Tuberculosis Infection Control

Ohio Assisted Living Association Spring Conference

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Bureau of Infectious Diseases

Ohio Department of Health

Department of Health

Gary M. Trentman, ASN, RN

I’m a current member of the National Tuberculosis Coalition of America, National Tuberculosis Nurse Coalition Corrections Committee.

I also participate in the Carceral Health Peer Network.

I have experience in tuberculosis case management, infection control, correctional healthcare, emergency medical services, mental health focused long-term care, disaster response, health and safety education to varied industries, employee development, quality improvement and assurance, informatics, and business operations.

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What is Tuberculosis (TB)?

What, like, tuber roots?

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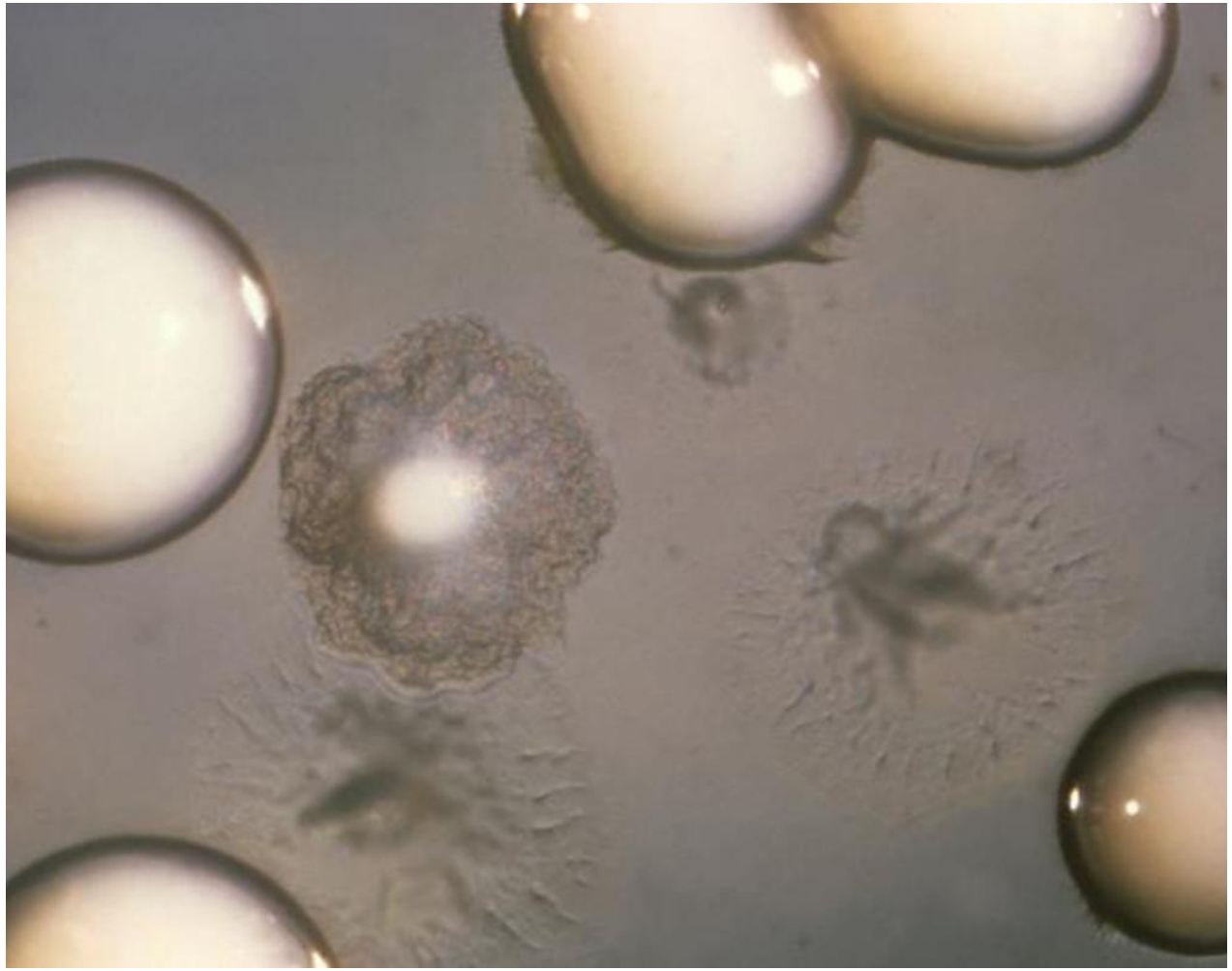
Mycobacterium tuberculosis

- Usually characterized pathologically by the formation of granulomas.
- The most common site of infection is the lung, but other organs may be involved.
- Slow growing.
- Highly hydrophobic, which increases aerosol transmission.



