Objectives

After this lecture, you should be able to:

♦ Define and calculate prevalence
♦ Define and calculate incidence
♦ Define and give examples of risk factors
♦ Know how risk factors are used
♦ Define and give examples of primary, secondary and tertiary prevention
♦ Describe characteristics of a condition that is amenable to screening
♦ Understand that optimal provision of preventive services involves coordination and collaboration of medical services and public health services.

How common is the disease?

Typically, medicine and society are more concerned with common diseases or conditions.

Prevalence indicates the number of existing cases (individuals with a disease or a condition) in a population. It is determined by counting the number of people with a disease in a population at one point in time.

\[
\text{Prevalence (P)} = \frac{\text{number of individuals with condition}}{\text{number of persons in population}}
\]

For example, in 1997, out of 100 people aged 18 to 24, 63 were current consumers of alcohol. \( P = \frac{63}{100} = .63 \).

Incidence (also called incidence density) is a measure of how rapidly new cases of a disease develop in a population. It is determined by observing a population over a given period of time, and counting how many new cases of a disease develop in that period of time. It is usually determined over a one-year time period, and reported per 100,000 population. It can also be reported for any period of time (for example, cases per person-month, person-year, person-day, etc)

\[
\text{Incidence (I)} = \frac{\text{number of new cases}}{\text{number of susceptible individuals – time observed}}
\]
For example, in 1997, there were 73.7 new cases of lung cancer per 100,000 men, or \( I = 73.7 \) cases/100,000 man-years.

Distinguishing incidence and prevalence

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Incidence</th>
<th>Prevalence</th>
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</thead>
<tbody>
<tr>
<td>Numerator</td>
<td>New Cases</td>
<td>All Cases</td>
</tr>
<tr>
<td>Denominator</td>
<td>All susceptible people</td>
<td>All people examined</td>
</tr>
<tr>
<td>Time</td>
<td>Duration of a period</td>
<td>Single point</td>
</tr>
<tr>
<td>How measured</td>
<td>Cohort study</td>
<td>Cross-sectional study</td>
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Who is in the population at risk?

Individuals susceptible to the disease or outcome being measured. For example, a study of prostate cancer would exclude women.

Comparing rates in different populations is more meaningful when using age-specific (or adjusted) or gender-specific (or adjusted rates) than crude rates.

For example, the incidence of prostate cancer increases with age. Meaningful comparison of the incidence of prostate cancer between a state with an older population and a younger population requires adjustment for age.

What do we know about the disease?

What are the disease outcomes – how much suffering does it cause?

Typically, medicine and society are willing to commit greater resources to fighting diseases that are more severe or more costly. Severity can be measured in a number of different ways, including the following:

♦ case-fatality rate (how many patients diagnosed with a disease will die),
♦ survival time (the average duration from diagnosis to death)
♦ median survival time (the time at which half of the patients with the disease are still alive)
♦ years of potential life lost – YPLL (for example, a condition that kills large numbers of children, such as trauma, has a YPLL of 935 in comparison to heart disease, that typically kills older persons, with a YPLL of 628).
♦ quality of life years lost – for example, a potentially non-fatal condition may significantly impair someone’s quality of life, forcing them to retire, causing disability, etc.
♦ costs – these might include costs of treatment, costs to the individual, or total cost to society. The most comprehensive measures of cost also include opportunity costs – costs to the individual, their family, and society for lost productivity.
What is the natural history of the disease?

Disease characteristics will affect our ability to prevent, detect and treat an illness.

What causes the disease?
Is it transmissible?
What are risk factors for the disease?
What is the time course of the disease?
Does it have an asymptomatic period?

| No disease | Asymptomatic disease | Clinical course |

What is a risk factor, and how does it relate to development of a disease?

Risk factor is a characteristic associated with an increased probability of a disease. Risk factors may be inherited (genetic), environmental (toxin, drug or infection), social (socioeconomic status, educational status, cultural group, stress, marital status) or behavioral (smoking, alcohol, sexual practices, safety practices).

For a risk factor to increase the risk of a disease in a given individual, that individual must come into contact with or have that risk factor – that is be exposed to the risk factor.

This relationship can be conceived as follows:

Risk → exposure → disease

Unprotected intercourse → HIV exposure → HIV infection

Exposure can be quantified in a number of ways that account both for duration and amount of exposure.

- Current exposure
- Largest exposure
- Total cumulative exposure
- Years of exposure

Some diseases can be caused by a single exposure. For example, contracting hepatitis A from eating contaminated oysters, or developing melanoma after a severe sunburn as a child. Other diseases may take much longer and greater exposures. Lung cancer usually develops only after years of exposure to cigarette smoke or radon.
Knowledge about risk factors can be used in several ways:

♦ Predict the likelihood that a person exposed to a risk factor will develop a disease
♦ Risk factors can lead to an understanding of the cause of the disease
♦ In diagnosis, the presence of a risk factor for a disease in an individual increases the likelihood of that disease in an individual
♦ Removing a risk factor may prevent disease.

