

Health Promotion (S245)



Collect, calculate and evaluate health and disease data, as part of implementing a health promotion campaign



Lesson 4: Measuring health

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Before we begin this lesson, let's play a game called *Solve the Outbreak*, created by the national public health agency of the United States, the Centers for Disease Control and Prevention (CDC).

Click [here](#) to go to the game at CDC's website. Pick a scenario to play "disease detective", and resume this lesson after you are done.

CONTINUE

Driving a healthier and safer society with data

So, how did you fare in the game?

While the various scenarios in CDC's game seemed tuned for the Covid-19 pandemic, its underlying premise of collecting, calculating and evaluating health and disease data has been practiced by health organisations around the world for over a century to drive healthier and safer societies.

There are many important applications for health and disease data. For instance, tracking historical health trends can point to where past interventions have improved the health of a population, thus helping health organisations identify where current and future interventions may be needed. Another example: Tracking disease outbreak data can indicate where the outbreak occurred and who it is most likely to impact, thus helping to control the spread of the disease and prevent future outbreaks.

Health and disease data also form the backbone of health promotion initiatives, allowing health organisations to design activities and programmes that hit the mark. Conversely, crafting messages using the right health and disease data is key to drumming up public awareness and support for such initiatives.

In the previous lessons, you looked at the health promotion efforts of important global health stakeholders such as the World Health Organisation (WHO), which helped create the Ottawa Charter For Health Promotion that has five action areas: Build healthy public policy, create supportive environments for health, strengthen community action for health, develop personal skills, and re-orient health services.

You have also looked at recent campaigns by the Health Promotion Board (HPB) of Singapore, including "Healthier Choice", "I Quit Programme", "Sundays @ the Park", "My Healthy Plate", and "Keep Myopia away, go outdoors and play!".

In this lesson, we will look at how to measure health and diseases in populations and apply it to health promotion.

Lesson objectives

At the end of this lesson, you should be able to:

1. Explain the importance of measuring health and diseases in a population and society
2. Describe the key terminologies for measuring health and diseases
3. Describe the uses of epidemiology and its relevance to health promotion

This lesson should take about 3h 30m to complete

CONTINUE

Why measure health and diseases?

When it comes to planning and implementing health promotion initiatives, campaigns and activities, the use of health and disease data serve three important purposes, namely:

It establishes needs and priorities —

The data gathered can help planners answer crucial questions, for instance: What is the size of the problem? How many people are affected? How important are the campaign's goals?

It helps evaluation and planning —

Establishing base line data is an essential part of evaluating and planning health promotion programmes. Take the HPB's National Steps Challenge for instance. Collecting data following the campaign's implementation will let organisers know if more people are walking after the campaign and thus evaluate how successful the campaign has been and plan for its next iterations.

It justifies the use of resources —

This is especially pertinent when a campaign has to compete with other activities for resources and funding. Through collecting and evaluating the relevant health and disease data, health organisations can decide whether their campaigns justify the allocation of resources, or which campaigns to focus on for the best use of current resources. For instance, whether to run a diabetes- or obesity-related campaign at a point in time.

Activity 1 (expected time to complete ~ 10 minutes)
Match the risks and causes with the diseases

Match the risk factors and causes on the left, with the diseases on the right. To pair them up, drag the panels on the left.



Too much food and little exercise increases the risk of

Cardiovascular disease



Having a high fat diet increases the risk of

High cholesterol



Consuming lots of sugar increases the risk of

Diabetes



High daily intake of salt increases the risk of

Hypertension



Smoking increases the risk of

Lung cancer



Drinking too much alcohol increases the risk of

Liver damage



Bird flu is caused by

H1N1 virus



Not wearing a helmet when cycling increases the risk of

Head injuries

SUBMIT

CONTINUE

Epidemiology

How many of the risk factors, causes and diseases listed in Activity 1 are already familiar to you? If the majority of them are, it likely means health agencies here have been successful in reaching you with their health promotion campaigns, messages and activities.

Risk factors (something that increases the chance of developing a disease) and causes (something that directly leads to a disease) are important concepts in a branch of medicine called epidemiology. The name itself comes from three Greek words: Epi, which means "on" or "upon"; demos, which means "people"; and logos, which means "the study of". Together, they translate to "the study of what befalls a population".

The WHO defines epidemiology as the "study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the prevention and control of health problems".

