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How can Scotland and Ireland achieve HIV transmission elimination?

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

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Executive Summary

Background: Scotland and Ireland have committed to eliminating HIV transmission by 2030, in line with the UN Sustainable Development Goal (SDG) 3.3 target. While both countries have expanded prevention efforts, the timeline to reach transmission elimination remains uncertain.

Objectives: We aim to assess when Scotland and Ireland are likely to achieve transmission elimination if intervention efforts remain at current levels, considering four population groups in each country: Gay, Bisexual and other Men-who-have-sex-with-men (GBMSM); heterosexual men; women; and people who inject drugs. Where the countries are not currently achieving the goal, we aim to assess how increasing intervention levels can help get them closer to the elimination goal.

Methods: We developed an adapted version of a previously published Markov state transition open cohort model of HIV transmission with a 50-year time horizon and baseline year of 2023. The population modelled is adults aged 16+ living in Scotland and Ireland, 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. We assess if each population group is predicted to achieve the elimination target by 2030, with “elimination” defined using the UNAIDS target of <1 transmission per 10,000 population. For the population groups where the target is not met, we then run a scenario to assess how ‘moderate’ increases in intervention levels (which reflect a substantial but realistic expansion of interventions), can get them closer to the elimination goal.

Results: We predict that under current intervention levels, the number of new HIV transmissions in both Scotland and Ireland are expected to decrease over the next 50 years. The UNAIDS target is already being achieved for the total population, heterosexual men, women and people who inject drugs in both countries. Despite an expected downward trend in transmissions with the GBMSM population, neither country is expected to meet the 2030 target for GBMSM. We find that with moderate increases in intervention levels, Scotland can reach the target for GBMSM by 2030 and Ireland by 2035.

Conclusions: The contributions these countries have made in expanding their prevention efforts have led to a decrease in HIV transmissions. However, further expansion of these efforts is needed for GBMSM in Scotland and Ireland to reach the target. While few new transmissions are being acquired within these countries, there is a higher number of annual diagnoses due to acquisitions outside of each country. Ongoing investment will be necessary to continue providing care for these individuals.

Key takeaways

Under current intervention levels



Scotland and **Ireland** have already **achieved** the UNAIDS HIV transmission elimination **targets** (<1 transmission per 10,000 population) for their **total populations**.



Trajectories for new transmissions are expected to continue to **decline** over time.



10%

Between 2024 and 2030, annual transmissions are projected to **decrease** from **20** to **18**.



31%

Between 2024 and 2030, annual transmissions are projected to **decrease** from **45** to **31**.

By
population
group

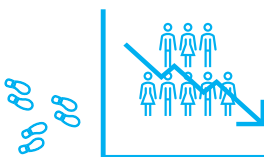


- **Both countries** are already **meeting the target** for **heterosexual men, women and people who inject drugs**.



- However, they **are not** projected to meet the **GBMSM** target by **2030**, despite a downward trend in this population.

Getting closer to the 2030 goal



With “**moderate**” increases in intervention levels, Scotland could reach the **GBMSM** target (<8 annual transmissions) by

2030.



With “**moderate**” increases in intervention levels, Ireland could reach the **GBMSM** target (<12 annual transmissions) by

2035.

Despite significant progress in reducing HIV transmissions in **Scotland** and **Ireland**, **further expansion** of these efforts is needed for **GBMSM** to reach the **2030 goal**.



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1. Introduction

The governments of Scotland and Ireland have committed to eliminating HIV transmission by 2030, in line with the UN Sustainable Development Goal (SDG) 3.3 target (1–3).

Both countries have continued to expand prevention efforts. In Scotland, health services have increased access to PrEP, self-testing services, and are piloting opt-out HIV testing in emergency departments (ED) (2). Ireland also increased PrEP uptake, offers free testing in clinics and community venues, and distributes self-test kits (4).

Despite this progress, the timeline to reach transmission elimination remains unclear. Recent global and national changes, including the COVID-19 pandemic, cuts to international funding for HIV prevention and increasing inward migration of people in both countries, may have impacted the number of new HIV transmissions.

