Who is at Risk of TB?

Annie Kizilbash, MD, MPH
February 28, 2024

Screening & Treating Tuberculosis Infection
February 28, 2024
San Antonio, Texas

Annie Kizilbash, MD, MPH has the following disclosures to make:

- No conflict of interests

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Heartland National TB Center,
San Antonio, TX

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Objectives

1. Describe the current epidemiology of TB

2. List the groups of people who are more likely to be exposed to or infected with *Mycobacterium tuberculosis*

3. List risk factors for progression to TB disease after infection with *M. tuberculosis*

What is the Current Epidemiology of TB in the US and along the US/Mexico Border?

FIGURE. Tuberculosis disease cases* and incidence,† by patient U.S. birth origin status§,¶ — National Tuberculosis Surveillance System, United States, 2012–2022
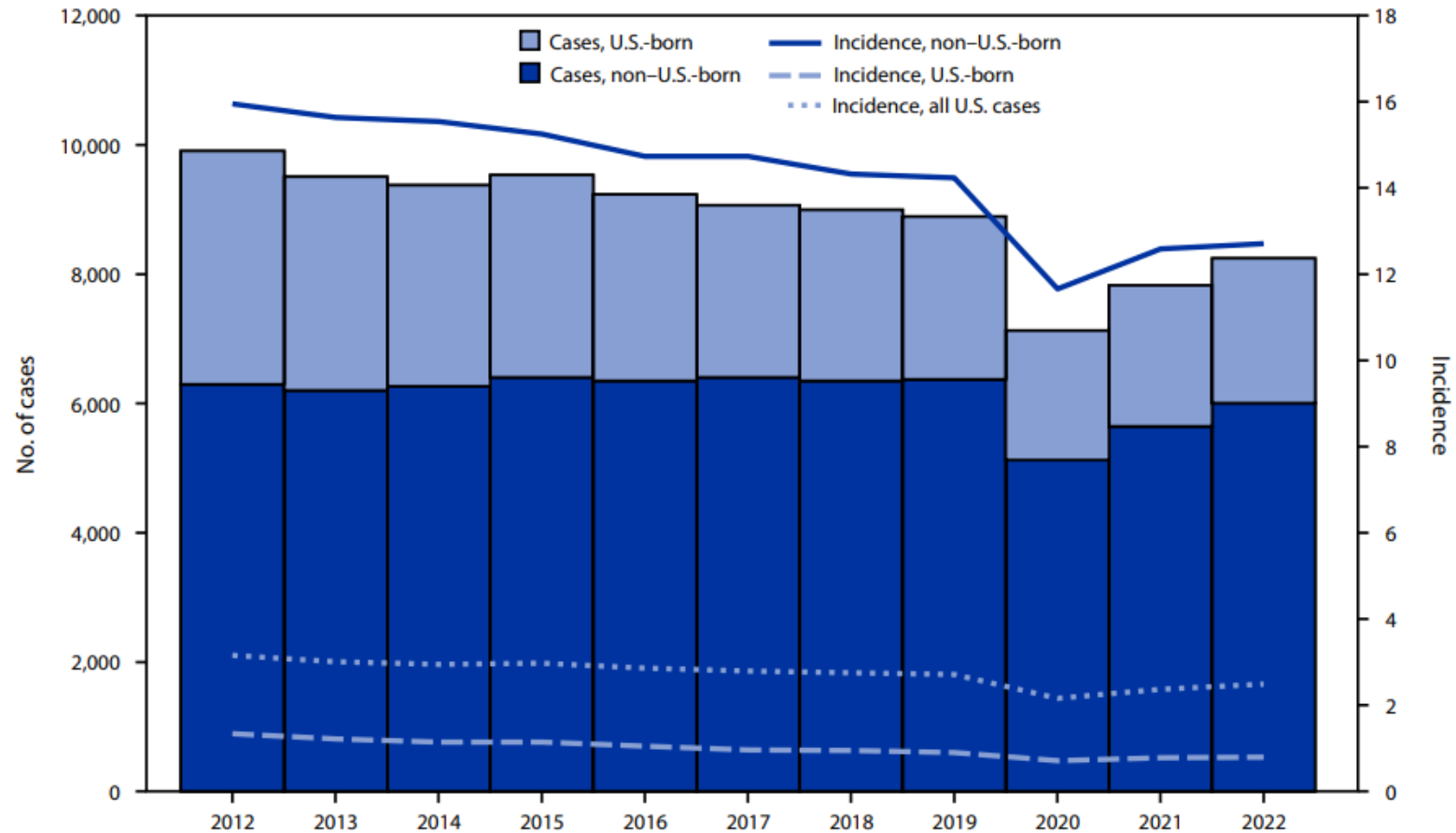
8,300 new TB cases (5.9% increase from 2021), 2.5 TB cases per 100k population in 2022

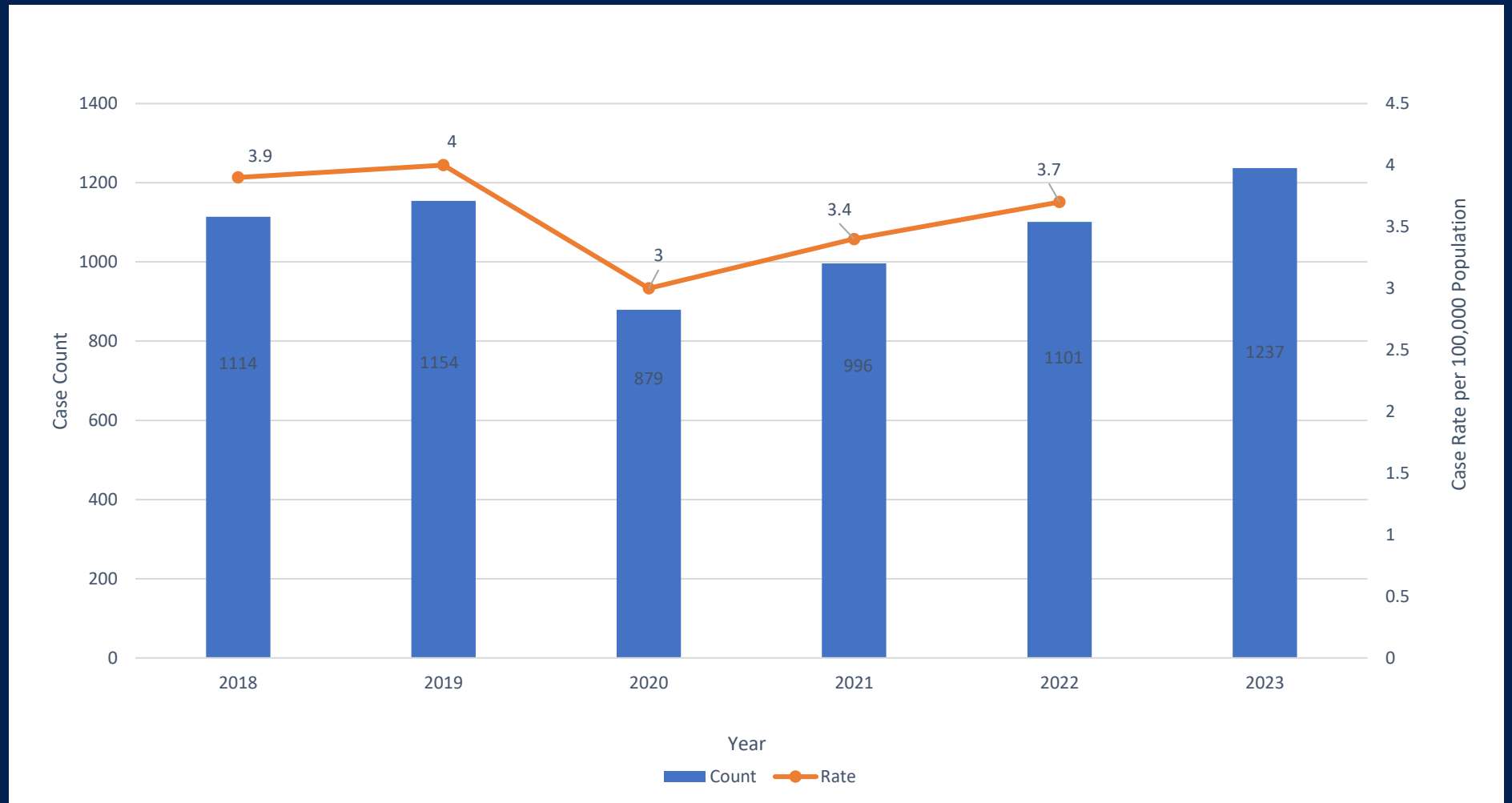**TB Cases and Incidence Rates* by Reporting Area, United States, 2022**

*Cases per 100,000 persons
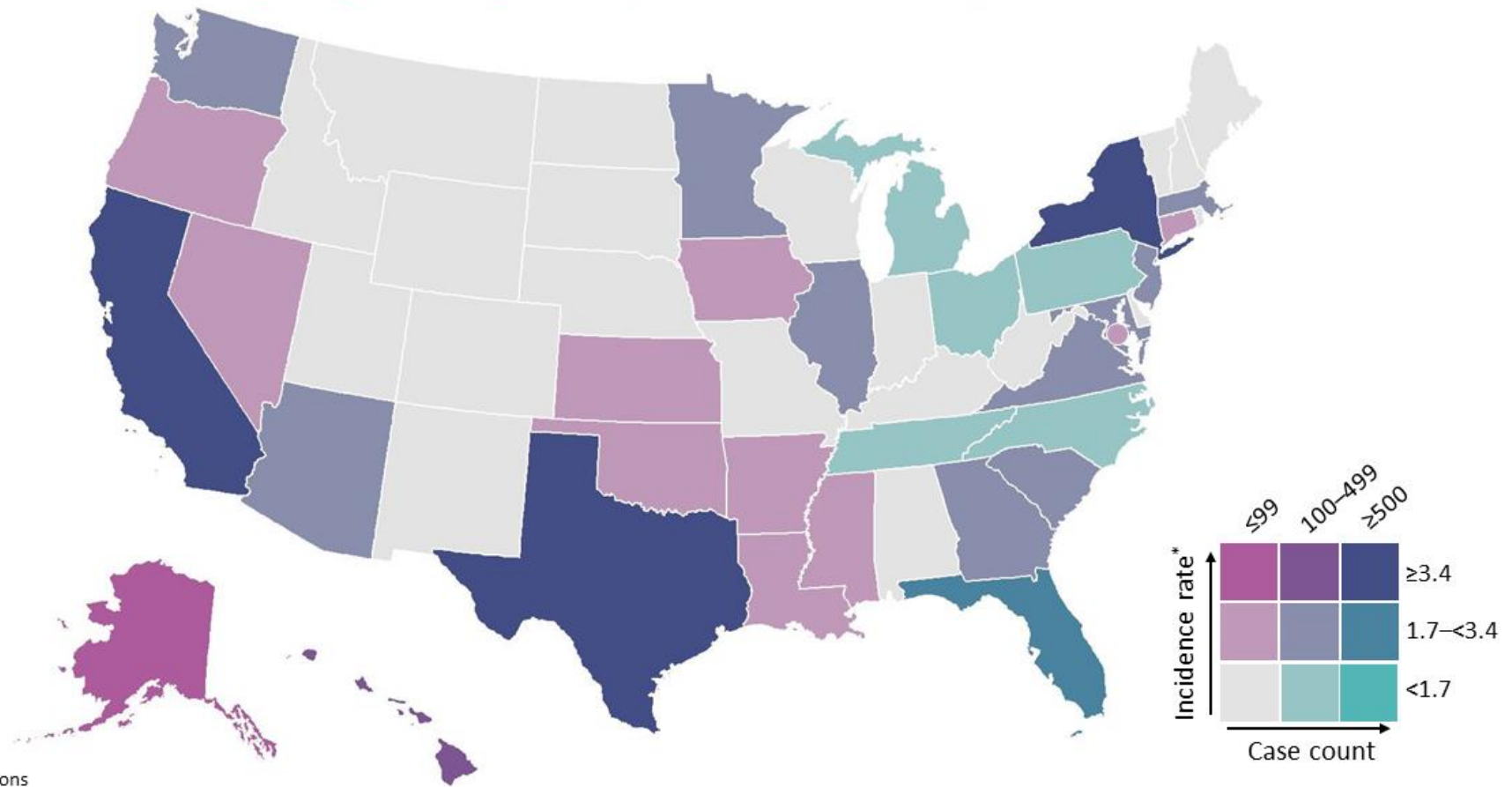
TB Case Counts and Rates in Texas, 2018-2023*

