Consortium to Assess Prevention Economics (CAPE)

Optimizing Targeted LTBI Testing & Treatment among California's Foreign Born Population

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Organizations within CAPE

UCSF Global Health Economics Consortium

STANFORD SCHOOL OF MEDICINE

UC Berkeley - UCSF
Joint Medical Program

California Department of Public Health CDPH

San Francisco Department of Public Health

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Who We Are

Principle Investigators

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Clinical Experts

- Priya Shete, MD
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- Marion Peters, MD

Epidemiologist

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Modelers

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Senior Program Manager

- Devon McCabe

TB Control, CADPH

- Jennifer Flood, MD, MS
- Pennan Berry, MD, MPH
- Peter Oh, DrPH

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Research Questions

- What is the epidemiologic and economic impact of expanded testing and treatment to classes of immigrants not currently screened?
- What is the best test and treatment scenario to reach pre-elimination?
- What is the impact of a combination of these strategies?

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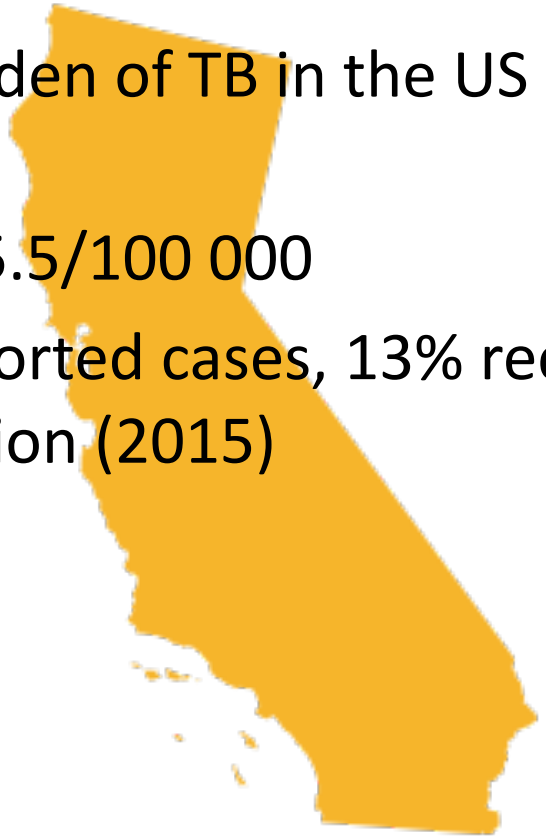
Background

- CA has largest burden of TB in the US with 2,137 Cases in 2015
- Incidence rate of 5.5/100 000
- Estimated 7% imported cases, 13% recent transmission and 80% reactivation (2015)



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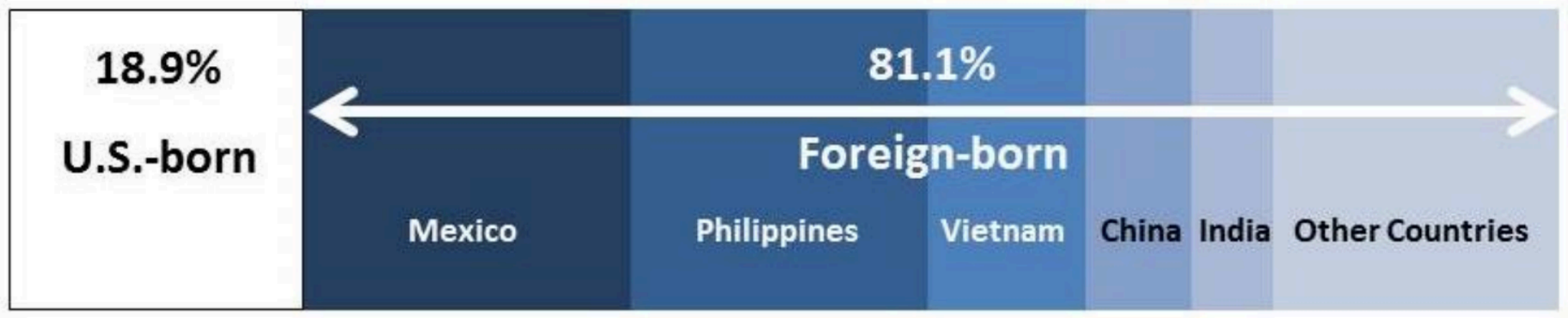
Background

- 27% of CA population is FB
- TB in CA disproportionately affects FB (incidence 16.5/100 000)
- 81% of all TB cases are in FB



from CDPH TB Fact Sheet 2016

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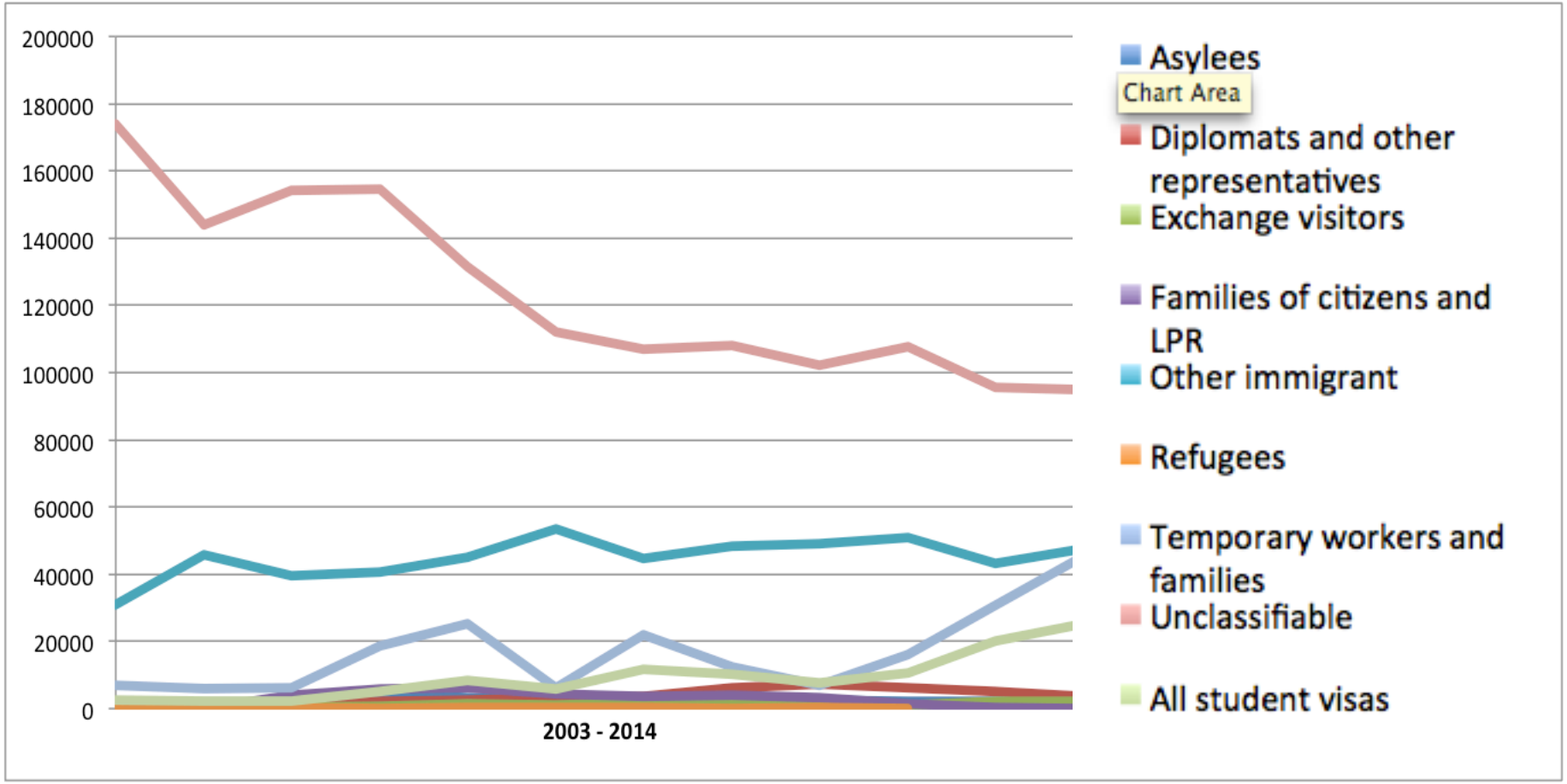
New immigrants by visa classes in California



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Main topics for this talk

- Model aspects and design
- Initial validation: Population diversity and Risk factors
- Parameter Estimation:
  - Risk of progression
  - Risk ratios
- Targeted test and treatment design
- Results and analysis

