Epidemics and Outbreaks

Prof. Ashraf Zaghloul

Learning Objectives

- Epidemics
- Outbreaks
- Case Definition
- Epidemic Curve

Investigation of Disease Outbreaks

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Public Health Surveillance

- Through **public health surveillance**, a health department systematically collects, analyzes, interprets, and disseminates health data on an ongoing basis

- Public health surveillance, which has been called "**information for action**", is how a health department takes the pulse of its community.

- ***By knowing the ongoing pattern of disease occurrence and disease potential***, a health department can effectively and efficiently investigate, prevent, and control disease in the community.

- At the local level, the most common source of surveillance data is reports of disease cases received from health-care providers, who are required to report patients with certain **“reportable”** diseases, such as cholera or measles or syphilis.

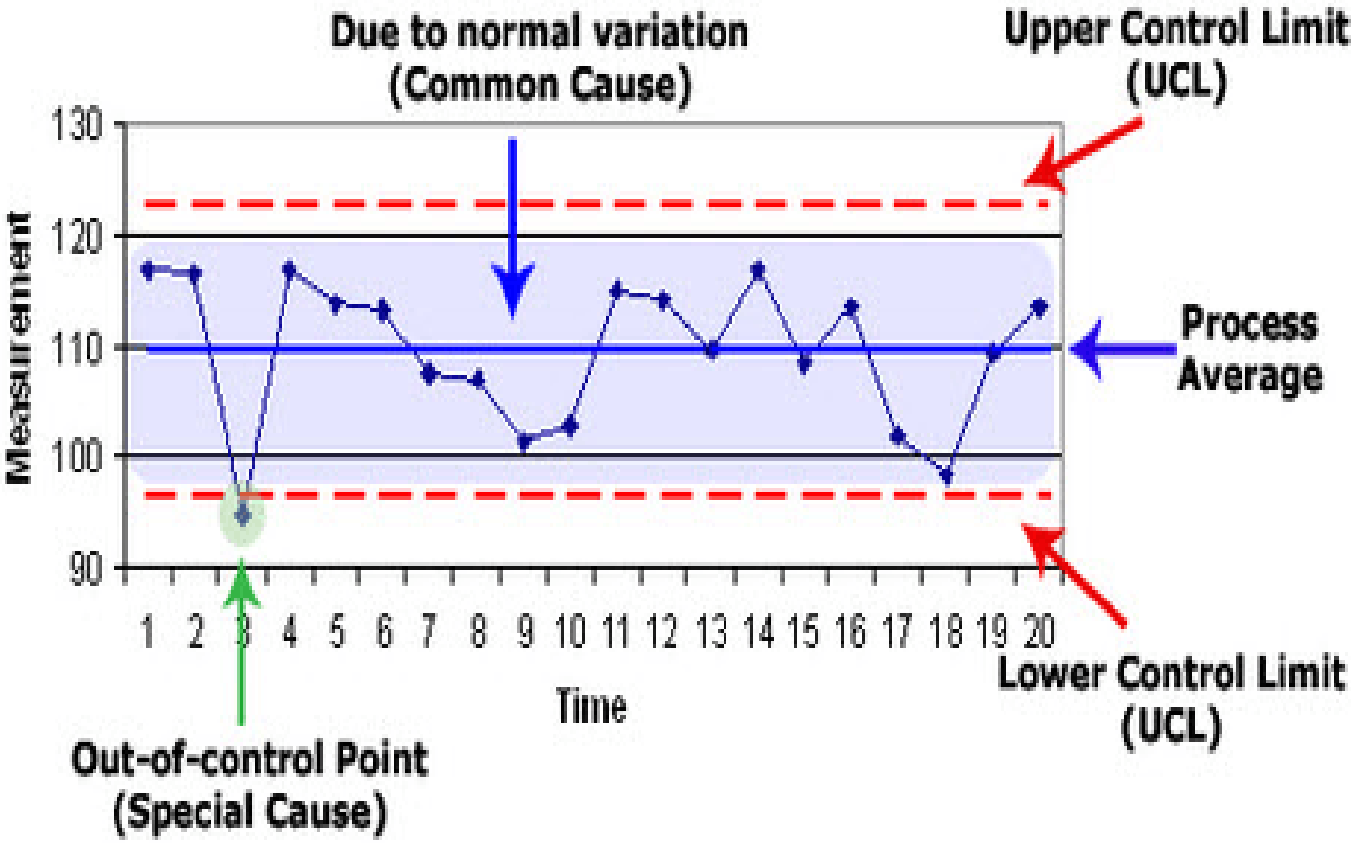
- In addition, surveillance data may come from laboratory reports, surveys, disease registries, death certificates, and public health program data such as immunization coverage.

- It may also come from investigations by the health department of cases or clusters of cases reported to it.

Most health departments use simple surveillance systems

They monitor individual morbidity and mortality case reports, record a limited amount of information on each case, and look for patterns by time, place, and person.

Control Charts



Disease Investigation

Surveillance is considered information for action

The first action of a health department when it receives a report of a case or a cluster of cases of a disease is to investigate.

The investigation may be as limited as a telephone call to the health-care provider to confirm or clarify the circumstances of the reported case, or it may be as extensive as a field investigation coordinating the efforts of dozens of people to determine the extent and cause of a large outbreak

Objectives of Investigations

With a communicable disease, one objective may be to **identify additional unreported or unrecognized cases** in order to control spread of the disease.

For example, one of the hallmarks of sexually transmitted disease investigations is the identification of sexual contacts of cases.

When these contacts are interviewed and tested they are often found to have asymptomatic infections.

For other diseases, the objective of an investigation may be to **identify a source or vehicle of infection** which can be controlled or eliminated.

For example, the investigation of a case of botulism usually focuses on trying to identify the vehicle contaminated with botulinum toxin, such as a food that was improperly canned. Once they have identified the vehicle, the investigators can establish how many other people may have been exposed and how many continue to be at risk, and take action to prevent their exposure.

Example: Botulism in Taiwan

In Taiwan 2006, investigators of a cluster of botulism cases implicated consumption of **canned peanuts prepared by a single manufacturer**.

They then initiated a nationwide recall of that product from warehouses, stores, and homes to reduce the risk of exposure for others.

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- Investigators initially use descriptive epidemiology to examine clusters of cases or outbreaks of disease. They examine incidence of the disease and its distribution by time, place, and person.

- They calculate rates and identify parts of the population that are at higher risk than others. When they find a strong association between exposure and disease, the investigators may implement control measures immediately. More often, investigators find that descriptive studies, like case investigations, generate hypotheses which they can then test with analytic studies

