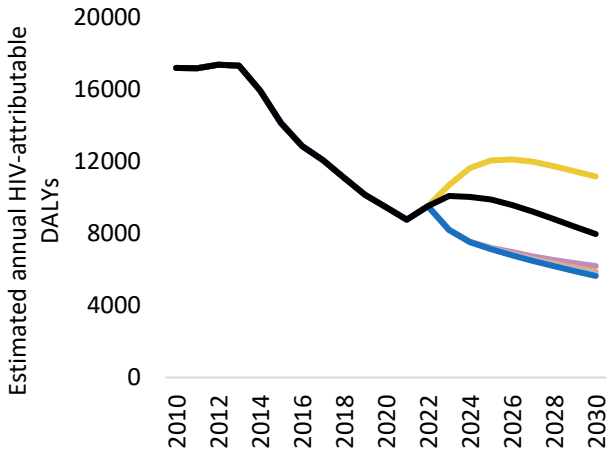
(b) Moldova Right: annual new HIV infections in budget optimizations



(c) Moldova Right: annual HIV deaths in budget optimizations



(d) Moldova Right: annual HIV-attributable DALYs in budget optimizations



(e) Moldova Right: projected care cascade in 2030

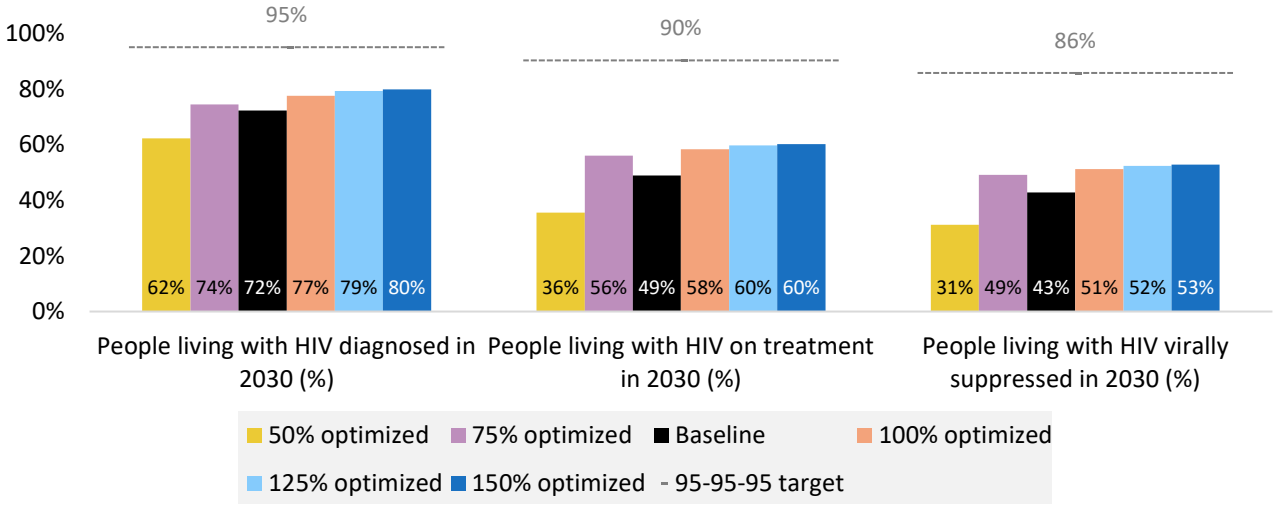


Figure 3. Model outcomes from budget optimization scenarios aiming to minimize infections and deaths: Moldova Right Bank. Panels show (a) optimal budget allocations under varying levels of annual HIV budgets according to percentage of current HIV funding; (b) estimated annual new HIV infections; (c) 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; DALY, disability-adjusted life year; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe programs; OST, opioid substitution therapy; PMTCT, prevention of mother to child transmission.

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 4,631 (+127%) more new infections, 3,024 (+106%) more deaths and 73,815 (+100%) more DALYs over 2023-2030 compared to the baseline scenario of fixed annual spending on programs in Moldova Right Bank (Table 1).

Table 1. Cumulative new HIV infection, 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: Moldova Right Bank

	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	8,276	5,866	147,846	127%	106%	100%
50% optimized	5,137	3,605	92,900	41%	27%	25%
75% optimized	3,222	2,090	55,741	-12%	-26%	-25%
Baseline	3,645	2,842	74,030			
100% optimized	2,911	2,052	54,701	-20%	-28%	-26%
125% optimized	2,627	2,032	54,131	-28%	-28%	-27%
150% optimized	2,570	2,023	53,892	-29%	-29%	-27%
*95-95-95**	1,907	1,570	43,337	-48%	-45%	-41%

Percentage optimized refers to percentage of baseline spending.
* Optimization was only able to reach 86-95-95; refer to section 4.3.

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, Moldova Right Banks'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).

An additional US$9.6M per annum, or a total 300% of targeted HIV spending, over 2023-2030 is projected to increase diagnosis of people living with HIV to 86% by 2030, which is still short of the 95% diagnosis target. In Moldova reaching the diagnosis target is challenging due to undiagnosed infections in people who had past risk factors but are no longer members of key populations (e.g. people with a history of sex work or injecting drug use but who no longer would be reached by those programs), as well as their partners. Although not modeled, delivery approaches and modalities for the general population testing program could be strategically utilized to better reach undiagnosed people living with HIV with existing or expanded HTS resources. This could incorporate index testing and social network testing strategies, tailored demand creation, task shifting and HIV self-testing, and focused provider-initiated testing (11).

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 Moldova Right Bank to improve linkage to care, treatment adherence and retention to achieve 95% treatment coverage and 95% viral suppression.

Achieving "86-95-95" in this optimized scenario could avert 1,836 (50%) new infections, 1,309 (46%) deaths and 31,613 (43%) 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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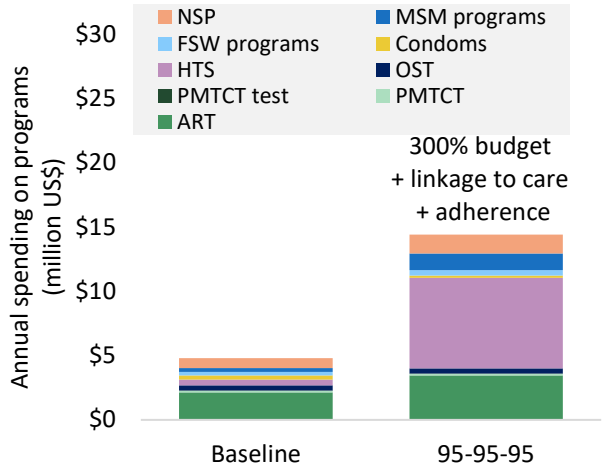
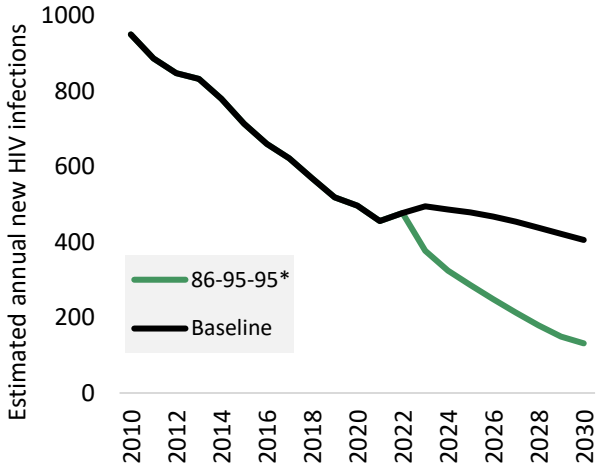
Allocation of HIV resources towards maximizing the impact of funding

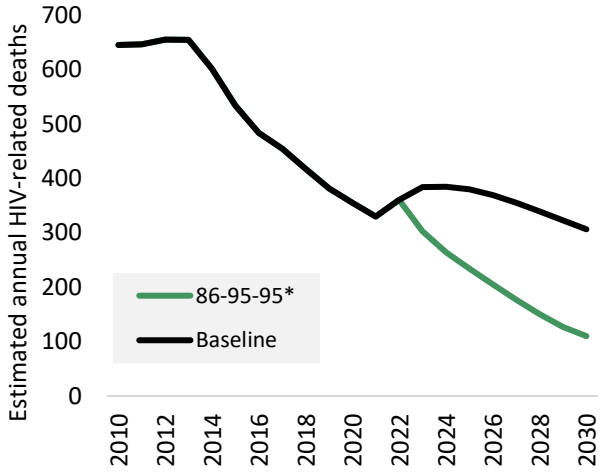
(a) Moldova Right: optimized budget to reach 95-95-95 targets



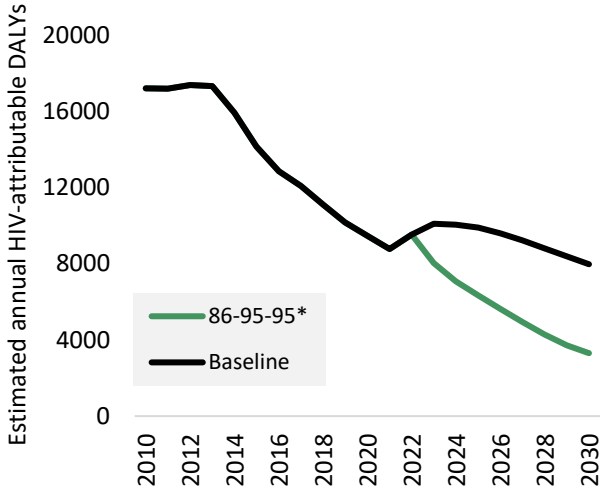
(b) Moldova Right: annual new HIV infections in 95-95-95 scenario



(c) Moldova Right: annual HIV deaths in 95-95-95 scenario



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



(e) Moldova Right: projected care cascade

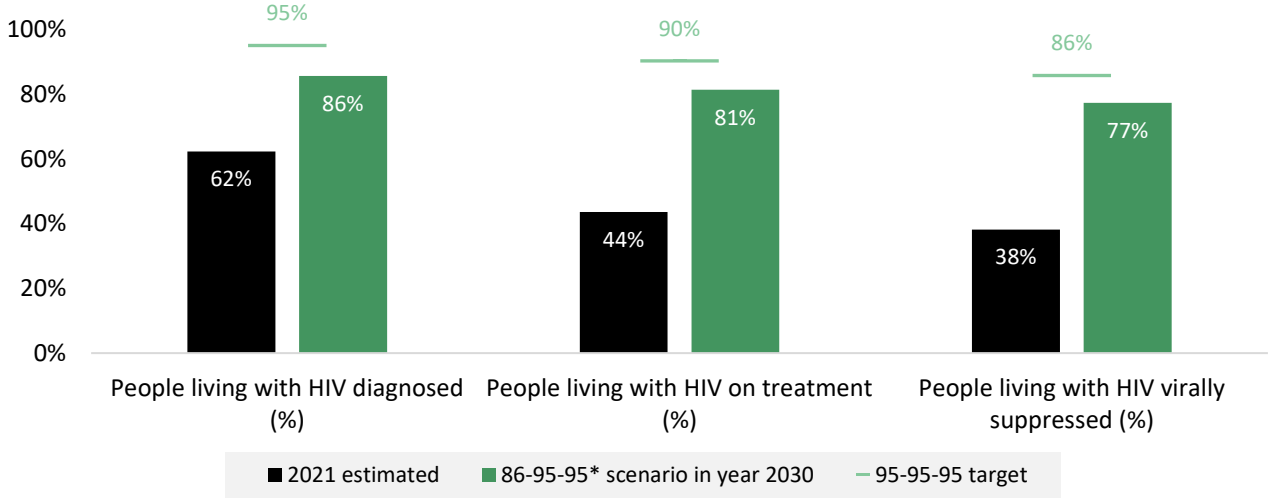


Figure 4. Optimized HIV budget level and allocation to achieve 95-95-95 targets by 2030: Moldova Right Bank. *The 95% diagnosis target could not be reached with 300% spending optimized, and impact is shown for the achieved cascade. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) projected care cascade for the year 2030 among all people living with HIV. ART, antiretroviral therapy; DALY, disability-adjusted life year; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

5 Findings – Left Bank

5.1 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 Moldova Left Bank total spending on HIV from domestic and international sources was US$1.9M in 2021, incorporating US$1.2M targeted HIV spending for the programs considered above and US$0.7M non-targeted spending. The majority of targeted spending was for ART (66%), followed by 9% for prevention programs for PWID, and 8% for testing and prevention programs for FSW (Figure 6; Table A5b. Non-targeted spending, which was not included in the optimization analysis, encompassed management, infrastructure costs, monitoring and evaluation as well as 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 78%. If ART unit costs remain constant (US$353 in 2021), ART spending would need to increase by US$38,000 (5% 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 5a), 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, including meeting the needs for additional treatment, a counterfactual "Baseline" of fixed annual spending on ART was used, although this would result in slightly different epidemic projections (Figure 5b).

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 Moldova Left Bank, 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).

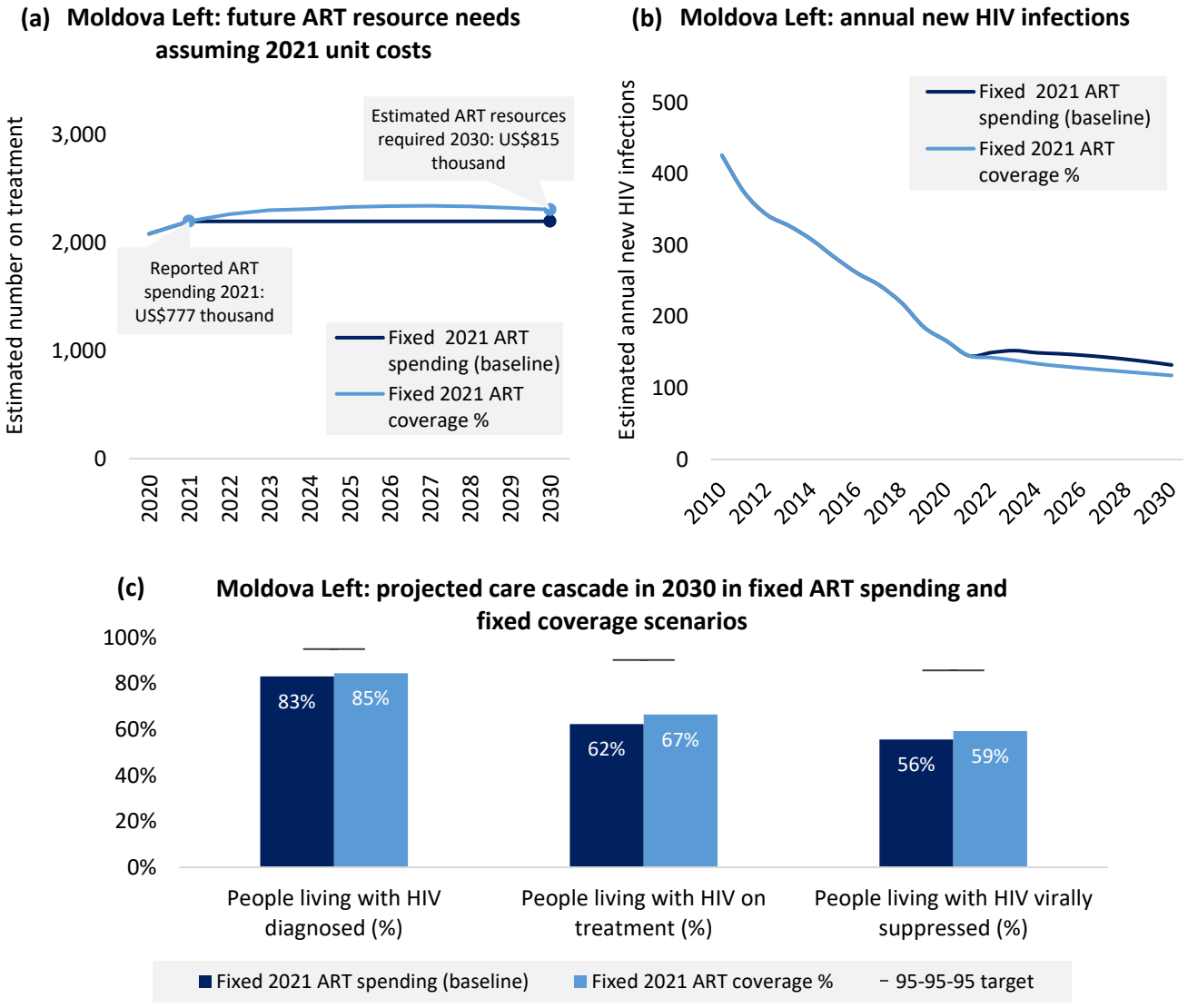


Figure 5. Fixed proportional coverage of people living with HIV on ART compared to fixed ART spending: resource needs and epidemic outcomes by 2030. Panels show (a) Resources required to maintain 2021 proportional coverage of ART among people living with HIV until 2030 if ART unit cost remains constant; (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 1,137 new HIV infections, 662 HIV-related deaths and 18,033 HIV-attributable DALYs over 2023-2030. Without additional spending on ART, the HIV care cascade in this scenario was projected to be "83-75-89" in the year 2030 (i.e. 83% of people diagnosed, 75% of diagnosed people on treatment and 89% of people on treatment virally suppressed) (Figure 5c; Table 2).

