

Introduction to Epidemiology: Basic Terminology Part 2

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In this lecture, I'll define some common epidemiologic terms that will be the building blocks for how we measure disease occurrence and how we make comparisons between groups.

In the previous part of this module, we talked about case definitions of a disease or outcome of interest. Building off that, we can now talk about disease types.

A **disease event** is used to describe diseases or outcomes that happen essentially instantaneously. While the results of a disease event may last for some period of time, the event itself has no duration. Examples of a disease event would be a fall or suicide or death.

Disease events can be **recurrent**, meaning that they can happen multiple times, or non-recurrent. A **non-recurrent** event can occur only once, as in the case of death or specific illness that a person can have only at one point in their life, whereas recurrent events, such as falls, can happen repeatedly.

Disease states are used to describe periods of time when an individual is in a susceptible, diseased, or resistant or immune state. Diseases that have some duration are described as diseased states rather than disease events. Examples of diseases that would be considered diseased states include chronic disease such as diabetes or an infectious disease. While the disease onset occurs instantaneously, the individual stays in the disease state for some period of time, which may vary from person to person.

As with disease events, disease states can be non-recurrent, such as measles, where infection confers immunity to future infection, or recurrent such as a urinary tract infection, which can recur repeatedly. A disease may be non-recurrent because, either by definition or by immunity, the disease cannot happen again after the disease is resolved, or because once a person is in a particular disease state, they remain in that state for the rest of their life. Individuals can move in and out of the disease state, or not-disease state. All of these can be represented using a state transition model. In a later lecture I will introduce the concepts of prevalence and incidence, at which time the importance of these disease state transitions will become even more clear.

The boxes represent the state that a person may occupy at any one time. They can be susceptible or not susceptible or diseased or not diseased. An individual can only be in one state at a time. The arrows represent the transition from one state to another. For example, in this figure, we can see that people can move from non-disease state to disease state.

For chronic diseases such as coronary artery disease, people can only move from non-diseased to diseased state but not vice-versa. For influenza infection, for example, one may move from non-diseased to diseased and back.

Another important term is **susceptibility**, which is used to define the population that is “at risk” for the disease of interest. Susceptibility means “at risk” of a disease and doesn’t necessarily mean “at high risk”. Some people may not be susceptible to a disease because of their genetic characteristics assigned at birth. For example, someone assigned female at birth lacks a prostate, and therefore is not susceptible, or “at risk,” of getting prostate cancer.

Susceptibility for a disease may change over time. For example, one may no longer be susceptible to tetanus after vaccination. However, after immunity to tetanus wanes, they may again be susceptible after many years.

People who are already diseased are no longer susceptible. For example, if you are already suffering from pneumonia, you are not considered to be susceptible to pneumonia at that time. As we state to talk about measuring disease occurrence, it will be very important to think about both the number of people who are diseased as well as the number of people who are susceptible to the disease.

Here’s an example to illustrate this concept. Everyone who has an appendix and is not already suffering from appendicitis is susceptible to appendicitis. Susceptible people can move to the disease state if they get acute appendicitis. When these individuals get an appendectomy after an acute appendicitis, they move from the disease to the non-susceptible state. Similarly, there may be a susceptible group moving to the non-susceptible group—getting elective (or optional) appendectomy and never passing through the disease state.

A fundamental concept in measuring disease or outcome occurrence is **observation time**. This is the time that an individual, participant, or patient is being observed for the presence or onset of disease or the outcome of interest. We must determine the timeline for each person in order to define the period of observation. It is important to be very clear on when a person is being observed, when they're not being observed, for example, the study duration or the breastfeeding period. We will see from later examples when we're talking about the frequency and the incidence that specificity here is critical.

Let’s turn now to talking about populations. **Defined populations** are a group of individuals that can be defined by certain shared characteristics. These can be personal, such as socio-demographic characteristics, or age, or gender or race or ethnicity. For example, a defined population of girls between the age of 17 years and 19 years. It can be related to place, residence, occupation, or other factors, which may be related to a period of time. This defined population will again be important when we start to quantify the occurrence of disease. Populations can be either open or closed.

In a **closed population**, the membership in the population does not change over the period of observation. For example, we could have passengers on an airplane, participants in a study with complete follow-up, players on a football team during a match, or all babies that were born in a country in a particular year. These populations are shown here. No one exits or enters during the fixed observation period. At the end of the observation period, the outcome of every participant is known in a closed population. In practice, closed populations are relatively uncommon, but it's helpful to understand the concept of a closed population as we think about quantifying disease occurrence.

Open populations can gain or lose members over time. And this gain or loss can be due to births, deaths, migration, newly eligible people, and so on. People may become newly eligible as they move in and out of a susceptible group. In most applications of epidemiology, open populations are the most common. For example, the population of a country changes over time as people enter and leave, are born and die. The individuals in an open population may have different amounts of follow-up time and the outcome of all individuals is not necessarily known at the end of the observation period if they have left the population.

In this lecture, you learned some common epidemiological terms, including disease states, susceptibility, and open and closed populations. In the next part, we will cover how we measure disease occurrence in a population and make comparisons between groups.