Epidemiology of Infectious Diseases

Purposes of Public Health Surveillance

1. Assess public health status
2. Define public health priorities
3. Evaluate programs
4. Stimulate research

Measures of Disease Frequency

Prevalence and incidence
are commonly confused.
They are similar,
but differ in the number of cases
included in the numerator:
•Prevalence includes all cases

（new and old）during a given time period.
•Incidence includes only the number of

new a given time period

Prevalence

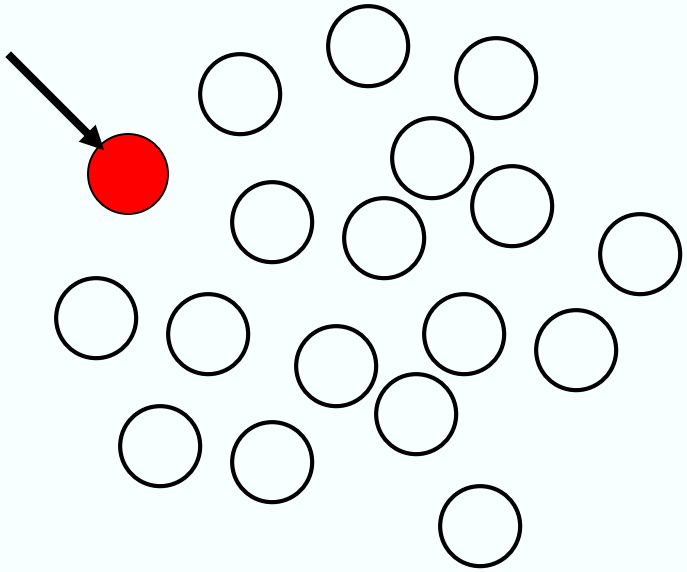
Prevalence = number of existing case sdivided by total population
The numerator for prevalence includes all persons during a specified interval or point in time, regardless of when the condition began.For example, a visual examination survey of 2477 persons between the ages of 52 and 85 years showed that 310 had cataracts. The prevalence of the condition was310 / 2477 x 100 = 12.5

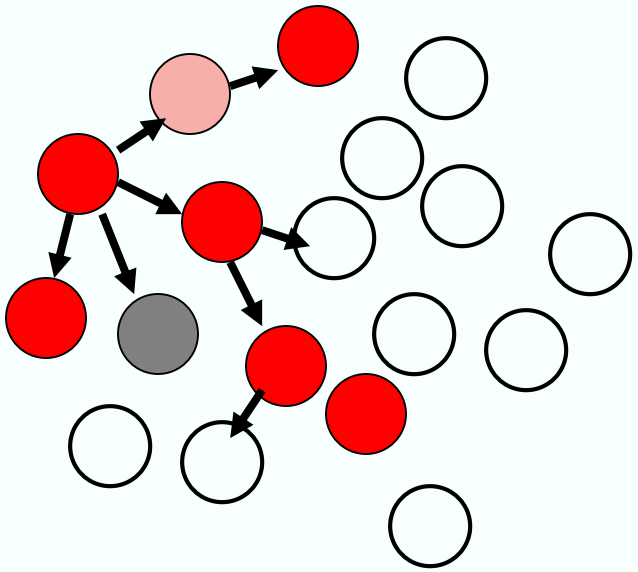
Concepts Specific to Infectious Disease Epidemiology

Attack rate, immunity, vector, transmission, carrier, subclinical disease, serial interval, source, exposure, reservoir, incubation period, colonization, generations, susceptible, non-specific immunity, clone, resistance, repeat episodes …

What is *infectious disease epidemiology?*

- A case is a risk factor …
  - Infection in one person can be transmitted to others





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What is *infectious disease epidemiology?*

What is infectious disease epidemiology used for?

