

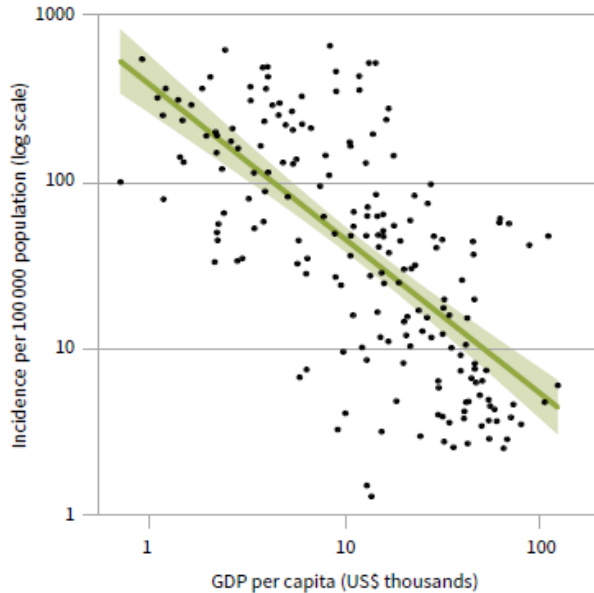
Modelling the social determinants of TB to inform a 'cash, care and data' TB response model

Dr Delia Boccia

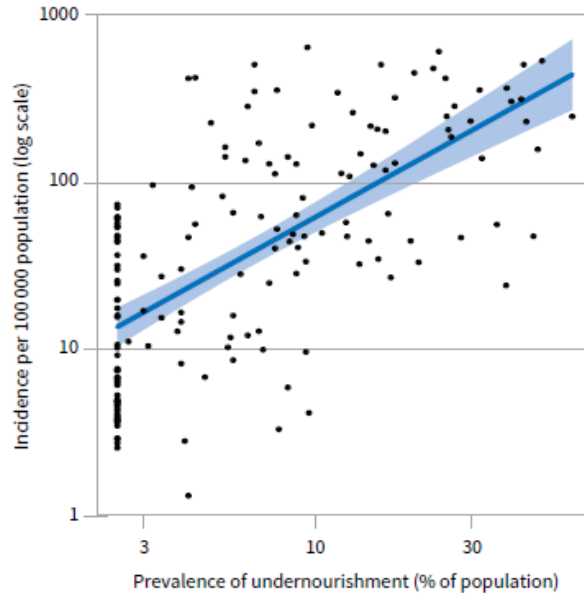
IDM Annual Symposium – Seattle, 22-24 May 2023



The social determinants of TB: poverty and undernutrition



Poverty



Undernutrition

* The year of data used for GDP per capita and undernourishment is the latest year for which data are available in the World Bank (<https://data.worldbank.org/>) and SDG (<https://unstats.un.org/sdgs/dataportal>) databases, respectively.

- 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 social determinants of TB: living and working conditions



Housing



Imprisonment



Working condition

Crowding – Indoor and outdoor pollution - low income – social exclusion - violence

Determinants of TB incidence decline

Trends in tuberculosis incidence and their determinants in 134 countries

C Dye,^a K Lönnroth,^a E Jaramillo,^a BG Williams^a & M Raviglione^a

Objective To determine whether differences in national trends in tuberculosis incidence are attributable to the variable success of control programmes or to biological, social and economic factors.

Methods We used trends in case notifications as a measure of trends in incidence in 134 countries, from 1997 to 2006, and used regression analysis to explore the associations between these trends and 32 measures covering various aspects of development (1), the economy (6), the population (3), behavioural and biological risk factors (9), health services (6) and tuberculosis (TB) control (7).

