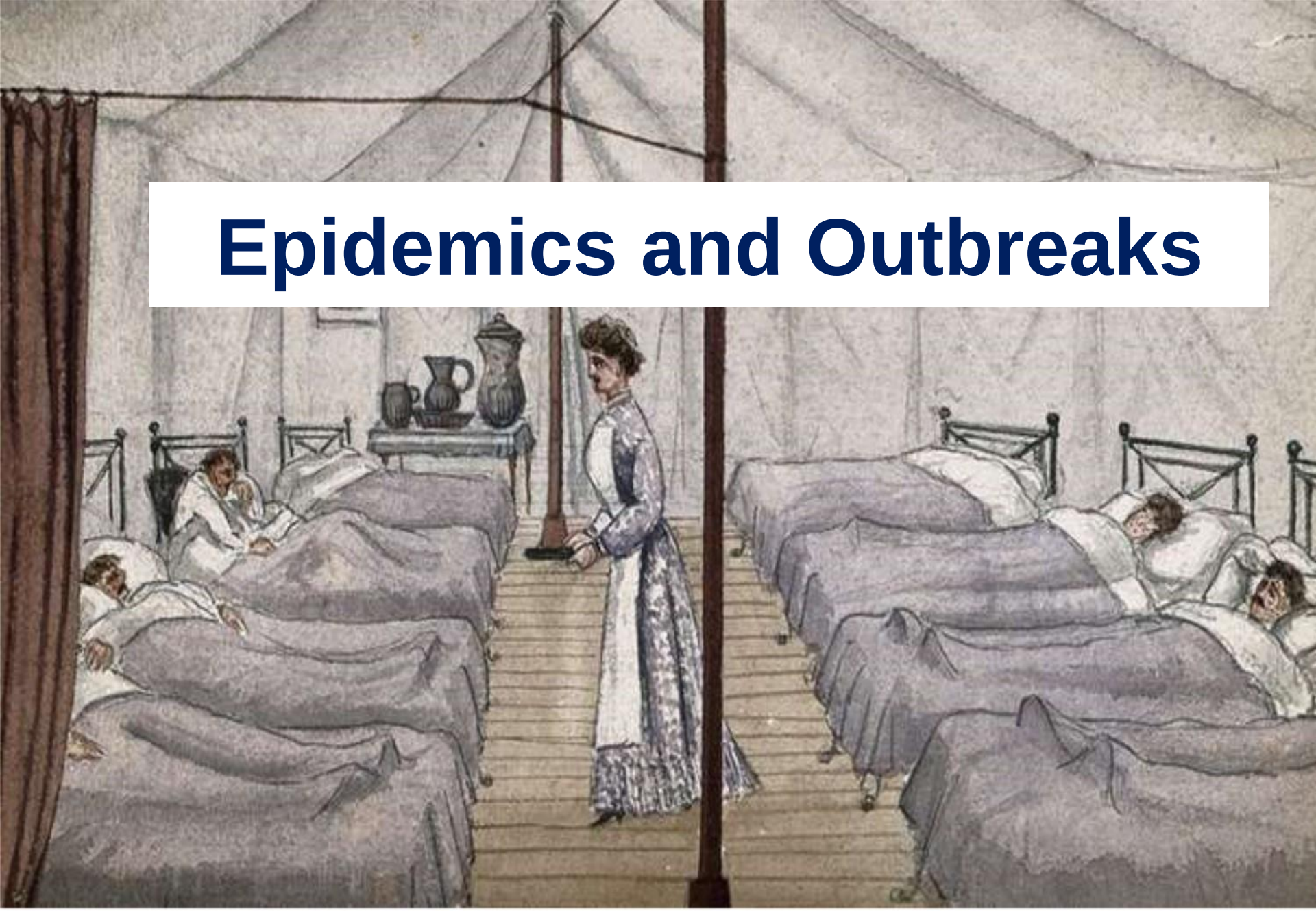
Epidemics and Outbreaks



Learning Objectives

- Definitions
- Procedures for Investigating an Epidemic

- 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

- 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.

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**.

