Institute for Microbiology, Faculty of Medicine, Masaryk University
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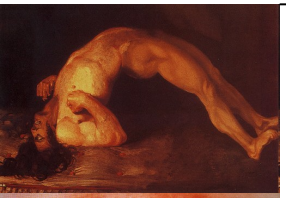
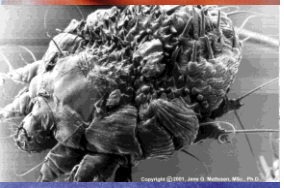




Miroslav Votava
Vladana Woznicová
Ondřej Zahradníček

Clinical Microbiology

Lecture for 3rd-year dentistry students

Institute for Microbiology, Faculty of Medicine, Masaryk University
and St. Anna Faculty Hospital, Brno

Agents of respiratory diseases

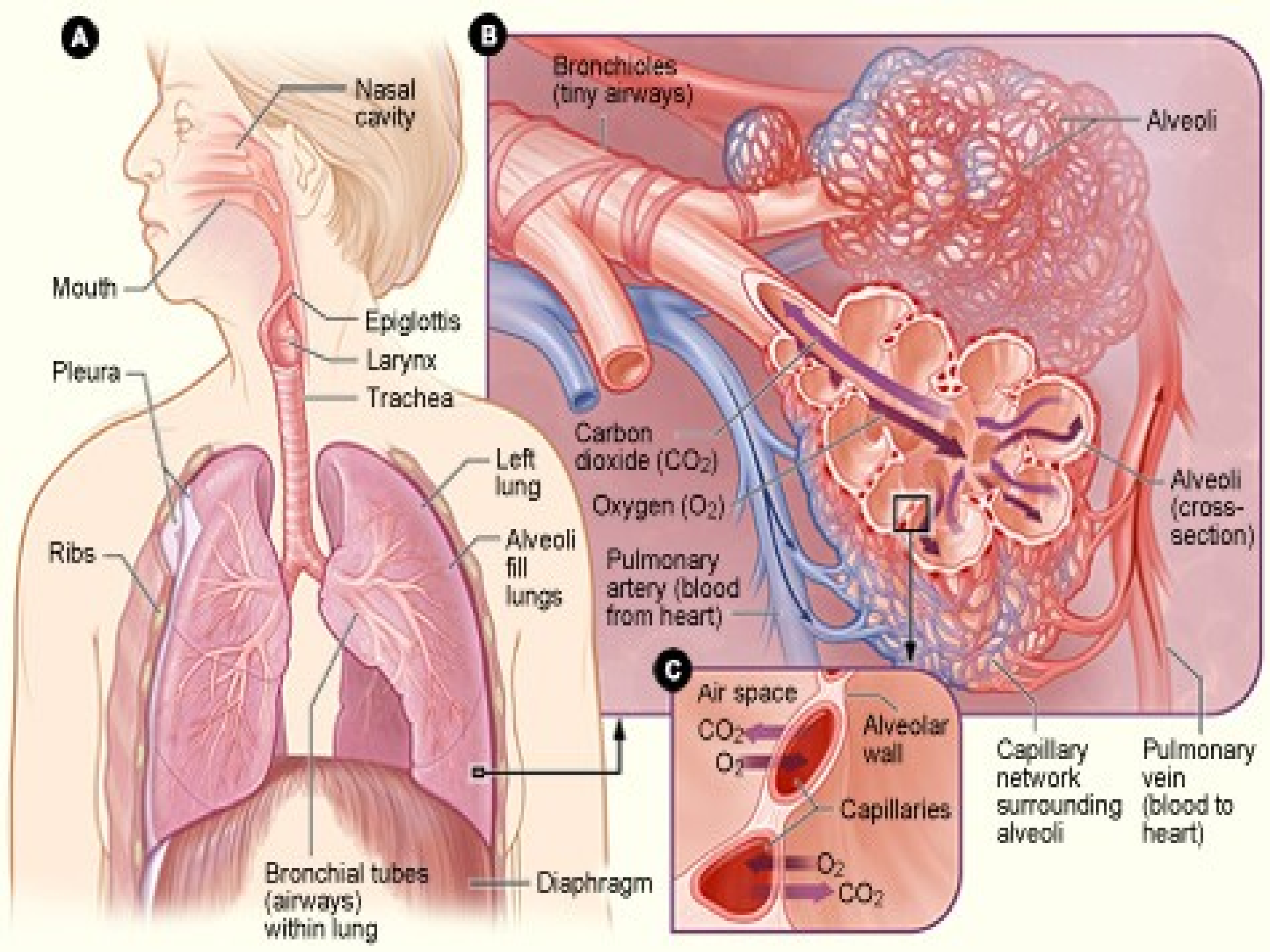
Part One

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
Nasal cavity
Mouth
Epiglottis
Larynx
Pleura
Trachea
Left lung
Alveoli fill lungs
Ribs
Bronchial tubes (airways) within lung
Diaphragm
B
Bronchioles (tiny airways)
Alveoli
Carbon dioxide (CO_2)
Oxygen (O_2)
Alveoli (cross-section)
Pulmonary artery (blood from heart)
C
Air space
CO_2
O_2
Alveolar wall
Capillaries
O_2
CO_2
Capillary network surrounding alveoli
Pulmonary vein (blood to heart)

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 epiglottis
- 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 (2nd position)**
  - **other respiratory viruses (but 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 - the majority of rhinitis and nasopharyngitis does not need antibiotic treatment and bacteriological examination

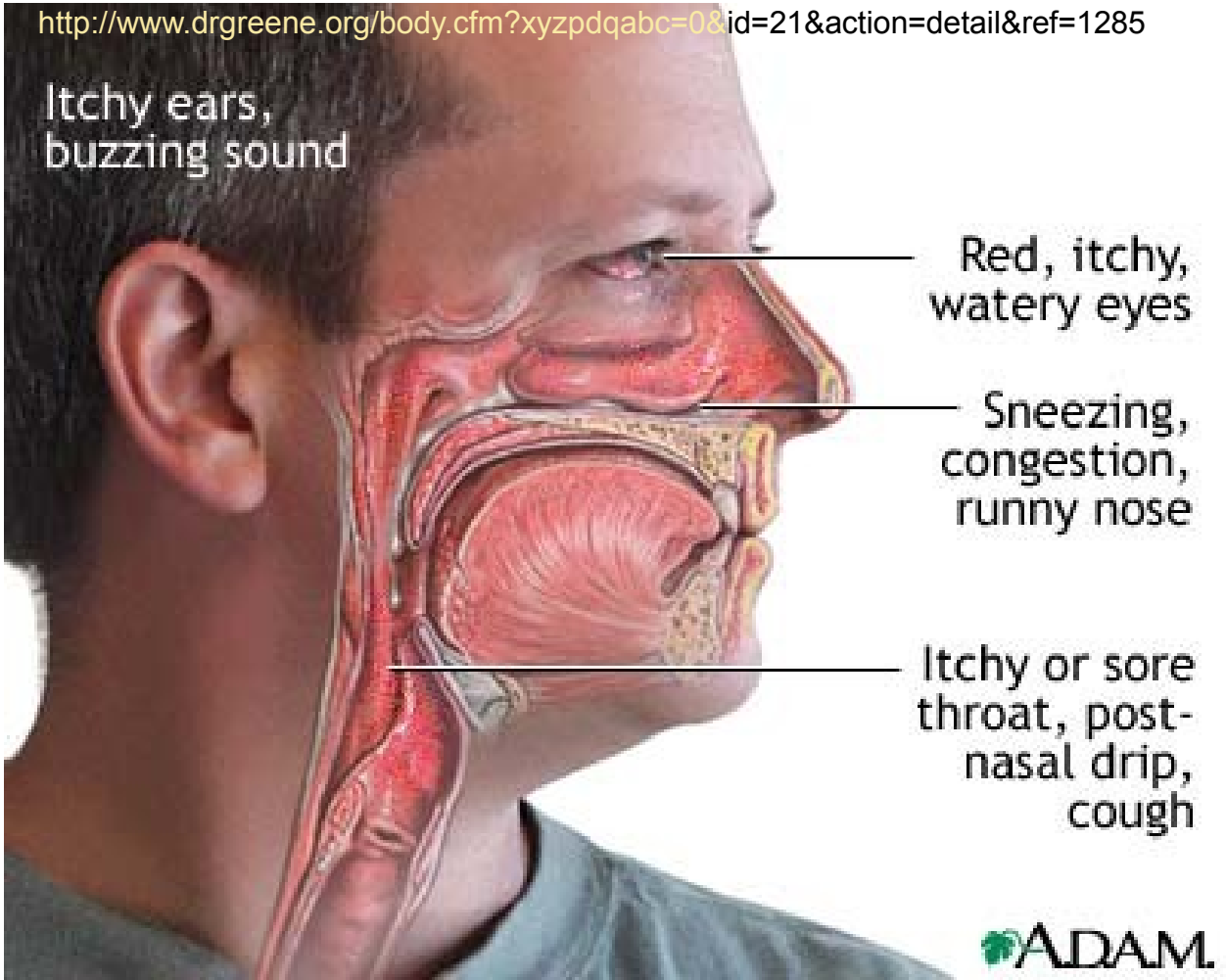
- If necessary (pus full of polymorphonuclears, high CRP levels → markers of bacterial infection) treatment based on the result of bacteriological examination

