



Public Health

Title :

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وَقُلْ رَبِّ زِدْنِي عِلْمًا

Introduction to Public Health

Chain of Infection

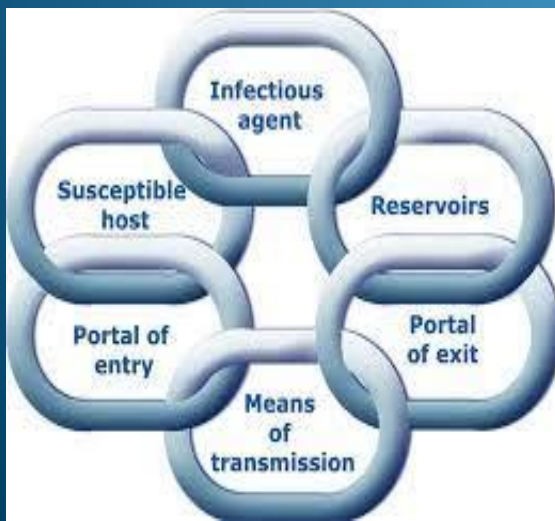
L17

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mode of transmission

- 1. Respiratory tract by inhalation**
- 2. the mucous membrane by direct contact**
- 3. oral (fecal oral route)**
- 4. injection through blood**

Chain of Infection = سلسلة من العدوى

The traditional model (epidemiological triad) illustrates that infectious diseases result from the interaction of agent, host, and environment.

More specifically , transmission occurs when:

1. the agent leaves its reservoir or host through a portal of exit, and
2. is conveyed by some mode of transmission, and
3. enters through an appropriate portal of entry to infect a susceptible host.

This is sometimes called the **chain of infection**



Reservoir

- The reservoir of an agent is the habitat in which an infectious agent normally lives, grows, and multiplies.
- Reservoirs include humans, animals, and the environment.
Food, insect, water
- The reservoir may or may not be the source from which an agent is transferred to a host.

يمكن يكون هذا ال reservoir ليس هو
ال sources

➤ For example, the reservoir of *Clostridium botulinum* is soil, but the source of most botulism infections is improperly canned food containing *C. botulinum* spores.

Direct from soil or indirect by food



Human reservoirs

Many of the common infectious diseases have human reservoirs

Diseases which are transmitted from **person to person** without intermediaries

This disease is directly transmitted from human to human

HIV

i. e. sexually transmitted diseases, measles, mumps, streptococcal infection, most respiratory pathogens, and many others.

Smallpox was eradicated after the last human case was identified and isolated because humans were the only reservoir for the smallpox virus.

هو **reservoir** بس موجود في الانسان
فسهل جداً أنه نعمله **eradication**

Two types of human reservoir exist:

- persons with symptomatic illness
- carriers

Symptomatic individual who can transmit the disease to another individual

A carrier is a person without apparent disease who is nonetheless capable of transmitting the agent to others. Carriers may be :

If is hidden in nervous system when decreased immunity
يصير عندهم الحزام الناري

If the mother during pregnancy have cytomegalovirus can be affect the baby

Asymptomatic carriers, who never show symptoms during the time they are infected, such as EBV and Cytomegalovirus, Herpes simplex, typhoid fever, measles, HIV

Incubatory carriers :A person infected with a certain microorganism but in such an early stage of disease that clinical manifestations are not apparent , typhoid fever, hepatitis A, mumps, chicken pox.

إذا صار ال measles or chickenpox قد يكون الطفل
infected but during incubation. Period. He has no sign of symptoms But he can transmit the infection

Convalescent carriers, a person who is clinically recovered from an infectious disease but still capable of transmitting the infectious agent to others.

اللي يشتغلوا بالمطاعم continuous screening for salmonella

This happens with many diseases. **Example**: Salmonella patients may excrete the bacteria in feces for several weeks, and rarely even for a year or more.

This is most common in infants and young children. Treatment with inappropriate antibiotics may prolong the convalescent carrier phase.

