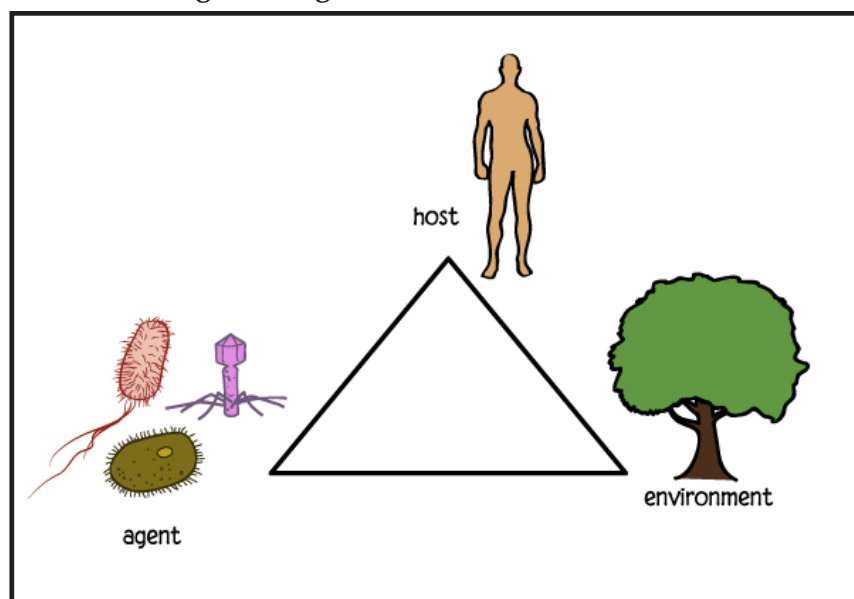


## MODES OF TRANSMISSION READING

The spread of a disease from one person to another is called transmission. There are many different types of transmission and each one involves a pathogen and a host. The pathogen can be a bacterium, a virus, a fungus, a parasite, or a prion (a protein particle). These are the infectious agents that cause illness. Do you remember the vocabulary from the introduction to this unit? When an organism causes disease in another, the interaction is called parasitism. But some cause the host no harm at all; this is an interaction called commensalism. Some actually help the host, and this is called mutualism.

A host is an organism that acts as a home for the pathogen. This can be a human, an animal, or an insect. The environment is also an important part of transmission because in order for the disease to spread, the habitat of the pathogen and host must overlap somehow. The environment includes both natural and social aspects. The types of diseases that are common (or endemic) in particular areas relate to environmental factors such as temperature, rainfall, and proximity to bodies of water. Social factors affect how humans interact with one another. For example, a pathogen may spread more easily from one person to another in a crowded home or classroom. Figure 1 can help you remember the three important parts of transmission.

Figure 1. Agent-Host-Environment Triad



### Modes of Transmission

#### 1. Airborne / Respiratory

Examples: Influenza, Severe Acute Respiratory Syndrome (SARS), Tuberculosis

A pathogen may be spread from one person to another by airborne particles from a cough or sneeze. Respiratory droplets containing an infectious agent, such as the influenza virus, are propelled through the air. These droplets may land in the nose or mouth of someone nearby or on an object such as a doorknob that someone may touch. For influenza, infectivity is relatively high, which means that the disease spreads easily from person to person. Symptoms of influenza include fever, cough, fatigue, runny or stuffy nose, muscle aches, and nausea or vomiting.

There are three types of influenza: seasonal, avian (bird), and pandemic. Seasonal flu is the respiratory illness caused by an influenza virus that results in an annual epidemic. Every influenza season is different because the virus constantly mutates (changes). As a result, each year a new vaccine must be developed. The seasonal flu can cause serious disease and even death. On average, over 41,000 people in the United States die every year from flu-related illness.

The avian, or bird, flu is caused by influenza viruses that occur naturally in birds. However, these viruses can also infect humans if a human comes into close contact with birds. The avian flu continues to be a threat. Since the most recently described avian influenza is relatively novel to humans and can cause serious disease due to lack of human immunity, it has the potential to cause a pandemic if the virus becomes easily transmissible. The most recent avian influenza outbreaks have been limited, with few documented human-to-human transmissions. Rather, the infections that have been documented occurred as a result of direct exposure of the person to birds affected by the avian influenza virus. Of the 442 total cases that have been reported to the World Health Organization (WHO), 262 have been fatal as of 2009.

