

# Viruses causing respiratory system

Color index:

- Important
- Doctor Notes
- Extra, TN



# Objectives :

- Introduction to respiratory viral infections.
- Characteristics of respiratory viruses (Orthomyxoviridae, Paramyxoviridae).
- Characteristics of MERS-CoV, Rhinovirus, Coxsackieviruses & other Picornaviruses, Adenovirus, and Epstein - Barr virus.
- Knowing the mode of transmission (hint: most of it by inhalation ^^).
- Clinical features.
- Lab diagnosis.
- Treatment and prevention. (Most of them are self limiting and have no treatment).



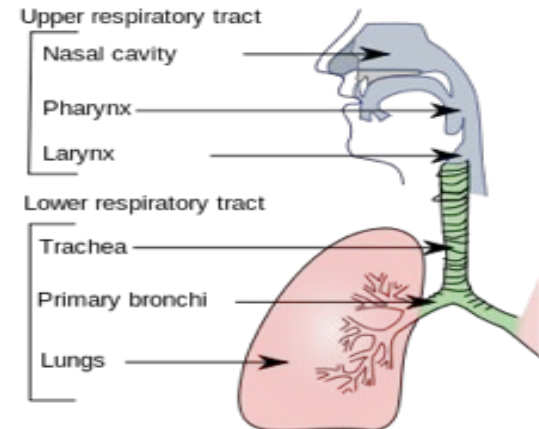
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# Respiratory Tract Infections

- ❖ 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). (if it gets to the lower respiratory tract it become severe)
- ❖ Mostly are self-limiting disease. ( a disease that tends to go away on its own, without treatment)
- ❖ URT-infection may spread to other organs causing more severe infection and death.

## Clinical Manifestations (symptoms)

- ❖ Common cold (rhinitis).
  - ❖ Pharyngitis.
  - ❖ Tonsillitis.
  - ❖ Sinusitis & otitis media.
  - ❖ **Croup** (acute laryngotracheobronchitis).
  - ❖ Acute bronchitis.
  - ❖ Acute bronchiolitis.
  - ❖ Viral pneumonia.
- } Lower respiratory tract infections





# Orthomyxoviridae Family

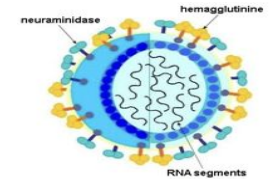
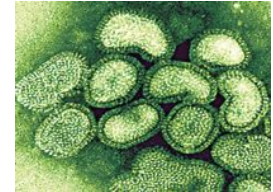
Influenza virus, (Avian flu and Swine flu)

## 1. Influenza Virus:

<b>Family:</b> Orthomyxoviridae	<b>Structural features:</b> <b>Enveloped virus</b> with 2 projecting glycoprotein spikes: - Haemagglutinin (H) - Neuraminidase (N)	<b>Genome:</b> - <b>8 Segmented</b> -ev polarity ssRNA, - This virus is highly <b>susceptible to mutations</b> and rearrangements within the infected host.
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### - Influenza viral proteins:

★ Haemagglutinin (H)	Neuraminidase (N)
<b>Attachment</b> to the host cell surface receptors. No Attachment = No infection	Responsible for <b>release of the progeny viral</b> particles from the infected cell.
Antibodies to the HA is responsible for immunity. *our immune system use it as an antigen .	-
<b>16</b> haemagglutinin antigenic type, (H1 – H16).	<b>9</b> neuraminidase antigenic type, (N1 – N9).
Human associated H antigenic type are <b>H1, H2, H3</b> Other H for animals, though it can infect human (*).	Human associated N antigenic type are <b>N1, N2</b> . Other N for animals, though it can infect human (*)



Because it's highly susceptible to mutations it's hard to make a specific drug for it

\*If there is only one of the human associated antigenic in a virus, either H or N, this virus can infect a human.

# Influenza Virus

Types	Type A	Type B	Type C
Infect:	Human and Animal.	Human only.	Human only.
Cause:	Human: Epidemic & Pandemic. Animal: Epizootic.	Outbreak.	Mild illness.
Antigenic changes :	- Antigenic drift - Antigenic shift = Reassortment = rearrangement	Antigenic drift only.	-

What is antigenic changes ?

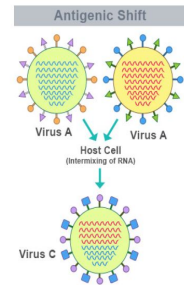
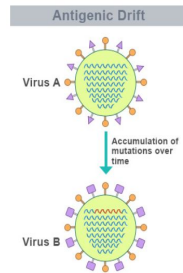
- influenza virus is highly susceptible to mutations and rearrangements within the infected host, which can lead to formation of new set of antigens expressed in the virus.

Thus, formation of new set of antigens will create a difficulty to control the infection of the virus, which can lead to epidemic disease.

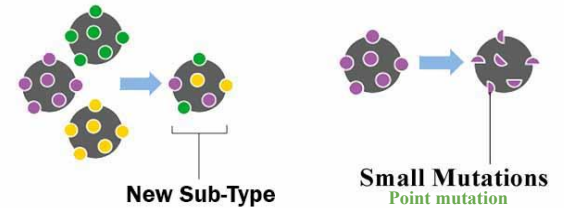
Ex: if (Human H2) and (Avian H3 Human can't accept it) (viruses where H represent type of Hemagglutinin ) unite to produce a new virus ( Human H3 humans and avians can accept it and it is more aggressive)

So how can they unite ?

