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Clinical Microbiology

Lecture for 3rd-year students

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Agents of respiratory diseases

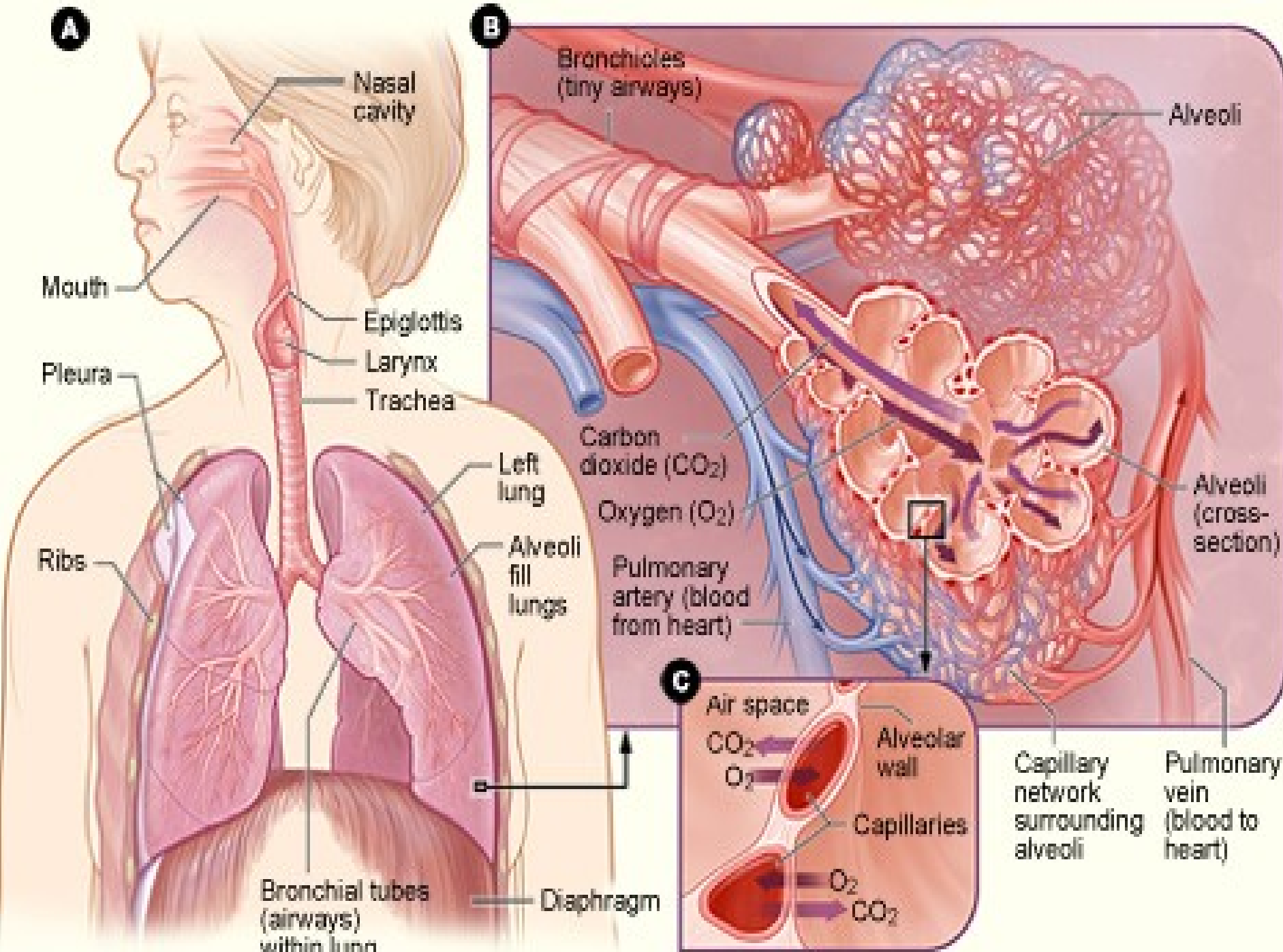
Part One

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**
- **3/4** 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

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 (CO_2)

Oxygen (O_2)

Pulmonary artery (blood from heart)

Alveoli (cross-section)

Capillary network surrounding alveoli

Pulmonary vein (blood to heart)

Air space

CO_2

O_2

Alveolar wall

Capillaries

O_2

CO_2

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 differentiate 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 differentiated from allergic/vasomotoric rhinitis

