

Treatment of URTIs

EDITING FILE

COLOR INDEX :

- MAIN TEXT
- IMPORTANT
- GIRLS SLIDES
- BOYS SLIDES
- NOTES
- EXTRA





Objectives:

- Define the upper respiratory tract infections (URTIs) and list sites of infection
- Identify etiology, signs, and symptoms of URTIs
- Outline pharmacological options for URTIs
- Determine the antibiotic of choice for the different URTIs
- Determine the anti-viral drugs for URTIs
- Describe pharmacological mechanisms of action of URTI drugs.

URTIs

Upper respiratory tract infections (URTI) is inflammation of the upper airways or Infections of airway above glottis or vocal cords.

URTIs involve: the nose, sinuses, ears, pharynx, larynx, & large airways.

infections of the upper respiratory tract include:

Otitis media - Sinusitis - Pharyngitis - Rhinitis - Laryngitis - Epiglottitis - Tonsillitis - Common cold - Flu.

Common symptoms of URTIs:

Cough - Sore throat - Running nose - Nasal congestion - Headache - Low-grade fever - Facial pressure - Sneezing - Nasal discharge - Painful swallowing (odynophagia)

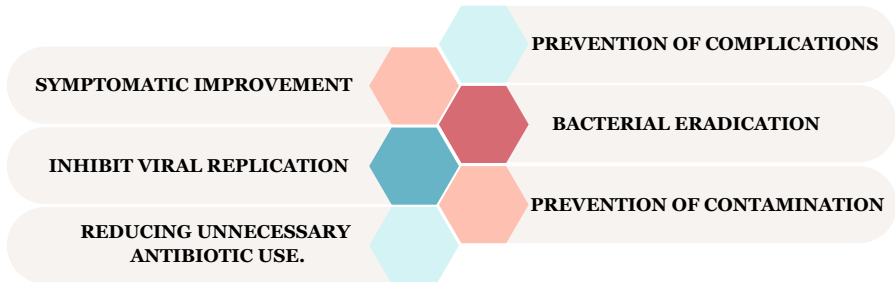
no signs of pneumonia, or with no history of chronic obstructive pulmonary disease, emphysema, asthma, or chronic bronchitis.

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

Etiology of URTIs

Viruses	Bacteria
Should NOT be treated with antibiotics	
The most common virus is rhinovirus .	The most common is Streptococcus pyogenes [Group A (GAS)] Haemophilus influenza Moraxella Catarrhalis
Other viruses include: the influenza virus, adenovirus, enterovirus & respiratory syncytial virus.	Bacteria may cause roughly 15% of sudden onset pharyngitis

Aims of Pharmacotherapy



Drugs for URTIs

Incubation period of a cold = 1 to 4 days before onset of symptoms & first 3 days of the cold.

Home remedies = rest, chicken soup, Vitamins

4 groups of drugs used to manage symptoms:

- antihistamines (H-1 blocker)
- decongestants (sympathomimetic amines), Short duration 3-5 days
- antitussives to reduce dry cough
- expectorants for productive cough

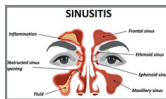
Other medications, may include:

- NSAIDs, ibuprofen for body pain. (Analgesic)
- Acetaminophen (Tylenol) to reduce fever and body ache.
- Nasal ipratropium (topical) to diminish nasal secretions.

Normal saline

Local steroids

Acute Sinusitis



DEFINITION

Acute rhinosinusitis is inflammation of the nasal cavities & **Paranasal sinuses** of less than four weeks duration.

The inflammation can lead to increased mucus production & blocked sinuses, due to difficulty draining.

SYMPTOMS

- Fever.
- Purulent nasal discharge.
- Facial pain.
- Headache.

TREATMENT

Based on this microbiology, the first-line treatment for Acute

Bacterial rhinosinusitis is:
amoxicillin/clavulanate
(Augmentin).

Clavulanate Is Beta-Lactamase inhibitor which increase the efficacy of Amoxicillin.

ETIOLOGY

Viruses (most common cause, Up to 90-98% of the cases):

Rhinoviruses, Influenza viruses, Parainfluenza viruses

Bacterial agents(develop in 0.5% to 2% of all URIs):

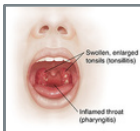
Str. pneumoniae, **H. influenzae**, **M catarrhalis**,
Pseudomonas & other gram negative bacilli
(Nosocomial sinusitis: hospital-acquired infection)

Agents of chronic sinusitis:

Obligate Anaerobes.

