DISEASE CAUSATION

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Community Medicine 2023/ 2024
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Cause of Disease

- Cause defined as "anything producing an effect or a result". [Webster]
- Cause in medical textbooks discussed under headings like- "**etiology**", "**Pathogenesis**", "**Mechanisms**", "**Risk factors**".
- Important to physician because it guides their approach to three clinical tasks- **Prevention, Diagnosis & Treatment.**

Causal Relationships

A causal pathway may be direct or indirect

- In direct causation, A causes B without intermediate effects (very rare) مباشرة مجرد ما كان A موجود ، رح يسبب B
  هنا المقصود فيها steps
- In indirect causation, A causes B, but with intermediate effects There is an effect of so many factors and different stages in order for A to cause B

In human biology, intermediate steps are virtually always present in any causal process

Theories of Disease Causation مرتّبين حسب التسلسل الزمني الصحيح

نظريّات خارقة للطبيعة يعني لعنة Especially psychiatric problems

- Supernatural Theories: curse, evil force of the demon.
- Hippocratic Theory من سنة ٤٦٠ قبل الميلاد " التاريخ مهم نحفظه"، أستطاع أبوقراط ان يلاحظ كيف تصيب الأمراض الناس و استنتج ان العوامل البيئية (أين يعيش الناس ؟ ماذا يعملون ؟ ماذا يأكلون ؟)لها دور في ذلك و تؤثر على احتمالية اصابتهم بمرض معين
- Miasma A cloud near the surface of Earth , usually found in places where there are bad smells with humidity,so it causes disease to people when they come in contact with this Miasma….Cholera was explained using this theory , that was when John snow and Farr used to argue!
- Theory of Contagion بعد ظهور الميكروسكوب و اكتشاف الكائنات الحية الدقيقة ، بدأنا نفهم انه هاي الكائنات الحية الدقيقة ممكن تدخل الجسم و تسبب المرض

Infectivity

- Germ Theory (cause shown via Henle-Koch postulates)
- Classic Epidemiologic Theory
- Multicausality and Webs of Causation (cause shown via Hill’s criteria) It describes chronic diseases .

Hippocratic Theory

Hippocrates promoted the concept that disease was the result of an imbalance (Excess/deficiency) among four vital "humors" (سوائل) within us: Yellow Bile, Black Bile, Phlegm, Blood

Hippocrates believed that if one of the humors became excessive or deficient, health would deteriorate and symptoms would develop.

Hippocrates was a keen observer and tried to relate an individual's exposures (e.g., diet, exercise, occupation, and other behaviors) to subsequent health outcomes.

Henle-Koch Postulates (Germ Theory)

Even though there was a "germ" of truth in miasmatic theory, in that it focused attention on environmental causes of disease and partly explained social disparities in health (poor people being more likely to live near foul odors), the theory began to fall into disfavor as the germ theory gained acceptance.

Louis Pasteur introduced the germ theory in 1878, that was developed later into Henle-Koch postulates:

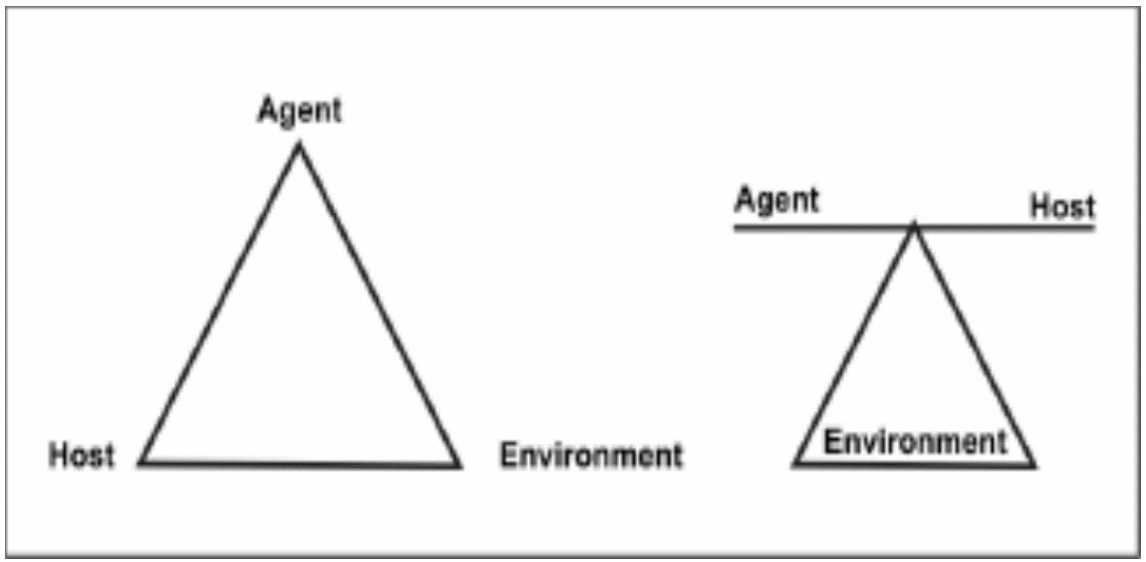
- The agent is present in every case of the disease — True
- It does not occur in any other disease (one agent one disease) — حالياً هاي الجملة مش كثير صحيحة، خاصة لما نحكي عن امراض مزمنة .
- It can be isolated and if exposed to healthy subjects will cause the related disease — It could be true

It visualises the disease as a system of three elements

Classic Epidemiologic Theory: Epidemiologic Triad

Disease is the result of forces within a dynamic system consisting of:

1. Agent of disease
2. Susceptible Host
3. External environment In which the agent and the host are present



Classic Epidemiologic Theory (Epidemiologic Triad)

So there are different ways and complex interactions to cause the disease ….Not a simple procedure ya3ni

- Agent, host, and environmental factors interrelate in a variety of complex ways to produce disease.
- Different diseases require different balances and interactions of these three components.
- Development of appropriate, practical, and effective public health measures to control or prevent disease usually requires assessment of all three components and their interactions.

Classic Epidemiologic Theory

أساسًا علم الوبائيات في بدايته كان مهتم بدراسة الأمراض المعدية قبل ما نعرف الأمراض المزمنة لذلك هذا كان تعريف ال Agent .

Agent originally referred to an infectious microorganism or pathogen: a virus, bacterium, parasite, or other microbe.

- Generally, the agent must be present for disease to occur; however, presence of that agent alone is not always sufficient to cause disease.
- A variety of factors influence whether exposure to an organism will result in disease, including the organism's **pathogenicity, infectivity, virulence,** and dose.

يعني مثلًا مش اي تعرّض لأي كمية من فايروس الانفلونزا رح تخلي الشخص مصاب بالانفلونزا ،في عدة احتمالات :

-subclinical infection

-clinical infection with symptoms

-very severe infection

An Infectious Agent:

For an infectious agent:

Infectivity refers to the proportion of exposed persons who become infected.

Infected means that the microorganism has entered the body and multiplicated and antibodies have been produced .However , that does necessarily mean that the host will develop a clinical disease
I.e;Hepatitis B is one of the viruses with a very high infectivity.

Pathogenicity refers to the proportion of infected individuals who develop clinically apparent disease.

We all have been infected with COVID-19 , but some of us have not shown any clinical symptoms(subclinical infection).

Virulence refers to the proportion of clinically apparent cases that are severe or fatal.

I.e:Rabies is very fatal disease .Any one who gets infected have to take medications immediately.
الله يشفي جميع المرضى .

As well as the dose that the host was exposured to

Classic Epidemiologic Theory

Agent: Over time, the concept of agent has been broadened to include chemical and physical causes of disease or injury.

- These include chemical (poison, smoke, alcohol) , as well as physical forces (such as repetitive mechanical forces associated with carpal tunnel syndrome, radiation), and nutritional (vitamin deficiency).

ممكن يكون عند الناس الي بتشتغل عالكيبورد كثير لانه معصم اليد بيتأذّى

Classic Epidemiologic Theory

Host refers to the human who can get the disease.

