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

KOSOVO

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THE GLOBAL FUND

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Optima HIV

UNAIDS

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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 Ministry of Health and National Institute of Public Health of Kosovo, the Global Fund, UNAIDS, Swiss Tropical and Public Health Institute and the Burnet Institute.

Summary and key recommendations for HIV resource optimization include:

- Kosovo has a maintained a small HIV epidemic with less than 150 cases of HIV registered to date (2). Estimated HIV prevalence is <0.005% among the general population and <1% among key populations (2, 3), but men who have sex with men are disproportionately affected by HIV (estimated prevalence 2.8% in 2018) (4).
- In 2021 an estimated €514,000 was spent on targeted HIV interventions, with testing and prevention programs for key populations accounting for 74% and antiretroviral therapy (ART) for 2% of this.
- In a baseline scenario where 2021 spending on programs was maintained, including a fixed annual spending on ART, it was estimated that there would be 51 new infections, 31 HIV-related deaths and 819 HIV-attributable disability-adjusted life years (DALYs) over 2023-2030.
- **The current HIV spending allocation is estimated to be close to optimized. Further optimization would explore opportunities to scale up ART coverage by improving linkage and retention to treatment, and strategic information about people who leave the county for treatment in other settings.** Reprioritization from other key population programs to programs targeting men who have sex with men needs to be balanced with equity concerns and other health benefits.
- Optimized reallocation of 2021 spending can advance epidemic gains without additional resources and was estimated to avert 40 new infections (77%), 25 deaths (80%) and 629 DALYs (77%) over 2023-2030 relative to a baseline of continued 2021 spending.
- **Maintaining current spending i s projected to be sufficient for maintaining the low-level epidemic. Additional investments in current HIV interventions are projected to have diminishing returns in terms of cost-effectiveness but could potentially be considered in the context of an HIV elimination plan.**
- Further analysis would explore opportunities to improve treatment retention to have a greater impact on the epidemic, and additional targeted HIV interventions such as partner notifications strategies for female partners of men who have sex with men.
- Moving from 67-60-81[1] care cascade modeled in 2021 to reach the 95-95-95 targets by 2030 will require progress particularly in increasing diagnoses and linking and retaining people on treatment. 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, and novel programs may be needed to better reach undiagnosed people living with HIV. Meeting the 95% treatment target may require improved strategic information to track treatment status among diagnosed people living with HIV who have emigrated from Kosovo as well novel programs to improve linkage to care and treatment adherence that are not costed in the analysis.

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

1 Background

Kosovo has maintained a low prevalence of HIV, with an estimated prevalence of <0.005% among the general population and <1% among key populations (2, 3). Since 1986 to 2021 there have been 140 HIV cases registered in Kosovo, and the country has maintained one of the smallest HIV epidemics in the world (2). The epidemic is concentrated among men who have sex with men (MSM), and the last integrated biological behavioral survey (IBBS) in 2018 estimated HIV prevalence of 2.8% among MSM (4). However, there are uncertainties in the prevalence among MSM due to small sample size, unwillingness to participate in surveys, and emigration or immigration rates among people living with HIV. During recent years, the HIV epidemiological situation in Kosovo has remained stable, with an average of six cases per year between 2019 and 2021 (2). However, in 2022 this increased to 15 HIV cases reported as of 30 September 2022 (5). Updated IBBS estimates are an opportunity to follow-up the prevalence among HIV groups who may be at higher risk of HIV acquisition. Due to the highly stigmatized society attitudes towards people living with HIV and the ease of registering for provision of antiretroviral in neighboring countries, report that a high proportion of people living with HIV are not accounted in the Kosovo surveillance system (6).

The HIV response in Kosovo is primarily funded by the Global Fund and the Government of Kosovo. A new HIV/AIDS National Strategic Action Plan 2022-2024 was approved in November 2022 which will guide the national HIV response. The goals of this plan are to maintain HIV prevalence below 0.1% among the general population and below 1% for key populations, as well as to improve the quality of life for people affected by AIDS in the country. The 2022-2024 Action Plan also prioritizes HIV testing to accelerate progress in the 95% diagnosis target and serve as an entry point for antiretroviral therapy and pre-exposure prophylaxis (PrEP). Strategies include mobile testing and the introduction of HIV self-testing. The Government of Kosovo is committed to ending the spread of HIV and to achieving the UNAIDS 95-95-95 targets.

The Permanent Secretary of the Ministry of Health recently established a working group to draft the clinical protocol for pre-exposure prophylaxis (PrEP), with plans to implement a one-year pilot PrEP program. The protocol will be revised based on the findings from the pilot to inform ongoing PrEP implementation among MSM and other key populations. The purchase of PrEP from 2022 to 2024 will be covered by the Global Fund and subsequently transition to the Ministry of Health.

This is the second Optima HIV analysis for Kosovo after analysis in 2019 with support from the World Bank, UNAIDS, the Global Fund and other partners. The analysis is 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 Ministry of Health and National Institute of Public Health of Kosovo. Epidemiological and program data were provided by the country team and validated during a regional workshop that was held in September 2022 in Istanbul, Turkey. Country teams were consulted before and after the workshop on data collation and validation, objective and scenario building, and results validation. Demographic, epidemiological, behavioral, programmatic, and expenditure data from various sources including UNAIDS Global AIDS Monitoring and National AIDS Spending Assessment reports, IBBS surveys, national reports and systems were collated. In Kosovo, baseline spending was derived from the 2021 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, with a total of Euro €514,000. 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 (7).

3.1 Populations and HIV programs

Populations and HIV programs considered in this analysis were:

- Key populations
  - Female sex workers (FSW)
  - Clients of sex workers (Clients)

    - Men who have sex with men (MSM)
    - People who inject drugs, male (PWID)
- 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)
    - Opioid substitution therapy (OST)
    - HIV testing services for the general population (HTS)
    - Social and behavioral change communication (SBCC) and condoms
    - HIV testing and prevention programs for female sex workers (FSW programs)
    - HIV testing and prevention programs for men who have sex with men (MSM programs)
    - HIV testing and prevention programs for people who inject drugs, including needle-syringe programs (PWID & NSP)

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 aimed to minimize new HIV infections and HIV-related deaths by 2030 for a given budget, with a weighting of 1 to 5 for infections to deaths. Objective 3 weightings were to reach 95% diagnosis by 2030 with the minimal possible total spending. As no defined HIV programs target treatment retention or viral suppression, Objective 3 optimization of defined programs assumed that the proportion of diagnosed people in care would reach 95% and the proportion of people on treatment with viral suppression would reach 95%.

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. Kosovo has a latest reported spending of €514,000 in 2021 for the targeted HIV programs above, incorporating both domestic and international sources. The majority (74%) of targeted spending was for prevention programs for key populations, followed by OST (14%) and SBCC & condoms (9%) (Figure 2; Table A5).

Resource needs to maintain 2021 ART coverage. In 2021, estimated ART coverage among diagnosed people living with HIV was <100. If ART unit costs (€219 in 2021) and current coverage of other HIV programs remained constant, annual ART spending would need to increase by €2,300 (26% of 2021 ART spending) from 2021 to 2030 to maintain a constant proportion of diagnosed people living with HIV on treatment given current epidemic trends, including current coverage of other HIV programs. Maintaining the "status quo" proportion of diagnosed people living with HIV on treatment will require additional future investment in HIV (Figure 1a), further reductions in ART unit costs, or reallocation of resources from other HIV programs.

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

Comprehensive strategic information was not available to define the combination of factors leading to people not being retained in care and 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 Kosovo, 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).

