Centers for Disease Control and Prevention
National Center for HIV, Viral Hepatitis, STD, and TB Prevention

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

Created December 2021

Objectives

Users will be able to:

- Estimate future state-level TB cases and LTBI prevalence
  - Without additional interventions (base case scenario)
  - 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.

Tabby 2

https://ppmltools.org/tabby2

Documentation of the Tabby2 model:

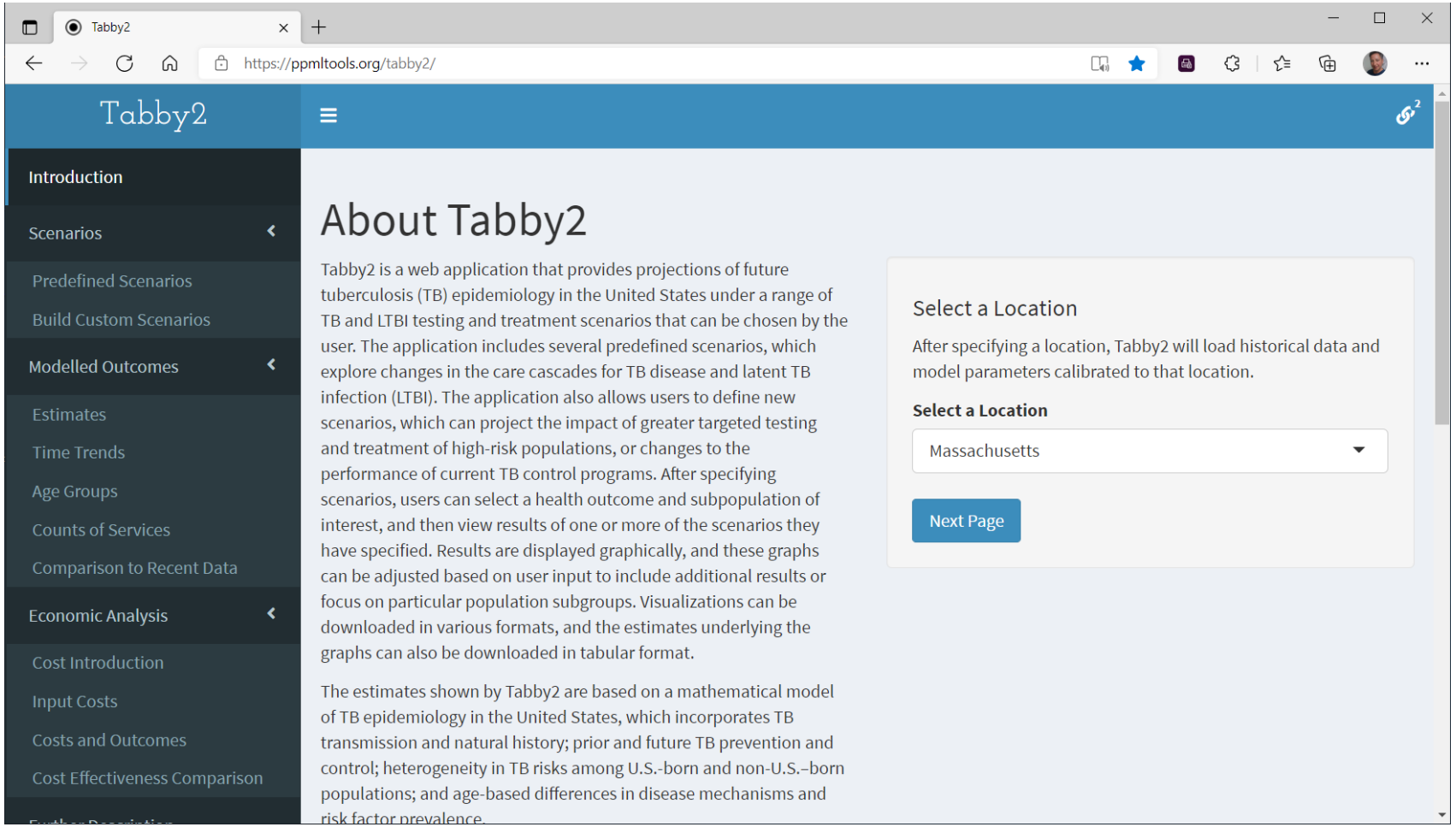
Menzies et al. 2018. “Prospects for tuberculosis elimination in the United States: results of a transmission dynamic model” Am J Epid. 187(9):2011-2020. https://academic.oup.com/aje/article/187/9/2011/4995883

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 at: https://github.com/PPML/tabby2/blob/master/utilities/inst/md/Tabby2EconomicAnalysisMethods.md . Users should familiarize themselves with the Tabby2 methods before use.

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

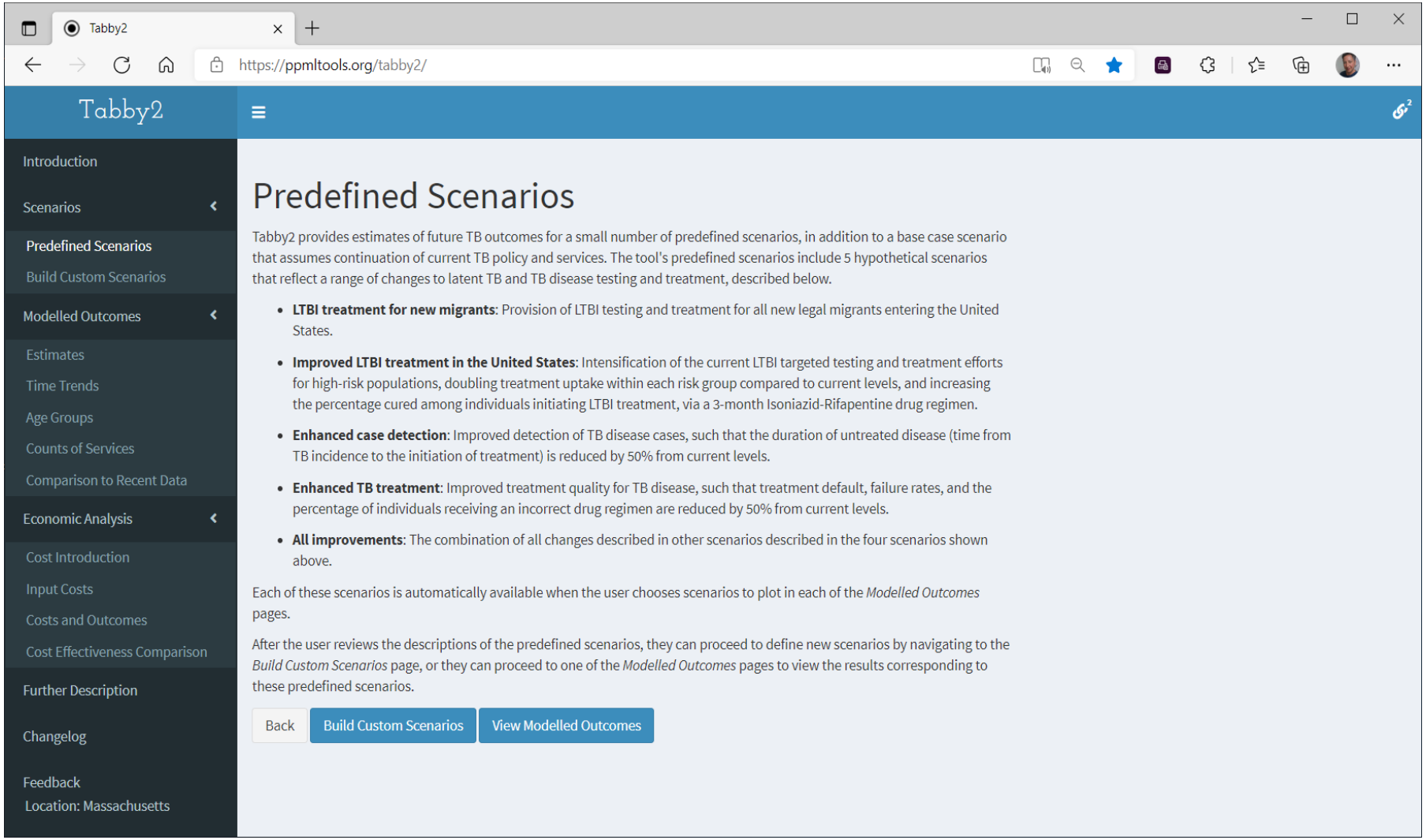
Select Massachusetts for Estimation

- Under “Select a location”: Choose “Massachusetts”, then select “Next Page”