Optimized resource allocation of 2021 spending. Optimization of 2021 spending in Moldova Left Bank identified that additional impact may be possible by reallocating some spending from condom programs and programs for FSW and MSM to enable further scale-up of ART for all populations, PMTCT, as well as NSP (Figure 6). The Optima model suggests that 79% of diagnosed people living with HIV were on treatment in 2021. Assuming that more people could be accessed for treatment through enhanced linkage to care and adherence programs, then closing this treatment gap through increased investment in ART could reduce mortality as well as new infections through treatment-as-prevention. The scale-up of NSP is prioritized to continue the decreasing prevalence trend among PWID and prevent epidemic rebound. Prevention programs for other key populations were deprioritized despite their importance because at the existing budget level ART can have more impact on epidemic outcomes and benefit all populations. Although an increasing proportion of new HIV infections are estimated to be occurring outside of identified key populations, prioritizing investment for all key populations remains a priority ahead of expanding general population testing.

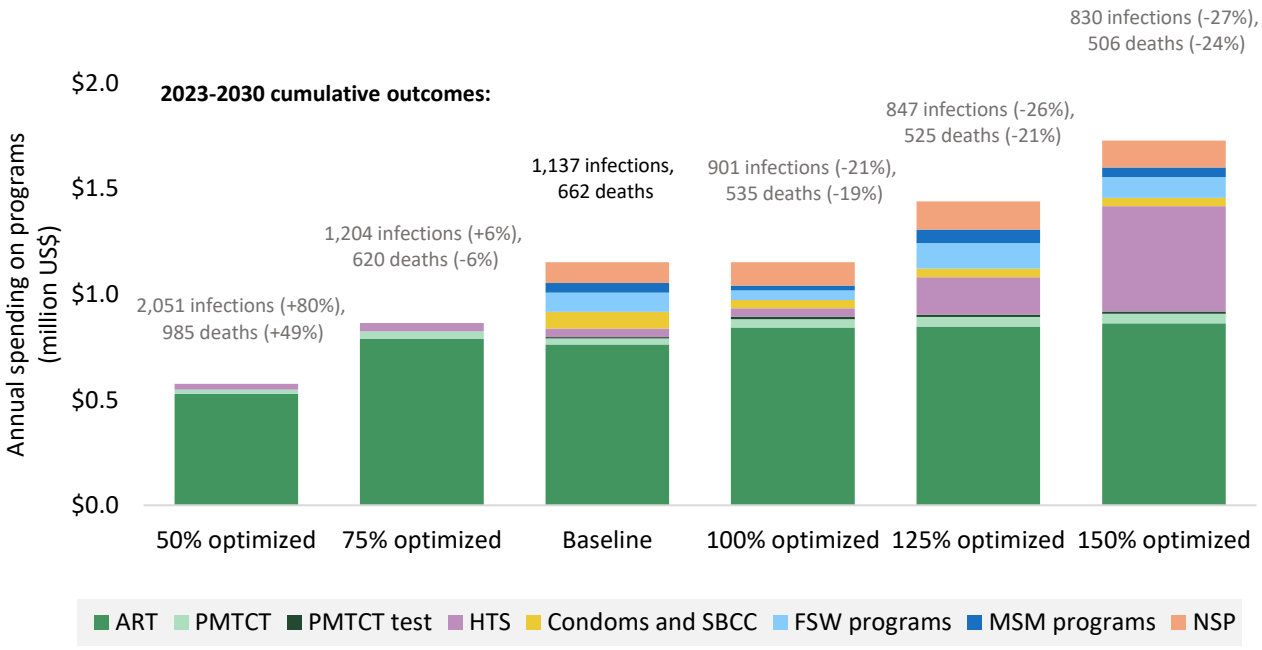


Figure 6. Optimized allocations under varying levels of annual HIV budgets for 2023 to 2030, to minimize new infections and HIV-related deaths by 2030: Moldova Left Bank. Percentage optimized refers

to the percentage of baseline HIV funding at a given budget level. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; 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 key priorities were identified as expanded investment in HIV testing and scale-up of programs for FSW and MSM, followed by further scale-up of NSP to reach saturation. The prioritization of these key populations at higher budgets may prevent epidemic rebound among FSW and prevent the epidemic expanding among MSM.

If funding were reduced, based on program constraints priorities were identified as maintaining as many people on treatment as possible, maintaining PMTCT coverage and HTS.

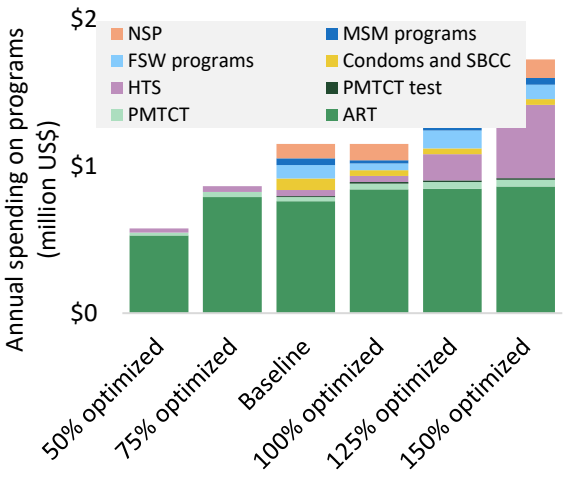
Impact of optimization on HIV epidemic. Compared with the baseline scenario, optimized reallocation of 2021 spending averted 236 new infections (21%), 126 deaths (19%) and 3,184 DALYs (18%) over 2023-2030. This benefit increases to 27% infections, 24% deaths and 22% DALYs averted with an optimized 150% budget (Figure 7; Table 2).

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

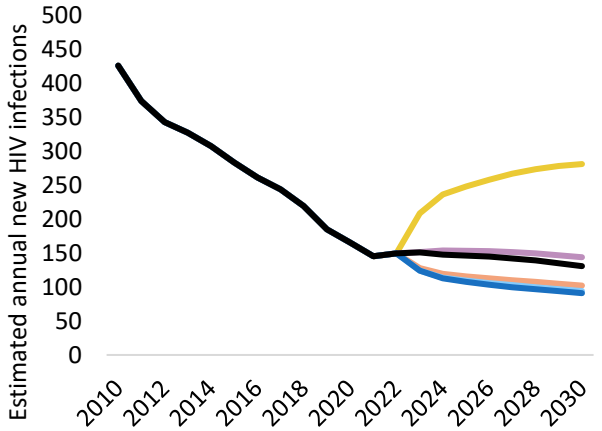
MOLDOVA

Allocation of HIV resources towards maximizing the impact of funding

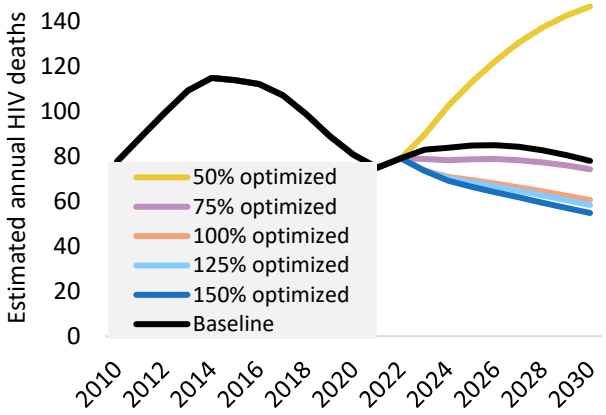
(a) Moldova Left: budget optimizations



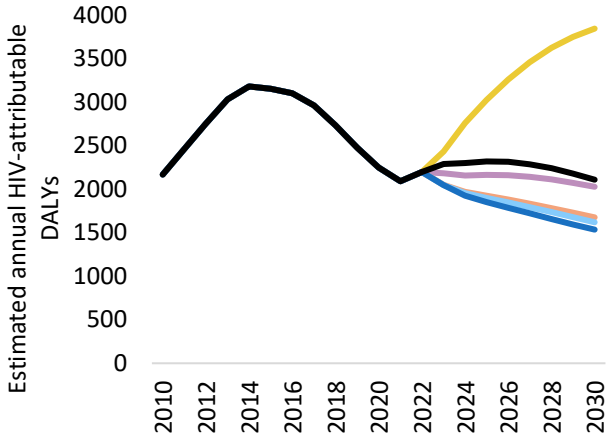
(b) Moldova Left: annual new HIV infections in budget optimizations



(c) Moldova Left: annual HIV deaths in budget optimizations



(d) Moldova Left: annual HIV-attributable DALYs in budget optimizations



(e) Moldova Left: projected care cascade in 2030

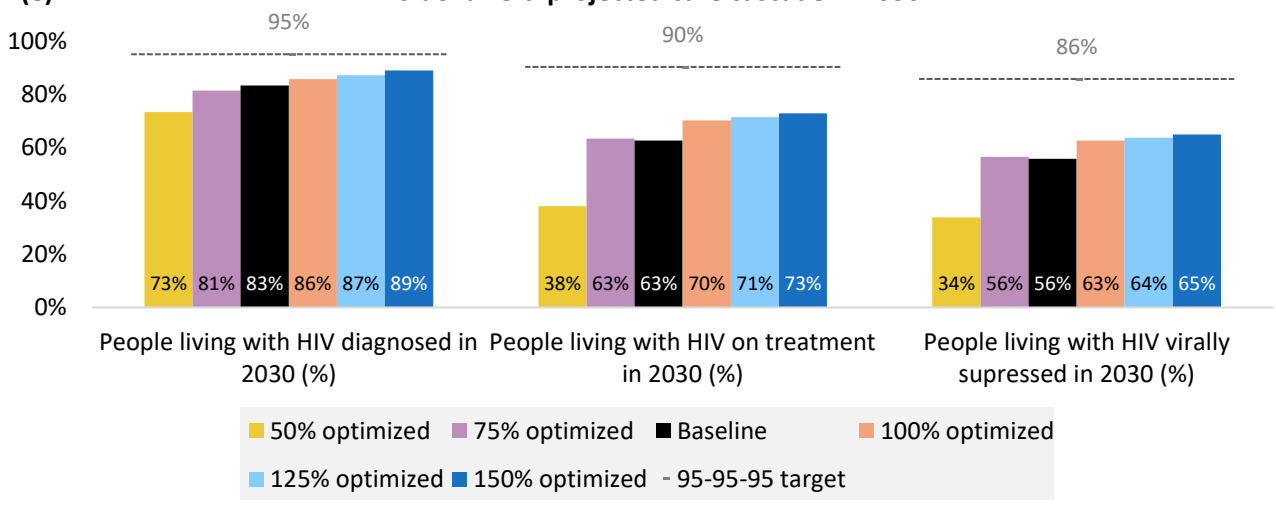


Figure 7. Model outcomes from budget optimization scenarios aiming to minimize infections and deaths: Moldova Left Bank. Panels show (a) optimal budget allocations under varying levels of annual HIV budgets according to percentage of current HIV funding; (b) estimated annual new HIV infections; (c) HIV-related 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; DALY, disability-adjusted life year; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission; SBCC, social and behavior change communication.

5.2 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 2,381 (+209%) more new infections, 962 (+145%) more deaths and 23,874 (+132%) more DALYs over 2023-2030 compared to the baseline scenario of fixed annual spending on programs in Moldova Left Bank (Table 2).

Table 2. Cumulative new HIV infection, 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: Moldova Left Bank.

	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	3,518	1,624	41,907	209%	145%	132%
50% optimized	2,051	985	26,152	80%	49%	45%
75% optimized	1,204	620	17,023	6%	-6%	-6%
Baseline	1,137	662	18,033			
100% optimized	901	535	14,849	-21%	-19%	-18%
125% optimized	847	525	14,576	-26%	-21%	-19%
150% optimized	830	506	14,116	-27%	-24%	-22%
95-95-95	542	346	10,282	-52%	-48%	-43%

Percentage optimized refers to percentage of baseline spending.

5.3 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, Moldova Left Bank'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 8e).

To reach the 95% diagnosis target, a minimal additional US$2.3M per annum, or a total 300% of the 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, people with a history of injecting drug use or sexual partners of key populations) may make it possible to reach the 95% diagnosis target more cost-efficiently. Although not modeled, delivery approaches and modalities for the general population testing program could be strategically utilized to better reach undiagnosed people living with HIV with existing or expanded HTS resources. This could incorporate index testing and social network testing strategies, tailored demand creation, task shifting and HIV self-testing, and focused provider-initiated testing (11).

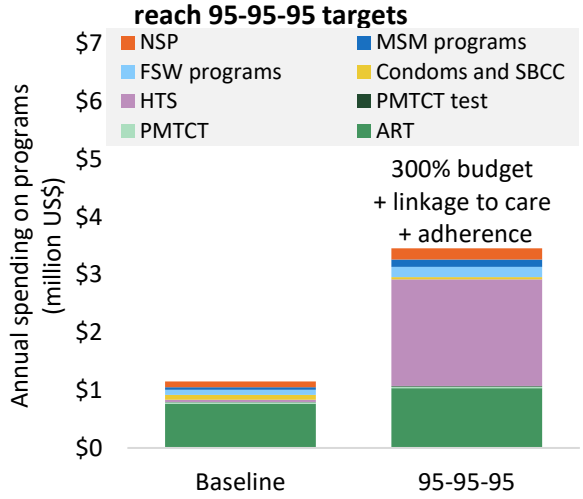
No programs were modeled to improve linkage and retention in treatment, adherence, and viral suppression, and thus the cost of reaching the second and third cascade pillars is unknown. In addition to ART spending, novel programs may be necessary in Moldova Left Bank to improve linkage to care, treatment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

Achieving the 95-95-95 targets could avert 595 (52%) new infections, 315 (48%) deaths and 7,751 (43%) DALYs compared to the baseline scenario of fixed 2021 spending on programs and no improvements to linkage to care or treatment adherence (Figure 8).