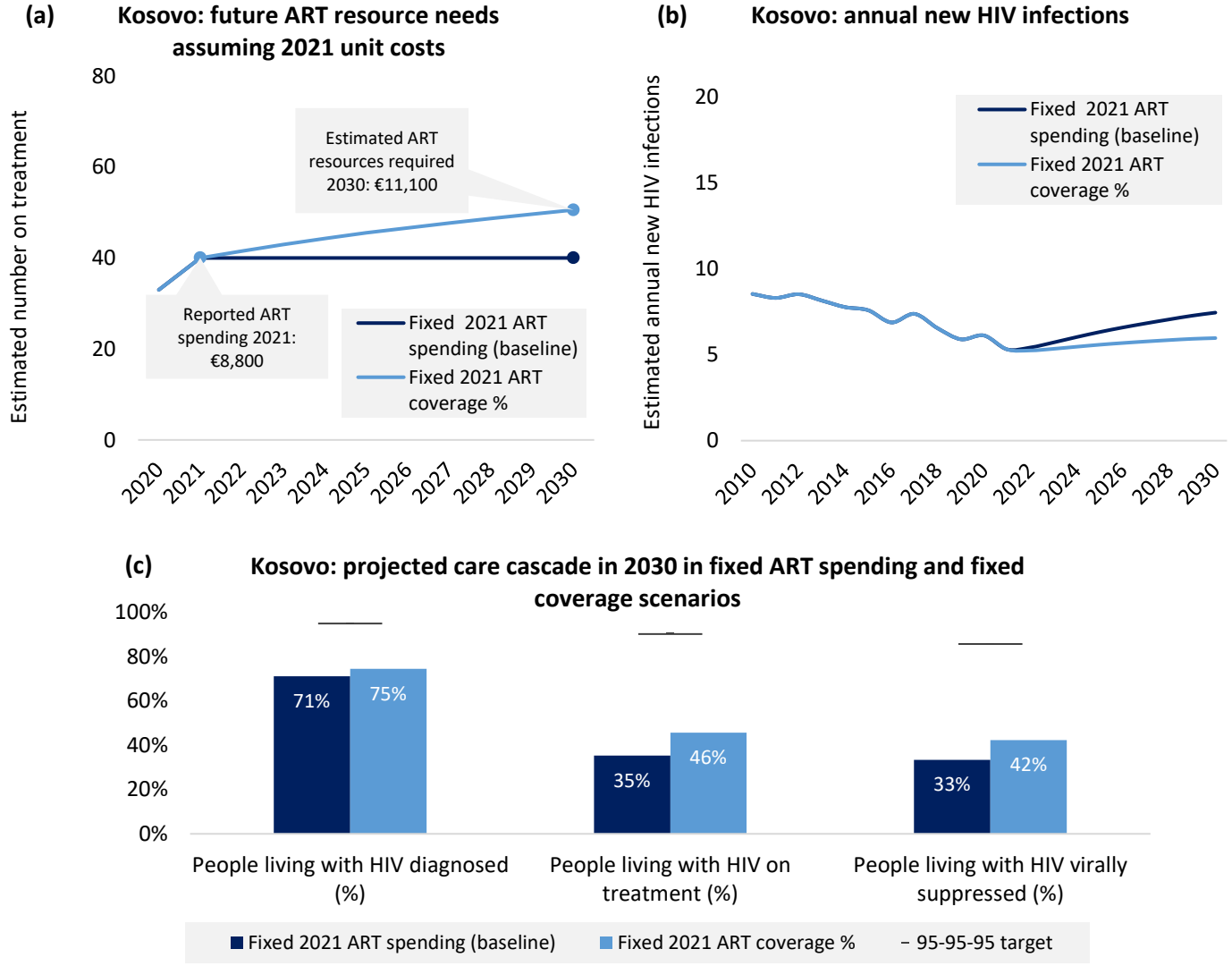

Figure 1. Fixed proportional coverage of people living with HIV on ART compared to fixed ART spending: resource needs and epidemic outcomes by 2030. Panels show (a) Resources required to maintain 2021 proportional coverage of ART among people living with HIV until 2030 if ART unit cost remains constant; (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 spending on programs with fixed allocations, the model projects that there would be 51 new infections, 31 HIV-related deaths

and 819 HIV-attributable DALYs over 2023-2030 (Table 1). Without additional spending on ART, the HIV care cascade was projected to be "71-50-95" in the year 2030 (i.e. 71% of people diagnosed, 50% of diagnosed people on treatment and 95% of people on treatment virally suppressed) (Figure 1c). The relatively 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 reallocation of 2021 spending. The current HIV spending allocation is estimated to be close to optimized, with testing and prevention programs for key populations remaining the main priority. Optimization of 2021 spending identified that additional impact may be possible by reallocating some funds from the SBCC and condoms program and programs for FSW and PWID to enable scale-up of ART for all populations and prevention and testing programs for MSM. Programs for FSW, PWID, and SBCC & condoms were deprioritized in the optimization not because they are not effective or important, but because with limited funding ART and MSM programs were more cost-effective. MSM have the highest burden of HIV relative to other key populations in Kosovo, and ART is cost-effective in reducing mortality and new infections through treatment-as-prevention. However, the prioritized scale-up of ART assumes that it is possible with more investment to increase the number of people starting and retained on ART. In the model, only 60% of people diagnosed with HIV were on treatment in 2021, even though based on program data all people diagnosed with HIV who were under surveillance were on treatment. In practice, there are unique challenges for Kosovo to increase treatment coverage given stigmatization of people living with HIV and high levels of emigration among people who are diagnosed but have left the country to seek treatment in neighboring countries.

Strengthened communication, data and information sharing between Kosovo other countries, especially neighboring countries, would improve the surveillance system to effectively follow-up all people living with HIV who are lost from surveillance due to migration. In addition, effective procurement of ART and cost negotiation may lead to reduced ART unit costs. This would enable not only increased coverage of ART at a lower cost, but reinvestment of savings into other HIV programs to achieve the impact of higher budget level optimizations without an increase in total spending.

Optimized resource allocation at different budget levels. As the total budget envelope increased, the priorities were identified as continued scale-up of prevention programs for MSM, followed by programs for FSW.

If funding were reduced, priorities were identified as maintaining MSM testing and prevention programs and as many people on treatment as possible.

Impact of optimization on HIV epidemic. Compared with the baseline scenario, optimized reallocation of 2021 spending could avert 39 new infections (76%), 25 deaths (80%) and 629 DALYs (77%) over 2023-2030 (Figure 2; Table 1). However, there are diminishing returns with higher investment, and increasing the budget from 100% to 150% may only produce an additional 1% decrease in new infections. At this level of spending, the main gap in the care

cascade is viral suppression rates. Additional approaches may be needed to improve viral load suppression, for example introducing a register and other tracking methods to ensure regular clinic appointments, timely viral load screening and client-centered adherence and retention support.

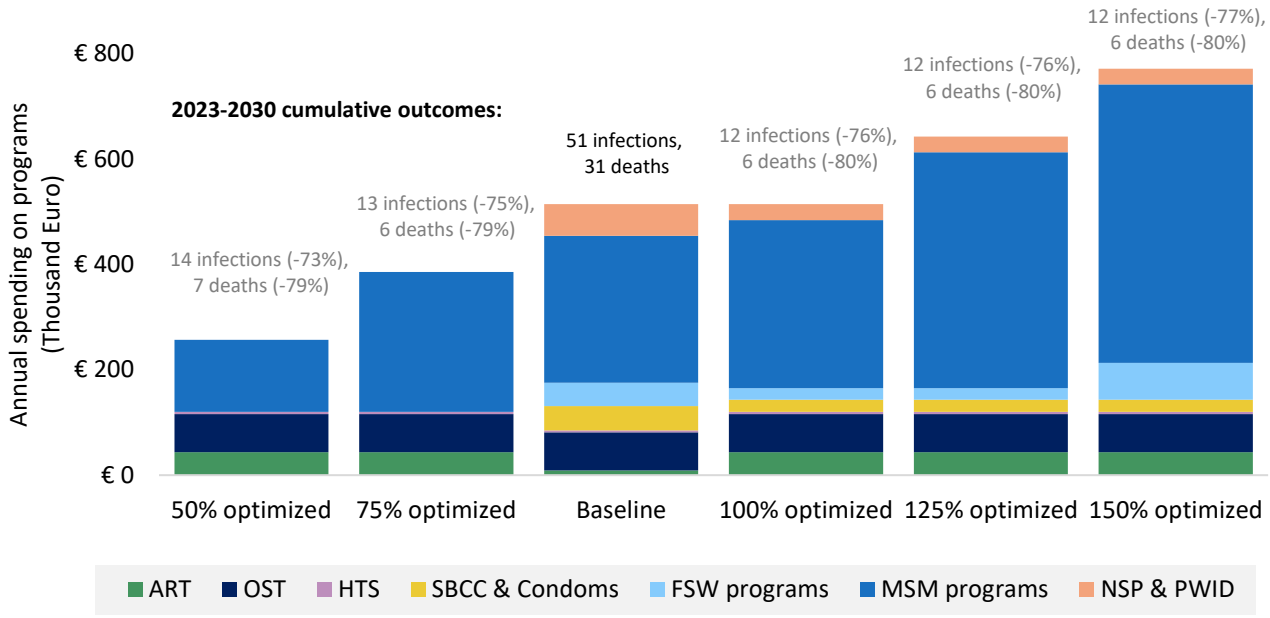

Figure 2. Optimized allocations under varying levels of annual HIV budgets for 2023 to 2030, to minimize new infections and HIV-related deaths by 2030. Percentage optimized refers to the percentage of baseline spending (i.e. 2021 spending). ART, antiretroviral therapy; HTS, HIV testing program targeting general population; FSW, female sex worker; MSM, men who have sex with men; NSP & PWID, programs for people who inject drugs, including needle-syringe programs; OST, opioid substitution therapy.

Increased impact was possible in the model even with 50% optimized spending compared to the baseline (Figure 3), since the reallocation of (reduced) funds was still able to increase treatment by 15%. This highlights the importance of increasing treatment coverage though whatever mechanisms are available.

