


# Testing for Tuberculosis: Tuberculin Skin Test & IGRA Blood Test

This continuing nursing education activity was awarded a maximum of 4.00 nursing contact hours. This continuing nursing education activity was approved by the Ohio Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation. (OBN-001-91)

Updated 2/20



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## Disclosures

**Criteria for Completion:** To obtain continuing education hours and TST certification the participant must:

- Be in attendance for the entire workshop
- Sign your name on the sign-in sheet clearly showing credentials and email address
- Complete the post-test with a passing score of 80% or greater
- Complete the practicum with a passing score of 87.5% or greater and show correct intradermal injection

**Disclosure:** There is no conflict of interest for anyone with the ability to control content for this activity.

This continuing nursing education activity was approved by the Ohio Nurses Association, an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation. (OBN-001-91) Activity #21884

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## Learning Objectives

- Describe global, national, and state epidemiologic trends for tuberculosis (TB).
- Identify factors that contribute to *Mycobacterium tuberculosis* transmission.
- Describe TB pathogenesis from *Mycobacterium tuberculosis* infection to TB disease.
- Explain the difference between latent TB infection (LTBI) and TB disease.
- Identify methods used for evaluating LTBI and TB disease.
- List high-risk target groups for TB testing.
- Demonstrate how to place, read, and interpret the Tuberculin Skin Test (TST).
- Describe how to interpret Interferon-Gamma Release Assay (IGRA) test results.
- Understand the role of local health in TB control.

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### Components of the Workshop

- Pre-Test
- PowerPoint Presentation
  - I. History and Epidemiology of TB
  - II. *Mycobacterium tuberculosis* Transmission & Pathogenesis
  - III. Testing and Evaluating for TB
  - IV. TB Case Management
- Video: Testing for TB Infection
- Post-Test
- Practicum: Administer and Read the TB Skin Test
- Evaluation

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### I. History and Epidemiology of Tuberculosis

- Global history of TB
- Coverage of the BCG vaccine
- Epidemiology of TB: Global, United States, and Michigan
- Quiz question

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### Global History of Tuberculosis

The timeline shows key events in the history of tuberculosis:

- 1000 BC:** TB of the spine found in Egyptian mummy
- 1851:** 1 in 4 people killed by TB in Europe and US
- 1882:** Robert Koch discovers *M. tuberculosis*
- 1907:** Charles Mantoux introduces TST
- 1921:** First BCG vaccine administered
- 1944:** Streptomycin, first anti-TB med, discovered
- 1970:** First outbreak of drug-resistant TB in the US
- 2012:** FDA approves the first anti-TB drug in more than 40 years

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### Global TB Epidemiology

*"The End TB Strategy milestones...can only be achieved if TB diagnosis, treatment and prevention services are provided within the context of progress towards universal health coverage, and if there is...action to address...determinants that influence TB epidemics and their socioeconomic impact."*



Globally, in 2018...

- **10 million** people fell ill from TB  
→ that's over **27,300** people every day
- **1.2 million** people died from TB  
→ that's over **4,300** people every day
- **1 in 3** people needing treatment for drug resistant TB received treatment  
→ Drug resistant TB treatment success rate was **56%**
- **1.7 billion** people are estimated to have latent TB infection (LTBI)  
→ that's **23%** of the world's population

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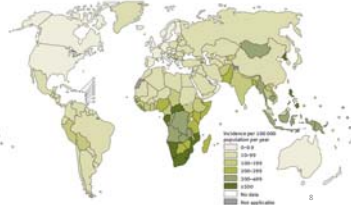


### Global TB Epidemiology, 2018

- 30 high TB-burden countries accounted for **87%** of new TB cases
- 8 of the 30 high TB-burden countries accounted for **67%** of new TB cases

1. India
2. China
3. Indonesia
4. Philippines
5. Pakistan
6. Nigeria
7. Bangladesh
8. South Africa

*Estimated TB incidence rates, 2018*



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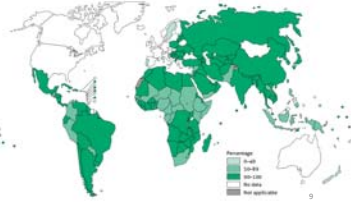
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### BCG (Bacillus Calmette–Guérin) Vaccine

- Prevents disseminated disease in infants and young children
- Protection lasts for 10-15 years; response has been shown to wane with time if not exposed to TB
- Among the 30 high TB burden countries, BCG vaccination coverage ranged from 52% (Papua New Guinea) to 99% (Bangladesh, China, Thailand and the United Republic of Tanzania)

*Estimated BCG vaccine coverage, 2018*



[www.bcgatlas.org](http://www.bcgatlas.org)

