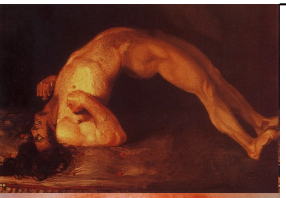
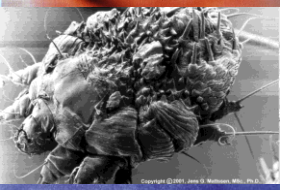
Institute for Microbiology, Faculty of Medicine, Masaryk University
and St. Anna Faculty Hospital, Brno





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Clinical Microbiology

Lecture for 3rd-year students

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

Agents of respiratory diseases

Part One

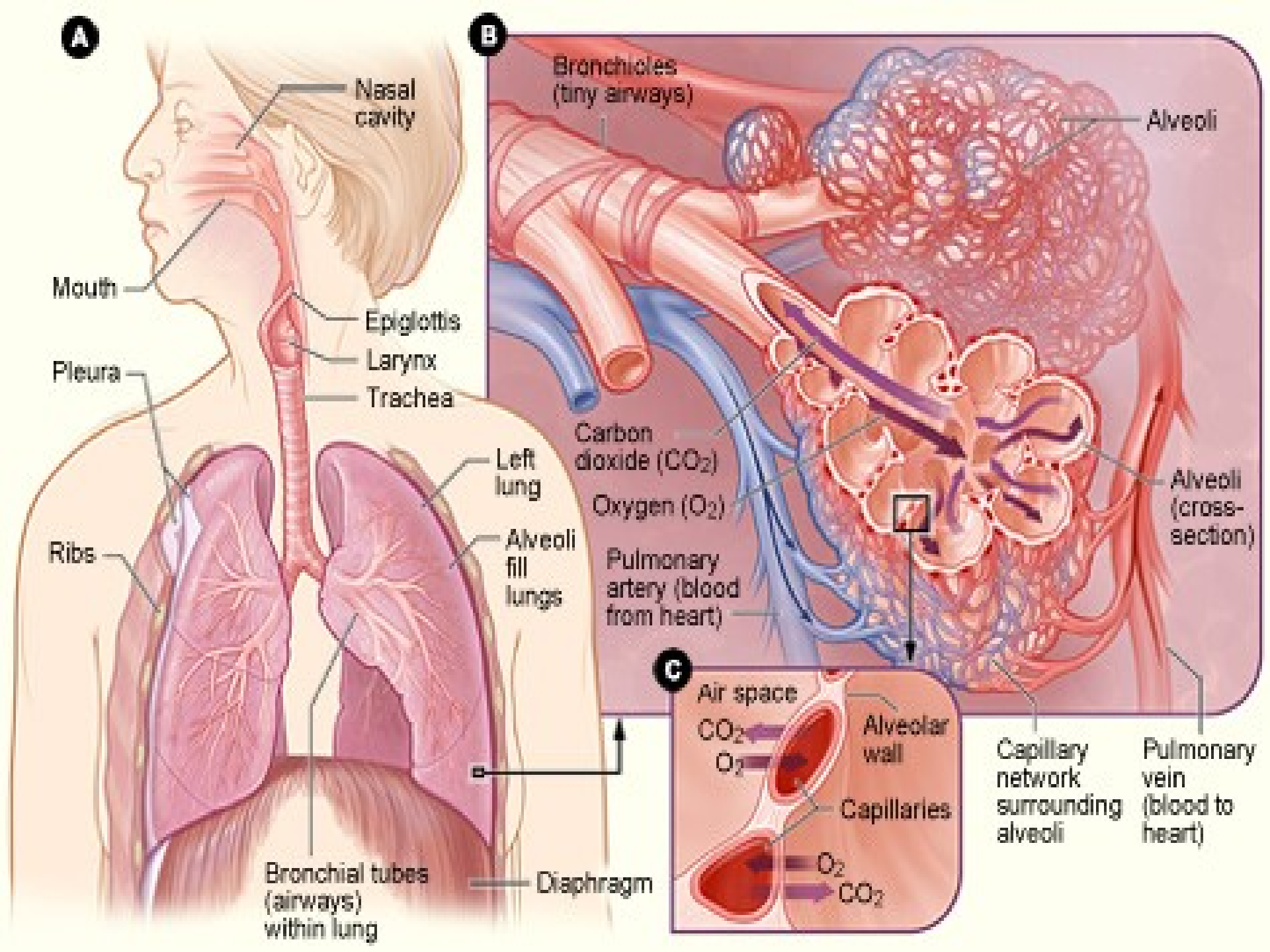
Importance of respiratory diseases

- They are the most important infections in general practitioner‘s office (respiratory tract = an ideal incubator)
- They have a big economic effect on the economics in general and on health care in particular
- They tend to be seen in collectives and often produce outbreaks and epidemics
- ¾ of respiratory infections (and even more in children) are caused by viruses

Localization of infection in the respiratory tract

- **Localization of infection**
  - **influences the clinical symptomatology**
  - **enables to suspect specific agents**

- **Therefore, it is necessary to distinguish:**
  - **upper respiratory tract (URT) infections (and adjacent organs infections)**
  - **lower respiratory tract (LRT) infections (infections of lower respiratory ways and 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

Classification:

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

LRT infections and lung infections

Classification:

- **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

- **To differenciate between the pathologic or normal finding it is necessary to know which bacteria are 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: rather sterile; nevertheless, materials from these sites are often contaminated by URW flora**

Etiology of rhinitis and nasopharyngitis

- **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***

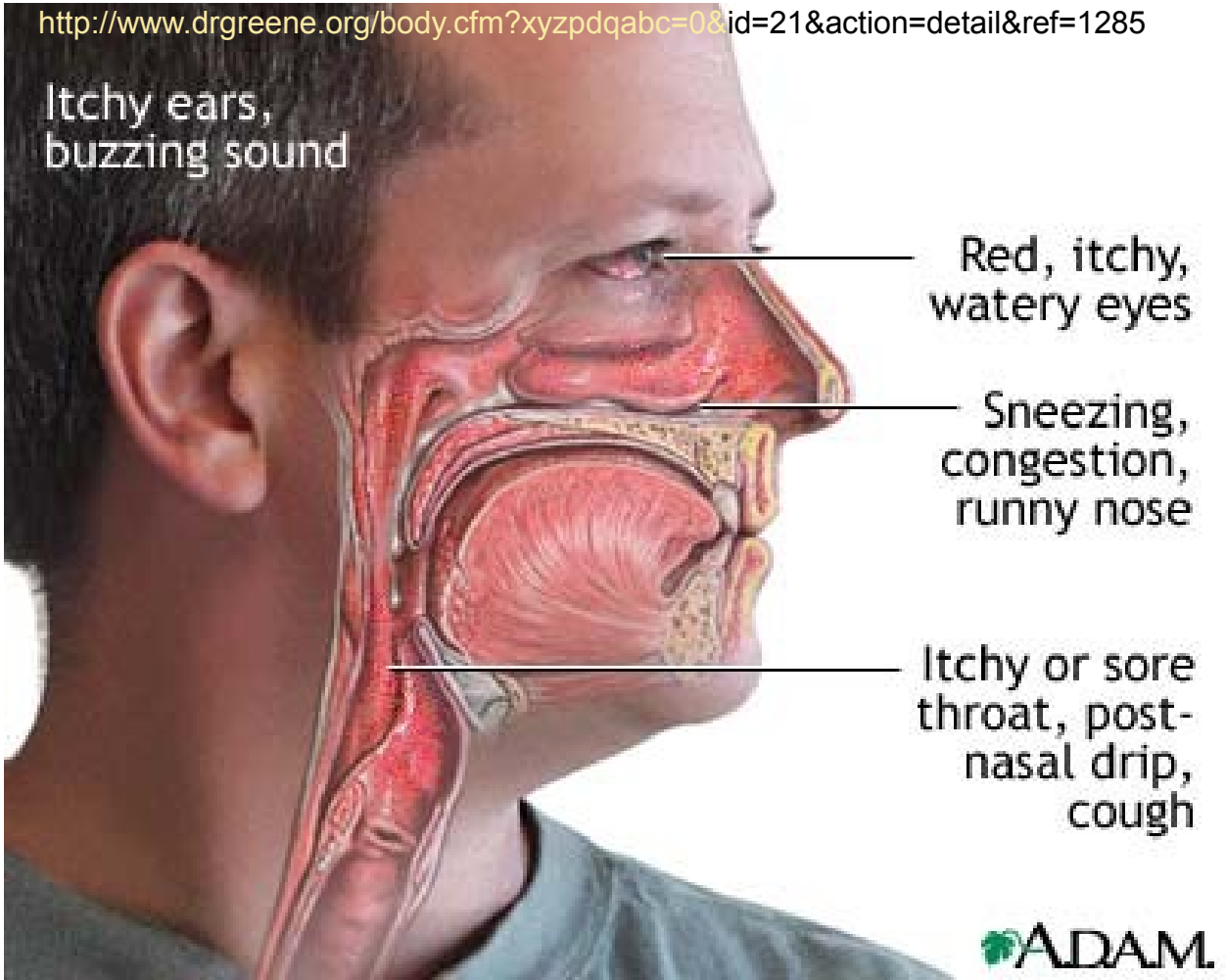
Treatment recommendation

- Because of viral etiology, the majority of rhinitis and nasopharyngitis does not need antibiotic treatment and even does not need bacteriological examination
- If necessary (pus full of polymorphonuclears, high CRP levels → markers of bacterial infection) treatment should fit with the result of bacteriological examination
- Sometimes we treat (but rather locally only) even without symptoms – treatment of carriers of some epidemiologically important pathogens (e. g. MRSA)

