

# Respiratory infections



**Pavel Drevinek**  
**Department of Medical Microbiology**

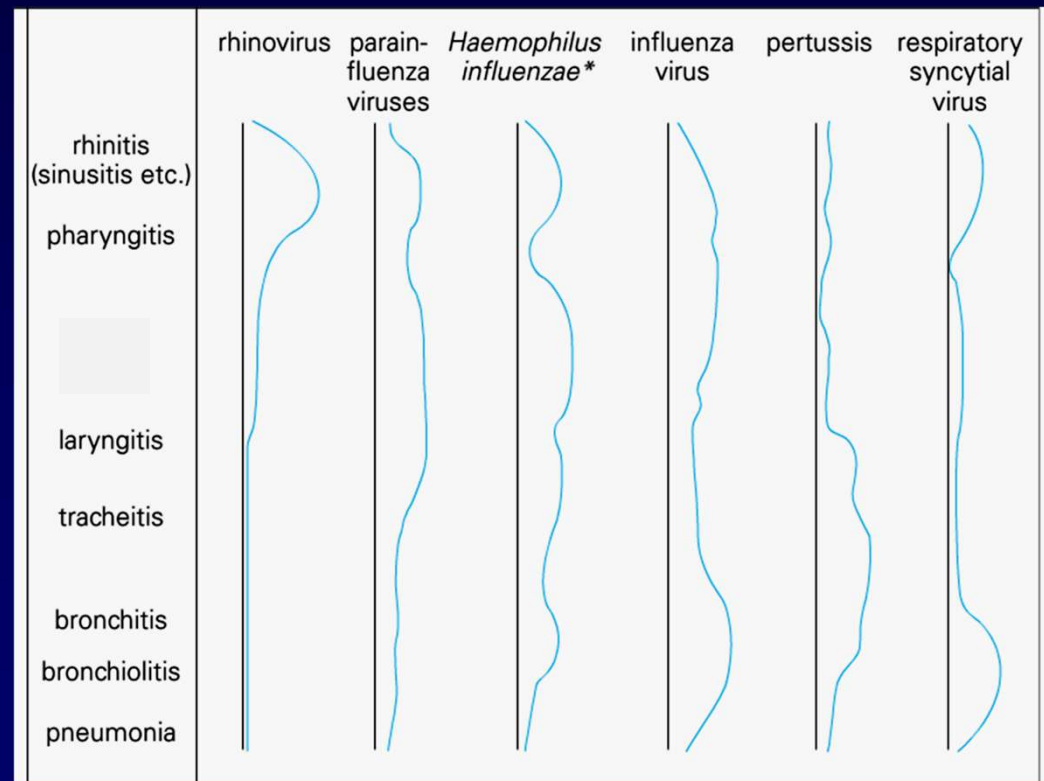


**2<sup>nd</sup> Faculty of Medicine, Charles University**  
**Motol University Hospital**

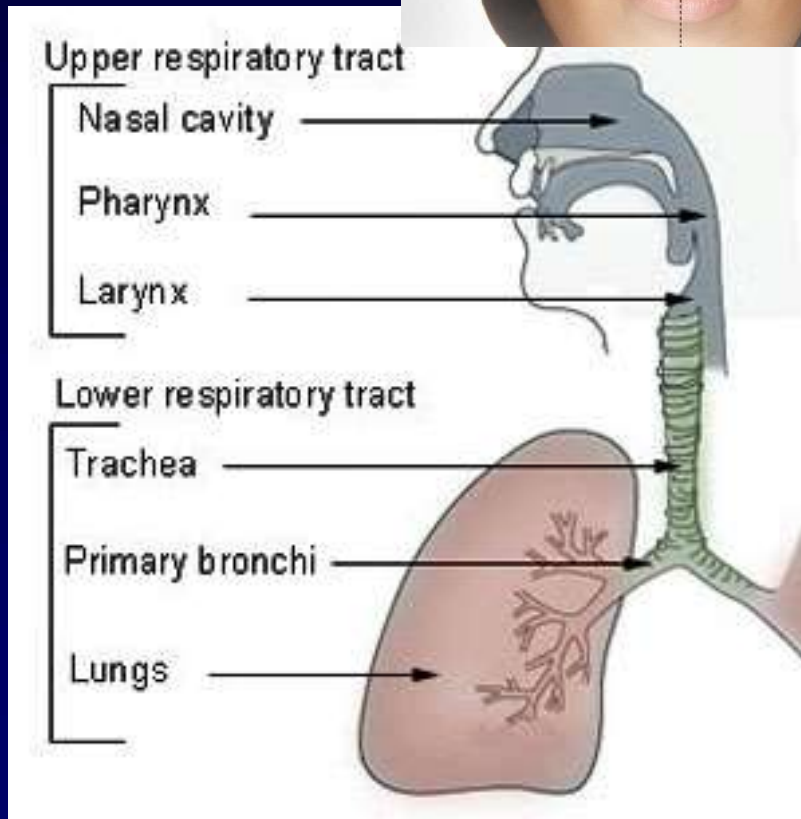
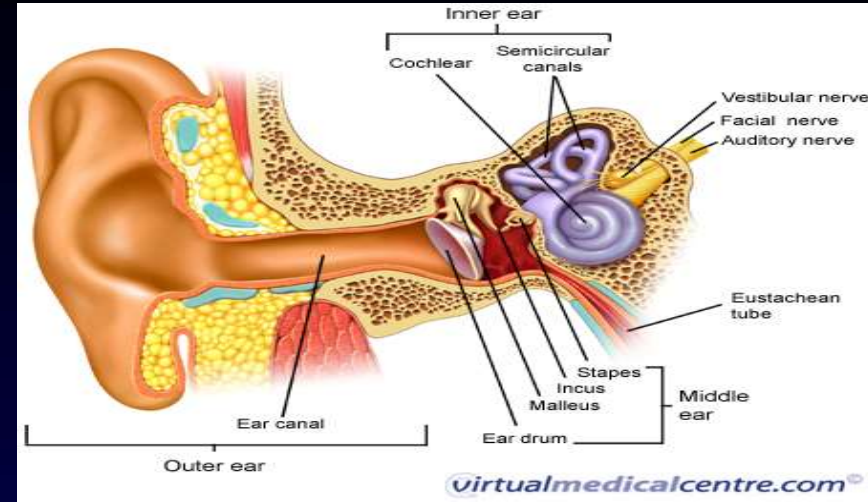
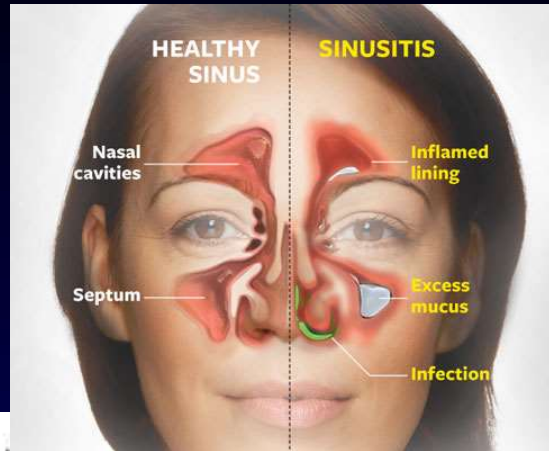
## Layout

- Introduction
  - Material for investigation, examination methods
  - Major pathogens
  - Upper airway infections
  - Lower airway infections
    - community acquired pneumonia
      - typical agents
      - atypical agents (bacterial, viral)
    - hospital acquired pneumonia
- Other: chronic infections, immunocompromised

- most common infections worldwide
- often epidemic outbreaks: droplet transmission; direct contact  
seasonal pattern
- acute or chronic
- community acquired or nosocomial
- bacterial or viral (with the risk of bacterial superinfection) ... or fungal
  - the same microorganism can cause different diseases
  - from mild to life threatening