By a creature which can accept both type of hemagglutinin which is usually "pigs"

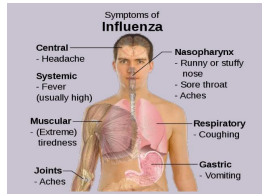


## Differences Between Antigenic shift & Antigenic drift



- Antigenic drift → Minor change in genetic material.
- Antigenic shift → Major change in genetic material.

# Influenza Virus



1-4 days

I.P.

Transmission

Inhalation of infectious aerosol droplets.

Pathogenesis

infects the epithelial cells of the nose, throat, bronchi and occasionally the lungs.

Symptoms

-Fever, malaise, headache, cough, chills, sore throat, generalized pain.

Prognosis

Usually self-limiting disease.

Complications

- Primary influenza pneumonia. (if virus enters the lung directly without infect URT first)
- 2<sup>nd</sup> bacterial pneumonia (Bacteria enters the lungs in response to viral infection)
- Reye's syndrome (fatty degeneration of CNS and Liver, if you give Aspirin to child with viral infection.)

Lab diagnosis

Direct detection of influenza A or B virus from :  
 - Nasopharyngeal Aspirate (NPA) - Sputum  
 routine testing: -respiratory secretion -Nasopharyngeal swab  
 By Direct Immunofluorescence assay (IFA)

Treatment

- 1- Amantadine: for Influenza A virus only.
- 2- Rimantadine, Oseltamivir (Tamiflu) or Zanamivir (Relenza) : For both Influenza A & B viruses & Can be used as treatment of prophylaxis (Prevention).

Prevention  
The available:

1- Given to people older than 6-months, either healthy or those with chronic medical conditions: (the flu shot vaccine, which is inactivated "Killed vaccine").

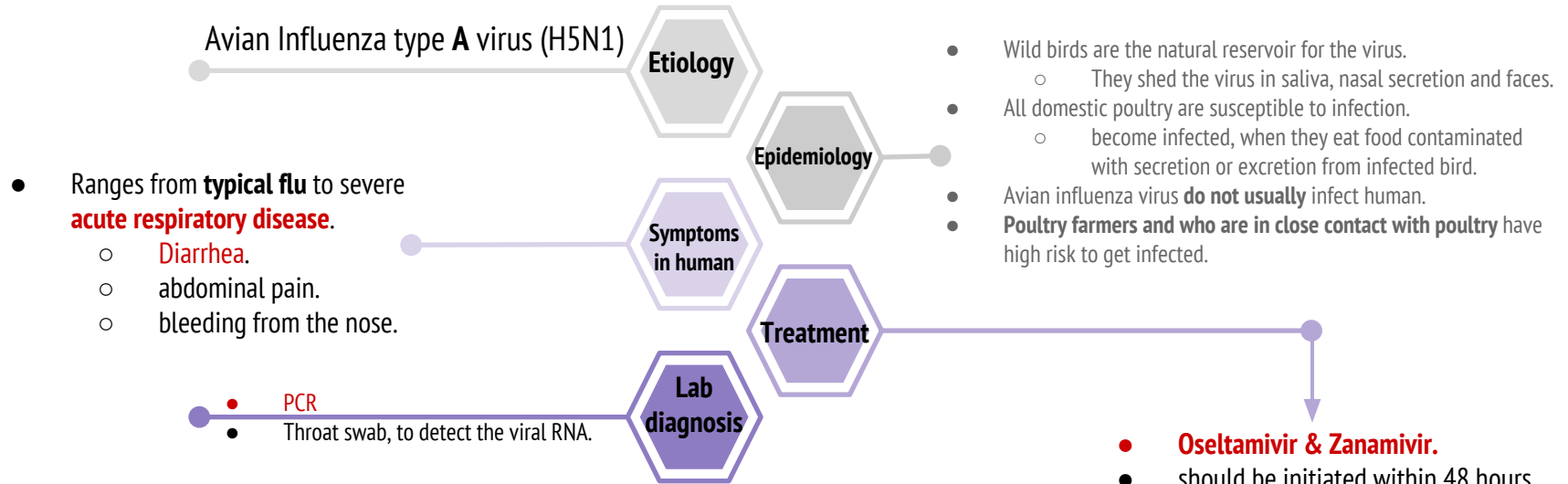
2- Approved for healthy people between 5-49 years: (the nasal spray flu vaccine "Flu mist" which is Live attenuated).

-Both of them contain two strains of current circulation of Influenza A&B viruses. (affect both A&B).

-vaccine should be given in Oct & Nov before the influenza season begins.

# Influenza Virus

- Divided into subtypes based on the haemagglutinin and neuraminidase proteins.
  - The currently circulating strains are: H1N1 & H3N2.
- There are two Flu:
  - 1- Swine flu. (H1N1)
  - 2- Avian (bird) flu:
    - Typical of Orthomyxovirus family.





# Paramyxoviridae Family

ParaInfluenza virus, RSV & Human metapneumovirus, Measles virus, and Mumps virus.