- Identification of causes of new, emerging infections, e.g. HIV, SARS
- Surveillence of infectious disease
- Identification of source of outbreaks
- Studies of routes of transmission and natural history of infections
- Identification of new interventions

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Table 14.12 Terms Used to Classify Infectious Diseases

Term	Definition
Acute disease	Disease in which symptoms develop rapidly and that runs its course quickly
Chronic disease	Disease with usually mild symptoms that develop slowly and last a long time
Subacute disease	Disease with time course and symptoms between acute and chronic
Asymptomatic disease	Disease without symptoms
Latent disease	Disease that appears a long time after infection
Communicable disease	Disease transmitted from one host to another
Contagious disease	Communicable disease that is easily spread.
Noncommunicable disease	Disease arising from outside of hosts or from opportunistic pathogen
Local infection	Infection confined to a small region of the body
Systemic infection	Widespread infection in many systems of the body; often travels in the blood or lymph
Focal infection	Infection that serves as a source of pathogens for infections at other sites in the body
Primary infection	Initial infection within a given patient
Secondary infection	Infections that follow a primary infection; often by opportunistic pathogens

Routes of transmission

Direct

- Skin-skin
  - Herpes type 1
- Mucous-mucous
  - STD
- Across placenta
  - toxoplasmosis
- Through breast milk
  - HIV
- Sneeze-cough
  - Influenza

Indirect

- Food-borne
  - Salmonella
- Water-borne
  - Hepatitis A
- Vector-borne
  - Malaria
- Air-borne
  - Chickenpox

Exposure

- A relevant contact – depends on the agent
  - Skin, sexually, water contact, etc

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COVER UP!

YOUR COUGHS AND SNEEZES

SPRAY SPREADS

COLDS · FLU · TUBERCULOSIS

THE ANNUAL SALE OF Christmas Seals MADE THIS POSTER POSSIBLE

Some Pathogens that Cross the Placenta

Table 14.3 Some Pathogens that Cross the Placenta

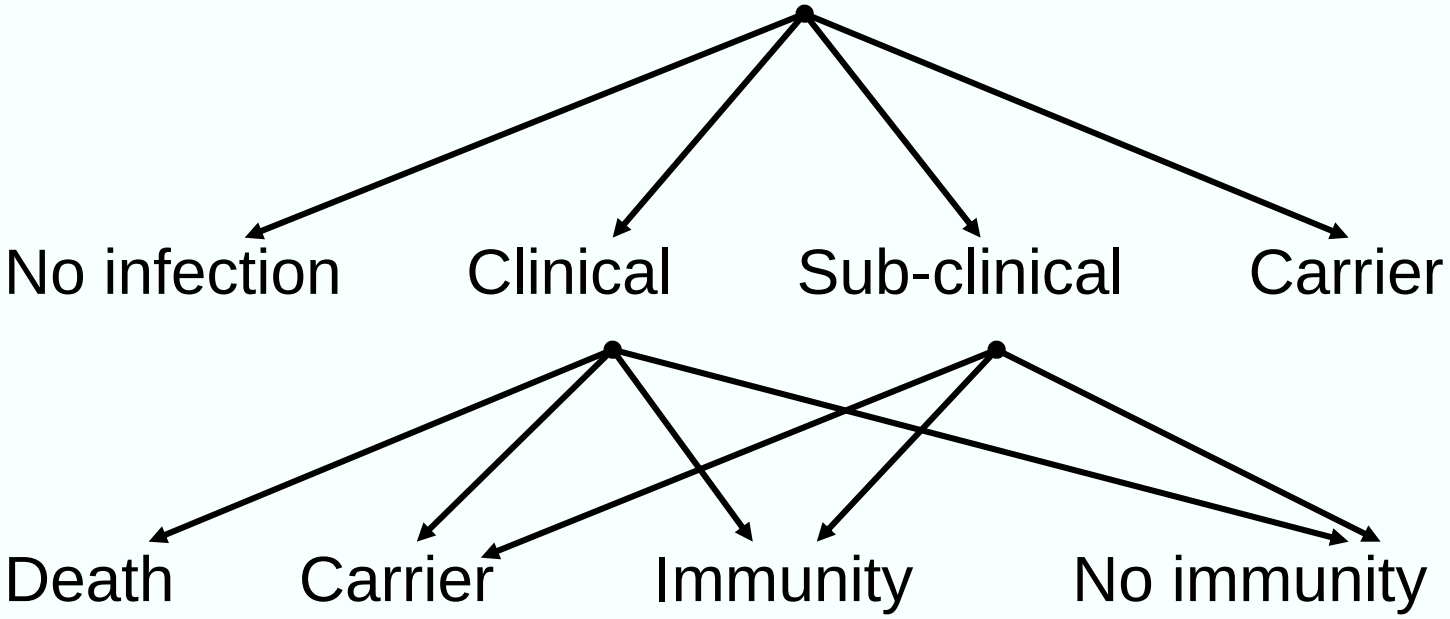
	Pathogen	Condition in the Adult	Effect on Embryo or Fetus
Protozoan	*Toxoplasma gondii*	Toxoplasmosis	Abortion, epilepsy, encephalitis, microcephaly, mental retardation, blindness, anemia, jaundice, rash, pneumonia, diarrhea, hypothermia, deafness
Bacteria	*Treponema pallidum*	Syphilis	Abortion, multiorgan birth defects, syphilis
	Listeria monocytogenes	Listeriosis	Granulomatosis infantiseptica (nodular inflammatory lesions and infant blood poisoning), death
DNA viruses	*Cytomegalovirus*	Usually asymptomatic	Deafness, microcephaly, mental retardation
	Parvovirus B19	Erythema infectiosum	Abortion
RNA viruses	*Lentivirus* (HIV)	AIDS	Immunosuppression (AIDS)
	Rubivirus rubella	German measles	Severe birth defects or death

