



Lecture 5: Treatment of bacterial respiratory infections 1

Respiratory system

Second year

Medical school

Hashemite University

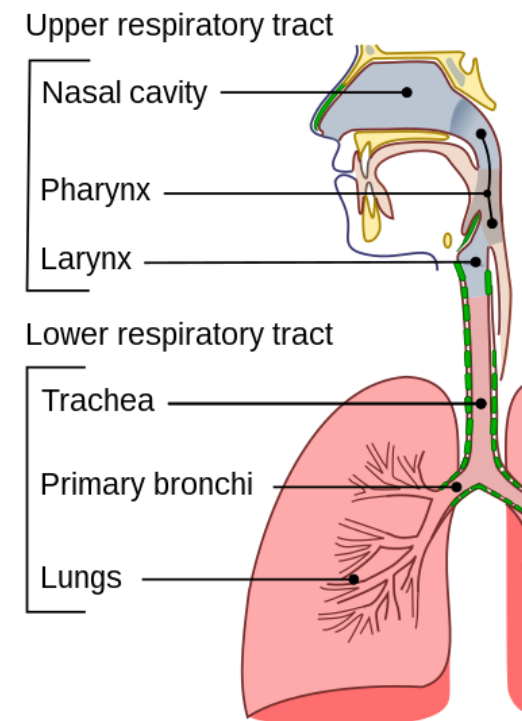
2nd semester 23/24

Sofian Al Shboul, MD, PhD.



Respiratory tract

- ✓ the **upper** airways : above the sternal angle (outside of the thorax), above the vocal folds, or above the cricoid cartilage
- ✓ and **lower** airways: trachea, bronchi (primary, secondary and tertiary), bronchioles (including terminal and respiratory), and lungs (including alveoli)
- ✓ The larynx is sometimes included in both the upper and lower airways

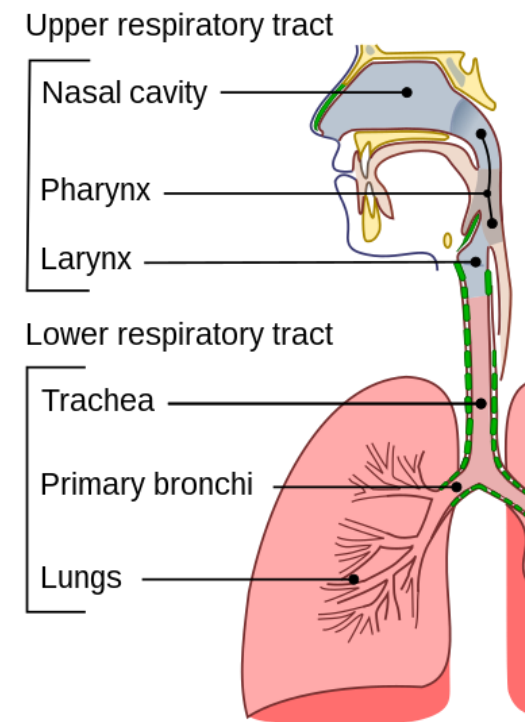




Respiratory tract infections

- Divided to:

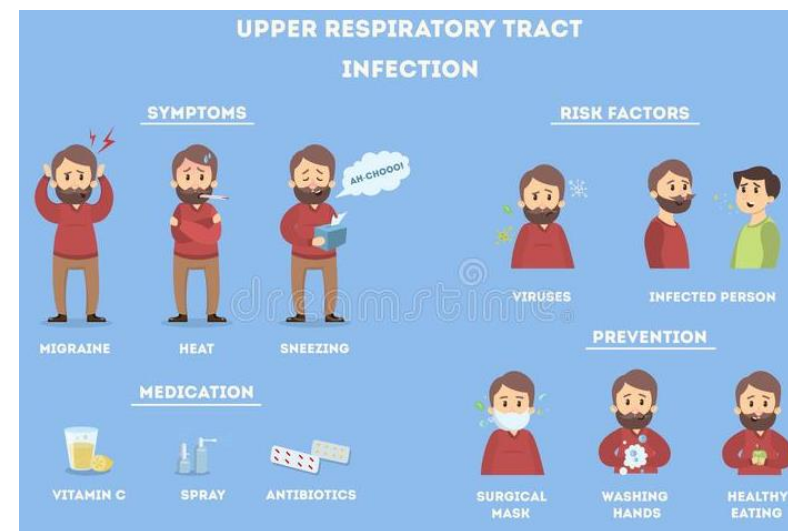
- I. Upper Respiratory tract Infection (URTI)
(common cold, pharyngitis, epiglottitis, & otitis media etc.)
- II. Lower Respiratory tract Infection (LRTI)
(bronchitis, bronchiolitis & pneumonia)





Upper respiratory tract infection (URTI)

- Self-limited irritation and swelling of the upper airways with associated cough and no signs of pneumonia
- Common cold: rhinovirus, influenza virus.
- Bacteria: sudden onset pharyngitis presentations(strep throat): Group A streptococcus (*Streptococcus pyogenes*)
- Due to better efficacy, safety, cost-effectiveness and experience, penicillins are preferred for treatment of URTIs

