

# Interpretation of Chest Radiographs

## Objectives (Regarding the Blueprint):

1. To be able to differentiate between different views.
2. To recognize what is normal and abnormal.
3. Adapt a systematic approach to a chest x-ray interpretation.
4. To be able to recognize common and important diseases based on chest x-rays.

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## Editing File

### Color Index

- Slides / Reference Book
- Doctor notes
- OnlineMeded / Amboss
- Important
- Extra

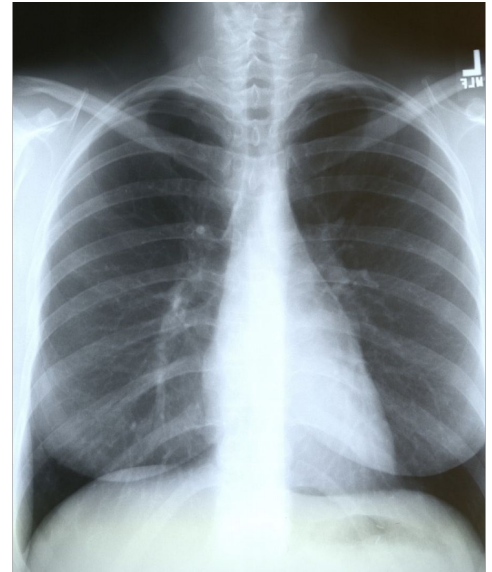
# To be able to differentiate between different views.

## Chest X-ray

Is the most commonly performed diagnostic **x-ray** examination.

### Images

- heart, lungs, airways, blood vessels and the bones of the spine and **chest**.
- Easily and readily available
- It's non-invasive
- Cheap



Normal chest X-ray

## The 12-step program<sup>1</sup>

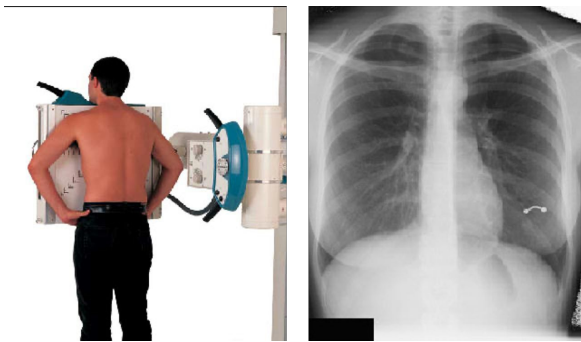
- 1- Name
  - 2- Date
  - 3- Old films
  - 4- What type of **view(s)**
  - 5- Penetration
  - 6- Inspiration
  - 7- Rotation
  - 8- Angulation
  - 9- Soft tissues / bony structures
  - 10- Mediastinum
  - 11- Diaphragms
  - 12- Lung Fields
- pre-read
- Quality control
- Findings

<sup>1</sup>- There are many different systems to read the CXR and this one of the most commonly used

# To be able to differentiate between different views.

## Pre-reading

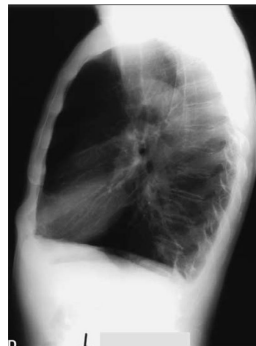
1. Check the name
2. Check the date<sup>1</sup>
3. Obtain old films if available<sup>2</sup>
4. Which **view(s)** do you have?
  - PA / AP, lateral, decubitus, AP lordotic
  - Techniques - Projection



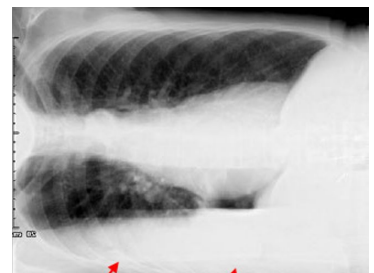
P-A (relation of x-ray beam to patient)<sup>3</sup>



Lateral<sup>5</sup>



Lateral Decubitus<sup>4</sup>



1- make sure that this is a new x-ray especially if the patient presented acutely.

2- to compare

3- Radiation comes from behind the patient and the x-ray film is anterior to the patient.

4-Lateral Decubitus the patient will be laying on the side, and we can use it when we are looking for fluids in the chest and whether it is free fluids or not.(not used anymore)

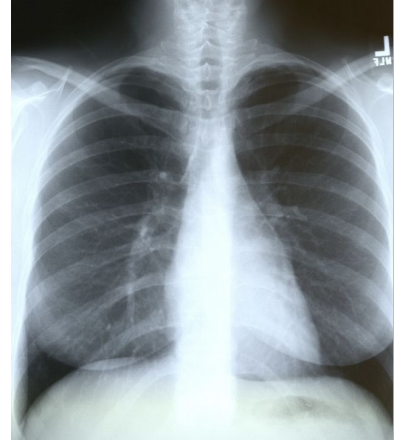
5- the x-ray machine will be on the patient's side. If you didn't ask the radiology technician to make right lateral imaging, they will automatically do a left lateral.

# To be able to differentiate between different views.

## Quality control

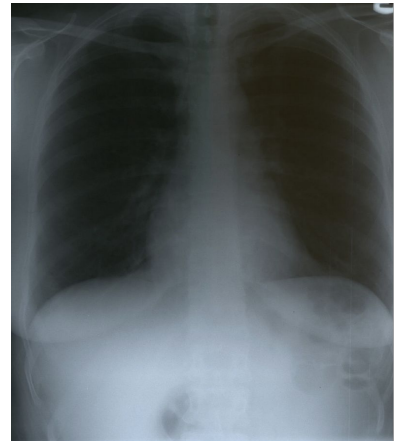
### 5. penetration<sup>1</sup>:

- Should see ribs through the heart
- Barely see the spine through the heart
- Should see pulmonary vessels nearly to the edges of the lungs



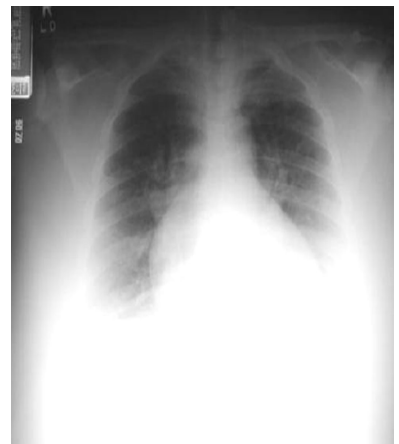
### Over-penetrated film

- Lung fields darker than normal—may obscure subtle pathologies
- See spine well beyond the diaphragms
- Inadequate lung detail



### Under-penetrated film

- Hemidiaphragms are obscured
- Pulmonary markings more prominent than they actually are



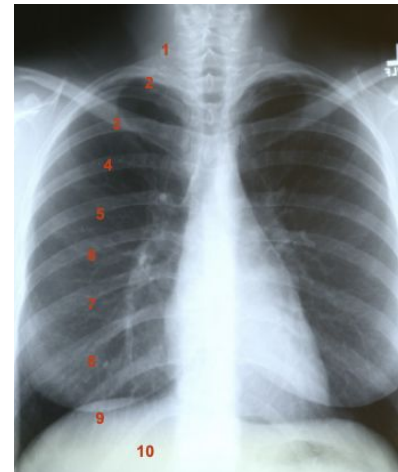
1- For an adequate penetration you need to see these three

# To be able to differentiate between different views.

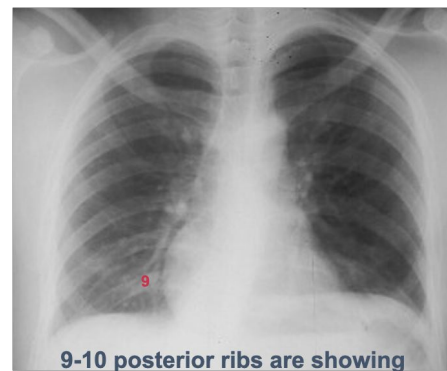
## Quality control

### 6. Inspiration:

- Should be able to count 9-10 posterior ribs<sup>1</sup>
- Heart shadow should not be hidden by the diaphragm



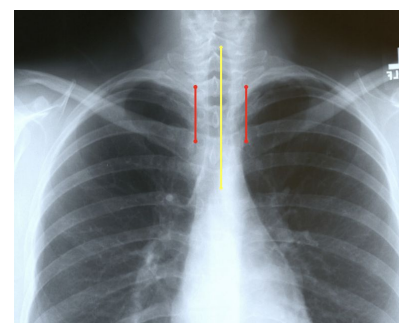
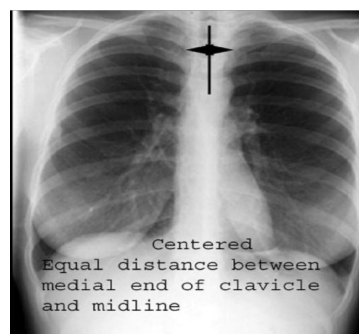
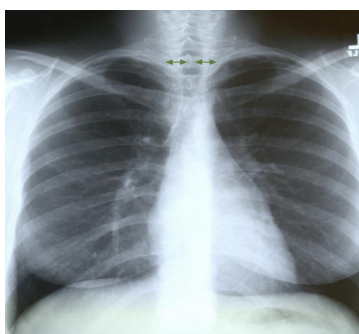
Poor inspiration can crowd lung markings producing pseudo-airspace disease



With better inspiration, the "disease process" at the lung bases has cleared

### 7. Rotation:<sup>2</sup>

- Medial ends of bilateral clavicles are equidistant from the midline or vertebral bodies



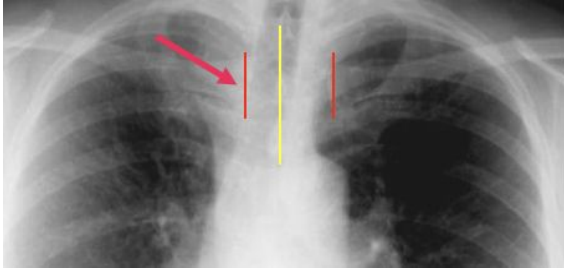
1- anterior = 7

2-The patient should be central, and the spinous processes of the vertebrae are centered.

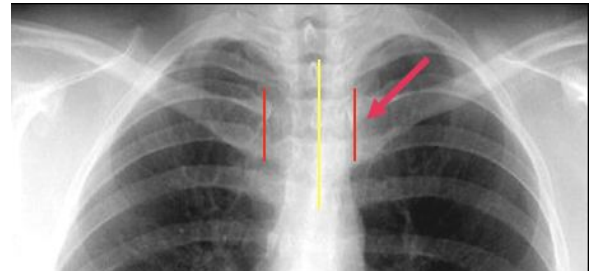
# To be able to differentiate between different views.

## Quality control

### 7. Rotation:



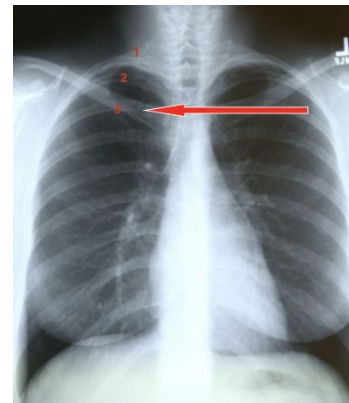
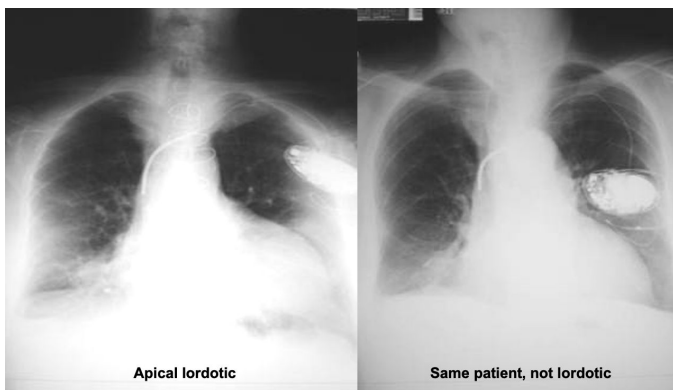
If spinous process appears closer to the right clavicle (red arrow), the patient is rotated toward their own **left side**



If spinous process appears closer to the left clavicle (red arrow), the patient is rotated toward their own **right side**

### 8. Angulation<sup>1</sup>:

- Clavicle should lay over 3<sup>rd</sup> rib
- Pitfall Due to Angulation:



A film which is apical lordotic (beam is angled up toward head) will have an unusually shaped heart and the usually sharp border of the left hemidiaphragm will be absent

