OBSTRUCTIVE PULMONARY CONDITIONS & ITS OCULAR IMPLICATIONS

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Course Description

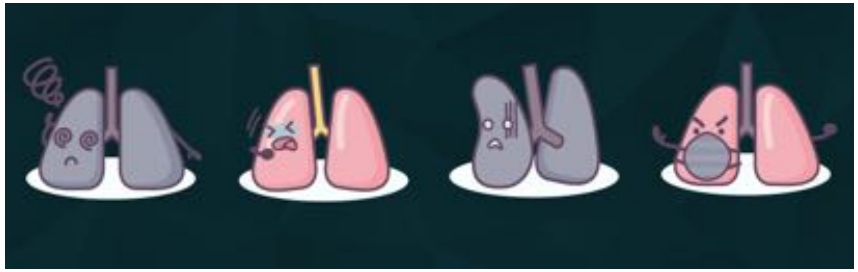
- This course focuses on giving an introduction and review of common obstructive pulmonary diseases and conditions
- This course will also highlight some ocular consequences of these pulmonary diseases and conditions

Course Objective

- Briefly introduce and define obstructive pulmonary disease
- To review types of obstructive pulmonary diseases in detail: asthma, COPD, cystic fibrosis and obstructive sleep apnea
- To highlight how these pulmonary conditions relates to optometry and what ocular manifestations can result from these conditions

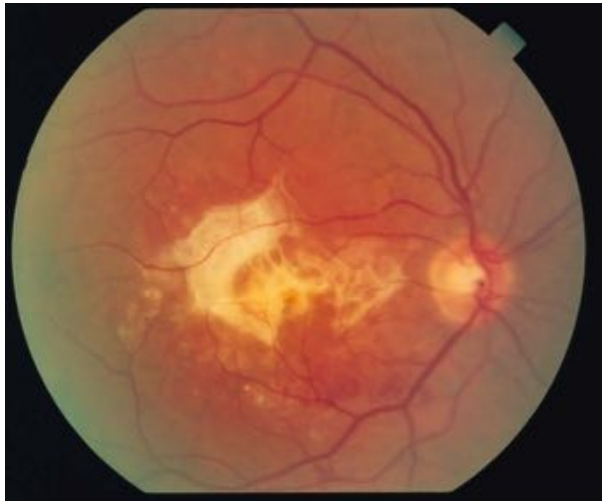
Outline

- Introduction
- Introduction of obstructive pulmonary disease
- **<u>Types of obstructive pulmonary disease</u>**:
  - 1. **Chronic lower respiratory disease:**
    - Asthma
    - COPD
      - *Emphysema*
      - *Chronic bronchitis*
    - Cystic fibrosis
  - 2. **Upper respiratory tract:**
    - Sleep Apnea



Optometric considerations

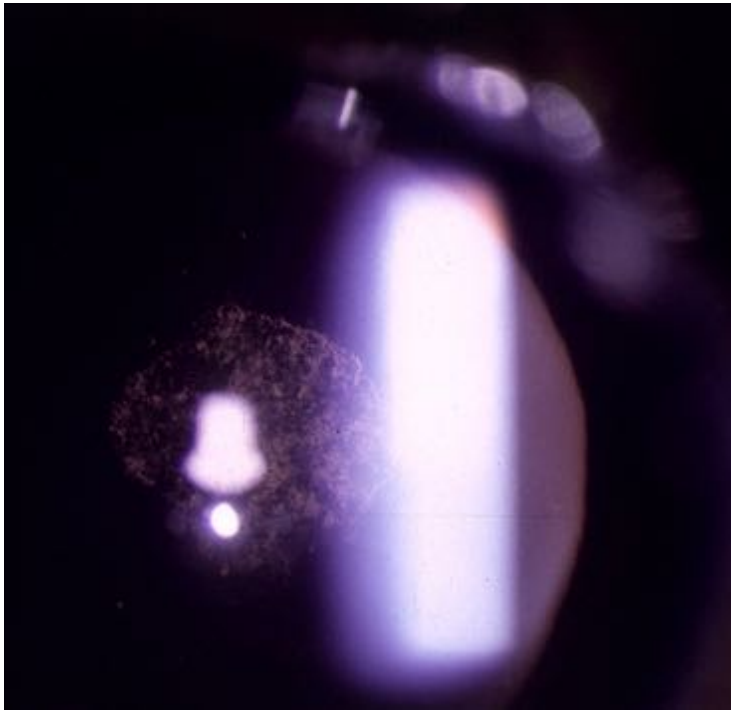
- Pulmonary disease can increase the risk of ocular disease
  - Dry Eye
  - Glaucoma
  - ARMD
  - Retinal vascular changes
  - Optic nerve head changes



