بسم الله الرحمن الرحيم

Epidemiological triad

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Prof DR. Waqar Al – Kubaisy

ا. د وقار عبد القهار الكبيسي

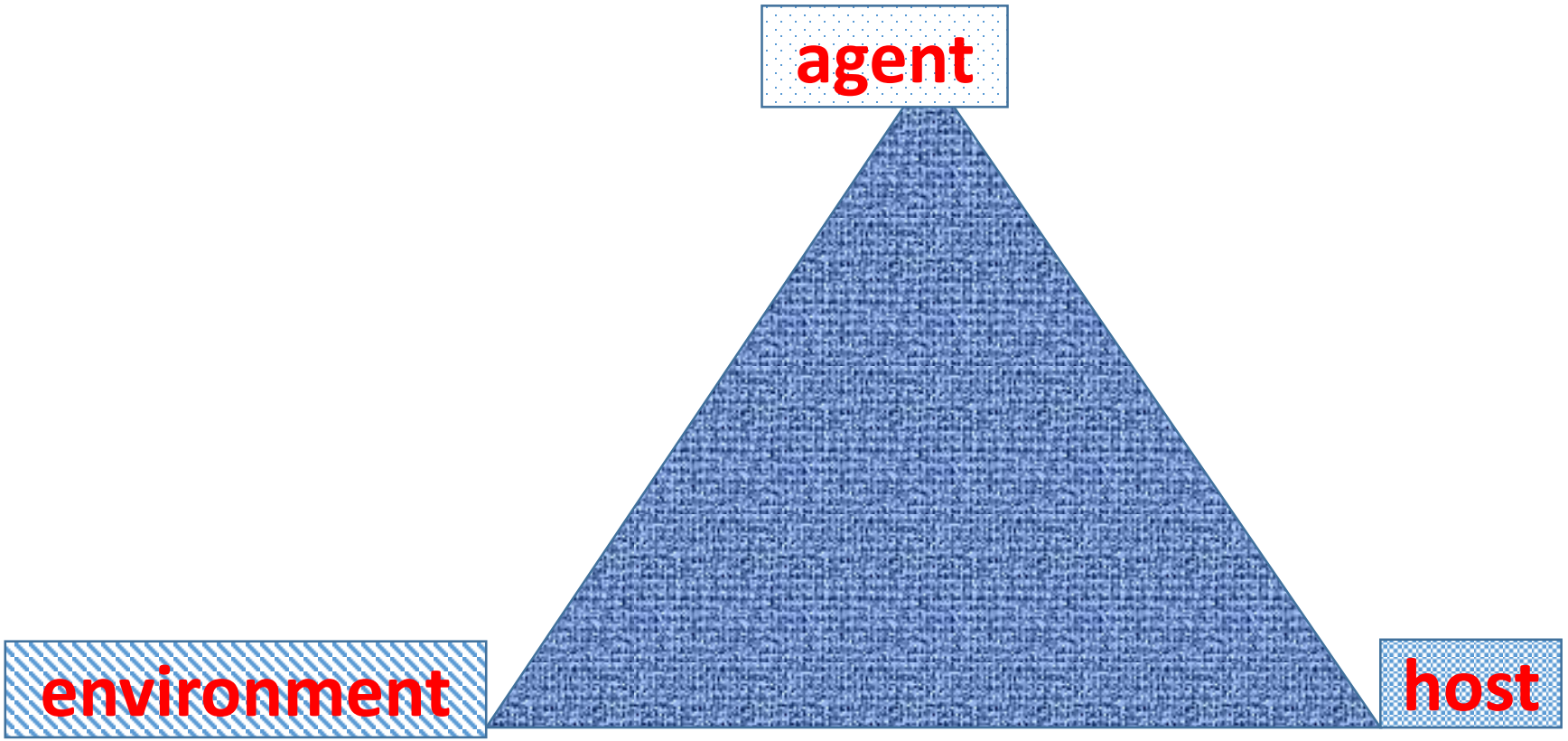
Epidemiology

I Keep six honest serving-men: (They taught me all I knew)
Their names are

What and Where and When and How and Why and Who.

—*Rudyard Kipling (1865–1936)*

Epidemiological triad



Germ theory of disease

During the **19th and the early part of 20th century**, this concept Referred to as a **one-to-one** relationship between causal agent and disease.

