

INTERPRETATION OF CHEST RADIOGRAPHS

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Talk Outline

- Role of Chest X-ray (CXR) in TB care
- Assessing the quality of the CXR
- Systematic approach to reading a CXR
- CXR findings that are more specific to TB
- Examples

A PRIMER FOR CLINICIANS

Radiographic Manifestations of Tuberculosis

SECOND EDITION 2006

(REPRINT 2020)

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Could this be TB?

- A. Yes
- B. No



Image credit: Daley CL, Gotway MB, Jasmer RM. Radiographic Manifestations of Tuberculosis: A Primer for Clinicians. Second Edition (2006). Reprint 2020

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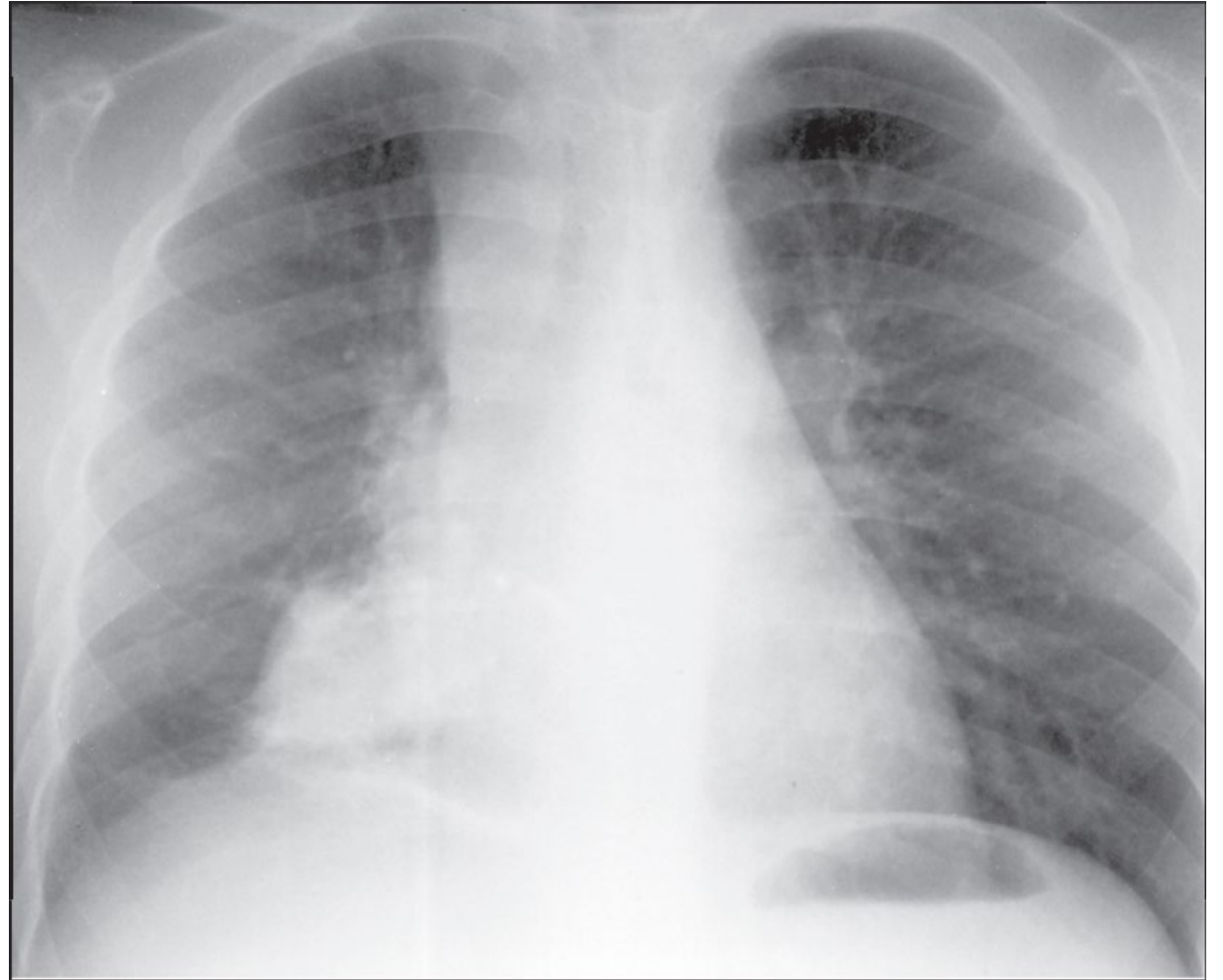


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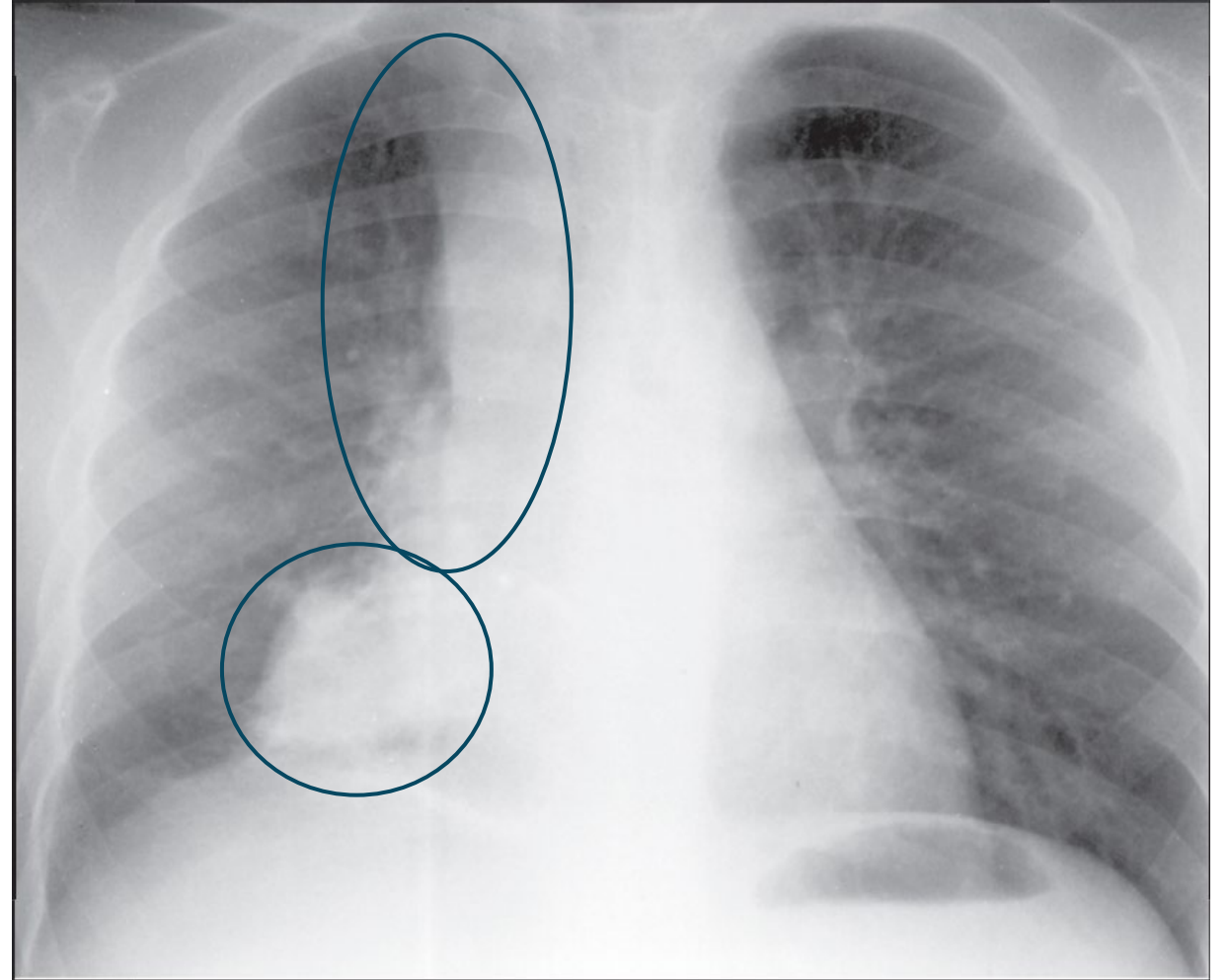
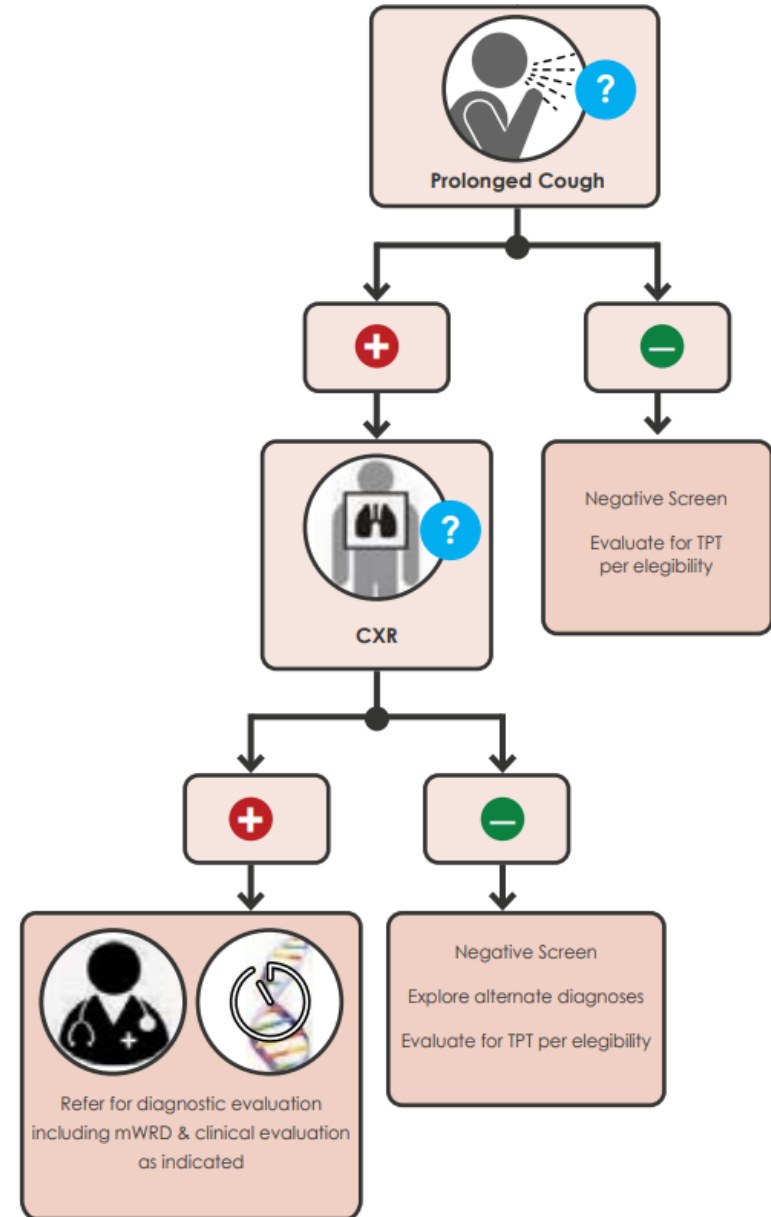
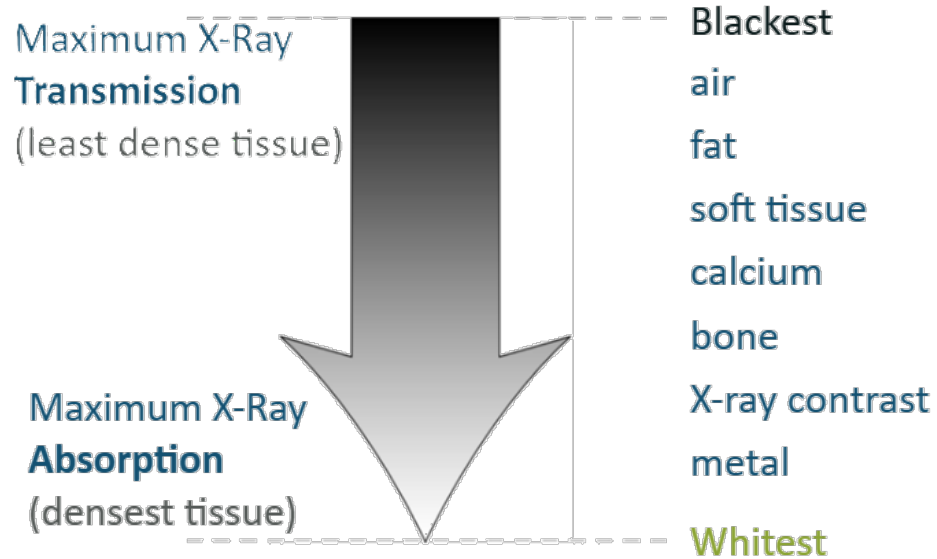


