

*Course 4*  
*Special epidemiology*

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# *Influenza*



# *Definition*

- **A viral acute infection with aerogenous transmission and significant general effects on the body;**

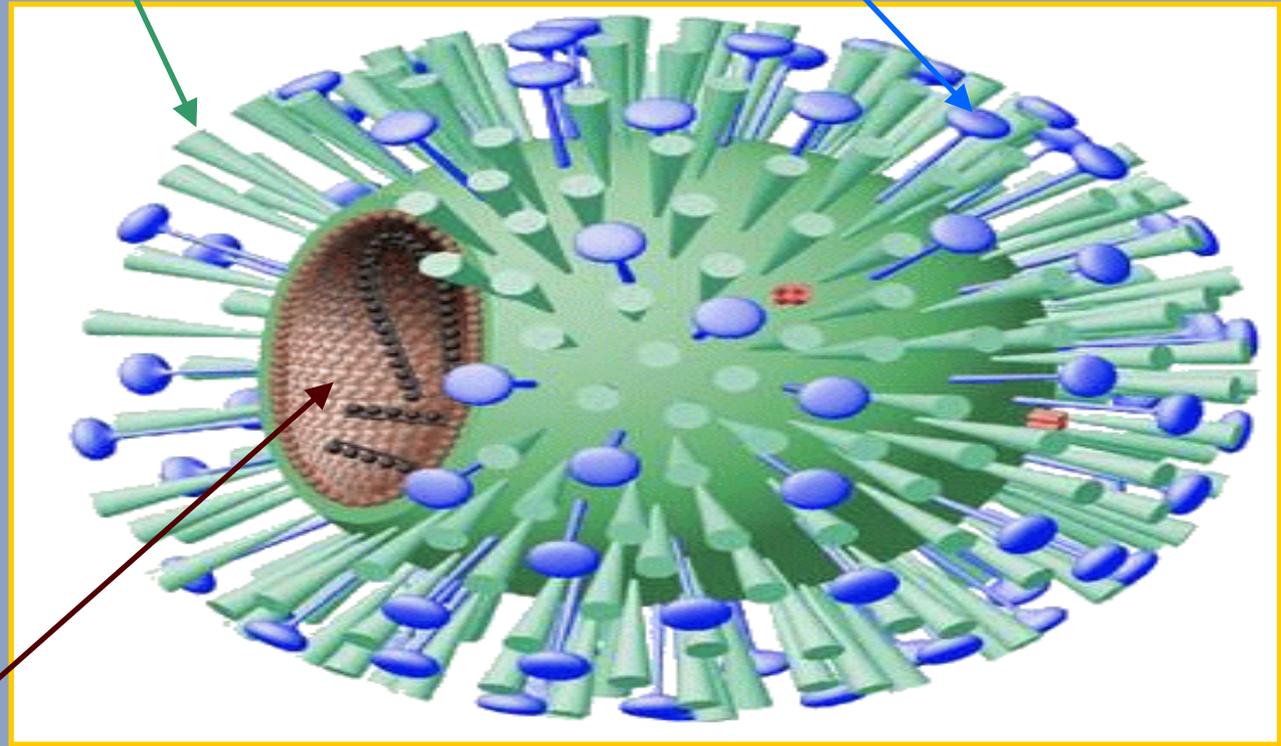
## **Characteristics of the aetiological agent**

- ✓ **part of the *Orthomyxoviridae* family, genus *Influenzae*;**
- ✓ **Less resistant in the external environment;**
- ✓ **Influenza viruses type A are sensitive to hydrochloric amantadine and to rimantadine;**

