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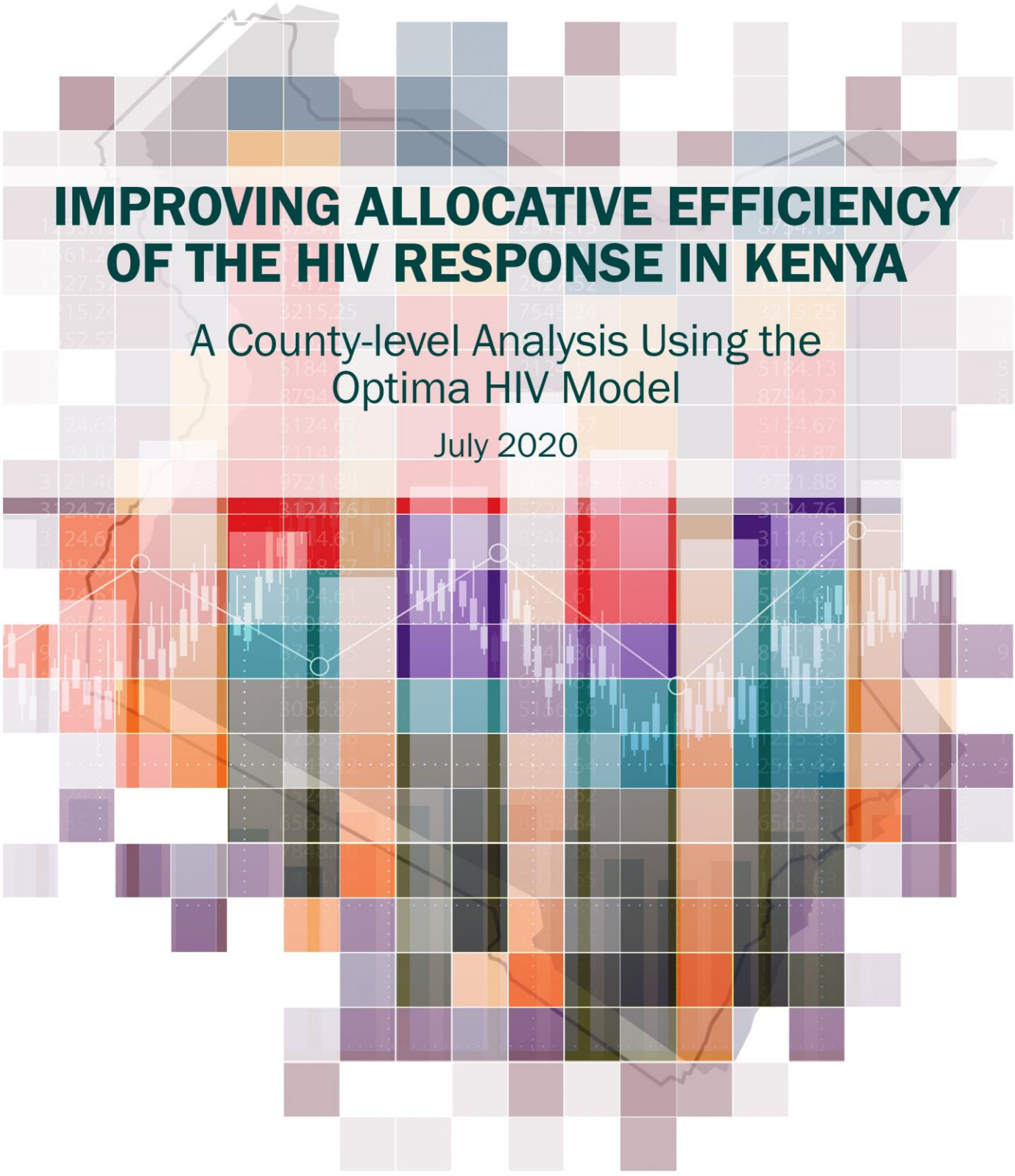
IMPROVING ALLOCATIVE EFFICIENCY OF THE HIV RESPONSE IN KENYA

A County-level Analysis Using the Optima HIV Model

July 2020



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MINISTRY OF HEALTH

IMPROVING ALLOCATIVE EFFICIENCY OF THE HIV RESPONSE IN KENYA:

A County-level Analysis Using the Optima HIV Model

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July 2020

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ACKNOWLEDGEMENTS

This study is the result of a collaboration of various institutions and individuals who all made essential contributions to the work presented in this report. Contributors within each organization are listed in alphabetical order.

The core study, analysis, and report-writing team comprised of Benard Lukoba, Joseph Simiyu and Wendy Chege (National AIDS Control Council); Sherrie Kelly and Mark Minnery (Burnet Institute); and Lonjezo Sithole and Zara Shubber (World Bank).

Substantial strategic and technical inputs were also provided by Dr. Nduku Kilonzo, Regina Ombam, Dennis Kamren, John Kamigwi, Emmy Chesire, Joshua Gitonga, Geoffrey Obonyo, and Caro Ngare, (National AIDS Control Council); Dr Joyce Wamicwe, Irene Mukui, and Helgar Musyoki, (National AIDS and STIs Control Programme); Costing Experts; the National TWG; Azfar Hussain and Anna Roberts (Burnet Institute); Marelize Görgens and Nejma Cheikh (World Bank).

The team would also like to thank all the County AIDS Coordinators, County HIV/AIDS Coordinators (CACS), County AIDS and STI coordinators (CASCOs) and the Strategic Information Technical Working Group who provided critical data, insights and support, as well as other stakeholders and colleagues, including colleagues from the National AIDS Control Council, Kenya National Treasury, the Joint United Nations Programme on HIV/AIDS (UNAIDS), National AIDS and STIs Control Programme (NASCOP) and President's Emergency Plan for AIDS Relief (PEPFAR).

Cover and design: Theo Hawkins (World Bank)

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral therapy
CD4	Cluster of differentiation 4
FSW	Female sex worker
HTS	HIV testing services
KASF	Kenya AIDS Strategic Framework
KENPHIA	Kenya Population-based HIV Impact Assessment
KNBS	Kenya Bureau of Statistics
MSM	Men who have sex with men
NACC	National AIDS Control Council
NASCOP	National AIDS and STIs Control Programme
PWID	People who inject drugs
SBCC	Social behavior change communication
STI	Sexually transmitted infections
UNAIDS	Joint United Nations Programme on HIV/AIDS
VL	Viral load
VMMC	Voluntary medical male circumcision

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EXECUTIVE SUMMARY

Despite significant progress in Kenya's national HIV/AIDS response, Kenya's HIV epidemic remains the fifth largest in the world in terms of the number of people living with HIV, which was estimated to be 1.4 million in 2018 (1). HIV continues to be a leading cause of adult morbidity and mortality (2). There is significant heterogeneity in HIV risk by population and across Kenya's 47 counties. Kenya exhibits a range of subnational HIV epidemic patterns including generalized, concentrated, and mixed with almost a third (30%) of new HIV infections estimated to have occurred among key populations such as female sex workers (FSWs) (3). Estimates for HIV prevalence across counties range from <0.1% in Garissa to 19.6% in Homa Bay, with a national HIV prevalence estimate of 6.6% among females and 3.1% among males aged 15–64 years and 0.7% among children 0–14 years in 2018 (1).

There is significant heterogeneity in HIV risk by population and across Kenya's 47 counties. Kenya exhibits a range of subnational HIV epidemic patterns including generalized, concentrated, and mixed with almost a third (30%) of new HIV infections estimated to have occurred among key populations such as female sex workers.

Although the Kenya Government has increased spending on the HIV response in the last decade, around 70% of the national HIV response is still reliant on external donor financing (4). With uncertainty around availability of future international HIV/AIDS funding, the sustainability of Kenya's HIV/AIDS response is at risk. For Kenya to sustain its national HIV response, the best decisions and delivery choices must be made to help ensure that the response is as efficient and effective as possible.

This report outlines findings from an allocative efficiency modeling analysis for Kenya's HIV epidemic and response that was conducted by the National AIDS Control Council (NACC), the National AIDS and STIs Control Programme (NASCOP), the World Bank, and the Optima Consortium for Decision Science, in consultation with other stakeholders at the national and county levels. This study was conducted to inform the 2020/21–2024/25 Kenya AIDS Strategic Framework (KASFII).

We estimated the optimized resource allocations within counties, whereby the total HIV budget for each county was kept the same, and across counties, where resources could be shifted between counties. The time horizon for this analysis was from 2019 to 2030 with the objective to minimize new HIV infections and HIV-related deaths by 2030 to align with the Kenya's Vision 2030. Estimated outcomes for infections and deaths were also presented in the Appendix for 2025 to align with the new 2020/21–2024/25 KASFII.

KEY RECOMMENDATIONS FOR HIV INVESTMENT IN KENYA

- **Reallocate the latest reported HIV budget prioritising the scale up of care and treatment as well as cost-effective preventative programmes to minimize the number of new HIV infections and HIV-related deaths.** To minimize new HIV infections and HIV-related deaths by 2030, recommendations to optimize resources within counties includes prioritizing scale-up of care and treatment, HIV prevention and testing programs targeting females sex workers (FSW), HIV prevention services for the general population (condoms and SBCC), and HIV prevention and testing programs targeting people who inject drugs (PWID) by 2030. This could lead to 50,000 more new HIV infections (almost 10% more) and 40,000 more HIV-related deaths (almost 15% more) being averted.
- **The current HIV budget should be maintained at minimum to avoid reversing the gains made in the HIV response.** Decreasing the latest reported budget by 50% is estimated to potentially result in 84,000 more new HIV infections (5% more) and 74,000 more HIV-related deaths (6% more) over the 2019 to 2030 period when compared to the status quo. To continue progress in reducing the HIV epidemic at least maintaining the HIV budget is therefore recommended. Effective budget increases are possible through, for example, implementation efficiency gains (not explored by this analysis), such as using more optimal service delivery modalities, reduced cost of antiviral regimens, and reduced spending on non-targeted programs, among others.

  The current HIV budget should be maintained at minimum to avoid reversing the gains made in the HIV response.
- **Additional interventions and innovations to further reduce service delivery costs and increase effectiveness will be required if Kenya is to reach the 2030 target to end AIDS as a public health threat.** Even with a doubling of budget for the HIV response optimized within all counties, the 2030 HIV incidence reductions targets are unlikely to be met, meaning there are diminishing marginal returns with the current available 'toolbox' of interventions. In countries with large existing disease burdens such as Kenya, reducing HIV incidence to such low levels will need personalized and pre-emptive HIV prevention strategies.

SECTION 1

INTRODUCTION

Kenya's 2014/15–2018/19 AIDS Strategic Framework (KASF)I marked a milestone in the country's HIV response in the wake of a new constitution that devolved political and economic power to its 47 newly created counties. The KASFI recognized and emphasized the importance of focusing on effective evidence-based interventions and prioritising investments for improved health outcomes for all. This included an investment case approach with emphasis on geographical, population and intervention prioritisation, and feasibility and sustainability for impact. As Kenya approached the end of the 2014/15–2018/19 KASFI period and started preparations for the new 2020/21–2024/25 KASFII, a county-level HIV allocative efficiency analysis was conducted to review and re-evaluate approaches to ensure that future investments and response were efficient and effective. Allocative efficiency analyses allow the most cost-effective resource allocation, within a defined resource envelope, to be estimated. The aim of any allocative efficiency analysis is to guide the financing of the right interventions, for the right people, in the right places, to maximize health outcomes.

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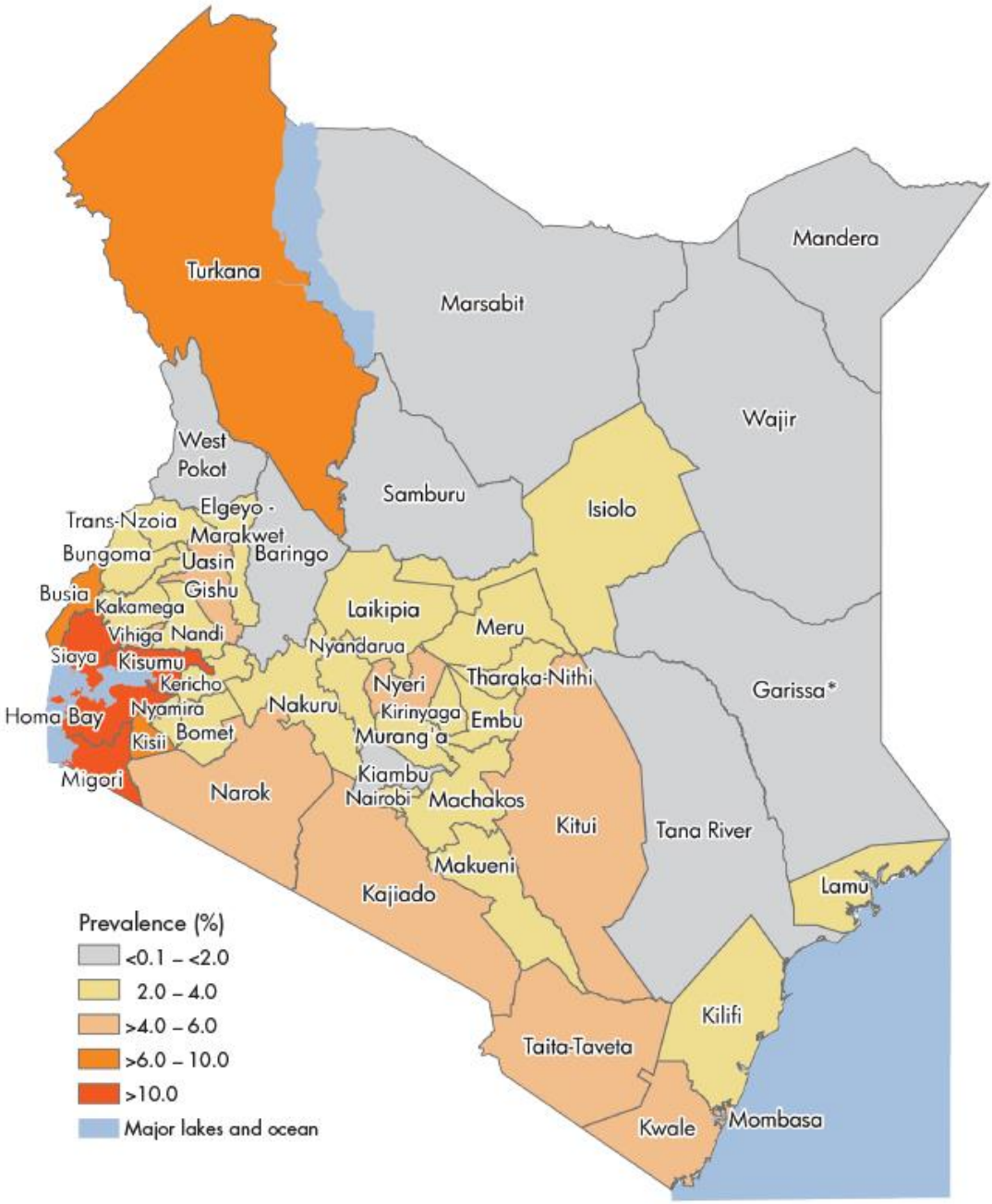
1.1 Kenya's HIV epidemic and response

While there has been a gradual decline in the number of annual new adult HIV infections to 36,000, there were still an estimated at 1.4 million people living with HIV in Kenya in 2018 (1), with population and geographical heterogeneity across the country. Four Western counties, Homa Bay, Kisumu, Migori, Siaya, are described as hyperendemic with HIV prevalence estimates higher than 13%. Furthermore, almost half (43%) of all new HIV infections were estimated to have occurred in only five counties, namely Nairobi, Homa Bay, Kisumu, Siaya, and Migori. Female sex workers in Nairobi had the highest respondent driven sampling estimate for HIV prevalence of any other group (29.3% [95% CI: 24.6%–34.9%], N=593, November 2010–January 2011), followed by people who inject drugs in Nairobi (18.7% [12.2%–26.7%], N=263, January–March 2011), and men who have sex with men in Nairobi (18.2% [13.1%–23.6%], N=563, July–October 2010) (3).

Map 1.1 County HIV prevalence of adults aged 15–64 years



Source: KENPHIA 2018 Preliminary Report, 2020.

Kenya's HIV response is widely praised as a success story with significant achievements in reducing new HIV infections and HIV-related deaths over the last decade. The response at the national and county levels is guided by the KASFI. The country reports reaching the first and second 90-90-90[1] targets, with 79.5% (95% CI: 77.0%–82.0%) of adults aged 15–64 living with HIV knowing their HIV status, 96.0% (95% CI: 94.7%–97.3%) of those adults who know their status were on ART, and 90.6% 95% CI: 88.5%–92.7%) of those adults on ART having achieved viral suppression. The number of people on HIV treatment has also

1 By 2020, 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy and 90% of all people receiving antiretroviral therapy will have viral suppression.

significantly increased, almost doubling over the last five years, from approximately 600,000 in 2013 to 1.12 million in 2018 (5). This translates to an increase in ART coverage from 43% to 75% over this period. Across the counties, however, there is significant disparity in ART program performance. ART coverage among adults living with HIV at the county level ranges from 23% to 99% (table A2.1). Eleven counties latest reported ART coverage among adults 15 years and older above 80%, 25 counties coverage between 50% and 79%, nine 32% to 49%, one county an ART coverage of 23% (Tana River), and one county with coverage not reported (Mombasa). There is similar county-wide heterogeneity in prevention of mother-to-child transmission (PMTCT) coverage, with 12 counties achieving greater than 80% coverage, 21 counties achieving 50%–79% coverage, 11 counties achieving 24%–49% coverage, and three counties having less than 23% coverage of PMTCT (5). The incidence of mother-to-child transmission of HIV at 18 months in Kenya stood at 11.5% in 2017, down from 14.0% in 2014 (5). There has also been progress in scale-up of non-ART prevention efforts. For example, the annual number of voluntary medical male circumcisions (VMMC) conducted in 2017 (230,854) surpassed the 200,000 circumcisions annual targets set for the 2014/15–2018/19 KASFI mid- (2017) and end-term (2019). The proportion of men circumcised is now greater than 95%. Similar achievements have been reported in the coverage of HIV programmes targeting key populations, with over 80% of FSWs, MSM, and PWID being reached with combination prevention programmes in 2017.

1.2 Rationale for this study

Since 70% of Kenya's HIV response is externally funded and donor funding is declining (7), the future of HIV funding for Kenya is at risk. Furthermore, since Kenya graduated to the World Bank's lower-middle income country status in 2015, it will be less eligible for donor funding in this round of Global Fund disbursement. For Kenya to sustain its national HIV response, in addition to the 2014/15–2018/19 KASFI commitment to increase domestic HIV financing to 50% of the total program budget, sound decisions and delivery choices must be made to help ensure that the HIV response is as efficient and effective as possible. Kenya's diversity in HIV epidemics, ranging from generalized to concentrated and mixed, with high heterogeneity in the contribution of key populations to county-level HIV transmission also necessitates within-county resource allocations and policy choices that are tailored to the local epidemic profile in each county. To help inform the next iteration of the KASF (KASFII), this modelling study was conducted by the National AIDS Control Council (NACC) and the National AIDS and STIs Control Programme (NASCOP), in collaboration with the World Bank, the Optima Consortium for Decision Science, and other stakeholders.

For Kenya to sustain its national HIV response, in addition to the 2014/15-2018/19 KASFI commitment to increase domestic HIV financing to 50% of the total program budget, sound decisions and delivery choices must be made to help ensure that the HIV response is as efficient and effective as possible.

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SECTION 2

OBJECTIVES

To improve the HIV response, resources can be optimally reallocated within counties in Kenya. To this end, the following study objectives were examined:

Objective 1: Optimization within counties

- To estimate the optimized annual resource allocations within counties for 2019 to 2030 to minimize new HIV infections and HIV-related deaths by 2030 for varying budget levels [2], and to present estimated outcomes for infections and deaths by 2025 to align with the end of the new 2020/21–2024/25 KASFII.
- To examine future HIV epidemic trends at the national and county levels to better understand the HIV epidemic and thereby help guide strategic planning through to 2030 to align with Kenya's Vision 2030.

Objective 2: Impact of past HIV spending

- To estimate the epidemiological impact of the 2014/15–2018/19 KASFI spending on new HIV infections and HIV-related deaths averted compared with no spending over this period, as well as to evaluate and learn from the successes in the HIV response in Kenya.

2 Varying budget levels of 50%, 90%, 100%, 110%, 150%, and 200% were examined.

Kenya's HIV response is widely praised as a success story with significant achievements in reducing new HIV infections and HIV-related deaths over the last decade.

Khadija Rama, standing with a group of people, is the founder of Pepo La Tumaini Jangwani, HIV/AIDS Community Rehabilitation Program, Orphanage & Clinic. offers hope, support and care for orphan and vulnerable children living with HIV/AIDS in Nairobi, Kenya, Africa. Photo: Joseph Sohm/Dreamstime.com

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SECTION 3

METHODS

3.1 Model choice

This analysis was conducted using the Optima HIV model version 2.9.2. Optima HIV is an epidemiological model of HIV transmission overlaid with an economic analysis compartment that contains a resource optimization algorithm.

3.2 Study design

A separate Optima HIV model was created for each of the 47 counties in Kenya. County models used in this analysis were developed by the country team (officers within NACC and NASCOP), the World Bank, and the Optima Consortium for Decision Science, in consultation with other stakeholders.

3.3 Data sources

Data and estimates used to inform the county models were retrieved from national, county-level, and stakeholder reports, HIV program data sources, other publications, and from expert opinion (table A1).[3]

3.4 Populations modeled

General population and key population groups were included in the Optima HIV model for each of the 47 counties in Kenya. General population groups include females aged 0–14 years, males 0–14, females 15–24, males 15–24, females 25–49, males 25–49, females 50 years and older (females 50+), and males 50 years and older. Key populations include female sex workers (FSW), clients of female sex workers (clients), men who have sex with men (MSM), and people who inject drugs (PWID).

3 Reports included but were not limited to the Behavioural Assessment of Key Populations in Kenya Polling Booth Survey (2017); County Profile reports (2014, 2016, 2018); Demographic and Health Survey (2014); District Health Information System 2 and other program data; DREAMS Overview (2016-2017); HIV Financing County Profiles (2018); Kenya AIDS Indicator Survey (2012); Kenya AIDS Response Program reports; Kenya AIDS Strategic Framework (2014/15-2018/19) and Mid-Term Review Report (2018); Kenya HIV Estimates report (2015 and 2017); Kenya Integrated Biological and Behavioral Surveillance reports; Kenya Most At Risk Populations Size Estimate Consensus report (2013); Kenya National Bureau of Statistics County Projections (2017); Key populations reports; National AIDS Spending Assessment reports (2006-2007 and 2009-2011); PEPFAR Country Operational Plan Strategic Direction Summary (2017); UNAIDS AIDSinfo and Key Population Atlas; and United Nations World Population Prospects (WPP, 2017) estimates and projections.

3.5 HIV programs modeled

Seven HIV programs were included in this analysis, including: (1) care and treatment (comprised of antiretroviral therapy (ART) and prevention of mother-to-child therapy (PMTCT)); (2) HIV prevention services (condoms and social behavior change communication (SBCC)); (3) HIV testing services (biomedical services only); (4) HIV prevention and testing programs targeting female sex workers (FSW); (5) HIV prevention and testing programs targeting men who have sex with men (MSM); (6) HIV prevention and testing programs targeting people who inject drugs (PWID) including needle-syringe programs opiate substitution therapy (OST); and (7) voluntary medical male circumcision (VMMC). Pre-exposure prophylaxis (PrEP) programs were not modelled. Only targeted HIV programs were considered in this analysis. Non-targeted programs, representing programs whose direct impact on the epidemic is not readily determinate, were excluded. These non-targeted programs include environmental HIV programs, human resources, management, monitoring and evaluation, non-disaggregated prevention programs, orphans and vulnerable children, other HIV care, social protection. All costs are reported in United States Dollars (USD) with no discounting applied.

3.6 Model overview

Optima HIV has a population-based dynamic, compartmental model. It has a disease transmission module that is calibrated to demographic (population size, and birth and background death rates) and epidemiological (HIV, ulcerative STIs, and tuberculosis prevalence) estimates. It is informed by sexual and injecting behavioural values and mixing patterns, as well as programmatic data for testing and treatment across the care cascade (time for linkage to care, percentage lost-to-follow-up, and treatment failure rate). The model assumes parameter values for relative disease-related transmissibility and disease progression specified for acute infection and CD4 health states. People on suppressive ART are assumed to have a 92% reduction in HIV transmission compared with people not on ART (table A2.2). People not on suppressive ART and not in early or late stage infection were assumed to have a relative HIV transmission rate of 50%. Different death rates by health state (acute infection or CD4 stage), ART status (on suppressive or non-suppressive ART), and tuberculosis cofactor were applied.