- A variety of factors intrinsic to the host, sometimes called risk factors, can influence an individual's exposure, susceptibility, or response to a causative agent.
- Opportunities for exposure are often influenced by behaviors such as sexual practices, hygiene, smoking, physical exercise, dietary habits, and other personal choices as well as by age and sex.
- Susceptibility and response to an agent are influenced by factors such as genetic composition, nutritional and immunologic status, anatomic structure, presence of disease or medications, and psychological makeup.

Genetic composition:
يعني مش ممكن حد يصاب الثلاسيميا و هو مش عنده بالجينات
الله يشفي المرضى .

Immunological status
مرضى السرطان الي بيتعالجوا بالعلاج الكيميائي او الاشعاعي بتكون مناعتهم ضعيفة و بالتالي التعرض لفيروس بكمية لا تسبب مرض عند الشخص العادي ،تكون خطرة عليهم ، الله يشفيهم و يعافيهم .

Classic Epidemiologic Theory

Environment refers to extrinsic factors that affect the agent and the opportunity for exposure.

Environmental factors include

physical factors such as geology and climate,

biologic factors such as insects that transmit the agent, socioeconomic factors such as crowding, sanitation, and the availability of health services.

ملاريا ، الله يشفي كل المصابين .

Factors Associated with Increased Risk of Human Disease

HOST (Intrinsic)

- Age
- Gender
- Ethnicity
- Religion
- Customs
- Occupation
- Heredity
- Marital status
- Family background
- Previous diseases

AGENTS

- Biological

Viruses (bacteria, etc.)

- Chemical (poison, alcohol, smoke)
- Physical (auto, radiation, fire)

They cause injury

- Nutritional (lack, excess)

ENVIRONMENT (Extrinsic)

- Temperature
- Humidity
- Altitude الارتفاع عن سطح البحر
- Crowding
- Housing
- Neighborhood
- Water
- Milk
- Food
- Radiation
- Air pollution
- Noise

الماء و الطعام دايما مرتبطين بال Environment

Radiation ممكن يكون ضمن Environment زي, يكون الانسان عايش بمنطقة فيها اشعاعات .

Multicausal Theories

…… While the epidemiologic triad serves as a useful model for many diseases, it has proven inadequate for cardiovascular disease, cancer, and other diseases that appear to have multiple contributing causes without a single necessary one.

