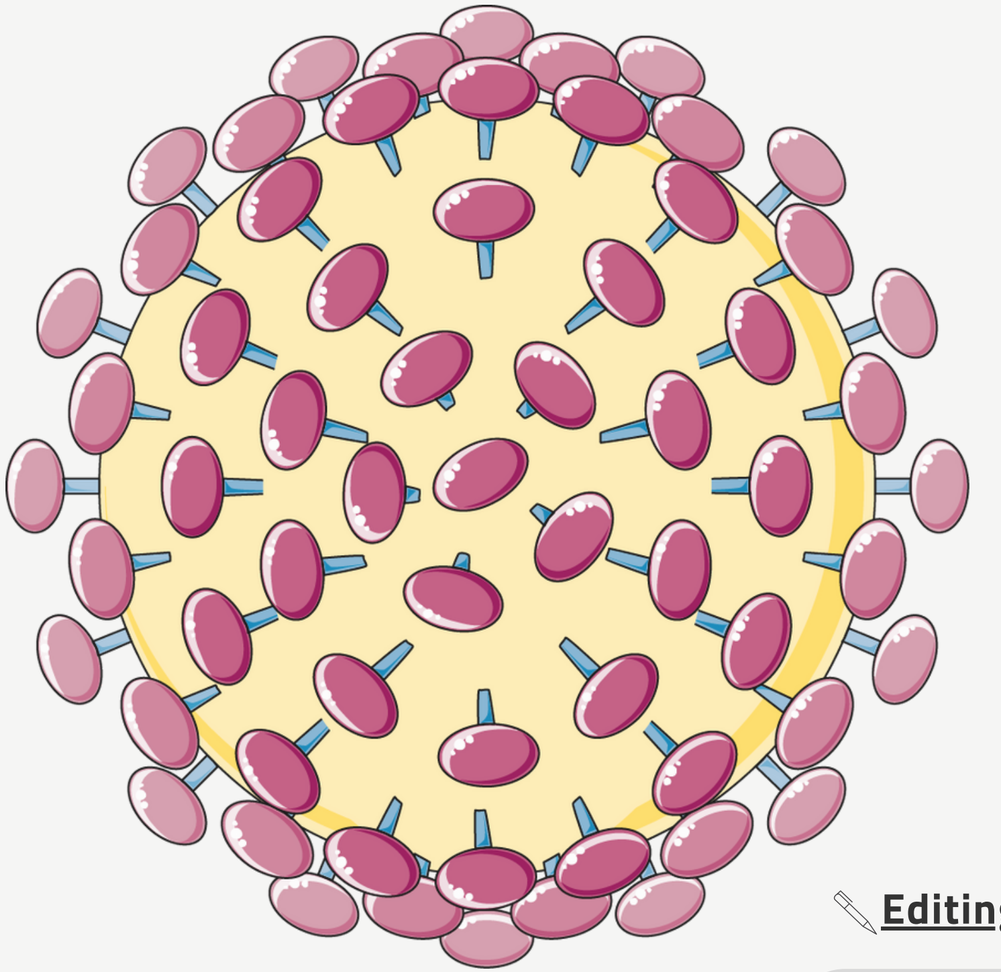
VIRUSES
CAUSING RESPIRATORY INFECTIONS 1

Lecture no.5



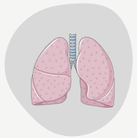
Editing File

Color index:

Main text	Girls' slides
Important	Boys' slides
Dr. notes	Extra

(اللَّهُمَّ انْفَعْنِي بِمَا عَلَّمْتَنِي، وَعَلِّمْنِي مَا يَنْفَعُنِي، وَزِدْنِي عِلْمًا)

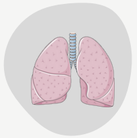
OBJECTIVES



Introduction to respiratory viral infections.

Characteristics of respiratory viruses (Orthomyxoviridae, Paramyxoviridae).

Mode of transmission.



Clinical features.

Lab diagnosis.