A chronic carrier is one who continues to harbor an agent (such as hepatitis B virus or *Salmonella typhi*— the agent of typhoid fever) for an extended time (months or years) following the initial infection.

Many individual have the hepatitis B virus in the blood and can transmit the disease with any contact with blood

We must continue screening, the doctor for hepatitis B, because they infect by contact with patient which is called accidental infections during preparation

Carriers commonly transmit disease because they do not recognize they are infected and consequently take no special precautions to prevent transmission.

Symptomatic persons, on the other hand, are usually less likely to transmit infection widely because their symptoms increase their likelihood of being diagnosed and treated, thereby reducing their opportunity for contact with others.

He knows that he is infected, so they diagnose and treat

Animal reservoirs

Infectious diseases that are transmissible under normal conditions from vertebrate animals to humans are called zoonosis.

The disease that transmitted by different animal

Such diseases include brucellosis (cows, sheep and pigs),

Anthrax (sheep, horses)

plague (rodents)

leishmania (dogs)

Rabies (bats, raccoons, dogs, and other mammals)

- ❖ Another group of diseases with animal reservoirs are those caused by viruses transmitted by insects. = vector
- ❖ Or caused by parasites that have complex life cycles, with different reservoirs at different stages of development.

Such as malaria (requiring mosquitoes) and schistosomiasis (requiring fresh water snails). And then the development of the egg inside the water and in snail

Lyme disease is a zoonotic disease of deer incidentally transmitted to humans by the deer tick. Chronic and systemic diseases

inflammatory disease characterized at first by a rash, headache, fever, and chills, and later by possible arthritis and neurological and cardiac disorders,

↳ Caused by bacteria that are transmitted by ticks.

So they are two types of Vector
Mechanical or biological

such as flies can pick up infectious agents on the outside of their bodies and transmit them through physical contact

such as mosquitoes and ticks may carry pathogens that can multiply within their bodies and be delivered to new hosts, usually by biting.

inside the vector

Environmental reservoirs

- Plants, soil, and water in the environment are also reservoirs for **some infectious agents**.
- **Many fungal agents**, such as those causing histoplasmosis, live and multiply in **the soil**.
- **The primary reservoir of Legionnaires' bacillus** appears to be pools of water, **including those produced by cooling towers**.
- **Parasitic infection, Hookworm (ancylostoma duodenale), toxoplasmosis**

كون fetal خاصه لل
HIV patient

Ancylostomiasis is infection with the hookworm *Ancylostoma duodenale* or *Necator americanus*

Portal of exit

➤ Portal of exit is the path by which an agent leaves the source host, usually corresponds to the site at which the agent is localized.

By speaking or coughing

➤ Thus, tubercle bacilli and influenza viruses exit the **respiratory tract**, cholera vibrio in **feces**, *Sarcoptes scabiei* in **scabies skin lesions**. And salmonella, hepatitis B

جرب

➤ **Genitourinary**: This portal of exit is the route of sexually transmitted diseases, including syphilis, gonorrhea, chlamydia, and HIV, **schistosomes through urine**.

Trans placenta infection from the mother to fetus like hepatitis B , syphilis, HIV, human papillomavirus, gonorrhea

➤ Some **blood borne agents** can exit by **crossing the placenta** (rubella, syphilis, toxoplasmosis), **while others exit by way of the skin** (percutaneously) through cuts or needles (hepatitis B) or **blood-sucking arthropods (malaria)**.

➤ Portal of exit is important for **the prevention of the infection**.

