



Tuberculosis: A Persistent Public Health Threat

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OBJECTIVES



1. Describe the “natural history of disease” of tuberculosis infection, its management, and associated risk factors



2. List three challenges to TB eradication



3. Recognize the potential downstream effects of the COVID-19 pandemic on TB eradication

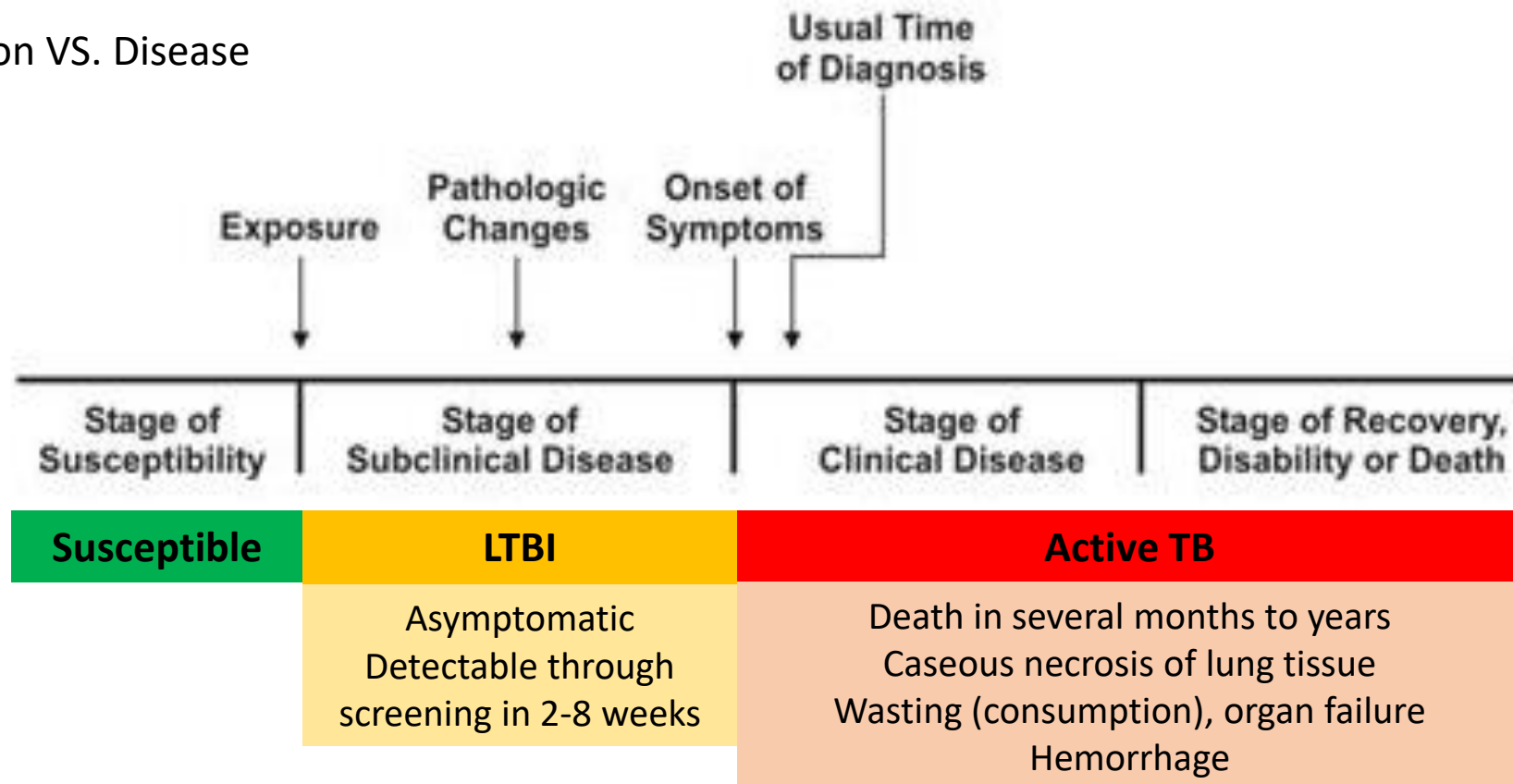


NATURAL HISTORY OF DISEASE

NATURAL HISTORY OF DISEASE

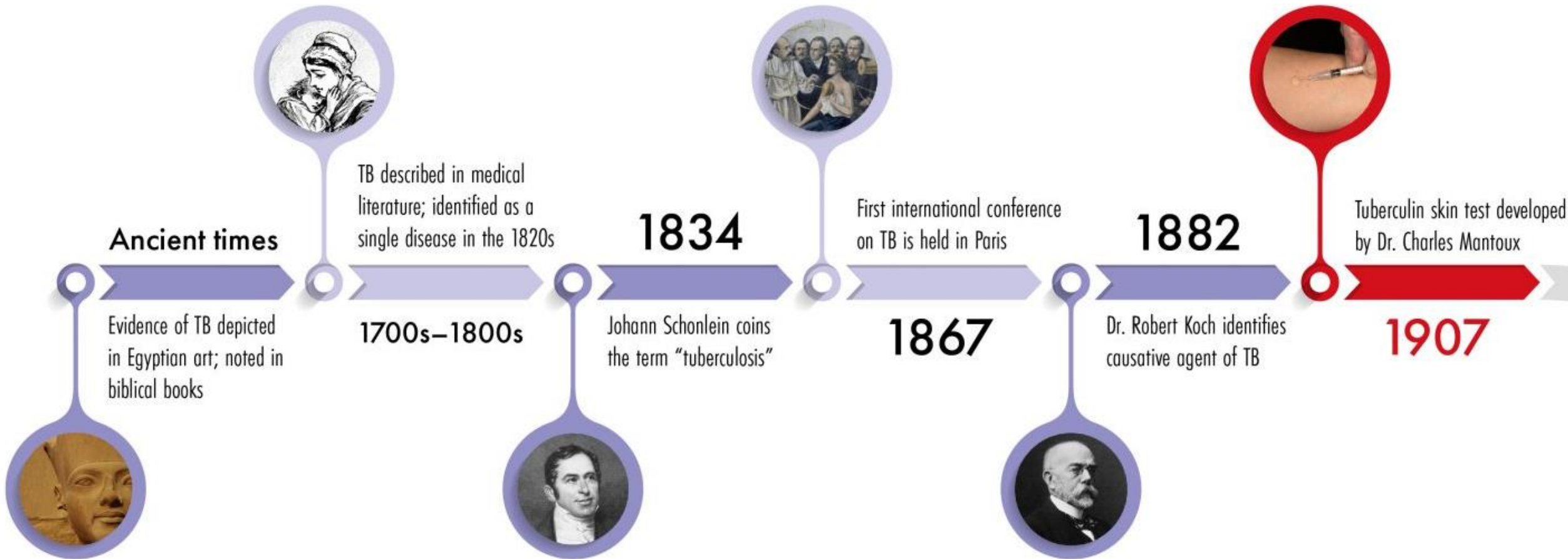
Definition: the progression of a disease process in an individual over time, in the absence of treatment

- Infection VS. Disease



[Caseous Necrosis](#)

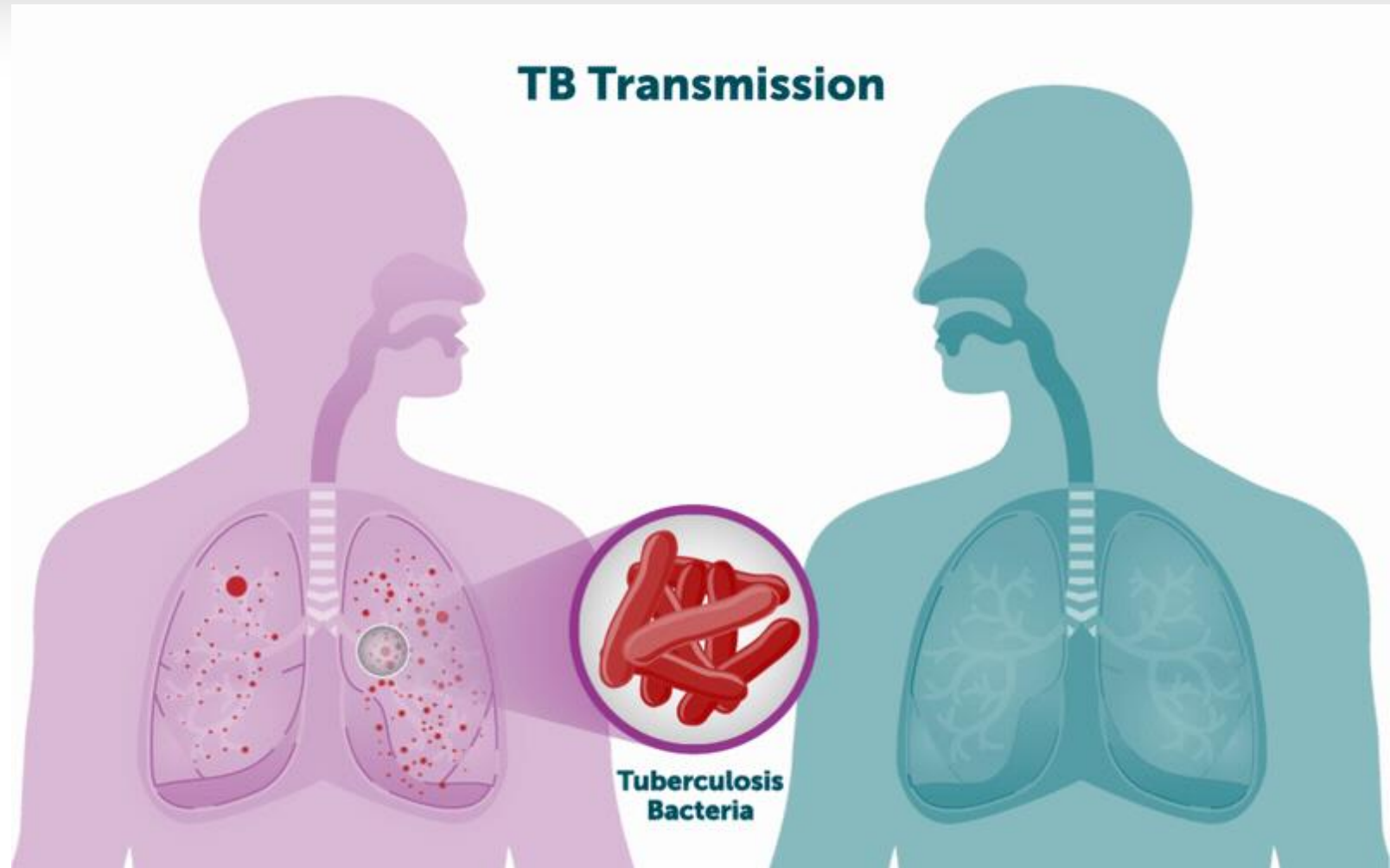
TB TIMELINE



<https://www.oxfordmeded.com/wp-content/uploads/2020/05/OI-Timeline-v4a-2048x1852.jpg>

