Pandemic Plan for the Church

Ministering to the Community in a Time of Crisis

Description of a Virus

Viruses are not considered to be living organisms due to the fact they do not have the capability to metabolize energy for respiration, growth, or reproduction. However, they are unique in their ability to mutate and adapt in order to outmaneuver their hosts.

They are the epitome of a parasite in that they are unable to replicate on their own and need to invade another organism in order to survive. In so doing their invasion can result in mild to severe illnesses in humans, animals, and plants. Diseases caused by viruses include the common cold, measles, chicken pox, hepatitis, influenza, polio, rabies, HIV/AIDS, Ebola, and SARS.

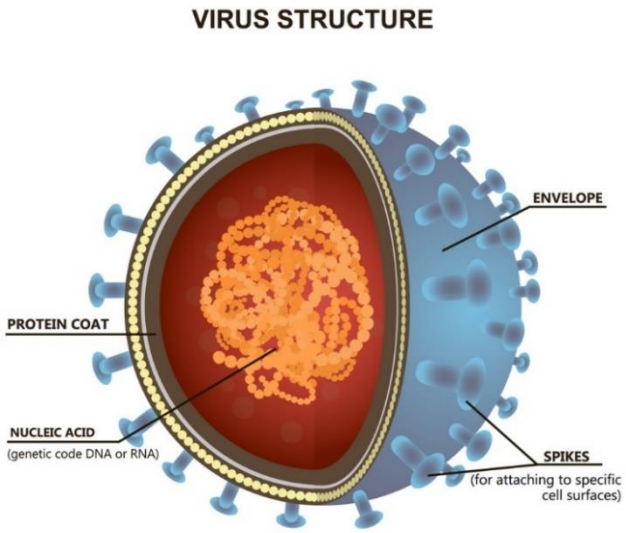
Viruses are small entities consisting of one or more molecules of either DNA or RNA. These are enclosed in a coat of protein in some cases consisting of lipids and carbohydrates. They can range in size from about 20 to 400 nanometers. By comparison, a red blood cell is 6000 to 8000 nanometers (6-8 micrometers).

A virus particle is one hundred times smaller than a single bacteria cell which is ten times smaller than a human cell. A human cell is ten times smaller than the diameter of a single human hair. A virus is the smallest infectious organism; so small that millions of them can fit inside one human cell.

Among several characteristic that separate viruses from living organisms are viruses:

- Do not have cell membranes - viruses have a protein shells
- Do not have organelles as other living cells
- Do not eat or burn energy
- Must invade living cells in order to reproduce

Structure of a Virus



Structure of a Virus
SkyPics Studio/Shutterstock.com[i]

A virion (virus particle) has three main parts:

- Nucleic acid – The substance within the core of the virus that holds the DNA or RNA (deoxyribonucleic acid and ribonucleic acid respectively). The DNA and RNA protein contain the genetic material.
- Coat (capsid) – The covering and protection of the nucleic acid.
- Lipid membrane (envelope) – The cover of the capsid. Some viruses may not have this membrane.

Viruses have proteins on the surface called *antigens*. It is by these antigens that viruses are able to attach to specific receptors on host cells. In addition, the immune system recognizes viruses by their various antigens, allowing the body to fight off the infection. When viruses reproduce, the antigens on the new viruses may become slightly different, a process called *mutation*. This process of mutation helps prevent the immune system from recognizing the virus. These changes are known as *antigenic drift* and *antigenic shift*. These will be discussed in further detail later; however, it is important to note that it is the mutations of these antigens that result in epidemics and pandemics.

Virus Species

A virus species is a group of viruses with similar characteristics that infect the same type of hosts. Viruses are classified by several qualities including the following:

- nucleic acid
- capsid symmetry
- presence or absence of an envelope
- hosts they infect
- diseases caused

There are eighteen different virus classifications, and at least twenty-seven different human diseases known to be caused by viruses. For the purposes of this document, we will focus on the two classifications of influenza and corona.

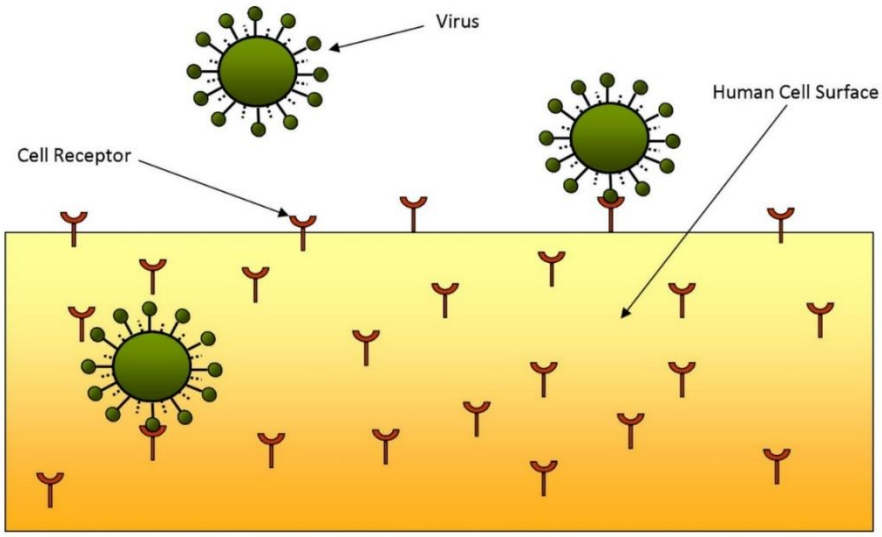
Pathogenesis of Viral Diseases

Viruses do not have the reproductive means needed to multiply or replicate; therefore, they must use the mechanisms of host cells to replicate in order to survive. This is the sole purpose of a virus – to enter a host cell, replicate, breakout, and find another host cell to invade.

