

# Chronic Obstructive Pulmonary Disease

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# Chronic Obstructive Pulmonary Disease (COPD)

Basic Disease:

Progressive disease of airflow obstruction

Types:

Emphysema and Chronic Bronchitis

# Prevalence

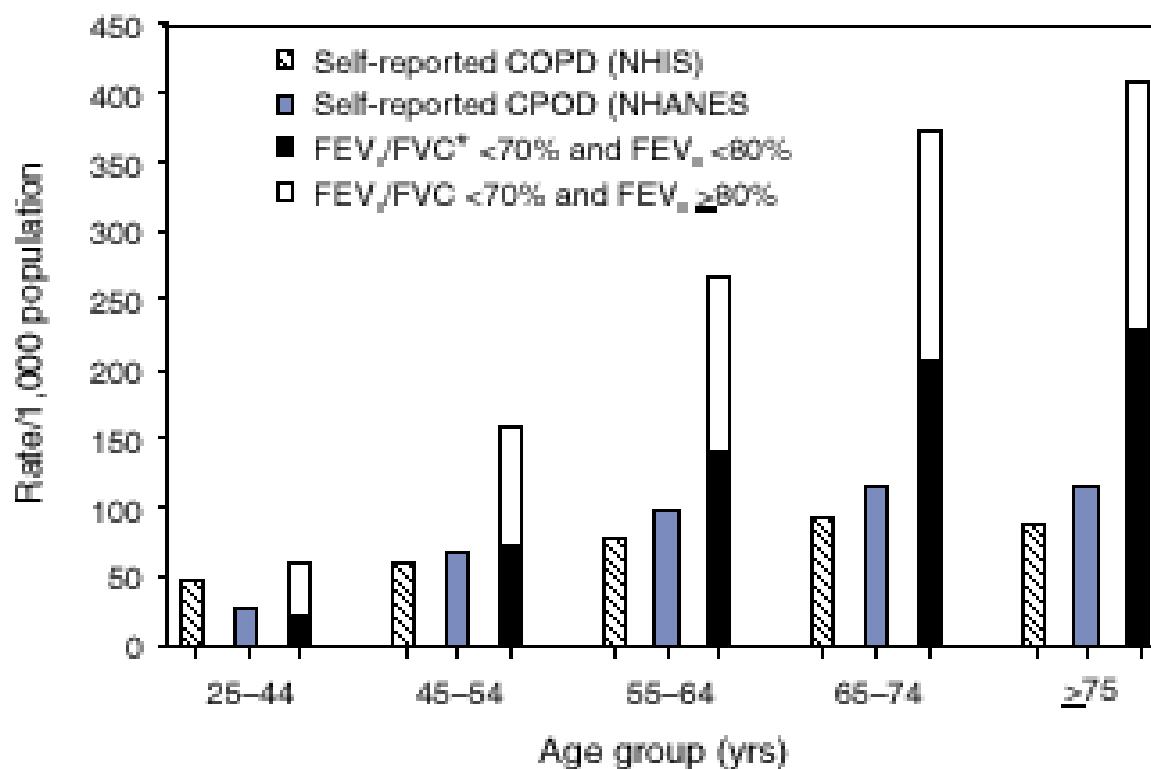
- According to WHO, 5<sup>th</sup> most common cause of death worldwide
- Projected to be 3<sup>rd</sup> most common cause of death by 2020
- In one large scale epidemiological study (over 20,000 adult participants) in China, prevalence was 8.2% overall, 12.4% for men, and 5.1% for women

# Prevalence

- In U.S. during 2000, 10 million people (3.5% population) were known to have COPD, but it was probably under-diagnosed because over 24 million people were known to have impaired lung function
- In U.S. during 2000, COPD was responsible for
  - 8 million physician office and hospital outpatient visits
  - 1.5 million emergency department visits
  - 726,000 hospitalizations
  - 119,000 deaths

# Prevalence

**FIGURE 1. Estimated prevalence of self-reported chronic obstructive pulmonary disease (COPD), by age group — United States, questionnaire data from the National Health Interview Survey (NHIS), 1988–1994, and questionnaire and pulmonary function data from the Third National Health and Nutrition Examination Survey (NHANES III), 1988–1994**



\* FEV<sub>1</sub> is the forced expiratory volume in 1 second, and FVC is the forced expiratory volume.

# Incidence

- About 3 per 1000 subjects per year were diagnosed with COPD in a population based study in Netherlands of over 185,000 participants
  - Men-3.54%
  - Women-2.34%
- Average in other studies of COPD incidence rates ranged from 0-10% of adult participants, depending on who was tested

# Pathophysiology

## Emphysema

- Airways and air sacs lose elastic quality
- Walls between air sacs are destroyed
- Enlarged air sacs cannot expel oxygen as easily

## Chronic Bronchitis

- Walls of airways (bronchi) become thick and inflamed
- Airways become clogged with excess mucus

\*Many people with COPD have both

## Chronic Irritation

### Chronic Inflammation and Oxidative Stress

Destruction of Alveolar Walls and Loss of Elastic Fibers

Alveoli become large, floppy, and less able to expel air

Decreased Forced Expiratory Volume (FEV)  
Increased Residual Volume (RV)  
Increased Breathing Rate  
Breathlessness  
Limited Exercise Capacity  
Increased Muscle Fatigability

### Metaplasia of Epithelial Cells

Swelling of Lining of Bronchi (Smaller Airways)

