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HPTN MODELLING CENTRE
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Imperial College London

Modelling HIV Transmission and Treatment for US MSM to Estimate the Impact of HPTN 078 on HIV Incidence

Kate Mitchell, PhD
Imperial College London
London, UK
14th June 2016

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Introduction: HPTN 078

Enhancing Recruitment, Linkage to Care and Treatment for HIV-Infected Men Who Have Sex with Men (MSM) in the United States

Protocol chair: Chris Beyrer

Protocol co-chair: Robert Remien

Trial sites: Atlanta GA, Baltimore ML, Birmingham AL, Boston MA

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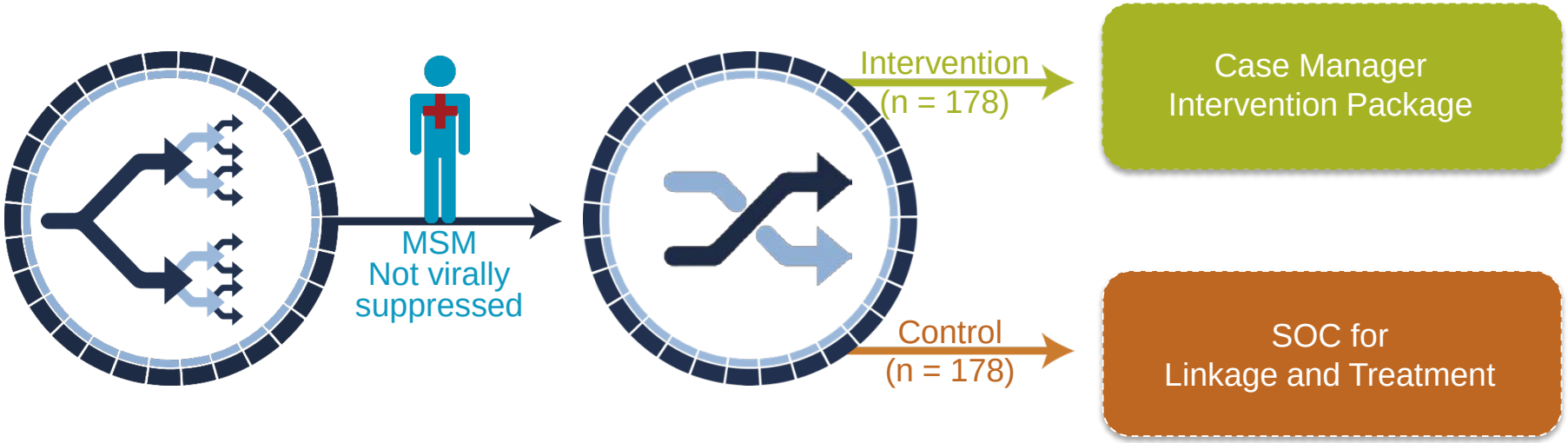
Enhancing Recruitment, Linkage to Care and Treatment for HIV-Infected Men Who Have Sex with Men (MSM) in the United States



Deep-Chain Respondent Driven Sampling

Individual Randomization

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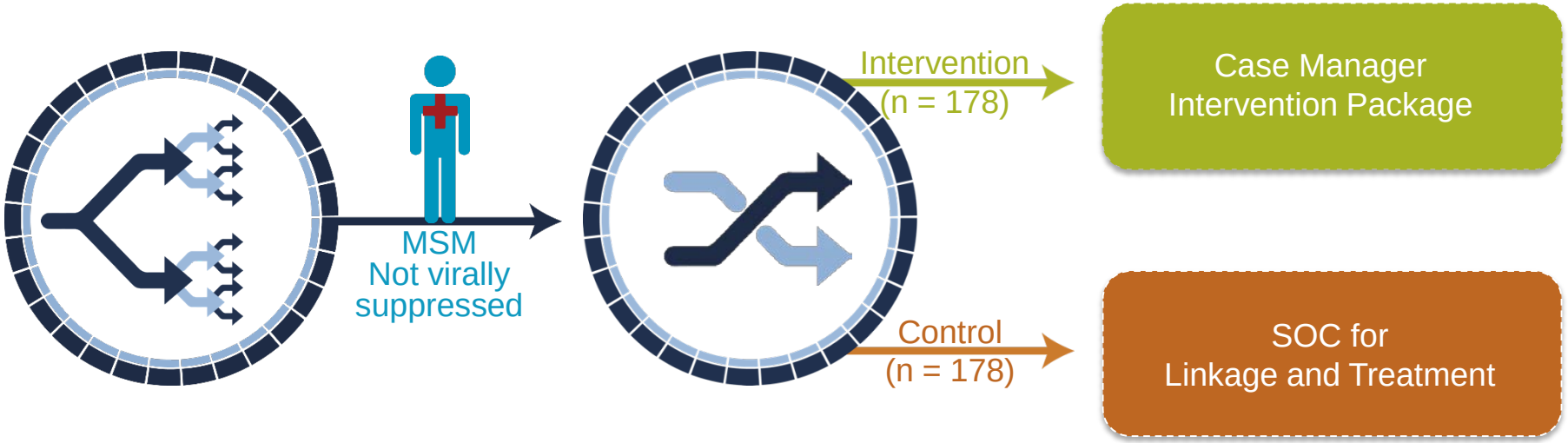

Deep-Chain Respondent Driven Sampling

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Modelling: predict population-level HIV incidence reduction

HPTN 078: Modelling Centre involvement

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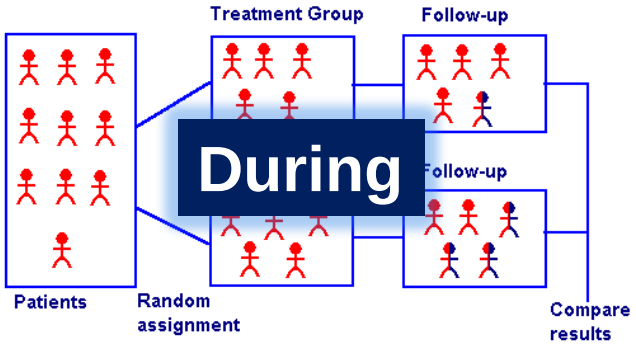
Before



