TB:
Recognizing it on a Chest X-Ray

Michigan World TB Day April 8, 2016
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Disclosures

- Grant support from Michigan Department of Community Health
  - Despite conflict of interest I still want to:

  - There's enough TB for job security.

Objectives

- You will
  - Be able to identify **major structures** on a normal chest x-ray
  - Identify and correctly name **CXR abnormalities** seen commonly in TB
  - **Recognize chest x-ray patterns** that suggest TB & when you find them you will

Basics of Diagnostic X-ray Physics

- X-rays are directed at the patient and variably absorbed
  - When not absorbed
    - Pass through patient & strike the x-ray film **or**
  - When completely absorbed
    - Don't strike x-ray film **or**
  - When scattered
    - Some strike the x-ray film

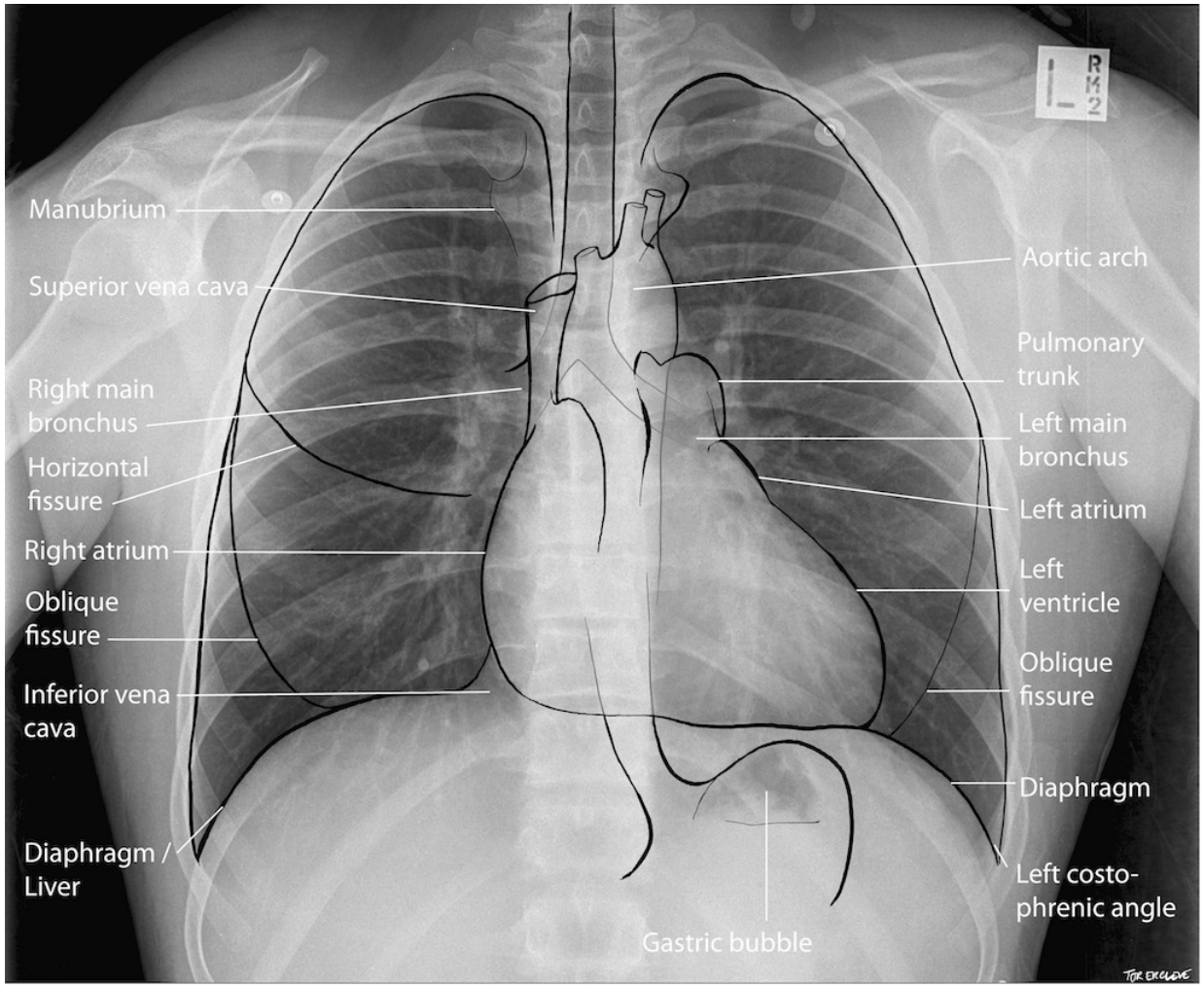
Absorption

- Absorption depends on the
  - Energy of the x-ray beam
  - Density of the tissue

Shade / Density

- Whitest = Most Dense
  - Metal
  - Contrast material (dye)
  - Calcium
  - Bone
  - Water
  - Soft Tissue
  - Fat
  - Air / Gas
- Blackest = Least Dense

Normal Frontal Chest X-ray: Posterior Anterior

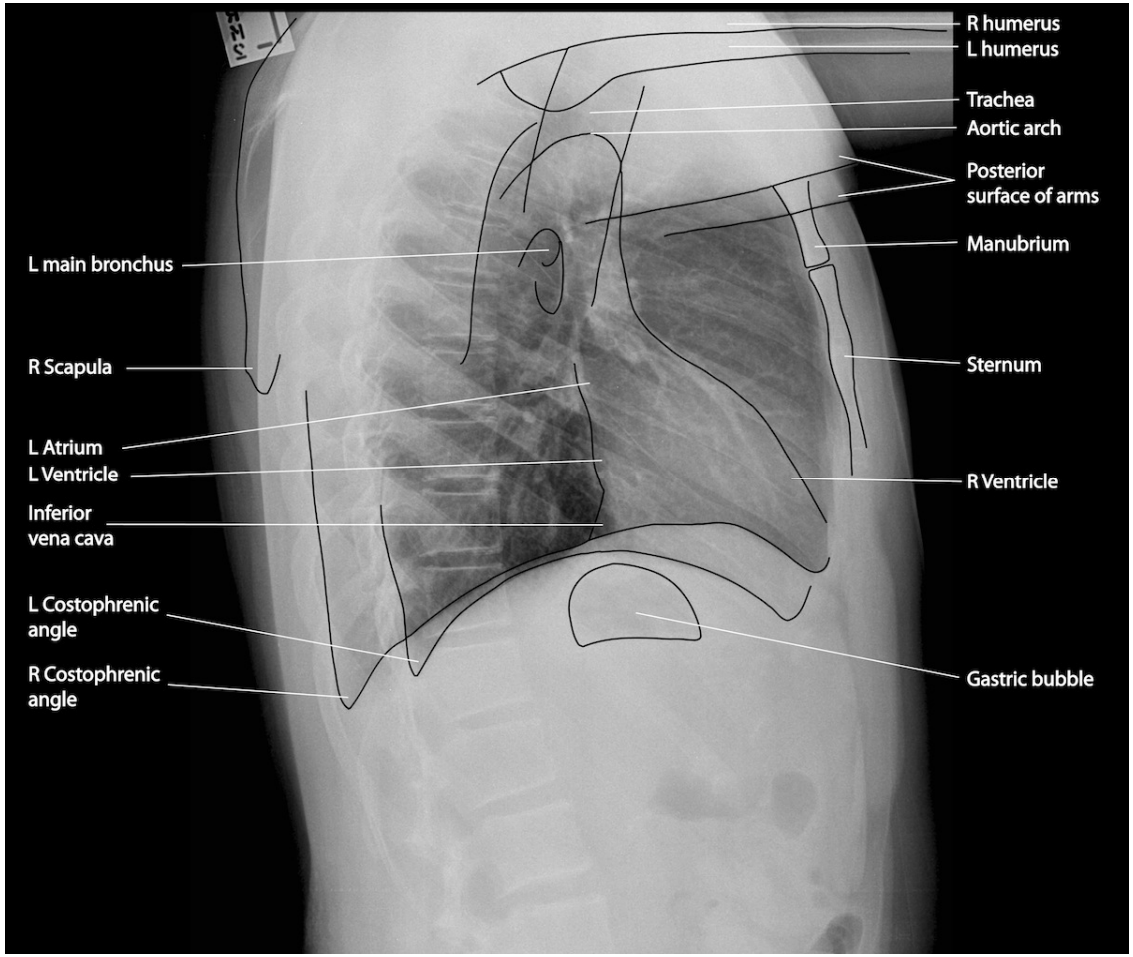


Lifeinthefastlane.com

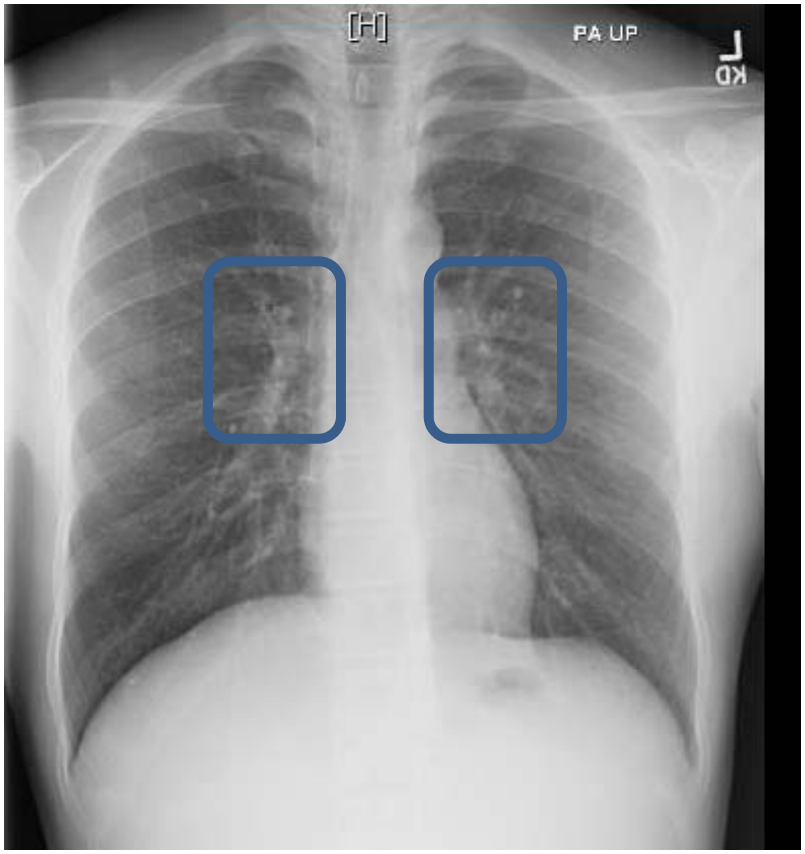
Note <u>silhouette</u> formed by
- lung adjacent to heart
- lung adjacent to diaphragm

Silhouette Sign

Normal Lateral Chest X-ray

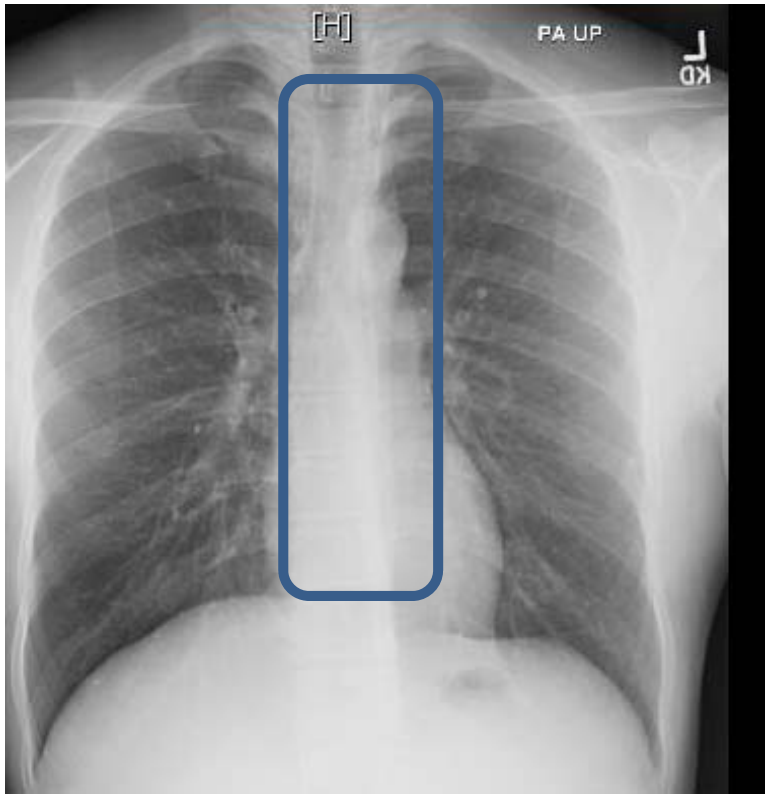


Normal PA & Lateral X-ray: Hilum



<u>Hilum</u> – Major bronchi, Pulmonary veins & arteries, Lymph nodes at the root of the lung.

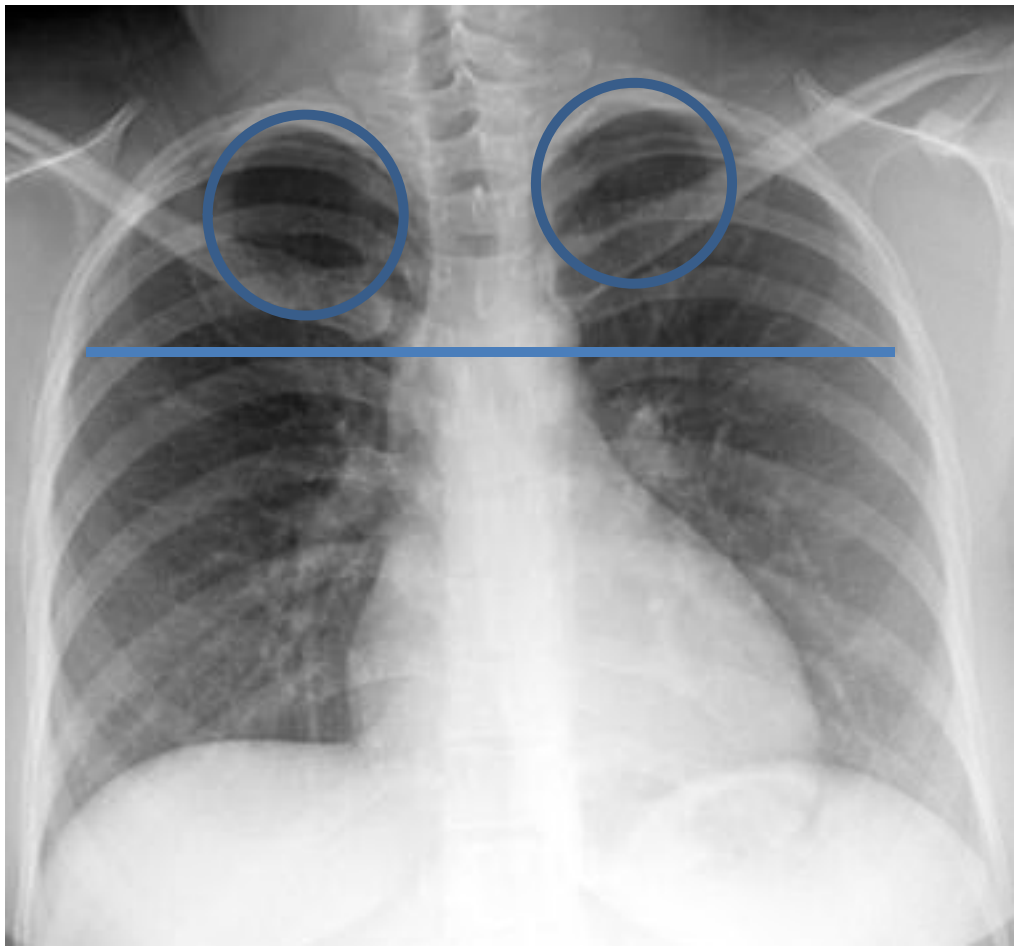
Normal PA & Lateral X-ray: Mediastinum



<u>Mediastinum</u> – Central chest organs (not lungs) – Heart, Aorta, Trachea, Thymus, Esophagus, Lymph nodes, Nerves

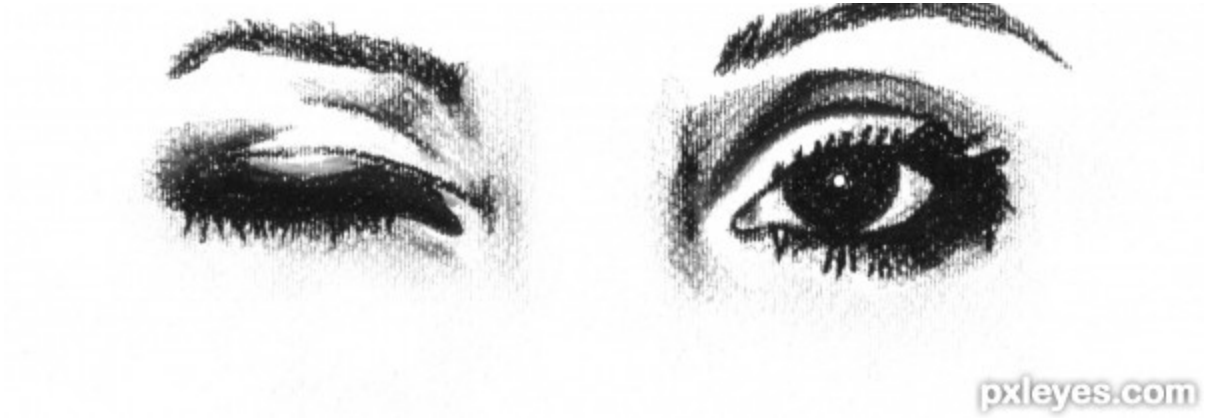
(Between 2 pleuras or linings of the lungs)

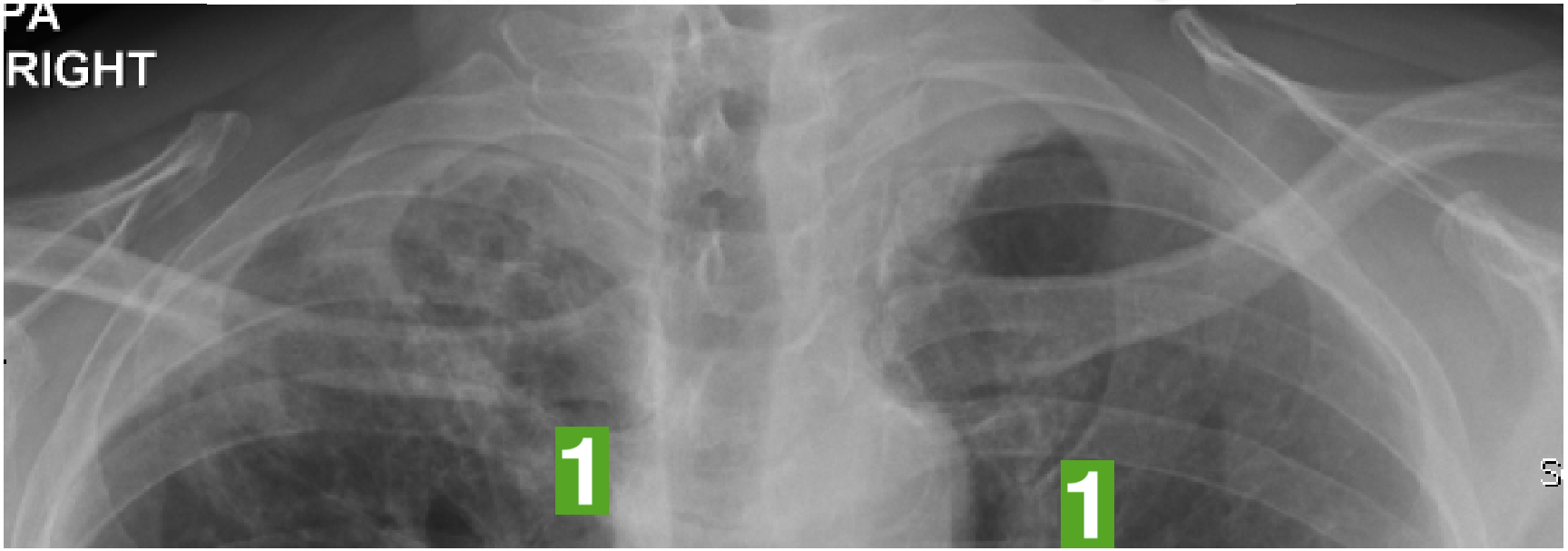
Normal PA & Lateral X-ray: Apex



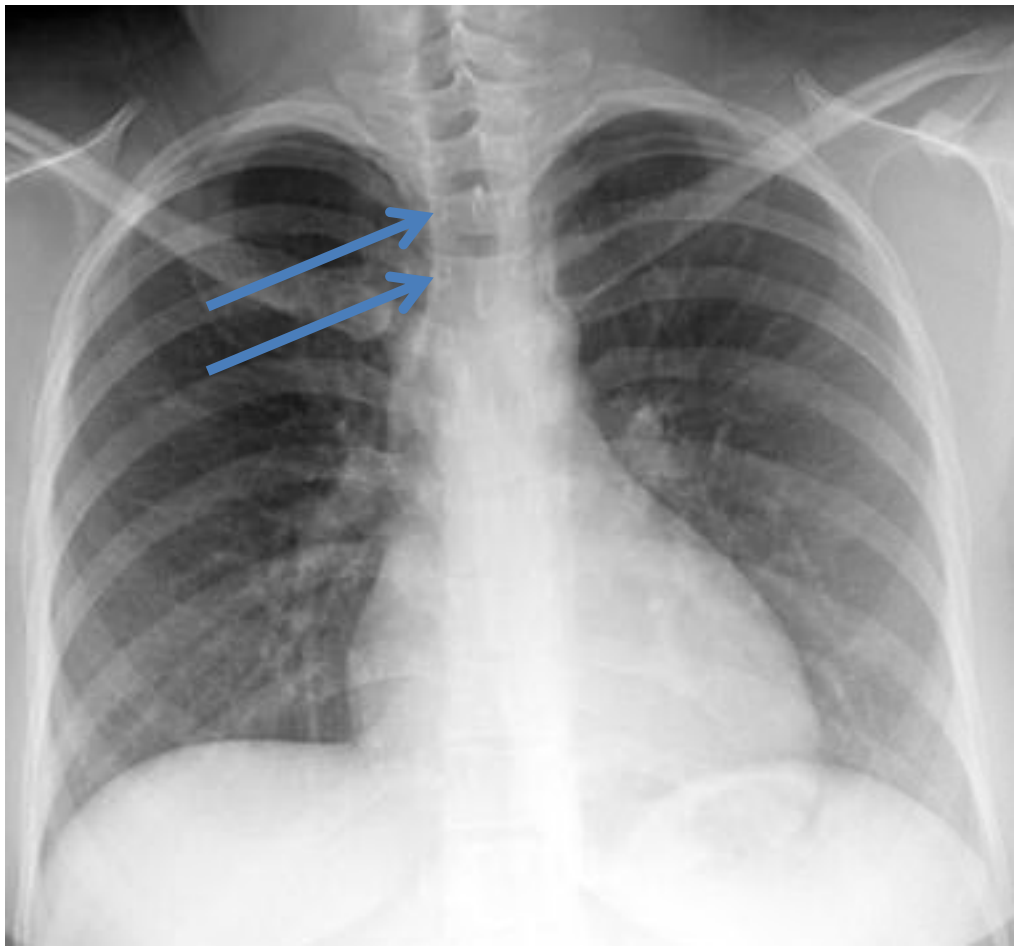
- Apex of lung
  - Area of lung above the level of the anterior end of the 1st rib

