

# Chronic Obstructive Pulmonary Disease

**By**

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# Case history

A 56-year-old man with a **smoking history** of 1 pack per day for the past 37 years presents with **progressive shortness** of breath and chronic productive cough of **yellowish sputum**, for the past 2 years.

On examination, he appears in moderate **respiratory distress**, especially after walking to the examination room, and has **pursed-lip breathing**.

Lung examination reveals a **barrel chest** and poor air entry bilaterally, with moderate diffuse expiratory **wheezing**. Heart and abdominal examination are within normal limits. Lower extremities exhibit scant **pitting edema**.

# Burden of COPD

**COPD is a leading cause of morbidity & mortality worldwide**

**The burden will increase in coming decades due to continued exposure to risk factors & the aging of the world's population**

**COPD is associated with significant economic burden**

# Mortality :

*Global burden of Disease study: COPD rank*

## World's Top Ten Killers

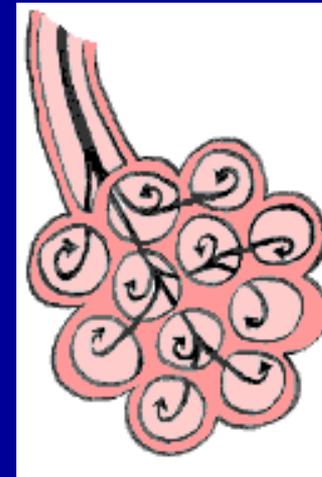
# 2020



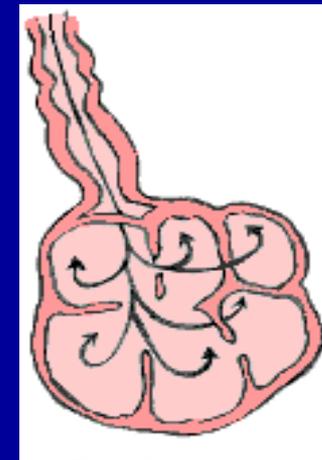


# Definition of COPD

- ❖ COPD, a common preventable disease, characterized by airflow limitation which is **persistent (not fully reversible)** usually **progressive** and associated with an enhanced **chronic inflammatory** response in the airways and the lung to noxious particles or gases.
- ❖ **The most common respiratory diseases related to smoking.**



Healthy Alveolus



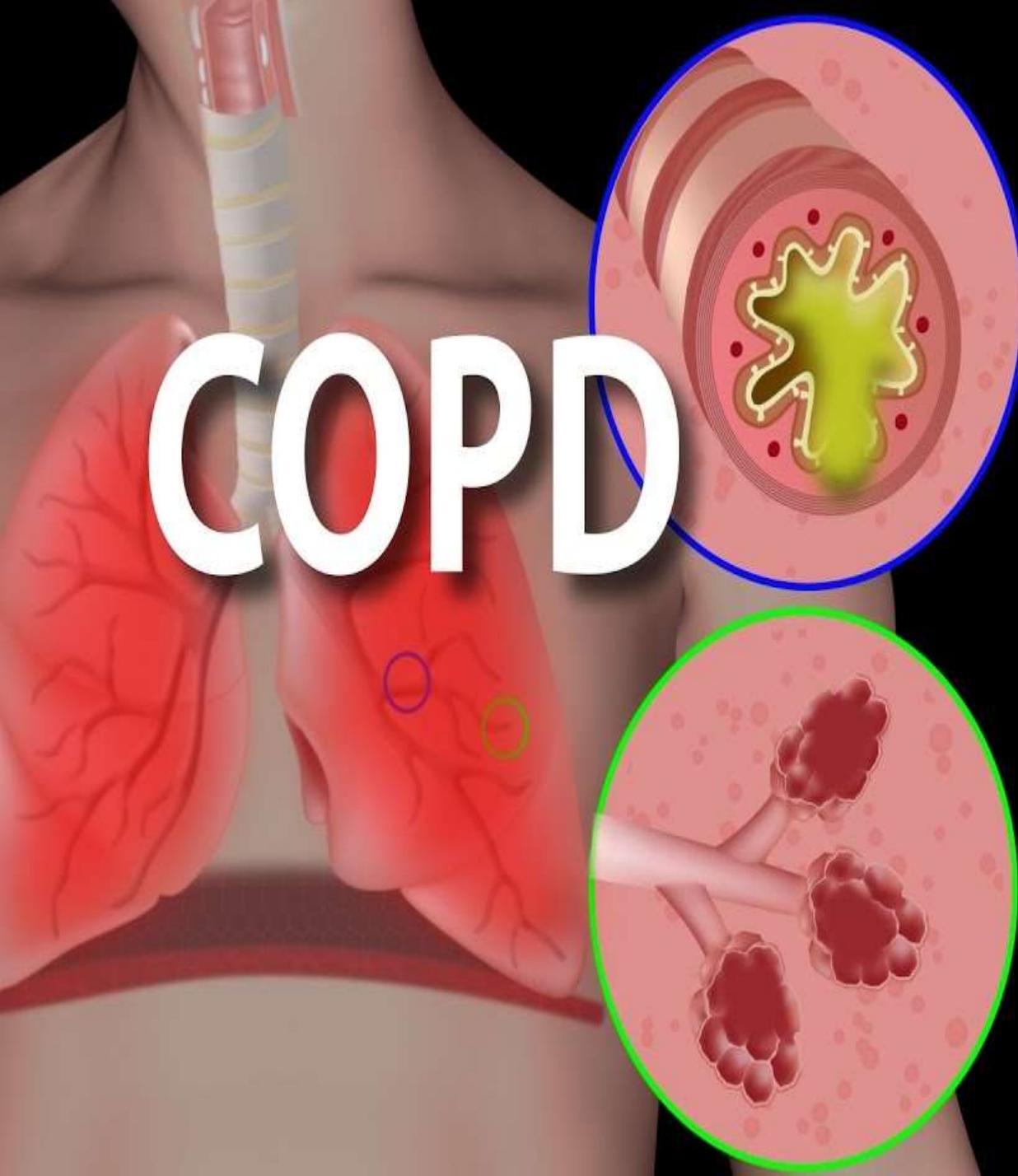
COPD

**Which of the following diseases is included in the umbrella term COPD?**

- A. Emphysema**
- B. Chronic bronchitis**
- C. Lung cancer**
- D. A and B**



# COPD



Chronic  
Bronchitis



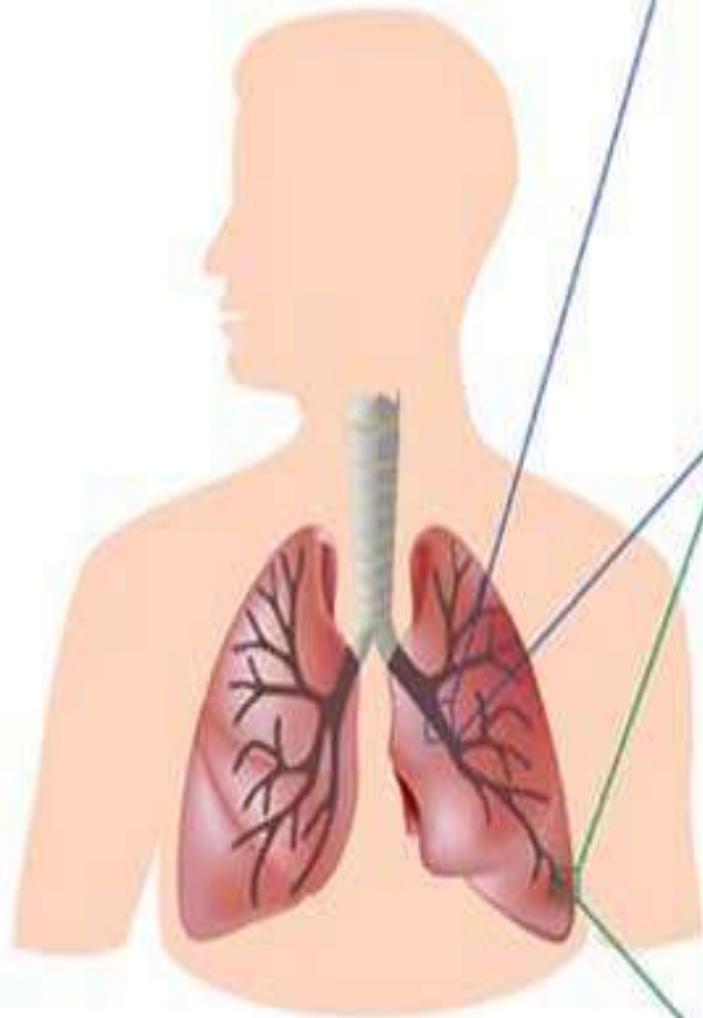
Emphysema

# Pathologic Types

# B- Chronic Bronchitis

Presence of chronic **productive cough** for 3 months / year for 2 successive years **after exclusion** of other causes of chronic productive cough

# Chronic Obstructive Pulmonary Disease (COPD)



## ***Chronic Bronchitis***

Healthy



Inflammation  
& excess mucus



## ***Emphysema***

Healthy



Alveolar membranes  
break down



# A- Emphysema

- Abnormal **permanent enlargement** of the air space distal to the terminal bronchioles
- Accompanied by **destruction** of the alveolar wall.