TORCH infections are the term given to a group of infectious diseases that can be passed to your baby during pregnancy, at delivery or after birth. TORCH stands for toxoplasmosis, rubella, cytomegalovirus, herpes and other agents. Jun 21, 2022

* Modes of transmission

33:22

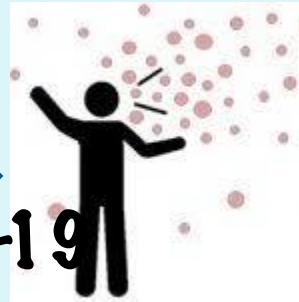
After an agent exits its natural reservoir, it may be transmitted to a susceptible host in numerous ways. These modes of transmission are classified as:

■ Direct

- Direct contact
- Droplet spread



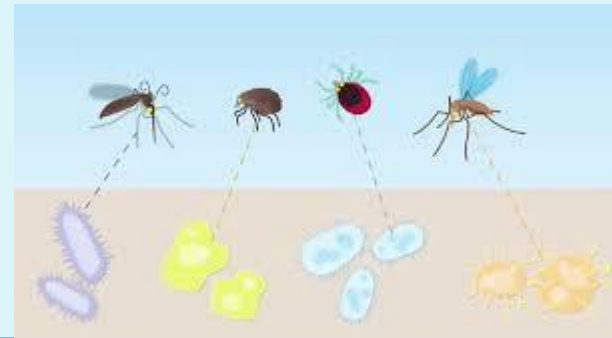
Covid-19




نوع من الرذاذ الي يكون
حجمها اكبر من الاعتيادي
وتوقع على الاشياء عشان هيك
تكون مباشرة

■ Indirect

- Airborne
- Vehicle borne
- Vector borne
 - Mechanical
 - Biologic



Direct transmission

- there is essentially immediate transfer of the agent from a reservoir to a susceptible host by **direct contact** or **droplet spread**.
- **Direct contact** occurs through **mucous membranes, skin-to-skin contact, and sexual relations**.
- **Direct contact** refers also to contact with **soil** or vegetation harboring infectious organisms.  **larva** الذي تحتوي مرحلة من مراحل نمو
- Thus, infectious mononucleosis (“kissing disease”) and gonorrhoea are spread from **person-to-person** by direct contact.
- Hookworm is spread by **direct contact with contaminated soil**.
- **Droplet spread** refers to spray with relatively large, short-range aerosols produced by **sneezing, coughing, or even talking**.
- **Droplet spread** is classified as direct because transmission is by direct spray over a few feet, before the droplets fall to the ground.

Indirect transmission

- An agent is carried from a **reservoir** to a **susceptible host** by suspended air particles or by animate (**vector**) or inanimate (**vehicle**) intermediaries.

المفصليات

- Most **vectors** are **arthropods** such as mosquitoes, fleas, and ticks. These may carry the agent through purely **mechanical means**. For example, flies carry *Shigella* on *leges*; fleas carry *Yersinia pestis* (agent that causes plague) in the *gut* and deposit the agent on the skin of a new host.

- In mechanical transmission, the agent does not multiply or undergo physiologic changes in the vector.



الفرق بينهم فوق شرفه

- This is in contrast to instances in which an agent undergoes part of its life cycle inside a vector before being transmitted to a new host.
- When the agent undergoes changes within the vector, the vector is serving as both an intermediate host and a mode of transmission. This type of indirect transmission is a biologic transmission.
- **Vehicles** that may indirectly transmit an agent include food, water, biologic products (blood), and fomites (inanimate objects such as handkerchiefs, bedding, or surgical scalpels).
- As with vectors, vehicles may **passively** carry an agent—as food or water may carry **hepatitis A virus**—or may provide an environment in which the agent grows, multiplies, or produces toxin—as improperly canned foods may provide an environment in which *Clostridium botulinum* produces toxin.

Air-born transmission

- By particles that are suspended in air.
- There are two types of these particles: **dust and droplet nuclei**.

Small

- **Airborne dust** includes infectious particles **blown from the soil** by the wind as well as material that has settled on surfaces and become **resuspended by air** currents.
- **Droplet nuclei** are the residue of dried droplets. The nuclei are **less than 5 μ (microns)** in size and may **remain suspended in the air** for long periods, may be blown over great distances, and are easily **inhaled** into the lungs and exhaled.
- Tuberculosis, for example, is believed to be transmitted more often **indirectly, through droplet nuclei**, than **directly**, through **droplet spread**.
- **Legionnaires'** disease and histoplasmosis are also spread through airborne transmission.



