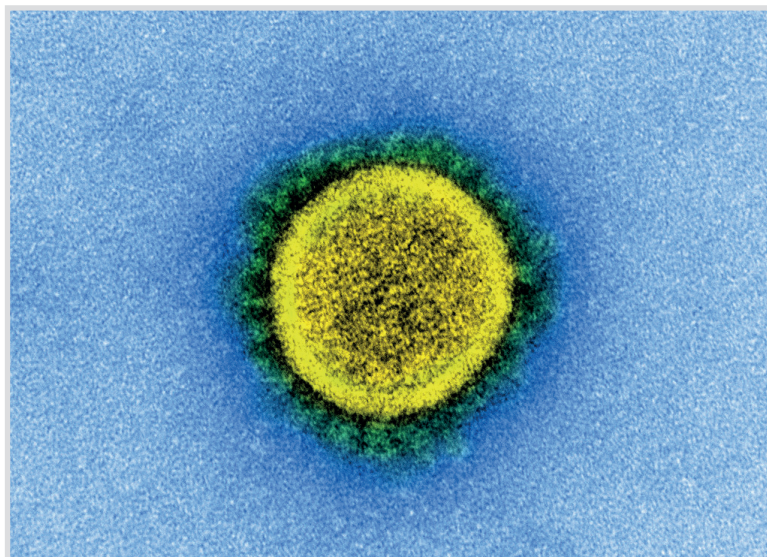


COVID-19: essential questions

Obtaining comprehensible answers to the main questions generated by the COVID-19 pandemic is a useful tool to understand its complexity and evolution



The international spread of COVID-19, the infectious disease caused by SARS-CoV-2 coronavirus (in the picture), and its direct incidence generate a multitude of unknowns for the population, derived from the low general knowledge on the pandemic, to which news lacking scientific rigour are sometimes added (Source: NIAID / Creative Commons).

What is a virus?

A virus is an infectious agent which does not always cause a disease and needs a living organism to replicate itself. It is much smaller than a bacterial cell and consists of a small DNA or RNA genome surrounded by a protein cover, which in some cases, such as coronaviruses, is enveloped in an exterior lipid layer. Viruses enter the host cells and sequester the enzymes and the materials from these host cells to produce more copies of themselves. Viruses cause a wide variety of diseases, such as AIDS, measles, the common cold, and poliomyelitis.

What is a coronavirus?

Coronaviruses are a group of viruses that can cause diseases in both animals and humans. Their envelope includes symmetrically distributed proteins that form a corona. Hence, the etymology of the term *coronavirus*. In the case of humans, several coronaviruses are known to cause respiratory infections, from the common cold to more severe diseases, such as the Middle East respiratory syndrome (MERS) and the severe acute respiratory syndrome (SARS). The most recently discovered coronavirus causes the COVID-19 coronavirus disease.

What is SARS-CoV-2?

SARS-CoV-2 coronavirus, or severe acute respiratory syndrome coronavirus 2, is a new type of coronavirus that produces an infectious disease called COVID-19 in people. It was first identified in December 2019 in the city of Wuhan, China, and has been spreading around the world.

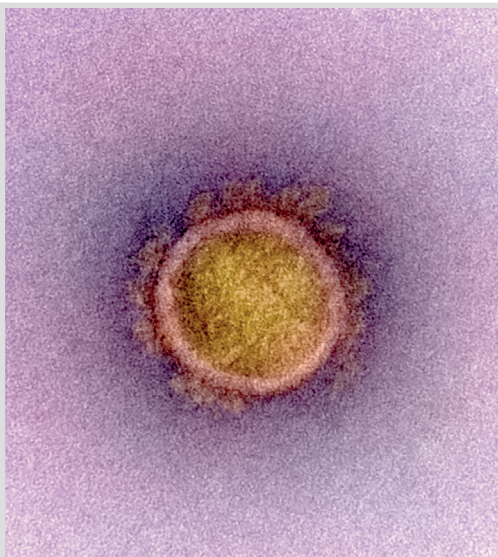
What is COVID-19?

It is the name given to the infectious disease caused by SARS-CoV-2 coronavirus, just like AIDS is the name given to the disease caused by the human immunodeficiency virus (HIV), which is not a coronavirus, but a retrovirus.