Modes of Disease Transmission

Table 14.10 Modes of Disease Transmission

Mode of Transmission	Diseases Spread Include:
Contact Transmission	
Direct Contact: *e.g.* handshaking, kissing, sex, bites	cutaneous anthrax, genital warts, gonorrhea, herpes, rabies, staphylococcus infections, syphilis
Indirect Contact: *e.g.* drinking glasses, toothbrushes, toys, punctures, droplets from sneezing and coughing (within one meter)	common cold, enterovirus infections, influenza, measles, Q fever, pneumonia, tetanus, whooping cough
Vehicle Transmission	
Airborne: *e.g.* dust particles	chicken pox, coccidiomycosis, histoplasmosis, influenza, measles, pulmonary anthrax, tuberculosis
Waterborne: *e.g.* streams, swimming pools	*Campylobacter* infections, cholera, *Giardia* diarrhea
Foodborne: *e.g.* poultry, seafood Mec	food poisoning (botulism, staphylococcal); hepatitis A, listeriosis, tapeworms, toxoplasmosis, typhoid fever
Vector Transmission	
Mechanical: *e.g.* (on insect bodies) flies, roaches	*E. coli* diarrhea, salmonellosis, trachoma
Biological: *e.g.* lice, mites, mosquitoes, ticks	Chagas' disease, Lyme disease, malaria, plague, Rocky Mountain spotted fever, typhus fever, yellow fever

