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# **Clinical Microbiology**

**Lectures - dentistry studies 2014**

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# **Agents of respiratory diseases**

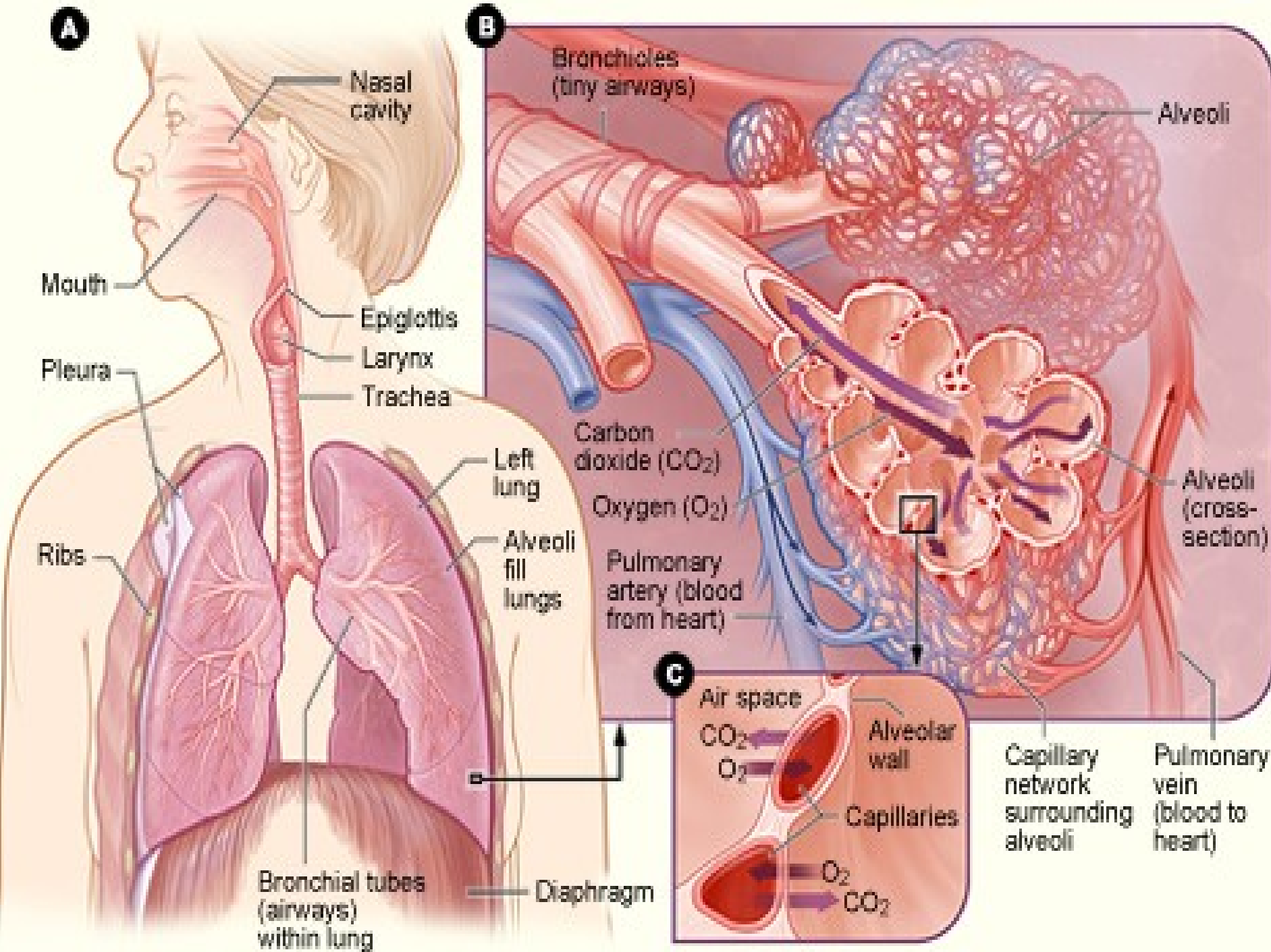
## **Part One**

# Importance of respiratory infections

- **The most important/frequent infections** in GP's office (respiratory tract = an ideal incubator)
- **Big economic impact** on the economics in general and on the health care in particular
- **Often produce outbreaks and epidemics**
- **75 %** (and even more in children) are caused by **viruses**

# Where is RTI localized?

- **clinical symptomatology + specific agents**
- **It is necessary to distinguish:**
  - **upper respiratory tract (URT) infections**  
(+ adjacent organs infections)
  - **lower respiratory tract (LRT) infections**  
(infections of lower respiratory ways + pneumonias)



**A**

**B**

**C**

Nasal cavity

Mouth

Pleura

Epiglottis

Larynx

Trachea

Left lung

Ribs

Alveoli fill lungs

Bronchial tubes (airways) within lung

Diaphragm

Bronchioles (tiny airways)

Alveoli

Carbon dioxide ( $\text{CO}_2$ )

Oxygen ( $\text{O}_2$ )

Pulmonary artery (blood from heart)

Alveoli (cross-section)

Capillary network surrounding alveoli

Pulmonary vein (blood to heart)

Air space

$\text{CO}_2$

$\text{O}_2$

Alveolar wall

Capillaries

$\text{O}_2$

$\text{CO}_2$

# URT infections and infections of adjacent organs

- infections of **nose a nasopharynx**
- infections of **oropharynx incl. tonsillae**
- infections of **paranasal sinuses**
- **otitis media**
- **conjunctivitis**

# LRT infections and lung infections

## Infections of LRT

- infection of epiglottitis
  - infection of larynx and trachea
  - infection of bronchi
  - infection of bronchioli
- infections of lungs

# Common flora in respiratory ways

- i.e. bacteria typically found in respiratory tract of a healthy person
- **Nasal cavity:** usually *Staph. epidermidis*, less often sterile, coryneform rods, *Staph. aureus*, pneumococci
- **Pharynx:** always neisseriae and streptococci (viridans group), usually haemophili, rarely pneumococci, meningococci, enterobacteriae, yeasts
- **LRW:** sterile, clinical materials from these sites are often contaminated by URW flora



# Rhinitis/nasopharyngitis - ETIOLOGY

- **Viruses** – the most common - „common cold“:
  - more than 50 % rhinoviruses
  - coronaviruses
  - other respiratory viruses (NOT flu!)
- **Bacteria:**
  - **Acute** infections: usually secondary
    - *Staph. aureus, Haem. influenzae, Strep. pneumoniae, Moraxella catarrhalis*
  - **Chronic** infections:
    - *Klebsiella ozaenae, Kl. rhinoscleromatis*

# Rhinitis/nasopharyngitis - TREATMENT

- **Viral etiology - does NOT need antibiotic treatment and bacteriological examination**
- **If necessary** (pus full of polymorphonuclears, high CRP levels → markers of bacterial infection) treatment based on the **result of bacteriological examination**
- **Topical treatment - carriers of epidemiologically important pathogens - e.g. MRSA – mupirocin (Bactroban)**

