

PROJECTING THE IMPACT OF PRE-EXPOSURE PROPHYLAXIS FOR HIV PREVENTION IN THE CONTEXT OF GONORRHEA AND CHLAMYDIA INFECTION

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ABSTRACT

Pre-exposure prophylaxis (PrEP) is recommended for preventing HIV infection among individuals at high risk, including men who have sex with men (MSM). The synergy of HIV and other sexually transmitted infections (STIs) including gonorrhea (NG) and chlamydia (CT) can provide a unique opportunity to target populations at highest risk for HIV infection. However, the population-level impact of such programs at current (and improved) levels of STI screening remains uncertain. Applying an agent-based simulation of HIV and NG/CT infection, we explored the impact of NG/CT-targeted PrEP among MSM in Baltimore City. Our results suggest that targeting MSM infected with NG/CT can be an effective means of PrEP delivery. If high levels of STI screening can be achieved at the community level, NG/CT diagnosis may be an important and efficient entry point for PrEP evaluation and delivery; expanding NG/CT screening in conjunction with PrEP can augment this impact even further.

1 INTRODUCTION

Pre-exposure prophylaxis (PrEP) is a novel biomedical intervention for HIV prevention that has been at the center of clinical research and political discussions in recent years. On the basis of evidence for reducing risk of HIV transmission, PrEP is now widely recommended for implementation across the US, and among key populations including men who have sex with men (MSM). Given the high cost of PrEP and the substantial barriers to implementation among most high-risk groups, it is therefore critical to target limited prevention resources to optimize impact at the population-level.

The synergy of HIV and other sexually transmitted infections (STIs), including gonorrhea (NG) and chlamydia (CT), provides a unique opportunity to direct interventions toward populations at highest risk. Those diagnosed with STIs experience a higher than average risk of HIV infection due to a combination of biological factors and sexual risk behaviors. While CDC recommends NG/CT screening at least annually for sexually active MSM, rates of STI screening/treatment in practice remain suboptimal. Improving the underlying rate of STI screening and treatment can help HIV prevention efforts in two ways: 1) diagnosing and treating more STIs and averting the additional associated biological risk for HIV infection, and 2) identifying more potential candidates for PrEP evaluation and delivery. To assess this hypothesis, we expanded an existing agent-based simulation model of HIV among MSM in Baltimore City to incorporate NG/CT. We applied this model to explore the impact PrEP implementation among MSM diagnosed with NG/CT at existing and improved levels of NG/CT screening, and projected the population level impact on HIV and NG/CT incidence and prevalence over 5 years.

2 METHODS

Our agent-based simulation model of the HIV epidemic among MSM in Baltimore City has been previously published in Kasaie, et al. (2017). Given similarities in clinical manifestation and co-treatment, and

for simplicity of modeling, we modeled NG/CT as a single infection. We distinguished NG/CT infections by site of infection (urethral, rectal or pharyngeal) and presence of symptoms (symptomatic versus asymptomatic disease). We further modeled various pathways for NG/CT screening/treatment through guideline-based screening, testing symptomatic patients and self recovery. Guideline-based screening was modeled for HIV-positive MSM in care at the time of annual examinations, and among all MSM presenting to HIV/STI care services (e.g., STI clinics, community health centers). The model was calibrated against aggregate estimates of HIV and NG/CT incidence, prevalence, and the HIV care continuum in Baltimore City.

3 EXPERIMENTS

Our primary outcome was the projected incidence of HIV after 5 years of delivering PrEP to all MSM diagnosed with NG/CT in the population (at the time of diagnosis). We compared this result across a range of hypothetical scenarios for improving the underlying level of NG/CT screening at the population level, and studied the additional gain in effectiveness of NG/CT-targeted PrEP under this assumption. In all scenarios, eligibility for PrEP was considered in accordance with CDC recommendations and includes HIV-negative individuals diagnosed with NG/CT in the last 6 months, living in a serodiscordant partnership, or reporting an unprotected sex act or a new casual partnership in the last 6 months. Those eligible for PrEP were assumed to initiate therapy with a 60% probability (uptake) and to take medications with sufficient frequency to provide protection against HIV infection on 60% of days (adherence). PrEP eligibility is reassessed every 3 months, and those who remain eligible for PrEP continue to receive it over time.

4 RESULTS & CONCLUSION

At baseline and in the absence of PrEP (assumed to represent a steady state equilibrium), 347 [286 – 411] MSM were annually diagnosed and treated for NG/CT (calibrated to data from Baltimore City). If 60% of this population could be started on PrEP and maintained on treatment with 60% adherence, HIV incidence was estimated to decline by 4% [2 – 6%] over 5 years, relative to no PrEP. This corresponds to averting 31 [0 – 92] new cases of HIV during this time. Given the increased frequency of STI screening among those on PrEP, the prevalence of NG/CT was reduced by 22% [20 – 24%] during this timeline. The population-level impact of NG/CT-targeted PrEP was further improved with an increase in community-level rates of NG/CT diagnosis and treatment: if individual MSM were to undergo STI screening at least every other year and were offered PrEP at the time of NG/CT diagnosis (with 60% uptake), HIV incidence could fall by 10% [7 – 12%] in 5 years. Despite a substantial projected decrease in prevalence of NG/CT by 69% [68 – 70%] during this time, NG/CT incidence began to increase after the end of program, reflecting the need for additional STI-targeted prevention programs to avert future transmission of NG/CT.

This agent-based simulation of HIV transmission among MSM suggests that screening for NG/CT may be an important and efficient entry point for PrEP evaluation and delivery. Expanding NG/CT diagnosis in conjunction with PrEP delivery can augment this impact even further. While PrEP does not provide protection against NG/CT, the increased frequency of STI screening among those on PrEP can improve the community-level prevalence of NG/CT. Further prevention strategies targeting risk factors for NG/CT transmission (e.g., unprotected sex, concurrent partnerships) are needed to maintain reductions in incidence of NG/CT and control disease prevalence in long term.

REFERENCES

Kasaie, P., Pennington, J., Shah, M. S., Berry, S. A., German, D., Flynn, C. P., Beyrer, C. and Dowdy, D. W. (2017). “The Impact of Preexposure Prophylaxis Among Men Who Have Sex With Men: An Individual-Based Model”. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 75(2), 175-183.