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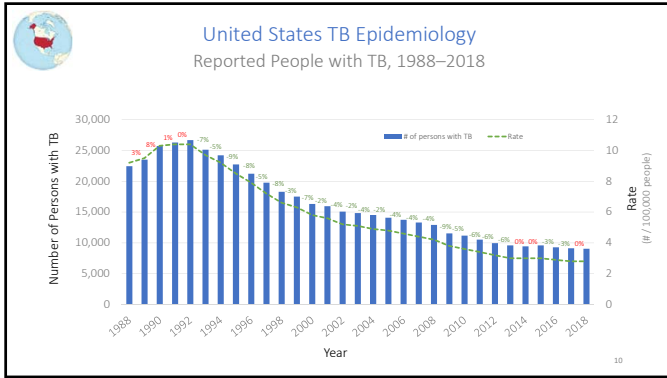
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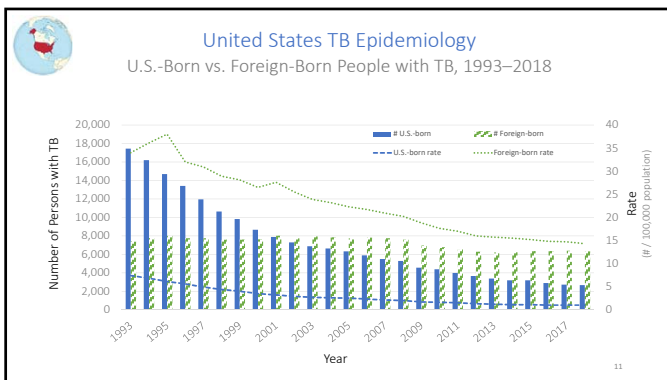
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**United States TB Epidemiology**

Nationally, in 2018...

- **9,025** people fell ill from TB
  - that's over **24** people diagnosed each day
- The rate was **2.8** people with TB per 100,000 population
  - that's only a **0.75%** decrease from 2017
- **605** people had INH resistant TB
  - **98** people had multi-drug resistant (MDR) TB
- **26%** of people with TB were ≥ 65 years old
  - in other words, for every 100,000 people aged ≥ 65, **4.5** had active TB

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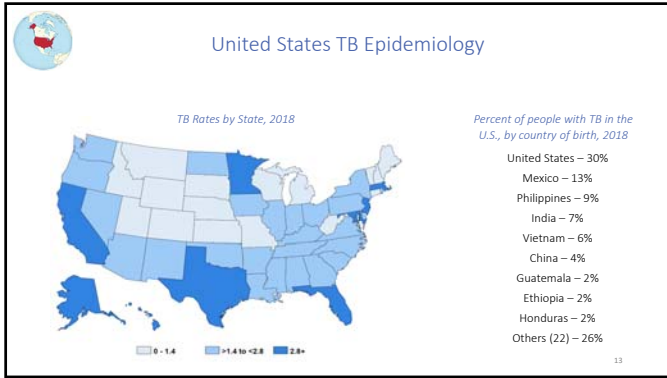
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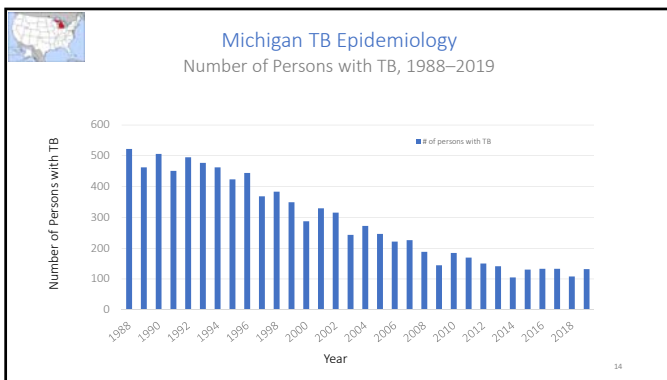
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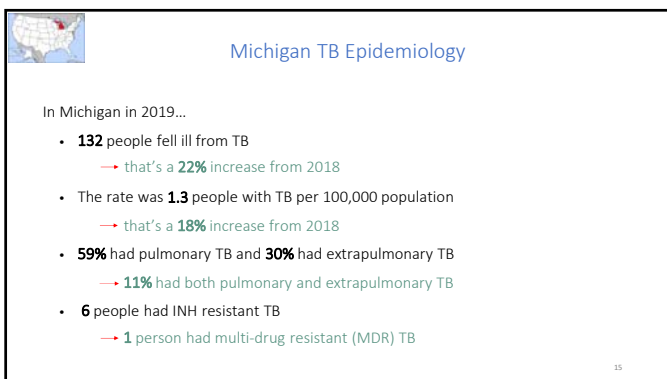
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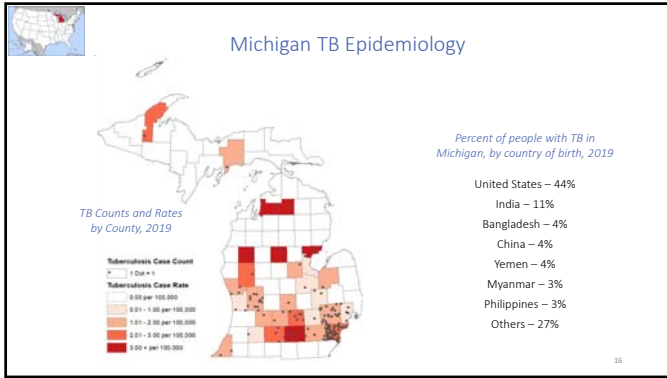
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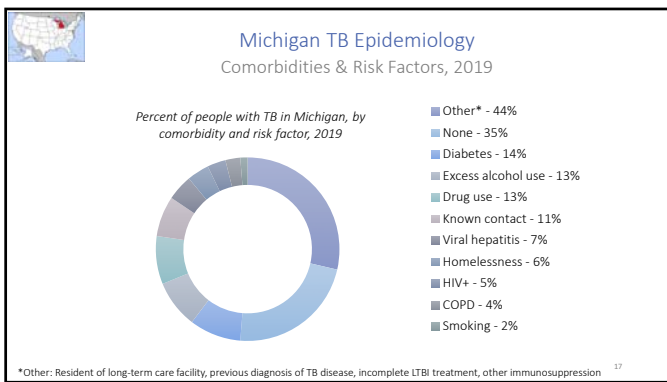
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**Epidemiology Question**

