Modelling and Universal Health Coverage

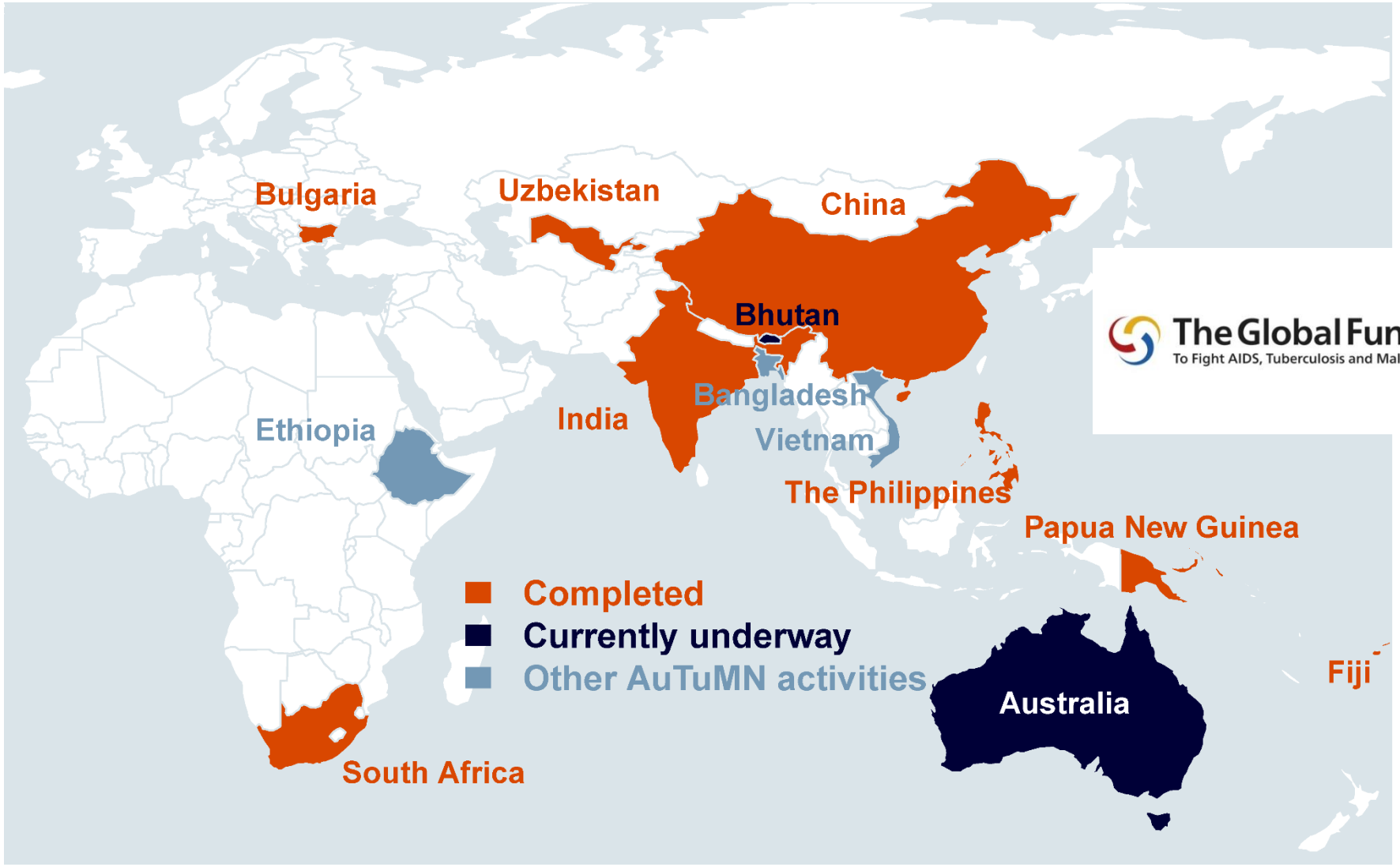
Emma McBryde

On behalf of the AuTuMN team

Istanbul

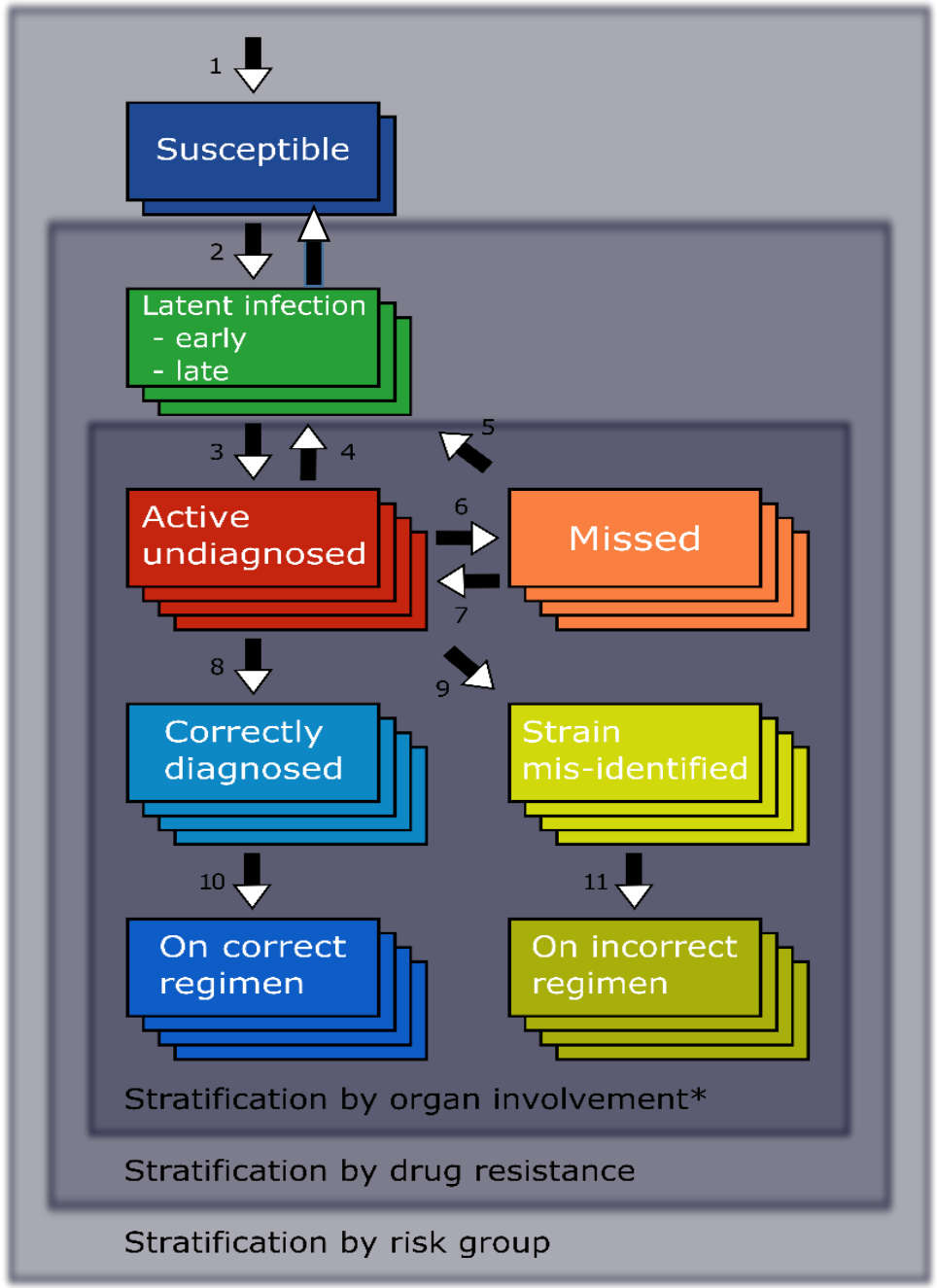
4th October, 2019

Countries of application



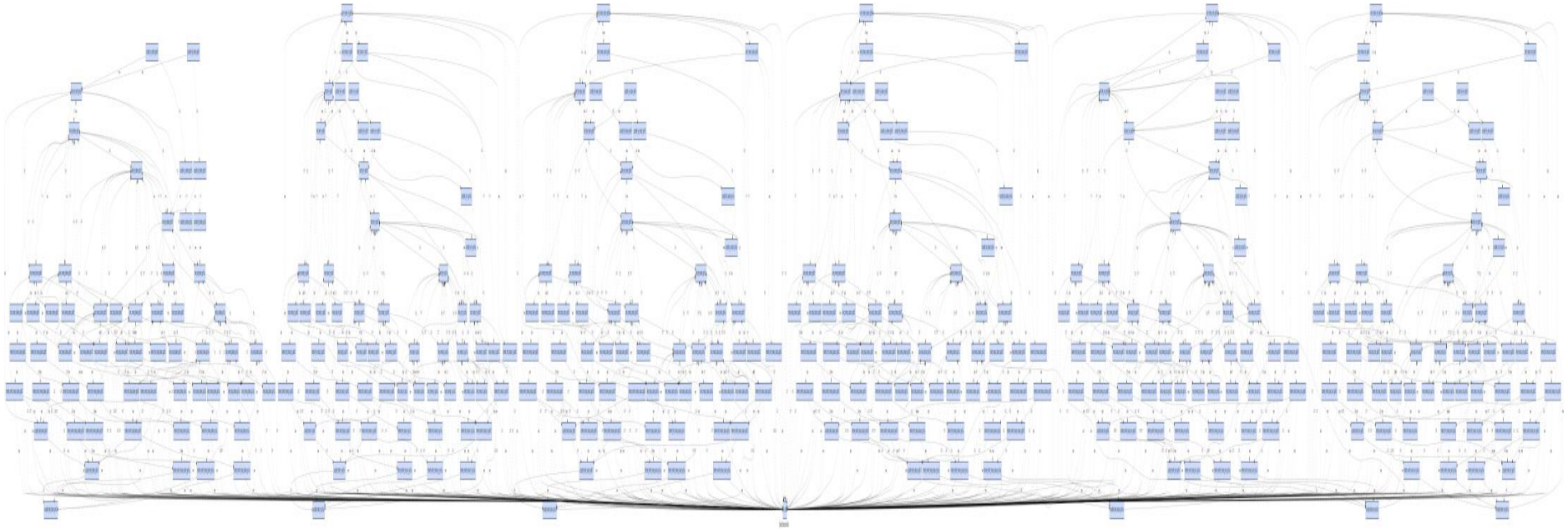
How can Modelling Help ?

- Estimate impact through fitting models to data before and after UHC
- Estimate the cost and benefit
- Give insights into historic changes in incidence
- Disease specific models have limitations when it comes to the social determinants of health
- Models can be modified to take in social determinants


1
Susceptible
2
Latent infection
- early
- late
3
4
5
Active
undiagnosed
6
Missed
7
8
9
Correctly
diagnosed
Strain
mis-identified
10
11
On correct
regimen
On incorrect
regimen
Stratification by organ involvement*
Stratification by drug resistance
Stratification by risk group