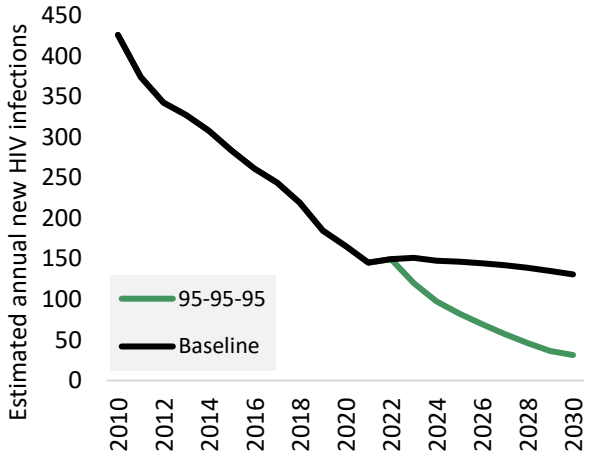
MOLDOVA

Allocation of HIV resources towards maximizing the impact of funding

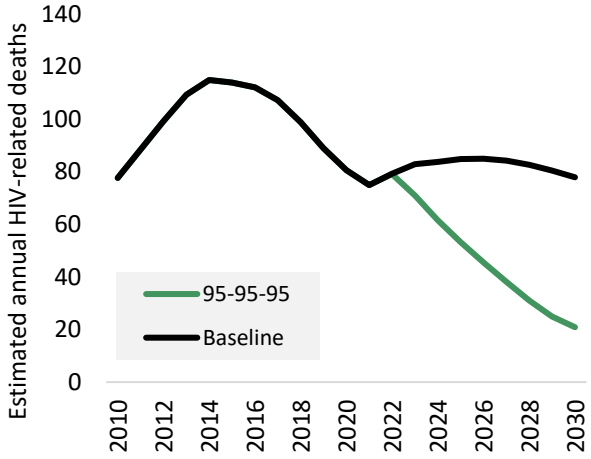
(a) Moldova Left: optimized budget to reach 95-95-95 targets



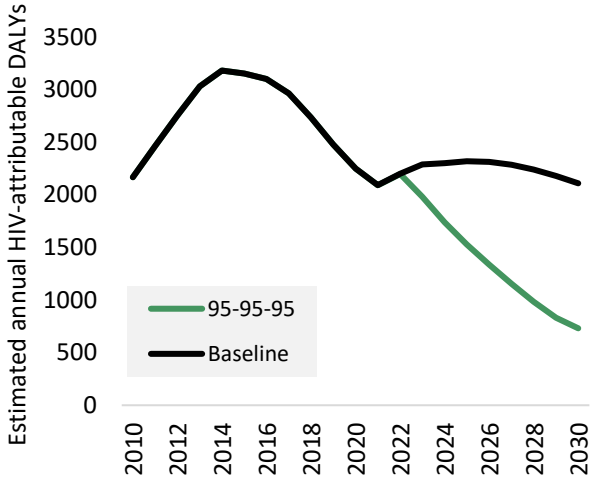
(b) Moldova Left: annual new HIV infections in 95-95-95 scenario



(c) Moldova Left: annual HIV deaths in 95-95-95 scenario



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



(e) Moldova Left: projected care cascade

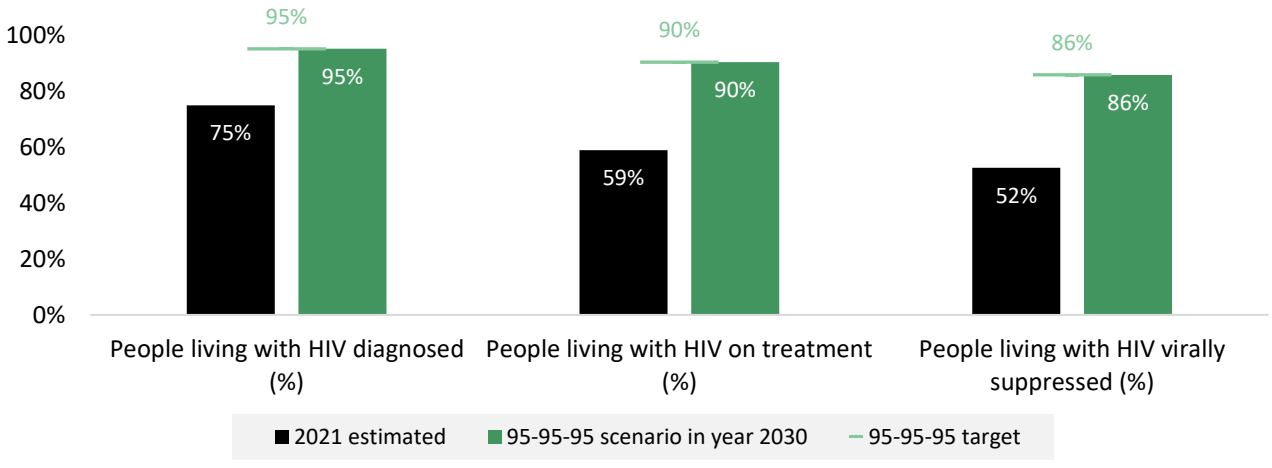


Figure 8. Optimized HIV budget level and allocation to achieve 95-95-95 targets by 2030. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) projected care cascade for the year 2030 among all people living with HIV. ART, antiretroviral therapy; DALY, disability-adjusted life year; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; PMTCT, prevention of mother to child transmission; SBCC, social and behavior change communication.

6 Comparison between Moldova Right Bank and Left Bank

Due to differences in the population size and burden of HIV, most recent targeted **HIV spending** was substantially higher in Moldova Right Bank (US$4.8M) than Left Bank (US$1.2M) in 2021. Comparisons in relative budget allocation in 100% budget optimized are shown in Figure 9.

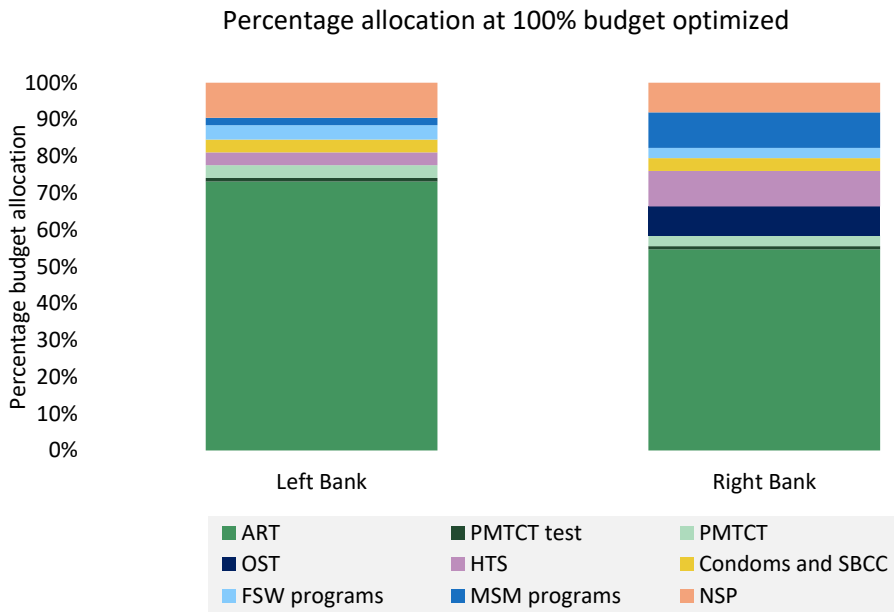


Figure 9. Comparison of relative optimized program allocations as a proportion of most recent budget in Moldova Right Bank and Left Bank. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; OST, opioid substitution therapy; PMTCT, prevention of mother to child transmission.

The distribution of **new HIV infections** differed between Right Bank and Left Bank and impacted the order of program prioritization. In the Right Bank it was estimated that new infections among MSM are increasing, and in 2021 they accounted for a higher proportion of new infections (26%) than PWID (15%) and FSW and their clients (2% and 5% respectively). In Moldova Left Bank it was estimated that new infections among MSM are decreasing, accounting for a lower proportion of new infections in 2021 (7%) than PWID (16%) and FSW and their clients (6% and 14% respectively). As well as declining incidence, the decrease in

new infections among MSM in the Left Bank is influenced by the population size of MSM decreasing more rapidly than the overall population based on most recent population size estimates (12); in contrast the population size of MSM in the Right Bank has remained relatively stable.

Subsequently, in the Right Bank **HIV prevention and testing programs for MSM** are prioritized for scale-up at 100% budget, ahead of NSP. In the Left Bank, prevention programs for key populations first prioritized NSP followed by prevention and testing programs for FSW.

ART and PMTCT are scaled up in both Banks in the 100% budget optimization. In the Left Bank, the proportion diagnosed among people living with HIV (75%) and treatment coverage among diagnosed people living with HIV (79%) was higher than the Right Bank (62% and 70% respectively) in 2021. ART and PMTCT programs have slightly lower unit costs in the Left Bank than in the Right Bank, enabling more cost-effective scale up. Given the higher proportion diagnosed in the Left Bank, there is more opportunity for the ART program to expand among both existing diagnosed and newly diagnosed people living with HIV. Subsequently, a higher proportion of the overall budget was allocated to ART.

7 Comparison with past spending

Spending on targeted HIV programs both Banks of Moldova has decreased over time, from US$5.7M in 2018 to US$4.8M in 2021 in the Right Bank (Figure 10), and from US$1.4M in 2018 to US$1.2M in 2021 in the Left Bank (Figure 11). Due to aggregation of Left and Right Bank in the 2014 analysis, 2013 spending is not included in this comparison.

There has been a shift in the allocation of funding across programs, with increased spending on OST and MSM programs in the Right Bank, and increased spending on PMTCT and MSM programs in the Left Bank. Since its introduction, the unit cost of ART has been steadily decreasing in both banks, which has allowed for the scale-up of treatment coverage with a reduced budget. In the Right Bank, the unit cost decreased from US$1,264 in 2013 to US$663 in 2018 to $421 in 2021; ART unit costs similarly decreased in the Left Bank from US$827 to $550 to $353 in the same time period (9, 10). These changes, made possible using competitive procurement mechanisms through open contracting (13) and procurement of dolutegravir at preferential prices have enabled coverage of ART to increase despite a reduction in spending.

In the Right Bank, the 2019 allocative efficiency analysis recommended a reallocation of funding from HTS, programs for PWID, and condoms and SBCC to prioritize ART and HIV programs for MSM and FSW. In the Left Bank, the previous analysis recommended a reallocation of funding from HTS and prevention and treatment programs for key populations, all towards ART. The changes in spending and coverage mostly align with the previous analysis across both banks and would likely have improved the cost-effectiveness and impact of investment.

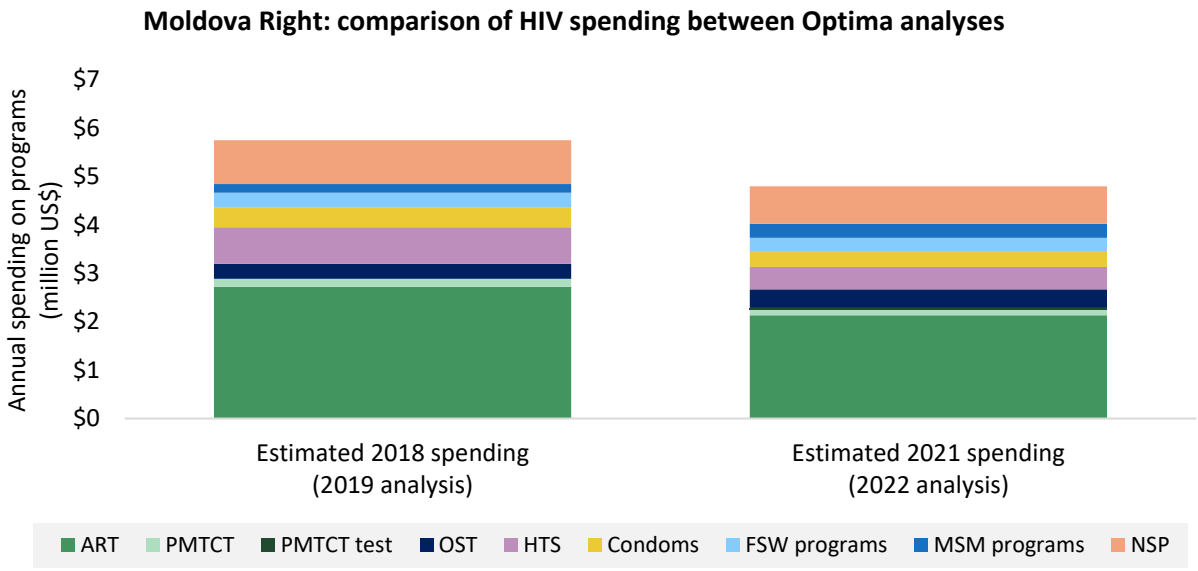


Figure 10. Estimated budget allocations from 2019 and 2022 Optima analyses: Moldova Right Bank. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

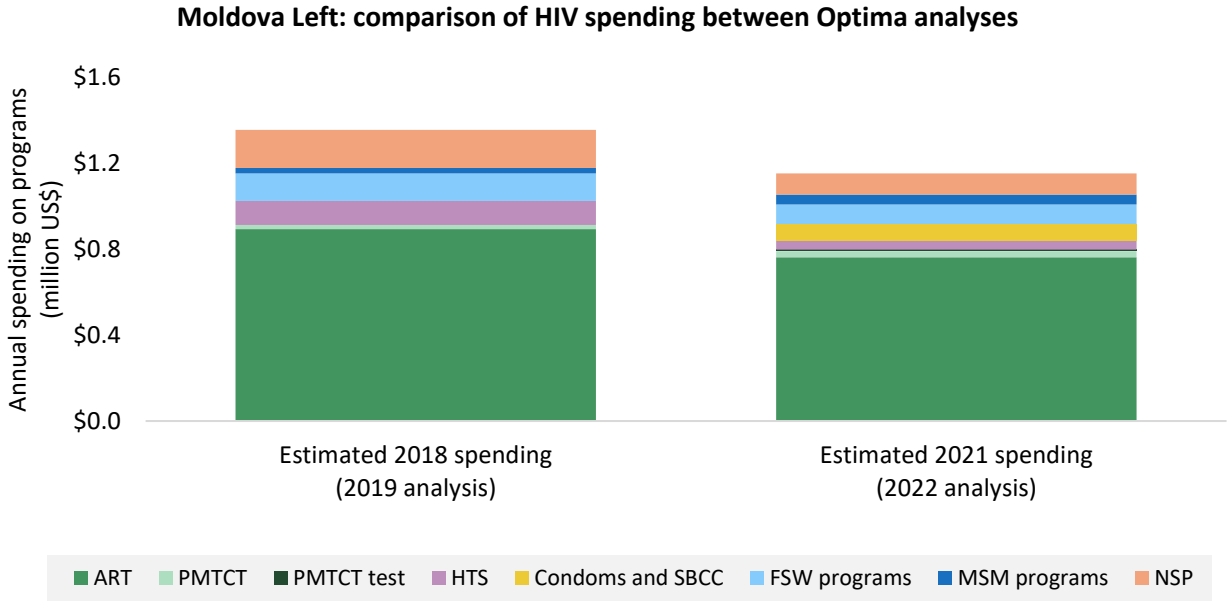


Figure 11. Estimated budget allocations from 2019 and 2022 Optima analyses: Moldova Left Bank. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

8 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. In particular, epidemiological indicators were limited for Moldova Left Bank, with some of them being inferred from available Right Bank data.
- **Effect (i.e. impact) sizes for interventions** are taken from global literature (e.g. the effectiveness of condom use for preventing infections). Actual program effects may vary depending on context or quality of implementation.
- The model does not capture the effects of **needle-syringe programs** on annual testing rates among people who inject drugs and may thus underestimate the overall impact of the program. There were insufficient data on HTS uptake within the NSP, thus testing among PWID was modeled through the general HTS program, with assumptions that it has a similar impact and baseline to the general population.
- **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.
- **Changes to unit costs:** The model assumes fixed cost functions over time; however unit costs are subject to vary over time depending on changing supply and implementation costs, which would change the cost functions in the model.
- **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.
- **Retention in care:** Programs were not considered that could improve 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.