HIV program cost and coverage data are used to generate cost functions for each HIV program. Cost functions represent the relationship between cost and coverage and coverage and outcomes for each program. Different values for changes in transmissibility are applied for condom use, circumcision, and treatment types (table A2.2). Additional Optima HIV model details are provided in Kerr et al. (8).

Optimization analyses were conducted to estimate the most cost-effective investment across a combination of HIV programs to minimize new HIV infections and HIV-related deaths.

3.7 Optimization

Optimization analyses were conducted to estimate the most cost-effective investment across a combination of HIV programs to minimize new HIV infections and HIV-related deaths. The optimization was conducted using the adaptive stochastic descent (ASD) algorithm (9). Resources were optimized either within or across counties. For optimizations within counties, the total HIV

budget for each county is maintained and resources optimized within each county budget. In contrast, for optimizations across counties, resources could be shifted between counties and optimized for cost-effectiveness. For the optimization within counties, constraints were applied within the optimizations to ensure those on treatment remained on treatment unless lost by natural attrition. Thus, in the optimized allocation, budgets for antiretroviral therapy (ART) and prevention of mother-to-child transmission (PMTCT) could not be reduced to ensure at least the same number of people were maintained on treatment. Optimization across counties is an illustrative analysis only and no constraints were applied.

Prioritization for given programs within the optimization is defined for this study as a proportional scale-up of allocation of any magnitude from the latest reported level. Finally, the model algorithm aimed to estimate a theoretical optimal distribution of resources and emphasis of different HIV programmatic responses which minimizes both new HIV infections and HIV-related deaths given the local epidemic parameters and data, cost of delivering services, subject to the constraints as defined. Appendices 2–5 show key model parameters, model calibration and cost curve figures for Nairobi county as an example, and unit costs used in this study.

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Optimization analyses were conducted to estimate the most cost-effective investment across a combination of HIV programs to minimize new HIV infections and HIV-related deaths. The optimization was conducted using the adaptive stochastic descent (ASD) algorithm (9). Resources were optimized either within or across counties. For optimizations **within** counties, the total HIV budget for each county is maintained and resources optimized within each county budget. In contrast, for optimizations **across** counties, resources could be shifted between counties and optimized for cost-effectiveness. For the optimization within counties, constraints were applied within the optimizations to ensure those on treatment remained on treatment unless lost by natural attrition. Thus, in the optimized allocation, budgets for antiretroviral therapy (ART) and prevention of mother-to-child transmission (PMTCT) could not be reduced to ensure at least the same number of people were maintained on treatment. Optimization across counties is an illustrative analysis only and no constraints were applied.

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Prioritization for given programs within the optimization is defined for this study as a proportional scale-up of allocation of any magnitude from the latest reported level. Finally, the model algorithm aimed to estimate a theoretical optimal distribution of resources and emphasis of different HIV programmatic responses which minimizes both new HIV infections and HIV-related deaths given the local epidemic parameters and data, cost of delivering services, subject to the constraints as defined. Appendices 2–5 show key model parameters, model calibration and cost curve figures for Nairobi county as an example, and unit costs used in this study.

After scale-up of treatment for all diagnosed people living with HIV, the next priority to improve outcomes across the cascade of care and avert infections and deaths is to increase diagnoses by scaling-up testing.

Kenyan women stand in line to get health checkup for HIV/AIDS at the Pepo La Tumaini Jangwani, HIV/AIDS Community Rehabilitation.
Photo: Joseph Sohm/Dreamstime.com

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SECTION 4

STUDY LIMITATIONS

As with any modelling study, there are limitations with this analysis that should be considered when interpreting results and recommendations. One of the main limitations for this study was around the availability of data at the county-level. Limitations in data availability and reliability can lead to uncertainty around projected results. The model optimization algorithm accounts for inherent uncertainty, but it may not be possible to account for all aspects of uncertainty because of poor quality or insufficient data.

The following data were available at the county-level and were used to inform the respective county models or to guide calibration of the county models: demographic data (population size, birth rate, background death rate) and treatment (antiretroviral therapy (ART), prevention of mother-to-child transmission (PMTCT), and opiate substitution therapy (OST; by proportion of PWID)), and annual numbers of HIV tests, HIV diagnoses, HIV infections, HIV-related deaths, ART initiations, and those virally suppressed, as well as the percent of people living with HIV who know their status.

The availability of detailed county-level costing data, which are needed to generate cost functions, that is the relationship between spending and coverage and coverage and outcomes, was limited. County-level estimates of expenditure were only readily available for two program categories (1) overall HIV prevention and (2) care and treatment (6). Care and treatment county expenditure estimates were used directly for this modeled intervention. Care and treatment unit costs were calculated using care and treatment estimates of expenditures and numbers of people on antiretroviral therapy for each county (table A4.2). Since it cost some counties more to put an average person living with HIV on treatment for one year, for various operational and programmatic reasons, unit costs for care and treatment differed between counties with an average unit cost of US$663, ranging from US$85 in Kiambu to US$3,677 in Wajir. Overall HIV prevention expenditure estimates for each county needed to be disaggregated into separate HIV prevention programs that were modeled. In consultation with the country team, county expenditures for HIV prevention programs, including HIV testing, condoms and SBCC, VMMC, HIV testing and prevention targeting FSW, HIV testing and prevention targeting MSM, and HIV testing and prevention targeting PWID, were derived by triangulating county expenditure estimates for overall prevention for 2013/2014, 2014/2015, and 2015/2016; county coverage values for

The availability of detailed county-level costing data, which are needed to generate cost functions, that is the relationship between spending and coverage and coverage and outcomes, was limited.

HIV testing for 2015 and for VMMC for 2017; nationally informed unit costs for each HIV prevention program (tables A4.1 and A4.2); and the latest reported proportion spent on each HIV prevention program of the national prevention budget.

Another key indicator to inform this model exercise is HIV prevalence. HIV prevalence estimates at the county-level were not available for all populations. The following HIV prevalence estimates were used to calculate missing estimates: overall HIV prevalence by county for 2018 (figure 1), HIV prevalence for adults 15–49 years of age for 2017 (overall, male, and female) (6), estimated numbers of people living with HIV by county for children aged 0–14, youth 15–24, and adults 15 years or older for 2015 (6), and HIV prevalence values for female sex workers for 2010 (3) and 2012 (10). Estimates of HIV prevalence from the Spectrum model were not generated at the county level, only at the regional level, so could not be used to compare trends for county model calibrations.

County-level values for HIV testing, breastfeeding rates, sexual and injecting partnership and behaviour, average time to be linked to care, percentage of people in care who are lost to follow-up, average number of viral load monitoring tests conducted per person per year, and treatment failure rate were not readily available. As such, national values were used as proxy values for each county model. Pre-exposure prophylaxis data by country was not available at the county-level and was therefore not considered in this analysis.

The sum of all county annual HIV diagnoses values was high given the testing rates and HIV incidence estimates. This is likely due to double counting of diagnoses (e.g., repeat testing in antenatal care) and the study team chose to put less weight on diagnoses values during the calibration process.

The full results from the Kenya Population-based HIV Impact Assessment (KENPHIA) were not available when this study was conducted and could therefore not be used to inform the study. The preliminary KENPHIA report has since been made available and was used to validate estimates generated in this analysis.

During the workshop held in Nairobi, Kenya in September 2019, the study team worked closely with the country team to validate the derived values used to inform county models. County model calibrations and county costing values were shared widely with county program teams to further ascertain the plausibility of the derived values.

Finally, these findings are only modeled projections and have not been confirmed in a practical setting in Kenya. The country models used in this study have been calibrated to reflect county-level epidemiological estimates provided by the country team, but validation of results suggesting optimized reallocations that will lead to reductions in infections and deaths in real-world practice has not been done. Shifting resources following evidence from this study will not always be feasible and may not necessarily be politically favorable but should be considered for greater impact.

SECTION 5

RESULTS

OBJECTIVE 1: To estimate the optimized annual resource allocations within counties for 2019 to 2030 to minimize new HIV infections and HIV-related deaths by 2030 for varying budget levels[5], estimate outcomes for infections and deaths by 2025 to align with the end of the new 2019/20–2024/25 KASFII, and examine future HIV epidemic trends at the national and county levels to better understand the HIV epidemic to guide strategic planning through to 2030 to align with Kenya's Vision 2030.

Recommendations to optimize annual allocations within counties to 2030 to minimize new HIV infections and HIV-related deaths by 2030 using the 47 county projects, represented at the national-level, include prioritizing scale-up of care and treatment, HIV prevention and testing programs targeting females sex workers (FSW), and HIV prevention and testing programs targeting people who inject drugs (PWID) (figure 5.1; tables A6.1, A6.5, A6.7). These recommendations align with country strategic plans to treat more people diagnosed with HIV, as well as to increase treatment coverage of people living with HIV from an estimated 75% in 2018 (5) to potentially achieving 79% by 2030. It is also estimated that female sex workers and their clients accounted for almost 20% of new HIV infections in 2018; therefore, prioritizing HIV prevention and testing programs targeting female sex workers will be important to minimize HIV transmission among sex workers, clients, and their other partners.

While there has been a gradual decline in the number of annual new adult HIV infections to 36,000, there were still an estimated at 1.4 million people living with HIV in Kenya in 2018 (1), with population and geographical heterogeneity across the country.

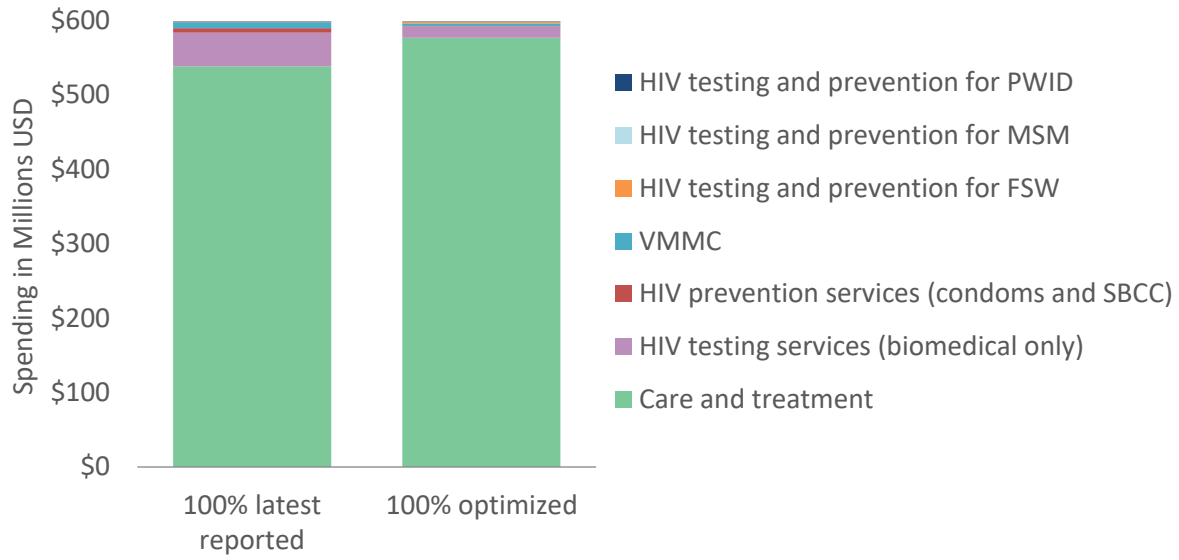
See appendix table A6.6 for budget values to support figure 5.2 and table A6.7 for changes in allocation, as well as figures A6.1–A6.5 for optimization allocations within counties for other budget levels.

For all counties, it is recommended to scale-up care and treatment over the period between 2019 and 2030 to minimize infections and deaths by 2030, except for Kakamega, Kilifi, and Nairobi counties where it is recommended to maintain care and treatment budgets at latest reported levels. This aligns with the national targets of increasing treatment coverage. Furthermore, since it was estimated that almost one fifth of all new HIV infections in 2018 were among female sex workers and their clients, it is recommended to scale-up HIV testing and prevention targeting FSW in all counties 1 to 80-times higher than current coverage across counties, with the highest increase

5 Varying budget levels of 50%, 90%, 100%, 110%, 150%, and 200% were examined.

recommended in Nakuru county and an overall recommended 3-times increase in funding for this program at the national level. It is important to be mindful that county-level latest reported budgets for this program, and other prevention programs, were derived from county-level 2015/16 spending on prevention from the 2018 County Profile reports and national unit costs for the respective programs.

Figure 5.1 Annual HIV budget optimization within counties to 2030 represented at the national level

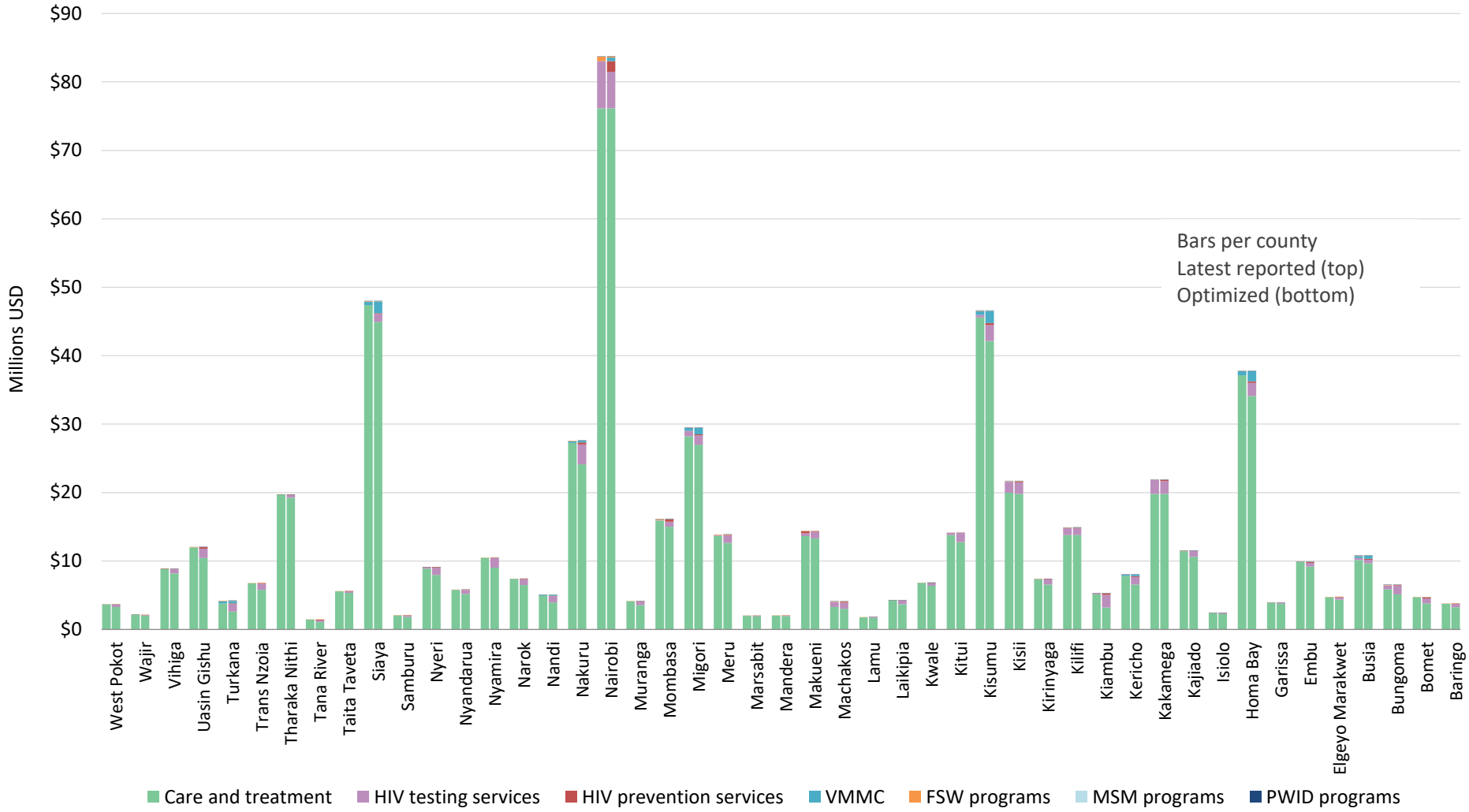


Source: Authors from Optima data.

Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; SBCC = social behaviour change communication; VMMC = voluntary male medical circumcision; USD = United States dollar.

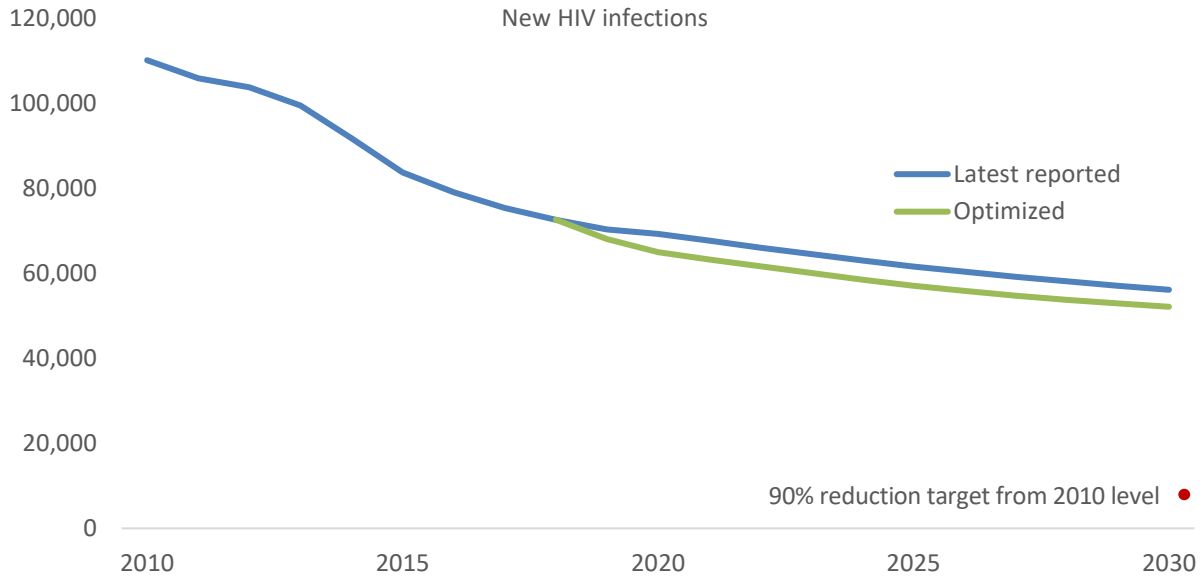
If annual county budgets were optimized **within counties** from 2019 to minimize infections and deaths by 2030, it is estimated that an additional 29,000 new HIV infections (6% more) could be averted by 2025, and 50,000 more could be averted (almost 10% more) by 2030 compared with the latest reported allocation being maintained over this period (figure 5.3). This is however not enough to reach the 2030 end AIDS target of a 90% reduction in HIV incidence by 2030 from 2010 levels.

Figure 5.2 100% annual HIV budget optimizations within counties, 2019 to 2030



Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; VMMC = voluntary male medical circumcision.

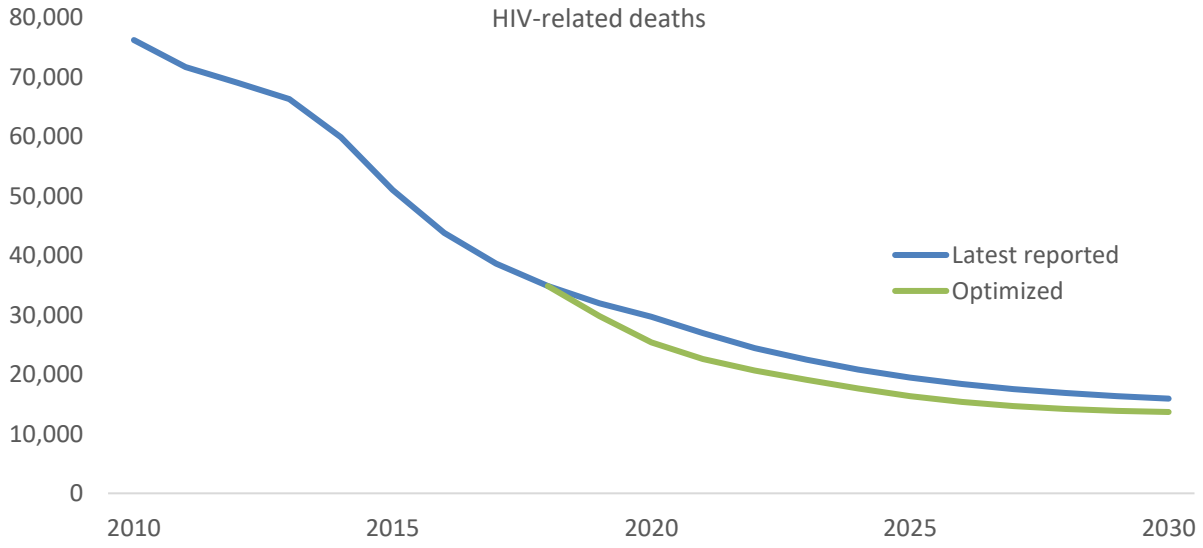
Figure 5.3 Impact of optimizing the 100% annual HIV budgets within counties from 2019 to 2030 on new HIV infections represented nationally



Source: Authors from Optima data.

If annual county budgets were optimized **within counties** from 2019 to minimize infections and deaths by 2030, it is estimated that an additional 24,000 HIV-related deaths (14% more) could be averted by 2025, and 40,000 more could be averted (almost 15% more) compared with the latest reported allocation being maintained over this period (figure 5.4).

Figure 5.4 Impact of optimizing the 100% annual HIV budgets within counties from 2019 to 2030 on HIV-related deaths represented nationally



Source: Authors from Optima data.

Optimization within counties under varying budget levels from 2019 to 2030 to minimize infections and deaths shows that if more budget were to become available, more should be spent on prevention services including VMMC and particularly HIV testing (figure 5.5). However, with increasing budget, overall, there are diminishing returns on investment (figures 5.6 and 5.7). The ratio of new HIV

infections averted through optimization of resources within all counties to the percent of increased budget is 14.8 for the 110% optimized budget but drops to 10.5 for the 150% optimization budget and to 7.2 for the 200% optimized budget. This ratio is an indicator of the amount of return on investment should additional HIV funding be made available versus the amount of infections or deaths that could be averted. It is important to note that even with a doubling of budget that is optimized, the reduction in new HIV infections would not be enough to reach the 2030 target of a 90% reduction in new infections by 2030 from 2010 level.

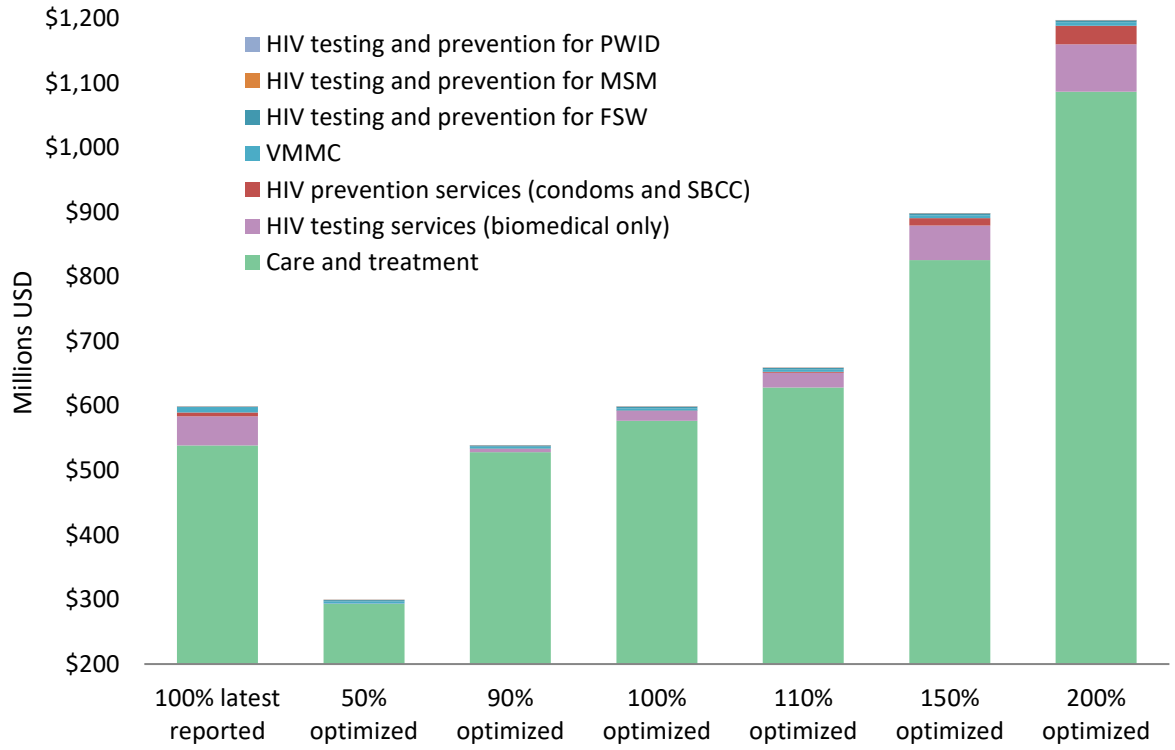
Diminishing returns with increased HIV budget optimized within all counties is also observed for HIV-related deaths with a ratio of 7.3 for the 110% optimized budget, which drops to 2.2 at 150% optimized budget, but rises slightly to 2.7 at 200% optimized budget. One possible reason that may help explain this trend is that at 200% optimized budget, it could be possible to achieve the target of 90% of those aware of their HIV status receiving treatment by 2030, thus driving down deaths even further.

