Planning for TB Elimination Using Tabby2: A tool to estimate state-level future TB and latent TB infection (LTBI), and costs associated with targeted LTBI testing and treatment.

Slide 1

This slide set shows people how to use the Tabby2 web tool to estimate future TB and resources needed to eliminate TB. The tool was developed by the Harvard TH Chan Prevention Policy Modeling Lab through funding from the CDC NCHHSTP Epidemiologic and Economic cooperative agreement (NEEMA). The slide set reflects the web tool as of December 2021.

Slide 2

Objectives: Users will be able to:

Estimate future state-level TB cases and LTBI prevalence, without additional interventions (base case scenario) and with accelerated testing and treatment of populations at high risk for TB;

Estimate the associated number of LTBI tests, costs, and benefits; and

Use the estimations to set informed targets for progress towards TB elimination.

Slide 3

This slide shows the URL for Tabby2. Documentation of the Tabby2 model can be found in a publication by NA Menzies in the American Journal of Epidemiology. Estimation methods are detailed on the first page of the tool, by clicking "Cost Introduction" and "Further Description" from the left-hand panel. Assumptions and parameter estimates are found on GITHUB. Users should familiarize themselves with the Tabby2 methods before use.

Slide 4

Example: The following slides show screen shots from Tabby2, using Massachusetts (MA) as an example, to show how to use Tabby2 to estimate TB cases in 2050 under the base case scenario.

Slide 5

This is the opening page on the Tabby2 web tool. It describes the tool and allows users to select a US state or the United States to model. I will be using Massachusetts as an example. Please note that the estimates for 2020 do not (yet) take into account the decline in 2020 TB cases during the the COVID-19 pandemic. Select Massachusetts for Estimation. Under “Select a location”: Choose “Massachusetts”, then select “Next Page.”

Slide 6

This page lists the pre-defined intervention scenarios for comparison with the base case scenario. The base case is the default scenario, assuming no change in current TB prevention and control activities. This scenario is automatically included in all visualizations, and other scenarios are defined and analyzed with reference to this scenario. First, we will estimate the base case scenario by selecting "view modeled outcomes" at the bottom.

Slide 7

Now, we will estimate TB Incidence in 2050 Under the Base Case. Leave the default settings for Comparison (absolute values), Population (total), Age Groups (all age groups). Under Outcomes, select “TB Incidence per 100,000.” Under Labels, select “Values.” This picture shows base case estimates of TB incidence at 2.75 per 100,000 in year 2020, 2.66 in year 2022, 2.56 in year 2025, 2.29 in year 2035 , and 1.99 in year 2050.

Slide 8

To estimate the LTBI prevalence percentage in 2050 under the base case, select outcome “LTBI Prevalence (percentage)”. This picture shows the LTBI prevalence percentage under the Base Case: at 3.74% in 2020, 3.63% in 2022, 3.47% in 2025, 2.98% in 2035, and 2.33% in 2050

Slide 9

To estimate the number of persons with LTBI in 2050 under the Base Case, select outcome “LTBI Prevalence (in thousands).” This picture shows the estimated number of persons with LTBI: 265,000 in the year 2020, 260,000 in 2022, 253,000 in 2025, 228,000 in 2035, and 188,000 in 2050.

Slide 10

Now, we will estimate Massachusetts TB and LTBI under the pre-defined "Improved LTBI Treatment" Scenario, which is described under the Tabby2 left-hand “Pre-defined Scenarios” tab and under the “Further Description” tab. “Improved LTBI Treatment” in Tabby2 is defined as a doubling of the current LTBI targeted (one-time) testing of high-risk populations, 77.3% LTBI treatment initiation, and 87.2% LTBI treatment completion. High-risk populations were defined to include people experiencing homelessness and associated marginalized populations who have poor access to care, higher background mortality, and higher TB exposure than the general population. It was assumed that the high-risk population would represent approximately 0.5% of the total population.

Slide 11

Under the “Improved LTBI Tx” Scenario, we will estimate the number with LTBI in 2050. Under Modeled Scenarios, select: “Improved LTBI Tx in the United States,” which includes for populations at high risk, a doubling of one-time testing, with 77.3% LTBI Tx initiation and 87.2% completion. This reduces the number with LTBI in MA in 2050 to 177,000 from 188,000. This picture compares the number of persons with LTBI over 30 years under the base case and improved LTBI treatment scenarios.

Slide 12

Under the “Improved LTBI Tx” Scenario, Estimate TB Incidence in 2050. On the left-hand panel, Select Outcome “TB Incidence (per 100,000).” This picture compares TB incidence per 100,000 over 30 years under the base case and improved LTBI treatment scenarios. In 2050, incidence is reduced from 1.99 to 1.74.

