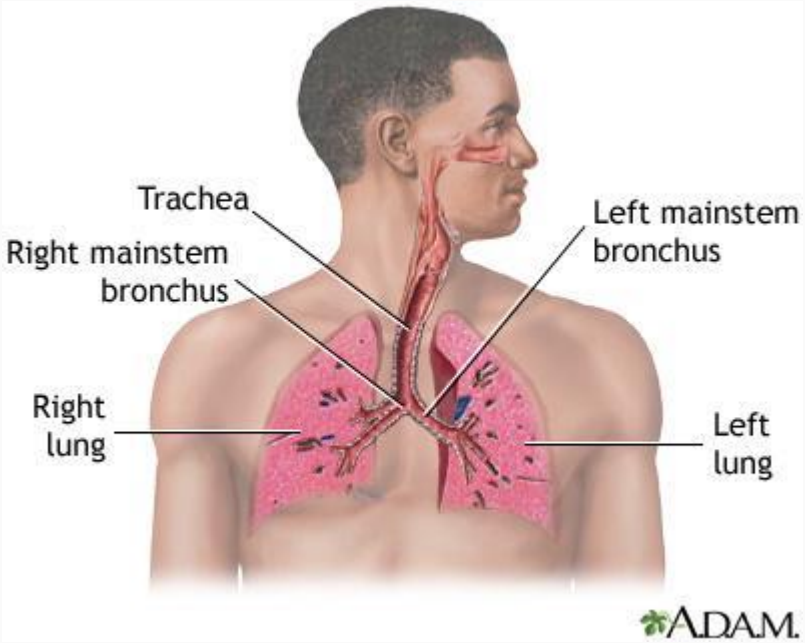
Chest Diseases

Chest Disease Problem

Chest disease is any problem in the chest that prevents the lungs from working properly.



There are three main types of lung disease

1. **Airway diseases:-**

   These diseases affect the tubes (airways) that carry oxygen and other gases into and out of the lungs.

1. **Lung tissue diseases:-**

   These diseases affect the structure of the lung tissue. Scarring or inflammation of the tissue makes the lungs unable to expand fully.

1. **Lung circulation diseases:-**

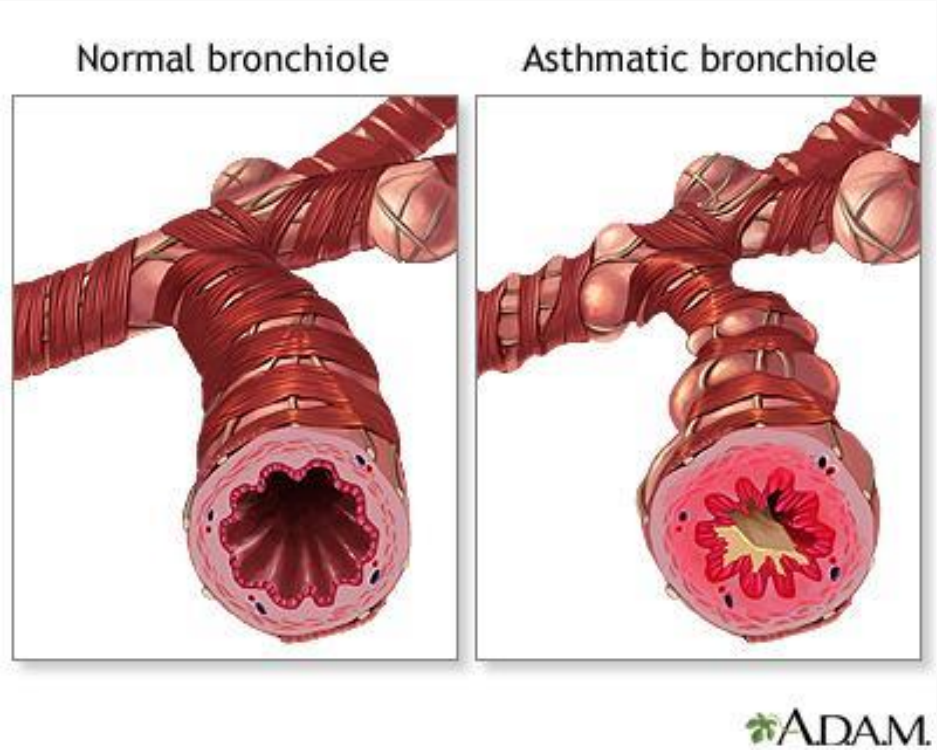
   These diseases affect the blood vessels in the lungs. They are caused by clotting, scarring, or inflammation of the blood vessels.

Types of Chest Diseases

Asthma

Asthma:-

- ❖ is a chronic disease causes the airways of the lungs to swell and narrow.
- ❖ It leads to breathing difficulty such as wheezing, shortness of breath, chest tightness, and coughing.