- Pulmonary disease can contraindicate ocular medications

Optometric considerations

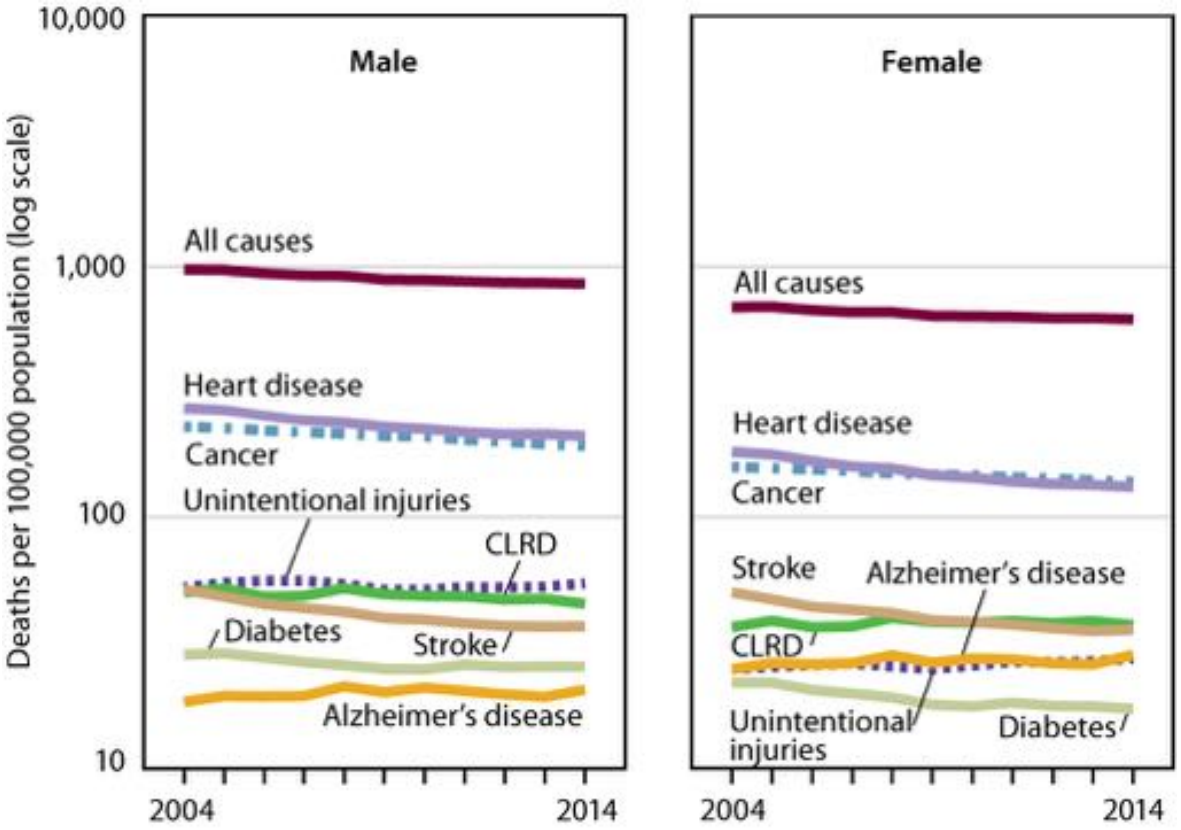
- **Medications** taken for pulmonary disease can cause ocular problems
  - Optic atrophy
  - Glaucoma
  - Cataract
  - Blurred vision
  - Tear effects
  - Conjunctivitis



Lung disease

- Top 4 causes of death in adults
- Every year, > 200,000 Americans die of lung disease in US

*CLRD: chronic lower respiratory disease



NOTES: Rates are age-adjusted. Cause of death is coded according to ICD–10.
SOURCE: CDC/NCHS, *Health, United States, 2015*, Figure 2 and Table 17. Data from the National Vital Statistics System (NVSS).

