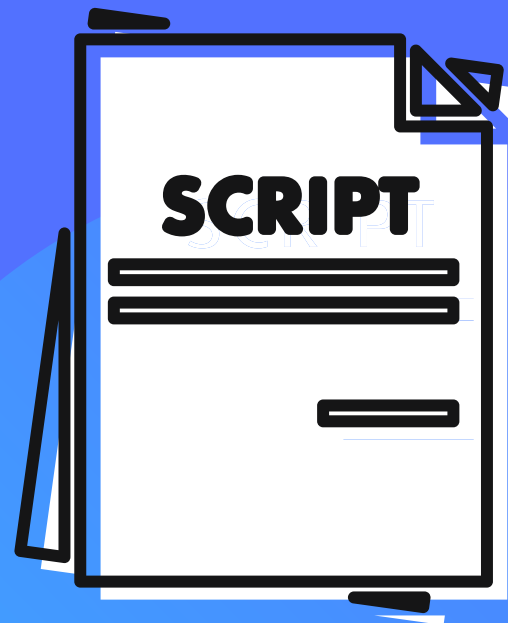


Yarmouk University

Community Medicine

Lec. 10 - The Dynamics of disease
Transmission

Written By : Group C1



If you come by any mistake , please
kindly report it to
shaghafbatch@gmail.com

The Dynamics of disease Transmission

MED 410

Lec. 11

Dr. Ola Soudah

What is epidemiology?

- Is the art of asking question and answering them (core science in research)
- It's (WH questions)

“I keep six honest serving-men (They taught me all I knew); Their names are **What and Why and When And How and Where and Who**”. —Rudyard Kipling¹ (1865–1936)

- Epidemiologists are the scientists that collect, analyze, and interpret data to inform interventions to halt further spread.

- **Studies of the epidemiology of infectious diseases include evaluation of the:**
 - **Disease determinants:** Factors leading to the disease,
 - **Transmission:** factors affecting the transmission of the disease from one person to another, and
 - **Symptoms:** factors associated with clinically recognizable disease among those who has the disease.

- **In public health**, it is the epidemiologic features—**for instance, the prevalence, incidence, transmission route**, and susceptible populations—that are of paramount importance in developing a control program.
 - We do health Prevention programs and promotion.
- **Clinicians** role is to treat a disease may be more concerned with the clinical symptoms or pathophysiology.
 - To reach the diagnosis & treatment.

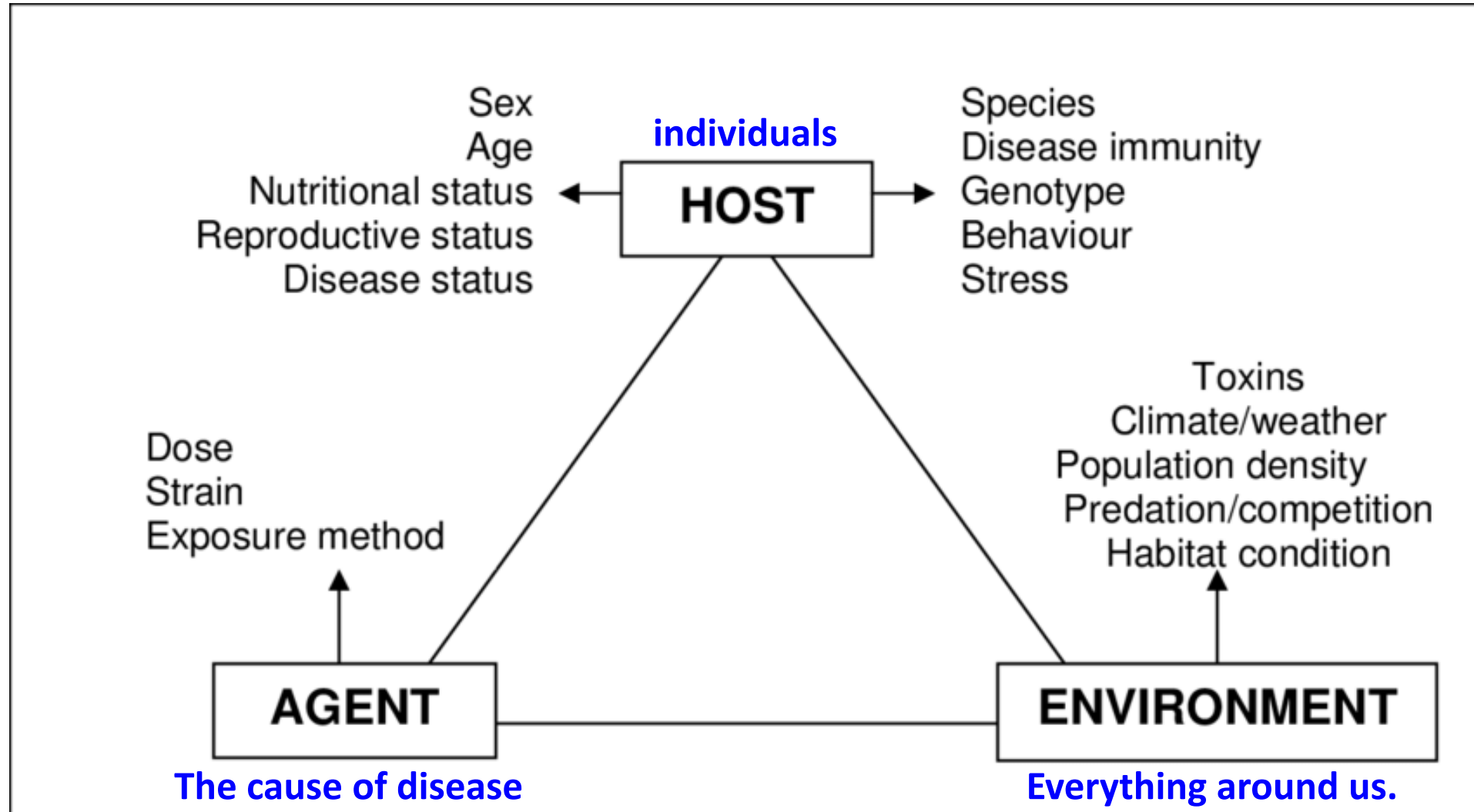


So, the **goal** is different , BUT **the tool** is the same

Epidemiologic Triad

Agent, host, and the environment

رح نطبق على infectious diseases بس كمان ممكن نطبق الالية على ال chronic diseases (non-communicable diseases)



- **Agents** are biological, physical, and chemical factors whose presence, absence, or relative amount (too much or too little) **are necessary for disease to occur.**
- **Host factors** include personal characteristics and behaviors, genetic predispositions, and immunologic and other susceptibility-related factors that influence the likelihood or severity of disease. Host factors **can be physiological, anatomical, genetic, behavioral, occupational, or constitutional.**
- **Environmental factors** are external conditions other than the agent that contribute to the disease process. Environmental factors **can be physical, biological, social, economic, or political in nature.**

TABLE 2.1 Factors That May Be Associated With Increased Risk of Human Disease

Host Characteristics	Types of Agents and Examples	Environmental Factors
Age Sex Race Religion Customs Occupation Genetic profile Marital status Family background Previous diseases Immune status	Biologic Bacteria, viruses Chemical Heavy metals, alcohol, smoke Physical Trauma, radiation, fire Nutritional Lack, excess	Temperature Humidity Altitude Crowding Housing Neighborhood Water Milk Food Radiation Air pollution Noise

Epidemiologic homeostasis

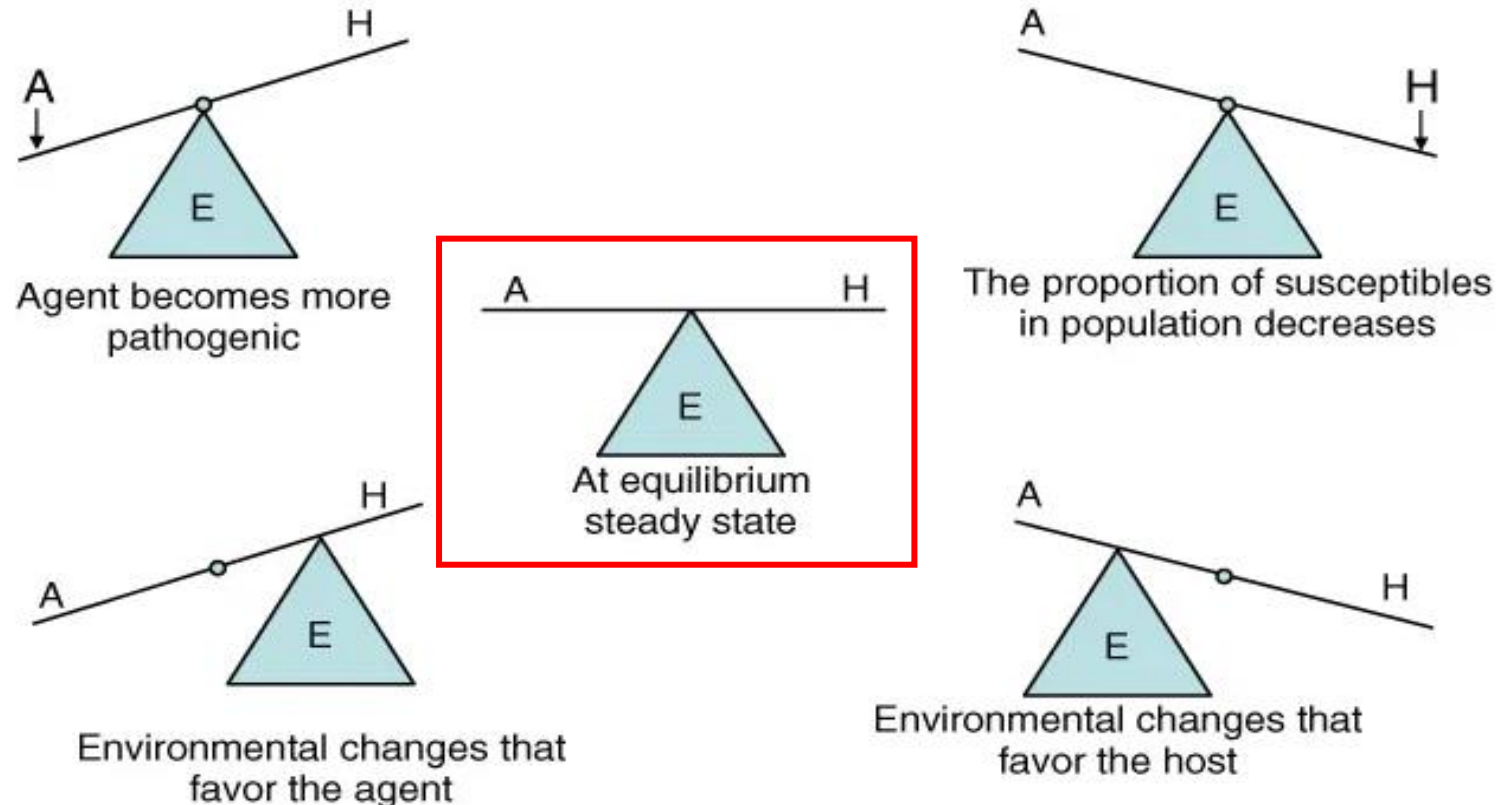
- Over time, an **epidemiologic homeostasis** may form as agent, host, and environmental factors **reach equilibrium (balance)**.

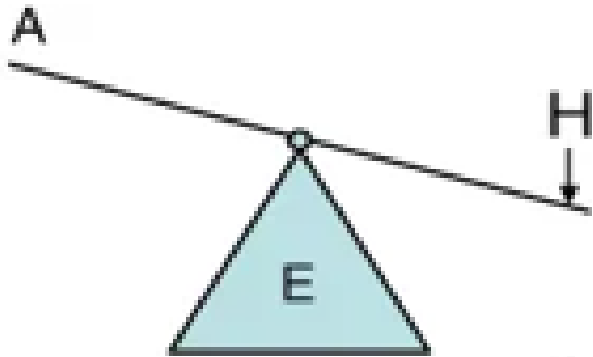
لما ما يكون في عنا مرض رح يكون في حالة من التوازن
ولكن مجرد ما اختل التوازن رح تبدأ الامراض بالظهور

- When an element contributing to the epidemiologic equilibrium is disturbed, the population may experience an increase or decrease in disease occurrence.
- In state of equilibrium >>> we don't have a disease
- Disease >>> is a matter of equilibrium distribution.

