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Impact of Improvements in the HIV Care Continuum in Miami, FL, USA: A Modeling Study

Dan Escudero, MPH PhD
Assistant Professor of Medicine
Vanderbilt University Medical Center
Nashville, USA

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Conflicts of Interest

- No conflicts to report

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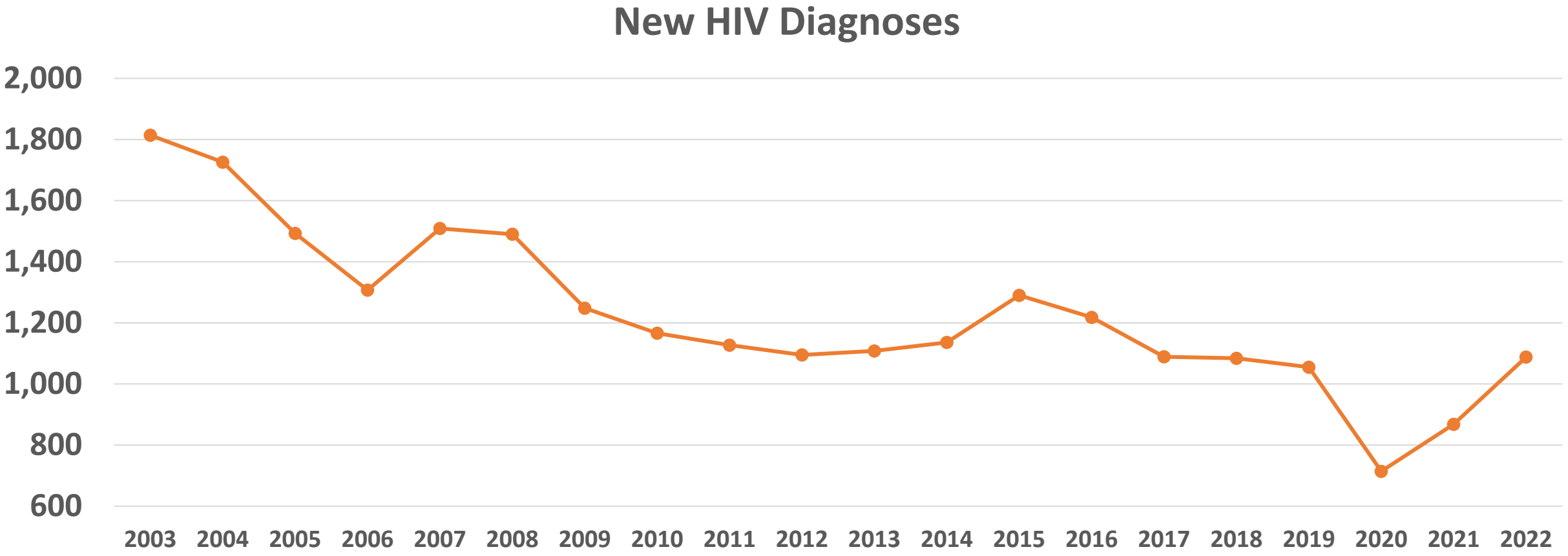
HIV Epidemic in Miami



Source: Florida Department of Health

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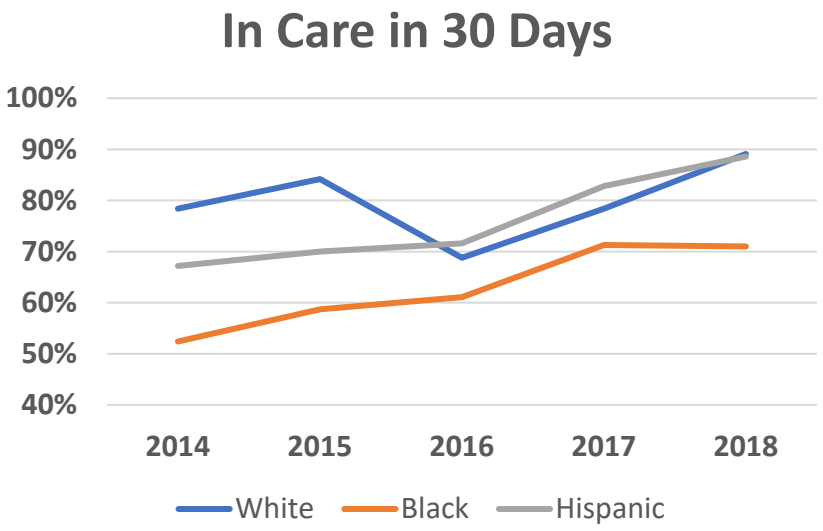
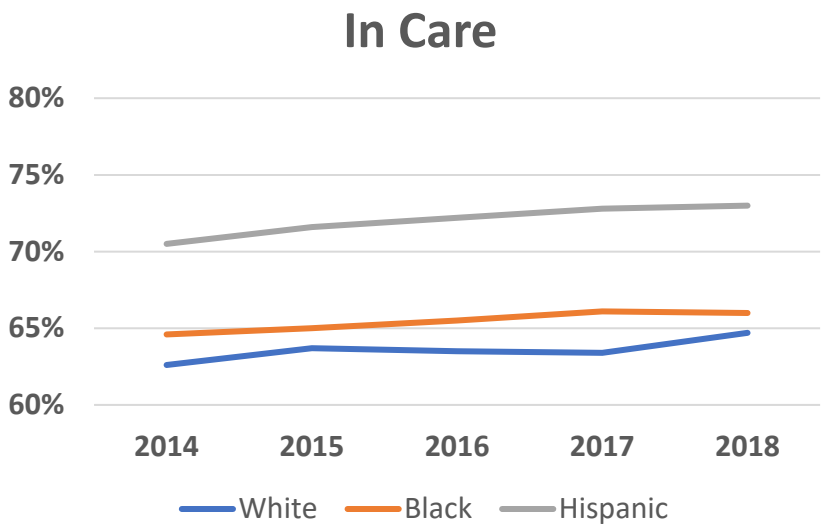
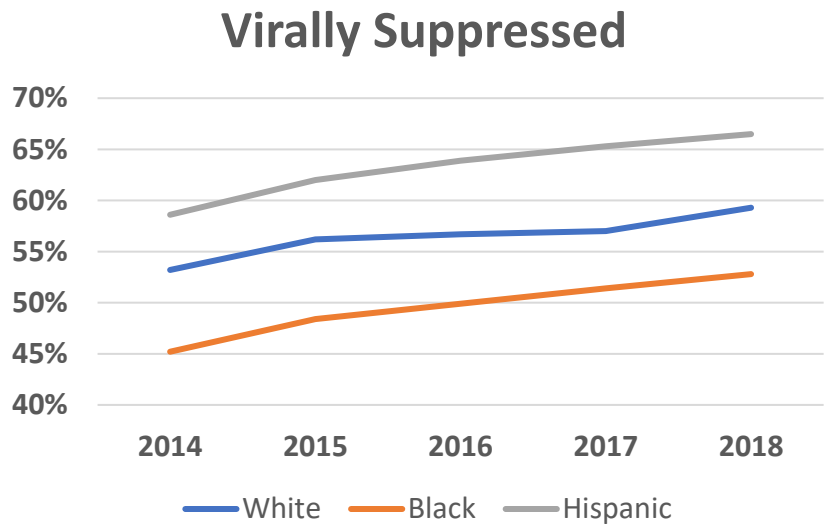
Progress in the HIV Care Continuum