Staphylococcus aureus.

Pharyngitis/Tonsillitis



DEFINITION

Pharyngitis is inflammation of the mucous membranes that line the pharynx, or back of the throat.

SYMPTOMS

- A sore or scratchy throat
- Inflammation
- Fever
- Headache
- Difficulty swallowing

ETIOLOGY

Bacterial agents:

Group A Streptococcus (GAS) (Str. pyogenes)
Corynebacterium diphtheriae
Neisseria gonorrhoeae

Viruses: **Without pus**

Epstein-Barr virus, Adenovirus, Influenza A&B, Coxsackie A, Parainfluenzae



TREATMENT

ORAL:

PENICILLIN V , AMOXICILLIN

PARENTERAL:

Benzathine PENICILLIN

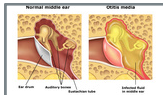
ALLERGY TO PENICILLIN:

Erythromycin estolate/ethylsuccinate, Azithromycin(**Macrolides Antibiotic**)

- A 10-day course of **penicillin V** or **amoxicillin** is the first-line therapy for group A beta-hemolytic streptococcal pharyngitis (GABHS). (Str. pyogenes)
- Analgesic(pain relieve) or antipyretic(reduce fever) medications should also be considered.

ORAL	Dr.: No Need for Doses	
Penicillin V	250 mg qid ,10 days	
Amoxicillin	50 mg/kg/day ,10 days	
PARENTERAL		
Benzathine penicillin	Adults:>27kg:600 000 U single dose, IM	>27 kg:1.200 000 U single dose, IM
ALLERGY TO PENICILLIN		
Erythromycin estolate	20-40 mg/kg/day, 2x1 or 3x1, 10 days	
Erythromycin ethylsuccinate	40 mg/kg/day, 2x1 or 3x1, 10 days	
Azithromycin	12 mg/kg once daily for 5 days	

Acute Otitis Media (AOM)



DEFINITION

is Inflammation of the **middle ear**.
AOM is uncommon in adults, mainly in **children**.

SYMPTOMS

- Fever.
- Ear pain
- Previous history of cold symptoms (runny nose, nasal congestion or cough)

TREATMENT

For Adult:

- **First line:**
Amoxicillin/Clavulanate (Augmentin)
- **Penicillin allergy:**
Cefdinir - Cefpodoxime (3rd gen. cephalosporin)
Doxycycline (Tetracycline Antibiotic)
Azithromycin (Macrolide Antibiotic)

For Children:

- **First line:**
Amoxicillin
- **Penicillin allergy:**
Cefdinir - Cefpodoxime (3rd gen. cephalosporin)
- **Second Line:**
Amoxicillin/Clavulanate (Augmentin)

ETIOLOGY

Acute Otitis Media AOM:

Str. pneumoniae 30%
H. influenzae 20%
M. Catarrhalis 15%
Str. pyogenes 3%
St. aureus 2%
Dr.:
No Need for Percentage

Chronic Otitis Media:

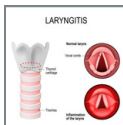
Pseudomonas aeruginosa
St. aureus
anaerobic bacteria
Viral (alone or with bacteria)

Appropriate Antibiotic Dosing for Outpatient Treatment of Upper Respiratory Tract Infections

Infection	Adults	Children
Acute Otitis Media	First-line treatment: Amoxicillin/clavulanate, 875 mg orally twice per day or 500 mg orally every eight hours for five to 10 days*	First-line treatment: Amoxicillin, 90 to 90 mg per kg per day orally divided every 12 hours for five to 10 days†
	Penicillin allergy: Cefdinir, 300 mg orally twice per day or 600 mg orally per day for five to 10 days* Cefpodoxime, 200 mg orally twice per day for five to 10 days* Doxycycline, 100 mg twice per day for five to 10 days* Azithromycin (Zithromax), 500 mg orally on day 1 then 250 mg orally per day on days 2 to 5	Penicillin allergy: Cefdinir, 14 mg per kg per day orally divided in one to two doses for five to 10 days† Cefpodoxime, 10 mg per kg per day divided in two doses for five to 10 days† Second-line treatment for children who have taken amoxicillin within the past 30 days, with concurrent purulent conjunctivitis, with a history of recurrent acute otitis media, unresponsive to amoxicillin, or with no improvement after 48 to 72 hours of initial treatment with amoxicillin: Amoxicillin/clavulanate, 90 mg per kg per day of amoxicillin with 6.4 mg per kg per day of clavulanate in two divided doses for five to 10 days

Dr.: No Need for Doses

Laryngitis



DEFINITION

Acute laryngitis is an inflammation of the larynx & vocal cords that clinically presents as a **horse voice** typically associated with other symptoms of URI.

