Aquarius Population Health

How can England achieve HIV transmission elimination?

Modelling the impact of HIV prevention efforts on progress towards the 2030 elimination goal.

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Acknowledgements: This work was commissioned and funded by Gilead Sciences. The work was carried out independently by Aquarius Population Health.

UKI-UNB-1437

Date of preparation: July 2025

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Executive Summary

Background: In 2019, the previous UK Government set the ambitious target of eliminating HIV transmission within England by 2030, with the current government affirming their commitment to the goal in their 2024 manifesto and commissioning a new HIV action plan in England (1,2). Since then, many actions have been taken to improve access to and provision of a number of prevention strategies, including expanding PrEP (pre-exposure prophylaxis) provision and introducing opt-out ED (emergency department) testing in high-prevalence areas (3). However, the Secretary of State for Health and Social Care recently stated that "we are not on track" to reach the 2030 goal (4).

Objectives: We aim to assess when England is likely to achieve transmission elimination if intervention efforts remain at current levels, considering four population groups: Gay, Bisexual and other Men-who-have-sex-with-men (GBMSM); heterosexual men; women; and people who inject drugs. We also assess the impact on Black African heterosexual men and women as a subgroup. We then aim to assess how increasing intervention levels can help get us closer to the elimination goal.

Methods: We developed an adapted version of a previously published Markov state transition open cohort model of HIV transmission (5) with a 50-year time horizon and baseline year of 2023. The population modelled is adults aged 16+ living in England, and each individual is assumed to belong to one of the four population groups based on their highest relevant risk of acquiring HIV. We consider six interventions, including PrEP, HIV testing, HIV diagnosis within three months of infection, timely treatment initiation and HIV viral load suppression. 'Zero transmissions' is defined using the England-specific HIV Commission targets for 2030 (<100 transmissions for the total population). To assess the impact of increasing interventions, we run two future scenarios. The first we define as 'moderate' increases in intervention levels, called the 'moderate' scenario. These reflect substantial, but realistic increases in interventions. In the second scenario, we assume larger, more ambitious increases in interventions, called the 'optimal' scenario. We assume the increases in interventions are implemented linearly between 2024 to 2029.

Results: We predict that the number of new HIV transmissions in England is expected to increase over the next 50 years for heterosexual men, women and people who inject drugs if prevention efforts remain at 2023 levels. In contrast, we expect decreases over time for GBMSM.

Between 2024 and 2030, annual transmissions are expected to decrease by 26% for GBMSM, while they are expected to grow by 9-21% for heterosexual men, women and people who inject drugs, due to inequalities in intervention uptake in these groups. After 2030, we predict a steady upward trend in transmissions as the growing number in the heterosexual population begins to offset the great progress in the GBMSM population.

For the total population, we predict annual new transmissions will increase by 25% over the next 50 years (from 947 in 2024 to 1,186 in 2073), and without any changes to interventions, transmissions among heterosexual men and women are predicted to be three-quarters of the total new transmissions, with 22% of these among the Black African heterosexual population.

Our results indicate that England will not reach the 2030 transmission elimination target under current intervention levels. However, increasing intervention efforts can significantly alter the upward trajectory and help get us closer to the goal.

With 'moderate' increases in intervention levels, we predict the annual number of new transmissions will decrease over time, reducing the total number acquired between 2024 and 2030 by 9% (599 transmissions). This downward trend means that the annual transmissions in 2030 would be reduced to 750 (compared to 924 if interventions remain at the current level). In the 'optimal' scenario modelled, we could reduce new transmissions by 30% (1,932) by 2030. This would reduce the number of annual transmissions in 2030 to 411.

While expanding intervention efforts requires significant increases in funding, it could avoid substantial HIV treatment and management costs. The transmissions prevented by 2030 in our two future scenarios could avert £44 - £391 million in lifetime HIV treatment costs, while the transmissions prevented by 2073 could avert £1.4 - £7.1 billion.

Conclusions: While great progress has been made in HIV prevention and treatment, and England has already achieved the UNAIDS elimination target for the overall population, a substantial increase in prevention efforts is needed to meet the HIV Commission population-specific goal. This goal is ambitious, but ambitious commitments are needed to end HIV transmissions in all population groups, and we must leverage the learnings from the success of the response to date. The new HIV Action Plan for England should consider the most effective prevention strategies to reduce transmissions, such as expanding screening programs and equitable access to PrEP. No single intervention will be sufficient to achieve the goal, and increasing investment in a combination of prevention interventions is necessary.

Key takeaways

Under current intervention levels

England is **not predicted** to reach the 2030 HIV Commission elimination target (<100). However, we are already meeting the UNAIDS target.

Annual new HIV transmissions in England are expected to **increase** by 25% between 2024 and 2073.

Between 2024 and 2030, transmissions are expected to **decrease** by 26% for GBMSM, while they are expected to **grow** by 9-21% for heterosexual men, women and people who inject drugs, due to lower intervention uptake.

Nearly 3 in 4

new transmissions between 2024 and 2073 are predicted to be among women and heterosexual men

22%

of these are expected to be among the **Black African** heterosexual population.

The net effect means we predict transmissions will **decrease by 2% for the total population** by 2030. After this, we predict a steady upward trend.

Getting closer to the 2030 goal

While England is not predicted to make the ambitious 2030 HIV Commission target under current intervention levels, **increasing investment** in **interventions** can alter the upward trajectory and help get us **closer to the goal**.

Between 2024 and **2030:**

9% **'Moderate' increases** in intervention indicators could **reduce transmissions** by 599 (9%).

30% **'Optimal' increases** in intervention indicators could **reduce transmissions** by 1,932 (30%).

Between 2024 and **2073:**

37% **'Moderate' increases** in intervention indicators could **reduce transmissions** by 19,444 (37%) .

67% **'Optimal' increases** in intervention indicators could **reduce transmissions** by 35,530 (67%).

Impact on treatment costs

In England, the lifetime cost of managing HIV ranges from **£73,300** to **£202,300** per person[1].

Preventing these transmissions could avoid substantial HIV treatment costs.

The transmissions prevented by 2030 from 'moderate' and 'optimal' increases could avert

£44 - £391 million

in lifetime HIV treatment costs, while the transmissions prevented by 2073 could avert

£1.4 -£7.1 billion.

Notes: [1]Ong et al (2019) (6)

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1. Introduction

Progress on achieving the HIV transmission elimination goal

The UK Government has committed to the ambitious target of eliminating HIV transmission in England by 2030. While great progress has been made in HIV prevention and treatment in the UK, with England reaching the UNAIDS 95-95-95 target in 2023 (3), the Secretary of State for Health and Social Care, Wes Streeting, recently stated "we're not on track" to reach the 2030 goal (4). Past modelling evidence also suggested that the goal of elimination by 2030 is unlikely to be met for Gay, Bisexual, and other Men who have Sex with Men (GBMSM) if prevention interventions remain at current levels (5,7,8). No research has been done to evaluate this question for other groups, such as women.

Additionally, since the publication of previous models, England has also taken actions to improve the provision of prevention interventions. For example, access to PrEP has been expanded, with PrEP users increasing by 57% between 2021 and 2023 (61,473 to 96,562) (9). However, uptake has been mostly among GBMSM. Emergency department (ED) opt-out HIV testing was also introduced in 2022 in high-prevalence areas in England (10), with plans to expand the program to 89 EDs in 2025 (11).

We expand on previous modelling work by analysing transmissions for all adult population groups (GBMSM, heterosexual men, women, and people who inject drugs) to provide a comprehensive picture of new HIV transmissions.

Current trends in surveillance data

While new diagnoses have historically been higher in the GBMSM population, surveillance data shows a steep rise in new HIV diagnoses among the heterosexual population in 2023 compared to 2022 (12). In addition to increases in diagnoses, there have been decreases in accessing preventative services. For example, there was a 22% decrease in HIV testing at sexual health centres for heterosexual men and a 10% decrease in testing for heterosexual and bisexual women in 2023 compared to 2019 (12).

The increased number of new diagnoses in the Black African heterosexual population is of particular concern. HIV disproportionately affects heterosexual men and women of Black African ethnicity and in 2023, Black African heterosexual men and women accounted for 25% (688 / 2,810) of new diagnoses (first made in England) (13) despite people of Black African ethnicity only making up ~3% of the population (14). People of Black African ethnicity may also experience barriers in accessing HIV services, are diagnosed at a late stage and face health inequalities (15–17).

Research questions

Our modelling study aims to assess overall and individually for each population group:

1) Will we achieve the elimination target by 2030 if the prevention interventions remain at their current levels? If not, will we reach it in 50 years?
2) How many new transmissions will occur by 2030, and in the next 50 years, if prevention interventions remain at their current levels?
3) How can increasing intervention levels help us get closer to the elimination target?

2. Overview of Methods

A. Study design and setting

We developed an adapted version of a previously published Markov state transition open cohort model to estimate the trajectory of HIV transmission in England (5) with a 50-year time horizon and baseline year of 2023. We focus only on transmissions acquired within the UK.

B. Model structure

The model simulates transitions between HIV-related health states at 3-month intervals over a 50-year time horizon (see **Appendix 1**). This cycle length aligns with clinical schedules for PrEP monitoring and ART initiation. Health states include HIV-negative without PrEP, HIV-negative on PrEP, HIV-positive undiagnosed (stratification by CD4 cell count), diagnosed but not on ART, on ART but not virologically suppressed, and virologically suppressed. Death from any state was also modelled, with mortality rates dependent on age, treatment status, and CD4 count.