Patterns and Trends in Obesity

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Definitions

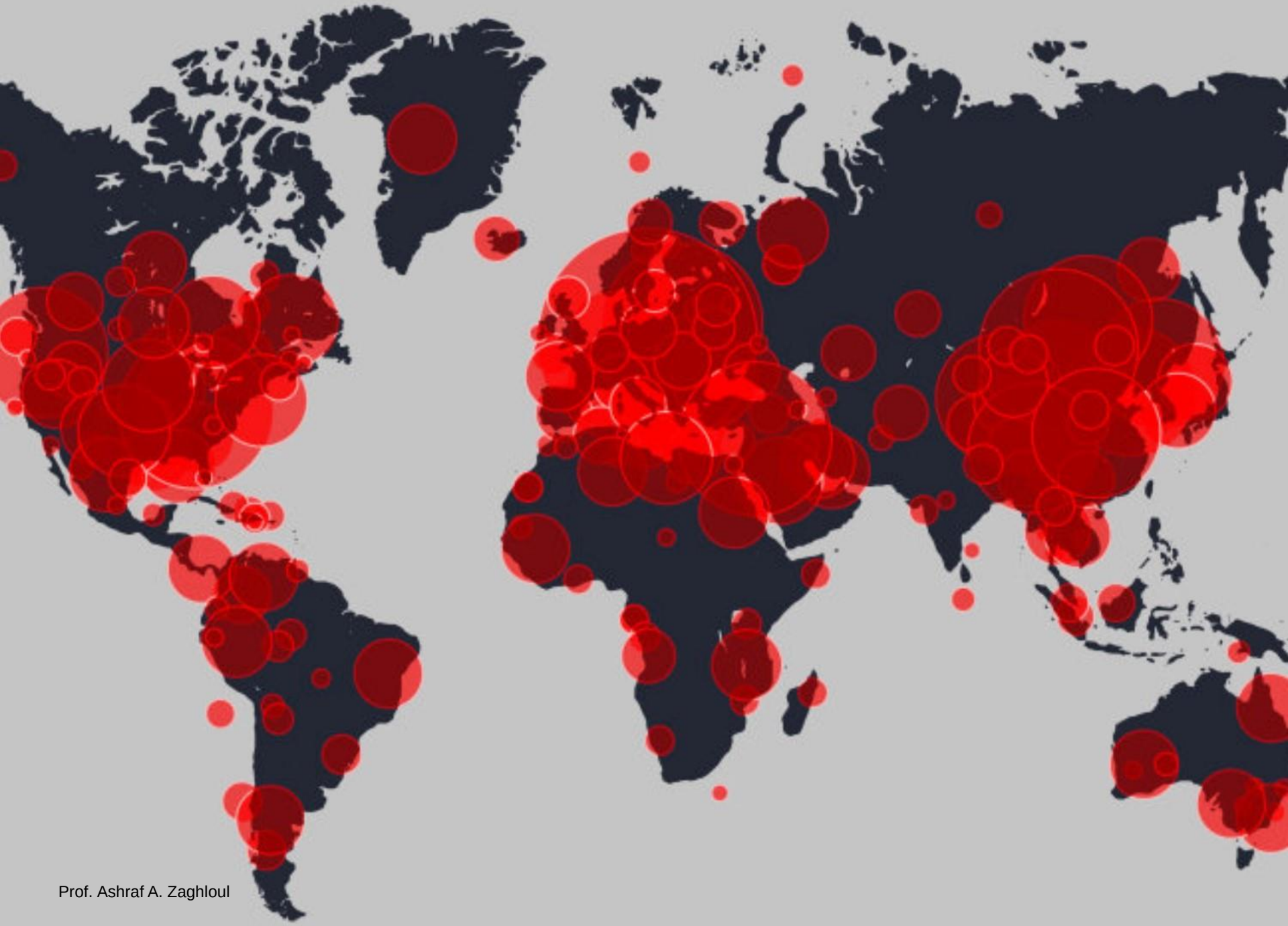
- **Endemic** متوطن is defined as the **habitual /usual occurrence** of a disease **within a given geographical area**. (A persistently high level of occurrence is called a hyperendemic level)

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

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



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- **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

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.

EXAMPLE

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

Investigators of acute disease outbreaks ordinarily use a measure of disease **frequency of incidence** called the **Attack Rate** particularly when the period of exposure is short (i.e., considerably less than 1 year).

Attack Rate is the proportion of exposed persons that becomes ill.

Attack rate

$$\frac{\text{Number of new cases of a disease (same time period)}}{\text{Number of persons exposed in a particular outbreak (same time period)}} \times 100$$

Epidemic 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 يتحقق**.

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.

- **By providing treatment that these contacts had not realized they needed, the health department prevents them from spreading the disease further**

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.

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Example: Botulism in Taiwan

In Taiwan, 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.

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.

1

Establish the Diagnosis

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Many people start investigating an outbreak without taking this first step.

Many cases are solved just by making the correct diagnosis and showing that the disease occurrence was not unusual after all.

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

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

2

Establish Epidemiologic Case Definition

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The epidemiologic case definition is the list of specific criteria used to decide whether or not a person has the disease of concern.

The case definition is not the same as a clinical diagnosis

A case definition establishes consistent criteria that enable epidemiologic investigations to proceed before definitive diagnoses are available.

Establishing a case definition is especially important if the disease is unknown, as was the case in the early investigations of legionnaires' disease, AIDS, hantavirus pulmonary syndrome, eosinophilia-myalgia syndrome, and severe acute respiratory syndrome.

No case definition is perfect because there are always some

false positives (i.e., individuals without the disease who are wrongly included in the group considered to have the disease) and

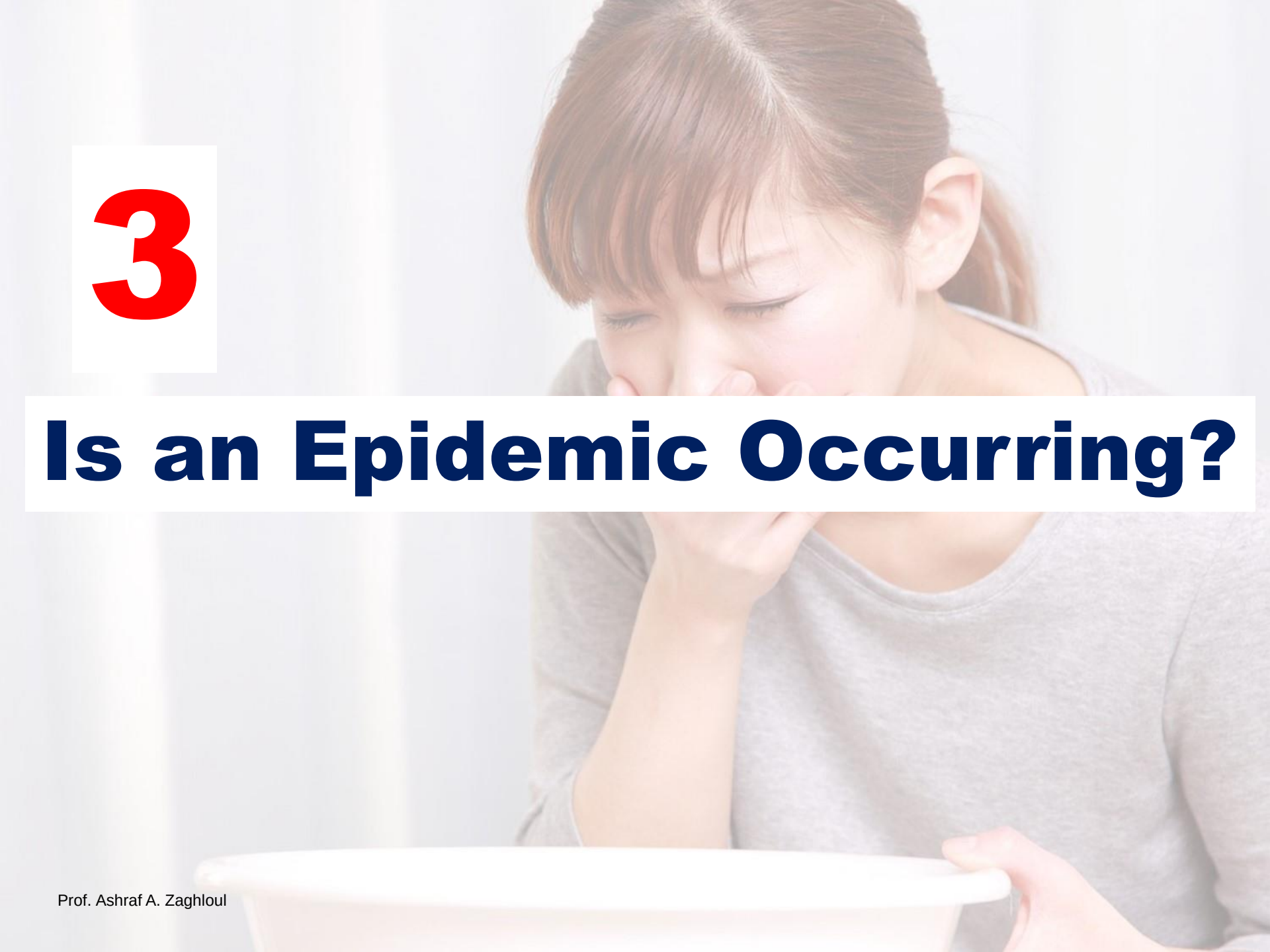
false negatives (i.e., diseased individuals