Lung disease is common

- Lung disease is not only a killer, most lung disease is **chronic**
  - > 35 million Americans are living with chronic lung disease
- **Smoking** is directly responsible for 90% of lung cancer and causes most cases of **emphysema** and **chronic bronchitis**

Symptoms of Lung Disease

TWO common symptoms of lung disease

1. **Dyspnea**
- Shortness of breath (**SOB**)
  - Can be caused by lung or heart disease

2. **Chronic cough**
- Production of phlegm
- Hemoptysis: *heme* (blood); *ptysis* (to spit) – coughing blood

Atypical symptom of Lung Disease

Chest pain is **not** a common symptom

- Lung tissue has **no pain receptors**

- Pain is possible with:
  - Pleural disease
  - Pulmonary vascular disease
  - Musculoskeletal pain

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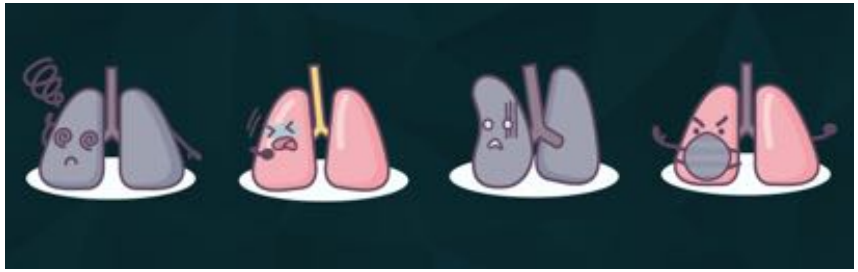

Introduction to Obstructive pulmonary disease

- **Definition**: Limitation of airflow *especially* on **exhalation** (*passive process)*
  - Makes breathing harder
  - Can be caused by:
    - **1. Change in lumen size**
      - Altered secretions in asthma or cystic fibrosis
    - **2. Thickening of airway wall**
      - Inflammation in bronchitis and remodeling in asthma
    - **3. Changes in supporting structure surrounding the airway**
      - Emphysema

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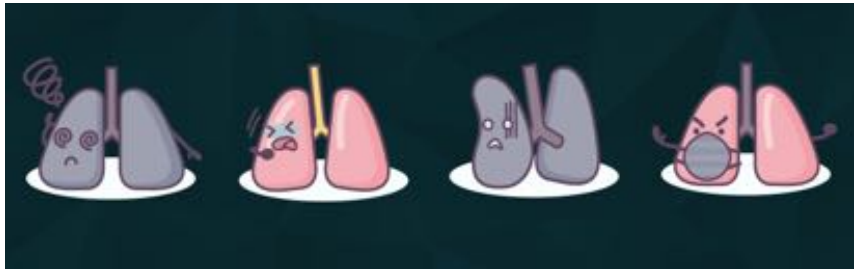
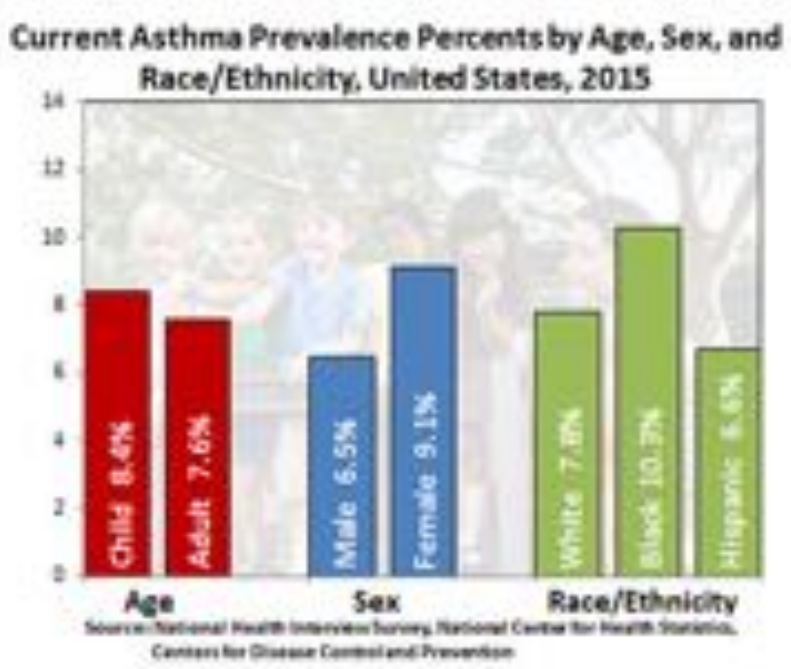