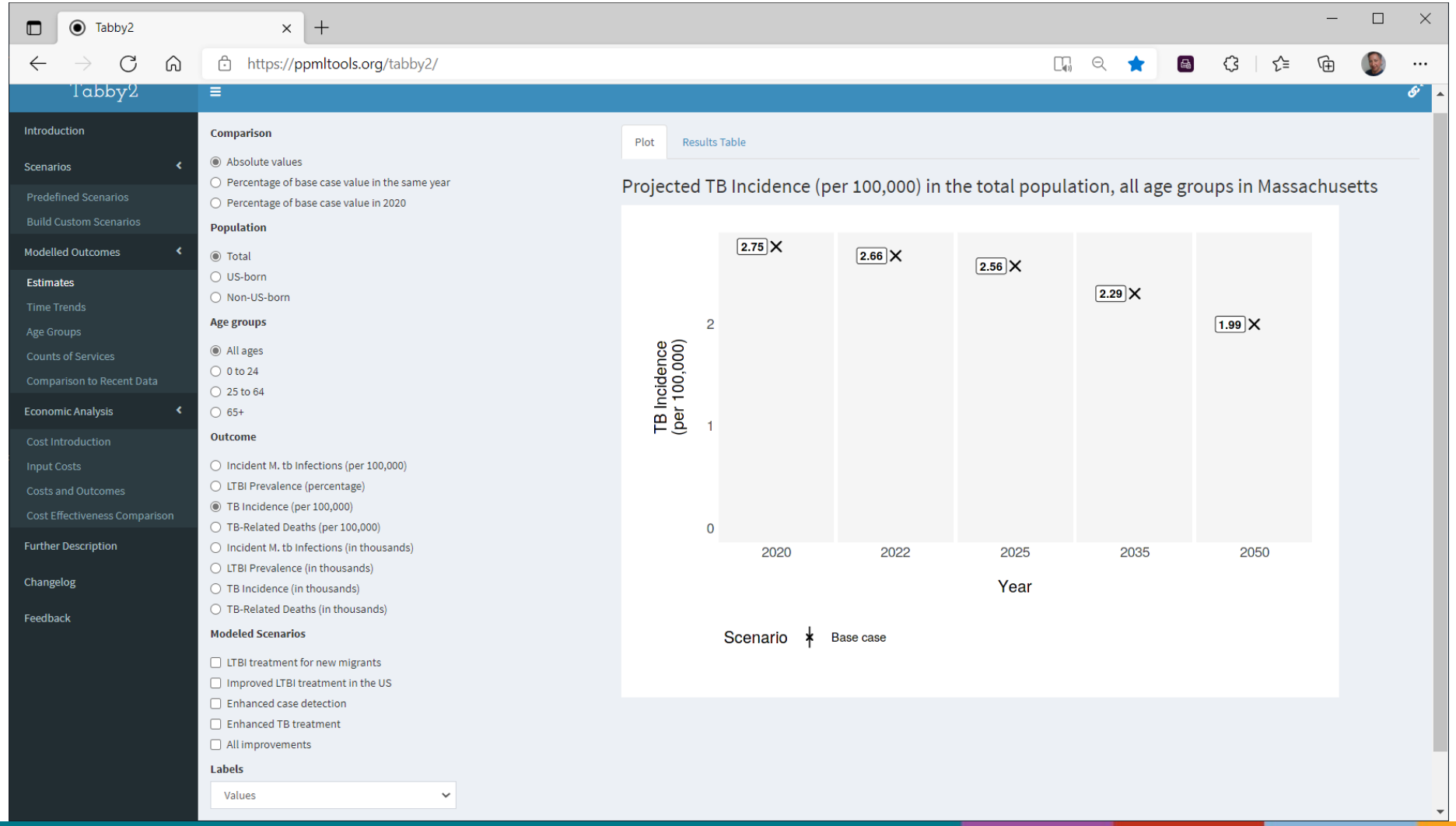
Estimate the Base Case

- **Under Predefined Scenarios: Select "View Modeled Outcomes"**



Estimate TB Incidence in 2050 Under the Base Case Scenario

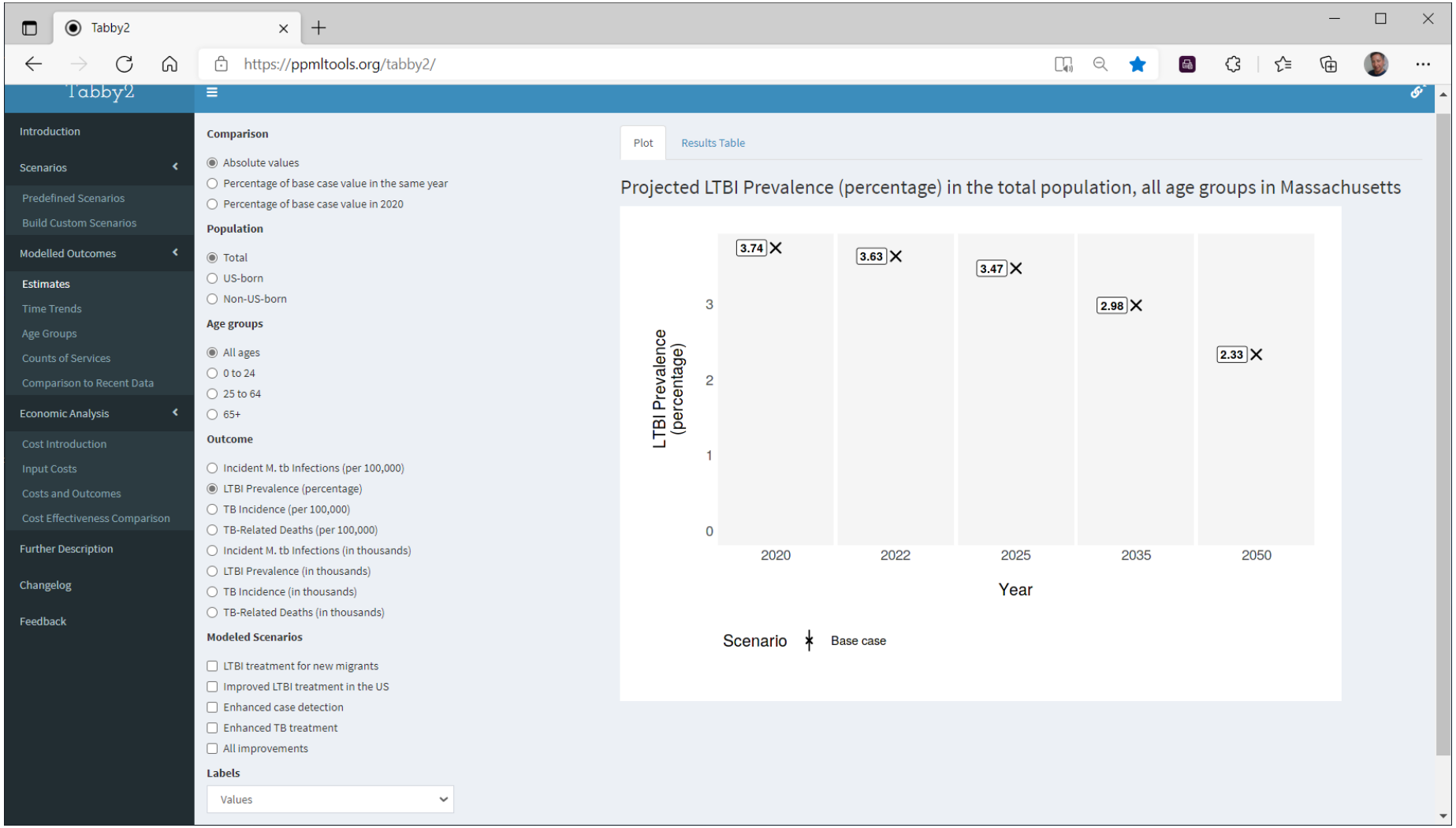
- Under Outcomes, select “TB Incidence per 100,000”
- Under Labels, select “Values”
- Results: 2.75/100,000 in 2020 and 1.99/100,000 in 2050