TB BASICS

- *Mycobacterium tuberculosis*
- Airborne Transmission
- Incubation
- Forms of disease
- Genetic protections



https://www.cdc.gov/tb/webcourses/TB101/images/tb_transmission_final8.20.gif

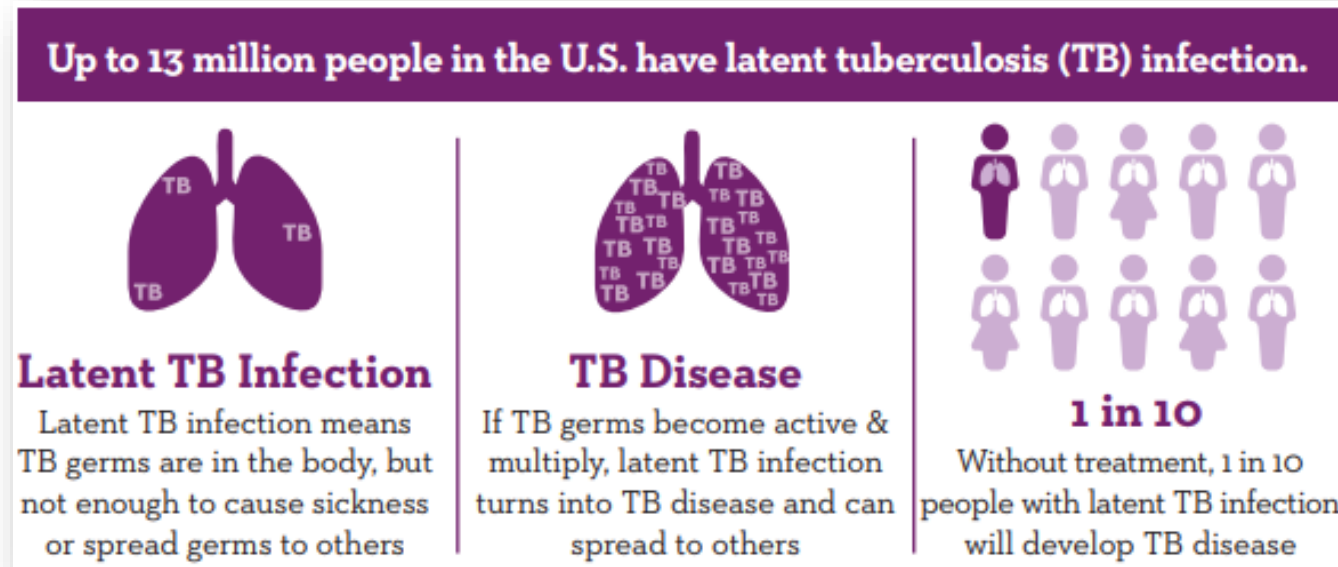
LATENT TB INFECTION (LTBI) and TB DISEASE

Latent TB Infection


- The **inactive state** of TB infection
- 1/4th of the world estimated to be infected
- 13 million in the US
- Considered **non-infectious**

TB Disease

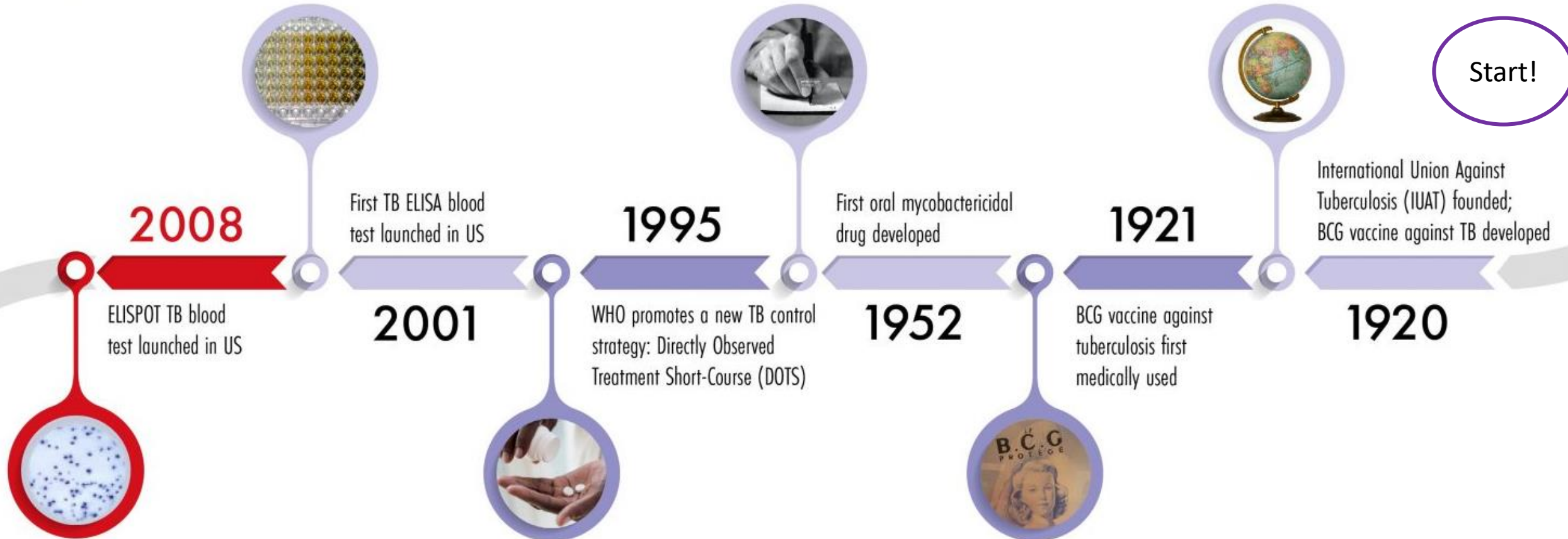
- The **active state** of TB Infection
- 10% of infected people will develop active disease
- Considered **infectious**



LATENT TB INFECTION (LTBI) and ACTIVE TB DISEASE

Risk Factor	Risk of Developing TB Disease	Description
TB infection and no risk factors	About 10% over a lifetime	For people with TB infection, no risk factors , and no treatment, the risk is about 5% in the first 2 years after infection and about 10% over a lifetime.
TB infection and diabetes	About 30% over a lifetime	For people with TB infection, diabetes , and no LTBI treatment, the risk is about 30% over a lifetime (3 times as high as those with no risk factors).
TB infection and HIV infection	About 7% to 10% PER YEAR 	For people with TB infection, untreated HIV infection and with no LTBI treatment, the risk is about 7% to 10% PER YEAR, a very high risk over a lifetime.

TB TIMELINE

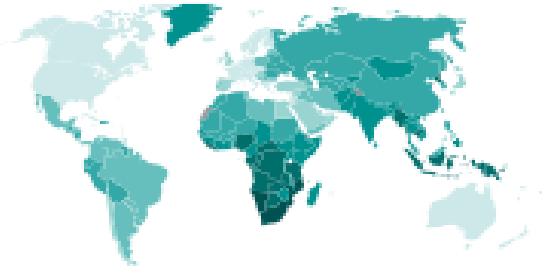


<https://www.oxfordmeded.com/wp-content/uploads/2020/05/OI-Timeline-v4a-2048x1852.jpg>

PEOPLE WHO SHOULD BE TESTED FOR TB INFECTION INCLUDE:



Contacts of
people with
TB disease



People who were born in or who
frequently travel to countries
where TB disease is common



People with health
problems that make it
hard to fight TB disease



HOSPITALS



HOMELESS
SHELTERS

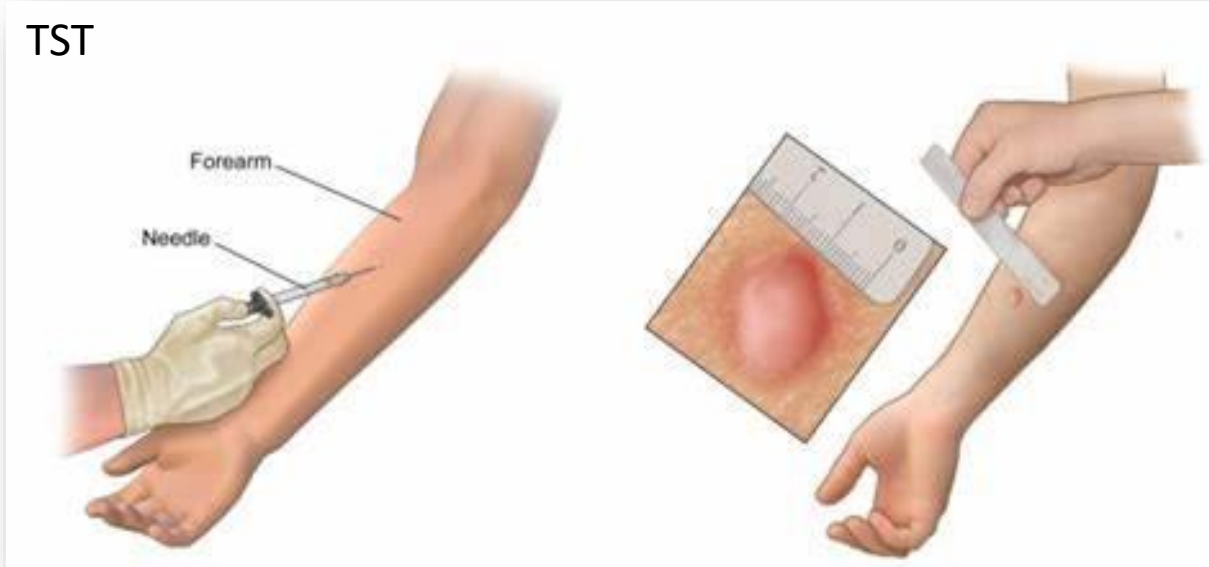


CORRECTIONAL
FACILITIES

People who spend time in places
where TB is more common

https://www.cdc.gov/tb/publications/infographic/pdf/Take-On-LatentTB_Annual_TB_FNLCLR.pdf

TST



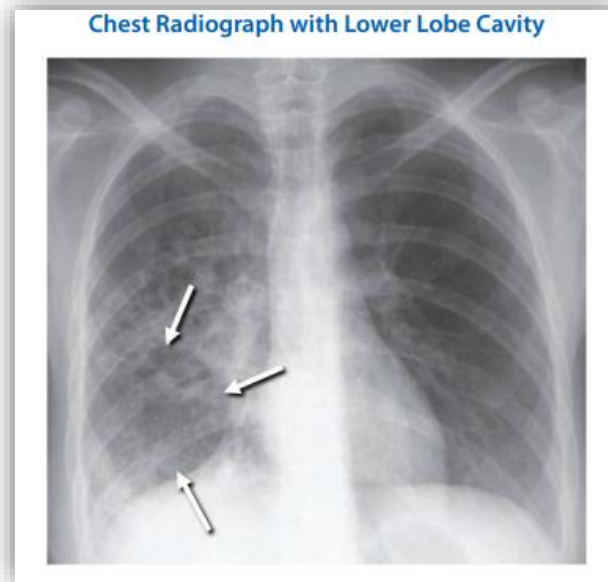
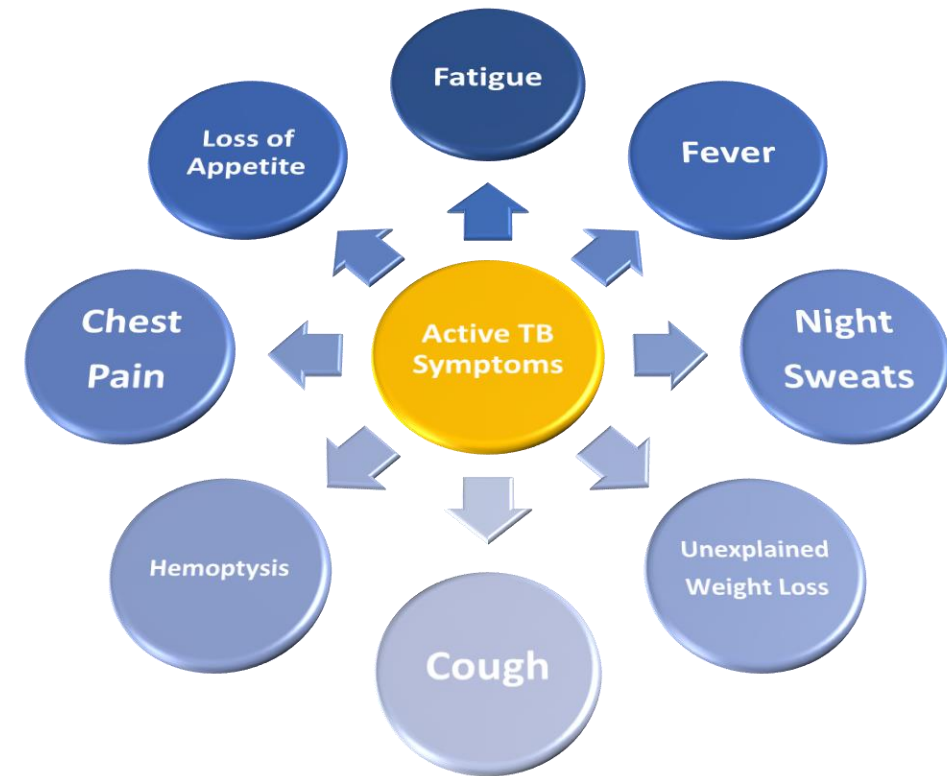
Quantiferon Collection Tubes