wrongly considered to be disease free). Nevertheless, the case definition should be developed carefully and adhered to in the collection and analysis of data.

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.



3

Is an Epidemic Occurring?

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Even if proven, cases must occur in sufficient numbers to constitute an epidemic.

It is difficult to assess whether the number of cases is high unless the usual number is known by ongoing surveillance.

4

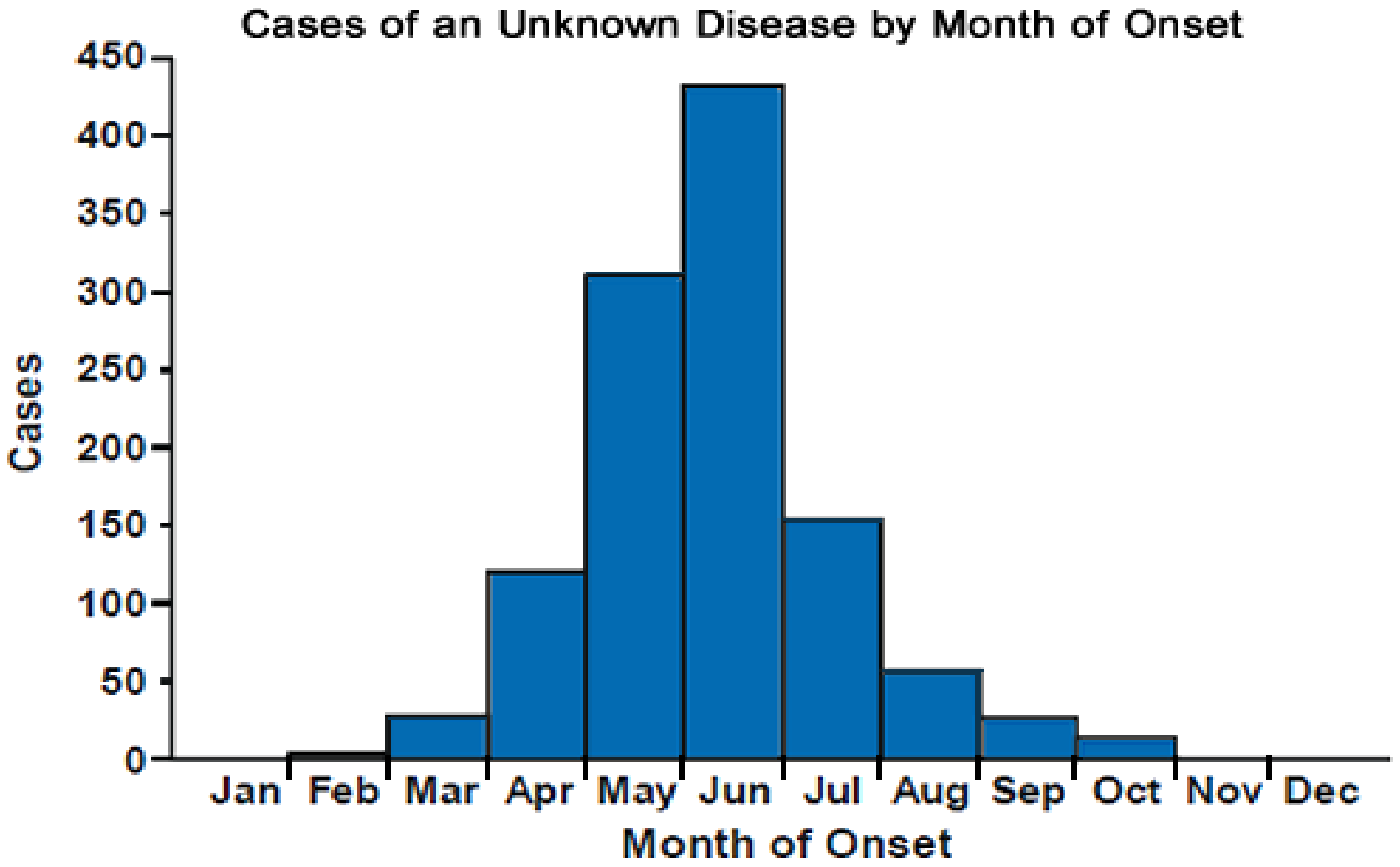
Characterize Epidemic by Time, Place, and Person

The epidemic should be characterized by time, place, and person, using the criteria in the case definition. It is unwise to start data collection until the case definition has been established, because it determines the data needed to classify persons as affected or unaffected.

TIME

The time dimension of the outbreak is best described by an epidemic time curve.

This is a graph with time on the x-axis and the number of new cases on the y-axis.