# *The influenza virus*

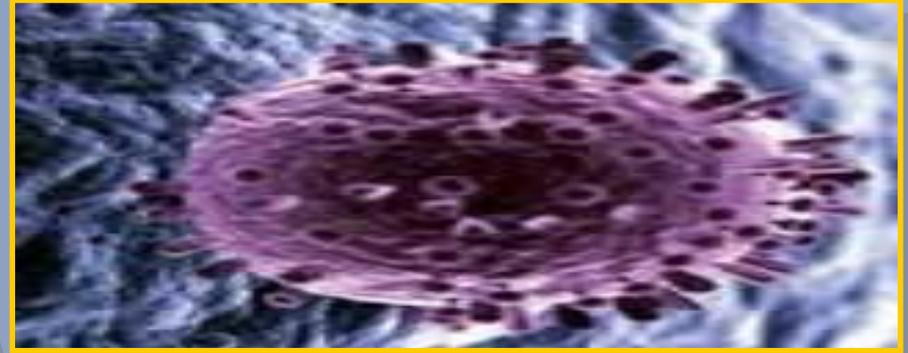
Hemagglutinin/H

Neuraminidase/N



RNP with nucleoprotein and 8 segments of single-chain RNA

# *The influenza virus*



## The central component of the virus:

- ✓ It is the soluble antigen of the influenza virus;
- ✓ It is made up of ribonucleoprotein, which contains nucleoprotein and 8 RNA segments, each of which represents a gene;
- ✓ Associated with ribonucleoprotein, we have viral transcriptase, making 256 genetic recombinations among the RNP fragments theoretically possible;

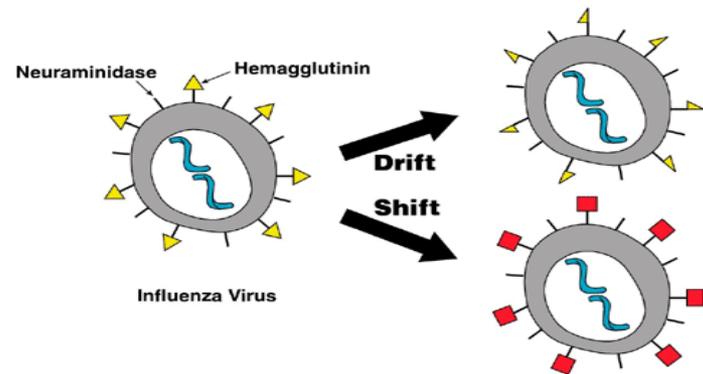
# *The influenza virus*

## Peripheral coating:

- ✓ Lipoproteic, double-layered;
- ✓ Covered with glycoproteic structures with surface antigens:
  - At least 15 haemagglutinins (H), in the shape of a cane, with a role in the attachment of the virus on the specific receptors of the host cell and in the onset of the infection;
  - At least 9 neuraminidases (N), mushroom-shaped;
- ✓ Strain formula: Ex: A/Hong-Kong/1/68(H<sub>3</sub>,N<sub>2</sub>)

# *The influenza virus*

## **Influenza: Antigenic Drift and Shift**

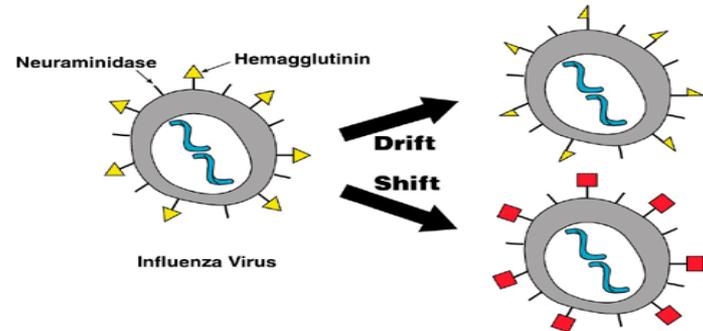


### **Antigenic drifts (minor variability):**

- ✓ once in a few years, the sequence of some antigens in the structure of haemagglutinin or neuroaminidase changes and new variants of the same subtype of influenza virus emerge;
- ✓ They may cause moderate epidemics;