The disease model accordingly is :

Disease agent → Man → Disease

The germ theory of disease, though it was a revolutionary concept, **led many epidemiologists to**

- **take one-sided view of disease causation.**

That is, they could not think beyond the germ theory of disease.

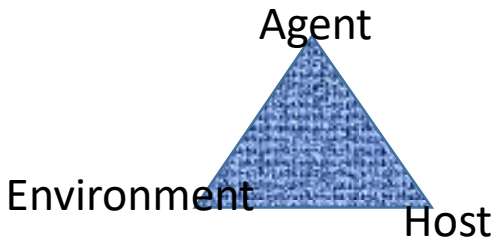
- **It is now recognized** that a **disease is rarely caused by a single agent alone,** but rather **depends upon a number of factors which contribute to its occurrence**.

- **The germ theory of disease has many limitations.**

For example, it is well-known, that **not everyone exposed** to TB develops tuberculosis. The same exposure, however, in an undernourished or otherwise susceptible person may result in clinical disease.

- **Therefore**, modern medicine has **moved away** from the strict adherence to the **germ theory** of disease
- **There are other factors relating to the host and environment which are equally important to determine** whether or not disease will occur in the exposed host.
- **This demanded a broader concept of disease causation that** synthesized the basic **factors** of **agent, host** & environment
- **The model - agent, host and environment ,**has been in use for many years.
- **It helped** epidemiologists to **focus on different classes of factors,** especially with regard to infectious diseases

Epidemiologic triad



the Triangle has three corners (called vertices):

Agent, ***or microbe*** that causes the disease (the **"what"** of the Triangle)

Host: or organism harboring the disease (the **"who"** of the Triangle)

Environment: or those **external factors** that cause or allow disease transmission (the **"where"** of the Triangle)

Epidemiologic triad

It could be considered as a model or approach to **analyze** health and disease

- **Health is a balance between agent, host and environment**
  - **Changes** in any one of these **three factors** may result in loss of health.

- **Epidemiologist** try to characterize the **relationship** among agent, host and environment

- As epidemiology developed by study of infectious disease, the triad can help to understand them
- However, it could be applied to **all health problems e.g. NCDs**

- It should be noted also that there is sometimes overlap between these factors

The triad is not applied only to the causation

But to all the disease process including:

Management (diagnosis, treatment, availability utilization of health services):

Accessibility

affordability

Prognosis

Epidemiologic triad

The Agent "What"

The agent is the **cause** of the disease.

When studying the epidemiology of most infectious diseases, the agent is a microbe. (microorganism)

Disease causing microbes are bacteria, virus, fungi, and protozoa

- **Presence of an agent is not always sufficient to cause the disease**

Epidemiologic triad

A. The Agent "What" :

I. Biological:

is not limited to infectious diseases, microorganisms contribute to cancer and other NCD (rheumatic heart, type 1 DM)

II. Chemical:

poisons

chronic exposures:

heavy metals e.g. lead and toxic materials e.g. asbestos (could be occupational)

III. Physical

Radiation: accidents, occupations Injuries

Temperature high/low

Sun; Sunburn, dermatological cancer

B. The Host "Who"

Hosts are organisms, usually humans or animals, which are exposed to and harbor a disease.

The host can be the organism as any animal, that gets sick, as well (including insects and worms) **carrier** that may or may not get sick.

Although the host may or may not know it has the disease or have any outward signs of illness, the disease does take lodging from the host.

- **Different people may have different reactions to the same agent.**

For example, adults infected with the virus varicella (chickenpox) are more likely than children to develop serious complications.

Characteristics of Person

1. **Age**
2. **Sex**
3. **Marital status**
4. **Socioeconomic status**
5. **Religion**
6. **Occupation**
7. **Ethnic group** (in addition to the previous factors)

8. Genetics (***host or agent***)

genetic diseases

Sickle cell, alkaptonuria

Multifactorial: genetic predisposition

The genes are partially responsible for the racial differences

Cancer Heart disease and NCDs

The Host "Who" :

9. Immunity

Natural Artificial

Passive Active: immunization

autoimmunity: auto-immune diseases

Rheumatoid arthritis Systemic lupus

Multiple sclerosis

10. Nutrition:

A. Breast feeding

- **Breast fed infants** specially **exclusive** breast fed are
- protected against diarrhea & other infections (ear, ARI)
- Better Growth and development
- **Long acting effect**: protection against DM and other chronic disease
- **Breast feeding benefits to mother** e.g. protect mothers against cancer breast