Over 130 cases of TB were reported in Michigan in 2019.

TRUE      FALSE

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## II. *Mycobacterium tuberculosis* Transmission & Pathogenesis

- *Mycobacterium tuberculosis* transmission
- Transmission & pathogenesis timeline
- TB infection TB disease
- Latent TB infection (LTBI) treatment regimens
- LTBI vs. TB Disease
- Quiz question

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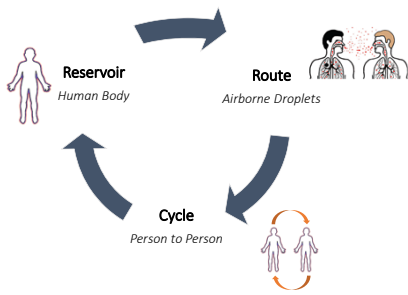
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### *M. tuberculosis* Transmission



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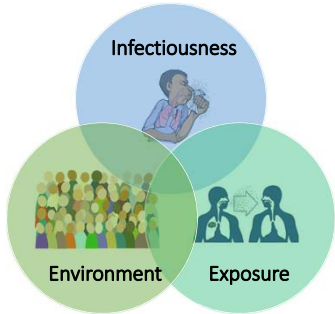
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### *M. tuberculosis* Transmission Factors



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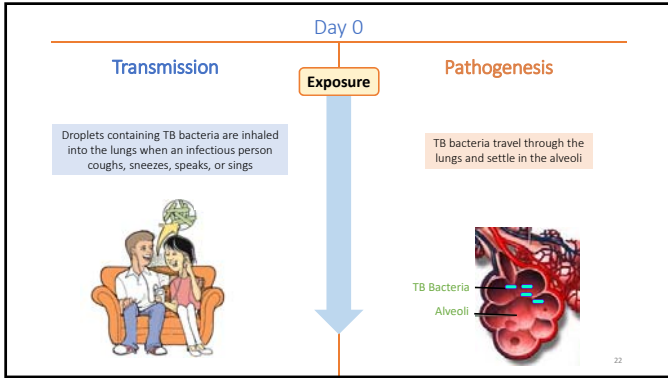
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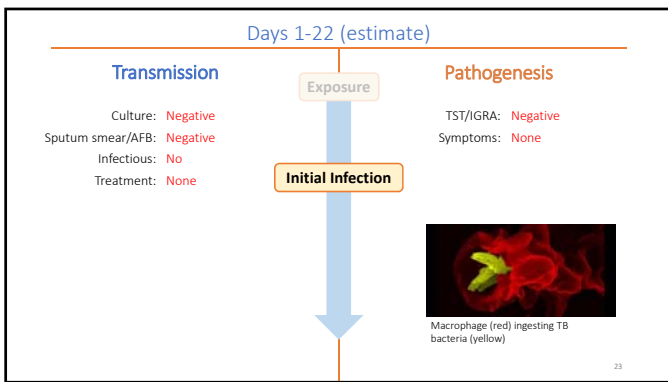
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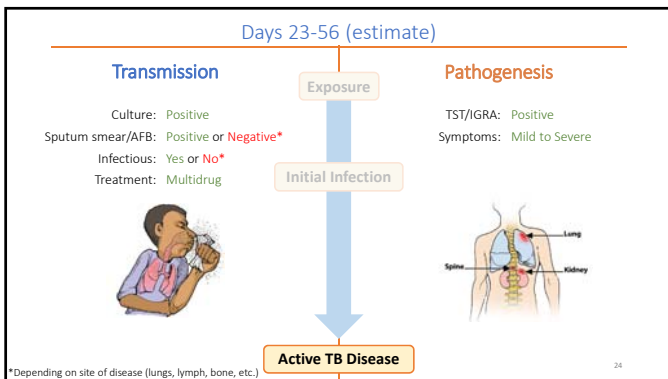
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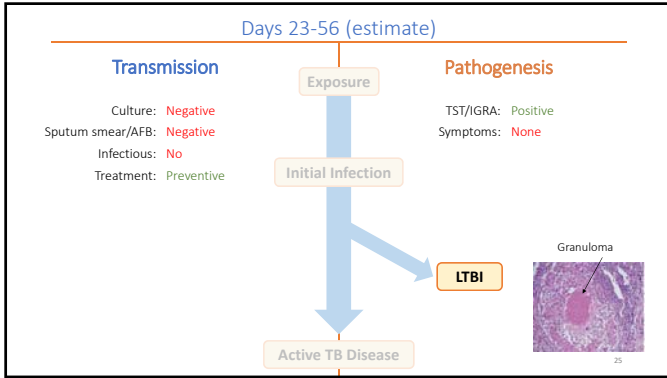
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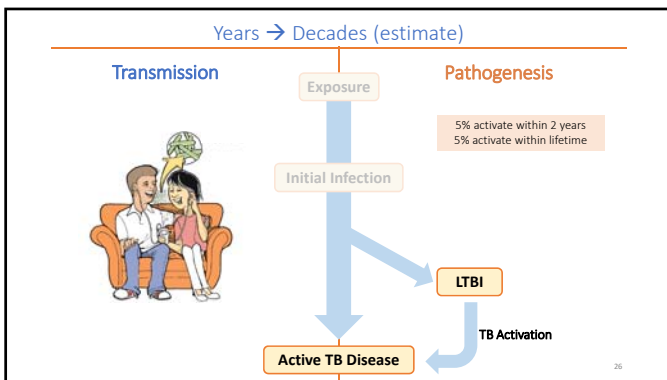
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**Latent Tuberculosis Infection (LTBI)**

- LTBI is a state of persistent immune response to *Mycobacterium tuberculosis* without evidence of clinical TB disease (**no symptoms, not infectious**)
- There is currently no direct test specifically for LTBI
- TB disease can be prevented by treating LTBI
- TB disease is the tip of the iceberg...up to 13 million people in the U.S. have LTBI

> 80% of people with active TB disease comes from **untreated LTBI**

www.cdc.gov/tb

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### TB Infection to TB Disease

Active TB disease occurs in **5-10%** of those with untreated LTBI:

- Majority of people develop TB disease five years after infection
- Risk of TB disease is much higher in some\*

\*TB Activation Risk Factors

