# TUBERCULOSIS: IDENTIFYING OPPORTUNITIES FOR TB PREVENTION, JANUARY 7, 2026

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# BACKGROUND

# WHAT IS TUBERCULOSIS?

- An airborne, contagious disease caused by *Mycobacterium tuberculosis*
  - TB Infection, Latent TB Infection (LTBI)
  - TB Disease, Active TB

# ROBERT KOCH: DISCOVERY OF TB ORGANISM

- One of main founders of modern bacteriology
  - Established that germs could cause a specific disease
- *Bacillus anthracis (*1876)
- *Vibrio cholera* (1884)
- *Mycobacterium tuberculosis*
  - Announced discovery on March 24, 1882, observed by WHO as "World Tuberculosis Day" every year since 1982
- Nobel prize 1905 for research on TB,
  - Including discovery of tuberculin (later developed for TB diagnosis)

# TB: HISTORICAL KEY DATES

- 1882: discovery of organism causing TB (Koch)
- 1907: tuberculin developed into testing agent for diagnosing TB (von Pirquet)
- 1912: intradermal technique for tuberculin sensitivity test described (Mantoux)
- 1921: first human administration of Bacille Calmette-Guerin (BCG) vaccine
- 1934: development of purified protein derivative (PPD) of tuberculin (Seibert), enabling creation of reliable TB test
- 1944: discovery of use of first anti-TB treatment – streptomycin, soon followed by discovery of use of para-aminosalicyclic acid for TB treatment;
  - Later in 1940's: Learned that TB treatment more effective by combining the two drugs
- 1951: Isoniazid added to TB treatment regimen, creating first triple therapy for an infectious disease

# LTBI VS. PULMONARY TB DISEASE

## Latent TB Infection

- Test for TB infection* positive
- Chest x-ray negative
- No symptoms or physical findings suggestive of TB disease
- Respiratory specimens are negative
- Not contagious

## Pulmonary TB disease

- Test for TB infection* usually positive
- Chest x-ray may be abnormal
- Symptoms (may include: fever, night sweats, weight loss, fatigue, hemoptysis, decreased appetite)
- Respiratory specimens may be smear or culture positive
- May be contagious

*Tuberculin skin test (TST),
Interferon-γ Release Assay (IGRA)

# PERSONS AT RISK OF DEVELOPING TB DISEASE AFTER INFECTION

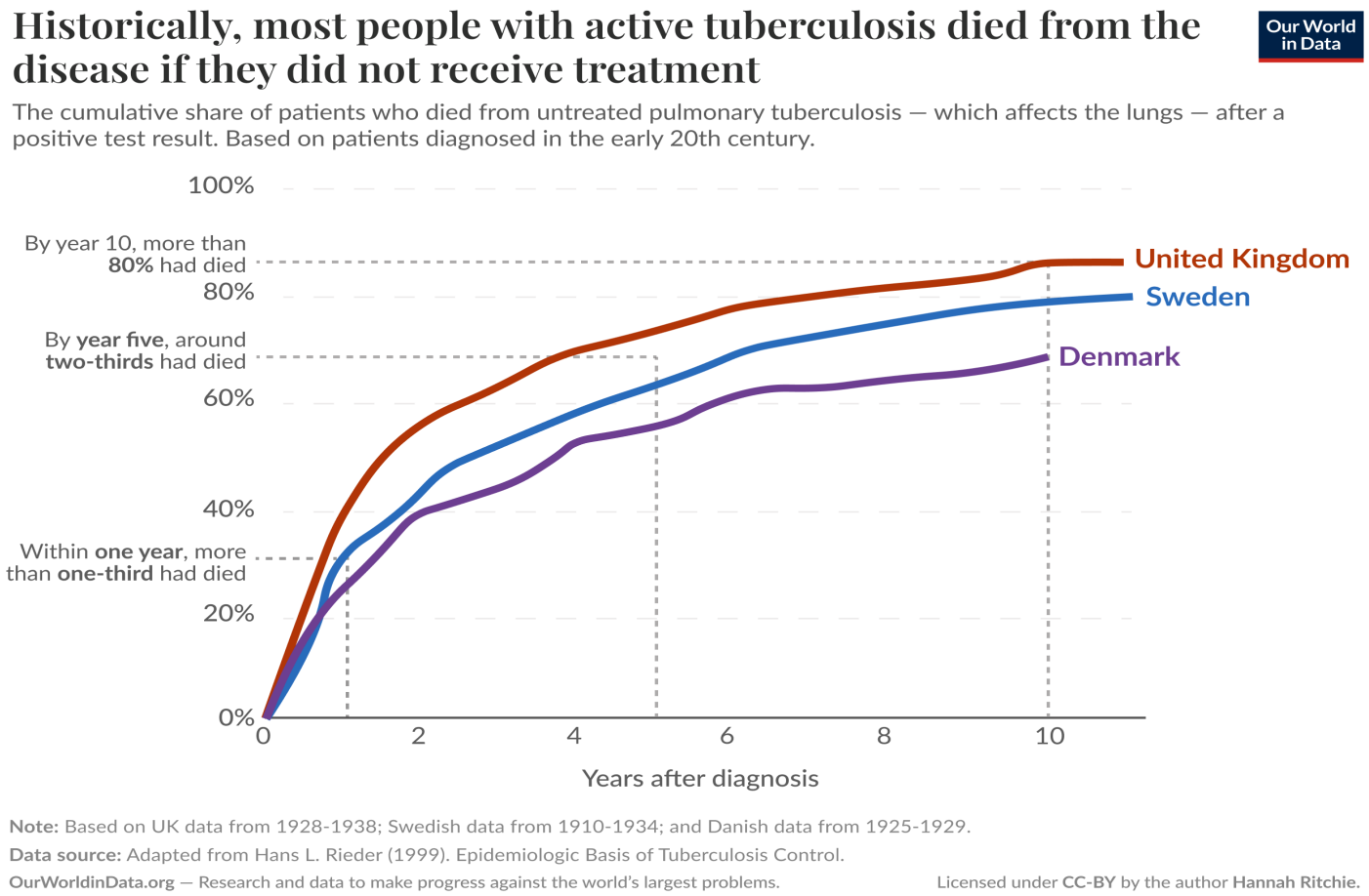
- Persons at highest risk for developing TB disease fall into 2 main categories:
  - Those who have been recently infected
  - Those with clinical conditions that increase their risk of progressing from LTBI to TB disease

# PATHOGENESIS: RISK OF DEVELOPING TB DISEASE WITHOUT TREATMENT

- 10% of persons with normal immune systems develop TB disease at some point in life
  - 5% within the first 2 years after infection; 5% sometime later in life
- HIV strongest individual risk factor for development of TB if infected
  - Risk of developing TB disease 7-10% **each year**
- Diabetes is the strongest population risk factor for development of TB disease if infected
  - About 30% over a lifetime
- Certain other medical conditions also increase risk that TB infection will progress to TB disease

# TB DISEASE OUTCOMES

- Without proper treatment, most people with TB disease die
- Around one-quarter of people spontaneously recovered from the disease; unclear why some respond more positively than others
- Today in U.S., with proper treatment readily available, 5-10% of people with TB disease die



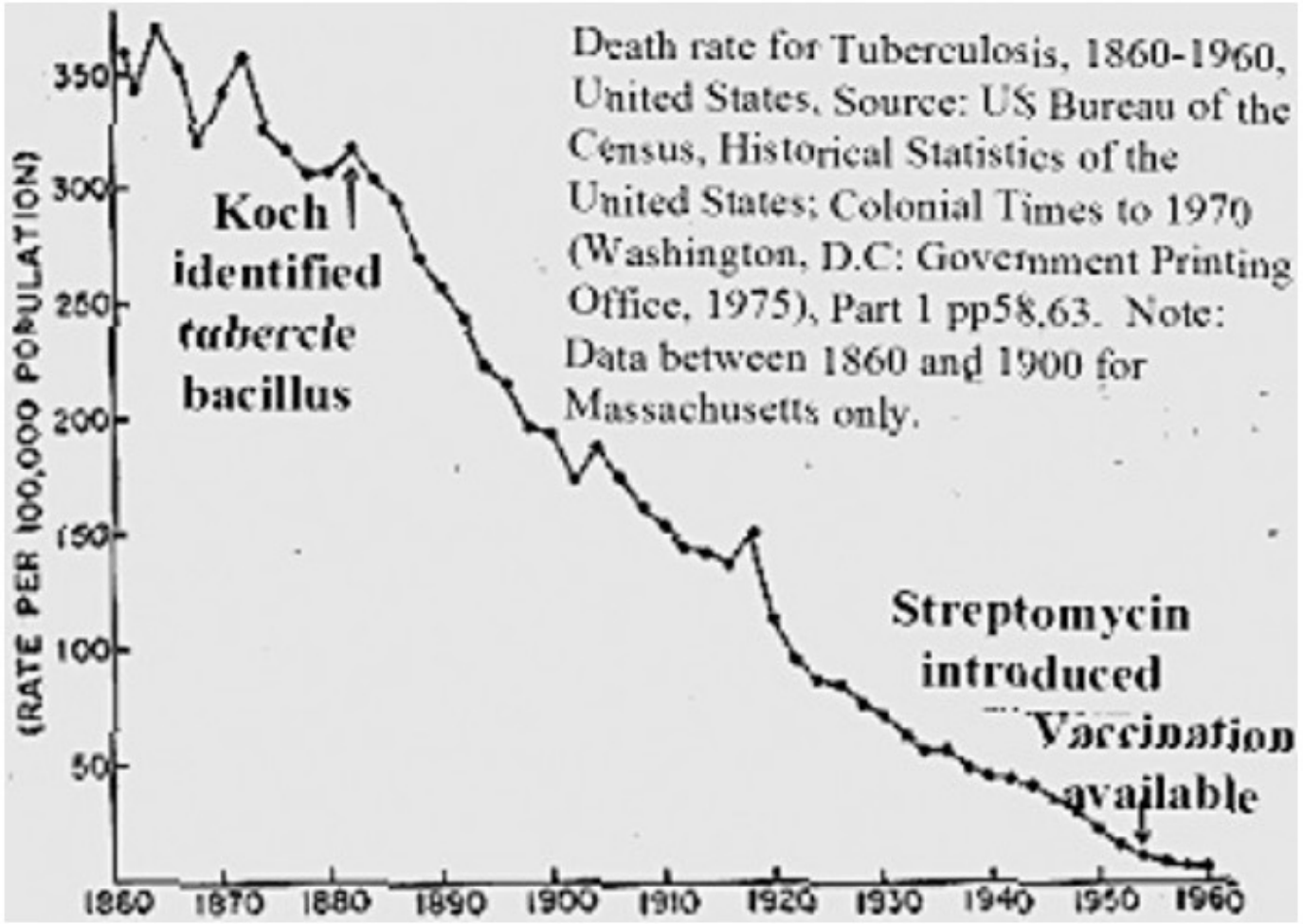
# BACILLE CALMETTE-GUERIN (BCG) VACCINE

- Only vaccine available today: currently used primarily in TB high-burden countries
- Used for more than 100 years with astonishing safety record; efficacy remains controversial
- 1950s: major trials set up to evaluate efficacy by UK's Medical Research Council and by US's Public Health Service using two different BCG strains:
  - UK study: a Copenhagen strain BCG, given to tuberculin negative 13-year-olds, was highly efficacious against tuberculosis
  - US study: Tice strain, given to tuberculin negatives of various ages, provided little or no protection
  - Based on these results, BCG recommended as a routine for tuberculin-negative adolescents in UK, whereas BCG was not recommended for routine use in US but restricted to certain high-risk populations
  - Majority of world followed lead of Europe and WHO and introduced routine BCG vaccination according to various schedules (e.g., at birth, school entry, school leaving)
  - Netherlands and **US** decided against routine BCG use and **based their TB control strategy upon contact tracing and use of tuberculin to identify individuals for preventive therapy.**