Infectious rhinitis also should be differenciated from 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



Etiology of sinusitis and otitis media – I

- Acute sinusitis and otitis is usually started by respiratory viruses, *M. pneumoniae* (myringitis)
- Secondary pyogenic inflammations are due to:
- *S. pneumoniae, H. influenzae* type b, *Moraxella catarrhalis, Staph. aureus, Str. pyogenes*
- even anaerobes: genus *Bacteroides*, *Prevotella*, *Porphyromonas*, *Peptostreptococcus*
- Complications: mastoiditis, meningitis purulenta

Etiology of sinusitis and otitis media – II

- **Sinusitis maxillaris chronica, sinusitis frontalis chronica: *Staph. aureus*, genus *Peptostreptococcus***

- **Otitis media chronica: *Pseudomonas aeruginosa, Proteus mirabilis***

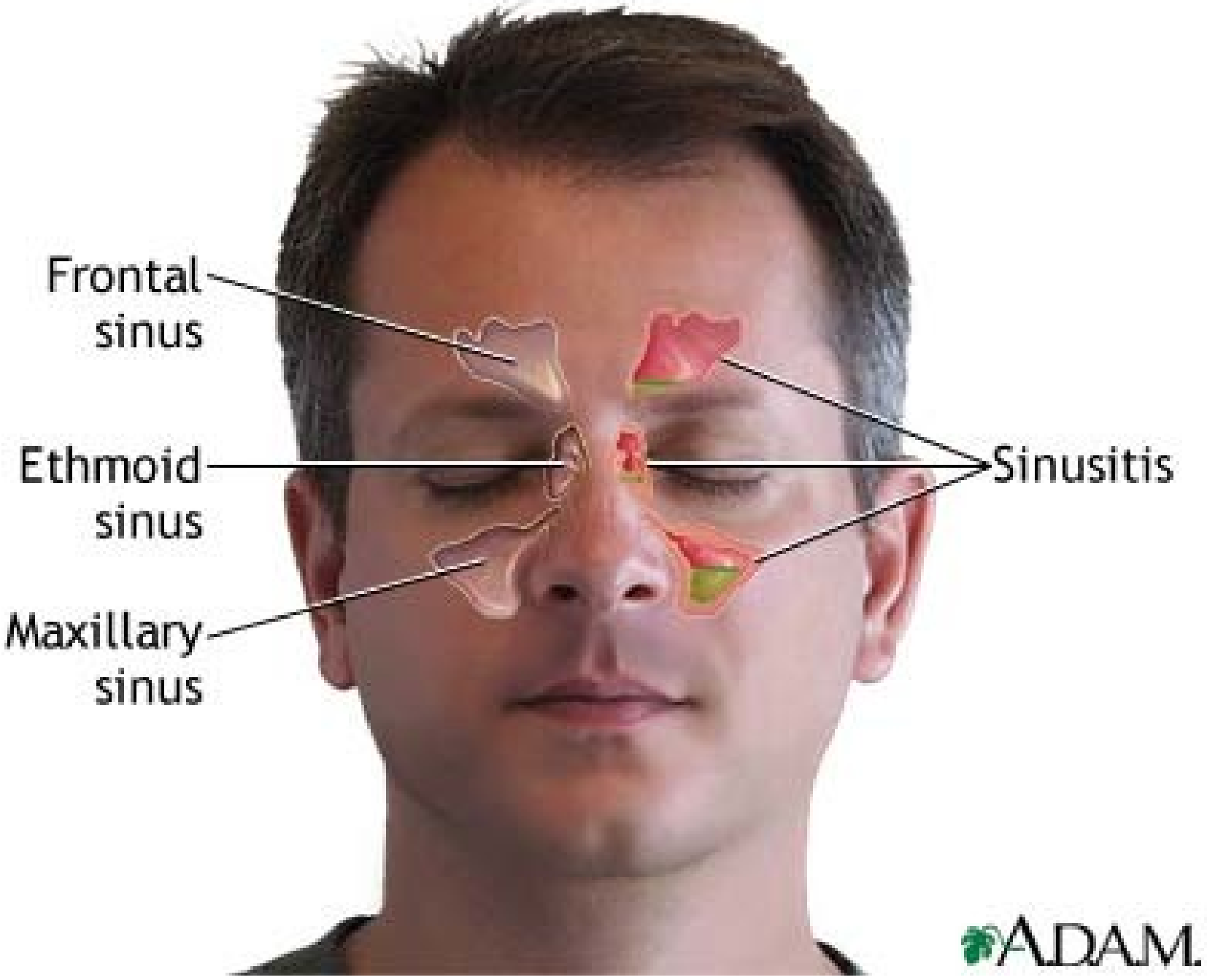
Examination and treatment

- Today, it is not recommended to perform bacteriological examination in otitis media and sinusitis, except when a relevant specimen is available
- Relevant specimen – only a punctate from middle ear or paranasal sinus; NOT nasal swab and NOT ear swab (contamination is present, but no pathogen)
- Treatment is usually started by an aminopenicillin or a 1st gen. cephalosporin

Inflamation of paranasal cavities (sinusitis acuta)

- Temporary finding in cavities is normal at classical rhinitis and there is no reason for treatment
- Treatment should be started in case of **painful sinusitis**, with teathache, headache, fever, lasting at least a weak, eventually neuralgia of N. trigeminus