Findings The TB incidence rate changed annually within a range of $\pm 10\%$ over the study period in the 134 countries examined, and its average value declined in 93 countries. The rate was declining more quickly in countries that had a higher human development index, lower child mortality and access to improved sanitation. General development measures were also dominant explanatory variables within regions, though correlation with TB incidence trends varied geographically. The TB incidence rate was falling more quickly in countries with greater health expenditure (situated in central and eastern Europe and the eastern Mediterranean), high-income countries with lower immigration, and countries with lower child mortality and HIV infection rates (located in Latin America and the Caribbean). The intensity of TB control varied widely, and a possible causal link with TB incidence was found only in Latin America and the Caribbean, where the rate of detection of smear-positive cases showed a negative correlation with national incidence trends.

Conclusion Although TB control programmes have averted millions of deaths, their effects on transmission and incidence rates are not yet widely detectable.

Dye C, Lönnroth K, Jaramillo E, Williams BG, Raviglione M. Trends in tuberculosis incidence and their determinants in 134 countries. *Bull World Health Organ.* 2009 Sep;87(9):683-91.

Költringer et al. *BMC Public Health* (2023) 23:337
<https://doi.org/10.1186/s12889-023-15213-w>

BMC Public Health

RESEARCH

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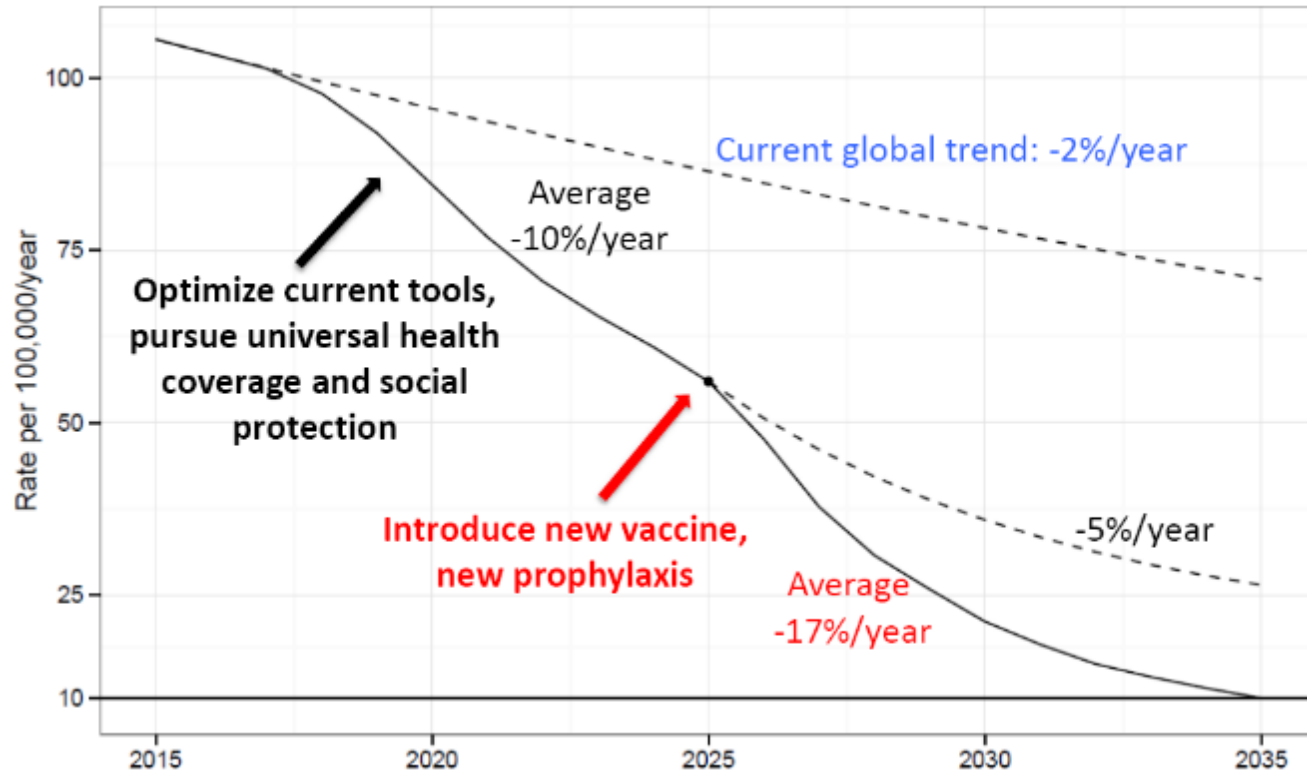


