

MUTATION OF SARS-COV-2

Juju Q - Term 2 Biology Final

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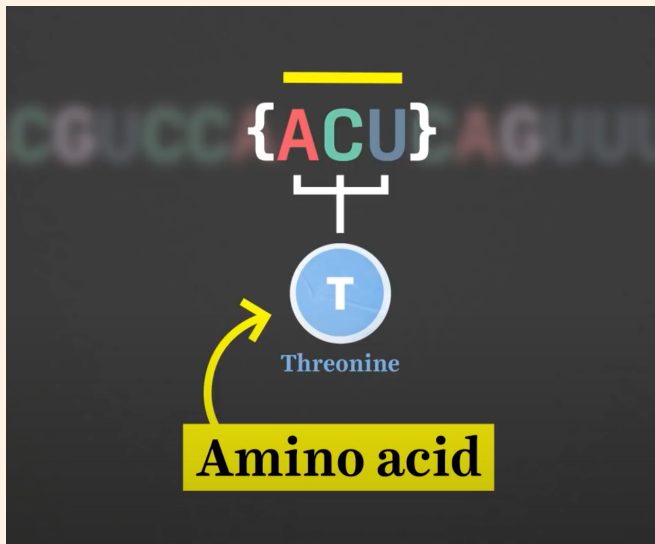
CLOSING

THE PANIC

SARS-CoV-2 carriers were said to be emerging in November 2019. It was not reported and called attention to the public until December 08 2019. (Tiwari) The first confirmed case was found in Hua Nan seafood and animal market in Wuhan, Hubei Province, China presented with symptoms such as cough, fever, and breathing difficulties. In January 02 2020, 41 cases were confirmed. 14 out of 41 patients have never gone to the market. The virus quickly spread to neighbouring provinces. (Huang)

On February 01 the panic of the pandemic was pushed to another high. A resident in a community in Wuxi, Jiangsu Province sent a message on social media claiming that the community manager buried his cat alive because he/she turned out to be a confirmed case. More pet persecution was reported through the media such as abandoning pets on highways and community management breaking into resident's houses and taking away their pets by force. Only after official clarification that the virus in pet animals (cats and dogs) was not transmissible, or there were no cases of pet passing disease to humans by that point, the fanatic movement of animal killing ceased.

People feared the mutation of this novel virus. We were fragile and helpless in front of this invisible enemy from the start. Its mutation makes it sound more obnoxious. Mutation signifies its possibility to become more contagious, cause more deaths, reinforcing irrational emotions. However, are COVID mutations really what we should spend time worrying about?



Vox. "The Coronavirus Is Mutating. Now What?" Youtube, 7 Aug. 2020, www.youtube.com/watch?v=Djy3WNLz_mM&list=LL&index=6. Accessed 19 Nov. 2020.

Characteristics spawned from mutations can help the virus increase its possibility to spread and thrive and be passed on to the next generation. Ones that are not would die out. Characteristics that cause more damage to the human body don't necessarily become the survivor of the fittest. If the host dies too soon before it spreads, this strain would disappear. (Vox) Mutations are inevitable, and happens all the time like how humans breathe. For the vast majority of time, these constant mutations do not pass on more lethality.

MUTATION?

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the cause of coronavirus disease 2019 (COVID-19), a respiratory illness. It is a strain of virus belonging to a class of viruses called coronavirus due to its crown like protein spikes on the surface. One of the main attributes of viruses is constant mutation. Mutation refers to errors made during the replication of the virus' genome, and is part of the mechanism of virus' survival. Only the individual that adapts to environments and reproduces the most can survive, because viruses are not living organisms that can stand alone like bacteria, they need a host to proliferate. (History)

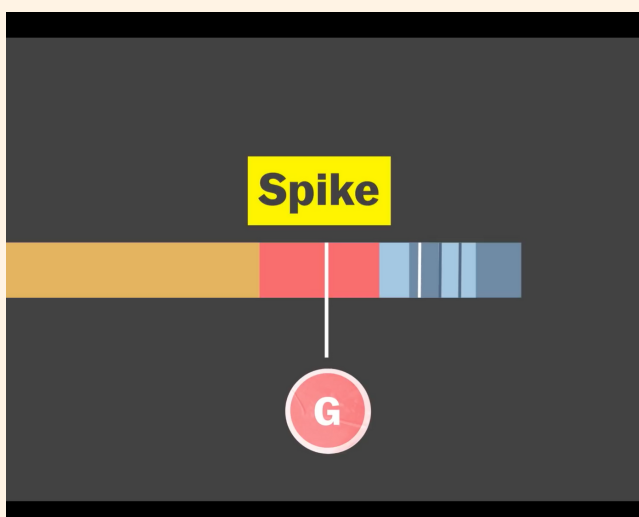
How easily does SARS-CoV-2 mutate? SARS-CoV-2 is an RNA (Ribonucleic acid) virus. RNA viruses mutate faster than DNA viruses. Because the DNA replication enzyme DNA polymerase prevents mutation (replication error). Whereas, in the RNA viruses they usually don't have this enzyme. However, overall it mutates much slower compared to HIV and the influenza virus, because it does have a mechanism of correcting errors in the RNA sequence. (DOE) (Grubaugh) Once the virus enters the body through the nose, mouth, and eyes, it starts to create more copies of itself, and spread out through air or adhere to surfaces. Between its high mutation rate and efficiency in taking over the cellular genome, SARS-CoV-2 is a master at proliferation. (Somers)