Alveoli with emphysema



Microscopic view of normal alveoli



# Pathophysiological changes in emphysema

- Hyperinflation of alveoli
- Destruction of alveolar walls
- Destruction of alveolar capillary walls
- Loss of lung elasticity
- Narrowed airways

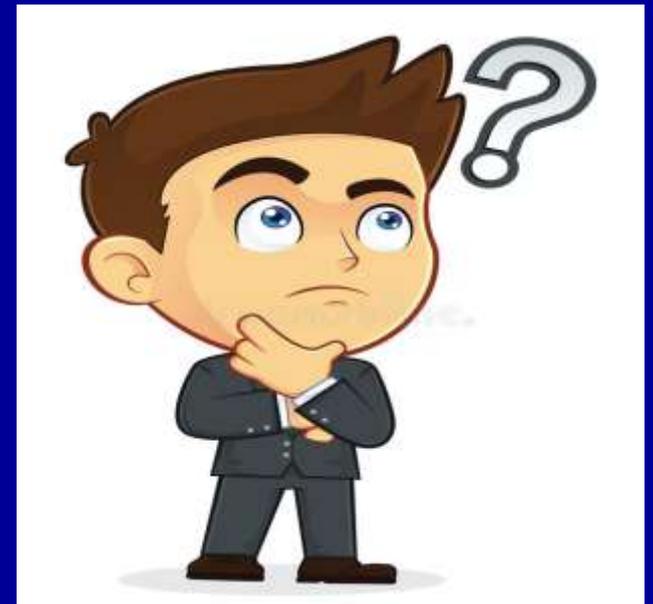
**COPD is almost always caused by .....**

**A. Pollution**

**B. Dust**

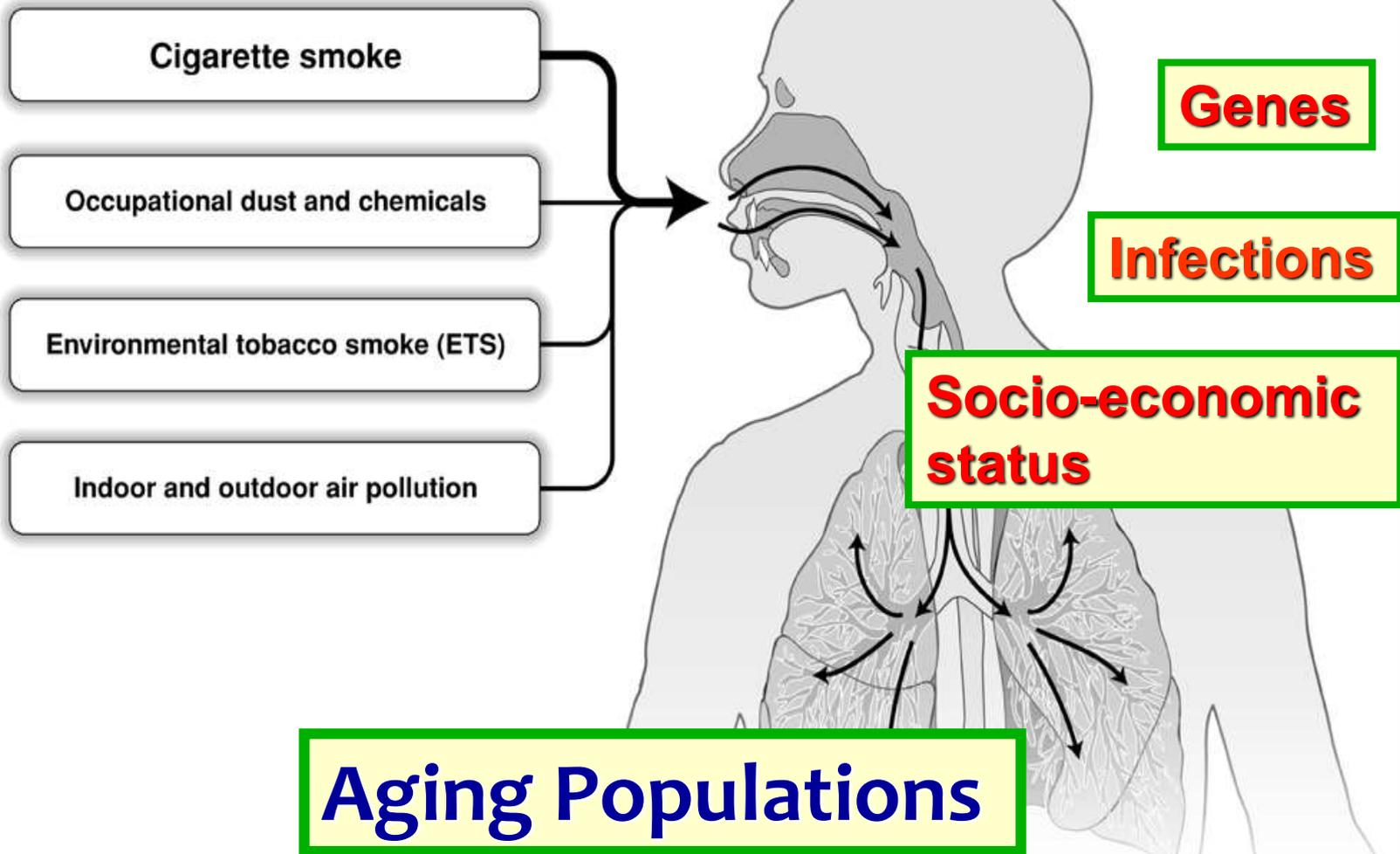
**C. Smoking**

**D. Exposure to asbestos**





# Risk Factors for COPD



# Risk Factors for COPD

- **Tobacco smoking** is the **main risk factor** for COPD, although other **inhaled noxious particles** and gases may contribute.
- **Smoking causes COPD by these mechanisms:**
  - **Inflammation**
  - **Imbalance of proteases and anti- proteases**
  - **Oxidative stress.**