# Infectious rhinitis VS. allergic/vasomotor rhinitis

<http://www.drgrgreen.org/body.cfm?xyzpqabc=0&id=21&action=detail&ref=1285>

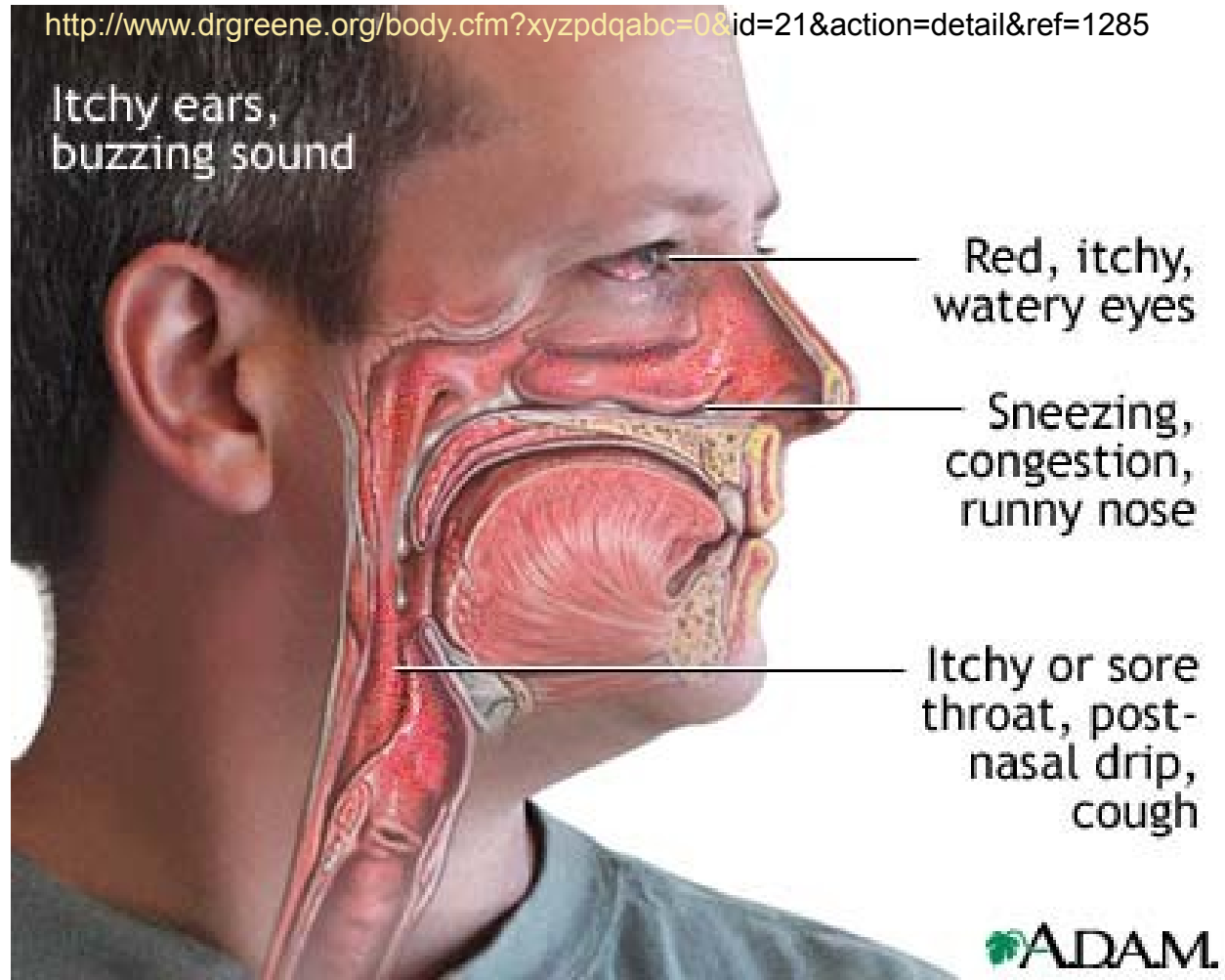
Itchy ears,  
buzzing sound

Red, itchy,  
watery eyes

Sneezing,  
congestion,  
runny nose

Itchy or sore  
throat, post-  
nasal drip,  
cough

[http://www.bupa.co.uk/health\\_information/asp/direct\\_news/general\\_health/rhinitis\\_240706.asp](http://www.bupa.co.uk/health_information/asp/direct_news/general_health/rhinitis_240706.asp)



# Sinusitis/otitis media – ETIOLOGY I

- **Acute sinusitis and otitis usually started by respiratory viruses, *M. pneumoniae* (myringitis)**
- **Secondary pyogenic inflammations:**  
***S. pneumoniae*, *H. influenzae* type b, *Moraxella catarrhalis*, *Staph. aureus*, Str. group A, OR even anaerobes (genus *Bacteroides*, *Prevotella*, *Porphyromonas*...)**

**Complications:** mastoiditis, purulent meningitis

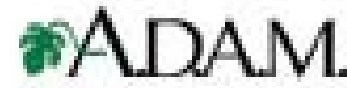
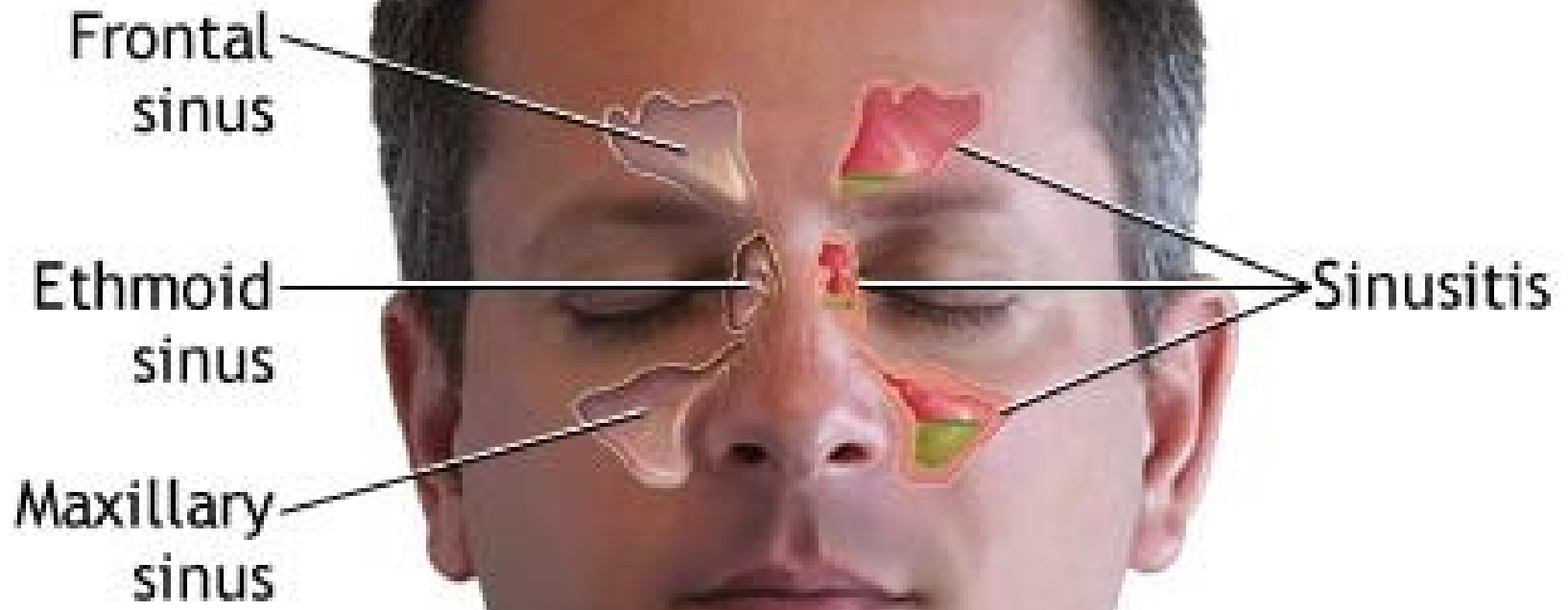
# Sinusitis/otitis media – ETIOLOGY II

- **Sinusitis maxillaris chronica, sinusitis frontalis chronica:** *Staph. aureus*, genus *Peptostreptococcus*
- **Otitis media chronica:** *Pseudomonas aeruginosa*, *Proteus mirabilis*