Is there effective prevention, diagnosis, and treatment of the disease?

<table>
<thead>
<tr>
<th>Onset</th>
<th>Clinical onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>No disease</td>
<td>Asymptomatic disease</td>
</tr>
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</table>

♦ Primary prevention – prevention of exposure to risk factor, protection against causative agent of disease, before disease develops.
Examples
Immunization
Treatment of water
Washing hands
School programs to prevent children from smoking
Encouraging appropriate diet and exercise to prevent high cholesterol.

♦ Secondary prevention – identification of risk factors and removal or treatment of risk factors, identification of disease in early, asymptomatic stages when it may be treatable.
Examples
Taking antibiotics to prevent anthrax infection after possible exposure
Stopping smoking
Pap smear to identify cervical cancer at early stages.
Treating high cholesterol to reduce risk of a heart attack.

♦ Tertiary prevention – treatment of a condition once it has developed, to cure the condition or limit further damage from the condition.
Examples
Treating high cholesterol in a person who has had a heart attack to prevent a second heart attack.
Regular colonoscopy in a patient after surgery for colon cancer to detect early recurrence.
Screening

Is a condition suitable for screening? The following criteria are commonly used to identify conditions that are suitable for screening – a form of secondary prevention.

Important health problem
Relatively prevalent in population to be screened
Knowledge of the natural history of the disease or condition
Detectable asymptomatic phase
Treatment in detectable phase is beneficial compared to waiting for condition to become symptomatic
Suitable screening test

Characteristics of a suitable screening test.
Acceptable to people being screened
Inexpensive, easy to perform
Safe, noninvasive, low morbidity
Diagnostic workup for positive test must have acceptable morbidity, as there will be many false positives.
Accurate
Suitable cost/benefit ratio

Other approaches to prevention
Although screening is an important strategy to prevent morbidity and mortality from disease, it is limited to certain conditions, and generally requires some access to medical care for detection and follow-up. It is also usually provided on a one to one basis by a physician and a patient (case finding). As the graphic below illustrates, few individuals actually seek care in a given month. Over the course of a year (or two or three), many people do not seek medical care.

A Typical Month of Healthcare in the United States

Each box contains a subgroup of the biggest box of 1000 persons
The most effective preventive medicine programs use a variety of strategies employed by different public and private entities, targeted towards individuals in a variety of settings, to improve health.

As this figure illustrates, health is determined by a variety of factors, all of which may need to be addressed to maximize the health of a population and an individual.

**Determinants of Health**

- Individual determinants include *Biology* – an individual’s propensity towards disease or health. An example would be inheritance of the *BRCA-1* gene, predisposing a woman towards certain cancers.
- Individual *Behavior* may be one of the most important determinants of health. An analysis of US mortality indicated that half of all premature deaths were attributable to potentially modifiable behaviors, such as smoking, diet, exercise, firearm use, alcohol and substance use, sexual behavior, and driving accidents.
- *Physical environment* includes both environmental and occupational hazards. While we enjoy the benefits of a safe water and food supply, our health is endangered by man-made chemicals in the environment and in the workplace.
- *Social environment* is also significantly associated with health. Considerable evidence links health with marital stress, social support, etc. Health is also linked to socioeconomic status and to cultural and ethnic heritage.
Access to quality health care is necessary for individuals to obtain some preventive measures and appropriate treatment for disease. There is data associating lack of insurance or regular source of medical care with worse health outcomes.

Policies and interventions. Both governmental and private sector organizations can affect health through policy making and by interventions designed to improve health. For example, increasing the price of cigarettes by raising excise taxes has been found to reduce tobacco use-initiation by teen-agers. Smoke-free policies in the workplace have been shown to increase smoking cessation in adult smokers.

Looking ahead – Healthy People 2010

The US Department of Health and Human Services (HHS) sponsors this program that outlines a comprehensive approach to health promotion and disease prevention, thereby laying out the preventive medicine agenda for the nation for the next 10 years.

The overarching goals of Healthy People 2010 are to:

- Increase quality and years of life, and
- Eliminate health disparities between socioeconomic, racial, geographic and cultural groups.

To achieve these goals, Healthy People describes 467 objectives in 28 focus areas (ranging from cancer to injury prevention to public health infrastructure) and 10 leading health indicators –

Physical activity
Overweight and obesity
Tobacco use
Responsible sexual behavior
Mental health
Injury and violence
Environmental quality
Immunization
Access to health care

These leading health indicators will help to guide interventions and measure their success. Many of these health indicators involve changing behavior and also have potential ramifications for health and social policy. Physicians have important roles to play in helping motivate individual patients to lead a healthier lifestyle, in advocating for policy changes, and in helping to develop and implement policy changes.
References