# The influenza virus

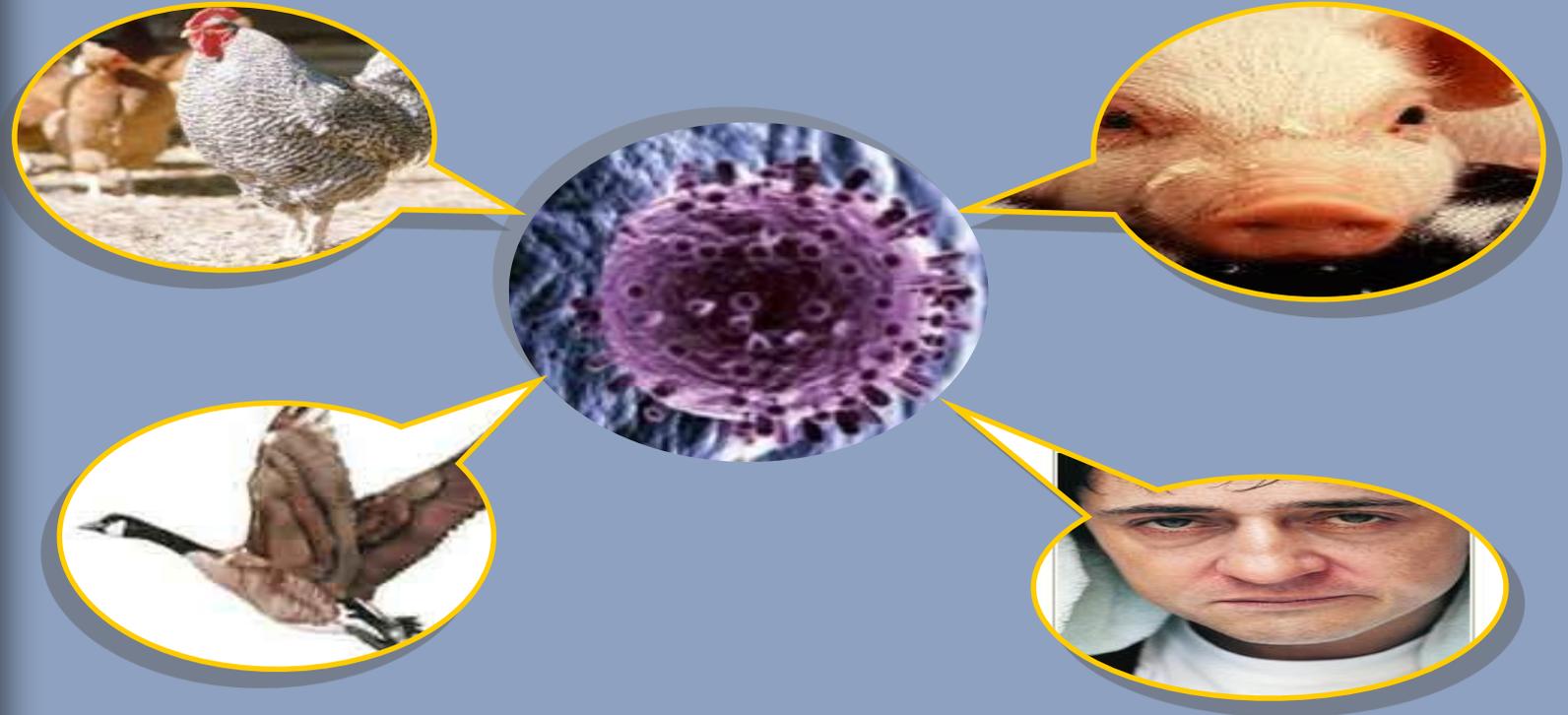
## Influenza: Antigenic Drift and Shift



### Antigenic shifts (major variability):

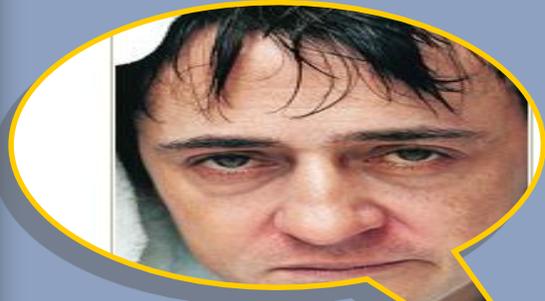
- ✓ at a larger interval of time, 2 different influenza virus subtypes simultaneously infect the same host cell and can undergo a rearrangement of the 8 genic segments;
- ✓ This generates new subtypes of the influenza virus, with a pandemic potential, in an immune naive population.