Traps Air During Expiration

Hyperinflation of Lungs at Rest

Decreased Ciliary Function

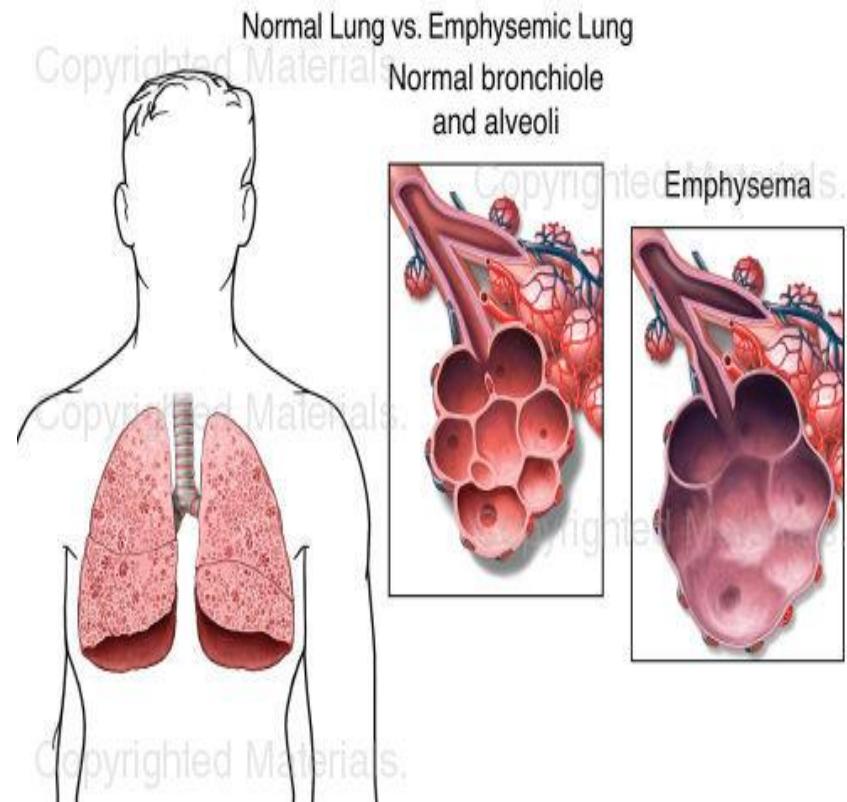
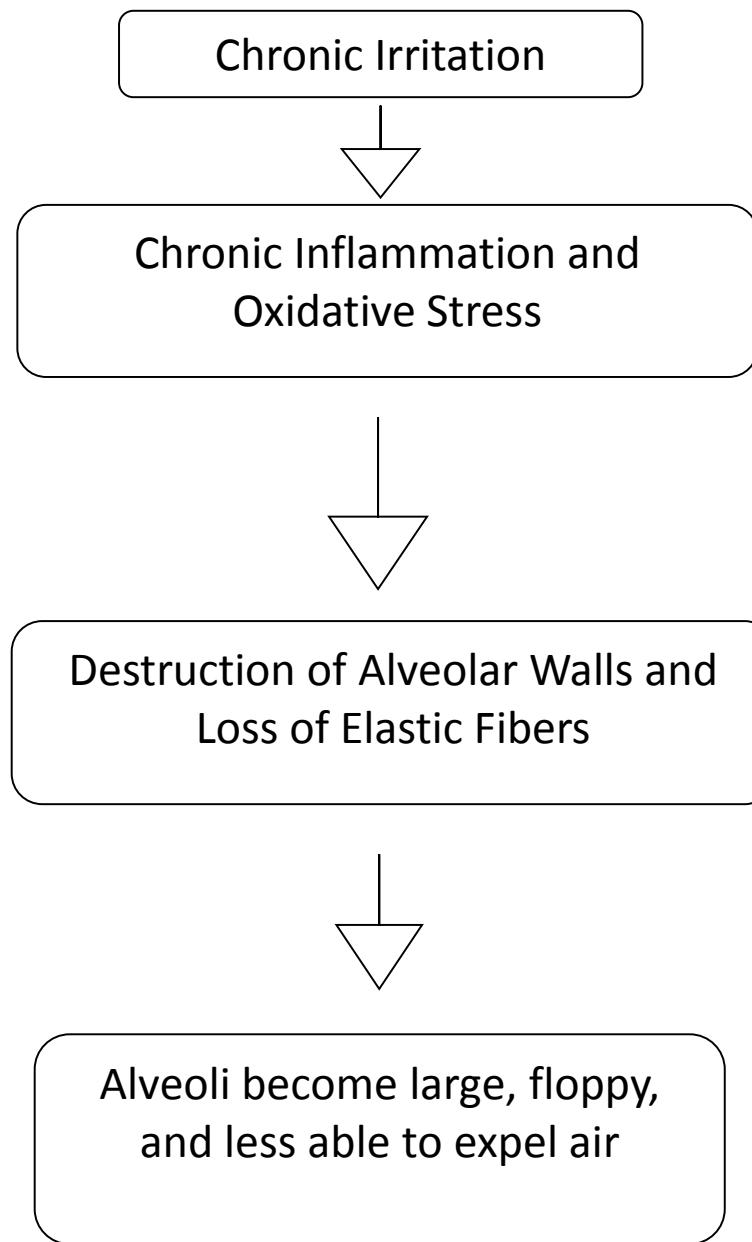
Recurrent Respiratory Infection