Agent (A), host (H), and environmental homeostasis (H) and imbalance.

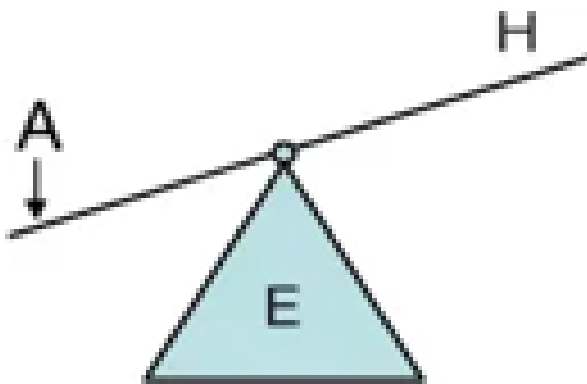
- Causal forces can strengthen, weaken, or cancel-out each other, tipping the epidemiologic balance in favor of the host or in favor of the disease causing agent.





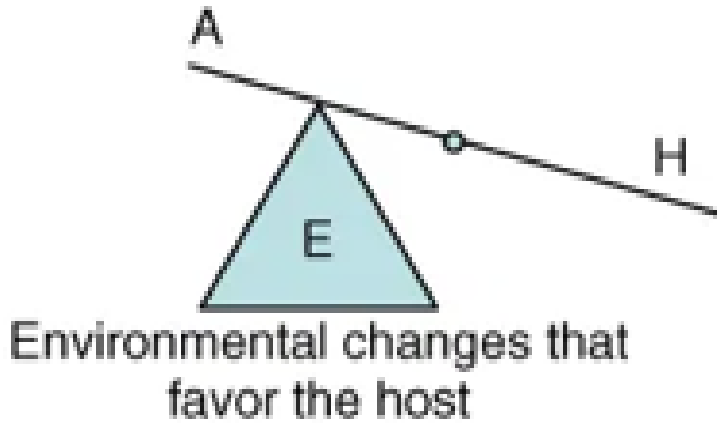
The proportion of susceptibles in population decreases

- Sometimes host (H) characteristic well different with time (e.g. increase in age , change his habits to either good or bad habits)
- So, H is susceptible part because he's the one where the disease will happen.
- Difference in characteristic either :
 - ❑ Increase susceptibility
 - ❑ E.g. : pt. who take immunosuppressant drugs
 - ❑ Decrease susceptibility

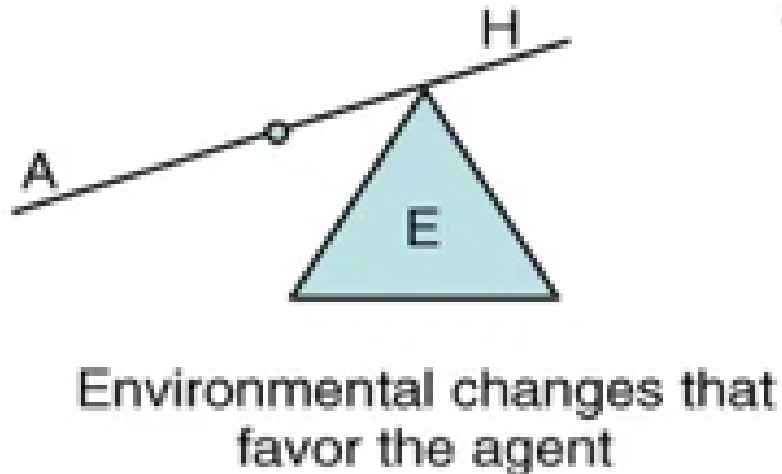


Agent becomes more pathogenic

- Sometimes (let we talk about biologic agents) like certain viruses / bacteria they change in their characteristic >>> they became
 1. More virulent
 2. More pathogenic
 3. More transmissible
- These things can be either increase / decrease risk to get the diseases.
 - E.g. : resistance bacteria for Abs



- Environmental changes can favor (toward) the agent by get it advantages to cause the disease.
 - E.g. : climate changes
 - Increase temp. in certain regions in the world lead to appear some mosquitos with certain viruses like : Zika Virus
 - So, these mosquitos travels from region to another due to increase temp. Therefore, virus outbreaks in south US.



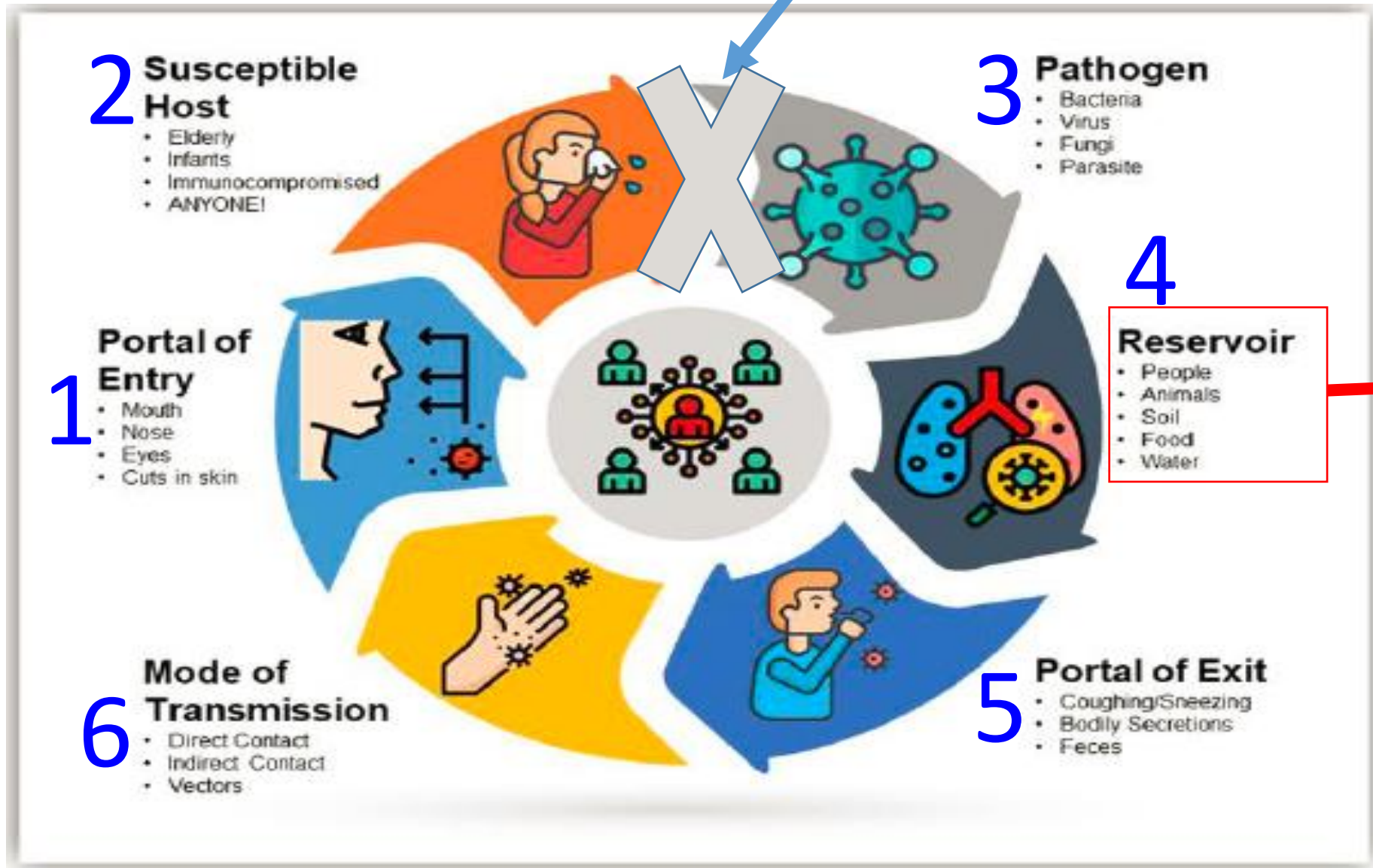
- Environmental changes can favor (toward) the Host
 - E.g. : Cholera
 - Modern lifestyle and hygiene practice so, **favor Host health**
 - Bad lifestyle and sometimes natural disaster . so, **decline host health**

- **For example, an epidemic may arise from any of the following:**

- introduction of a new agent into the population
- increases in the ability of an agent to survive in the environment
- increases in an agent's ability to infect the host (**infectivity**)
- increases in the ability of the agent to cause disease once inside the host (**pathogenicity**)
- increases in the severity of the disease caused by the agent once it has established itself in the host (**virulence**)
- increases in the proportion of susceptible in the population
- environmental changes that favor growth
- environmental changes that favor transmission of the agent
- environmental changes that compromise host resistance.

The chain of infection

In case of prevention, we mainly try to break this action



Could be present on NOT depend on pathogens

- The diagram above is a model used to understand the infection process. Each link in the chain must be present and in the correct sequential order for an infection to occur.

1. **Agent** - a microbial organism with the ability to cause disease
2. **Reservoir** - a place where agents can thrive and reproduce
3. **Portal of exit** - a place of exit providing a way for an agent to leave the reservoir
4. **Mode of transmission** - method of transfer by which the organism moves or is carried from one place to another
5. **Portal of Entry** - an opening allowing the microorganism to enter the host
6. **Susceptible host** – a person who cannot resist an microorganism invading the body, multiplying and resulting in infection.

- **Period of communicability** - the **period when you are infectious and can spread your germs** (whether bacteria, viruses, or parasites) to an uninfected person.
- **Disease susceptibility or vulnerability:** Persons more vulnerable to becoming susceptible hosts include the young, the elderly, and people with weakened immune systems.

Mode of transmission

- **Direct transmission:** a disease can be transmitted **from person to person** (direct transmission) by means of **direct contact** (as in the case of sexually transmitted infections).
- **Indirect transmission** can occur through a common vehicle such as a **contaminated air or water supply or by a vector such as the mosquito.**

BOX 2.1 MODES OF DISEASE TRANSMISSION

1. Direct
 - a. Person-to-person contact
2. Indirect
 - a. Common vehicle
 - 1) Single exposure
 - 2) Multiple exposures
 - 3) Continuous exposure
 - b. Vector

Directly,

Sexually (HIV),
Touching (scabies), by biting (rabies),
Vertically from mother to child (rubella and cytomegalovirus (CMV)).

Indirectly:

A **vector** or **vehicle** (food- and water-borne pathogens, healthcare-associated infections (HAIs), e.g. an infected catheter).

Droplets over very short distances (Ebola) and by droplet nuclei, which are smaller and can travel longer distances (airborne transmission, e.g. influenza and tuberculosis (TB)).