# Respiratory tract: anatomy



## Conductive zone:

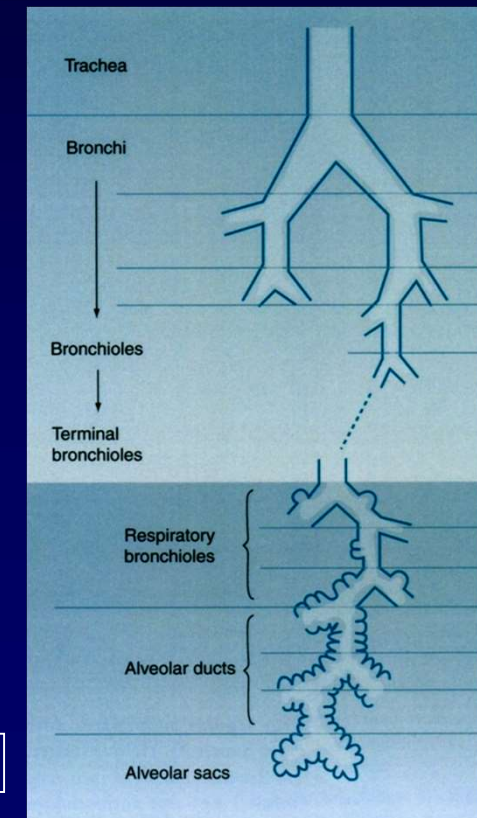
Cilia, mucus (submucosal glands)  
Anaerobic growth conditions  
- inside sputum

Targeted with inhaled antibiotics

## Respiratory zone:

No cilia, no mucus  
Mostly aerobic growth conditions

Targeted with systemic antibiotics

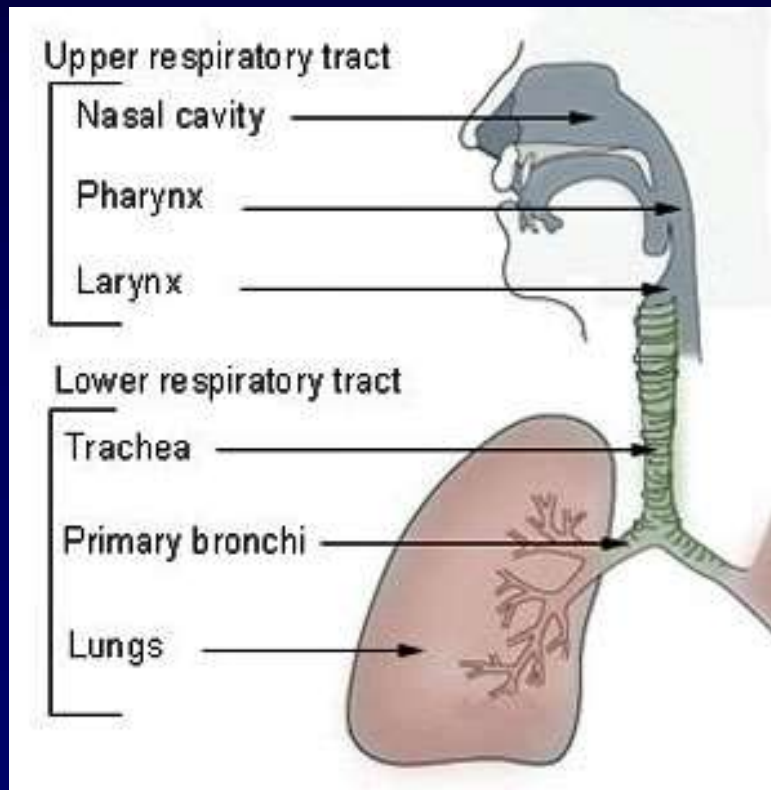


## Respiratory tract: one of important ports of entry

- some infections remain there
- some spread further
  - per continuitatem (*S. pneumoniae*)
  - via blood (*S. pneumoniae*, TB, measles)
  - systemic effect of toxin (scarlet fever, diphtheria, pertussis)

## Respiratory tract: naturally colonized

- not every bug means infection (microbiota)



- staphylococci, diptheroids, *S. aureus*

- *H. influenzae*, *S. pneumoniae* (over 50% of children), viridans streptococci, neisseria, meningococci, enterobacteria, candida

- Lung microbiome: streptococci, haemophilus, anaerobes, pseudomonads

.....

## Layout

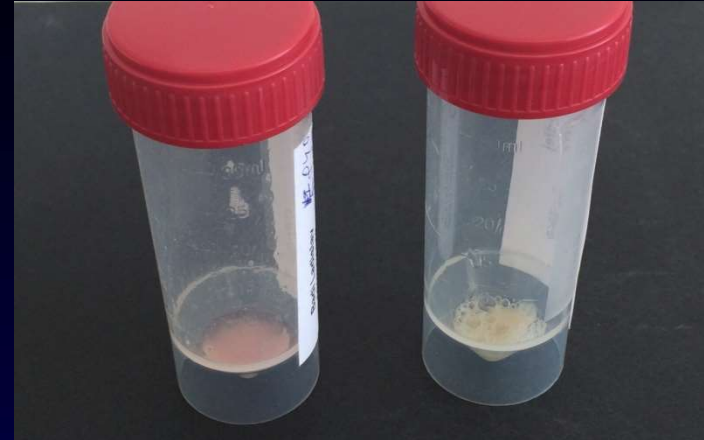
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## Suitable material for investigation

- SPUTUM

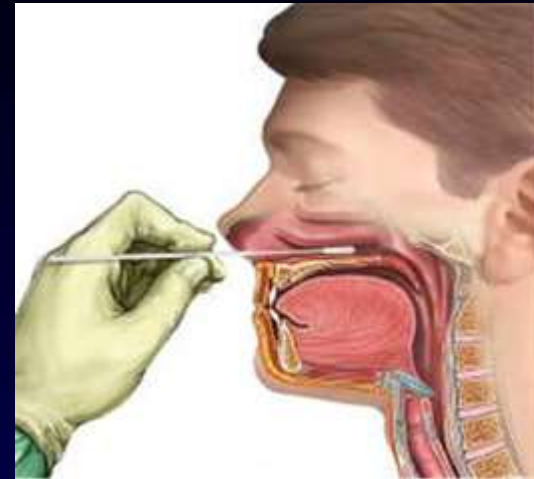
- microscopy (to validate sputum)
- culture (incl. quantification)
- molecular genetics

- Induced sputum





- **nasopharyngeal swab**
  - viral dg. (PCR, Ag)
  - pertussis, atypical pathogens

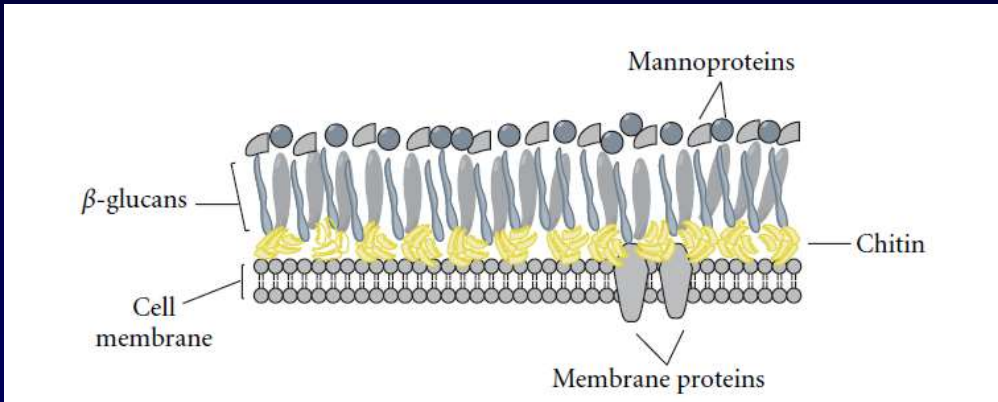


- bronchoalveolar lavage (BAL)