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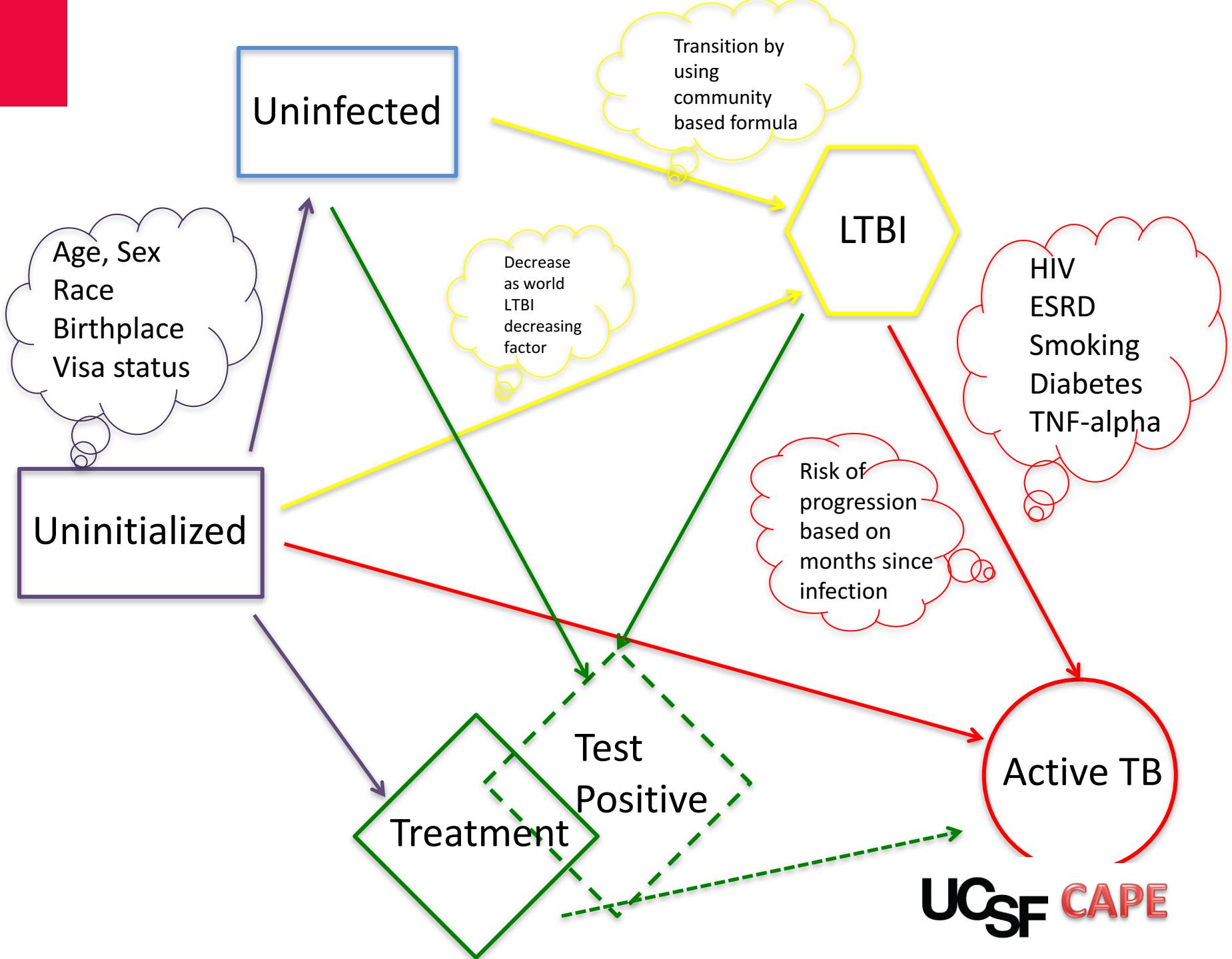
Uninfected
Transition by using community based formula
LTBI
Age, Sex
Race
Birthplace
Visa status
Decrease as world LTBI decreasing factor
HIV
ESRD
Smoking
Diabetes
TNF-alpha
Uninitialized
Risk of progression based on months since infection
Test Positive
Treatment
Active TB
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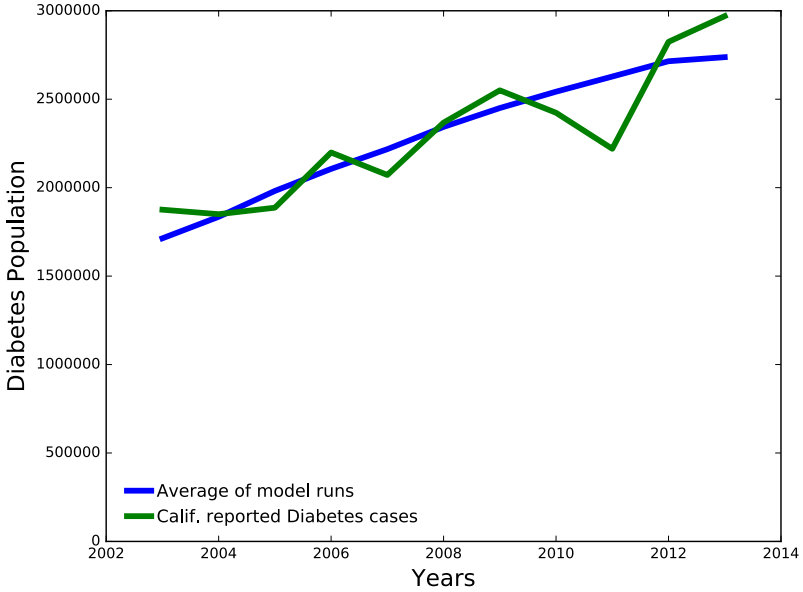
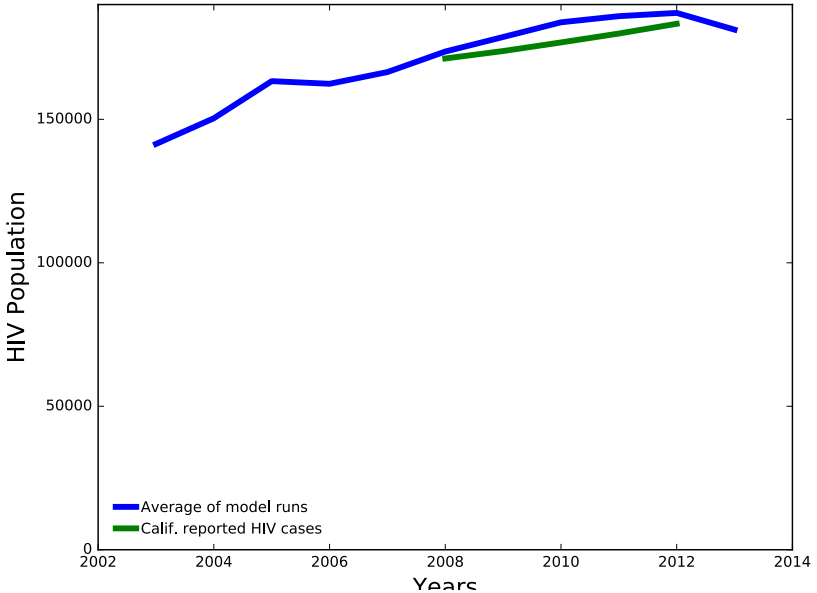
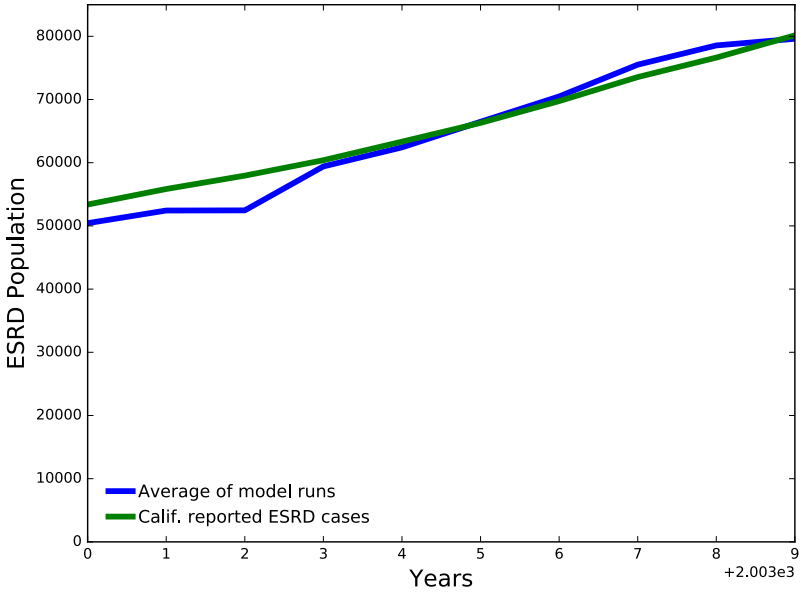
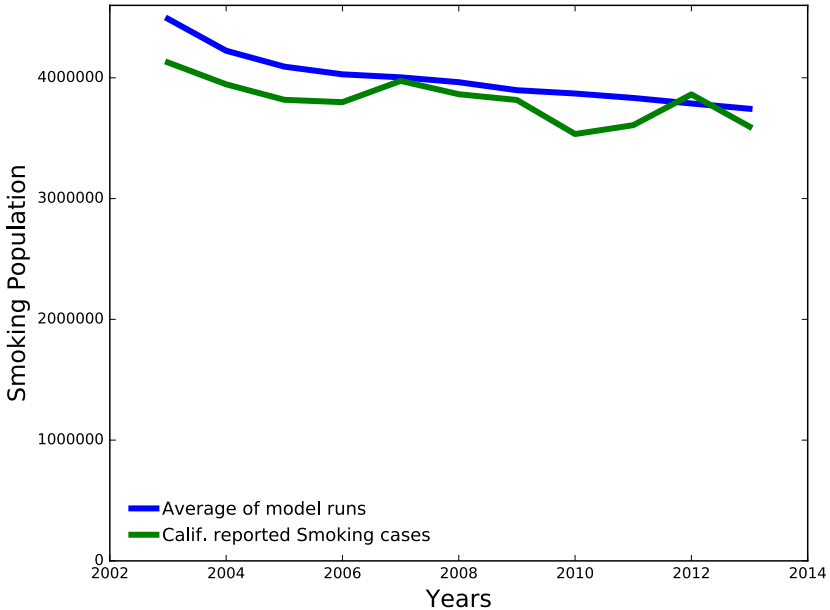
Validation of model for risk factors

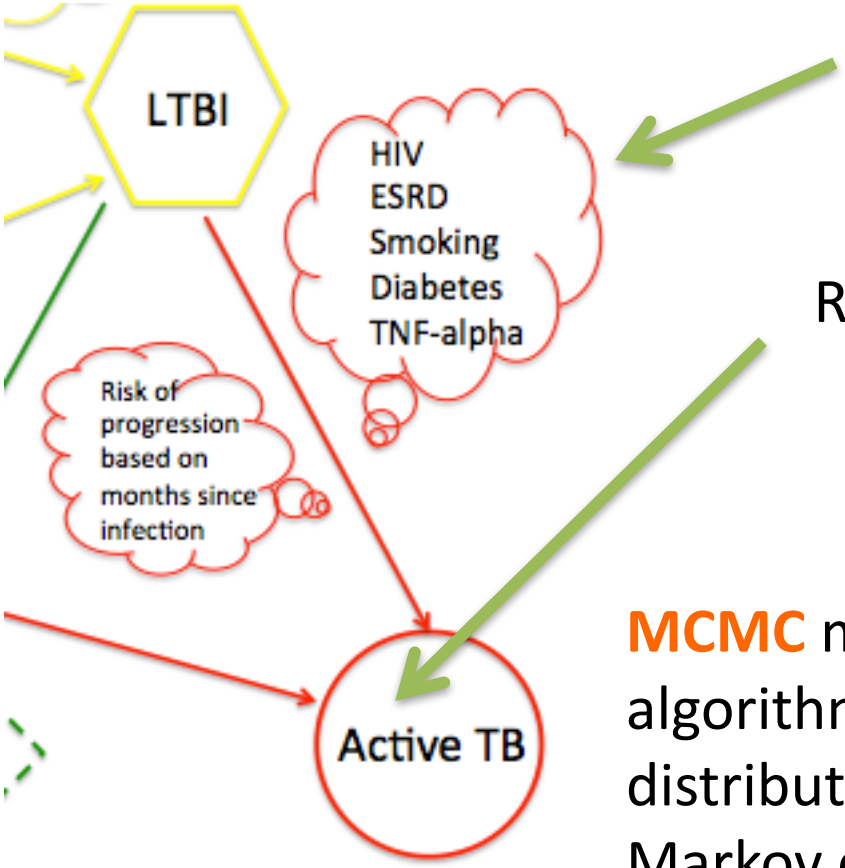








Parameter estimation using Markov Chain Monte Carlo (MCMC)