More Goblet Cells and Larger Submucosal Glands

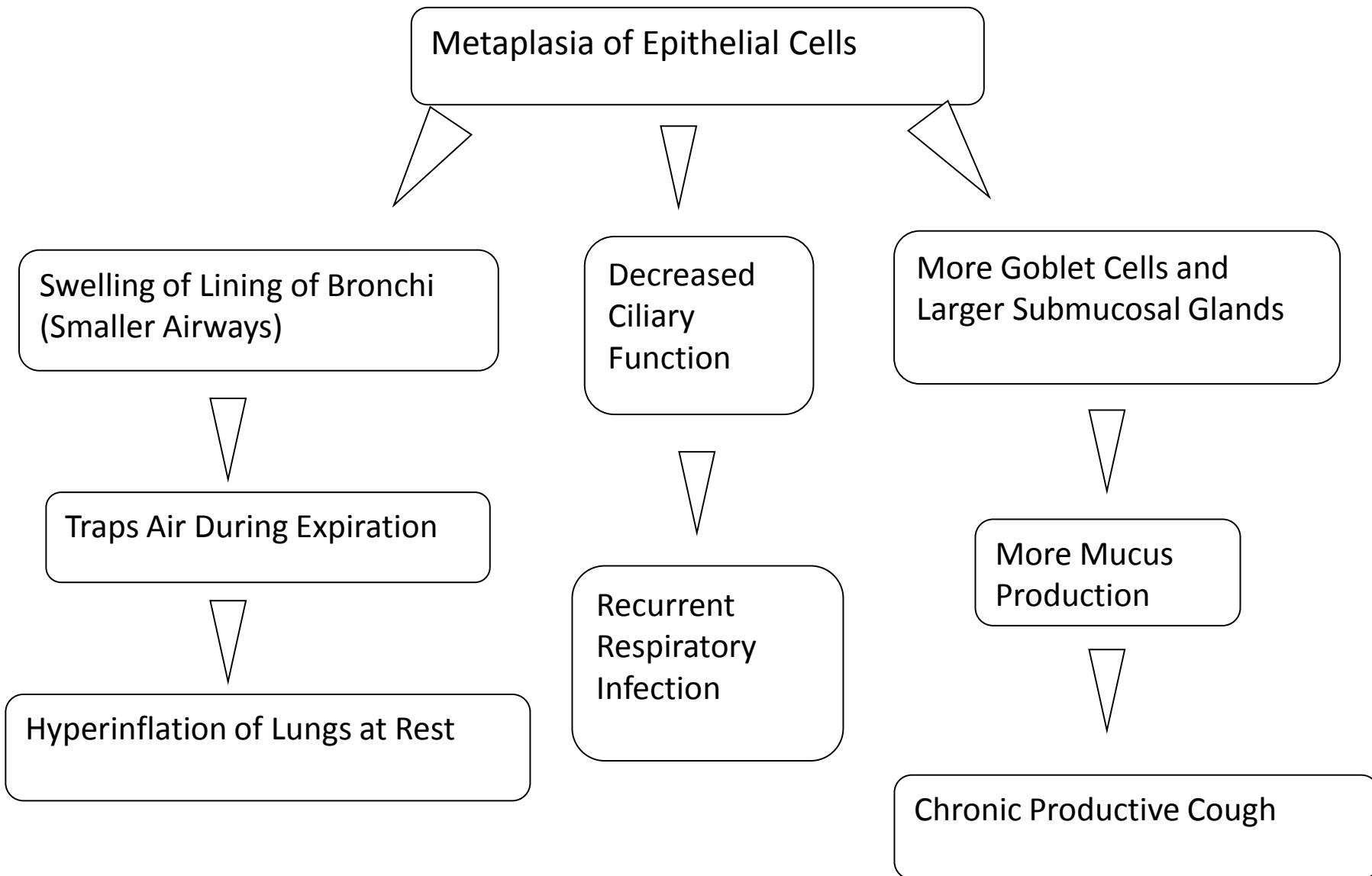
More Mucus Production

Chronic Productive Cough

# Emphysema



# Chronic Bronchitis



# Progression of COPD

Can lead to:

- Decreased Forced Expiratory Volume (FEV)
- Increased Residual Volume (RV)
- Increased Breathing Rate
- Breathlessness
- Limited Exercise Capacity
- Increased Muscle Fatigability
- Difficulty in walking, cooking, taking care of one's self

# Progression of COPD

Late in the Disease:

- Decreased Gas Exchange
- Hypoxemia
- Hypercapnia
- Respiratory Acidosis
- Respiratory Failure
- Pulmonary Hypertension and Right Ventricular Enlargement (“Cor Pulmonale”)

# Cor Pulmonale

## Contributing Factors:

- Low oxygen exchange  
(blood is shunted to alveoli with the most oxygen; if all of them have little oxygen, then all pulmonary arteries vasoconstrict, increasing blood pressure and stress on the right ventricle)
- Endothelial dysfunction
- Hypertrophy and hyperplasia of pulmonary arteries
- Systemic Inflammation

# Prognosis

- Poor: No cure or reversal of disease
- Worse if malnourished
- Goals of treatment are mainly to manage the exacerbations and enhance overall well-being
- Decreased life expectancy
  - In the UK COPD was found to reduce life expectancy by 1.8 years
  - In the Netherlands study 26% of patients with very severe COPD died after 1 year of follow-up

# Etiology

# COPD Causes

- COPD is characterized by slowly progressive obstruction of the airways, often the result of long-term exposure to irritants.
- In rare occasions, genetics may play a major role in causing COPD.