- HIV infection
- Age (elderly, infants, and children)
- Dialysis
- TNF $\alpha$  medications
- Smoking
- Silicosis
- Diabetes mellitus
- Severe kidney disease
- Organ/hematologic transplant
- Abusing drugs/alcohol

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    graph LR
      Exposure --> LTBI
      LTBI --> Active_TB[Active TB]
      Risk_Factors((Risk Factors*)) --> LTBI_Active_TB
  
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### Treatment Regimens for Latent TB Infection

Drug(s)	Duration	Frequency	Total Doses
INH and RPT (3HP)	3 months	Once-weekly	12
RIF	4 months	Daily	120
INH	9 months	Daily	270
		Twice-weekly*	76
	6 months	Daily	180
		Twice-weekly*	52

**CDC Recommends Use of 3HP:**

- By DOT or self-administered therapy in persons >2 years
- In children and adolescents, 2-11 years old
- In persons with LTBI who are living with HIV/AIDS and taking antiretroviral medications with acceptable drug interactions with RPT

INH = isoniazid, RPT = rifapentine, RIF = rifampin  
\*Directly-observed therapy (DOT) should be used for intermittent dosing

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### LTBI vs. TB Disease

Person with Latent TB Infection	Person with TB Disease
Has a <i>small</i> amount of <i>contained</i> TB bacteria in their body	Has a <i>large</i> amount of <i>active</i> TB bacteria in their body, <i>not</i> contained
<b>Cannot</b> spread TB bacteria to others ( <b>Not</b> infectious)	May spread TB bacteria to others (Infectious)
Does <b>not</b> require respiratory isolation	May require respiratory isolation
Does <b>not</b> feel sick	May feel sick and have symptoms (cough, hemoptysis, fever, weight loss, etc.)
Chest x-ray is typically <i>normal</i>	Chest x-ray may be <i>abnormal</i>
Sputum smears and cultures are <i>negative</i>	Sputum smears and cultures may be <i>positive</i>
Recommend treatment for LTBI: One or two medications	Required treatment for TB Disease: Four medications
Usually has a positive TST or IGRA	
<b>Not</b> a TB case (but could become one)	A TB case