HIV acquisition, disease progression, testing, treatment uptake, viral suppression, and disengagement from care were incorporated in the model. HIV transmission was determined by a dynamically updated transmission coefficient (β), accounting for PrEP use, HIV prevalence, diagnosis rates, ART initiation, and the proportion virologically suppressed. The model also includes disengagement and re-engagement in care, a novel addition not present in the original model, to reflect emerging evidence that disengagement may contribute more substantially to ongoing transmission than undiagnosed infection (5).

C. Population and stratification

The simulated population includes all adults aged 16 years and older residing in England. Each individual was categorised according to their highest relevant risk for acquiring HIV. The population groups included GBMSM, people who inject drugs, heterosexual men, and women (all sexual orientations), with the heterosexual groups limited to sexually active individuals (18). Population estimates were derived from the 2023 Office for National Statistics (ONS) data (19) and the UK Health Security Agency's (UKHSA) 2021 'Shooting Up' report (20) (**Table 1**).

TABLE 1. Size and proportion of each subgroup within the adult population

Population	N	%
GBMSM	1,031,801	2.7%
Heterosexual men	18,072,132	47.8%
Black African heterosexual men	420,316	1.1%
Women	18,577,720	49.2%
People who inject drugs	88,281	0.2%
Black African heterosexual women	455,115	1.2%
Total population (16+)	**37,769,934**	**100%**

D. Intervention indicators and scenarios

Key indicators to evaluate the impact of current HIV prevention, testing, and treatment efforts were included in the model. These indicators served as critical proxies for monitoring progress across the first three themes of the HIV Action Plan (3). They were essential for simulating the impact of interventions and assessing the feasibility of achieving the 2030 zero-transmission targets (3).

We modelled three scenarios. The first modelled the current intervention levels (at 2023), then we modelled two future scenarios: the 'moderate' future scenario and the 'optimal' future scenario'. Inputs are stratified by population group.

Current scenario

The inputs for the current intervention levels were collected using a targeted literature review. Interviews with experts were then conducted to validate assumptions. Data was primarily sourced from the UKHSA HIV Action Plan monitoring and evaluation framework 2024 report and their annual HIV surveillance data (3,21). Definitions and sources of the data for the current scenario can be found in **Appendix 2**.

The values for the six intervention indicators in the current scenario are shown in **Table 2**.

TABLE 2. Intervention indicators for the current scenario for each sub-population

	GBMSM	Heterosexual men	Women	People who inject drugs	Black African heterosexual women	Black African heterosexual men
Annual probability of PrEP initiation (among those with PrEP need)*	17.6%	1.1%	1.3%	0.1%	0.1%	0.2%
Proportion diagnosed within 3 months of transmission	26.0%	9.0%	10.0%	8.0%	9.5%	9.5%
Annual testing probability	22.8%	3.7%	8.4%	3.7%	15.6%	8.6%
Probability of starting ART within 3 months	83.0%	77.0%	76.0%	61.9%	75.4%	75.4%
Probability of starting ART within 6 months	95.5%	92.0%	93.5%	90.0%	92.5%	92.5%
Proportion virologically suppressed	98.0%	97.0%	98.0%	93.0%	97.0%	97.0%

*'Annual probability of the HIV-negative population with PrEP need starting PrEP' is a function of the number of people currently accessing PrEP and the proportion that discontinues PrEP each year. For example, 17.6% for GBMSM is based on 83,210 currently accessing PrEP in 2023 (9) and 27% of PrEP users discontinuing each year (22). PrEP need numbers were informed by Huntington et al (23).

Moderate future scenario

For heterosexual men, women, and people who inject drugs, we defined the moderate future scenario as the midpoint between the current intervention rates within each group and those observed in the current scenario for the GBMSM population. This scenario was considered moderate because achieving these intervention levels would require considerable investment, while recognising that it is likely unrealistic for these populations to reach the levels observed in the GBMSM group in this time frame.

For the GBMSM population, the moderate future scenario was defined as a substantial, yet realistic, increase from their current scenario.

Optimal future scenario

For the optimal scenario, we selected substantial increases in intervention levels to illustrate the extent to which efforts would need to be scaled up to meet the ambitious 2030 target. While these interventions levels are very optimistic, we did not set them to 100% in acknowledgement of capacity constraints. We assumed that, once individuals are diagnosed and linked to care, intervention uptake would be similar across all groups. Consequently, the proportion of individuals who have initiated treatment and are virologically suppressed (TasP), as well as the probability of starting treatment within three and six months of diagnosis, were held constant across all population groups.

The annual probability of initiating PrEP among HIV-negative individuals with a PrEP need was assumed to be the same across all groups, as it is based on the level of need specific to each group (23). It was further assumed that 80% of individuals with a PrEP need are accessing PrEP.

The values for the six intervention indicators in the moderate and optimal scenarios are shown in **Appendix 3**. We assume the increases in interventions are implemented linearly between 2024 to 2029.

E. Outcomes

The outcomes proposed for the model were defined as absolute numbers of HIV transmissions in England, measured against the England-specific targets established by the HIV Commission for 2030 (24). The HIV Commission outlined an overall goal of fewer than 100 new transmissions annually across the entire population, along with specific subpopulation targets, including for GBMSM, heterosexual men, and women (24).

While the HIV Commission's 2030 targets did not explicitly include people who inject drugs and the Black African heterosexual population, we made assumptions based on the relative size in the populations and their proportion of new diagnoses in 2019 (21). Based on this framework, the population-specific transmission targets are listed in **Table 3**.

England has already achieved the UNAIDS target (less than 1 transmission per 10,000 population (25)) for the overall population, however, we have not met this target for population groups where the transmission levels are higher (24). The HIV Commission targets, while more ambitious, acknowledge transmissions vary by population group and thus their targets are more policy-relevant and ensure that progress towards elimination will be equal across groups

(24). We have included the UNAIDS target for our population numbers in **Table 3** for comparison. A new definition for "elimination" is currently under review by the UKHSA (26).

TABLE 3. Transmission elimination 2030 targets for each population.

Population	HIV Commission target*	UNAIDS target**
GBMSM	< 50	<103
Heterosexual men	< 19	<1,807
Black African heterosexual men	*< 5*	*<42*
Women	< 26	<1,858
Black African heterosexual women	*< 11*	*<46*
People who inject drugs	< 6	<9
Total population (16+)	**< 100**	**<3,777**

Notes: *Population-specific goals from the HIV Commission (24). **UNAIDS target of <1 transmission per 10,000 population (25), based on our population numbers in **Table 1**.

F. Model Validation

We compared model outputs against surveillance estimates to confirm that the model reproduced baseline epidemiological patterns with acceptable accuracy. Where we had data gaps or limitations, parameter estimates were informed by expert opinion and prior studies. For validation, model projections under the current scenario were compared against historical trends in HIV incidence and diagnoses over the previous decade to assess face validity.

G. Uncertainty analysis

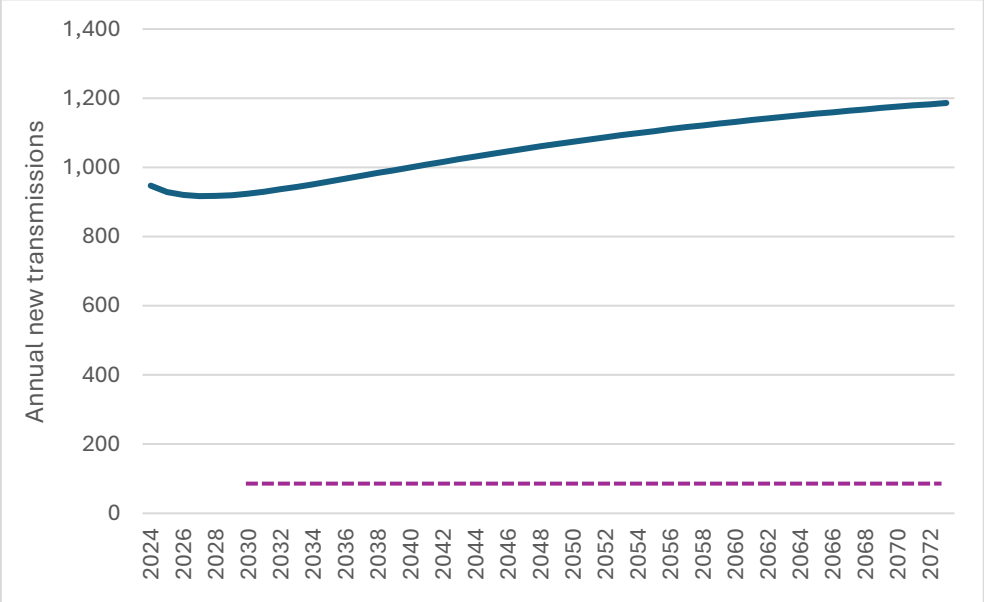
The model included a wider range of variables in the Deterministic Sensitivity Analysis (DSA) to assess the sensitivity of results to variations in parameter inputs and to identify the most influential parameters. We applied a variation of ±20% around the base case value (inputs that are percentages or proportions were bound by 0 and 1).

3. Results

A. Trajectories of new transmissions under current intervention levels

We predict new transmissions (acquired in England) will grow over time for the total population, if intervention efforts remain at 2023 levels, from 947 transmissions in 2024 to 1,186 in 2073 (25% increase) (**Figure 1**). This means England would not achieve the elimination goal of <100 per year by 2030. The UNAIDS target has already been achieved for the overall population (<3,777 transmissions).

FIGURE 1. Number of new transmissions each year under current intervention levels for the total population, 2024 to 2073



Note: The dashed purple line is the HIV Commission elimination target (100). The UNAIDS target of 1 transmission per 10,000 population is not shown as it has already been achieved.