D614G

The strain first found in Wuhan, China, was identified as D614. 614 represents the 614th amino acid in the virus' RNA sequence. (Vox) D represents that the 614th amino acid is aspartate amino acid. Soon after D614G (which will be called G614 afterwards) appeared. D614G means the 614th amino acid in the ancestral strain mutated into glycine amino acid. (Campbell) This change in a single amino acid produced a whole new strain of virus. The protein that comprises the spikes of Coronavirus was constructed from a long string of amino acids containing the 614th amino acid.

In February, Europe's flights hadn't been closed down for the sake of pandemic. "The most COVID-19 cases shifted from China to Europe, and then in March on to the United States."(Grubaugh) D614 was more prevalent during the early outbreak in Wuhan, but what is causing the pandemic all over the world now is G614. D614 infection decreased because of the community lockdown and strictly controlled quarantine. Whereas G614 leaked out and proliferated globally, extending this pandemic. The transmissibility of G614 was proven to be stronger compared to the old form in the lab. It generates higher loads of viral RNA in the cell culture. Nevertheless, it doesn't mean the G form would exacerbate the pandemic in reality.(Campbell)

In the aspect of vaccine design, the existence of this mutated strain won't lead to complex obstacles. Again, the mutated amino acid is on the protein spike of the virus. Amino acid G forms the part which is not in the receptor binding domain of the spike. In another word, it does not interact with the direct binding of the ACE2 receptor site of the human host cell. The absence of direct binding diminishes the possible burden in vaccine design. Furthermore, naturally generated antibodies (antibodies created by human cells) for D614 and G614 can cross-neutralize. Meaning that antibodies from someone who is infected with D form, could still be active to virus after given to someone that has G form. Cross-neutralization prevents invalidation of vaccines. (Campbell)



ANIMALS

It's more accurate to think of "a whole spectrum of viruses that are variations on a theme," said Epstein. "They're a bunch of cousins that are genetically almost identical but different in ways that could really impact their ability to make that jump from their natural animal reservoir into people." (Tiwari)

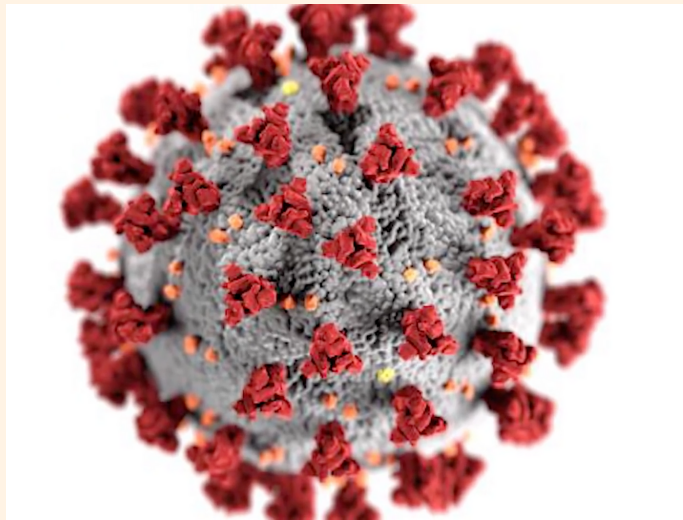
Dogs, cats, tigers, hamsters, monkeys, minks, ferrets and genetically engineered mice are all able to be infected. SARS-CoV-2 replicates poorly in dogs, pigs, chickens, and ducks, but efficiently in ferrets and cats. Five Siberian tigers (*Panthera tigris*) and three African lions (*Panthera leo*) are housed in two enclosures at the Bronx Zoo in New York City. On March 27, 2020, a four-year-old tiger, named Nadia, developed a dry cough and some wheezing. She tested positive for SARS-CoV-2. By April 3, three additional tigers and all of the lions exhibited cough and a loss of appetite. None of the animals were in respiratory distress. As of April 6, 2020, the presumably infected animals were stable and recovering, though they have not all been tested. (Lero)



Gorman, James. "Covid Infections in Animals Prompt Scientific Concern." The New York Times, 8 Nov. 2020. The New York Times, www.nytimes.com/2020/11/08/science/Covid-virus-transmission-mink.html. Accessed 19 Nov. 2020.