## *The infection source*



**It may be sick humans as well as sick animals,  
which is why influenza is considered an  
anthropozoonosis.**

## *The infection source*



**The human infection source** – is represented by:

- ✓ the acutely sick person (contagious in the first 3-5 days of the disease);
- ✓ The inapparently infected persons (with the largest share);
- ✓ The persons with a latent infection, which would maintain the virus among the population between the epidemic seasons.

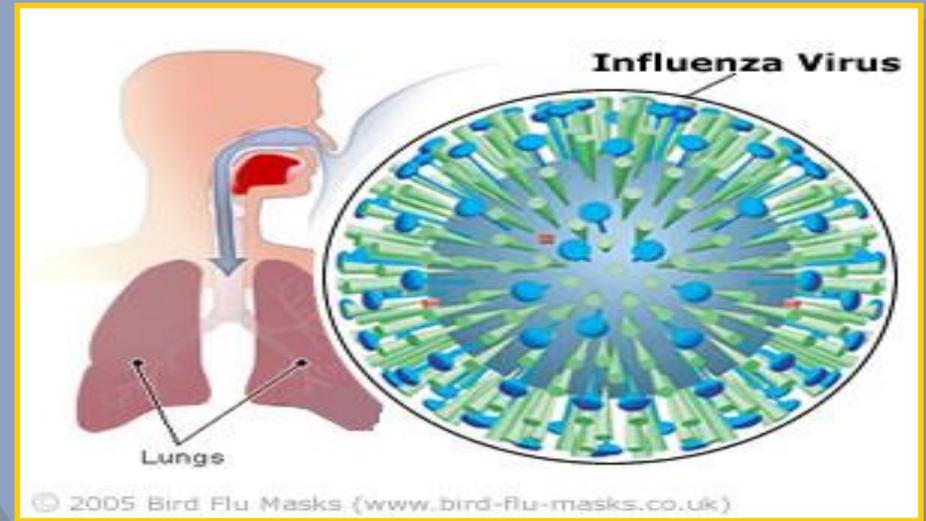


## *The infection source*

### The animal or extra-human infection source

- ✓ pigs, horses, and other wild or domestic animals/birds;
- ✓ These species can display:
  - Manifested acute infection;
  - Persistent infection;
  - Vertically transmitted infection;
  - Cross-infection among species.

# *Transmission routes and mechanisms*



- ✓ Transmission is **direct, aerogenous**, through Flugge's droplets, especially in confined spaces;
- ✓ There is the possibility of transmitting the infection from the animal infection source to the human species, followed by inter-human retransmission of the viruses of animal origin.

## *The receiving population*



- ✓ General population receptiveness;
- ✓ Higher among children – the most efficient vectors of influenza;
- ✓ Post-infectious immunity is **strain-specific** and permanent;
- ✓ Post-vaccine immunity is homologous to the vaccine formula and transitory – no longer than 1 year.

# *Factors favouring the epidemiological process*



- ✓ **Natural factors:** favour the cold-season feature of influenza in the temperate area;
- ✓ **Economic and social factors** – favour the spreading of the disease among the population, especially through various types of human agglomeration.