If intervention levels remain at current levels, we predict the number of transmissions will increase each year in heterosexual men, women and people who inject drugs (**Figure 2**). However, in continuation of current trajectories, the number of transmissions among GBMSM will continue to decrease as a result of a higher uptake of prevention measures.

Between 2024 and 2030, transmissions are expected to decrease by 26% for GBMSM, while they are estimated to grow by 9-21% for heterosexual men, women and people who inject drugs, due to inequalities in intervention uptakes in these groups (**Table 4**). The net effect means we predict transmissions will decrease by 2% between 2024 and 2030 for the total population (from 947 to 924). After 2030, transmissions for the total population increase as the growing transmissions in the heterosexual population begin to offset the great progress in the GBMSM population.

Without any changes to interventions, we predict that between 2024 and 2073, the number of new transmissions will be highest in heterosexual men and women, representing nearly three-quarters of the total new transmissions (73%; 38,315 out of 52,727). This aligns with recent trends observed in surveillance data. While 44% of new diagnoses in 2019 were among GBMSM and 41% were heterosexual men and women, in 2023, this had changed to 29% and 49%, respectively (27). Heterosexual men also have lower uptakes of interventions than women. Most notably, the proportion of people having an annual HIV test was higher for women due to universal antenatal screening, which 631,449 women benefited from in 2023, and more women tested at sexual health services (3).

This divergence in predicted trendlines highlights inequities in accessing HIV services between the population groups. For example, the UNAIDS recently set a new target of 50% people at the highest risk of acquiring HIV should access PrEP(28). However, recent research suggests that around 80% of people in England with an estimated PrEP need do not access PrEP and that there are great disparities in access. This unmet need was lowest for GBMSM (52.8% of those with PrEP need do not access PrEP) and highest for heterosexual women (98.5%), followed closely by heterosexual men (97.9%)(23).

FIGURE 2. Number of new transmissions each year under current intervention levels by population group, 2024 to 2073

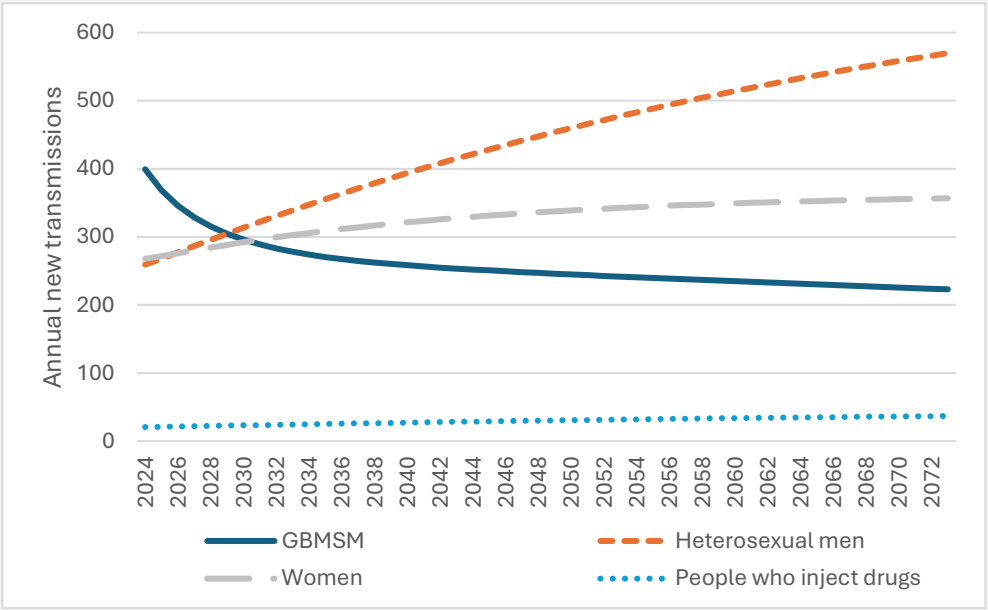


TABLE 4. Annual new transmissions: Comparing 2024 and 2030

Population Group	2024	2030 (projected)	*Difference (n)*	*Difference (%)*
GBMSM	399	296	-103	-26%
Heterosexual men	259	313	+54	+21%
Women	268	292	+24	+9%
People who inject drugs	21	23	+3	+12%
Total	**947**	**924**	**-23**	**-2%**

Our subgroup analysis predicts that new transmissions each year are expected to decrease over the next 50 years for both Black-African heterosexual men and women (**Figure 3**). For women, transmissions are expected to decrease from 125 in 2024 to 84 in 2073 (33%). The trend is less pronounced for men, decreasing from 74 to 66 (10%). The main difference in the uptake of interventions between Black African heterosexual men and women is the probability of annual HIV testing (15.6% vs 8.6%) which is largely driven by the universal antenatal screening program (similar to the general heterosexual population).

This downward trend for the Black African heterosexual population indicates that the recent increased efforts to improve intervention levels in this group are working. For example, between 2019 and 2023, testing at sexual health services for the Black African heterosexual population increased by 10% (55,453 to 61,072), while testing for the overall heterosexual population decreased by 15% (1,030,203 to 880,342)(29).

Similar to GBMSM, the Black African heterosexual population is disproportionately affected by HIV, with a higher prevalence. Additionally, there have been historic inequalities in accessing HIV care for this population and increasing trends in intervention levels in recent years for this population are closing the gap in the inequalities. This gap could be closed further by improving access to PrEP. People of Black African ethnicity have the highest unmet PrEP need in England, with 98.6% of those with PrEP need not accessing PrEP. Only 1,874 accessed PrEP in 2023, despite an estimated 136,734 having a PrEP need (23).

Figure 4 adjusts for population size, showing the number of new transmissions per 10,000 population. Despite the predicted downward incidence trend for GBMSM and the Black African heterosexual populations, new transmissions per 10,000 population still remain over the UNAIDS goal of <1 transmission for these populations. Predicted new transmissions for people who inject drugs are also over the UNAIDS target.

FIGURE 3. Number of new transmissions each year under current intervention levels for the Black African heterosexual population, 2024 to 2073

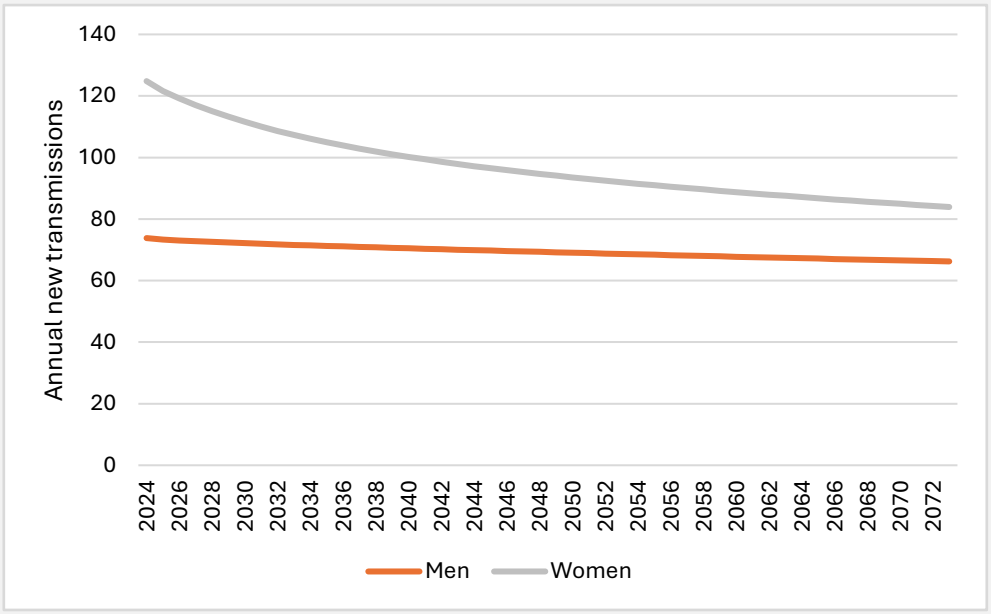
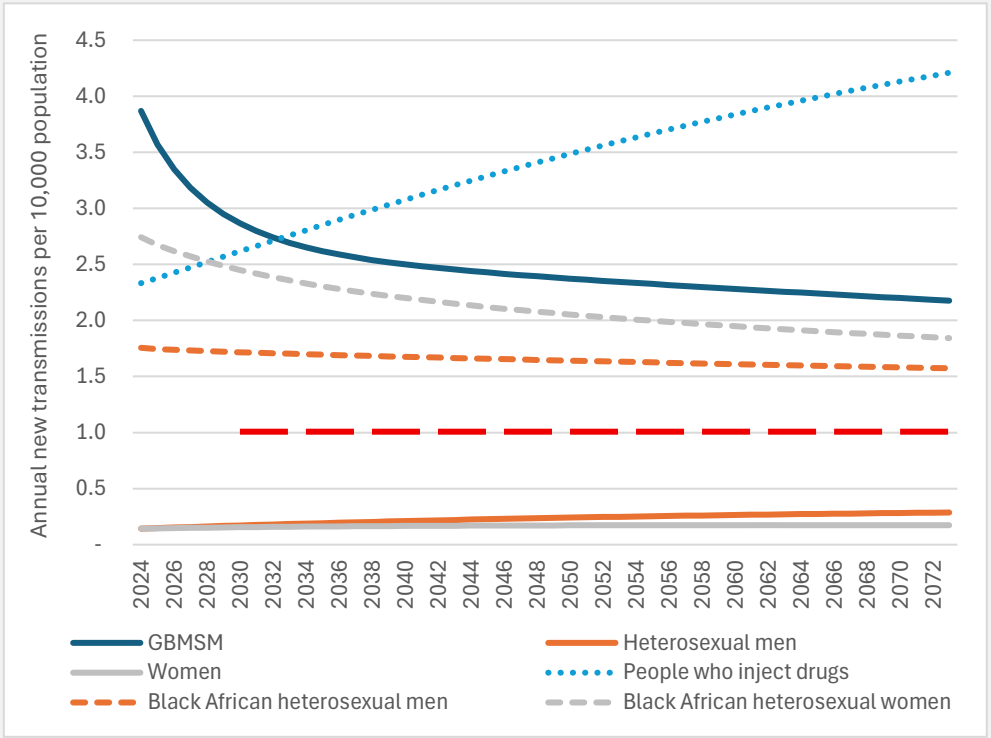


FIGURE 4. Number of new transmissions each year per 10,000 population under current intervention levels, 2024 to 2073



Note: The red dashed line at 1 presents the UNAIDS target of 1 transmission per 10,000 population.

