Person Place and Time
Infectious disease epidemiology

Saengsit Kritsadee, ATM.Dr., Ph.D.

Why is it important to consider these factors in an epidemiologic study? i.e.

Disease Outbreak

Person: Who is affected by the disease?

What do these people have in common?

Place: When did the people get ill?

Did they get ill during the same time period?

Time: When did the people get ill?

Did they eat at the same restaurant?

If we can answer these questions we may be able to determine the cause or at least the origin of the disease outbreak.

Disease definition

Definitions of diseases change as new knowledge is accumulated.

- Time: If disease rates are compared between different time periods it is important to insure that the disease definition did not change over time.
- Place: if disease rates are compared between different locations (e.g. countries, states) it is important to insure that the same definition is used in all locations.

Descriptive epidemiology

Incidence rate

Prevalence rate

Mortality rate

Person

- Age
- Sex
- Race
- Occupation
- Socioeconomic status
- Marital status

Place

- International comparisons
- Intranational comparisons
- Urban-rural comparisons
- Local distribution and clustering in place

time

- Secular trends
- Cyclic fluctuations
- Short-term fluctuations

Prediction of time trend

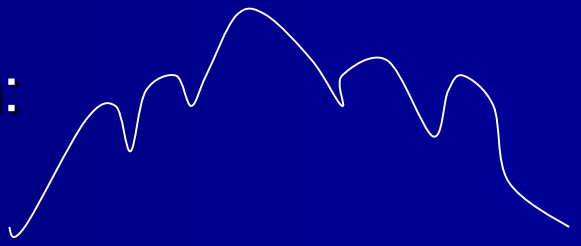
- Current , Cohort age patterns
- Age specific death rates
- Crude death rates
- Age composition

The Epidemic curve

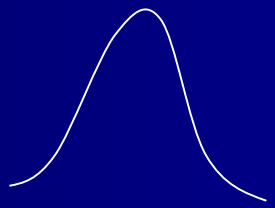
- To get better idea of the time factor in our investigation we can plot the number of cases vs. the time of onset. This plot called “Epidemic Curve”

- Why is the epidemic curve important?
  - Gives information about the time and type of exposure and the mode of spread
  - Easier to interpret than a table of numbers

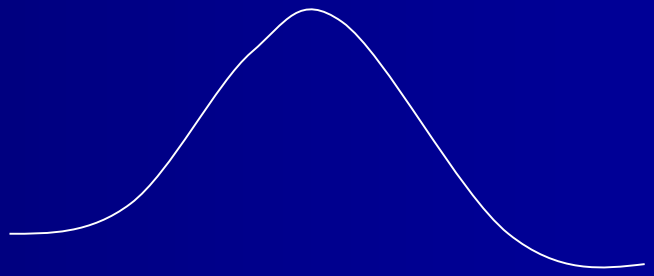
- What would the epidemic curve of the following epidemics look like?
- Consider shape, time frame, and number of onsets.
  - Propagated person-to-person:



  - Single exposure:



  - Continuous exposure:



What are examples of these types of epidemics?

- Propagated person-to-person: (e.g. Influenza, Ebola) the epidemic extends over a number of incubation cycles with an increasing number of cases in each successive cycle
- Single exposure: (e.g. food poisoning) the epidemic curve rises and falls rapidly in one incubation period
- Continuous exposure: (e.g. contaminated water) the peak of the epidemic curve is less distinct and the curve may extend over several incubation periods

- The three types of epidemic curves are often hard to distinguish. Thus geographic spread of the disease and commonalities between the sick are generally needed to pinpoint the type of epidemic.

About Infectious Agents

- Intrinsic properties of infectious agents

Morphology, size, chemical character, antigenic make-up, growth requirements (i.e. temperature, nutrients, etc), ability to survive outside the host (i.e. in water), viability under different conditions (i.e. temperature, humidity), spectrum of hosts, ability to produce toxins, ability to become resistant to antibiotics/other chemicals, etc.

Interactions between infectious agent and host

- Infectivity
- Pathogenicity
- Virulence
- Immunogenicity

Interactions between infectious agent and host

- Infectivity: the ability of an agent to invade and multiply (produce infection) in a host.
  - High infectivity: measles; Low infectivity: leprosy
- Pathogenicity: the ability of an agent to produce clinically apparent illness.
  - High pathogenicity: AIDS; Low pathogenicity: polio in young children
- Virulence: the proportion of clinical cases resulting in severe clinical manifestation.
  - High virulence: AIDS; Low virulence: common cold
- Immunogenicity: the ability of an agent to produce immunity.
  - High immunogenicity: measles; Low immunogenicity: gonorrhea

1. new infection rate

   – New infection = $\frac{\text{Number of new infected persons x 100}}{\text{Number of susceptible persons}}$

