

A Review on Infectious Pathogens and Mode of Transmission

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Abstract

The pathogen is a microorganism that is responsible for the infection. Specific pathogens cause specific infections with specific transmission cycles. Pathogens cause the diseases in humans as well as in animals. The life cycle of these pathogens includes growth phase, consolidation, and modification of structure, multiplication/reproduction, spreading, and infection of a new host, which is called the development of the pathogen. The transmission of pathogens from present to future host follows a repeating cycle which can be simple or complex, where transmission occurs through multiple host/vectors which are known as a transmission cycle of disease. To prevent the infections, the transmission cycles of particular pathogen must be understood. In the present review, we focus on the pathogen development mechanisms in association with the host, symptoms and signs of infection of pathogens, and their transmission routes.

Keywords: Microorganisms; Pathogen; Transmission; Infection; Vector; Foodborne

Introduction

A pathogen (Greek word: pathos “suffering, passion” and genes “producer of”) is a microorganism that causes disease in another organism (host) [1,2]. This pathogenic microorganism is known as the infectious agent who may be the virus, bacteria, fungi, protozoa, prion or other micro-organisms. The study of pathogen and disease is described under the field of pathology. There are a number of substrates as well as pathways where the pathogens can invade a host, the principal pathways have diverse episodic time frameworks, but soil contamination has the fastest or most persistent potential for anchoring a pathogen. There are many diseases which are caused by viral pathogens consist of influenza, smallpox, chickenpox, mumps, measles, rubella and Ebola. Diseases caused by microorganisms in the human body are distinguished as pathogenic diseases.

Literature Review

Pathogens developed specific mechanisms in association with host

The human body is a multifaceted and flourishing ecosystem which contains near about 10¹³ human cells and surrounds several natural defences adjacent to various frequent pathogens in the form of the human immune system and through a number of “helpful” bacteria, protozoan, and fungal cells, which represent thousands of microbial species. These microbes found in the human body’s known the normal flora, are frequently limited to certain areas of the body, together with the skin, mouth, large intestine, and vagina. Besides, humans are frequently infected with viruses, most of which occasionally, if ever, become symptomatic. Pathogens are commonly distinguished from the normal flora and do not require that the host be immuno-compromised or injured. The pathogens have developed eminently specialized mechanisms for passing biochemical barriers as well as cellular barriers and for eliciting peculiar responses from the host organism that contribute to the survival and multiplication of the pathogen. Consecutively to survive and multiply in the host, a conquering pathogen must be competent to following criteria:

- i. Colonize the host;
- ii. Stumble on a nutritionally well-suited niche in the host body;
- iii. Avoid, subvert, or circumvent the host innate and adaptive immune reactions;

- iv. Reproduce, by the use of host resources; and
- v. Exit and expand to a new host.

Symptoms and signs of infection caused by pathogens

Albeit, it is easily understood that why pathogenic microorganisms would expand to reproduce in a host, but there is less lucid information about that why they would evolve to cause disease. One justification may be that microorganisms elicited the pathological responses by increasing the efficiency of their spread or proliferation/propagation and therefore clearly have a discriminating advantage for the pathogen. For example, virus-containing lesions found on genitalia caused by *Herpes simplex* infection, to expedite direct spread of the virus from an infected host to an uninfected partner for the duration of sexual contact. In addition, diarrheal infections are proficiently extended from patient to caretaker. Moreover, the stimulation of the disease has no probable advantage for the pathogen [1,2]. There are several symptoms and signs that related to the infectious disease are directly emergence of the host’s immune responses via swelling and redness at the site of infection as well as production of pus (mostly dead white blood cells), therefore the direct result of immune system cells attacking to exterminating the invading microorganisms. Fever, is also a preventive reaction, when the raise in body temperature can diminish the development of several microorganisms.