Source: CDC/ Annie Vestal https://phil.cdc.gov/Details.aspx?pid=17560

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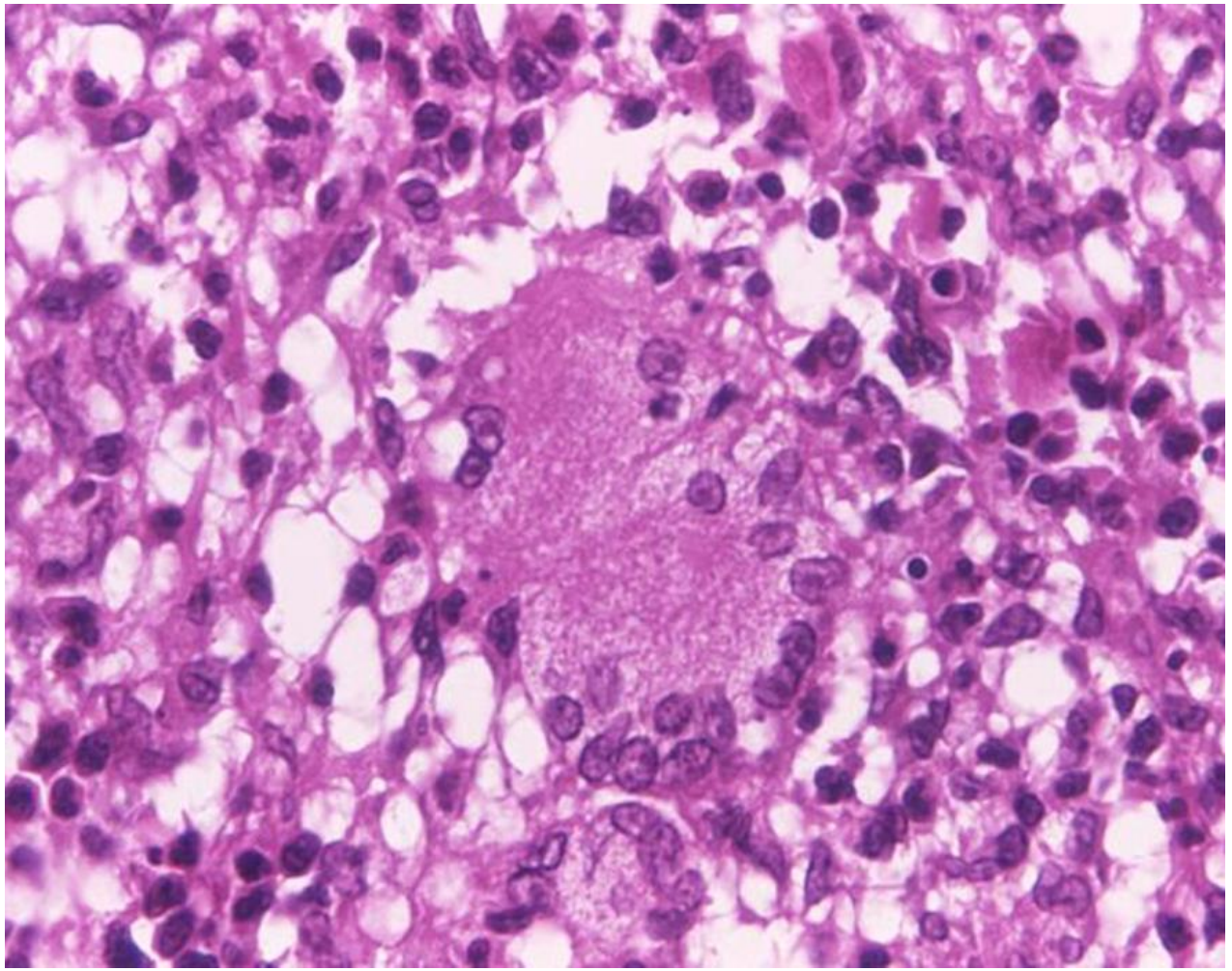
Pathogenesis

- A person inhales droplet containing bacilli that reach the alveoli of the lungs.
- Ingested by macrophages.
- Destroyed, inhibited, or survive.
- If the bacilli survive, macrophages may form a barrier called a granuloma.
- Bacilli may stay in lungs or may spread to other areas.



Source: CDC/ Roger A. Feldman, MD https://phil.cdc.gov/Details.aspx?pid=11230

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Sites of TB Disease

Pulmonary

- Cavitary disease.
- Miliary/disseminated disease.
- Hilar/paratracheal lymphadenopathy.
- Tree-in-bud opacities.
- Ground-glass opacities.
- Poorly defined consolidation.

Extrapulmonary Sites

- Lymph nodes (LN).
- Cervical LN (scrofula).
- Pleura.
- Bone and joint.
- Ocular.
- Urogenital tract.
- Meninges.
- Gastrointestinal/Peritoneal.

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Latent vs. Active

Latent TB Infection (LTBI)

- Small number of inactive bacilli.
- Patient cannot spread disease.
- Patient does not feel ill.
- Has a positive blood or skin test.
- Chest X-ray is usually normal.
- Smears and culture negative.

TB Disease (Active TB)

- Large number of active bacilli.
- Patient can spread disease.
- Patient may feel ill.
- Usually has a positive blood or skin test.
- Chest X-ray may be abnormal.
- Smears and cultures may be positive.

Typical Progression

Exposure → **Latent Infection** → **Active Disease**

- Exposed to a person with infectious TB.

- Asymptomatic.
- Smear (-).
- Molecular (-).
- Culture (-).
- Chest X-ray has no or minimal abnormalities.

- Asymptomatic then becoming symptomatic.
- Initially smear (-) then becoming smear (+).
- Initially molecular (-) then becoming molecular (+).
- Initially culture (-) then becoming (+).
- Chest X-ray has no abnormalities or minimal abnormalities then progresses to extensive abnormalities.

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TB Epidemiology

Looking at the Current Trends

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TB Anywhere is TB Everywhere.

- TB is the top infectious disease killer worldwide.
- **A quarter of the world's population may be infected with TB.**
- **Global response to TB ensures a healthier U.S. and Ohio.**
  - Find, Cure, Prevent, Enhance.

Source: https://www.cdc.gov/global-hiv-tb/php/our-approach/combatingglobaltb.html

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Ohio TB Epidemiology - 2024

- **Verified countable cases included 198 cases of TB disease.**
  - Meet the laboratory or clinical case definition and received TB disease diagnosis in Ohio.