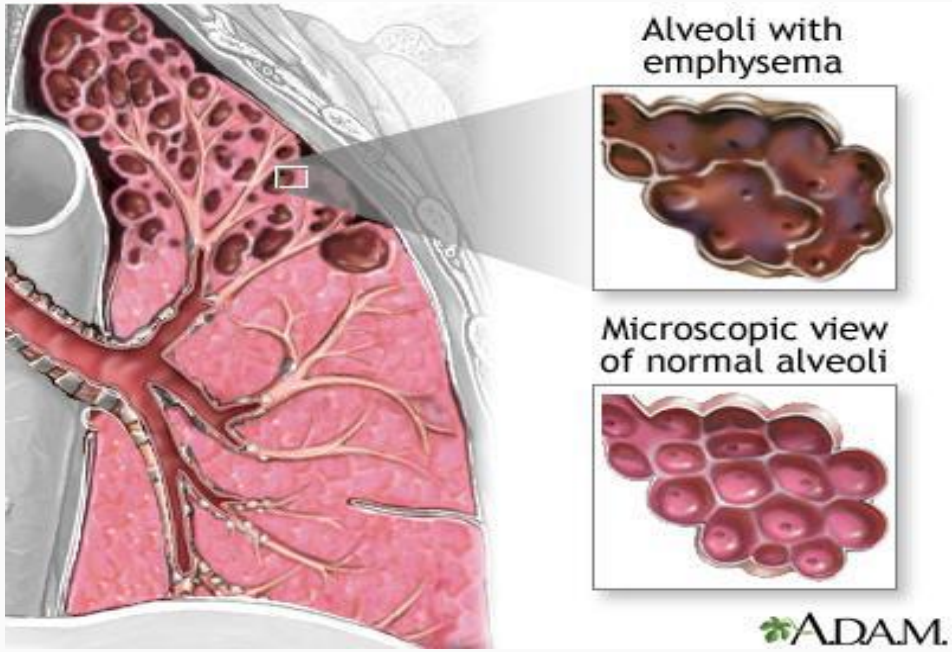


Chronic obstructive pulmonary disease

COPD:- Is a common lung disease. Having COPD makes it hard to breathe.

There are two main forms of COPD:

- **Chronic bronchitis**: which involves a long-term cough with mucus
- **Emphysema**: which involves damage to the lungs over time

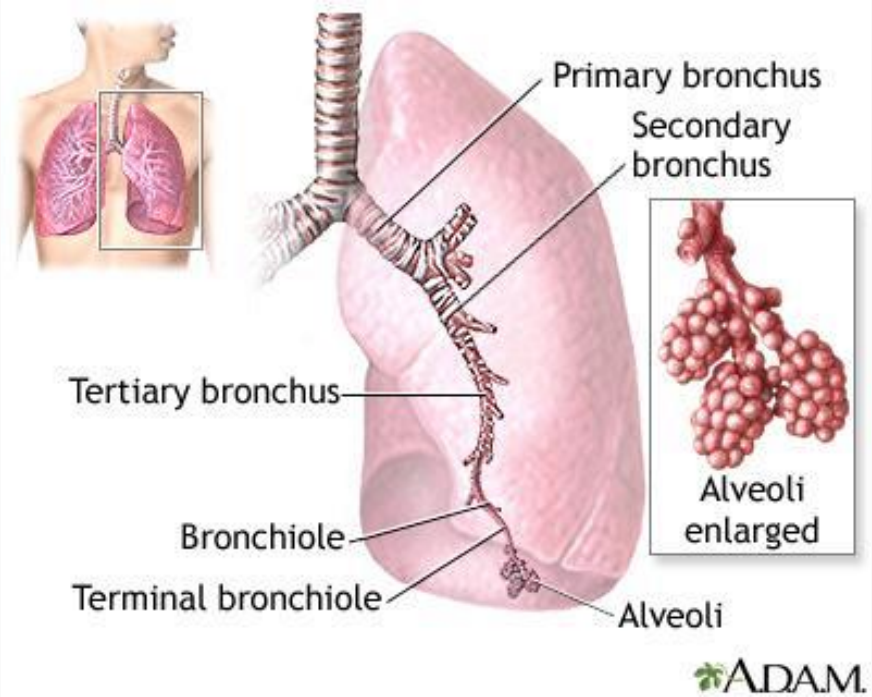


Smoking is the main cause of COPD

Pulmonary edema

Pulmonary edema:-

- ❖ is an abnormal buildup of fluid in the lungs.
- ❖ This buildup of fluid leads to shortness of breath.



