

Task 2 Transmission of infectious organisms and agents in humans and factors which influence transmission between individual and to whole populations

In medical terms transmission is the passing of a disease from an infected person or group to a previously uninfected person or group. The micro organisms that cause disease may be transmitted from one person to another by one or more of the following means

- Direct contact
- Indirect contact
- Droplet contact
- Airborne
- Fecal-oral
- Vector

Direct contact

The easiest way to catch most infectious diseases is by coming in contact with someone who has one. This "someone" can be a person, an animal or, for an unborn baby, its mother. Three different ways infectious disease can be spread through direct contact are:

- Person to person. The most common way for infectious disease to spread is through the direct transfer of bacteria, viruses or other germs from one person to another. This can occur when an individual with the bacterium or virus touches, coughs on or kisses someone who isn't infected. These germs can also spread through the exchange of body fluids from sexual contact or a blood transfusion.
- Animal to person. Animals and pets can carry many germs. Being bitten or scratched by an infected animal can make you sick and, in extreme circumstances, could even cause death. Handling animal waste can be hazardous, too. You can become infected by scooping your cat's litter box or by cleaning bat or mouse droppings in your house or garage.
- Mother to unborn child. A pregnant woman may pass germs that cause infectious diseases on to her unborn baby. Germs can pass through the placenta, as

is the case of the AIDS virus and the toxoplasmosis parasite. Or you could pass along germs during labor and delivery, as is the case for a mother infected with group B streptococcus.

Indirect contact

Disease-causing organisms can also be passed along by indirect contact. Many germs can linger on an inanimate object, such as a tabletop, doorknob or handles. When you touch the same doorknob grasped by someone ill with the flu or a cold, for example, you can pick up the germs he or she left behind. If you then touch your eyes, mouth or nose before washing your hands, you may become infected.

Infectious diseases spread through the air

Droplet transmission

When you cough or sneeze, you expel droplets into the air around you. When you're sick with a cold or the flu — or any number of other illnesses — these droplets contain the germ that caused your illness. Spread of infectious disease in this manner is called droplet spread or droplet transmission.

Droplets travel only about three feet because they're usually too large to stay suspended in the air for a long time. However, if a droplet from an infected person comes in contact with your eyes, nose or mouth, you may soon experience symptoms of the illness.

Crowded, indoor environments may promote the chances of droplet transmission — which may explain the increase in respiratory infections in the winter months.

Particle transmission

Some disease-causing germs travel through the air in particles considerably smaller than droplets. These tiny particles remain suspended in the air for extended periods of time and can travel in air currents. If you breathe in an airborne virus, bacterium or other germ, you may become infected and show signs and symptoms of the disease.

Tuberculosis and SARS are two infectious diseases usually spread through the air, in both particle and droplet forms.

Infectious diseases spread through vectors and vehicles

Bites and stings

Some germs rely on insects — such as mosquitoes, fleas, lice or ticks — to move from host to host. These carriers are known as vectors. Mosquitoes can carry the malaria parasite or West Nile virus, and deer ticks may carry the bacterium that causes Lyme disease.

The vector-borne spread of germs happens when an insect that carries the germ on its body or in its intestinal tract lands on you or bites you. The germs travel into your body and can make you sick. Sometimes the germs that cause infectious disease need the insect for specific biological reasons. They use the insect's body to multiply, which is necessary before the germs can infect a new host.

Food contamination

Another way disease-causing germs can infect you is through food and water. Common-vehicle transmission allows the germs to be spread to many people through a single source. Food is the vehicle that spreads the germs and causes the illness. For instance, contamination with *Escherichia coli* (*E. coli*) is common. *E. coli* is a bacterium present in certain foods — such as undercooked hamburger or unwashed fruits or vegetables. When you eat foods contaminated with *E. coli*, chances are you'll experience an illness — also commonly referred to as food poisoning.

Disease Transmission

First it is important to understand some of the terms used to the infection of an individual.

Infection in Individuals

Infection is the term used to indicate the presence of an infectious agent in an individual or population. Infection, as opposed to passive contamination, implies colonisation of the host's cells, tissues or body cavities, to the benefit of the organism.

Colonisation indicates the presence of the organism without clinical or sub clinical disease, whereas contamination refers to the presence of microbes on a body surface without invasion or response.

Depending upon the host-microbe interaction, infection can be silent (in apparent. Asymptomatic, sub clinical), or overt, causing a disease of infection.

Infecting organisms causing disease are termed pathogens. Individuals who are infected and can transmit infection to others are infectious. Silent or asymptomatic infections, such as HIV infection during the early phase, can still be infectious.

A carrier is a person who is infected with an organism but shows no evidence of disease although disease may have been present earlier.

Acute infection implies a 'short-lived' infection, such as influenza; with the pathogen continually replicates and the patient may be persistently infectious to others, e.g. hepatitis B infection.

Latent infection refers to a persistent infection with possibility of intermittent shedding of pathogens, e.g. varicella zoster virus causing shingles or herpes simplex virus causing cold sores or genital herpes.

