

Overview of Tuberculosis Outline

American Lung Association of Michigan
Michigan Department of Community Health

I. History of *M. tuberculosis*

- A. Phthisis known since ancient times
- B. Often thought of as a hereditary condition
- C. 1839 all forms designated as TB
- D. 1859 first sanatorium
- E. 1882 Koch demonstrated relationship between germ and disease
- F. 1896 Roentgen discovery of diagnostic x-ray
- G. 1940's-1950's chemotherapy

II. Transmission

- A. Spread via droplet nuclei
- B. Organism (bacteria)- *Mycobacterium tuberculosis* (*M. tb*)
- C. Transmission factors:
 - 1. Infectiousness of case
 - 2. Environment of exposure
 - 3. Duration of exposure
 - 4. Virulence of the organism
- D. Latent TB infection (LTBI)-NOT INFECTIOUS
- E. TB disease-IS INFECTIOUS

III. Pathogenesis

- A. Inhale droplet nuclei
- B. Bacteria multiplies in alveoli
- C. Macrophages consume bacteria, then die
- D. Travel through the bloodstream, lymph system
- E. It may take 2-10 weeks to develop + reaction to TST
- F. Containment-infection (LTBI)
- G. Multiplication-disease
- H. 10% of infected persons with normal immune systems develop TB at some point in life
- I. Conditions that increase the risk of progression to TB disease
HIV infection, substance abuse, recent infection with *M. tb*, chest x-ray findings suggestive of previous TB, diabetes mellitus, silicosis, prolonged corticosteroid therapy, cancer of the head and neck, hematologic and reticuloendothelial diseases, end-stage renal disease, intestinal bypass or gastrectomy, chronic malabsorption syndromes, and low body weight (10% or more below ideal).
 - 1. Risk of developing TB disease if HIV infected is 7-10% per year
 - 2. Some studies suggest the risk of developing TB disease with diabetes is 3 times greater than those persons with healthy immune systems
- J. Common sites of TB Disease
 - 1. Lungs

2. Pleura
 3. Central nervous system
 4. Lymphatic system
 5. Genitourinary systems
 6. Bones and joints
 7. Disseminated (miliary TB)
- K. Drug-resistant TB
1. Drug-resistant TB transmitted same way as drug susceptible TB
 2. Drug resistance is divided into two types
 - a. Primary resistance develops in persons initially infected with resistant organisms
 - b. Secondary resistance (acquired resistance) develops during TB therapy
 3. Terms
 - a. MDR-TB: Multidrug Resistant TB
 - b. XDR-TB: Extensively Drug Resistant TB
- L. Classification System for TB
1. Class 0-No TB exposure, not infected
 2. Class 1-TB exposure, no evidence of infection
 3. Class 2-TB infection, no disease
 4. Class 3-TB, clinically active
 5. Class 4-TB, not clinically active
 6. Class 5-TB suspected

IV. Around the World

- A. An estimated 1.58 million deaths in 2005 from TB disease
- B. 8.8 million new TB cases estimated in 2005
- C. 1/3 of world population has TB infection

High Burden Countries (World Health Organization)

- | | | |
|---|-------------|------------------------------|
| ●Afghanistan | ●Ethiopia | ●Philippines |
| ●Bangladesh | ●India | ●Russian Federation |
| ●Brazil | ●Indonesia | ●South Africa |
| ●Cambodia | ●Kenya | ●Thailand |
| ●China | ●Mozambique | ●Uganda |
| ●Democratic Republic of the Congo | ●Myanmar | ●United Republic of Tanzania |
| | ●Nigeria | ●Viet Nam |
| | ●Pakistan | ●Zimbabwe |