# *Manifestations of the epidemiological process*

**Influenza can manifest itself:**

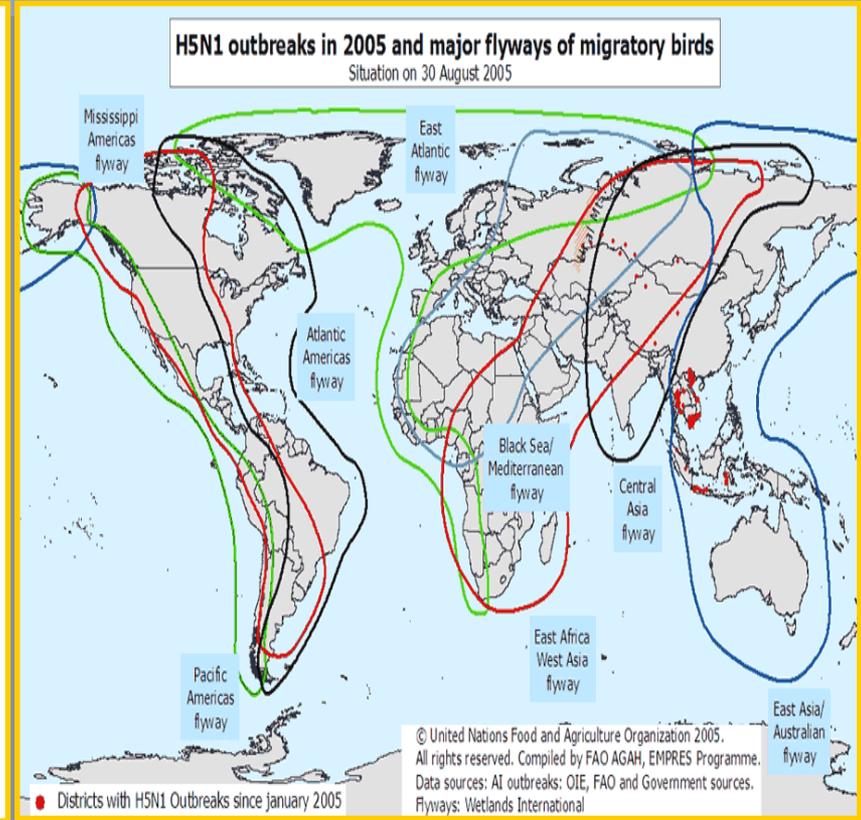
- ✓ **Sporadically (type C);**
- ✓ **Epidemically (types B and A) and**
- ✓ **Pandemically (type A).**

**Epidemics occur almost exclusively in the **cold season**, in the temperate area (October-April in the northern hemisphere and May-September in the southern hemisphere), and in the **rainy season** in the tropical area.**

# *Manifestations of the epidemiological process*

- During an **epidemic**, just one influenza virus strain is predominant among the population (with one exception during the past 15 years);
- In the inter-epidemic periods, the influenza virus apparently disappears from the population (but let us not forget latent infection)!
- New influenza virus strains usually appear in **the Far East**, from where they are then spread worldwide (exception H1N1 in 2009);
- The start of an epidemic is signalled by an increase in school and industrial absences, as well as an increase in morbidity due to pneumonia and influenza infections;

# The origin of antigenic shifts



# *Manifestations of the epidemiological process*

- In any influenza epidemic wave, the case incidence rapidly rises during the first 2-3 weeks and gradually decreases during the next 4-6 weeks;
- Between epidemics, influenza manifests itself **endemo-sporadically**, especially among infants, on the background of collective immunity against the circulating strain;
- The first epidemic wave of a **pandemic** affects between 30-50% of the population, depending on the age group distribution;
- The following epidemic waves are smaller and smaller (one wave in each epidemic season);
- 5 pandemics have been signalled during the past 100 years ,the last one in 2009.

# *Manifestations of the epidemiological process*

- The current forecast envisages the possible emergence of a resorted virus, through the combination of the H5N1 strain with a human influenza strain.



*The Spanish Flu of 1918*

# *Prevention and control*

## The measures regarding sick people include:

- ✓ early identification and home quarantining for 1 week or
- ✓ hospital admission of the people in risk groups and those with complications.

## Measures regarding suspects:

- ✓ Same as in the case of sick people, pending possible disproof.

# *Prevention and control*



## Measures regarding the transmission routes:

- ✓ Those applying to aerogenous infections:
  - Avoiding human agglomerations;
  - Mechanical protection of coughing and sneezing, especially in confined spaces;
  - Hygienic education of the population;
- ✓ Closing and suspending activity in children's collectivities is generally a consequence of high absence rates, not an anti-epidemic measure.

# Prevention and control



## Measures regarding the receptive population:

- ✓ Measures to increase the non-specific resistance of the body (balanced diet, rich in vitamins, avoiding prolonged exposure to cold and excessive fatigue during epidemics);
- ✓ Specific prevention through anti-influenza vaccination at least 2 weeks before the occurrence of sick cases.

