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

Findings from Optima HIV modeling analyses across 12 countries in Eastern Europe and Central Asia

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Azerbaijan	**Moldova**
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Executive summary

The Eastern European and Central Asian (EECA) region continues to have the fastest rising HIV epidemic in the world (1). The COVID-19 pandemic and the on-going war in Ukraine threaten economic growth and progress towards HIV targets. To ensure that progress against the HIV epidemic can continue, it is vital to make cost-effective funding allocation decisions to maximize the impact of HIV programs. In 2022, a series of allocative efficiency analyses was conducted for 12 countries in the EECA region in partnership with national representatives, the Global Fund, UNAIDS, Swiss Tropical and Public Health Institute, and the Burnet Institute. These analyses update findings from previous multi-country EECA allocative efficiency analyses conducted in 2014 and 2019.

Key findings

- **Epidemiological context.** HIV infections have decreased and seem to be stabilizing among people who inject drugs, but this group remains disproportionately affected by HIV in the EECA region.
- HIV infections are estimated to be increasing among men who have sex with men. Legal frameworks, stigma and discrimination may make it harder to identify and reach additional "hidden" males among the general population who have male-to-male sex.
- Progress in increasing treatment coverage among diagnosed people living with HIV has stalled since 2019 despite improvements in other pillars of the treatment cascade. In 2022 it was estimated that in the 12 participating countries, 79% of people living with HIV were diagnosed, 72% of diagnosed people were on treatment, and 86% of people on treatment were virally suppressed.
- **Targeted HIV spending.** In 2021, the total baseline spending for targeted HIV programs was US$119.1M across the 12 participating countries of which 51% was for antiretroviral therapy (ART).
- In line with 2019 recommendations, countries have continued to invest in ART and have realized significant unit cost reductions for ART, with a median cost of US$375 in 2021 among participating countries. However, there is still wide country variation, ranging from US$120 to US$6,778 per person per year.
- Existing spending for treatment is projected to only be enough to fund ART for 60% of diagnosed people living with HIV by 2030 with current spending and unit costs. An estimated 111,500 new HIV infections and 34,500 HIV-related deaths could occur from 2023 to 2030 across participating countries if spending and allocations remain fixed at 2021 levels. An additional US$17.2 million could be required for all 12 participating countries to maintain 2021 treatment coverage from 2023 to 2030.
- **Optimized HIV spending.** In most countries ART was the first priority for scale-up with 100% optimized spending to at least maintain current proportional treatment coverage or respond to the reported treatment gap in 2021. However, even with 100% optimized spending, participating countries are only projected to reach 80% treatment coverage by 2030.

- After treatment, key population programs specific to country epidemiological trends were prioritized ahead of HIV testing for the general population.
- Optimized reallocation of 2021 spending could avert a cumulative 35,900 new infections (32%) and 9,200 deaths (27%) across participating countries compared with the baseline scenario.
- 95% diagnosis may be within reach by 2030 across most participating countries with an additional US$74.9M optimally allocated, but the costs of reaching the second and third 95 were not evaluated as there were no programs included to increase ART retention or viral load monitoring. Achieving 95-95-95 could avert 73,600 (66%) HIV infections and 19,000 (55%) cumulative HIV-related deaths compared with the baseline scenario.

Key recommendations

- **Scaling up spending for ART** and/or further reductions in ART unit costs is necessary to at least maintain current treatment coverage. New or scaled-up programs to support treatment retention and adherence will be essential to achieving 95-95-95 targets regionally, but the cost of implementing these in EECA is not known.
- **Overall current spending can be optimized** by prioritizing spending for ART and tailored programs to improve HIV prevention and testing among key populations with the highest rates of new infections.
- **Reaching 95% diagnosis** among people living with HIV will require tailored testing programs for key populations and substantial increases in spending for HIV testing programs. This target may be able to be achieved more cost-efficiently with novel strategies and testing modalities.
- **Future analyses** would benefit from data for programs regarding ART retention, adherence, loss to follow-up, and viral load testing to better estimate the impact of such programs on reaching the second and third 95 and determine prioritization of those programs within the wider HIV response.
- **More research** or data collation is needed around "hidden" key populations as well as the role of human rights and societal enablers in progressing the HIV epidemic response in EECA.

1 Introduction

The Eastern European and Central Asian (EECA) region reports the most rapidly increasing HIV incidence and mortality in the world (1). In 2021, the majority of these new HIV infections were reported among males (69%) and mostly among key populations such as people who inject drugs (39%), female sex workers and their partners (33%), men who have sex with men and transgender women (23%), and other populations that include seasonal labor workers and other migrants (5%) (1). Based on UNAIDS reporting, there are still major gaps in achieving 95% diagnosis and 95% treatment coverage which may impact ability to achieve 95-95-95 Fast Track targets regionally (1).

The region experiences several challenges that may hinder an effective HIV response across all settings and populations. In parts of EECA, there remain discriminatory policies, prosecutions and legal barriers that are known to increase HIV risks, vulnerability and negatively impact access to prevention and treatment services among key populations (2-5). This may include criminalization of same-sex sex acts, sex work and drug use, criminalization of HIV transmission and exposure, punitive measures against key populations, and forced HIV testing (1, 6). At the same time, the EECA region experiences substantial cross-border movement due to seasonal labor migration as well as forced displacement driven by the war in Ukraine (7). Migrants may travel to and from areas with higher prevalence of HIV, and social exclusion, limited access to health care, and host country legislation may increase vulnerability of migrants to HIV and worsen health outcomes (8, 9).

Given the differing contexts and HIV epidemiology, targeted spending for HIV needs to be tailored to the specific needs of people most affected and living with HIV in each country. Total resources for HIV in the region peaked in 2019 and have declined in 2020 and 2021, potentially due to resource constraints as a result of the COVID-19 pandemic (1). At a regional level, domestic spending on HIV decreased from US$1.6 billion in 2019 to US$1.4 billion in 2021 (10). While international funding in EECA has increased from 9% of total HIV spending in 2019 to 12% in 2021, including a predicted increase in Global Fund contributions in 11 countries included in this analysis from US$100.7M (2020-2022) to US$120.4M (2023-2025), this is not enough to fill the funding gap (10).

Prior allocative efficiency analyses were conducted in the EECA region in 2014 and 2019 to support evidence-informed HIV funding decisions given resource constraints (11, 12). The 2019 recommendations suggested increasing spending for ART and to ensure sufficient funding for relevant key population prevention and testing programs. The Fast Track 95-95-95 targets were estimated to be out of reach by 2030 at the time, and progress towards these targets may be further threatened by the on-going war in Ukraine, the COVID-19 pandemic, a decreasing trend in HIV spending, and changing epidemiology. To estimate the (potential) impact of these factors, assess changes from previous analyses and to support of the 2023-2025 Global Fund funding round, a third multi-country Optima HIV analysis was conducted in

2022 to optimize the allocation of resources for maximal impact on the HIV epidemic in the EECA region.

2 Methodology

In 2022, allocative efficacy modelling analyses were undertaken in 12 participating countries in the Eastern Europe and Central Asia (EECA) region. These analyses were 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, a detailed description of the Optima HIV model is available in Kerr et al (13). Optima HIV is a population-based compartmental model of HIV transmission and disease progression integrated with an economic and program analysis framework. It applies an algorithm to estimate the optimized allocation of resources across a combination of HIV programs (13).

Separate country models were informed using demographic, epidemiological, behavioral, programmatic and cost data. These values were collated from published sources, including UNAIDS, Global AIDS Monitoring (GAM) and National AIDS Spending Assessment reports and IBBS surveys, or were provided by national teams from programmatic data (14, 15). Baseline spending was derived for the year 2021 for all countries. Budget optimizations were based on targeted HIV spending for programs with a direct and quantifiable impact on HIV parameters included in the model, excluding spending on fixed overheads, infrastructure, and management.

Respective country models were validated by national teams and key stakeholders during a regional workshop held in September 2022 in Istanbul, Turkey. National programs and key stakeholders were also consulted before and after the workshop to set objectives, build scenarios and validate results. Full findings for each country are presented in separate country reports (16-27). Results presented in this regional report are an aggregate of results from the 12 country analyses.

2.1 Study objectives

The objectives of the country-level analyses in EECA in 2022 are described in Appendix 1.

This multi-country EECA analysis seeks to collate data from the 12 countries that were part of the most recent round of Optima HIV analyses to:

1. Assess changes in the HIV epidemic, spending and unit costs since 2019;
2. Explore optimized prioritizations within and between countries, and compare with previous EECA analyses; and
3. Collate the projected collective impact of optimizing resource allocation in participating countries.

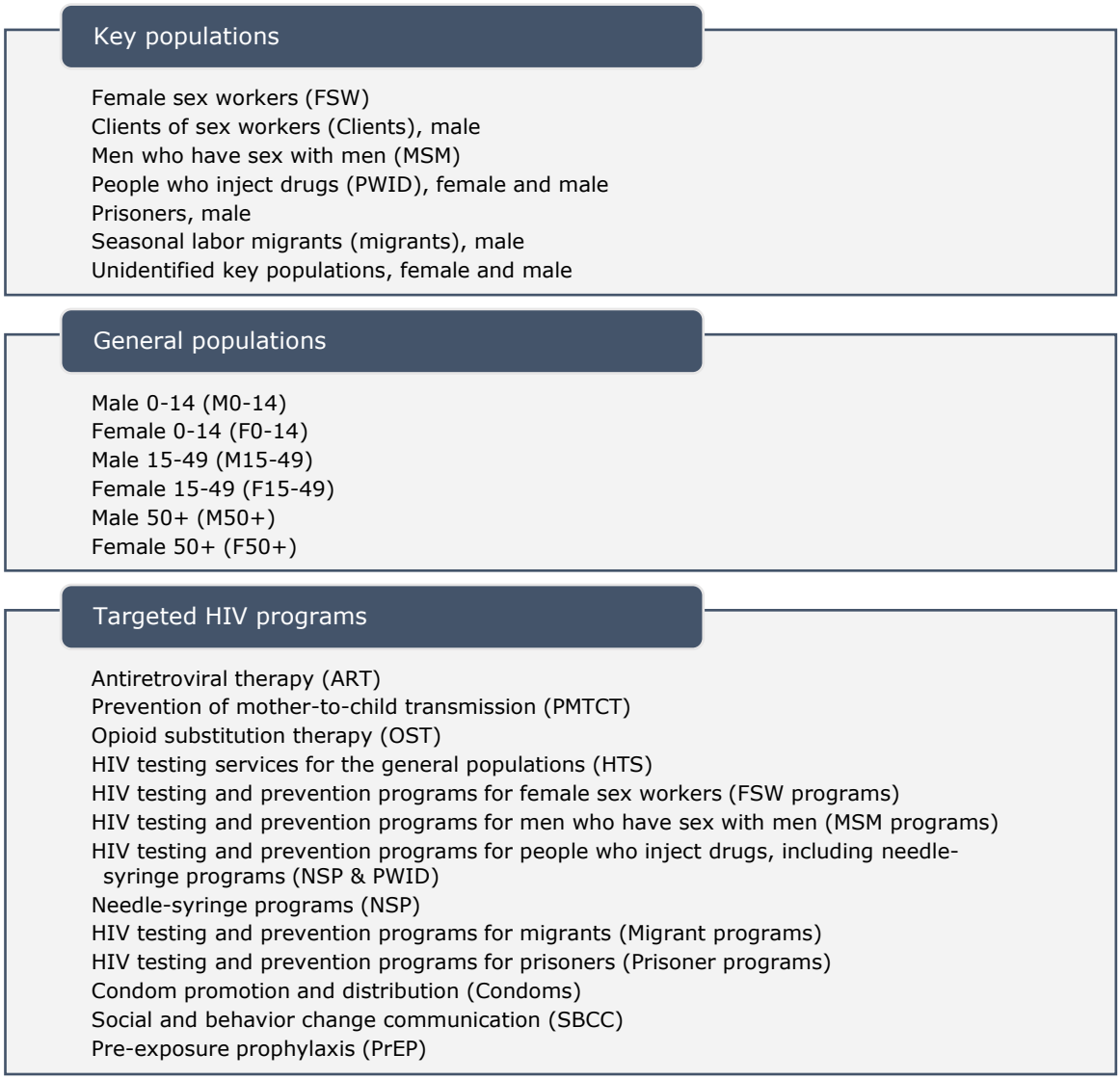
2.2 Participating countries

Twelve countries participated in the 2022 EECA analysis: Albania, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kosovo, Kyrgyzstan, Moldova, Serbia, Tajikistan and Uzbekistan. Separate models for Moldova were stratified by the Left and Right Bank. Seven out of twelve countries participated in the 2014 analysis, ten participated in the 2019 analysis including a Kosovo analysis completed independently from the regional workshop, and this was the first analysis for Albania and Serbia (Appendix 2).