During

After

Protocol design
Questionnaires

Model development
Data analysis
Model calibration

Initial analyses

Final impact analysis

HPTN 078: Modelling Centre involvement

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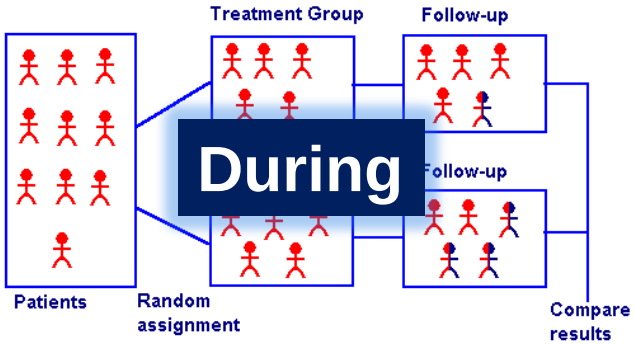
Before



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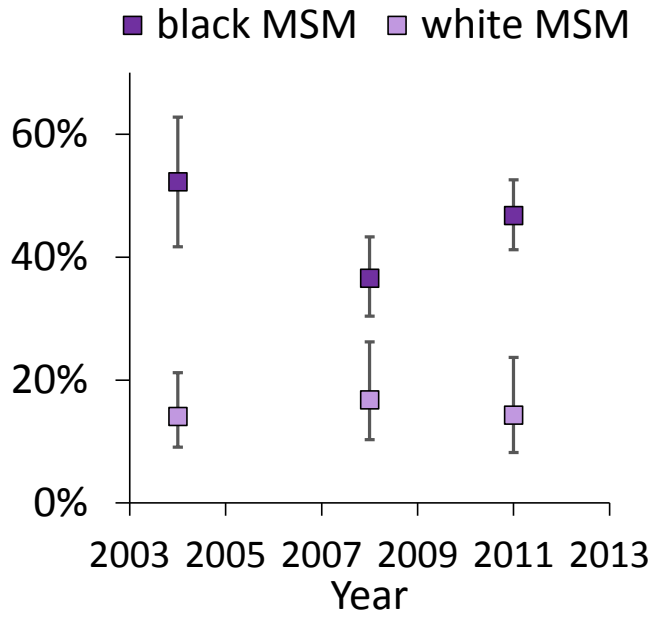
Introduction: Baltimore

- HIV prevalence among MSM: 41% 2011, 31% 2014 (NHBS)
- Higher HIV prevalence among black MSM than white MSM
- Levels of viral suppression among MSM: 24% 2011, 31% 2013 (Maryland Health Dept)

HIV prevalence by race Baltimore MSM



NHBS data

Model development and calibration

Stages:

- Model design, coding and development
- Finding model inputs (parameters) and calibration data
  - Review of data
  - Data analysis
- Calibration of model to data

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Model structure

- HIV disease progression: CD4 decline by viral load
- Risk groups: age (<25, 25+) x race (black, white)

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Model structure

- HIV disease progression: CD4 decline by viral load
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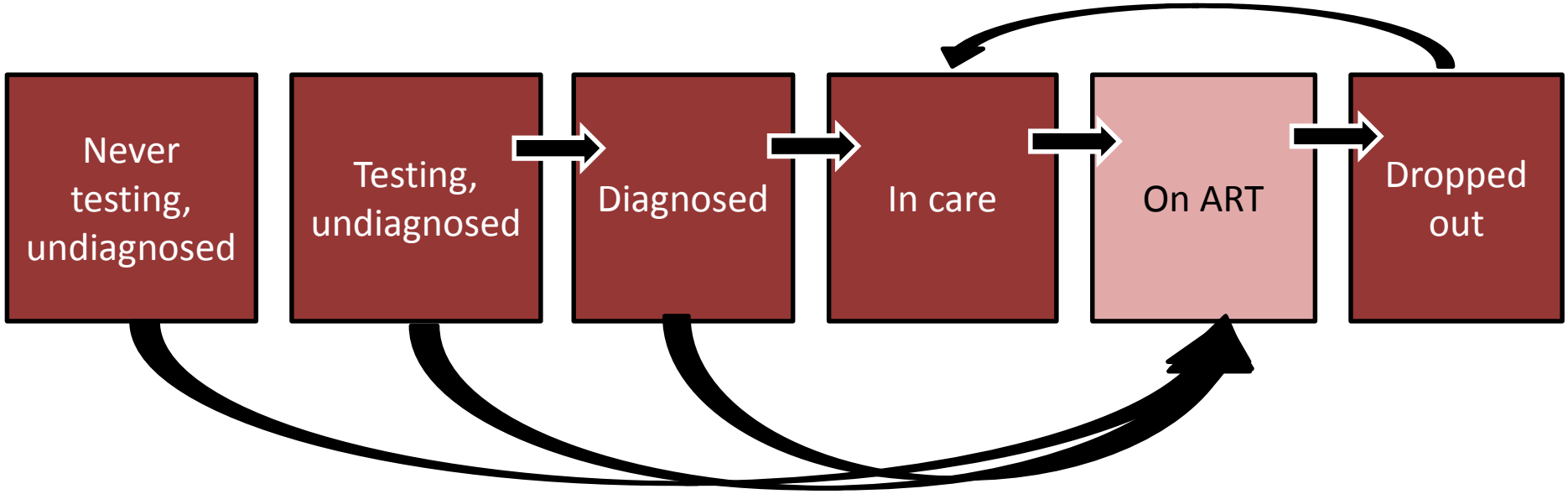
- Care cascade:



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Model inputs (parameters)

Domain	Examples	Data source
Disease progression	• Initial CD4 and viral load distribution • HIV-related mortality • CD4 progression rates	Published studies: cohorts in North America and Europe
Infection probabilities	• Per-sex-act transmission probability • Relative infectiousness different disease stages	Published studies: meta analyses, study of Australian MSM
Intervention efficacy	• Reduction in HIV transmission risk: condoms, ART	Published studies: clinical trials, meta-analyses
Sexual risk behaviour	• Number and type of partners • Condom use • Age and race of partners	NHBS surveillance data, *078 trial*
Intervention behaviour	• HIV testing • Linkage/dropout from HIV care • ART linkage and dropout	NHBS surveillance data, clinical cohorts, state health department data, *078 trial*

