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The best of both worlds: Collaborations can improve epidemiological analyses of public health data

Catherine R. Lesko, MPH, PhD¹ and Jonathan V. Todd, MSPH²

¹Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health

²Department of Epidemiology, University of North Carolina

The HIV care continuum has gained significant traction as a useful framework among both public health practitioners and academic researchers. The continuum estimates the proportion of HIV-infected persons who are HIV diagnosed, linked to and retained in care, initiated on antiretroviral therapy (ART) and virally suppressed.^{1,2} Public health practitioners are increasingly being called upon (and required)³ to estimate and improve the HIV care continuum in their jurisdiction (e.g., state, dependent area, metropolitan statistical area). Public health estimates of the HIV care continuum typically rely on CD4 counts and viral loads reported to HIV surveillance.⁴ In this issue of *Sexually Transmitted Diseases*, Toren et al.⁵ use surveillance data to show that the time between HIV diagnosis and viral suppression for persons diagnosed with HIV in Seattle & King County decreased dramatically from 2007 to 2013. We welcome the contribution by Toren et al.⁵ as a valuable and timely contribution to the literature on the effects of rapidly changing treatment paradigms on improvements in the HIV care continuum.

Being population-based, public health surveillance data offers a unique opportunity to obtain unbiased estimates of the HIV care continuum. Estimation of the HIV care continuum is inherently limited in clinical cohorts. Namely, clinical cohorts represent a non-random subset of all HIV-diagnosed persons who 1) ever entered care and 2) remained in care *at the clinic* where the cohort is based. Because surveillance data are population-based, the recent work by Toren et al.⁵ has the advantage of being able to include all persons diagnosed with HIV in Seattle & King County, including persons who never enter care and never achieve viral suppression. The inclusion of persons diagnosed with HIV avoids bias inherent in clinic-based analyses: 1) of absolute time to viral suppression if persons who never enter care and thus never suppress are excluded from the risk set; 2) of characteristics associated with prompt viral suppression if HIV-infected persons who enter care differ from those who do not enter care; and 3) of changing time to viral suppression over calendar time if the characteristics of HIV-infected persons who entered care varied over time.

Most clinics do not have the resources for extensive patient tracing if patients fail to return for follow-up. Patients may leave a clinic because they move out of the area, switch clinical

Correspondence to Catherine Lesko, 615 N Wolfe Street, Baltimore, MD 21205, Tel: 410-614-6517, Fax: 410-614-0902, clesko2@jhu.edu.

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providers within the same area, or fall out of clinical care; this information is not generally recorded. In one clinical cohort, loss-to-clinic was substantial (5-year risk = 46%) yet mortality among persons lost-to-clinic was similar to mortality among persons retained in care, suggesting that some of those who were lost-to-clinic likely entered care elsewhere and loss-to-clinic may overestimate loss-to-care.⁶ Because public health surveillance data are *not* clinic-based, they (hypothetically) capture laboratory measures for HIV-infected patients, regardless of the provider who ordered the labs, and therefore follow patients if they change clinics within the same area. (Rules for laboratory reporting and levels of compliance with reporting rules vary across jurisdictions.) However, public health surveillance data still cannot typically distinguish between persons who move out of jurisdiction or are lost to care. Seattle & King County is one of very few public health agencies that have gathered additional information to distinguish out-migration loss-to-care so that emigrants can be censored.⁷

Indeed, Seattle & King County is also one of a minority of public health jurisdictions that have been collecting laboratory surveillance data consistently enough to be able to estimate changes in time to viral suppression. Name-based reporting of HIV diagnoses was not implemented in all 50 states until 2008,⁸ a full year after follow-up in the analysis by Toren et al. began.⁵ From 2011 to 2013, out of 50 states and 6 dependent areas, only 19, 18 and 28 jurisdictions (respectively) had laboratory data that was estimated to be 95% complete.⁹⁻¹¹ These observations serve to illustrate both how quickly HIV surveillance rules have changed to incorporate laboratory reporting, and yet still how few jurisdictions have data that is complete enough to provide reliable information on the HIV care continuum.