9 Conclusions

This modeling analysis evaluated the allocative efficiency of direct HIV programs in Moldova, finding that an optimized resource allocation can have an impact on reducing infections and deaths. Since new HIV infections peaked in the Right and Left Bank in 2002 and 2009, respectively, key population programs have played a crucial role in reducing behavioral risks and increasing HIV testing among key populations, leading to the substantial decline in new infections in both Banks.

The analysis found different optimal budgets for both the Right Bank and the Left Bank of Moldova based on differences in trends and distribution of new infections among key populations. For the Right Bank, program priorities were identified as increased treatment scale-up where possible and HIV programs for men who have sex with men. For the Left Bank, program priorities were identified as increased treatment scale-up where possible and PMTCT, followed by investment in needle-syringe programs. Both Banks are projected to have challenges in reaching 95% diagnosis, and can enhance strategies to better focus HIV testing on individuals at past or current risk, including those with a history of injecting drug use or sex work and the sexual partners of key populations. This could incorporate proposed but not modeled index testing and social network testing strategies, tailored demand creation, task shifting and HIV self-testing, and focused provider-initiated testing. Additionally, 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 Moldova country team and international partners.

Country team: Iurie Climasevschi, National AIDS Programme Coordinator with the Hospital of Dermatology and Communicable Diseases; Svetlana Popovici, National TARV Coordinator, with the Hospital of Dermatology and Communicable Diseases; Daniela Lupan, National M&E Coordinator, with the Hospital of Dermatology and Communicable Diseases; Tatiana Costin, National M&E Coordinator, with the Hospital of Dermatology and Communicable Diseases; and Svetlana Plamadeala, UNAIDS Country Office Director.

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

10 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

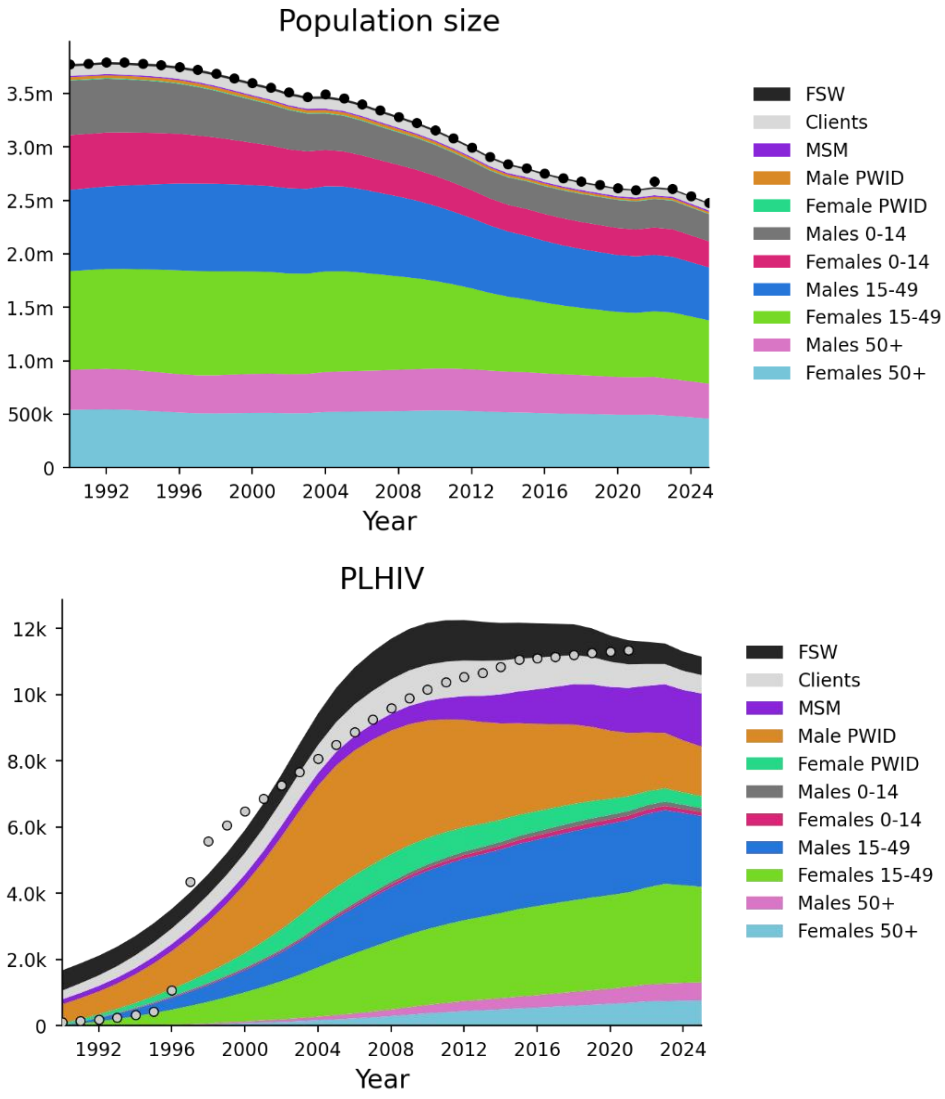
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

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

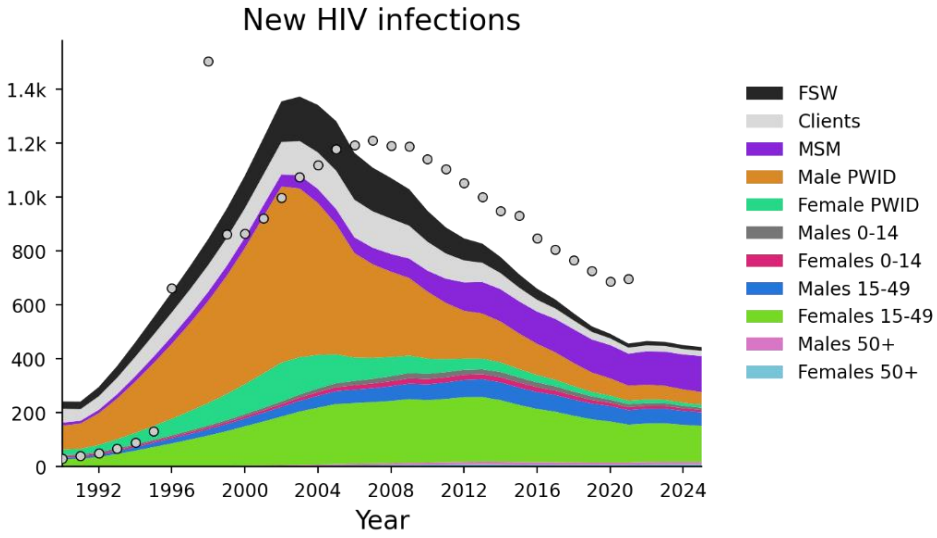
Appendix 2. Model calibration

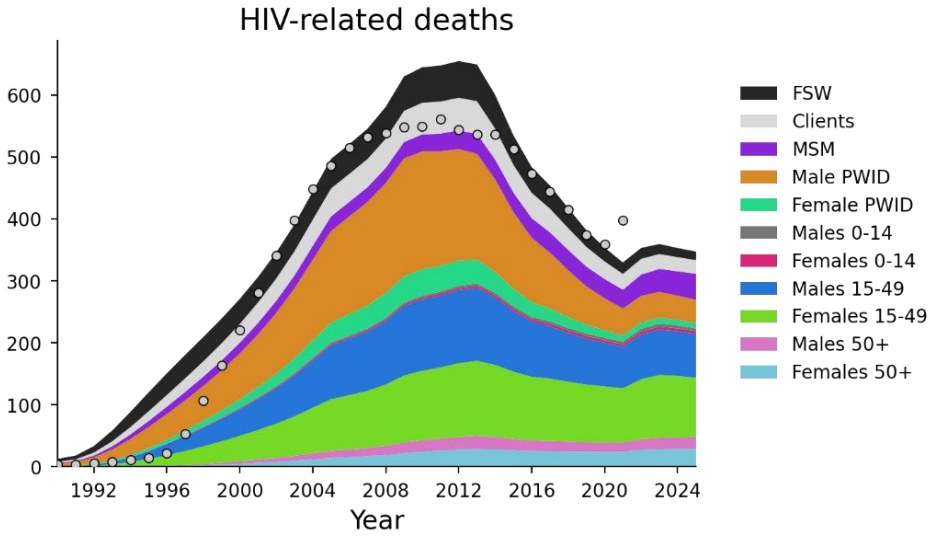
Figure A1a. Calibration outputs – Right Bank. Dots represent official country estimates based on World Population Prospects, Spectrum model, surveillance surveys, program data and UNAIDS.

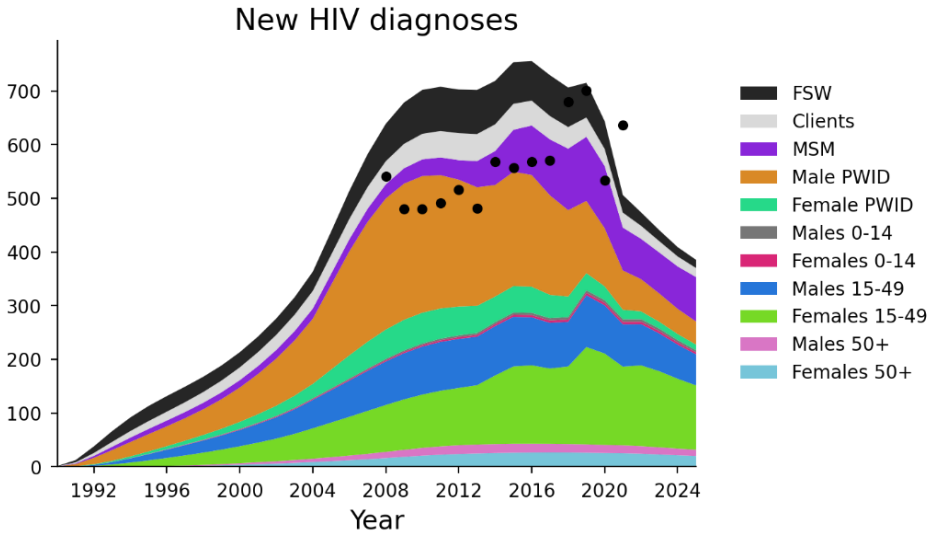


MOLDOVA

Allocation of HIV resources towards maximizing the impact of funding







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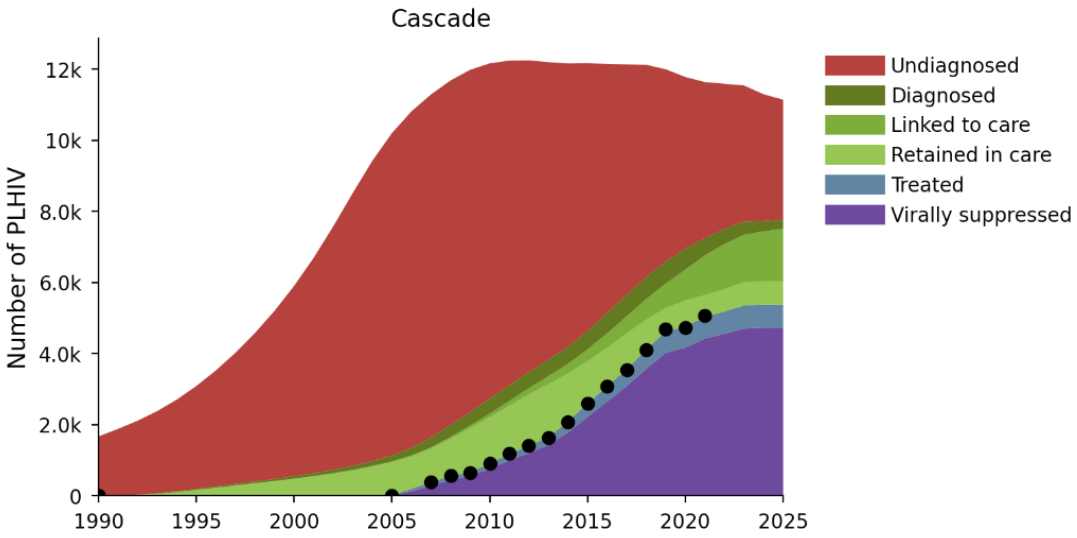
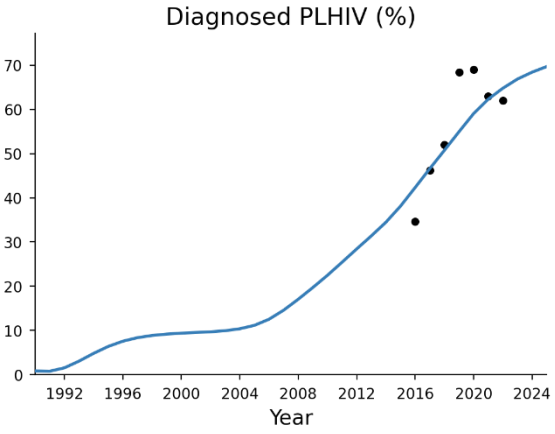
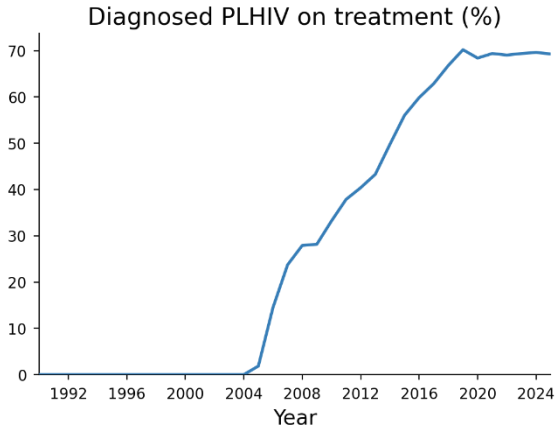
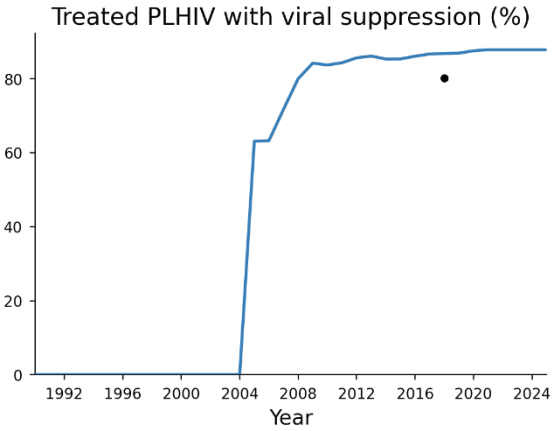
Allocation of HIV resources towards maximizing the impact of funding