Source: Florida Department of Health

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Analysis

Objective

Estimate the impact of progress in the HIV care continuum on HIV outcomes (new infections, HIV incidence rate, mortality)

- Calibrate model (HIV-CDM) using new HIV diagnoses, 2014-2021
  - By race, ethnicity, sex
- Construct baseline scenario and compare to counterfactual in which three components did not improve from 2014 levels:
  - Enrollment in 30 days
  - Loss-to-follow-up
  - Re-engagement in care

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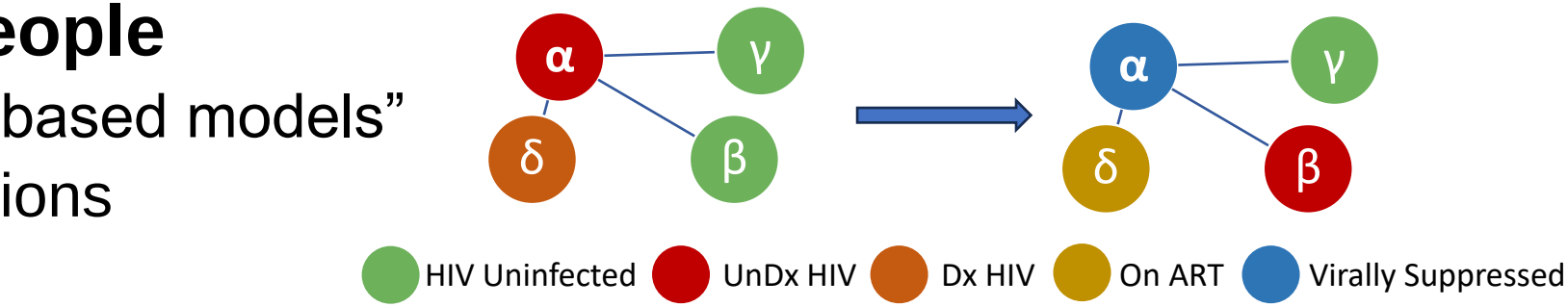
The HIV-CDM to Estimate HIV Epidemic in Miami

- The HIV-Calibrated Dynamic Model **(HIV-CDM)** is an agent-based model
- Our agents represent **people**
  - Analogous to “individual-based models”
  - Permits complex interactions
  - Network effects
  - Emergent phenomena
- Distinct from common models: SIR/SEIR/Compartmental



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Model Inputs and Agent Characteristics

Demographics

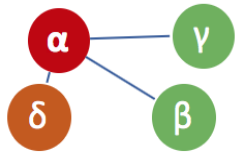
- Race/Ethnicity
- Age
- Sex
- Fertility rate

Health Status

- HIV infection
- Acute, chronic, or late infection
- CD4 count
- Viral load
- Opportunistic infections
- Diagnosed vs. undiagnosed infection
- Treatment failure

Prevention Modalities

- PrEP
- Antiretroviral therapy
- Condom use
- Male circumcision
- HIV testing



Risk Behavior

- High or low risk network
- Number of partners
- Type of relationship (steady, regular, casual, CSW)
- Duration of relationship
- Age of sexual debut

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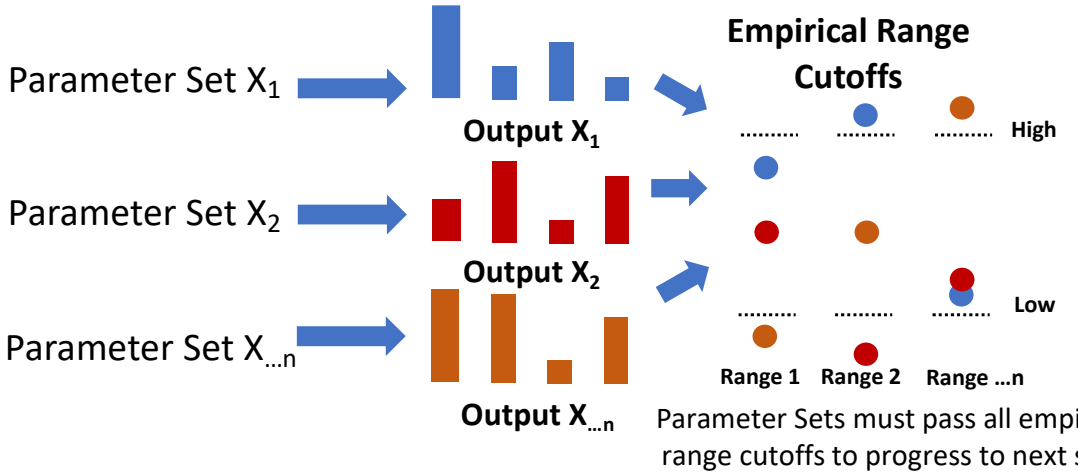
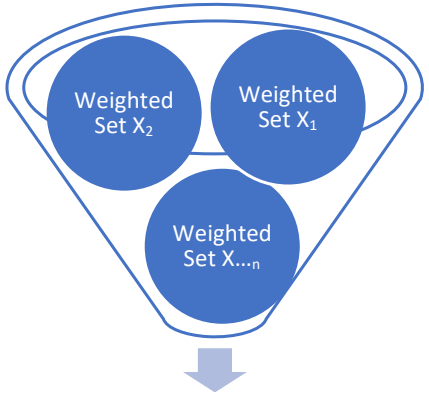
Model Calibration

- The model performs calibration runs for each set, that samples the unknown parameter space
- Sets that produce outcomes within an established range of empirical values are moved to the next stage of calibration—weighting.