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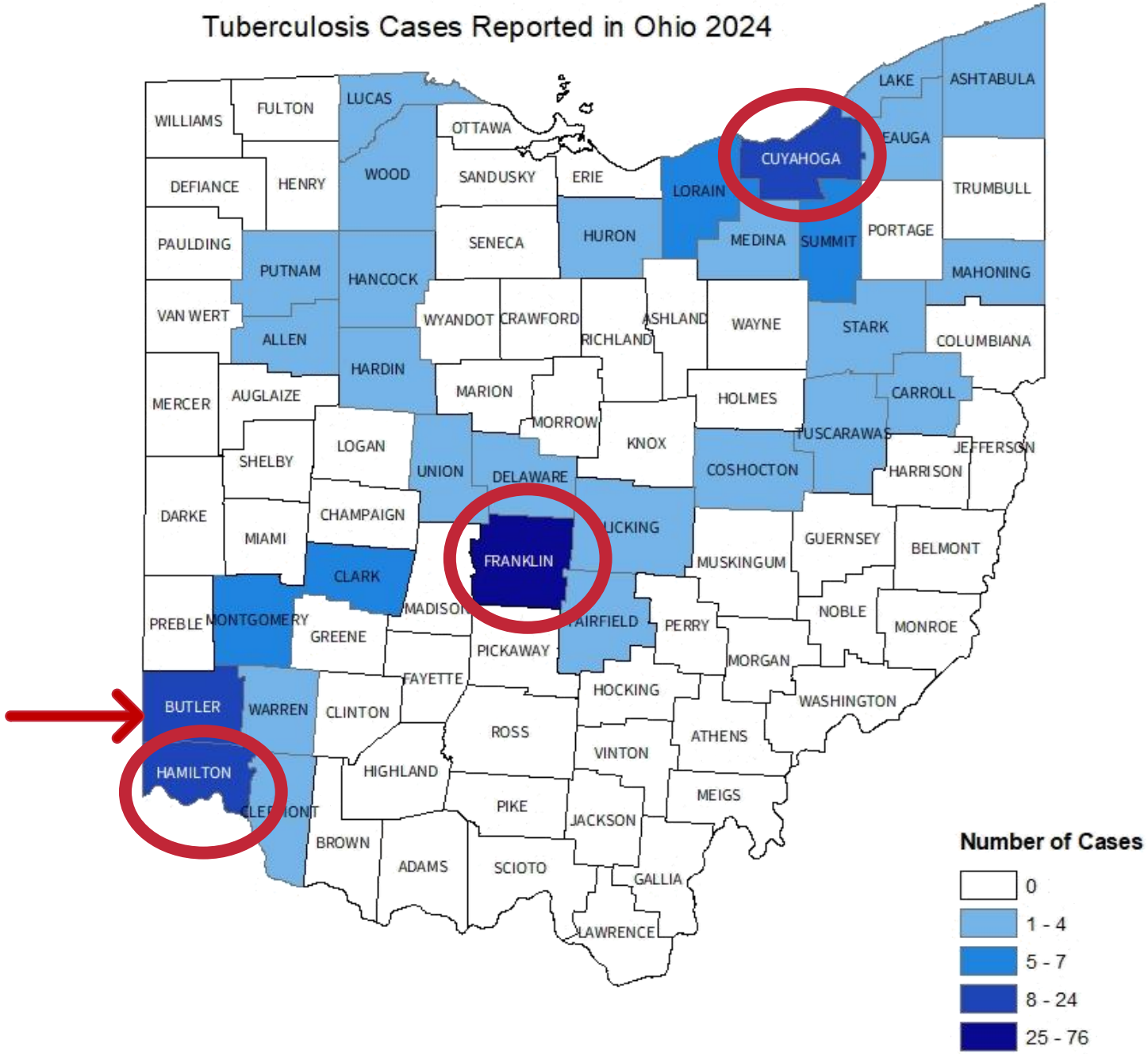
Tuberculosis Cases Reported in Ohio 2024



Data source: Ohio Disease Reporting System.

