BASICS OF RADIOLOGY INTERPRETATION

X-RAY AND CT MODALITIES

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LEARNING OBJECTIVES

- Understand X-ray & CT physics
- Apply systematic interpretation frameworks to CXR and abdominal xray.
- Dig in to interpreting CXR and abdominal xrays with some abnormal findings
- Understand basics of CT viewing and interpretation.
- Practice viewing CT emergent findings.

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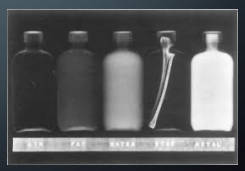
RADIOGRAPHIC DENSITIES

- Air, Fat, Soft Tissue, Bone, Metal
- Understand grayscale hierarchy



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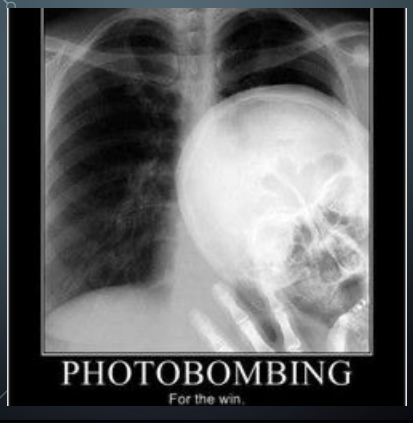
CXR



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NORMAL PA CHEST X-RAY

- Assess symmetry
- Cardiac size <50% thoracic width
- Clear costophrenic angles

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CXR SYMMETRY "RIPE"

- **Rotation**: The clavicles should appear symmetrical and be seen as equal length. The distance between the thoracic spinal process and clavicular heads should be equal (Figure-1). If there is a rotation, mediastinum may look abnormal.
- **Inspiration**: On good inspiration, the diaphragm should be seen at the level of the 8th – 10th posterior rib or 5th – 6th anterior rib.
- **Position**: PA, AP, or lateral view? The standard chest X-Rays consists of a PA and lateral chest X-Ray.
- **Exposure / Penetration**: Ideally, you should be able to see the heart, the blood vessels, and the intervertebral spaces. Exposure should be adequate if you are able to see approximately T4 vertebra and spinal process.

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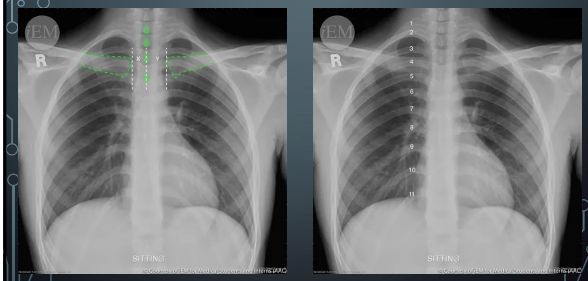
RIPE CONT.



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SYSTEMATIC CHEST X-RAY INTERPRETATION (ABCDEF)

- Assess film quality: projection (PA/AP), rotation, inspiration, penetration
- A – Airways (trachea position, deviation, carina)
- B – Bones (ribs, clavicles, vertebrae for fracture or lesion)
- C – Cardiac silhouette (cardiothoracic ratio <50% on PA view)
- D – Diaphragm (costophrenic angles, free air, asymmetry)
- E – Extra-thoracic tissues (soft tissue, subcutaneous air)
- F – Lung Fields & fissures (opacities, pneumothorax, nodules)

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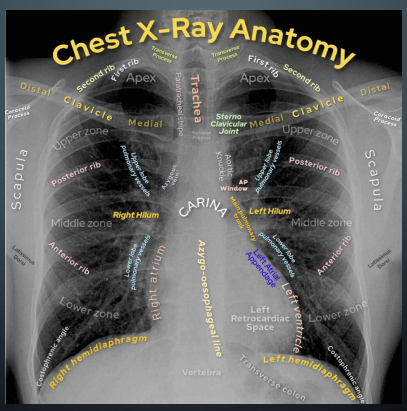

