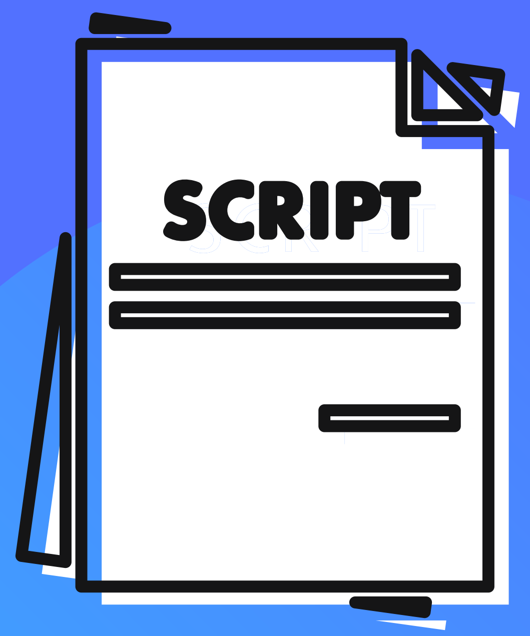
Yarmouk University

Community Medicine

Lec. 11 - Outbreak Investigation

Written By : Group H3



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Outbreak investigation

MED 410

Lec. 14

Dr. Ola Soudah

So how are outbreaks uncovered?

- Outbreaks may come to the attention of health professionals through a report from :
  - Routinely collected public health surveillance reports.
  - Clinicians, infection control practitioners, or laboratories about one or cluster of cases.
  - Patients or community public health partners.

From the record

- the most famous example of clinical investigations is outbreak investegations . Which means that the steps you are going to learn about outbreak Investigations are the same ones of clinical invsetigations.
- What do you mean by “outbreak”: it is a sudden rise of cases.
- Survielince is routinly done, Clinicians play an important role in reporting, along aside with laboratories
- To check for reportable diseases in Jordan visit the ministry of health website

When do outbreaks are investigated?

- The decisions regarding whether and how extensively to investigate a potential outbreak depend on a variety of factors.
- **Factors include:**
  - The severity of the illness,
  - The number of cases,
  - The source,
  - Mode or ease of transmission,
  - The availability of prevention and control measures.

More than 800 hospitalised in Jordan food poisoning outbreak

Child dies after surge of cases that health minister linked to single restaurant offering cheap meal deal

▲ Hundreds of extra doctors and nurses have b
outbreak. Photograph: Muhammad Hamed/Reuters

Jordan: Expired meat caused mass food poisoning

Boy died, 826 others were hospitalised after eating shawarma

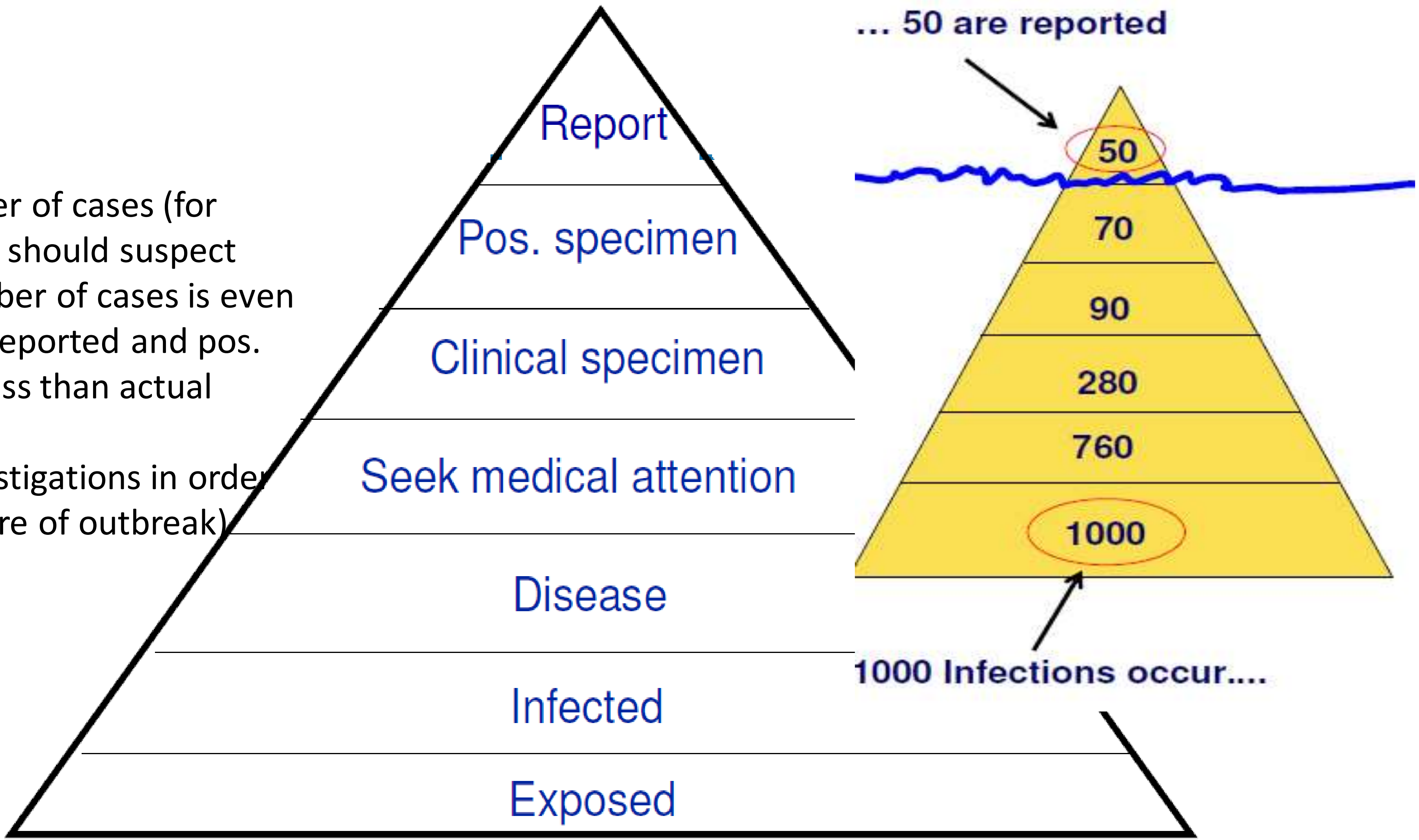
Published: August 02, 2020 18:41
Khitam Al Amir, Senior Staff Writer