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

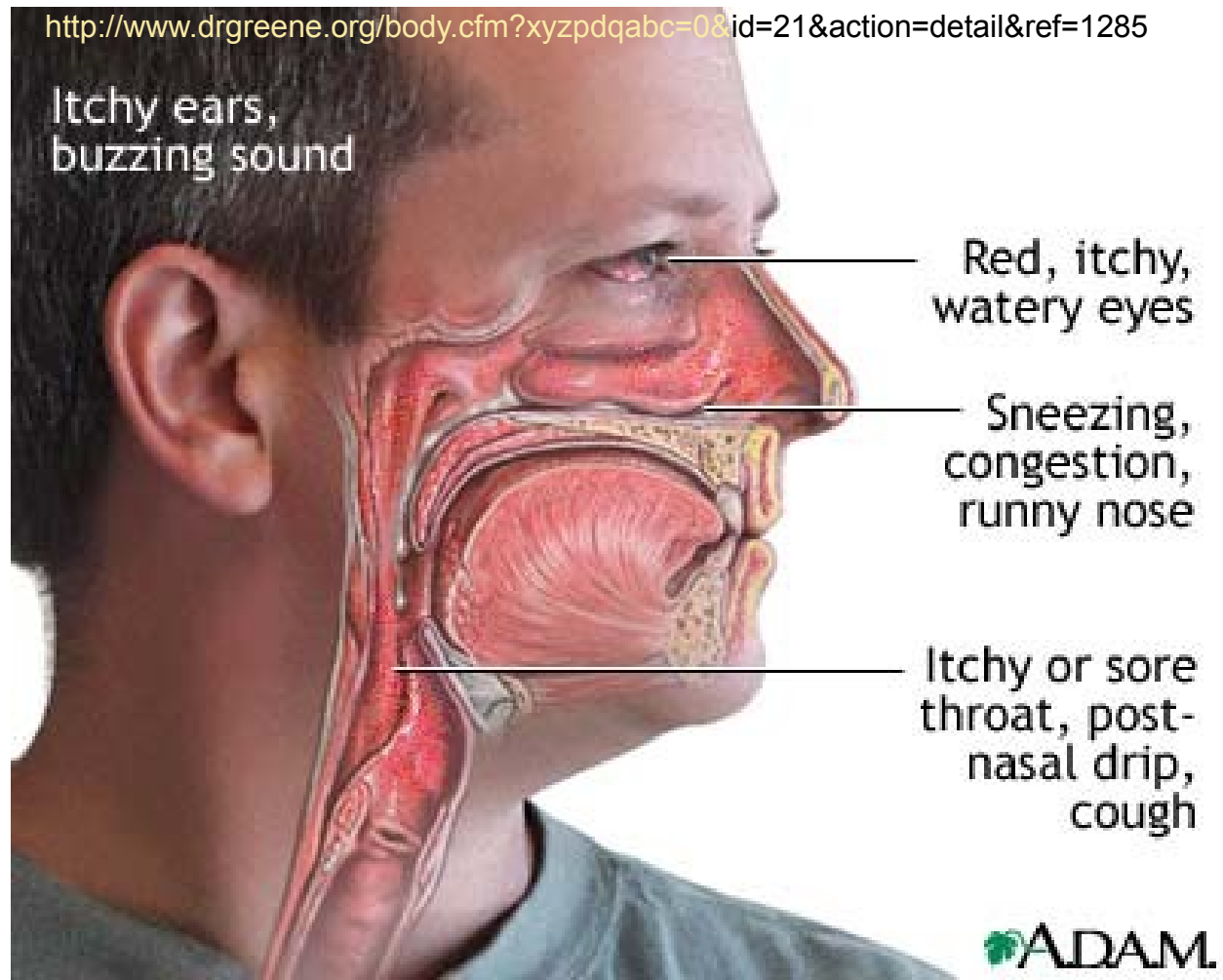
Itchy ears,
buzzing sound

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



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*

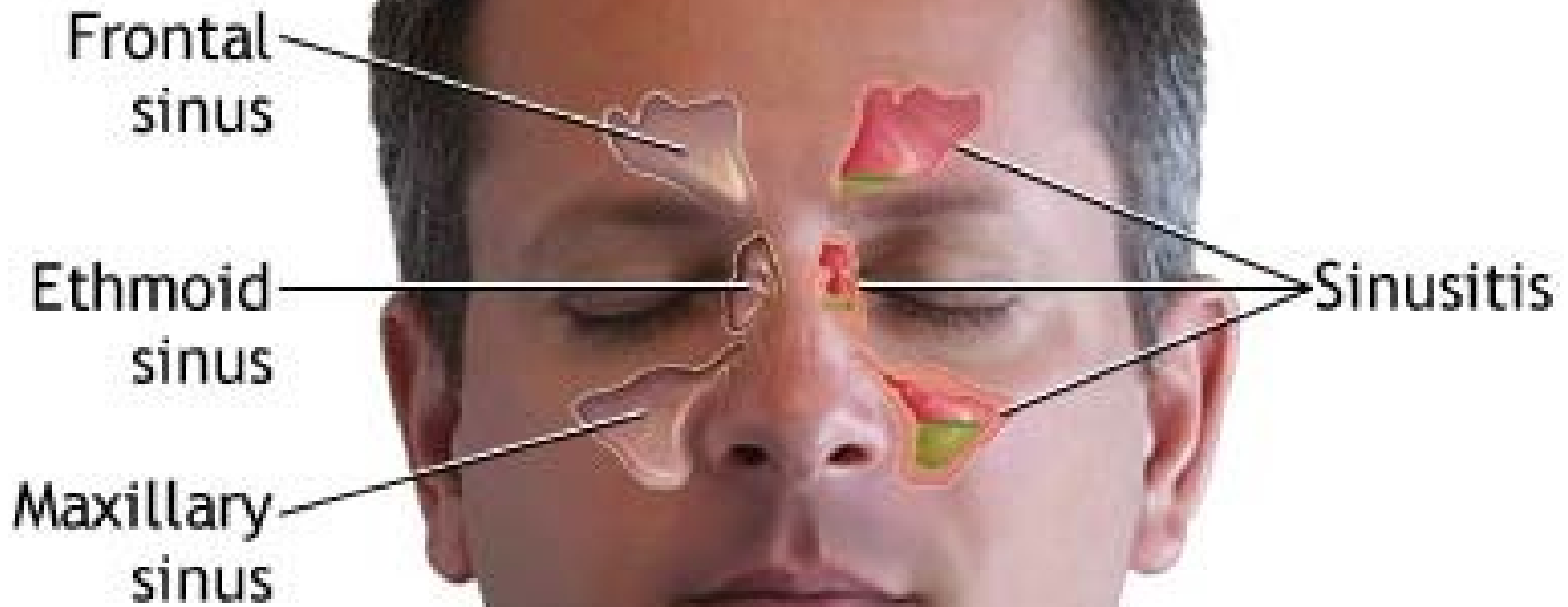
Examination and treatment

- **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**

Inflammation of paranasal cavities (sinusitis acuta)