2. secondary attack rate

   – Secondary attack rate = $\frac{\text{Number of secondary cases x 100}}{\text{Number of susceptible persons-primary case(s)}}$

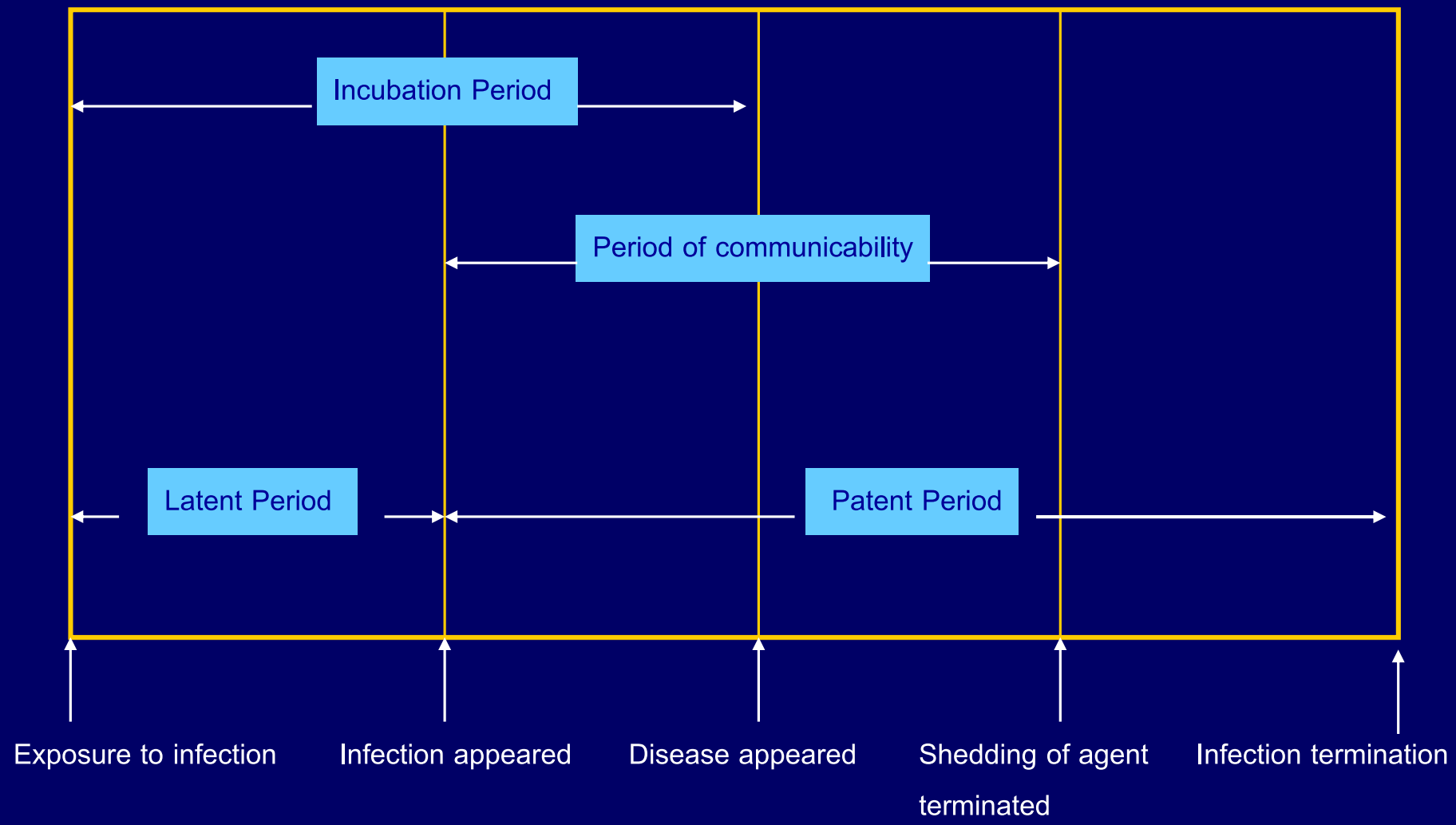
Pathogenicity rate / Attack rate among infected persons)

- Pathogenicity rate = $\frac{\text{Number of new cases x 100}}{\text{Total number infected}}$

Virulence

- Case fatality rate = $\frac{\text{Fatal cases x 100}}{\text{Total cases}}$

- Virulence rate = $\frac{\text{Severe cases and fatal cases x 100}}{\text{Total cases}}$


Incubation Period
Period of communicability
Latent Period
Patent Period
Exposure to infection
Infection appeared
Disease appeared
Shedding of agent terminated
Infection termination