Portal of entry

When microorganism enter susceptible individual

- An agent **enters** a susceptible host through a **portal of entry**.
- The portal of entry must provide **access to tissues** in which the agent can multiply, or a toxin can act. Often, organisms use the same portal to enter a new host that they use to exit the source host.
- For example, **influenza virus** must exit the respiratory tract of the source host and enter the respiratory tract of the new host.
- The route of transmission of many **enteric (intestinal)** pathogenic agents is described as “**fecal-oral**” because the organisms are **shed in feces**, carried on inadequately washed hands, and then transferred through a **vehicle** (such as **food, water, or cooking utensil**) to the mouth of a new host.
- Other portals of entry include the **skin (hookworm)**, **mucous membranes (syphilis, trachoma)**, and blood (hepatitis B).

The **final** link in the chain of infection is a susceptible host.

Susceptibility of a host depends on:

1. **genetic factors**, An individual's genetic makeup may either **increase or decrease susceptibility**.
2. specified **acquired immunity**, vaccination, active or passive.
3. other **general factors** which alter an individual's ability to resist infection or to limit pathogenicity.

General factors which defend against infection include the skin, mucous membranes, gastric acidity, cilia in the respiratory tract, the cough reflex, and nonspecific immune response.

General factors that may increase susceptibility are malnutrition, alcoholism, and disease or therapy which impairs the nonspecific immune response.

Specific acquired immunity refers to protective antibodies that are directed against a specific agent. Individuals gain protective antibodies in two ways:

- 1) They develop antibodies in response to infection, vaccine, or toxoid; immunity developed in these ways is called **active immunity**.
- 2) They acquire their mothers' antibodies before birth through the placenta or they receive injections of antitoxins or immune globulin; immunity that is acquired in these ways is called **passive immunity**.

portal of exist, mode of transmission you can interrupted
this chain by certain intervention

■ Note that the **chain of infection may be interrupted** when an agent does not find a susceptible host. This may occur if a high proportion of individuals in a population is resistant to an agent.

■ These persons **limit spread** to the relatively few who are susceptible by reducing the probability of contact between infected and susceptible persons. This concept is called **herd immunity**.

■ The degree of herd immunity necessary to prevent or abort an outbreak varies by disease.

portal of exist, mode of transmission you can interrupted
this chain by certain intervention

■ In theory, herd immunity means that not everyone in a community needs to be resistant (immune) to prevent disease spread and occurrence of an outbreak.

But we want a larger proportion of people to be immunised and vaccinated

■ In practice, herd immunity has not prevented outbreaks of measles and rubella in populations with immunity levels as high as 85 to 90%.

يكون دائما اقل ما هو مطلوب

■ One problem is that, in **highly immunized populations**, the relatively few susceptible persons are often clustered in population subgroups, usually defined by socioeconomic or cultural factors. **If the agent is introduced into one of these subgroups, an outbreak may occur.**

مناعة القطيع
إذا اعطينا مطعوم لكل الناى بيصيروا زى الحزام المنيع ضد المرض

Implications for public health

By knowing how an agent exits and enters a host, and what its modes of transmission are, we can **determine appropriate control measures.**

نحاول نسلط prevention للحد الي نقدر نوقف انتقال المرض

In general, we should direct control measures against the **link in the infection chain that is most susceptible to interference.**

For some diseases, the most appropriate intervention may be directed **at controlling or eliminating the agent at its source.**

In the hospital setting, patients may be treated and/or isolated, with appropriate:

1. **“enteric precautions,” To prevent feco oral transmission**
2. **“respiratory precautions,” To prevent RS infection**
3. **“universal precautions,” and the like for different exit pathways. To prevent all infection**

In the community, **soil may be decontaminated** or covered to prevent escape of the agent.