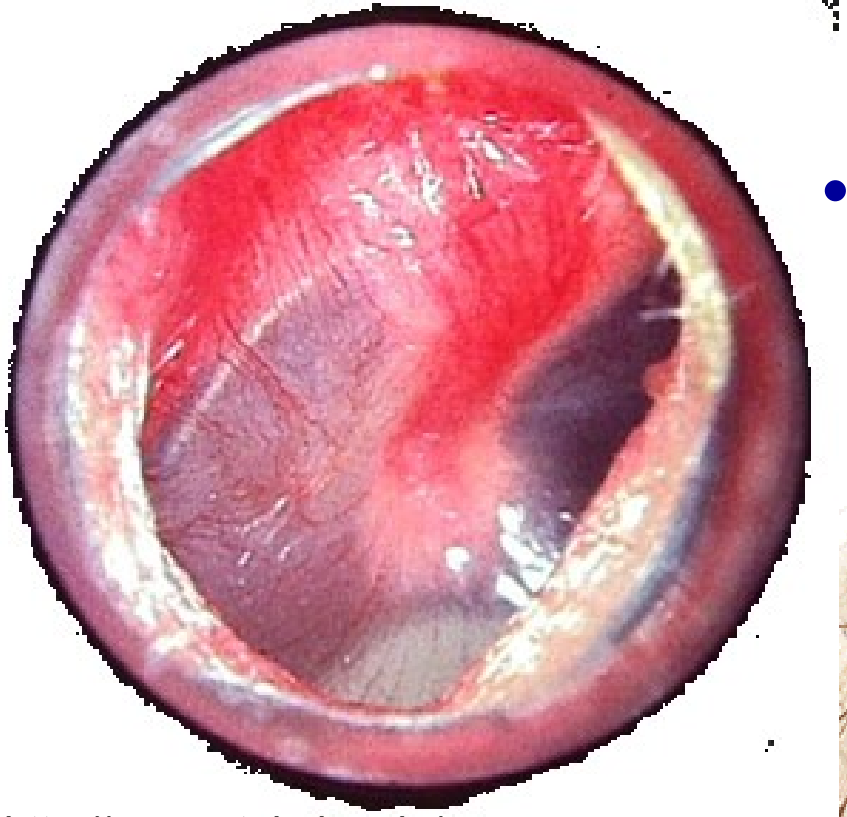
Sinusitis acuta



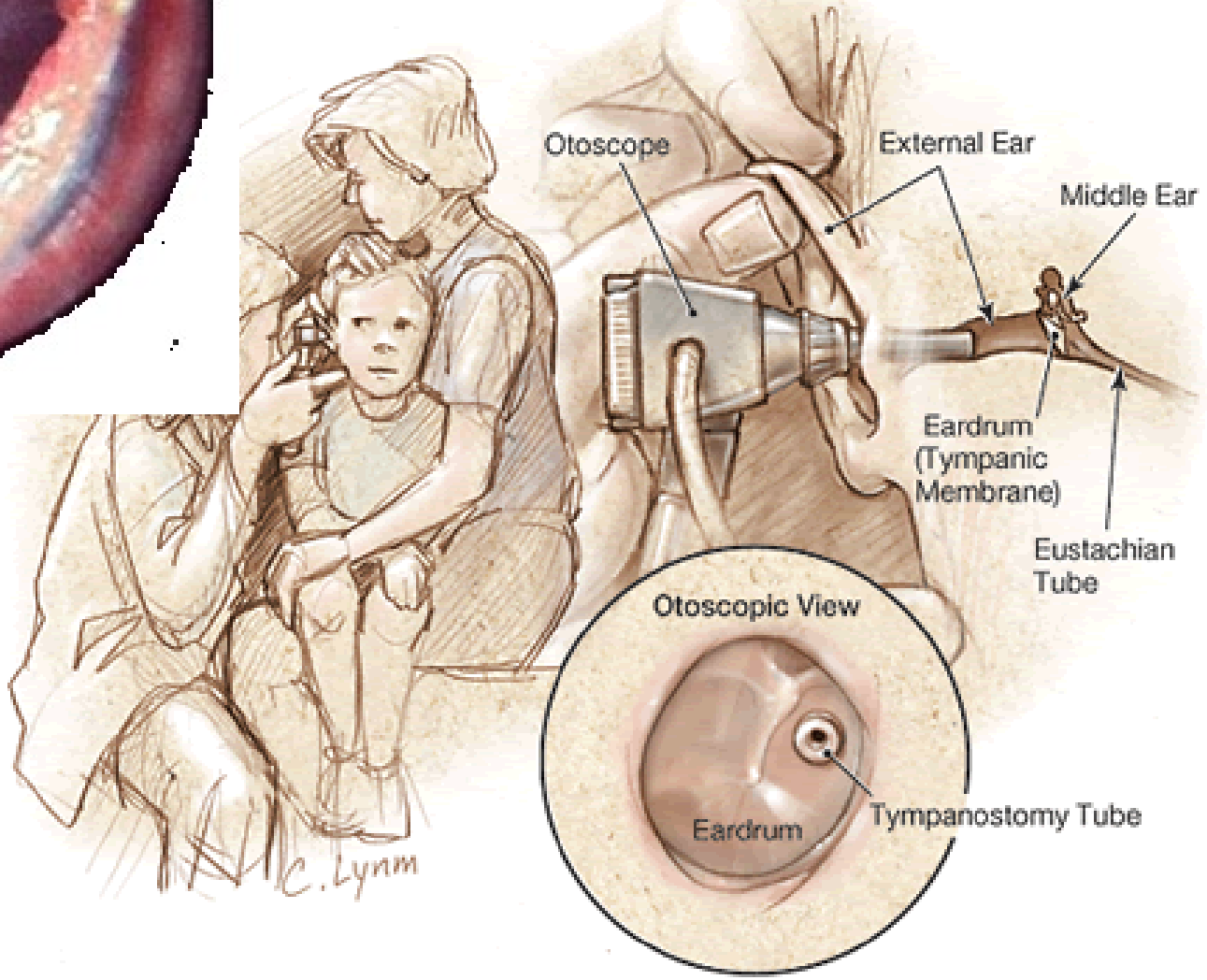
http://www.drgreene.org/body.cfm?xyzpdqabc=0&id=21&action=detail&ref=1285

Otitis media

- **Causative agents the 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

Examination and treatment of otitis media

- **Atb treatment** is recommended, when inflammation (pain, red colour, fever) is presented and anti-inflammatory treatment is not sufficient
- **Drug of choice** is amoxicillin (e. g. AMOCLEN), alternative possibly co-trimoxazol
- **Ear swab** examination is useless, except after paracentesis, or natural tympanon perforation
- **Pyogene fluid**, taken during paracentesis, can be examined

Etiology of conjunctivitis – I

- Conjunctivitis is usually of viral origin
- It usually accompanies acute URT infections

  In adenovirus infections typically:
  follicular conjunctivitis, faryngoconjunctival fever (adenoviruses 3, 7), epidemic keratoconjunctivitis (adeno 8,19)
- Other viral conjunctivitides:

  hemorrhagic conjunctivitis (enterovirus 70)

  herpetic keratoconjunctivitis (HSV)

Treatment is usually local only

Etiology of conjunctivitis – II

- **Bacterial conjunctivitis**
- **Acute:**
  - **suppurative conjunctivitis:**

    ***S. pneumoniae, S. aureus*, in children also other bacteria**
  - **inclusion conjunct.: *C. trachomatis* D – K**
- **Chronic:**
  - ***S. aureus*, *C. trachomatis* A – C (trachoma)**
- **Allergic, mechanic (allien body)**

Oropharyngeal infections

- **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 according to Lancefield)**
- **More bacterial agents: streptococci group C, F, G, pneumococci, *Arcanobacterium haemolyticum*, *H. influenzae*?, *N. meningitidis*?, anaerobes?**
- **Rare, but important: *Corynebacterium diphtheriae*, *Neisseria gonorrhoeae***

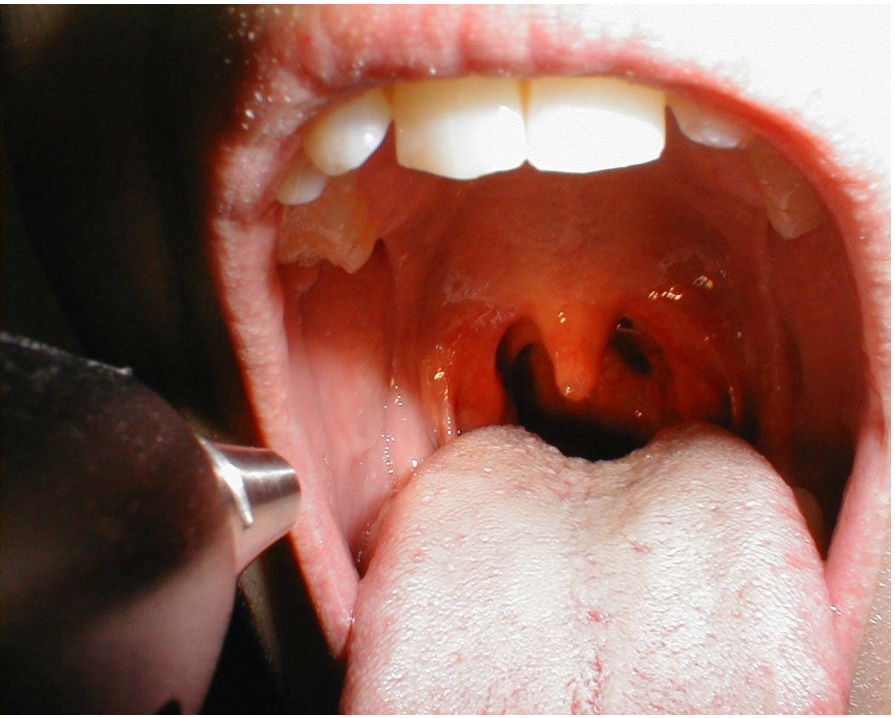
Treatment of oropharyngeal infections

- Bacteriological examination recommended in all cases, incl. a „typical tonsilitis“
- When *Streptococcus pyogenes* is found, the „old good“ Fleming‘s penicillin is the best
- Modern drugs like azithromycin, clarithromycin etc. have worse effect and should be used in allergic persons only
- Besides bacteriological examination, a determination of CRP level (marker of a bacterial infection) is recommended