Estimate the LTBI Prevalence Percentage in 2050

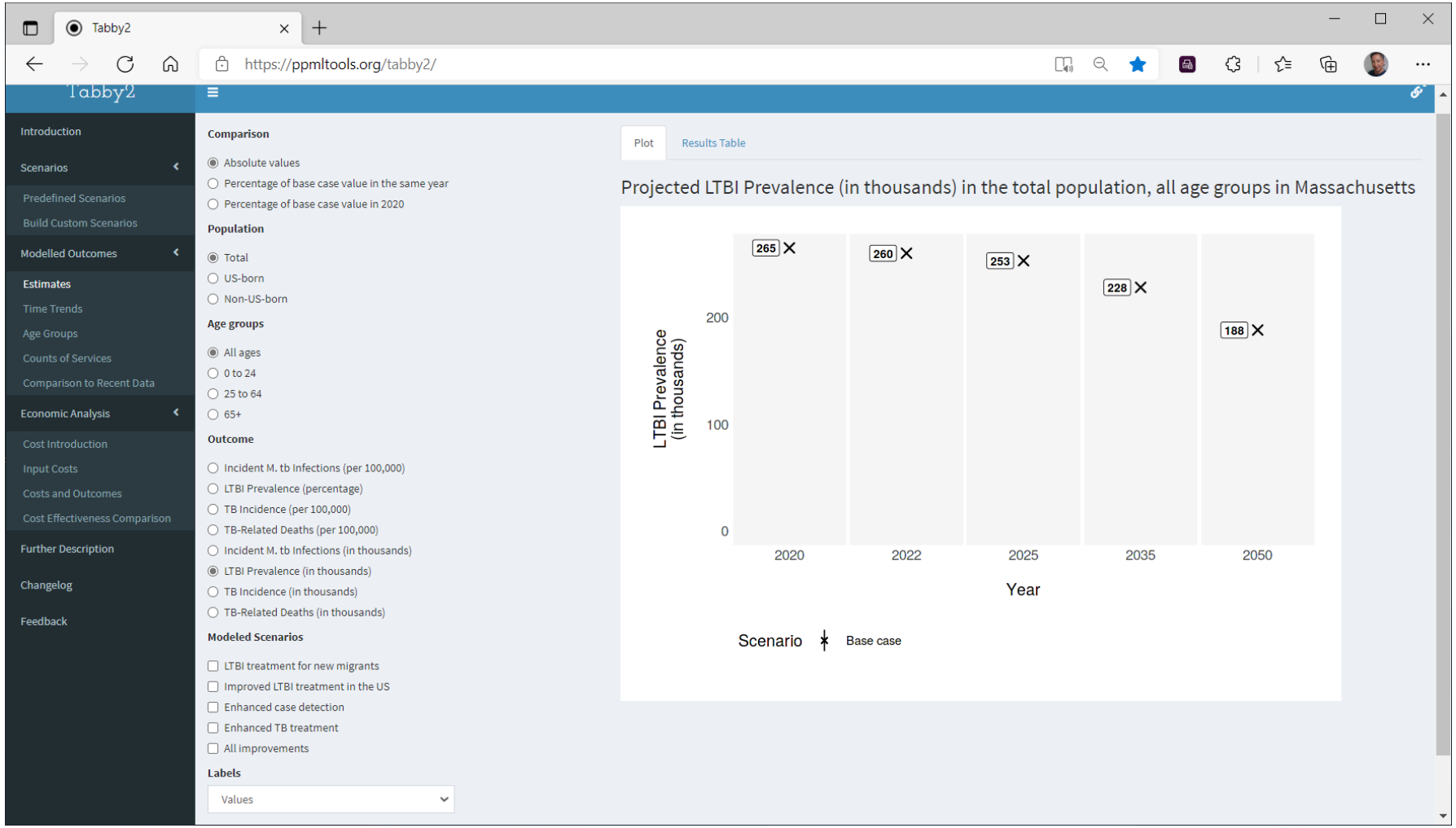
Under the Base Case Scenario

- Select Outcome “LTBI Prevalence (percentage)”
- LTBI prevalence projected at 3.74% in 2020, 2.33% in 2050



Estimate the Number of Persons with LTBI in 2050 Under the Base Case Scenario

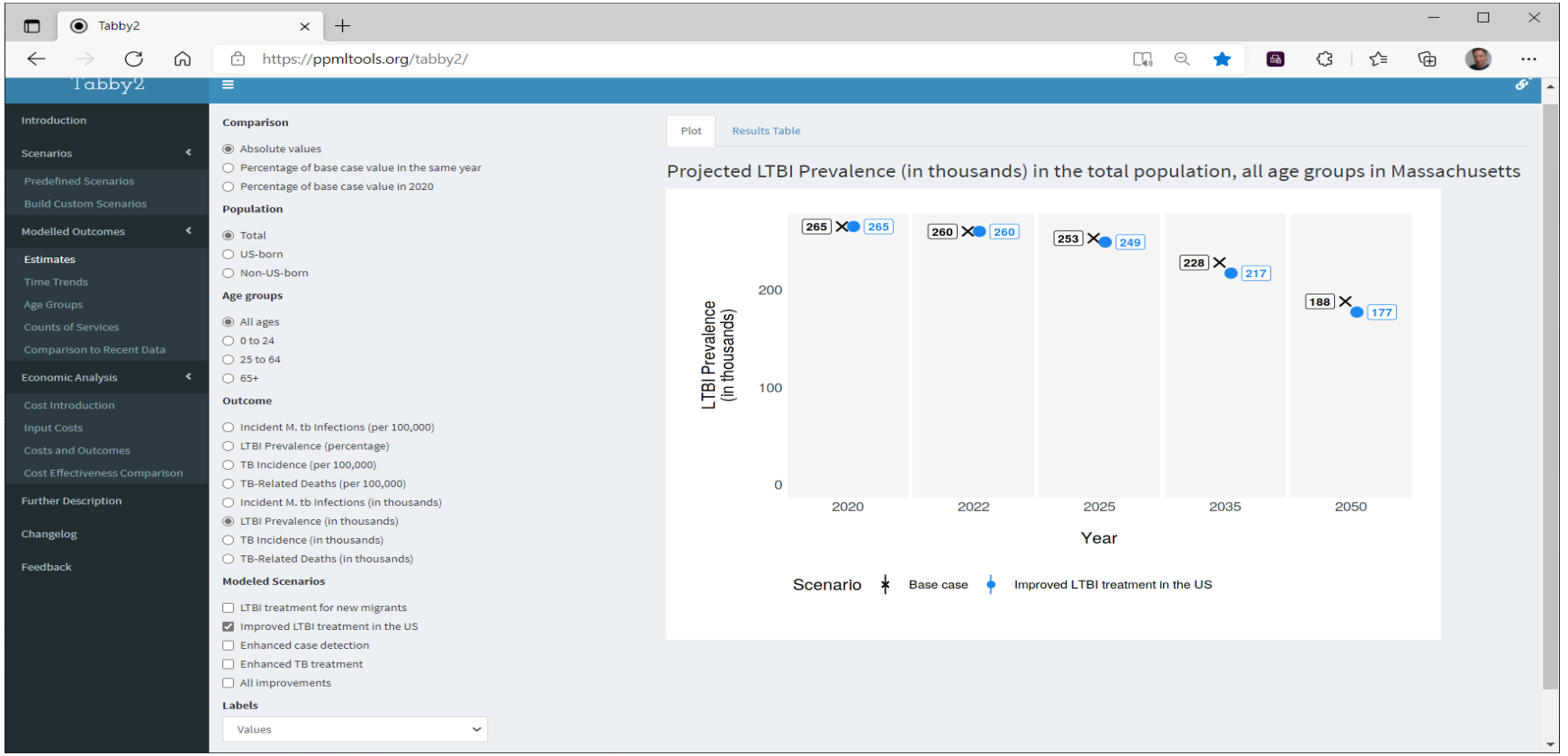
- Select Outcome “LTBI Prevalence (in thousands)”
- LTBI prevalence projected at 265,000 in 2020; 188,000 in 2050



Estimate MA TB and LTBI in 2050 Under the “Improved LTBI Treatment (Tx)” Scenario

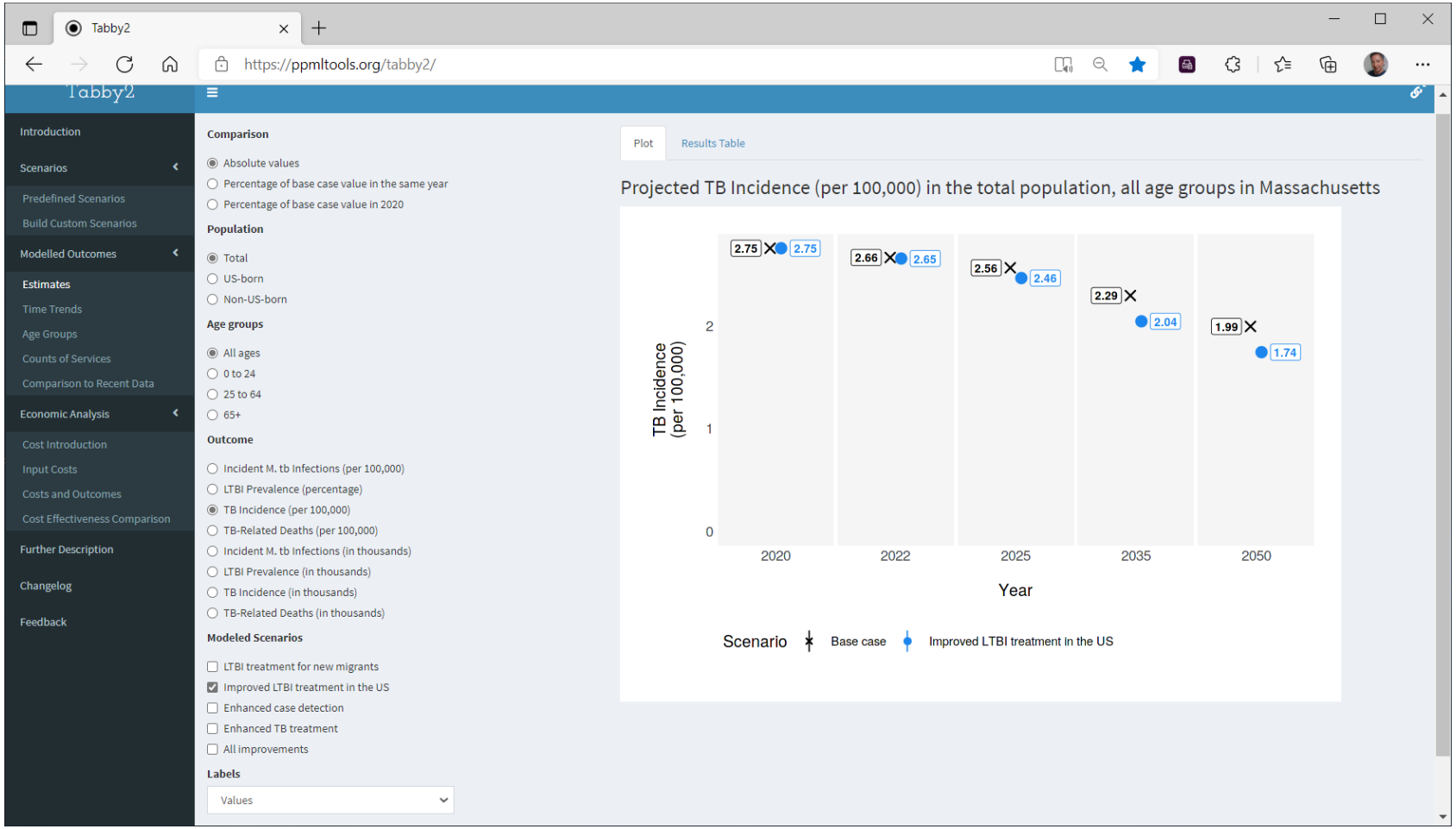
Under the “Improved LTBI Tx” Scenario, Estimate the Number with LTBI in 2050

- 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.