Level of Disease

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

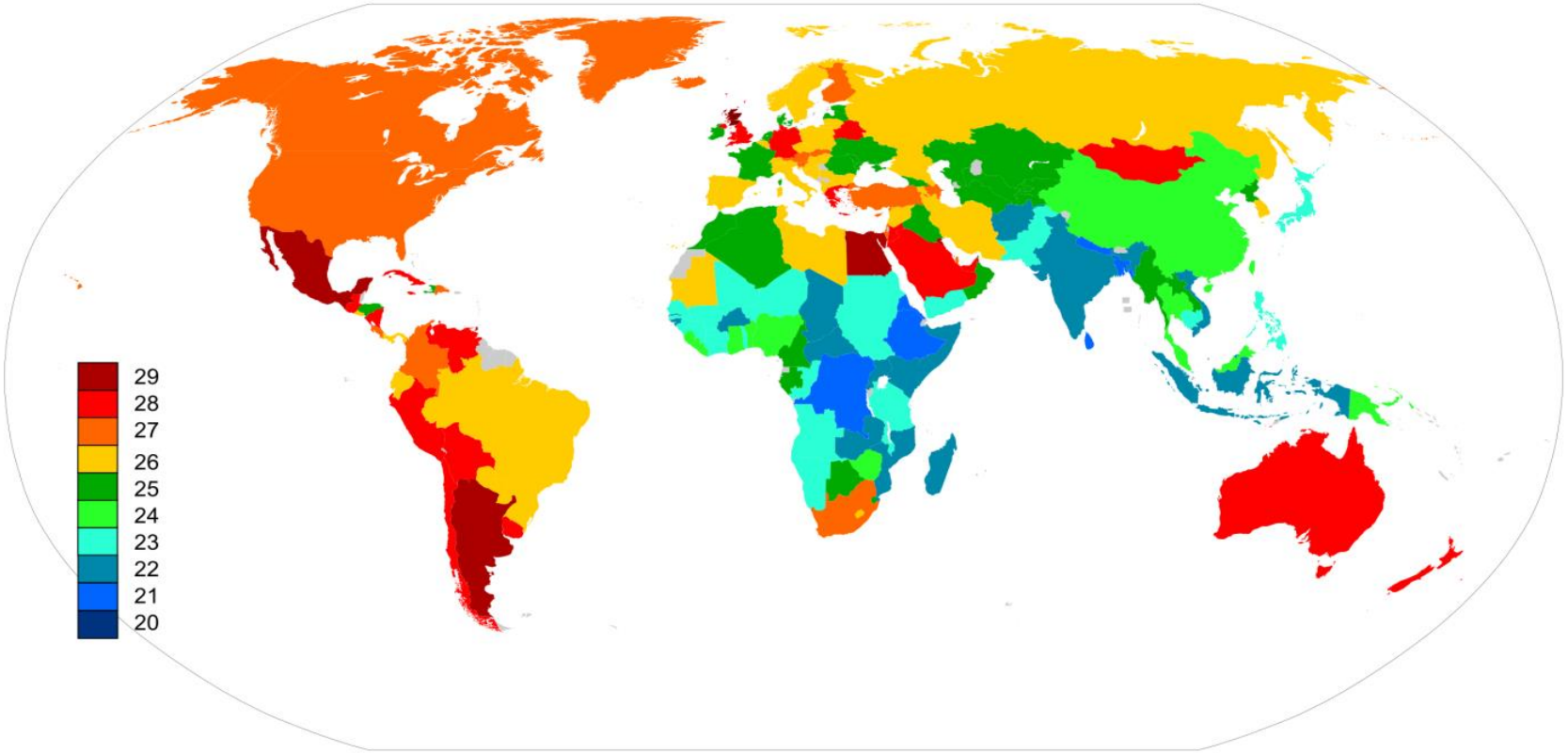
- **This level is not necessarily the preferred level, which should in fact be zero; rather it is the observed level**

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

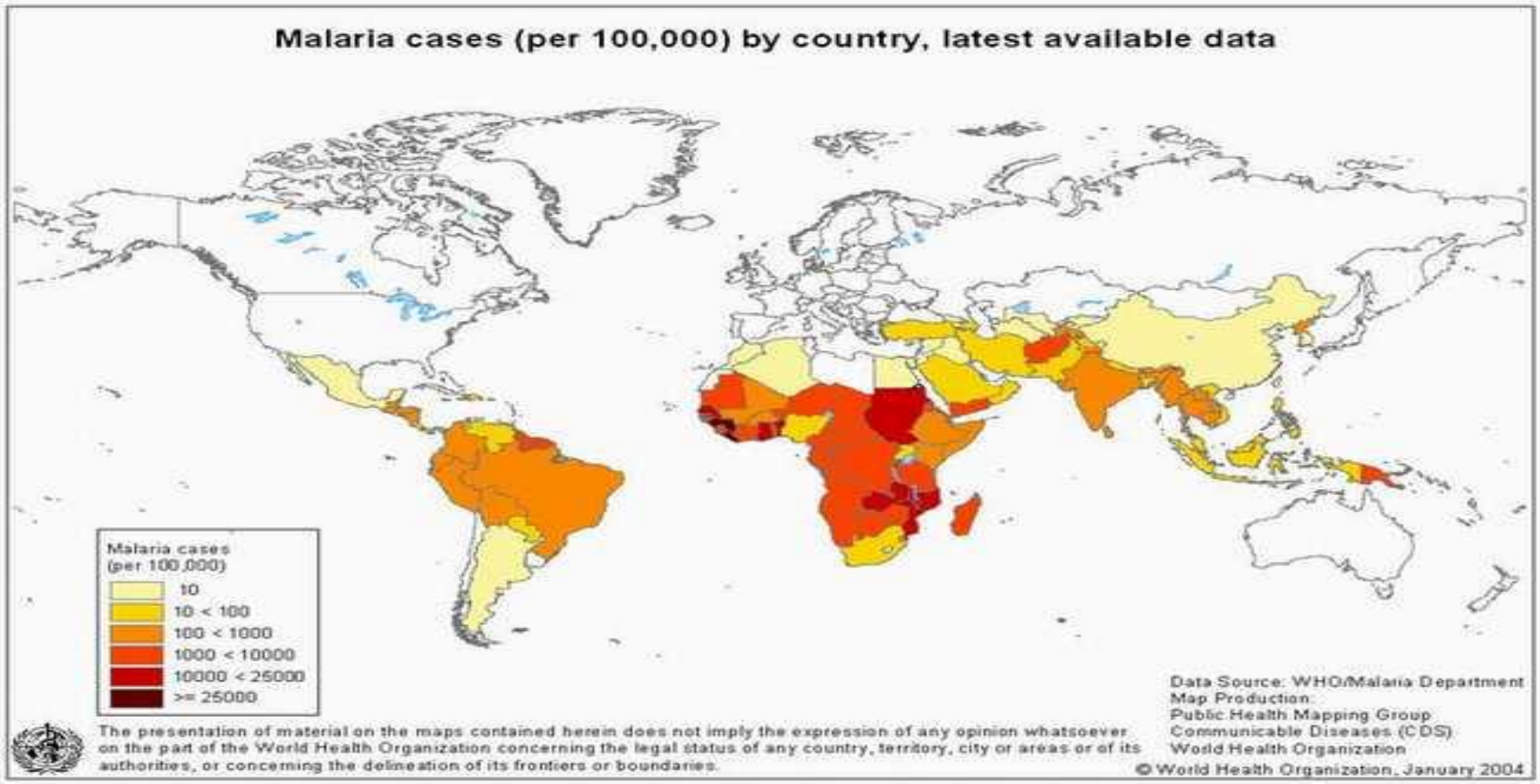
For example, over the past 4 years the number of reported cases of poliomyelitis has ranged from 5 to 9. Therefore, assuming there is no change in population, we would expect to see approximately 7 reported cases next year.

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

Pattern of Obesity Globally



Pattern of Malaria Globally



Definitions

- **Endemic** is defined as the **habitual /usual occurrence** of a disease within a given geographical area. (A persistently high level of occurrence is called a hyperendemic level)

- **Sporadic متفرقة** is an irregular pattern of occurrence, with occasional cases occurring at irregular intervals

Definitions

- **Epidemic** is defined as the occurrence in a community or region of cases of an illness, specific health related behavior, or other health related events clearly in excess of its normal expectancy. Epidemic involves a **temporary increase in the incidence of a disease.**

- **Outbreak** refers to a localized temporary increase in the incidence of a particular disease e.g. in a village, a town, or closed institution.

- **Pandemic** refers to an **EPIDEMIC OCCURING WORLDWIDE** or over a very wide area, crossing international boundaries, and usually affecting a large number of people

- **Food-borne illnesses (Common source outbreak)** are illnesses arising from consumption of contaminated or spoiled foodstuffs and liquids i.e. solid foods, liquid foods, milk, water and beverages

- **Food-borne disease outbreak**

Is an incident involving :

> 2 people with the same disease

- Time, place, person association
- **Food as a vehicle**

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Investigating an Outbreak

One of the most exciting and challenging tasks facing an epidemiologist working in a public health department is investigating an outbreak.