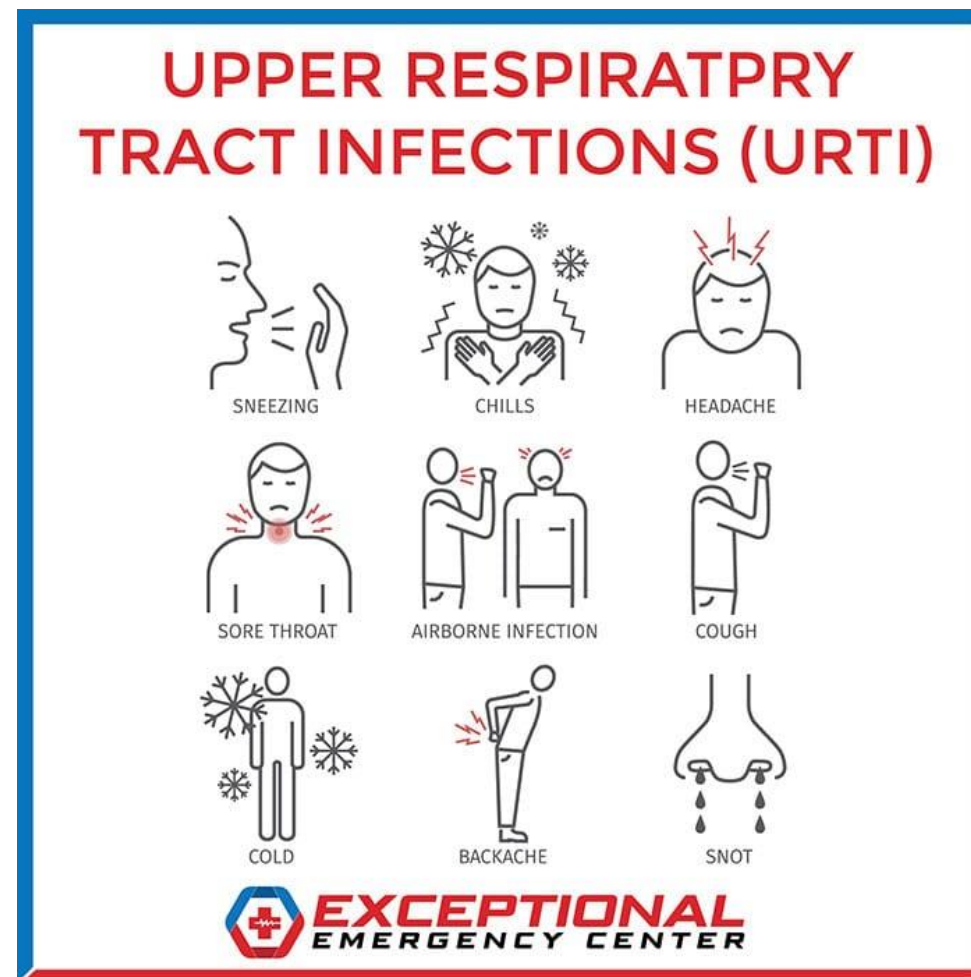




Upper respiratory tract infection (URTI)

- Cough
- Sore throat
- Runny nose
- Nasal congestion
- Headache
- Low-grade fever
- Facial pressure
- Sneezing

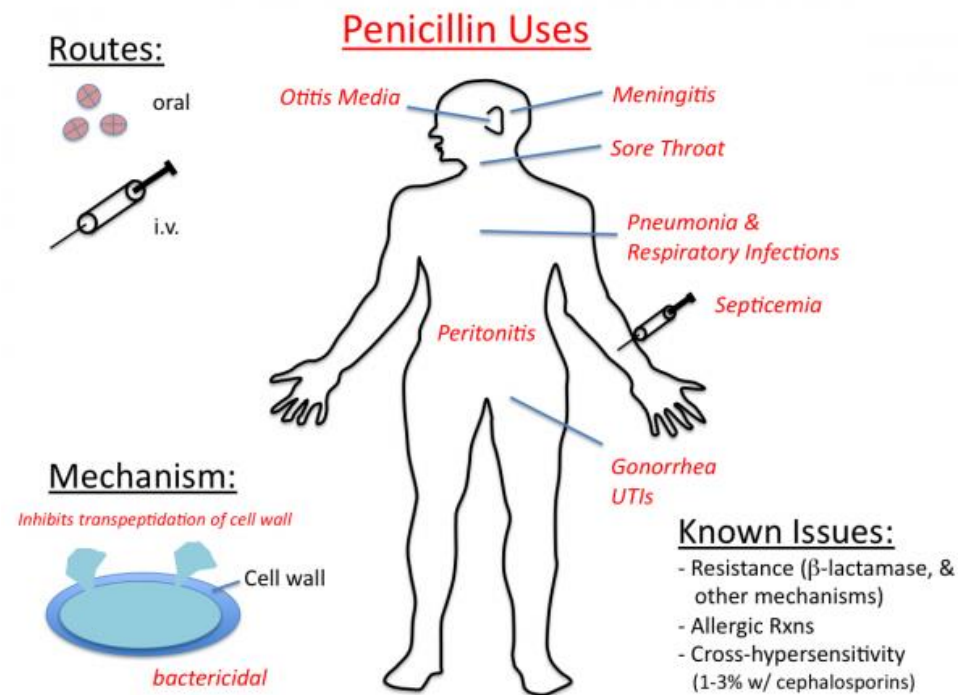
➤ The onset of symptoms usually begins one to three days after exposure and lasts 7–10 days, and can persist up to 3 weeks.