<https://th.bing.com/th/id/OIP.0-etpffs4E5dGxvBu7ngXAHaDe?pid=ImgDet&rs=1>

https://3.bp.blogspot.com/-Rn3PXrTEoQU/WiWRiUf6cFI/AAAAAAAAAbU/9bBEnsxlIhUwH7KxrPylc8rkrAA0yEYgQCPcBGAYYCw/s1600/IMG_20171204_094331_2%255B6893%255D.jpg

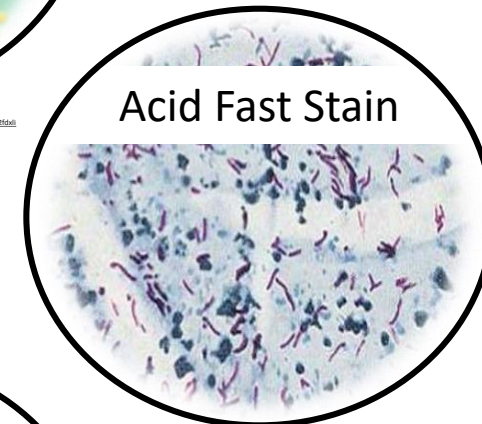
DIAGNOSING ACTIVE TB DISEASE



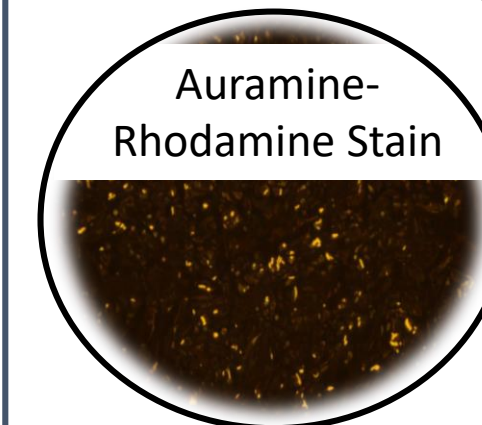
<https://www.cdc.gov/tb/education/corecurr/pdf/chapter4.pdf>



https://th.bing.com/th/id/R_390427599206f8b5e408e4522320d67?rik=BH4H6T2LcWg&u=http%3A%2F%2Fdeinfo2img%2Fnew_all%2Fmicrobacteri...culture_3.jpg&ehk=PT47YdMOT7ae3hN2FQ2eImqU7XKXthNvPIASd8huJN3d8r1nR&pid=img&w=600



https://th.bing.com/th/id/R_40690e5545742824d0af7f3c73d87a?rik=409w8u5u0QeA&u=http%3A%2F%2Fwww.abc.co.uk%2Fstatic%2Fnew%2Fdeinfo2img%2Fnew_all%2Fmicrobacteri...culture_3.jpg&ehk=PT47YdMOT7ae3hN2FQ2eImqU7XKXthNvPIASd8huJN3d8r1nR&pid=img&w=600



https://th.bing.com/th/id/R_a0886642db9287a1c5cb01ad3f14f39?rik=Ubm07K0nTnaUg&u=http%3A%2F%2Fwww.urmc.rochester.edu%2Furmc-labs%2Fpathology%2Fstainsmanual%2Fimages%2Fimage1109702174.jpg&ehk=T1N4879W%2BriO7vqgBok3AvaNZRi05JN5Wrmg48RH3js%3d8r1nR&pid=img&w&r=0&res=1&resct=1

TB MANAGEMENT

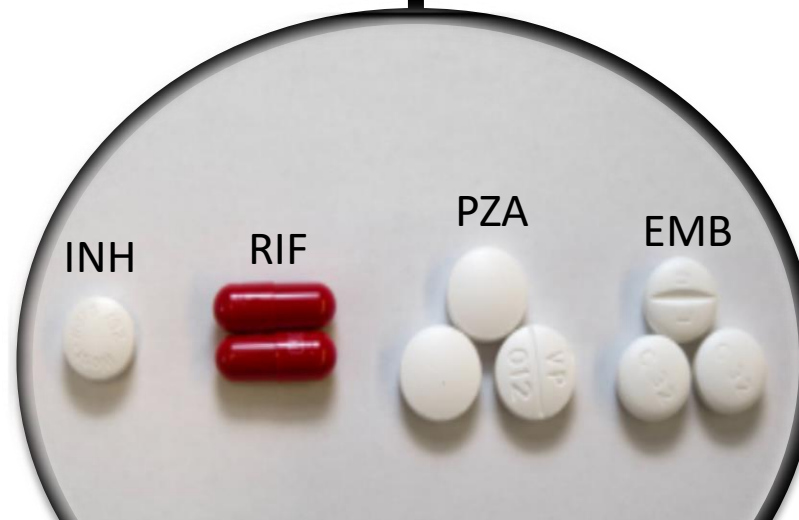
LTBI

- Treatment
 - Isoniazid (INH)
 - Rifapentine (RPT)
 - Rifampin (RIF)
- Course
 - 1HP (Short-HIV)
 - 3HP (Short)
 - 4R (Short)
 - 3HR (Short)
 - 6H/9H (Long)

of months _____ Drug

Active TB Disease

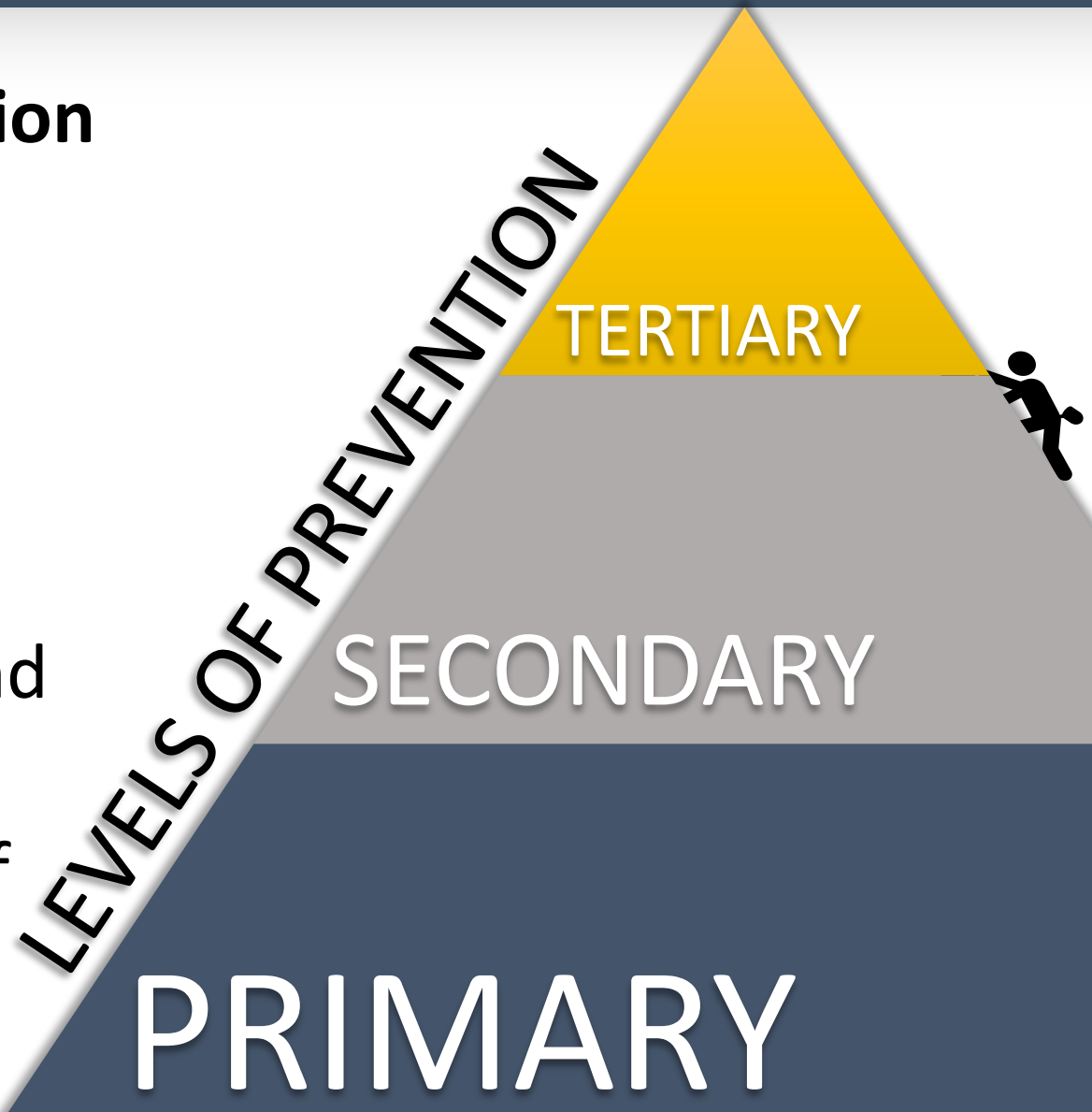
- Treatment (1st line)
 - R | rifampin (RIF)
 - I | isoniazid (INH)
 - P | pyrazinamide (PZA)
 - E | ethambutol (EMB)
- Course
 - 6-9 months
 - 18-24 months (MDR)



