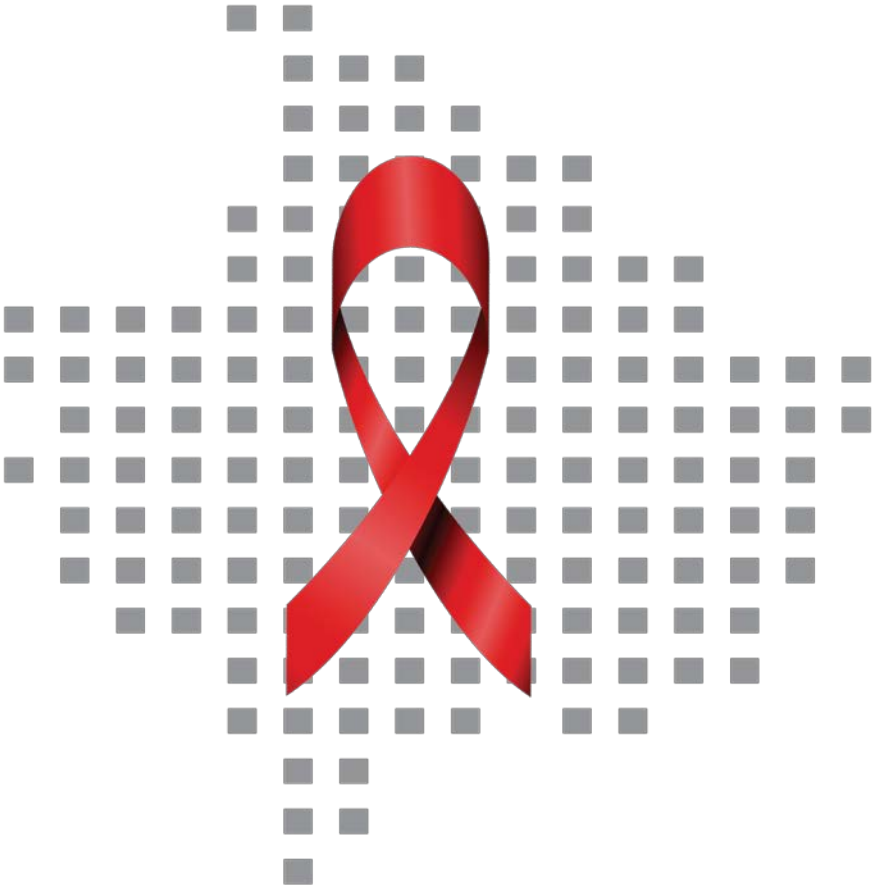
Improving the allocative efficiency of Kosovo's HIV response



Findings from a modeling analysis

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Abbreviations

AE	Allocative efficiency
AIDS	Acquired immune deficiency syndrome
ART	Antiretroviral therapy
ARV	Antiretroviral (drugs)
Clients	Clients of female sex workers
DALY	Disability-adjusted life year
FSW	Female sex workers
GDP	Gross domestic product
GFATM	The Global Fund to fight AIDS, Tuberculosis and Malaria
HIV	Human immunodeficiency virus
HTS	HIV testing services
LTFU	Loss to follow-up
NSAP	HIV/AIDS National Strategic Action Plan
NSP	Needle and syringe program
MSM	Men who have sex with men
M&E	Monitoring and Evaluation
OST	Opioid substitution therapy
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission
PWID	People who inject drugs
SBCC	Social and behavioral change communication

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1. Executive summary

Kosovo is a low HIV prevalence country with prevalence <1% among the general population and <5% among key populations.[1] There have been 122 HIV cases registered in Kosovo since 1986.[2] There were no cases detected through surveillance surveys among people who inject drugs (PWID) or female sex workers in 2011, 2014, or 2018.[3-6] HIV prevalence is increasing among men who have sex with men (MSM) from 0% (no detected cases) in 2011 to 2.8% in 2018.[3, 6]

The HIV response in Kosovo is primarily funded by two sources, the Government of Kosovo and the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), and is guided by the 2018-2022 HIV/AIDS National Strategic Action Plan (NSAP).[1] 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.[1] The Government of Kosovo is committed to ending the spread of HIV within the next five-years and to achieving the UNAIDS 90-90-90 targets.

An allocative efficiency analysis of Kosovo's HIV response was conducted using Optima HIV, an epidemiological model of HIV transmission that is coupled with a programmatic component and a resource optimization algorithm. The following objectives were examined, (1) to determine the impact of past HIV program implementation on the status of HIV and the response in Kosovo, (2) to determine how close Kosovo could get to their national HIV targets by 2022, with the latest HIV funding allocations, (3) to estimate how close Kosovo could get to reaching their national targets by 2022, if the latest HIV funding allocation were to be optimized, and (4) to ascertain how much additional funding would be required to achieve national HIV targets by 2022. Results from this analysis have been summarized herein, with key messages and recommendations presented below.

1.1 Key messages

Cost savings from non-targeted programs, representing 70% of Kosovo's HIV budget, should be optimally re-invested in targeted programs. Over 70% of Kosovo's HIV budget is invested in management, human resources, and other non-targeted HIV programs. Identifying measures to reduce spending on such programs would provide an opportunity to reinvest these savings cost-effectively in high-priority targeted HIV programs. This may well strengthen the HIV response.

Past investments have had an impact on maintaining low HIV prevalence in Kosovo. As a result of past investment in the HIV response in Kosovo, the country has sustained low prevalence of HIV. A scenario analysis whereby investments made from 2011 to 2018 were removed, showed that there would have been almost 50% more new HIV infections (almost 100 more infections) and over 150% more HIV-related deaths (over 20 more deaths), today.

Optimized allocation of the latest budget from 2018 could avert almost 30% more HIV infections and almost 40% more HIV-related deaths by 2022. Opportunities exists to further slow the progression of the spread and impact of HIV in Kosovo. By prioritizing

scale-up of antiretroviral therapy and HIV testing targeting MSM, further reductions in new HIV infections (71 fewer) and HIV-related deaths (11 fewer) could be achieved by 2022.

However, even under optimized allocation of the HIV budget, projections suggest 90-90-90 targets may not be attainable by 2020. Further progress towards these targets can be made if funding is prioritized to increase ART coverage, and to increase the rate of HIV diagnosis, particularly among MSM. However, even by shifting funds from non-targeted HIV program and optimally reinvesting in targeted programs, the 2020 target may not be achievable.

2. Status of and response to HIV in Kosovo

Kosovo has experienced sustained political and economic progress since the end of conflict in 1999, and has been under temporary United Nations administration since then.[7] While the United Nations Interim Administration Mission in Kosovo still functions today, it's role has reduced since Kosovo's independence was recognised in 2008.[7] Despite increasing stability, Kosovo is still one of the poorest countries in Europe with gross domestic product (GDP) of $US3,877 per capita in 2017.[1] Unemployment rates are high, at 40.7% for men, and 56.4% for women in 2016 and it is estimated 29.7% of the population lived below the poverty line in 2011.[1]

Government expenditure on health is increasing, government expenditure on health out of the total government spending has increased from 5% in 2011 to 10% in 2016.[8] Behind government expenditure, the largest source of healthcare financing is out of pocket payments (OOP), with 39% of healthcare is funded through OOP.[8] Despite increasing investments, Kosovo's 2017-2021 Health Sector Strategy has acknowledged that investments in healthcare are insufficient, with government spending on health is lower than regional averages, at 2.6% of GDP compared to 4.4% in South Eastern Europe.[9] Spending on health is also below spending averages of countries with similar GDP outside the region.[9] Given limited funding for health and low prevalence of HIV, securing additional funds for the HIV programme may be a challenge.[1] If so, prioritizing available funds becomes crucial to achieve maximum impact.

Kosovo is a low HIV prevalence country, with reported low HIV prevalence among the general population and key populations comprised of men who have sex with men (MSM), people who inject drugs (PWID), and female sex workers (FSWs).[1] Between 1986 and 2018 a total of 122 HIV cases were registered in Kosovo,[2] with no cases detected among people who inject drugs (PWID) or female sex workers in 2011, 2014, or 2018 HIV prevalence surveys.[3-6] There is however, evidence of an increasing HIV prevalence among men who have sex with men, with a rise in HIV prevalence among MSM from no reported cases in 2011, to 0.5% in 2014 up to 2.8% in 2018.[3, 6] Due to cultural and traditional attitudes, human rights organisations report that MSM in Kosovo face pressures to conceal their sexual orientation, face overt discrimination and challenges accessing healthcare.[10] Barriers to testing and treatment, along with a limited number of testing sites, are likely contributing to levels of HIV testing coverage among MSM (25% in 2018[6]). It has been suggested that these factors could be contributing the recent rise of HIV prevalence among this population.[11]

A review of the HIV response in Kosovo conducted by the World Health Organisation in 2014 showed that despite sustained progress, there are still shortcomings in the HIV response in Kosovo.[11] There is limited access to HIV testing services. It was planned that eight HIV testing sites would be operational by 2015; however, only one site was opened.[11]

From 2012 to 2014, there were frequent antiretroviral (ARV) drug stockouts, sometimes lasting up to eight months as a result of poor procurement planning.[11] Disruption in the support of ART supply contributed to problems with linking and retaining people in care, in 2016 only 65% of those diagnosed with HIV were in care.[12] Key populations were most affected by limited access to HIV services.[11]

Kosovo's HIV response is primarily funded by two groups, the Government of Kosovo, who financed approximately 40% of the HIV expenditure in 2015, and the Global Fund to Fight AIDS, TB and Malaria (GFATM), who funded the bulk of the remaining budget. The GFATM primarily supports HIV services targeting key populations, including fully funding HIV case detection programs for these populations.[1] Harm reduction services, including needle syringe programs, have financing support from the Global Fund.[1] The Government fully covers the cost of methadone for the OST program, antiretroviral drug costs, and the cost of testing of blood units for sexually transmitted infections, including for HIV.[1]

The HIV response in Kosovo is guided by the 2018-2022 HIV/AIDS National Strategic Plan (NSAP).[1] The goals of this plan are to maintain HIV prevalence among the general population below 0.1% and below 1% for key populations and to improve the quality of life for people affected by AIDS in Kosovo.[1] The government of Kosovo is also committed to ending the spread of HIV in the country within the next five-year period, and to achieve UNAIDS 90-90-90 targets.[1]

In order to maintain low HIV prevalence and achieve national targets, it is integral that the HIV response is sustained in Kosovo. Low HIV prevalence and a limited health budget mean that investments in the HIV response are unlikely to increase significantly. However, given the identified increasing HIV prevalence among the MSM population, sustained and targeted investments will be imperative to an effective HIV response. Ensuring that the current HIV programme budget is invested optimally will be integral to ensure that available resources continue to have the greatest impact.

3. Methodology

An allocative efficacy modeling analysis was undertaken in collaboration with the Global Fund Community Development Fund (CDF). Epidemiological data was provided by the National Institute of Public Health and program data was provided by the CDF. This analysis was conducted using Optima HIV, an epidemiological model of HIV transmission overlayed with a programmatic component and a resource optimization algorithm. A more detailed description of the Optima HIV model has been published by Kerr et al.13

3.1 Objective questions

In particular, the Optima HIV model was used to address the following objectives:

1. What was the impact of past HIV program implementation on the status of HIV in Kosovo?
2. If the available HIV budget were to be reallocated across program areas, how close could Kosovo get to their national HIV targets by 2022?
3. If the latest HIV funding allocation were to be optimized, how close could Kosovo get to reaching their national targets by 2022?
4. How much additional funding would be required to achieve national HIV targets by 2022?

