

VIRUSES AND THEIR IMPACT ON LIVING ORGANISMS

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**Annotation.** Viruses are acellular forms of life that represent autonomous genetic structures. Viruses can cause harm not only to nearly all representatives of flora and fauna but also to microorganisms. The effectiveness of combating many viruses does not always yield positive results, as viruses not only have natural reservoirs in the environment but also constantly undergo mutations; therefore, the effectiveness of vaccine prophylaxis is reduced. One of the most striking examples is the long-term ineffective struggle against the human immunodeficiency virus. A particular threat to humanity is the coronavirus COVID-19, which can lead to severe complications and even death.

**Keywords:** vaccination, influenza, pandemic, virus, bacteria, disease, hepatitis

**Introduction.** History of viruses. Dmitry Iosifovich Ivanovsky is recognized as the scientist who discovered viruses. Ivanovsky reported that a tobacco disease widespread in Crimea was caused by a highly infectious agent with a specific mode of action. This discovery demonstrated the existence of living systems that, together with cellular forms, are invisible under light microscopes, pass through fine porous filters, and lack cellular structure.

**Literature review and methodology.** Dmitri Ivanovsky's experiments played a fundamental role in the formation of virology as a scientific discipline. His 1888 dissertation entitled "On Two Diseases of Tobacco" and the monograph of the same name published in 1892 were aimed at demonstrating that tobacco mosaic disease is caused by infectious agents smaller than bacteria. As a result of these studies, the existence of filterable infectious agents was scientifically established, and this phenomenon is now regarded as the starting point in the discovery of viruses.

The most significant scientific contribution of Ivanovsky's work lies in the fact that he demonstrated that infectious disease agents are not limited to bacteria visible under a light microscope, but also include distinct biological entities that can pass through bacterial filters and lack cellular structure. This fundamentally changed the classical paradigm of microbiology and introduced the concept of "acellular infectious agents" into scientific discourse.

According to modern understanding of viral nature, viruses are the simplest infectious biological entities. They consist of genetic material—either deoxyribonucleic acid (DNA) or ribonucleic acid (RNA)—which is enclosed within a protein coat known as the capsid. The capsid plays a crucial role in protecting the viral genome from environmental factors and facilitating attachment and entry into host cells.

From a biological perspective, viruses are obligate intracellular parasites. This means that they lack an independent metabolic system and are unable to generate energy on their own. Therefore, they must enter a living host cell in order to replicate and carry out their life cycle. Once inside the host cell, the virus redirects the cellular biosynthetic machinery to produce new viral particles.

Outside the host cell, viruses exhibit no biological activity and exist as inert chemical particles without metabolic functions. For this reason, viruses are often regarded as transitional forms between living and non-living matter. This characteristic indicates that viruses do not fully conform to classical definitions of life, making them unique objects of biological study.

From the perspective of modern virology, viruses are considered highly ancient biological structures. There are hypotheses suggesting that they may have co-evolved with cellular life forms or even predated them. Their high mutation rates ensure continuous genetic variability, which contributes to the emergence of new viral strains and the persistence of epidemiological threats.

**Structure of viruses.** Viruses have a very simple structure. They consist of the following components:

- **Genome** – genetic material represented by DNA or RNA; DNA or RNA may be single- or double-stranded;
- **Capsid** – a protective protein coat surrounding the genome;
- **Nucleocapsid** – a complex structure formed by the genome and capsid;
- **Envelope** – some viruses, such as HIV and influenza virus, possess an additional lipoprotein layer derived from the host cell plasma membrane;
- **Capsomers** – repeating subunits forming the capsid.

Capsid structure is characterized by specific types of symmetry, especially icosahedral and helical symmetry. The most common viral form is the icosahedron, which has 20 triangular faces, 12 vertices, and 30 edges.

**Bacteriophages.** Viruses that infect bacteria form a group called bacteriophages or simply phages. Some bacteriophages have a distinct icosahedral head and a tail with helical symmetry. In modern medicine, bacteriophage therapy is widely used. This treatment produces positive results because properly selected preparations destroy harmful bacteria.

**Viruses as pathogens.** Various infectious diseases in humans, animals, and plants are caused by viruses. Some of them are discussed below.