2.3 Populations and HIV programs

Populations and HIV programs considered in the analyses varied between countries. All included populations and targeted HIV programs across countries are provided below:

Figure 1. Population groups and HIV programs modelled in the 2022 Optima HIV EECA analyses



2.4 Scenario analysis

This multi-country EECA report summarizes results from three scenarios (Table 1):

Table 1. Key scenarios considered in the multi-country EECA analysis, 2022

Scenario	Description
Baseline scenario	Continued spending and fixed allocation of 2021 budget (including fixed spending and coverage for ART)
Optimized spending 100%	Continued spending of 2021 budget (100%) with allocation of funding optimized to reduce new infections and HIV-related deaths by 2030
95-95-95 targets	Explores resources required and optimized allocation of resources to reach 95% diagnosis as part of the 95-95-95 targets and the projected impact if 95-95-95 targets were reached (see section 2.6).

To compare scenarios with optimized allocation of resources within a fixed budget envelope, a counterfactual "baseline" with fixed annual spending on all programs including ART was used. This would result in different epidemic projections to maintaining fixed coverage but means that optimizations consider the needs and prioritization for additional treatment resources in coming years.

2.5 Model constraints

Within the optimization analyses, there is an ethical constraint that 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, in which case no constraints were applied.

Limited additional constraints corresponding to specific country considerations are described in the individual country reports.

2.6 Treatment retention parameters

The model did not include any defined HIV programs aimed at improving linkage to care, 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. The projected care cascade with optimized spending may therefore underestimate the second and third 95 targets, should programs be in place but not included in this analysis.

Unlike Objective 1, which maintained most recent values for the care cascade 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, considering the lack of data to inform programs linked to these two pillars. Objective 3 therefore includes the impact of improvements to reach the treatment and viral suppression targets, however not the cost of programs required to achieve these gains.

2.7 Model objective function 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 in all countries, with the exception of Albania where a weighting of 1 to 7 was applied. Objective 3 weightings were to reach 95% *diagnosis* by 2030 with the minimal possible total spending (see section 2.6 for reasoning).

3 Findings

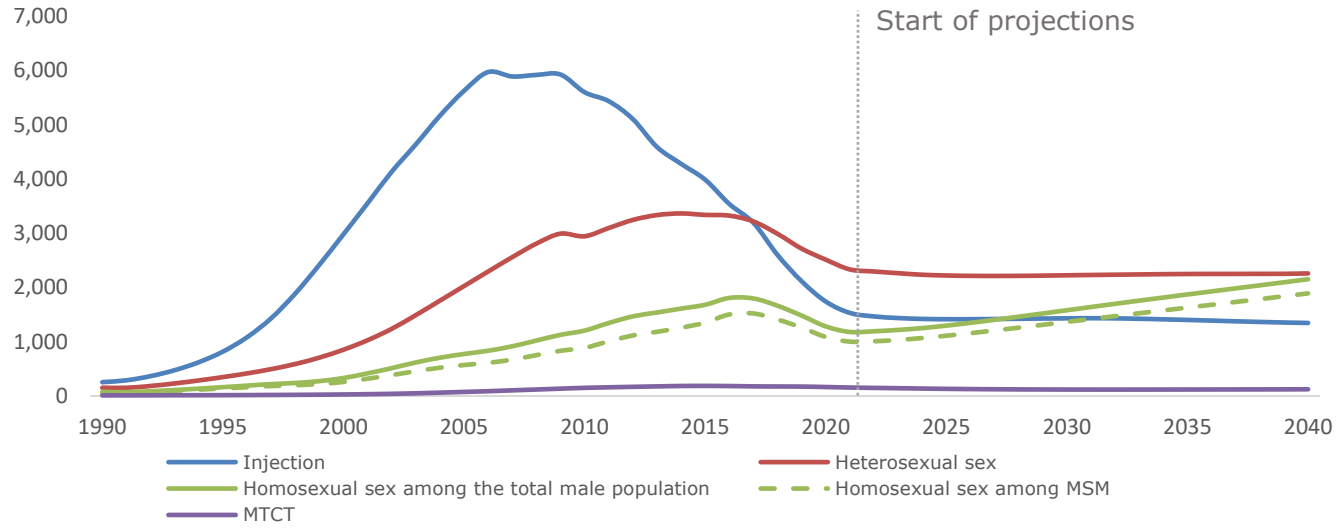
3.1 Baseline epidemiological situation

Modes of HIV transmission

The data suggest the epidemiology of HIV in the EECA region is evolving. At the time of the first multi-country EECA analysis in 2014, injection still accounted for the largest share of new HIV infections (Figure 2). Transmission via injections has been declining since 2009, perceived to be due to the scale-up of prevention and harm reduction programs for people who inject drugs as well as changes in drug use. Though new HIV infections are projected to remain stable among people who inject drugs with current conditions, changes in services or behavior could alter this trajectory, and people who inject drugs remain disproportionately affected by HIV in the region.

New HIV infections attributable to heterosexual transmission have increased over time but are projected to stabilize, while estimated HIV infections transmitted through male-to-male sex have been increasing since 2020 and are projected to account for an increasing share of new HIV infections. In this analysis we modeled male-to-male sexual transmission through both identified and unidentified populations of men who have sex with men. Some people engaging in male-to-male sex may not be recognized through official estimates or reached through existing key population programs, in part due to structural barriers such as stigma and discrimination. The estimated proportion of adult males who have sex with men were lower than the WHO and UNAIDS recommended population size estimates of >1% in three out of 12 countries (5, 29). Partnerships between adult males in the general population and men who have sex with men were modelled in Georgia, Moldova Right Bank and Uzbekistan.

Figure 2. Regional new HIV infections by mode of transmission in 12 countries from 1990 to 2040



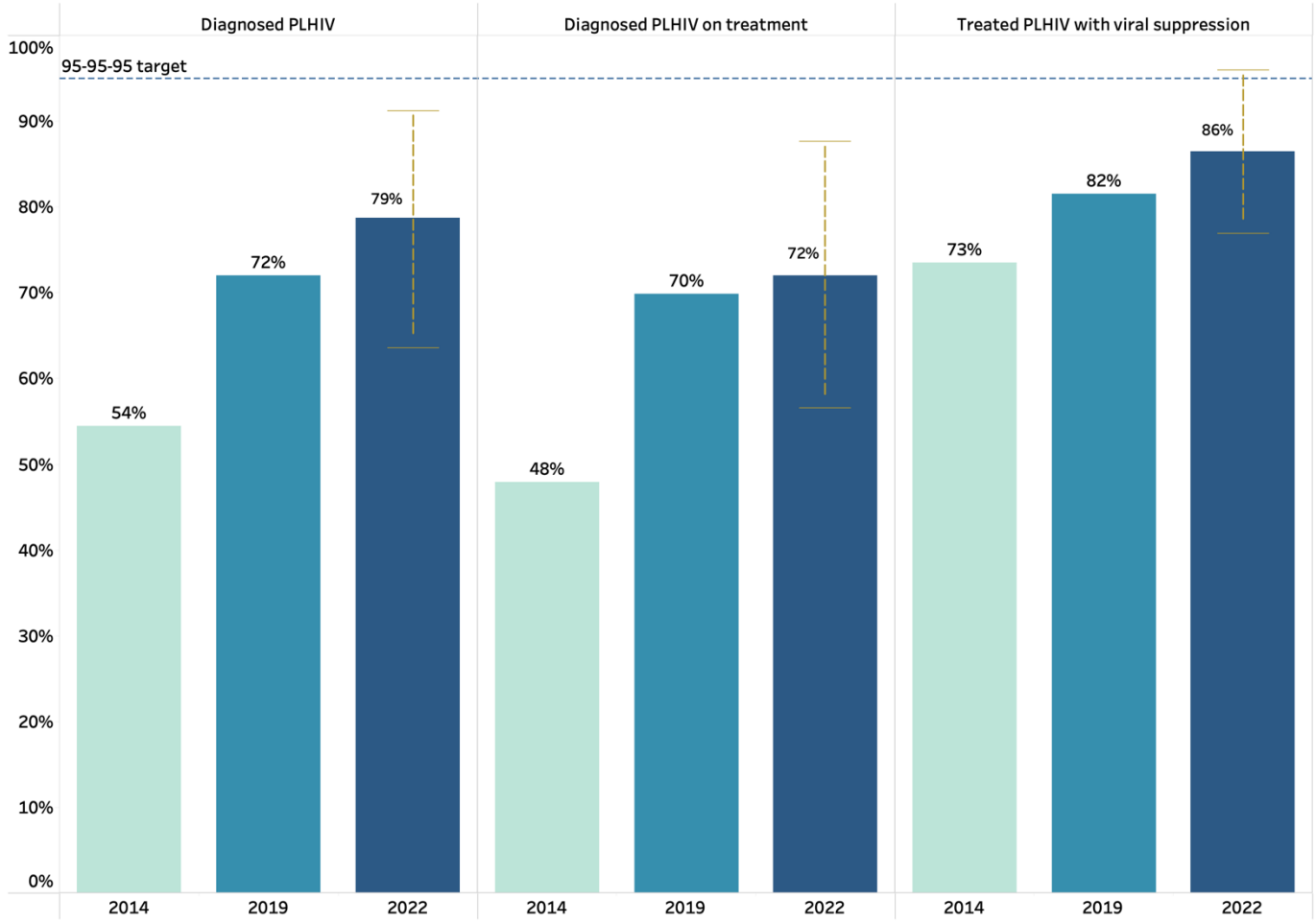
Note: Homosexual sex among the total male population (solid line) includes total number of infections estimated to be transmitted through male-to-male sex among MSM, M15-49 or other populations. Homosexual sex among MSM (dashed line) is a subset of this total occurring between identified MSM populations only. This figure excludes Uzbekistan, as there were no data to inform the mode of transmission among a large population of unidentified key populations (Appendix 3).

HIV treatment cascade

Among the 12 participating countries, the average HIV treatment cascade in 2022 was estimated to be 79% (range: 68% to 91%) of people living with HIV diagnosed, 72% (range: 56% to 87%) of diagnosed people on treatment, and 86% (range: 76% to 96%) of people on treatment virally suppressed.