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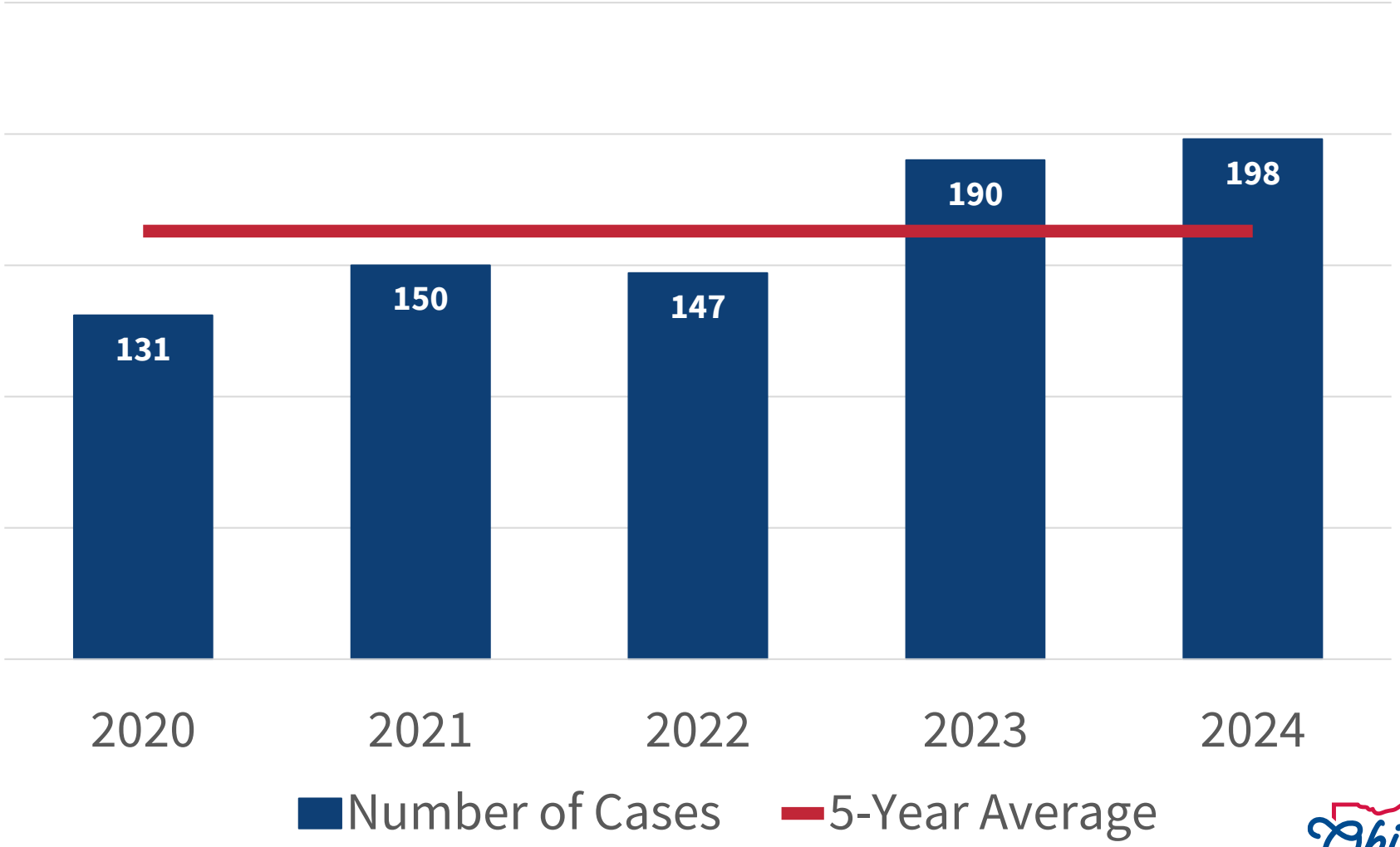
Ohio TB Epidemiology - 2024

TB Cases Per Year Compared to Average 2020 – 2024



Source: Ohio Disease Reporting System (ODRS)

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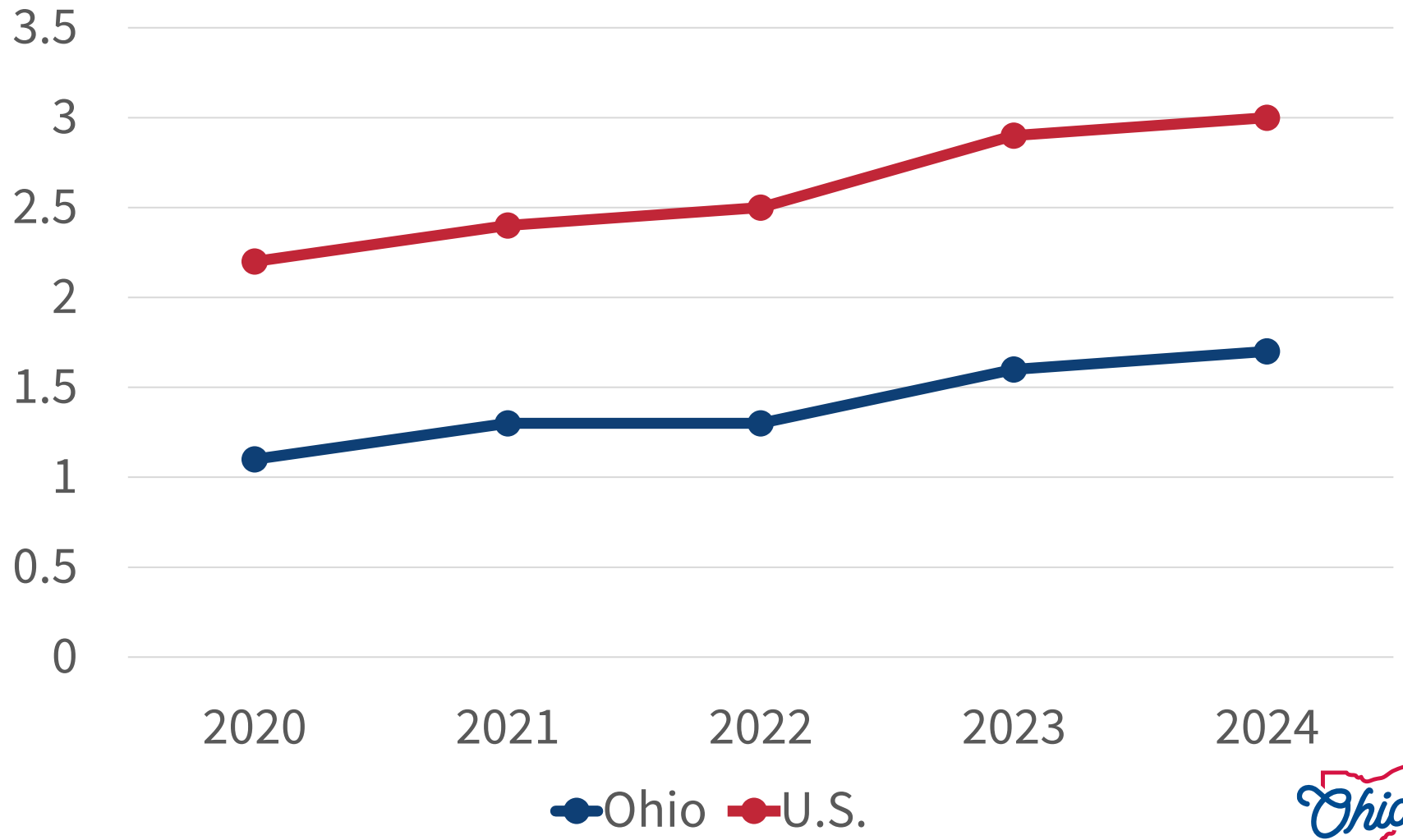
Ohio TB Epidemiology - 2024