B. Getting closer to the 2030 elimination goal

While we predict the elimination goal will not be achieved by 2030, increasing intervention efforts can get us closer to the target. Without this, new transmissions will continue to grow overtime for the total population.

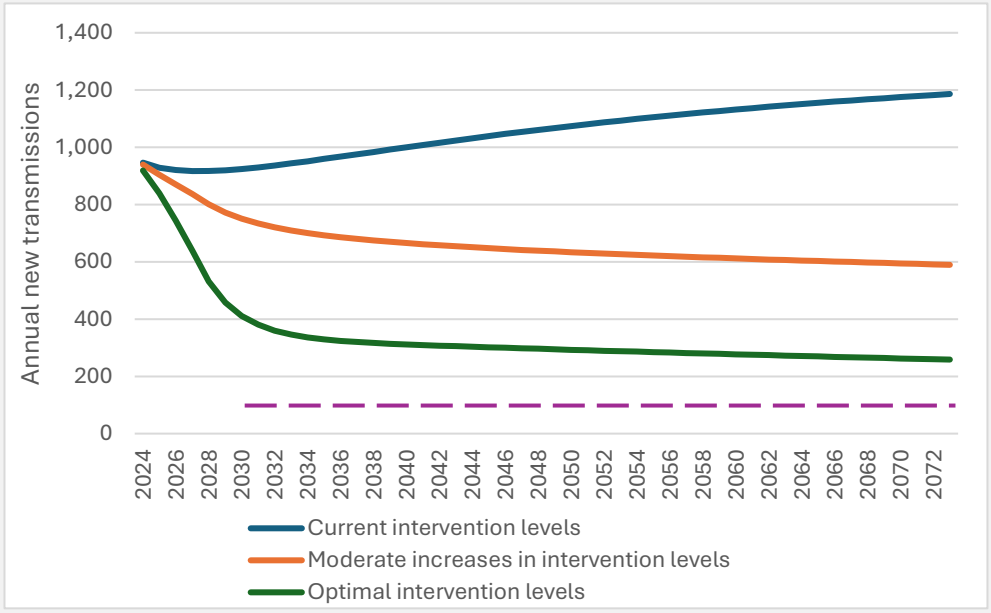
Total population

With 'moderate' increases in intervention levels, we predict the annual number of new transmissions for the total population will decrease over time, decreasing from 940 in 2024, to 750 in 2030 (compared to 924 if intervention levels remained at 2023 levels) (**Figure 5**).

The downward trend in the 'moderate' scenario means the total number of new transmissions acquired between 2024 and 2030 would decrease by 9% (from 6,474 to 5,875) (**Figure 6**). When looking at the 50-year time horizon, the number would decrease by 37% (52,727 to 33,282)[1] by 2073 (**Figure 7**).

In the 'optimal' scenario, which models drastic increases in intervention levels, we predict annual transmissions in 2030 could be 411. It could reduce new transmissions acquired between 2024 and 2030 by 30% (6,474 to 4,542). By 2073, transmissions could reduce by 67% (52,727 to 17,196).

FIGURE 5. The number of new transmissions per year for the total population, 2024 to 2073



Note: The dashed purple line is the HIV Commission elimination target (100).

[1] When each intervention was increased individually, 'moderate' increases in PrEP uptake reduced transmissions in the total population by 5,589 (10.6%) between 2024 and 2073.

FIGURE 6. Total number of new transmissions between 2024 to 2030 by intervention level: Total population

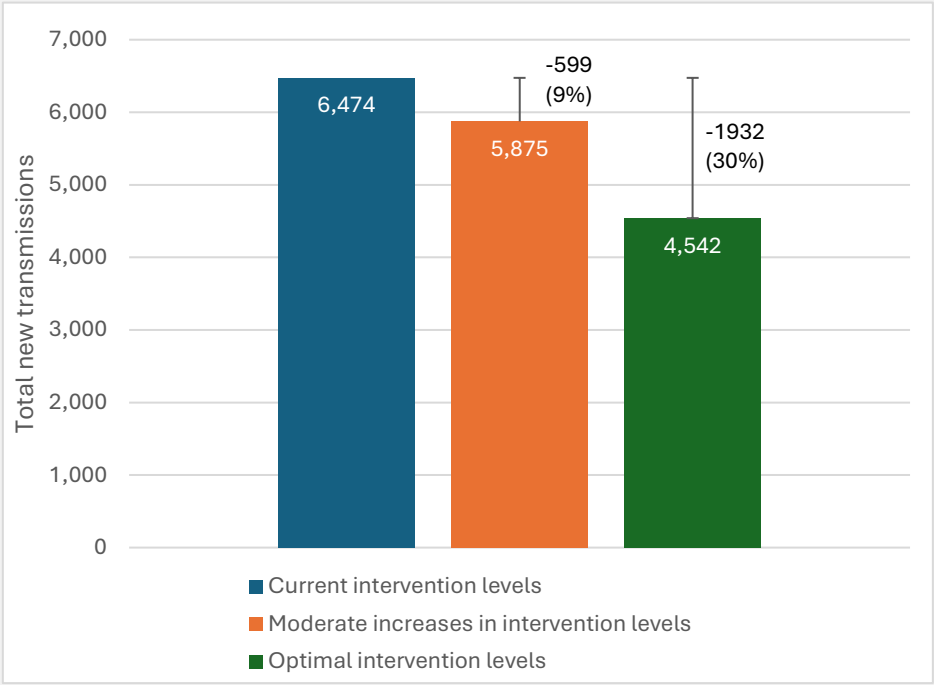
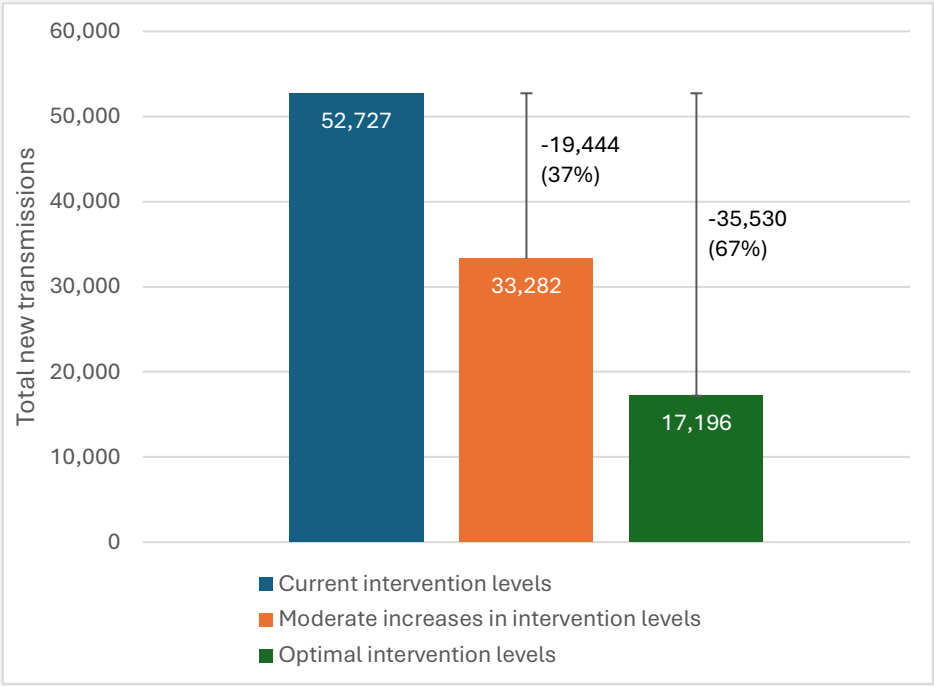


FIGURE 7. Total number of new transmissions between 2024 to 2073 by intervention level: Total population



Population groups

'Moderate' increases in intervention levels can change the current trajectories to downward trendlines for all population groups (**Figure 8**). **Appendix 4** presents trajectories adjusted by population size, showing the number of new transmissions per 10,000 population for each of the future scenarios.

We predict 'moderate' increases in intervention efforts could decrease new transmissions between 2024 and 2030 by 8-12% for each population group, while large increases in efforts (optimal' scenario) could decrease transmissions by 30-36% (**Figure 9**). **Table 5** presents the annual transmissions in 2030 for each scenario.