3.2 Populations and programs modeled

The populations considered in this analysis included general populations; males aged 0-14 years, females 0-14, males 15-49, females 15-49, males 50 and older, and females 50 and older. The key populations included in the analysis included; female sex workers (FSW), clients of female sex workers (clients), men who have sex with men (MSM) and people who inject drugs (PWID).

Following consultation with the country team the following programs were included in this analysis. HIV targeted programs included antiretroviral therapy (ART), female sex worker (FSW) programs, HIV testing services (HTS), programs targeting men who have sex with men (MSM), needle-syringe programs (NSP), programs targeting people who inject drugs (PWID), opioid substitution therapy (OST), prevention of mother-to-child transmission (PMTCT), and social behavior change communication (SBCC) and condom distribution programs. Non-targeted programs included programs facilitating an enabling environment, human resources, infrastructure, management, monitoring and evaluation, and other HIV care programs.

3.3 Model constraints

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

3.4 Limitations of the analysis

As with any modelling study, there are limitations with this analysis. Therefore, these modeling results should be interpreted with caution. The following are key limitations which should be taken into account when considering results and recommendations from this analysis. First, limitations in data availability and reliability can lead to uncertainty about projected results. Although the model optimization algorithm accounts for inherent uncertainty, it might not be possible to account for all aspects of uncertainty because of poor quality or insufficient data, particularly for important cost values. Coupled with epidemic burden, cost functions are a primary factor in modeling optimized resource allocations. Second, we used contextual values and expert opinion where available, and otherwise evidence from systematic reviews of clinical and research studies to inform model assumptions. Third, we did not capture the effect of migration of people living with HIV from other countries.

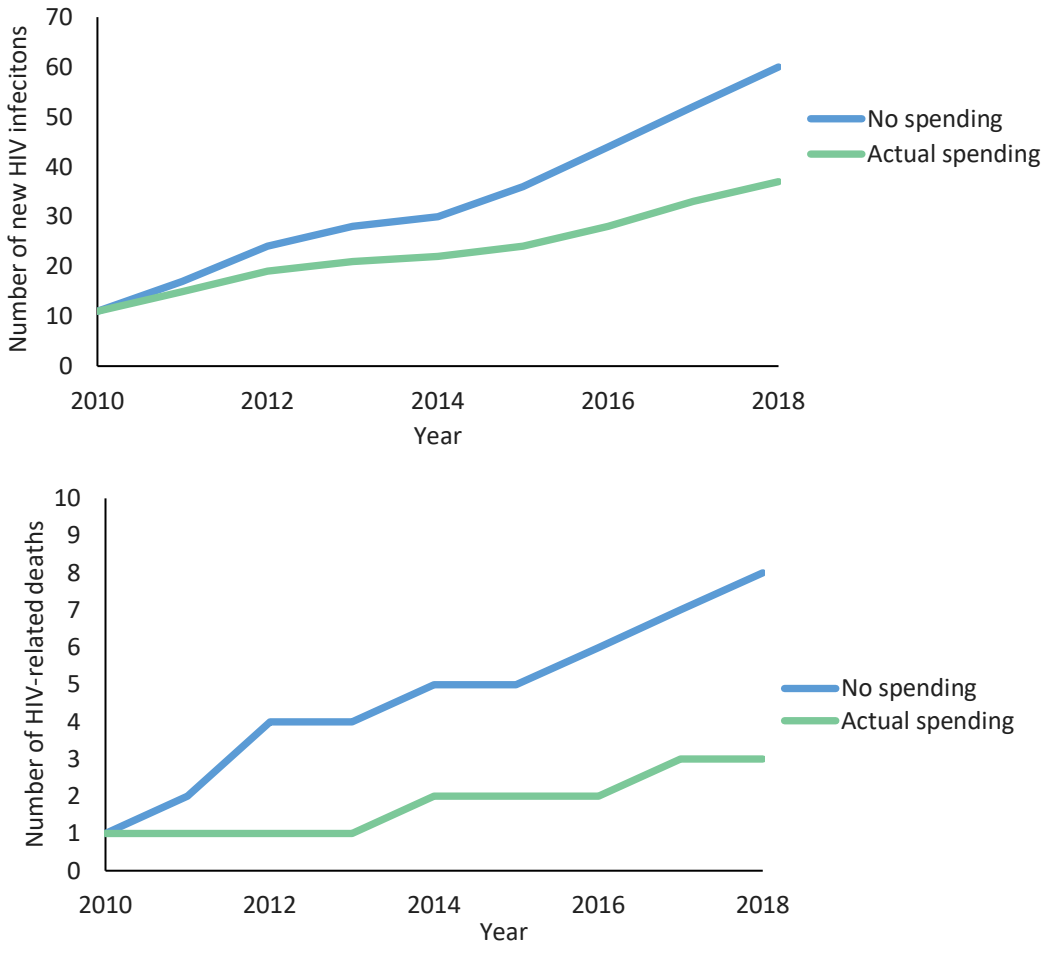
4. Results

4.1 What was the impact of past HIV program implementation on the status of HIV in Kosovo?

To estimate the impact of past HIV spending on the status of HIV in Kosovo, all spending on HIV programs was removed from 2011 (the earliest year program spending data was available) to 2018. This was compared with actual program spending, referred to as the baseline scenario, over the same period.

Despite a low prevalence of HIV, results suggests that past investments have had an important impact on the HIV response. Had the HIV program not been implemented from 2011 to 2018, by 2018 it is estimated that there were likely to have been almost 50% more new HIV infections (almost 100 more HIV infections) and over 150% more HIV-related deaths (approximately 25 more HIV-related deaths) over this period (figure 1).

Figure 1 Estimated new HIV infections and HIV-related deaths in the absence of HIV program spending, 2010-2018



Source: Optima HIV model, 2019

4.2 If the available HIV budget were to be reallocated across program areas, how close could Kosovo get to their national HIV targets by 2022?

4.2.1 Will Kosovo achieve HIV prevalence targets by 2022?

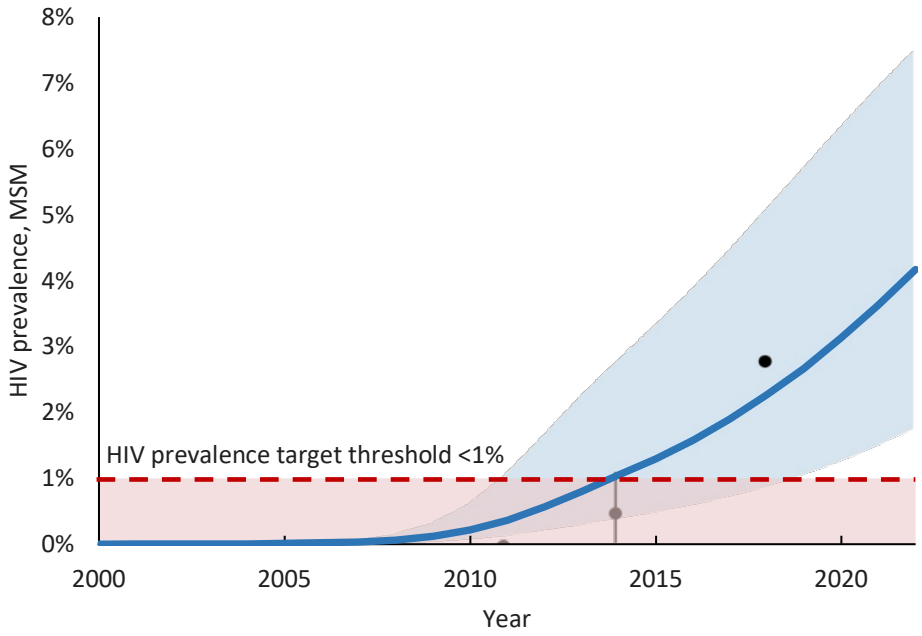
Model projections suggest Kosovo could maintain national HIV prevalence targets of <0.1% among the general population and <1.0% among key populations, other than for MSM. Surveillance estimates show an increase in HIV prevalence among MSM from 0% in 2011 to 0.5% in 2014, and up to 2.8% in 2018, signifying that the target to maintain MSM prevalence to less than 1% is no longer realistic or feasible, given the number of MSM who are living with HIV (table 1). Model projections suggest that if allocations are maintained HIV prevalence may rise to 4.2% by 2022 (table 1 and figure 2). Given the rise in HIV prevalence among MSM, investing in high-impact programs targeting this population will continue to be an important of Kosovo's HIV response.

Table 1 Model input and estimated HIV prevalence by population, 2017/2018 and 2022

Population	Input HIV prevalence (latest year)	Estimated HIV prevalence (PLHIV), 2022
General populations	*target <0.1%*	
F0-14	0.000% (2017)	0.0004% (1)
M0-14	0.001% (2017)	0.0004% (1)
F15-49	0.003% (2017)	0.0092% (43)
M15-49	0.006% (2017)	0.0104% (45)
F50+	0.001% (2017)	0.0022% (5)
M50+	0.002% (2017)	0.0022% (5)
Key populations	*target <1.0%*	
MSM	2.800% (2018)	**4.1700% (286)**
PWID	0.000% (2018)	0.0103% (1)
FSW	0.000% (2018)	0.0077% (1)
Clients	0.006% (2017)	0.0080% (1)

Sources: 2017: HIV registry; 2018: Integrated Biological and Behavioral Surveillance among key populations in Kosovo, 2017-2018; 2022: Optima HIV model, 2019

Figure 2 Estimated HIV prevalence among MSM, 2000-2022

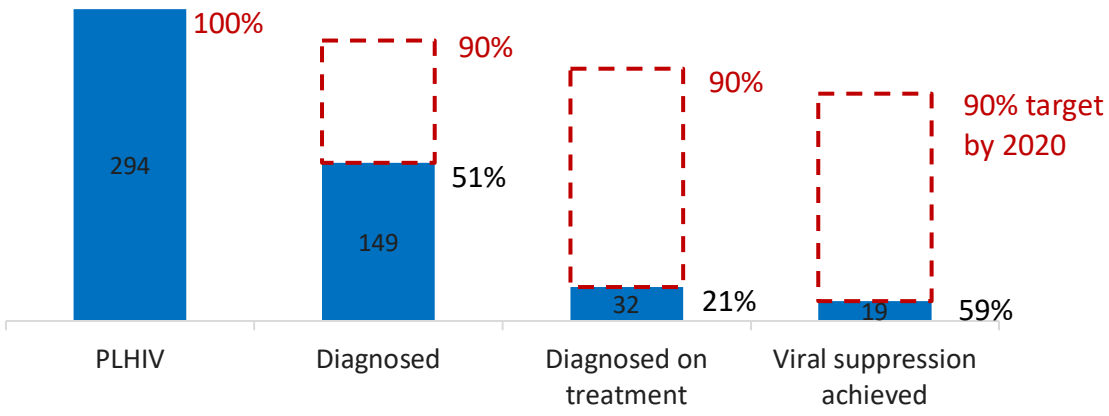


Source: Optima HIV model, 2019

4.2.2 Will Kosovo achieve UNAIDS 90-90-90 targets by 2020?

If the latest budget allocation were to be maintained, model projections suggest 90-90-90 diagnosed-treated-virally suppressed targets will not be achieved by 2020. By 2020, it is estimated that 51% of people living with HIV will be diagnosed, 21% of those diagnosed with HIV will receive treatment, and 59% of those on treatment will achieve viral suppression (figure 3). It is recommended that Kosovo's national HIV Programme strives to further improve diagnosis and treatment coverage, as well as linkage and retention to care. It was reported that 60% of those diagnosed with HIV were not in care in 2014. In 2016, this value was reported as 35%, although this is an improvement, continued focus should be made to better link and retain people living with HIV to care.