V. Reported TB Cases, United States, 1985-2005

- | | | |
|---------|--------|-------------------------------|
| A. 1985 | 22,201 | 9.3 cases/100,000 population |
| B. 1992 | 26,673 | 10.5 cases/100,000 population |
| C. 1998 | 18,361 | 6.8 cases/100,000 population |
| D. 2000 | 16,377 | 5.8 cases/100,000 population |
| E. 2001 | 15,989 | 5.6 cases/100,000 population |

| | | |
|---------|--------|------------------------------|
| F. 2002 | 15,078 | 5.2 cases/100,000 population |
| G. 2003 | 14,871 | 5.1 cases/100,000 population |
| H. 2004 | 14,517 | 4.9 cases/100,000 population |
| I. 2005 | 14,097 | 4.8 cases/100,000 population |

VI. Michigan TB Cases, 1998 – 2006

| | | |
|---------|-----|------------------------------|
| A. 1998 | 385 | 3.9 cases/100,000 population |
| B. 2000 | 285 | 2.9 cases/100,000 population |
| C. 2001 | 330 | 3.3 cases/100,000 population |
| D. 2002 | 315 | 3.2 cases/100,000 population |
| E. 2003 | 243 | 2.4 cases/100,000 population |
| F. 2004 | 272 | 2.7 cases/100,000 population |
| G. 2005 | 246 | 2.5 cases/100,000 population |
| H. 2006 | 221 | 2.2 cases/100,000 population |

VII. Evaluation for TB

- A. Medical history
- B. Physical examination
- C. Mantoux tuberculin skin test
- D. Chest radiograph
- E. Bacteriologic or histologic exam

VIII. TB Disease-Signs/Symptoms

- A. Productive, prolonged cough (> 2 weeks)
- B. Shortness of breath
- C. Chest pain
- D. Hemoptysis
- E. Fever / chills
- F. Appetite loss / Unexplained weight loss
- G. Night sweats
- H. Fatigue

IX. TB Disease Identification

- A. History
 - 1. S/S
 - 2. Potential for exposure
 - 3. Past TB treatment
 - 4. Demographic risk factors
 - 5. Medical conditions that increase risk of TB
 - 6. HIV testing recommended in a person with TB disease
- B. Skin test
 - 1. Most commonly used method of testing for LTBI
 - 2. May be neg if:
 - a. Too soon after exposure
 - b. Severe illness

- c. <6 months old
 - 3. Useful when S/S present
 - 4. Useful to determine how many people infected
- C. CXR
 - 1. Abnormalities often seen in apical or posterior segments of upper lobe or superior segments of lower lobe
 - 2. HIV: may be unusual
 - 3. Cannot confirm dx of TB
- D. Specimens
 - 1. Sputum: 3 consecutive days
 - 2. Spontaneous
 - 3. Induced
 - 4. Bronchoscopy
 - 5. Gastric aspiration
- E. Laboratory
 - 1. Smear
 - 2. Culture = Gold standard for diagnosis
 - 3. Susceptibilities

X. TB Disease Treatment

- A. Provides safest, most effective therapy in shortest time
- B. Uses multiple drugs to which the organisms are susceptible
- C. Never add a single drug to a failing regimen
- D. Ensure adherence to therapy
- E. Monitoring
 - 1. Case management
 - 2. Client side effects
 - 3. Lab testing
 - a. Adverse reactions
 - b. Disease clearance
 - c. HIV testing
- F. Compliance
 - 1. 25% do not complete therapy within one year
 - 2. DOT-directly observed therapy
 - 3. Incentives/enablers
 - 4. Accommodations for barriers
- G. Usually 6 months, some cases 9 months
 - 1. Four drugs for first two months
 - a. INH-isoniazid, RIF-rifampin, PZA-pyrazinamide, EMB-ethambutol
 - 2. Then two drugs for four or seven months
 - a. INH-RIF
 - 3. Intermittent therapy may be an option after two weeks of daily therapy
 - 4. Adjust regimen when susceptibility results are known
- H. Extrapulmonary TB
 - 1. Surgery may be an option
 - 2. May require longer therapy
- I. Children
 - 1. Prompt and aggressive
 - 2. EMB not recommended