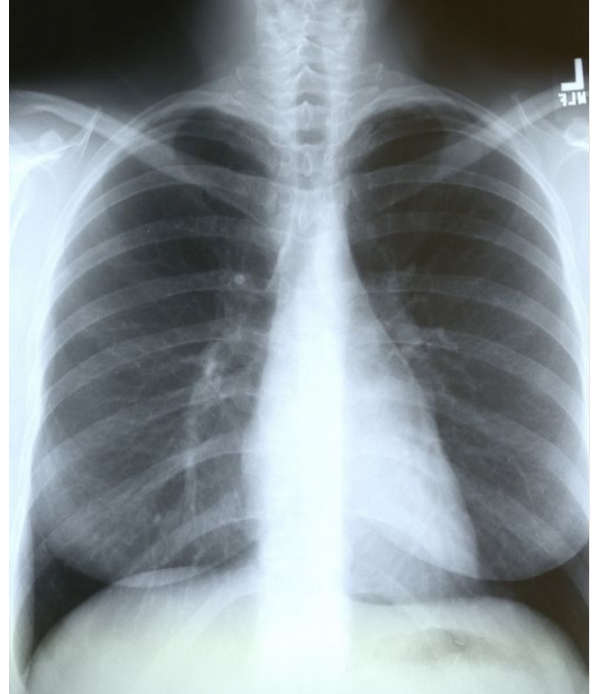
1- the rays meet the chest at an angle other than 90 , we do angulated films when we want to see the apex of the lung

# To be able to differentiate between different views.

## Findings

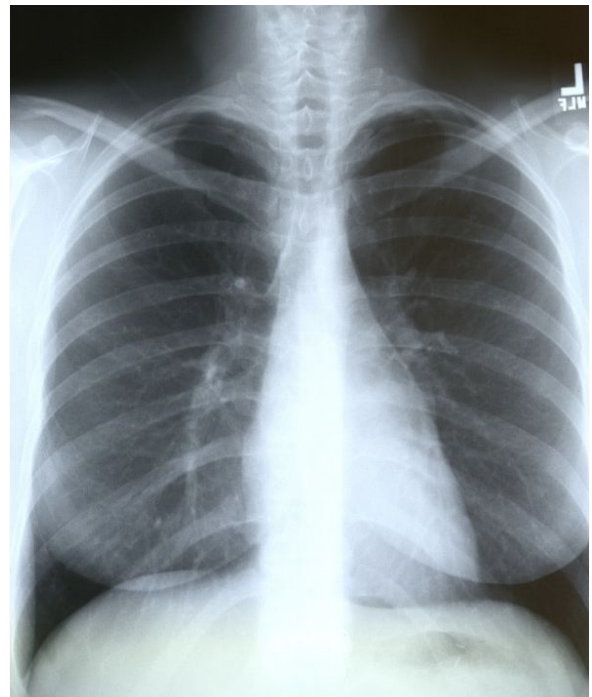
### 9. Soft tissue and bony structures :

- Check for
  - Symmetry<sup>1</sup>
  - Deformities
  - Fractures
  - Masses
  - Calcifications
  - Lytic lesions



### 10. Mediastinum :

- Check for
  - Cardiomegaly
  - Mediastinal and Hilar contours for increase densities or deformities<sup>2</sup>



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1-compare two sides

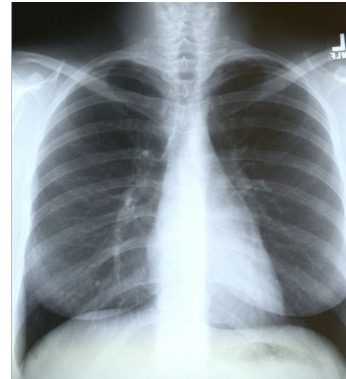
2- left hilum is higher than the right hilum

# To be able to differentiate between different views.

## Findings

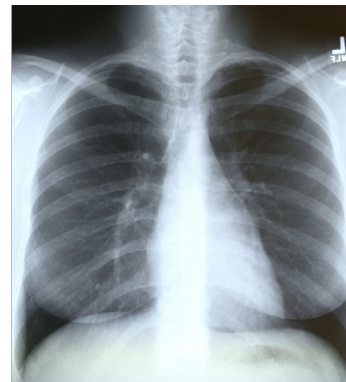
### 11. Diaphragm :

- Check sharpness of borders<sup>1</sup>
- Right is normally higher than left
- Check for free air, gastric bubble<sup>2</sup>, pleural effusions

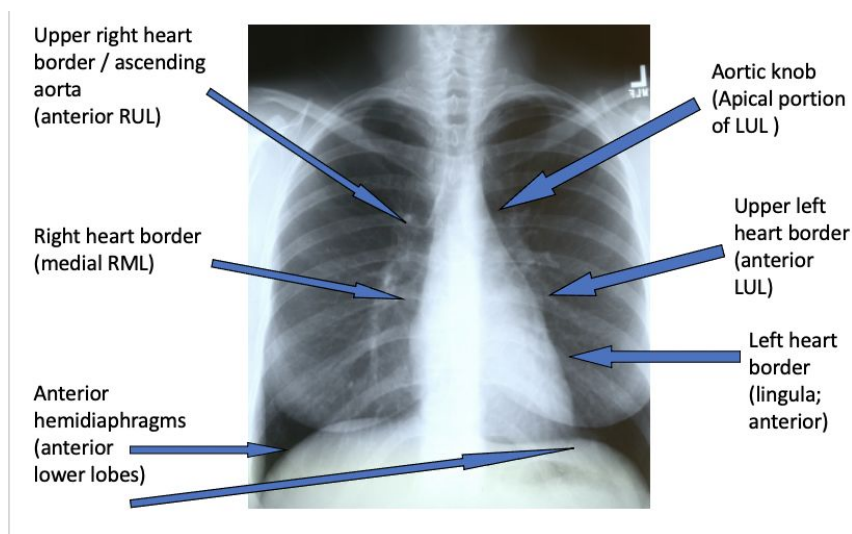


### 12. The lung fields :

- To help you determine abnormalities and their location...
- Use silhouettes of other thoracic structures
- Use fissures:
  - The fissures can also help you to determine the boundaries of pathology



Major oblique fissure	Right major fissure	Right minor fissure
Separate the LUL from the LLL	Separate the RUL/RML from the RLL	Separate the RUL from the RML



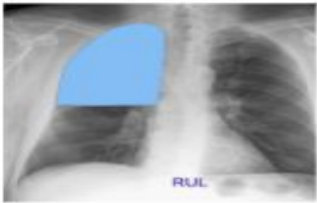


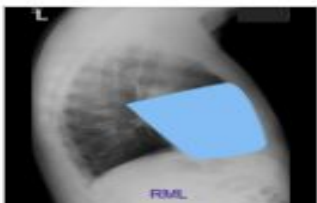

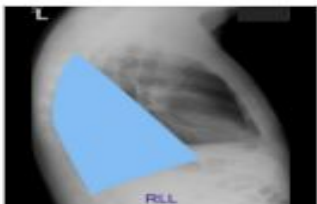
1- cardiophrenic and costophrenic borders.  
2- on the left



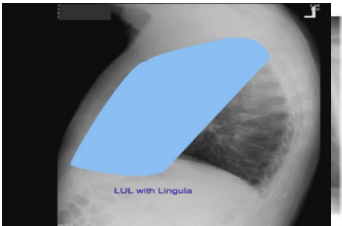
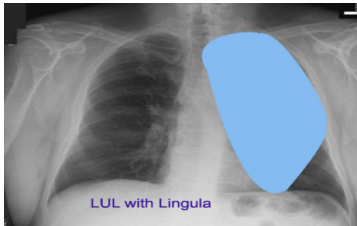
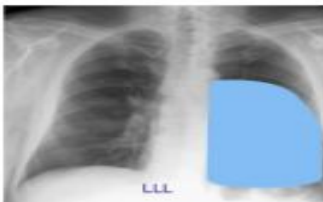
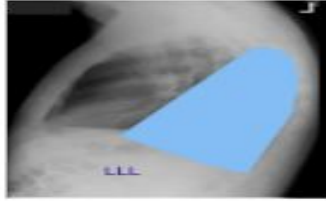
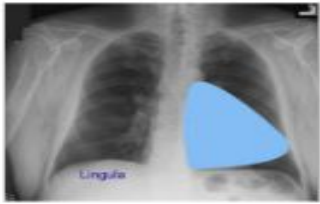
# To be able to differentiate between different views.

## Lobes

### Right lobe

<b>RUL</b>		
<b>RML</b>		
<b>RLL</b>		

### Left lobe

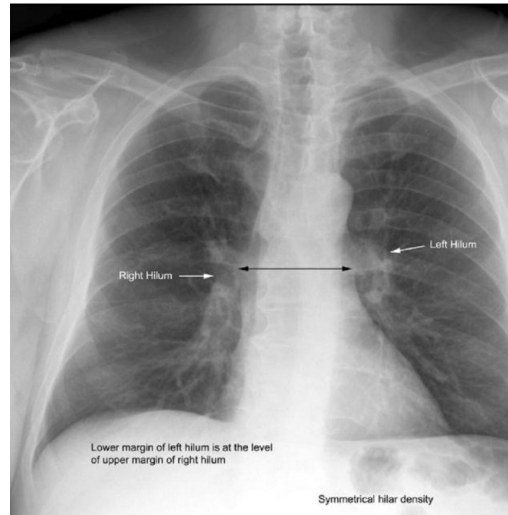
<b>LUL with lingula</b>		
<b>LLL</b>		
<b>Lingula</b>		

1- you can't see the heart

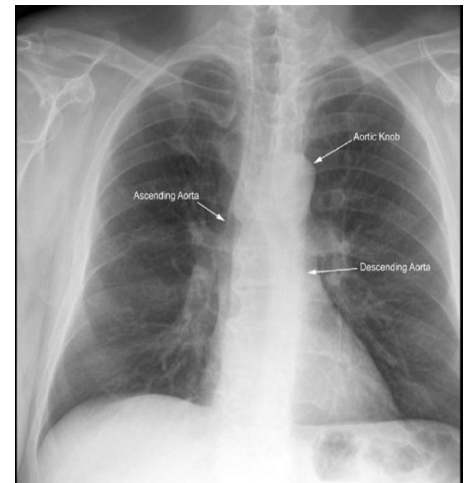
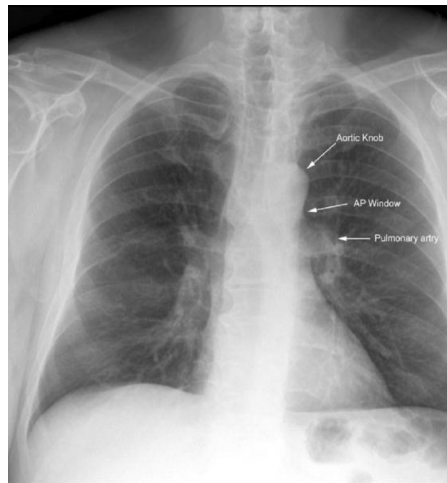
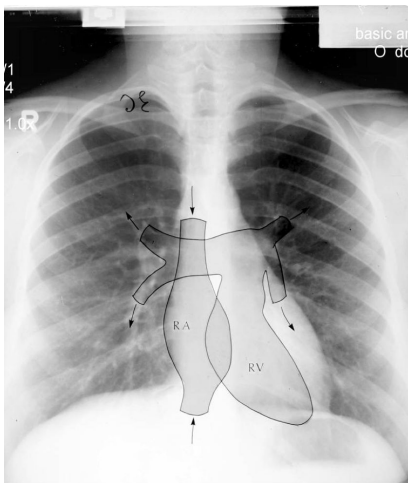
# To be able to differentiate between different views.