Figure 3 Projected HIV care cascade, 2020

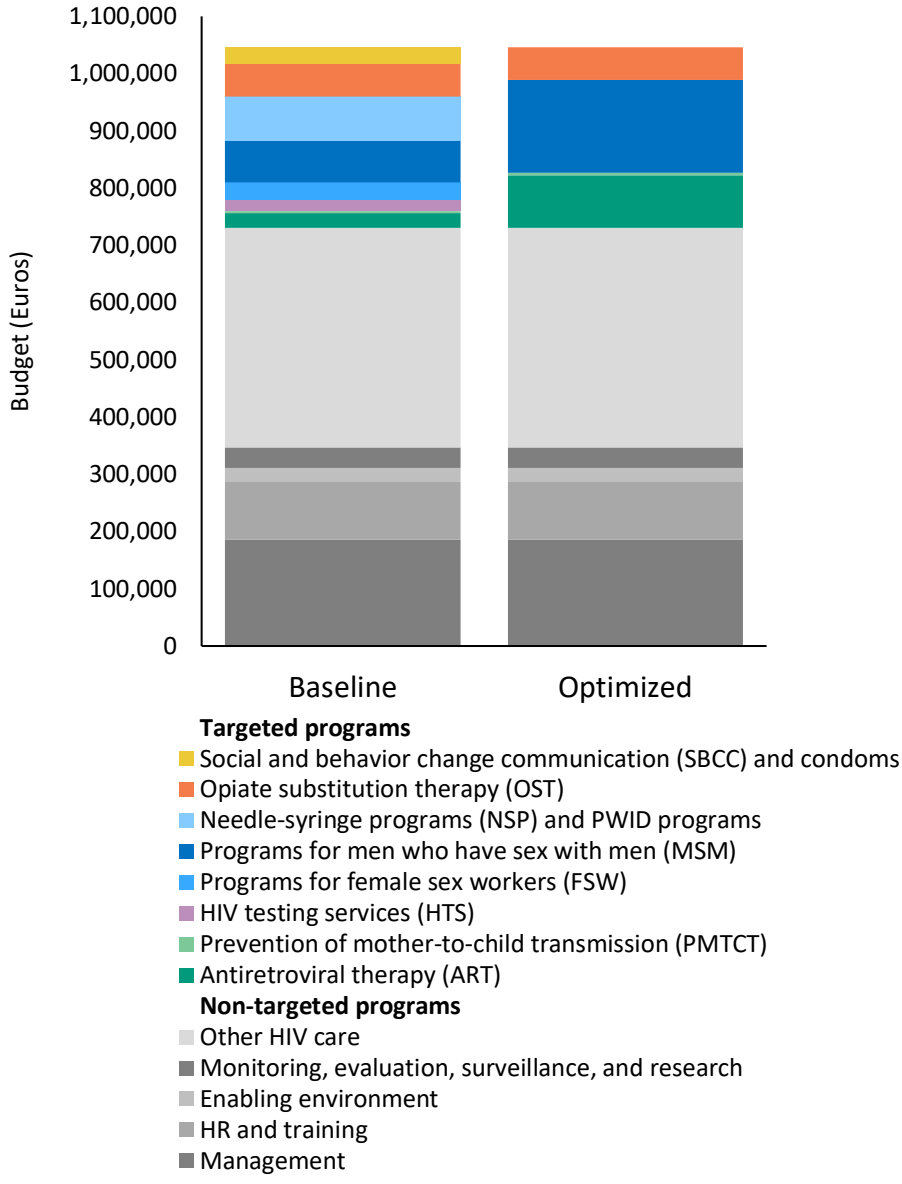


Source: Optima HIV model, 2019

4.3 If the latest HIV funding allocation were to be optimized, how close could Kosovo get to reaching their national targets by 2022?

With a latest reported HIV program budget of €1,046,085, with 70% invested on non-targeted HIV programs (€730,301 of the total budget spent on non-targeted programs including programs to facilitate an enabling environment, human resources, infrastructure, management, monitoring and evaluation, and other HIV care programs), with only 30% invested in HIV targeted programs (€315,784). It should be investigated if spending 70% of the total budget on non-targeted HIV programs is appropriate, if cost savings from these non-targeted programs can be realized, and if so these savings should be reinvested in the most cost-effective programs, including ART and MSM programs (figure 4).

Figure 4 Optimized HIV annual resource allocation, 2018 to 2022

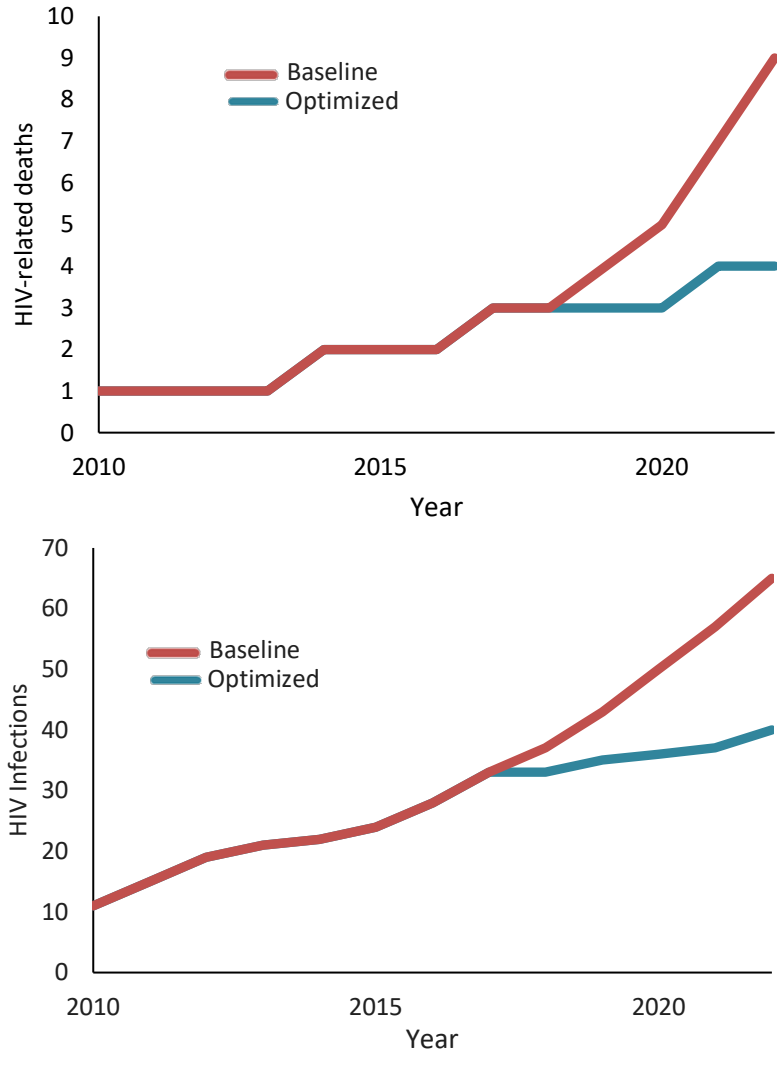


Source: Optima HIV model, 2019

Recommendations to optimize the budget allocation to minimize HIV infections and HIV-related deaths by 2022 include prioritizing scale-up of ART and MSM programs. Optimization results suggest that the ART budget should be increased by over 250% (from €26,000 to €92,000). Optimized allocations also suggest that investment in MSM programs should be increased by 100% (from €73,000 to €162,000). Given that MSM programs provide a combination of services including HIV testing and condom distribution and promotion, programs targeting MSM are cost effective in increasing the rate of HIV diagnosis, treatment coverage, and thus will lead to fewer new infections in this group. Model estimates suggest that for 2018, 71% (155 of 218) of all people living with HIV in Kosovo are men who have sex with men. Given that only 49% (76 of 155) of MSM living with HIV are diagnosed, testing programs targeting MSM, are a critical and will have the highest impact.

By 2022 under optimized budget to minimize HIV infections and HIV-related deaths, it is estimated that from 2018 to 2022 an additional, 27% of new HIV infections could be averted (40 infections averted) and 45% of HIV-related deaths could averted (13 deaths averted) compared with baseline (figure 5).

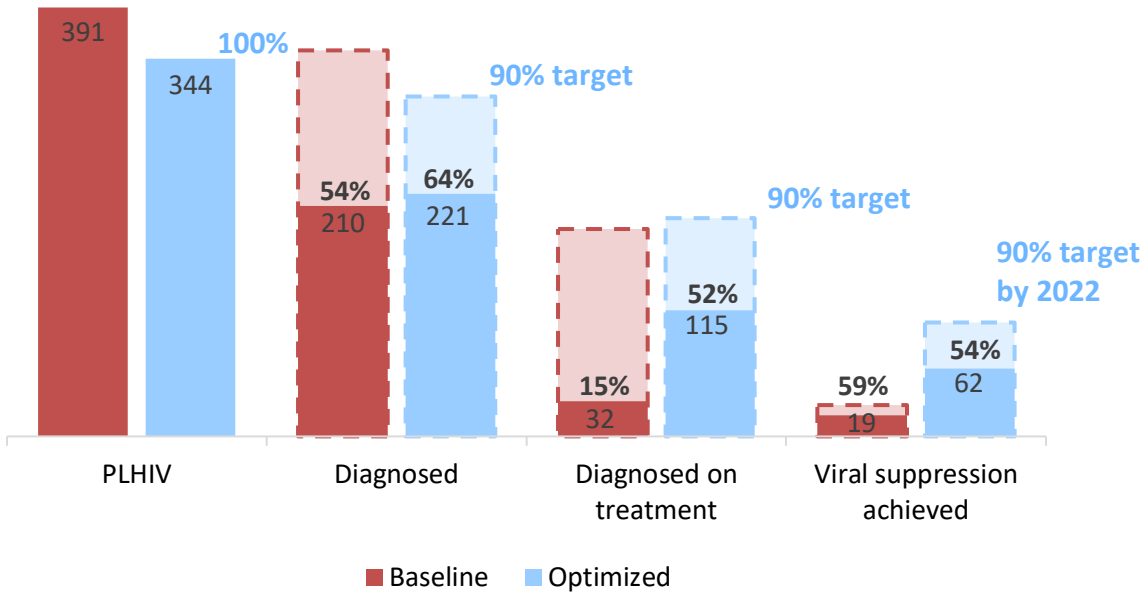
Figure 5 Estimated HIV infections and HIV-related deaths, 2010-2022



Source: Optima HIV model, 2019

Even with optimized HIV budget allocation, projections suggest that it will not be possible to achieve 90-90-90 targets by 2022 as indicated by dashed line area in figure 6.