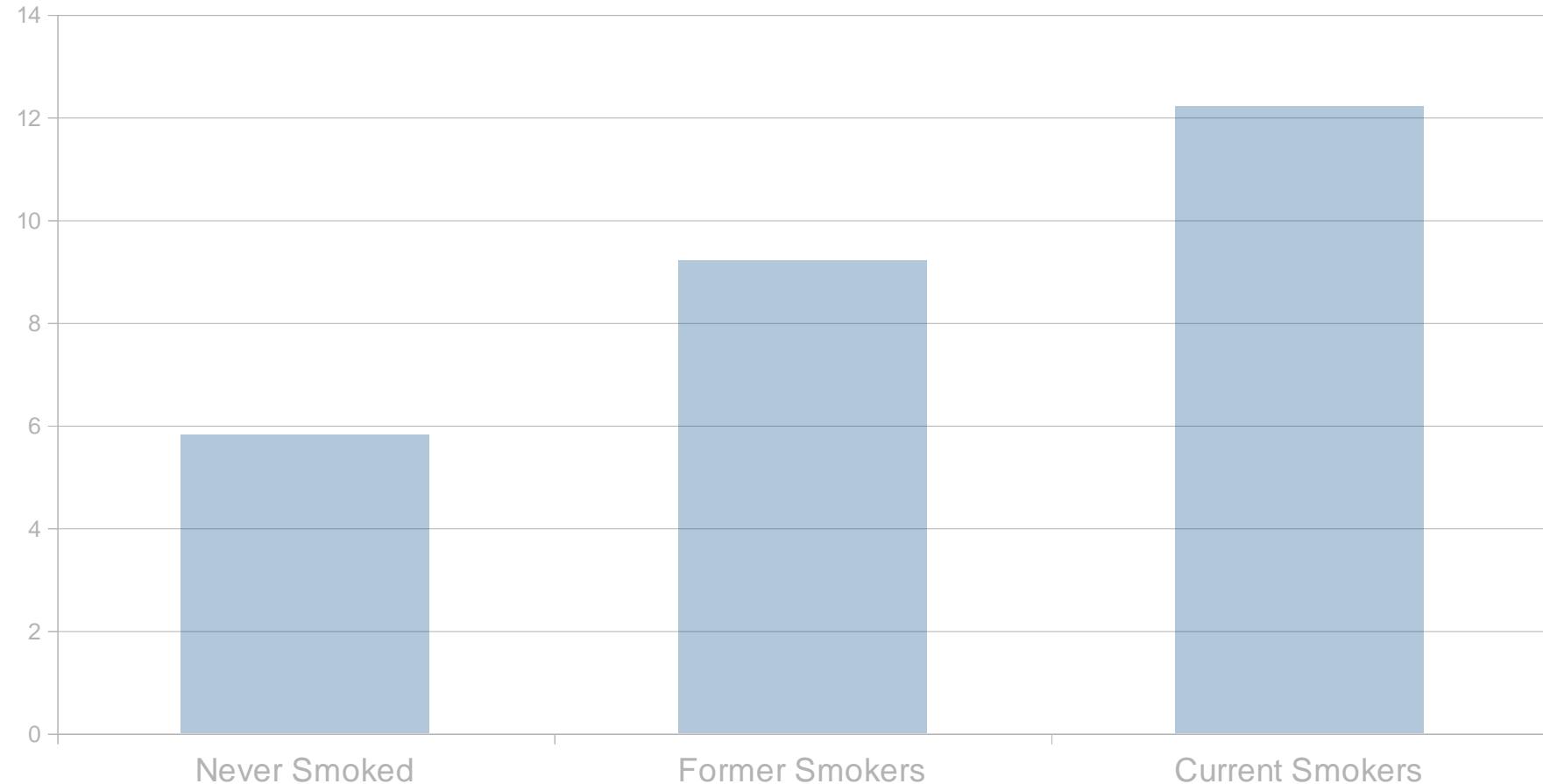
# Causes of COPD

- Tobacco Use
- Exposure to Other Irritants
- Genetic Factors

# Tobacco Use

- Cigarette smoking is the single most important risk factor, attributing to 80-90% of cases.
- Pipe and cigar smoking also increase risk.
- 10-20% of smokers develop clinically significant COPD.
- Even if you quite smoking, you're still at risk to develop COPD.

# % Prevalence of Airflow Obstruction in U.S. Adults

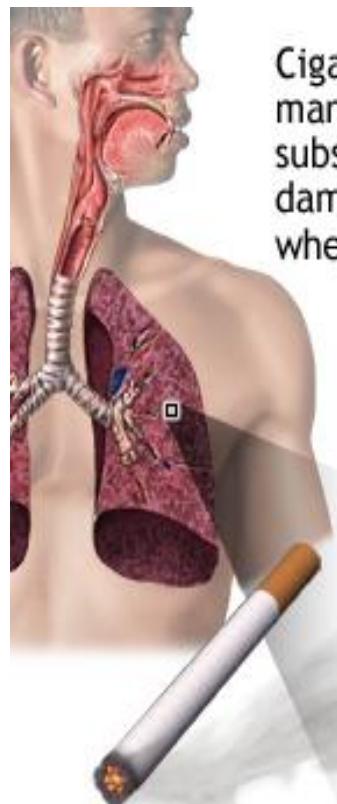


# How Tobacco Effects the Body

- <http://video.about.com/copd/COPD.htm>

# How Tobacco Effects the Body

Cigarettes contain many hazardous substances that damage the lung when inhaled, including tar nicotine, carbon monoxide, and cyanide.

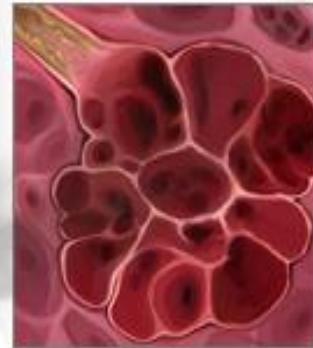


Cigarettes contain many hazardous substances that damage the lungs when inhaled

Normal healthy air sacs



Damaged air sacs (alveoli)



Normal bronchi



Bronchitis



ADAM.

ADAM.

# How Tobacco Effects the Body

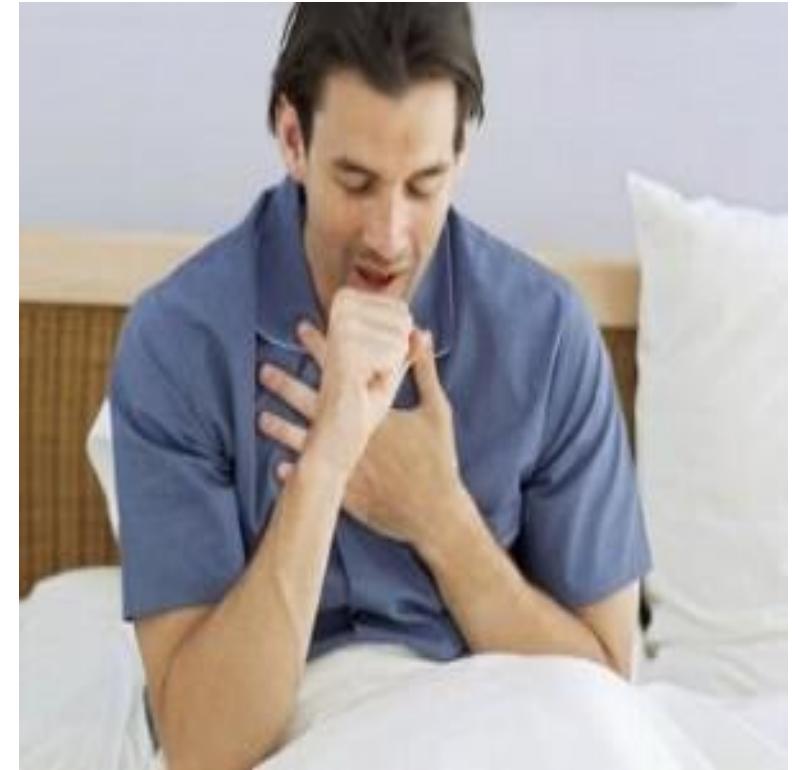
- Smoking causes alveolar walls to breakdown and bronchi to narrow
- This increases resistance to airflow and lowers FEV<sub>1</sub>
- FEV<sub>1</sub> is the volume of air expelled during the first second of FVC
  - FVC (forced vital capacity) is the amount of air that can be forcefully expelled from a maximally inflated lung position.

# Exposure to Other Lung Irritants

Occupational



Indoor



# Occupation Exposure/Outdoor Pollutants

- Found in work place and outdoors environment
  - Vapors
  - Fumes
  - Dust
- Examples include air pollution in urban areas, cadmium, coal, other mineral dusts, and welding fumes.