Slide 13

Under the “Improved LTBI Tx” Scenario, Estimate the Number of TB Cases in 2050. On the left-hand panel, Select Outcome “TB Incidence (in thousands).” This picture compares the number of persons with TB over 30 years under the base case and improved LTBI treatment scenarios. In 2050, the number is reduced from 161 to 140 with improved LTBI treatment.

Slide 14

Under the “Improved LTBI Tx” Scenario, Estimate TB Trends. Select “Time Trends” from the left-hand dark bar. Re-select Outcome “TB incidence in thousands” and “Improved LTBI Tx” under Scenarios. This picture compares the number of persons with TB over the period under the base case and improved LTBI treatment scenarios. The results are presented as lines over 30 years for each scenario.

Slide 15

Under the “Improved LTBI Tx” Scenario, Estimate the Number of TB Cases by Year. Select “Results Table” from above the graph. This picture shows a table displaying the number of persons with TB each year over the 30 years under the base case and improved LTBI treatment scenarios. The table can be downloaded as an Excel or CSV file.

Slide 16

Now, we will look at resources needed by MA in the base case and in the improved LTBI treatment scenarios to achieve the outcomes presented in the previous slides.

Slide 17

Estimate the Number of LTBI Tests in the Base Case and "Improved LTBI Tx" Scenarios. On the left-hand bar, select "Counts of Services" and LTBI tests (in thousands) and reselect the Scenario "Improved LTBI Treatment." The number of LTBI tests in the base case and the scenario are displayed. This graph shows the number of LTBI tests estimated to occur in the improved LTBI treatment scenario, compared with the number in the base case, over the 30-year period.

Slide 18

Estimate the Number of LTBI Tests by Year in the Base Case and "Improved LTBI Tx" Scenarios. Above the graph, select "Results Table." This table shows the annual number of LTBI tests over the 30 years under the base case and improved LTBI treatment scenarios. Download the table and sum. The 30-year total increase in LTBI tests is 87,640 with improved LTBI treatment vs. the base case (239,670-152,030).

Slide 19

Estimate the Number of LTBI Treatment Starts under the Base Case and "Improved LTBI Tx" Scenarios. Under Outcomes, select "LTBI Treatment Initiations (in thousands)." This table shows the annual number of LTBI treatment starts over the period under the base case and improved LTBI treatment scenarios. The table can be downloaded. Download the table and sum. The 30-year total increase in LTBI treatments is 46,960 with improved LTBI treatment vs. the base case (128,450-81,490).

Slide 20

Review or Change Input Costs. On the left-hand bar, select "Input Costs." The default settings for costs are displayed. You can modify or keep these. IMPORTANT: then, select "Calculate Costs." Give the software a few minutes to calculate.

Slide 21

Calculate Costs and Outcomes under the Base Case and "Improved LTBI Tx" Scenarios. On the left-hand bar, select "Costs and Outcomes." Reselect the "Improved LTBI Treatment" scenario. In this picture, there are 2 tables showing results over the 30-year 2020-2050 period. The top table shows outcomes of TB cases, deaths, QALYs, and life years lost under the base case and improved LTBI treatment scenarios. The bottom table shows the costs of LTBI treatment, TB disease treatment, productivity losses due to TB and due to LTBI treatment, total health services costs, and total costs for the base case and improved LTBI treatment scenarios. Improvements in health may yield longer and better lives—outcomes that can be quantified as life-years gained or QALYs gained. Results in the top table, second column, show 476 (5,445-4,969) TB cases and in the third column 48 (418-370) deaths prevented. Estimated additional costs of the intervention ($166,502-$150,650=$15,852,000 in 2019 dollars) can be calculated from the "Total Health Services Cost" column in the bottom table.

Slide 22

Use Cost Effectiveness Analysis to Compare "Improved LTBI Tx" with the Base Case Scenario. Cost effectiveness analysis provides information to answer: "Is the intervention the best use of scarce resources?"

The Incremental Cost Effectiveness Ratio (ICER)=($Net\ Cost\ of\ Improved\ LTBI\ Tx – Net\ Cost\ of\ Base\ case\ Services$)/($Change\ in$ TB cases$with\ Improved\ LTBI\ Tx – Change\ in$ TB cases $with\ Base\ case\ Services$)

> Where net costs equal the costs of the Improved LTBI Tx intervention or Base Case services minus the costs of prevented TB cases occurring under each scenario

Typically, both future costs and outcomes are discounted, because money available for spending today is worth more than the same amount of money available for spending in the future. Favorable outcomes are similarly valued more today than in the future. Discounting converts all future costs and outcomes to their present value. Use of a social discount rate of 3% is standard. In Tabby2, you can select discounting under the "Cost Effectiveness" tab. Otherwise, the default is no discounting, which provides undiscounted costs that might be helpful for current budgeting purposes.