From the record

- How do we know there is an outbreak? We observe a clustring of cases. An example is food poisoning outbreak in certain restaurants.
- (the clusters of cases is the first alarm of case outbreak)
- The decisions regarding whether and how extensively to investigate a potential outbreak depend on a variety of factors. (not every outbreak needs an investigation, how we decide relays on several factors which includes
  - The severity of the illness,
  - The number of cases,
  - The source, (do cases have the same source?)
  - Mode or ease of transmission,
  - The availability of prevention and control measures

The epidemiologic iceberg

When I have a cluster of cases (for example 50 cases), I should suspect that the actual number of cases is even higher (detection (reported and pos. specimen) is even less than actual numbers).
That's why I do investigations in order to see the real picture of outbreak)



Why outbreak investigation is important?

- **To control** the outbreak.
- **To prevent** future outbreaks
- **To prepare** by providing training opportunities
- To provide mandated services, policies and laws
- To strengthen surveillance at local level (covid 19 wasn’t part of the surveillance before the outbreak but it became one)
- To advance knowledge about a disease (understand disease characteristics and mode of transmission)

Components of Effective Outbreak Management

- Anticipation/Prediction (Surveillance should predict outbreaks before they even occur)
- Preparedness
- Early warning/Surveillance
- Effective and co-ordinated response

A good field investigator must be a good manager and collaborator as well as a good epidemiologist, because most investigations are **conducted by a team** rather than just one individual.