*2023 data are provisional and subject to change

Geographic Distribution of TB in Texas Communities, 2023*

- 284 (23%)
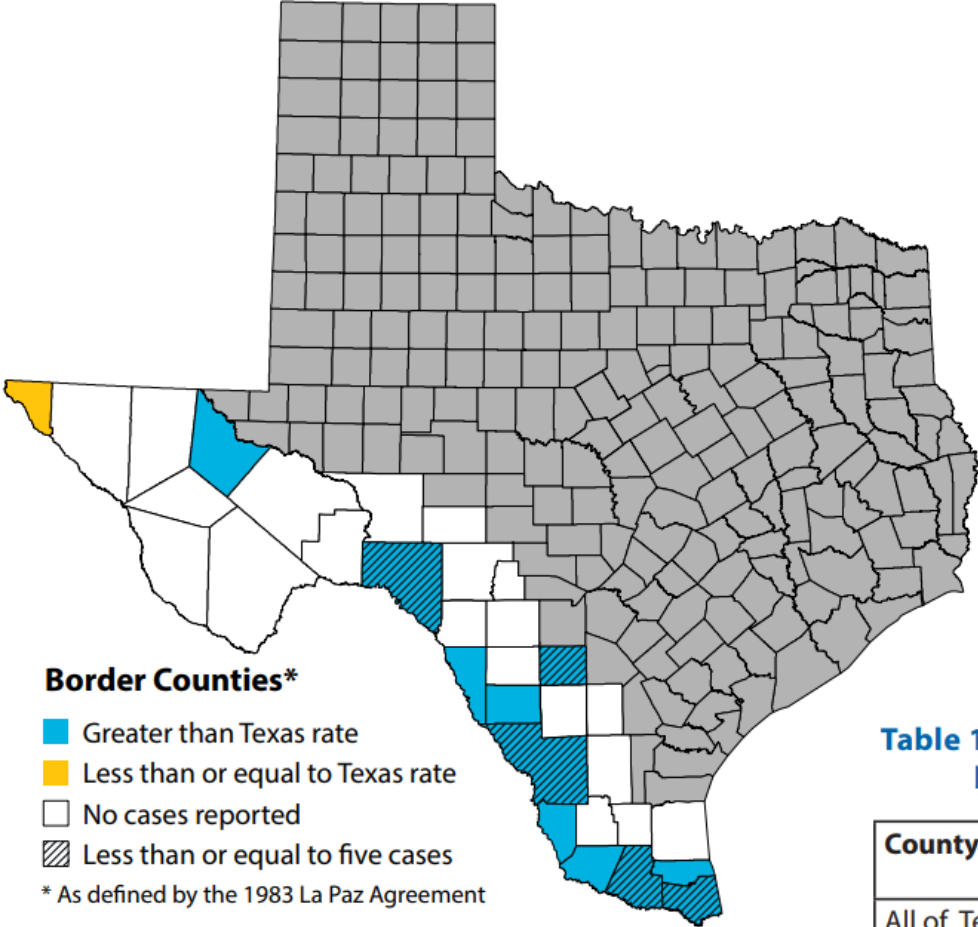- 583 (47%)
- 370 (30%)
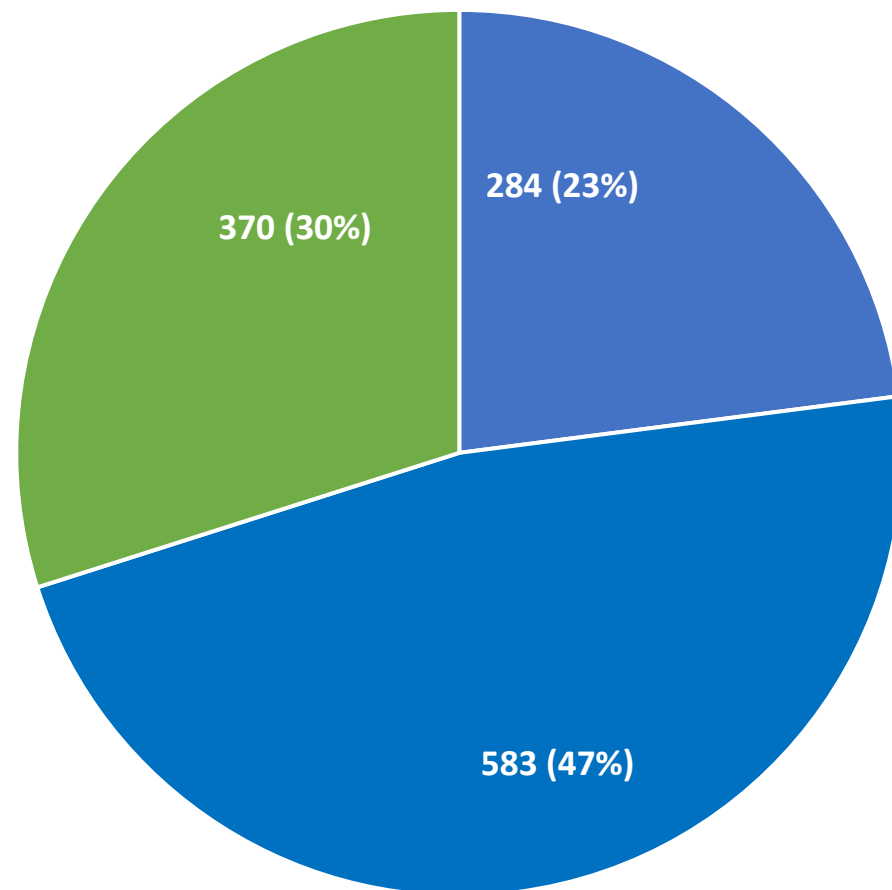
■ Border   ■ Metropolitan (Non-Border)   ■ Non-Metropolitan (Non-Border)

US/Mexico Border States

# Figure 1: Tuberculosis (TB) Case Rate, Texas Border Counties, 2019

The border between Texas and Mexico is 1,254 miles long. The 1983 La Paz agreement between the United States and Mexican federal governments designated counties within 100 kilometers of the U.S.-Mexico border as border counties. Texas has 32 border counties. Figure 1 illustrates a map of border counties and incident TB rates in relation to the overall rate in Texas.

Border Counties*

- 🟦 Greater than Texas rate
- 🟨 Less than or equal to Texas rate
- ⬜ No cases reported
- ▨ Less than or equal to five cases

* As defined by the 1983 La Paz Agreement

Source: Texas DSHS, 2019

Table 1: Top 5 Border Counties by TB Cases, 2019

County/State	Number of Cases	Case Rate*
All of Texas	1,159	4.0
Hidalgo County	71	8.2
Cameron County	49	11.6
Webb County	34	12.3
Frio County	24	118.2
El Paso County	22	2.6

Figure 2: TB Incident Rate Comparison Among Texas, U.S., and Texas-Mexico Border Counties
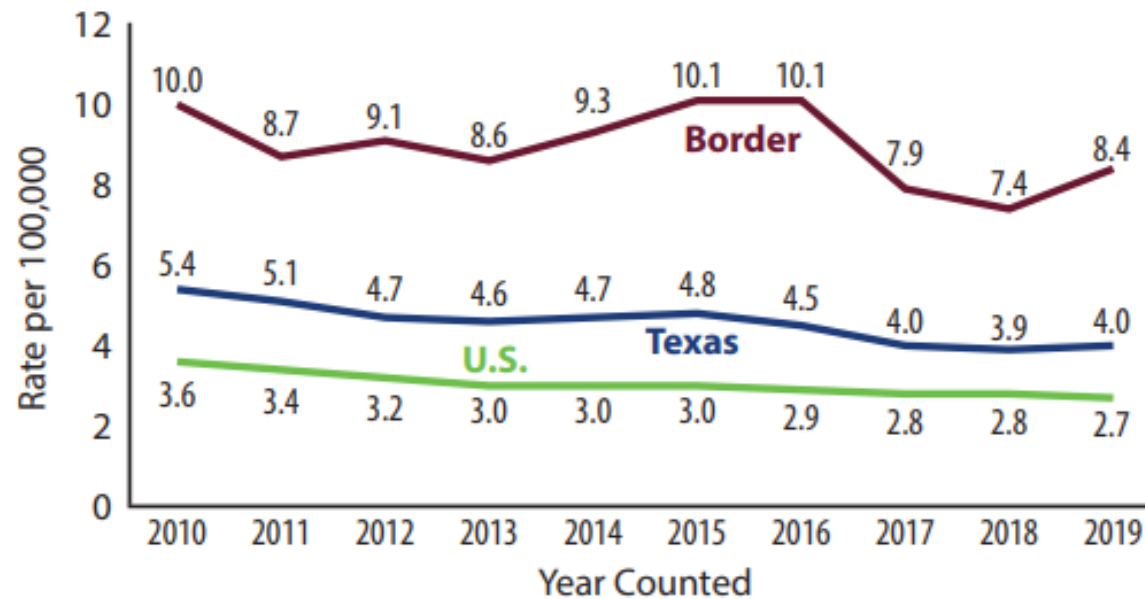
In 2019, the 32 border counties had an average TB incidence rate of 8.4/100,000, which was more than double the Texas TB rate of 4.0/100,000, and nearly triple the national rate 2.7/100,000.[1]

Table 2: Risk Factors Among Persons Diagnosed with TB Along the Border and Non-Border Counties, 2019

	Border	Non-Border
Alcohol Abuse	10%	10%
Non-Injection Drug Use	10%	9%
Injection Drug Use	1%	1%
Non-U.S. born	69%	61%
Homelessness	2%	4%
HIV	2%	5%
Diabetes	27%	20%
Resistant to Any Drugs	10%	6%

Who is more likely to be exposed or infected with *Mycobacterium tuberculosis* ?