Cases of an Unknown Disease by Month of Onset
Cases
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month of Onset

The epidemic time curve provides clues about what is happening in an outbreak and helps the epidemiologist answer the following questions:

1 - What was the **type of exposure** (single source or spread from person to person)?

2- What was the **probable route of spread** (respiratory, fecal-oral, skin-to-skin contact, exchange of blood or body fluids, or via insect or animal vectors)?

3- When were the affected persons exposed? What was the **incubation period**?

4- In addition to **primary cases (index case)** (persons infected initially by a common source), were there secondary cases? (**Secondary cases** represent person-to-person transmission of disease from primary cases to other persons, often members of the same household.)

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.

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	+	–	+		+	–		pendg	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

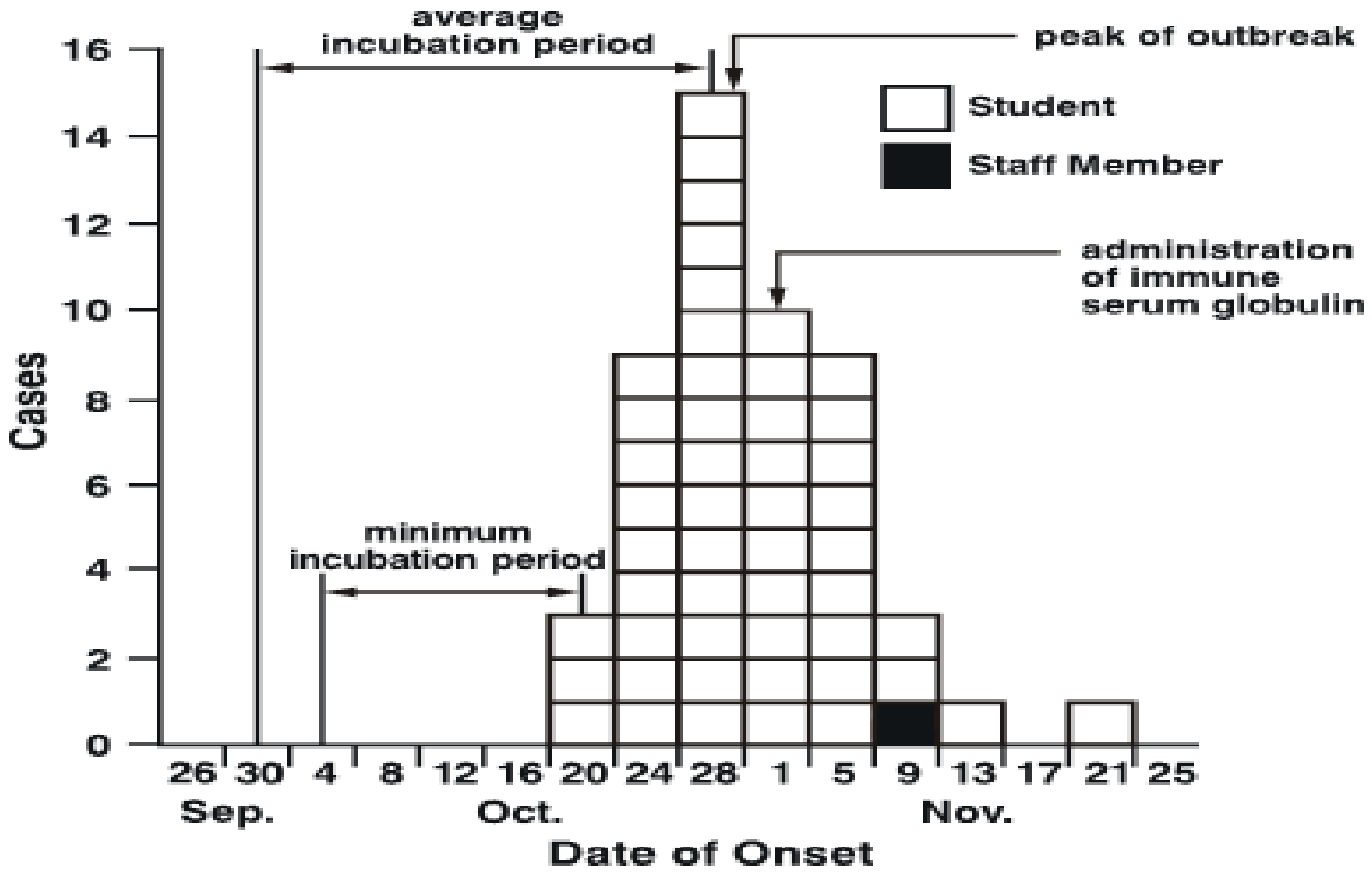
To identify the **likely period of exposure** from an epidemic curve

