

The Illinois "Getting To Zero" Campaign Formulating a Strategy for Eliminating HIV Infections by 2030

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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.
- A plan for "Getting to zero" (G2Z) new HIV infections is being collaboratively developed by the AFC, CDPH and IDPH.
- Many of the new HIV infections are concentrated among young Black men who have sex with men (YBMSM, defined here as <u>18-</u> <u>34 years of age</u>), where prevention successes have had little effect.
- G2Z efforts among YBMSM require expanded use of preexposure prophylaxis (PrEP) and antiretroviral treatment (ART).







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Objectives



- We aim to assess how much ART and PrEP use need to be scaled up to eliminate HIV infections among YBMSM by 2030.
- We use regression and agent-based modeling (ABM) techniques to estimate the impact of PrEP and ART scaleup among YBMSM.
- Different models may provide qualitatively different results, and we assess the strengths and weaknesses of different approaches among YBMSM.
- We will interpret our findings to inform broader strategies for HIV elimination for YBMSM (18-34 years).





Methods



- 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. W.S. Cleveland, S.J. Devlin. J Am Stat Assoc. 83 (1988).
- 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. *R.A. Bonacci, D.R. Holtgrave. AIDS Behav. 20, 1383-1389 (2016).*
- Agent-Based Model (ABM): Incorporates micro-level behaviors to aggregate macro-level outcomes. HIV prevention interventions are simulated among a population of young Black men who have sex with men (BMSM) in Chicago.





Interventions



1) No increase in antiretroviral treatment (ART) or preexposure prophylaxis (PrEP).

2) ART use increased by 20% over the first 5 years, and held constant for the remaining period.

3) **PrEP use increased by 20%** over the first 5 years, and held constant for the remaining period.

4) ART and PrEP both increased under the above schemes.





Results from the LOESS model for IL YBMSM (18-34 years)



Intervention	Number of infections in the 10 th year of the intervention
No change in ART/PrEP (Control)	302
PrEP scaled by 20%	145
ART scaled by 20%	278
PrEP and ART scaled by 20%	79

Compute infections in year (t) = infections in year (t-1) – (slope of decline * 0.92 * PrEP coverage in year (t)/ Current PrEP Coverage). Repeat iteratively for all 10 years.





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Results from Bonacci-Holtgrave (B&H) for IL YBMSM (18-34 years)





Year

Incidence was estimated for year t by I(t) = I(t-1)*A, where A is the average change in HIV incidence over the past 3 years





The Agent-Based Model (ABM)



- Our 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, preexposure prophylaxis.
- We use data from our empirical studies and the published literature to parameterize these processes.
- We use computational tools to assess conduct sensitivity analyses and aggregate outcomes from model runs.





Results from the Agent-based model for YBMS A finite Chicago



Intervention	Number of infections in the 10 th year of the intervention
No change in ART/PrEP (Control)	216
PrEP scaled by 20%	159
ART scaled by 20%	126
PrEP and ART scaled by 20%	106





Limitations



- The Loess and B&H models are not designed for long projections. We are working on implementing an adaptation of B&H that may be better suited for longer time frames.
- ART usage is influenced by a number of factors: 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, and how they impact final incidences, are in progress.
- Our analyses assume that all other parameters will be held constant as ART and/or PrEP are scaled up. In reality, many parameters change with time. The efficacy of our modeled interventions will depend on synergies with these changes.
- The agent-based model assumes that YBMSM are retained on PrEP for an average of 1 year; the nonparametric models, due to their simpler nature, do not make such an assumption. This may impact the simulated effectiveness of PrEP in the BARS ABM.





Conclusions and Future Directions



- All models indicate that a combination ART and PrEP strategy is more effective than either intervention alone.
- Further work includes assessing how the projected impact of these interventions in the overall population.
- We are further investigating behavioral complexity in agent-based models that that may refine our results.





Acknowledgments





The Repast Suite

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 Lead: Ozik https://repast.github.io/ GETTING TO ZERO ILLINOIS



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