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Model calibration (fitting)

- Ensure that model outputs can reproduce observed data:
  - HIV prevalence trends - by age and race (NHBS)
  - MSM demography (NHBS, census)
    - Age and race
  - Viral suppression level (NHBS, Maryland Health Dept, CDC national estimates)

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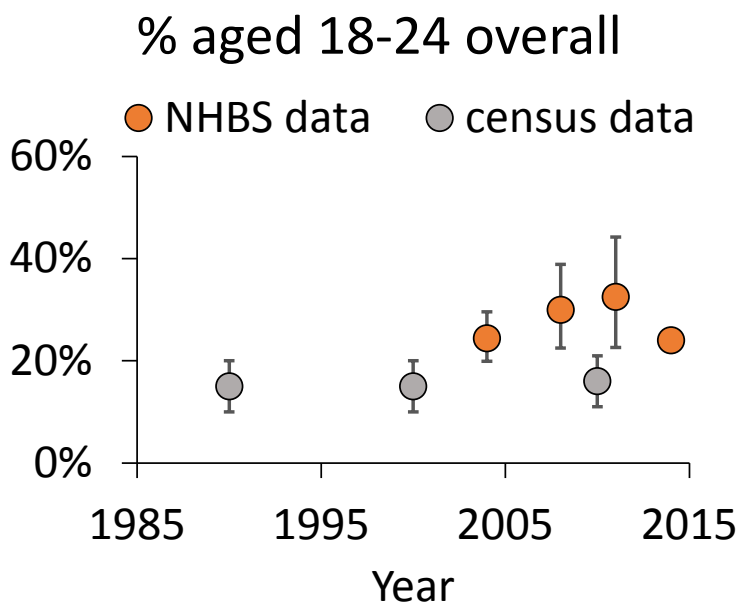
Model calibration: challenges

Uncertainty around MSM population demography



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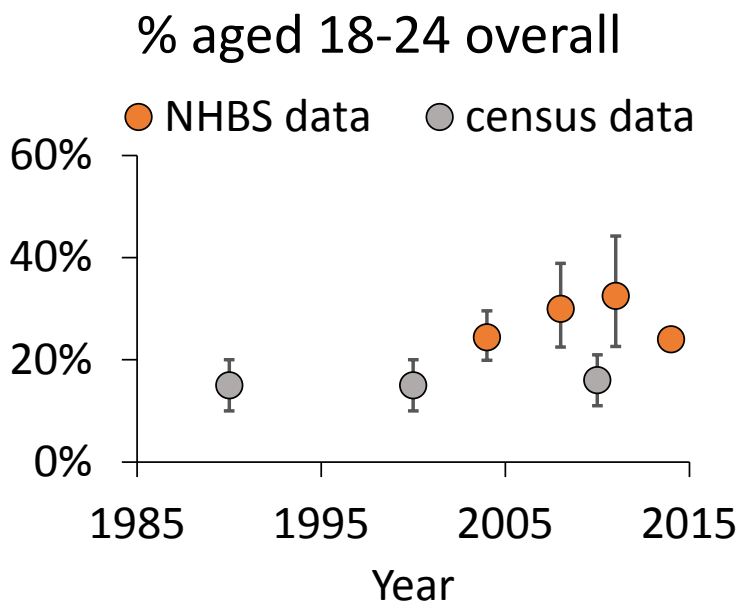

Dealt with: fitted to 2 different scenarios

Model calibration: challenges

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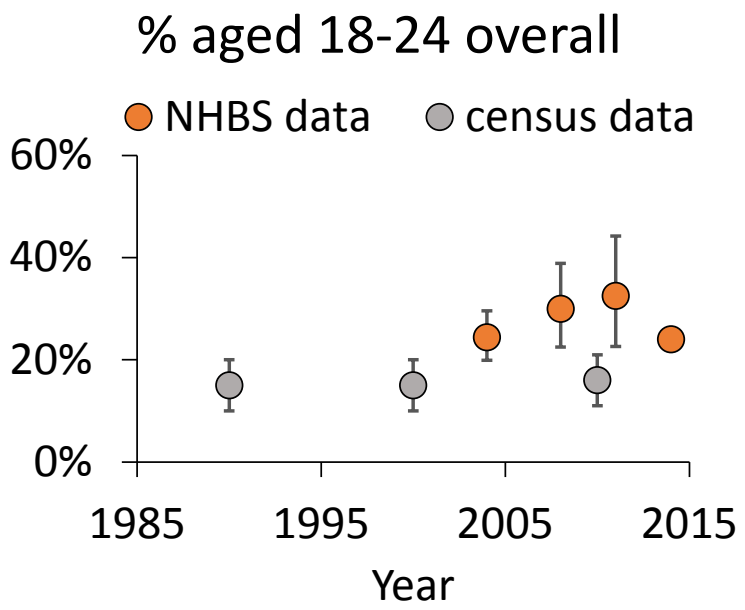

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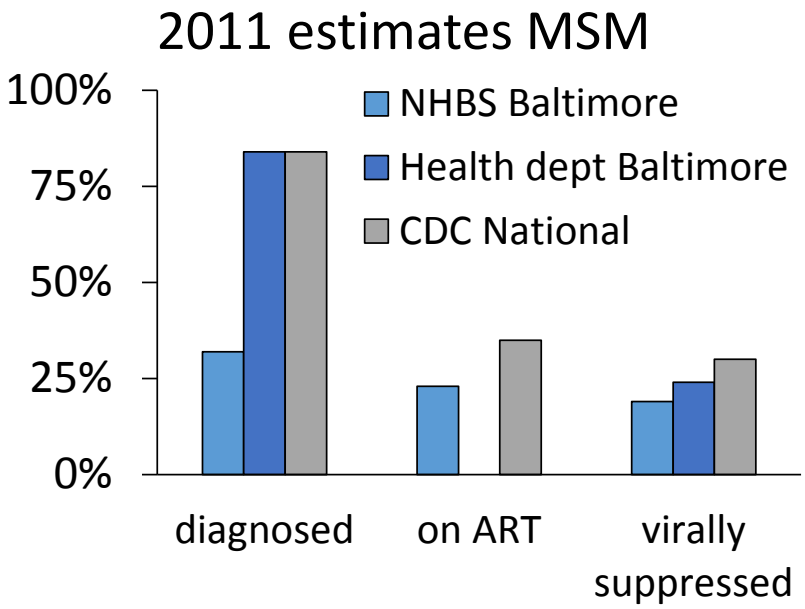
Uncertainty in current level of viral suppression