# Sinusitis/otitis media - EXAMINATION + TREATMENT

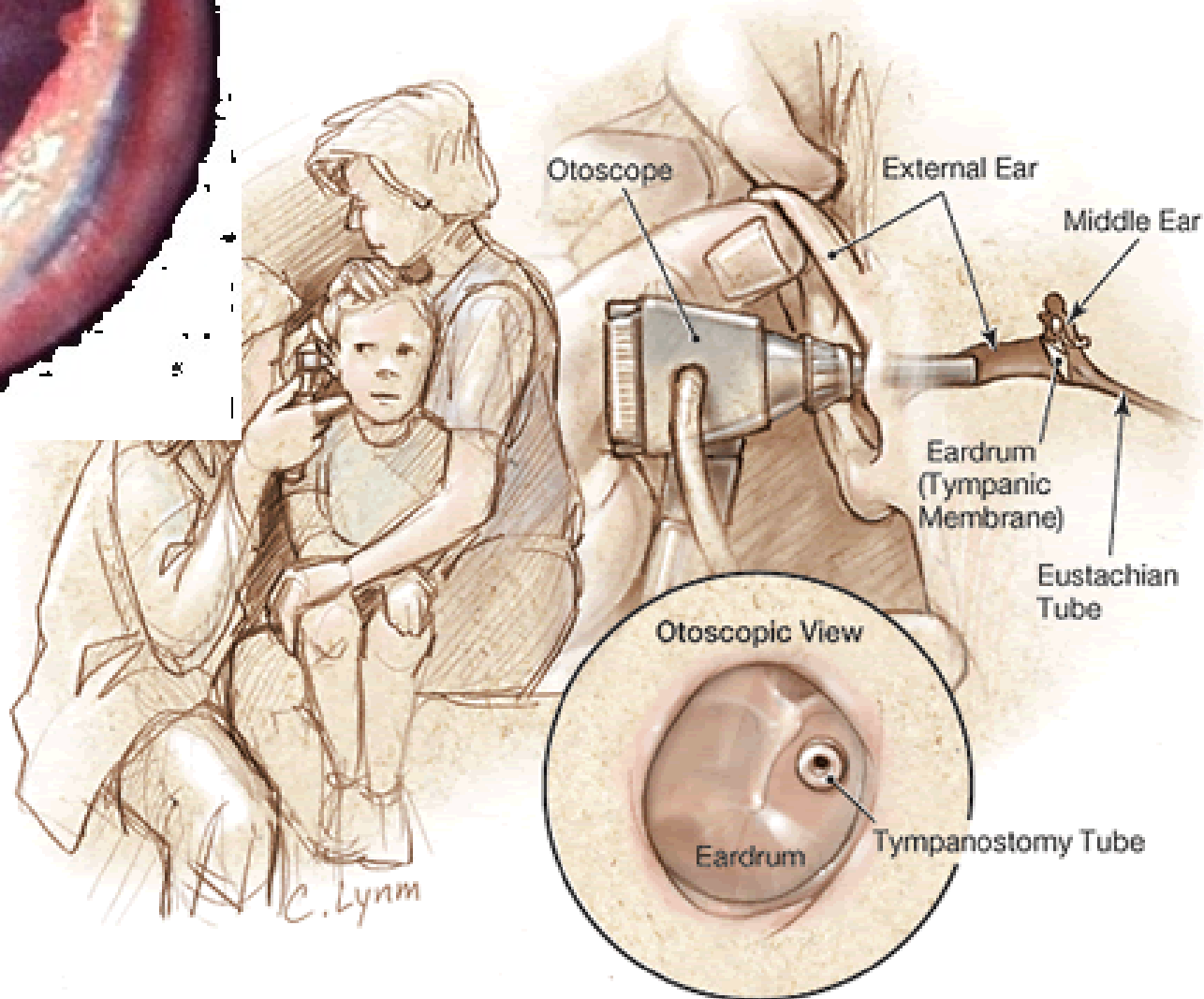
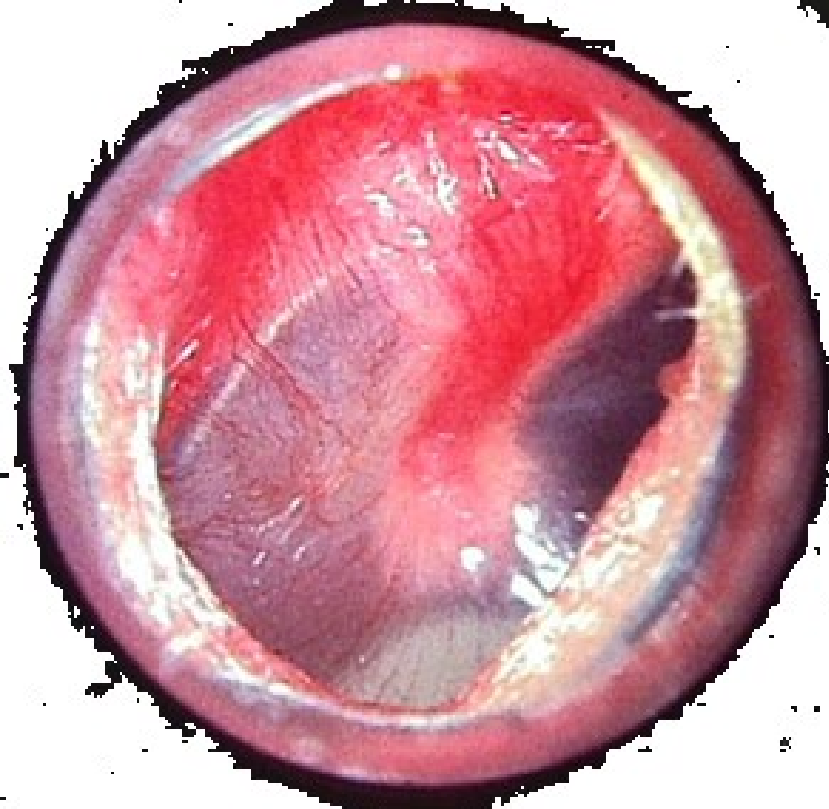
- **Relevant specimen** – only a **punctate** from the middle ear or paranasal sinus; NOT nasal, ear swabs (contaminants)
- **Sinusitis** ATB treatment **ONLY** in **painful sinusitis**, with teathache, headache, fever, lasting at least a weak, eventually neuralgia of N. Trigemini
- **Otitis media** ATB when inflammation (pain, red colour, fever) and anti-inflammatory treatment not sufficient
- **e.g. Aminopenicillin or 1st gen. cephalosporin**

sitis



# Otitis media

- Causative agents
- as in sinusitis



<http://www.otol.uic.edu/research/microto/Microtscopy/acute1.htm>

[http://www.medem.com/MedLB/article\\_detailb.cfm?article\\_ID=ZZZPMV6D1AC&sub\\_cat=544](http://www.medem.com/MedLB/article_detailb.cfm?article_ID=ZZZPMV6D1AC&sub_cat=544)



# Conjunctivitis - ETIOLOGY

- Usually **viral**, accompanies acute URT infections/  
**adenovirus, enterovirus** - hemorrhagic conjunctivitis, **HSV** -  
herpetic keratoconjunctivitis
- **Bacterial**
  - a. Acute:  
suppurative conjunctivitis: ***S. pneumoniae, S. aureus***  
inclusion conjunct.: ***C. trachomatis* D – K**
  - b. Chronic: ***S. aureus, C. trachomatis* A – C** (trachoma)
- **Allergic, mechanic** (alien body)
- Usually **topical** treatment

# Oropharyngeal infections - ETIOLOGY

- **Acute tonsillitis and pharyngitis:**

usually **viral** (rhinoviruses, coronaviruses, adenoviruses, EBV – inf. mononucleosis, coxsackieviruses – herpangina)