Pathogenesis of Tuberculosis

Exposure to TB bacilli

No infection
(70-90%)

Infection
(10-30%)

Latent TB (90%)
-will never develop active TB
-not infectious

Active TB(10%)
-5% develop TB within 2 years
-5% develop TB years later

Risk Factors for Tuberculosis
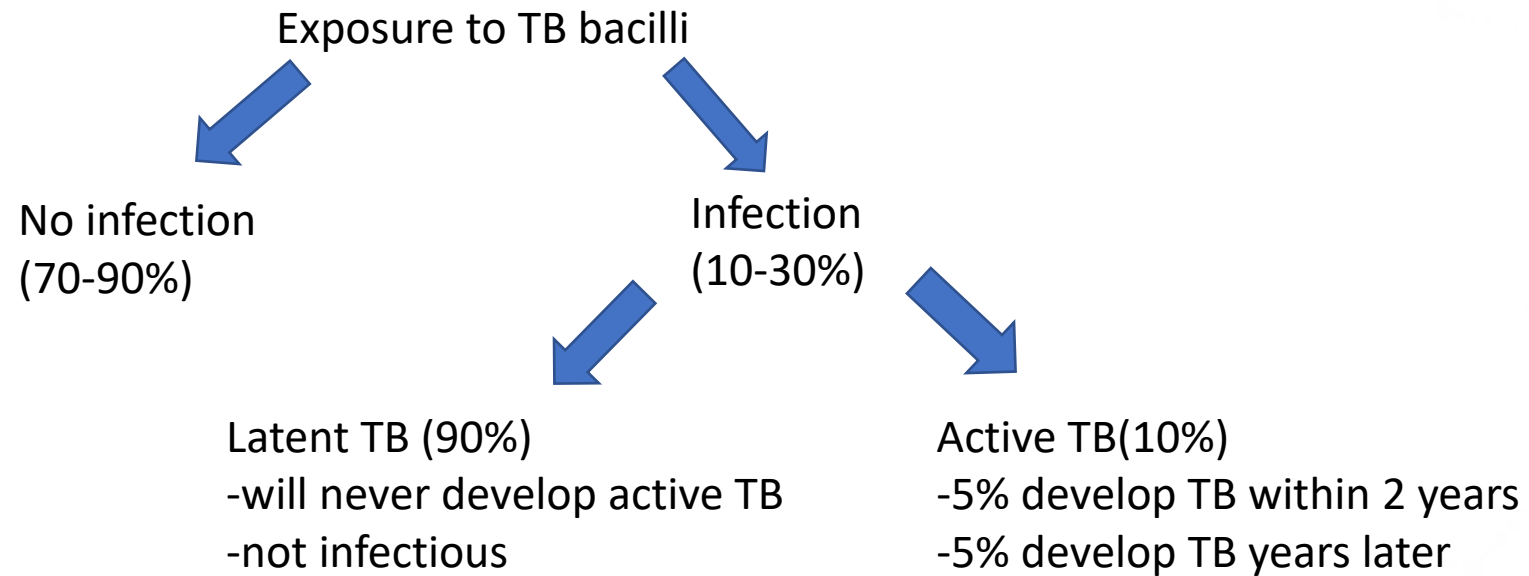
Who is more likely to be exposed to *M. tuberculosis*?

- Foreign born persons from countries with a high incidence of TB disease

- Residents and employees of high risk congregate settings (e.g. correctional facilities, long term care facilities)

- Healthcare workers

- Contacts to persons with infectious TB disease

- Persons who spend time in shelters

- Persons who use illicit drugs

Table 1. Prevalence of Latent Tuberculosis Infection among U.S. Residents, as Assessed by Tuberculin Skin Testing.*

Group and Study	Expected Prevalence (95% CI) %
Foreign-born persons	
Bennett et al.[4]	18.7 (13.5–25.2)
Close contacts of persons with infectious tuberculosis†	
Marks et al.[8]	37.1 (35.7–38.5)
Homeless persons	
Kong et al.[9]	12.8 (12.2–13.5)
Moss et al.[10]	32.4 (30.5–34.4)
Injection-drug users	
Riley et al.[11]	16.1 (12.5–22.4)
Grimes et al.[12]	27.7 (19.3–37.5)
Brassard et al.[13]	22.4 (17.7–28.5)
Salomon et al.[14]	14.0 (11.4–17.1)
Prisoners	
Lobato et al.[15]	17.0 (16.8–17.1)
U.S.-born, no other risk	
Bennett et al.[4]	1.8 (1.4–2.1)

* See the Supplementary Appendix for the definition of a positive test result. CI denotes confidence interval.
† This group was not strictly defined but is generally considered to consist of members of the household of an infected person.

Latent Tuberculosis Infection in the United States, Horsburgh R., NEJM, 4/14/2011

Incidence of TB Global vs. USA

- Globally: In 2022
  - 10.6 million estimated cases of TB disease
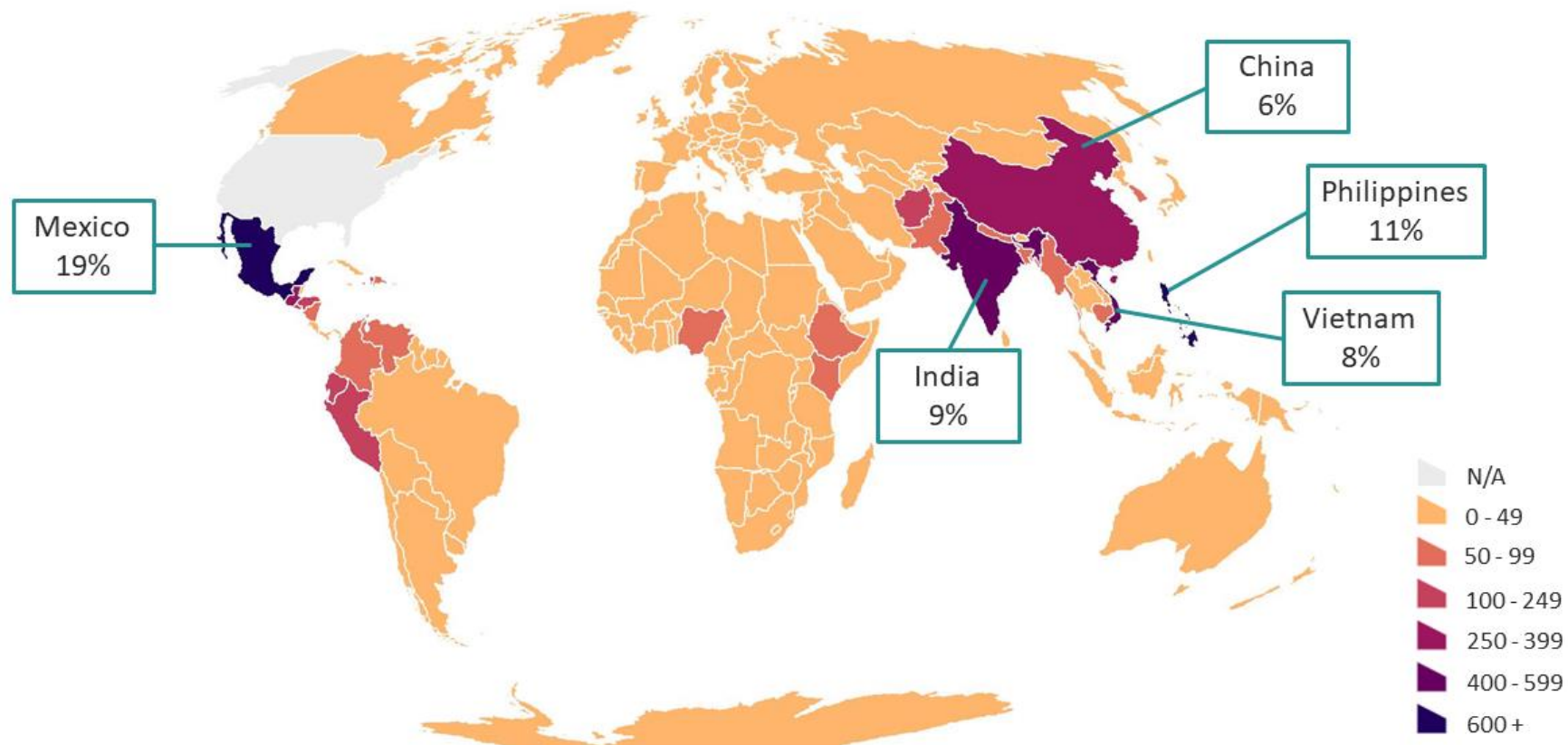 - 133 per 100,000 population

Global Tuberculosis Report WHO Report 2023

- USA: In 2022
  - 8,300 TB disease cases reported
  - 2.5 cases per 100,000 population

MMWR March 2023

TB Cases by Countries of Birth Among Non-U.S.–Born* Persons with TB, United States, 2022 (N=6,148)

China 6%

Philippines 11%

Mexico 19%

Vietnam 8%

India 9%

Legend:
- N/A
- 0 - 49
- 50 - 99
- 100 - 249
- 250 - 399
- 400 - 599
- 600 +

*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.