The social determinants of national tuberculosis incidence rates in 116 countries: a longitudinal ecological study between 2005–2015

Fiona A. Költringer^{1*}, Kristi Sidney Annerstedt¹, Delia Boccia², Daniel J. Carter³ and William E. Rudgard³

Költringer FA, Annerstedt KS, Boccia D, Carter DJ, Rudgard WE. The social determinants of national tuberculosis incidence rates in 116 countries: a longitudinal ecological study between 2005–2015. *BMC Public Health.* 2023 Feb 15;23(1):337.

Projected acceleration of TB incidence decline to target levels



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.

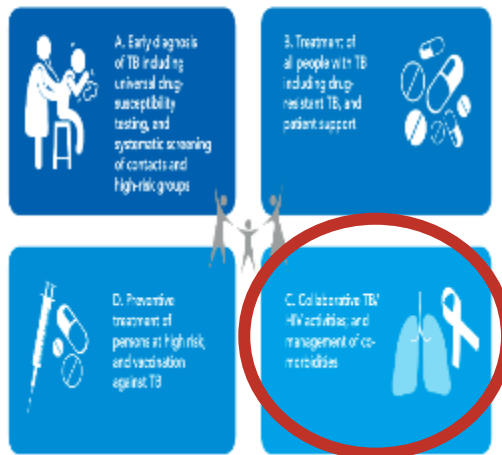
Source: ILO. 2017. "World Social Protection Report 2017-19: Universal social protection to achieve the Sustainable Development Goals". Geneva: International Labour Organization. <https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_604882.pdf>

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.