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FOUR-PATTERN APPROACH TO LUNG DISEASE ON CHEST X-RAY

- Most lung pathology presents as areas of increased density (opacities)
- 1. Consolidation – alveolar filling process
- 2. Interstitial pattern – reticular or nodular changes
- 3. Nodules/Masses – focal space-occupying lesions
- 4. Atelectasis – volume loss or lung collapse

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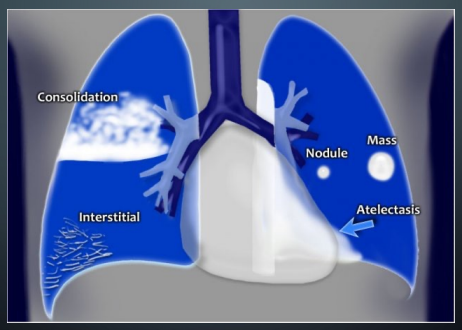

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RECOGNIZING CONSOLIDATION ON CXR

- Alveoli filled with fluid, pus, blood, or inflammatory cells
- Homogeneous increased opacity
- Air bronchograms may be visible
- Common causes: pneumonia, pulmonary edema, hemorrhage

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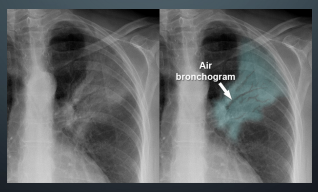
PNEUMONIA

- Lobar consolidation
- Air bronchograms



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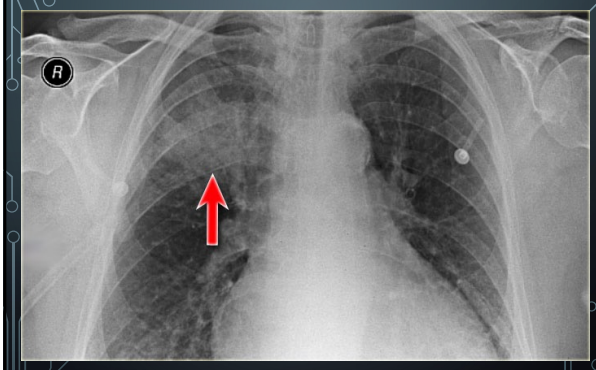
LOBAR PNEUMONIA



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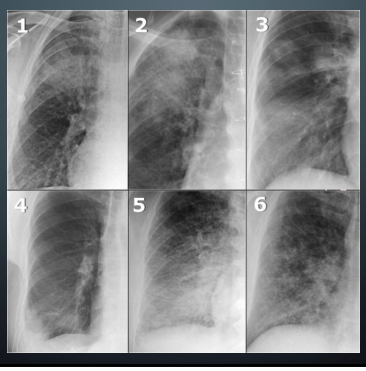
LOBAR PNEUMONIA



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INTERSTITIAL LUNG PATTERNS

- Reticular (linear) opacities
- Nodular or reticulonodular appearance
- Often seen in edema, fibrosis, chronic inflammatory disease

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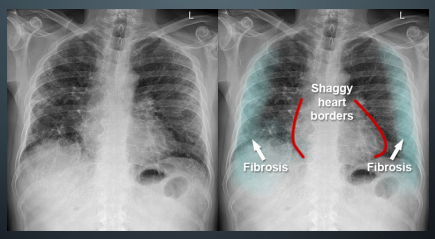
INTERSTITIAL LUNG PATTERS



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PULMONARY NODULES AND MASSES

- Rounded focal opacities
- Solitary or multiple lesions
- Evaluate size, margins, and clinical risk factors
- CT often required for further assessment

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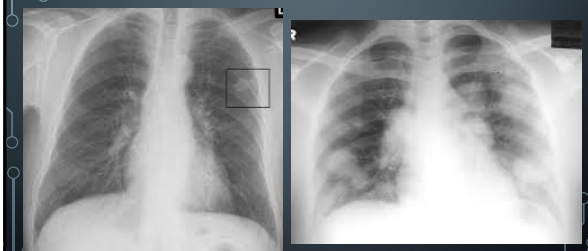
NODULES AND MASSES



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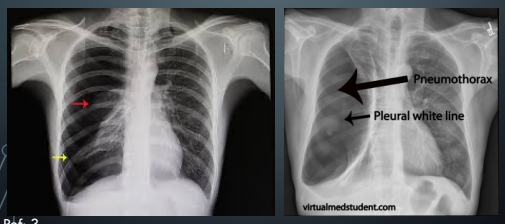
PNEUMOTHORAX

