Cost-effectiveness of ART and the *Three I’s for HIV/TB* to prevent tuberculosis among people living with HIV

Somya Gupta, Taiwo Abimbola, Anand Date, Amitabh B. Suthar, Rod Bennett, Nalinee Sangrujee, Reuben Granich

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Kuala Lumpur, Malaysia
The *Three I’s for HIV/TB* activities

<table>
<thead>
<tr>
<th>WHO-recommended collaborative TB/HIV activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Establish and strengthen the mechanisms for delivering integrated TB and HIV services</td>
</tr>
<tr>
<td>A.1. Set up and strengthen a coordinating body for collaborative TB/HIV activities functional at all levels</td>
</tr>
<tr>
<td>A.2. Determine HIV prevalence among TB patients and TB prevalence among people living with HIV</td>
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<tr>
<td>A.3. Carry out joint TB/HIV planning to integrate the delivery of TB and HIV services</td>
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<tr>
<td>A.4. Monitor and evaluate collaborative TB/HIV activities</td>
</tr>
<tr>
<td>B. Reduce the burden of TB in people living with HIV and initiate early antiretroviral therapy (the <em>Three I’s for HIV/TB</em>)</td>
</tr>
<tr>
<td>B.1. Intensify TB case-finding and ensure high quality antituberculosis treatment</td>
</tr>
<tr>
<td>B.2. Initiate TB prevention with isoniazid preventive therapy and early antiretroviral therapy</td>
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<tr>
<td>B.3. Ensure control of TB infection in health-care facilities and congregate settings</td>
</tr>
<tr>
<td>C. Reduce the burden of HIV in patients with presumptive and diagnosed TB</td>
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<tr>
<td>C.1. Provide HIV testing and counselling to patients with presumptive and diagnosed TB</td>
</tr>
<tr>
<td>C.2. Provide HIV prevention interventions for patients with presumptive and diagnosed TB</td>
</tr>
<tr>
<td>C.3. Provide co-trimoxazole preventive therapy for TB patients living with HIV</td>
</tr>
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<td>C.4. Ensure HIV prevention interventions, treatment and care for TB patients living with HIV</td>
</tr>
<tr>
<td>C.5. Provide antiretroviral therapy for TB patients living with HIV</td>
</tr>
</tbody>
</table>
WHO 2011 IPT/ICF recommendations

Person living with HIV (including pregnant women and those on ART)

Screen for TB using:
- Current cough
- Fever
- Weight loss
- Night Sweat

No

Assess IPT contraindications

- No
  - Give IPT
- Yes
  - Defer IPT

Yes

Investigate for TB & other disease

Other diagnosis
- Appropriate treatment & consider IPT

Not TB
- Follow up; consider IPT

TB
- Treat for TB

* Duration of IPT: 6 months (conditional recommendation: 36 months)
Objective of analysis

Evaluate the health outcomes, costs, and cost-effectiveness of policy scenarios with different TB prevention interventions

- Expanded ART coverage of 90% (at CD4 count ≤ 350 cells/mm³)
- ICF using four-symptom screening
- IPT for all/TST+ for 6 or 36 months
- TB infection control in health-care facilities

Outcomes:
1. TB cases
2. Total costs
3. Cost-effectiveness

Base scenario:
- 55% ART coverage
- Standard TB screening (cough)
Policy alternatives

<table>
<thead>
<tr>
<th>POLICY SCENARIO</th>
<th>ART COVERAGE</th>
<th>TB SCREENING</th>
<th>IPT ELIGIBILITY</th>
<th>DURATION OF IPT</th>
<th>TB IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Base</td>
<td>55%</td>
<td>Cough</td>
<td>None</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2 ART</td>
<td>90%</td>
<td>Cough</td>
<td>None</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3 ART ICF IPT 6 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>All</td>
<td>6 months</td>
<td>No</td>
</tr>
<tr>
<td>4 ART ICF IPT 36 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>All</td>
<td>36 months</td>
<td>No</td>
</tr>
<tr>
<td>5 ART ICF TST IPT 36 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>TST-positive</td>
<td>36 months</td>
<td>No</td>
</tr>
<tr>
<td>6 ART IC ICF IPT 6 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>All</td>
<td>6 months</td>
<td>Yes</td>
</tr>
<tr>
<td>7 ART IC ICF IPT 36 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>All</td>
<td>36 months</td>
<td>Yes</td>
</tr>
<tr>
<td>8 ART IC ICF TST IPT 36 MONTHS</td>
<td>90%</td>
<td>Four symptom</td>
<td>TST-positive</td>
<td>36 months</td>
<td>Yes</td>
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TB diagnostic algorithms:
1) Sputum smear microscopy and chest radiography
2) Xpert MTB/RIF
Methodology