- Topical treatment - carriers of epidemiologically important pathogens - e.g. MRSA – mupirocin (Bactroban)

Infectious rhinitis VS. allergic/vasomotoric rhihitis

http://www.bupa.co.uk/health_information/asp/direct_news/general_health/rhinitis_240706.asp

http://www.drgreene.org/body.cfm?xyzpdqabc=0&id=21&action=detail&ref=1285



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*, *Peptostreptococcus*

- Complications: mastoiditis, meningitis purulenta

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

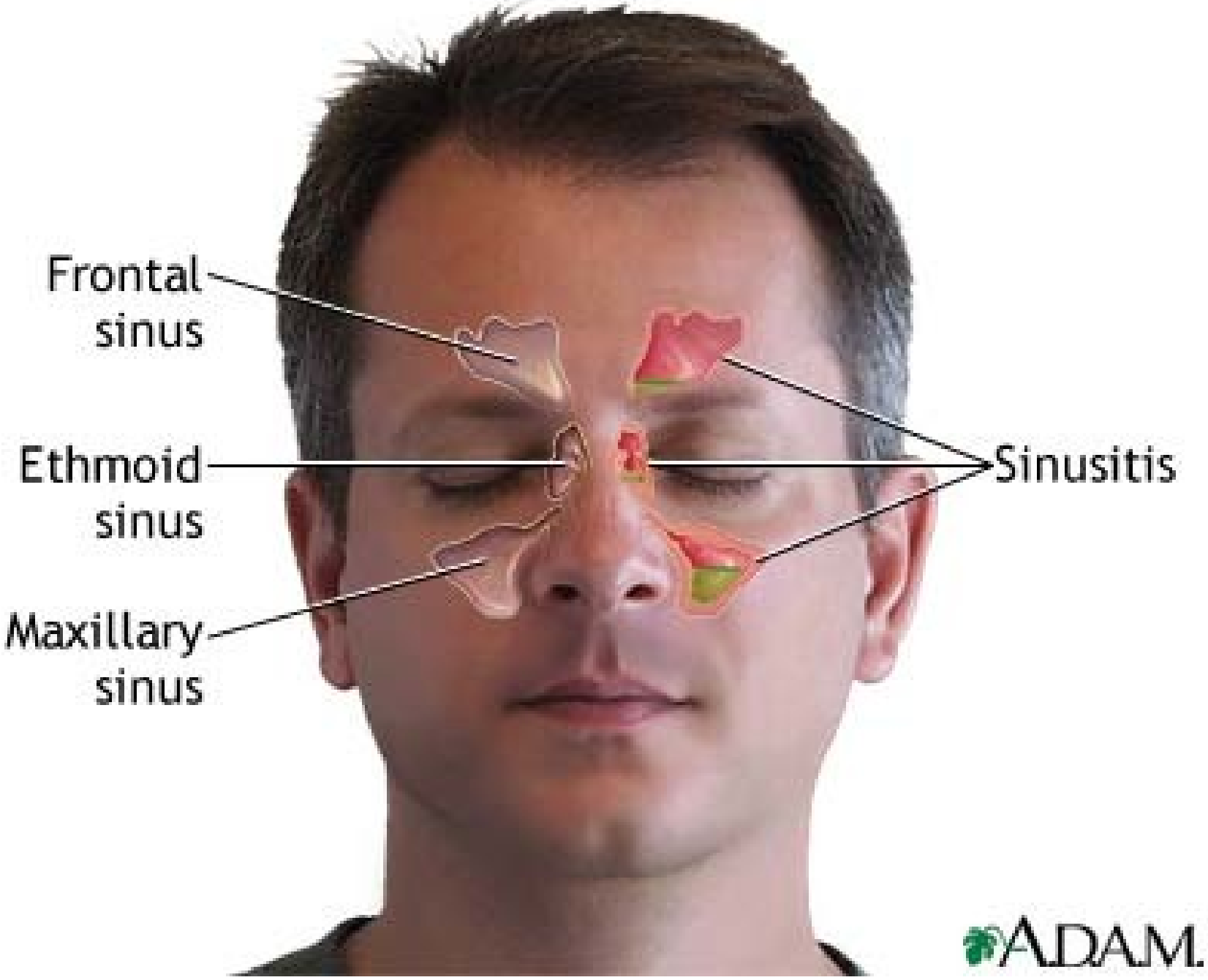
- **Relevant specimen – only a punctate from the middle ear or paranasal sinus; NOT nasal swab and NOT ear swab (contaminants, no pathogens)**

- **Sinusitis ATB treatment ONLY in case of painful sinusitis, with teathache, headache, fever, lasting at least a weak, eventually neuralgia of N. Trigeminus**

- **Otitis media ATB treatment only when inflammation (pain, red colour, fever) is presented and anti-inflammatory treatment is not sufficient**

- **Aminopenicillin or a 1st gen. cephalosporin**

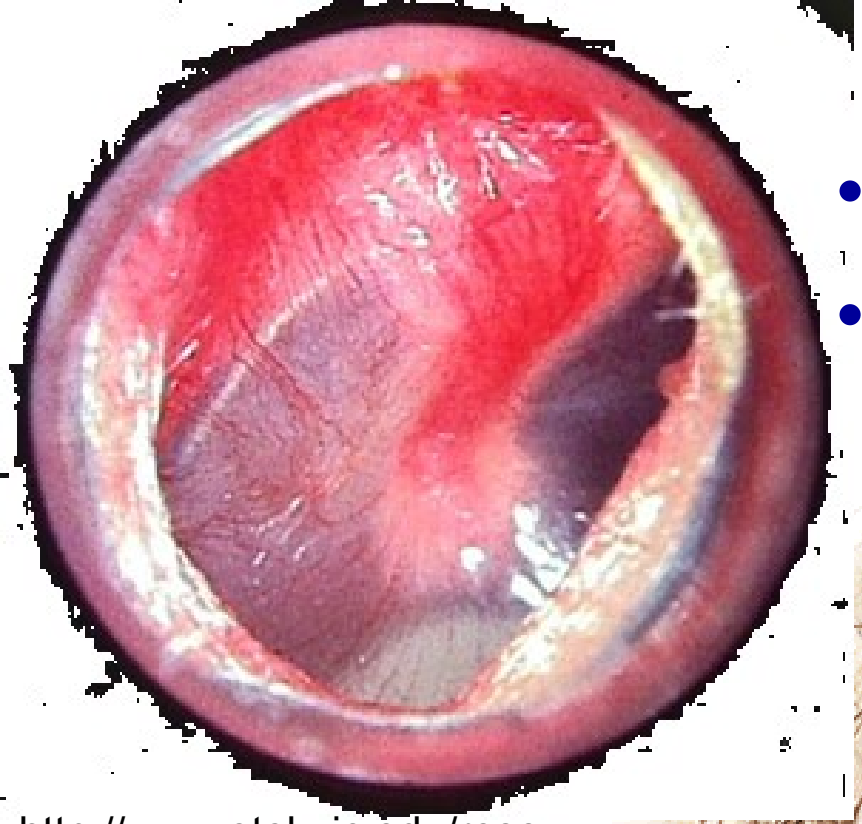
Sinusitis acuta



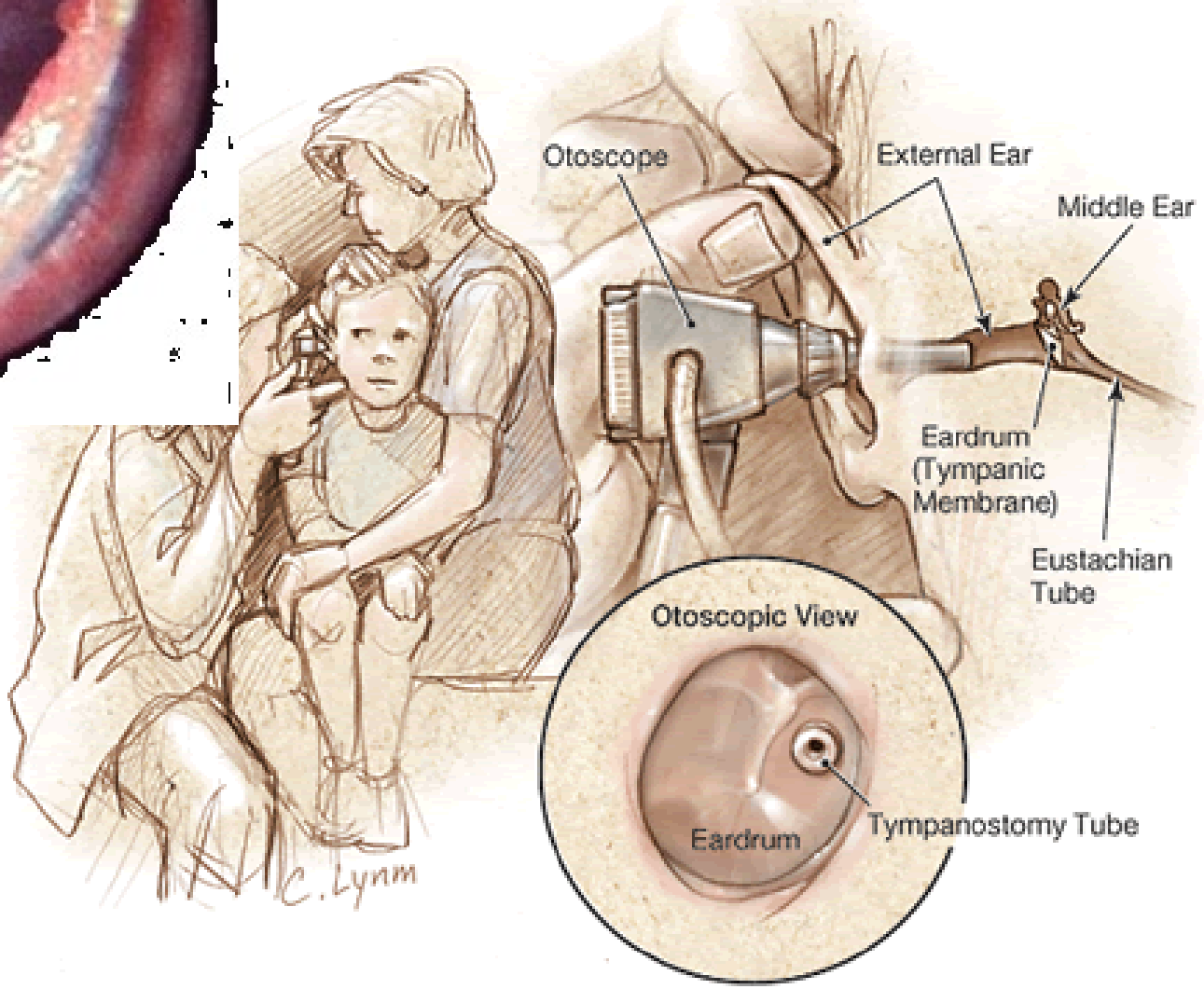
http://www.drgreene.org/body.cfm?xyzpdqabc=0&id=21&action=detail&ref=1285