## Hilum

- Pulmonary Art.+Veins
- The Bronchi
- Left Hilum higher (max 1-2,5 cm)
- Identical: size, shape, density



## Heart



- Left atrium is posterior

# To recognize what is normal and abnormal.

## Cases:

### Be systemic

#### Case 1 (Acute)- pneumonia :

- Fever
- Cough
- Breathlessness
- Hypoxia
- Spo2 92% ON HFNC 50L/min 70% O2



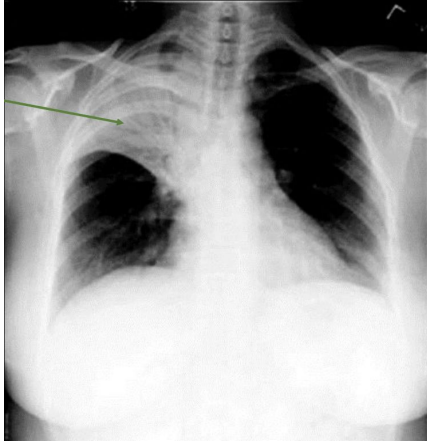
Bilateral consolidation , the diagnosis is pneumonia

# To recognize what is normal and abnormal.

## Case 1 cont.

If the patient came with the same history but with this X-ray

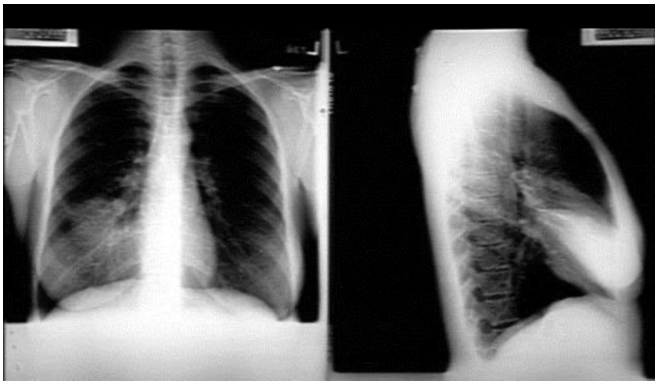
Dark lines:  
air  
bronchograms



RUL<sup>1</sup> pneumonia

In the history ask about :

- Pets (parrots / birds) → chlamydia pneumonia
- Caves/ bats → fungal
- Travel → legionella
- They will present with right pleuritic chest pain



RML<sup>1</sup> pneumonia

You cant see the right heart border



RLL<sup>1</sup> pneumonia

- You can see the right heart border but you cant see the right hemidiaphragm
- Lower lobe sits on the diaphragm

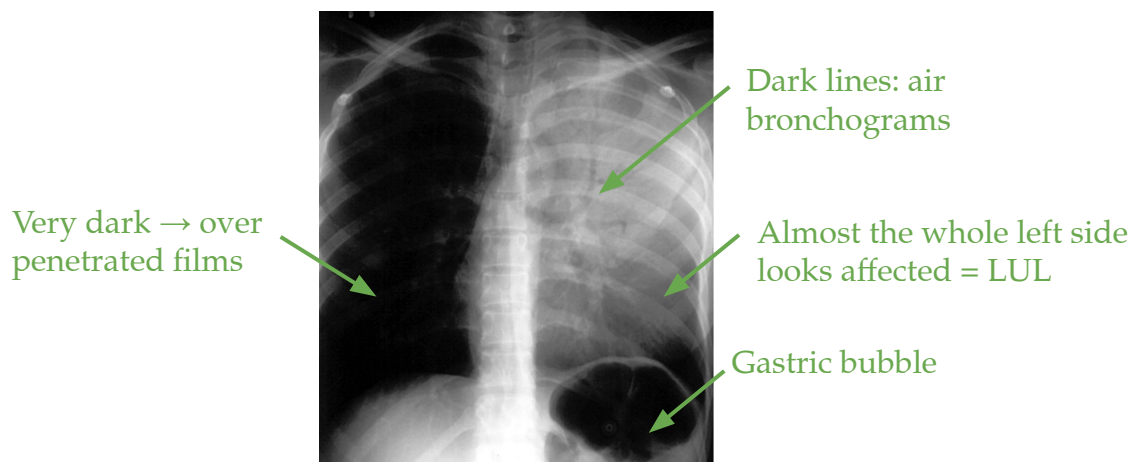
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1- you must mention which lobe is involved

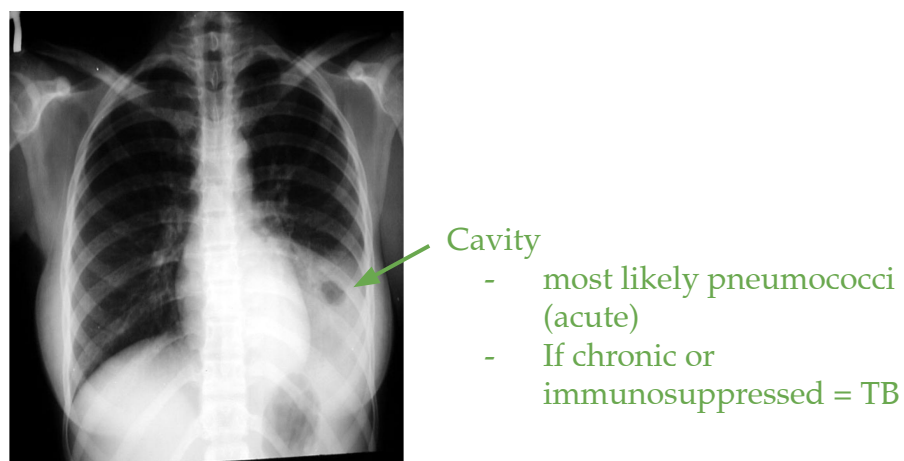
# To recognize what is normal and abnormal.

## Case 1 cont.

If the patient came with the same history but with this X-ray



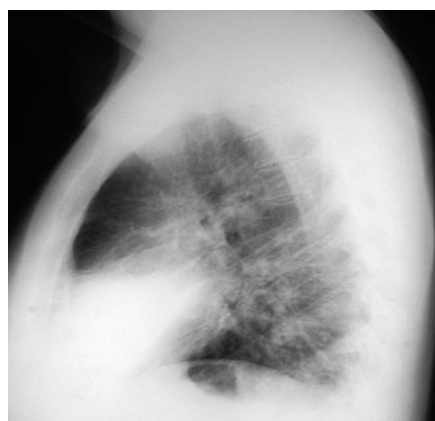
LUL<sup>1</sup> pneumonia



LLL<sup>1</sup> pneumonia<sup>2</sup>



RML<sup>1</sup> pneumonia - PA view  
RML consolidation and loss of right heart silhouette



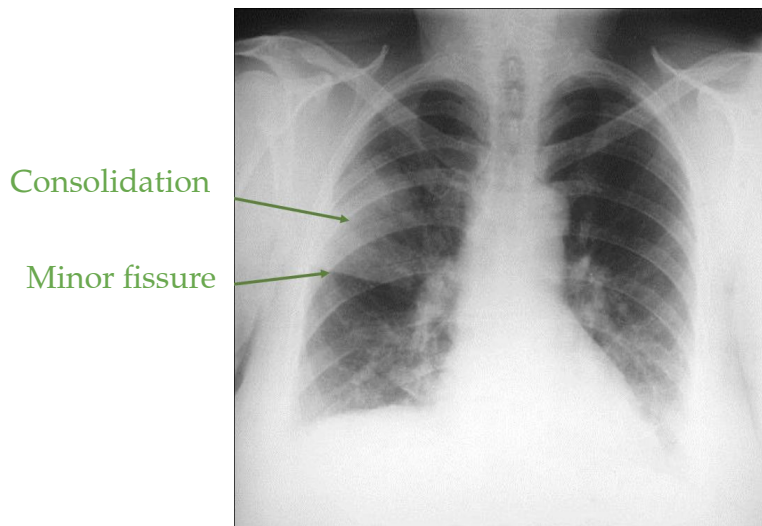
RML<sup>1</sup> pneumonia -Lateral view  
RML wedge shaped consolidation

- 
- 1- you must mention which lobe is involved
  - 2- You cant see the left hemidiaphragm

# To recognize what is normal and abnormal.

## Case 1 cont.

If the patient came with the same history but with this X-ray



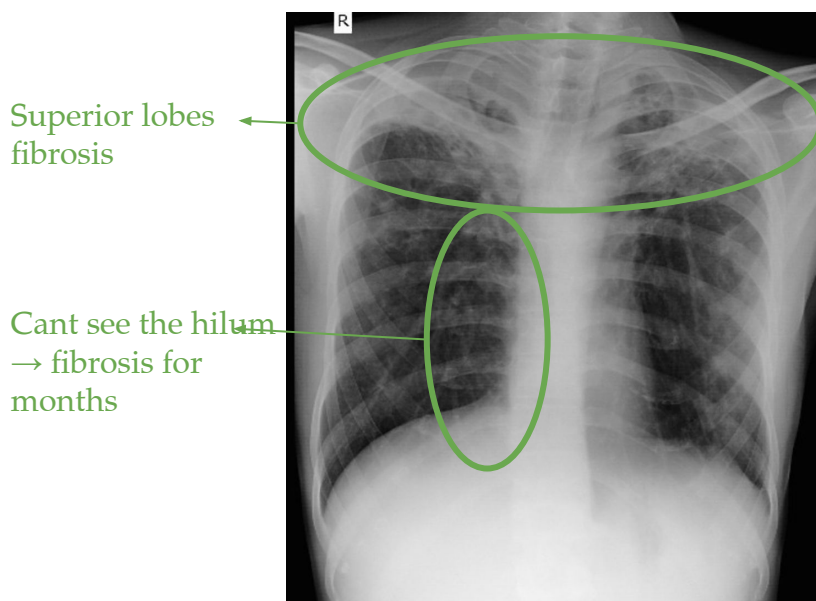
RUL infiltrate / consolidation, bordered by minor fissure inferiorly

Patchy LLL infiltrate that obscures the left hemidiaphragm; right and left heart borders obscured

RUL and LLL<sup>1</sup> pneumonia

## Case 2 (Subacute/Chronic) - TB:

Hx : unwell for 3 months , fever , night sweats , weight loss



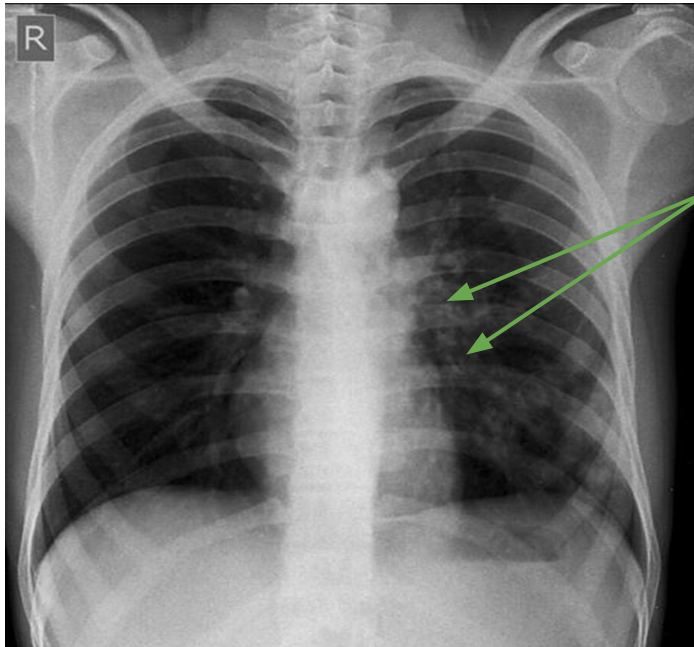
There is fibrosis in the upper area (consolidation with loss of lung volume). Hilum is not clear; they are pulled upwards because loss of volume. This is a patient with **TB (chronic)**.

**DDx:** ILD that affects upper lobes: silicosis

1- you must mention which lobe is involved

# To recognize what is normal and abnormal.

## Case 2 cont.

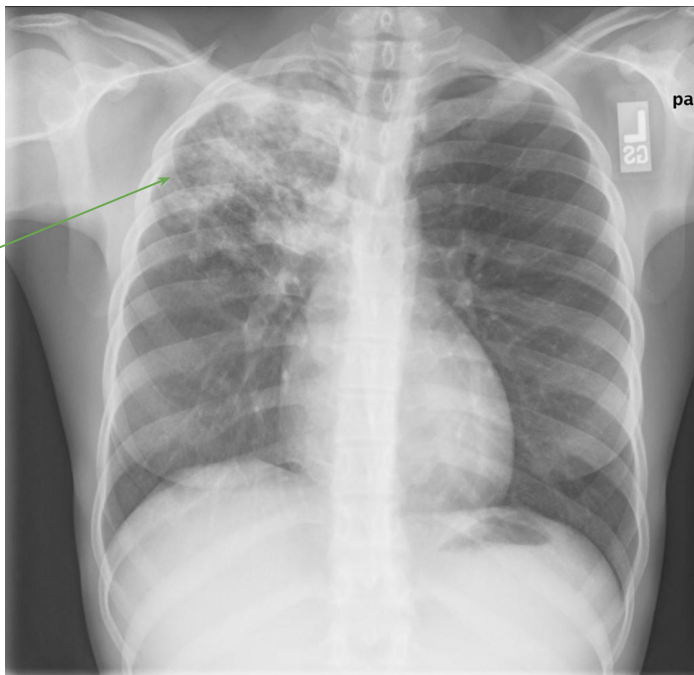


Patchy consolidation

- Depending on the history:

a) Acute symptoms: Lung infection.