• Developed decision-analytic model to evaluate policies
• Setting: generalized HIV epidemic with active TB prevalence of 5%
• Population: cohort of 10,000 people living with HIV presenting to health facilities
• Timeframe and analytic horizon: 36 months
• Model parameters taken from published studies
• Costs (2010 USD): healthcare utilization costs from South Africa
Cost-effectiveness analysis

• All policy alternatives were evaluated for TB cases and total cost over 3 years

• ICER = \frac{\text{Difference in total costs}}{\text{Difference in TB cases}}

• Strategies excluded:
  • Strongly dominated (higher cost and less TB cases prevented)
  • Weakly dominated (higher ICER than the next alternative)

• ICER calculated for the cost-effective strategies
Results

TB diagnostic algorithm: Sputum smear and chest radiography

![Graph showing the relationship between Total TB cases and Total cost (in US $)]

- ART IC ICF IPT 36m
- ART IC ICF TST IPT 36m
- ART IC ICF IPT 6m
- ART

Total cost (in US $)

Milliers

$7 500

$7 000

$6 500

$6 000

$5 500

$5 000

$4 500

$4 000

$3 500

Total TB cases

700

800

900

1000

1100

1200

1300

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non-dominated

Base

$6 000 $6 500 $7 000 $7 500 $8 000 $8 500 $9 000 $9 500 $10 000 $10 500 $11 000 $11 500 $12 000 $12 500 $13 000
Results

TB diagnostic algorithm: Xpert MTB/RIF
## ICER for cost-effective strategies

TB diagnostic algorithm: Sputum smear and chest radiography

<table>
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<tr>
<th>Scenario</th>
<th>TB cases</th>
<th>Total costs (in US $)</th>
<th>TB cases averted</th>
<th>Incremental costs</th>
<th>ICER</th>
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<tr>
<td>Base</td>
<td>1289</td>
<td>3,934,204</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ART IC ICF IPT 36 MONTHS</td>
<td>791</td>
<td>7,079,682</td>
<td>498</td>
<td>3,145,478</td>
<td>6316</td>
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TB diagnostic algorithm: Xpert MTB/RIF

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<tr>
<td>Base</td>
<td>1308</td>
<td>3,815,187</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ART IC ICF IPT 36 MONTHS</td>
<td>815</td>
<td>6,826,399</td>
<td>493</td>
<td>3,011,212</td>
<td>6108</td>
</tr>
</tbody>
</table>

Incremental cost-effectiveness ratio (ICER) is expressed in US $ per TB case averted.
Limitations

• Impact of ART at CD4 count ≤ 500 cells/mm³ and immediate ART on TB incidence not considered
• Cost of developing and maintaining diagnostic capacity excluded
• Efficacy and cost of TB infection control package are an estimate
• Estimated the costs and health benefits of one-time TB screening per person over 3 years
Conclusion and recommendation

- Combination strategy with expanded ART coverage, infection control and 36-months IPT averted the most TB cases.
- Combination TB prevention strategy was more cost-effective when compared with other strategies.
- Accelerated scale-up of ART and the *Three I’s for HIV/TB* will reduce TB burden among people living with HIV.
Thank you...

Reuben Granich (UNAIDS)
Taiwo Abimbola (CDC)
Anand Date (CDC)
Rod Bennett (Hexor)
Amitabh Suthar (consultant)
Nalinee Sangrujee (CDC)