Emily Tateyama

Colorado State University Honors Program

Fall 2024

How do viruses avoid the immune system?

This is a complicated answer because different viruses have different strategies for avoiding the immune system. For example, adenoviruses that may cause the common cold, block interferon.[8] Interferon is how your body sends messages to alert that there is a viral infection and the body can respond. If there are no interferons, the body cannot clear the infection as quickly. Several viruses use similar strategies to block signaling molecules like interferon. The influenza virus uses a different strategy. Influenza goes through a process called reassortment, whereby the genes from one virus mix with the genes from another virus, creating a virus with different genes the immune system does not recognize from a previous exposure.[9] This is why flu vaccines are different from year to year.

How do viruses replicate?

Viruses require a host because they cannot replicate on their own. They hijack the host's machinery to make their genome and proteins.[6] There are DNA and RNA viruses. The DNA viruses use the host's polymerase, an enzyme that makes DNA or RNA, to make more viral DNA and make RNA for proteins. The RNA viruses replicate their genome using their own polymerase but use the host ribosomes.[10] There are 3 types of RNA viruses, positive sense, negative sense, and double stranded. The replication mechanisms are slightly different for each. The mechanism is complicated, but if you are interested, this paper describes how replication works between the types of viruses. https://doi.org/10.1016/B978-0-12-800947-5.00004-1

Why do viruses mutate so quickly?

This depends on the virus. There are 2 categories of viruses, DNA and RNA viruses. The DNA viruses do not mutate as quickly as RNA viruses do. RNA viruses do not go through as much proofreading as DNA viruses, allowing for more mistakes in replicating the viral genome.[10] Without proofreading, the mistakes in the genome are not fixed, resulting in a mutation.

What effect does bacteria have on people?

Bacteria have a large influence on people, which can be both positive and negative. We have a lot of bacteria in or on our bodies that provide a variety of effects. For example, bacteria can produce vitamin K for blood clotting or prevent infections.[2] However, as many know, bacteria can also have negative effects. Some bacteria are pathogenic and can cause disease. *Clostridium difficile* is a bacterium commonly found in people's gut that can cause disease after people take antibiotics.[13] This is caused because the antibiotics kill the bacteria in your gut, allowing the antibiotic-resistant *C. difficile* to grow.

What causes antibiotic resistance?

Bacteria mutate, gaining resistance and giving genetic material to other bacteria, spreading resistance. The over and misuse of antibiotics selects for resistance by killing the susceptible bacteria, allowing resistant bacteria more resources to grow.[12] As antibiotic resistance grows, antibiotics will become less effective.

Why do some vaccines last longer than others?

Some vaccines require boosters because the pathogen mutates. For example, Covid-19 has a higher mutation rate than HPV. The Covid-19 vaccine is recommended every year, but the HPV vaccine only needs the original series.[18,19]

What are the pros and cons of vaccines?

Vaccines protect people against diseases. They have shown in the past to be effective, such as measles and polio. Measles and polio are not as prominent as they used to be because of vaccines. However, there are some side effects. A heavy majority of side effects are mild, including soreness at the injection site and tiredness. The larger concern are the more severe side effects, including swelling of the throat and dizziness. However, severe side effects do not occur often, and the probability of a severe reaction is one or two in a million people.[20]