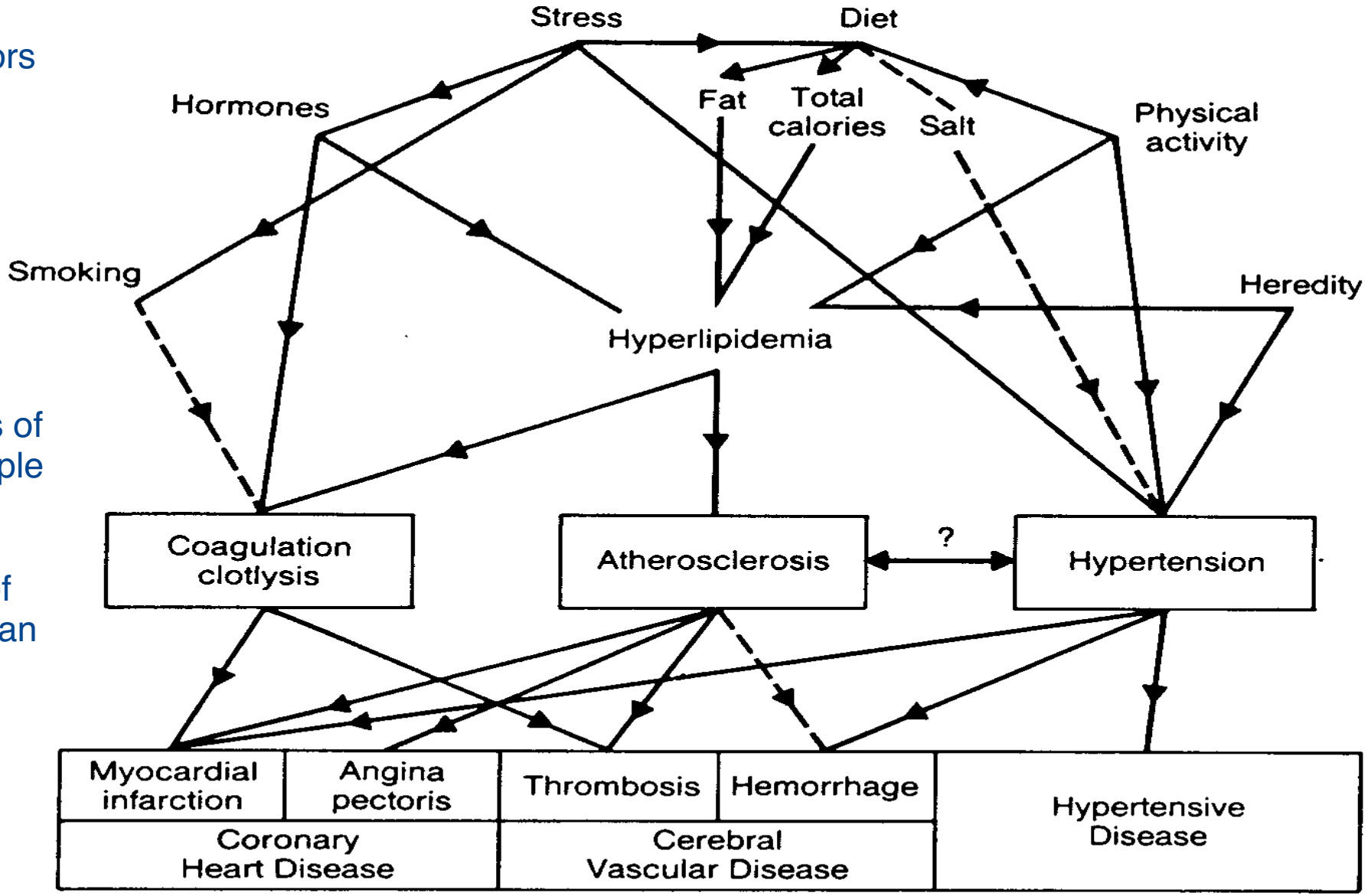
Several other models that attempt to account for the multifactorial nature of causation have been proposed.