Click on the "+" labels of the graphic below for elaborations of the WHO definition.

A closer look at the definition of Epidemiology



A closer look at the definition of Epidemiology



Study

This refers to research and data analysis methods, such as surveillance, observation, hypothesis testing, analytic research and experimental methods.

A closer look at the definition of Epidemiology



Distribution

Distribution means how something is spread out. In epidemiology, it relates to two concepts: Frequency and pattern.

Frequency refers to the number of health events—for instance, the number of cases of diabetes—in a population during a specific period of time.

Pattern refers to the occurrence of health events in terms of time (when), place (where) and person (who).

A closer look at the definition of Epidemiology



Determinants

Determinants are factors that influence health. They can be biological, chemical, physical, social, cultural, economic factors, genetic and behavioral in nature. For instance, physical activity (or inactivity) can be a determinant that influences the occurrence of cardiovascular diseases.

A closer look at the definition of Epidemiology



Health-related states

A health-related state is anything that affects the well-being of an individual or population. They can be diseases, injuries, behaviours such as smoking, the way individuals respond to efforts to prevent the spread of diseases, and the provision and use of health services. Health-related states can be positive or negative.

A closer look at the definition of Epidemiology



Specified populations

A specified population refers to a group of people who share certain identifiable characteristics, such as age, gender, occupation and disease status.

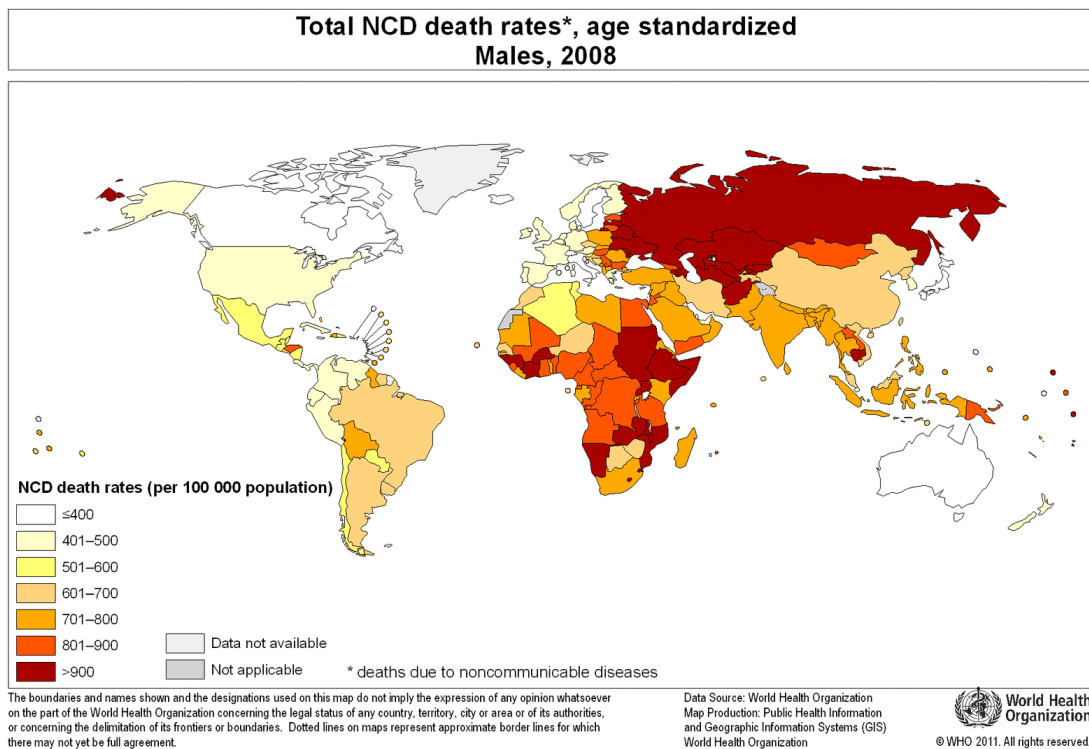
A closer look at the definition of Epidemiology



Prevention and control

The aims of public health programmes and initiatives are to promote, protect and restore the health of inhabitants of the region or country.

