61ST ANNUAL

Denver **TB** Course
(Hybrid Event)

APRIL 2-4, 2025

National Jewish Health®
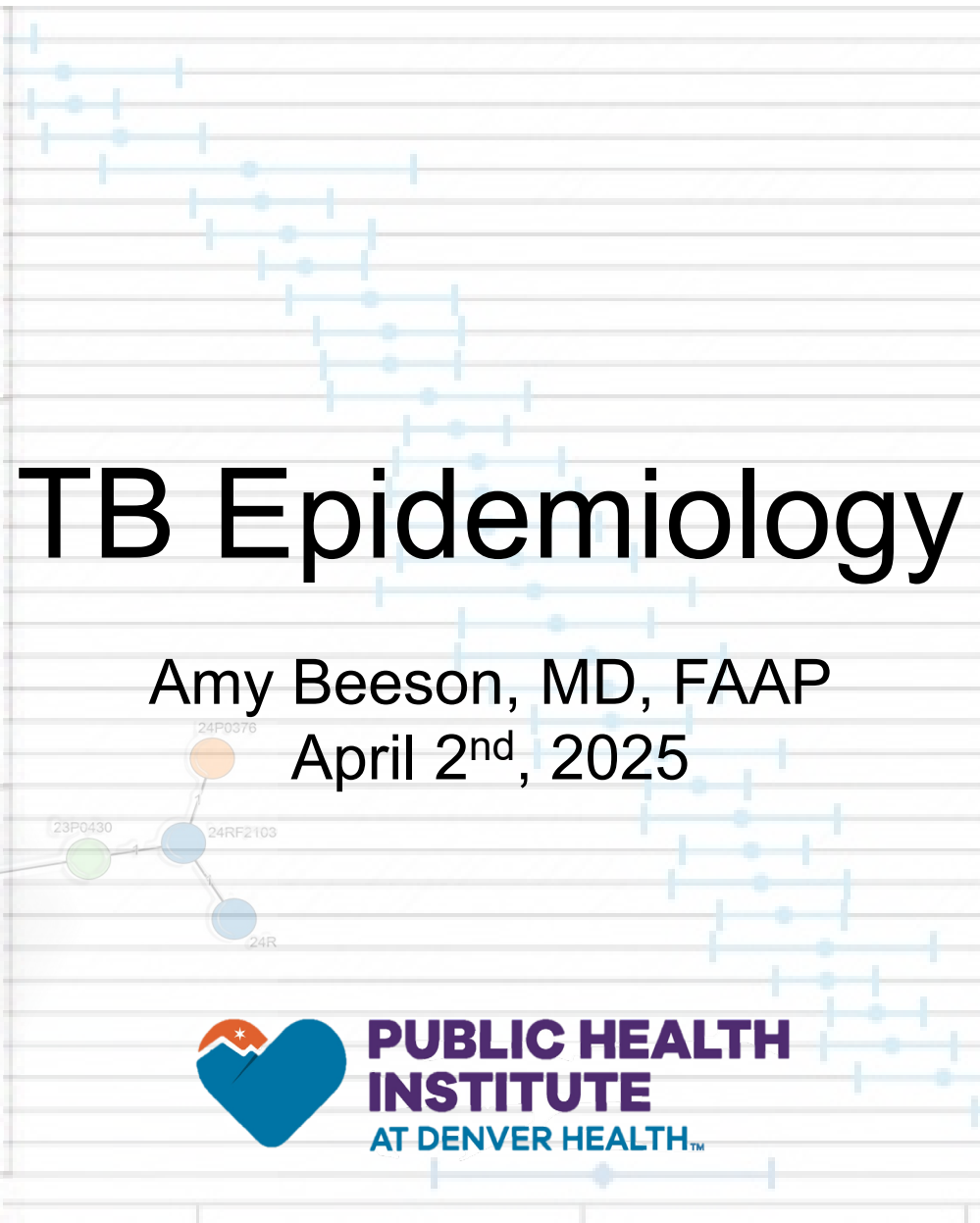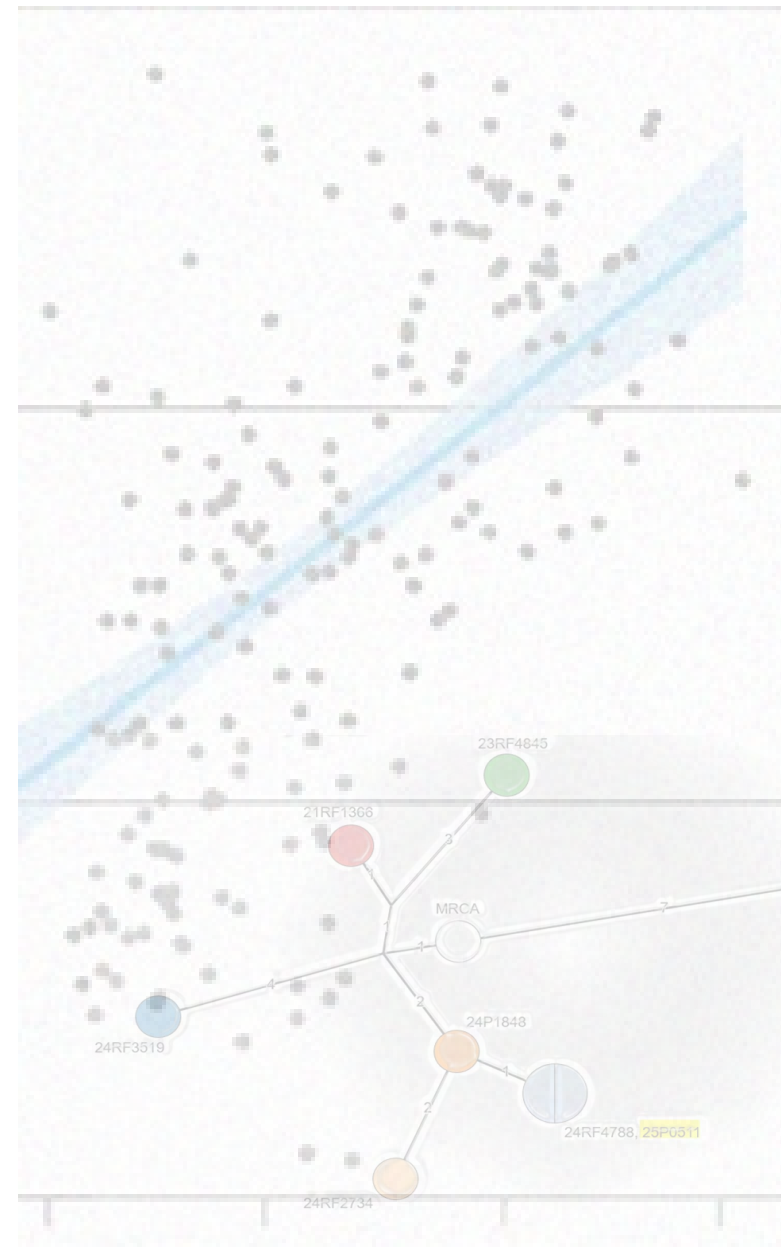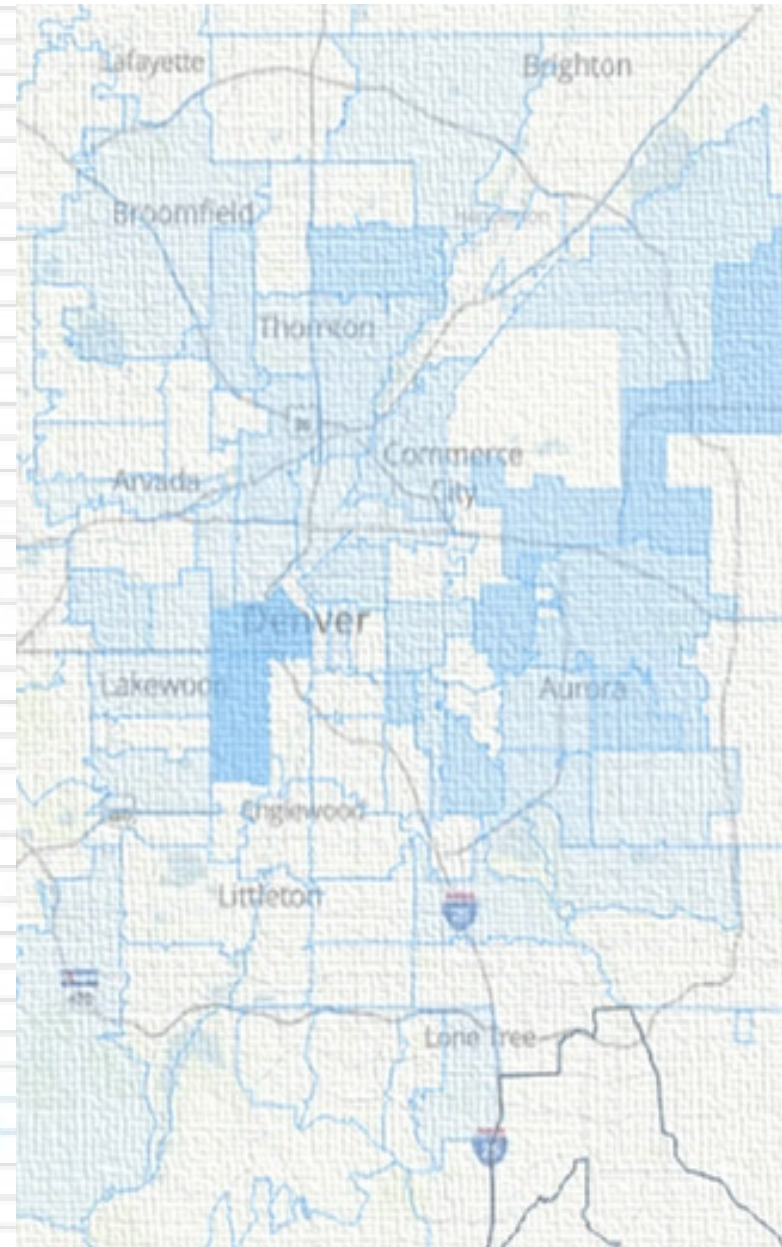
# TB Epidemiology

Amy Beeson, MD, FAAP
April 2nd, 2025
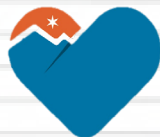
PUBLIC HEALTH
INSTITUTE
AT DENVER HEALTH™

# Relevant disclosures

- None

# Objectives

- Review global and U.S. estimates and trends in TB infection, TB disease, DR-TB, and death from TB

# Objectives

- Review global and U.S. estimates and trends in TB infection, TB disease, DR-TB, and death from TB

- Describe biopsychosocial factors associated with TB infection and outcomes

# Objectives

- Review global and U.S. estimates and trends in TB infection, TB disease, DR-TB, and death from TB

- Describe biopsychosocial factors associated with TB infection and outcomes

- Discuss how TB epidemiology informs clinical decision making and elimination strategy