## *Prevention and control*



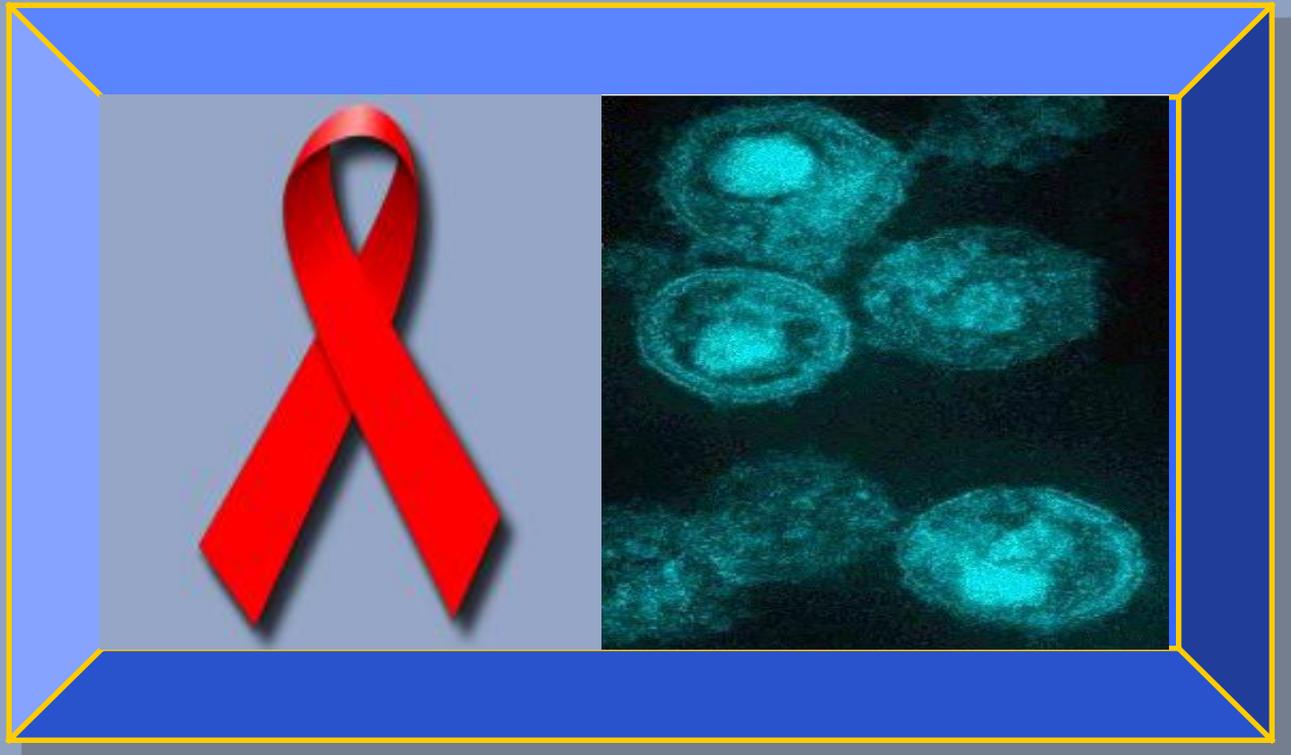
### Measures regarding the receptive population:

- ✓ For type A influenza, chemoprevention with amantadine or rimantadine;
- ✓ Protection is approximately 70%;
- ✓ This type of chemoprevention is recommended to unvaccinated people, whose vaccination is not possible and where there is high individual risk.

## *Infections with parainfluenza viruses*

- These are significant especially in the acute respiratory infection pathology of **children under 5 years of age**, with a peak of seriousness under 6 months;
- Parainfluenza viruses (1,2,3,4) are present worldwide;
- Transmission is aerogenous;
- Post infectious immunity is type-specific;
- Cases show an autumn-winter seasonal periodicity;
- There is no specific immune- or chemotherapy.