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Role of CXR

- Play an important role in TB disease evaluation
- Sensitive but less specific
- Part of many TB evaluation algorithms



CXR are only one piece of TB evaluation



The Silhouette Sign

- A boundary will appear between 2 structures of different densities due to differential absorption of the x-ray beam
- An example: Right heart border and the right middle lobe
- When the right middle lobe changes density due to pneumonia or edema, it approximates the density of the right heart border → The boundary will no longer be visible → The silhouette sign

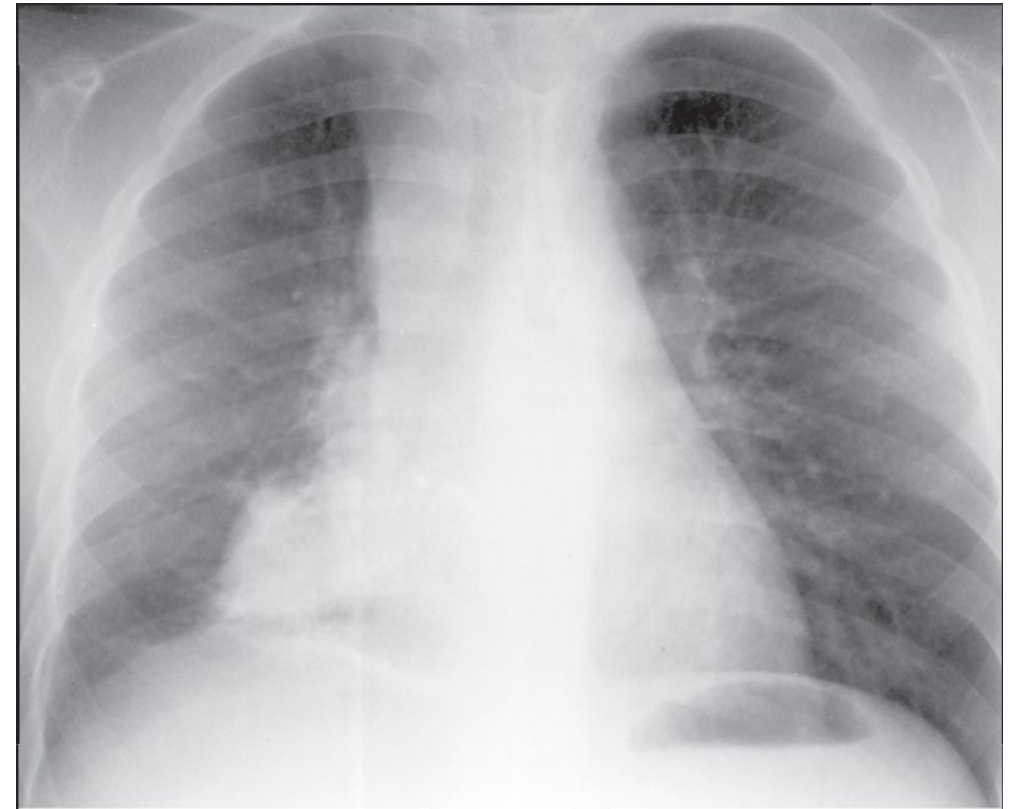


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Are these good-quality CXRs?

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This image was contributed by Etienne Leroy-Terquem from Support Pneumologique International, to the Union's Diagnostic CXR Atlas for Tuberculosis in Children Image Library

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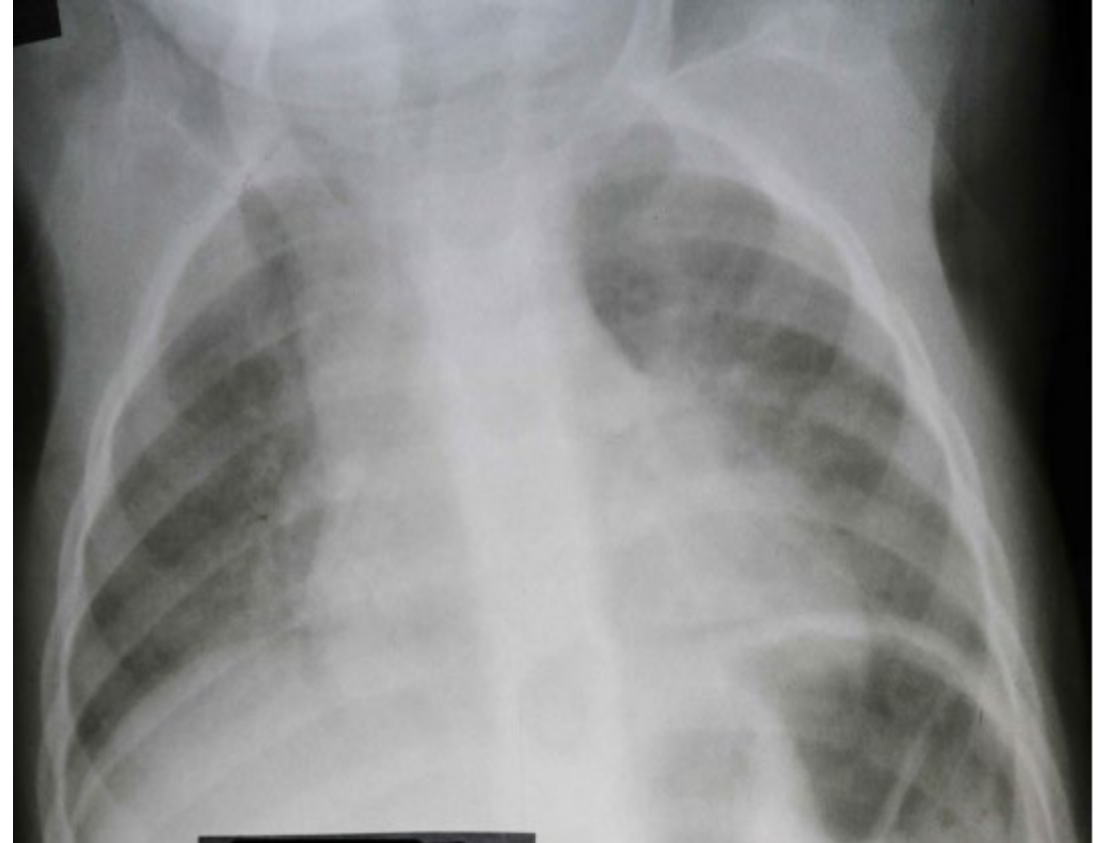
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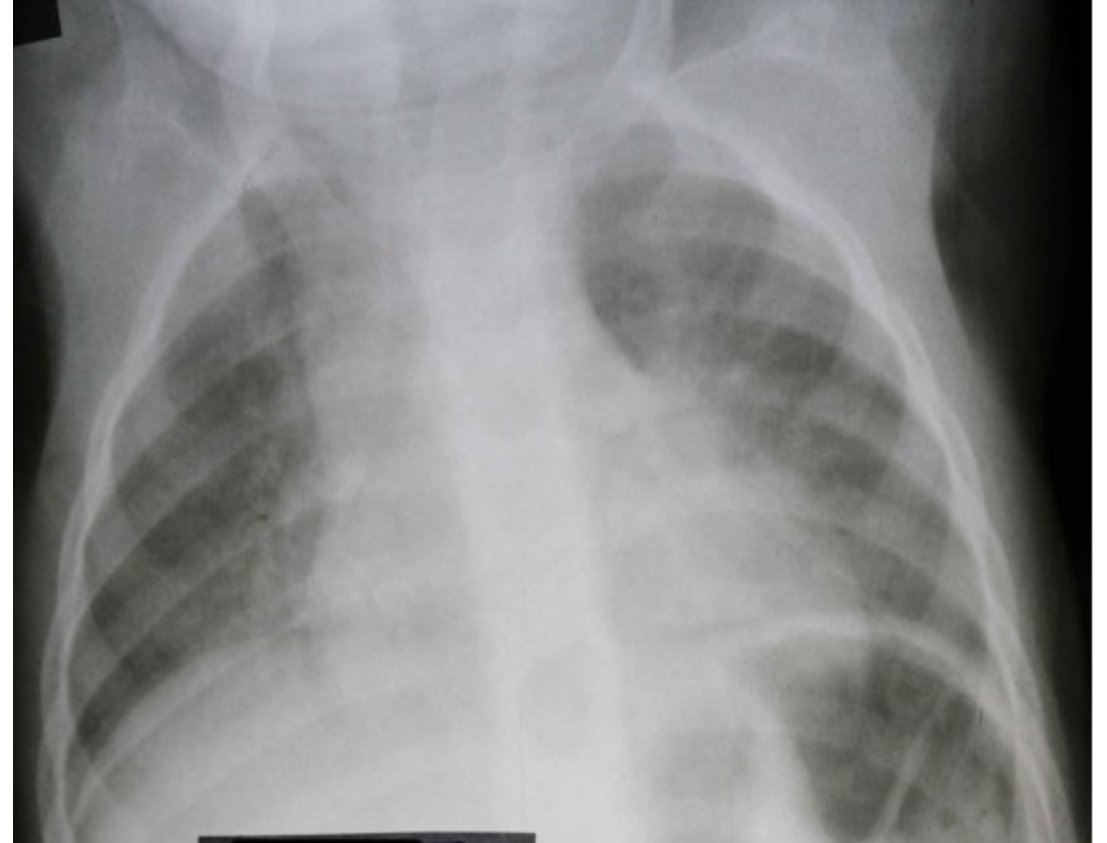