Correctional Facilities and Risk for TB

Incarcerated Americans
1920-2013
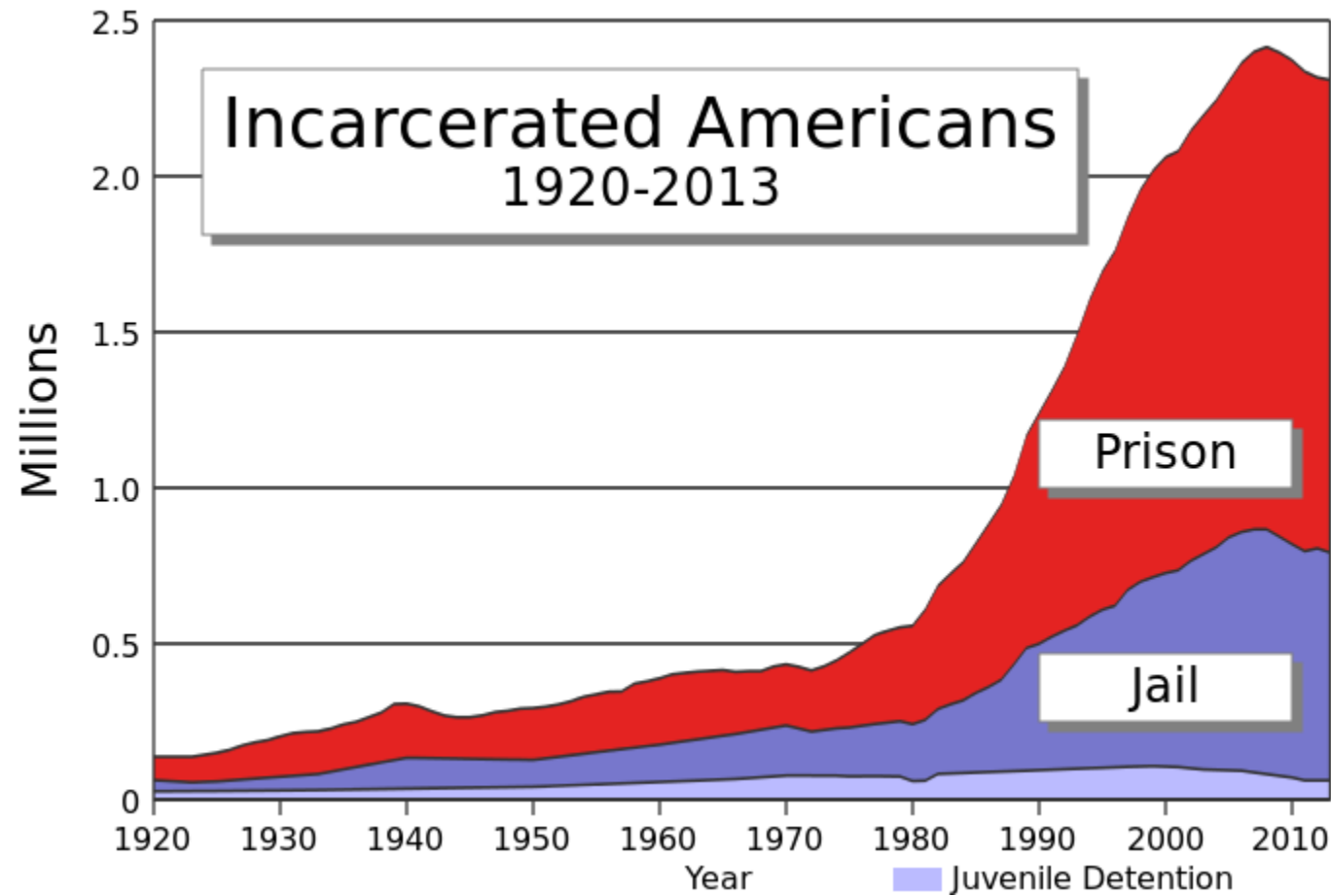
The U.S. has the highest incarceration rate of any country in the world, imprisoning about 730 out of every 100,000 citizens.
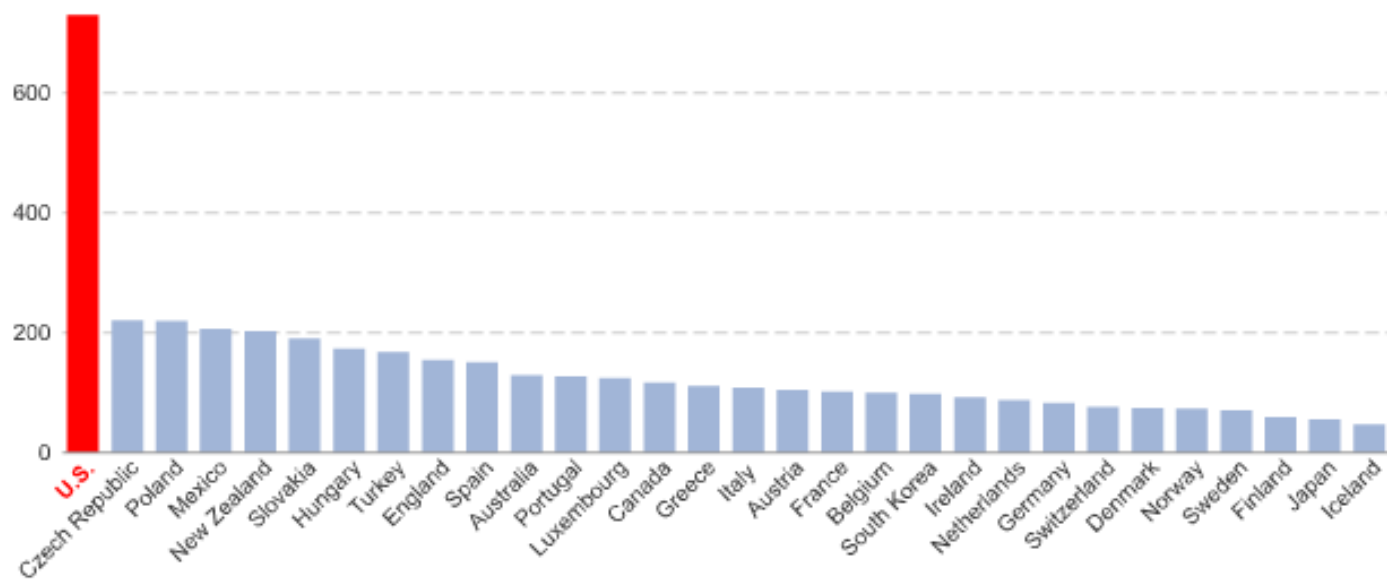
Incarceration Rates for Countries in the OECD

800 prisoners per every 100,000 citizens

Correctional facilities and Risk for TB

- Prevalence of LTBI among inmates high
  - 49 correctional facilities in 12 states, 198102 inmates , 17% TST positive
    - Treatment for latent TB in correctional facilities: a challenge for TB elimination; Loboto MN; Am J Prev Med. 2003; 24:249-53
- Correlation between length of incarceration and positive TST
  - 8% LTBI newly incarcerated, 5% increase with each year
    - Active and latent tuberculosis in Brazilian correctional facilities: cross sectional study; Carbone; BMC Infectious Diseases 2015
- Substantially higher TB disease cases rates in correctional populations
  - E.g. New Jersey (1994) - 91.2 cases per 100,000 (11 cases per 100,000 among all residents)

**Prevention and Control of Tuberculosis in Correctional and Detention Facilities:
Recommendations from CDC; MMWR: July 7, 2006**

Why ?

- At least three factors:

  - Those incarcerated are at higher risk for TB

  - Physical structure of the facility – inadequate ventilation, overcrowding, close living quarters

  - Movement of inmates into and out of facilities

3.3% TB cases diagnosed at a correctional facility in 2018

Tuberculosis among the Homeless

- TB outbreaks frequently originate in homeless shelters – high risk of recurrence

- Homeless – person without a fixed, regular adequate nighttime residence within 12 months preceding the diagnosis of TB

Homelessness in the U.S. hit a record high last year as pandemic aid ran out

UPDATED DECEMBER 15, 2023 · 4:25 PM ET ⓘ
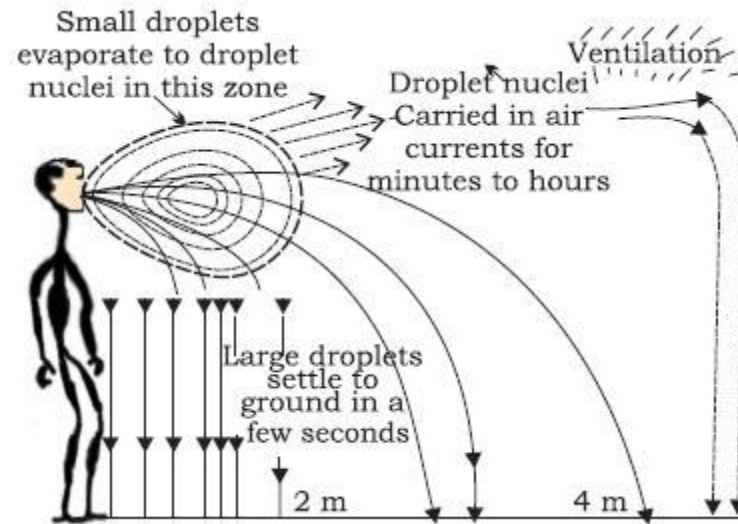
HEARD ON ALL THINGS CONSIDERED

Jennifer Ludden

▶ 4-Minute Listen   + PLAYLIST ⬇ <> ☰

What are environmental factors which increase likelihood of TB transmission?

- Poorly ventilated settings
- Crowding

Crowding and Risk of TB Transmission

- 'Persons per room' is widely used an indicator of crowding
  - Definition is problematic, varies between countries and temporally

- Increases the likelihood of contact between an infectious TB case and a susceptible person and increases intimacy of exposure
  - PPD conversion in children living in houses of TB cases is associated with the number of cubic ft/person in house
    - Chapman JS. Social and other factors in intrafamilial transmission of tuberculosis. Am Rev Respir Dis 1964
  - The number of new TB cases was highly correlated with overcrowding.
    - Stein L. Glasgow tuberculosis and housing. Tubercle 1954:35; 195-203

Shocking, the overcrowding in our prisons.

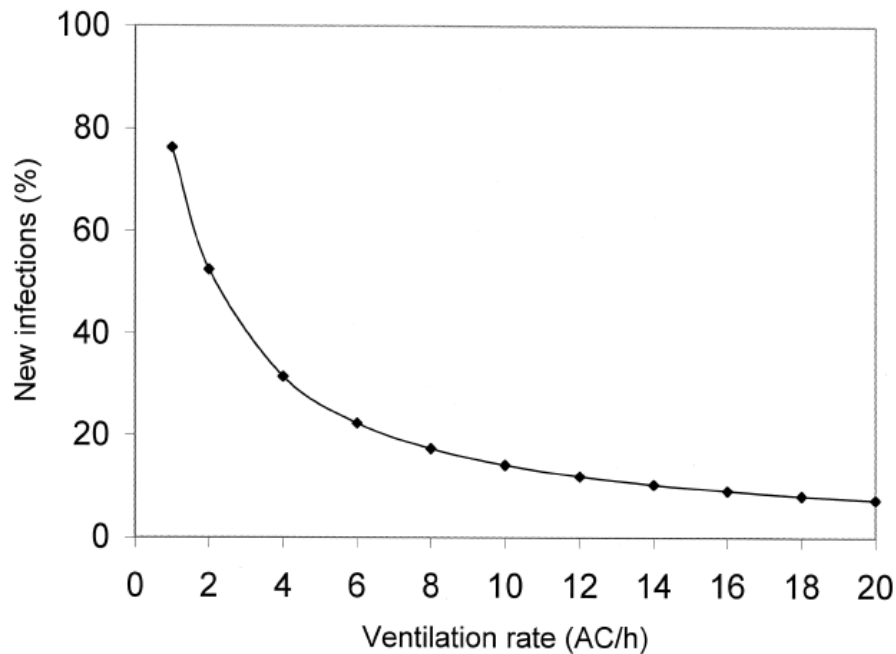# Poor Ventilation and Risk of TB Transmission

Figure 5 Effect of ventilation rate on new infections for base condition parameters with a total quanta production rate of 12 quanta/h and an exposure time of 16 h.

- Simplistic parametric model

- Depends on other factors such as room volume, occupancy density, infectious dose and susceptibility of host

The transmission of tuberculosis in confined spaces: an analytical review of alternative epidemiological models, Beggs C.B., Int J Tuberc Ling Dis 7(11): 1015-1026, 2003

Guidelines for Preventing the Transmission of *M.tuberculosis* in Health-Care Settings 2005; CDC

M. tb droplet nuclei size range (1 to 5 microns)
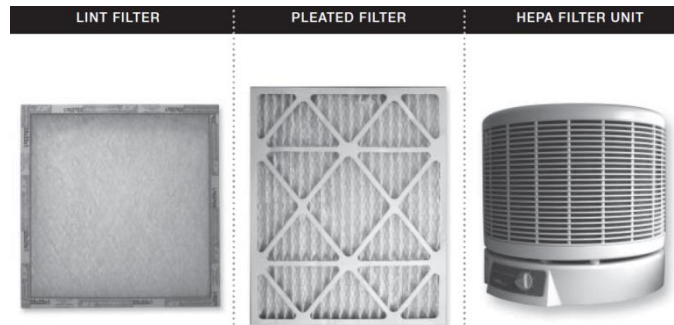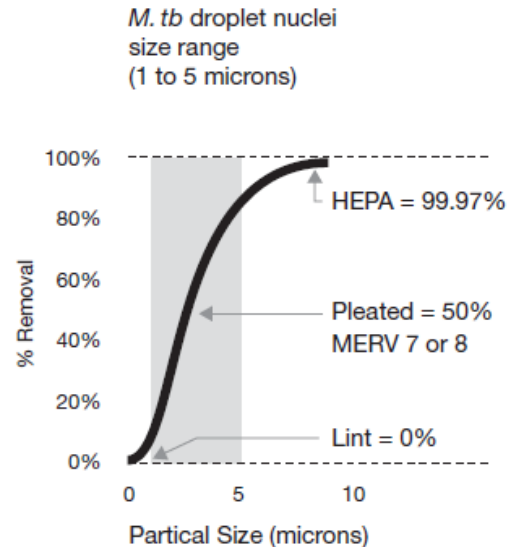
- Airborne infection isolation room
  - Minimum ventilation rate of 12 air changes per hour
  - Negative pressure rooms created by exhausting air
  - HEPA filters recommended ± UV germicidal irradiation

Why are Healthcare Workers Sick of TB?