Important phases of infection

1. Latent period
2. Patent period
3. Period of communicability

    Quarantine

    Differential diagnosis

Important phases of infection

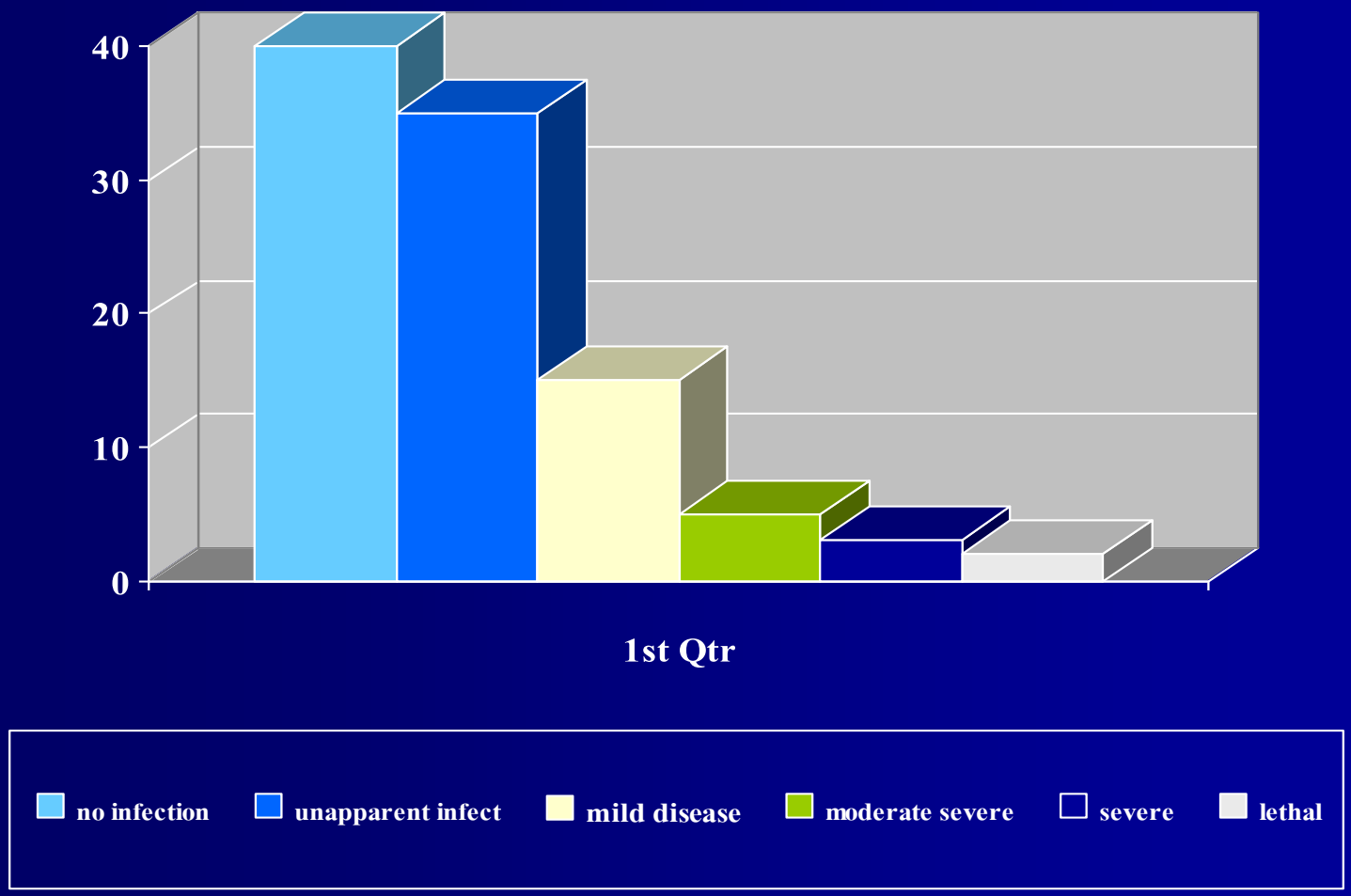
1. Period of communicability
2. Generation time