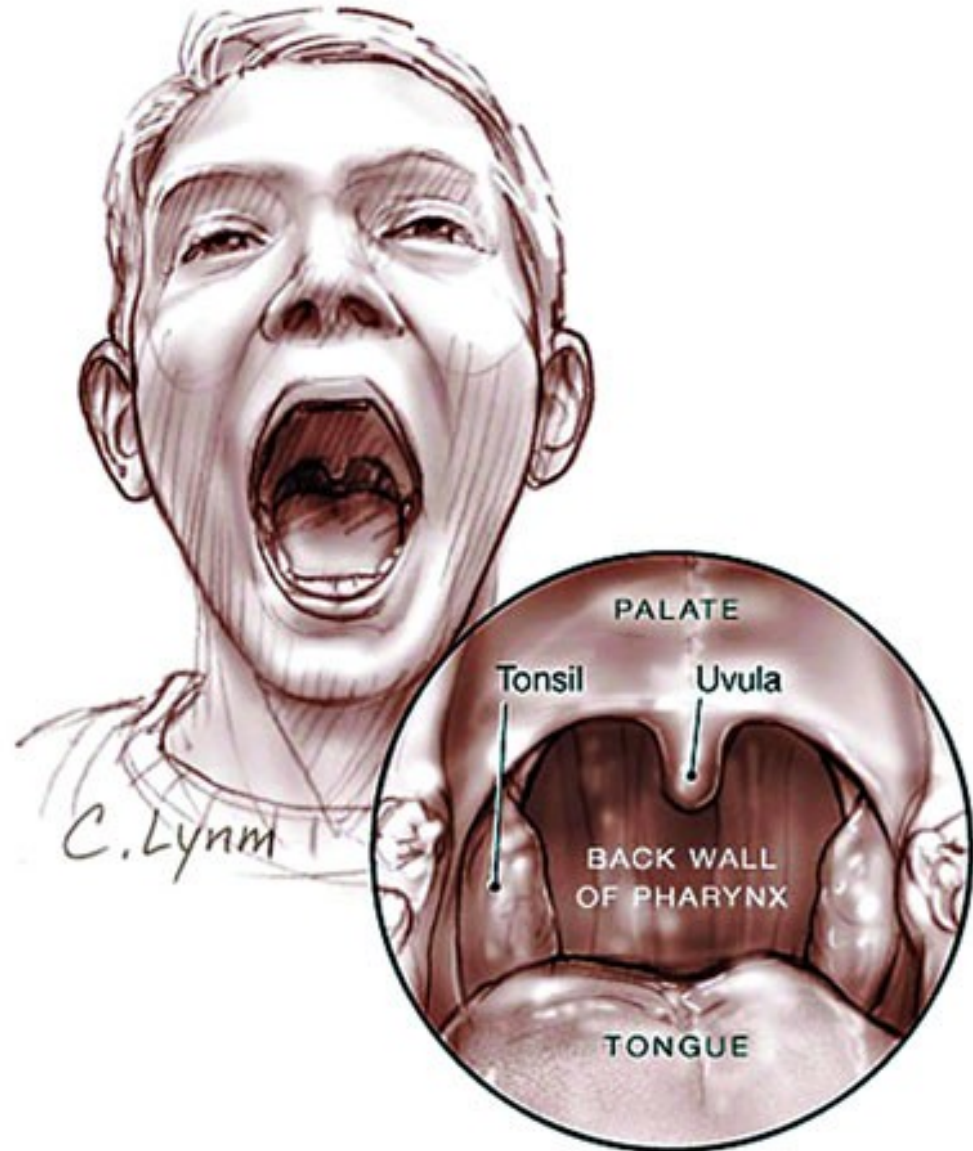
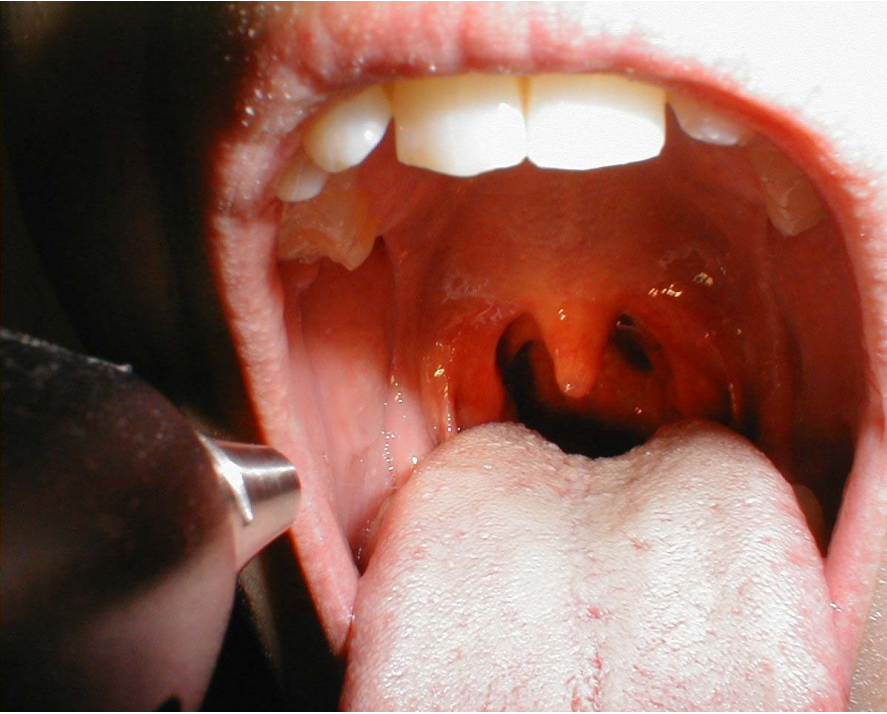
**Most important bacterial: *S. pyogenes* (=  $\beta$ -haemol. streptococcus group A)**

- **Other bacterial:** streptococci group C, F, G, pneumococci, *H. influenzae?*, *N. meningitidis?*,
- **Rare, but important:** *Corynebacterium diphtheriae*, *Neisseria gonorrhoeae*

# Oropharyngeal infections -TREATMENT

- **Throat swab recommended in all cases, incl. a „typical tonsillitis“**
- ***Streptococcus pyogenes* - penicillin still the best!**
- **Macrolides, e.g. clarithromycin in allergic patients only (resistance, worse effect)**
- **determination of CRP level (marker of a bacterial infection)**