Figure 6 HIV care cascade under optimized resource allocation, 2022

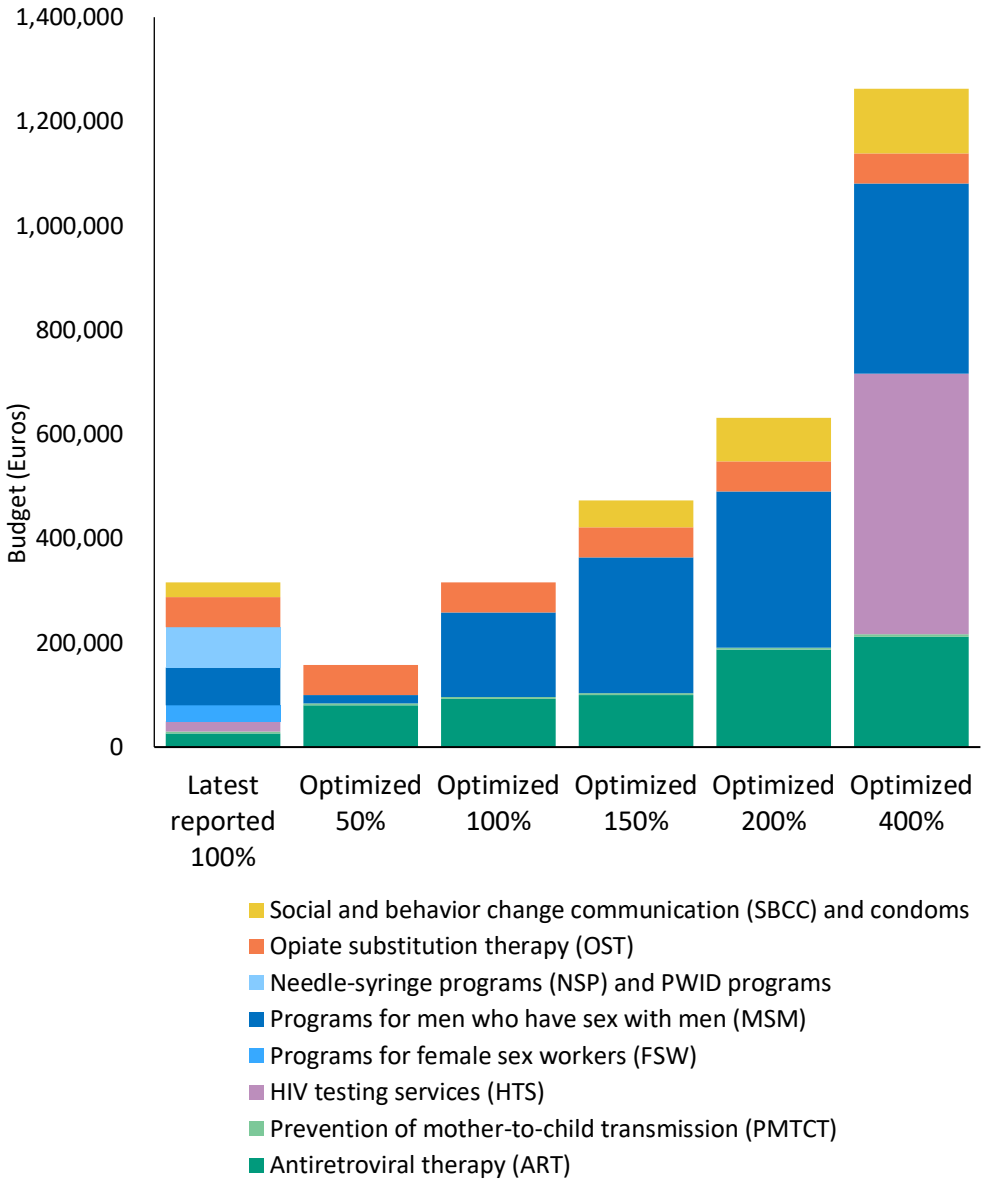


Source: Optima HIV model, 2019

4.4 How much additional funding would be required to achieve national HIV targets by 2022?

Recommendations to optimize allocations to minimize HIV infections and HIV-related deaths by 2022 suggest prioritizing scale-up of ART and MSM programs, regardless of budget level (figure 7). Increased investment in social behaviour change and communication (SBCC) and condom programs should be included in prioritization at ≥150% budget. HIV testing conducted outside of the testing component from programs targeting key populations should be re-prioritized at ≥400% budget.

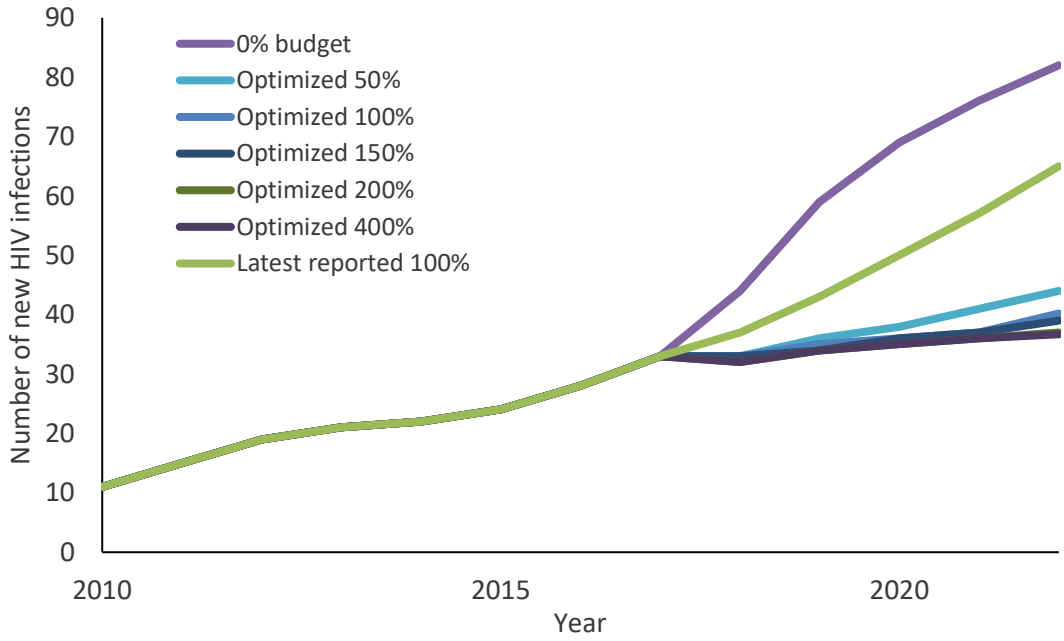
Figure 7 Optimized annual budget allocations with varying budget, 2018 to 2022

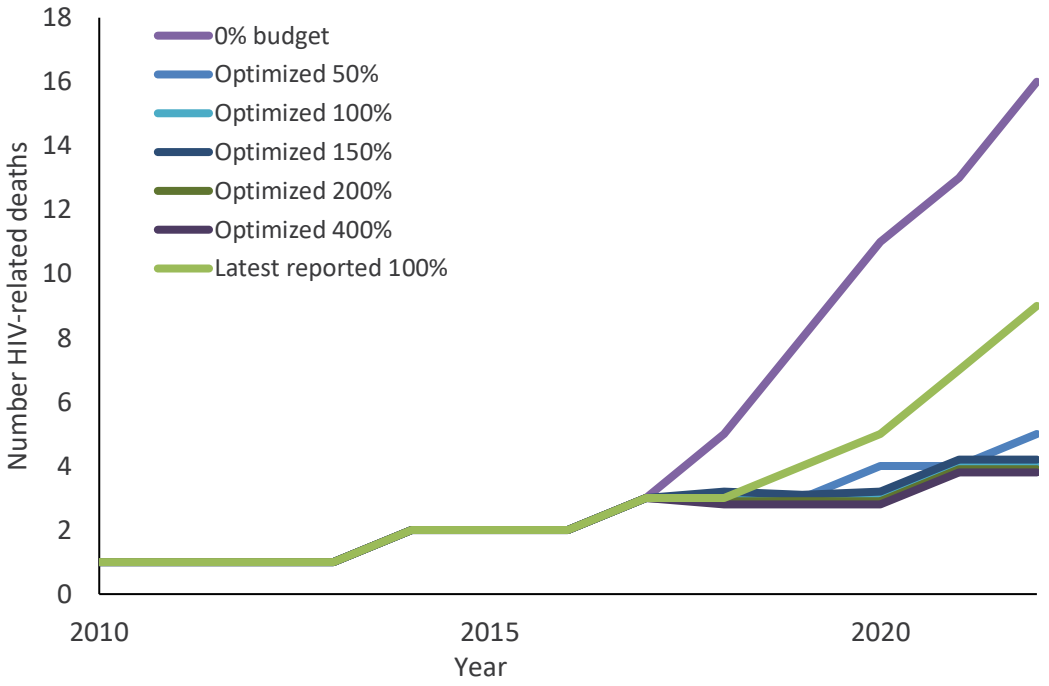


Source: Optima HIV model, 2019

Compared with the latest reported allocation at 100% budget, if the budget were to be doubled (200% budget) and optimally allocated, it is estimated that HIV infections could be reduced by an additional 29% (43 more infections averted) and HIV-related deaths by an additional 45% (13 more deaths averted) by 2022 (figure 8).

Figure 8 Estimated new HIV infections and HIV-related deaths with optimized varying budget, 2010-2022

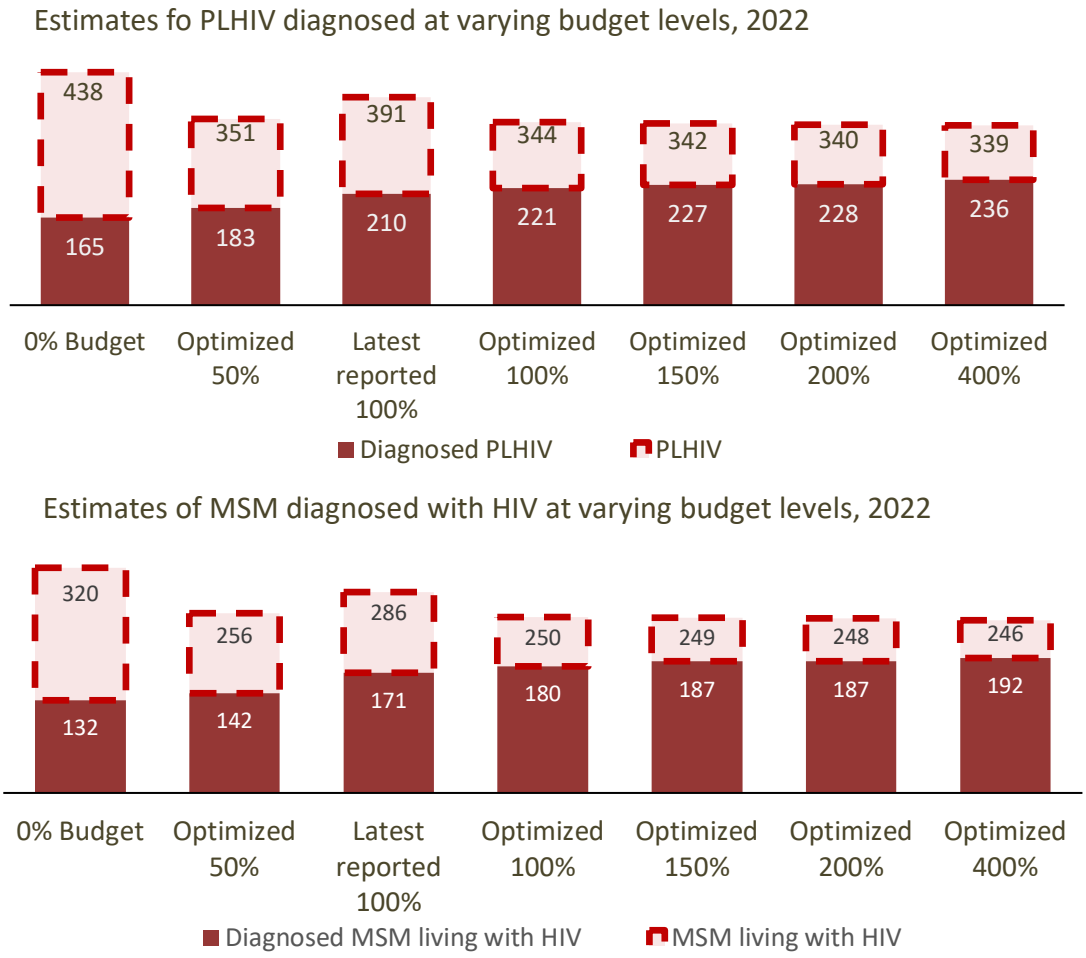




Source: Optima HIV model, 2019

By 2022, a 13% increase in overall diagnosis could be realized if the targeted HIV program budget were to be doubled and optimally allocated from 2018, that is 228 diagnoses estimated at 200% optimized budget versus 210 at 100% latest reported budget allocation (figure 9). In addition to prioritizing treatment scale-up, increasing diagnosis levels should be made a priority, especially among MSM who in 2018 were estimated to account for 71% of PLHIV (155 of 218 PLHIV were MSM) and 68% of those undiagnosed (78 out of 114 undiagnosed were MSM).