شيء غير حي

شيء حي

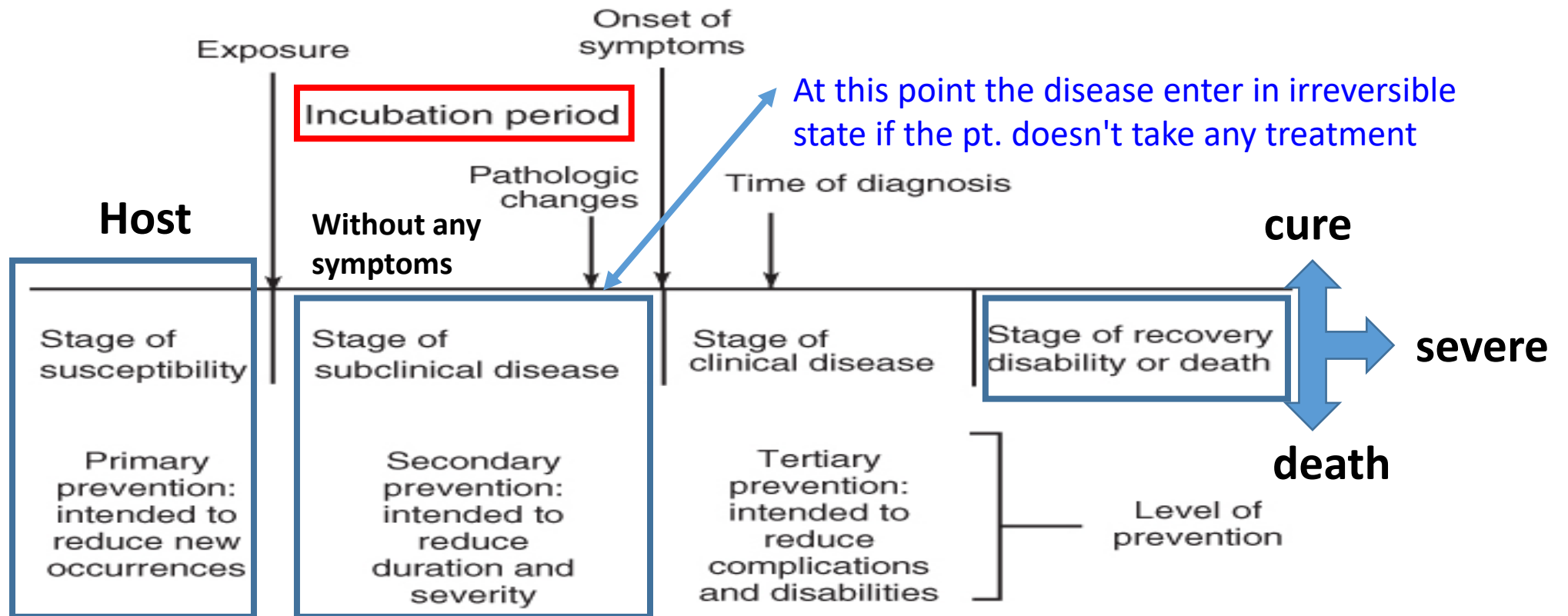
- **Vector** – an animate intermediary in the indirect transmission of an agent that carries the agent from a reservoir to a susceptible host.
 - Sometimes there are organisms as insects, arthropods, or even mammals as dogs or bats who can act as **vectors**; as a mosquito transmits the malaria protozoans.
- **Fomite** - a physical object that serves to transmit an infectious agent from person to person. **Indirect transmission : touching contaminated physical objects**
 - A comb infested with one or more head lice would be a fomite or the dust particles containing infectious cold virus that remain after droplets of infected saliva are coughed into the air. **مثلا حد بعطس على كيبورد جهاز لابتوب وبجي حدا بعده وبستخدمه**
- **Zoonosis** - An infectious disease that is transmissible from animals to humans.
 - Most of viruses / bacteria have an zoonotic origin : jump from animals / mosquitos to humans**
 - E.g. : COVID-19 from bats (خفافيش)**

Infectious Diseases Transmitted by More Than One Means

- **Anthrax** is an infection with *Bacillus anthracis*, the resulting disease has three clinical forms in humans: cutaneous, gastrointestinal and inhalation anthrax.
- Different disease manifestation based on route of transmission:
 - **Contact** with infected animal cause *wool sorter's disease*.
 - **Inoculation of organisms into the skin during** butchering of an infected animal; this type of exposure usually leads to cutaneous anthrax.
 - **Consumption of meat** from an infected animal leads to gastrointestinal anthrax.
 - **Inhalation anthrax (most dangerous)** occurs when an infectious aerosol of *B. anthracis* spores is inhaled and germinates in the pulmonary lymphatic tissues.

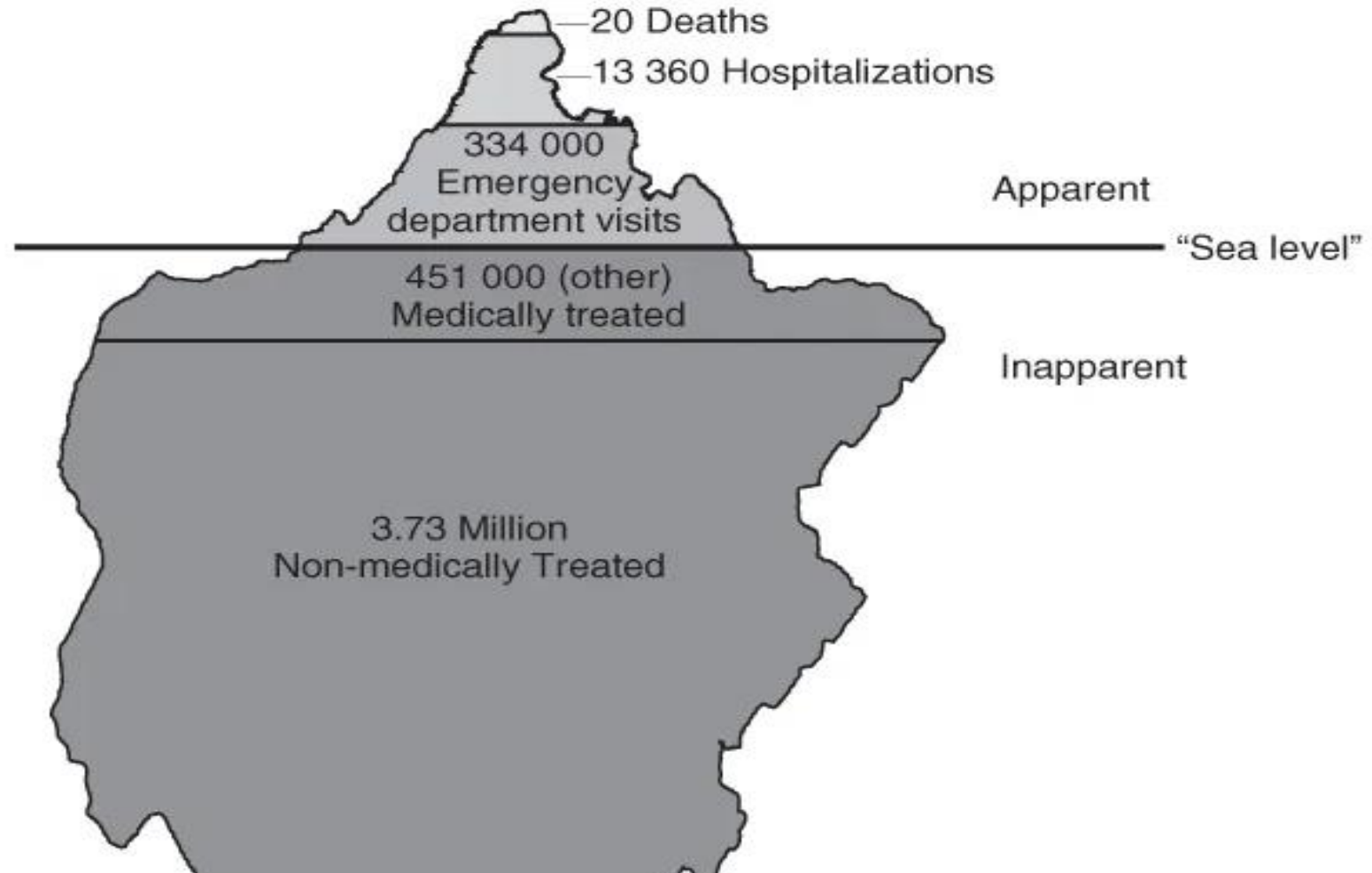
Natural History and Spectrum of Disease

- Natural history of disease refers to the progression of a disease process in an individual over time, in the absence of treatment.



The epidemiologic iceberg

The bulk of a health problem in a population may be hidden from view. This phenomenon, referred to as the **epidemiologic iceberg**.

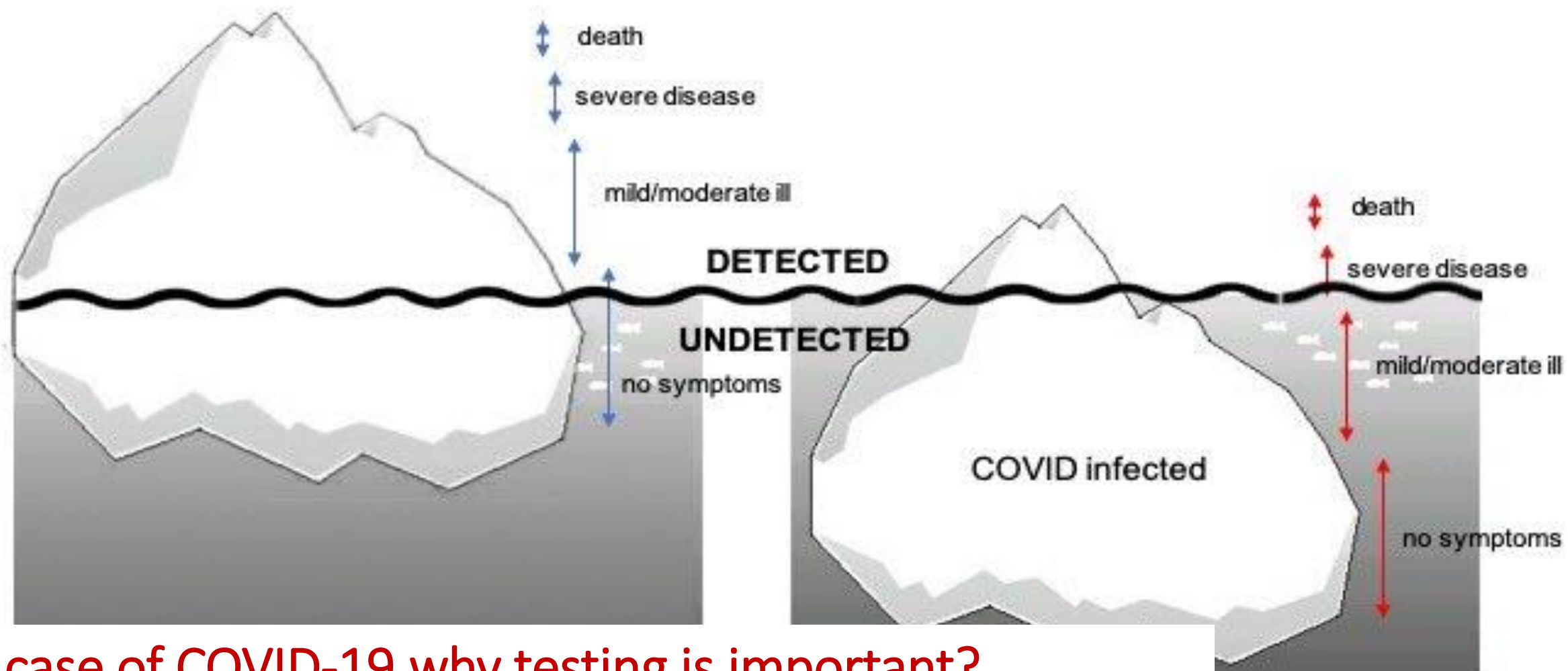


Uncovering disease that might otherwise be "below sea level" by screening and better detection often allows for better control of health problems.

ICEBERG ANALOGY COVID19 REPORTING

Germany (reported death/detected 0,25%)

United Kingdom (reported death/detected 4%)



The case of COVID-19, why testing is important?