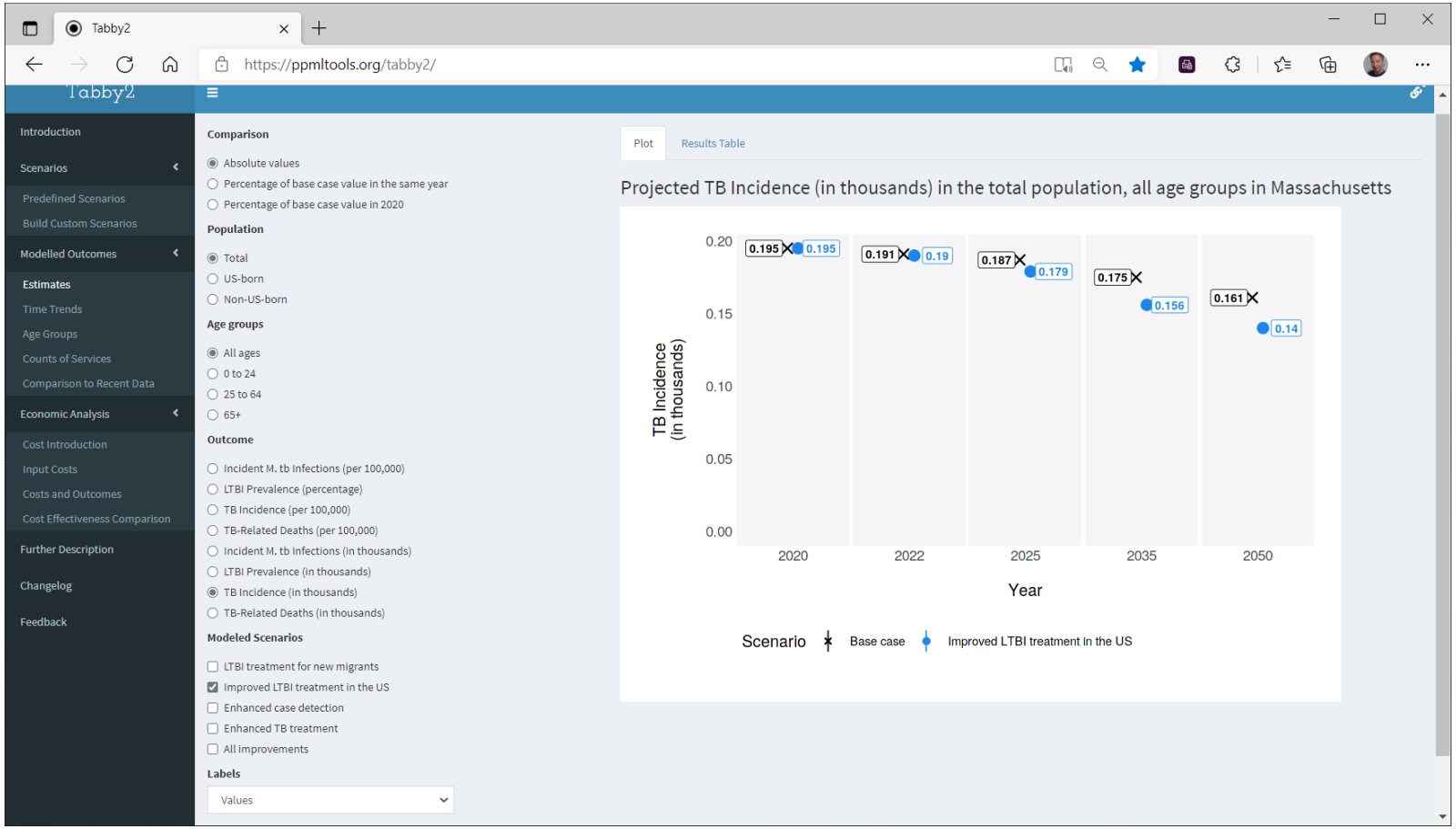
Under the “Improved LTBI Tx” Scenario, Estimate TB Incidence in 2050

- On the left-hand panel, Select Outcome “TB Incidence (per 100,000)”
- With improved LTBI Tx, TB incidence is projected at 1.74 versus 1.99 per 100,000 under the base case scenario in 2050



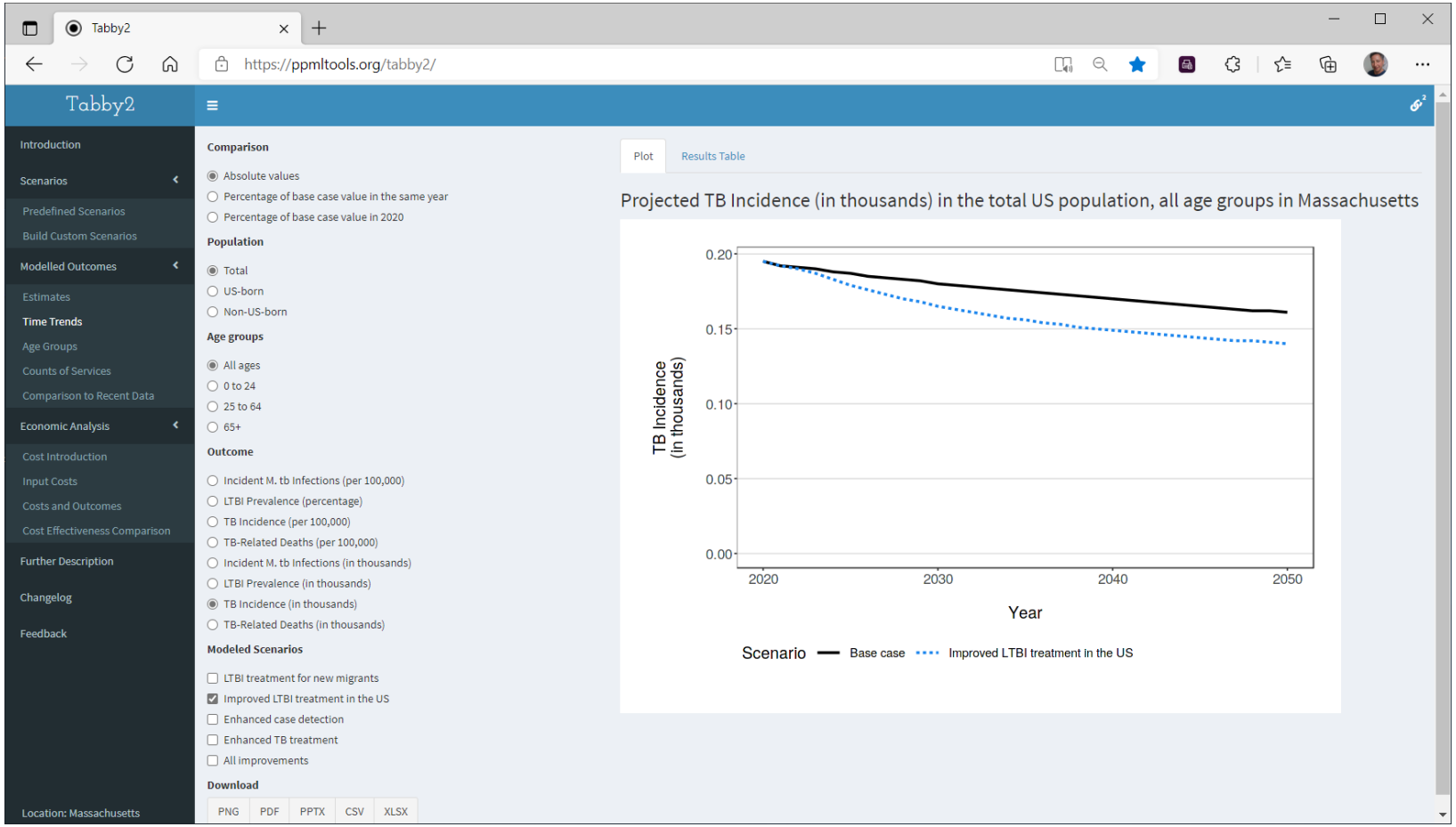
Under the “Improved LTBI Tx” Scenario, Estimate the Number of TB Cases in 2050

- On the left-hand panel, Select Outcome “TB Incidence (in thousands)”
- With improved LTBI Tx, TB cases are projected at 140 versus 161 under the base case scenario in 2050