Parameter Sets must pass all empirical range cutoffs to progress to next step



Data from all weighted sets contribute toward the final results for a given analysis.

- The final results are determined from a set of the top-20 runs, using by weights calculated by comparing model output to new HIV diagnoses in Miami for each demographic, 2014-2021

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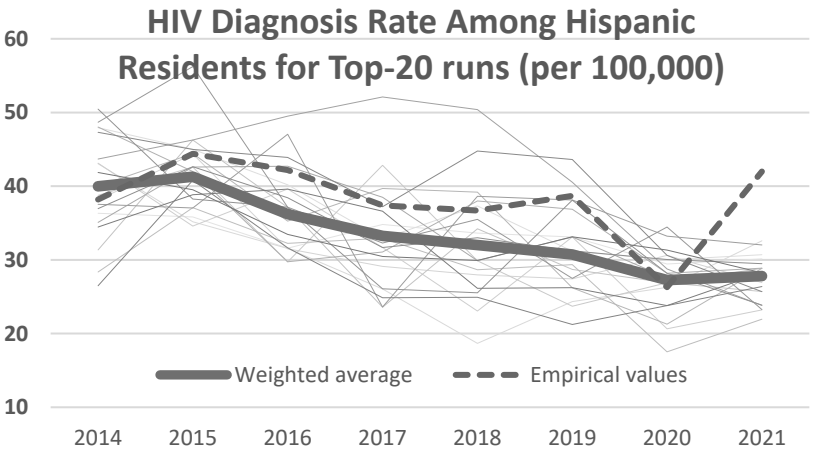
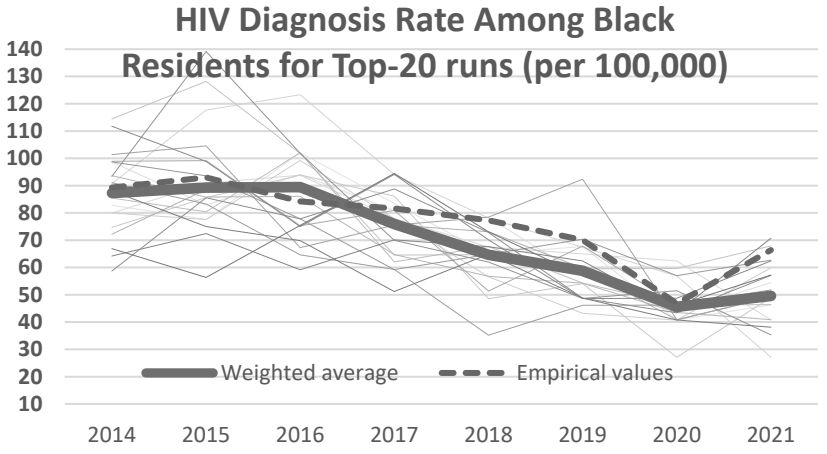
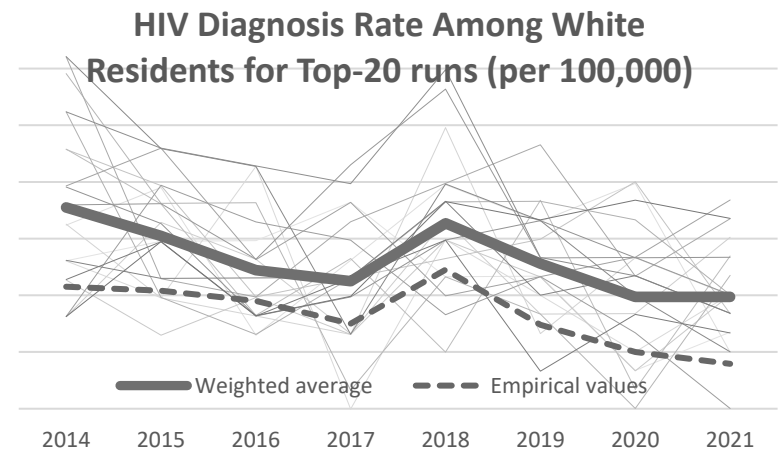
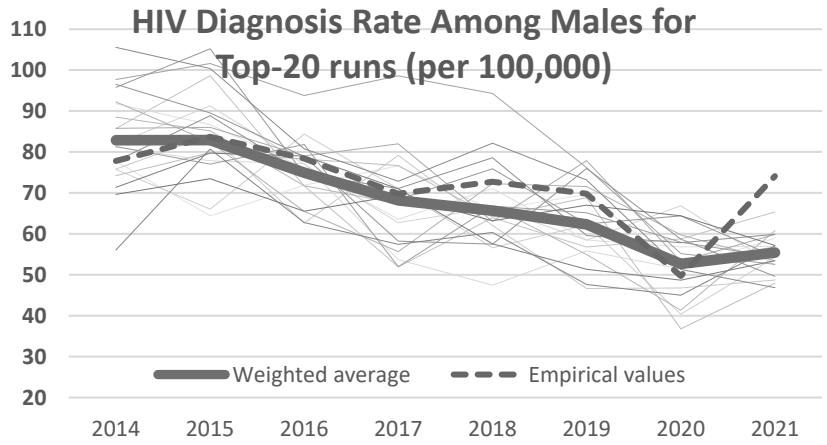
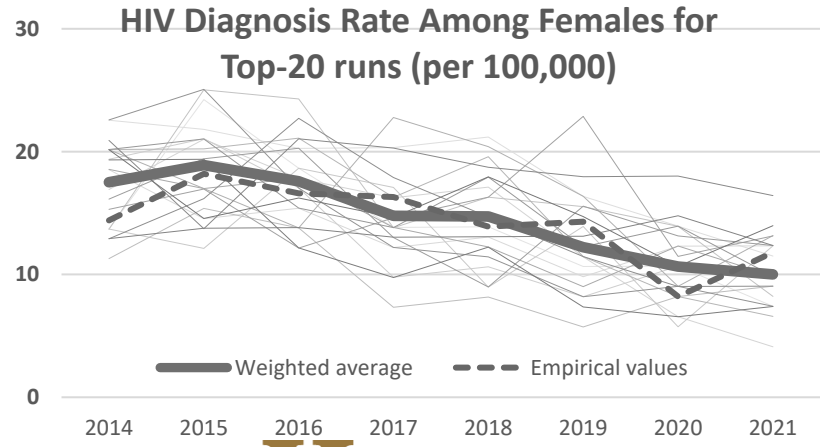
Model Calibration











