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Can the 'Ending the HIV Epidemic' initiative transition the US towards HIV/AIDS epidemic control?

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Running head: Reaching HIV epidemic control in 6 US cities

Summary

Using a dynamic HIV transmission model calibrated for 6 US cities, we projected HIV incidence from 2020-2040 and estimated whether an established UNAIDS HIV epidemic control target could be met under ideal implementation of optimal combination strategies previously defined for each city. Four of six cities (Atlanta, Baltimore, New York City, and Seattle) were projected to achieve epidemic control by 2040 and we identified differences in reaching epidemic control across racial/ethnic groups.

Introduction

Progress towards addressing HIV/AIDS in the United States (US) has stalled, spurring the 2019 declaration to 'End the HIV Epidemic' (EHE) in the US, which aims for a 90% reduction in the number of incident infections by 2030 [1]. To generate international consensus, UNAIDS defined several metrics for HIV epidemic control [2–4]. Using surveillance data, Bosh and colleagues found the US to meet several, but not all control targets by 2015 [5]; however, their assessment obscures trends occurring at subnational levels and key population subgroups.

Our previous HIV epidemic modeling study identified optimal, city-specific combinations of evidence-based interventions to prevent, diagnose and treat HIV/AIDS in six US cities accounting for 24% of all people living with HIV (PLHIV) [6–12]. We found that substantial reductions in HIV incidence (population-weighted average reduction of 63.5% across cities) could be achieved if interventions were implemented at ideal levels (90% target population coverage for each intervention) for 10 years [11], but that racial/ethnic disparities would persist [13]. Achieving epidemic control represents a critical benchmark on the path to ending HIV epidemics [3,4]. Given longstanding racial/ethnic [14] and regional disparities in HIV/AIDS, more detailed analysis on epidemic control is warranted, particularly as epidemics become increasingly concentrated among key sub-populations [4,5,15].

Our objective was to determine whether extending the ideal implementation of city-specific, combination implementation strategies

identified in our prior research for 20 years could lead to meeting an established measure of epidemic control in six US cities. We also sought to examine potential disparities in reaching control in key racial/ethnic and transmission groups.

Methods

We employed a calibrated and validated dynamic, compartmental HIV transmission model to simulate HIV micro-epidemics in six US cities: Atlanta, GA, Baltimore, MD, Los Angeles (LA), CA, Miami, FL, New York City (NYC), NY, and Seattle, WA [11]. We previously identified optimal combination strategies for each city, which provided the greatest health benefits while remaining cost-effective. In this study, we extended the sustainment of these combinations implemented at 'ideal' levels (i.e., 90% target population coverage) from a 10- year to a 20-year time horizon (2020-2040) and stratified projected HIV incidence by racial/ethnic groups (also by HIV transmission risk groups for additional analysis). We defined HIV epidemic control as absolute HIV incidence of less than one infection per 10,000 adults per year (according to UNAIDS [2,4]) and conducted probabilistic sensitivity analysis.

Results

Under ideal implementation, 4/6 cities (Atlanta, Baltimore, NYC and Seattle) are projected to achieve epidemic control by 2030. We estimate that LA and Miami are unlikely to reach epidemic control within the study time horizon, with an estimated incidence rate of 1.77 [95% Credible Intervals (CI): 1.21, 2.51] and 2.09 [95% CI: 0.98, 5.19] per 10,000 adults in

2040, respectively (**Fig. 1**).

We also found differences in reaching epidemic control across racial/ethnic and risk groups by 2040. In Atlanta, Baltimore, NYC and Seattle, epidemic control was reached for the White population earlier than for Hispanic and Black populations (**Fig. 1**). In all cities but Miami, the control target was reached among heterosexuals prior to 2020, while control was not achieved in any city among MSM by 2040 (results not shown).

Discussion

Our findings suggest that implementing city-specific, optimal combination strategies can reach an international benchmark of epidemic control in four of the six US cities in our study, but will require upfront investment, substantial increases in service access, and a long-term commitment to sustain these efforts. Although LA and Miami would not reach the control target by 2040, implementing the recommended combinations would narrow the racial/ethnic disparities in HIV incidence between White and Black/Hispanic populations.

Differences in reaching epidemic control between cities are driven by diverse factors, including disparities in available resources [16], the extent of sexual mixing between race/ethnic groups [17] as well as existing differences and projected shifts in the demographic composition of each city. On the latter point, increases in the relative size of the Hispanic population in Miami and Los Angeles in particular will challenge these cities' responses without targeted, culturally sensitive approaches. NYC and Seattle, cities with the strongest political and funding support, already have low incidence that approaches the point of epidemic control (2.44 and 1.30 per 10,000 adults respectively in 2020). Further, the assortative sexual mixing between racial/ethnic groups accounted for in our model will likely exacerbate existing disparities in HIV incidence as the impacts of interventions conferred to White populations will not extend to other racial groups, a barrier to reaching control and other targets. Authorities must respond to existing epidemic characteristics and anticipated

demographic changes by targeting HIV-related services to Black and Hispanic populations while engaging with the broader social/structural forces that shape these epidemics.

Our analysis assumed proportional scale-up of interventions by race/ethnicity from existing levels representing disparate barriers to care at baseline. Explicit efforts to reduce inequality

and structural constraints in healthcare access are needed to reduce these barriers. Across diverse settings, program uptake and engagement in care among PLHIV and susceptible populations are mediated by socioeconomic needs, including housing, transportation, employment, navigation support, and substance use treatment and mental health services [18,19]. As disadvantaged populations are less likely to have these needs satisfied [20], intersectional approaches to service delivery may be warranted. Patient-centered delivery models that require funding recipients (states, metropolitan areas, community-based organizations) to detail their approach to reducing disparities have increased viral suppression and reduced disparities in care outcomes among key populations [21] and should be considered for expansion/replication.

This study features several limitations, which have been described in our prior publications on this topic [6,10–13]. The combination strategies we assessed and recommended should not be considered exhaustive, as more effective interventions, such as long-acting injectable PrEP modalities are expected to come available in the near future and will accelerate efforts towards epidemic control.

This study highlights the importance of local, disaggregated assessment of epidemic control. Large increases in service access/delivery and sustained implementation of optimal combination strategies can lead to epidemic control, but inequitable results across race/ethnic and transmission risk groups will persist unless efforts to explicitly reduce these disparities are implemented.

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Fig.1. Projected HIV incidence (per 10,000 adults, aged 15-64) between 2020-2040 under ideal implementation of combination strategies in six US cities, in relation to the UNAIDS epidemic control target, overall and stratified by racial/ethnic groups. The y- axis is in the logarithmic scale with base 2.