TABLE 5. Annual new transmissions: Progress to the 2030 goal in the future scenarios

Population Group	2024	2030 (projected) - Current intervention levels	2030 (projected) – 'Moderate' scenario	2030 (projected) – 'Optimal' scenario
GBMSM	399	296	241	157
Heterosexual men	259	313	248	116
Women	268	292	244	130
People who inject drugs	21	23	18	8
Total	**947**	**924**	**750**	**411**

We predict that the impact of the 'moderate' increase in interventions would be highest amongst heterosexual men and people who inject drugs, decreasing new transmissions between 2043 and 2073 for these groups by 49% and 48%, respectively (**Appendix 5**). The lower reduction for women (34%) and GBMSM (19%) reflect higher current intervention uptakes in these two groups (e.g. the probability of HIV testing for women is higher than that of heterosexual men in 2023 due to universal antenatal testing).

Despite experiencing the highest reduction in transmissions from 'moderate' increases in interventions, the number of new transmissions between 2024 and 2073 is still highest in the heterosexual men group (11,164).

The only population group that is project to reach the HIV Commission target is people who inject drugs in the 'optimal' scenario (reached by 2034).

When using the UNAIDS definition, the target has already been reached for women and heterosexual men. The UNAIDS target is almost reached for GBMSM in the optimal scenario in the last year of the model (109 transmissions when the target is 103).

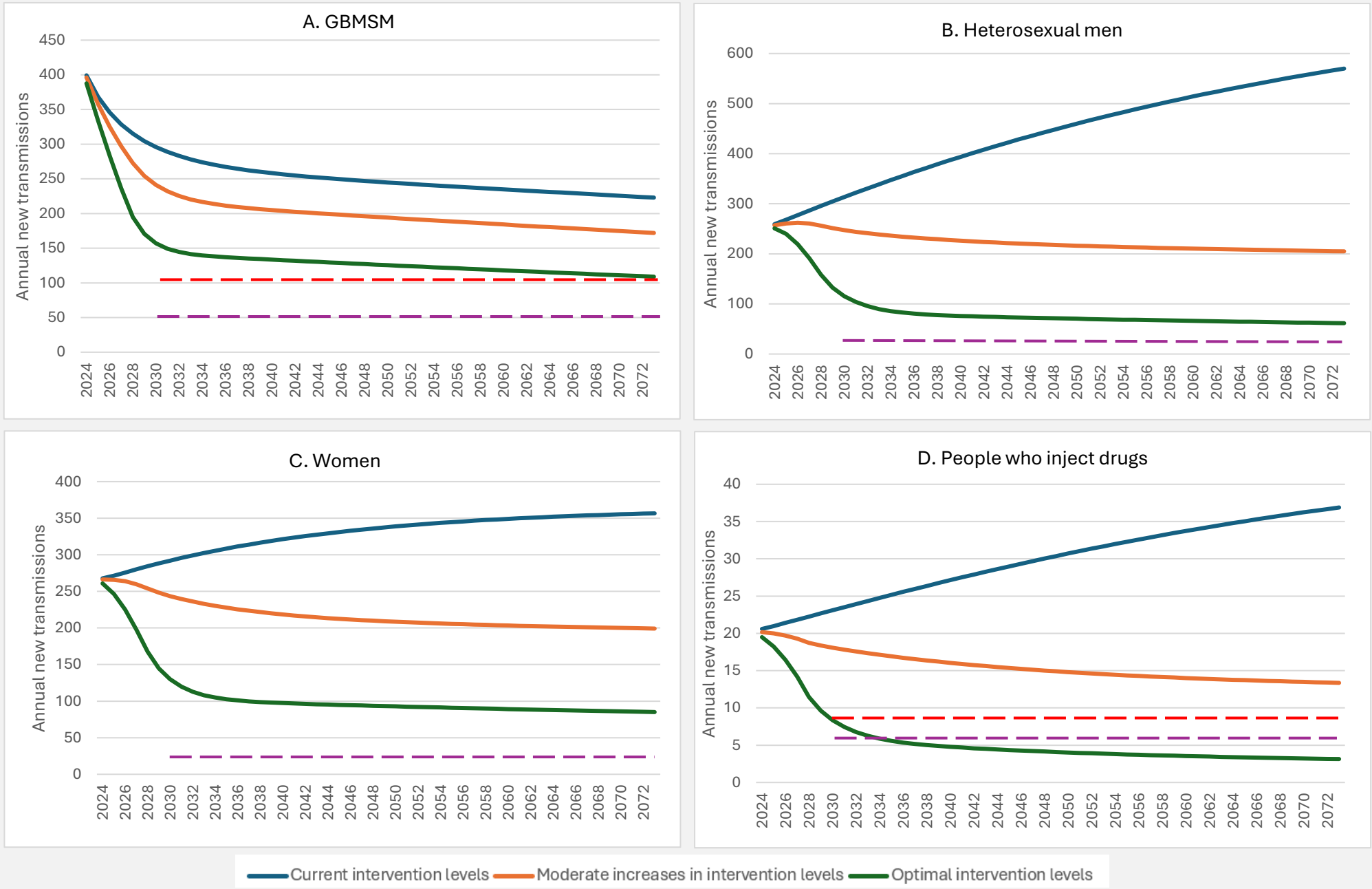
Subgroup analysis

Our subgroup analysis predicts that 'moderate' increases in intervention efforts could decrease new transmissions between 2024 and 2030 by 7-8% for Black African heterosexual men and women, while large increases in efforts ('optimal' scenario) could decrease transmissions by 28-30% (**Figures 10** and **11**).

While the HIV Commission target is not reached for either population, the UNAIDS target can be achieved in 50 years. The UNAIDS target can be reached for Black African heterosexual men by 2049 with 'moderate' increases in interventions, or by 2028 in the 'optimal' scenario. For women, the target is achieved by 2032 in the 'optimal' scenario.

Between 2024 and 2073, we predict these 'moderate' increases in intervention levels could decrease transmissions by 37% (2,077) for Black African heterosexual men and 20% (975) for women (**Appendix 5**). With 'optimal' intervention levels, this increases to 73% (4,087) and 59% (2,846), respectively.

FIGURE 8. The number of new transmissions per year by population group, 2024 to 2073



Note: The dashed purple line represented the HIV Commission elimination target while the red dashed line represents the UNAIDS target. UNAIDS target is not shown for women and heterosexual men as the target has already been achieved for these groups.

FIGURE 9. Total number of new transmissions between 2024 to 2030 by intervention level for each population group.