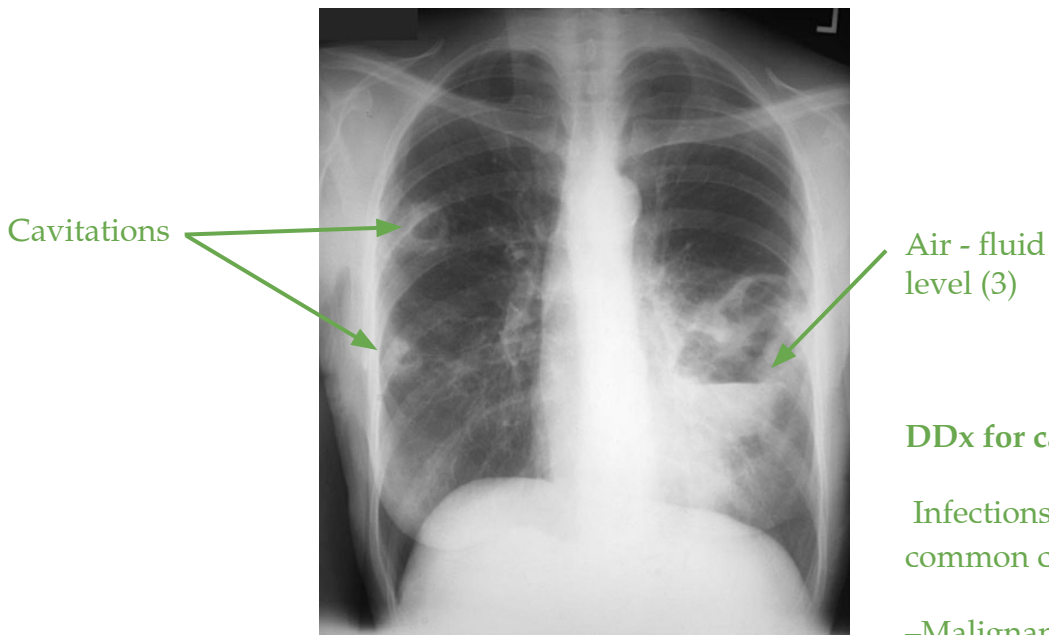
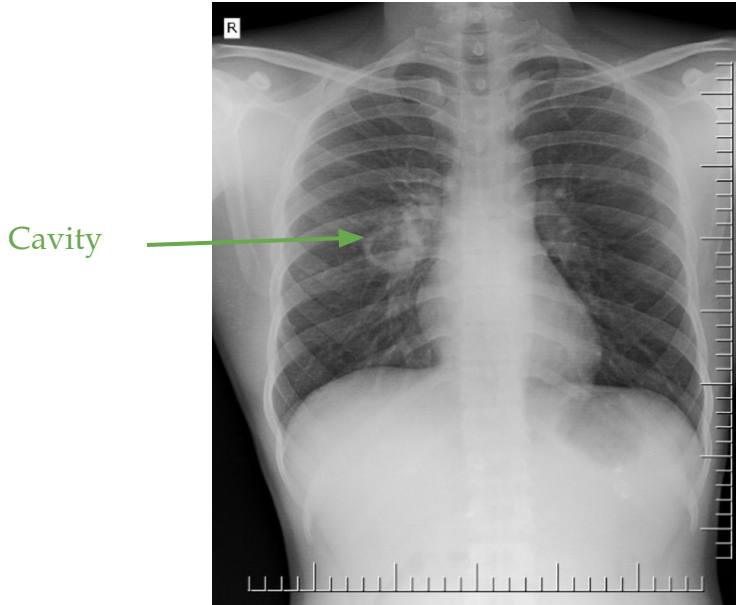
b) Chronic symptoms: **TB**



RUL  
Patchy  
consolidation  
TB because it's  
an oblique  
aerobe (high  
conc of O<sub>2</sub>)

# To recognize what is normal and abnormal.

## Case 2 cont.



Multiple bilateral cavitary lesions with air-fluid levels c/w MetAbsseces

### DDx for cavity :

Infections (bacterial (TB is the most common cause) / fungal)

-Malignancies

- Vasculitis

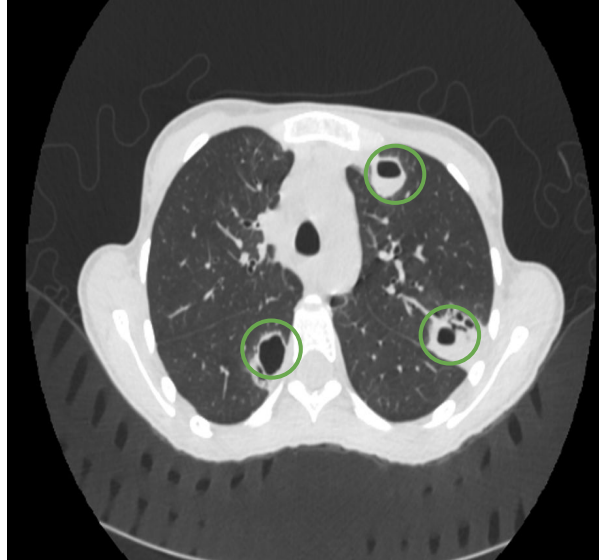
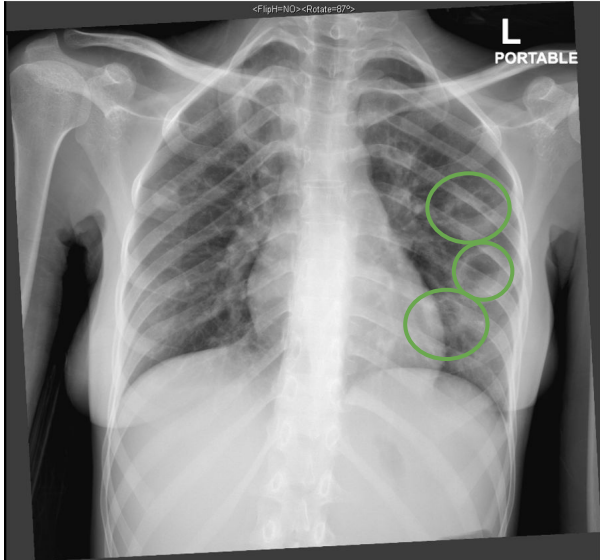
-Trauma (Infarction/contusion).



# To recognize what is normal and abnormal.

## Case 3 - multiple cavitation lesion:

Hx :young ,coughing, unwell , ↓ kidney function , red eyes , sinus nasal symptoms , vasculitis, 18 months hospital admission

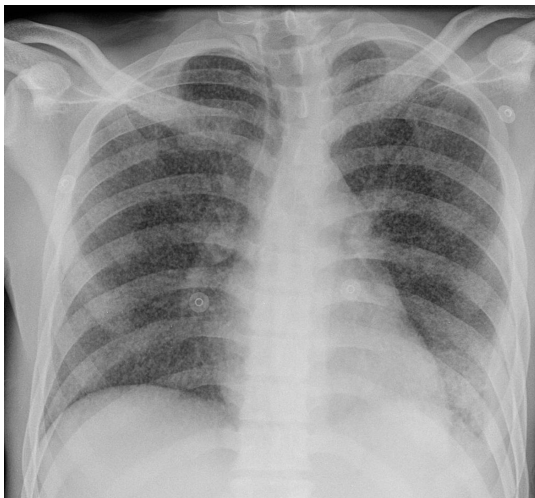


Multiple cavitations

- ANCA + Wegener granulomatosis / granulomatosis with polyarteritis (Churg Strauss).
- If a patient is a drug addict and has multiple lung abscesses the differential diagnosis can be :
  - Aspiration pneumonia
  - Infective endocarditis

## Case 4 - miliary mottling / miliary TB<sup>1</sup>:

Fever, night sweats, months ago



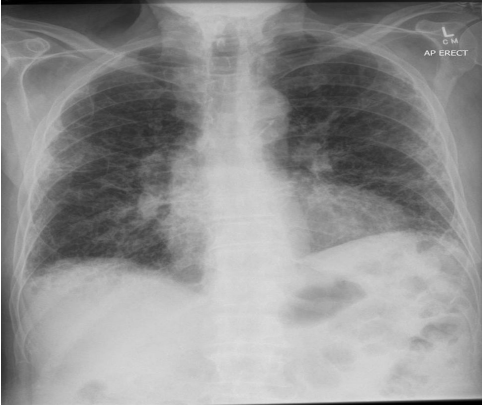
Multiple micro-nodules

1- isolate the patient , wear N95 maske

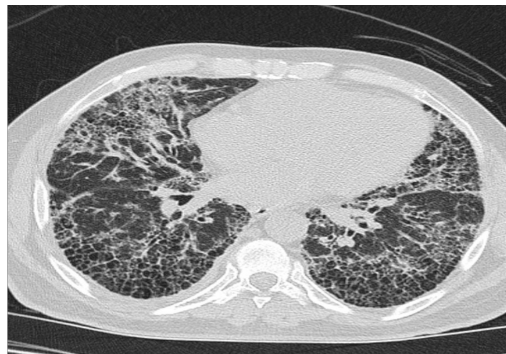
# To recognize what is normal and abnormal.

## Case 5 -ILD:

60 YO , progressive SOB for 2 years , dry cough, breathless on exertion, clubbing, fine crackles (end-inspiration velcro-like crackles)

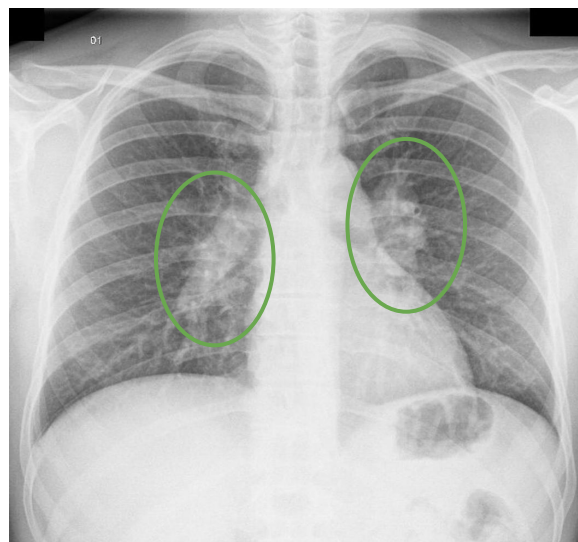


This patient has become breathless gradually among the two past years, the lung looks smaller (shrunk lung volume in both sides), and there are multiple lines that cross each other (reticular changes in both lungs), so this is what you see in **pulmonary fibrosis**.



Lines and dots (reticulonodular).

Hx: young , bruises on shins (erythema nodosum<sup>1</sup>)



Bilateral dense prominent hilum

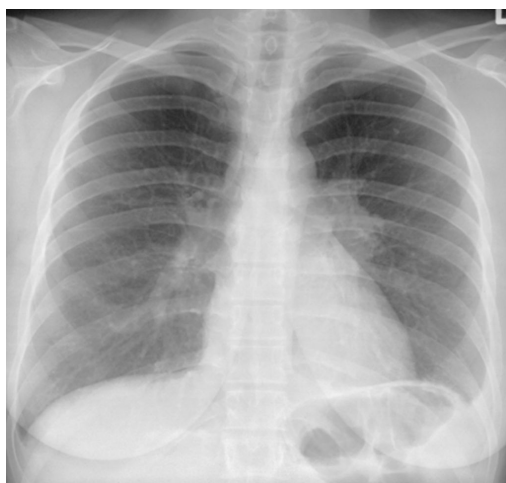
DDx: sarcoidosis, histoplasmosis , lymphoma

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1- causes of erythema nodosum : sarcoidosis , TB, drugs, IBD

# To recognize what is normal and abnormal.

## Case 5 -ILD cont.

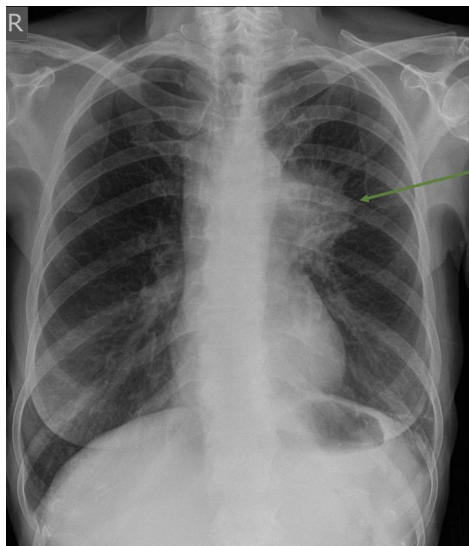


Hilar lymphadenopathy - BL  
Bilateral hyperdense hilum



Bilateral Hilar Adenopathy but look at the changes in the lungs= sarcoidosis.  
Reticular pattern.

## Case 6 - lung masses



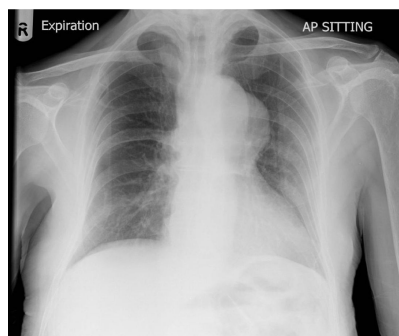
The edge is not Smooth.

Lung mass, look at the edges its irregular speculated



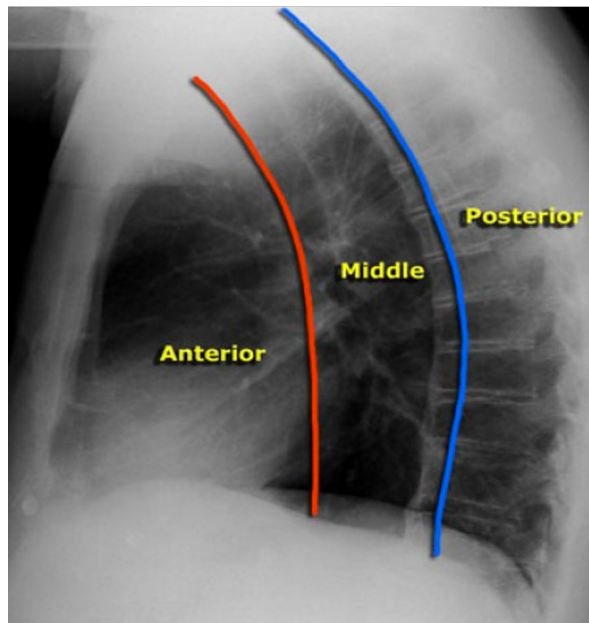
mass with a smooth edge.