- microscopy, culture, PCR

- Ag of molds

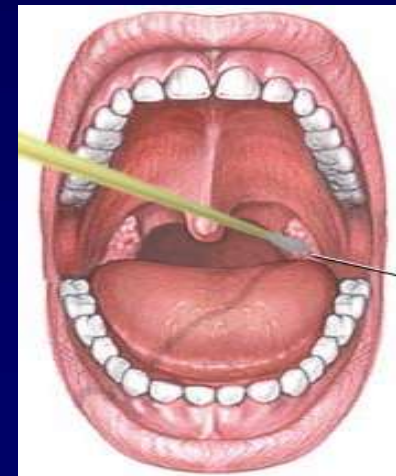
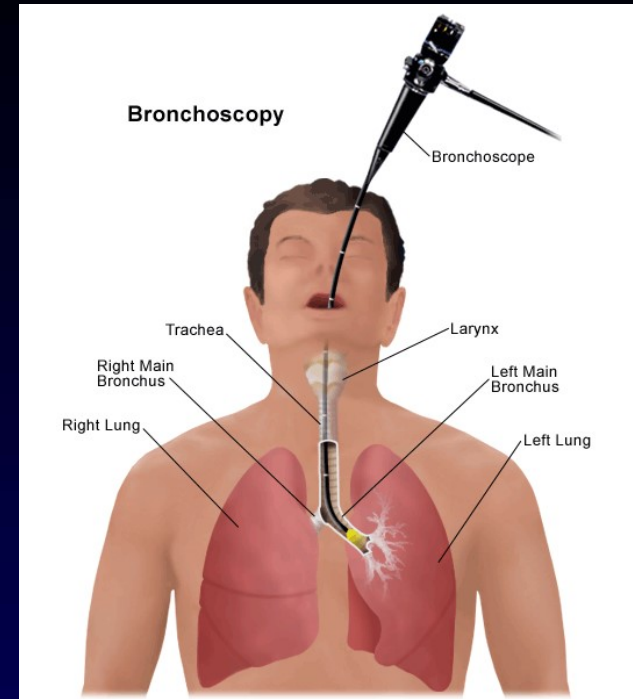
- (glucan, galactomannan)



- throat/cough swab

- culture

- Ag (Strep test)



- urine

- pneumococcal Ag (in children low PPV)
- legionella Ag

- serum

- mold Ag (glucan; galactomannan ~ aspergillus)
- antibodies (chlamydia, mycoplasma, pertussis, flu)

- blood cultures

- pleural fluid

## Summary of the specimens

Specimen	outpatient	inpatient – low severity	inpatient – moderate severity	inpatient – ICU, high severity
sputum	none routinely	yes	yes	yes
blood culture		none routinely	yes	yes
legionella urinary Ag			yes	yes
pneumococcal urinary Ag			yes	yes
invasive respiratory tract sample			none routinely	yes
others (mycology, TB, serology...)		none routinely	yes	

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## Key players

Viruses, called respiratory viruses:

orthomyxoviruses: influenza A, B

paramyxoviruses: parainfluenza PIV 1 to 4, RSV,  
metapneumovirus hMPV, measles

picornaviruses: rhinovirus HRV; coxsackie and echovirus (= enteroviruses!)

adenoviruses

coronaviruses HCoV

- „seasonal“ 229E, OC43, NL63, HKU1
- MERS-CoV
- SARS-CoV
- SARS-CoV-2

## Key players

### Bacteria:

*S. pneumoniae*

*H. influenzae*

*C. pneumoniae*

*M. pneumoniae*

*S. aureus*

*L. pneumophila*

*M. tuberculosis*, NTM

*B. pertussis*, *B. parapertussis*

*C. diphtheriae*

### Nosocomial infections:

*P. aeruginosa*

other G- non-fermenters

enterobacteria

**Fungi:** *Aspergillus* spp., *Pneumocystis jiroveci*

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## Rhinitis

- rhinoviruses (also others – e.g. coronaviruses, coxsackie)  
mucoid secretion is not a sign of bacterial infection

### What do the different snot colors mean?

	clear	white	green or yellow	red or pink	brown or orange	black
"normal" or healthy	✓					
allergic sinusitis	✓					
common cold		✓	✓			
fungal infection						✓
injury or irritation				✓	✓	
nonallergic or pregnancy rhinitis	✓			✓		
sinusitis		✓				
smoking/drug use						✓

## Sinusitis, otitis media

- viruses
- *S. pneumoniae*, *H. influenzae*, *M. pneumoniae*, *M. catarrhalis*, anaerobes

otitis in young children

complications - mastoiditis, risk of meningitis

Th: amoxicillin

## Tonsillopharyngitis (sore throat)

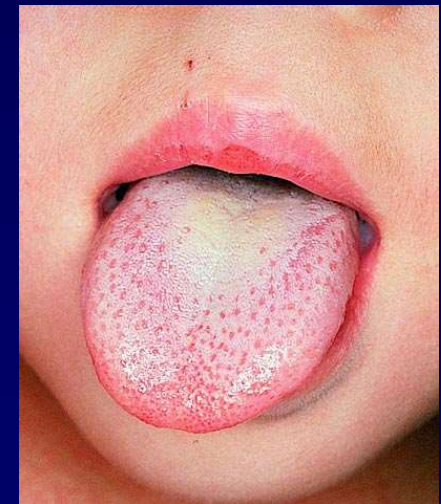
- adenoviruses (often accompanied with conjunctivitis)
- EBV (part of inf mononucleosis)
- *S. pyogenes* (5-15 yrs of age)
- streptococci groups C, G
- *Arcanobacterium heamolyticum*
- *N. gonorrhoeae*

### complications in GAS

- scarlet fever (when exotoxin is produced)
- rheumatic fever (alteration of mitral valve, arthritis, chorea minor, erythema)
- glomerulonephritis
- peritonsillar abscessus

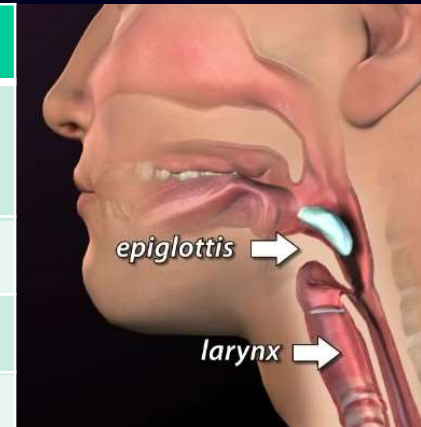
Th: GAS: PNC V for 10 days

*Arcanobacterium*: macrolides



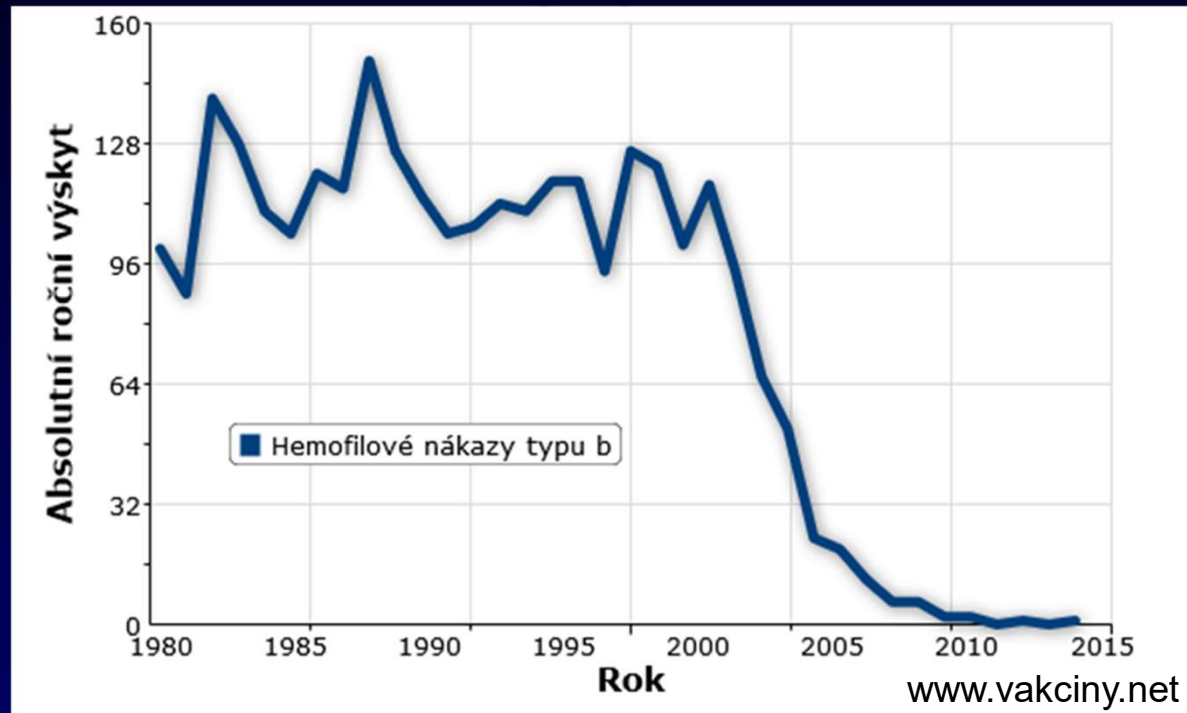
## epiglottitis versus laryngitis (subglottic laryngitis, laryngotracheitis)

Epiglottitis	Croup, pseudocroup
<i>H. influenzae</i> type b	viruses (parainfluenza)
rapid onset	upper airway infection
no cough	barking cough
fever above 38 deg. C	temp below 38 deg. C
no swallowing	
anxiety	
blood cultures	
swab from epiglottis questionable	
ATB th! aminoPNC, cephalosporins II., III. gen.	