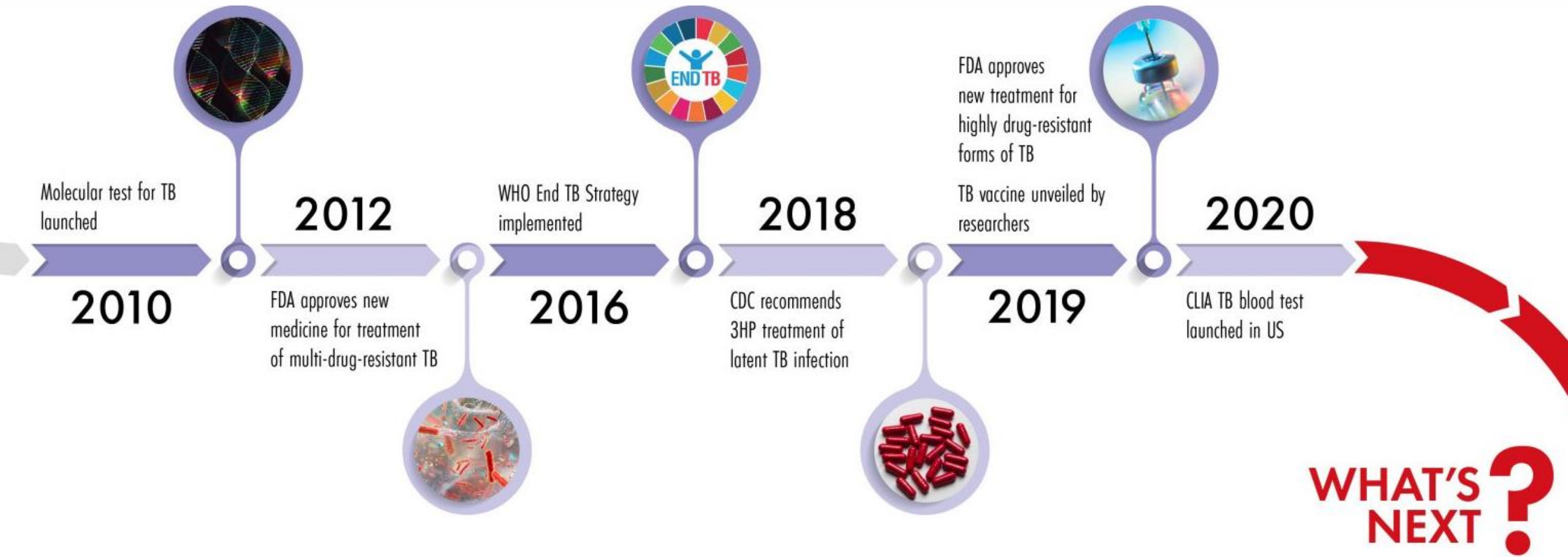
TB PREVENTION

Multi-pronged approach to prevention

- Diagnosis & Treatment
- Transmission-based precautions
- Safe travel practices
- Vaccination
- Public health control measures and funding
- Addressing Social determinants of health



TB TIMELINE



<https://www.oxfordmeded.com/wp-content/uploads/2020/05/OI-Timeline-v4a-2048x1852.jpg>

CHALLENGES TO TB ERADICATION

WINNING TB REQUIRES EXPANDING TESTING
TREATMENT OF LATENT TB INFECTION. CDC WORKS



Engage Communities
& Healthcare Providers



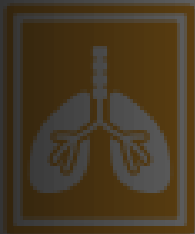
Promote Effective Testing
& Treatment Options



Develop

WINNING TB REQUIRES A COMPREHENSIVE APPROACH

Fighting TB whenever & wherever it occurs through:



Better Diagnostics
& Treatments



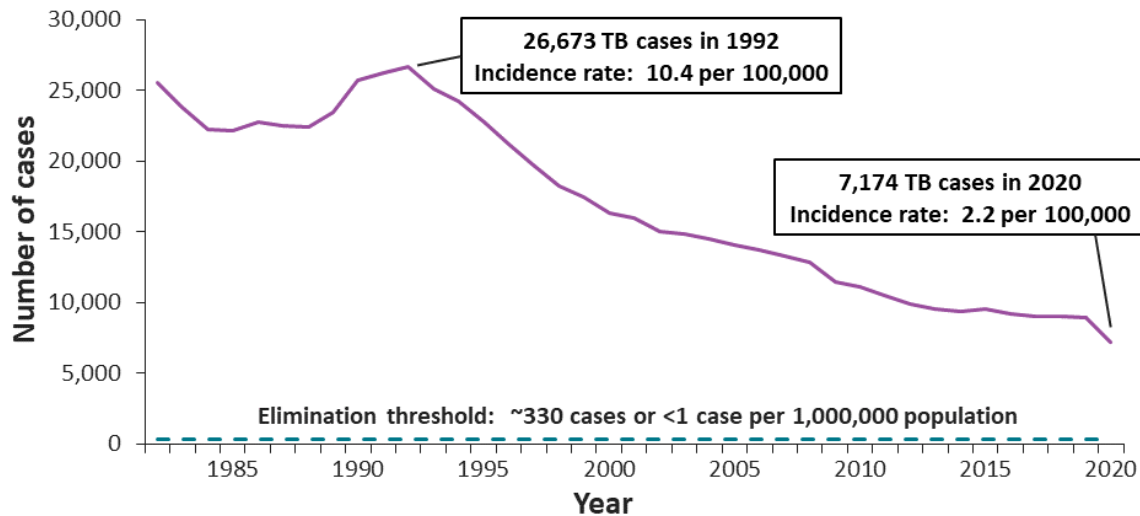
Testing & Treatment of
Populations at Risk for TB



TGH Tampa General Hospital

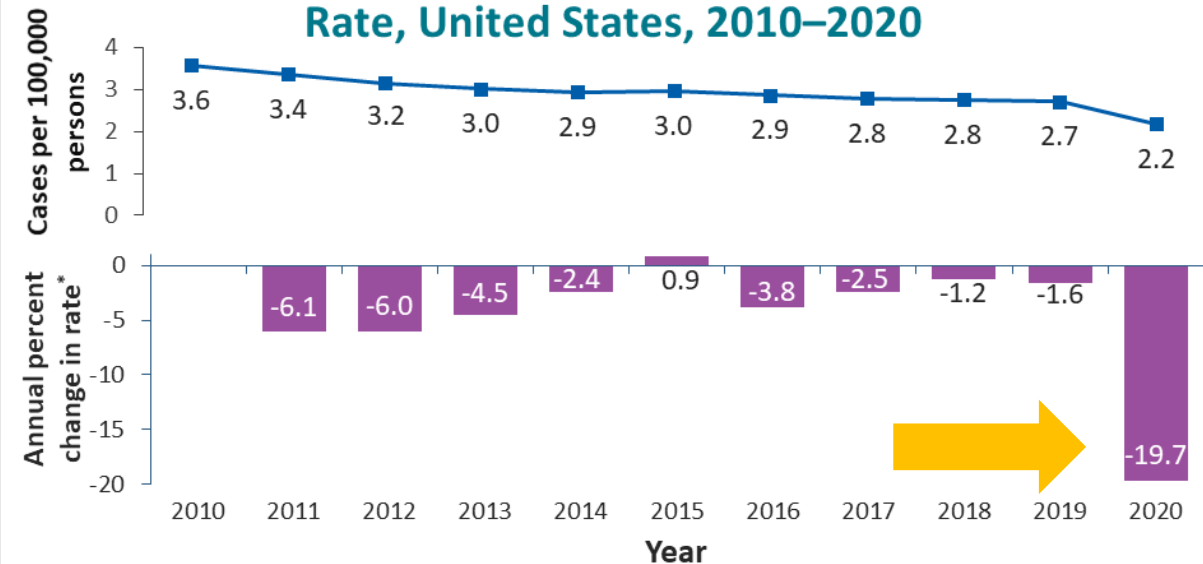
TUBERCULOSIS IN THE UNITED STATES

Progress Towards TB Elimination, United States, 1982–2020



https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide2.PNG?_=53322?noicon

TB Incidence Rates and Annual Percent Change in Rate, United States, 2010–2020



*Annual percent change in rate based on unrounded data

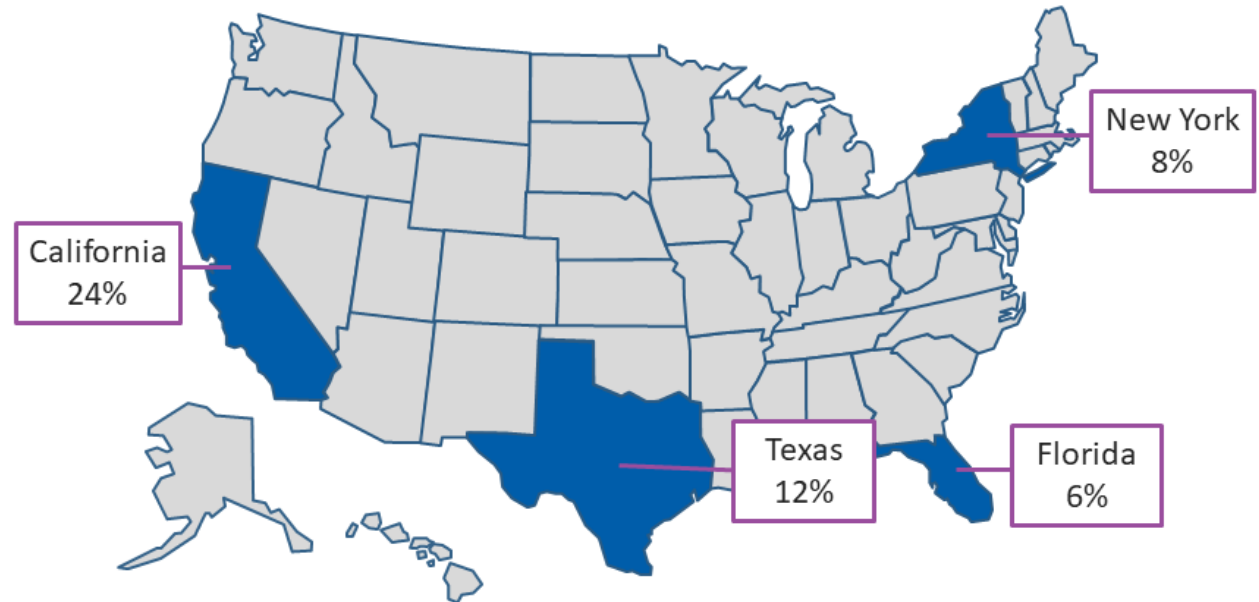
https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide4.PNG?_=16651

TUBERCULOSIS IN THE UNITED STATES

In 2020, slightly more than half (50.3%) of TB cases continue to be reported from 4 states:

1. California (23.8%)
2. Texas (12.3%)
3. New York state (8.4%)
4. Florida (5.7%)

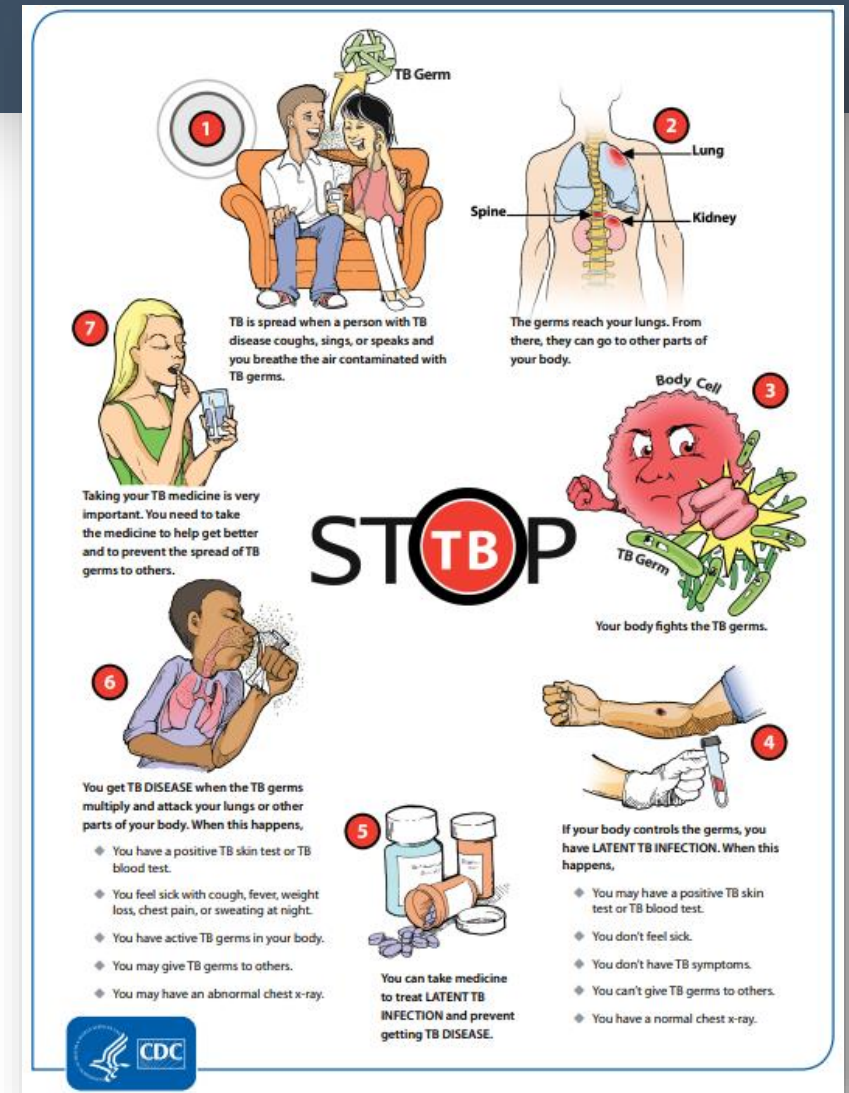
Majority of TB Cases Occur in Four States, United States, 2020



https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide7.PNG?_=16655

UNDERDIAGNOSIS

- High risk populations exist globally, including in the US:
 - Contacts of those with TB
 - People living in congregate settings
 - People born in or traveling from high risk/endemic areas
 - Children living with at risk adults
 - Healthcare workers
 - Workers in congregate settings
- Estimated that >30% of latent TB cases go undiagnosed

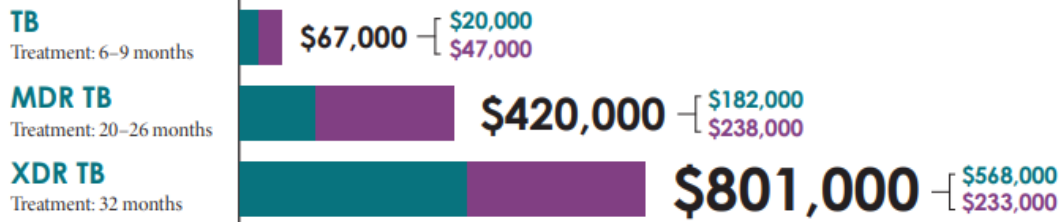


[StopTBlarge.pdf \(cdc.gov\)](https://www.cdc.gov/StopTB/StopTBlarge.pdf)

DRUG RESISTANCE

THE OUTSIZED FINANCIAL TOLL OF MDR AND XDR TB DISEASE COST INCREASES WITH GREATER RESISTANCE

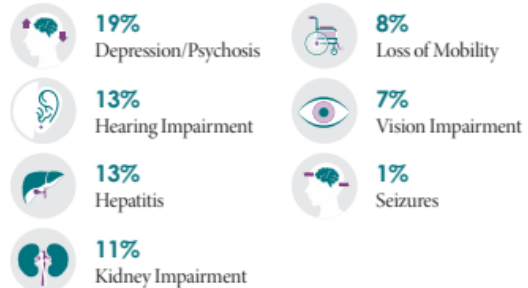
Average treatment costs, per case (2020 dollars)



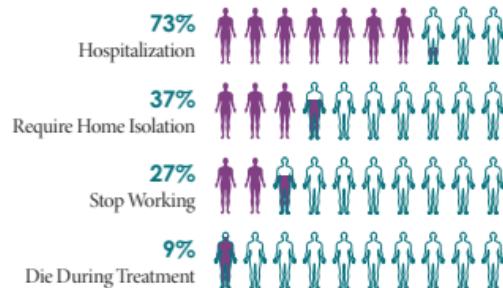
■ **Direct treatment costs:** Drugs, diagnostics, case management, social work, housing, transportation, and hospitalization

■ **Productivity loss during treatment, including deaths**

SERIOUS SIDE EFFECTS experienced by many patients treated for drug-resistant TB:



A MAJOR HUMAN COST of those treated for drug-resistant TB:



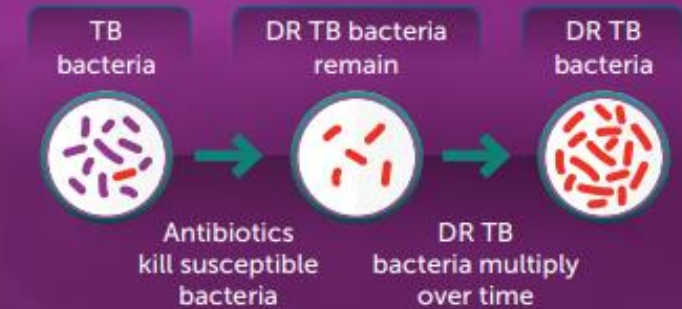
MDR AND XDR TB IS PREVENTABLE AND CONTROLLABLE IN THE U.S. THROUGH:

- Better treatment options
- Rapid diagnosis
- Expert treatment of every TB case
- Improving global TB diagnosis and treatment

<https://www.cdc.gov/nchhstp/newsroom/docs/factsheets/costly-burden-dr-tb-508.pdf>

How Drug Resistance Develops

Changes in DNA can cause TB bacteria to become resistant to treatments. Even one change in the right location in a DNA sequence can lead to DR.

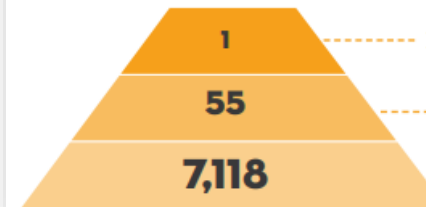


<https://www.cdc.gov/tb/publications/infographic/pdf/tbMDDR508.pdf>

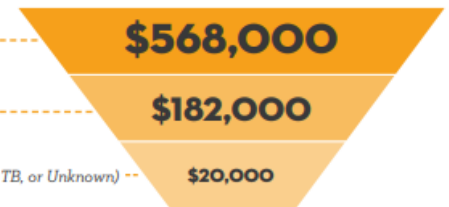
DRUG-RESISTANT TB IS COMPLEX & COSTLY

Drug-resistance threatens our ability to treat & control TB

TOTAL 2020 CASES



DIRECT TREATMENT COST PER CASE



<https://www.cdc.gov/tb/publications/infographic/pdf/take-on-tuberculosis-infographic.pdf>

SOCIAL DETERMINANTS

Health Disparities

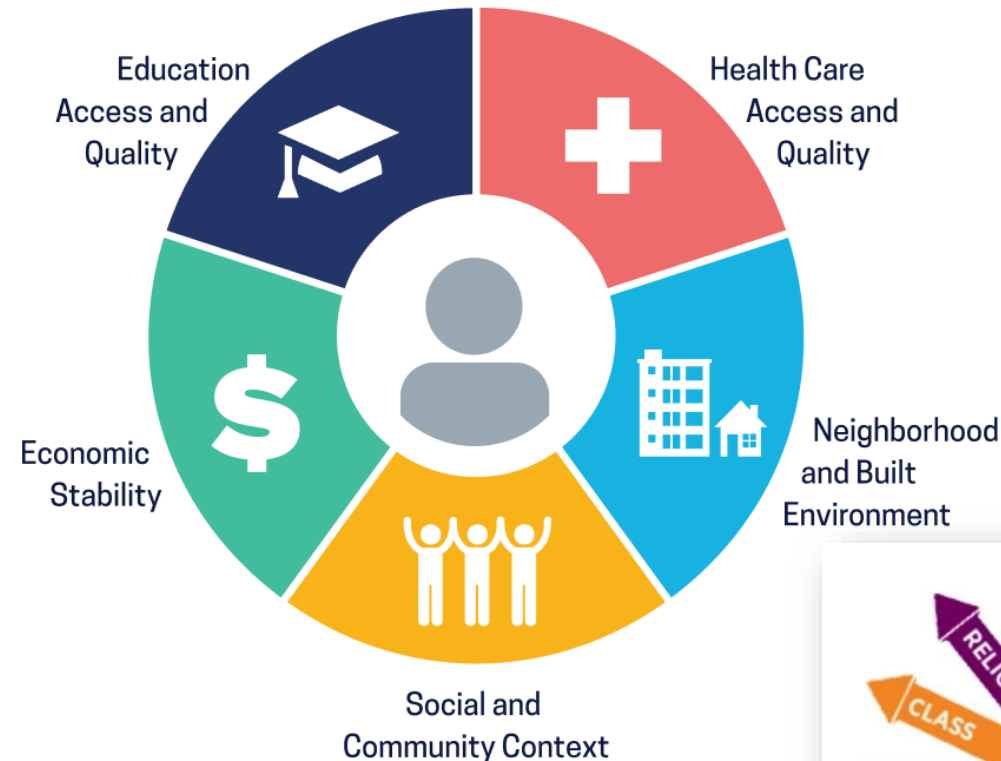
- Race/ethnicity
- Medical conditions
- Geographic location
- Homelessness
- Incarceration

Dr. Taison Bell, SHEA SPRING PLENARY PRESENTATION, 2021

"When White folks catch a cold, Black folks get pneumonia"

- Christine Taylor (my Great-grandmother)

Social Determinants of Health



Social Determinants of Health

Copyright-free



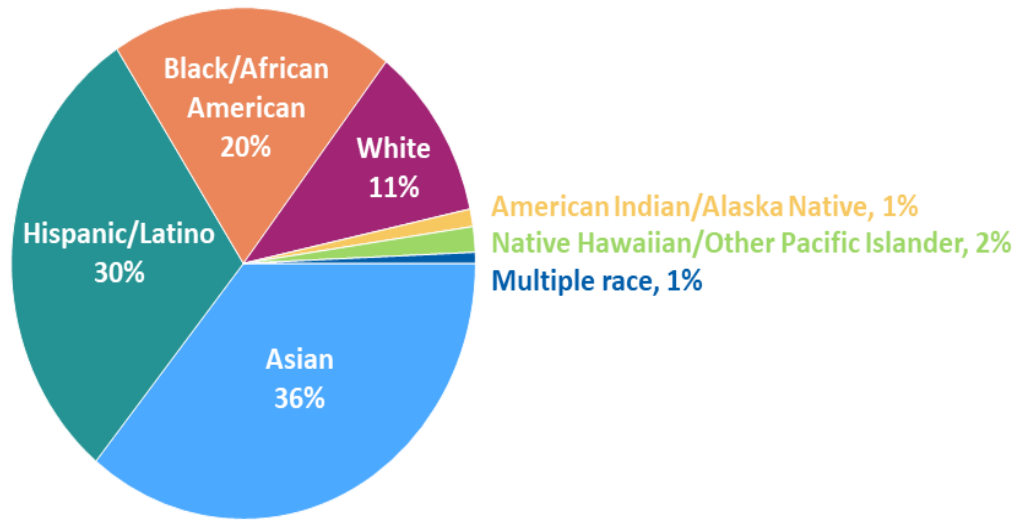
<https://health.gov/healthypeople/objectives-and-data/social-determinants-health>



https://1.bp.blogspot.com/-HmExGtTLqul/Xj8_ABsKC2/AAAAAAAAACIk/t4xmKoNBH9AwUIX9JYNPACHKH9RufgAAClCBGAsYHQ/s1600/Intersectionality%2Bexplained.jpg