TB transmission model

Also stratified by risk groups



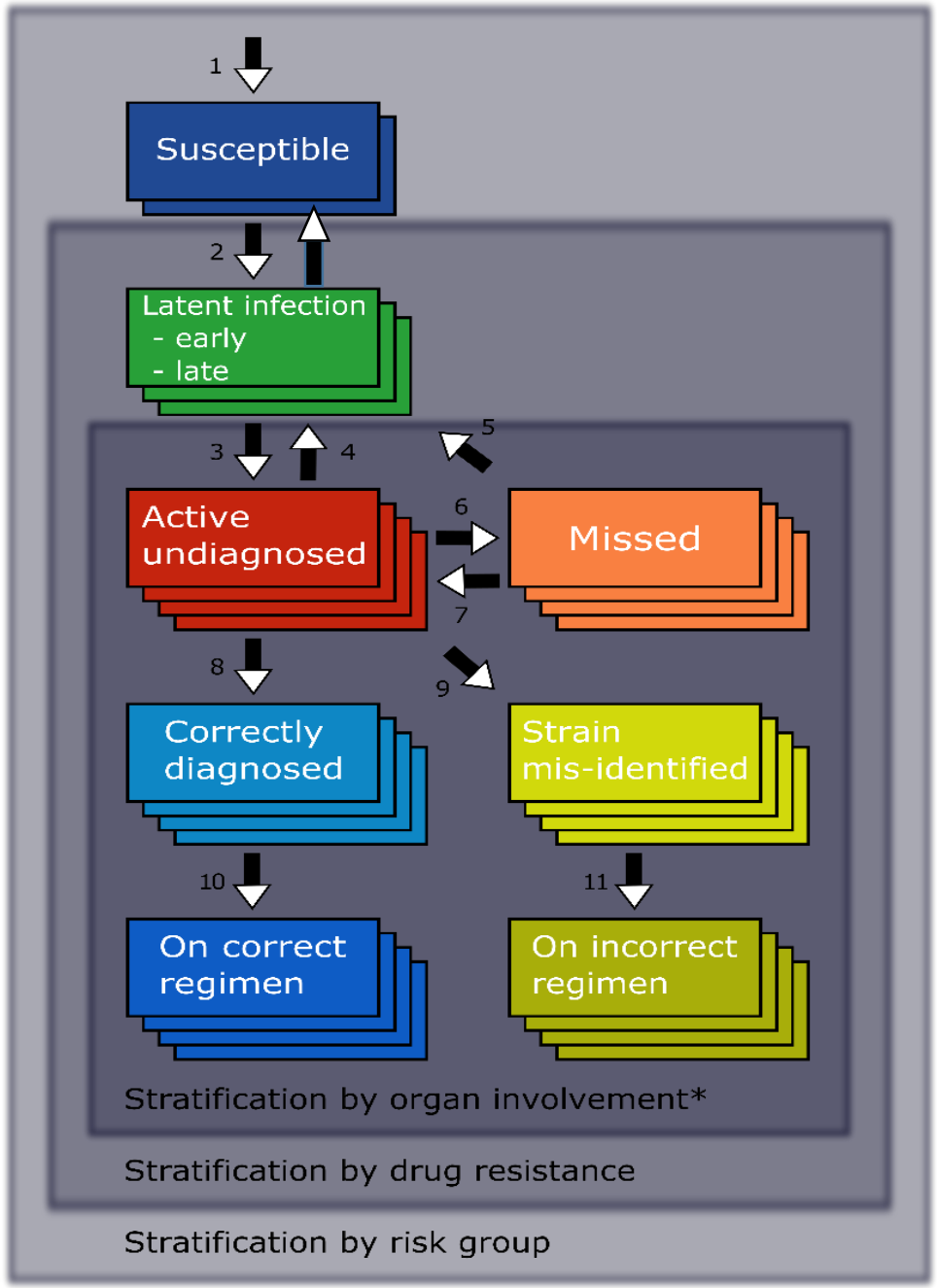
user interface

Costing and UHC

- TB specific activities
- General activities

TB specific activities and UHC: “easy” to model

- UHC -> Improvements in Vaccination
- Access to care → Greater reach of treatment of latent TB
- Access to care → Diagnosis → Seek test treat strategies
  - Treatment: ACF, adherence, correct diagnosis
- Cash transfers & Access to care → improve treatment outcome…
- These can all be modelled
- Avoiding catastrophic costs through cash transfers