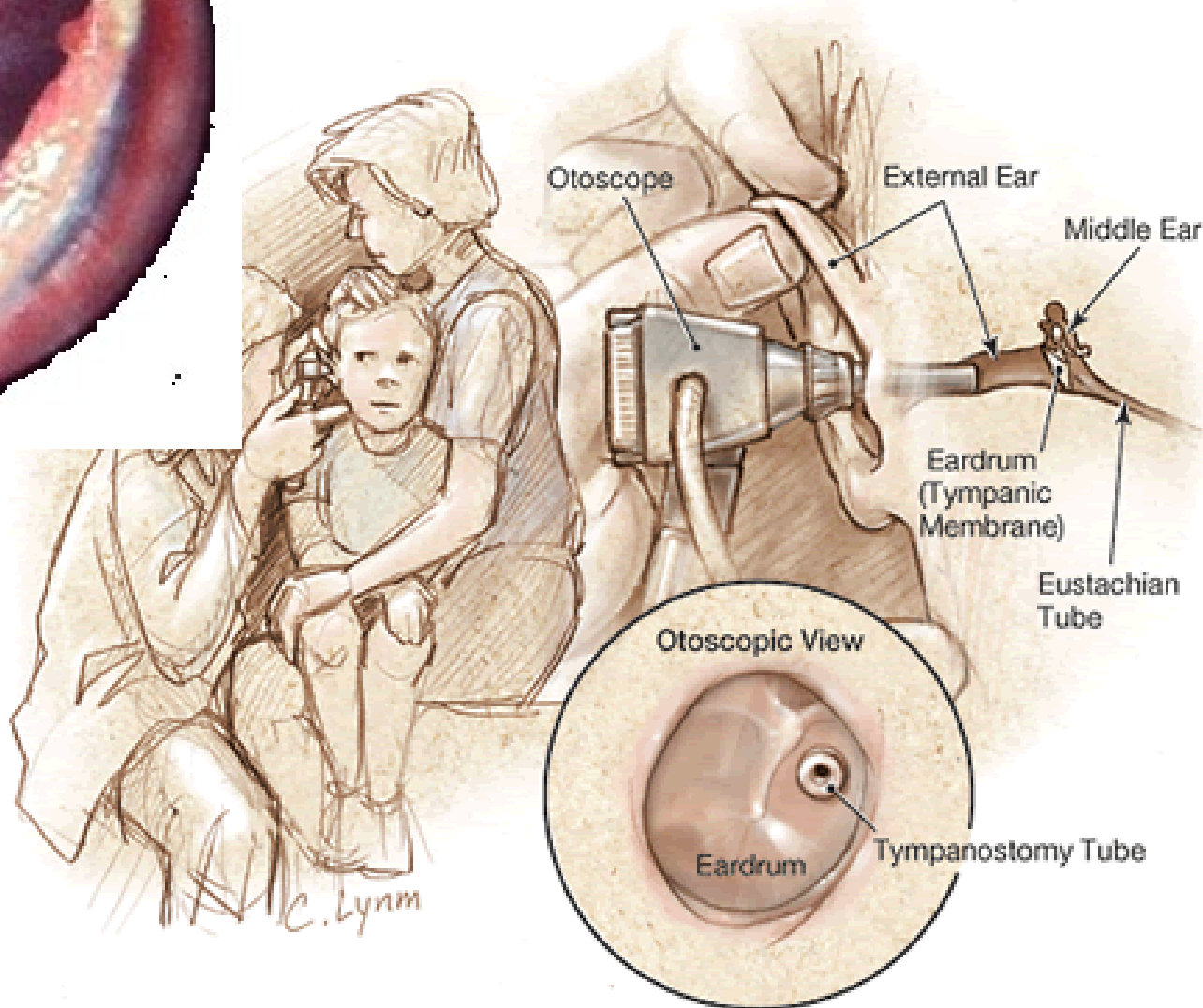
- Temporary finding in cavities is normal at classical rhinitis and there is no reason for treatment
- Treatment should be started in case of **painful sinusitis**, with teathache, headache, fever, lasting at least a weak, eventually neuralgia of N. trigeminus

Sinusitis acuta



Otitis media

- Causative agents the same 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

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, faringoconjunctival 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

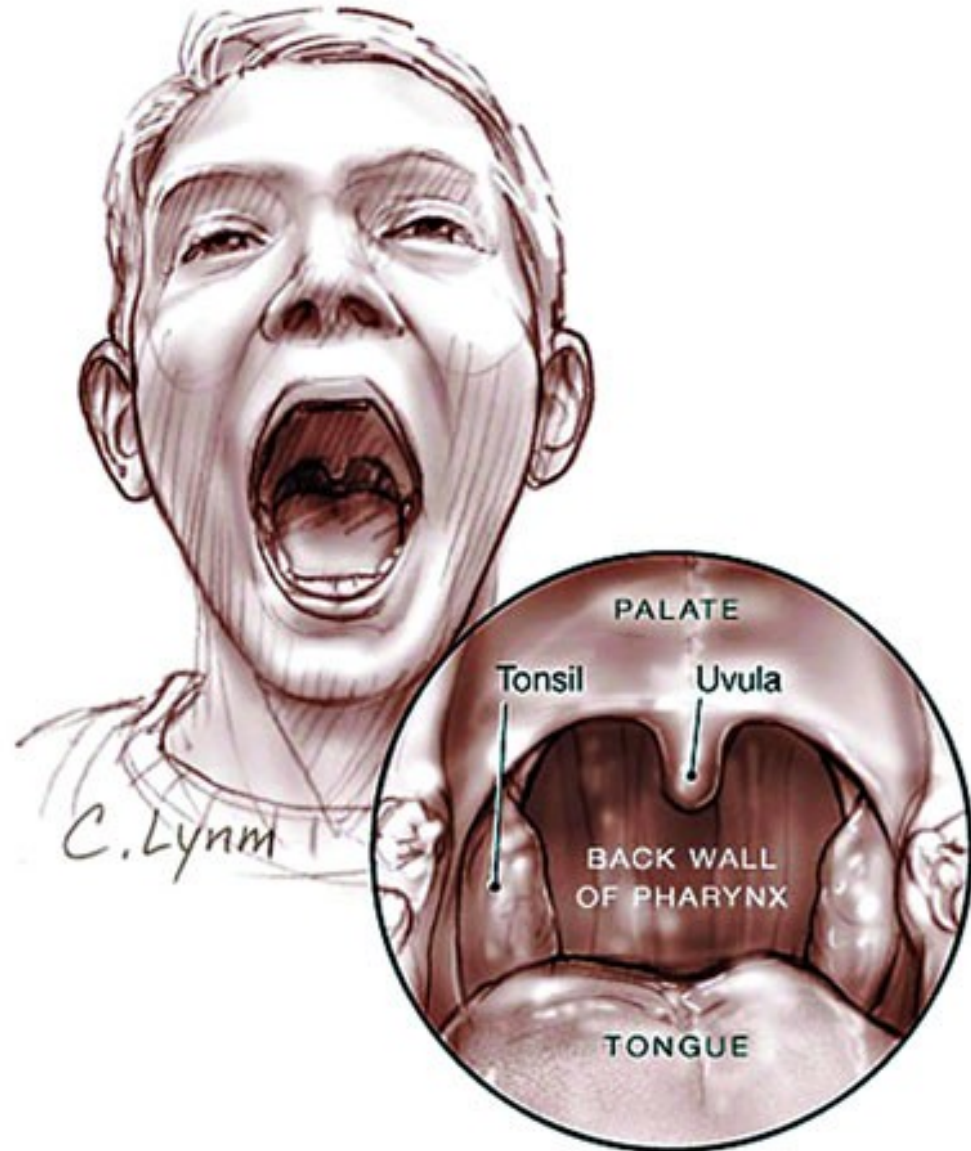
- Bacteriological examination recommended in all cases, incl. a „typical tonsillitis“
- When *Streptococcus pyogenes* is found, the „old good“ Fleming’s penicillin is the best
- Modern drugs like azithromycin, clarithromycin etc. have worse effect and should be used in allergic persons only
- Besides 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