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### Transmission & Pathogenesis Question

Which of the following patient characteristics indicate LTBI, TB disease, or both? Choose one of the following:

- LTBI
- TB Disease
- Both LTBI and TB Disease

Patient Characteristics	Type of TB
Has a positive TST or IGRA	
May spread TB bacteria to others	
Has TB bacteria in his/her body	
Is NOT a case of TB...yet	

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### III. Testing and Evaluating for TB

- TB evaluation process
- Testing for TB: TST & IGRA
- Screening for TB in healthcare workers
- Quiz question

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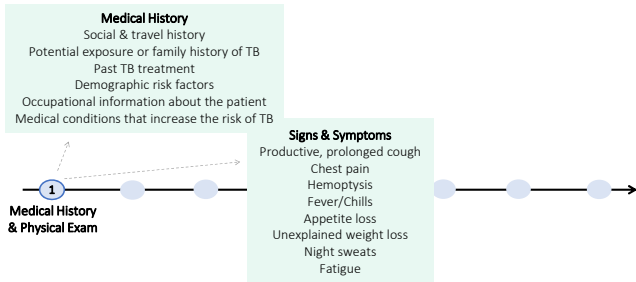
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### TB Evaluation Process

Medical History & Physical Exam



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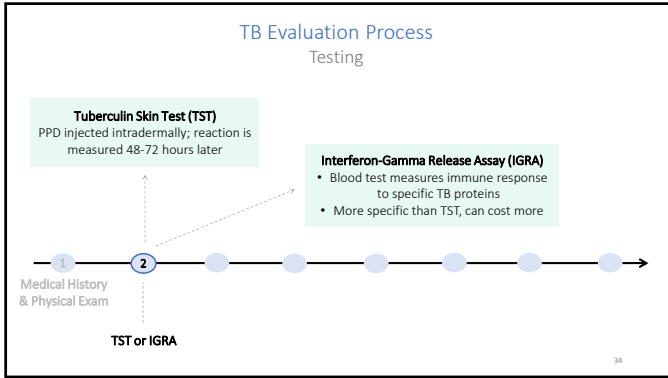
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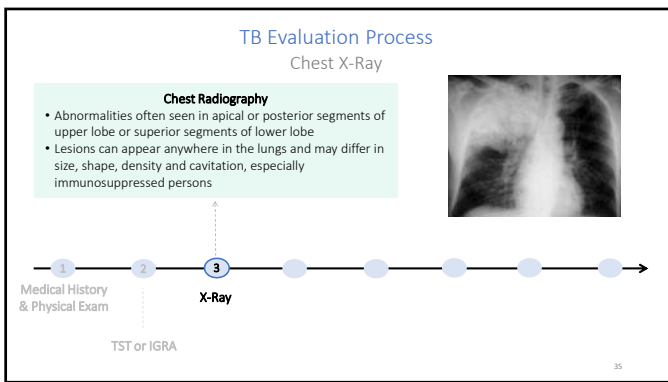
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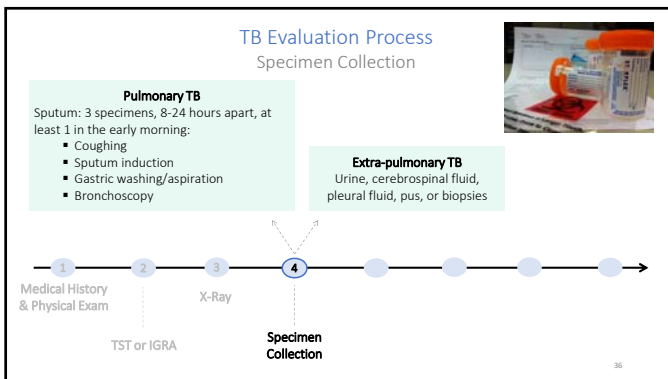
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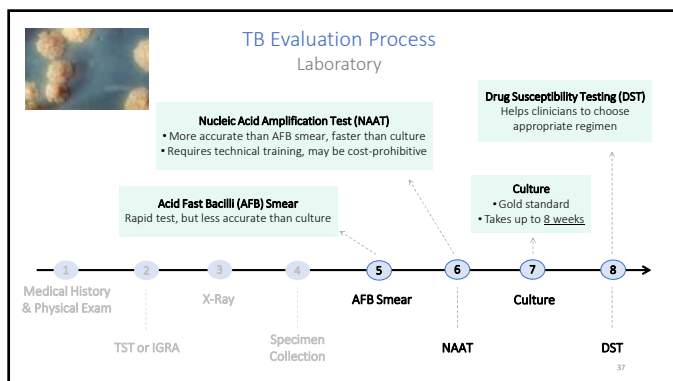
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### Different Types of Mycobacteria

