

“GETTING TO ZERO” (G2Z) NEW HIV INFECTIONS IN CHICAGO: TRIANGULATING PROJECTIONS FROM STATISTICAL AND AGENT-BASED MODELS

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Background

- The annual number of new HIV infections has been <1000 since 2013 in Chicago, a reduction of 28% from 2006-2015.
- Project “Getting to zero” (G2Z) new HIV infections is under development.
- Many of the new HIV infections are concentrated among young Black men who have sex with men (YBMSM), where prevention successes have had little effect.
- G2Z efforts among YBMSM require expanded use of preexposure prophylaxis (PrEP) and antiretroviral treatment (ART).

Objectives

- Use regression and agent-based modeling (ABM) techniques are used to estimate the impact of PrEP and ART scaleup.
- Assess how the projected number of HIV infections in Chicago over the next decade is likely to change under various scenarios of ART and PrEP scaleup.
- Determine appropriate HIV prevention interventions for Chicago’s YBMSM population in particular.

Methods

Two statistical models of HIV Incidence in Chicago

- Locally weighted regression (loess): A non-parametric regression technique that fits multiple regression lines on clusters of points within one data set. It does not assume that all the data can be described using a line with one slope.
- Bonacci and Holtgrave (B&H) method: Projects HIV incidence using the average of the changes in incidence in the past three years. The number of new infections is calculated as: $I(t+1) = I(t) * A$, where $I(t)$ is the HIV incidence in year t , and A is the average slope of HIV incidence of the past three years.

Modeling HIV incidence among YBMSM in Chicago

- The BARS model: An ABM that incorporates micro-level behaviors to aggregate macro-level outcomes.
- HIV prevention interventions were simulated among a YBMSM population.

Interventions

The following scenarios were considered:

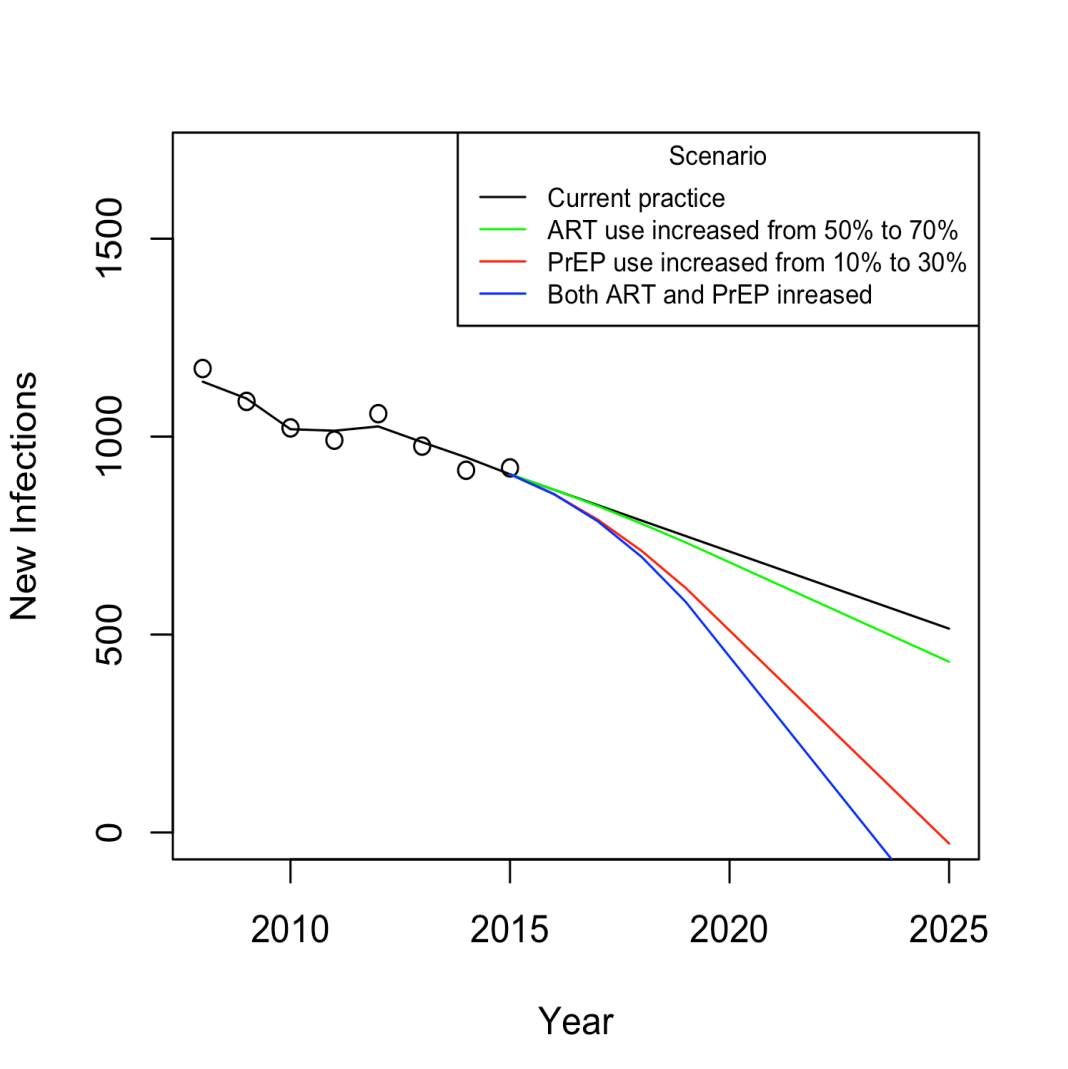
- 1) No increase in ART or PrEP.
- 2) ART use increased by 20% over the first 5 years, and held constant for the next 5 years.
- 3) PrEP use increase by 20% over the first 5 years, and held constant over the next 5 years.
- 4) ART and PrEP both increased under the above schemes.