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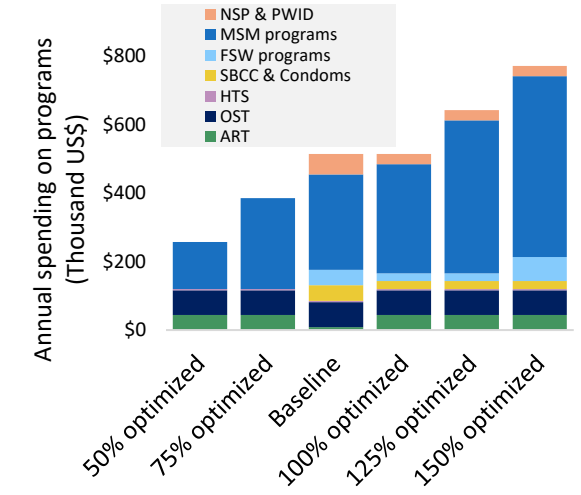
(a)



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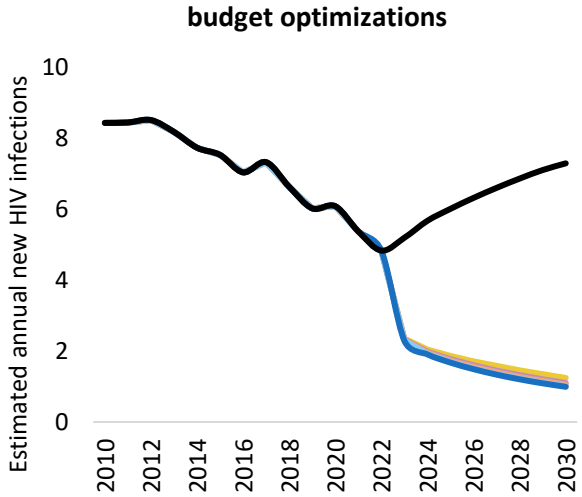
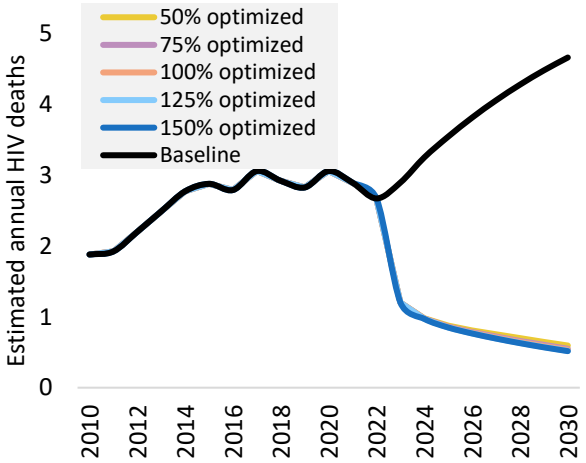
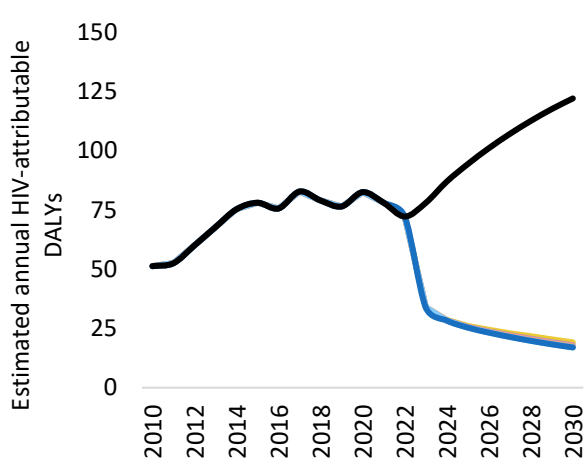


(c)



(d)



(e)

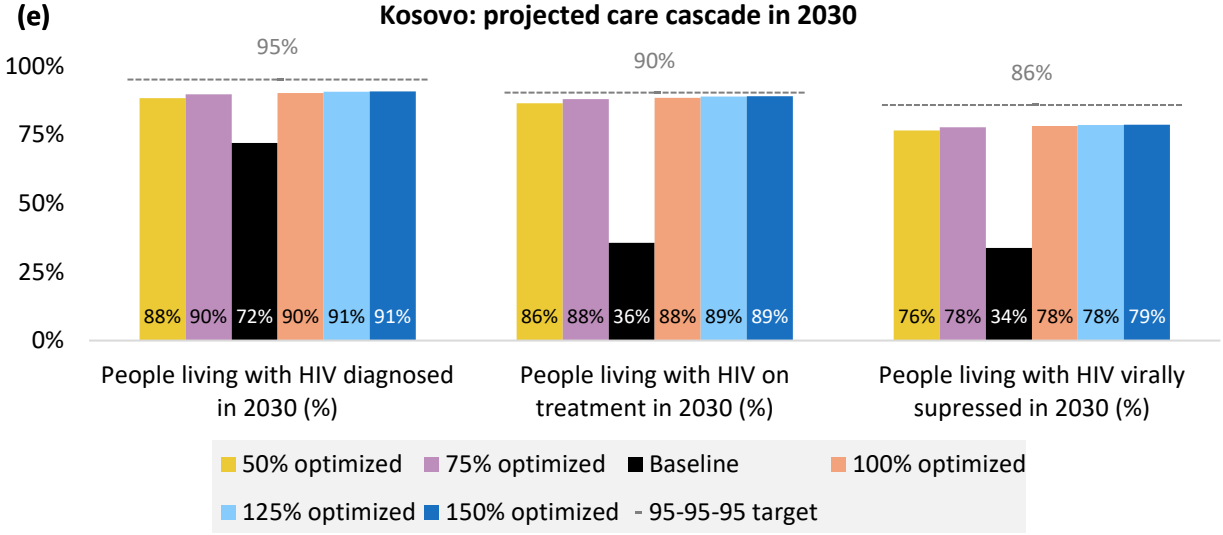


Figure 3. Model outcomes from budget optimization scenarios aiming to minimize infections and deaths. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years (DALYs); and (e) projected care cascade for the year 2030 among all people living with HIV. ART, antiretroviral therapy; HTS, HIV testing program targeting general population; FSW, female sex worker; MSM, men who have sex with men; NSP & PWID, programs for people who inject drugs, including needle-syringe programs; OST, opioid substitution therapy.

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 the epidemic expanding in Kosovo. In a scenario with no HIV spending from 2023, the model estimates that there would be 90 (+77%) more new infections, 48 (+55%) more deaths and 1,261 (+54%) more DALYs over 2023-2030 compared to the baseline scenario of fixed annual spending on programs (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.

	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	90	48	1,261	77%	55%	54%
50% optimized	14	7	197	-73%	-79%	-76%
75% optimized	13	6	191	-75%	-79%	-77%
Baseline	51	31	819			
100% optimized	12	6	190	-76%	-80%	-77%
125% optimized	12	6	188	-76%	-80%	-77%
150% optimized	12	6	187	-77%	-80%	-77%
95-95-95*	11	6	192	-78%	-79%	-77%

*Optimization was only able to reach 91% of people diagnosed with HIV; 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, Kosovo's care cascade is not projected to reach the 95-95-95 targets by 2030 (equivalent to 95-90-86 of all people living with HIV) (Figure 3e).

Increasing resources by an additional €1.0M per annum, or a total 300% of targeted HIV spending, will only increase diagnosis of people living with HIV to 91% by 2030. Model projections based on the reported partnerships between MSM and F15-49 in the 2018 IBBS survey suggest that women living with HIV are less likely than MSM to know their status (4), and female partners of MSM are currently not reached by programs. There may be opportunities to explore additional partner notification strategies as part of a targeted testing strategy to reach diagnosis targets more cost-efficiently. The prevalence and incidence of HIV among PWID and FSW are currently extremely low (estimated to be less than one per year), and HIV testing rates were lower among these groups relative to MSM in 2021. Scaling-up of these programs may yield minimal gains in terms of projected new infections, deaths and DALYs averted, but continued or enhanced HIV surveillance is necessary to maintain low prevalence and incidence, as any new infections that remain undiagnosed could rapidly change the epidemic.

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 Kosovo to improve linkage to care, treatment adherence and retention to achieve 95% treatment coverage and 95% viral suppression. Improved communication between Kosovo and other countries, especially neighboring countries, would strengthen strategic information to efficiently track all people living with HIV who are lost from surveillance due to migration.

Achieving the "91-95-95" in this optimized scenario could avert 40 new infections (78%), 25 deaths (79%) and 627 DALYs (77%) 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).

These findings reinforce those of the previous sections that additional investments in current key population programs are projected to have diminishing returns in terms of cost-effectiveness and epidemiological impact, but could be considered in the context of an HIV elimination plan. With the described scenario prioritizing cascade targets, annual new infections may be reduced to one in coming years, making HIV elimination a feasible target given the uncertainty inherent in the modeling results. Achieving care cascade and elimination targets will be more costly, but the cost-efficiency may be improved by exploring additional opportunities to improve linkage and retention to treatment, strengthen treatment monitoring, and improve accessibility and uptake of HIV testing among key populations.