Calcificated costal cartilages

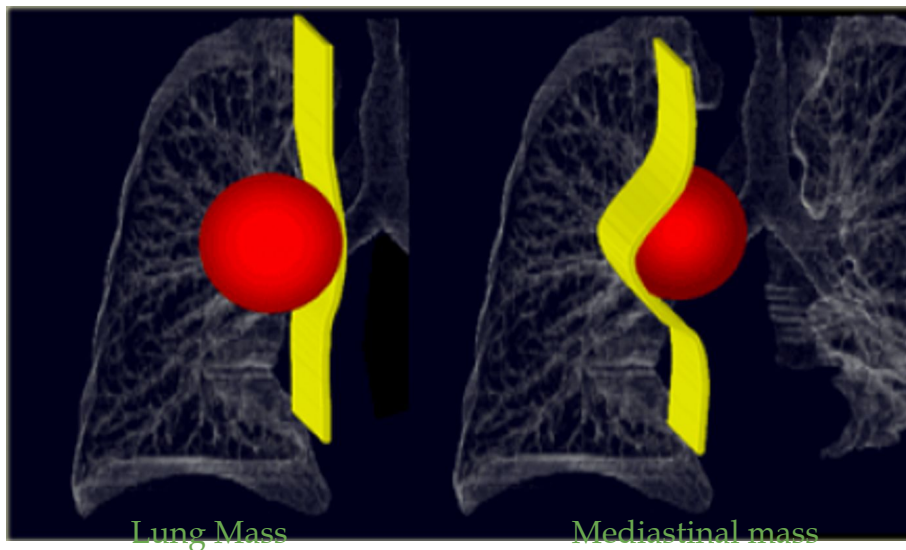


# To recognize what is normal and abnormal.

## Mediastinum

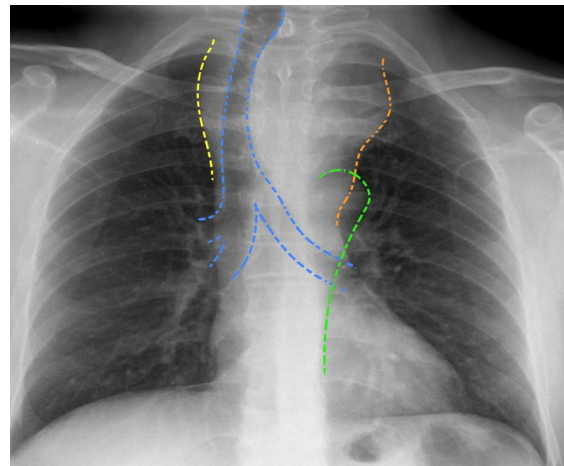
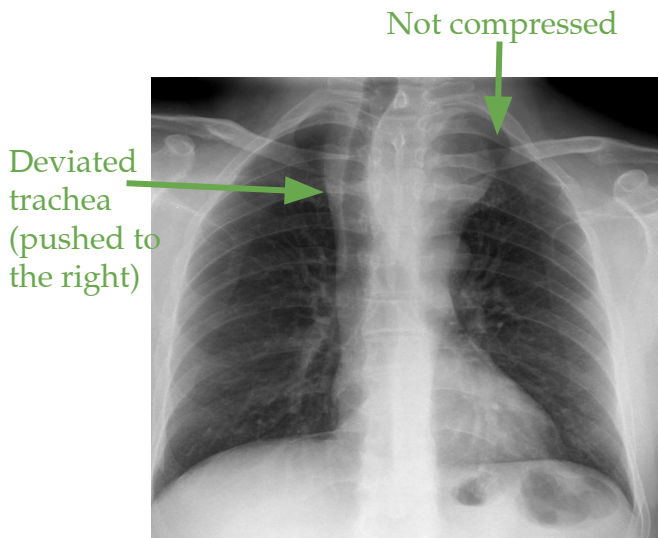
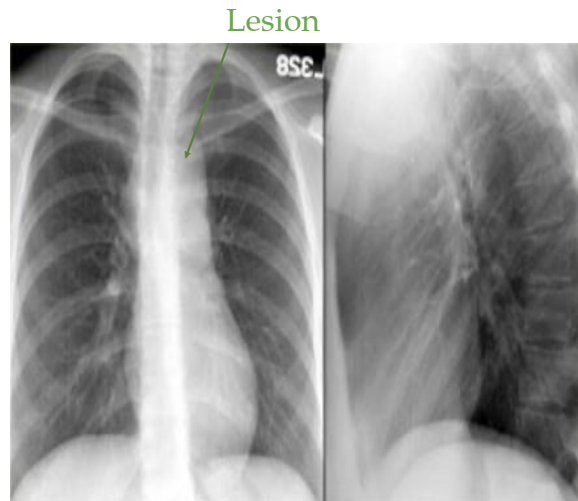


## Mediastinal vs lung masses



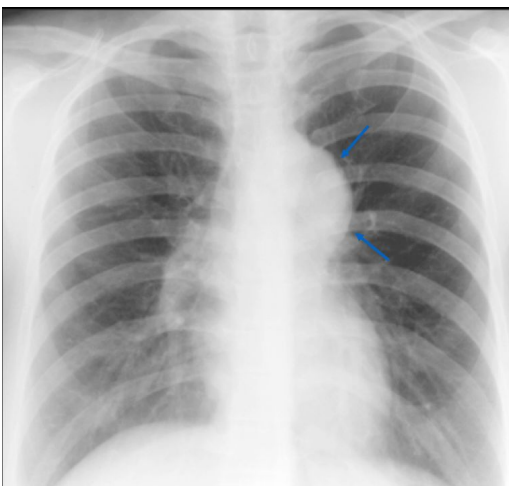
If the lesion is in the mediastinum, it will be pushed against the lung

# To recognize what is normal and abnormal.



Retrosternal goiter

## Anterior mediastinal mass

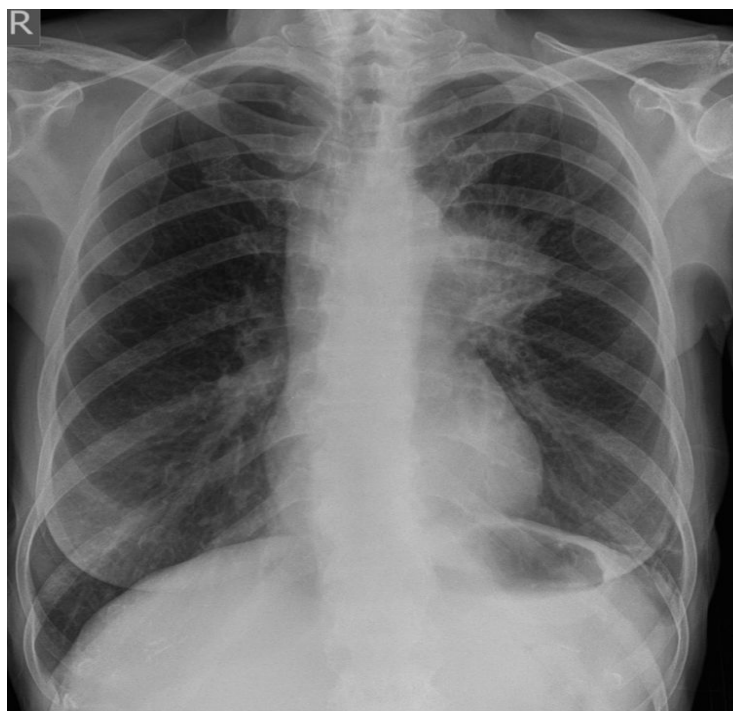


- Thyroid tumors (malig.or benign)
- Thymic tumors (malig. or benign)
- Lymphomas
- Teratomas & other germ-cell tumors
- Others (incl. lung CA, sarcomas, aneurysms, mets)

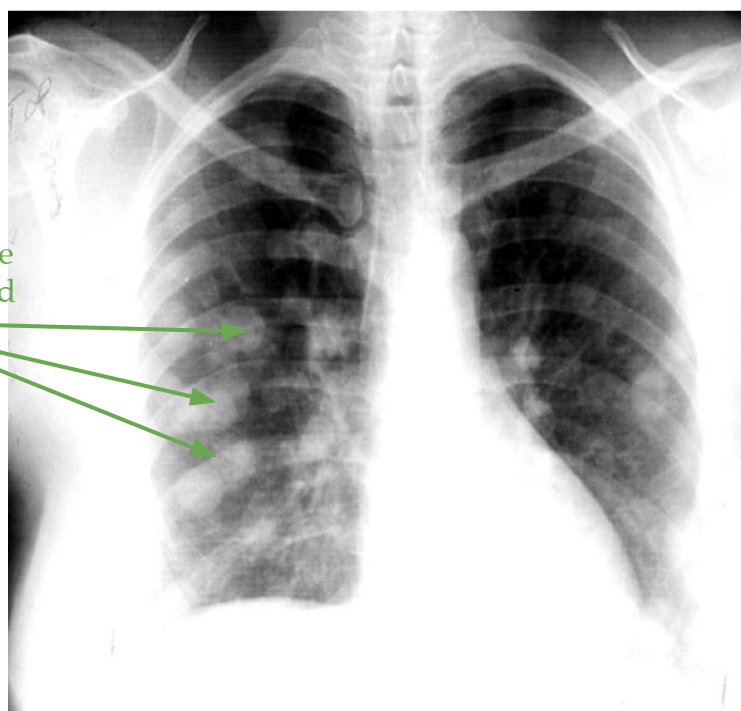
# To recognize what is normal and abnormal.

## Smoker (Abnormal x-ray)

Cancer, COPD



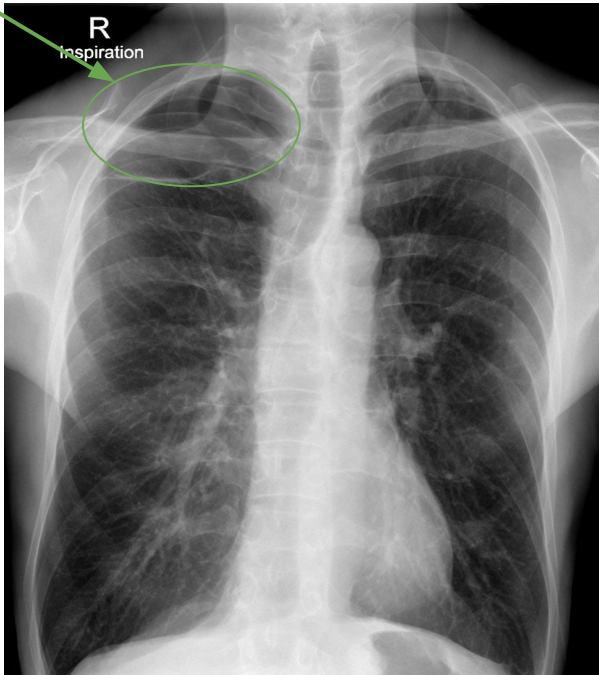
Multiple opacities  
(cotton ball  
malignancies) from the  
kidney, liver, breast, and  
thyroid



Multiple masses

# To recognize what is normal and abnormal.

Air sac

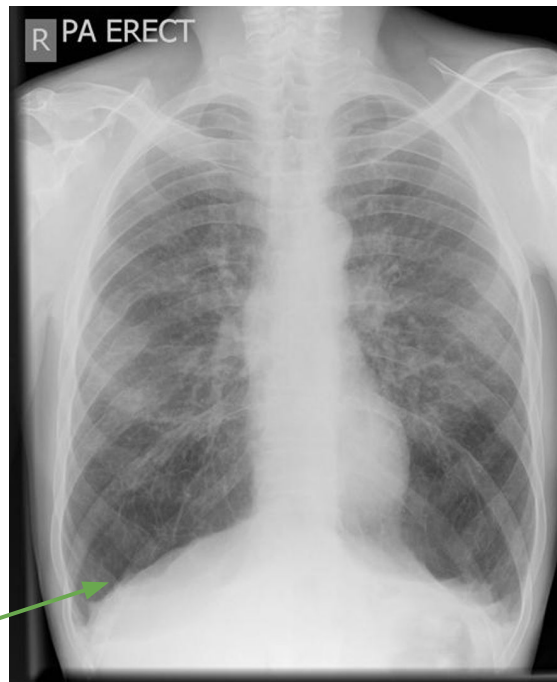


Hyperinflated lungs (more than 10 posterior ribs) emphysema

Bullae of air



Final diagnosis is reached by spirometry If the damage is in the lower lobes= alpha antitrypsin