Frequently, the cause and source of the outbreak are unknown. Sometimes large numbers of people are affected.

Often, the people in the community are concerned because they fear more people, including themselves, may be stricken unless the cause is found soon.

Investigation of outbreaks

1. When did the exposure take place?
2. When did the event begin?
3. What is the incubation period for the disease?

Investigation of outbreaks

- Who was attacked by the disease?

Factors such as gender, age (pertussis in children)

- When did the disease occur?

seasonal patterns (diarrhoeal diseases in summer and respiratory diseases in winter)

- Where did the cases arise?

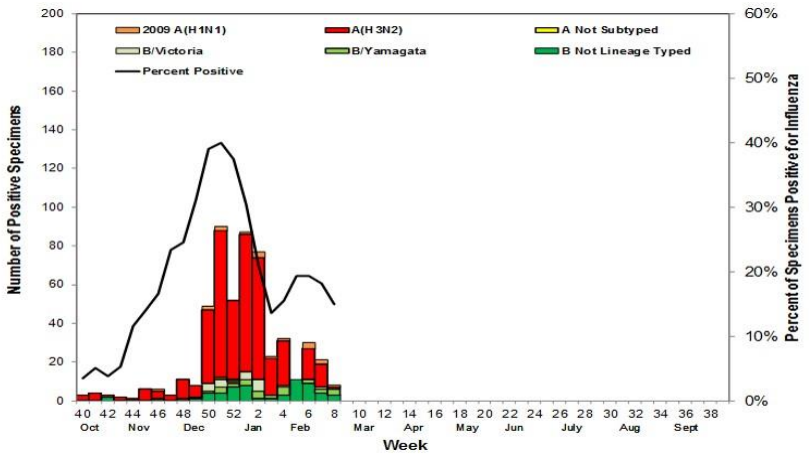
10 Steps of an outbreak investigation

1) Prepare for field work
2) Establish the existence of an outbreak
3) Verify the diagnosis
4) **Define and identify case**
5) Describe and orient the data in terms of time, place and person
6) Develop hypotheses
7) Evaluate hypotheses
8) Refine hypotheses and carry out additional studies
9) Implement control and prevention measures
10) Communicate findings

Step 1: Prepare for field work

- Know the disease and gather the supplies and equipment you will need

- Anyone about to embark on an outbreak investigation should be well prepared before leaving for the field



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Good preparation includes

- **(a) Investigation**
- First, as a field investigator, you must have the **appropriate scientific knowledge**, supplies, and equipment to carry out the investigation.

- Discuss the situation with someone knowledgeable about the disease and about field investigations, and review the applicable literature

- **(b) Administration**

- Second, as an investigator, you must pay attention to administrative procedures

- **(c) Consultation**

- Third, as an investigator, you must know your expected role in the field.

- Before departure, all parties should agree on your role, particularly if you are coming from “outside” the local area.

Example
An outbreak of Hepatitis in a school

Features of hepatitis:

- An acute viral illness characterized by the abrupt onset of fever, malaise, nausea, abdominal discomfort and diminished appetite, followed by a few days of jaundice
- Illness usually lasts 1-2 weeks, only occasionally requires hospitalization.
- Incubation period: 15-50 days, average 28-30 days

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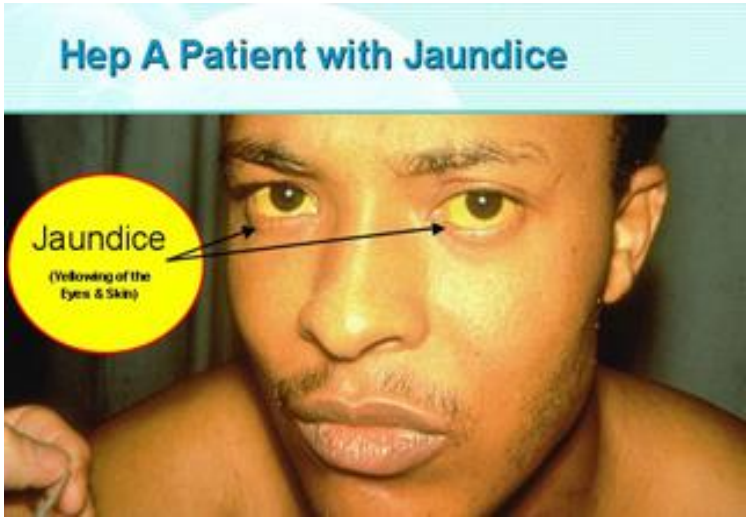

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Primary modes of transmission for **Hepatitis A**:

1) Person-to-person by fecal-oral route and

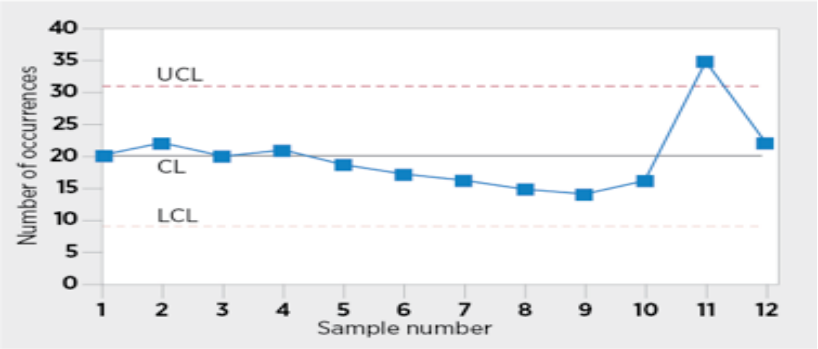
2) Common-vehicle spread by water or food (raw or undercooked shellfish, salads, sliced meats, etc).
3) Persons shed the virus in their stool and are infectious from about 10 days prior to onset of symptoms to a few days after the onset of jaundice

Step 2: Establish the existence of an outbreak

- Before you decide whether an outbreak exists, you must first **determine the expected number of cases** for the area in the given group

Compare the Observed with the Expected

Number	Frequency	Cumulative frequency
5	2	2
6	3	5
7	2	7
8	2	9
9	1	10
10	1	11



How to determine what's expected?

Usually we **compare** the current **number** of cases with the number from the previous few weeks or months, or from a comparable period during the previous few years

- Even if the current number of reported cases exceeds the expected number, the excess may not necessarily indicate an outbreak

- **Reporting may rise because of changes in:**
  - local reporting procedures,
  - **changes in the case definition,**
  - increased interest because of local or national awareness,
  - improvements in diagnostic procedures
  - A new physician, infection control nurse,

More consistently reported cases, when in fact there has been no change in the actual occurrence of the disease

NOTE

Whether you should investigate an apparent problem further is not strictly tied to your verifying that an epidemic exists (observed numbers greater than expected).

The severity of the illness, the potential for spread, political considerations, public relations, available resources, and other factors all influence the decision to launch a field investigation

Step 3: Verify يؤكد the diagnosis

Two goals in verifying a diagnosis:

1. Ensure that the problem has been properly diagnosed (the outbreak is really what it has been reported to be)
   - Review clinical findings and laboratory results for people affected.

2. For outbreaks involving infectious or toxic-chemical agents, be certain that the increase in diagnosed cases is not the result of a mistake in the laboratory

(Frequency Distributions)

Step 4: **Define and identify cases**

Establish a ***Case Definition***

A standard set of criteria for deciding whether a person should be classified as having the disease under study.

Includes four components:

- **Information** about the event,
- **Characteristics** about the people who are affected,
- Information about the **location or place**,
- A specification of **time** during which the outbreak occurred

A **Case** is a person who satisfies the set criteria

The case definition was any person who resided in this city or visited since a given time (months or day) with either acute onset on or after a particularly set date (i,.e April 1st, October etc…) of jaundice or a clinical syndrome and laboratory evidence compatible with Hepatitis A.