## 1. Parainfluenza Virus:

<b>Family:</b> Paramyxoviridae Family	<b>Structural features:</b> <ul style="list-style-type: none"><li>- Enveloped virus with -ve polarity ssRNA genome with 5 serotypes</li></ul>
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## 2. Respiratory Syncytial Virus (RSV) & Human metapneumovirus:

<b>Family:</b> Paramyxoviridae Family	<b>Structural features:</b> <ul style="list-style-type: none"><li>- Enveloped virus with -ve polarity ssRNA genome</li></ul>
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## 3. Measles Virus:

<b>Family:</b> Paramyxoviridae Family	<b>Structural features:</b> <ul style="list-style-type: none"><li>- Enveloped virus with -ve polarity ssRNA genome</li></ul>
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## 4. Mumps Virus:

<b>Family:</b> Paramyxoviridae Family	<b>Structural features:</b> <ul style="list-style-type: none"><li>- Enveloped virus with -ve polarity ssRNA genome</li><li>- The viral envelope is covered by two glycoprotein spikes, hemagglutinin and neuraminidase</li></ul>	<b>is an acute benign viral parotitis.</b> <b>Parotitis</b> : (painful inflammation and swelling of salivary gland and mainly <b>parotid glands</b> ) -it is a <b>disease of children</b> (5-15 years), but also can be seen in young <b>adult with more complicated feature.</b>
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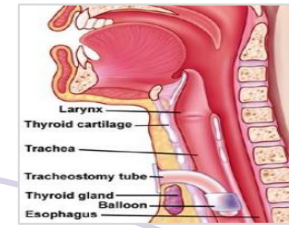
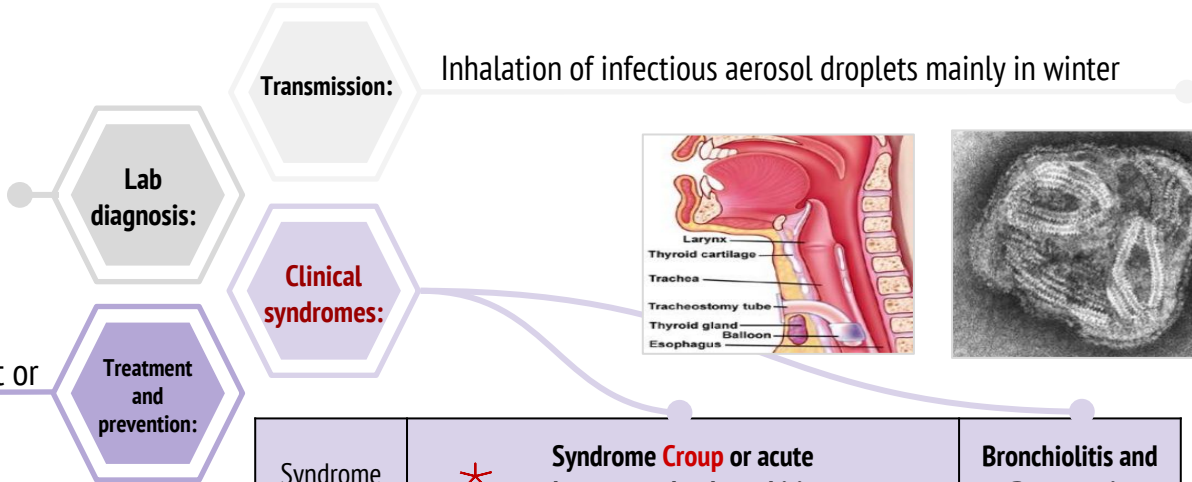
# 1. Parainfluenza Virus:

## routine testing :

-direct Immunoflourecent assay (IFA), by Nasopharyngeal swab, Sputum and , Nasopharyngeal Aspirate (NPA) .

**Other detection :** tissue culture and PCR

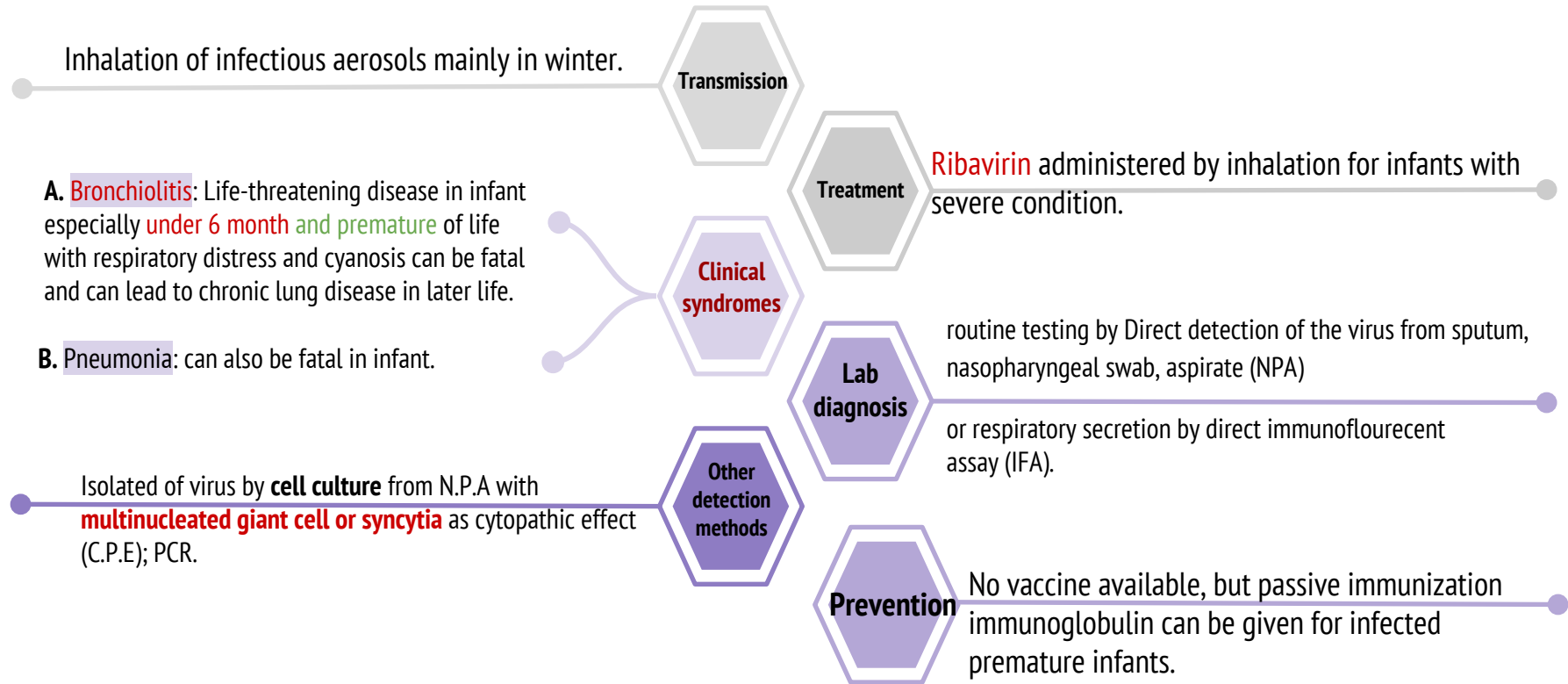
Supportive treatment, **No** specific treatment or vaccine available.