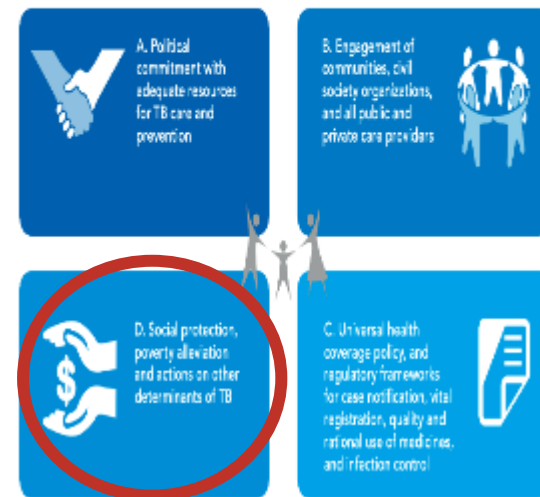
INTEGRATED, PATIENT-CENTRED CARE AND PREVENTION

How pillar 1 works : Key actions



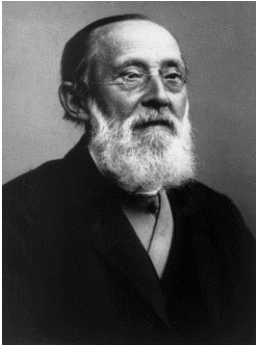
BOLD POLICIES AND SUPPORTIVE SYSTEMS

How pillar 2 works : Key actions



No TB-affected household face catastrophic costs by 2020

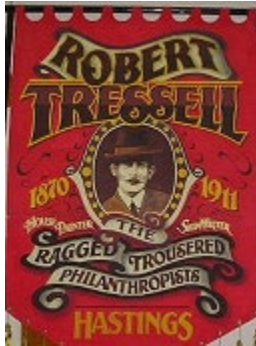
Social protection in TB history



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

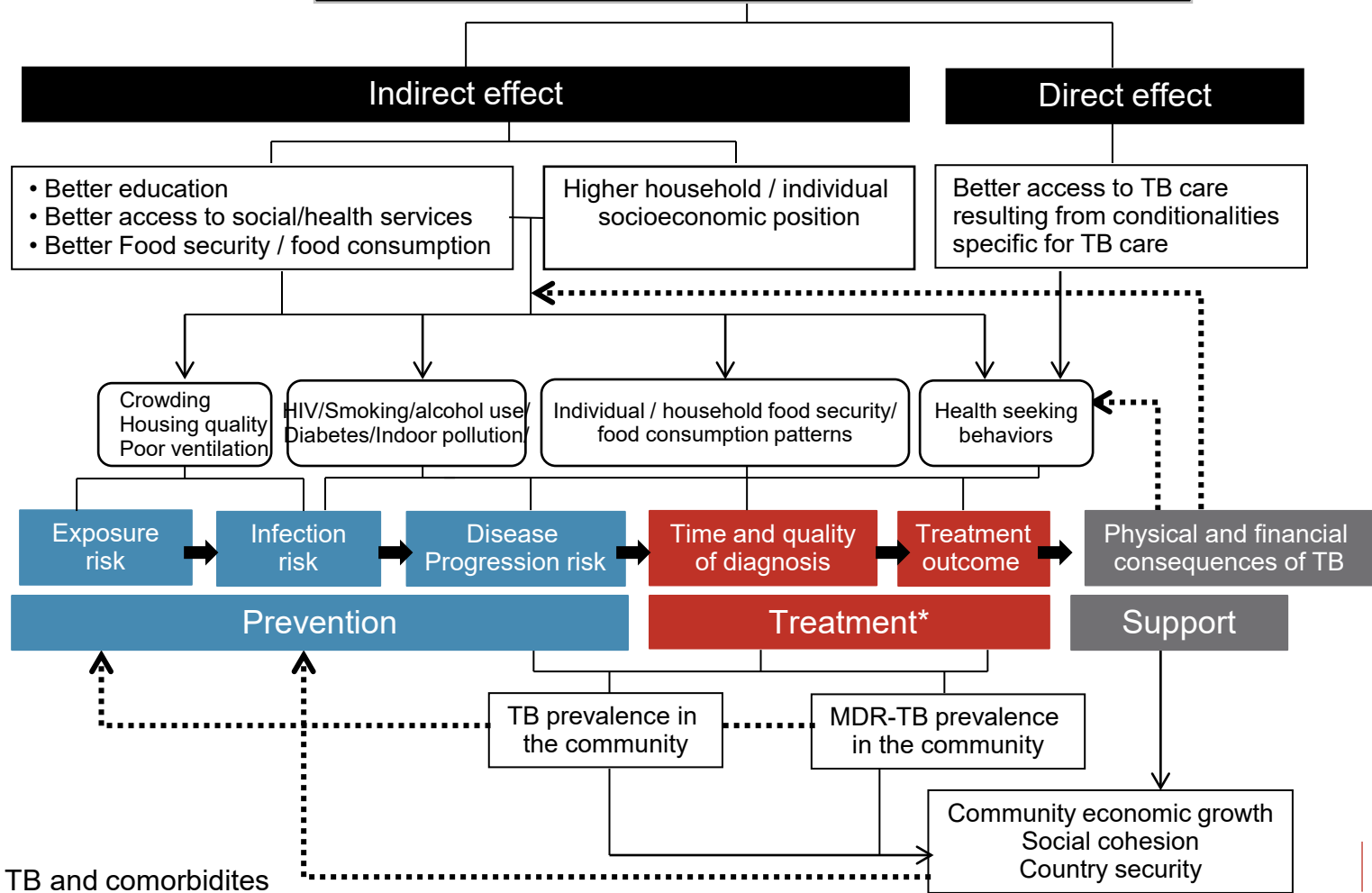


“One of the most powerful weapons we can use against TB is social welfare centres.”
Robert Koch, 1890s