The Ice-berg at Individual level

Disease severity increased with viral / bacterial load in the body

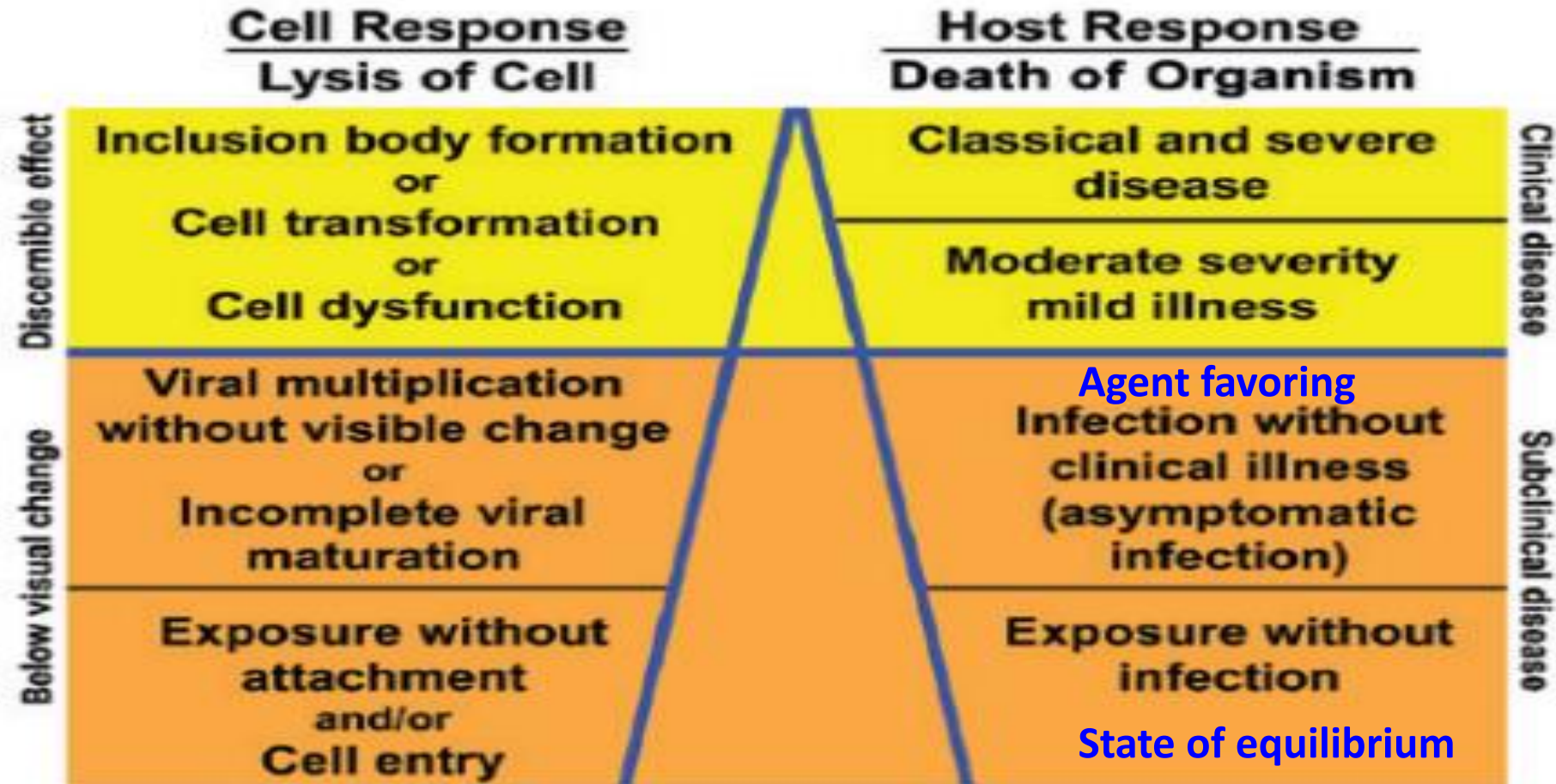
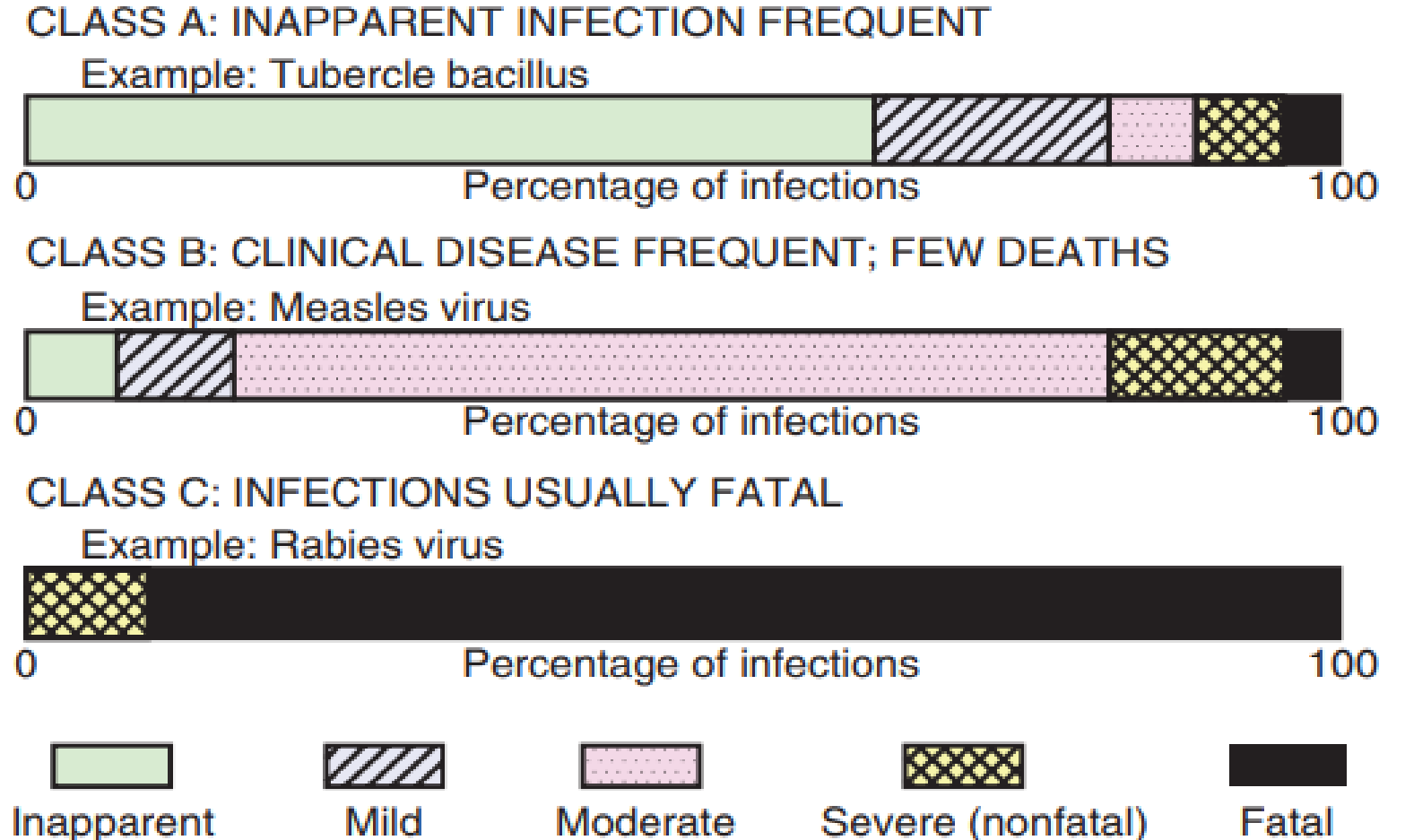


Fig. 2.4 The "iceberg" concept of infectious diseases at the level of the cell and of the host. (Modified from Evans AS, Kaslow RA, eds. *Viral*

Clinical and Subclinical Disease

- We should not only look at the iceberg, we need to understand the spectrum of severity ...

- Which disease we should screen for??



- As we said the incubation period rely on the type of pathogen.
- Sometimes, the inapparent phase which is in the green colour at the figure then mild, moderate, and fatal (death) .
- For example; Tubercles bacillus stay in the inapparent phase (incubation period) for along time ,then mild , moderate, severe and fatal for shorter time. So, in this pathogen the longer phase is the inapparent phase.
- Okay , now when we compare TB with measles virus we realise that this pathogen has longer moderate phase.
- In more virulent virus like Rabies virus there are no inapparent, mild , moderate phases ((directly jump to severe and fatal phases)) .
- Dr. Ola asked which disease we must prevent it completely ?? The answer is Rabies virus, we must give vaccines to prevent the infection because there is no inapparent phase (directly jump to severe phase) .
- Measles virus also can get a vaccine.
- Tubercles bacillus screening good .
- Also we take in the consideration the incidence, prevalence, timeline of disease and it's severity to make design for health prevention program or promotion.

- **CLINICAL DISEASE** Clinical disease is characterized by signs and symptoms. Exposure في بداية ال
- Symptoms or signs هو لما يكون عند المريض
- **NONCLINICAL (INAPPARENT) DISEASE** may include the following: (ما بنقدر نشوفه)
 - A+ B about time
 - A. Preclinical disease:** Disease that is not yet clinically apparent but is destined to progress to clinical disease. (بداية ال exposure)
 - B. Subclinical disease:** Disease that is not clinically apparent and is not destined to become clinically apparent. This type of disease is often diagnosed by serologic (antibody) response or culture of the organism.
- Pathogens live long period in your body before the manifestations appear . Ex; HIV for 10 years and so on

- We could be healed from some kind of viruses but still have them in our bodies (dormant phase) like varicella zoster virus .
- بتتصاب بالجذري وبتتشفى منه ولكن بضل الفيروس بالجسم ما بروح بعدين لما تصير بظهر immunocompromised على الجلد حزام ناري .
- في ناس بكون عندهم long COVID يعني they are tested positive for long time with no symptoms.

C. Persistent (chronic) disease: A person fails to “shake off” the infection, and it persists for years, at times for life.

It will stay for long time

“In recent years, an interesting phenomenon has been the manifestation of symptoms many years after an infection was thought to have been resolved. Ex. Long COVID-19 syndrome”.

D. Latent disease: An infection with no active multiplication of the agent, as when viral nucleic acid is incorporated into the nucleus of a cell as a provirus.

In contrast to persistent infection, only the genetic message is present in the host, not the viable organism. EX. COVID -19 keep testing positive by PCR for 3 months in some individuals.

- Persistent (chronic) disease:
 - حتى بال infectious disease ال HIV صاروا يصنفوا انه هو ممكن يكون chronic
 - persist for years and long time لانه disease more than infectious
- Latent disease: ((dormant state))
 - بضل بالجسم زي ال HIV وبوخذ وقت قبل ما بصير له multiplication and manifestation ومثال عليه أيضاً الجدري وكمان ال HSV لما يكون في stress بتلاقي manifestation on the skin .
- So, latent means it stays dormant then it will manifest .
- (persistent & latent) about the characteristic of the disease.
- (Preclinical & subclinical) about time .
 - لهيك ممكن يكون ال disease latent subclinical بحيث انه latent من حيث ال characteristic و subclinical من حيث ال time .

• **Carrier Status** : carrier of pathogen

• ال disease ما بعمل jump for clinical state خلال هاي الفترة .

- In a carrier state I only can see it by serologic studies or PCR ,, so no clinical manifestations .
- Infectious or not depends on pathogen characteristics.
- A carrier is an individual who harbors the organism but is not infected as measured by serologic studies (no evidence of an antibody response) or shows no evidence of clinical illness.
- This person can still infect others, although the infectivity is generally lower than with other infections. Carrier status may be of limited duration or may be chronic, lasting for months or years.

• يعني ال inapparent phase بنقدر نحكي عنها ال carrier status لانه ما عنده signs or symptoms ولكن لما نعمل PCR بطلع عنده HIV مثلاً وبقدر ينقل المرض He can transmit the disease.

• لكن لو عنا مريض وكان معه measles بحالة ال dormant ما بقدر ينقل المرض He can't transmit the disease.

• ال measles لما يكون بال dormant phase ما بقدر ينقل المرض وبهاي الحالة يكون latent disease.