Transmission of pathogens

Pathogenic microorganisms cause disease in humans, animals, plants as well as in other species. The pathogenic transmission comprises three steps: rescue from the host, travel and infection of the new host. Pathogenic transmission occurs in numerous manners, frequently reliant on the organism’s ecology. For instance, respiratory

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Received December 07, 2018; **Accepted** January 21, 2019; **Published** January 25, 2019

Citation: Meena M, Swapnil P, Barupal T, Sharma K (2019) A Review on Infectious Pathogens and Mode of Transmission. J Plant Pathol Microbiol 10: 472. doi: [10.4172/2157-7471.1000472](https://doi.org/10.4172/2157-7471.1000472)

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pathogens are mostly airborne, whereas digestive tracts pathogens are arising in water or food [3]. Pathogenic agents can be spread from animal-to-animal or animal-to-human via different transmission ways. Generally, pathogen transmission may occur through two types of contact, direct and indirect, in which there are various mechanisms are involved. Figure 1 shows the chain of infectious disease via various pathogenic infectious agents, the different mode of transmission of pathogens, types of susceptible host, portal of entry and exit, and types of the reservoir.

Transmission via direct contact

Indirect transmission, an infected host transmits a disease directly to another host via direct contact. The pathogens that pass through this manner are extremely sensitive to the environment and cannot be sustain at the outer surface of the host for any length of time. For example, sexually transmitted diseases (STDs) are caused by the pathogens which are transmitted through blood, semen, or saliva. There are some pathogens which are responsible for STDs comprise *Tremonema palidum* (syphilis), *Neisseria gonorrhoea* (gonorrhoea),

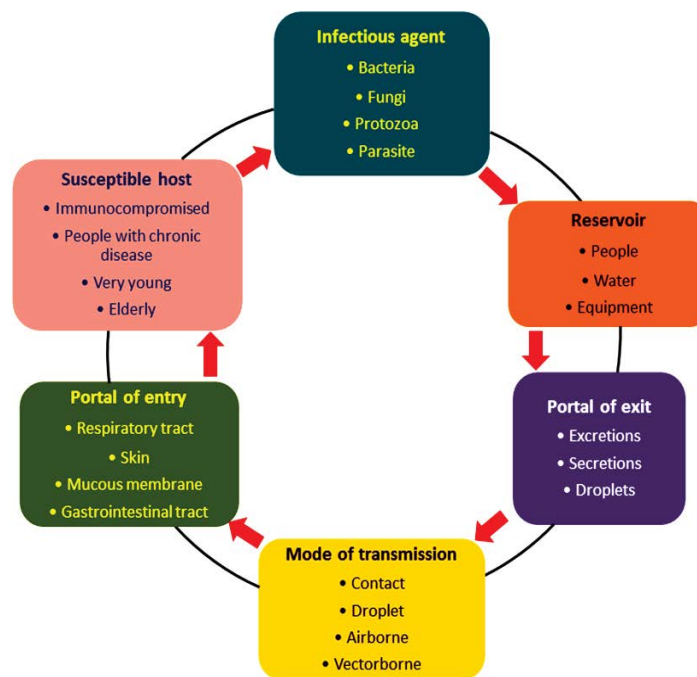


Figure 1: Summary of infection of disease through several pathogenic infectious agents, different mode of transmission, types of susceptible host, portal of entry and exit, and types of reservoir.

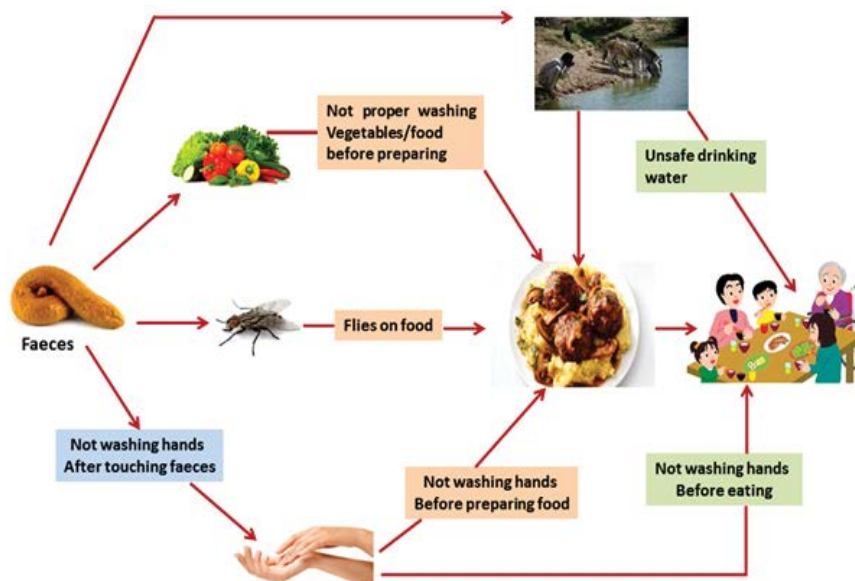


Figure 2: Showing various routes of faecal-oral transmission with faeces via directly or indirectly to someone's mouth could potentially transmit the pathogen.