- J. Pregnancy and lactation
 - 1. Nine month therapy of INH, RIF, and EMB
 - 2. PZA and SM (streptomycin) are contraindicated
 - 3. No toxic effect on breast milk
- K. Monitoring for adverse reactions
 - 1. Baseline measurements
 - 2. At least monthly
 - 3. Must be individualized
 - 4. Instruct patients to immediately report adverse reactions

XI. Infectiousness

- A. Patients should be considered infectious if they:
 - 1. Are coughing
 - 2. Are undergoing cough-inducing or aerosol-generating procedures, or
 - 3. Have sputum smears positive for acid-fast bacilli and they
 - a. Are not receiving therapy
 - b. Have just started therapy, or
 - c. Have poor clinical response to therapy

XII. Infection Control - TB Control Plans

- A. Administrative
 - 1. Alert to S/S of *M. tb*
 - 2. Early isolation of suspect cases
 - 3. Prompt initiation of therapy with suspect cases
 - 4. Alert for undiagnosed pulmonary illness with HIV
- B. Engineering
 - 1. Neg. pressure isolation rooms
 - 2. Enhanced air exchanges
 - 3. UV lights
 - 4. Hepa filtration systems
- C. Personal protection
 - 1. Client to wear surgical mask
 - 2. HCW wears N-95 respirator

XIII. TB Skin Test Classification

- A. Positive skin test and no disease
 - 1. Reactor: No history of skin test or negative skin test >2 yrs ago
 - 2. Converter: History of negative skin test within past 2 yrs

XIV. LTBI Treatment

- A. TB disease must be ruled out
- B. If you test-you treat
- C. Pregnant women: treat if high risk for the progression of LTBI to active disease
- D. Adults and children
 - 1. INH for 9 months (daily or intermittent)

- 2. RIF for 4 months (daily)
- E. LTBI-Therapy Monitoring
 - 1. Determine history of treatment for LTBI or disease
 - 2. Assessment for contraindications to treatment
 - 3. Obtain history of current medications
 - 4. Concurrent medical conditions
 - 5. Recommend HIV testing if risk factors present
- F. LTBI-Therapy Monitoring
 - 1. Establish rapport and emphasize
 - a. Benefits of treatment
 - b. Possible side effects: n/v, anorexia, malaise, hepatitis, neurotoxicity, elev T. >3 days
 - c. Importance of adherence to regimen
 - d. Establishment of optimal follow-up plan

XV. BCG (bacille Calmette-Guérin)

- A. Vaccine used in many countries outside the USA
- B. Controversial efficacy
- C. Response wanes with time
- D. NOT a contraindication for skin testing

XVI. Other Mycobacteria

- A. Terms
 - 1. NTM: nontuberculosis causing mycobacteria
 - 2. MOTT: mycobacteria other than tuberculosis
 - 3. Atypical: mycobacteria other than tuberculosis
 - 4. MAC: Mycobacteria avium complex
 - a. Found in water and soil
 - b. Seen with HIV
 - c. Treatment: surgery or chemotherapy, can be difficult to treat

XVII. Community Control

- A. Surveillance
 - 1. Primarily the responsibility of the Local Health Department (LHD)
 - 2. Nurses, ICP's, labs, and physicians responsible to report TB case to LHD
 - 3. Monitoring drug susceptibility
- B. Containment
 - 1. Case management
 - 2. Primary responsibility of LHD, even if treatment is through private provider
 - 3. Ensure health care accessibility and cost
- C. Contact investigation
 - 1. Starts with closest contacts
 - 2. Priority to children and those with HIV
 - 3. Expands with infectivity

