Where Should We Focus?

PrEP retention vs. PrEP uptake: Results from an agent-based network model of HIV transmission

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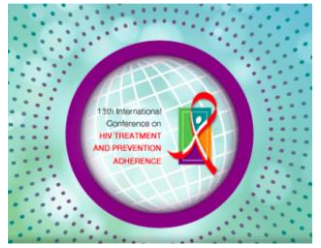
Study Motivation



- The annual number of new HIV infections has been <1000 since 2013 in Chicago, a reduction of 28% from 2006-2015.
- A plan for “Getting to zero” (G2Z) new HIV infections is being developed in Chicago and Illinois by the Health Departments and convened by the AIDS Foundation of Chicago.
- Many of the new HIV infections are concentrated among young Black men who have sex with men (YBMSM), where overall prevention successes have had limited effect.
- G2Z efforts among YBMSM require expanded uptake of **preexposure prophylaxis (PrEP)** and antiretroviral treatment (ART).

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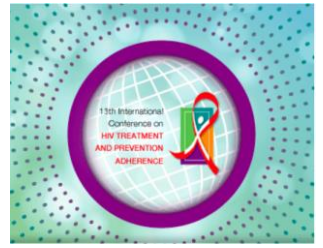
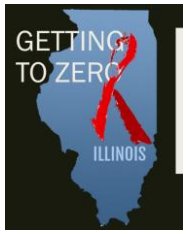
PrEP Uptake in Chicago: Current levels and targets



HEALTHY CHICAGO
CHICAGO DEPARTMENT OF PUBLIC HEALTH

HIV / STI SURVEILLANCE REPORT

AIDS FOUNDATION OF CHICAGO



Overall, about 10% of individuals who can benefit from PrEP in Chicago are using it.

Data indicate that about 13% of HIV-negative Black MSM are using PrEP.

The "Getting to Zero" initiative aims to increase ART and PrEP use by about 20% over the next 10 years.

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The BARS Agent-Based Model (ABM)

- The BARS ABM incorporates empirical data on micro-level behaviors and sexual network structure to aggregate population-level outcomes.
- Additionally, we account for a number of process that impact transmission, including demography, biology, antiretroviral treatment (ART), preexposure prophylaxis (PrEP).
- We use data from empirical studies* and the published literature to parameterize these processes.
- We use computational tools to conduct sensitivity analyses and aggregate outcomes from model runs.