Mycobacterium tuberculosis Complex (MTC)

- 10 genetically related mycobacteria species that can cause TB disease
- Examples: *M. tuberculosis*, *M. bovis*, *M. africanum*, *M. canetti*

Non-Tuberculous Mycobacteria (NTM)

- All other mycobacterial species that do not belong to MTC
- Examples: *M. avium* complex (MAC), *M. kasassii*, *M. marinum*
- Also known as environmental mycobacteria, atypical mycobacteria, or MOTT (**M**ycobacteria **O**ther **T**han **T**uberculosis)

*Mycobacterium marinum* infection on the arm of a fish-tank worker

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### Testing for TB

#### Mantoux Tuberculin Skin Test (TST)

PPD (purified protein derivative)

- Proteins from dead *Mycobacterium bovis*
- **Not** a vaccine
- Store at 2-8°C, protected from light
- Discard 28 days after opening
- Mark/label vial after opening

Process

- Inject 0.1 mL PPD intradermally
- Immune system produces a delayed reaction to the PPD
  - Read test 48-72 hours after administration
  - Measure induration transversely, across the arm

BCG and most NTMs (non-tuberculosis mycobacteria) can cause a false-positive TST result

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### TST Interpretations & Risk Factors

≥ 5 mm is positive in	≥ 10 mm is positive in	≥ 15 mm is positive in
<ul style="list-style-type: none"> <li>HIV positive persons</li> <li>Recent contacts to persons with infectious TB</li> <li>Persons with fibrotic changes on a chest radiograph</li> <li>Organ transplant recipients and other immunosuppressed persons (including patients taking a prolonged course of oral or intravenous corticosteroids or TNF-α antagonists)</li> </ul>	<ul style="list-style-type: none"> <li>Recent arrivals (within the past 5 years) from high incidence countries</li> <li>Injection drug users</li> <li>Residents and employees of high-risk congregate settings (hospitals, long-term care facilities, residential facilities for patients with immunocompromising conditions, correctional facilities, homeless shelters)</li> <li>Mycobacteriology laboratory personnel</li> <li>People with certain medical conditions that place them at high risk for TB (silicosis, diabetes mellitus, severe kidney disease, certain types of cancer, and certain intestinal conditions)</li> <li>Children younger than 5 years of age</li> <li>Infants, children, and adolescents exposed to adults at high risk for developing TB disease</li> </ul>	<ul style="list-style-type: none"> <li>People with no known risk factors for TB disease</li> <li>HCWs who are otherwise at low risk for TB disease and who received baseline testing at the beginning of employment as part of their TB screening program</li> </ul>

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### Testing for TB

#### Interferon-Gamma Release Assay (IGRA)

- Blood test measures immune response to highly specific TB proteins
- Two FDA-approved IGRA tests:
  - QuantIFERON®-TB Gold Plus (QFT®-Plus)
  - T-Spot®.TB Test (T-Spot)
- IGRA test result interpretation is discussed in detail in the Testing for TB Infection Video

Some NTMs can cause a false-positive IGRA result, but not as many as TST.

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### CDC Recommendations

#### Who to Test & Which Test to Use

**Risk of TB infection...**

- Household contact or recent exposure to an active case
- Mycobacteriology lab personnel
- Immigrants from high-burden countries
- Residents/employees high-risk congregate settings

**Risk of developing TB if infected...**

- Age (< 5 years)
- HIV+
- On immune-suppressive therapy
- Abnormal CXR or prior TB
- Silicosis
- Diabetes
- Chronic renal failure
- Intravenous drug use

Considerations when choosing a TST or IGRA

- Prevalence of BCG vaccination
- Expertise of staff and/or laboratory
- Test availability
- Patient perceptions
- Programmatic concerns

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### CDC Recommendations Testing Certain Populations

Population	TST	IGRA
Infants	Same dosage as adults; may receive false-negatives	Not Recommended
Children < 2 years	Recommended	Not Recommended
Occupational screening	Either test	
Unlikely to return for TST reading	Not Recommended	Recommended
Recent contacts to persons with TB disease who need follow-up testing	Not Recommended	Recommended
History of BCG (vaccine or cancer therapy)	Not Recommended	Recommended
TNF-α meds (Humira/Enbrel/Remicade)	Wait one month after prolonged steroid use	
HIV/AIDS	Be aware of false-negatives	Draw 2X rec. volume of blood
Pregnant or breastfeeding women	Both are safe to use	
History of positive TB test	Do <b>not</b> administer either test; ensure disease was ruled-out	
Live-virus vaccines	Use same day as live-virus vaccine or 4-6 weeks after; wait at least one month after smallpox vaccine	

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### False-Negative TB Tests

When a TB test is interpreted as "**negative**" when there **actually is** TB infection/disease present.  
False-Negative TB tests can be due to...