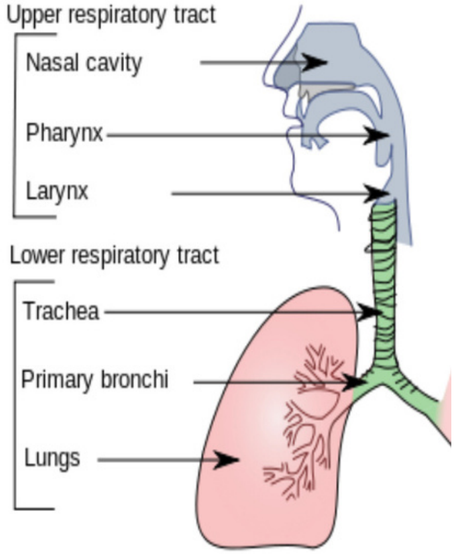
Treatment & Prevention

RESPIRATORY TRACT INFECTION

- Are the commonest of human infections and cause a large amount of morbidity and loss of time at work (sick leave).
- Are common in both children and adults, Mostly caused by viruses
- Mostly are mild and confined to the upper respiratory tract (URT).
- Mostly are self-limiting disease.(It means you can heal at home).
- URT-infection may spread to other organs causing more severe infection and death.

CLINICAL MANIFESTATIONS

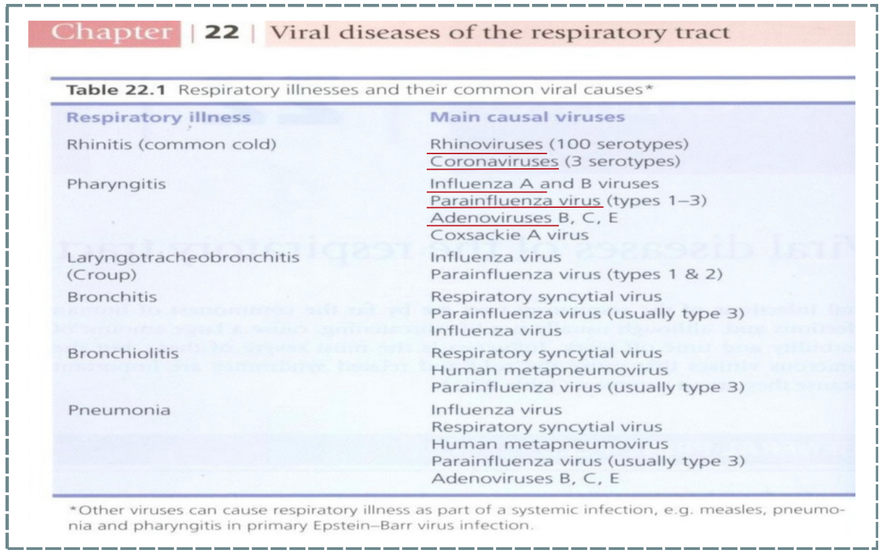
- Common cold (rhinitis)
- Pharyngitis
- Tonsillitis التهاب اللوز
- Sinusitis & otitis media
  التهاب الجيوب الأنفية التهاب الإذن
- Croup (acute laryngo-tracheobronchitis)
- Acute bronchitis
- Acute bronchiolitis
- Viral pneumonia



In female slides only:

Name of the virus	Family
1.Influenza virus	Orthomyxoviridae
2.Parainfluenza virus	Paramyxoviridae
3.Respiratory syncytial virus	Paramyxoviridae
4.Rhinovirus	Picornaviridae
5.Coronavirous	Coronaviridae
6.Adenovirus	Adenoviradia

In male slides only:



Chapter | 22 | Viral diseases of the respiratory tract

Table 22.1 Respiratory illnesses and their common viral causes*

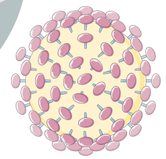
Respiratory illness	Main causal viruses
Rhinitis (common cold)	Rhinoviruses (100 serotypes) Coronaviruses (3 serotypes)
Pharyngitis	Influenza A and B viruses Parainfluenza virus (types 1–3) Adenoviruses B, C, E Coxsackie A virus
Laryngotracheobronchitis (Croup)	Influenza virus Parainfluenza virus (types 1 & 2)
Bronchitis	Respiratory syncytial virus Parainfluenza virus (usually type 3) Influenza virus
Bronchiolitis	Respiratory syncytial virus Human metapneumovirus Parainfluenza virus (usually type 3)
Pneumonia	Influenza virus Respiratory syncytial virus Human metapneumovirus Parainfluenza virus (usually type 3) Adenoviruses B, C, E

*Other viruses can cause respiratory illness as part of a systemic infection, e.g. measles, pneumonia and pharyngitis in primary Epstein–Barr virus infection.