SOCIAL DETERMINANTS

**Percentage of TB Cases by Race/Ethnicity,*
United States, 2020 (N=7,174)[†]**



*All races are non-Hispanic; multiple race indicates two or more races reported for a person but does not include persons of Hispanic or Latino origin.
[†]Percentages are rounded. Percentages of unknowns/missing are <1% and are not displayed in graph.

https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide21.PNG?_=16669?noicon

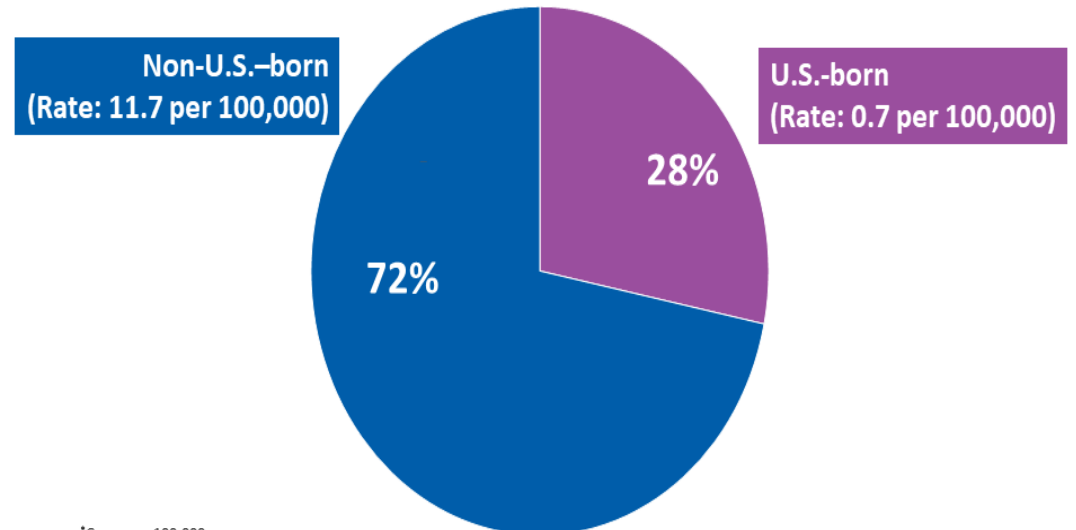
TB CAN HAPPEN ANYWHERE & TO ANYONE

To eliminate TB, we must prioritize groups at increased risk of TB



<https://www.cdc.gov/tb/publications/infographic/pdf/take-on-tuberculosis-infographic.pdf>

TB Incidence Rates* and Percentages by Origin of Birth, United States, 2020 (N=7,145)

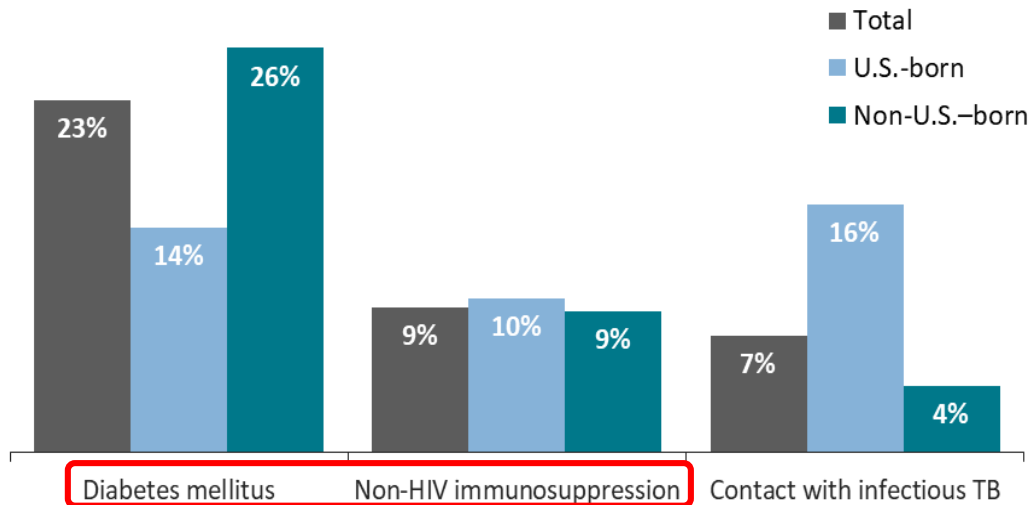


*Cases per 100,000 persons

https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide12.PNG?_=16660?noicon

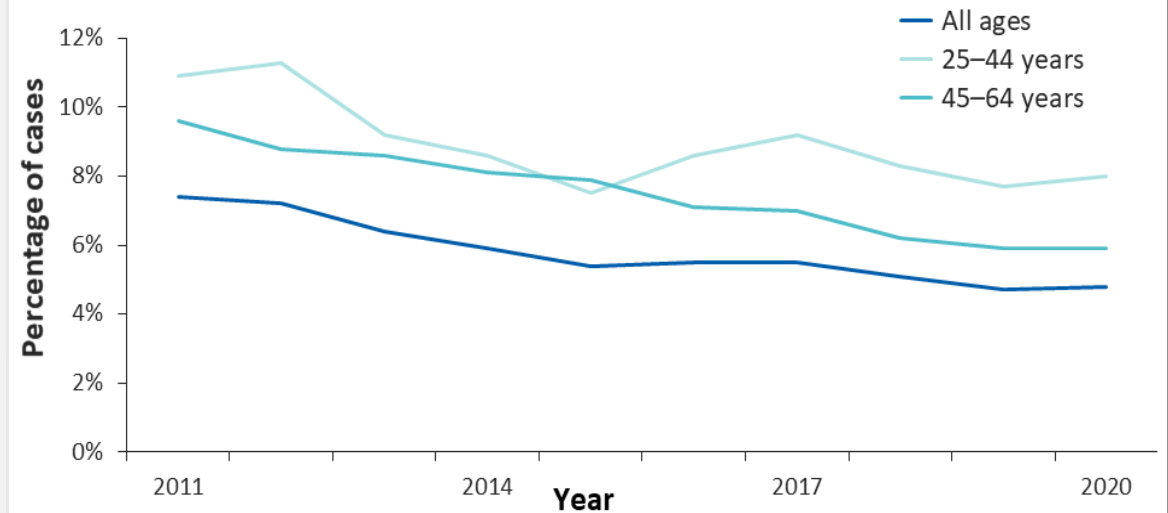
SOCIAL DETERMINANTS

Percentage of Selected Risk Factors Among Persons with TB by Origin of Birth, United States, 2020



https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide58.PNG?_=16632?noicon

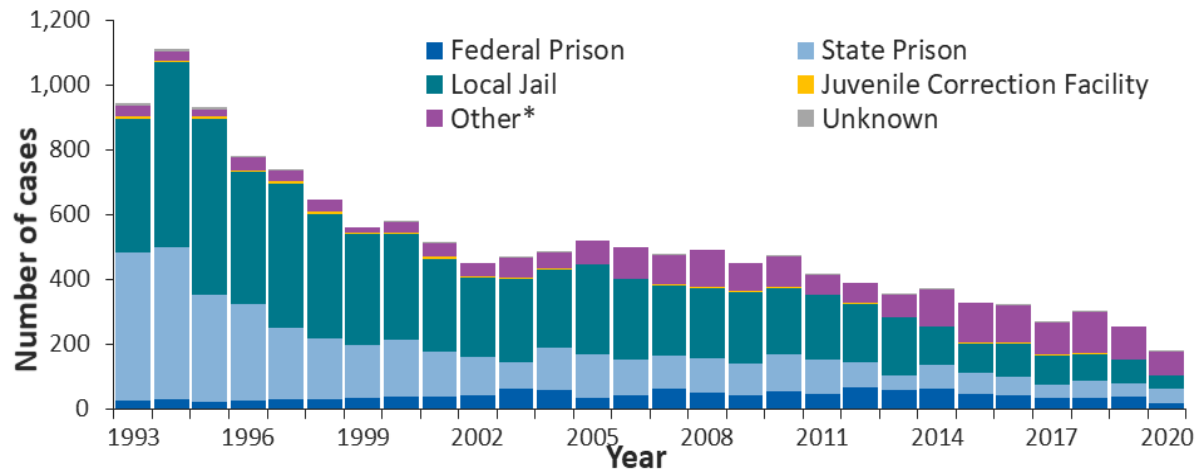
Percentage of HIV Coinfection by Age among Persons with TB, United States, 2011–2020



https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide57.PNG?_=16631?noicon

SOCIAL DETERMINANTS

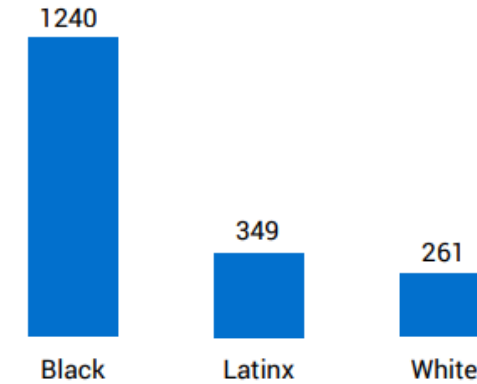
TB Cases Among Correctional Facility* Residents Aged ≥15 Years by Type of Facility, United States, 1993–2020



*Includes Immigration and Customs Enforcement (ICE) detention centers, tribal jails operated by Indian reservations, police lockups (temporary holding facilities for person who have not been formally charged in court), military stockades and jails, or federal park facilities

https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide62.PNG?_=16636?noicon

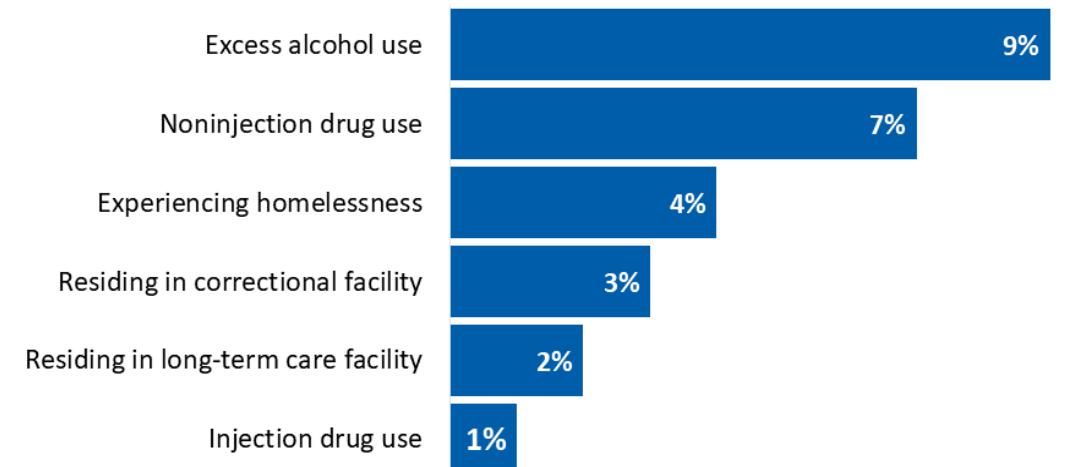
Figure 1. Average Rate of Black, Latinx and White Imprisonment Per 100,000 Residents



Data Source: Carson, E. A. (2021). Prisoners in 2019. Bureau of Justice Statistics; U.S. Census Bureau (n.d.). Age, sex, race, and Hispanic-origin–6 race groups. (SC EST 2019-ALLDATA6).