Whereas countries have made continued progress in advancing diagnosis and viral suppression from 2014 to 2022, progress in increasing treatment coverage among diagnosed people living with HIV has stalled since 2019 according to Optima HIV estimates (Figure 3). The reasons for gaps in treatment coverage may be multifold, and more strategic information is needed to understand the barriers to achieving 95% treatment coverage. One possible contributor may be the overestimation of the denominator data for number of people living with HIV diagnosed, alive and remaining in country, including due to migration of people living with HIV. Other reasons may include fatigue in current approaches to linkage to treatment or insufficient retention support, emphasizing a need for novel interventions. In addition to improved strategic information, there is a need for greater emphasis on treatment retention and adherence support programs to close the treatment gap, including activities tailored to sub-populations experiencing disproportionate barriers to treatment.

Figure 3. HIV treatment cascade for EECA region in 2014, 2019 and 2022 and range among participating countries



2022 error bar depicts range among 12 participating countries; PLHIV, people living with HIV
Source: Optima HIV EECA analyses 2014, 2019, 2022

3.2 Baseline spending

Targeted HIV spending

In 2021, the total baseline spending for targeted HIV programs was US$119.1M across the 12 countries included in this analysis, ranging from US$0.6M (Kosovo) to US$39.6M (Kazakhstan) (Appendix 4, Figure A2). ART accounted for half of spending across countries, at US$61.2M (51%). The second largest spending category was general HIV testing services at US$30.2M (25%).

Program unit costs

The estimated median HIV antiretroviral treatment unit cost was US$375 in 2021, ranging from US$120 (Armenia) to US$6,778 (Serbia). Treatment unit costs are intended to include all scalable costs to deliver treatment to one person, including antiretrovirals (ARVs), time and

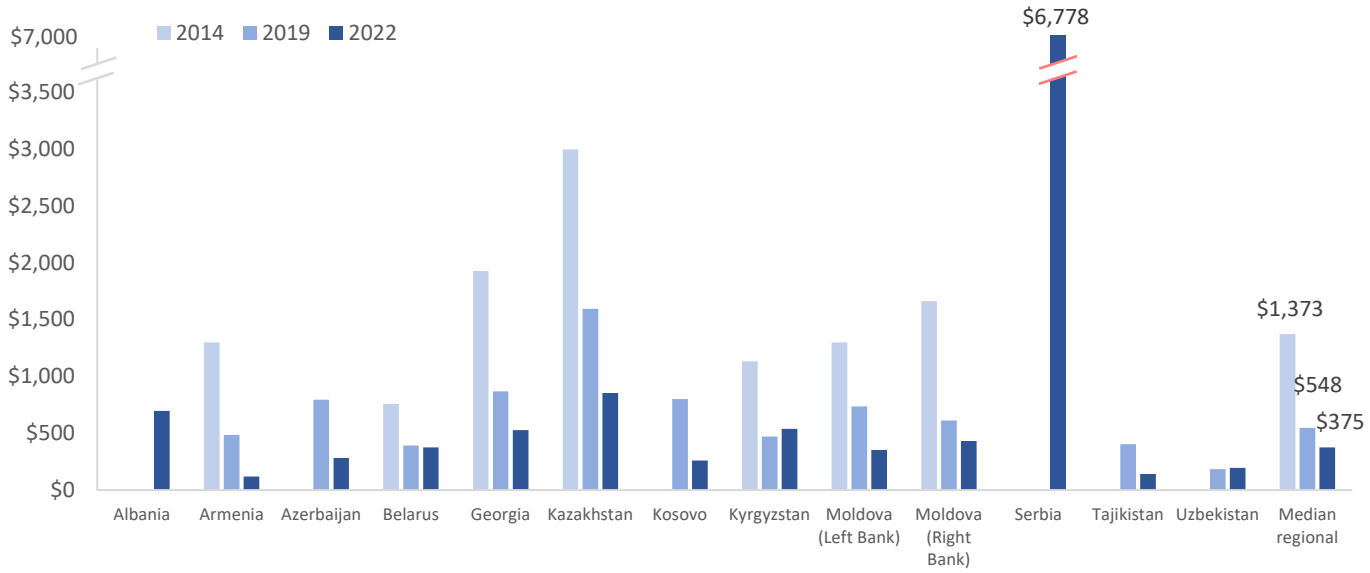
salary of healthcare workers to deliver the service, and cost of supply logistics. However, the availability of data varied, and some countries based the unit cost on drug procurement only, which limits comparability between countries. Notwithstanding these limitations, the treatment unit cost in Serbia was substantially higher than other upper-middle income countries in the EECA region (30).

The majority of participating countries achieved ARV price reductions and cost efficiencies from 2013 to 2018 (13) which had further decreased by 2021. Overall median unit costs for treatment have declined from $1,373 in 2013 (adjusted for inflation) to $375 in 2021 (Figure 4). Simplified procurement mechanisms, access to cheaper generic antiretrovirals and access to low-cost dolutegravir may have contributed to these costs reductions (31, 32). An example of a significant reduction in unit cost is Armenia, where the unit cost reduced by nearly 90% from 2013 to 2021.

In addition to ART price reductions, PrEP unit costs have also seen an encouraging reduction by 58% in Georgia between 2018 and 2021 (Appendix 5, Figure A3). In the 2022 analysis, four countries–Armenia, Georgia, Kazakhstan and Serbia–reported spending on PrEP, with unit costs ranging from $61 to $800. Serbia was the outlier at $800, but PrEP is not yet implemented in Serbia and the unit cost represents predicted costs based on expert opinion.

The unit cost of delivering key population programs varied substantially by country (Appendix 5, Figure A3). The unit costs reflect the current services delivered in each country and may not be directly comparable due to differences in program definitions, such as the inclusion of testing and/or prevention; and differences in cost inclusions, such as consideration of Global Fund contributions only or all government service costs, and whether all implementation costs have been accounted for.

Figure 4. ART unit costs (US$) from the HIV efficiency analysis studies by country and regional median, 2014, 2019 and 2022 analysis



Source: Optima HIV EECA analyses 2014 (2013 costs), 2019 (2018 costs), 2022 (2021 costs)
ART, antiretroviral therapy; All unit costs are reported in USD and adjusted for inflation. Unit costs for Kosovo were provided in Euro and converted to USD based on average exchange rate in reporting year (1 Euro:US$1.1811 in 2018 and 1 Euro:US$1.18 in 2021).

3.3 Optimized resource allocations

100% optimized spending

With 100% optimized spending, ART was the main priority for scale-up in eleven out of twelve countries (Figure 5, Figure 6, Appendix 6). This addresses the current treatment gap as well as the need to increase resources for ART in order to maintain existing treatment coverage levels, given more people will continue to be diagnosed and require treatment. One exception was Serbia, where programs for men who have sex with men were expanded ahead of ART given the very high unit cost of treatment (US$6,778) compared to HIV prevention programs for key populations (US$15-37).

After treatment, key population programs were prioritized ahead of HIV testing for the general population. Programs for men who have sex with men were prioritized for expansion in many countries given increasing HIV prevalence and incidence, including Azerbaijan, Georgia, Kosovo, Moldova Right Bank and Serbia (Figure 5). Programs for people who inject drugs were prioritized in Azerbaijan, Belarus, Kazakhstan, Moldova Left Bank and Uzbekistan. In other settings resources for people who inject drugs were either maintained or reduced given decreasing HIV incidence in this group. However, it may still be important to maintain services in this group to prevent epidemic rebound and for prevention of other blood-borne viruses.

Where programs for migrants were included in the model (Tajikistan, Armenia) they were prioritized for scale-up.

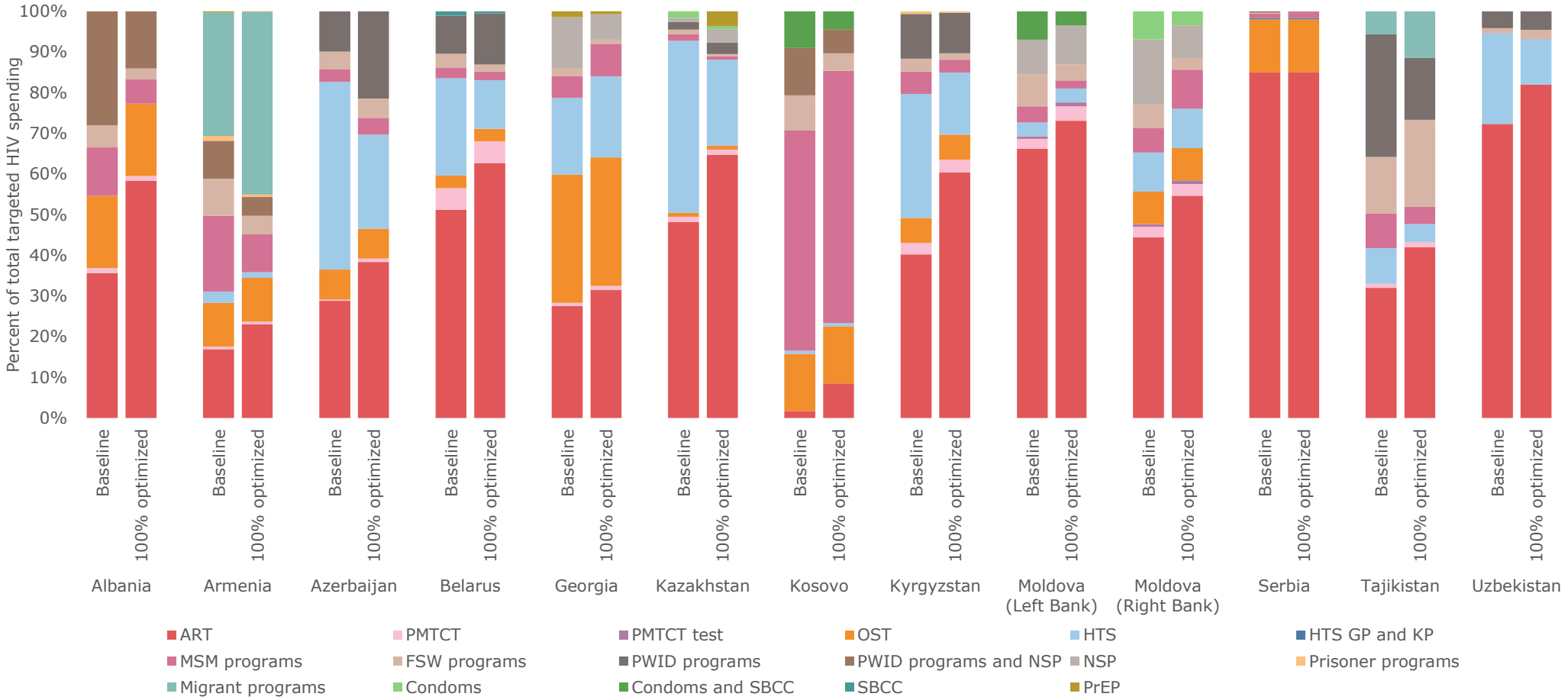
Figure 5. Overview of change in resource allocation from baseline to 100% optimization scenario

Source: 2022 Optima HIV EECA analysis

* HTS program reaches both general population and key population groups

ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services for general populations; MSM, men who have sex with men; NSP, needle-syringe program; PrEP, pre-exposure prophylaxis; PWID, people who inject drugs

Figure 6. 100% optimized allocation of spending as a proportion of total targeted HIV spending, 2021



Source: 2022 Optima HIV EECA analysis. ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services for general populations; MSM, men who have sex with men; NSP, needle-syringe program; PMTCT, prevention of mother-to-child transmission; PrEP, pre-exposure prophylaxis; PWID, people who inject drugs

Resources for PrEP programs were maintained or optimized for scale-up in two out of four settings. At existing funding levels, the analyses prioritize placing existing people living with HIV on treatment, then diagnosing those people living with HIV who are unaware of their status, while lastly opting for prevention of transmission among those not living with HIV. Therefore, PrEP will become a higher priority as diagnosis, treatment and viral suppression rates increase.