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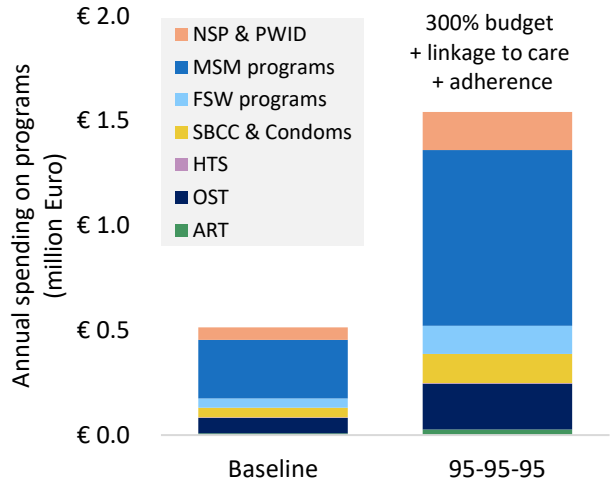
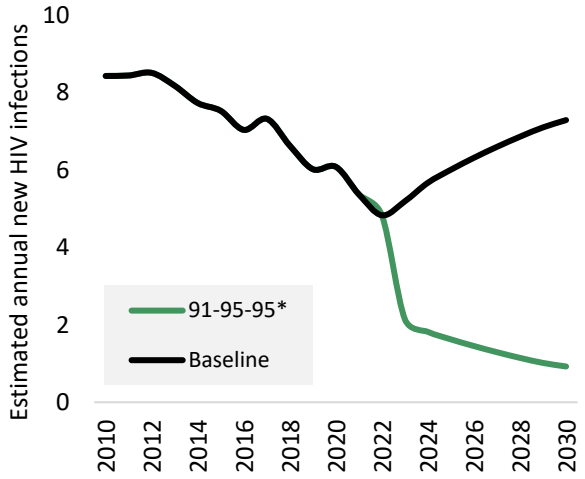
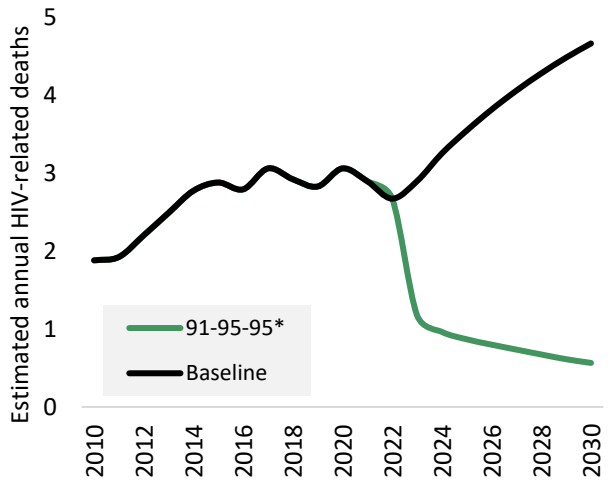
(a) **Kosovo: optimized budget to reach 95-95-95 targets**



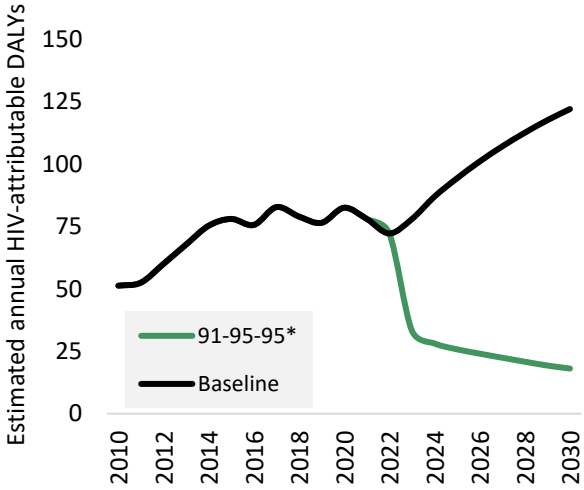
(b) **Kosovo: annual new HIV infections in 95-95-95 scenario**



(c) **Kosovo: annual HIV deaths in 95-95-95 scenario**



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



(e) **Kosovo: projected care cascade**

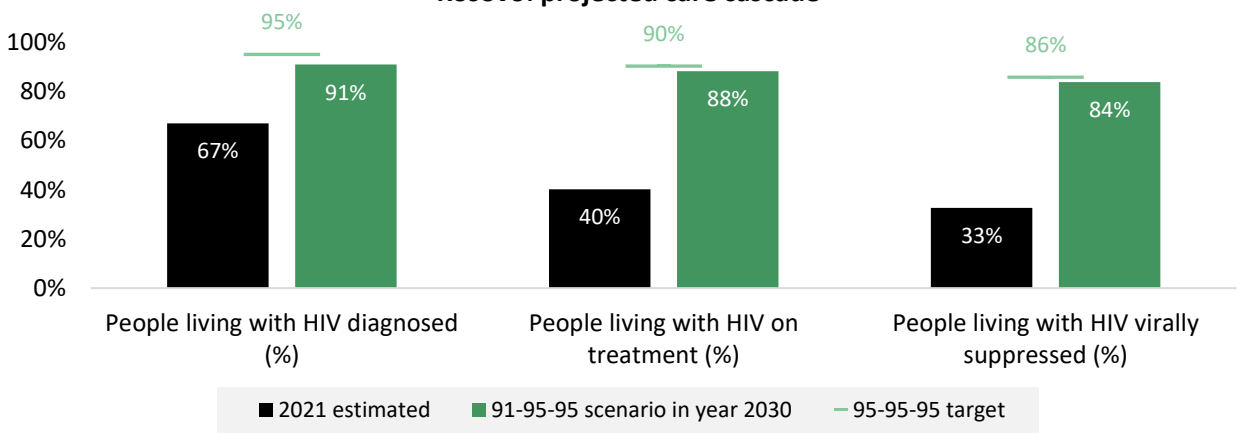


Figure 4. Optimized HIV budget level and allocation to achieve 95-95-95 targets by 2030. Panels show (a) optimal budget allocations; (b) estimated annual new HIV infections; (c) HIV-related deaths; (d) HIV-related disability-adjusted life years; and (e) estimated care cascade in baseline year 2021 and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

5 Comparison with past spending

In Kosovo spending on targeted HIV programs has increased over time, from €316,000 in 2018 to €514,000 in 2021. The key recommendations for optimizing spending were consistent between the 2019 and 2022 analysis, recommending scale-up of MSM programs and ART. The absolute spending on prevention and testing programs for MSM nearly quadrupled between 2018 and 2021, while coverage increased more than four-fold. ART coverage increased from 32 people on treatment in 2018 to 40 in 2021 despite a reduction in overall spending on ART. This was possible due to a substantial decrease in the unit cost of ART, from €1000 to €219 per person per year. These changes would likely have improved the cost-effectiveness and impact of investment.

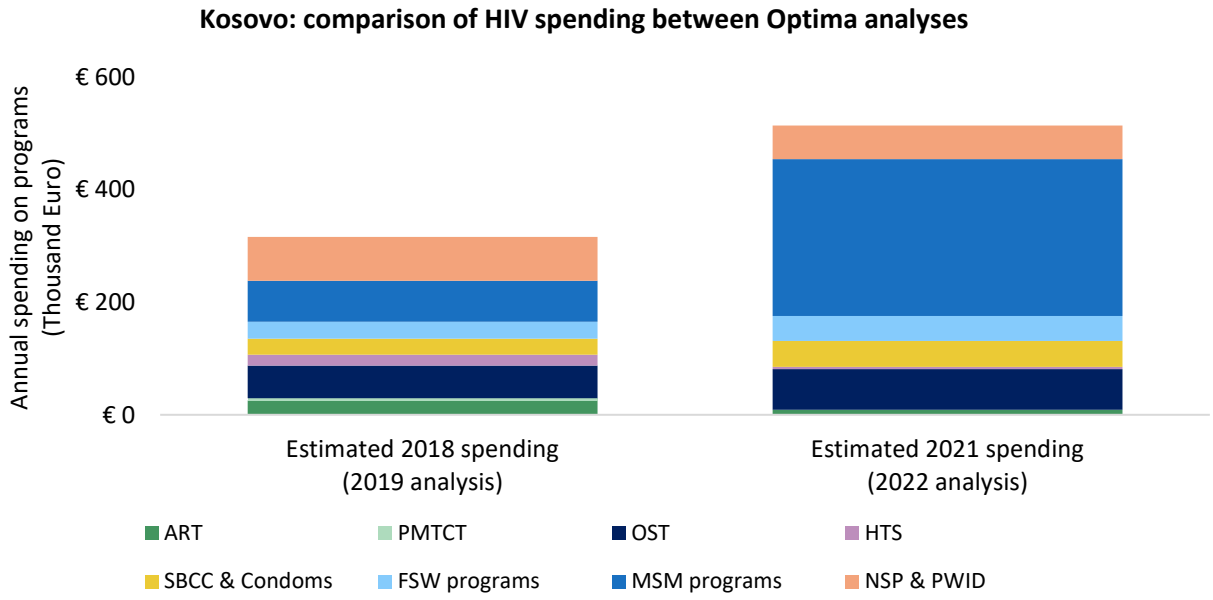


Figure 5. Estimated budget allocations from 2019 and 2022 Optima analyses. ART, antiretroviral therapy; HTS, HIV testing program targeting general population; FSW, female sex worker; MSM, men who have sex with men; NSP & PWID, programs for people who inject drugs, including needle-syringe programs; OST, opioid substitution therapy; PMTCT, prevention of mother-to-child transmission. Current analysis did not include PMTCT as there was no diagnosed HIV in pregnant women.