# Tonsilopharyngitis



<http://medicine.ucsd.edu/Clinicalimg/Head-Pharyngitis.htm>

<http://www.newagebd.com/2005/sep/12/img2.html>

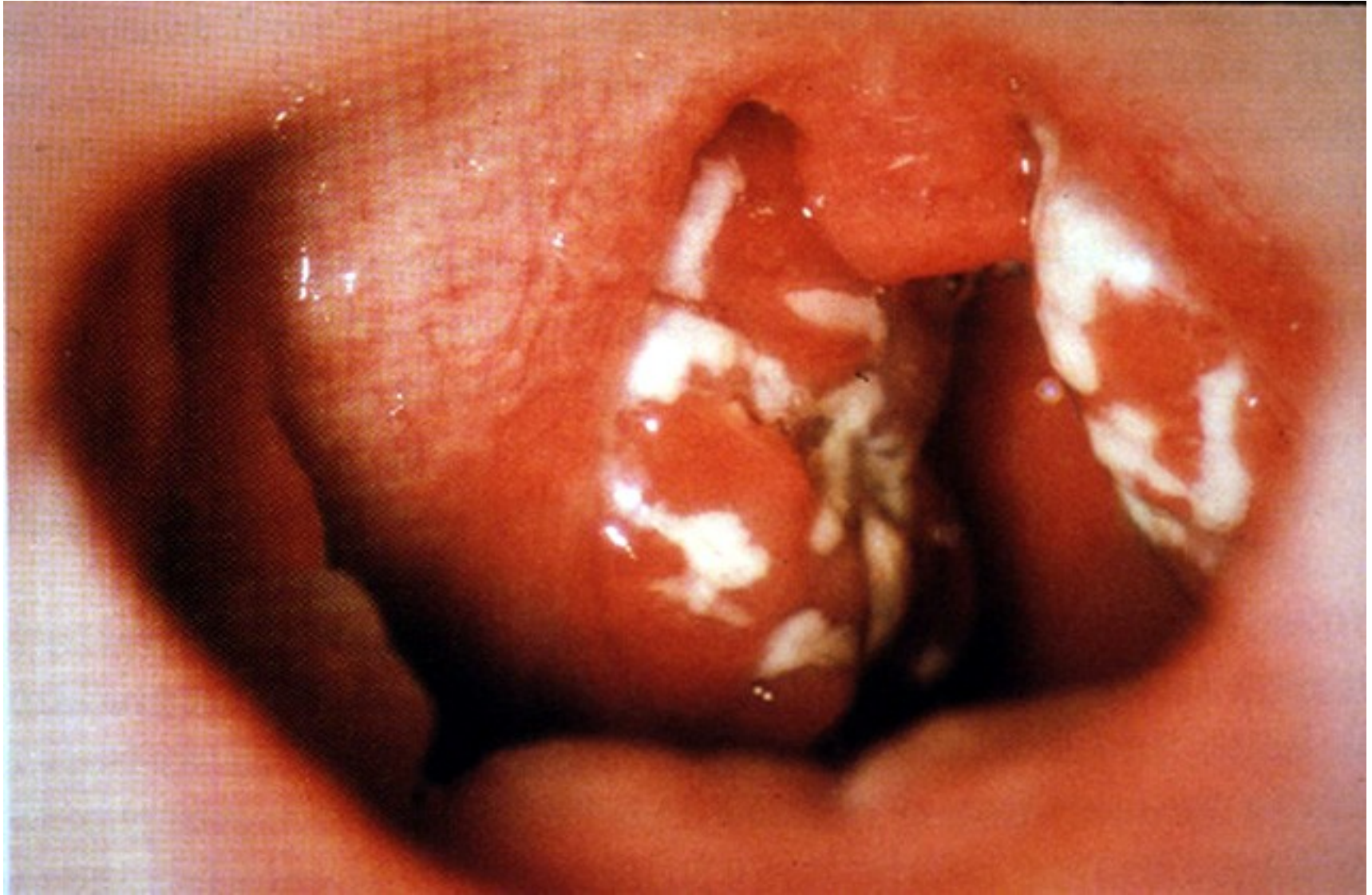
# Viral tonsilopharyngitis



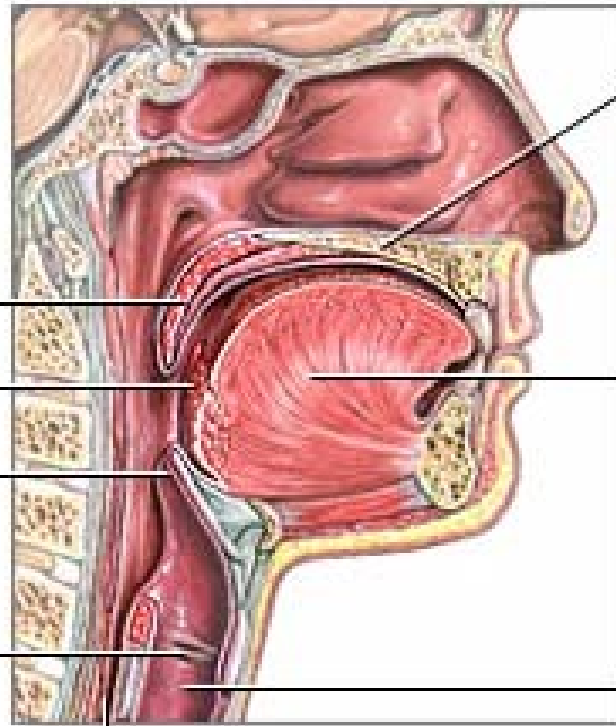
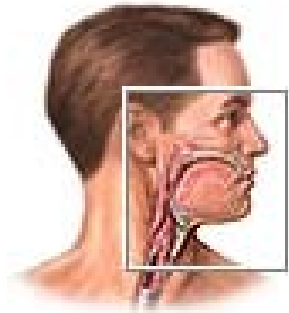
<http://upload.wikimedia.org/wikipedia/commons/thumb/b/b1/Pharyngitis.jpg/250px-Pharyngitis.jpg>

# Purulent bacterial tonsillitis

<http://www.meddean.luc.edu/lumen/MedEd/medicine/PULMONAR/diseases/pul43b.htm>



# Epiglottitis



Hard  
palate

Tongue

Trachea

Soft palate

Palatine tonsil

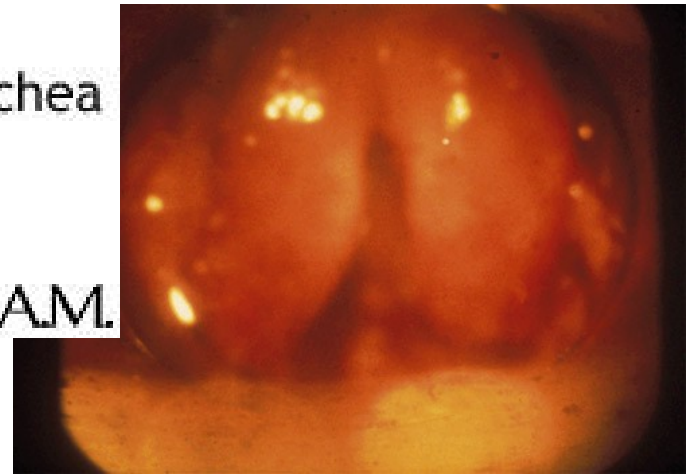
Epiglottis

Vocal fold

Esophagus

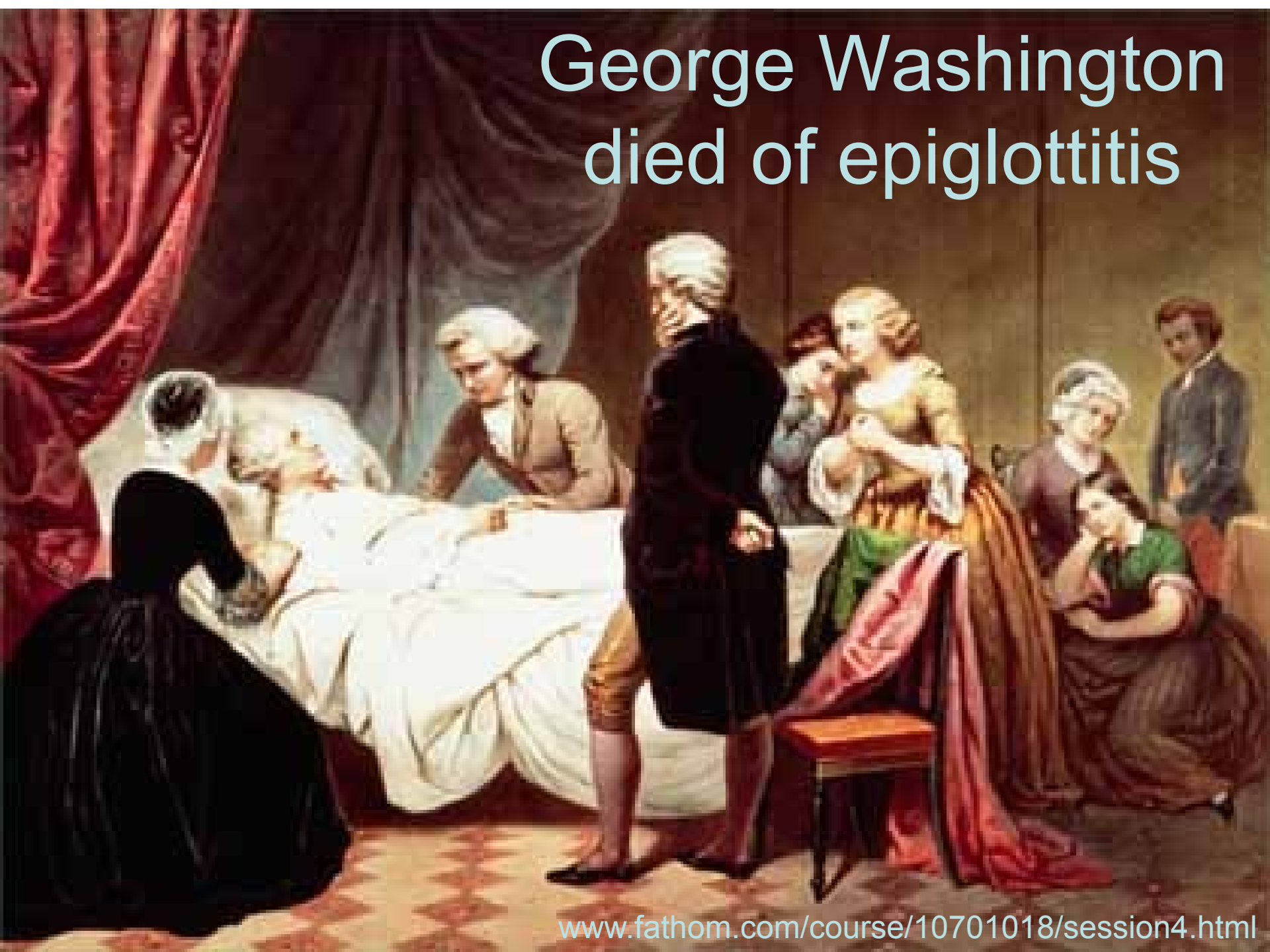
[de.wikipedia.org/wiki/  
Epiglottitis](http://de.wikipedia.org/wiki/Epiglottitis)

ADAM.