Exposure to Infectious Agents

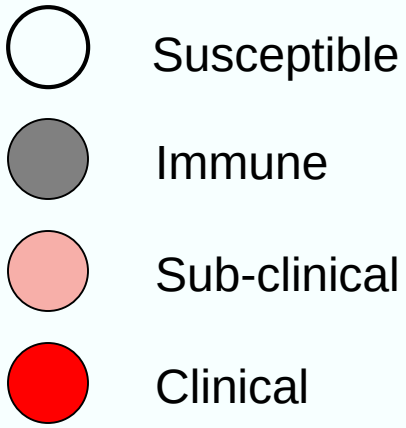


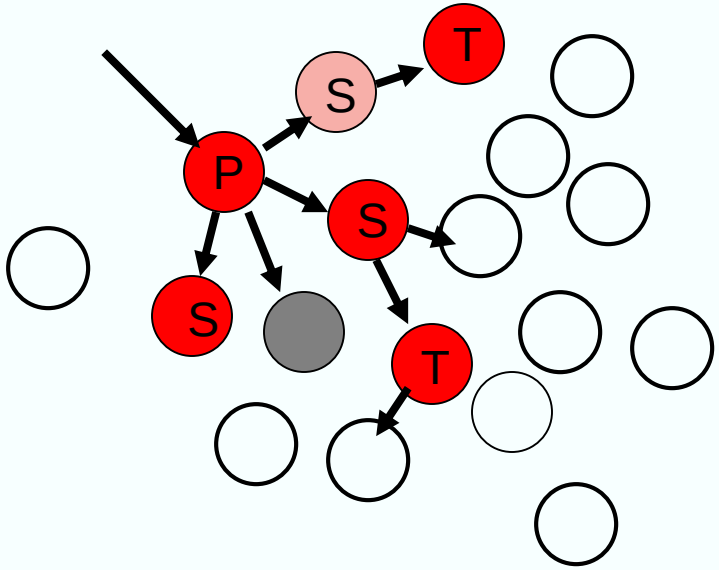
Outcome

Transmission

Cases

- Index – the first case identified
- Primary – the case that brings the infection into a population
- Secondary – infected by a primary case
- Tertiary – infected by a secondary case





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Person-to-Person Transmission

Data from Dr. Simpson's studies in England (1952)			
	Measles	Chickenpox	Rubella
Children exposed	251	238	218
Children ill	201	172	82
attack rate	0.80	0.72	0.38

Attack rate = $\frac{\text{ill}}{\text{exposed}}$

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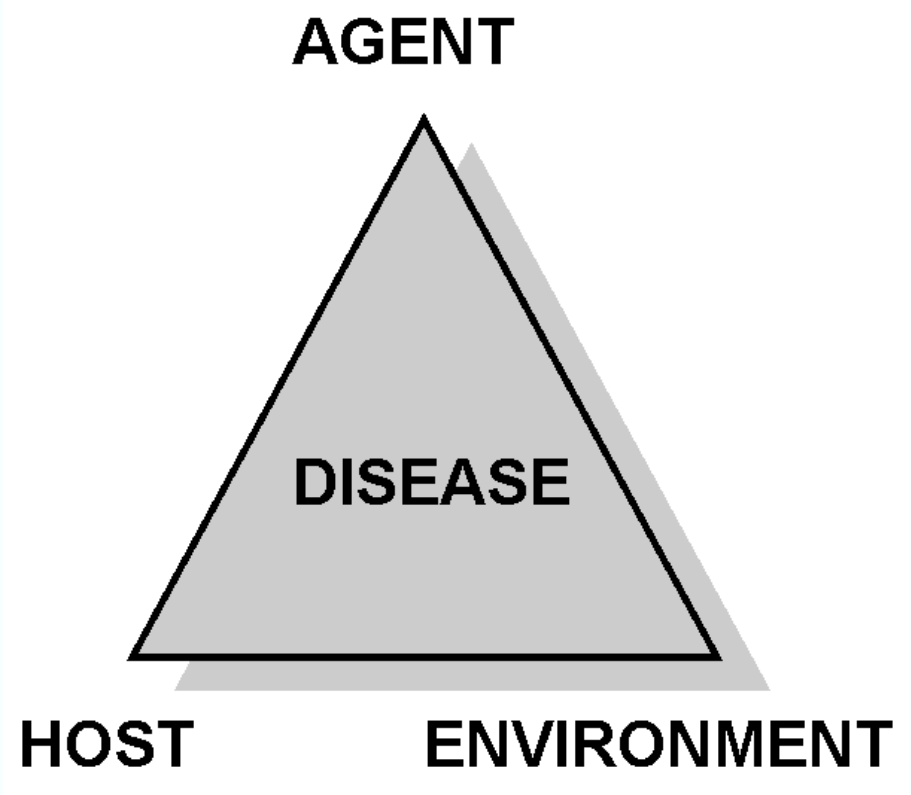
Epidemiologic Triad