- Sometimes, we **direct interventions at the mode of transmission.**

Sauce of exist and mode of the transmission

- For **direct transmission**, we may **provide treatment to the source host** or educate the source host to avoid the specific type of contact associated with transmission.

There is a disease that are transmitted by direct contact First treating the disease and educated people about it like STD ,TB

- In **the hospital setting**, since most infections are transmitted by direct contact, **hand washing** is the single most important way to prevent diseases from spreading.
- For **vehicle borne transmission**, we may decontaminate or eliminate the vehicle.
- For **fecal-oral transmission**, we may also try to reduce the risk of contamination in the future by **rearranging the environment and educating the persons** involved in better personal hygiene.

Epidemic Disease Occurrence

Level of disease

■ The **amount** of a particular disease that is usually present in a community is the **baseline level of the disease**.

Epidemic increase in numbers of cases more than expected level what is the expected level of infection? Zero Depend on the type of the disease

■ This level is **not** necessarily the **preferred level**, which should in fact **be zero**; rather it is the **observed level**.

في بعض الامراض يكون ال **expected level** أكثر من **zero**

■ Theoretically, if **no intervention occurred** and if the level is **low** enough not to deplete the pool of susceptible persons, the disease occurrence should **continue at the baseline level indefinitely**.

حالة مثل ال **measles** اذا صارت بالروضة عند الاطفال لازم ياخذ اجازته لانه هاد المرض بيتنقل بسرعه و **it's can be transmitted during incubation period**

■ Thus, the **baseline level is often considered the expected level of the disease**.

■ For example, over the past 4 years the number of reported cases of **poliomyelitis** has ranged from **5 to 9**. Therefore, assuming there is **no change** in population, we would expect to see approximately 7 reported cases next year.

Different diseases, in different communities, show different patterns of expected occurrence:

- 1) a persistent level of occurrence with a low to moderate disease level is referred to as an **endemic level**; *The prevalence very high*
- 2) a persistently high level of occurrence is called a **hyperendemic level**; *Depend on the type of the infection and we measure it by prevalence*
- 3) An **irregular pattern of occurrence**, with occasional cases occurring at irregular intervals is called **sporadic**.
We measure endemic. by prevalence *We measure epidemic by incidence*

Occasionally, the level of disease rises above the expected level.

When the occurrence of a disease within an area is clearly **in excess** of the expected level for a given time period, it is called an **epidemic**.

Public health officials often use the term **outbreak**, which means the same thing. *Very short epidemic*

When an epidemic spreads over several countries or continents, affecting a large number of people, it is called a **pandemic**. *attack rate*

More specifically, an epidemic may result from the following:

- ❖ a recent **increase in amount or virulence of the agent**.
Epidemic Introduction of microorganism agent.
The people are susceptible to disease
- ❖ the **recent introduction of the agent** into a setting where it has not been before.
- ❖ an **enhanced mode of transmission** so that more susceptible are exposed.
- ❖ some **change in the susceptibility of the host response to the agent**.
- ❖ factors that **increase host exposure** or involve introduction through new portals of entry.

Epidemic patterns

We sometimes classify epidemics by **how they spread** through a population, as shown below:

❖ **Common source** One source cause the infection

- **Point** They exposed once at the same time →
- **Continuous** There are contuuation of exposure

جموعه من الطلاب في
مدرسه ما اكلو نفس
الوجبه من نفس المكان
في نفس الوقت وبالتالي

❖ **Propagated**

- **Mixed**
- **Other**

لحاله الاولى بتعمل
infection ل groups of people
وبعدين بيعملو
infection لناس تانين

كل مرة ناس جديدة

↓
we detect the cases in
minimum and maximum
incubation period

Common source outbreak

When group of persons is exposed to a **common** noxious influence, such as an **infectious agent or a toxin**.