<http://health.allrefer.com/health/epiglottitis-throat-anatomy.html>

# George Washington died of epiglottitis



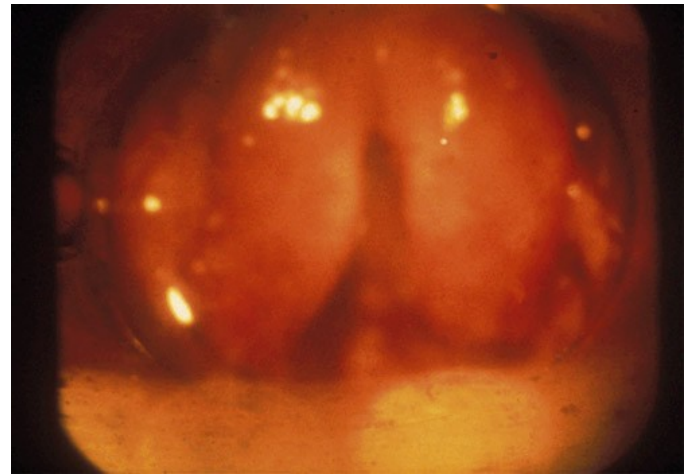


# Epiglottitis

- **Serious disease – medical emergency**

**The child may suffocate!**

- ***Haemophilus influenzae* type b („Hib“)**  
**- vaccination**



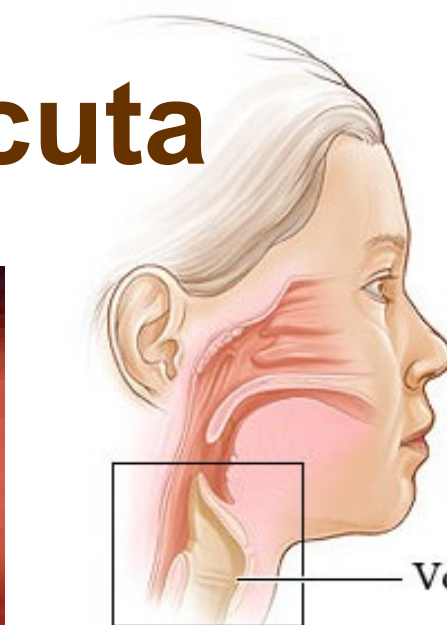
# Laryngitis and tracheitis

- **Respiratory viruses** (other than in nasopharyngitis):  
parainfluenza/influenza A viruses & RSV

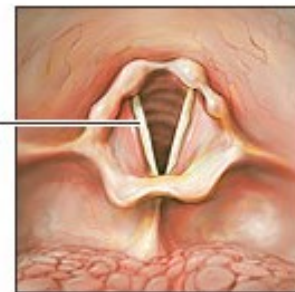
**Treatment symptomatic** - antibiotics NOT recommended

- **Bacterial:** *Chlamydophila pneumoniae*, *Mycoplasma pneumoniae*, secondary: *S. aureus* and *Haemophilus influenzae*, laryngotracheitis pseudomembranosa (croup): *Corynebacterium diphtheriae*
- Throat swab is useless, except for chronic situations.

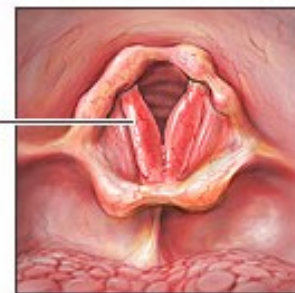
# Laryngitis acuta



Normal vocal cords



Inflamed vocal cords



Vocal cords



© Healthwise, Incorporated



IAN BAKER...

# Bronchitis - ETIOLOGY

- **Acute bronchitis:**

**influenza**, parainfluenza, adenoviruses, RSV

**Bacterial - secondary:** pneumococci, haemofili, stafylococci, moraxellae

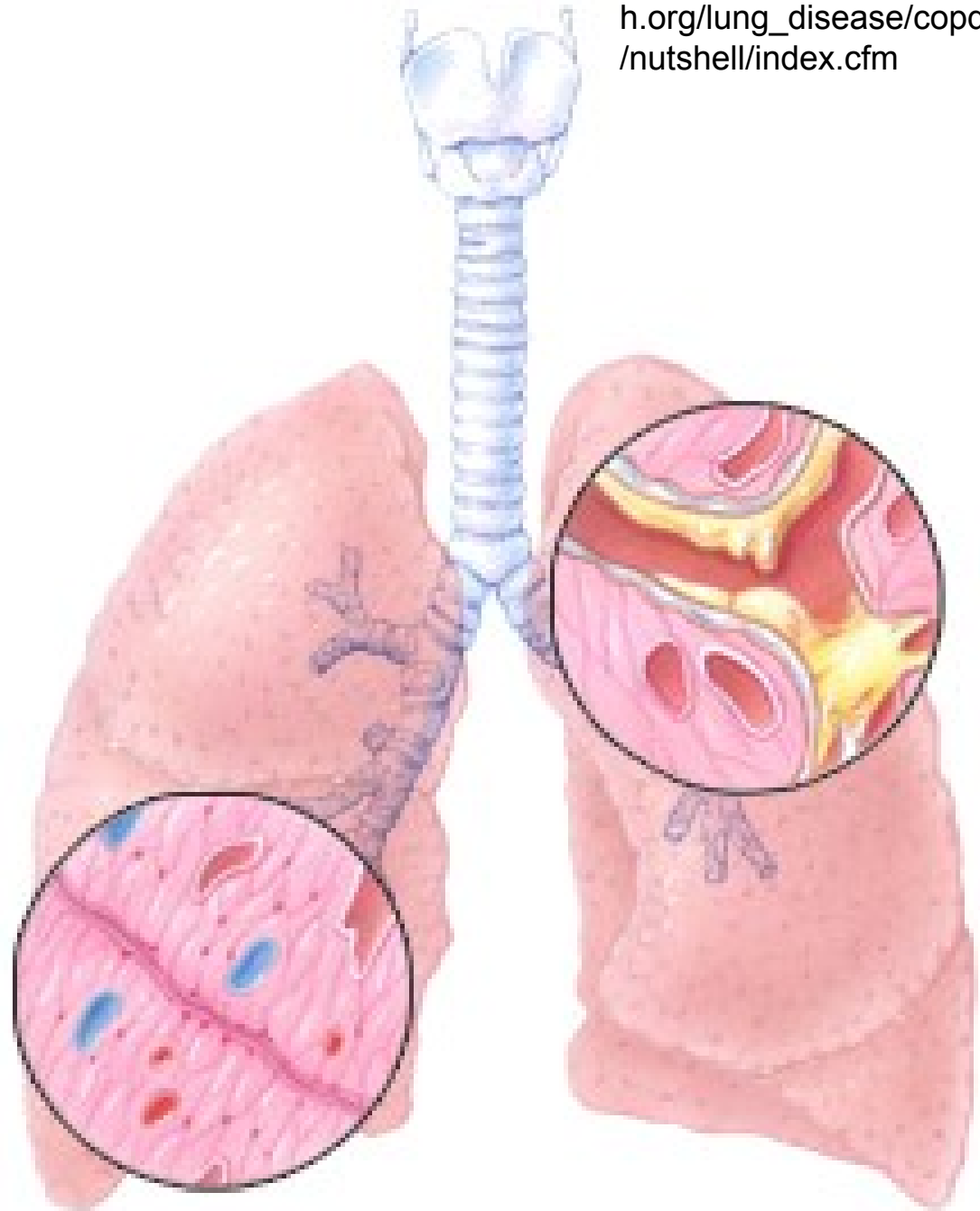
**Bacterial - primary:** *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, *Bordetella pertussis*

- **Chronic bronchitis (cystic fibrosis):**

*Pseudomonas aeruginosa*, *Burholderia cepacia*

# Bronchitis acut

[http://www.yourlunghealth.org/lung\\_disease/copd/nutshell/index.cfm](http://www.yourlunghealth.org/lung_disease/copd/nutshell/index.cfm)



<http://www.lhsc.on.ca/resptherapy/students/p/atho/brnchit5.htm>

# Bronchiolitis

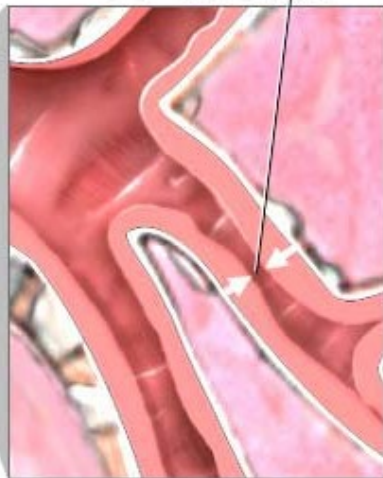
- Isolated bronchiolitis in newborns and infants only:

*Pneumovirus* (= RSV)

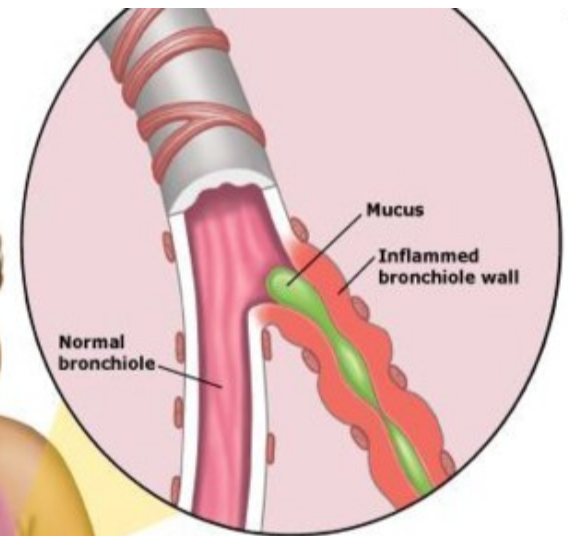
*Metapneumovirus*



Bronchial swelling



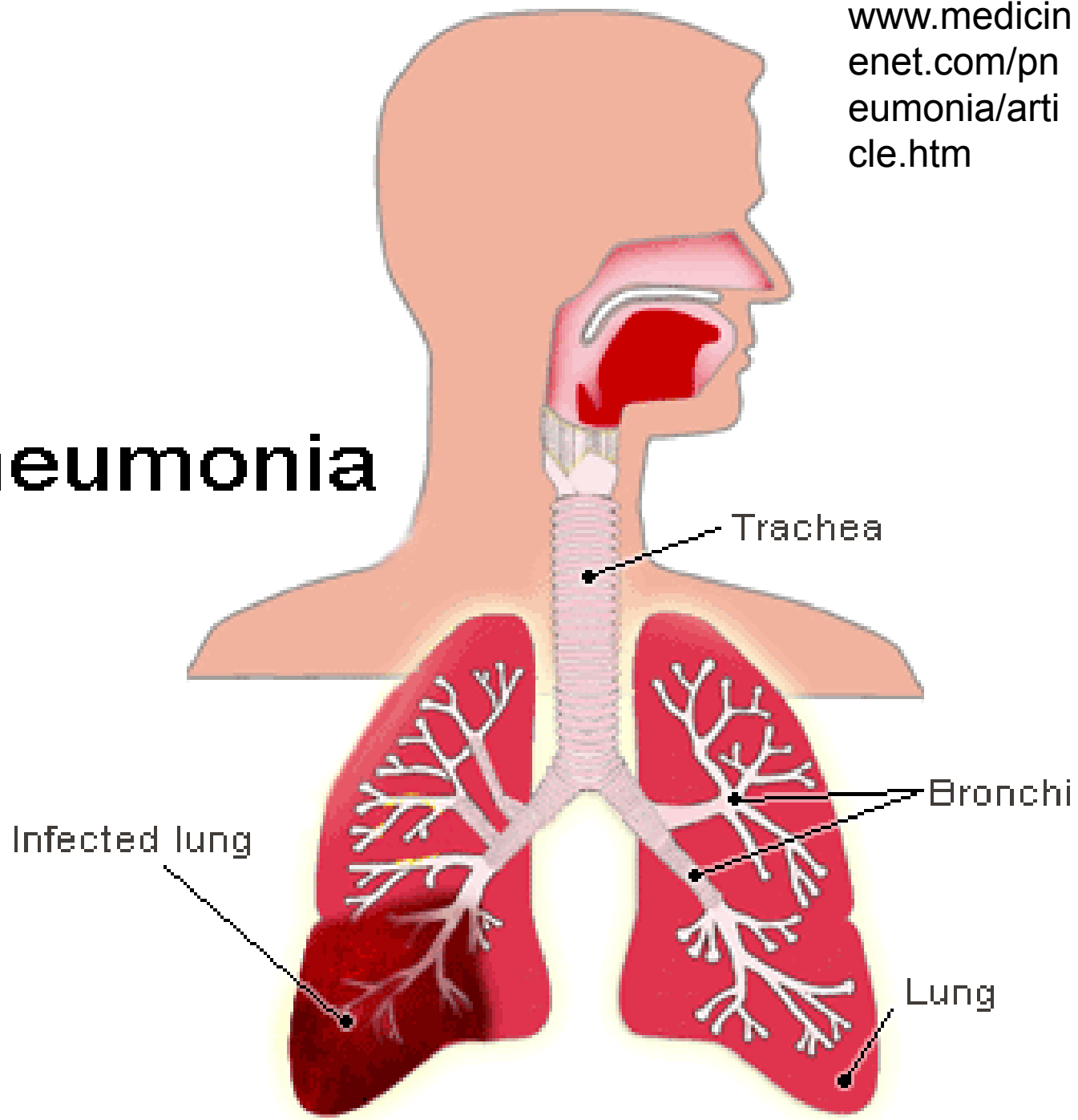
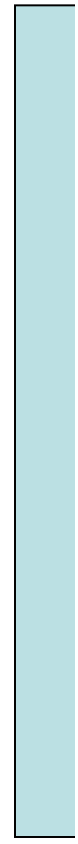
In bronchiolitis, the airway becomes obstructed from swelling of the bronchiole walls



<https://www.nlm.nih.gov>

# Pneu

## Pneumonia





# Types of pneumoniae

- **Acute – community-acquired pneumoniae CAP**
  - in originally healthy
    - adults
    - children
  - in debilitated persons
  - after a contact with animals (e.g. *Pasteurella multocida*, *Coxiella burnetii* - Q-fever, *Chlamydophila psittaci* - psittacosis)
- **Acute – nosocomial pneumoniae**
  - ventilator-associated
    - a) early
    - b) late
  - others
- **Subacute and chronic pneumoniae**

# Pneumoniae – ETIOLOGY I

**Acute, community-acquired, in healthy adults**

- **bronchopneumonia and lobar pneumonia:**
  - *Streptococcus pneumoniae*
  - *Staph. aureus*
  - *Haemophilus influenzae* type b
- **atypical pneumonia:**
  - *Mycoplasma pneumoniae*
  - *Chlamydophila pneumoniae*
  - **Influenza A virus**

# Pneumoniae – ETIOLOGY II

- **Acute, community-acquired, in debilitated individuals:**
  - pneumococci, staphylococci, haemofili
  - *Klebsiella pneumoniae* (alcoholics)
  - *Legionella pneumophila*
- **In more serious immunodeficiency:**
  - *Pneumocystis jirovecii*
  - CMV
  - atypical mycobacteria
  - *Nocardia asteroides*
  - aspergilli, candidae