6 Study limitations

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

- **Population sizes:** There is uncertainty in population size estimates; for key populations stigma may lead to underestimation of population size, and for total populations there is instability in migration patterns due to the war in Ukraine. This may influence estimates of people living with HIV and subsequently, service and funding needs for each key population.
- **Epidemiological indicators** come from population surveys or programmatic data that have varying degrees and types of biases. Uncertainty in these indicators combined with uncertainty in population sizes can lead to uncertainty in model calibration and projected baseline outcomes and subsequently, service and funding needs for each key population.
- **Effect (i.e. impact) sizes for interventions** are taken from global literature (e.g. the effectiveness of condom use for preventing infections). Actual program impacts may vary depending on context or quality of implementation.
- **Geographical heterogeneity** is not modeled, and outcomes represent national averages. There may be opportunities for additional efficiency gains through appropriate geographical targeting.
- **Cost functions for each program** are a key driver of model optimizations. Cost functions determine how program coverage will change if funding is reallocated, as well as maximum achievable program coverage. There is uncertainty in the shapes of these cost functions, values which could influence how easily or how high programs could be scaled up.
- **Currency:** The COVID-19 pandemic, war in Ukraine and global economic crises have led to instability in currencies over the past few years.
- **Retention in care:** This analysis did now 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.

- **Epidemic size:** with a small population size and an epidemic that has been controlled to a very low number of infections every year, prevalence is highly susceptible to small numbers of people migrating, or annual variations in the number of new infections. As Optima HIV is a deterministic model, one new infection may be projected with improved diagnosis and treatment coverage, but just a small number of additional new infections in one year following a change in behavior for a small number of people could be enough to change the trajectory of the epidemic. Continued surveillance is critical despite the projected diminishing returns of cost-effectiveness, and future analyses could explore more uncertainty with different migration or risk scenarios.

7 Conclusions

The Government of Kosovo has implemented an effective HIV response to maintain a very low HIV epidemic. This modeling analysis evaluated the allocative efficiency of direct HIV programs in Kosovo, finding that an optimized resource allocation can have an impact on further reducing infections and deaths to approach HIV elimination. Program priorities were identified as increased treatment coverage where possible and scale-up of HIV prevention programs for MSM. Addressing non-financial barriers that limit treatment scale-up in combination with continuing the current prioritization of HIV prevention spending could achieve significant reductions in new infections, deaths and DALYs. In addition to these recommendations, continued surveillance and flexible planning will be required to enable rapid responses to any epidemiological changes, emerging risks or novel interventions that meet the specific needs of Kosovo in order to maintain the low-level epidemic and address any new infections that emerge in the years to come.

Acknowledgements

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

Country team: Besfort Kryeziu, Luljeta Gashi, *National Institute of Public Health of Kosovo*; Merita Vuthaj, Pashk Buzhala, Arsim Qavdarbasha, Bekim Fusha, *Ministry of Health of Kosovo*; Murat Mehmeti, *Infectious Disease Clinic*; Edona Deva, Flora Robelli, *Community Development Fund*; Arbër Nuhiu, *Center for Social Group Development Kosovo*

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

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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	0.08
	Untreated HIV, CD4 (>500)	0.01
	Untreated HIV, CD4 (350-500)	0.02
	Untreated HIV, CD4 (200-350)	0.07
	Untreated HIV, CD4 (50-200)	0.27
	Untreated HIV, CD4 (<50)	0.55
	Treated HIV	0.05

Source: Optima HIV User Guide Volume VI Parameter Data Sources

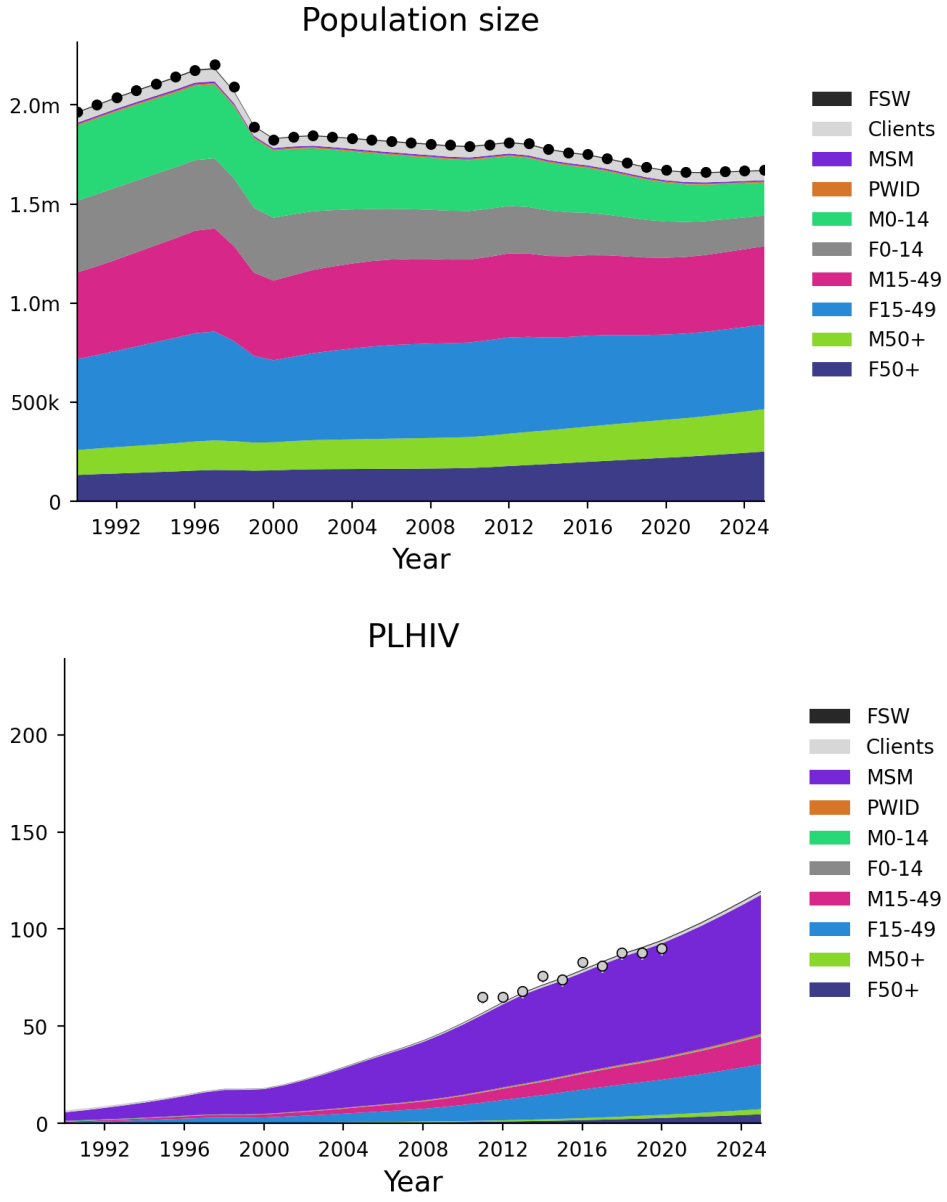
Table A2. Model parameters: treatment recovery and CD4 changes due to ART, and death rates

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

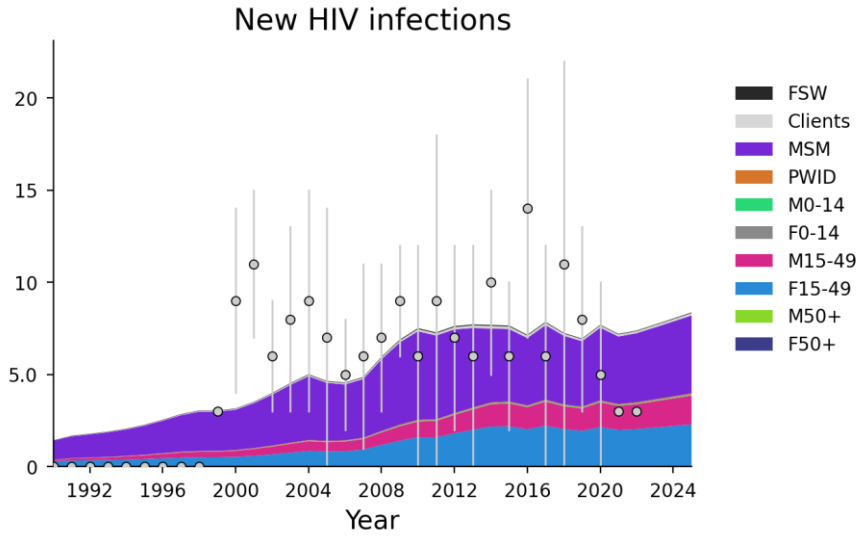
Appendix 2. Model calibration

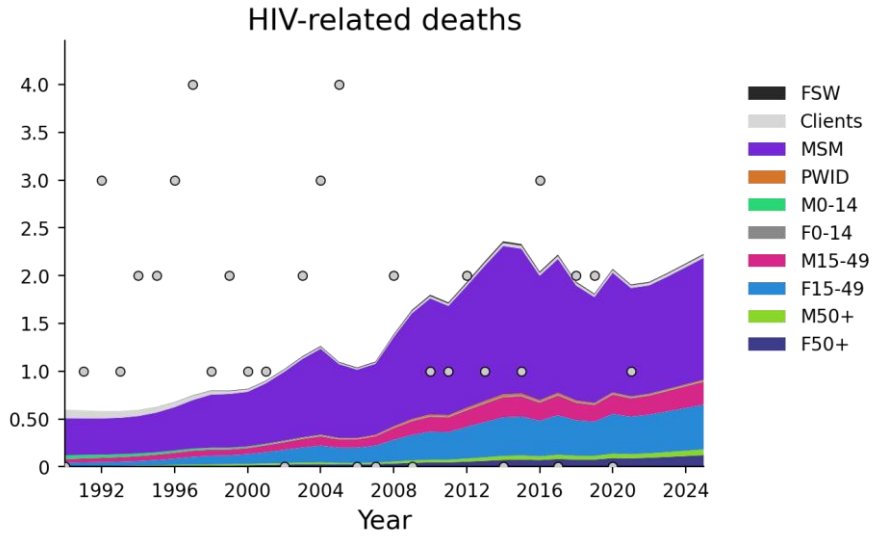
Figure A1. Calibration outputs. Dots represent official country estimates based on World Population Prospects, Spectrum model, surveillance surveys, program data and UNAIDS.

