Quantifying the effect of Pre-Exposure Prophylaxis on HIV-1 transmission in New South Wales using molecular epidemiology

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Background:
Australia's rapid roll-out of pre-exposure prophylaxis (PrEP) in 2016 led to a steep decline in new diagnoses of human immunodeficiency virus 1 (HIV-1). However, routine surveillance data from NSW indicated an uneven effect across sub-populations, with minimal changes outside inner Sydney. We quantify the discrepancy in transmission dynamics pre- and post-PrEP roll-out using HIV-1 sequences from individuals newly diagnosed in NSW from 2011-2023. This work was conducted in association with the H2Seq working group, and we further include considerations for how such results add value to routine surveillance.

Methods:
2,760 sequences with metadata were used for analysis. A maximum likelihood phylogeny was estimated using IQTree, from which transmission clusters were defined using ClusterPicker at a 3% genetic distance threshold. We then estimated the reproductive number (R_e) for large clusters (>10 sequences) using a Bayesian phylodynamic approach in BEAST v2.

Results:
Sixteen large clusters (≥ 10 sequences) were found representing 207 sequences (7.5%). Phylodynamic analysis of these inferred an increasing reproductive number alongside the roll-out of PrEP in 2016 and post COVID-19 lockdowns. The demographic mapping of these clusters showed substantial changes across time

with an increase in the proportion of heterosexual relative to MSM diagnoses. We also observed an increase in diagnoses in Greater Western Sydney and a decline in the Sydney inner city areas, likely coinciding with successful PrEP uptake in the latter.

Conclusion:
Our phylodynamic results offer sharper insight into the uneven effect of PrEP roll-out on HIV-1 transmission in NSW. While decline in transmission was sharpest among inner Sydney clusters, a subset of larger clusters show increasing growth with shift towards Western Sydney and heterosexual diagnoses. More generally, the analyses herein demonstrate that molecular epidemiology adds resolution and confidence results from traditional routine surveillance.

Disclosure of Interest Statement:
The Australasian Society for HIV, Viral Hepatitis & Sexual Health Medicine recognises the considerable contribution that industry partners make to professional and research activities. We also recognise the need for transparency of disclosure of potential conflicts of interest by acknowledging these relationships in publications and presentations.

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