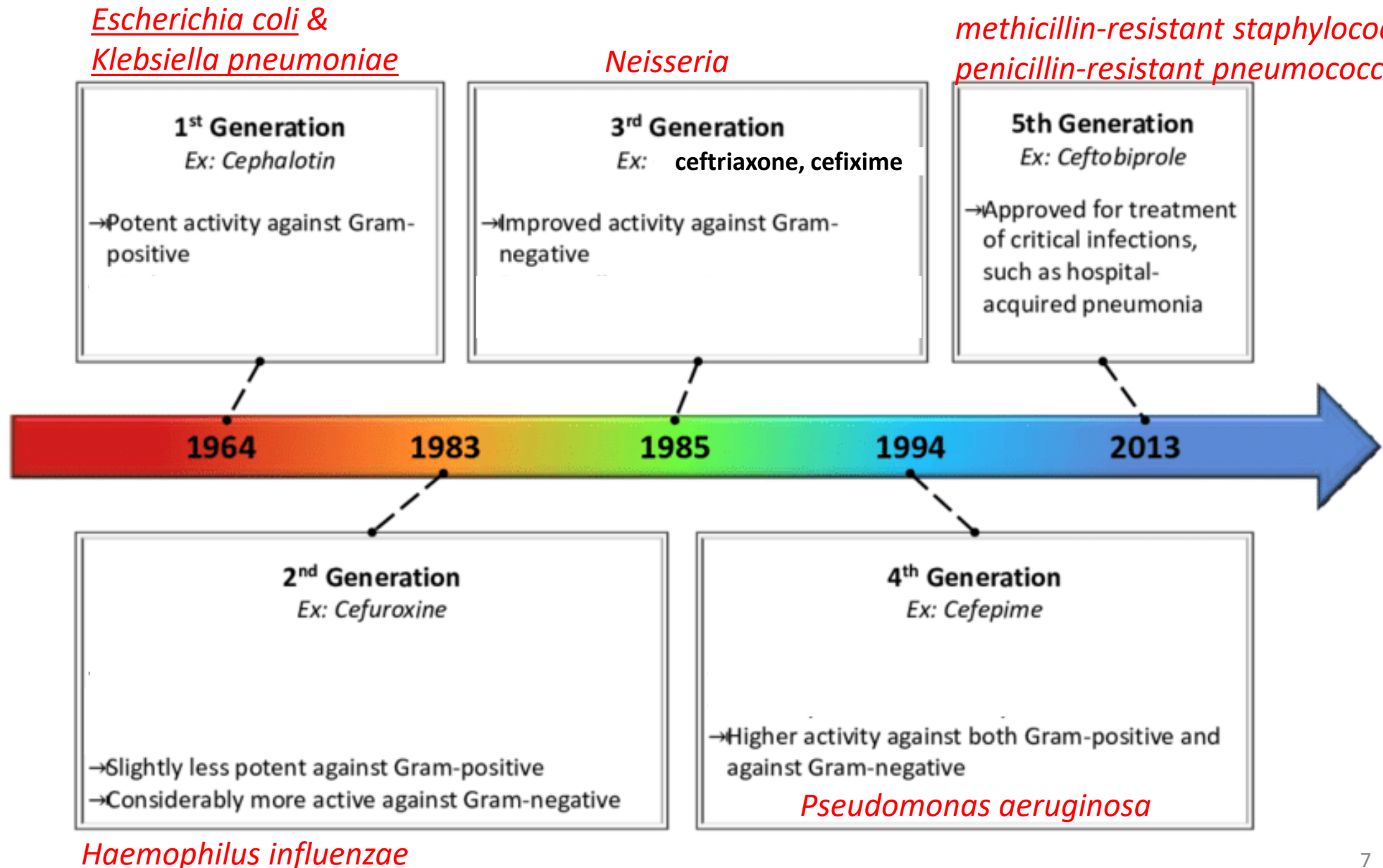
Penicillin

- **Penicillin G:** Gram-positive and – negative cocci, gram-positive rods and anaerobes.
- **Broad-spectrum penicillins (gram-negative bacilli):**
 - second generation: ampicillin, amoxicillin
 - third generation: carbenicillin
 - fourth generation: piperacillin
- All penicillins have relatively short half-lives and require frequent administration.