Male's Dr's note:

Viruses that affect upper respiratory tract:
Rhinoviruses - Coronaviruses - Adenoviruses - Enteroviruses

Viruses that affect lower respiratory tract:
Influenza virus -Parainfluenza virus - Respiratory syncytial virus - Human meta pneumovirus - EsteinBarr virus



TYPES OF INFLUENZA VIRUS

Type A ★

- Infect human and animal
- ▪ Cause epidemic (specific place) and pandemic (world wide)
  ▪ Cause epizootic in animal
- Antigenic drift (Minor change) which is simply a change in the viral protein
- Antigenic shift (Major change) which is simply a change in the RNA of the virus

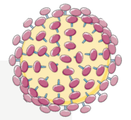
Ex:Swine Flu , Avian Flu

Type B

- Infect human only
- Cause outbreak
- Have antigenic drift only

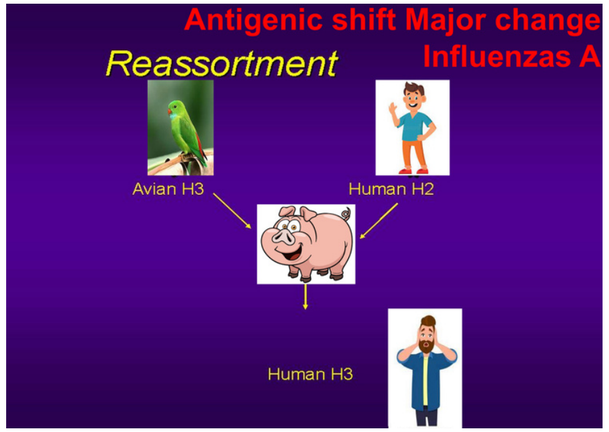
Type C

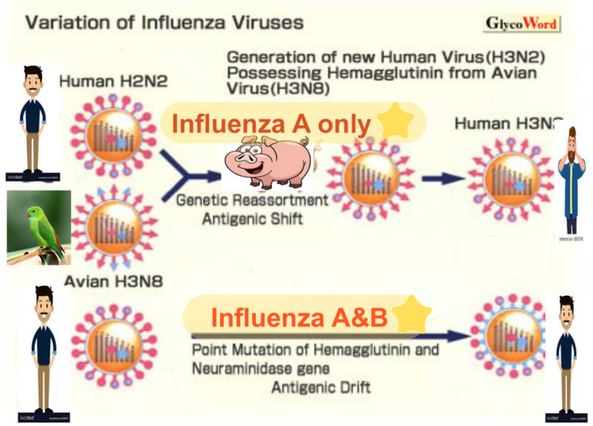
- Infect human only
- Cause mild illnesses



دائمًا، أي فايروس يصيب الإنسان فقط يكون الControl عليه
سهل مقارنة بالفايروسات اللي تصيب الإنسان والحيوانات سويًا،
والسبب في ذلك إننا مانقدر نتحكم بالحيوانات ونستخدم عليهم
اللقاحات والعكس صحيح

ANTIGENIC SHIFT & DRIFT





The pictures are important, thus u should understand them very well, so this is an extra explanation from team 443, **the whole thing is very important:**

- **Antigenic shift**: mixing of genes from influenza viruses from different species.
- Human H2N2 is special for humans and can't infect birds because the receptors are different (circles).
- Avian H3N8 is special for birds and can't infect human because the receptors are different (triangles).
- But, the swine can take the infection from the two viruses because it has all the receptors (for both shapes)
- The viruses within the swine (infected host) will undergo genetic reassortment (RNA mutations).
- So the swine infection will produce a new type that infect humans and animals which is H3N2.
- This **antigenic shift is only for Influenza A virus.**
- Required 50-100 years.
- Called reassortment , major change. (antigenic shift=major change=reassortment)

Antigenic drift : the accumulation of a series of minor (small) genetic mutations or change in the arrangement of H & N.