- In low- and middle-income countries annual risk of TB infection in HCWs 3.9% to 14.3% (between 2.6% and 11.3% attributable to occupational exposure).

Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health-care workers in low- and middle-income countries: a systematic review. PLoS Med 2006;3(12):e494.

- Annual risk of developing TB disease was three times higher (95% CI:2.43–3.51) for HCWs compared to the general population.

Baussano I, Nunn P, Williams B, Pivetta E, Bugiani M, Scano F. Tuberculosis among health care workers.
Emerg   Infect Dis 2011;17(3):488–94.

Four occupational drug-resistant TB survivors unite behind ZERO TB and ZERO STIGMA on South African National Women's Day.

Healthcare Associated Outbreaks

Table Quanta production rate data for TB and measles outbreaks, as reported by various sources

Disease	Description	Reported quanta per hour	Reported by	Original source
TB	Average TB patient	1.25	Nardell et al.[13]	Riley et al.[15]
TB	Outbreak in office building	12.7	Nardell et al.[13]	Nardell et al.[13]
TB	Laryngeal case of TB	60	Nardell et al.[13]	Riley et al.[15]
TB	Bronchoscopy-related outbreak	250	Nardell et al.[13]	Catanzaro[14]
TB	Bronchoscopy-related outbreak	360	Gammaitoni & Nucci[11]	Catanzaro[14]
TB	Outbreak related to jet irrigation of abscess	2 280	Gammaitoni & Nucci[11]	Hutton et al.[16]
TB	Autopsy outbreak	5 400	Gammaitoni & Nucci[11]	Kantor et al.[17]
TB	Intubation-related outbreak	30 840	Gammaitoni & Nucci[11]	Haley et al.[18]
Measles	Outbreak in a school (index case)	5 580	Riley et al.[9]	Riley et al.[9]

- Extraordinarily high rate of production of droplet nuclei containing *M. tuberculosis* in 'artificial' clinically-induced outbreaks compared to 'normal' pulmonary TB patients

The transmission of tuberculosis in confined spaces: an analytical review of alternative epidemiological models, Beggs C.B., Int J Tuberc Ling Dis 7(11): 1015-1026

TB Screening and Testing of Healthcare Personnel, U.S., 2018

- Few (3%–5%) U.S. HCP test positive for *M. tb* at baseline
- Low rate of conversion of test to positive (<1%) among U.S. HCP during serial testing (*little transmission?*)
- Almost half of U.S. HCP reverted from positive to negative test result during serial testing (*false positive?*)
- No cases of TB disease reported among the ~64,000 U.S. HCP included in studies reviewed (*low incidence*)

Sosa et al. Tuberculosis Screening, Testing, and Treatment of U.S. Health Care Personnel: Recommendations from the NTCA and CDC, 2019. MMWR Morb Mortal Wkly Rep 2019;68:439–43.
https://www.cdc.gov/mmwr/volumes/68/wr/mm6819a3.htm?s_cid=mm6819a3_w

Contacts to persons with infectious TB disease

- Factors include:
  - Infectiousness of TB patient
  - Susceptibility of contact
  - Duration of contact
    - No safe exposure time has been established
  - Proximity of contact
    - Difficult to determine

Contact Investigation for Tuberculosis: a systematic review
and meta-analysis; Fox G, Eur Respir J. 2013

Proximity and Duration of MTB Exposure

- 32 years old Korean lady MDR pulmonary TB

- Flight from Chicago to Honolulu

- Flight duration 8.75 hours

- 15 positive TST
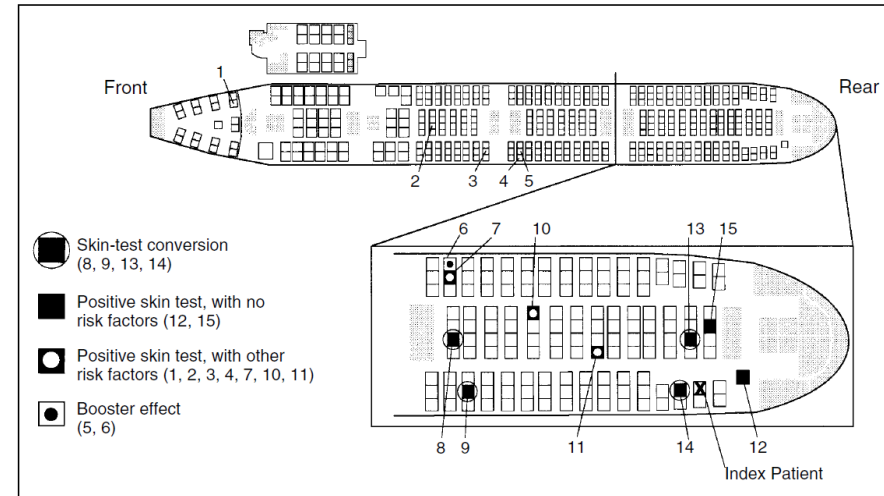 - 6 without TB risk factors

Figure 2. Diagram of the Boeing 747-100, with Seat Assignments of the Passengers and Flight Crew on Flight 4 Who Had Positive Tuberculin Skin Tests.

Numbers refer to the contacts listed in Table 2. Contact 12 was a member of the flight crew.

Table 3. Seat Locations in Aircraft and Results of Tuberculin Skin Tests of Passengers and Crew Members on Flight 4 Who Had No Risk Factors.*

SEAT LOCATION	NO. WITH POSITIVE SKIN TESTS/NO. TESTED (%)	RATE RATIO (95% CI)†	P VALUE
Not same cabin section as index patient	0/136	Reference value	—
Same cabin section as index patient	6/68 (8.8)	Undefined	0.001
Within 2 rows	4/13 (30.8)	8.5 (1.7–41.3)	0.01
Elsewhere in same section	2/55 (3.6)	Reference value	

Transmission of Multidrug Resistant Mycobacterium tuberculosis during a long airplane flight, NEJM 4/11/96

Chest X-ray of Index Patient 8 days after Flight

Sputum Bacteriology – AFB smear positive
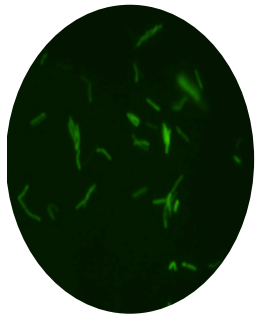
one microscopic field

CAP	ATS	Interpretation	AFB/ml sputum	Infectiousness of patient
negative	negative	negative	<5,000	probably not infectious
1 or 2 per smear	1 or 2 per smear	weakly positive	~5,000	probably infectious
<1 per field	1+	moderately positive	~10,000	probably infectious
	2+	moderately positive	~100,000	probably infectious
1-10 per field	3+	strongly positive	~1,000,000	probably very infectious
>10 per field	4+	strongly positive	>1,000,000	probably very infectious

Illicit Drug Use and TB

- IDU often share risk factors which confer additional risk for exposure

    Tuberculosis and Illicit Drug Use: Review and Update; Deiss R.G.; CID 2009: 48 Jan 1

- 'Shotgunning' – inhaling and exhaling smoke into another's mouth – Kansas TB outbreak

    A network informed approach to investigating a tuberculosis outbreak: implications for enhancing contact investigations. McElroy RD; Int J Tuberc Lung Dis 2003; 7 S486-93

Who is likely to progress to TB disease after infection with *M. tuberculosis?*

Risk Factors for Progression to TB disease after infection with *M.tuberculosis*

- Infants and children aged ≤5 years
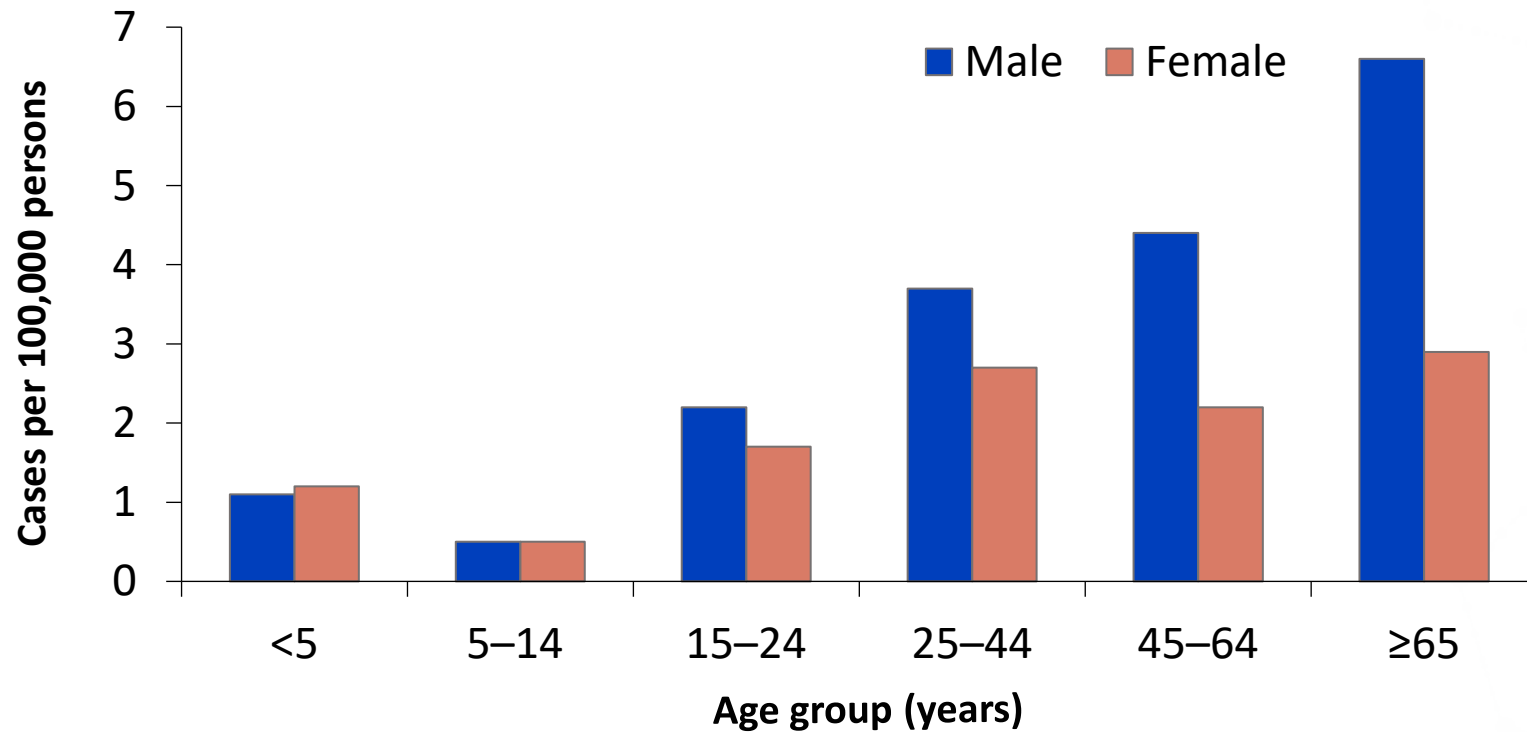
Percent Risk of Disease by Age