Entrance and Receptors

The first step in the infectious process is the entrance of the virus into a susceptible host in order to penetrate the host's cells. A virus enters the body from the environment once it has been emitted from another infected individual (carrier). It is expelled through the nose, mouth, eyes, or any breaks in the skin by the carrier. Some viruses gain entry through the gastrointestinal or urogenital systems. Others gain entry by insect vectors or needle sticks.

Once the virus has entered a host, it now must gain entrance into the cells. Viruses are not simply taken into cells, they must first attach to a receptor on the surface of a host cell.



Viruses and Host Cell Receptors

Each virus has its own specific receptor, or a complementary structure on the surface of the host cell to which it can bind and attach itself. These specific receptors can be by cell, tissue, or organs.

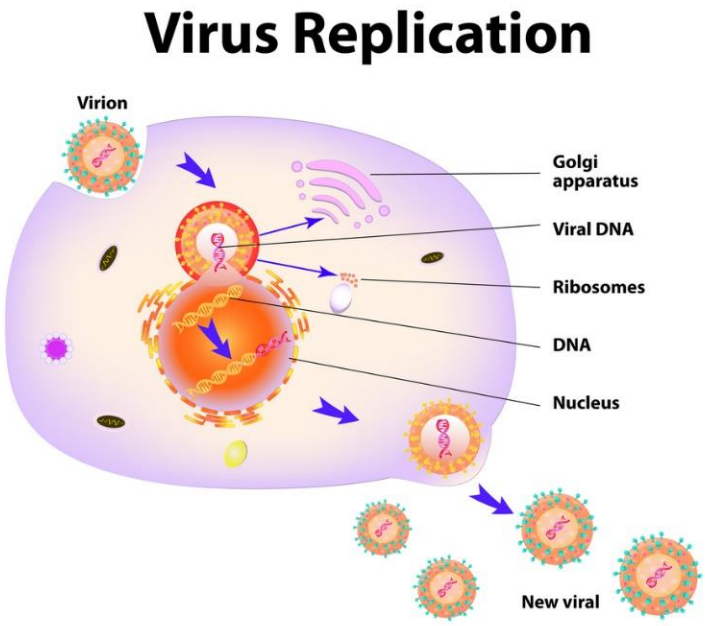
The receptor molecules on host cells of a specific tissue type determine the preference of a specific virus. It is the distribution of these receptor molecules on host cells that determines the cell-preference of viruses. A cold or flu virus for example will target cells that line the

respiratory (i.e. the lungs) or digestive (i.e. the stomach) tracts. The HIV (human immunodeficiency virus) that causes AIDS attacks the T-cells (a type of white blood cell that fights infection and disease) of the immune system. Although enteroviruses enter through the gastrointestinal tract, they can target other systems in the human body. Polio for example, targets the central nervous system.

Life Cycle of a Basic Virus

Viruses are only capable of reproducing inside a living "host" cell that they have invaded. There are a few basic steps that all infecting viruses follow called the lytic cycle. These steps include:

1. Adsorption – A virus first attaches to a host cell by its receptor. Then the virus gains entry by either being engulfed or by fusing with the cell membrane.
2. Entry – The virus injects its DNA or RNA into the host cell.
3. Replication – The DNA or RNA of the virus then takes over the functions of the host cell in order to reproduce new viruses. This may also be known as assembly.



4. Release – The host cell then dies and ruptures releasing the new viruses to find new host cells.

Lifecycle of a Virus
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Cell Injury and Clinical Illness

Clinical illness is due to the destruction of the virus-infected cells in the target tissue. Symptoms such as a sore throat, fever, chest congestion, nausea, vomiting and diarrhea are just some effects of a viral disease. Some tissue may regenerate easily after a viral attack without much damage, for example intestinal epithelium. Other tissues may not regenerate and may never return to normal functioning after the virus has destroyed its host cells, such as with nervous system tissue.

Recovery from Infection

The host's immune system is what eventually destroys the invading virus. This will include both antibodies recognizing and attacking the virus, and other cellular components of the immune system. The host will either succumb or recover.

Virus Shedding

The final step of a virus' lifecycle is its' return into the environment to find another host. This is called *shedding*. Shedding must take place to allow the repopulation of the virus to ensure its survival. This usually occurs from the same site used for entry. For example, a cough or a sneeze will release an influenza virus back into the environment from the tissue it just invaded. During this period, an infected host is infectious and can spread the virus.

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