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Approach to Interpreting Chest X-Rays

Community CXR Indications:
- Symptomatic pts with cardiac or respiratory symptoms
- Following up known pulmonary diseases
- Evaluating malignancies (staging, determining extent of spread)

1. Decide if the CXR quality is suitable for interpretation:

ID, Date
❑ Make sure you have the right CXR.
❑ Know when the X-ray was taken, to compare sequential CXRs for the pt.

Imaging technique: AP or PA?
- Assume PA unless told otherwise.
- PA: clavicles usually more V-shaped.
- AP: clavicles usually more horizontal.
- In babies, AP view is common.
- Only assess heart size on PA view *(AP projection artificially magnifies heart)*.

Rotation/Centering
- CXR is centered when spinous processes are midway between clavicular ends.
- If not centered, normal anatomy can be misinterpreted (i.e. tracheal shifts).

Adequate inspiration? *Count Ribs!*
- Good = 8-10 posterior ribs visible above diaphragm (Remember: ribs 1+2 overlap)
- Inadequate inspiration can be misinterpreted (i.e. as interstitial lung disease)

Adequate exposure?
- Exposure adequate when intervertebral discs can be just barely seen through the cardiac shadow *(can adjust digitally)*.
- Under-exposure creates abnormal whiteness on CXR; over-exposure (x-ray darkening) may hide pathologies.

Costo-phrenic angles
- Blunted = pleural effusion >200-400mL.
- Wide = flat diaphragm; suggests air trapping due to obstructive lung diseases.

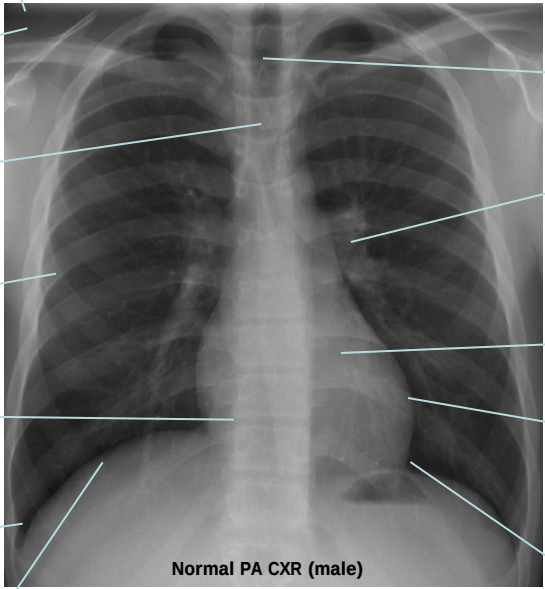
Hemi-Diaphragms (Right and Left)
- If flat: COPD, asthma exacerbation, foreign body
- **Air under R hemidiaphragm: perforated viscous**
- Blurred edge of diaphragm: lower lobe airspace disease
- Hemi-diaphragm height: normally R > L (liver underneath)
- If one side abnormally higher: volume loss (atelectasis)

2. Analyze Frontal (PA/AP) CXR:

Symmetry: are findings similar on both left and right sides?

Bones *(inspect while counting ribs)*: Inspect for **fractures, lesions (lucencies or densities in the bone)**, or rib notching (small grooves along the edges of the ribs, suggestive of aortic coarctation).

Pleura: Assess for any pleural lines (suggestive of pneumothorax), masses, thickening, or calcification.



Normal PA CXR (male)

Lung fields - Assess:
❑ Degree of whiteness
❑ Equivalency between right and left sides
❑ Opacifications/Infiltrates
❑ Presence of Kerley A/B lines
❑ Lung apices (above clavicles).
❑ Vasculature (size, position, and whether vascular markings run to the lung periphery)

If infiltrates present, note pattern:
- Lobar, cloud-like densities with air-bronchograms: alveolar/air-space disease (aka consolidation); suggests pus (i.e. pneumonia), blood, water, cells, or protein within alveoli.
- Net-like, reticular: suggests interstitial lung diseases (upper-lobe predominant: inhalational lung injuries; lower-lobe predominant: aspiration, asbestosis, sarcoidosis, etc).

Trachea:
- Find air column, check for tracheal deviation (**Tension pneumothorax** or pleural effusion).
- If a patient is intubated, the endotracheal tube tip should ideally be 4cm above the carina.

Hilum:
- Contains 1) pulmonary arteries/veins, 2) main-stem bronchi, 3) lymph nodes.
- Enlarged? (if hilum contour is straight or convex instead of concave, hilum is enlarged).
- Hilum Shifted? Asymmetrical?
- **Unilateral hilar enlargement: 95% malignant**

Heart:
- Size (normal cardiothoracic ratio <0.5 on PA film), shape, and location within mediastinum.

Cardiac Shadows (Right and Left):
- R cardiac shadow = R atrium.
- L cardiac shadow (top to bottom) = aortic arch, L pulmonary artery, L ventricle.
- Assess contour, shape, size, and location.
- White blurring of any cardiac border suggests airspace disease of upper or middle lung lobes.

Cardio-phrenic angles
- Blunted = tumor masses (**lymphoma**, other mediastinal tumors), pericardial fat, pericardial cysts, cardiophrenic space varices, diaphragmatic hernia.