Wink Sign: Apex





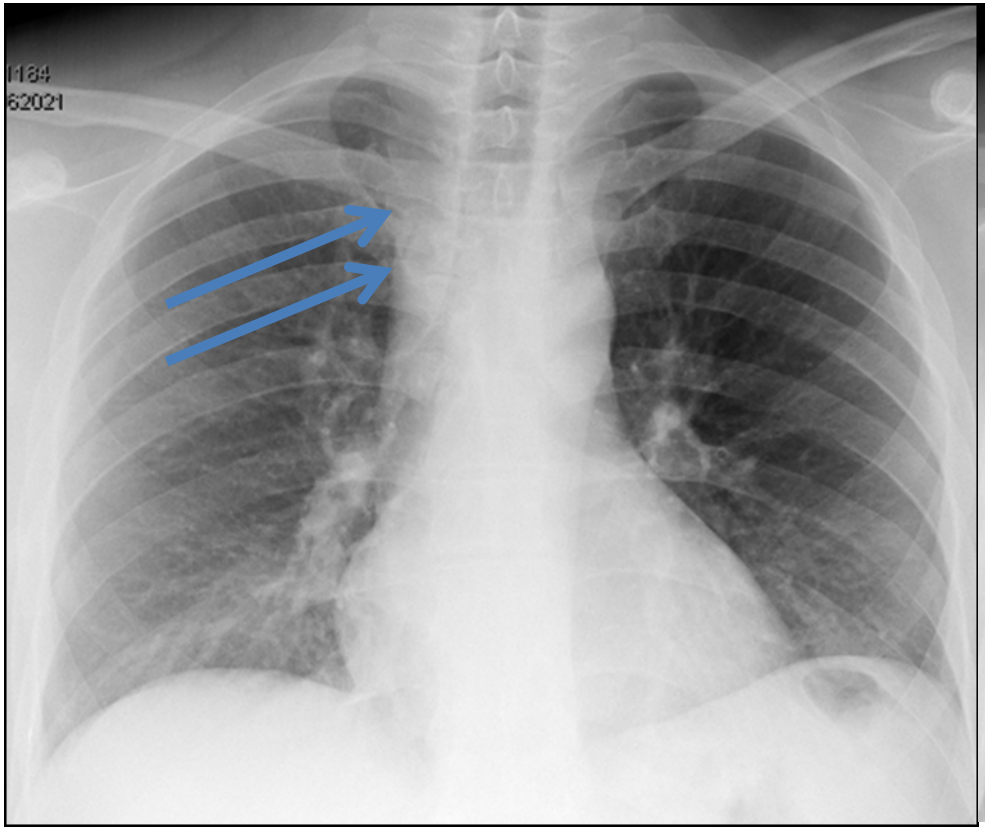
Normal PA & Lateral X-ray: Right Paratracheal Stripe



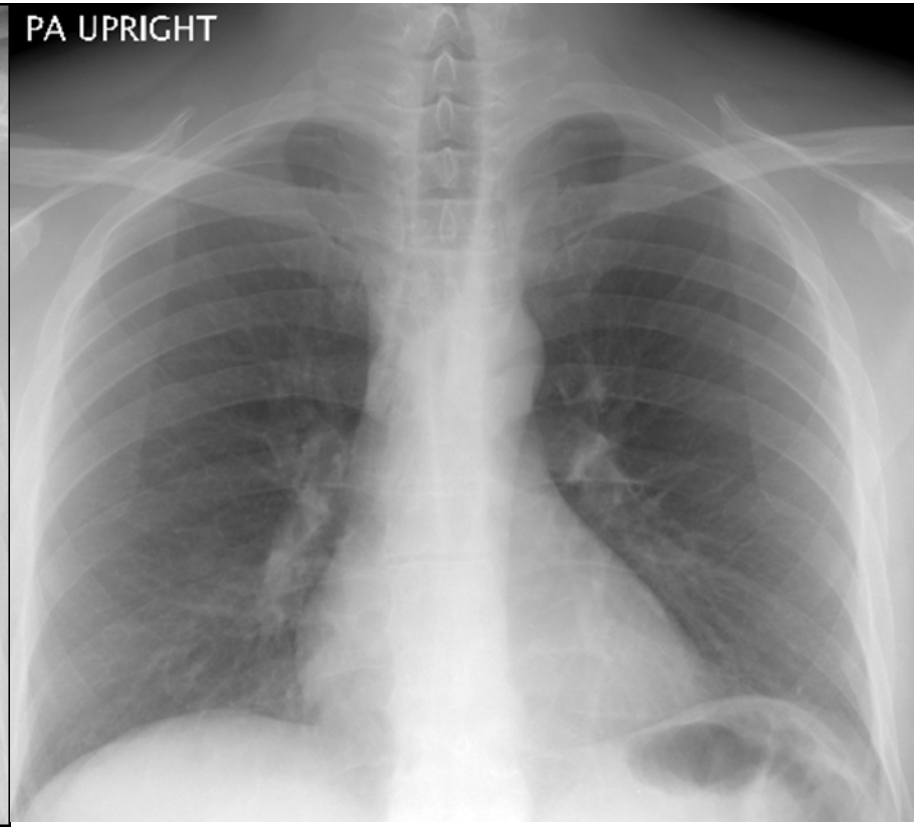
- Paratracheal stripe
  - Seen between the air in the trachea & air in the lung

50 Year Old Iraqi with Fevers

- At Diagnosis **LNs**



- At End of Treatment



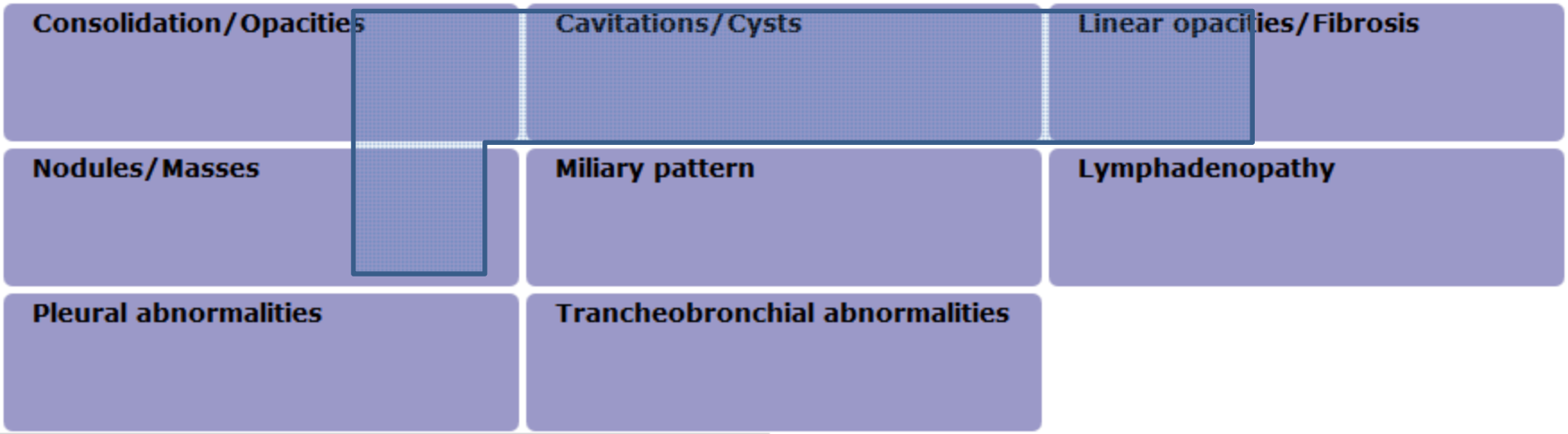
Curry International Tuberculosis Center | Firland Northwest Tuberculosis Center

TB Radiology Image Library

The TB Image Library is a joint project of the Curry International TB Center and Firland Northwest TB Center as an educational resource to share radiographic images related to tuberculosis.

- Individuals may use this site to gain an appreciation for the broad spectrum of presentation TB may have using various imaging modalities.
- The library images are free to download for non-commercial educational purposes only. All images should be credited in the format: CITC/Firland TB Image Library; contributor.
- To contribute images or offer comments/feedback/questions, please email: CurryTBcenter@ucsf.edu

Basic TB Chest abnormalities and patterns of disease



Consolidation

- Appears as a relatively homogeneous white area on chest x-ray
- Although the terms opacity and density are sometimes used, areas of consolidation are usually translucent; structures such as ribs are visible through the consolidation
- Is caused by filling of airspace with fluid, cells, pus, blood
- Without significant volume loss

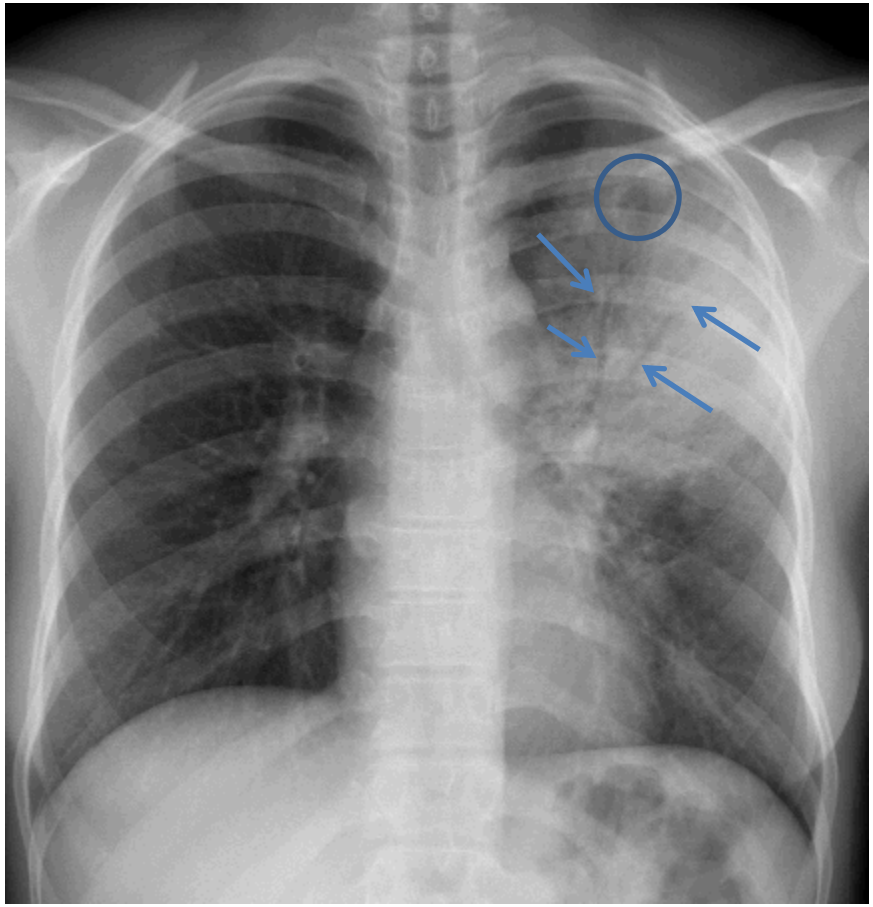
Consolidation

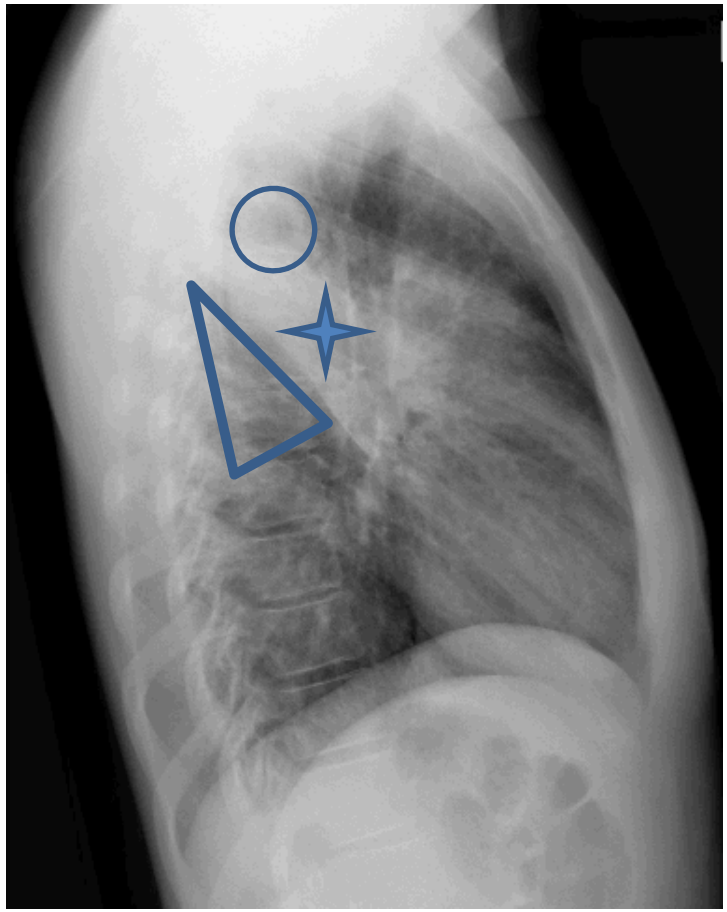
- Air bronchogram may be visible because air in the bronchus forms a silhouette with fluid in airspace (characteristic of consolidation; not always present).
- Silhouette sign occurs when opacity is contiguous with heart or diaphragm, causing loss of normal silhouette

Consolidation / Opacity / Density

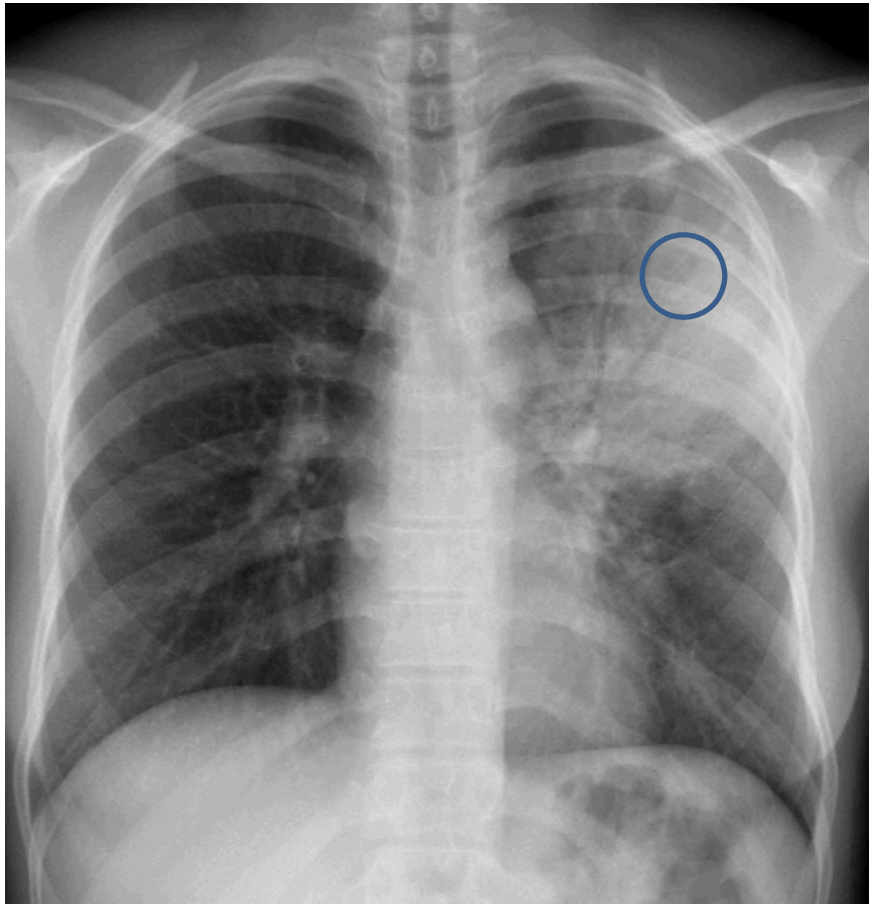
- The initial lesion in primary TB can be in any location in the lung
- In later (“reactivation”) TB, location is most frequently in the upper and posterior portions of the lung
  - Apical and posterior segments of the right upper lobe
  - Apical-posterior segment of the left upper lobe
  - Superior segments of the lower lobes

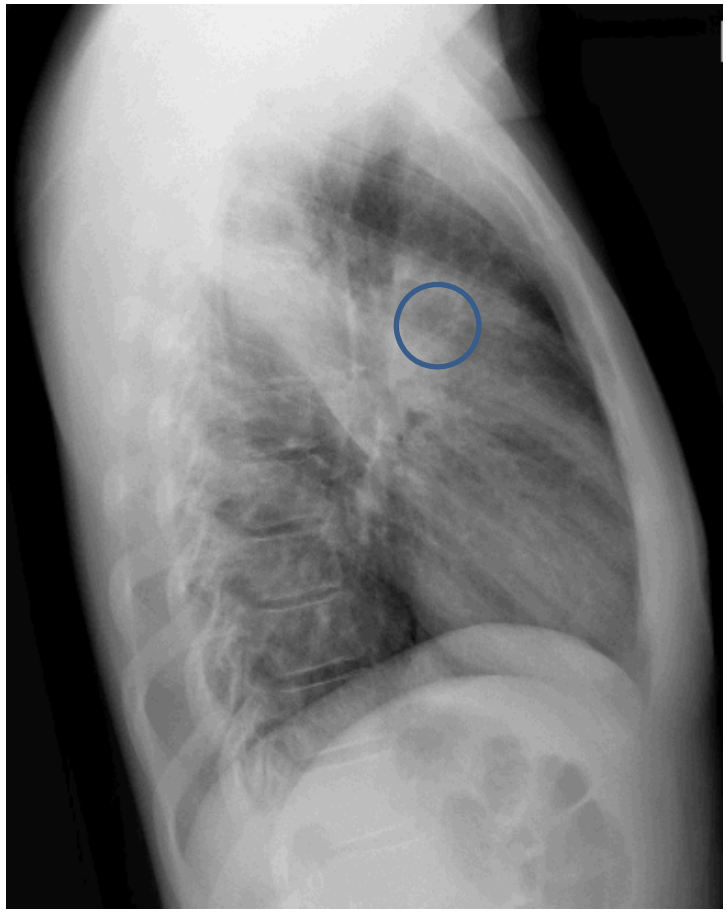
Consolidation, Air Bronchogram
Left upper lobe apical-posterior segment





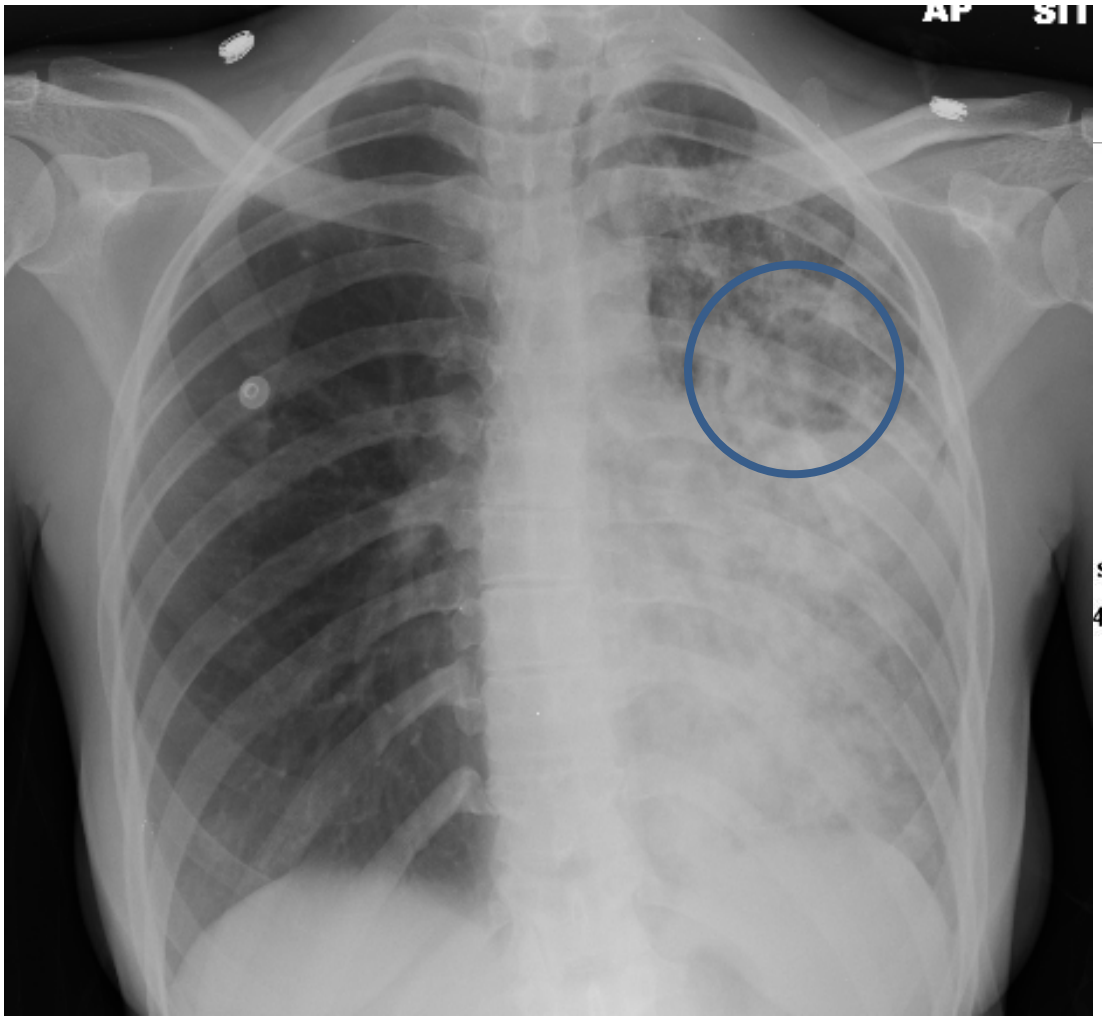
Consolidation, Air Bronchogram
Left upper lobe apical-posterior segment