# Indoor Air Pollutants

- More common a cause of COPD in underdeveloped, low income areas
- Due to exposure to biomass fuels such as coal, straw, animal dung, crop residues, and wood, which are used to heat and cook in poorly ventilated homes
- Includes second hand smoke
- Globally, perhaps the most important risk factor

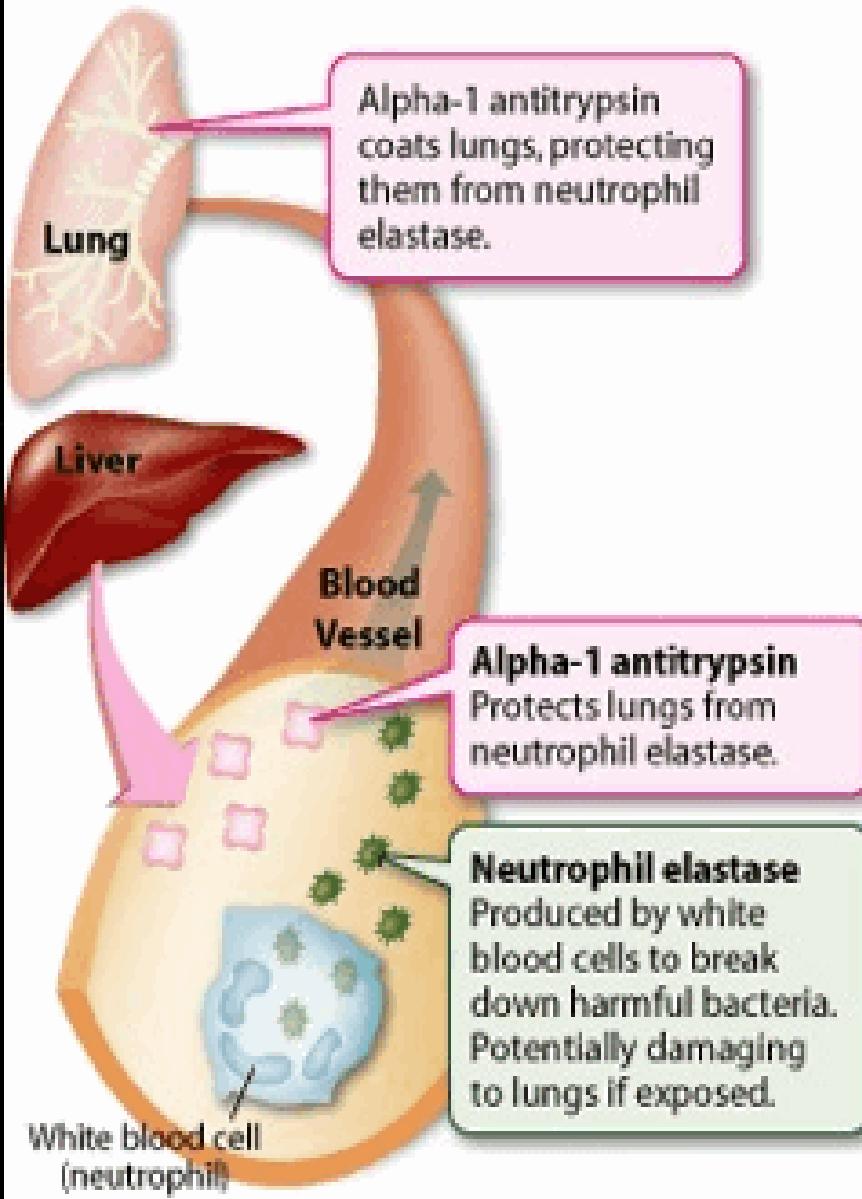
# Genetics

- As only 10–20% of smokers develop COPD, a genetic susceptibility to COPD seems reasonable.
- The best understood risk is  $\alpha_1$  antitrypsin deficiency.
- Probably accounts for only 1-2% of COPD patients

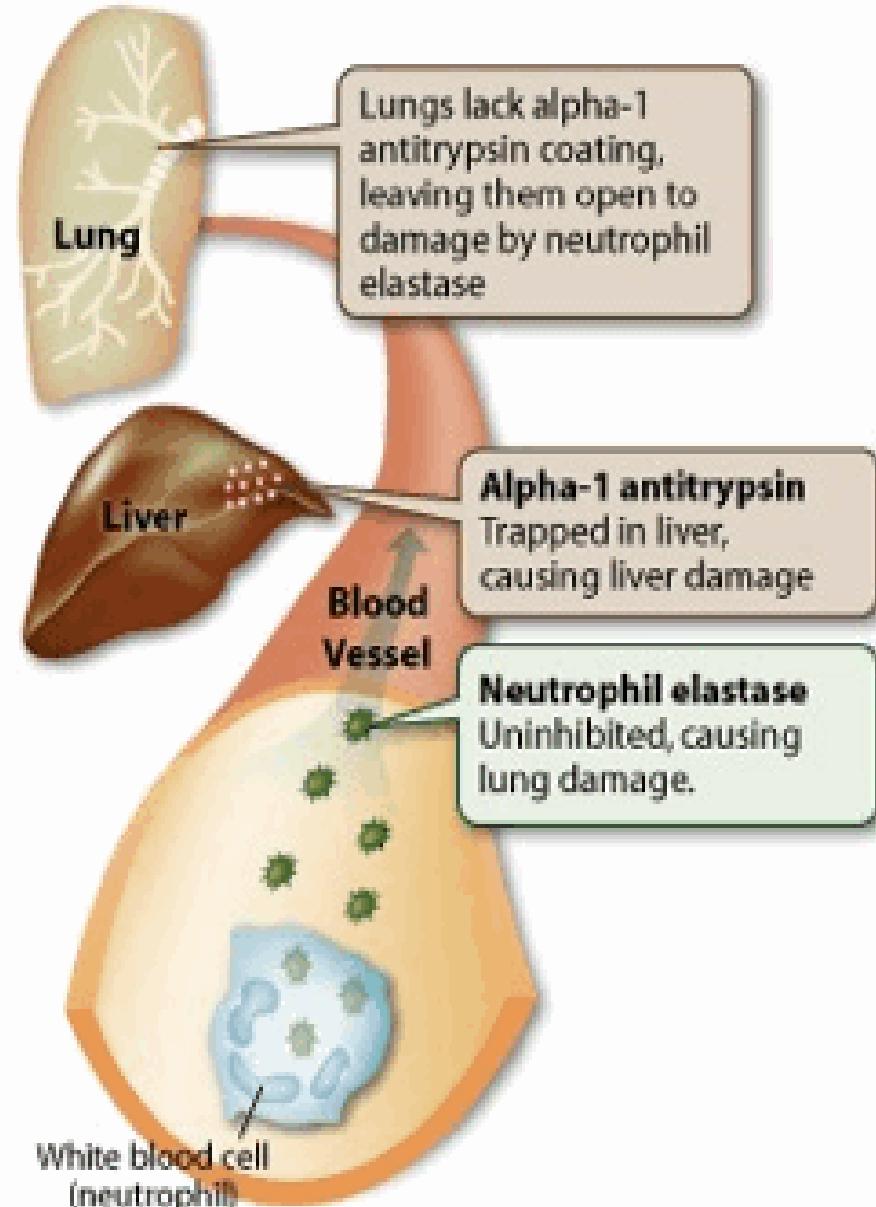
# $\alpha_1$ Antitrypsin (AAT) Deficiency

- Inherited Disease
- Protein made in the liver. It travels in the bloodstream and protects the lungs from other harmful proteins.
- In AAT deficiency, the number of functioning AAT proteins is reduced and adequate amounts can't enter the bloodstream to protect the lungs.
- Many people live normal lives with an AAT deficiency.