Recommendations for prioritizing resource allocation change as budget amounts vary. For example, at 200% budget it is recommended to allocate 9% of the national budget on prevention, versus 4% at 100% budget, and 2% at 50% budget (figures 5.2, 5.5, A4.1, and A6.2). Inversely, if less funding were available, it is recommended to make care and treatment an even higher priority, whereby, at 50% budget 98% of the budget should be allocated for treatment, compared with 96% at 100% optimized budget, and 91% at 200% optimized budget. It is important to note that programs with an indirect impact on the HIV epidemic, such as program management and strategic information, are not included in the optimized budget. At all budget levels examined in this analysis, it is recommended to allocate 90% or more of the budget towards treatment. This holds true for all counties, except for Machakos county where at 100% budget it is recommended to allocate 80% of the budget to treatment under optimized allocation, up from the approximate 75% of the budget allocated for treatment in the latest reported allocation. This is the third lowest proportion allocated to care and treatment in the latest reported budget of all counties: only Kiambu, 60%, and Turkana, 62%, allocated less for treatment in the latest reported allocation. However, of these three counties, Machakos was estimated to have the lowest budget contribution for testing services of its overall HIV budget, 22%, compared with the other two counties (Turkana 26% and Kiambu 34%). Under the optimized allocation, it is recommended for Machakos to retain a higher proportion of its total budget for testing, 18%, than the other two counties. This suggests Machakos has a greater need to prioritize HIV testing, while still scaling up treatment. Nevertheless, for Machakos, while treatment coverage in 2018 was already relatively high at almost 90%, even with 80% of the budget allocated for treatment (with a recommended 5% increase in spending on care and treatment over this period) it is estimated that by 2030 treatment coverage would still increase to almost 95%.

More specifically, under optimized allocation based on percent of the total budget, with increasing budget it is recommended to decrease the proportional allocation for care and treatment and HIV testing and prevention programs for FSW at 150% budget and above, and VMMC, while increasing allocation for HIV testing services (biomedical only), HIV prevention services (condoms and SBCC), and HIV testing and prevention programs for MSM. Recommended allocations for HIV testing and prevention programs for PWID remain relatively stable regardless of budget level. If total county budgets were to be decreased, it is recommended to prioritize care and treatment even more. For example, at 50% total budget, VMMC, HIV testing and prevention for FSW, and HIV testing and

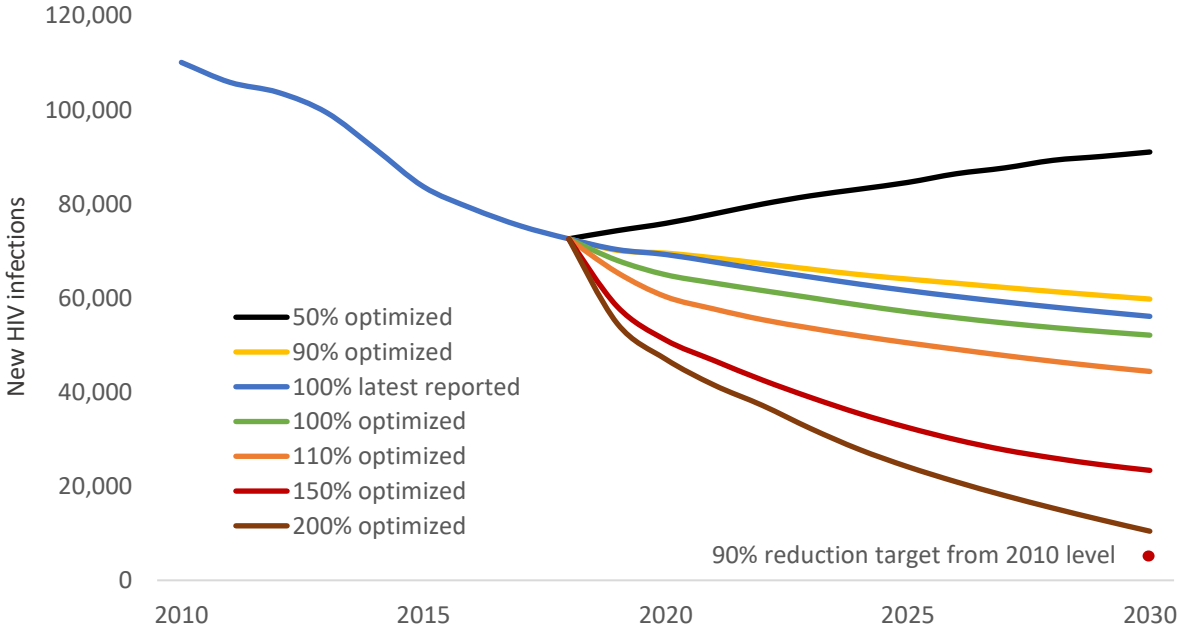
prevention for PWID should get a bigger proportion of the reduced budget, but HIV testing services (biomedical only), HIV prevention services (condoms and SBCC), and HIV testing and prevention for MSM should get less priority.

Figure 5.5 Changing levels of HIV budgets optimized within counties for 2019 to 2030 represented nationally



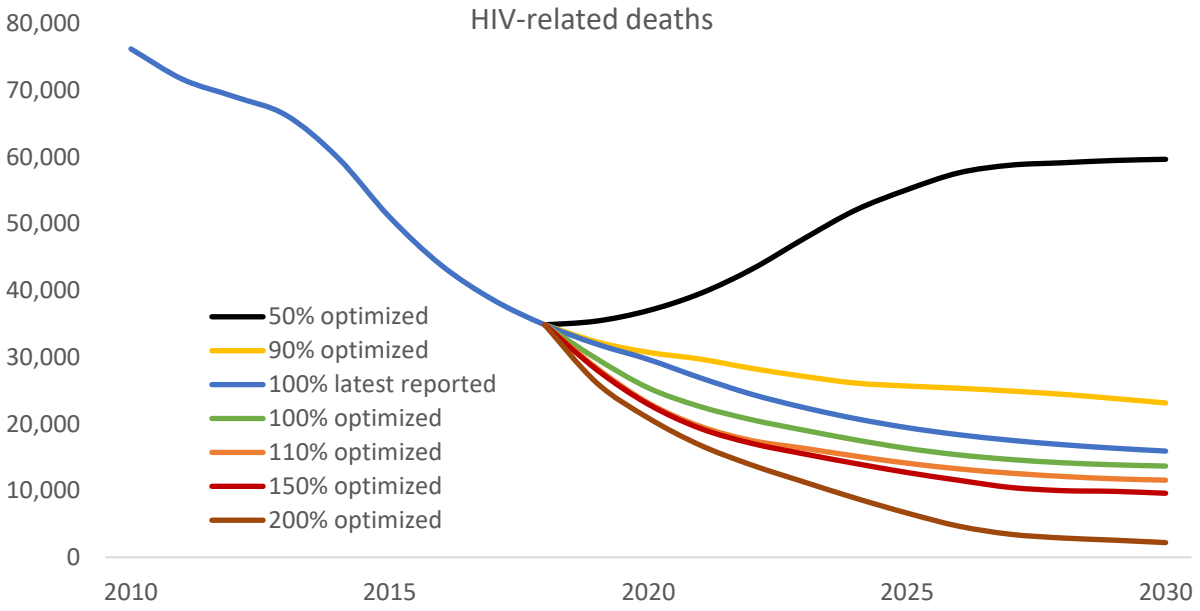
Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; SBCC = social behaviour change communication; VMMC = Voluntary male medical circumcision.

Figure 5.6 Impact of optimizing changing levels of HIV budgets within counties from 2019 to 2030 on new HIV infections represented nationally



Source: Authors from Optima data.

Figure 5.7 Impact of optimizing changing levels of HIV budgets within counties from 2019 to 2030 on HIV-related deaths represented nationally



Source: Authors from Optima data .

The optimized allocation to minimize new HIV infections and HIV-related deaths by 2025 to align with the end of the new 2019/20–2024/25 KASFII are shown in table A6.10.

Box 5.1 Illustrative analysis: To estimate the optimized 100% annual resource allocations across counties for 2019 to 2030 to minimize new HIV infections and HIV-related deaths by 2030

An illustrative analysis whereby resource allocations are optimized across counties without constraints shows how resources could be shifted towards certain counties and then how these adjusted county budgets could be invested towards the most cost-effective HIV programs. Findings for 100% budget optimization across counties show that among the seven counties with the highest estimated number of new HIV infections in 2018, it is recommended to shift the largest amount of funds for any county to six out of seven of these high-burden counties (figure 5.8; tables A8.8 and A6.9). The seven counties with the highest estimated number of new HIV infections, in descending order, are Homa Bay, Siaya, Kisumu, Nairobi, Migori, Kiambu, and Nakuru, accounted for an estimated 25% of all new HIV infections in Kenya in this year. Optimal redistribution of funds to these six counties would account for over 50% of the total budget for the national HIV program in Kenya. Of these top seven counties, Nairobi was the only county for which it is recommended to allocate less funding under optimized allocation. Since Nairobi county has the highest estimate of people living with HIV (PLHIV) of any county in Kenya, approximately 191,000 in 2018 or 12% of the total 1.49M PLHIV nationally, it follows that the biggest county HIV budget, $83M in 2018 or 14% of the national budget, was allocated to this county. However, based on model recommendations, more new HIV infections could be averted nationally over the 2019 to 2030 period if some of the HIV budget for Nairobi county were shifted to other counties and thereafter all county budgets optimally allocated.

Box continued…

Box 5.1 Illustrative analysis: To estimate the optimized 100% annual resource allocations across counties for 2019 to 2030 to minimize new HIV infections and HIV-related deaths by 2030 (continued)

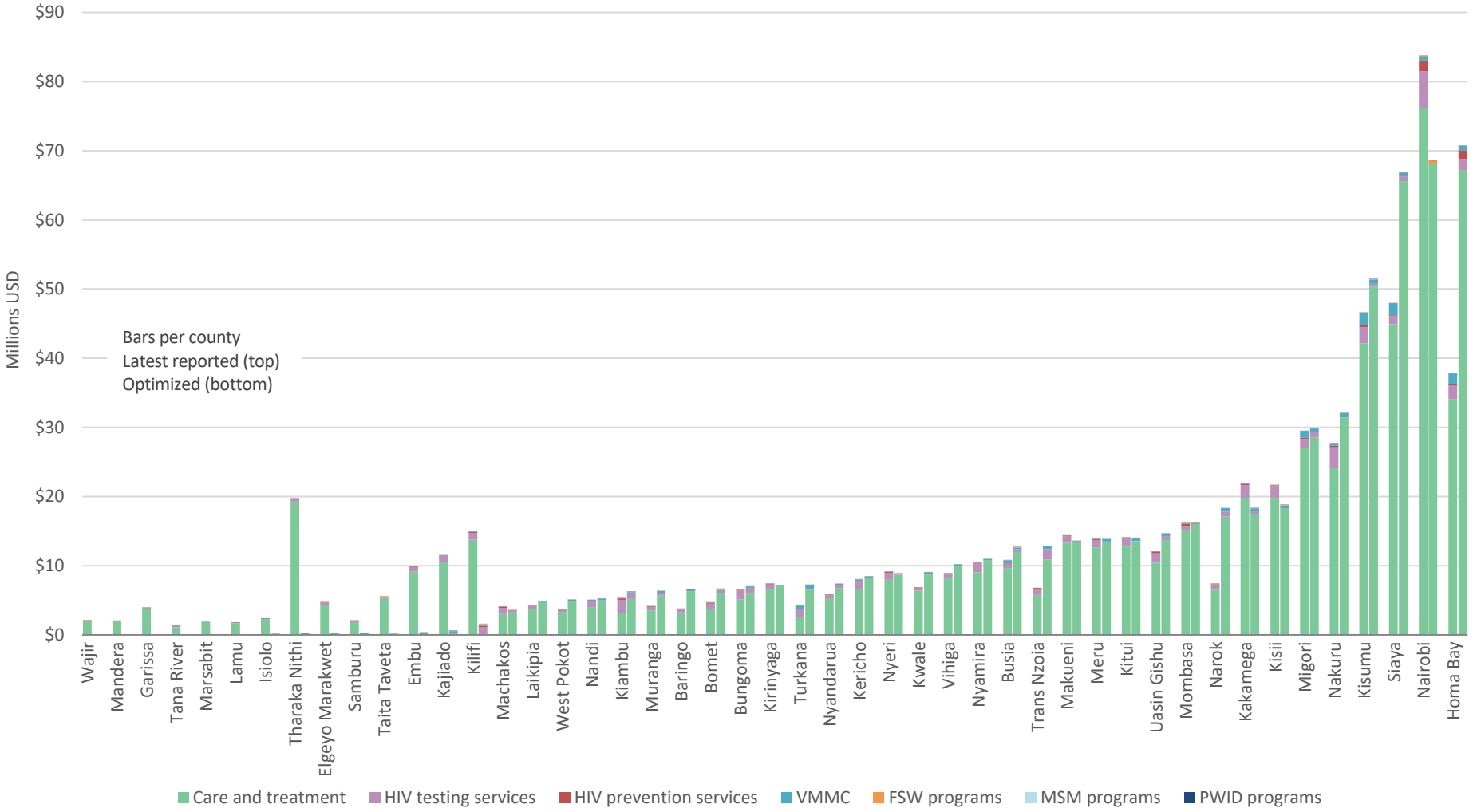
Prioritizing the most cost-effective HIV programs as part of this illustrative optimization includes scaling-up care and treatment in over half of the counties, as well as prioritizing VMMC, HIV prevention and testing programs targeting FSW, and HIV prevention and testing programs targeting PWID. Besides, some funding should be maintained for HIV testing services mainly targeting the general population and for HIV prevention services, including condoms and SBCC.

This suggests that in the context of Kenya's HIV response, there is potential for leveraging additional impact if resources were permitted to shift across not only programs, but also geographical space. From this illustrative analysis of resource optimization across counties, whereby the treatment program of a given county could be defunded, shifts in resources across counties according to burden and cost-effectiveness criteria **could lead to 160,000 more new HIV infections (over 20% more) and 73,000 more HIV-related deaths (almost 30% more) being prevented by 2030.**

For counties where it is recommended to increase the total budget from 2019 to 2030, it is also recommended to scale-up care and treatment (figure 5.6, tables A6.8 and A6.9). For Kirinyaga, Kitui, Machakos, and Nyeri counties where a decreased total budget is recommended, it is still recommended to scale-up care and treatment.

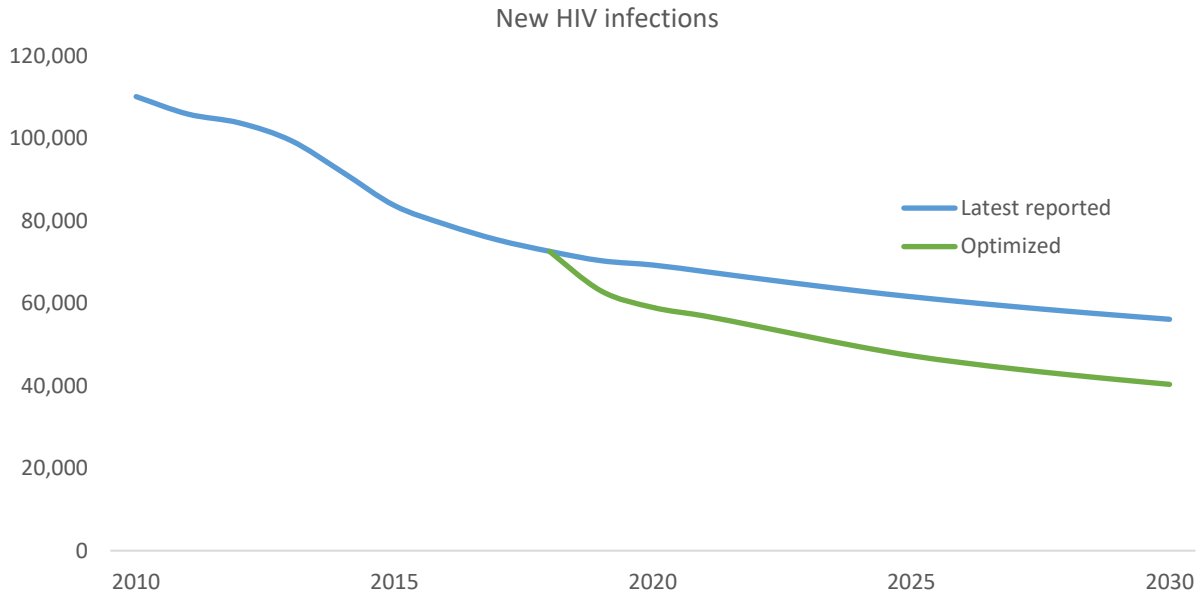
If annual county budgets were optimized **across counties** from 2019 to 2030 to minimize infections and deaths by 2030, then an additional 160,000 new HIV infections could be averted (over 20% more) compared with the latest reported allocation being maintained over this period (figure 5.3)

Figure 5.8 100% annual HIV budget optimizations for targeted HIV services across counties, 2019 to 2030 (sorted in ascending order by optimized allocation)*



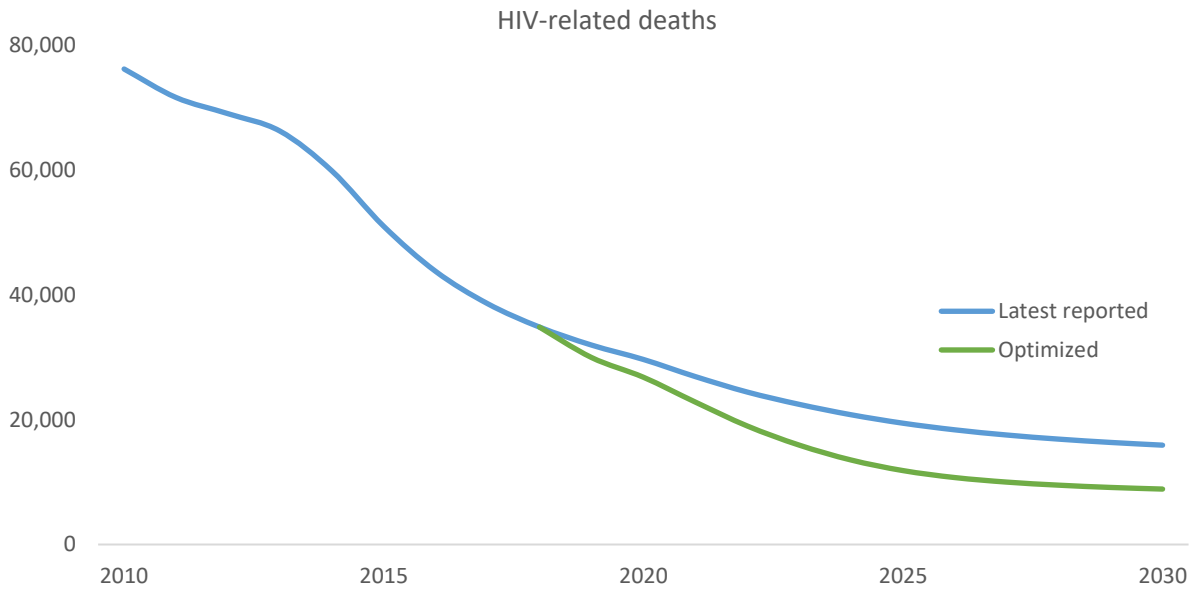
Source: Authors from Optima data.
Note: * = This is an illustrative analysis only and no constraints were applied to the model. FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; VMMC = Voluntary male medical circumcision.

Figure 5.9 Estimated new HIV infections with 100% HIV budget optimized across counties from 2019 to 2030 represented nationally



Source: Authors from Optima data.

Figure 5.10 Estimated HIV-related deaths with 100% HIV budget optimized across counties from 2019 to 2030 represented nationally



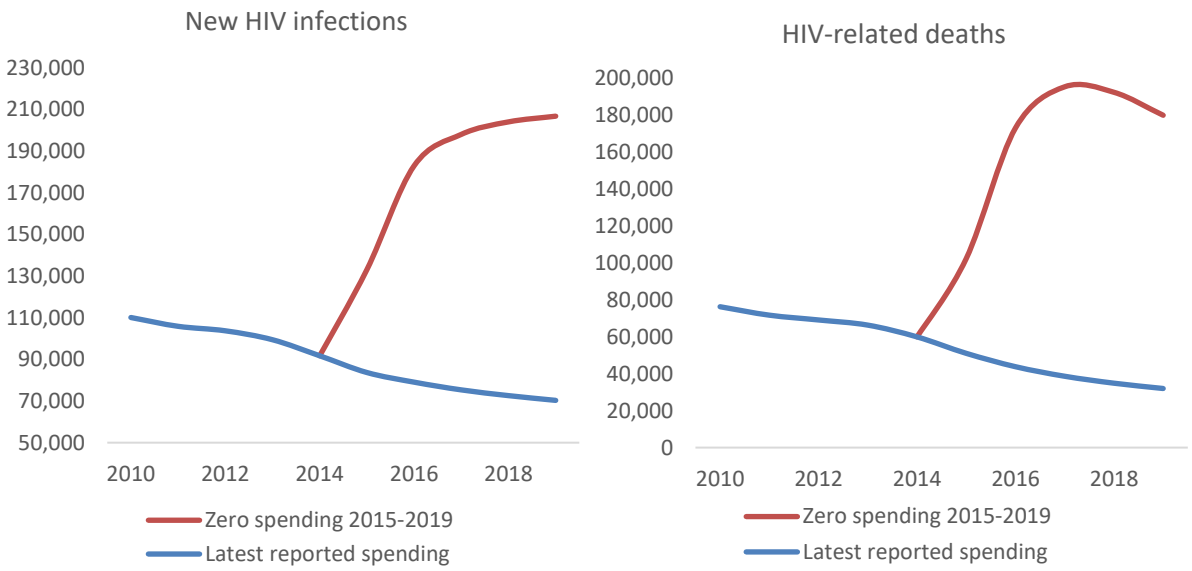
Source: Authors from Optima data.

OBJECTIVE 2: To estimate the epidemiological impact of the 2014/15–2018/19 KASFI spending on new HIV infections and HIV-related deaths averted compared with no spending over this period, to evaluate and learn from the successes in the HIV response in Kenya.

At the national level, it is estimated that no spending on the HIV program during the 2014/15–2018/19 KASFI period compared with what was spent over this 5-year period could have resulted

in 500,000 more new HIV infections (almost 150% more) and 600,000 more HIV-related deaths (over 300% more) (figure 5.11). This suggests that investments made by the HIV program over the 2014/15–2018–19 KASFI period was effective in preventing at least half a million new HIV infections and over half a million HIV-related deaths in Kenya.

Figure 5.11 2015–19 HIV program spending removed to estimate the impact this spending had on new HIV infections and HIV-related deaths over this period



Source: Authors from Optima data.