If the group is **exposed over a relatively brief period**, so that everyone who **becomes ill develops disease at the end of one incubation period**, then the common source outbreak is further classified as a **point source outbreak**.

i.e. **عجوة انصابته بالمرض وظهورته الادراس وظهورت الوبائيات في يوم معين**

- **epidemic of leukemia cases in Hiroshima** following the atomic bomb blast.
- the epidemic of hepatitis A among college football players who unknowingly drank contaminated water after practice one day each had a point source of exposure.

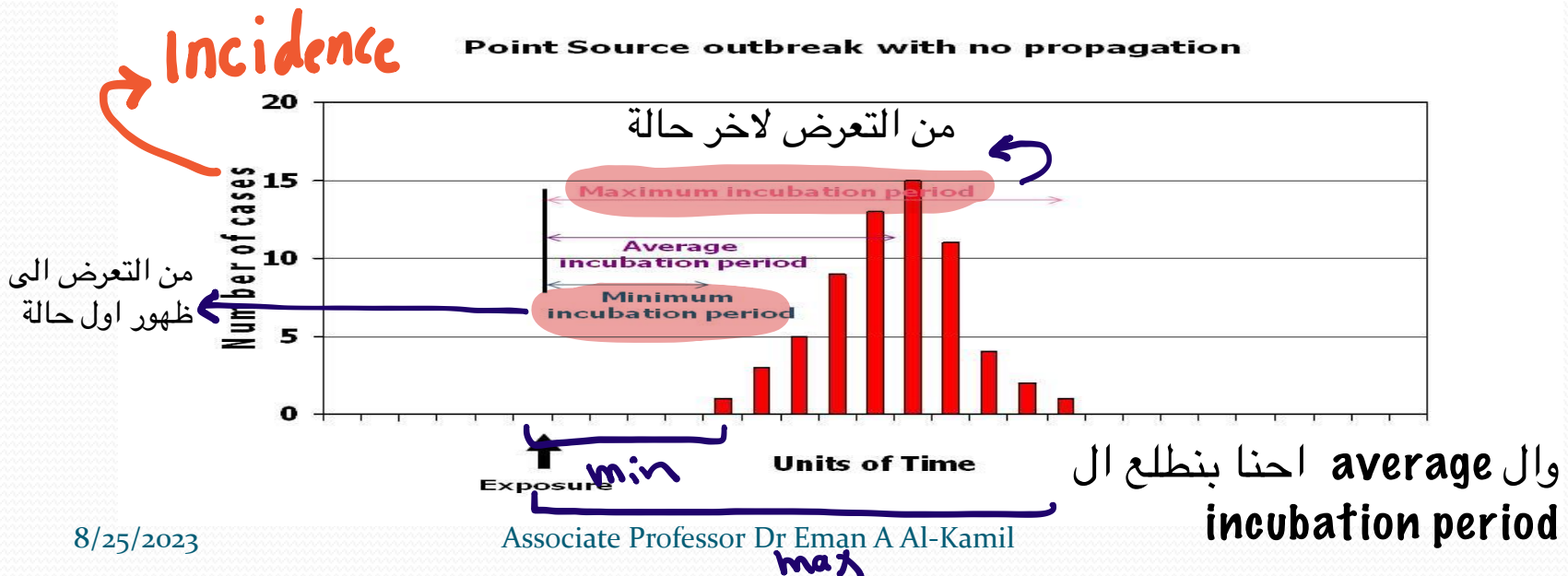
When the number of cases in a point source epidemic is **plotted over time**, the resulting **epidemic curve** classically has a **steep upslope and a more gradual downslope** (a so-called “**normal distribution**”).

Point Source outbreak

Here, all cases appear to occur within one incubation period, suggesting that cases **did not arise from person-to-person spread**.

The fact that the outbreak was of **short duration** suggests that it was **a single, brief** (hence "point") **exposure** that did not persist over time.