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Model calibration: challenges

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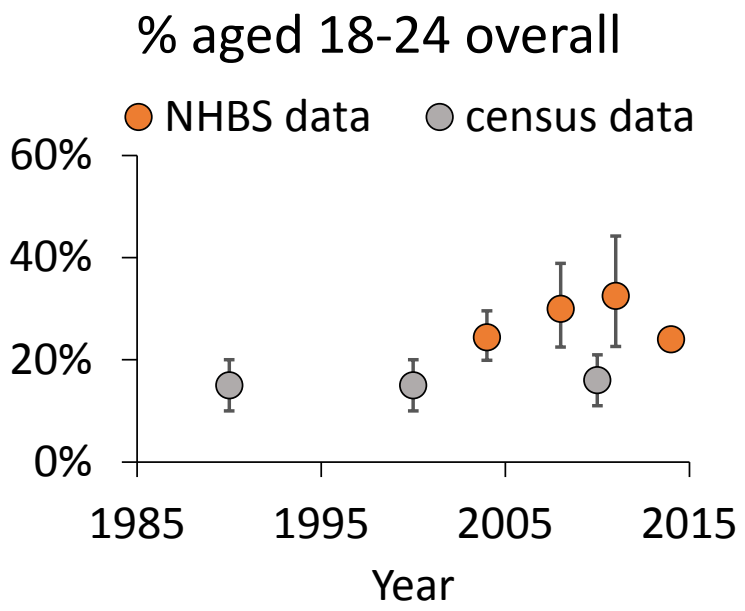

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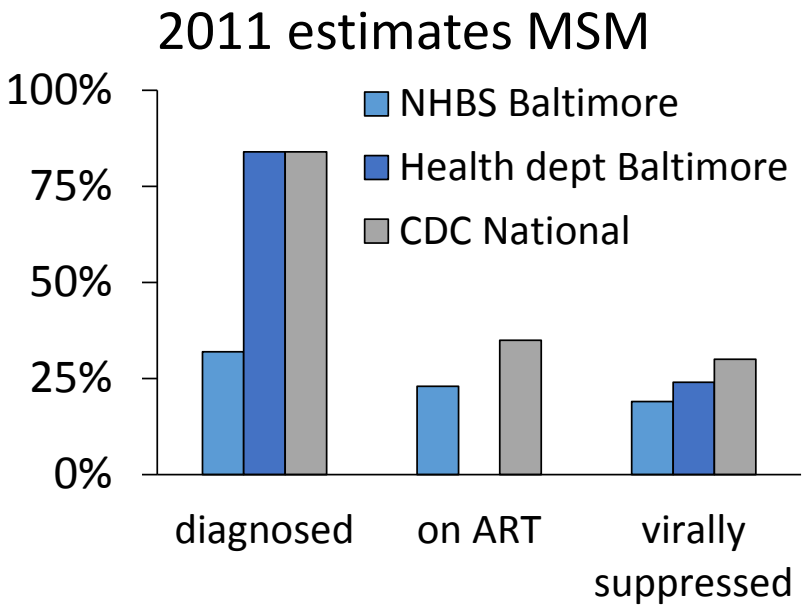
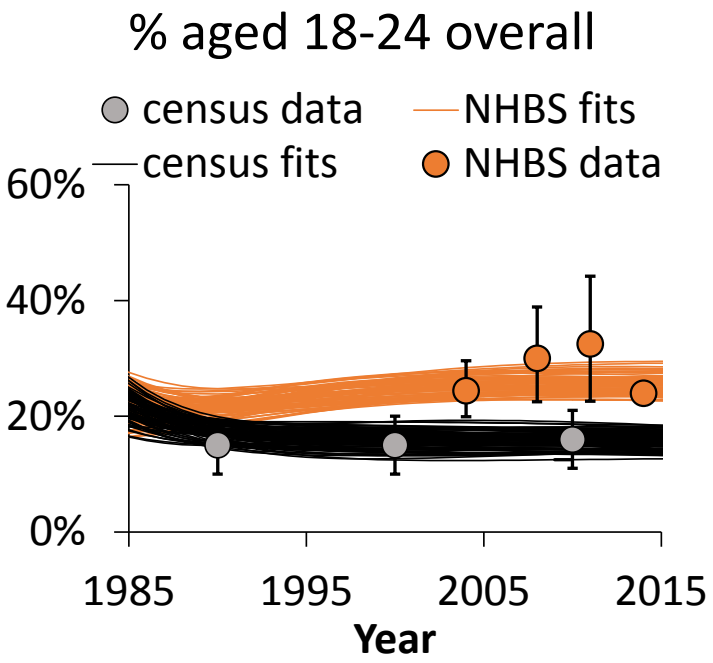