Risk Ratios

Risk of progression

MCMC methods are a class of algorithms for sampling from a probability distribution based on constructing a Markov chain that has the desired distribution of its equilibrium distribution

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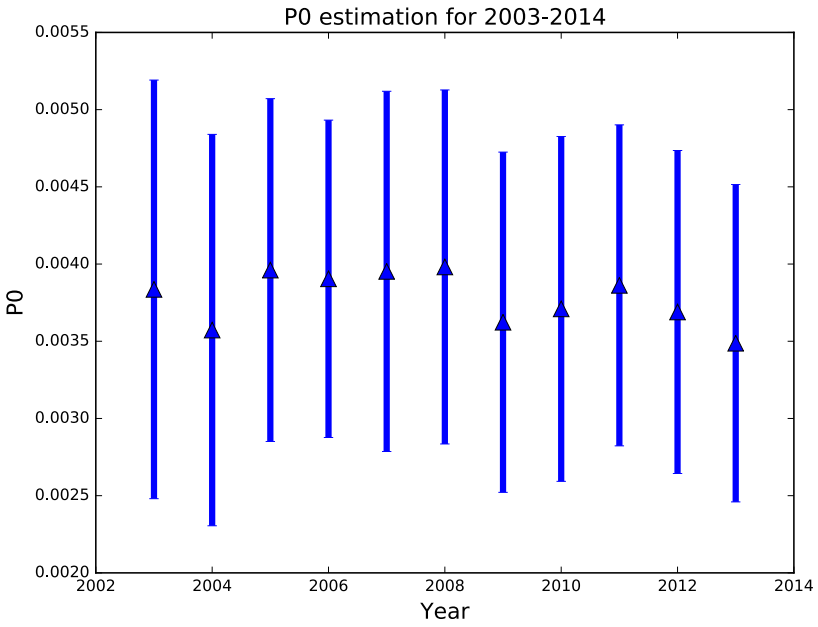
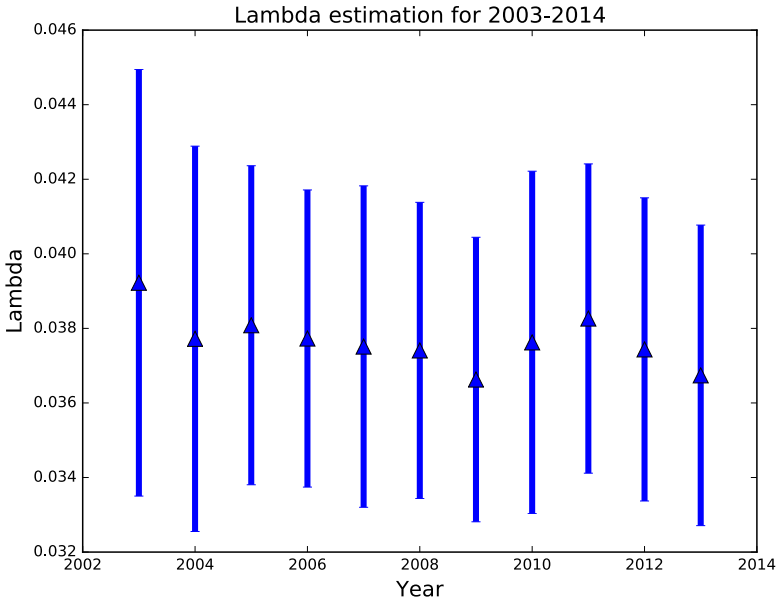
Risk of progression estimation

Risk of progression where the risk of progression in month t after infection (P_t) is determined by the following equation:

$$P_t = P_0 e^{-\lambda t}$$





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Challenges

MCMC estimates P_0 and λ for each year but we need a one value for each. To find the best P_0 and λ we tried three different approaches:

1. Using only two different P_0 and λ for before and after 2009 where we have jump in MCMC estimation.
2. Using one value as an average of all P_0 and λ
3. Using P_0 and λ as normal distribution with mean and sigma as average of all P_0 and λ estimated by MCMC.

	Mean	Standard deviation
P_0	0.00378	0.00025
λ	0.0377	0.00112

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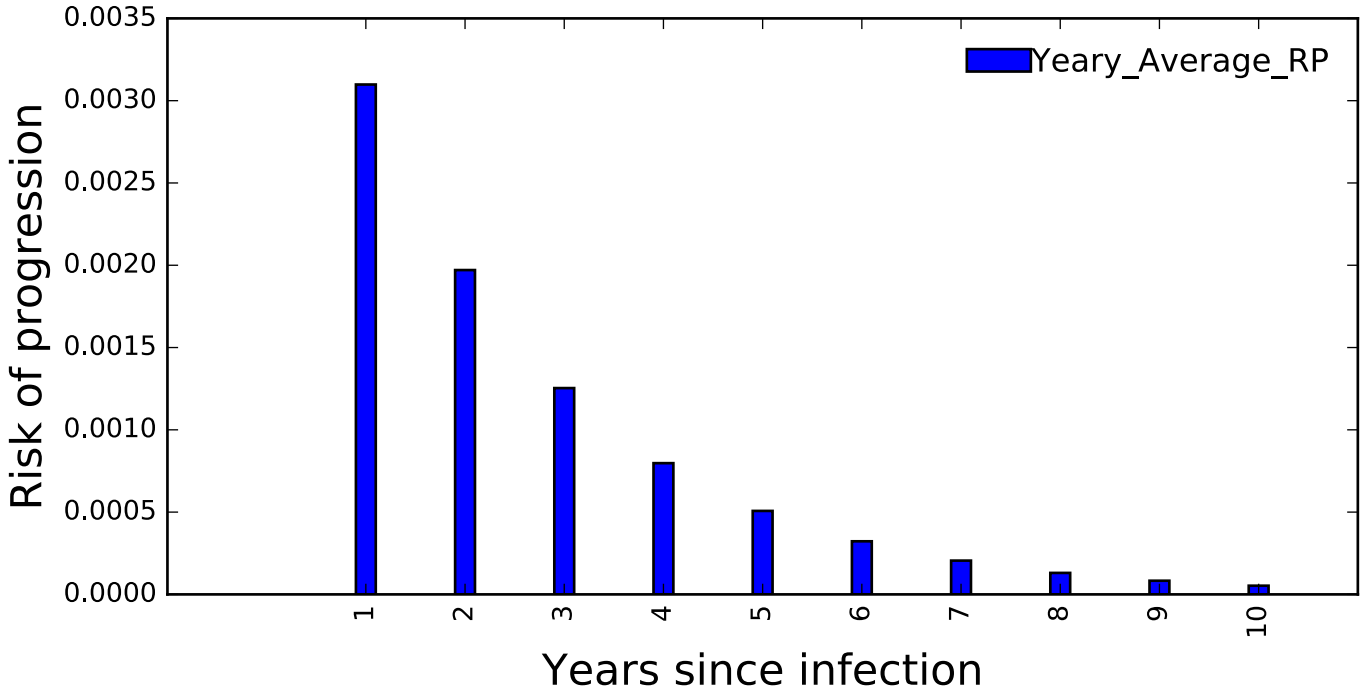
Risk of progression estimated by month since infection



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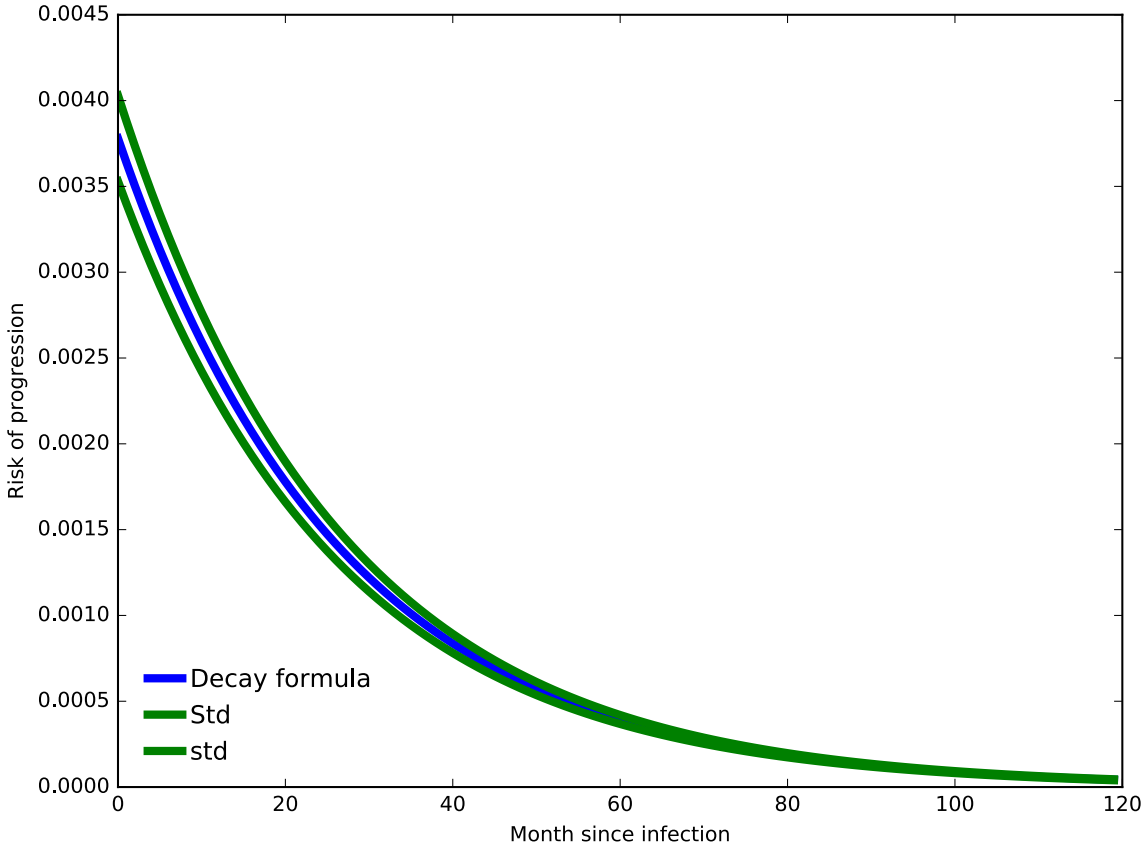
RP error range