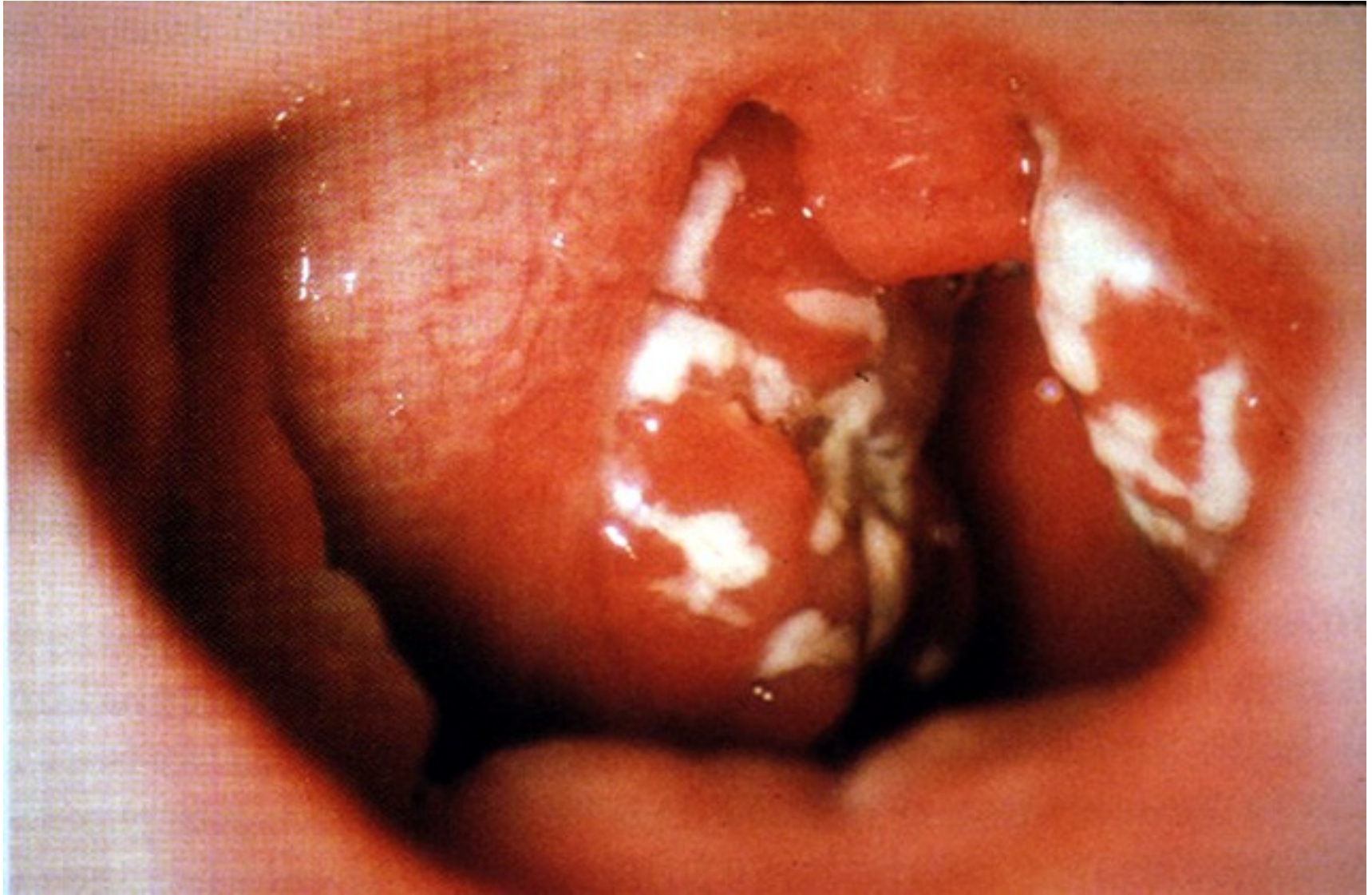


<http://medicine.ucsd.edu/Clinicalimg/Head-Pharyngitis.htm>

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

Purulent bacterial tonsillitis

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



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

- **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)

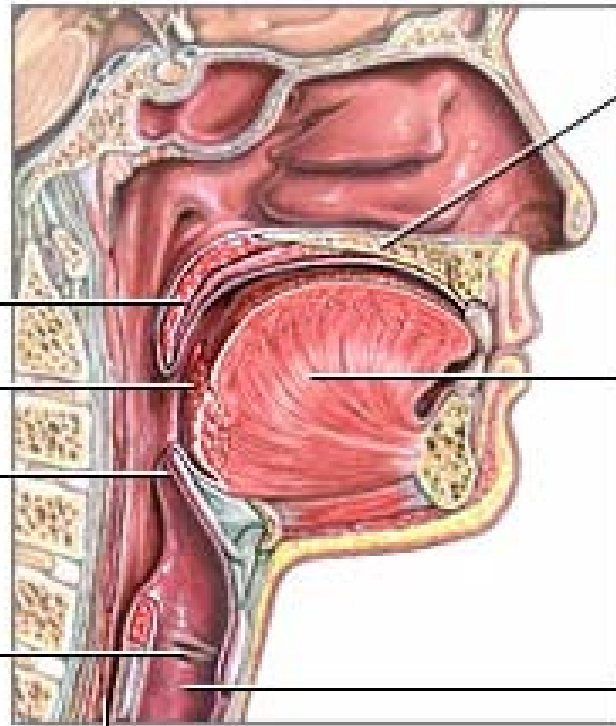
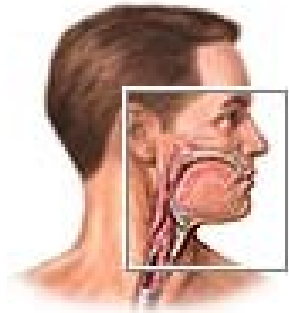
Respiratory viruses – II