Web of Causation (Multicausal theory) for Major Cardiovascular Diseases

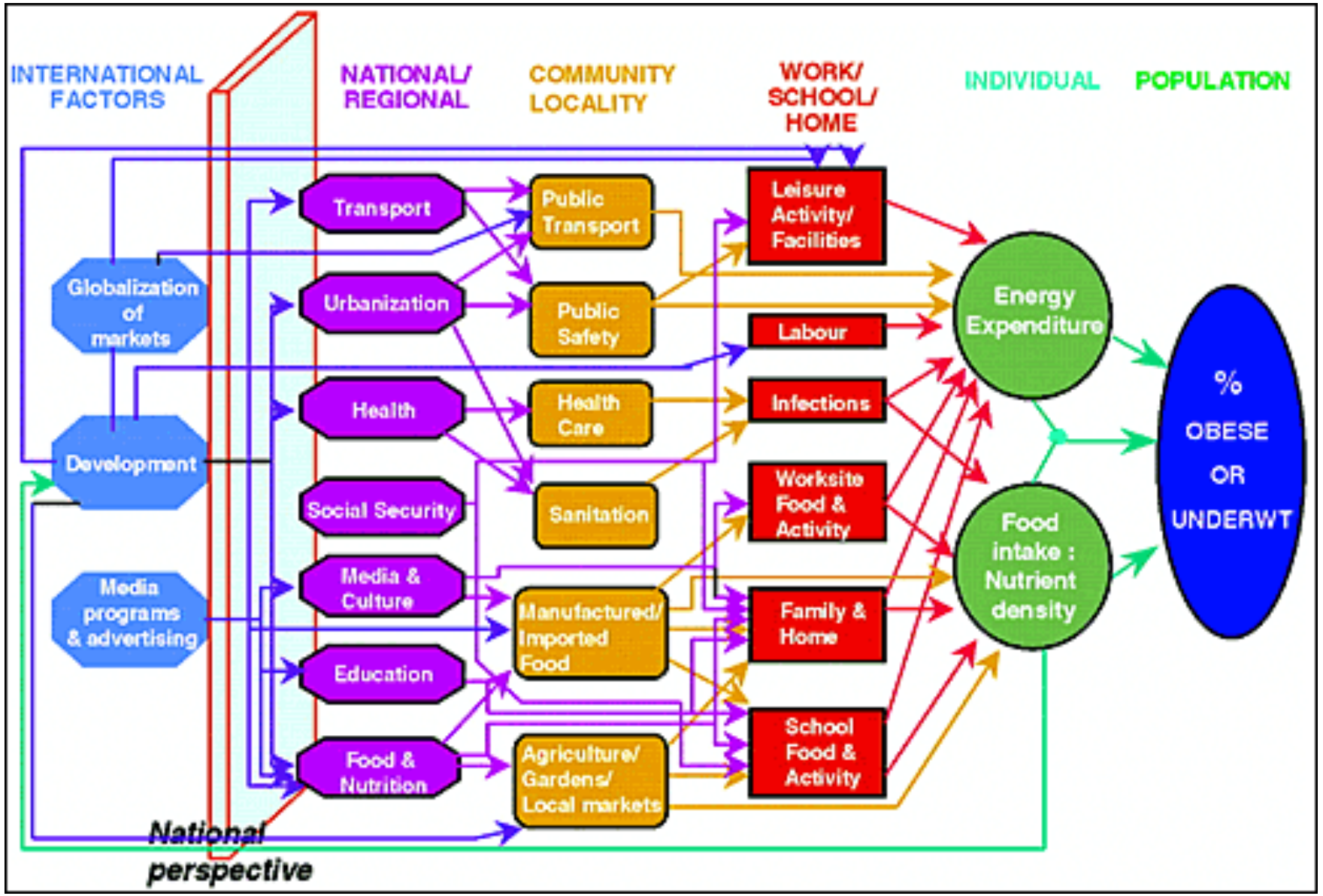
-There are many factors that work together to cause the disease .

-we still don't know all factors that cause the disease.

-each patient has different combinations of these factors , so people have different combinations with different proportions of different factors that can contribute to the development of a disease in a very complex way



Multicausal theory for Obesity



Concept of Disease Occurrence ….Etiology of a disease

- The sum of all factors that contribute to the occurrence of a disease

- Agent factors +Host factors +Environmental factors = Etiology of a disease

You can never change genetics of any person ,but we can change eating habits , life style factors …etc

- The factor which can be modified, interrupted or nullified is most important.

Causal Relationships

- A causal pathway may be **direct or indirect**
- In **direct** causation, A causes B without intermediate effects (very rare)
- In **indirect** causation, A causes B, but with intermediate effects

In human biology, intermediate steps are virtually always present in any causal process

Factors for disease causation

- **Sufficient factors**: one that inevitably produces disease (the presence of the factor always result in disease). Micro-bacterium tuberculosis is sufficient to cause TB
يعني وجودها لوحده كافٍ للتسبب بالمرض ، بغض النظر عن اي عوامل اخرى

- **Necessary factors**: without which disease does not occur, but by itself, it is not sufficient to cause disease (the disease will not occur without the presence of the factor) وجود Micro-bacterium tuberculosis ضروري للتشخيص بالمرض، بوجود عوامل أخرى أيضًا

Types of Causal Relationships

Four types possible:

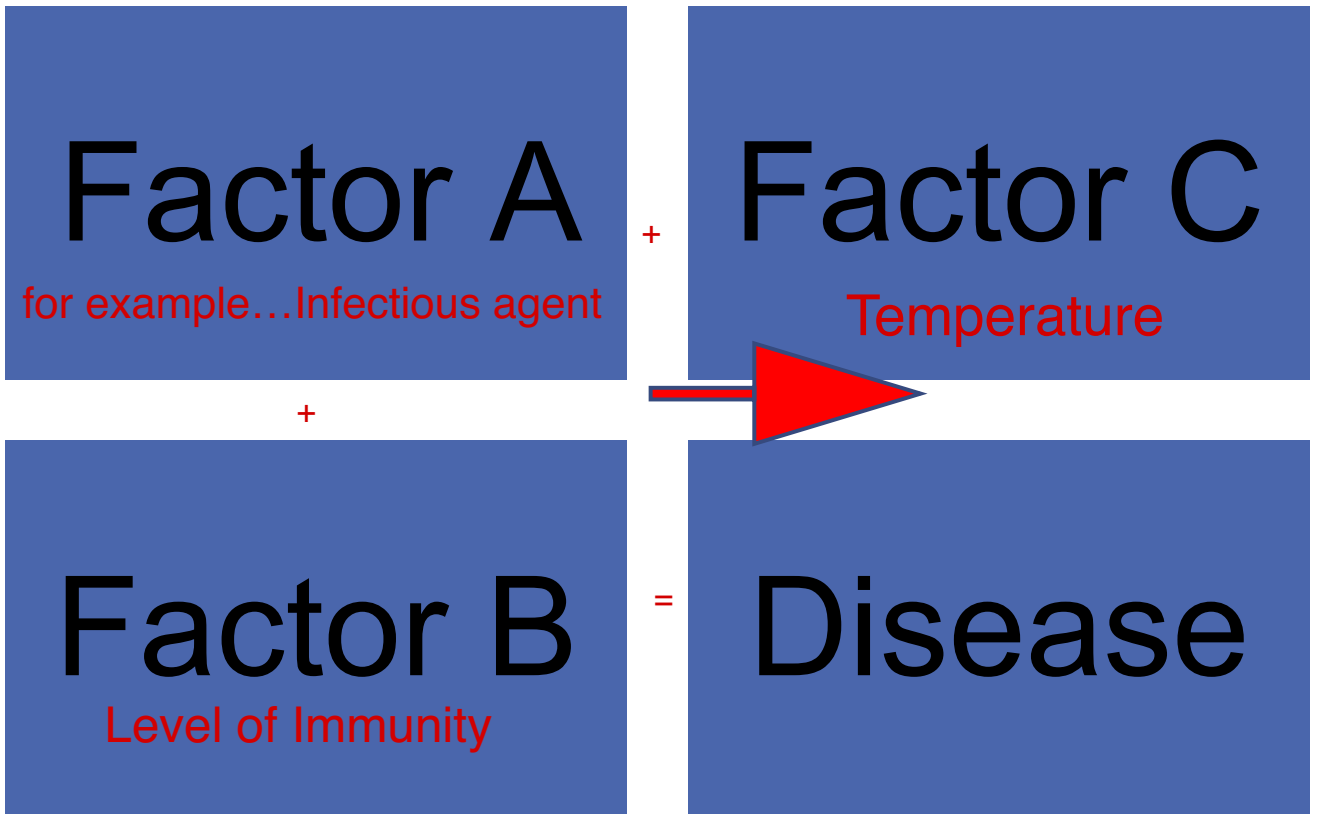
- Necessary & sufficient
- Necessary, but not sufficient
- Sufficient, but not Necessary
- Neither Sufficient nor Necessary

I. Necessary & Sufficient

- Without that factor, the disease never develops (factor is necessary)
- and in presence of that factor, the disease always develops (factor is sufficient).
- **Rare situation**.