Key References: Raoof S *et al.* Interpretation of plain chest roentgenogram. *Chest*. 2012 Feb; 141(2):545-58. Pineda V *et al.* Lesions of the Cardiophrenic Space: Findings at Cross-sectional Imaging. *RadioGraphics*. 2007 Jan; 27:19-32. Kivrak AS *et al.* Differential diagnosis of dumbbell lesions associated with spinal neural foraminal widening: Imaging features. *Eur J Radiol*. 2009 July; 71(1): 29-41

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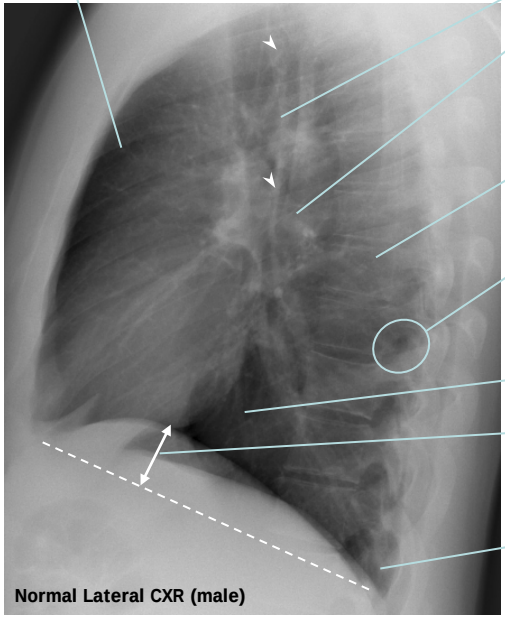
3. Analyze lateral CXR projection:

- The retro-cardiac space is blocked from view in the frontal projection. Lateral projections can visualize this hidden anatomy, and is also a better reflection of total lung volume.

Retrosternal Clear Space:
- If opacified, consider "4 Ts" *(in order of commonality in adults)*:
1) Thymoma, 2) Terrible lymphoma, 3) Teratoma, 4) Thyroid tumor



Normal Lateral CXR (male)

Mediastinum:
- Note posterior para-tracheal tissue line between the anterior trachea & the posterior esophagus (between white arrowheads): if <3mm, can rule out lymphadenopathy.

Hilum:
- Look for changes (enlargement, shifts, asymmetries) in pulmonary vessels, main-stem bronchi, and lymph nodes.
- Extra opacification around pulmonary vessels and bronchi = hilar lymphadenopathy

Spinal column:
- Assess vertebral bodies for densities and abnormal shapes or compressions.
- Assess intervertebral disc spaces: if not well-defined, may indicate discitis.
- Assess neural foramina (holes between vertebral processes). If enlarged: likely tumor or cyst. If narrowed: likely bony enlargement impinging on spinal nerves.

Clear space posterior to heart:
- If opacified: consolidation, atelectasis, enlarged vessels, masses, or hiatus hernias.

Diaphragm:
- Flat if height above anterior-posterior costophrenic angle "line" is <2.7cm
- Flat diaphragm = lung hyperinflation due to airway obstruction (asthma, COPD).

Costo-phrenic angles
- Small pleural effusions best picked up with lateral projection (most commonly due to congestive heart failure).

4. Important notes to keep in mind:

- **Findings that require immediate attention**:
  - Tracheal Shift: may indicate a **tension pneumothorax** on the side opposite to the tracheal shift. If suspected on Hx/exam, don't do CXR; immediately decompress.
  - Free air under R hemi-diaphragm: **bowel perforation,** urgent surgery consult needed. (Note that air under L hemi-diaphragm is usually the gastric bubble)
  - Massive cavitations & infiltrates, especially in upper lobes, in the context of cough & fever: suspect **active tuberculosis,** isolate patient and work up to establish diagnosis.
  - Complete white-out of lung fields: **severe pulmonary edema,** stabilize and transport for definitive ER/ICU care.

- **Most common CXR false-negatives (real findings that were not detected):**
  - Airspace disease (i.e. consolidation)
  - Apical and retro-cardiac densities
  - Solitary pulmonary nodules
  - Mediastinal widening
  - Cardiomegaly, changes in heart contour

- **Ask for previous CXRs** to track CXR changes, especially to monitor solitary pulmonary nodules for any changes.

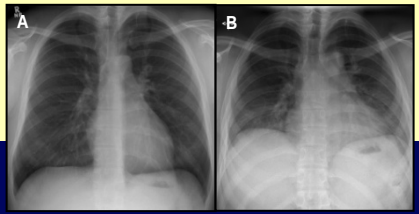
- Lower lung lobes can normally appear to be opacified by both breast and fatty tissue.

Other CXR types/views:

- **An AP frontal CXR** is done for pts who can't stand (i.e. ICU pts, babies), and when a portable CXR is needed. Note that the AP view 1) magnifies the heart and 2) may shrink apparent lung volume.

- **Expiratory View** is done to accentuate:
  - Air trapping: localize area of obstruction
  - Pneumothorax
  - *Do not confuse expiratory views for pulmonary vasculature congestion, restrictive lung disease, or pneumonia.*

Film A (Right): Normal PA CXR
Film B (Far Right): same patient, expiratory CXR



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Key References (continued from previous card): Petinaux B *et al.* Accuracy of radiographic readings in the emergency department. *Am J Emerg Med.* 2011 Jan; 29(1):18-25. Gatt ME *et al.* Chest radiographs in the emergency department: is the radiologist really necessary? *Postgrad Med J.* 2003 Apr; 79(930):214-7. Klein EJ *et al.* Discordant radiograph interpretation between emergency physicians and radiologists in a pediatric emergency department. *Pediatr Emerg Care.* 1999 Aug; 15(4):245-8. Kuritzky L *et al.* Interpretation of chest roentgenograms by primary care physicians. *South Med J.* 1987 Nov; 80(11):1347-51.