# *The human immunodeficiency syndrome*



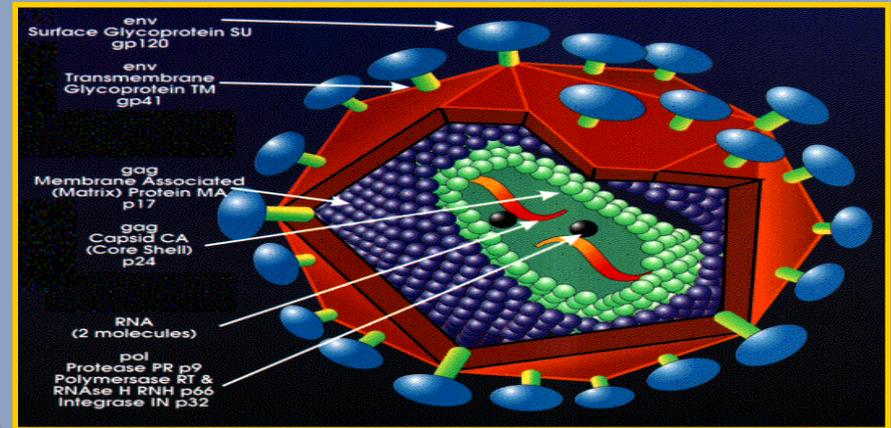
# *Definition*

- **The HIV/AIDS infection is a transmissible disease with a massive and fast spread;**
- **It perfectly matches the definition of a pandemic epidemiological process – new etiological agent, transmitted fast and efficiently among an immune "naive" population;**
- **Since the beginning of the epidemic , almost 78 million people have been infected with HIV virus and about 39 million people died of HIV. Globally , 42 million people were living with HIV at the end of 2019. Sub-saharian Africa remains most severely affected , with nearly 1 in every 20 adults living with HIV and accounting for nearly 71% of the people living with HIV worldwide !**

## *Features of the etiological agent*

- ✓ The human immunodeficiency virus is classified within the family of *Retroviridae*;
- ✓ It maintains virulence at room temperature and in dry material for 3-7 days, and in a water medium for over 2 weeks;
- ✓ Alcohols, hypochlorites, detergents make the virus inactive at lower concentrations than usual ones (ethanol 25%) but in practice, the following are used: hydrogen peroxide 6%, ethanol 70°, Ca and Na hypochlorite 1%, iodophors 2.5%, glutaraldehyde 2%, applied for 1-5 minutes.

# *Features of the etiological agent*



- ✓ The medical instruments must be sterilized by autoclaving and with ethylene oxide;
- ✓ Instruments that cannot withstand thermal processing are immersed in glutaraldehyde solutions (2% concentration) for 30 minutes;

# *The epidemiological process*



**The infection source** – is represented by the infected person, who remains contagious throughout their life;

✓ **Risk groups and infection sources:**

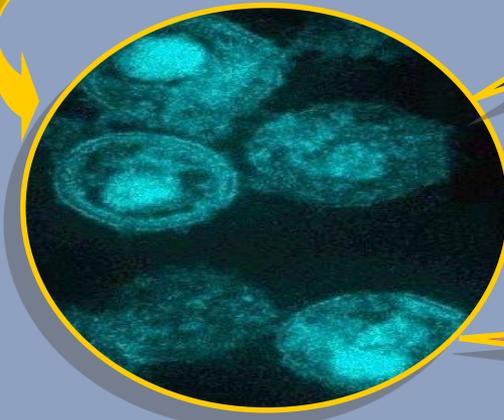
- **Homosexuals and bisexuals;**
- **Heterosexuals with partners from the risk groups or from areas where heterosexual transmission is dominant;**
- **Children born of HIV-infected mothers;**
- **People with sexually transmitted diseases and drug addicts.**

# *The infection source*

- ✓ the virus was isolated from:
  - Blood;
  - Sperm/vaginal secretion;
  - Saliva;
  - Milk;
  - Tears;
  - Urine;
  - LCR;
  - Alveolar and amniotic liquid;
- ✓ Certain role in the transmission: blood and genital secretions.

# *Transmission routes and mechanisms*

- Occurs in practice through sexual intercourse, exposure to blood, and perinatally.



# *Transmission routes and mechanisms*



Sexual transmission – the main transmission route worldwide (80%);

✓ The transmission risk depends on:

- Sexual practices (high risk for unprotected penetration practices);
- Source infectivity (higher towards the final stages);
- Number of partners;
- Coexistence of venereal diseases;
- Vitamin A deficit;
- Susceptibility of the partner – 4 times higher risk for the receptive partner;
- Possibly the viral strain.

