HIV in MSM in the UK: Prevention effects of ART in perspective

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Transmission of HIV in MSM in Europe remains at high levels.

Greater rates of HIV testing and earlier ART initiation are proposed as means to reduce HIV incidence, by decreasing the number of MSM living with unsuppressed HIV viral load.

In the UK, ~60% of HIV+ MSM (diagnosed and undiagnosed) are estimated to have viral suppression on ART.
Questions to be addressed

Taking the specific example of the HIV epidemic in MSM in the UK, and considering potential future increases in testing and changes in ART initiation threshold:

- What proportion of people with HIV should have viral suppression in order to reduce incidence below 1 per 1000 person years? (i.e. ~ 600 new infections per year)
- Will policies to increase testing be cost-effective?
HIV Synthesis Model

- Individual based stochastic simulation model
- Each time model program is run it simulates a dataset of the experience of the entire adult population of a country
- Variables in simulated data set:-

<table>
<thead>
<tr>
<th>Whole adult MSM population</th>
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<tbody>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Condomless anal sex</td>
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<tr>
<td>Current STI</td>
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<table>
<thead>
<tr>
<th>HIV positive MSM</th>
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<tbody>
<tr>
<td>Time from infection</td>
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<tr>
<td>CD4 count</td>
</tr>
<tr>
<td>Viral load</td>
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<tr>
<td>Specific drugs</td>
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<tr>
<td>Currently on ART</td>
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<tr>
<td>Current adherence level</td>
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<tr>
<td>Drug resistance mutations ++</td>
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Model-based analysis of the UK epidemic in MSM

Number of men diagnosed with HIV per year

Number living with HIV (age 15-60)

Number of deaths per year

Number seen for care per year

Proportion of men tested for HIV in past 5 years

Median CD4 count at diagnosis

Proportion diagnosed < 6 months from infection

Number on ART

Proportion of men having condomless anal sex in past year
Potential increases in testing: Probability of diagnosis by time from infection  For those infected after 2015

![Graph showing probability of having been diagnosed over time for different test rates.](image-url)
Potential increases in testing: Number of tests done per year

Number

% men tested in each year

- Base test rate: 19%
- Test rate +: 38%
- Test rate ++: 65%
Potential increases in testing and change in ART initiation criteria: Initiation of ART by time from infection

For those infected after 2015

Probability of having started ART

Years from infection

base test rate  ART at 350
test rate +   ART at 350
test rate ++  ART at 350
base test rate  ART at diagnosis
test rate +   ART at diagnosis
test rate ++  ART at diagnosis
Proportion of all HIV positive people with VL < 500

Proportion with VL < 500

- **base test rate**
- **test rate +**
- **test rate ++**
- **ART at 350**
- **ART at diagnosis**
HIV incidence

Number of new infections per year (95% CI)

<table>
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<tr>
<th></th>
<th>ART at 350</th>
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<th>ART at diagnosis</th>
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<tbody>
<tr>
<td>base test rate</td>
<td>ART at 350</td>
<td>base test rate</td>
<td>ART at diagnosis</td>
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<td>test rate +</td>
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% reduction in 2030

- 32% ↓
- 32% ↓
- 54% ↓
- 64% ↓
- 80% ↓

95% CI given for two lines to illustrate uncertainty over mean effect
Number of men on ART

![Graph showing the number of men on ART from 2015 to 2030. The graph includes lines representing different test rates and ART at diagnosis scenarios.]

- **base test rate**
- **test rate +**
- **test rate ++**
- **ART at 350**
- **ART at diagnosis**
Mean number of new infections per year according to proportion of people with HIV who have VL < 500

Incidence (per 1000 person years)

We would need an increase in the proportion of all men with VL suppressed from ~ 60% to 90% to see a reduction in incidence to < 1 per 1000 person years.

95% confidence intervals are within squares.
Proportion of all MSM aged 15-45 with condomless anal sex partner in past year

Change in condomless sex (CLS)

- no change
- condomless sex
- condomless sex +
Predicted effect of changes in condomless sex on HIV incidence

Incidence of HIV (95% CI) (number of new infections)

Graph showing the predicted incidence of HIV with and without condomless sex, comparing no change in condomless sex versus condomless sex with ART at 350.
Effect of change in condomless sex on HIV incidence according to change in condomless sex.

Incidence of HIV (95% CI) (number of new infections)

- condomless sex +
- no change condomless sex

Test rate ++ ART at diagnosis
Cost effectiveness analysis

- A certain amount of resource spent on an effective intervention is buying (healthy) life years
- Cost effectiveness is about allocating resources such that any resources available for health care are used to buy the maximum number of (healthy) life years.
- Quality adjusted life year (QALY) = 1 year of healthy life
Increment in (discounted) QALYs

Incremental cost effectiveness ratio (ICER) - concept

ICER = £50 m / 50,000 = £1000 per QALY gained

ICER = £1000 means that with the introduction of the intervention you are buying (healthy) life years for £1000 each.
Incremental cost effectiveness ratio (ICER) - concept

**Increment in (discounted) cost (£million)**

- **New interventions**

**Increment in (discounted) QALYs**

\[ \text{ICER} = \frac{\text{£150 m}}{25,000} = \text{£6000 per QALY gained} \]

**ICER = £1000** means that with the introduction of the intervention you are buying (healthy) life years for £1000 each.
How low does the cost of the healthy life years produced (the ICER) need to be?

Consider ICER associated with every possible activity that results in health benefit.

Implement them from cheapest up, until we have exhausted the health budget.

Current UK working threshold £20,000 - £30,000

For fixed or declining health budget, adopting any new intervention that incurs costs means displacing other interventions.
Total cost of HIV care (discounted at 3.5% per year)
Difference in QALYs lived per year in entire MSM population compared with base test rate, ART at 350
Increment in (discounted) cost (£million over 15 years)

Increment in (discounted) QALYs over 15 years compared with base test rate, ART at 350

- Test rate ++ ART at 350
  - ICER ~ £32,000 per QALY
- Test rate + ART at diagnosis
- Test rate ++ ART at diagnosis
  - ICER ~ £20,000 per QALY

NB: does not include cost of the intervention required to increase uptake of testing
Incremental costs and QALYs over 15 years compared with base test rate, ART at 350

Increment in (discounted) cost (£million over 15 years)

Incremental costs and QALYs over 15 years compared with base test rate, ART at 350:
- Test rate ++
  - ART at 350
  - ICER = £20,077

- Test rate +
  - ART at 350
  - ICER = £12,335

- Base test rate ART at diagnosis

ICER remains < £20,000 with £8m per year spent on campaigns / community mobilisation.

Generic drug prices.
Infections from men in primary infection

Assume men with large numbers of condomless sex partners are not differentially resistant to testing or taking ART

ART coverage in MSM visiting from abroad who have sex in the UK

PrEP has been introduced in model (Cambiano et al presented at BASHH)
What proportion of people with HIV should have viral suppression in order to reduce incidence below 1 per 1000 person years?

Around 90%. To achieve this requires:
- around 90% of people are diagnosed within 1 year of infection (currently < 50%),
- linkage, adherence and retention remain high
- ART is initiated at diagnosis (trial results awaited).
- levels of condomless sex do not increase significantly.
Will policies to increase testing in UK MSM be cost-effective?

*Considering current drug prices, over a time horizon of 15 years or more, increased testing is likely to be cost effective.*

*If antiretroviral drug costs are substantially reduced with introduction of generics then increased testing is cost effective over a much shorter time horizon, and highly cost-effective if ART is initiated at diagnosis.*
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Simon Collins  iBase

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