Otitis media

- Causative agents
- same as in sinusitis



http://www.otol.uic.edu/research/microto/Microtoscopy/acute1.htm



http://www.medem.com/MedLB/article_detaillb.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 (allien body)**

- **Usually topical treatment**

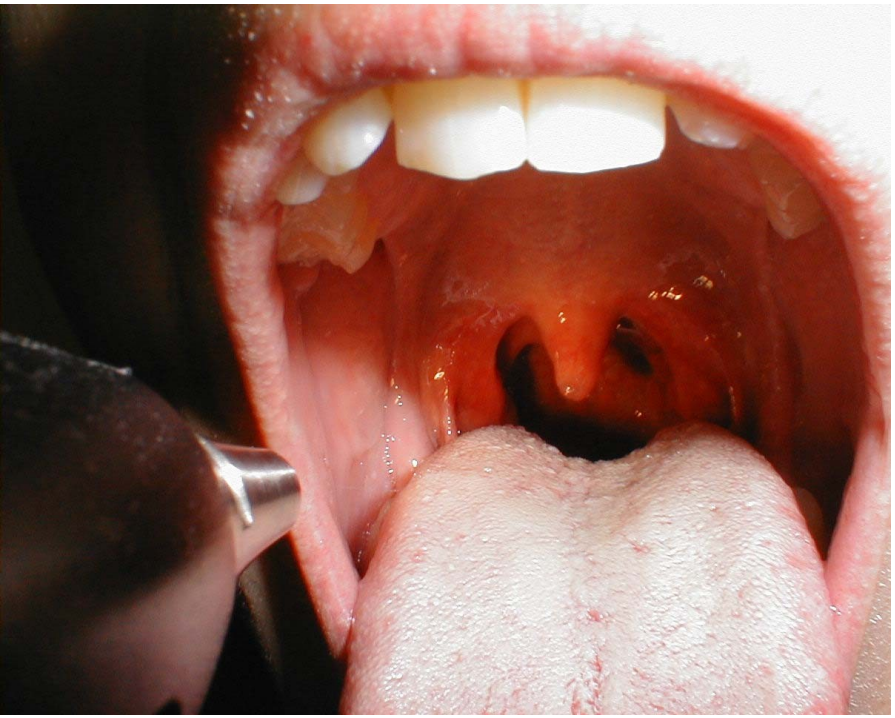
Oropharyngeal infections - ETIOLOGY

- **Acute tonsillitis and pharyngitis:**
  usually viral (rhinoviruses, coronaviruses, adenoviruses, EBV – inf. mononucleosis, coxsackieviruses – herpangina)
- **Among bacterial, the most important: ac. tonsillitis or tonsillopharyngitis due to *S. pyogenes* (= β-haemolytic streptococcus group A)**
- **Other bacterial agents: streptococci group C, F, G, pneumococci, *Arcanobacterium haemolyticum*, *H. influenzae*?, *N. meningitidis*?, anaerobes?**
- **Rare, but important: *Corynebacterium diphtheriae, Neisseria gonorrhoeae***

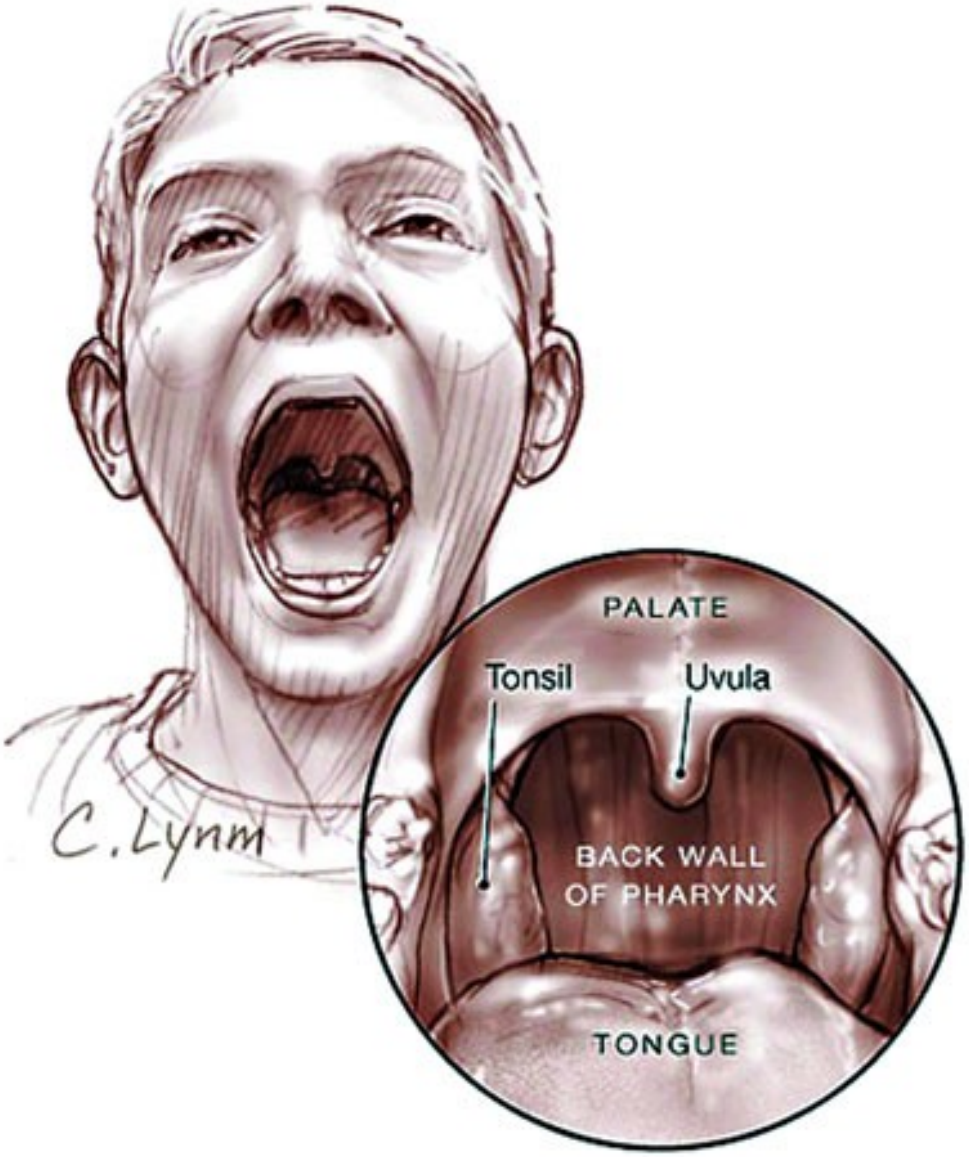
Oropharyngeal infections -TREATMENT

- **Bacteriological examination recommended in all cases, incl. a „typical tonsilitis“**
- **When *Streptococcus pyogenes* is found, the „old good“ Fleming‘s penicillin is the best**
- **Macrolides, e.g. clarithromycin should be used in allergic persons only (resistance, worse effect)**
- **determination of CRP level (marker of a bacterial infection) is recommended**