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

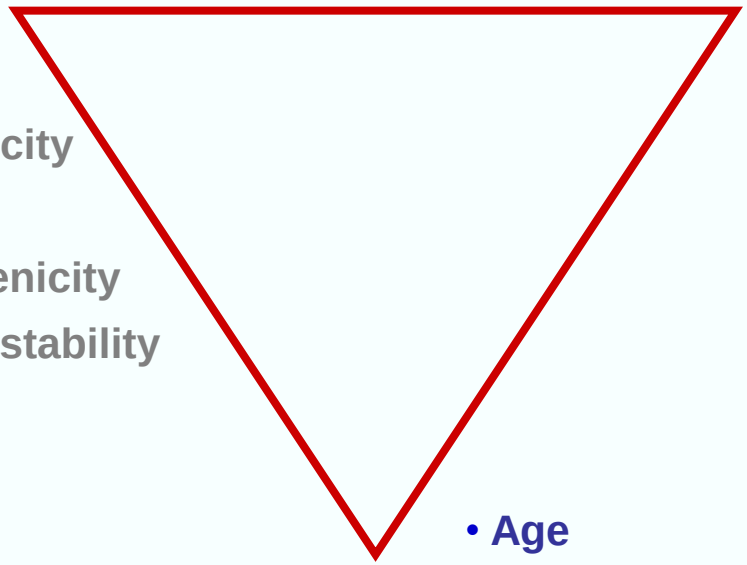
- agent of infection
- host
- environment



Factors Influencing Disease Transmission

Agent

- Infectivity
- Pathogenicity
- Virulence
- Immunogenicity
- Antigenic stability
- Survival



Environment

- Weather
- Housing
- Geography
- Occupational setting
- Air quality
- Food

Host

- Age
- Sex
- Genotype
- Behaviour
- Nutritional status
- Health status

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Epidemiologic Triad-Related Concepts

Infectivity (ability to infect)

(number infected / number susceptible) x 100

Pathogenicity (ability to cause disease)

(number with clinical disease / number infected) x 100

Virulence (ability to cause death)

(number of deaths / number with disease) x 100

All are dependent on host factors

Predisposition to Infections
(Host Factors)