The chart below shows a typical graphical representation of an epidemiological study:

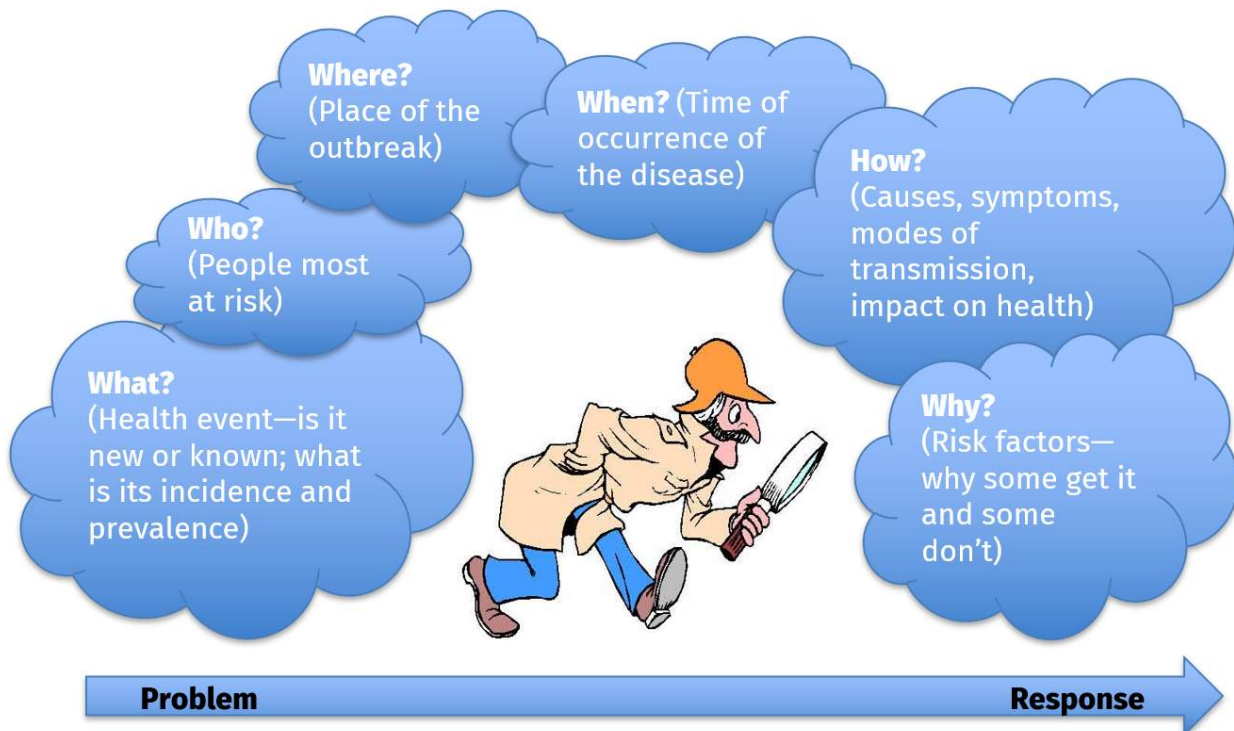


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The methods of an epidemiologist

Part of the job description of an epidemiologist is to be a disease detective, like with the CDC game you played at the start of the lesson. When there is a health-related problem or health event, the epidemiologist will investigate, gather data, and analyse the data, in order to explain how the disease was transmitted from an infected person to those not previously infected. The analysis of the data also lets the epidemiologist and health agencies identify the behaviours that put people at risk of diseases and ill-health.

The diagram below shows the typical methods of an epidemiologist when investigating a disease outbreak:



Sources of data

Here are common data types that epidemiologists and health organisations use, and the places where the data are typically found:

Type of data	Where to find them
Causes of death and associated information such as the demographic data of the deceased	Death certificates
Real time or trending information about the occurrence of diseases	Surveillance data
Personal health information	Hospital and insurance records, general practitioners (GP), and the police
Health-related information, attitudes and behaviors of individuals in specified populations	Surveys, such as the annual National Nutrition Survey by HPB
Health events and diseases that are required to be reported by law (in Singapore, they include events such as food poisoning, and diseases such as tuberculosis, bird flu and malaria)	Government notifications and media reports

Endemic, epidemic or pandemic?

The classification of diseases according to their spread is important for epidemiologists. There are three broad groups of classification: Endemic, epidemic and pandemic.

An **endemic** disease exists permanently in a particular region or population. E.g., malaria is an endemic disease in tropical countries, as it is a common concern in these countries.