Tonsilopharyngitis



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



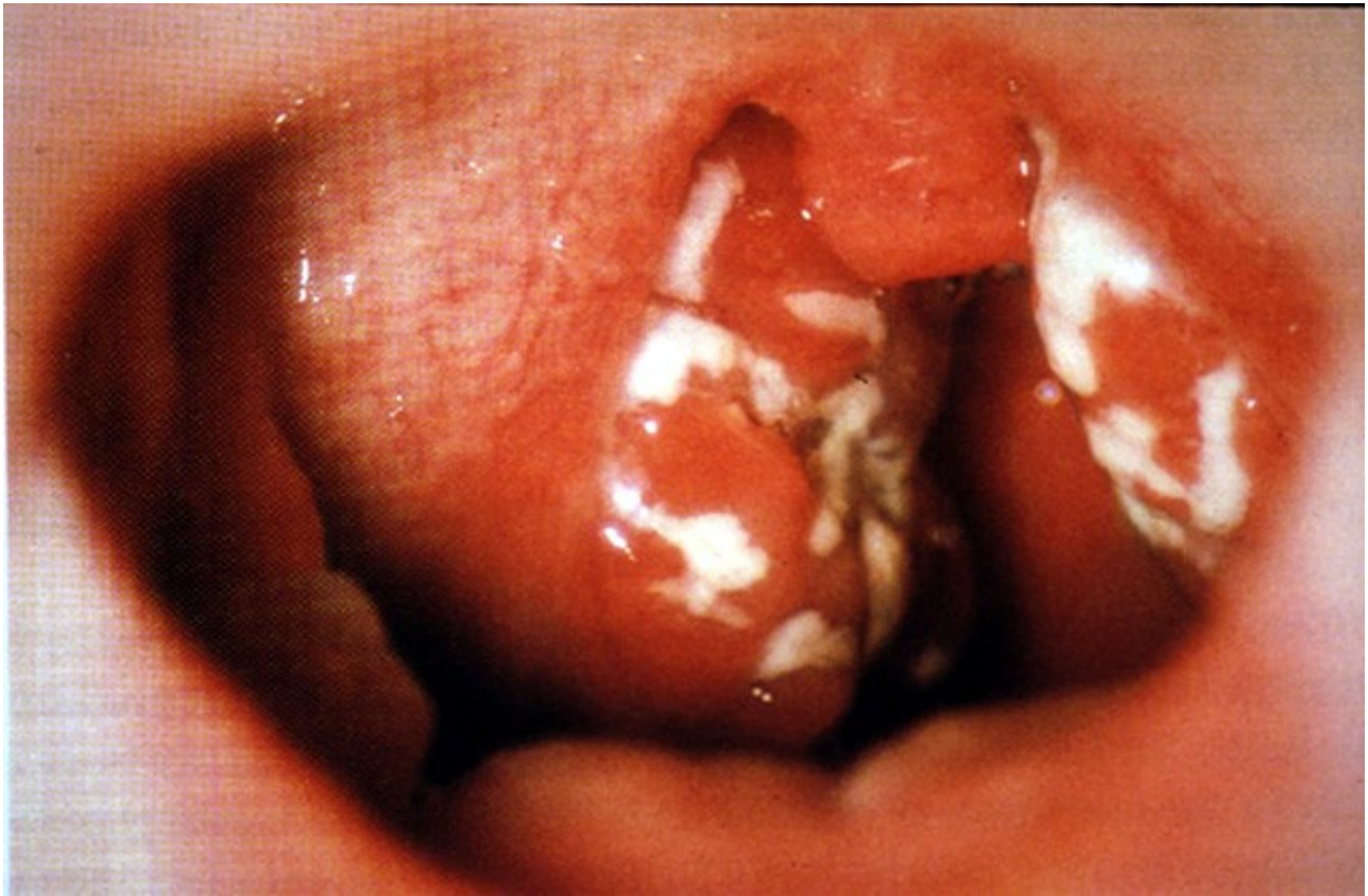
http://www.newagebd.com/2005/sep/12/img2.html

Viral tonsilopharyngitis

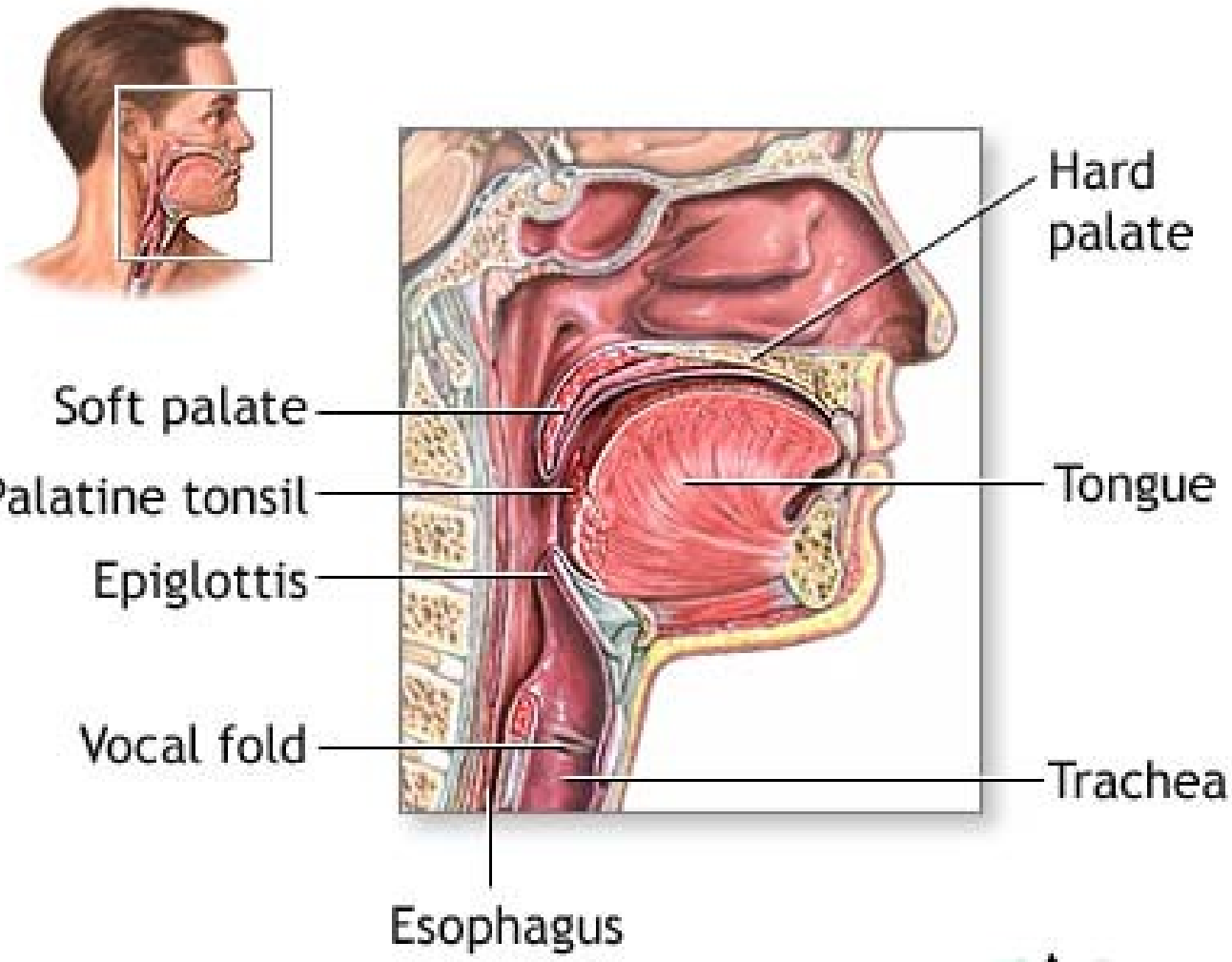
http://upload.wikimedia.org/wikipedia/commons/thumb/b/b1/Pharyngitis.jpg/250px-Pharyngitis.jpg

Purulent bacterial tonsilitis

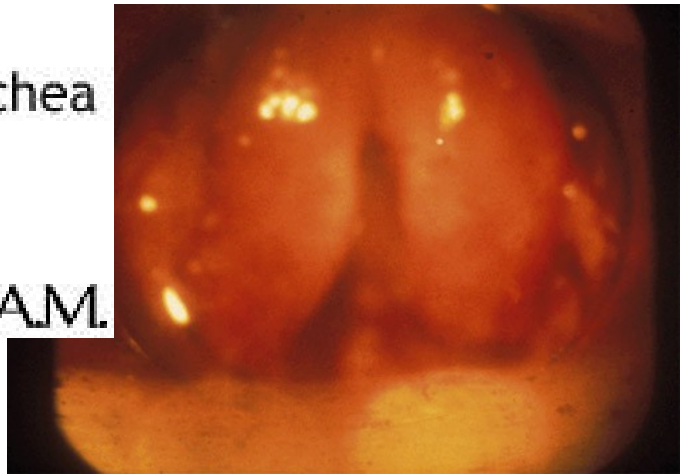
http://www.meddean.luc.edu/lumen/MedEd/medicine/PULMONAR/diseases/pul43b.htm