Optimized resource allocation at different budget levels

With reduced funding available, priorities commonly identified were maintaining as many people on treatment as possible followed by programs for key populations according to local incidence patterns. As the total budget envelope increases, priorities varied by country depending on treatment cascade and epidemiological context. Generally, with additional resources, it was suggested to scale-up funding for key population programs that may not have been prioritized in the 100% optimization.

95-95-95 scenario

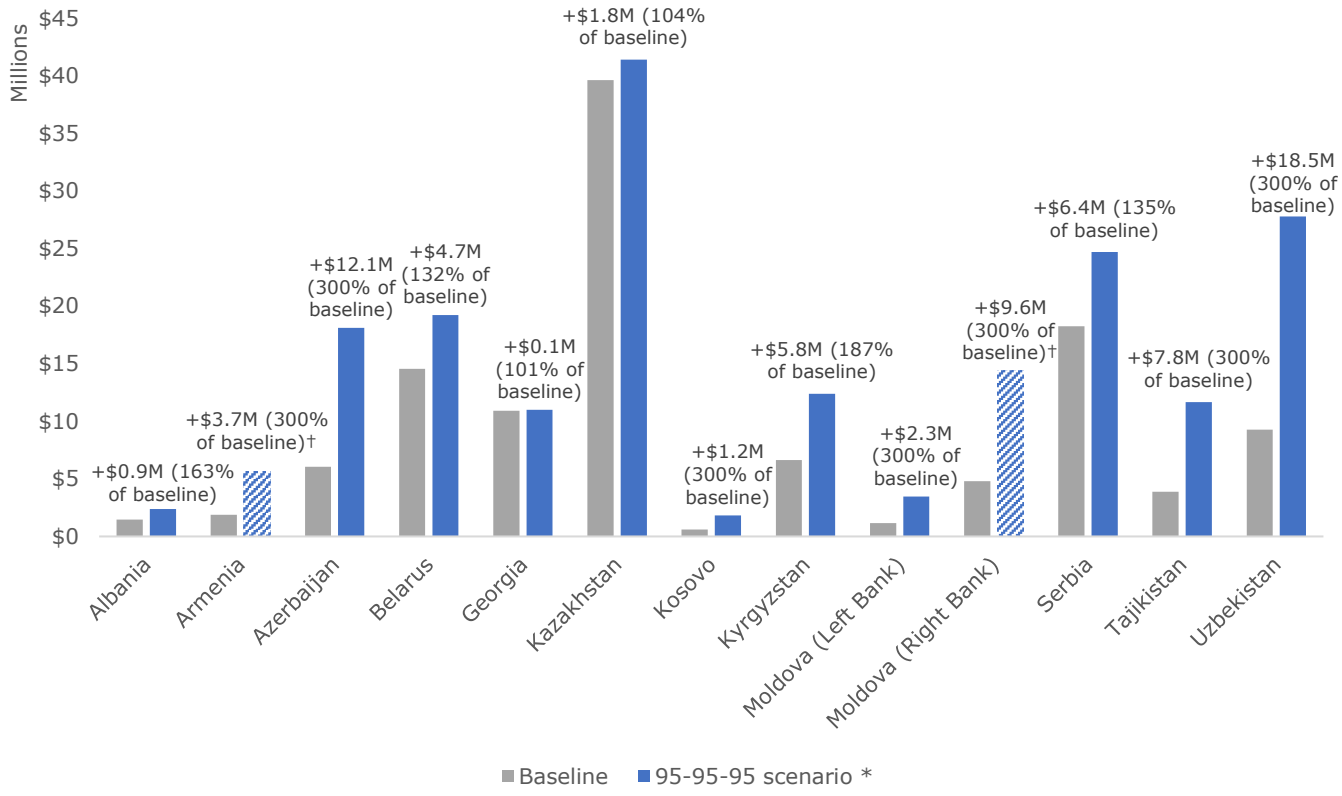
With 100% up to a maximum of 300% spending optimized, most countries are expected to achieve or be within reach of 95% of people living with HIV diagnosed (Figure 7). This equates to US$74.9M needed across all participating countries. Armenia and Moldova Right Bank are only projected to reach 86% diagnosis with 300% spending optimized, suggesting a limited reach of current testing programs. Challenges to reaching 95% diagnosis include undiagnosed infections among unidentified and past key populations (people who had past risk factors but are no longer members of key populations) and their partners, as well as migration of people living with HIV in some contexts.

To reach or approach 95% diagnosis, it is estimated that HIV testing programs for the general population would need to be scaled up in most countries (Figure 8), in contrast to prioritization with 100% optimization (Figure 5). The HIV testing programs for the general population may be the only means to reach unidentified key populations in some contexts and close the gap in people living with HIV unaware of their status. However, the yield from these testing programs is often minimal. Substantial levels of spending will be required to close the gap to the 95% target once high rates of diagnoses are achieved among identifiable key populations. New programs or testing modalities may be needed to reach 95% diagnosis more cost efficiently, as well structural and social changes to reduce stigma and discrimination for those wishing to access HIV testing. Programs for men who have sex with men and people who inject drugs were also commonly prioritized for expansion to increase diagnoses among most affected populations. Although not modeled, delivery approaches and modalities for testing services can be strategically utilized to more cost-effectively reach undiagnosed people living with HIV, such as through index testing and social network testing strategies, tailored demand creation, task shifting and HIV self-testing, and focused provider-initiated testing (33).

ART was suggested to be scaled up in all countries in the 95-95-95 scenario to maximize the number of diagnosed people on treatment. However, no programs were modelled 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 across EECA countries to improve linkage to care, treatment adherence and retention to achieve 95% treatment coverage and 95% viral suppression.

Figure 7. Estimated resources (US$) required to reach 95% of people living with HIV diagnosed by 2030

Explores the resources required to reach **95% diagnosis** as part of the 95-95-95 targets*



Source: 2022 Optima HIV EECA analysis. Baseline based on reported targeted HIV spending in 2021.

* Scenario optimized to reach 95% diagnosis only due to absence of ART retention and adherence programs. Additional funds will be needed to reach the second and third 95 in most contexts.

† Country not projected to be within reach of 95% of people living with HIV diagnosed by 2030 (<90%)

Figure 8. Overview of change in resource allocation from baseline to 95-95-95^ optimized scenario to reach 95% diagnosis

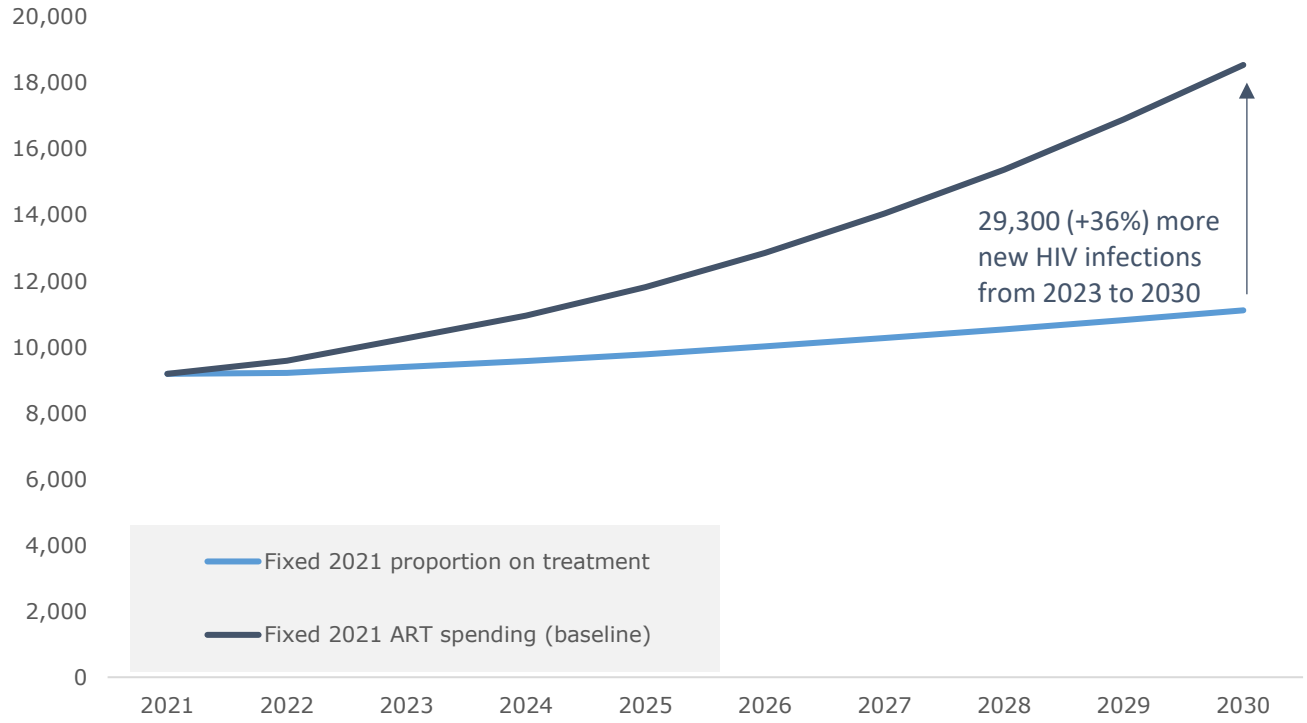
Source: 2022 Optima HIV EECA analysis
^ Scenario optimized to reach 95% diagnosis only due to absence of ART retention and adherence programs in model which will be required to reach 95% treatment coverage and viral suppression in most settings
* HTS program reaches both general population and key population groups

3.4 Projected impact on HIV epidemic

HIV treatment cascade

In 2022, it was estimated that the regional treatment cascade was 79-72-86 in participating countries (Figure 3). By 2030, treatment coverage could reduce to 60% if baseline spending and allocations are maintained, reflecting that additional ART resources will be required to at least maintain current treatment coverage. To ensure the proportion of people on treatment as of 2021 is maintained, an additional US$17.2 million could be required for all 12 participating countries. Should these resources not be available, and spending is maintained at 2021 levels, there could be an estimated 29,300 (+36%) more HIV infections in all participating countries over the 2023 to 2030 period (Figure 9).