ليست حصرا على قطاع صحي معين انما هي عمل منسجم بين مختلف الجهات

Anticipation/Prediction

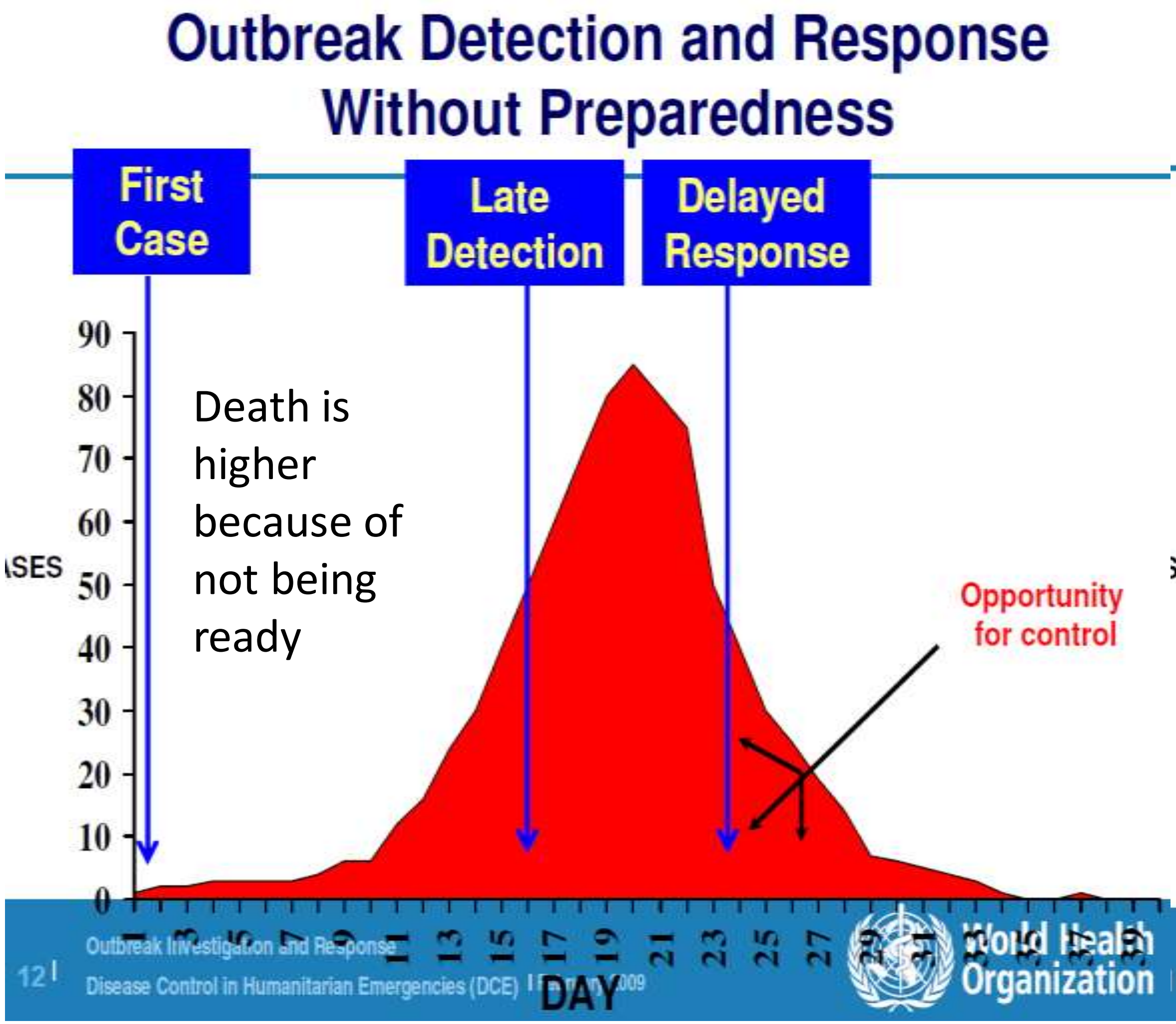
- بيل جتس استخدم computer model بالاعتماد على SARS بعمل stimulations لحتى يشوف متى ال breakالقادم وتوقع انه حيكون بعد عدد من السنين عن طريق دراسة سلوك الناس اللي اصيبو بSARS.
- فهو عمل predictions based on surveillance وتوقع covid 19

Covid-19: New scientific model can predict virus peaks of contamination in Europe

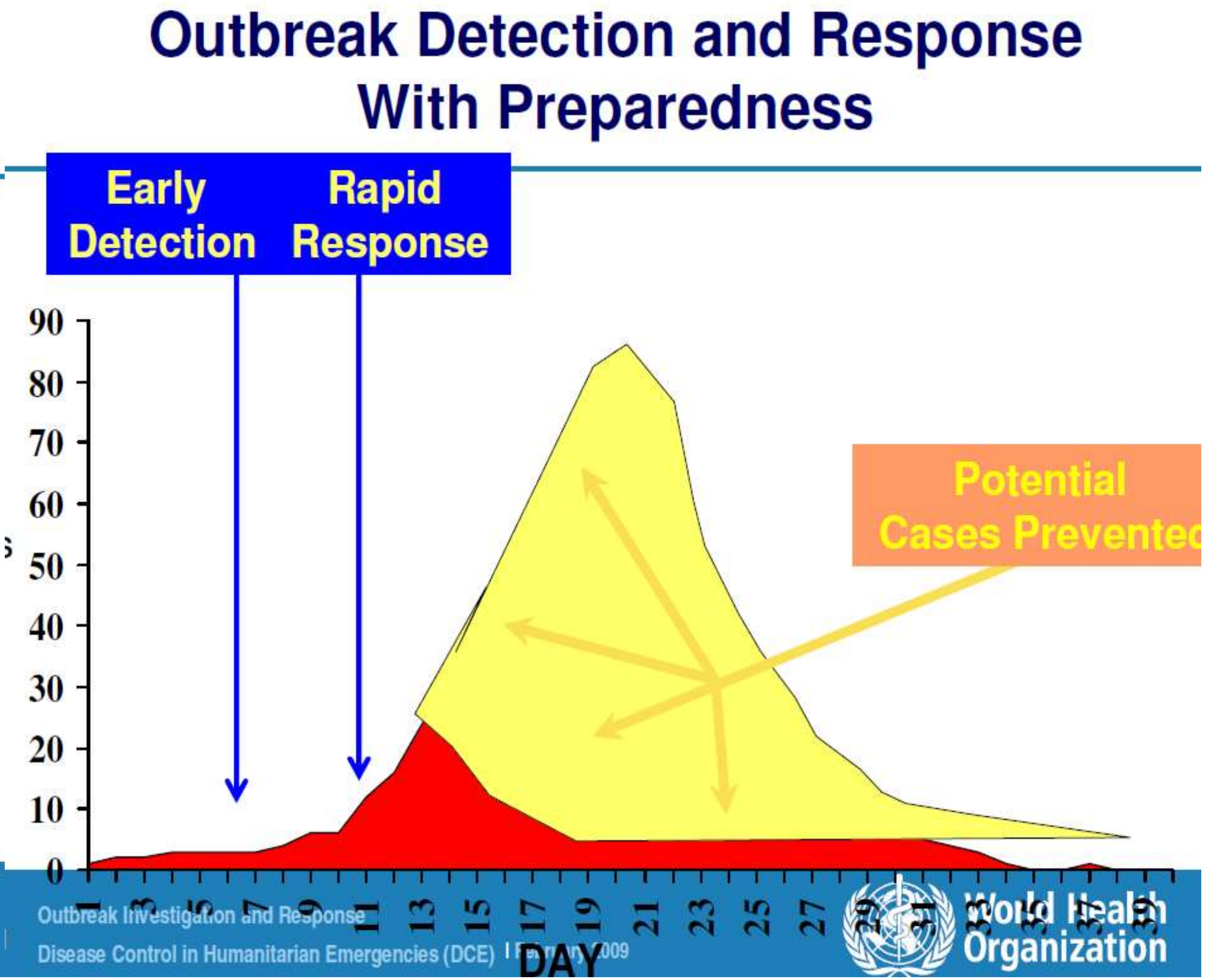
Issued on: 25/09/2020 - 17:26 Modified: 25/09/2020 - 17:29