Cephalosporins





Macrolide

- Gram-positive bacteria and limited Gram-negative bacteria
- Antimicrobial spectrum is slightly wider than that of penicillin>> common substitute for patients with a penicillin allergy.
- Unlike penicillin, they are effective against Legionella pneumophila, mycoplasma, mycobacteria, and chlamydia.
- **Azithromycin, Clarithromycin and Erythromycin**



Respiratory tract infection

1. Rhinitis (common cold)
2. Pharyngitis
3. Sinusitis
4. Otitis Externa
5. Acute Otitis Media (Ear Infection)
6. Diphtheria
7. Epiglottitis
8. Laryngitis and croup
9. bronchitis and bronchiolitis
10. Pneumonia



Upper respiratory tract infection (URTI): Rhinitis

- Known as common cold
- Cough, headache, fever (not often or mild), sore throat and runny nose (rhinorrhea)
- Symptoms begin 2-3 days after infection
- Mainly viruses (Rhinoviruses)

Pharmacological management:

1. Dextromethorphan
2. Anti-histamines
3. Pain-killers
4. Decongestants

The infographic is divided into three horizontal panels, each featuring a cartoon illustration of a person with a symptom on the left and treatment options on the right.

- Top Panel:** A person coughing. Text: "Treat Symptoms of the Cough with:" followed by a red-bordered box containing "Dextromethorphan", "Antihistamines", and "Honey". Below the box is a list: "• warm Liquids". An illustration of a mug with a tea bag and a bumblebee is on the right.
- Middle Panel:** A person with a sore throat. Text: "Treat Symptoms of a Sore Throat by Gargling Salt Water". An illustration of a salt shaker and a glass of water with a plus sign between them is on the right.
- Bottom Panel:** A person with a fever holding their head. Text: "Treat Symptoms of Aches, Pains, & Fever with:" followed by a red-bordered box containing "Ibuprofen" and "Acetaminophen". Below the box is a list: "• Saline Nasal Spray", "• Humidified Air", "• Topical or Oral Decongestants", and "• Antihistamines in combination with decongestants or guaifenesin". An illustration of pills and a pill bottle is on the right.



Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.



Upper respiratory tract infection (URTI): Pharyngitis

- Inflammation of the throat (pharynx)
- Symptoms usually last 3–5 days
- Complications: sinusitis and acute otitis media
- ***Streptococcus pyogenes***:

Penicillin or Amoxicillin (Oral) >> Cephalosporin (Cephalexin) >> Macrolide (Azithromycin)

- **Viral**: self-limiting

Conservative + oral CS (1-2 for pain on swallowing) + lidocaine wash + NSAIDs

- ***Candida albicans***: clotrimazole



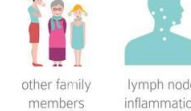
sore throat
increased body temperature



Pain when swallowing
dry cough



muscle pain
bad breath

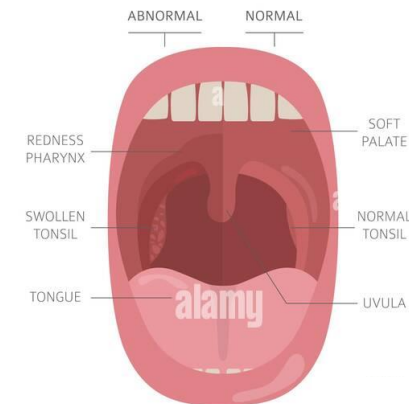


other family members may be sick
lymph node inflammation

TONSILS AND THROAT
medical disease infographic

PHARYNGITIS

acute or chronic inflammation of the pharyngeal mucosa



cause



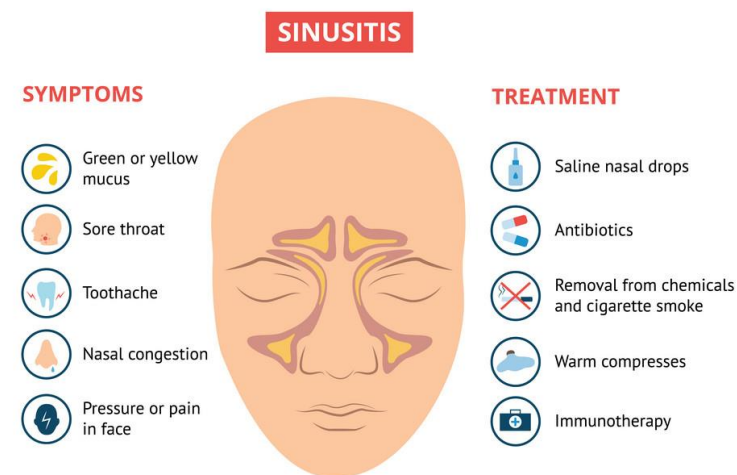


Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.
Pharyngitis	Sore throat , difficulty speech and swallowing, swollen tonsils and bad breath	<u>Strep. Pyogens</u> : Penicillin/Amoxicillin (Oral)^> Cephalosporin (Cephalexin) ^> Macrolide (Azithromycin) <u>Viral</u> : self-limiting: conservative + oral CS (1-2 for pain on swallowing) + lidocaine wash + NSAIDs <u>Candida albicans</u> : clotrimazole	



Upper respiratory tract infection (URTI): Sinusitis

- ❖ Predisposing factors:
URTI, nasal septum deviation, tooth extractions, smoking, cystic fibrosis and immunodeficiency.
- ❖ Nasal congestion (headache or toothache), facial swelling, tenderness, discharge (**green or yellow color= bacterial** infection or clear= allergy)
- ❖ Antibiotics not recommended in those with mild/moderate + for first 7-10 days
- ❖ Viral
- ❖ Bacteria: Streptococcus pneumoniae, Haemophilus influenzae and Streptococcus pyogenes (uncommon)