# TB infection estimates



- 25% of the world's population is infected with TB (1.7 billion people)
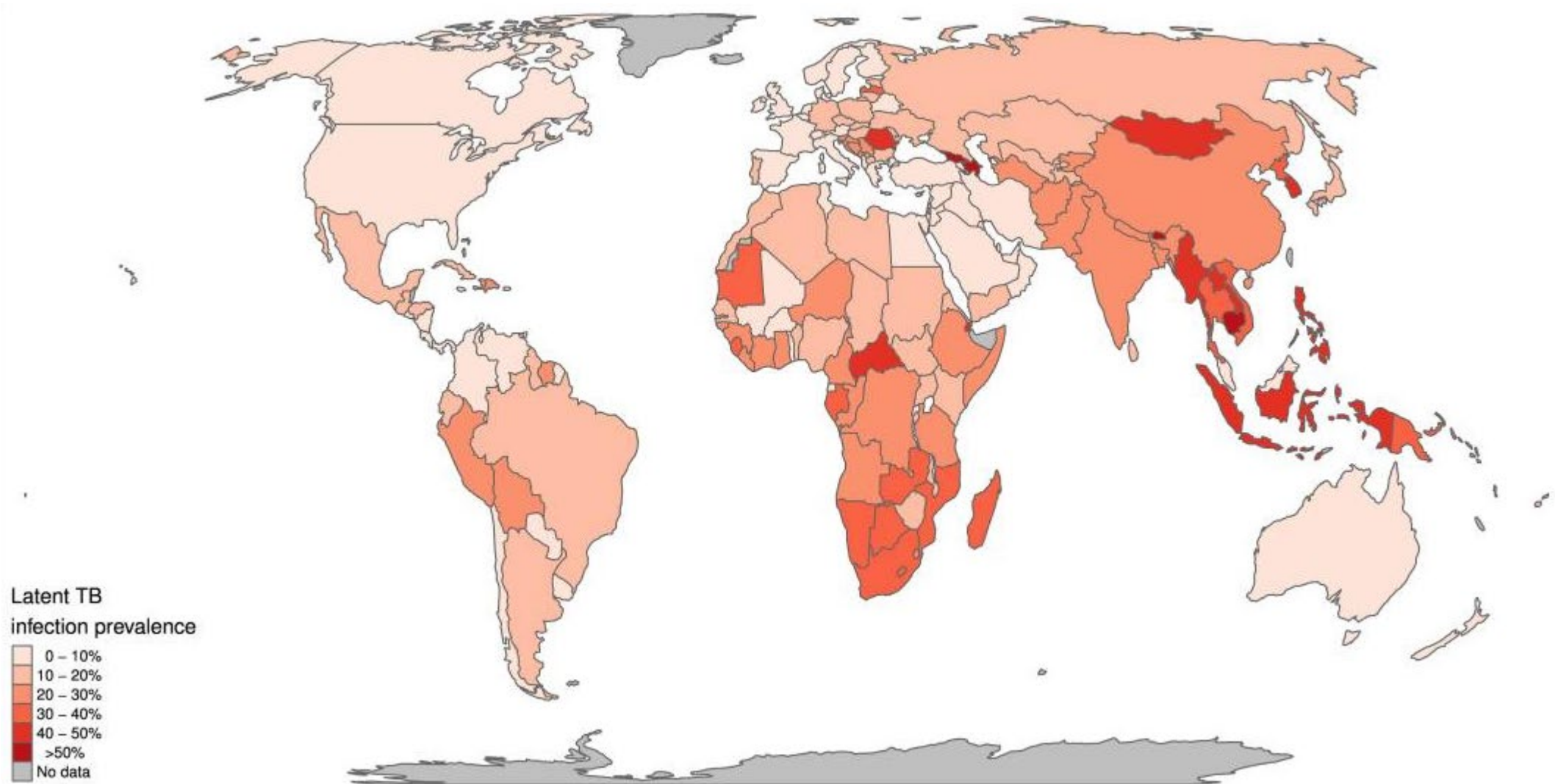
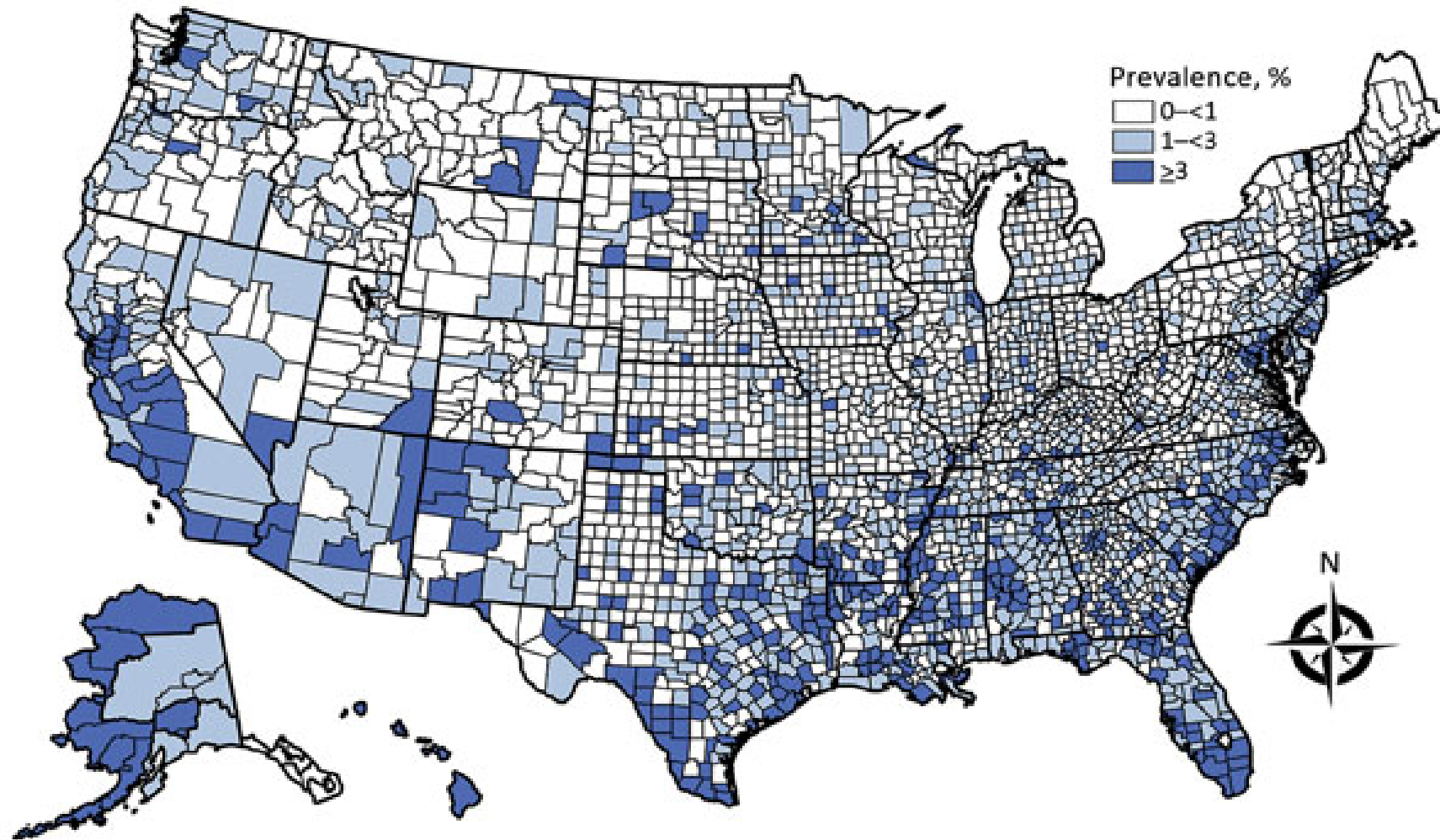# TB infection estimates



- 25% of the world's population is infected with TB (1.7 billion people)

- 2-3% of the U.S. population is infected with TB (8-10 million people)

  - 14% among people born outside U.S.

  - 1% among people born in U.S.

# Global map of prevalence of latent TB infection, 2014



Latent TB
infection prevalence

- 0 – 10%
- 10 – 20%
- 20 – 30%
- 30 – 40%
- 40 – 50%
- >50%
- No data

Houben RM, Dodd PJ. The Global Burden of Latent Tuberculosis Infection: A Re-estimation Using Mathematical Modelling. PLoS Med. 2016 Oct 25;13(10):e1002152. doi: 10.1371/journal.pmed.1002152. PMID: 27780211; PMCID: PMC5079585.

# Estimated prevalence of latent tuberculosis infection, by county, United States, 2011–2015



Haddad MB, Raz KM, Lash TL, Hill AN, Kammerer J, Winston CA, et al. Simple Estimates for Local
Prevalence of Latent Tuberculosis Infection, United States, 2011–2015. Emerg Infect Dis.
2018;24(10):1930-1933. https://doi.org/10.3201/eid2410.180716

# TB disease estimates



- TB is increasing globally since 2020
  - The rate of increase slowed in 2023
  - There is significant variability by region
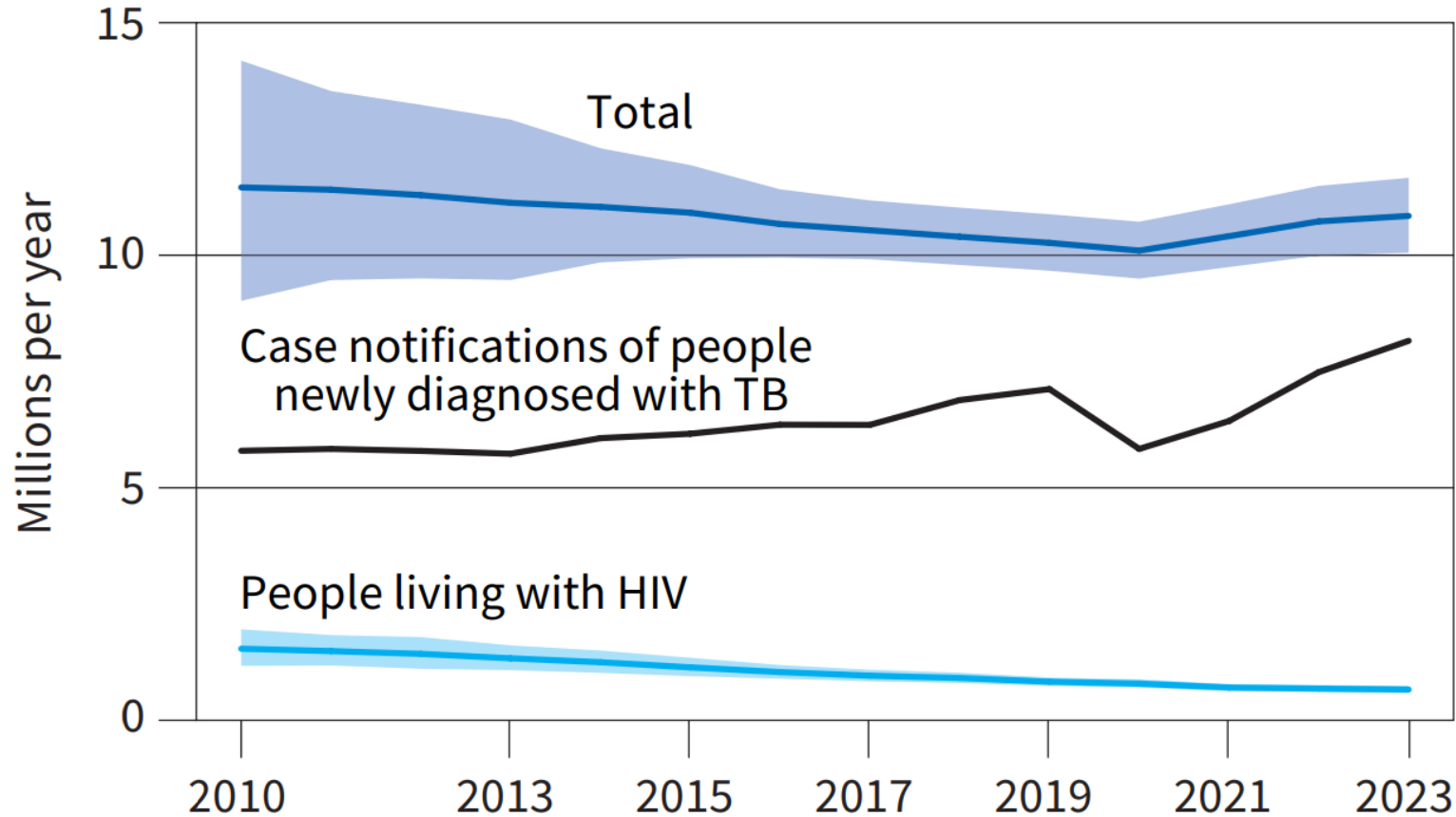
Image: Public Health Image Library, CDC