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SECTION 6

RECOMMENDATIONS FOR HIV INVESTMENT IN KENYA

- **Reallocate the latest reported HIV budget prioritising the scale up of care and treatment as well as cost-effective preventative programmes to minimize the number of new HIV infections and HIV-related deaths.** To minimize new HIV infections and HIV-related deaths by 2030, recommendations to optimize resources within counties includes prioritizing scale-up of care and treatment, HIV prevention and testing programs targeting females sex workers (FSW), HIV prevention services for the general population (condoms and SBCC), and HIV prevention and testing programs targeting people who inject drugs (PWID) by 2030. This could lead to 50,000 more new HIV infections (almost 10% more) and 40,000 more HIV-related deaths (almost 15% more) being averted. While ART remains the most cost-effective program for preventing HIV-related deaths, it is also highly effective at reducing incidence by providing a preventative mechanism for those on treatment to limit new HIV infections. After scale-up of treatment for all diagnosed people living with HIV, the next priority to improve outcomes across the cascade of care and avert infections and deaths is to increase diagnoses by scaling-up testing. This is achieved by increasing the coverage of HIV prevention programs targeting key populations that include a testing component as well as the HIV testing services program. Those newly diagnosed can then be put on treatment. It is important to note that outcomes shown for 2025 (end of the new 2020/21–2024/25 KASFII period) and for the 10-year horizon (2030 to match the Kenya Vision 2030) used for this analysis were too short for the impact of certain interventions, such as VMMC, to be realized and whose effectiveness may therefore be undervalued in this study (11). Optimized allocation recommendations will need to be tempered by logistical realities. As such, there may be economic, programmatic, and even ethical reasons why certain HIV services would not be defunded completely in any county.

While ART remains the most cost-effective program for preventing HIV-related deaths, it is also highly effective at reducing incidence by providing a preventative mechanism for those on treatment to limit new HIV infections.

- **The current HIV budget should be maintained at minimum to avoid reversing the gains made in the HIV response.** Decreasing the latest reported budget by 50% is estimated to potentially result in 84,000 more new HIV infections (5% more) and 74,000 more HIV-related deaths (6% more) over the 2019 to 2030 period when compared to the status quo. To continue progress in reducing the HIV epidemic at least maintaining the HIV budget is therefore recommended. Effective budget increases are possible through, for example, implementation efficiency gains not explored by this analysis, such as using more optimal service delivery modalities, reduced cost of antiviral regimens, and reduced spending on non-targeted programs, among others.

- **Additional interventions and innovations to further reduce service delivery costs and increase effectiveness will be required if Kenya is to reach the 2030 target to end AIDS** as a public health threat. Even with a doubling of budget for the HIV response optimized within all counties, the 2030 HIV incidence reductions targets are unlikely to be met, meaning there are diminishing marginal returns with the current available 'toolbox' of interventions. In countries with large existing disease burdens such as Kenya, reducing HIV incidence to such low levels will need personalized and pre-emptive HIV prevention strategies.

SECTION 7

CONCLUSION

1. **SIGNIFICANT PROGRESS HAS BEEN MADE IN THE HIV RESPONSE IN KENYA.** It is estimated that HIV spending over the 2015–2019 KASFI period led to the prevention of half a million new HIV infections and HIV-related deaths. However, there are still an estimated 1.4 million people living with HIV in the country, the fifth highest national burden worldwide. The country has achieved remarkable reductions in new HIV infections and HIV-related deaths over the last decade. Driving these improvements has been the progress towards the 95-95-95 targets. There have been great achievements in male circumcision and for HIV service coverage among key populations. However, there is significant disparity in ART program performance across the counties and double the proportion of women are estimated to be living with HIV than men.

2. **EVEN GREATER IMPACT COULD BE ACHIEVED THROUGH ADDITIONAL ALLOCATIVE EFFICIENCY OF THE LATEST REPORTED HIV BUDGET.** National HIV incidence is declining, but so is external donor funding for HIV, which the country currently relies on to fund 70% of its HIV response. For the same amount of total funding, more infections and deaths could be averted if the highest impact programs are prioritized. It is imperative that funding for the HIV response should be maintained and this will likely require implementation efficiency gains to be made. Should more resources become available, HIV prevention interventions should be further prioritized. While financial resources may not be easily redistributed, nor reallocation be politically favorable, opportunities to allocate HIV financial resources more efficiently should be explored to achieve the biggest gain with the available resources.

3. **THE PRIMARY BENEFIT OF OPTIMIZATION TO IMPROVE ALLOCATIVE AND IMPLEMENTATION EFFICIENCY LIES IN CREATING AN OBJECTIVE PLATFORM TO MAKE EVIDENCE-INFORMED RESOURCE DECISIONS.** This is with the caveat that modelling relies on strong assumptions of data quality and the impact of targeted and non-targeted programs. Deploying the recommendations provided in this report should consider the costs and benefits of using optimization as a basis for resource allocation.

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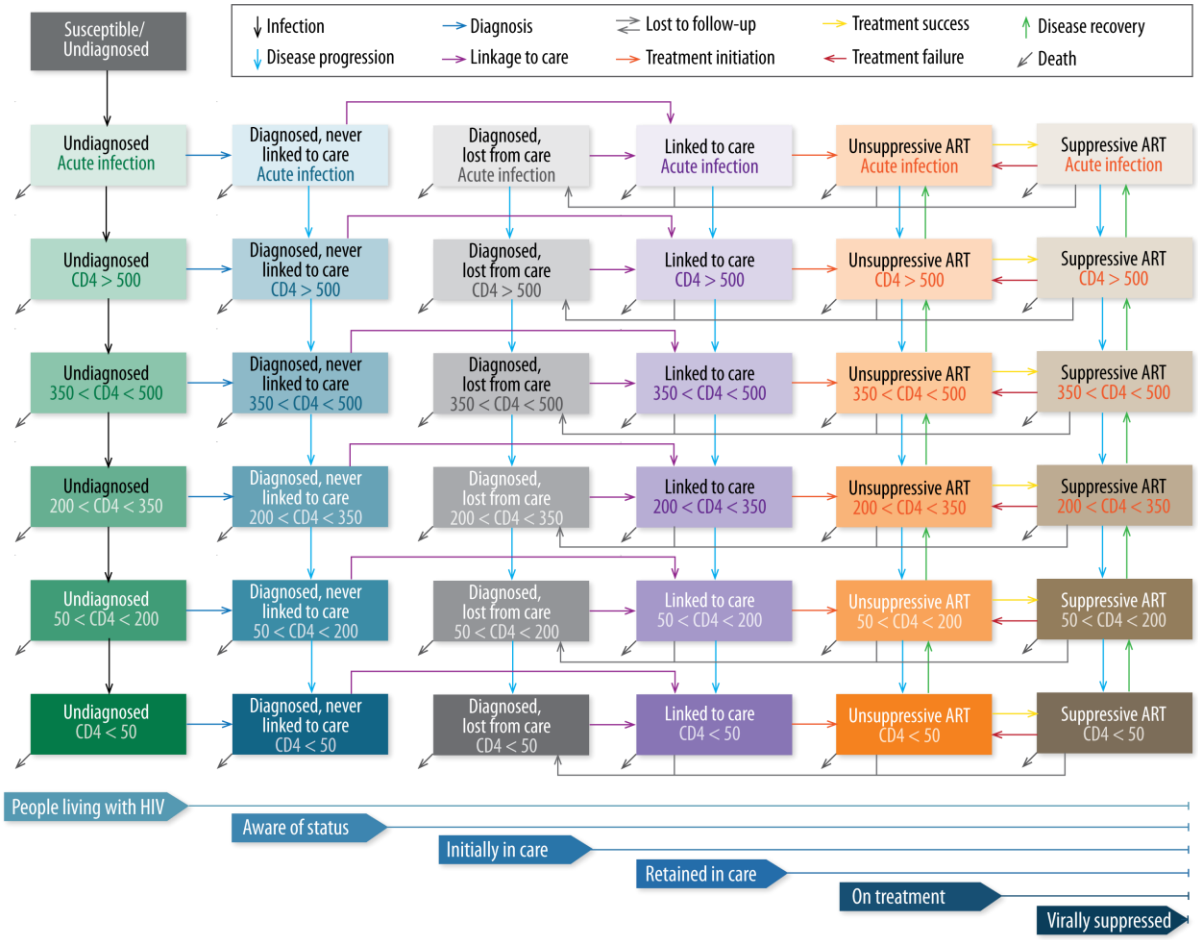
APPENDICES

APPENDIX 1: OPTIMA HIV MODEL

This Appendix provides a brief technical overview of Optima. A more detailed summary of the model and methods is provided elsewhere. Optima is based on a dynamic, population-based HIV model. Figure A1.1 shows the disease progression implemented in the model. Optima tracks the entire population of people living with HIV (PLHIV) across stages of CD4 count, including key aspects of the antiretroviral therapy (ART) service delivery cascade. Figure A1.2 provides a summary of the populations and mixing patterns used in the Optima HIV.

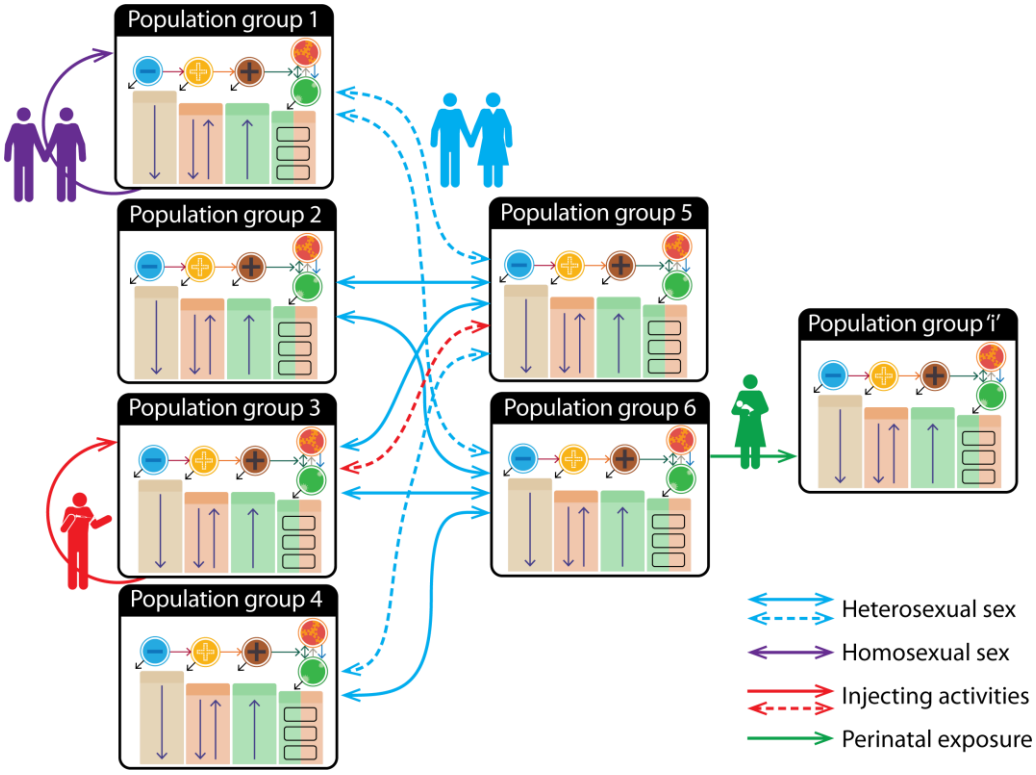
Figure A1.1 HIV health states compartments and transmission-related interactions across the care cascade represented in Optima HIV (8)



Source: Optima consortium.

Schematic diagram of the health state structure of the model. Each compartment represents a single population group with the specified health state while each arrow represents the movement of numbers of individuals between health states. All compartments except for susceptible represent people living with HIV. Death includes all causes of death.

Figure A1.2 Risk-based population mixing patterns represented in Optima HIV (8)



Source: Optima consortium

The model uses a linked system of ordinary differential equations to track the movement of PLHIV between HIV health states; the full set of equations can be accessed via the Optima supplementary index provided in the overall population is partitioned in 2 ways: by population group and by HIV health state. Individuals are assigned to a given population group based on their dominant risk. [6] HIV infections occur through the interaction between different populations by regular, casual, or commercial (including transactional) sexual partnerships, through sharing of injecting equipment or through mother-to-child transmission. The force-of-infection is the rate at which uninfected individuals become infected, and it depends on the number and type of risk events to which individuals are exposed in a given period (either within their population groups or through interaction with other population groups) and the infection probability of each event. Mathematically, the force of-infection has the general form:

$$\lambda = 1 - (1 - \beta)^n,$$

where λ is the force-of-infection, β is the transmission probability of each event, and n is the effective number of at-risk events (i.e., n gives the average number of interaction events with HIV-infected people where HIV transmission may occur).

6 However, to capture important cross-modal types of transmission, relevant behavioral parameters can be set to non-zero values (e.g., males who inject drugs may engage in commercial sex; some MSM may have female sexual partners).

There is one force-of-infection term for each type of interaction [e.g., casual sexual relationships between male sex workers and female sex workers (FSW)]; the force-of-infection for a given population will be the sum of all interaction types. In addition to the force-of-infection rate, which is the number of individuals who become infected with HIV per year, there are 7 other ways individuals may change health states. The change in the number of people in each compartment is determined by the sum over the relevant rates described above, multiplied by the population size of the compartments on which they act.

APPENDIX 2: KEY MODEL PARAMETERS

Table A2.1 Latest reported key data and estimates used to inform the Optima HIV county models for Kenya

County	HIV prevalence M15–49	HIV prevalence F15–49	15+ LHIV	0–14 LHIV	PLHIV all ages	15+ on ART	15+ ART coverage	0–14 on ART	0–14 ART coverage	PMTCT coverage	HIV prevalence FSW	HIV prevalence MSM	HIV prevalence PWID	HIV prevalence Clients
Kenya	4.5%	5.2%	1,388,169	105,213	1,493,382	1,035,618	75%	86,325	82%	76%	11.0%	17.2%	5.3%	6.1%
Baringo	1.1%	1.9%	5,397	477	5,874	3,450	64%	364	76%	72%	4.0%	4.4%	1.4%	1.6%
Bomet	1.6%	2.7%	9,761	863	10,624	9,186	94%	850	99%	91%	5.9%	6.5%	1.9%	2.2%
Bungoma	2.4%	3.9%	27,648	2,396	30,044	22,375	81%	2,104	88%	76%	7.1%	7.2%	2.7%	3.0%
Busia	5.7%	9.4%	35,527	3,078	38,606	33,654	95%	2,415	78%	67%	17.1%	17.2%	6.4%	7.2%
Elgeyo Marakwet	1.4%	2.3%	4,400	389	4,789	2,540	58%	232	60%	76%	4.9%	5.3%	1.6%	1.9%
Embu	1.6%	3.8%	9,866	855	10,721	7,846	80%	747	87%	70%	7.9%	6.3%	1.9%	2.2%
Garissa	0.3%	1.4%	2,356	532	2,888	1,296	55%	71	13%	16%	2.9%	1.2%	0.4%	0.4%
Homa Bay	19.1%	22.1%	128,199	10,722	138,921	100,677	79%	9,655	90%	90%	47.7%	41.8%	22.6%	26.0%
Isiolo	1.9%	4.3%	2,889	250	3,139	1,972	68%	248	99%	44%	9.1%	6.9%	2.2%	2.5%
Kajiado	3.3%	5.5%	22,850	2,020	24,869	11,658	51%	845	42%	77%	11.6%	12.5%	3.9%	4.4%
Kakamega	3.4%	5.6%	48,752	4,224	52,976	40,525	83%	3,977	94%	66%	10.1%	10.3%	3.8%	4.3%
Kericho	2.4%	4.1%	16,111	1,424	17,535	16,045	100%	1,462	NA	63%	8.6%	9.1%	2.9%	3.3%
Kiambu	2.1%	5.9%	56,622	2,394	59,016	34,417	61%	1,972	82%	NA	13.5%	8.8%	2.5%	3.0%
Kilifi	2.3%	5.4%	30,597	2,422	33,019	21,224	69%	2,233	92%	69%	11.3%	8.5%	2.7%	3.1%
Kirinyaga	1.7%	4.6%	13,893	588	14,481	9,074	65%	625	NA	83%	8.9%	5.3%	1.9%	2.1%
Kisii	4.0%	4.7%	34,950	2,923	37,874	27,571	79%	2,337	80%	55%	9.3%	14.0%	4.7%	5.3%

Table continued…

Table A2.1 Latest reported key data and estimates used to inform the Optima HIV county models for Kenya (continued)

County	HIV prevalence M15–49	HIV prevalence F15–49	15+ LHIV	0–14 LHIV	PLHIV all ages	15+ on ART	15+ ART coverage	0–14 on ART	0–14 ART coverage	PMTCT coverage	HIV prevalence FSW	HIV prevalence MSM	HIV prevalence PWID	HIV prevalence Clients
Kisumu	15.0%	17.4%	112,862	9,439	122,301	101,527	90%	8,225	87%	87%	36.9%	57.2%	17.6%	20.3%
Kitui	2.7%	6.1%	26,375	2,286	28,661	17,257	65%	2,003	88%	53%	11.7%	8.7%	3.0%	3.4%
Kwale	2.3%	5.4%	17,877	1,415	19,292	7,286	41%	785	55%	49%	13.1%	10.4%	2.8%	3.3%
Laikipia	2.3%	3.8%	8,530	754	9,284	5,386	63%	457	61%	68%	8.1%	8.8%	2.7%	3.1%
Lamu	1.8%	4.3%	2,445	194	2,638	954	39%	99	51%	77%	8.8%	6.7%	2.1%	2.4%
Machakos	2.2%	5.1%	27,695	2,400	30,095	22,712	82%	2,148	90%	81%	10.7%	8.5%	2.6%	3.0%
Makueni	2.5%	5.7%	22,621	1,960	24,581	15,841	70%	1,719	88%	55%	12.1%	9.4%	2.9%	3.4%
Mandera	0.1%	0.3%	805	182	987	445	55%	39	21%	5%	1.5%	0.8%	0.1%	0.2%
Marsabit	0.8%	1.8%	2,372	206	2,577	1,155	49%	160	78%	28%	3.7%	2.9%	0.9%	1.1%
Meru	1.4%	3.3%	22,090	1,914	24,005	17,283	78%	1,649	86%	58%	6.9%	5.3%	1.7%	1.9%
Migori	12.2%	14.2%	79,146	6,619	85,765	65,820	83%	6,175	93%	93%	28.1%	42.5%	14.1%	16.0%
Mombasa	2.5%	5.9%	38,548	3,051	41,599	41,748	NA	2,630	86%	100%	15.7%	13.1%	3.2%	3.8%
Murang'a	2.2%	6.2%	29,144	1,232	30,376	12,922	44%	935	76%	59%	11.9%	7.3%	2.5%	2.9%
Nairobi	4.7%	7.5%	182,856	8,137	190,993	140,724	77%	7,611	94%	90%	14.5%	15.6%	5.4%	6.1%
Nakuru	2.9%	4.8%	45,549	4,026	49,575	37,619	83%	2,963	74%	81%	10.2%	11.0%	3.4%	3.9%
Nandi	1.7%	2.9%	11,712	1,035	12,748	7,681	66%	667	64%	78%	6.1%	6.6%	2.0%	2.3%
Narok	2.3%	3.9%	16,810	1,486	18,296	7,512	45%	887	60%	54%	7.8%	8.3%	2.7%	3.1%
Nyamira	3.9%	4.5%	17,537	1,467	19,004	13,439	77%	1,357	93%	53%	10.8%	17.5%	4.7%	5.6%
Nyandarua	1.9%	5.2%	15,355	649	16,005	5,944	39%	539	83%	83%	9.3%	5.6%	2.1%	2.3%
Nyeri	1.9%	5.5%	20,559	869	21,428	12,643	61%	732	84%	81%	10.1%	6.1%	2.2%	2.5%

Table continued…

Table A2.1 Latest reported key data and estimates used to inform the Optima HIV county models for Kenya (continued)

County	HIV prevalence M15–49	HIV prevalence F15–49	15+ LHIV	0–14 LHIV	PLHIV all ages	15+ on ART	15+ ART coverage	0–14 on ART	0–14 ART coverage	PMTCT coverage	HIV prevalence FSW	HIV prevalence MSM	HIV prevalence PWID	HIV prevalence Clients
Samburu	1.5%	2.5%	2,820	249	3,069	1,197	42%	232	93%	32%	5.4%	5.7%	1.8%	2.1%
Siaya	19.4%	22.4%	113,605	9,501	123,107	80,123	71%	7,462	79%	73%	46.7%	72.0%	22.7%	26.0%
Taita Taveta	2.5%	5.8%	9,462	749	10,211	4,710	50%	352	47%	37%	14.0%	11.2%	3.0%	3.6%
Tana River	0.8%	1.8%	2,071	164	2,235	657	32%	74	45%	24%	4.3%	3.5%	0.9%	1.1%
Tharaka Nithi	1.9%	4.4%	7,779	674	8,453	6,022	77%	507	75%	39%	9.3%	7.2%	2.2%	2.6%
Trans Nzoia	3.7%	6.1%	26,610	2,352	28,962	12,510	47%	1,144	49%	44%	12.9%	13.8%	4.3%	4.9%
Turkana	2.7%	4.5%	21,343	1,887	23,230	4,945	23%	713	38%	48%	9.8%	10.6%	3.2%	3.7%
Uasin Gishu	3.3%	5.5%	29,640	2,620	32,260	29,557	100%	2,067	79%	71%	11.7%	12.6%	3.9%	4.5%
Vihiga	4.0%	6.7%	18,346	1,590	19,935	13,131	72%	1,370	86%	49%	12.0%	12.1%	4.5%	5.1%
Wajir	0.03%	0.2%	262	59	321	194	74%	9	15%	0%	0.9%	0.5%	0.1%	0.1%
West Pokot	1.3%	2.2%	5,524	488	6,012	3,164	57%	478	98%	45%	4.3%	4.3%	1.5%	1.7%

Sources: 2018 County Profile reports, other than for HIV prevalence estimates derived from 2010 IBBS values.
Note: ART = antiretroviral therapy; F = female; FSW = female sex worker; LHIV = living with HIV; M = male; MSM = men who have sex with men; PWID = people living with HIV.