Age at Infection	Risk of Active TB
Birth – 1 year*	43%
1 – 5 years*	24%
6 – 10 years*	2%
11 – 15 years*	16%
Healthy Adults	5-10% lifetime risk
HIV Infected Adults[+]	30-50% lifetime

*Miller, Tuberculosis in Children Little Brown, Boston, 1963

[+]WHO, 2004

TB Case Rates by Age Group and Sex, United States, 2017*

*Cases per 100,000 population

Risk Factors for Progression to TB disease after infection with *M.tuberculosis*

- Infants and children aged ≤5 years
- Infected with *M. tuberculosis* within the prior 2 years

Pathogenesis of Tuberculosis

Exposure to TB bacilli

No infection
(70-90%)

Infection
(10-30%)

Latent TB (90%)
-will never
 develop active TB
-not infectious

Active TB(10%)
-5% develop TB within
2 years
-5% develop TB years
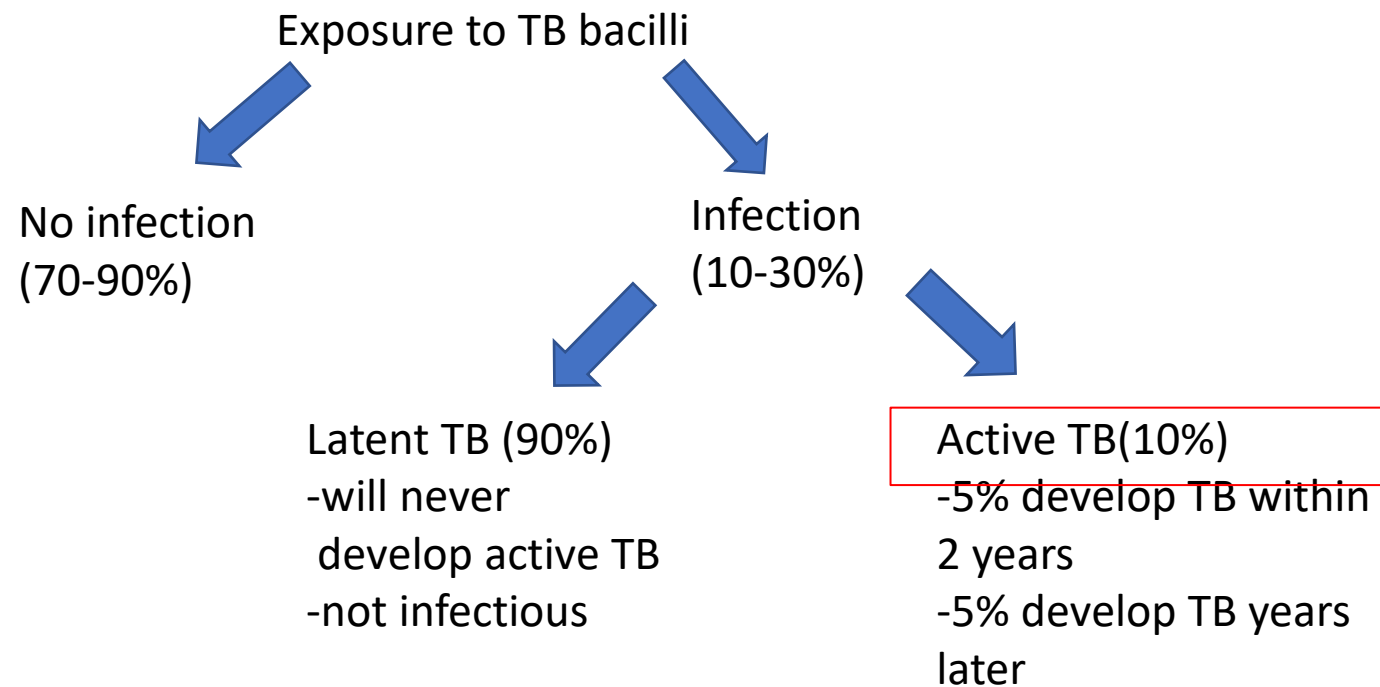later

Risk Factors for Progression to TB disease after infection with *M.tuberculosis*

- Infants and children aged ≤ 5 years
- Infected with *M.tuberculosis* within the prior 2 years
- HIV infection and other medical risk factors

Table 2. Common Risk Factors for Increased Likelihood of Progression from Latent Tuberculosis Infection to Active Disease.*

Risk Factor and Study	Relative Risk (95% CI)
	%
Advanced, untreated HIV infection	
Moss et al.[10]	9.9 (8.7–11)
Pablos-Méndez et al.[16]	9.5 (3.6–25)
Close contact with a person with infectious tuberculosis†	
Ferebee[17]	6.1 (5.5–6.8)
Radiographic evidence of old, healed tuberculosis that was not treated	
Ferebee[17]	5.2 (3.4–8.0)
Treatment with ≥15 mg of prednisone per day‡	
Jick et al.[18]	2.8 (1.7–4.6)
Chronic renal failure	
Pablos-Méndez et al.[16]	2.4 (2.1–2.8)
Treatment with TNF-α inhibitor	
Askling et al.[19]	2.0 (1.1–3.5)
Poorly controlled diabetes	
Pablos-Méndez et al.[16]	1.7 (1.5–2.2)
Weight ≥10% below normal	
Palmer et al.[20]	1.6 (1.1–2.2)
Smoking	
Bates et al.[21]	1.5 (1.1–2.2)

* Relative risk was calculated as described in Horsburgh.[5] CI denotes confidence interval, HIV human immunodeficiency virus, and TNF tumor necrosis factor.
† Relative risk was calculated for the first 3 years after exposure.
‡ The drug was taken for 2 weeks or more.

Latent Tuberculosis Infection in the United States, Horsburgh R., NEJM, 4/14/2011

Effect of HIV on Progression from Latent to TB Disease

Tuberculosis in the Homeless; A Prospective Study
Moss, A.; J Respir Crit Care Med Vol 162. pp 460–464, 2000

INCIDENCE OF REPORTABLE TUBERCULOSIS IN THE SAN FRANCISCO GENERAL HOSPITAL HOMELESS COHORT BY HIV AND TUBERCULIN SKIN TEST (TST) STATUS AT BASELINE

	n	Person-years	Cases	Rate per Person-Year	95% Confidence Interval
TST+, HIV+	40	134	6	4.46	(1.76–9.10)
TST+, HIV−	695	2,524	12	0.48	(0.25–0.80)
TST−, HIV+	155	559	3	0.56	(0.14–1.46)
TST−, HIV−	1,382	4,422	3	0.07	(0.02–0.18)
TST unknown, HIV+	49	185	1	0.54	(0.02–2.14)
TST unknown, HIV−	443	1,418	0	0	(0.0–0.21)
Total	2,764	9,221	25	0.27	(0.18–0.39)

HIV infected had about a 10 times higher risk of reactivation than those HIV uninfected

Effect of HIV on Latent TB Reactivation

*HIV infected with 25 times the rate of reactivation of latent TB compared to HIV uninfected

Table 5. Estimated Rate of Reactivation Tuberculosis Among HIV-infected and HIV-uninfected Tuberculosis Patients Aged 15–64 Years Not Residing in California, United States, 2006–2008
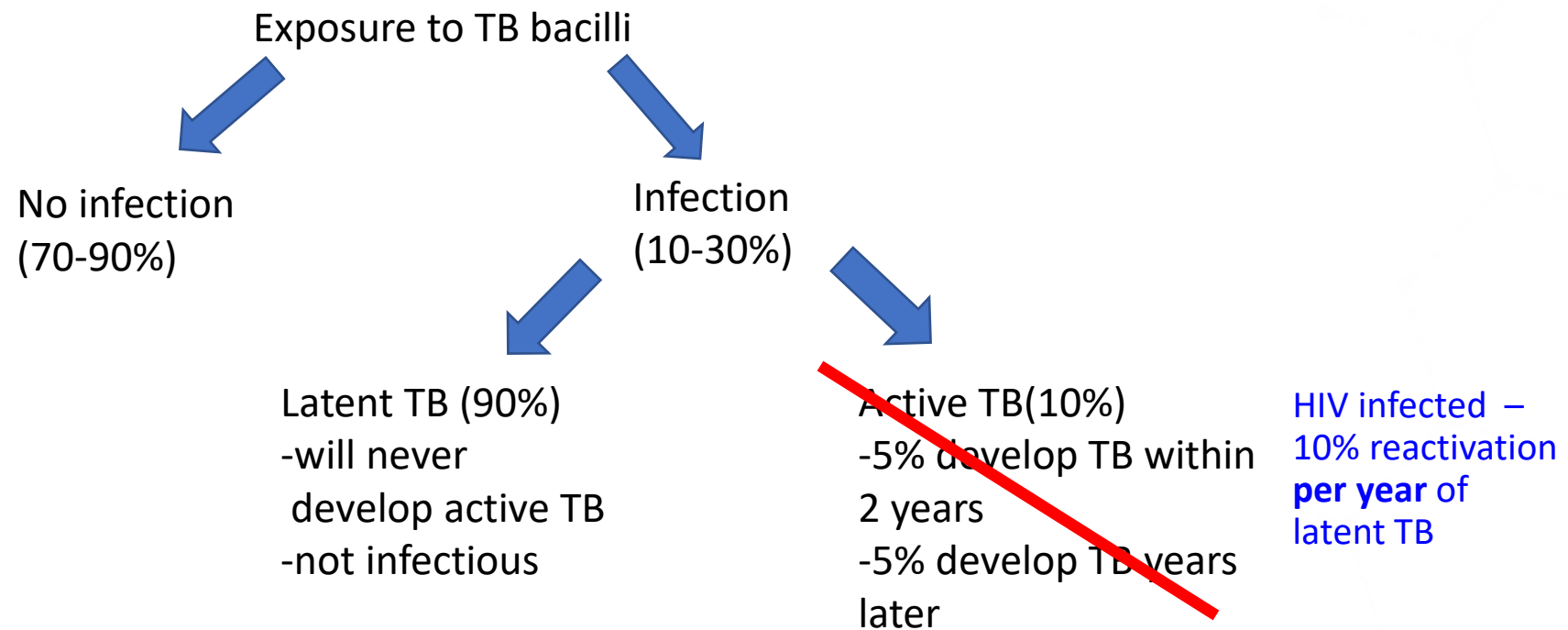
	Estimated No. of Reactivation TB Cases	Estimated % of US Population With Latent TB Infection	Estimated US Population	Estimated No. of PY at Risk for Reactivation TB	Estimated Rate of Reactivation TB per 100 PY	95% Confidence Interval
HIV-infected	2,198	4.2	961,000	121,100	1.82	1.74, 1.89
HIV-uninfected	16,568	4.2	182,243,000	22,850,000	0.073	0.070, 0.075

Abbreviations: HIV, human immunodeficiency virus; PY, person-years; TB, tuberculosis.