For both Scotland and Ireland, our modelling study aims to assess if the countries can achieve the elimination target by 2030 if prevention interventions remain at their current levels. We assess this for the total population and for four population groups: Gay, Bisexual, and other Men who have Sex with Men (GBMSM), heterosexual men, women (all sexual orientations) and people who inject drugs. Where the target is not being achieved, we assess how increasing intervention levels can help get them closer to elimination.

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 Scotland and Ireland (5) with a 50-year time horizon and baseline year of 2023. We focus only on transmissions acquired within each country.

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. Any state can transition to Death, 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 Scotland and Ireland. 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 men and women populations limited to sexually active individuals (6) (**Table 1**).

For Scotland, population estimates were obtained from the National Records of Scotland, and data from Public Health Scotland (PHS) and The Scottish Government for people who inject drugs (7–9).

For Ireland, population estimates were derived from Central Statistics Office (CSO) data (10), UNAIDS data for GBMSM and Health Research Board (HRB) data for people who inject drugs (11,12).

TABLE 1. Size and proportion of each population group within the adult population in Scotland and Ireland

Population	Scotland		Ireland	
	Population numbers (n)	Population percentage (%)	Population numbers (n)	Population percentage (%)
GBMSM	84,243	2.5%	117,400	3.5%
Heterosexual men	1,743,710	47.2%	1,582,870	46.9%
Women	1,854,914	50.2%	1,664,426	49.3%
People who inject drugs	9,342	0.3%	12,523	0.4%
Total population (16+)	3,692,209	100%	3,377,219	100%

D. Intervention indicators and scenarios

Six key indicators to evaluate the impact of current HIV prevention, testing, and treatment efforts were included in the model (**Table 2**). These were essential for simulating the impact of interventions and assessing the feasibility of achieving the 2030 zero-transmission targets.

We first modelled the projected new transmissions under current intervention levels (at 2023). Where the 2030 target was not met under current intervention levels, we then modelled a scenario to assess the impact of increasing intervention levels.

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 were primarily sourced from the PHS (Scotland) and Health Service Executive (HSE) (Ireland) (13,14). Definitions of the six intervention indicators and data sources for the current scenario can be found in **Appendix 2**, and values are shown in **Table 2**.

TABLE 2. Intervention indicators for the current scenario for each sub-population in Scotland and Ireland

A. Scotland				
	GBMSM	Heterosexual men	Women	People who inject drugs
Proportion of HIV-negative population with PrEP need starting PrEP annually*	7.1%	0.1%	0.2%	0%
Proportion diagnosed within 3 months of transmission	26.0%	6.0%	6.0%	25.0%
Proportion testing annually	11.2%	1.7%	4.9%	12.0%
Proportion starting treatment within 3 months of diagnosis†	82.7%	77.4%	76.2%	61.9%
Proportion starting treatment within 6 months of diagnosis†	95.5%	92.0%	93.5%	90.0%
Proportion of people on treatment who are virologically suppressed	98.0%	97.0%	98.0%	93.0%

B. Ireland				
	GBMSM	Heterosexual men	Women	People who inject drugs
Proportion of HIV-negative population with PrEP need starting PrEP annually*	8.2%	0.5%	0.2%	0%
Proportion diagnosed within 3 months of transmission	12.7%	4.3%	4.3%	21.4%
Proportion testing annually	32.1%	5.8%	9.5%	7.0%
Proportion starting treatment within 3 months of diagnosis†	82.7%	77.4%	76.2%	61.9%
Proportion starting treatment within 6 months of diagnosis†	95.5%	92.0%	93.5%	90.0%
Proportion of people on treatment who are virologically suppressed	98.7%	97.6%	97.5%	92.0%

Note: **Proportion of HIV-negative population with PrEP need starting PrEP* annually' is a function of the number of people currently accessing PrEP and the proportion that discontinues PrEP each year. For example, 8.2% for GBMSM in Ireland is based on 5,100 currently accessing PrEP (15) and assuming 27% discontinue PrEP annually (16). Data on PrEP need was not available for Scotland and Ireland and was informed by PrEP need analyses from England (17). †Timeliness of treatment initiation inputs were proxied from England data for both Scotland and Ireland due to lack of country-specific stratified data (18,19).

