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

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Conflicts of Interest

• No conflicts to report
HIV Epidemic in Miami

New HIV Diagnoses

Source: Florida Department of Health
Progress in the HIV Care Continuum

**In Care in 30 Days**
- 2014: White 60%, Black 50%, Hispanic 40%
- 2018: White 80%, Black 70%, Hispanic 60%

**In Care**
- 2014: White 65%, Black 55%, Hispanic 45%
- 2018: White 75%, Black 65%, Hispanic 55%

**Virally Suppressed**
- 2014: White 40%, Black 30%, Hispanic 20%
- 2018: White 60%, Black 50%, Hispanic 40%

Source: Florida Department of Health
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
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
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
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 Set X₁ → Output X₁
Parameter Set X₂ → Output X₂
Parameter Set Xₙ → Output Xₙ

Empirical Range Cutoffs

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

Final Results

• 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
Model Calibration

HIV Diagnosis Rate Among Hispanic Residents for Top-20 runs (per 100,000)

HIV Diagnosis Rate Among Black Residents for Top-20 runs (per 100,000)

HIV Diagnosis Rate Among White Residents for Top-20 runs (per 100,000)

HIV Diagnosis Rate Among Males for Top-20 runs (per 100,000)

HIV Diagnosis Rate Among Females for Top-20 runs (per 100,000)
## Results – Network Demographics

### NODES:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic MSW</td>
<td>28.4%</td>
</tr>
<tr>
<td>Hispanic female</td>
<td>25.1%</td>
</tr>
<tr>
<td>Black female</td>
<td>13.3%</td>
</tr>
<tr>
<td>White female</td>
<td>12.1%</td>
</tr>
<tr>
<td>Black MSW</td>
<td>9.7%</td>
</tr>
<tr>
<td>White MSW</td>
<td>9.4%</td>
</tr>
<tr>
<td>Other race/ethnicity female</td>
<td>0.8%</td>
</tr>
<tr>
<td>Hispanic MSM</td>
<td>0.7%</td>
</tr>
<tr>
<td>Hispanic MSMW</td>
<td>0.3%</td>
</tr>
<tr>
<td>Others</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

**Note:**
- MSM: Men who have sex with men
- MSW: Men who have sex with women
- MSMW: Men who have sex with men and women
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
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
Results – HIV Infections Averted

HIV Infections averted among males 2014-2021

HIV Infections averted among females, 2014-2021

HIV Infections averted in total population, 2014-2021

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

Total Estimated Infections Averted, by Sex, 2014-2021

Males: 106
Females: 13
Results – HIV Incidence by Race/Ethnicity

HIV Incidence by Scenario Among Black Residents 2014-2021 (per 100,000)

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

HIV Incidence by Scenario Among Hispanic Residents 2014-2021 (per 100,000)
Results – HIV Mortality

HIV Mortality Rate by Scenario, 2014-2021 (per 100,000)

- Baseline 5%
- Baseline
- Baseline 95%
- NO IMPROVEMENT 5%
- NO IMPROVEMENT
- NO IMPROVEMENT 95%
- EMPIRICAL
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
Thank you!

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