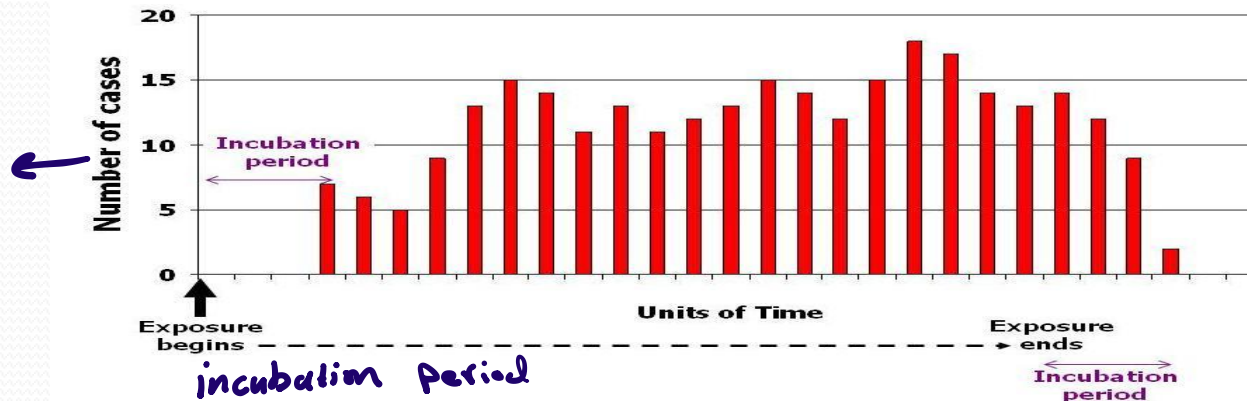
Examples include that embarrassing **diarrhea** saga following the neighbor's summer barbecue, or a **respiratory illness** in workers following a breakdown of a fume hood.



Continuing Source outbreak

- As with the point source outbreak, a group of **people are exposed to a single noxious influence**.
- ****But here the exposure continues over a longer time** (e.g., a contaminated water supply that doesn't get fixed), so the outbreak persists for longer.
- The relatively **abrupt beginning** of the outbreak suggests that many people were **exposed simultaneously**, rather than it spreading via transmission from one case to another.
- The fact that no cases arise beyond one incubation period following the termination of the exposure also **supports this conclusion**.

Continuing Source Outbreak.



Incidence rate

كل مرض موجود لحاله فعشان هيك الفترة رح تطول

Person-to-Person Spread

- Here the disease **spreads via person-to-person contact** – the classic infectious disease pattern.
- **Controlling the source is no longer sufficient** to control the outbreak.
- **Index case with limited spread.** *more than 2 incubation period*
- Here a **single 'index' case** (for example, a returning traveler) infects other people, and **cases arise after an incubation period**. (Perhaps confusingly, you may also hear this called a point source with secondary transmission).
- The outbreak wanes when the infected people no longer transmit the infection to other susceptible people, perhaps because of **successful control measures** (isolation or quarantine).

propagated outbreak

- An outbreak that **does not have a common source**, but instead **spreads gradually from person to person**—usually growing as it spreads—is called a **propagated outbreak**.
- Usually transmission is by **direct person-to-person contact**, as with syphilis.
- Transmission may also be **vehicle borne**, as the transmission of **hepatitis B or HIV by sharing needles**, or **vector borne**, as the transmission of yellow fever by mosquitoes.
- In a propagated epidemic, cases **occur over more than one incubation period**.
- In theory, the epidemic curve of a propagated epidemic would have a **successive series of peaks** reflecting increasing numbers of cases in each generation.

contact tracing

Stop to spread the disease

Propagated Spreadcont....

