INVESTIGATING HIV MIXING BY INJECTION DRUG USE STATUS IN MIAMI USING A NOVEL APPROACH FOR BAYESIAN INFERENCE ON PARTIALLY OBSERVED MOLECULAR NETWORKS

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Background: Understanding HIV disease dynamics among populations is important to develop effective interventions and assess their impact. Molecular HIV Surveillance (MHS) supports such investigation through linking individuals with genetically similar viral sequences. A limitation of MHS to investigate disease dynamics is that substantial data are missing as not everyone diagnosed is sequenced. In Miami-Dade County (MDC), only 30.1% of people with HIV have a reported sequence. Ignoring missing data results in biases in estimates of disease dynamics.

Methods: We develop a novel statistical method to draw Bayesian inference on the partially observed viral sequence network constructed using MHS data; the approach leverages recent advances in network models and graph theory to overcome theoretical and computation limitations of previous methods. We apply our approach to estimate HIV transmission dynamics among men who have sex with men (MSM) who do and do not report inject drug use (IDU) based on MHS data from MDC. To validate the approach, we perform a simulation study of 900 simulations.

Results: Using our Bayesian inference method, linkages from MSM with no reported IDU to MSM with reported IDU increase from 4.4% observed in MHS data to 12.2% using our Bayesian inference method. Similarly, linkages from MSM with reported IDU to other MSM with reported IDU increase from 1.7% observed to 32.3% using Bayesian inference. Under random mixing assumptions by IDU status, we would expect 4.3% of edges to link to MSM with reported IDU.

Conclusions: Using our novel statistical approach to account for missing data, we estimate increased sexual mixing between among MSM with and without reported IDU, compared to observed values. Our approach is successfully able to statistically investigate complex network properties based on partial observed networks of tens of thousands of individuals. This work can inform intervention design, analysis, and impact.

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