Gender

Genetics

Climate and Weather

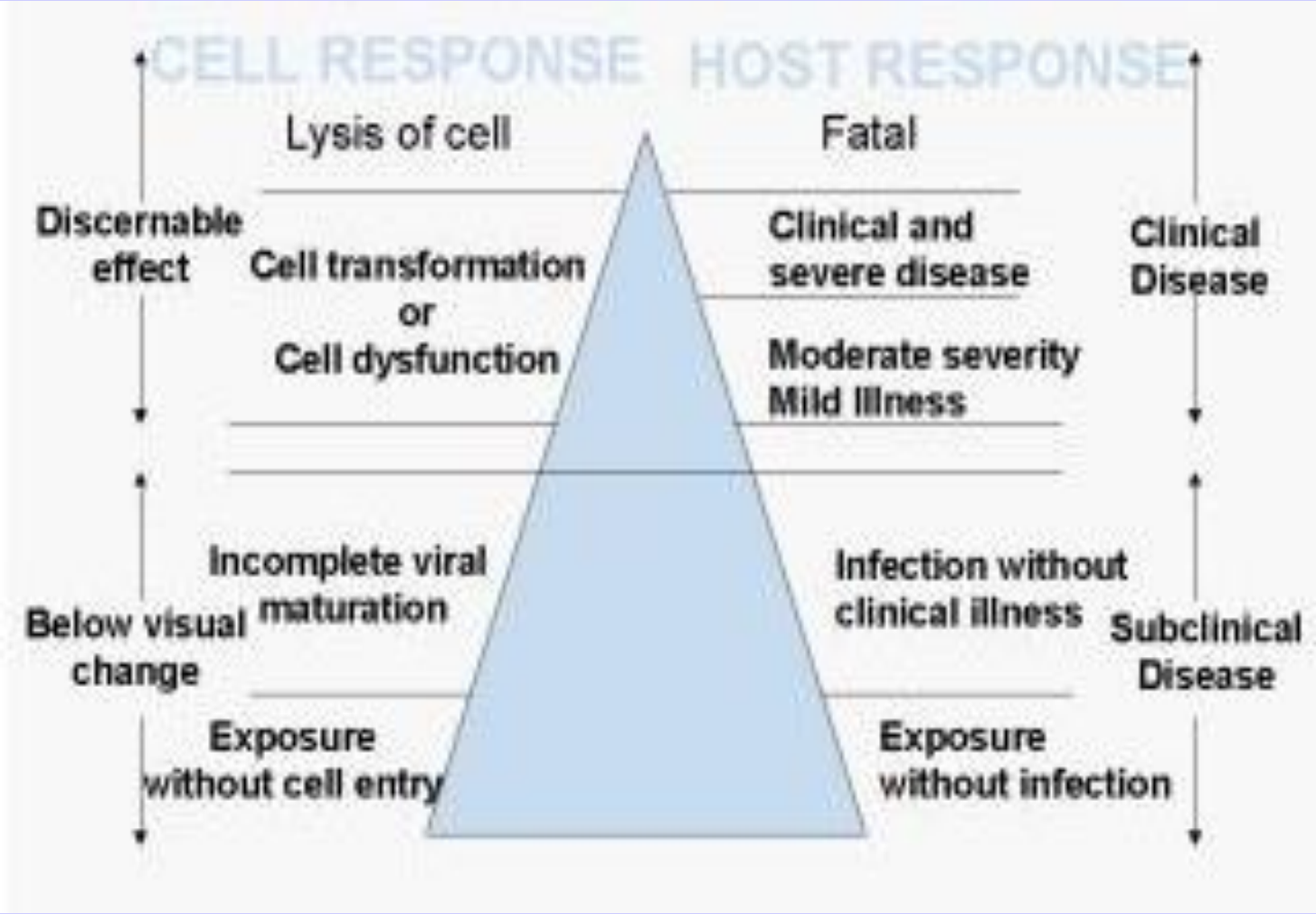
Nutrition, Stress, Sleep

Smoking

Stomach Acidity

Hygiene

Iceberg Concept of Infection



Infectious Agents

Bacteria

Viruses

Fungi

Protozoa

Helminths

Algae

Prions

(proteinaceous infectious agents)

Reservoirs

A host that carries a pathogen without injury to itself and serves as a source of infection for other host organisms

(asymptomatic infective carriers)

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Reservoirs

Humans

{hepatitis}

Other Vertebrates

{zoonoses}

Birds & Bats

{histoplasmosis}

***NOT* vectors**

Vectors

A host that carries a pathogen without injury to itself and spreads the pathogen to susceptible organisms

(asymptomatic carriers of pathogens)