# Pneumoniae – ETIOLOGY III

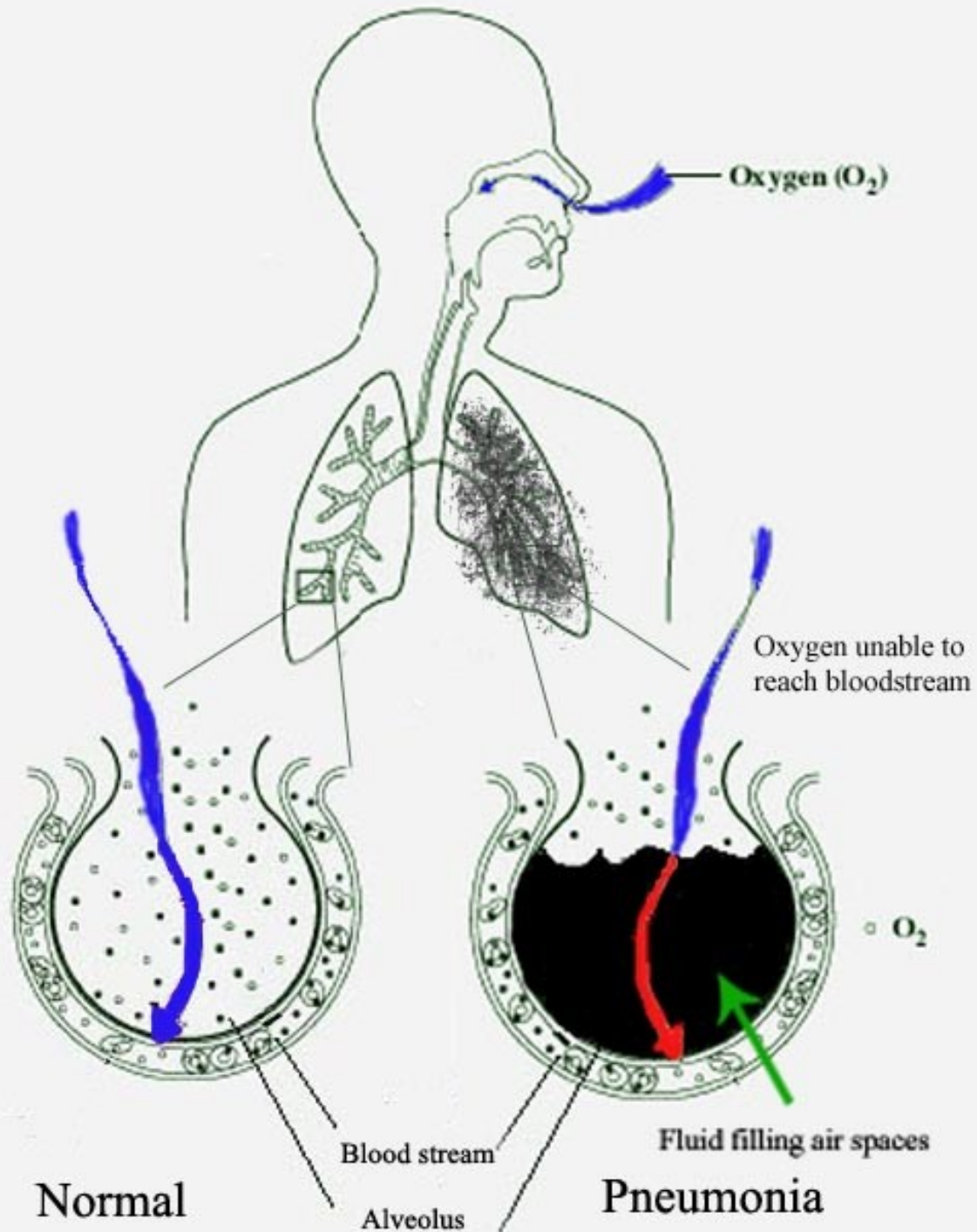
## Acute, nosocomial:

- Ventilator-associated pneumonia - VAP:
  - early (up to the 4th day of hospitalization):  
sensitive community strains
  - late (from the 5th day):  
resistant hospital strains
- Others
  - viruses (RSV, CMV)
  - Legionella

# Pneumoniae – ETIOLOGY IV

- **Subacute and chronic:**
  - **aspiration pneumonia and lung abscesses**
    - *Prevotella melaninogenica*
    - *Bacteroides fragilis*
    - **peptococci and peptostreptococci**
  - **lung tuberculosis and mycobacterioses**
    - *Mycobacterium tuberculosis*
    - *Mycobacterium bovis*
    - **atypical mycobacteria**

# Pneumonia



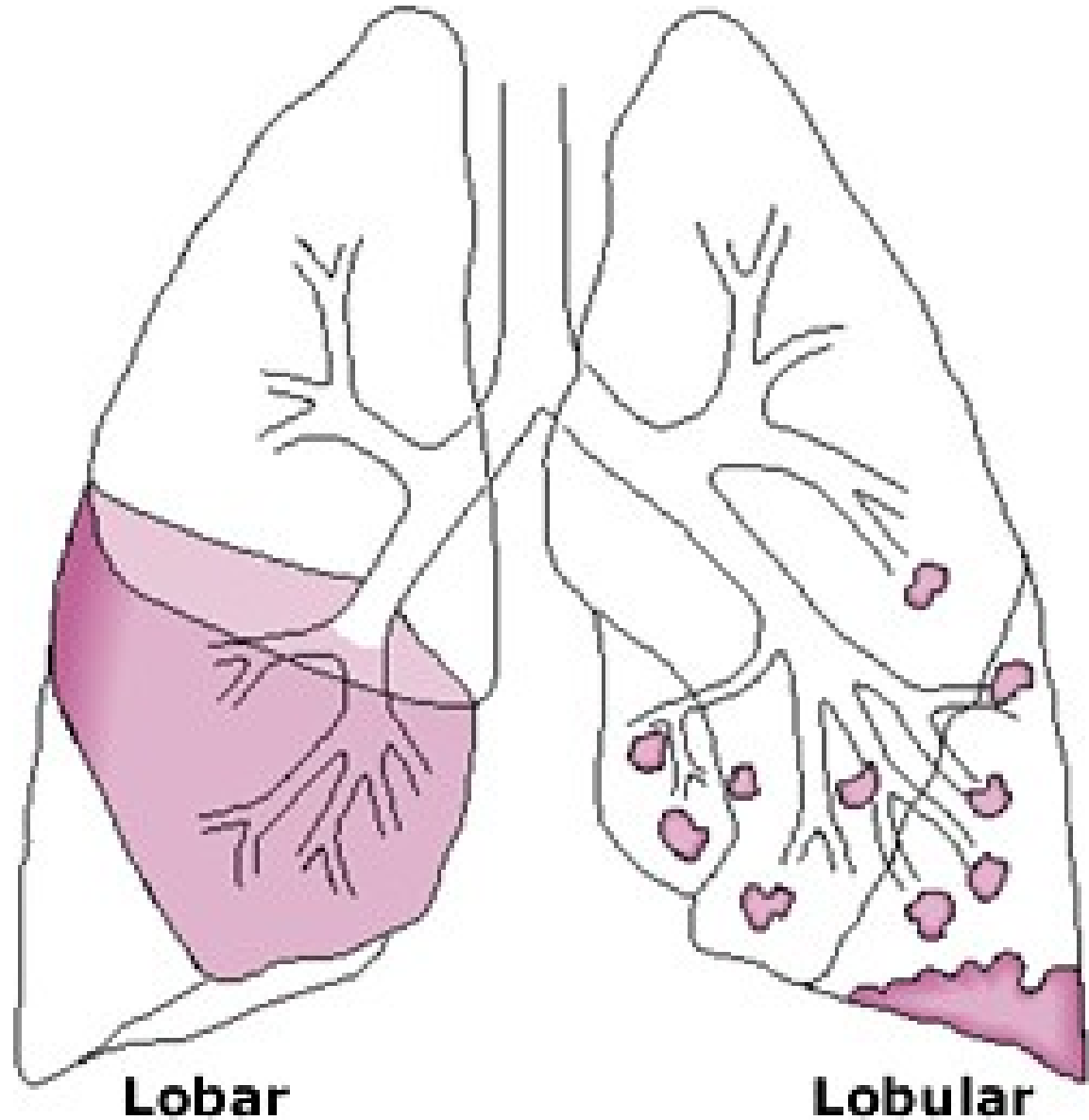
<http://www.uspharmacist.com/index.asp?page=ce/105057/default.htm>



# Bronchopneumonia

See the inhomogenous shadow in the lower and middle lobes of the right lung

# Lobar and lobular pneumonia



**Lobar**

**Lobular**



# Lung infections - EXAMINATION

- Clinical examination and chest X-ray, differentiation classical atypical pneumonia
- Classical pneumoniae - sputum is useful, blood for blood culture, *S. pneumoniae* Ag in urine
- Atypical pneumoniae - serology - mycoplasma and chlamydomphila (+ „viral screen“).
- Hospital pneumoniae also *Legionella* examination – Ag in urine

# Bronchitis and pneumonia - TREATMENT

- CAP **amoxicilin**, (eventually according to a causative agent and antibiotic susceptibility)
- In atypical pneumoniae **tetracyclins** or (esp. in children < 8) **macrolides**.
- Combination therapy
- In **hospital infections** - **susceptibility test** - resistances!
- In TB usually combination of three drugs

# **Gerrit Dou (1613 - 1675)**

## **The Physician**