A study by Fédération des Fabricants d'Aliments pour Chiens, Chats, Oiseaux et autres animaux familiers (Facco) / Taylor Nelson Sofres (TNS Sofres), conducted in 2016 among 14,000 household's representative of French households, reported a population of about 7.3 million dogs and 13.5 million cats, and that nearly 50% of households have at least one dog or cat. The American Veterinary Medical Association estimates that in the USA, the percent of pet-owning households at 57–59%, with dogs constituting 38.4% and cats 25.4%. Isolation of SARS-CoV-2 from dogs has also been reported. (Lero) There were cases discovered recently: two dogs and two cats, belonging to SARS-CoV-2 infected owners, in Hong Kong and Liège, Belgium. (Gorman) Virus transmission from humans to their pets once induced panic in the early stage of the pandemic because people were afraid of their pets would further spread the disease by becoming viral vectors.

This provoked persecution and violence towards dogs and cats. Moreover, the situation created an overwhelming workload for volunteers who tried to save abandoned animals in the middle of the pandemic panic. Luckily, there's no known cases of human infection caused by animals that were infected by humans. There is one exception -- minks. Viruses that have mutated in minks and spread to humans are not more transmissible or cause more severe illness among humans. Out of safety concerns the Denmark government still culled millions of minks in early November since they can spread COVID to humans. (Gorman)



Vox. "The Coronavirus Is Mutating. Now What?" Youtube, 7 Aug. 2020, www.youtube.com/watch?v=Djy3WNLz_mM&list=LL&index=6. Accessed 19 Nov. 2020.

CLOSING

2020 has been an difficult year for everyone. The fear of death and depression was amplified on social media through January and March and continues on. The increasing death rate, confirmed cases, in the time of the diseases emergence produced fragility within communities, where people felt helpless and disabled as the information continued to be updated. Panic grew to be something more dreadful than the virus itself. Unfortunately in China, pets became the victims of unfounded fears. The goal of this essay is to prove fearing mutation of the virus is unfounded to date. Though, what is true today may not be tomorrow. Knowledge is always the key to lead people out of fear of the unknown.

Works Cited

- Campbell, John. "Viral Mutations of SARS-CoV-2." *Youtube*, 23 July 2020, www.youtube.com/watch?v=u2TB91sDEHI&list=LL&index=3. Accessed 19 Nov. 2020.
- DOE/Los Alamos National Laboratory. "Newer Variant of COVID-19-Causing Virus Dominates Global Infections : Virus with D614G Change in SpikeOut-Competes Original Strain, but May Not Make Patients Sicker." *ScienceDaily*, edited by ScienceDaily, 2 July 2020, www.sciencedaily.com/releases/2020/07/200702144054.htm. Accessed 19 Nov. 2020.
- Gorman, James. "Covid Infections in Animals Prompt Scientific Concern." *The New York Times*, 8 Nov. 2020. *The New York Times*, www.nytimes.com/2020/11/08/science/Covid-virus-transmission-mink.html. Accessed 19 Nov. 2020.
- Grubaugh, Nathan D., et al. "We Shouldn't Worry When a Virus Mutates during Disease Outbreaks." *Nature Microbiology*, 18 Feb. 2020, www.nature.com/articles/s41564-020-0690-4. Accessed 19 Nov. 2020.
- The History of Vaccines*. 10 Jan. 2018, ftp.historyofvaccines.org/index.php/content/articles/viruses-and-evolution. Accessed 19 Nov. 2020.
- Huang, Chaolin, et al. "Clinical Features of Patients Infected with 2019 Novel Coronavirus in Wuhan, China." *The Lancet*, vol. 395, no. 10223, 24 Jan. 2020. *The Lancet*, DOI:[https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5). Accessed 19 Nov. 2020.
- Katsnelson, Alla. "How Do Viruses Leap from Animals to People and Spark Pandemics?" *C&EN*, vol. 98, no. 33, 30 Aug. 2020. *C&EN*, cen.acs.org/biological-chemistry/infectious-disease/How-do-viruses-leap-from-animals-to-people-and-spark-pandemics/98/i33. Accessed 19 Nov. 2020.
- Lero, Eric M., et al. "The Risk of SARS-CoV-2 Transmission to Pets and Other Wild and Domestic Animals Strongly Mandates a One-Health Strategy to Control the COVID-19 Pandemic." *One Health*, vol. 10, 13 Apr. 2020. *NCBI*, [doi:10.1016/j.onehlt.2020.100133](https://doi.org/10.1016/j.onehlt.2020.100133). Accessed 19 Nov. 2020.
- Somers, James. "How the Coronavirus Hacks the Immune System." *The New Yorker*, 2 Nov. 2020, www.newyorker.com/magazine/2020/11/09/how-the-coronavirus-hacks-the-immune-system. Accessed 22 Nov. 2020.
- Tiwari, Ruchi, et al. "COVID-19: Animals, Veterinary and Zoonotic Links." *Veterinary Quarterly*, vol. 40, no. 1, 25 May 2020. *Taylor&Francis Online*, www.tandfonline.com/doi/citedby/10.1080/01652176.2020.1766725?scroll=top&needAccess=true. Accessed 19 Nov. 2020.
- Vox. "The Coronavirus Is Mutating. Now What?" *Youtube*, 7 Aug. 2020, www.youtube.com/watch?v=Djy3WNLz_mM&list=LL&index=6. Accessed 19 Nov. 2020.