A pandemic flu is a global outbreak of a new form of influenza. For example, in 1918–1919, the Spanish flu killed 20 million people worldwide and 550,000 in the United States. Later, you will learn about the mechanisms whereby influenza can be a typical seasonal epidemic in one year, and then the cause of a pandemic and major killer in another year.

Other airborne diseases include Severe Acute Respiratory Syndrome (SARS) and tuberculosis (TB). The SARS virus spread rapidly across 37 countries beginning in China in November 2002. Over the course of the outbreak in 2003, SARS affected more than 8,000 people and killed 774. Tuberculosis is a bacterial disease that most often affects the lungs. Symptoms include cough (sometimes with bloody sputum), persistent fever, and weight loss. Approximately two billion people, or one-third of the world's population, are infected with TB. Although only a small percentage of those people become sick and contagious, TB results in millions of deaths every year.

## 2. Contact (Direct and Indirect)

Examples: Human Immunodeficiency Virus (HIV), Common Cold

Transmission by direct contact occurs when a pathogen from an infected person is directly and immediately transferred to a susceptible person. This must occur by way of physical contact, such as skin-to-skin contact, contact with wounds, kissing, or sexual intercourse. Transmission by indirect contact involves contact with an intermediate object, such as a handrail, doorknob, or drinking glass.

Human Immunodeficiency Virus, or HIV, is an important example of contact transmission. HIV is found in blood, sexual fluids, and breast milk. It is spread directly through sexual contact and breastfeeding and during childbirth. HIV is spread indirectly through injection drug use or by way of a blood transfusion with infected blood. This viral infection kills specialized white blood cells, primarily CD4+ T cells that are needed by the immune system to fight infection. Acquired Immunodeficiency Syndrome (AIDS) occurs as a result of a weakened immune system caused by HIV. An individual is said to be HIV-infected or HIV-positive from the time he or she acquires the virus. It can take time, however, for the person's immune system to become damaged, resulting in AIDS. Once a person's immune system has deteriorated to a certain level, it becomes easier for the person to develop infections such as pneumonia, tuberculosis, and chronic

diarrhea. Some of the infections that can occur in AIDS patients are due to organisms that do not usually cause disease in healthy individuals. These are called opportunistic infections and can arise in any individual with compromised immunity.

The HIV / AIDS epidemic emerged and spread very quickly. The first cases of AIDS were identified in homosexual men in the United States in 1981. The most recent report estimates that 33 million people are living with HIV worldwide. In 2007, approximately 2.7 million people were newly infected with HIV, and about two million people died from AIDS-related illness. HIV / AIDS occurs in every part of the world, but more than 60 percent of all people with HIV live in sub-Saharan Africa. This is an example of an epidemic whose consequences highlight the importance of public health interventions. It is important to understand the ways in which HIV is transmitted in order to devise appropriate and effective interventions.

Another illness that is transmitted by direct or indirect contact is the common cold. There are hundreds of viruses that cause the common cold. They are found in saliva and mucus and can be transmitted directly through kissing or touching contaminated hands. Unlike HIV, these viruses are able to remain in the environment for a couple days once they become airborne from a cough or sneeze of an infected person. Therefore, a susceptible person may become indirectly infected with a cold virus by touching a contaminated surface in the environment, such as a tabletop or telephone. Though HIV and the common cold are categorized under the same mode of transmission, there are important differences in the way each illness is spread.

### 3. Fecal-Oral

Examples: Cholera, Hookworm, Hepatitis A

Transmission of an infectious agent can occur through the fecal-oral (feces-to-mouth) route. This can happen when fecal matter in the environment contaminates food, water, or soil, and is ingested by humans. Thus, many food-borne and water-borne illnesses can also be classified this way. The feces can derive from humans or animals and must contain pathogens to cause disease. These types of diseases are most prevalent in areas with poor sanitation or where human feces are present in fertilizer. Once in the human digestive system, the infectious agent multiplies and is then excreted into the environment, continuing the infectious cycle.