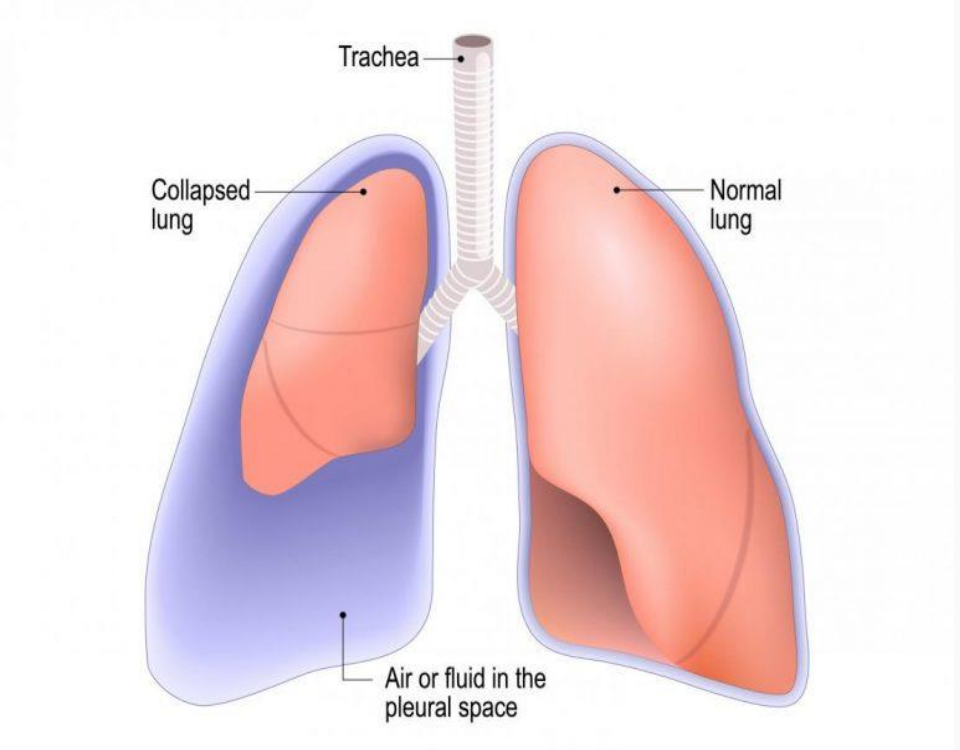
Causes:-

- Heart failure
- High blood pressure
- Lung damage
- Kidney failure
- High altitude exposure