Upper respiratory tract infection (URTI): Sinusitis

❖ Decongestants

- ❖ Amoxicillin/clavulanic acid >> doxycycline or cephalosporins^{3rd} (cefixime) >> fluoroquinolone (levofloxacin or moxifloxacin)
- ❖ Macrolides (clarithromycin or azithromycin) are **not** recommended for empiric therapy
- ❖ Chronic: Intranasal saline, Intranasal corticosteroids, Oral corticosteroids and antibiotics (limited evidence, after culture)

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SINUS INFECTION

Let's talk...

FACT

- Most cases of sinus infection (sinusitis) are caused by viruses.
- Antibiotics do not work against viruses.
- Green or yellow discharge forms with inflammation. It can be found in both bacterial and viral infections.

ANTIBIOTICS ARE NOT NEEDED IN MOST CASES*

NO ANTIBIOTICS VS **ANTIBIOTICS**

9 of 10 people feel better within 1-2 weeks, WHETHER OR NOT they use antibiotics.

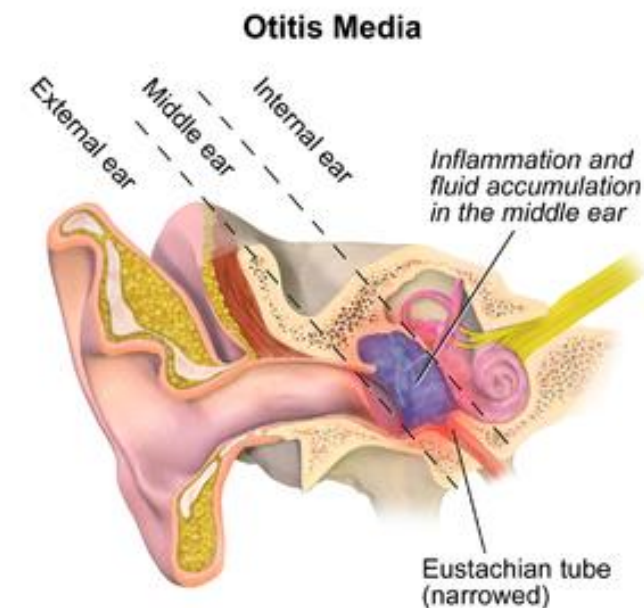


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Sinusitis	Nasal congestion, facial swelling, tenderness, discharge (colour?)	Strep. Pneumonia and H. Influenza.	❖ Amoxicillin/clavulanic acid ^{^^} > doxycycline or cephalosporins ^{3rd} (cefixime) ^{^^} > fluoroquinolone (levofloxacin or moxifloxacin) ❖ Chronic: Intranasal saline, Intranasal corticosteroids, Oral corticosteroids and antibiotics (limited evidence, after culture)



Upper respiratory tract infection (URTI): Acute Otitis Media (Ear Infection)

- Inflammation of the Eustachian tubes and buildup of fluid in the middle ear >> possible bacterial growth in the fluids
- Ear pain (otalgia), fever, sensation of fullness, irritable, tug on the involved ear, difficulty sleeping (children)
- Untreated or severe infections >> eardrum rupture or mastoiditis and CNS involvement.
- Streptococcus pneumoniae, haemophilus influenzae and Staphylococcus aureus
- Amoxicillin-clavulanate>>cephalosporin (Cefuroxime)>> doxycycline or macrolide (Azithromycin)



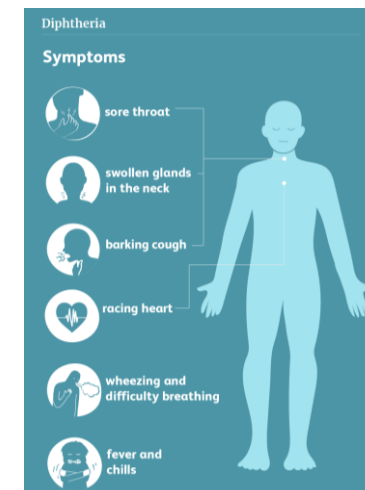


Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.
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Acute Otitis Media	Ear pain (otalgia), fever, sensation of fullness	Strep. Pneumonia, H. Influenza and Staph. aureus	Amoxicillin-clavulanate ^{^^} > cephalosporin (Cefuroxime) ^{^^} > doxycycline or macrolide (Azithromycin)



Upper respiratory tract infection (URTI): Diphtheria

- Most infections are asymptomatic or have a mild clinical course.
- Sore throat, lack of appetite, low-grade fever and grey or white patch develops in the throat
- *Corynebacterium diphtheriae*
- Complications: myocarditis, inflammation of nerves, and kidney problems.
- Diphtheria antitoxin (horses) + erythromycin >> penicillin