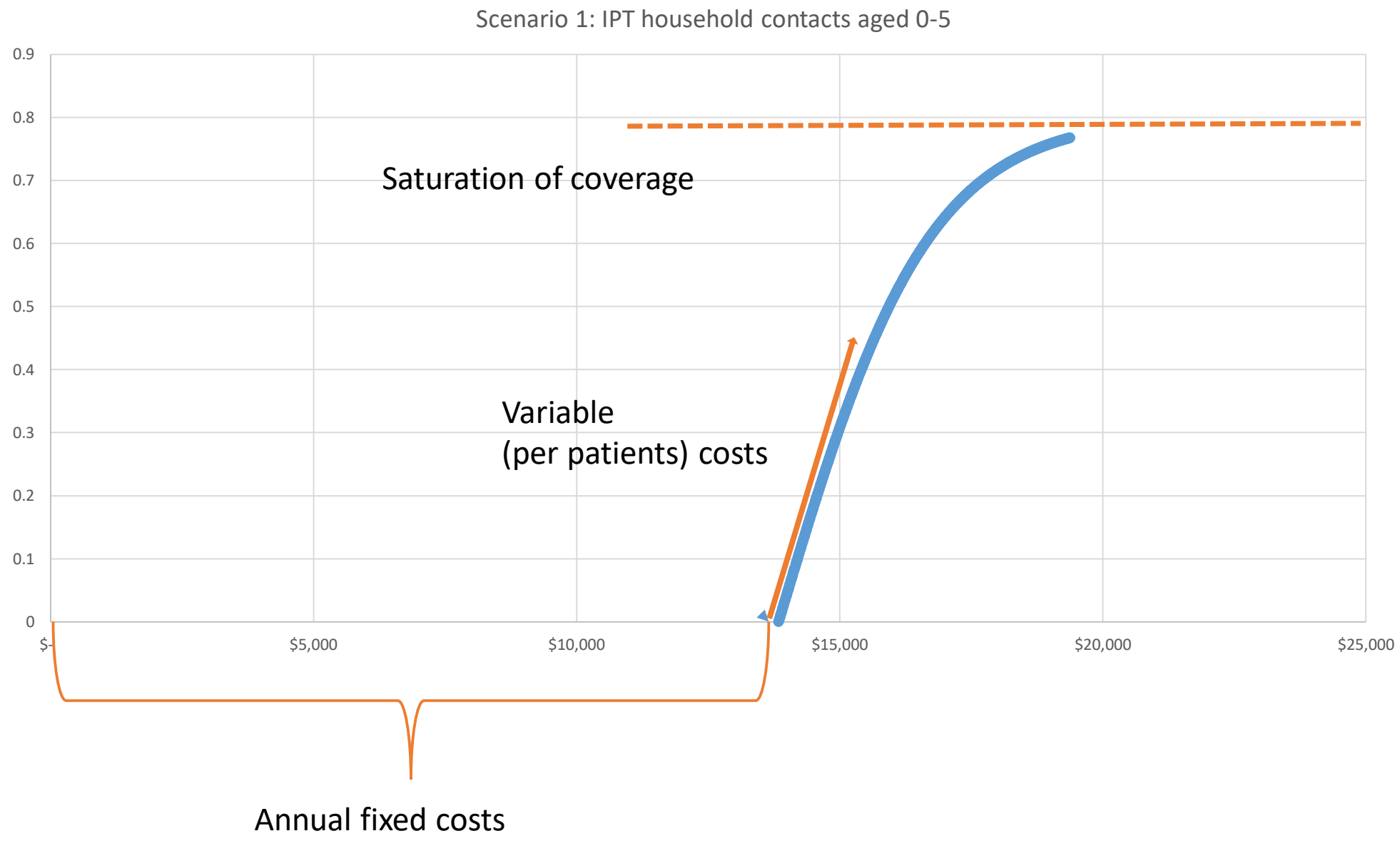

1
Susceptible
2
Latent infection
- early
- late
3
4
5
Active
undiagnosed
6
Missed
7
8
9
Correctly
diagnosed
Strain
mis-identified
10
11
On correct
regimen
On incorrect
regimen
Stratification by organ involvement*
Stratification by drug resistance
Stratification by risk group

	Cost of scenario	Cumulative incidence	Cumulative Mortality	Prevalence	Catastrophic costs/out-of-pocket/etc.
Scenario A					
Scenario B					

Some things are harder to model

- Integrated approach
- Strengthening primary care
- Impact on costs through economies of scale
- Impact of nutrition (hard to determine causal direction)
  - Improve diagnosis
  - Improve success rate of treatment
  - Reduce activation following infection

Shared costs and efficiencies of scale and greater access can impact on cost-coverage curve