Preparedness

Is to know what to do, the readiness of outbreak, what is the steps we need to follow when outbreaks occur,



Death is higher because of not being ready



Early warning/ Surveillance

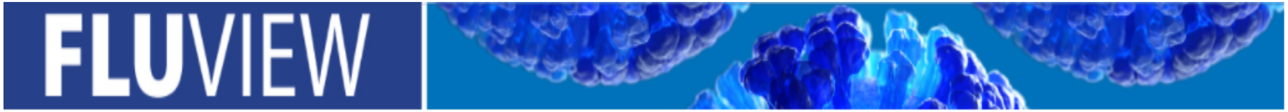
"Too often infectious outbreaks spread undetected due to gaps in surveillance at the community level. These gaps have contributed to tragic and unnecessary illness and loss of life, as we have seen over the past year," says senior author Jeffrey Shaman, PhD, a professor in the Department of Environmental Health Sciences at the Columbia Mailman School.

Early warning is now easier because the use of online reporting

Trump administration cut pandemic early warning program in September

- Predict project wound down three months before outbreak
- Project had identified 160 potentially dangerous coronaviruses
- Coronavirus - live US updates
- Live global updates
- See all our coronavirus coverage

▲ Medical staff move bodies from the Wyckoff Heights Medical Center to a refrigerated truck, New York, NY, USA - 03 Apr 2020



U.S. Influenza Surveillance System: Purpose and Methods

The Influenza Division at CDC collects, compiles and analyzes information on influenza activity year-round in the United States. FluView, a weekly influenza surveillance report, and FluView Interactive, an online application which allows for more in-depth exploration of influenza surveillance data, are updated each week. **The data presented each week are preliminary and may change as more data is received.**

On This Page

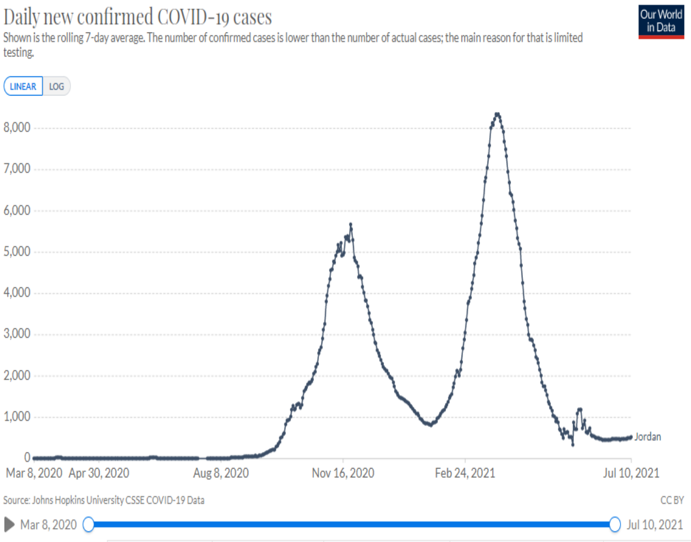
U.S. World Health Organization (WHO) Collaborating Laboratories System and the National Respiratory and Enteric Virus

- This surveillance system is considered as real time monitoring (example for early warning).

https://www.cdc.gov/flu/weekly/overview.htm

All institutions in the country should be coordinated against the outbreak.