Estimated rate of reactivation of latent tuberculosis infection in the United States, overall and by population subgroup; Shea KM, Am J Epidemiol. 2014 Jan 15; 179(2):216-25

5.3% of TB patients with known HIV status in 2018 were coinfected with HIV, including 8.6% among persons aged 25–44 years. MMWR 2019

Pathogenesis of Tuberculosis

Exposure to TB bacilli

No infection
(70-90%)

Infection
(10-30%)

Latent TB (90%)
-will never
 develop active TB
-not infectious

Active TB(10%)
-5% develop TB within
2 years
-5% develop TB years
later

HIV infected –
10% reactivation
per year of
latent TB

Diabetes and TB

Richard Morton (1637-98) and his Phthisiologia

RICHARDUS MORTON M.D.

- A link between diabetes and TB has been recognized for centuries

- Diabetics have increased risk of progression to disease, failure of therapy, relapse and mortality from TB

Tuberculosis and diabetes mellitus: convergence of two epidemics; Dooley K; *Lancet Infect Dis*. 2009 December; 9(12): 737–746.

TABLE 3—Adjusted[a] Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Tuberculosis among Patients Discharged from Civilian Hospitals in California during 1991, by Race/Ethnicity

Variable	Whites Adjusted OR	Whites 95% CI	Hispanics Adjusted OR	Hispanics 95% CI	Blacks Adjusted OR	Blacks 95% CI
Sex (male vs female)	1.51	1.42, 1.61	1.02	0.96, 1.10	1.87	1.68, 2.08
Age, y						
<25 (reference)						
25–54	4.98	4.35, 5.70	2.87	2.66, 3.10	5.92	5.02, 6.98
>54	12.71	11.02, 14.65	9.98	8.93, 11.15	4.90	4.00, 6.01
Foreign born[b]	1.18	1.15, 1.21	1.14	1.11, 1.19	0.94	0.90, 0.99
Poor education[b]	1.40	1.31, 1.50	0.96	0.88, 1.05	2.33	2.02, 2.68
Median income[c]	0.99	0.98, 0.99	1.00	0.99, 1.01	0.97	0.95, 0.99
Health insurance						
Other (reference)[d]						
Medicare	2.22	2.04, 2.42	1.78	1.54, 2.06	2.58	2.17, 3.07
Medicaid	5.87	5.33, 6.46	3.71	3.39, 4.05	5.21	4.50, 6.02
None	2.10	1.88, 2.36	2.51	2.29, 2.76	5.39	4.61, 6.29
Diabetes mellitus	1.31	1.19, 1.45	2.95	2.61, 3.33	0.93	0.78, 1.09
Type II, uncomplicated	0.99	0.87, 1.15	1.67	1.39, 2.01	0.63	0.49, 0.82
Type I, uncomplicated	1.49	1.17, 1.88	2.22	1.66, 3.00	0.80	0.56, 1.13
Poor control/complicated	1.93	1.64, 2.28	5.73	4.78, 6.87	1.52	1.18, 1.95
HIV-related conditions	54.26	47.66, 61.77	237.81	160.81, 351.56	79.37	52.64, 119.67
Chronic renal insufficiency	4.11	3.30, 5.11	10.92	7.50, 15.89	2.23	1.61, 3.09
Alcohol-related conditions	10.19	8.87, 11.70	24.49	18.95, 31.64	9.29	6.92, 12.47
Drug use	4.63	3.26, 6.58	9.51	6.36, 14.20	9.26	6.26, 13.70

[a]Race stratified models containing all the variables listed in the table. The odds ratios for all variables, except drug use, were statistically different across race/ethnicity (P < .01 for each two-way interaction term).
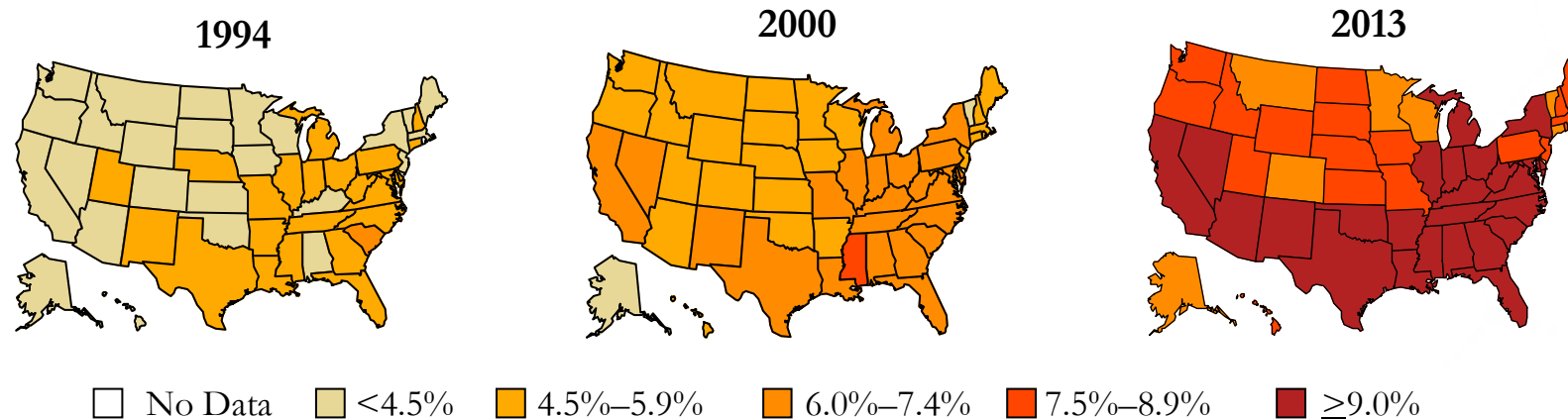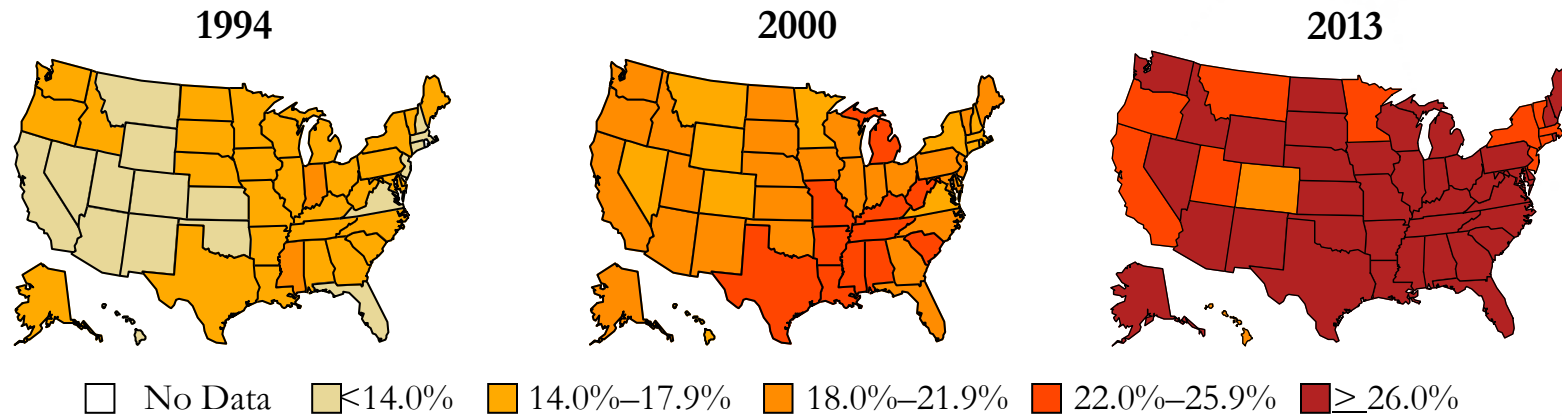[b]Risk associated with a 10% increase in the prevalence of foreign-born people or the proportion not completing high school in the zip code area where patients resided.
[c]Risk associated with a $1000 decrease in the mean income per capita in the zip code area where patients resided.
[d]Health insurance other than Medicare or Medicaid.

The role of diabetes mellitus in the higher prevalence of tuberculosis among Hispanics; Pablos M.A.; Am J Public Health 1997; 87:574-9

Age-adjusted Prevalence of Obesity and Diabetes

1994   2000   2013

No Data   <14.0%   14.0%–17.9%   18.0%–21.9%   22.0%–25.9%   ≥ 26.0%

1994   2000   2013

No Data   <4.5%   4.5%–5.9%   6.0%–7.4%   7.5%–8.9%   ≥9.0%

Chronic Kidney Disease and TB

TABLE 3—Adjusted[a] Odds Ratios (ORs) and 95% Confidence Intervals (CIs) for Tuberculosis among Patients Discharged from Civilian Hospitals in California during 1991, by Race/Ethnicity

Variable	Whites Adjusted OR	Whites 95% CI	Hispanics Adjusted OR	Hispanics 95% CI	Blacks Adjusted OR	Blacks 95% CI
Sex (male vs female)	1.51	1.42, 1.61	1.02	0.96, 1.10	1.87	1.68, 2.08
Age, y						
<25 (reference)						
25–54	4.98	4.35, 5.70	2.87	2.66, 3.10	5.92	5.02, 6.98
>54	12.71	11.02, 14.65	9.98	8.93, 11.15	4.90	4.00, 6.01
Foreign born[b]	1.18	1.15, 1.21	1.14	1.11, 1.19	0.94	0.90, 0.99
Poor education[b]	1.40	1.31, 1.50	0.96	0.88, 1.05	2.33	2.02, 2.68
Median income[c]	0.99	0.98, 0.99	1.00	0.99, 1.01	0.97	0.95, 0.99
Health insurance						
Other (reference)[d]						
Medicare	2.22	2.04, 2.42	1.78	1.54, 2.06	2.58	2.17, 3.07
Medicaid	5.87	5.33, 6.46	3.71	3.39, 4.05	5.21	4.50, 6.02
None	2.10	1.88, 2.36	2.51	2.29, 2.76	5.39	4.61, 6.29
Diabetes mellitus	1.31	1.19, 1.45	2.95	2.61, 3.33	0.93	0.78, 1.09
Type II, uncomplicated	0.99	0.87, 1.15	1.67	1.39, 2.01	0.63	0.49, 0.82
Type I, uncomplicated	1.49	1.17, 1.88	2.22	1.66, 3.00	0.80	0.56, 1.13
Poor control/complicated	1.93	1.64, 2.28	5.73	4.78, 6.87	1.52	1.18, 1.95
HIV-related conditions	54.26	47.66, 61.77	237.81	160.81, 351.56	79.37	52.64, 119.67
Chronic renal insufficiency	4.11	3.30, 5.11	10.92	7.50, 15.89	2.23	1.61, 3.09
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[a]Race stratified models containing all the variables listed in the table. The odds ratios for all variables, except drug use, were statistically different across race/ethnicity (P < .01 for each two-way interaction term).
[b]Risk associated with a 10% increase in the prevalence of foreign-born people or the proportion not completing high school in the zip code area where patients resided.
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The role of diabetes mellitus in the higher prevalence of tuberculosis among Hispanics;
Pablos M.A.; Am J Public Health 1997; 87:574-9

Malnutrition and Progression from Latent to Active TB

- Ecologic Study
  - Prisoners of War
    - British soldiers given food supplements – TB incidence 1.2%

    - Russian soliders not given food supplements – TB incidence 15-19%
      - Leyton G B. Effects of slow starvation. Lancet 1946; 2: 253–255

The Effects of Smoking on Latent TB

Figure 3. Forest plot of results for men only and for men and women combined in studies[4,17,19-28] that examined smoking and tuberculosis disease. The smoking type (ex-smokers [Ex], current smokers [Current], and ever smokers [Ever]) of the study population is shown on the y-axis.