How different are a virus and a bacterium?

Viruses are very different from bacteria, starting with its structure or its size. A virus is much smaller than a bacterial cell. Moreover, unlike a bacterium, it is on the limit of what is considered or not as a living organism. Viruses need a living host cell to replicate themselves, while a bacterium is self-sufficient. Antibiotics are not effective against viruses, but vaccines can be, as well as antiviral drugs.

SARS-CoV-2 coronavirus, or severe acute respiratory syndrome coronavirus 2, was first identified in December 2019 in the city of Wuhan, in China, and has been spreading around the world (Source: NIAID / Creative Commons).



What does our organism do to defend itself from coronavirus?

Once the virus enters the body, generally through the mouth or nose, it enters the cells and binds to a protein layer of the lungs –where it descends into the alveoli–, the kidneys or the heart. The epithelial cells of these organs are infected by the virus, and they replicate it until self-destructing and the copies are released. It has been detected that these replicas can reach the brain, the muscular tissue and the hemoglobin. This process inflames the lungs and causes activation of the immune response of the body. As this response unfolds, liquid begins to accumulate in the alveoli, causing dry cough and complicating breathing.

In addition, the immune system causes the body temperature to rise to create a hostile environment for the virus.

Why can SARS-CoV-2 cause death?

Clinical observations indicate that when the immune response is not able to control the virus effectively, as in the case of elderly people whose immune system is weak, the virus spreads more effectively. Damage in the lung tissue occurs, activating the macrophages and granulocytes (white blood cells) and leading to the massive release of proinflammatory cytokines (immune system overreaction). This causes pulmonary hyperinflammation associated with the acute respiratory failure syndrome or the adult respiratory distress syndrome, which has been described as the main cause of death. Bacterial infections can also occur in this process and the weakened immune system would have difficulties in fighting them.

Why are hygienic measures so important to fight COVID-19?

Hand hygiene is the easiest and most effective measure to prevent transmission of microorganisms, including the COVID-19 virus, since these are surrounded by a lipid layer which is deactivated by the surfactant substances of soaps. Moreover, it is also recommended to wear gloves and face mask and keep 1.5 meters of distance between people to make it more difficult for the virus to contact and access the human body.

How does research try to stop a viral disease like COVID-19?

Several public and private organizations around the world are currently researching which molecules or mechanisms of SARS-CoV-2 infection can become therapeutic targets. One of the strategies consists in generating immunity in the human host by injecting a viral protein, part of the genetic material of the virus (DNA or RNA) or of the attenuated virus itself. Nevertheless, as the development of a vaccine is a slow and complex process, other possible treatments for infected people are meanwhile being researched, such as different antiviral drugs licensed for other diseases.

What a vaccine is like?

A vaccine is a preparation that is obtained from a microorganism or one of its derivatives. It stimulates the formation of antibodies and obtains a specific, active and long-lasting immunization against several infections.

Which are the stages in the development of a vaccine?

The development of a vaccine consists of six stages. The first stage is an intensive research, which tries to identify natural or synthetic antigens; the second one is the preclinical stage, where cell and animal cultures are usually used to find out whether the antigens produce immunity; the third stage is the clinical trials, where the vaccine is tested on humans, and consists of three stages (stage I, stage II and stage III); the fourth one is the review and approval by governments once the three stages of the clinical trials have been completed; the fifth stage is the massive production by the main drug manufacturers, and the sixth one is the quality control or stage IV, which tries to detect the possible adverse and rare effects and ensure the vaccine long-term effectiveness.

When will we have a vaccine against COVID-19?

According to the World Health Organisation (WHO), there are already more than 80 vaccine candidacies around the world. Five of them are already carrying out the first tests in humans, while others expect to begin the clinical trials in the second half of 2020. Thus, if the candidate vaccines pass the three stages of human testing, or clinical trials, and are approved by the authorities, a vaccine would be in theory available in 12 or 18 months.

What does being immune mean?

Being immune means to be resistant to a disease, especially an infectious one, through the formation of specific antibodies. Immunity can be natural or acquired, the latter second case being the result of a previous infection, or caused by a therapeutic action (vaccination). In the case of SARS-CoV-2 coronavirus, the presence of antibodies against this virus could provide some degree of protection, though scientific research is trying to determine how long do these antibodies last after an infection and whether they protect from a possible reinfection.