Table A2.2 Key parameters used to inform the Optima HIV county models for Kenya

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)	0.3
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)	1.9
Changes in transmissibility (%)	
Condom use	95%
Circumcision	58%
Diagnosis behavior change	0%
STI cofactor increase	265%
Opiate substitution therapy	54%
PMTCT	90%
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
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	1.00

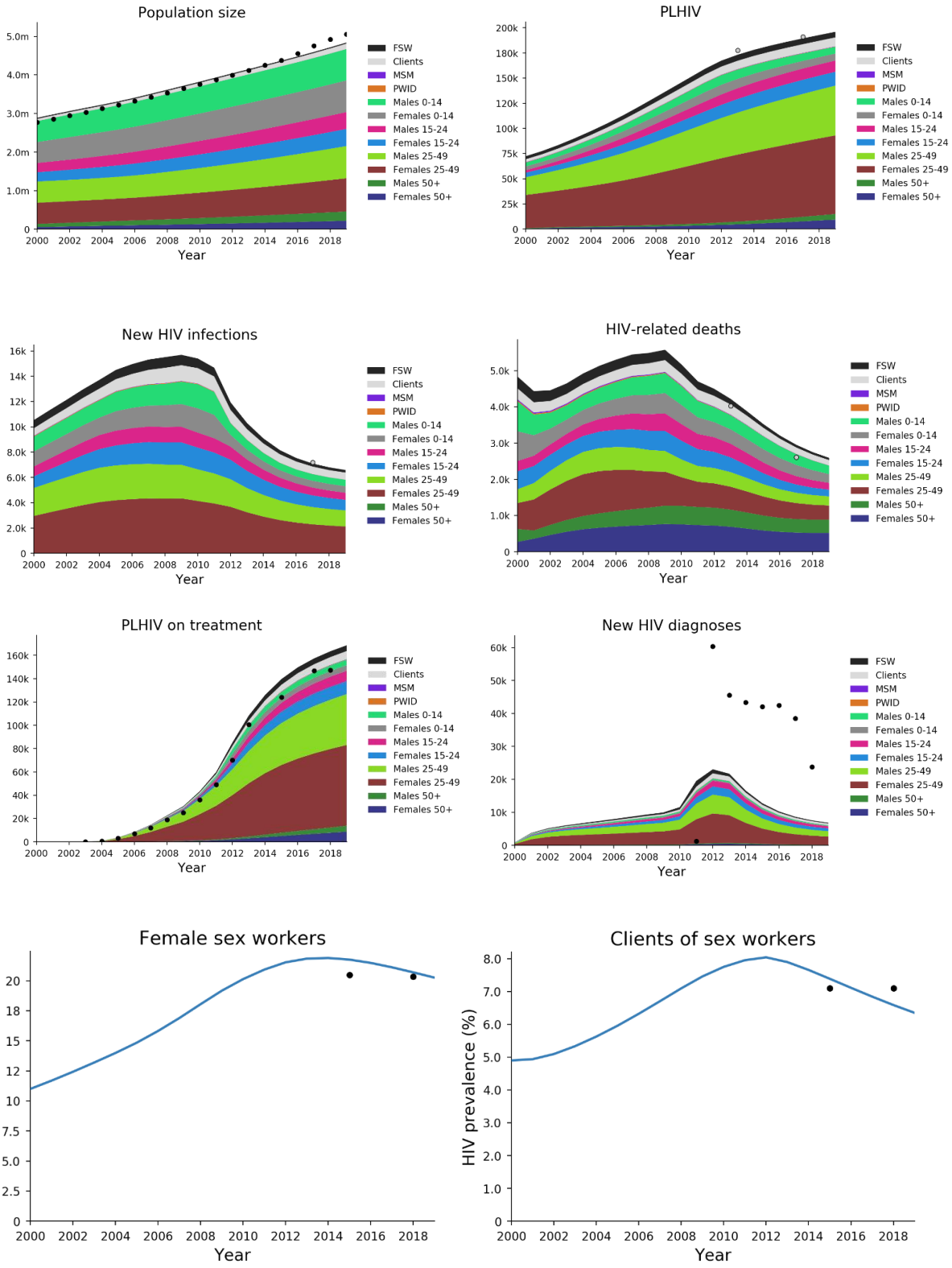
Table A2.2 continued…

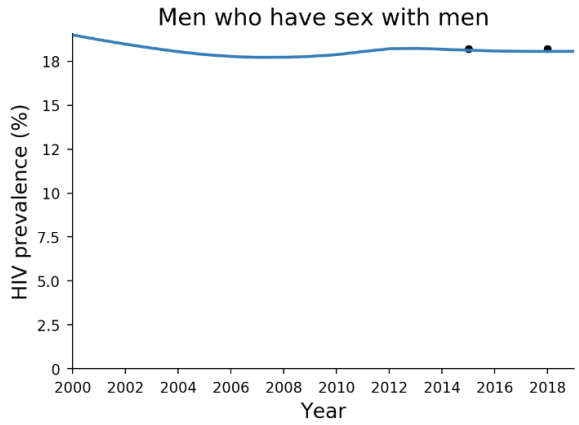
Table A2.2 Key parameters used to inform the Optima HIV county models for Kenya (continued)

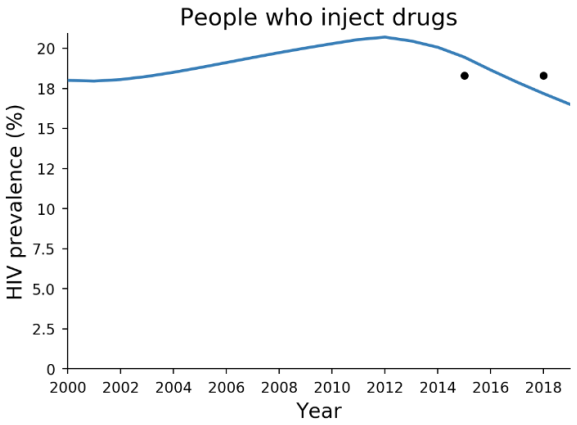
CD4 change due to non-suppressive ART (%/year)	
CD4 (500) to CD4 (350–500)	3%
CD4 (350–500) to CD4 (>500)	15%
CD4 (350–500) to CD4 (200–350)	10%
CD4 (200–350) to CD4 (350–500)	5%
CD4 (200–350) to CD4 (50–200)	16%
CD4 (50–200) to CD4 (200–350)	12%
CD4 (50–200) to CD4 (<50)	9%
CD4 (<50) to CD4 (50–200)	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%

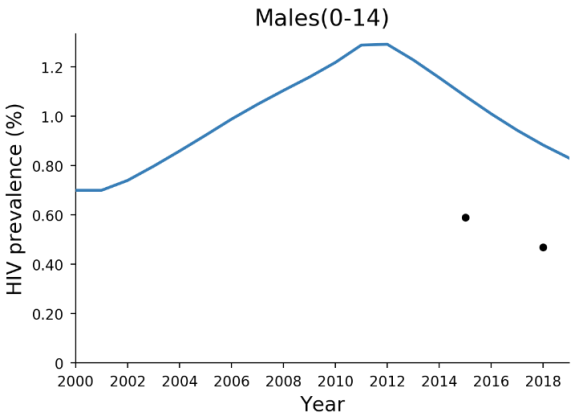
Source: Authors from Optima data.
Note: ART = antiretroviral therapy

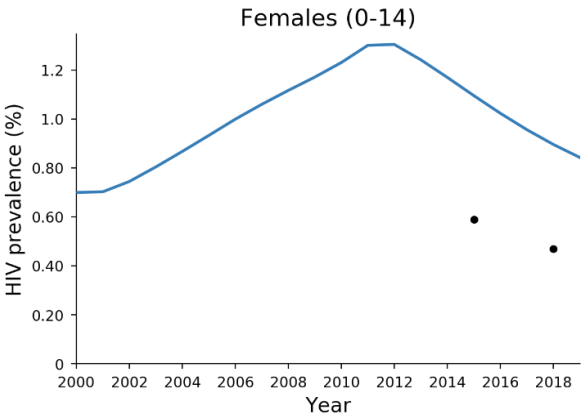
APPENDIX 3: EXAMPLE MODEL CALIBRATION FOR NAIROBI COUNTY

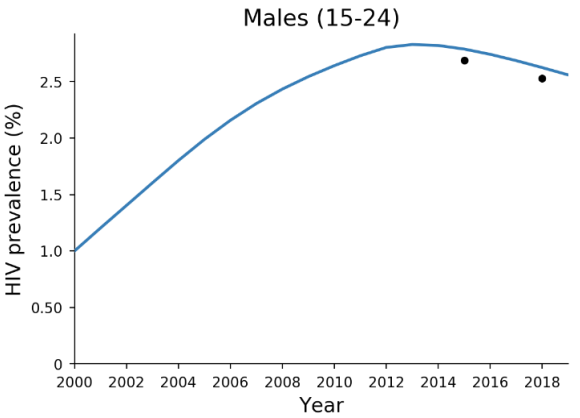


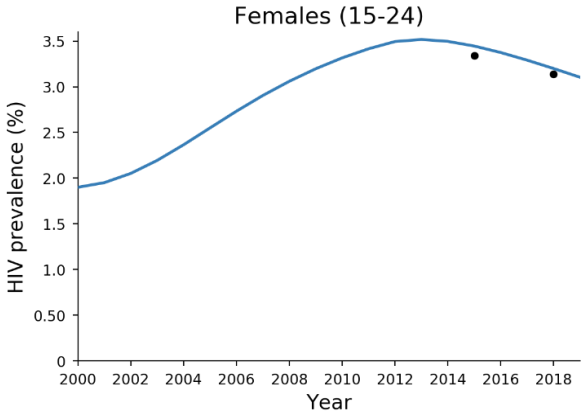

Men who have sex with men
HIV prevalence (%)
Year

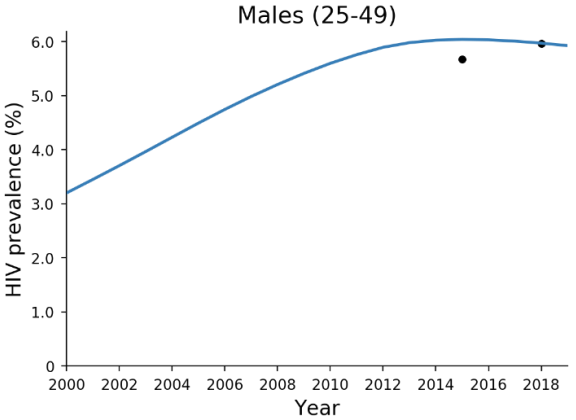

People who inject drugs
HIV prevalence (%)
Year

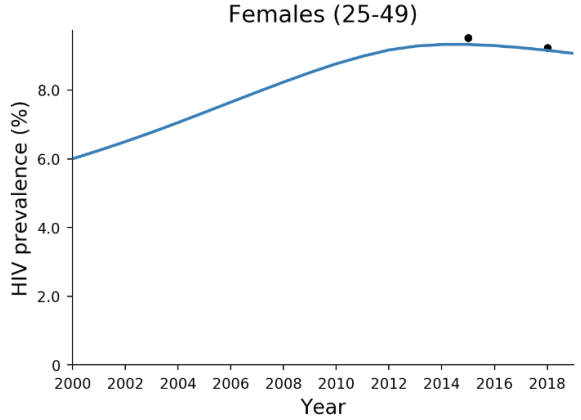

Males(0-14)
HIV prevalence (%)
Year

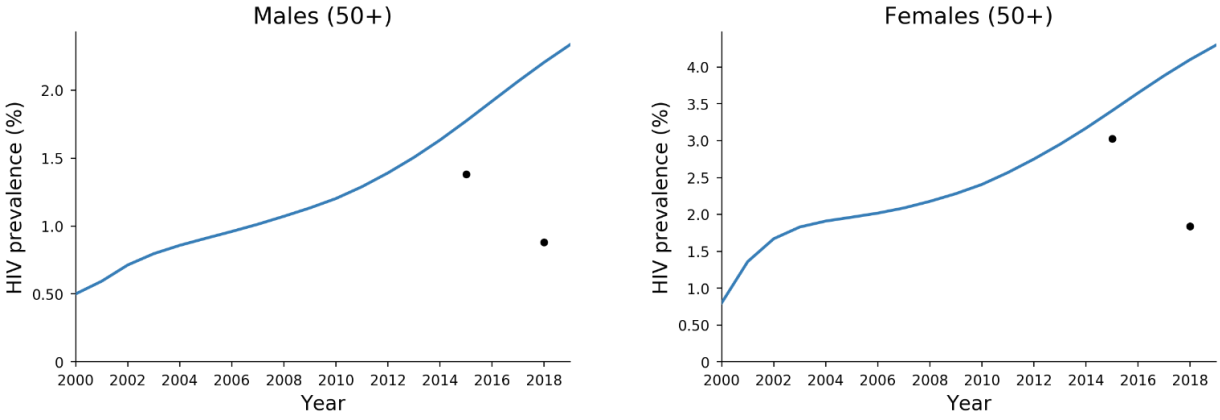

Females (0-14)
HIV prevalence (%)
Year


Males (15-24)
HIV prevalence (%)
Year


Females (15-24)
HIV prevalence (%)
Year


Males (25-49)
HIV prevalence (%)
Year


Females (25-49)
HIV prevalence (%)
Year



Source: Authors from Optima data.

APPENDIX 4: HIV PROGRAM UNIT COSTS

Table A4.1 HIV program unit costs at the county and national level

	Unit costs, 2018	
HIV programs, county level	**Low bound**	**High bound**
HIV prevention services (condoms and SBCC)	$3.00	$4.00
HIV testing and prevention programs for FSW	$13.00	$15.00
HIV testing and prevention programs for MSM	$8.16	$16.32
HIV testing and prevention programs for PWID	$13.00	$20.00
Voluntary medical male circumcision (VMMC)	$33.91	$42.40
HIV programs, national level		**Unit costs, 2018**
Antiretroviral therapy (ART)		$273.27
Prevention of mother-to-child transmission (PMTCT)		$638.62
HIV testing services (biomedical only)		$6.50
HIV prevention services (condoms and SBCC)		$3.22
HIV testing and prevention programs for FSW		$14.39
HIV testing and prevention programs for MSM		$8.16
HIV testing and prevention programs for PWID		$13.33
Voluntary medical male circumcision (VMMC)		$33.91

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PMTCT = prevention of mother-to-child transmission; PWID = people living with HIV; SBCC = social behaviour change communication; VMMC = Voluntary male medical circumcision.

Table A4.2 HIV program unit costs for care and treatment by county

County	Care and treatment unit cost, 2018	County	Care and treatment unit cost, 2018
Baringo	$881.25	Marsabit	$1,426.03
Bomet	$370.20	Meru	$714.07
Bungoma	$235.02	Migori	$394.69
Busia	$303.09	Mombasa	$347.06
Elgeyo Marakwet	$1,580.66	Muranga	$245.41
Embu	$1,058.41	Nairobi	$516.18
Garissa	$2,982.66	Nakuru	$653.51
Homa Bay	$324.85	Nandi	$389.29
Isiolo	$1,296.15	Narok	$769.98
Kajiado	$981.17	Nyamira	$676.83
Kakamega	$497.08	Nyandarua	$676.25
Kericho	$440.06	Nyeri	$484.17
Kiambu	$85.37	Samburu	$1,726.41
Kilifi	$653.93	Siaya	$547.88
Kilifi	$646.24	Taita Taveta	$975.21
Kirinyaga	$672.35	Tana River	$1,410.73
Kisii	$414.48	Tharaka Nithi	$3,166.24
Kisumu	$694.92	Trans Nzoia	$465.65

Table A4.2 continued…

Table A4.2 HIV program unit costs for care and treatment by county (continued)

County	Care and treatment unit cost, 2018	County	Care and treatment unit cost, 2018
Kitui	$681.12	Turkana	$364.25
Kwale	$448.63	Uasin Gishu	$384.90
Laikipia	$1,205.46	Vihiga	$598.99
Lamu	$123.70	Wajir	$9,383.46
Machakos	$742.17	West Pokot	$905.79
Makueni	$3,677.23	Median	$663.14
Mandera	$881.25	Minimum	$85.37
		Maximum	$9,383.46

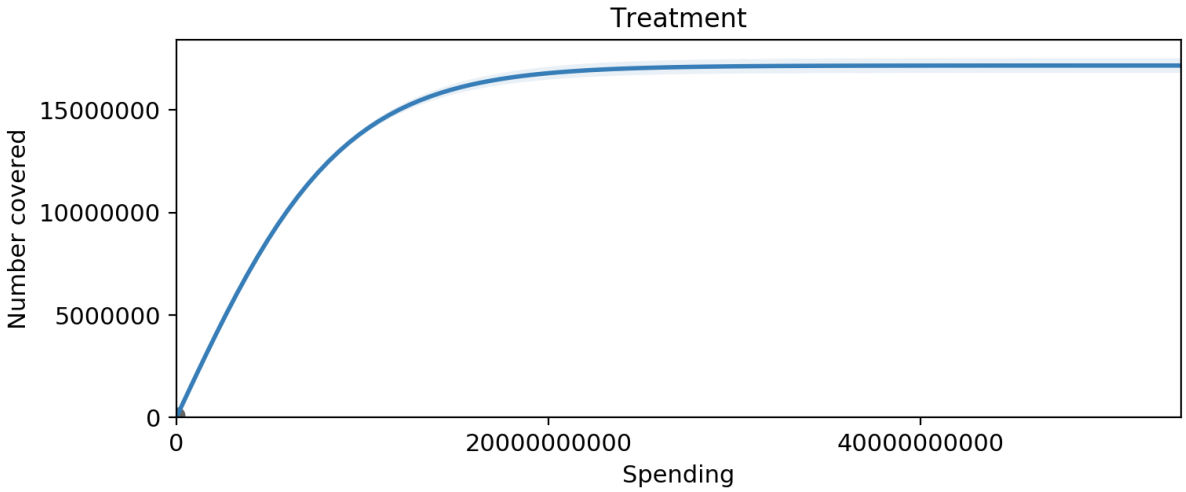
Source: Authors from Optima data.

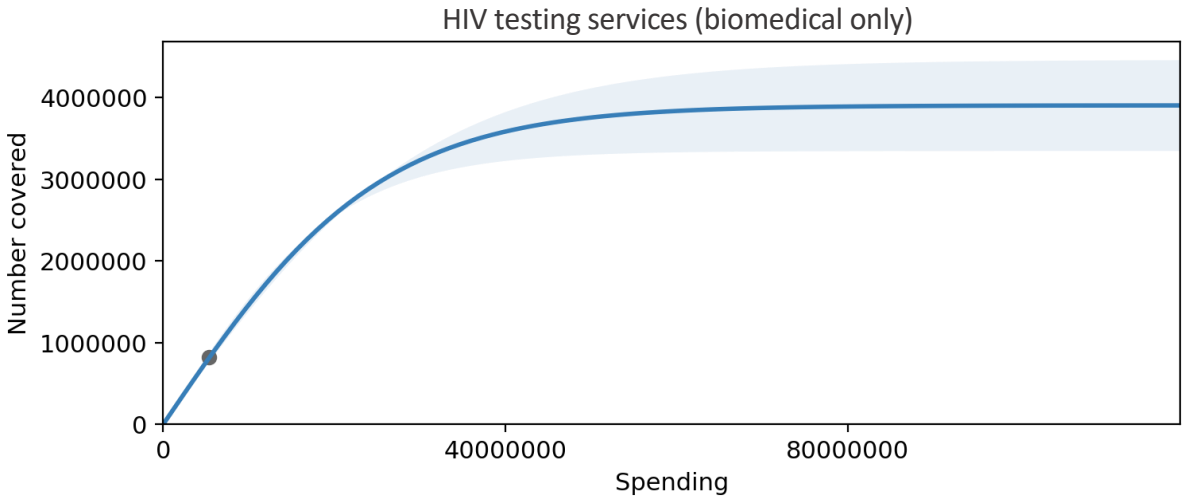
Table A4.3 HIV program unit costs for HIV testing services by county

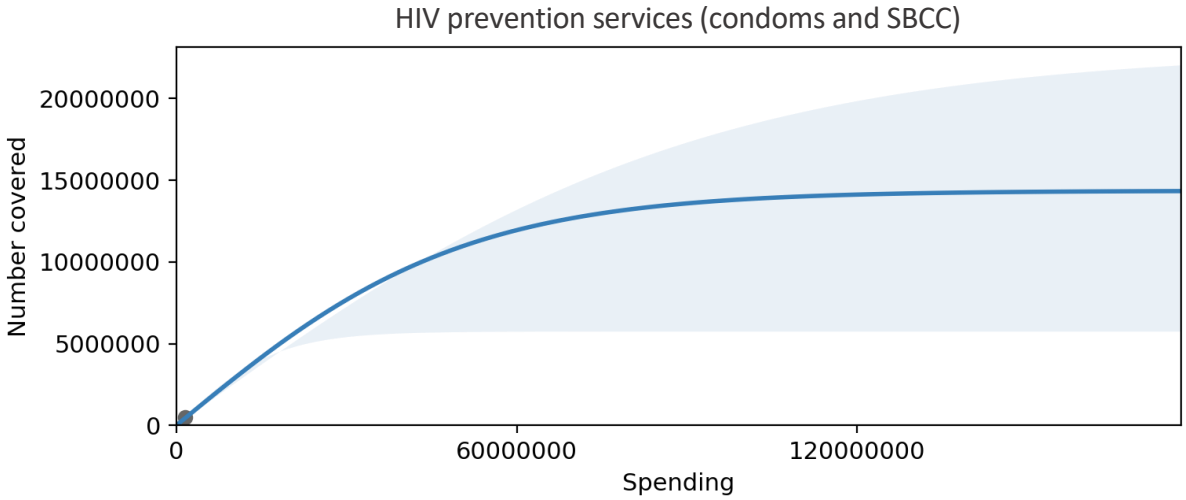
	HIV testing services Unit costs, 2018			HIV testing services Unit costs, 2018	
County	Low bound	High bound	County	Low bound	High bound
Baringo	$6.00	$8.00	Mandera	$6.00	$7.00
Bomet	$6.00	$8.00	Marsabit	$6.00	$7.00
Bungoma	$6.00	$7.00	Meru	$6.00	$7.00
Busia	$2.00	$2.16	Migori	$0.75	$2.00
Elgeyo Marakwet	$6.00	$7.00	Mombasa	$2.60	$4.00
Embu	$6.00	$7.00	Muranga	$2.75	$3.50
Garissa	$6.00	$7.00	Nairobi	$6.00	$7.00
Homa Bay	$2.00	$3.50	Nakuru	$5.00	$6.60
Isiolo	$6.00	$7.00	Nandi	$6.00	$6.30
Kajiado	$5.70	$7.00	Narok	$5.50	$7.00
Kakamega	$6.00	$7.00	Nyamira	$4.00	$6.00
Kericho	$6.00	$7.00	Nyandarua	$5.50	$7.00
Kiambu	$5.20	$6.00	Nyeri	$5.20	$7.00
Kilifi	$5.70	$7.00	Samburu	$5.70	$7.00
Kilifi	$5.70	$7.00	Siaya	$0.50	$1.70
Kirinyaga	$5.10	$5.90	Taita Taveta	$6.00	$7.00
Kisii	$4.00	$5.30	Tana River	$5.50	$7.00
Kisumu	$1.50	$3.00	Tharaka Nithi	$5.00	$7.40
Kitui	$5.00	$7.00	Trans Nzoia	$5.50	$7.00
Kwale	$6.00	$7.00	Turkana	$5.50	$7.00
Laikipia	$5.70	$7.00	Uasin Gishu	$5.00	$7.00
Lamu	$6.00	$7.00	Vihiga	$5.50	$7.00
Machakos	$2.25	$3.50	Wajir	$6.00	$7.00
Makueni	$6.00	$8.00	West Pokot	$6.00	$8.00
			Median	**$5.70**	**$7.00**
			Minimum, maximum	**$0.50**	**$8.00**

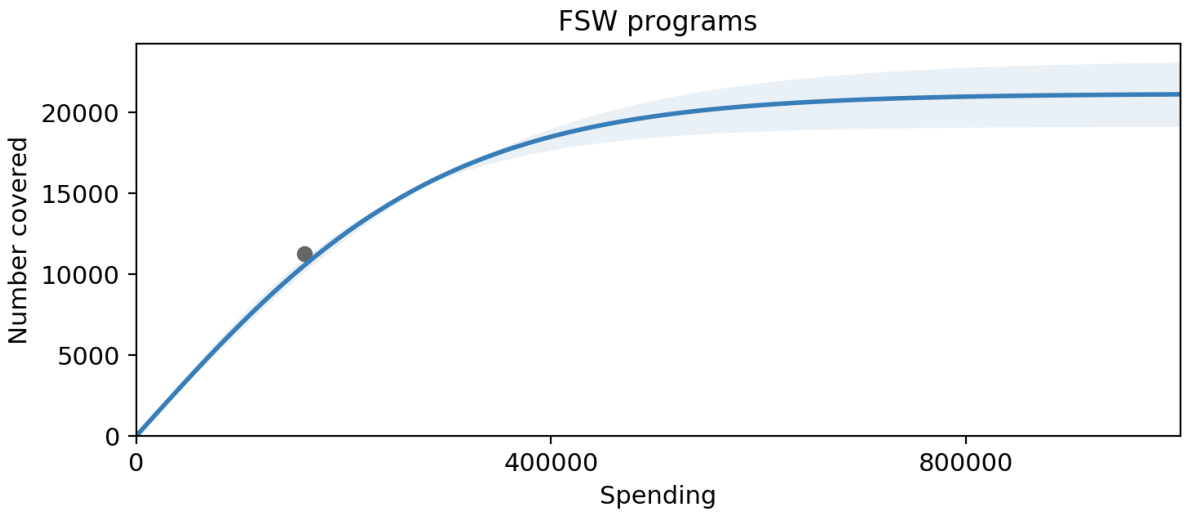
Source: Authors from Optima data.