Increased intervention scenario

Where the 2030 target was not met for a population group, we increased the level of each intervention by a “moderate” amount. This scenario reflects what would be considered a substantial, yet realistic, increase from the current scenario.

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

E. Outcomes

Both countries have committed to “eliminating” HIV (2,3). The Scottish Government have set the ambitious “elimination” definition of “zero people” contracting HIV within Scotland, while the Irish Government do not specify a definition for their elimination goal.

For comparability, we have defined the outcomes as the absolute number of new HIV transmissions each year, measured against the UNAIDS target of less than 1 transmission per 10,000 population (20) (**Table 3**).

TABLE 3. Transmission elimination targets for each population group in Scotland and Ireland.

Population	UNAIDS target*	
	Scotland	Ireland
GBMSM	<8	<12
Heterosexual men	<174	<158
Women	<185	<166
People who inject drugs	<1	<1
Total population (16+)	<368	<337

Notes: *UNAIDS target of <1 transmission per 10,000 population (20), 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 range of values for the inputs 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 $\pm 20\%$ 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

Scotland

Scotland has already achieved the UNAIDS HIV transmission elimination target for the total population (<368 annual transmissions, **Table 3**). The annual number of new transmissions in the total population is projected to decrease slightly over time. Between 2024 and 2030, annual transmissions decrease from 20 to 18 (10% reduction) and subsequently plateau around 15 (**Figure 1A**).

When broken down by population group, our projections show that Scotland is meeting the target (**Table 3**) for heterosexual men, women, and people who inject drugs (**Figure 1A**). The trajectories for these three groups remain relatively low and stable across the next 50 years.

However, the target for GBMSM is not projected to be met by 2030 under current intervention levels. While transmissions among GBMSM are projected to decline over time, the decline is not rapid enough for Scotland to meet the target of <8 annual transmissions by 2030. Scotland is projected to achieve the GBMSM elimination target around 2043.