## Smoke

- Particles
- Chemicals
- Reactive oxygen species

Inflammation

Activation of  
neutrophils

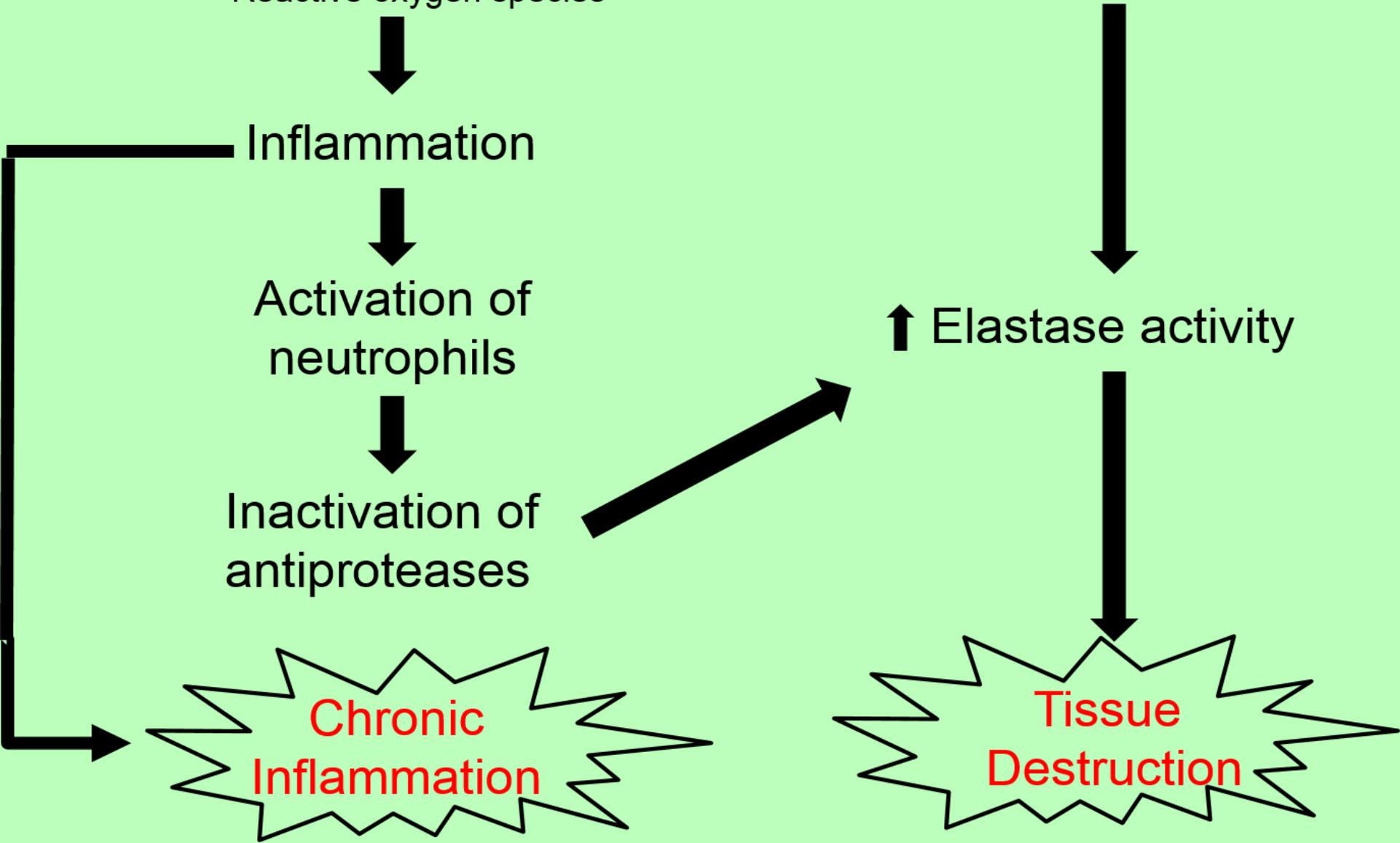
Inactivation of  
antiproteases

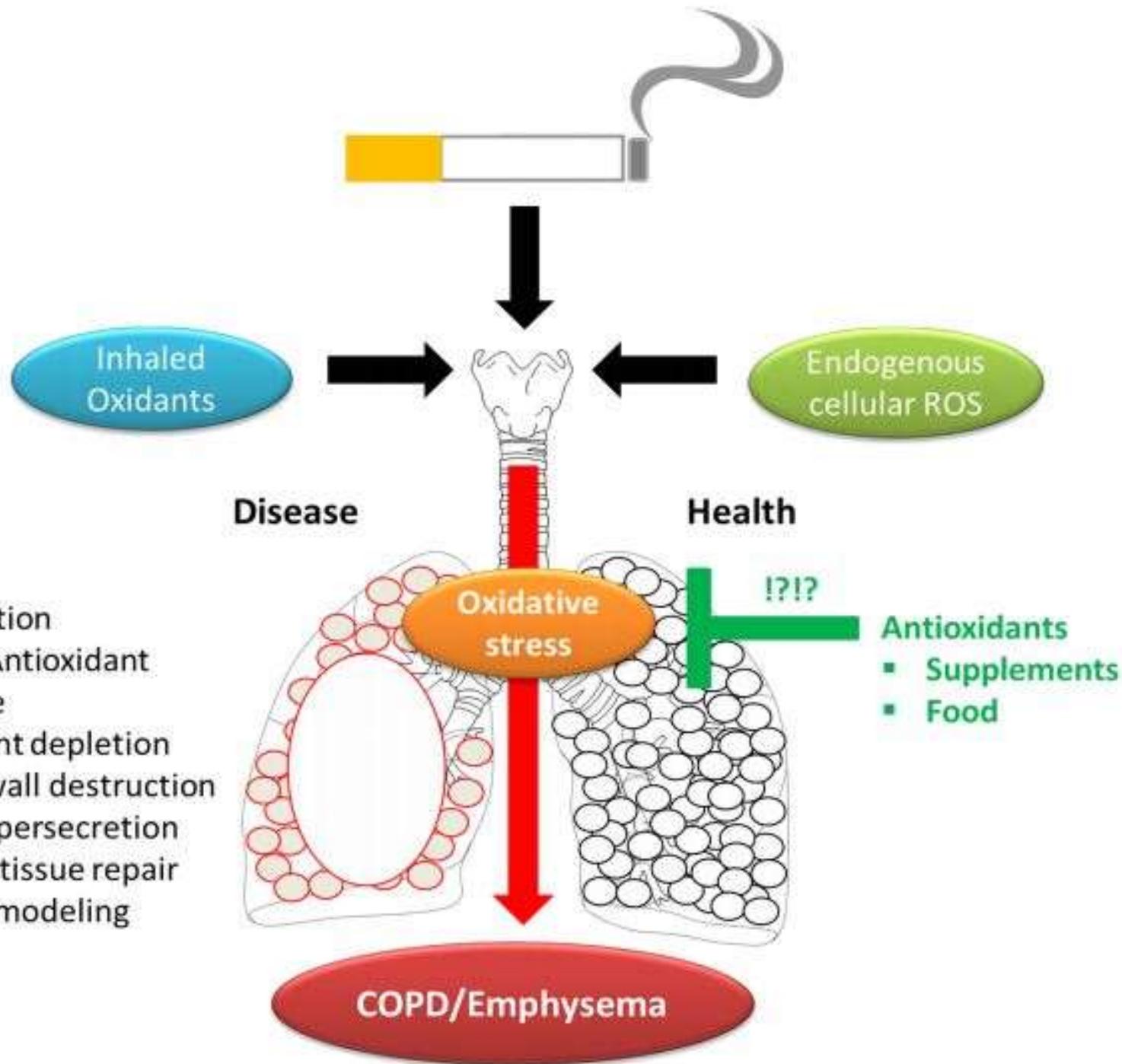
**Chronic  
Inflammation**

## Hereditary deficiency in $\alpha_1$ -antitrypsin

↑ Elastase activity

**Tissue  
Destruction**



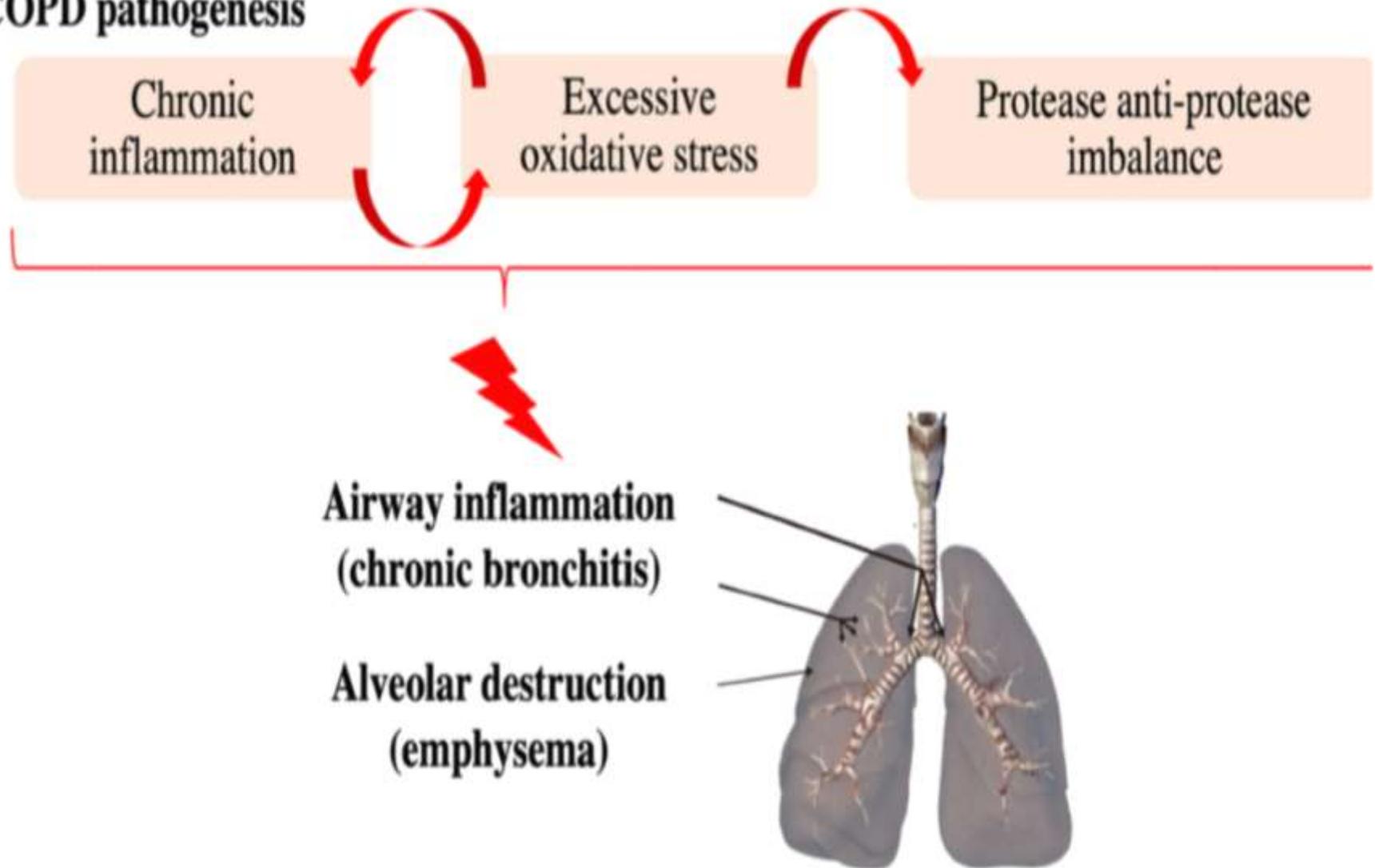


- Inflammation
- Oxidant/Antioxidant imbalance
- Antioxidant depletion
- Alveolar wall destruction
- Mucus hypersecretion
- Defective tissue repair
- Airway remodeling

- Antioxidants
  - Supplements
  - Food

COPD/Emphysema

## COPD pathogenesis



**90 %** of COPD patient are smoker.  
**10-20% of smokers** develop COPD.

# Risk Factors for COPD

- **Infection**

- Major contributing factor in **exacerbation** and progression of COPD

- **Heredity**

- **$\alpha$ -Antitrypsin (AAT) deficiency** (produced by liver and found in lungs); accounts for **< 1%** of COPD cases
- Emphysema results from destruction of lung tissues by **proteolytic enzymes** from neutrophils and macrophages