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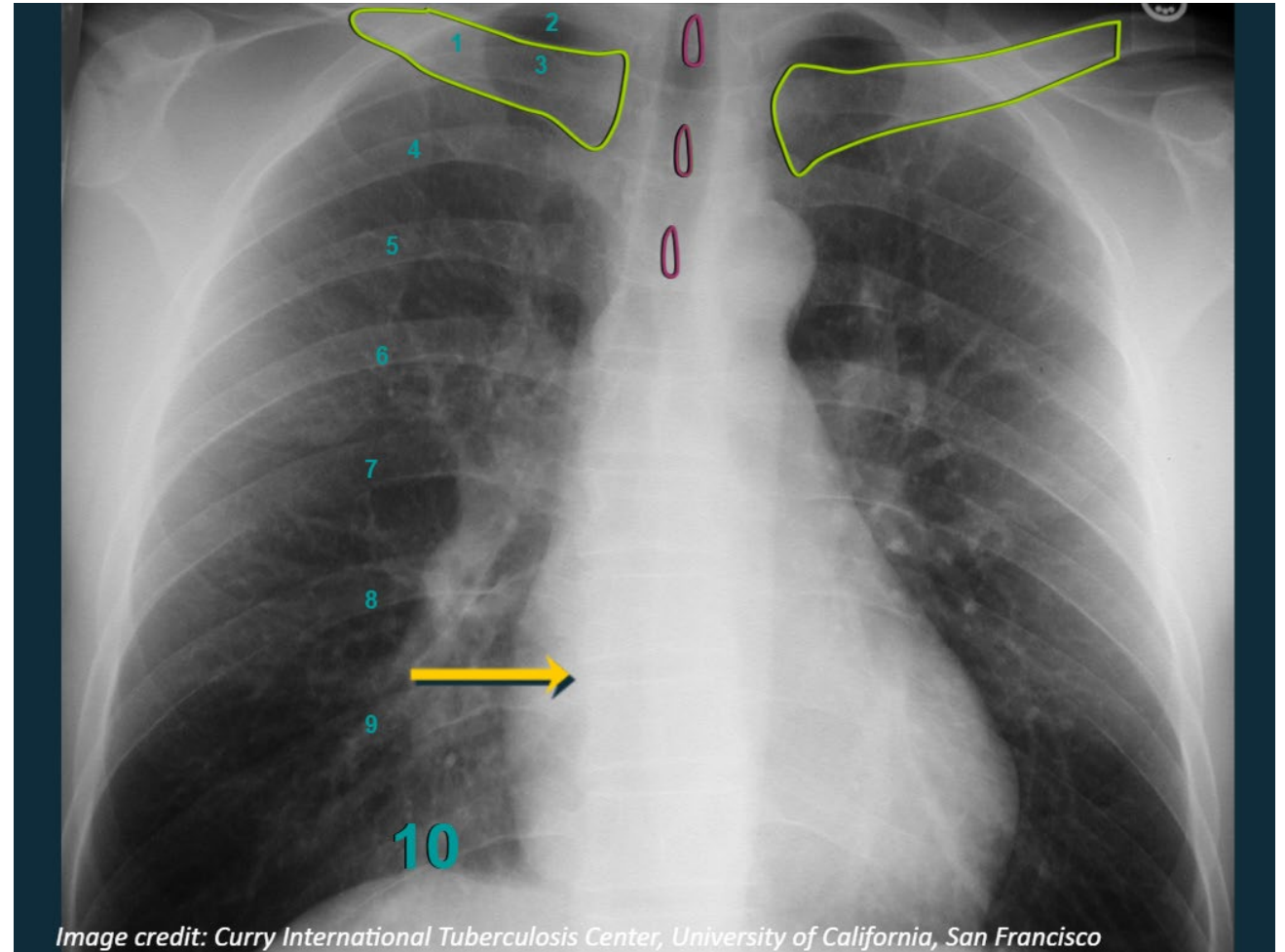
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Assessing the quality of the CXR

- Position: medial clavicle heads are equidistant from spinous process
- Inspiratory effort: 9-10 posterior ribs
- Penetration: thoracic intervertebral disc space just visible



Systematic approach to reading a CXR

- Lungs:
 - Apices, retrocardiac and behind the diaphragm
- Pleura
- Cardiac-mediastinal: Lymphadenopathies:
 - Paratracheal, perihilar, subcarinal, paravertebral
- Osseous structures
- Intra-abdominal

Normal CXR-Frontal

- AA: Aortic arch
- APO: Aortopulmonary window
- PLPA: Proximal left pulmonary artery
- LB: Left bronchus
- LIPA: Left interlobar pulmonary artery
- LAA: Left atrial appendage
- DA: Descending aorta
- LV: Left ventricle
- LD: Left diaphragm
- CPA: Costophrenic angle
- RD: Right diaphragm
- RA: Right atrium
- RIPA: Right interlobar pulmonary artery
- SVC: Superior vena cava
- AV: Azygous vein
- RPS: Right paratracheal stripe