TST	IGRA
Technical error: incorrect application, reading, or interpretation	Technical error: incorrect specimen handling and/or processing
Age: less than 6 months or elderly	Age: < 2 years or elderly
Those recently infected with <i>M. tuberculosis</i> (within the last 8 weeks)	
Absence of normal immune response. May be due to: TNF-α medications, HIV/AIDS, recent live-virus vaccination, bacterial, viral, and fungal illnesses, or severe TB disease	
Chronic renal failure	
Diseases affecting lymphoid organs, such as Hodgkin's disease, lymphoma, chronic leukemia, sarcoidosis	
Stress (surgery, burns, mental illness, graft-versus-host reactions)	

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### False-Positive TB Tests

When a TB test is interpreted as "**positive**" when there **actually is no** TB infection/disease present.  
False-Positive TB tests can be due to...

TST	IGRA
Technical error: incorrect application, reading, or interpretation	Technical error: incorrect specimen handling and/or processing
Infection with NTMs	Infection with <i>M. kansasii</i> , <i>M. szulgai</i> , <i>M. marinum</i> , and <i>M. leprae</i>
History of BCG vaccine/use	
Administration of incorrect solution	

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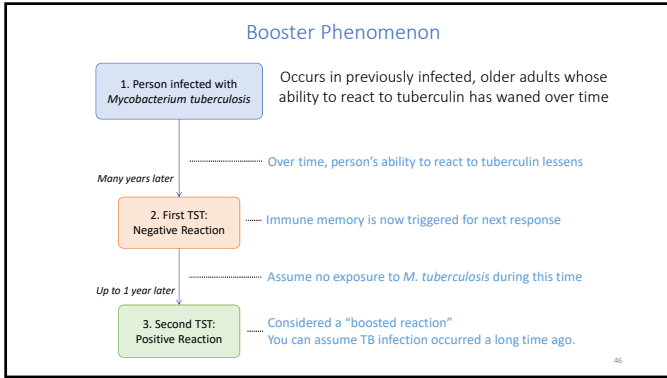
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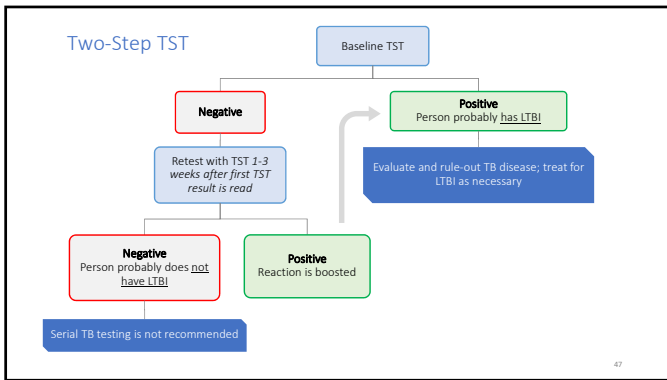
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### Updated Recommendations

#### TB Screening in Health Care Personnel (HCP)

Screening Stage	Updated 2019 CDC Recommendations	Resources
Baseline screening and testing	<ul style="list-style-type: none"> <li>Test those without documented prior TB disease or LTBI</li> <li>Screen all HCP with a symptom evaluation and adult TB risk assessment</li> </ul>	<a href="#">2019 CDC Recommendations</a> TB Screening
Post-exposure screening and testing	<ul style="list-style-type: none"> <li>Symptom evaluation for all HCP</li> <li>For HCP with a baseline negative TB test and no prior TB disease or LTBI, perform a test when exposure is identified; if that test is negative, repeat test 8-10 weeks after last exposure</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">TB sign and symptom review</a></li> <li><a href="#">Adult TB risk assessment</a></li> </ul> Possible Exposure <ul style="list-style-type: none"> <li>Work with your <a href="#">health department</a> for suspected TB exposures and contact investigations</li> </ul>
Serial screening and testing for HCP	<ul style="list-style-type: none"> <li>Serial TB testing <u>not</u> routinely recommended                             <ul style="list-style-type: none"> <li>Can consider for selected HCP groups</li> </ul> </li> <li>Annual:                             <ul style="list-style-type: none"> <li>Screening for TB using an adult TB risk assessment</li> <li>TB education for all HCP; include information about TB exposure risk, signs and symptoms and LTBI treatment</li> </ul> </li> </ul>	Annual Education <ul style="list-style-type: none"> <li><a href="#">MDHHS TST Workshop</a></li> <li><a href="#">CDC online trainings</a></li> </ul>
Evaluation and treatment of positive test results	<ul style="list-style-type: none"> <li>Evaluate all positive tests for active TB disease</li> <li>LTBI treatment is encouraged for all HCP with untreated LTBI</li> <li>Emphasize shorter-course regimens</li> </ul>	LTBI Diagnosis & Treatment <ul style="list-style-type: none"> <li><a href="#">Recommended LTBI treatment regimens</a></li> <li><a href="#">CDC's online LTBI resources hub</a></li> </ul>

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### TB Screening in Health Care Personnel

**Baseline testing:**

- Provides a basis for comparison if exposed to *Mycobacterium tuberculosis*, and
- Helps to detect and treat TB before employment begins.