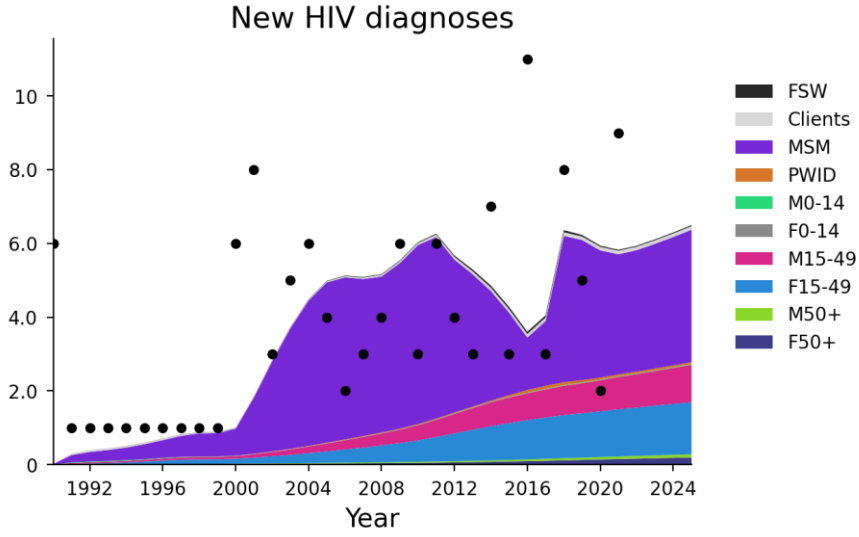


KOSOVO

Allocation of HIV resources towards maximizing the impact of funding







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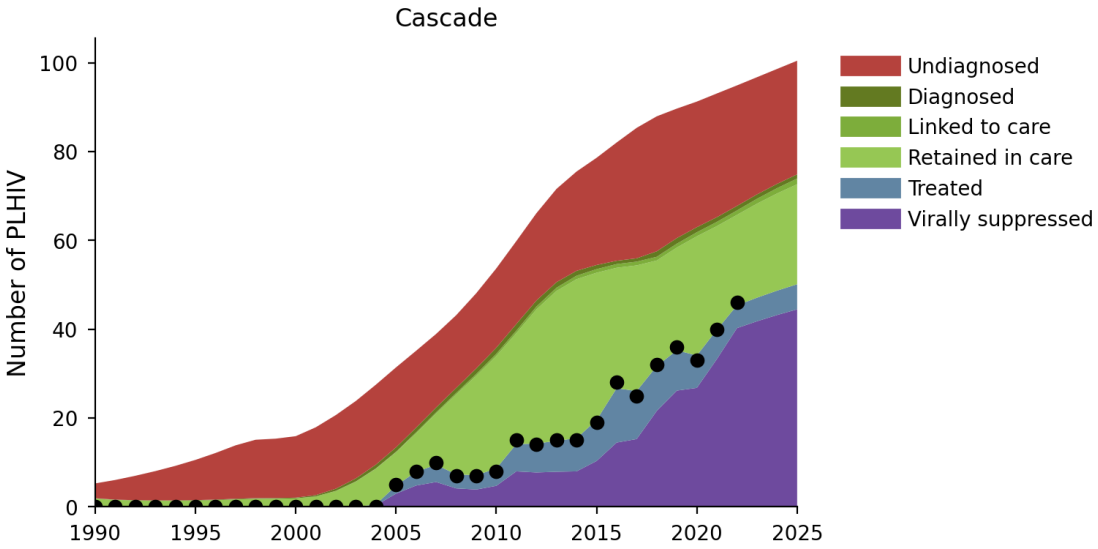
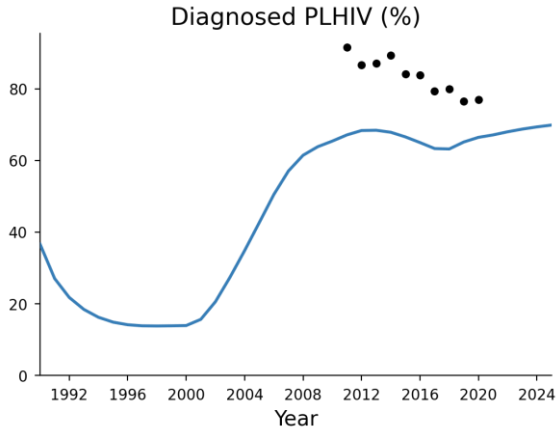
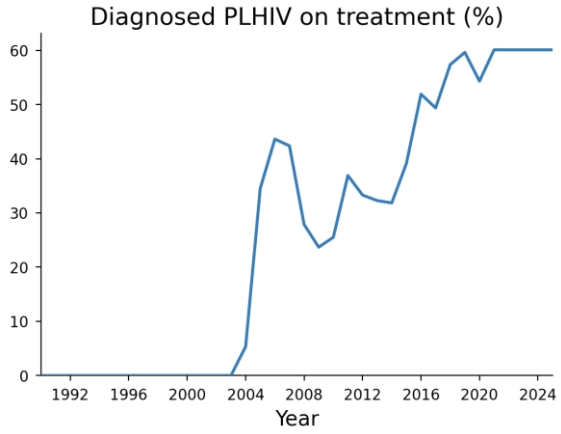
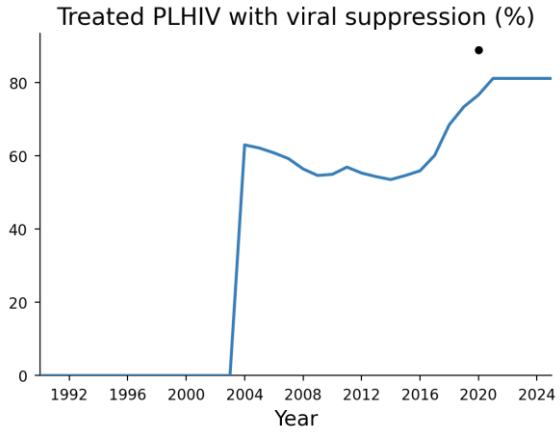
Allocation of HIV resources towards maximizing the impact of funding









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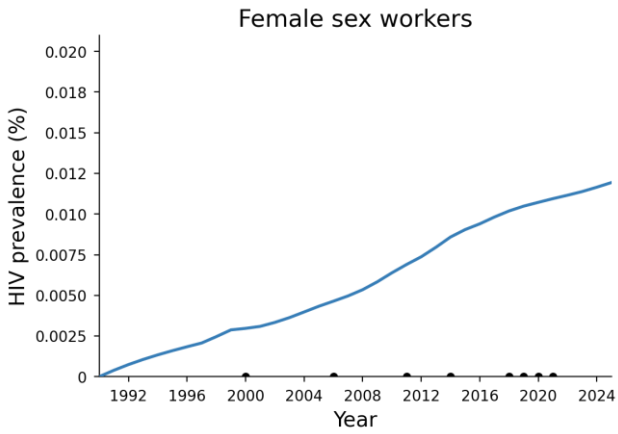
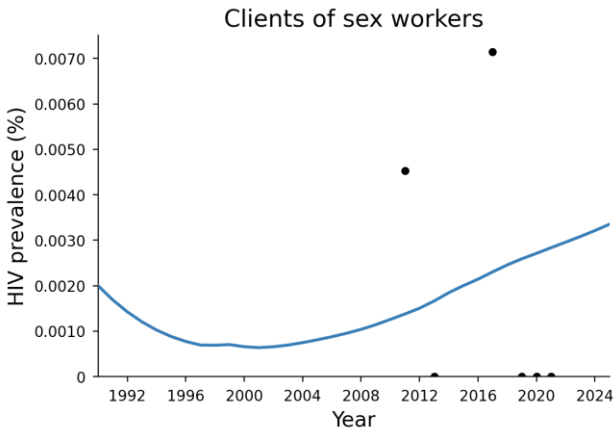
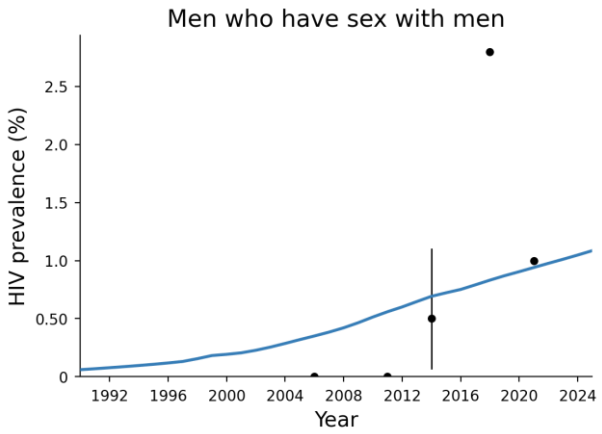
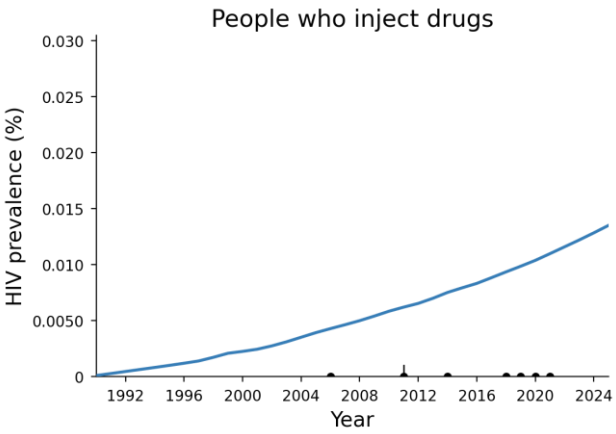
Allocation of HIV resources towards maximizing the impact of funding