Effective and co-ordinated response



https://ourworldindata.org/coronavirus/country/jordan

THE JORDAN TIMES

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Home » Local » Schools suspended, borders closed, gatherings banned as gov't responds to continued coronavirus spread

Schools suspended, borders closed, gatherings banned as gov't responds to continued coronavirus spread

By Maram Kayed , Petra - Mar 14,2020 - Last updated at Mar 14,2020

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AMMAN — Prime Minister Omar Razzaz announced on Saturday a set of new measures taken by the government to address the global outbreak of the novel coronavirus "in light of rapid global developments and with the aim of protecting the homeland and citizens".

In a press statement, the government announced that all educational institutions, including kindergartens, nurseries, schools, universities, colleges, training institutions and institutes, are to be closed as of Sunday, March 15, for a period of two weeks.

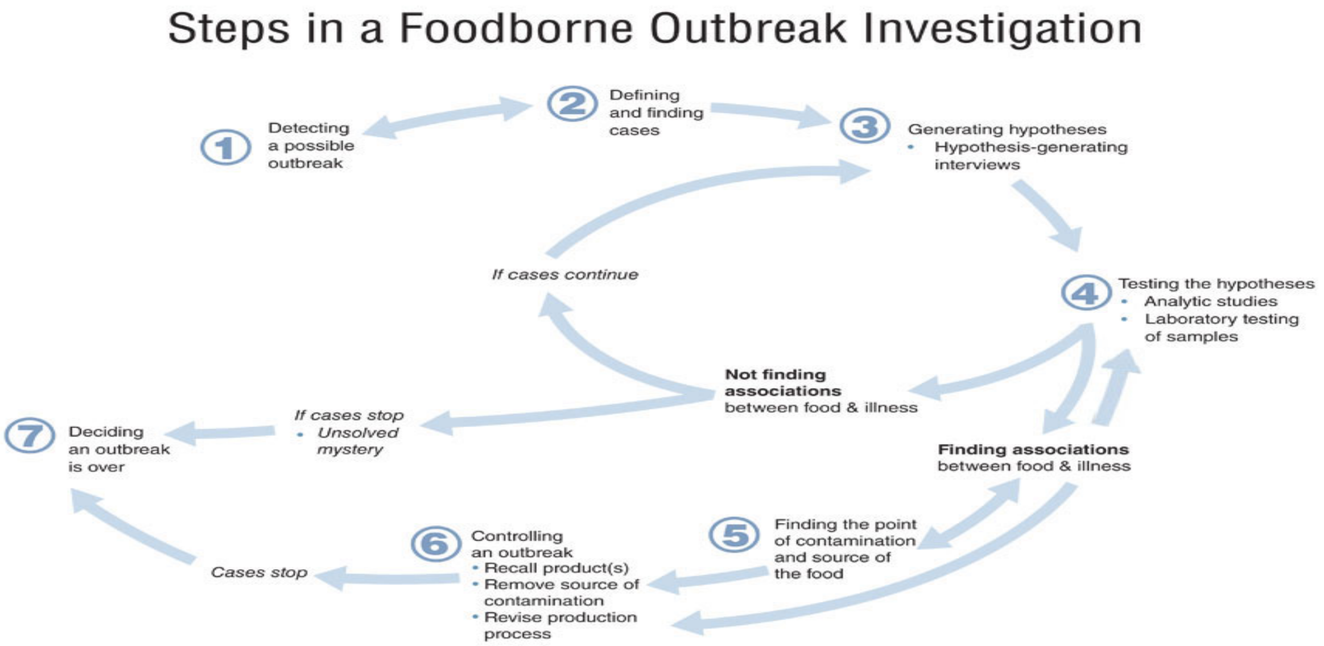
- There are several governmental institutions participate in the outbreak controlling other than the ministry of health, this is called —> comprehensive response.