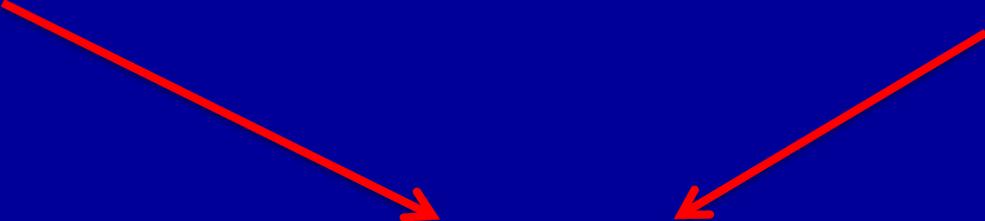
# Mechanisms of Airflow Limitation in COPD

## Small Airways Disease

- Airway inflammation
- Mucus hypersecretions
- Airway fibrosis,

## Parenchymal Destruction

- Loss of alveolar attachments ► Decrease of elastic recoil



**Airflow limitation**

# CHRONIC BRONCHITIS

CLINICAL DIAGNOSIS: DAILY PRODUCTIVE COUGH FOR THREE MONTHS OR MORE, IN AT LEAST TWO CONSECUTIVE YEARS

OVERWEIGHT AND CYANOTIC



ELEVATED HEMOGLOBIN



PERIPHERAL EDEMA



RHONCHI AND WHEEZING



# EMPHYSEMA

PATHOLOGIC DIAGNOSIS: PERMANENT ENLARGEMENT AND DESTRUCTION OF AIRSPACES DISTAL TO THE TERMINAL BRONCHIOLE

OLDER AND THIN



SEVERE DYSPNEA



X-RAY: HYPERINFLATION WITH FLATTENED DIAPHRAGMS

QUIET CHEST

# Clinical Picture of COPD

- Cough
- Expectoration
- Chest Wheeze
- Progressive dyspnea



# Global Strategy for Diagnosis, Management and Prevention of COPD

## Modified MRC (mMRC) Questionnaire

PLEASE TICK IN THE BOX THAT APPLIES TO YOU  
(ONE BOX ONLY)

mMRC Grade 0. I only get breathless with strenuous exercise.

mMRC Grade 1. I get short of breath when hurrying on the level or walking up a slight hill.

mMRC Grade 2. I walk slower than people of the same age on the level because of breathlessness, or I have to stop for breath when walking on my own pace on the level.

mMRC Grade 3. I stop for breath after walking about 100 meters or after a few minutes on the level.

mMRC Grade 4. I am too breathless to leave the house or I am breathless when dressing or undressing.

# Signs of COPD

## General examination

- Tripod position with pursed lip breathing
- ↑Respiratory Rate
- Cyanosis
- Flapping tremors
- Pitting lower limb edema





# Signs of COPD

## Inspection / Palpation

- Bilateral Diminished chest expansion
- Litten 's sign
- Barrel chest
- Tracheal tug



## Normal Chest vs. Barrel-Shaped Chest

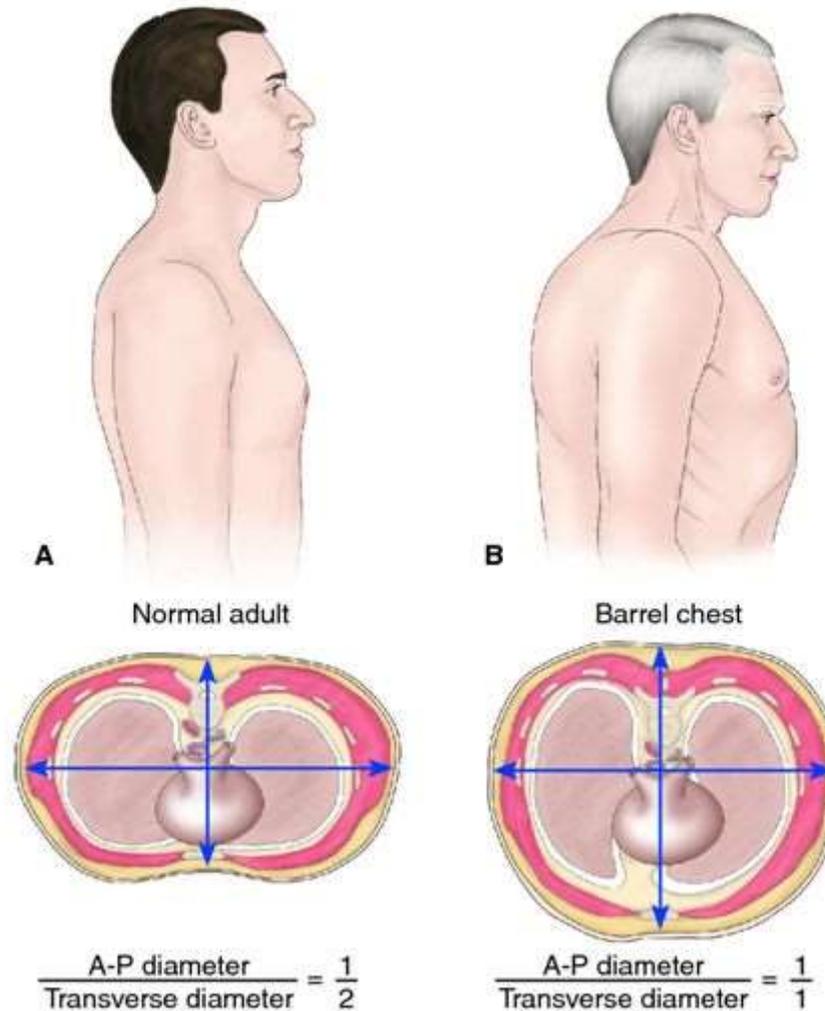


Figure 24-3

# Litten's sign



## **Percussion :**

- Hyperresonant chest
- Depressed diaphragm
- Resonant bare area of the heart

## **Auscultation:**

- Harsh vesicular BS with Prolonged expiration
- Wheezing during quiet or forced breathing
- Crackle can be heard if infection exist.
- The heart sounds are best heard over the xiphoid area.

# COPD

CHRONIC AIRFLOW LIMITATION  
"EMPHYSEMA AND CHRONIC BRONCHITIS"

- Easily Fatigued
- Frequent Respiratory Infections
- Use of Accessory Muscles to Breathe
- Orthopneic

- Wheezing
- Pursed-Lip Breathing
- Chronic Cough
- Barrel Chest
- Dyspnea
- Prolonged Expiratory Time

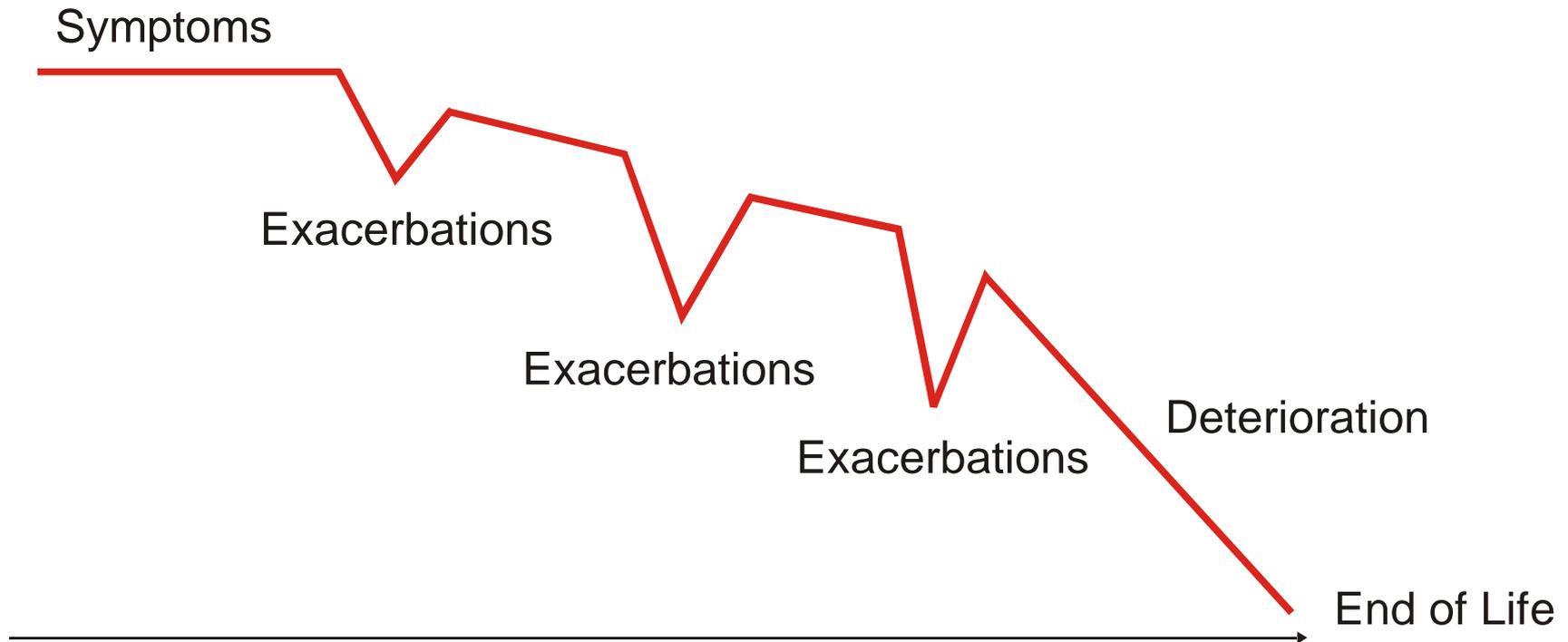
- Bronchitis - Increased Sputum

- Cor Pulmonale (Late in Disease)

