Potential Impact on HIV Incidence of Increasing Viral Suppression among HIV-positive MSM in Baltimore: Mathematical Modelling for HPTN 078

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Conflicts of Interest

• In the past 2 years I have been an employee of: Imperial College London, London School of Hygiene and Tropical Medicine
• In the past 2 years I have received research support (grants) from: NIH
• I have no conflicts of interest to declare
Introduction: HIV epidemic among MSM in Baltimore

- HIV prevalence: 30% in 2014 (NHBS*)
- Virally suppressed: 37% of diagnosed in 2013 (Maryland Health Dept)
- PrEP use: 2.4% in 2014 (NHBS)

*CDC National HIV Behavioral Surveillance
Introduction: HPTN 078

- HPTN 078: Enhancing Recruitment, Linkage to Care and Treatment for HIV-Infected Men Who Have Sex with Men (MSM) in the United States
- Recruiting MSM at 4 sites including Baltimore
- Mathematical modelling is being used:
  1. Before/during the trial - to estimate levels of viral suppression that must be reached to attain HIV incidence reduction targets
  2. After the trial - to estimate reduction in HIV incidence achieved by trial interventions
Research Questions

1. How much does the level of viral suppression need to be increased by to reduce HIV incidence among Baltimore MSM by 10, 20, 30 or 50% after 2, 5 and 10 years?

2. By how much could HIV incidence be reduced if US National HIV/AIDS strategy (NHAS) targets met by 2020:
   – 90% diagnosed
   – 90% of diagnosed retained in care
   – 80% of diagnosed virally suppressed
Methods: Model

- Deterministic compartmental model
- Sexual HIV transmission
- HIV disease progression: CD4 decline stratified by viral load
- Risk groups: age (<25, 25+) x race (black, white)
- Care cascade:

  Never testing, undiagnosed → Testing, undiagnosed → Diagnosed → In care → Achieving suppression

- Adherent

- Non-adherent

- Dropped out

- On ART
## Model Inputs (Parameters)

<table>
<thead>
<tr>
<th>Domain</th>
<th>Examples</th>
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  - HIV prevalence trends - by age and race (NHBS)
  - MSM demography - age and race (NHBS, census)
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  – Age distribution of the MSM population
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Differences explored in sensitivity analysis
HIV prevalence by age and race

18-24 yr old black MSM

25+ yr old white MSM
Analysis – Meeting Incidence Reduction Targets

Overall HIV incidence

% of HIV-infected men virally suppressed
Analysis – Meeting Incidence Reduction Targets

Overall HIV incidence

- Baseline
- 20% reduction in 2 years

% of HIV-infected men virally suppressed

- Baseline
- 2 years
Results: Required Increase in Viral Suppression Level

Target: reduce HIV incidence by 20%

- **Baseline:** 44%
- **+12% (10-15%)** at 2 yrs: 57%
- **+10% (8-12%)** at 5 yrs: 57%
- **+8% (7-10%)** at 10 yrs: 58%

Time over which target met:
- 2 yrs: +12% (10-15%)
- 5 yrs: +10% (8-12%)
- 10 yrs: +8% (7-10%)
Results: Required Increase in Viral Suppression Level

Target: reduce HIV incidence by 20%

- 2 yrs: 44% (Baseline) vs. 57% (20% incidence reduction)
- 5 yrs: 47% vs. 57%
- 10 yrs: 50% vs. 58%

In terms of incidence reduction:
- 2 yrs: 12% (10-15%)
- 5 yrs: 10% (8-12%)
- 10 yrs: 8% (7-10%)
Target: reduce HIV incidence by 20%
Target: reduce HIV incidence by 10, 20, 30, 50%

- To reduce HIV incidence by 50% after 5 years, need to:
  - Increase viral suppression by 26 percentage points
  - Achieve 73% virally suppressed after 5 years

- Not possible to reach 50% incidence reduction target after 2 years
Results: Sensitivity Analysis

To reduce incidence 20% - by demography scenario

NHBS data
census data

Time over which target met

increase in % virally suppressed

0 2 4 6 8 10 12 14 16

2 yrs 5 yrs 10 yrs
Results: Sensitivity Analysis

To reduce incidence 20% - by demography scenario

- NHBS data
- Census data

To reduce incidence 20% - by care cascade data source

- NHBS data
- Health department data
If targets all met in 2020:

- 90% diagnosed
- 90% of diagnosed retained in care
- 80% of diagnosed virally suppressed

i.e. very similar effect to reaching 50% incidence reduction target after 5 years
Discussion

- Large increases in viral suppression are needed to achieve moderate reductions in HIV incidence among Baltimore MSM, especially short-term.
- Achieving NHAS targets on diagnosis, retention in care and viral suppression by 2020 is projected to reduce HIV incidence in 2020 by ~50%.
- Results are robust to uncertainty in MSM demography but somewhat influenced by uncertainty in current levels of viral suppression.
- In future modelling, the impact of increased PrEP coverage should also be considered.
ACKNOWLEDGEMENTS

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