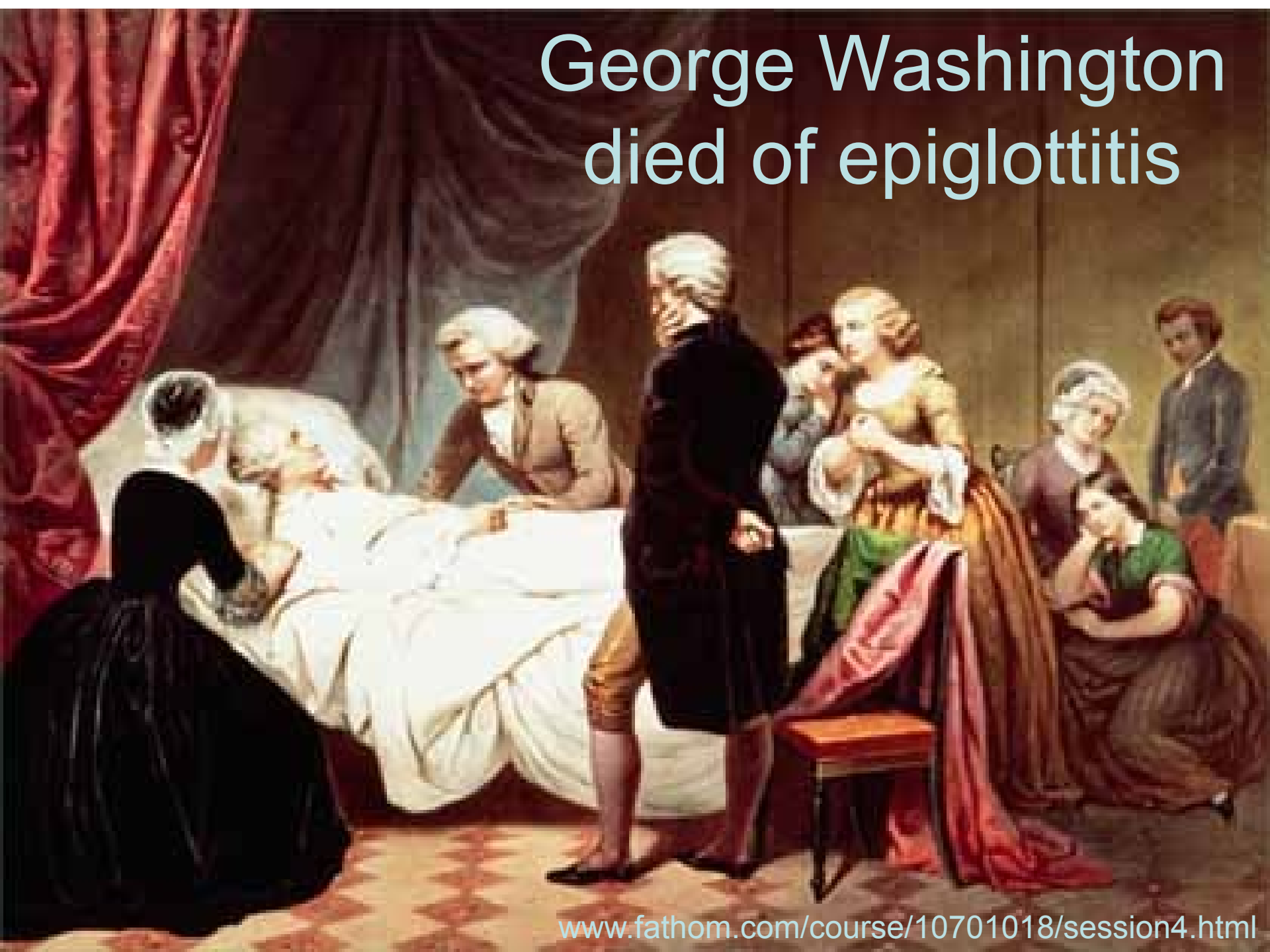
Epiglottitis



de.wikipedia.org/wiki/Epiglottitis



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


George Washington
died of epiglottitis
www.fathom.com/course/10701018/session4.html

Epiglottitis

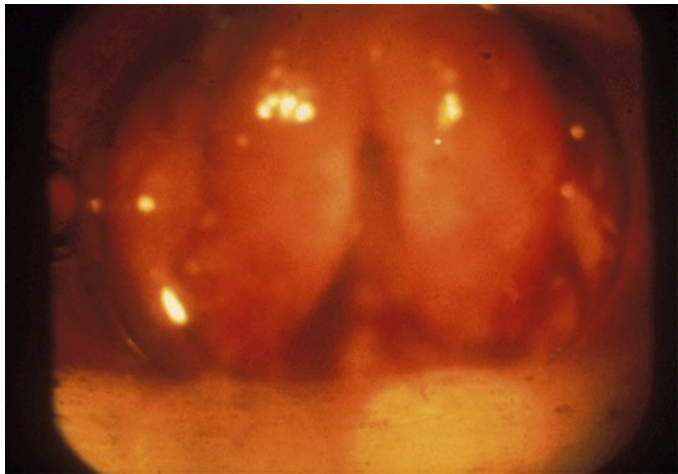
- **Serious disease – medical emergency**

The child may suffocate!