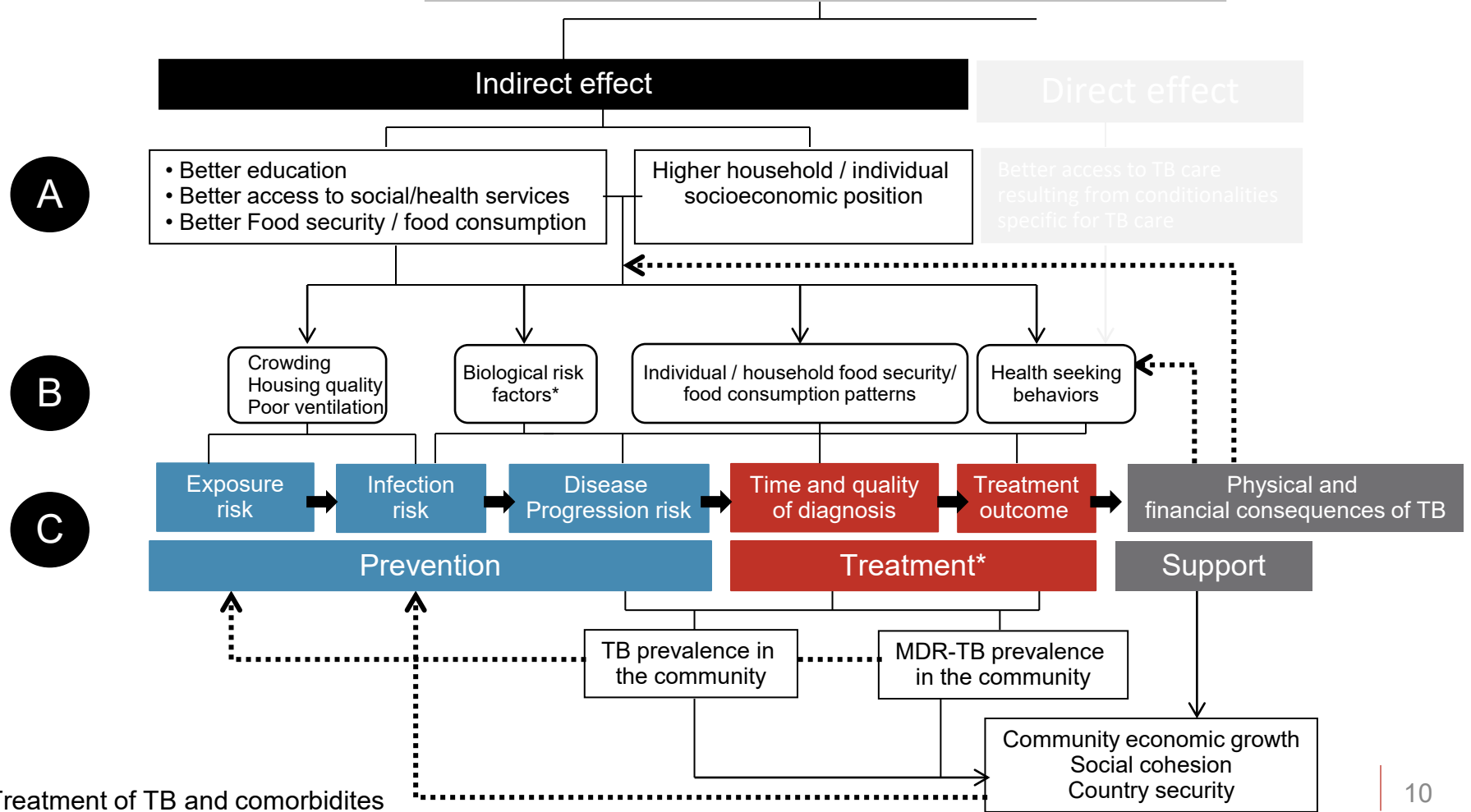
“Those who profess to be desirous of preventing and curing consumption must be either hypocrites or fools, for they ridicule the suggestion that it is necessary first to cure and prevent poverty.”
Robert Tressell, 1912

