EPHP8.03

Incorporating sexual health survey and clinical data to predict the impact of testing among gay, bisexual and other men who have sex with men in Vancouver, Canada

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BACKGROUND:

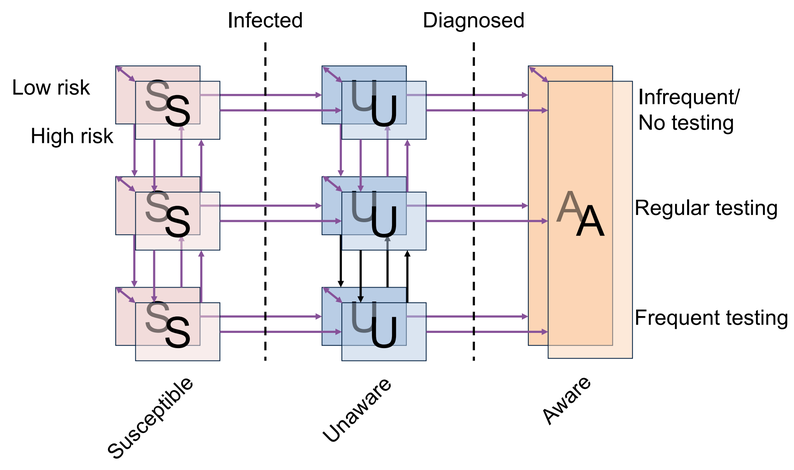
- Coupled with effective treatment and behavioural change among individuals with detected infection, increased testing should reduce onward incidence of HIV in the population.
- It can be difficult to predict the strengths of these effects and thus the overall impact of testing.
- Coupled with this is a difficulty in combining sexual health survey data with firm clinical data to produce robust estimates of future trends.
- We construct a mathematical model of an ongoing HIV epidemic in a population of gay, bisexual and other men who have sex with men (GBMSM) in Metro Vancouver, CA.
- The model incorporates different levels of infection risk, testing habits and awareness of HIV status among members of the population.

OBJECTIVE:

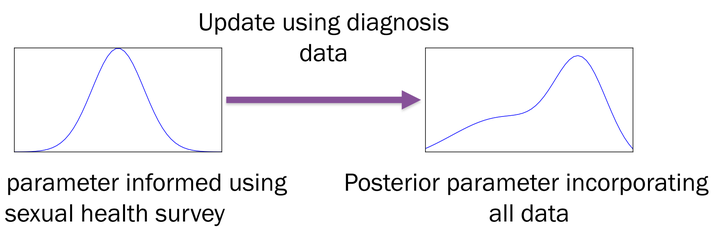
- Develop novel Bayesian methodology for robustly fitting infectious disease model, incorporating potentially unreliable sexual health survey data along with firm clinical diagnosis data.
- For Vancouver context, understand how current patterns of risk and testing impact overall HIV dynamics.
- Project forwards to estimate the impact of short-term enhanced testing versus a slow scale-up of testing over a longer term.

METHODS:

- Modelling approach: Compartments of susceptible (S), infected and unaware (U), infected and aware (A) population. Stratified by risk group and testing pattern.



- Data and model fitting: Bayesian model fitting using well-informed priors derived from sexual health survey data of longitudinally-tracked HIV negative GBMSM within Vancouver. Distributions were then updated using diagnosis data from Vancouver between 2005-2014 to produce final estimate.



- Scenarios were constructed around increasing rates of conversion from no testing to regular testing for five years or for whole future projected period.