- **Practically only important agent:**

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

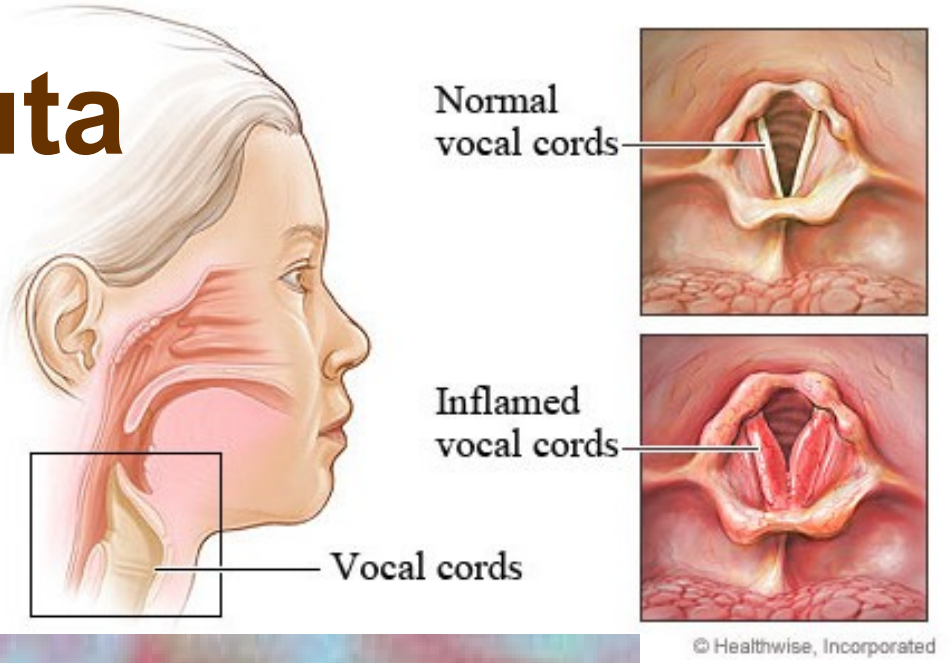
- vaccination



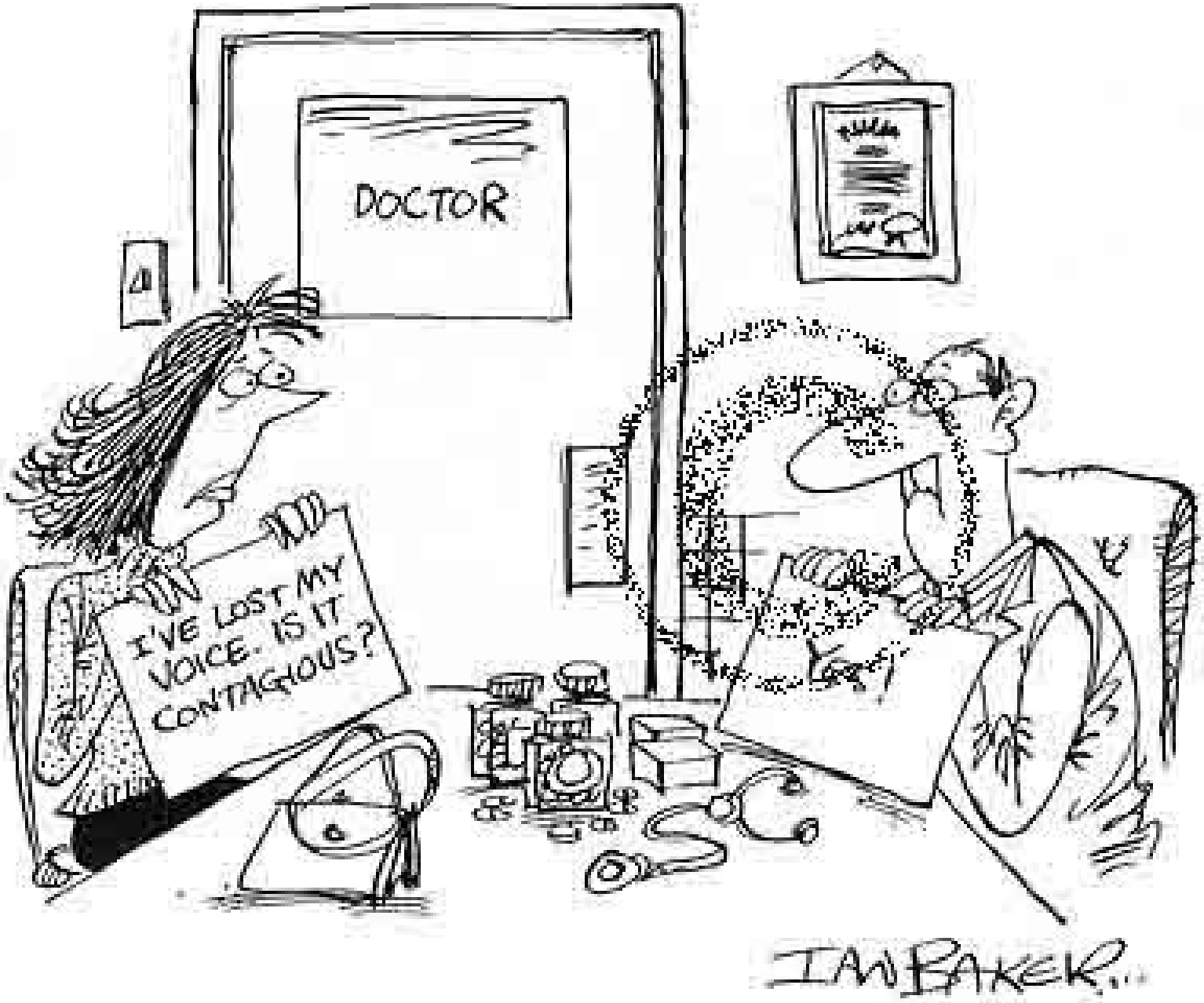
Laryngitis and tracheitis

- **Respiratory viruses (other than agents of nasopharyngitis):parainfluenza/influenza A viruses & RSV**
- **Bacterial: *Chlamydophila pneumoniae*, *Mycoplasma pneumoniae*, secondarily: *S. aureus* and *Haemophilus influenzae,* laryngotracheitis pseudomembranosa (croup): *Corynebacterium diphtheriae***
- **Throat swab is useless (different bacteria in pharynx than in larynx), except for chronical situations, microbiological examination is not indicated.**
- **Treatment symptomatic - antibiotics NOT recommended**

Lagyngitis acuta



http://www.emedicine.com/asp/image_search.asp?query=Acute%20Laryngitis



www.cartoonstock.com/directory/l/laryngitis.asp

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directory/l/laryngitis.asp

"I'VE GOT LARYNGITIS. WOULD YOU MIND CACKLING FOR ME WHILE I LAY AN EGG?"

Bronchitis - ETIOLOGY

- **Acute bronchitis:**

  influenza, parainfluenza, adenoviruses, RSV

  Bacterial, secondarily after viruses: pneumococci, haemofili, stafylococci, moraxellae

  Bacterial, primarily: *Mycoplasma pneumoniae, Chlamydophila pneumoniae, Bordetella pertussis*

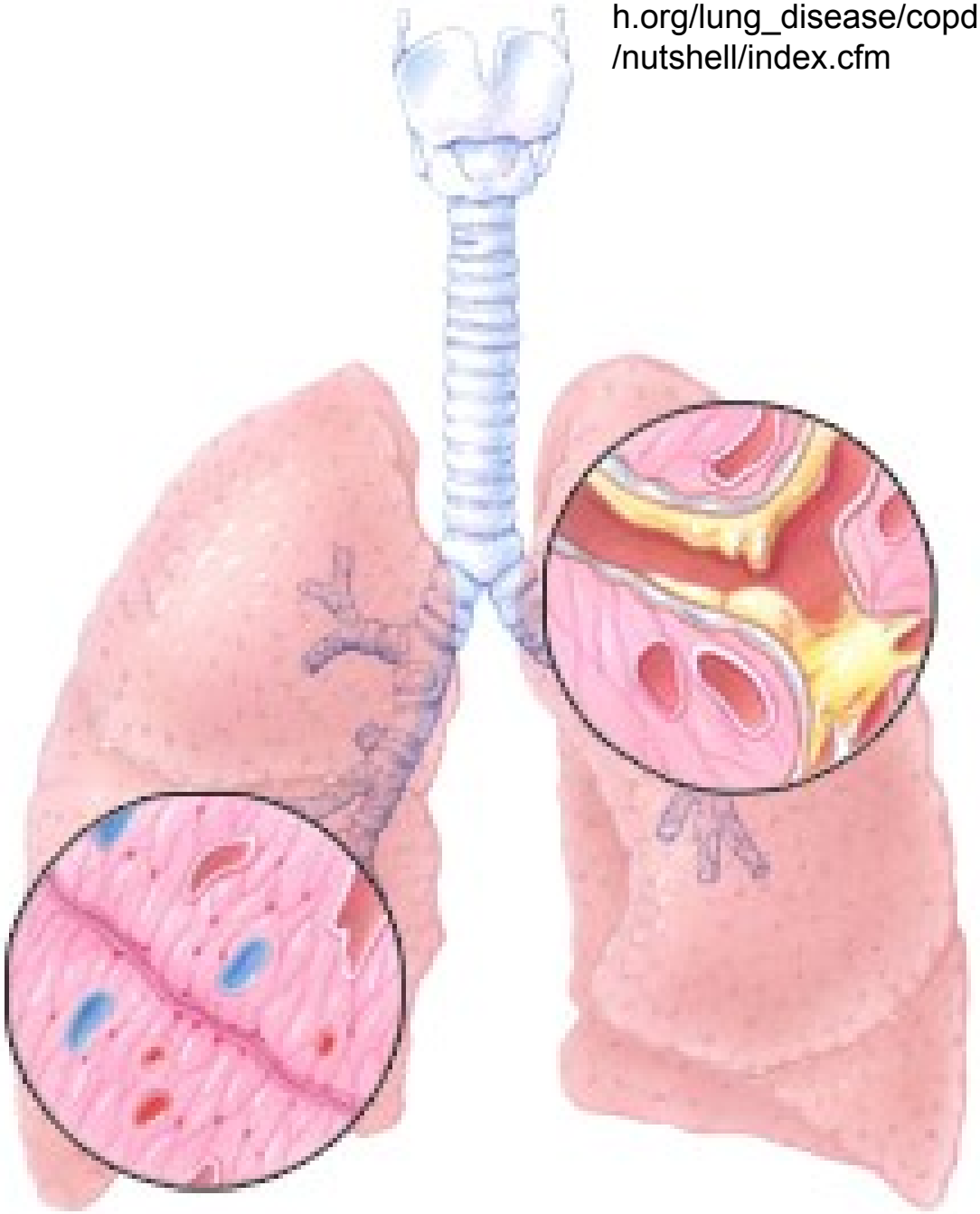
- **Chronic bronchitis (cystic fibrosis):**