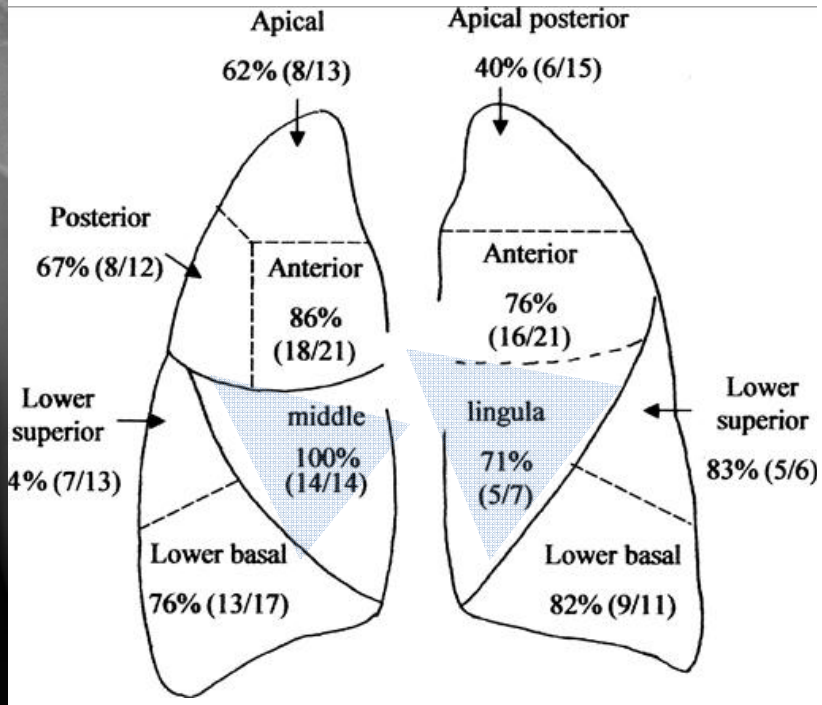


Silhouette Sign (no heart) & More

21 year old, severe agorophobia



Lingula



Nodules / Masses

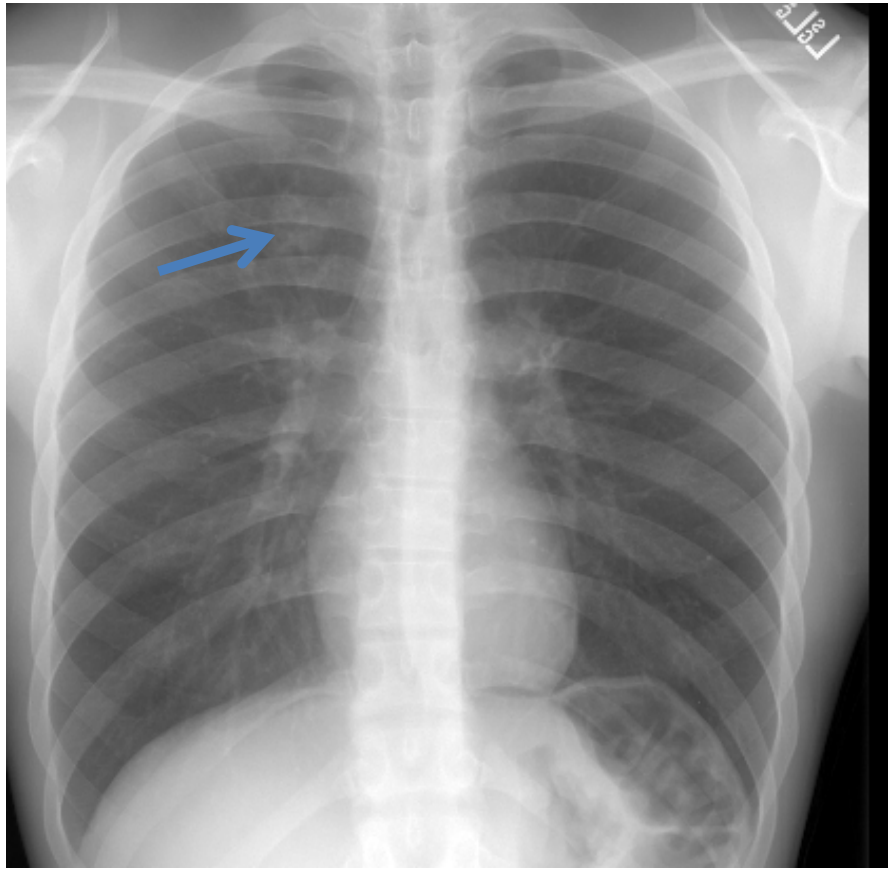
- Nodule - discrete opacity or density that is 2-30 mm in diameter
- TB nodules can be
  - Solitary
  - Multiple
  - Associated with other chest x-ray abnormalities due to TB
- A common pattern for primary TB is a nodule (the primary focus of infection) plus ipslateral enlarged mediastinal or hilar lymph node(s)

Nodules / Masses

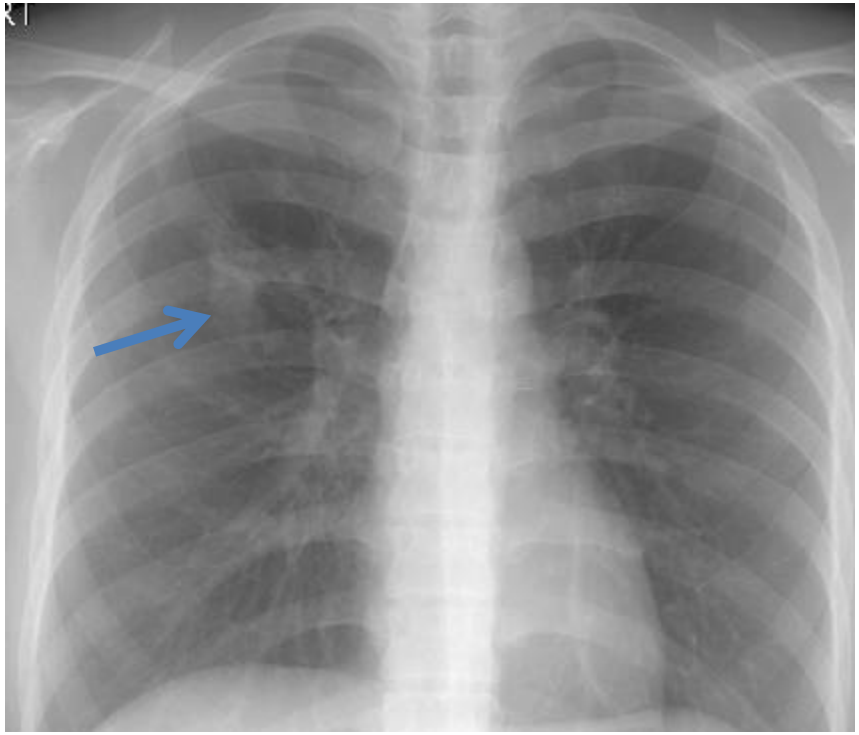
- TB nodules
  - Can cavitate (form cavities)
  - Calcify when they heal
- A mass is larger than a nodule and is not typical of TB

Screening for TB in High Risk Individuals

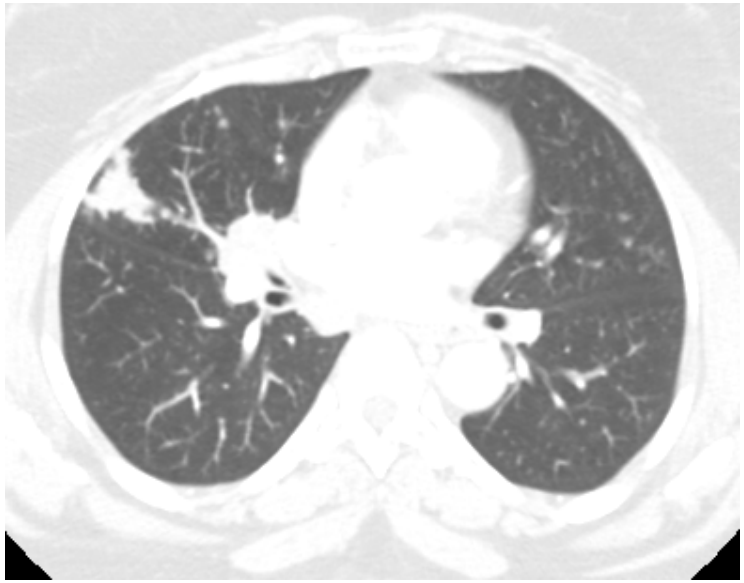
- 22 year old, cough for 4 days, contact of case

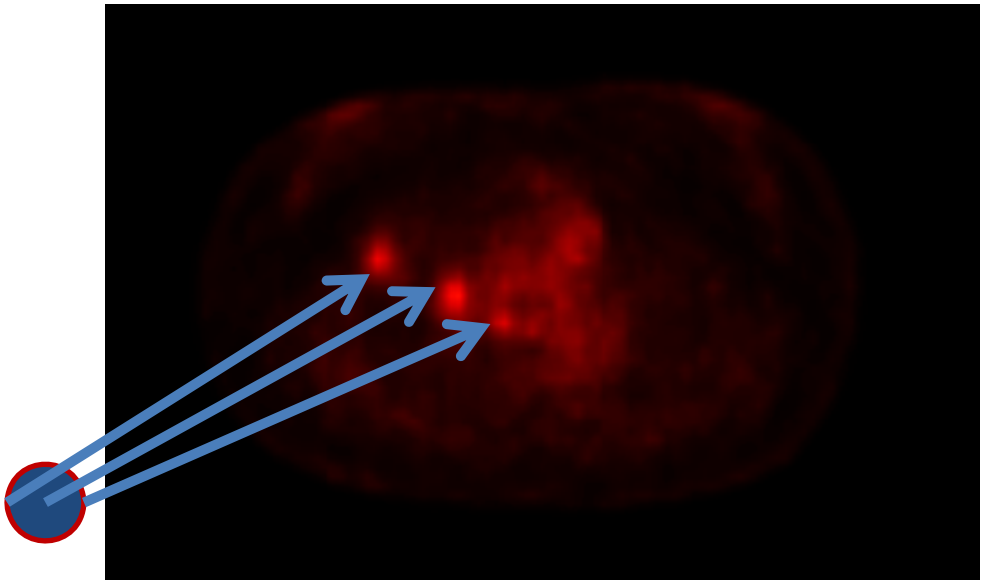


- OT Student from Taiwan, TB skin test + 3 years ago; no symptoms, no Rx



PET Scans do NOT Differentiate TB from Cancer: This Patient had TB



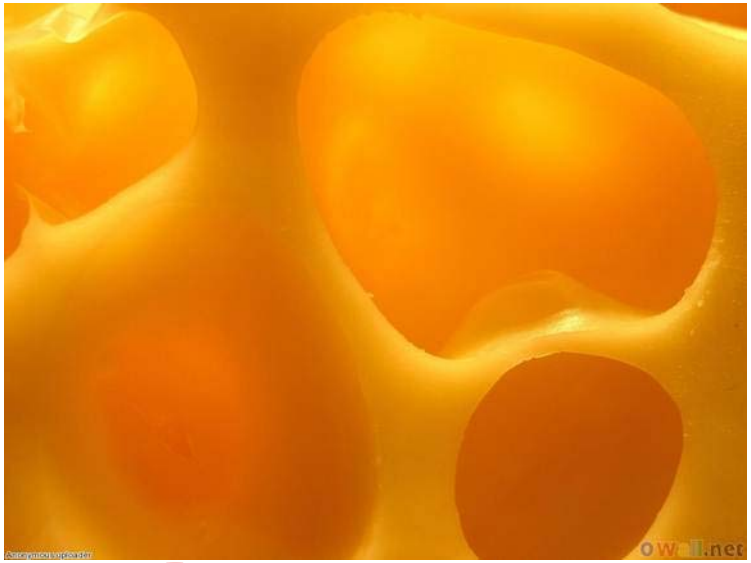


"FDG avid pulmonary nodule in the right middle lobe, along with two FDG avid lymph nodes involving the right hilum and subcarinal region. Findings suspicious for malignancy."

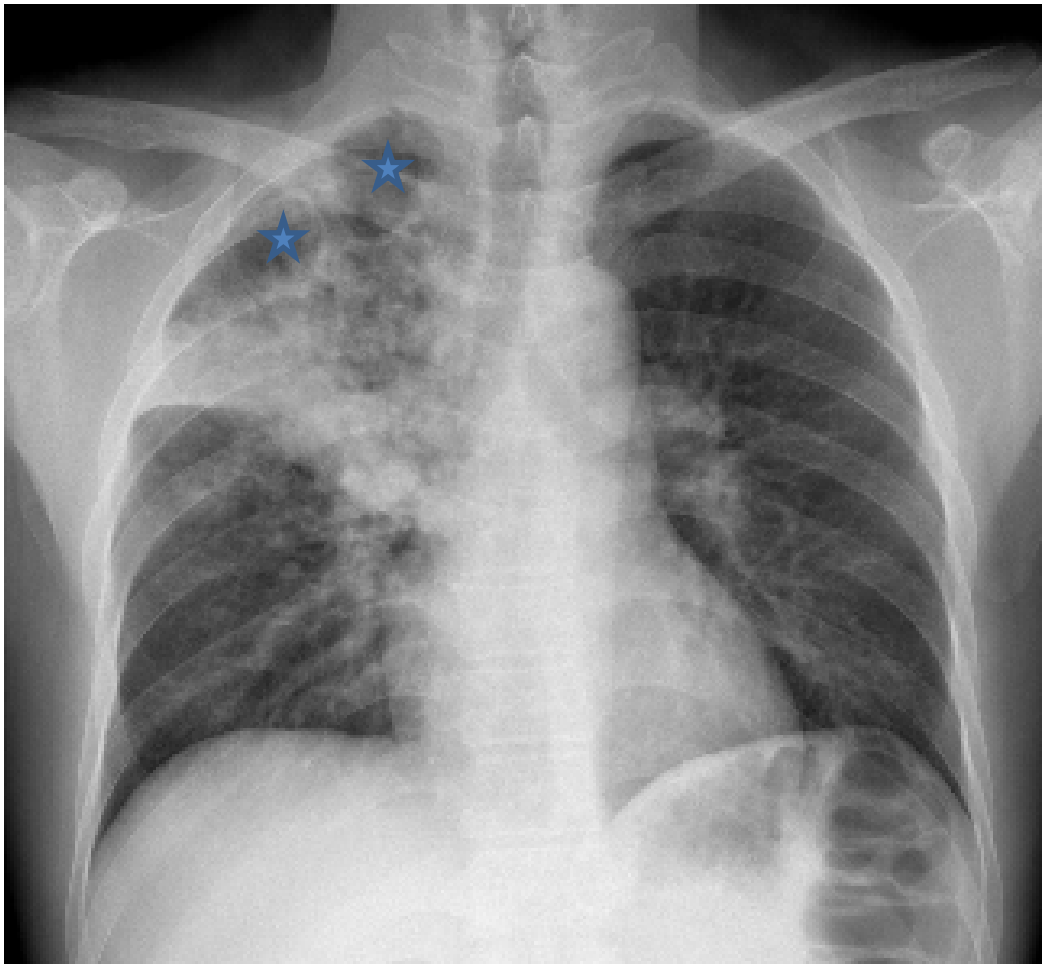
Cavities

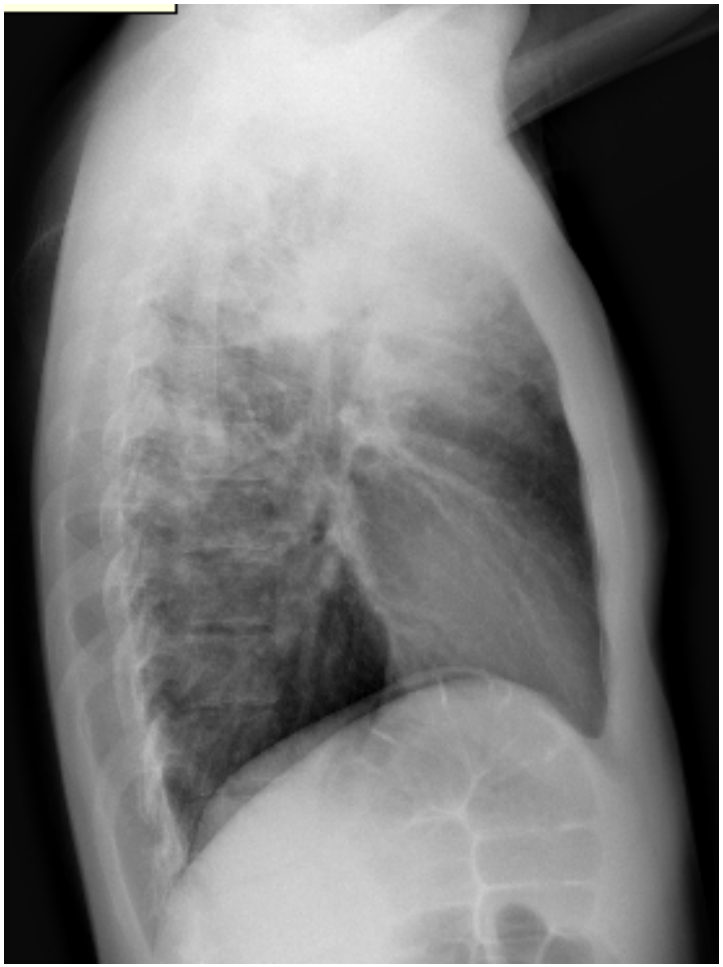
- Most common in advanced disease (reactivation TB)
- Highly contagious, contain many actively multiplying organisms
- Endobronchial spread to other areas of lung
- Higher risk of developing drug resistance
- May take longer to treat
- Wall thickness thin to medium
- Significant air / fluid levels are rare

Cavities: Think Swiss Cheese



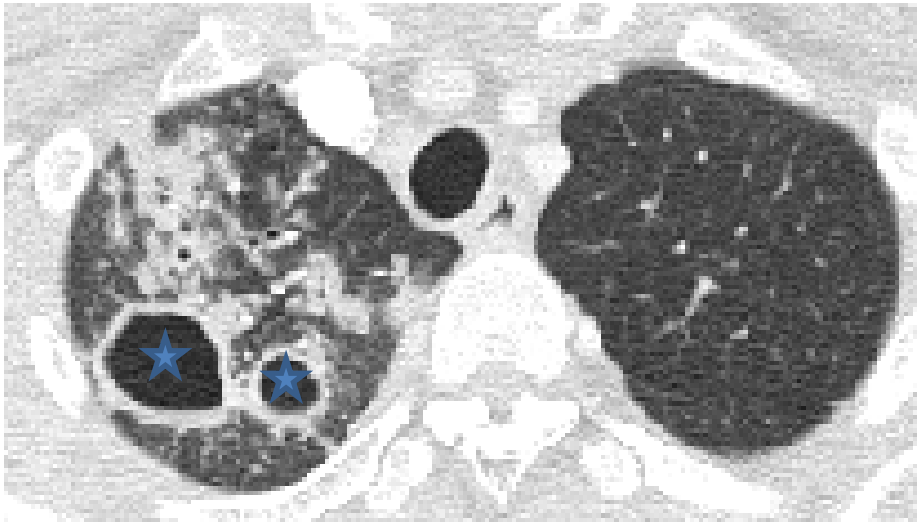
Young Man from Vietnam:
Negative TB skin test, T-Spot, and QFT

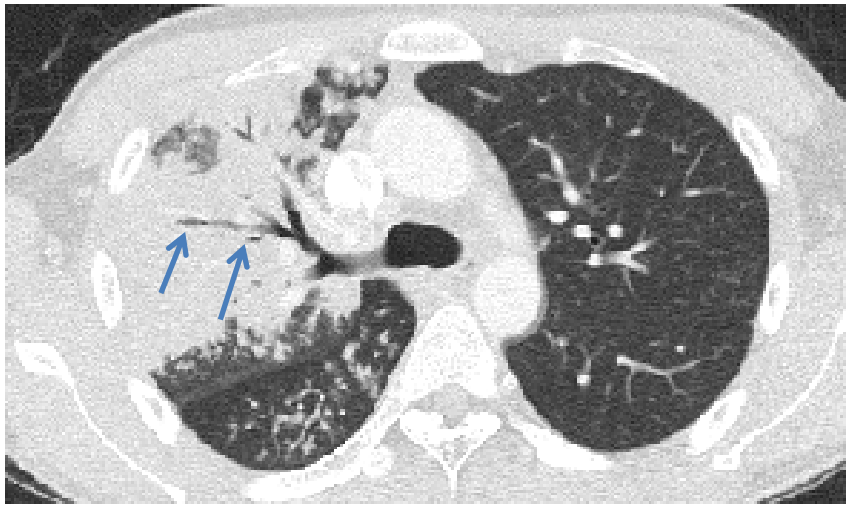




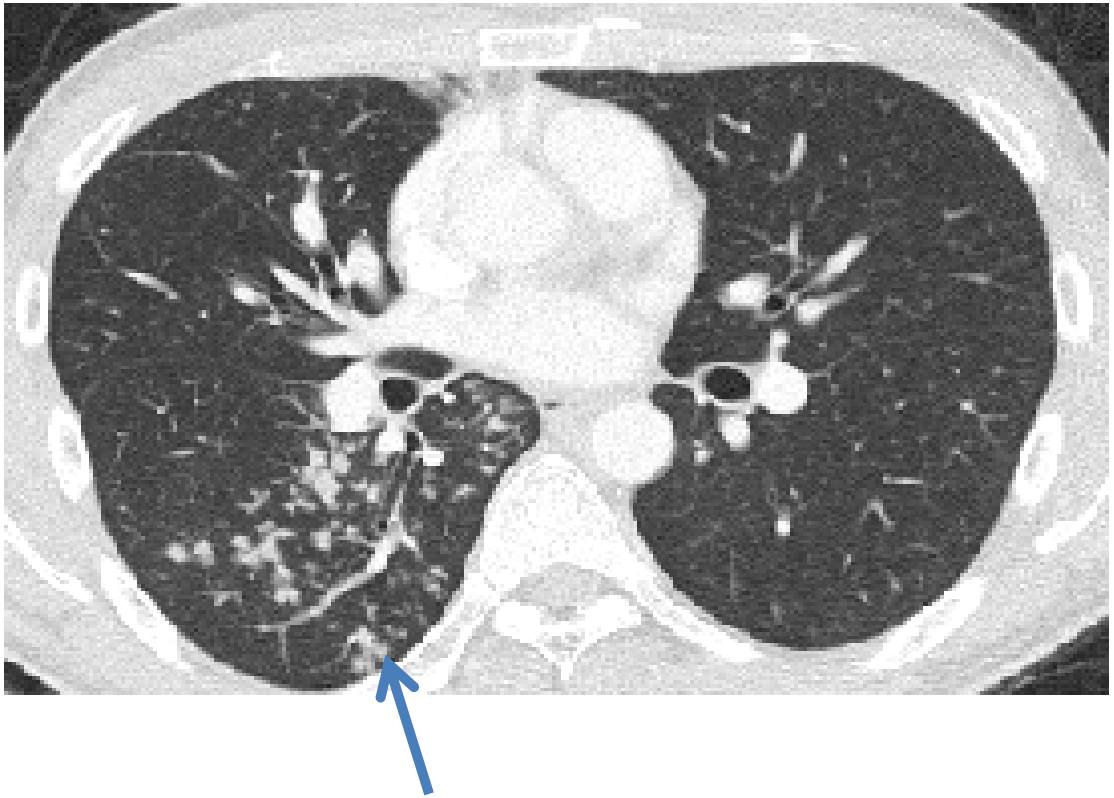
Multiple Findings on CT Scan

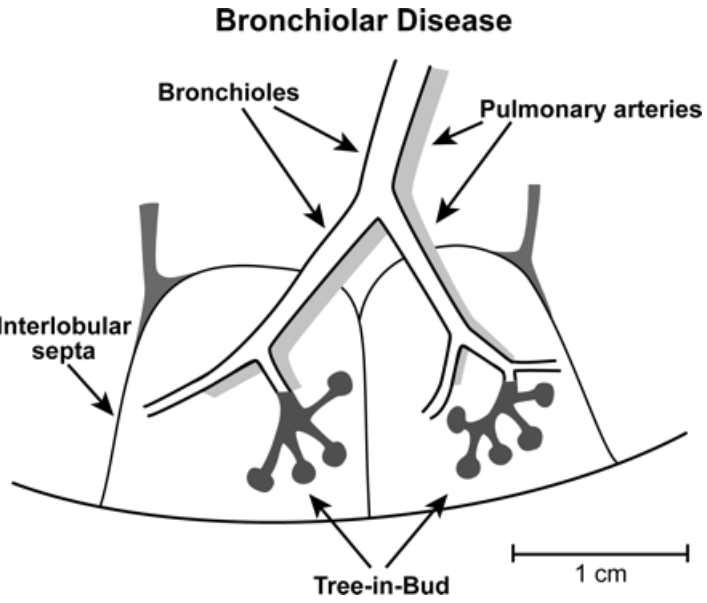
- Cavities, consolidation with air bronchograms, nodules, “tree-in-bud” densities



