The potential impact of novel tuberculosis vaccines on health equity and financial protection in LMICs

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Motivation

- Optimize use of current & new tools emerging from pipeline, pursue universal health coverage and social protection.

- Introduce new tools: a vaccine, new drugs & treatment regimens for treatment of active TB disease and latent TB infection, and a point-of-care test.

- Current global trend: -1.5%/year

- -10%/year by 2025

- -5%/year

- -17%/year
Global TB vaccine development pipeline

Tuberculosis Vaccine Initiative https://www.tbvi.eu/what-we-do/pipeline-of-vaccines/
Objective

We assessed the potential health gains and financial risk protection from introducing novel TB vaccines, and how these benefits would be distributed across income quintiles.
Model development

• A novel age-structured *Mtb* transmission model separately calibrated to demographic and epidemiological data from 105 countries, representing 93% of the TB incidence in LMICs

• Model calibration allowed for negative correlation between tuberculosis burden and health care access
  - 2 explicit groups: high-access-to-care, representing top 3 quintiles (60% of the population), and low-access-to-care, representing bottom 2 quintiles (40% of the population)
  - TB prevalence rate ratio, upper 60% to lower 40% = 0.67 (0.57-0.80) in 2019 (11 studies)

• As data limited on mechanism, relative to lower-access-to-care group, we assumed the high-access-to-care group has:
  - Reduced *Mtb* transmission probability per contact
  - Increased rate of treatment initiation
  - Reduced rate of progression to tuberculosis disease
Vaccine scenarios

Infant vaccine

- Scale up to target coverage
- Country-specific introduction years

Adolescent/adult vaccine

- Routine scale up to target coverage
- Country-specific introduction years
- Campaign rolled out to target over 5-year period
Health equity and financial risk protection

• Two SES strata stratified into outcomes across 5 income quintiles within each modeled country, based on current distribution of TB burden

• For each country and quintile, costs incurred by patients (direct medical, direct non-medical, indirect costs) estimated by extrapolating from national TB patient cost survey data (N=20 surveys, in 2020 constant dollars)

• Catastrophic costs of TB defined as patient costs per TB episode >20% of household annual income
Distribution of benefits across countries and income strata

Within country distribution

Country A

Country B

Country C

Country D

Global distribution

Income

Poorest → Richest
Results
TB cases and catastrophic costs averted for all modelled countries, by income quintile

Lower income quintiles:
- Higher TB incidence
- Greater proportion with catastrophic costs

<table>
<thead>
<tr>
<th>Income quintile</th>
<th>TB cases averted (millions)</th>
<th>Catastrophic costs averted (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poorest</td>
<td>12.9</td>
<td>14.2</td>
</tr>
<tr>
<td>Poorer</td>
<td>10.6</td>
<td>12.9</td>
</tr>
<tr>
<td>Middle</td>
<td>8.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Richer</td>
<td>6.9</td>
<td>8.2</td>
</tr>
<tr>
<td>Richest</td>
<td>5.6</td>
<td>6.9</td>
</tr>
</tbody>
</table>

- Infant: 3.7 (3.3–4.1) million
- Ado/adult: 22.9 (21.4–24.5) million
Cases of tuberculosis over time and by income quintile

[Graph showing the number of tuberculosis cases over time, categorized by income quintile (richest, richer, middle, poorer, poorest).]
TB cases and catastrophic costs averted across all modelled strata, ordered by household income

Poorest 20% of households:
- 18.3 (14.2–22.7) million TB cases projected to be averted (41% of total)
- 12.1 (9.4–15.0) million households experiencing catastrophic costs averted (53% of total)
Limitations

• Constrained by data availability for many LMIC settings; only 105 countries were successfully parameterized and calibrated

• Not a comprehensive set of analyses, but demonstrate the potential distributional consequences of novel TB vaccines according to specified characteristics

• We assumed that per-patient costs of TB would not change in future years

• We assumed vaccines would be provided free-of-charge
  ➢ Requiring payment to receive a new TB vaccine would likely reduce uptake, particularly within low-income groups
Summary

- New TB vaccines could be highly impactful and help narrow income-based disparities in health and economic consequences of TB for LMICs
  - Benefits concentrated in lower income quintiles
- Countries will need to commit to rapid introduction once an effective vaccine is approved, achieve high population coverage, and prevent differentials in vaccine uptake by poor and marginalized groups
  - Requires sustained political and financial commitments by affected countries and international partners, as well as implementation research on approaches to eliminate uptake barriers
- While challenges remain, successful development and introduction of a new TB vaccine has potential to accelerate burden reduction for a disease that represents one of the greatest health threats for poor households
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