So for an infection to occur we need an 'agent' this is the entity necessary to cause disease in a susceptible host. There are several characteristics which are important when talking about agents

Infectivity – the capacity to cause infection in a susceptible host:

- Pathogenicity – the capacity to cause disease in a host.
- Virulence – the severity of disease that the agent causes in the host

The 'host' is the person that is susceptible to the effect of the agent. The host can be classified as susceptible, immune or infected. The host's response to exposure can vary

widely from showing no effect to manifesting sub clinical disease, atypical symptoms, illness or severe illness. The environment is the conditions or influences that are not part of either the agent or the host, but that influence their interaction. There can be a wide variety of factors such as physical, climatologic, biologic, social and economic conditions for example in many infectious disease outbreaks, social and economic conditions cause overcrowding and lead to high levels of exposure.

However the agent, the host and the environment alone are not sufficient to cause an epidemic, a chain of transmission must be present. This process requires a source for the agent, a portal of exit, a mode of transmission and a portal of entry. –

The first element, the source for the agent is usually where it lives, grows and multiplies this is not the case i.e. the agent that causes botulism (*Clostridium*) originates in soil but the source of most botulism infections is improperly canned food containing the *C. Botulinum* spores,

The second element a portal of exit is the pathway by which the agent can leave the source. This pathway is usually related to the place where the agent is localised e.g. the agents that cause tuberculosis and flu are released through the respiratory tract, whereas agents for many stomach ailments are released through the digestive tract. Agents found in the blood, such as hepatitis B and HIV can be released through cuts or needles.

The next step is the mode of transmission which we talked about earlier and can happen in a number of ways; direct transmission includes contact with people, soil or plants. Indirect transmission the agent can be airborne, vector borne or vehicle borne. In airborne transmission the agent is carried from the source to the host suspended in air particles, vector borne diseases are transmitted indirectly by a live carrier usually an arthropod such as mosquitoes, fleas or ticks. Vehicle borne diseases are carried by inanimate objects such as food or water, blood or items like handkerchiefs, bedding and surgical instruments.

Finally there must be a pathway into the host, a portal of entry that gives the agent access to tissue where it can multiply or act. Often the agent enters the host in the same way that it left source. This is the case with the flu virus which leaves the source through the respiratory tract and enters a new host through the respiratory tract.

Infectious in Populations

The following are common terms used in Epidemiology which is the study of the occurrence, distribution and control of disease in populations.

- Endemic infection refers to infection or disease that occurs regularly at low or moderate frequency.
- Epidemics occur when there are sudden increases in frequency above endemic levels.
- Pandemics are global epidemics. The size of 'outbreaks are dependant upon factors such as the ratio of susceptible to immune subjects, period of infectivity, population density, etc.
- The prevalence of infection describes the number of acses in a population at a point in time, whereas the incidence refers to the number of cases arising over a defined period of time.
- Secular trend refers to a change in the prevalence of infection over years. This relates to better living conditions, better hygiene, and vaccination. An example of a secular trend is the decrease in tuberculosis in the United Kingdom.
- Seasonal trend refers to changes in the prevalence of infection occurring over the year, e.g., RSV outbreaks - the reason the seasonality is unclear but changes of temperature, crowding and humidity may play a role.
- Seroprevalence refers to the number of individuals who have antibodies to a particular pathogen. It shows how common the pathogen is in the population. Seroprevalence is usually measured in age-bands to identify the age at which transmission is greatest.

There are three commonly used terms 'epidemic', 'outbreak', and 'cluster'. An epidemic is the occurrence of more cases of disease than would normally be expected in a group of people over a given period of time. There are 2 major types of epidemics.

Common – Source epidemic

This occurs when a large number of people are infected by a common source such as food or water. This can occur when there is a problem with water supply or sanitation, food and water borne diseases are usually intestinal i.e. the faeces contaminates the food or water by improper sanitary procedures (the most important is not washing your hands after using the toilet), then it enters the intestinal tract by eating or drinking the contaminated source. This type of outbreak is characterised by a rapid rise in numbers of people affected over a relatively short time followed by a rapid decline although this is slightly longer than the rise. Examples of this are guests at a wedding who are having the same contaminated meal or people sharing a contaminated swimming pool when on holidays.

Host to Host Epidemic

This type shows a slower progressive rise and gradual decline, cases can continue to be reported over a period of time equivalent to several incubation periods of the disease. The pathogen causing the disease can arise in one individual into a susceptible population where it multiplies and replicates causing an outbreak. Examples of this are flu and common childhood illnesses such as chicken pox. Chicken pox is a good example of a disease that occurs in cycles. An infected child entering school for the first time can cause an epidemic in the school as most of the other children will be susceptible as they may not have been exposed to the virus previously so would have no immunity.

The incidence and prevalence of disease are determined from statistical analysis of illness and death. The DHSSPS issues a list of "notifiable Diseases" which have to be reported to the Public Health Department. Mortality is the incidence of death in the population

.Infectious diseases were the major cause of death in the early twentieth century in developed countries, however these have now decreased and disease such as cancer and heart disease are now the major causes of death. Recently we have all been concerned with the news of “Avian Flu” and the transfer of the virus from birds to humans if this was to occur it could become a worldwide major killer.

Morbidity refers to the incidence of disease in population and includes both fatal and non-fatal diseases. These statistics give a better overview of the population health as the major cause of illness may not necessary result in death i.e. the common cold and acute digestive system conditions.