Vector	Species	Pathogen	Disease
Black fly	<i>Simulium</i> spp.	<i>Onchocerca volvulus</i>	Onchocerciasis (river blindness)
Flea	<i>Xenopsylla cheopis</i>	<i>Rickettsia typhi</i>	Murine typhus
		<i>Yersinia pestis</i>	Plague
Kissing bug	<i>Triatoma</i> spp.	<i>Trypanosoma cruzi</i>	Chagas disease
Louse	<i>Pediculus humanus humanus</i>	<i>Bartonella quintana</i>	Trench fever
		<i>Borrelia recurrentis</i>	Relapsing fever
		<i>Rickettsia prowazekii</i>	Typhus
Mite (chigger)	<i>Leptotrombidium</i> spp.	<i>Orientia tsutsugamushi</i>	Scrub typhus
	<i>Liponyssoides sanguineus</i>	<i>Rickettsia akari</i>	Rickettsialpox
Sand fly	<i>Phlebotomus</i> spp.	<i>Leishmania</i> spp.	Leishmaniasis
Tsetse fly	<i>Glossina</i> spp.	<i>Trypanosoma brucei</i>	African trypanosomiasis (sleeping sickness)
Mosquito	<i>Aedes</i> spp., <i>Haemagogus</i> spp.	Yellow fever virus	Yellow fever
	<i>Anopheles</i> spp.	<i>Plasmodium falciparum</i>	Malaria
	<i>Culex pipiens</i>	West Nile virus	West Nile disease
Tick	<i>Ixodes</i> spp.	<i>Borrelia</i> spp.	Lyme disease
	<i>Dermacentor</i> spp. and others	<i>Rickettsia rickettsia</i>	Rocky Mountain spotted fever

Table 1: Selected arthropod vectors and their particular pathogens and diseases.

and AIDS (Immunodeficiency Syndrome) caused by HIV (Human Immunodeficiency Virus) pathogen. Another example is viruses which are the cause of haemorrhagic fever such as Ebola, transmitted by direct contact passing through blood. Direct transmission includes three types of disease groups: faecal-oral infections, leptospirosis, and infections spread through direct contact.

Faecal-oral infections

These types of pathogens leave the host through faeces, and enter in the susceptible person or animal via ingestion. Mostly, this type of transmission occurs via direct contact with contaminated fingers; food contaminated directly with excreta contaminated hands, domestic flies, soil, or water; contaminated drinking-water; or contaminated soil. This type of infection may be food-borne, water-borne, and water-washed. Figure 2 showing several frequent transmission ways of faecal-oral infection. Faecal-oral infections are transmitted directly through any route that will take substance polluted with faeces via directly or indirectly to someone's mouth could potentially transmit the pathogen. Faecal-oral infections cover diarrhoeal diseases like as cholera, typhoid, bacillary dysentery, hepatitis A and poliomyelitis [4,5]. There is several common infections can extent through faecal-oral transmission in several cases comprising: *Coxsackievirus* (hand-foot-mouth disease), *Campylobacter* infection, *Adenovirus*, *Enteroviruses*, *E. coli* infection, *Giardia* infection, hepatitis A virus, polio, rotavirus *Salmonella*, *Shigella*, pinworms, tapeworms, and toxoplasmosis.

Leptospirosis

This type is infection is mainly caused by rats, although several other animals can possibly transmit the infection by passing pathogen through urine. The routes of transmission are generally direct contact through body tissues of infected animals or ingesting urine contaminated food. People are commonly infected in the course of direct skin contact with water, moist soil, or urine contaminated vegetation from an infected source. Person to person transmission is very rare [4].