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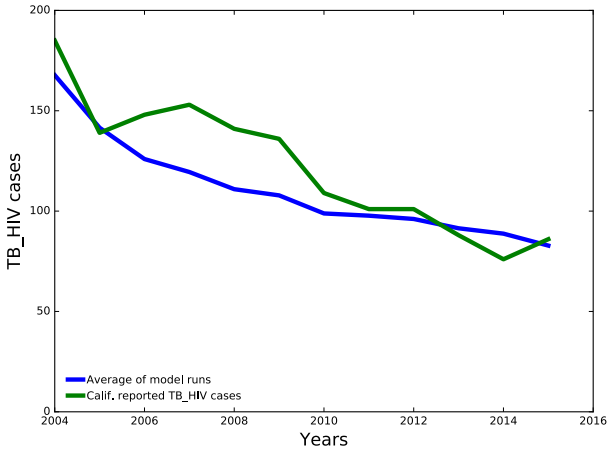
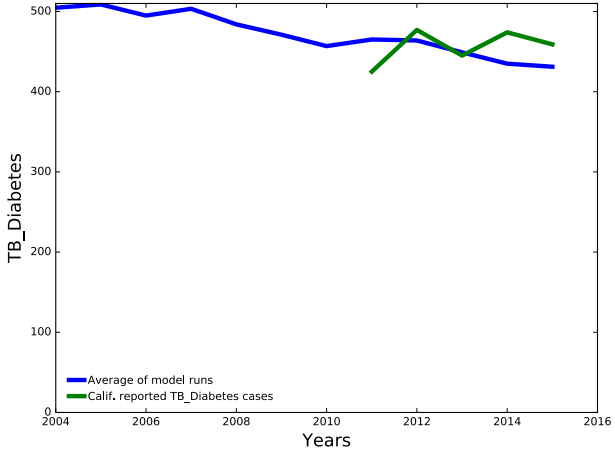
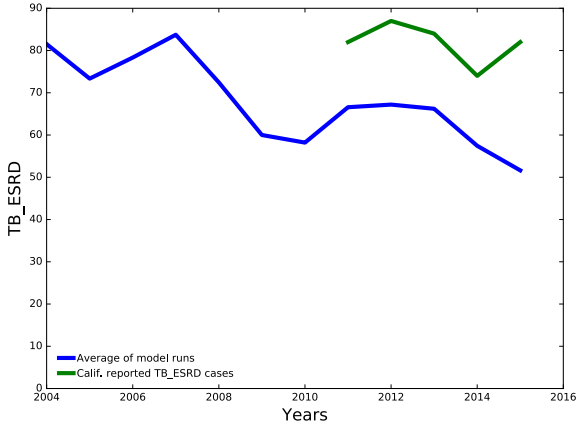
Estimated Risk ratios

	HIV	Diabetes	ESRD
Literature	2.9-22	1.3-3.6	2-20
MCMC	16	2.7	19.78







Limitation: Control data is available for only few years

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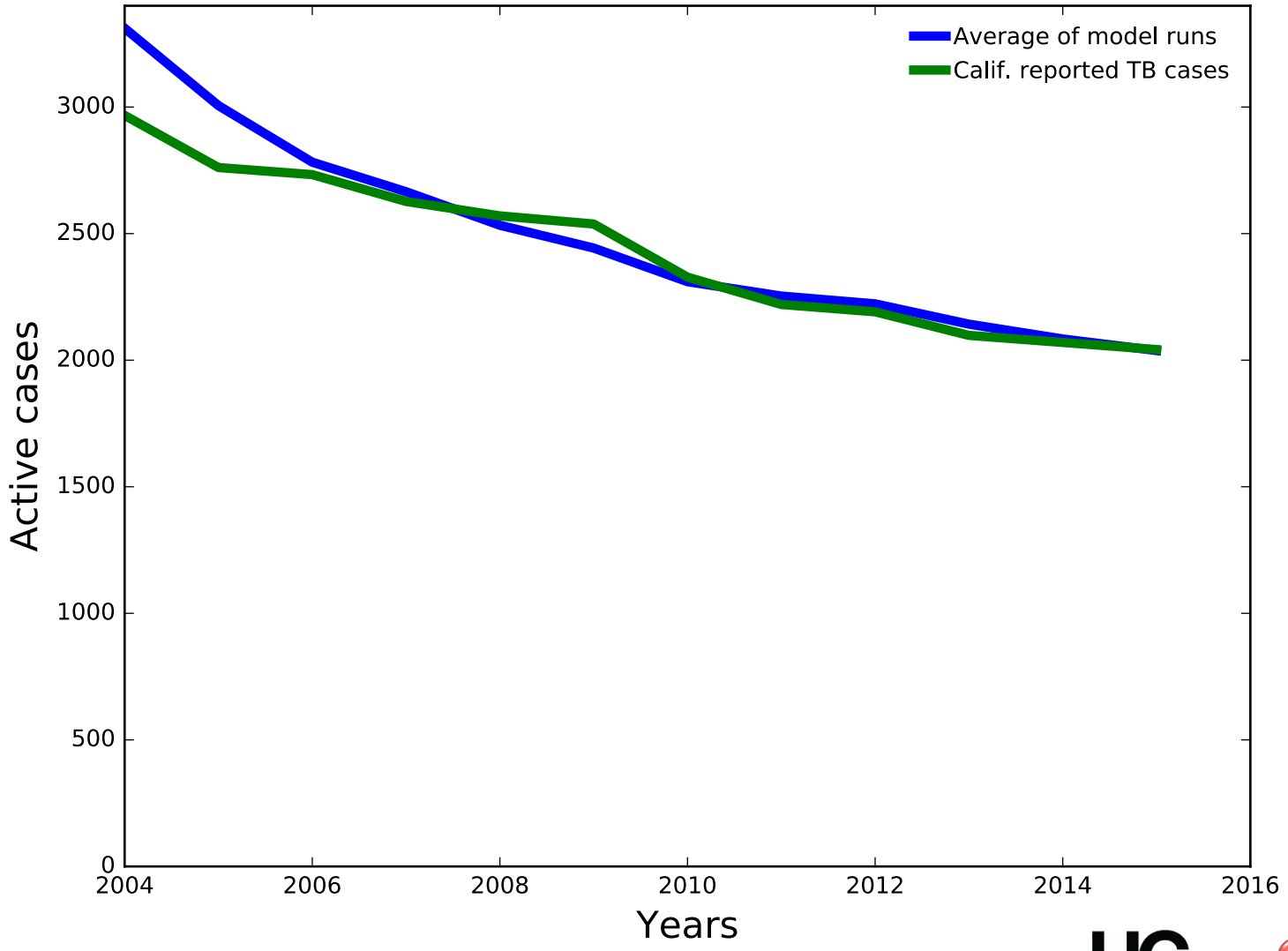
TB trend by estimated parameters



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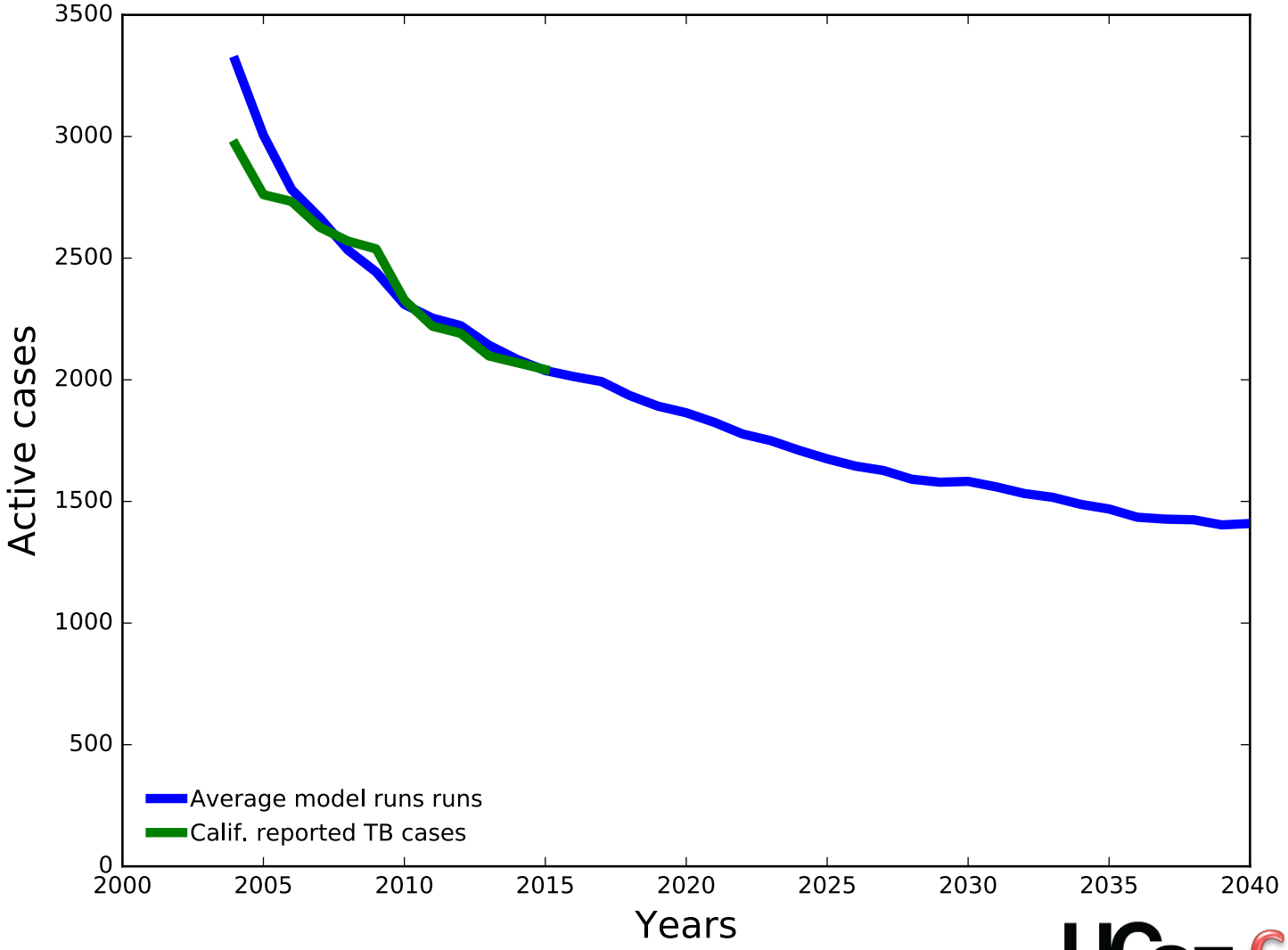
TB trend estimation till 2040