# TB EPIDEMIOLOGY

# TB: HISTORICAL US DEATH RATE

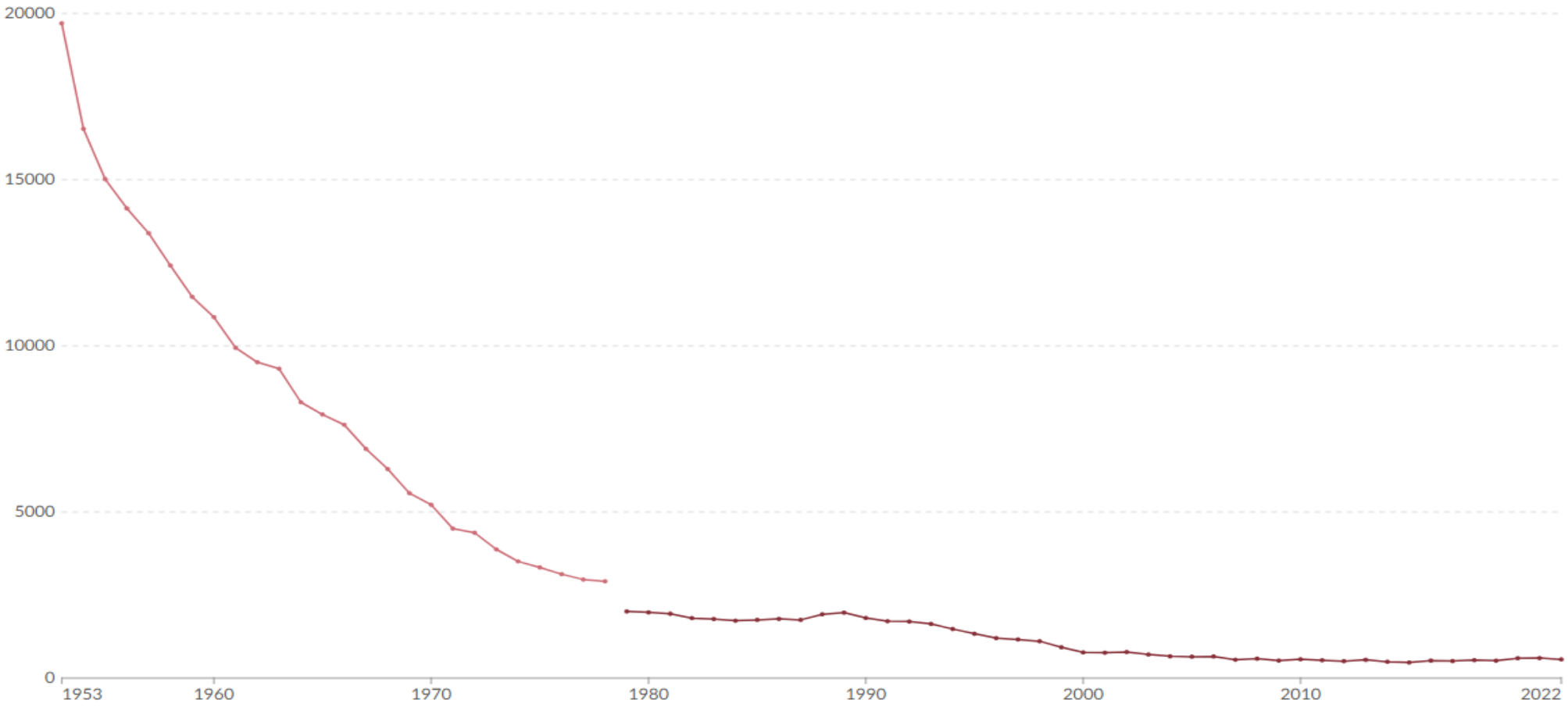
- TB disease was responsible for as many as 1/4 of all deaths in the US and Europe during parts of the 18th and 19th centuries



# Tuberculosis deaths in the United States, 1953 to 2022

Our World in Data

Table | Line | Bar



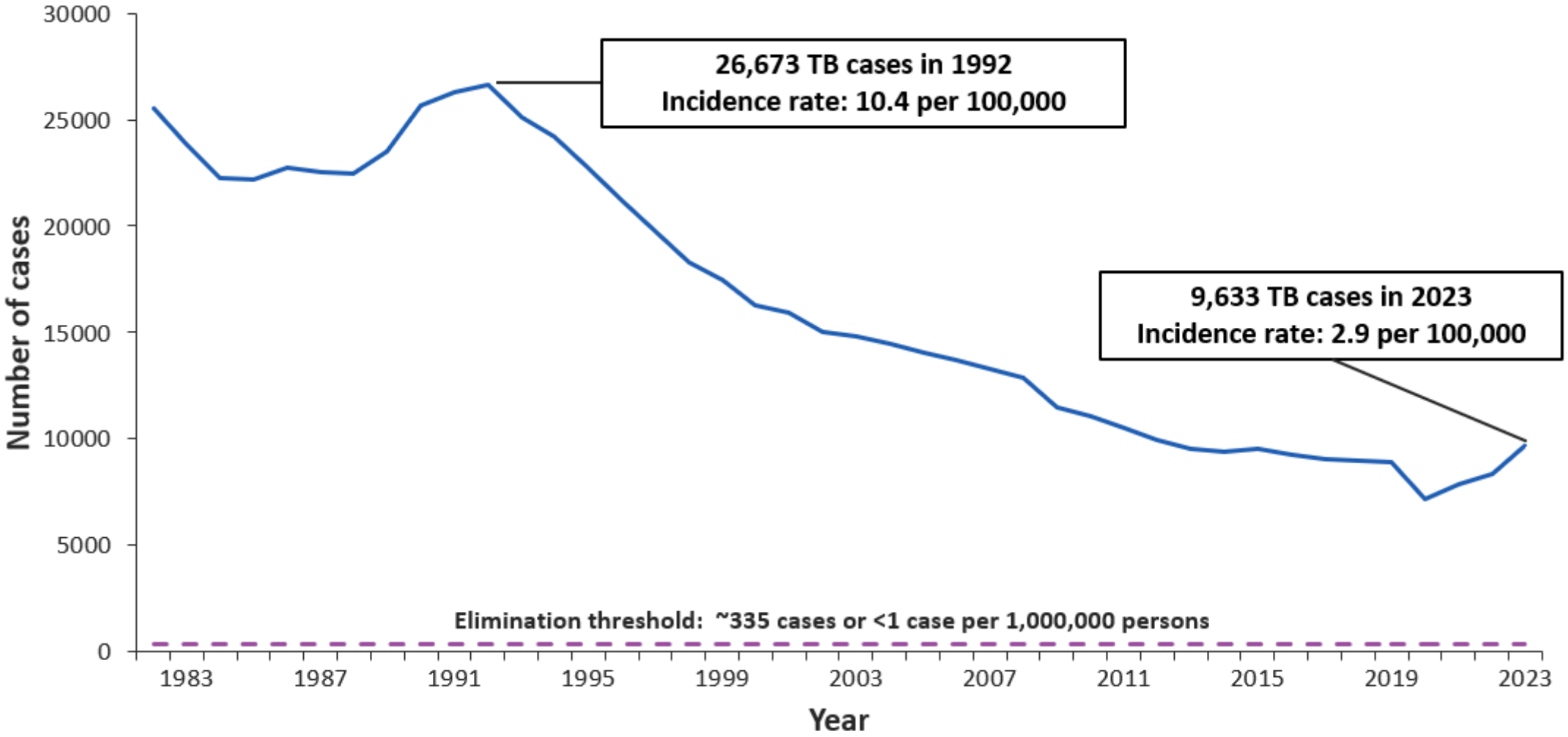

Play time-lapse 1953 2022

**Data source:** U.S. Centers for Disease Control and Prevention (2024) – Learn more about this data

**Note:** A methodological change from the source explains the step-change in deaths in 1979; late effects of tuberculosis and pleurisy with effusion were no longer included in tuberculosis deaths.

OurWorldinData.org/tuberculosis | CC BY

# Progress Towards TB Elimination, United States, 1982–2023



# TB PROBLEM

## World

- 2 billion infected (approx. 25% w/ LTBI)
- 10.7 million new disease cases (2024)
- Incidence rate (new disease cases): 131/100,000 (2024)
- 1.23 million deaths (2024): world's leading cause of death from single infectious agent

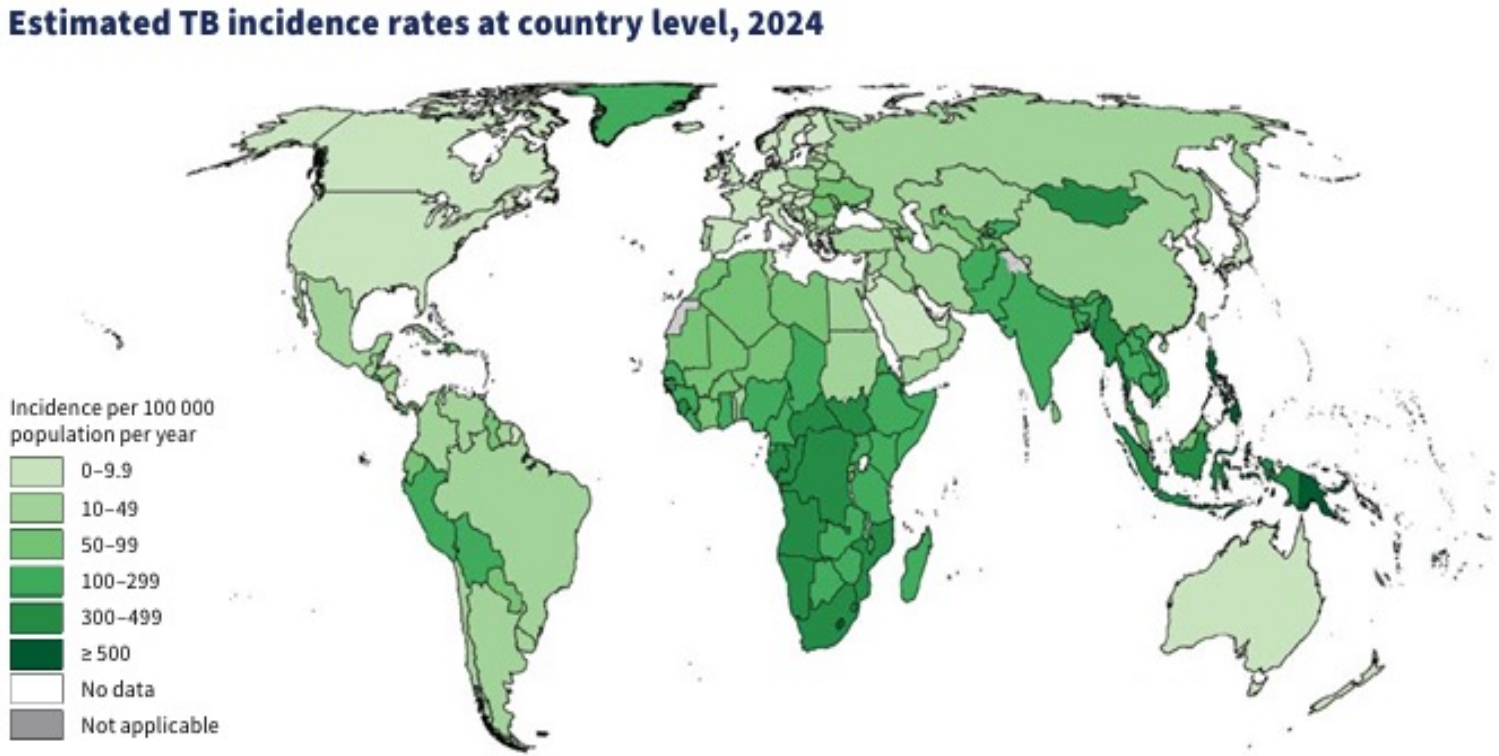
## United States

- 13 million infected
- 10,347 new disease cases (2024, provisional data)
- Incidence rate: 3.0/100,000 (2024, provisional data)
- 565 TB-related deaths (2022)