- One virus has changed itself over time.
- **This antigenic drift for influenza A & B viruses.**
- Required 10-30 years (less period).

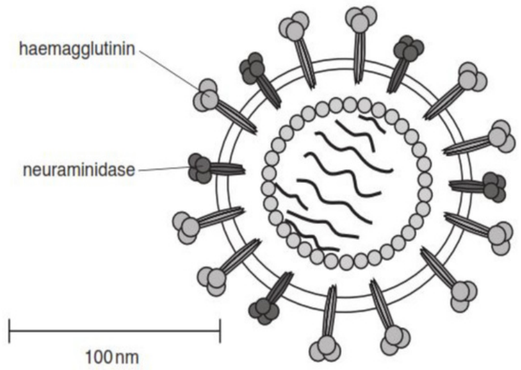
INFLUENZA VIRAL PROTEINS

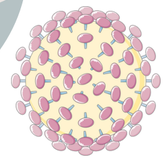
Haemagglutinin (H)

- Attachment to the cell surface receptors (function)
- Antibodies to the HA is responsible for immunity, (it will stimulate the antibody's production after binding with cell surface receptors)
- 16 haemagglutinin antigenic type, H1– H16
- Human associated H antigenic types are H1, H2, H3
- The disease start when it bind

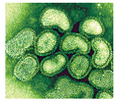
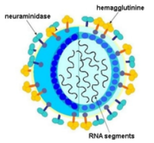
Neuraminidase (N)

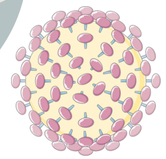
- Responsible for release of the progeny viral particles from the infected cell
- 9 neuraminidase antigenic type, N1– N9
- Human associated N antigenic type are N1, N2





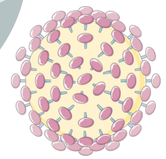
INFLUENZA A VIRUS

Overview	• Divided into subtypes based on the hemagglutinin (H) and neuraminidase (N) proteins • The currently circulating strains are: H1N1 & H3N2
Family	Orthomyxoviridae
Structural features	Enveloped virus with 2 projecting glycoprotein spikes: **Haemagglutinin (H)** & Neuraminidase (N) 
Genome	8 Segmented -ve polarity ssRNA (as the viruses in this lecture). This virus is highly susceptible to **mutations & rearrangements** within the infected host (Change it self frequently) 
Pathogenesis	The virus infects the epithelial cells of the nose, throat, bronchi and occasionally the lungs
Transmission	Inhalation of infectious aerosol droplets
I.P	1-4 Days



INFLUENZA A VIRUS CONT…

Symptoms	★**Fever**, malaise, headache, cough, chills, sore throat, and generalized pain
Prognosis	Usually self-limiting disease
Complications	• Primary influenza pneumonia • 2nd bacterial pneumonia (when the lung gets tired and there is already a virus in the nose, it will descend to the lung and cause pneumonia) • **Reye's syndrome** which is **fatty degeneration of CNS and Liver** caused by **(Aspirin)**, simple explanation: when u use aspirin with a viral infection it will cause Reye's syndrome
Lab diagnosis	Routine testing by: - Direct detection of Influenza A or B virus from sputum - **Nasopharyngeal swab/aspirate (NPA)** (like the one for covid-19) - Respiratory secretion by **direct immunofluorescent assay** (IFA) (antigen antibody reaction) ★Other detection methods: Cell culture, PCR
Treatment	• **Amantadine** is effective against **influenza A virus only** (old medication) • Rimantidine (old medication), **oseltamivir (Tamiflu)** or Zanamivir (Relenza) are effective against **both influenza A&B viruses** and can be used as treatment and prophylaxis.



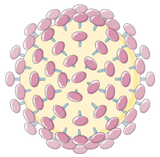
PREVENTION OF INFLUENZA VIRUS

Prevention

- Both vaccines contain two strains of the current circulating of **both influenza A&B virus** (★effective against both influenza A & B)
- Vaccine should be given in October or November, before the influenza season begins.