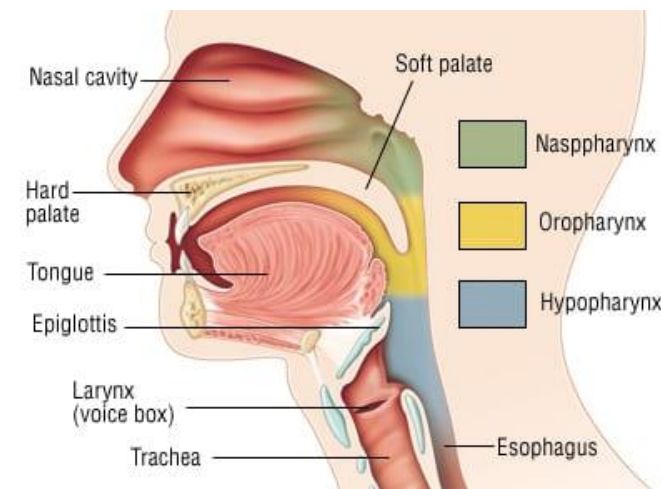


Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.
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Acute Otitis Media	Ear pain (otalgia), fever, sensation of fullness	Strep. Pneumonia, H. Influenza and Staph. aureus	Amoxicillin-clavulanate ^{^^} > cephalosporin (Cefuroxime) ^{^^} > doxycycline or macrolide (Azithromycin)
Diphtheria	Sore throat, lack of appetite, low-grade fever and grey or white patch develops in the throat	Corynebacterium diphtheriae	Diphtheria antitoxin (horses) + erythromycin ^{^^} > penicillin



Upper respiratory tract infection: **Acute epiglottitis**

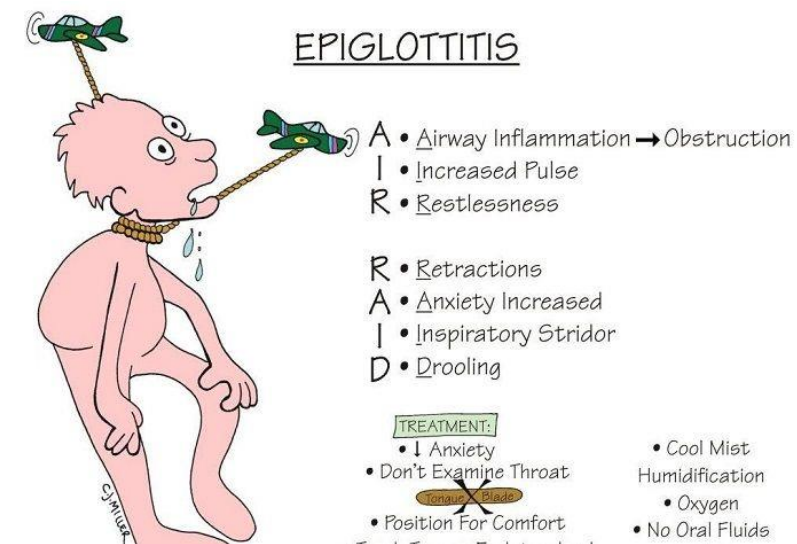
- An acute inflammation in the supraglottic region of the oropharynx including epiglottis
- Rapid onset: trouble swallowing >> drooling, fever, aphonia and an increased breathing rate
- Primarily caused by bacteria, haemophilus influenzae and Streptococcus pneumoniae.





Upper respiratory tract infection: Acute epiglottitis

- direct inspection using a laryngoscope.
- Do not use tongue depressor or attempt throat swab
- requires immediate airway management (tracheal intubation).
- Cephalosporin^{3rd} (ceftriaxone) + vancomycin



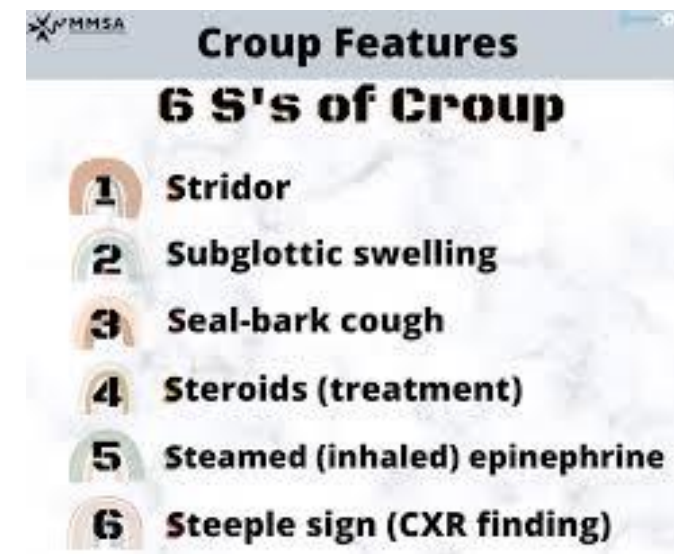


Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.
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Diphtheria	Sore throat, lack of appetite, low-grade fever and grey or white patch develops in the throat	Corynebacterium diphtheriae	Diphtheria antitoxin (horses) + erythromycin ^{^^} > penicillin
epiglottitis	Trouble swallowing, drooling, fever, aphonia and an increased breathing rate	Streptococcus pneumoniae and haemophilus influenzae	requires immediate airway management (tracheal intubation). Cephalosporin ^{3rd} (ceftriaxone) + vancomycin