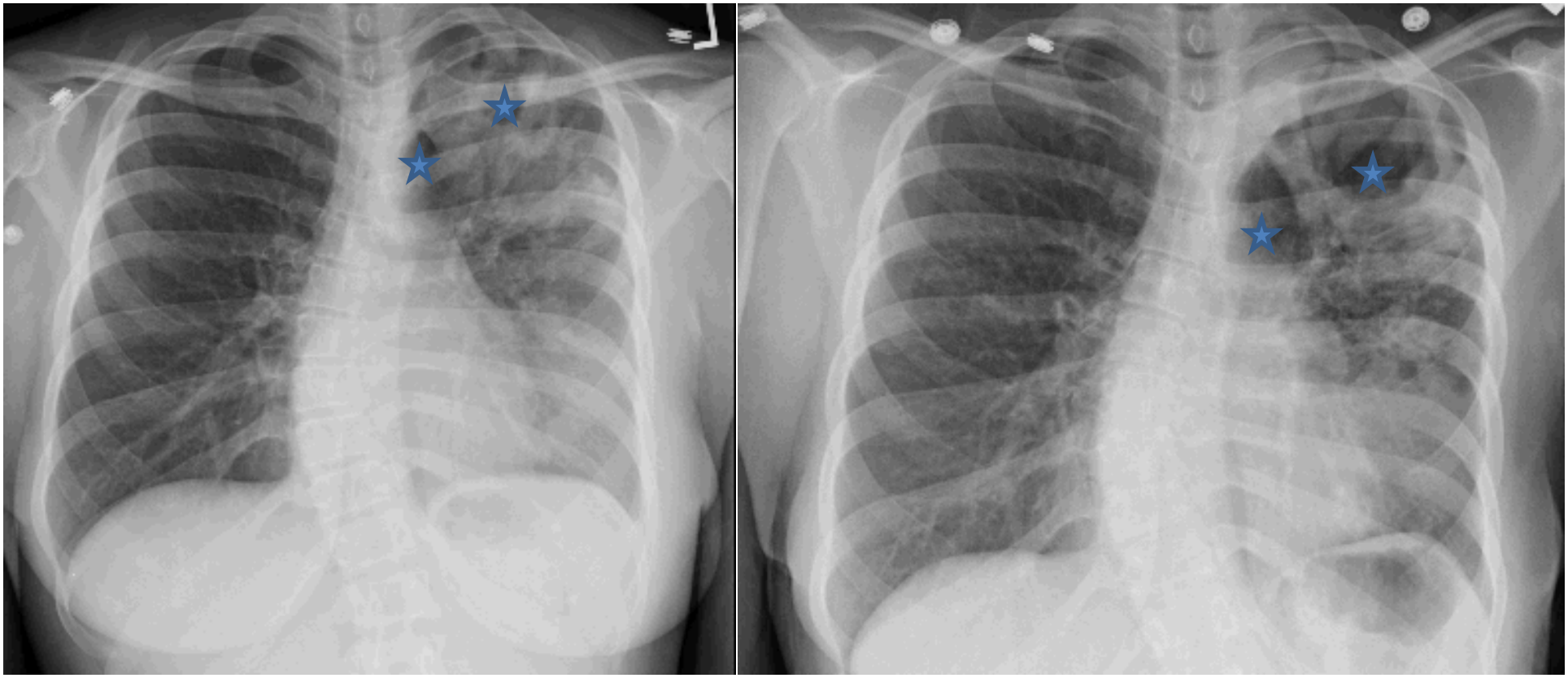


Tree-in-Bud Opacities





Young Woman Treated for Pneumonia And 6 Months Later



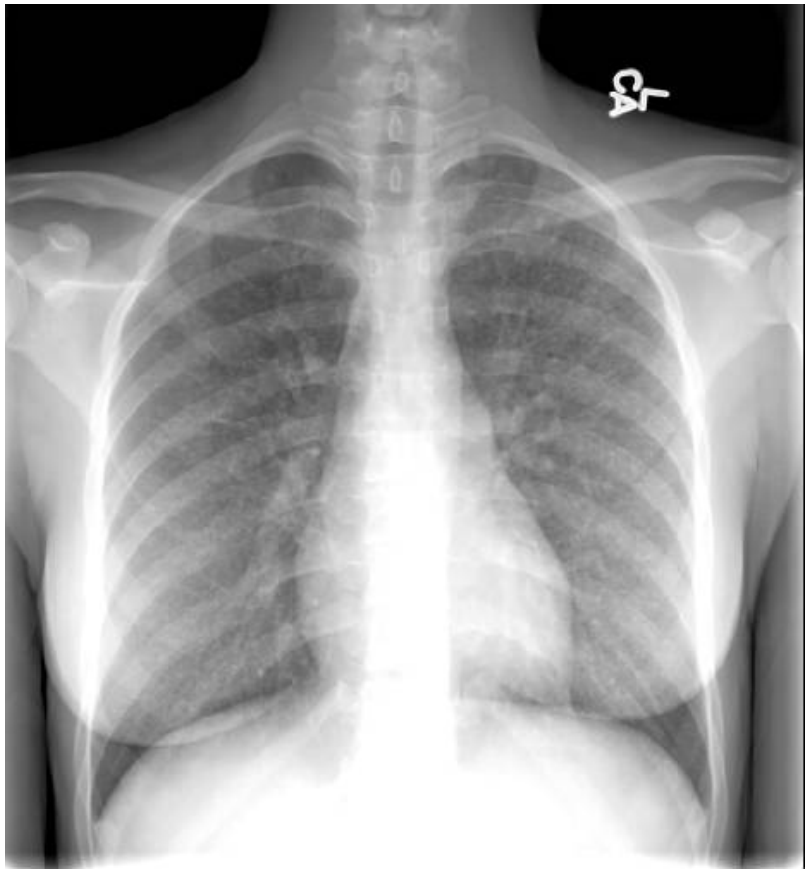
Miliary TB

- Disseminated disease
- *Usually* occurs during initial (primary) infection with hematogenous spread of MTB
- Uniformly distributed nodules ~ 2 mm. in size
- May progress to septic shock and acute respiratory failure
- After infection, miliary TB &/or meningitis occur in ~ 10-20% of babies < 1 year old

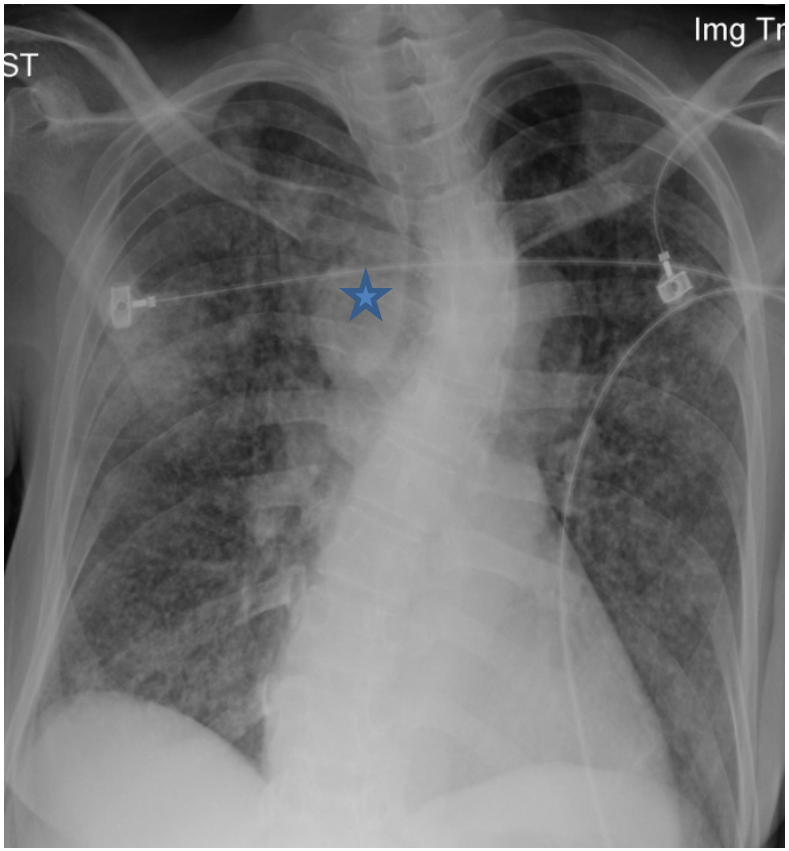
NEJM – New@NEJM.org Oct, 2013

Miliary Pattern

- 15 year old with disseminated MDR TB



- Substance abuser, treated with prednisone for misdiagnosis of sarcoidosis

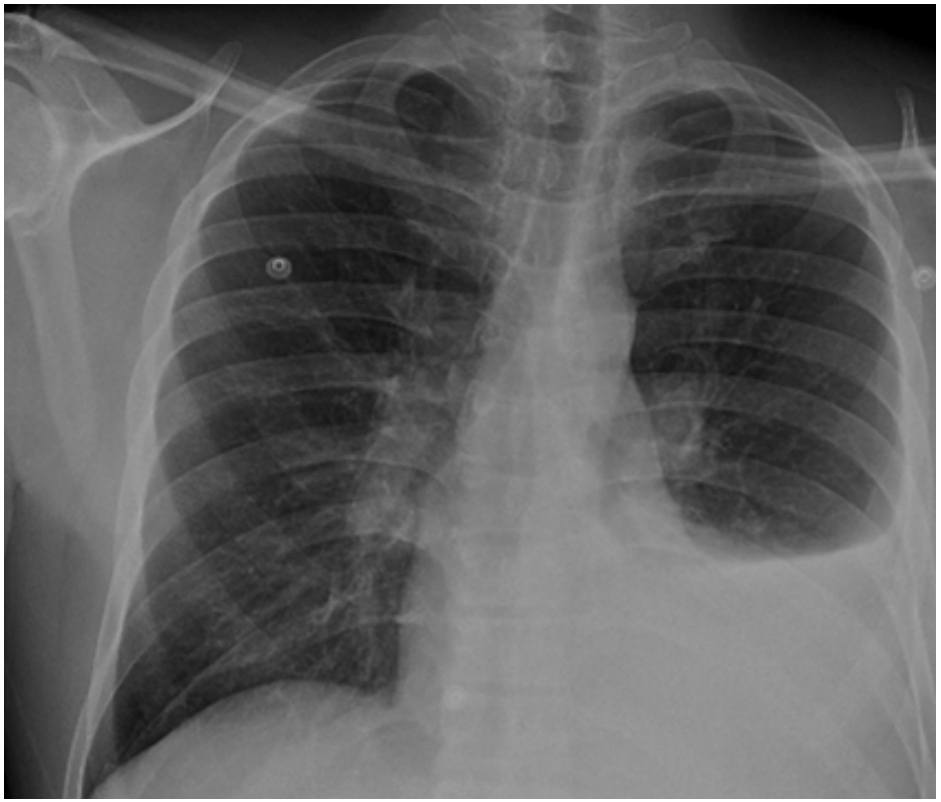


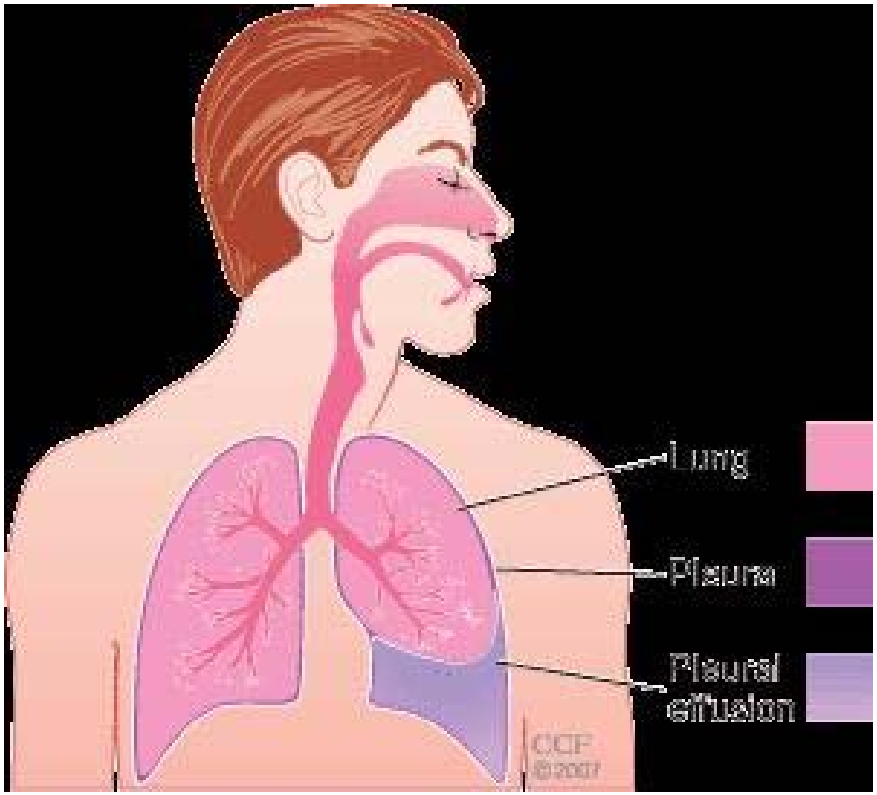
TB Pleural Effusions and Other Abnormalities

- Small to very large, can loculate
- Usually unilateral
- Primary (or post primary disease)
- Fluid can be serous, thick & congealing, or bloody – not frank pus unless complicated
- Exudate – high protein and LDH, white cells predominantly lymphocytes
- ↑ Adenosine deaminase and IFN-γ levels
- Bronchopleural fistulas can occur

44 Year Old Man: Homeless Shelter Outbreak

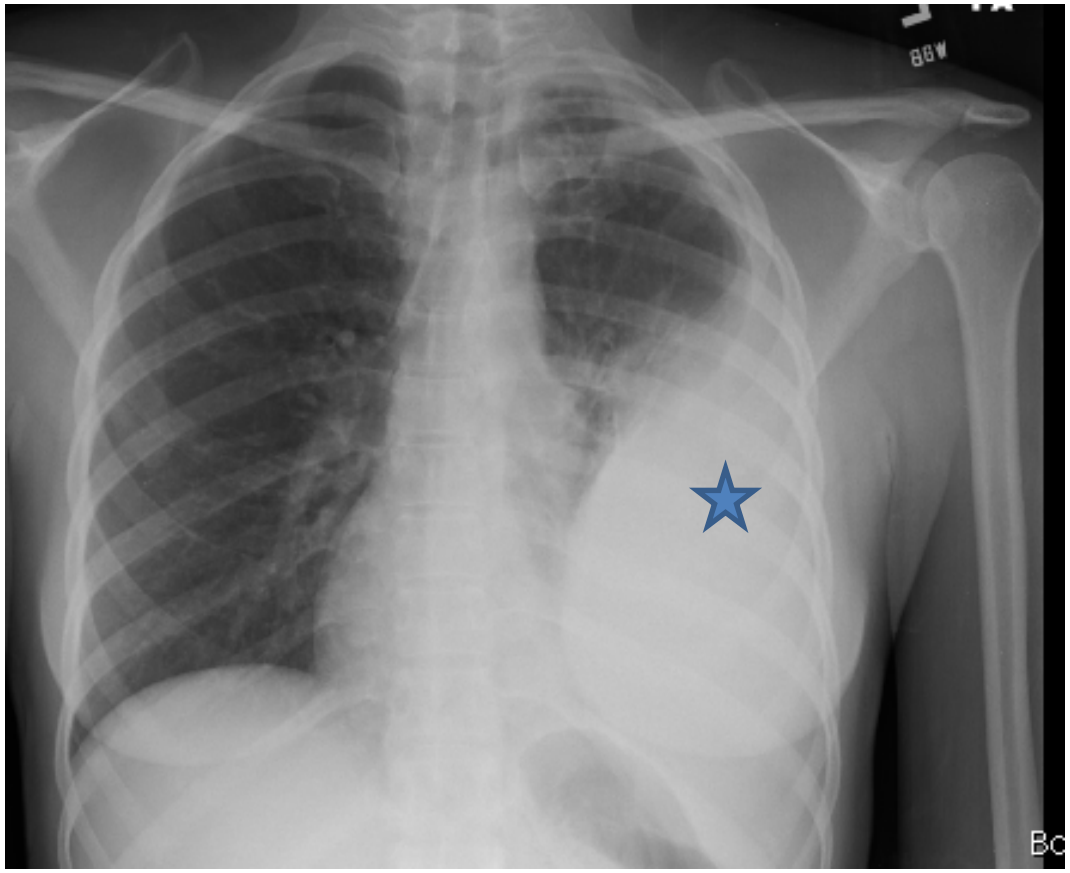
- Note meniscus sign, silhouette sign, less translucency than consolidation

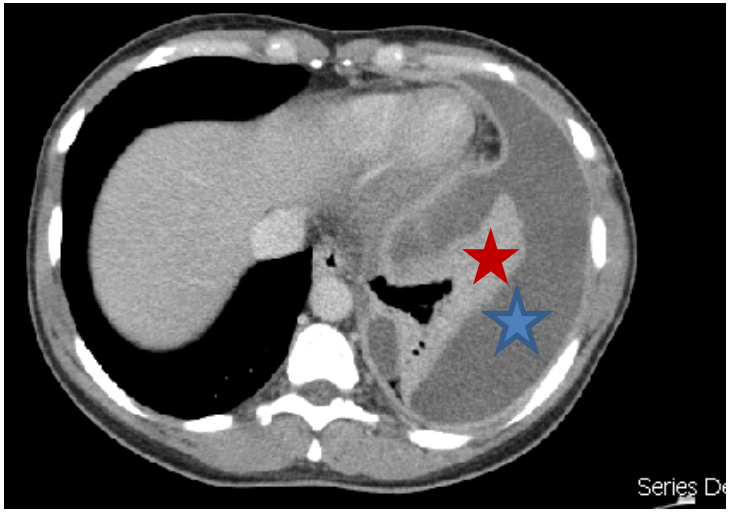


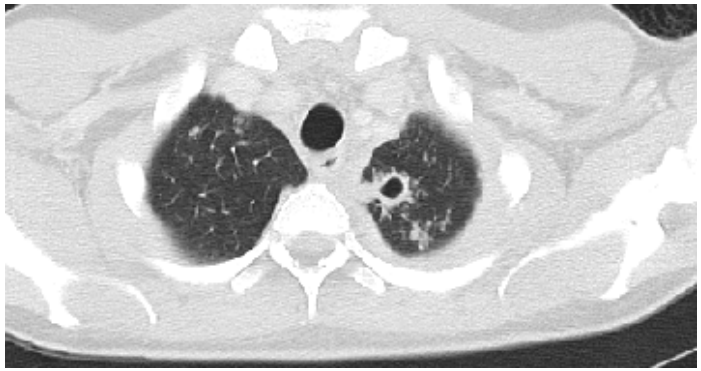


40 Year Old with Known Exposure to Contagious Case 1-2 Months Ago

- IV dye helps distinguish lung from pleural fluid



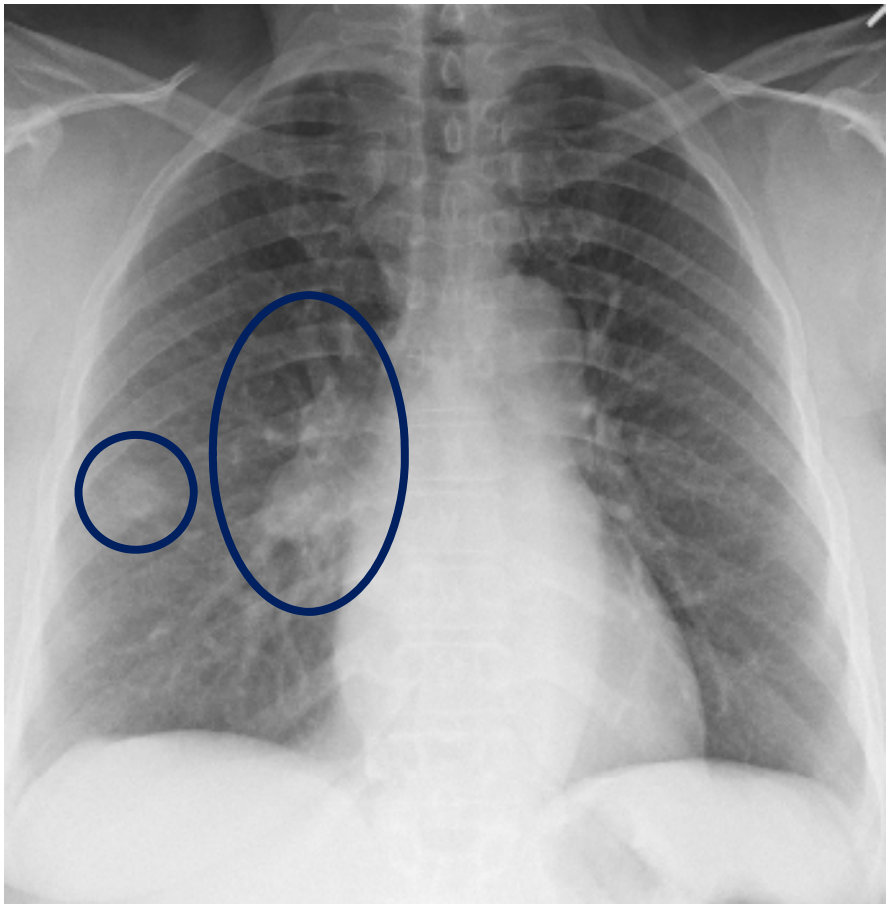


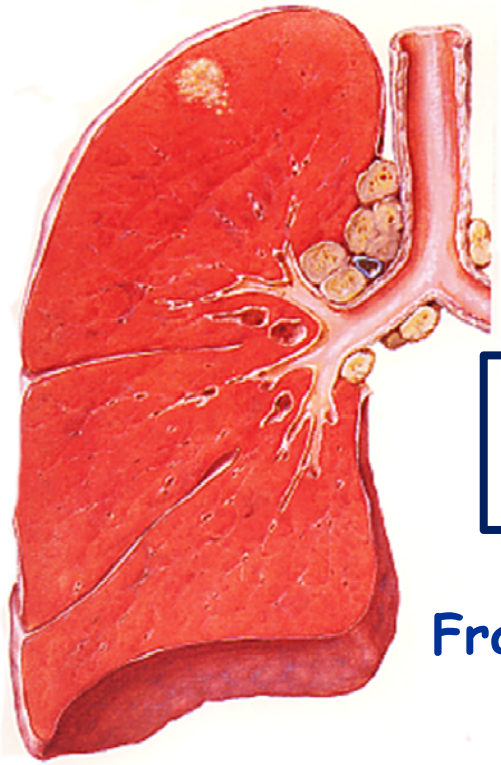


Lymphadenopathy

- Frequent in primary disease
- In children can be massive and compress airways
- Rim enhancement with dye and low attenuation centrally suggests TB