The Host "Who" :

B. Nutrition pattern

Feeding pattern weaning

Eating pattern: diet

Both are affected by other **host** and **environment** factors and may result in illness

- **This pattern includes**
  - Who will eat what and when
  - And nutrition during sickness
- Good nutrition means good health

C. Nutritional deficiencies They are diseases and predispose to other diseases and mortality

"**Nutrition-related factors contribute to about 45% of deaths in children under 5 years of age.**"

Protein energy malnutrition

Trace elements

Iron anemia

Iodine deficiency

Anemia:

Anemia is a common disease that affects ~1.6 billion people worldwide, especially infants and women.

WHO estimates that 42% of children less than 5 years of age and 40% of pregnant women worldwide are anaemic.

The prevalence of anaemia in children under five was highest in the African Region, 60.2%

- In 2019, global anaemia prevalence was
- **29.9%** in women of reproductive age (15-49 years),
- equivalent to over half a billion women
- **29.6%** in non-pregnant women of reproductive age,
- **and 36.5% in pregnant women.**

Stunting

(**chronic protein energy malnutrition**)

2021,the UNICEF-WHO-World Bank Group Joint Malnutrition Estimates shows that

stunting prevalence has been declining since the year 2000

more than one in five,149.2 million children under 5 –were stunted in 2020*,

22.0% of all children under 5 years were stunted in 2020

and 45.4 million under 5 years suffered from wasting

13.6 Million children **<5 years** old were affected by sever wasting form in 2020

Obesity

WHO classifies weight of adults using body mass index (BMI):
BMI **greater than or equal** to 25, as overweight and
BMI **greater than or equal** to 30 as an obese
a survey 2021 estimated that around two billion adults WW are currently overweight
The biggest health problems facing people from 30 different countries a obesity was ranked **fifth**, behind COVID-19, cancer, mental health, and stress.

13% of adults in the world are obese.
39% of adults in the world are overweight.
One-in-five children and **adolescent**s, globally, are **overweight**
38.9 million children **<5 years** were overweight. globally In 2020
5.7% of all children **< 5** were overweight in 2020
Approximately **6%** of adolescents (10-19 years old)WW were obese **(2016)**
This statistic shows a forecast of the estimated overweight population share in the **World until 2025. It is projected overweight to reach 42% by 2025.**

The Host "Who" :

Government health reports indicate that **about 40% of Jordanian adults are overweight** and child obesity stands at more than 50%. "Of course we are fat. Feb 19, 2017

11. Behaviour

a. Personal hygiene

Simple measures of personal hygiene as hand washing and tooth brushing can prevent many health problems

b. Smoking: COPD, cardiovascular, cancer

c. Addiction and drug abuse (dependence)

Risk behaviour: accidents, HIV

d. Healthy life style: diet, exercise

e. Compliance to treatment

The Environment "Where"

- The environment is the favorable surroundings and conditions **external** to the host that cause or allow the disease to be transmitted.
- Some diseases agent live best in **dirty water**. Others survive in **human blood.** Still others, like E. coli, thrive in **warm temperatures** but are killed by high heat.
- Other environment factors include the **season** of the year (in the U.S., the peak of the flu season is between November and March, for example). :
- **Biological environment:**

Includes **all the living organisms** in the environment that may be agent, vector, **environment for their breeding** and transmission, food resources,

Microorganisms and vectors

Agricultural and poultry and livestock (source of food, & disease transmission)

Fishery Forests

Medicinal plants and herbs

- **Physical environment**

Season and temperature (weather)

Rural versus urban

Urbanization: slums and squatters

City planning: factories and **sources of pollution**

Traffic and transportation

Housing conditions overcrowding

Water Sewage and waste disposal

Recreational areas

The Environment “Where” :

❑ Social environment and Culture:

Cultural values and beliefs affect or control many health related behaviours

- **family formation pattern** (age at marriage, spacing, &family size)
- **Consanguinity:**
  35% (population and family health survey 2012)
  28% (population and family health survey 2017)
  genetic diseases
- **Health seeking behaviour**
- **Nutritional pattern**

❑ technology

The Environment “Where” :

- **Disaster and crisis:**

Natural: earthquakes, storms

Man made: armed conflicts

- Destroys the resources
- Affects the infrastructure
- Housing
- Health, transportation
- High mortality and morbidity

The mission of an epidemiologist is

- **to break at least one of the sides of the Triangle,**
- **disrupting the connection between the environment, the host, and the agent, and**
- **stopping t**he continuation of disease.

