

Estimating tuberculosis incidence and mortality in India

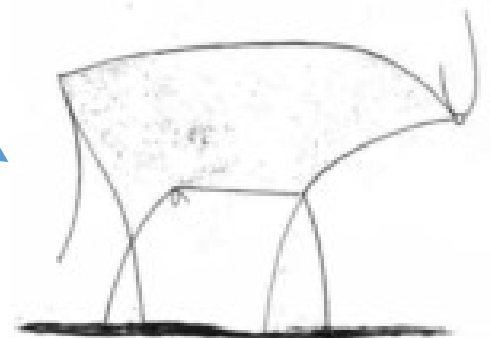
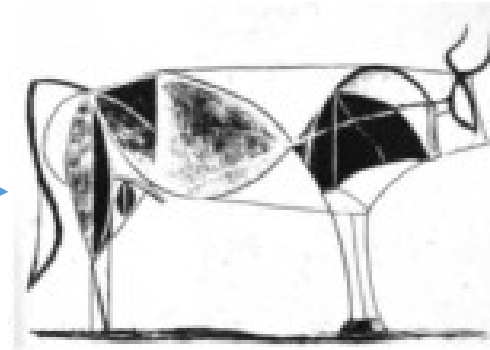
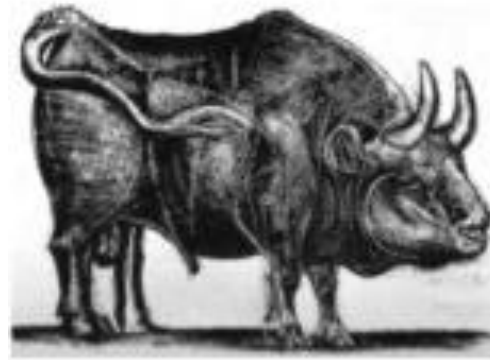
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TB India - Modelling Interest Group, IIT Bombay

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Overview

- Mathematical modelling
- Background: Why did we need new estimates?
- Model overview
- TB incidence estimates
- TB mortality estimates
 - New nationally-representative cause-of-death data published for 2014-2019
 - Updated estimates for WHO Global TB Report 2023



Depending on the availability of data and question to address - we construct our model

Complex reality

Models

Gujarat prevalence survey (2011)



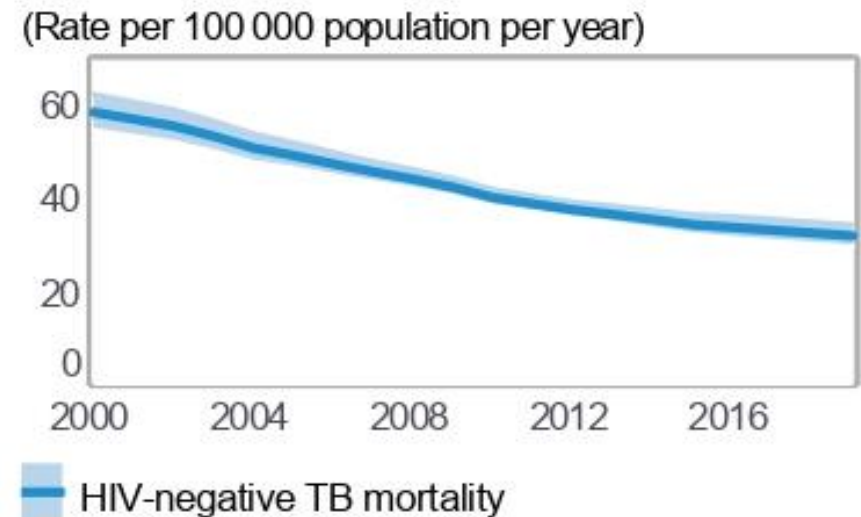
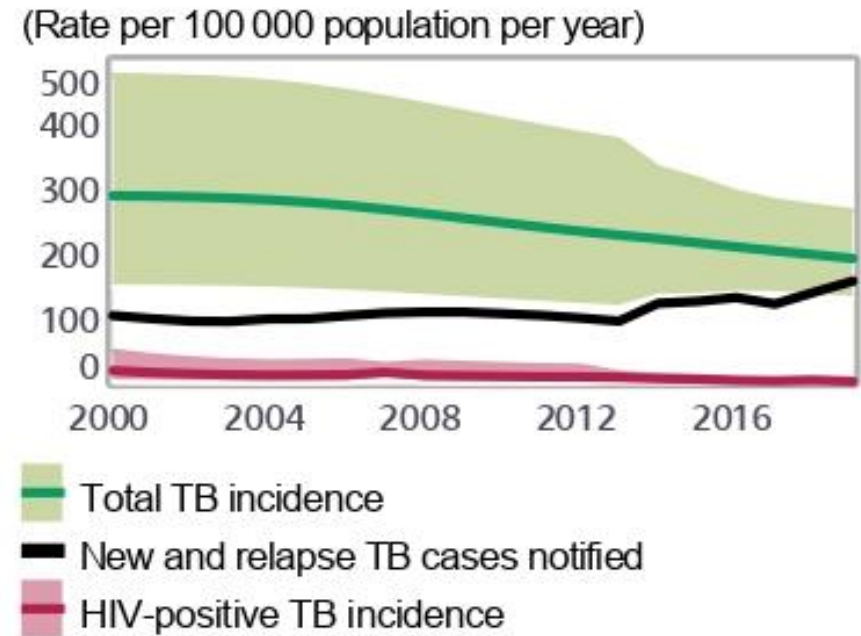
Prevalence in 2011
(Gujarat): 395 [146- 746]

Population of Gujarat in
2011: 59 million (5% of
Indian population)



Estimated incidence and mortality

(GTB Report-2020)



What changed from late 2019 onwards

Generation of new data

- National prevalence survey (2019 – 2021)
- Sub-national certification: additional data at district level

COVID-19 related disruption

- Routine TB services got disrupted
 - Likely leading to increase in undiagnosed, untreated TB
- Anti-COVID restrictions (e.g. lockdowns) likely to have temporarily affected TB transmission