Arthropod Vectors

Pathogen - Vector

Viruses (Arbovirus) - Mosquitoes

Bacteria (Yersinia) - Fleas

Bacteria (Borrelia) - Ticks

Rickettsias (*R. prowazeki*) - Lice, ticks

Protozoa (Plasmodium) - Mosquitoes

Protozoa (Trypanosoma) -Tsetse flies

Helminths (Onchocerca) - Simulium flies

Koch's Postulates

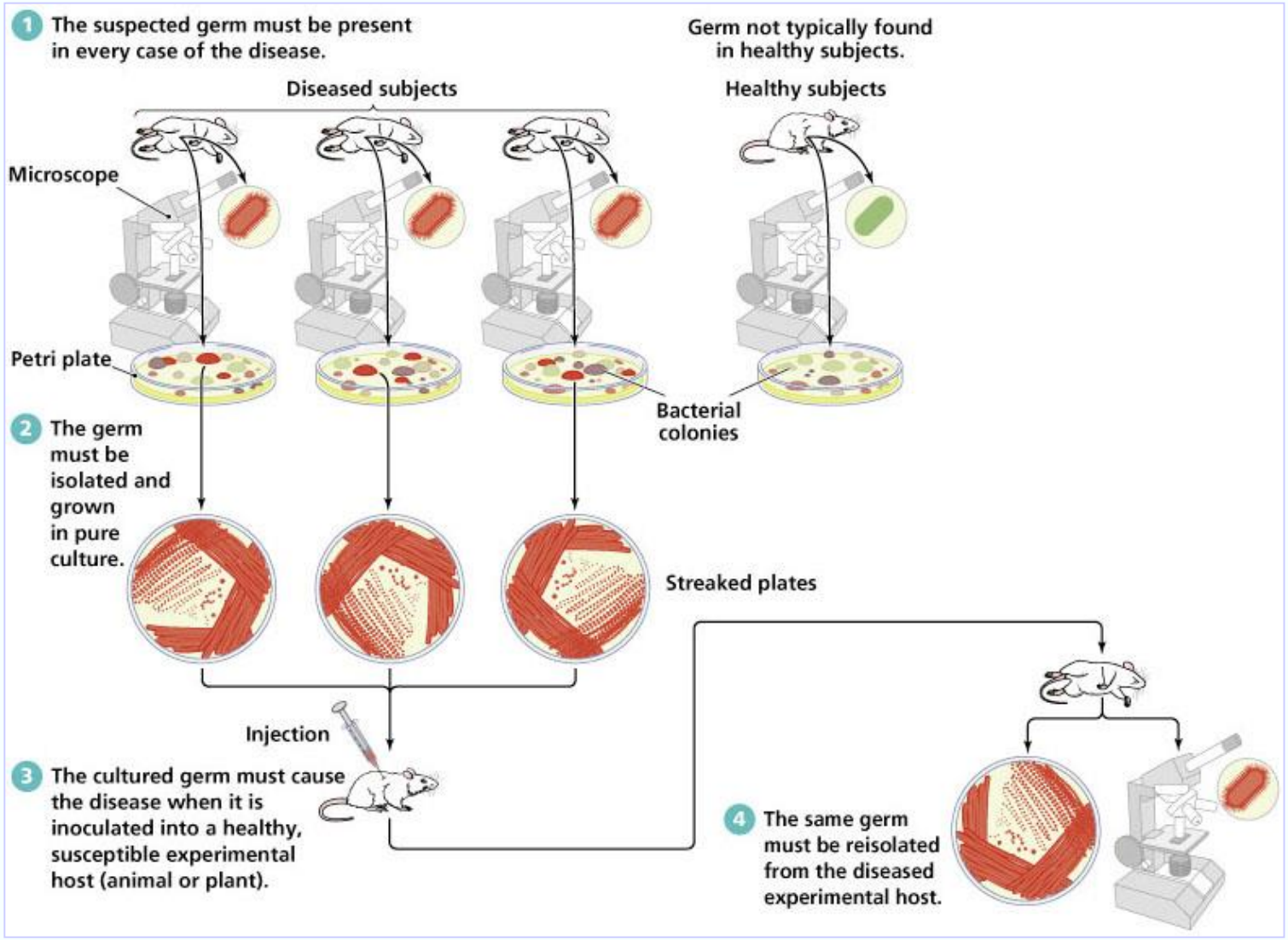
The same organism is present in every case

It is isolated or grown in pure culture

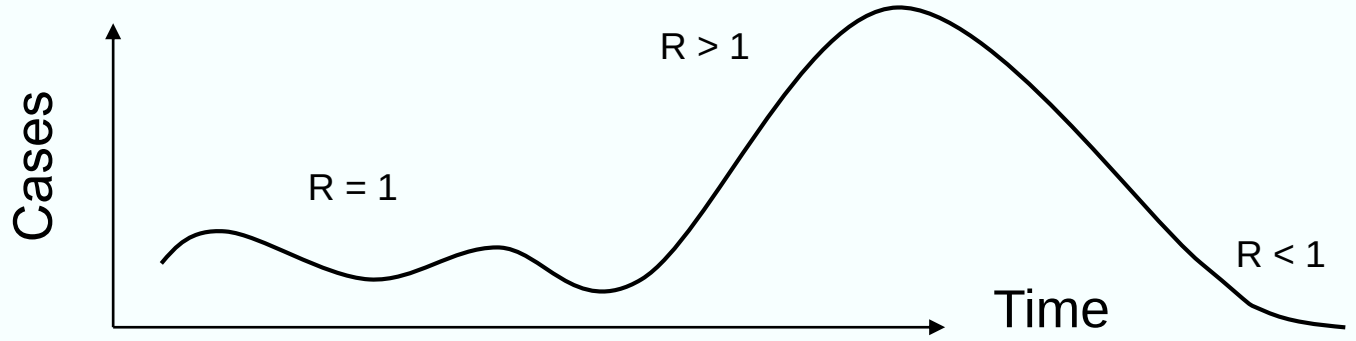
The disease can be reproduced in healthy animals after infection with pure culture

