The influence of risk group turnover in STI/HIV epidemics: mechanistic insights from transmission modeling

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Background: Heterogeneity in the risks of STI/HIV acquisition and transmission are central to core group theory. We examined the influence of population turnover among risk groups on group-specific STI prevalence and the contribution of unmet needs among the core group to onward transmission.

Methods: We developed an analytical approach to modeling risk group turnover that leverages demographic data and ensures constant relative risk group size. A deterministic model of STI transmission without disease-attributable mortality incorporated this turnover approach with three risk groups, including: a core group with the highest rates of partner change, a multiple-partnerships group, and a low-risk group. We varied the duration within the core group (3 to 33 years) via turnover among all groups and duration of infectiousness (5 years to lifetime) via a uniform treatment rate. We then compared the influence of turnover on group-specific STI prevalence at different treatment rates. We also calibrated to group-specific STI prevalence with and without turnover, and compared the fitted partner change rates and transmission population attributable fraction (tPAF) of the core group to cumulative STI infections in the total population.

Methods: Across the range of turnover and treatment parameters explored, turnover consistently decreased STI prevalence in the core group. In the low-risk group, turnover increased prevalence under low treatment rate, but had the opposite effect under high treatment rate. When calibrating to the same STI prevalence, fitted core group partner change rates were higher with turnover than without. Using these fitted parameters, models with turnover then consistently projected a higher tPAF of the core group versus models without.

Conclusion: Modeling of risk group turnover can influence the projected group-specific STI prevalence and fitted risk parameters. Models without turnover may underestimate the contribution of core groups in STI epidemics, and thus the impact of interventions prioritizing these populations.

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