Syndrome	* Syndrome <b>Croup</b> or acute laryngotracheobronchitis	Bronchiolitis and Pneumonia
Infecting type	PIV Type-I, II	PIV Type-III
Host	infants and young children.	young children
symptoms	Fever, harsh cough, difficult inspiration can lead to airway obstruction which may require hospitalization and tracheostomy.	-

More common in infant and young children. In adult is just a common cold.

## 2. Respiratory Syncytial Virus (RSV) & Human metapneumovirus



More common in infant

# 3. Measles Virus

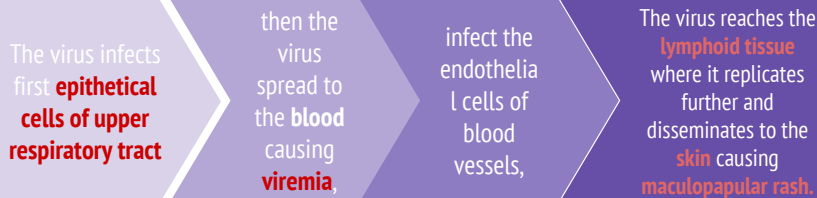
## Transmission

Inhalation of infectious aerosol droplets.

## Epidemiology

- Measles virus **infects human only**.
- Most cases in **preschool children**, very infectious, infection occurs mainly in **winter** and **spring**.

## Pathogenesis



## Lab diagnosis

- Serology by detection of IgM Ab using ELISA.
- in case of SSPE, detection of measles Abs in CSF or detection of viral NA using PCR.

## Clinical features

- **Incubation period:** 7-10 days.
- Prodromal symptoms: **Fever, cough, conjunctive & running nose.**
- ★• **Koplik's spot\*:** small red papules with **white central dots** appear mostly in **buccal mucosa**.
- **Rash:** Maculopapular rash first on face, trunk, extremities.
  - it is red, & become confluent, last for 4 - 5 days, then disappears the skin become brownish, and desquamation.
  - recovery complete in normal children with life long immunity, & complication can occurs.



\*little spots inside the mouth that are highly characteristic of the early phase of measles (rubeola).