The identical pathogen is reisolated from the experimental animals

Koch's Postulates



Endemic - Epidemic - Pandemic



- **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**

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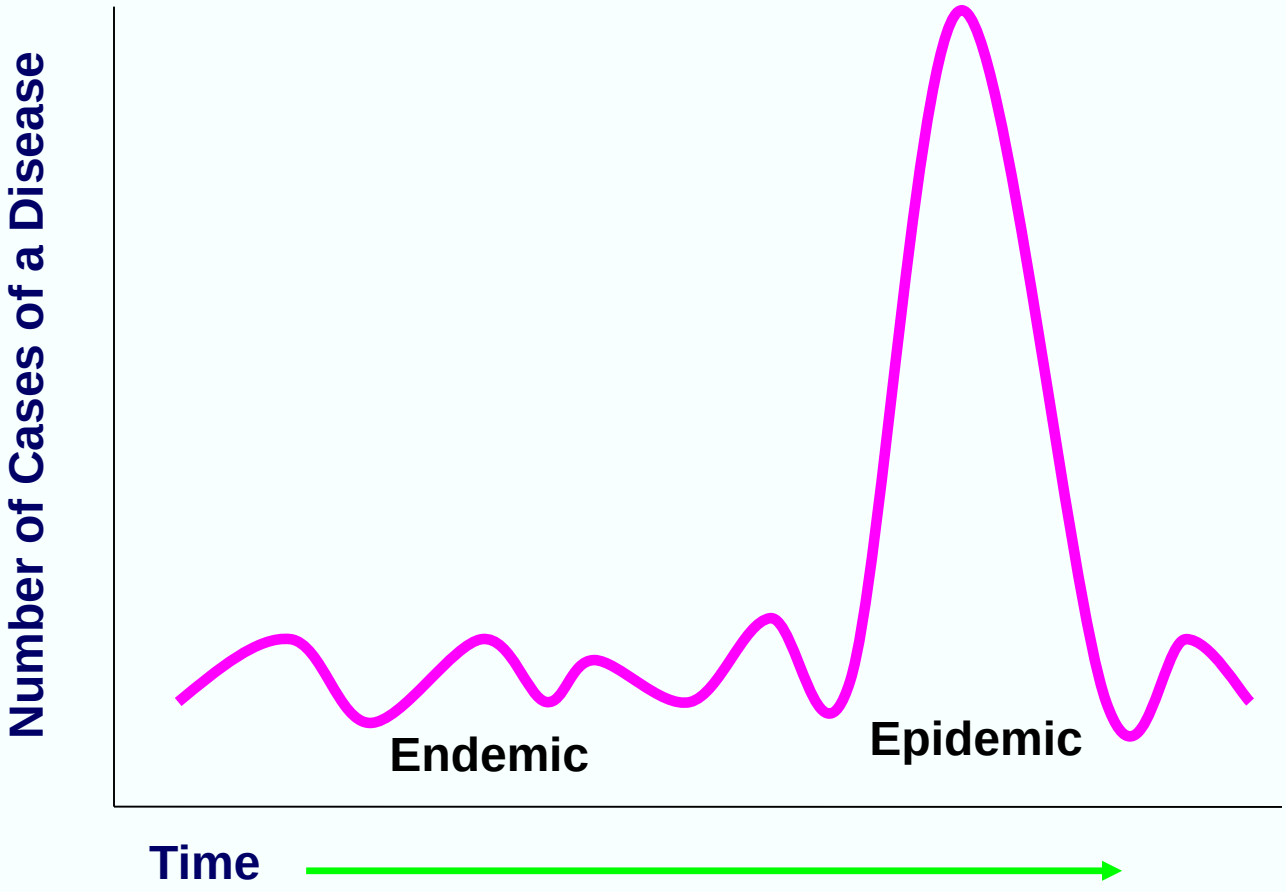
Endemic vs Epidemic



Levels of Disease Occurrence

Sporadic level: occasional cases occurring at irregular intervals

Endemic level: persistent occurrence with a low to moderate level

Hyperendemic level: persistently high level of occurrence

Epidemic or outbreak: occurrence clearly in excess of the expected level for a given time period

Pandemic: epidemic spread over several countries or continents, affecting a large number of people

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