TREATMENT

- The treatment of acute laryngitis with antibiotics is usually unnecessary because the infectious source is **viral**, & is self-limited
- Antibiotics in the treatment of laryngitis should be **avoided**.
- Rx. Corticosteroids (prednisone or **Prednisolone**) reduce inflammation of vocal cords.

Epiglottitis



OVERVIEW

- Edema & inflammation of epiglottis & soft tissue above vocal cords. Epiglottitis is a rare, life-threatening condition resulting from inflammatory edema of the epiglottis & surrounding supraglottic tissues, often due to infection.
- **Age:** children 2–6 years
- **Symptoms:** Fever, Difficulty in swallowing, Inspiratory stridor.

Epiglottitis

ETIOLOGY

- **H influenzae type b (Hib)** is no longer the most common cause of epiglottitis since the vaccine was developed in 1985, & **Hib now affects adults more than children.**

Str. pneumoniae, group A beta-hemolytic streptococcus & St. aureus are among the pathogens responsible for epiglottitis.

TREATMENT

- **Maintenance of airway**

- **Treatment includes:**

broad-spectrum IV antibiotics such as third-generation cephalosporins (ceftriaxone , cefotaxime , cefixime) or ampicillin/sulbactam* (Unasyn) may also require methicillin-resistant *S. aureus* (*MRSA*) such as *Vancomycin* or other bacterial or fungal coverage.

- **Empiric drugs:** (Drug For emergency conditions)

Ceftriaxone (3rd gen. cephalosporin)

Vancomycin (Glycopeptides Antibiotic)

Amoxicillin-clavulanate, 2nd or 3rd generation cephalosporin

*Sulbactam Is Beta-Lactamase inhibitor

Epiglottitis

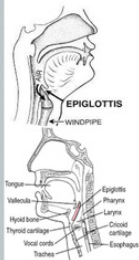
PREVENTION

- HiB vaccination.
- H influenzae type b (Hib) Vaccine for infant & children.
- Hib vaccine can prevent H influenzae type b (Hib) disease.

EPIGLOTTITIS

Definition:

- Epiglottitis is inflammation of the epiglottis and adjacent supraglottic structures.
- Without treatment, epiglottitis can progress to life-threatening airway obstruction

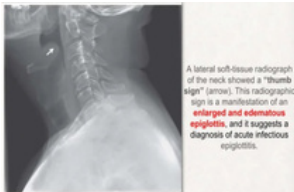


X ray findings

- Lateral soft tissue X Ray of Neck Shows **swollen epiglottis**

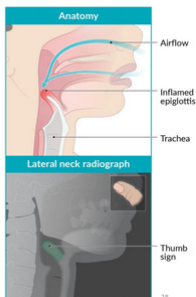
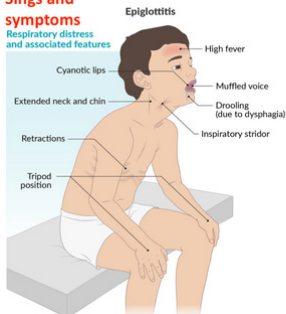
ie **Thumb sign**

this is hallmark of epiglottitis



Sings and symptoms

Respiratory distress and associated features



Thumb sign (Epiglottitis)



Steeple sign (Croup)



Antibiotics in URTIs

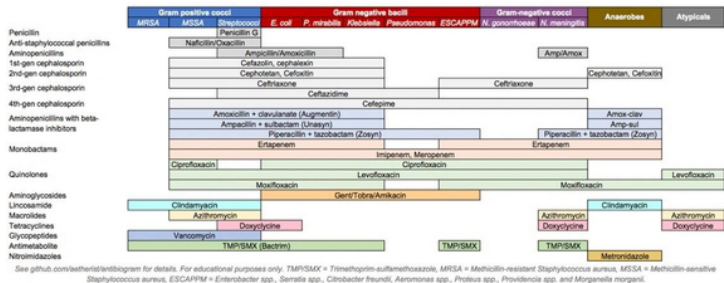
Will Discuss in details Next Lecture (LRTIs)