# TB disease estimates
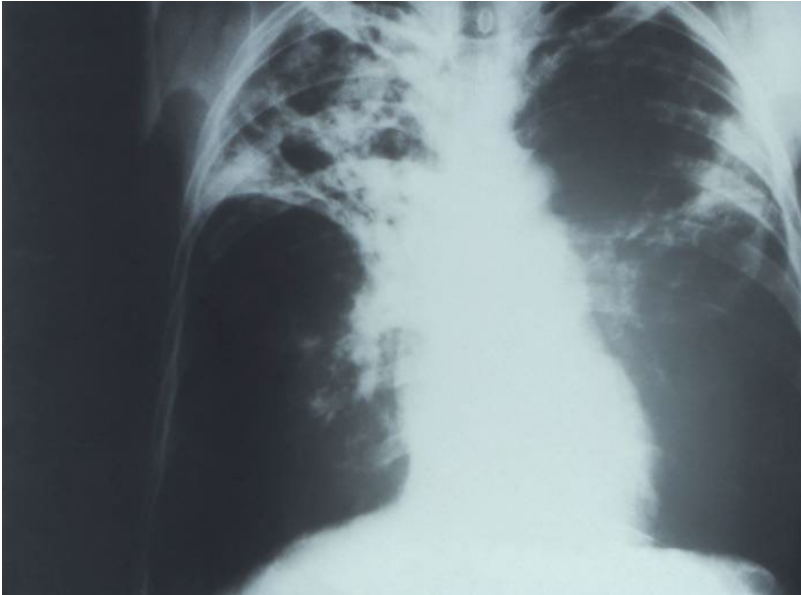


- TB is increasing globally since 2020
  - The rate of increase slowed in 2023
  - There is significant variability by region

- **TB is increasing in the U.S. since 2020**
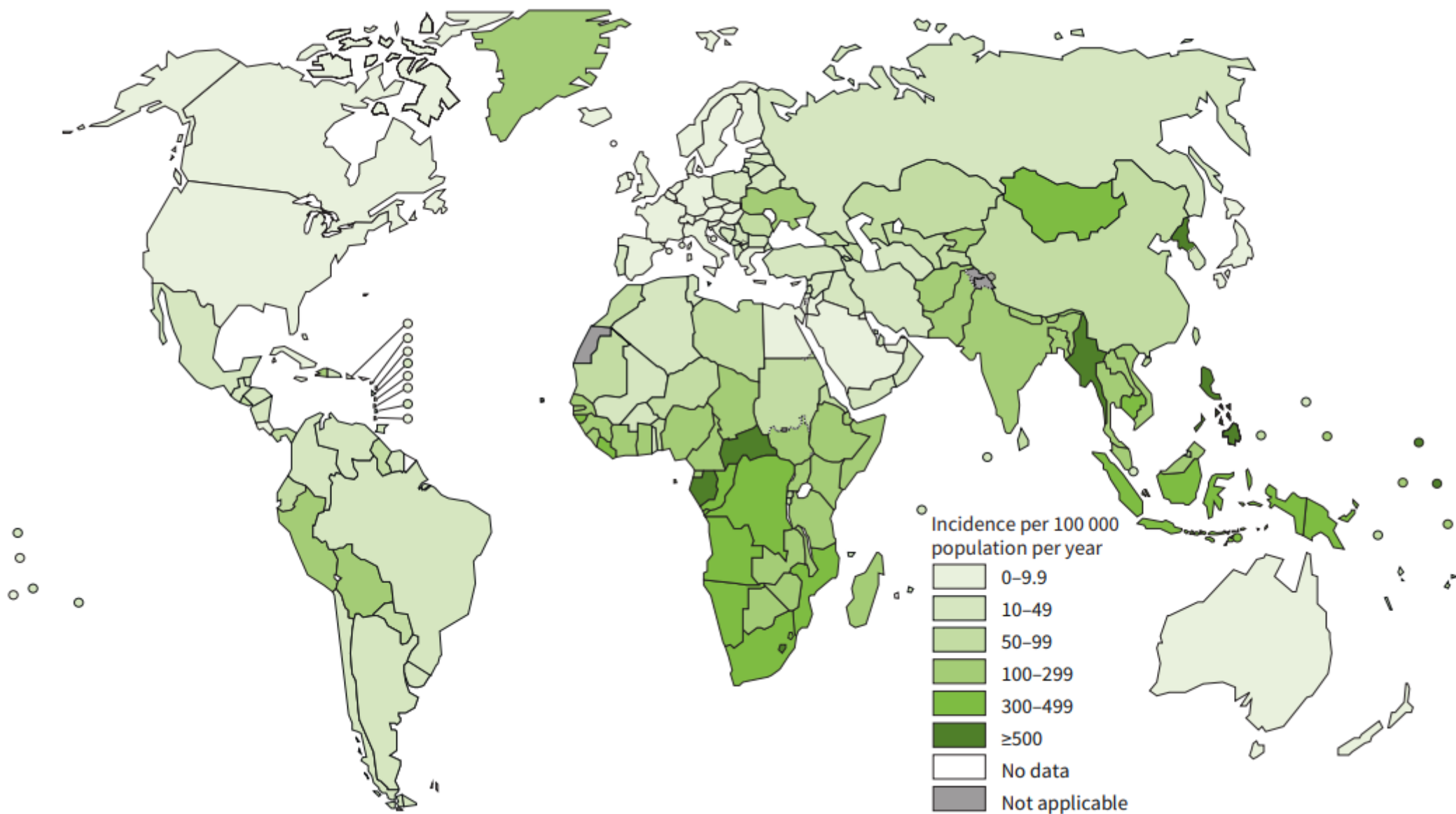
Image: Public Health Image Library, CDC

# TB is increasing worldwide



10.8 million (134 cases per 100,000 persons)