## California

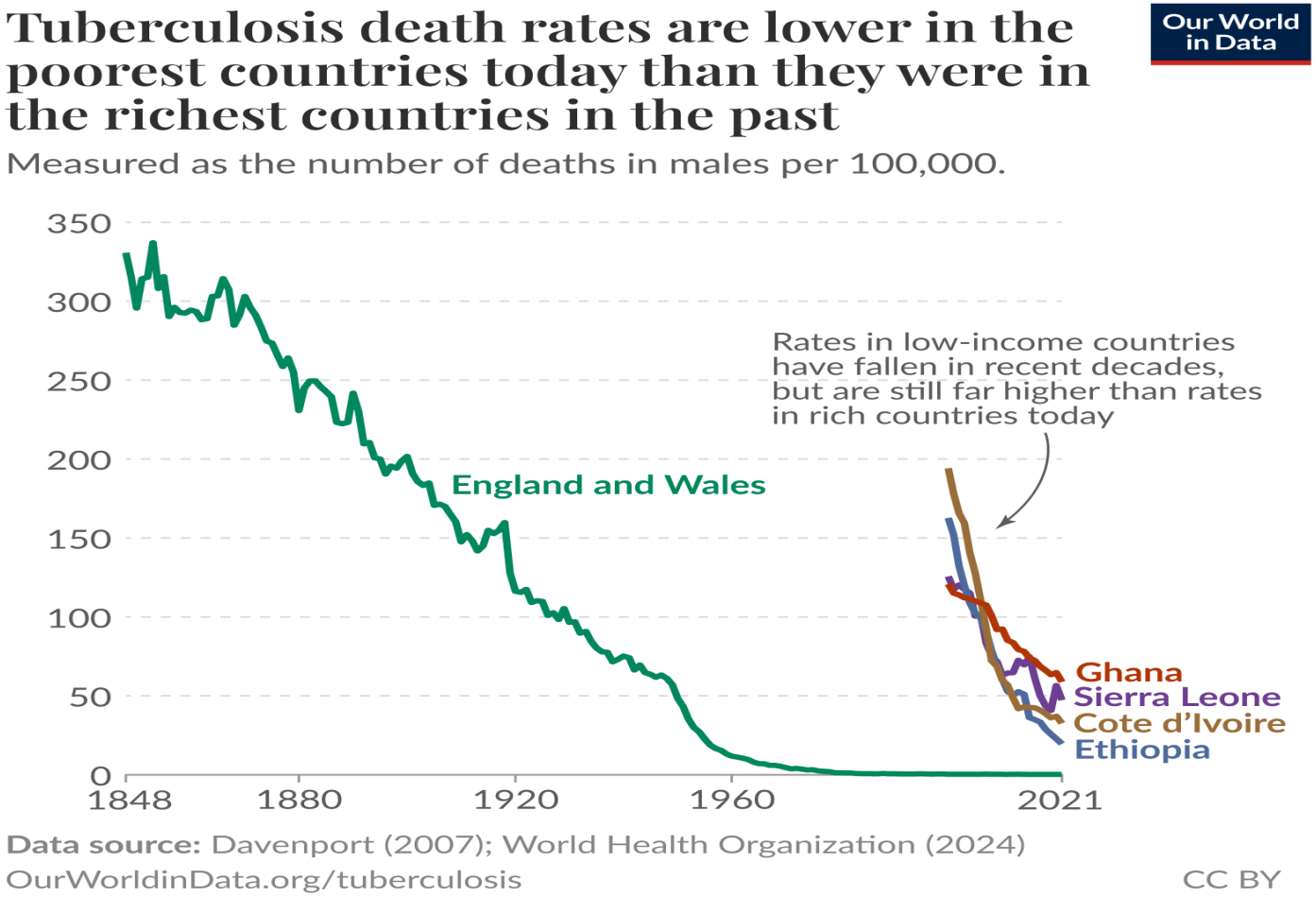
- 2 million infected (approx. 6% with LTBI)
- 2,109 new disease cases (2024)
- Incidence rate 5.4/100,000 (2024)
- 258 TB-related deaths (2022)

# ESTIMATED TB INCIDENCE RATES AT COUNTRY LEVEL, 2024

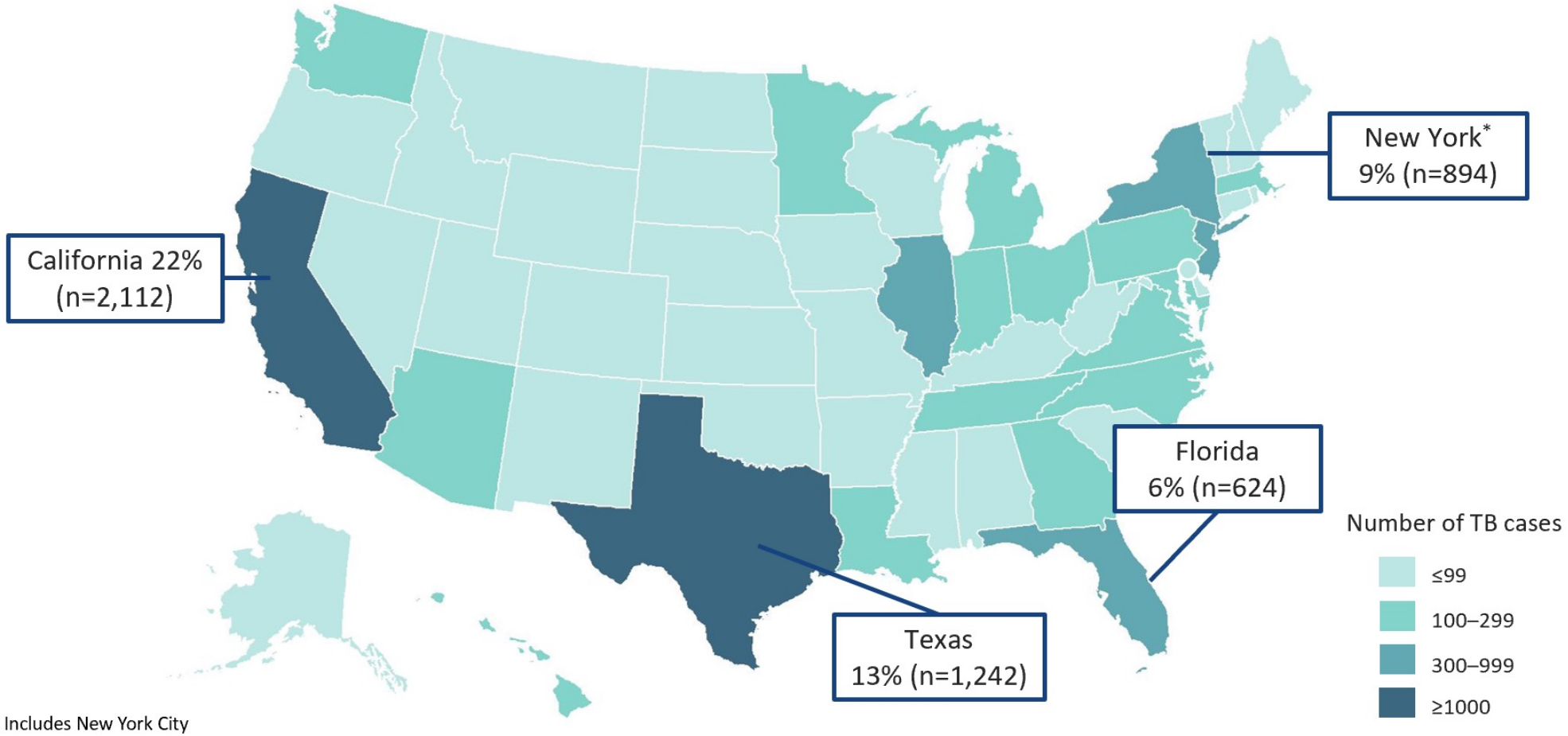


# COMPARISON OF TB DEATH RATES, HISTORICAL PERSPECTIVE

- Can progress in TB in the US and Europe be replicated elsewhere?
- Low-income countries have already made progress
- TB death rates in the US and UK were far higher in the past then they are today in some of the worst-off countries