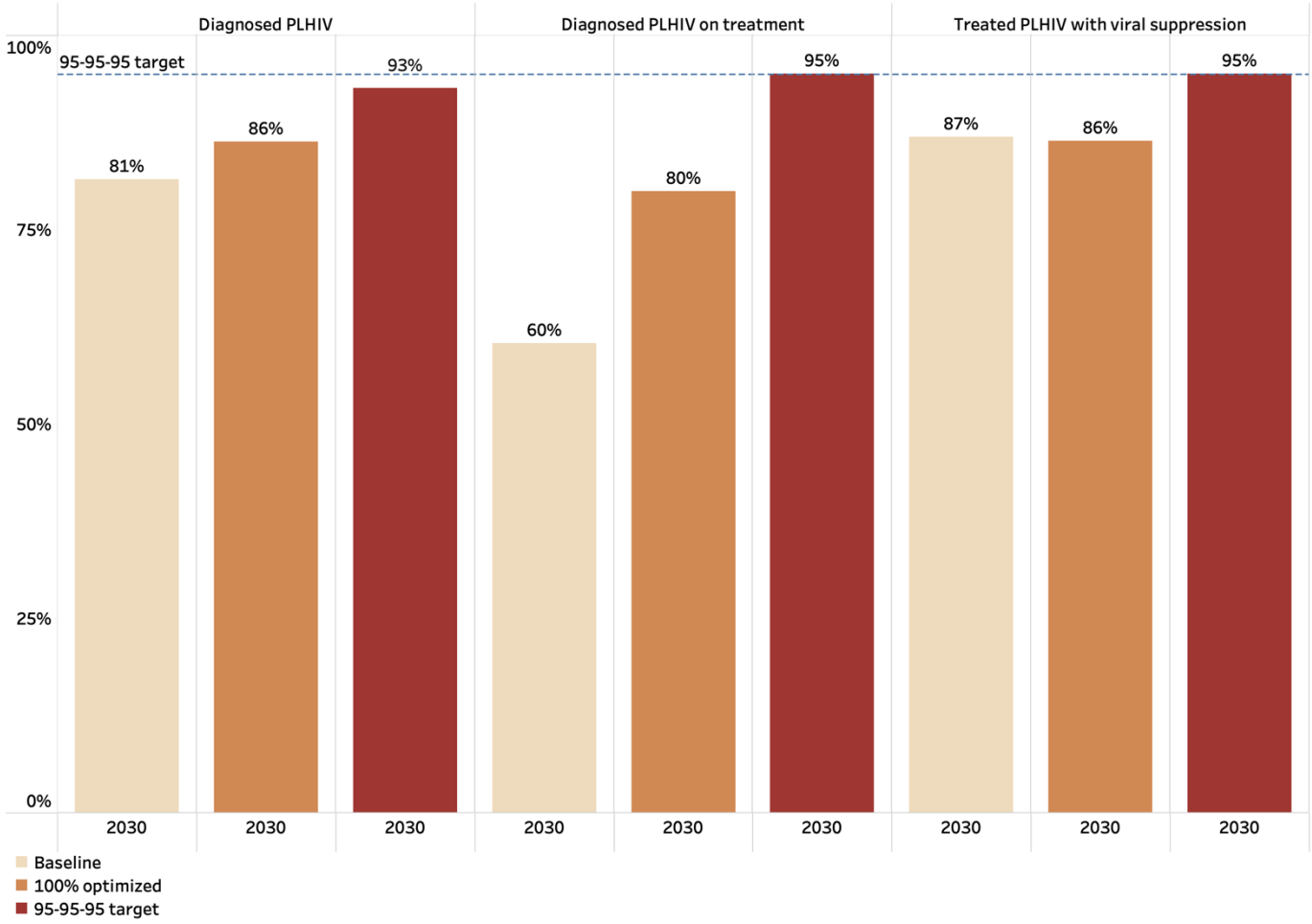
Figure 9. Estimated number of annual new HIV infections if 2021 ART spending is fixed until 2030 (baseline) compared with if 2021 ART proportional coverage is maintained



With 100% optimized spending, it was estimated that the treatment cascade could reach 86-80-86 among the 12 participating countries by 2030 (Figure 10). Only one country, Georgia, was projected to be on track to reach of the 95-95-95 targets by 2030 with optimized spending.

Collectively it is projected that participating countries could reach 93% diagnosis among people living with HIV by 2030 with up to 300% of current resources optimized to approach 95% diagnosis. The diagnosis outcome is slightly short of the target due to the limitations of existing HIV testing programs in some countries (see section 3.3 – 95-95-95 scenario). This scenario assumed the 95% treatment coverage and 95% viral suppression targets would be met (Figure 10).

Figure 10. Projected treatment cascade outcomes by 2030 in relation to the 95-95-95 targets among 12 participating countries in the baseline, 100% optimized and 95-95-95 scenarios



Source: 2022 Optima HIV EECA analysis
Note: Marginal decrease in percentage virally suppressed in 100% optimized scenario due more people starting treatment compared to the baseline scenario.

New HIV infections and HIV-related deaths

In the counterfactual baseline scenario, projections from 2023 to 2030 estimate an increase in the annual number of new HIV infections in the absence of additional funding for ART in all included countries, except for Armenia and Moldova (Figure A5). Overall, there may be an estimated 111,500 new HIV infections and 34,500 HIV-related deaths from 2023 to 2030 across participating EECA countries if allocations and spending are fixed at 2021 levels (Table 2). Optimized reallocation of 2021 spending could avert 35,900 new infections (32%) and 9,200 deaths (27%) compared with the baseline scenario (Table 2, Figure 11).

The 95-95-95 scenario, which was optimized to reach 95% diagnosed and assumes that 95% treatment coverage and 95% viral suppression could also be reached, could avert 73,600 (66%) HIV infections and 19,000 (55%) HIV-related deaths compared with the baseline scenario (Table 2, Figure 11). While treatment retention and adherence programs were not

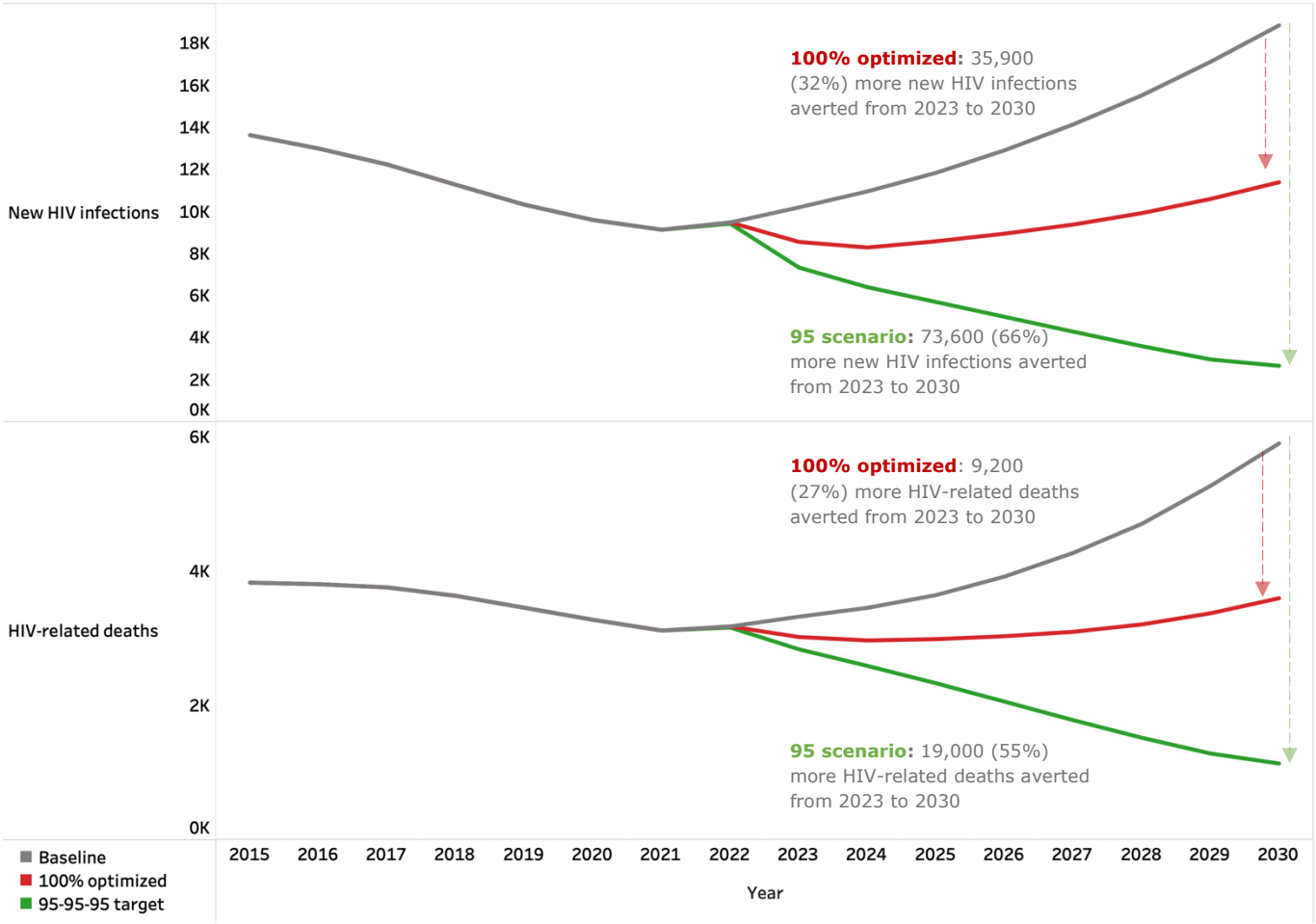
costed or included in the optimization analyses, these findings illustrate the high potential impact of implementing or scaling up such programs.

Table 2. EECA 12-country aggregate cumulative new HIV infections, HIV-related deaths, HIV-related DALYs between 2023-2030 under different scenarios compared with the baseline scenario of fixed 2021 spending on programs

	Cumulative, 2023-2030			Difference from baseline		
	New HIV infections	**HIV-related deaths**	**DALYs**	**New HIV infections**	**HIV-related deaths**	**DALYs**
Baseline	111,500	34,500	915,000			
100% optimized	75,600	25,300	687,500	-35,900 (32%)	-9,200 (27%)	-227,500 (25%)
95*-95-95 scenario	37,900	15,500	462,300	-73,600 (66%)	-19,000 (55%)	-462,300 (49%)

Source: 2022 Optima HIV EECA analysis. All numbers rounded to nearest 100.
95% diagnosis not achieved in Armenia (86%) Azerbaijan (94%), Kosovo (91%), Moldova Right Bank (86%), Tajikistan (90%) and Uzbekistan (92%). Modelled impact based on achievable proportion diagnosed (with up to 300% spending optimized) and assumption that 95% treatment coverage and 95% viral suppression are reached.

Figure 11. Estimated annual new HIV infections and HIV-related deaths (in thousands) under the counterfactual baseline, 100% optimized spending, and 95-95-95 scenarios



Source: 2022 Optima HIV EECA analysis
* Modelled impact based on achievable proportion diagnosed (with up to 300% spending optimized) and assumption that 95% treatment coverage and 95% viral suppression are reached.

4 Study limitations

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

- **Country inclusion:** this report includes multi-country comparisons for 2014, 2019, and 2022, however it should be noted that not all countries were included in each round of analyses, limiting the conclusions that can be made across countries.
- **Population sizes:** There is uncertainty in population size estimates; for key populations stigma may lead to underestimation of population size which 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.

- **Differences noted between UNAIDS (Spectrum) and Optima HIV estimates** are outlined in Appendix 3 and have been discussed with UNAIDS colleagues. These are most likely due to recent reported behavioral changes, which are not included in Spectrum estimates (potentially underestimating their impact) but are included directly in Optima (potentially overestimating their impact if they are overstated in the reports).
- **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.
- **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. Programs were generally modelled with non-linear costs to capture increasing costs as coverage approaches the maximum value. For instance, as the gap in undiagnosed people living with HIV narrows, testing to reach the remaining proportion of people who do not know their status will incur additional costs and challenges and may require different approaches. There is uncertainty in the shapes of these cost functions, values which could influence how easily or how high programs could be scaled up.
- **Retention in care.** This analysis did not consider programs that could improve linkage and retention in care for people diagnosed, or viral suppression for people on treatment. These programs will be essential to achieving the 95-95-95 targets and future analyses should focus on quantifying the spending and impacts of relevant programs, including those tailored to priority populations.
- **Currency.** The COVID-19 pandemic and global economic crises have led to instability in currencies over the past few years. Countries reported spending in US$ and Euros, but what this value represents in local currency may change over time in unknown ways.
- **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.