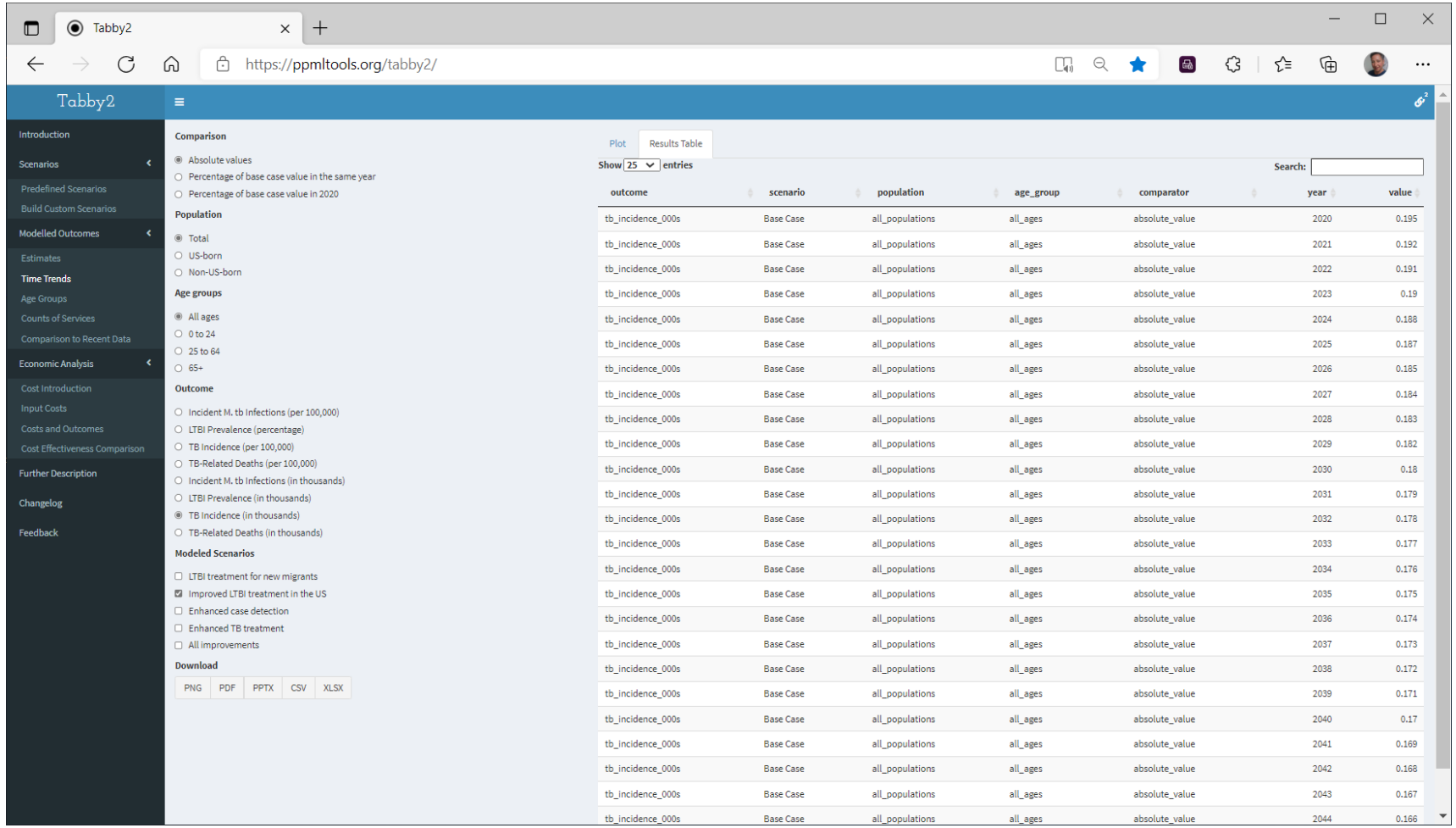
Under the “Improved LTBI Tx” Scenario, Estimate TB Trends

- Select “Time Trends” from the left-hand dark bar
- Re-select Outcome “TB incidence in thousands” and “Improved LTBI Tx” under Scenarios



Under the “Improved LTBI Tx” Scenario, Estimate the Number of TB Cases by Year

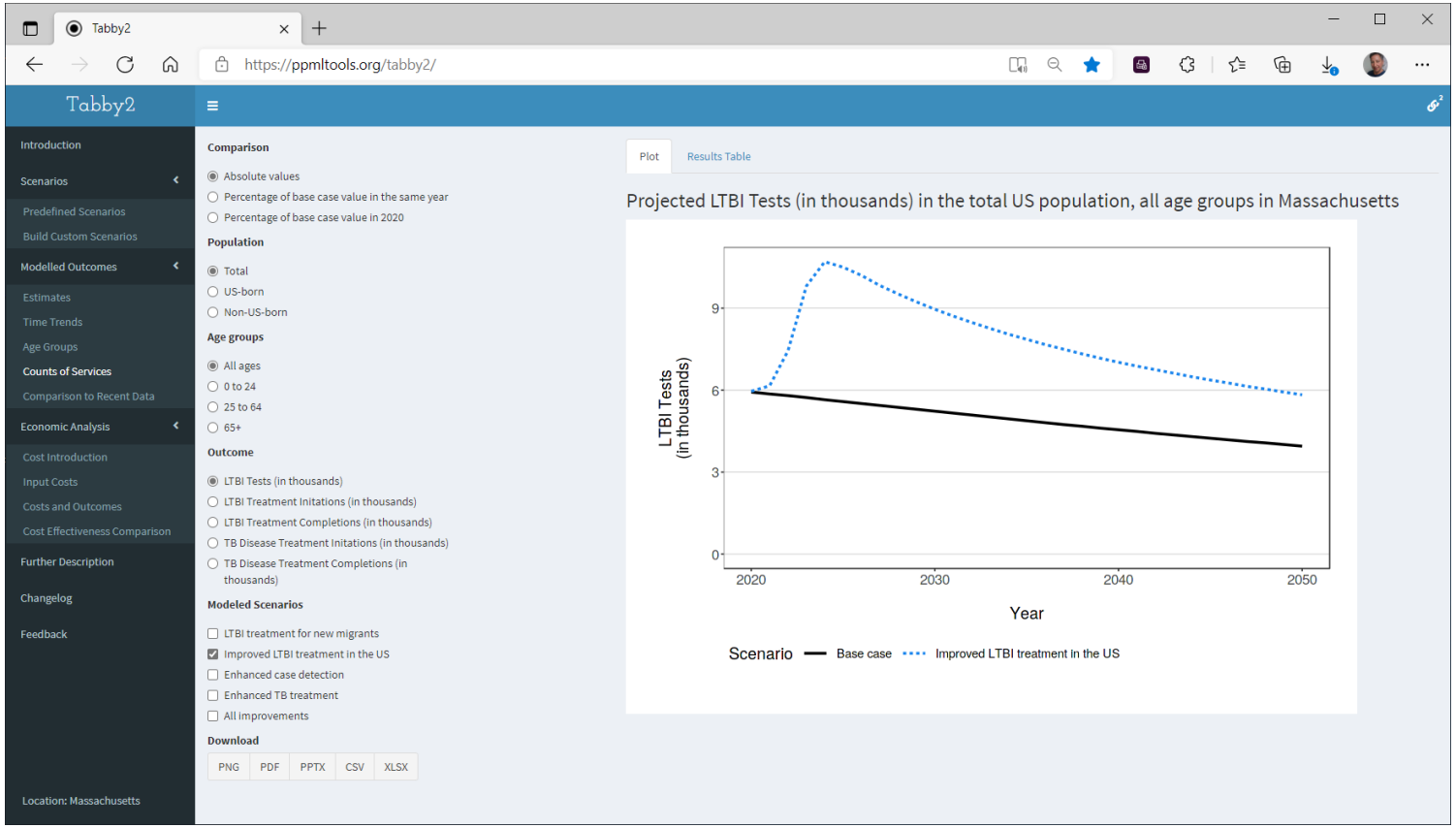
- Select “Results Table” from above the graph: point estimates by year for the base case scenario and for the “Improved LTBI Tx” scenario are displayed and can be downloaded



Estimate Resources Needed by MA in the Base Case and in the “Improved LTBI Tx” Scenario

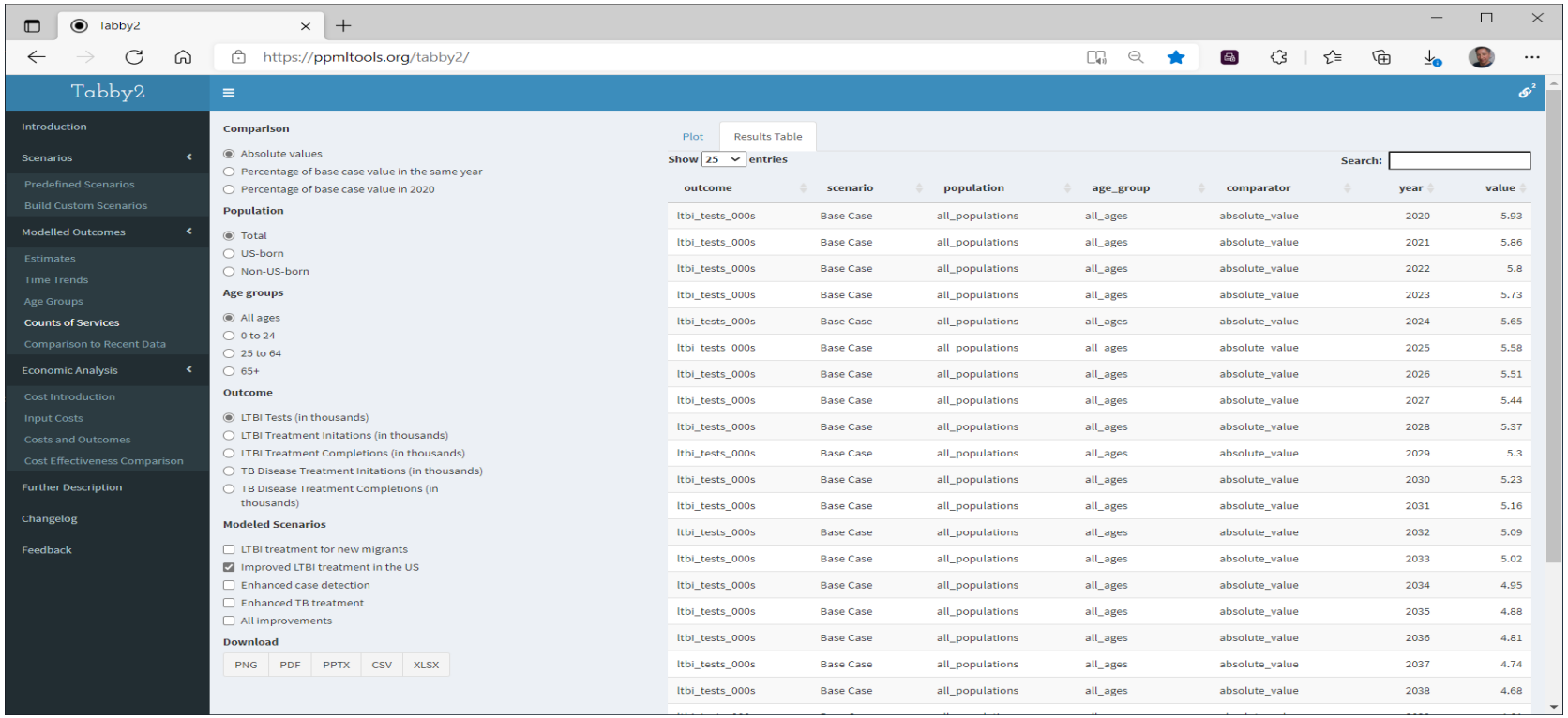
Estimate the Number of LTBI Tests in the Base Case and "Improved LTBI Tx" Scenarios