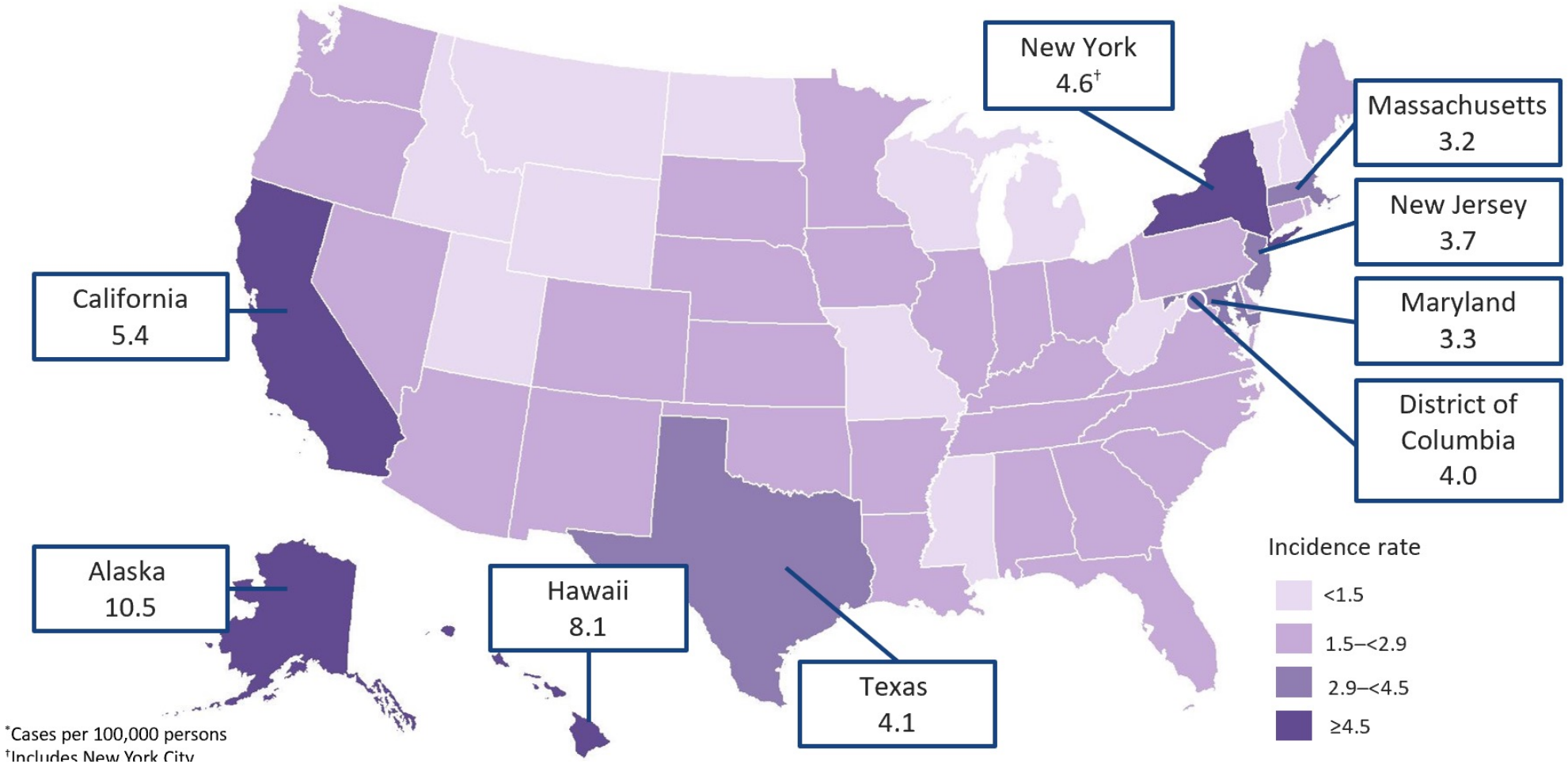


# TB Cases and Percentages by Reporting Area, United States, 2023 (N=9,633)



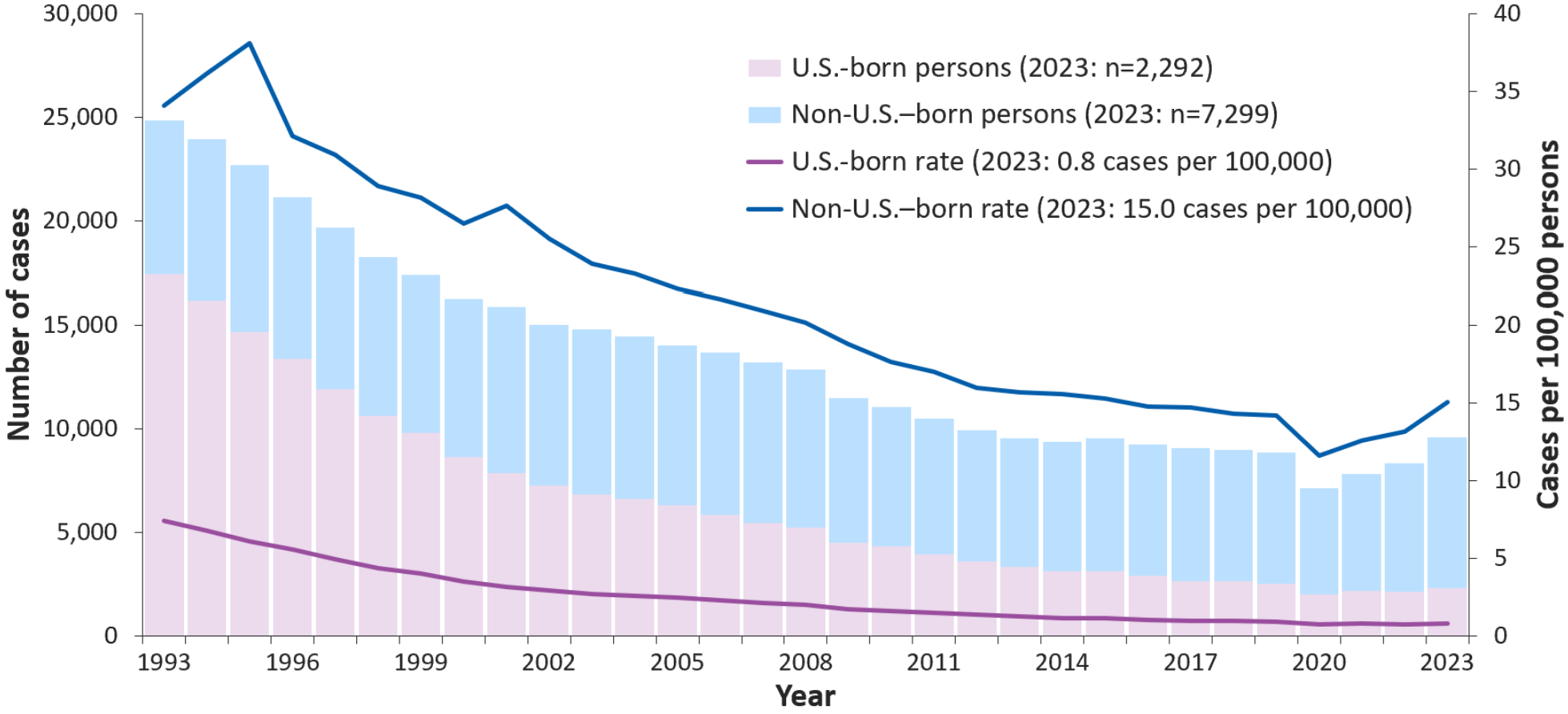

* Includes New York City

# TB Incidence Rates* by Reporting Area, United States, 2023




*Cases per 100,000 persons
†Includes New York City

# TB Cases and Incidence Rates by Origin of Birth,* United States, 1993–2023




*Persons born in the United States, certain U.S. territories, or elsewhere to at least one U.S. citizen parent are categorized as U.S.-born. All other persons are categorized as non-U.S.–born

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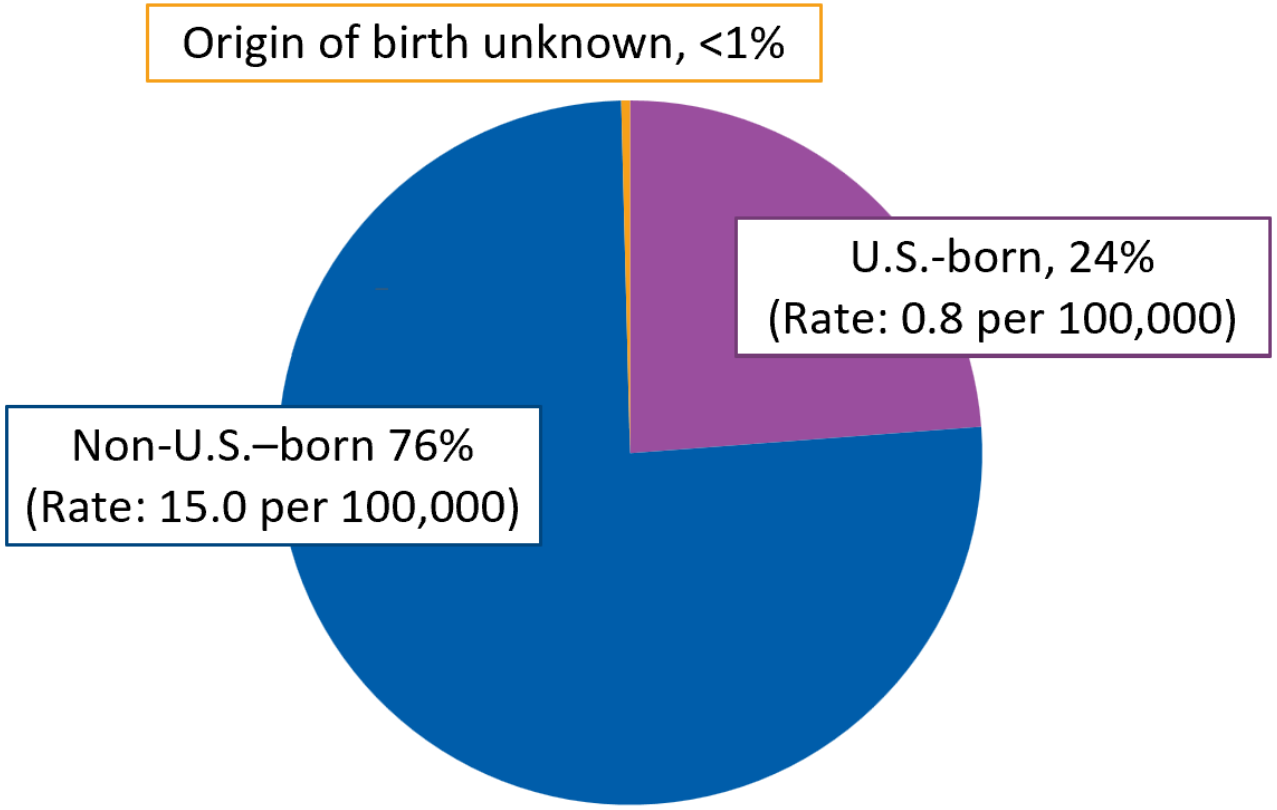
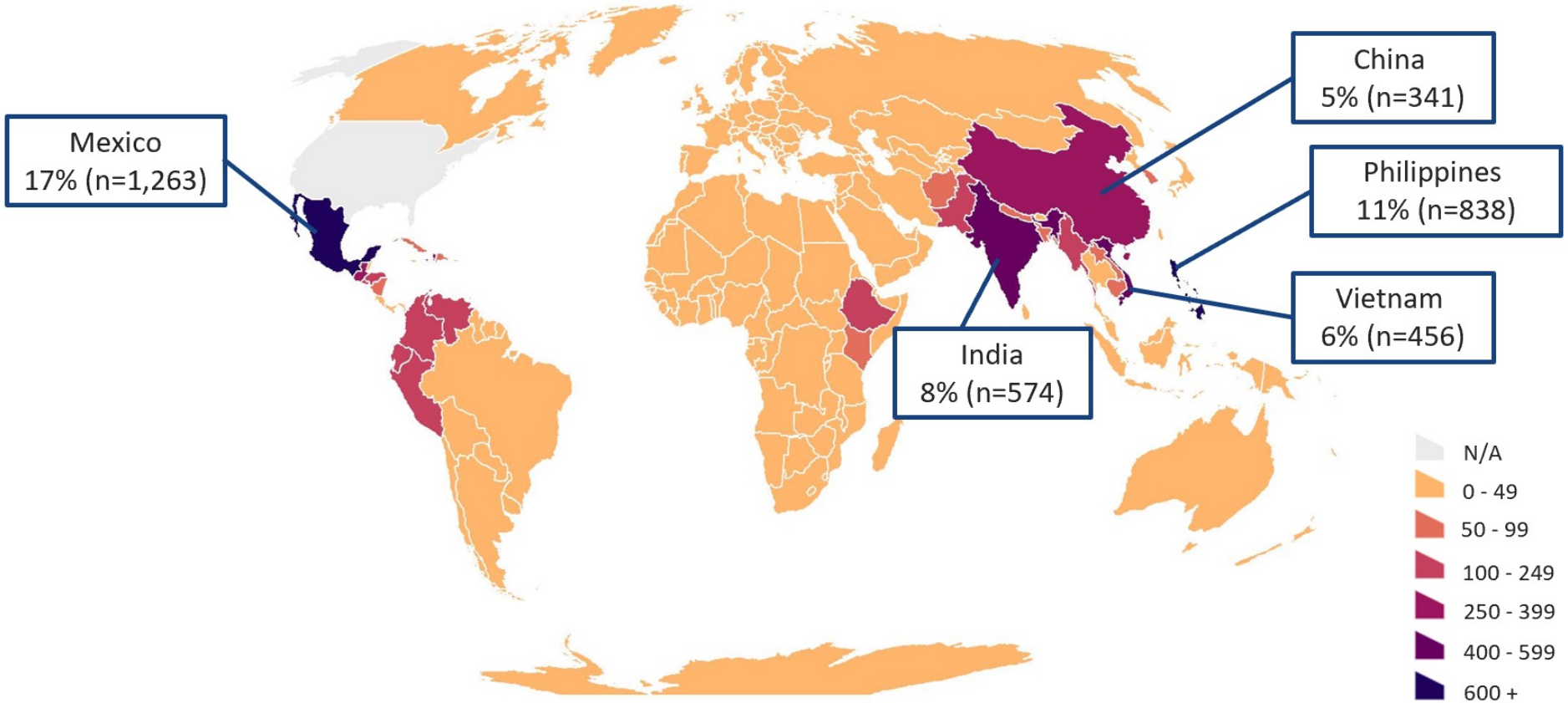