Recent Contact with TB Case: PET Scan Shown Before



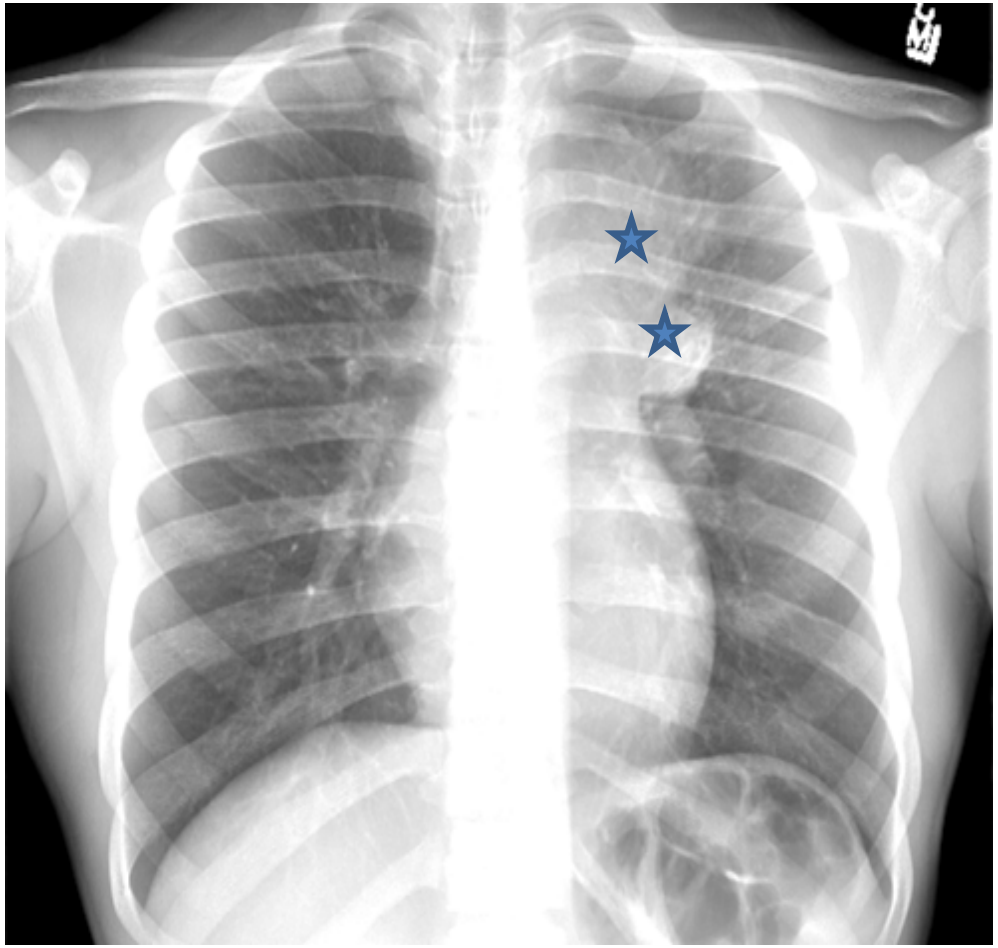


Ghon Complex

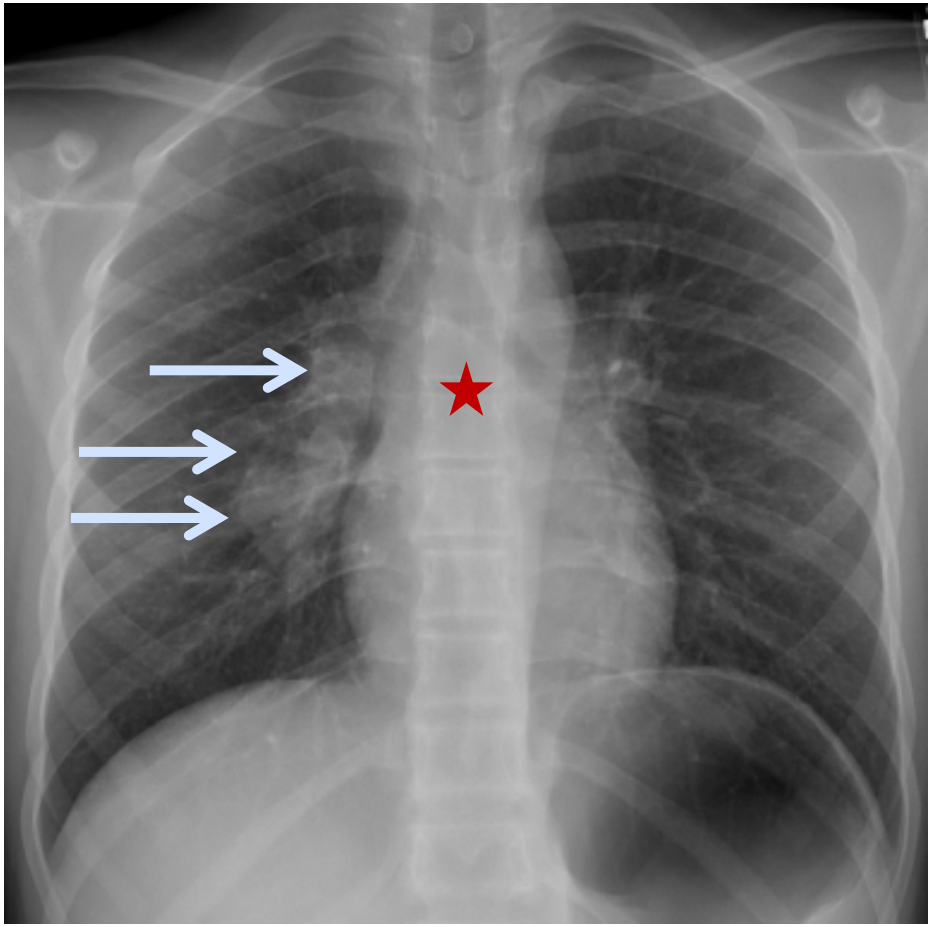
Frank Netter

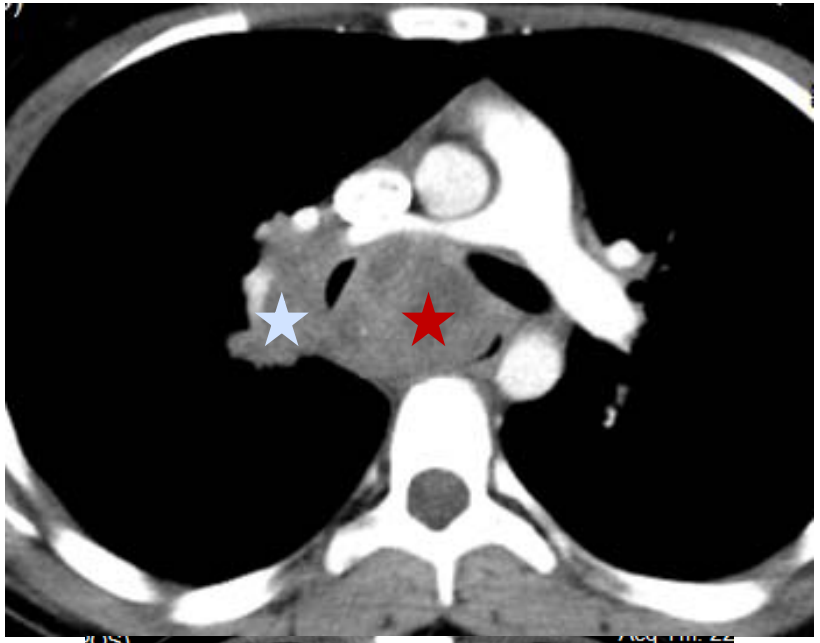
15 Year Old Boy with Cough Contact to Aunt with MDR TB

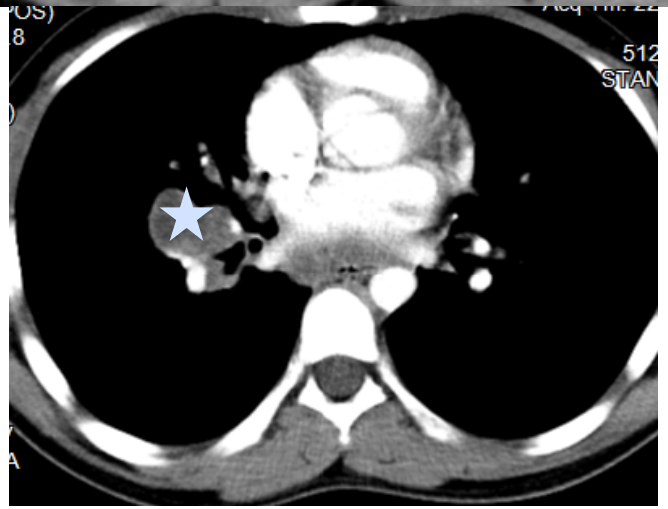
- Sputum culture + for MDR TB



15 Year Old Somali Boy.
Chest pain, Difficulty Eating



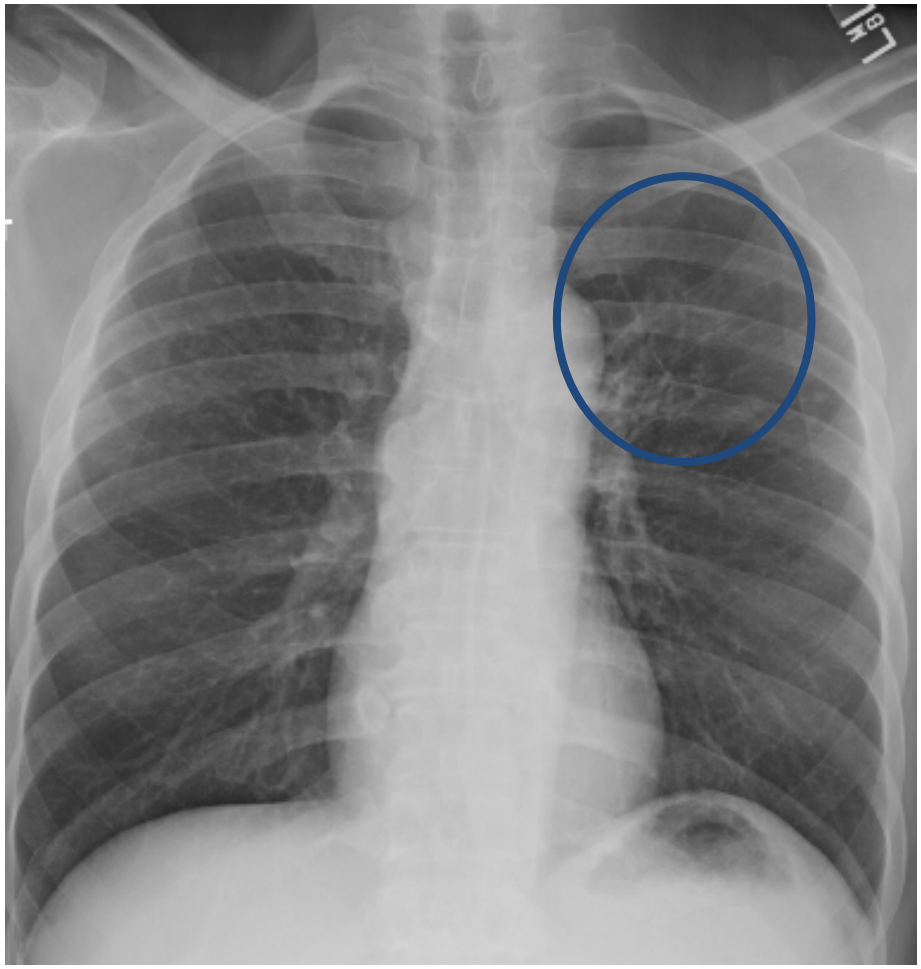


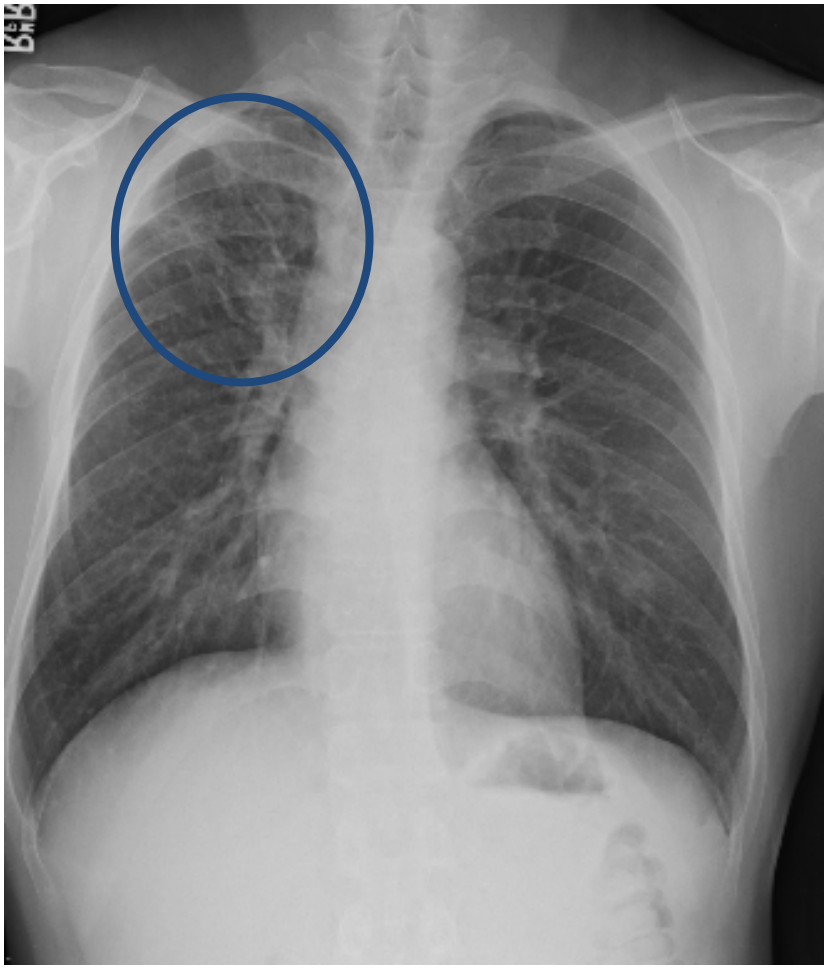


Linear Shadows / Fibrosis

- Can be old healed TB or active chronic TB
- Often seen with immigrants labeled B1
- Can be associated with volume loss

Treated TB:
Note Volume Loss

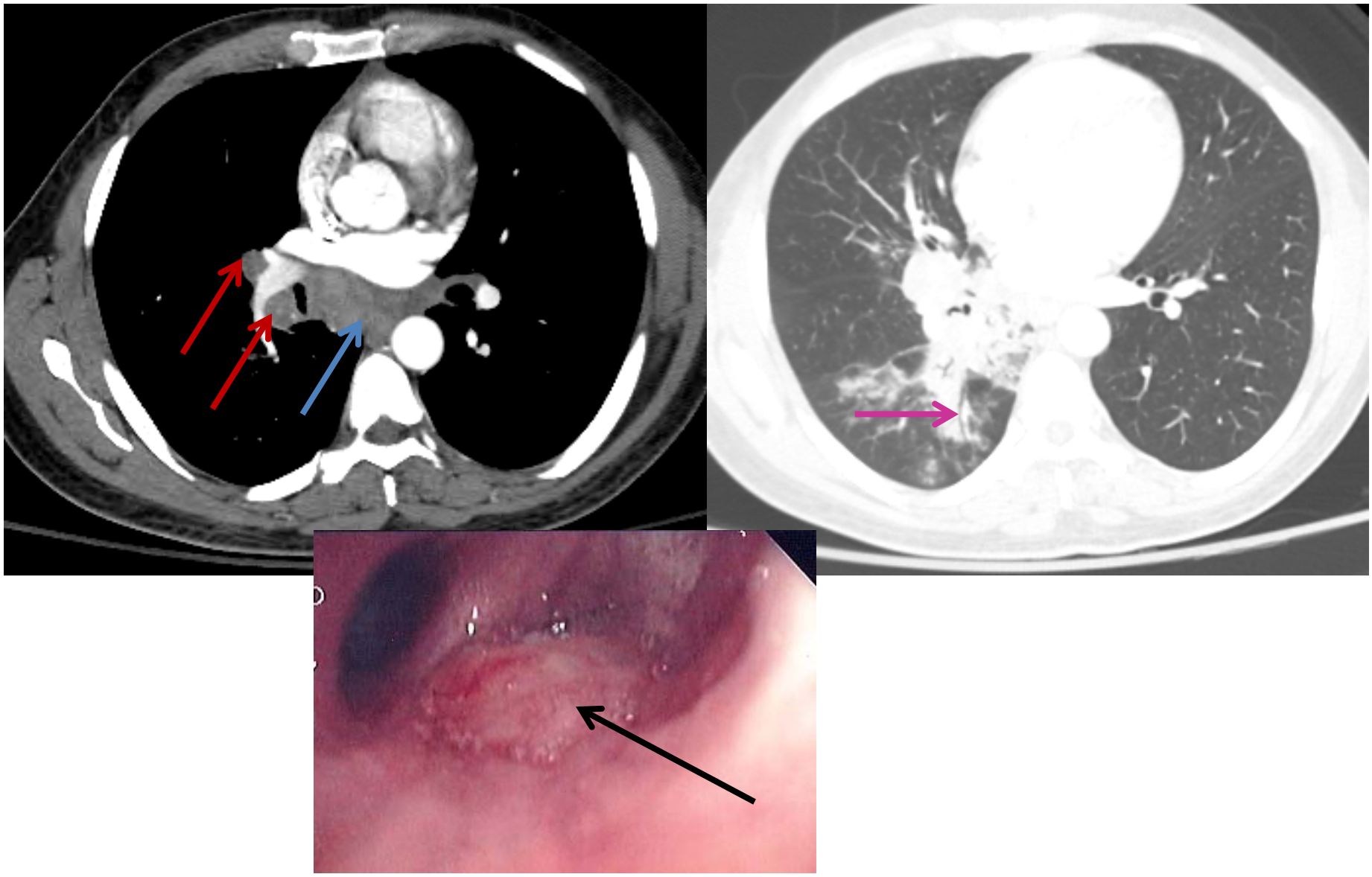




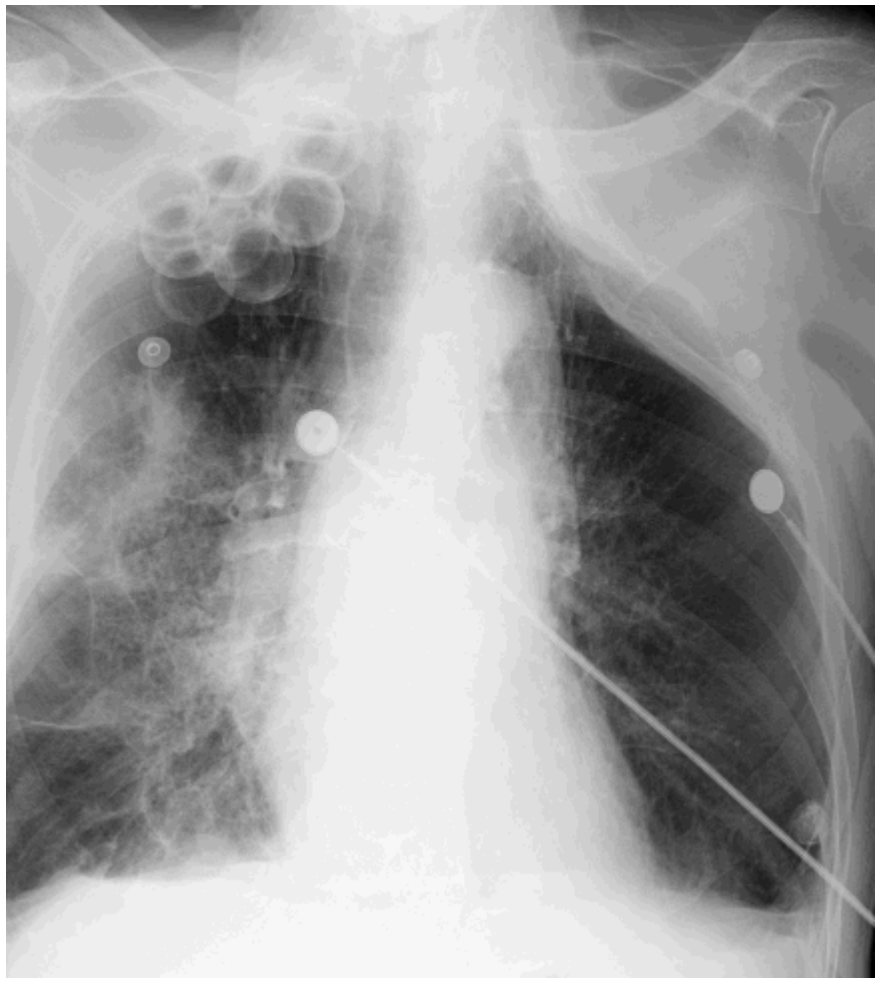
Tracheobronchial TB

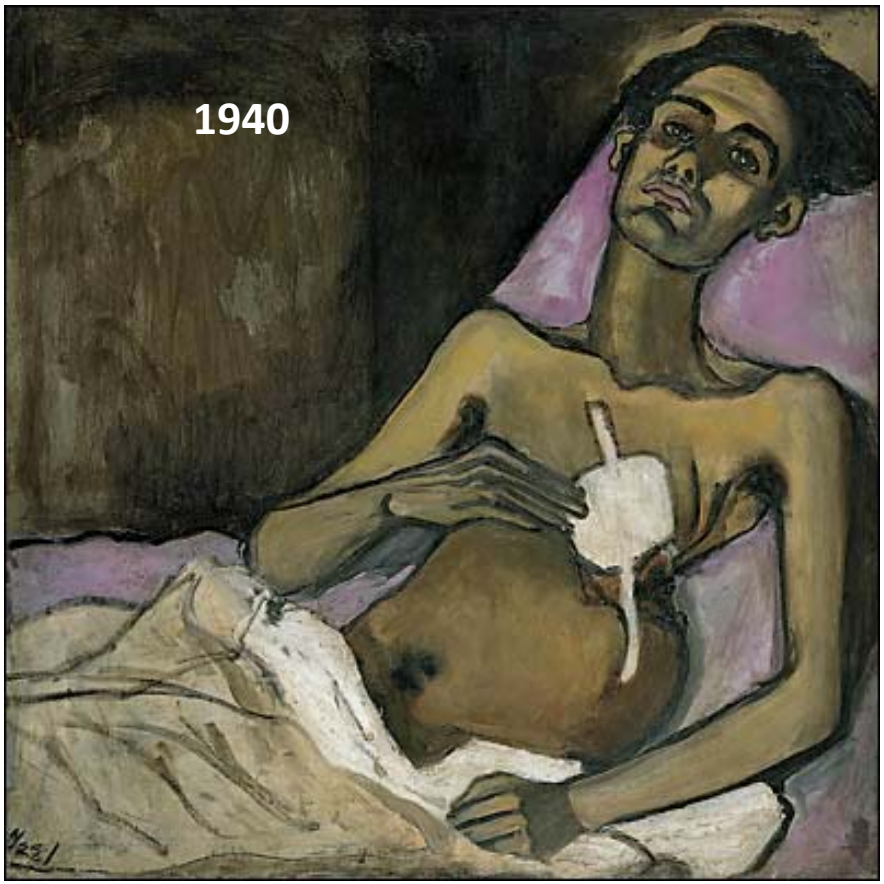
- Airways can be compressed by large lymph nodes
- TB can be endobronchial
- Bronchiectasis and bronchostenosis are common sequelae
- Atelectasis or collapse of the lung beyond an obstructing lesion can occur (similar to lung cancer)

Homeless Man



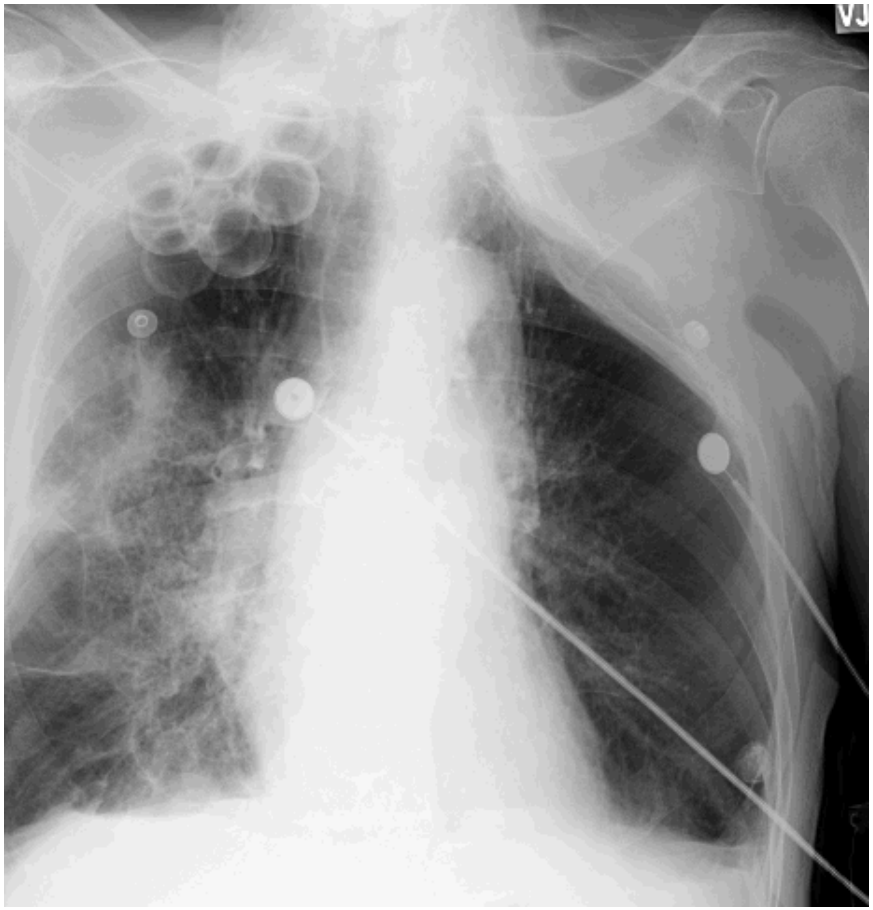
Who can name the 2 surgical procedures performed on this patient?