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 Epidemic

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

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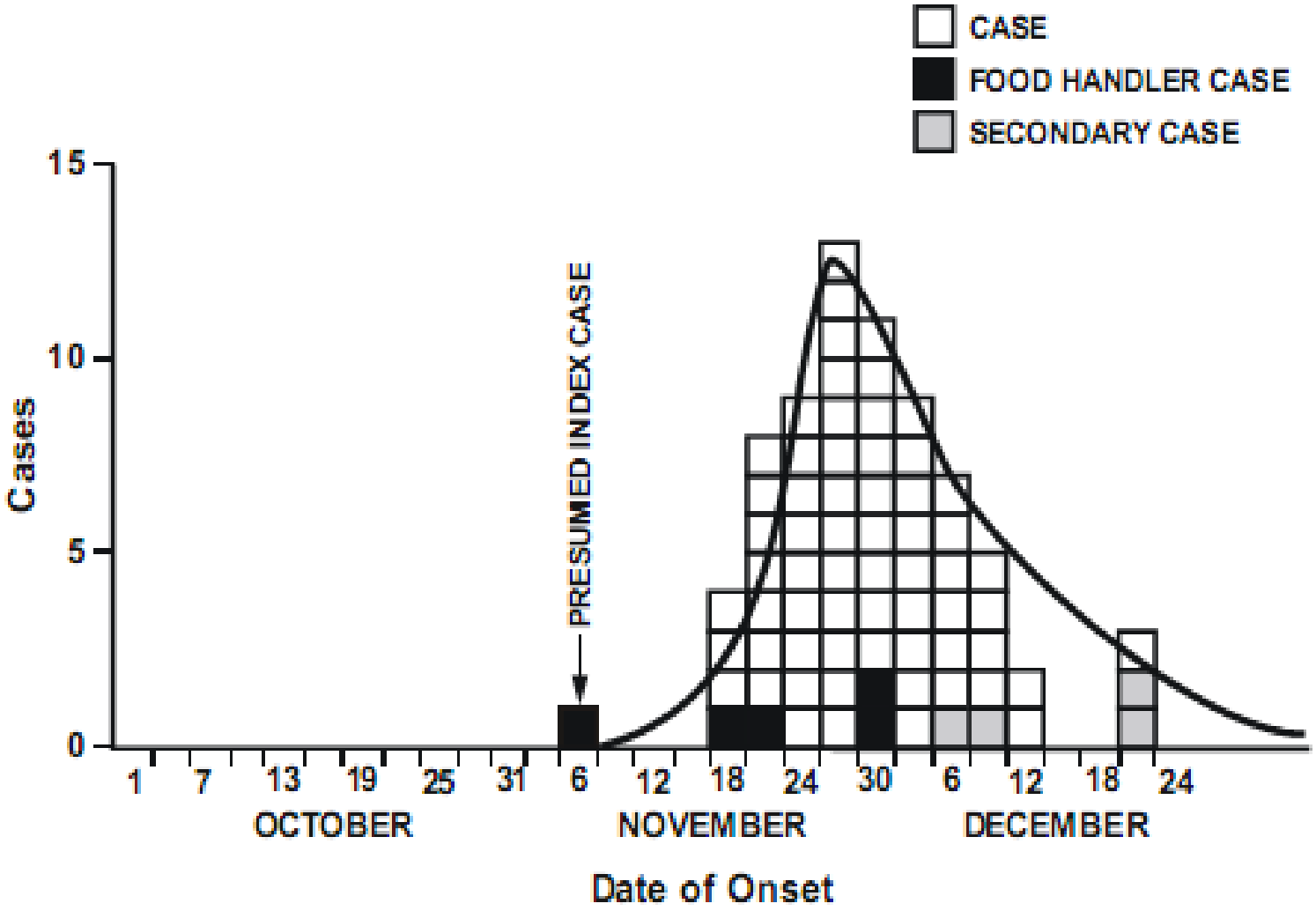
Example of common source outbreak with point source exposure: Hepatitis A cases by date of onset, Fayetteville, Arkansas, November-December 1978, with log-normal curve superimposed



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

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NHS Lothian

think Measles

It's not just a kids' problem

Teenagers, young adults and adults who have no or incomplete immunisation may be at risk of Measles.

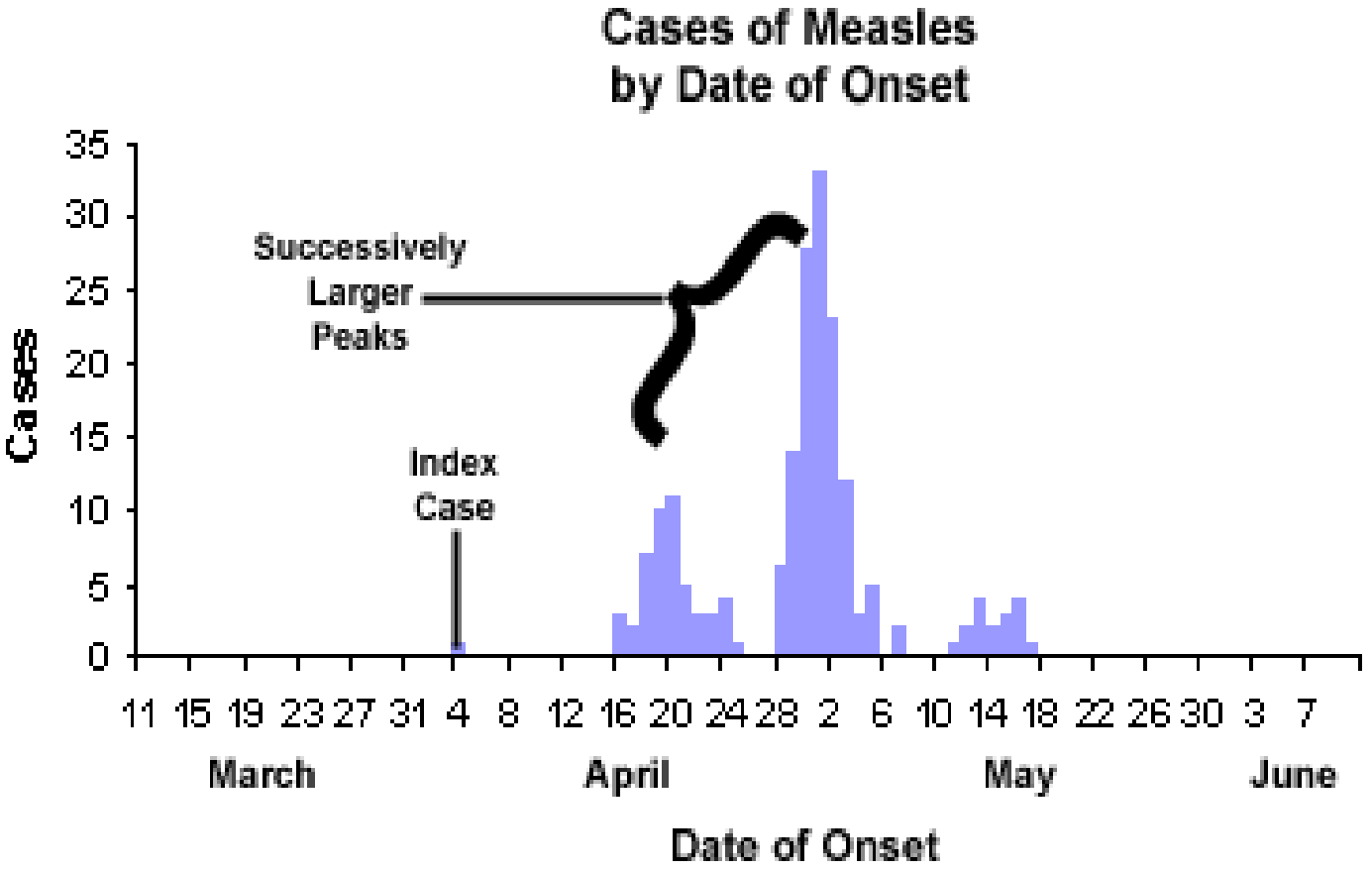
Symptoms include:

- **High fever (temperature over 38ºC)**
- **Rash – sometimes starting around the eyes**
- **Sore, red eyes (Conjunctivitis)**
- **Cough**
- **Flu like symptoms**

Please advise your nurse or doctor now if you are unsure about or have not had your MMR immunisations.

For more information go to **www.immunisationscotland.org.uk**

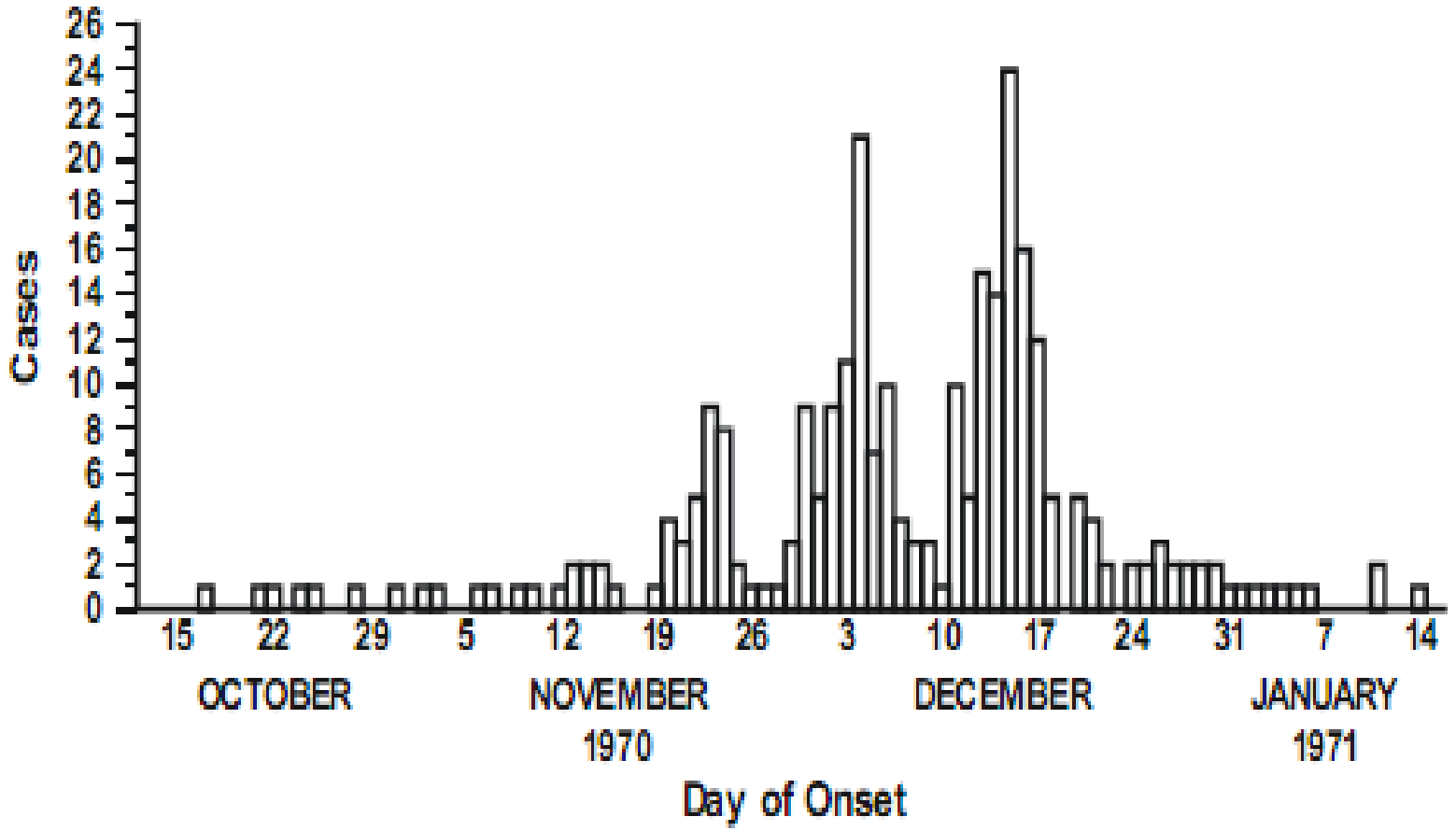
Adapted from Public Health England May 2016 Campaign