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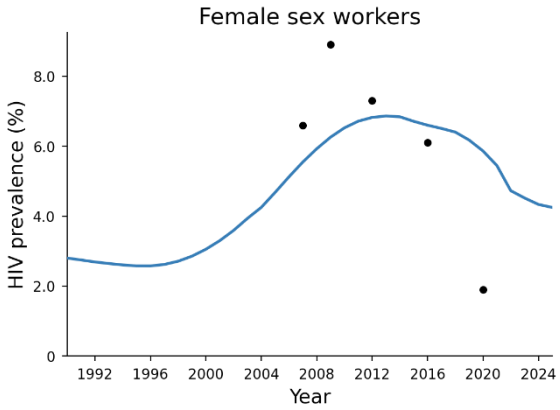
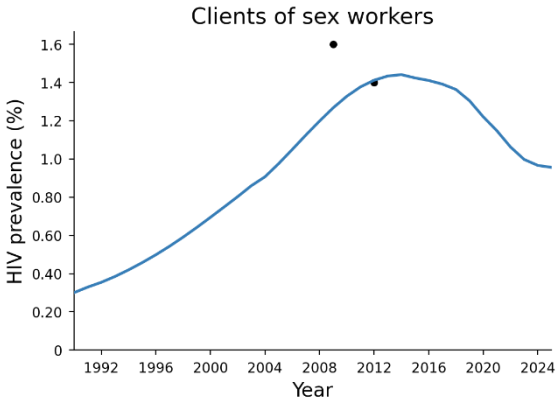
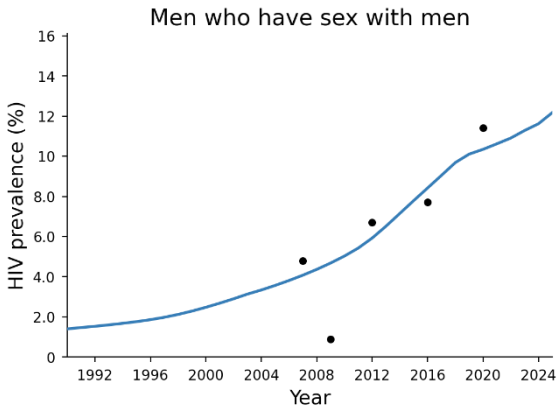
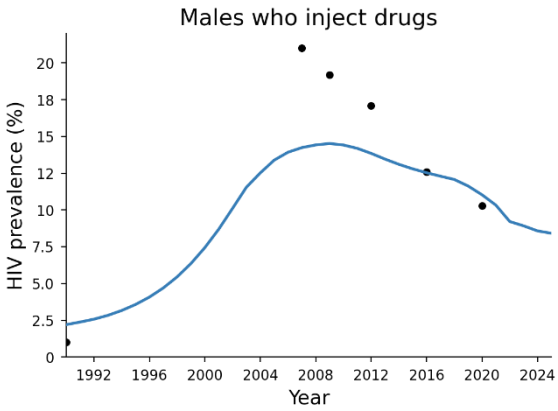
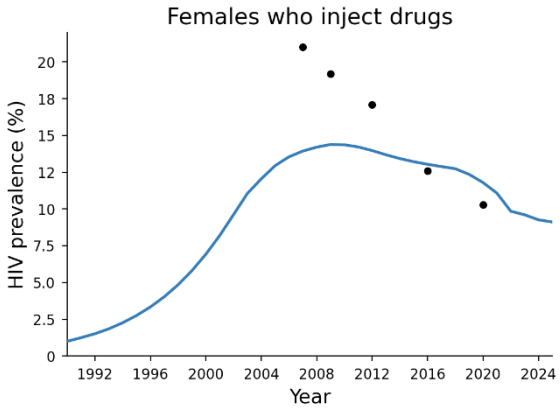
Allocation of HIV resources towards maximizing the impact of funding











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Allocation of HIV resources towards maximizing the impact of funding

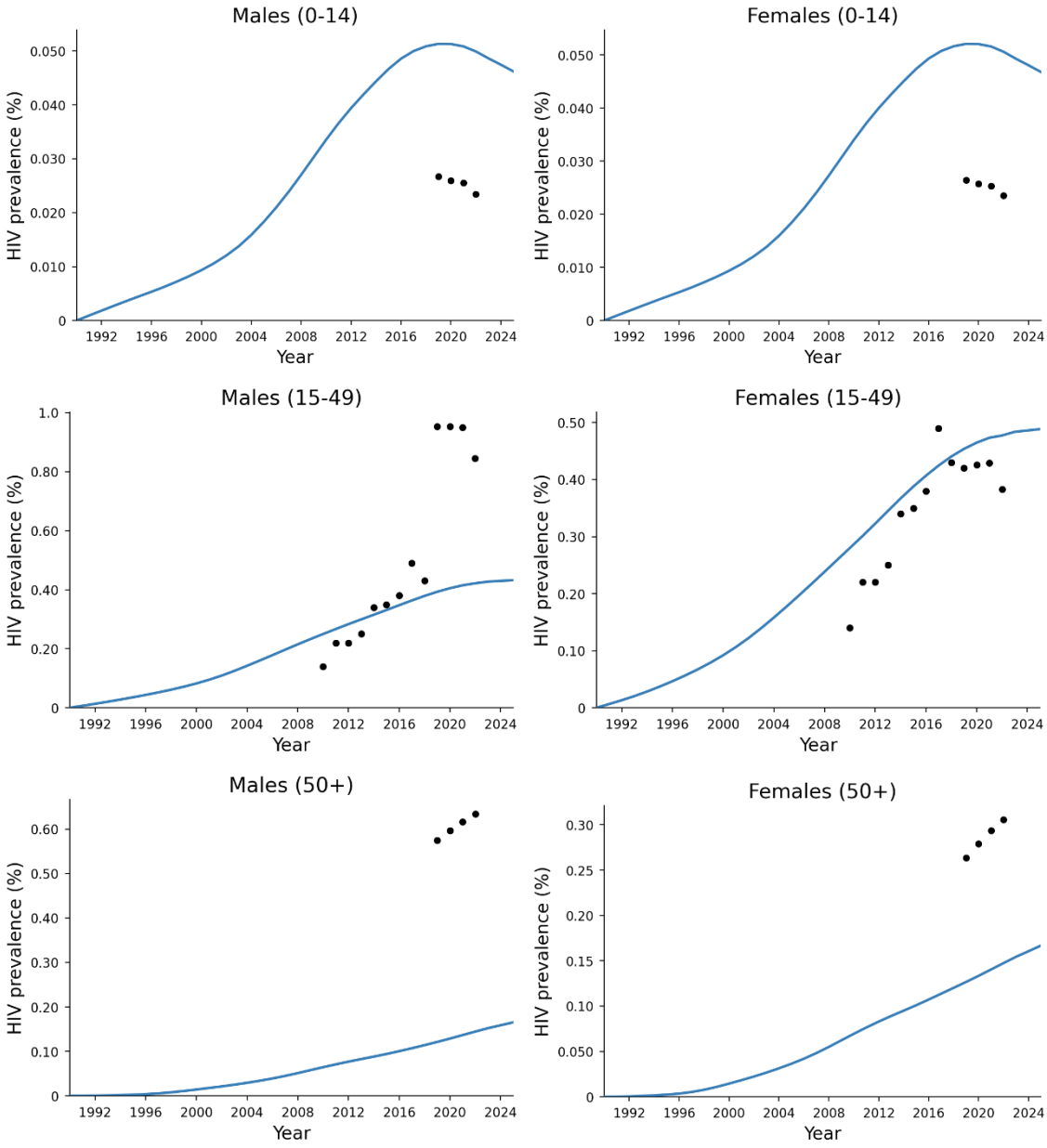
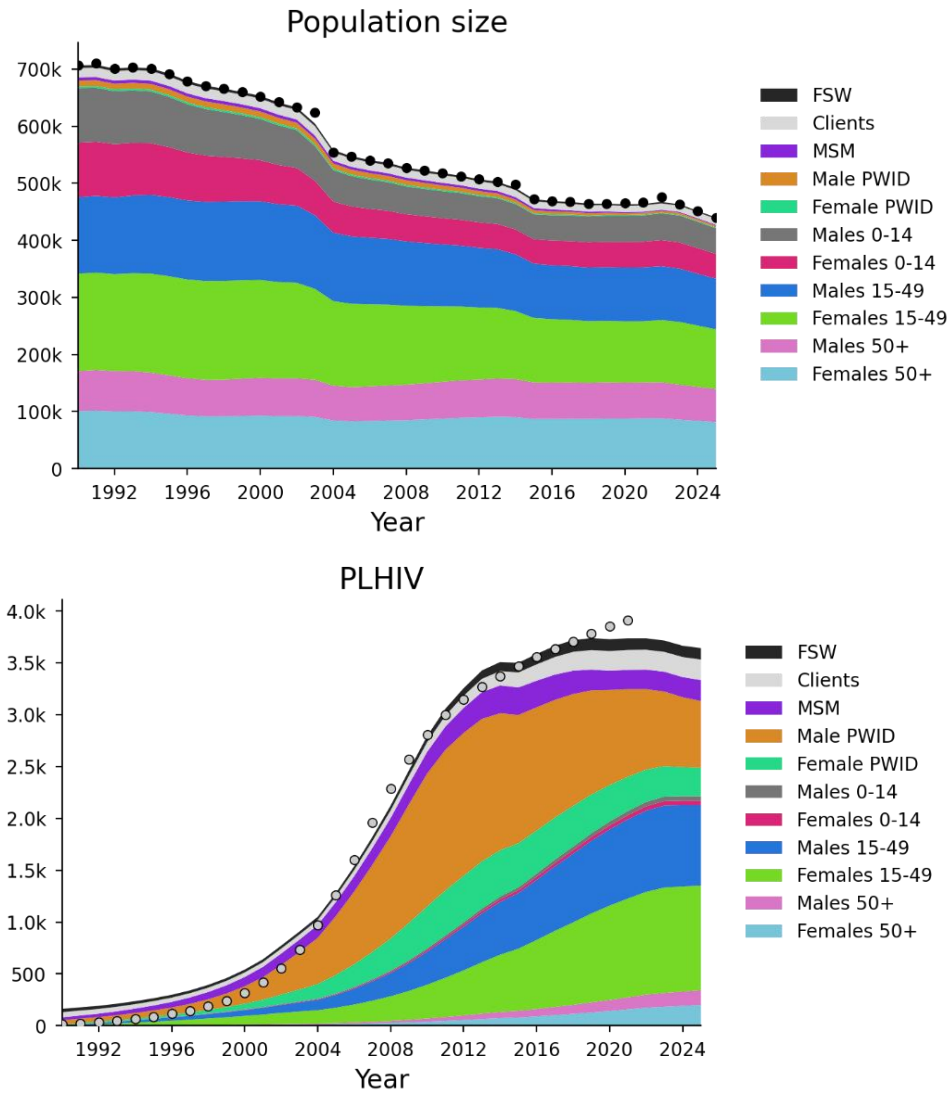


Figure A1b. Calibration outputs – Left Bank. Dots represent official country estimates based on World Population Prospects, Spectrum model, surveillance surveys, program data and UNAIDS.



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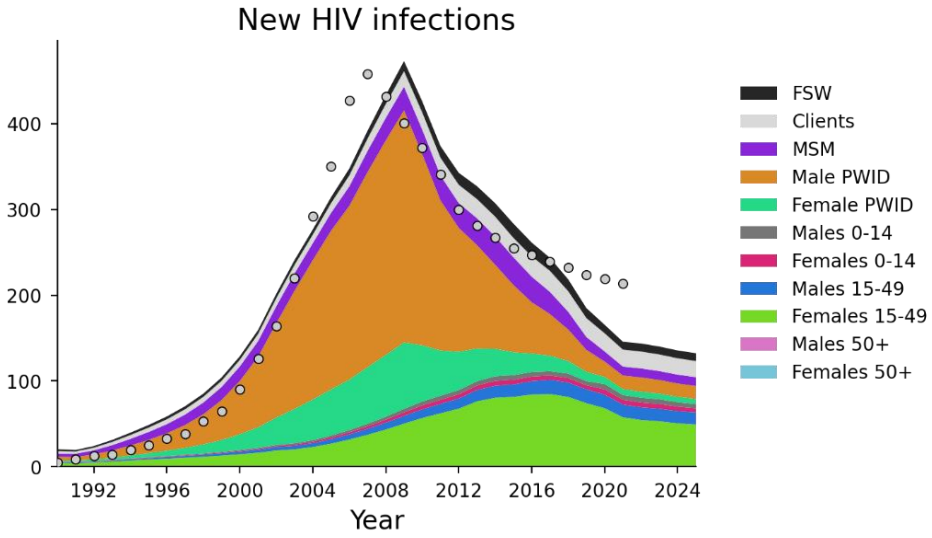
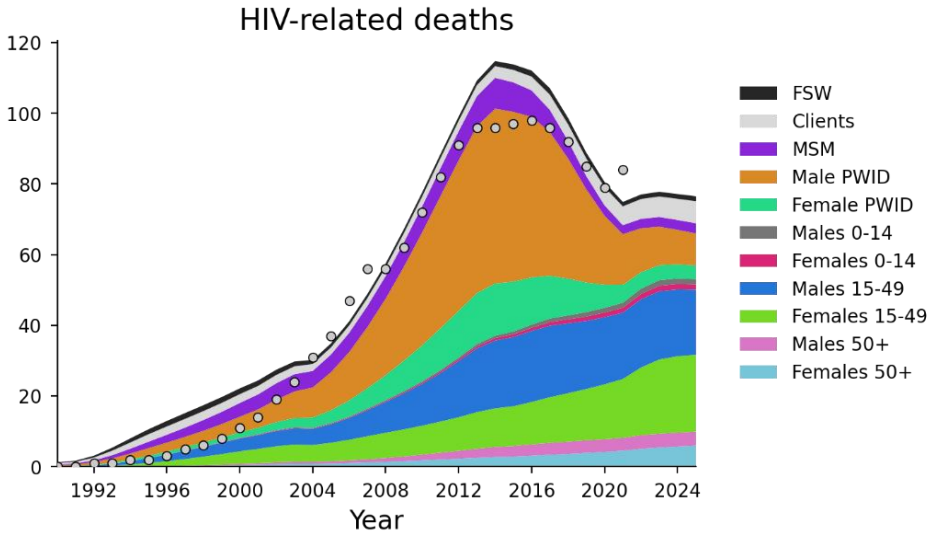
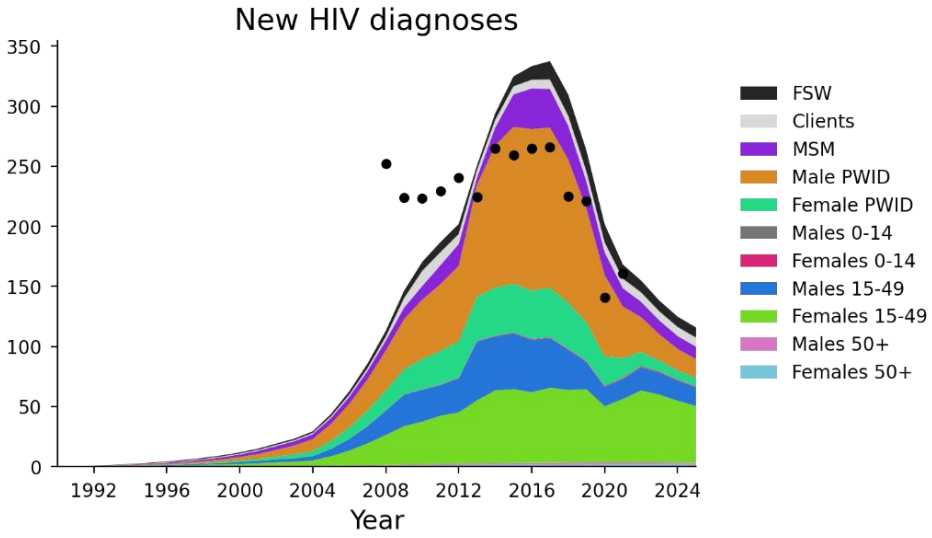
Allocation of HIV resources towards maximizing the impact of funding







