MITUS

Modeling Interventions for TB in the United States: a flexible framework for modelling TB epidemiology and policy effects

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Prevention Policy MODELING LAB

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- Model structure allowing for the modeling of several, diverse risk populations, including HIV+ persons, diabetics, and non-US born persons.
- Expanded geographic scope allowing for modeling of TB epidemiology on the national & subnational scale.
- Deterministic model allows for 100 year simulations to be completed in 0.2 seconds, generating 500+ outputs for each modelled year.

BACKGROUND

- In the United States, TB epidemiology varies by geographic area, by characteristics of at-risk populations (e.g., by immigration flows, by availability of and access to prevention services, and by historical latent TB infection (LTBI) burden.)

- Published mathematical models of tuberculosis have focused on specific high risk populations, such as HIV-positive, non-US born, or diabetic individuals.

MODEL STRUCTURE a deterministic, compartmental model of tuberculosis

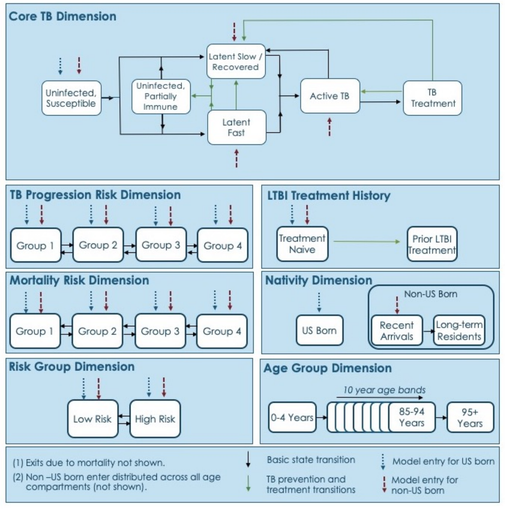


Figure 1: Diagram of compartmental model structure

METHODS

- We extended a published mathematical TB model[1] to allow flexibility in defining risk strata, so that these characteristics can be matched to the features of a target population in a local jurisdiction.

- This model is parameterized based on most recently reported TB and population data, and programmed in R and C++.

- We applied a Bayesian approach to calibrate the model to demographic and TB data in a range of geographic areas.

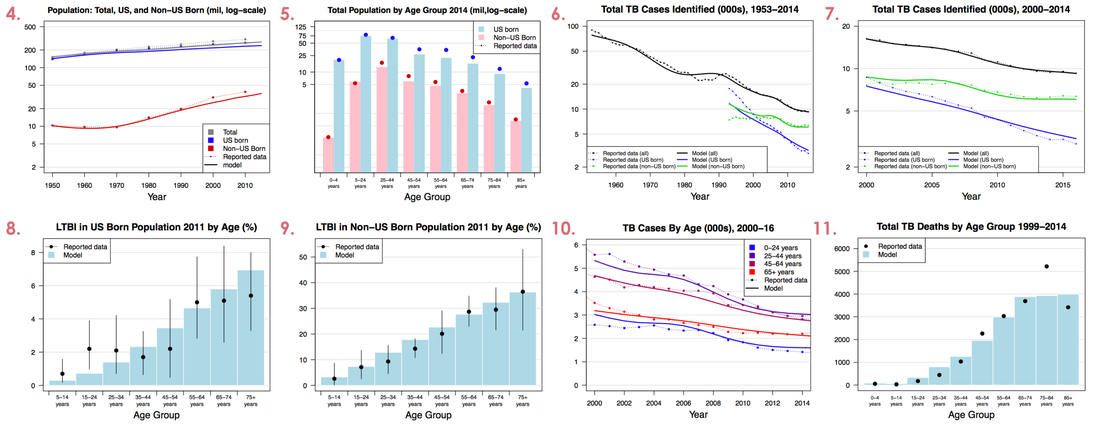
GENERIC RISK STRATA

We identified key population characteristics that determine risk of active TB disease:

- Elevated background LTBI prevalence.
- Elevated risk of progression to active disease.
- Competing mortality risk.

Figure 2: Example risk population definitions within the MITUS model structure

MODEL PERFORMANCE



Figures 4 –11 demonstrate the MITUS model's fit to calibration targets at the national level.

MULTIPLE GEOGRAPHIES

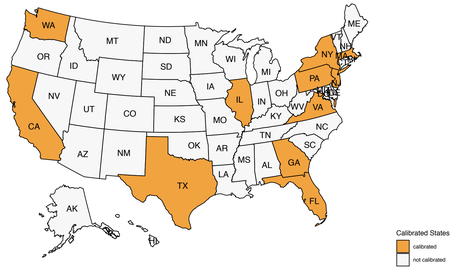


Figure 3: States for which MITUS is currently calibrated

- MITUS fits demographic and TB trends for the national level and 11 individual states, accounting for ~69% of TB cases in the United States.

- We plan to fit the model to other states in the coming months as well as expand to other sub-state geographies.

CONCLUSIONS

- The development of a flexible mathematical model of TB dynamics provides public health officials with a method to predict TB outcomes in a geography of interest under different intervention scenarios.

- Use of the MITUS modeling package has the potential to accelerate TB elimination efforts by informing optimal policy decisions.

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See Also

Our poster entitled:
Tabby2: A User Friendly Web Tool for Exploring Future State-Level TB Outcomes for User-Specified Scenarios.

Nicolas A Menzies, Ted Cohen, Andrew N Hill, Reza Yaesoubi, Kara Galer, Emory Wolf, Suzanne M Marks, Joshua A Salomon, Prospects for Tuberculosis Elimination in the United States: Results of a Transmission Dynamic Model, American Journal of Epidemiology, Volume 187, Issue 9, September 2018, Pages 2011–2020