# Estimated TB incidence rates, 2023



Incidence per 100 000
population per year

- 0–9.9
- 10–49
- 50–99
- 100–299
- 300–499
- ≥500
- No data
- Not applicable

2024 World TB Report, World Health Organization

Rate per 100 000 population per year

**African Region**

**Region of the Americas**

**South-East Asia Region**

**European Region**

**Eastern Mediterranean Region**

**Western Pacific Region**
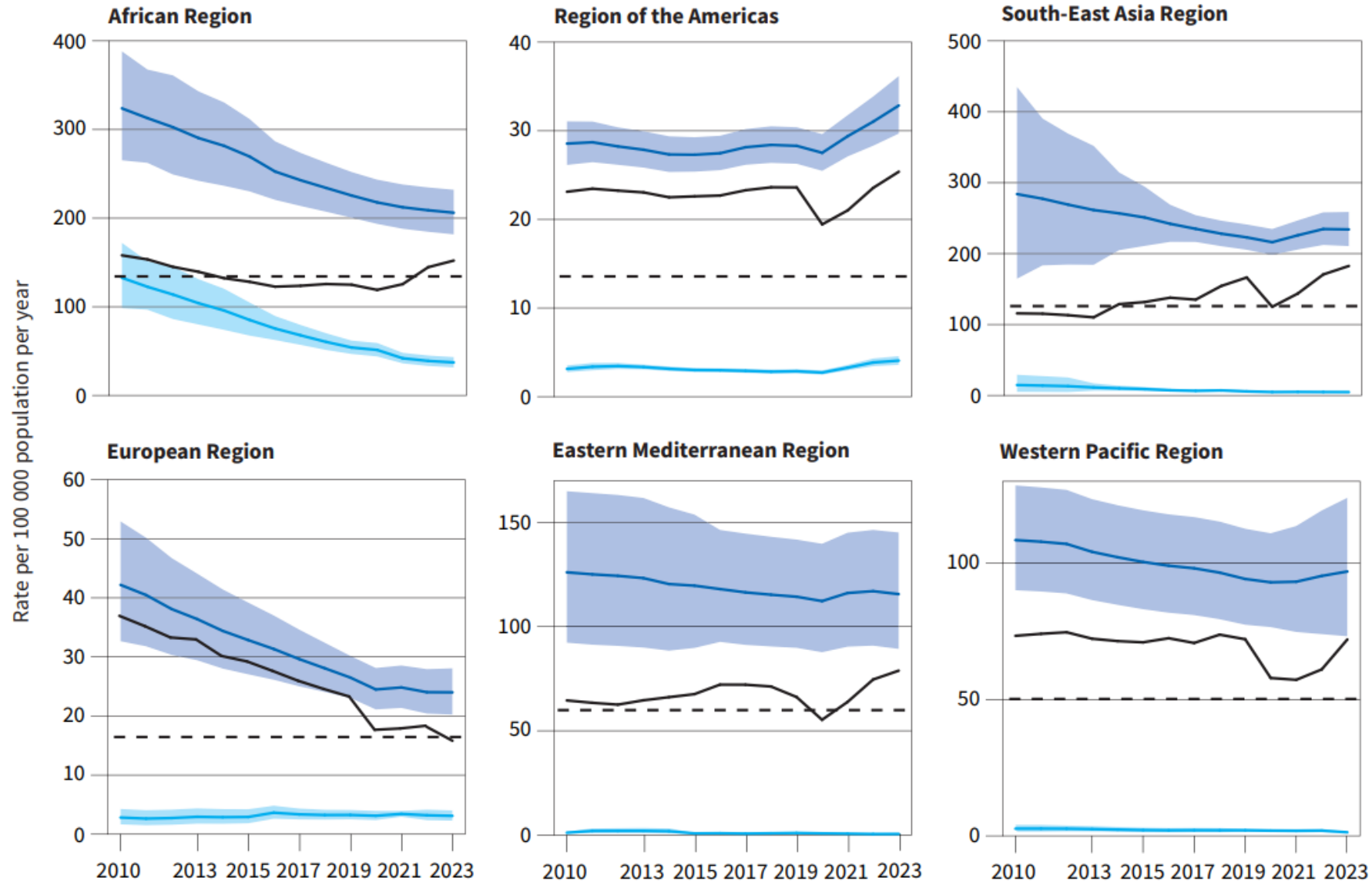
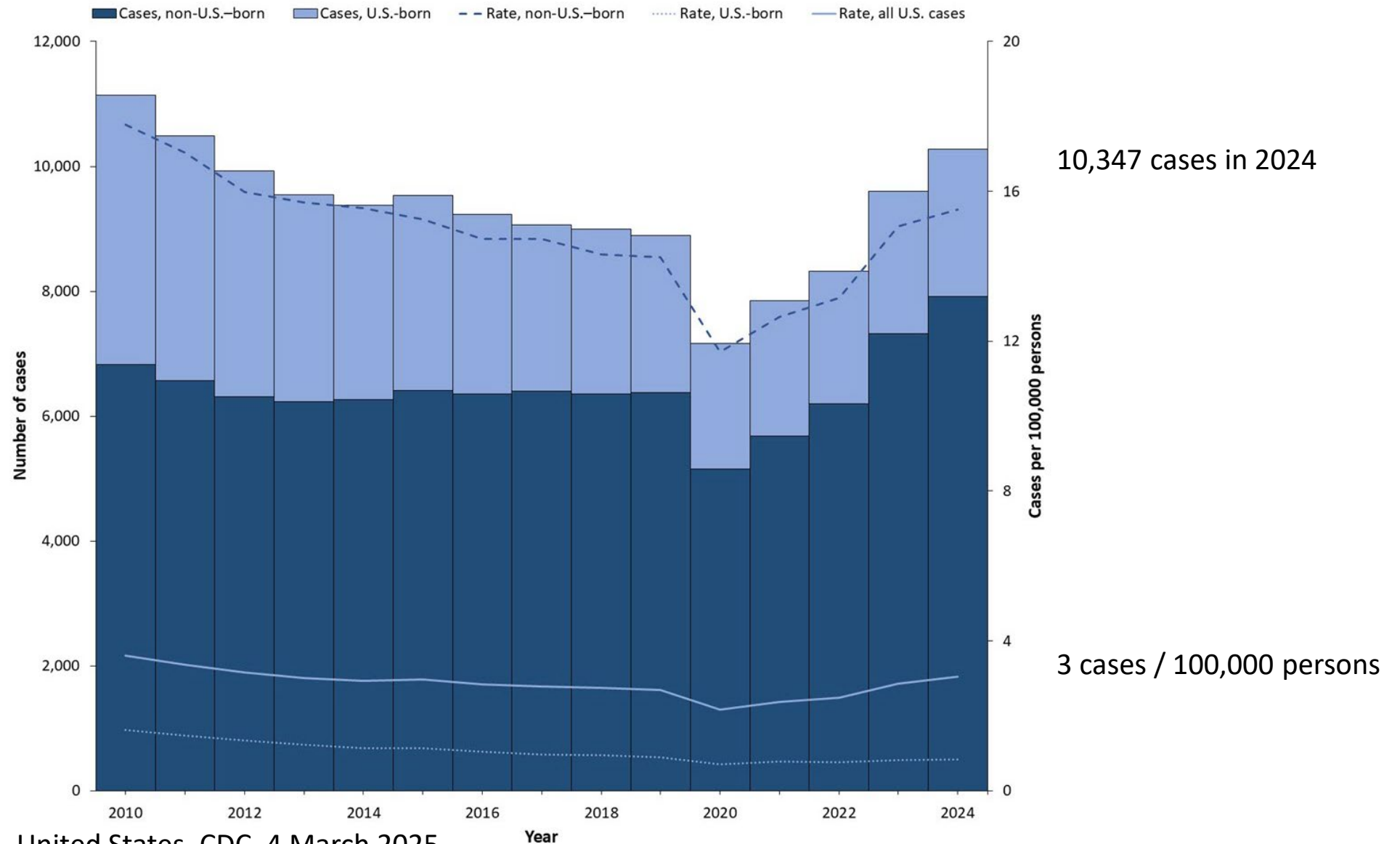**Global estimates of TB incidence disaggregated by age group and sex (female in purple; male in orange), 2023**
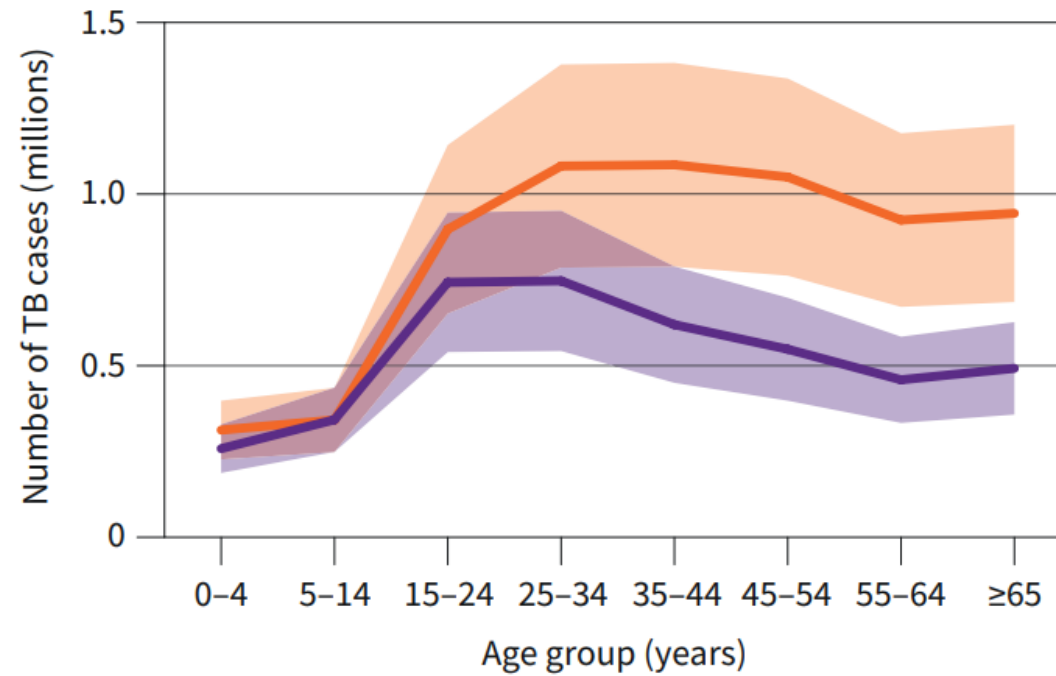
# TB is increasing in the United States



10,347 cases in 2024

3 cases / 100,000 persons

Provisional 2024 TB Data, United States, CDC, 4 March 2025

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

Number of cases vs. Year

Elimination threshold: ~335 cases or <1 case per 1,000,000 persons
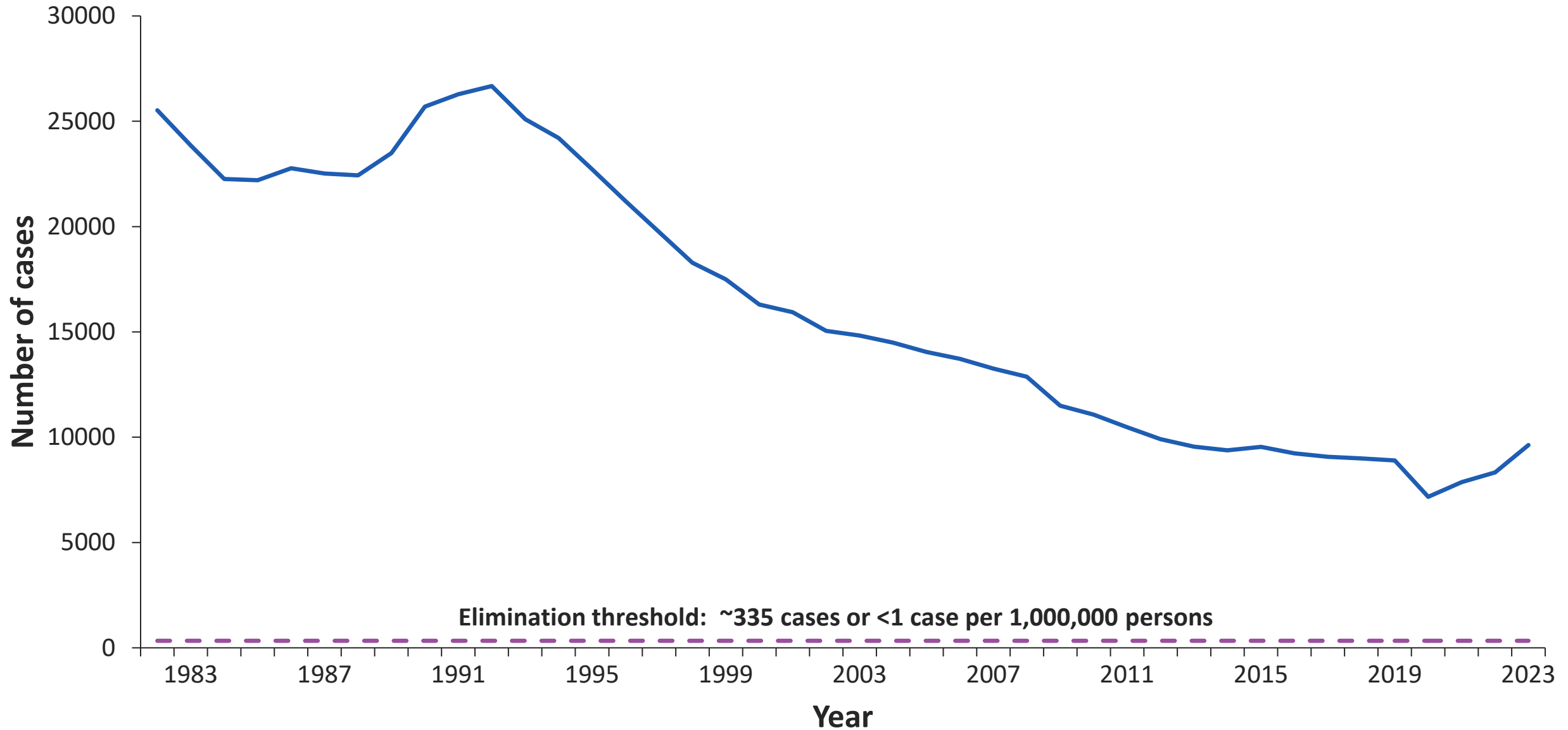
Reported Tuberculosis in the United States, 2023, CDC, data as of 17 July 2024