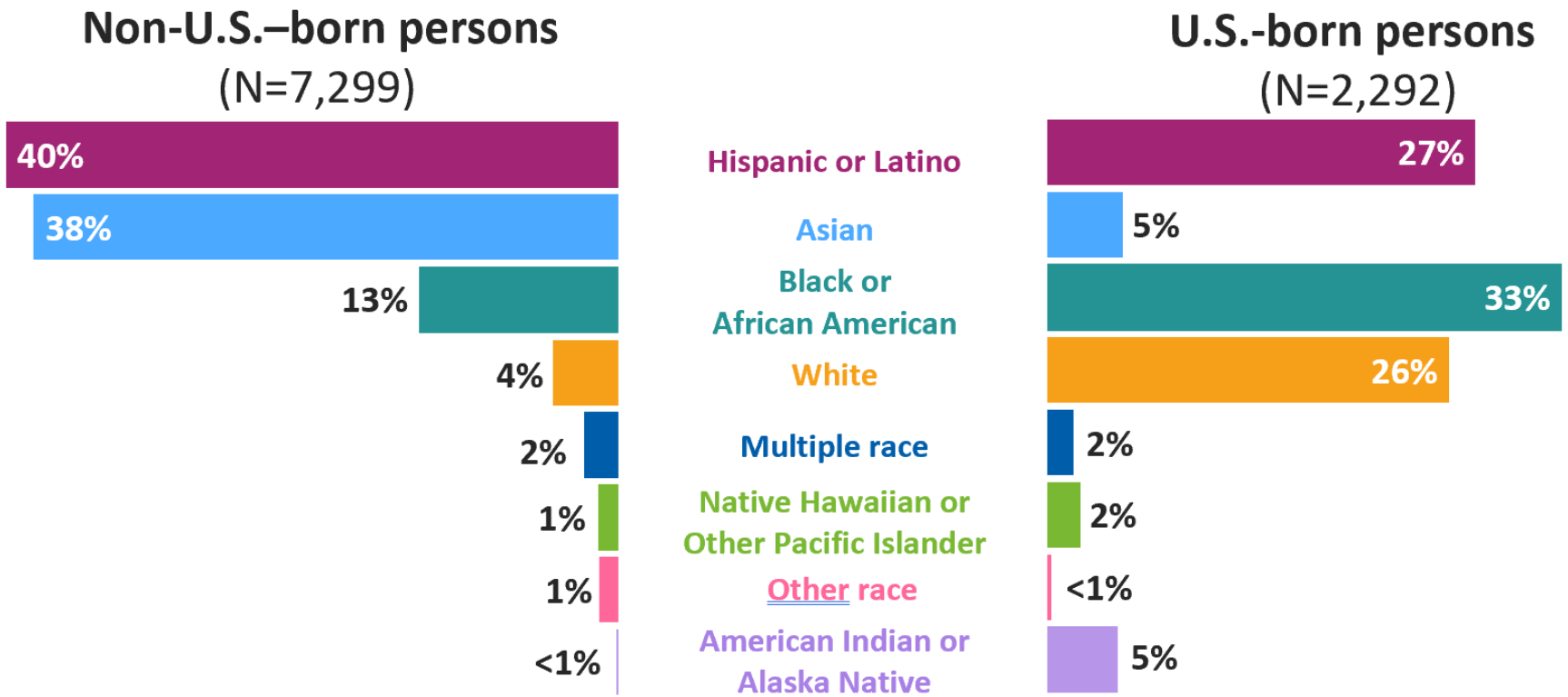

*Persons born in the United States, certain U.S. territories, or elsewhere to at least one U.S. citizen parent are categorized as U.S.-born. All other persons are categorized as non-U.S.–born.

# TB Cases by Countries of Birth Among Non-U.S.–Born* Persons, United States, 2023 (N=7,299)



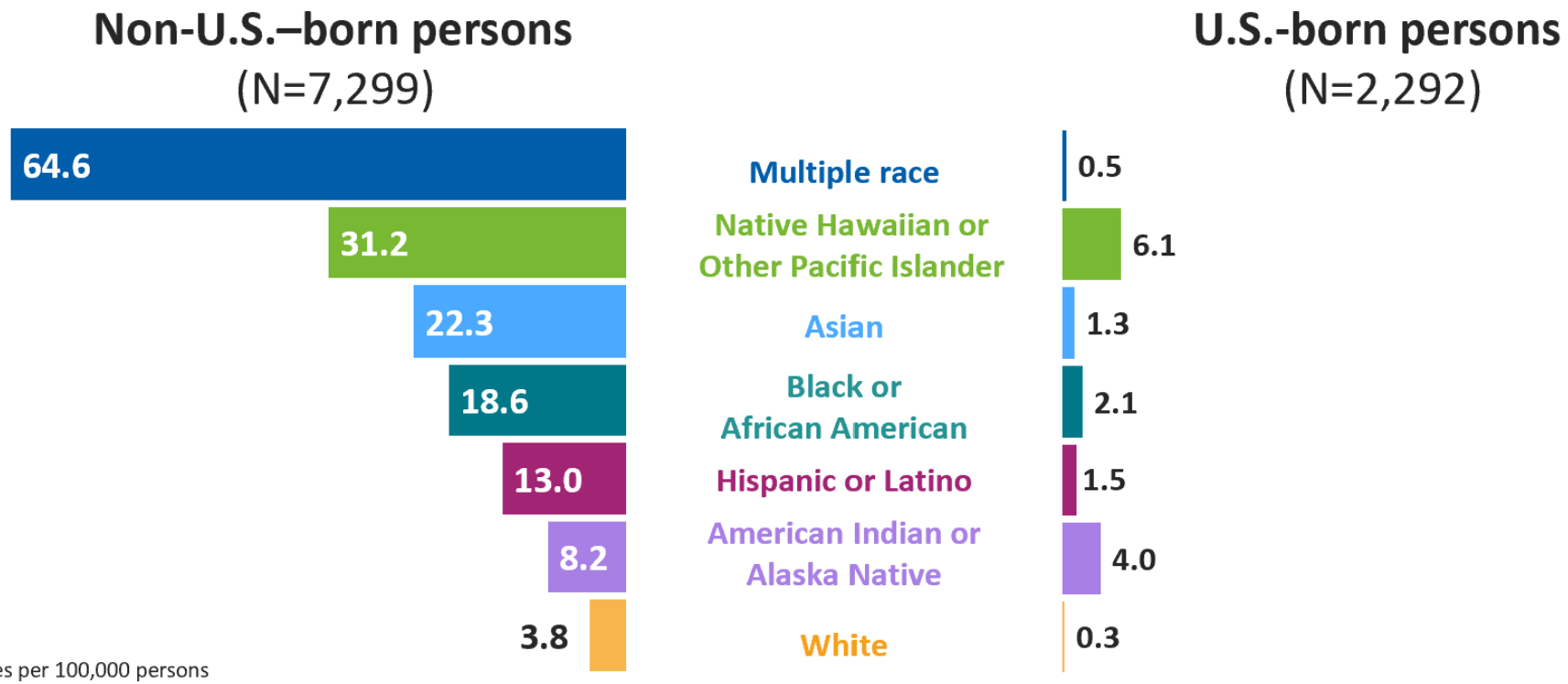

*Persons born in the United States, certain U.S. territories, or elsewhere to at least one U.S. citizen parent are categorized as U.S.-born. All other persons are categorized as non-U.S.–born.

# Percentage* of TB Cases by Origin† and Race/Ethnicity,§ United States, 2023




*Percentages are rounded.
†Persons born in the United States, certain U.S. territories, or elsewhere to at least one U.S. citizen parent are categorized as U.S.-born. All other persons are categorized as non-U.S.–born.
§Persons who identified as Hispanic or Latino were categorized as "Hispanic," regardless of self-reported race. Persons who did not identify as Hispanic or Latino were categorized by self-reported race; if more than one race was reported, the person was categorized as "Multiple race."

# TB Incidence Rates* by Origin† and Race/Ethnicity,§ United States, 2023




*Cases per 100,000 persons

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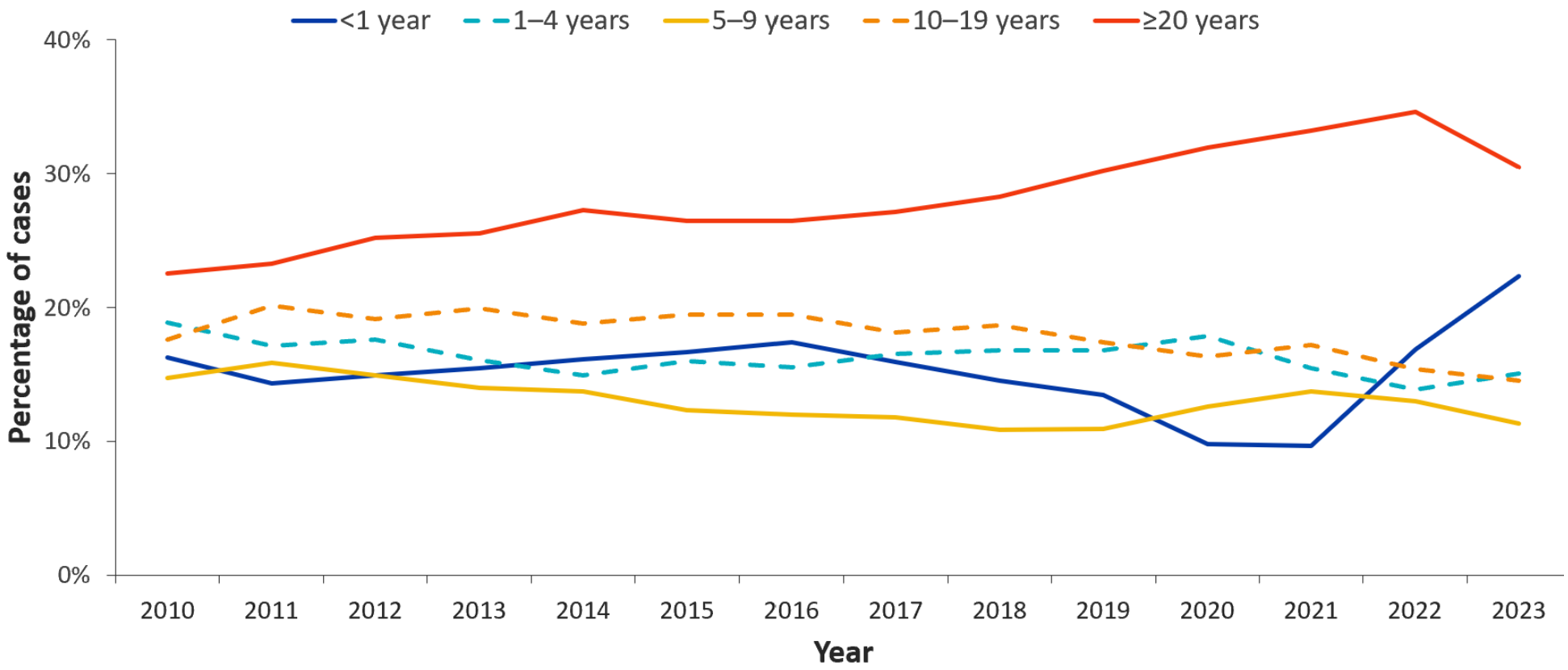
Note: The increase in numbers and percentages of persons identified as "Multiple race" might be related to changes in processing and transmission of race data for 2023 cases as compared to previous years.