Social protection strategies based on food / cash transfers



*Treatment of TB and comorbidites

Social protection strategies based on food / cash transfers



*Treatment of TB and comorbidites

Social assistance and TB: an overview of the evidence

A

Distal factors

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

Strong and consistent evidence

B

Intermediate / proximal factors

- Health seeking behaviours
- Exposure to behavioural/biological risk factors

Strong evidence on some but not all relevant risk factors

C

Direct impact on actual TB indicators

- TB incidence
- TB morbidity / mortality
- TB treatment compliance / TB cure
- TB costs mitigation

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

Boccia et al. *BMC Public Health* (2016) 16:266
<https://doi.org/10.1186/s12889-016-5339-x>

BMC Public Health

RESEARCH ARTICLE

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



D. Boccia^{1*}, W. Rutgard¹, S. Shrestha², K. I. Birmah³, P. Fekkol⁴, J. Galub⁵, M. Sanchez⁶, E. Marid⁷, D. Basella⁸, P. Shera^{9,10}, D. Pedrazzi¹¹, R. Houben¹¹, S. Chang⁸ and D. Dowdy²

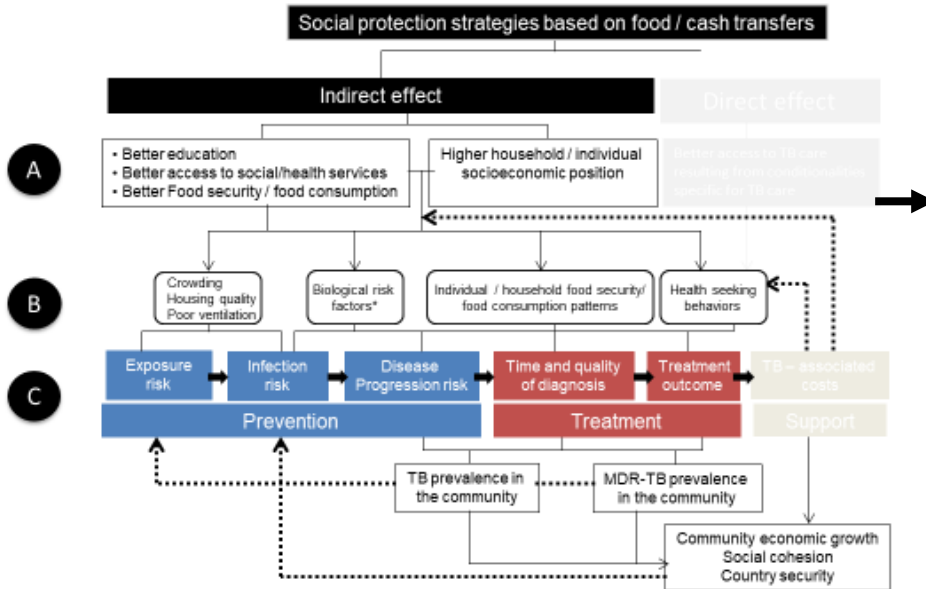
Abstract

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.