An **epidemic** is a sudden outbreak of a disease above the level of what is normally expected, and that attacks many people at the same time within a geographic area. E.g., the 2013–16 outbreak of the Ebola virus disease in Western Africa was an epidemic during that period.

A **pandemic** is an epidemic that has spread across continents and the world. E.g., Covid-19, the swine flu and the Severe Acute Respiratory Syndrome (SARS). Non-communicable diseases, such as obesity, can also become a pandemic.

CONTINUE

4 health and disease concepts to know

Let's look at four key health and disease measurement concepts that epidemiologists, health agencies and health campaign organisers have to know. They are: Population at risk, morbidity, the relationship between incidence and prevalence, and mortality and life-expectancy.

Key concept 1

Population at risk

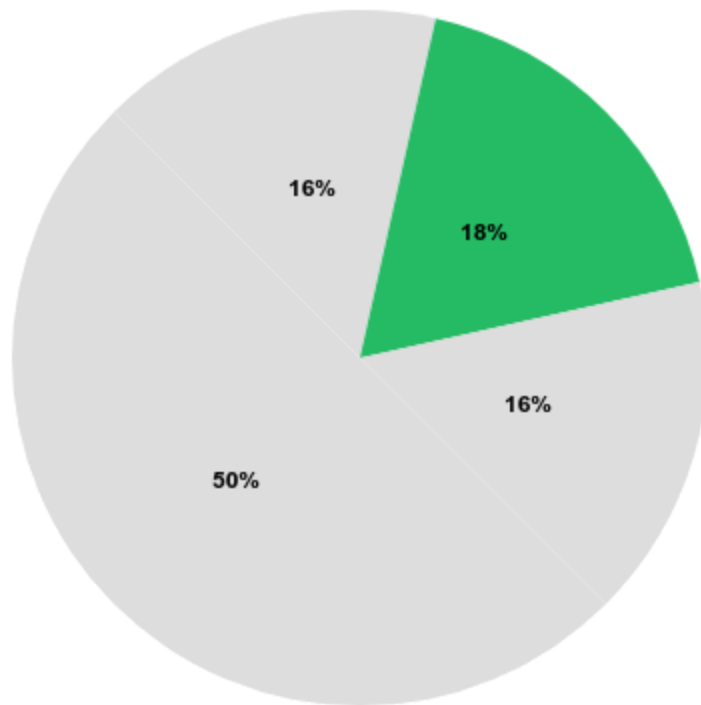
When calculating the impact of a disease or condition, it is important to identify and estimate those in the population who are vulnerable to the targeted disease or condition, and exclude those who are not.

For example, say you plan to conduct a cervical cancer-related study. Clearly, you should exclude men from the study. You are also likely to exclude women under 24 years-old and above 70 years-old, as the chances of women in those two age ranges developing cervical cancer are [extremely low](#).

Here's another example: If obesity is a risk factor in a study, then people who fall within the ideal Body Mass Index (BMI) range should be excluded from the study's calculations.

The chart below illustrates the notion. The green portion represents the size of the population at risk. Hover your mouse over the pie chart to see the different groups within the population.

What is the actual population at risk from cervical cancer?



- ☐ Men
- ☐ Women (under 24 years-old)
- ☒ Women (25-69 years-old)
- ☐ Women (above 70 years-old)

CONTINUE

Key concept 2

Morbidity

Morbidity has to do with having a disease, and morbidity data lets epidemiologists and health organisations understand how fast a disease is developing and how much of a disease is present in a population. There are two key metrics for morbidity. First is incidence, which measures the new cases of a disease or health condition over a period of time. Second is prevalence, which estimates the number of people who have a disease or health condition.

Incidence reflects how quickly a disease or health condition occurs in a population. It can be expressed as a rate (the number of health events that occur in a population over a period of time), or proportion (the percentage of people with a health outcome or characteristic). As incidence tracks the transition from healthy to disease state, it is a measure of risk.

Prevalence reflects the burden of a disease or health condition on a population. It can be measured at a point in time (called point prevalence or usually just prevalence), or over a period of time (called period prevalence). Prevalence is not a measure of risk.