TB Skin Testing Outline

I. Target Groups for TB Skin Testing

- A. Persons at higher risk for exposure to or infection with TB
 - 1. Close contacts to TB case
 - 2. Foreign born from areas of high prevalence of TB
 - 3. Those living in congregated settings
 - a. Long term care, correctional facilities, shelters, etc.
 - 4. HCWs (health care workers) who serve high risk clients
 - 5. Medically underserved populations
 - 6. High-risk racial or ethnic minority populations
 - 7. Children exposed to adults in high-risk categories
 - 8. Persons who inject illicit drugs
- B. Persons at higher risk for TB disease once infected
 - 1. HIV or at risk for HIV
 - 2. Persons recently infected with *M. tb*
 - 3. Persons with certain medical conditions
 - 4. Persons who inject illicit drugs
 - 5. Persons with a history of inadequately treated TB
- C. All testing activities should be accompanied by a plan for follow-up care

II. Tuberculin Skin Testing

- A. Purpose: find persons with LTBI/TB disease who would benefit from tx
- B. *M. tb* infection produces delayed type hypersensitivity reaction to the purified protein derivative (PPD)
 - 1. Reaction begins 5-6 hrs after injection and peaks at 48-72 hrs
- C. Protein extract of tubercle bacilli killed by heating
- D. Not a vaccine
- E. Detects individuals infected with mycobacterium
- F. The ID TST (intradermal tuberculin skin test) is the most commonly used method
 - 1. QuantiFERON-TB test: whole blood test
 - 2. Multiple puncture test (ie tine) no longer recommended
- G. TST is a diagnostic aid-screening tool

III. Application of the TB Skin Test

- A. Health screening questions
 - 1. Previously + TST reaction?
 - 2. Recent live virus vaccine?
 - 3. Recent viral infection?
 - 4. Recent steroid therapy?
 - 5. Immune compromised?
 - 6. Vaccinated with BCG?

- B. History of previously positive reaction to TB skin test
 - 1. Do not administer another TB skin test
 - 2. Clarify that individual understands what a positive reaction is
- C. TB skin testing with immunizations
 - 1. Either administer TB skin test on same day as live-virus vaccines (MMR, varicella, smallpox, yellow fever, intranasal influenza, herpes zoster) OR
 - 2. 4-6 weeks after administration of the live-virus vaccine
 - 3. Wait at least one month after smallpox vaccination
- D. Immunocompromised (eg. receiving the equivalent of >15mg/d of prednisone for > 1 mo)- reactivity to TST may be depressed or suppressed
- E. BCG is not a contraindication to TB skin testing
 - 1. Determine when the last BCG was given
 - 2. Response will wane after time
- F. TB skin testing during pregnancy
 - 1. Not a vaccine
 - 2. Safe to administer for targeted tuberculin skin testing

IV. Storage of PPD

- A. Store PPD in a refrigerator at 2-8° C (35-46°F) when not in use
- B. Protect from light
- C. Discard 30 days after opening vial

V. Administering the Tuberculin Skin Test

- A. Inject intradermally 0.1 ml of 5 TU PPD tuberculin (bevel up)
- B. Produce wheal 6 mm to 10 mm in diameter
- C. Do not recap, bend, or break needles or remove needles from syringes
- D. Follow standard precautions for infection control

VI. TB Skin Test Readings

- A. Read the test 48-72 hours after the application
- B. Measure the widest diameter of induration (transverse)
- C. Measure the induration up to 1 week after the skin test
- D. Negative TB skin test results read after 72 hours should be repeated
- E. Document date skin test read, induration in mm, and read by whom

VII. Classifying the Tuberculin Reaction

- A. ≥ 5 mm is classified as positive in
 - HIV-positive persons
 - Recent contacts of TB case
 - Persons with fibrotic changes on chest radiograph consistent with old healed TB
 - Patients with organ transplants and other immunosuppressed patients