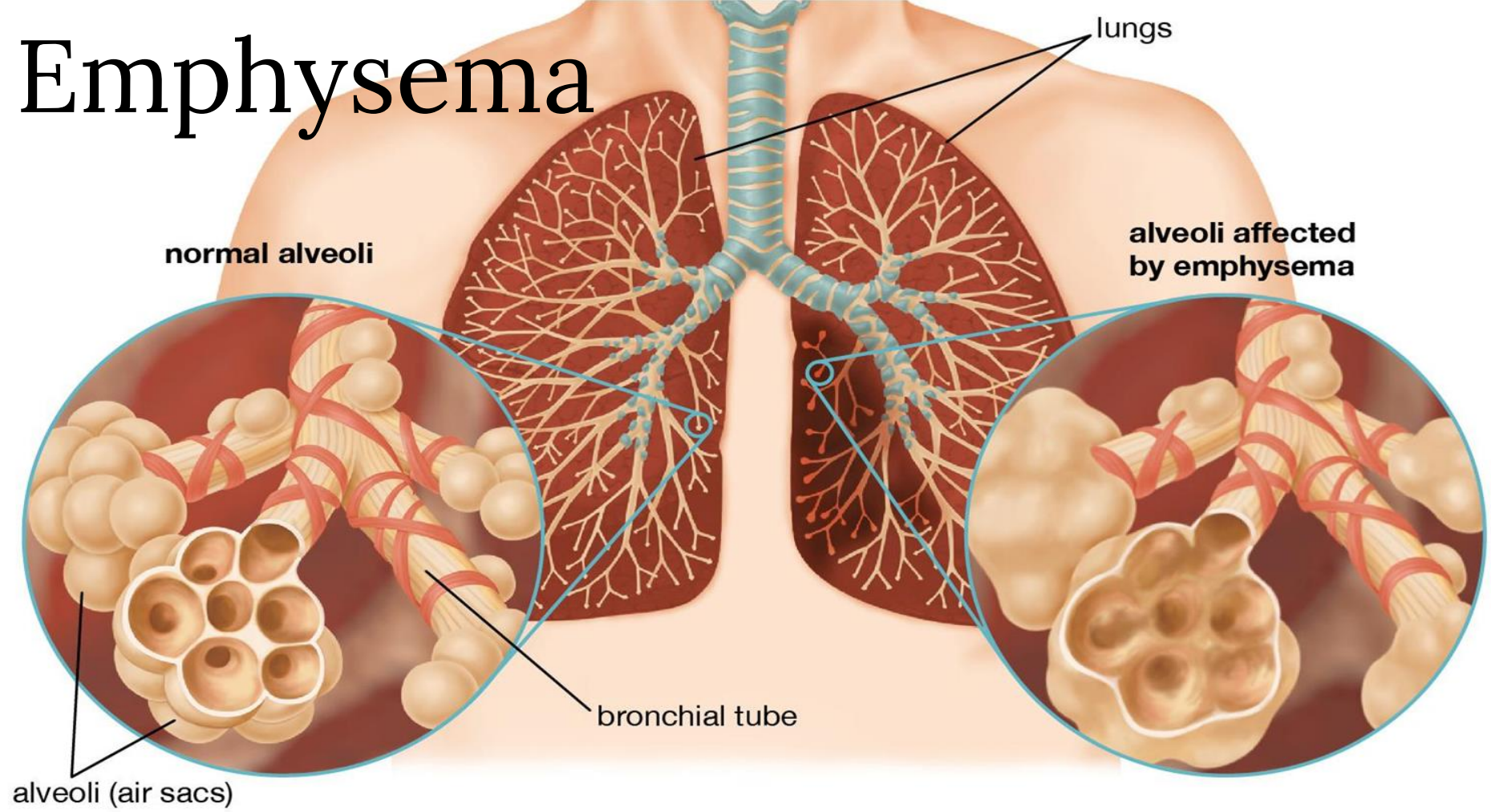
Pneumothorax

collapsed lung (Pneumothorax)

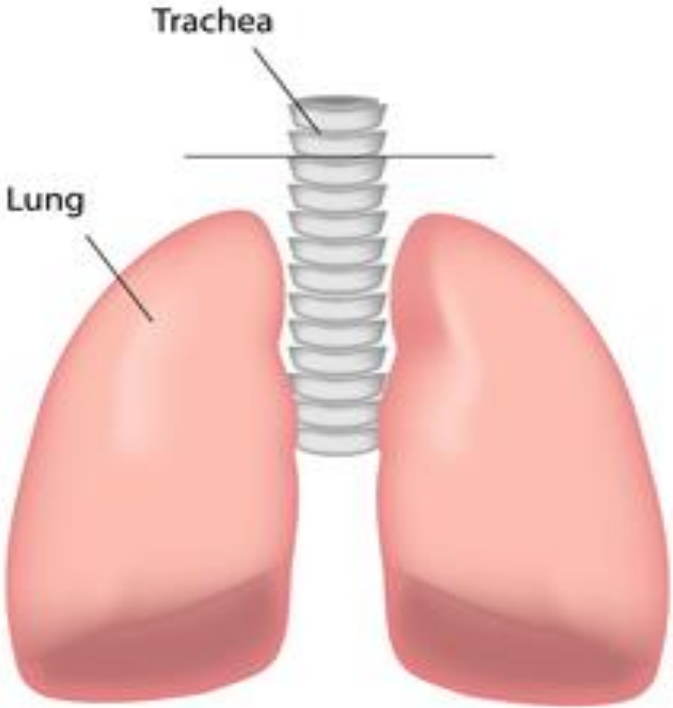
- occurs when air escapes from the lung.
- The air then fills the space outside of the lung, between the lung and chest wall.
- This buildup of air puts pressure on the lung, so it cannot expand as much as it normally does when you take a breath.