TB Test History	Upon Hire	Established Employee
Documented history of <b>negative TB test</b> within the past 12 months	One TST (to complete two-step) or one IGRA	<ul style="list-style-type: none"> <li>Serial TB screening with adult risk assessment, sign and symptom review and TB education</li> </ul>
<b>No</b> documented history of TB test	Two-step TST or one IGRA	
Documented history of <b>negative TB test</b> older than 12 months	Two-step TST or one IGRA	<ul style="list-style-type: none"> <li>Serial TB testing <b>not</b> recommended</li> </ul>
Documented history of <b>positive TB test</b> or treatment for LTBI or active TB disease	Chest x-ray (rule-out active TB disease)	

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### Review: TST vs. IGRA

TST	IGRA
PPD injected intradermally; produces a delayed reaction against TB proteins	Blood is drawn; measures the immune response to TB proteins in whole blood
Requires two or more patient visits	Requires one patient visit
Results are available in 48-72 hours	Results can be available in 24 hours
Can cause booster phenomenon	Does not cause booster phenomenon
Reading is subjective	Reading not affected by perception/bias
BCG and most NTMs can cause false-positive results	BCG and most NTMs do not cause false-positive results
Cold storage is required	Cold storage is not required
Price per test is low compared to IGRA	Price per test is high compared to TST
Phlebotomy and lab equipment not required	Phlebotomy and lab equipment are required
Can result in scarring or bad reactions	Can not result in scarring or bad reactions

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### Testing and Evaluating for TB Question

Match the characteristic with the type of TB test.  
Use the following type of TB test:

**TST**  
**IGRA**  
**Both TST and IGRA**

Characteristic	Type of TB Test
Test used to detect TB infection	
PPD is injected intradermally for this test	
This test requires two or more patient visits	
BCG vaccination may cause a false-positive in this test	
Immune status should be considered for this test	

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### IV. TB Case Management

- TB disease treatment
- Drug resistant TB
- Roles of the Local Health Department

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### TB Disease Treatment

- First-line anti-TB drugs:
  - Isoniazid (INH)
  - Rifampin (RIF)
  - Ethambutol (EMB)
  - Pyrazinamide (PZA)
- Treatment can range from 6-24 months, with doses ranging from 2-7 days per week
- LHDs ensure therapy adherence through:
  - Patient education
  - Reinforcement
  - Directly Observed Therapy (DOT)

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### Drug Resistant TB

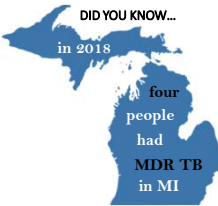
*Drug-resistant TB develops when the antibiotics used to treat TB are misused or mismanaged.*

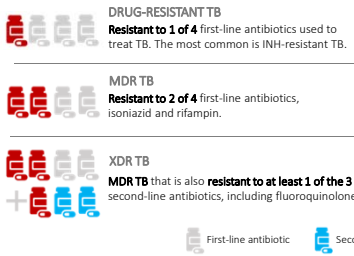
**DRUG-RESISTANT TB**  
Resistant to **1 of 4** first-line antibiotics used to treat TB. The most common is INH-resistant TB.

**MDR TB**  
Resistant to **2 of 4** first-line antibiotics, isoniazid and rifampin.

**XDR TB**  
MDR TB that is also resistant to **at least 1 of the 3** second-line antibiotics, including fluoroquinolones.

**DID YOU KNOW...**  
in 2018  
**four people had MDR TB in MI**





First-line antibiotic      Second-line antibiotic

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### Roles of the Local Health Department

**Surveillance**

- Mandatory reporting TB disease to LHD
- Monitoring drug susceptibility

**Case management**

- Ensure health care accessibility and cost
- Ensure completion of appropriate treatment

**Contact Investigations**

- Start with closest contacts, give priority to children and immunosuppressed
- Expand with infectivity (concentric circle model)

*State and local health departments have the primary responsibility for preventing and controlling TB. However, TB is a complex disease and requires the collaborative efforts of people and organizations throughout the public health sector.*

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## Questions

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*Online Portal: registration, event creation, etc.  
 Continuing education  
 Waivers, instructor and MRT applications  
 Ruler requests*

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 517-284-4957

*TB testing  
 TST Workshop content*

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### Evaluation

<https://www.surveymonkey.com/r/TSTworkshop>



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