## Normal



## Alpha-1 Antitrypsin Deficiency



# Other Possible Genetic

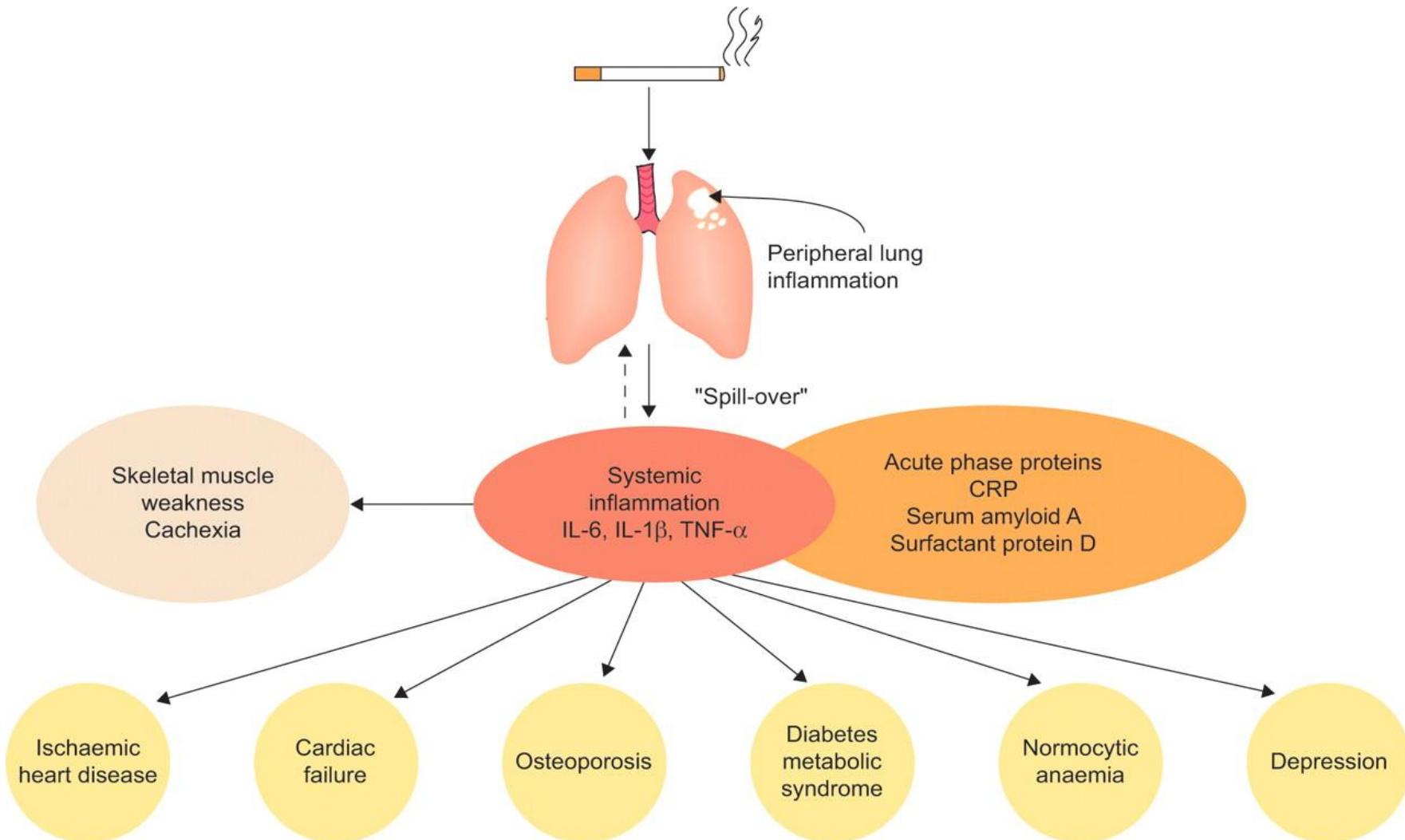
- Genes coding polymorphisms of...
  - Growth Factor  $\beta_1$ ,
  - Tumor Necrosis Factor  $\alpha$
  - Microsomal Epoxide Hydrolase 1.
- None of these yet proven to contribute to COPD

# Risk Factors

- Smoking/Pollutant Exposure
- Family History
- Age (lung function peaks in 20s, decline 30-40)
- Gender
- Respiratory Infection/Asthma
- Socioeconomic Status

# Comorbidities

# Systemic Inflammation



# Common Comorbidities

- Cardiovascular Problems Due to Inflammation
  - Cor Pulmonale
  - Pulmonary Hypertension
- Lung Cancer
  - Increased inflammation and Oxidative Stress
- Osteoporosis
  - Advanced age, poor mobility, smoking, poor nutrition, low BMI
- Diabetes
  - Unknown but due to inflammation

# Preventative Measures

- Do Not Smoke!
- Limit Exposure to Second Hand Smoke and Other Pollutants



# Emphysema- Signs and Symptoms

- Thin
- Mild hypoxemia
- Normal hematocrit values
- Dyspnea
- Tachypnea with prolonged expiration
- Hypercapnia
- Barrel chest
- Chest has hyperresonant sound with percussion
- When breathing, will often lean forward with arms extended and braced on knees while sitting
- Exhale through pursed lips, helps prevent expiratory airway collapse
- Morning headache
- Confusion

# Emphysema- Signs and Symptoms

- Fatigue
- Anorexia
- Difficulty chewing and swallowing
- Diarrhea
- Increased energy expenditure
- Reduced respiratory and limb muscle strength and endurance
- Altered pulmonary accessory muscle function
- Increased susceptibility to infection
- Nutritional depletion
- Loss of lean body mass (weight may seem stable)
- Later development of cor pulmonale
- Fluid retention

# Chronic Bronchitis- S/S

- Hypersecretion of mucus
- Chronic productive cough (smoker's cough)
- Inflammation of the bronchi
- Often overweight
- Increased hematocrit values
- Early development of cor pulmonale
- Decreased exercise tolerance
- Wheezing
- Shortness of breath
- Hypoxemia- leads to polycythemia and cyanosis

# Chronic Bronchitis- S/S

As disease progresses:

- Pulmonary hypertension
- Large amounts of sputum produced
- Frequent pulmonary infections
- FVC and FEV<sub>1</sub> decrease
- FRC and RV increase since airway obstruction and air trapping are more pronounced

# Pulmonary Function Tests

- Group of tests that measure how well the lungs take in and release air and how well they move gases from the atmosphere into the body's circulation
- Spirometry
  - A spirometer records the amount and the rate of air that is breathed in and out over a period of time
- Lung Volume measurement
  - The most accurate way is to sit in a sealed, clear box (body plethysmograph) while breathing in and out into a mouthpiece. Changes in pressure inside the box help determine the lung volume.
  - Breath nitrogen or helium gas through a tube for a certain period of time. The concentration of the gas in a chamber attached to the tube is measured to estimate the lung volume.