- Thin in Appearance



# Disease Trajectory of a Patients with COPD



# Diagnosis of COPD

## Symptoms & Signs

cough

sputum

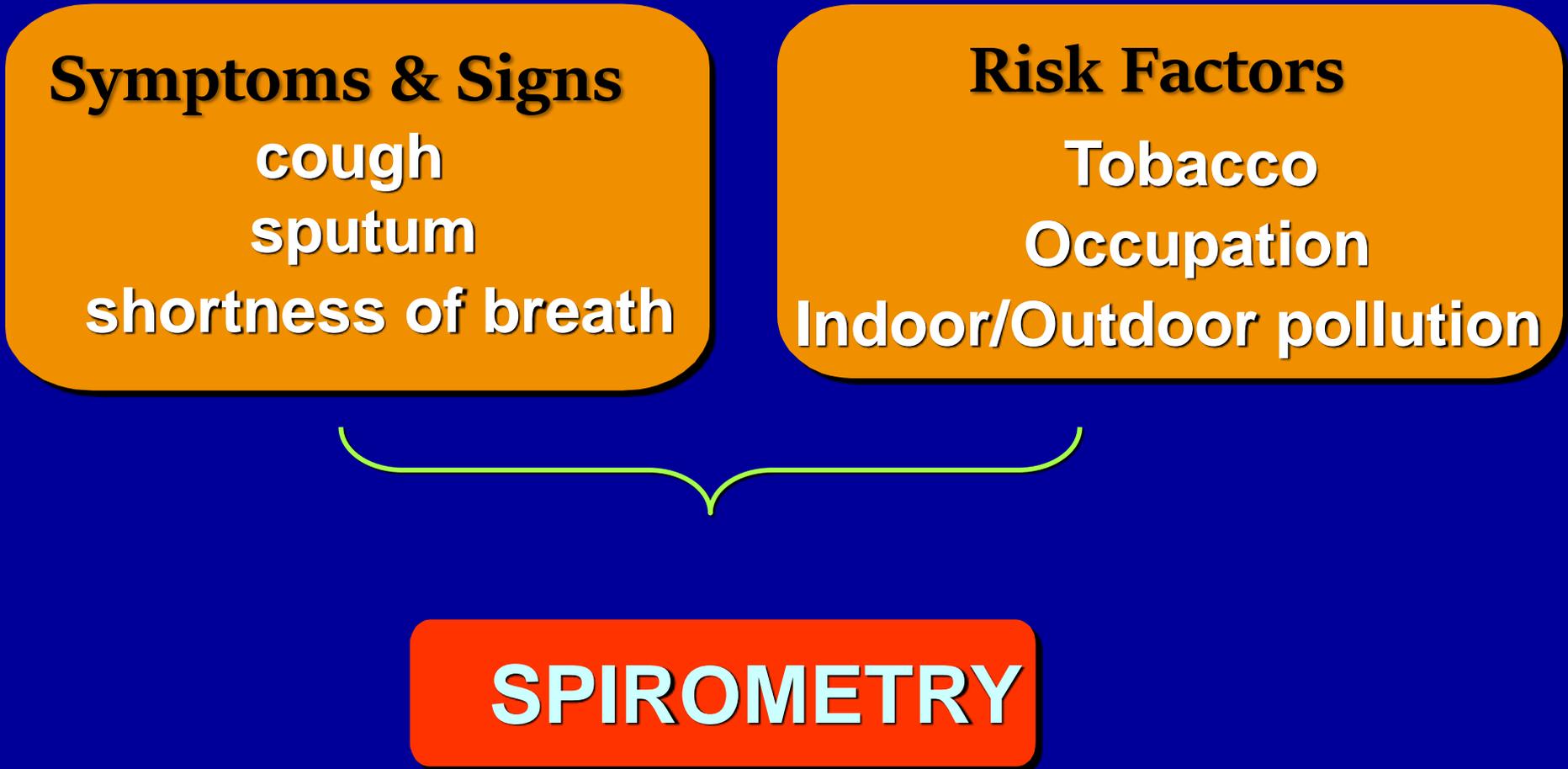
shortness of breath

## Risk Factors

Tobacco

Occupation

Indoor/Outdoor pollution



**SPIROMETRY**

# Spirometry

- ◆ Diagnosis
- ◆ Assessing severity
- ◆ Assessing prognosis
- ◆ Monitoring progression



# Spirometry

## Classification of Severity of Airflow Limitation in COPD (Based on Post - Bronchodilator FEV<sub>1</sub> )

In patients with post - bronchodilator FEV<sub>1</sub>/ FVC < 0.70

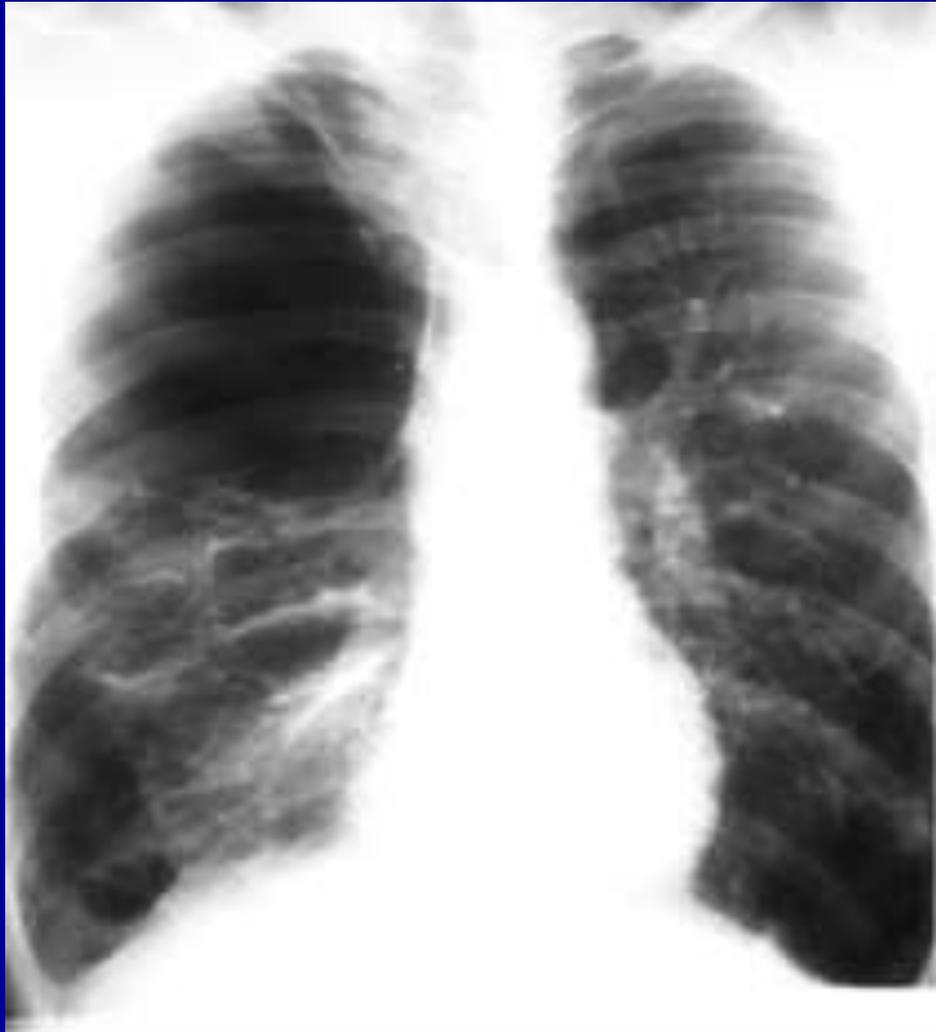
<b>GOLD 1</b>	<b>Mild</b>	<b>FEV<sub>1</sub> ≥ 80% predicted</b>
<b>GOLD 2</b>	<b>Moderate</b>	<b>≤ 50% FEV<sub>1</sub> &lt; 80% predicted</b>
<b>GOLD 3</b>	<b>Severe</b>	<b>≤ 30% FEV<sub>1</sub> &lt; 50% predicted</b>
<b>GOLD 4</b>	<b>Very severe</b>	<b>FEV<sub>1</sub> &lt; 30 % predicted</b>