# Percentage of TB Cases Among Non-U.S.–Born* Persons by Years in the United States Prior to Diagnosis, 2010–2023

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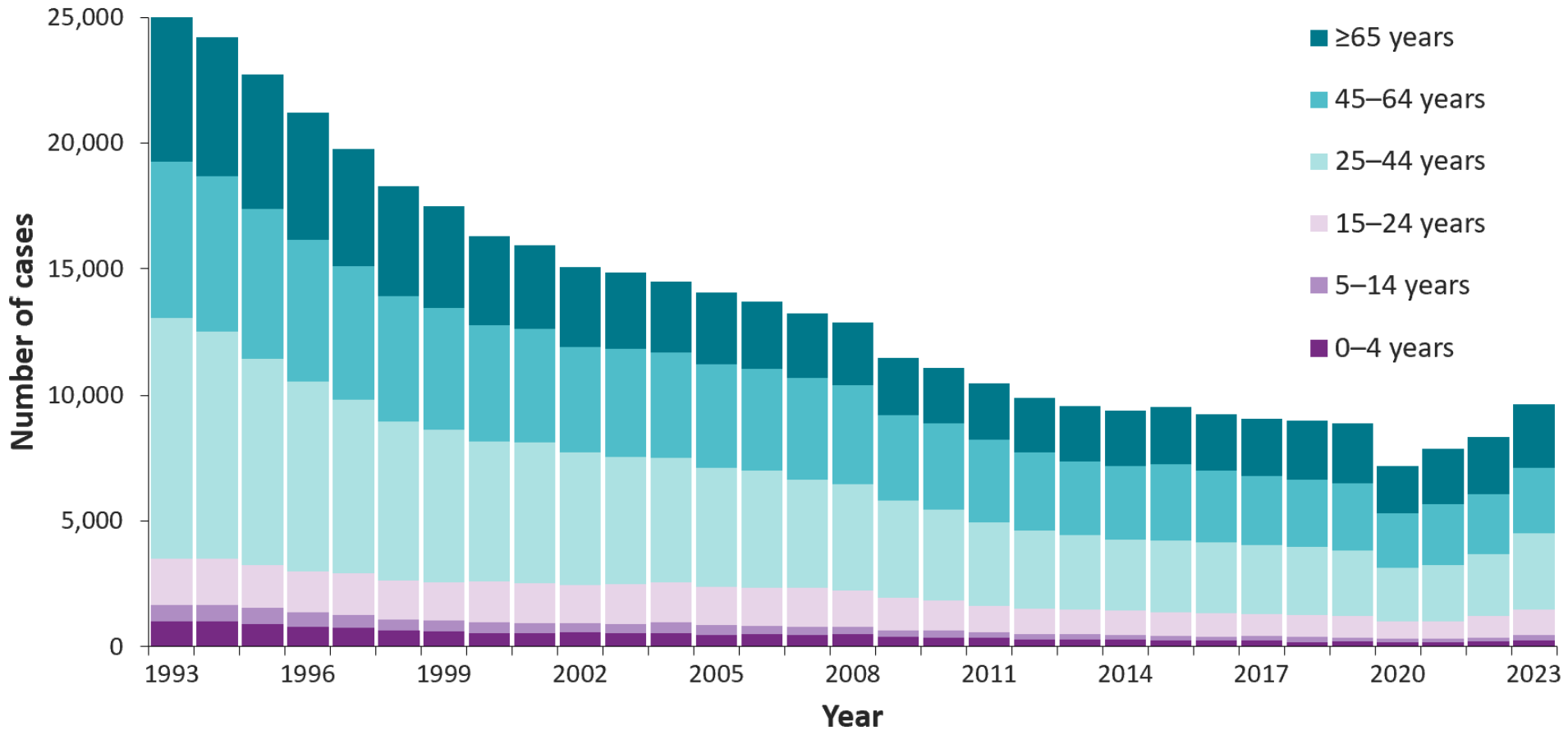
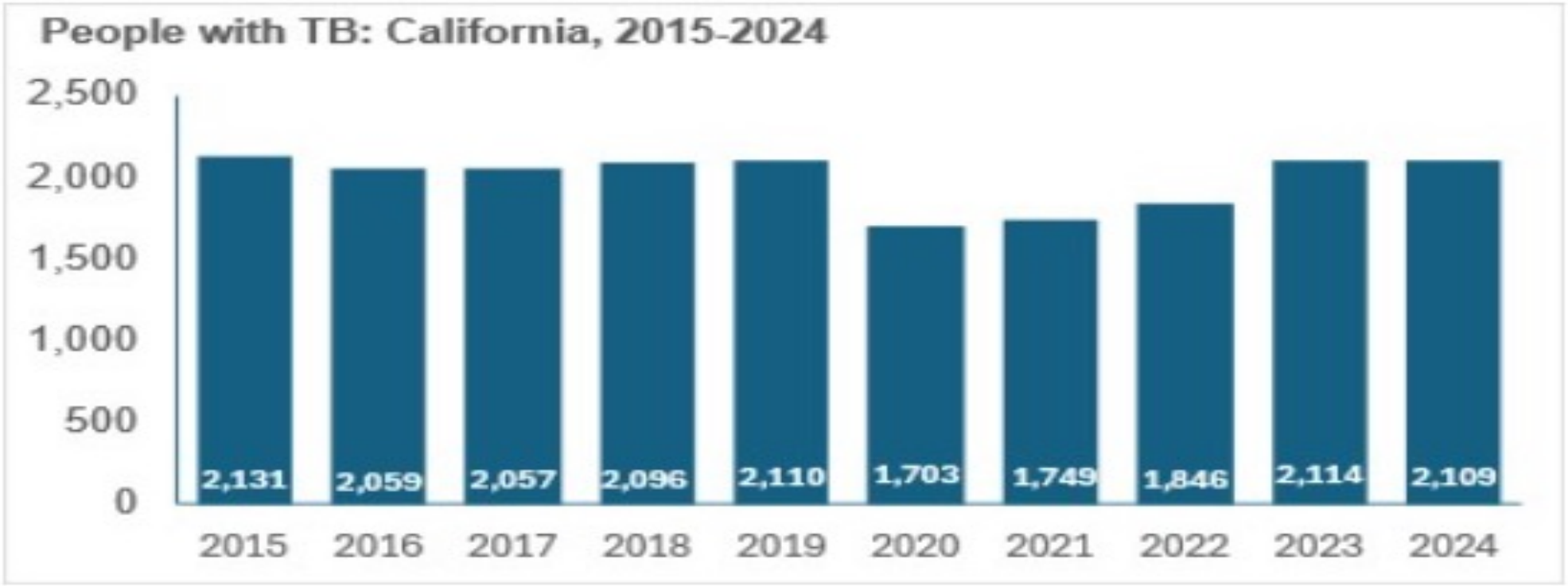
# TB Cases by Age Group, United States, 1993–2023

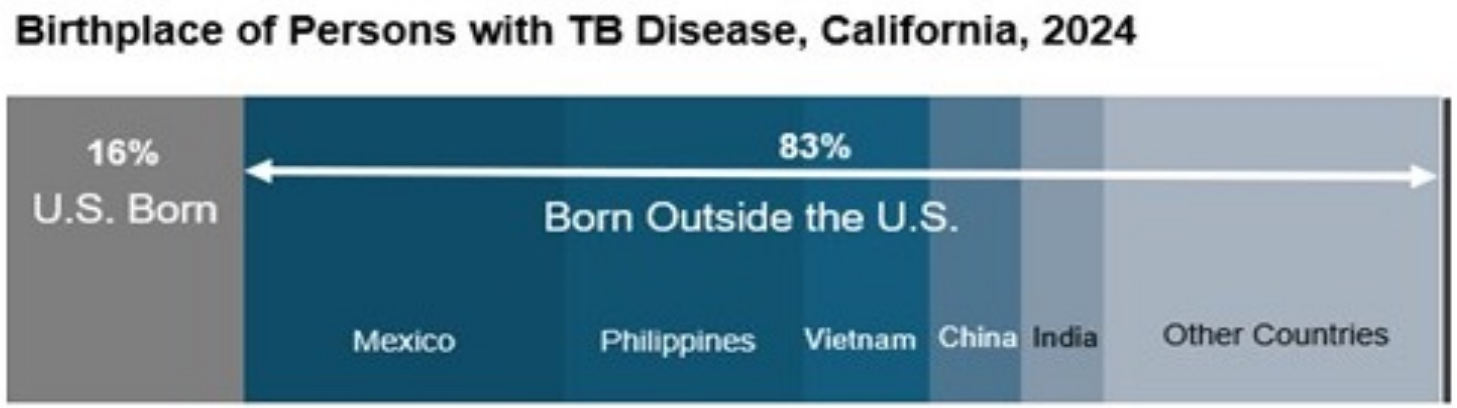


# TB: CA AND STANISLAUS COUNTY

# TB CASE NUMBERS IN CA

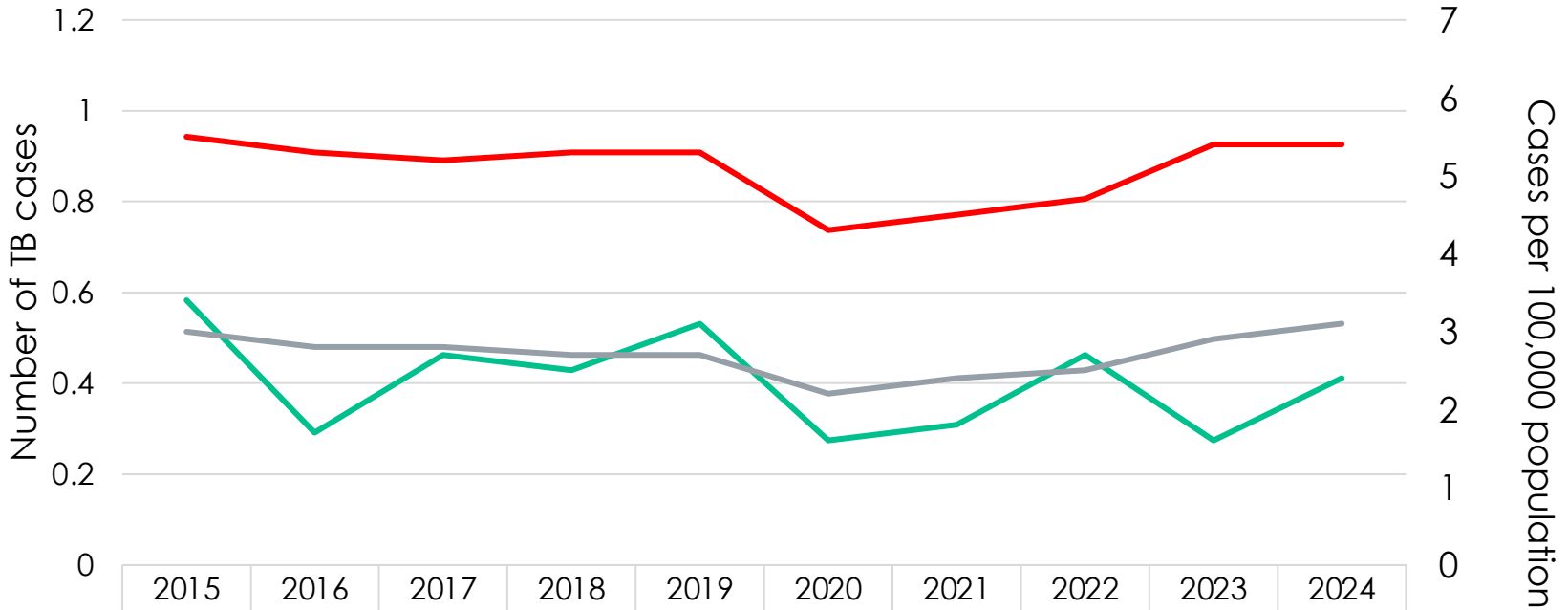


# PEOPLE BORN OUTSIDE OF US BEAR LARGEST TB BURDEN IN CA (2024 DATA)



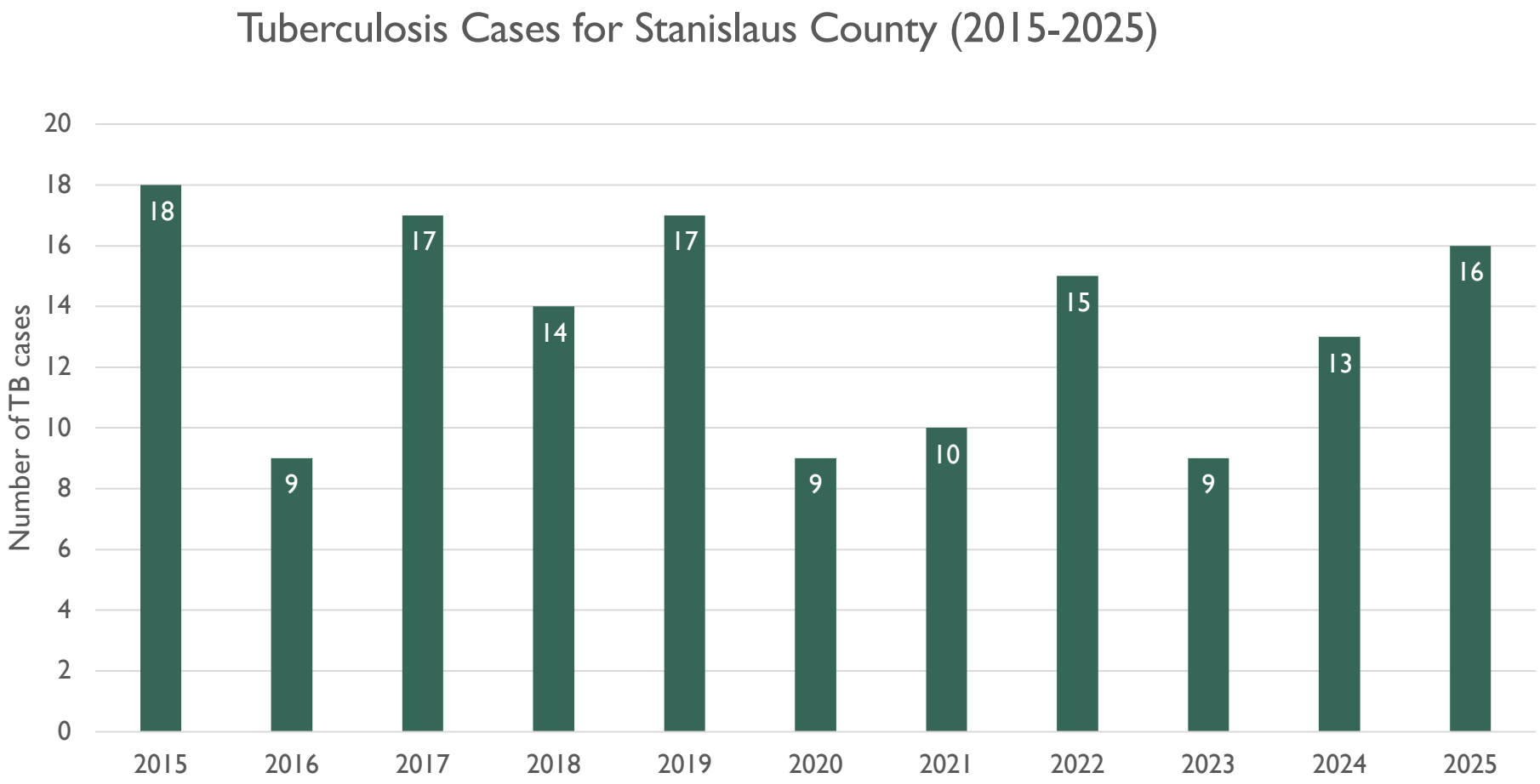

- TB rate of people born outside US (16.3/100,000) in CA was **14 times higher** than rate among US born persons (1.2/100,000)
- 70% of TB in people born outside the U.S. occurred more than 5 years after U.S. arrival; nearly half occurred more than 20 years after arrival.
- TB rate highest among people born in Philippines (41.8/100,000) and Vietnam (34.3/100,000), followed by India (21.0/100,000), China (16.5/100,000), and Mexico (12.2/100,000)