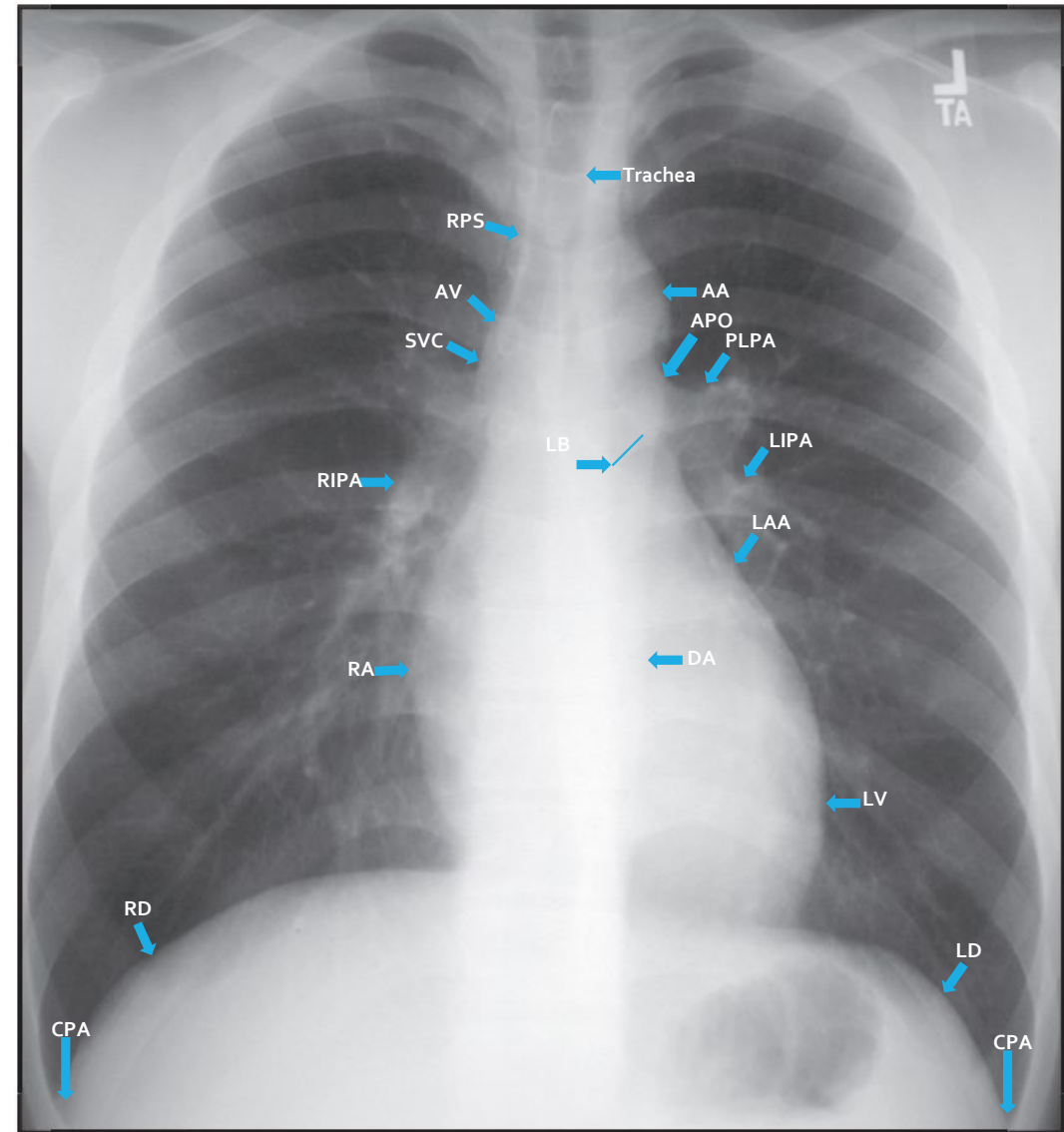


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Normal CXR-Frontal

- 1-RPS
- 2-RIPA
- 3- APO
- 4-LV

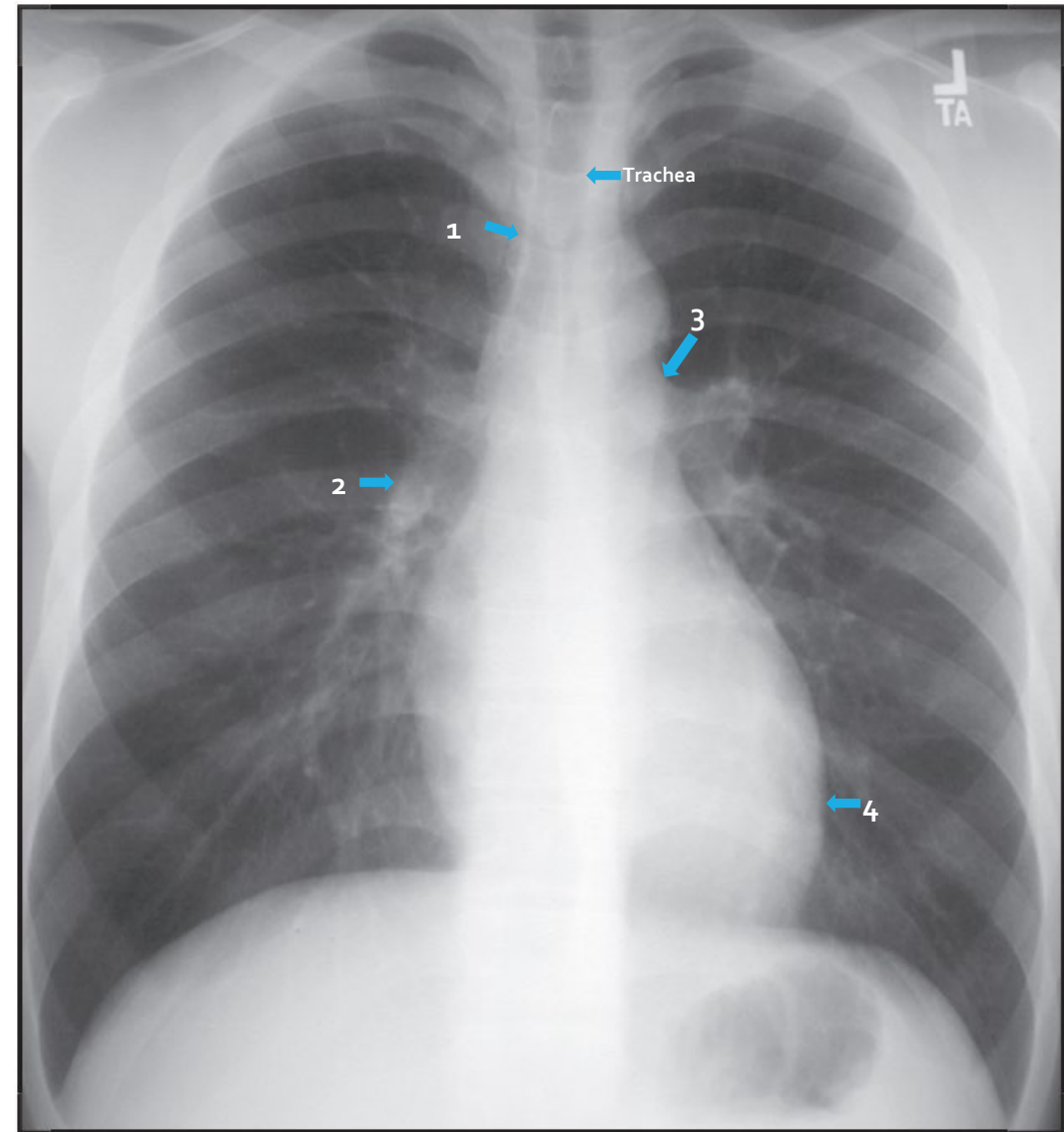
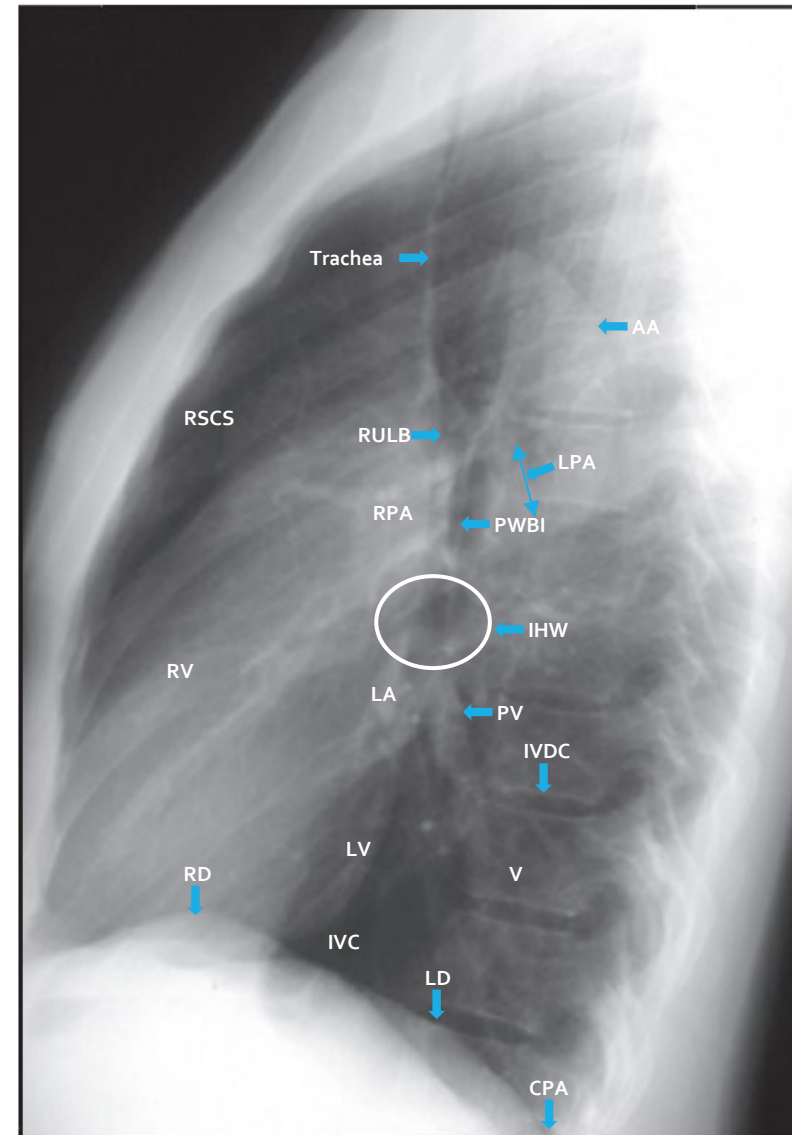


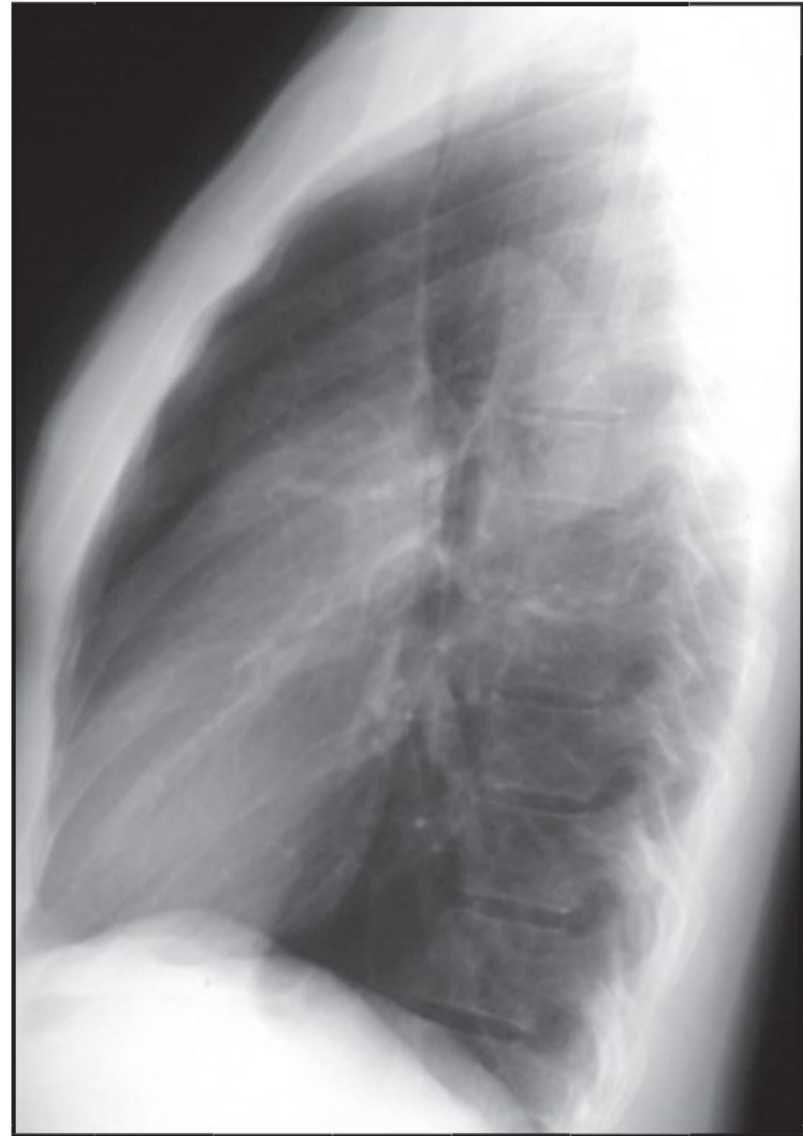
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Normal CXR-Lateral