# Chest X-ray

## **Radiological signs of Hyperinflation:**

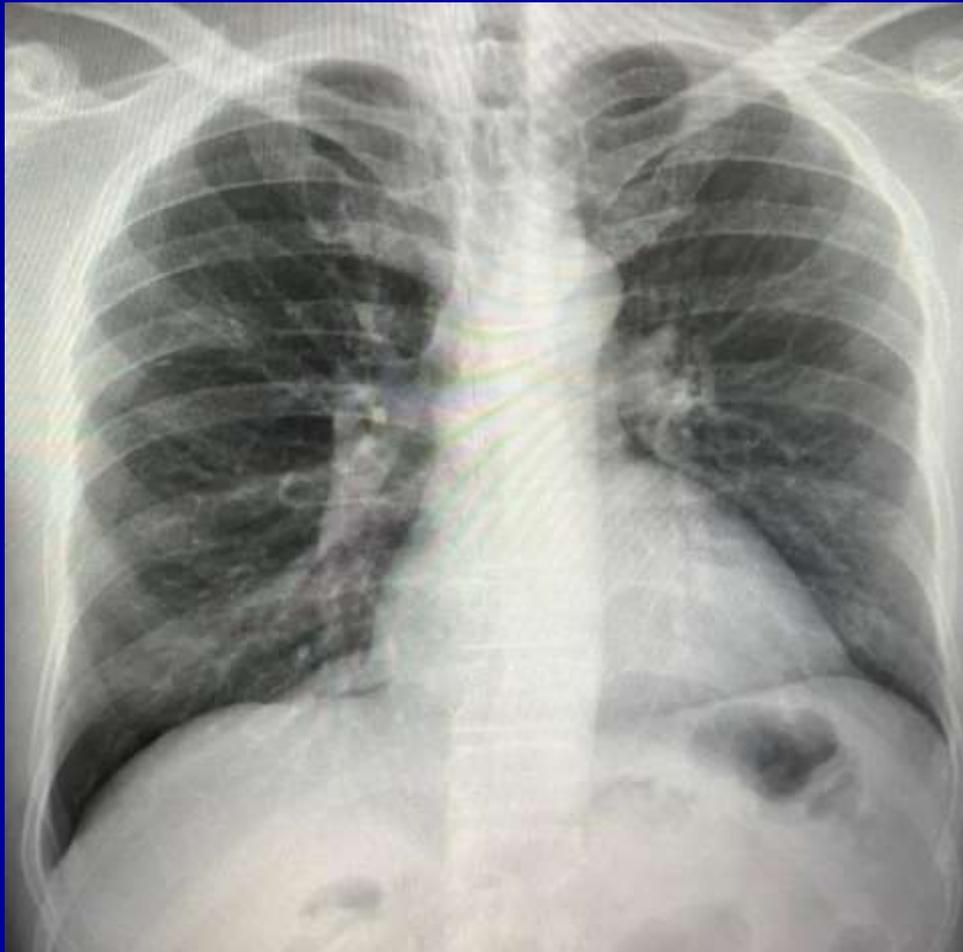
- ✓ Low flat diaphragm with indentation
- ✓ Intercostal space becomes widen
- ✓ Horizontal pattern of ribs
- ✓ A long thin heart shadow
- ✓ Decreased Bronchovascular markings of lung (airways & vessels)

# Chest X-ray - Emphysema



# Chest X-ray - Chronic Bronchitis

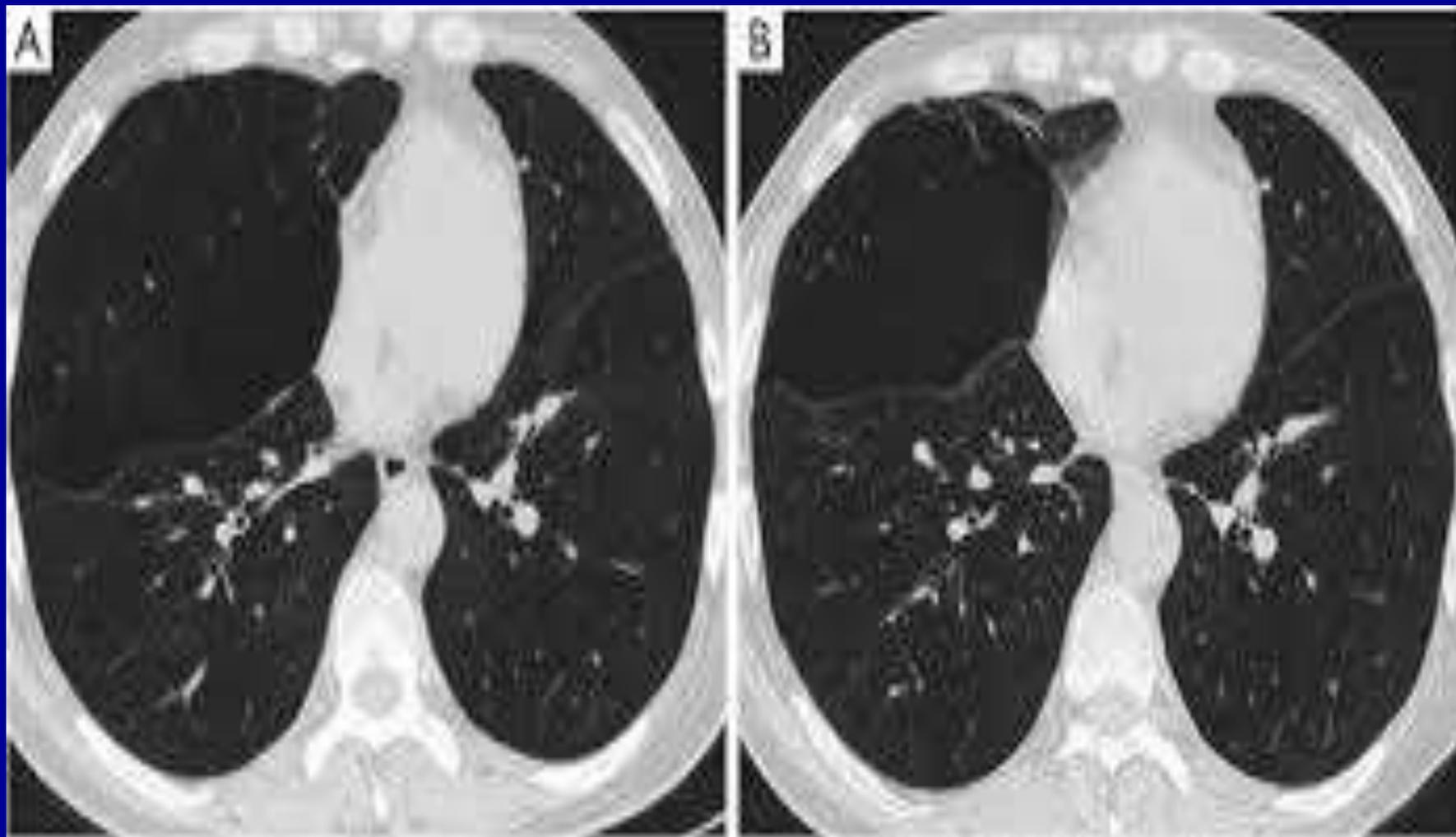
Thickened and increased of the lung markings, BVM