# DR-TB



- Globally, MDR-TB (total cases and proportion of all new cases) is estimated to be stable or slowly decreasing
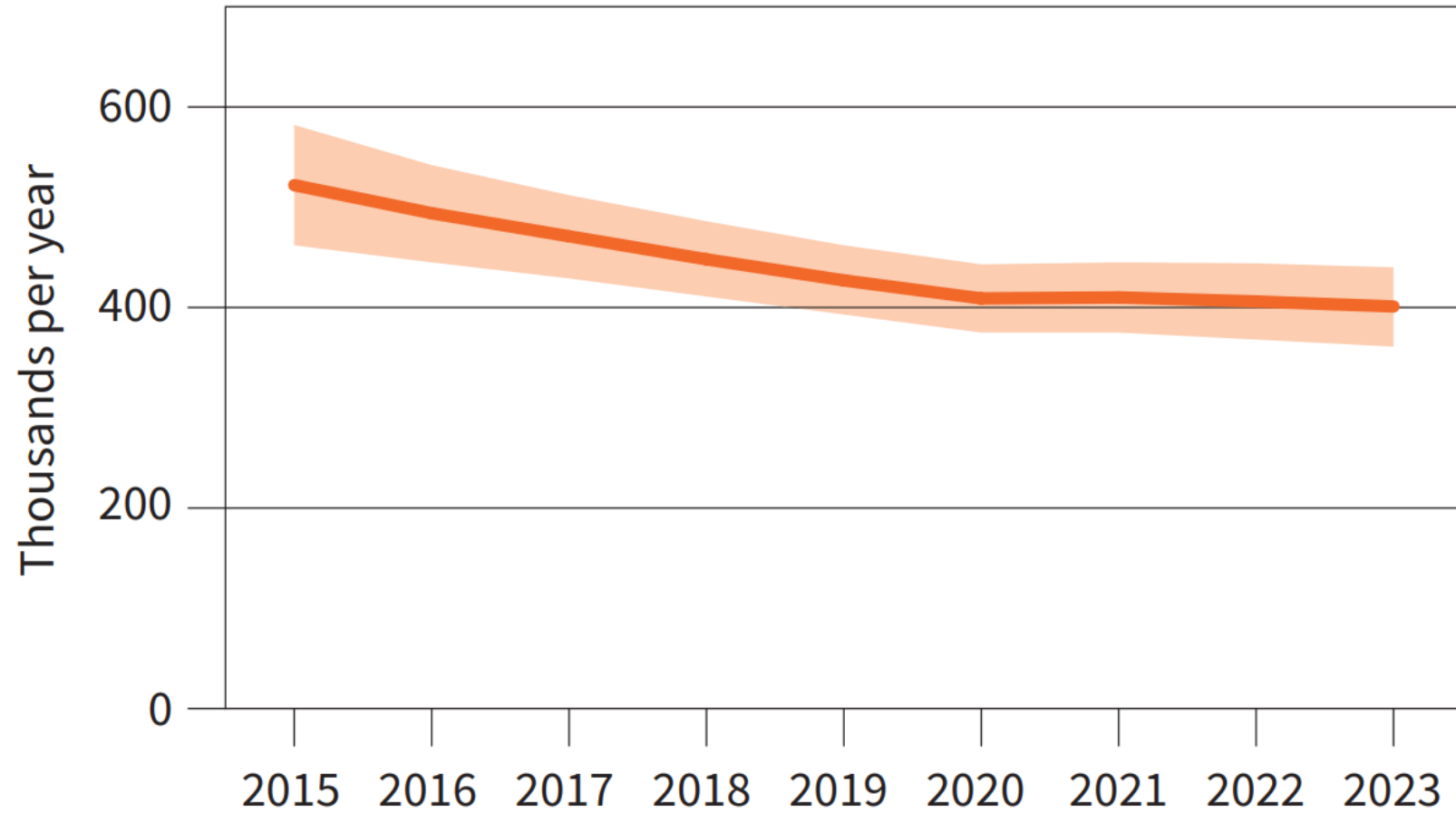
Image: James Nachtwey (Tomsk, Siberia)

# DR-TB



- Globally, MDR-TB (total cases and proportion of all new cases) is estimated to be stable or slowly decreasing

- In the U.S., MDR-TB is relatively stable (100 cases/year)

Image: James Nachtwey (Tomsk, Siberia)

# Global DR-TB

# Estimated number of people who developed MDR/RR-TB (incident cases) in 2023, for countries with at least 1000 incident cases[a]



Russian Federation

China

Philippines

India

Indonesia

Number of cases

- 1 000
- 10 000
- 100 000

2024 World TB Report, World Health Organization
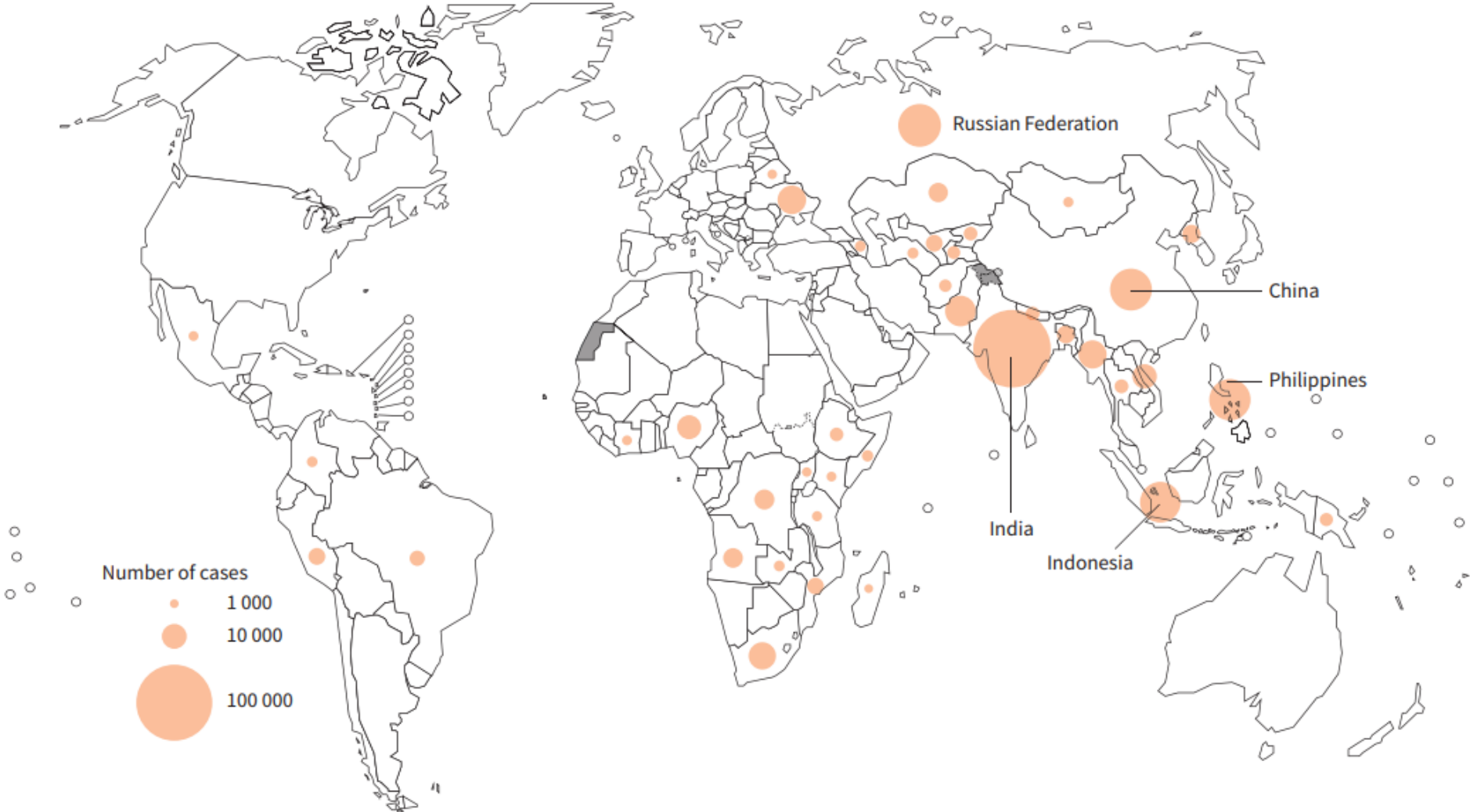
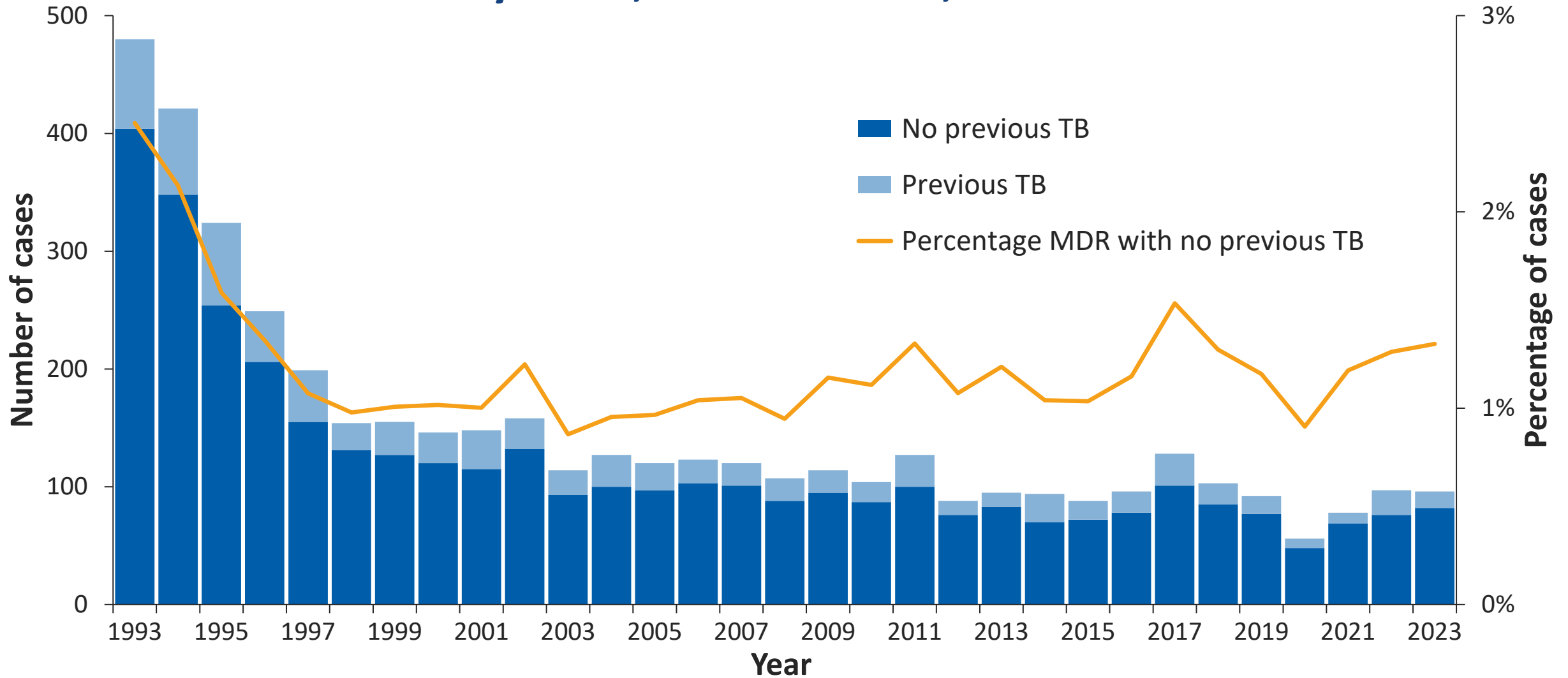# Number and Percentage of Multidrug-Resistant (MDR) TB Cases by History of TB, United States, 1993–2023

Legend:
- No previous TB
- Previous TB
- Percentage MDR with no previous TB

Number of cases (left axis): 0 to 500
Percentage of cases (right axis): 0% to 3%

Year (x-axis): 1993 to 2023

Reported Tuberculosis in the United States, 2023, CDC, data as of 17 July 2024

# Deaths from TB



Image: James Nachtwey (Tugela Ferry, KwaZulu-Natal, South Africa)

# Deaths from TB



- In 2023, TB *probably* caused more deaths globally than any other infection, and twice as many as HIV/AIDS
  - 1.25 million deaths (1.09 million among HIV-negative people)