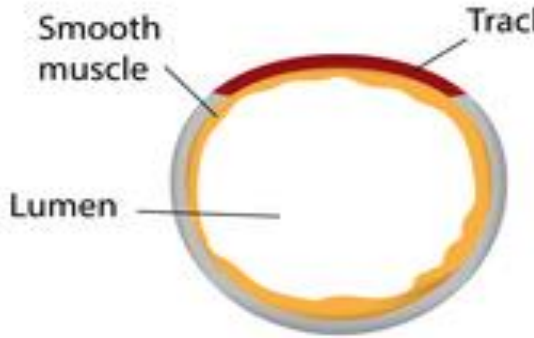


Emphysema

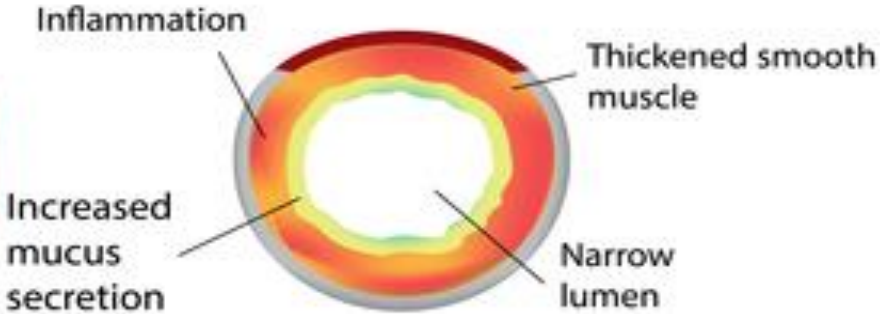


Cystic Fibrosis



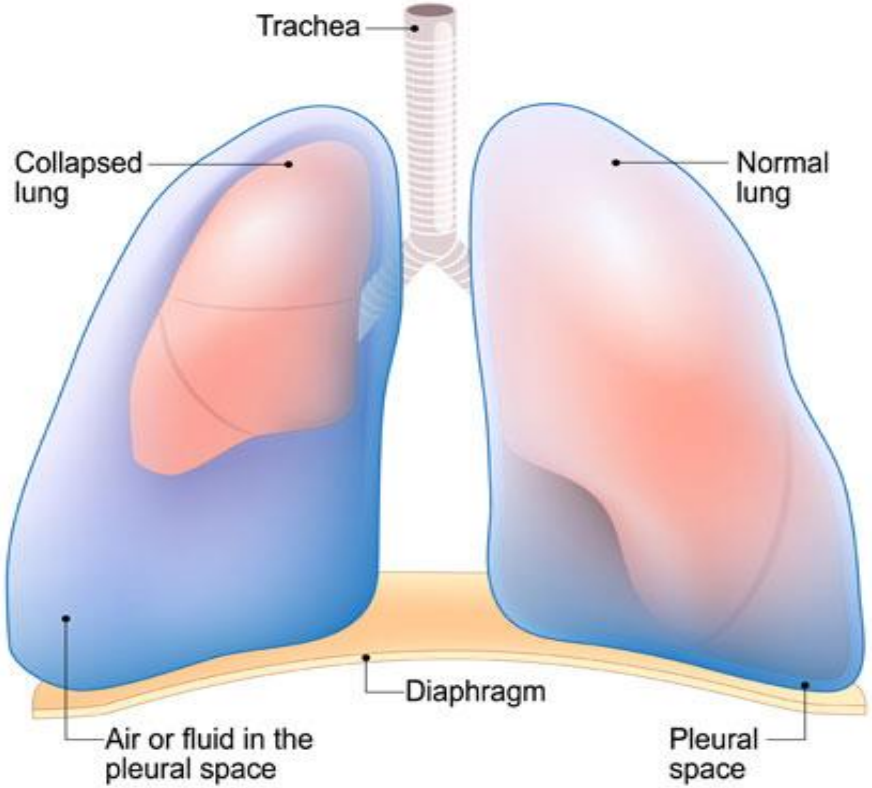


Healthy

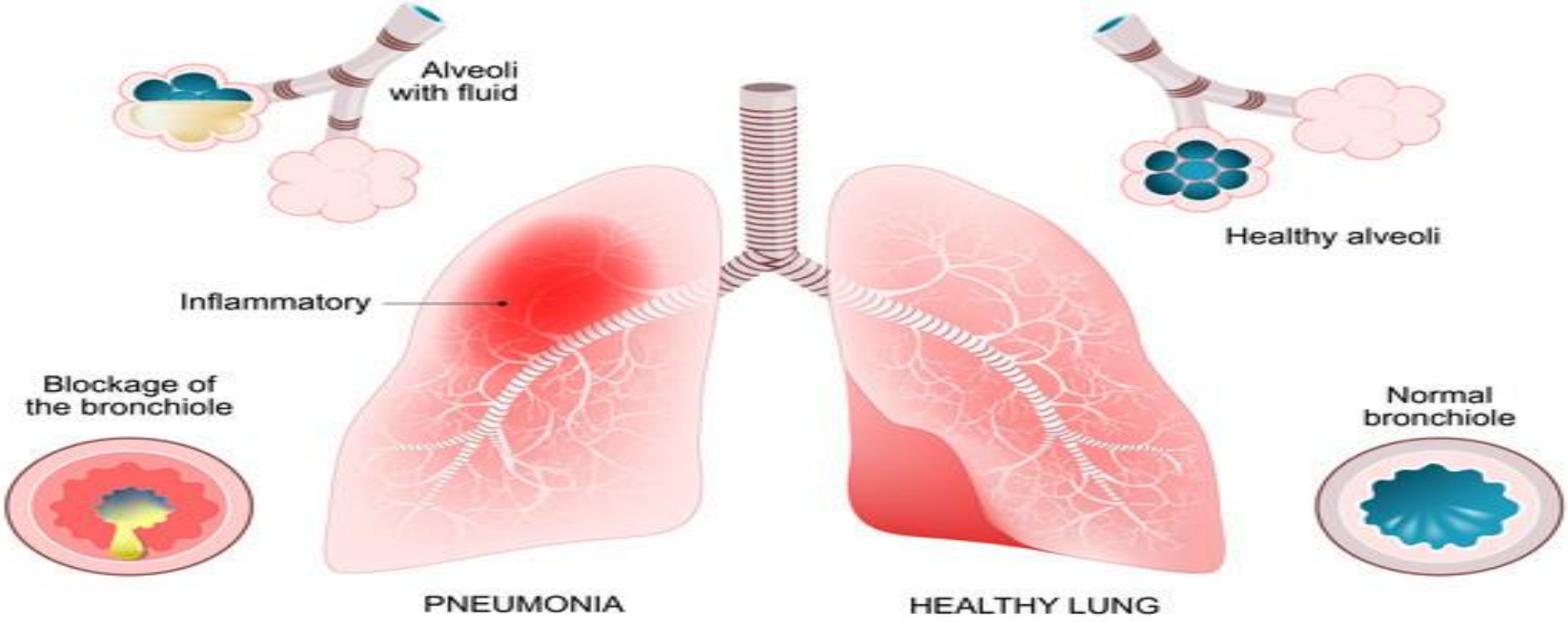


Cystic Fibrosis

Pleural Effusion



Pneumonia


Alveoli
with fluid
Healthy alveoli
Inflammatory
Blockage of
the bronchiole
Normal
bronchiole
PNEUMONIA
HEALTHY LUNG

AI in pneumonia Detection

RSNA Pneumonia Detection Challenge (2018)

In this challenge their are:-

- Over 1,400 teams participating in the training phase.
- The 10 top entries in the test phase were recognized at an event in the **AI Showcase** at RSNA's 2018 annual meeting.
- The dataset is a chest x-rays made public by the National Institutes of Health (**NIH**) and available by kaggle.