Bullae full of air, not enough lung matrix

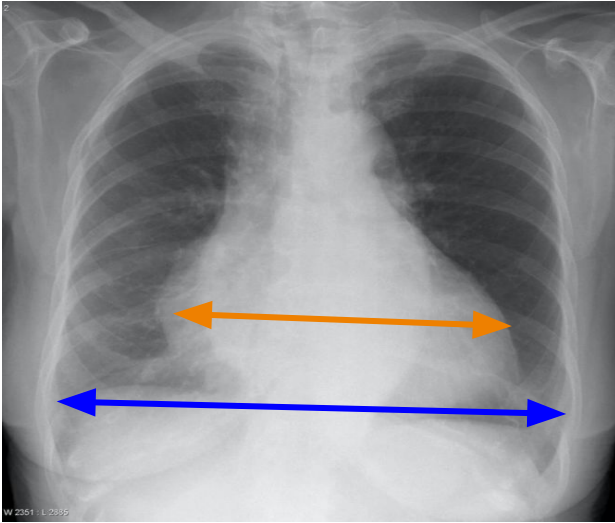
not enough lung Alpha-1 antitrypsin deficiency



# To recognize what is normal and abnormal.

## Heart

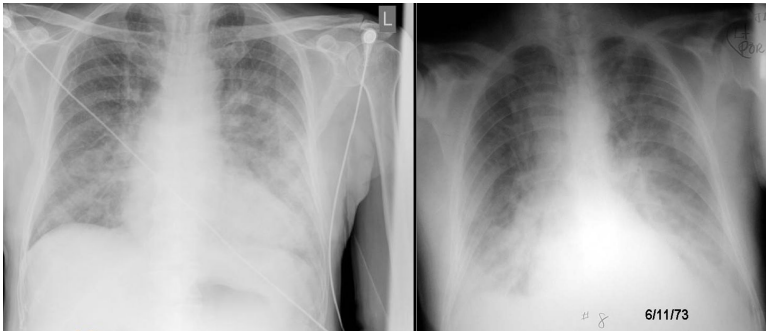
### Case 7 - Cardiomegaly



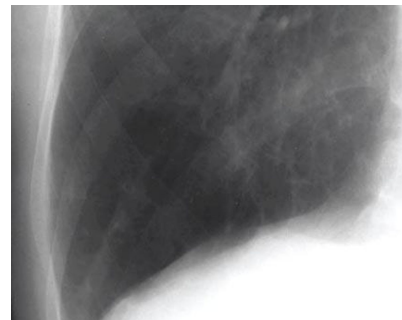
Cardiothoracic ratio is more than 50%



If pericardial effusion, look for signs of cardiac tamponade



Heart failure



Kerley B lines

#### Sign of heart Failure :

- Big heart (>50% cardiothoracic ratio)
- Blood vessel in the top of the lung is  $\frac{1}{2}$  the size in the lower part of the lung
- Kerley B lines (seen at the edge of the lungs)

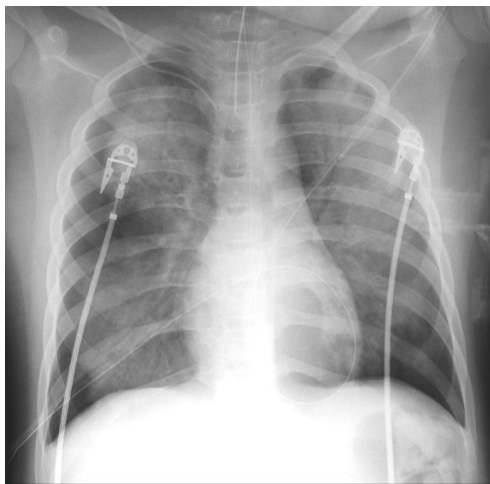
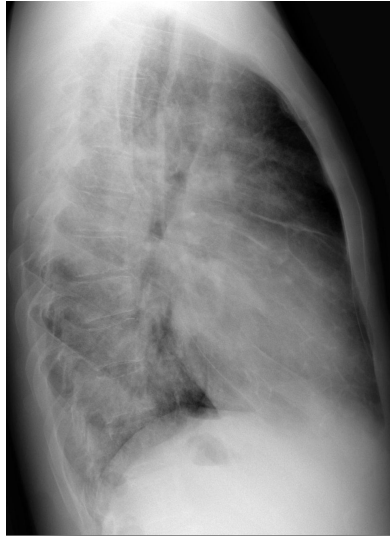
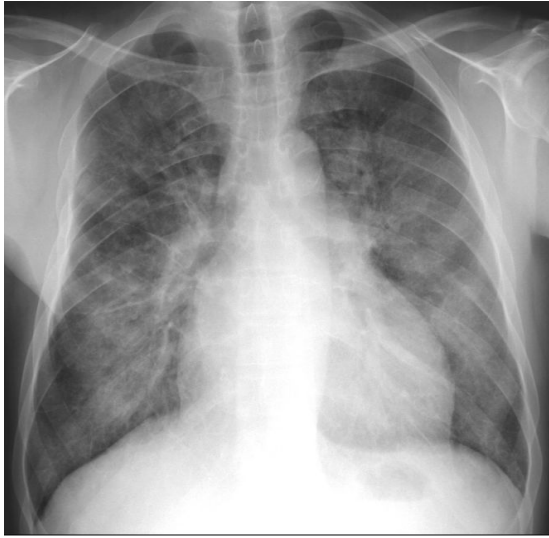


Pericardial effusion- Cardiomegaly



# To recognize what is normal and abnormal.

## Case 8 - Pulmonary Edema

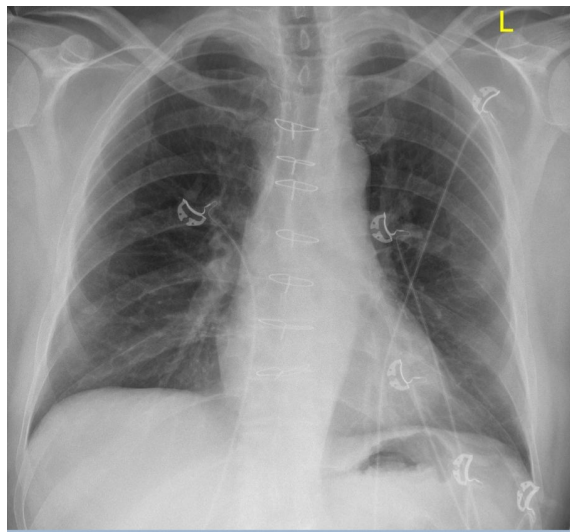
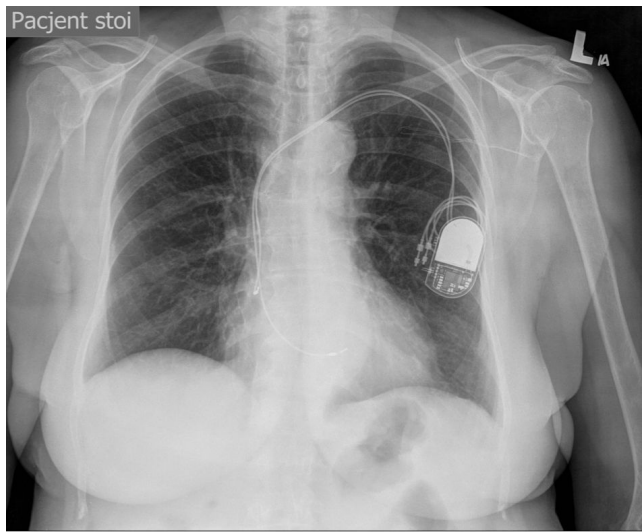


- Perihilar interstitial & airspace opacities
- Bilateral and symmetric
- "Batwing" or "butterfly" configuration
- In upright patient, lower > upper

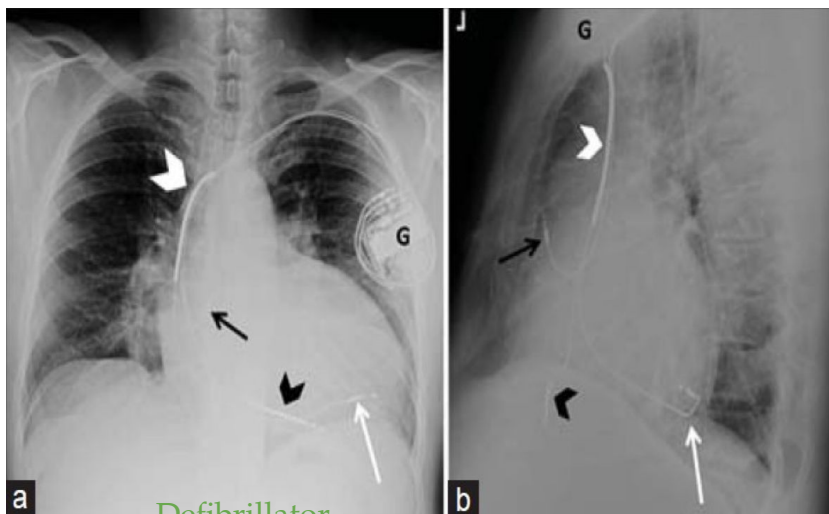
## Causes of Pulmonary Oedema

- **Cardiogenic:** e.g. HF, cardiogenic shock, mitral stenosis
- **non-cardiogenic:** e.g. ARDS, salicylate, AKI

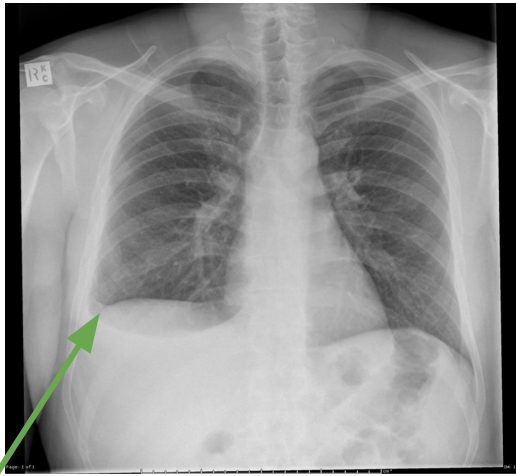
# To recognize what is normal and abnormal.



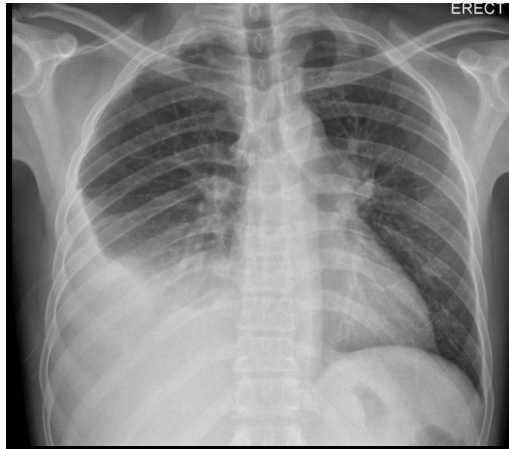
Sternotomy



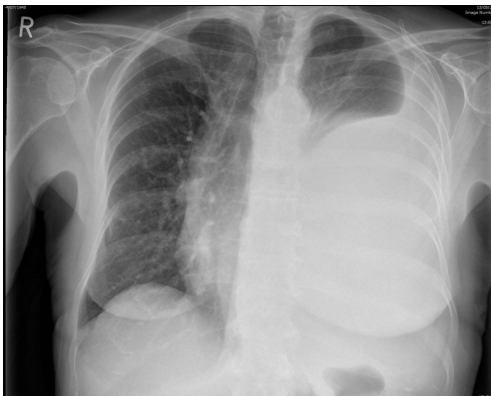
# To recognize what is normal and abnormal.