Cholera is an example of a disease that is transmitted through fecal-oral contact. It is caused by a bacterium that infects the intestines, resulting in acute diarrheal illness. In severe cases, excessive loss of body fluids leads to dehydration, shock, and even death. A person may become infected by consuming food or water contaminated by the feces of an infected person. Thus, cholera epidemics tend to occur in areas with inadequate treatment of sewage and drinking water. Since 1816, there have been seven pandemics worldwide, claiming millions of lives. Today, outbreaks continue to occur in developing countries of sub-Saharan Africa and South Asia.

Another example of fecal-oral transmission is hookworm infection, which affects over one billion people worldwide. It is most common in tropical and subtropical climates and in areas with poor sanitation. It can be caused by swallowing soil contaminated with intestinal parasitic worms, although infection commonly occurs by walking barefoot in contaminated soil. In most cases, hookworm infections are asymptomatic but can present with anemia. Anemia is a consequence of the worm feeding on red blood cells. Infected persons may also complain of ground itch, which is a minor immune system reaction at the site where the infectious worm enters the body, usually on the bottom of the feet or on the buttocks.

Hepatitis A is a viral infection of the liver that is also transmitted through contaminated food and water. Symptoms of fever, fatigue, jaundice, stomach pain, and nausea usually last less than two months but can last as long as six months. Most people infected with Hepatitis A recover completely. Transmission often occurs in child day care centers, as well as by careless food handlers. Children, travelers, and others at risk for the disease are now routinely vaccinated. Decreasing rates of Hepatitis A in the United States are attributed to vaccination, along with improved hygiene.

#### 4. Vector-borne

Example: Malaria

Transmission of a pathogen may occur indirectly by a vector, which is a carrier of an infectious agent. Mosquitoes, ticks, and sand flies are examples of vectors. Vectors are not sickened by the pathogen but transport the pathogen from one host to another. Successful transmission depends on many factors, including the habitat and behavior of the vector and of the host.

Malaria is a protozoan infection that is transmitted by a female mosquito. A mosquito becomes infected with protozoan parasites after biting an infected human during a blood meal. The malaria protozoan parasites reproduce inside the mosquito and are transferred to the mosquito's salivary glands. During the next blood meal, the mosquito can transmit the parasite to a susceptible human by injecting its saliva into the human when it bites.

The word "malaria" means "bad air." It was originally used to describe this infection because people erroneously believed that breathing in fumes from swamps caused the disease. Coincidentally, stagnant water that produces this bad air is now known to provide a desirable breeding ground for mosquitoes. This is a good example of the importance of environment in transmission of infectious disease.

Every year, between 1.5 and 2.7 million people die from malaria. More than 90 percent of these people live in sub-Saharan Africa, where mosquitoes thrive in the warm and moist tropical climate. Malaria is one of the leading causes of death for African children, causing more than 2,000 deaths every day. Signs and symptoms range from fever, chills, headaches, anemia, coma, seizures, and neurological deficits in severe cases. Adults who have grown up in endemic areas may have milder symptoms with repeated episodes of malaria; however, pregnant women who are anemic may suffer serious consequences during pregnancy.

A fifth category of transmission is called zoonotic transmission. A zoonotic disease is transmitted from animals to people. This type of disease normally exists in animals but can infect humans. This is a special category that can involve any one of the modes of transmission already discussed. For example, animal pathogens can be introduced to humans by way of respiratory droplets (airborne transmission), an animal bite (contact transmission), contaminated water (fecal-oral transmission), or a tick bite (vector transmission). Many of the diseases you have learned about can be classified as zoonotic since approximately 60 percent of all human pathogens are derived from animal pathogens. Examples include rabies, toxocariasis, cysticercosis, and West Nile virus.

Remember that pathogens are organisms that are simply trying to survive. Thus, diseases do not always fit neatly into one of the categories described above. A pathogen may be spread in a way that incorporates more than one mode of transmission or in a way that scientists are unable to describe. However, we can learn how to protect ourselves from diseases from what we do understand about disease transmission.