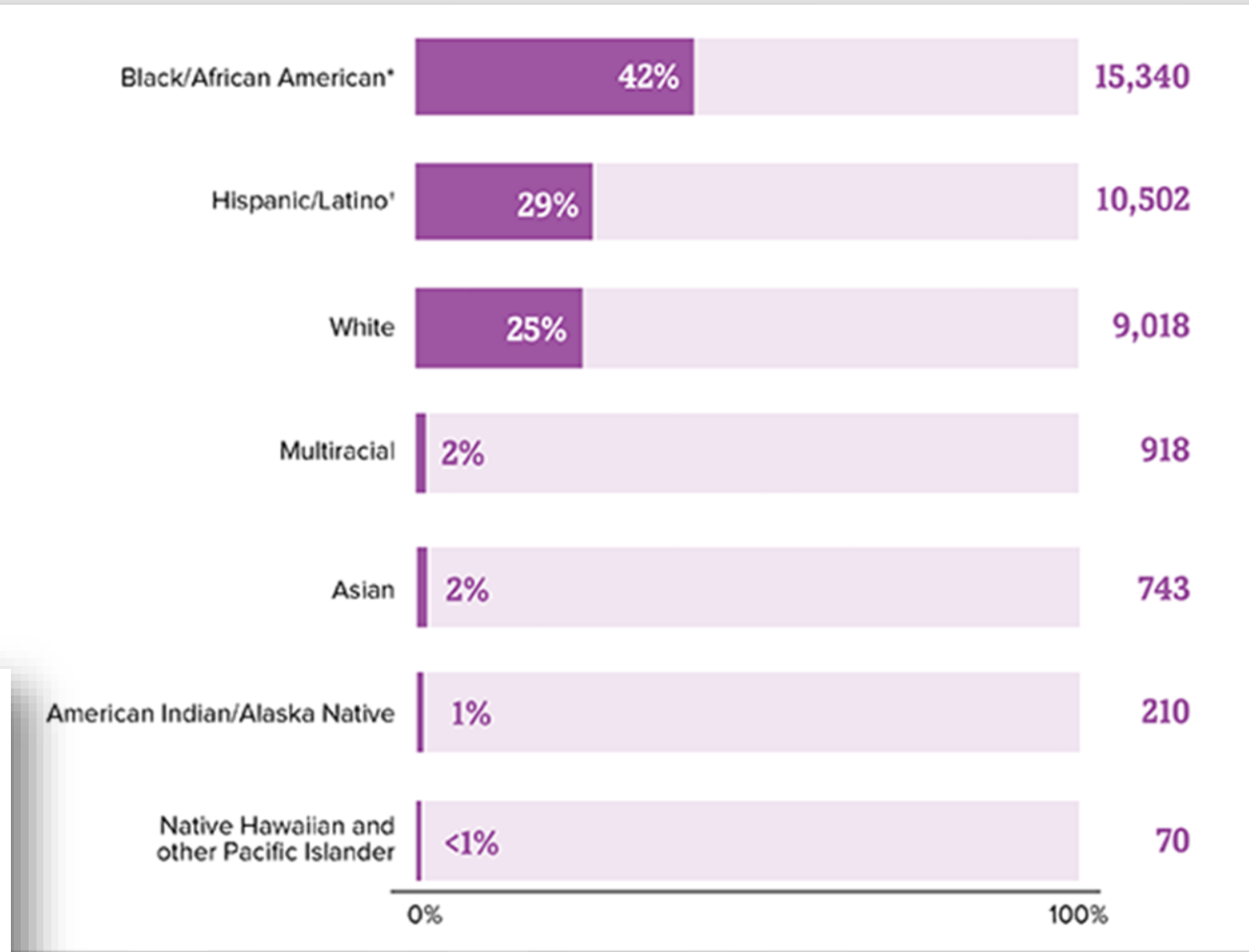
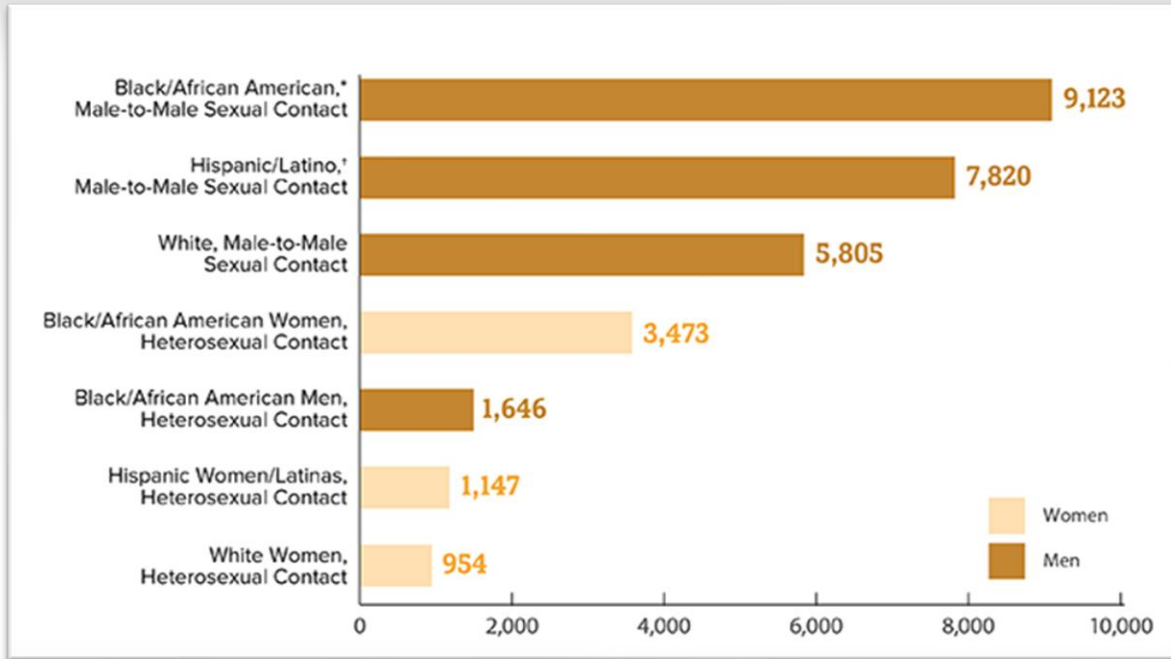
<file:///C:/Users/D17877/Downloads/The-Color-of-Justice-Racial-and-Ethnic-Disparity-in-State-Prisons.pdf>

Percentage of Social Risk Factor Among Persons Aged ≥15 Years with TB, United States, 2020



https://www.cdc.gov/tb/statistics/surv/surv2020/images/Slide59.PNG?_=16633?noicon

HIV IN THE UNITED STATES - 2019

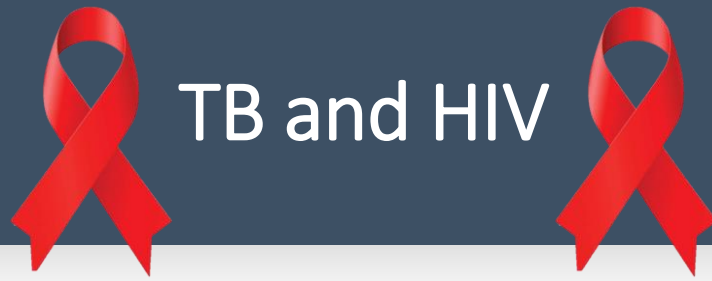


Gay and bisexual men are the population most affected by HIV.



Black/African American and Hispanic/Latino people are disproportionately affected by HIV.





- Identifying co-infection is paramount
- CDC provides guidelines on treating HIV patients with TB drugs:
<https://clinicalinfo.hiv.gov/en/guidelines/hiv-clinical-guidelines-adult-and-adolescent-arv/overview>
- Several treatment options exist depending on the patient's HIV cocktail
- Case Management



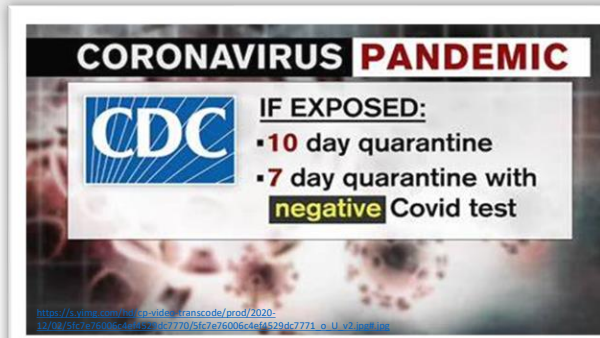


Coronavirus Disease 2019 (COVID-19)

COVID-19 AND TUBERCULOSIS

COVID-19 AND TUBERCULOSIS

- Control measures for COVID
- COVID infection and treatment
- Reduced reported rates
- Supply Chain issues
- Clinical trials halted



COVID-19

Developed by Stop TB Partnership in collaboration with Imperial College, Avenir Health, Johns Hopkins University and USAID.

THE POTENTIAL IMPACT OF THE COVID-19 RESPONSE ON TUBERCULOSIS IN HIGH-BURDEN COUNTRIES: A MODELLING ANALYSIS

Country	Excess cases between 2020-2025 (% increase)		Excess deaths between 2020-2025 (% increase)	
	2-month lockdown + 2-month recovery	3-month lockdown + 10-month recovery	2-month lockdown + 2-month recovery	3-month lockdown + 10-month recovery
India	514,370 (3.55%)	1,788,100 (12.32%)	151,120 (5.70%)	511,930 (19.31%)
Kenya	12,154 (1.51%)	40,992 (5.08%)	4,873 (2.15%)	15,800 (6.99%)
Ukraine	2,348 (1.19%)	7,589 (3.86%)	455 (2.40%)	1,578 (8.31%)
Global	1,826,400 (3.1%)	6,331,100 (10.7%)	342,500 (4.0%)	1,367,300 (16.0%)

Table 1. Model-estimated impact for the excess TB cases and deaths that would occur in each country, as a result of the COVID-19 response. As noted in the text, estimates are relative to a 'status quo' comparator, assuming that TB services continue indefinitely at pre-lockdown levels. Note that even though the global impact estimates fall within the range of country estimates, they are based on country-specific and different status quo trends than the ones used in the modelled countries (i.e. statistical projections of status quo as opposed to projections via a dynamic compartmental model).