Asthma

- Common syndrome found in **1 in 12**
- Genetic predisposition to type I hypersensitivity
- There are different asthma phenotypes
  - Some have ↑ IgE, some ↓ IgE
  - Treatment is all the same currently

- **More likely to have asthma:**
  - Children: can grow out of it
  - Females: smaller pipes
  - African American: genetically more susceptible

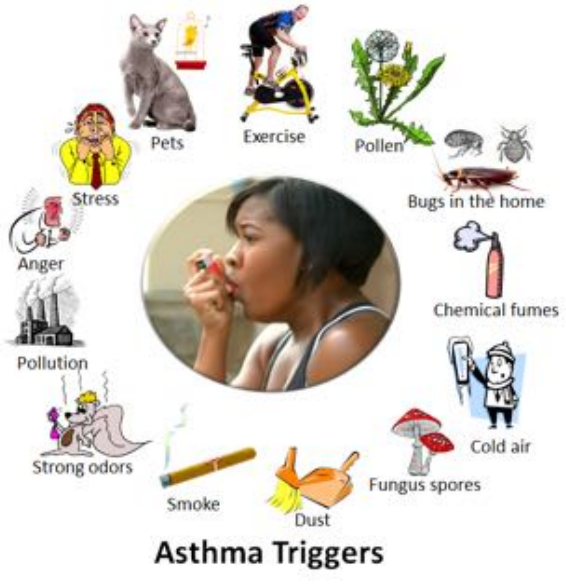


Asthma

- Characterized by **exacerbations** and **remissions**
- Initiating factors include:
  - Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle, obesity, lack of sleep, alcohol, (exercise)

Poor Control:

- 93% of patients with inhalers **missed** at least one important step for correct use
  - For example: exhaling fully or shaking inhaler before use
- 1 in 5 children with asthma go to ER for asthma each year



Signs and symptoms

- Intermittent (patients appear normal between attacks)
- Vary due to range in severity

Signs/Symptoms include:

Most common symptoms
- Chronic cough
- Wheezing (if severe, wheezing may not be prese
- Chronic episodic dyspnea (SOB)

More severe symptoms
- Sympathetic discharge (perspiration/flushing of skin)
- Tightness in chest
- Tachypnea
- Severe cases can have cyanosis of nail beds, confusion, agitation, nasal flaring, difficulty talking, no breath sounds

Asthma Therapy

Goals:

- Relieve symptoms
- Prevent recurrences of attacks

Therapies:

- Control triggers including smoking cessation
- Exercise and breathing exercises
- Bronchodilators: Adrenergic and Anticholinergics
- Anti-inflammatories

Steroid anti-inflammatories	Leukotriene inhibitors
Mast cell stabilizers	Monoclonal antibodies against IgE
Vitamin D?	

- Thermoplasty – using radiowaves to change shape of airways

Glucocorticoids

www.courses.ahc.umn.edu/medical-school

Most common adverse effects:

- Osteoporosis
- Impaired wound healing
- Increased risk of infection
- Hypertension
- Decreased growth in children (oral >> than inhaled)
- Edema
- Ulcers
- Psychoses
- Cushing-like syndrome
- Oral candidiasis (Thrush) – use spacer to ↓ risk
- Glaucoma
- Cataracts
- ↑ risk of DM

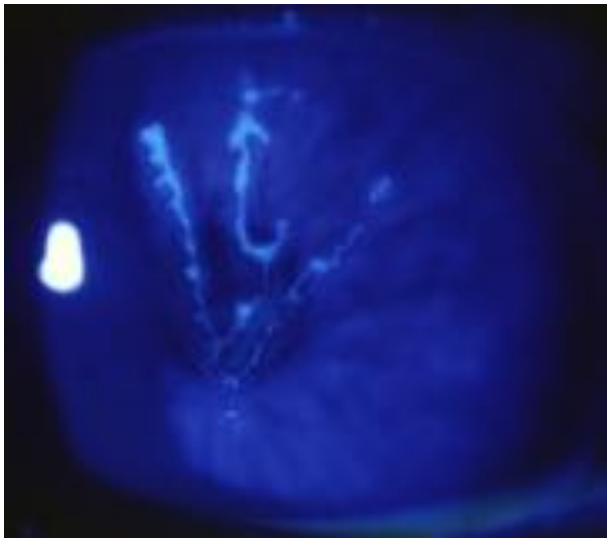
} Very little risk with inhaled

FDA guidelines:

Use inhaled glucocorticoids with caution in patients with:

- Parasitic infection (ex: histoplasmosis)
- Active or inactive TB
- Ocular herpes simplex
- **Increased IOP**

**use caution, but not absolute contraindication!



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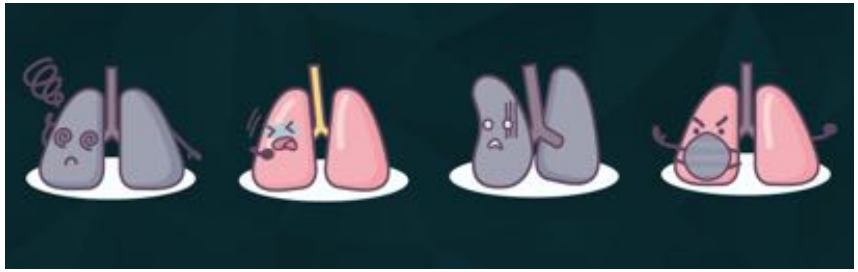


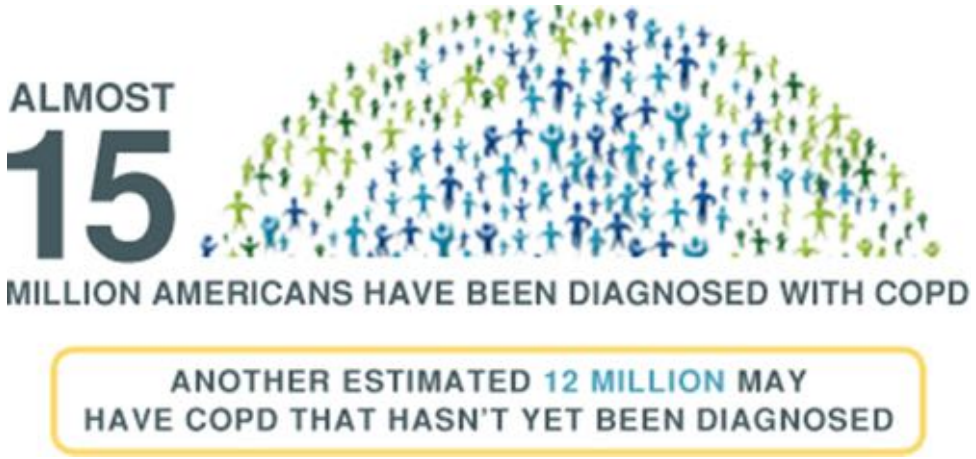
Chronic Obstructive Pulmonary Disease (**COPD**)

<u>Includes two common diseases:</u>

- **Emphysema**
- **Chronic bronchitis**

- Slowly, **progressive** airway obstruction
  - Disease does NOT go away!
- Takes years to become clinically apparent
  - **1st symptom**: SOB on exertion
  - People tend to subconsciously avoid exertion tasks to mask symptoms

COPD



- About **15 million** US adults have COPD diagnosis
  - Probably more, just undiagnosed
- **Smoking** is the #1 cause
  - 6 – 10% of adult pop but up to 50% of smokers
- Lifetime risk is now estimated at ¼
- COPD kills more than 120,000 Americans each year
  - 1 death every 4 minutes

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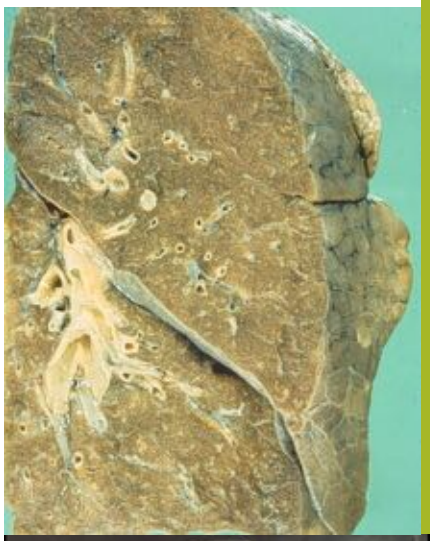
Emphysema

Aka: Type A COPD

- **≈ 4 million** diagnosed patients in the U.S.
- Abnormal enlargement of the air spaces due to destruction of alveolar wall
- Repeated and prolonged inflammation causes release of proteolytic enzymes that digests alveolar septal walls
- Most common cause: **cigarette smoking**
  - Tobacco allows destructive enzymes to work over time and destroy alveoli walls