- 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 scenario and the "Improved LTBI Tx" scenario are displayed



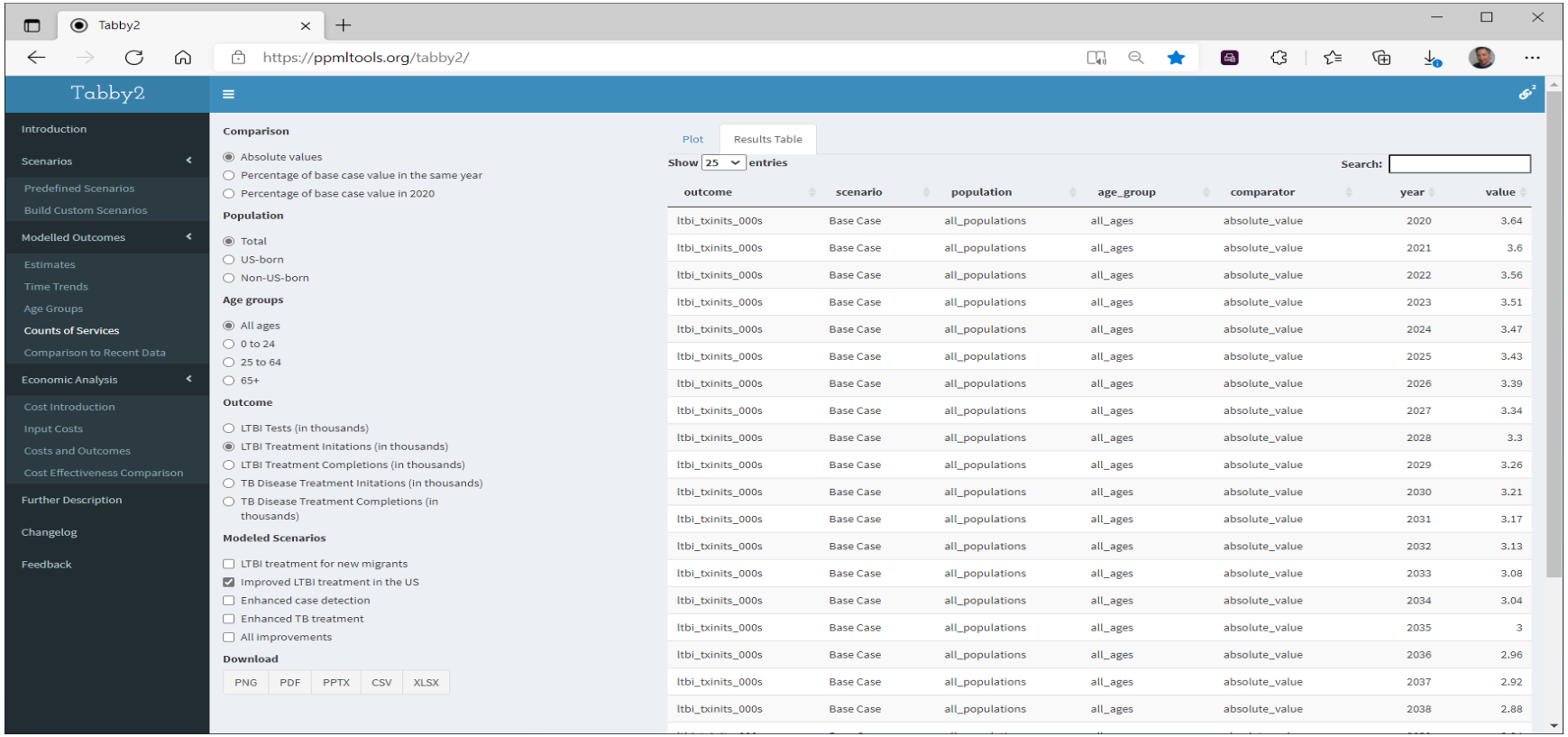
Estimate the Number of LTBI Tests by Year in the Base Case and "Improved LTBI Tx" Scenarios

- Above the graph, select "Results Table"
- The number of LTBI tests in the base case and the scenario are displayed by year. Download the table and sum. The 30-year total increase in LTBI tests is 87,640 with improved LTBI treatment vs. the base case scenario (239,670-152,030).



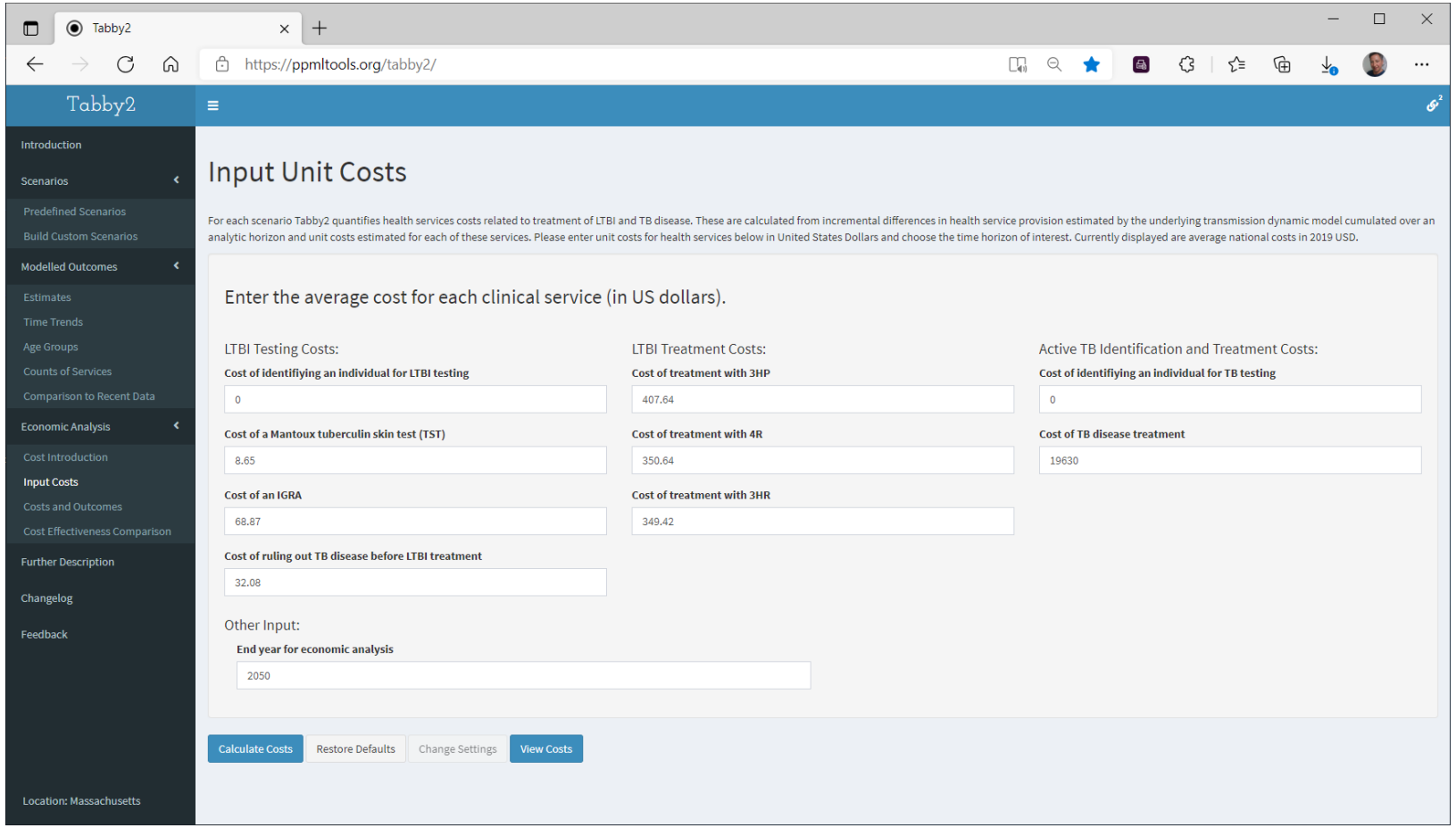
Estimate the Number of LTBI Treatment Starts under the Base Case and "Improved LTBI Tx" Scenarios

- Under Outcomes, select "LTBI Treatment Initiations (in thousands)." Download the table and sum. The 30-year total increase in LTBI treatments is 46,960 with improved LTBI treatment vs. the base case scenario (128,450-81,490).