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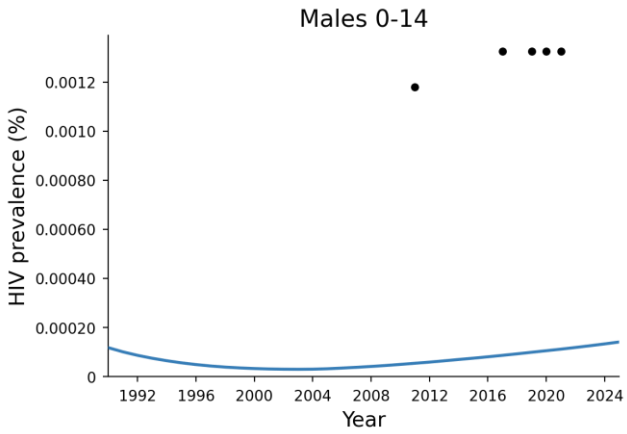
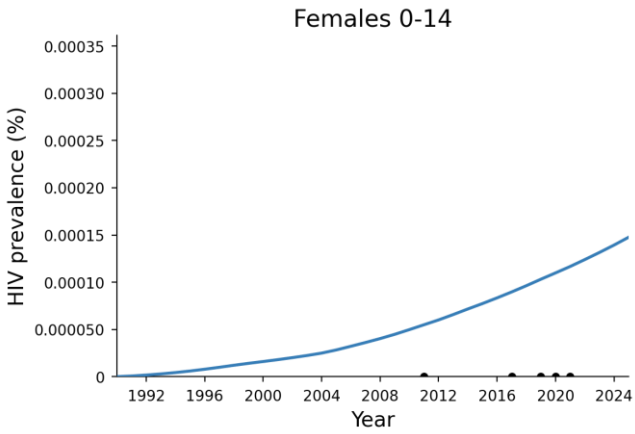
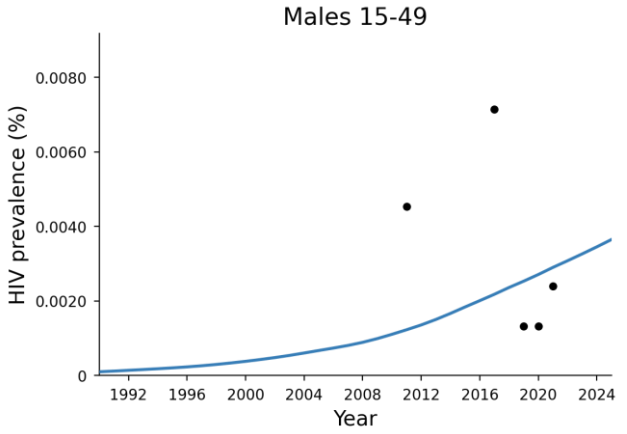
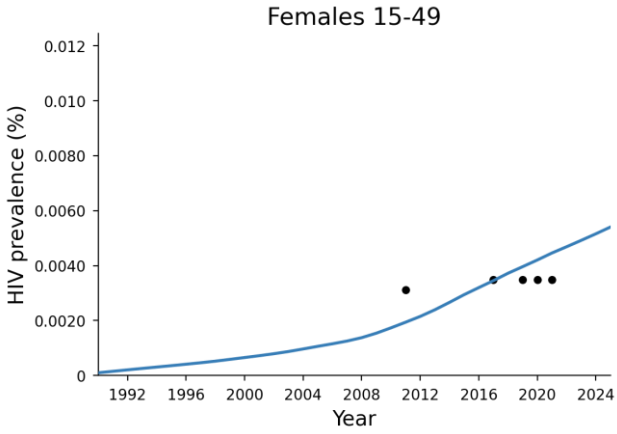
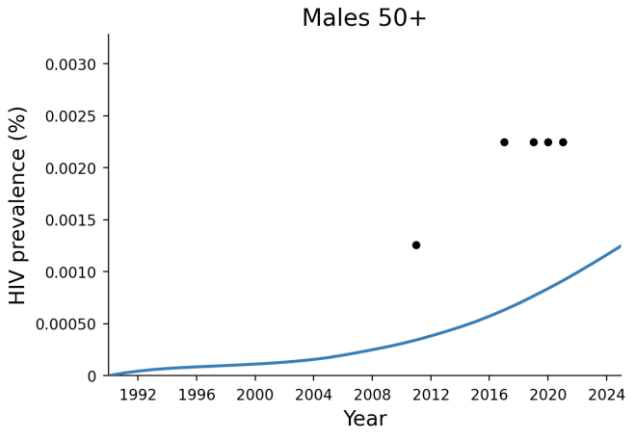
Allocation of HIV resources towards maximizing the impact of funding

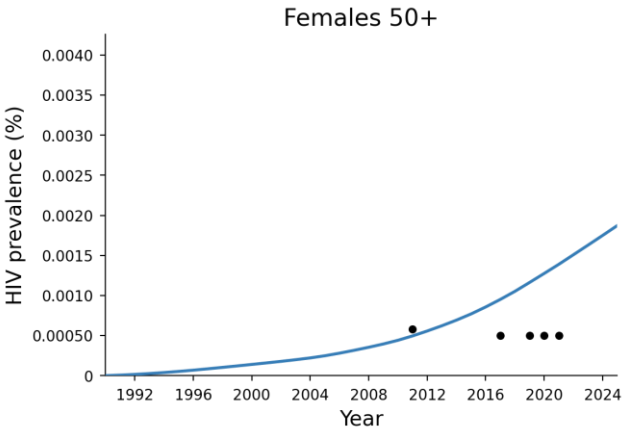












Appendix 3. HIV program costing and impacts

Table A3. HIV program unit costs and saturation values

HIV program	Unit cost (Euro)	Saturation (low)	Saturation (high)
Antiretroviral therapy	€219.20	97%	100%
HIV testing services (general population)	€1.20	70%	93%
Opioid substitution therapy	€256.35	0%	10%
Social and behavioral change communication and condoms	€0.50	30%	50%
FSW programs	€32.00	30%	50%
MSM programs	€33.00	60%	90%
PWID and NSP programs	€32.70	30%	50%

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

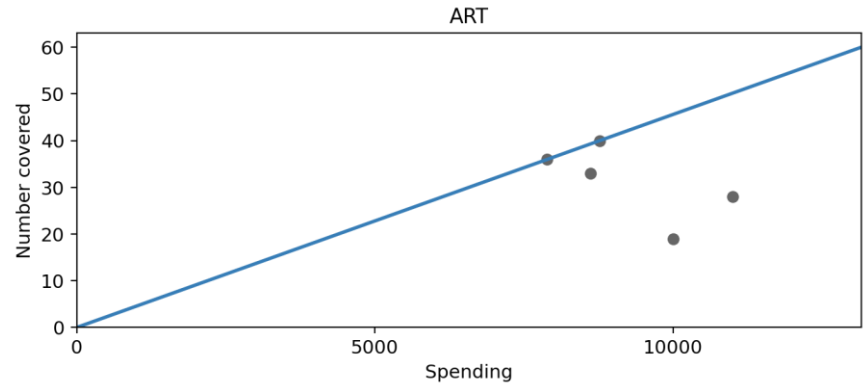
Table A4. Data inputs of impact of programs

