Utility of the 1% HIV prevalence threshold in defining concentrated HIV epidemics

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BACKGROUND

•Regions continue to be labeled as experiencing “concentrated” HIV epidemics if their overall (or general population) HIV prevalence is less than1%.

•Concentrated epidemics →prioritize and inform surveillance and prevention among key populations most at risk of HIV acquisition and transmission, such as female sex workers (FSW).

QUESTION

•What is the sensitivity and specificity of the 1% threshold in distinguishing HIV epidemics by the risk factors that sustain HIV spread, such as unprotected sex work?

METHODS

•9,000 synthetic HIV epidemics using a deterministic mathematical model of heterosexual HIV transmission
•FSW, clients, general population
•Two age-groups
•Condom-use, no antiretroviral treatment

•Data sources:
- systematic review of published FSW/client data from Sub-Saharan Africa (SSA)
- sub-national general population data from demographic health surveys in SSA

•Epidemic classification (based on R0)
- Concentrated
  - Unprotected sex work necessary and sufficient for HIV spread
- Generalized
  - Unprotected sex work insufficient on its own for HIV spread
- Mixed
  - Sustained epidemics neither concentrated nor generalized

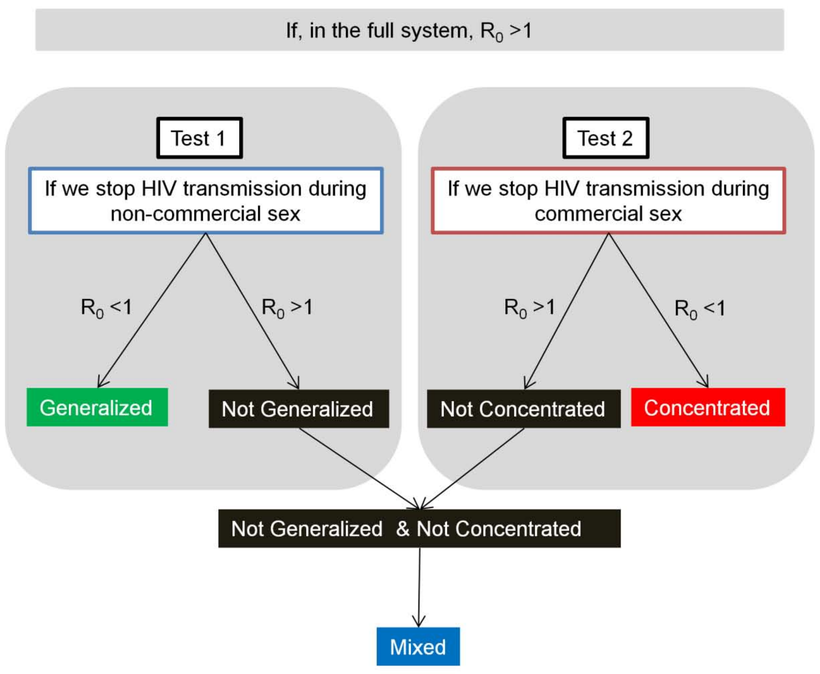


Figure 1. Conceptual framework for defining HIV epidemics on the basis of R_0. Test 1 and Test 2 are mutually exclusive tests to help define epidemics. In Test 1, if we stop transmission during non-sex work, and the R_0 is below 1, then the epidemic is generalized; and not-generalized otherwise. In Test 2, if we stop transmission during sex work, and the R_0 is below 1, the epidemic is concentrated; not-concentrated otherwise. If, after performing Test 1 and Test 2 separately, the answer is that the epidemic is not generalized *and* not concentrated, then the epidemic is mixed.

Epidemic Type	Year	Sens (%)	Spec (%)	PPV (%)	NPV (%)
Concentrated vs. Non-concentrated (Mixed and Generalized)	1990	65%	92%	80%	84%
	2008	89%	75%	65%	94%
(Concentrated and Mixed) vs. Generalized	1990	60%	90%	93%	53%
	2008	83%	63%	85%	68%

Sens (sensitivity); Spec (Specificity); PPV (Positive Predictive Value); NPV (Negative Predictive Value). PPV and NPV estimated under assumption that each epidemic type is equally likely in real-life.