## complication

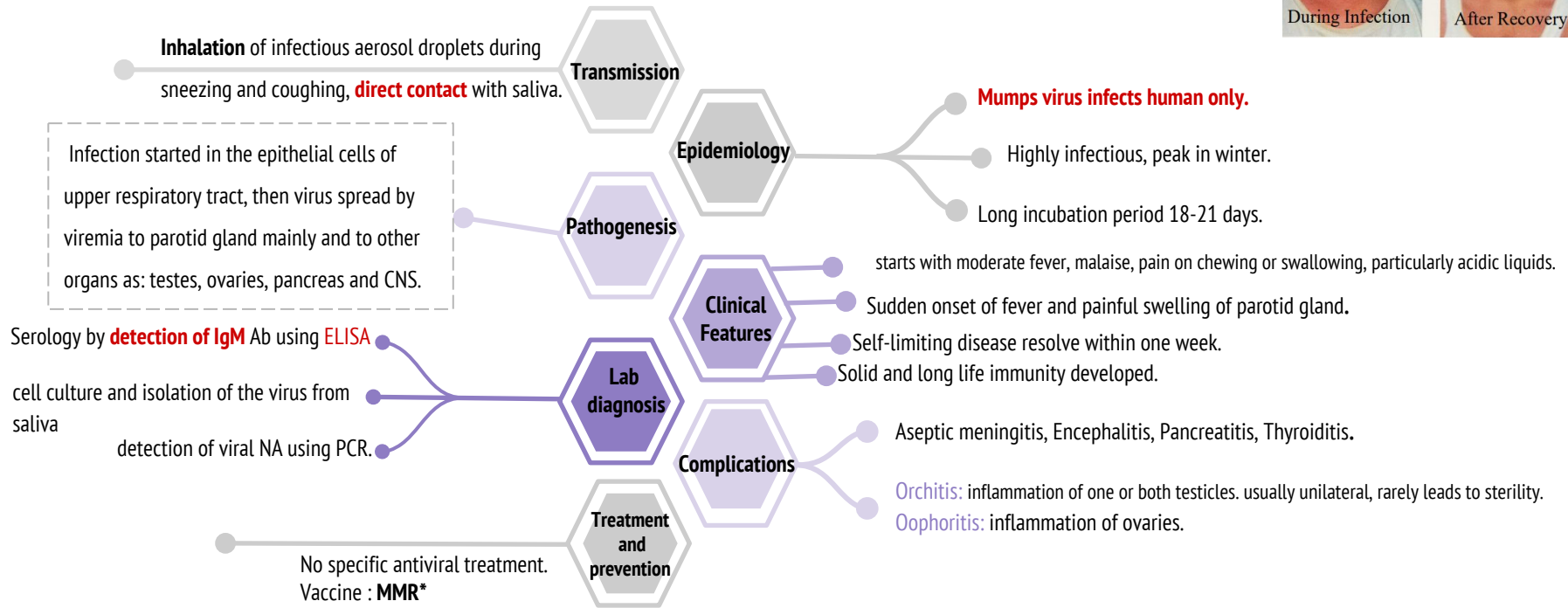
1. **Encephalitis:** Acute or subacute sclerosing panencephalitis (SSPE).
2. **Giant cell pneumonia:** in immunocompromised children is rare due to direct invasion of measles virus to lung tissue.

## Treatment & prevention

- No specific treatment.
- prevention by **giving the live attenuated vaccine (MMR)** for Measles, Mumps, & Rubella (to all children 15 months age and booster dose at school entry), **it give excellent long last protection.**

# 4. Mumps Virus

Very infectious



\***MMR**: Live attenuated vaccine for Measles, Mumps and Rubella given to all children 15 month and booster dose at school entry. Give excellent long last protection.

Complications are more common in adults

# Coronaviridae Family

## Family:

Corona Virus (Coronaviridae family)

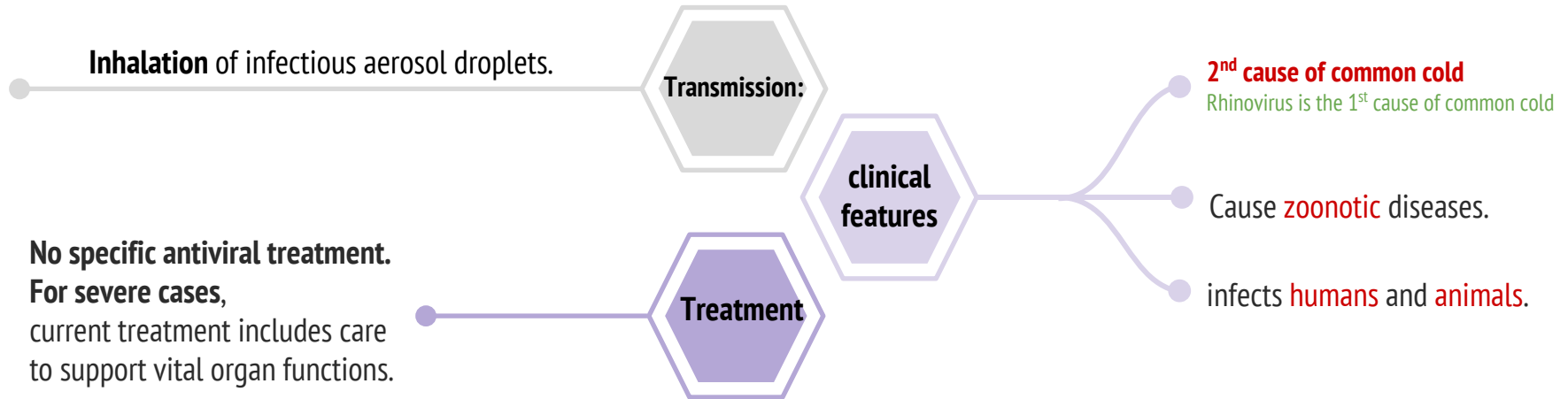
## Structural features:

- Enveloped virus with +ve polarity ss-RNA genome

## Severe forms of Corona virus

1) Severe Acute Respiratory Syndrome (SARS)

2) Middle East Respiratory Syndrome (MERS)



# Severe forms of Corona virus

## 1) Severe Acute Respiratory Syndrome (SARS)

### Severe forms of Corona virus

1) Severe Acute Respiratory Syndrome (SARS)

2) Middle East Respiratory Syndrome (MERS)



The animal reservoir may be **cats** or **bats**.

### Symptoms :

- SARS starts with **high fever** followed by **cough** with **difficulty in breathing** (atypical pneumonia).
- Associated with high mortality due to respiratory failure.

In winter of 2002, a new respiratory disease known as (SARS) emerged in China after a new mutation of **coronavirus**.

The disease spread worldwide due to travelling.