  Pseudomonas aeruginosa, Burholderia cepacia

Bronchitis acut

http://www.lhsc.on.ca/resptherapy/students/patho/brnchit5.htm

http://www.yourlunghealth.org/lung_disease/copd/nutshell/index.cfm

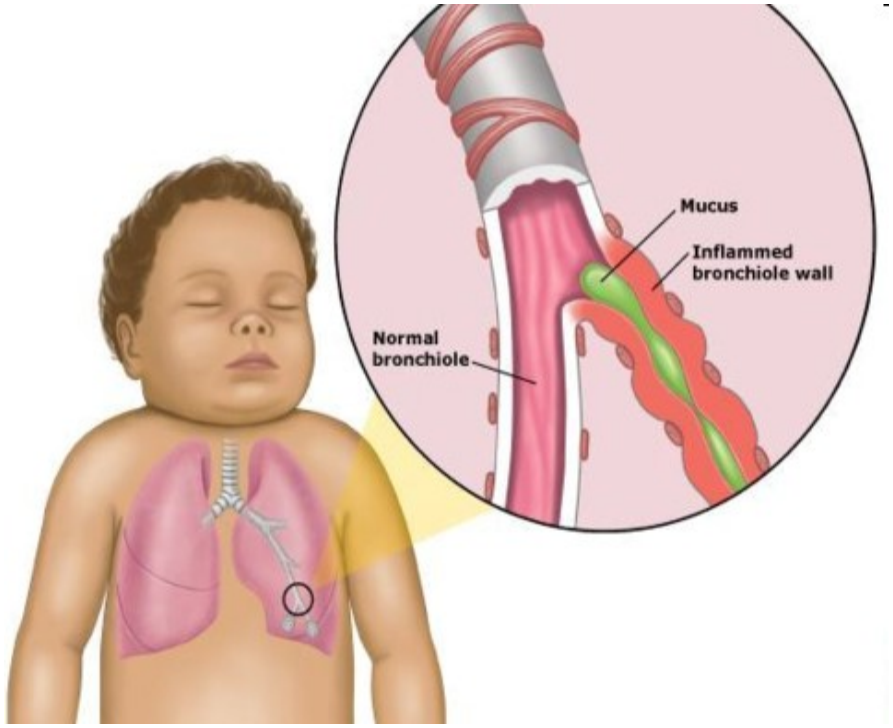


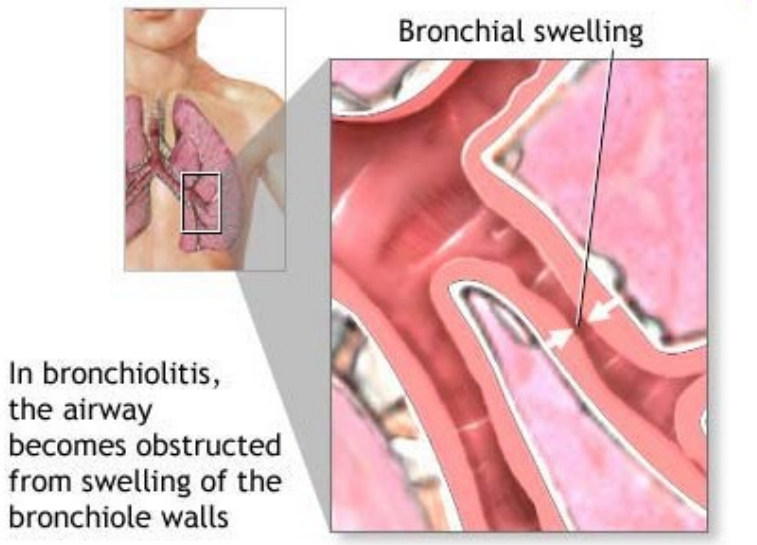
Bronchiolitis

- **Isolated bronchiolitis in newborns and infants only:**

  ***Pneumovirus* (= RSV)**

  Metapneumovirus



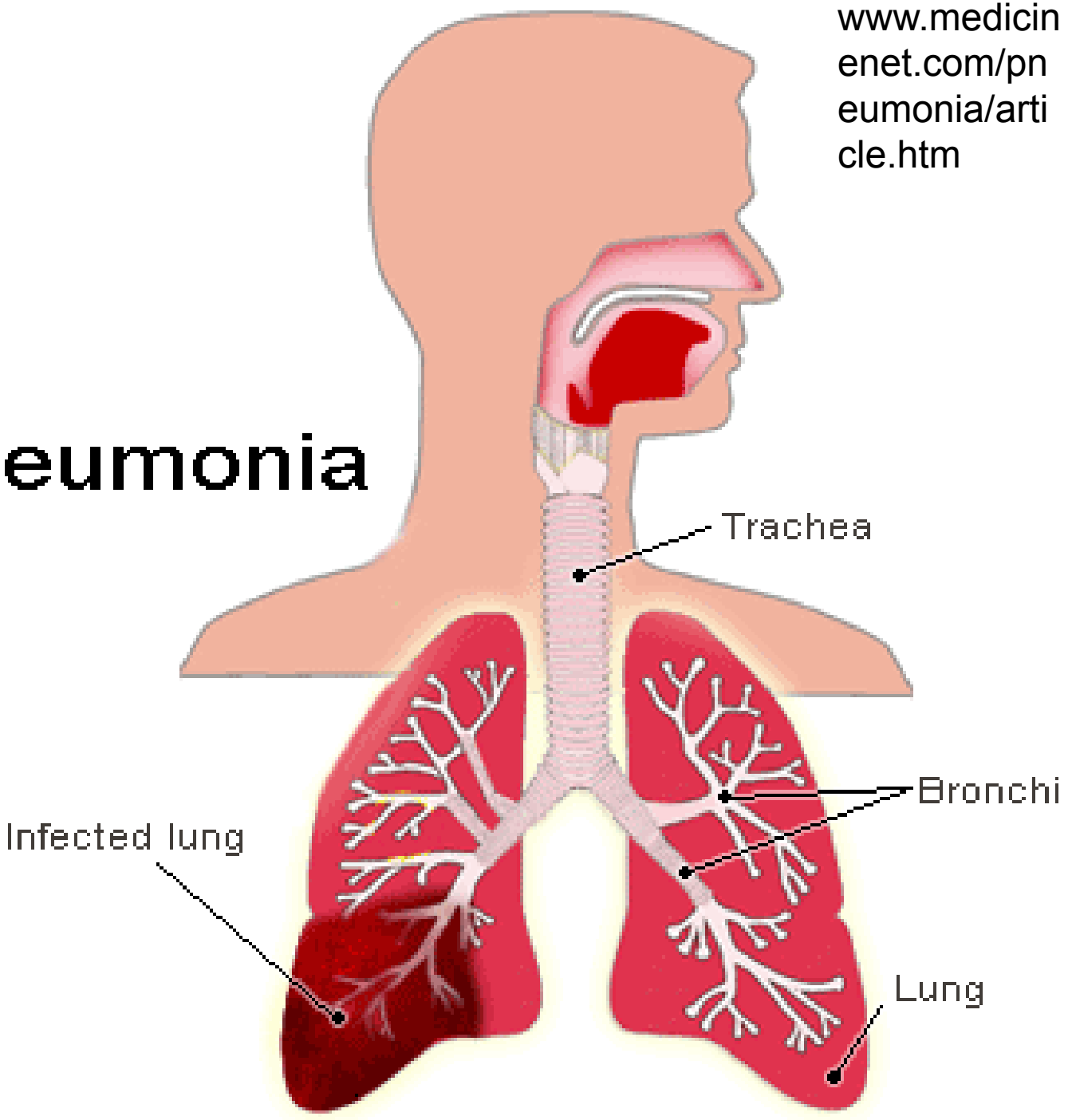


https://www.nlm.nih.gov

Pneu

www.medicinenet.com/pneumonia/article.htm

Pneumonia



Types of pneumoniae

- **Acute – community-acquired pneumoniae**
  - **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 (during an epidemic only)**

Pneumoniae – ETIOLOGY II

Acute, community-acquired, in healthy children

- **Bronchopneumonia:**
  - ***Haemophilus influenzae***
  - ***Streptococcus pneumoniae***
  - ***Moraxella catarrhalis***
  - **In newborns: *Streptococcus agalactiae***
    enterobacteriae

- **atypical pneumonia:**
  - **respiratory viruses (RSV, infl. A, adenoviruses)**
  - ***Mycoplasma pneumoniae***
  - ***Chlamydophila pneumoniae***
  - **in newborns: *Chlamydia trachomatis* D-K**

Pneumoniae – ETIOLOGY III

- **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 IV

Acute, nosocomial:

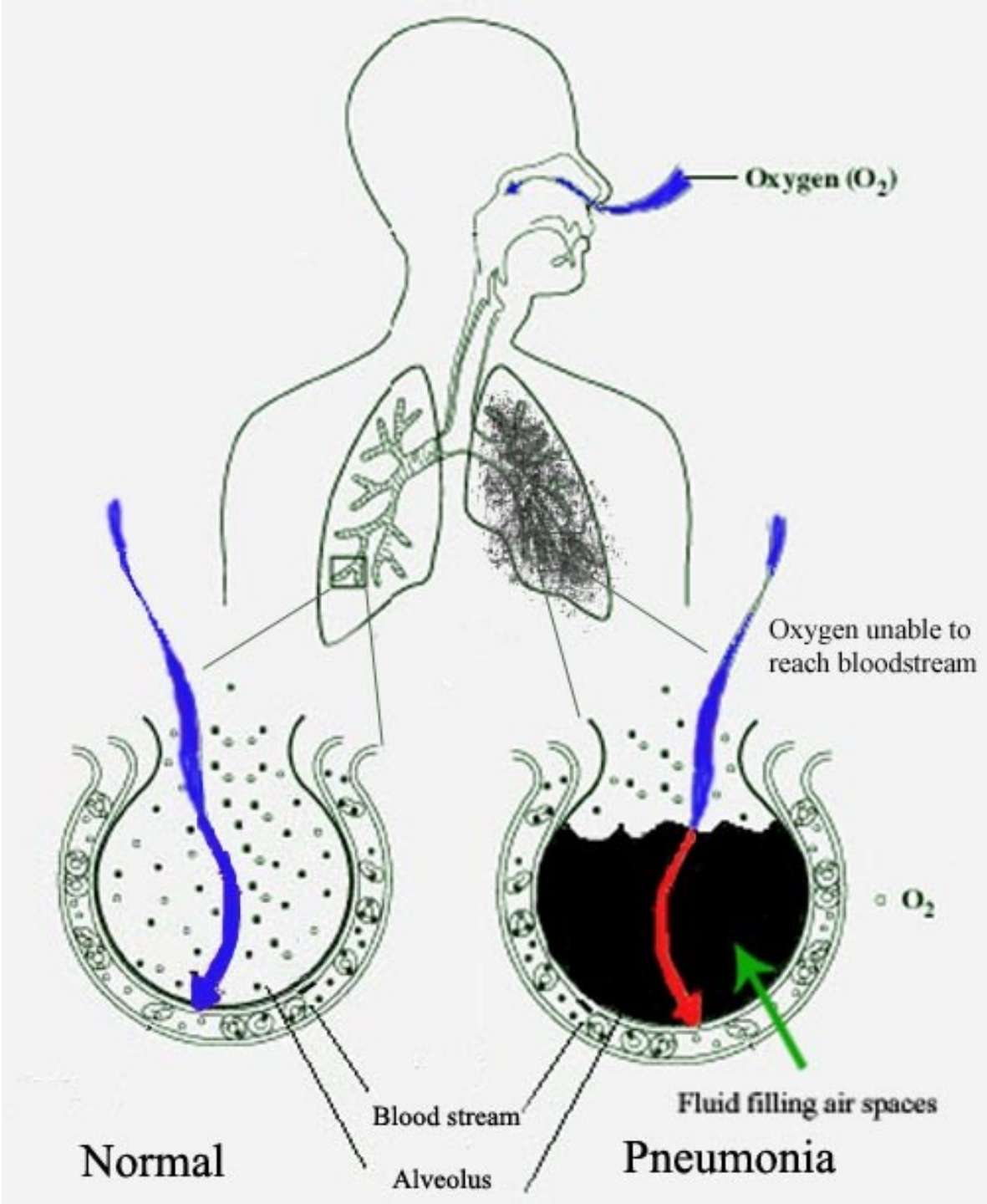
- Ventilator-associated pneumonia - VAP:
  - early (up to the 4th day of hospitalization): sensitive community strains
  - late (from the 5th day): resistant hospital strains