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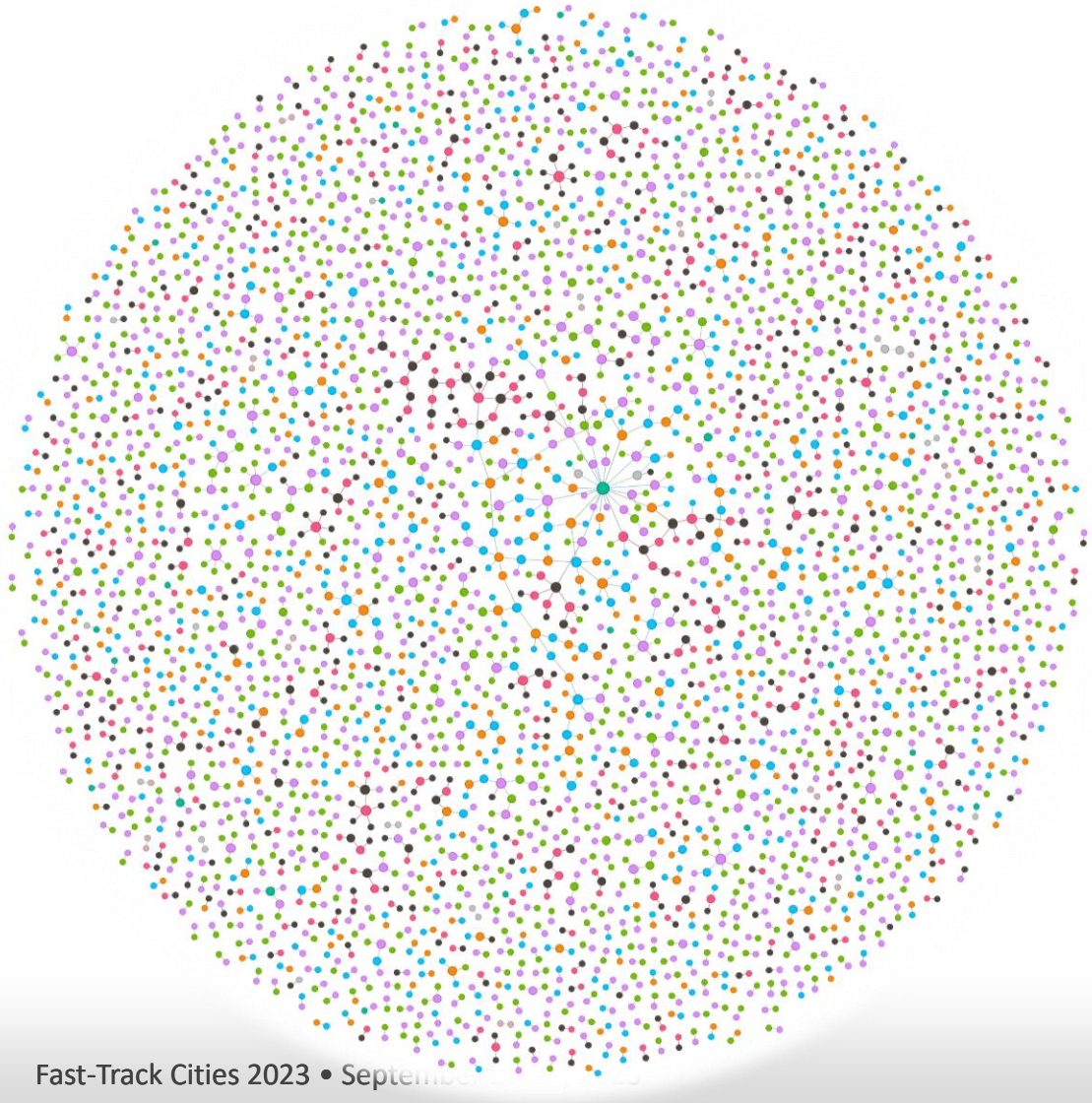
Results – Network Demographics



NODES:

Hispanic MSW	28.4%
Hispanic female	25.1%
Black female	13.3%
White female	12.1%
Black MSW	9.7%
White MSW	9.4%
Other race/ethnicity female	0.8%
Hispanic MSM	0.7%
Hispanic MSMW	0.3%
Others	0.2%

Note:
MSM: Men who have sex with men
MSW: Men who have sex with women
MSMW: Men who have sex with men and women