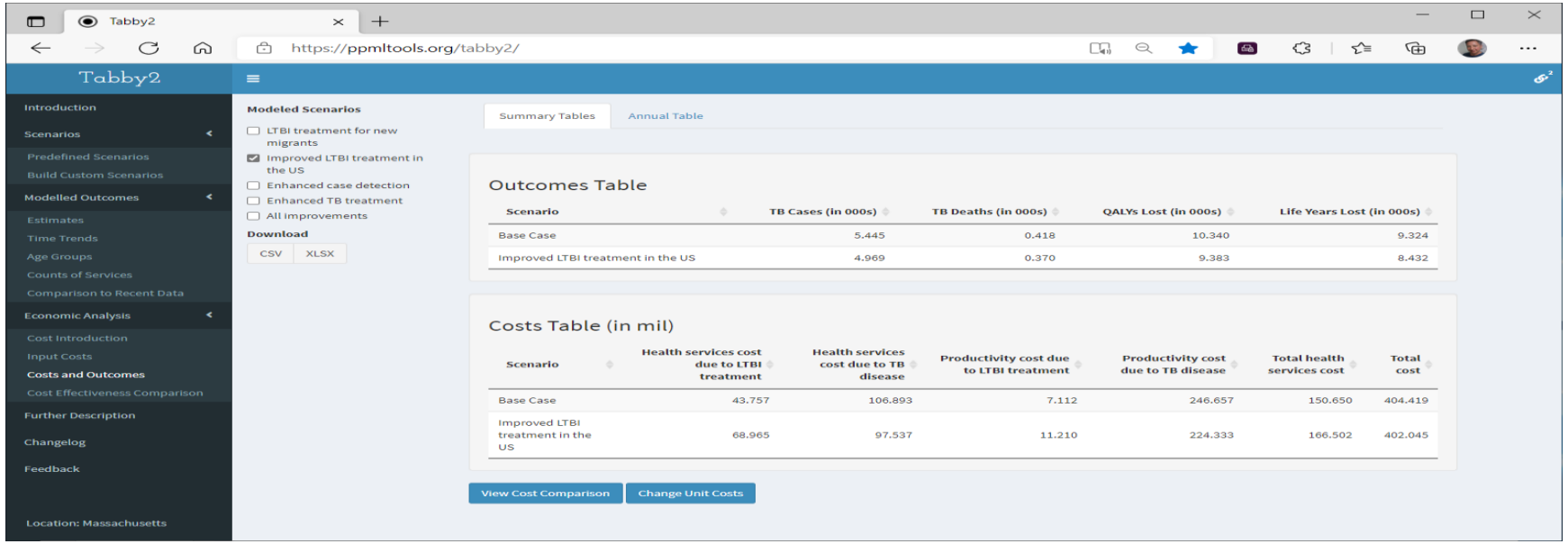
Review or Change Input Costs

- 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.



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
- Estimated TB cases, deaths, quality-adjusted life years (QALYs), and life years over 2020-2050 are in the top table. 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.



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)

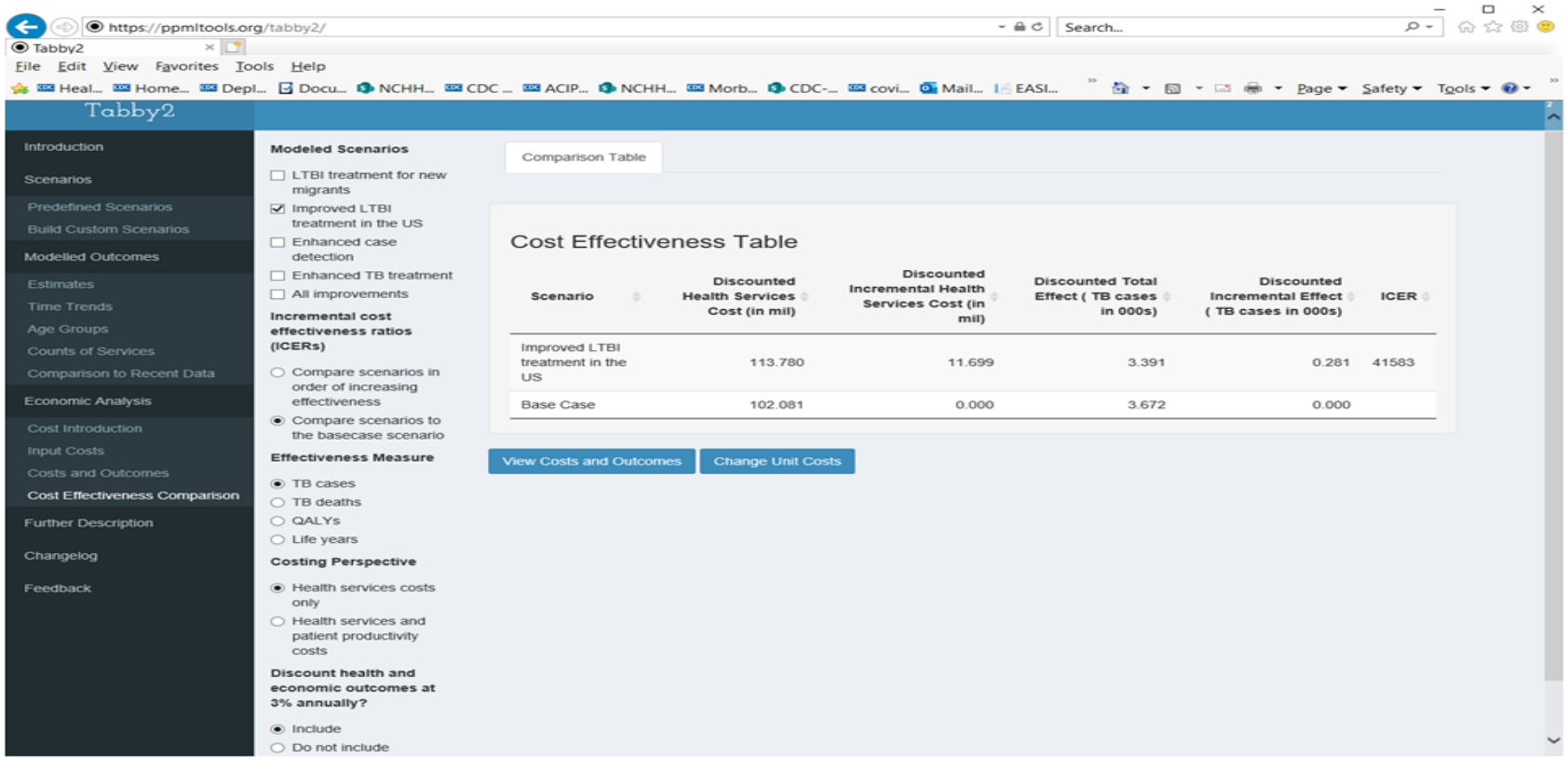
$$= \frac{Net\ Cost\ of\ Improved\ LTBI\ Tx - Net\ Cost\ of\ Base\ case\ Services}{Change\ in\ TB\ cases\ with\ Improved\ LTBI\ Tx - Change\ in\ TB\ cases\ with\ Base\ case\ Services}$$

  - 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

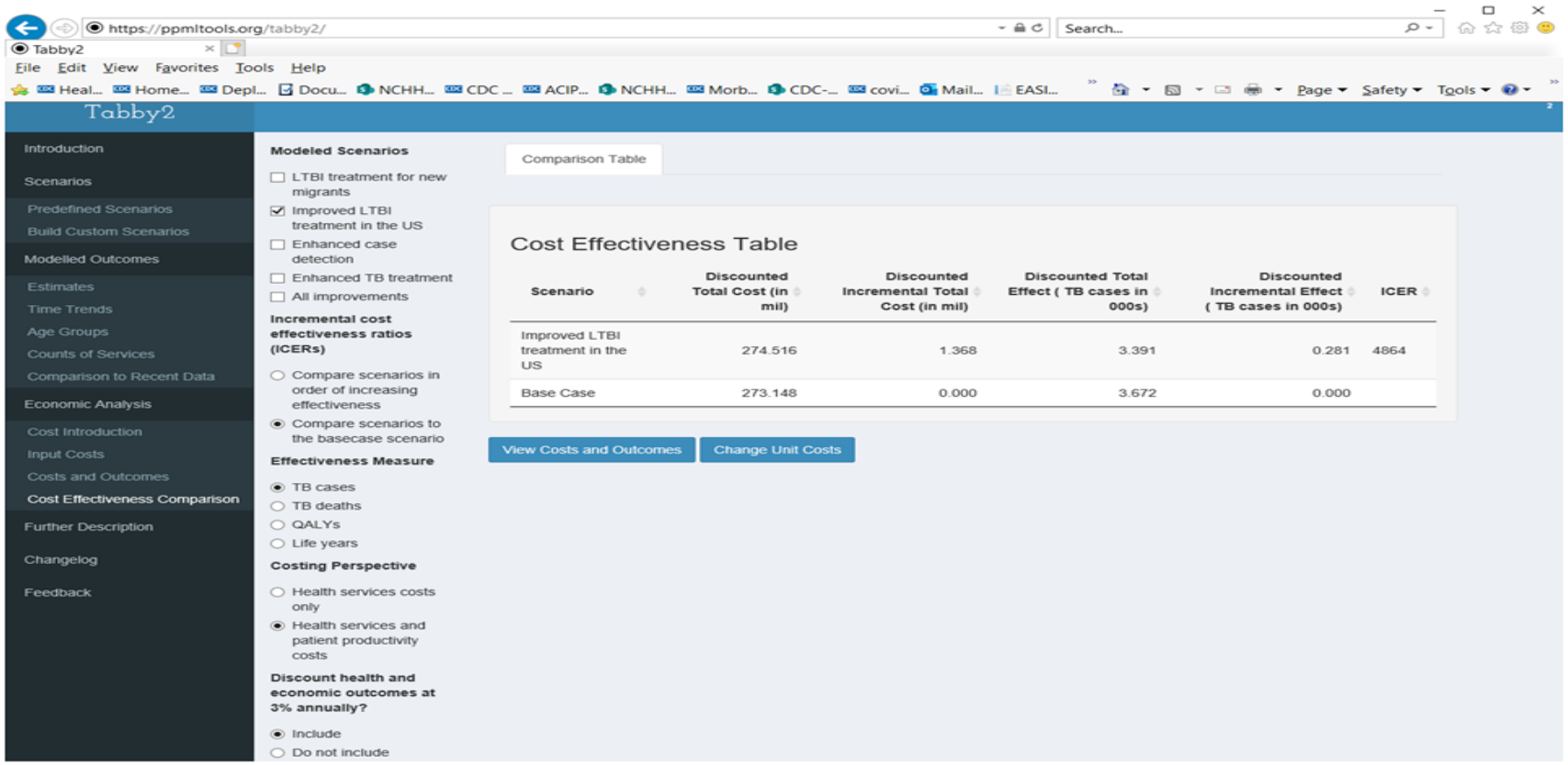
Estimate the Cost per Additional TB Case Prevented in the "Improved LTBI Tx" Compared with the Base Case Scenario