- Ideally, a case definition will include most if not all of the actual cases, but very few or none of what are called “false-positive” cases (persons who actually do not have the disease in question but nonetheless meet the case definition).

- Recognizing the uncertainty of some diagnoses, investigators often classify cases as confirmed, probable, or possible

- To be classified as confirmed:
  - A case usually **must** have **laboratory verification**
- To be classified as probable:
  - usually has typical clinical features of the disease **without laboratory confirmation**
- To be classified as possible:
  - usually has fewer of the typical clinical features.

Step 4: Define and identify cases

The following information should be collected about every affected person in an outbreak:

1) Identifying information- name, address, phone
2) Demographic information- age, sex, race, occupation allows you to identify the population at risk
3) Risk factor information
4) Clinical information
   - verify the case definition has been met
   - Date of onset to create an epidemic curve

Example of line listing for an outbreak of hepatits A

Line Listing of reported suspect cases, page 1

Case #	Initials	Date of Report	Date of Onset	Diagnostic							Lab		Age	Sex
				MD Dx	Signs and Symptoms						HA IgM	Other		
					N	V	A	F	DU	J				
1	JG	10/12	10/6	Hep A	+	+	+	+	+	+	+	SGOT↑	37	M
2	BC	10/12	10/5	Hep A	+	–	+	+	+	+	+	ALT↑	62	F
3	HP	10/13	10/4	Hep A	±	–	+	+	+	S*	+	SGOT↑	30	F
4	MC	10/15	10/4	Hep A	–	–	+	+	?	–	+	HBs Ag -	17	F
5	NG	10/15	10/9	NA	–	–	+	–	+	+	NA	NA	32	F
6	RD	10/15	10/8	Hep A	+	+	+	+	+	+	+		38	M
7	KR	10/16	10/13	Hep A	±	–	+	+	+	+	+	SGOT – 240	43	M
8	DM	10/16	10/12	Hep A	–	–	+	+	+	–	+		57	M
9	PA	10/18	10/7	Hep A	±	–	+	±	+	+	+		52	F
10	SS	10/11	10/11	R/o Hep A Hep	+	+	+		+	–	pending	HBsAg (-)	21	M

S* = scleral
N = nausea
V = vomiting
A = anorexia
F = fever
DU = dark urine
J = jaundice
HA IgM = hepatitis A IgM antibody test

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Epidemic Curve

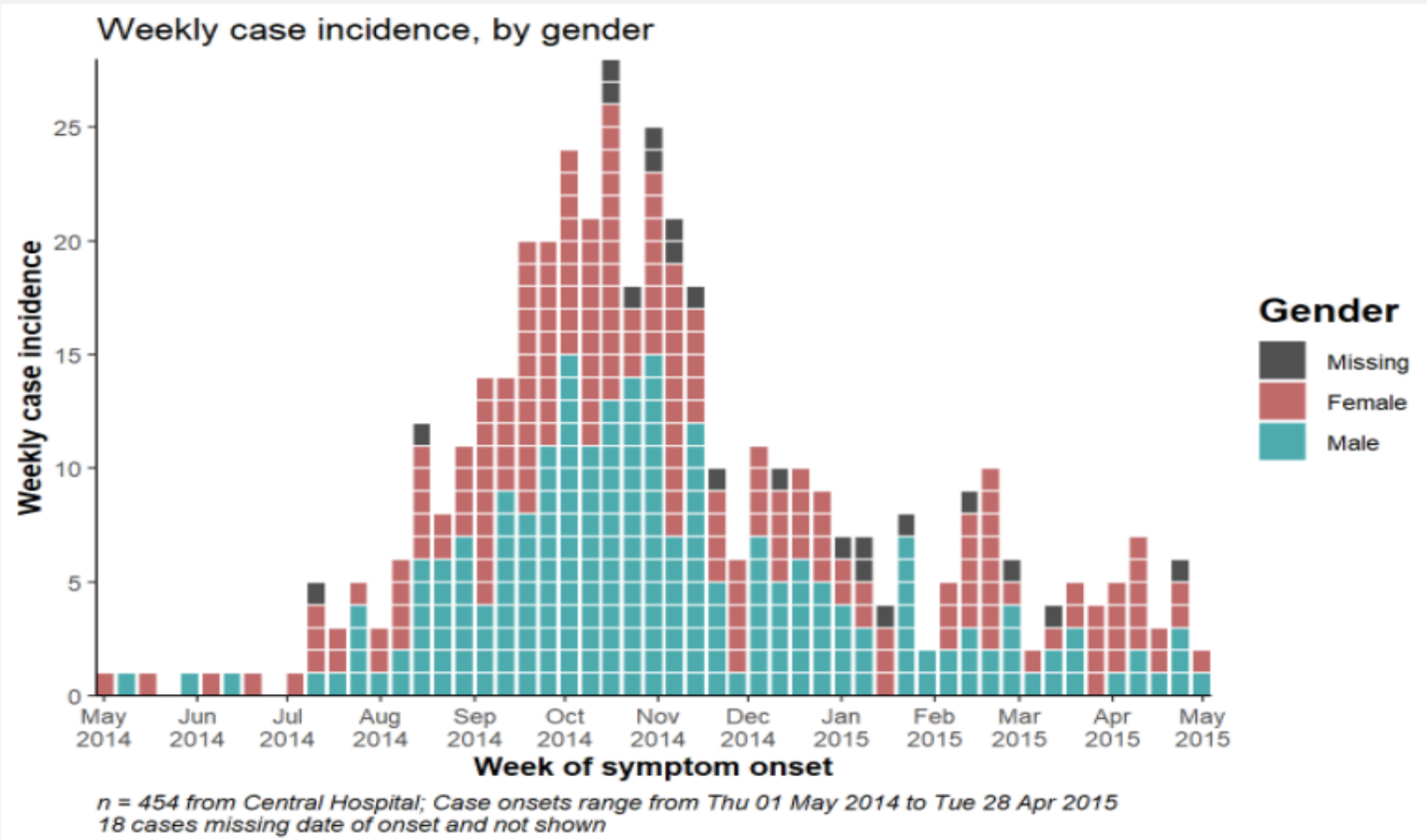
It provides information on:

Where you are in the course of the epidemic, and possibly project to it's future course

If the disease is identified and incubation period is known, probable time period of exposure can be estimated and a questionnaire developed focusing on that time period

You may be able to draw inferences about the epidemic pattern: common source exposure, person-to- person spread, etc.

Epidemic Curve



Interpreting an Epidemic Curve

The first step in interpreting an epidemic curve is to consider its overall shape. The shape of the epidemic curve is determined by the epidemic pattern (common source versus propagated), the period of time over which susceptible persons are exposed, and the minimum, average, and maximum incubation periods for the disease.