Dealt with: wide uncertainty range

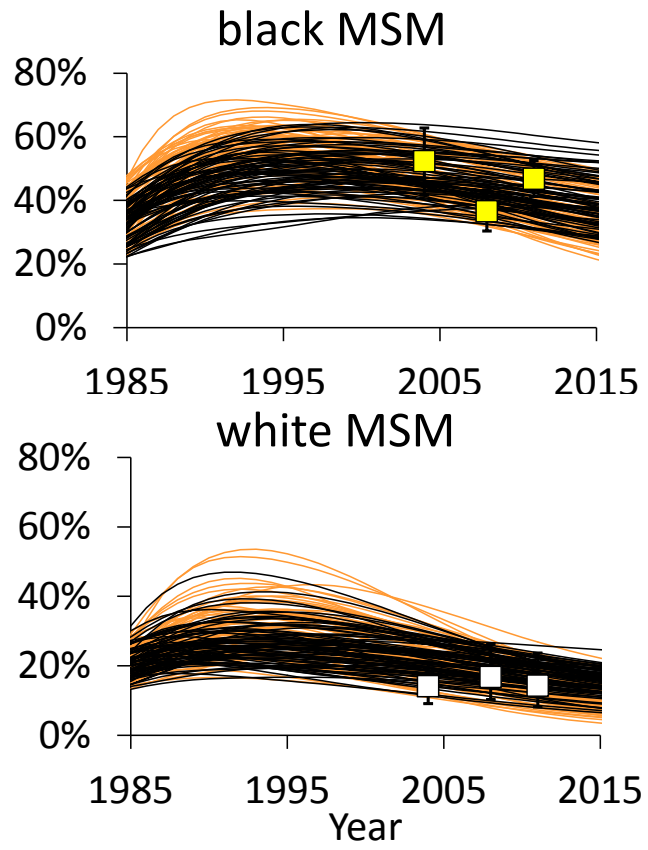
Model calibration (fitting)

Select combinations of inputs giving model outputs reproducing demography, HIV prevalence and viral suppression data

Age



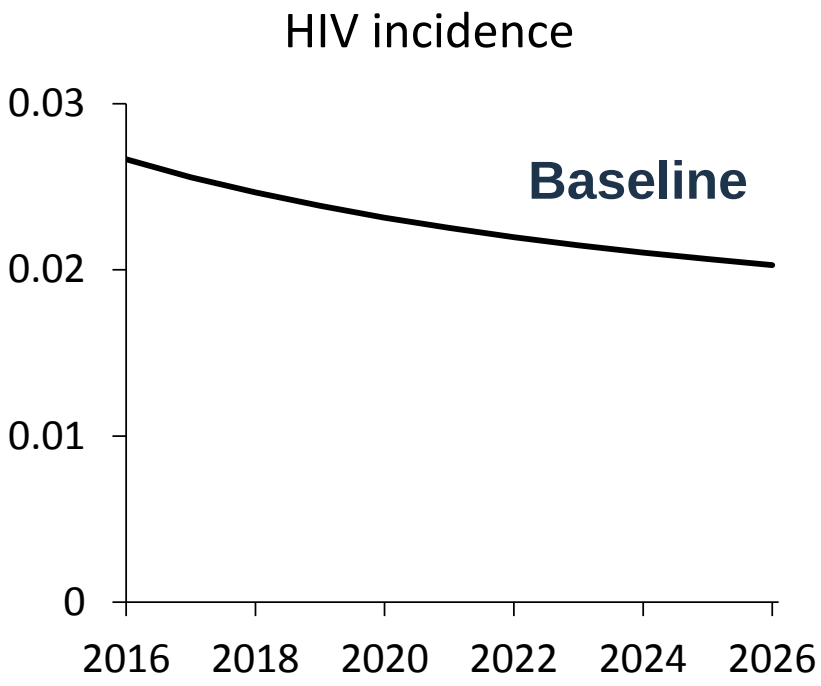
HIV prevalence

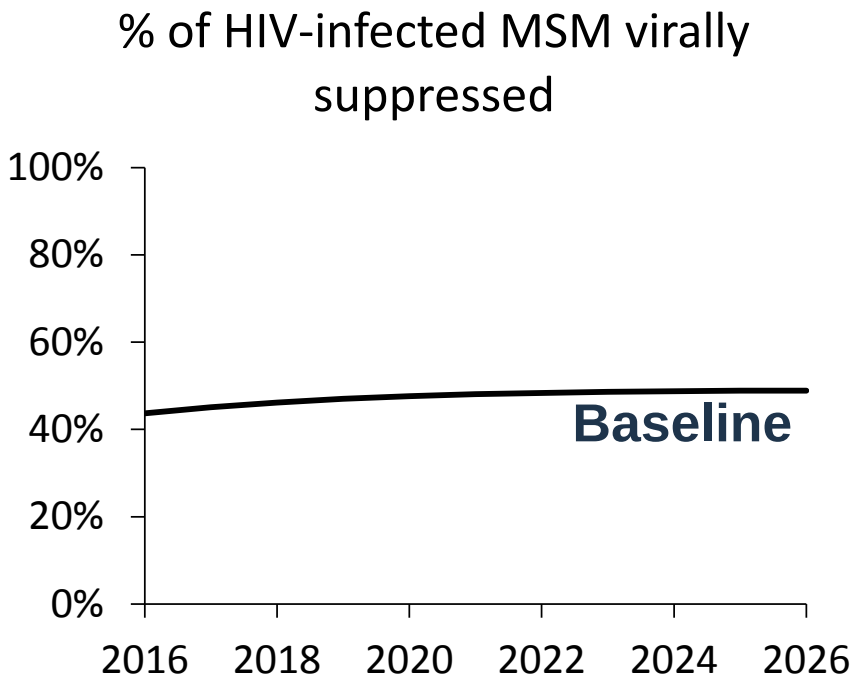


Initial analysis

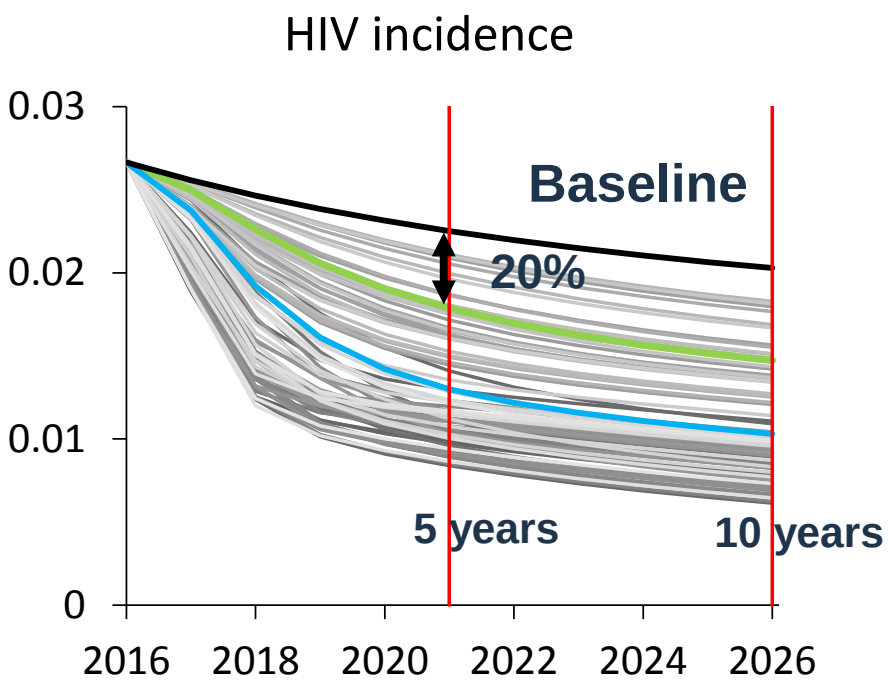
What level of viral suppression must be reached to reduce HIV incidence among Baltimore MSM by 20% or 50% after 5 and 10 years?