Two types of vaccines are available:

The annual trivalent Flu shot vaccine:	The nasal spray (Flu mist):
Inactivated (killed vaccine) . Given to people older than 6-months including healthy people and those with chronic medical conditions	Live attenuated vaccine. Approved for use in healthy people between 5-49 years of age



AVIAN INFLUENZA TYPE A VIRUS: (H5N1)

Family:
Typical orthomyxovirus. (same as human type A virus)
Epidemiology:
Wild birds are the natural reservoir for the virus,They shed the virus in saliva, nasal secretion and feces.

Treatment:
- Should be initiated within 48 hours.
- **Oseltamivir and Zanamivir** are used.

Lab diagnosis:
RT-**PCR**, detection of the viral RNA in throat/nasopharyngeal swab

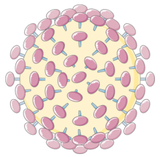
Symptoms of Avian flu in human:
- Ranges from typical flu to severe acute lower respiratory disease.
- Diarrhea, abdominal pain and bleeding from the nose have been reported.

Avian influenza type A virus: (H5N1)

- All domestic poultry are susceptible to infection.
- They become infected, when they eat food contaminated with secretion or excretion from infected bird.
- High risk group includes those who are working in poultry farms and those who are in close contact with poultry

- Avian influenza viruses **do not usually infect human easily.**
- The ability of H5N1 strain to infect birds more effectively than human is due to the presence of a certain type of viral receptor throughout the mucosa of the bird upper respiratory tract, in contrast, **human have this receptor only in alveoli, not in the upper respiratory tract.**

This explains why human are rarely infected and need long close contact with infected bird ,**but if human become infected will have severe lower respiratory tract infection and pneumonia**



SWINE FLU

In female slides only

-We will tell you the story of Swine flu epidemic. Which was caused by the type A influenza virus (H1N1)
-This disease is because of reassortment of two strains, one human strain, and one avian strain

The beginning

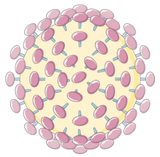
⇒ March 2009, an outbreak of respiratory illnesses was first noted in Mexico, which was eventually identified as being related to a novel H1N1 influenza A virus.
⇒ The outbreak spread rapidly to the United States, Canada, and throughout the world as a result of airline travel In June 2009, the World Health Organization (WHO) raised its pandemic alert level to the highest level, phase 6

Becomes a disaster

Increased rates of severe complications, hospitalization, and death were observed among infected pregnant women compared with the general population, particularly during the second and third trimesters and after delivery.

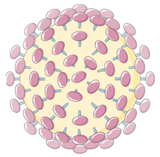
Mortality

Most deaths were related to respiratory failure resulting from severe pneumonia with multifocal infiltrates on lung. Although the majority of reported deaths occurred in individuals with underlying health problems, up to one-third of hospitalized patients had no underlying chronic illness.



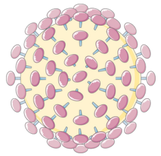
PARAINFLUENZA VIRUS

Family	Paramyxoviridae
Structural features	-Enveloped virus with negative polarity -ssRNA genome -5 serotypes 
Transmission	Inhalation of infectious aerosol mainly in winter.
Lab diagnosis	-**Routine testing by:** Direct detection of the virus from sputum, nasopharyngeal swab/aspirate (NPA) or respiratory secretion by direct immunofluorescence assay (IFA). - Other detection methods: tissue/cell culture, RT-**PCR**. (same as lab diagnosis of influenza)
Clinical syndrome	**-Infants & Young Children:** (من العمر تقدرون تحددون النوع) ★**Croup or Acute laryngotracheobronchitis** (Inflammation of vocal cords) - PIV **type-I, II** - Common cold, fever, harsh cough, difficult inspiration (Can lead to airway obstruction which may require hospitalization and tracheostomy).
	-Young children only: - Bronchiolitis and Pneumonia -PIV type-III
Treatment & Prevention	Supportive treatment (reassurance), no specific treatment or vaccine available.