## Invasive *H. influenzae* type b in CR

1999: 54x meningitis, 36x epiglottitis, 6x sepsis, 5x pneumonia



BUT: other serotypes of *H. influenzae* still out there  
*H. influenzae* non-typeable, types e, f

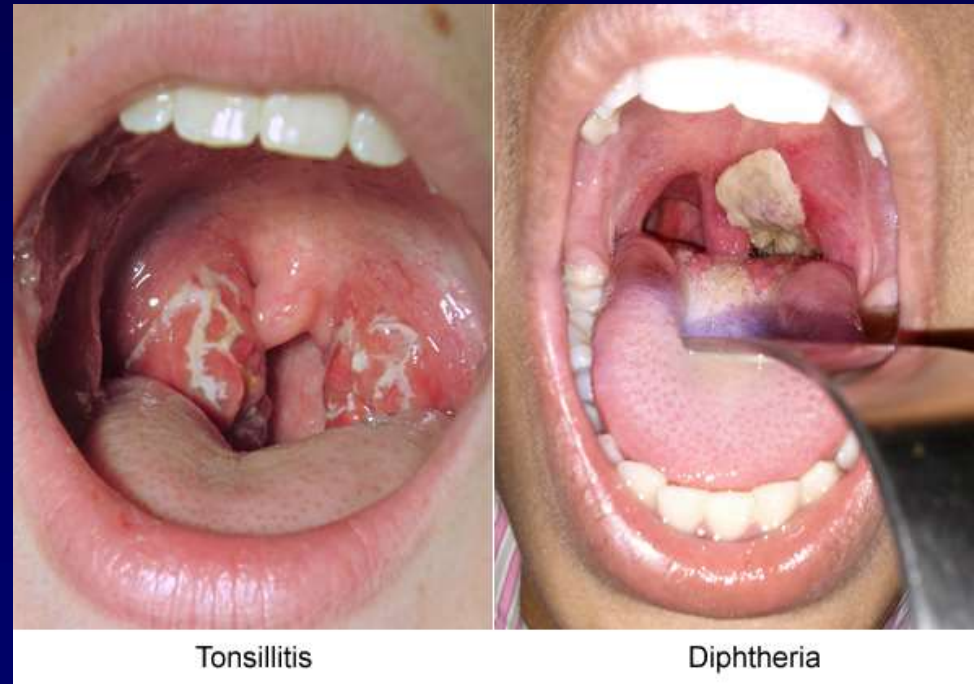
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## Diphtheria

*Corynebacterium diphtheriae* (and other corynebacteria) with production of the toxin (the evidence by PCR)

- tonsillitis, pharyngitis
- laryngitis (true croup) with production of pseudomembranes
- myocard alteration
- neurological problems



# Pertussis

*Bordetella pertussis, B. parapertussis*

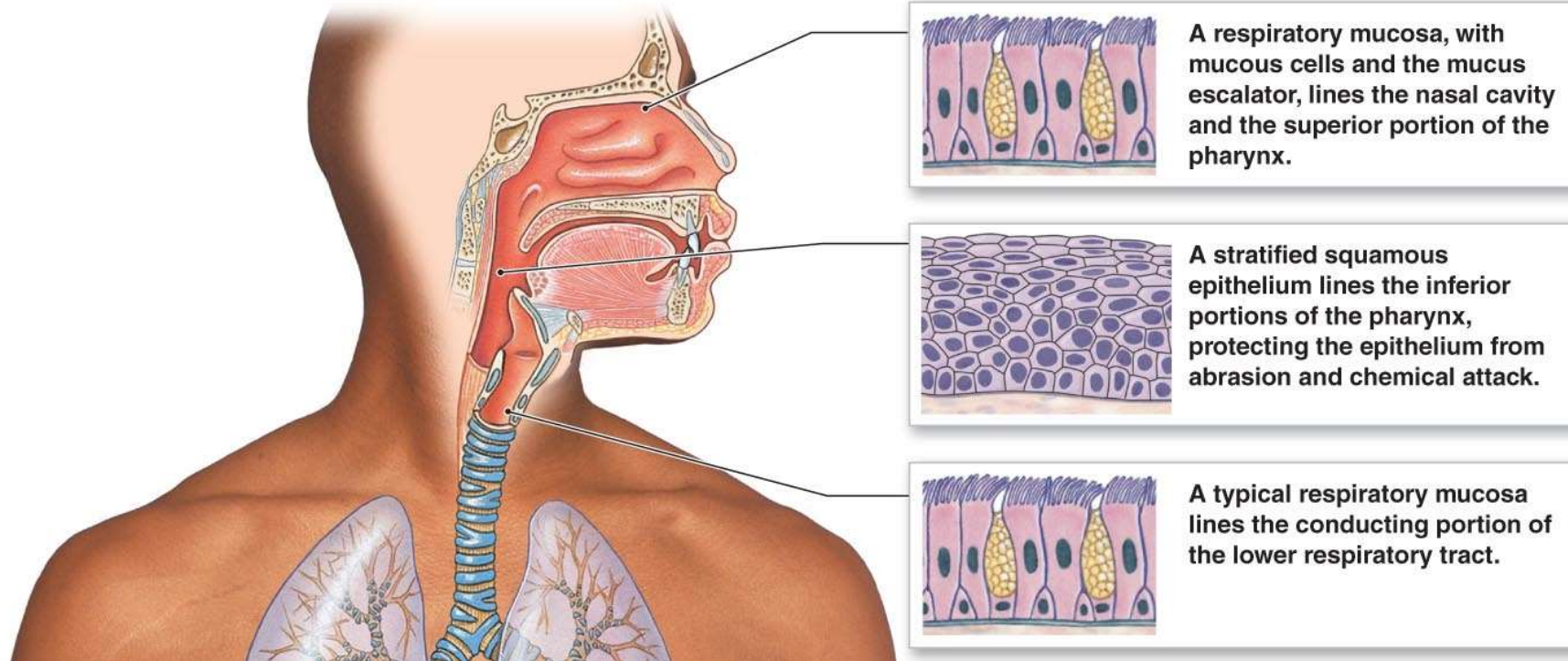
## Disease stages:

- catarrhal (common cold)
- paroxysmal (paroxysmal cough, dyspnoe, vomiting)
- convalescent (risk of secondary infections, encephalopathy)
  
- today more likely atypical course (persistent cough in adults)
- in infants (non-vaccinated) a risk of malignant pertussis:
  - respiratory failure
  - leukocytosis and right-sided heart failure
  - encephalopathy



Dg: culture, PCR, serology

The structure of the respiratory epithelium at different sites within the respiratory tract



non-invasive disease affecting ciliated epithelium

→ nasopharyngeal swab, aspirate

## Bronchiolitis (obliterans)

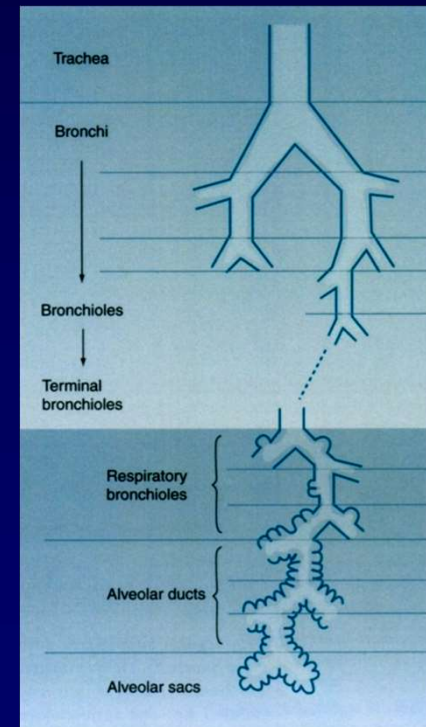
respiratory syncytial virus RSV-A, RSV-B