STEPS IN AN OUTBREAK INVESTIGATION

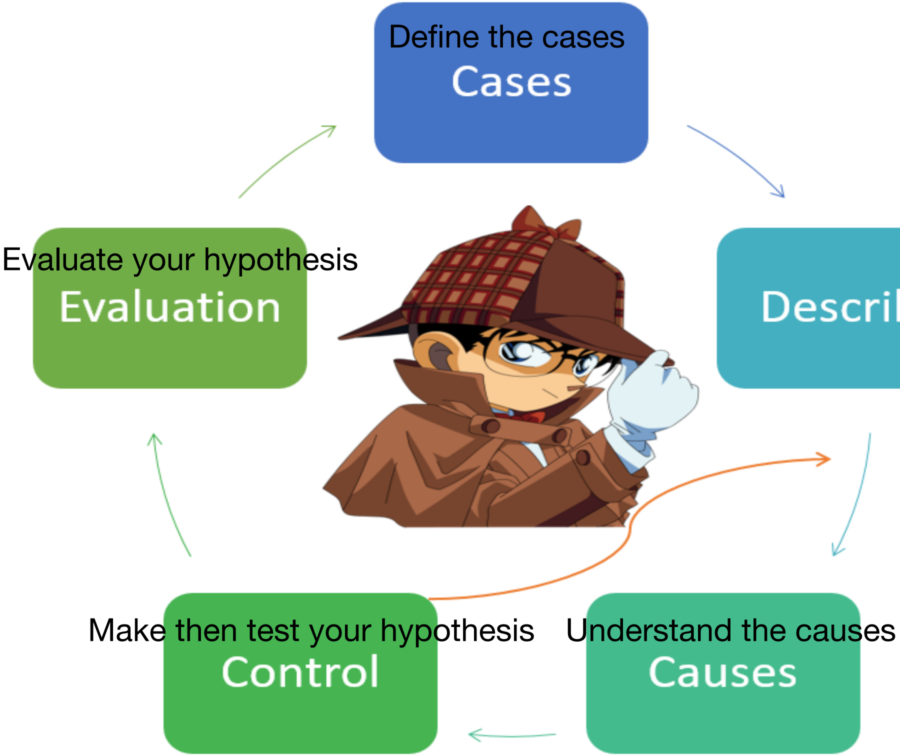
1. Prepare and plan for the investigation → A plan should be found in the ministry of health that control the outbreaks.
2. Confirm the existence of an outbreak—verify the diagnosis —> Clear definition of outbreak
3. Identify and count cases and exposed persons
    1. Select a case definition
    2. Identify cases, population at risk, and controls
4. Choose a study design —> Quantitative, quantitative, or mix
5. Find cases systematically and record information **(Tracing)**
6. Tabulate the data in terms of time, place, and person —> Produce data
7. Collect specimens for laboratory analysis
8. Conduct an environmental investigation
9. Institute control measures
10. Formulate and test hypotheses —> test your hypothesis using epidemiological method and research method
11. Conduct additional systematic studies
12. Communicate the findings

- Note: The outbreak investigation is similar to the doing of pilot study (observe —> collect data —> make hypothesis —> test hypothesis —> evaluate hypothesis).

- Outbreak investigation **is a systematic process** of evaluating data to form hypotheses, and then collecting additional data to test the hypotheses.



Simply


Define the cases
Cases
Describe
Understand the causes
Causes
Make then test your hypothesis
Control
Evaluate your hypothesis
Evaluation

Defining a case

It is a decision criteria (you decide who has the disease and who doesn't have).

- **A case definition** is **a set of standard criteria** for classifying whether a person has a particular disease, syndrome, or other health condition.

  - **A Case definition:** is the standard set of criteria by which we decide if a person has the disease or not (classify sick population from normal ones').

- Use of an agreed-upon standard case definition ensures that every case **is equivalent.** The disease definition should be standardized on all cases, you should avoid variations in the disease definition between the cases + the disease definition should be agreed by the medical community.
- Furthermore, the number of cases or rate of disease identified in one time or place **can be compared** with the number or rate from another time or place.

Components of a case definition for outbreak investigations

- **A case definition consists of clinical criteria and, sometimes, epidemiologic criteria.**

1 • **The clinical criteria** usually include confirmatory laboratory tests, if available, or combinations of symptoms (subjective complaints), signs (objective physical findings), and other findings.

The clinical criteria depend on the specialist doctors (they determine the signs and symptoms of the disease and they determine the lab tests that are used in the disease diagnosis).

2 • **Epidemiologic criteria** usually to specify limits on **time, place, and/or person** than those used for surveillance. —> Epidemiological criteria = When, Who, and Where.

Components of a case definition for outbreak investigations

Could be
- both
- clinical criteria only or epidemiologic criteria

- A case definition consists of clinical criteria **and, sometimes,** epidemiologic criteria.

  - **The clinical criteria** usually include confirmatory laboratory tests, if available, or combinations of symptoms (subjective complaints), signs (objective physical findings), and other findings.
    - physicians determine it
    - Used in order to diagnose the disease
  - **Epidemiologic criteria** usually to specify limits on **time, place, and/or person** than those used for surveillance.
    - who , when , where ???