Here are the equations for calculating incidence and prevalence:

$$\text{Incidence} = \frac{\text{Number of new events in a specified period}}{\text{Number of people at risk during the period}} \times 10^n$$

$$(\text{Point}) \text{ Prevalence} = \frac{\text{Number of people with the disease or condition at a specified time}}{\text{Number of people in the population at risk at the specified time}} \times 10^n$$

$$\text{Period prevalence} = \frac{\text{Number of people with the disease or condition during a specified period}}{\text{Number of people in the population at risk midway through the specified period}} \times 10^n$$

* $n = 2$ if the metric is expressed in percentage or per 100 people; $n = 3$ if expressed as per 1,000 people, and so on

An important distinction between incidence and prevalence lies in the data used in the **numerator** of the equations:

- For incidence, the numerator includes only new cases
- For (point) prevalence, the numerator includes both new and existing cases, and excludes people who have been cured of or have died from the disease

- For period prevalence, the numerator includes both new and existing cases. However, it also includes the cured and deceased cases that occur within the specified period

Let's look at some examples, as well as the implications and applications of incidence and prevalence.

	Incidence	(Point) Prevalence	Period prevalence
Examples	When expressed as a rate, it refers to the number of new cases of a disease that occur over a specified time period, per number of people. E.g., 500 new flu cases per 10,000 people per week. When expressed as a proportion, it refers to the percentage of people who develop a disease over a specified time period. E.g., 5% of people caught the flu in the first week of Dec, 2021.	It is the proportion of a population who have a condition at a point in time. It may be reported in percentage, or as cases per number of people. E.g., the point prevalence of Covid-19 in Singapore on Sep 10, 2021, was 0.01%, or 10 cases per 100,000 people, assuming a population of 5.7 million people.	It is the proportion of a population who have a condition at any time during a period of time. It may be reported in percentage, or as cases per number of people. E.g., in the 2020 National Population Health Survey by the Ministry of Health, the period prevalence of hypertension among Singapore residents aged 18 to 74 years was 35.5%, or about 1 in 3 people, over the survey period of 2019 to 2020.
Implications	Incidence shows how fast a disease is spreading and	Prevalence gives a snapshot of the	Period prevalence gives a view of the disease

	Incidence	(Point) Prevalence	Period prevalence
	estimates the risk of the disease.	disease burden on a population at a given point in time.	burden on a population over a period of time.
Applications	Incidence data and trends can reveal the effectiveness or inadequacy of current disease control measures, as well as help healthcare administrators assess or plan intervention measures such as vaccination. E.g., If there is an increase in the incidence of flu in older adults during winter, then one area epidemiologists can study is the uptake of vaccination programmes by the elderly in the community. They can also assess how well the elderly are responding to vaccinations.	By estimating how many people are affected by a disease at a point in time or over a period of time, prevalence data and trends (i.e., whether the disease burden is increasing or decreasing), can help healthcare administrators estimate the magnitude of the problem and conduct better healthcare planning. E.g., If the prevalence of a disease is substantial and has risen from the previous year, then healthcare administrators may look to provision for more healthcare services and staff, or run more health promotion programmes, or even roll out plans to build more hospitals and rehabilitation facilities.	

Examples of incidence calculation

In Town A, 20 people caught the flu virus in the first week of December, out of an at risk population of 2,400. By end-February, the total number of new infections since Dec 1 stand at 360. The period spanning December to February is the peak flu season.

The incidence of flu in the first week of December is $20/2400 \times 1000 = 8.3$ cases per 1,000 people per week.

The incidence of flu in the Dec-Feb flu peak period is $360/2400 \times 100 = 15\%$. This means the risk of someone in Town A catching the flu during the peak flu season is 15%.

Examples of prevalence calculation

A study of 3,150 new diabetic patients was started on Jan 1, 2015. Researchers found that 15 of the patients had developed kidney disease as at Jan 1, 2016. No one has been cured of or have died from kidney disease at the time.

Over a five-year follow-up period from the start of the study, it was found that 245 patients developed kidney disease at some point. Among them, 10 patients had died from the disease, all within the final year of the five-year period.