- NIH has **112,120** X-ray images with disease labels from **30,805** unique patients

OSIC Pulmonary Fibrosis Progression

predict a patient's severity of decline in lung function based on a CT scan of their lungs for checks in the last 3 weeks using forced vital capacity (FVC)

- Open Source Imaging Consortium (OSIC)
- Detect the Pulmonary Fibrosis using 176 cases and 750 images. From 20 to 500 image for every patient within 2 year follow up using 4 classes
- using Image format Digital imaging and communication in medicine (DICOM) which is a standard protocol for the management and transmission of medical images and related data and is used in many healthcare facilities.

CheXpert

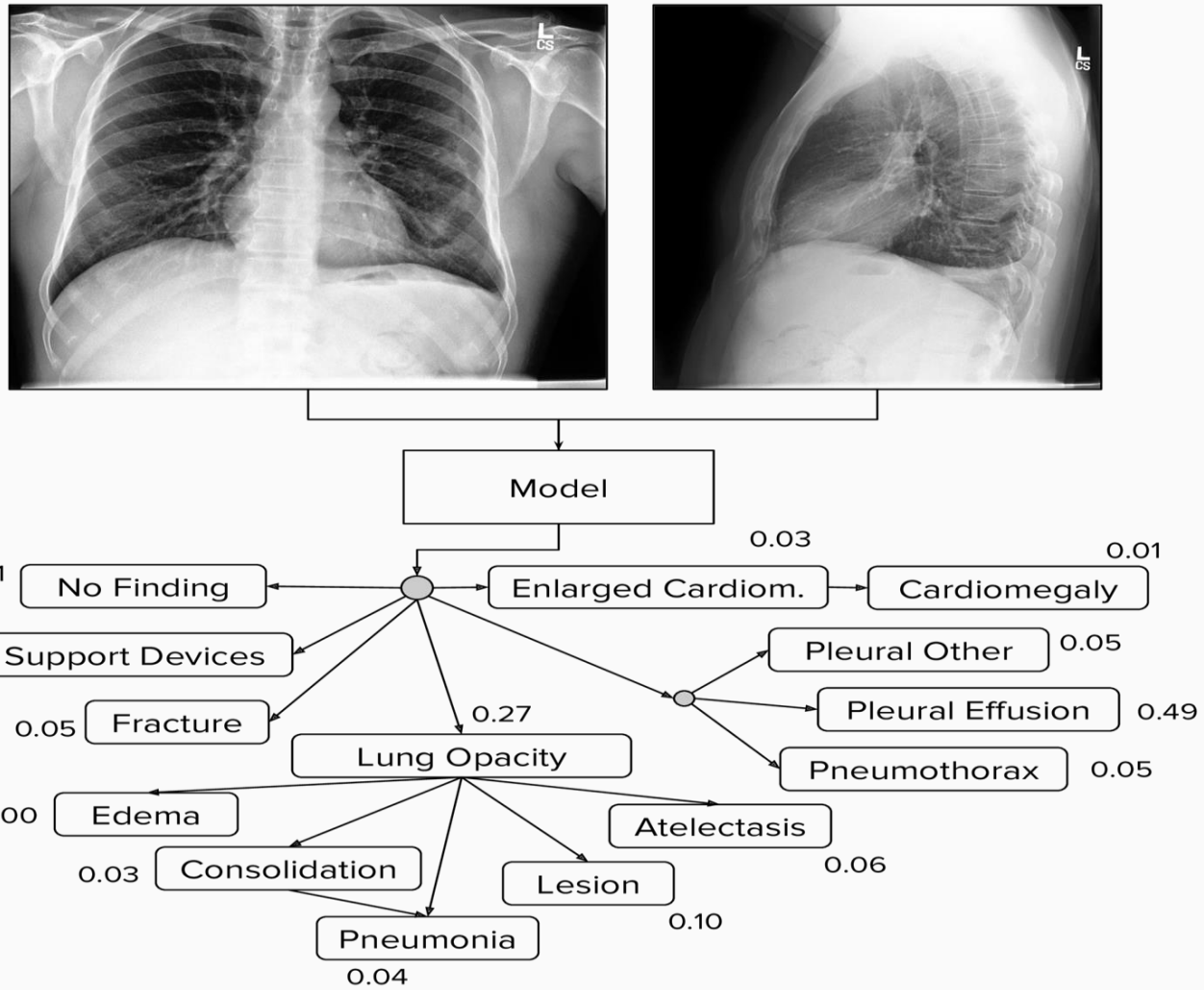
CheXpert is a large dataset of chest X-rays and competition.