Figure 9 Estimated HIV diagnoses with optimized varying budget, 2022



Source: Optima HIV model, 2019

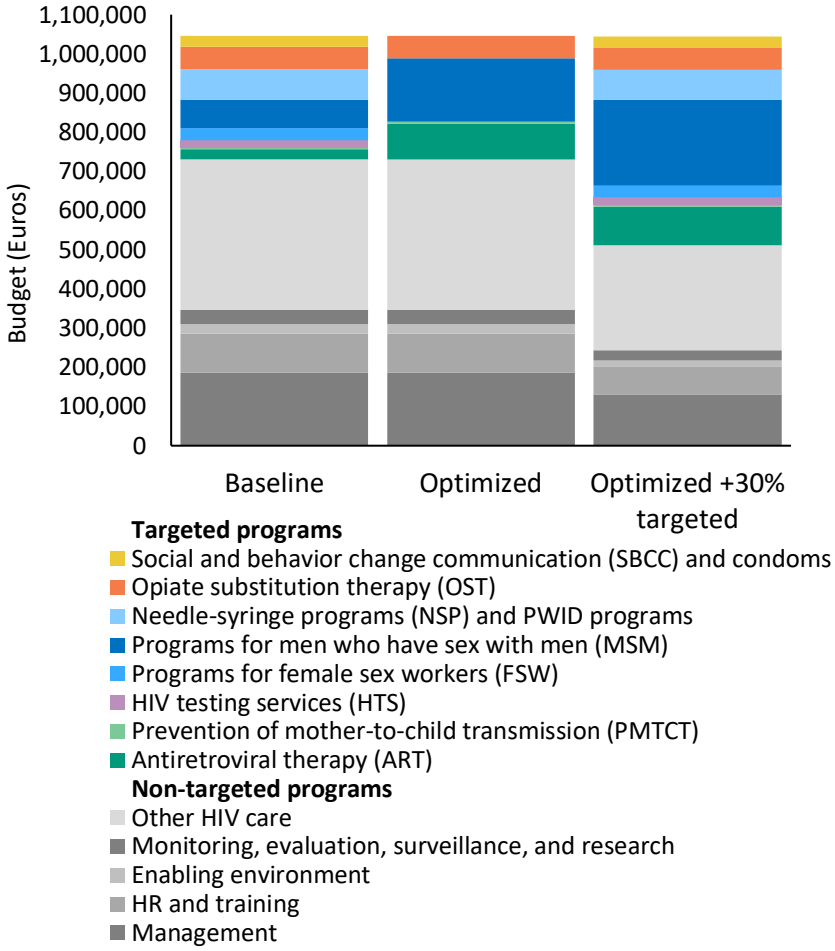
Even if budget levels were increased and optimally allocated across the existing set of programs, projections suggest 90-90-90 targets may not be attainable by 2020. To best achieve 90-90-90 targets, scale-up of ART coverage and increasing diagnosis, in particular among MSM, should continue to be prioritized. In 2014, 60% of those diagnosed with HIV were reported as not being in care. By 2016, this improved to 35%; however, efforts to increase linkage and retention to care should be strengthened.

To continue to curb the progression of a HIV prevalence in Kosovo, it is recommended to maintain, and where possible to increase, investment in HIV. Budget increases may be through additional funding from outside sources, or may also include reducing the percentage of total budget spent on non-targeted programs within the latest reported spending envelope, such as management and human resources.

4.4.1 Additional funding through reallocation of non-HIV program targeted spending

Non-targeted HIV programs including management, programs that facilitate an enabling environment, and other elements of HIV care account for 70% of Kosovo's HIV budget. Identifying cost savings for these programs would provide an opportunity to reinvest any savings in high-impact targeted HIV programs.

Figure 10 Optimized reallocation of 30% of the non-targeted HIV program annual budget across targeted programs, 2018 to 2022



Source: Optima HIV model, 2019

As a starting point, if 30% of the non-targeted HIV program annual budget (eg, other HIV care costs, human resources, etc.) were able to be freed up and optimally reinvested across targeted programs, investment of the existing targeted HIV program budget could be maintained. It is estimated that an additional 29% of new HIV infections (over 70 additional infections averted) and 39% of HIV-related deaths (over 10 additional deaths averted) could be averted by 2022 compared to baseline (figure 10). Maintaining funding for programs targeting FSW and PWID could ensure prevalence is low in these groups and ensure health services beyond HIV are still provided, such as screening for other sexually transmitted infections.

5. Conclusion

Kosovo has maintained a low level of HIV prevalence over the last decade and this, in part, can be attributed to past investment in the HIV response. There are however, further opportunities to improve the cost effectiveness in how resources are allocated. By optimally investing in ART programs and programs to improve HIV testing, particularly among men who have sex with men, further reductions in HIV infections and HIV-related deaths can be achieved.

Prioritizing resources and freeing up additional non-targeted resources for reinvestment in targeted programs will be especially important given the rising prevalence of HIV among MSM. Without targeted investment, the increasing HIV prevalence among MSM will continue to rise, with projections suggesting it could be as high over 4% by 2022.

Low HIV prevalence and a limited health budget mean that investments in the HIV response are unlikely to increase significantly. To re-emphasize, in addition to optimizing resources across targeted HIV programs, it will be important to identify costs savings from non-target HIV programs, such as management, enabling environment programs and other HIV care, which account for 70% of Kosovo's HIV budget, and to reinvest these savings cost-effectively in high-impact, targeted programs. Ensuring that the current HIV programme budget is invested optimally will be integral to ensure that HIV programs continue to have the greatest impact.

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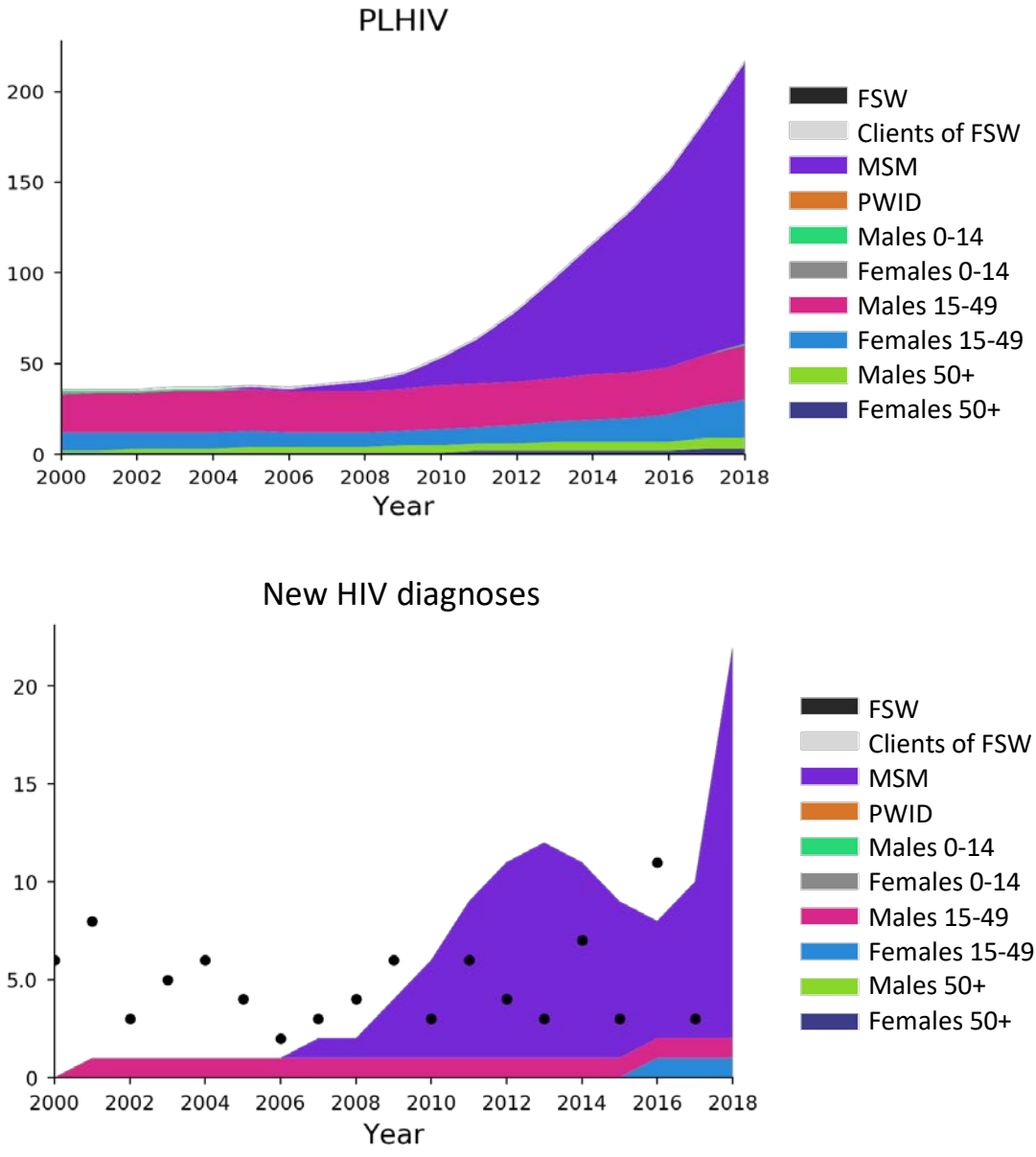
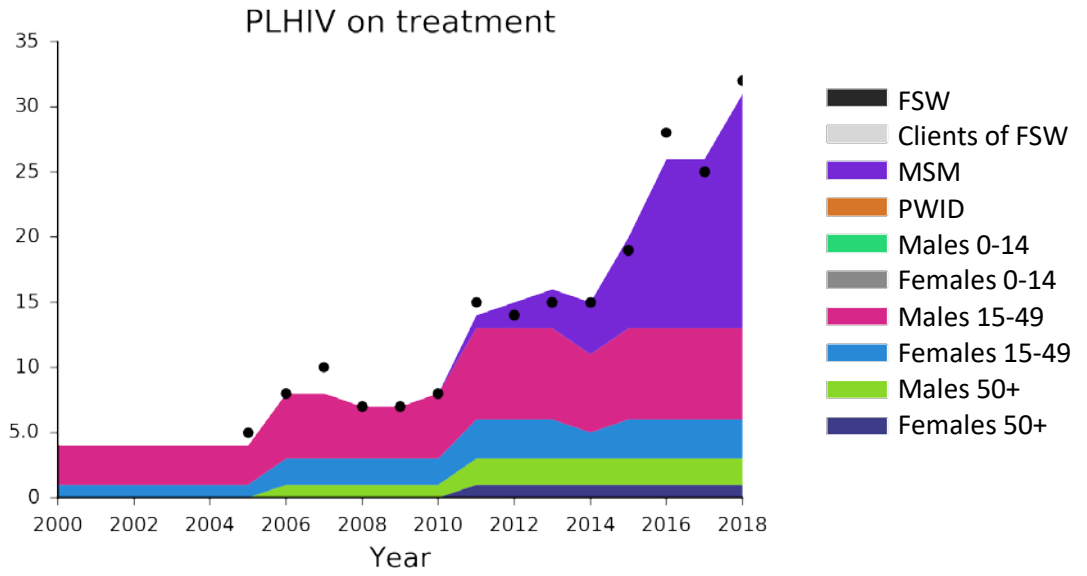
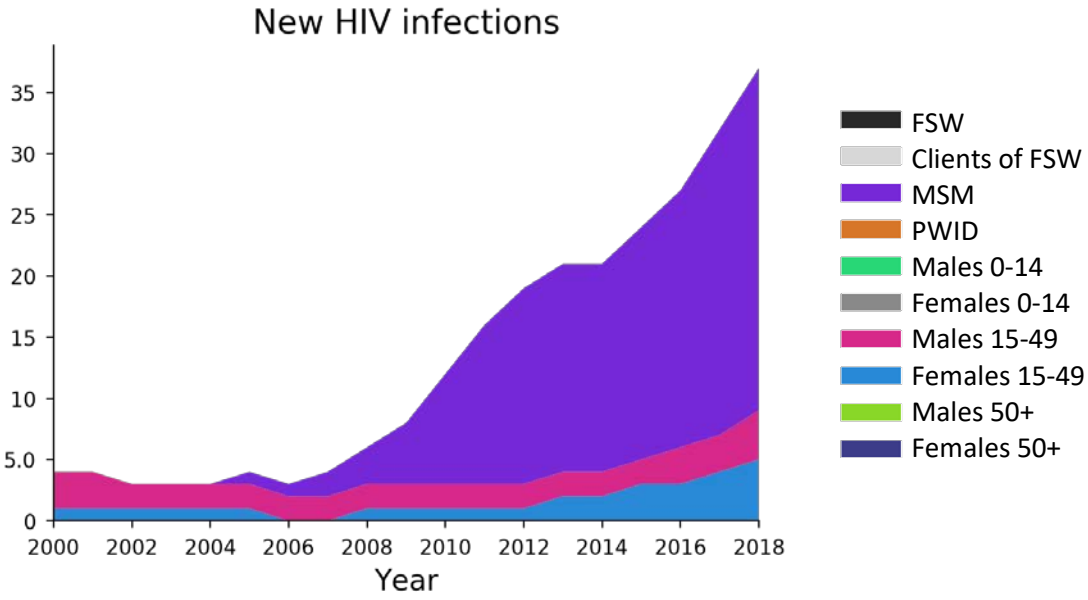
Appendices

