What happens when the coronavirus mutates?

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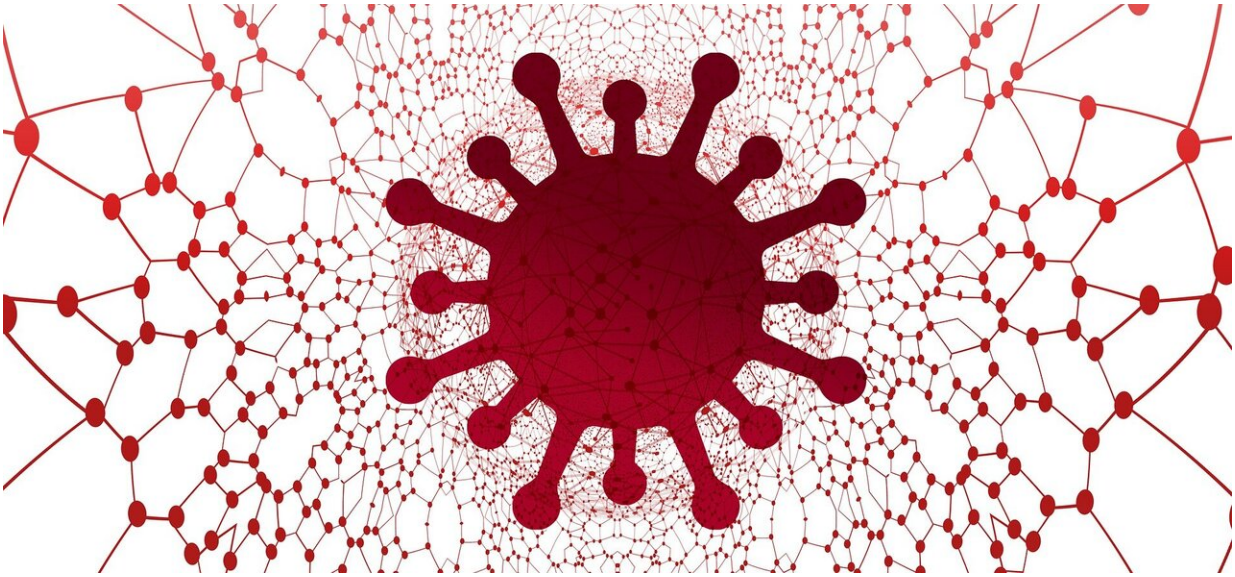

Mutations in the coronavirus that have become widespread so far are unlikely to create resistance to the vaccines developed, but may require new tests for detection, says Illinois professor Gustavo Caetano-Anollés. Credit: Pixabay/CC0 Public Domain

New mutations to the coronavirus that causes COVID-19 are emerging, including a more-infectious variant first found in the United Kingdom, even as vaccines containing bits of viral genetic material are beginning distribution. Gustavo Caetano-Anollés, a professor of crop sciences and a member of the Carl R. Woese Institute for Genomic Biology at the

University of Illinois Urbana-Champaign, has been studying and cataloging genetic mutations to the virus. In an interview with News Bureau biomedical sciences editor Liz Ahlberg Touchstone, Caetano-Anollés discussed viral mutation and what it could mean for vaccinations.

How and why do viruses mutate?

RNA viruses, such as coronaviruses, have incredibly dynamic genomes. Not all mutations are relevant or significant or are present in all proteins. However, some may provide features that are beneficial to the virus or important for their survival, which the viruses like to preserve. Those features are fixed in the virus population because they are advantageous—for example, because they allow the virus to spread more effectively. That often results in a strain becoming popularly sampled in genomic analyses. This is probably what happened with the B.1.1.7 variant isolated in the U.K.

What kinds of mutations have we already seen in the virus that causes COVID-19?

Coronavirus genomes are made of a single strand of RNA. These types of viruses are the most rapidly mutating on the planet. They mutate so fast that one should refer to them as a "quasispecies"—they represent viral swarms of highly diverse individuals. Because of the high viral mutation rate, a patient is likely to shed a diversity of mutant viral strains.

In April, we published a study that explored the mutational landscape of the virus during the first wave of the pandemic. We surveyed 12,606 SARS-CoV-2 genomes available at that time and discovered only 27 significant mutations that the virus is likely to preserve. One of these,

D614G, is present in most viral genomes sampled today—which now number in the hundreds of thousands. D614G helps the virus spread, so it was of importance.

The B.1.1.7 variant has 17 mutations that have been catalogued as important for further study. For example, there are relevant mutations to the spike proteins on the outside of the virus, which attaches to the human cells for infection; the N protein, which diverts the human immunological response—to the virus's advantage; and structural proteins that help the virus spread. Similar mutations were highlighted in our April study.

Are the mutations we're seeing in the coronavirus appearing faster or more slowly than you'd expect?

Mutations occur at random, but there are proteins that protect the virus-replication system from acting too wildly. Why? Too many mutations could be deleterious to the virus. They would destroy its chances of finding more useful mutations. Yet too few mutations could eliminate opportunities for the virus to innovate. So, what we are observing is nothing out of the ordinary. What is out of the ordinary is the size of the pandemic. More virus spread provides more opportunities for the virus to innovate.

Could any of the mutations seen so far give the virus resistance to the vaccines being developed? Why or why not?

It appears mutations such as those in the B.1.1.7 variant are not hitting sites with high antibody accessibility scores. This is good news for vaccination. The bad news is that it appears those mutations are interfering with virus detection in the PCR analyses used by most

COVID-19 tests. This implies a lot of work coming our way to fix the problem of accurate testing.

Could new strains necessitate periodic new vaccines, similar to annual flu vaccinations?

The coronavirus behaves like the flu and is seasonal like the flu. So yes, the virus strains will change and we may need new vaccines developed. However, the new RNA technology appears very effective and quick to deploy. That is excellent news.

Provided by University of Illinois at Urbana-Champaign