APPENDIX 5: EXAMPLE COST COVERAGE CURVES FOR NAIROBI COUNTY





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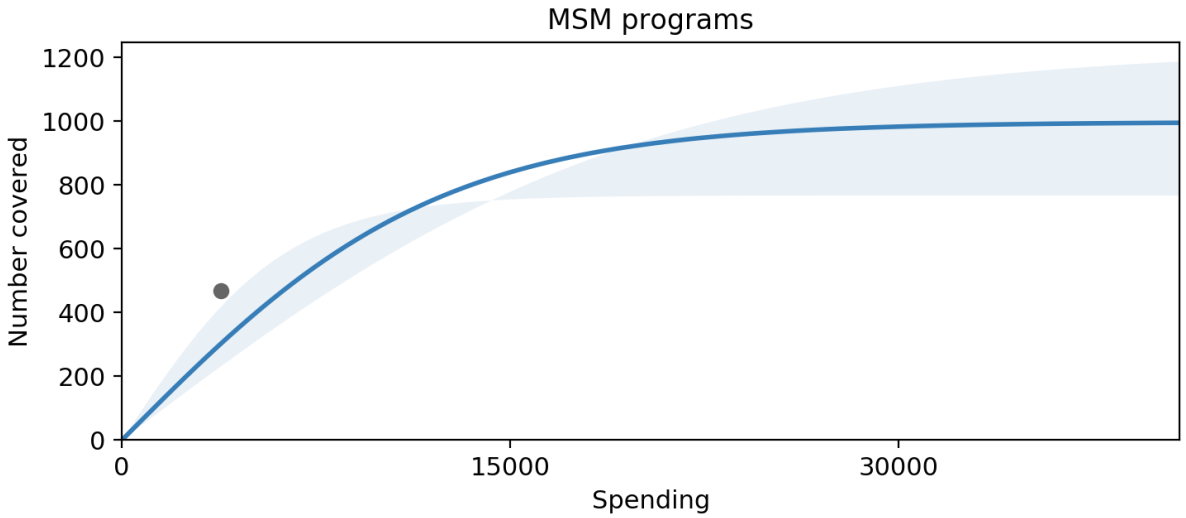
Spending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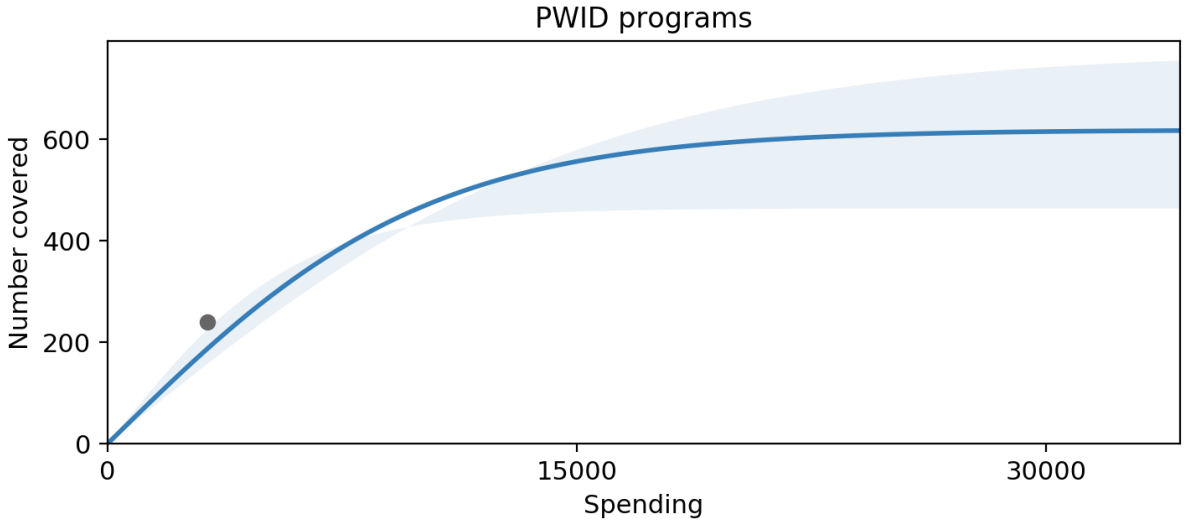
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Number covered
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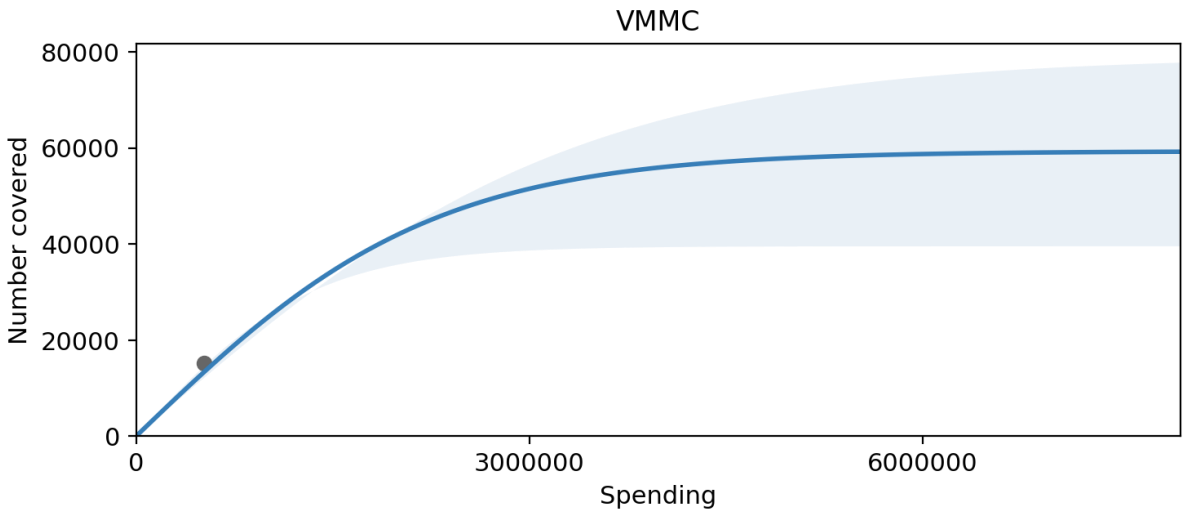
Spending



Source: Authors from Optima data.

APPENDIX 6: SUPPORTING DATA FOR RESULTS AND ADDITIONAL RESULTS

Table A6.1 100% annual optimized allocation within counties represented nationally for 2019 to 2030, and percent of the national budget

HIV programs	Latest reported national budget	100% budget optimized within counties, represented nationally	% National budget	
			Latest reported budget	100% budget optimized
Care and treatment	$538,574,507	$576,905,275	90%	96%
HIV testing services (biomedical only)	$45,147,988	$15,467,543	8%	3%
VMMC	$8,105,135	$3,353,402	1.4%	0.6%
HIV testing and prevention for FSW	$760,474	$2,436,503	0.1%	0.4%
HIV prevention services (condoms and SBCC)	$6,013,639	$399,169	1.01%	0.07%
HIV testing and prevention for PWID	$21,615	$68,805	0.004%	0.011%
HIV testing and prevention for MSM	$28,043	$20,704	0.005%	0.003%
Total	**$598,651,401**	**$598,651,401**	**100%**	**100%**

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; SBCC = social behaviour change communication ; VMMC = Voluntary male medical circumcision.

Table A6.2 Changing levels of HIV budgets optimized within counties for 2019 to 2030, represented nationally

HIV programs	100% latest reported	50% optimized	90% optimized	100% optimized	110% optimized	150% optimized	200% optimized
Care and treatment	$538,574,507	$293,132,793	$528,210,917	$576,905,275	$628,109,660	$825,658,933	$1,086,351,556
HIV testing services (biomedical only)	$45,147,988	$692,481	$5,077,022	$15,467,543	$23,149,900	$53,570,225	$73,304,590
HIV prevention services (condoms and SBCC)	$6,013,639	$0	$87,497	$399,169	$1,222,746	$11,384,574	$28,641,997
VMMC	$8,105,135	$3,134,817	$3,085,941	$3,353,402	$3,478,321	$4,539,827	$5,777,675
HIV testing and prevention for FSW	$760,474	$2,302,012	$2,260,502	$2,436,503	$2,444,255	$2,654,661	$3,008,416
HIV testing and prevention for MSM	$28,043	$6,680	$9,626	$20,704	$35,719	$81,799	$117,114
HIV testing and prevention for PWID	$21,615	$56,918	$54,756	$68,805	$75,940	$87,083	$101,455
Total	**$598,651,401**	**$299,325,701**	**$538,786,261**	**$598,651,401**	**$658,516,541**	**$897,977,102**	**$1,197,302,802**

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; SBCC = social behaviour change communication ; VMMC = Voluntary male medical circumcision.

Table A6.3 Percentage of budget allocated by HIV program for changing budgets optimized within counties represented nationally for 2019 to 2030

HIV programs	100% latest reported	50% optimized	90% optimized	100% optimized	110% optimized	150% optimized	200% optimized
Care and treatment	90%	98%	98%	96%	95%	92%	91%
HIV testing services (biomedical only)	8%	0.2%	0.9%	3%	4%	6%	6%
HIV prevention services (condoms and SBCC)	1%	0%	0.02%	0.07%	0.2%	1%	2%
VMMC	1%	1%	0.6%	0.6%	0.5%	0.5%	0.5%
HIV testing and prevention for FSW	0.1%	0.8%	0.4%	0.4%	0.4%	0.3%	0.3%
HIV testing and prevention for MSM	0.005%	0.002%	0.002%	0.003%	0.005%	0.009%	0.010%
HIV testing and prevention for PWID	0.004%	0.019%	0.010%	0.011%	0.012%	0.010%	0.008%

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people living with HIV; SBCC = social behaviour change communication ; VMMC = Voluntary male medical circumcision.

Table A6.4 Percentage of total budget allocated to HIV prevention and treatment with changing budgets levels optimized within counties represented nationally for 2019 to 2030

HIV program categories	100% latest reported	50% optimized	90% optimized	100% optimized	110% optimized	150% optimized	200% optimized
Total prevention	10.0%	2.1%	2.0%	3.6%	4.6%	8.1%	9.3%
Total treatment	90.0%	97.9%	98.0%	96.4%	95.4%	91.9%	90.7%

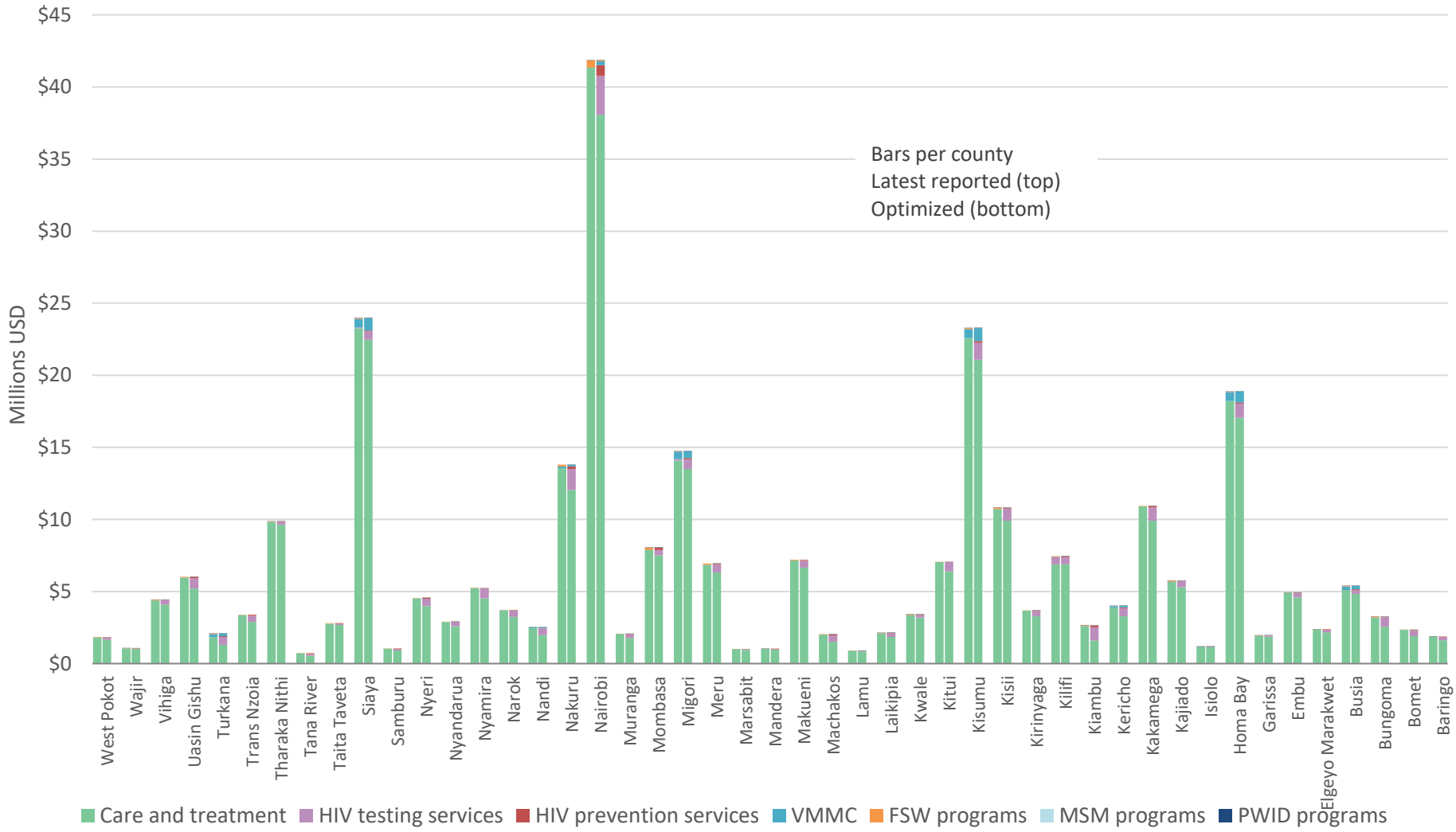
Source: Authors.

Table A6.5 HIV program coverage levels at 100% HIV budget optimized within counties represented nationally for 2019 to 2030

HIV programs	100% latest reported	100% optimized
Care and treatment (ART and PMTCT)	600,000	640,000
HIV testing services (biomedical only)	6,400,000	2,200,000
HIV prevention services (condoms and SBCC)	1,700,000	110,000
VMMC	210,000	87,000
HIV testing and prevention for FSW	54,000	170,000
HIV testing and prevention for MSM	2,300	1,700
HIV testing and prevention for PWID	1,300	4,200

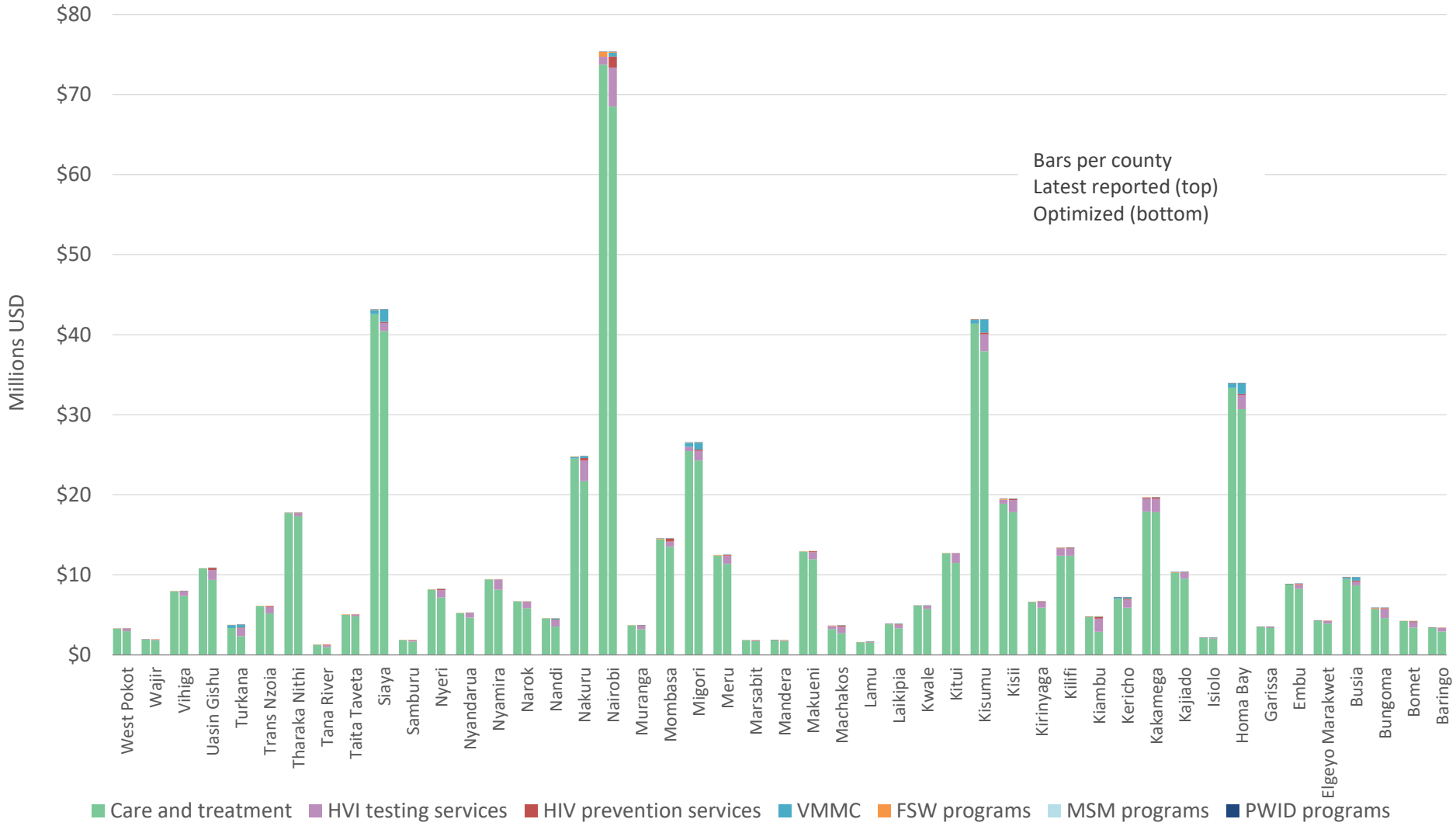
Source: Authors from Optima data.
Note: ART = antiretroviral therapy; FSW = female sex worker; MSM = men who have sex with men; PMTCT = prevention of mother-to-child transmission; PWID = people living with HIV; SBCC = social behaviour change communication ; VMMC = Voluntary male medical circumcision.

Figure A6.1 50% annual HIV budget optimized within counties



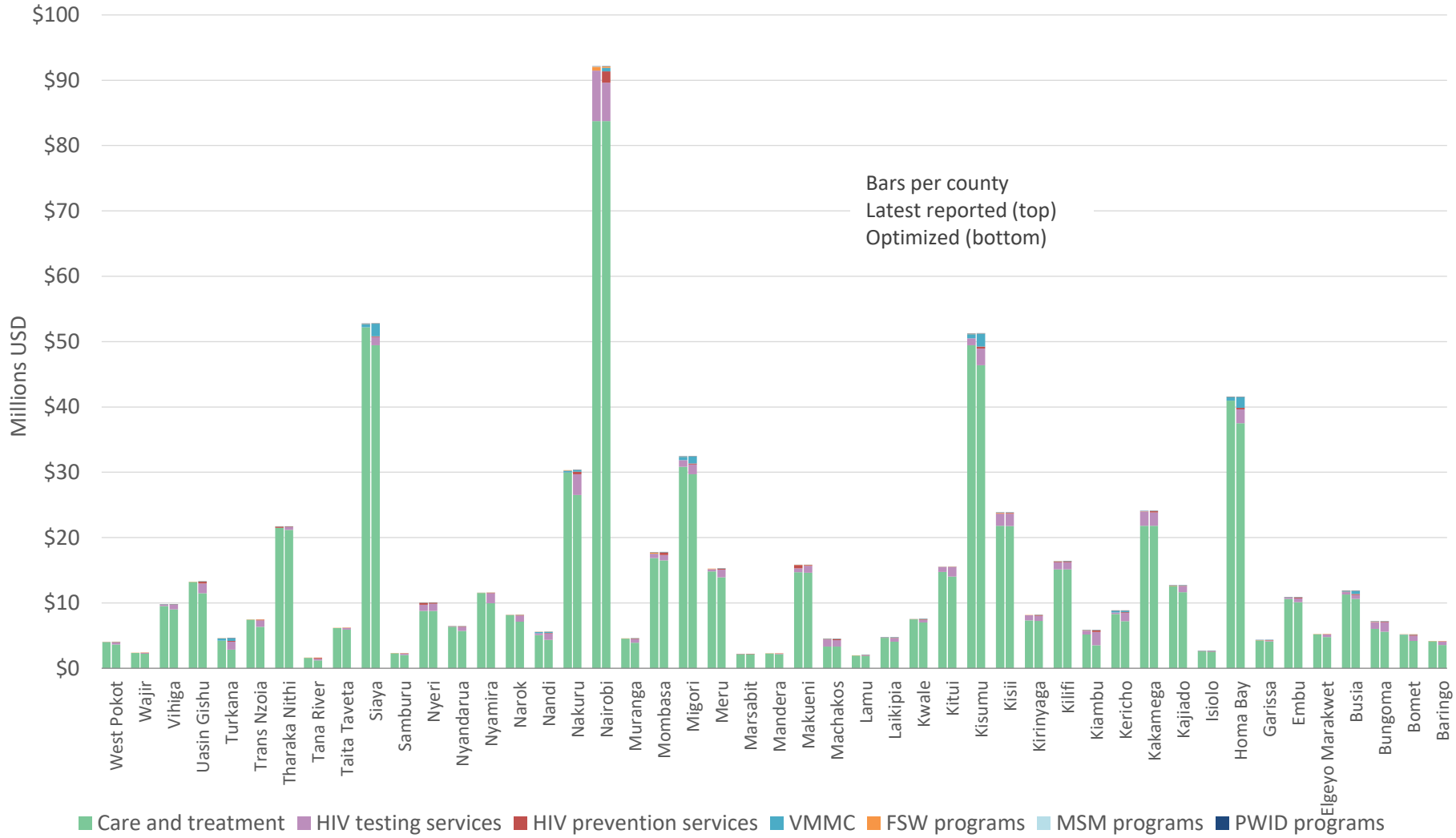
Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, VMMC = voluntary male medical circumcision.

Figure A6.2 90% annual HIV budget optimized within counties



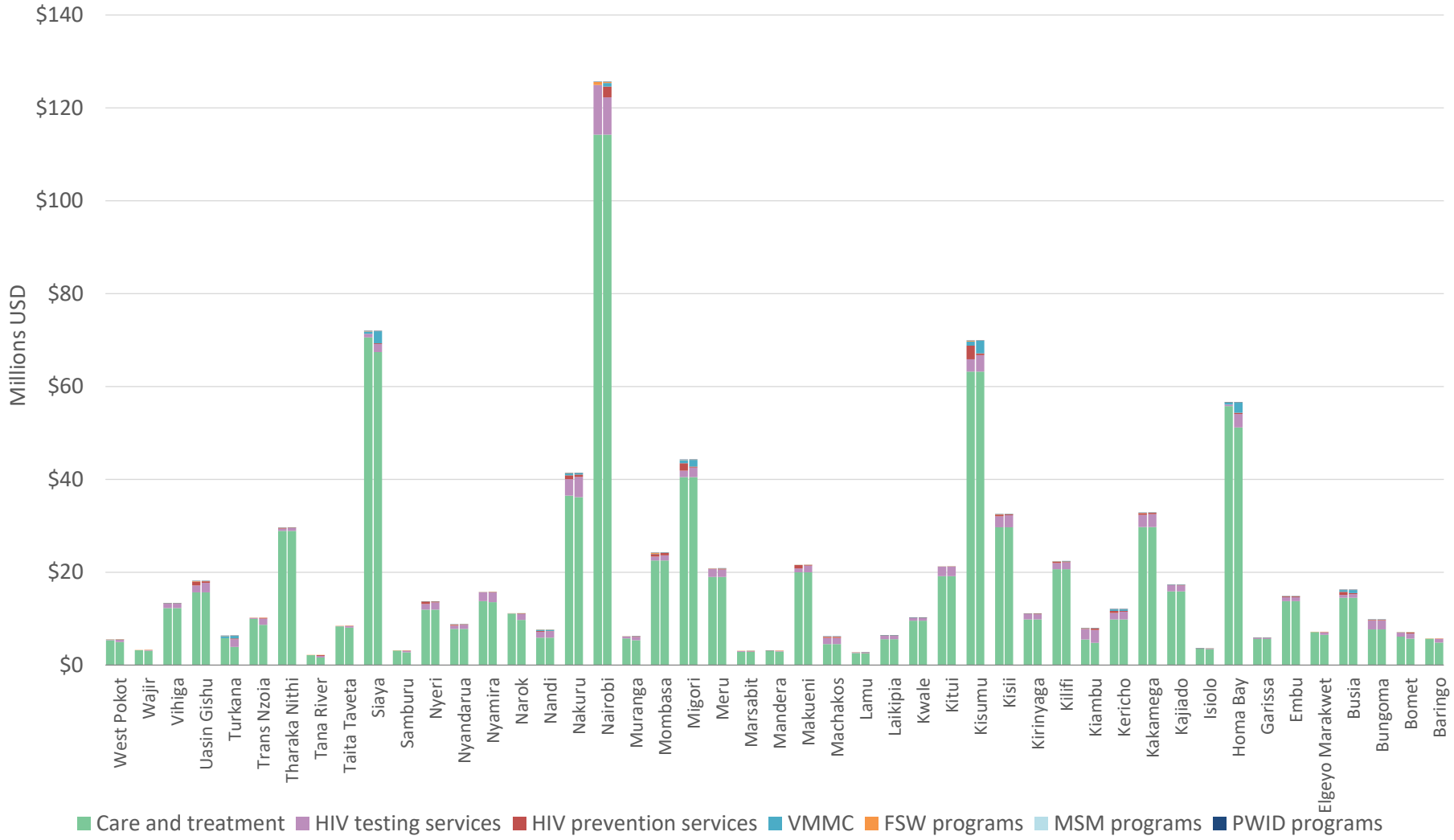
Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, VMMC = voluntary male medical circumcision.