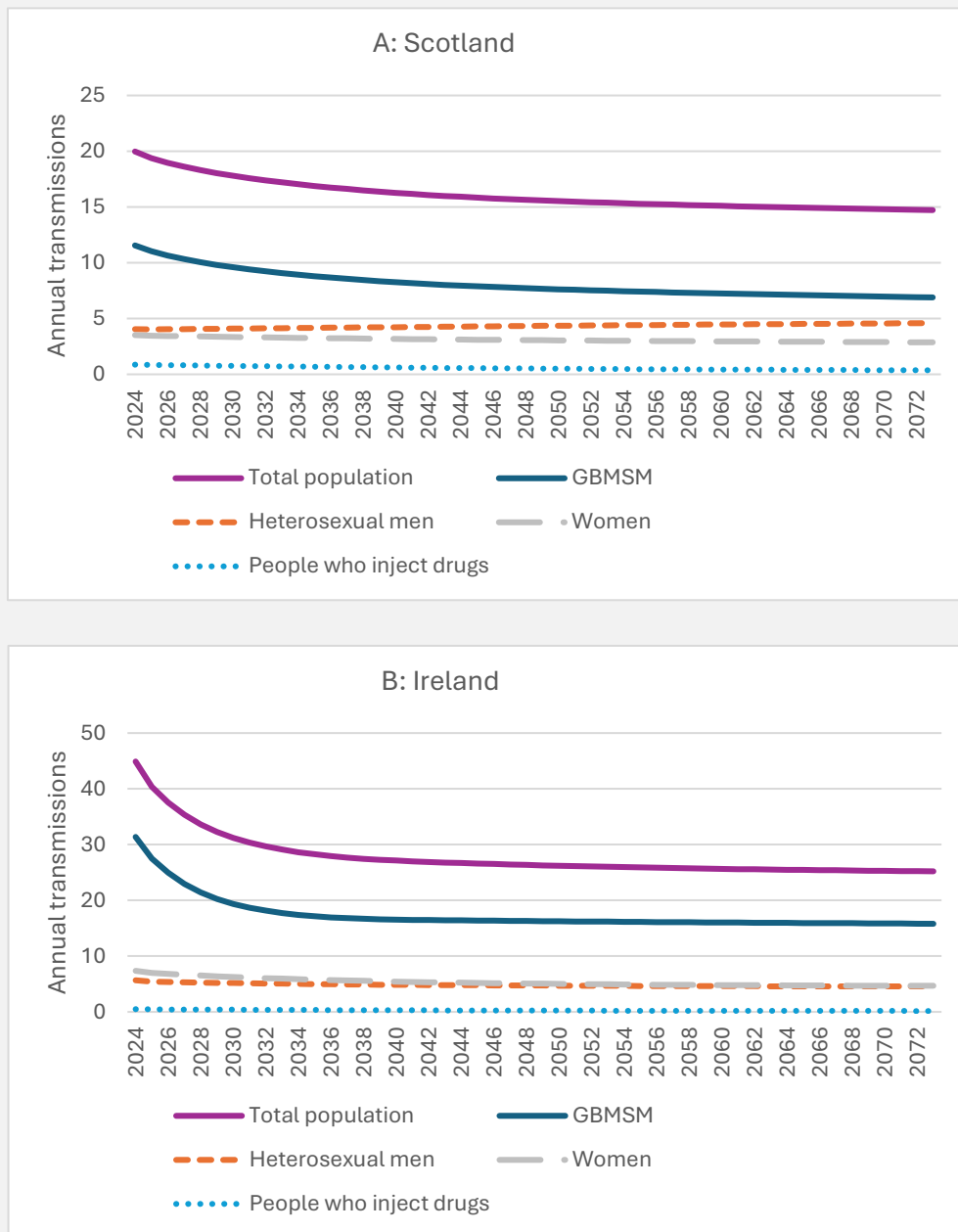
Ireland

Ireland has already achieved the UNAIDS HIV transmission elimination target for the total population (<337 annual transmissions, **Table 3**). Under current intervention levels, the annual number of new transmissions in the total population is projected to gradually decline over time. Between 2024 and 2030, annual transmissions decrease from 45 to 31 (31% reduction) and subsequently plateau around 26 (**Figure 1B**).

By population group, projections suggest that the target (**Table 3**) is also being met for heterosexual men, women, and people who inject drugs in Ireland (**Figure 1B**). The trajectories for these three groups remain relatively low and stable across the next 50 years.

Similar to Scotland, Ireland is not expected to meet the 2030 target for GBMSM under current intervention levels. Although transmissions among GBMSM are predicted to decline over time, they remain above the target of <12 annual transmissions, plateauing at 16 annual transmissions from 2043.

FIGURE 1. Number of new transmissions each year under current intervention levels by population group in Scotland and Ireland, 2024 to 2073



B. Getting closer to the 2030 transmission elimination goal

Our model predicted that both Scotland and Ireland will not achieve the 2030 goal for GBMSM under current intervention levels. We modelled an increased intervention scenario to assess how increasing intervention levels can get them closer to the goal.

Scotland

Our scenario results indicate that with moderate increases in intervention levels, Scotland could reach the UNAIDS target for GBMSM (<8 annual transmissions) by 2030 (**Figure 2A**). In this scenario, annual transmissions would decrease from approximately 12 in 2024 to 8 in 2030 (31% reduction).