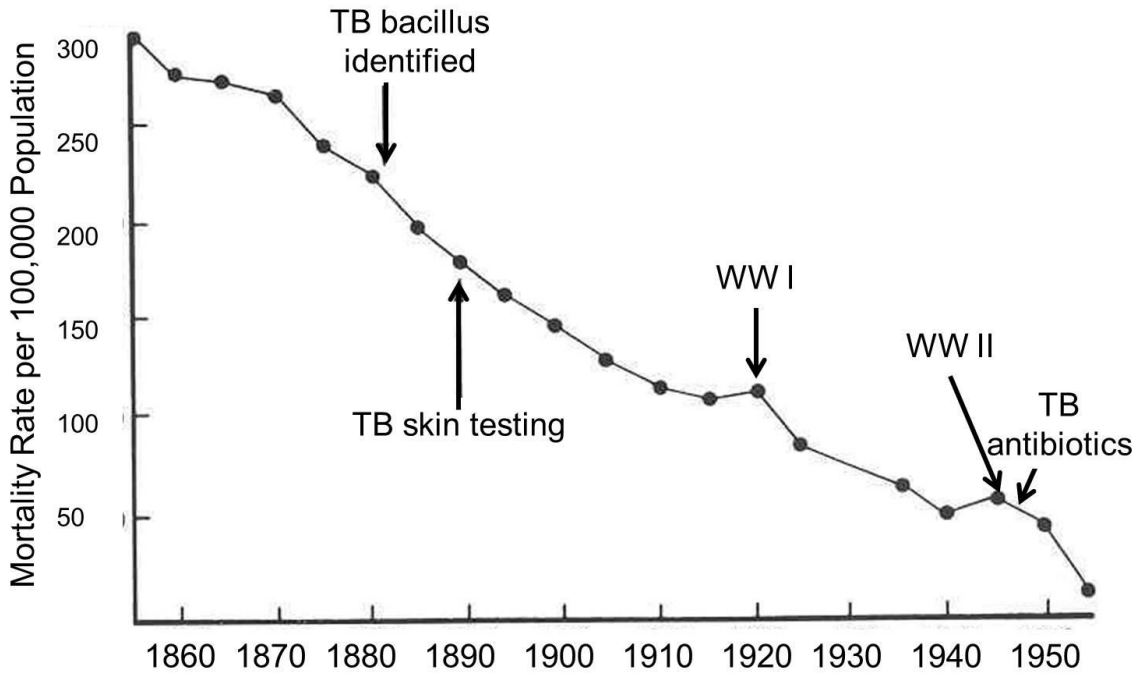


General health and impact on TB ?

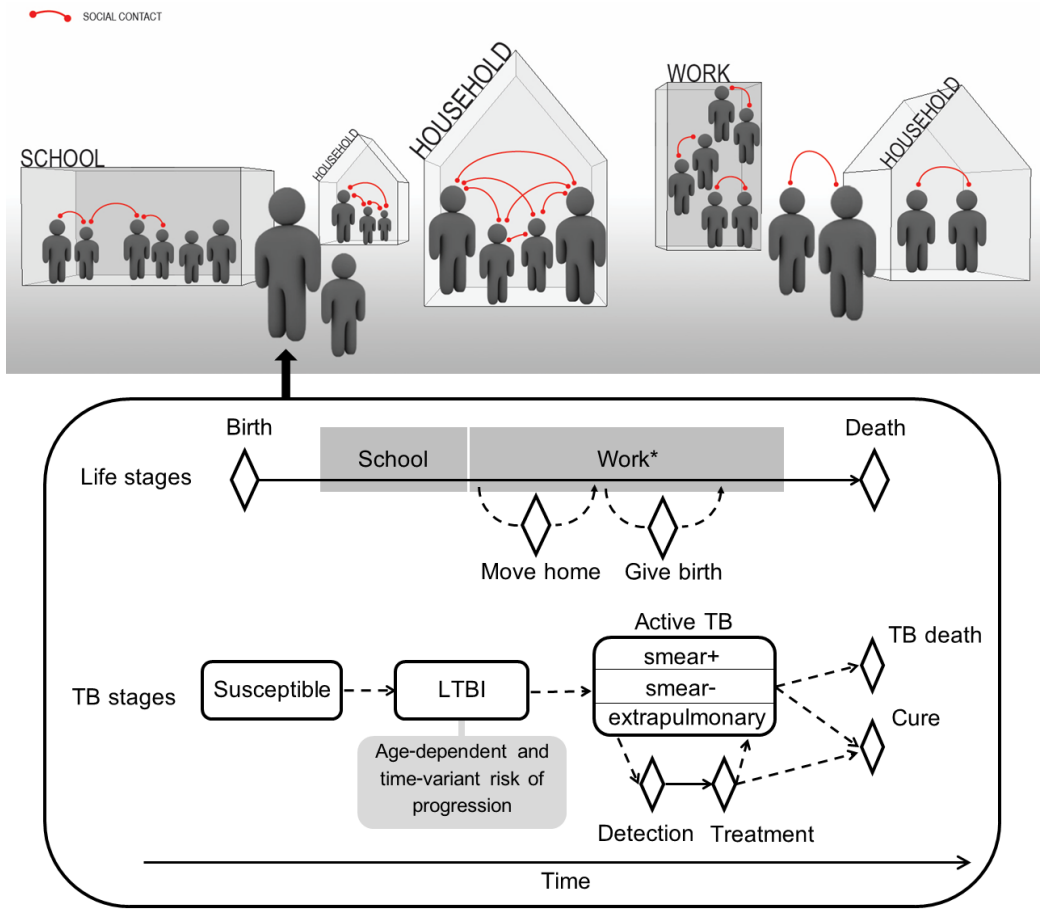
- HIV
- Diabetes control
- Smoking cessation
- nutrition

General social measures and TB

- Historic data is very persuasive
- What drove this ? Mostly non-specific measures