- RSCS: Retrosternal clear space (Superior mediastinum pathology)
- AA: Aortic arch
- RULB: Right upper lobe bronchus
- LPA: Left pulmonary artery
- RPA: Right pulmonary artery
- PWBI: Posterior wall of bronchus intermedius
- IHW: Infrahilar window (subcarinal lymph nodes)
- LA: Left atrium
- PV: Pulmonary veins
- IVDC: Intravertebral disc space
- V: Vertebral body
- LV: Left ventricle
- RD: Right diaphragm
- LD: Left diaphragm
- IVC: Inferior vena cava
- CPA: Costophrenic angle



Normal CXR-Lateral



Basic Patterns of Disease on CXR

- Consolidation
- Interstitial
- Nodules
- Masses
- Cysts and cavities
- Lymphadenopathies
- Plural abnormalities

Consolidation

- Occurs when the air within the lung parenchyma is replaced by another substance (fluids, blood, pus, etc.)
- Occasionally, an air bronchogram can be visible when the air within a bronchus is outlined by the consolidated surrounding lung parenchyma
- When the lung parenchyma is aerated, bronchi are not visible since they're also filled with air)

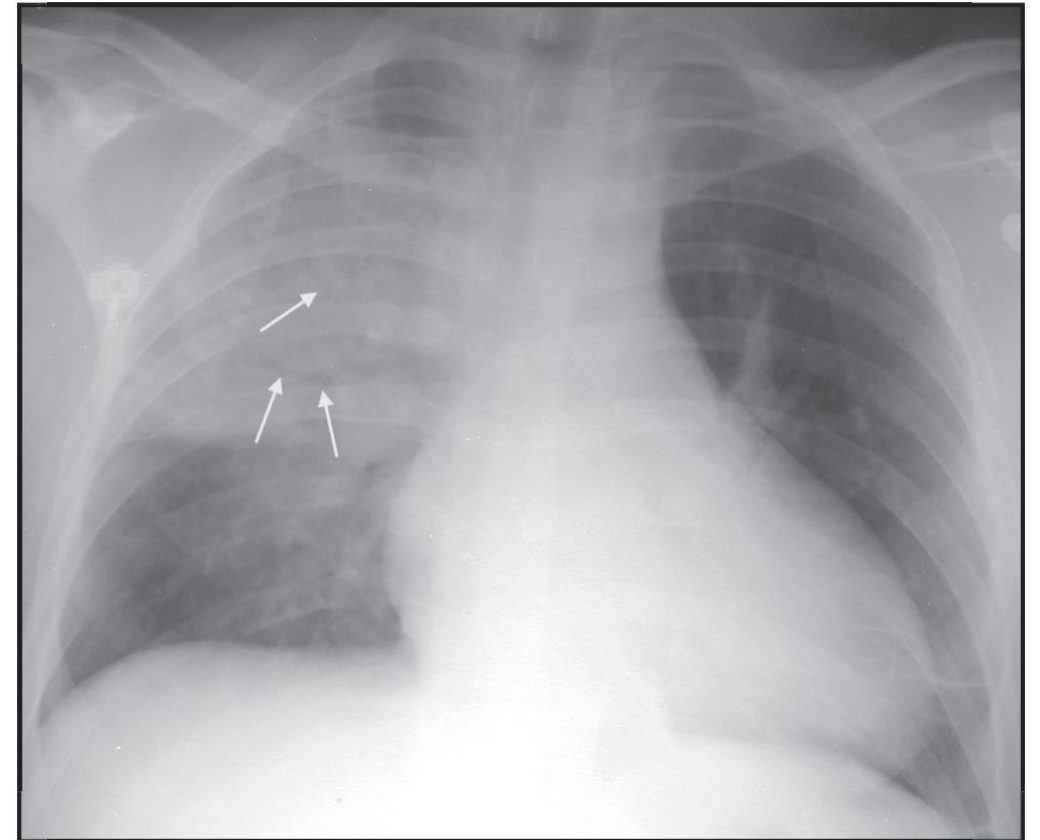


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Linear and Reticular Interstitial Markings

- These pattern suggest a process localized to the lung interstitium
- Linear opacities are typically septal lines that are perpendicular to the pleura
- Reticulations refer to the multiple lines intersecting each others at different angles resembling a net

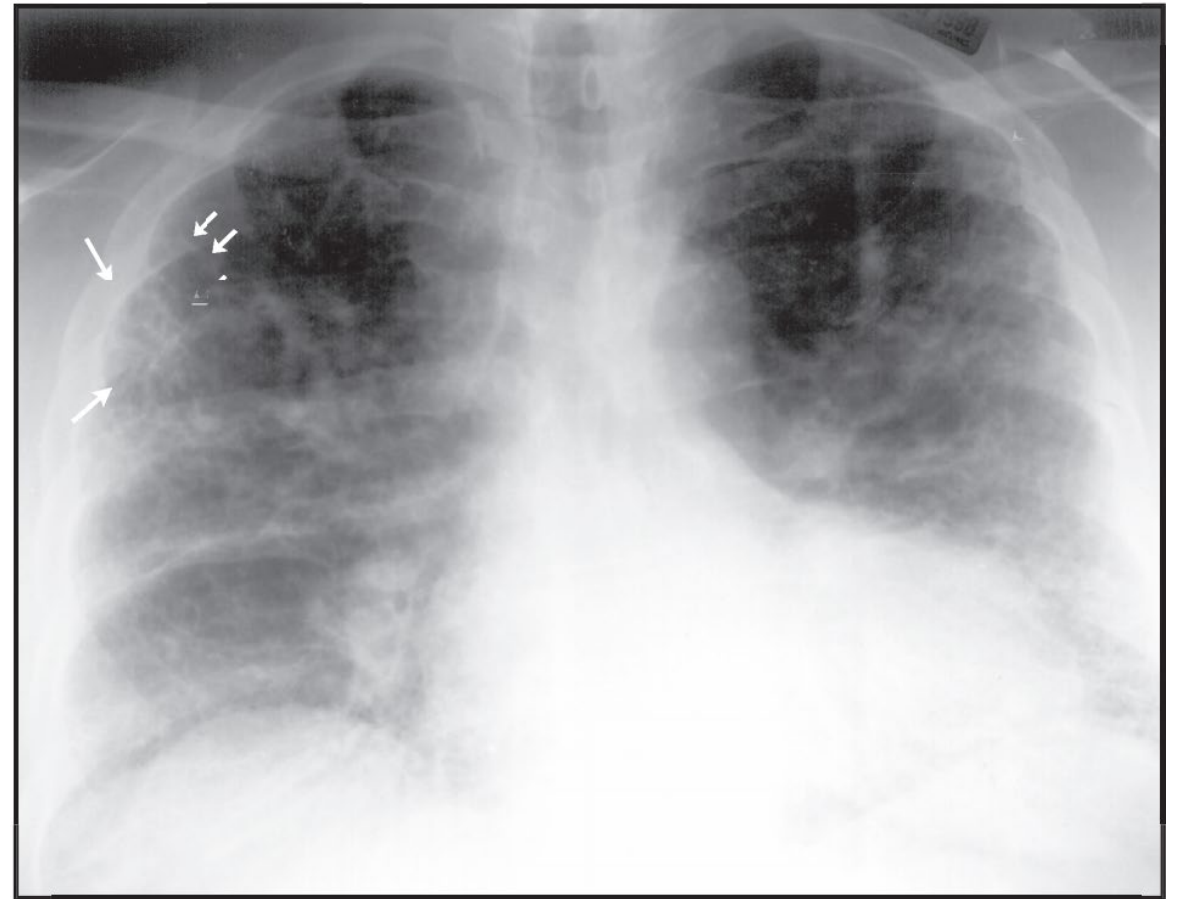


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Nodules and Masses

- Discrete areas of increased opacity
- Can involve the airway or the interstitium
- Should be characterized based on the following:
 - Size
 - Number
 - Location
 - Borders
 - Calcification
- Masses are nodules larger than 3 cm

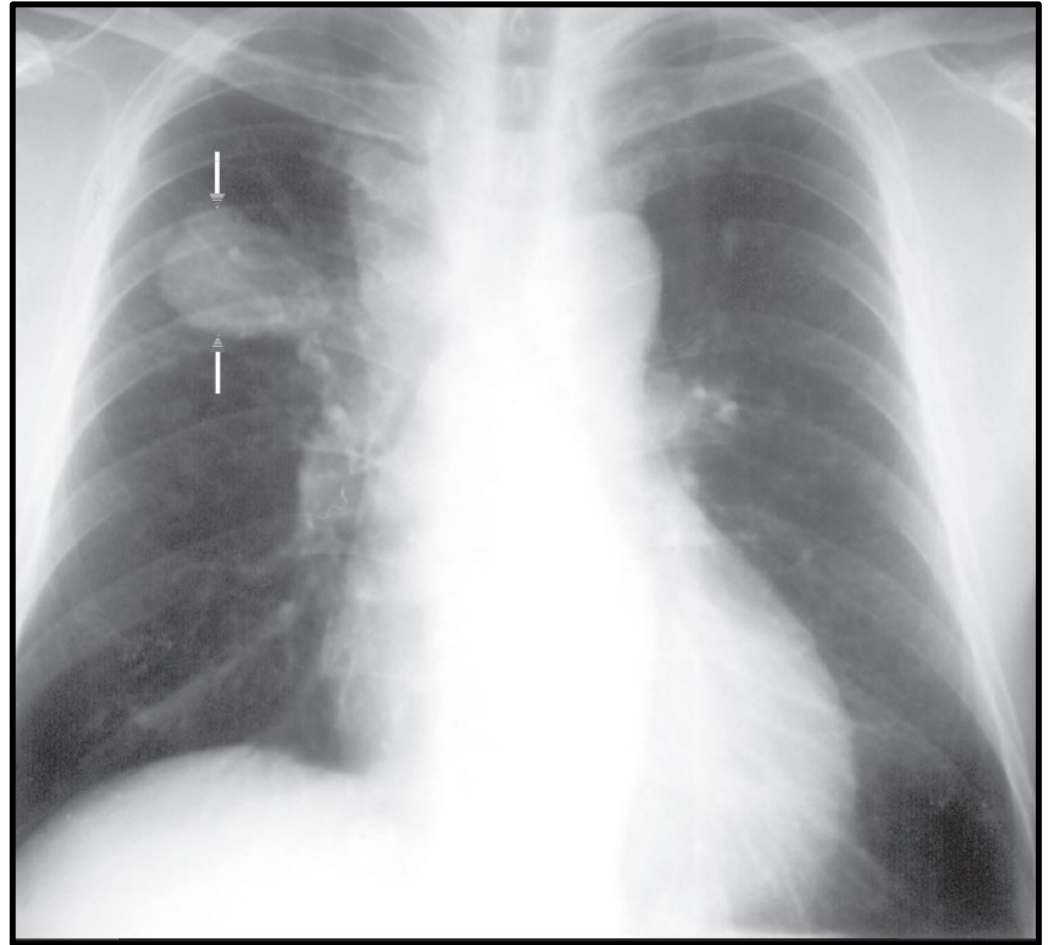


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Cysts and Cavities

- Cavities occur when pulmonary tissue undergoes necrosis due to infection, neoplasm, or infarction
- Cysts are formed by separate processes and can be seen infections, trauma, toxic ingestions among other causes
- Can also be characterized by
 - Size, number and location
 - Character of the inner lining
 - Wall thickness
 - Content of the lesion (fluid vs air filled)