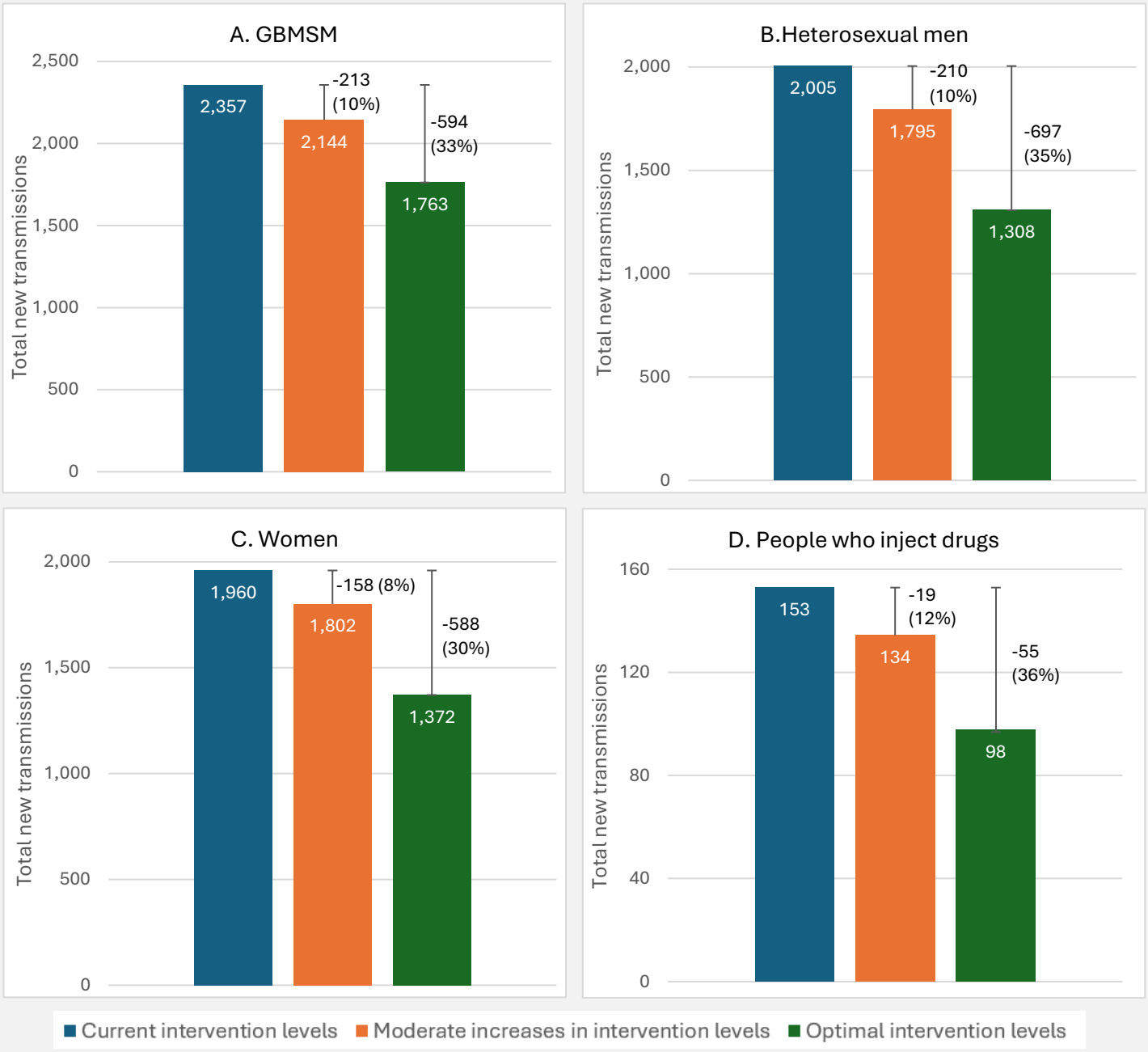
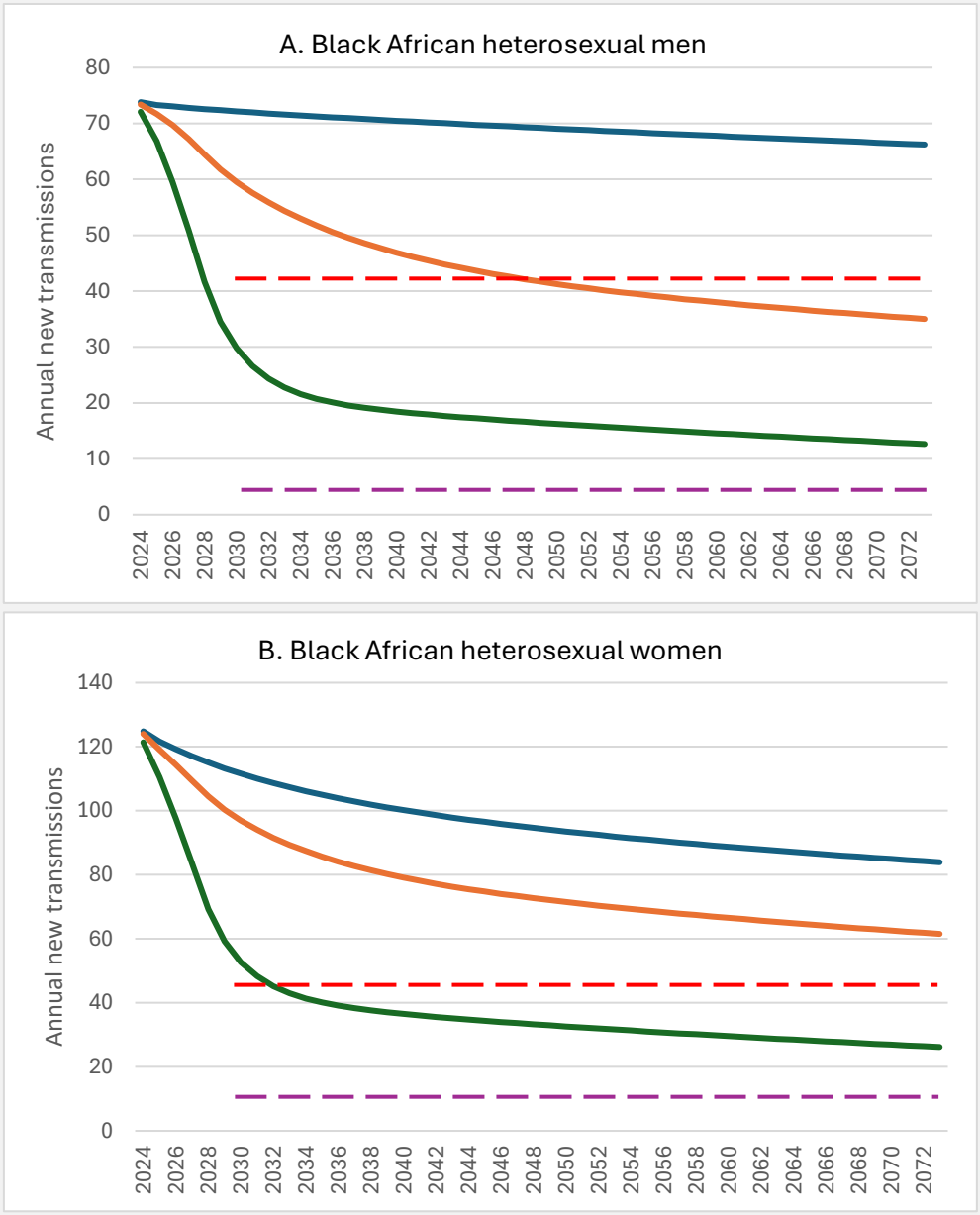
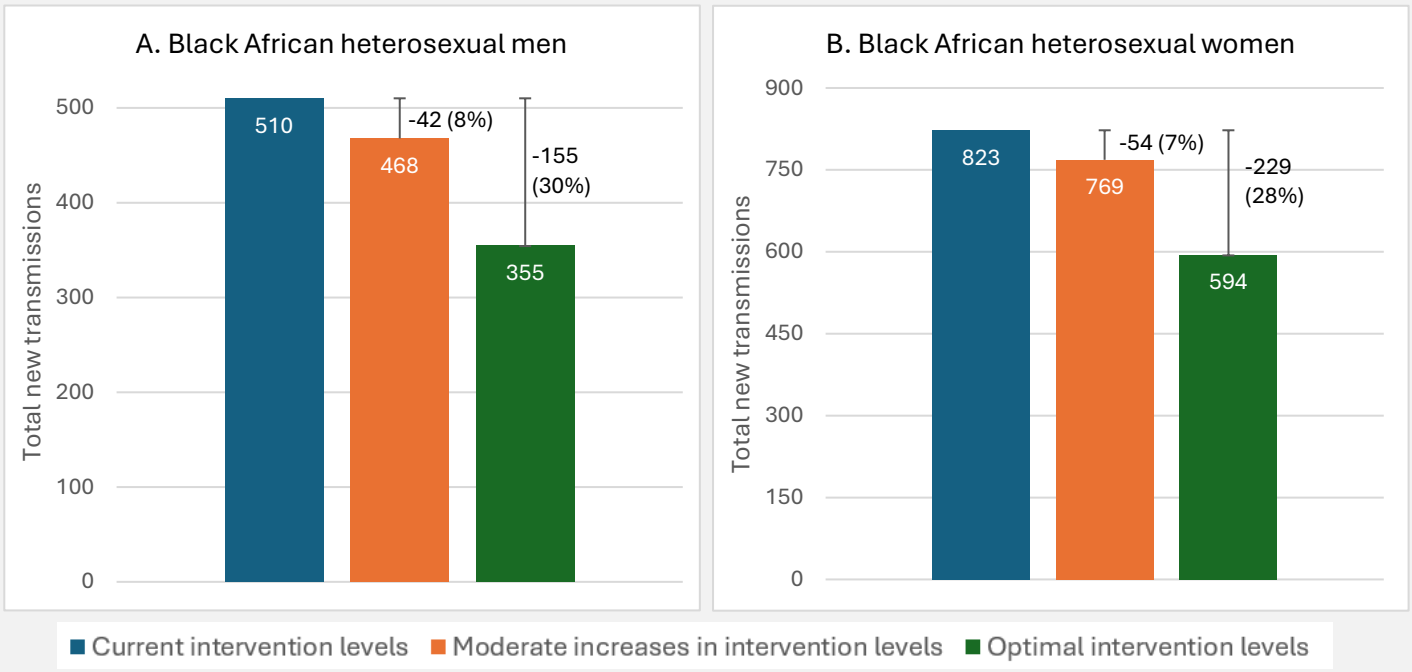


FIGURE 10. The number of new transmissions per year for the Black African heterosexual population, 2024 to 2073.



Note: The dashed purple line represented the HIV Commission elimination target while the red dashed line represents the UNAIDS target.

FIGURE 11. Total number of new transmissions between 2024 to 2030 by intervention level for the Black African heterosexual population



C. Uncertainty analysis

Varying the proportion of HIV-positive people with viral suppression and the annual probability of HIV testing over the full time frame had the largest impact on new transmissions across the population groups.

For example, in the baseline model, the number of new transmissions for heterosexual men in quarter 4 of 2073 (the last cycle of the model) was 141. Varying the proportion of patients taking ART who are virally suppressed by ±20% changed the number of new transmissions among heterosexual men from approximately 131 (–7%) to 164 (+16%) cases. This is still far from the elimination target of <5 transmissions per quarter (<19 per year).

Overall, there were no individual inputs that, when varied by ±20%, changed the overall results of the model (i.e. if the population achieves the elimination target by 2073 or not).

D. Cost averted

While expanding intervention efforts requires significant increases in funding, it could avoid substantial HIV treatment and management costs.

In England, the lifetime cost per person of managing HIV ranges from approximately £73,300 to £202,300 (a 3.5% annual discount rate applied) (6). The transmissions prevented by 2030 could avert £44 - £121 million ('moderate' scenario) to £142 - 391 million ('optimal' scenario) in lifetime HIV treatment costs. The transmissions prevented by 2073 could avert £1.4 -£3.9 billion ('moderate' scenario) to £2.6 - £7.1 billion ('optimal' scenario).

4. Strengths and limitations

Our study builds on previous evidence that focused on the GBMSM population, by analysing new transmissions within other population groups, and capturing the impact of increased intervention efforts by the UK Government in recent years.

As with any modelling evaluation, models are a simplified representation of the real world, and there could be changes to factors affecting new transmissions that we have not assessed, such as innovative interventions and treatments or shifts in population dynamics. Additionally, our model focuses on HIV transmissions acquired in the UK. We do not assess the impact of changes in migration and HIV acquired abroad. However, evidence suggests that people who acquire HIV abroad and continue HIV care in England are unlikely to pass on HIV in England (30).

We also project the current scenario with the assumption that funding will remain at current levels. If funding were to decrease, our current scenario would present an optimistic estimate.