- 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.



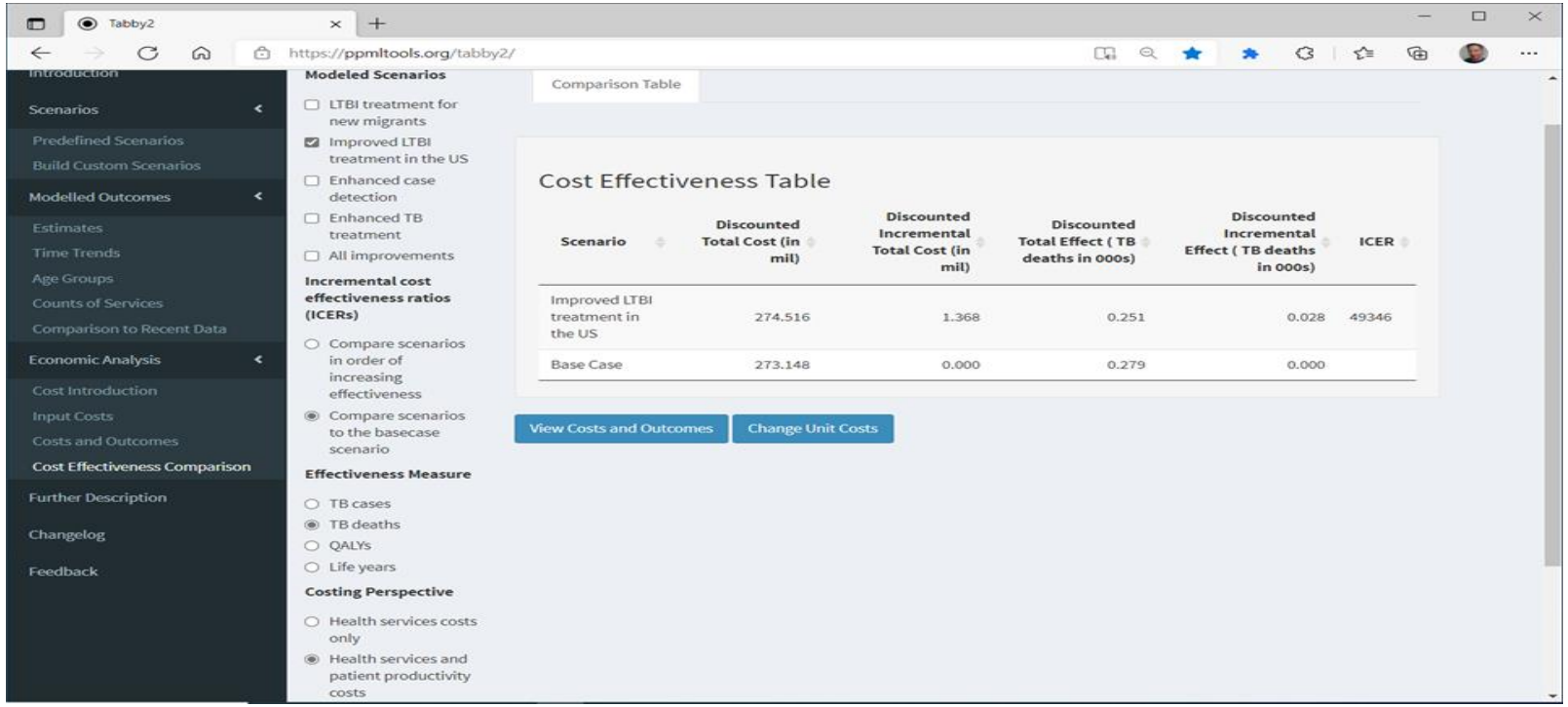
Change the Costing Perspective from “Health Services” to “Health Services and Patient Productivity Losses”

- Select a costing perspective of “health services and patient productivity losses.” (Note losses=costs). The ICER becomes more cost effective, at $4,864 per additional TB case prevented.



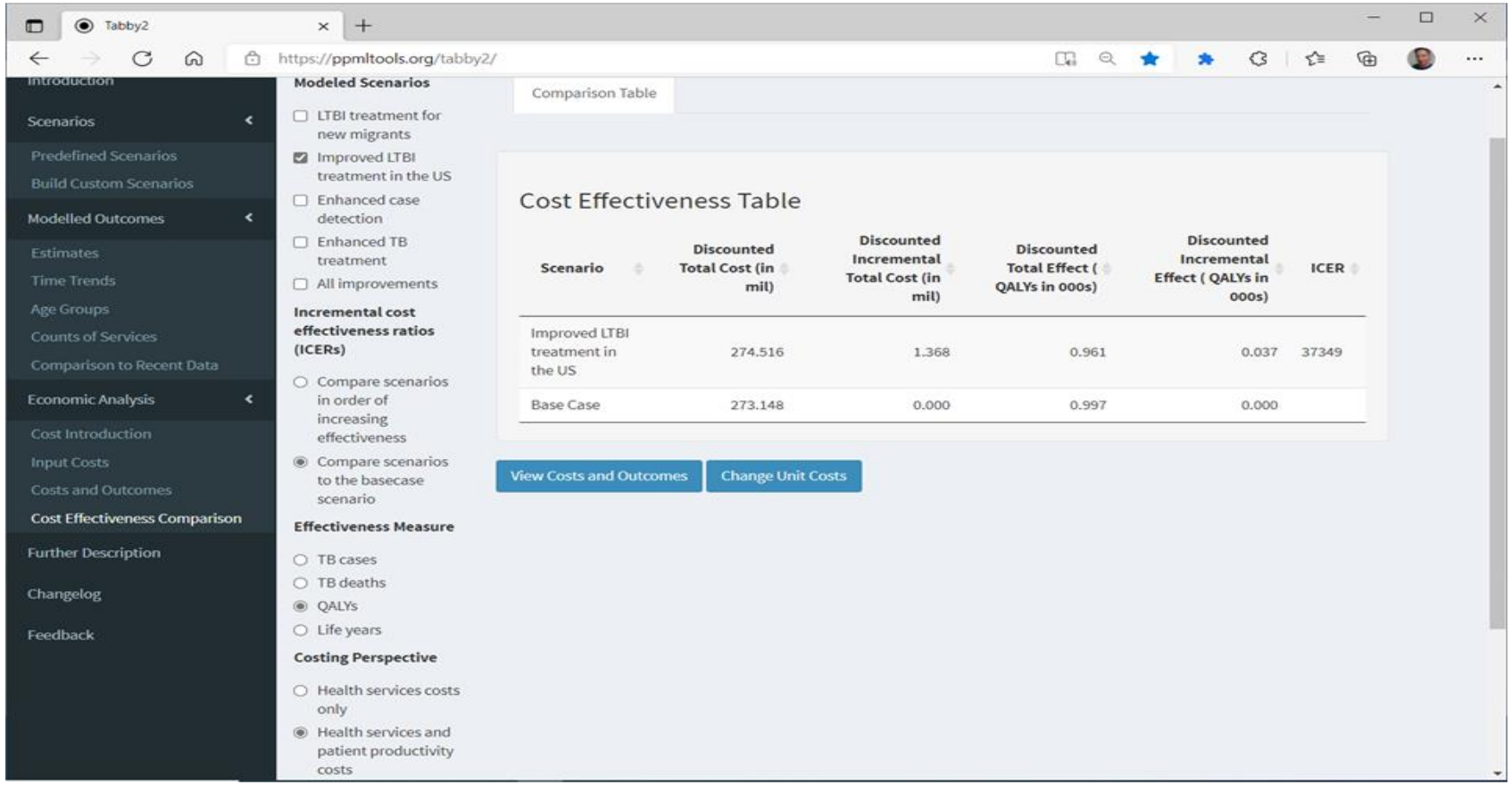
Estimate the Cost per Additional TB Death Prevented in the "Improved LTBI Tx" Compared with the Base Case Scenario

- 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.



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.



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;
  - Over the 30-year period, 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.

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.

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

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

Funding, Acknowledgements, and Contact Information

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Contact Nicole Swartwood at nswartwood@hsph.harvard.edu or Suzanne Marks at smarks@cdc.gov for further information.