Tracking the end of AIDS—how will we know? How will we get there?

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"Ending AIDS" by 2030 is a monumental challenge [1]. Tracking progress as incidence reaches lower levels may be just as challenging. Nsanzimana and colleagues illustrate progress and highlight the challenges that lie ahead on both fronts. The Rwanda HIV Incidence Survey enumerated a nationally representative sample of 13,728 HIV-negative adults in 2013, and followed up a remarkable 92% of participants one year later. They observed 35 HIV seroconversions [2]. Two findings are especially noteworthy. First, estimated annual HIV incidence in 2013 was 0.27% (95% confidence interval 0.18–0.36%), almost twice as high as the 0.15% (0.11–0.19%) incidence estimate published in the UNAIDS 2016 Global Report [3], derived using the Spectrum model [4]. Second, the study suggests clusters of new infection responsible for sustaining HIV transmission, with the few new infections clustered in three villages and two households having multiple seroconversions. We consider implications of these findings for future surveillance efforts and the HIV response.

What might explain the difference between cohort study and model-based incidence estimates? The wide uncertainty ranges around each estimate remind us that uncertainty is an inherent feature of our estimates that must be recognized by policy processes. For example, at the higher transmission level, Rwanda may need to initiate around 75,000 more adults on ART between 2015 and 2020 to reach 90% coverage, compared to 45,000 if transmission levels are more aligned with the lower figure (see Figure 1). Resource allocation plans will need to accommodate the full range of plausible scenarios and surveillance efforts must be oriented towards determining which trajectory we are on and how to respond.

Both sources of information have potential error. Cohort studies may experience participation biases. Alternatively, the presence of just 16 false positive results among over 12,000 tests undertaken at follow-up (reflecting a specificity of 99.9%) would fully explain the difference between survey and model estimates. Participation rates were high and there are no particular reasons to suspect the testing accuracy in this study, but this does reinforce the importance of

critically appraising and triangulating data sources, especially when detecting increasingly rare events.

On the other hand, the model enforces an intrinsic relationship between the number of new HIV infections, the number of HIV deaths, and changes in HIV prevalence. Have there been more deaths than previously thought, counterbalancing the higher than expected number of new infections suggested by the cohort study? Nsanzimana and colleagues have previously reported a crude mortality rate on ART around 1% in 2013 [5], similar to the Spectrum model estimates, suggesting this may be unlikely. Alternatively, has prevalence increased more than previously thought, despite a series of prevalence surveys suggesting this has been stable at 3.0% since 2010 [2,6,7]? Our best information likely comes from appropriately combining all the data we have (e.g. prevalence trends, mortality estimates, incidence data). New data provide a critical opportunity to review, validate, and improve the assumptions underpinning future model projections for Rwanda, and for other countries that use the same tools [8].

The new study suggests that localised outbreaks may now be an important feature of the HIV epidemic in Rwanda. Halting the epidemic will increasingly depend on rapidly identifying, characterizing, and stopping transmission clusters. This requires a re-tooled surveillance portfolio that includes risk mapping to know where and among whom transmission clusters might emerge [9], careful monitoring of new diagnoses across all HIV testing platforms [10,11], and the roll-out of new surveillance and public health tools such as incidence assays and phylogenetic sequencing to characterize transmission [12].

These findings underscore that further studies of the type conducted by Nsanzimana and colleagues are essential to improve our understanding of HIV dynamics in Rwanda and beyond. But the study also reminds us that, as incidence declines, measuring and accelerating progress towards ending AIDS will depend on how quickly we can determine and respond to new HIV infections in 2017 and beyond. This will require new types of data analysed with new models to rapidly identify where, when, and why HIV transmission occurs. We must be ready to use this information to trigger a timely, data-driven public health response if we are to continue to drive down HIV incidence.

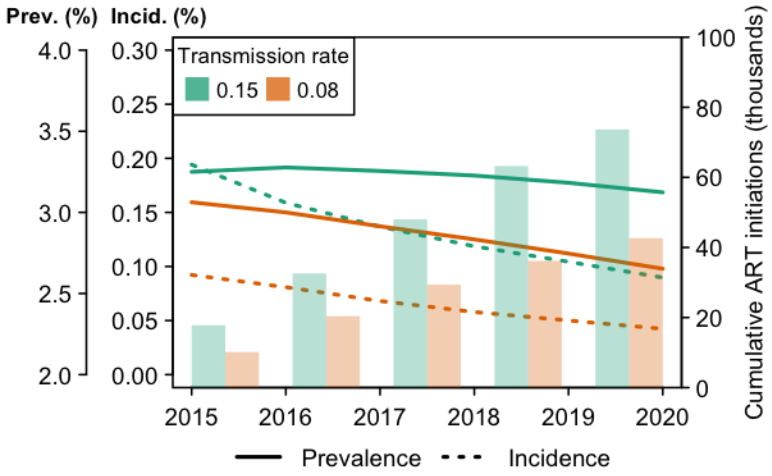

Figure: Projected HIV incidence, HIV prevalence, and cumulative number of ART initiations required to reach 90% coverage by 2020 under two assumptions about future HIV transmission. Assuming ART coverage of 63% in 2013 and 82% viral suppression among those on treatment [5], an incidence rate of 0.27% in 2013 (consistent with the Rwanda incidence survey) implies that each 1000 unsuppressed HIV-positive adults generated 15 new HIV infections per year, compared to 8 new infections per year if incidence was 0.15% (consistent with the model estimate). Numbers of new infections are projected assuming that untreated adults continue to transmit HIV at these same rates (no other prevention interventions are modelled). ART coverage is assumed to scale-up linearly from 75% to 90% over the period 2015 to 2020 and viral suppression among PLHIV is assumed to scale up linearly from 82% [5] to 90% from 2015 to 2020. In both cases, incidence is expected to continue declining as progress continues towards achieving national 90% coverage and viral suppression targets in 2020, but the remaining incidence rate in 2020 will be higher, and prevalence will be higher in 2020 owing to the higher number of new infections, resulting in greater numbers requiring treatment to reach 90% coverage targets.

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