U.S. and Ohio TB Incidence Rates 2020-2024 (per 100,000)



Source: ODRS

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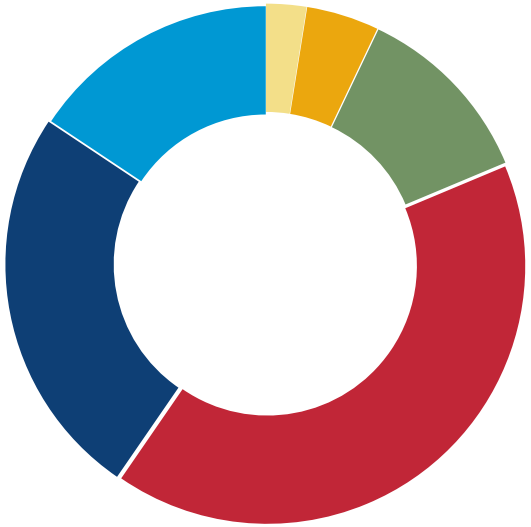
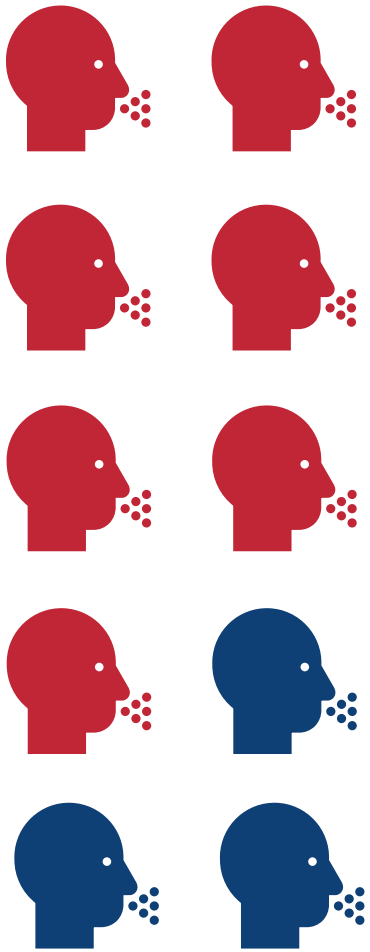
Ohio TB Epidemiology - 2024

Over half of 2024 TB cases reported in Ohio were between the ages of **25 - 64**.

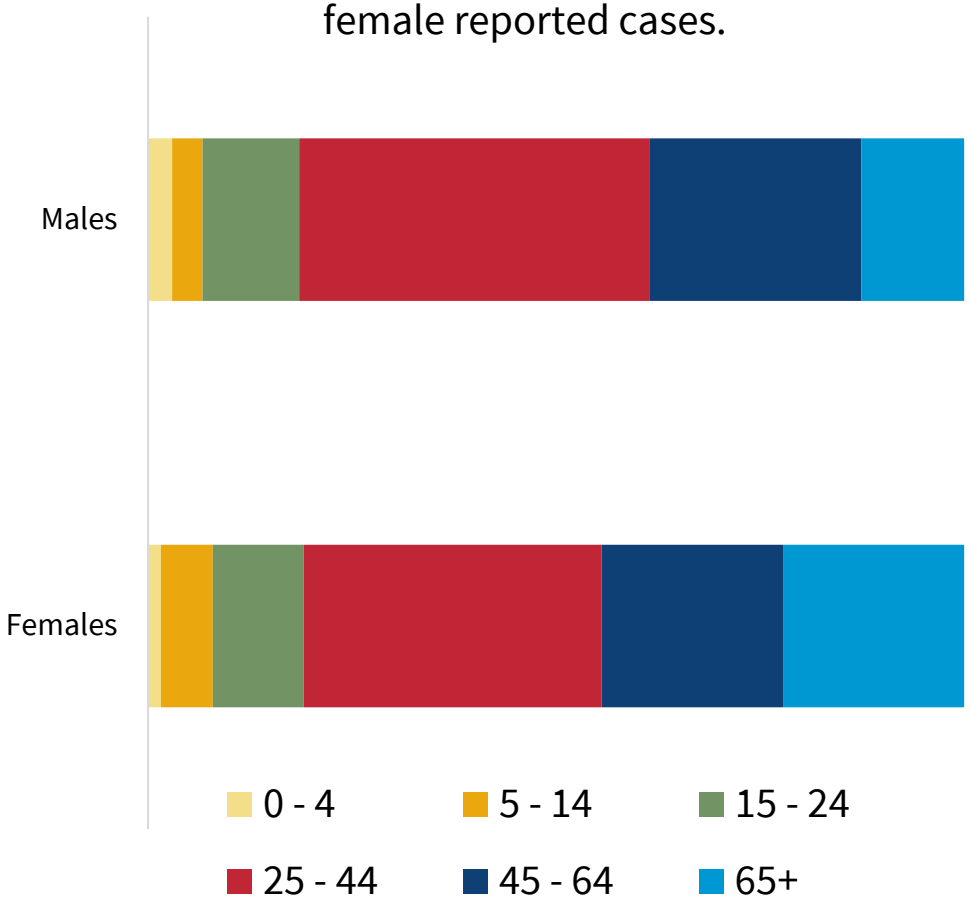


41% were between the ages of **25 – 44**.