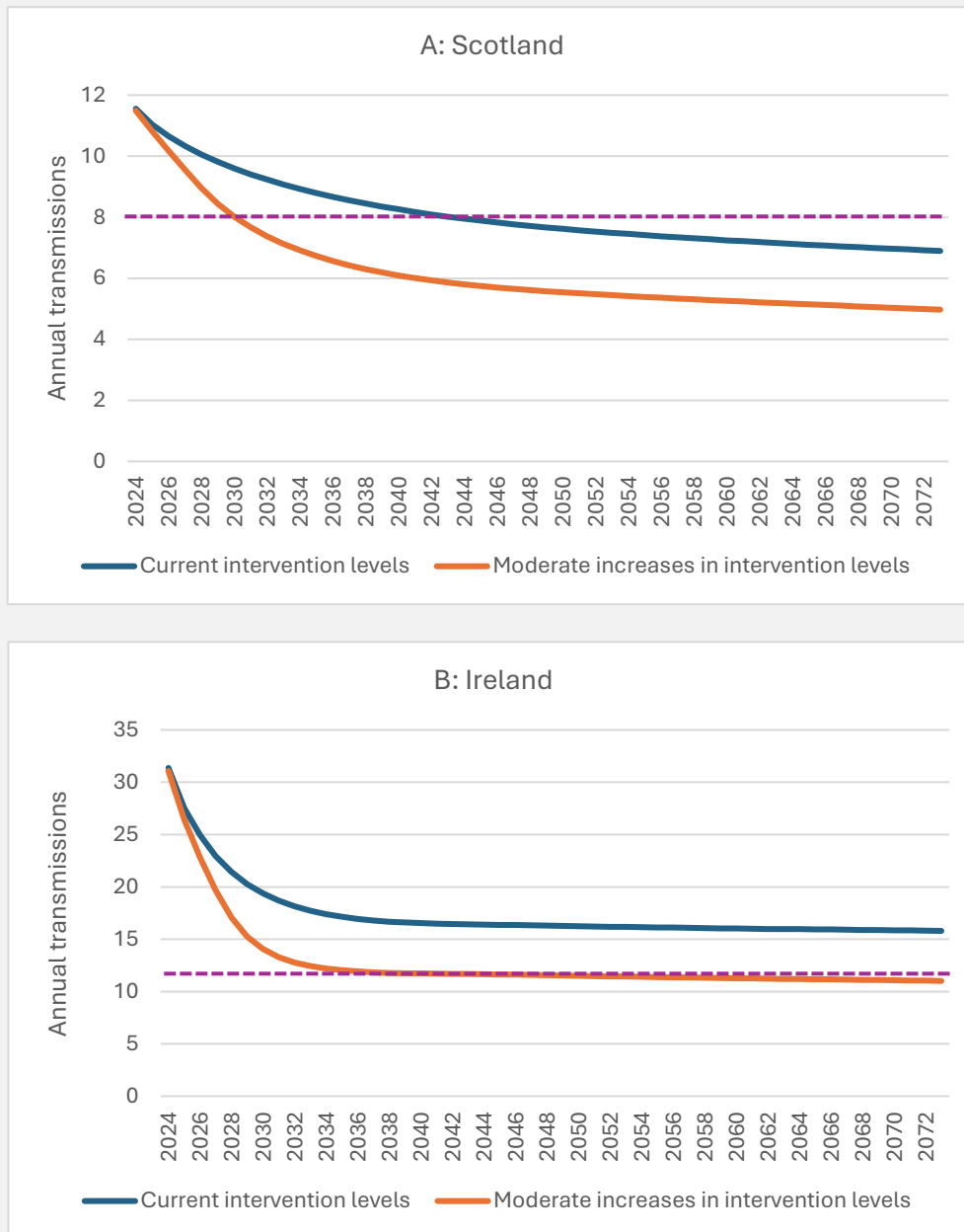
Ireland

With moderate increases in intervention levels, the target (<12 annual transmissions) could be achieved for GBMSM in Ireland by 2035 (**Figure 2B**). In this scenario, annual transmissions would decrease from 31 in 2024 to 14 in 2030 (55% reduction), declining to 12 transmissions in 2035.

C. Uncertainty analysis

There were no individual inputs that, when varied by $\pm 20\%$, changed the overall results of the model for any population group in either country (i.e. if the population group achieves the 2030 elimination goal or not).

