

## **Epidemiology (quickie version)**

**Epidemiology** – Epidemiology is the quantitative study of the occurrence of disease and factors that influence disease frequency and distribution.

It involves data collection and analysis with the goal of disease prevention. Within the US, data collection, analysis and distribution is coordinated through the **Centers for Disease Control and prevention (CDC)**, the headquarters of which are located in Atlanta, Georgia. World wide epidemiological efforts involve the **World Health Organization (WHO)** centered in Geneva, Switzerland.

Disease categories as they relate to epidemiology include the following:

1. **Endemic** – An endemic disease is one that is always present within a population, i.e., one involving relatively few cases, but occurring all the time.

The common cold is endemic to most human populations, plague is endemic to rodent populations in California, and cholera is endemic to some regions of Southeast Asia.

2. **Sporadic** – A disease that occurs in small, localized, unpredictable outbreaks is categorized as a sporadic disease. Legionnaires disease associated with water misters, fountains, etc. and malaria (in some places) would qualify as sporadic diseases.
3. **Epidemic** – When the number of cases of a disease is significantly above the expected background level, the disease is considered to be an epidemic.
4. **Pandemic** – When disease is spreading to involve people in multiple nations on more than one continent, it is considered to be a pandemic.

### **Factors influencing the prevalence of disease:**

The primary factors influencing the prevalence of disease are the reservoirs involved and the mode of transmission possible.

**Reservoirs** – The term reservoir when applied to epidemiology refers to the total of all potential sources for a disease-causing agent. Reservoirs can be categorized as non-living or living as described below.

#### **Non-living reservoirs include:**

1. **Water** – Water contains variable nutrient levels, some microbes can reproduce in water, others cannot.
2. **Air** – Microbes don't grow but can stay alive in air. Air can pick up microbes from soil, water, or from living organisms (droplet nuclei = packets of microbes in sneeze or cough expelled material).
3. **Soil** – Soil is an excellent reservoir as it is the natural habitat for many types of bacteria. Fungi, protozoa and other types of microbes live there also.

4. **Food** – Food materials contain lots of nutrient, microbes reproduce readily if foods are maintained at moderate temperatures.
5. **Fomites** – Fomites are small articles such as utensils, bedding, clothing, money, etc. Bacteria do not typically reproduce on fomites, but can be carried about on them.

**Vehicles** – The term vehicle, when applied to epidemiology, refers to non-living factors involved in disease transmission. Reservoirs such as water, air, food and fomites can also be vehicles because they carry microorganisms (sometimes considerable distances) and can play a role in disease transmission.

#### **Living reservoirs include:**

1. **Humans** – Some diseases such as small pox and measles are restricted to the human population. These could be eliminated if the entire population could be immunized. Smallpox was declared eradicated in 1979, but is now making a come back as an agent of germ warfare.  
Humans may be reservoirs but show no disease symptoms. Typhoid Mary (Mary Malone) worked in food preparation and carried the *Salmonella* responsible for causing typhoid. She did not show symptoms, and refused to believe that she was a carrier, so was ultimately incarcerated to avoid disease transmission.
2. Non-human animals (mammals, birds, reptiles) – Many types of diseases occur primarily in non-human animals, but can be transmitted to humans, so animals are important reservoirs.

**Zoonoses** = Diseases usually associated with non-human animals, but can be transmitted to humans. Plaque, Lyme disease, Equine encephalitis, Rabies, etc. are examples of zoonoses.

3. **Arthropods** (Insects, mites, etc.) – Arthropods play a dual role as reservoirs and vectors.

**Vectors** are living organisms (usually arthropods) involved in disease transmission. Fleas, lice, ticks and mosquitoes are vectors, but so are rabid dogs and pigs with trichinosis.

The 2<sup>nd</sup> Factor influencing prevalence is mode of transmission, or how the disease is transmitted from one host to the next. Transmission may be either direct or indirect.

**Direct Transmission** = occurs between a susceptible host and a living reservoir. Syphilis, is transmitted directly from one person to the next, but plague and rabies are also directly transmitted. If a person acquires trichinosis from eating raw pork, that is also considered to be direct transmission.

**Indirect Transmission** = when a susceptible host contacts a vehicle previously in contact with a reservoir. Stepping on a rusty nail, falling into contaminated water, etc. would be examples of indirect transmission.

The primary factor influencing mode of transmission for a particular pathogen is how sensitive the pathogen is to exposure, e.g., to heat, cold, drying, U.V. radiation, etc.

## Factors influencing the severity of epidemics (How bad will they be)

Some of the most important factors influencing the severity of epidemics include:

1. **Acquired immunity** – Host resistance due to acquired immunity, i.e., the population has been immunized, or exposed before, can significantly influence the severity of an epidemic.
2. **Genetic background** – Genetic background may give some people an advantage over others. For example, people with sickle-cell anemia (a genetic disorder) are more resistant to malaria than are most others. Different people have different levels of or potential ability to develop immunity.
3. **General state of the population** – The age, nutritional status, pre-existing disease load, etc. can influence susceptibility to disease.
4. **Intensity of exposure** – Intensity of exposure can vary considerably both in time and space. People using water from a well contaminated during a flood are very likely to encounter a new pathogen and become ill. People using similar water on a regular basis may have already developed resistance to the pathogens present, then a person just stopping by for a glass of lemonade is more likely to become infected.
5. **Cultural practices, or habits of the people** – People using the same river for drinking, washing, bathing and carrying excrement are more likely to experience epidemics, than those using treated water for drinking, washing and bathing. People randomly tossing disposable diapers are seriously counterproductive to maintaining sanitation in this country.
6. **Virulence of pathogen** – Bacteria vary significantly in terms of their ability to cause disease symptoms, and this can also influence the severity of epidemics.

## Control of Epidemics:

Since disease control and prevention is the goal of epidemiology, it is important to consider the best methods for controlling disease, these include the following.

1. **Increase host resistance** – If possible, provide **immunization**, if not, **education** can be helpful. On the other hand, people are surprisingly resistant to education. How easy would it be to convince people they should stop using disposable diapers?
2. **Decrease exposure to reservoirs and/or vectors** – Within the United States, many reservoirs have been eliminated or significantly reduced, and programs are maintained to control vectors. Hear again, education is potentially useful.
3. **Isolate or segregate infected individuals** – It is common practice to keep sick children home from school (until they enter college) and to segregate patients in clinical settings. Never-the-less, segregation has negative connotations, and often meets with opposition.

In order to determine how well epidemics are being controlled or prevented, it is often useful to know the following:

**Morbidity rate** = The number of cases of a particular disease, per unit population and time period.

**Mortality rate** = The number of deaths attributed to a specific disease, per unit population and time period.