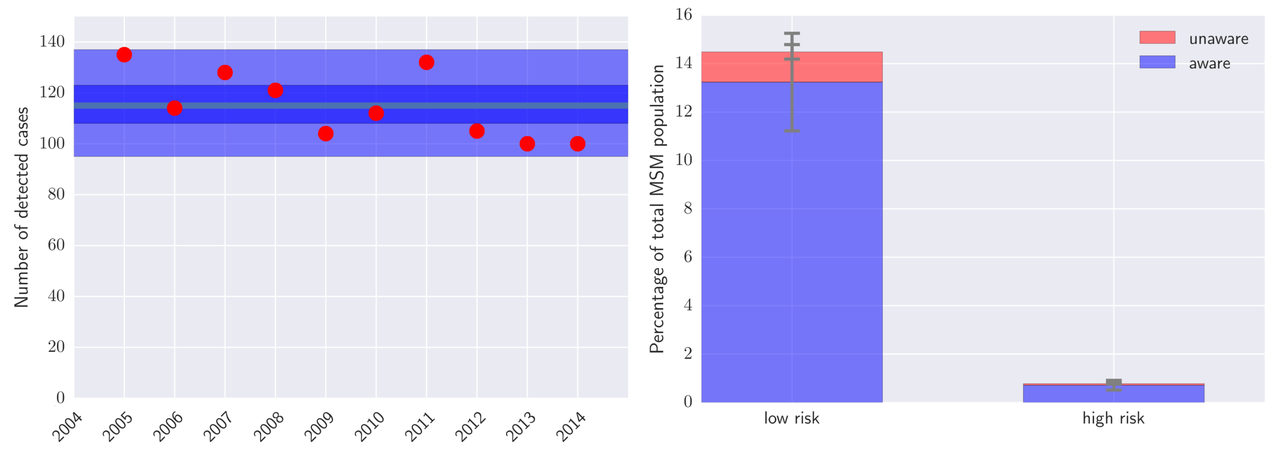
RESULTS:

- Mixing between high and low risk groups, population turnover rate, rate of sexual encounter in high risk group, per-contact risk of infection in low risk group and rate of transitioning from high to low risk all significantly updated using Bayesian method.
- Estimated total prevalence was 18.9% (17.2%–20.5%). Estimated unaware of HIV-positive status was 1.3% (1.2%–1.6%) of GBMSM population or 6.7% (5.3%–8.3%) of HIV-positive population.
- For a testing campaign intervention that has a lifetime of 5 years, the cumulative numbers of cases averted at a 30-year time-horizon are 29 (11-48), 43 (17-79), 68 (34-113) and 95 (54-164) where 50%, 60%, 70% and 80% of none-testers become regular testers respectively within five years since the start of the intervention.

CONCLUSIONS:

- Novel Bayesian methodology has potential to combine multiple different data sources in order to provide a robust consistent picture of the current HIV epidemic in GBMSM.
- Number of individuals who are unaware of their HIV status and can potentially be targeted in a testing intervention is estimated to be 260 (240–290), indicating testing is already highly effective in Vancouver.
- A short-lived but intensive testing campaign can potentially produce many of the same benefits as a campaign that is less intensive but of longer duration.

Figure 1: Predictive model-based incidence and prevalence



Left : Model fitting to diagnoses between 2004-2014 (fit: median, 50% credible interval, 95% credible interval shown from dark to light shades respectively, data: red). Right: Predicted prevalence of HIV-positive cases in GBMSM population by high/low risk group and awareness of status.

Figure 2: Impact of updating prior health survey parameters with additional data

Significant differences between prior distributions derived from sexual health survey (blue) and posterior combined with diagnosis data (green). From top to bottom parameters are: probability of per-contact transmission (aware, low risk), mixing rate, high-risk rate of sexual contact, turnover rate, and low-risk rate of sexual contact