Classification of Antibiotic

Mechanism of action	Class
Inhibits Cell Wall Synthesis	Cephalosporins Penicillins Carbapenems Glycopeptides
Inhibits Protein Synthesis	Macrolides Aminoglycosides Lincosamides Tetracyclines
Inhibits F olate Metabolism	Sul F onamides
Inhibits DNA Replication	Fluoro Q uinolones

MALT =protein

Examples for antibiotic drugs (drug of choice; DOC) from each class and names of susceptible bacteria



Cell Wall Synthesis

Beta Lactams
 Penicillins
 Cephalosporins
 Carbapenems
 Monobactams

Vancomycin
Bacitracin

Cell Membrane
 Polymyxins

Folate synthesis

Sulfonamides
 Trimethoprim

THF A
 DHF A
 PABA

50S subunit
 Macrolides
 Clindamycin
 Linezolid

30S subunit
 Tetracyclines
 Aminoglycosides

Nucleic Acid Synthesis

DNA Gyrase
 Quinolones
RNA Polymerase
 Rifampin

50S subunit
 Macrolides
 Clindamycin
 Linezolid
 Chloramphenicol
 Streptogramins

Protein Synthesis

Class	Examples	How They Work
Penicillins	penicillin, amoxicillin	Penicillins kill bacteria by preventing formation of the bacterial cell wall.
Macrolides	azithromycin, erythromycin	Macrolides prevent bacteria from multiplying by keeping bacteria from making proteins.
Cephalosporins	cephalexin, cefdinir	Cephalosporins kill bacteria by preventing formation of the bacterial cell wall.
Fluoroquinolones	ciprofloxacin, levofloxacin	Fluoroquinolones kill bacteria by keeping bacteria from making DNA.
Beta-lactams with increased activity	amoxicillin/clavulanate, ceftazidime/avibactam	Beta-lactams with increased activity are combinations that consist of two different drugs: a penicillin or cephalosporin and a beta-lactamase inhibitor. The penicillin or cephalosporin kills bacteria by preventing formation of the bacterial cell wall. The beta-lactamase inhibitor has little antibiotic activity on its own. Its job is to protect the penicillin or cephalosporin from being destroyed by an enzyme some bacteria produce. This protection increases the activity of the penicillin or cephalosporin.
Tetracyclines	tetracycline, doxycycline	Tetracyclines prevent bacteria from multiplying by keeping bacteria from making proteins.
Trimethoprim-sulfamethoxazole	trimethoprim-sulfamethoxazole	Trimethoprim and sulfamethoxazole work together to inhibit the ability of bacteria to make folic acid, which is necessary to make DNA and proteins. This prevents bacteria from multiplying.



Therapy for URTI



For elderly and children younger than 4 years of ages: be caution with Cough and cold drugs, may cause excessive **drowsiness**.

Antibiotics are sometimes used for URTIs if the cause of infection **bacteria**. Such as in bacterial sinusitis, strep throat, epiglottitis.

The use of antibiotics is associated with bacterial resistance and secondary infections.

Antibiotics adverse effects:

1

Antibiotic resistance

2

usually mild (e.g., diarrhea, rash)

3

could be sever EX:
-stevens johnson syndrome (**severe skin reaction**), clostridies
difficile colitis

4

life threatening such as anaphylaxis or sudden
cardiac death





Common cold



IS A **VIRAL INFECTION** OF URT.

E.G. **RHINOVIRUSES (FREQUENT PATHOGEN)**,
CORONAVIRUS, INFLUENZAS,
PARAINFLUENZA VIRUSES, ADENO,
ENTEROVIRUSES.

USUALLY LAST WITHIN 7 DAYS.



Common cold signs and symptoms

1

fatigue, fever, feeling cold

2

nose burning, obstruction and rhinorrhea
and nasal secretions(usually clear and watery)

3

redness and swelling of nasal mucus membranes,
sneezing and watery eyes.

Treatment:

- Specific antiviral and antibiotic therapy has no role in the treatment of common cold.
- Prevention: face mask and handwashing

Complications:

- Otitis media (AOM), esp. in children
- Sinusitis
- Exacerbation of asthma.



Management of common cold



Treatments with established effectiveness for those symptoms in adults are limited to over-the-counter (OTC) (ادويه ما تحتاج وصفه طبيه):

- analgesics
- antihistamine/decongestant combinations.