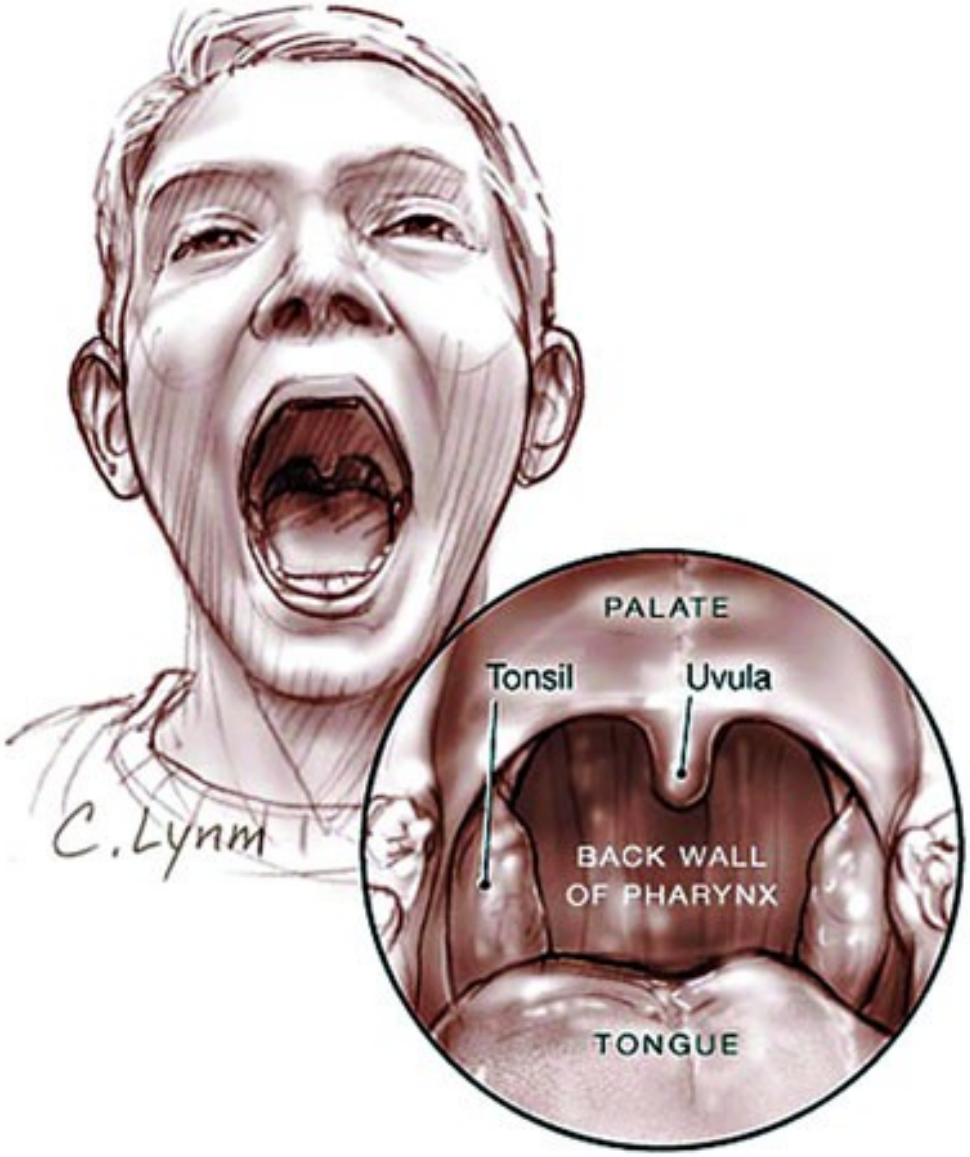
Viral tonsilopharyngitis

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

Tonsilopharyngitis



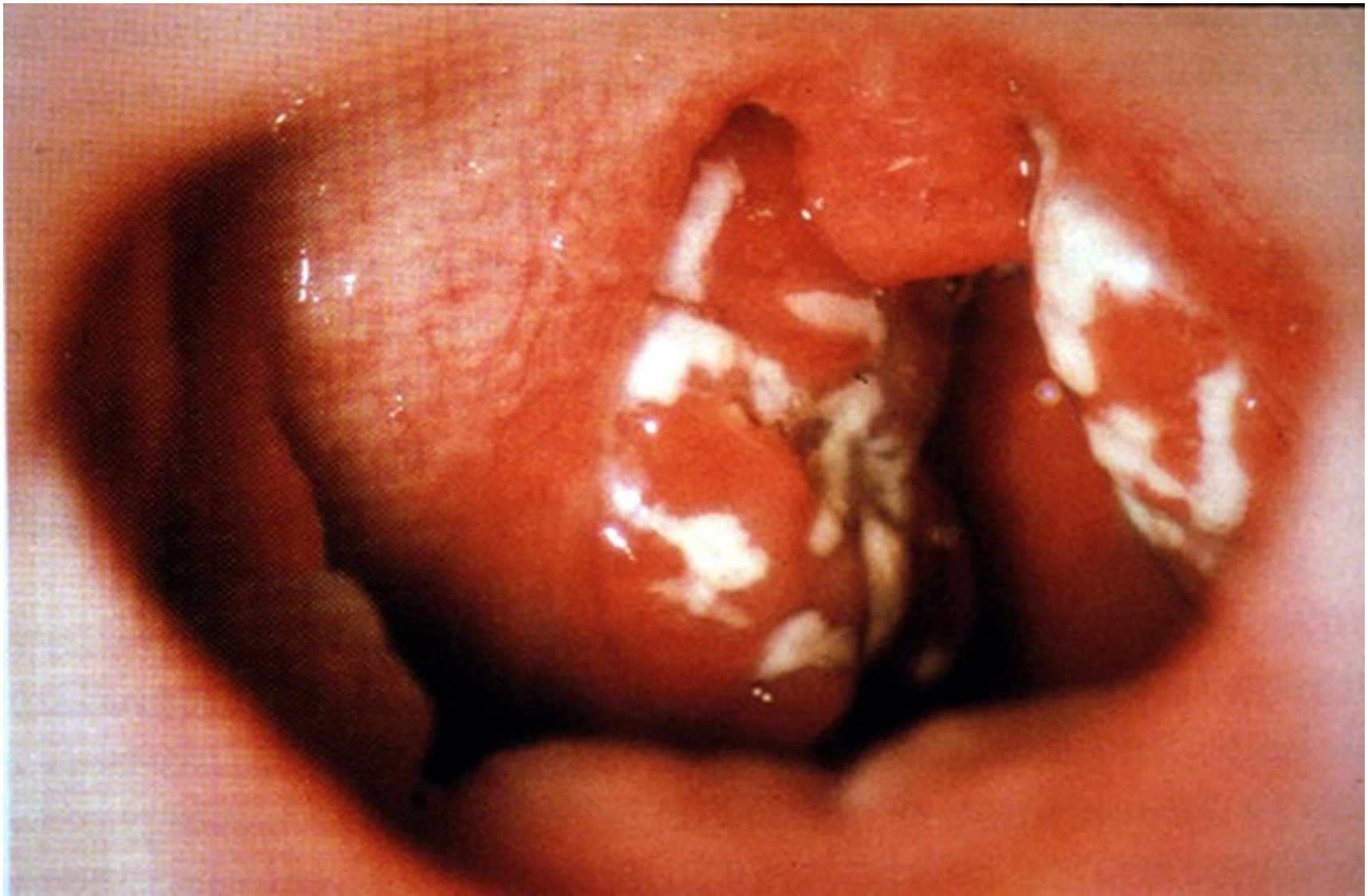
http://medicine.ucsd.edu/Clinicalimg/Head-Pharyngitis.htm



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

Purulent bacterial tonsilitis

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



A note on respiratory viruses and other „virologically examined“ microoorganisms

- **Respiratory viruses** are related to many types of respiratory infections, therefore it is useful to know them
- **Virological laboratories** examine patients´ sera labelled „examination of antibodies against respiratory viruses“ – usually, they perform tests for the most common agents
- Such examinations **often include non-viral agents** – atypical bacteria, that are not keen to be caught by bacteriological cultivation

Respiratory viruses – I

- **The most important and most common:**
  - **influenzavirus A a B**
  - **adenoviruses**
  - **RSV and metapneumoviruses**
  - **parainfluenzaviruses (type 1+3 = *Respirovirus*, type 2+4 = *Rubulavirus*)**
  - **rhinoviruses**
  - **coronaviruses (incl. SARS causing virus)**

Respiratory viruses – II

- **Less common viral agents**

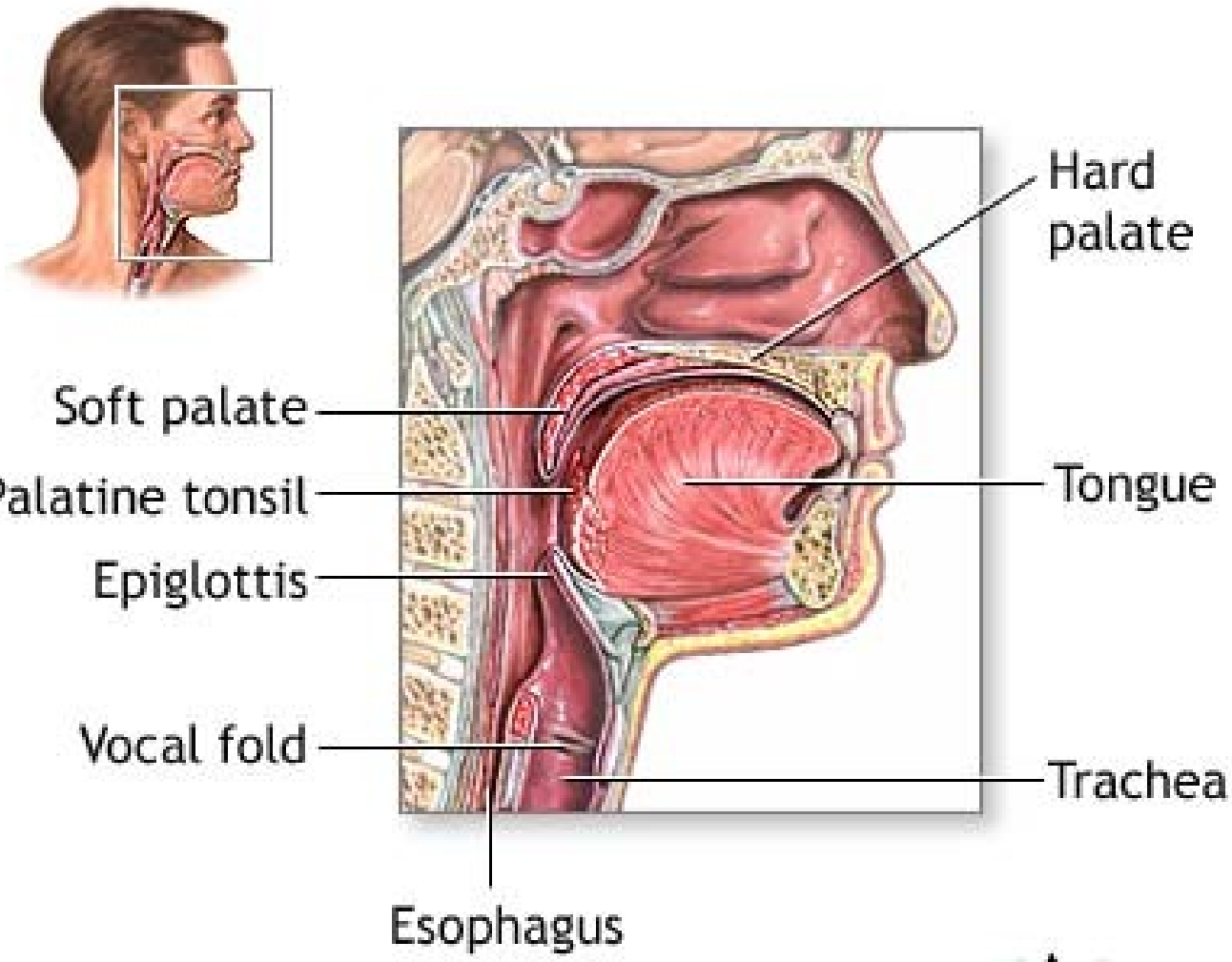
- **HSV**
- **coxsackieviruses**
- **echoviruses**
- **EBV**
- **Ťahyňa virus**