- in children below 2 years of age (high risk in preterm babies by 6 mo of age)
- serious condition

Th: ribavirin

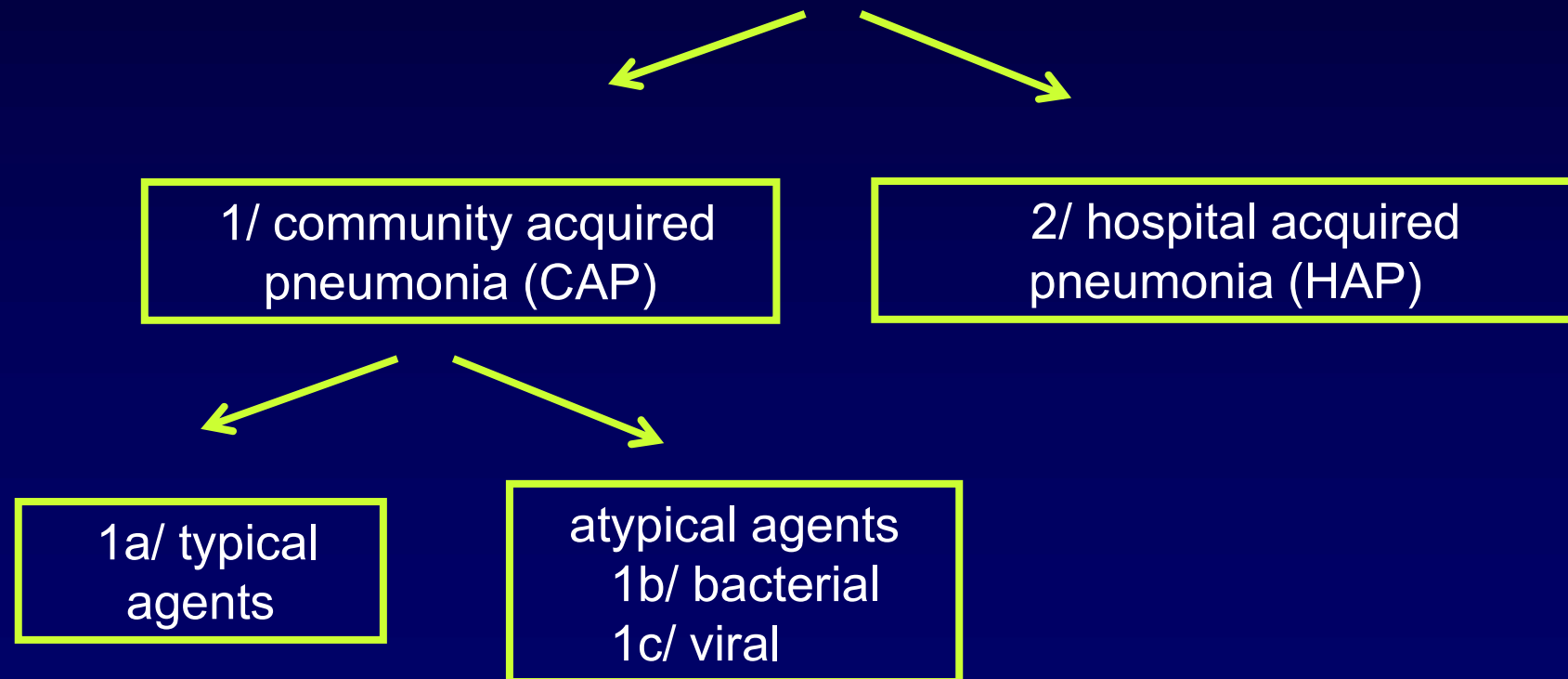
+ passive immunization (Ab against F protein;  
palivizumab)

= also as prevention  
for infants at risk in winter months



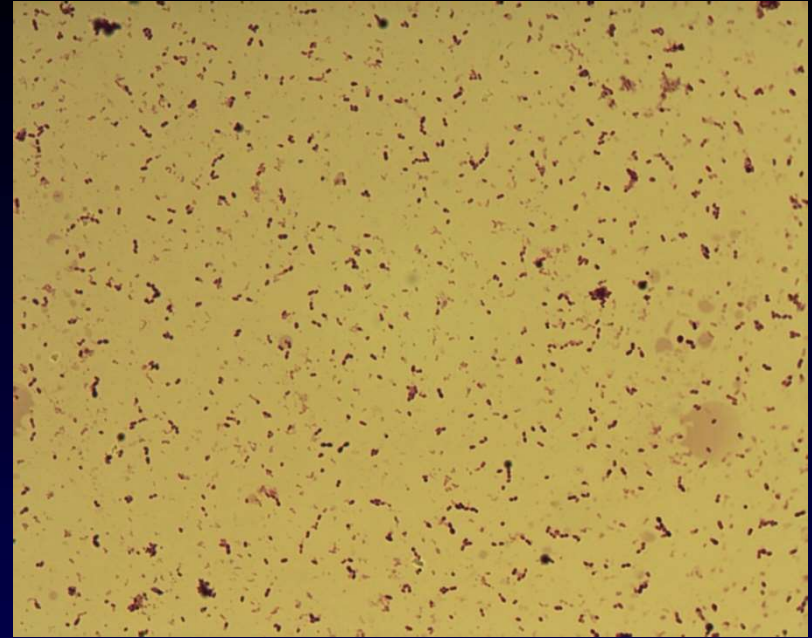
# Pneumonia

- infectious condition with corresponding respiratory symptomatology (cough, tachypnoe, dyspnoe, ...) and the fresh radiological finding on lungs
- inflammation affecting alveoli, respiratory bronchioli (bronchopneumonia), or also interstitium



## 1a/ CAP with typical pathogens

- *S. pneumoniae* (most common)
- *H. influenzae*
- *Moraxella catarrhalis*
- *S. aureus* (secondary pneumonia; production of PVL)
- *K. pneumoniae*, *E. coli*



### Diagnostics: direct methods

- sputum
  - microscopy, culture
  - PCR occasionally
- detection of pneumococcal antigen in urine
- blood cultures

## 1b/ CAP with atypical pathogens

sometimes termed atypical pneumonia, walking pneumonia,  
several weeks cough

- *Mycoplasma pneumoniae*: former primary atypical pneumonia
- *Chlamydophila pneumoniae*
- *Chlamydophila psittaci*: psittacosis
- *Coxiella burnetii*: Q fever

Diagnostics: indirect methods

- serology; careful interpretation (up to 80% prevalence in healthy)

direct method - PCR

## 1b/ CAP with atypical pathogens

- *Legionella pneumophila*
  - pontiac fever (mild infection, not pneumonia)
  - Legionnaire's disease



## *Legionella pneumophila*

### Diagnostics:

- detection of legionella antigen in urine
- culture
- PCR
  
- serology



## *Legionella longbeachae*

# Avoiding Legionnaires' this spring

Spring is a great time to be out in the garden, but it's also important to take care of yourself when handling potting mix and compost to prevent Legionnaires' disease. Here are five easy things you can do:

- 1** Open potting mix or compost bags carefully with scissors.
- 2** Wear a well-fitting disposable face mask and gloves.
- 3** Reduce dust by dampening down potting mix or compost.
- 4** Work with potting mix or compost in a well-ventilated area outside.
- 5** Wash your hands after handling potting mix or compost and before removing your mask.