# Severe forms of Corona virus

## 2) Middle East Respiratory Syndrome (MERS)

### Severe forms of Corona virus

1) Severe Acute Respiratory Syndrome (SARS)

2) Middle East Respiratory Syndrome (MERS)

### Story skip me

In September 2012, a case of novel (New) coronavirus infection was reported involving a man in Saudi Arabia who was admitted to a hospital with **pneumonia and acute kidney failure**. This virus has been named as **Middle East Respiratory Syndrome- CoronaVirus (MERS-CoV)**, virus closely related to several bat coronaviruses.

### Epidemiology

- MERS-CoV infected several human cells, including **lower but not upper respiratory**, kidney, intestinal, and liver cells.
- So far, all the cases have been linked to countries in and near the Arabian Peninsula
- Highly infectious, Peak in winter, with **incubation period** (2-14 days)

### Transmission

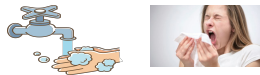


- close contact with ill people
- **it's not epidemic or pandemic.**
- close contact with infected animals

### Prevention

People should protect themselves from respiratory illnesses by taking everyday preventive actions:

- Wash hands often with water and soap or use an alcohol-based hand sanitizer.
- Cover nose and mouth with a tissue when cough or sneeze.
- Avoid touching eyes, nose and mouth with unwashed hands.
- Avoid personal contact with sick people.
- Clean and disinfect frequently touched surfaces such as toys and doorknobs.



### Risk group

- Individuals with weakened **immune systems**
- People with **pre-existing medical conditions** (or comorbidities) such as diabetes, cancer, and chronic lung, heart, and kidney diseases

### Clinical features

- Some people also had **gastrointestinal symptoms** including **diarrhea** and **nausea/vomiting**.
- Some **infected people had mild symptoms** (such as cold like symptoms) or **no symptoms** at all and they **recovered completely**.
- Most people with confirmed MERS CoV infection developed **severe acute respiratory illness**.
- They had **fever, cough, and shortness of breath**.

### Complication

- Severe complications include pneumonia and kidney failure.
- About 30% of infected people died (specially those who had included in the risk group)

### Diagnosis

- Detection of the viral nucleic acid (NA) by **PCR** (Polymerase Chain Reaction).
- Other methods: Isolation of the virus from Nasopharyngeal aspiration (NPA) by cell culture.

# Picornaviridae Family

Rhinovirus, Coxsackieviruses, & other Picornaviruses

## 1. Rhinovirus:

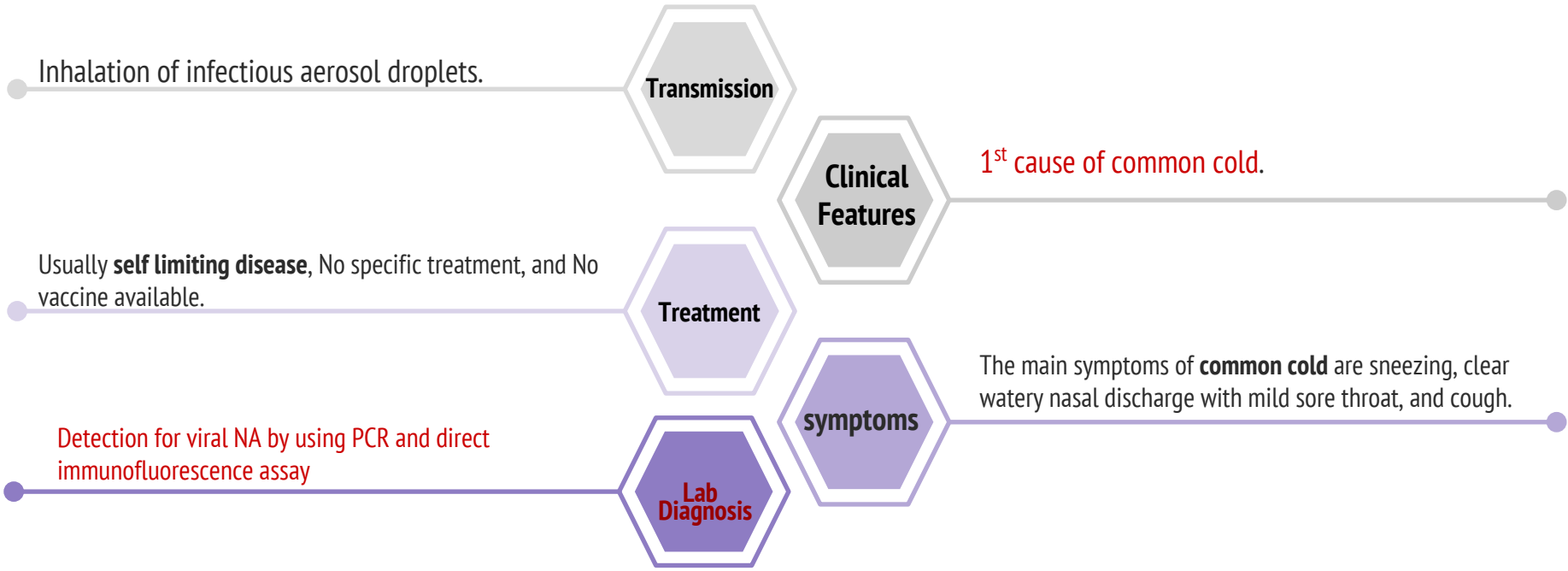
<b>Family:</b> Picornaviridae	<b>Characteristic:</b> <b>Non enveloped</b> virus with (+ve polarity ssRNA) genome, more than 100 serotypes available.
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## 2. Coxsackieviruses & other Picornaviruses:

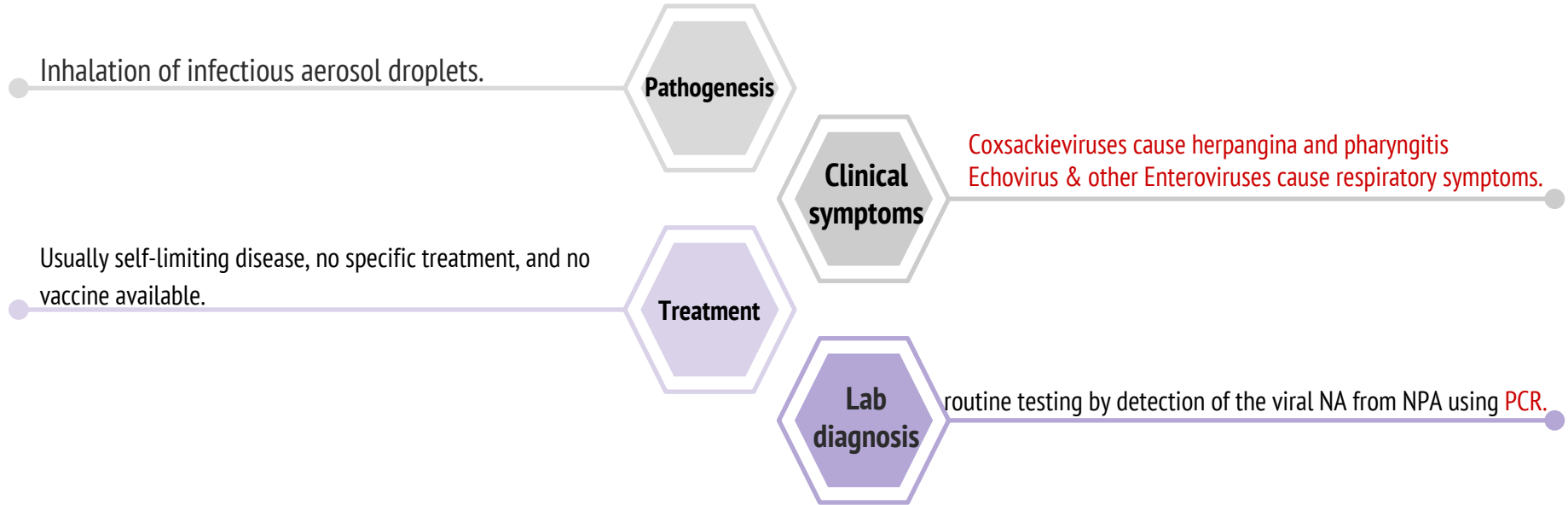
<b>Family:</b> Picornaviridae	<b>structural features :</b> <b>Non-enveloped</b> virus with + polarity ssRNA genome Coxsackieviruses group A & B, Echovirus, Enteroviruses.
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# 1. Rhinovirus:



## 2. Coxsackieviruses & other Picornaviruses





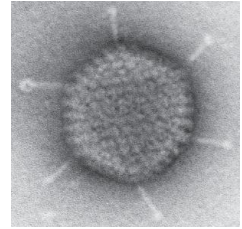
# Adenoviridae Family

## Adenovirus:

**Family:** Adenoviridae

**structural features :**

**Non-enveloped** virus with **ds-DNA genome** .



Adenovirus infects **epithelial cell lining respiratory tract**, conjunctiva, urinary tract, gastrointestinal tract and genital tract\*.

**Pathogenesis**

**Lab diagnosis**

routine testing by **direct detection** of the Ag from NPA by direct IFA.  
**Other detection methods:** tissue culture, PCR.

**Treatment**

No specific treatment or vaccine.

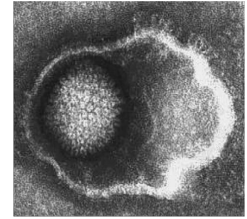
### Clinical syndromes:

1. Pharyngitis and tonsillitis
2. Pharyngoconjunctivitis
3. Conjunctivitis
4. Pneumonia: in preschool children.
5. Gastroenteritis
6. Acute hemorrhagic cystitis.
7. UTI (Cervicitis and urethritis).

#### IMPORTANT

\* But it **can't** affect the brain and cause meningitis or encephalitis

# Herpesviridae Family



## Epstein - Barr Virus (EBV):

<p><b>Family:</b> Herpesviridae</p>	<p><b>structural features :</b> <b>enveloped</b> , icosahedral <b>dsDNA virus</b>.</p> <ul style="list-style-type: none"><li>- It is <b>lymphotropic</b>.</li><li>- It has <b>oncogenic</b>* properties; Burkitt's lymphoma. Nasopharyngeal carcinoma.</li></ul> <p><small>* can cause cancer</small></p>	<p><b>Epidemiology :</b></p> <ul style="list-style-type: none"><li>● <b>Distribution:</b> worldwide (Mainly in teenagers &amp; young adults)</li><li>● Transmission:<ul style="list-style-type: none"><li>- <b>Saliva</b> [kissing disease]</li><li>- <b>Blood</b> [rarely]</li></ul></li><li>● Age:</li></ul> <p>Socio-economic status: SE Low SE class → early childhood. (Mild) High SE class → adolescence . (Severe)</p>
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## clinical features