Respiratory agents – III

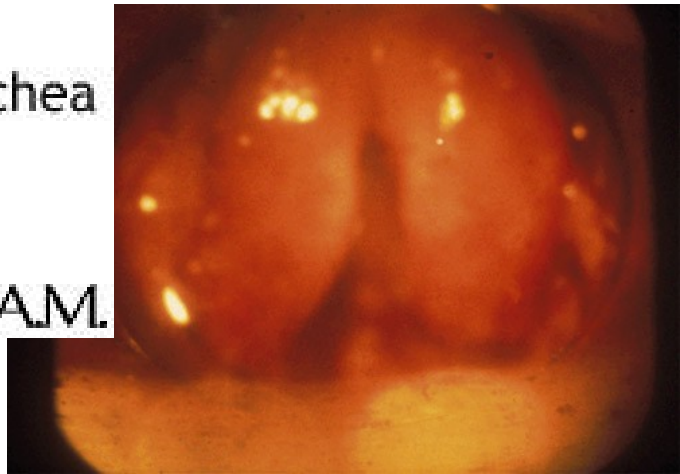
- **Bacterial agents causing atypical pneumoniae (but diagnosed in virological laboratories):**

- ***Mycoplasma pneumoniae* – the most common**
- ***Coxiella burnetii* – Q-fever**
- ***Chlamydia psittaci* – ornithosis**
- ***Chlamydophila pneumoniae***

Epiglottitis



de.wikipedia.org/wiki/Epiglottitis



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

Etiology of epiglottitis

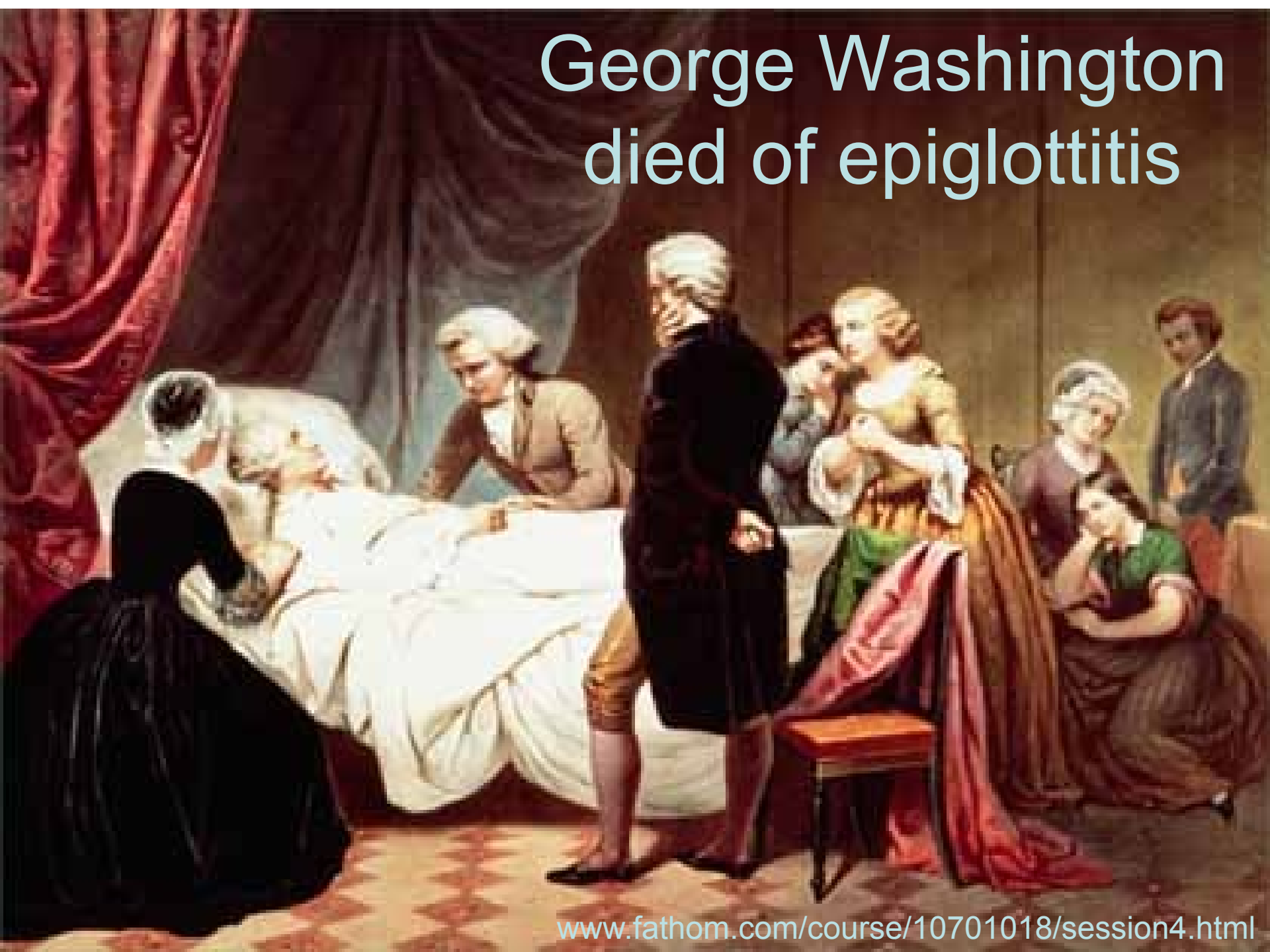
- **Epiglottitis acuta:**

  Serious disease – medical emergency

  The child may suffocate!

- **Practically one and only important agent:**

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


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

Etiology of laryngitis and tracheitis

- **Respiratory viruses (other than agents of nasopharyngitis):**

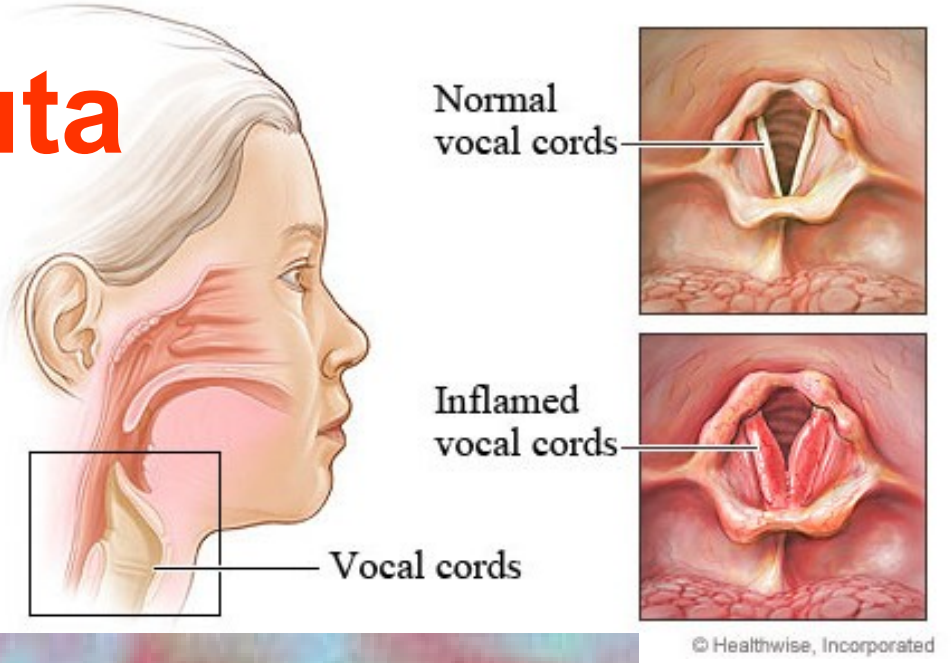
  parainfluenza and influenza A viruses & RSV