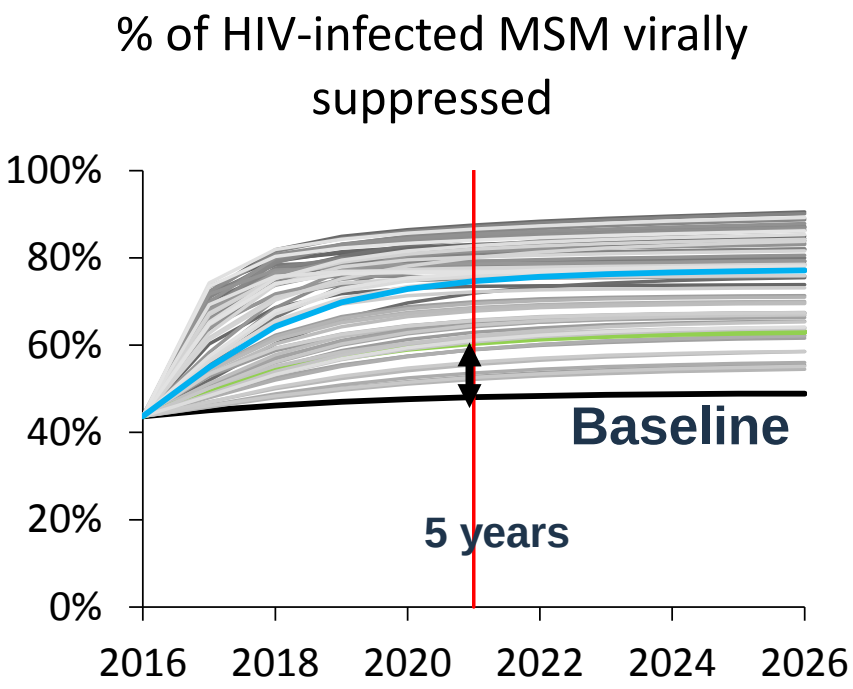
Initial analysis – meeting incidence reduction targets