RESULTS

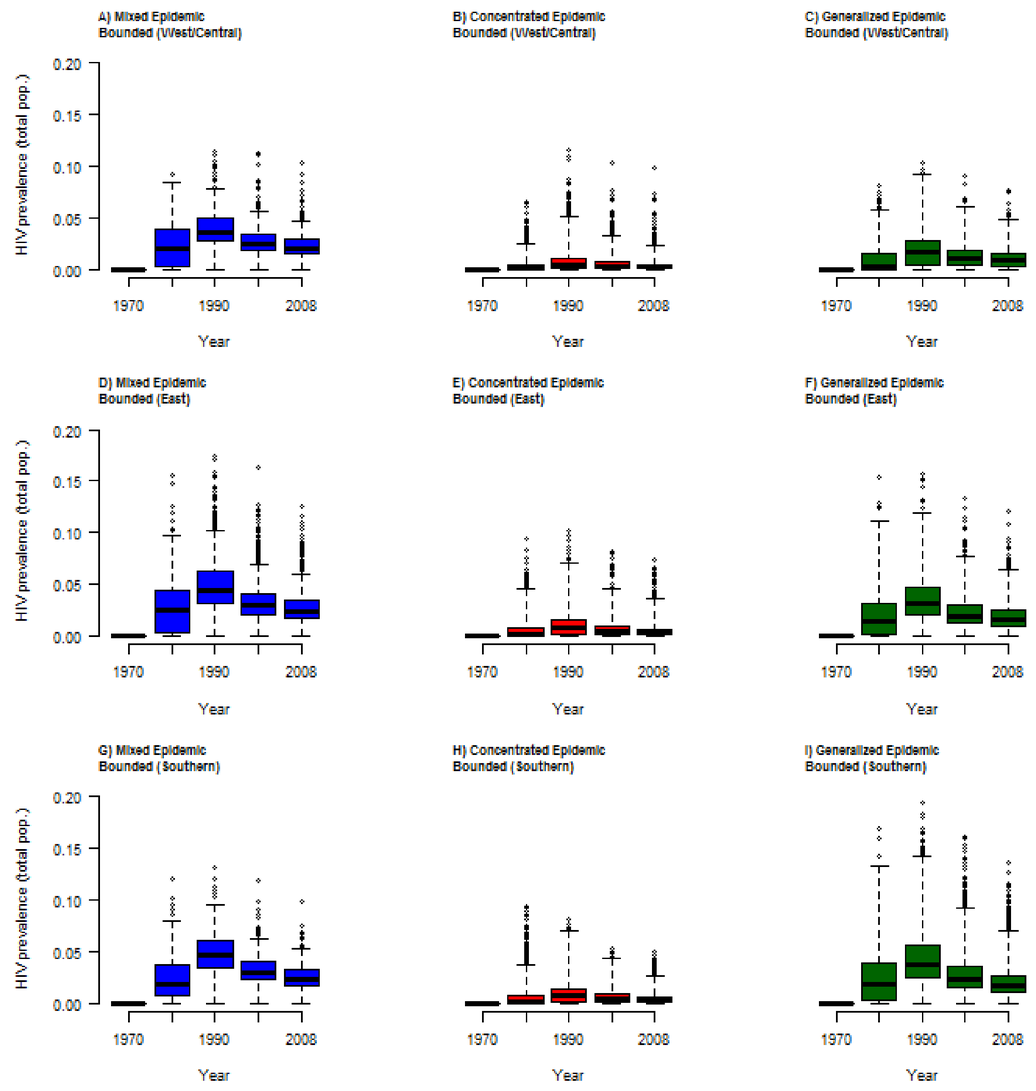


Figure 2. Bounded HIV prevalence in the total population based on parameter inputs from West and Central (A-C), East (D-F), and Southern (G-I) Africa. Overall HIV prevalence (total population) from synthetic epidemics generated using range of data from each region with constraints imposed by observed data (upper values of observed trends in HIV prevalence in the total population, young women <24 years of age, and FSWs prior to 2008).

