Assessment of the Potential Cost-Effectiveness of HIV Self-Testing in Resource Limited Settings

Valentina Cambiano1, Debbie Ford2, Travor Mabugu3, Sue Napierala Mavedzenge4, Alec Miners5, Owen Mugurungi6, Fumiyu Nakagawa1, Paul Revill7, Andrew Phillips1


e-mail: v cambiano@ucl.ac.uk

Correspondence:
Tel number: +44 (0)2077940500 (Ext: 34570)

Background

Despite the dramatic increase in HIV testing in low and middle income countries in the last few years, over 50% remain unaware of their HIV status.

Implementation studies demonstrated that HIV self-testing (ST) is highly acceptable, could overcome some of the obstacles to testing for HIV and allow savings in costs, given its potentially lower implementation cost compared to provider-delivered HIV testing and counselling (PHTC).

Donors and stakeholders are evaluating whether investments should be made to support product development, promotion and marketing of self-testing in resource limited settings.

The aim of this study is to evaluate the potential benefits of introducing self-testing, in addition to the standard provider-delivered HIV testing and counselling over 20 years, using Zimbabwe as an example setting.

Methods

HIV Synthesis Transmission Model


Updates for the present analyses include age and gender specific rates of first time and repeat testing, including self-testing, and calibration to reflect HIV prevalence and age and gender specific levels of testing observed in Zimbabwe. A 3-fold reduction in rate of testing for people who never had condom-less sex is incorporated and increased rates of PHTC for women attending antenatal clinics and for subjects experiencing symptoms. A proportion (5%) are assumed to be not willing to be tested for HIV and will only be tested if symptoms occur.

Table 1. Assumptions on PHTC and ST

Parameter | Value | Source
--- | --- | ---
Accuracy of ST | SE = 0.92; SP = 0.99 | FDA Approval Orquide in: Home HIV test
Accuracy of PHTC | SE = 0.98; SP = 1 | Pant Pai, Lancet Inf Dis 2012
Proportion of probability of ST as a direct consequence of a +ve ST (ST not sufficient to be defined as diagnosed) | 0.81 year since +ve ST | Assumption
Proportion of probability of link to care after HIV diagnosis (by 1 year of ST since diagnosis) | 0.6 (same value whether diagnosis was triggered by +ve ST or not) | Rosen, AIDS 2011
Change in condom-less sex following: a +ve PHTC | with primary P: -13%, with casual P: -7% in the first 6 mos, -9% after | Kennedy, AIDS Behav 2012; Foner, Cochrane 2012
Change in condom-less sex following: a +ve ST | No change | Cremin, AIDS Behavior 2010
Disability weights | WHO 4 event: 0.55; TB: 0.40; WHO 3 event: 0.22 | Salomon, Lancet 2012
Cost of ST | US $3 | Assumption
CD4 threshold for ART | <500 cells/mm³ | Zimbabwe MoH

Scenarios modelled

The HIV epidemic in Zimbabwe is simulated up to 2015, based on existing data on HIV prevalence and HIV testing (DHS survey 2006 and 2011).

From 2015, we compare the following two scenarios:

- Reference Scenario (RS): ST is not introduced and the rates of 1st time and repeat testing increase linearly by 0.5% per year and the scale up of ART continues at the same rate as before 2015.

- Self-testing scenario (STS - base case): ST is introduced for the general population aged 15-65 years old and has the following three main effects:
  1. halving of the population not willing to receive an HIV test (from 5 to 2.5%);
  2. substitution of 10% first time and 30% repeat PHTC tests with STs;
  3. an overall increase in the rate of first time and repeat testing by 20%, due to the availability of ST.

Availability of ST is not assumed to affect PHTC testing in antenatal care settings. These assumptions, and those in Table 1, are based on limited current evidence available but overall are believed to be conservative in estimating the potential benefits of ST.

Economic Analysis

The two scenarios are compared on the basis of their costs and health outcomes, which are both discounted to present value at 3% per annum, over 20 years. Costs are estimated based upon resource use (e.g. number of tests, number of clinic visits) and associated unit costs:

- ART cost (1st line: TDF+3TC+NNVP): US $97 per year (Source: MSF report 2013)
- WHO stage 4: US $220; WHO stage 3: US $20; TB: US $50; Cotrimoxazole (CTX) per year US $5
- Clinic Visit: US $20; CD4 measurement: US $10

Health outcomes are summarised in the form of disability-adjusted life years (DALYs). Expected costs and health outcomes under both scenarios can be compared using incremental cost-effectiveness analysis to establish whether ST is likely to represent good value from available health sector resources.

Results

Figure 1. Total discounted cost over 20 years in US $ billions

Figure 2a. Cost-effective scenario (STS or RS) under base case and alternative assumptions and according to cost effectiveness threshold (CET)

Table 2. Predictions over time in the two main scenarios (median over simulations)

<table>
<thead>
<tr>
<th>Data-DHS</th>
<th>2011</th>
<th>2015</th>
<th>2025</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV prevalence (%)</td>
<td>15</td>
<td>14</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>% ever tested for HIV</td>
<td>50</td>
<td>65</td>
<td>77</td>
<td>80 83</td>
</tr>
<tr>
<td>% tested for HIV in the last year</td>
<td>28</td>
<td>37</td>
<td>46</td>
<td>50 53 56</td>
</tr>
<tr>
<td>% on ART (of those HIV+)</td>
<td>-</td>
<td>53</td>
<td>71</td>
<td>76 71 76</td>
</tr>
</tbody>
</table>

Acknowledgements

Thanks to UCL Computing Services for use of Legion high performance cluster computing. This work was funded by the Bill and Melinda Gates Foundation (Global Health Grant Number OPP1064862).

Conclusions

Under our base case assumptions, our results suggest that the introduction of ST is not only cost-effective but cost-saving, with an estimated saving of around US $53 million over 20 years in Zimbabwe and a small (100,000) number of DALYs averted.

However, the population costs and health effects of ST depend upon a range of complex and interacting factors, many of which are currently uncertain due to limited data. In particular, while most scenarios may lead to cost-savings, a number of plausible scenarios do not result in DALYs averted. It will therefore be important to update these predictions as more data become available.