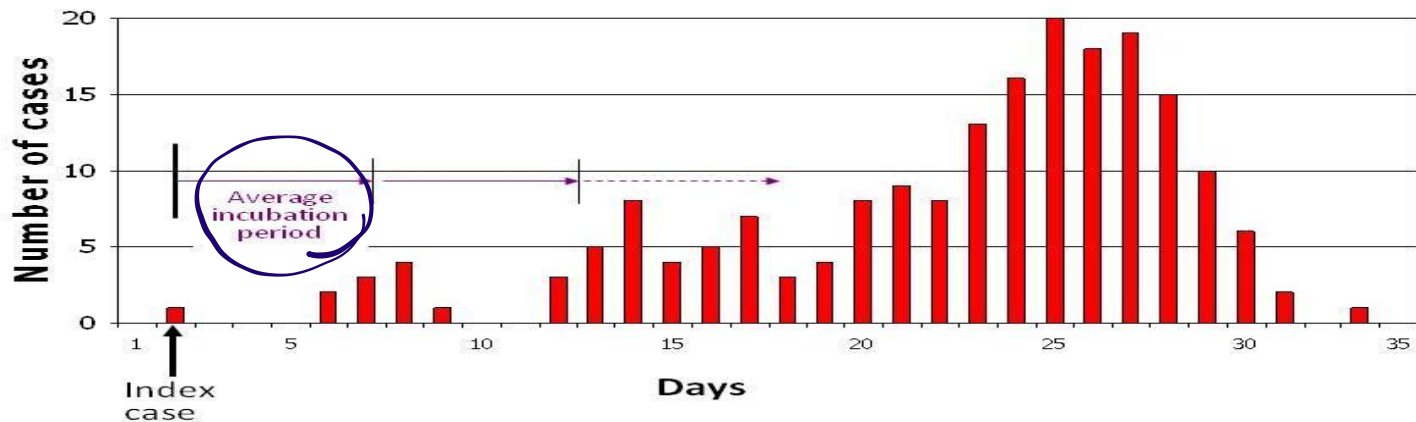
This begins like an infection from an **index case** but then develops into a full-blown epidemic with **secondary cases infecting new people** who, in turn, **serve as sources for yet other cases**.

This produces **successively taller peaks**, initially **separated by one incubation period**, but the peaks tend to merge into waves with increasing numbers of cases in each generation.

The epidemic continues until the :

1. remaining numbers of susceptible individuals declines or
2. until intervention measures take effect.

Disseminated outbreak originating from an index case with propagated spread



Investigation of an epidemic

الدكتورة حكت الباقي قراءة بس مهم

There is a systematic method to investigate an epidemic as in case of an epidemic of typhoid fever or meningitis or hepatitis or any other disease:

1. **Verification of the diagnosis**. It is important to make sure that the cases under investigation **are definite cases of that disease**. This is done by careful history, physical examination and relevant laboratory investigation. For example, blood culture in typhoid fever is very reliable diagnostic method.
2. **Confirmation of the existence of epidemic (excess cases above normal expectancy)**. This is ascertained by comparing the reported cases at the time of the epidemic with cases reported in previous months or years.
3. **Identification of the affected cases and their characteristics**. This is important because, it may help to identify a common experience or exposure of the cases and thus to facilitate the identification of source of epidemic.

4. Further investigation of the population at risk, contacts, carriers and hidden cases.

5. Study of the environment to identify factors which are likely to be related to the epidemic. Search for any change in the environment at or immediately before the onset of the epidemic.

6. Formulation of hypotheses about the epidemic regarding source of infection, mode of transmission and existence of reservoir of infection and carriers.

Management of the epidemic. This includes:

a. Treatment of cases and carriers.

b. Protection of high risk and susceptible persons ; immunization and chemoprophylaxis

c. Writing a report about the epidemic.

d. Continuous surveillance to prevent future epidemics.

e. Experimental verification of agent of the disease and mode of transmission.

وهيك نكون خلصنا 🤔🤔
انتبهوا على كلام الدكتور + الحسابات

هاي النوت ركزت عليها 🙌🙌

Disease Transmission: Source of Infection

- Biological vector
 - An organism which not only transports a pathogen but also plays a role in the life cycle of the pathogen (virus inside of mosquito, bacteria inside of tick)
- Mechanical vector
 - An organism which only transports a pathogen (fly)



(a) Biological vectors are infected.



(b) Mechanical vectors are not infected.