- **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



Hard
palate

Tongue

Trachea

Soft palate

Palatine tonsil

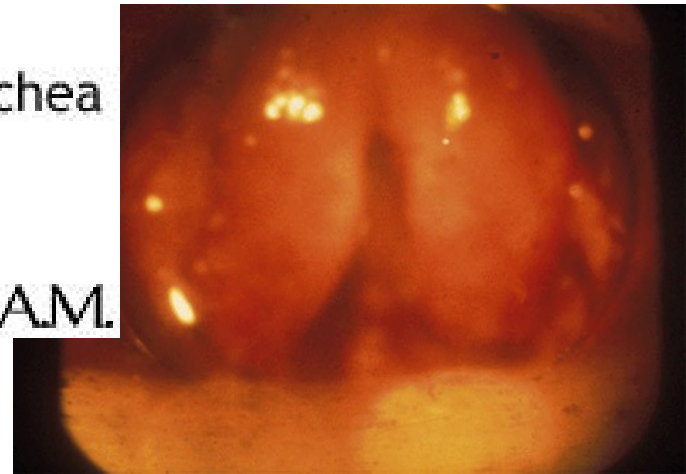
Epiglottis

Vocal fold

Esophagus

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

ADAM.



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

Etiology of epiglottitis

- **Epiglottitis acuta:**

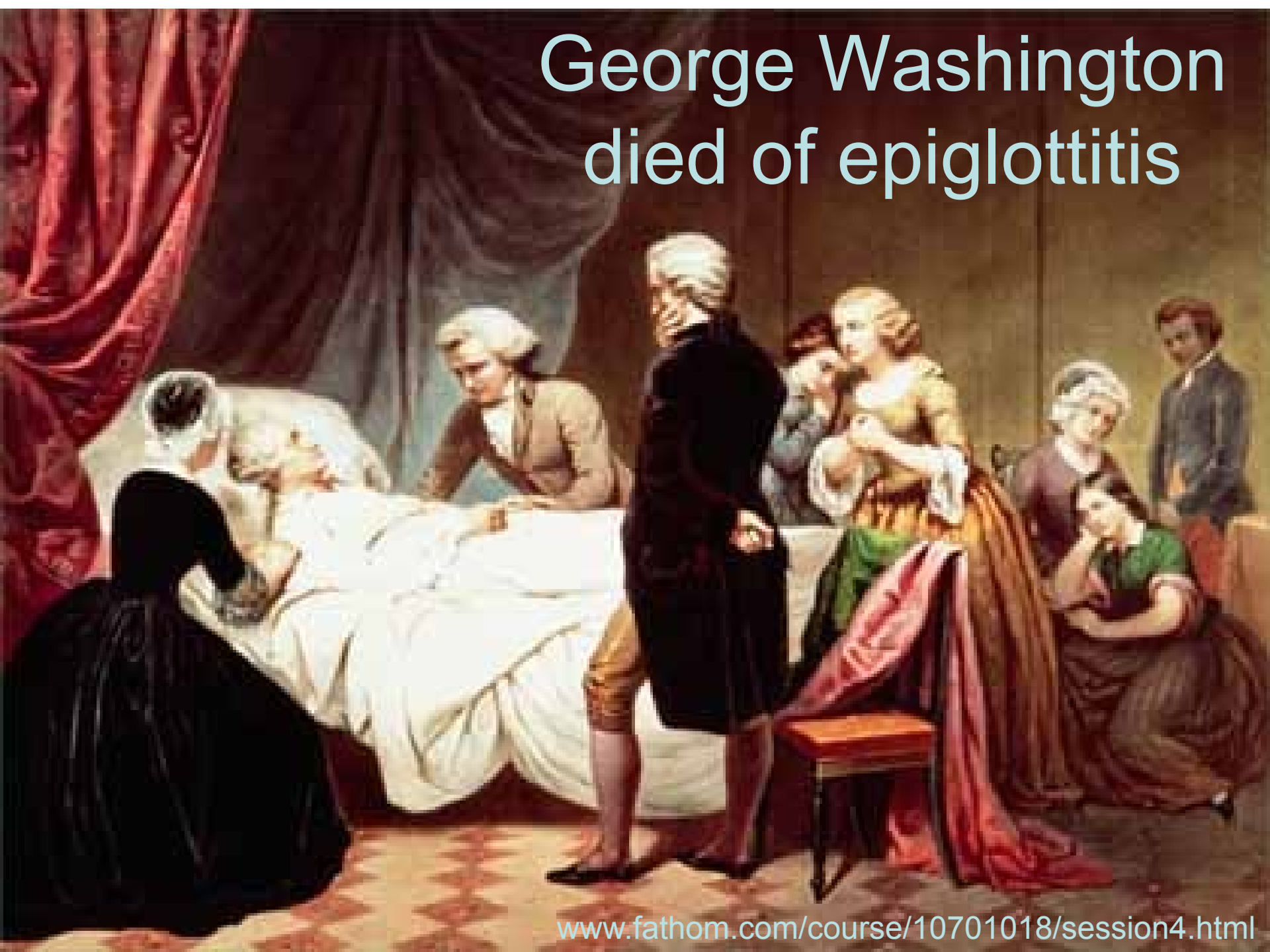
Serious disease – medical emergency

The child may suffocate!

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

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

George Washington died of epiglottitis



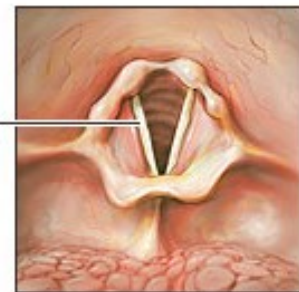
Etiology of laryngitis and tracheitis

- **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

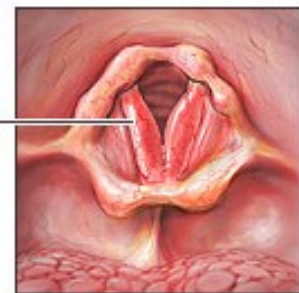
Laryngitis acuta



Normal vocal cords



Inflamed vocal cords



Vocal cords

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IAN BAKER...