Of the 198 TB cases reported in Ohio in 2024, **68%** (n= 135) were **male**.

Age group distributions between male and female reported cases.



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Source: ODRS

Ohio’s Rules

Ohio Administrative Code Requirements for Residential Care Facilities

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Rule 3701-16-12: Changes in residents' health status; incidents; infection control; TB control plan.

- **Residential Care Facilities/Assisted Livings.**
  - Written policy and procedures to control development and transmission of infectious diseases, including TB.
  - Can be combined with nursing home’s infection control.

Rule 3701-15-03: TB standards for the purposes of section 3701.14 of the Revised Code.

- **Outlines CDC guidance documents.**
  - LTBI Testing & Treatment.
  - TB Disease Testing & Treatment.
  - Preventing Transmission in Health-Care Settings.
- **Sets standards for screening.**
  - Based on Local Epidemiologic Data.
  - Shall Consult with Local TB Control Units (LTCU).

Testing Methods

Which to Choose?

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Bacille Calmette-Guérin (BCG) Vaccination

- Live, attenuated, derived from a strain of *M. bovis*.
- First used in 1921.
- Primarily used to prevent infants and young children from contracting disseminated or meningeal TB which have a high likelihood of death or disability.
- Not used in U.S. because:
  - Low risk and low prevalence.
  - Variable efficacy against pulmonary TB.
  - Interferes with testing.

TST or IGRA?

Tuberculin Skin Test (TST)

- Produces a delayed-type hypersensitivity reaction.
- Requires two or more visits.
- Results in 48-72 hours.
- BCG vaccine known to cause false-positive.
- Infection with nontuberculosis mycobacteria (NTM) can cause false-positive.

Interferon Gamma Release Assay (IGRA)

- Measures the immune response to TB proteins.
- Requires one visit.
- Results in little as 24 hours.
- BCG vaccination does not cause false-positive.
- Infection by most NTMs does not cause false-positive.

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Pros and Cons of TSTs

Pros

- Results have been validated through follow-up of large cohorts.
- Low cost.
- Does not require phlebotomy and laboratory coordination.

Cons

- Requires experience and sound clinical judgment to place, read, and interpret.
- Sensitivity is only 70-85%.
- Vaccination with live viruses (measles, mumps, rubella) might interfere with reactivity causing false-negative.

Placing the Test

Preparation

- Firm, well-lit surface.
- A twenty-seven-gauge tuberculin syringe.
- Alcohol swabs.
- A two-by-two gauze or cotton ball.
- Sharps container.
- Record-keeping forms.
- Perform safety checks.

Administration

- Inject 0.1 ml of PPD (five units of tuberculin) intradermally.
- Bevel facing up.
- Volar surface of the forearm.
- Should produce a discrete, pale elevation of the skin (wheal) 6 mm to 10 mm across.
- Do not cover.
- May use gauze or cotton ball to pat dry.

Reading the TST

- Assess 48 to 72 hours after administration.
- Do not look, palpate!
- Mark then measure the indurated (hard) area across the forearm.
- Do not measure the erythema (redness).
- If no induration, record as 0 mm.

Interpreting the TST

- **At 5 or more mm consider positive IF:**
  - Person living with Human Immunodeficiency Virus (HIV).
  - Recent contact to a person with infectious TB.
  - Has fibrotic changes to a chest radiograph.
  - Person has received an organ transplant.
  - Prolong corticosteroid treatment greater than or equal to 15 mg/day prednisone.
  - On a TNF-α antagonist.
  - Immunosuppressed otherwise.

Interpreting the TST

- **At 10 or more mm consider positive IF:**
  - From a country where TB disease is common.
  - History of drug or alcohol use disorder.
  - Mycobacteriology laboratorians.
  - Live or work in high-risk congregate settings.
  - Have medical risk factors.
  - Less than 90% ideal body weight.
  - Children under 5 years old.

Interpreting the TST

- **At 15 or more mm consider positive IF:**
  - No known risk factors for TB.

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TST False-Positive Reactions

- Prior BCG vaccination is the most common cause.
- Prior treatment of bladder cancer with a BCG bladder installation.
- Incorrect antigen used (i.e., not PPD).
- Incorrectly measured.
- Incorrectly interpreted.
- NTM infection.

TST False-Negative Reactions

- Concurrent viral, fungal, or bacterial infection.
- Chronic renal failure.
- Low protein states (malnutrition, liver disease, kidney disease, gastrointestinal, and malabsorption disorders).
- Diseases affecting lymphoid organs.
- Immunosuppressive drugs.

TST False-Negative Reactions Cont.

- Advanced age (i.e., waning immunity).
- Stress (e.g., psychologic or physiologic).
- Incorrect storage of tuberculin.
- Live-virus vaccinations.
- Recent TB infection.

Two-Step TSTs

Likely has infection.

Complete evaluation.

Considered a boosted reaction.

TB infection occurred long ago.

No retesting needed; likely to have TB infection.

Complete evaluation.

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TSTs and Pregnancy

- Safe and reliable throughout the course of pregnancy.
- No documented episodes of fetal harm have been reported.
- No evidence adverse effects on the mother.

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Pros and Cons of IGRAs

Pros

- Single visit required.
- Results in less than 24 hours.
- No booster phenomenon.
- BCG vaccination does not cause a false-positive.
- Not subject to biases and errors associated with the TST.

Cons

- Expensive.
- Blood must be processed within eight to 32 hours of collection.
- Errors in collection, transport, or processing can decrease accuracy.
- Cannot exclude TB.