Upper respiratory tract infection: Croup and laryngitis

- “barking/brassy” cough, inspiratory stridor, hoarseness, difficult breathing, fever and runny nose
- Starts or get worse at night and normally lasts one to two days.
- Mainly viral (parainfluenza and influenza)
- Corticosteroids and nebulized epinephrin
- Used in very specific cases: Cephalosporin^{3rd} (ceftriaxone) + vancomycin





Disease	Symptoms	Pathogens (common)	Pharmacotherapy
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Acute Otitis Media	Ear pain (otalgia), fever, sensation of fullness	Strep. Pneumonia, H. Influenza and Staph. aureus	Amoxicillin-clavulanate ^{^^} > cephalosporin (Cefuroxime) ^{^^} > doxycycline or macrolide (Azithromycin)
Diphtheria	Sore throat, lack of appetite, low-grade fever and grey or white patch develops in the throat	Corynebacterium diphtheriae	Diphtheria antitoxin (horses) + erythromycin ^{^^} > penicillin
epiglottitis	Trouble swallowing, drooling, fever, aphonia and an increased breathing rate	Streptococcus pneumoniae and haemophilus influenzae	requires immediate airway management (tracheal intubation). Cephalosporin ^{3rd} (ceftriaxone) + vancomycin
Croup and laryngitis	“barking/brassy” cough, inspiratory stridor, hoarseness, difficult breathing, fever and runny nose Starts or get worse at night	Mainly viral (parainfluenza and influenza) Rarely bacterial	Corticosteroids and nebulized epinephrin Used in very specific cases: Cephalosporin ^{3rd} (ceftriaxone) + vancomycin



Lower respiratory tract infection (LRTI)

- A group of disease effect the respiratory system below the throat
- Pneumonia, lung abscess, bronchiolitis and bronchitis.
- Symptoms include shortness of breath, weakness, fever, coughing and fatigue

Antibiotics:

- the first line treatment for pneumonia
- NOT effective and NOT indicated for parasitic or viral infections.
- Acute bronchitis typically resolves on its own with time.
- Vaccines available for many pathogens

UPPER RESPIRATORY TRACT VERSUS LOWER RESPIRATORY TRACT

Upper respiratory tract is the uppermost section of the respiratory tract, which is mainly involved in the conduction of air	Lower respiratory tract is the lowermost section of the respiratory tract, which is mainly involved in the gas exchange
Consists of the upper parts of the respiratory tract above the lung	Consists of the lower parts of the respiratory tract that occur inside the lung
Composed of nose, sinus, throat, larynx, and trachea	Composed of bronchi, bronchioles, and alveoli
Lined by the pseudostratified epithelium	Alveoli and bronchioles are lined by the simple squamous epithelium
Main function is to conduct air to the bottom part of the respiratory tract	Conduction of air and gas exchange are the main functions
Flu, common cold, laryngitis, sinusitis, and tonsillitis are infections of the upper respiratory tract	Pneumonia, tuberculosis, bronchitis, and bronchiolitis are infections of the lower respiratory tract

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Lower respiratory tract infection: **bronchitis**

- Bronchitis: inflammation of the bronchi (medium and large airways)

Acute bronchitis:

- cough that lasts around three weeks, wheezing, shortness of breath, chest pain.
- primarily viral (parainfluenza and influenza), could be bacterial infection (Mycoplasma)
- Risk factors: exposure to tobacco smoke, dust, and other air pollution
- Paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs)
- Antibiotics should generally not be used except pertussis (macrolide: azithromycin)

Chronic bronchitis:

- productive cough that lasts for three months or more per year for at least two years. (remember COPD)
- Tobacco smoking, air pollution and genetics
- Quit smoking, vaccinations, rehabilitation, and inhaled bronchodilators and steroids



Disease	Symptoms	Pathogens (common)	Pharmacotherapy
bronchitis	<p>Acute: cough (≤ 3 weeks (Sputum?), wheezing, shortness of breath, chest pain.</p> <p>Chronic: productive cough that lasts for three months or more per year for at least two years. (remember COPD)</p>	primarily viral (parainfluenza and influenza), could be bacterial infection (Mycoplasma)	<p>Acute: Paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) Antibiotics should generally not be used except pertussis (macrolide: azithromycin)</p> <p>Chronic: Quit smoking, vaccinations, rehabilitation, and inhaled bronchodilators and steroids</p>



Lower respiratory tract infection: **bronchiolitis**

- acute inflammatory injury of the bronchioles (small airways)
- Mainly viral (RSV).
- any age, but severe and more common <2 years
- Risk factors: preterm infant, illness < 3 months of age, congenital heart disease and tobacco smoke exposure
- Fever, cough, runny nose, wheezing, and breathing problems.
- Complications: dehydration and aspiration pneumonia
- No diagnostic test are required
- No specific treatment, home care is sufficient
- Hospital admission for oxygen, support with feeding, or intravenous fluids
- No clear evidence for antibiotics, antivirals, bronchodilators, or nebulized epinephrine?!