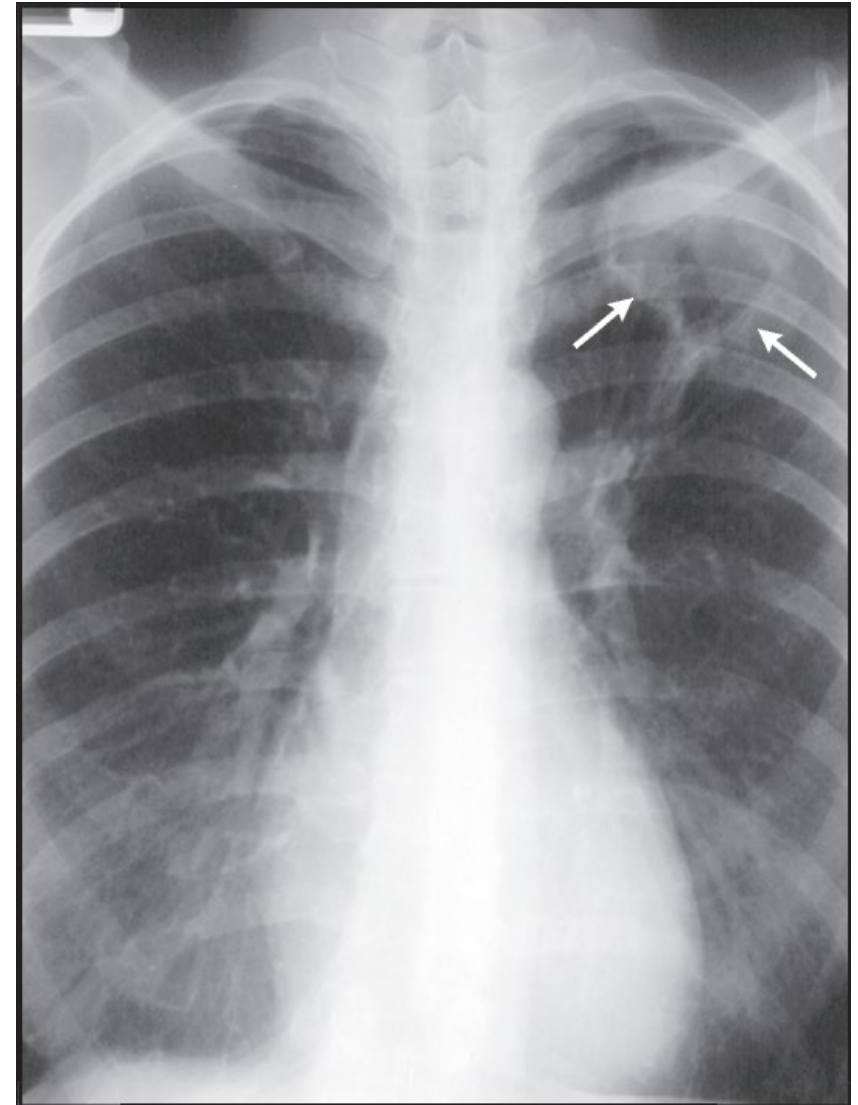


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Lymphadenopathies

- Can be noted along the cardiomedastinal contours:
 - Paratracheal
 - Subcarinal (easier to see on later CXR)
 - Aorticopulmonary
 - Hilar
 - Paraspinal

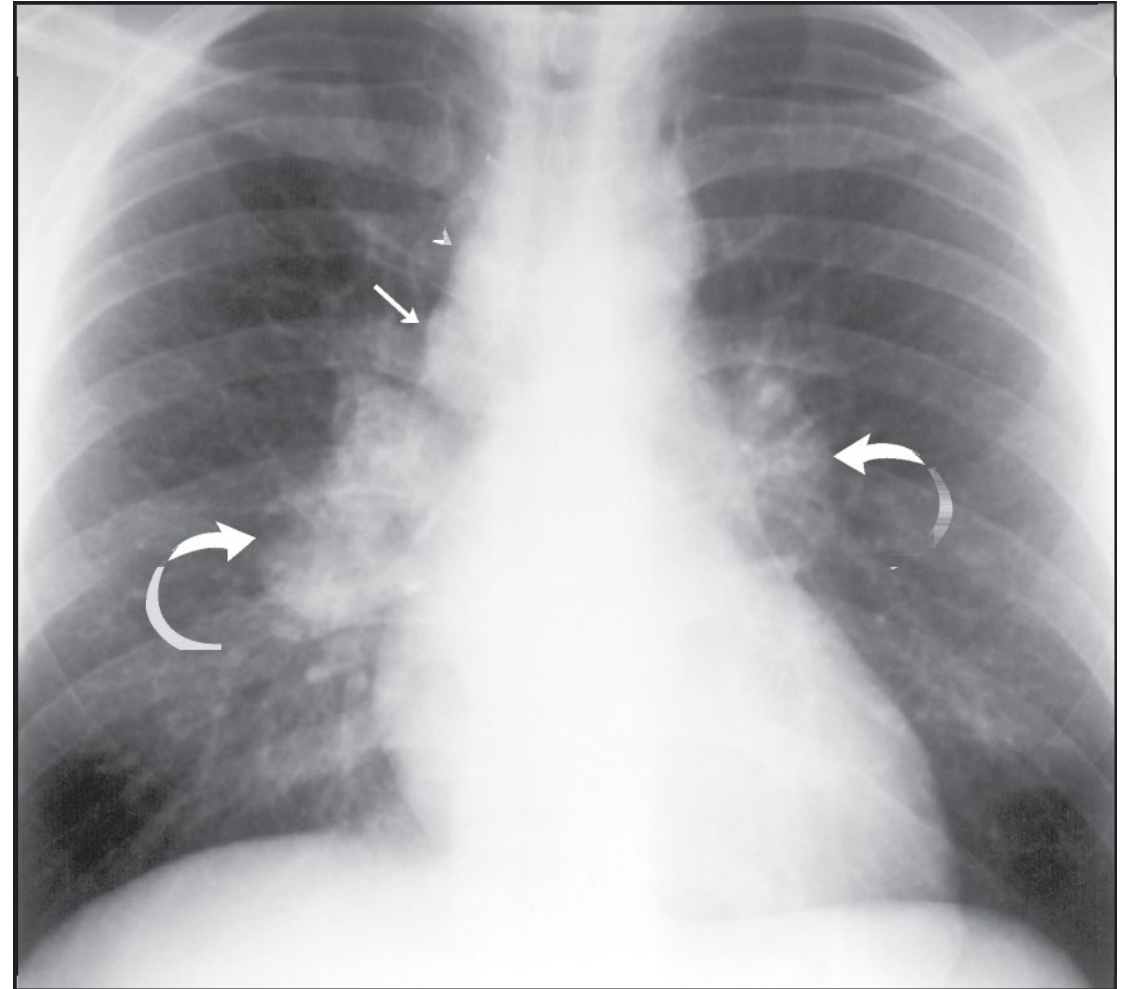


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Plural abnormalities

- Nodular thickening (may suggest malignancy)
- Calcifications (Prior empyema, hemothorax, TB, asbestos-related pleural disease)
- Effusions, simple or loculated