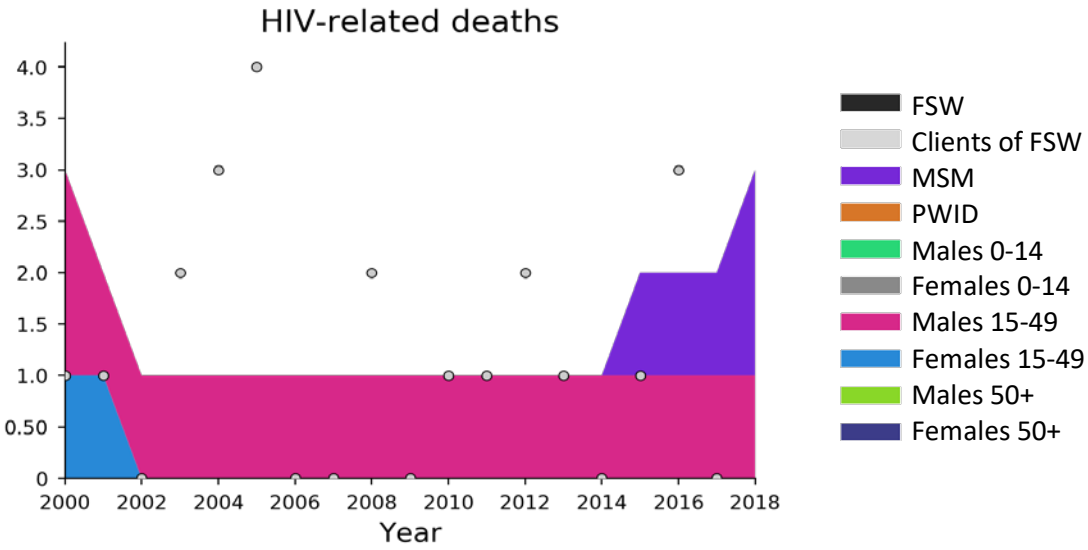
Appendix 1 Model calibration

Figure A1 Model calibration for PLHIV, new HIV diagnoses, PLHIV on treatment, new HIV infections, and HIV-related deaths



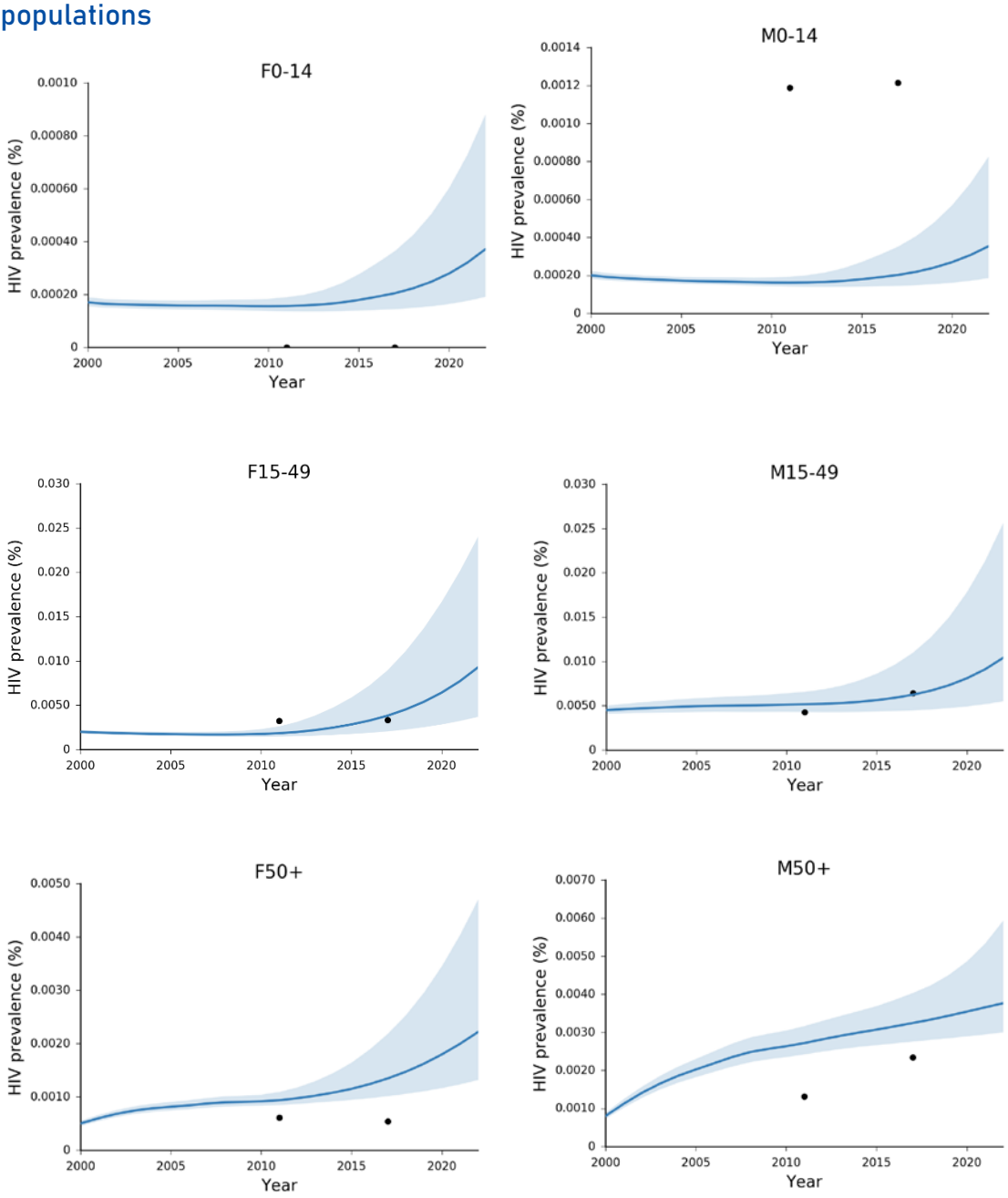






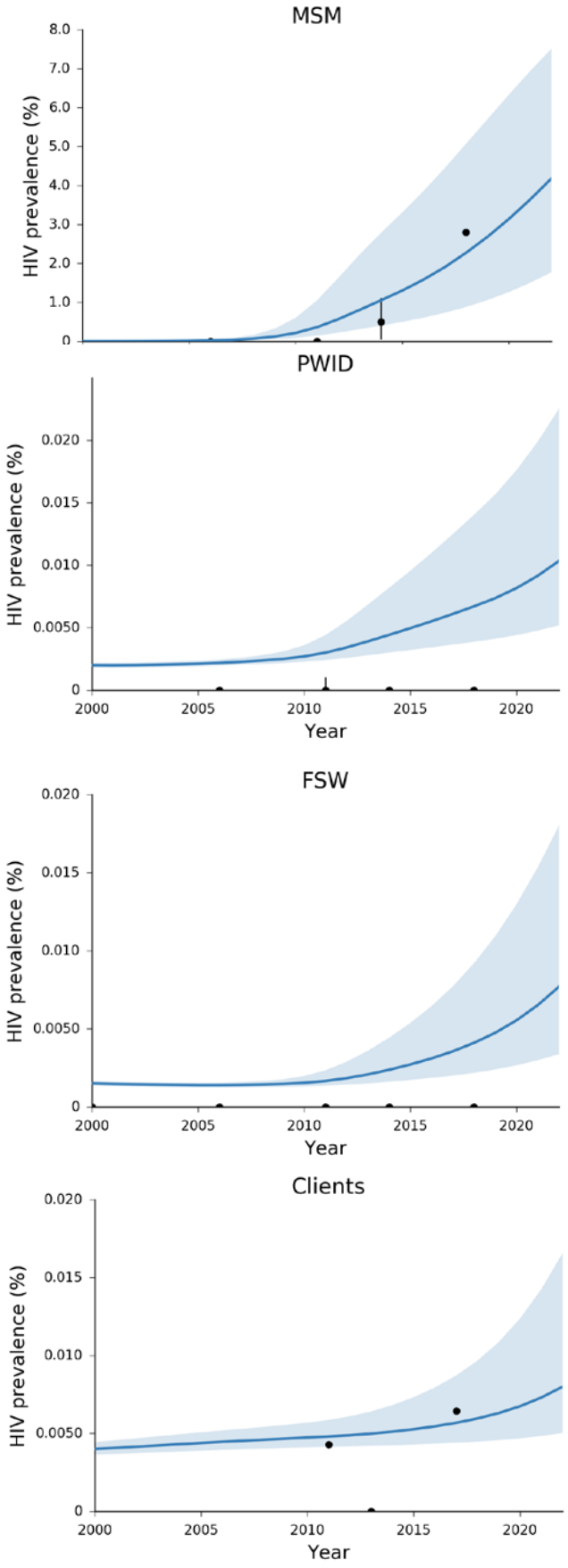
Source: Optima HIV model, 2019

Figure A2 Model calibration to HIV prevalence estimates, general populations



Source: Optima HIV model, 2019

Figure A3 Model calibration to HIV prevalence estimates, key populations



Source: Optima HIV model, 2019

Appendix 2 Key epidemiological estimates

Table A1 Model inputs: population size and HIV prevalence, and estimated PLHIV, 2018