The (point) prevalence of kidney disease in the study group at Jan 1, 2016, is $15/3150 \times 100 = 0.5\%$

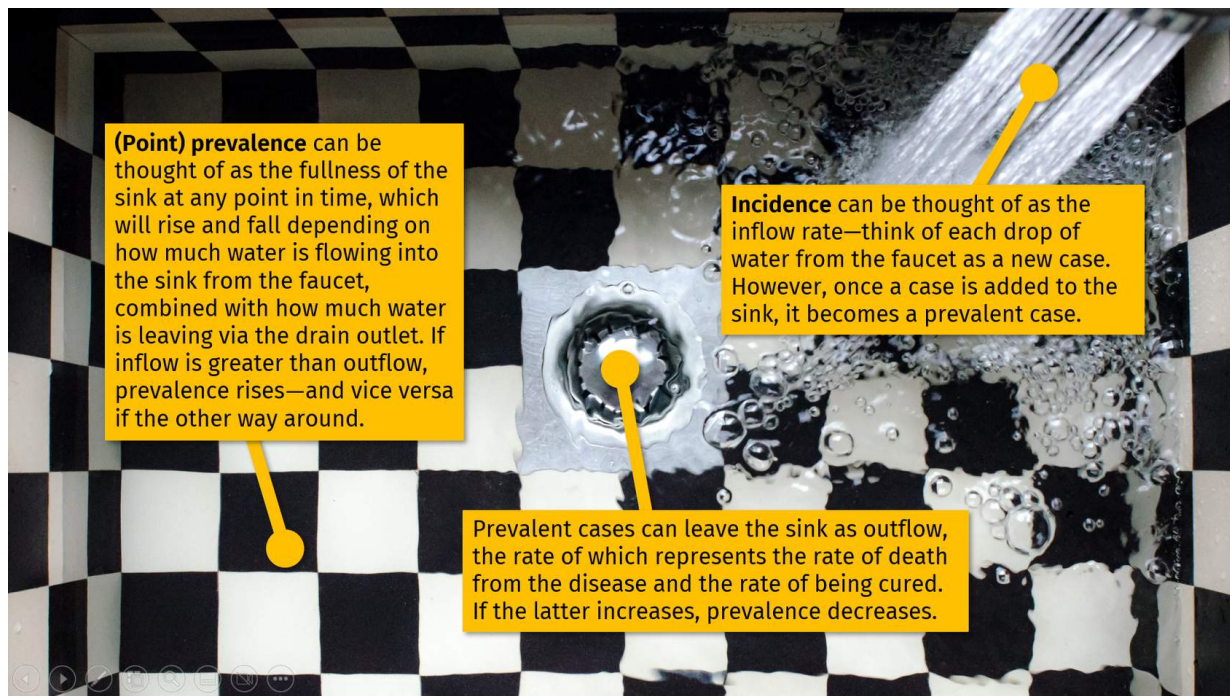
The period prevalence of kidney disease in the study group during the five-year follow-up period is $245/3150 \times 1000 = 77.8$ cases per 1,000 patients.

CONTINUE

Concept 3

Relationship between incidence and prevalence

While incidence and prevalence measure different phenomena, they are closely related to each other. The link between the two is analogous to the relationships among water inflow, water outflow, and the fullness of a sink, as the graphic below shows.



Above: Understanding the relationships among water inflow, water outflow, and the fullness of a sink can be useful for exploring the causes behind incidence and prevalence trends

The sink analogy can be useful for exploring the causes behind incidence and prevalence trends, which may not be clear at first glance. For instance, consider a case in which the point prevalence of a disease is declining (i.e., the water level is falling).

The sink analogy allows two possible causes:

1. The rate of death and being cured (**outflow**) has remained constant, while the number of new cases (**inflow**) is declining
2. The number of new cases (**inflow**) has remained constant, but the rate of death (**a part of the outflow**) has been increasing while the number of people cured has remained constant

Clearly, two scenarios with different implications can lead to the same prevalence outcome.

What goes on behind the data

Let's look at two real-life scenarios that can lead to an increase in the prevalence of a disease in a population.

- Prevalence of a disease in a population is likely to rise when a medicine, which controls the disease and prevents death but does not cure the patient, is made readily available. One such medicine is the insulin medication typically prescribed to people who have diabetes
- Prevalence of a disease is also likely to rise when health agencies introduce more screening for the disease, which results in more people are being identified as having the disease. Hence, prevalence rising in this case may not mean that more are being infected, just that more existing but undetected cases are being identified



CONTINUE

What do you think the stats below mean?

According to the World Bank, the mortality rate for adults in Singapore in 2021 was 56.2 per 1,000 (males) and 33.3 per 1,000 (females), while the average life expectancy here in the same year was 81.1 years (males) and 85.9 years (females).