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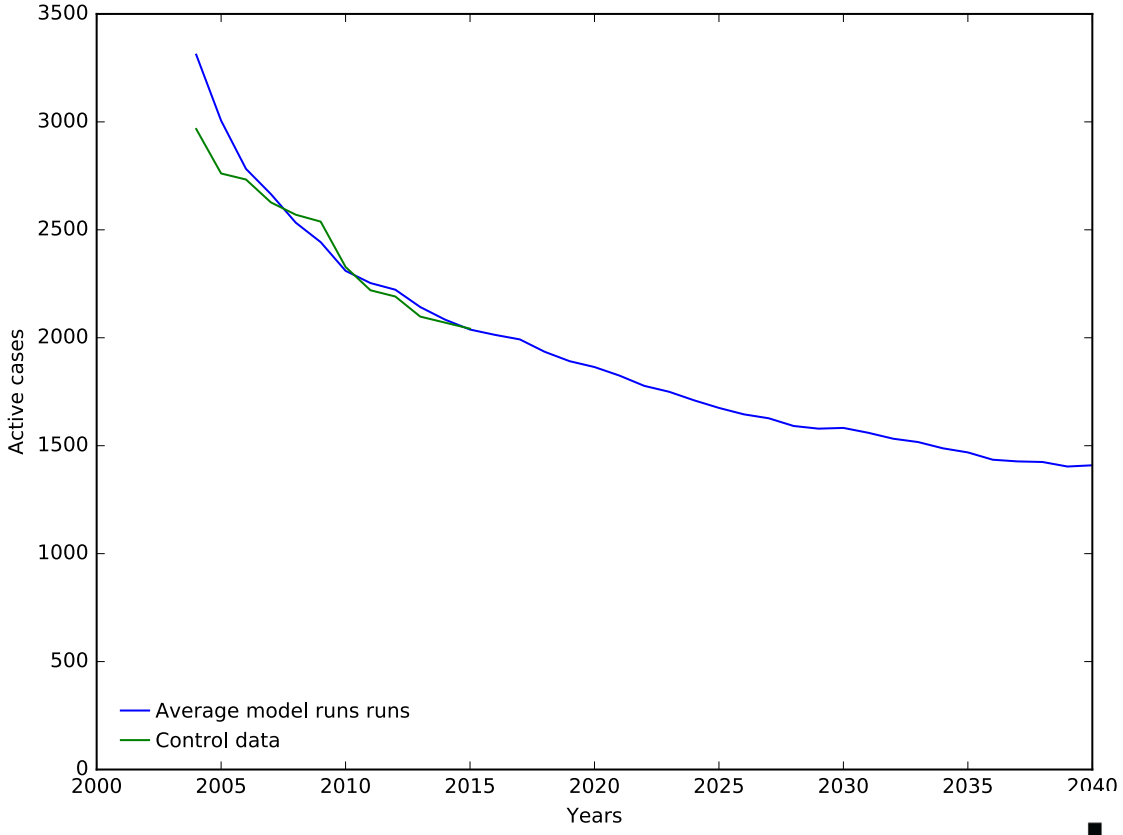
Base-case scenario

Testing 4.5% of population annually.

Subtracting the number of people get green cart, because they have been tested for the process.



TB trend till 2040 only applying base-case TT

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TTT scenarios

Previously tested scenarios:

- Base_case: Current LTBI screening (random, .004 uptake)
- Foreign born testing: (2x(.004), 4x, 10x uptake)
- Risk factor testing: (2x(.004), 4x, 10x uptake)

New tested scenarios:

- Visa-class: Screening new immigrants based on their visa classes
- Universal on Arrival: Screening all new immigrants that have classifiable visas
- High prevalence: Screening people in higher prevalence targeted population using combination information of visa classes and risk factors

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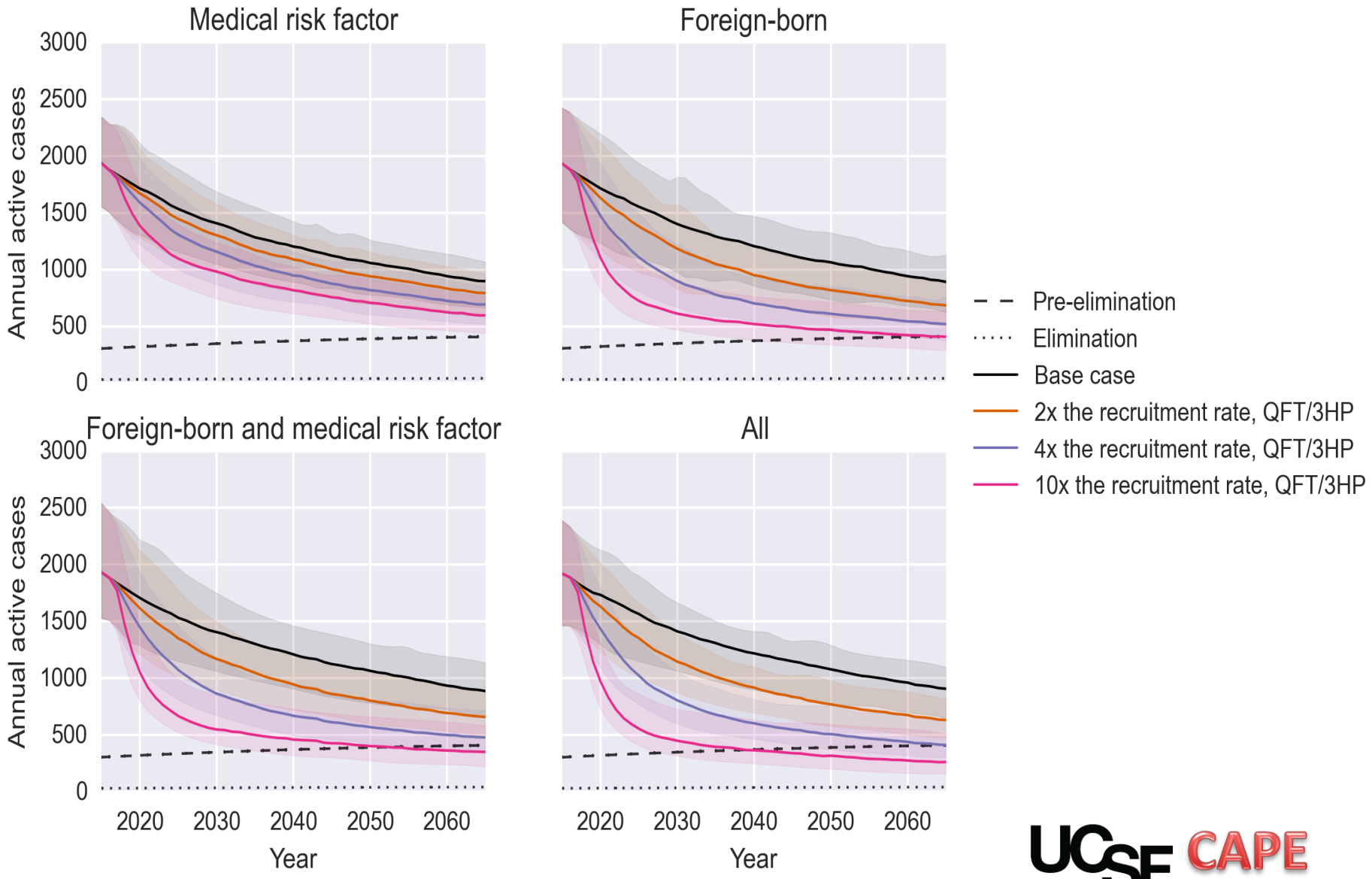
Previously TTT results