Image: James Nachtwey (Tugela Ferry, KwaZulu-Natal, South Africa)
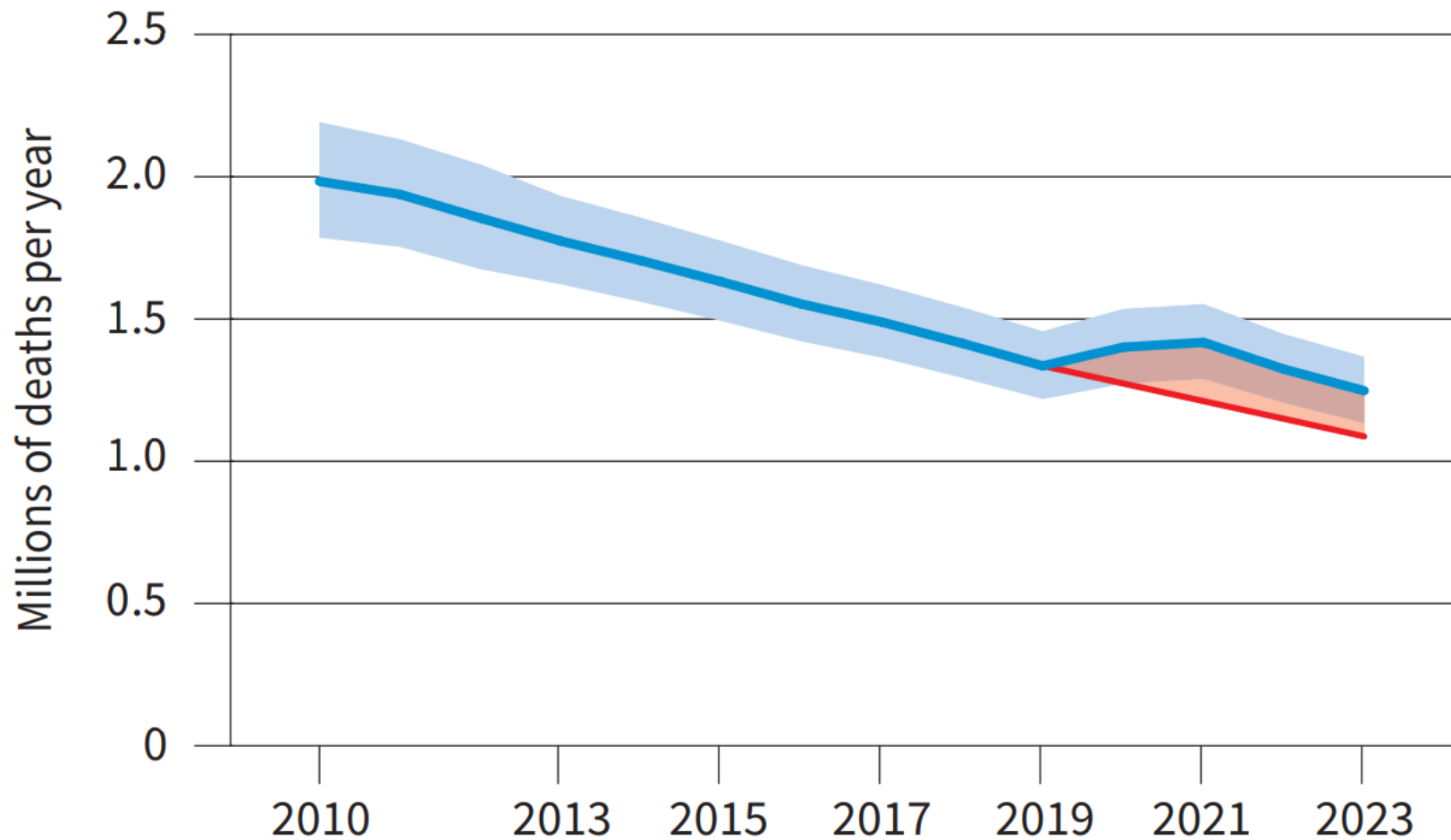
# Deaths from TB



- In 2023, TB *probably* caused more deaths globally than any other infection, and twice as many as HIV/AIDS

    - 1.25 million deaths (1.09 million among HIV-negative people)

- 565 people in the U.S. died from TB in 2022

Image: James Nachtwey (Tugela Ferry, KwaZulu-Natal, South Africa)

# COVID-19 disruptions drove excess TB mortality



2024 World TB Report, World Health Organization

# Objectives

- Review global and U.S. estimates and trends in TB infection, TB disease, DR-TB, and death from TB


- Describe biopsychosocial factors associated with TB infection and outcomes

# Biopsychosocial model and TB



Image: Lewis Hine, taken January 1912 (Library of Congress)
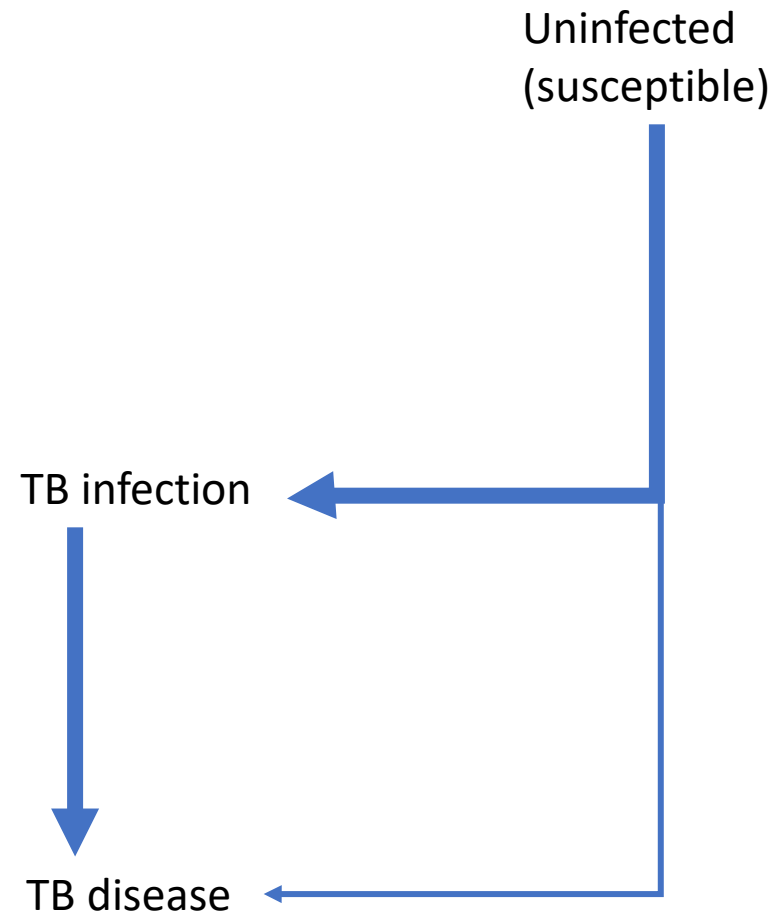
# Biopsychosocial model and TB



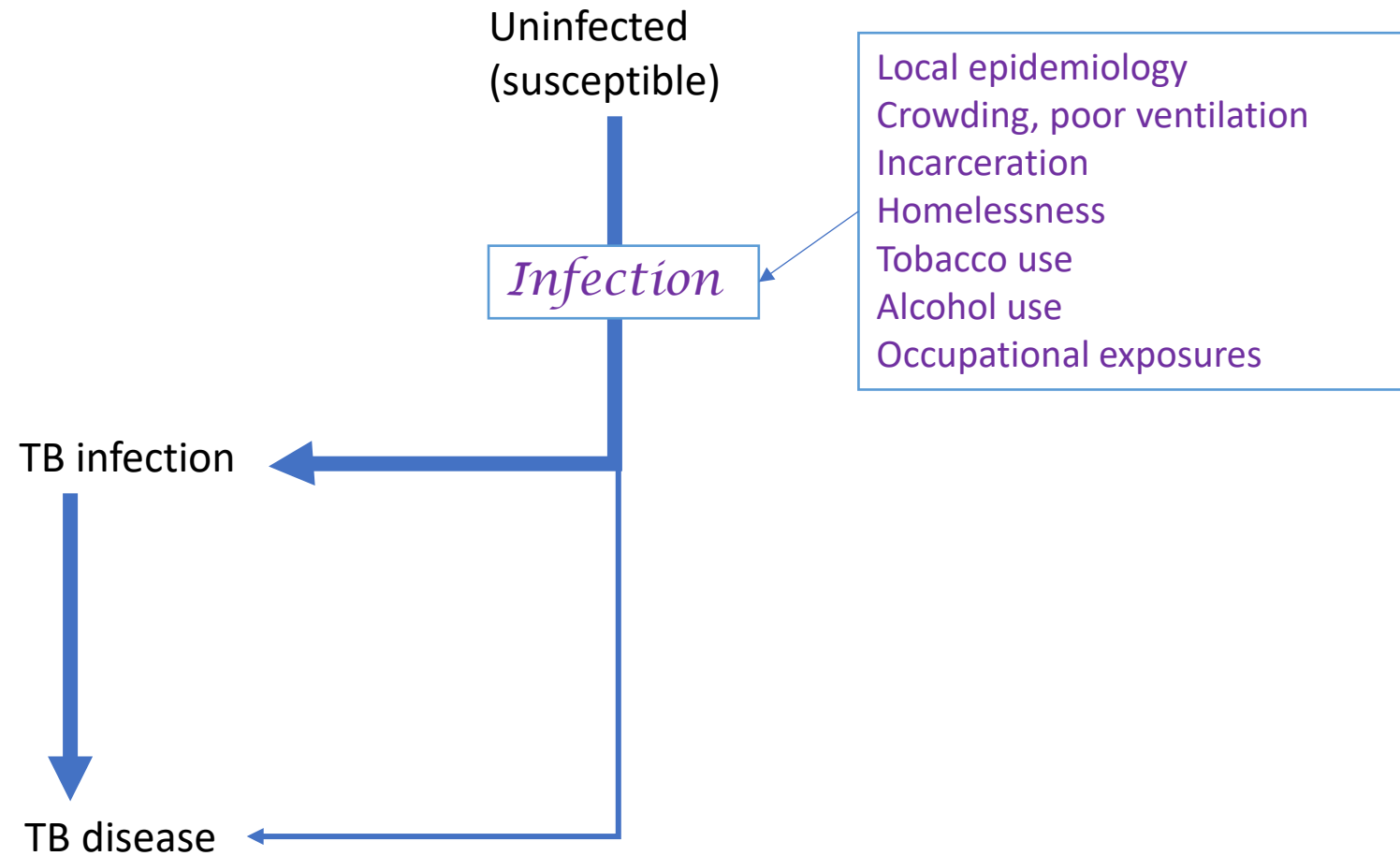Image: Carabayllo, Lima, Peru (Socios En Salud)