Figure A6.3 110% annual HIV budget optimized within counties



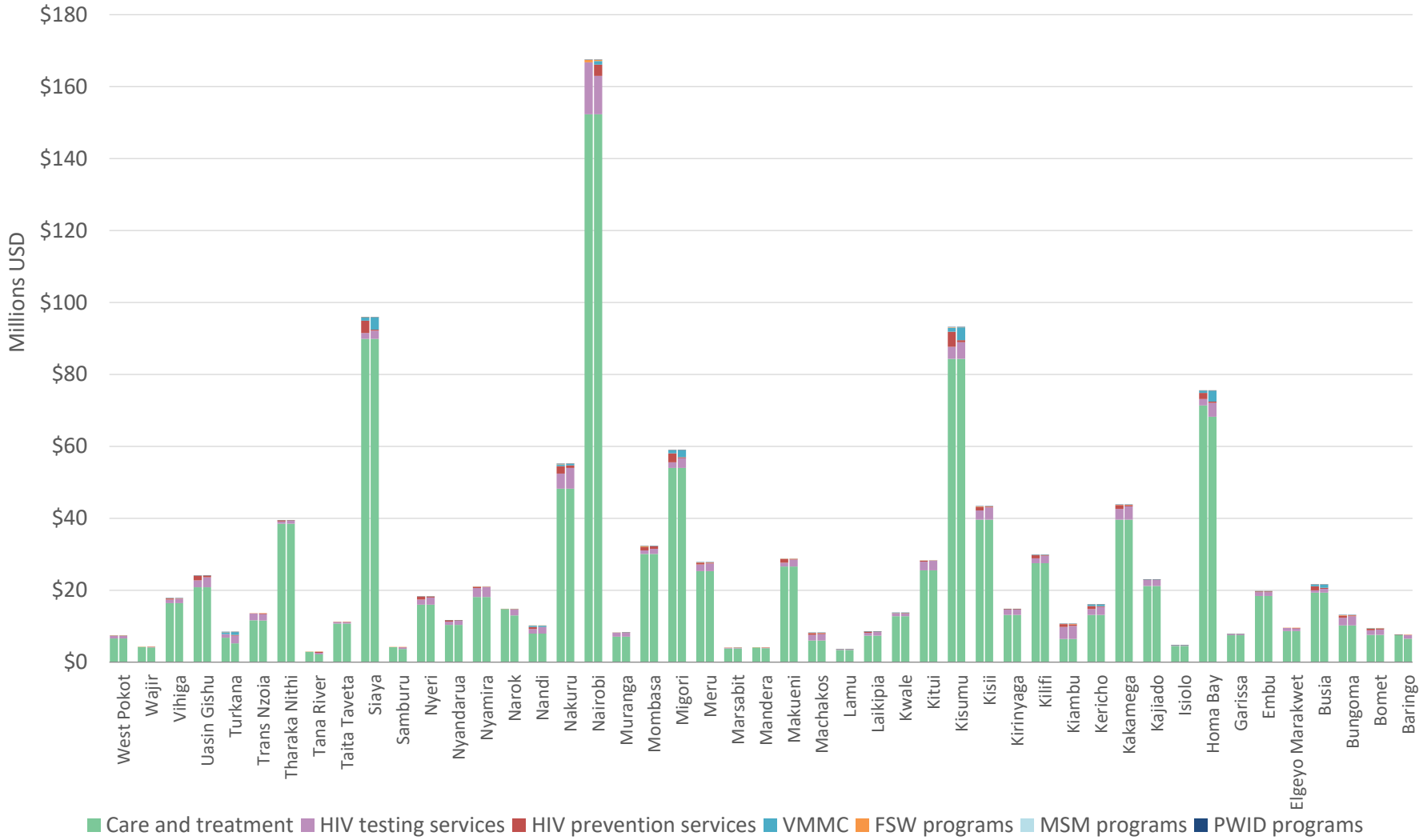
Source: Authors.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, VMMC = voluntary male medical circumcision.

Figure A6.4 150% annual HIV budget optimized within counties



Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, VMMC = voluntary male medical circumcision.

Figure A6.5 200% annual HIV budget optimized within counties



Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, VMMC = voluntary male medical circumcision.

Table A6.6 100% annual HIV budget optimizations within counties, 2019 to 2030

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Baringo	Latest reported	$3,250,922	$487,240	$41,345	$0	$2,170	$0	$0	$3,781,677
	Optimized	$3,771,903	$0	$0	$0	$9,774	$0	$0	$3,781,677
Bomet	Latest reported	$3,795,302	$732,895	$138,331	$43,642	$3,173	$0	$0	$4,713,343
	Optimized	$4,702,819	$0	$0	$0	$10,524	$0	$0	$4,713,343
Bungoma	Latest reported	$5,107,718	$1,293,019	$80,951	$0	$38,316	$900	$755	$6,521,659
	Optimized	$5,845,066	$609,337	$0	$0	$65,342	$220	$1,694	$6,521,659
Busia	Latest reported	$9,664,843	$516,681	$142,195	$456,395	$28,791	$676	$567	$10,810,148
	Optimized	$10,135,237	$310,560	$0	$291,834	$70,326	$244	$1,947	$10,810,148
Elgeyo	Latest reported	$4,342,077	$353,945	$47,141	$0	$1,507	$0	$0	$4,744,670
Marakwet	Optimized	$4,736,337	$0	$0	$0	$8,333	$0	$0	$4,744,670
Embu	Latest reported	$9,183,850	$541,821	$127,319	$0	$5,192	$61	$234	$9,858,477
	Optimized	$9,836,136	$0	$0	$0	$21,176	$0	$1,165	$9,858,477
Garissa	Latest reported	$3,746,225	$129,987	$17,968	$0	$6,996	$600	$414	$3,902,190
	Optimized	$3,875,435	$0	$0	$0	$25,511	$0	$1,243	$3,902,190
Homa Bay	Latest reported	$34,111,042	$1,925,676	$192,814	$1,513,878	$5,368	$1,952	$151	$37,750,881
	Optimized	$37,149,352	$0	$0	$572,005	$28,455	$0	$1,069	$37,750,881
Isiolo	Latest reported	$2,264,373	$78,072	$17,388	$102	$1,962	$42	$20	$2,361,959
	Optimized	$2,351,989	$0	$0	$102	$9,737	$0	$131	$2,361,959
Kajiado	Latest reported	$10,600,549	$849,895	$22,411	$407	$24,029	$62	$25	$11,497,378
	Optimized	$11,445,180	$0	$0	$407	$51,739	$0	$52	$11,497,378
Kakamega	Latest reported	$19,811,955	$1,856,134	$187,211	$0	$11,470	$1,220	$1,024	$21,869,014
	Optimized	$19,811,955	$2,009,095	$0	$0	$46,731	$806	$427	$21,869,014

Table continued…

Table A6.6 100% annual HIV budget optimizations within counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Kericho	Latest reported	$6,551,128	$1,132,027	$107,612	$226,960	$5,948	$178	$60	$8,023,913
	Optimized	$7,809,966	$0	$0	$191,798	$21,946	$0	$204	$8,023,913
Kiambu	Latest reported	$3,213,795	$1,831,363	$221,987	$0	$51,954	$1,220	$1,024	$5,321,343
	Optimized	$5,124,804	$115,277	$0	$0	$75,217	$858	$5,189	$5,321,343
Kilifi	Latest reported	$13,772,970	$999,980	$97,744	$1,356	$30,956	$727	$610	$14,904,343
	Optimized	$13,772,970	$996,804	$90,126	$1,356	$40,115	$2,971	$0	$14,904,343
Kirinyaga	Latest reported	$6,573,568	$740,917	$67,620	$0	$3,933	$0	$422	$7,386,460
	Optimized	$7,361,983	$7,409	$0	$0	$17,068	$0	$0	$7,386,460
Kisii	Latest reported	$19,800,751	$1,704,517	$113,022	$0	$45,026	$1,058	$887	$21,665,261
	Optimized	$20,003,096	$1,550,384	$0	$0	$108,785	$2,532	$464	$21,665,261
Kisumu	Latest reported	$42,147,243	$2,337,739	$269,869	$1,797,027	$21,665	$2,446	$2,052	$46,578,041
	Optimized	$45,572,660	$379,160	$0	$540,418	$77,305	$1,620	$6,878	$46,578,041
Kitui	Latest reported	$12,767,821	$1,353,235	$2,941	$0	$4,014	$951	$0	$14,128,962
	Optimized	$13,802,865	$304,779	$0	$0	$20,034	$1,285	$0	$14,128,962
Kwale	Latest reported	$6,380,058	$363,766	$71,870	$610	$19,050	$447	$375	$6,836,176
	Optimized	$6,796,896	$0	$0	$610	$38,669	$0	$0	$6,836,176
Laikipia	Latest reported	$3,697,176	$494,462	$58,346	$610	$19,483	$67	$384	$4,270,528
	Optimized	$4,238,983	$0	$0	$610	$30,415	$0	$520	$4,270,528
Lamu	Latest reported	$1,694,873	$79,606	$17,388	$0	$2,372	$178	$149	$1,794,566
	Optimized	$1,783,401	$0	$0	$0	$11,165	$0	$0	$1,794,566
Machakos	Latest reported	$3,020,338	$879,099	$146,446	$0	$37,450	$1,307	$429	$4,085,069
	Optimized	$3,262,914	$750,664	$0	$0	$68,318	$2,815	$358	$4,085,069
Makueni	Latest reported	$13,301,166	$966,526	$107,469	$0	$27,059	$98	$0	$14,402,318
	Optimized	$13,660,541	$379,793	$309,043	$0	$52,680	$261	$0	$14,402,318

Table continued…

Table A6.6 100% annual HIV budget optimizations within counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Mandera	Latest reported	$1,941,577	$83,330	$25,502	$0	$7,577	$0	$0	$2,057,986
	Optimized	$2,042,013	$0	$0	$0	$15,973	$0	$0	$2,057,986
Marsabit	Latest reported	$1,908,023	$74,367	$15,649	$237	$869	$0	$0	$1,999,145
	Optimized	$1,995,023	$0	$0	$237	$3,885	$0	$0	$1,999,145
Meru	Latest reported	$12,639,113	$1,095,231	$93,887	$0	$40,048	$941	$789	$13,870,009
	Optimized	$13,676,015	$113,616	$0	$0	$80,378	$0	$0	$13,870,009
Migori	Latest reported	$26,994,656	$1,345,552	$159,776	$973,624	$12,265	$1,413	$1,186	$29,488,472
	Optimized	$28,198,654	$803,180	$0	$435,878	$43,286	$2,014	$5,460	$29,488,472
Mombasa	Latest reported	$15,023,512	$729,957	$347,976	$21,092	$25,760	$605	$508	$16,149,410
	Optimized	$15,906,507	$32,202	$0	$21,162	$165,917	$1,681	$21,940	$16,149,410
Muranga	Latest reported	$3,550,369	$507,725	$67,234	$0	$2,212	$412	$346	$4,128,298
	Optimized	$4,120,646	$0	$0	$0	$7,652	$0	$0	$4,128,298
Nairobi	Latest reported	$76,142,281	$5,358,997	$1,546,306	$516,992	$162,572	$3,818	$3,203	$83,734,169
	Optimized	$76,142,281	$6,906,679	$0	$0	$663,807	$3,221	$18,182	$83,734,169
Nakuru	Latest reported	$24,106,103	$2,905,864	$328,425	$238,625	$1,078	$2,471	$288	$27,582,854
	Optimized	$27,252,562	$0	$0	$243,922	$86,369	$0	$0	$27,582,854
Nandi	Latest reported	$3,952,806	$901,914	$52,917	$173,144	$3,084	$0	$0	$5,083,865
	Optimized	$4,892,897	$0	$0	$177,750	$13,218	$0	$0	$5,083,865
Narok	Latest reported	$6,478,647	$867,204	$51,264	$2,340	$3,284	$0	$0	$7,402,739
	Optimized	$7,382,472	$0	$0	$2,348	$17,919	$0	$0	$7,402,739
Nyamira	Latest reported	$9,043,146	$1,404,761	$50,234	$0	$4,586	$824	$0	$10,503,551
	Optimized	$10,481,225	$0	$0	$0	$22,326	$0	$0	$10,503,551
Nyandarua	Latest reported	$5,184,140	$584,987	$37,094	$0	$4,967	$0	$486	$5,811,674
	Optimized	$5,793,982	$0	$0	$0	$17,692	$0	$0	$5,811,674

Table continued…

Table A6.6 100% annual HIV budget optimizations within counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Nyeri	Latest reported	$7,976,176	$1,011,784	$117,079	$0	$5,202	$0	$580	$9,110,821
	Optimized	$8,890,712	$198,605	$0	$0	$21,443	$0	$61	$9,110,821
Samburu	Latest reported	$1,836,898	$223,412	$19,320	$0	$847	$0	$0	$2,080,477
	Optimized	$2,075,555	$0	$0	$0	$4,922	$0	$0	$2,080,477
Siaya	Latest reported	$44,934,550	$1,154,392	$120,750	$1,735,955	$11,570	$1,637	$123	$47,958,977
	Optimized	$47,386,078	$0	$0	$507,568	$64,465	$0	$866	$47,958,977
Taita	Latest reported	$5,363,680	$221,761	$21,059	$0	$11,906	$0	$0	$5,618,406
Taveta	Optimized	$5,573,523	$0	$0	$0	$44,883	$0	$0	$5,618,406
Tana River	Latest reported	$1,096,139	$216,795	$123,648	$0	$903	$0	$0	$1,437,485
	Optimized	$1,432,790	$0	$0	$0	$4,695	$0	$0	$1,437,485
Tharaka	Latest reported	$19,257,062	$416,611	$26,275	$0	$5,219	$0	$341	$19,705,508
Nithi	Optimized	$19,679,213	$0	$0	$0	$25,911	$0	$383	$19,705,508
Trans	Latest reported	$5,783,377	$873,327	$121,890	$0	$4,630	$0	$0	$6,783,224
Nzoia	Optimized	$6,759,712	$0	$0	$0	$23,512	$0	$0	$6,783,224
Turkana	Latest reported	$2,606,202	$1,091,818	$109,544	$375,994	$14,584	$1,083	$909	$4,200,134
	Optimized	$3,804,389	$0	$0	$338,799	$56,946	$0	$0	$4,200,134
Uasin	Latest reported	$10,427,658	$1,382,875	$223,814	$0	$13,818	$222	$71	$12,048,458
Gishu	Optimized	$11,990,235	$0	$0	$0	$58,048	$175	$0	$12,048,458
Vihiga	Latest reported	$8,193,543	$633,159	$27,628	$0	$18,184	$427	$3,203	$8,876,144
	Optimized	$8,824,047	$0	$0	$0	$51,778	$0	$319	$8,876,144
Wajir	Latest reported	$2,036,212	$77,272	$14,490	$0	$1,693	$0	$0	$2,129,667
	Optimized	$2,119,658	$0	$0	$0	$9,756	$0	$252	$2,129,667

Table continued…

Table A6.6 100% annual HIV budget optimizations within counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
West	Latest reported	$3,298,894	$336,291	$14,490	$26,145	$5,732	$0	$0	$3,681,552
Pokot	Optimized	$3,632,599	$0	$0	$26,597	$22,356	$0	$0	$3,681,552
Total	**Latest reported**	**$538,574,507**	**$45,147,988**	**$6,013,639**	**$8,105,135**	**$760,474**	**$28,043**	**$21,615**	**$598,651,401**
national	**Optimized**	**$576,905,275**	**$15,467,543**	**$399,169**	**$3,353,402**	**$2,436,503**	**$20,704**	**$68,805**	**$598,651,401**
		90.0%	7.5%	1.0%	1.4%	0.1%	0.005%	0.004%	100.0%
		96.4%	2.6%	0.1%	0.6%	0.4%	0.003%	0.011%	100.0%

Source: Authors from Optima data.
Note: Latest reported program budgets for each county were derived using the county budgets for treatment and for overall prevention; FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, SBCC = social behavior change communication; VMMC = voluntary male medical circumcision.

Table A6.7 Percentage of total annual HIV budget to optimally reallocate within counties, 2019 to 2030

	Percentage of total HIV budget recommended to allocate to each program (percentage difference of total budget between the optimized and latest reported allocation) by county						
County	**Care and treatment**	**HIV testing (biomedical)**	**HIV prevention services (condoms and SBCC)**	**VMMC**	**HIV testing and prevention for FSW**	**HIV testing and prevention for PWID**	**Total budget**
Baringo	99.7% (+13.8%)	Not prioritized	Not prioritized	Not prioritized	0.3% (+0.2%)	Not prioritized	$3,781,677
Bomet	99.8% (+19.3%)	Not prioritized	Not prioritized	Not prioritized	0.2% (+0.2%)	Not prioritized	$4,713,343
Bungoma	89.6% (+11.3%)	9.3% (-10.5%)	Not prioritized	Not prioritized	1.0% (+0.4%)	0.03% (+0.01%)	$6,521,659
Busia	93.8% (+4.4%)	2.9% (-1.9%)	Not prioritized	2.7% (-1.5%)	0.7% (+0.4%)	0.02% (+0.01%)	$10,810,148
Elgeyo Marakwet	99.8% (+8.3%)	Not prioritized	Not prioritized	Not prioritized	0.2% (+0.1%)	Not prioritized	$4,744,670
Embu	99.8% (+6.6%)	Not prioritized	Not prioritized	Not prioritized	0.2% (+0.2%)	0.01% (+0.01%)	$9,858,477
Garissa	99.3% (+3.3%)	Not prioritized	Not prioritized	Not prioritized	0.7% (+0.5%)	0.03% (+0.02%)	$3,902,190
Homa Bay	98.4% (+8.0%)	Not prioritized	Not prioritized	1.5% (-2.5%)	0.1% (+0.1%)	0.003% (+0.002%)	$37,750,881
Isiolo	99.6% (+3.7%)	Not prioritized	Not prioritized	0.004% (+0.0%)	0.4% (+0.3%)	0.006% (+0.005%)	$2,361,959
Kajiado	99.5% (+7.3%)	Not prioritized	Not prioritized	0.004% (+0.0%)	0.5% (+0.2%)	Not prioritized	$11,497,378
Kakamega	90.6% (+0.0%)	9.2% (+0.7%)	Not prioritized	Not prioritized	0.2% (+0.2%)	0.002% (-0.003%)	$21,869,014
Kericho	97.3% (+15.7%)	Not prioritized	Not prioritized	2.4% (-0.4%)	0.3% (+0.2%)	0.003% (+0.002%)	$8,023,913
Kiambu	96.3% (+35.9%)	2.2% (-32.2%)	Not prioritized	Not prioritized	1.4% (+0.4%)	0.1% (+0.1%)	$5,321,343
Kilifi	92.4% (+0.0%)	6.7% (+0.0%)	0.6% (-0.001%)	0.01% (+0.0%)	0.2% (+0.0%)	Not prioritized	$14,904,343
Kirinyaga	99.7% (+10.7%)	0.1% (-9.9%)	Not prioritized	Not prioritized	0.2% (+0.1%)	Not prioritized	$7,386,460
Kisii	92.3% (+0.9%)	7.2% (-0.7%)	Not prioritized	Not prioritized	0.5% (+0.2%)	0.002% (-0.002%)	$21,665,261
Kisumu	97.8% (+7.4%)	0.8% (-4.2%)	Not prioritized	1.2% (-2.7%)	0.1% (+0.1%)	0.02% (+0.01%)	$46,578,041
Kitui	97.7% (+7.3%)	2.2% (-7.4%)	Not prioritized	Not prioritized	0.1% (+0.1%)	Not prioritized	$14,128,962
Kwale	99.4% (+6.1%)	Not prioritized	Not prioritized	0.01% (+0.0%)	0.5% (+0.2%)	Not prioritized	$6,836,176
Laikipia	99.3% (+12.7%)	Not prioritized	Not prioritized	0.01% (+0.0%)	0.7% (+0.2%)	0.012% (+0.003%)	$4,270,528
Lamu	99.4% (+4.9%)	Not prioritized	Not prioritized	Not prioritized	0.6% (+0.4%)	Not prioritized	$1,794,566
Machakos	79.9% (+5.9%)	18.4% (-3.1%)	Not prioritized	Not prioritized	1.6% (+0.7%)	0.009% (-0.002%)	$4,085,069
Makueni	94.8% (+2.5%)	2.6% (-4.1%)	2.1% (+0.01%)	Not prioritized	0.3% (+0.1%)	Not prioritized	$14,402,318
Mandera	99.2% (+4.9%)	Not prioritized	Not prioritized	Not prioritized	0.7% (+0.4%)	Not prioritized	$2,057,986
Marsabit	99.8% (+4.4%)	Not prioritized	Not prioritized	0.01% (+0.0%)	0.1% (+0.1%)	Not prioritized	$1,999,145

Table continued…

Table A6.7 Percentage of total annual HIV budget to optimally reallocate within counties, 2019 to 2030 (continued)

	Percentage of total HIV budget recommended to allocate to each program (percentage difference of total budget between the optimized and latest reported allocation) by county						
County	**Care and treatment**	**HIV testing (biomedical)**	**HIV prevention services (condoms and SBCC)**	**VMMC**	**HIV testing and prevention for FSW**	**HIV testing and prevention for PWID**	**Total budget**
Meru	98.6% (+7.5%)	0.8% (-7.1%)	Not prioritized	Not prioritized	0.5% (+0.2%)	Not prioritized	$13,870,009
Migori	95.6% (+4.1%)	2.7% (-1.8%)	Not prioritized	1.5% (-1.8%)	0.1% (+0.1%)	0.02% (+0.01%)	$29,488,472
Mombasa	98.5% (+5.5%)	0.2% (-4.3%)	Not prioritized	0.1% (+0.0%)	1.0% (+0.8%)	0.1% (+0.1%)	$16,149,410
Muranga	99.8% (+13.8%)	Not prioritized	Not prioritized	Not prioritized	0.1% (+0.1%)	Not prioritized	$4,128,298
Nairobi	90.9% (+0.0%)	8.2% (+1.8%)	Not prioritized	Not prioritized	0.7% (+0.5%)	0.02% (+0.02%)	$83,734,169
Nakuru	98.8% (+11.4%)	Not prioritized	Not prioritized	0.9% (+0.02%)	0.3% (+0.3%)	Not prioritized	$27,582,854
Nandi	96.2% (+18.5%)	Not prioritized	Not prioritized	3.5% (+0.1%)	0.2% (+0.1%)	Not prioritized	$5,083,865
Narok	99.7% (+12.2%)	Not prioritized	Not prioritized	0.03% (+0.0%)	0.2% (+0.1%)	Not prioritized	$7,402,739
Nyamira	99.8% (+13.7%)	Not prioritized	Not prioritized	Not prioritized	0.2% (+0.1%)	Not prioritized	$10,503,551
Nyandarua	99.7% (+10.5%)	Not prioritized	Not prioritized	Not prioritized	0.3% (+0.2%)	Not prioritized	$5,811,674
Nyeri	97.6% (+10.0%)	2.2% (-8.9%)	Not prioritized	Not prioritized	0.2% (+0.1%)	0.001% (-0.006%)	$9,110,821
Samburu	99.8% (+11.5%)	Not prioritized	Not prioritized	Not prioritized	0.2% (+0.1%)	Not prioritized	$2,080,477
Siaya	98.8% (+5.1%)	Not prioritized	Not prioritized	1.6% (-2.6%)	0.1% (+0.1%)	0.002% (+0.002%)	$47,958,977
Taita Taveta	99.2% (+3.7%)	Not prioritized	Not prioritized	Not prioritized	0.7% (+0.5%)	Not prioritized	$5,618,406
Tana River	99.7% (+23.4%)	Not prioritized	Not prioritized	Not prioritized	0.3% (+0.2%)	Not prioritized	$1,437,485
Tharaka Nithi	99.9% (+2.1%)	Not prioritized	Not prioritized	Not prioritized	0.1% (+0.1%)	0.002% (+0.0%)	$19,705,508
Trans Nzoia	99.7% (+14.4%)	Not prioritized	Not prioritized	Not prioritized	0.3% (+0.2%)	Not prioritized	$6,783,224
Turkana	90.6% (+28.5%)	Not prioritized	Not prioritized	8.1% (-0.9%)	1.3% (+1.0%)	Not prioritized	$4,200,134
Uasin Gishu	99.5% (+13.0%)	Not prioritized	Not prioritized	Not prioritized	0.4% (+0.3%)	Not prioritized	$12,048,458
Vihiga	99.4% (+7.1%)	Not prioritized	Not prioritized	Not prioritized	0.5% (+0.3%)	0.004% (-0.032%)	$8,876,144
Wajir	99.5% (+3.9%)	Not prioritized	Not prioritized	Not prioritized	0.4% (+0.3%)	0.01% (+0.01%)	$2,129,667
West Pokot	98.7% (+9.1%)	Not prioritized	Not prioritized	0.7% (+0.01%)	0.6% (+0.4%)	Not prioritized	$3,681,552
National	**96.4% (+6.4%)**	**2.6% (-5.0%)**	**0.1% (-0.01%)**	**0.6% (-0.8%)**	**0.4% (+0.2%)**	**0.01% (+0.01%)**	**$598,651,401**

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, SBCC = social behavior change communication; VMMC = voluntary male medical circumcision.

