Implementation of a near real-time phylogenetic monitoring program for HIV transmission outbreaks

Art FY Poon[1,2], Conan K Woods[1], Susan Shurgold[1], Guillaume Colley[1], Robert S Hogg[1,3], Mel Krajden[4], Mark Gilbert[4,5], Reka Gustafson[6], Julio SG Montaner[1,2], and P Richard Harrigan[1,2]

[1]BC Centre for Excellence in HIV/AIDS Vancouver, Canada; [2]Department of Medicine, University of British Columbia; [3]Faculty of Health Sciences, Simon Fraser University; [4]BC Centre for Disease Control; [5]Ontario HIV Treatment Network; [6]Vancouver Coastal Health

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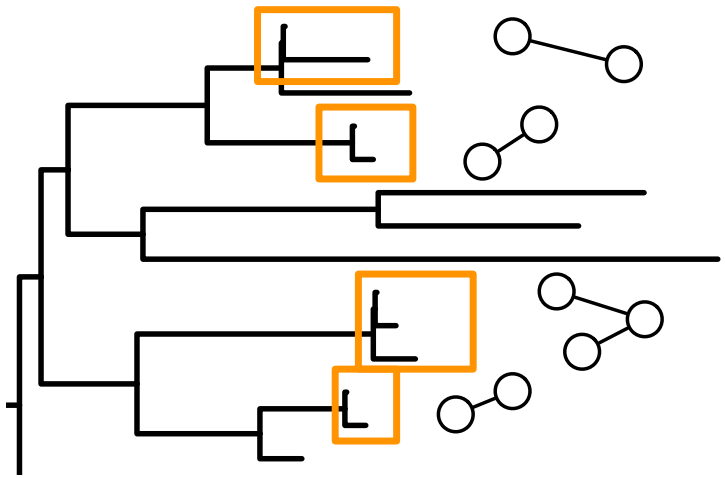
Phylogenetic clustering

- A popular method for characterizing the transmission history of an epidemic.
- HIV evolution and transmission unfold on similar time scales.
- Clusters of genetically similar infections can represent localized outbreaks of HIV transmission.



HIV treatment in BC, Canada

- BC Centre for Excellence in HIV/AIDS is responsible for all routine HIV drug resistance genotyping in the province.
- HIV genotyping is automatically performed on all new patients' baseline samples submitted for viral load testing.
- Data are already available from ∼75% of the 11,000 people ever enrolled in Drug Treatment Program (DTP)*.
- All de-identified sequences deposited in DTP database with anonymous clinical, demographic, and risk factor data.

*Estimated HIV prevalence in BC: ∼15,000 persons

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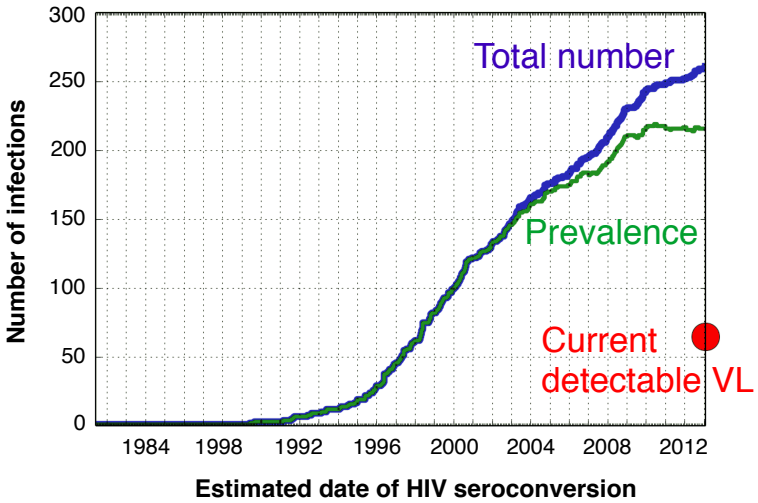
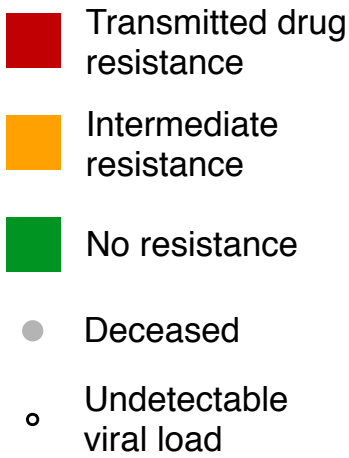
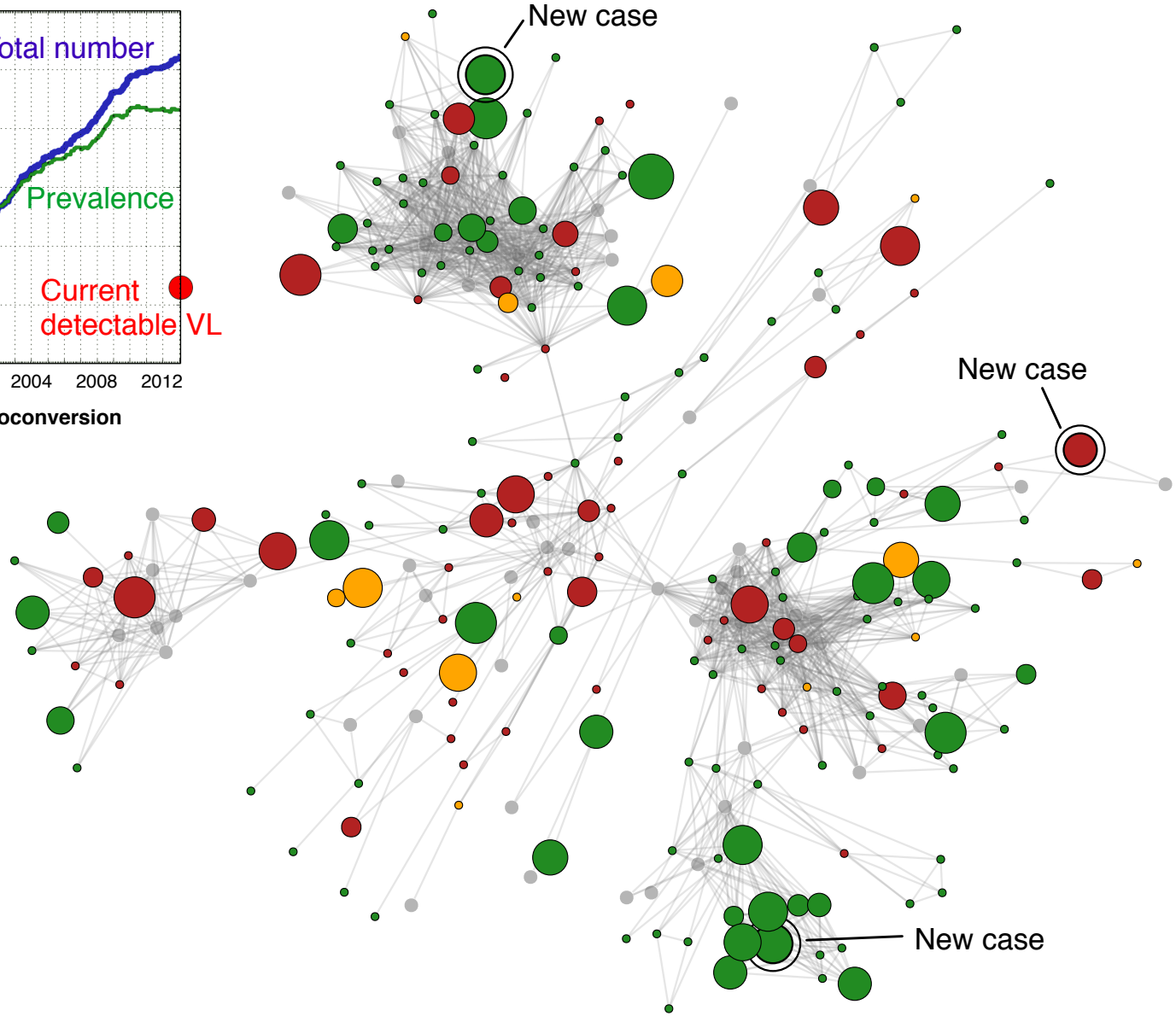
BC Centre monitoring system