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

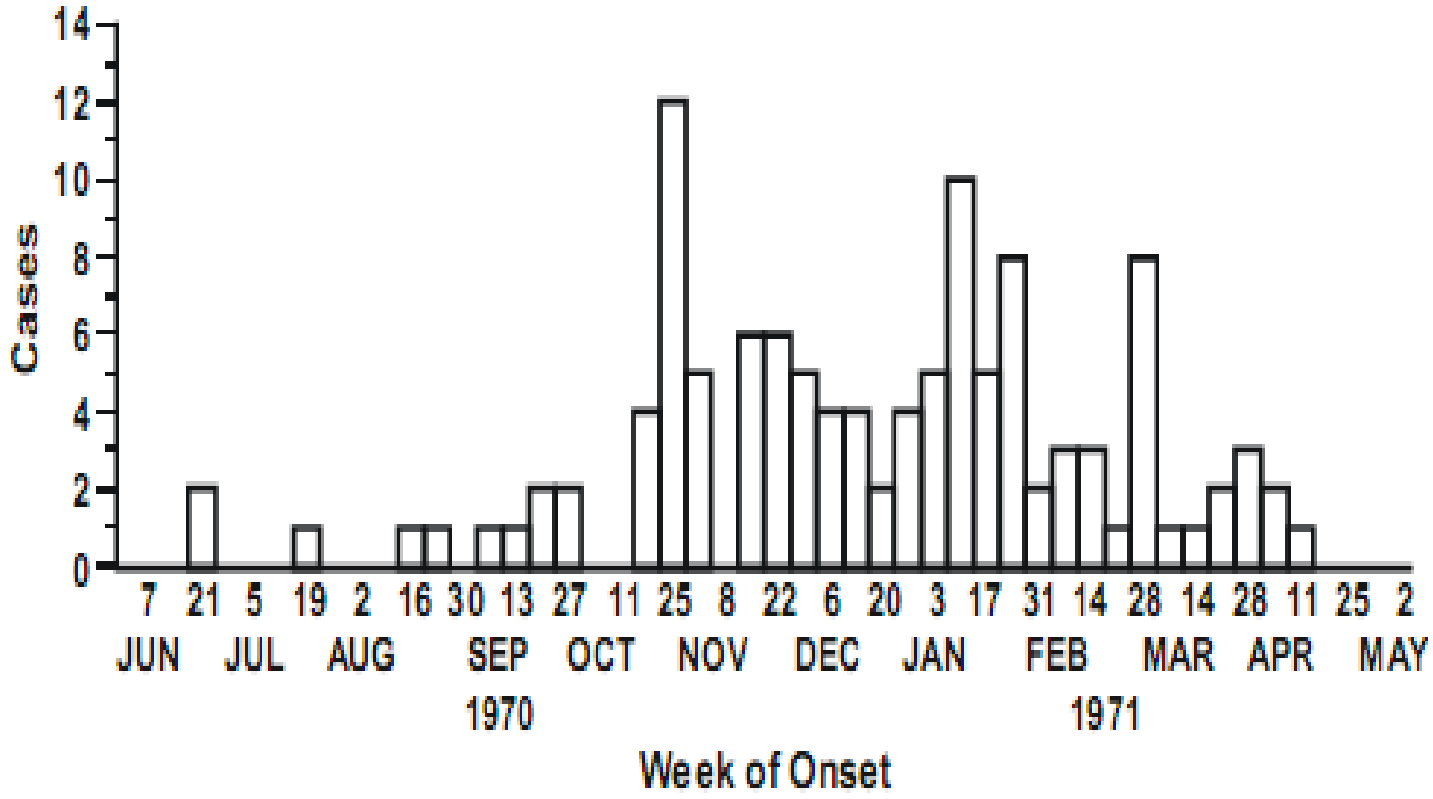
Occurs when a common source epidemic is followed by person-to-person contact and the disease is spread as a propagated epidemic.

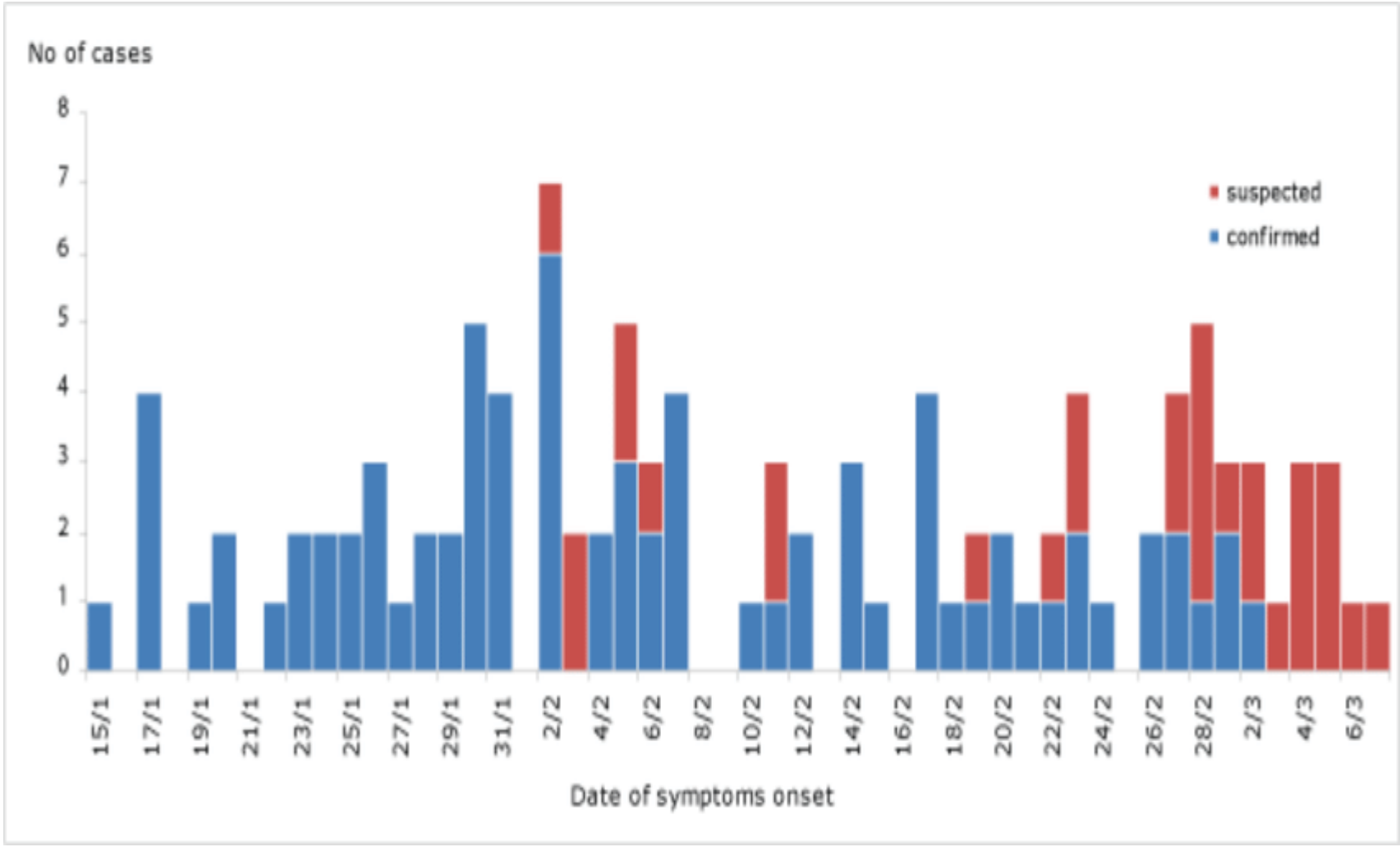
Example of the classic epidemic curve of a propagated epidemic: Measles cases by date of onset, Aberdeen, South Dakota, October 15, 1970-January 16, 1971