Population	Model input population size, 2018	Model input HIV prevalence (latest year)	Model estimated PLHIV, 2018	% of total estimated PLHIV, 2018
MSM	6,767	2.800% (2018)	155	71.43%
PWID	5,779	0.000% (2018)	1	0.00%
FSW	5,182	0.000% (2018)	0	0.00%
Clients of FSW	15,007	0.006% (2017)	1	0.46%
F0-14	211,807	0.000% (2017)	0	0.00%
M0-14	229,950	0.001% (2017)	0	0.46%
F15-49	478,038	0.003% (2017)	21	9.68%
M15-49	440,645	0.006% (2017)	30	13.82%
F50+	210,028	0.001% (2017)	6	1.38%
M50+	187,639	0.002% (2017)	3	2.76%
Total	**1,790,842**		**217**	**100.00%**

Sources: key populations: Integrated Biological and Behavioral Surveillance among key populations in Kosovo, 2017-2018; general populations: Kosovo HIV progress report, 2015 (as submitted to UNAIDS)

Table A2 Model inputs: values for risk behaviors and HIV testing

Population	Average number of acts with casual partners per year (latest year)	Average number of acts with commercial partners per year (latest year)	Condom use casual partnerships (latest year)	Condom use commercial partnerships (latest year)	Average number of injections/ person/year (latest year)	% shared needles/ syringes at last injection (latest year)	% tested in last 12 months (latest year)
MSM	24 (2014)	29 (2018)	60% (2018)	60% (2018)	0*	0%*	25.00% (2018)
PWID	26 (2018)	10 (2018)	60% (2011)	49% (2018)	71 (2014)	19% (2018)	29.00% (2018)
FSW	30 (2011)	260 (2014)	25% (2014)	78% (2018)	30 (2018)	7% (2011)	26.00% (2018)
Clients of FSW	9*	104*	68%*	78%*	0*	0%*	1.40%*
F0-14	1*	NA	74% (2014)	NA	0*	0%*	0.00%*
M0-14	1*	NA	74% (2014)	NA	0*	0%*	0.00%*
M15-49	9*	NA	68% (2014)	NA	0*	0%*	1.00% (2014)
F15-49	10*	NA	37% (2014)	NA	0*	0%*	1.00% (2014)
F50+	2*	NA	50%*	NA	0*	0%*	0.01%*
M50+	5*	NA	30%*	NA	0*	0%*	0.01%*

*assumption used
NA = not applicable
Sources: MSM, PWID, FSW: Integrated biological and behavioral surveillance among key populations in Kosovo, 2017-2018; General populations: Kosovo HIV progress report, 2015 (as submitted to UNAIDS)

Appendix 3 Model parameters

Table A3 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	0.09%
	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)	0.30
	CD4(500) to CD4(350-500)	1.11
	CD4(350-500) to CD4(200-350)	3.10
	CD4(200-350) to CD4(50-200)	3.90
	CD4(50-200) to CD4(<50)	1.90
Changes in transmissibility (%)		
	Condom use	95%
	Circumcision	58%
	Diagnosis behavior change	0%
	STI cofactor increase	265%
	Opiate substitution therapy	54%
	PMTCT	90%
	Pre-exposure prophylaxis	73%
	Unsuppressive ART	50%
	Suppressive ART	92%
Disutility weights		
	Untreated HIV, acute	0.15
	Untreated HIV, CD4(>500)	0.01
	Untreated HIV, CD4(350-500)	0.02
	Untreated HIV, CD4(200-350)	0.07
	Untreated HIV, CD4(50-200)	0.27
	Untreated HIV, CD4(<50)	0.55
	Treated HIV	0.05

Source: Optima HIV User Guide Volume VI Parameter Data Sources

Table A4 Model parameters: treatment recovery and CD4 changes due to ART, and death rates

Treatment recovery due to suppressive ART (average years to move)		
	CD4(350-500) to CD4(>500)	2.20
	CD4(200-350) to CD4(350-500)	1.42
	CD4(50-200) to CD4(200-350)	2.14
	CD4(<50) to CD4(50-200)	0.66
	Time after initiating ART to achieve viral suppression (years)	0.20
	Number of VL tests recommended per person per year	2.00
CD4 change due to non-suppressive ART (%/year)		
	CD4(500) to CD4(350-500)	3%
	CD4(350-500) to CD4(>500)	15%
	CD4(350-500) to CD4(200-350)	10%
	CD4(200-350) to CD4(350-500)	5%
	CD4(200-350) to CD4(50-200)	16%
	CD4(50-200) to CD4(200-350)	12%
	CD4(50-200) to CD4(<50)	9%
	CD4(<50) to CD4(50-200)	11%
Death rate (% mortality per year)		
	Acute infection	0%
	CD4(>500)	0%
	CD4(350-500)	1%
	CD4(200-350)	1%
	CD4(50-200)	8%
	CD4(<50)	43%
	Relative death rate on suppressive ART	30%
	Relative death rate on non-suppressive ART	70%
	Tuberculosis cofactor	217%

Source: Optima HIV User Guide Volume VI Parameter Data Sources

Appendix 4 HIV program values

Table A5 HIV program unit costs and saturation values

Program	Unit cost (low) (Euros)	Unit cost (high) (Euros)	Saturation (low)	Saturation (high)
ART	$720.00	$880.00	95%	97%
FSW programs	$41.39	$50.59	70%	80%
HIV testing services	$2.25	$2.75	65%	75%
MSM programs	$36.08	$44.10	55%	65%
NSP and PWID	$14.61	$17.85	40%	60%
OST	$259.56	$317.24	20%	30%
PMTCT	$1,800.00	$2,200.00	95%	100%
SBCC and condoms	$0.14	$0.18	50%	60%

Source: Unit costs were derived from the following sources: National HIV/AIDS Strategic Action Plan Kosovo 2018-2022 (Annex b), HIV Budget and Expenditure 2011-2017 report, and the Global Fund programmatic mapping and size estimation of key populations in Kosovo, 2016. Used to inform the Optima HIV model, 2019.

Table A6 Values used to inform HIV program cost-outcome curves

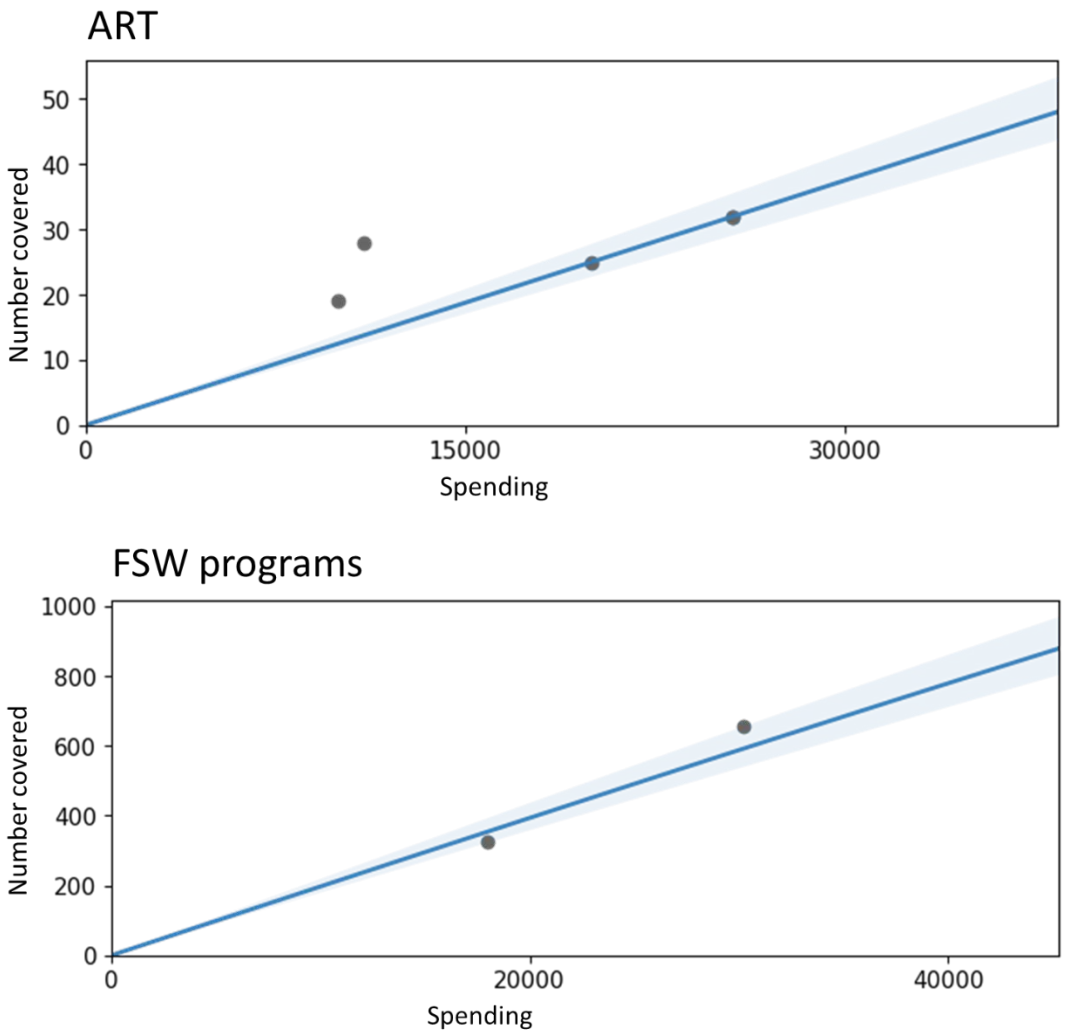
Program	Parameter	Population interactions or populations	In absence of any programs		At max attainable	
			low	high	low	high
MSM programs	Condom use for casual acts	MSM - MSM	0.45	0.52	0.76	0.86
MSM programs	HIV testing rate	MSM	0.10	0.14	0.62	0.66
SBCC and condoms	Condom use for casual acts	Clients of FSW - F15-49	0.44	0.54	0.76	0.91
SBCC and condoms	Condom use for casual acts	Clients of FSW - F15-49	0.44	0.54	0.76	0.91
SBCC and condoms	Condom use for casual acts	M0-14 - F0-14	0.67	0.77	0.85	0.95
SBCC and condoms	Condom use for casual acts	M15-49 - F15-49	0.44	0.54	0.81	0.91
SBCC and condoms	Condom use for casual acts	M15-49 - F50+	0.51	0.61	0.80	0.90
SBCC and condoms	Condom use for casual acts	M50+ - F15-49	0.30	0.30	0.67	0.77

Program	Parameter	Population interactions or populations	In absence of any programs		At max attainable	
			low	high	low	high
SBCC and condoms	Condom use for casual acts	MSM - MSM	0.45	0.52	0.75	0.85
SBCC and condoms	Condom use for casual acts	PWID - F15-49	0.40	0.50	0.80	0.90
FSW programs	Condom use for commercial acts	FSW - Clients of FSW	0.65	0.70	0.85	0.95
FSW programs	Condom use for commercial acts	FSW - PWID	0.52	0.67	0.85	0.95
FSW programs	HIV testing rate	FSW	0.16	0.20	0.75	0.85
HIV testing	HIV testing rate	Clients of FSW	0.00	0.02	0.85	0.95
HIV testing	HIV testing rate	F0-14	0.00	0.00	0.01	0.03
HIV testing	HIV testing rate	FSW	0.16	0.20	0.85	0.90
HIV testing	HIV testing rate	M0-14	0.00	0.00	0.01	0.03
HIV testing	HIV testing rate	M15-49	0.11	0.17	0.45	0.50
HIV testing	HIV testing rate	F15-49	0.00	0.012	0.17	0.22
HIV testing	HIV testing rate	MSM	0.10	0.14	0.47	0.50
HIV testing	HIV testing rate	PWID	0.27	0.29	0.50	0.54
HIV testing	HIV testing rate	M50+	0.00	0.00	0.05	0.10
HIV testing	HIV testing rate	F50+	0.00	0.00	0.04	0.10