5 Future analysis priorities

Key priorities for future modelling analyses in the EECA region and associated data needs are as follows:

1) Data for cost, coverage, and impact for **treatment retention, adherence support, and viral load monitoring programs** are required to fully assess the necessary resources and optimized resource allocation to achieve 95-95-95 targets;
2) Collection and consideration of more **strategic information on treatment status** among diagnosed people living with HIV to inform ART resource needs, including an understanding of migration among people living with HIV;
3) Increased consideration for **migration** in country-level models, requiring relevant population, epidemiological, behavioral, program cost and coverage data to inform independent populations of seasonal migrants, account for fluctuations in annual immigration and emigration of sub-populations, and consider the impact and optimized resource allocation for HIV programs for migrants;
4) Inclusion of structural programs such as **stigma and discrimination** reduction, which will require additional data to inform the direct impact of these programs on HIV parameters.

6 Conclusions

This modeling analysis evaluated the allocative efficiency of direct HIV programs across 12 countries in EECA, finding that an optimized resource allocation can have an impact on reducing infections and deaths. Program priorities were broadly identified as scale-up of ART and prevention programs tailored to key populations. 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.

- **Epidemiological situation:**
  - There are **improvements** witnessed in the region since the 2019 analysis, with **more people living with HIV on treatment**. Nevertheless, **progress has stagnated**, and new HIV infections are predicted to continue to increase if there is no additional funding for ART.
  - The HIV epidemic is estimated to be **stabilizing among PWID and further concentrating among MSM**, with indications that there are additional "hidden" key populations among the general population.
- **Optimization recommendations:**
  - In line with 2019 recommendations, **countries have continued to invest in ART** and have realized significant unit cost reductions for ART.

  - Treatment remains the main priority, however this will need to be **complemented by programs to improve ART retention, reduce loss to follow-up and improve viral load testing.** This may require novel programs tailored to the needs of specific key populations and sub-populations.
  - At the same time, there is still substantial investment in general HIV testing programs, where more investment in **tailored programs for key populations** may reach more people living with HIV.
- **95-95-95 targets:**
  - Reaching 95% diagnosis could be within reach with optimized spending for Georgia, but will require substantial investment for the other 11 countries and may be out of reach for Armenia and Moldova (Right Bank) with current testing programs.

7 Appendices

Appendix 1. Country-level model objectives in Optima HIV EECA analyses, 2022

Objective 1: Optimizing resource allocations for targeted HIV interventions at varying budget levels
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: Zero future spending for HIV
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, the opportunity lost to avert HIV infections, deaths, and DALYs?
Objective 3: Achieving 95 targets
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?

Appendix 2. Participating countries in Optima HIV EECA analyses

Table A 1. Participating countries in the Optima HIV EECA workshops 2014-2019

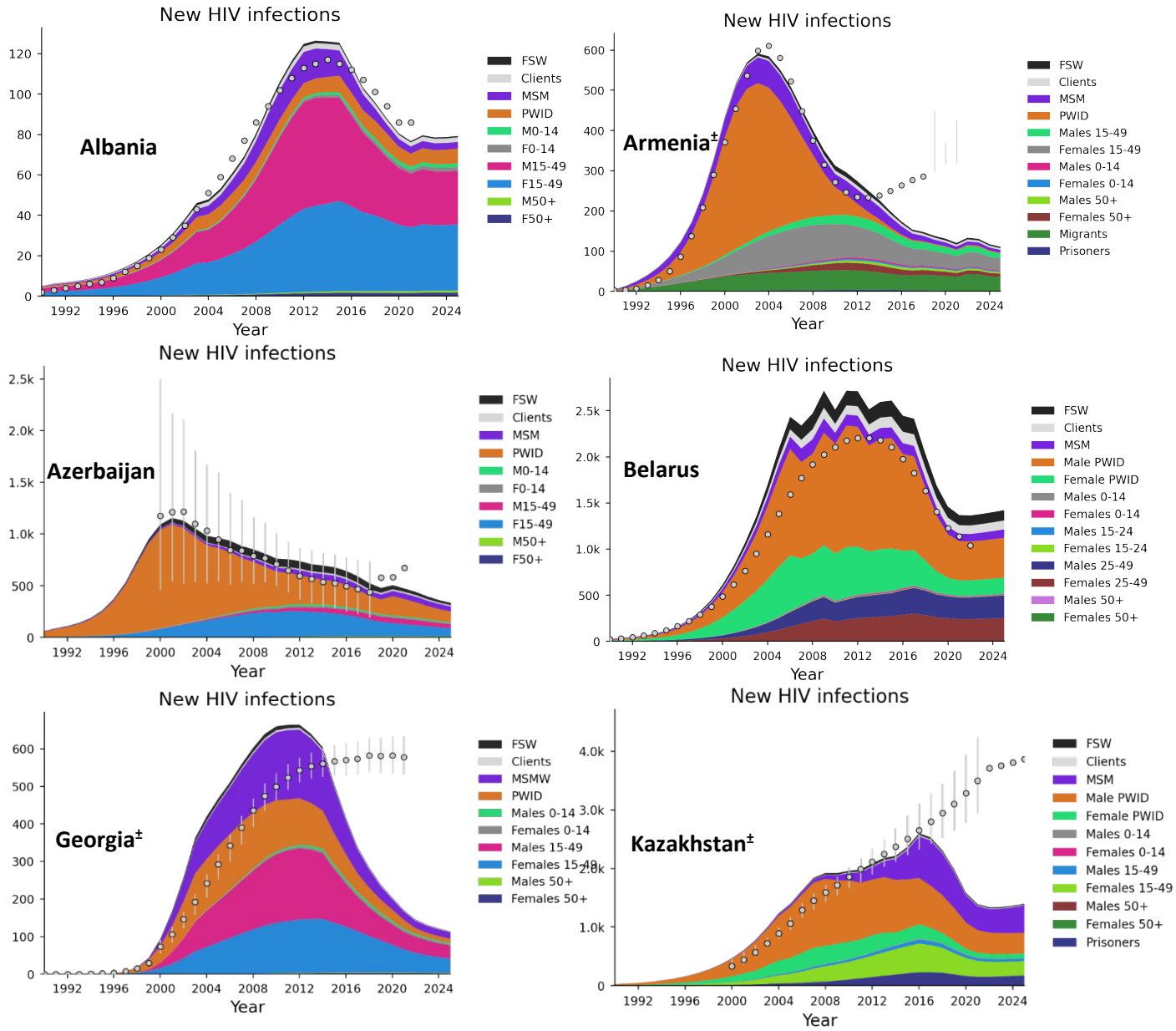
	2014 (n=9)	2019 (n=11)	2022 (n=12)
Albania			■
Armenia	■	■	■
Azerbaijan		■	■
Belarus	■	■	■
Georgia	■	■	■
Kazakhstan	■	■	■
Kosovo		■ *	■
Kyrgyzstan	■	■	■
Moldova	■	■	■
Romania		■	
Serbia			■
Tajikistan	■	■	■
Ukraine	■	■	
Uzbekistan	■	■	■

*The 2019 Kosovo analysis was completed after the collective 2019 workshop

Appendix 3. Model calibration

The model calibration for new HIV infections by subpopulation for each country is shown in Figure A1.

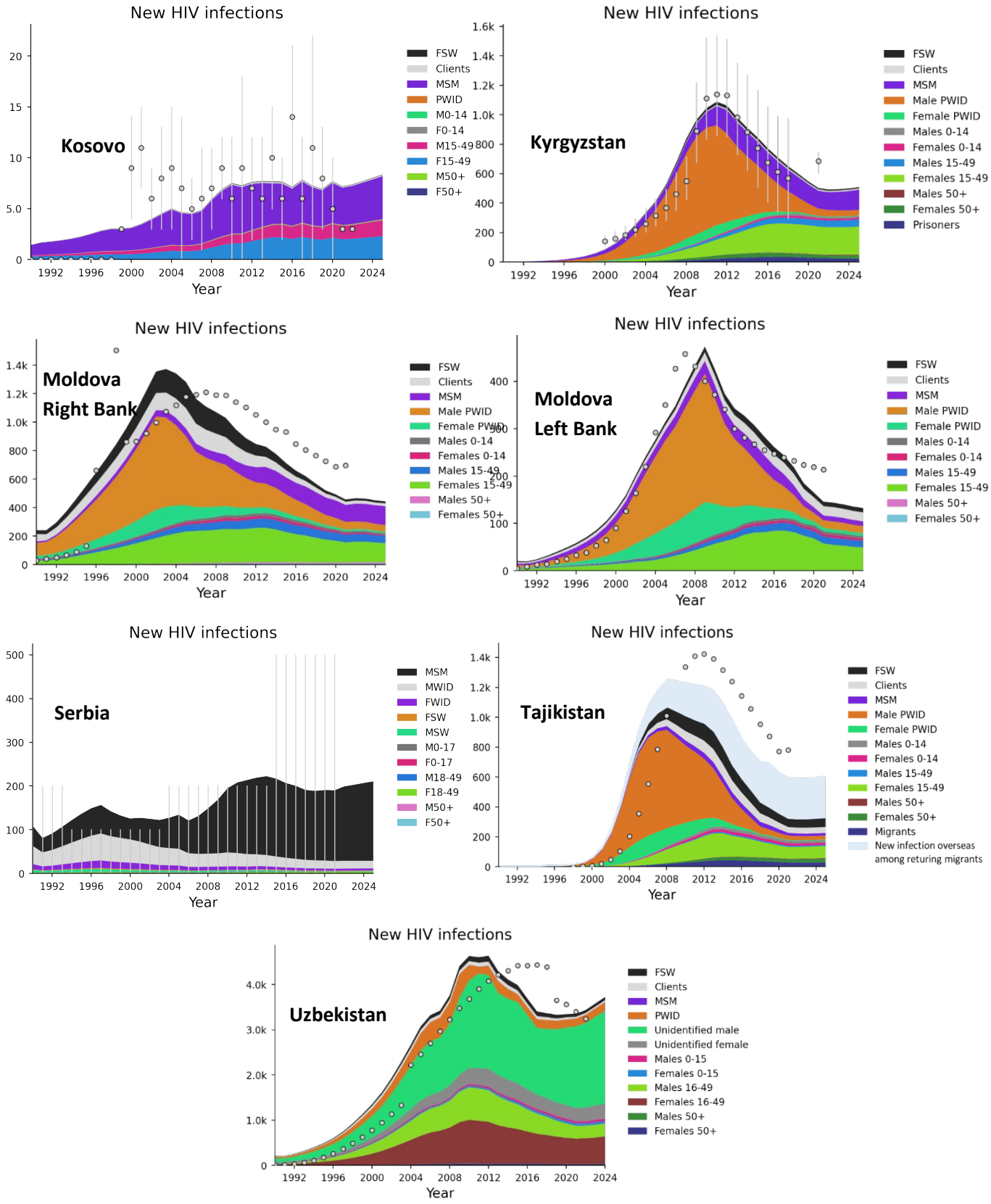
Figure A1. New HIV infections by subpopulation for each country, 1990 to 2026*



FSW, female sex worker; MSM, men who have sex with men; MSMW, men who have sex with men and women; MSW, male sex workers; PWID, people who inject drugs

*Grey data points indicate Spectrum estimates

±Divergence of Optima estimates from Spectrum estimates have been discussed with UNAIDS colleagues. The Spectrum estimates do not take behavioral changes into account, while the Optima HIV model responds significantly to these behavioral changes. Actual estimates may lie somewhere in between.