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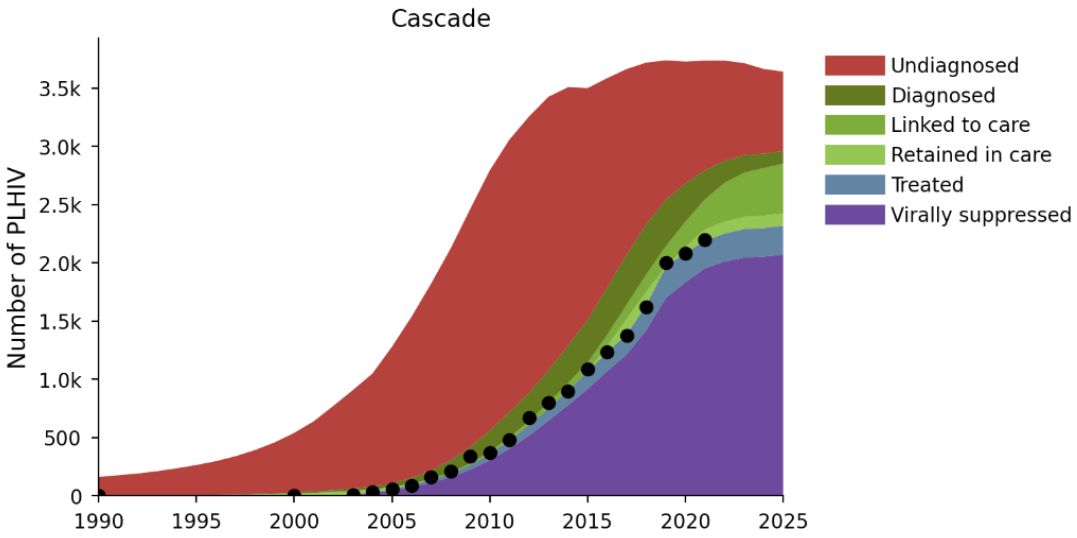
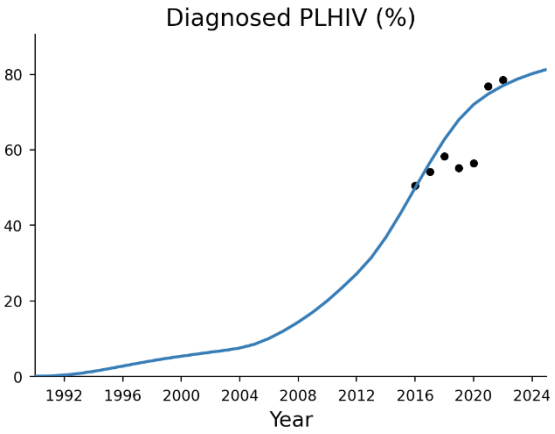
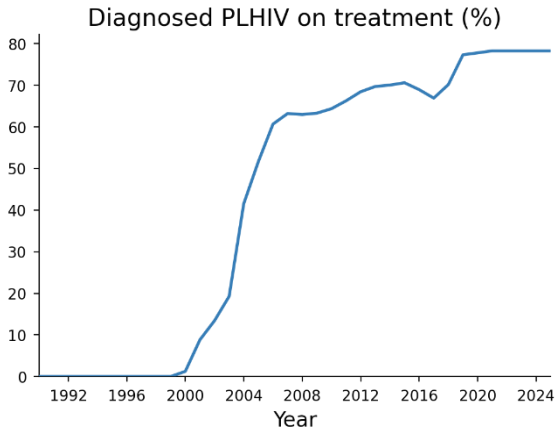
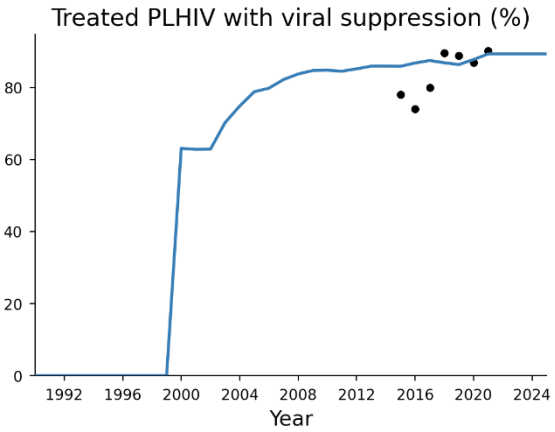
Allocation of HIV resources towards maximizing the impact of funding









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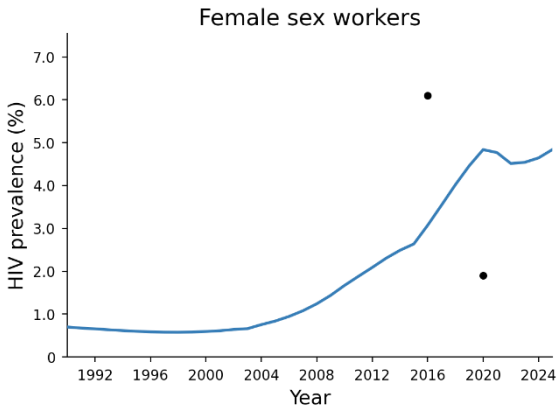
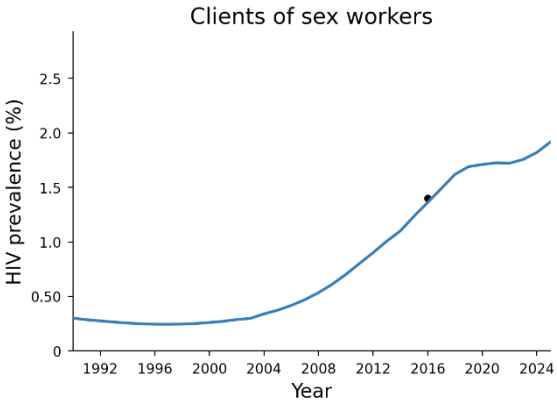
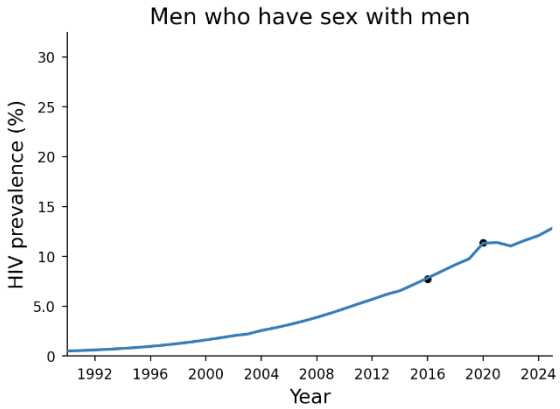
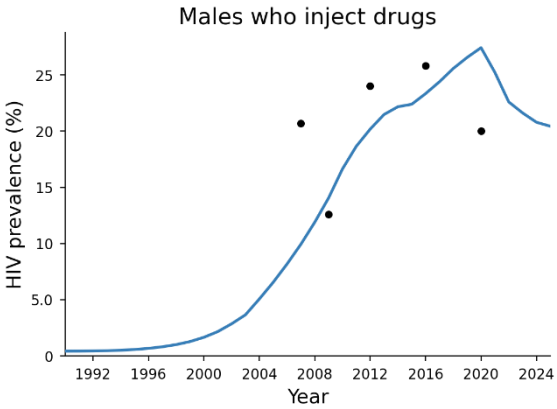
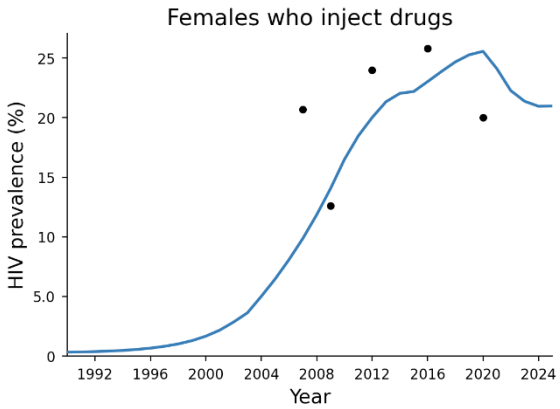
Allocation of HIV resources towards maximizing the impact of funding











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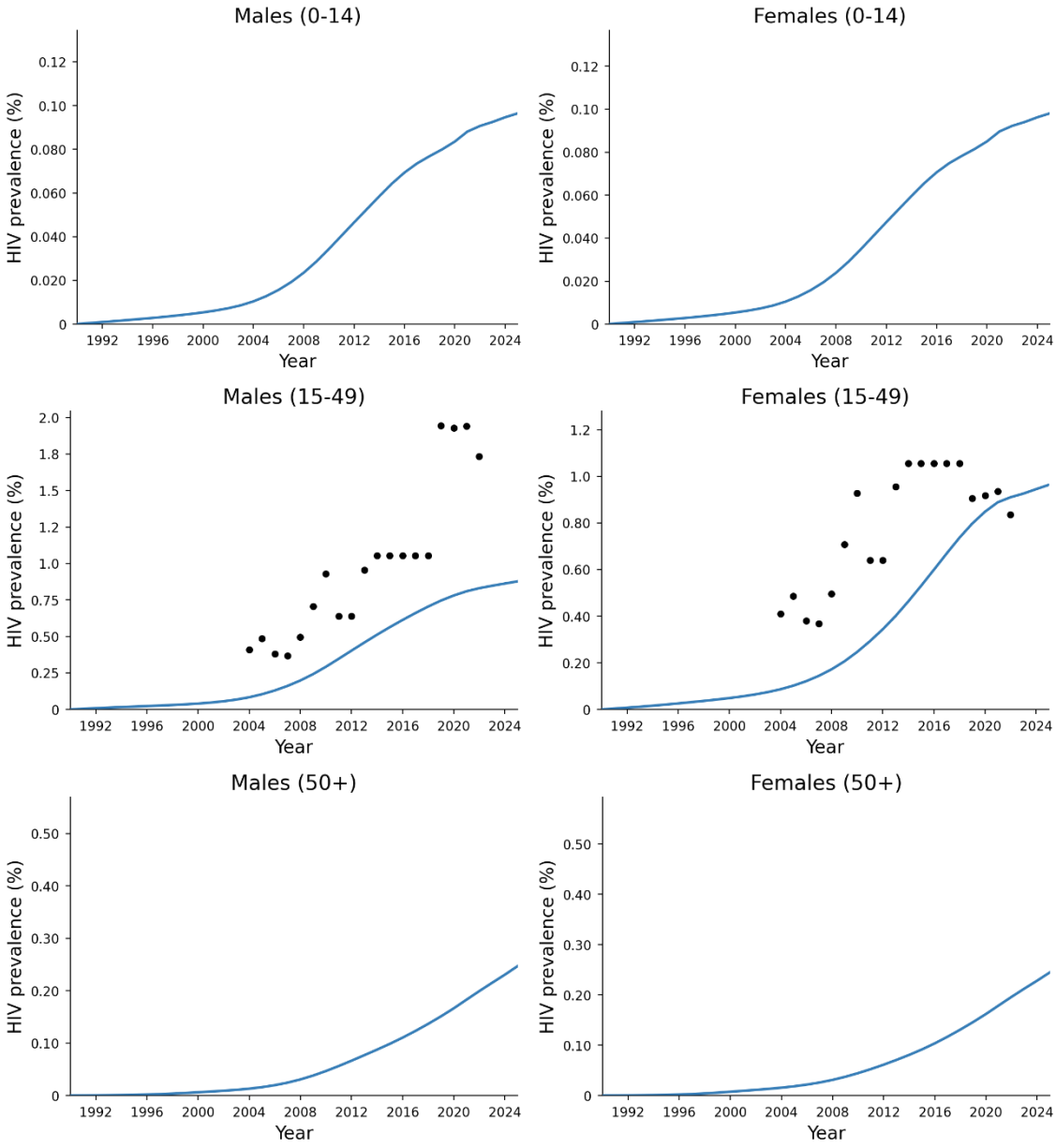
Allocation of HIV resources towards maximizing the impact of funding



Appendix 3. HIV program costing and impacts

Table A3a. Right Bank: HIV program unit costs and saturation values

HIV program	Unit cost (USD)	Saturation (low)	Saturation (high)
Antiretroviral therapy*	$432.01	95%	100%
Condom promotion and distribution	$1.07	30%	90%
HIV testing services	$2.50	0%	90%
Needle-syringe programs	$56.14	30%	80%
Opioid substitution therapy	$672.42	20%	40%
Prevention of mother-to-child transmission	$944.00	95%	100%
Prevention of mother-to-child transmission testing	$1.06	95%	100%
Programs for female sex workers	$47.63	30%	80%
Programs for men who have sex with men	$78.82	30%	80%

ART unit cost was derived top-down from total ART spending divided by ART coverage, excluding ART coverage funded through PMTCT. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

Table A3b. Left Bank: HIV program unit costs and saturation values

HIV program	Unit cost (USD)	Saturation (low)	Saturation (high)
Antiretroviral therapy*	$353.00	95%	100%
Condom promotion and distribution	$2.41	30%	90%
HIV testing services	$2.41	30%	90%
Needle-syringe programs	$38.79	30%	60%
Prevention of mother-to-child transmission	$675.07	95%	100%
Prevention of mother-to-child transmission testing	$1.53	95%	100%
Programs for female sex workers	$46.47	30%	85%
Programs for men who have sex with men	$79.34	30%	90%

ART unit cost was derived top-down from total ART spending divided by ART coverage, excluding ART coverage funded through PMTCT. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission.