- Pleural line
- Absent peripheral lung markings



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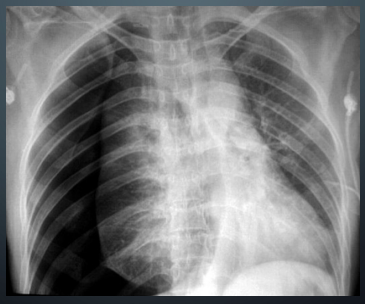
PNEUMOTHORAX CONT.



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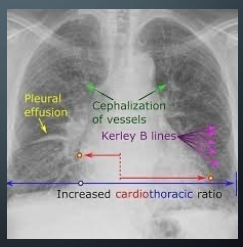
PULMONARY EDEMA

- Bat-wing opacities
- Kerley B lines



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PULMONARY EDEMA

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LETS PRACTICE CXR

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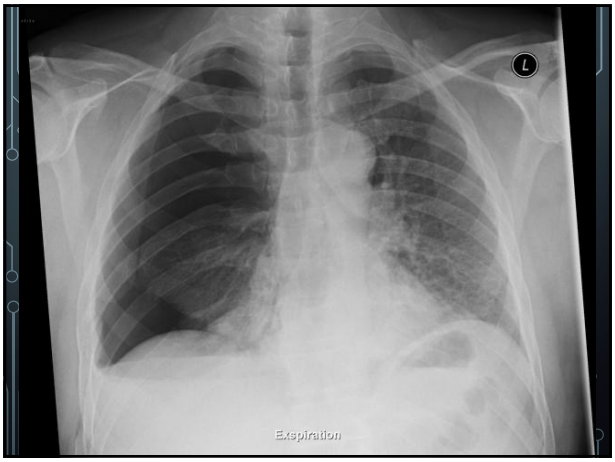

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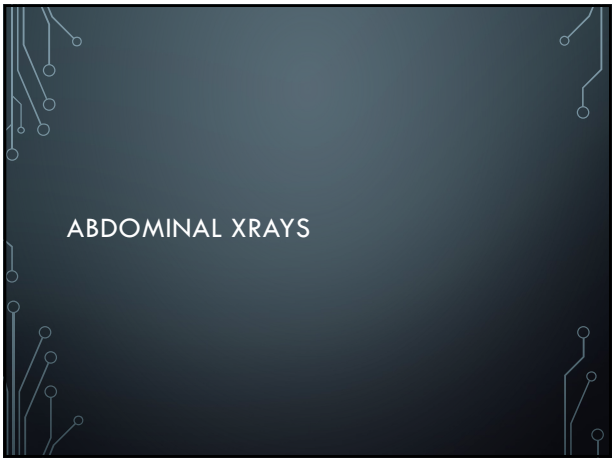

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ABDOMINAL XRAY

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NORMAL BOWEL GAS PATTERN

- Small bowel diameter <3 cm
- Colon diameter <6 cm (cecum <9 cm)
- Valvulae conniventes (small bowel)
- Haustra (colon)

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SMALL BOWEL OBSTRUCTION (SBO)

- Dilated loops >3 cm
- Multiple air-fluid levels
- Step-ladder pattern
- Minimal distal colonic gas

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LARGE BOWEL OBSTRUCTION (LBO)

- Colon dilation >6 cm
- Cecum >9 cm suggests perforation risk
- May visualize transition point

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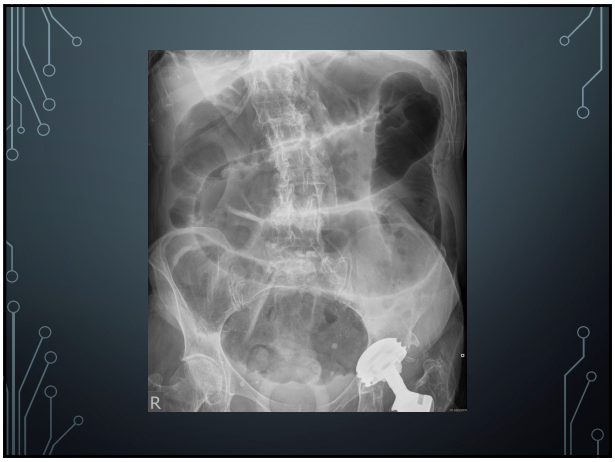