• متى بنحكي عن الشخص carrier او لا !! When he can infect others

• Carrier : when the person can infect others. (it may work as reservoir)

Endemic, Epidemic, and Pandemic

.....What is the differences between

ENDEMIC



Transmission occur, but
the number of cases
remains constant

EPIDEMIC



The number of cases
increases

PANDEMIC



When epidemics occur at
several continents
-global epidemic-

• لازم نفرق بين هاي المصطلحات وبين ال out break كمان .

- Endemic: cluster of the disease in small geographic area and the disease prevalence is low . (continuously low)
 - Epidemic: cluster of the disease in certain county, for example; corona in Jordan. (Still within the county)
 - Pandemic: if the spread of the disease becomes worldwide. (several countries are involved)
 - Hyper-endemic : use it with chronic disease. Ex; Diabetes
 - Outbreak: sudden raise of cases in specific geographic area or in specific time.
 - Cluster: group of cases in the same place and time.
- ال cluster بكون في بينهم ارتباط زمانياً او مكانياً .
- Sporadic: random cases.

Basic Epidemiology Terms – Levels of Disease Frequency

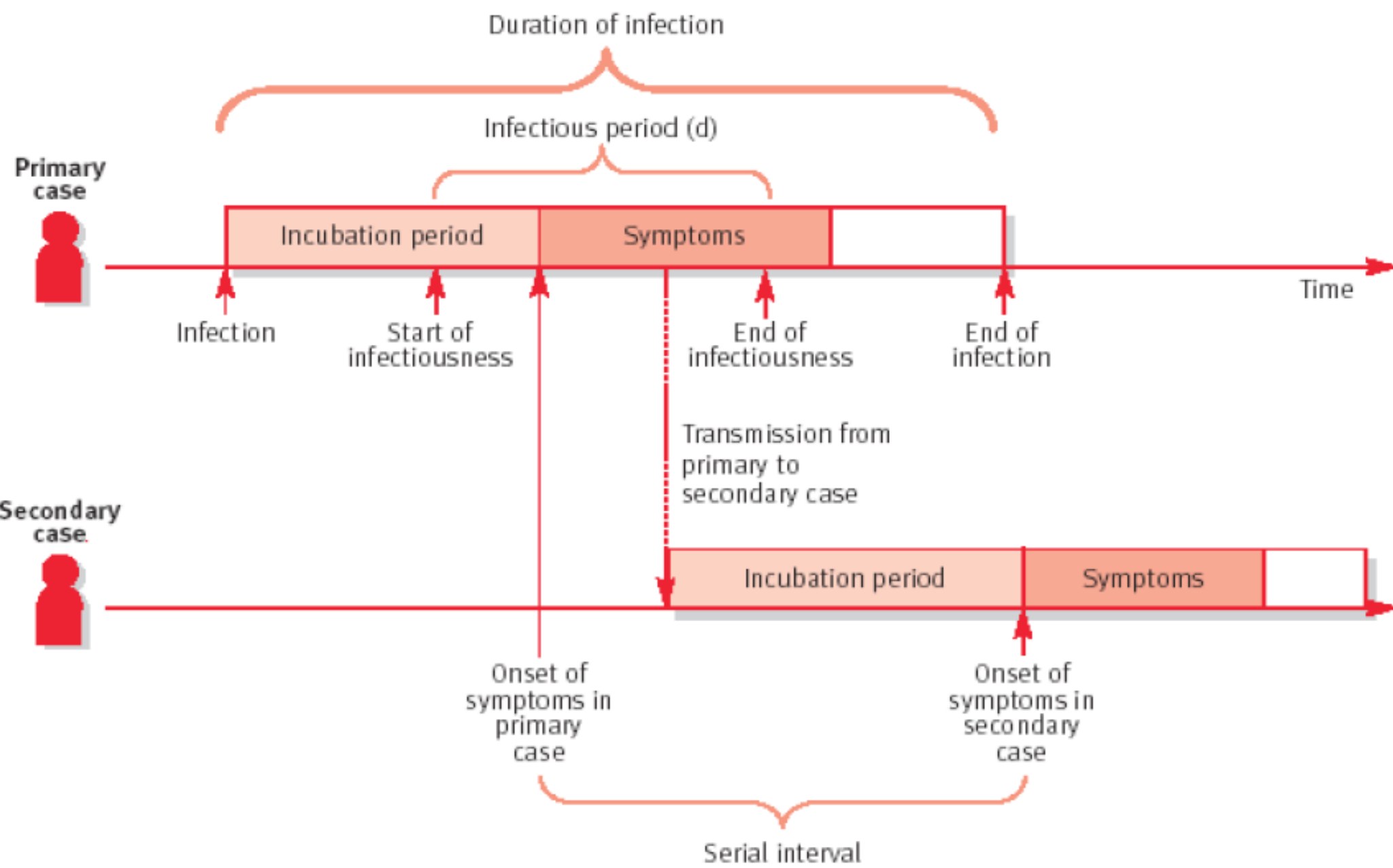
- **Endemic** – disease or condition present among a population at low level in all times.
- **Hyper-endemic**-- refers to persistent, high levels of disease occurrence.
- **Outbreak** – (localized epidemic) – more cases of a particular disease than expected in a given area or among a specialized group of people over a particular period of time.
- **Epidemic** – large numbers of people over a wide geographic area affected.
- **Pandemic** -An epidemic occurring over a very wide area (several countries or continents) and usually affecting a large proportion of the population.
- **Cluster** –refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known.
- **Sporadic** – a disease that occurs infrequently and irregularly.

Epidemiologic Characteristics of Infectious Diseases

1. Incubation Period:

- The incubation period of an infectious disease is the time between exposure to an infectious agent and the onset of symptoms or signs of infection.
- Infectious agent during incubation period do multiply until it cross a threshold necessary to produce symptoms or laboratory evidence of infection.
- During this stage, disease is said to be **asymptomatic** (no symptoms) or inapparent.

- اذا عملنا testing خلال هاي الفترة مش شرط يكون positive هالاشي بعتمد على ال virus load .
- If it's negative then the number of viruses aren't enough to detect by PCR .
- ال incubation period لازم تكون asymptomatic .



- اول يومين ثلاث من بداية ال exposure ما يكون في عدوى (not infectious) ما بتنتقل العدوى بعدين بيصير عنا point of time to start of infectiousness and it will continue to the symptomatic period.
- فترة نقل العدوى تنتهي قبل فترة انتهاء المرض عند المريض .
- The incubation period depends on the immune system لهيك هي مش ثابتة عند الكل مثلاً ل ١٢ يوم فقط لا ، بتتحدد ب range من (٧-٥) أيام ، ، اقل شخص بحتاج ل ٥ واكثر شخص بحتاج ل ٧ وكل ما كان المريض اكبر بالعمر ال incubation period بتكون اقل .

- **The incubation period from person to another may vary, Why?**

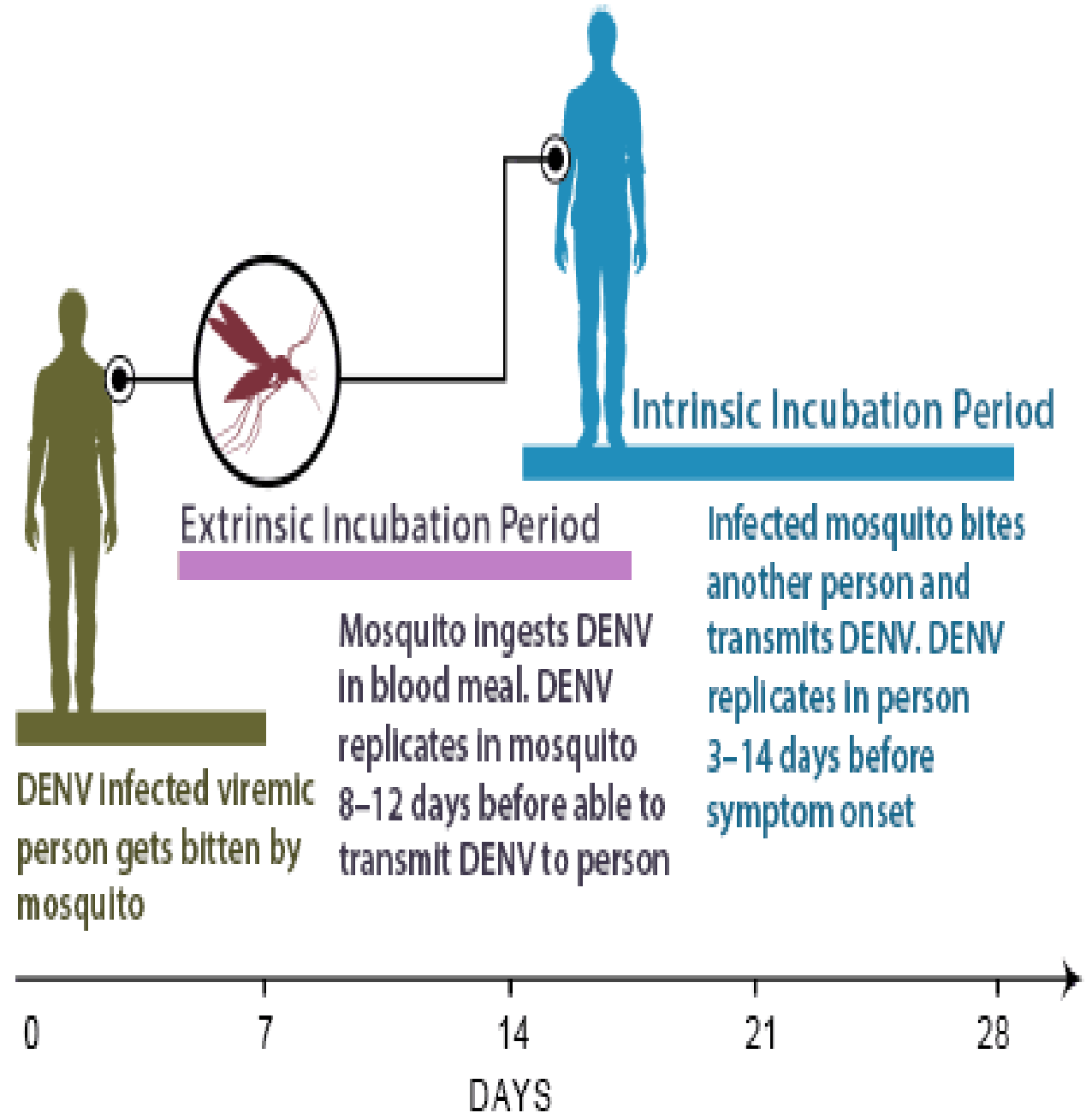
- The dose or inoculum of the infectious agent,
 - بمعنى كم عدد الفيروسات التي دخلت على الجسم ، وكل ما كان ال inoculation size عالي بيصير للفيروس multiplication اسرع وبتظهر ال manifestation للمرض اسرع .
- The route of inoculation, and
- The rate of replication of the organism. (depends mainly on the immune system)

Infectious dose or inoculation size - the amount of pathogen (measured in number of microorganisms) required to cause an infection in the host. Usually it varies according to the pathogenic agent and the consumer's age and overall health.

- Incubation period applies to vector-borne infections; it is the time that a vector-borne agent requires for maturation to infectivity in the vector before the organism becomes infectious to humans, we call it **The extrinsic incubation period**.

• المرض يحتاج وسط لحتى ينتقل

- The extrinsic incubation period can be affected by environmental conditions as well.



- بعض الامراض بحتاج وسط لحتى تنتقل مثل ال malaria طريقة انتقال الفيروس من شخص ل mosquito لشخص اخر ،، ما بتنتقل من شخص لشخص directly والسبب انه لازم الفيروس يعمل multiplication داخل البعوضة وبعدين يرجع ينتقل للإنسان .
- وكمان مثال ال DENV نفس مبدأ الملاريا .