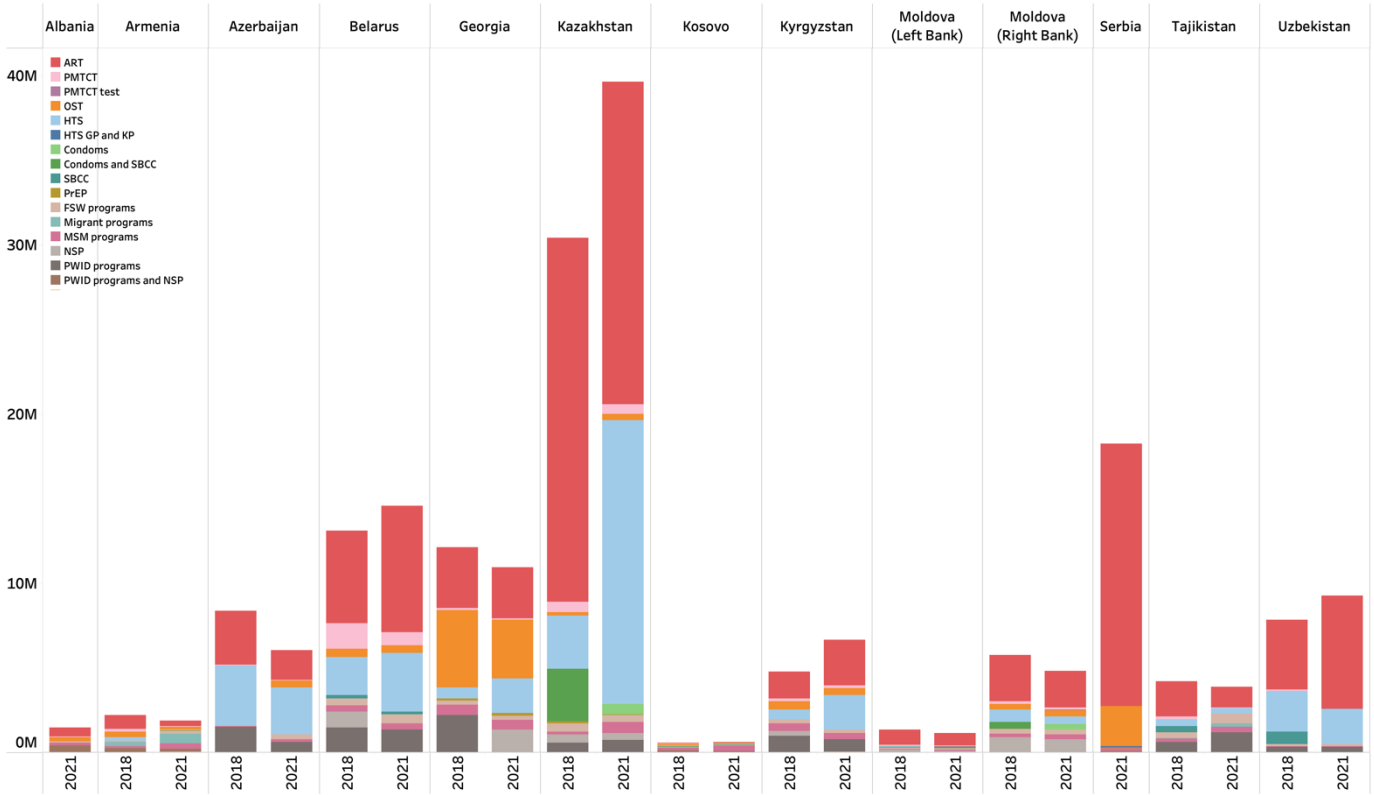
FSW, female sex worker; MSM, men who have sex with men; MSMW, men who have sex with men and women; MSW, male sex workers; PWID, people who inject drugs

*Grey data points indicate Spectrum estimates
±Divergence of Optima estimates from Spectrum estimates have been discussed with UNAIDS colleagues. The Spectrum estimates do not take behavioral changes into account, while the Optima HIV model responds significantly to these behavioral changes. Actual estimates may lie somewhere in between.

Appendix 4. Targeted spending for HIV

Targeted spending includes spending for treatment, testing, and prevention for the general and key populations. The targeted spending for HIV has increased in four countries and decreased in six countries from 2018 to 2021 (Figure A2). Of not, definitions and hence spending of a program may have changed, thus there are limited conclusions to be drawn from the changes in spending. Spending for HIV in 2021 includes a substantial increase in spending for HIV testing among the general population, which was not aligned with the recommendations from the 2019 Optima analysis. Encouragingly, spending for ART has increased in line with the 2019 recommendations, and in countries where it has not, the unit cost has decreased.

Figure A2. Targeted spending for HIV by program for each country, 2018 and 2021

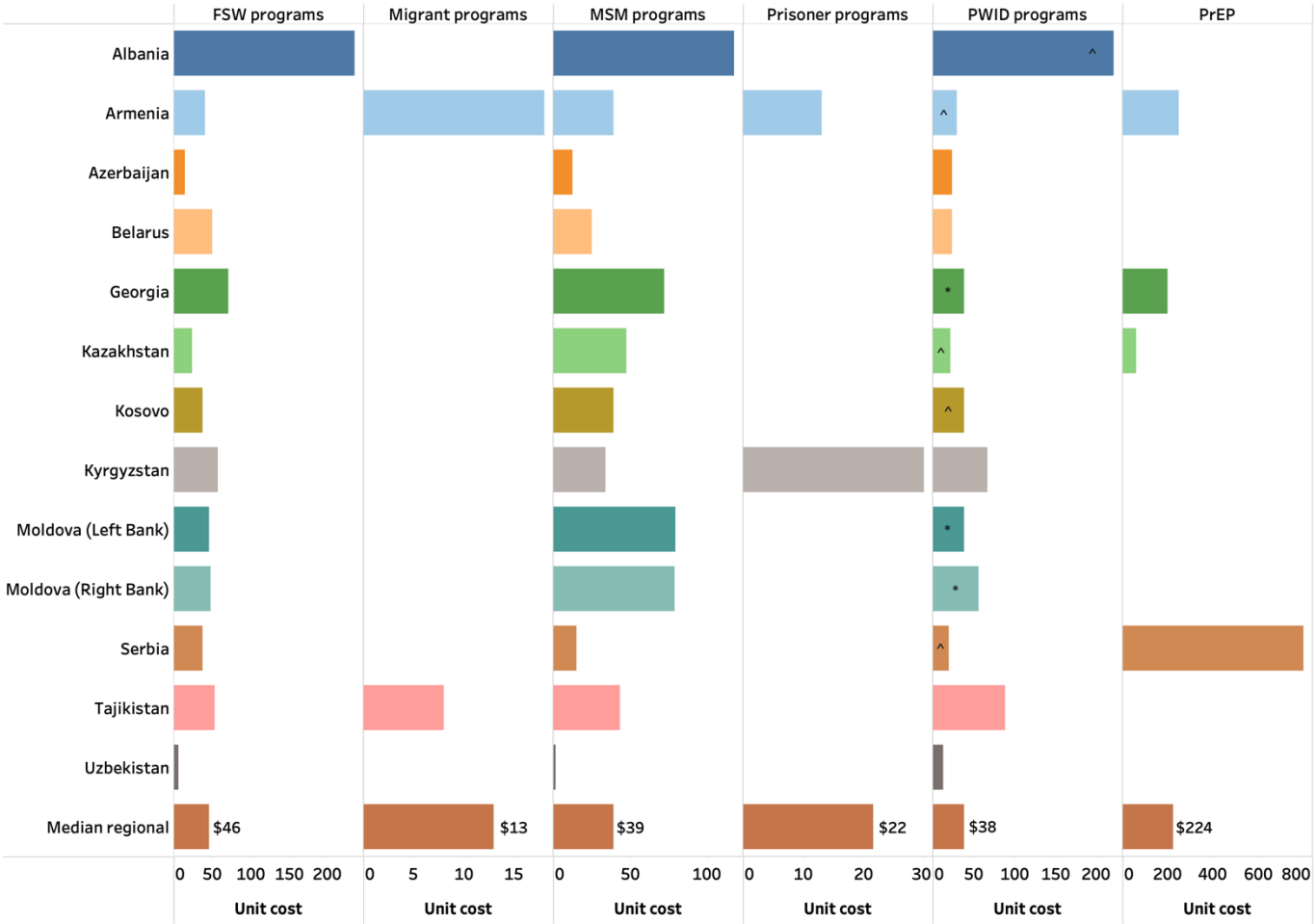


Source: Optima HIV EECA analyses 2019 (2018 spending) and 2022 (2021 spending)
Spending for Kosovo was provided in Euro and converted to USD based on average exchange rate in reporting year (1 Euro:US$1.1811 in 2018 and 1 Euro:US$1.18 in 2021). ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services for general populations; MSM, men who have sex with men; NSP, needle-syringe program; PMTCT, prevention of mother-to-child transmission; PrEP, pre-exposure prophylaxis; PWID, people who inject drugs

Appendix 5. Unit costs by HIV program for key populations

The unit costs for each program vary significantly (Figure A3), most likely due to different definitions of programs in each country, and as a consequence, the costs included for the programs. For instance, a female sex worker program may include testing and prevention in one country but may be limited to only prevention in another. Similarly, the unit costs may include staff resources and commodity costs in some countries while only including procurement costs for commodities in others. In some countries only Global Fund spending was calculated. Unfortunately, we cannot draw any conclusions from the variance between countries for these reasons.