Infections of direct contact

The pathogens are directly transmitted through contaminated hands, clothes, domestic flies, or such other type of contaminated substances. This type of infections affect the skin or eyes, and the pathogens are present on the skin or in the affected body parts or eyes. The pathogen enters the body through the skin or mucous membranes such as the eyes. This category showed several other diseases such as trachoma, conjunctivitis, yaws, and scabies. These infections are connected with deprived personal hygiene and are water-washed. Some of these infections also have animal hosts.

Transmission via indirect contact

Indirect transmission takes place when an agent is required for the essential transfer of the pathogen from an infected host to a susceptible host. The pathogen may be either animate or inanimate. Animate transmission agents determined as disease vehicles containing water, air, and food, although inanimate agents also comprise fomites (object on which the pathogen has been deposited). Example of fomites is toys, clothes, bedding or surgical equipment's, furthermore animate (living) agents of disease transmission are generally insects, mites, fleas, and rodents. These living agents of transmission are known to as vectors. In hospitals, the diseases are spread through indirect contact are distinctively known as nosocomial infections. Several respiratory viruses and bacterial spores are light to be elevated by the wind. These spores can be consequently be inhaled by the human, where they cause lung infection. For example, an airborne bacterial pathogen *Bacillus anthracis* (causing anthrax disease), their spores spread through the air and causes a serious respiratory disease when inhaled. Indirect pathogen transmission is spread by a several routes but a common route is via water. Microbes contaminated water can affect the gastrointestinal tract. *Vibrio cholera* is the common waterborne pathogen that causes cholera disease.

Vector based transmission

This vector-based transmission is known as biological transmission, in which transmission the existence and reproduction inside a parasitized vector, complicates the biology of the pathogen and its transmission. Several other vital non-arthropod vectors of disease comprising mammals and birds are present that can transmit the disease, such as mammals can transmit rabies to humans by a bite that transfers the rabies virus. Chickens and other domestic poultry can transmit avian influenza to humans by direct or indirect contact with avian influenza virus a shed in the saliva, mucous, and faeces of chickens. Table 1 shows the selected arthropod vectors and their specific pathogens and diseases.

Foodborne pathogens

Foodborne pathogens are divided into two groups: pathogens that produce the toxins and that toxin affected the host, and other pathogens that infect itself the host and then grow there. Food poisoning is usually caused by the *Staphylococcus aureus* bacterium which produces enterotoxins that result in vomiting and diarrhea [6,7]. The bacterium *Clostridium botulinum* is liable for the botulism disease, which is very serious and fatal food poisoning [8,9].

Microorganisms' anchorage by the vectors which cause disease and transfer them to humans via a bite or by other contacts [10]. Q fever is caused by the bacterium *Coxiella burnetii*, which is conveyed to humans from the management of animals such as sheep. Moreover, the common vectors of disease are insects. Malaria is caused by the mosquitos which extent the protozoan *Plasmodium vivax*. Lyme disease

is caused by the spirochete *Borrelia burgdorferi* which is responsible to infect deer ticks. The bacterium that causes plague *Yersinia pestis* is communicated by the rat flea [11].

Discussion and Conclusion

In this review, we focus that how pathogen developed specific mechanisms in association with the host, how to transmit the pathogens in the host and what are the symptoms and signs of infection caused by pathogens. It is concluded that there is no approach to entirely preclude pathogen transmission, but the preeminent manner to diminish the changes of acquiring a pathogenic disease is to maintain good hygiene. This encompasses like washing the hands accurately after using the restroom, managing raw foods, managing pets or pet excrement, should be followed by coming in contact with surfaces that have been exposed to germs. Novel innovations are being made that expand our understanding to study the pathogenesis of infectious organisms. A better portrayal of the host response pathways and non-essential host factors captured by the pathogen may be the way to discover novel focuses for the advancement of new treatments and molecular diagnostics dependent on a mechanistic comprehension of infectious disease pathogenesis, and provided researchers to a better insight for various novel strategies for the immunization and drug development for disease resistance.

Acknowledgement

The author, MM is thankful to Mohanlal Sukhadia University, Udaipur for providing the necessary facilities during the course of study.

Author Contributions

MM conceived the idea of review, provided the general concept and inputs for each specific section, finally prepared, wrote and drafted the manuscript. MM, PS, TSB and KS edited and finalized the manuscript. All the authors read and approved it for publication.

Conflict of Interest

The authors declare that the work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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