- Automated system queries the drug resistance database hourly.
- If new records exist, it performs a phylogenetic analysis of entire database and maps clusters.
- Determines if new cases appear within clusters, defined at a minimum size of 5 individuals.
- Monthly and quarterly reports[†] on cluster growth and characteristics issued to Centre directors, BC Centre for Disease Control, BC Ministry of Health.

[†]Daily reports to lab director.

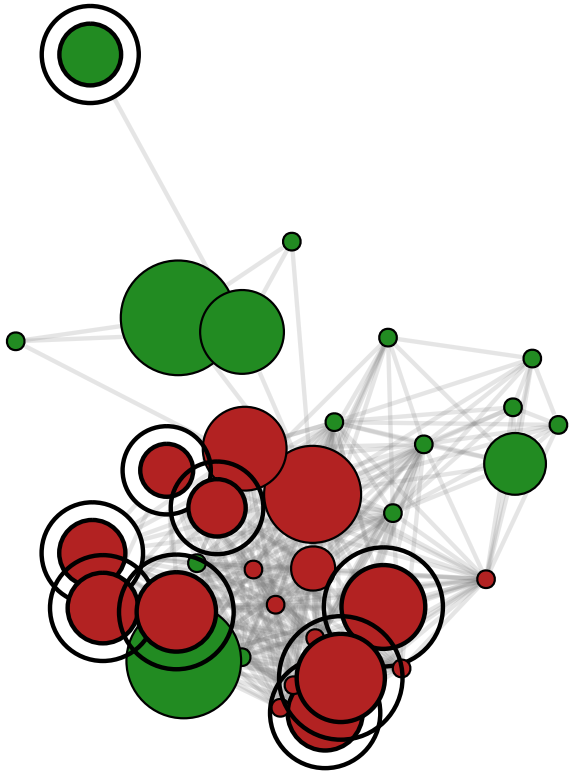

300
250
200
150
100
50
0
Number of infections
Total number
Prevalence
Current
detectable VL
1984
1998
1992
1996
2000
2004
2008
2012
Estimated date of HIV seroconversion


Transmitted drug resistance
Intermediate resistance
No resistance
Deceased
Undetectable viral load


New case
New case
New case

An ‘actionable’ cluster

- Detected growth of a cluster by 9 new cases in 3 months.
- All but one carried transmitted HIV drug resistance[‡] (TDR).
- Prompted a formal outbreak investigation, currently ongoing.
- Majority of viral loads have since changed from high to undetectable.



[‡]K103N, NNRTI resistance

Concluding remarks

- Difficult to obtain timely information on recent changes in an epidemic.
- Real-time monitoring of population-wide resistance data can inform targeted HIV prevention efforts.
- Preserving treatment options by detecting and averting transmission of HIV drug resistance.
- Knowledge translation was driven by a recent local outbreak of transmitted drug resistance.

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