- B. ≥ 10 mm is classified as positive in
 - Recent arrivals from high-prevalence countries
 - Injection drug users
 - Residents and employees of high-risk congregate settings
 - Mycobacteriology laboratory personnel
 - Persons with clinical conditions that place them at high risk
 - Children <4 yrs, or children and adolescents exposed to adults in high-risk categories
- C. ≥ 15 mm is classified as positive in
 - Persons with no risk factors identified
- D. Targeted skin testing programs should only be conducted among high-risk groups

VIII. TB Skin Tests in Children

- A. For infants and children use same strength test and dosage
- B. More likely to get false negative results in infants
- C. Positive TB skin tests in children indicate recent transmission of TB in community
- D. Refer all children with + reaction for medical follow-up

IX. Anergy Testing

- A. No longer recommended
- B. No consistent standardization
- C. Responses not consistent
- D. Evaluation of status should be based on ‘whole picture’ and not based on one test

X. The Booster Effect

- A. Delayed type hypersensitivity may wane with age
- B. Initial skin test may be negative
- C. This test may ‘boost’ reactivity
- D. Subsequent tests may be ‘+’
- E. Individual may be mistakenly classified as a new infection
- F. Remember-you can’t booster someone who is not infected
- G. Two Step TB Testing
 1. Distinguishes between boosted reactions and new infections
 2. Recommended for persons who will be retested periodically and who have not had a TB skin test for over one year
 - First test ‘+’ : Person infected
 - First test ‘-’ : Do second test in 1-3 weeks
 - a. Second test ‘+’ : Old infection
 - b. Second test ‘-’ : Uninfected

XI. Health Care Workers *M. tb* Screening

- A. Negative or no history of skin tests
 - 1. New hire: 2 step (unless tested within past year)
 - 2. Current: Annual skin test
- B. Past positive
 - 1. New hire: TB questionnaire
 - 2. Current: Annual questionnaire
- C. High risk screened every 3 or 6 months (in MI OSHA TB document from 7-11-05)
- D. *Any changes require evaluation*

XII. False Negative TB Skin Tests

- A. Failure to react to skin test even though person is infected with mycobacterium
- B. Technical errors (remember the five “rights”)
 - 1. Incorrect method of administration
 - a. Too little antigen
 - b. Subcutaneous injection
 - 2. Incorrect interpretation
- C. Cutaneous anergy
 - 1. HIV infection
 - 2. Severe or febrile illness
 - 3. Hodgkin’s disease
 - 4. Sarcoidosis
 - 5. Corticosteroids
 - 6. Immunosuppressive drugs
- D. Recent TB infection- 2-10 weeks for conversion of TST post-exposure
- E. Very young age (<6 months old)
- F. Recent live-virus vaccination (including smallpox)
- G. Overwhelming TB disease
- H. Some viral illnesses (e.g. measles and chickenpox)

XIII. False Positive Tests

- A. A positive reaction in an individual who is not infected with *M. tb*
 - 1. Infected with a mycobacteria other than tuberculosis
 - 2. Vaccination with BCG
 - 3. Incorrect interpretation
 - 4. Administration of incorrect antigen