## ATB therapy of CAP

### Pneumococcal pneumonia:

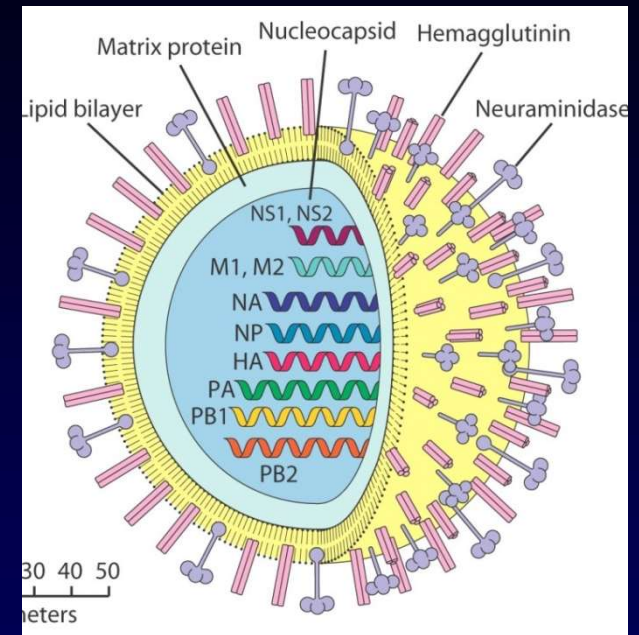
non complicated - amoxicillin (not hospitalized)  
hospitalization - PNC G or cephalosp. III. gen.

### Atypical agents:

macrolides  
tetracyclines  
respiratory fluoroquinolons (moxifloxacin)

## 1c/ CAP with atypical pathogen - virus

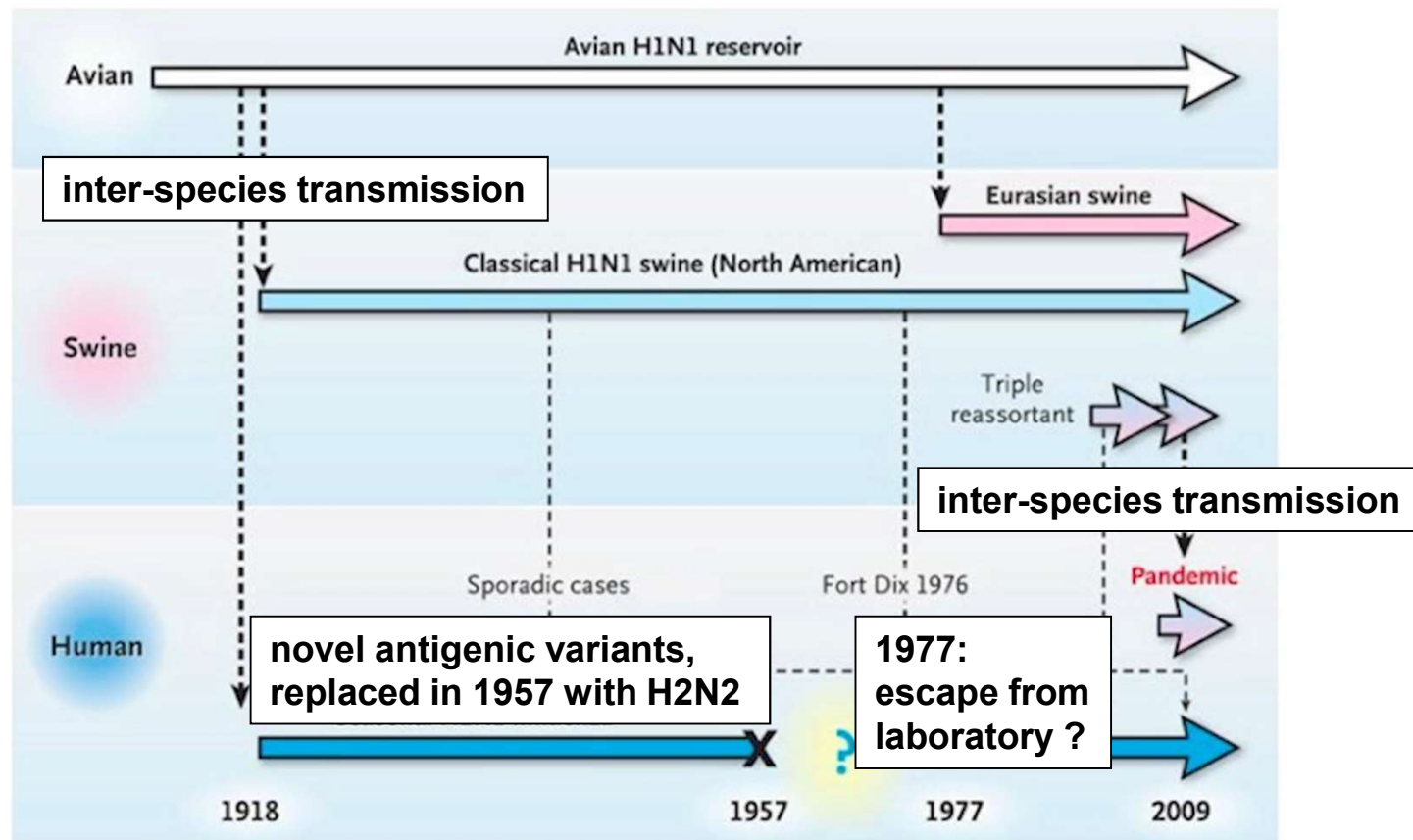
Influenzavirus type A, B, C  
subtypes HxNx  
(H1N1, H2N2, H3N2)



# H1N1

## Historical Perspective — Emergence of Influenza A (H1N1) Viruses

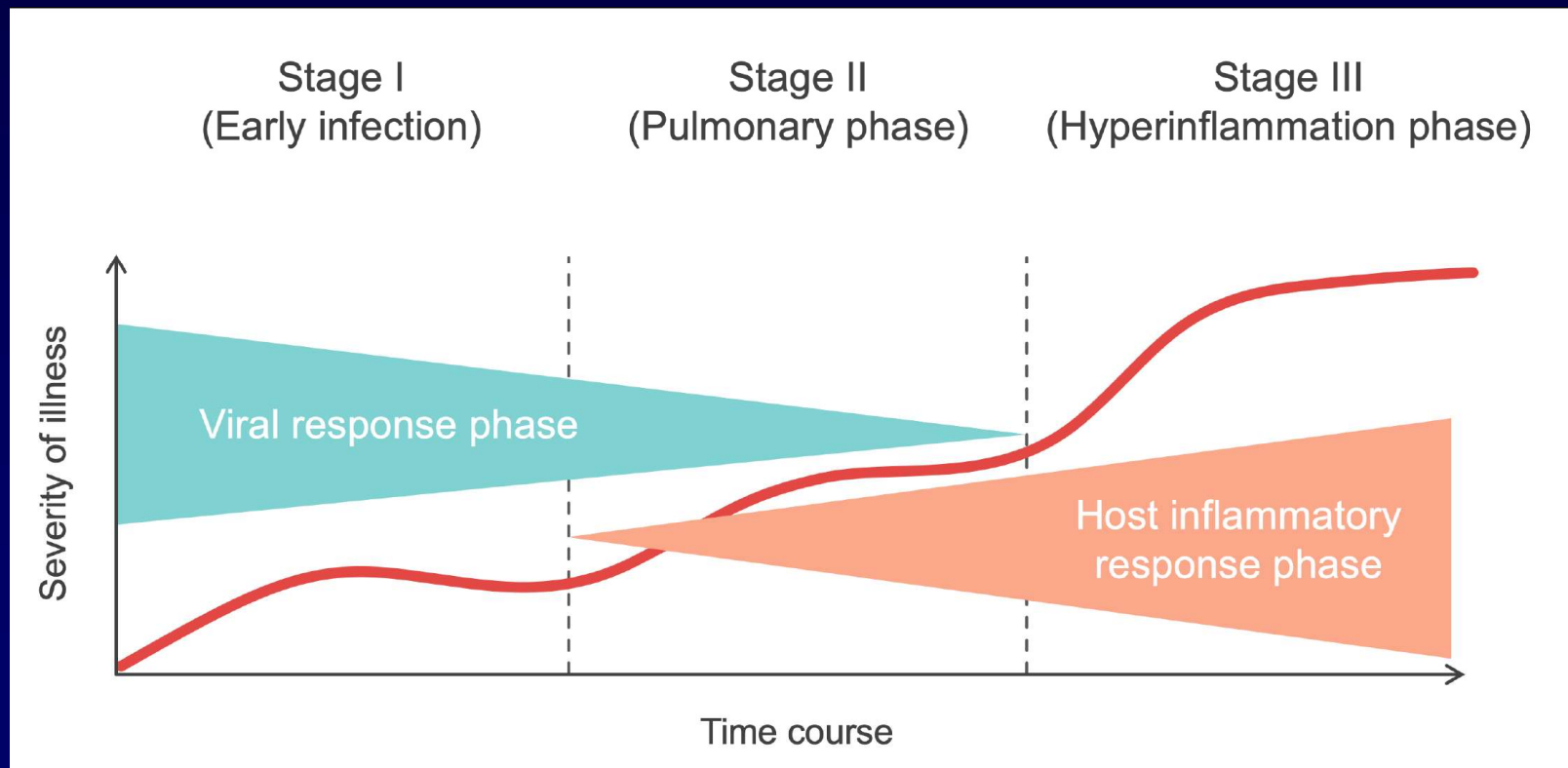
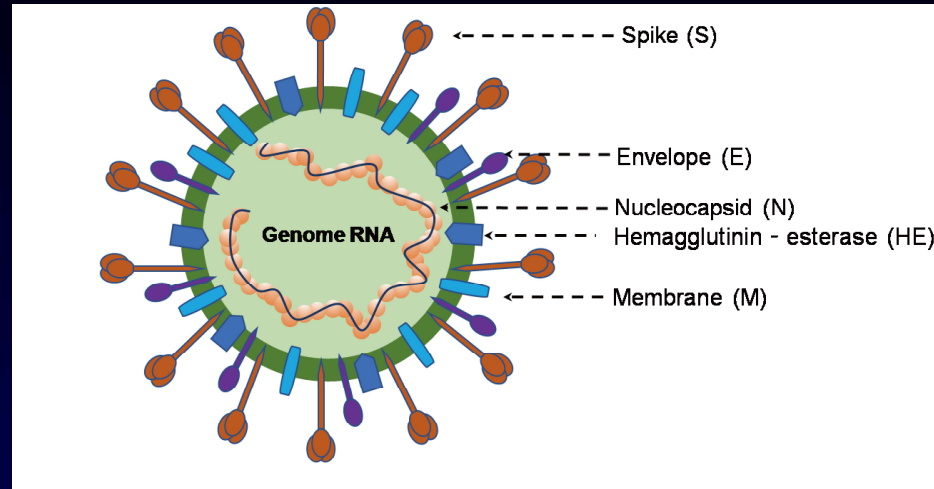
Shanta M. Zimmer, M.D., and Donald S. Burke, M.D.