# Annual TB Disease Case Rates for Stanislaus County, California and U.S. (2015-2024)




| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Stanislaus Case Rate | 3.4 | 1.7 | 2.7 | 2.5 | 3.1 | 1.6 | 1.8 | 2.7 | 1.6 | 2.4 |
| California Case Rate | 5.5 | 5.3 | 5.2 | 5.3 | 5.3 | 4.3 | 4.5 | 4.7 | 5.4 | 5.4 |
| U.S Case Rate | 3.0 | 2.8 | 2.8 | 2.7 | 2.7 | 2.2 | 2.4 | 2.5 | 2.9 | 3.1 |

Stanislaus Case Rate  California Case Rate  U.S Case Rate


Tuberculosis Cases for Stanislaus County (2015-2025)
Number of TB cases
20
18
16
14
12
10
8
6
4
2
0
18
9
17
14
17
9
10
15
9
13
16
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

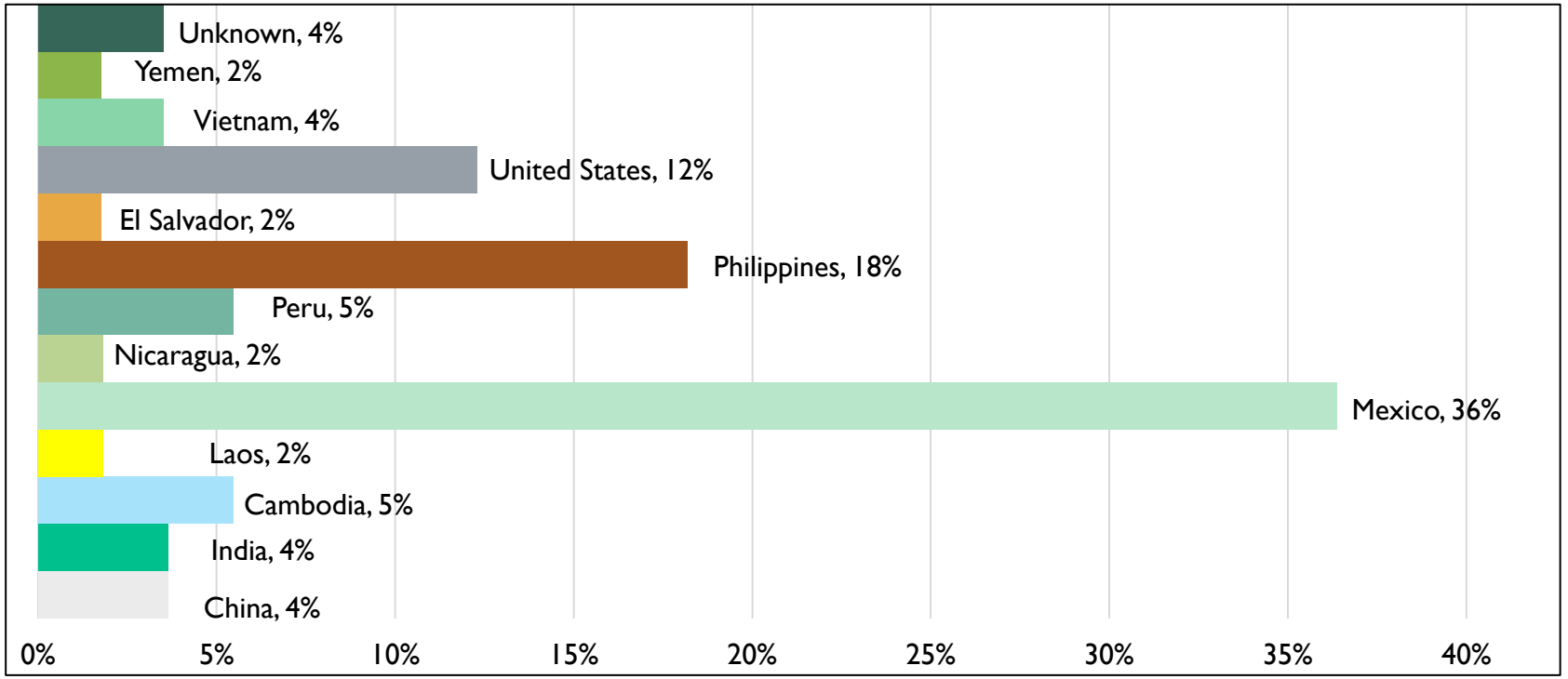
# TB cases by Site of Disease, Stanislaus County, 2022- 2025

| Site of Disease | Number of Cases | Percent of Cases |
|---|---|---|
| Pulmonary | 38 | 70% |
| Extrapulmonary | 8 | 15% |
| Both | 8 | 15% |

| TB Cases & Percentage by Gender and Age, Stanislaus County, 2022-2025 | | |
|---|---|---|
| | Case Count | Percentage |
| **Sex** | | |
| **Female** | 22 | 37% |
| **Male** | 38 | 63% |
| **Age Group** | | |
| **15- 24** | 4 | 7% |
| **25- 34** | 4 | 7% |
| **35- 44** | 5 | 8% |
| **45- 54** | 12 | 20% |
| **55- 64** | 11 | 18% |
| **65+** | 24 | 40% |

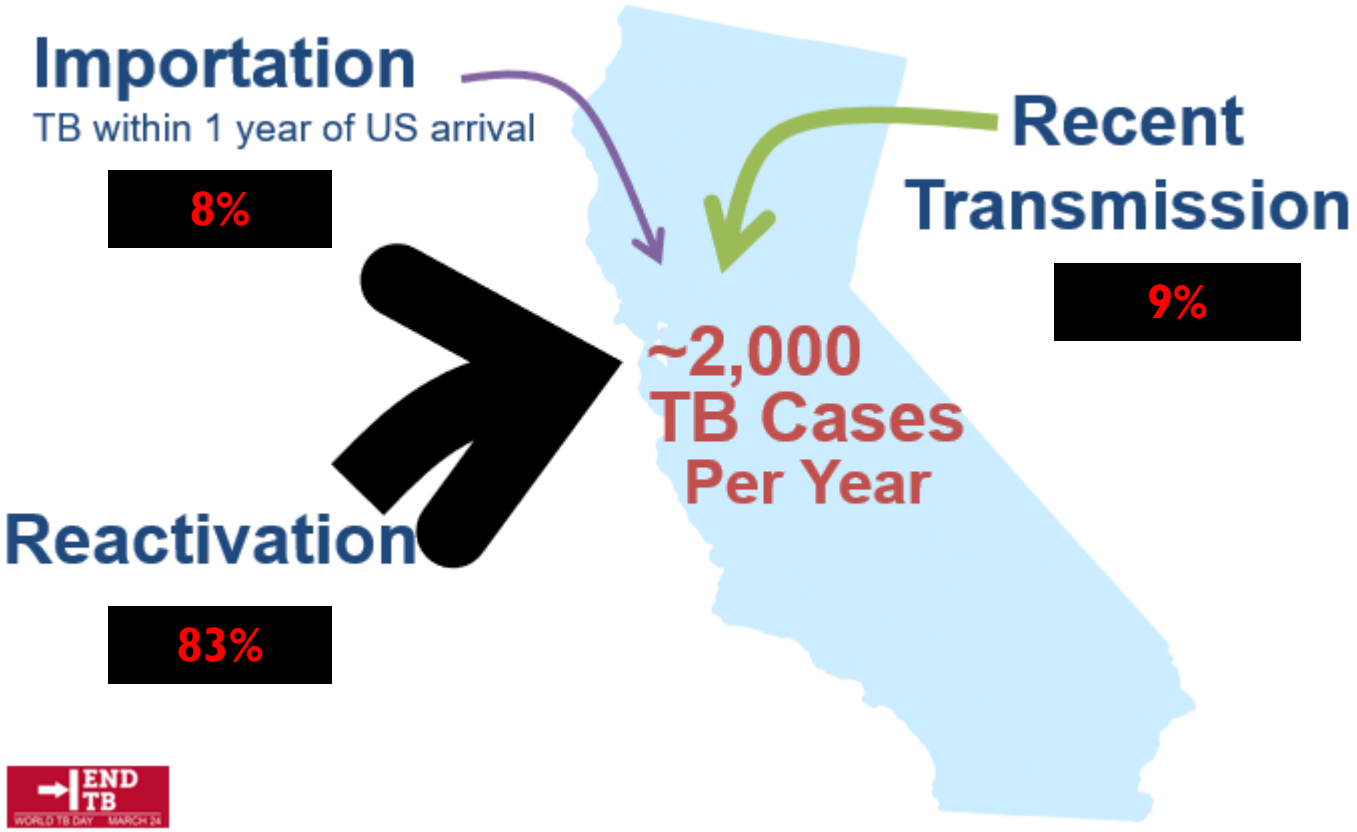
| TB Cases & Case Rates by City of Residence, Stanislaus County, 2022-2025 | | | |
|---|---|---|---|
| | Case Count | Percentage | Case Rate per 100,000 |
| **Ceres** | 4 | 8% | 8.1 |
| **Modesto** | 33 | 66% | 15.1 |
| **Newman** | 1 | 2% | 8.3 |
| **Patterson** | 3 | 6% | 12.1 |
| **Riverbank** | 2 | 4% | 8.0 |
| **Salida** | 2 | 4% | 33.3 |
| **Turlock** | 5 | 10% | 7.0 |

# TB CASES BY COUNTRY OF BIRTH, STANISLAUS COUNTY, 2022-2025




| Country | China | India | Cambodia | Laos | Mexico | Nicaragua | Peru | Philippines | El Salvador | United States | Vietnam | Yemen | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cases | 2 | 2 | 3 | 1 | 20 | 1 | 3 | 10 | 1 | 7 | 2 | 1 | 2 |
| Percentage | 4% | 4% | 5% | 2% | 36% | 2% | 5% | 18% | 2% | 12% | 4% | 2% | 4% |