RESPIRATORY SYNCYTIAL VIRUS (RSV)
HUMAN METAPNEUMOVIRUS

Family	Paramyxoviridae
Structural features	-Enveloped virus with negative polarity -ssRNA genome
Transmission	Inhalation of infectious aerosol mainly in winter.
Clinical syndrome	Bronchiolitis & pneumonia Life-threatening disease in ★**infants**★ especially **under 6 months,** respiratory distress and cyanosis can be fatal and can lead to chronic lung disease in later life -if not treated-
Lab diagnosis	-Routine testing by: Direct detection of the virus from sputum, nasopharyngeal swab/aspirate (NPA) or respiratory secretion by direct immunofluorescence assay (IFA).(same as lab diagnosis of influenza and parainfluenza) - Other detection methods: Isolated of virus by **cell culture from N.P.A** look for multinucleated giant cell or syncytia as cytopathic effect (C.P.E); RT-**PCR**
Treatment & Prevention	-**Ribavirin**: administered by **inhalation** for infants with severe condition of RSV infection. - No vaccine available, but passive immunization immunoglobulin can be given for infected premature infants. -The difference between vaccinations & passive immunization: Vaccin is injecting a weak virus, then the body produce antibodies to it while passive immunization is injecting of the antibody itself-

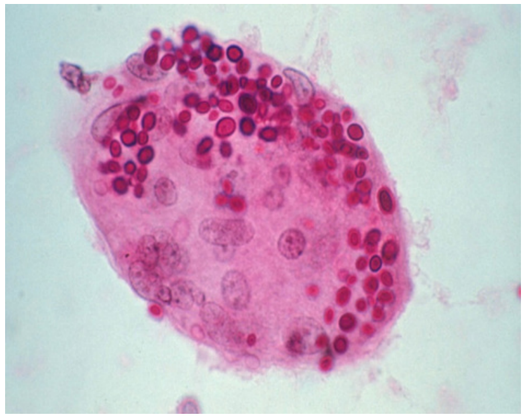


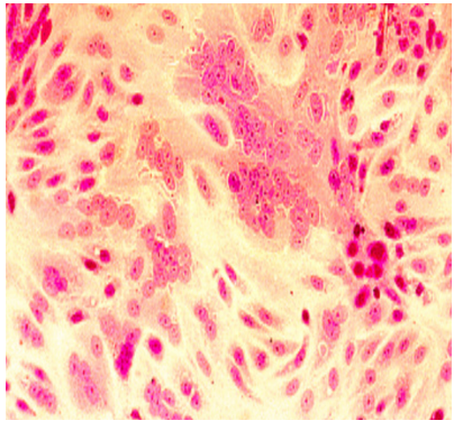
RESPIRATORY SYNCYTIAL VIRUS (RSV)
HUMAN METAPNEUMOVIRUS

In female slides only

Multinucleated giant cells called syncytia

- Usually these syncytia are the result of expression of a viral fusion protein at the host cell membrane during viral replication.
- Viruses such as RSV are known to induce the formation of syncytia.

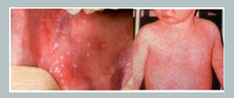




MEASLES & MUMPS VIRUSES

Virus	Measles	Mumps
Definition	-	is an acute benign viral **parotitis (painful inflammation and swelling of salivary gland and mainly parotid glands)**, it is a disease of children (5-15 years), but also can be seen **in young adult** with **more complicated feature**.
Family	Paramyxoviridae	
Structural features	-Enveloped virus with negative polarity -ssRNA genome	-Enveloped virus with negative polarity -ssRNA genome -The viral envelope is covered with two glycoprotein spikes, hemagglutinin and neuraminidase.
Transmission	Inhalation of infectious aerosol droplets. That's why we consider them both respiratory viruses.	Inhalation of infectious aerosol droplets during sneezing and coughing, direct contact with saliva.
Epidemiology	-Measles virus infects **human only.** So we can eradicate it, easy to control -Most cases in preschool children, very infectious. -Infection occurs mainly in winter and spring.	-Mumps virus infects **human only.** Easy to control, so we can eradicate it -Highly infectious, peak in winter. -Long incubation period 18-21 days
Pathogenesis	1- The virus infects first epithetical cells of upper respiratory tract. (It is not really a respiratory infection, but its transmission is through URT) 2- Then the virus spreads to the **blood** causing viremia and infect the endothelial cells of blood vessels 3- Then the virus reaches the **lymphoid tissue** where it replicates further and disseminates to the skin causing **maculopapular rash.**	1- Infection started in the epithelial cells of upper respiratory tract. 2- Then virus spread by viremia to parotid gland mainly. (in children) 3- **Also might spread to other organs such as: testes, ovaries, pancreas and CNS.** (These are complications in adults)

MEASLES & MUMPS VIRUSES CONT...