(Both HIV and PrEP usage were assumed to have a 92% efficacy in averting new HIV infections.)

Results

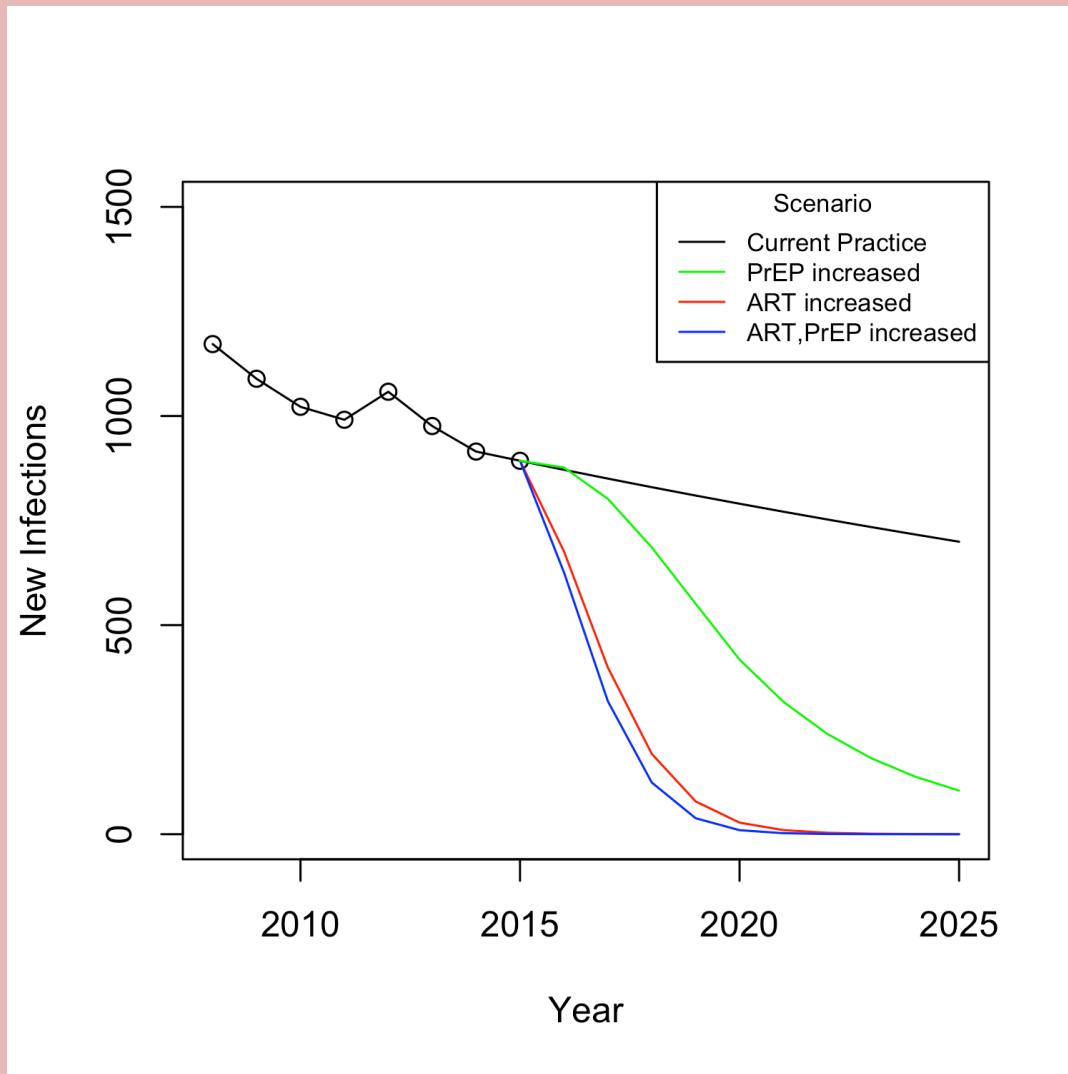
Loess Curve Model

- The PrEP intervention alone had a greater effect than the ART intervention.
- Over 10 years HIV incidence is projected to decrease to 531 cases per year with no intervention, and to <1 cases per year with both ART and PrEP interventions implemented.