IGRA Background Information

- Measures immune reactivity to *M. tuberculosis*.
- White blood cells from most persons that have been infected with *M. tuberculosis* will release interferon-gamma (IFN-γ) when mixed with antigens (substances that can produce an immune response) derived from *M. tuberculosis*.
- To conduct the test, fresh blood samples are mixed with antigens and controls.
- Effect of live virus vaccines on IGRAs have not been studied.
- Either draw on day of live virus vaccine or wait four to six weeks.

Comparison of QFT and T-Spot

Characteristics	QFT	T-SPOT
Processing Time	Within 16 hours (whole blood)	Within 8 to 32 hours (blood cells)
M. tuberculosis Antigens	ESAT-6 and CFP-10	ESAT-6 and CFP-10
Measurement	IFN-γ concentration	Number of IFN-γ producing cells (spots)
Possible Results	Positive, negative, indeterminate	Positive, negative, invalid, borderline

Image Source: Centers for Disease Control and Prevention (2011). TB Elimination Interferon-Gamma Release Assays (IGRAs) – Blood Tests for TB Infection https://stacks.cdc.gov/view/cdc/21966

IGRA False-Positive Results

- Errors in running the test and/or interpretation.
- ESAT-6 and CFP-10 Proteins are present in all *M. tuberculosis* but absent in BCG and most nontuberculosis mycobacterium.
- ESAT-6 and CFP-10 are present in:
    - *M. kansasii.*
    - *M. szulgai.*
    - *M. marinum.*
    - Sensitization to these organisms might contribute to the release of IFN-γ in response to these antigens.

IGRA False-Negative Results

- Can have a negative TB blood test result even though they are infected with *M. tuberculosis*.
- May occur if the TB infection occurred within eight weeks of testing.
- Advanced HIV infection.
- Advanced immunosuppression.
- Incorrect blood sample collection.
- Incorrect handling of the blood collection tubes.
- Incorrect performance of the assay.

CDC Guidelines for Preventing TB Transmission in Healthcare Settings

Long Documents with a Plethora of Information

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2005 Guidelines & 2019 Modifications

- **Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-Care Setting, 2005.**
  - Holds majority of guidelines.

- **Tuberculosis Screening Testing, and Treatment of U.S. Health-Care Personnel: Recommendations from the National Tuberculosis Controllers Association and CDC, 2019.**
  - Has updates based on updated epidemiology.

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TB Infection-Control Program

I love it when a plan comes together!

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Administrative Controls

- **First & Most Important:**
  - Assign responsibility for TB infection control.
  - Conduct the annual risk assessment.
  - Written control plan.
  - Train and educate healthcare personnel (HCPs) about TB.
  - Screening and evaluating HCPs.
  - Appropriate signage.
  - Coordinate with LTCU.

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Environmental Controls

- **Second:**
  - Preventing the spread and reducing infectious droplet nuclei.
  - Dilute and remove contaminated air by using general ventilation.
  - Control airflow using airborne infection isolation rooms (AIIR).
  - High efficiency particulate air (HEPA) filtration next to AIIR.
  - Ultraviolet germicidal irradiation (UVGI) next to AIIR.

Respiratory-Protection Controls

- **Third & Last Line of Protection:**
  - Implement a respiratory-protection program.
  - Train HCPs on respiratory-protection program.
  - Educate patient/residents on respiratory hygiene.

Facility Risk Assessments

It’s that time of year again!

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TB Facility Risk Assessment

- Appendix B is the worksheet to use.
- Done initially and annually.
- Need national TB case rate from CDC.
- Need Ohio's and your county's TB case rate.
- Data is released annually after World TB Day in March.

- **TB by County and Seven Major Cities ribbon for Ohio and county case rates: https://odh.ohio.gov/know-our-programs/tuberculosis/Data-and-Surveillance.**

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Risk Classification

- Use “Nontraditional facility-based settings.”
- **Low Risk:**
  - If less than three TB patients.
  - Persons to be treated have LTBI and not TB disease.
  - System in place for prompt detection and triage.
  - No cough inducing or aerosol producing procedures.
- **Medium Risk:**
  - Persons with TB disease are encountered.
  - Otherwise, does not meet low risk criteria.

Individual Healthcare Personnel Assessments

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Who Should Be Included?

- [A]ll paid and unpaid persons working in healthcare settings who have the potential for exposure to *M. tuberculosis* through air space shared with persons with infectious TB disease.

- Ask yourself if this person will ever be in a shared airspace with any patient/resident.
  - If yes, screening is needed.
  - If no, screening is not needed.

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Persons at Highest Risk of Exposure

- Close contacts.
  - Closer proximity and longer duration increases risk of being infected.
- Persons born outside the U.S. in countries with high TB incidence.
- Congregate setting residents and employees.
- HCPs that serve high risk populations.
- HCPs with unprotected exposure.
- Medically underserved.
- Locally defined population with increased incidence.

Persons at High Risk of Progression

- Immunosuppressed and persons living with HIV.
- Infection within the last two years.
- Less than 5 years old.
- Untreated LTBI or inadequately treated TB disease.
- Tobacco use.
- Illicit Drugs.

Persons at High Risk of Progression Medical Risk Factors

- Silicosis.
- Diabetes mellitus.
- Chronic renal failure & end-stage renal disease.
- Low body weight (≥10% below ideal body weight).
- Prolonged corticosteroid use, immunosuppressive treatments.
- Organ transplant.
- Intestinal bypass or gastrectomy.

Patient Characteristics that Increases the Risk of Infectiousness

- Cough.
- Cavitation on chest imaging.
- Positive acid-fast bacilli (AFB) sputum smear result.
- Respiratory track disease.
- Cough-inducing or aerosol producing procedures.