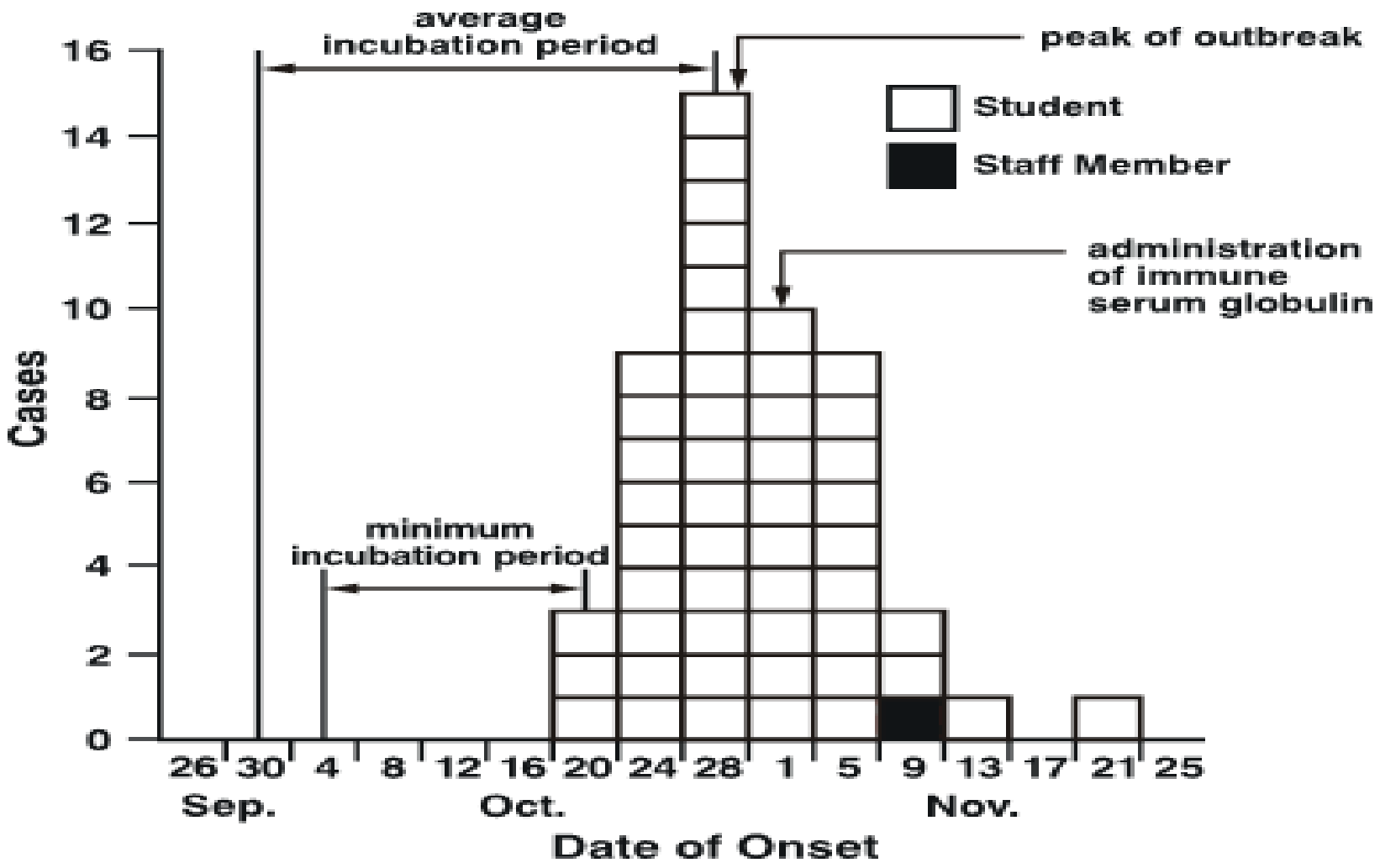
To identify the likely period of exposure from an epidemic curve

1. Look up the average and minimum incubation periods of the disease.

2. Identify the peak of the outbreak or the median case and count back on the x-axis one average incubation period. Note the date.

3. Start at the earliest case of the epidemic and count back the minimum incubation period, and note this date as well.

Hepatitis A cases in Colbert County, Alabama, October-November 1972



Types of Epidemics

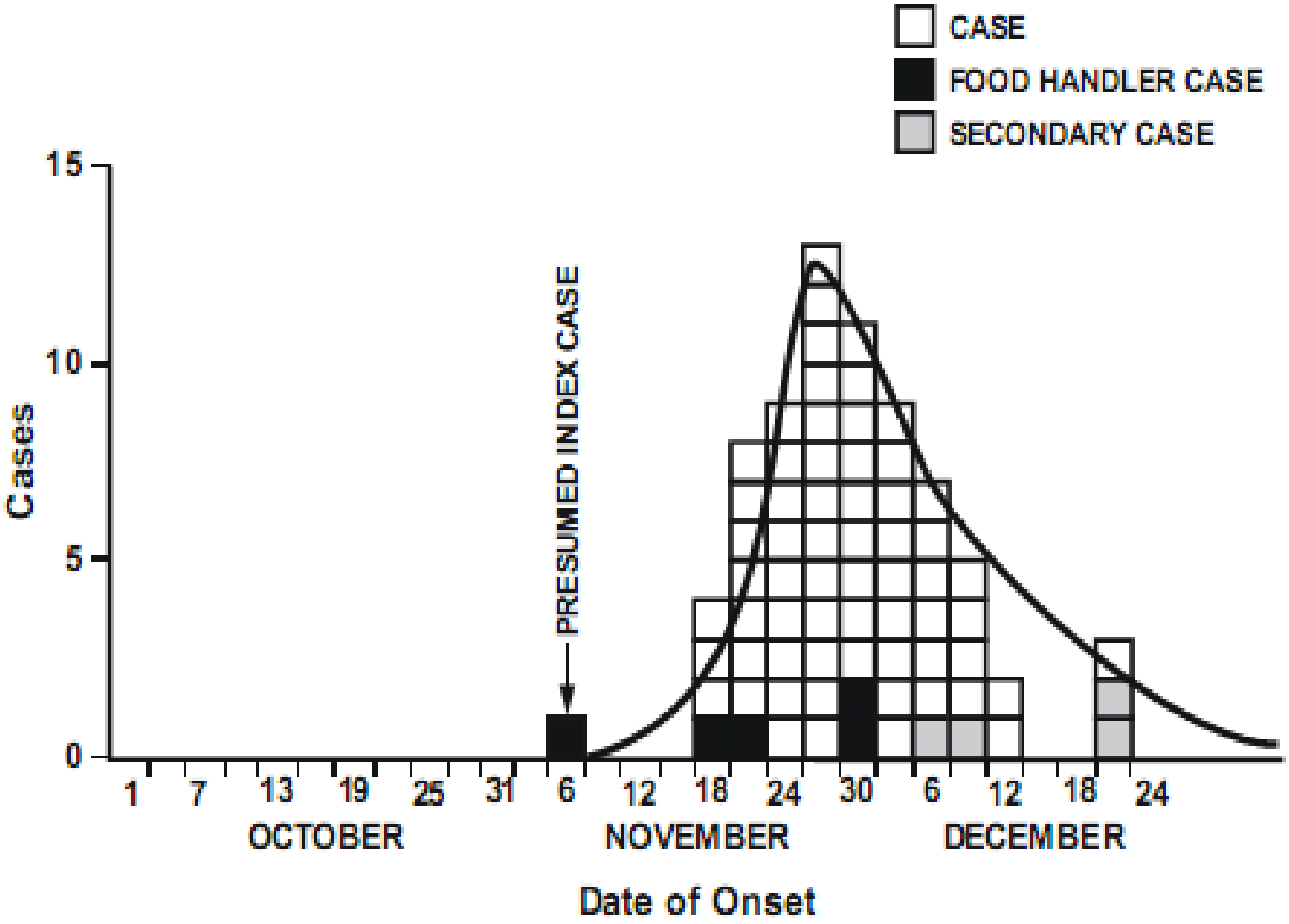
Common Source epidemic occurs when a group of persons are exposed to a common infection or source of pathogenic agents

→ **point source epidemic** when the disease agent comes from a single source (e.g. food)