Normal



Emphysema

Typical emphysema patient

"Pink puffer"

- **Thin** (working to breath all the time)
  - Average person: 4-5% calories breathing
  - Pink puffer: ~30% calories breathing
- Pursed lips respiration
- Tripoding
- SOB and tachypnea (breath quickly)

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Chronic bronchitis

- **≈ 10 million** diagnosed patients in the U.S.
- Chronic bronchitis is **more common** than emphysema: ~3/4 of patients with COPD
- Leading cause is cigarette **smoking**, also air pollution and infections

- **Definition**: Persistent, productive cough on most days for at least 3 consecutive months in 2 consecutive years
  - This defines **CHRONIC**
  - Anyone with a cold has had chronchitis – but those are **acute** symptoms

Chronic bronchitis (Smoker's cough)

- **Inflammation of the airways*** with hypertrophy of large airway mucous glands and **hypersecretion of mucus***
  - Airway size is <u>compromised</u> and <u>obstructed</u>

<u>Clinical manifestations:</u>

- **Wheezing** - Tremendous mucus production blocking airways
- **Crackles** - Caused by edema
- **Tachycardia** is common but not universal
  - Periphery not getting enough O2 → lungs will breath faster and heart will pump faster to get blood out
- **Polycythemia** - ↑ RBC to carry O2 → ↑ risk of clotting

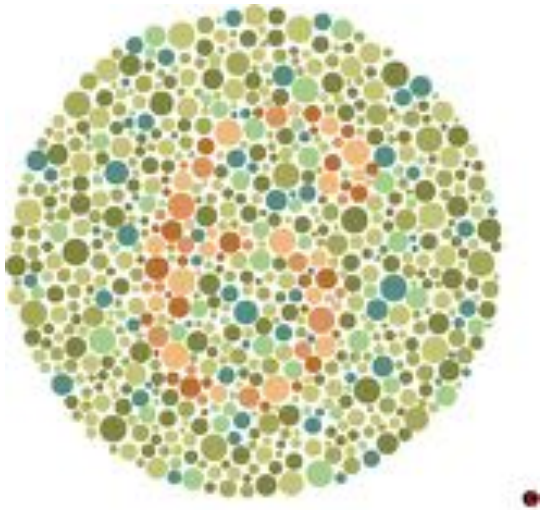
* - makes tube obstruct

Typical chronic bronchitis patient

"Blue bloaters"

- Stereotypical chronic bronchitis patient
- Chronic cough and expectoration
- Obese, edematous due to right sided heart failure
  - Heart has to push against closed capillaries when there is poor oxygenation of the lungs
- Increased anterioposterior chest diameter – using accessory muscles
- Cyanotic
- CO_2 narcosis can cause decreased memory and info processing ability

Chronic bronchitis



Lack of O2 causes a lot of ocular problems!

Associated with:

- Decreased VA especially at night
- Decreased color vision
- Transient visual obscurations (different from TIA)
- 7% had swollen optic nerve heads
- 82% had decreased retinal function as determined by abnormal VEP
- Increased risk with increased PCo_2 and decreased pH in blood

Treatment for chronic bronchitis and emphysema

No curative therapies but treatment may **slow** progression

- **Goal:** control of symptoms and avoiding harmful environments
  - Smoking cessation including vaping
  - Many still smoke with diagnosis
- Pharmaceutical treatment very similar to treatment for asthma

Pharmaceutical Tx for chronic bronchitis and emphysema

Bronchodilators

- Short acting or long acting Beta-2 agonists
- Anticholinergics

Anti-inflammatory drugs

- Glucocorticoids
  - Most useful during exacerbations
  - May decrease number of exacerbations

Combination medications

- Steroid & long acting beta agonists
- Long acting beta agonist/long acting muscarinic antagonist

*Note: Many of the same meds as asthma!