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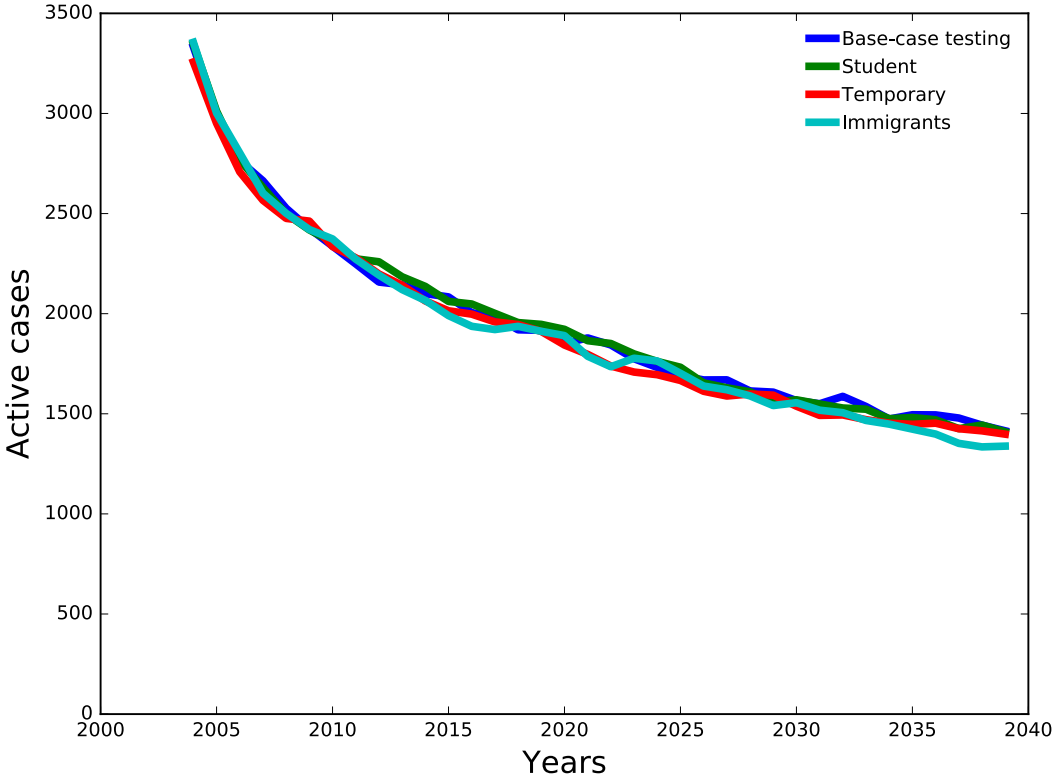
Visa-class testing scenario

- Testing new immigrants with three largest visa class population : Student, Temporary workers and Immigrant visa classes.



The population target sizes are small (limited number of new immigrants in classifiable visa status), and their LTBI prevalence rate is almost the same. Therefore the tastings have almost the same effect on reducing TB active cases.

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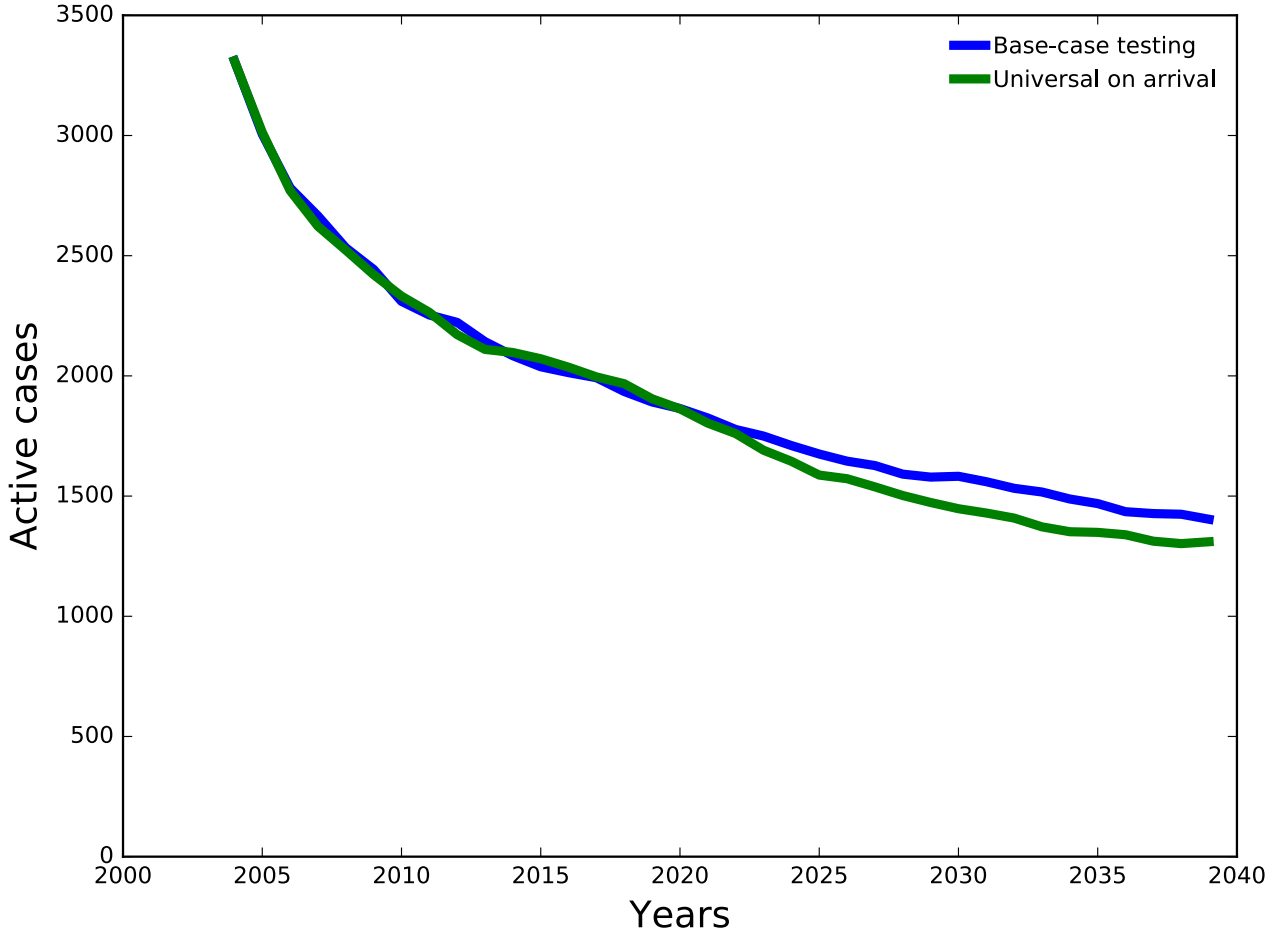
Universal on Arrival testing scenario

Testing people from top 5 countries at their arrival in classifiable visa status.



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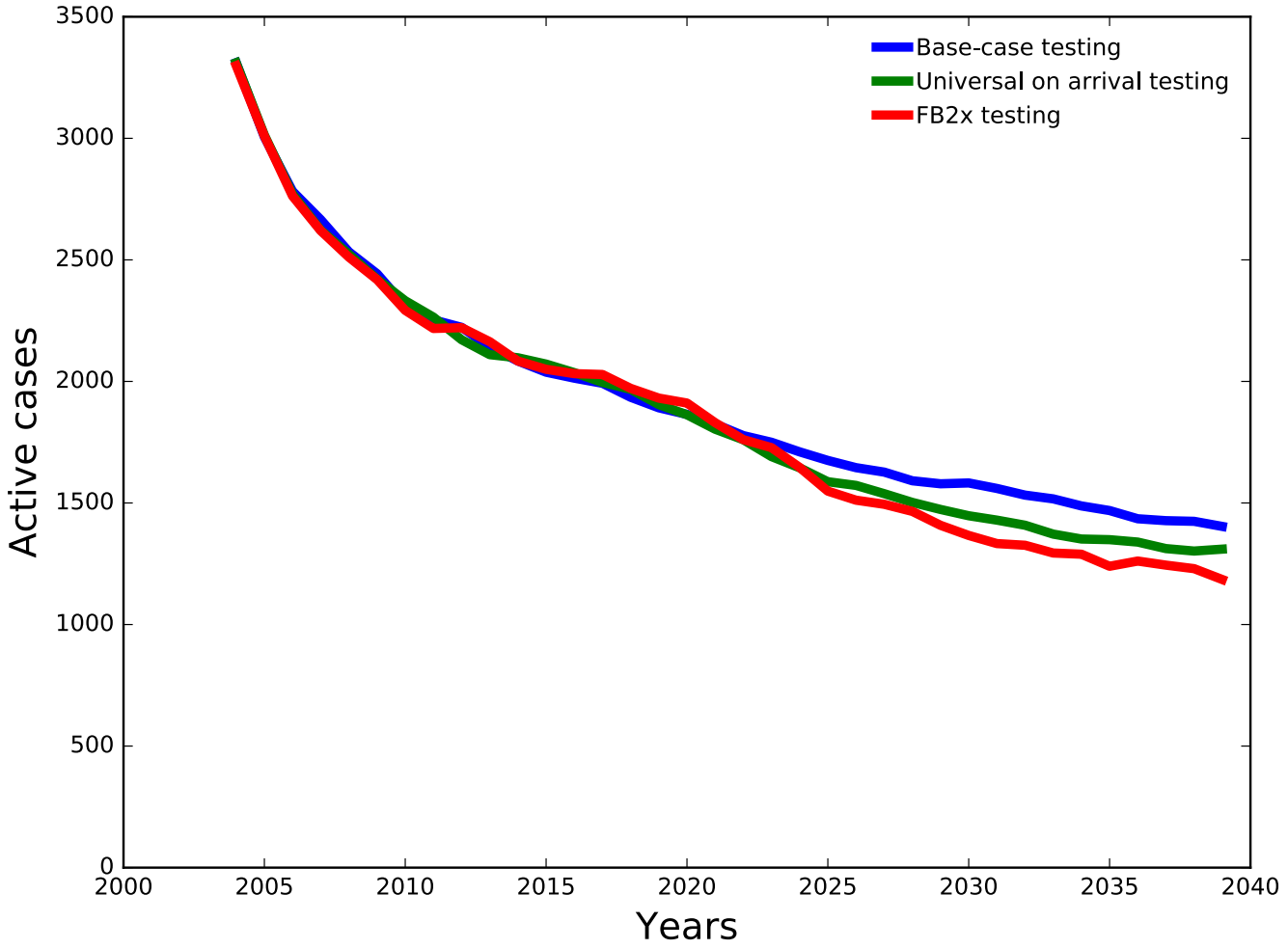
Comparing Universal at arrival and Fb2x