What is the purpose of sequencing a genome?

One of the best ways to understand an organism is sequencing its genome, which contains the instructions for its functioning. Knowing the genome of the infectious agent that has caused the disease allows researchers to verify which kind of agent it is, identify the cause of the disease, know its origin and time evolution, and develop therapeutic strategies to deal with it.

What is a mutation?

A mutation is a random change in the nucleotide sequence of a gene. It can occur because of an error in the process of replication (or copy) of the genetic material as well as because of the exposure to ionizing radiation or to certain chemical substances. Although mutations can be harmful, favorable or neutral in the short term, in the long term the changes they cause are essential for life to evolve.

Will SARS-CoV-2 experience a notable mutation?

All RNA viruses mutate routinely, but most of these mutations entail negative impact on the virus before disappearing. The mutation rate of SARS-CoV-2 is similar to those of other viruses, although compared to the influenza virus it

is two to four times slower. This stability can be an advantage when developing a vaccine.

What is a diagnostic test?

It is a technique used to detect the presence or absence of certain elements that allow to diagnose an infection or disease in the organism.

How is the infection by SARS-CoV-2 diagnosed?

There are two different types of tests. The first one is the polymerase chain reaction (PCR) test, which detects genetic material of the virus in a nasopharyngeal respiratory sample. It can detect the virus during the first infection stages, and it is used in cases of new epidemic outbreaks. This is a more reliable and complex technique, and this is why it requires specialised personnel.

There are also two types of rapid detection tests: antigen tests, which detect the proteins on the surface of the virus (antigens) in a nasopharyngeal sample as well as, as the PCR does, the presence of a virus, and serologic tests, which detect in a blood sample the antibodies produced by the defenses of the organism some days after having been infected by the virus. The latter detect active, recent or past infections and are used to determine the level of infection among the population.

What is a PCR, and how does it work?

The PCR, or polymerase chain reaction, is a technique which allows copying a small sample of genetic material millions of times, so that there is enough quantity of it to be analysed and identified. Its aim is basically to imitate what cells do naturally throughout their multiplication process. This is why the same enzyme, the polymerase, is used to duplicate the DNA chains.

What is an epidemic?

It is an accidental and temporary infectious disease that spreads to a large number of people in a given territory or region.

What is a pandemic?

It is an epidemic disease that has spread to many countries and affects many individuals in the same country at the same time.

Why is there a higher pandemic risk now?

Epidemics have always occurred throughout the history of humankind, but we are currently more likely to suffer from them because of the

increase in contact between humans and wild-life and the intense global mobility. According to WHO, 75% of new infectious diseases in the last decade are zoonotic, which means that were caused by viruses of animal origin.

Main sources consulted

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National Human Genome Research Institute (NHGRI): <https://www.genome.gov>

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<https://www.nature.com/articles/s41564-020-0690-4>

Fake news and COVID-19

Fake news or news with little scientific rigour are spreading by taking advantage of the current COVID-19 health crisis, and we should therefore pay attention and avoid their dissemination. Fake information can be difficult to detect, but there are some clues: hardly credible, highly improbable information; lack of facts, data from official surveys or statistics; sources from unknown experts; publication on websites with strange domains; headlines seeking to provoke or cause anger; presence of spelling or grammatical mistakes; disturbing or alarming images to catch attention, and suspicious dates (old information or events which can come back and make people think they have just occurred). The main pieces of fake information on this subject that the scientific community has hurried to refute lately are:

—Vitamin D reduces the risk of coronavirus infection.

—Coronavirus is a human creation which emerged from the laboratory of the Wuhan Institute of Virology.

—5G mobile networks spread COVID-19.

—Sodium chlorite treats coronavirus.

—Ibuprofen worsens coronavirus symptoms.

If the first case it is about hasty and inaccurate conclusions based on a scientific study, the second and third cases have a clear malicious or conspiratorial intention.

The two latter cases are typical examples of “miracle cures” and a misinterpretation of the possible side effects of this non-steroidal anti-inflammatory drug, respectively.

When in doubt, the best strategy is to visit the website of official bodies.

See section “Main sources consulted”.