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Are new HIV cases going down in response to more persons taking antiretroviral pills in South Africa?

Joël Mossong - Senior infectious disease epidemiologist, National Health Laboratory, Luxembourg.

It is well known that over the past decade, South Africa has rolled out a massive public service antiretroviral treatment (ART) programme with 2 million patients on treatment by the end of 2012 (1). As a result, persons living with HIV can now have a near-normal lifespan as long as they start treatment early (2). Also, life expectancy in KwaZulu-Natal (KZN) has risen dramatically by more than ten years between 2003 and 2011 (3). While the positive effects of ART on mortality are now unquestionable, much less is known on whether incidence levels of HIV (i.e. the rate of new HIV infections) have also decreased as a result of more persons taking ART.

Such a reduction of HIV incidence is theoretically expected because the primary purpose of ART is to reduce viral load in patients, which then lowers their chance to pass on the virus to other persons. The main issue though is that, unlike mortality or prevalence, HIV incidence is very difficult to measure from an epidemiological point of view, let alone assess trends of it. One of the (admittedly many) ways to do precisely this is to use a technique known as catalytic mathematical models. This type of modelling was initially developed to study the impact of vaccination campaigns for childhood infections like measles (4) and was then later adapted specifically for HIV by including high AIDS-related mortality (5). As input, these mathematical models require age-stratified sero-prevalence data and as output, they produce parametric estimates of incidence (as a function of age) and survival (as a function of the duration of infection).

In our recently published study (6), we applied for the first time this type of catalytic modelling approach to South African sero-prevalence data in the ART era, namely from a demographic surveillance site in rural KZN. We were particularly interested to see whether the model would suggest any trends during three calendar periods (2003-05, 2006-08, 2009-11) reflecting periods of increasing ART coverage. We then compared our model-based estimates of HIV incidence with directly observed estimates from the longitudinal HIV surveillance cohort.

The results of the modelling were interesting and surprisingly robust. First of all, the model-based HIV incidence estimates were in good agreement with observed cohort-based estimates from the HIV surveillance. The age of peak incidence occurred at around 22 years for women and 28 years for men with little variation over time.

Also, as expected from previous work, the median survival after HIV infection was estimated to have increased significantly between 2003-2005 and 2009-2011 from 10 to 14 years for both sexes. However, to our surprise, we found no significant reduction of HIV incidence between 2003-2005 and 2009-2011, neither in men nor women. Thus the model suggests that incidence during that period has remained flat despite increasing ART coverage.

So from a public health perspective, our results put into perspective one of the major goals set by the South African government, which is to reduce HIV incidence by 50% (7). Another recent study in our setting has shown that treatment levels have to reach a relatively high coverage (between 20 and 30% of all HIV positive individuals on treatment) to have a significant effect on reducing the risk of acquiring HIV infection at the population level (8). Also the decline in the risk of acquisition of HIV infection with increasing ART coverage was more pronounced in the older age groups (>35 years of age). Taken together, this might suggest that incidence reductions are more likely to have occurred in older age groups due to higher access and uptake of ART.

Finally, our study is also proof that the rather 'old-fashioned' catalytic modelling approach using cross-sectional sero-prevalence data can still be a useful approach to monitor trends of HIV incidence and survival and it would be interesting to apply this model to other African settings.

Joël Mossong, Senior infectious disease epidemiologist, National Health Laboratory, Luxembourg. From 2011 until 2013, he took a sabbatical from managing the national gastro-intestinal and influenza surveillance to work on HIV epidemiology and mortality at the Africa Centre in rural KZN funded by the German development agency CIM. *joelmossong@gmail.com*

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