# 1c/ CAP with atypical pathogen - virus

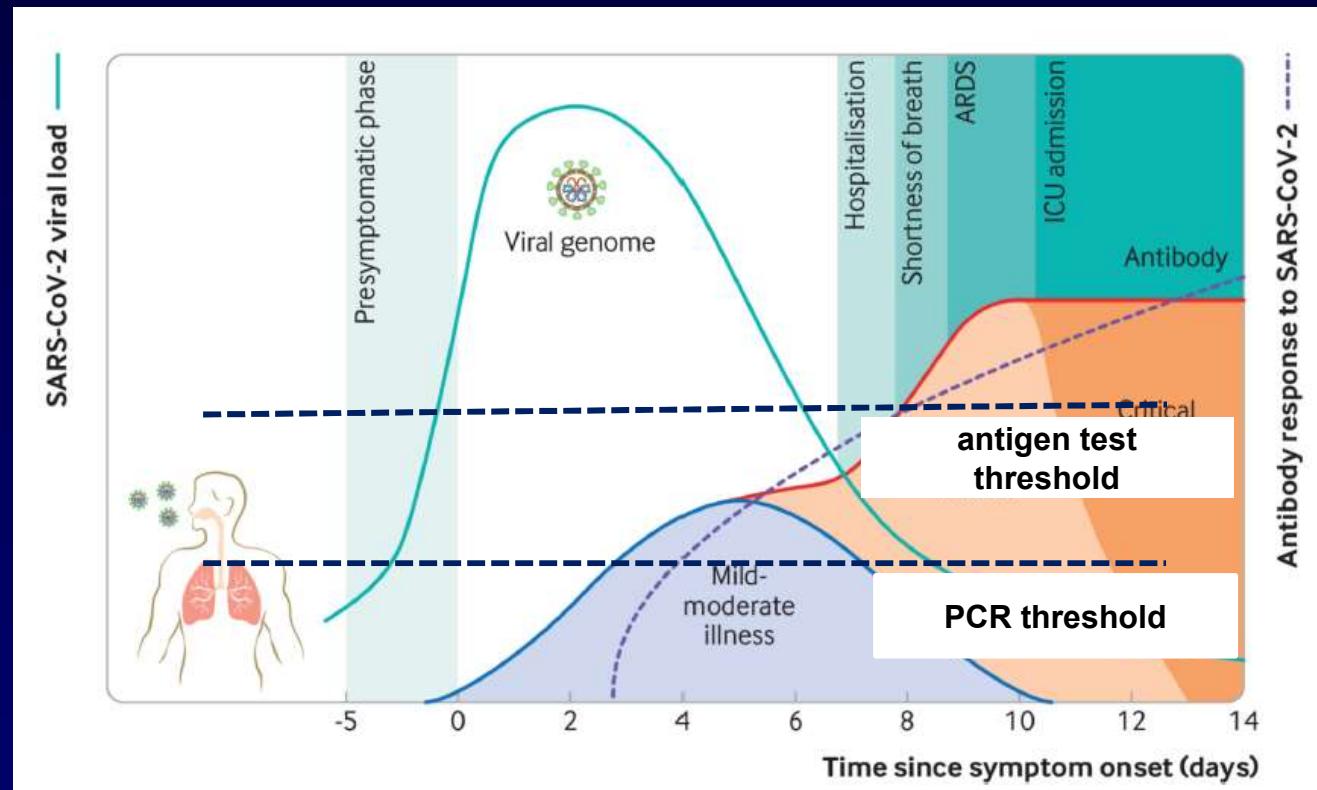
## SARS-CoV-2

- asymptomatic course
- pneumonia

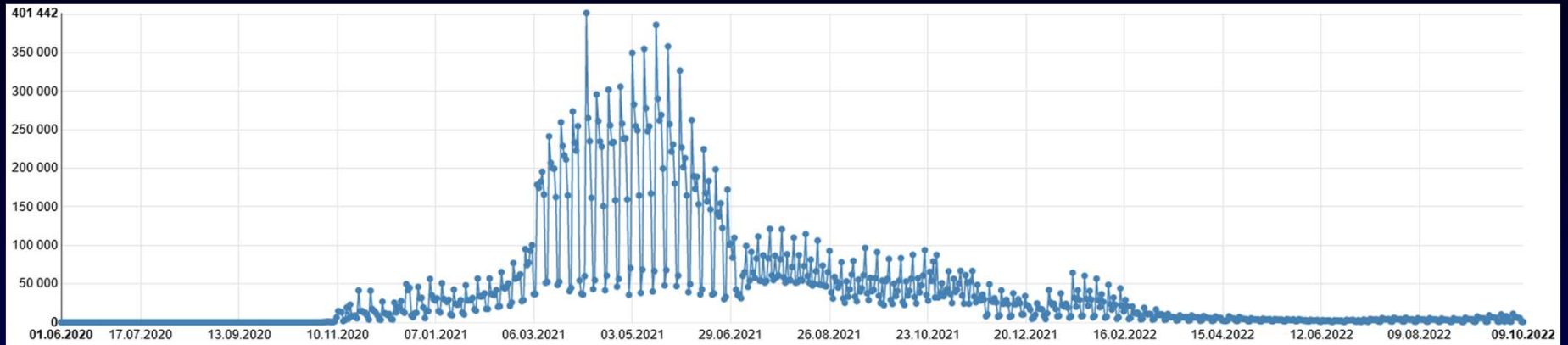


- **direct detection**  
microscopy (EM)  
antigen  
RNA

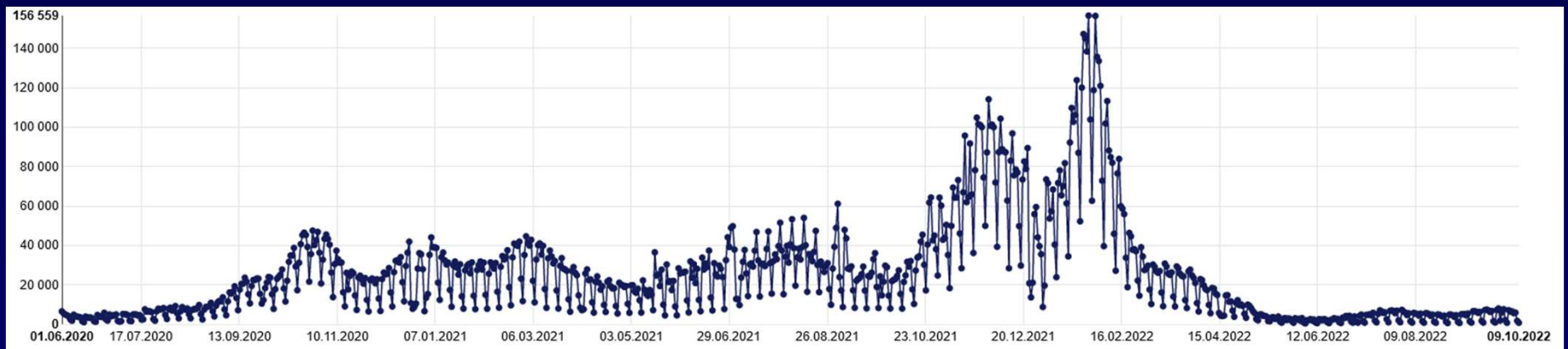
- **Indirect detection**  
IgM, IgA, IgG



## Daily numbers of antigen tests performed



## PCR tests



## 2/ HAP; hospital acquired pneumonia

develops min. 48 hours post admission and in association with hospitalization  
typically of bacterial origin

### Ventilator associated pneumonia (VAP)



#### Early onset (by day 5)

- *S. aureus*
- *S. pneumoniae*
- *H. influenzae*
- *K. pneumoniae, E. coli*

#### Late onset

- *K. pneumoniae, E. coli ...*
- *P. aeruginosa*
- MRSA
- *A. baumannii*

Diagnostics: endotracheal aspirate

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## Newborn pneumonia