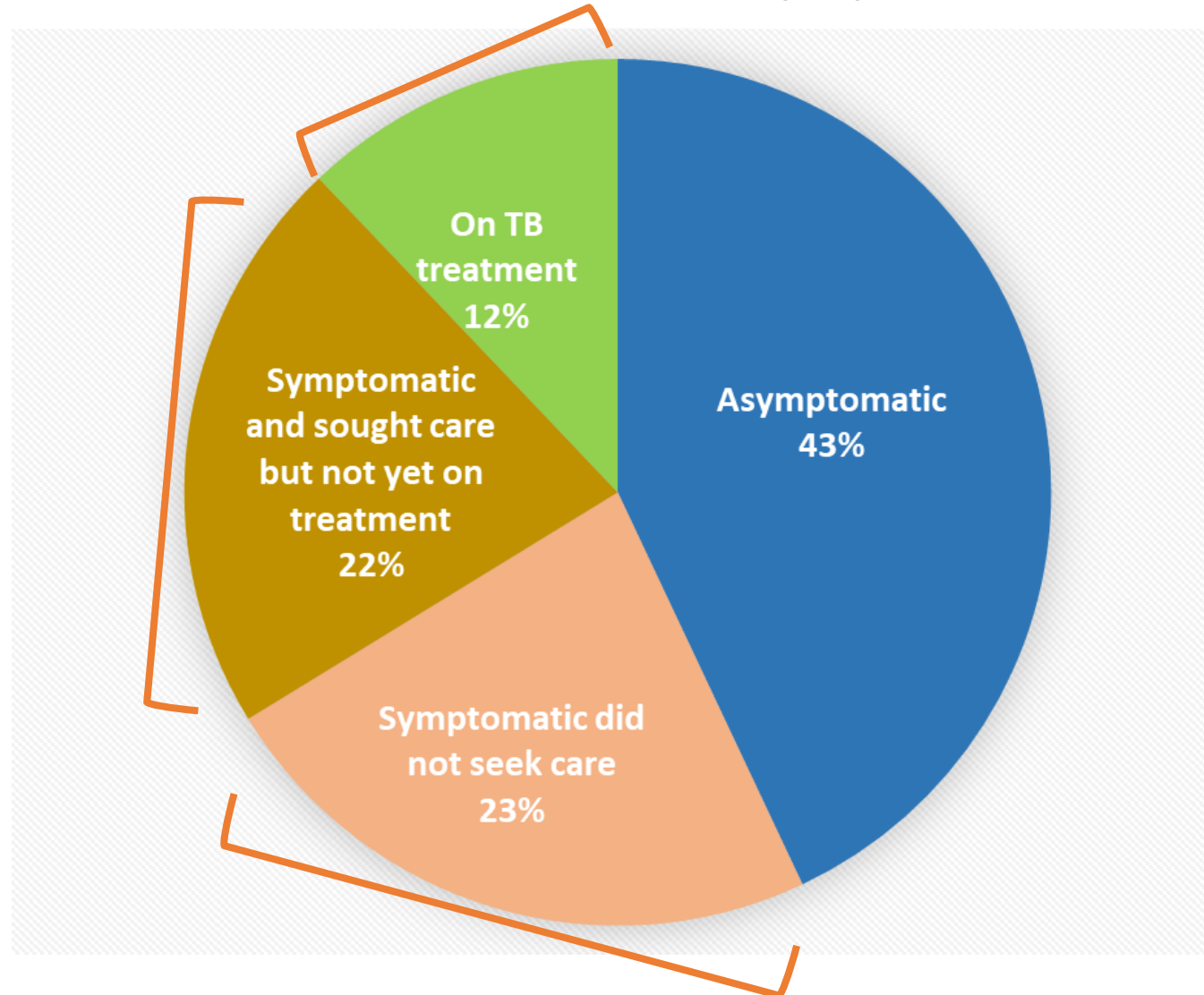
National TB prevalence survey (2019 - 2021)



- The survey was conducted from 2019 to 2021 (2.5 years)
- Prevalence (all forms of TB for all ages): 312[286 – 337]