Table A6.8 100% HIV budget optimization across counties, 2019 to 2030

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Baringo	Latest reported	$3,250,922	$487,240	$41,345	$0	$2,170	$0	$0	$3,781,677
	Optimized	$6,260,411	$0	$0	$262,581	$8,383	$0	$45	$6,531,420
Bomet	Latest reported	$3,795,302	$732,895	$138,331	$43,642	$3,173	$0	$0	$4,713,343
	Optimized	$6,069,575	$440,809	$0	$178,980	$11,791	$0	$0	$6,701,155
Bungoma	Latest reported	$5,107,718	$1,293,019	$80,951	$0	$38,316	$900	$755	$6,521,659
	Optimized	$5,989,094	$725,922	$0	$225,324	$83,608	$511	$2,148	$7,026,607
Busia	Latest reported	$9,664,843	$516,681	$142,195	$456,395	$28,791	$676	$567	$10,810,148
	Optimized	$11,988,897	$400,578	$0	$230,156	$60,613	$118	$1,818	$12,682,180
Elgeyo	Latest reported	$4,342,077	$353,945	$47,141	$0	$1,507	$0	$0	$4,744,670
Marakwet	Optimized	$2,631	$0	$0	$224,341	$8,426	$0	$67	$235,465
Embu	Latest reported	$9,183,850	$541,821	$127,319	$0	$5,192	$61	$234	$9,858,477
	Optimized	$59,314	$0	$0	$251,678	$26,386	$0	$1,560	$338,938
Garissa	Latest reported	$3,746,225	$129,987	$17,968	$0	$6,996	$600	$414	$3,902,190
	Optimized	$4,155	$0	$0	$11,425	$21,673	$0	$779	$38,032
Homa Bay	Latest reported	$34,111,042	$1,925,676	$192,814	$1,513,878	$5,368	$1,952	$151	$37,750,881
	Optimized	$67,200,229	$1,603,507	$1,256,646	$623,501	$30,736	$0	$1,451	$70,716,070
Isiolo	Latest reported	$2,264,373	$78,072	$17,388	$102	$1,962	$42	$20	$2,361,959
	Optimized	$30,053	$0	$0	$77,291	$10,405	$0	$145	$117,894
Kajiado	Latest reported	$10,600,549	$849,895	$22,411	$407	$24,029	$62	$25	$11,497,378
	Optimized	$147,327	$0	$0	$415,141	$58,239	$0	$143	$620,850
Kakamega	Latest reported	$19,811,955	$1,856,134	$187,211	$0	$11,470	$1,220	$1,024	$21,869,014
	Optimized	$17,402,318	$470,869	$0	$423,987	$42,120	$0	$226	$18,339,520
Kericho	Latest reported	$6,551,128	$1,132,027	$107,612	$226,960	$5,948	$178	$60	$8,023,913
	Optimized	$8,186,760	$7,250	$0	$221,183	$25,395	$0	$313	$8,440,901

Table continued…

Table A6.8 100% HIV budget optimization across counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Kiambu	Latest reported	$3,213,795	$1,831,363	$221,987	$0	$51,954	$1,220	$1,024	$5,321,343
	Optimized	$5,201,407	$713,448	$0	$267,961	$84,883	$1,121	$6,113	$6,274,933
Kilifi	Latest reported	$13,772,970	$999,980	$97,744	$1,356	$30,956	$727	$610	$14,904,343
	Optimized	$0	$1,115,462	$215,903	$212,916	$75,722	$2,459	$0	$1,622,462
Kirinyaga	Latest reported	$6,573,568	$740,917	$67,620	$0	$3,933	$0	$422	$7,386,460
	Optimized	$6,968,951	$0	$0	$153,899	$15,208	$0	$0	$7,138,058
Kisii	Latest reported	$19,800,751	$1,704,517	$113,022	$0	$45,026	$1,058	$887	$21,665,261
	Optimized	$18,277,744	$0	$0	$444,887	$98,288	$0	$164	$18,821,083
Kisumu	Latest reported	$42,147,243	$2,337,739	$269,869	$1,797,027	$21,665	$2,446	$2,052	$46,578,041
	Optimized	$50,347,599	$422,994	$0	$593,490	$83,225	$1,815	$7,411	$51,456,534
Kitui	Latest reported	$12,767,821	$1,353,235	$2,941	$0	$4,014	$951	$0	$14,128,962
	Optimized	$13,532,829	$57,447	$0	$389,895	$19,319	$529	$0	$14,000,019
Kwale	Latest reported	$6,380,058	$363,766	$71,870	$610	$19,050	$447	$375	$6,836,176
	Optimized	$8,713,512	$0	$0	$327,288	$40,739	$0	$655	$9,082,194
Laikipia	Latest reported	$3,697,176	$494,462	$58,346	$610	$19,483	$67	$384	$4,270,528
	Optimized	$4,768,627	$0	$0	$86,905	$32,668	$0	$623	$4,888,823
Lamu	Latest reported	$1,694,873	$79,606	$17,388	$0	$2,372	$178	$149	$1,794,566
	Optimized	$12,447	$0	$0	$59,747	$11,909	$0	$0	$84,103
Machakos	Latest reported	$3,020,338	$879,099	$146,446	$0	$37,450	$1,307	$429	$4,085,069
	Optimized	$3,226,608	$366,641	$0	$0	$53,922	$0	$0	$3,647,171
Makueni	Latest reported	$13,301,166	$966,526	$107,469	$0	$27,059	$98	$0	$14,402,318
	Optimized	$13,240,511	$32,277	$0	$320,646	$47,096	$113	$0	$13,640,643
Mandera	Latest reported	$1,941,577	$83,330	$25,502	$0	$7,577	$0	$0	$2,057,986
	Optimized	$0	$0	$0	$9,346	$14,158	$0	$54	$23,558

Table continued…

Table A6.8 100% HIV budget optimization across counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Marsabit	Latest reported	$1,908,023	$74,367	$15,649	$237	$869	$0	$0	$1,999,145
	Optimized	$33,091	$0	$0	$17,391	$3,133	$0	$0	$53,615
Meru	Latest reported	$12,639,113	$1,095,231	$93,887	$0	$40,048	$941	$789	$13,870,009
	Optimized	$13,496,324	$0	$0	$359,047	$72,033	$0	$0	$13,927,404
Migori	Latest reported	$26,994,656	$1,345,552	$159,776	$973,624	$12,265	$1,413	$1,186	$29,488,472
	Optimized	$28,536,795	$817,892	$0	$419,498	$40,627	$367	$5,282	$29,820,461
Mombasa	Latest reported	$15,023,512	$729,957	$347,976	$21,092	$25,760	$605	$508	$16,149,410
	Optimized	$15,912,406	$40,586	$0	$156,690	$145,970	$1,212	$19,847	$16,276,711
Muranga	Latest reported	$3,550,369	$507,725	$67,234	$0	$2,212	$412	$346	$4,128,298
	Optimized	$5,717,609	$341,867	$0	$316,044	$10,500	$0	$0	$6,386,020
Nairobi	Latest reported	$76,142,281	$5,358,997	$1,546,306	$516,992	$162,572	$3,818	$3,203	$83,734,169
	Optimized	$68,133,947	$0	$0	$0	$433,782	$0	$8,062	$68,575,791
Nakuru	Latest reported	$24,106,103	$2,905,864	$328,425	$238,625	$1,078	$2,471	$288	$27,582,854
	Optimized	$31,460,454	$0	$0	$657,450	$101,094	$0	$0	$32,218,998
Nandi	Latest reported	$3,952,806	$901,914	$52,917	$173,144	$3,084	$0	$0	$5,083,865
	Optimized	$4,952,168	$58,422	$0	$263,181	$13,639	$0	$0	$5,287,410
Narok	Latest reported	$6,478,647	$867,204	$51,264	$2,340	$3,284	$0	$0	$7,402,739
	Optimized	$17,123,972	$699,468	$0	$498,546	$17,533	$0	$0	$18,339,519
Nyamira	Latest reported	$9,043,146	$1,404,761	$50,234	$0	$4,586	$824	$0	$10,503,551
	Optimized	$10,756,907	$0	$0	$237,982	$22,892	$0	$0	$11,017,781
Nyandarua	Latest reported	$5,184,140	$584,987	$37,094	$0	$4,967	$0	$486	$5,811,674
	Optimized	$6,744,659	$500,778	$0	$166,890	$13,935	$0	$0	$7,426,262

Table continued…

Table A6.8 100% HIV budget optimization across counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Nyeri	Latest reported	$7,976,176	$1,011,784	$117,079	$0	$5,202	$0	$580	$9,110,821
	Optimized	$8,713,280	$58,117	$0	$151,899	$17,551	$0	$0	$8,940,847
Samburu	Latest reported	$1,836,898	$223,412	$19,320	$0	$847	$0	$0	$2,080,477
	Optimized	$118,154	$0	$0	$133,721	$4,831	$0	$0	$256,706
Siaya	Latest reported	$44,934,550	$1,154,392	$120,750	$1,735,955	$11,570	$1,637	$123	$47,958,977
	Optimized	$65,598,685	$681,641	$0	$496,058	$63,909	$0	$1,129	$66,841,422
Taita Taveta	Latest reported	$5,363,680	$221,761	$21,059	$0	$11,906	$0	$0	$5,618,406
	Optimized	$185,968	$0	$0	$97,183	$38,564	$0	$0	$321,715
Tana River	Latest reported	$1,096,139	$216,795	$123,648	$0	$903	$0	$0	$1,437,485
	Optimized	$0	$0	$0	$44,852	$3,789	$0	$0	$48,641
Tharaka Nithi	Latest reported	$19,257,062	$416,611	$26,275	$0	$5,219	$0	$341	$19,705,508
	Optimized	$0	$0	$0	$167,132	$26,158	$0	$544	$193,834
Trans Nzoia	Latest reported	$5,783,377	$873,327	$121,890	$0	$4,630	$0	$0	$6,783,224
	Optimized	$10,908,768	$1,482,172	$0	$465,405	$25,449	$0	$0	$12,881,794
Turkana	Latest reported	$2,606,202	$1,091,818	$109,544	$375,994	$14,584	$1,083	$909	$4,200,134
	Optimized	$6,478,517	$179,826	$0	$552,965	$74,950	$0	$0	$7,286,258
Uasin Gishu	Latest reported	$10,427,658	$1,382,875	$223,814	$0	$13,818	$222	$71	$12,048,458
	Optimized	$13,715,164	$507,233	$0	$464,015	$60,670	$0	$0	$14,747,082
Vihiga	Latest reported	$8,193,543	$633,159	$27,628	$0	$18,184	$427	$3,203	$8,876,144
	Optimized	$9,936,208	$0	$0	$200,031	$51,630	$0	$486	$10,188,355

Table continued…

Table A6.8 100% HIV budget optimization across counties, 2019 to 2030 (continued)

County	Scenario	Care and treatment	HIV testing services (biomedical only)	HIV prevention services (condoms and SBCC)	VMMC	FSW programs	MSM programs	PWID programs	Total budget
Wajir	Latest reported	$2,036,212	$77,272	$14,490	$0	$1,693	$0	$0	$2,129,667
	Optimized	$0	$0	$0	$7,135	$7,359	$0	$32	$14,526
West Pokot	Latest reported	$3,298,894	$336,291	$14,490	$26,145	$5,732	$0	$0	$3,681,552
	Optimized	$4,895,633	$0	$0	$214,959	$21,054	$0	$0	$5,131,646
Total, national	**Latest reported**	**$538,574,507**	**$45,147,988**	**$6,013,639**	**$8,105,135**	**$760,474**	**$28,043**	**$21,615**	**$598,651,401**
	Optimized	**$571,049,708**	**$11,725,206**	**$1,472,549**	**$12,100,642**	**$2,235,964**	**$8,245**	**$59,097**	**$598,651,411**
	% of total latest reported budget	90.0%	7.5%	1.0%	1.4%	0.1%	0.005%	0.004%	100.0%
	% of total optimized budget	95.4%	2.0%	0.2%	2.0%	0.4%	0.001%	0.010%	100.0%

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, SBCC = social behavior change communication; VMMC = voluntary male medical circumcision.

Table A6.9 Percentage of total annual HIV budget to optimally reallocate across counties, 2019 to 2030

		Percentage of total HIV budget recommended to allocate to each program (percentage difference of total budget between the optimized and latest reported allocation) by county						
County	**Optimized % budget increase or decrease**	**Care and treatment**	**HIV testing (biomedical)**	**HIV prevention services (condoms and SBCC)**	**VMMC**	**HIV testing and prevention for FSW**	**HIV testing and prevention for MSM**	**HIV testing and prevention for PWID**
Baringo	73%	95.8% (+9.8%)	Not prioritized	Not prioritized	4.0% (+4.0%)	0.1% (+0.1%)	0% (+0%)	0.0007% (+0.0007%)
Bomet	42%	90.5% (+10%)	6.5% (-8.9%)	6.5% (-8.9%)	2.6% (+1.7%)	0.2% (+0.1%)	0% (+0%)	0% (+0%)
Bungoma	8%	85.2% (+6.9%)	10.3% (-9.4%)	10.3% (-9.4%)	3.2% (+3.2%)	1.2% (+0.6%)	0.007% (-0.007%)	0.03% (+0.02%)
Busia	17%	94.5% (+5.1%)	3.1% (-1.6%)	3.1% (-1.6%)	1.8% (-2.4%)	0.5% (+0.2%)	0.001% (-0.005%)	0.01% (+0.01%)
Elgeyo Marakwet	-95%	1.1% (-90.3%)	Not prioritized	Not prioritized	95.2% (+95.2%)	3.6% (+3.5%)	0% (+0%)	0.03% (+0.03%)
Embu	-97%	17.4% (-75.6%)	Not prioritized	Not prioritized	74.2% (+74.2%)	7.8% (+7.7%)	0% (-0.0006%)	0.5% (+0.5%)
Garissa	-99%	10.9% (-85.0%)	Not prioritized	Not prioritized	30.0% (+30.0%)	57.0% (+56.8%)	0% (-0.02%)	2.0% (+2.0%)
Homa Bay	87%	95.0% (+4.6%)	2.2% (-2.8%)	2.2% (-2.8%)	0.8% (-3.1%)	0% (+0%)	0% (-0.005%)	0.002% (-0.003%)
Isiolo	-95%	25.4% (-70.3%)	Not prioritized	Not prioritized	65.5% (+65.5%)	8.8% (+8.7%)	0% (-0.002%)	0.1% (+0.1%)
Kajiado	-95%	23.7% (-68.4%)	Not prioritized	Not prioritized	66.8% (+66.8%)	9.4% (+9.2%)	0% (-0.001%)	0.02% (+0.02%)
Kakamega	-16%	94.8% (+4.2%)	2.5% (-5.9%)	2.5% (-5.9%)	2.3% (+2.3%)	0.2% (+0.2%)	0% (-0.01%)	0.001% (-0.004%)
Kericho	5%	96.9% (+15.3%)	0% (-14%)	Not prioritized	2.6% (-0.2%)	0.3% (+0.2%)	0% (-0.002%)	0.004% (+0.002%)
Kiambu	18%	82.8% (+22.4%)	11.3% (-23%)	11.3% (-23%)	4.2% (+4.2%)	1.4% (+0.4%)	0.02% (-0.01%)	0.1% (+0.1%)
Kilifi	-89%	0% (-92.4%)	68.7% (+62%)	68.7% (+62%)	13.1% (+13.1%)	4.7% (+4.5%)	0.2% (+0.1%)	0% (-0.005%)
Kirinyaga	-3%	97.6% (+8.6%)	Not prioritized	Not prioritized	2.1% (+2.1%)	0.2% (+0.2%)	0% (+0%)	0% (+0%)
Kisii	-13%	97.1% (+5.7%)	Not prioritized	Not prioritized	2.3% (+2.3%)	0.5% (+0.3%)	0% (-0.005%)	0.001% (-0.004%)
Kisumu	10%	97.8% (+7.3%)	0.8% (-4.1%)	0.8% (-4.1%)	1.1% (-2.7%)	0.2% (+0.1%)	0.004% (-0.002%)	0.01% (+0.01%)
Kitui	-1%	96.6% (+6.2%)	0.4% (-9.1%)	0.4% (-9.1%)	2.7% (+2.7%)	0.1% (+0.1%)	0.004% (-0.003%)	0% (-0.007%)
Kwale	33%	95.9% (+2.6%)	Not prioritized	Not prioritized	3.6% (+3.5%)	0.4% (+0.2%)	0% (-0.01%)	0.007% (+0.001%)
Laikipia	14%	97.5% (+10.9%)	Not prioritized	Not prioritized	1.7% (+1.7%)	0.7% (+0.2%)	0% (-0.002%)	0.01% (+0.01%)
Lamu	-95%	14.7% (-79.6%)	Not prioritized	Not prioritized	71.0% (+71.0%)	14.2% (+14.0%)	0% (-0.01%)	0% (-0.01%)
Machakos	-11%	88.4% (+14.5%)	10% (-11.4%)	10.0% (-11.4%)	Not prioritized	1.5% (+0.6%)	0% (-0.03%)	0% (-0.03%)
Makueni	-5%	97.0% (+4.7%)	0.2% (-6.4%)	0.2% (-6.4%)	2.3% (+2.3%)	0.3% (+0.2%)	0.0008% (+0.0001%)	0% (-0.0007%)

Table continued…

TableA6.9 Percentage of total annual HIV budget to optimally reallocate across counties, 2019 to 2030

County	Optimized % budget increase or decrease	Percentage of total HIV budget recommended to allocate to each program (percentage difference of total budget between the optimized and latest reported allocation) by county						
		Care and treatment	HIV testing (biomedical)	HIV prevention services (condoms and SBCC)	VMMC	HIV testing and prevention for FSW	HIV testing and prevention for MSM	HIV testing and prevention for PWID
Mandera	-99%	0% (-94.3%)	Not prioritized	Not prioritized	39.6% (+39.6%)	60.1% (+59.7%)	0% (+0%)	0.2% (+0.2%)
Marsabit	-97%	61.7% (-33.7%)	Not prioritized	Not prioritized	32.4% (+32.4%)	5.8% (+5.8%)	0% (+0%)	0% (+0%)
Meru	0.4%	96.9% (+5.7%)	Not prioritized	Not prioritized	2.5% (+2.5%)	0.5% (+0.2%)	0% (-0.007%)	0% (-0.007%)
Migori	1%	95.6% (+4.1%)	2.7% (-1.8%)	2.7% (-1.8%)	1.4% (-1.8%)	0.1% (+0.1%)	0.001% (-0.004%)	0.02% (+0.01%)
Mombasa	1%	97.7% (+4.7%)	0.2% (-4.2%)	0.2% (-4.2%)	0.9% (+0.8%)	0.9% (+0.7%)	0.007% (+0.004%)	0.1% (+0.1%)
Muranga	55%	89.5% (+3.5%)	5.3% (-6.9%)	5.3% (-6.9%)	4.9% (+4.9%)	0.2% (+0.1%)	0% (-0.01%)	0% (-0.01%)
Nairobi	-18%	99.3% (+8.4%)	Not prioritized	Not prioritized	Not prioritized	0.6% (+0.4%)	0% (-0.005%)	0.01% (+0.01%)
Nakuru	17%	97.6% (+10.2%)	Not prioritized	Not prioritized	2% (+1.1%)	0.3% (+0.3%)	0% (-0.01%)	0% (-0.009%)
Nandi	4%	93.6% (+15.9%)	1.1% (-16.6%)	1.1% (-16.6%)	4.9% (+1.5%)	0.3% (+0.2%)	0% (+0%)	0% (+0%)
Narok	148%	93.3% (+5.8%)	3.8% (-7.9%)	3.8% (-7.9%)	2.7% (+2.6%)	0.1% (+0.1%)	0% (+0%)	0% (+0%)
Nyamira	5%	97.6% (+11.5%)	Not prioritized	Not prioritized	2.1% (+2.1%)	0.2% (+0.2%)	0% (-0.008%)	0% (-0.008%)
Nyandarua	28%	90.8% (+1.6%)	6.7% (-3.3%)	6.7% (-3.3%)	2.2% (+2.2%)	0.2% (+0.1%)	0% (+0%)	0% (+0%)
Nyeri	-2%	97.4% (+9.9%)	0.6% (-10.4%)	0.6% (-10.4%)	1.6% (+1.6%)	0.2% (+0.1%)	0% (+0%)	0% (+0%)
Samburu	-88%	46% (-42.2%)	Not prioritized	Not prioritized	52.0% (+52.0%)	1.9% (+1.8%)	0% (+0%)	0% (+0%)
Siaya	39%	98.1% (+4.4%)	1% (-1.3%)	1.0% (-1.3%)	0.7% (-2.8%)	0.1% (+0.1%)	0% (-0.003%)	0.002% (-0.002%)
Taita Taveta	-94%	57.8% (-37.6%)	Not prioritized	Not prioritized	30.2% (+30.2%)	12.0% (+11.8%)	0% (+0%)	0% (+0%)
Tana River	-97%	0% (-76.2%)	Not prioritized	Not prioritized	92.2% (+92.2%)	7.8% (+7.7%)	0% (+0%)	0% (+0%)
Tharaka Nithi	-99%	0% (-97.7%)	Not prioritized	Not prioritized	86.2% (+86.2%)	13.5% (+13.5%)	0% (+0%)	0.3% (+0.3%)
Trans Nzoia	90%	84.6% (-0.5%)	11.5% (-1.3%)	11.5% (-1.3%)	3.6% (+3.6%)	0.2% (+0.1%)	0% (+0%)	0% (+0%)
Turkana	73%	88.9% (+26.8%)	2.4% (-23.5%)	2.4% (-23.5%)	7.5% (-1.3%)	1.0% (+0.7%)	0% (-0.03%)	0% (-0.03%)
Uasin Gishu	22%	93.0% (+6.4%)	3.4% (-8%)	3.4% (-8.0%)	3.1% (+3.1%)	0.4% (+0.3%)	0% (-0.002%)	0% (-0.002%)
Vihiga	15%	97.5% (+5.2%)	Not prioritized	Not prioritized	1.9% (+1.9%)	0.5% (+0.3%)	0% (-0.005%)	0.005% (+0%)
Wajir	-99%	0% (-95.6%)	Not prioritized	Not prioritized	49.1% (+49.1%)	50.7% (+50.6%)	0% (+0%)	0.2% (+0.2%)
West Pokot	39%	95.4% (+5.7%)	Not prioritized	Not prioritized	4.1% (+3.4%)	0.4% (+0.3%)	0% (+0%)	0% (+0%)

Source: Authors from Optima data.
Note: FSW = female sex worker; MSM = men who have sex with men; PWID = people who inject drugs, SBCC = social behavior change communication; VMMC = voluntary male medical circumcision.

Table A6.10 100% annual HIV budget optimization within counties, represented nationally 2019–25

HIV programs	Baseline 100% budget	Optimized 100% budget	Baseline % total budget	Optimized % total budget
Care and treatment	$538,574,507	$576,551,518	90.0%	96.3%
HIV testing services (HTS) (biomedical only)	$45,147,988	$17,401,809	7.5%	2.9%
HIV prevention services (condoms and SBCC)	$6,013,639	$296,755	1.00%	0.05%
VMMC	$8,105,135	$2,035,885	1.4%	0.3%
HIV prevention for FSW	$760,474	$2,313,651	0.1%	0.4%
HIV prevention for MSM	$28,043	$2,456	0.0047%	0.0004%
HIV prevention for PWID	$21,615	$49,327	0.004%	0.008%
Total	**$598,651,401**	**$598,651,401**	**100%**	**100%**