Virus	Measles	Mumps
Clinical Features  	-Incubation period 7- 14 days - Prodromal symptom: Fever, Cough, conjunctivitis (pink eye) and running nose. **Koplik's spot:** Small red papules with white central dots appear mostly in buccal mucosa. Is very specific symptom in? Measles (buccal mucosa is the lining of the cheeks and the back of the lips, and inside the mouth). **Rash: Maculopapular rash** first on face, trunk, extremities. - The rash is red, become confluent, last for 4 or 5 days, then disappears leaving brownish discoloration of the skin and final desquamation. -Recovery complete in normal children **with life long sold immunity**	-Classic mumps starts with moderate fever, malaise, pain on chewing or swallowing, particularly acidic liquids. -Sudden onset of fever and painful swelling of parotid gland (parotitis) -Self-limiting disease resolve within one week. **- Solid and long life immunity developed.** 
Complications	**Encephalitis:** Acute or subacute sclerosing panencephalitis (SSPE). (VERY RARE) **Giant cell pneumonia:** rare in immunocompromised children due to direct invasion of measles virus to the lung tissue.	Aseptic meningitis, Encephalitis, Pancreatitis, Thyroiditis. **After puberty:** 1- Orchitis: inflammation of one or both testicles. usually unilateral, rarely leads to sterility. 2- Oophoritis: inflammation of ovaries.
Lab diagnosis	Serology by detection of IgM Ab /specific antibodies using ELISA, and in case of SSPE detection of measles antibodies in CSF or detection of viral RNA/NA using RT-PCR.	Serology by detection of IgM specific antibodies using ELISA, cell culture and isolation of the virus from saliva or detection or viral RNA/NA using RT-PCR.
Treatment & prevention	• No specific treatment. • Prevention by giving the live attenuated vaccine (**MMR**) for Measles, Mumps and Rubella (given to all children 15 month and booster dose at school entry). Give excellent long last protection.	

Q1:D
Q2:A
Q3:A

MCQs:

Q1/ Which of the following can be used in the treatment of influenza A virus?

A	Amantadine	B	Tamiflu	C	Rimantadine	D	All of the above

Q2/ Which of the following is used in the treatment of influenza A virus ONLY?

A	Amantadine	B	Tamiflu	C	Rimantadine	D	All of the above

Q3/ Which of the following has antigenic shift only ?

A	Influenza A	B	Influenza B	C	Influenza C	D	All of the above

Q4: B
Q5: B
Q6: C

MCQs:

Q4/ A child was diagnosed with a viral infection and the doctor prescribed Amantadine to relieve his symptoms. What viral infection did the child experience?

A	RSV	B	Influenza A	C	Influenza B	D	Coronavirus

Q5/ A child has severe blue skin and lips (cyanosis) and was diagnosed with RSV infection. What treatment is suitable for him?

A	Paracetamol Pills	B	Inhaled Ribavirin	C	Inhaled Amantadine	D	Inhaled Tamiflu

Q6/ Acute or subacute sclerosing panencephalitis is characteristic of which virus?

A	Swine Flu	B	RSV	C	Measles	D	Mumps

SAQs:

Q1/ What is the common viral cause of laryngotracheobronchitis (Croup)?

Parainfluenza virus

Q2/ Which virus causes bronchiolitis and pneumonia for infants below 6 months?

Respiratory Syncytial Virus (RSV)

Q3/ Kolpiks spots is a unique diagnostic feature for?

Measles

Meet The Team :)

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Ali Al-Abdulazem

Khalid Al Tameem

Mohammed Alsahali

Omar Albaqami

Rakan Alarifi

Saud Alsaeed

Ali ALhajji