Biologic Characteristics of the Organism (agent)

- **Infectivity** refers to the proportion of exposed persons who become infected.
- **Pathogenicity** refers to the proportion of infected persons who develop clinical disease.
- **Virulence** refers to the proportion of persons with clinical disease who become severely ill or die.
 - Virulence can best be measured by the case fatality rate or as the proportion of clinical cases that develop severe disease.
- **Immunogenicity** is the ability of an organism to produce an immune response after an infection that is capable of providing protection against reinfection with the same or a similar organism.

- ال infectivity يعني !! How much this virus can infect people يعني لنفترض انه ١٠ اشخاص تعرضوا للفيروس بس الي انصابوا ٥ اشخاص فقط هون بتكون ال infectivity هي 5 / 10 .
- ال pathogenicity هي كم شخص طلع عليهم الاعراض من الأشخاص الي انصابوا بالمرض ! يعني مثلاً من المثال السابق ٣ اشخاص من اصل ٥ طلع عليهم الاعراض هون بتكون ال pathogenicity هي 3/5 .
- ال virulence هي كم شخص كانت حالته خطيرة او مات !! حسب المثال ٣ اشخاص طلع عليهم اعراض وواحد مات مثلاً فهون بتكون ال virulence هي 1/3 .
- ال immunogenicity
- Measles vaccine is a life long immunity لأنه بيصير عندي memory cells كافية
- لكن ال COVID 19 has low immunogenicity (just for 6 months) then you need another dose of vaccine .

Table 2-7

Natural History Patterns of Some Important Infectious Diseases

Natural History	Disease
<i>Acute</i> with recovery and long-term immunity	Measles, mumps, rubella, polio, diphtheria
<i>Acute</i> with some chronic carriers	HBV, HSV-1 and HSV-2, VZV, <i>Chlamydia trachomatis</i> infections
<i>Acute disease, chronic sequelae</i> without carrier state	Group A streptococcal (ARF, AGN), syphilis, Lyme disease
<i>Chronic carriers</i> common (or usual)	HIV, HBV, HSV-2, HPV, HCV, <i>H. pylori</i> infections, <i>Opisthorchis viverrini</i> , <i>Schistosoma</i> infections
<i>Chronic carriers</i> may develop cancer	HBV—Hepatocellular CA HCV—Hepatocellular CA HPV—Cervical or laryngeal CA <i>H. pylori</i> —Gastric CA HTLV-1—T-cell leukemia EBV—Nasopharyngeal carcinoma HHV-8—Kaposi's sarcoma Opisthorchis—Cholangiocarcinoma

- Long –term immunity from this disease. vaccine إصابة وحدة او كافية لحتى تعطي protection
- Carrier mean still can transmit the disease of the disease. chronic state وعم تتحول لل
- Carrier may develop cancer not just affect other people

- **Herd Immunity** مناعة القطيع

- يعني اغلب الافراد بالمجتمع عندهم مناعة ضد مرض معين بحيث انه not got vaccinated but still be protected from the disease

- The level of immunity of the population may be critical in determining whether an epidemic will occur and, therefore, the risk of infection for a susceptible individual in the population.

- اهم اشئ فيها انه الشخص الي ما بيؤخذ vaccines لانه immunocompromised يكون protected by herd immunity

- If the number of immune persons is large enough that it is unlikely that a susceptible individual will have contact with an infected person, the population is said to have *herd immunity*.

- What percentage of a population must be immune for herd immunity to operate? **The level of immunity required (immune individual percentages)** to attain herd immunity depends on the characteristics of the infectious disease. (infectivity, pathogenicity ,)

Herd immunity is defined as the resistance of a group of people to an attack by a disease to which a large proportion of the members of the group are immune.

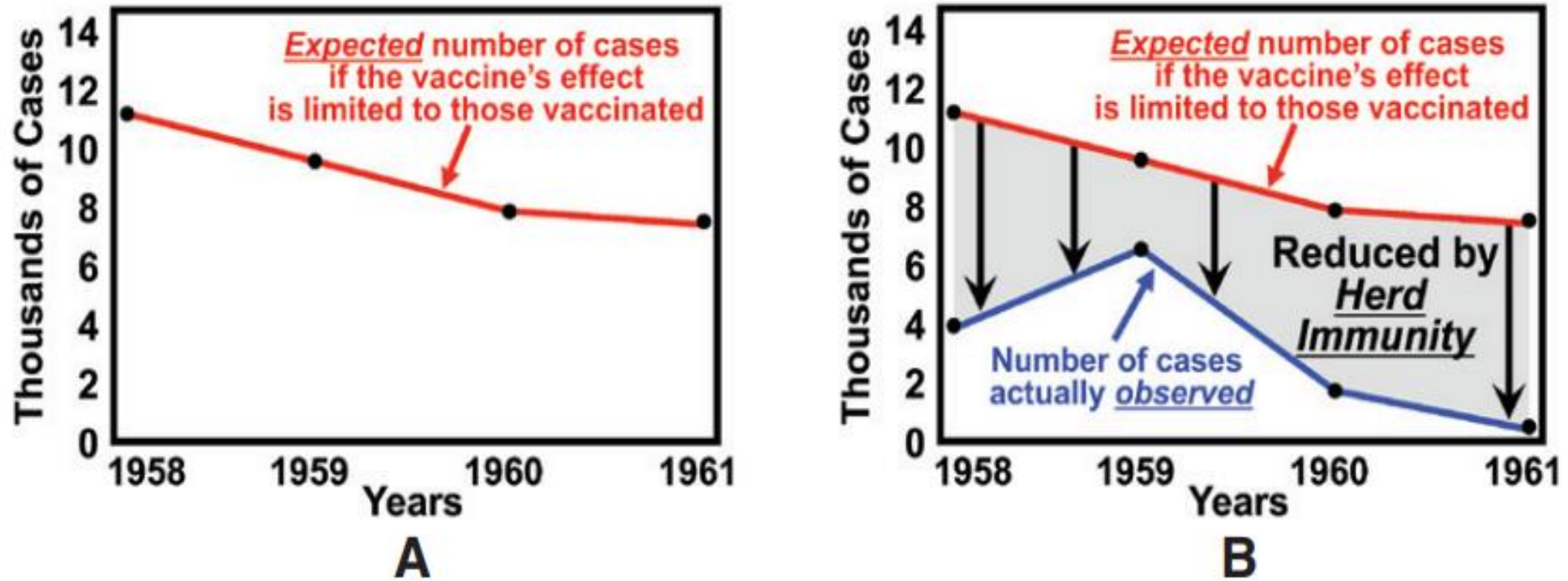


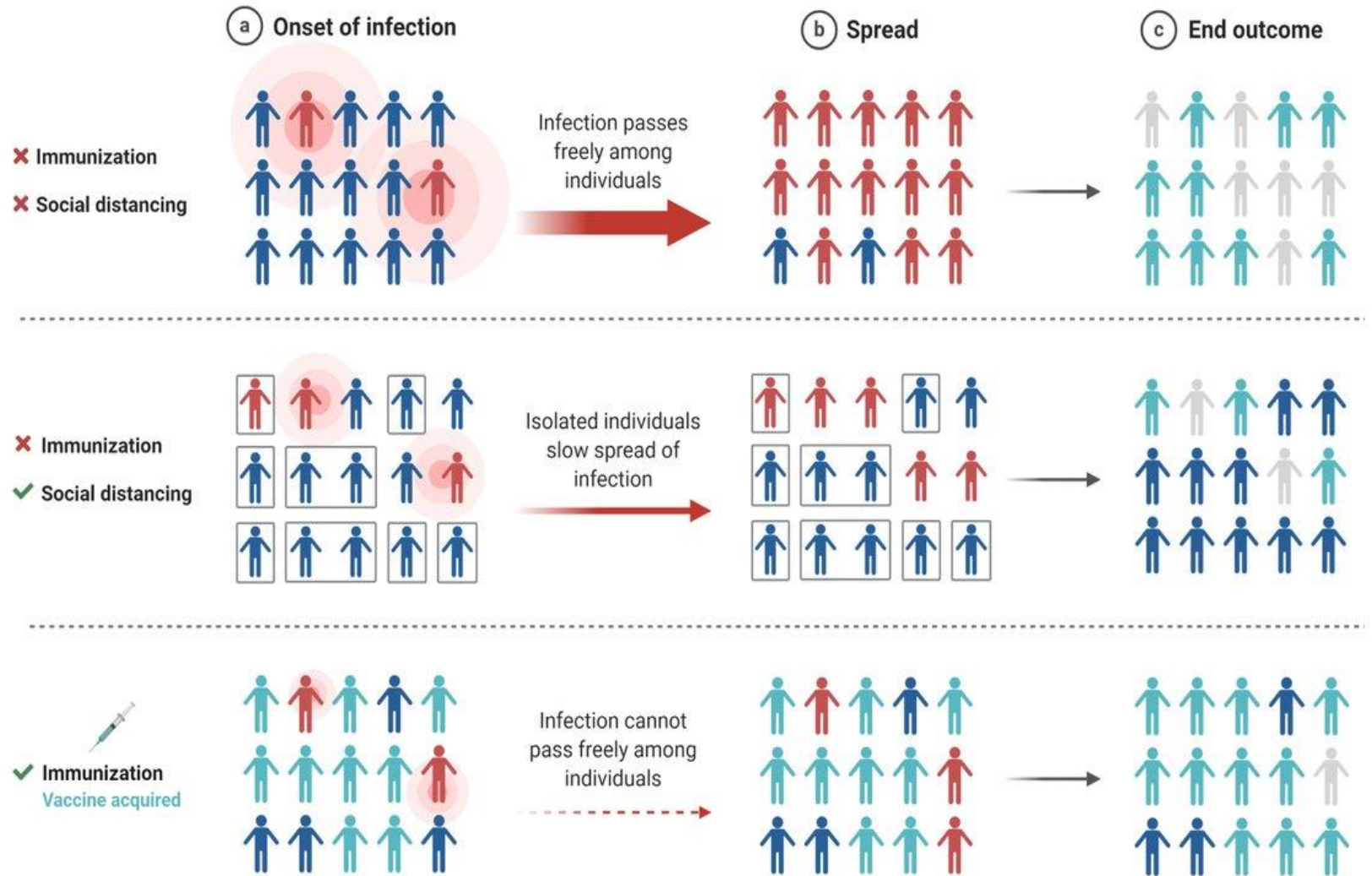
Fig. 2.11 Effect of herd immunity, United States, 1958–61. (A) Expected number of paralytic poliomyelitis cases if the vaccine's effect was limited to vaccinated people. (B) Number of cases observed as a result of herd immunity. (Modified from American Academy of Pediatrics News.

• لما نعطي مطعوم لشريحة كبيرة من الناس ، مش الكل رح يوخذ المطعوم ولكن الأغلبية رح يوخذه وأهميتها to reduce the prevalence and the incidence of disease we can't completely remove the cases we protect number of cases by herd immunity.

• الدكتورة سألت مين هو المرض الي صار له complete eradication أي تم التخلص منه نهائياً والجواب هو smallpox ولأنه eradicated ما في داعي للمطعوم وصار له completely shut down for transmission الفيروس بطل ينتقل لهيك انتهى ، كيف احنا بنقدر نحصل على complete eradication !! لما يصير في عنا global herd immunity.

• ال smallpox حالياً بين الناس مش موجود ولكن موجود as a lab sample in USA and Russia وموجود ايضاً بال natural reservoir تبعه يعني بال animal الي طلعه لسا بكون موجود فيه و للان ما قدروا يحددوا ال natural reservoir for smallpox بسبب خطورة الفيروس .

Principles of HERD IMMUNITY & SOCIAL DISTANCING



If a large percentage of the population is immune, the entire population is likely to be protected, not just those who are immune.