Data: the value of prevalence survey

Prevalence of tuberculosis (TB) in India

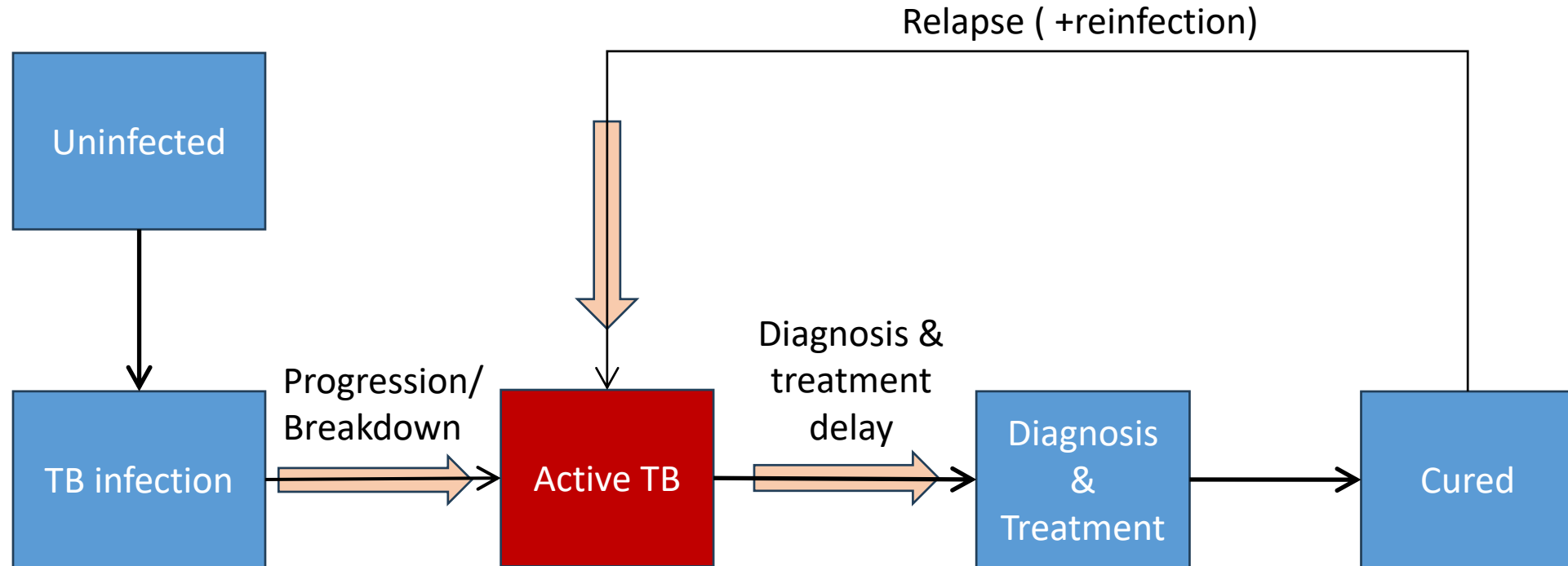


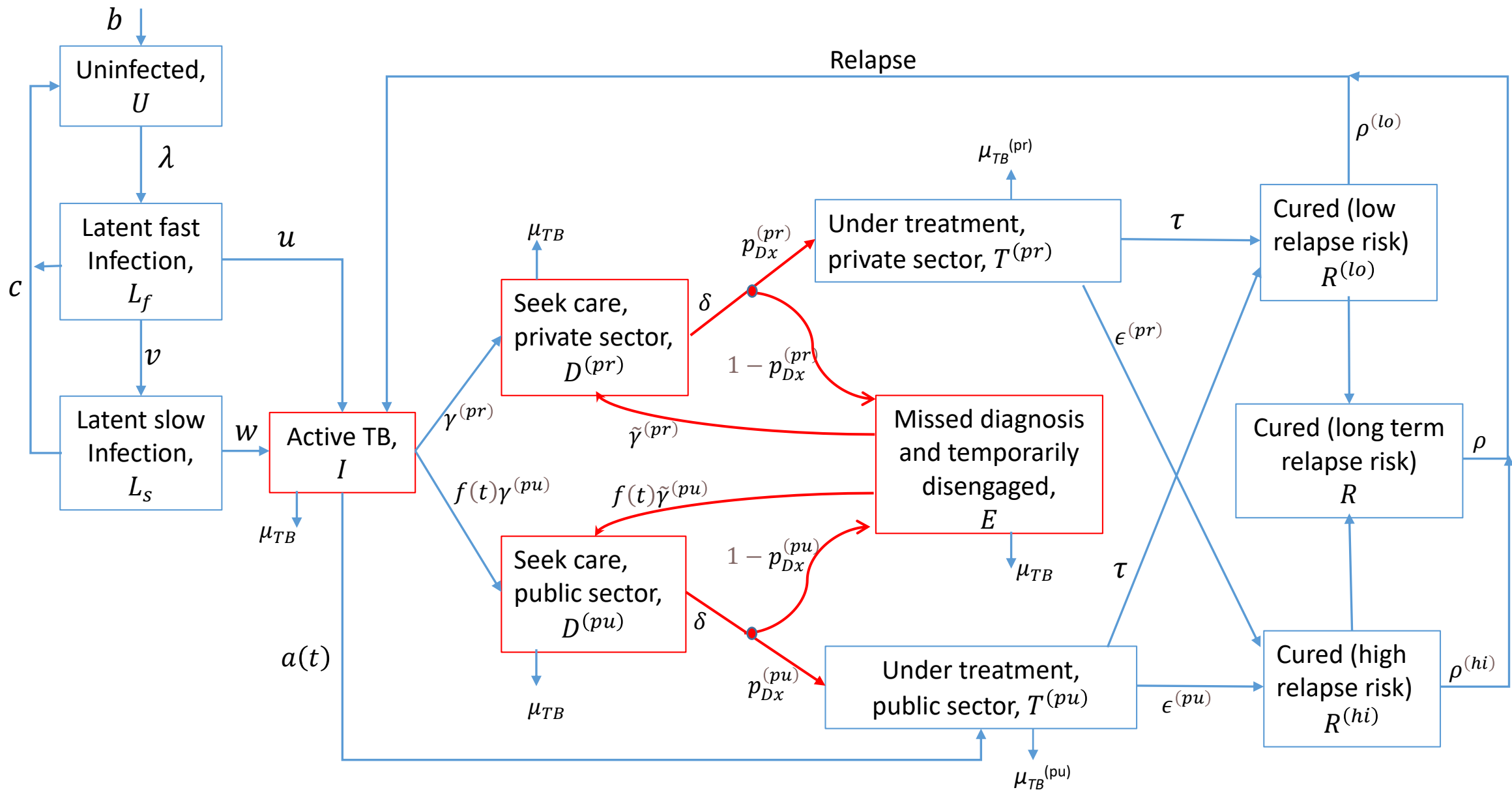
Data used for the current estimation

- National prevalence survey data
 - Prevalence of TB disease
 - Proportion of prevalent cases under treatment
 - Prevalence of TB infection
- Subnational certification
 - Estimates for levels of underreporting
- Programmatic data
 - Notification (public and private sector)
 - Trend in public sector notification
 - Active case finding
- Drug sale data
 - Trend in private sector treatment initiation
 - Proportion of privately managed patients treated with publicly supplied drugs
- Google mobility data (to inform periods when TB transmission might have got reduced)

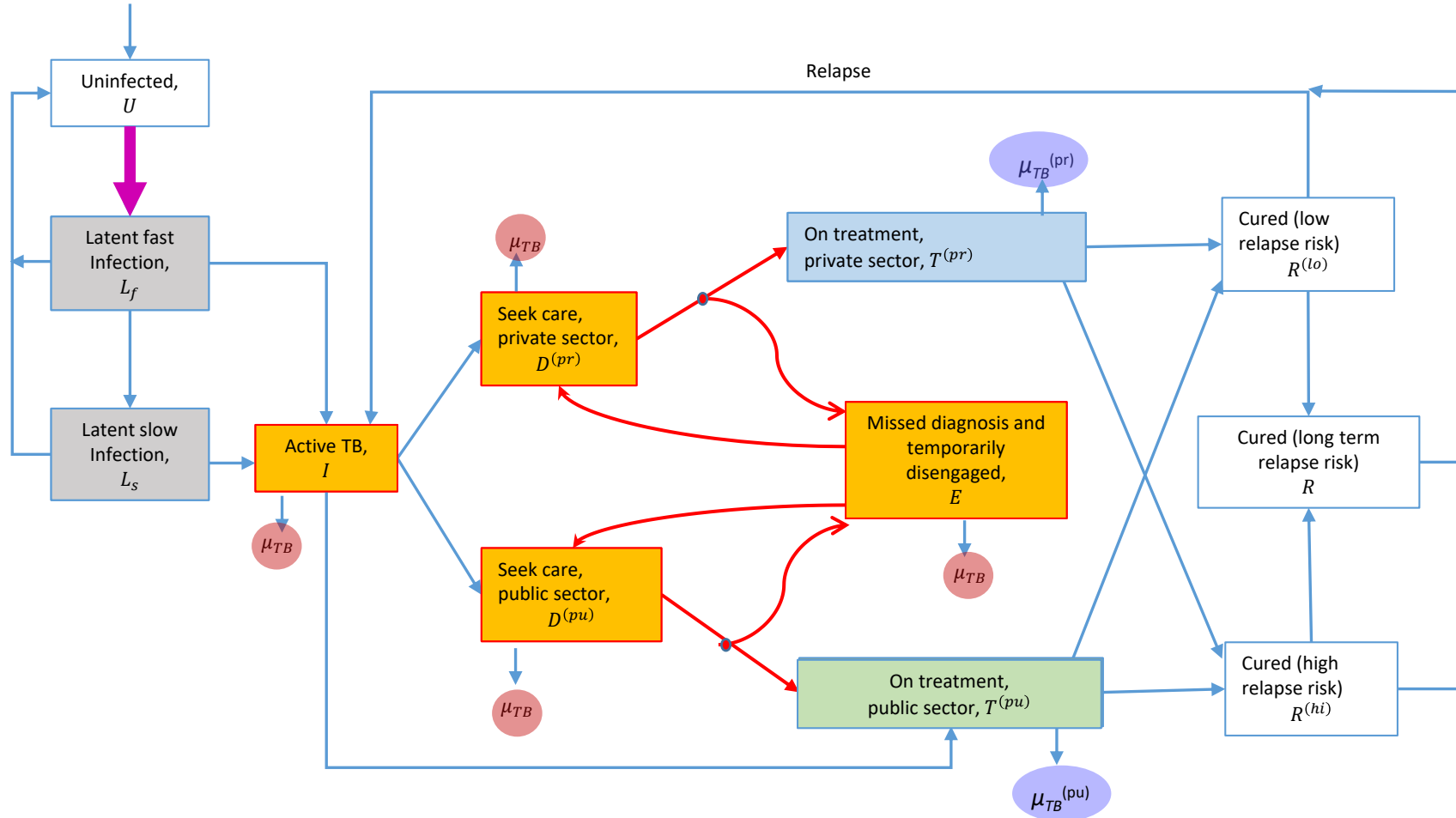
Model

Model: Schematic diagram





Where the data are used in the model



- Prevalence 2019 and proportion of prevalent cases under treatment

- Notifications, 2011-2019:

- For the numbers of patients being managed in the public sector

- Private sector drug sales, 2015 - 2019:

- For trends in numbers managed by private sector

- WHO estimates for overall TB mortality (SRS-based), 2015 and 2019

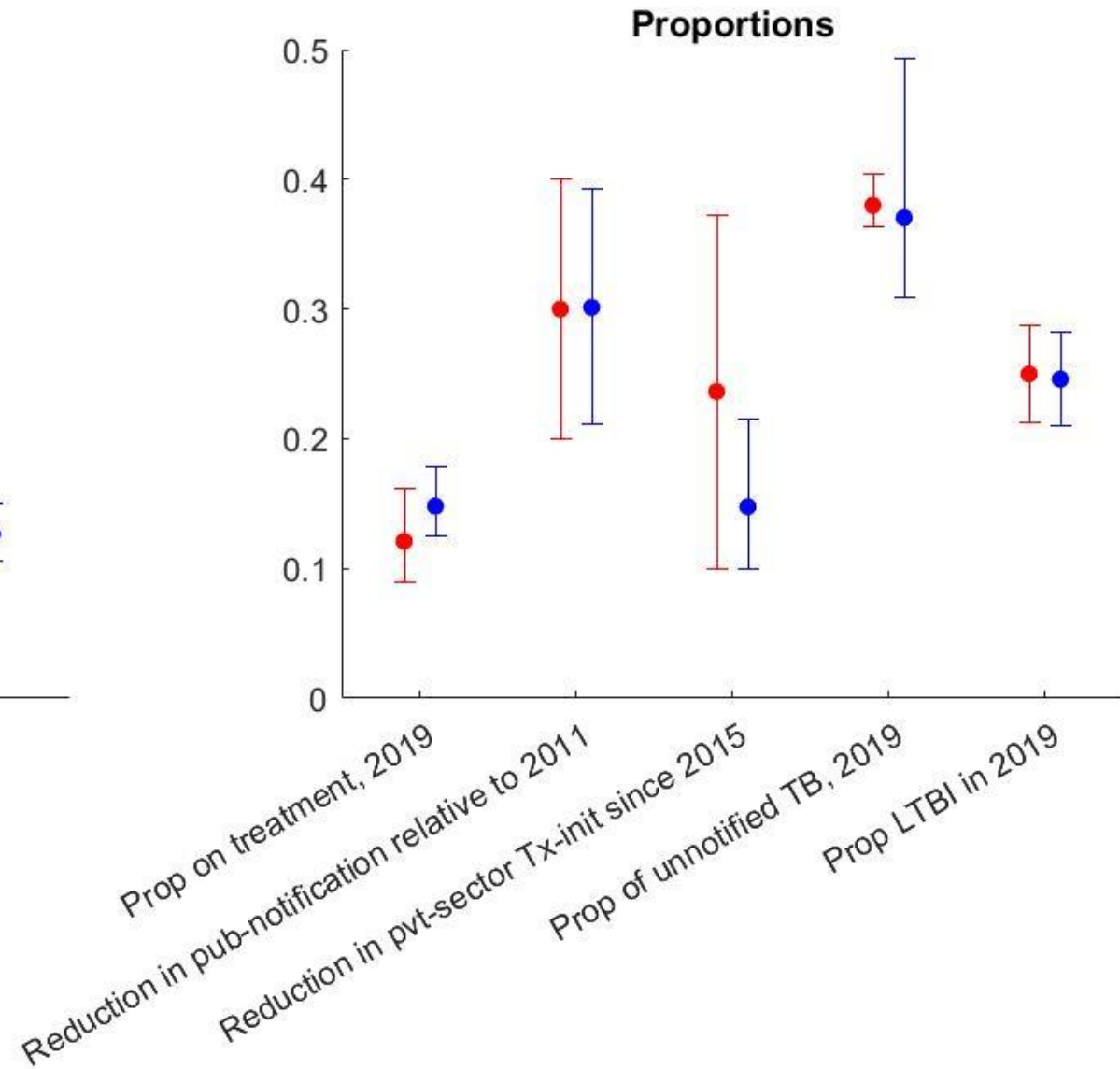
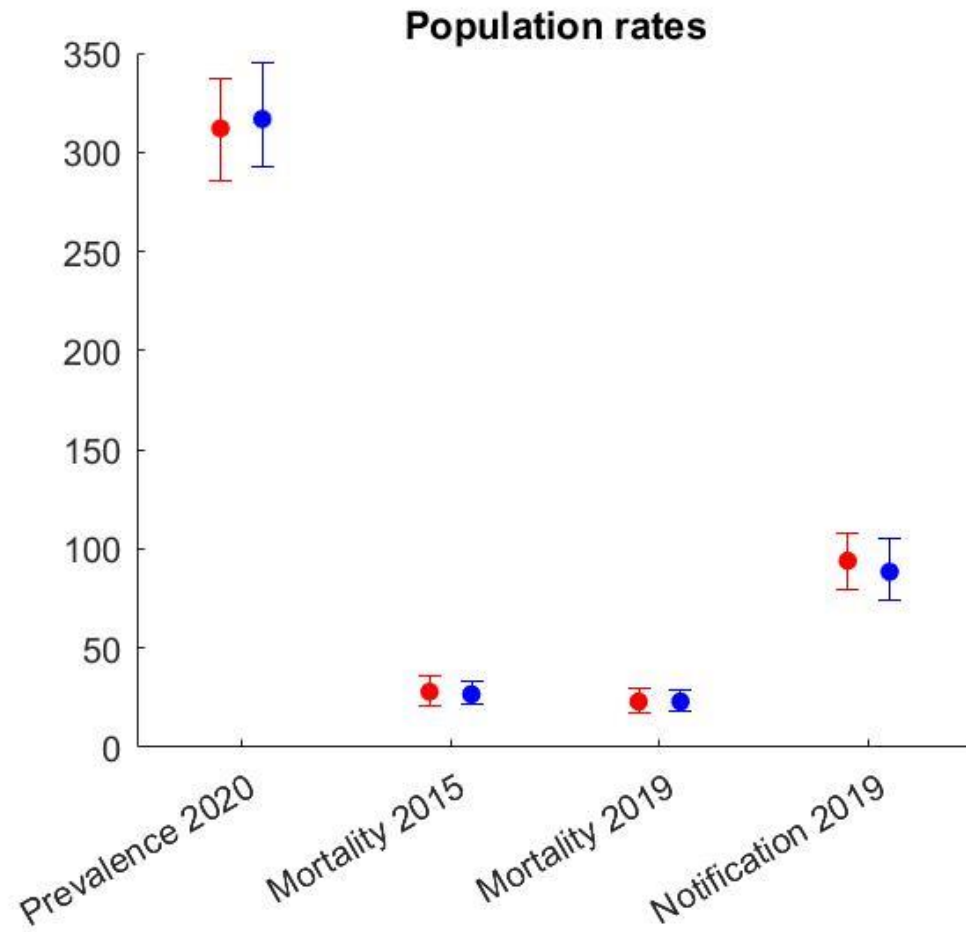
- Programmatic data deaths on treatment

- TB infection survey:

- For the prevalence of TB infection

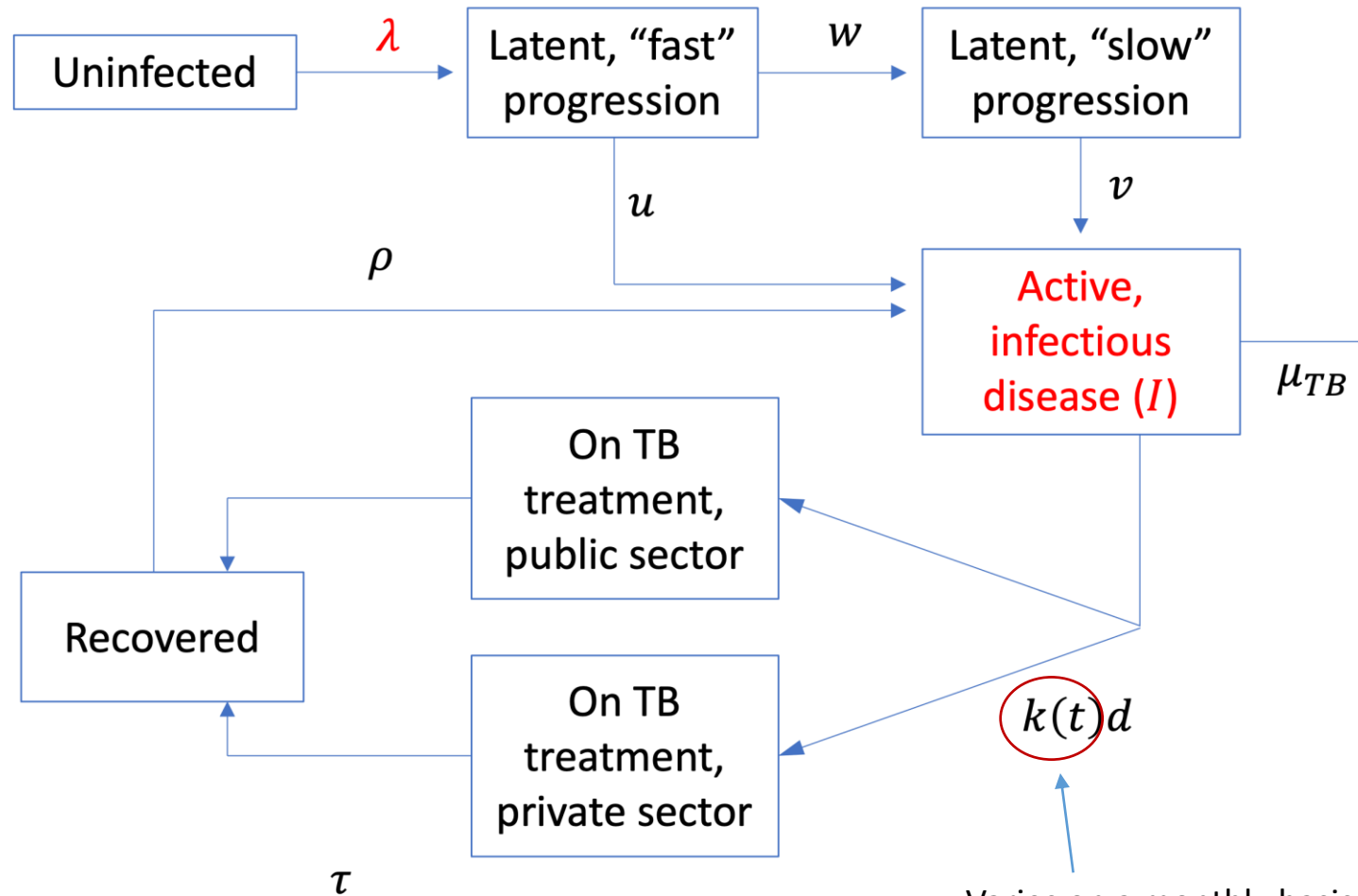
- Google mobility data

Calibration results



Modelling the impact of COVID-related disruptions

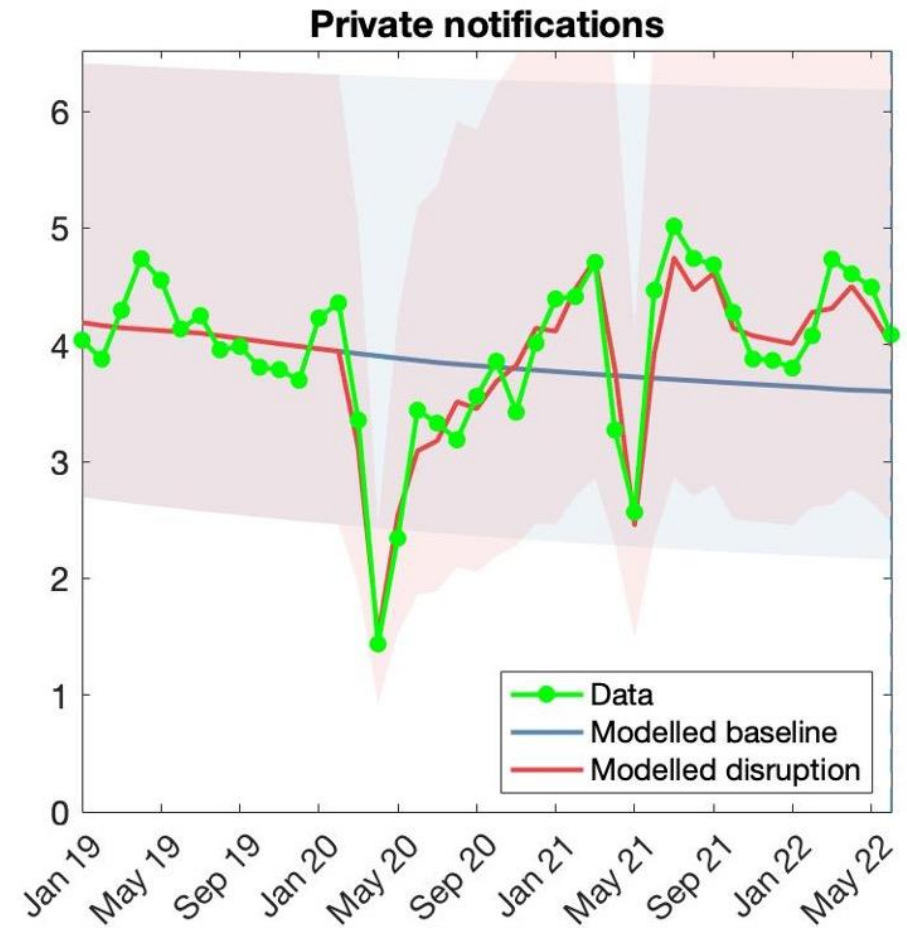
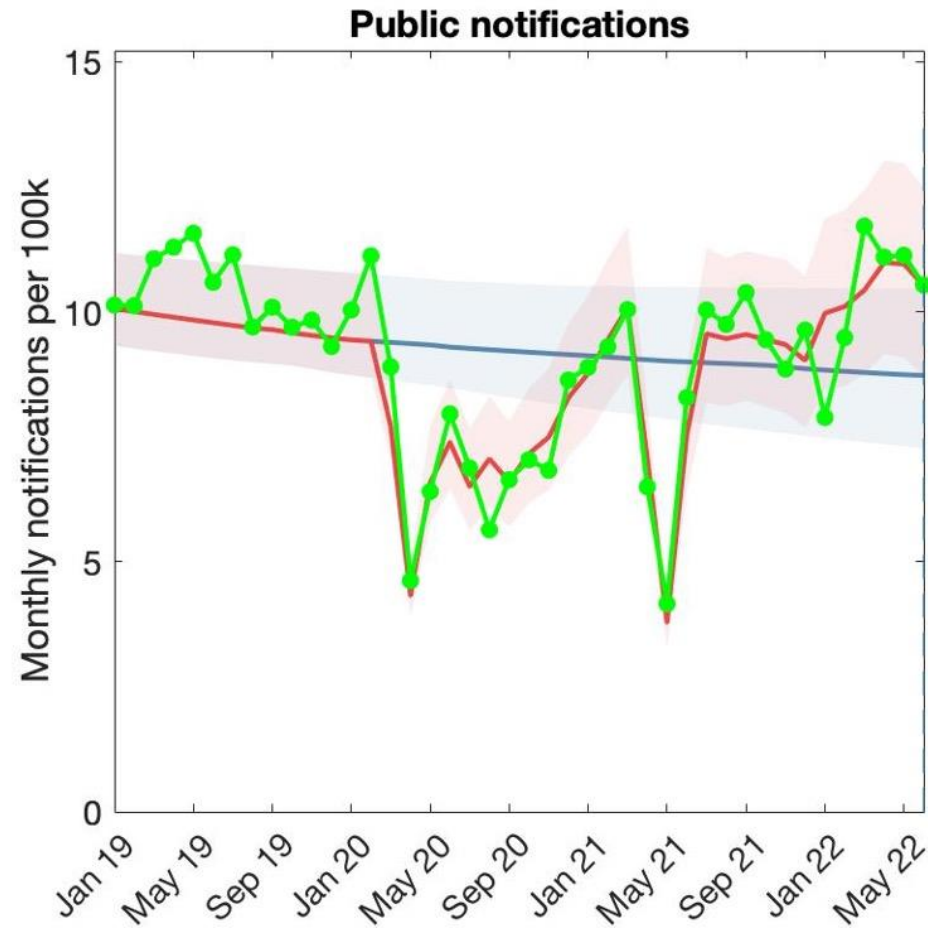
Modelling disruptions, 2020 – 2021