**Khanna et al. JAMA Intern Med. 2016 Jan;176(1):136-8.*

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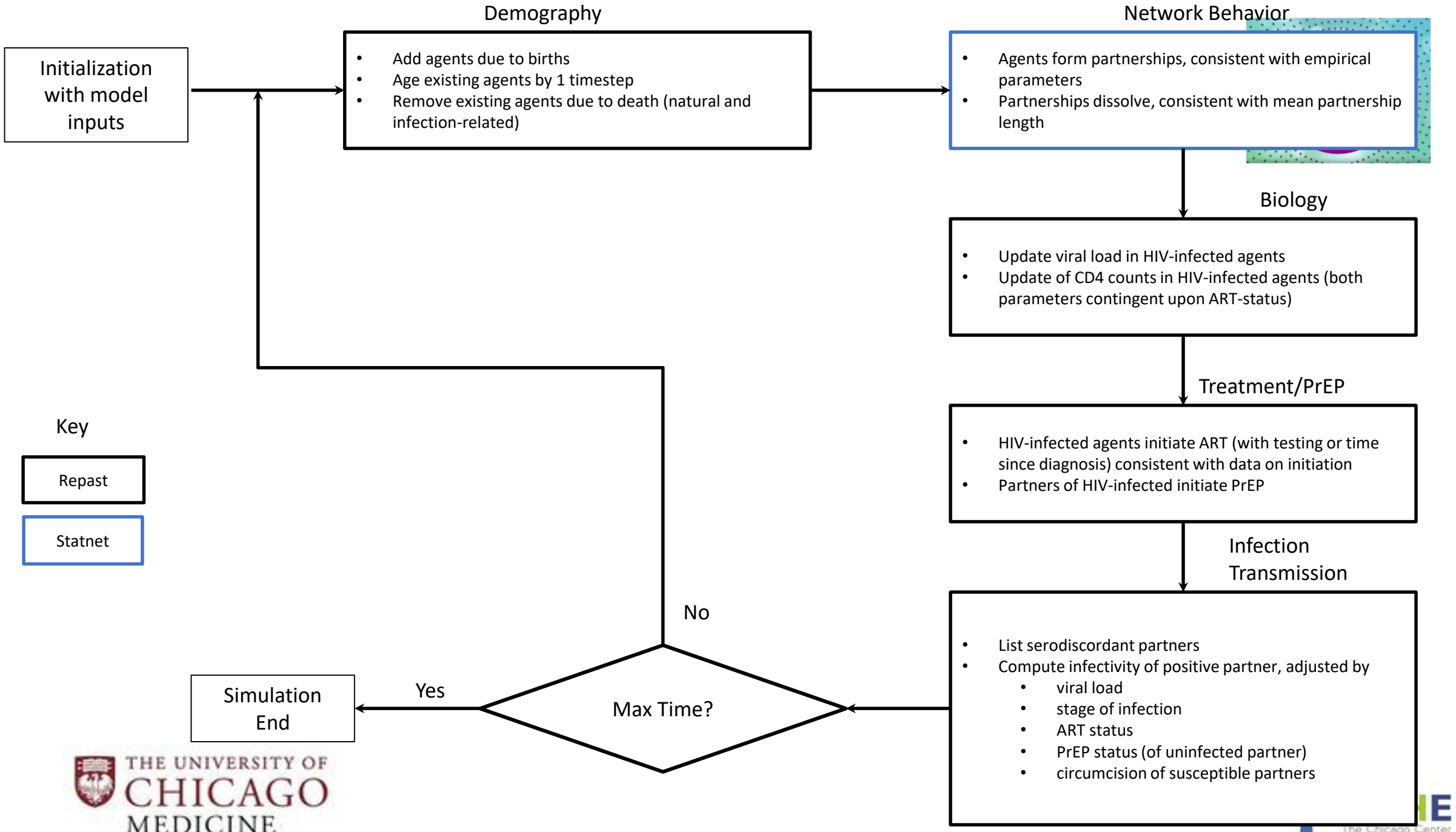

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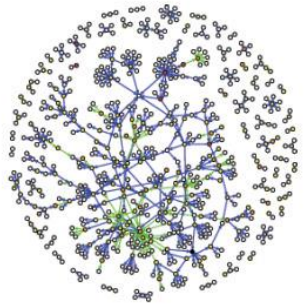
Implementing the ABM

https://github.com/khanna7/BARS/



- Dynamic network modeling tools in the statnet project to simulate sexual networks.

  http://www.statnet.org/

- Agent behaviors are simulated using the Repast High Performace Computing toolkit.

  https://repast.github.io/repast_hpc.html

repast

Repast for High Performance Computing

- Large parameter spaces are searched using tools from the EMEWS project.

  http://emews.org

EMEWS

Extreme-scale Model Exploration with Swift

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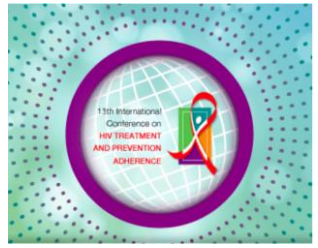
Modeling Objectives



- To project, if current levels of PrEP uptake and other parameters do not change, what the simulated incidence among young Black MSM after 10 years will be.
- If PrEP is scaled up to higher levels of uptake according to G2Z targets, what will the incidence be after 10 years?
- If the average retention of PrEP uptake is increased, what will the incidence be after 10 years?
- **Where should G2Z initiatives focus – levels of uptake or retention periods?**