Spectrum of disease

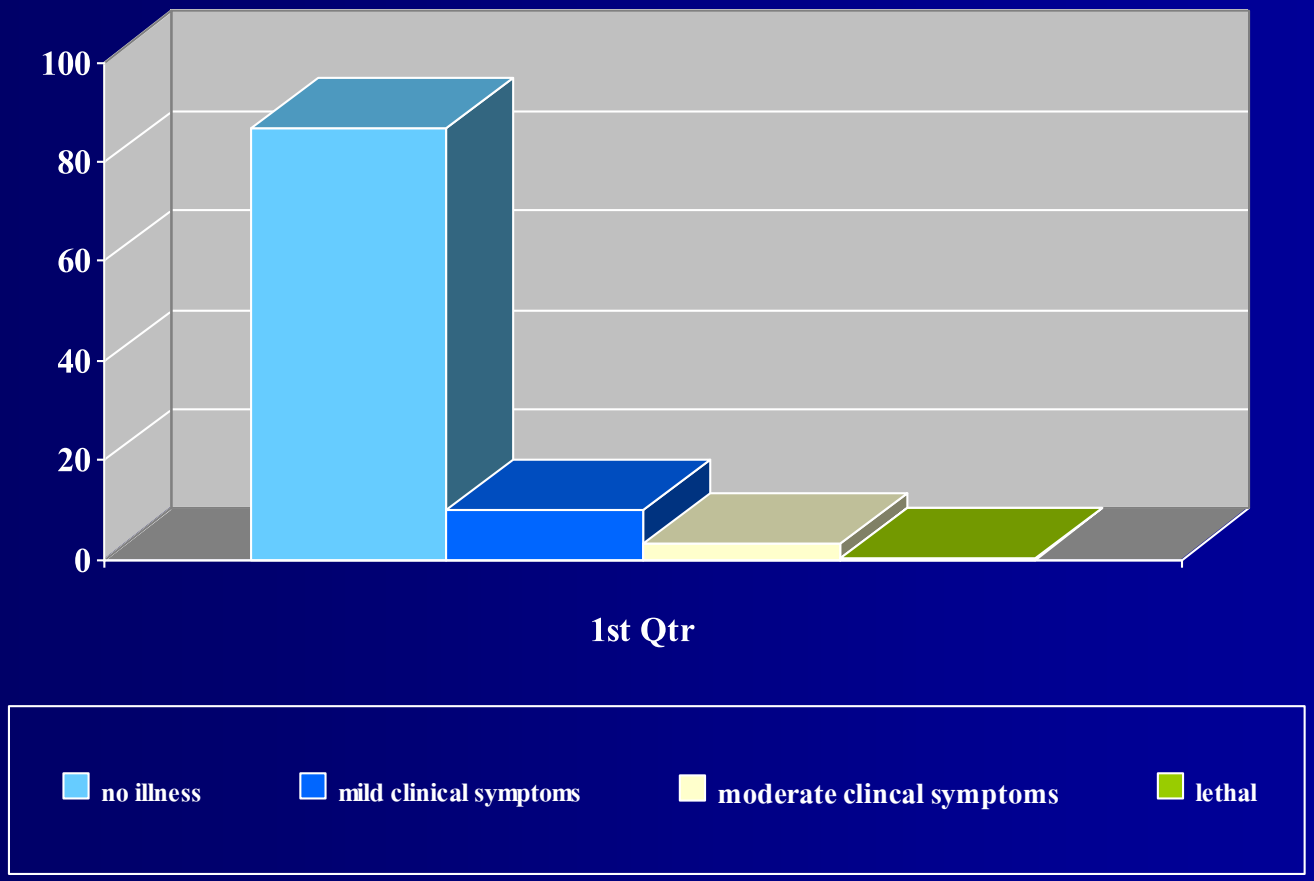
1. No infection
2. In apparent infection
3. mild disease
4. moderately severe disease
5. severe disease
6. fatal disease

Spectrum	Microbic virulence	Host resistance	Symptoms
1. No infection	Stable	++++	0
2. In apparent infection	Stable	+++	0
		++	+
3. Mild disease	Stable	+	++
4. Moderately severe disease		+	+++
5. Severe disease	Stable	0	++++
6. Fatal disease	Stable		

Hypothetical epidemic



The Epidemic Spectrum of Typhoid Fever



Pathogenic mechanisms

- Direct tissue invasion (i.e. parasite diseases, viral infections)
- Toxin production (i.e. tetanus)
- Immunologic enhancement or allergic reaction leading to damage to the host (i.e. allergic reactions to fungi in hay or mold)
- Chronic or latent infection (i.e. salmonella, hepatitis B)
- Enhancement of host susceptibility to drugs of otherwise minimal toxicity (i.e. Reye's syndrome)
- Immune suppression (i.e. AIDS)

Mechanisms of transmission

1. direct transmission
2. indirect transmission
    a) Vehicle-borne transmission
    b) Vector-borne transmission
    c) Airborne transmission

Reference

- ไพบูลย์ โล่ห์สุนทร บทบรรณาธิการ วิทยาการระบาดคลินิค จุฬาลงกรณ์เวชสาร กรกฎาคม 2528; 29(4): 415-420
- ไพบูลย์ โล่ห์สุนทร บทบรรณาธิการ ประโยชน์ของวิทยาการระบาดต่อชุมชน จุฬาลงกรณ์เวชสาร กรกฎาคม 2529; 30(7): 603-605
- ไพบูลย์ โล่ห์สุนทร ระบาดวิทยา ภาควิชาเวชศาสตร์ป้องกัน คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย 2540
- Annette Bachand, Introduction to Epidemiology: Colorado State University, Department of Environmental Health