Also including:
Exogenous reinfection
Relapse
Population turnover
Self-cure

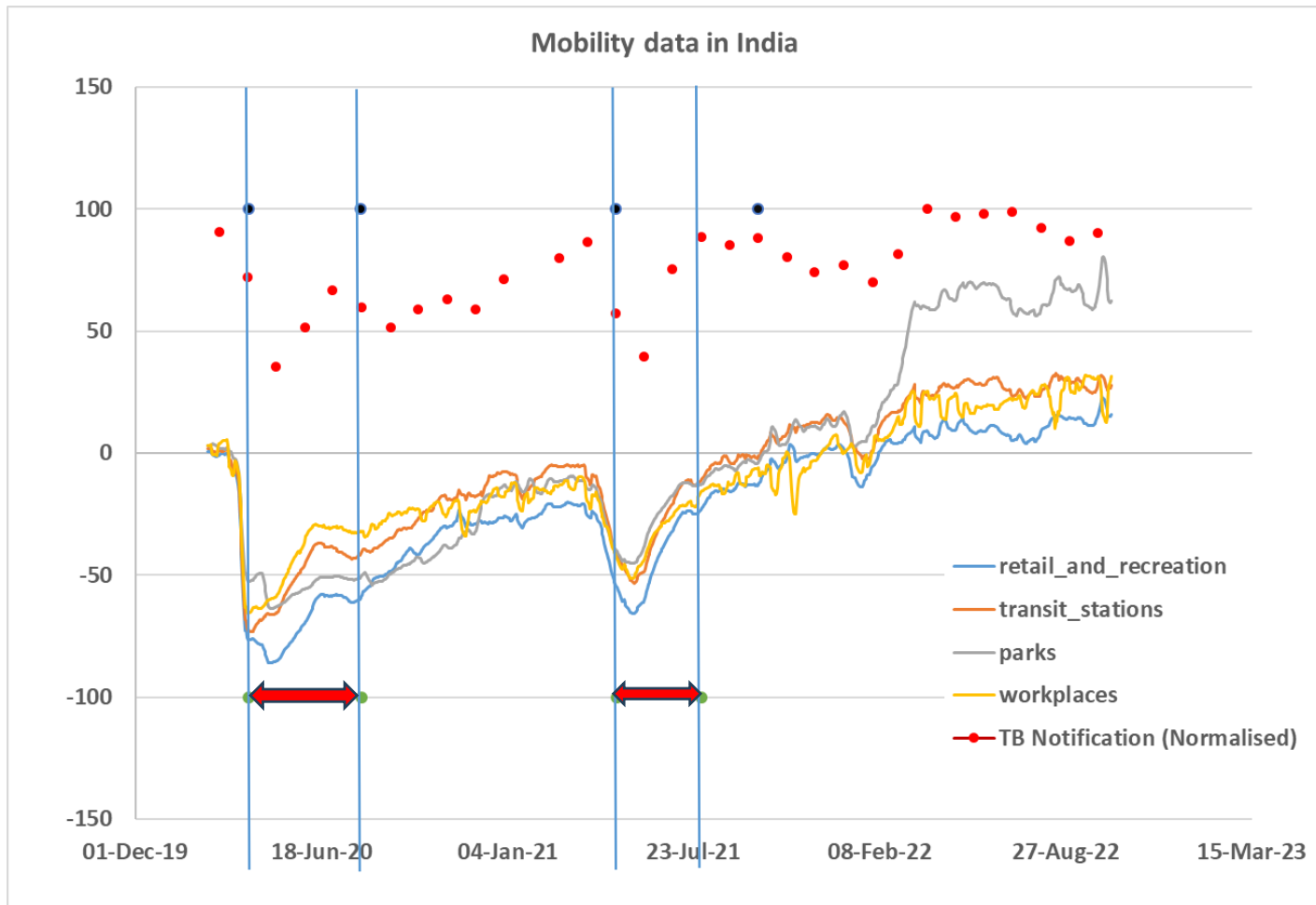
Varies on a monthly basis to capture monthly notification data

Modelling disruptions, 2020 – 2021



Model calibrated to India model estimates for 2015-2019

Google mobility data used to inform assumption about reduced transmission during COVID-19 delta wave



50% Reduced transmission:
1st: April – July, 2020

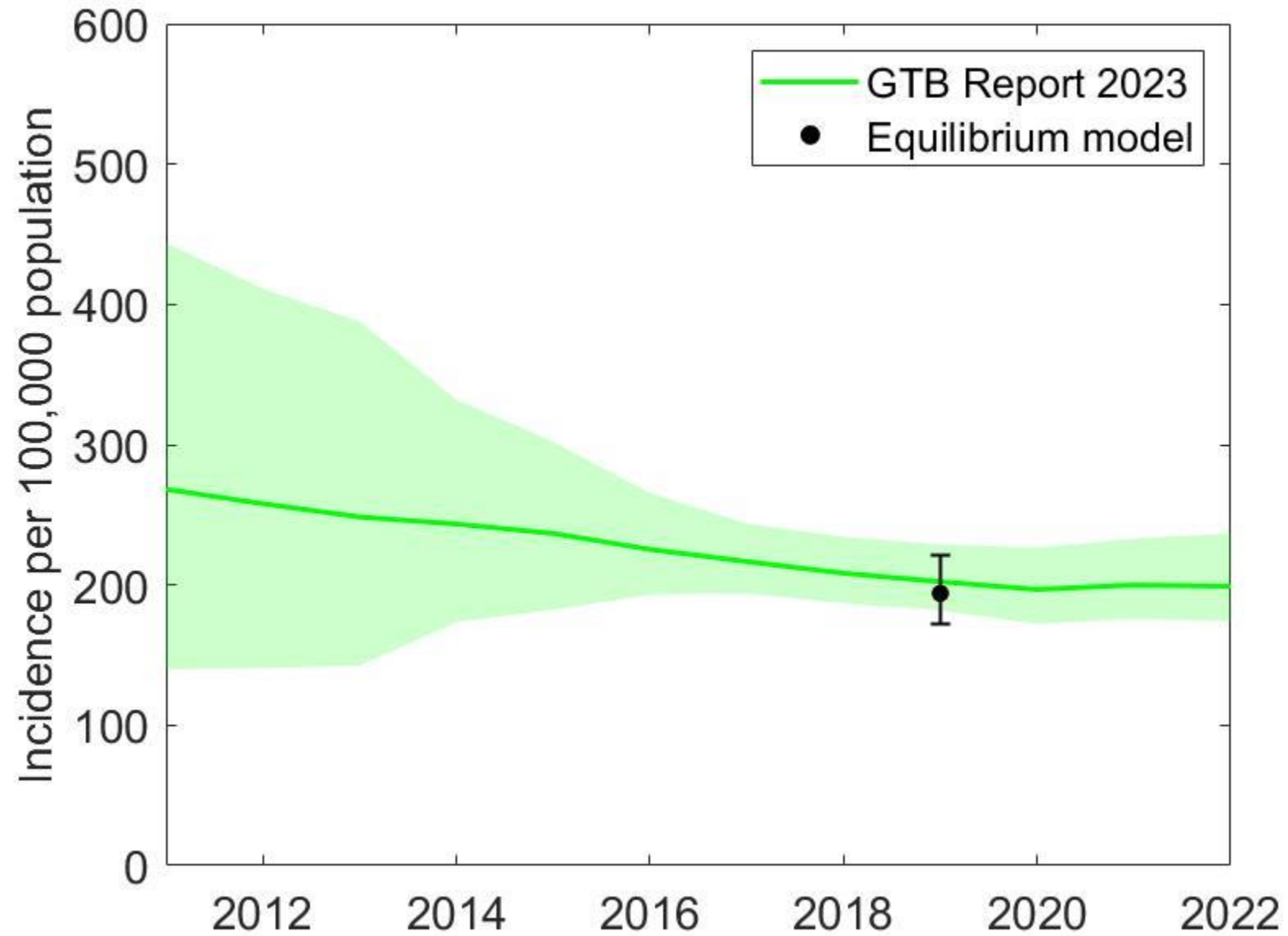
40% Reduced transmission:
2nd: May– July, 2021