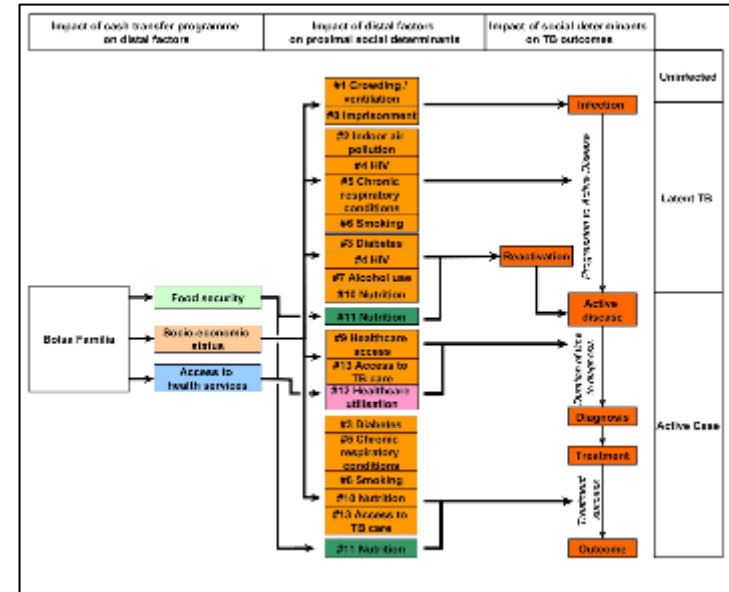
Methods: S-PROTECT used a three-steps approach: 1) the development of a conceptual framework; 2) the extraction from this framework of three high-priority mechanistic pathways amenable for modelling; 3) the development of a

Conceptual framework translation

A) Original version



B) Quantitatively derived version



S-PROTECT: the methodological approach

Intervention

Conditional cash transfer (CCT)

I. Effect of intervention on each level of impact (Level 1, 2, 3)

Level 1

Distal social determinant of TB

Higher Household socioeconomic position (SEP)

CCT → Household SEP (income)

Level 2

Proximal social determinant of TB

Malnutrition reduction (BMI)

Household SES (income) → BMI

Level 3

TB outcome

TB transmission, reactivation, treatment

Nutrition (BMI) → TB treatment → TB transmission

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

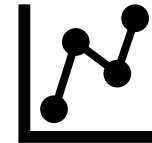
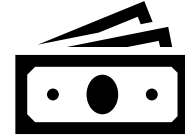
Challenge	S-PROTECT advance	Way forward
Study population	CCT target population and assumed no mixing	More epidemiological studies to understand extent of overlap between TB patients and CCT recipients
Pathways understanding	13 pathways	Go beyond material models of aetiology for TB inequalities
		Gather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

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.

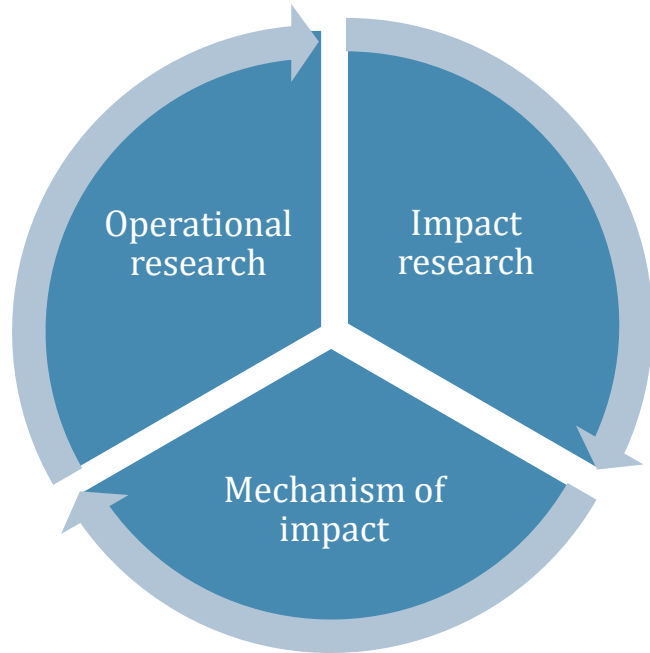
A 'cash, care and data' model for a better TB response

- 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



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