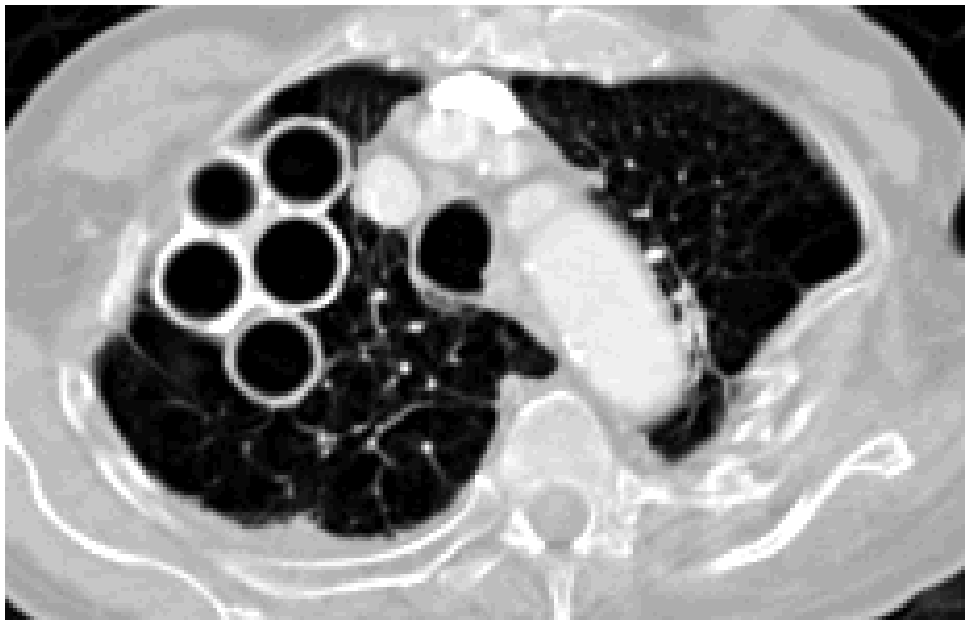


Alice Neel (1900-1984) TB Harlem

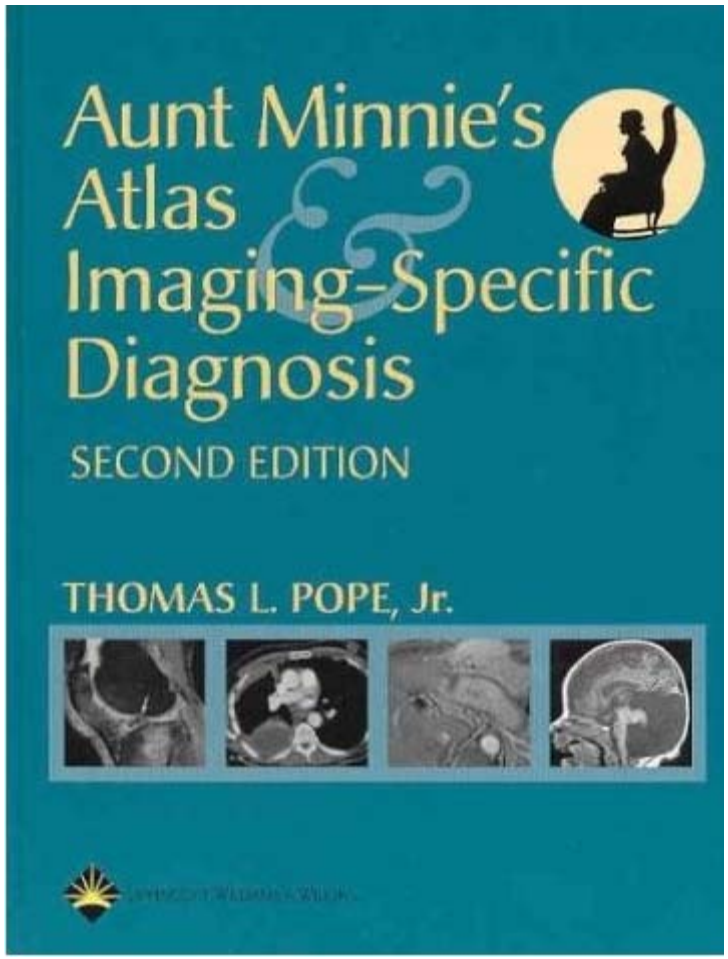
And The Names Are:



- Right plombage
- Left thoracoplasty



Conclusion: You can Learn to Recognize TB When You See It!



Ed Neuhauser and Ben Felson

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World TB Day Conference
Migration & TB

TB Testing
Requirements for Licensed Facilities

Bureau of Community & Health Systems (BCHS)

Presenters
Larry Horvath
Teri Dyke, MSN, RN
Tom Bissonnette, MS, RN

Disclosures Oversight

- None of the speakers or planners involved in this activity has any relevant conflict of interest.
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Regulatory Oversight

Bureau of Community & Health Systems (BCHS) - Effective July 6, 2015 Provides:

- State Licensing
  - Health Facilities & Agencies (including Homes for the Aged)
    - Life Safety Code Inspections of Long Term Care Facilities
  - Substance Use Disorder Programs
  - Child Care Homes & Centers
  - Adult Foster Care Homes

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BCHS Also Provides:

- Federal Certification of Providers and Suppliers on Behalf of the Centers for Medicare and Medicaid Services (CMS)
- Plan Review/Construction Permits for State Licensed Health Facilities
- Workforce Background Checks
- Nurse Aide Training Program/Nurse Aide Registry (February 1, 2016)

BCHS Organizational Overview

Larry Horvath
Bureau Director

Steve Gobbo
Deputy Bureau Director

Mark Jansen, Director
Child Care Licensing Division

State Licensed

- Child Care Group Homes/Centers

Jay Calewarts, Director
Adult Foster Care & Camps Division

State Licensed

- Adult Foster Care Homes
- Adult Foster Care/Child Camps
- Homes for the Aged
- Complaint Intake (AFC, HFA, Child Care, Camps)
- Application Processing (AFC, HFA, Child Care, Camps)

Teri Dyke, Director
Health Facility Licensing, Permits, and Support Division

State Licensed

- Freestanding Surgical Outpatient Facilities
- Hospice Agencies & Residences
- Hospitals
- Nursing Homes
- Substance Use Disorder Programs

Other Functions

- Complaint Intake (Health)
- Construction Permits
- Fire Safety (LTC)
- Nurse Aide Training Program
- Nurse Aide Registry
- FOIA
- Workforce Background Checks
- Enforcement/Compliance

Michelle Roepke, Director
Federal Survey & Certification Division

Federal Certification

- Ambulatory Surgical Centers
- Clinical Laboratory Services
- Comprehensive Outpatient Rehabilitation Facilities
- Dialysis Centers
- Home Health Agencies
- Hospice Agencies & Residences
- Hospitals
- Nursing Homes
- Outpatient Physical Therapy (OPT)/Speech Pathology Providers
- Portable X-Ray Suppliers
- Rural Health Clinics

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Michigan Covered Providers

(As of December 29, 2015)

** Some federal oversight for organ procurement organizations (1) and federally qualified health centers (215).*

No. of Providers	Type
9,876	Child Care Homes & Centers
8,445	Clinical Laboratory Services (CLIA)
4,248	Adult Foster Care Homes
1,300	Substance Use Disorder Programs
1,061	Adult Foster Care/Child Care Camps
616	Home Health Agencies
460	Nursing Homes/LTC Facilities
234	Homes for the Aged
196	Dialysis Centers (ESRD)
169	Hospitals
168	Rural Health Clinics
160	Outpatient Physical Therapy (OPT)/Speech Pathology
141	Hospice Agencies
136	Freestanding Surgical Outpatient Facilities/ASC
58	Inpatient Psychiatric Hospitals/Units
18	Hospice Residences
9	Organ Transplant Facilities
9	Portable X-Ray Providers
5	Community Mental Health Centers
4	Comprehensive Outpatient Rehab Facilities (CORF)

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BCHS State/Federal Oversight by Covered Providers

State	Federal	Type
YES	NO	Adult Foster Care Homes
YES	NO	Adult Foster Care/Child Care Camps
YES	NO	Child Care Centers
YES	NO	Homes for the Aged
YES	NO	Substance Use Disorder Programs
YES	YES	Freestanding Surgical Outpatient Facilities/ASC
YES	YES	Hospice Agencies
YES	YES	Hospice Residences
YES	YES	Hospitals
YES	YES	Inpatient Psychiatric Hospitals/Units
YES	YES	Nursing Homes/LTC Facilities
NO	YES	Clinical Laboratory Services (CLIA)
NO	YES	Community Mental Health Centers
NO	YES	Comprehensive Outpatient Rehab Facilities (CORF)
NO	YES	Dialysis Centers (ESRD)
NO	YES	Home Health Agencies
NO	YES	Organ Transplant Facilities
NO	YES	Outpatient Physical Therapy (OPT)/Speech Pathology
NO	YES	Portable X-Ray Providers
NO	YES	Rural Health Clinics (RHC)

General Overview

State Licensure

- Initial licensure
- Routine surveys/inspections
- Complaints
- Renewal
- Enforcement

Federal Certification

- Initial certification
- Routine recertification surveys
- Complaints
- Recertification
- Enforcement

LICENSING AND REGULATORY AFFAIRS
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Web Change

www.michigan.gov/bchs

Bureau of Community and Health Systems

The Bureau of Community and Health Systems performs state licensing and federal certification regulatory duties as required by state and federal laws. The bureau programs are designed to protect the health, safety and welfare of individuals receiving care and services through various covered licensed/certified provider types. Activities include issuance of state licenses and construction permits, routine inspections, complaint investigations, enforcement of state and federal requirements, and a host of other regulatory activities. The bureau covers more than 20 various provider types.

- Covered Providers
- Look Up a License
- Contact Us
- Request Documents (FOIA)
- File a Complaint
- Spotlight & News
- Plan Review & Construction Permits
- Workforce Background Checks
- Nurse Aide Training Program

Bureau of Community and Health Systems – Covered Providers

The Bureau of Community and Health Systems performs state licensing and federal certification regulatory duties as required by state and federal laws. This page is designed to assist providers through the state licensing and federal certification processes. We hope you find this page user-friendly to find the information needed and easy to navigate.

- Adult Foster Care Homes
- Camps Adult Foster Care & Child
- Child Care Homes & Centers
- Clinical Laboratory Services (CLIA)
- Comprehensive Outpatient Rehab Facilities (CORF)
- Dialysis Centers (ESRD)
- Freestanding Surgical Outpatient Facilities (FSOF/ASC)
- Home Health Agencies
- Homes for the Aged
- Hospice Agencies & Residences
- Hospitals
- Psychiatric Hospitals & Units
- Nursing Homes
- Outpatient Physical Therapy (OPT)/ Speech Pathology
- Portable X-Ray Providers
- Substance Use Disorder Programs
- Rural Health Clinics (RHC)

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Presentation Objectives

- Discuss recent changes made by LARA in TB testing requirements for healthcare facilities.

- Describe how these changes may affect employee and patient TB screening in the workplace.

Proposed TB Requirements

- **Administrative Rules**
  - Use the CDC's TB risk assessment* as a guide for requirements for routine TB screening
  - Eliminated the requirement for admission chest x-ray along with the History & Physical
  - Maintain record of baseline screening for communicable disease for employee

Frequently Asked Questions

How often to screen employees and patients?

- Baseline, and then according to the facility's risk assessment; Low, Medium and Ongoing transmission.

What to do if there is a positive TB test?

- Identify the source, isolate, N-95/mask patient notify Local Health Department, initiate contact tracing.

When to conduct TB risk assessments for your facility type?

- Annually, or when a cluster of conversions or an actual TB case

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Resources

- Guideline for Preventing Transmission of Mycobacterium Tuberculosis in Healthcare Setting http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm?s_cid=rr5417a1_e
- **TB Risk Assessment form: http://www.cdc.gov/tb/publications/guidelines/AppendixB_092706.pdf
- Prevention and control in Long-term care facilities http://www.cdc.gov/mmwr/preview/mmwrhtml/00001711.htm
- State of Michigan Data and Statistics: http://www.michigan.gov/mdhhs/0,5885,7-339-71550_5104_5281_46528_59091---,00.html

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Questions & Answers

Bureau of Community and Health Systems

Ottawa Building, 1st Floor

611 W Ottawa Street

Lansing, MI 48909

Main Line: (517) 335-1980

www.michigan.gov/bchs

Thank you for your efforts to provide quality health care to Michigan residents!

TB GENOTYPING AND CLUSTERS IN MICHIGAN

Shona Smith, MPH
TB Epidemiologist
Michigan Department of Health and Human Services

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Objectives

1. Provide a brief overview of genotyping and how it is used with *M. tuberculosis* specimens
2. Review the TB GIMS system and its application of genotyping for identifying outbreak clusters
3. Examine prominent TB clusters in Michigan
4. Discuss best practices for investigating clusters

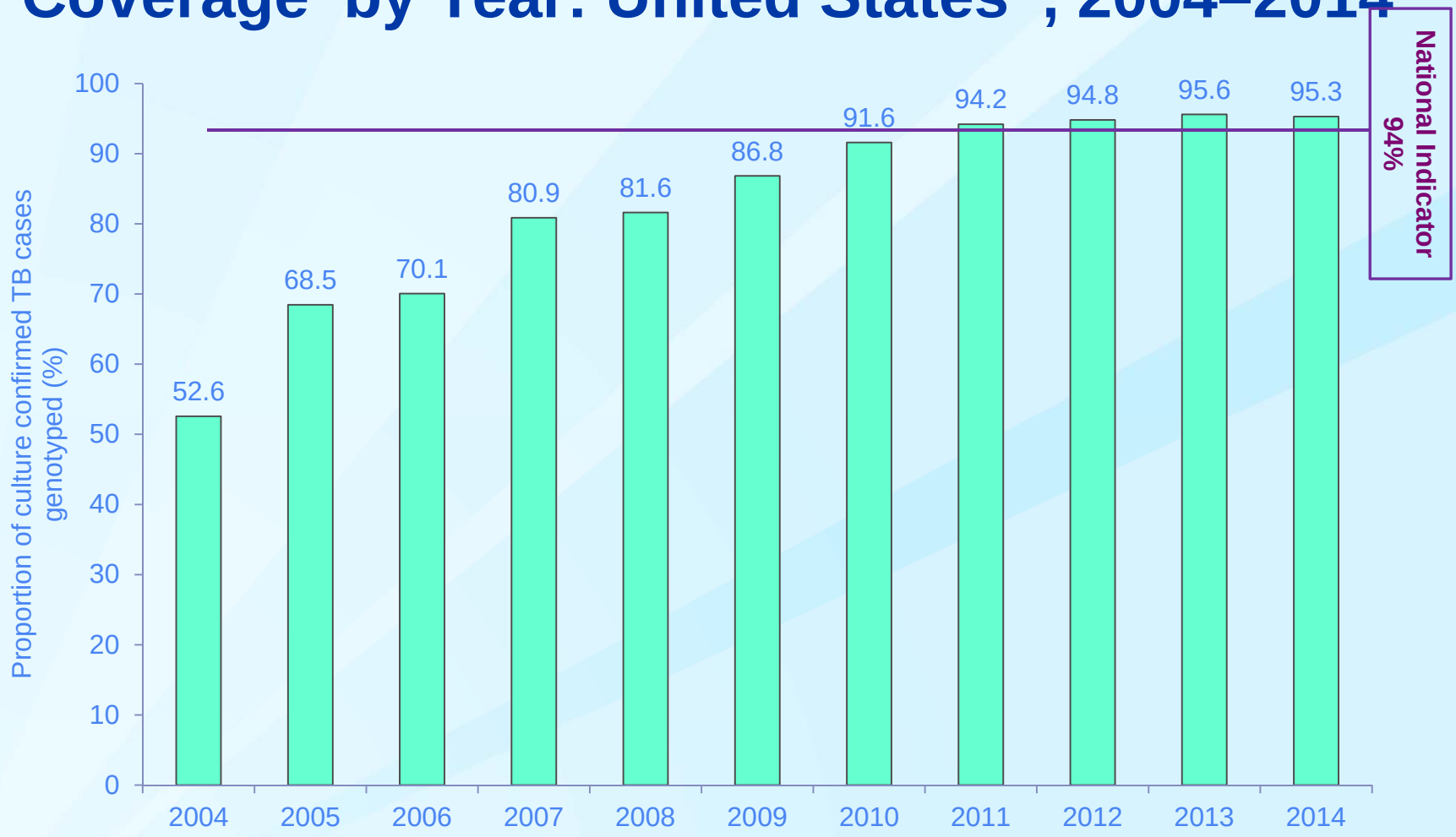
Content

- Genotyping overview for Tuberculosis
  - Best practices for cluster investigations
  - Using genotype information to assist in contact investigations
- TB GIMS
  - Overview of cluster reports
  - Interpretation of cluster reports
- Genotype clusters in MI
  - Trends in primary Michigan clusters
  - Compare with clusters nationwide
- Intro to new cluster survey tool

What does it mean?

OVERVIEW OF GENOTYPING FOR TUBERCULOSIS

National Tuberculosis Genotyping Surveillance Coverage* by Year: United States**, 2004–2014

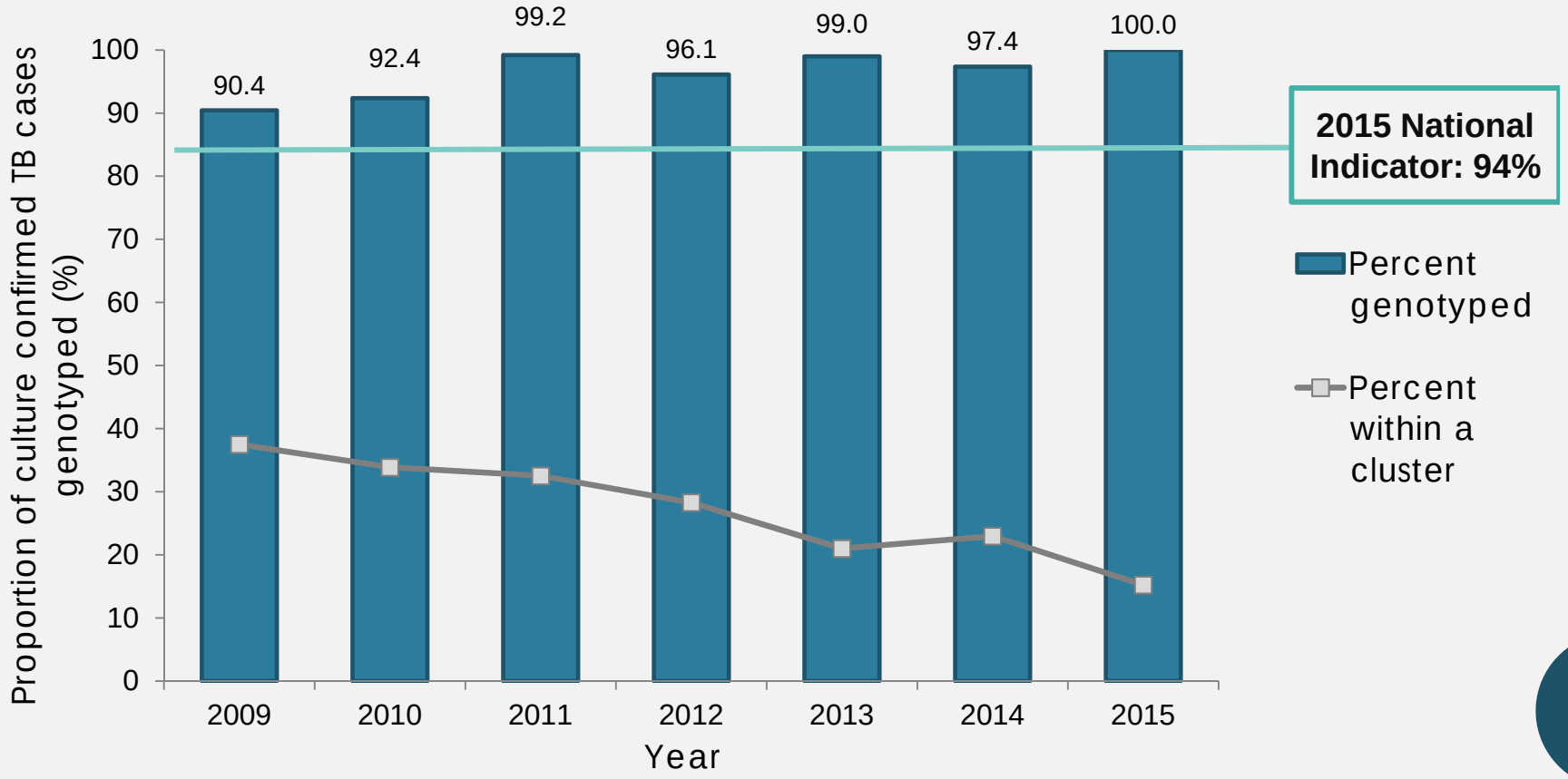


* The proportion of positive cultures with at least one genotyped isolate.

** Includes 50 states and the District of Columbia.

Genotyping Coverage for Culture Positive TB Cases

Michigan, 2010-2015



QUESTION:
What is TB Genotyping?

a. Laboratory method to detect TB infection

b. A blood test to detect drug-resistant TB

c. Laboratory approach to analyze genetic material (DNA) of *Mycobacterium tuberculosis (M. tuberculosis)*

d. Tool to help understand transmission of *M. tuberculosis*

e. Both c and d

DNA = deoxyribonucleic acid

ANSWER:
TB Genotyping Is

a. Laboratory method to detect TB infection

b. A blood test to detect drug-resistant TB

c. Laboratory approach to analyze genetic material (DNA) of *M. tuberculosis*

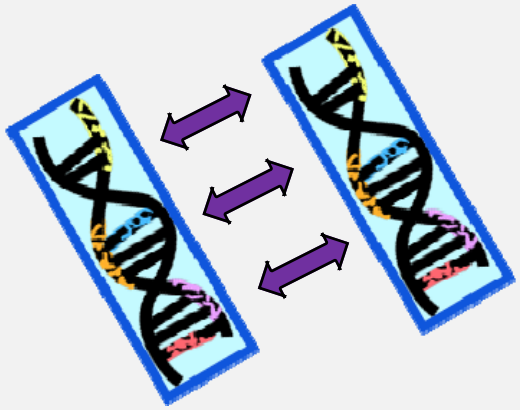
d. Tool to help understand transmission of *M. tuberculosis*

e. Both c and d

DNA = deoxyribonucleic acid

TB Genotyping

- Only for culture-confirmed TB
  - The technique requires material from a culture
- Matching genotypes may indicate that TB cases are related



Genotypes and M. tuberculosis Transmission

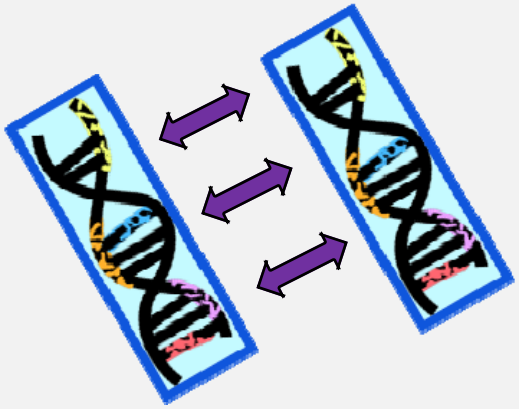
- Genotyping helps us understand transmission relationships between TB cases
- We expect genotypes from transmission-related TB cases

Matching Game – Do the Pictures Match?