Modelling incidence disruptions, 2020 – 2022*

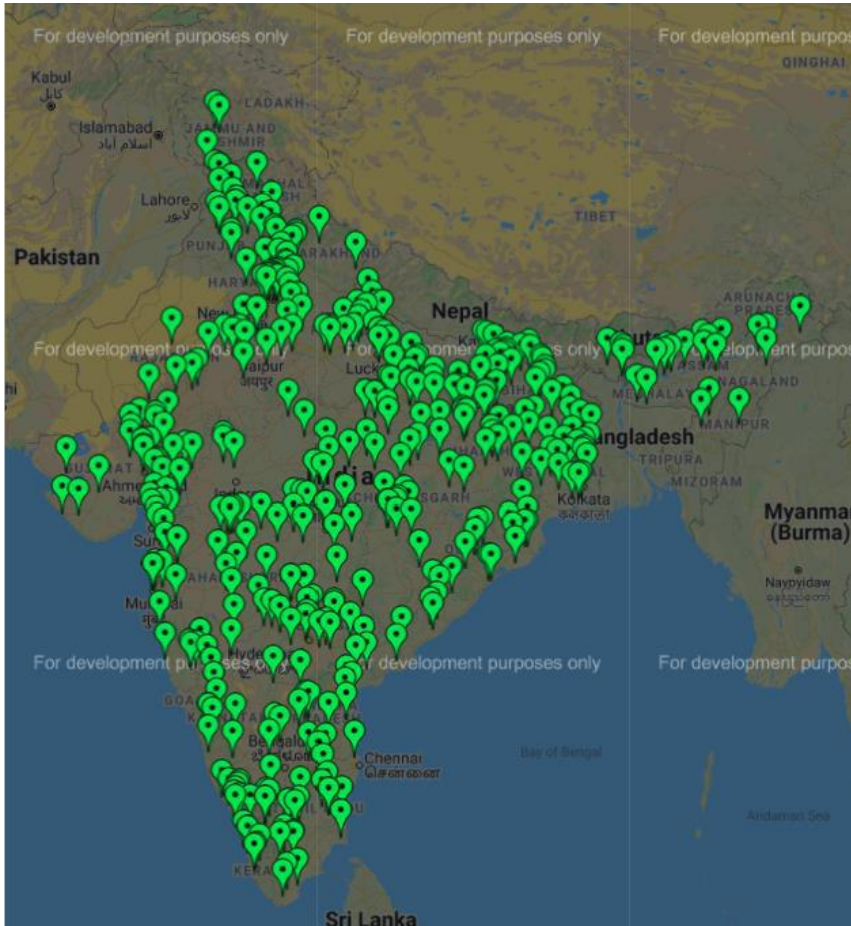
- ← Disruptions modelled using 'WHO model' calibrated to outputs from India model and mortality data
 - ← *Key purpose*: comparability between countries, by using same model across all modelled countries
- Incidence calibrated to central estimates and uncertainty intervals for India estimates in 2015, and 2019
 - Using two timepoints to capture correct pre-pandemic trends
 - As a mechanism for this trend, modelling an increase in public sector case-finding (consistent with country data for trends in presumptive examination rates)
- As for other countries, performing final adjustments ensure continuity between pre- and post-pandemic estimates

TB incidence: estimates

Results



National prevalence survey (2019 - 2021)



- Prevalence (all forms of TB for all ages): 312[286 – 337]
- Highest prevalence (Delhi): 747 [510 - 984]
- Lowest prevalence (Gujarat): 137 [76 - 198]

For India, subnational estimation is crucial

TB mortality

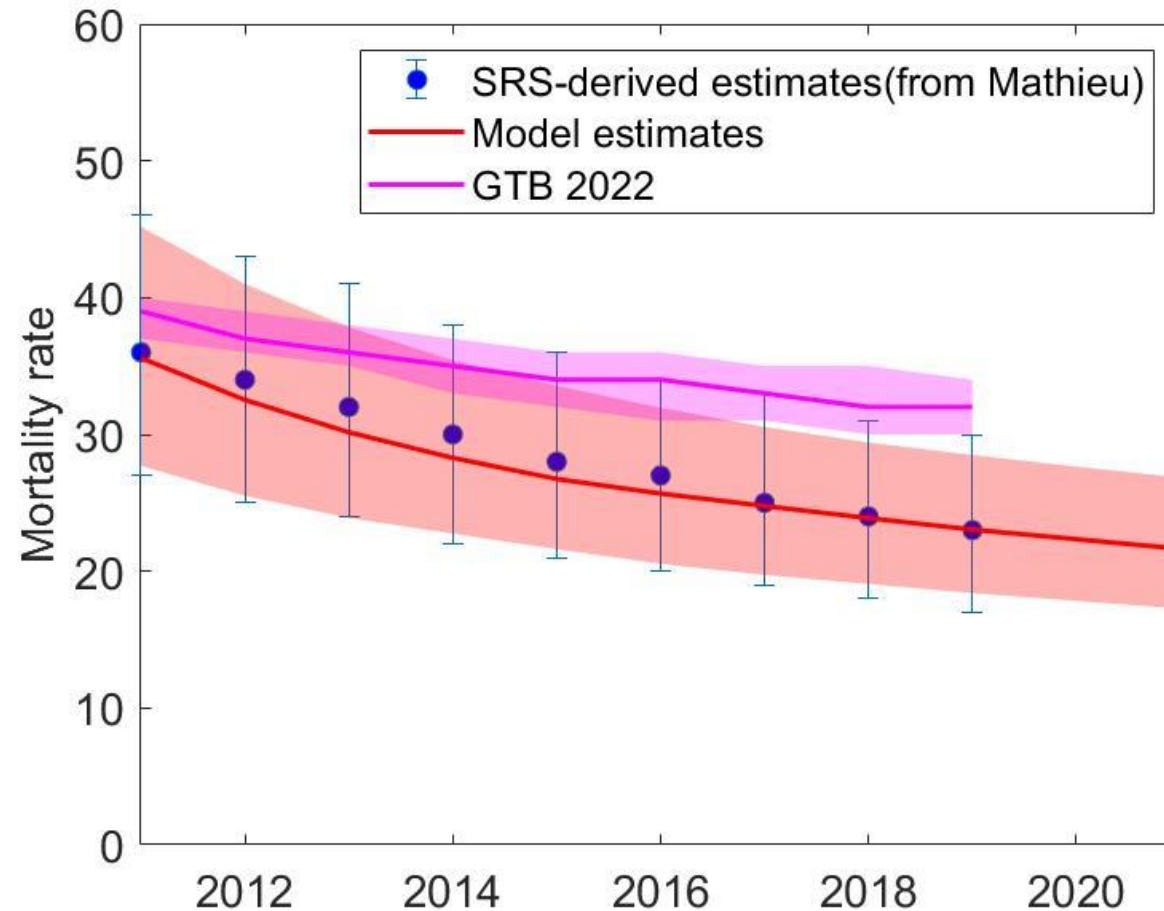
New data available for use

- **Reports from Office of the Registrar-General and Census Commissioner of India (RGI), with summary statistics for 2014–2019 on the distribution of causes of death at national level, including for TB specifically, based on Sample Registration System (SRS) data**
 - Recently published reports
 - Report for 2014–2016 published May 2022
 - Report for 2015–2017 published April 2023
 - Report for 2016–2018 published October 2022
 - Report for 2017–2019 published February 2023