The American Academy of Pediatrics Choosing Wisely recommendation states that cough and cold medicines should be avoided for respiratory illness in children younger than four years

Antibiotics are **ineffective** for the treatment of the **common cold** in adults and children and should not be prescribed based on consistent findings of no benefit and **increased** adverse effects and resistance.

THERAPY OF COMMON COLD:

OTC DRUGS ARE NOT RECOMMENDED FOR CHILD < 6YR.

1

OTC drugs, rest, fluid, saline nasal irrigation, and only time.

2

Antiviral therapy is not available for viruses that cause the common cold with exception of influenza virus.

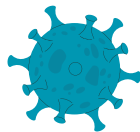
Influenza(flu)



Ninja nerd :
influenza start In
33:53 to 47:26



dr. Abdel-motal fouda :
influenza start in 10:09
till the end



1 Causes epidemics and pandemics

2 Highly contagious

3 **Viral infection.**

Causes:

-80 % **Influenzae virus**

-Parainfluenza %2-9

-Rhinovirus %3

-Adenovirus %4

Signs And symptoms



1

- Sudden onset after 12-24 hours incubation
- General weakness and fatigue

2

- Feeling cold, shivering, temp. Up to 39-40 C
- No sore throat or running nose

3

Severe back, muscle and joint pain



Types of influenza



There are 4 types of **influenza** viruses: **A**, **B**, **C**, and **D** :

1

Influenza **A** and **B** viruses cause seasonal epidemics of disease in people (known as flu season) almost every winter

2

Influenza **C** virus infections generally cause mild illness and are not thought to cause human epidemics.

3

Influenza **D** viruses primarily affect **cattle** with spillover to other animals but are not known to infect people to cause illness.

Influenza **A** viruses are divided into subtypes based on two proteins on the surface of the virus:

- **hemagglutinin (H)** and **neuraminidase (N)**(for release).
- There are **18** different **hemagglutinin** subtypes and **11** different **neuraminidase** subtypes (H1 through H18 and N1 through N11, respectively).

بالنسبة لإختلاف الأرقام بين الفارما والمايكرو ، دكتورة المايكرو قالت نعتمد الفارما

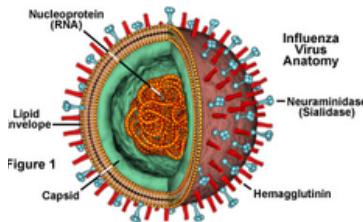


Figure 1

Viral replication

Requires several steps

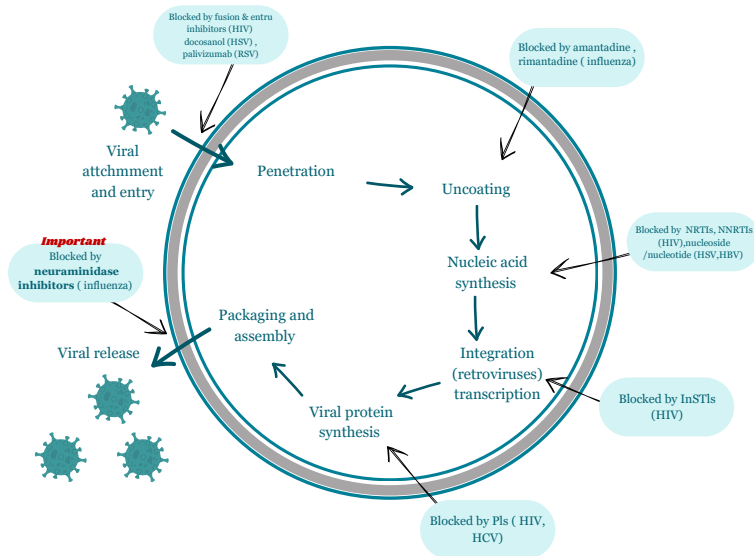


Life cycle of influenza A
antivirals

Antiviral agents can potentially target any of these steps.

(i.e. Classification of Antiviral Drugs).

the details is not important for HIV , the important is the last step for influenza

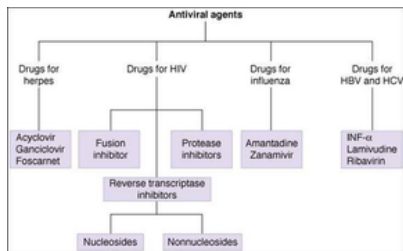


viral replication



- FOUR INFLUENZA ANTIVIRAL MEDICATIONS APPROVED BY THE U.S. FOOD AND DRUG ADMINISTRATION (FDA).