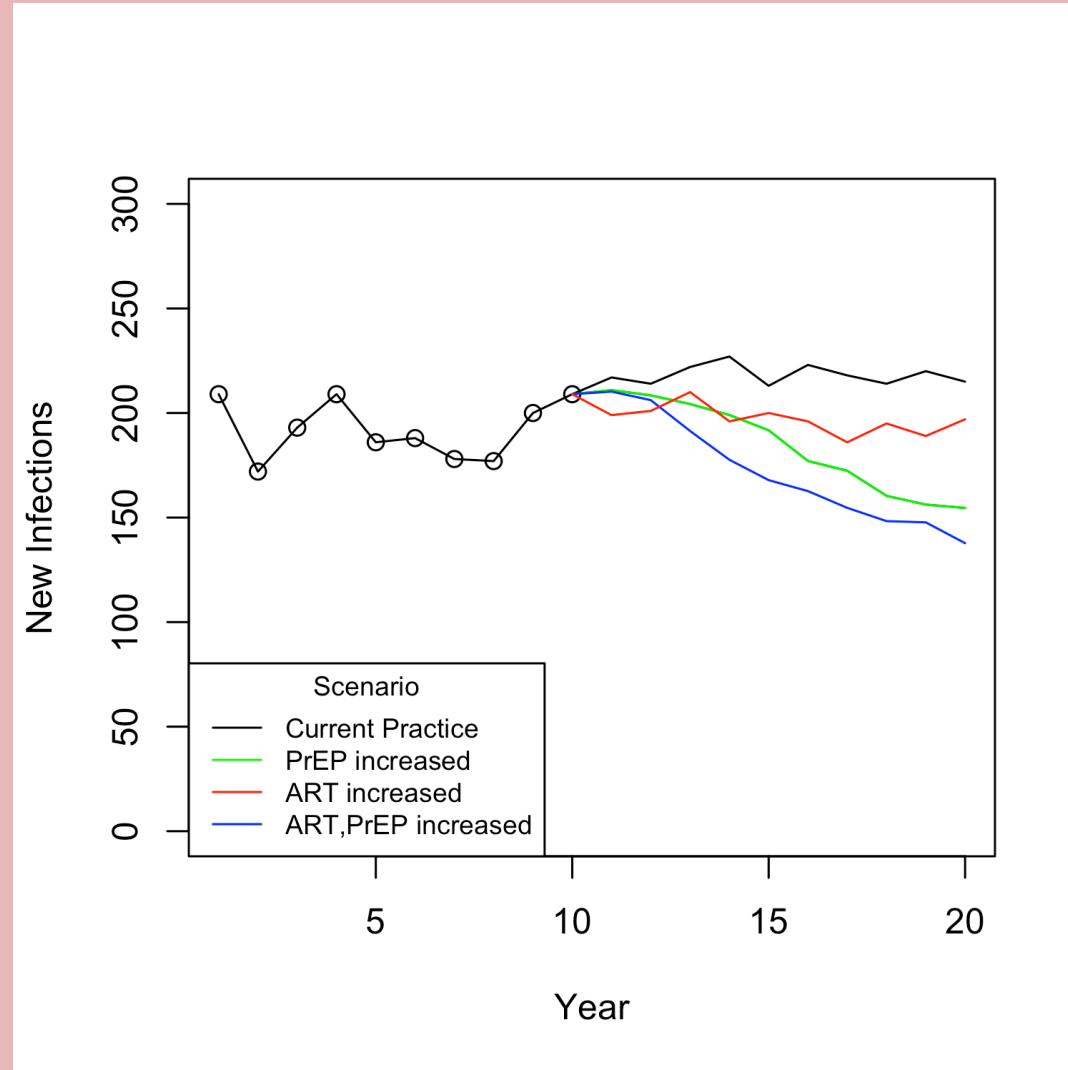
B&H Model

- The PrEP intervention had a greater effect than the ART intervention.
- Over 10 years HIV incidence is projected to decrease to ~528 cases per year with no intervention, and to <1 cases per year with both ART and PrEP interventions implemented.



BARS Model

- The ART intervention alone had a greater effect than the PrEP intervention.
- HIV incidence is projected to be 200 cases per year with no intervention, and 138 cases per year with both interventions implemented.



Conclusions

- Loess and B&H models indicate that ART and PrEP scaleup are more effective than either intervention alone.
- The BARS model differs in its predictions of the relative effects of the ART and PrEP interventions, but also indicates that the interventions have the greatest effect when they are combined.
- The BARS model provides a less optimistic view of the impact of ART and PrEP scaleup. This is likely due to the relatively nuanced nature of its underlying assumptions.

Limitations

- The Loess and B&H models are based on data for all new HIV infections in Chicago. The BARS ABM is based on data from Chicago YBMSM only. Further work in making our analyses comparable are in progress.
- The BARS ABM assumes that individuals use PrEP for an average of 6 months, while the nonparametric models do not make such an assumption. This may impact the simulated effectiveness of PrEP in the BARS ABM.
- In the BARS ABM, ART usage is influenced by testing frequency, time between HIV diagnosis and ART initiation, and levels of adherence. Further work in examining the influence of these parameters on ART scaleup are in progress.
- Our analyses assume that all other parameters will be held constant as ART and/or PrEP are scaled up. The efficacy of our modeled interventions will depend on synergies with these changes.

Acknowledgements

- Grant R01 DA 039934.
- Research Computing Center at the University of Chicago.
- AIDS Foundation of Chicago for convening the G2Z campaign.

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