FIGURE 2. Annual new transmissions for GBMSM by intervention level in Scotland and Ireland, 2024 to 2073



Note: The purple dashed line represents the UNAIDS target of <1 transmission per 10,000 population

4. Strengths and limitations

Our study predicts future transmissions to assess whether the Scottish and Irish Governments are on track to meet the UNAIDS 2030 elimination goal. We break the population into four key population groups which captures variation in intervention uptakes by group. Population group-level estimates help identify inequities in transmission rates and allow for more targeted prevention intervention strategies.

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 within each country. We do not assess the impact of changes in migration and HIV acquired abroad.

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

Scotland and Ireland have already achieved the UNAIDS HIV transmission elimination targets for their total populations, and trajectories for new transmissions are expected to continue to decline over time. When disaggregated by population group, both countries are meeting the population-specific targets for heterosexual men, women, and people who inject drugs. However, neither country is on track to achieve the target for GBMSM by 2030. Our model indicates that moderate increases in intervention levels among GBMSM could accelerate progress and enable Scotland to achieve the target by 2030 and Ireland by 2035.

Our findings highlight the effectiveness of sustained HIV prevention efforts in Scotland and Ireland; however, further expansion of prevention initiatives for GBMSM is critical to ensure transmission elimination is achieved equitably across all groups.

In addition, while a few new transmissions are occurring within both countries, overall diagnoses remain higher due to acquisitions outside the country, reinforcing the need for continued investment in a combination of prevention strategies alongside long-term support for affected individuals.

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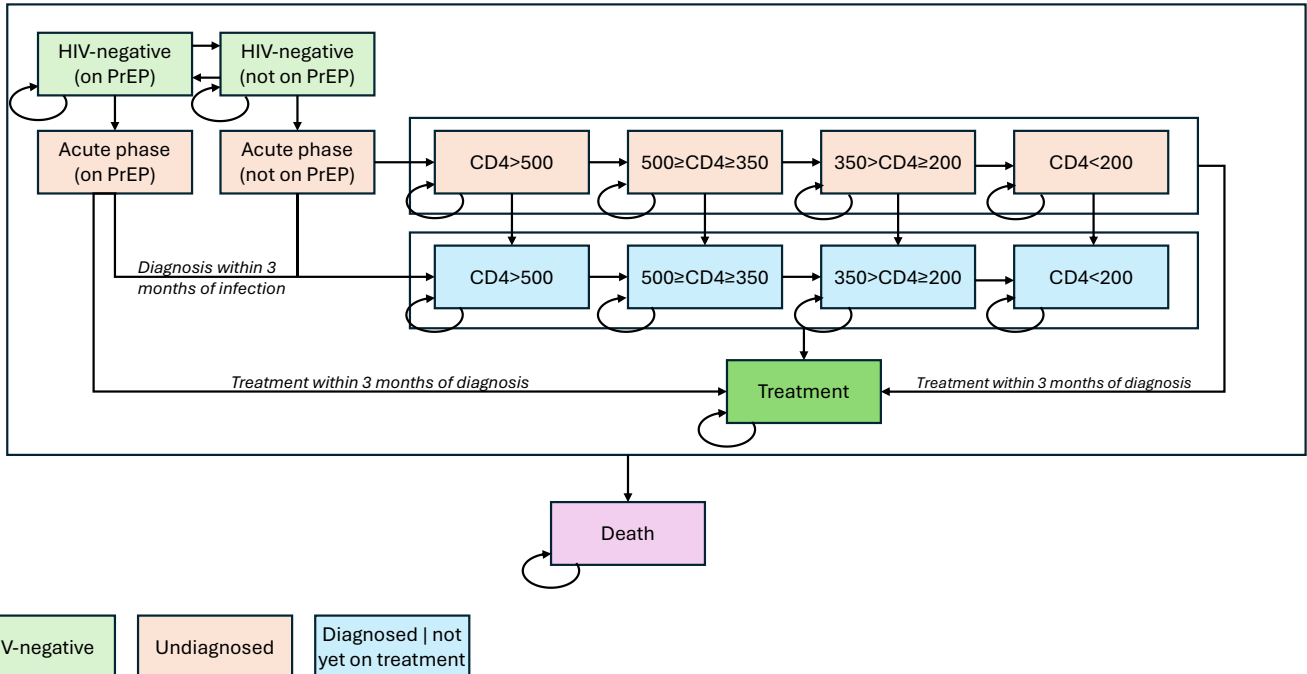
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7. Appendices