Unilateral pleural effusion (most likely as x)



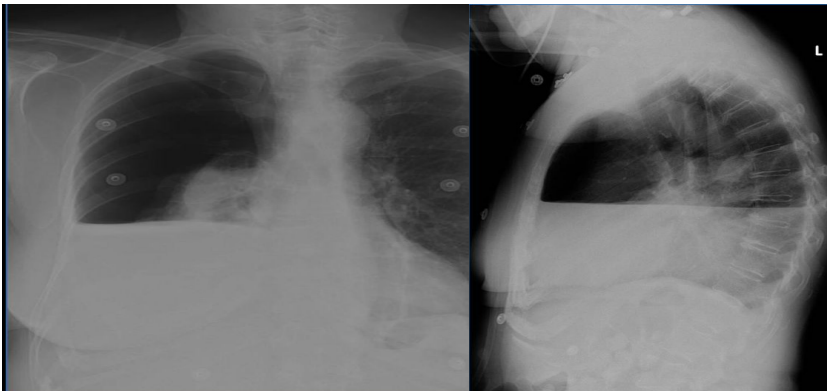
Unilateral pleural effusion



Unilateral pleural effusion



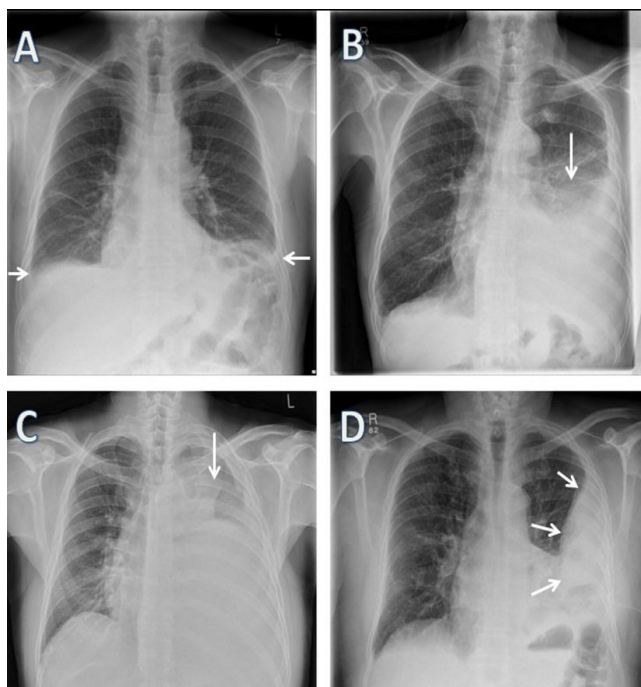
- Loculation + increased density of effusion
- Most likely TB



Hydropneumothorax

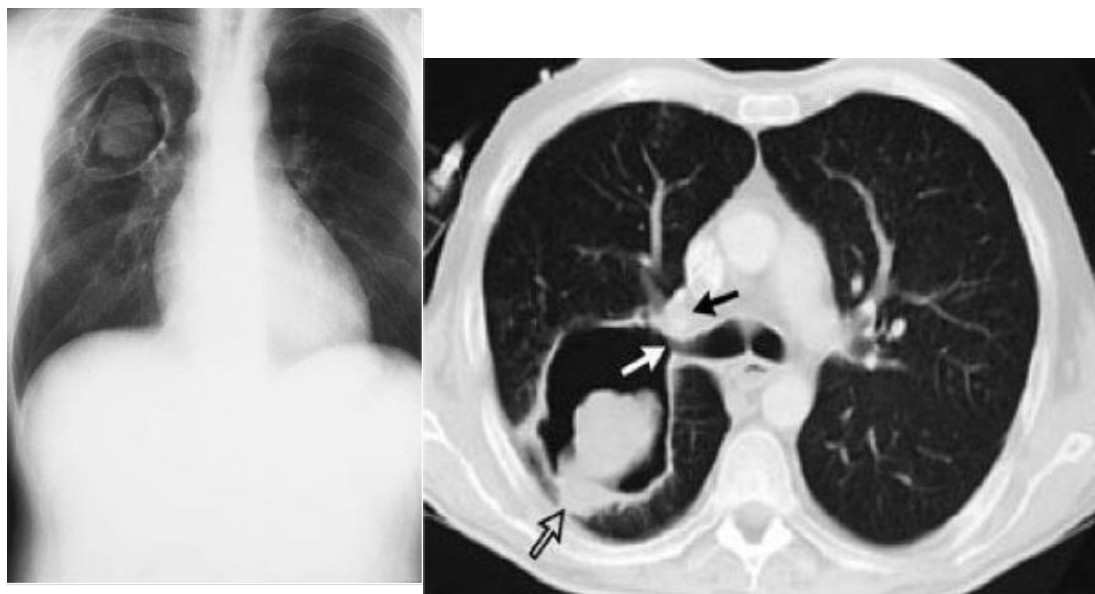


## To recognize what is normal and abnormal.

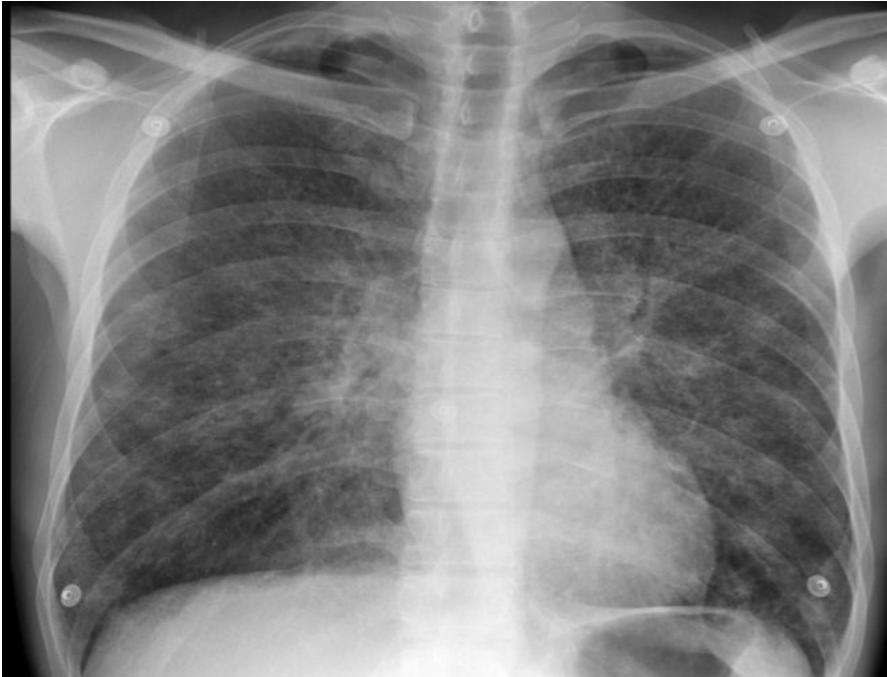


Cavitating lesion

- A. Bilateral effusion: HF
- B. Predominately unilateral effusion: malignancy, infection, pleuritis
- C. Massive effusion

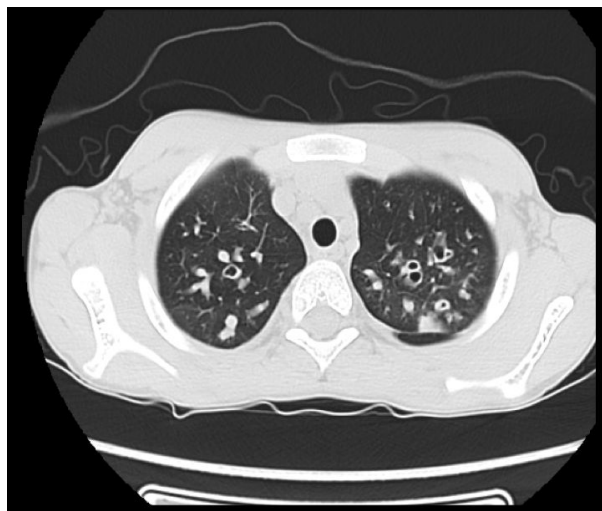
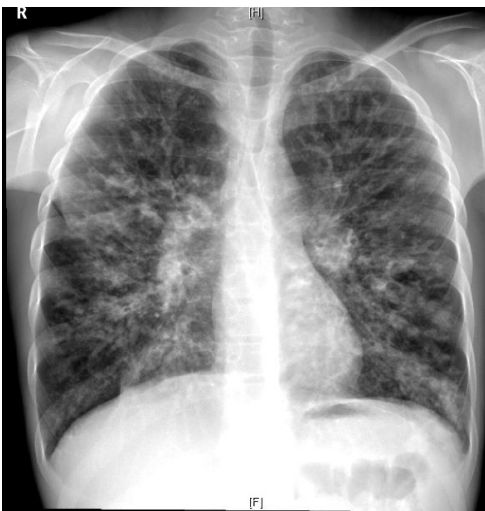


## To recognize what is normal and abnormal.



Immunocompromised patient

Pneumocystis (common in cats)



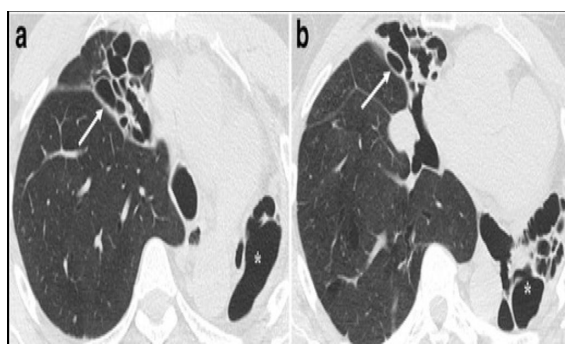
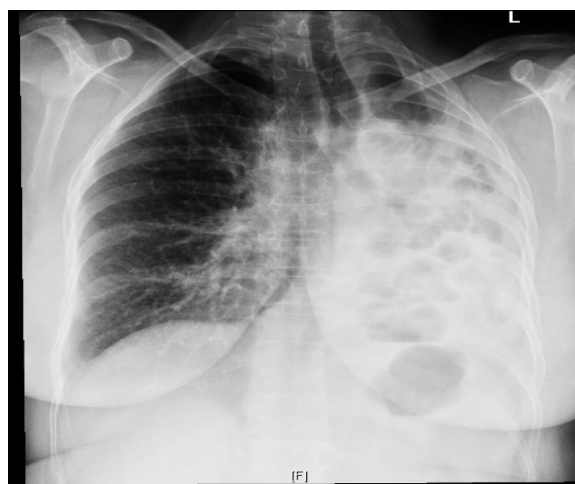
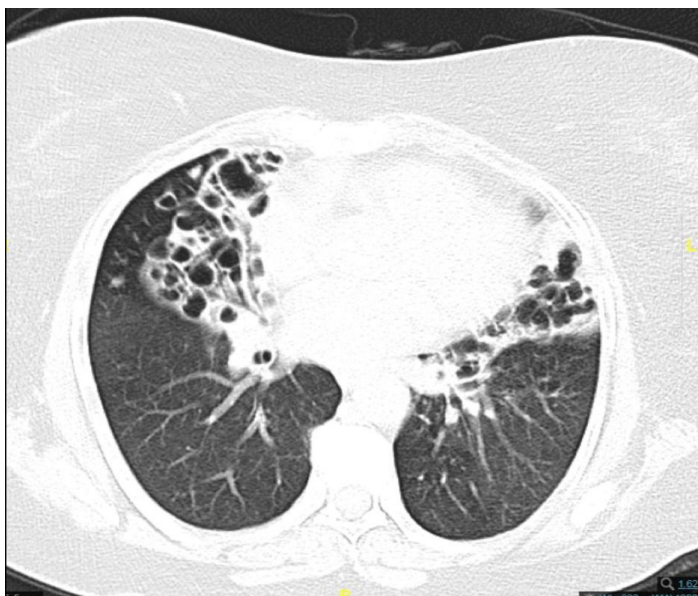
- **Chronic Cough**
- **Sputum production**
- Malabsorption

Thickened dilated bronchioles

**Bronchiectasis (cystic fibrosis)**

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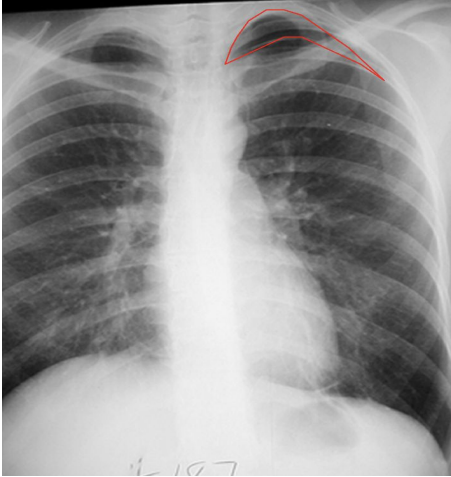
# To recognize what is normal and abnormal.