Cumulated testing on Universal on Arrival is less than FB2x testing

FB2x :625835

Universal on Arrival: 575400

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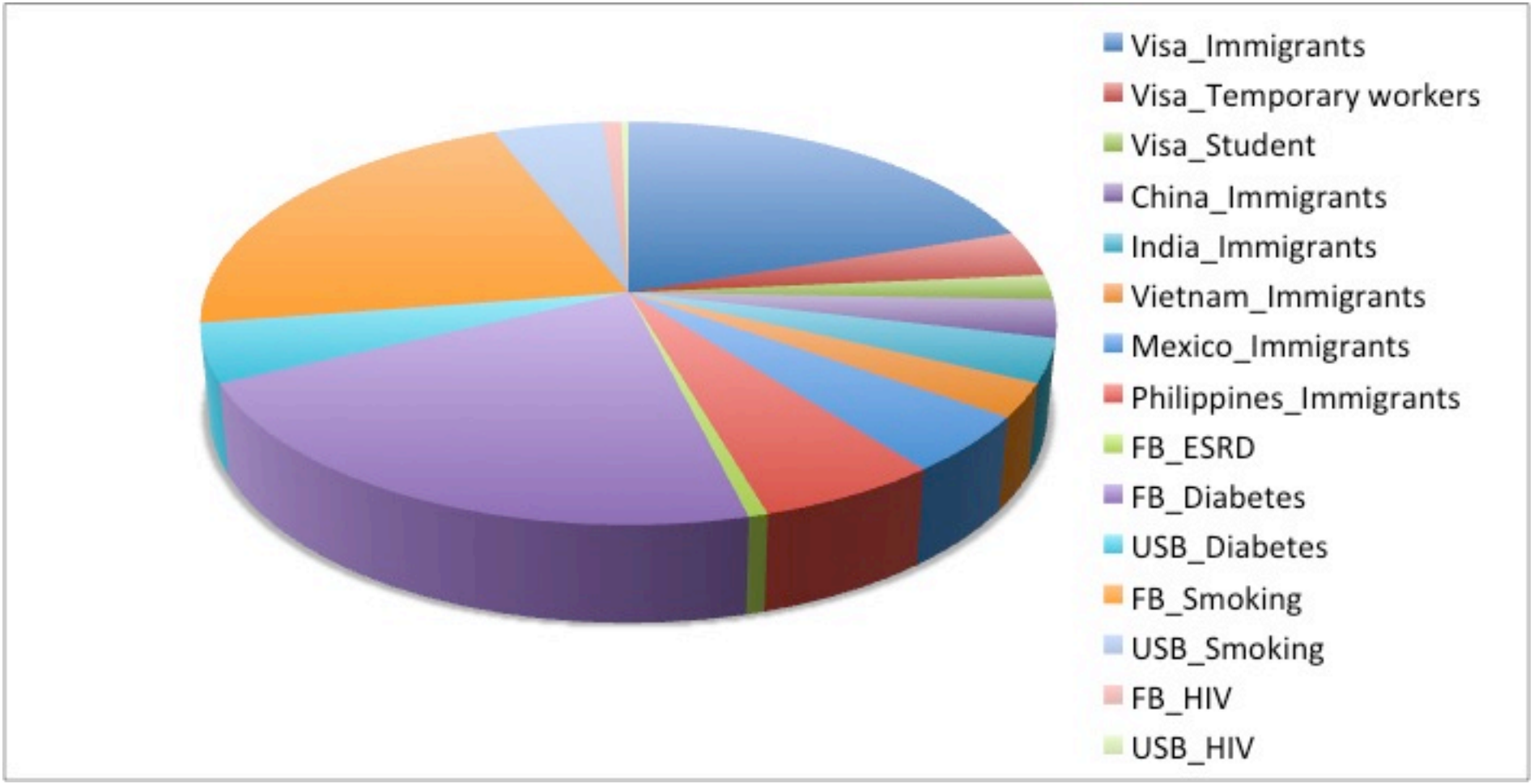
LTBI diversity at 2014



Largest population

- People with immigrant visa and not tested in previous year.
- Foreign born population with diabetes and smoking
- All HIV infected people

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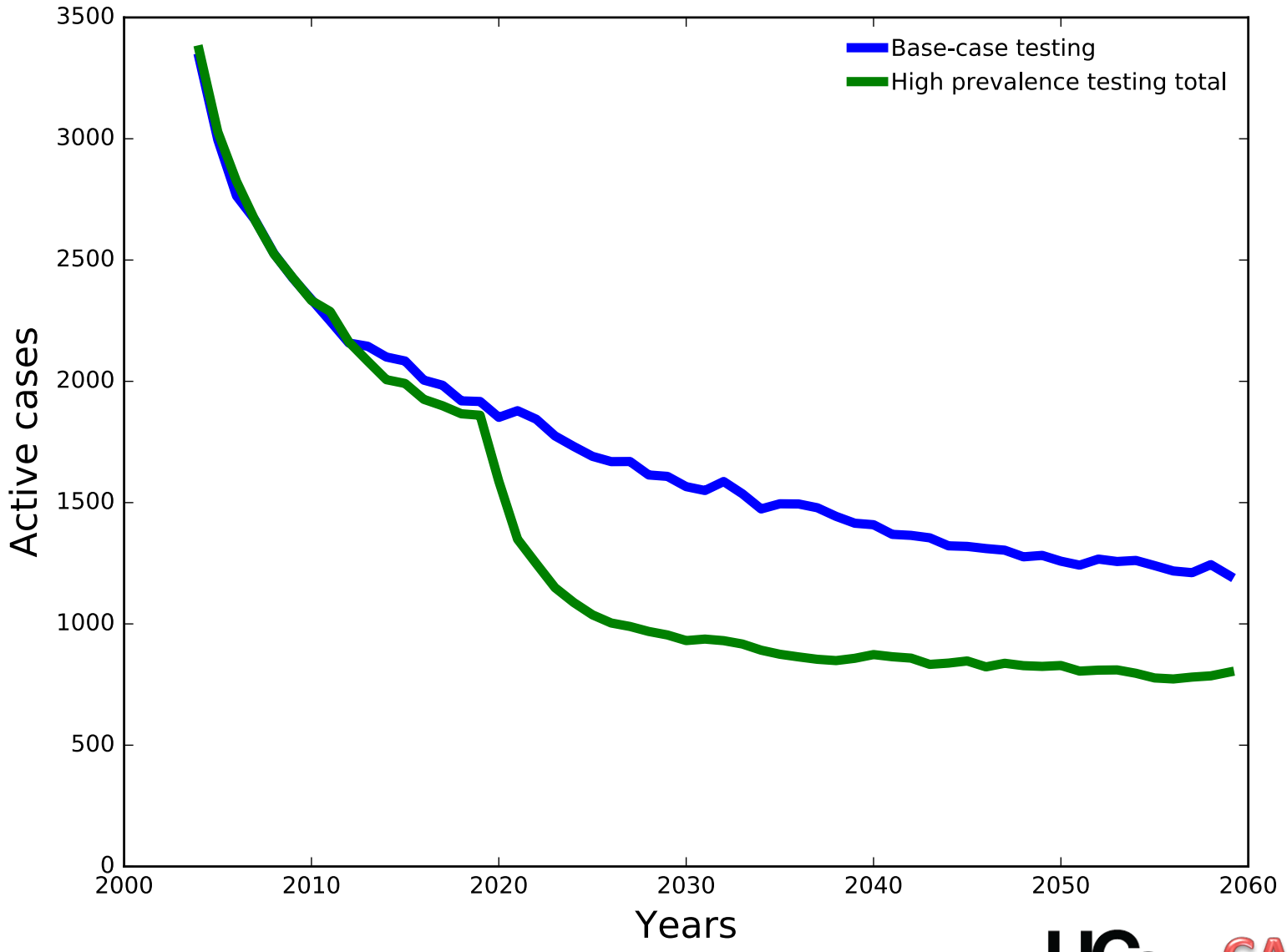
High prevalence targeted population testing result



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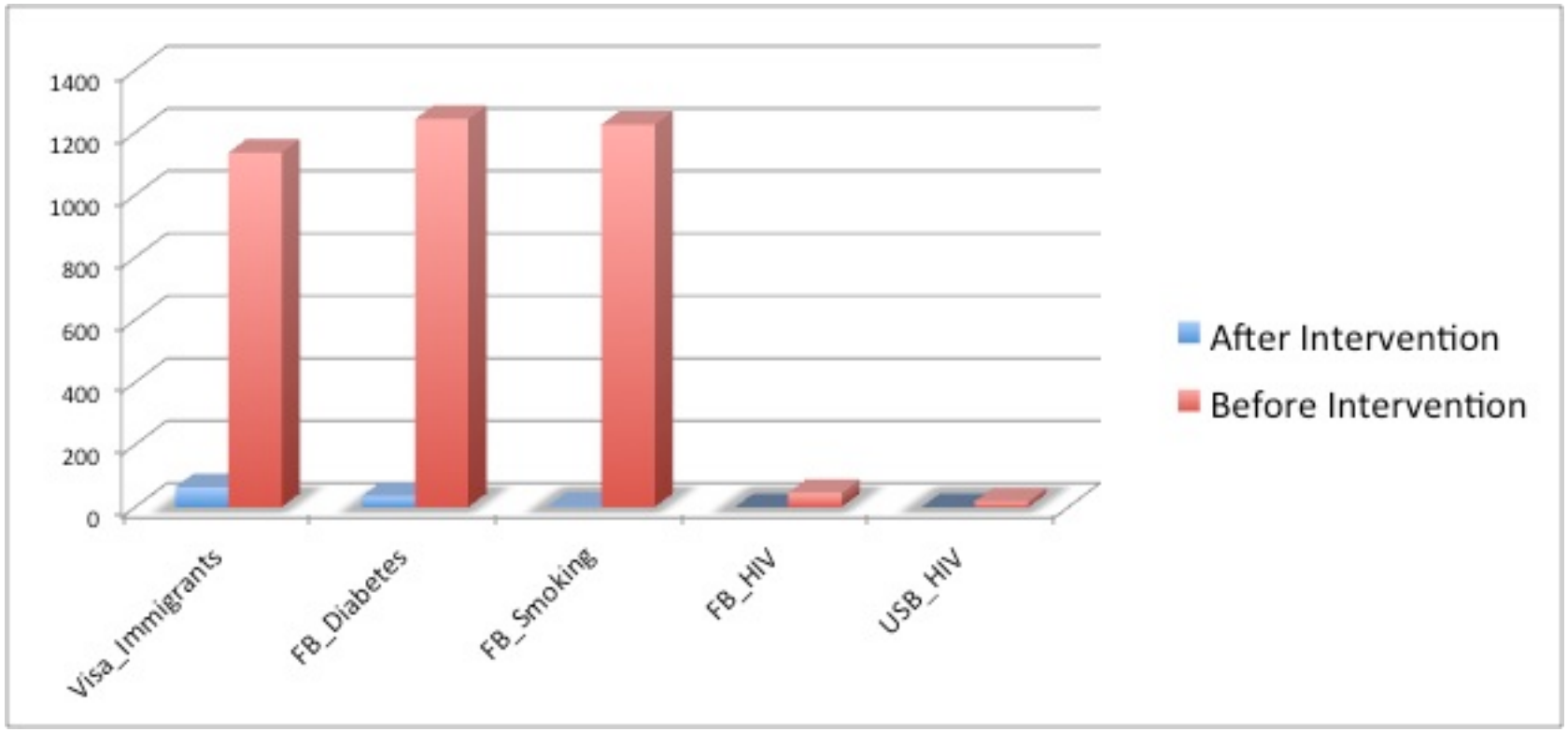
LTBI diversity before and after TTT at 2014 and 2030



