Abstract: Modelling the cost-effectiveness of using HIV/syphilis dual tests in antenatal care in high and low HIV burden settings
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Cost-effectiveness of Dual Maternal HIV and Syphilis Testing and Retesting Strategies in High and Low HIV Prevalence Countries

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ABSTRACT

**Background:** Dual HIV/syphilis testing has been proposed for prevention of mother-to-child-transmission (PMTCT) of HIV and congenital syphilis. The cost-effectiveness of implementing dual testing in antenatal care (ANC) in countries with varying HIV prevalence is unknown.

**Methods:** We developed Markov decision-analytic models for HIV and syphilis to estimate the costs and infant health outcomes (infections, deaths, and disability-adjusted life years (DALYs)) of maternal testing strategies: testing at the first ANC visit with individual tests (base case), testing at the first ANC with a dual test. We modeled countries with high/intermediate (South Africa, Kenya) and low (Colombia, Ukraine) HIV prevalence. Strategies with an incremental cost-effectiveness ratio (ICER) of <$500 per DALY averted were considered cost-effective.

**Findings:** Routine testing at the first ANC with a dual test was cost-saving, compared to testing with individual tests (ICER: Kenya =$23, South Africa= $316, Colombia= $844, Ukraine= $454). Routine retesting with individual tests was cost-effective in Kenya (ICER = $437) and Colombia (ICER= $2,685) (comparator: individual testing at first ANC).

**Interpretation:** Incorporating dual HIV/syphilis testing in ANC can be cost-effective, or cost-saving, across countries with varying HIV prevalence and may help support the goal of dual elimination of MTCT of HIV and congenital syphilis.

**New WHO recommendation and implementation guidance:**
All pregnant women should be tested for HIV, syphilis and hepatitis B surface antigen (HBsAg)* at least once and as early as possible, ideally at the first antenatal care visit (syphilis: strong recommendation, moderate-quality evidence; HBsAg*: strong recommendation, low-quality evidence). Dual HIV/syphilis rapid diagnostic tests (RDTs) can be considered as the first test in HIV testing strategies and algorithms in ANC settings (https://www.who.int/publications-detail/dual-hiv-syphilis-rapid-diagnostic-test).

*Particularly in settings with a ≥2% HBsAg seroprevalence in the general population.

**Table G1.** Dual HIV/syphilis testing model scenarios

<table>
<thead>
<tr>
<th>Model scenarios</th>
<th>1st ANC Syphilis</th>
<th>1st ANC HIV</th>
<th>Late ANC Syphilis</th>
<th>Late ANC HIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case (independent tests)</td>
<td>RPR/TPHA</td>
<td>Rapid</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dual</td>
<td>Dual</td>
<td>Dual</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

ANC, antenatal care; RPR, rapid plasma regain; TPHA, *Treponema pallidum* hemagglutination assay. Dual test is a single, point-of-care rapid test for HIV and syphilis. Independent tests include rapid HIV tests and laboratory-based syphilis tests (RPR, TPHA to confirm reactive results). Late ANC is 36 to 39 weeks gestation.
Table 4: Health impact and cost-effectiveness of maternal HIV and syphilis testing scenarios.

<table>
<thead>
<tr>
<th>Testing scenarioa,b</th>
<th>Total costs</th>
<th>Total HIV infections</th>
<th>Total syphilis infections</th>
<th>Total DALYs</th>
<th>Incremental costs</th>
<th>Incremental DALYs averted</th>
<th>ICER</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>KENYA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base: Individual tests – 1st ANC only</td>
<td>$73,720,217</td>
<td>11,344</td>
<td>18,652</td>
<td>1,009,460</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dual test – 1st ANC only</td>
<td>$73,493,646</td>
<td>11,346</td>
<td>15,676</td>
<td>999,689</td>
<td>-$226,571</td>
<td>9,771</td>
<td>$-23**</td>
<td>Base</td>
</tr>
<tr>
<td>SOUTH AFRICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base: Individual tests – 1st ANC only</td>
<td>$168,938,857</td>
<td>23,788</td>
<td>13,482</td>
<td>730,809</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dual test – 1st ANC only</td>
<td>$164,743,010</td>
<td>23,795</td>
<td>9,347</td>
<td>717,523</td>
<td>-$4,195,847</td>
<td>13,286</td>
<td>$-316**</td>
<td>Base</td>
</tr>
<tr>
<td>COLOMBIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base: Individual tests – 1st ANC only</td>
<td>$6,275,872</td>
<td>145</td>
<td>1,281</td>
<td>73,248</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dual test – 1st ANC only</td>
<td>$5,214,791</td>
<td>145</td>
<td>878</td>
<td>71,991</td>
<td>-$1,061,081</td>
<td>1,258</td>
<td>$-844**</td>
<td>Base</td>
</tr>
<tr>
<td>UKRAINE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base: Individual tests – 1st ANC only</td>
<td>$8,866,150</td>
<td>71</td>
<td>2,333</td>
<td>54,817</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dual test – 1st ANC only</td>
<td>$7,966,929</td>
<td>71</td>
<td>1,694</td>
<td>52,837</td>
<td>-$899,222</td>
<td>1,980</td>
<td>$-454**</td>
<td>Base</td>
</tr>
</tbody>
</table>

aDALYs averted and incremental costs are compared against the base case scenario. Individual tests are HIV rapid tests and RPR tests for syphilis; TPHA used for confirmatory syphilis testing for reactive RPR results. Reactive rapid HIV tests and dual HIV tests confirmed with an additional HIV rapid test. ICER, incremental cost effectiveness ratio, in 2017 US$ per DALY averted; ANC, antenatal care; RPR, rapid plasma regain; TPHA, Treponema pallidum hemagglutination assay; MCH, maternal and child health; DALY, disability-adjusted life-year.

*Indicates scenario is cost-effective compared to $500 per DALY threshold. * Indicates scenario is cost-saving.