### Immunocompetent host.

- Asymptomatic ( in young children )
- **Infectious mononucleosis** ( in adolescence )  
[or glandular fever]
- IP = 4-7 weeks
- Fever
- sore throat , tonsillitis, malaise , pharyngitis
- hepatosplenomegaly & abnormal LF
- hepatitis.
- Complications :  
(acute airway obstruction, splenic rupture, CNS inf)



### Immunocompromised host.

- Lymphoproliferative disease ( LD).
- oral hairy leukoplakia (OHL)
- Nasopharyngeal carcinoma
- Burkitt's lymphoma

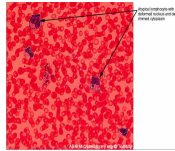


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## Diagnosis

### Hematology :

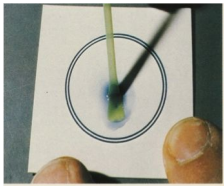
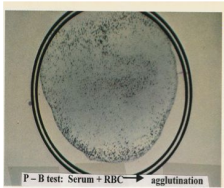
↑ WBC .  
lymphocytosis



(Atypical lymphocytes)

### Serology tests:

- Non-specific AB test ;  
-Heterophile Abs +ve.  
-Paul-Bunnell or monospot test.
- EBV-specific AB test :  
Detection of IgM Abs to EBV capsid antigen by ELISA .



## Management

- Treatment:  
there is no treatment for infectious mononucleosis.
- Prevention:  
-No vaccine .

## Influenza Virus

- Antigenic drift → minor change. (No change in genome)
- Antigenic shift “rearrangement” → major change (change in genome ) 2 strains enter the intermediate host (pig)

Treatment:

Amantadine -

Cover group A&B : oseltamivir (tamiflu)

Diagnosis: nasopharyngeal aspirate, culture ( golden standard method ), direct immunofluorescent test, PCR

## Parainfluenza Virus

Cause Common cold  
In children and young children it cause **croup** or **acute laryngotracheobronchitis**

## Respiratory Syncytial Virus (RSV) & Human metapneumovirus

Cause Common cold in all people except in infant under 6 months can cause bronchiolitis

## Measles

- Transmissions by aerosoles respiratory tract infections → viremia → lymphnodes → skin (maculopapular)
- Main clinical feature is **Koplik's spot in mucus cavity.**
- Diagnosis: detection of IgM**
- No Treatment**
- Prevention: MMP vaccine**
- Complications: encephalitis, pneumonia**

## Mumps Virus

- Transmissions by aerosoles respiratory tract infections
- Inflammation of the pituitary gland
- Diagnosis: detection of IgM**
- No Treatment**
- Prevention: MMP vaccine**
- Complications: infertility, pancreatitis**

## MERS corona

- Epidemiology: in & near the arabian peninsula
- Transmitted by close contact to either human and animals “camels”
- Complications : kidney failure, pneumonia, Respiratory failure and GI problem
- Detect by PCR
- No specific treatment no vaccine

### *Coronaviridae :*

- Second cause of common cold
- can be mutated by cats
- Lead to SARS because of respiratory distress and lower respiratory tract infection

## Rhino Virus

- 1<sup>st</sup> cause of common cold
- Detect by PCR

### *Picornaviridae :*

- ss-RNA +ve polarity.
- Non-enveloped

## Coxsackieviruses & Others

- Cause herpangina & pharyngitis.
- Cause respiratory symptoms
- Detect by PCR

## Adenovirus

- Infect epithelial cells lining respiratory tract, GI, conjunctiva, urinary tract, **(don't affect the brain)**
- Conjunctivitis
- Detect by IFA and PCR

### *Adenoviridae :*

- ds-DNA
- Non-enveloped

## Epstein – Barr Virus (EBV)

- Has oncogenic properties
- Transmit by saliva & Blood
- IMMUNOCOMPETENT:
  - Asymptomatic
  - Infectious mononucleosis
- IMMUNOCOMPROMISED:
  - LD & OHL diseases
  - Nasopharyngeal carcinoma
  - Burkitt's lymphoma
  - Increase WBC (atypical lymphocytosis”
- Nonspecific Ab test :
  - +ve heterophile Abs
- Specific Ab test:
  - IgM Abs by ELISA
- No specific treatment No Vaccine

### *Herpesviridae :*

- Icosahedral ds-DNA
- Enveloped



# Quiz :



1) the genome of influenza virus is :			
A. <b>8 Segmented</b> +ev polarity ssDNA	B. <b>6 Segmented</b> -ev polarity ssRNA	C. <b>8 Segmented</b> -ev polarity ssRNA	D. <b>8 Segmented</b> -ev polarity dsRNA
2) Measles virus infects ....			
A. Human & animals	B. Humans only	C. Animals only	D. infants only.
3) Coxsackieviruses & other Picornaviruses are transmitted by :			
A. inhalation	B. orally	C. sexually	D. skin contact
4) which one of the viruses below is the 1st cause of common cold ?			
A. Corona Virus	B. Mumps Virus	C. Epstein - Barr virus	D. Rhinovirus
5) how to detect swine flu ?			
A. Immunofluorescence	B. PCR	C. Culture	D. Serology IgM Ab by ELISA
6) koplik's spot is characteristic of which virus ?			
A. Adenovirus	B. Herpes virus	C. Influenza virus	D. Measles virus



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