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Cystic fibrosis (CF)

- Most common lethal genetic disease that affects Caucasians
  - 1 in 3700 live births in North America
  - Autosomal recessive trait:
    - ≈1 in 30 Caucasians are carriers
- Multi-system disease associated with **abnormal chloride transport** of epithelial cells
  - Either protein is in wrong place or it doesn't function well
  - Increases chloride and sodium content in sweat
  - "**Sweat test**": mother's kissing salty child

Cystic fibrosis

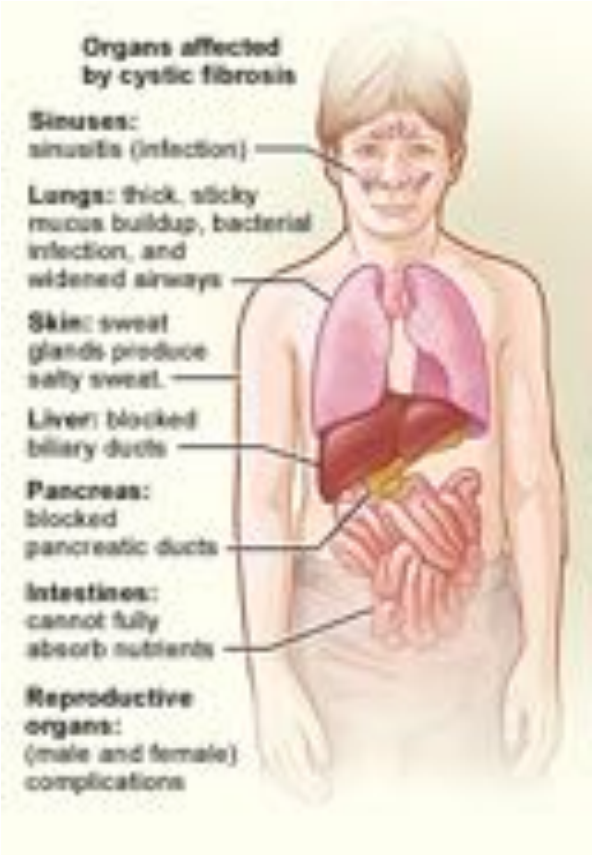
Pulmonary involvement:

- Infection with normal floral bacteria
- Followed by infection with other bacteria
  - Cilia not working well, can't cough it out!
- Persistent **infection** and **inflammation** cause damage to airway walls and obliteration of small airways*
- Most patients **die** of **pulmonary failure secondary to infection**
  - Two CF patients cannot be in the same room!

Many other organ systems are involved in CF

<u>Any organ system with a duct will likely be affected!</u>

- ↑ thickness of secretions causes blockage
  - Poor digestion of fats
  - Malabsorption of proteins and carbohydrates
  - Infertility (fertility ducts blocked)
  - Cirrhosis of liver (liver ducts blocked)
  - Increased incidence of sleep apnea (sinuses blocked)



http://www.patient.org.in/lung/cystic-fibrosis.htm

Ocular involvement in CF

Abnormal chloride transfer in the eye

- Aqueous deficient dry eye with epithelial staining
- Reduced endothelial cell density
- Increased corneal thickness (edema)
- Posterior sub capsular cataract
- Reduced contrast sensitivity (Cl problems in retina)
- Diabetic retinopathy (diabetes more common → pancreas issue)
- Nutritional effects: decreased macular pigmentation; Xerophthalmia

Tx of cystic fibrosis

No cure, try to improve length and quality of life!

Airway clearance techniques

- **Goal**: remove mucus build up to prevent infection
- **Medicinal method:**
  - Can use **dornase alpha (Pulmozyme)**
    - Makes sputum less viscous and easier to clear
    - Can cause condition similar to **bacterial conjunctivitis**

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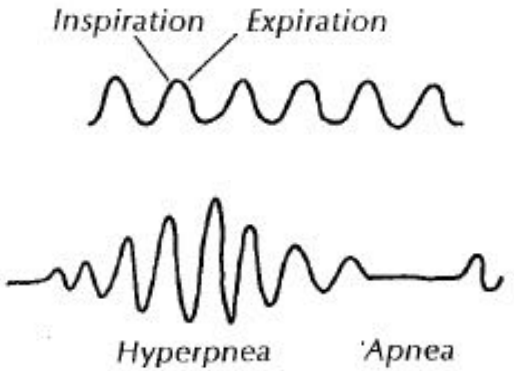
Sleep apnea



- **Apnea**: complete cessation of respiration 10 seconds
- 2 forms of sleep apnea
  - **1. Central**:
    - ***Not*** an obstructive disease
    - *Cheyne-Stokes* respiration: dysfunction in brain respiratory control centers
      - Poor feedback loop: low O2 gets to brain → breathe MORE → high O2 → breathe less(stops breathing) → low O2……
    - Often due to **heart failure** (slow response due to poor blood flow)
  - **2. Obstructive**: mechanical (MOST common)