CONTINUE

Concept 4

Mortality and life expectancy

Mortality is the number of deaths in a population. In epidemiology, it is usually expressed as a rate: The number of deaths in a population divided by the total number of this population. Its equation is as follows:

$$\text{Crude mortality rate} = \frac{\text{Number of deaths during a specified period}}{\text{Number of people at risk of dying during same the period}} \times 10^n$$

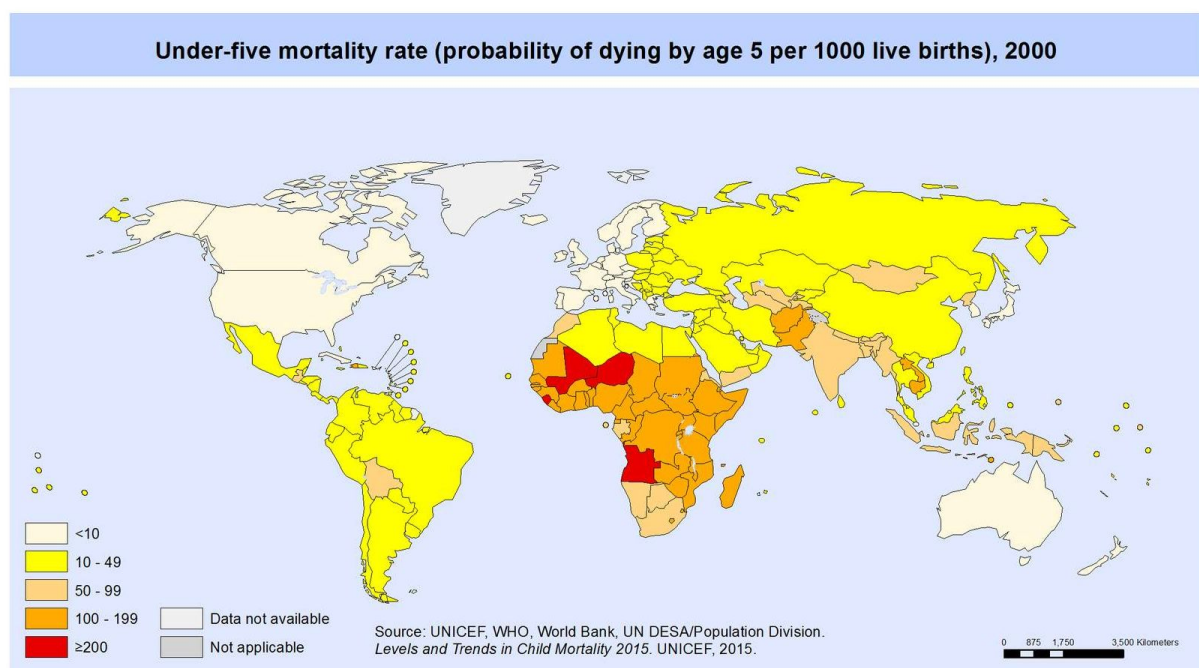
* $n = 2$ if the metric is expressed in percentage or per 100 people; $n = 3$ if expressed as per 1,000 people, and so on

The equation above is for a general scenario. Mortality rate is usually reported according to a set of conditions, such as a specific geographical area, period of time, cause of death, cause of a disease, gender, age-range, etc. For example, healthcare organisations in Singapore have been tracking cancer mortality rates for various types of cancer and for each gender. Another

commonly-tracked mortality rate is adult mortality, defined by WHO as the probability of dying between the ages of 15 and 60.

Thus, mortality rate is an indicator of population health. Another indicator of health is **life expectancy**, which is the average number of years a person of a given age is expected to live, given the mortality rates observed in the population, which means life expectancy reflects the factors that influence mortality rates, such as lifestyle and behavioral factors (lack of physical activities, poor diet, etc.).

Ultimately, morbidity and mortality information allows for continuous evaluation of health care systems and interventions, estimation of how a health event can affect a population, and the planning of resources toward the potential onset of a health event.



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Health Statistics and
Information Systems (HSI)
World Health Organization



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Above: Under-five mortality rate is an important indicator of the healthcare standard of a country

Activity 2 (~2 minutes)

Can you spot incidence, prevalence and mortality?

Take a minute to read the Covid-19 advisory below.