<https://censusindia.gov.in/census.website/data/SRSCOD>

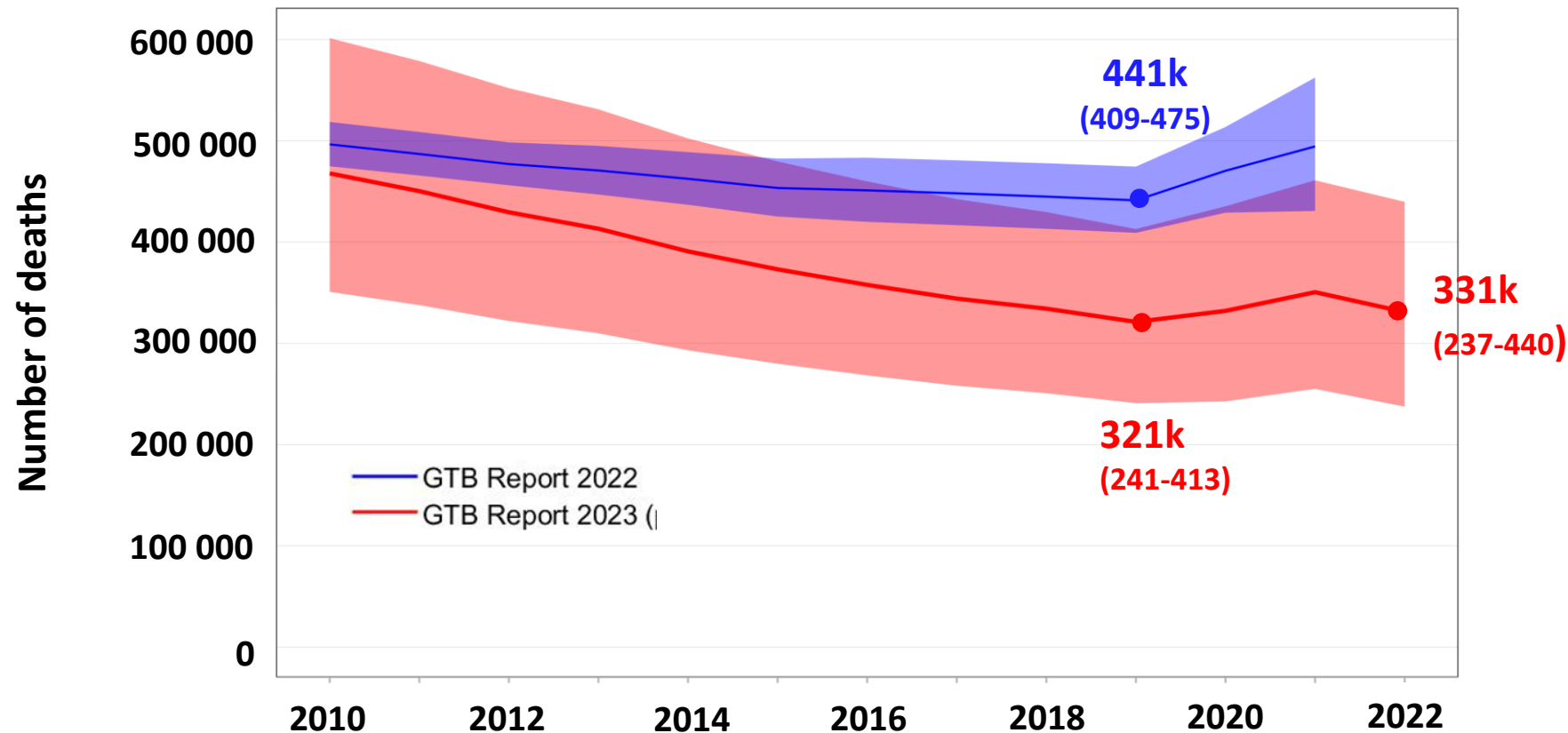
- Older reports for: 2004–2006, 2007–2009, 2010–2013 (all published Sep 2021)

Estimated Mortality rate, 2011-2019 (without disruption)



Estimated number of TB deaths*, 2010-2022

(GTB Report 2022 and GTB Report 2023)



*Among HIV-negative people. TB deaths among people with HIV are officially classified as deaths from HIV/AIDS, estimated separately, and relatively low in India (about 10,000 per year since 2016).

India TB report 2023



One World TB Summit, Varanasi (24 March-2023)



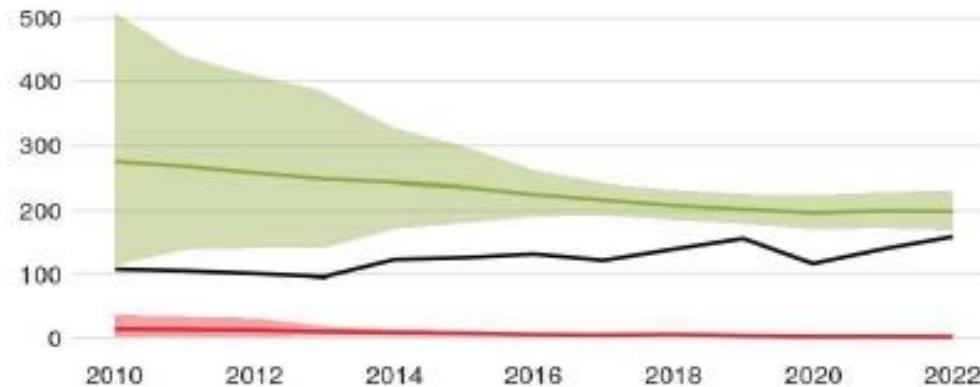
“India has become the first country in the world to estimate the tuberculosis (TB) burden in-country and launch its own mathematical system to estimate the disease burden.”

It has created its own revisions of official estimates by the World Health Organization (WHO).



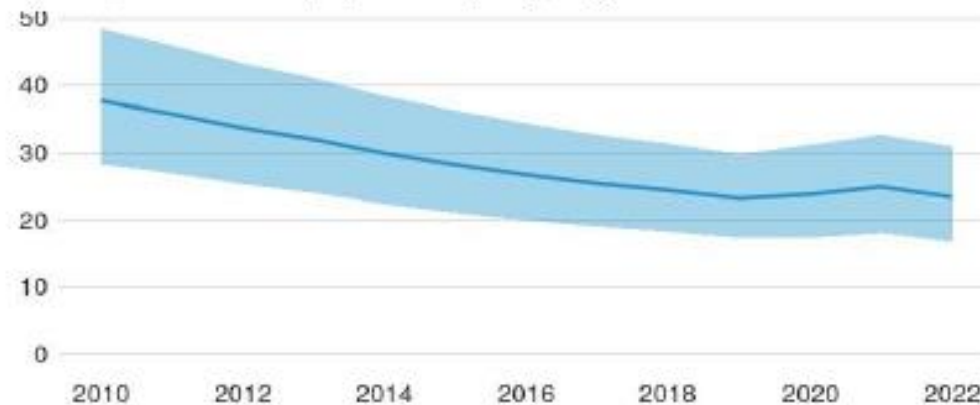
Incidence, New and relapse TB cases notified, HIV-positive TB incidence

(Rate per 100 000 population per year)



HIV-negative TB mortality

(Rate per 100 000 population per year)



Report 2023

(2023)

so grateful to Philippe
related to TB disease
(2022) for his advice on
ating (as appropriate)
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cidence and mortality

Acknowledgements



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(WHO)



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(CTD)



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Ex-WHO

Thank you

Questions