# Pulmonary Function Tests

- Diffusion capacity
  - Breathe a harmless tracer gas often for only one breath. The concentration of the gas in the air breathed out is measured
  - The difference in the amount of gas inhaled and exhaled measures how effectively gas travels from the lungs into the blood.
  - This test allows the doctor to estimate how well the lungs move oxygen from the air into the bloodstream.

# Pulmonary Function Tests

- Forced expiratory volume (FEV<sub>1</sub>)
  - The volume of air that can be forced out in one second after taking a deep breath
- Forced vital capacity (FVC)
  - The amount of air that can be forcible exhaled after taking the deepest breath
- Functional residual capacity (FRC)
  - Volume of air left in the lungs after a normal, passive exhalation
- Residual volume (RV)
  - The volume of air remaining in the lungs after a maximum exhalation
- Total lung capacity (TLC)
  - The volume of gas that is contained in the lungs at the end of maximal inspiration

# Emphysema- Diagnosis

- Decrease in FVC and FEV<sub>1</sub> and increase in FRC, RV, and TLC due to airway collapse and air trapping in distal portions of the lung
- Decreased diffusing capacity due to destruction of alveolocapillary membranes
- Radiographs- diaphragm appears flattened and lung fields appear overdistended

# Emphysema- Treatment

- Acute
  - Receive oxygen
  - Bronchodilators via inhaler or nebulizer
  - Immediate use of oral corticosteroids and antibiotics
- Chronic
  - Immediate cessation of smoking
  - Inhaled anticholinergic agents and beta agonists
  - Pulmonary rehabilitation, improved nutrition, and breathing techniques can all improve symptoms
- In some patients, lung reduction surgery or transplantation can be considered

# Chronic Bronchitis- Diagnosis

- Characterized by a having obstructed airflow and a productive cough for 3 months within a year for 2 consecutive years
- History of symptoms
- Pulmonary function test
- Physical examination
- Chest radiograph
- Blood gas analyses

# Chronic Bronchitis- Treatment

- Pathologic changes are not reversible
- Bronchodilators and expectorants
  - Control cough and reduce dyspnea
- Nutritional counseling
- Respiratory hygiene
- Oxygen therapy with severe hypoxemia

# •Medications

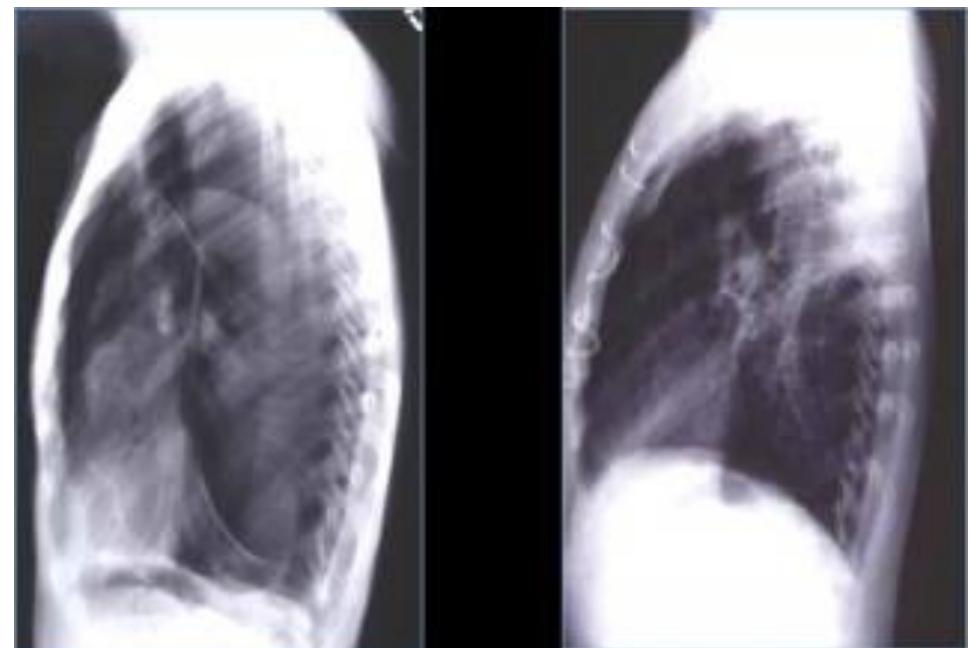
- Bronchodilators
  - Relax the muscles around airways. This can help relieve coughing and shortness of breath and make breathing easier
- Inhaled steroids
  - Inhaled corticosteroids can reduce airway inflammation and help ease breathing
  - Prolonged use of these medications can weaken bones and increase risk of high blood pressure, cataracts and diabetes
  - Reserved for people with moderate or severe COPD
- Beta Agonists
  - Relax muscles of the airway
- Antibiotics
  - Respiratory infections (acute bronchitis, pneumonia and influenza) can aggravate COPD symptoms

# Lung Transplants

- COPD is the most common cause in adults
- Aren't very common due to small amount of donor organs
- A last resort treatment
- There are several tests that are done to make sure a patient is healthy enough to receive one.