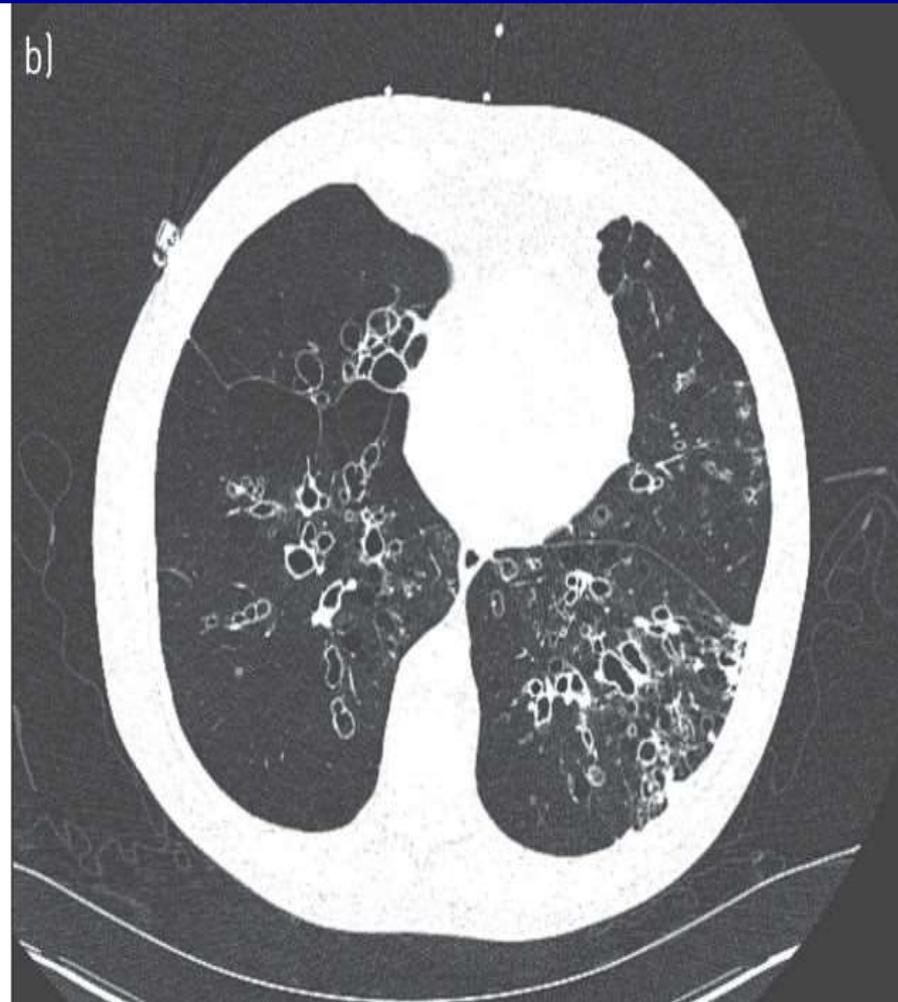
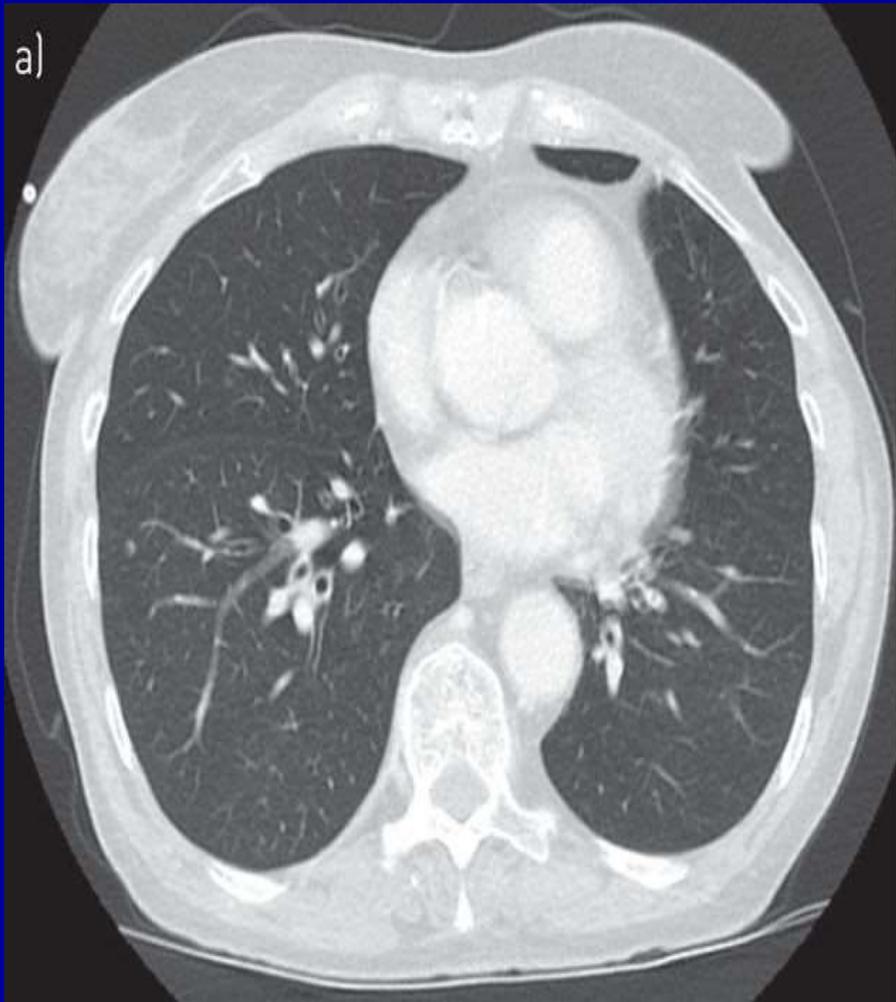
# CT Chest

- Greater **sensitivity and specificity** for emphysema than CXR
- Especially for the diagnosis of **bronchiectasis** and evaluation of **bullous disease**

# CT Chest



# CT Chest



# Diagnostic studies

- ABGs
  - ↓ PaO<sub>2</sub>
  - ↑ PaCO<sub>2</sub> (especially in chronic bronchitis)
  - ↓ pH (especially in chronic bronchitis)
  - ↑ Bicarbonate level found in late stages  
COPD

# Complications of COPD

- **Pulmonary hypertension**
- **Cor pulmonale** (Rt. ventricular enlargement  $\pm$  Heart Failure resulting from diseases that affect structure or function of the lungs)
- **Pneumothorax**
- **Respiratory Failure**
- **Lunge cancer**
- **Bronchiectasis**
- **Psychological disorders eg depression.**

## Clinical Differences Between Asthma and COPD

Clinical features	Asthma	COPD
Age of onset	Usually early childhood, but may have onset at any age	Usually > 40 years old
Smoking history	May be non-, ex- or current smoker	Usually > 10 pack-years
Atopy	Often	Infrequent
Family history	Asthma or other atopic disorders commonly present	Not a usual feature
Clinical symptoms	Intermittent and variable	Persistent and gradually progressive worsening
Cough	Nocturnal cough or on exertion	Morning cough with sputum
Sputum production	Infrequent	Often
Reversibility of airflow obstruction	Characteristic of asthma	Airflow limitation may improve but never normalises