1. Drugs are chemically related antiviral medications known as **neuraminidase inhibitors** that **block the viral neuraminidase enzyme & have activity against both influenza A and B viruses**:



2. **Baloxavir is a cap-dependent endonuclease inhibitor** that interferes with viral RNA transcription & blocks virus replication

3- **M2 proton channel antagonists** (like **amantadine**) are not recommended for antiviral treatment or chemoprophylaxis because of high levels of resistance to circulating influenza A viruses.

Virus	Antiviral drug	Target
Influenza A	Amantadine , Rimantadine	Haemagglutinin protein
Influenza A & B	Relenza and Tamiflu	Neuraminidase inhibitors

Extra note from the doctor





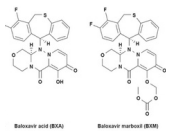
Mechanism of Action

Amantadine and rimantadine share two concentration-dependent mechanisms of anti-influenza action. Low concentrations inhibit the ion channel function of the M2 protein of influenza A viruses, which affects two different stages in virus replication.¹⁷⁻¹⁹ The primary effect involves inhibition of viral uncoating or disassembly of the virion during endocytosis. For subtype H5 and H7 viruses, a late effect on hemagglutinin maturation and viral assembly is presumably mediated through altered pH regulation of the trans-Golgi network. Amantadine and rimantadine block proton permeation and prevent M2-mediated changes in pH. This action probably accounts for inhibition of the acid-mediated dissociation of the matrix protein from the ribonucleoprotein complex within endosomes early in replication and potentiation of acidic pH-induced alterations in the hemagglutinin during its transport late in infection.

For more information , and if you want to see the MOA clearly [Click here](#)

Flu Antiviral Drugs for flu illness season

they block the viral neuraminidase enzyme & have activity against **both**

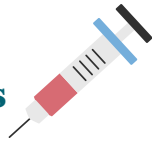
drugs:	Adminstration	Dose	M.O.A	-
Oseltamivir phosphate (Tamiflu)	orally 	five days	NeurAminidase Inhibitors (NAIs) (an enzyme essential for release of newly formed virus particles from infected cells and further spread of the infectious virus.)	NeurAminidase Inhibitors (NAIs) also include laninamivir
Zanamivir (Relenza)	Inhaled 	five days		
Peramivir (Rapivab)	IV 	one dose		
2- Baloxavir marboxil (Xofluxe) Trade Name not important -used in case of resistance to oseltamivir	orally 	one dose	-(polymerase acidic endonuclease inhibitor)Baloxavir marboxil (after conversion to baloxavir acid) acts to block influenza virus replication by inhibiting the cap-dependent endonuclease activity of the PA protein.	Active baloxavir inhibits influenza virus replication by selective binding of the RNA-dependent influenza virus RNA polymerase complex.  <p> Baloxavir acid (BXA) Baloxavir marboxil (BXM) </p> <p> Chemical structure of baloxavir acid (BXA, active form) and baloxavir marboxil (prodrug form). </p>

Cont...

drugs:	Contraindications	adverse effects
Oseltamivir phosphate (Tamiflu)	<ul style="list-style-type: none"> • Its is not recommended in infants younger than 1 year (because of fatalities in mice). • Probenecid reduces renal clearance of oseltamivir by 50%. Serum concentrations of oseltamivir increase with declining renal function; therefore, dosage should be adjusted in patients with renal insufficiency 	<p>Skin reaction, Headache and nausea, Vomiting, bronchitis, sore throat, nasopharyngitis, sinusitis, pain, and dizziness.</p>
Zanamivir (Relenza)	<ul style="list-style-type: none"> • allergy to milk protein • patients with glucose-galactose malabsorption, hereditary galactose intolerance, • Lapp lactase deficiency. • Zanamivir should be avoided in those with asthma or chronic obstructive pulmonary disease because it may cause bronchospasm. 	<p>skin reaction, such as rash, Diarrhea, hepatocellular injury, increased levels of transaminases (ALT and AST), neutropenia, and renal failure</p>
Peramivir (Rapivab)	<p>-</p>	<p>Diarrhea, Neutropenia, nausea, vomiting, injection site rash, and increased AST and ALT.</p>
Baloxavir marboxil (Xofluxe)	<p>-</p>	<p>Vomiting, diarrhoea</p>



Drugs Used for Influenza Treatment and Prophylaxis



3- M2 proton channel antagonists

amantidine, rimantidine

Amantidine was the **first** antiviral drug used in the treatment of influenza. It can **only** be used against **influenza A**.