# Lung Volume Reduction Surgery

- Emphysema patients
- Reduces the size of the lungs to facilitate better lung function
  - 20%-35% of the most damaged part of the lung is removed



# Breathing Techniques

- Bending forward at the waist
  - Allows diaphragm to move more easily
- Pursed Lip Breathing
  - Breath in through nose and out through pursed lips
  - Helps control dyspnea

# Breathing Techniques

- Diaphragmatic Breathing
  - Lie on back on a flat surface with a pillow under knees and head
  - Place left hand on upper chest and right hand on abdomen
  - Inhale slowly through nose so stomach moves out against right hand
    - Left hand shouldn't move at all

- Tighten stomach muscles and exhale with pursed lip technique
  - Left hand should not move

- Helps lungs expand and strengthens diaphragm

# Nutrition Assessment

# Nutritional Assessment

- Anthropometric
  - BMI
  - Skin-fold measurement
  - Weight
- Biochemical
  - Hemoglobin
  - Hematocrit
  - Serum electrolytes
  - Serum proteins
  - Nitrogen balance
  - Oxygen saturation

# Nutritional Assessment

- Clinical and Physical
  - Respiratory Status
  - Sense of smell and taste
  - Gastrointestinal function
- Dietary
  - Usual home diet
  - Supplements
  - Where they eat
  - Social activity during meals



# Nutritional Assessment cont.

- Functional Assessment
  - Motor function
  - ADLs
  - Can they prepare food?
- Histories
  - Medical
  - Nutritional
  - Family history of disease



# Energy Expenditure Elevated

- Affected by:
  - Airflow obstruction
  - Gas diffusing capacity
  - CO<sub>2</sub> Retention
  - Respiratory inflammation
  - Biochemical status
    - Cytokines
    - Hormones

# Assessing Energy Expenditure

- Preferred
  - Indirect calorimetry
  - Doubly labeled water
- Other
  - Energy equations with increases for physiological stress



# Protein

- Maintain or restore lung function and muscle strength
- Prevents respiratory infections
- 1.2-1.7 g/kg/day considered adequate



# Vitamins and Minerals

- Vitamin C
  - For people still smoking
- Magnesium
  - Muscle contraction and relaxation
- Calcium
  - Maintain bone density
- Vitamin D and K
  - If on glucocorticoids or have decreased bone mineral density
- Sodium restriction
  - For cor pulmonale and fluid retention

# Feeding Difficulties

## Problems

- Adequate calorie intake
- Distended/bloated stomach
- Short of breath
- Small appetite
- Aspiration

# Solutions to Feeding Difficulties

- . Small Appetite
  - . Eat whenever you are hungry
  - . Small portions
  - . Nutrient dense
    - . Supplements
- . Fatigue
  - . Rest before meals
  - . Prepare foods ahead of time
  - . Eat soon after waking up
  - . Mini fridge by the bed
- . Short of Breath
  - . Sit upright
  - . Eat soft foods
  - . Oxygen
  - . Eat slowly
- . Distended/Bloated Stomach
  - . Avoid gas-forming foods
  - . Carbonated beverages, some raw vegetables
  - . Drink between meals

# Enteral Supplementation

- Feeding tube
  - Can increase nutrition intake
  - Health can improve
  - Once supplementation is removed, nutrition status will revert

# Case Study

# Patient

- Stella Bernhardt (SB)
- Age: 62
- Female
- Diagnosed with Stage 1 COPD 5 yrs ago
- Complaining of being short of breathe and not able to do anything for herself
- Quit smoking 1 yr ago



# Anthropometric

- Ht: 5'3"
- Wt: 119 lb
- Usual weight: 145-150lbs
- Wt 1 yr ago: 139 lbs
  - 14% wt loss
- BMI: 21.1 kg/m<sup>2</sup>
- % IBW: 103%
- MAC: 19.05 cm
- TSF: 15mm



# Biochemical

- Albumin: 3.3 g/dL (L)
- Total CO<sub>2</sub>: 32 mEq/L (H)
- WBC: 15 x 10<sup>3</sup>/mm<sup>3</sup> (H)
- RBC: 4 x 10<sup>6</sup>/mm<sup>3</sup> (L)
- HGB: 11.5 g/dL (L)
- HCT: 35% (L)
- SEGS: 83% (H)
- LYMPHS: 10% (L)

# Clinical

- Pulmonary Function Tests (last admission)
  - FEV<sub>1</sub> = 0.7 L
  - FVC = 1.5 L
  - FEV<sub>1</sub>/FVC 46%
- Decreased breathe sounds
- Accessory muscles used at rest to breathe

# Dietary

- Poor appetite stated
- Meal prep is hard because it makes l
  - Daughters sometimes help
- Coughing decreases intake
- Avoids milk
  - Claims increases mucus productic



# 24-hr Recall

- Breakfast
  - $\frac{1}{2}$  c coffee w/ nondairy creamer
  - Few sips orange juice
  - $\frac{1}{2}$  c oatmeal w/ 1 tsp sugar
- Lunch/Dinner
  - $\frac{3}{4}$  c chicken noodle soup
  - 2 saltine crackers
  - $\frac{1}{2}$  c coffee w/ nondairy creamer
- Snack
  - Sips of Pepsi – total 32 oz
- **Nutrition Consumed**
  - **Kcal: 681**
  - **Protein: 8g**
- **SB Needs**
  - **REE = 1125 kcal**
  - **Stress factor: 1.3**
  - **Weight gain: 300kcal/day**
  - **Total kcal = 1763 kcal/day**
  - **Protein: 1.5 g/kg = 81 g**

# One Day Diet

- Breakfast
  - 1 scrambled eggs
  - 1 small hash brown patty
- Morning Snack
  - 1 can Ensure high protein
- Lunch
  - 1 cup chili
  - 1 piece cornbread
- Afternoon Snack
  - 1 can Ensure
- Dinner
  - 1 cup pasta w/ alfredo sauce and parmesan cheese
- HS Snack
  - 1 cup Applesauce
- Nutrition
  - 1763 kcal
  - 82 g protein

# Functional History

- She can prepare food but tires her out
  - Too tired to eat
- No other disabilities
- Diagnosed 5 yrs ago w/ COPD
- Quit smoking 1 yr ago
- Had a cold in the past two weeks

# Doctor's Diagnosis and Treatment

- Diagnosis
  - Acute exacerbation of COPD, increasing dyspnes, hypercapnia, secondary to bacterial pneumonia.
- Treatment
  - Aggressive treatment for emphysema
  - Home O<sub>2</sub> therapy
  - Outpatient pulmonary rehabilitation center
  - Oral course corticosteroids
  - 10-day course Keflex

# Nutrition Diagnosis

- SB has an inadequate energy intake related to a decreased ability to prepare food and anorexia as evidenced by her 14% unintentional weight loss in the last year.

# Interventions

- Supplement drinks
- Educate patient
  - Smaller portions more often
  - Nutrient dense foods
- Rest before meals
- Oxygen during meals
- Introduce patient to programs supplying meals



# Monitoring and Evaluation

- Watch weight every three months
- Schedule a follow up appointment to see how she has implemented nutrition advice
- Encourage physical activity in order to allow easier breathing

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