One of the aspects of the recent work from Toren et al. that we find most notable and exciting is its origins from a successful and relatively rare partnership between a public health agency (Seattle & King County HIV/STD Program) and an academic epidemiology program (University of Washington). Other public health agencies have reported difficulty analyzing and disseminating data due to lack of resources.⁸ Yet, if public health surveillance data are not available to inform interventions, a major purported goal of surveillance is controverted.¹² Furthermore, when the important work of public health agencies is not presented in peer-reviewed literature its impact on future public health practice and academic research may be stunted. By partnering with academic researchers, public health practitioners stand to benefit from the additional expertise, time, and resources that could be brought to the analysis of their surveillance data. Academics have a responsibility to address on-the-ground public health questions¹³ and stand to learn from addressing the methodological challenges posed in analyses of public health surveillance data.

Public health-academic epidemiology partnerships should serve to incorporate modern epidemiological methods into analyses of surveillance data. Specifically, while the analysis by Toren et al.⁵ represents the state of the art for public health surveillance, analyses of surveillance data could be improved with (relatively standard) epidemiological methods for the analysis of cohort data. First, longitudinal studies of HIV surveillance data should control for potentially informative censoring.¹⁴ In the study by Toren et al.,⁵ some HIV-diagnosed persons moved out of Seattle & King County. The authors were able to censor persons when they moved out of jurisdiction. However, if emigration was related to time to

viral suppression, the reported estimates may be biased.^{15,16} Second, longitudinal studies of outcomes that require observation should adjust for the observation plan.¹⁷ As the authors acknowledge, their estimates of time to viral suppression are likely overestimates because viral suppression cannot be recognized until viral load is measured. However, if viral load monitoring was more frequent in recent years, time to viral suppression would appear to decrease, even if actual time to viral suppression did not change. While viral load monitoring patterns are unlikely to explain the dramatic results presented in this analysis, future improvements in time to viral suppression will likely be more subtle, and the influence of observation patterns may play a bigger role. Additionally, comparisons of time to viral suppression between groups may be biased if access to care (and laboratory testing) differs between the groups. Third, public health surveillance data almost always suffers from missing data and analyses of public health surveillance data should employ missing data methods.^{18,19} Toren et al. made a decision to exclude persons missing baseline CD4 cell count from multivariable analyses, and showed that this decision did not impact results in a sensitivity analysis that included everyone. However, CD4 cell count is almost certainly not missing completely at random, and thus we expect the complete cohort analysis is not unbiased in expectation.¹⁹ In this instance, the sensitivity analysis showed little difference because the proportion of missing data was small and thus the amount of bias was small; nevertheless, the least biased estimate in this paper was likely the one presented in the sensitivity analysis. Finally, results from Seattle & King County may not be generalizable to the rest of the country and, furthermore, generalizability may not be the most important metric on which to judge these results. While the authors find their results comparable to those from New York City²⁰ and San Francisco,²¹ it remains unknown whether similar trends would be seen in the rest of the country, particularly in the Southeast, where most new HIV cases are being diagnosed.²² Examining the HIV continuum according to structural, demographic, and geographical differences is important for identifying groups and areas in need of further intervention. Thus we should not look for generalizable estimates, but rather we should seek out heterogeneity. Because most successful public health and academic partnerships exist in areas with strong public health infrastructure and proportionally more resources, we are lacking good information on the HIV care continuum in some of the most disproportionately impacted populations.

In conclusion, we applaud the work of the Seattle & King County HIV/STD Program and researchers from the University of Washington. Public health surveillance data can provide population-based estimates of progress towards the NHAS 2020 goals.²³ Identification of heterogeneity in progress towards these goals by region, demographic and clinical characteristics, will help identify groups in particular need of public health intervention. In estimating the distribution and movement of HIV-diagnosed persons across stages of the HIV care continuum and in monitoring improvements in the continuum, however, epidemiological methods for more traditional cohort analyses should be applied to guard against biases from loss to follow-up, differential observation of cohort members, and missing data. We hope this partnership and others like it inspire public health and academic partnerships in other geographic regions, and the publication of quality HIV care continuum estimates arrived at using rigorous epidemiological analyses.

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