# Differential diagnosis of COPD patients

## Respiratory

- Asthma
- Bronchiectasis
- ILD
- TB
- Recurrent PE
- OSAS

## Non-Respiratory

- Cardiac disease
- Vocal cord dysfunction
- Psychogenic

# TREATMENT OPTIONS FOR COPD

Self-Management Education and Smoking Cessation

Bronchodilators

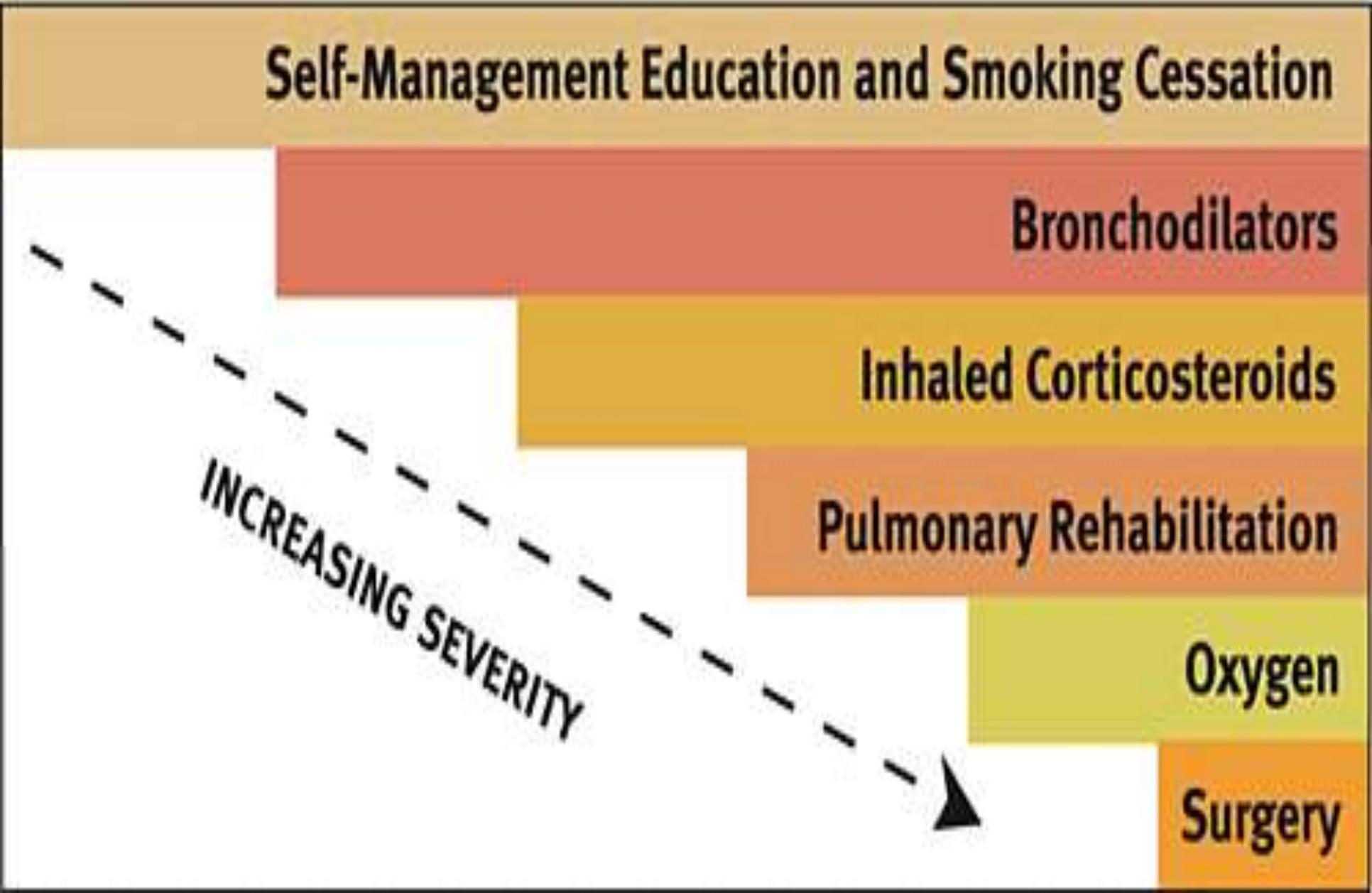
Inhaled Corticosteroids

Pulmonary Rehabilitation

Oxygen

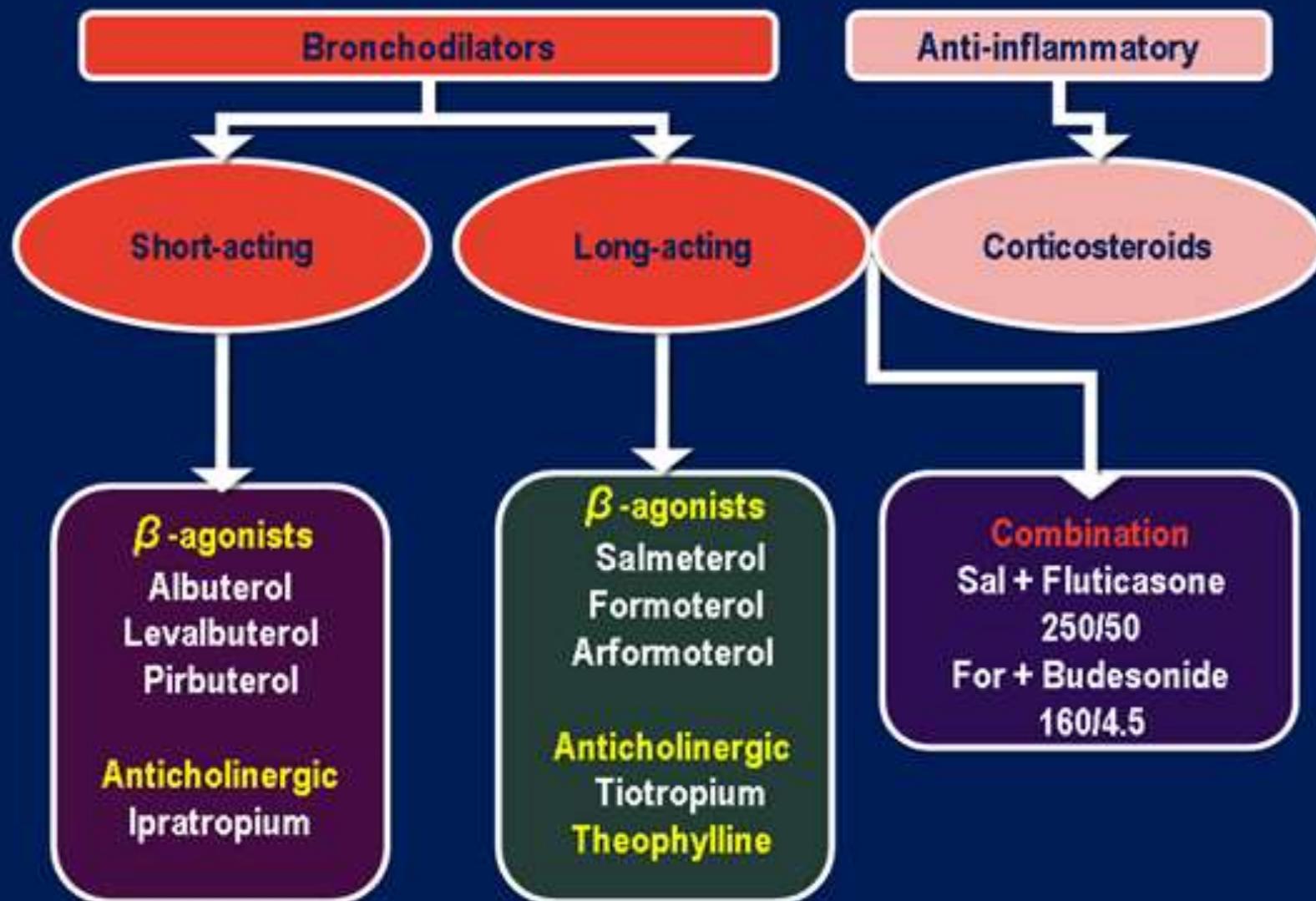
Surgery

INCREASING SEVERITY



The diagram illustrates a step-down approach to COPD treatment. It consists of six horizontal bars of decreasing length, each representing a treatment option. The bars are arranged in a descending staircase pattern from top-left to bottom-right. A dashed arrow points from the top-left towards the bottom-right, indicating that as the severity of COPD increases, more aggressive treatment options are required.

# Existing Pharmacologic Treatment Options in COPD





# Non-Pharmacological treatment in COPD



# Other Therapeutic Options

- **Smoking cessation** has the greatest capacity to influence the natural history of COPD
- **Nicotine replacement** reliably increase long-term smoking abstinence rates.
- **Influenza and pneumococcal vaccination** should be offered depending on local guidelines.
- **Alpha-1 antitrypsin augmentation therapy:** not recommended for patients with COPD that is unrelated to the genetic deficiency.
- **Mucolytics:** Patients with viscid sputum may benefit from Mucolytics; overall benefits are very small.

# Oxygen Therapy

## Chronic long term Oxygen therapy at home LTOT

- Improved prognosis
- Increased exercise tolerance
- Decreased hematocrit
- Reduced pulmonary hypertension

# Oxygen Therapy

- **Long-term oxygen therapy is generally introduced in Stage IV: for patients who have:**
  - PaO<sub>2</sub> < 55 mm Hg or SaO<sub>2</sub> < 88% or
  - PaO<sub>2</sub> 55-60 mm Hg or SaO<sub>2</sub> of 88-90%, if there is evidence of
    - Pulmonary hypertension,
    - Peripheral edema suggesting cor-pulmonale or
    - Polycythemia (hematocrit > 55%) .
- **The primary goal** is to increase PaO<sub>2</sub> to at least 60 mm Hg and SaO<sub>2</sub> at least 90%. This will preserve vital organ function without respiratory center depression.

# Surgical Treatment

**Lung volume reduction surgery (LVRS)** is more effective among patients with upper-lobe predominant emphysema and low exercise capacity.

In appropriately selected patients with very severe COPD, **lung transplantation** has been shown to improve quality of life and functional capacity.

# Acute exacerbation of COPD

- Acute exacerbation COPD is defined as acute **clinical deterioration** in patient's respiratory status
- The **cardinal symptoms** of COPD exacerbation includes:
  - **Worsening dyspnea.**
  - **Increase in sputum production.**
  - **Change in sputum color.**

# Assessing severity of exacerbation

- **Severe exacerbation;** have all three cardinal symptoms of acute exacerbation.
- **Moderate exacerbation;** exhibit two of the cardinal symptoms.
- **Mild exacerbation;** have **one of these** clinical findings plus at least one of the minor criteria:
  - Upper respiratory tract infection in the past 5 days.
  - Fever without other apparent cause.
  - Increased wheezing.
  - Increased cough.
  - Increase in respiratory rate or heart rate by 20 %.

# Acute exacerbation of COPD

## Causes

Most common bacterial and viral pathogens isolated from patients with COPD exacerbations

### Bacteria

- ✓ **Haemophiles influenzae**
- ✓ **Moraxella catarrhalis**
- ✓ **Streptococcus pneumoniae**
- ✓ **Pseudomonas aeruginosa**

### Viruses



- ✓ **Rhinovirus**
- ✓ **Parainfluenza**
- ✓ **Coronavirus**
- ✓ **Adenovirus**
- ✓ **Influenza**
- ✓ **Respiratory syncytial virus**

# Manage Exacerbations

- ❑ **Oxygen:** titrate to improve the patient's hypoxemia with a target saturation of 88-92% (controlled O<sub>2</sub> therapy).
- ❑ **Bronchodilators:** Short-acting inhaled beta<sub>2</sub>-agonists with short-acting anticholinergics are preferred.
- ❑ **Systemic Corticosteroids:** A dose of 30-40 mg Prednisolone daily for 7 days is recommended to:
  - Shorten recovery time,
  - Improve lung function (FEV<sub>1</sub>) and hypoxemia
  - ↓ Risk of early relapse, treatment failure,

# Manage Exacerbations

- ❑ **Antibiotics should be given to patients with:**
  - Three cardinal symptoms: increased dyspnea, increased sputum volume, and increased sputum purulence.
  
- ❑ **Aminophylline:** Intravenous infusion every 8 hours to be transformed into oral long acting preparation after improvement.

# Hospital management:

## Indications:

- Failure of response to outpatient management and still dyspnic.
- Co-morbid condition e.g pneumonia or embolism.
- Altered mentation.
- Worsening hypoxaemia or worsening hypercapnia

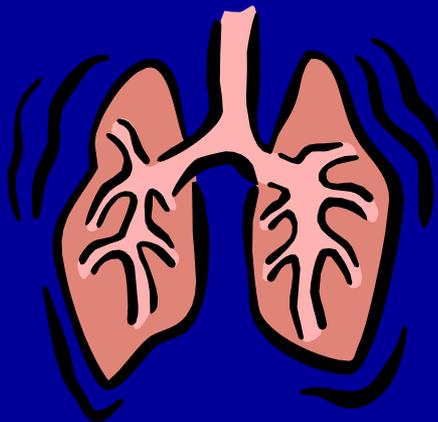
## Intensive care unit (ICU) management:

### Any of the followings:

- **Confusion**, or respiratory **muscle fatigue**.
- Persistent or worsening **hypoxaemia** despite supplemental O<sub>2</sub> or severe worsening of **respiratory acidosis** (PH ≤ 7.30).
- Required assisted M.V.



**Questions???**





Thank you