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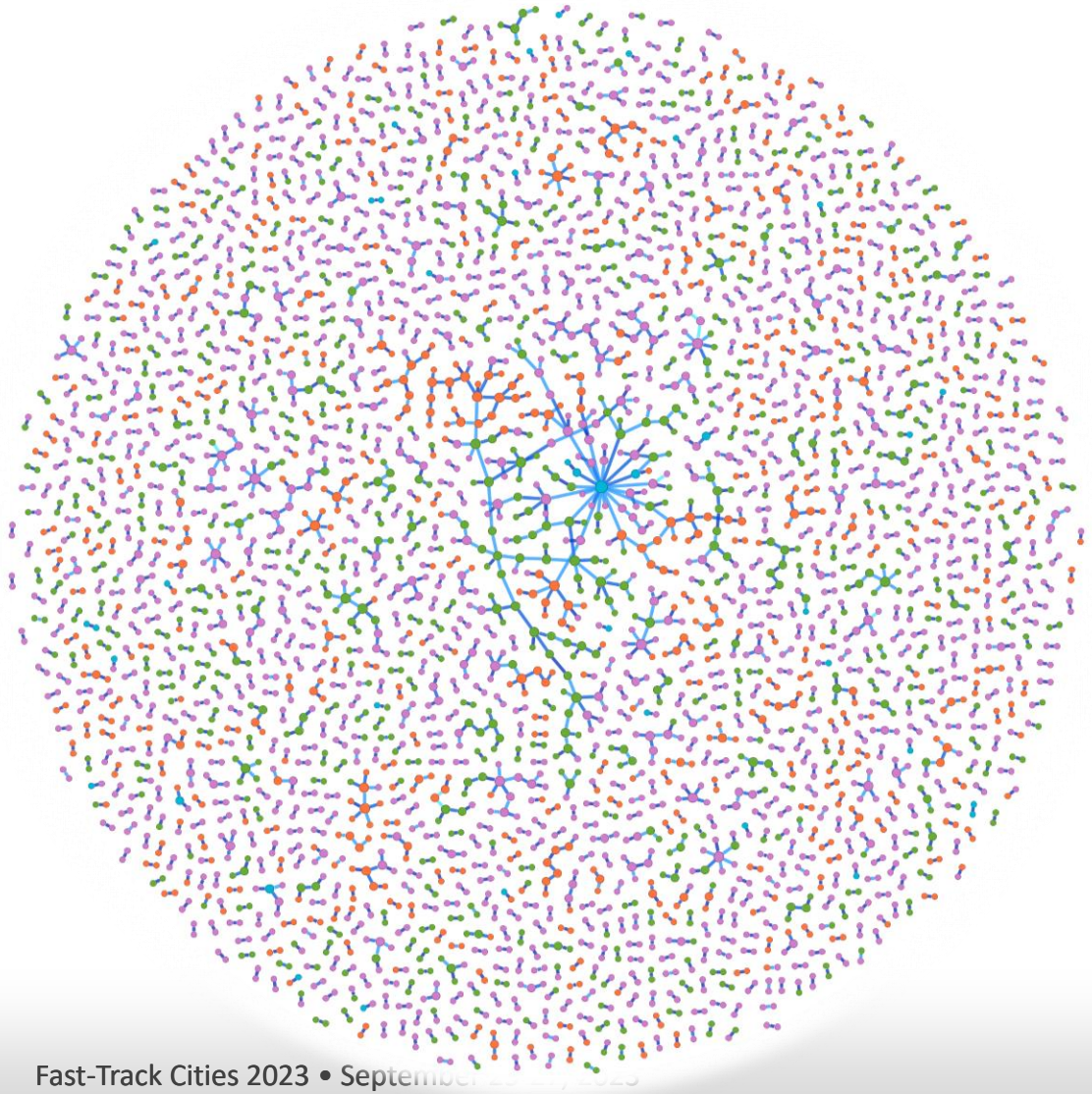
Results – Sexual Network Relationships



NODES:

- HISPANIC
- BLACK
- WHITE
- OTHER

EDGES (Partnership Types):

Steady	65.9%
Regular	18.1%
Casual	15.7%
CSW	0.3%

Note:
CSW: Commercial sex work

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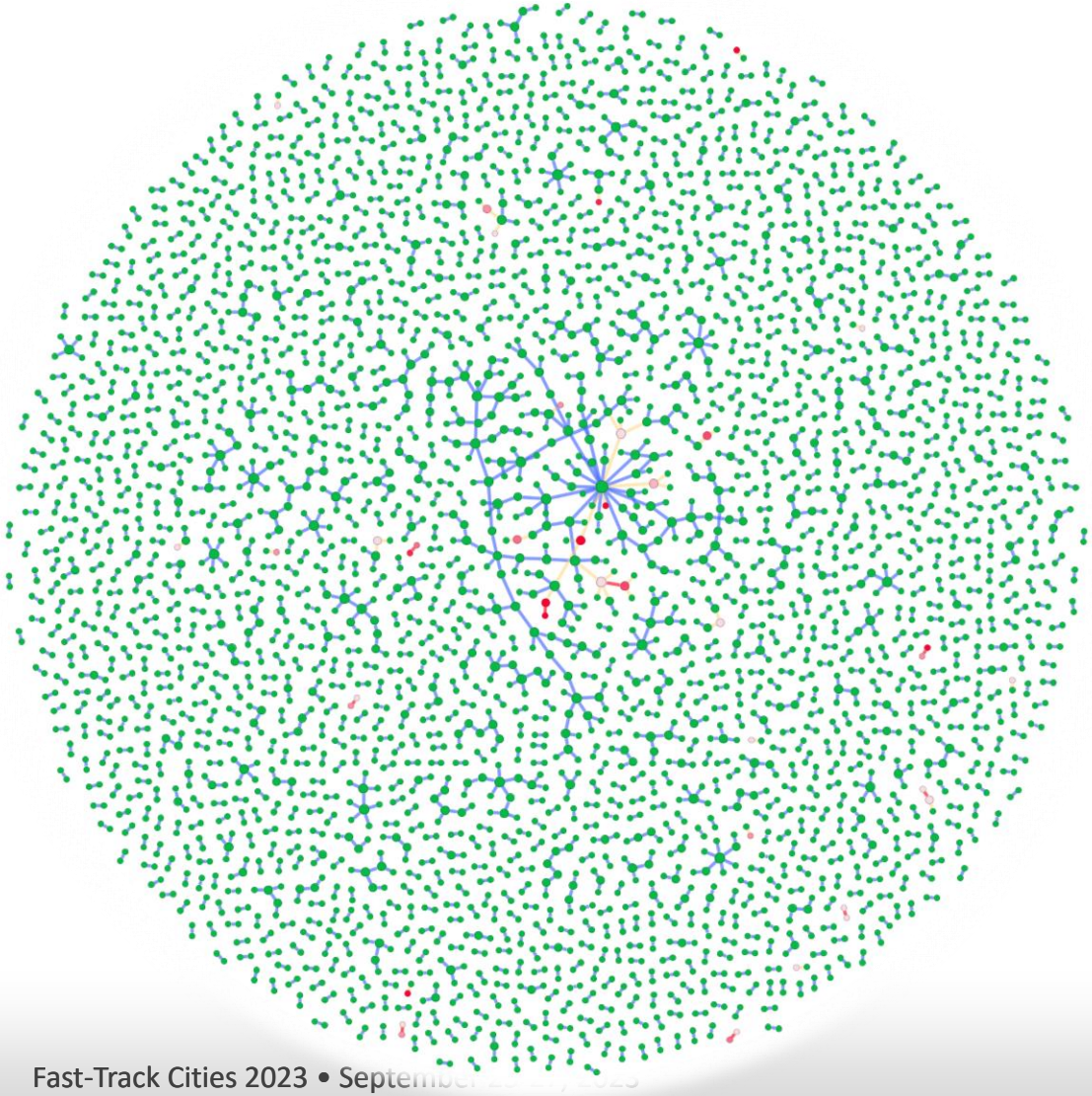
Results – Transmission Network