Health determinants

- Many factors combine together to affect the health of individuals and communities.
- Whether people are healthy or not, is determined by their **circumstances and environment**.
- **To a large extent**, **factors such as where** we live, the **state of our** environment, **genetics,** our **income** and education level, and our relationships with friends and family
- all have considerable impacts on health,
- **whereas the more commonly considered factors such as access** and **use** of **health care services** often have less of an impact.

❑ The main determinants of health include:

- Income and social status.
- Employment and working conditions.
- Education and literacy.
- Childhood experiences.
- Physical environments.
- Social supports and coping skills.
- Healthy behaviours.
- Access to health services.

❖ Individuals are unlikely to be able to directly control many of the determinants of health.

Risk factors

- A risk factor refers to an **aspect of personal habits** or an **environmental exposure,** that is **associated with an increased probability of occurrence of a disease**

- A risk factor is a characteristic, condition, or behaviour that increases the likelihood of getting a disease or injury. Risk factors are often presented individually, however in practice they do not occur alone.
- They often coexist and interact with one another. For example, *physical inactivity will, over time, cause weight gain, high blood pressure and high cholesterol levels. Together, these significantly increase the chance of developing* **chronic heart diseases** and **other health related problems**.
- Ageing populations and longer life expectancy have led to an increase in long-term **chronic** expensive-to-treat diseases and disabilities.

- **Health risk factors** are **attributes, characteristics or exposures that increase the likelihood of a person developing a disease or health disorder.**
  - **Behavioural risk factors are those that individuals have the most ability to modify**.
  - Biomedical risk factors are bodily states that are often influenced by behavioural risk factors.
- **Since risk factors can usually be modified***,
  - intervening to alter them in a favourable direction can reduce the probability of occurrence of disease.
- The impact of **these interventions** can be determined by repeated measures using the same methods and definitions
- ***Not all risk factors are modifiable**, therefore it is important to distinguish between modifiable and unmodifiable or less liable to modification*
- In general, **risk** factors can be categorised into the following groups:

In general, **risk** factors can be categorised into the following groups:

- Behavioural
- Physiological
- Demographic
- Environmental
- Genetic

❑ Behavioural risk factors

Behavioural **risk** factors usually relate to 'actions' that the individual has chosen to take. They can therefore be eliminated or reduced through lifestyle or behavioural choices. Examples include:

- smoking tobacco
- drinking too much alcohol
- nutritional choices
- physical inactivity
- spending too much time in the sun without proper protection
- not having certain vaccinations
- unprotected sex.

Physiological risk factors

Physiological **risk** factors are those relating to an individual's body or biology. They may be influenced by a combination of genetic, lifestyle and other broad factors. Examples include:

- being overweight or obese
- high blood pressure
- high blood cholesterol
- high blood sugar (glucose).

Demographic risk factors

Demographic **risk** factors are those that relate to the overall population. Examples include:

- age
- gender
- population subgroups, such as occupation, religion, or income.

Environmental risk factors

Environmental **risk** factors cover a wide range of topics such as social, economic, cultural and political factors as well as physical, chemical and biological factors. Examples include:

- access to clean water and
- sanitation **risk** in the workplace
- air pollution
- social settings.

Genetic risk factors

Genetic **risk** factors are based on an individual's genes.

- Some diseases, such as cystic fibrosis and muscular dystrophy, come entirely from an individual's 'genetic make-up'.
- Many other diseases, such as asthma or diabetes, **reflect the interaction between the genes** of the individual **and environmental factors**.
- Other diseases, like sickle cell anaemia, are more prevalent in certain population subgroups.

Measuring risk factors

Risk factors can include tobacco and alcohol use, diet, physical activity, blood pressure and obesity

Since risk factors can be used to predict future disease, their measurement at a population level is important, but also challenging.

Tobacco use can be measured

- **by self-reported exposure (yes/no),**
- **quantity of cigarettes smoked, or**
- **by biological markers (serum cotinine**

However, different surveys use different methods, often with different measurement techniques and criteria **for detecting a risk factor or** clinical outcome (for example, diabetes or hypertension).

Thank you for attention