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	Proportion of HIV-negative population with PrEP need starting PrEP annually	The annual percentage of 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.	<ul style="list-style-type: none"> Based on PHS and HSE numbers on those accessing PrEP (13,15). PrEP need proportion within each population group was informed by England data from Huntington et al (2025) (17). Model also incorporates an annual PrEP discontinuation rate among PrEP users (16,21,22), as well as PrEP efficacy by population group, adjusted for adherence (23–25).
2. Reduce the number of people living with HIV who are undiagnosed	Proportion testing annually	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.	<ul style="list-style-type: none"> Testing in Scotland includes testing at sexual health clinics, antenatal screening, testing at hospitals, testing at GPs, and testing reported from the Needle Exchange Surveillance Initiative (NESI) (13,26,27). Testing in Ireland includes laboratory tests (including antenatal screening), HSE home tests, MPOWER self-testing and community testing (14,28).
	Proportion of individuals diagnosed 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.	<ul style="list-style-type: none"> Recent infections reported by the PHS and HSE (13,29)
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.	<ul style="list-style-type: none"> UKHSA HIV Action Plan: Monitoring and Evaluation Framework 2024 Report(18). England data used as a proxy (no Scotland- or Ireland-specific data available).

<p>Proportion of diagnosed individuals starting treatment within six months of diagnosis</p>	<p>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.</p>	<ul style="list-style-type: none"> • Croxford et al (2021) (19). England data used as a proxy (no Scotland- or Ireland-specific data available).
<p>Proportion of individuals who have initiated treatment and are virologically suppressed (TasP)</p>	<p>The proportion of individuals on treatment who achieve sustained virological suppression, making them unable to transmit HIV (Undetectable = Untransmittable, or U=U).</p>	<ul style="list-style-type: none"> • Percentage with viral suppression from PHS and HSE (13,30).

Appendix 3: Inputs and methods for increased intervention scenario

Table A2 includes the input values for the ‘moderate increase in interventions’ scenario for GBMSM in both countries. The increased intervention scenario was defined as a substantial, yet realistic, increase from their current scenario. The values were informed by the relative increases between the current and ‘moderate increase intervention’ scenarios from our England analyses for comparability (31).

Using testing as an example, 11% of GBMSM individuals (excludes those diagnosed with HIV) testing in Scotland in 2023 (**Table 2**) equates to 9,136 people testing. In the ‘moderate increases in intervention’ scenario, a proportion of 17% implies 13,880 are testing annually by 2029 (an additional 4,744).

For proportion starting PrEP annually, 7.1% in GBMSM Scotland (**Table 2**) reflects 2,403 individuals accessing PrEP in 2023. Increasing this to 14% in the increased intervention scenario, assumes there are 4,714 accessing PrEP (2,311 additional). In terms of PrEP need, this represents 16% of GBMSM with a PrEP need accessing PrEP in 2023, increasing to 32% by 2029.

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

TABLE A2: Intervention indicators for the GBMSM ‘moderate increases in intervention’ scenario in Scotland and Ireland

	Scotland	Ireland
Proportion of HIV-negative population with PrEP need starting PrEP annually*	14.0%	16.0%
Proportion diagnosed within 3 months of transmission	35.0%	20.0%
Proportion testing annually	17.0%	45.0%
Proportion starting treatment within 3 months of diagnosis	88.0%	88.0%
Proportion starting treatment within 6 months of diagnosis	98.0%	98.0%
Proportion of people on treatment who are virologically suppressed	98.2%	99.0%

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