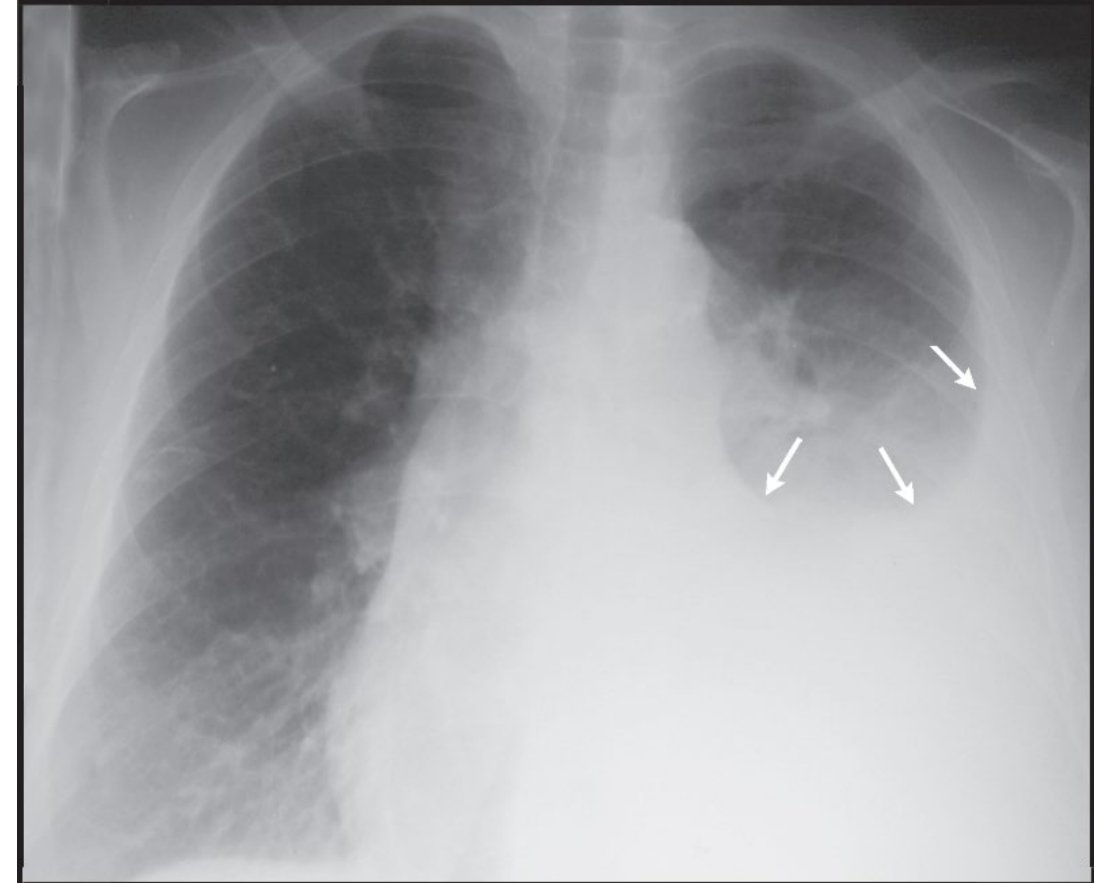
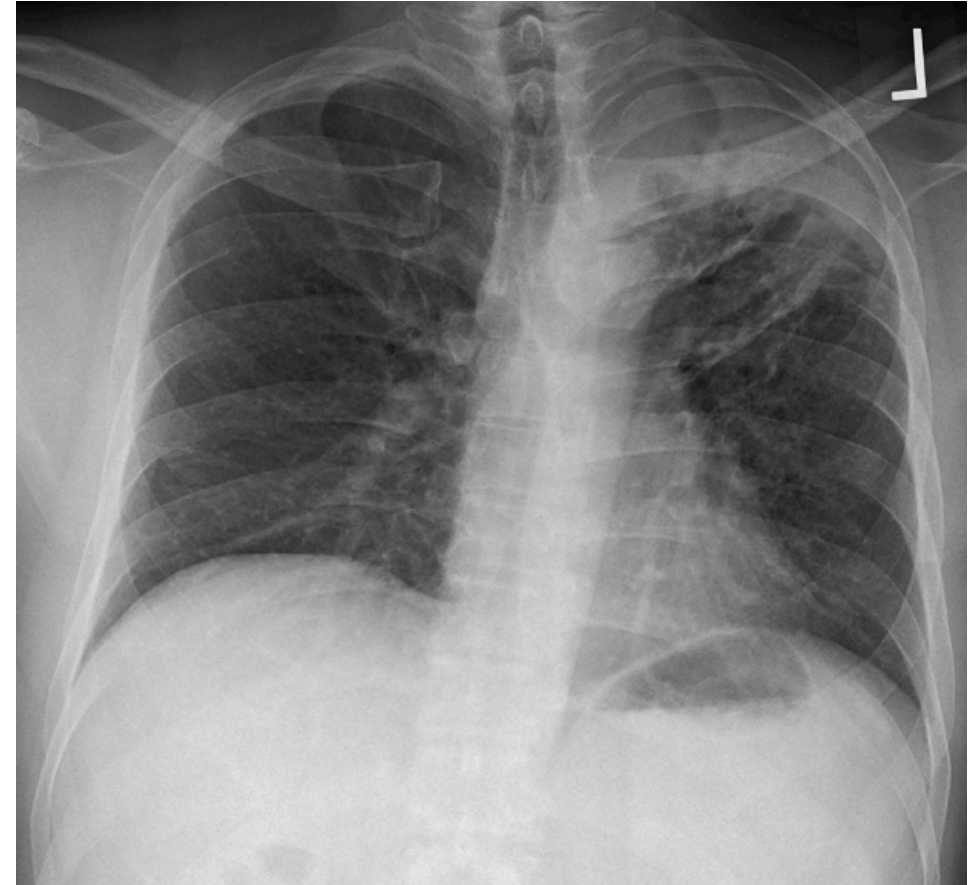


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CXR findings that are more specific to TB

- While airspace consolidation is one of the most common ways TB disease may present on CXR, it is not specific to TB
- CXR findings that are more specific to TB include:
 - Cavitations
 - Miliary pattern
 - Hilar and mediastinal lymphadenopathies, especially in children
 - Pleural effusions in high burden setting



A note on “post-primary” vs “primary TB”

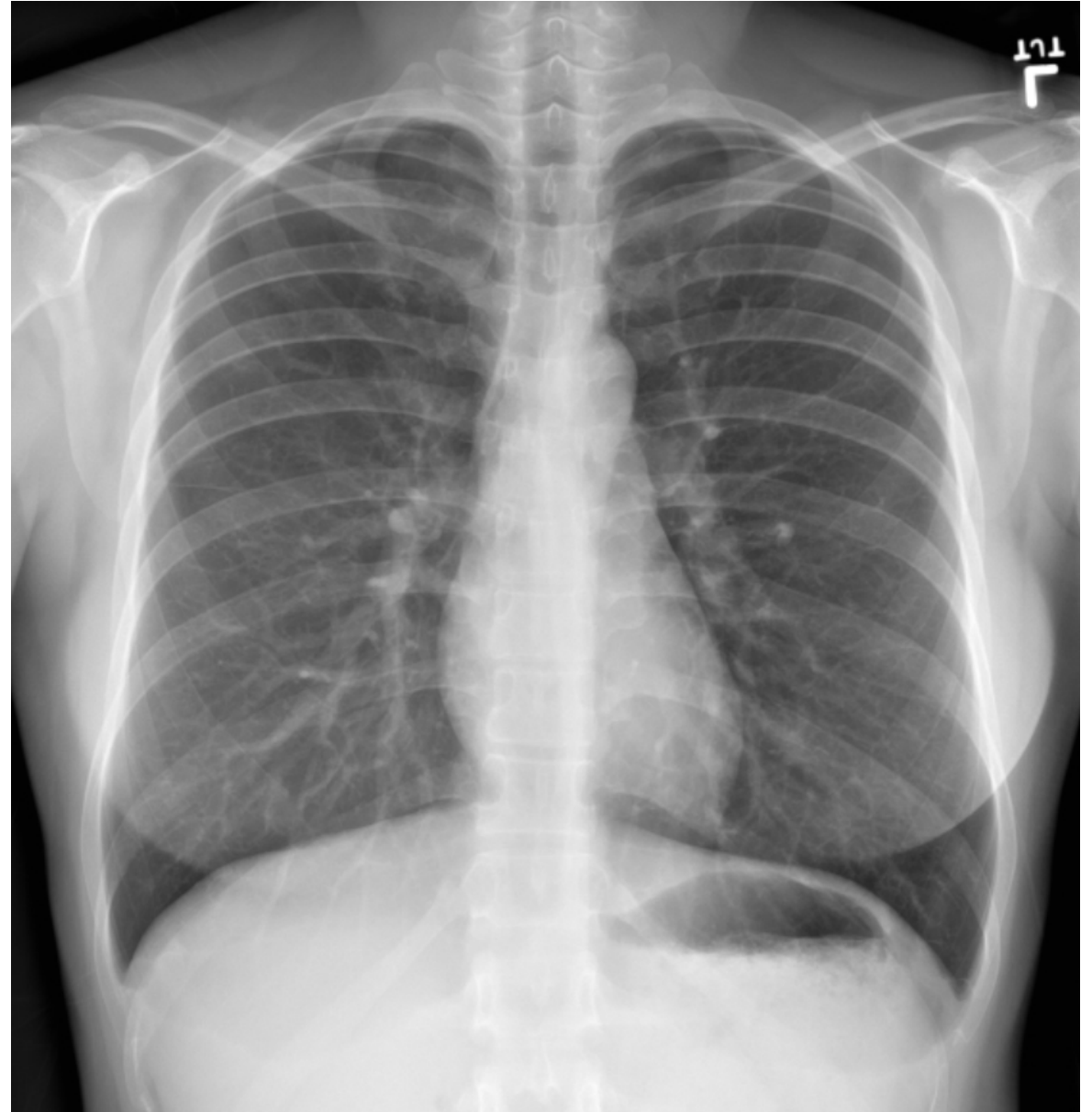
- Has no bearing on treatment or management.
- Different CXR patterns

TB Pattern	“Typical” (Post-Primary)	“Atypical” (Primary)
Infiltrate	85% upper	Upper : Lower 60 : 40 Usually upper in children
Cavitation	Common	Uncommon
Adenopathy	Uncommon	Children common Adults ~30% Unilateral > bilateral
Effusion	May be present	May be present

Image credit: Curry International Tuberculosis Center. Basic Chest Radiology for the TB clinician