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SBO VS LBO WHAT IS THE DIFFERENCE

Feature	Small Bowel Obstruction (SBO)	Large Bowel Obstruction (LBO)
Location of dilated loops	Centrally located	Peripherally located (frames abdomen)
Diameter of bowel	>3 cm (small bowel dilation)	>6 cm colon, cecum may be >9 cm
Valvulae conniventes / Haustra	**Valvulae conniventes visible** (thin folds crossing entire width → "stacked/coin" or "keyboard" appearance)	**Haustra visible** (do NOT cross entire lumen; spaced apart)
Number of loops	Multiple dilated loops	Fewer, larger loops
Air-fluid levels (upright film)	Numerous, at different heights ("step-ladder" pattern)	Fewer, often longer air-fluid levels
Gas in colon/rectum	Usually absent or minimal	May still be present early; absent if complete obstruction
String of pearls sign	Can be seen (small bubbles trapped between folds)	Not seen
Distribution of gas	Little/no gas in colon	Colon markedly distended; small bowel may be normal unless late
Closed loop / complications	Can show "C-shaped" loops, radial distribution	May show massively dilated colon (risk of perforation, especially cecum)

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ILEUS

- Diffuse dilation of small and large bowel
- Gas throughout colon and rectum
- No clear transition point

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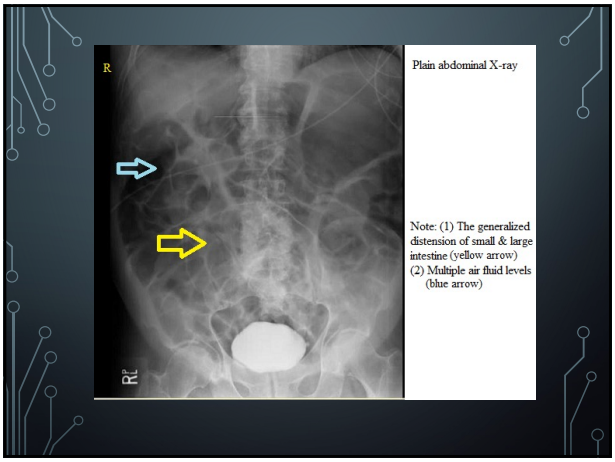

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FREE INTRAPERITONEAL AIR

- Subdiaphragmatic free air on upright film
- Rigler sign (double wall sign)
- Requires urgent surgical evaluation

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ABDOMINAL CALCIFICATIONS

- Renal calculi
- Gallstones (if radiopaque)
- Vascular calcifications
- Appendicolith

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LIMITATIONS OF ABDOMINAL X-RAY

- Low sensitivity for many intra-abdominal conditions
- Limited soft tissue contrast
- CT preferred for detailed evaluation

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LETS PRACTICE ABDOMINAL XRAY

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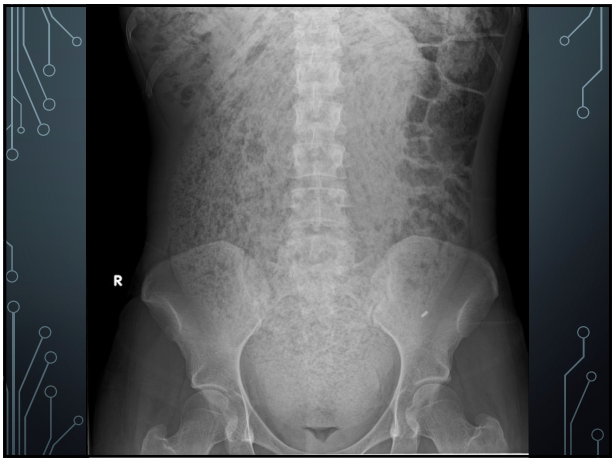

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CT SCAN

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CT SCAN BASICS

- Cross-sectional imaging using rotating X-ray beams
- Produces axial, coronal, and sagittal reconstructions
- Superior soft tissue contrast compared to plain radiography
- Picture that you are standing at the foot of the bed, looking up at a supine laying patient.
- In a trauma situation, always order contrasted CT scans.