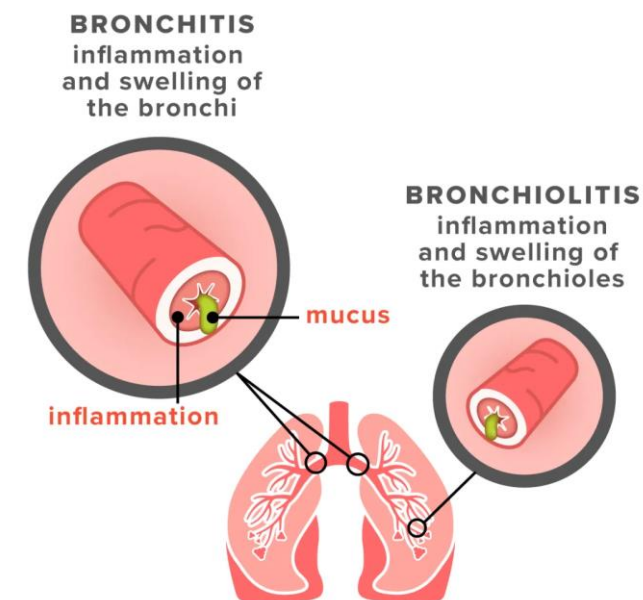
Lower respiratory tract infection: bronchitis and bronchiolitis

**Table comparing
Bronchitis & Bronchiolitis**

Characteristics	Bronchitis	Bronchiolitis
Definition	Inflammation of the bronchi and trachea of the upper respiratory tract	Infection and inflammation of the lower respiratory tract
Age affected	Any age	Usually only infants less than 2 years old
Symptoms	Coughing, wheezing and difficulty breathing	Coughing, wheezing, fast rate of breathing, difficulty breathing, cyanosis, and vomiting are symptoms seen in bronchiolitis
Diagnosis	Physical exam, chest X-ray to exclude other conditions	Physical exam, pulse oximetry, chest X-ray and RSV antigen test

**Table comparing
Bronchitis & Bronchiolitis**

Characteristics	Bronchitis	Bronchiolitis
Causes	Acute bronchitis can be caused by RSV, coronavirus, parainfluenza virus, influenza type A, and influenza type B virus. Chronic bronchitis can be caused by smoking cigarettes	RSV, rhinovirus, and parainfluenza virus type 3.
Risk factors	Having an upper respiratory tract infection and smoking cigarettes	Male infant, having a mother that smoked, being premature, living in crowded conditions
Treatment	Anti-inflammatories, pain medicine, and beta2-antagonists such as albuterol	Fluids and oxygen therapy





Disease	Symptoms	Pathogens (common)	Pharmacotherapy
Rhinitis	Cough, headache, fever*, sore throat and rhinorrhea	Viruses	Supportive: Dextromethorphan, Anti-histamines, Pain-killers, Decongestants.
Pharyngitis	Sore throat , difficulty speech and swallowing, swollen tonsils and bad breath	<u>Strep. Pyogens</u> : Penicillin/Amoxicillin (Oral) ^{^^} > Cephalosporin (Cephalexin) ^{^^} > Macrolide (Azithromycin) <u>Viral</u> : self-limiting: conservative + oral CS (1-2 for pain on swallowing) + lidocaine wash + NSAIDs <u>Candida albicans</u> : clotrimazole	
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Otitis Externa	Ear pain, swelling of the ear canal and decreased hearing*	Pseudomonas aeruginosa	acetic acid-hydrocortisone ^{^^} > ciprofloxacin-hydrocortisone (Cipro HC) + pain-killers
Acute Otitis Media	Ear pain (otalgia), fever, sensation of fullness	Strep. Pneumonia, H. Influenza and Staph. aureus	Amoxicillin-clavulanate ^{^^} > cephalosporin (Cefuroxime) ^{^^} > doxycycline or macrolide (Azithromycin)
Diphtheria	Sore throat, lack of appetite, low-grade fever and grey or white patch develops in the throat	Corynebacterium diphtheriae	Diphtheria antitoxin (horses) + erythromycin ^{^^} > penicillin



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epiglottitis	Trouble swallowing, drooling, fever, aphonia and an increased breathing rate	Streptococcus pneumoniae and haemophilus influenzae	requires immediate airway management (tracheal intubation). Cephalosporin3rd (ceftriaxone) + vancomycin
Croup and laryngitis	“barking/brassy” cough, inspiratory stridor, hoarseness, difficult breathing, fever and runny nose Starts or get worse at night	Mainly viral (parainfluenza and influenza) Rarely bacterial	Corticosteroids and nebulized epinephrin Used in very specific cases: Cephalosporin3rd (ceftriaxone) + vancomycin
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bronchiolitis	Fever, cough, runny nose, wheezing, and breathing problems. Complications: dehydration and aspiration pneumonia	Mainly viral (RSV). Risk factors: preterm infant, illness < 3 months of age, congenital heart disease and tobacco smoke exposure	No diagnostic test are required No specific treatment, home care is sufficient Hospital admission for oxygen, support with feeding, or intravenous fluids No clear evidence for antibiotics, antivirals, bronchodilators, or nebulized epinephrine?!