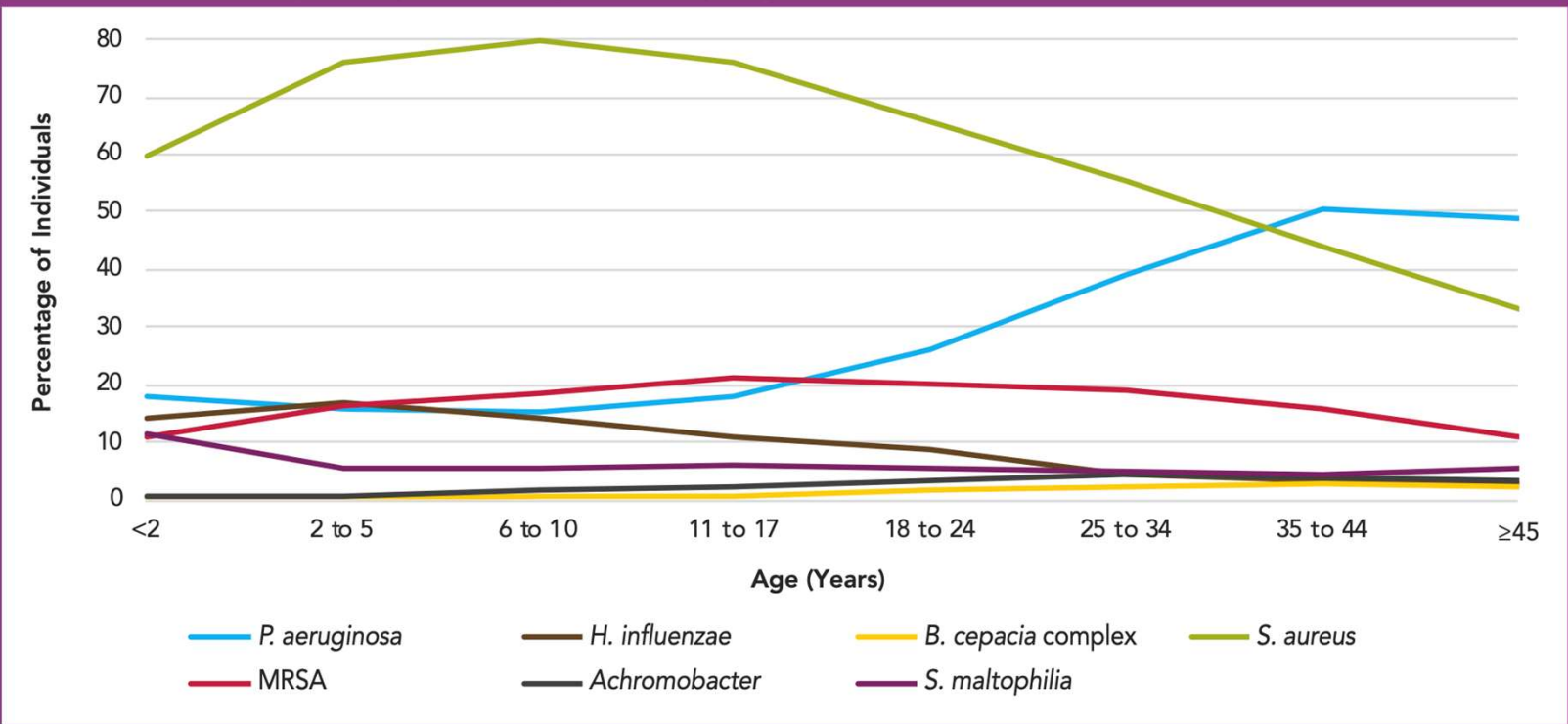
- *S. agalactiae* GBS
- *Chlamydia trachomatis*
  
- *K. pneumoniae, E. coli*

## Chronic respiratory diseases and chronic infections

- chronic obstructive pulmonary disease (COPN)
- chronic bronchiectasis
- cystic fibrosis (mucoviscidosis)

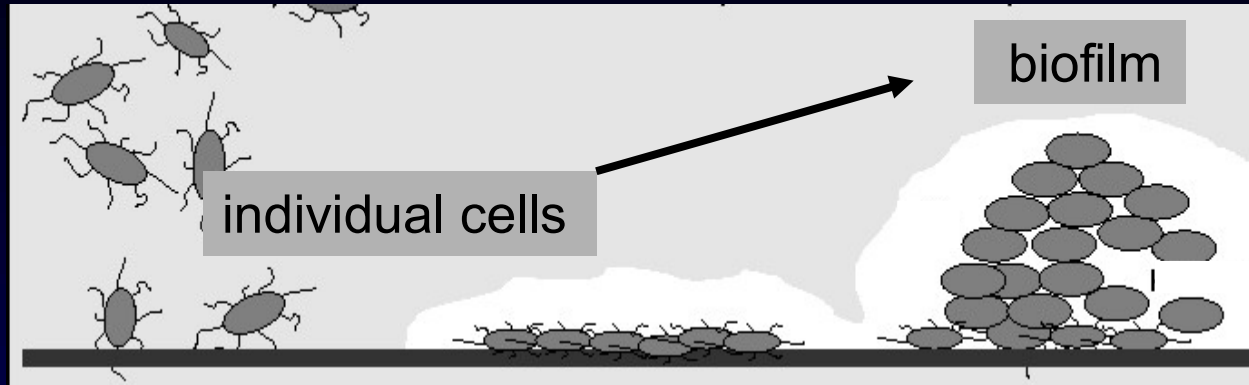
- *S. aureus*
- enterobacteria (*K. pneumoniae*)
- G- nonfermenters
  - *P. aeruginosa*
  - complex *Burkholderia cepacia*
  - *Stenotrophomonas maltophilia*
  - *Achromobacter xylosoxidans*

### Prevalence of Respiratory Microorganisms by Age Cohort, 2021



US cystic fibrosis registry. 2021

## Infection course



## Immunocompromised and respiratory infections

- haematological malignancies
- AIDS
- after solid or bone marrow transplantation

Opportunistic pathogens of both endogenous and exogenous origin

- CMV
- TB, NTM
- *Pneumocystis jiroveci*; microscopy, PCR
- fungi