# HOW DO TB CASES OCCUR IN CALIFORNIA?



## Active TB is only the "tip of the iceberg"

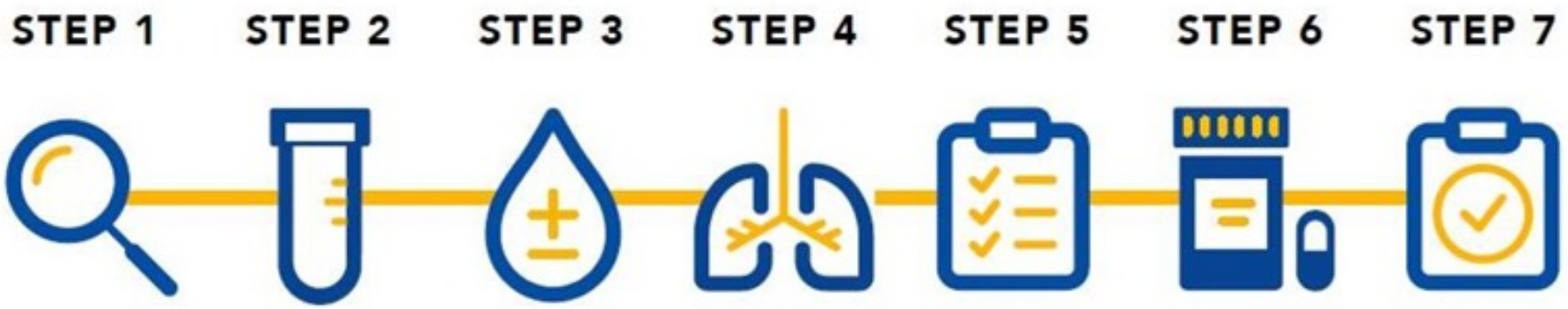
**2100** people had TB disease in CA in 2024

More than **2 million** Californians have LTBI

California

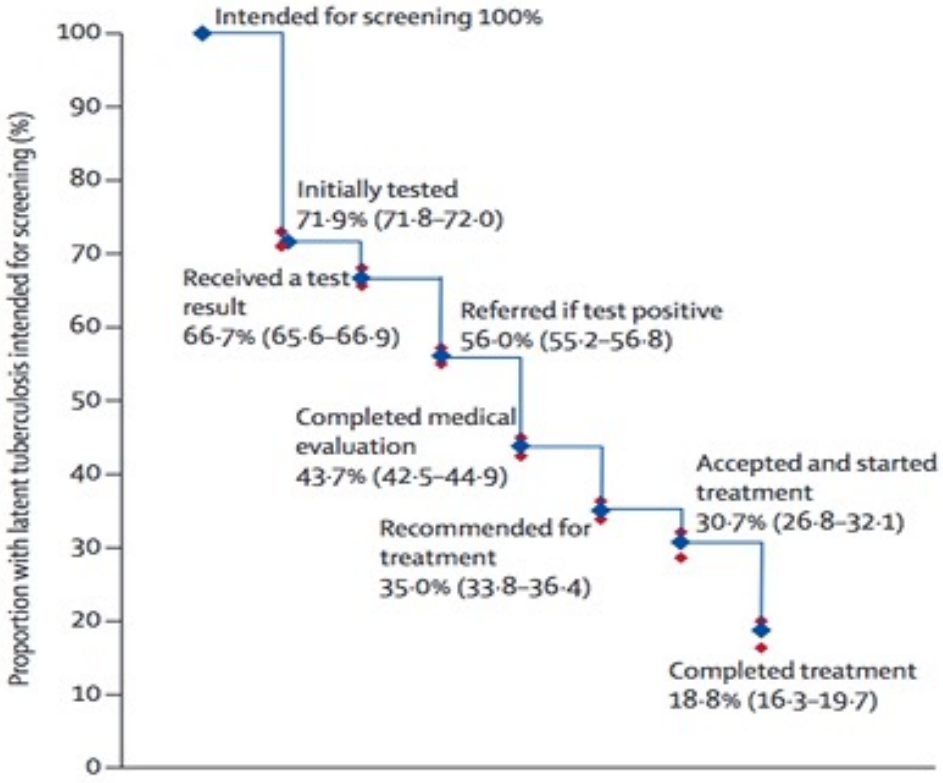

Source: CDPH TB Control Branch, Tuberculosis in California: 2024 Snapshot; San Diego TBEI Community of Practice

# LTBI Care Cascade Steps Overview




| STEP 1 | STEP 2 | STEP 3 | STEP 4 | STEP 5 | STEP 6 | STEP 7 |
|---|---|---|---|---|---|---|
| Assess patient risk for TB infection | Test for TB infection, IGRA preferred | Document positive tests for TB infection | Evaluate patient for TB disease, including chest x-ray | Complete chest x-ray and document normal result | Prescribe LTBI treatment | Retain patient in care and document treatment completion |

# Attrition at each step of the LTBI care cascade




Alsdurf H et al. Lancet ID, 2016

Systematic review & meta-analysis

- Reviewed 58 U.S. studies
- Published between 1946-2015 (~750,000 people)
- Looked at % of patients with LTBI completing each step of the cascade
- Identified barriers at the patient, provider and health-system level

Results:

- Patients lost at each step of the care cascade
- Less than one-quarter of at-risk people with LTBI completed treatment (18.8%)
- Most patients were lost early in the cascade before even being offered treatment

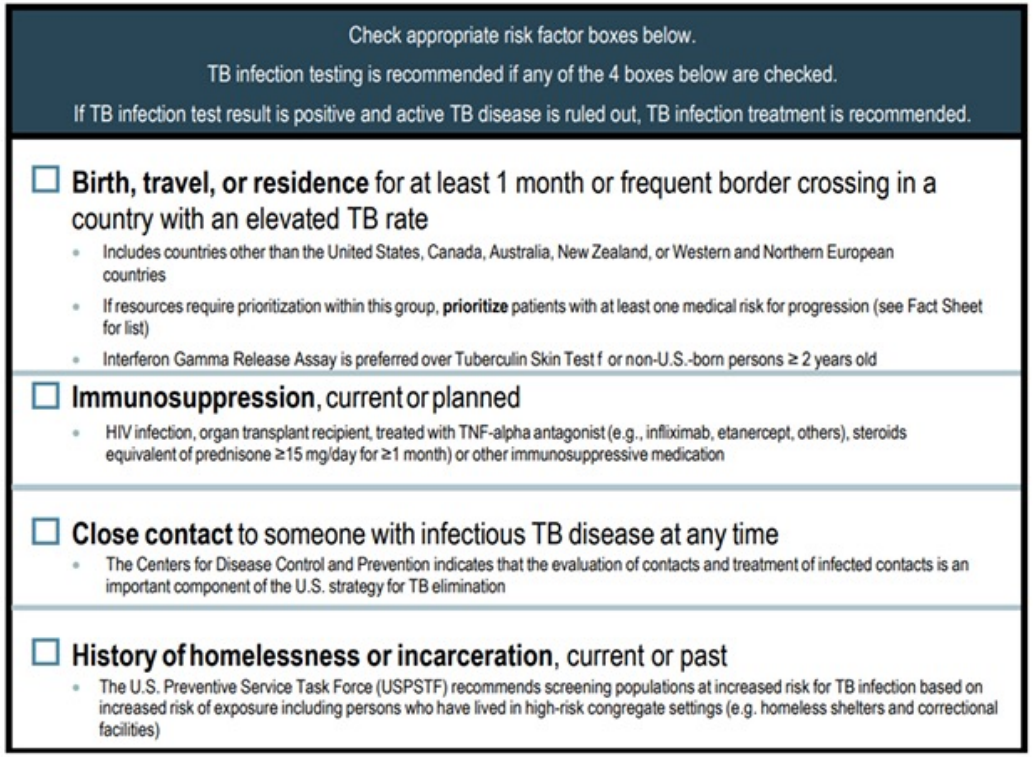
# TWO CORE LTBI CARE INDICATORS TO MEASURE AND MONITOR

**% at risk population that receive a TB test**

**% with a positive test that complete LTBI treatment**

# CA TB RISK ASSESSMENTS

- All patients at increased risk for TB disease should be **screened**
- To prevent TB disease: **test** those who answer "yes" to any questions(s)
- AB 2132 went into effect in CA January 1, 2025: requires all adult patients receiving primary care services to be offered a TB screening test if risk factors identified



Check appropriate risk factor boxes below.

TB infection testing is recommended if any of the 4 boxes below are checked.

If TB infection test result is positive and active TB disease is ruled out, TB infection treatment is recommended.

☐ **Birth, travel, or residence** for at least 1 month or frequent border crossing in a country with an elevated TB rate

- Includes countries other than the United States, Canada, Australia, New Zealand, or Western and Northern European countries
- If resources require prioritization within this group, **prioritize** patients with at least one medical risk for progression (see Fact Sheet for list)
- Interferon Gamma Release Assay is preferred over Tuberculin Skin Test f or non-U.S.-born persons ≥ 2 years old

☐ **Immunosuppression**, current or planned

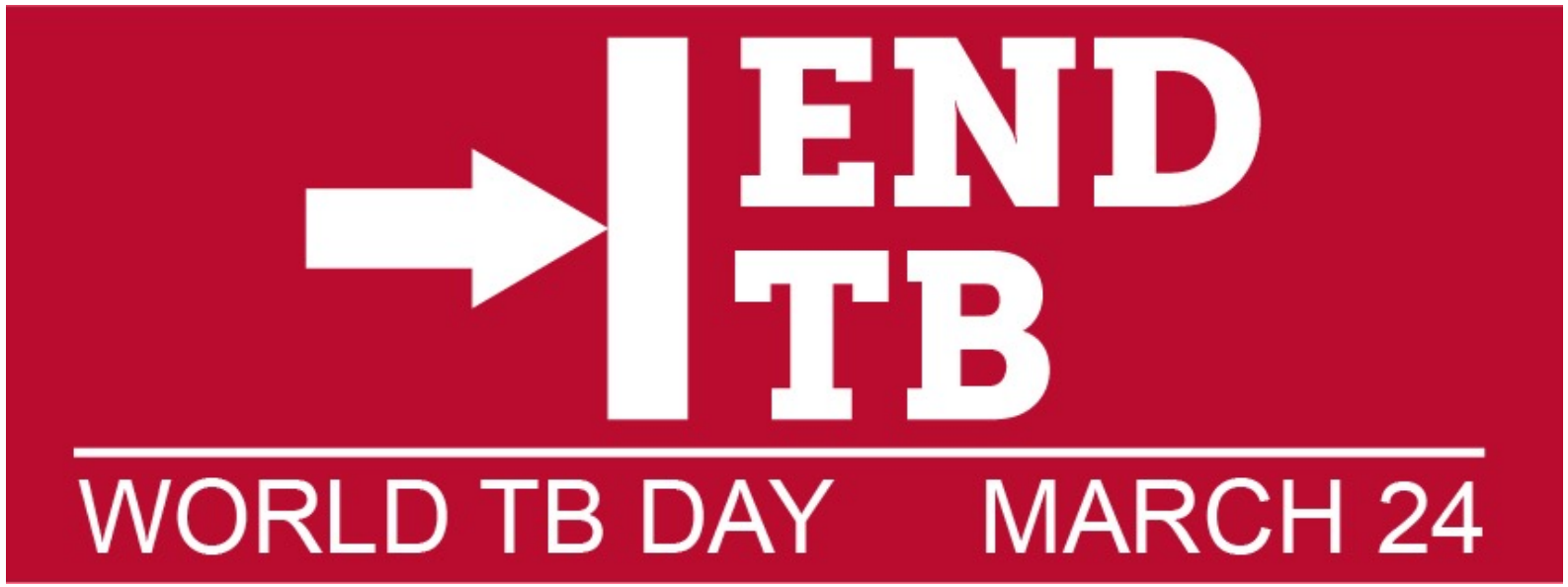
- HIV infection, organ transplant recipient, treated with TNF-alpha antagonist (e.g., infliximab, etanercept, others), steroids equivalent of prednisone ≥15 mg/day for ≥1 month) or other immunosuppressive medication

☐ **Close contact** to someone with infectious TB disease at any time

- The Centers for Disease Control and Prevention indicates that the evaluation of contacts and treatment of infected contacts is an important component of the U.S. strategy for TB elimination

☐ **History of homelessness or incarceration**, current or past

- The U.S. Preventive Service Task Force (USPSTF) recommends screening populations at increased risk for TB infection based on increased risk of exposure including persons who have lived in high-risk congregate settings (e.g. homeless shelters and correctional facilities)




# Unite to End TB