5. Conclusion

While great progress has been made in HIV prevention and treatment, and England has already achieved the UNAIDS elimination target for the overall population, particularly among the GBMSM population, a substantial increase in prevention efforts is needed to meet the HIV Commission population-specific elimination goal. This goal is ambitious, but ambitious commitments are needed to end HIV transmissions in all population groups, and we must leverage the learnings from the success of the response to date. A new definition for "elimination" is currently under review by the UKHSA (26).

The new HIV Action Plan for England should consider the most effective prevention strategies to reduce transmissions, such as expanding screening programs and equitable access to PrEP. No single intervention will be sufficient to achieve the goal, and increasing investment in a combination of prevention interventions is necessary.

Acknowledgements

We acknowledge Dr Deborah Flanagan, Louise Logan and Peter Shand of Gilead Sciences, who were not involved in the design of the work or interpretation of the results, but reviewed the text for scientific accuracy and clarity. We also want to acknowledge the contributions of several experts who advised on the inputs for the model, including Dr Michael Brady (King's College Hospital NHS Foundation Trust) and Dr Rachael Jones (Chelsea and Westminster Hospital NHS Foundation Trust).

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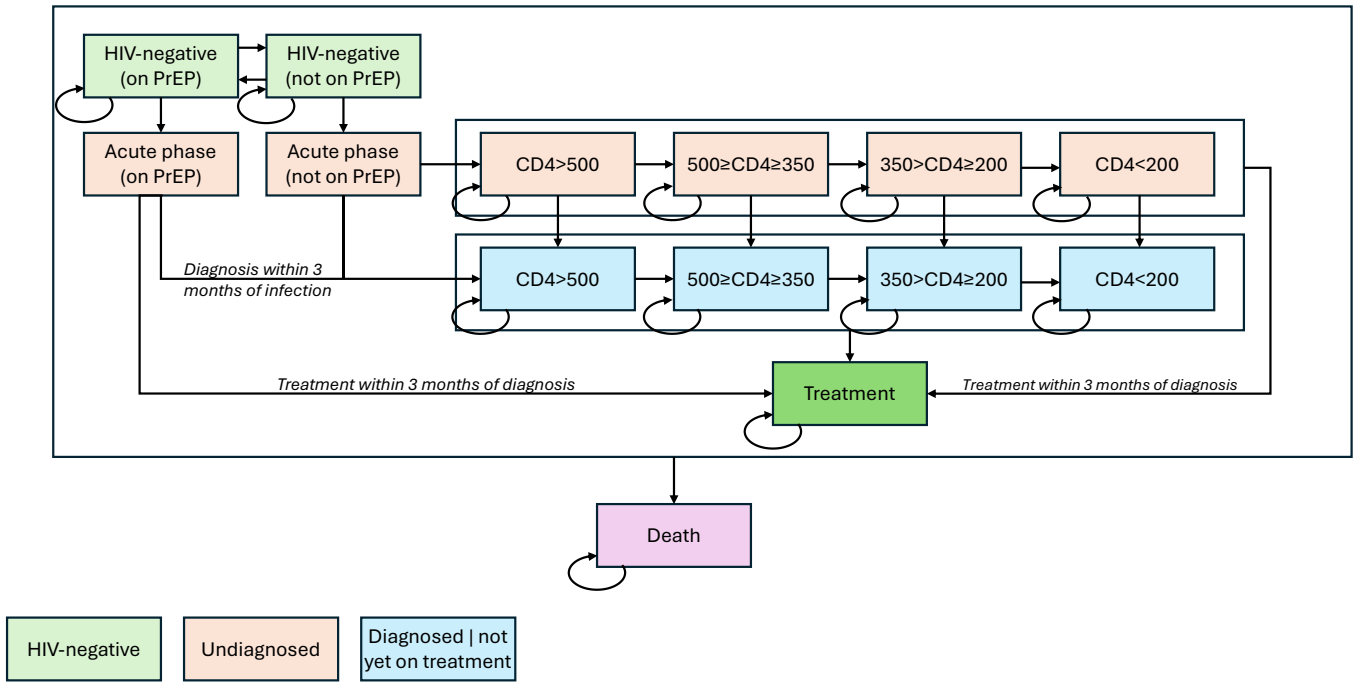
7. Appendices

Appendix 1: Model structure

FIGURE A1. Structure of the Markov state transition model.



Notes: Adapted from Massey et al. (2023)(5). PrEP = Pre-exposure prophylaxis.

Appendix 2: Descriptions of intervention indicators and sources of data

TABLE A1. Descriptions of intervention indicators and the sources of data

Theme	Intervention indicator	Description	Sources
1. Maintain people's negative HIV status	Annual probability of starting PrEP	The annual likelihood that HIV-negative individuals (with a PrEP need) initiate PrEP. Increasing PrEP uptake among at-risk populations reduces the susceptible population and prevents new HIV infections.	• Based on UKHSA numbers on those accessing PrEP (3), and PrEP need numbers from Huntington et al (2025) (23). • Model also incorporates an annual PrEP discontinuation rate among PrEP users (22,31,32), and PrEP efficacy (33–35).
2. Reduce the number of PLWH who are undiagnosed	Annual probability of testing for HIV	The proportion of the population tested for HIV annually. Higher testing rates increase the likelihood of diagnosing individuals living with HIV who are unaware of their HIV status.	• Testing includes testing at sexual health services (SHSs) (includes online testing)(3), universal antenatal screening (3), HIV Testing Week (3), and emergency department opt-out testing (10).
	Proportion of diagnosed individuals within three months of transmission	The proportion of individuals who are diagnosed within three months of acquiring HIV. Early diagnosis significantly reduces onward transmission by enabling timely treatment initiation.	• Recent infection testing algorithm (RITA) from Public Health England 2019 report (36).
3. Reduce the number of people with transmissible levels of virus	Proportion of diagnosed individuals starting treatment within three months of diagnosis	The percentage of individuals initiating ART within three months of diagnosis. This reflects the immediate ART policy which aims to start individuals on ART within 90 days of diagnosis. Faster initiation of ART further reduces the time individuals remain infectious after diagnosis.	• UKHSA HIV Action Plan: Monitoring and Evaluation Framework 2024 Report (3).
	Proportion of diagnosed individuals starting treatment within six months of diagnosis	The percentage of individuals initiating ART within six months of receiving an HIV diagnosis. Faster initiation of ART further reduces the time individuals remain infectious after diagnosis.	• Croxford et al (2021) (37).
	Proportion of individuals who have initiated treatment and are virologically suppressed (TasP)	The proportion of individuals on treatment who achieve sustained virological suppression, making them unable to transmit HIV (Undetectable = Untransmittable, or U=U).	• UKHSA HIV testing, PrEP, new HIV diagnoses and care outcomes for people accessing HIV services: 2024 report (9).

Appendix 3: Future scenario methods and inputs

We assume the increases in interventions are implemented linearly between 2024 to 2029.

'Moderate' scenario

Table A2 outlines the inputs for the future scenario. For heterosexual men, women, and people who inject drugs, we defined the moderate future scenario as the midpoint between the current intervention rates within each group and those observed in the current scenario for the GBMSM population. This scenario was considered moderate because achieving these intervention levels would require considerable investment, while recognising that it is likely unrealistic for these populations to reach the levels observed in the GBMSM group in this time frame. For the GBMSM population, the moderate future scenario was defined as a substantial, yet realistic, increase from their current scenario.

Taking the example of HIV testing to contextualise the magnitude of the increases, a 23% probability of HIV testing in the current scenario for GBMSM means 224,893 tested in 2023. In the 'moderate' scenario, a probability of 35% means 344,879 are testing annually by 2029 (an additional 119,985). For the PrEP indicator, it represents 83,120 GBMSM accessing PrEP in 2023, increasing to 105,755 in the moderate scenario (22,635 additional). This change represents 47% of GBMSM with a PrEP need accessing PrEP in 2023, increasing to 60%.

'Optimal' scenario

Table A3 outlines the inputs for the optimal scenario. For the optimal scenario, we selected substantial increases in intervention levels to illustrate the extent to which efforts would need to be scaled up to meet the ambitious 2030 target. While these intervention levels are very optimistic, we did not set them to 100% in acknowledgement of capacity constraints. We assumed that, once individuals are diagnosed and linked to care, intervention uptake would be similar across all groups. Consequently, the proportion of individuals who have initiated treatment and are virologically suppressed (TasP), as well as the probability of starting treatment within three and six months of diagnosis, were held constant across all four groups.

The annual probability of initiating PrEP among HIV-negative individuals with a PrEP need was assumed to be the same across all groups, as it is based on the level of need specific to each group (20). It was further assumed that 80% of individuals with a PrEP need are accessing PrEP.

TABLE A2: Intervention indicators for the moderate future scenario for each population group

	GBMSM	Heterosexual men	Women	People who inject drugs	Black African heterosexual women	Black African heterosexual men
Annual probability of PrEP initiation (among those with PrEP need)	22.8%	9.3%	9.5%	8.8%	8.8%	8.8%
Proportion diagnosed within 3 months of transmission	35.0%	17.5%	18.0%	17.0%	17.8%	17.8%
Annual testing probability	35.0%	13.3%	15.6%	13.3%	19.2%	15.7%
Probability of starting ART within 3 months	90.0%	80.0%	79.5%	72.5%	79.2%	79.2%
Probability of starting ART within 6 months	98.0%	93.8%	94.5%	92.8%	94.0%	94.0%
Proportion virologically suppressed	98.2%	97.5%	98.2%	95.5%	97.5%	97.5%

TABLE A3: Intervention indicators for the optimal future scenario for each population group

	GBMSM	Heterosexual men	Women	People who inject drugs	Black African heterosexual women	Black African heterosexual men
Annual probability of PrEP initiation (among those with PrEP need)	32.4%	32.4%	32.4%	32.4%	32.4%	32.4%
Proportion diagnosed within 3 months of transmission	50.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Annual testing probability	50.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Probability of starting ART within 3 months	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
Probability of starting ART within 6 months	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
Proportion virologically suppressed	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%

Appendix 4. Trajectories of the annual new transmissions per 10,000 population for the future scenarios.