NODES:

- HIV ⊖
- HIV ⊕ (Lowest VL)
- HIV ⊕ (Highest VL)
- Fewer Partners
- More Partners

EDGES:

- Both ⊖ Partners
- ⊕ and ⊖ Partners
- Both ⊕ Partners

Note:
VL: HIV RNA Viral Load

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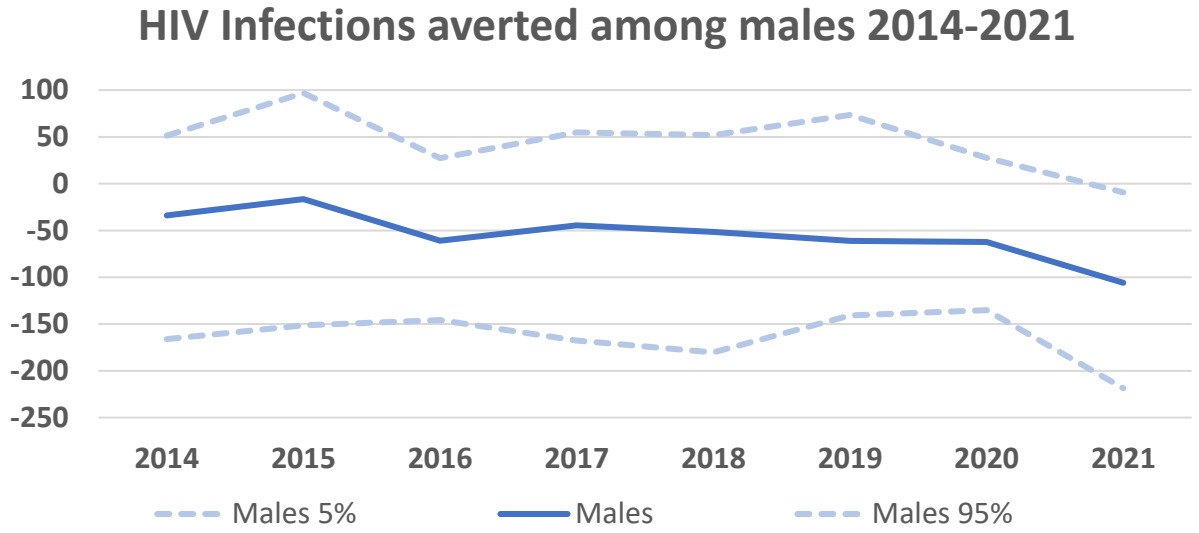
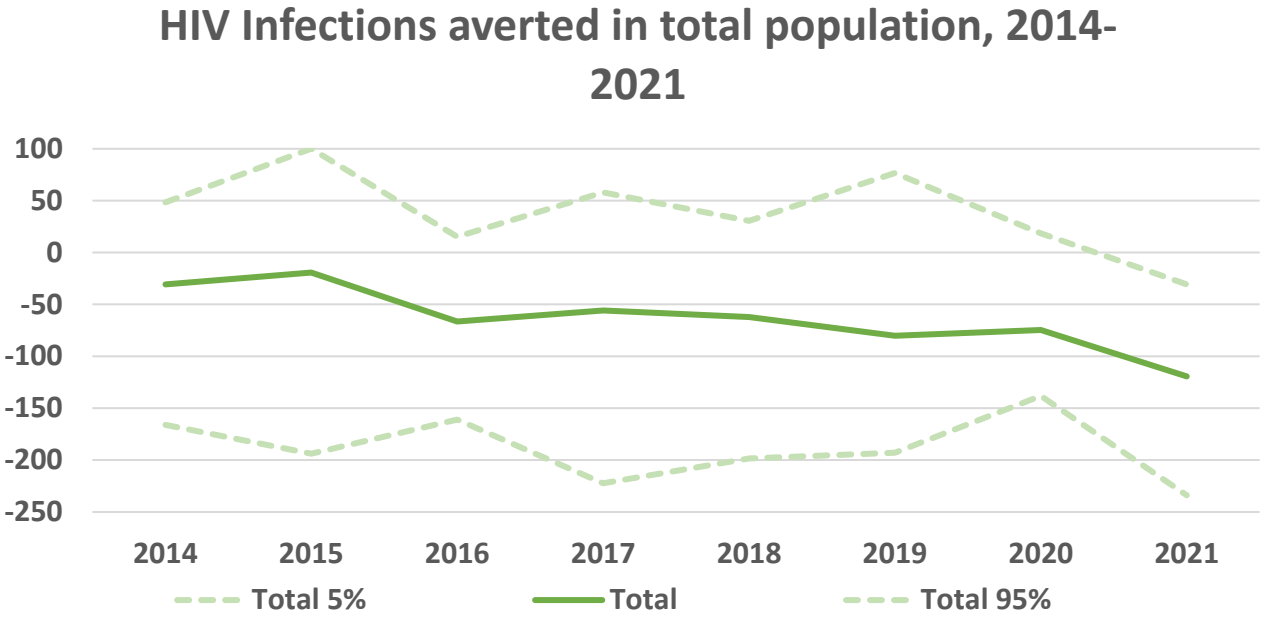
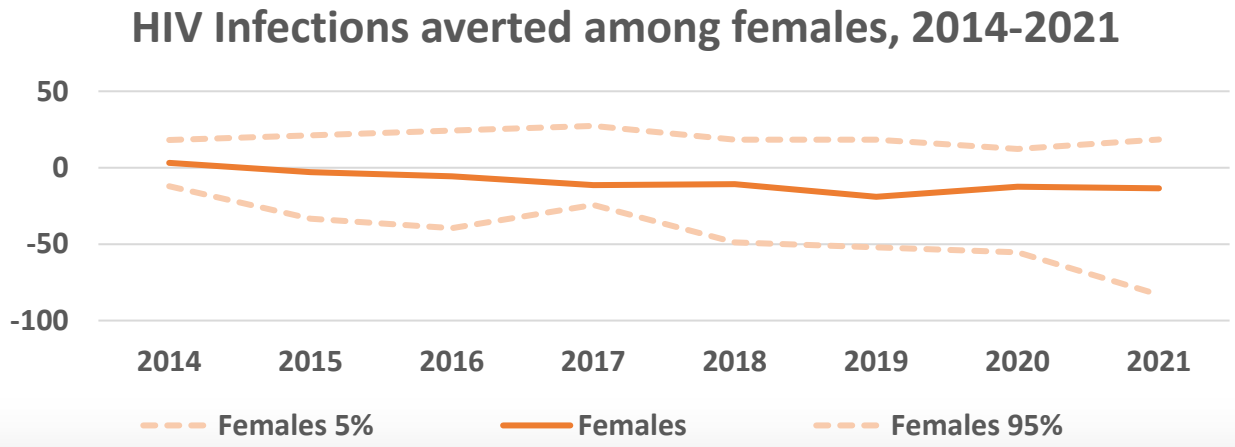
Results – HIV Infections Averted







