
How Do Novel Viruses Threaten Humankind?

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Viruses: The Overlords of Earth's Living Organisms

The world has been gripped with novel coronavirus (COVID-19) panic since early 2020. We are still under the dark shadow of COVID-19 even though five months have passed since the virus emergence in China. What has made it possible for a virus to totally upend the world as we know it?

Existing theories about viruses have been overturned as scientific research has found that viruses have an even broader diversity than previously known. That has accordingly made it more complicated to clearly define what is—and what is not—a virus. Basically, however, viruses are nothing more than “selfish genes” surrounded by proteins. Viruses are not able to create their own energy, which means they are unable to reproduce by themselves. In fact, viruses have a close relationship with their hosts and totally depend on their host cells during their entire life cycle. There is nothing more extraordinary than to watch a virus attach itself to a living host, break through the host's elaborate defense mechanisms to build a stronghold, and then use that stronghold to gradually dominate the host.

Viruses target all living organisms on Earth, including bacteria—the most basic living organism—fungi, yeasts, plants, and animals. Some scientists estimate that there are around 1.6 million unknown viruses in mammals and birds alone, a figure that demonstrates the incredible diversity of viruses that live in our world. That being said, we have discovered, at most, only 1 percent of the viruses in existence. Viruses, in the popular imagination, are just pathogens that cause infections; however, not all viruses are harmful to their hosts. In fact, more than 99 percent

of the viruses that exist on Earth are innocuous to human beings. Moreover, viruses sometimes even “help” their hosts survive. Viruses have used hosts as their habitat for many thousands of years, which means that most viruses actually have a symbiotic relationship with them.

Why are viruses considered “selfish”? Viruses used as vaccines to prevent infections or those used to treat specific diseases may even appear altruistic. In truth, this “altruism” is really no more than a way for viruses to build a stronghold within their hosts and keep themselves alive by “preserving” the genes that ensure they continue to exist. Essentially, the human race has been able to cleverly use this strategy of viruses for its own benefit. To survive, viruses eliminate some parts of the genes they do not need and, if required, they even use genetic recombination mechanisms to acquire the genes of our viruses. Viruses even manipulate genes to make them smaller so they can more efficiently copy themselves. Viruses compete among themselves within the immune systems of their hosts and those that win in this survival of the fittest become the dominant species and have the opportunity to dominate their hosts. Viruses evolve as this process repeats itself—something familiar to us because human beings have competed against each other for their survival.

Novel Viruses: An Ongoing Threat

It is likely that viruses came into existence after living organisms appeared on Earth. As different species began to appear through the process of evolution, viruses probably co-speciated with their hosts for long period. Viruses made their habitat in specific kinds of living organisms and created their own “species barriers” that allowed them to build up their host ranges. But this does

not mean that viruses have simply stayed in one place to dominate their own hosts.

Viruses become a threat to new hosts when they jump across the species barrier. This is otherwise known as “spillover,” and viruses that do this are called “novel viruses.” Spillover is just one part of the evolution process for viruses. Because novel viruses have no symbiotic relationship with their new hosts, they multiply at ferocious speeds to build strongholds in their new habitats. Meanwhile, the immunity systems of the new hosts work overtime to fight back against these novel viruses. While most viruses end up failing to cross the species barrier, they can cause significant harm to their new hosts if they succeed.

Measles, smallpox, AIDS, and other many viruses we know about have overcome the species barrier from original natural hosts (animals) as mentioned above. In recent years, we have witnessed that viruses in wild animals spill over to humans. We saw this in 2002 with severe acute respiratory syndrome (SARS), 2009 with the novel H1N1 influenza, 2012 with Middle East respiratory syndrome (MERS) (an outbreak of which occurred in 2015 in Korea) and, in 2019, COVID-19. This spillover does not just impact human beings. There are actually many more cases of viruses spilling over from one animal species to another, but these novel viruses have remained the interest of veterinary virologists and most have fallen beneath the radar of the general public. Many people have probably ignored news of such viruses because they do not impact their health or daily lives. One prominent example of this is bird flu (avian influenza). Wild migratory birds (ducks and geese) originally carry avian flu viruses without any clinical signs, but recently a strain of this influenza frequently has caused fatal infection in chickens and has resulted in substantial economic loss in poultry industry.