COVID-19: 16 Apr 2020 update

New cases: 728

- Imported: 0
 - Cases in community: 48
 - Work Permit holders (residing outside dormitories): 26
 - Work Permit holders (residing in dormitories): 654
- (Of new cases, 81% are linked to known clusters, the rest are pending contact tracing)

Total cases: 4427

- Hospitalised: 1886 (23 in ICU)
- In community facilities: 1848
- Fatalities: 10
- Total discharged: 683 (Discharged today: 31)

Question: If you were to calculate incidence, (point) prevalence and mortality rate from this April 16 alert, what data from the alert would you use?

[CLICK HERE FOR THE ANSWER TO ACTIVITY 2](#)

To calculate incidence, use "New cases" (728).

For (point) prevalence, use "Total cases" minus "Total discharged" and "Fatalities" ($4,427 - 10 - 683 = 3,734$).

For mortality rate, use "Fatalities" (10).

CONTINUE

What we have covered so far..

You are almost at the end of the lesson. Let's recap.

First, we looked at the key terminologies for measuring health and diseases—namely, population at risk, morbidity, incidence and prevalence, and mortality and life expectancy.

Second, we discussed how health and disease data can be harnessed for health intervention and health promotion.

Third, we looked at the many applications of epidemiology, which lets epidemiologists and health organisations do the following:



Determine the risk factors and causes for diseases (e.g., the relationship between high fat diet and heart disease)



Describe the distribution of disease in a community by using measurements such as incidence, prevalence and mortality rate



Predict disease occurrence and its impact (e.g., how heart disease impacts the health and quality of life of an individual)



Determine disease trends (e.g., by studying the incidence of heart disease in a population over a long period of time)



☐

Estimate the chance of getting a disease (e.g., the probability of an individual in a community getting heart disease over a specified age period)

☐

Measure the effectiveness of health measures (e.g., the effectiveness of an intervention that modifies risk behaviours that lead to heart disease)

☐

Plan current and future health care needs

The video below sums up what we have covered about epidemiology:



CONTINUE

Activity 3 (~20 minutes)

Quiz

Let's test your understanding.

There was an outbreak of the Ebola virus disease in Town A in 2021. At end-January 2021, 650 out of Town A's population of 5,000 had the disease. By 31 Mar 2021, epidemiologists found 100 new cases. Assuming no cases have been cured, what is the prevalence of Ebola on 31 Mar 2021?

- ☐ 2%
- ☐ 13%
- ☐ 15%
- ☐ 17.6%

SUBMIT

What is the prevalence of Ebola at 31 Mar 2021, per 1,000 people?

-
- ☐ 15 cases per 1,000 people
 - ☐ 12 cases per 1,000 people
 - ☐ 120 cases per 1,000 people
 - ☐ 150 cases per 1,000 people

SUBMIT

Ebola virus is associated with a high risk of blindness. What is the size of the population at risk of Ebola-associated blindness in Town A on 31 Mar 2021?

- ☐ 100
- ☐ 650

☐

750

☐

Cannot be calculated from given data

SUBMIT

Between Jan and Mar 2021, 60 people who had Ebola in Town A became blind. What is the incidence of Ebola-associated blindness per 100 people for that period?

☐

0.08

☐

1.2

☐

8

☐

40

SUBMIT

In the month of April 2021, 22 people died from various causes in Town A.
What is the mortality rate per 1,000 people in the month of April 2021?

- ☐ 0.44
- ☐ 0.44%
- ☐ 4.4
- ☐ Cannot be calculated from given data

SUBMIT

CONTINUE

Activity 4 (~20 minutes)

Process epidemiological data

Download the attached spreadsheet file below ("S245 Lesson 4 - Worksheet_Excel_Student"), and then watch the two videos below, which are tutorials on how to use the Microsoft Excel spreadsheet functions COUNTIF and SUMIF. Both functions are commonly used for epidemiological data computations.

After you have done so, apply the COUNTIF and SUMIF functions to the dengue fever data in the spreadsheet file, to extract the following information:

1. Number of dengue fever cases in each region
2. Number of dengue fever cases associated to each race
3. Number of male and female dengue fever cases in each region
4. Cost of treatment in each region

Your lecturer will go through the results of this exercise in the next lesson.



S245 Lesson 4 - Worksheet_Excel_Student.xlsx

17.6 KB





CONTINUE

Resources

Click on the attachments below to download the reading resource and a copy of this lesson in the PDF format.



Epidemiology reading 1.pdf

203.4 MB



S245-L4-Measuring-Health.pdf

4 MB



CONTINUE

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