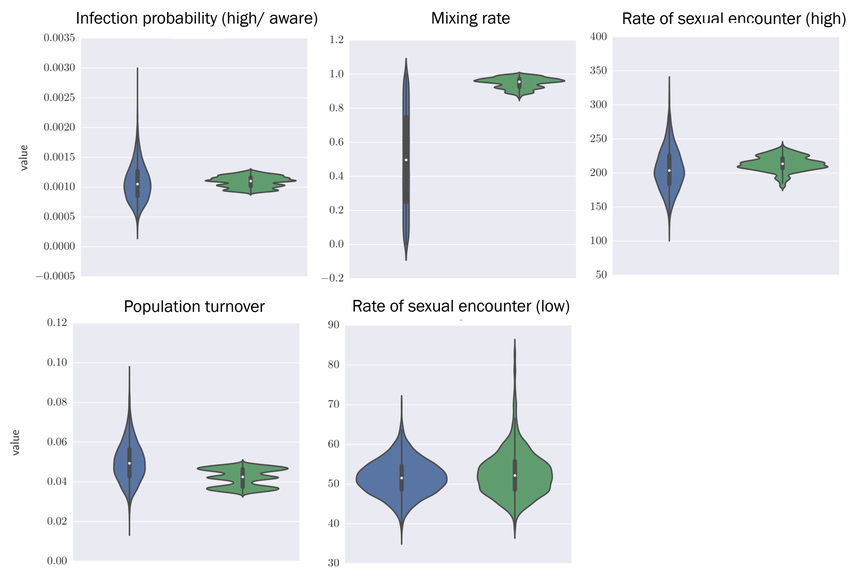


Figure 3: Change in detected cases under never-ending and five-year campaign

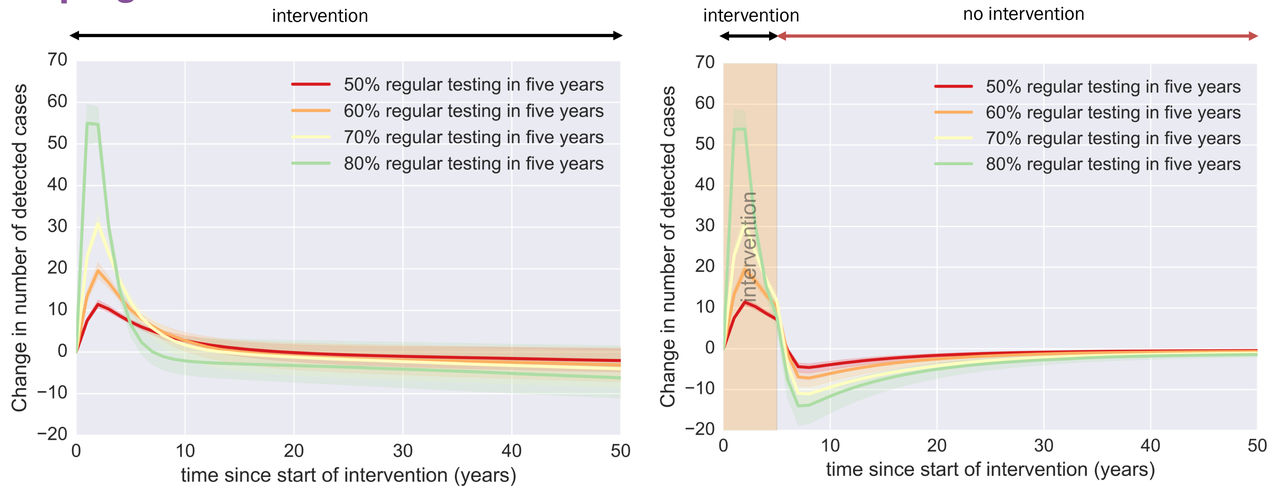


Table 1: Impact of increased testing on total cases averted (95% credible intervals)

		Time horizon (years)	
	Regular testing within 5 years	10	30
Never-ending campaign	50%	13 (6, 24)	75 (37, 132)
	80%	48 (20, 82)	200 (83, 331)
Five year campaign	50%	12 (5, 20)	29 (11,48)
	80%	42 (23, 74)	95 (54,164)

Future directions:

- More accurately model different stages of HIV infection and include age-structure.
- Understand the impact of PrEP within the context of different testing patterns.
- Expand modelling framework to whole of BC, where opportunities to test are more limited.

Reference

1. Irvine MA, Konrad BP, Michelow W, Balshaw R, Gilbert M, Coombs D. A novel Bayesian approach to predicting reductions in HIV incidence following increased testing interventions among gay, bisexual and other men who have sex with men in Vancouver, Canada. Journal of The Royal Society Interface. 2018 Mar 1;15(140):20170849.

Acknowledgements

M.A.I., D.C. and M.G. acknowledge support from the Canadian Institutes of Health Research Partnerships for Health Systems Improvement programme (grant no. 318068). D.C. acknowledges support from the Natural Science and Engineering Research Council of Canada.

Declaration

The authors declare no competing interests.

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To talk during/after the conference please email m.Irvine@math.ubc.ca. To find out more about our research projects including this one please visit our website www.lovebytesresearch.ca