Modelling the social determinants of TB to inform a ‘cash, care and data’ TB response model

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The social determinants of TB: poverty and undernutrition

- TB is strongly influenced by social and economic development.
- Fastest declines in TB incidence and mortality in western Europe occurred in the 1950s and 1960s, with expanding UHC, rapid socioeconomic development, and availability of effective treatments.
- There is a clear relationship between TB incidence and (i) undernourishment and (ii) GDP per capita.

*The year of data used for GDP per capita and undernourishment is the latest year for which data are available from the World Bank (https://data.worldbank.org/) and SDG (https://unstats.un.org/sdg/sdgs/dataset) databases, respectively.*
The social determinants of TB: living and working conditions

Crowding – Indoor and outdoor pollution - low income – social exclusion - violence
Determinants of TB incidence decline


Projected acceleration of TB incidence decline to target levels

Optimize current tools, pursue universal health coverage and social protection

Introduce new vaccine, new prophylaxis

Current global trend: -2%/year

Average -10%/year

Average -17%/year

Average -5%/year
What is social protection?

• Social protection, or social security, is a human right and is defined as the set of policies and programmes designed to reduce and prevent poverty and vulnerability throughout the life cycle.

• Social protection includes benefits for children and families, maternity, unemployment, employment injury, sickness, old age, disability, survivors, as well as health protection.

• Social protection systems address all these policy areas by a mix of contributory schemes (social insurance), non-contributory tax-financed benefits (social assistance), and legislation.

Social protection in the context of the WHO End TB Strategy

• Collaborate on TB/HIV activities and management of comorbidities

• Provide social and economic support to patients and affected households

• Reduce population level exposure to direct TB risk factors: undernourishment, harmful alcohol use, smoking, etc.

No TB-affected household face catastrophic costs by 2020
Social protection in TB history

“TB is a social disease.”
*Rudolf Virchow, 1880s*

“One of the most powerful weapons we can use against TB is social welfare centres.”
*Robert Koch, 1890s*

“Those who profess to be desirous of preventing and curing consumption must be either hypocrites or fools, for they ridicule the suggestion that it is necessary first to cure and prevent poverty.”
*Robert Tressell, 1912*
Social protection strategies based on food / cash transfers

Indirect effect

- Better education
- Better access to social/health services
- Better Food security / food consumption

Higher household / individual socioeconomic position

Better access to TB care resulting from conditionalities specific for TB care

Exposure risk

- Crowding
- Housing quality
- Poor ventilation

Infection risk

- HIV/Smoking/alcohol use
- Diabetes/Indoor pollution

Disease Progression risk

- Individual / household food security / food consumption patterns

Time and quality of diagnosis

- Health seeking behaviors

Physical and financial consequences of TB

Prevention

Treatment*

Support

TB prevalence in the community

MDR-TB prevalence in the community

Community economic growth

Social cohesion

Country security

*Treatment of TB and comorbidites
Social protection strategies based on food / cash transfers

Indirect effect

A
- Better education
- Better access to social/health services
- Better Food security / food consumption

B
- Crowding
- Housing quality
- Poor ventilation

C
- Biological risk factors*

Disease Progression risk

Time and quality of diagnosis

Treatment outcome

Treatment*

Prevention

Support

Physical and financial consequences of TB

TB prevalence in the community

MDR-TB prevalence in the community

Community economic growth
Social cohesion
Country security

Better access to TB care resulting from conditionalities specific for TB care

*Treatment of TB and comorbidites
Social assistance and TB: an overview of the evidence

**Distal factors**
- Poverty and inequalities reduction
- Food consumption / food security improvement
- Better access / use of education / health systems services

**Intermediate / proximal factors**
- Health seeking behaviours
- Exposure to behavioural/biological risk factors

**Direct impact on actual TB indicators**
- TB incidence
- TB morbidity / mortality
- TB treatment compliance / TB cure
- TB costs mitigation

**Evidence:**
- **A** Strong and consistent evidence
- **B** Strong evidence on some but not all relevant risk factors
- **C** Good and consistent evidence
The impact of social protection on TB: an overview of the evidence

- **TB incidence**: Good evidence
- **TB treatment**: Strong evidence
- **Catastrophic costs**: Good evidence
S-PROTECT: the first attempt to model the impact of social protection on TB

