Effects of increased antiretroviral scale-up on HIV transmission: analysis of 53 low and middle-income countries

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Introduction

In the HPTN 052 trial, antiretroviral treatment (ART) lowered the risk of HIV transmission by 96% in semi-discordant couples [1]. Increased ART coverage has also been associated with lower rates of HIV transmission at the community level [2]. The aims of this study were (1) to investigate the relationship between the percentage of HIV-infected individuals on ART and HIV incidence in a multi-country analysis; (2) To compare ART coverage rates between low, middle and high-income countries.

Methods

This analysis was based upon UNAIDS standardised country-level estimates for 2013: number of people with HIV infection, receiving antiretroviral treatment and new HIV infections [3]. There were 36 African countries included, plus 17 non-African low and middle-income countries with at least 40,000 HIV-infected individuals. Data from high-income countries were extracted from national reports, conference proceedings and articles [Canada (4), France (5), Russia (6), UK (7), USA[8]]. The number of adults on ART is used to adjust for the longer survival of people receiving ART in the calculation of incidence. In addition, people taking ART are assumed to have a 92% lower rate of HIV transmission, compared to untreated people. This assumption can be adjusted by countries as needed. Spectrum then estimates the number of new infections per year based on the incidence curve estimated from HIV prevalence and the population data within Spectrum (from the UN Population Divisions 2012 World Population Prospects).

Weighted least squares and linear regression methods were used to investigate the association between the percentage of HIV-infected individuals receiving ART and the number of new infections (as percentages of the national HIV epidemic). The relevance of GDP [9] and PEPFAR status [10] was assessed using nested models and likelihood ratio testing.

Results

ART coverage varied widely between countries (Figure 1 and Table 1). In the 53 low and middle income countries, the mean percentage of HIV-infected individuals receiving antiretroviral treatment was 35% (range <1% in Madagascar to 70% in Botswana).

There were examples of low or middle income countries with higher ART coverage rates than high income countries. For example Botswana, Cambodia and Rwanda had ART coverage rates above 60%, which was not achieved in Canada or USA. There were 7 countries with ART coverage rates below 15%: Central African Republic (14%) Russia (11%), Indonesia (8.5%), Sudan (6.5%), Pakistan (6.5%), Iran (6.4%), South Sudan (4.6%) and Madagascar (<1%).

The mean HIV transmission rate (percentage of new HIV infections in 2013, relative to the total number of people HIV positive in each country), was 6%, ranging from 2% in Cambodia to 21% in Pakistan. There was a correlation between higher ART coverage and lower percentage incidence (Figure 2). However this would be expected from the Spectrum model, which assumes a 92% lower HIV transmission rate for people on ART. Even so, there was a wide scatter around the line of correlation, as shown in Figure 2.

Some countries had HIV transmission rates substantially higher or lower than would be predicted by their ART coverage rates. Weighted least squares regression analysis showed that each 10% increase in ART coverage was associated with a 1.14% reduction in new HIV infections (Figure 2).

Conclusions

For the 53 low and middle income countries in this analysis, the mean percentage of HIV-infected people receiving antiretroviral treatment was 35% (range <1% in Madagascar to 70% in Botswana). Some low and middle-income countries have rates of antiretroviral treatment coverage higher than certain high-income countries (e.g. Botswana, Cambodia, Rwanda). However there are 8 low / middle income countries with very low ART coverage (<15%).

Low and middle income countries with higher rates of ART coverage had lower estimated rates of HIV transmission. However there is substantial variation around this correlation, which could reflect differences between countries in other preventative measures (e.g. HIV testing, condom use, needle exchange, male circumcision).
References

[1] HPTN052 trial

[2] ART and HIV transmission at the community level

[3] UNAIDS Database

[4] ART coverage in Canada

[5] ART coverage in France

[6] ART coverage in Russia

[7] ART coverage in the UK

[8] ART coverage in the USA

[9] GDP Database

[10] PEPFAR Database