Examination and treatment of laryngitis and tracheitis

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

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Etiology of bronchitis

- **Acute bronchitis:**

influenza, parainfluenza, adenoviruses, RSV

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

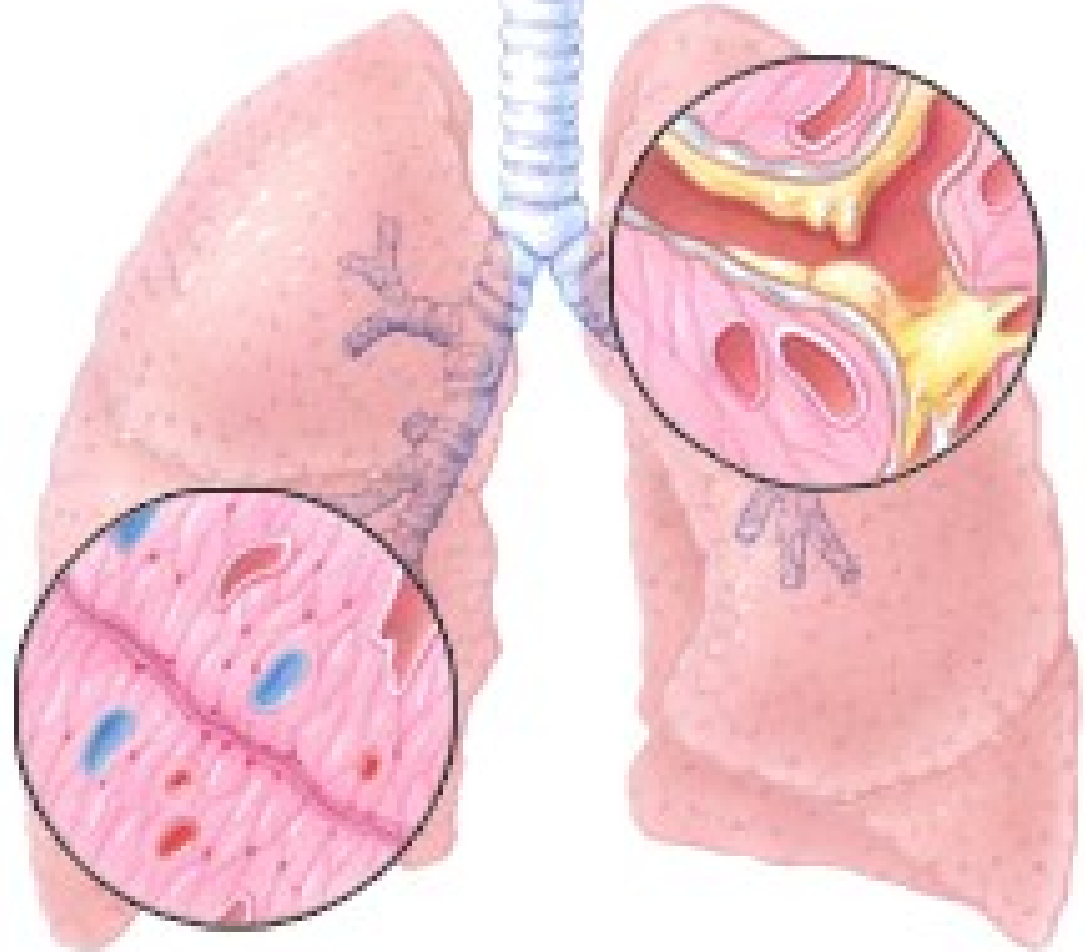
Bacterial, primarily: *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, *Bordetella pertussis*

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

Pseudomonas aeruginosa, *Burholderia cepacia*

Bronchitis acut

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



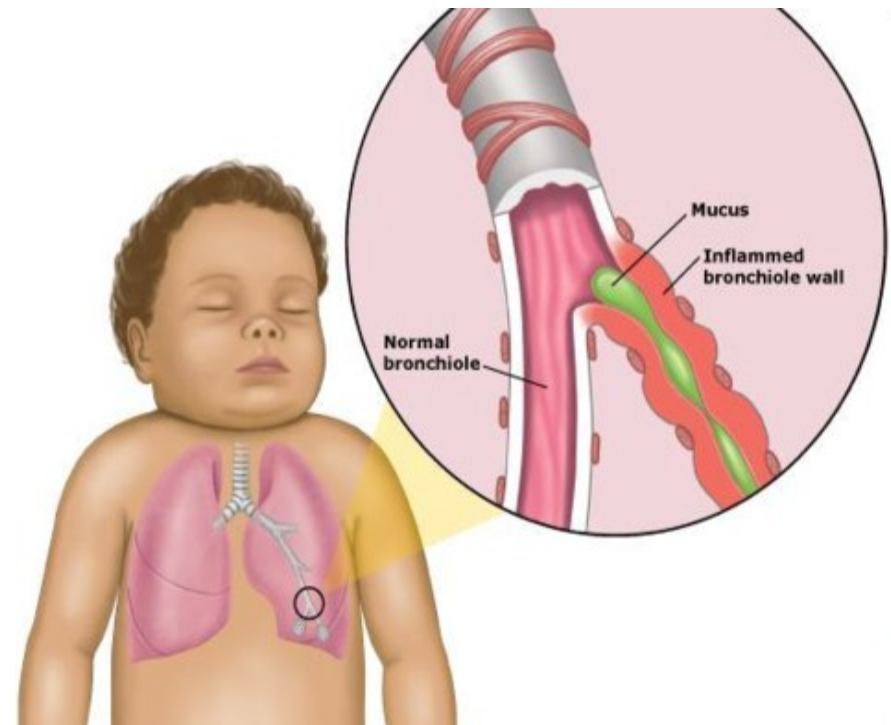
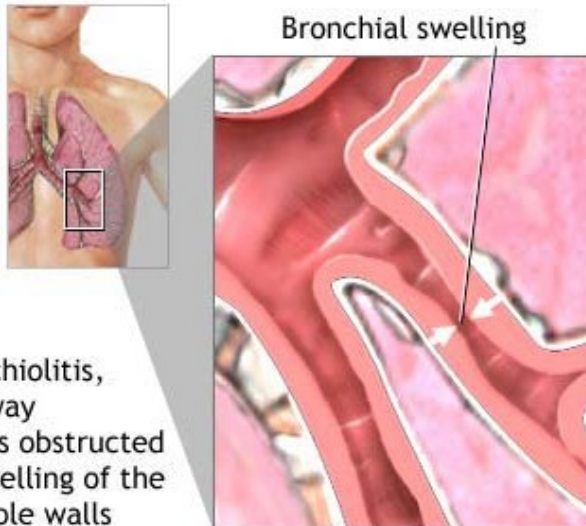
<http://www.lhsc.on.ca/resptherapy/students/p/atho/brnchit5.htm>