QALYs combine morbidity (for example, TB cases) and mortality (for example, deaths with TB) outcomes.

Slide 23

Estimate the Cost per Additional TB Case Prevented in the "Improved LTBI Tx" Compared with the Base Case Scenario. Select "View Cost Comparison" from below; Reselect the "Improved LTBI Tx" scenario. Select under Costing Perspective "Health Services costs only" and "include" discounting. The ICER is displayed as $41,583 per additional TB case prevented. This table shows the cost effectiveness of the improved LTBI treatment scenario compared with that of the base case. The incremental cost effectiveness ratio is $41,583 per additional TB case prevented by the improved LTBI treatment.

Slide 24

Change the Costing Perspective from "Health Services" to "Health Services and Patient Productivity Losses." Select a costing perspective of "health services and patient productivity losses." (Note: losses=costs). This table shows the cost effectiveness results when the perspective of the analysis is changed to include patient productivity losses. The intervention becomes much more cost effective, at $4,864 per additional TB case prevented.

Slide 25

Estimate the Cost per Additional TB Death Prevented in the "Improved LTBI Tx" Compared with the Base Case Scenario. Select "TB Deaths" from the left-hand menu "Effectiveness Measure." Displayed is the health services and patient productivity costs perspective, this is $49,346 per additional TB death prevented by the improved LTBI treatment scenario.

Slide 26

Estimate the Cost per Additional QALY Gained in the “Improved LTBI Tx” Compared with the Base Case Scenario. Keeping the costing perspective of “health services and patient productivity losses” and selecting QALYs as the outcome results in an ICER of $37,349 per additional QALY gained from the Improved LTBI treatment scenario.

Slide 27

Summarize results to educate policy makers for improved LTBI treatment in MA to further TB elimination. Over 30 years of doubling current LTBI one-time testing of persons at high risk for TB in Massachusetts:

TB incidence could be reduced from 1.99/100K in the year 2020 to 1.74/100K in the year 2050;

The number of TB cases could be reduced by 476; this could result in 48 fewer TB deaths;

The estimated number of additional people tested for LTBI is 87,640 and treated for LTBI to reduce future TB is 46,960;

New Slide 28

Summarize results to educate policy makers for improved LTBI treatment in MA to further TB elimination (continued)

Over 30 years of doubling current LTBI one-time testing of persons at high risk for TB in Massachusetts:

The (undiscounted) healthcare system cost of this intervention is $166,502,000 compared to $150,650,000 under current practices, an increase of $15,852,000.

Discounting of future costs and outcomes is necessary in cost effectiveness analysis to account for the preference for immediate versus delayed outcomes. However, policy makers would want to know the estimated undiscounted healthcare costs of the intervention to facilitate budgeting for the intervention.

Slide 29

Summarize results to educate policy makers for improved LTBI treatment in MA to further TB elimination (continued).

Over 30 years of doubling current LTBI testing of persons at high risk for TB in Massachusetts, compared with that of the base case scenario of continuation of current level of prevention services, the intervention results in:

Without including patient costs, $41,583 per additional TB case prevented

Including patient costs,

$4,864 per additional TB case prevented

$49,346 per additional TB death prevented

$37,349 per additional QALY gained.

Slide 30

Conclusions

Tabby2 can help states estimate the future number of TB cases and TB deaths over 30 years, based on projections from historical values

Tabby2 can be used with default values, or state-specific input costs

From pre- (or user)-defined scenarios, Tabby2 computes the impact of increasing LTBI testing and treatment on TB cases prevented, TB deaths, and QALYs gained

By comparing the base case with a scenario of increased LTBI testing/treatment, the number and cost of additional LTBI tests/treatments can be estimated, along with the preventable costs of TB cases and associated deaths

This information can be compiled to make a compelling case for furthering TB elimination

Slide 31

Funding and Acknowledgements

This research was funded by the CDC, NCHHSTP Epidemiologic and Economic Modeling Agreement (NEEMA) (# 5U38PS004644-01).

Acknowledgements: Thank you to Jennifer Cochran, Director, Division of Global Populations and Infectious Disease Prevention, Bureau of Infectious Disease and Laboratory Sciences, Massachusetts Department of Public Health, for allowing use of state data as an example in this presentation, and to Nicole Swartwood at the Harvard TH Chan Prevention Policy Modeling Lab for creating the tool. Contact Nicole Swartwood at nswartwood@hsph.harvard.edu or Suzanne Marks at smarks@cdc.gov for further information.