- **Bacterial:**

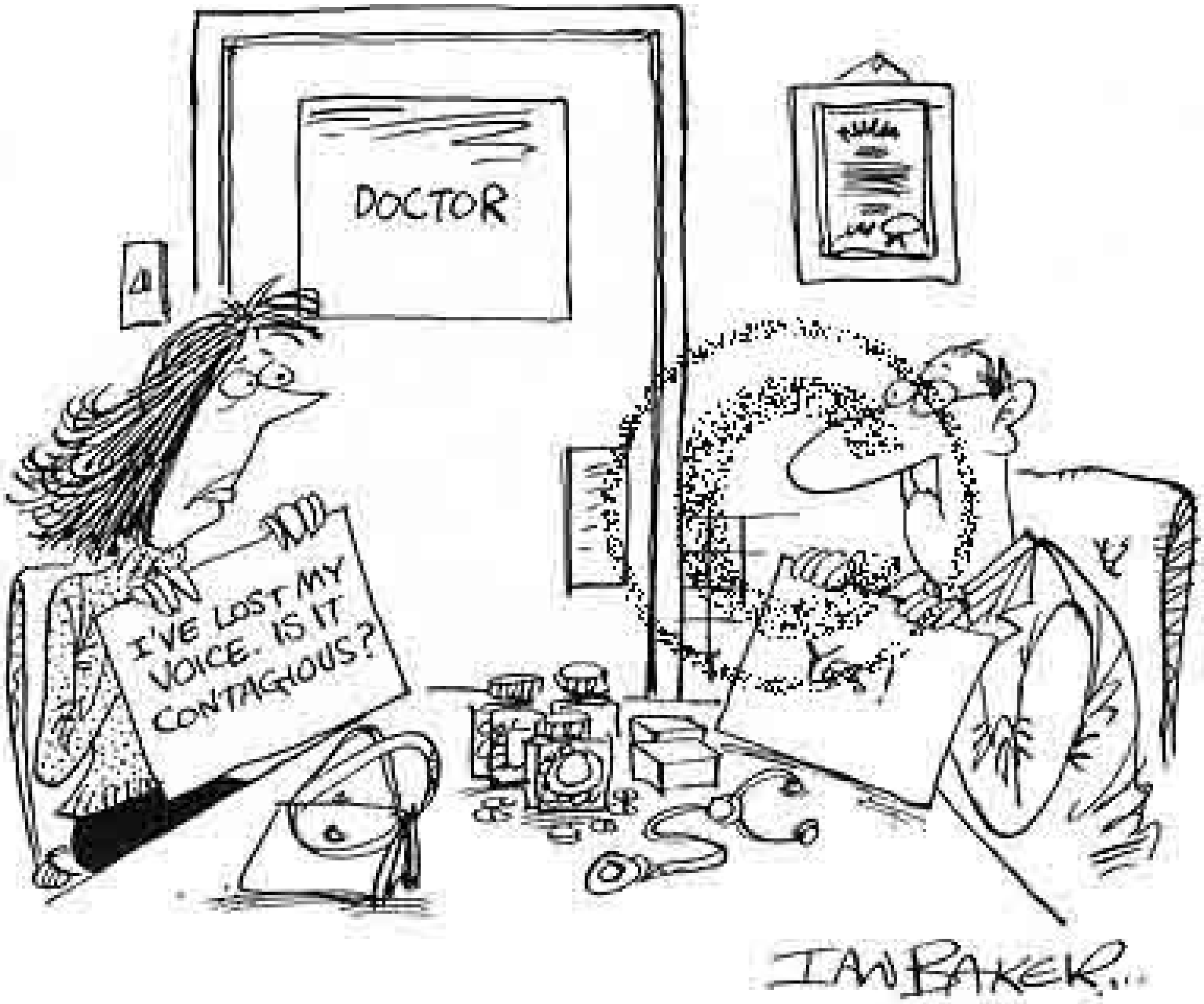
  Chlamydophila pneumoniae*, possibly *Mycoplasma pneumoniae*, secondarily: *S. aureus* and *Haemophilus influenzae

  laryngotracheitis pseudomembranosa (croup): *Corynebacterium diphtheriae*

Lagyngitis acuta



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



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

Examination and treatment of laryngitis and tracheitis

- To perform **throat swab is useless** (different bacteria in pharynx than in larynx). Except for chronical situations, **microbiological examination is not indicated**.
- **Treatment symptomatic -** antibiotics are not recommended

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

Etiology of bronchitis

- **Acute bronchitis:**

  influenza, parainfluenza, adenoviruses, RSV

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

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

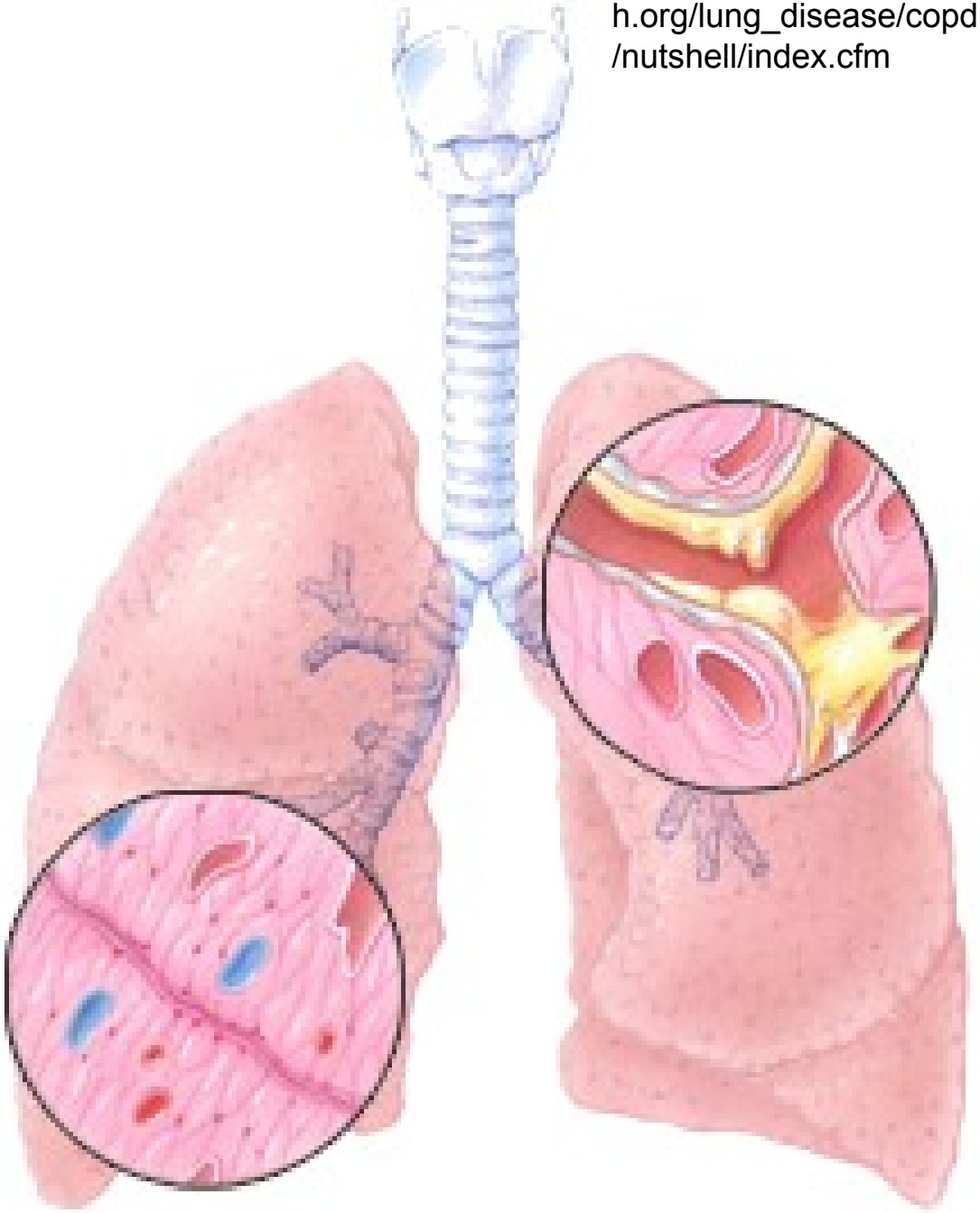
- **Chronic bronchitis (cystic fibrosis):**