How do novel viruses come into existence? Novel viruses are viruses that have either emerged recently or have been discovered in their hosts. In short, while the virus may be new to that host, the virus had a preexisting host (a natural host) that it used as its habitat. COVID-19, for example, only started infecting humans recently, but used bats as its host in the past. What this means is that a virus that already existed in nature went through the spillover process to enter a new host—in this case, human beings. In this sense, these novel viruses are really nothing “new.”

Novel viruses that have caught the attention of humans recently (SARS, H1N1 influenza, MERS, and COVID-19, among others) originally came from wild animals. The “push and pull” effect can be used to explain the environmental factors that helped create these novel viruses. Wild animals that carry a potential novel virus have been forcibly “pushed” out of their existing habitats and “pulled” into environments where they live closer to human beings. This process has increased the opportunities for wild animals to impact the habitats of new hosts (in this case, humans) and, accordingly, has increased the likelihood that the viruses will infect human beings. COVID-19 is an example of this. Phylogenetic analysis has shown that COVID-19 virus may originated from the Chinese horseshoe bat, which strongly suggests that the bat species was the natural host of the novel coronavirus. This may mean that human beings first caught the coronavirus while hunting the bats in caves or during the butchering process. It is tantalizing to think that if human beings had never pulled bats into the human world, COVID-19 may never have spilled over to humans.

When the first outbreak of COVID-19 occurred at a wet market in the Chinese city of Wuhan, the world focused its attention on Chinese wet markets. As a matter of fact, infectious disease experts have long focused their attention on Chinese wet markets as a “powder keg” that could ignite the “push and pull” effect required to create a novel virus. In contrast to Korean traditional markets, Chinese wet markets allow visitors to actually eat a range of wild animals. This eating culture has provided the environmental conditions for various wild animals to gather together in one place. It is unclear where all of these wild animals were caught or what kinds of viruses they hosted. In the case of COVID-19, it may have been that there was a mixing of viruses of many different wild animals and this created the new virus. Then human beings became infected during the process of butchering or touching the butchered meat of these animals. Ultimately, what this would mean is that wild animals in these wet markets were an important part of creating the new virus.

What’s Next?

The threat of novel viruses has reared its head frequently in the 21st century and led to several unpredictable virus shocks. The pandemic spread of COVID-19 has led to an omnidirectional crisis that has halted much of the world’s economic activity—something we have never experienced before. Infectious diseases are notoriously unpre-

dictable, which means it is close to impossible to know when the current crisis might end. Humankind, however, will eventually beat COVID-19 given that the full weight of its resources is being placed on developing a vaccine or at least a treatment for the disease. The 21st century, however, has witnessed periodical emergence and epidemic episodes of novel viruses fatal to human beings. Hardly anyone believes that the end of the COVID-19 pandemic means the end of the threat from novel viruses as a rule of thumb. We will continue to live with the danger of future outbreaks caused by novel viruses we have never experienced before.

Does that mean that we are helpless against novel virus shocks forever and ever? The COVID-19 crisis presents us with an opportunity to reflect on the limitations of our current public health response systems against novel viruses. The international community will likely begin discussing new strategies and ways to shift the paradigm of how the world can preemptively and internationally prevent the spread of infectious diseases. This may include establishing a system to manage the risk factors posed by the wildlife ecosystem; establishing a system to control risk factors of novel viruses (including, of course, chang-

ing some of our eating cultures); improving the sharing network of information about infectious diseases between countries; and ensuring countries are transparent in sharing information about infectious disease outbreaks.

The public health crisis caused by COVID-19 has forced the general public to make handwashing, wearing masks, and practicing social distancing an integral part of daily life. These practices have led to a significant decrease in not just COVID-19 infections but also cases of influenza, a disease that also affects our respiratory systems. The COVID-19 pandemic has created greater awareness among the public about how to deal with viruses. Indeed, the pandemic has drastically increased awareness and interest in the general public about infectious diseases caused by viruses more than any other time in the past. Better knowledge about viruses can help correct misunderstandings of information related with them and shore up support for evidence-based ways to handle outbreaks. There have been a diverse range of books published recently about viruses. The efforts of these authors will help diversify scientific discussions and provide a greater opportunity for the public to broaden their understanding of science in general.



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