Baseline Screening and Testing

- All HCPs should receive upon hire.
- Testing by TST or blood assay for those with no documented prior LTBI or TB disease.
- TST requires two step.
- Symptom screening.
- Individual TB risk assessment (added in 2019 recommendations).

Postexposure Screening and Testing

- LTCU will help guide.
- Symptom evaluation.
- If baseline was negative, and an exposure to TB was identified:
  - Repeat eight to 10 weeks after the last exposure.
- If either test is positive:
  - Chest radiograph (X-ray).
  - Medical evaluation.

Annual Screening

- For past negatives, not recommended unless there is known exposure or evidence of ongoing transmission (2019 revision).
- Should be done on HCPs with increased risk of occupational exposure.
- Should be done on all HCPs with past positives.
- Annual education is required, including information about TB exposure risk factors and signs and symptoms for all HCPs (new emphasis in 2019).

Evaluation & Treatment of HCPs with Positive Test Results

- New positives need to have chest radiograph and medical evaluation.
  - LTBI treatment is strongly encouraged, unless contraindicated.
- Prior positives don’t require repeat chest radiograph.
  - Except if:
    - Symptoms start.
    - Starting LTBI treatment.

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Evaluation & Treatment of HCPs with Positive Test Results Cont.

- If HCP did not do LTBI treatment, annual symptom screening is required.
  - Teach to notify immediately of any TB disease symptoms.

Screening Questions

Did You Just Cough Near Me?

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Purpose of Screening Questions

- Identify persons:
  - With medical risk factors for TB.
  - With epidemiological risk factors for TB.
  - That had/have temporary or permanent residence in a country with a high TB rate.
  - With symptoms consistent with TB.

Medical Risk Factors

- HIV infection.
- Organ transplant recipient.
- Treatment with a TNF-alpha antagonist.
- Chronic steroids (equivalent of prednisone ≥15 mg/day for ≥ one month).
- Other immunosuppressive medication or conditions.
- Diabetes Meletus.
- Silicosis.
- End-stage renal disease.

Epidemiological Risk Factors

- Close contacts of a person with infectious TB disease.
- Persons who have immigrated from areas of the world with high rates of TB.
- Children less than 5 years of age who have a positive TB test.
- Groups with high rates of TB transmission, such as:
    - Persons experiencing homelessness.
    - Persons who inject drugs.
    - Persons with HIV.

Epidemiological Risk Factors Cont.

- Persons who work or reside with people who are at high risk for TB in facilities or institutions, such as:
  - Hospitals.
  - Homeless shelters.
  - Correctional facilities.
  - Nursing homes.
  - Residential homes for those with HIV.

Countries With High TB Rates

- Utilize current WHO list for 2021-2025.
- Includes lists for:
  - High TB burden countries.
  - High TB/HIV burden countries.
  - High multidrug-resistant/rifampicin-resistant burden countries. (MDR/RR-TB).

Link to WHO List

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Symptoms of TB Disease

- Cough lasting longer than three weeks.
- Chest pain.
- Hemoptysis (bloody sputum).
- Fatigue/malaise.
- Unintended weight loss.
- Loss of appetite.
- Fever, chills, or night sweats.

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Individual TB Risk Assessment

- Now required on all baseline assessments.
- Useful in interpreting TB test results.
- Temporary or permanent residence (for ≥ one month) in a country with a high TB rate?
- Current or planned immunosuppression?
- Close contact since last test?

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Scenarios

Our most encountered questions.

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Quick TST Answers

- Any harm from multiple tests in one year?
- Can multiple tests cause a false positive?
- Any harm during pregnancy?
- Any harm during nursing?
- Measure lengthwise?
- Give to a BCG recipient?
- Cover with a bandage?

No.

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Two-Step TSTs

- My new HCP/admission said they recently had a negative TST. Do I need to repeat the two-step?

No, only if the following are met:

- **Must have a documented negative.**
- **Must be less than 12 months ago.**

If not, it must be repeated.

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TST Missteps

- I didn’t get a good wheal. Can a place another TST immediately?

Yes. Ideally in the other arm or at least four inches away from the first.

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TST Missteps

- My HCP/resident forgot/could not make it in for the reading before the 72-hour cut off, what do we do?

Another TST should be placed as soon as possible and read within 48–72 hours.

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TST Missteps

- What should be done if the second-step TST is not placed in one to three weeks?

Perform the second-step TST as soon as possible, even if several months have passed.

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TST Missteps

- Our HCP/resident got a live vaccine less than four weeks ago and we did the TST, what do we do now?

The reading will be invalid and will need to be repeated. A TST should be administered either on the same day as vaccination with live virus or four to six weeks later.

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IGRA Conundrum

- The results returned as invalid or indeterminate. Now what?

Most TB experts will opt to repeat the test later. They also consider reasons for the invalid or indeterminate results such as recent infections, pregnancy, immunocompromised state or immunosuppressive treatments or laboratory quality control failures to determine the timing.

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Past Positive TST or IGRA

- My new HCP/resident has a documented history of a positive TST/IGRA and a negative chest X-ray. Do we need an annual chest X-ray?

Annual chest X-rays are NOT recommended.

Only repeated when TB symptoms are present or under the direction of the HCP's/resident's provider.

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Annual HCP Screenings

- We are a low-risk facility. Do we test everyone? Do we screen everyone?

Repeat testing is only done where there is evidence of ongoing transmission.

Initially negative HCPs are not screened annually (2019 Revision).

Annual TB training including exposure risks are required.

Past positive HCPs that have not completed LTBI treatment must have an annual screening.

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QUESTIONS?

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