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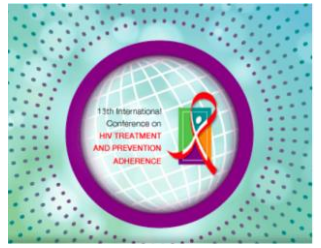
Modeling Assumptions: PrEP Uptake and Targets



Current Use

- We focus on 18-34 year-old Black MSM.
- We assume that 12.7% of HIV-negatives in the 18-25 year bracket and 14.7% of HIV-positives in the 26-34 year bracket currently use PrEP. (uConnect)
- We assume that PrEP initiators use PrEP for an average of 6 months.

Targets

- We consider PrEP uptake to reach levels from 20% to 60% in 10% point increments. These occur uniformly over the first 5 years, and stay constant over the next five.
- We increase average PrEP retention from 6 months to 24 months in discrete increments.

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Results: HIV outcomes in the 10th year of intervention

Increase PrEP Uptake		
% negatives on PrEP	Prevalence (%)	Incidence (per 100 py)
Base	27.1	3.5
20	25.8	3.2
30	25.2	2.9
40	23.4	2.3
50	22.1	2.0
60	21.1	1.8

Increase PrEP Retention		
Average retention on PrEP	Prevalence (%)	Incidence (per 100 py)
6 months (Base)	27.2	3.5
9 months	25.9	3.1
12 months	25.1	3.2
18 months	24.6	2.8
24 months	24.5	2.9

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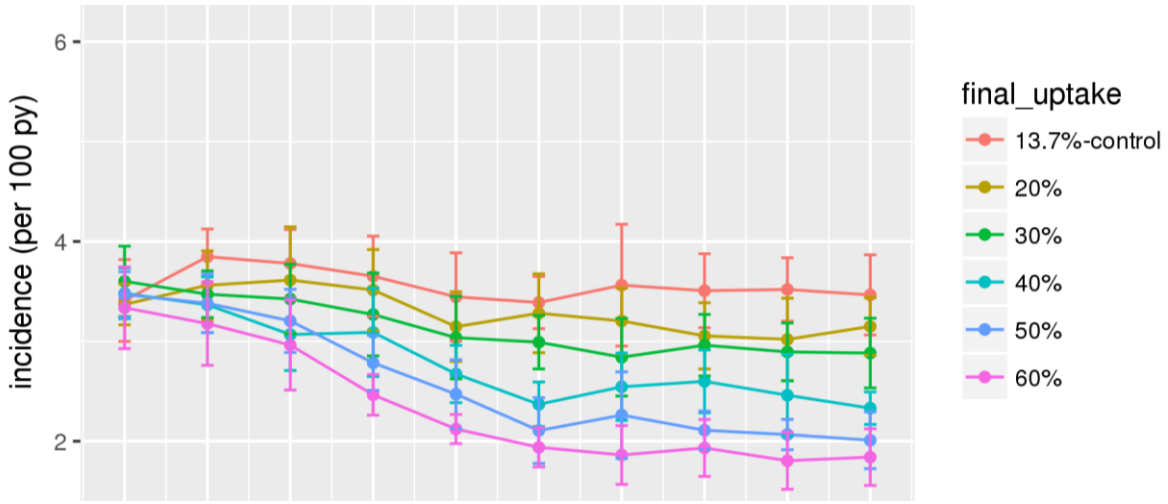
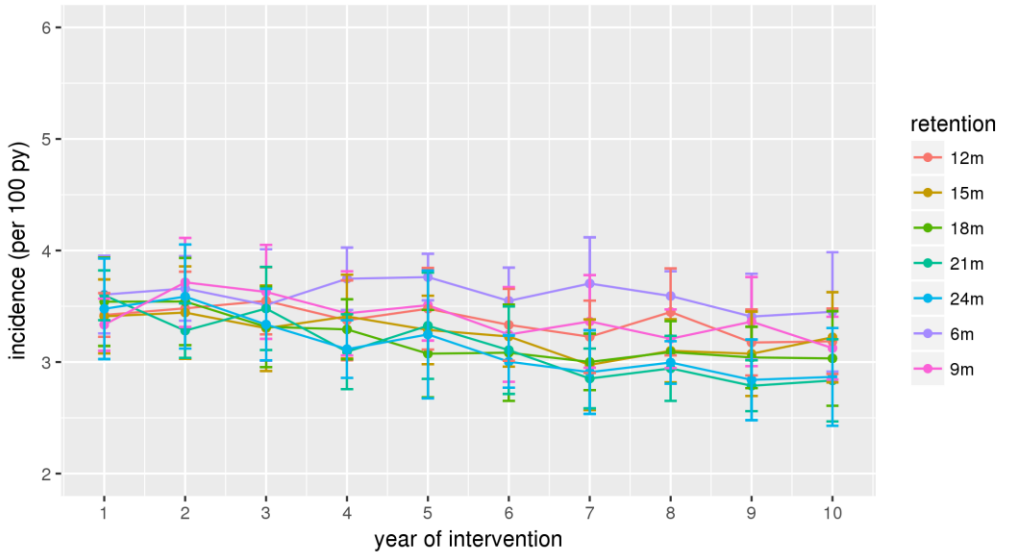
Results: HIV incidence in the 10th year of intervention