Initial analysis – meeting incidence reduction targets





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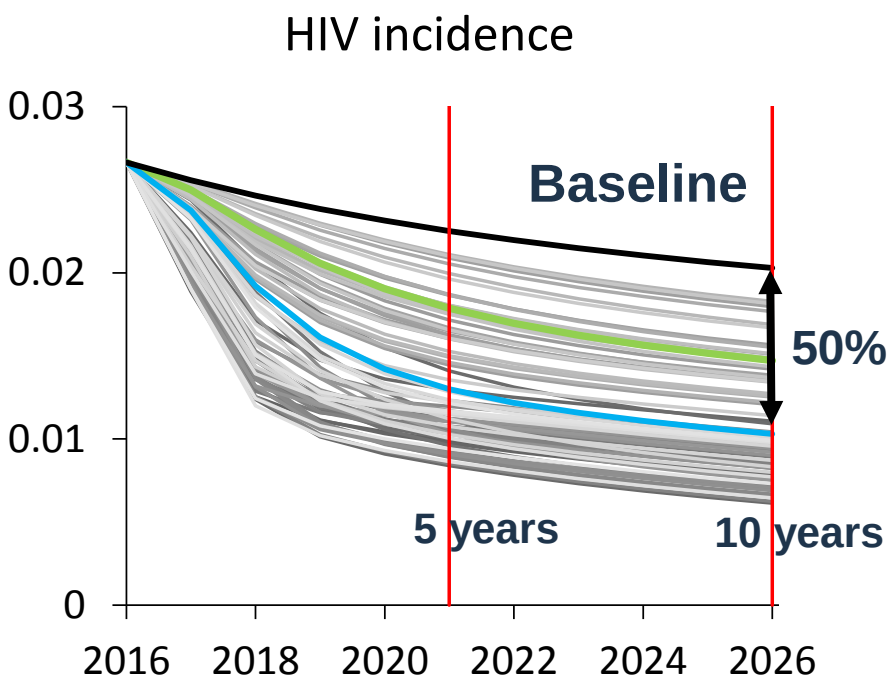
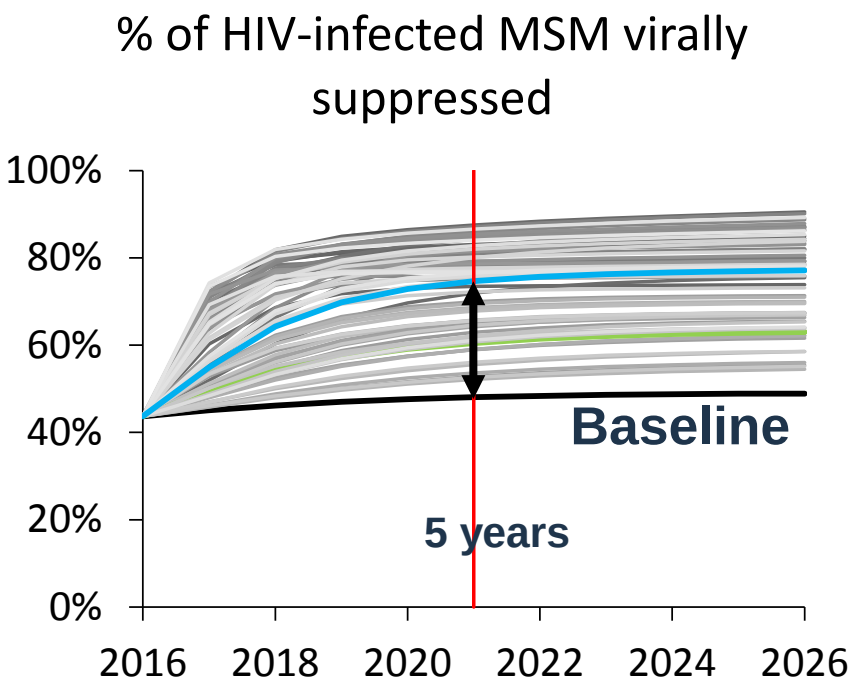
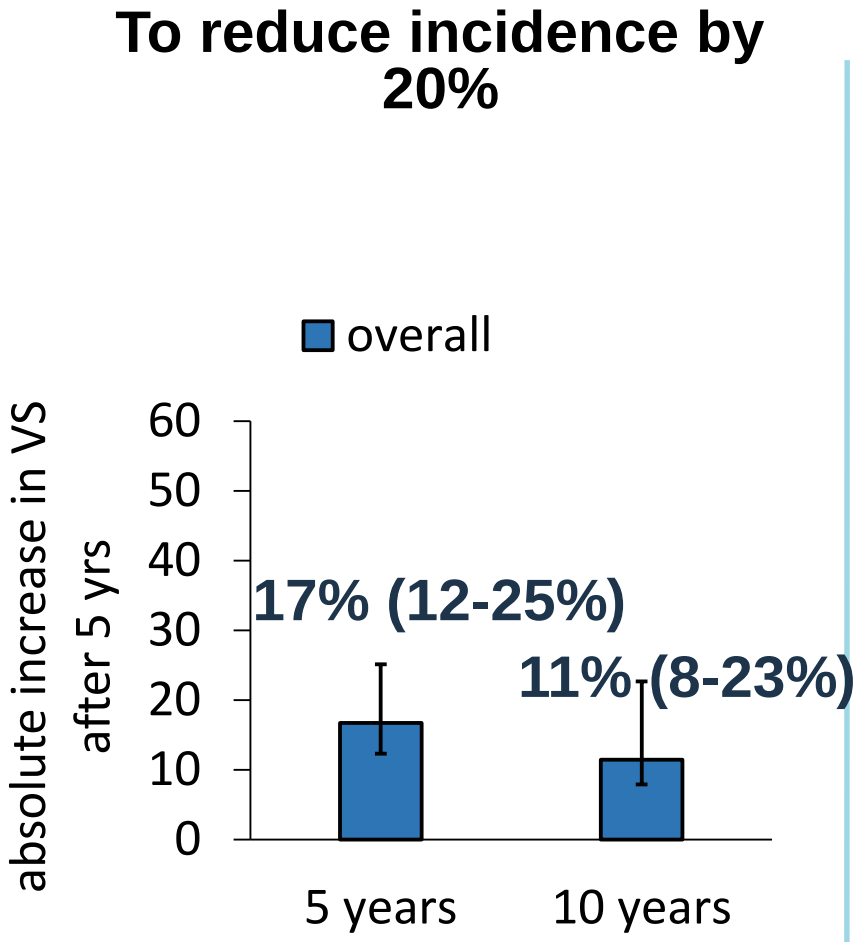




Preliminary results: required increase in viral suppression level



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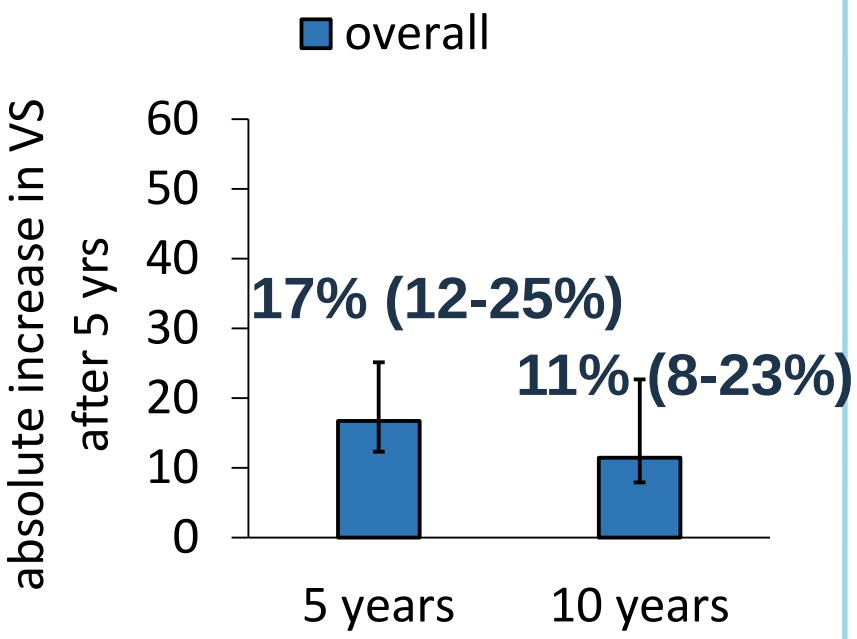
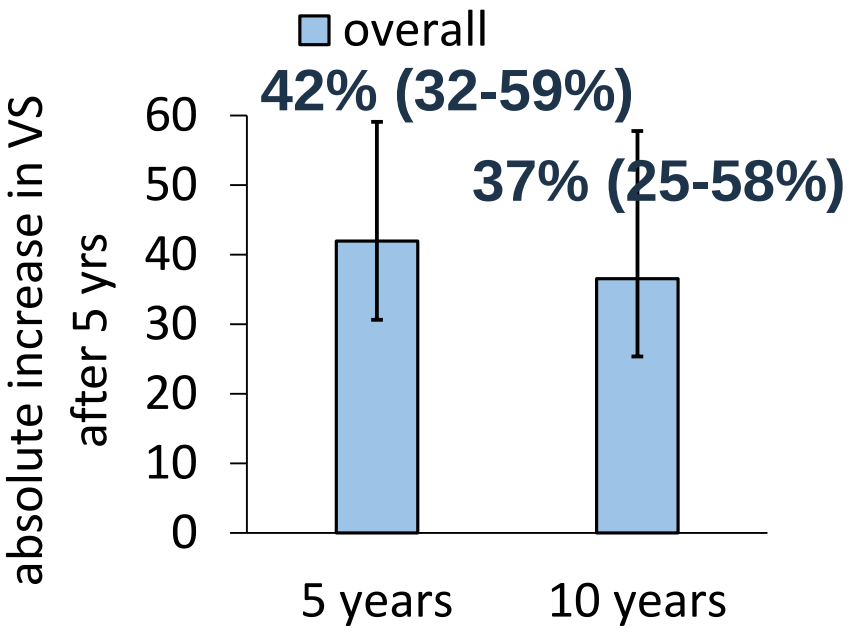
Preliminary results: required increase in viral suppression level