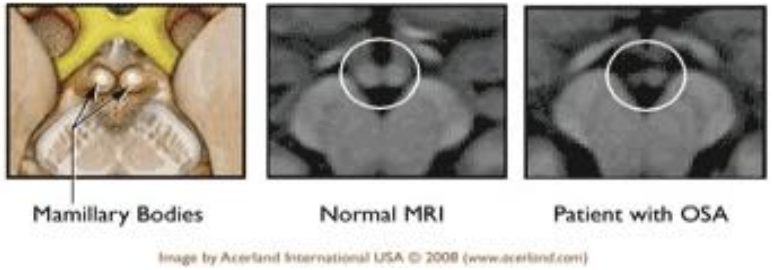
Obstructive Sleep Apnea (OSA)

- Most common sleep disorder
- Prevalence depends on how defined
- Most agree that 3-7% of adults have mod to severe sleep apnea
- Found in up to 1/4 of males over 20 years of age if include mild forms
- Women less commonly affected (tend to be post menopausal)
- Often undiagnosed (80%)
- Can also occur in children (ex: CF or down syndrome)

Obstructive Sleep Apnea (OSA)

Symptoms

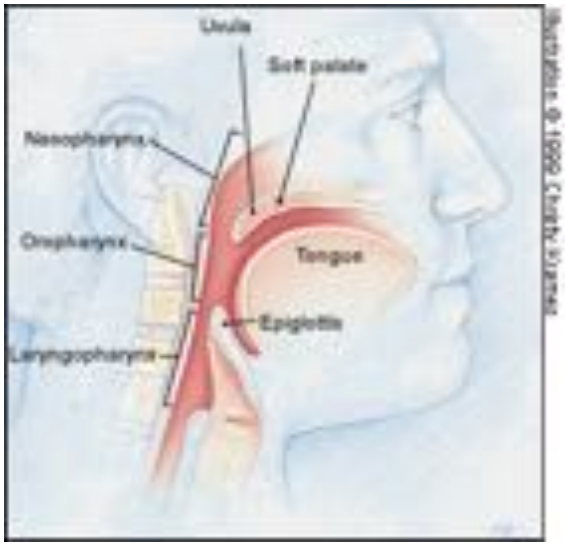
- Loud snoring (patient unaware)
- Chronically disturbed sleep (patient unaware)
- Excessive daytime sleepiness
- Irritability, depression, and personality changes
- Morning headaches
- Tired upon awakening
- Cognitive impairment (MRI scans on mammillary bodies)



OSA pathophysiology

- OSA is due to complete collapse of upper airway* in sleep
  - Upper airway: soft palate, uvula, the jaw
- As patient enters deep sleep, upper airway closes
- Thrashes, snorts, partially awakens and reopens airway with a gasp
- Can occur **hundreds** of time per hour

* - makes tube obstruct



http://www.aafp.org/afp/991115ap/2279.html

OSA contributing factors

<u>These factors *ONLY* ↑ risk of having OSA:</u>

- Most patients are **obese** and have "thick" necks
  - Fat around neck helps occlude airways
- May have small or receding jaw
- May have increased size of **soft palate** and **tongue**
- Often a history of heavy drinking
  - Alcohol relaxes muscles and less likely to wake from sleep
- History of asthma

http://www.aafp.org/afp/991115ap/2279.html

Medical conditions associated with OSA

- HTN in 30 to 50% with OSA; often difficult to control
  - Treating HTN drops BP by 3-5mmHg (= to a med)
- Obesity
- Multiple sclerosis (loss of muscle tone)
- Diabetes (3X) (1.7X even if control for obesity)
  - Increased risk of retinopathy, especially macular edema (lack of O2)
- Cardiovascular disease (lack of O2)
  - Ischemic heart disease, MI and angina (4-7X)
  - Nocturnal cardiac arrhythmias (2– 4X)
  - Stroke (3-8X)
  - Heart failure

Obstructive sleep apnea increases the incidence of some conditions

**Likely due to decrease in O2 supply!

- Alzheimer disease/ Brain atrophy/ Cognitive decline
- Emotional problems
- Impotence
- Osteoporosis (2X)
- Glaucoma (7-8% vs 2%) especially normal tension glc
- Anterior ischemic optic neuropathy
- Motor vehicle accidents (MVA) (2 – 7X): falling asleep while driving
- With CPAP use: Corneal dryness, Corneal ulcers, Bacterial ocular infections

THANK YOU

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