Note: Dotted lines represent 95%/5% simulation intervals

Total Estimated Infections Averted, by Sex, 2014-2021

Males	106
Females	13

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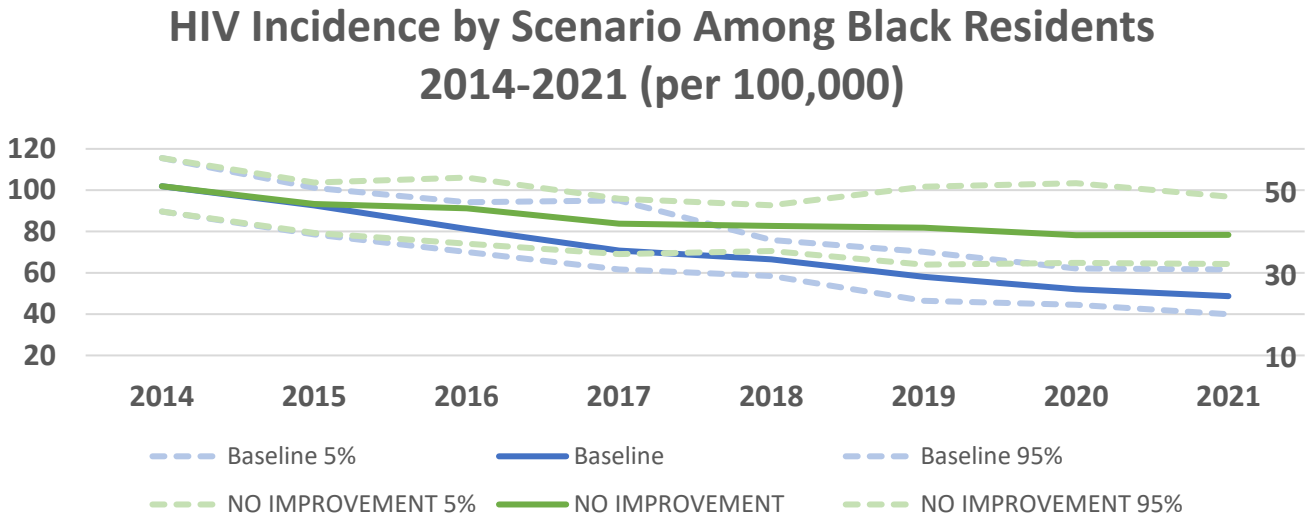
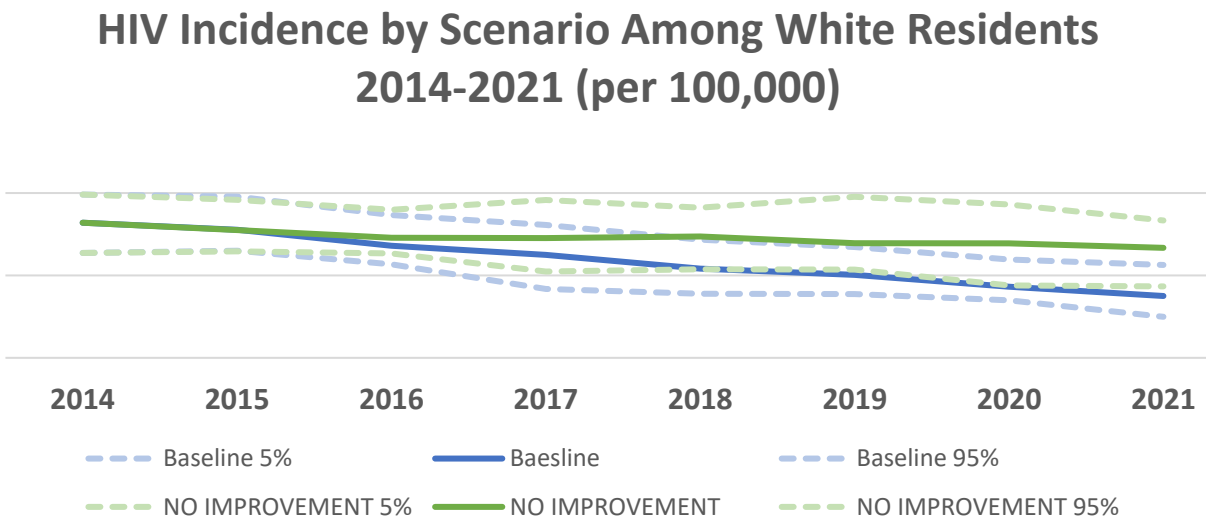
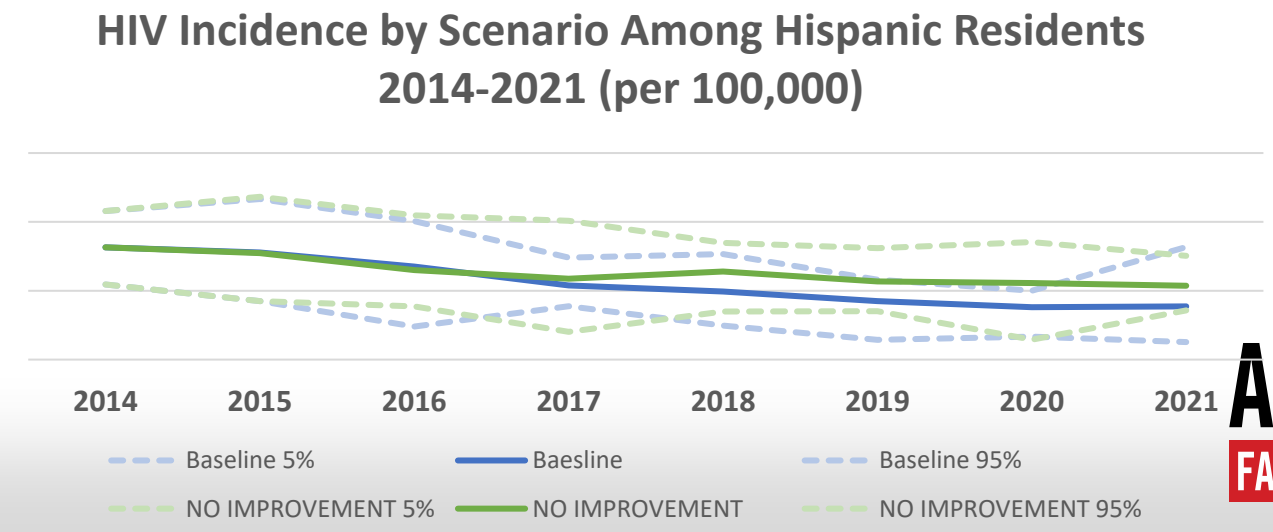
Results – HIV Incidence by Race/Ethnicity