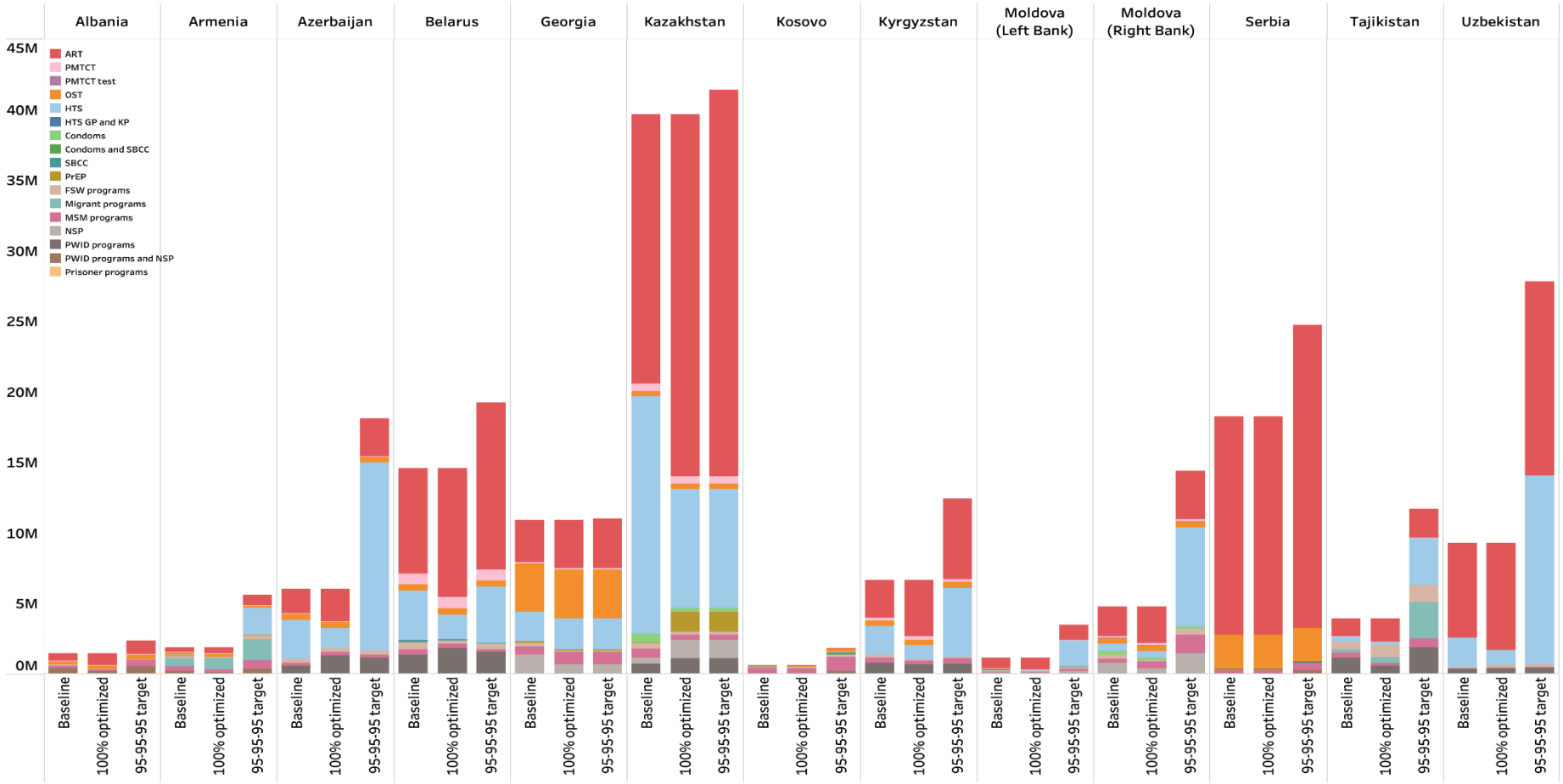
Figure A3. Unit costs (US$) for key population programs by participating country and regional median, 2021



Source: 2022 Optima HIV EECA analysis
^Countries reported spending on both PWID programs and NSP
*Countries reported spending on NSP only
PrEP unit cost for Serbia was estimated by the country team and is not a current program
Unit costs are reported in USD. Unit costs for Kosovo were provided in Euro and converted to USD based on average exchange rate in reporting year (1 Euro:US$1.18 in 2021).

Appendix 6. Spending in baseline, 100% optimized, and 95-95-95 scenarios

Figure A4. Spending in baseline, 100% optimized, and 95-95-95 scenarios for participating countries, 2022 analysis



ART, antiretroviral therapy; FSW, female sex worker; HTS, HIV testing services for general populations; MSM, men who have sex with men; NSP, needle-syringe program; PMTCT, prevention of mother-to-child transmission; PrEP, pre-exposure prophylaxis; PWID, people who inject drugs

Appendix 7. Impact of the optimization by country

The epidemiological impact of keeping baseline spending fixed, optimizing the latest reported spending and reaching 95-95-95 targets by country is illustrated in Figure A5 and Figure A6. The counterfactual baseline scenario estimates an increasing trend in new HIV infections and HIV-related deaths if there is no additional funding for ART in place, with the exception of Armenia, Georgia and Moldova. 100% spending optimized could help to stabilize or reduce annual new infections in most contexts, and further improvement is seen if 95-95-95 targets are achieved. Additional programs to improve treatment adherence and retention will be needed to reach 95-95-95 targets.

Figure A5. New HIV infections from 2022 to 2030 by country for three scenarios:
1) Baseline spending remains fixed
2) 100% of the latest report spending is optimized
3) Reaching 95-95-95 targets

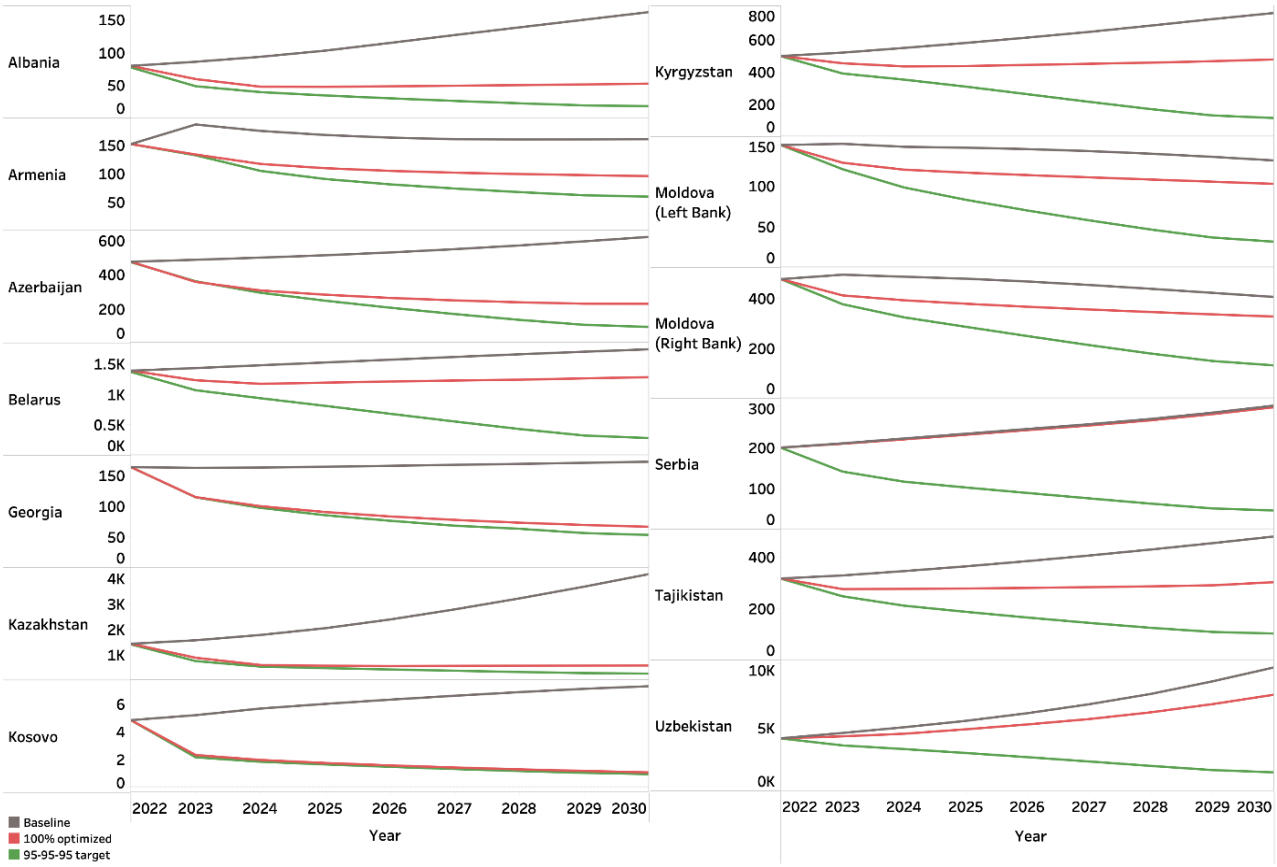
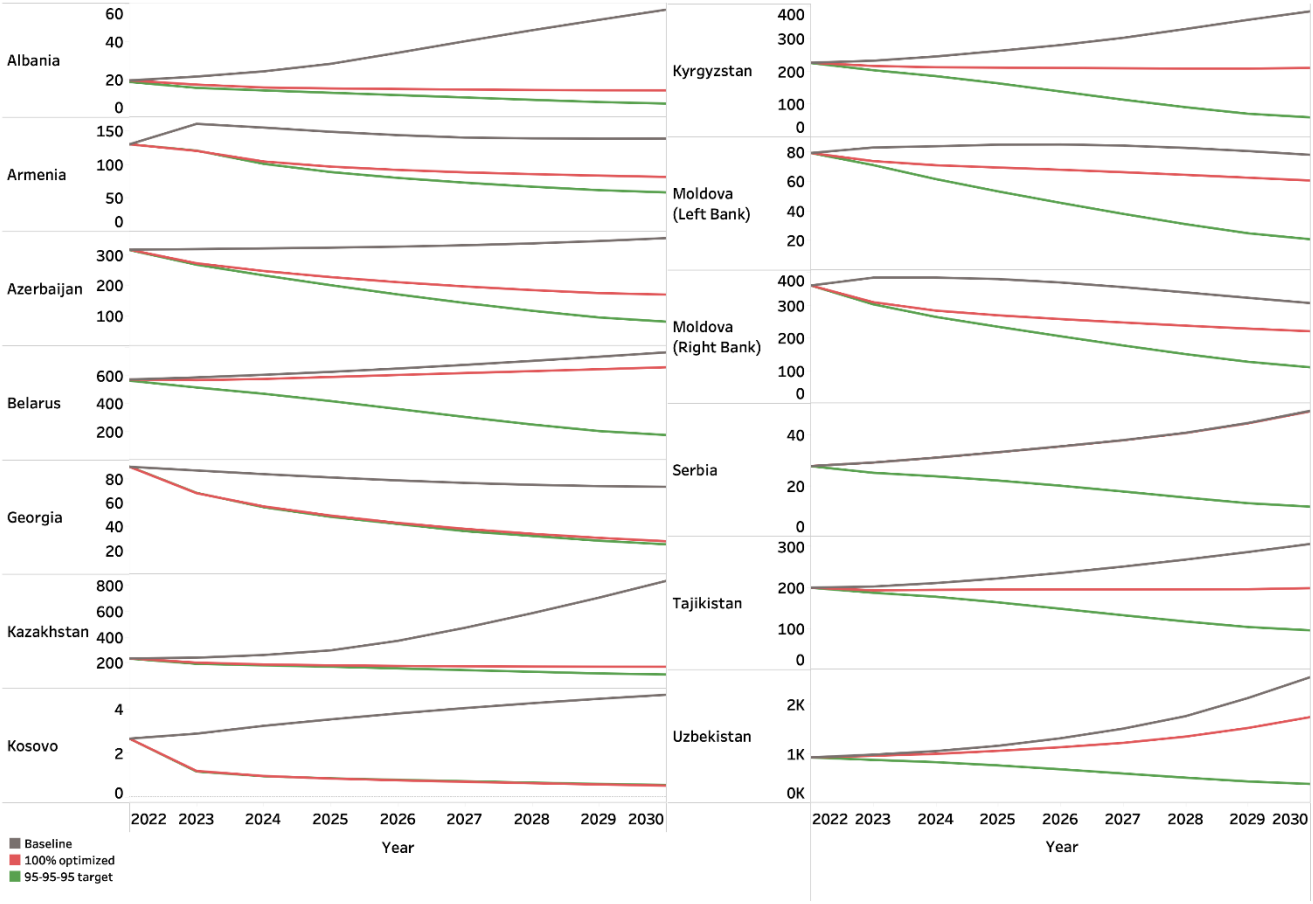


Figure A6. HIV-related deaths from 2022 to 2030 by country for three scenarios:
1) Baseline spending remains fixed
2) 100% of the budget is optimized
3) Reaching 95-95-95 targets



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