Table A4a. Right Bank: 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
Condoms	Condom use for casual acts	Clients, FSW	50%	50%	70%	70%
Condoms	Condom use for casual acts	Clients, Female PWID	48%	48%	70%	70%
Condoms	Condom use for casual acts	Clients, Females 15-49	20%	20%	60%	60%
Condoms	Condom use for casual acts	MSM, MSM	65%	65%	80%	80%
Condoms	Condom use for casual acts	MSM, Female PWID	65%	65%	85%	85%
Condoms	Condom use for casual acts	MSM, Males 15-49	50%	50%	57%	57%
Condoms	Condom use for casual acts	MSM, Females 15-49	42%	42%	64%	64%
Condoms	Condom use for casual acts	Male PWID, FSW	67%	67%	85%	85%
Condoms	Condom use for casual acts	Male PWID, Female PWID	69%	69%	85%	85%
Condoms	Condom use for casual acts	Male PWID, Females 15-49	43%	43%	65%	65%
Condoms	Condom use for casual acts	Males 15-49, FSW	44%	44%	65%	65%
Condoms	Condom use for casual acts	Males 15-49, MSM	51%	51%	58%	58%
Condoms	Condom use for casual acts	Males 15-49, Female PWID	48%	48%	65%	65%
Condoms	Condom use for casual acts	Males 15-49, Females 15-49	23%	23%	40%	40%
Condoms	Condom use for casual acts	Males 50+, Females 15-49	40%	40%	65%	65%
FSW programs	Condom use for casual acts	Clients, FSW	50%	50%	60%	60%
FSW programs	Condom use for casual acts	Male PWID, FSW	67%	67%	88%	88%
FSW programs	Condom use for casual acts	Males 15-49, FSW	44%	44%	70%	70%
MSM programs	Condom use for casual acts	MSM, MSM	65%	65%	92%	92%
MSM programs	Condom use for casual acts	MSM, Female PWID	65%	65%	85%	85%
MSM programs	Condom use for casual acts	MSM, Females 15-49	42%	42%	50%	50%
FSW programs	Condom use for commercial acts	Clients, FSW	81%	81%	91%	91%

HTS	HIV testing rate (average tests per year	FSW	0.14	0.14	0.56	0.56
HTS	HIV testing rate (average tests per year	Clients	0.02	0.02	0.19	0.19
HTS	HIV testing rate (average tests per year	MSM	0.13	0.13	0.42	0.42
HTS	HIV testing rate (average tests per year	Male PWID	0.34	0.34	0.49	0.49
HTS	HIV testing rate (average tests per year	Female PWID	0.25	0.25	0.47	0.47
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	0.04	0.04
HTS	HIV testing rate (average tests per year	Males 15-49	0.10	0.10	0.30	0.30
HTS	HIV testing rate (average tests per year	Females 15-49	0.08	0.08	0.28	0.28
HTS	HIV testing rate (average tests per year	Males 50+	0.02	0.02	0.20	0.20
HTS	HIV testing rate (average tests per year	Females 50+	0.02	0.02	0.20	0.20
PMTCT test	HIV testing rate (average tests per year	FSW	0.14	0.14	0.43	0.43
PMTCT test	HIV testing rate (average tests per year	Female PWID	0.25	0.25	0.37	0.37
PMTCT test	HIV testing rate (average tests per year	Females 15-49	0.08	0.08	0.22	0.22
FSW programs	HIV testing rate (average tests per year	FSW	0.14	0.14	0.60	0.60
MSM programs	HIV testing rate (average tests per year	MSM	0.13	0.13	0.55	0.55
NSP	Probability of needle sharing (per injection)	Male PWID	9%	9%	2%	2%
NSP	Probability of needle sharing (per injection)	Female PWID	9%	9%	2%	2%
OST	Number of PWID on OST	Total	0	0	-	-
PMTCT	Number of people on PMTCT	Total	0	0	-	-
ART	Number of people on treatment	Total	0	0	-	-

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; 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

Table A4b. Left Bank: Data inputs of impact of programs

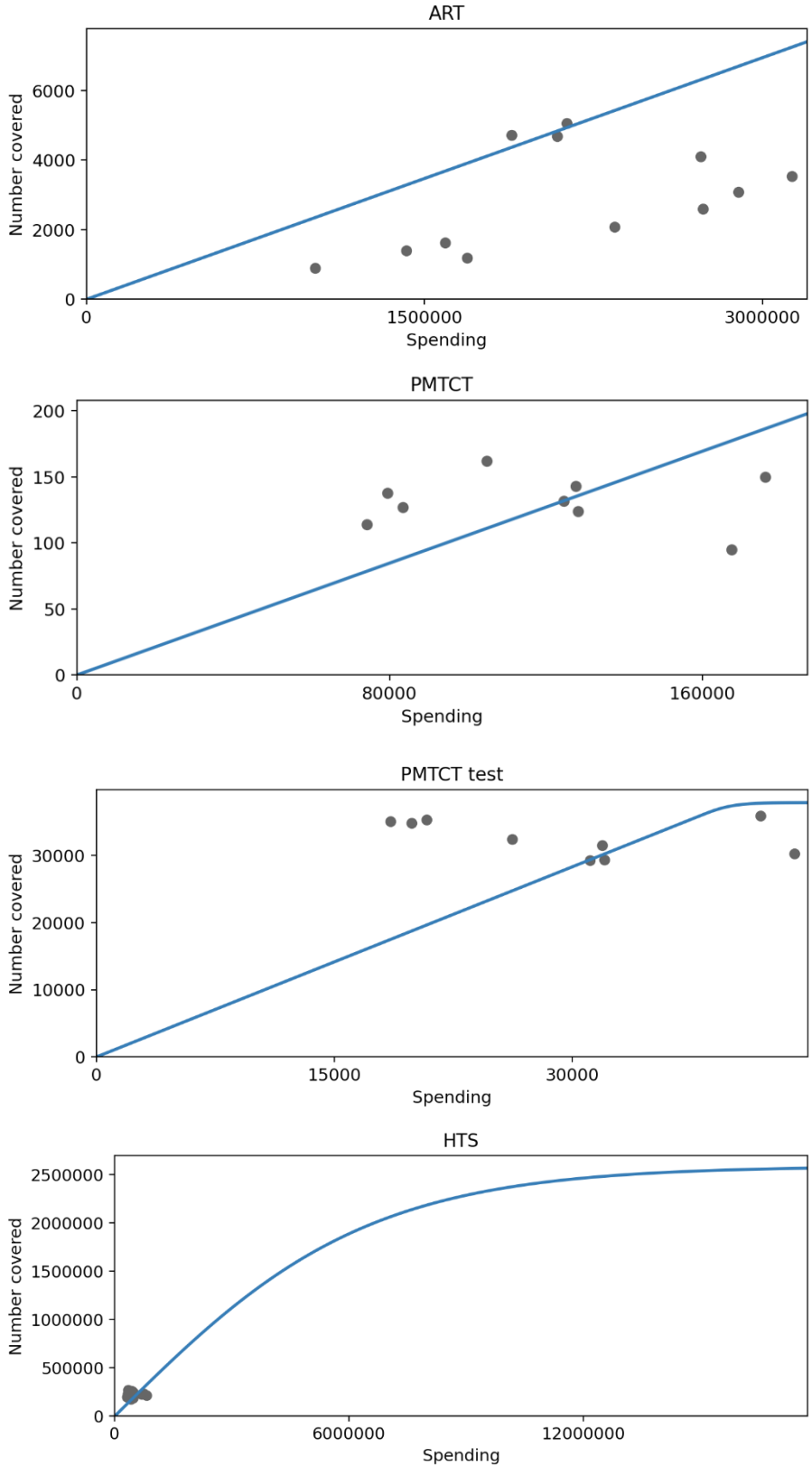
HIV program	Parameter	Population interactions or population	In absence of any programs		For each individual reached by this program	
			Low	High	Low	High
Condoms and SBCC	Condom use for casual acts	Clients, FSW	50%	50%	53%	53%
Condoms and SBCC	Condom use for casual acts	Clients, Female PWID	46%	46%	51%	51%
Condoms and SBCC	Condom use for casual acts	Clients, Females 15-49	25%	25%	30%	30%
Condoms and SBCC	Condom use for casual acts	MSM, MSM	66%	66%	73%	73%
Condoms and SBCC	Condom use for casual acts	MSM, Female PWID	63%	63%	67%	67%
Condoms and SBCC	Condom use for casual acts	MSM, Females 15-49	42%	42%	48%	48%
Condoms and SBCC	Condom use for casual acts	Male PWID, FSW	51%	51%	55%	55%
Condoms and SBCC	Condom use for casual acts	Male PWID, Female PWID	61%	62%	65%	65%
Condoms and SBCC	Condom use for casual acts	Male PWID, Females 15-49	40%	40%	44%	44%
Condoms and SBCC	Condom use for casual acts	Males 15-49, FSW	47%	47%	54%	54%
Condoms and SBCC	Condom use for casual acts	Males 15-49, Female PWID	46%	46%	53%	53%
Condoms and SBCC	Condom use for casual acts	Males 15-49, Females 15-49	24%	24%	35%	35%
Condoms and SBCC	Condom use for casual acts	Males 50+, Females 15-49	43%	43%	49%	49%
Condoms and SBCC	Condom use for casual acts	Males 50+, Females 50+	55%	55%	62%	62%
FSW programs	Condom use for casual acts	Clients, FSW	50%	50%	58%	58%
FSW programs	Condom use for casual acts	Male PWID, FSW	51%	51%	81%	81%
FSW programs	Condom use for casual acts	Males 15-49, FSW	47%	47%	59%	59%
MSM programs	Condom use for casual acts	MSM, MSM	66%	66%	92%	92%
MSM programs	Condom use for casual acts	MSM, Female PWID	63%	63%	81%	81%
MSM programs	Condom use for casual acts	MSM, Females 15-49	42%	42%	61%	61%
FSW programs	Condom use for commercial acts	Clients, FSW	75%	75%	90%	90%
HTS	HIV testing rate (average tests per year)	FSW	0.29	0.29	0.54	0.54
HTS	HIV testing rate (average tests per year)	Clients	0.07	0.07	0.25	0.25

HTS	HIV testing rate (average tests per year)	MSM	0.34	0.34	0.63	0.63
HTS	HIV testing rate (average tests per year)	Male PWID	0.49	0.49	0.65	0.65
HTS	HIV testing rate (average tests per year)	Female PWID	0.44	0.44	0.67	0.67
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	0.04	0.04
HTS	HIV testing rate (average tests per year)	Males 15-49	0.13	0.13	0.30	0.30
HTS	HIV testing rate (average tests per year)	Females 15-49	0.17	0.18	0.39	0.40
HTS	HIV testing rate (average tests per year)	Males 50+	0.03	0.03	0.20	0.20
HTS	HIV testing rate (average tests per year)	Females 50+	0.03	0.03	0.20	0.20
PMTCT test	HIV testing rate (average tests per year)	FSW	0.29	0.29	0.45	0.45
PMTCT test	HIV testing rate (average tests per year)	Female PWID	0.44	0.44	0.51	0.51
PMTCT test	HIV testing rate (average tests per year)	Females 15-49	0.17	0.18	0.23	0.25
FSW programs	HIV testing rate (average tests per year)	FSW	0.29	0.29	0.77	0.77
MSM programs	HIV testing rate (average tests per year)	MSM	0.34	0.34	0.85	0.85
NSP	Probability of needle sharing (per injection)	Male PWID	8%	8%	1%	1%
NSP	Probability of needle sharing (per injection)	Female PWID	8%	8%	1%	1%
PMTCT	Number of people on PMTCT	Total	0	0	-	-
ART	Number of people on treatment	Total	0	0	-	-

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; 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 A2a. Right Bank: Cost functions. Figures show relationship between total spending and number covered among targeting population of each program.



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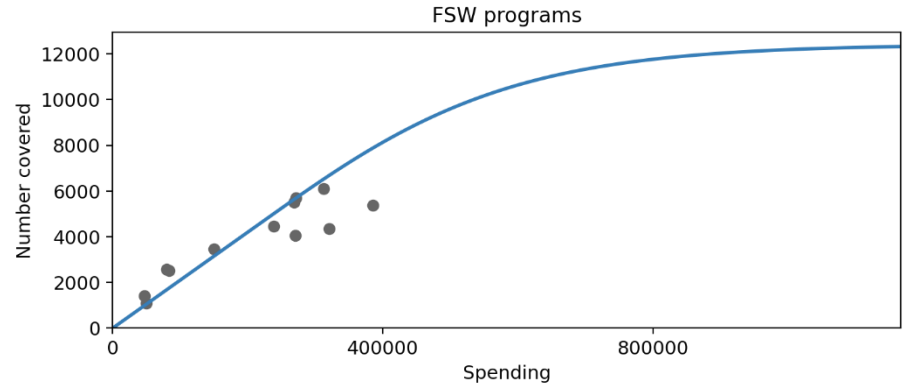
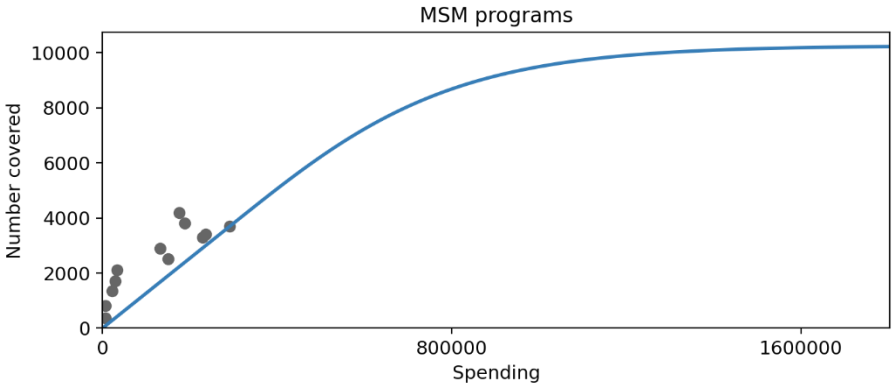
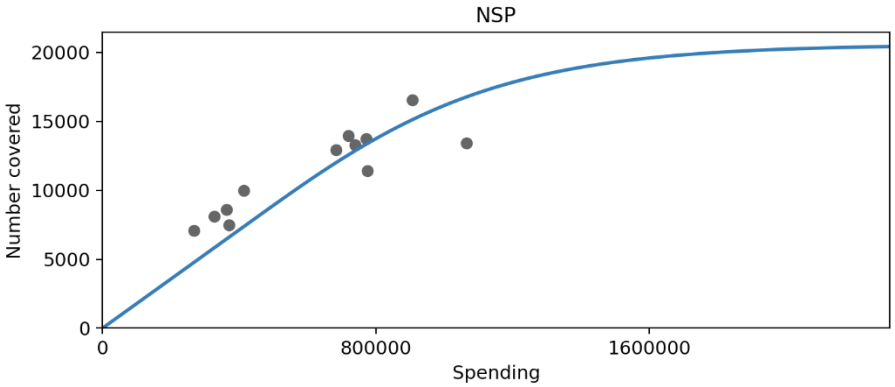
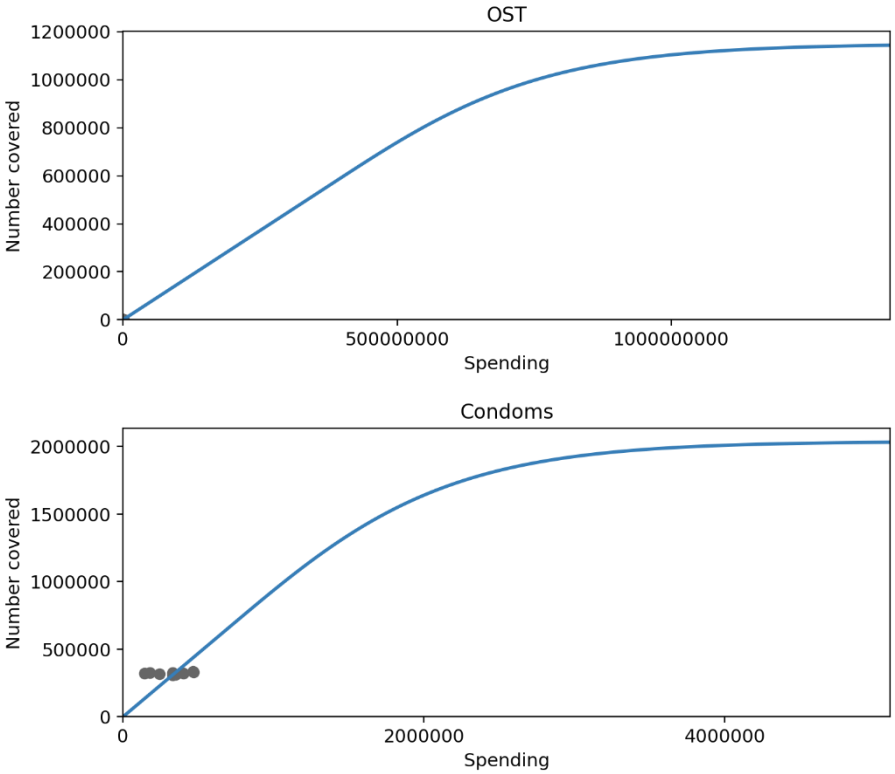
Allocation of HIV resources towards maximizing the impact of funding