Scope of the work

- To leverage an interdisciplinary consortium to strengthen our understanding of how social protection can enhance the end of TB through mathematical modelling

- To develop a conceptual framework suitable for mathematical modelling purposes

- To develop an innovative mathematical modelling approach

Evidence generated

Modelling the impact of social protection on tuberculosis: the S-PROTECT project

Background: Tackling the social determinants of Tuberculosis (TB) through social protection is a key element of the post-2015 End TB Strategy. However, evidence informing policies are still scarce. Mathematical modelling has the potential to contribute to fill this knowledge gap, but existing models are inadequate. The S-PROTECT consortium aimed to develop an innovative mathematical modelling approach to better understand the role of social protection to improve TB care, prevention and control.

Methods: S-PROTECT used a three-steps approach: 1) the development of a conceptual framework; 2) the extraction from this framework of three high-priority mechanistic pathways amenable for modelling; 3) the development of a...
Conceptual framework translation

A) Original version

Social protection strategies based on food / cash transfers

Indirect effect

- Better education
- Better access to social/health services
- Better food security / food consumption

Direct effect

- Higher household / individual socioeconomic position
- Better access to TB care

B) Quantitatively derived version

Impact of each transfer programme on key factors

Food security

Social economic status

Access to health services

Diagnosis

Treatment

Outcomes

Unaffected

Active healthy

Active case
### S-PROTECT: the methodological approach

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Conditional cash transfer (CCT)</th>
<th>I. Effect of intervention on each level of impact (Level 1, 2, 3)</th>
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</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Distal social determinant of TB</td>
<td>Higher Household socioeconomic position (SEP)</td>
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<td></td>
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<td>CCT → Household SEP (income)</td>
</tr>
<tr>
<td>Level 2</td>
<td>Proximal social determinant of TB</td>
<td>Malnutrition reduction (BMI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Household SES (income) → BMI</td>
</tr>
<tr>
<td>Level 3</td>
<td>TB outcome</td>
<td>TB transmission, reactivation, treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nutrition (BMI) → TB treatment → TB transmission</td>
</tr>
</tbody>
</table>

II. Estimate of combined effect across these three levels on 3 TB outcomes

III. Inclusion of these estimate into a TB transmission model
## Identified challenges and way forward

<table>
<thead>
<tr>
<th>Challenge</th>
<th>S-PROTECT advance</th>
<th>Way forward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study population</td>
<td>CCT target population and assumed no mixing</td>
<td>More epidemiological studies to understand extent of overlap between TB patients and CCT recipients</td>
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<tr>
<td>Pathways understanding</td>
<td>13 pathways</td>
<td>Go beyond material models of aetiology for TB inequalities</td>
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<tr>
<td>Data availability</td>
<td>Creation of a simple data repository</td>
<td>Gather better data and/or understand whether different modelling approaches are needed</td>
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<td>Data harmonisation and assumptions</td>
<td>First set of rules for data ‘conversion’</td>
<td>Reach consensus with TB and development experts.</td>
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Lessons learned from S-PROTECT

• S-PROTECT is and remains the first attempt to model the impact of social protection on TB.

• Modelling the impact of social protection on TB is complex, but doable.

• Impact findings are illustrative of the process and challenges met and can be extrapolated to other diseases as well.

• Significant progress have been made in this field, but future modelling work can elucidate the impact, feasibility and sustainability of a response model based on cash & care.
A ‘cash, care and data’ model for a better TB response

• Cash: social protection and mainly cash transfers to vulnerable populations, including people with, at risk of or vulnerable to the consequences of TB

• Care: access to quality and equitable TB care services

• Data: Monitoring and evaluation systems for social determinants data and better linkages between health and social protection data
The roadmap to a ‘cash, care and data’ TB response model

Research domains

Operational research

Impact research

Mechanism of impact

The role of mathematical modelling

• The impact of social protection under different coverage, benefit and delivery conditions

• The impact of social protection under different TB burden and epidemic profile

• The impact of implementation strategies or referral systems to make social protection programs more TB-inclusive

• The role of other pathways beyond nutrition

• The added value of social protection to achieve a more effective, sustainable and equitable TB response
Thank you for your attention

Delia Boccia