Etiology of bronchiolitis

- Isolated bronchiolitis in newborns and infants only:

Pneumovirus (= RSV)

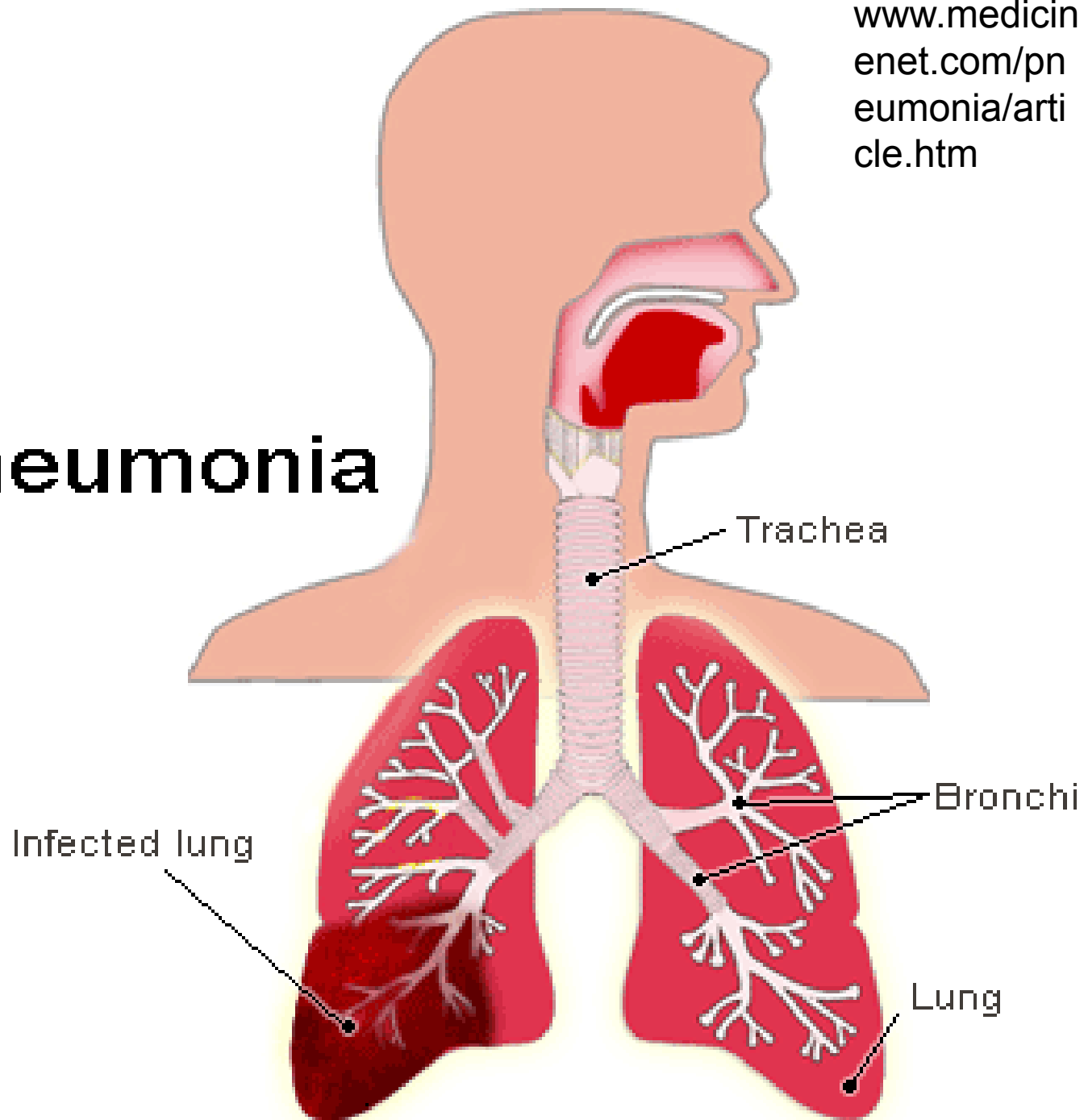
Metapneumovirus



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

Pneu

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

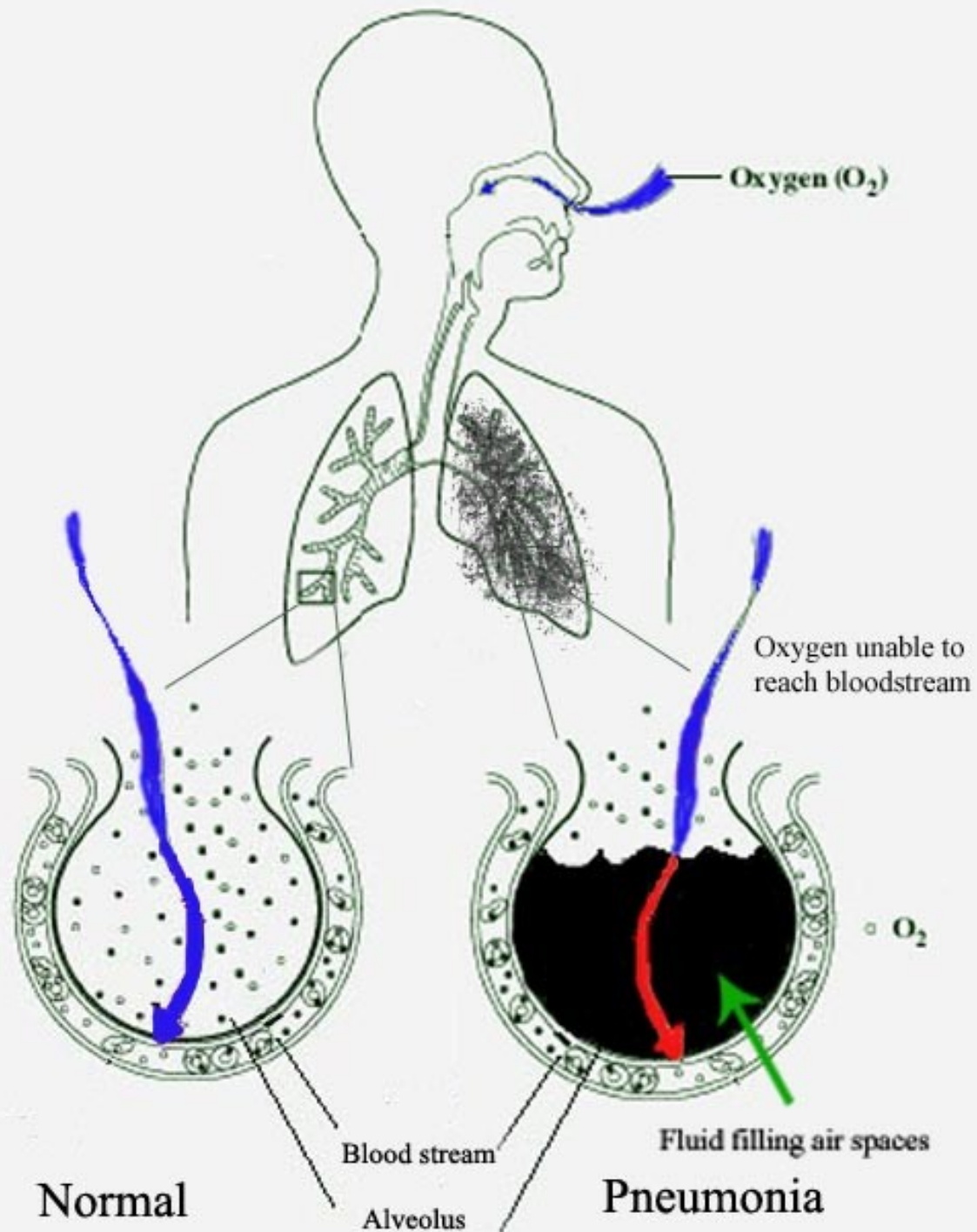
Acute, nosocomial:

- **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



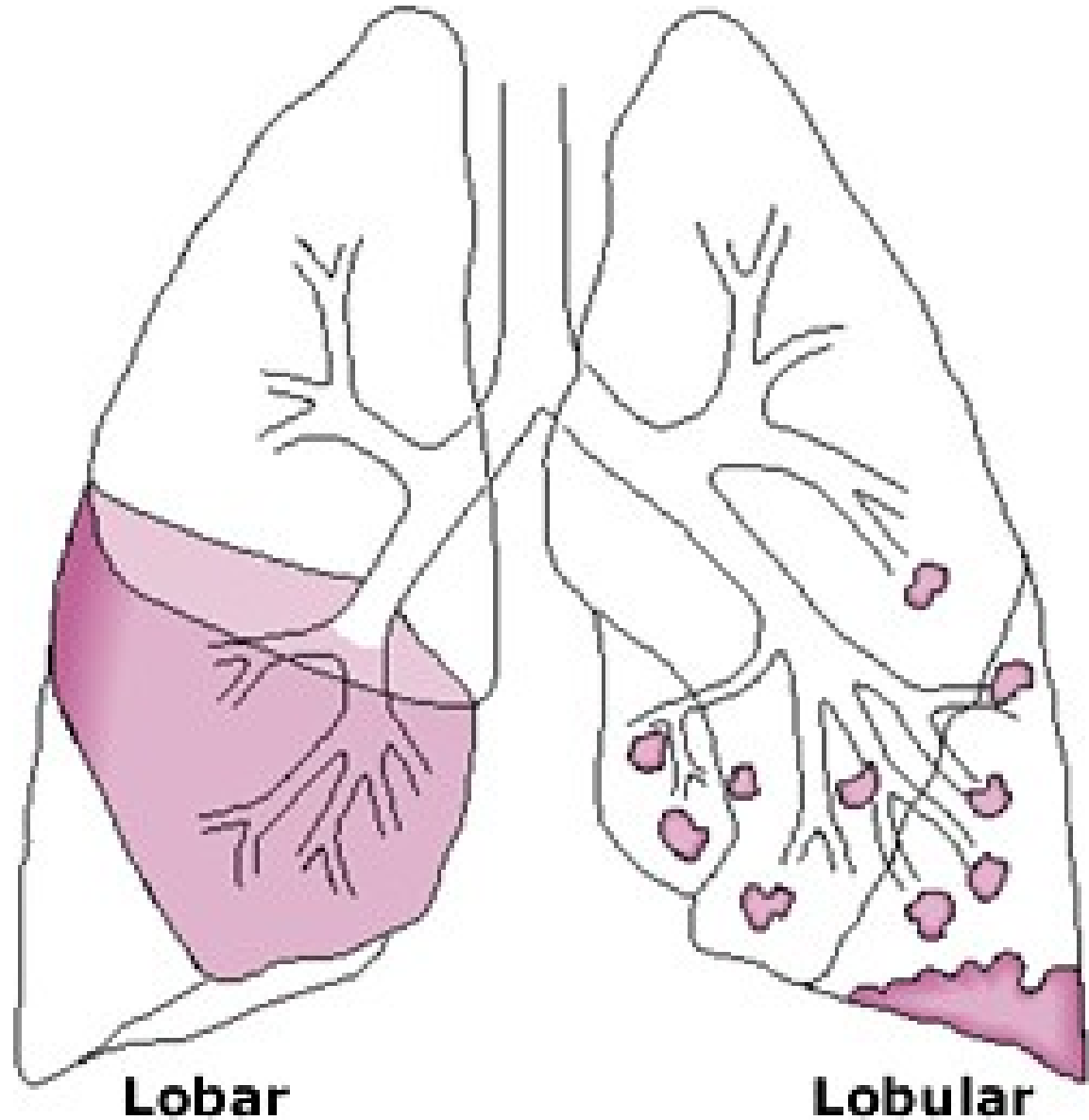
<http://www.uspharmacist.com/index.asp?page=ce/105057/default.htm>



Bronchopneumonia

An inhomogenous shadow can be noted in the lower and middle lobes of the right lung

Lobar and lobular pneumonia



Lobar

Lobular

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 chlamydia (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

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Thank you !

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