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MUTATION AND GENOMIC ANALYSIS OF COVID-19 VIRUS SPECIES

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In recent years, the COVID-19 pandemic has shaken the world and affected the lives of millions of people. The SARS-CoV-2 virus that caused this disease has attracted the attention of scientists not only because of its rapid spread, but also because it is constantly changing - that is, mutating. The study of the mutation of viruses and their genetic structure (genomic analysis) is important today not only for understanding COVID-19, but also for combating future dangerous diseases. So, what is mutation, how does it happen, and what can genomic analysis give us? Let's look for answers to these questions in simple language.

Viruses and mutation: What does it mean?

Viruses are not living organisms, but they reproduce inside our cells, copying their genetic material - DNA or RNA. The SARS-CoV-2 virus is an RNA virus, its genetic code consists of a long chain of about 30,000 “letters”. These “letters” control the life cycle of the virus: what cells it enters, how it multiplies, and how it spreads.

But as the virus multiplies, mistakes can occur in the process of copying this genetic code. For example, if you write a letter incorrectly while copying a book by hand, the text changes slightly, but the general meaning may remain the same. The same is true for viruses: as RNA is copied, small changes called mutations occur. These changes occur randomly and can often be either useless or harmful to the virus. But sometimes [4] a mutation can be “beneficial” to the virus — for example, making it more likely to spread more quickly or to hide from the immune system.[4]

The most famous mutations associated with COVID-19 are the “Delta” and “Omicron” variants. The Delta variant was characterized by its high infectiousness, while Omicron was able to partially evade vaccines and immunity from previous illness. These mutations have surprised scientists and prompted them to delve deeper into the virus’s genetic code.

Genomic Analysis: Reading the Virus’s “Passport”

[4]Genomic analysis refers to the process of reading and analyzing a virus’s genetic code—its RNA or DNA—letter by letter. This process, performed using cutting-edge technology, reveals the virus’s “vital document.”[4] Just as a person’s DNA helps them identify themselves, a virus’s genetic code can help us understand its properties.

When the COVID-19 pandemic began, scientists first sequenced (read) the genome of the SARS-CoV-2 virus in January 2020. This information spread around the world, and scientists began to trace the virus’s origins, spread, and mutations. Genomic analysis has made it possible to determine where the virus came from, how it spreads from person to person, and which mutations are dangerous.

For example, if a virus sample is taken from infected people in one city, its genetic code is read to determine how similar it is to a virus in another country. If there are small differences in the code, it means that the virus has mutated. In this way,[3] scientists have been able to quickly identify new variants such as “Delta” or “Omicron” and take measures against them.[3]

Why is this important?

Virus mutation and genomic analysis are important not only for scientific interest, but also for practical purposes. Let's look at a few reasons:

Vaccine updates: When mutations change the proteins on the outer shell of the virus, older vaccines can become ineffective. Using genomic analysis, scientists can identify which parts of

the virus have changed and adapt vaccines. For example, when the Omicron variant emerged, vaccine manufacturers began testing new formulations.
Tracking the spread of the disease: Genomic data can help track the geographic movement of the virus. If a new mutation is detected in one country, other countries can take measures such as closing their borders or conducting additional testing.Developing treatments: The genetic makeup of a virus can help determine which drugs or treatments will work. For example, if a mutation changes the virus's ability to enter cells, new drugs will be needed.
Preparing for the future: Other viruses may emerge after COVID-19. Genomic analysis technology can improve preparedness to prevent or respond to future pandemics.
Risks and expectations
Of course, mutations are not always bad news.[1] Some mutations can weaken a virus or reduce its ability to spread. For example, the flu virus has mutated many times over the years, but in some cases it has evolved into a less dangerous form.[1] However, dangerous mutations are not ignored. Although the Omicron variant is highly contagious, it often does not cause severe disease, prompting scientists to ask, "Is the virus naturally getting weaker?"
The development of genomic analysis offers hope.[2] Today, scientists around the world share their data on open platforms. Thanks to this collaboration, new variants are identified and countermeasures are taken within days.[2] As technology advances, genomic analysis is becoming cheaper and more countries are able to take advantage of this opportunity.
Summary
The mutation and genomic analysis of viruses like COVID-19 has become one of the most important areas of modern science and medicine. While viruses are constantly changing, humanity is also developing new methods and technologies to adapt to them. Mutations can pose a threat, but genomic analysis allows us to anticipate and combat this threat. Simply put, this process exposes the "plans" of the virus and brings humanity one step closer.
Every study, every analysis done today is important to avoid new pandemics in the future. Viruses change, but science does not stand still. Perhaps one day we will completely defeat viruses - and genomic analysis will become our most important weapon on this path.

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