This drug **inhibits viral replication** by **blocking the M2 proton channel specific to influenza A virus**.

Due to increased global **resistance**, amantidine has **not** been recommended for the treatment of influenza since 2006. However, influenza viruses are now largely resistant to M2 inhibitors

- Currently, **amantidine** is mainly used in neurodegenerative diseases, such as **Parkinson's disease**, therapy after traumatic brain injury, and multiple sclerosis.



CDC Antiviral treatment Recommendations

ANTIVIRAL TREATMENT IS RECOMMENDED AS EARLY AS POSSIBLE FOR ANY PATIENT WITH CONFIRMED OR SUSPECTED INFLUENZA WHO IS :

HOSPITALIZED

HAS SEVERE , COMPLI,
OR PROGRESSIVE
ILLNESS

IS AT HIGH RISK FOR
INFLUENZA COMPLI
CATIONS

CDC Antiviral treatment Recommendations

1

Antivirals sometimes can be recommended in immunocompromised patients with poor immune system defense

2

Early antiviral treatment for influenza infection shortens the duration of influenza symptoms, decreases the length of hospital stays, & reduces the risk of complications

3

Antiviral chemoprophylaxis is also helpful in preventing influenza (70% to 90% effective)

4

Vaccination is the most effective method of preventing influenza illness

5

Antiviral treatments can be considered for previously healthy, symptomatic outpatient not at higher risk with confirmed or suspected influenza, if treatment can be initiated within 48 hours of illness onset

“ study smarter , not harder “

Active recall



44 version

For Anki flash cards click the icon



Take active quizzes in our team channel to test your understanding.



click the icon to get free flash cards

summary



MCQs

1

What is the first line treatment for acute bacterial rhinosinusitis?

A Ceftriaxone

B Azithromycin

C Clavulanate

D Amoxicillin/clavulanate

2

What are The main medical condition for which amantadine is currently used

A Influenza B

B Influenza A

C both A&B

D Parkinson's disease

3

What is a potential adverse effect of zanamivir inhalation powder

A Skin rash

B Headache

C Nausea

D Fever

4

How do Beta-lactam antibiotics work?

A inhibit folate synthesis

B Inhibit Cell wall synthesis

C Inhibit protein synthesis

D Breakage of DNA

MCQs

5

What is the mechanism of function of Baloxavir marboxil

A

Inhibit of viral protein Tratransport

B

Endocytosis and fusion

C

cap-dependent endonuclease inhibitor

D

Penetration

6

Which class of antibiotic inhibit protein Synthesis

A

Penicillin

B

Fluoroquinolones

C

Tetracycline

D

Glycopeptides

7

Which antiviral is used as inhaler?

A

Zanamivir

B

Oseltamivir

C

Peramivir

D

Laninamivir

8

All below can affect influenza A and B except?

A

Zanamivir

B

Oseltamivir

C

Peramivir

D

Amantadine

SAQs

1 A girl with 5 years old came to Emergency with ear pain and fever, what is the diagnosis /most common causative /treatment?

◆

Diagnosis:
Acute Otitis Media
Etiology:
Streptococcus pneumoniae
treatment:
Amoxicillin

2 Enumerate two class of Antibiotics and give one example of each, and their mechanism of action

◆

• Penicillin
MOA: inhibit cell wall synthesis
example: penicillin, amoxicillin

• tetracycline
MOA: inhibit protein synthesis
example:tetracycline - doxycycline



Team leaders

Ritaj Alsubaie

Raseel Aldajany

Eyad Alzubaidi

Team members

Madaen Alarifi


Ali Al-Abdulazem

Haya Alateeq

Waleed Alanazi

Noreen Almarabah

Abdulaziz Sahhari

 Jenan Alsayari

Abdulrahman Almalki

Norah Alnoshan

khalid Alghamdi

Alanoud alnajawi

Abdulaziz Alanazi

Sahar Alfallaj


Abdulrahman Alnafisah

Samiyah sulaiman

 Abdullah Alzoom

shaden Alotaibi

Ahmed Alabbad

 Roaa Alhajri

Rimaz Alhammad



Contact us at : pharmacology.444ksu@gmail.com