Estimated Chance in HIV Incidence (per 100,000), by population, 2021

Males	-23.23
Females	-5.73
Black	-29.66
Hispanic	-5.98
White	-11.70



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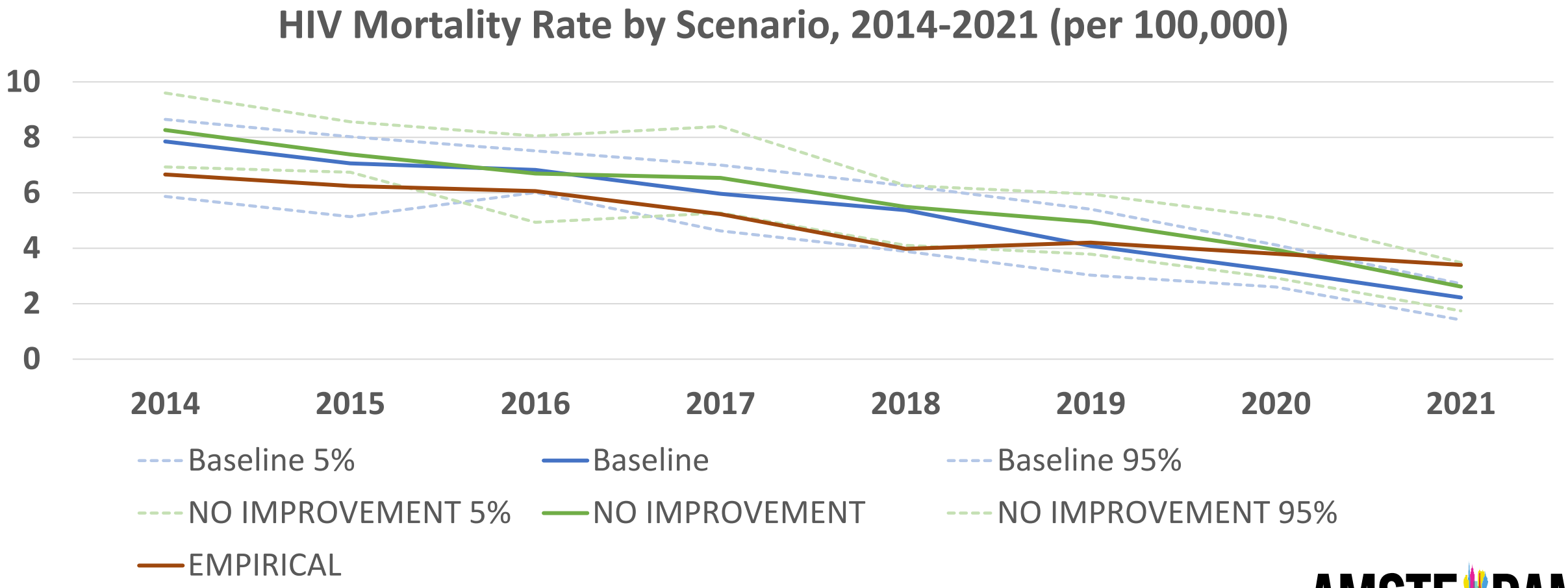
Results – HIV Mortality



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Conclusions

- Improvements in the HIV Care Continuum in Miami since 2014 have resulted in…
  - substantial decreases in HIV incidence among all simulated populations
  - aversion of new infections among both males and females
- Results for HIV mortality are more difficult to determine, require further study

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Thank you!

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