**Plant diseases.**

- **Leaf mosaic** – characterized by white or yellowish spots and stripes on leaves, and light or dark patterns on flowers resembling a mosaic.
- **Leaf mottling** – a viral disease characterized by numerous small spots (1–2 mm) on leaves, which later dry out; leaves become curled and flowers deformed.
- **Leaf yellowing (yellows disease)** – leaves turn yellow-green or completely yellow; plant growth slows; mosaic patterns may appear.

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ANIMAL DISEASES

• **Rabies** – an infectious disease transmitted through the saliva of infected animals via bites. Dogs, cats, and wild animals (especially foxes) are commonly affected. Increased use of vaccination in wildlife has significantly reduced rabies incidence in fox populations.

• **Canine distemper (Carré disease)** – a viral disease of carnivores characterized by fever, acute catarrhal inflammation of mucous membranes, skin exanthema, pneumonia, and severe nervous system damage.

• **Avian influenza (bird flu)** – primarily transmitted by wild birds. Infection occurs through contact with sick birds, feces, or contaminated objects (shoes, transport). Symptoms include high fever, nasal congestion, breathing difficulties, diarrhea, nausea, vomiting, and muscle and joint pain.

• **Human diseases.** The exact number of viruses cannot be determined, as they constantly mutate. The following viral diseases are among the most well-known:

**Influenza.** Influenza is a widespread viral infection characterized by acute intoxication, rhinitis, nasal congestion, and cough with bronchial involvement. It is transmitted easily, mainly via airborne droplets, and also through household contact. Seasonal influenza epidemics affect 20–35% of the population annually and account for about 95% of all infectious diseases worldwide when combined with acute respiratory viral infections (ARVI).

**Poliomyelitis.** Poliomyelitis is a viral disease affecting the gray matter of the central nervous system, as well as the throat and intestines, and sometimes the spinal cord motor neurons, leading to paralysis. The virus affects limbs and causes skeletal deformities. The most effective prevention method is the live poliomyelitis vaccine.

**AIDS (Acquired Immunodeficiency Syndrome).** AIDS is a relatively new infectious disease first reported in the USA in 1981. HIV (Human Immunodeficiency Virus) is not the same as AIDS. HIV suppresses the immune system, while AIDS is a syndrome of diseases occurring in HIV-positive individuals due to immune deficiency.

**Hepatitis. Hepatitis A** – the most common and mild form, often self-limiting with complete recovery.

- **Hepatitis B** – a more severe form requiring hospital treatment, strict diet, and lifestyle modification.

- **Hepatitis C** – the most severe form; no effective vaccine exists; often leads to chronic hepatitis, cirrhosis, or liver cancer.

- **Hepatitis E** – similar to hepatitis A, usually curable, but dangerous for pregnant women in the final months of pregnancy.

- **Coronavirus infection.** At the end of 2019, a new coronavirus infection emerged in Wuhan, China (Hubei Province), caused by the virus initially named 2019-nCoV. On February 11, 2020, WHO named the disease COVID-19. The International Committee on Taxonomy of Viruses later designated the pathogen as SARS-CoV-2.

A person infected with COVID-19 may not initially suspect the disease but can actively transmit it. COVID-19 can cause severe respiratory illness and pneumonia.

**Main symptoms:** fever, cough, fatigue, shortness of breath, muscle and joint pain, sore throat, and headache.

**Prevention of coronavirus.** Risk groups include elderly people, pregnant women, individuals with chronic diseases, and those with weakened immune systems. Children generally experience milder forms of infection compared to adults.

Vaccination remains one of the most effective methods of protection. Vaccines stimulate the immune system to recognize and fight infections. As of now, mass vaccination campaigns are ongoing in many regions.

**Conclusion.** Viruses are a special acellular form of life; viral diseases negatively affect the lives of humans, animals, and plants. Of particular concern is COVID-19, which can cause severe complications and even death. The coronavirus pandemic has become one of the most dangerous global challenges in recent years. The number of infected and deceased individuals continues to increase daily. Viruses represent a unique form of life; they possess a specific structure, constantly mutate, and this makes combating them increasingly complex.

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