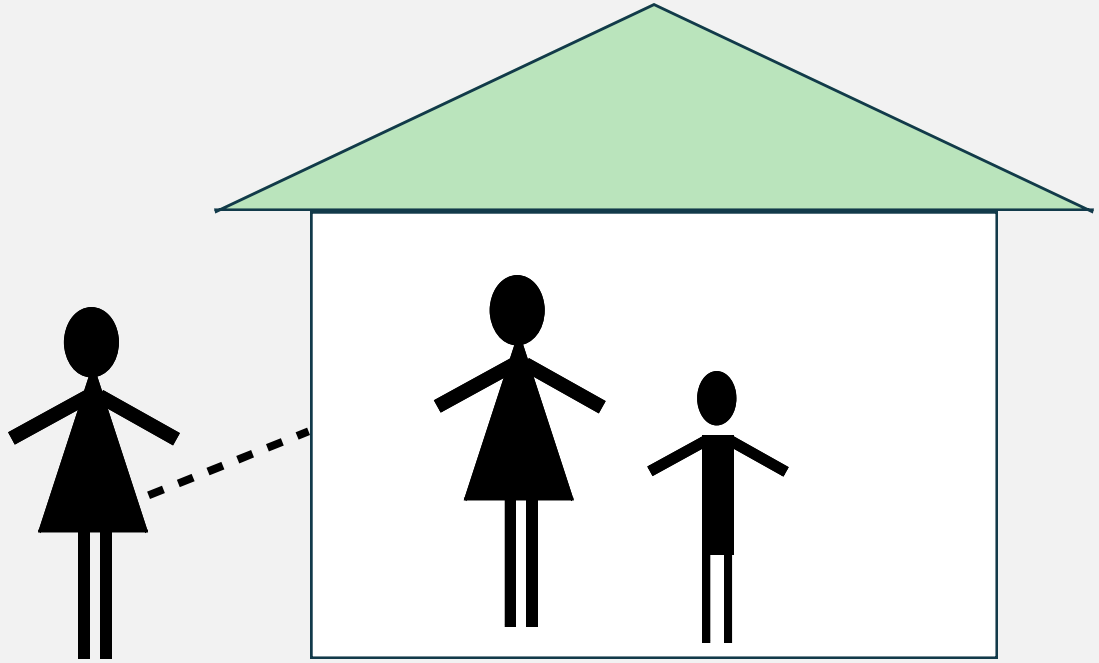
Genotype Clusters

How Can Genotyping be Useful in TB Control?

- Assist with contact investigations
  - Confirm or refute patient connections
- Find previously unidentified contacts
- Detect and prevent outbreaks
- Refute outbreaks
- Distinguish relapse from new infection
- Detect false-positive culture results



Case Scenario 1: A Household



Persons diagnosed with TB spent most of their time together at the same house

- *Likely related by transmission*

Case Scenario 1: A Household

Genotype results for TB cases linked to household

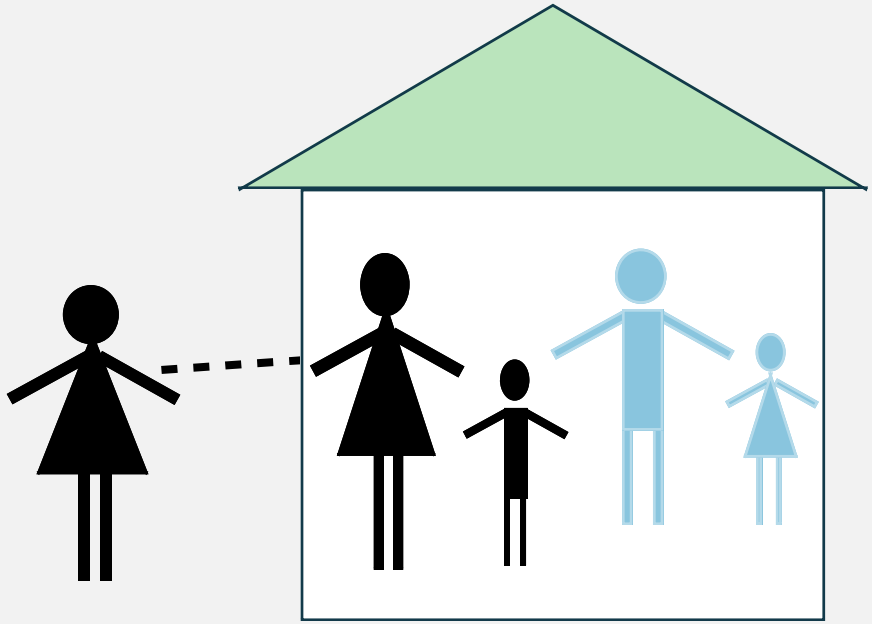
Mother	**G08464**
Son	**G08464**
Neighbor	**G08464**

Case Scenario 1: A Household
Interpretation of Genotyping Results

- All cases had matching genotypes
- All spent time together in the same house
- These cases were likely transmission-related

Case Scenario 1: A Household
Back to the Household

- Contact investigation did not find any other cases
- Two other family members were diagnosed and treated for TB infection
- Neighbor with TB did not identify any other contacts aside from family



Case scenario 1: A Household Review of Genotype Data for County A – 2013

Mother	**G08464**
Son	**G08464**
Neighbor	**G08464**
Patient A	**G08464**
Patient B	**G08464**

Case Scenario 1: A Household
What do the Genotype Results Indicate?

- Five cases with matching genotypes within 6 months

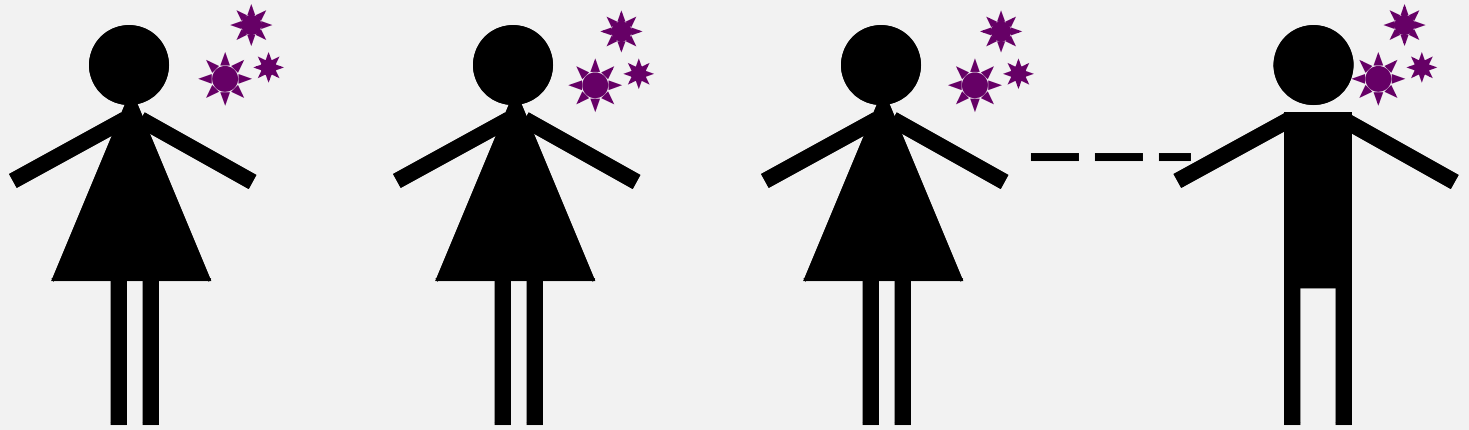
- Cases may all be related by transmission, but
  - *When?*
  - *Where?*

- More information is needed

Case Scenario 1: A Household
Next Steps

- Investigate to understand relationship of Patient A and Patient B to the other patients in the cluster
  - *Identify likely locations of transmission*
  - *Determine if there are missed contacts*
- Review
  - *Public health records*
  - *Contact investigation logs*
  - *Estimated infectious periods*
  - *Re-interview TB patients and contacts*

Case Scenario 2: A Workplace



- Within one month
  - *Three women diagnosed with TB*
  - *All work at the same casino*
  - *All work on the same evening shift*
- One woman's boyfriend also diagnosed with TB

Case Scenario 2: A Workplace

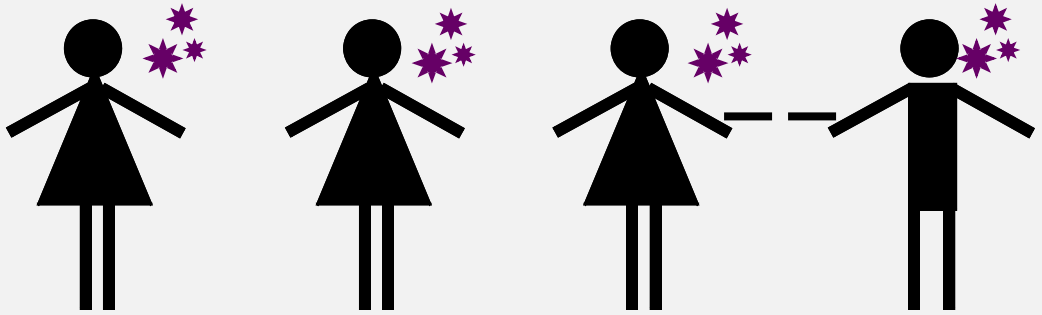
QUESTION:

Are these TB cases related by transmission?

a. Yes

b. No

c. Maybe



Case Scenario 2: A Workplace

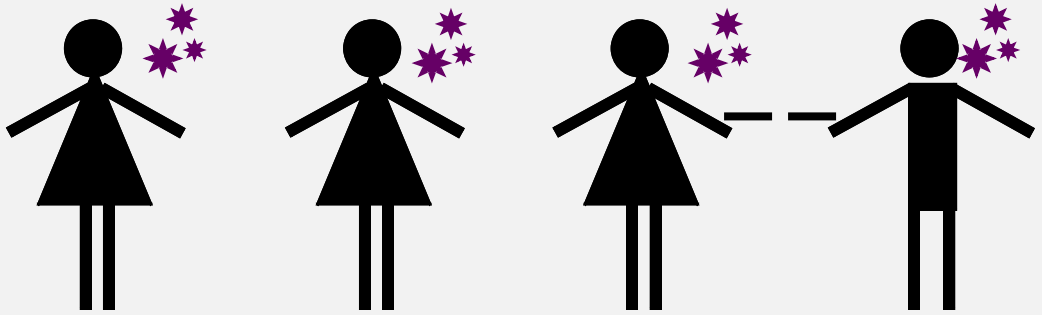
ANSWER:

Are these TB cases related by transmission?

a. Yes

b. No

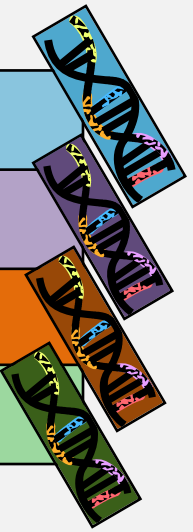
c. **Maybe!**



Case Scenario 2: A Workplace

Genotype Results for TB Cases Linked to Casino

Employee 1	**G08464**
Employee 2	**G15185**
Employee 3	**G00010**
Boyfriend	**G16470**



Case Scenario 2: A Workplace

QUESTION:

How to interpret the genotype results?

a. The genotype data are wrong

b. The genotype data could be wrong, since cases are linked epidemiologically

c. These cases are not related by transmission

d. I don't know

Case Scenario 2: A Workplace

ANSWER:

How to interpret the genotype results?

a. The genotype data are wrong

b. The genotype data could be wrong, since cases are linked epidemiologically

c. These cases are not related by transmission

d. I don't know

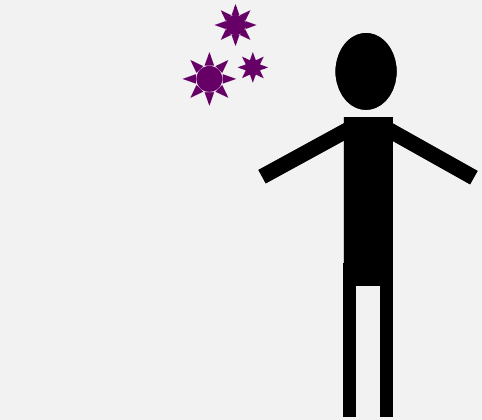
Case Scenario 2: A Workplace
Interpretation of Genotype Results

- Genotype results from all cases were different
  - *These cases are not related by transmission*
  - *This was a coincidence*
- Four contact investigations are needed
  - *Three in same work site*
- Not an outbreak

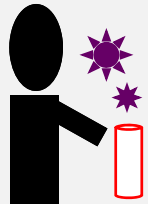
How is it created?

THE COMPOSITION OF A GENOTYPE

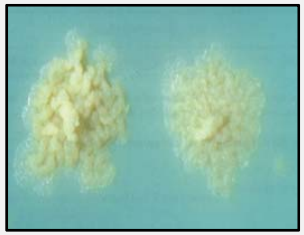
How are Genotyping Results Obtained?



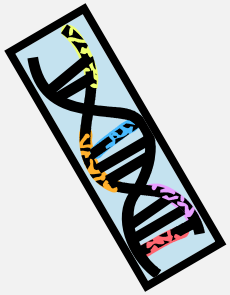
Person with suspected TB



Specimen

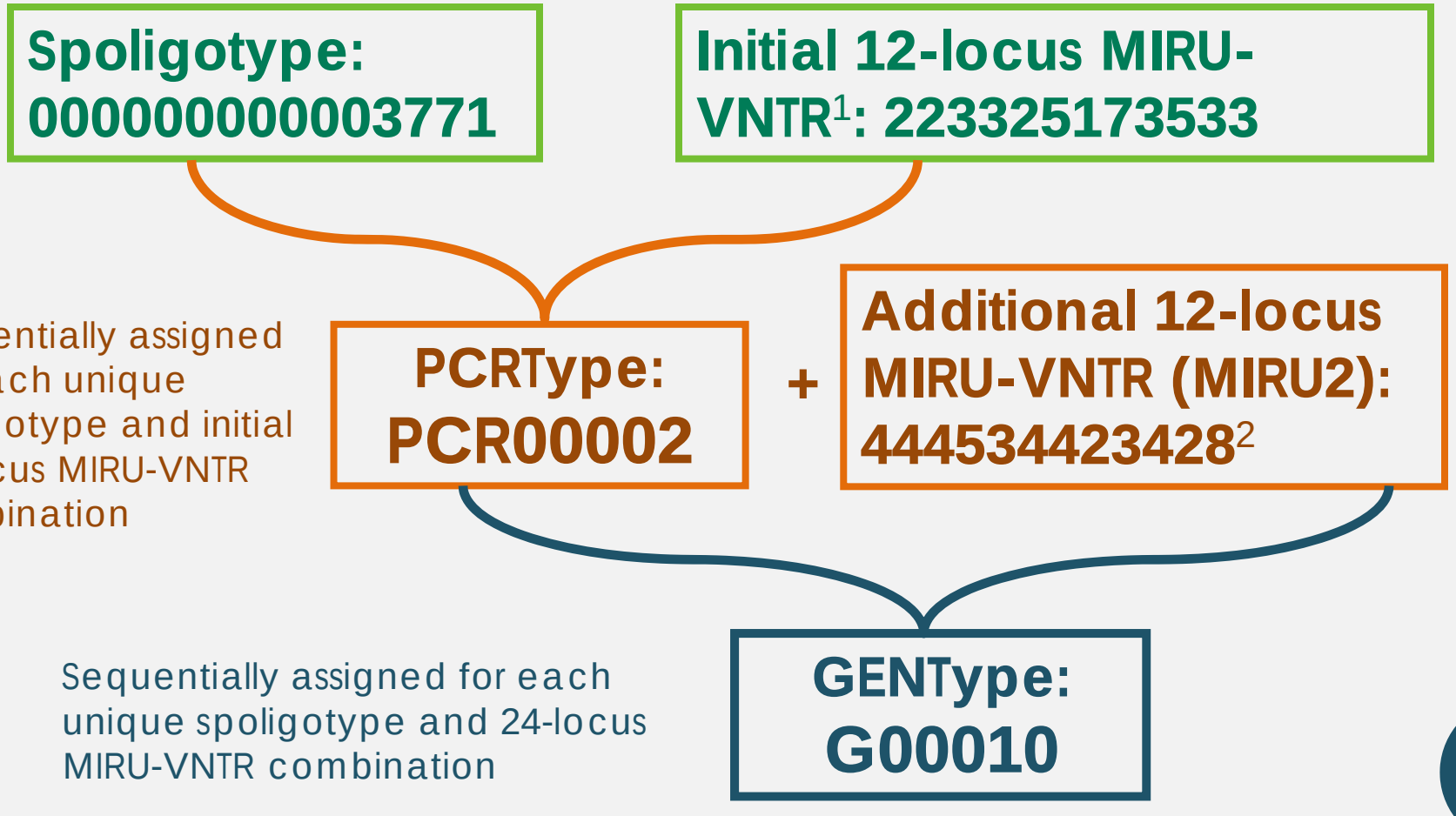


TB isolated from culture



TB genotype test result

Definition for Tuberculosis Genotyping in the United States



[1] Mycobacterial interspersed repetitive unit–variable number tandem repeat.

[2] The complete set of 24 loci is referred to as 24-locus MIRU-VNTR and is used for GENType designation for genotype in the United States.

A Few Examples

GENType	PCRType	ClusterName2	Spoligotype	MIRU	MIRU2
G16470	PCR00766	MI_0065_001	777777777760771	228325163423	236234223736
G11100	PCR00743	MI_0011_001	777776777760771	224225153324	433434423638
G15185	PCR00291	MI_0008_001	777777777760700	223325133224	242524224225
G15165	PCR00013	MI_0004_001	777777777760600	223325133224	242524224225
G00010	PCR00002	MI_0016_001	000000000003771	223325173533	444534423428
G01835	PCR00012	MI_0002_001	000000000003771	322325173543	445544423329
G00012	PCR00002	MI_0016_003	000000000003771	223325173533	445644423328
G23048	PCR00012		000000000003771	322325173543	44554442332%
G15184	PCR00291	MI_0008_002	777777777760700	223325133224	242424224225
G00392	PCR00803		000000000003771	222325173533	345544423328
G24832	PCR17412		000000000003771	2233251b3533	444744423348
G23020			No Result	234325152324	241334223128
G25354	PCR22382		703777740003771	224425183523	224--4223248

Differences by Spoligotype

GENType	PCRType	ClusterName2	Spoligotype	MIRU	MIRU2
G16470	PCR00766	MI_0065_001	777777777760771	228325163423	236234223736
G11100	PCR00743	MI_0011_001	777776777760771	224225153324	433434423638
G15185	PCR00291	MI_0008_001	77777777776070 0	223325133224	242524224225
G15165	PCR00013	MI_0004_001	77777777776060 0	223325133224	242524224225
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G23020			No Result	234325152324	241334223128
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Differences by MIRU

GENType	PCRType	ClusterName2	Spoligotype	MIRU	MIRU2
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G15185	PCR00291	MI_0008_001	777777777760700	223325133224	242524224225
G15165	PCR00013	MI_0004_001	777777777760600	223325133224	242524224225
G00010	PCR00002	MI_0016_001	000000000003771	223325173533	444534423428
G01835	PCR00012	MI_0002_001	000000000003771	322325173543	445544423329
G00012	PCR00002	MI_0016_003	000000000003771	223325173533	445644423328
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Differences by MIRU2

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G15185	PCR00291	MI_0008_001	777777777760700	223325133224	242**5**24224225
G15165	PCR00013	MI_0004_001	777777777760600	223325133224	242524224225
G00010	PCR00002	MI_0016_001	000000000003771	223325173533	44**453**4423**4**28
G01835	PCR00012	MI_0002_001	000000000003771	322325173543	445544423329
G00012	PCR00002	MI_0016_003	000000000003771	223325173533	44**564**4423**3**28
G23048	PCR00012		000000000003771	322325173543	44554442332**%**
G15184	PCR00291	MI_0008_002	777777777760700	223325133224	242**4**24224225
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G24832	PCR17412		000000000003771	2233251b3533	444744423348
G23020			No Result	234325152324	241334223128
G25354	PCR22382		703777740003771	224425183523	224--4223248

How is it used?

TB GENOTYPING INFORMATION SYSTEM (TB GIMS) REPORTS

Cluster Snapshot for G15185

Cluster Definition

GENType: G15185

PCRType: PCR00291 **Lineage:** EuroAmerican (L4) **State Cluster Name2:** MI_0008_001

Date Range: 10/11/2012 - 10/11/2015 **Date Type:** Count Date **# cases in cluster:** 10

State/County/Region: MICHIGAN

Data Completeness

Genotype Coverage: 96.8% **#Patients with PCRType but no MIRU2 result:** 0

#Isolates with no linked surveillance record: 0

Genotype report date of most recent isolate without surveillance record:

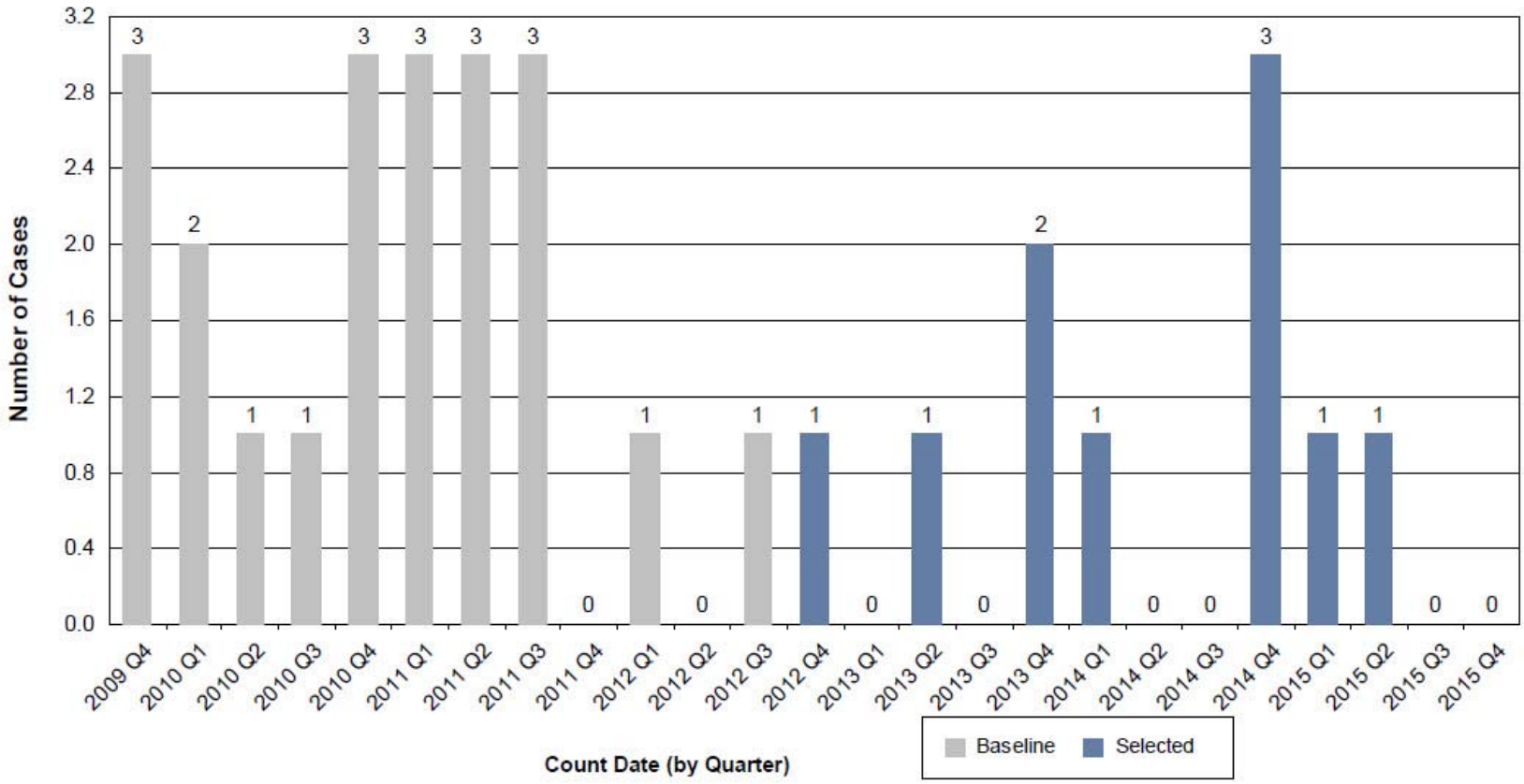
Cluster Detection

Alert Level: N/A **Recent change in alert level:**

Alert level and LLR are only available for single county areas.