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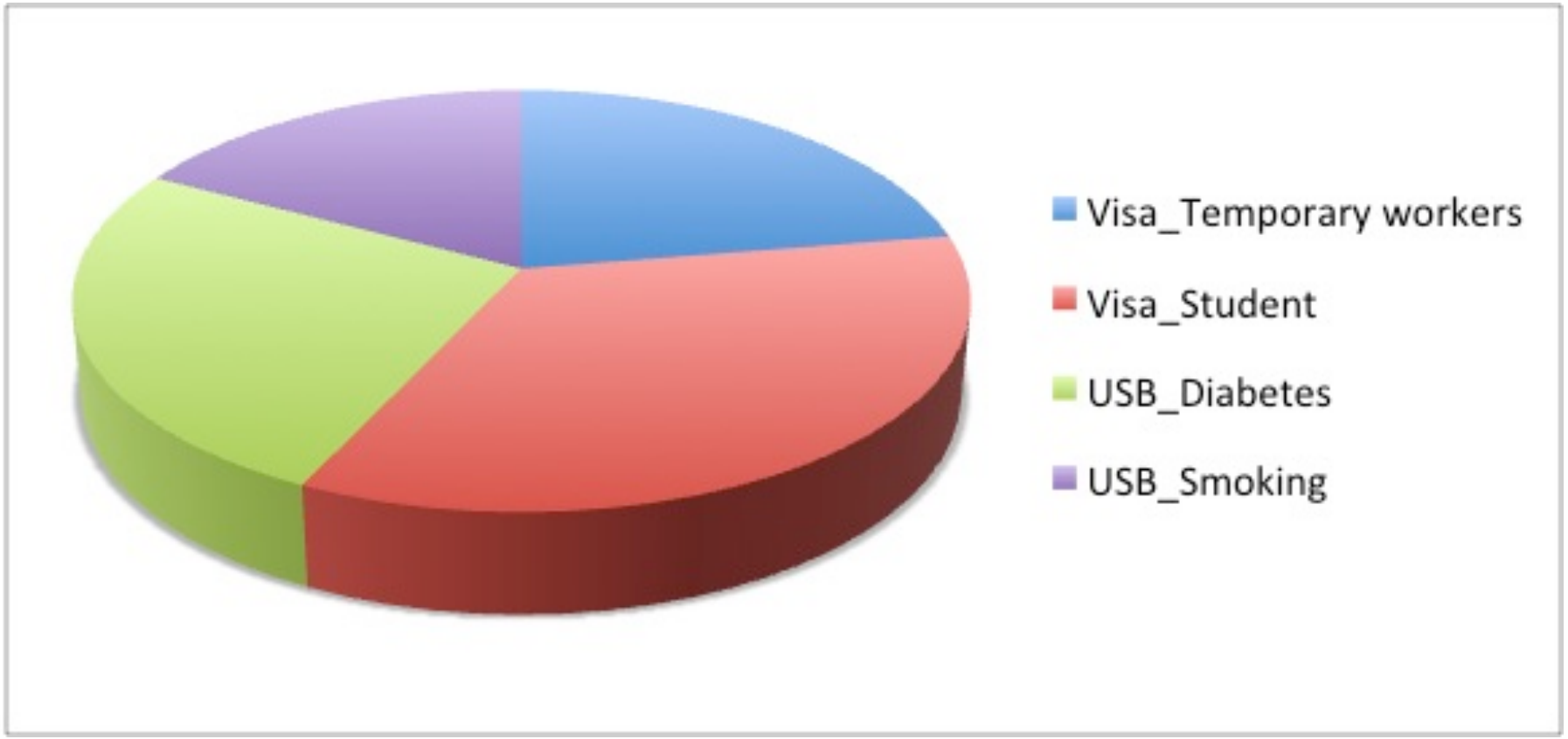
Largest population in LTBI state at 2030



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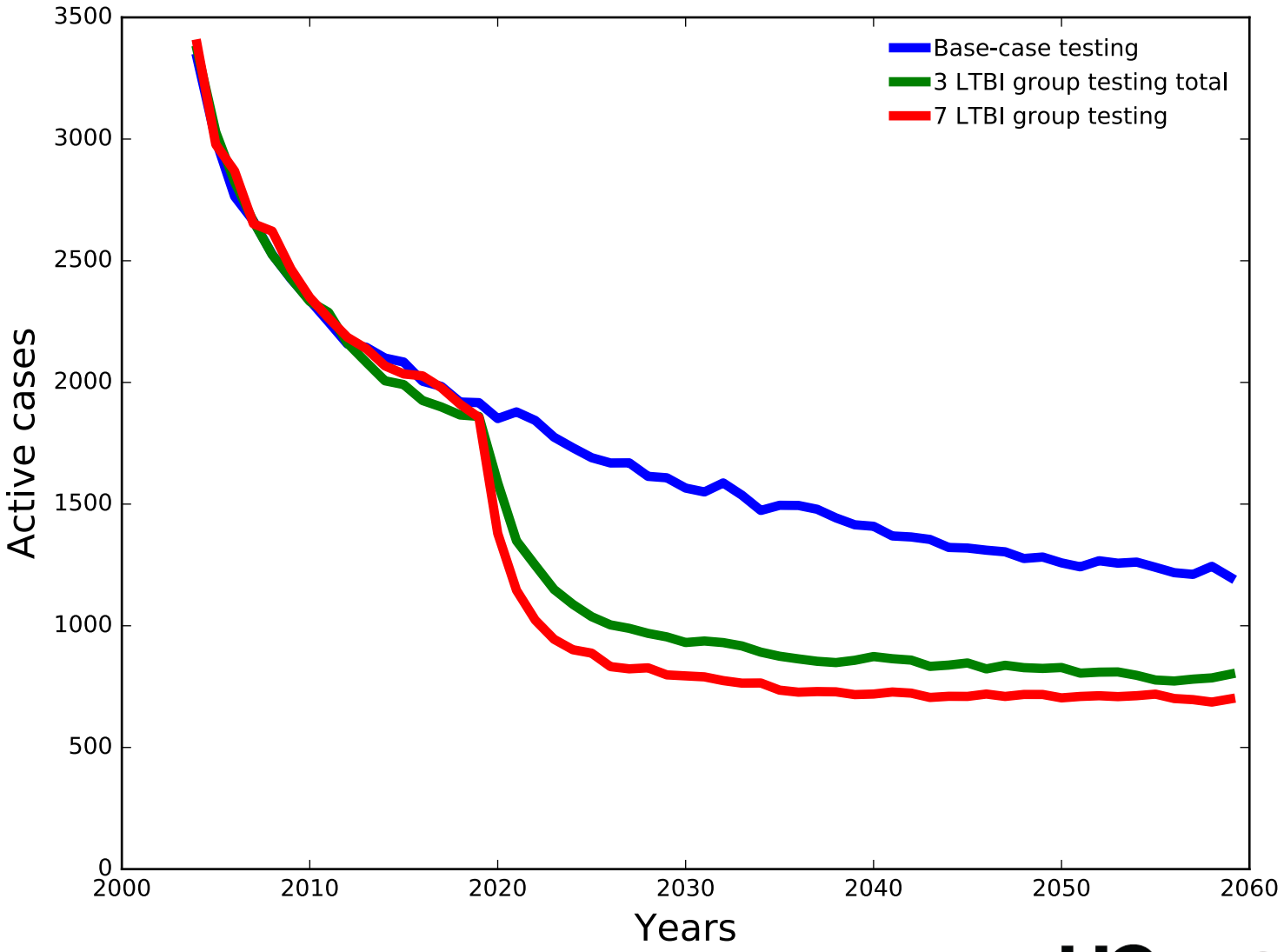
Comparing 3 and 7 targeted LTBI population results



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Comparing 3 and 7 targeted LTBI population with Fb4x and FB 10x and the number of test

Limitations

- Lack of control data tend to uncertainty in parameter estimation.
- Small sample sizes make projections challenging in an Individual based stochastic model
- Population projections past 2014 carry significant uncertainty
- Base case testing uptake may be an overestimate
- Modeled only >= 15 years old
- Did not model undocumented
- Inter-person transmission does not account for geography or households

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Overview and Conclusion

- Individual model based on Markov chain process
  .Pros: Having so many parameter for better modeling
  .Cons: Increasing uncertainty
- Using numerical algorithm for calibration (MCMC)
- Capable for having as many as demographic and biomedical attributes:
  .Better and more accurate modeling
  .Better TTT design
- Capable of extension for more than one state/region, by having initial information of new regions.

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Future work

- More TTT designs:
- With high prevalence testing, most of the pre-infected people are tested.

- With Universal on arrival, new immigrants are tested, so the initializing to LTBI is been covered.

- The transition to LTBI happen based on new active cases, with more weight on being in same community (in our model, its based on race and being foreign or US born), so maybe having only Universal on Arrival testing and community based testing can have better effect.

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