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




No of cases
8
7
6
5
4
3
2
1
0
suspected
confirmed
15/1
17/1
19/1
21/1
23/1
25/1
27/1
29/1
31/1
2/2
4/2
6/2
8/2
10/2
12/2
14/2
16/2
18/2
20/2
22/2
24/2
26/2
28/2
2/3
4/3
6/3
Date of symptoms onset

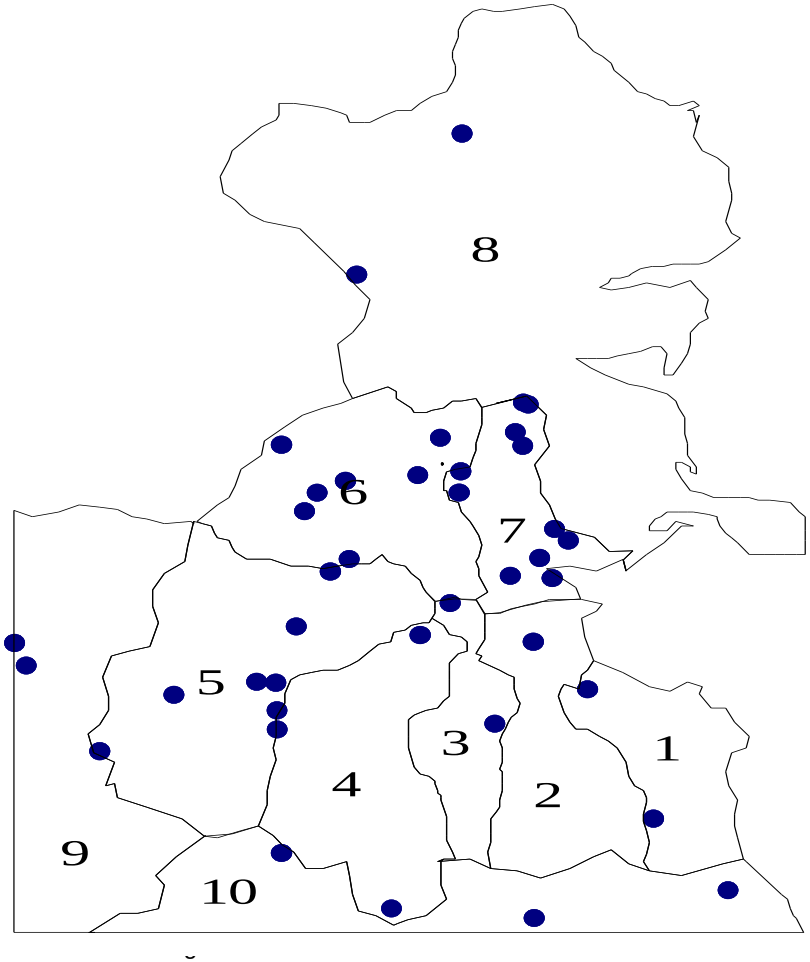
PLACE

The accurate characterization of an epidemic involves defining the location of all cases, because a geographic clustering of cases may provide important clues.

Usually, however, the geographic picture is not sufficient by itself, and other data are needed to complete the interpretation.

Spot maps that show where each affected person lives, works, or attends school is helpful in solving an epidemic puzzle.

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

The use of spot maps currently is limited in outbreak investigations because these maps show only the numerator (number of cases) and do not provide information on the

denominator (number of persons in the area).

Epidemiologists usually prefer to show **incidence rates by location**, such as

- by hospital ward (in a hospital infection outbreak),
- by work area or classroom (in an occupational or school outbreak), or
- by block or section of a city (in a community outbreak).

PERSON

Knowing the characteristics of persons affected by an outbreak may help clarify the problem and its cause.

Important characteristics include age; gender; race; ethnicity; religion; source of water, milk, and food; immunization status; type of work or schooling; and contacts with other affected persons.

5

Test Hypotheses

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Laboratory studies are important in testing epidemiologic hypotheses and may include one or more of the following:

1- Cultures from patients and, if appropriate, from possible vehicles, such as food or water

2- Stool examinations for ova and parasites

3- Serum tests for antibodies to the organism suspected of causing the disease (e.g., tests of acute and convalescent serum samples to determine if there has been an increase in antibodies to the organism over time)

4- Tests for non-microbiologic agents, such as toxins or drugs

6

Initiate Control Measures

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Four common types of intervention are used to control an outbreak

1 **Sanitation** often involves modification of the environment.

- Sanitation efforts may consist of removing the pathogenic agent from the sources of infection (e.g., water, food);

- removing the human source of infection from environments where he or she can spread it to others (quarantine); or

- preventing contact with the source, perhaps by cleaning the environment or removing susceptible people from the environment (evacuation).

2 **Prophylaxis** implies putting a barrier to the infection, such as a vaccine, within the susceptible hosts.

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3 **Diagnosis and treatment** are performed for the persons who are infected so that they do not spread the disease to others.

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4 Control of disease vectors

7

Follow-up Surveillance to Evaluate Control Measures

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No medical or public health intervention is adequate without follow-up surveillance of the disease or problem that initially caused the outbreak.

The importance of a sound surveillance program not only involves detecting subsequent outbreaks but also evaluating the effect of the control measures. If possible, the surveillance after an outbreak should be active because this is more reliable than passive surveillance

Thank You