# To recognize what is normal and abnormal.

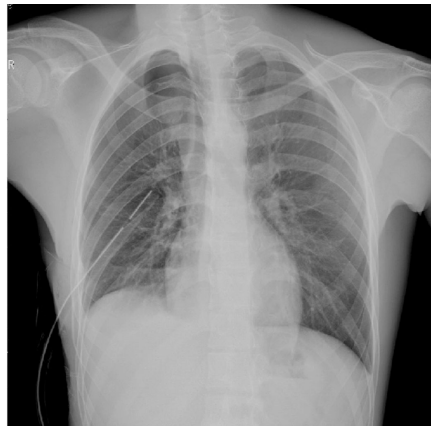
## Case 10

28 y/o female with sudden onset SOB while jogging this morning

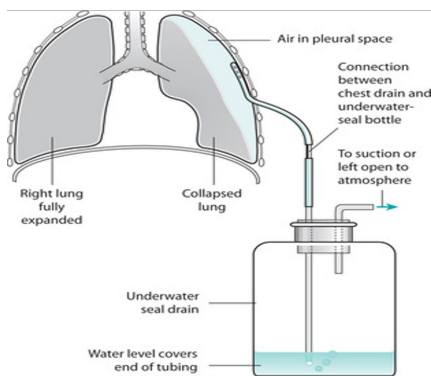


Well demarcated paucity of pulmonary vascular markings in right apex

Left spontaneous pneumothorax



Tension pneumothorax

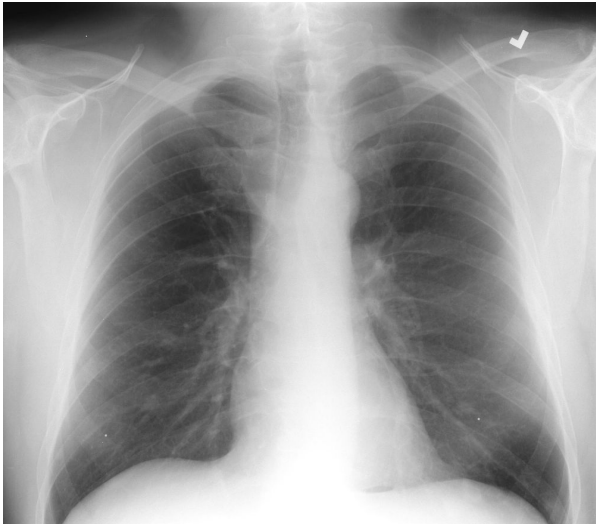


# To recognize what is normal and abnormal.

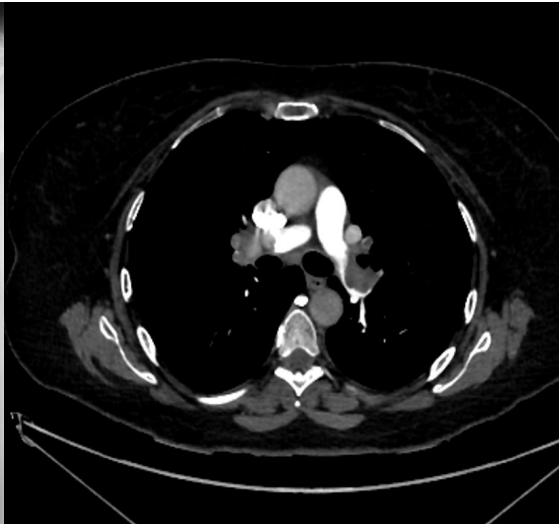
Some diseases don't show up on chest x rays

## Case 11

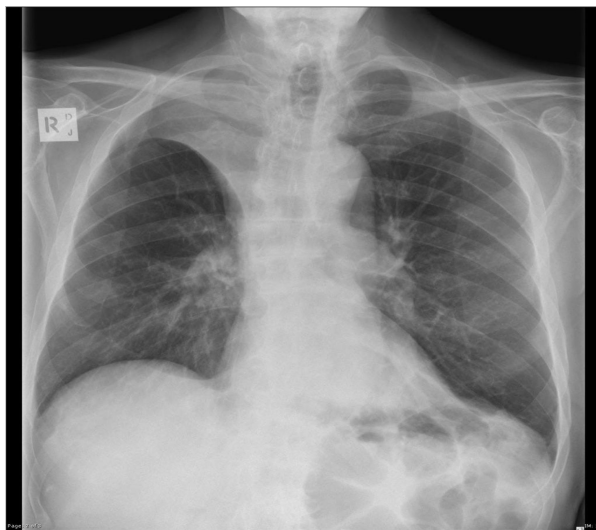
45 year old with UC, sudden onset SOB



Normal chest x-ray



Clot in the pulmonary artery

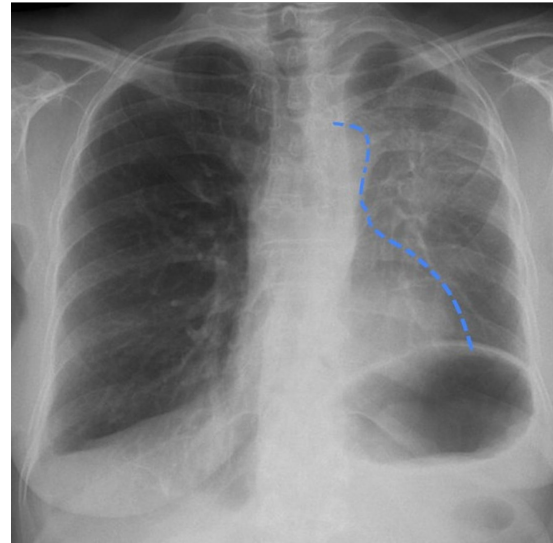
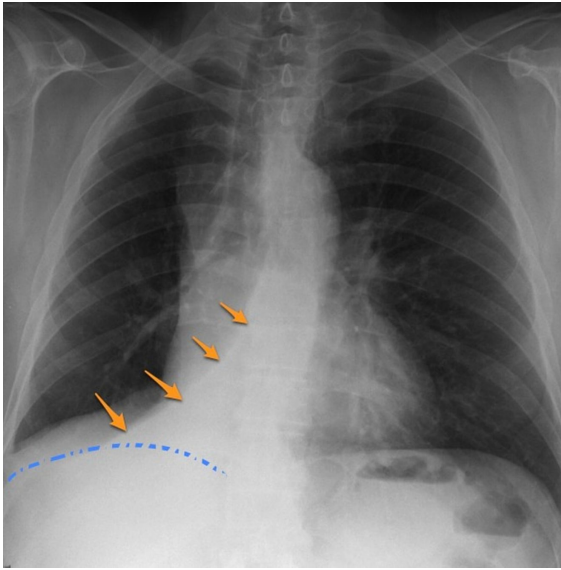


Right UL collapse

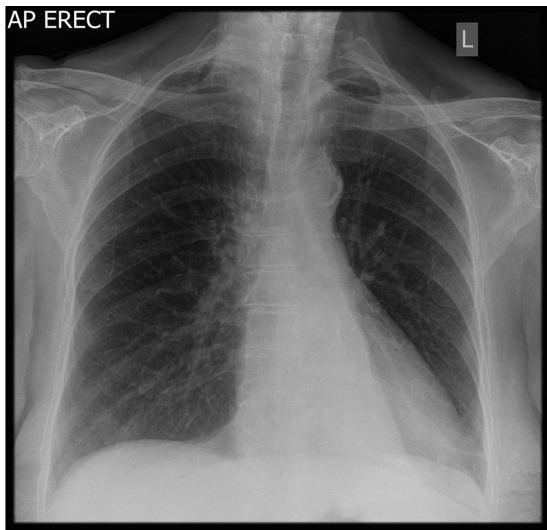




## To recognize what is normal and abnormal.



Right UL collapse



Left UL collapse

### What are the causes of collapsed lung

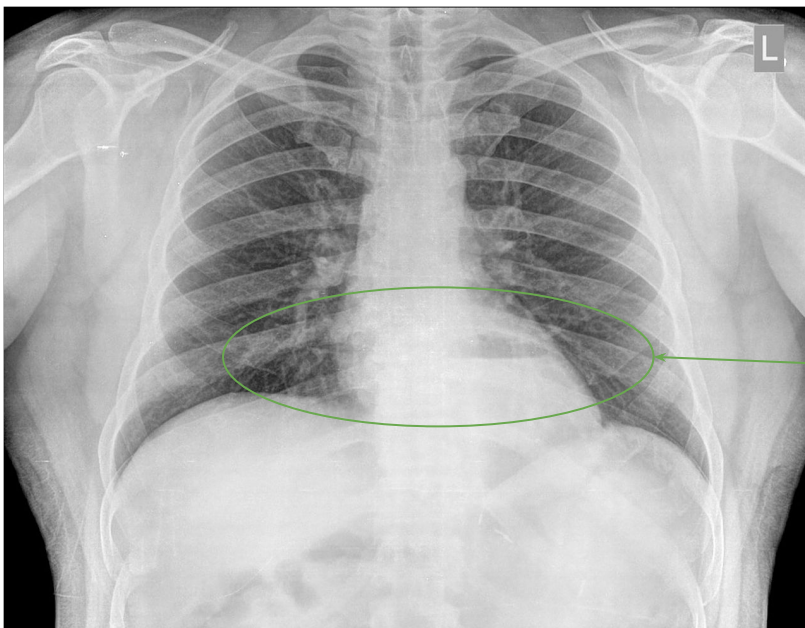
1. Airway obstruction
2. Tumors
3. Inability to clear secretions (e.g. elderly unable to cough)

## To recognize what is normal and abnormal.



Air under the diaphragm

Perforation



Air fluid level behind the heart

Chronic cough, upper gi symptoms, reflux sx,  
indigestion  
Hiatal hernia

# To recognize what is normal and abnormal.

## Patient 1

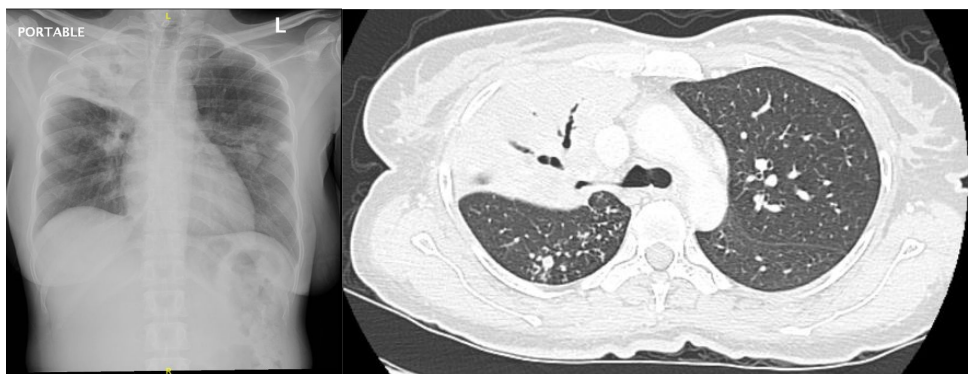
- Smoker 30 pack year history currentl 15/day
- SOBOE
- Breathless when rushes about
- Can climb 2 flight of stairs with difficulty
- FEV1 65%
- FEV1/FVC 60%



Describe the chest x ray?  
What's your diagnosis?

## Patient 2

- Cough, purulent sputum, with tinge of blood
- Fever on and off
- Sweats
- Unwell for 2 months

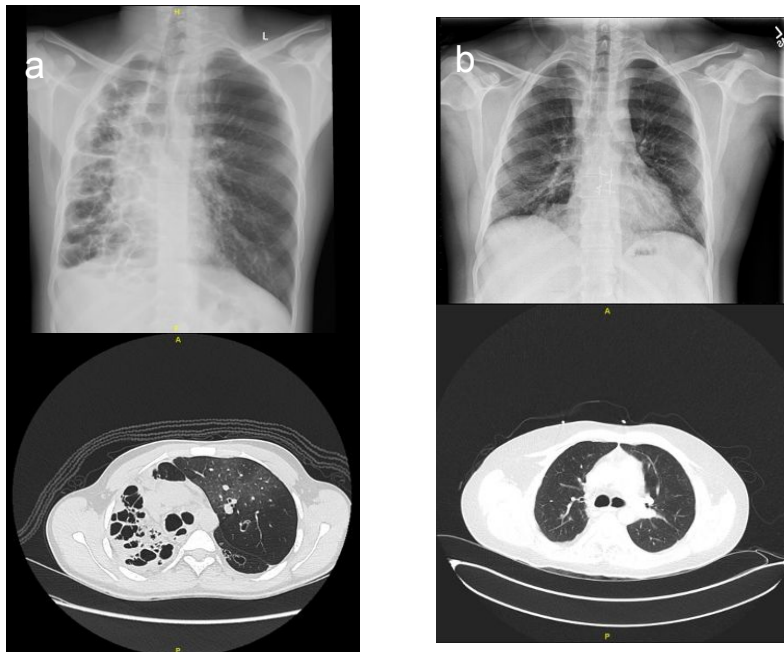


Describe the chest x ray? Consolidation with air  
bronchogram, collapse  
What's your diagnosis? TB

# To recognize what is normal and abnormal.

## Patient x

- Had a chronic lung disease
- Cough and sputum production up to 3 egg cups daily
- Recurrent hospital admissions with exacerbation of chest problem



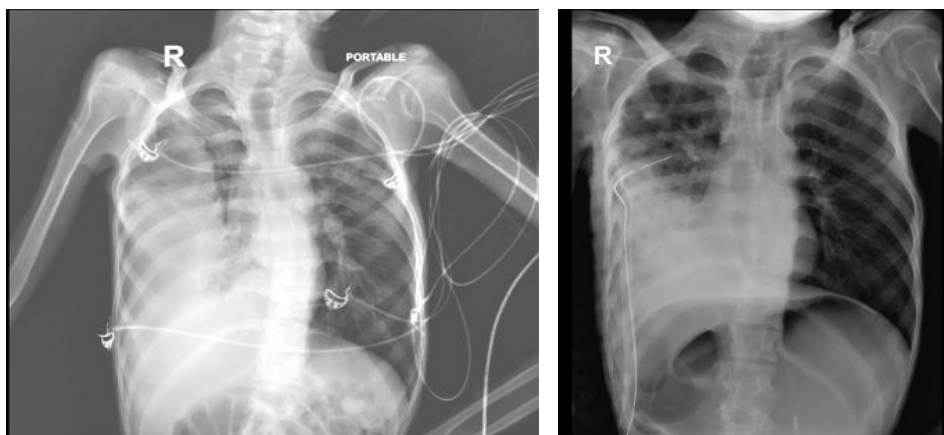
Describe the chest x ray?

What's your diagnosis? **Bronchiectasis**

what do you think happened to explain the difference in a and B? **a) before transplant b) after transplant**

## Patient Y

- Admitted
- Unwell, febrile, tachycardic and SOB
- Oxygen saturation and BP normal



**Emphysema**

**Chest drain**