"There was no social revolution to accompany the scientific one. As a result, we now live in a world in which several different standards of care may be advocated for the same disease. For those with chronic infectious diseases, including tuberculosis and AIDS, those standards of care include excellent treatment for some, ineffective treatment for others, and no treatment for most. Ironically, perhaps, the reality that hundreds of millions live without any access to effective therapy at all serves to justify the setting of double standards, with the excuse that any care is an improvement over current conditions."
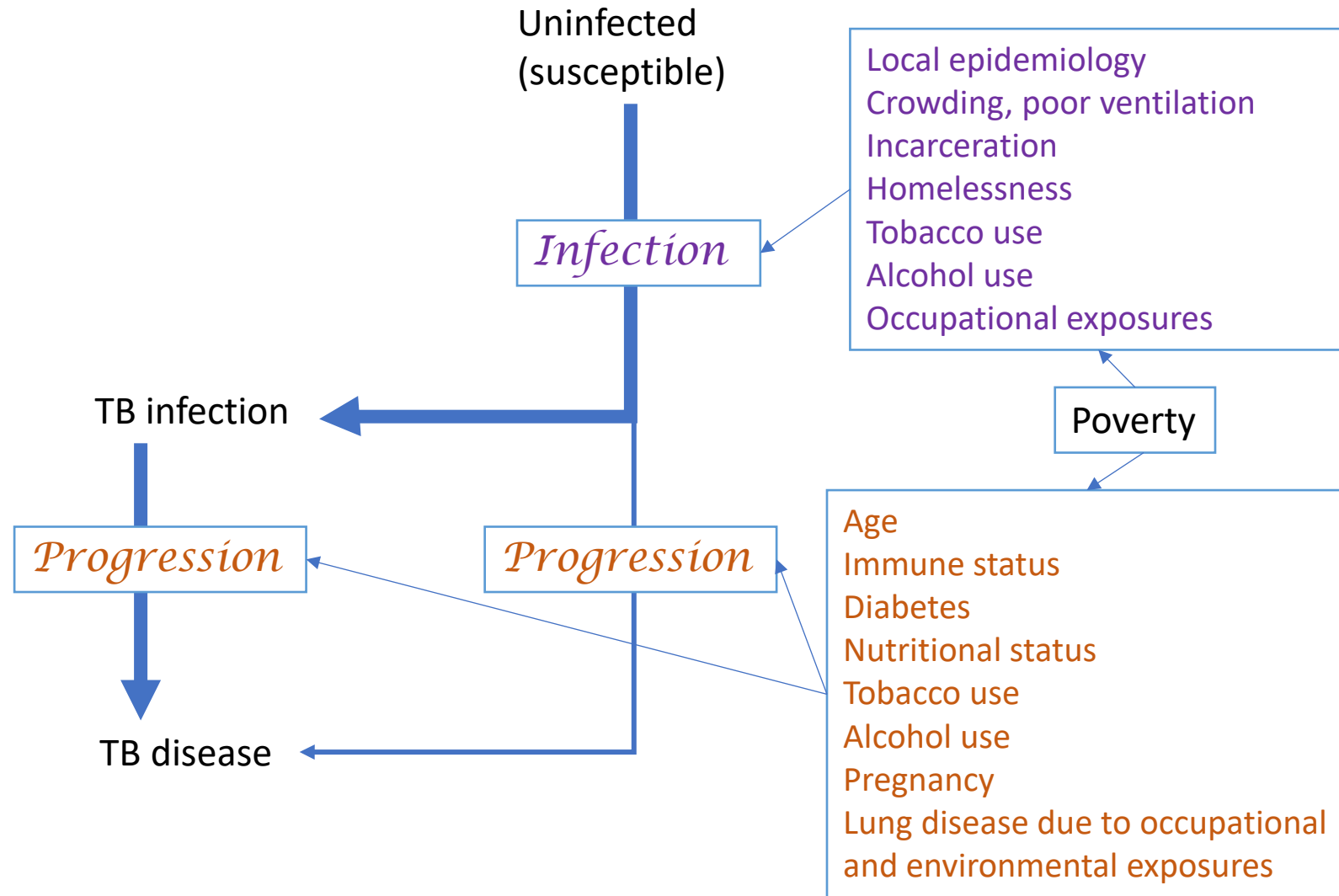
Social Medicine and the Challenge of Biosocial Research (2000)

# Model of TB

# Model of TB

Uninfected
(susceptible)

*Infection*

Local epidemiology
Crowding, poor ventilation
Incarceration
Homelessness
Tobacco use
Alcohol use
Occupational exposures

TB infection

TB disease

# Model of TB

# Likelihood of progression declines over time
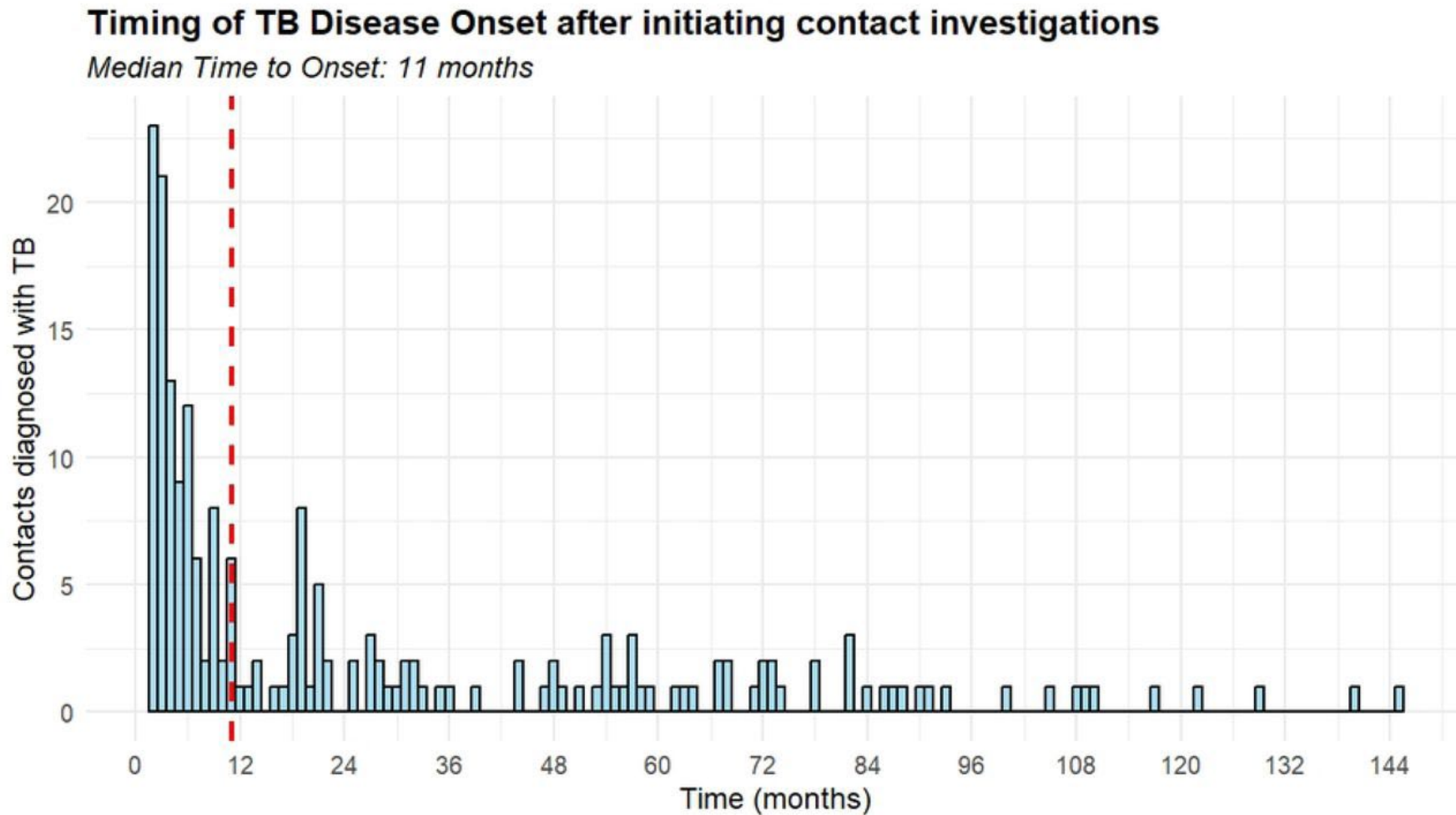


**Timing of TB Disease Onset after initiating contact investigations**
*Median Time to Onset: 11 months*

# Percentage of TB Cases Among Non-U.S.–Born Persons by Years Since Arrival in the United States Prior to Diagnosis, 2023 (N=7,299)