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CT PHYSICS OVERVIEW

- X-ray attenuation measured in Hounsfield Units (HU)
- Water = 0 HU
- Air = -1000 HU
- Bone ≈ +1000 HU
- Acute blood ≈ 60–80 HU

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HOUNSFIELD UNITS (CLINICAL RELEVANCE)

- Fat ≈ -100 HU
- Soft tissue ≈ 30–60 HU
- Acute hemorrhage appears hyperdense
- Chronic blood becomes isodense/hypodense over time

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CONTRAST VS NON-CONTRAST CT

- Non-contrast: Hemorrhage (brain), renal stones, baseline studies
- IV contrast: Vascular structures, tumors, inflammation, trauma (for acute bleeding in chest or abdomen)
- Oral contrast: GI tract evaluation (select cases)

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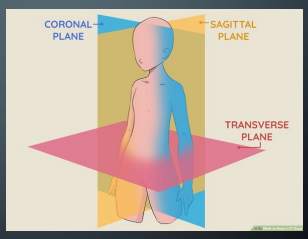
CT WINDOWING/CUTS

- Lung window
- Brain window
- Bone window



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CT HEAD – WHAT AM I LOOKING FOR

- Blood (hyperdense)
- Brain parenchyma symmetry
- CSF spaces & ventricles
- Bone windows for fractures

https://radiopaedia.org/cases/normal-ct-head-2?lang=us

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INTRACRANIAL HEMORRHAGE

- Hyperdense (bright) on non-contrast CT
- Epidural – lens-shaped
- Subdural – crescent-shaped
- Intraparenchymal – focal hyperdensity
- https://radiopaedia.org/cases/subdural-haematoma-13?lang=us
- https://radiopaedia.org/cases/epidural-haematoma-16?lang=us

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ISCHEMIC STROKE

- Often times CT is combined with CTA of head and neck in stroke protocol patients.
  - Why do we do that?
- Loss of gray-white differentiation
- Ischemic strokes do not show up on CT for 12-18 hours.
  - Why do we order that then?
- https://radiopaedia.org/cases/posterior-cerebral-artery-territory-infarct-2?lang=us

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CT CHEST

- Assess lung windows for parenchymal disease
- Evaluate mediastinum in soft tissue window
- Check pleural spaces for effusion or pneumothorax
- Identify pulmonary embolism on contrast studies

- https://radiopaedia.org/cases/normal-chest-ct-1?lang=us
- https://radiopaedia.org/cases/44208/studies/47806?lang=us

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CT ABDOMEN

- Evaluate solid organs (liver, spleen, pancreas, kidneys)
- Assess bowel wall thickness
- Look for free fluid or free air
- Identify inflammatory fat stranding

- https://radiopaedia.org/cases/normal-appendix-2?lang=us

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SOLID ORGAN INJURY

- Liver/spleen lacerations
- Active extravasation

- https://radiopaedia.org/cases/liver-laceration-aast-grade-iv-8?lang=us
- https://radiopaedia.org/cases/splenic-injury-grade-iii-with-active-bleeding-1?lang=us

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SUMMARY

- If you are ordering a xray or CT scan, you should be looking at it.
- Radiologist are human, just like us, and they can make mistakes to. Often times you have more reference about the patient's complaint, and are able to zone in on the area of question.
- If the read does not make sense, call and ask the radiologist questions.
- Looking at imaging takes practice, so give yourself grace if it is not easy for you right off the bat.

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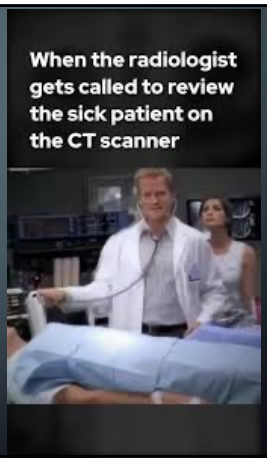
QUESTIONS???



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