- Others
  - viruses (RSV, CMV)
  - Legionella

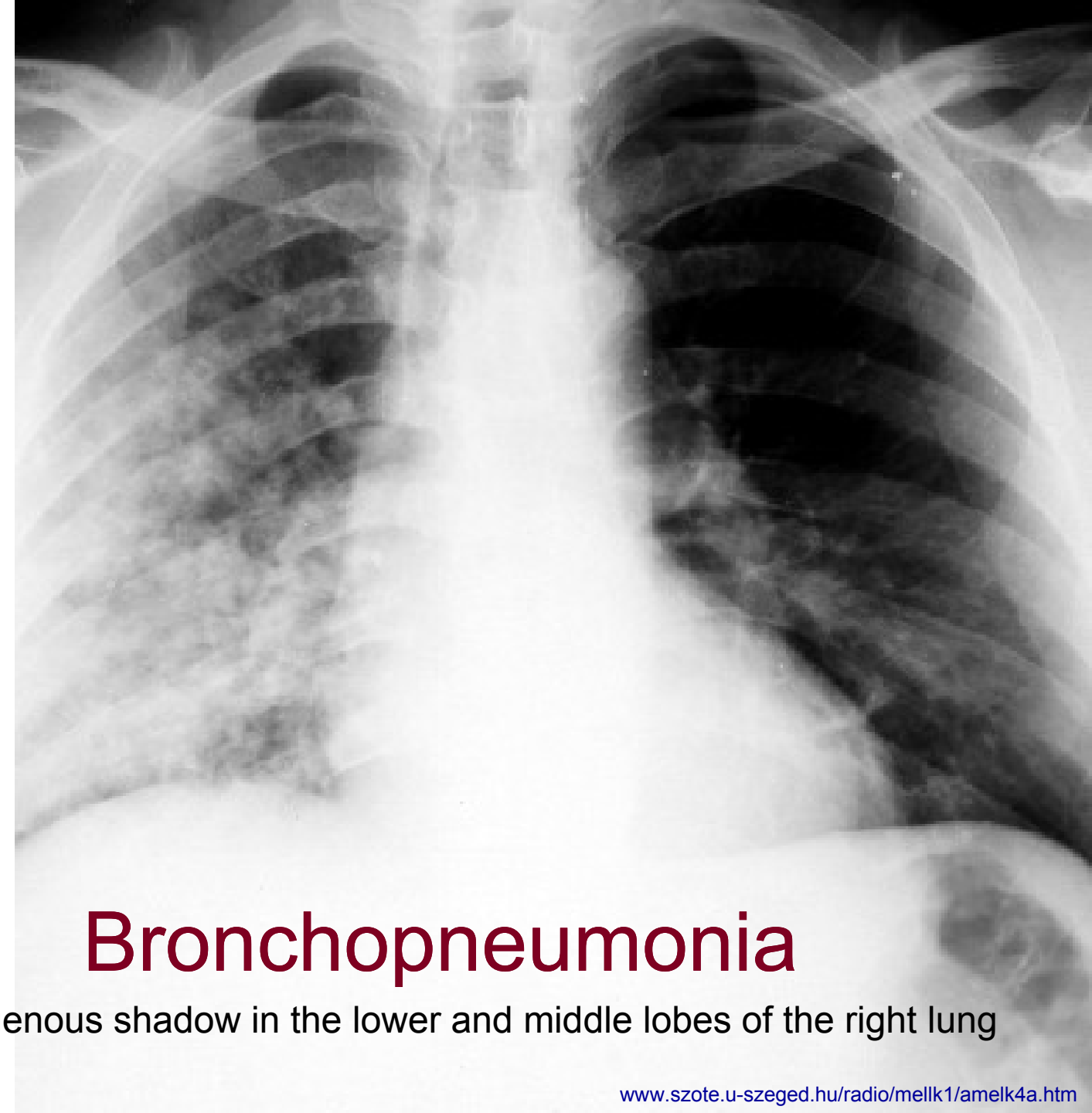
Pneumoniae – ETIOLOGY V

- **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

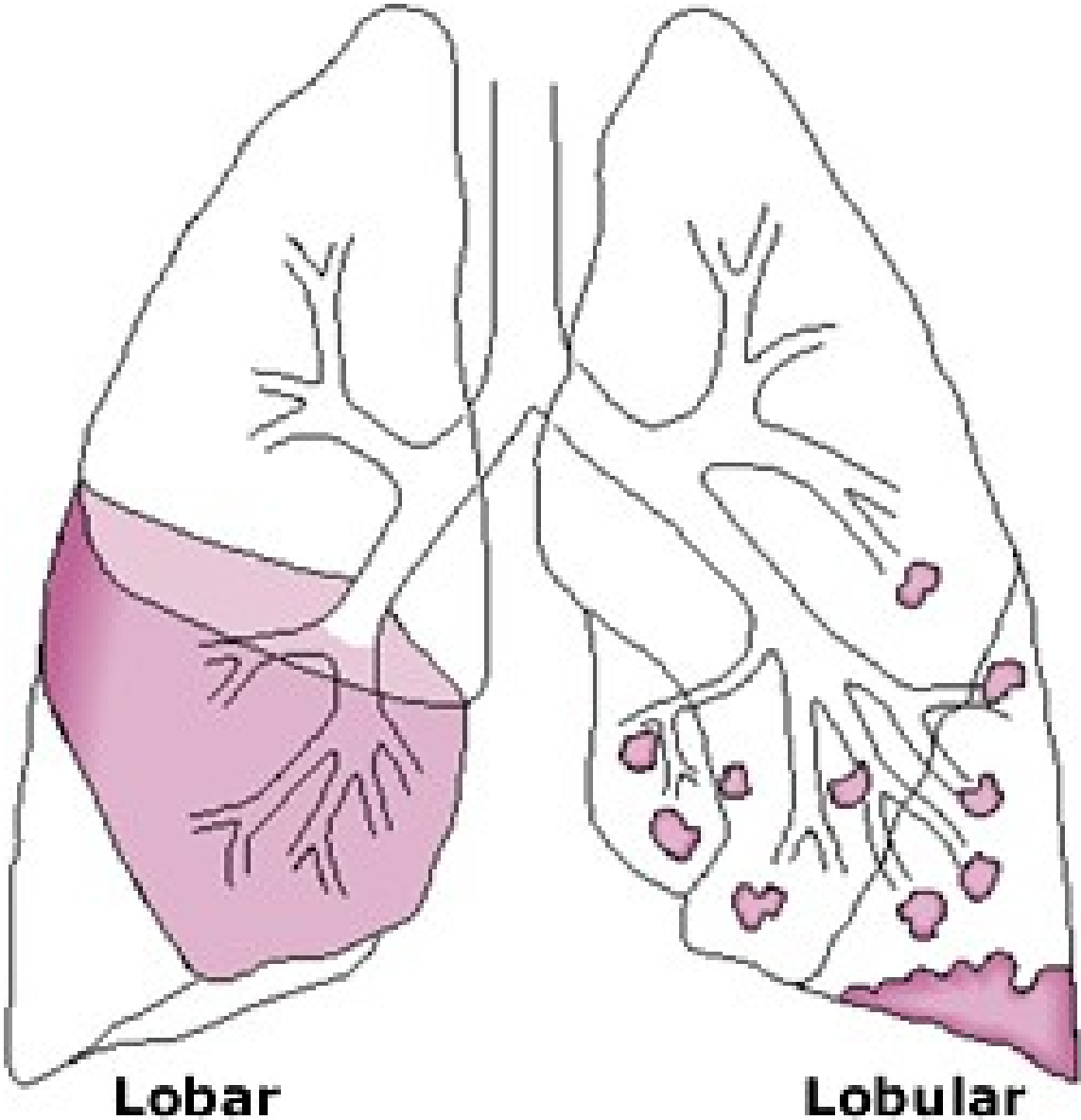


Bronchopneumonia

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

www.szote.u-szeged.hu/radio/mellk1/amelk4a.htm

Lobar and lobular pneumonia



www.supplementnews.org/
pneumonia

Lung infections - EXAMINATION

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

Bronchitis and pneumonia - TREATMENT

- In classic community pneumoniae amoxicilin, (eventually according to a causative agent and its antibiotic susceptibility)
- In atypical pneumoniae tetracyclins or (especially in children < 8) macrolids.
- Combination therapy
- In hospital infections treatment according to in vitro susceptibility test - resistances!
- In TB usually combination of three drugs

Gerrit Dou (1613 - 1675)
The Physician