II. Necessary, but not Sufficient

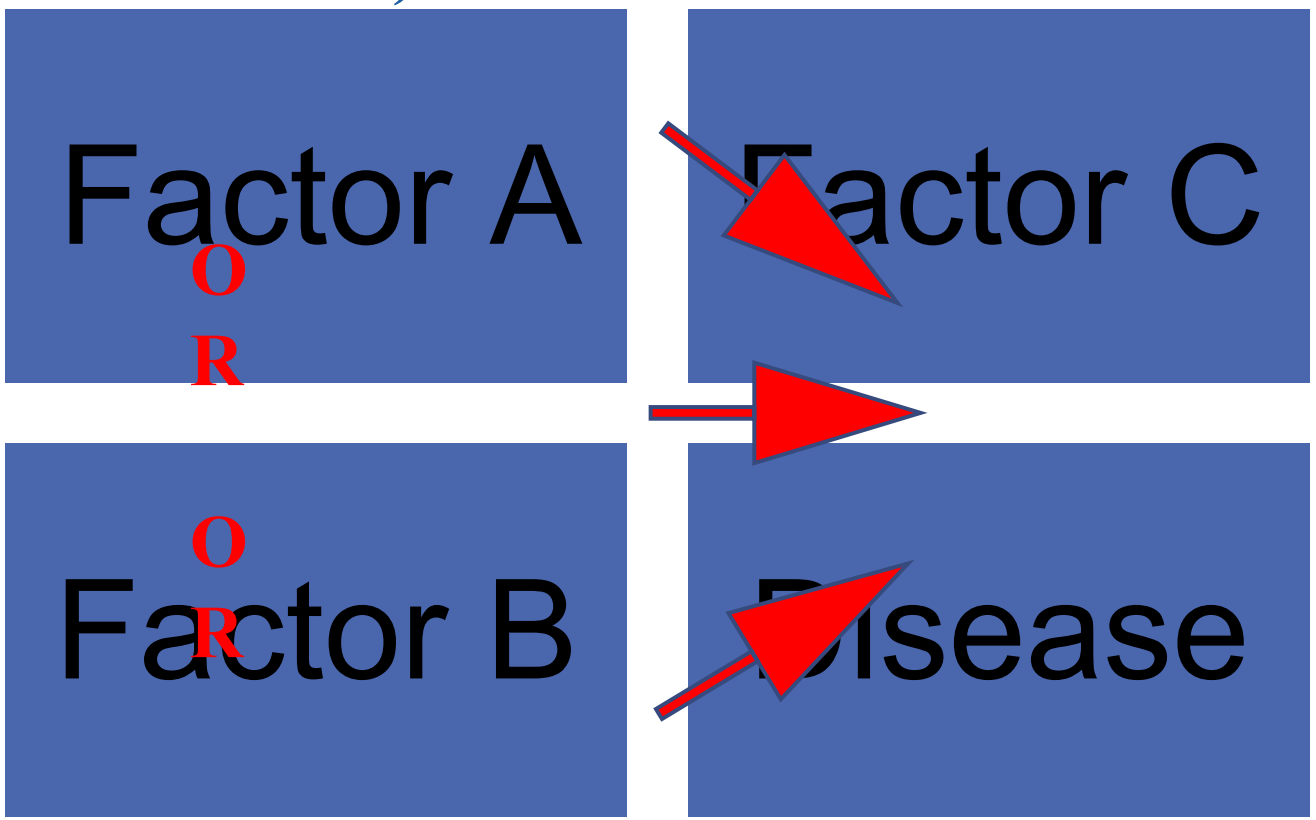
- Multiple factors are required, often in specific temporal sequence (cancer, initiator then promoter). Infectious diseases also (Infection with HIV is necessary but not sufficient to cause AIDS).