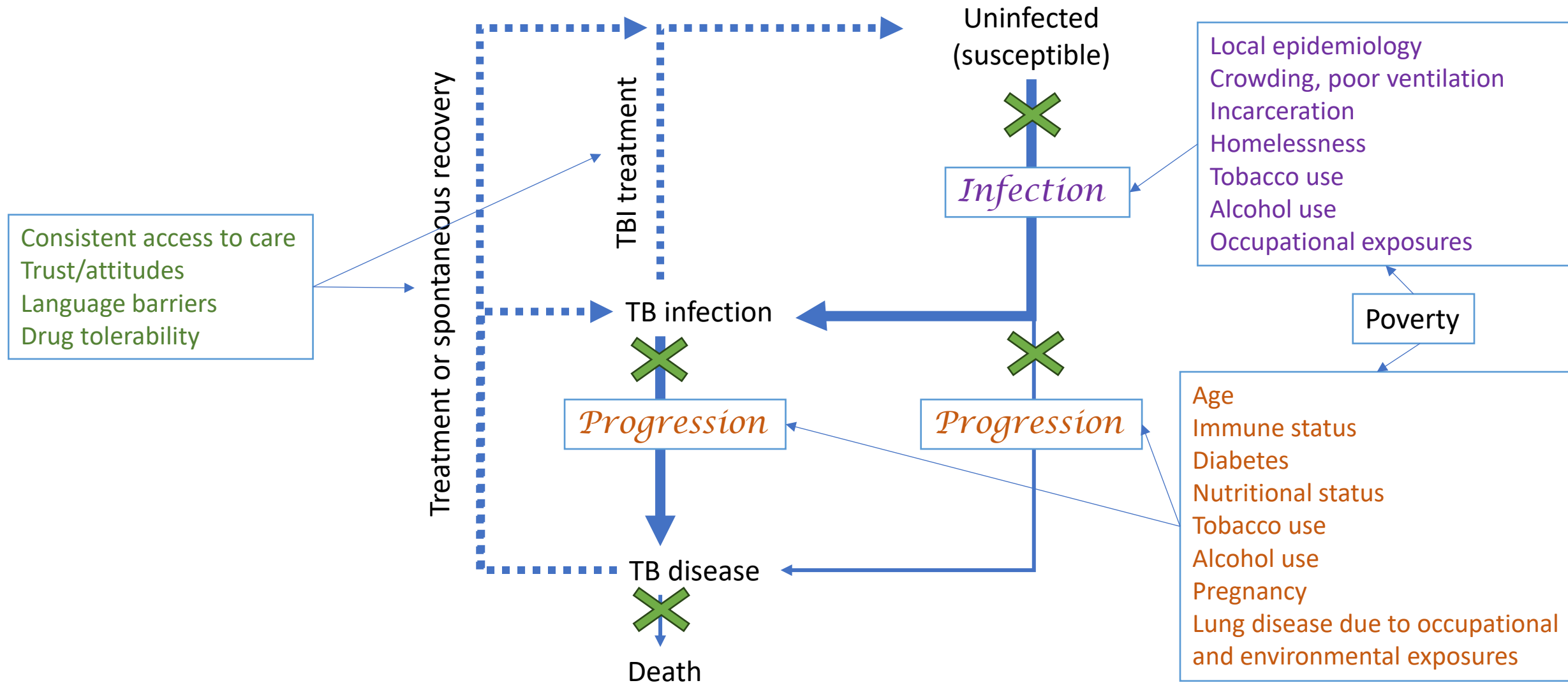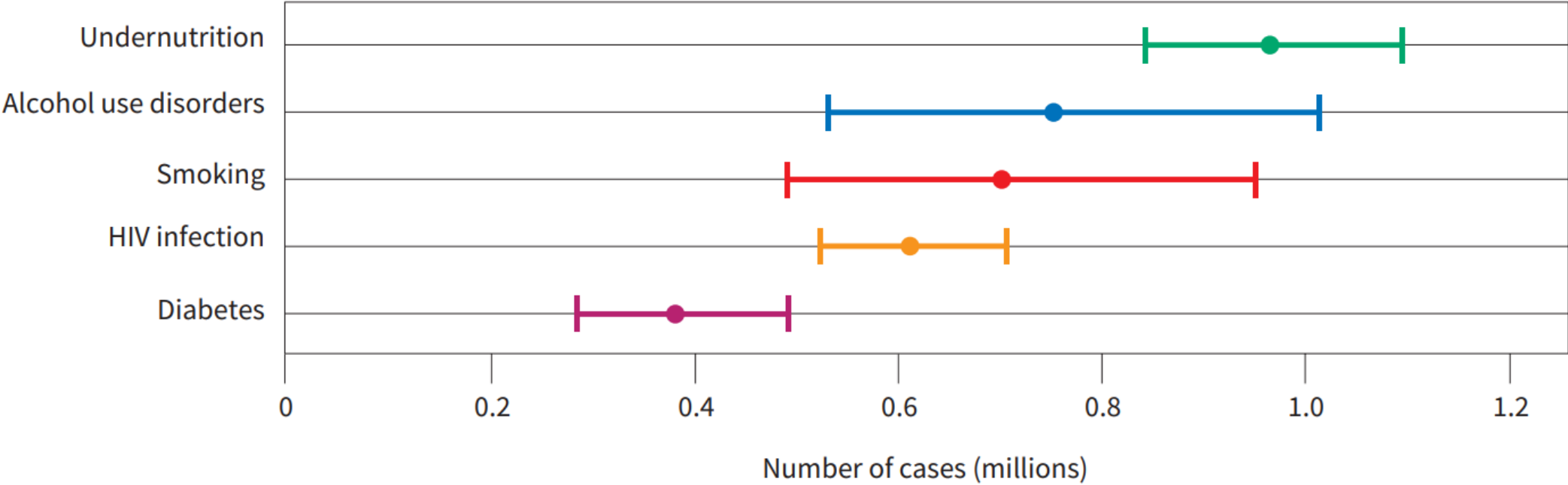| Years Since Arrival | Percentage |
|---|---|
| <1 year | 22% |
| 1–4 years | 15% |
| 5–9 years | 11% |
| 10–14 years | 7% |
| 15–19 years | 7% |
| 20–24 years | 7% |
| 25–29 years | 5% |
| 30–34 years | 6% |
| 35–39 years | 3% |
| ≥40 years | 9% |
| Unknown/missing | 6% |
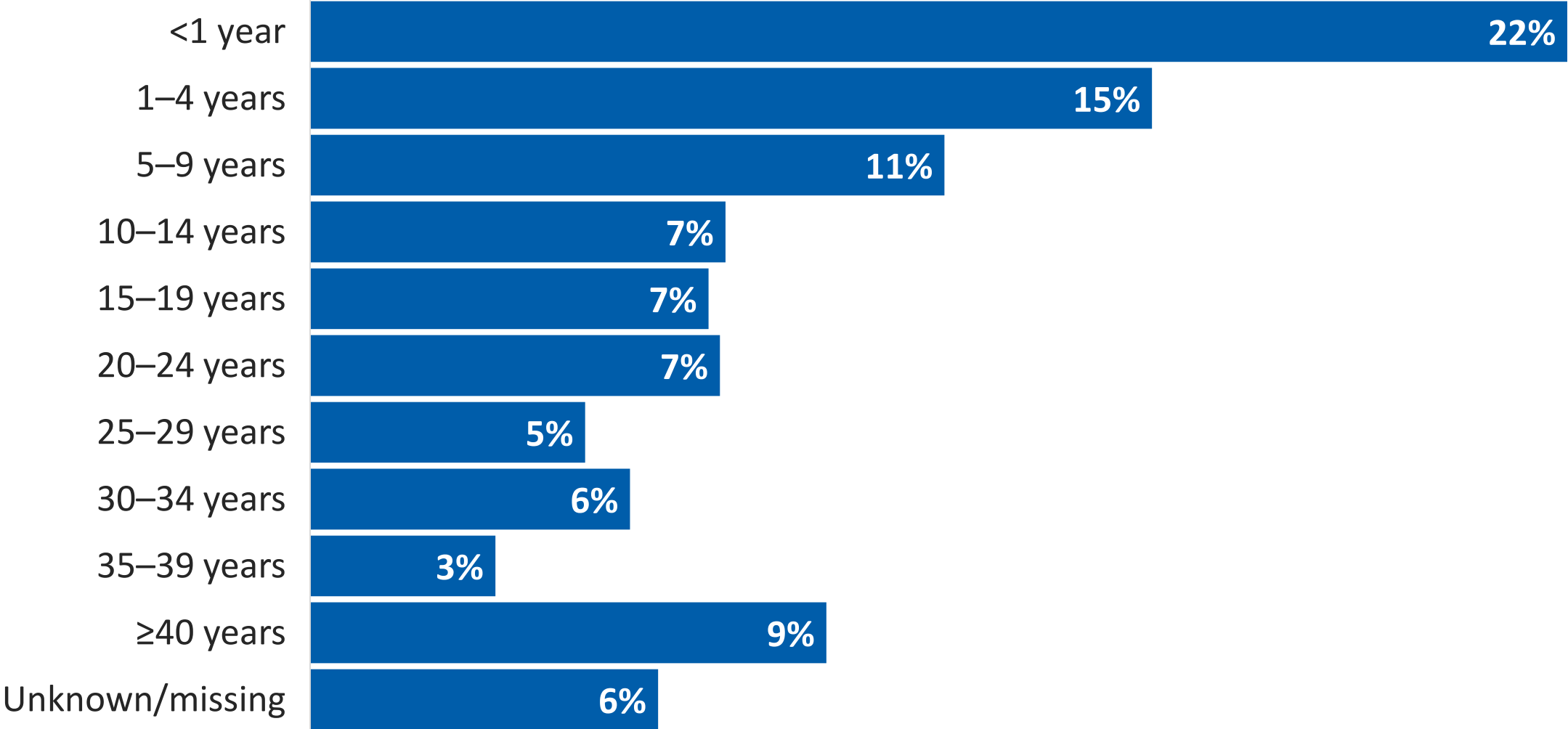
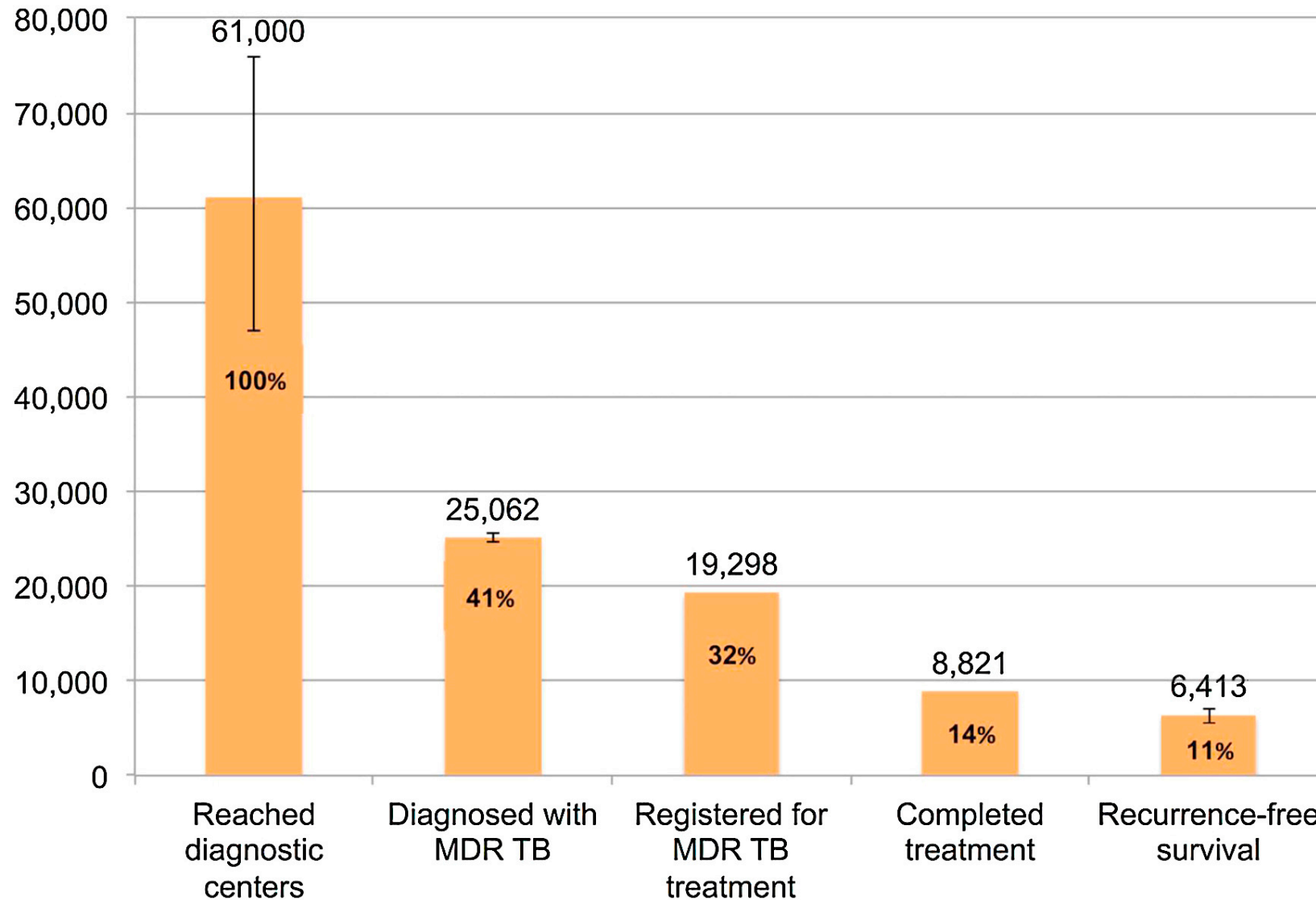Reported Tuberculosis in the United States, 2023, CDC, data as of 17 July 2024

# Model of TB

**Global estimates of the number of people with a new episode of TB (incident cases) attributable to five risk factors,[a] 2023**



2024 World TB Report, World Health Organization

# Implementation challenges: MDR-TB in India



Subbaraman R et al. The Tuberculosis Cascade of Care in India's Public Sector: A Systematic Review and Meta-analysis. PLoS Med. 2016 Oct 25;13(10):e1002149. doi: 10.1371/journal.pmed.1002149. PMID: 27780217; PMCID: PMC5079571.

# Objectives

- Review global and U.S. estimates and trends in TB infection, TB disease, DR-TB, and death from TB

- Describe biopsychosocial factors associated with TB infection and outcomes

- Discuss how TB epidemiology informs clinical decision making and elimination strategy

A 40yo healthy man who immigrated to the U.S. from South Africa 1 month ago has a positive IGRA. He has no symptoms and chest x-ray is normal. He does not recall contact with anyone with an active TB diagnosis or symptoms. How do you counsel him about risk-benefit of preventive treatment?

A. He is not at elevated risk as he does not recall a recent exposure; shared decision-making

B. He is at risk of progression to active TB due to recent immigration from a high-burden country; treatment highly encouraged

C. He is at risk of progression to active TB due to male sex; treatment highly encouraged

# Case 3

You are designing a program to eliminate TB in your state or region and are given $100 million over 5 years. Where do you start?

# Additional references

Farmer P, Robin S, Ramilus SL, Kim JY. Tuberculosis, poverty, and "compliance": lessons from rural Haiti. Semin Respir Infect. 1991 Dec;6(4):254-60. PMID: 1810004.

Narasimhan P, Wood J, Macintyre CR, Mathai D. Risk factors for tuberculosis. Pulm Med. 2013;2013:828939. doi: 10.1155/2013/828939. Epub 2013 Feb 12. PMID: 23476764; PMCID: PMC3583136.

Mirzazadeh A, Kahn JG, Haddad MB, Hill AN, Marks SM, Readhead A, Barry PM, Flood J, Mermin JH, Shete PB. State-level prevalence estimates of latent tuberculosis infection in the United States by medical risk factors, demographic characteristics and nativity. PLoS One. 2021 Apr 1;16(4):e0249012. doi: 10.1371/journal.pone.0249012. PMID: 33793612