  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

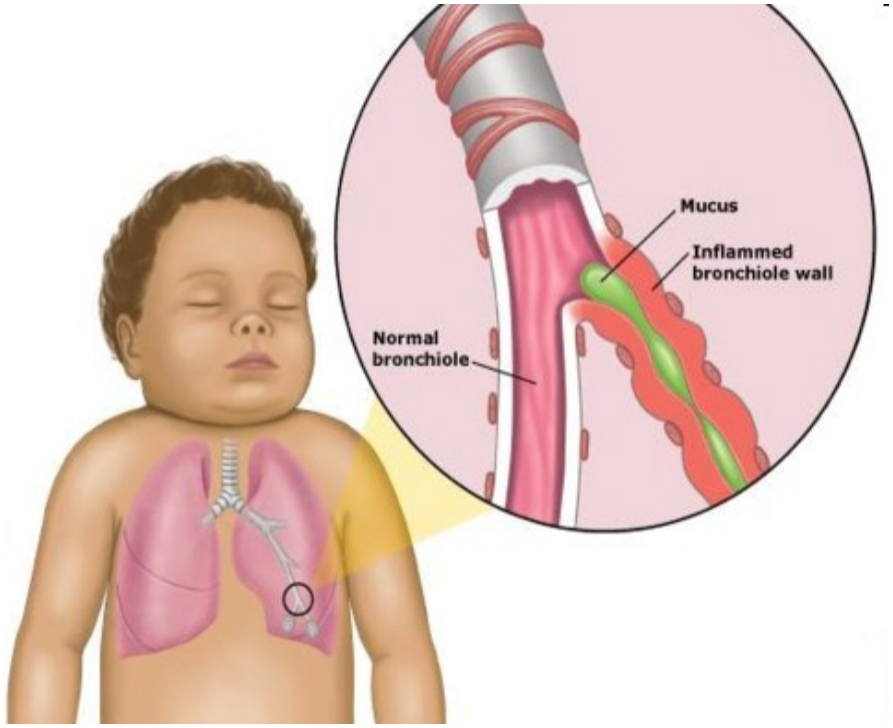


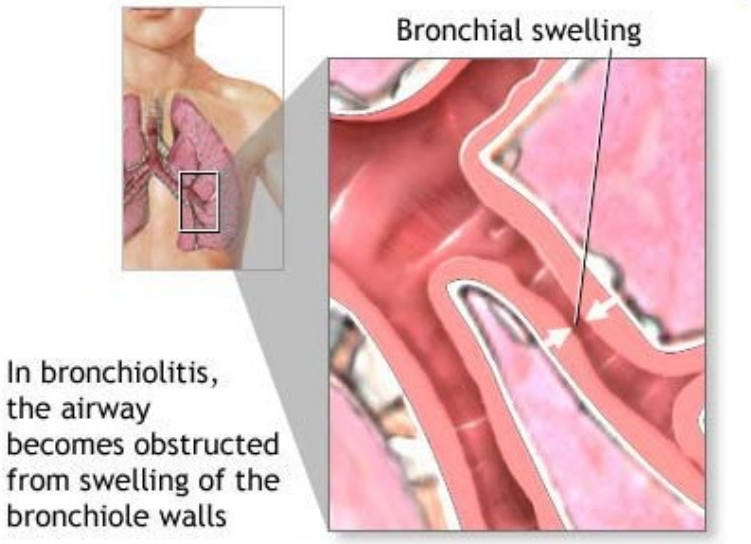
Etiology of bronchiolitis

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

  ***Pneumovirus* (= RSV)**

  Metapneumovirus



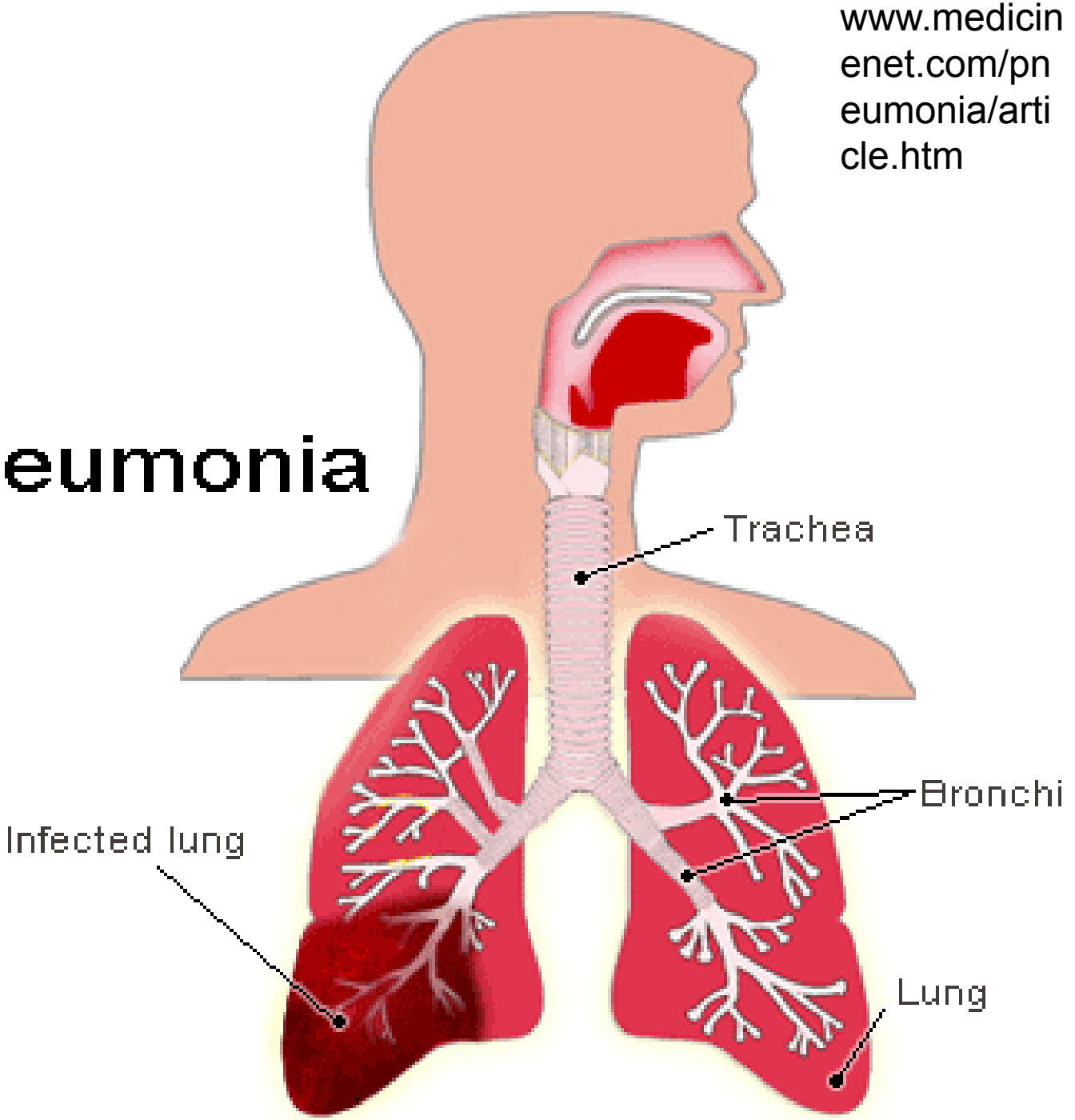


https://www.nlm.nih.gov

Pneu

www.medicinenet.com/pneumonia/article.htm

Pneumonia



Different types of pneumoniae

- Acute – community-acquired pneumoniae
  - in originally healthy
    - adults
    - children
  - in debilitated persons
  - after a contact with animals
- Acute – nosocomial pneumoniae
- ventilator-associated
  - early
  - late
- others
- Subacute and chronic pneumoniae

Etiology of pneumoniae – I

Acute, community-acquired, in healthy adults

- **bronchopneumonia and lobar pneumonia:**
  - ***Streptococcus pneumoniae***
  - ***Staphylococcus aureus***
  - ***Haemophilus influenzae* type b**
- **atypical pneumonia:**
  - ***Mycoplasma pneumoniae***
  - ***Chlamydophila pneumoniae***
  - **Influenza A virus (during an epidemic only)**

Etiology of pneumoniae – 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**

Etiology of pneumoniae – 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**

Etiology of pneumoniae – IV

Acute, community-acquired, after a contact with animals:

- **Bronchopneumonia**
  - ***Pasteurella multocida***
  - ***Francisella tularensis*** **(tularemia)**
- **Atypical pneumonia**
  - ***Chlamydia psittaci*** **(ornithosis)**
  - ***Coxiella burnetii*** **(Q-fever)**

Etiology of pneumoniae – V

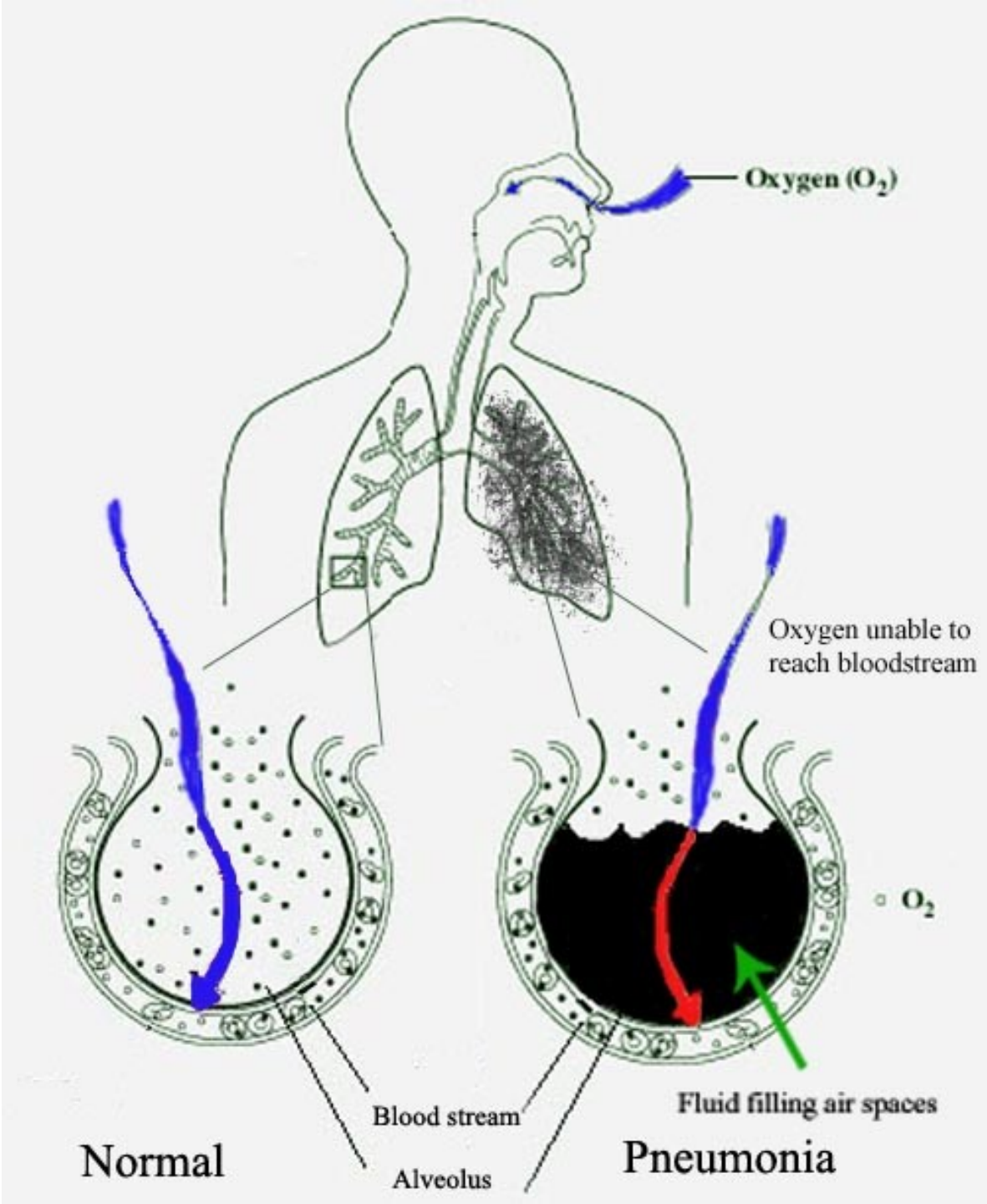
Acute, nosocomial:

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

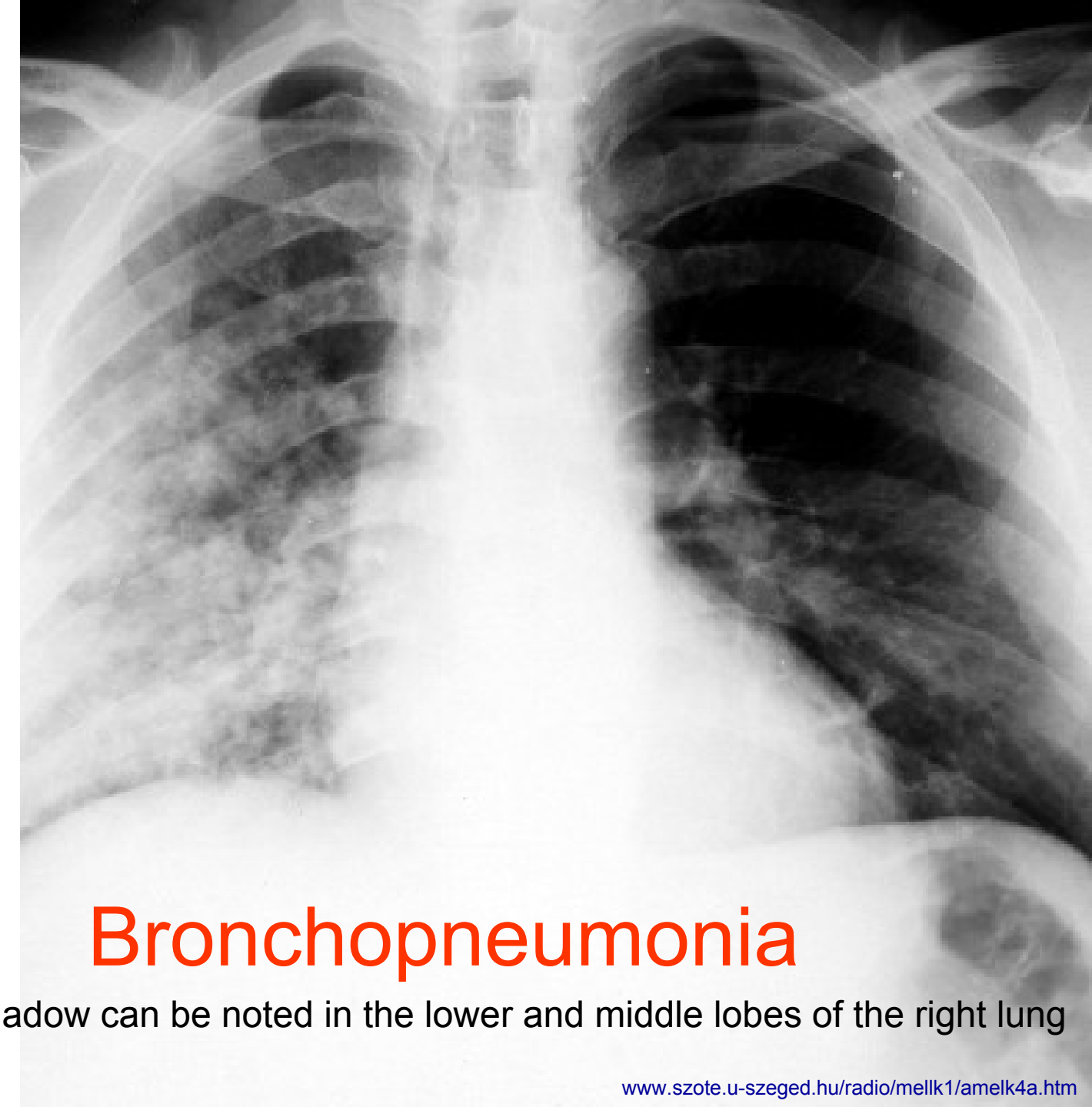
Etiology of pneumoniae – VI

- **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

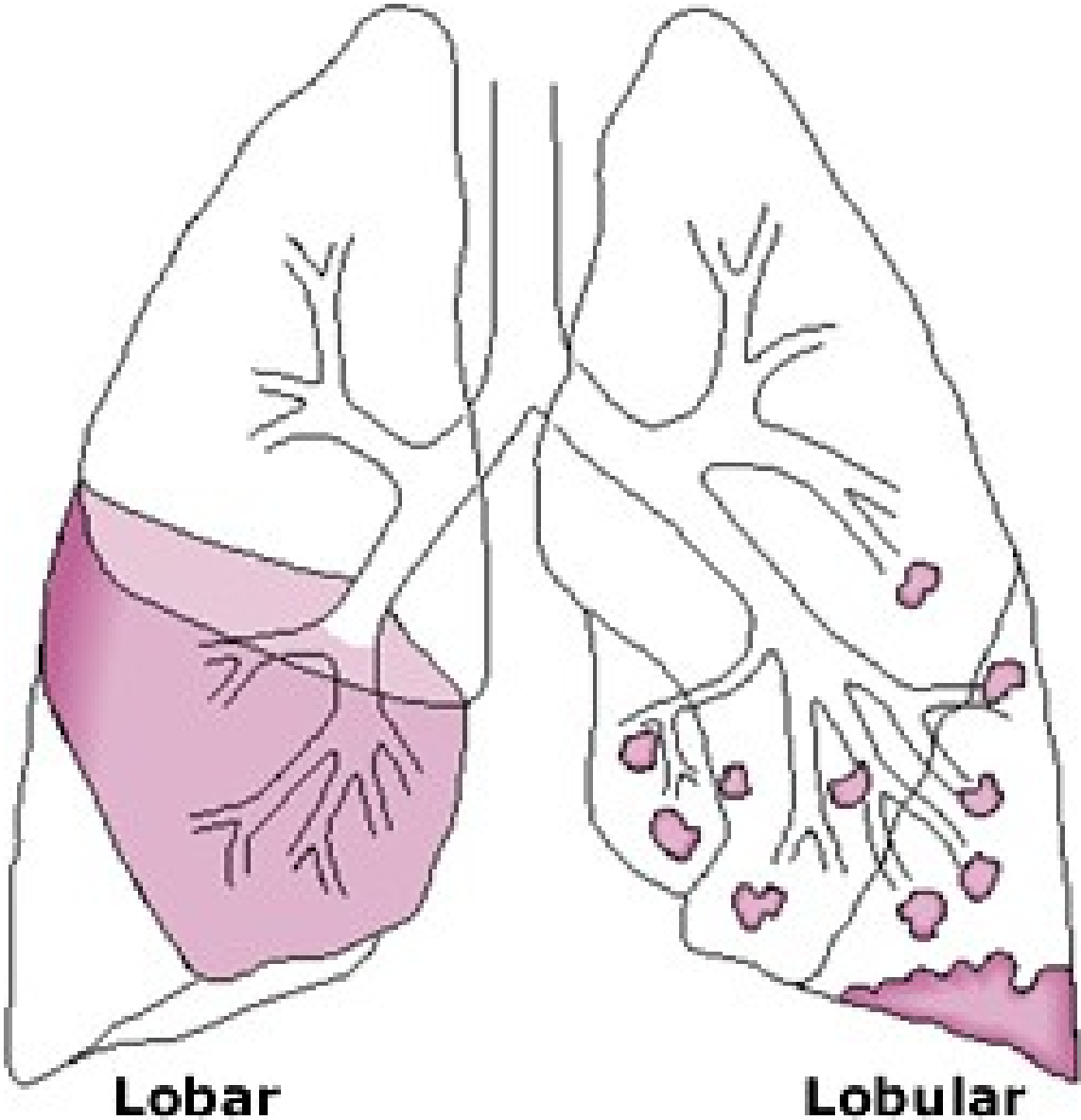


Bronchopneumonia

An inhomogenous shadow can be noted 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

Examination in lung infections

- **Clinical examination and X-ray**, important is differentiation classic × atypical pneumonia
- **Classical pneumoniae -** properly taken sputum is useful, eventually (in septic course) blood for blood culture
- **Atypical pneumoniae** - serology - mycoplasma and chlamydophila (eventually in complex of „respiratory viruses serology“).
- **Hospital pneumoniae** also **legionella examination**

Treatment in LRW and lung infections

- In classic community pneumoniae **amoxicilin**, eventually according to causative agent and its antibiotic susceptibility
- In atypical pneumoniae **tetracyclins** or (especially in children < 8) **macrolids**.
- In hospital infections treatment according to in vitro **susceptibility test** necessary – pseudomonads and burkholderiae resistant!
- In TB usually combination of three of four drugs necessary

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

Thank you !