- خلال الكورونا we can reach herd immunity either by infection or vaccination ،، بالبداية ما كان في immunisation و social distancing لهيك كل شخص صار يعدي الي حوليه وهيك صار الكل معدي وفي منهم من العدوى they survived and got immuned فبنوصل لمرحلة من ال herd immunity الي هي naturally ، لهيك كان في موجات للمرض بتيجي موجة بتعدي كل الي بالمجتمع وبعدين بترجع مرة ثانية بعد ٦ شهور وبعدها بترد ترجع وهكذا .
- لما طبقنا ال social distancing فعلياً we stop the transmission so we control the transmission.
- لما الشخص المصاب يعزل حاله ما بيعدي الأشخاص الي حوليه أما الشخص المصاب وبدون عزل بينقل العدوى فصار في انتشار للمرض ولكن اقل ،، وبنفس الطريقة ال social distancing بخلي في ناس ما يوصلهم المرض او ينعديوا لهيك بضلوا مش immuned. لكن الأشخاص الي صابهم المرض اما got immuned or died لهيك ال social distancing مش حل جيد .

• لما نعمل ال immunization then we immuned a lot of people ولكن بضل
ناش مش immuned والشخص المصاب already got immuned so we protect
more people because we break down the transmission in more
efficient way compare to social distancing.

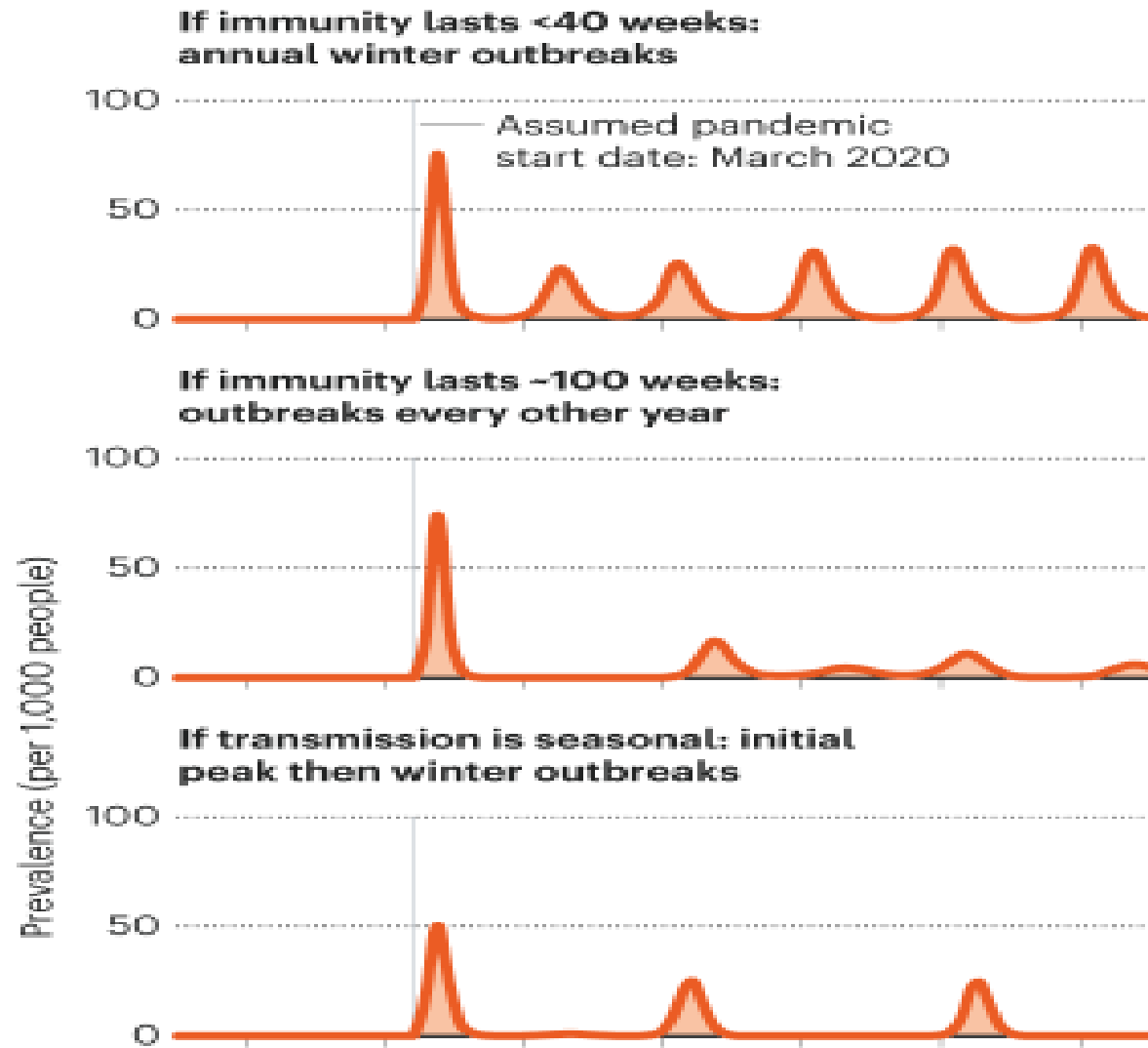
• لهيك ال herd immunity لما نوصلها بتكون افضل من social distancing لانه
يتحمي عدد اكبر من الأشخاص،، حتى الأشخاص الي بكونوا not immuned بكونوا
protected .

• هالحكي في حال انه افترضنا انه الناس بتتجمع بشكل عشوائي.

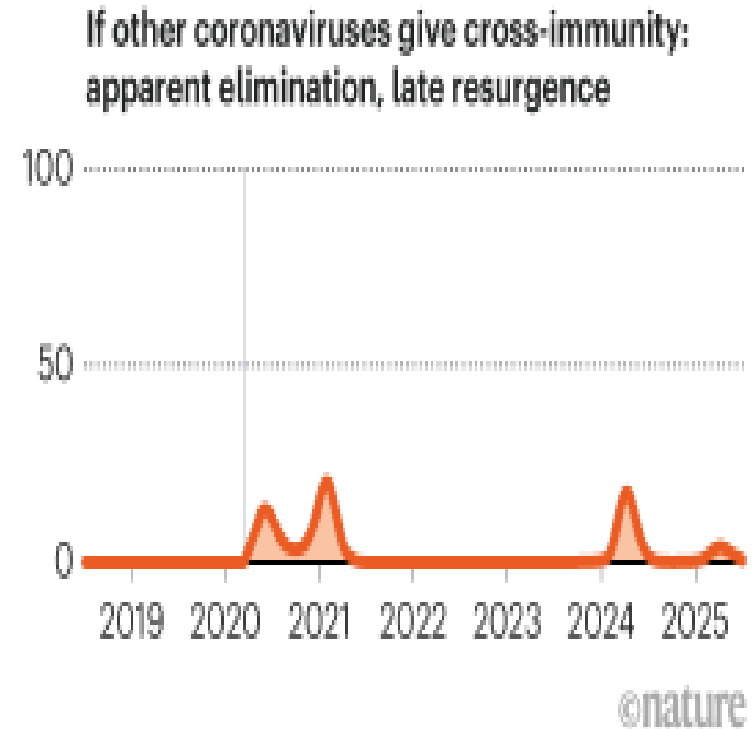
- The levels of herd immunity and individual susceptibility to infections are major epidemiologic factors that have influenced the periodicity and secular trends observed in many diseases, such as measles, rubella, varicella, and polio.

WHAT HAPPENS NEXT?

To predict how COVID-19 might come and go in temperate regions such as North America and Europe, researchers have modelled the influence of factors including how long immunity to the coronavirus might last, the role of seasons and whether other coronavirus infections might give some immunity to it.



Based on Simulation study.



Quantification of Diseases

- Epidemiologists use a variety of measurements to quantify the occurrence of disease:
- To study the characteristics of any disease and how rates change over time mainly we monitor the disease prevalence, incidence, mortality rate of the disease and the number of cases in a given year or month or week.
 - **The prevalence** of disease in a population is the number of people who are infected divided by the number of people in the population.
 - **The incidence** is either the rate at which persons acquire the disease or the rate at which the infectious agent is being transmitted throughout the population.
- Both measures always include a unit of time—the number of cases of influenza in a given year, month, or week.

Surveillance of Communicable Diseases

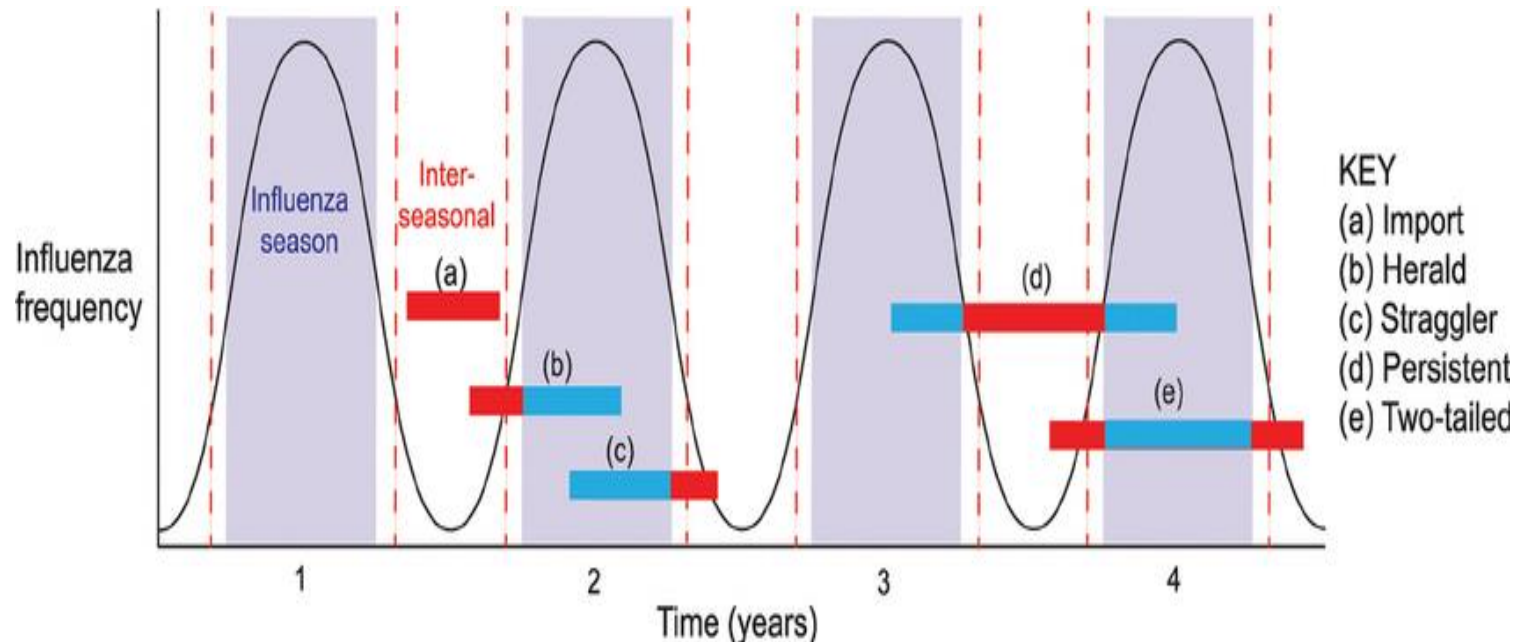
- **Surveillance** can be defined as the ongoing and systematic collection, collation, and analysis of data, and the dissemination of the results to those who need to know to avoid or prevent infections or epidemics.
 - كيف بنقدر نحسب ال measures عن طريق ال surveillance system كل دولة الها سيستم (communicable and uncommunicable)
 - كل فترة وفترة بيصير فيه data collection in a systematic way
- A disease surveillance system serves **two key functions**;
 - **The early warning functions** of surveillance are fundamental for national, regional and global health security. (Alarm for certain outbreaks and so on ..)
 - **The programme monitoring** function of surveillance of communicable diseases encompasses a variety of goals such as eradication or elimination and surveillance to monitor trends of endemic diseases.

