

Hello hello,

I hope you are all doing well. Spring has arrived early in Vancouver. Trees are budding and crocuses are blooming!

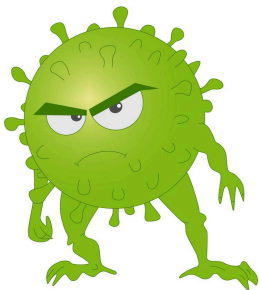


So bright and yellow!!!

One of my favourite courses I'm taking this semester is virology! In this course, I've been learning about the major viruses that have impacted humans. Specifically, I've learned about polio, HIV, and influenza.

In today's email, I'll focus on writing about poliovirus; how it's spread, how it replicates in humans, and the symptoms it causes.

But before we jump into things: what is a virus?



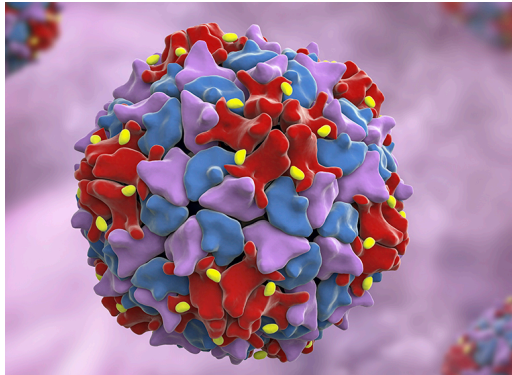
Viruses are defined as **obligate intracellular parasites**.

- They are described as **obligate** because they are completely dependent on other cells to survive. Unlike animals, plants, and bacteria, they are not able to replicate and survive without infecting another organism.
- They are described as **intracellular** because they cannot replicate unless they enter a cell. This means a virus cannot replicate on an inanimate surface, it has to enter inside a living cell.

- Finally, they are described as a **parasite** because they replicate at the expense of the host cell. Unfortunately, viruses don't live harmoniously with their infected host, their replication is harmful and more often than not - kills the host cell.

Okay, now focusing on poliovirus...

## 1. Poliovirus Structure and Background



Here is a brightly coloured image of the polio virus! This spherical virus is around 20-30 nanometers (1 nanometer =  $1e-9$  meter) in diameter. Major polio epidemics started around 1880, however, the virus has been around for a long time! Historians believe that polio has existed during the times of ancient Egyptians (1580 - 1350 BC) due to hieroglyphics depicting people with withered legs (a symptom that I'll get to later!).

Poliovirus reached its peak in the 1940s and 1950s, where the virus was recorded to have paralyzed or killed over half a million people worldwide every year.

## 2. How does poliovirus enter human cells?

Poliovirus enters humans via the oral fecal route. This means that infectious virus particles are shed through poop and can infect human cells found in the mouth, esophagus, and intestines. I.e. The virus particle typically enters through the mouth during infection.

I know what you're thinking: that's disgusting. Don't tell me millions of people got sick from not washing their hands after going to the bathroom and then eating? Well, kind of. Polio virus can survive up to **2 months** on inanimate surfaces (the virus is also resistant to many common disinfectants). That means, only one Joe had to touch infected poop and then touch an area that a lot of people came in contact with (+ hundreds of thousands of people were infected by drinking contaminated water).

Upon entering the human body, a protein called VP1 on the poliovirus binds a cell surface protein called CD155. Every virus contains an anti receptor (VP1) and a complementary receptor on the host cell (CD155) that works like a lock and key mechanism. The viral anti receptor binds specifically to its

receptor on the host cell. A virus cannot infect a host cell that doesn't have its complementary receptor. Our body contains the protein CD155 in intestinal cells, nerves and neurons, and some immune cells. Thus, the poliovirus can only infect those cells and cannot, say, infect our blood cells.

## 2. How does poliovirus use our cells to replicate itself?

After binding to our cells, poliovirus enters its host cell and starts hijacking the reproductive system. Proteins from the poliovirus will cut host cell ribosomes so that they no longer read human mRNA, but can only read poliovirus RNA.

Ribosomes are essential in translating genetic information (RNA) into tangible protein products that are necessary for basic cellular functions. By cutting these ribosomes, cellular protein synthesis completely shuts off (within 30 minutes of that particular virus entering that cell) and the poliovirus starts replicating. Once the poliovirus has replicated until a threshold amount, the virus particles exit the host cell (killing it in the process) and wander around until they find another cell to infect or are excreted via the feces. The time it takes for one virus particle to replicate in a host cell is around 4-6 hours.

## 3. Symptoms of poliovirus

There are 3 different scenarios that can occur when someone is infected with poliovirus:

### 1. Abortive polio (95% of cases)

- In this scenario, the individual is asymptomatic or has 'cold-like' symptoms for about 72 hours (slight fever, sore throat, headache, diarrhea).
- Polio infects the individual but their immune system is quick to fight it off. Some intestinal cells die:( but these cells are easily replaced!

### 2. Non-paralytic polio (1-2% of cases)

- In this scenario, the individual has mild 'influenza-like' symptoms.
- Usually, the individual has back pain, muscle stiffness and tenderness, and neck pain. Along with headaches, fevers, fatigue, vomiting, and diarrhea. Symptoms usually last 1-2 weeks.

### 3. Paralytic polio (1% of cases)

- Do you remember how I mentioned that the poliovirus receptor was CD155 and that this receptor was present in intestinal cells, **nerves and neurons**, and some immune cells?
- Well this is the worst case scenario where the poliovirus infects the cells in the central nervous system. Unlike intestinal cells, nerves/neurons have a very **limited regenerative capability**. Meaning that if a cell is infected with the virus and dies, it is not so easily replaced.
- In this scenario, the individual often has a fever for 5-7 days before they experience abnormal sensations like pins and needles and muscle spasms/cramps.
- Depending on what nervous cells are affected, the individual can become paralyzed if the spinal cord is infected or can have difficulty breathing if the nerves near the respiratory muscles are involved.

Why does poliovirus impact the central nervous system in only 1% of cases?

- Typically, your body's immune system can fight off the infection while the virus is localized in the intestinal tract. However, if the virus enters the bloodstream via the intestines, it can then infect nerves/neurons.

Anyways, I'll wrap this email up so it's not too long!

To end on a happy note here's a picture of me and a giant mushroom:



Lillian