      》 In Epidemiology we describe the disease by time , place and person characteristics

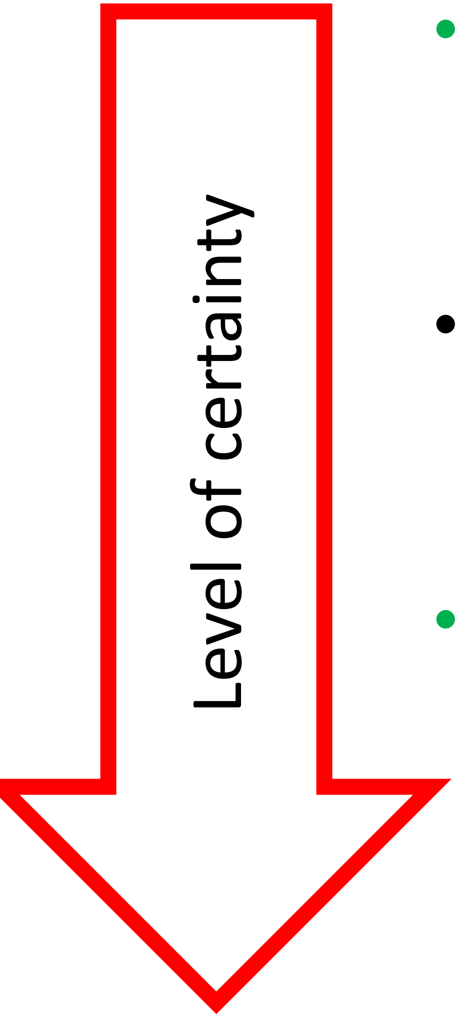
Criteria of good case definition

- Must be easily applied by health workers
  - Preferably does not require laboratory results (if possible)

- Must be standardized (agreed on and used by all authorities)

- Should be relatively sensitive
  - Detect most cases

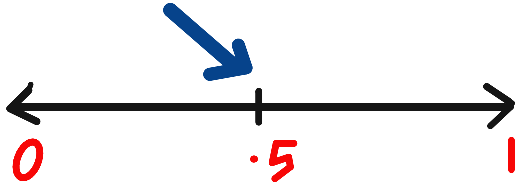
▪ Can detect all cases
▪ sensitivity :
- true positive rate (detect all positive cases)
- it is not accuracy



Sometimes define **levels of certainty** regarding diagnosis;

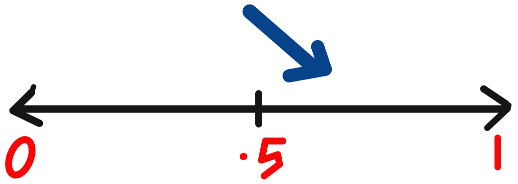
- **Suspect case (maybe a case/doubted about):** suggestive clinical signs but does not fit case definition

  - around .5



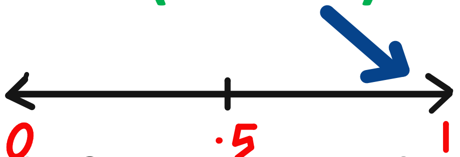
- **Probable case (likely a case):** fits all components of *clinical* case definition

  - Closer to 1



- **Confirmed case (a case):** laboratory confirmed

  - It is 1



- Unless it is infectious disease
  - ex. PCR to HIV
- Although, because of testing error there is no absolute

No one case definition is the **absolutely correct** case definition.

One investigator could decide to include those with symptoms but without testing as suspect or probable cases, while another investigator could exclude them.

WHO COVID-19: Case Definitions

Clinical Criteria:

- Acute onset of fever **AND** cough;

OR

- Acute onset of **ANY THREE OR MORE** of the following signs or symptoms: Fever, cough, general weakness/fatigue, headache, myalgia, sore throat, coryza, dyspnoea, anorexia/nausea/vomiting, diarrhea, altered mental status.

Epidemiological Criteria (contact):

- Residing or working in an area with high risk of transmission of virus (such as camp and camp-like settings) anytime within the 14 days prior to symptom onset;

OR

- Residing or travel to an area with community transmission anytime within the 14 days prior to symptom onset;

OR

- Working in any health care setting, including within health facilities or within the community; any time within the 14 days prior of symptom onset.

OR • **contact with confirmed case**

Case classification:

Suspected cases (May has the disease may not)

- A person who meets the clinical AND epidemiological criteria. Did not test for disease
- A patient with severe acute respiratory illness.
- Asymptomatic person not meeting epidemiologic criteria **with** a positive SARS-CoV-2 Antigen-RDT2.

Probable cases (most likely has the disease)

- A patient who meets clinical criteria above **AND** is a contact of a probable or confirmed case, or linked to a COVID-19 cluster.
- A suspect case with chest imaging showing findings suggestive of COVID-19 disease.
- A person with recent onset of anosmia (loss of smell) or ageusia (loss of taste) in the absence of any other identified cause.
- Death, not otherwise explained, in an adult with respiratory distress preceding death **AND** was a contact of a probable or confirmed case or linked to a COVID-19 cluster.

Confirmed cases (has the disease)

- A person with a positive Nucleic Acid Amplification Test (NAAT). PCR positive
- A person with a positive SARS-CoV-2 Antigen-RDT **AND** meeting either the probable case definition or suspect criteria.
- An asymptomatic person with a positive SARS-CoV-2 Antigen-RDT who is a contact of a probable or confirmed case.

- we do PCR directly
- in ER if probable order PCR

Collect Risk Information (Data)

Type of data should be collected:

- **Identifying information**. A name, address, and telephone
- **Demographic information**. Age, sex, race, occupation
- **Clinical information**. Signs and symptoms
- **Risk factor information**. This information must be tailored to the specific disease in question.