Cluster Snapshot for G15185

Time



The Epidemic Curve has been expanded to display the historical occurrence of cases for 3 years prior to dates selected.The first blue column will include all cases in the quarter regardless of whether they are in selected timeframe or are part of baseline period. 0 out of 1 cases are from the baseline period.

Geography

# cases in rest of state: N/A	**% of all cases in this state with this genotype:** 4.10
Five other counties with most cases: N/A	
# cases in adjacent states: 0	**Adjacent states with cases:**
# cases in entire rest of U.S.: 2	**% of all cases in U.S. with this genotype:** 0.06

Cluster Snapshot for G15185

Person

Comparative demographics (selected jurisdiction vs. rest of U.S.) n(%)

Characteristic	MICHIGAN	Rest of U.S. n (%)
Race/Ethnicity		
Black	9 (90.0%)	2 (100.0%)
White	1 (10.0%)	0 (0.0%)
Gender		
Female	1 (10.0%)	1 (50.0%)
Male	9 (90.0%)	1 (50.0%)
Birth		
US Born	10 (100.0%)	2 (100.0%)

High risk characteristics of transmission or poor outcome n(%)

Characteristic	n (%)
Case with smear positive and cavitary pulmonary disease	5 (50.0%)
Homeless	3 (30.0%)
Corrections	0 (0.0%)
Long Term Care Facility	1 (10.0%)
Any substance abuse	5 (50.0%)
Alcohol abuse	4 (40.0%)
Non-IDU	4 (40.0%)
IDU	0 (0.0%)
MDR	0 (0.0%)
INH resistance only	0 (0.0%)
Child (<5 years)	0 (0.0%)
Child (5-14 years)	0 (0.0%)
HIV	0 (0.0%)
Dead at diagnosis or died while on therapy	3 (30.0%)

There are no foreign born cases for the selected criteria.

Cluster Snapshot for G15185

Line List

StateCaseNo	Cnt.Date	County	Age3	RaceHisp	CountryLN	YrsInUS2	Smear	Cavity	DrugRes	HIV	SubAbus	Corr	Homeless	ReasEval
2015MID00000050	05/01/2015	WAYNE	45-64	BLACK	UNITED STATES		NEG	UNK	None	NEG	Y	N	N	TBSYMP
2015MI000000002	01/01/2015	WAYNE	45-64	WHITE	UNITED STATES		POS	N	None	NEG	Y	N	Y	TBSYMP
2014MID00000110	12/01/2014	WAYNE	25-44	BLACK	UNITED STATES		POS	Y	None	NEG	N	N	N	ABXRAY
2014MID00000081	10/01/2014	WAYNE	45-64	BLACK	UNITED STATES		POS	Y	None	NEG	Y	N	Y	TBSYMP
2014MID00000083	10/01/2014	WAYNE	45-64	BLACK	UNITED STATES		POS	Y	None	NEG	N	N	N	TBSYMP
2014MID00000016	03/01/2014	WAYNE	65+	BLACK	UNITED STATES		POS	N	None	NEG	N	N	N	TBSYMP
2013MID00000137	11/01/2013	WAYNE	45-64	BLACK	UNITED STATES		NEG	N	None	NEG	Y	N	N	TBSYMP
2013MID00000104	10/01/2013	WAYNE	65+	BLACK	UNITED STATES		POS	Y	None	NEG	N	N	N	TBSYMP
2013MID00000033	04/01/2013	WAYNE	45-64	BLACK	UNITED STATES		POS	Y	None	NEG	N	N	N	ABXRAY
2012MID00000138	12/01/2012	WAYNE	45-64	BLACK	UNITED STATES		POS	N	None	UNK	Y	N	Y	TBSYMP

National Distribution of G15185

Spoligotype: 777777777760700

24-locus MIRU-VNTR: 223325133224 242524224225

Number of cases with this genotype in U.S. (Z): 12

Percent of all genotyped cases in the U.S. with this genotype: 0.06

PCRType: PCR00291

Number of States reporting this genotype: 3

Family Name: EuroAmerican (L4)

Date Range: 08/19/2012 - 08/19/2015

Date Type: Count Date

	No. of cases with this genotype in state (X)	All cases with any genotype in state (Y)	% of all cases in state with this genotype (X/Y)	% of U.S. cases with this genotype in the state (X/Z)
FLORIDA	1	1362	0.07	8.33
IOWA	1	86	1.16	8.33
MICHIGAN	10	243	4.12	83.33

Surveillance Summary of G15185

State: MICHIGAN
County: ALL
Region: NA
Spoligotype: 777777777760700
Date Range: 03/03/2005 - 03/03/2015

Family Name: EuroAmerican (L4)
City: NA
PCRType: PCR00291
24-locus MIRU-VNTR: 223325133224 242524224225
Date Type: Count Date

	MICHIGAN		Other US	
	n	%	n	%
Age (years)				
0 - 4	0	0.0	0	0.0
5 - 14	0	0.0	0	0.0
15 - 24	3	7.3	0	0.0
25 - 44	10	24.4	1	50.0
45 - 64	26	63.4	1	50.0
65+	2	4.9	0	0.0
Unknown	0	0.0	0	0.0
Sex				
Male	34	82.9	1	50.0
Female	7	17.1	1	50.0
Birth				
US-Born	41	100.0	2	100.0
Foreign-Born	0	0.0	0	0.0
Unknown	0	0.0	0	0.0
Race/Ethnicity				
Hispanic	1	2.4	0	0.0
American Indian/Alaska Native	0	0.0	0	0.0
Asian	0	0.0	0	0.0
Black	40	97.6	2	100.0
Native Hawaiian/Pacific Islander	0	0.0	0	0.0
White	0	0.0	0	0.0
Multiple Race	0	0.0	0	0.0
Unknown	0	0.0	0	0.0
Homeless in past year				
Yes	16	39.0	1	50.0
Excessive Alcohol Use				
Yes	14	34.1	1	50.0
Drug Use (injecting/non-injecting)				
Yes	13	31.7	0	0.0
Incarcerated at Diagnosis				
Yes	4	9.8	0	0.0
HIV Status				
Positive	5	12.2	0	0.0
Negative	31	75.6	2	100.0
Other/Unknown	5	12.2	0	0.0
TOTAL	**41**		**2**	

***Note: 'County: ALL' refers to all the counties in the state.**

Surveillance Summary of G01835

State: MICHIGAN
County: ALL
Region: NA
Spoligotype: 000000000003771
Date Range: 08/06/2012 - 08/06/2015

Family Name: East Asian (L2)
City: NA
PCRType: PCR00012
24-locus MIRU-VNTR: 322325173543 445544423329
Date Type: Count Date

	MICHIGAN		Other US	
Drug Susceptibility Results	**n**	**%**	**n**	**%**
Susceptible to initial testing of first line drugs[1]	2	100.0	5	71.4
INH resistant only	0	0.0	1	14.3
RIF resistant only	0	0.0	0	0.0
PZA resistant only	0	0.0	0	0.0
MDR[2]	0	0.0	0	0.0
XDR[3]	0	0.0	0	0.0
Other resistance pattern[4]	0	0.0	0	0.0
Missing/unknown for first line of drugs[5]	0	0.0	1	14.3
TOTAL	**2**		**7**	

1.Includes INH, RIF, and EMB. PZA is included when results are available.
2.MDR indicates resistance to at least RIF and INH. May be resistant to other drugs, but not meet criteria for XDR.
3.XDR indicates resistance to RIF, INH, any fluoroquinolone and at least one injectable TB drug.
4.Any other combination of resistance patterns to the four first line drugs that do not fit into other categories.
5.Any patient with unknown/missing for RIF, INH or EMB, with or without PZA results.

***Note: 'County: ALL' refers to all the counties in the state.**

Surveillance Summary of G01835

State: MICHIGAN
County: ALL
Region: NA
Spoligotype: 000000000003771
Date Range: 08/06/2012 - 08/06/2015

Family Name: East Asian (L2)
City: NA
PCRType: PCR00012
24-locus MIRU-VNTR: 322325173543 445544423329
Date Type: Count Date

There are no US born cases born outside the 50 states and DC.

***Note: 'County: ALL' refers to all the counties in the state.**

Surveillance Summary of G01835

State: MICHIGAN
County: ALL
Region: NA
Spoligotype: 000000000003771
Date Range: 08/06/2012 - 08/06/2015

Family Name: East Asian (L2)
City: NA
PCRType: PCR00012
24-locus MIRU-VNTR: 322325173543 445544423329
Date Type: Count Date

Country of Birth for Foreign-Born TB Cases

	MICHIGAN		Other US	
Country	**n**	**%**	**n**	**%**
VIETNAM	0	0.0	1	100.0
Total	**0**	**0**	**1**	**100**

***Note: 'County: ALL' refers to all the counties in the state.**

What's been observed?

PRIMARY GENOTYPE CLUSTERS IN MICHIGAN

Genotyped and Clustered Cases, 2012-2014

United States

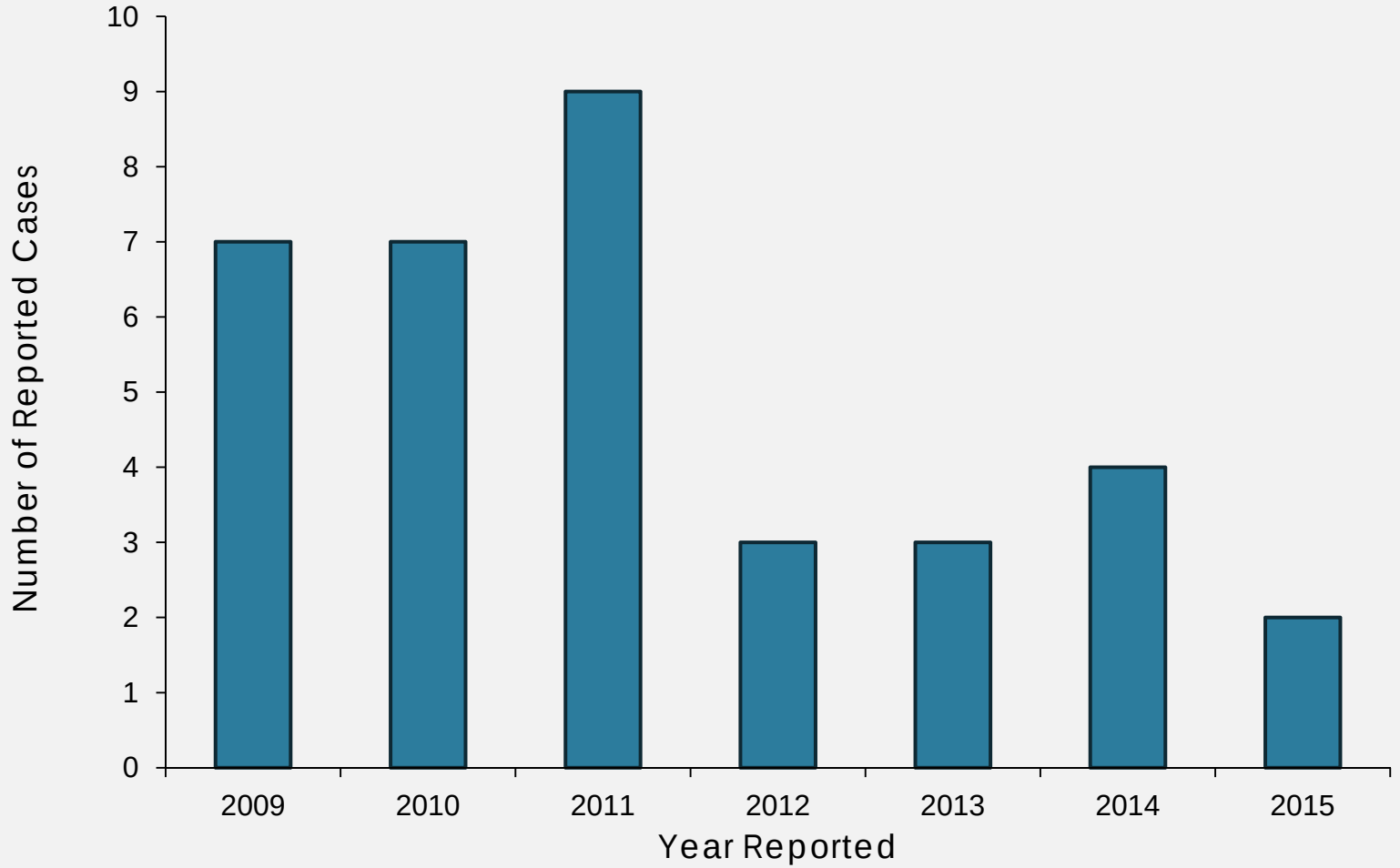
- 21,075 Genotyped Cases
- 4,544 (22%) Clustered Cases

Michigan

- 273 Genotyped Cases
- 241 GENTypes
- 33 Clusters
- 66 (24%) Clustered Cases

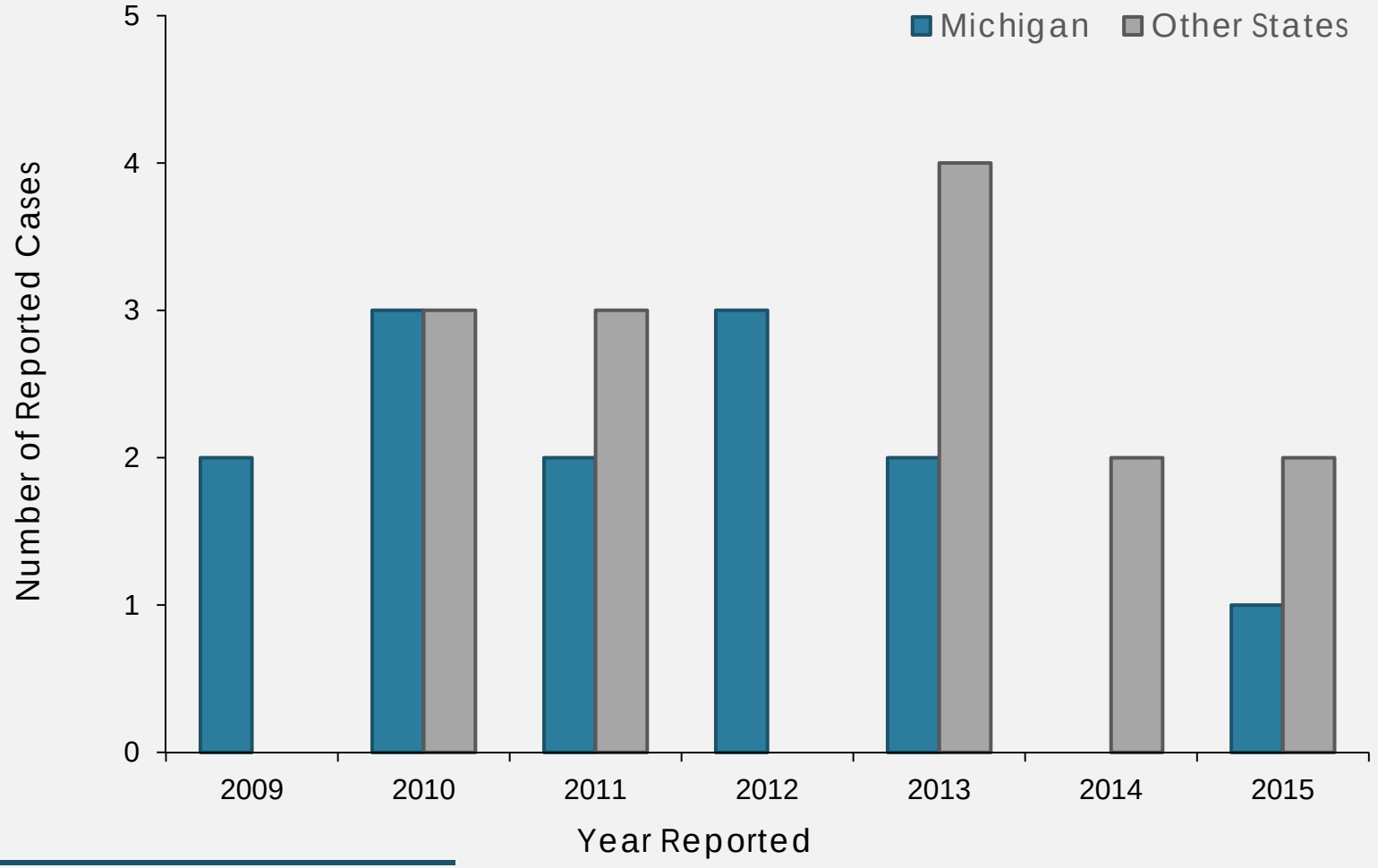
GENType	MI Cluster Name	No. in MI	No. in Rest of US
G15185	MI_0008_001	10	2
G15165	MI_0004_001	5	0
G01835	MI_0002_001	5	6
G08464	MI_0047_001	4	2
G16470	MI_0065_001	4	7
G00010	MI_0016_001	4	173
G00012	MI_0016_003	1	139
G05056		1	114
G00013	MI_0046_001	1	86
G12500		1	58
G10508		1	52
G00734		1	45

Cases of TB in Genotype Cluster G15185
Michigan, 2009-2015



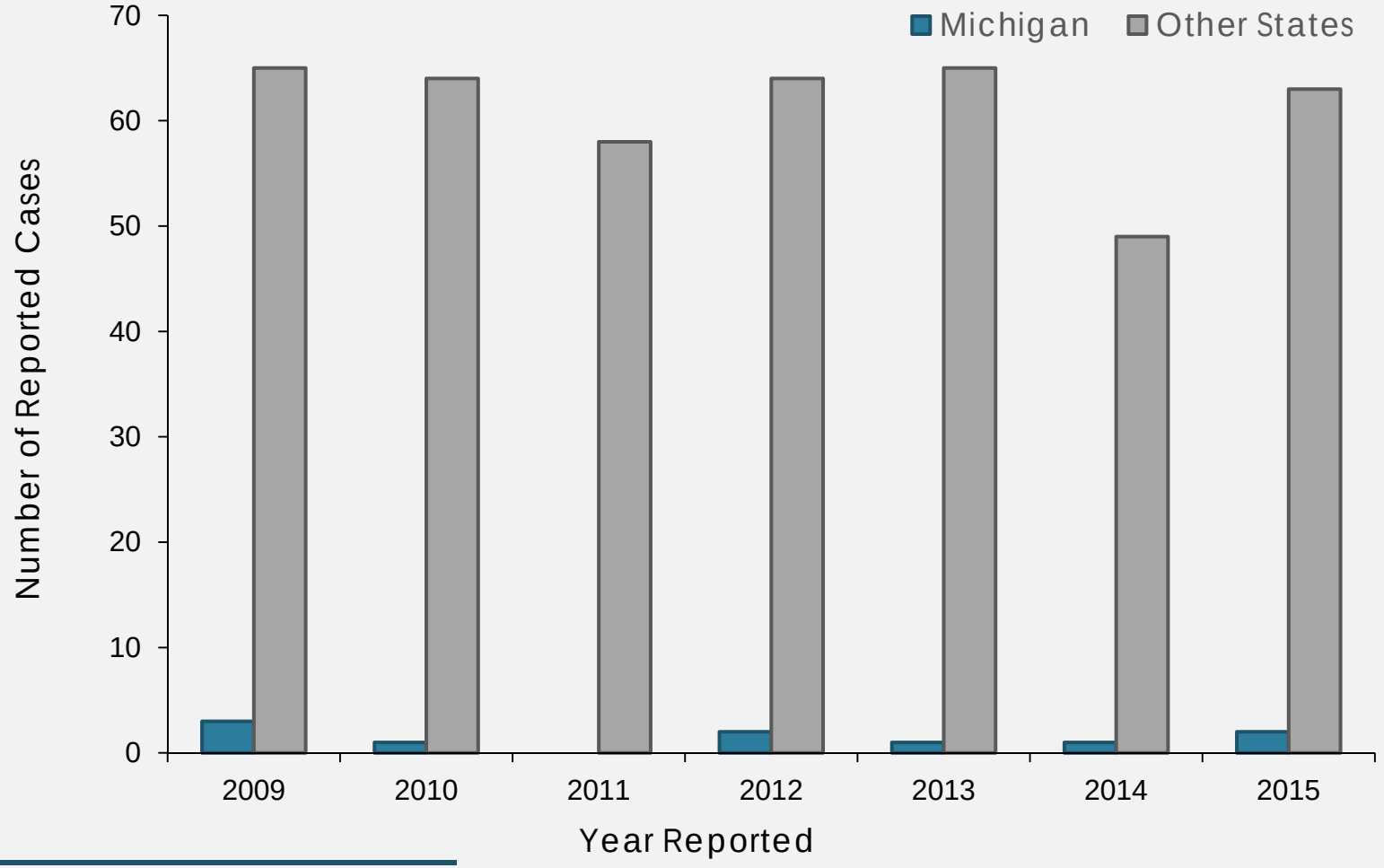
Cases of TB in Genotype Cluster G01835

Michigan vs. Rest of U.S., 2009-2015



Cases of TB in Genotype Cluster G00010

Michigan vs. Rest of U.S., 2009-2015



What else can be done?

CLUSTER INVESTIGATION TOOL

Take Home Points

- TB genotyping can be useful in TB control
  - *Find additional contacts*
  - *Detect and prevent outbreaks*
  - *Refute outbreaks*
- Interpreting genotyping results can be as simple as, "Do the pictures match?"
- The number and proportion of clustered genotype cases in Michigan decreases each year"

CDC Resources on Genotyping

- **CDC TB genotyping website**

  www.cdc.gov/tb/programs/genotyping/default.htm

- **TB genotyping best practices**

  www.cdc.gov/tb/publications/factsheets/statistics/Genotyping_BestPractices.pdf

- **TB Genotyping Information Management System (TB GIMS)**

  https://ajtv-nifm-web2.cdc.gov/TBGIMS/

- **Email CDC**

  tbgenotyping@cdc.gov

Thank You!

Acknowledgements

- CDC's Division of Tuberculosis Elimination
- MDHHS TB Units

References

- Introduction to Tuberculosis Genotyping Facilitator Guide http://www.cdc.gov/tb/programs/genotyping/default.htm
- TB GIMS Reports

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