Figure 1. Forest plot of results of 5 studies[11-14,16] that examined smoking and tuberculosis infection. The smoking type (current smokers [Current], ex-smokers [Ex], and ever smokers [Ever]) of the study population is shown on the y-axis.

- Smoking associated with RR 1.7 for TB Infection and RR 2.3-2.7 for TB disease

- Estimated RR for development. of TB disease in a TB infected population of 1.4-1.6

Risk of Tuberculosis From Exposure to Tobacco Smoke;
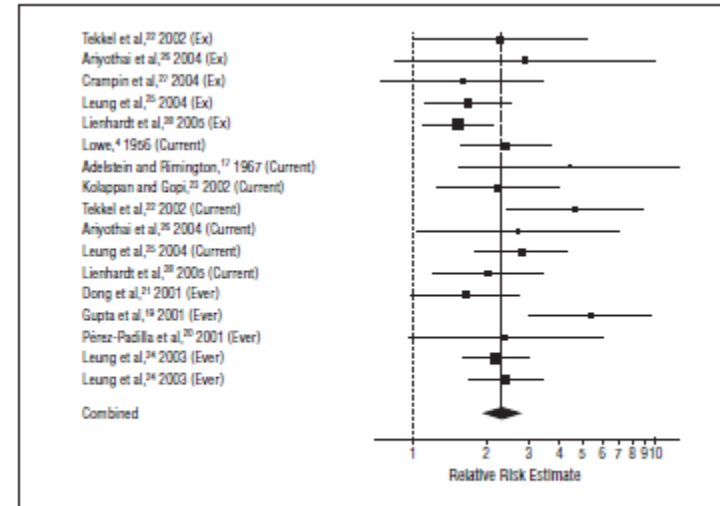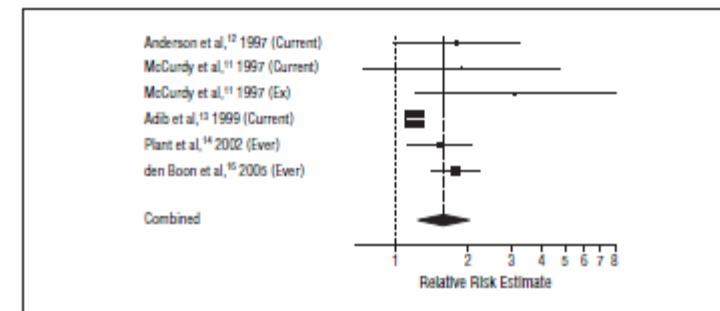Bates M.N.; Arch. Int. Med, Feb 2007

Steroids and TB

- CDC guidelines – Prednisone 15mg/day (or its equivalent) administered for 1 month is a risk factor for tuberculosis, primarily because this dosage has been shown to suppress tuberculin reactivity.

- However, specific thresholds of dose and duration that could increase the risk for tuberculosis were unknown

Table 4. Relationship between glucocorticoid dose and risk of tuberculosis*				
Exposure†	Cases (n = 497)	Controls (n = 1,966)	Crude OR (95% CI)	Adjusted OR‡ (95% CI)
Highest daily dose				
Nonexposed§	395	1,798	1.0	1.0
<7.5 mg	7	7	4.8 (1.6–13.8)	2.3 (0.7–7.5)
≥7.5 mg	20	10	9.7 (4.4–21.6)	7.0 (2.9–16.8)
Unknown dose	24	21	3.6 (0.9–13.4)	3.4 (0.7–14.6)
Recent or past use	51	130	1.9 (1.3–2.7)	1.5 (1.0–2.2)
Most recent daily dose				
Nonexposed§	395	1,798	1.0	1.0
<7.5 mg	8	7	5.5 (1.9–16.1)	3.1 (0.9–10.3)
≥7.5 mg	19	10	9.1 (4.1–20.1)	6.0 (2.5–14.5)
Unknown dose	42	21	3.0 (0.8–10.7)	3.0 (0.7–12.3)
Recent or past use	51	130	1.9 (1.3–2.7)	1.5 (1.0–2.2)
Cumulative dose				
Nonexposed§	395	1,798	1.0	1.0
<1,000 mg	17	12	6.5 (3.0–13.9)	4.1 (1.8–9.3)
1,000–2,999 mg	8	5	9.4 (2.7–32.0)	8.3 (2.1–33.5)
≥3,000 mg	14	12	5.9 (2.6–13.2)	3.9 (1.5–9.7)
Recent or past use	51	130	1.9 (1.3–2.7)	1.5 (1.0–2.3)

* Values are the number unless otherwise indicated. OR = odds ratio; 95% CI = 95% confidence interval.
† Represents the dose equivalent of prednisone (see text for details).
‡ Adjusted for body mass index, smoking, diabetes, pulmonary diseases, and use of antirheumatic or immunosuppressive agents.
§ Referent.

Glucocorticoid Use, Other Associated Factors, and the Risk of Tuberculosis; Jick S; Arthritis & Rheumatism, Vol. 55, No. 1, February 15, 2006, pp 19–26

TNF alpha Antagonists

- TNF alpha activity is required for granuloma formation and control of MTB infection

- Used for rheumatoid arthritis, Crohn's disease, psoriasis and a variety of other immune mediated diseases

- Remicaid   (inflixamab)
- Embril   (entanercept)
- Humira   (adalimubab)
- Cimzia   (certolizumab)

Warning: Risk Of Infections
Infliximab

- Tuberculosis (frequently disseminated or extrapulmonary at clinical presentation), …and other opportunistic infections have been observed in patients receiving Remicade some of these infections have been fatal.

- Patients should be evaluated for LTBI with a TST.

- Treatment of LTBI should be initiated prior to therapy with Remicade.

- SEE WARNINGS

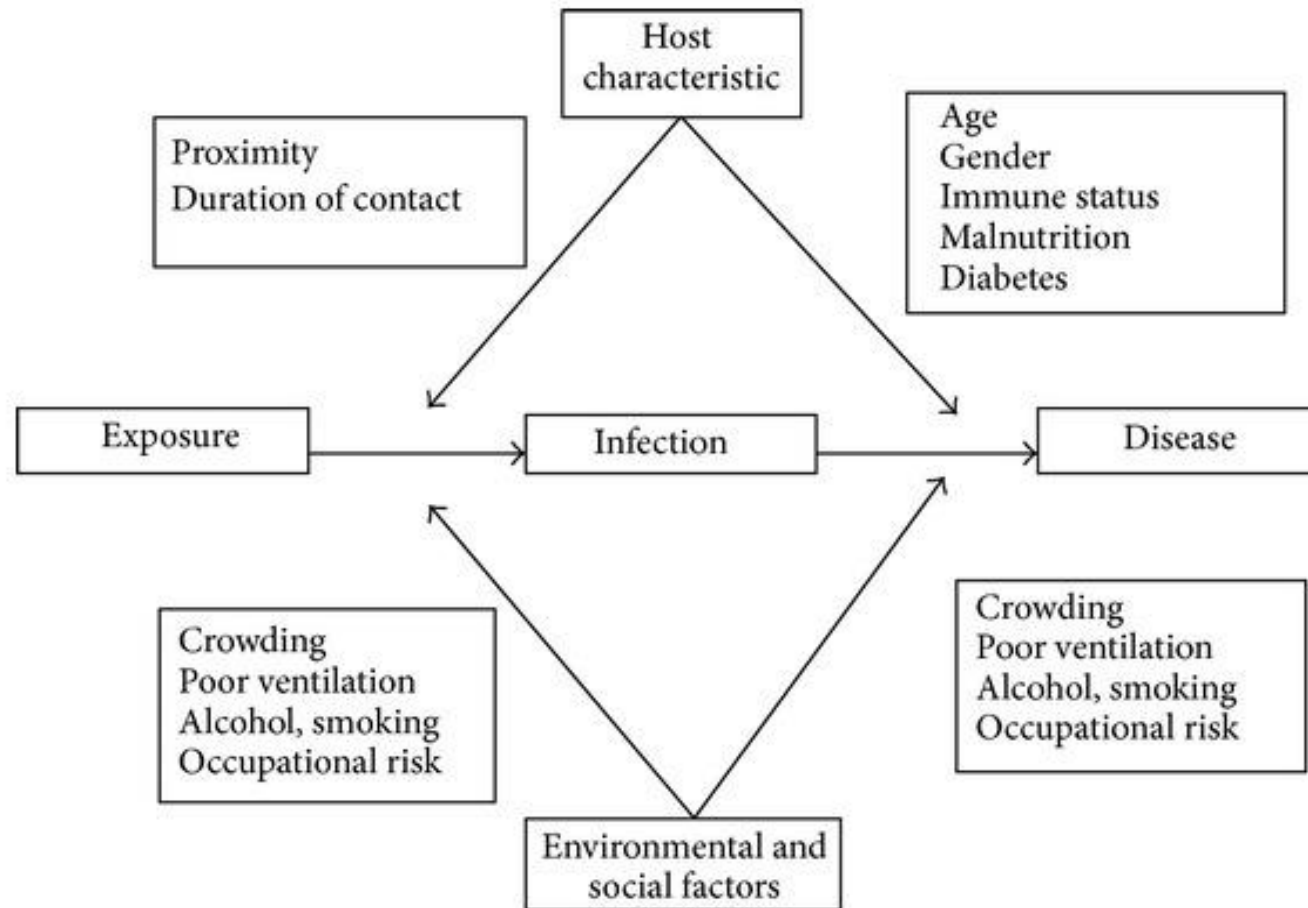 »   PDR 2004

TABLE 1 Risk factors for the development of active TB among persons infected with *Mycobacterium tuberculosis* (28)[a]

Risk factor	Estimated risk for TB relative to persons with no known risk factor
High risk (testing and treatment for LTBI recommended for all ages)	
AIDS (not on anti-HIV therapy)	110–170
HIV (not on anti-HIV therapy)	50–110
Transplantation (related to immunosuppressive therapy)	20–74
Silicosis	30
Chronic renal failure requiring hemodialysis	10–25
Carcinoma of head and neck	16
Recent TB infection (<2 yrs)	15
Abnormal chest X ray—with upper lobe fibronodular disease typical of healed TB infection	6–19
TNF-α inhibitors	2–9
Moderate risk (testing and treatment for LTBI recommended if age < 65 yrs)	
Treatment with glucocorticoids	5
Diabetes mellitus (all types)	2–4
Young age when infected (0–4 yrs)	2–5
Slightly increased risk (testing and treatment for LTBI recommended if age < 50 yrs)	
Underweight (<90% ideal body weight; for most persons, this is a BMI of 20)	2–3
Cigarette smoker (1 pack/day)	2–3
Abnormal chest X ray—granuloma	2
Low risk (testing and treatment for LTBI recommended if age < 35 yrs)	
Infected person, no known risk factor, normal chest X ray ("low-risk reactor")	1
Very low risk (treatment of LTBI not usually recommended)	
Person with positive two-step ("boosting"), no other known risk factor, and normal chest X ray	0.5

[a]Modified from the work of Lobue and Menzies (140) and the CDC.

Haley, CA, Treatment of LTBI, Microbiol. Spect. 2017, April 5(2).

Risk Factors for Tuberculosis

Thank you!