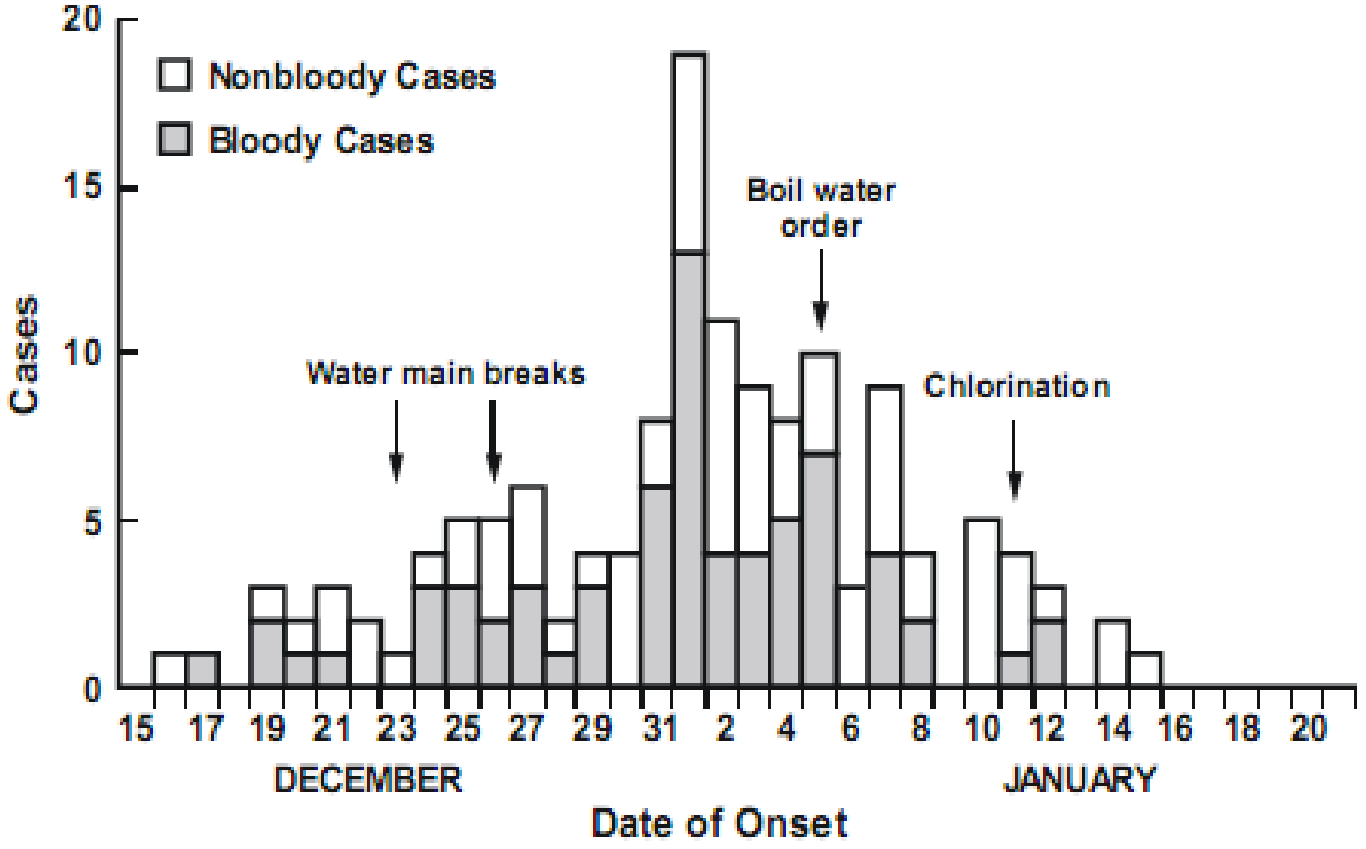
Example: A group of people on a picnic, where most of them share potato salad from a large common bowl. The majority of those who have eaten the potato salad fall ill because it was contaminated by *Staphylococcus* bacteria.

Persons exposed in one place at one time become ill within one incubation period of the agent obtained from a single source

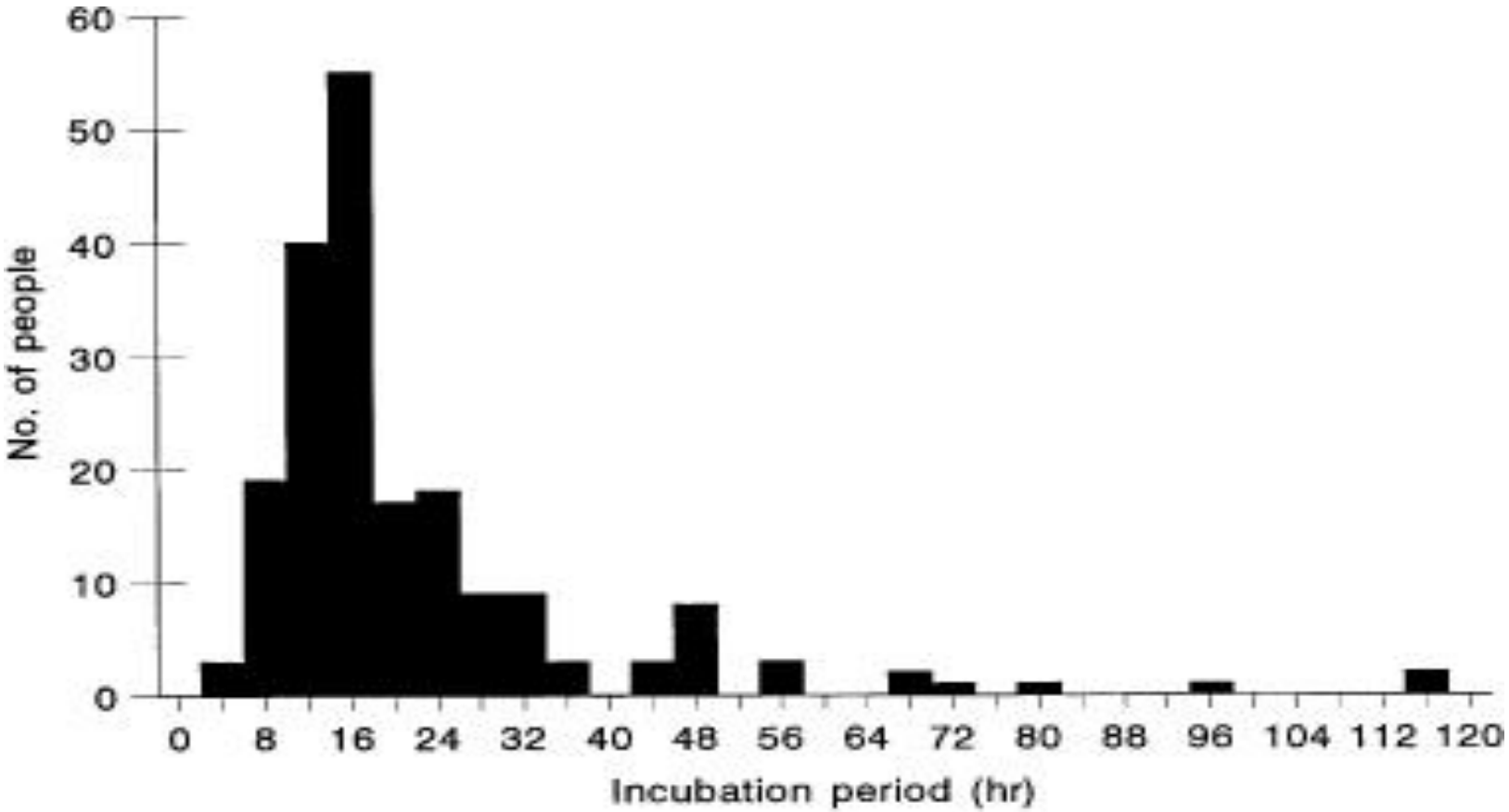
Example of common source outbreak with point source exposure: Hepatitis A cases by date of onset, Fayetteville, Arkansas, November-December 1978, with log-normal curve superimposed



Example of common source outbreak with continuous exposure: Diarrheal illness in city residents by date of onset and character of stool, Cabool, Missouri, December 1989-January 1990