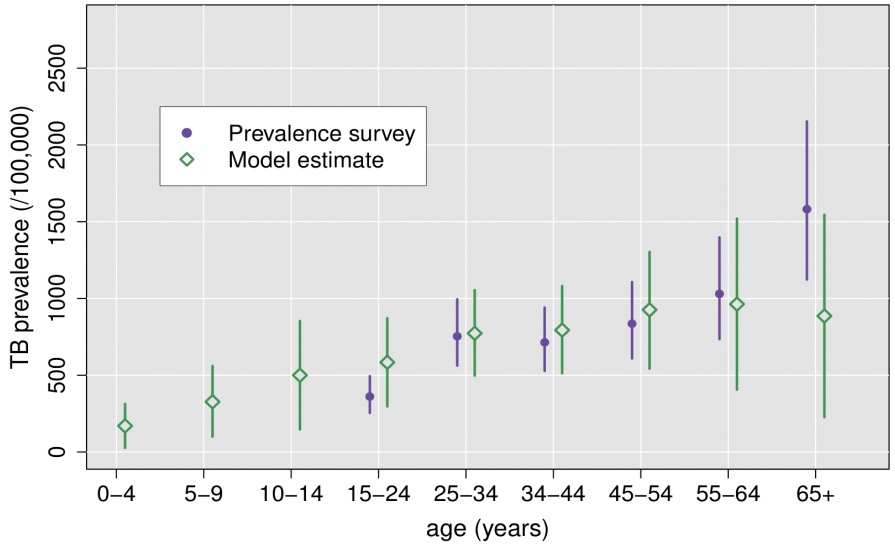


New kinds of models

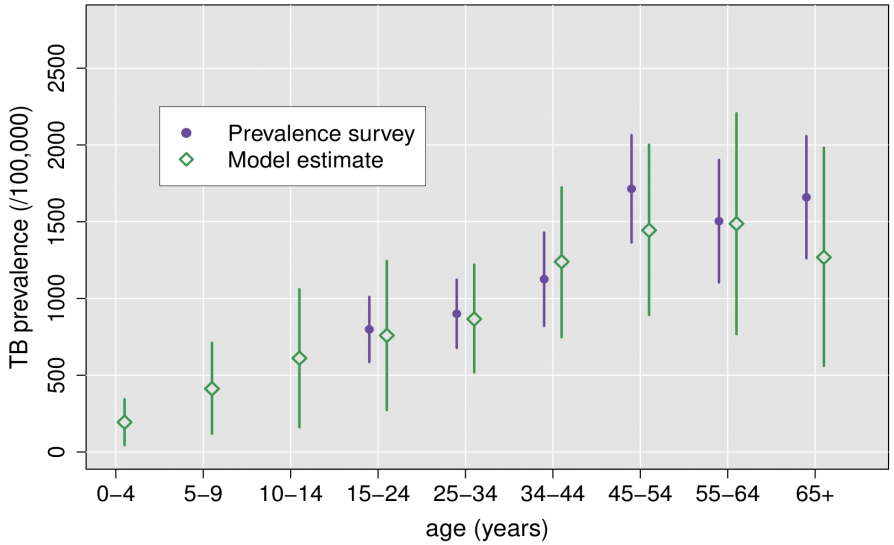


Parameter	India	Indonesia	China	Philippines	Pakistan	Source
Demographic						
Simulated population size	20,000	”	”	”	”	
Average household size	4.8	4.0	3.1	4.7	6.8	[27]
Number of schools (/100,000 population)	115	96	37	57	157	[28-32]
Average number of potential contacts at work*	10-30	”	”	”	”	Assumption
Proportion of the adult population engaged in regular work outside of the household (%)	53.8	66.3	68.9	62.3	54.4	[33]
Proportion contacts which are of high intensity by location, with locations listed as households / schools / workplaces / other locations (%)	46 / 30 / 20 / 10	”	”	”	”	[10]
Natural history of TB						
Proportion of active TB cases sm+[a] / sm-[b] / extra-p[c] (%)	50 / 25 / 25	62 / 19 / 19	52 / 24 / 24	60 / 20 / 20	44 / 28 / 28	[34, 35]
Rate of spontaneous clearance (sm+ / closed TB[d] years^{-1})*	0.18-0.29 / 0.09-0.24	”	”	”	”	[18]
Rate of TB-specific mortality (sm+ / closed TB years^{-1})*	0.33-0.45 / 0.016-0.036	”	”	”	”	[18]
Crude **probability of TB transmission** during a contact ($\times 10^{-4}$)*	38.5 (30.2-44.9)	39.8 (34.1-45.2)	36.1 (32.4-40.2)	39.1 (32.3-47.4)	38.3 (30.8-44.3)	Calibrated
Relative probability of transmission per contact if low-intensity contact	0.5	”	”	”	”	Assumption, tested in sensitivity analysis
Programmatic parameters						
BCG vaccine coverage	Time-variant	Time-variant	Time-variant	Time-variant	Time-variant	[36] Additional Figure S9
Case detection rate	Time-variant	Time-variant	Time-variant	Time-variant	Time-variant	[37] Additional Figure S9
Time from detection to treatment (days)*	0-14	”	”	”	”	[38-41]
Treatment success rate	Time-variant	Time-variant	Time-variant	Time-variant	Time-variant	[35] Additional Figure S9