To reduce incidence by 20%



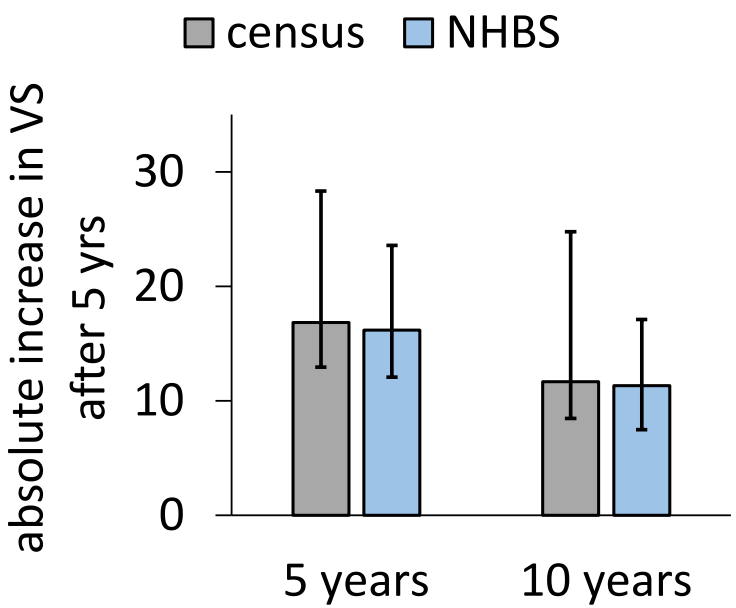
To reduce incidence by 50%

Could not be reached for 10% of fits



Preliminary results: required increase in viral suppression level

To reduce incidence 20%– by demography



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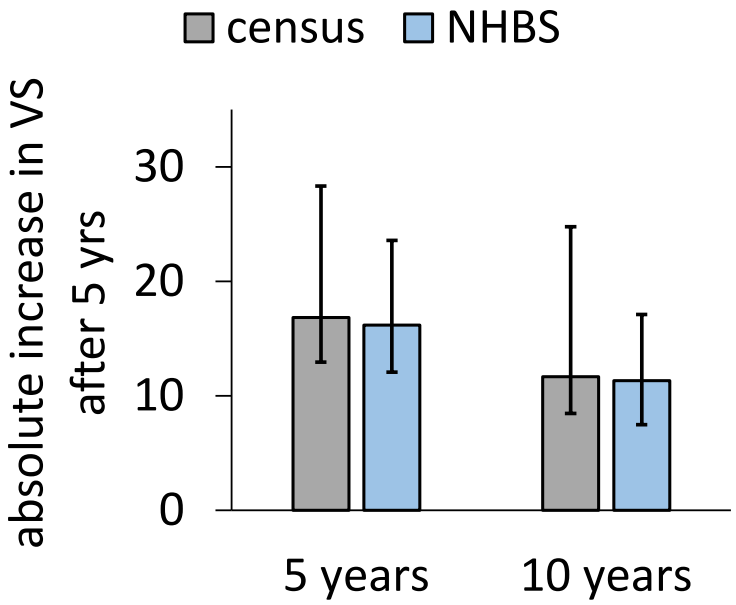
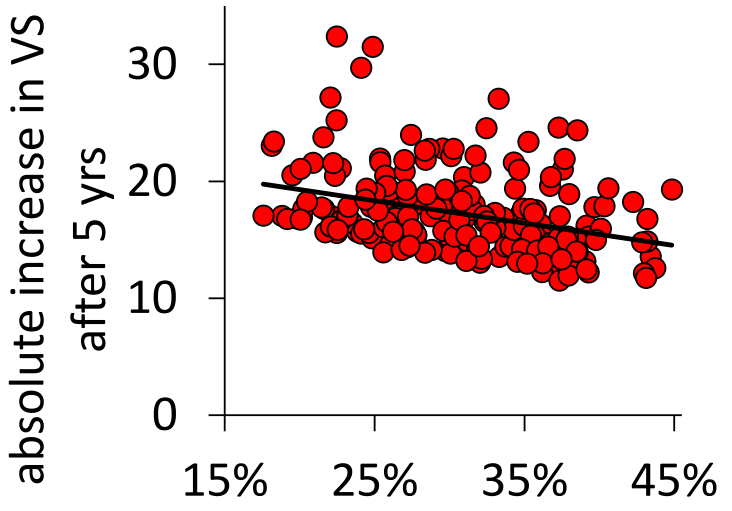


To reduce incidence 20%– by initial viral suppression



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Summary

- Large increases in viral suppression are needed to achieve moderate reductions in HIV incidence among Baltimore MSM, especially short-term
- Results are robust to uncertainty in MSM demography
- Results are influenced by uncertainty in current levels of viral suppression

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Next steps

- Estimate how much individual intervention components - testing, linkage, ART initiation and retention - need to be increased to achieve this reduction in HIV incidence
- Estimate predicted impact upon HIV incidence of meeting UNAIDS and CDC targets for diagnosis, treatment and viral suppression
- Extend analysis to other HPTN 078 sites – Atlanta, Boston, Birmingham

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ACKNOWLEDGEMENTS

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