

The impact and cost of Botswana's progress toward achieving the 2020 UNAIDS 90-90-90 antiretroviral therapy and virological suppression goals

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In a recent paper in *The Lancet HIV* Gaolathe *et al.* (2) have shown that the roll-out of treatment in Botswana has been very effective. In a random, population-based sample of 30 communities, they found that Botswana has reached 83-87-96, that is to say 83% of those infected with HIV know their status, 87% of these are on treatment and 96% of these have viral loads less than 400/ μ L. It is worth remarking that 93% of those on ART had viral loads below 40/ μ L. Botswana is well on the way to reaching the 90-90-90 targets and is to be congratulated on a remarkable achievement.

Using their data on ART coverage and viral load suppression we use a dynamical model of HIV and TB (1) to estimate the impact of treatment and various methods of prevention on new infections averted, lives saved and the total cost between 2016 and 2050.

Scenarios

We consider the following scenarios for Botswana:

1. *Scenario 1*: Counterfactual representing constant effort, in which the current national levels of treatment roll-out are maintained;
2. *Scenario 2*: 90-90-90, in which, by 2020, people at risk of HIV are tested twice a year, on average, and start ART as soon as they test positive for HIV assuming a cost of providing ART of US\$300 per patient *p.a.* and we assume that the roll out of ART continues at the same rate after 2020.
3. *Scenario 3* adding in the scale-up of VMMC to Scenario 2 from an estimated coverage of 25% to 80% within the target population by 2020 assuming that it costs US\$50 to circumcise one man.

4. *Scenario 4* adding in PrEP to Scenario 3 so that 20% of women within the target population are on PrEP by 2020 assuming that it costs US\$85 to maintain one woman on PrEP for one year.
5. *Scenario 5* adding in condom promotion to Scenario 4 so that 50% of sexually active people have access to condoms by 2020 assuming that it costs US\$5 to provide condoms for one man for one year.

We further assume that the average annual cost of providing health care to a person infected with HIV but not on ART is US\$50, of providing health care to a person on ART is US\$15, and of treating one case of TB is US\$356. We allow a 3% *p.a.* discount rate. Other epidemiological parameters and details of the model have been published (1).

The impact of treatment and prevention

The results are shown in Figure 1. Between 2016 and 2050, expanding treatment reduces the total cost of the programme from US\$ 2.03 Bn to US\$ 1.96 Bn saving US\$ 70M while averting 106k new infections by reducing the number of new infections from 315k to 209k and saving 42k lives by reducing the number of AIDS related deaths from 168 k to 126k. Including the three additional prevention interventions increases the cost by US\$ 150M to US\$ 2.11 Bn while averting 6k new infections by reducing the number of new infections from 209k to 103k and saving 40 lives. The total cost depends critically on the cost of ART but less on assumptions concerning the efficacy or coverage of the other various prevention interventions since their impact is small.

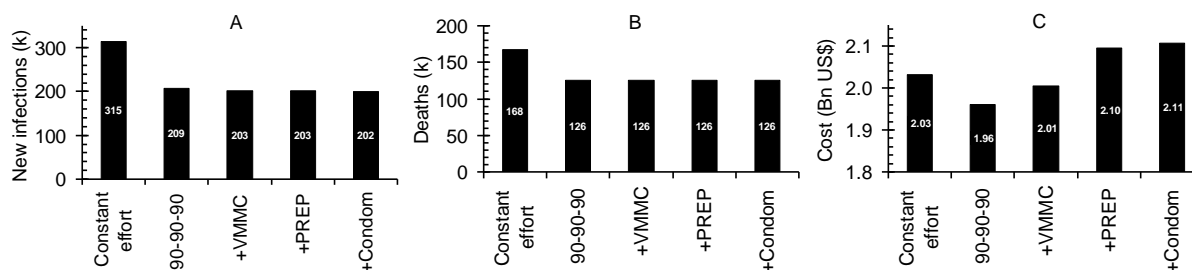


Figure 1. The cumulative expected number of new infections, deaths and costs between 2016 and 2050 for Botswana. A: the number of HIV infections, B: AIDS-related deaths and C: costs in discounted 2016 US\$ starting from the current level of ART provision (Scenario 1) and adding interventions by extending treatment according to the 90-90-90 guidelines (Scenario 2), adding in VMMC (Scenario 3) adding in PrEP (Scenario 4) and adding in condom distribution (Scenario 5).

Individual benefits of prevention

Botswana has, until recently, recommended ART for those whose CD4 count is less than 350 cells/ μ L; expanding their HIV-testing and treatment programme to achieve the 90-90-90 targets will save money and should achieve the UNAIDS goal of ending AIDS by 2030 when there will be less than one new HIV infection and one AIDS related death per ten thousand adults per year. Expanding prevention will have little additional public health benefit while adding significantly to costs, but there remain important individual benefits that follow from access to prevention. VMMC protects men against genital ulcer disease, HSV-2, papillomavirus and *Trichomonas vaginalis* (3), as well as HPV (4). PrEP will help to protect women from HIV which is of particular importance for women whose male partners do not know their HIV status and refuse to use condoms and for women at high risk of HIV infection, including female sex workers and adolescent girls. Condoms will reduce HIV transmission in both directions, reduce sexually transmitted infections (STIs), and also reduce unwanted pregnancies. Individuals who want to protect themselves should have free access to all available prevention modalities including treatment. While ensuring that everyone living with HIV has access to early diagnosis and treatment to prevent illness, death and transmission, offering various prevention methods will also help individuals to protect

themselves against a wide range of STIs as well as unwanted pregnancies.

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