- CheXpert is a large public dataset for chest radiograph interpretation.
- consisting of **224,316** chest radiographs of 65,240 patients from **Stanford Hospital** between October 2002 and July 2017

CheXpert Classes

Pathology	Positive (%)	Uncertain (%)	Negative (%)
No Finding	16627 (8.86)	0 (0.0)	171014 (91.14)
Enlarged Cardiom.	9020 (4.81)	10148 (5.41)	168473 (89.78)
Cardiomegaly	23002 (12.26)	6597 (3.52)	158042 (84.23)
Lung Lesion	6856 (3.65)	1071 (0.57)	179714 (95.78)
Lung Opacity	92669 (49.39)	4341 (2.31)	90631 (48.3)
Edema	48905 (26.06)	11571 (6.17)	127165 (67.77)
Consolidation	12730 (6.78)	23976 (12.78)	150935 (80.44)
Pneumonia	4576 (2.44)	15658 (8.34)	167407 (89.22)
Atelectasis	29333 (15.63)	29377 (15.66)	128931 (68.71)
Pneumothorax	17313 (9.23)	2663 (1.42)	167665 (89.35)
Pleural Effusion	75696 (40.34)	9419 (5.02)	102526 (54.64)
Pleural Other	2441 (1.3)	1771 (0.94)	183429 (97.76)
Fracture	7270 (3.87)	484 (0.26)	179887 (95.87)
Support Devices	105831 (56.4)	898 (0.48)	80912 (43.12)

baseline model



Leaderboard

Rank	Date	Model	AUC	Num Rads Below Curve
1	Aug 31, 2020	SuperCNN *ensemble*	0.930	2.8
2	Sep 01, 2019	Hierarchical-Learning-V1 (ensemble) *Vingroup Big Data Institute* https://arxiv.org/abs/1911.06475	0.930	2.6
3	Oct 15, 2019	Conditional-Training-LSR *ensemble*	0.929	2.6
4	Dec 04, 2019	Hierarchical-Learning-V4 (ensemble) *Vingroup Big Data Institute* https://arxiv.org/abs/1911.06475	0.929	2.6
5	Oct 10, 2019	YWW(ensemble) *JF&NNU* https://github.com/jfhealthcare/Chexpert	0.929	2.8

CheXNet

Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning developed by Stanford ML Group

- The model was trained using NIH dataset which contains 112,120 image and 14 classes.
- They label images that have pneumonia as positive and label all other images as negative.