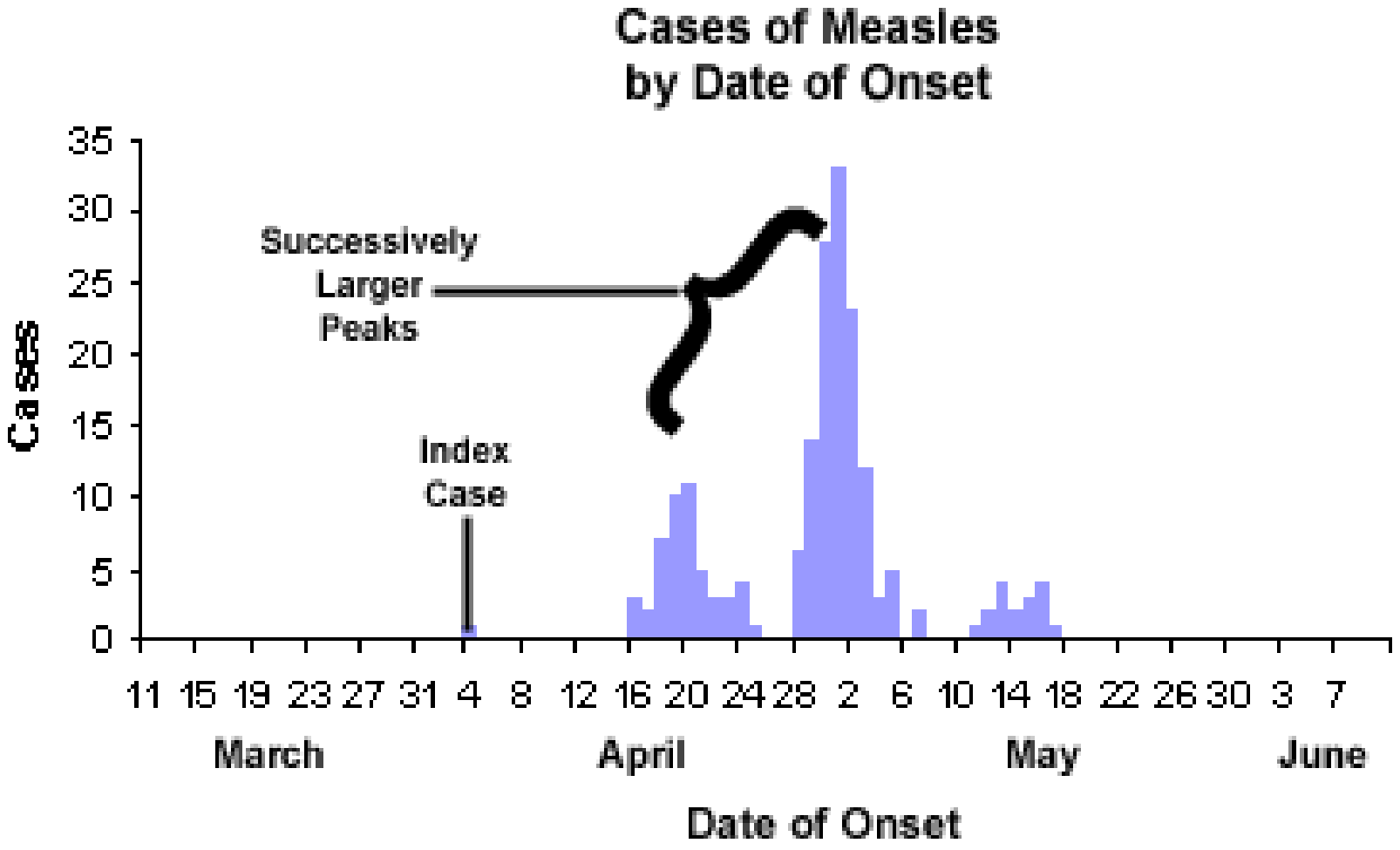
Incubation period



Propagated epidemic

When a single common source cannot be identified, yet the epidemic or disease outbreak continues to spread from person to person, growing in numbers, it is considered a propagated epidemic.

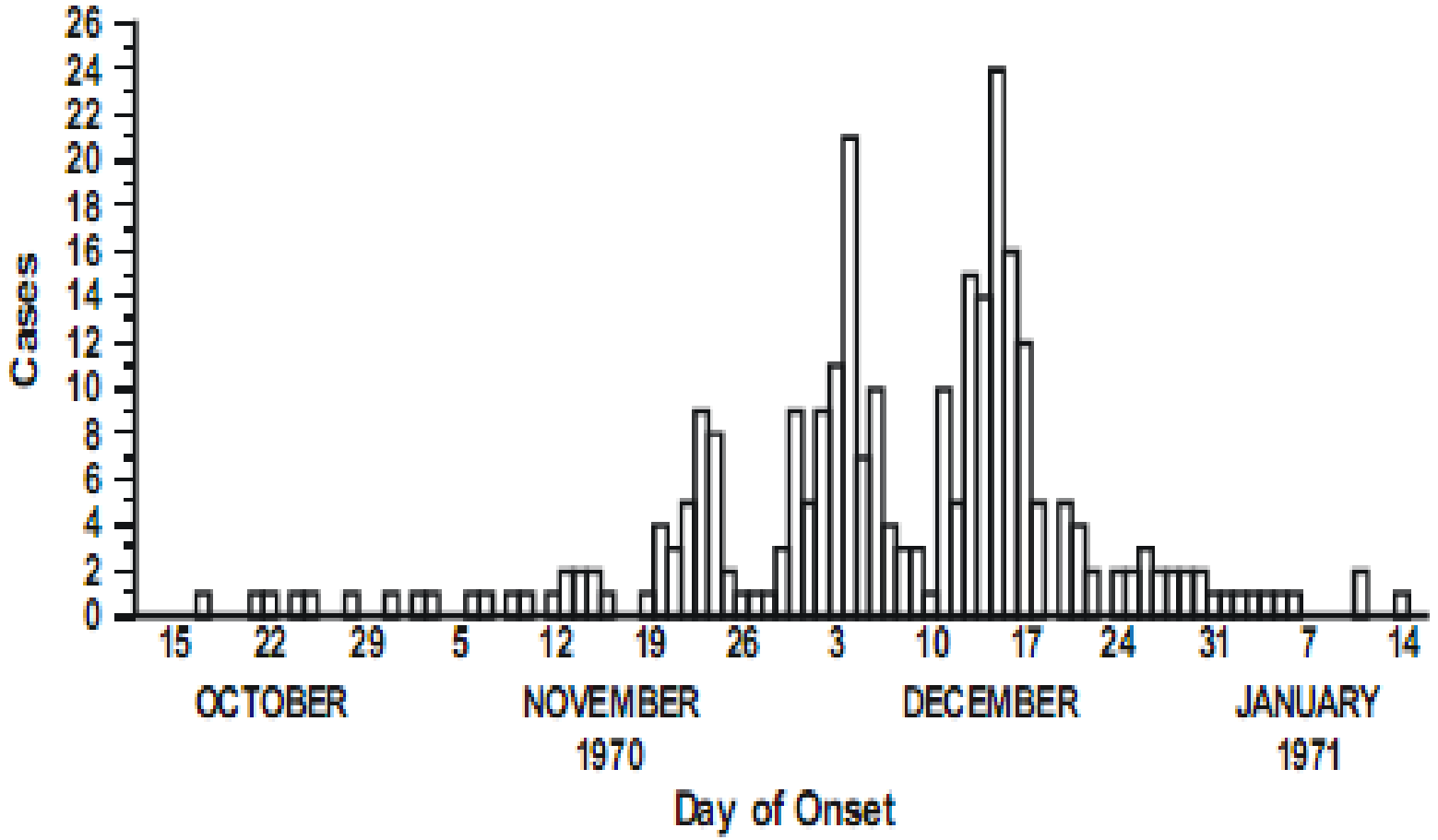
Cases occur over and over exceeding one incubation period