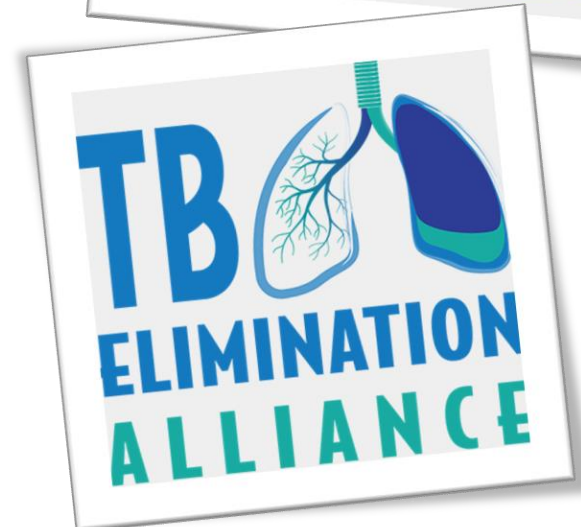
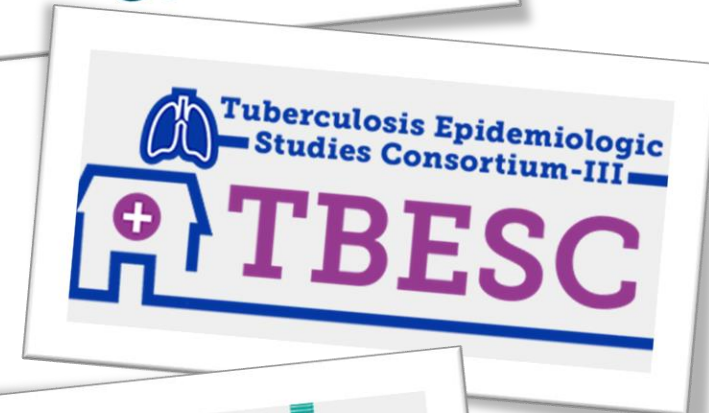
(Stop TB, 2020)



What's happening now?

WHAT'S BEING DONE TODAY?

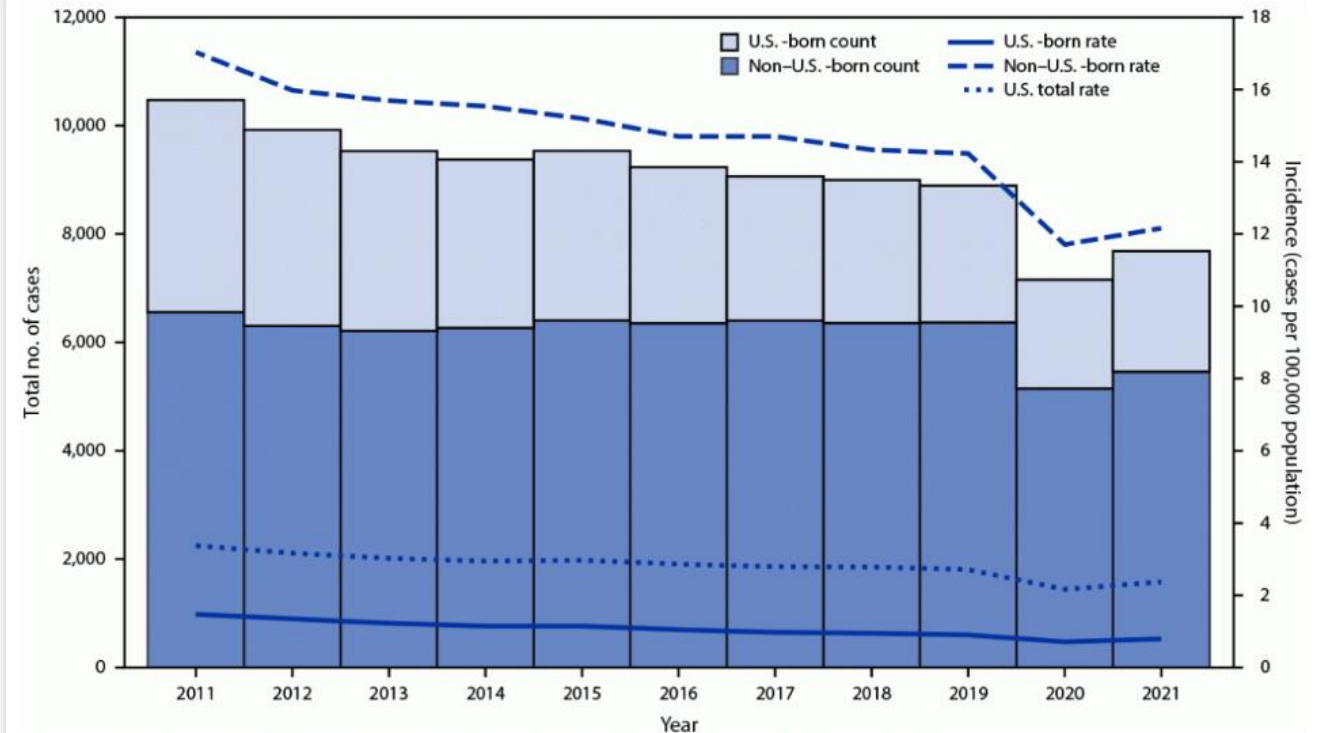
- **CDC Addressing Disparities**
 - Improve TB screening of immigrants
 - Spanish TB website: <https://www.cdc.gov/tb/esp>
 - Culturally appropriate education materials developed
 - Highlight personal experience to humanize the disease
 - Greater demographic stratification in available data
 - Engage with HCPs on treatment and diagnostic options
- **Research**
 - TBESC
 - TBTC
- **TB Elimination Alliance**
- **NEEMA**



LOOKING AHEAD

- Provisional National Data - 2021
- Public Health Funding
- Treatment availability
- Vaccine Technology

FIGURE. Tuberculosis disease case counts* and incidence,† by patient birth origin§ — United States, 2011–2021



* Case counts are based on data from the National Tuberculosis Surveillance System as of February 9, 2022.

† Cases per 100,000 persons. The Current Population Survey provides the population denominators used to calculate tuberculosis incidence according to national origin and racial/ethnic group. <https://www.census.gov/programs-surveys/cps.html> (Accessed February 9, 2022).

§ Cases with unknown origin at birth excluded.

[Tuberculosis — United States, 2021 | MMWR \(cdc.gov\)](https://www.cdc.gov/mmwr/2021/01/01/p0101a01.htm)

State Specific Data

2020 Data:

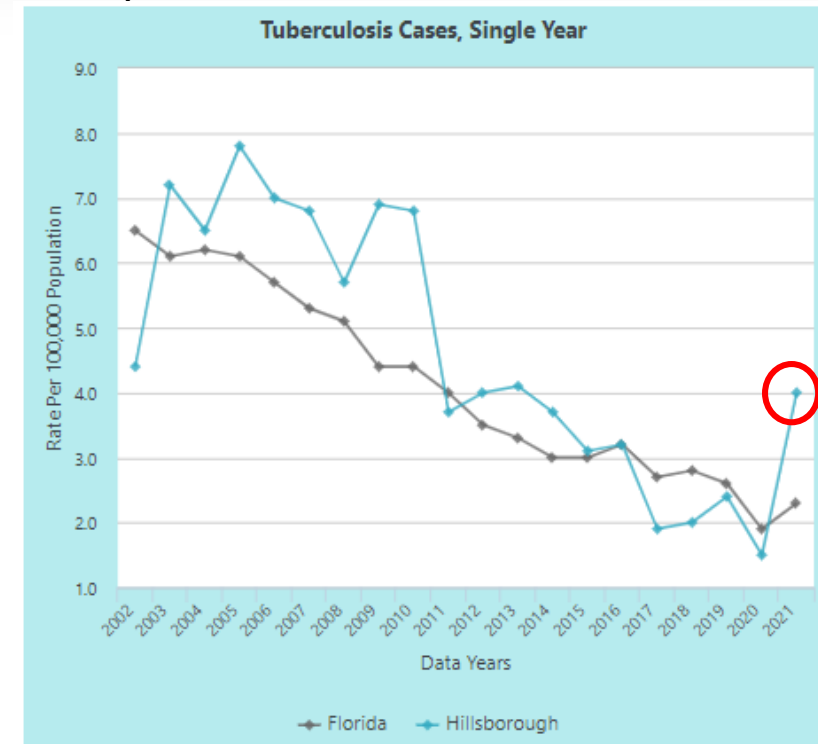
Louisiana: 2.1 / 100,000 population, with 99 cases
Jefferson Parish: 2.8 / 100,000 population, with 12 cases
Orleans Parish: 4.6 / 100,000 population, with 18 cases

2021 Data:

Louisiana: 1.9 / 100,000 population, with 86 cases
Jefferson Parish: 4.2 / 100,000 population, with 18 cases
Orleans Parish: 2.3 / 100,000 population, with 9 cases

[TBMorbidity5Year.pdf \(la.gov\)](#)

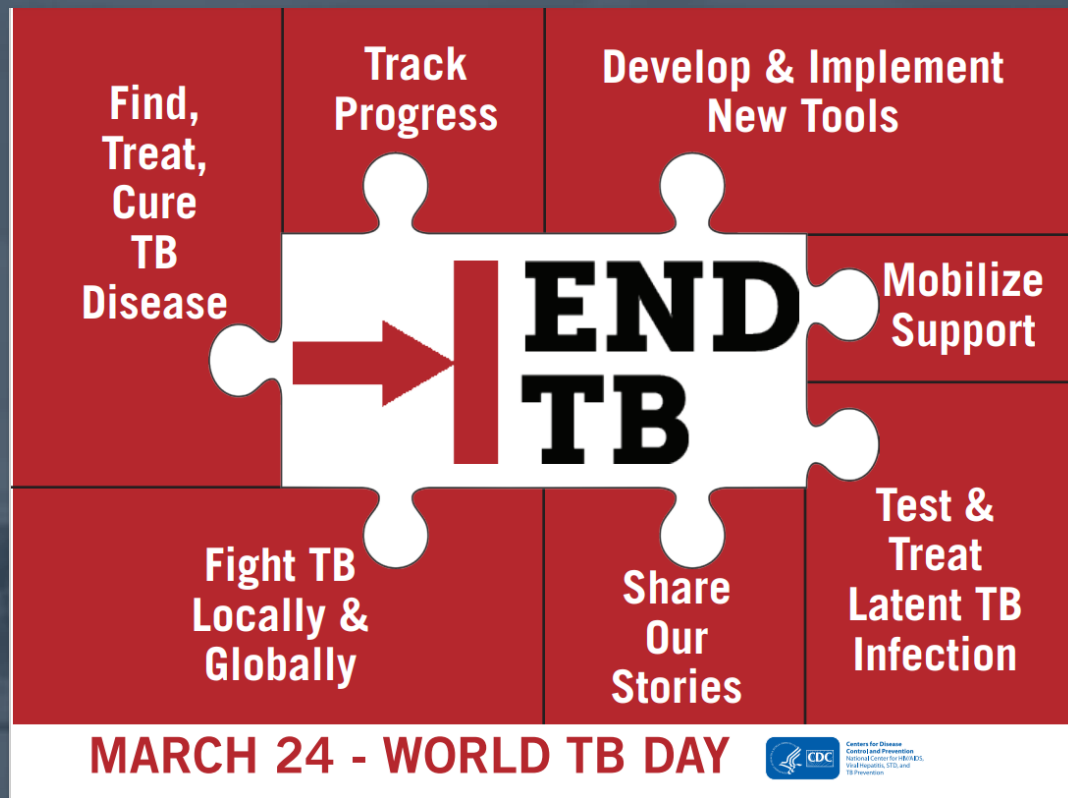
Compare to Florida...



Click on county name or "Florida" in the legend to hide or show the county or state.

Tuberculosis Cases, Rate Per 100,000 Population, Single Year								
Data Year	Hillsborough				Florida			
	Count	Denom	Rate	MOV	Count	Denom	Rate	MOV
2021	60	1,515,107	4.0	1.0	499	22,005,587	2.3	0.2
2020	22	1,481,163	1.5	0.6	412	21,640,766	1.9	0.2

[FLHealthCHARTS.gov: Reportable and Infectious Diseases Data](#)



Questions?



A large, modern hospital building with multiple wings and many windows, situated behind a body of water. The image is in grayscale and serves as a background for the text.

Thank you!

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