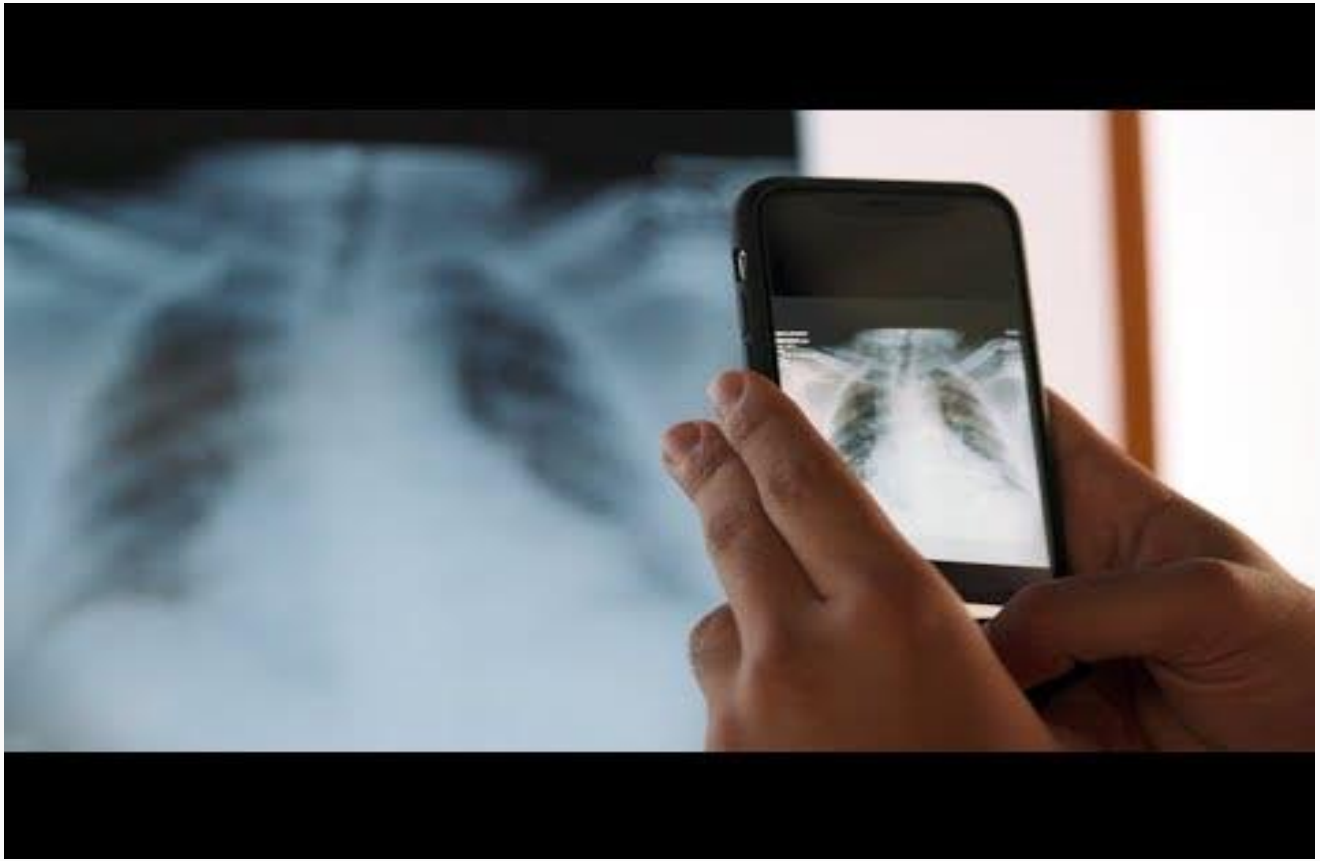
CheXNet Model

CheXNet
121-layer CNN

Model Output

	F1 Score (95% CI)
Radiologist 1	0.383 (0.309, 0.453)
Radiologist 2	0.356 (0.282, 0.428)
Radiologist 3	0.365 (0.291, 0.435)
Radiologist 4	0.442 (0.390, 0.492)
Radiologist Avg.	0.387 (0.330, 0.442)
CheXNet	0.435 (0.387, 0.481)

CheXNet Demo



Reference

- https://www.unitypoint.org/homecare/article.aspx?id=2448b930-1451-43e4-8634-c0c16707c749
- https://www.webmd.com/lung/lung-diseases-overview
- https://medlineplus.gov/ency/article/000066.htm
- https://medlineplus.gov/ency/article/000141.htm
- https://medlineplus.gov/ency/article/000091.htm
- https://www.unitypoint.org/homecare/article.aspx?id=2448b930-1451-43e4-8634-c0c16707c749
- https://medlineplus.gov/ency/article/000140.htm
- https://www.rsna.org/en/education/ai-resources-and-training/ai-image-challenge/RSNA-Pneumonia-Detection-Challenge-2018
- https://www.businesswire.com/news/home/20191001006176/en/AI-System-Accurately-Detects-Key-Findings-Chest/
- https://stanfordmlgroup.github.io/projects/chexnet/
- https://www.kaggle.com/c/osic-pulmonary-fibrosis-progression/data
- https://www.kaggle.com/c/osic-pulmonary-fibrosis-progression/overview

Thank You :)