Cases of Measles
by Date of Onset
Cases
35
30
25
20
15
10
5
0
Successively
Larger
Peaks
Index
Case
11 15 19 23 27 31 4 8 12 16 20 24 28 2 6 10 14 18 22 26 30 3 7
March
April
May
June
Date of Onset

Mixed epidemic

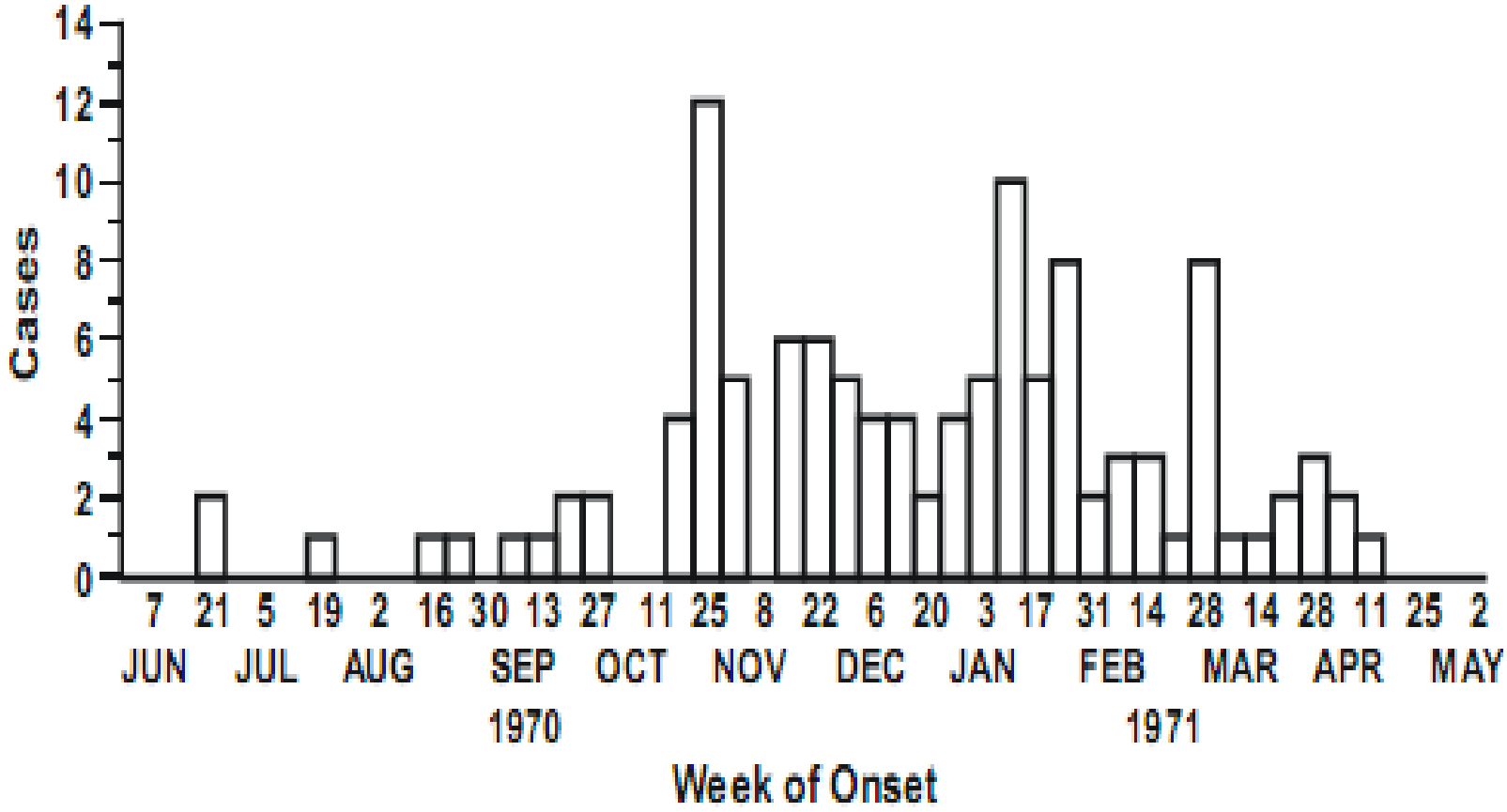
Occurs when a common source epidemic is followed by person-to-person contact and the disease is spread as a propagated epidemic.

Example of the classic epidemic curve of a propagated epidemic: Measles cases by date of onset, Aberdeen, South Dakota, October 15, 1970-January 16, 1971



- Some epidemics are **neither** common source in its usual sense nor propagated from person-to-person.

Example of a propagated epidemic that does not show the classic pattern: Infectious hepatitis cases by week of onset, Barren County, Kentucky, June 1970-April 1971

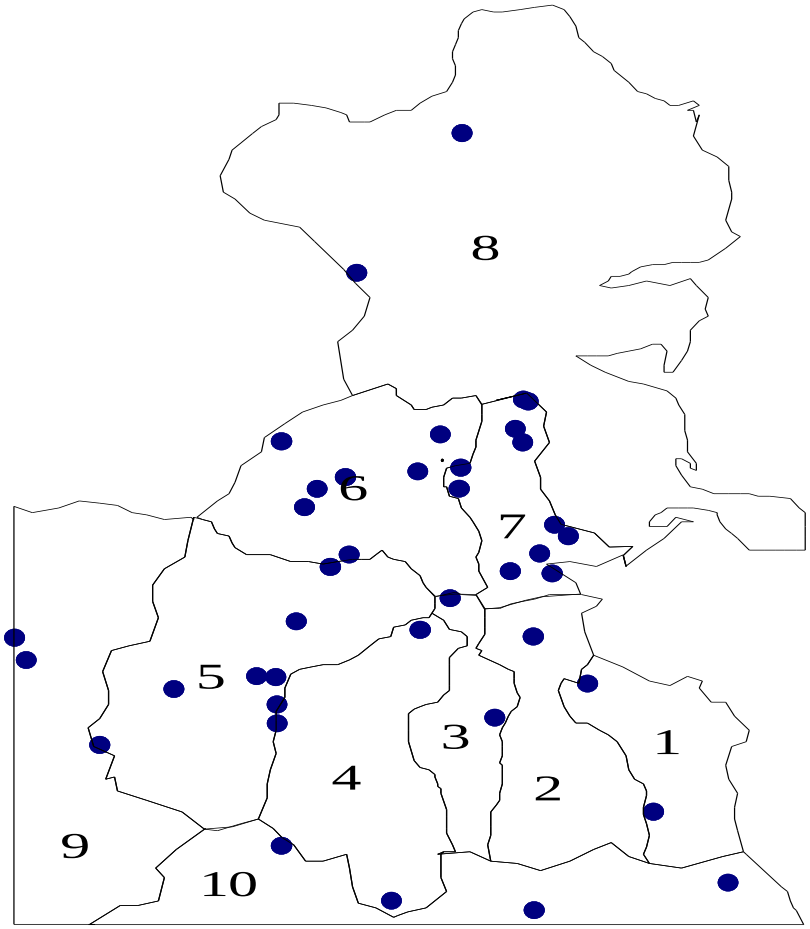


Step 5: Describe and orient the data in terms of place

Assessment of the outbreak by place provides:

- Information on the geographic extent of the problem
- May show clusters or patterns that provide clues to the identity and origins of the problem- patterns reflecting water supply (remember John Snow!), or proximity to a restaurant or grocery store.

The spot map



Cases of meningococcal disease by place of residence.

1 dot = 1 case

A Spot map shows the geographic location of people with a disease