# *Transmission routes and mechanisms*



## Transmission through blood and blood products

- ✓ Transmission through contaminated needles and syringes rank first, among consumers of intravenously administered drugs;
- ✓ Their risk increases with the duration of drug usage, sharing of needles, number of injections, residence in areas with high HIV prevalence;
- ✓ The infection risk from a blood unit coming from an HIV-positive person is practically 100%;
- ✓ The risk of infection following artificial insemination with sperm from an HIV-positive donor is 3.5%;

# *Transmission routes and mechanisms*



## Transmission through blood and blood products

- ✓ The risk of seroconversion after stinging with needles coming from HIV-positive patients is 0.2-0.5%, but the individual risk is higher if:
  - The lesion is deep;
  - Performed with contaminated IV needles or instruments;
  - The source patient is in the final stage;
- ✓ In the case of nosocomial accidents, chemoprevention should be started in a triple association, 1-2 hours following exposure, serologic surveillance after 6 weeks, 3 and 6 months, and monitoring adverse reactions.

# *Transmission routes and mechanisms*



**Perinatal transmission** - with a rate of 13-30% occurs

- ✓ transplacentally,
- ✓ during birth – through exposure to blood and other contaminated liquids;
- ✓ Postpartum – through milking;
- ✓ Currently, over 80% of HIV-positive women are at the reproductive age and their number is increasing;
- ✓ Although the maternal milk contains the HIV virus, in developing countries, the risk of infection among breast-fed children is counterbalanced by the beneficial effects for diarrhoeic and respiratory illnesses.

## *Transmission routes and mechanisms*



**Although the HIV virus was isolated from saliva, the risk of saliva-based transmission is extremely low, and transmission through vectors has not been proven.**

## *The receiving population*



- ✓ Receptiveness is general and, once contracted, the infection persists for a lifetime;
- ✓ The favouring factors: ethnic minorities and low-income people are affected, due to the concentration of risk factors
  - Prostitution;
  - Drug consumption;
  - Promiscuity.

# *Epidemiological process manifestation*



## **PANDEMIC**

- ✓ **1,8 million new infections in 2019 !**
- ✓ **or approximately 5.000 new cases/day.**

# *Prevention and control*

- The anti-AIDS battle has 3 major aims:

**Prevention of HIV infection**

**Reducing the personal and social impact among symptomatic or asymptomatic HIV-positive people**

**Coordinating national and international efforts**

# *Preventing the transmission*



Prevention is based on interrupting the transmission!

- ✓ **The risk of sexual transmission is reduced by:**
  - **Mechanical protection;**
  - **Reducing the number of partners;**
  - **Changing the sexual behaviour.**

# *Preventing the transmission*



**Prevention of blood and blood product transmission is done through:**

- ✓ Donor screening;
- ✓ Thermal and ethanol-based processing of the subproducts;
- ✓ For drug addicts – the correct use of needles and syringes is recommended; secondly, drug addiction prevention.

## *Preventing the transmission*



### Preventing the perinatal infection involves:

- ✓ Advising HIV-positive people not to procreate;
- ✓ Testing all pregnant women, especially in the average and high prevalence areas;
- ✓ HIV-positive women can have their pregnancy terminated (the decision belongs to the mother);
- ✓ Monitoring the pregnancy and administering antiretroviral treatment – have led to a reduction by 2/3 of maternal-foetal transmission.

## *Specific prevention*

Tomorrow!

- ✓ Most vaccination attempts are based on the induction of neutralizing Ab with coating protein (gp 120,160). Ag are obtained through the technology of recombined molecules or chemical synthesis;
- ✓ other vaccinal candidates:
  - Vaccine with core protein (p17, p24);
  - Live vaccines, less studied;
  - Vaccines with recombined Ag, associated with adjuvants or
  - Vaccines with recombined Ag, presented by live vectors – *the vaccinia virus*.

# *Thank you!*



*Images – sources  
The Internet*