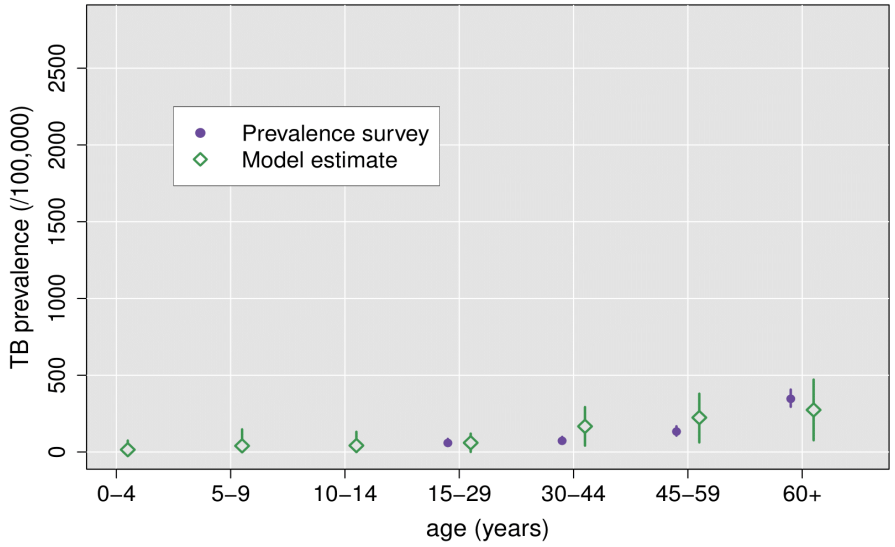
Indonesia



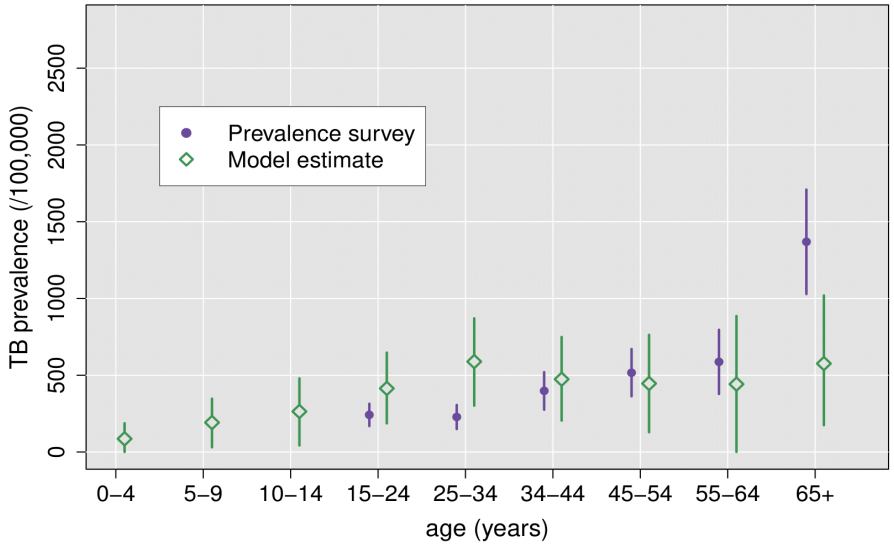
Philippines



China



Pakistan



Demography and household size drive TB in this model
Levers in this model framework

- Age distribution
- Household size and composition
- Not infectiousness per contact
- Not activation rate of TB