CDC TB SKIN TEST VIDEO OUTLINE

- I. Background on the tuberculin skin test
 - A. Standard method for detecting latent TB infection (LTBI) since 1930's
 - B. Used to evaluate people for LTBI in two situations
 1. Contact investigation
 2. Targeted testing for high risk groups
 - a. Healthcare workers
 - b. Residents and employees of congregate living settings such as long-term care, correctional facilities, homeless shelters, rehab facilities
 - c. Foreign-born people from countries of high TB incidence
- II. Administering the TB skin test
 - A. Preparation steps
 1. Collect supplies
 - a. Vial of tuberculin antigen (Tubersol or Aplisol)
 - b. Single-dose tuberculin syringe ¼-1/2 inch 27-gauge needle with a short bevel
 - c. A ruler with millimeter measurements
 - d. A 2x2 gauze pad or cotton balls
 - e. Alcohol swabs
 - f. A puncture-resistant sharps disposal container
 - g. Record keeping forms for the patient and the provider
 - h. A pen
 2. Provide patient education
 - a. Discuss the procedure with the patient
 - b. Explain that it is imperative that they return for the reading in 48-72 hrs
 - c. Encourage the patient to ask questions
 - d. Consult local practice regarding informed consent documentation
 - e. Provide educational materials appropriate for their learning level, culture and language
 3. Wash your hands or use alcohol based hand sanitizer
 4. Locate and clean the injection site
 - a. Choose a well lit surface
 - b. Expose the patient arm slightly flexed at the elbow
 - c. The injection should be placed on the palm-side-up surface of the forearm about 2-4 inches below the elbow
 - d. The site selected should be free of barriers such as heavy hair, veins, sores, scars, or muscle margins
 - e. Alternative sites include the upper chest or on the upper back below the scapula, consult your local institution's policy
 - f. Clean the area with an alcohol swab by circling from the center of the site outward.
 - g. Allow the site to AIR DRY before the injection
 5. Prepare the syringe
 - a. Wipe the top of the vial with a new alcohol swab before drawing up the tuberculin solution
 - b. Ensure that the needle is fastened tightly on the syringe, the needle bevel should be perpendicular to the flange of the syringe
 - c. Place the vial on a flat surface and hold the vial between the thumb and fingers, and insert the needle through the neoprene stopper
 - d. Invert the vial while keeping a firm hold on the syringe and plunger, the tip of the needle should be below the fluid level in the vial
 - e. Pull back on the plunger and draw out slightly more than the one tenth of a milliliter needed for the test

- f. Remove the needle from the vial. Hold the syringe in an upright position, then draw back lightly on the plunger. Tap the syringe lightly to break up air bubbles, then push forward expelling all air bubbles to leave on tenth of a milliliter of tuberculin solution in the syringe
- B. Injection steps
 1. Stretch the skin taut to provide an easier surface to penetrate
 2. Slowly inject the tuberculin at a 5-15 degree angle so that a 6-10 mm wheal is produced at the injection site
 3. Discard the needle and syringe into a designated container, engage the safety device before discarding, if available
 4. Check that the skin test was administered properly
 5. Repeat the test using a new needle if needed
 - C. Final steps
 1. Wash your hands
 2. Record the information
 - a. Date and time the test was administered and the site used
 - b. Manufacturer of the solution, the lot number, the dose, the expiration date, and your name
 3. Remind the patient about the return visit
 4. Provide patient education
 - a. Mild itching, swelling, or irritation are normal
 - b. Avoid scratching the site, keep the site clean and dry, and avoid putting creams, lotions, or adhesive bandages on it.
 - c. Getting the site wet is not harmful, but the site should not be scrubbed or wiped
 5. Return the vial of antigen to the refrigerator
- III. Reading the TB skin test
- A. Collect the appropriate supplies
 1. Small, plastic, flexible ruler
 2. A pen
 3. An alcohol pad
 - B. Inspect the site
 1. In good light and on a firm surface
 2. When on arm, slightly flex it at the elbow
 - C. Palpate the induration
 1. Keep fingernails short so that they don't protrude beyond the finger
 2. Rely on palpation, not vision
 3. With your fingers together, touch the area lightly with pads of fingertips
 - a. Use light, gentle motion to locate margins
 - b. If induration is present, use a zigzag, feather-like touch over induration
 - D. Mark the induration
 1. Mark lightly at the widest edge of the induration (transverse)
 2. Repeat procedure to mark the margin on the other side
 - E. Measure the induration – NOT THE REDNESS
 1. Transverse measurement only
 2. Place the zero ruler line inside the left dot edge
 3. Read the ruler line inside the right dot edge
 4. If the measurement falls between 2 divisions on the ruler, record the lower mark
 - F. Record the measurement
 1. Write the exact measurement in mm
 2. Do not simply record negative or positive
 3. Include date and time read, name and signature of reader of test, and adverse effects