PrEP Retention: 6 months (avg).



PrEP Uptake: 12.7% in 18-25; 14.7% in 26-34



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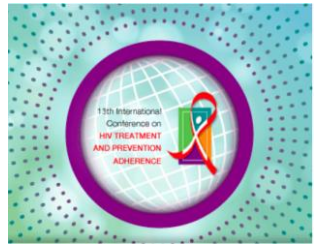
Discussion



- Increasing PrEP uptake and PrEP retention for young Black MSM both appear to have substantial effects on HIV incidence in the 10th year.
- Increasing PrEP uptake from base levels to 30% appears to have about the same effect as increasing average retention from 6 months to 18 months.
- One important consideration is the effort required to increase PrEP uptake versus PrEP retention.

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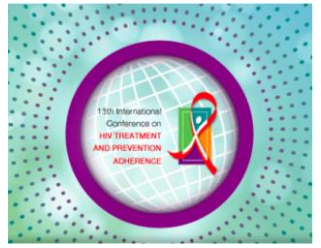
Limitations and Future Directions



- PrEP retention behavior is complex – one average statistic may not describe behavioral complexity in PrEP retention. We are using clinic data from Howard Brown Health to investigate more complex models of PrEP retention.*

- We are considering other interventions to increase PrEP uptake, where PrEP is prioritized to serodiscordant couples and to individuals in key positions in the HIV transmission network.

- We are building in structural factors (for instance, mass incarceration) that are known to adversely impact HIV outcomes.

*Rusie et al. Clin Infect Dis. 2018 Mar 1; doi: 10.1093/cid/ciy160.

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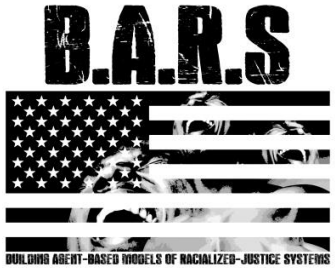

Building Agent-Based Models for Racialized Justice Systems
R01 DA 039 934 (Fujimoto, Harawa, Schneider)
https://github.com/khanna7/BARS/

Repast Suite of ABM Toolkits
Project Lead: Ozik
https://repast.github.io/

Extreme Scale Model Exploration with Swift
Project Lead: Ozik. Funding: R01 GM 115839 (An, Macal), R01 DA 039 934
http://emews.org