The red dashed line at 1 presents the UNAIDS target of <1 transmission per 10,000 population. In both **Figure A2** and **Figure A3**, the trendline for heterosexual men is not visible behind the line for women as both follow a similar trajectory.

FIGURE A2. Number of new transmissions each year per 10,000 population in the 'moderate' future scenario, 2024 to 2073

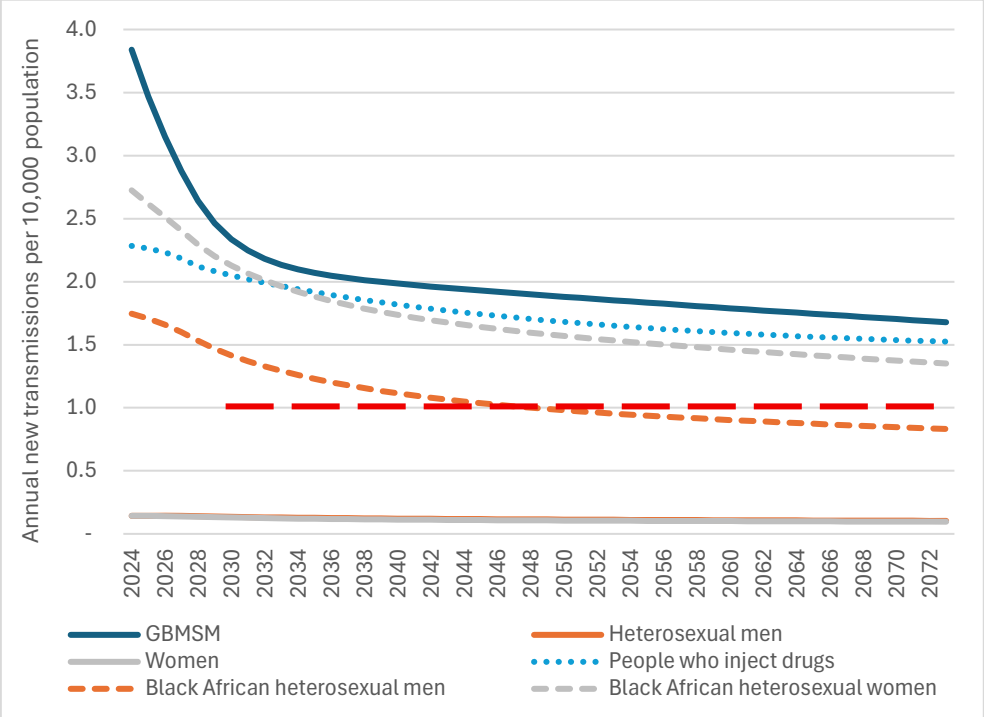
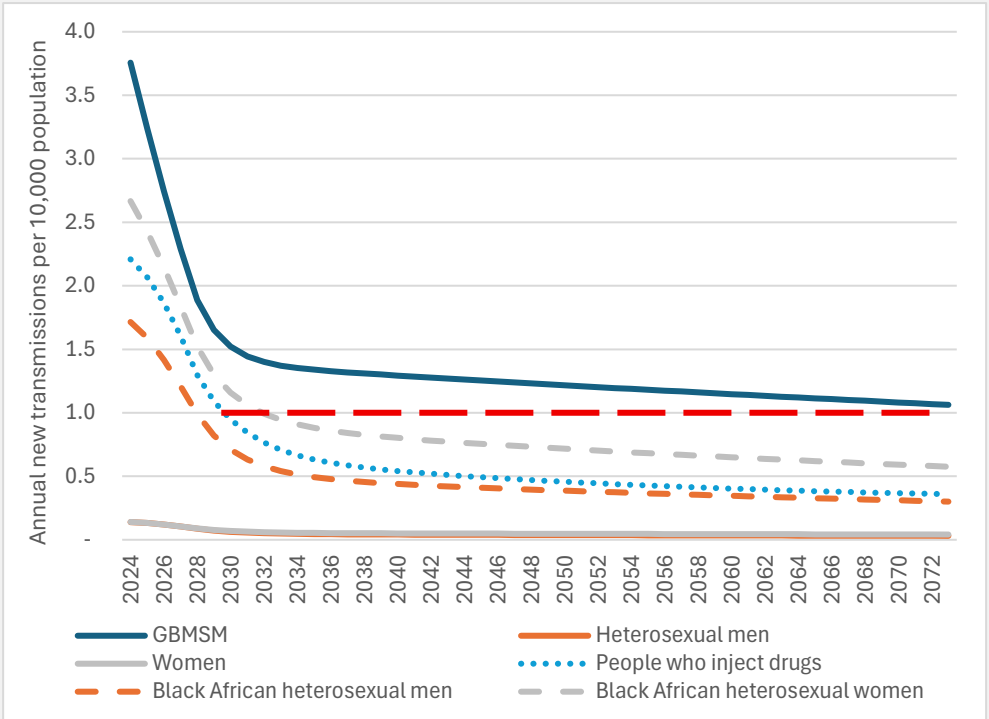


FIGURE A3. Number of new transmissions each year per 10,000 population in the 'optimal' future scenario, 2024 to 2073



Appendix 5. Cumulative new transmissions over a 50-year time horizon

FIGURE A4. Total number of new transmissions between 2024 to 2073 by intervention level for each population group.

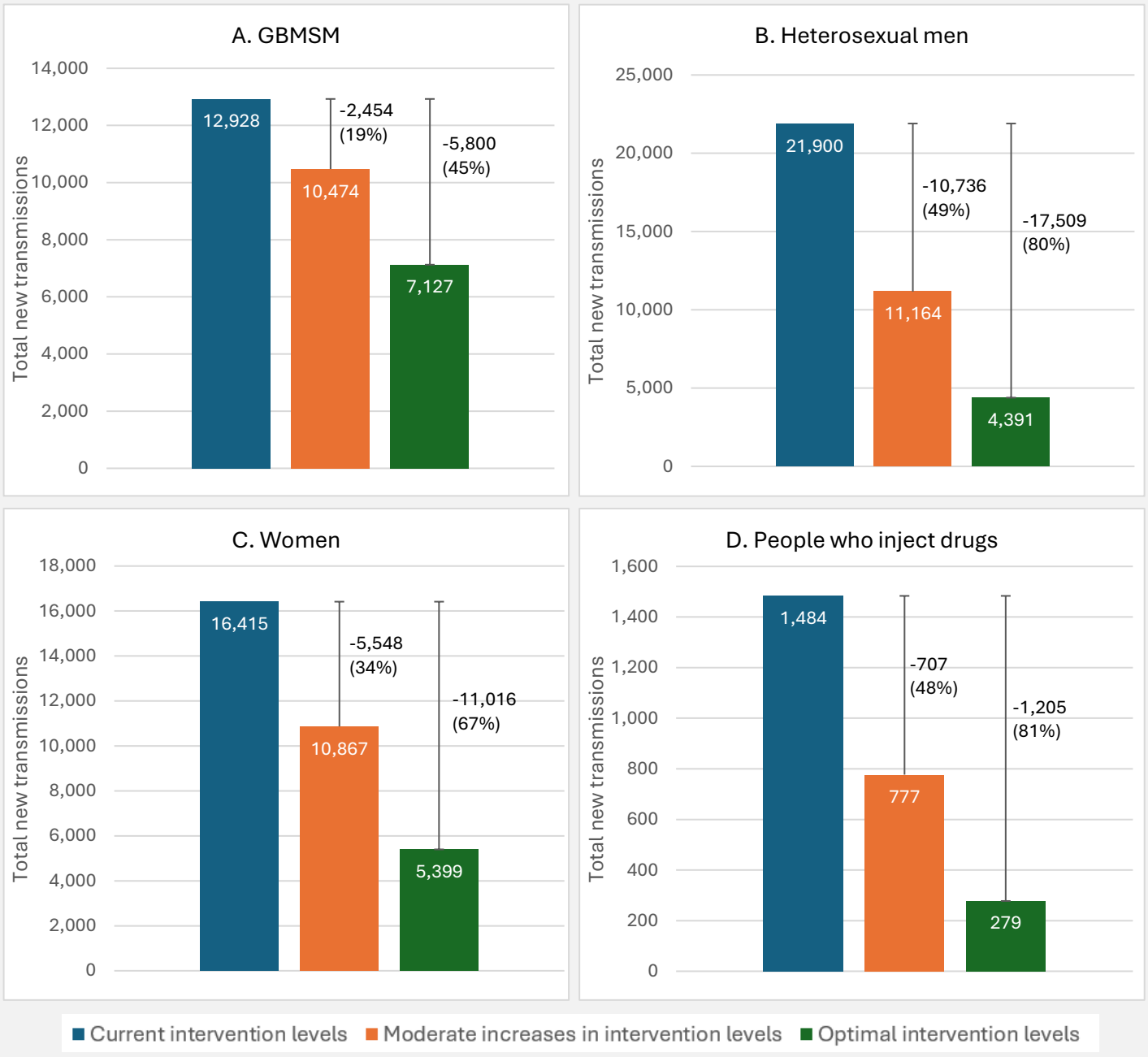


FIGURE A5. Total number of new transmissions between 2024 to 2073 by intervention level for the Black African heterosexual population