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Spending
Condoms
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1500000
1000000
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0
Number covered
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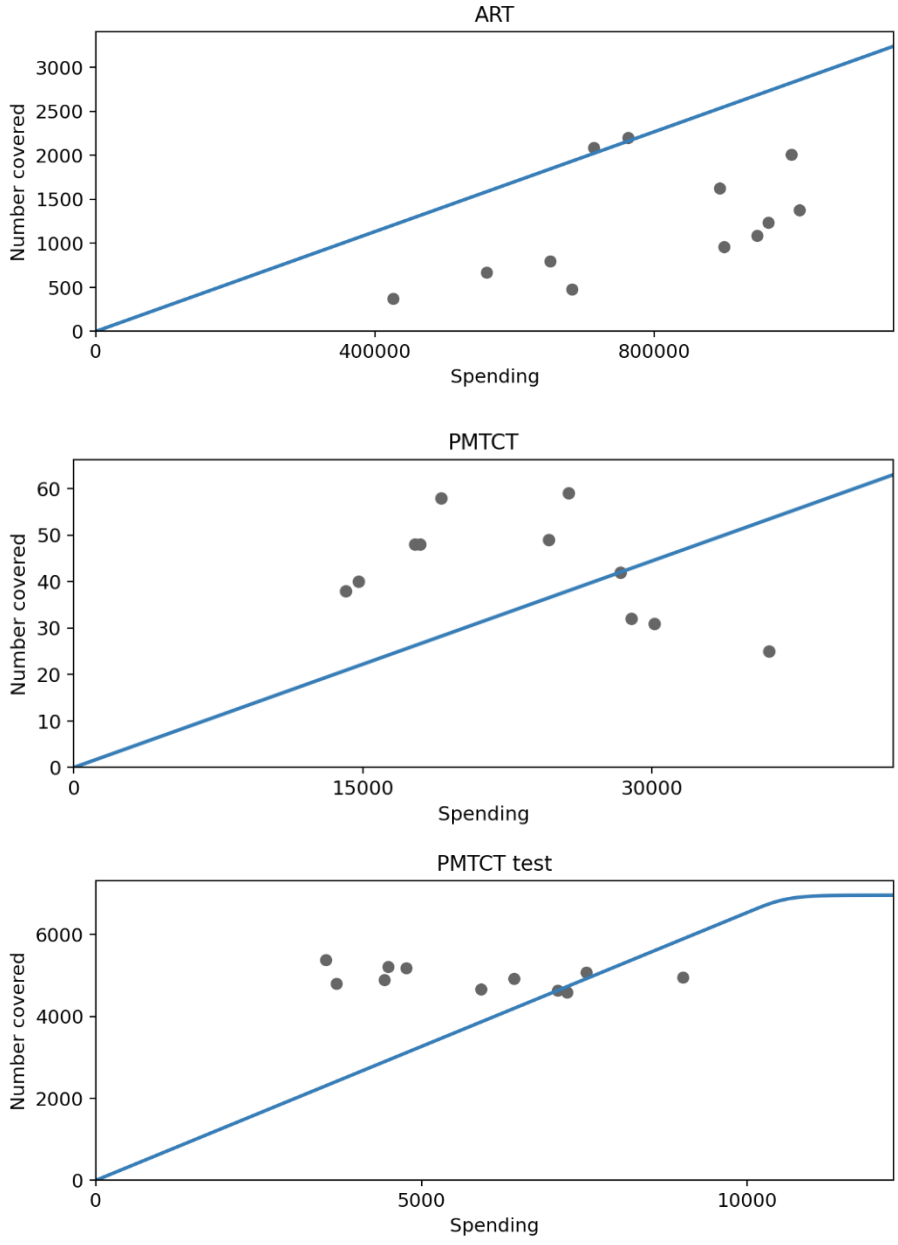
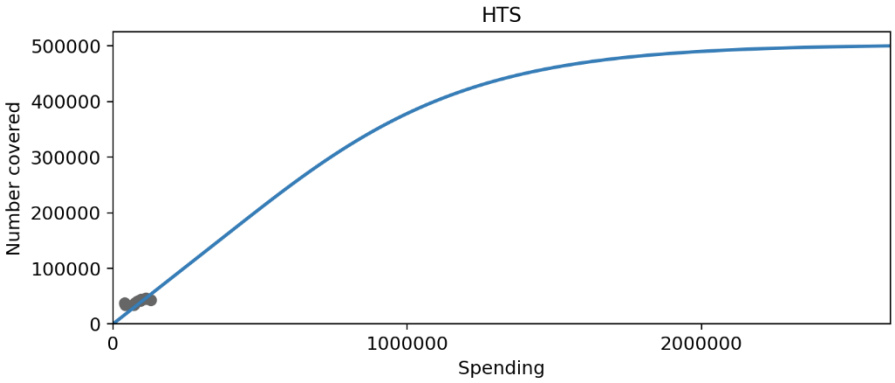
Spending

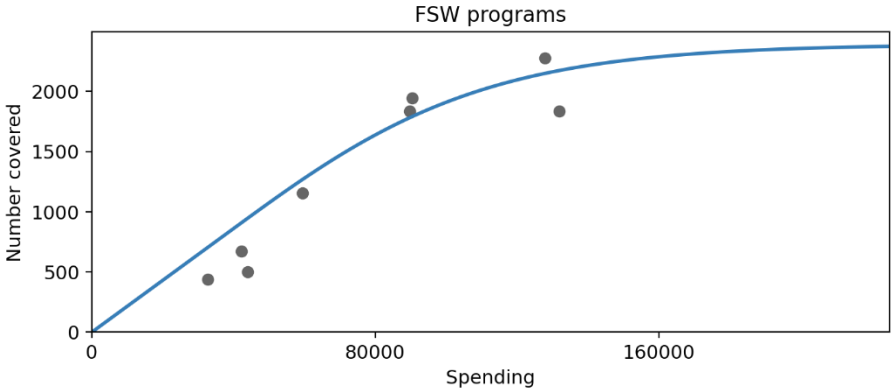
Figure A2b. Left Bank: Cost functions. Figures show relationship between total spending and number covered among targeting population of each program.

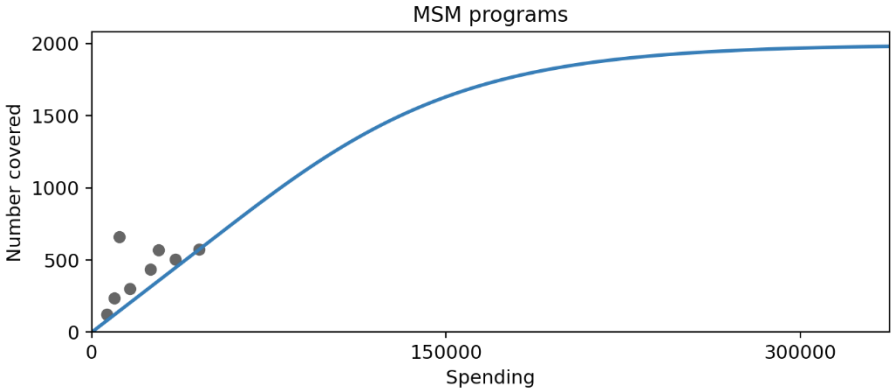


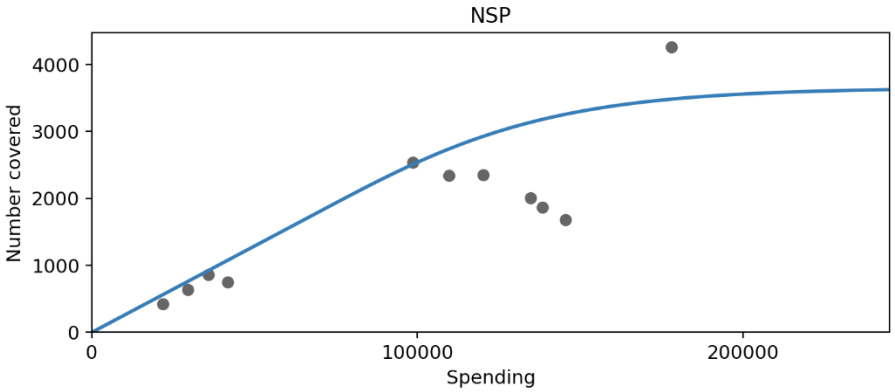
MOLDOVA

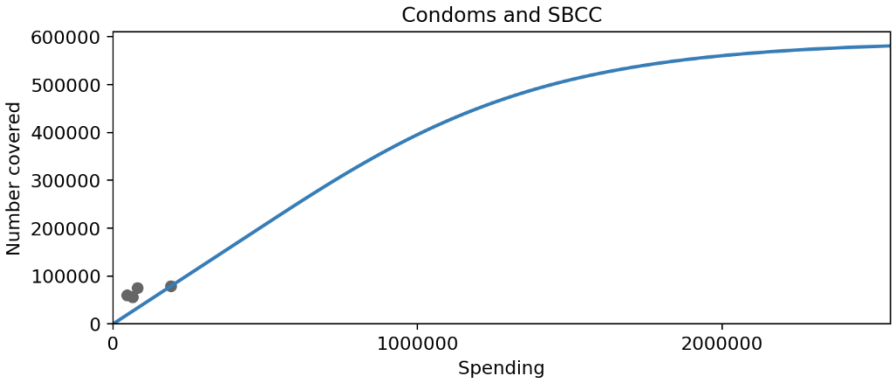
Allocation of HIV resources towards maximizing the impact of funding








NSP
Number covered
Spending
0
1000
2000
3000
4000
0
100000
200000


Condoms and SBCC
Number covered
Spending
0
100000
200000
300000
400000
500000
600000
0
1000000
2000000

Appendix 4. Annual HIV budget allocations at varying budgets

Table A5a. Right Bank: 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
ART	2,131,984	1,649,020	2,593,258	2,622,235	2,631,940	2,641,793
Condoms	331,001	-	-	165,501	165,501	165,501
FSW programs	271,448	-	-	135,724	135,724	348,370
HTS	462,756	357,926	462,756	462,756	462,756	865,237
MSM programs	291,306	-	-	463,158	835,166	1,108,676
NSP	771,645	-	-	385,823	1,203,282	1,502,544
OST	382,607	295,934	382,607	382,607	382,607	382,607
PMTCT	124,558	96,342	124,558	138,254	138,593	139,184
PMTCT test	31,140	-	35,655	42,388	42,489	43,754
Total targeted HIV program budget	4,798,445	2,399,222	3,598,833	4,798,445	5,998,056	7,197,667

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

Table A5b. Left Bank: 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
ART	762,040	528,534	789,742	841,891	846,235	861,413
Condoms	79,917	-	-	39,959	39,959	39,959
FSW programs	90,483	-	-	45,241	121,794	98,446
HTS	39,881	27,661	39,881	39,881	177,486	497,592
MSM programs	45,464	-	-	22,732	64,352	45,932
NSP	98,494	-	-	110,327	132,578	126,648
PMTCT	28,353	19,665	34,167	40,678	46,036	46,473
PMTCT test	7,088	-	-	11,012	11,210	11,117
Total targeted HIV program budget	1,151,720	575,860	863,790	1,151,720	1,439,650	1,727,580

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission; SBCC, social and behavior change communication.

Table A5c. Moldova totals (aggregating Right Bank and Left Bank): 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
ART	2,894,024	2,177,554	3,383,000	3,464,126	3,478,175	3,503,206
Condoms	410,918	-	-	205,459	205,459	205,459
FSW programs	361,930	-	-	180,965	257,517	446,816
HTS	502,637	385,587	502,637	502,637	640,242	1,362,829
MSM programs	336,770	-	-	485,890	899,518	1,154,609
NSP	870,140	-	-	496,149	1,335,860	1,629,192
OST	382,607	295,934	382,607	382,607	382,607	382,607
PMTCT	152,911	116,007	158,725	178,932	184,629	185,657
PMTCT test	38,228	-	35,655	53,400	53,699	54,871
Total targeted HIV program budget	5,950,164	2,975,082	4,462,623	5,950,164	7,437,706	8,925,247

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services; MSM, men who have sex with men; NSP, needle-syringe program; OST, opioid substitution therapy; PWID, people who inject drugs; PMTCT, prevention of mother to child transmission; SBCC, social and behavior change communication.

Table A6a. Right Bank: Latest reported budget of non-targeted HIV programs, 2021

	Latest reported budget (2021)
Enabling environment	$562,815
Human resources	*Not reported*
Infrastructure	$495,793
Monitoring and evaluation	$70,167
Management	$425,086
Other HIV care	$371,866
Other HIV costs	$738,469
Orphans and vulnerable children (OVC)	$264,656
Total non-targeted HIV program budget	$2,928,852

Table A6b. Left Bank: Latest reported budget of non-targeted HIV programs, 2021

	Latest reported budget (2021)
Enabling environment	$241,207
Human resources	*Not reported*
Infrastructure	$275,895
Monitoring and evaluation	$71,954
Management	$99,784
Other HIV care	*Not reported*
Other HIV costs	$6,035
Orphans and vulnerable children (OVC)	*Not reported*
Total non-targeted HIV program budget	$694,875

Table A6c. Moldova totals (aggregating Right Bank and Left Bank): Latest reported budget of non-targeted HIV programs, 2021

	Latest reported budget (2021)
Enabling environment	$804,022
Human resources	*Not reported*
Infrastructure	$771,688
Monitoring and evaluation	$142,121
Management	$524,870
Other HIV care	$371,866
Other HIV costs	$744,504
Orphans and vulnerable children (OVC)	$264,656
Total non-targeted HIV program budget	$3,623,727

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