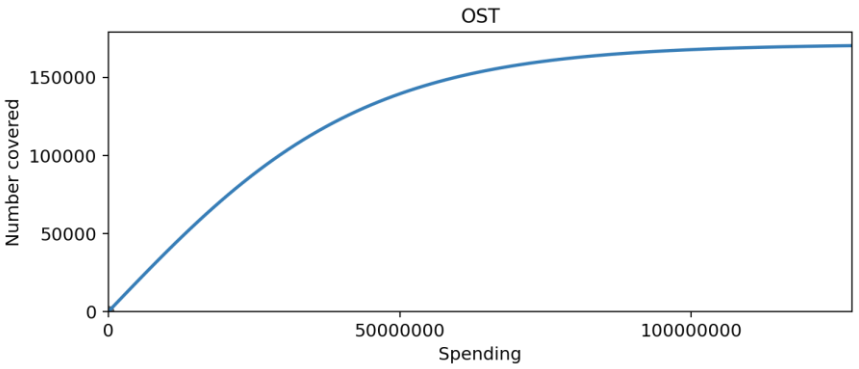
HIV program	Parameter	Population interactions or population	In absence of any programs		For each individual reached by this program	
			Low	High	Low	High
NSP & PWID	Condom use for casual acts	PWID, MSM	46%	50%	80%	80%
NSP & PWID	Condom use for casual acts	PWID, PWID	50%	60%	85%	85%
NSP & PWID	Condom use for casual acts	PWID, F15-49	41%	46%	70%	80%
MSM programs	Condom use for casual acts	MSM, MSM	21%	25%	80%	80%
MSM programs	Condom use for casual acts	MSM, F15-49	22%	23%	52%	56%
SBCC & Condoms	Condom use for casual acts	Clients, F15-49	47%	54%	78%	80%
SBCC & Condoms	Condom use for casual acts	M0-14, F0-14	71%	75%	80%	82%
SBCC & Condoms	Condom use for casual acts	M15-49, F15-49	48%	53%	86%	87%
SBCC & Condoms	Condom use for casual acts	M15-49, F50+	55%	60%	80%	90%

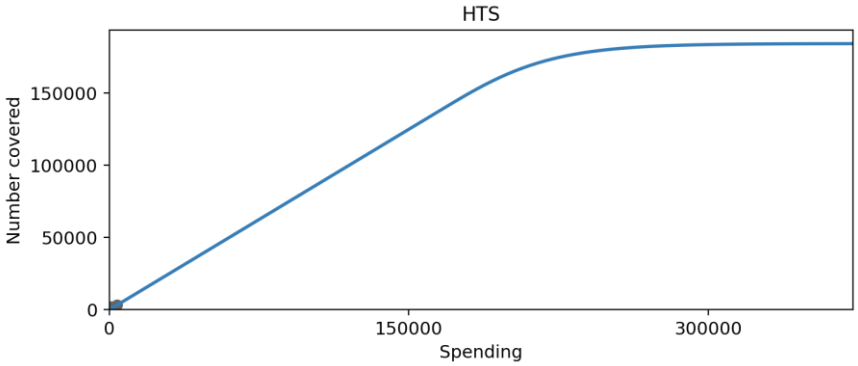
SBCC & Condoms	Condom use for casual acts	M50+, F15-49	30%	33%	75%	77%
SBCC & Condoms	Condom use for casual acts	M50+, F50+	35%	45%	35%	45%
FSW programs	Condom use for commercial acts	Clients, FSW	65%	75%	95%	98%
FSW programs	Condom use for commercial acts	PWID, FSW	50%	55%	85%	95%
HTS	HIV testing rate (average tests per year)	Clients	0.06	0.10	0.85	1.00
HTS	HIV testing rate (average tests per year)	M15-49	0.09	0.09	0.18	0.30
HTS	HIV testing rate (average tests per year)	F15-49	0.04	0.05	0.20	0.20
HTS	HIV testing rate (average tests per year)	M50+	0.00	0.00	0.01	0.01
HTS	HIV testing rate (average tests per year)	F50+	0.00	0.00	0.01	0.01
FSW programs	HIV testing rate (average tests per year)	FSW	0.05	0.05	0.28	0.31
MSM programs	HIV testing rate (average tests per year)	MSM	0.03	0.05	0.25	0.30
NSP & PWID	Probability of needle sharing (per injection)	FSW	1%	15%	0%	1%
NSP & PWID	Probability of needle sharing (per injection)	PWID	20%	20%	14%	18%
OST	Number of PWID on OST	Total	0	0	-	-
ART	Number of people on treatment	Total	0	0	-	-

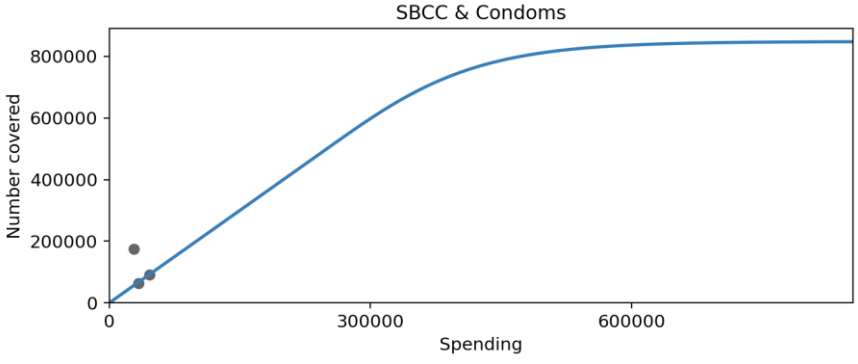
FSW, female sex worker; MSM, men who have sex with men; PWID & NSP, programs for people who inject drugs, including needle-syringe programs; OST, opioid substitution therapy; ART, antiretroviral.
- The number of people modeled as receiving ART and OST is equal to the coverage of the respective programs.

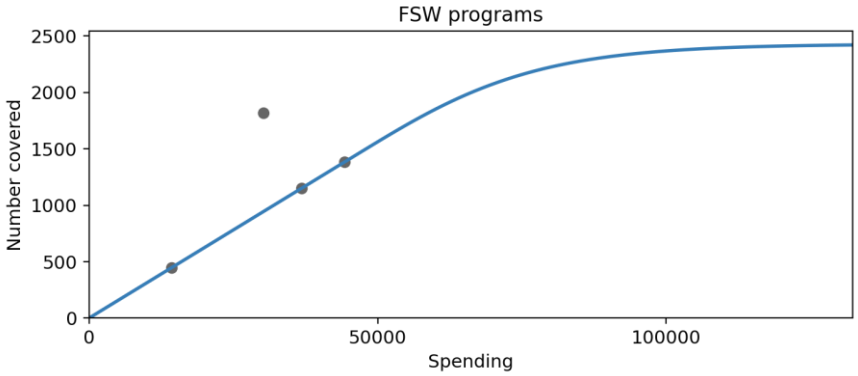
Figure A2. Cost functions. Figures show relationship between total spending and number covered among targeting population of each program.

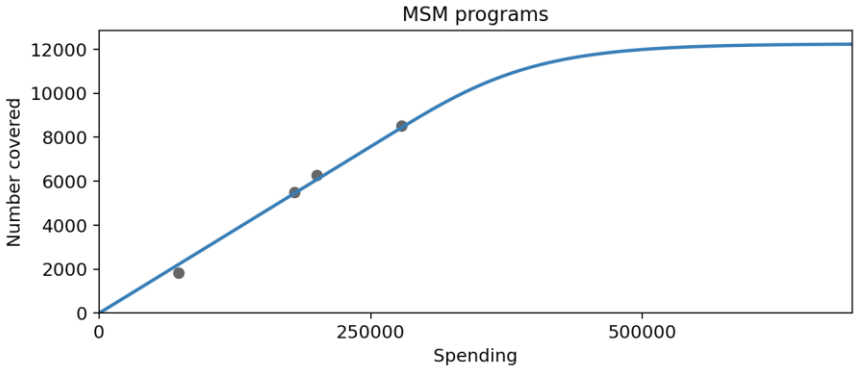


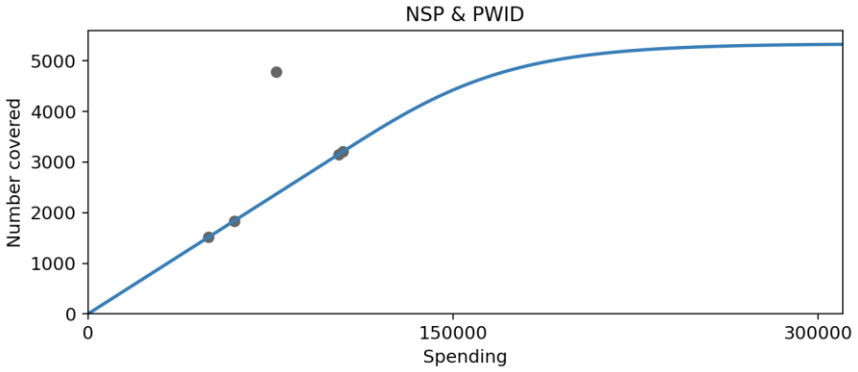







FSW programs
Number covered
2500
2000
1500
1000
500
0
0
50000
100000
Spending


MSM programs
Number covered
12000
10000
8000
6000
4000
2000
0
0
250000
500000
Spending


NSP & PWID
Number covered
5000
4000
3000
2000
1000
0
0
150000
300000
Spending

Appendix 4. Annual HIV budget allocations at varying budgets

Table A5. Annual HIV budget (Euro €) 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 (ART)	8,768	43,840	43,840	43,840	43,840	43,840
Opioid substitution therapy (OST)	72,291	72,292	72,291	72,291	72,291	72,391
HIV testing services (general population)	3,902	3,902	3,902	3,900	3,901	3,902
Social and behavioral change communication (SBCC) and condoms	46,168	-	-	23,084	23,084	23,091
HIV testing and prevention programs for FSW	44,288	-	-	22,144	22,144	69,946
HIV testing and prevention programs for MSM	278,571	136,996	265,510	318,762	447,276	527,953
HIV testing and prevention programs for PWID and NSP	60,070	-	-	30,035	30,035	30,035
Total targeted HIV program budget	514,058	257,029	385,544	514,058	642,573	771,087

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

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