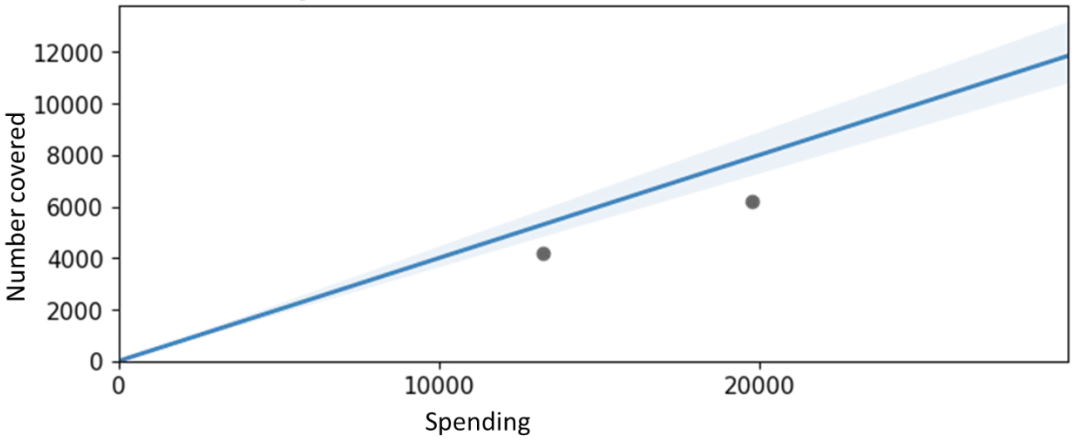
Source: used to inform the Optima HIV model, 2019

Appendix 5 Cost functions

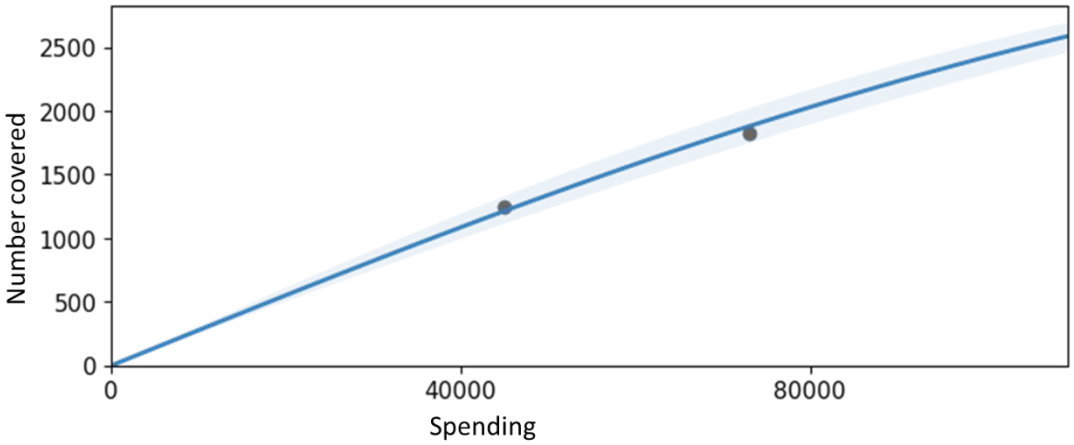
Figure A4 Cost-coverage curves by HIV program



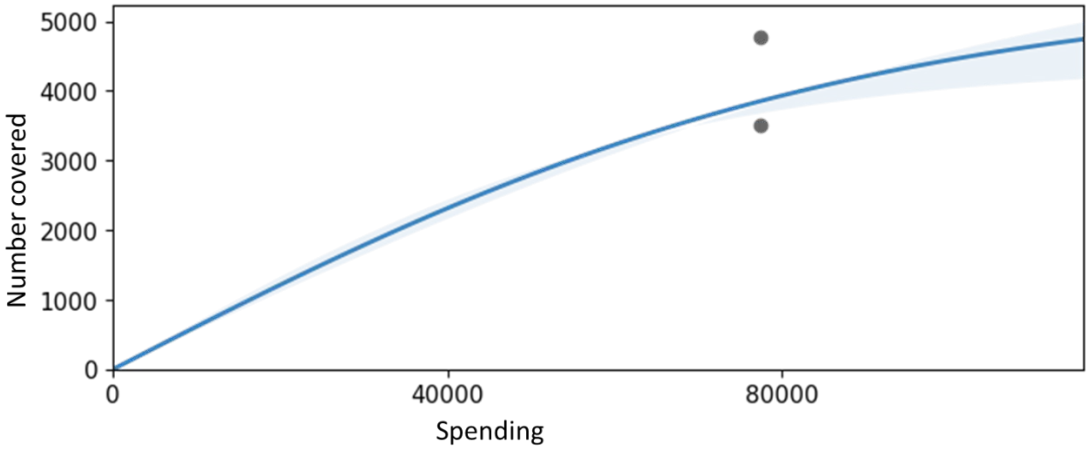
HIV testing services

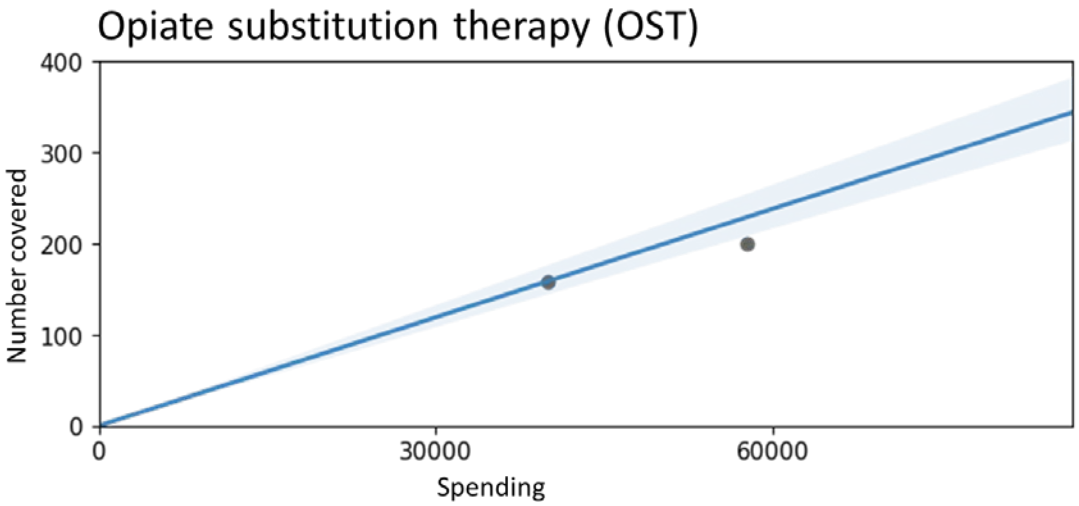


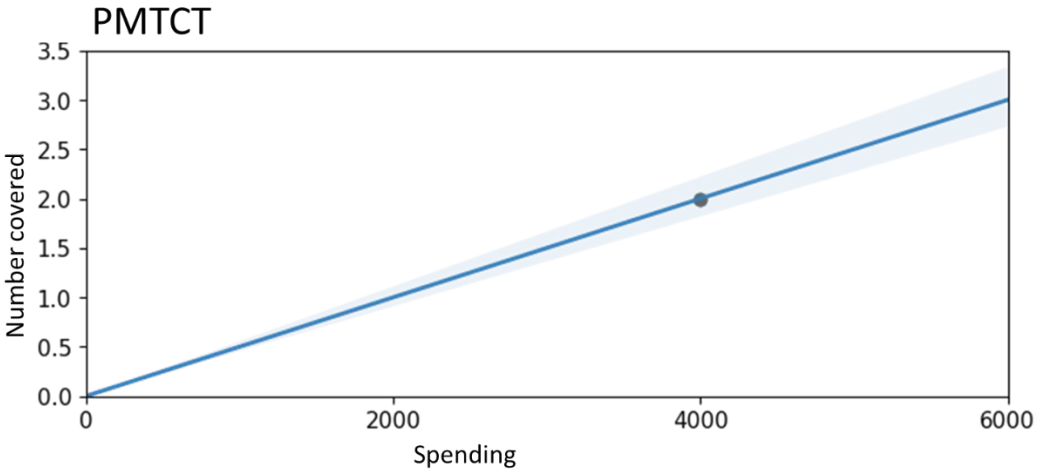
MSM programs

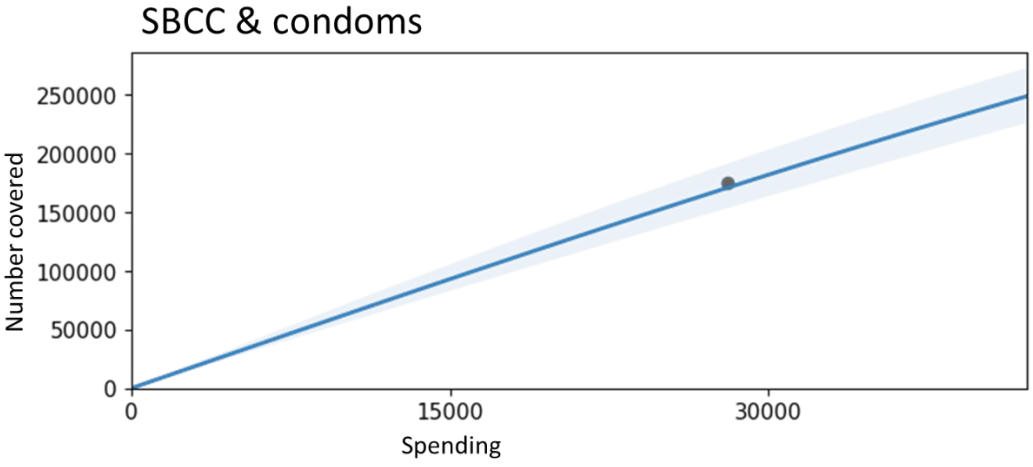


NSP & PWID programs









Source: Optima HIV model, 2019

Appendix 6 Optimization with varying budget, MSM

Table A7 Model outcomes for varying budget optimization among MSM

Indicator, among MSM	2018			2020			2022		
	Latest reported 100% budget	Optimized		Latest reported 100% budget	Optimized		Latest reported 100% budget	Optimized	
		100% budget	200% budget		100% budget	200% budget		100% budget	200% budget
New HIV infections	28	25	24	36	26	25	44	28	25
HIV-related deaths	2	1	1	3	2	2	6	2	2
People living with HIV	155	154	154	214	202	248	286	250	248
People diagnosed with HIV	76	76	77	120	130	187	171	180	187
People on treatment	18	45	45	21	74	110	23	90	110
Virally suppressed	11	27	27	12	42	60	13	49	60
Diagnosed with HIV (%)	49%	50%	50%	56%	64%	76%	60%	72%	76%
Diagnosed with HIV on treatment (%)	24%	59%	59%	17%	57%	59%	13%	50%	59%
Treated with viral suppression (%)	60%	61%	60%	58%	57%	55%	58%	54%	55%
HIV prevalence (%)	2%	2%	2%	3%	3%	4%	4%	4%	4%
Incidence (per 100 person years)	0.42	0.37	0.36	0.54	0.39	0.39	0.68	0.42	0.39
New HIV diagnoses	20	25	27	26	27	26	32	26	26
Population size	6,852	6,852	6,852	6,856	6,856	6,860	6,860	6,860	6,860

Source: Optima HIV model, 2019