لازم يكون في عوامل مجتمعة ، الى جانب ال agent .
عشان تسبب المرض

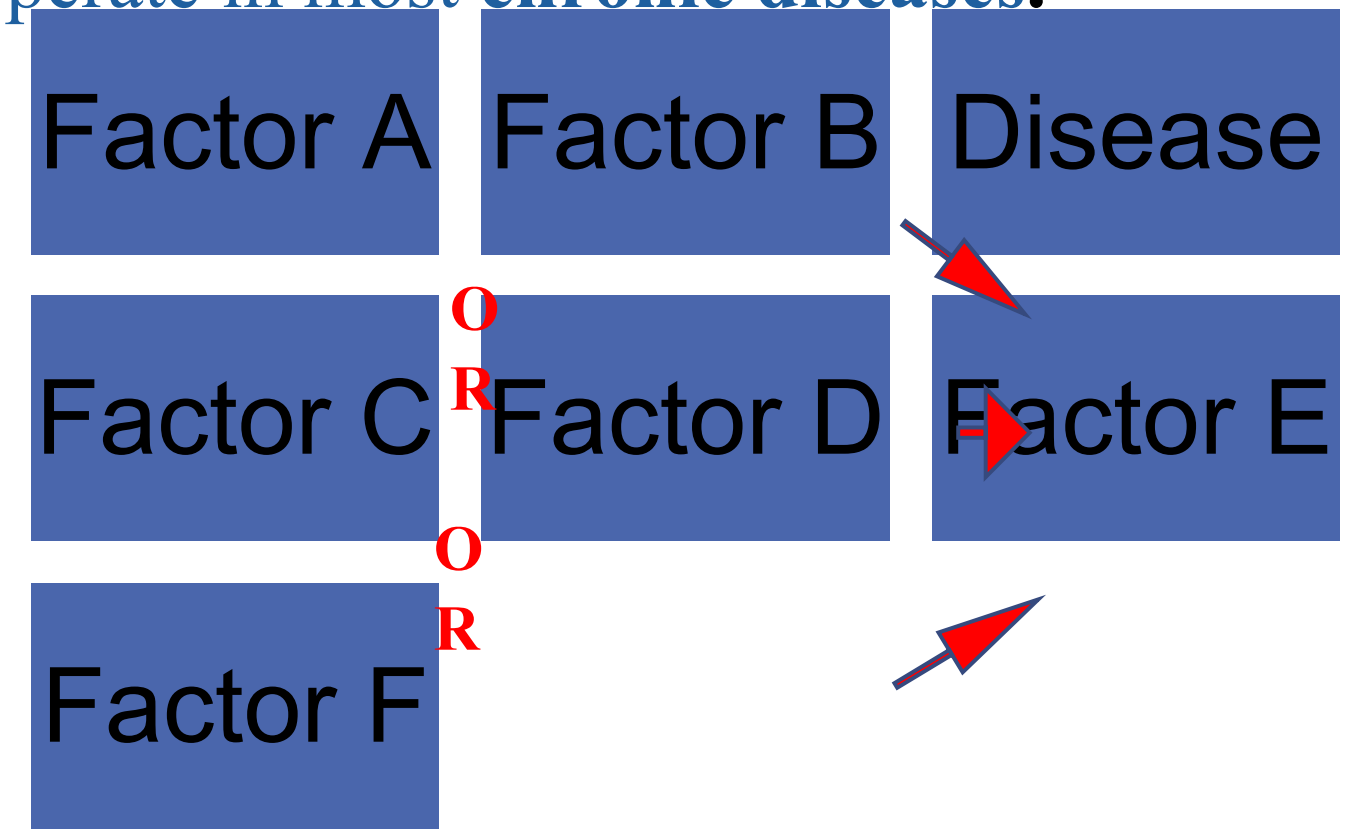
III. Sufficient, but not Necessary

- Various factors independently can produce the disease (**Either radiation or benzene exposure can each produce leukemia without the presence of the other**).



IV. Neither sufficient nor Necessary

- More complex model.
- Probably most accurately represents causal relationships that operate in most **chronic diseases.** Because there are so many variables



IV. Neither sufficient nor Necessary

- Public health action does not depend on the identification of every cause of a disease.
- Disease prevention can be accomplished by **blocking** any single factor from any combination of causes.

يعني لو كان في ٢٠ عامل مجتمعين بيساهموا بارتفاع ضغط الدم ، اذا عرفت اوقّف واحد او ٢ منهم ، رح امنع حدوث المرض لانه
The sequence will be stopped

- For example, elimination of smoking would prevent lung cancer, although some lung cancer would still occur to people who never smoked but have the right combination of other risk factors.