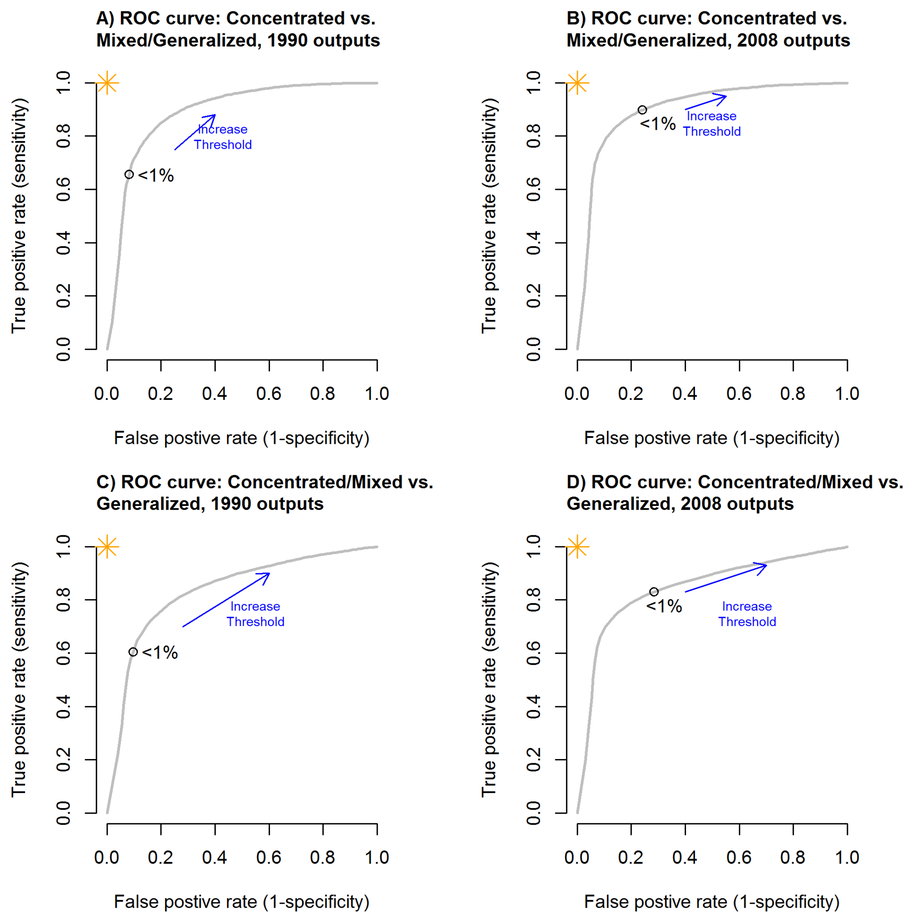


Figure 3. Receiver operating characteristic (ROC) curves for using the overall HIV prevalence to define concentrated HIV epidemics (Panels A [1990], B [2008]), and to define concentrated/mixed epidemics (Panels C [1990], D [2008]). The circle denotes the 1% overall HIV prevalence. A perfect threshold has a sensitivity and specificity at the top left hand corner of an ROC curve (orange star).

CONCLUSIONS

•The 1% HIV prevalence threshold is neither sensitive nor specific enough to adequately identify concentrated HIV epidemics.

•As a stand-alone approach, the 1% threshold should not form the basis of how surveillance and interventions are prioritized.

References
1. Wilson D, Halperin DT (2008) "Know your epidemic, know your response": A useful approach, if we get it right. Lancet 372: 423-426
2. Blanchard JF (2002) Populations, pathogens, and epidemic phases. Sex Transm Infect 78: I183-I188.

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