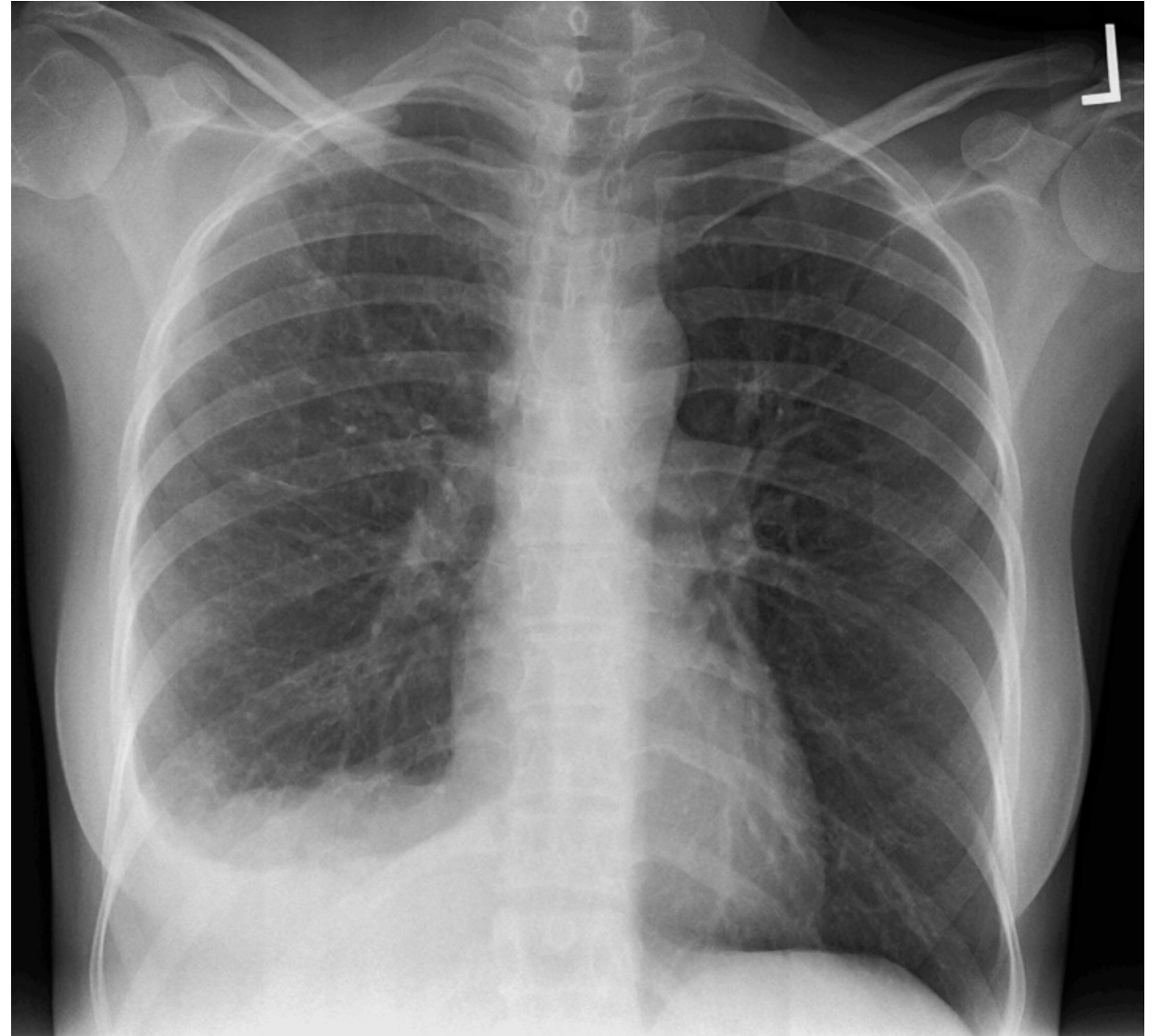
Example 1

- 29 F, Born in Myanmar
- +QFT, TB screening for immigration
- No TB symptoms
- Received 4R



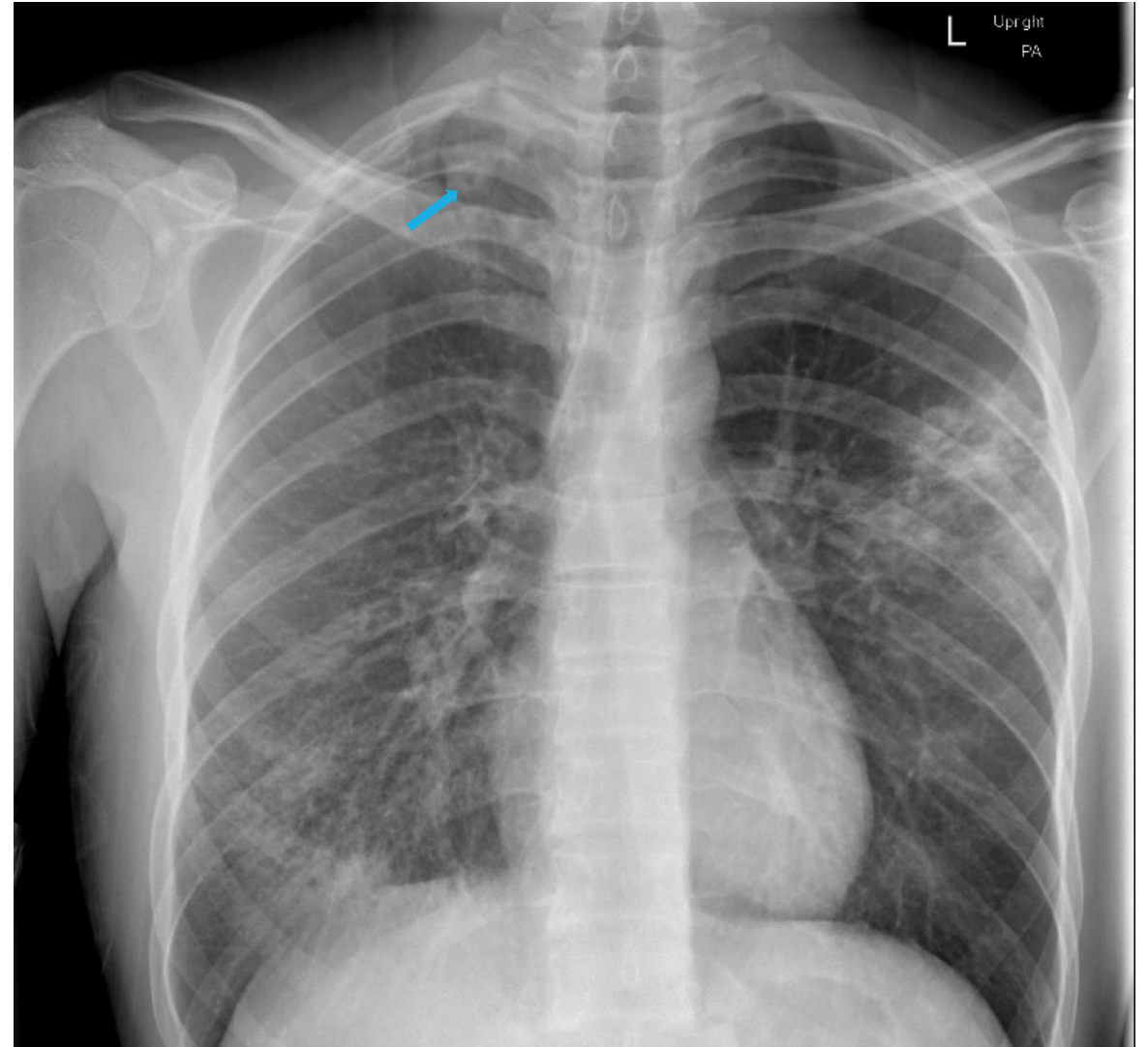
Example 2

- 36 F, Born in Ethiopia
- Hx of Crohn's on adalimumab
- 2 months of fever, chest pain & cough
- Thoracentesis lymph predominant
- Bronchoscopy: purulent fluid,
- BAL AFB cx +MTB complex.
- Resolution after 9 months of INH/RIF (did not tolerate PZA)



Example 3

- 19 M, US born, travel to Guatemala
- 2 weeks of productive cough
- Failed to improve with CAP abx
- CXR was done
- Sputum collected, GeneXpert +MTB PCR, no rpoB mutations.
- Ongoing treatment



References and Resources

- Daley CL, Gotway MB, Jasmer RM. Radiographic Manifestations of Tuberculosis: A Primer for Clinicians, Second Edition, 2020 reprint. San Francisco: Curry International Tuberculosis Center; December 2020.
- International Union Against Tuberculosis and Lung Disease. Diagnostic CXR Atlas for Tuberculosis in Children – image library. 2025. Online.
- WHO consolidated guidelines on tuberculosis: Module 3: Diagnosis – Tests for tuberculosis infection. Geneva: World Health Organization; 2022
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Acknowledgement

Many thanks to our clinic patients who have provided their de-identified CXRs for this talk

Table 2.4 Number needed to screen (NNS) for TB disease in general populations and in community-based screening

Primary screening strategy	Weighted mean NNS (range) (number of studies)	
	Low or moderate TB incidence ^a	Medium or high TB incidence ^a
Symptoms	4424 (2417–6031) n=1	1058 (31–4085) (n=22)
CXR	3016 (n=1)	475 (186–605) (n=3)
Symptoms or CXR	1567 (23–2857) (n=3)	426 (125–763) ^b (n=18)
mWRD (Xpert MTB/RIF)	–	1002 (338–1010) (n=2)

^a Low or moderate TB incidence (up to 100/100 000 population), medium or high TB incidence (> 100/100 000 population)

^b 15 studies with 18 cohorts

Table 3.1 Diagnostic accuracy of symptoms, CXR and mWRDs for screening for TB disease among HIV-negative individuals *

Screening test	Sensitivity (%)	Specificity (%)
Prolonged cough (≥ 2 weeks)	42	94
Any cough	51	88
Any TB symptom (cough, haemoptysis, fever, night sweats, weight loss)	71	64
CXR (any abnormality)	94	89
CXR (abnormality suggestive of TB)	85	96
MWRDs (adults at high risk)	69	99

* For people living with HIV, see Chapter 5. For more detail on the systematic review and data presented here, see **Web Annex B** of the guidelines)

Table 8. Should chest X-ray (any abnormality) be used to screen for TB disease in the general population?

Sensitivity	0.94 (95% CI: 0.92 to 0.96)
Specificity	0.89 (95% CI: 0.85 to 0.92)

Prevalences	0.5%	1%	2%
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Outcome	Nº of studies (Nº of patients)	Study design	Factors that may decrease certainty of evidence					Effect per 1,000 patients tested			Test accuracy CoE
			Risk of bias	Indirectness	Inconsistency	Imprecision	Publication bias	pre-test probability of 0.5%	pre-test probability of 1%	pre-test probability of 2%	
True positives (patients with active TB)	22 studies 4243 patients	cross-sectional (cohort type accuracy study)	very serious ^a	not serious	serious ^b	not serious ^c	none	5 (5 to 5)	9 (9 to 10)	19 (18 to 19)	⊕○○○ VERY LOW
False negatives (patients incorrectly classified as not having active TB)								0 (0 to 0)	1 (0 to 1)	1 (1 to 2)	
True negatives (patients without active TB)	22 studies 1012752 patients	cross-sectional (cohort type accuracy study)	not serious ^d	not serious	serious ^e	serious ^f	none	884 (848 to 912)	880 (844 to 908)	871 (835 to 899)	⊕⊕○○ LOW
False positives (patients incorrectly classified as having active TB)								111 (83 to 147)	110 (82 to 146)	109 (81 to 145)	