Trends of Infectious Diseases overtime

it's the pattern of the disease

- **Seasonal Variation**

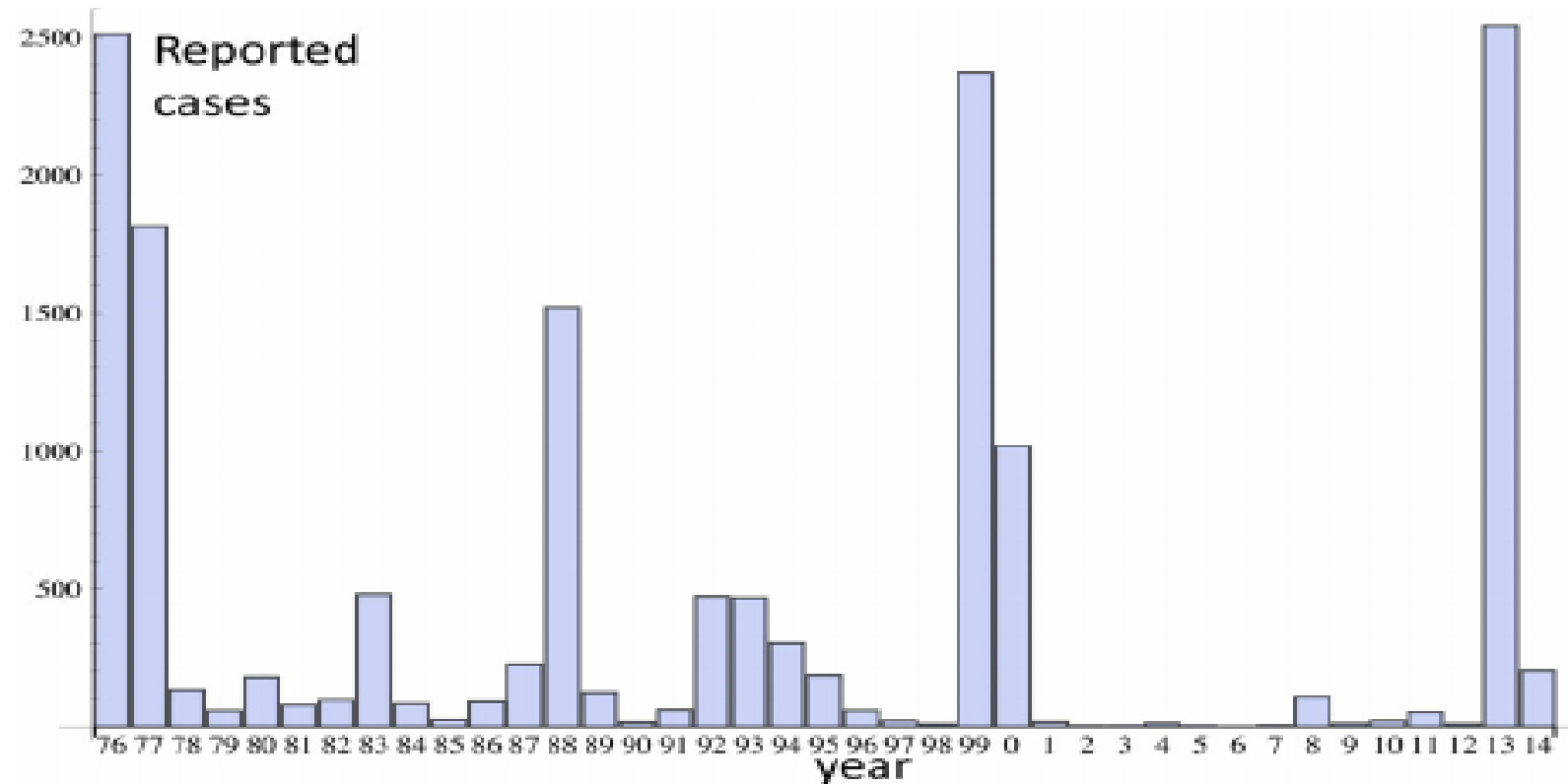
- زي مثلاً الانفلونزا بتزيد بالشتاء وبتقل بالصيف



• Annual Variation

- Infections exhibited marked and repetitive cyclical trends, which depended largely on an epidemic exhausting the susceptible population and another birth cohort replenishing it.
- This cyclical pattern indicates persistent transmission.

The annual number of reported cases of the measles in the Netherlands in the period 1976–2014.



- ال annual الي هو الاختلاف من سنة لسنة .
- ممكن يصير كل سنتين outbreak وممكن كل خمس سنوات وهكذا .

Variations of Infectious Diseases Over Decades

- After 1800s, there is a dramatic reduction in mortality rate that attributed to reduction in infectious diseases mortality.

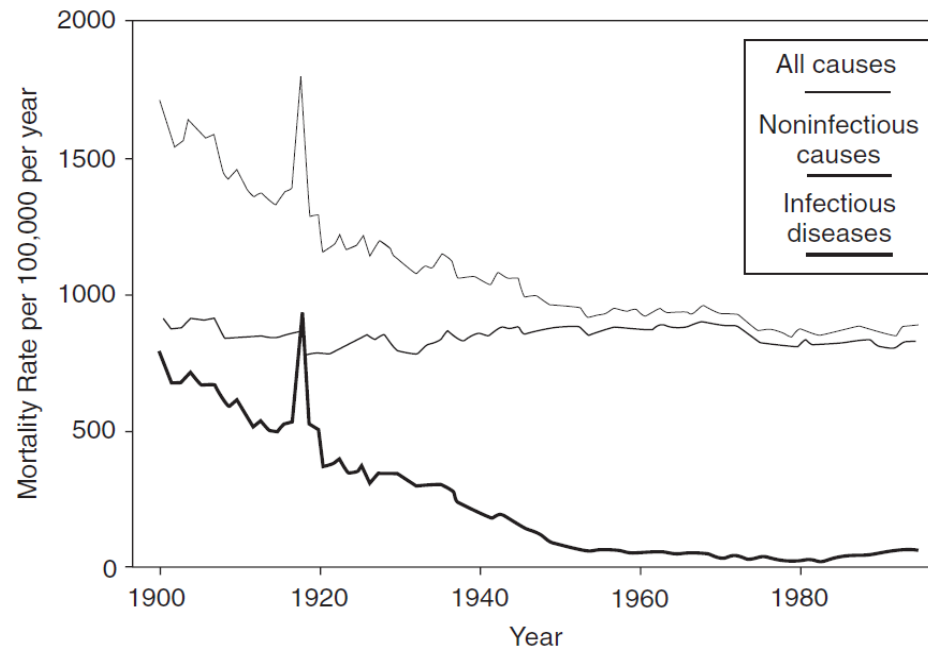


Figure 2-8 Crude mortality rates for all causes, noninfectious causes, and infectious diseases. Reproduced from GL Armstrong, L.A. Conn, and R.W. Pinner. Trends in Infectious Disease Mortality in the United States during the 20th century. *JAMA* Vol. 281, pp. 61–66, 1999.

- Form the previous figure ; it's a stage of infectious disease decline
- antibiotics, health care system, vaccination, سبب ال decline هو prevention measures

What caused these remarkable reductions in the mortality from common infectious diseases?

One might surmise that the development of modern microbiology with the understanding the discipline provided about the pathogenesis of specific infections led to the creation of vaccines and effective antibiotics to prevent or treat infections.

- In reality, for most of these infections, the evidence suggests a more complex scenario.

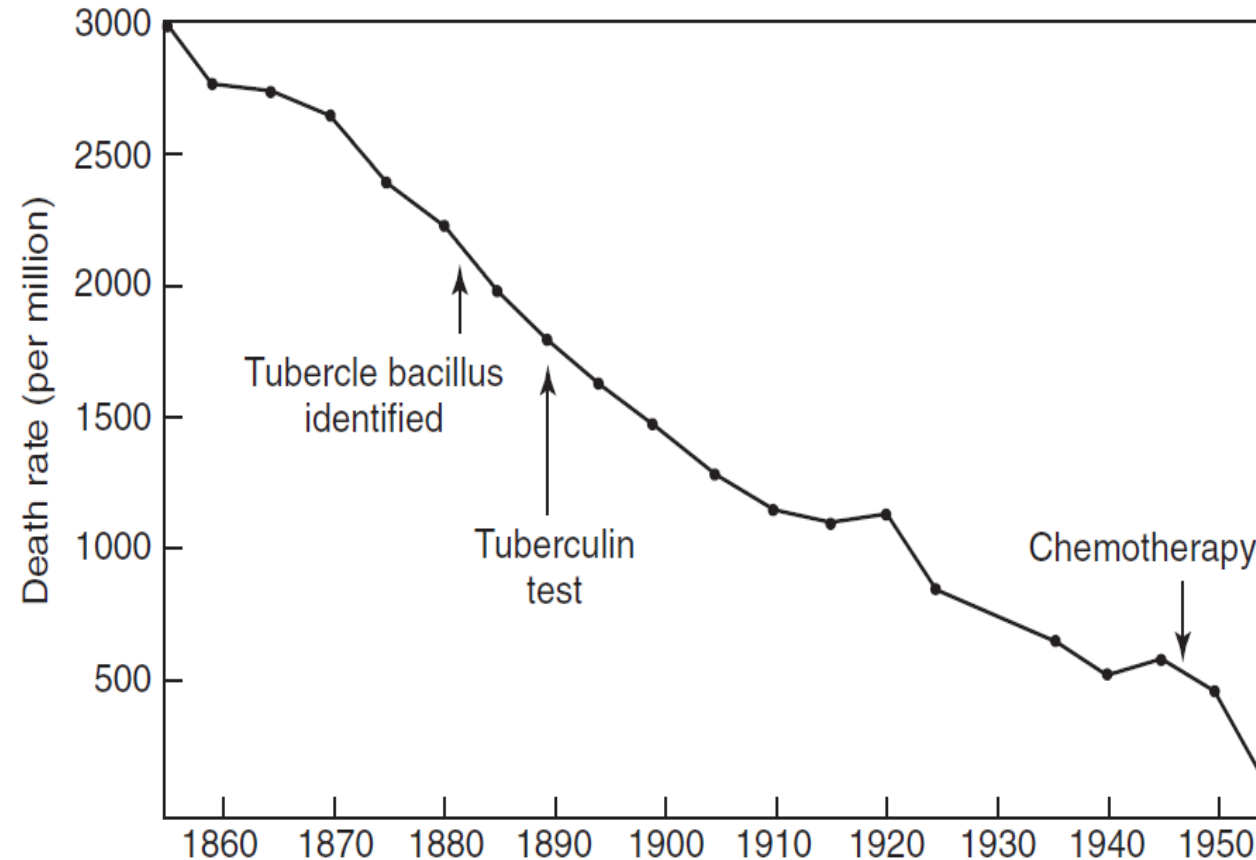


Figure 2-9 Mean annual death rate from respiratory tuberculosis, England and Wales. Reproduced from E. Kass. Infectious Diseases and Social Change. *Journal of Infectious Diseases*, Vol. 23(1):110–114. © 1971. By permission of Oxford University Press.

- هل ال medical care advance ينطبق على حالة ال TB؟؟ بمعنى هل اختراع الدواء لل TB هو السبب الرئيسي بأنه الحالات قلت!! الجواب هو لا ، هو ساعد بتقليل الحالات بطريقة غير مباشرة ولكن ال natural change for pathogenicity of TB and increase the people awareness الهم الدور الأكبر في انخفاض عدد الحالات so it's more complex scenario .

What might account for these declines in mortality?

- In Africa, some of these diseases still have high mortality in certain populations.
- For example, measles, which is rarely fatal when it occurs in children in the United States, is still associated with a 15–20% mortality rate in infants and children in sub-Saharan Africa.
- Hypotheses to explain this difference have **included poorer nutritional status, earlier ages at exposure, other concomitant infections, higher infectious dose, and greater crowding** during epidemic spread among infants in Africa.
- Clearly, **the complex changes that have occurred in society, hygiene, and lifestyle** in the United States and in Europe during the late 1800s and early 1900s have had a profound effect on these diseases.

Questions