Find cases systematically and record information

→ ▪ To uderstand how the disease transmitted (ROT)

- Investigators may conduct what is sometimes called stimulated or enhanced **passive surveillance** by sending a letter describing the situation and asking for reports of similar cases. reports from hospitals
- Alternatively, they may conduct **active surveillance** by telephoning or visiting the facilities to collect information on any additional cases. like sanad app
- In some outbreaks, public health officials may decide to alert the public directly, usually through the local media.

Ex. Active surveillance

Data collection tool

quantitative or qualitative or mix

Some times it becomes a routine when cases are widely spread

Gastroenteritis Case Report Form

Maryland Department of Health & Mental Hygiene
Epidemiology & Disease Control Program

Travel

Did patient travel to another state or country in the 2 weeks prior to symptom's onset? ☐ Yes ☐ No

Where ______________ When ______________

Animal Contact

Did patient have contact with the following animals [ ] hours/days* prior to symptom's onset?

☐ Dogs ☐ Parakeets ☐ Cows
☐ Cats ☐ Chickens ☐ Turtles
☐ Ducks ☐ Other ______________

Food History

Did patient eat any of the following within [ ] hours/days* prior to onset of illness?

	Yes	No	Unknown
1. Eggs			
a. Cooked eggs: scrambled, hard fried, other	☐	☐	☐
b. Undercooked eggs: poached, soft, scrambled, sunny side up, other	☐	☐	☐
c. Raw eggs: egg nog, Caesar salad, hollandaise sauce, meringue, bearnaise, other	☐	☐	☐
2. Raw or undercooked poultry (chicken, turkey)	☐	☐	☐
3. Raw or undercooked red meat	☐	☐	☐
4. Raw (unpasteurized) milk	☐	☐	☐
5. Homemade/unpasteurized cheese	☐	☐	☐
6. Raw or undercooked fish/shellfish	☐	☐	☐

Other Exposure

Within [ ] hours/days* prior to onset of symptom(s) did patient:

	Yes	No	Unknown
1. Handle raw poultry?	☐	☐	☐
2. Have exposure to a day care or nursery?	☐	☐	☐
3. Have household member or sexual partner with similar symptoms?	☐	☐	☐
4. Hike, camp, fish, swim?	☐	☐	☐
5. Drink from a spring, stream or lake?	☐	☐	☐
6. Take antibiotics in month prior to onset of illness?	☐	☐	☐

Disposition

Work or school restrictions? ☐ Yes ☐ No

Is yes, specify ______________

Was patient advised of appropriate precautions? ☐ Yes ☐ No

Is yes, how?

☐ Telephone ☐ Fact Sheet ☐ In Person ☐ In Writing

Food History for Food-borne Diseases. List the foods eaten within [ ] hours/days* prior to onset:
[12 hours] [24 hours] [48 hours] [72 hours]

Breakfast ______________

Lunch ______________

Dinner ______________

Household Members. List household contacts, even if asymptomatic; give onset if symptomatic:

Name	Age	Relationship to Case	Symptoms Y/N?	Onset of Symptoms	lab Testing (Date Collected, Result)	Occupation/Employer School/Grade, Day Care

Summary of Investigation - action taken on patients and contacts - outcome:

____

Name of person completing form ______________ Date of Interview ______________

*** Use the incubation period which applies to the agent/disease under investigation:** e.g., bacillus cereus (1–24 hours), Campylobacter (1–10 days), Clostridium (6–24 hours), E. coli (9–60 hours), Giardia (5–25 days), Listeria (3–70 days), Salmonella (6–72 hours), Shigella (12–96 hours), Staphylococcus (30 min.–7 hours), Typhoid fever (1–3 weeks), Vibrio (4–96 hours), Viral agent (24–72 hours).

Data Collection for each case …. Line-Listing

We may use raw data to build case definition

A line listing of 26 persons with symptoms of abdominal pain and/or diarrhea is presented below. Using the information in the line listing, develop a case definition that you might use for the outbreak investigation. [Note that persons infected with *E. coli* O157 typically experience severe abdominal cramps, bloody diarrhea, and low grade fever after a 1– to 8–day incubation period (usually 2–4 days).]

Table 6.4 Line Listing of 26 Persons with Symptoms — School District A, December 2003

Patient #	Grade & School	Age	Sex	Tour	Onset Date	Severe Abdominal Pain?	No. Times Diarrhea	Stool Testing
1	10 — 1	17	M	A	Dec. 8	Y	3	Not done
2	10 — 1	16	F	A	Dec. 6	N	1	Negative
3	10 — 2	16	M	A	Dec. 10	Y	2	*E. coli* O157
4	10 — 2	17	F	A	Dec. 8	Y	3	Not done
5	10 — 2	16	F	A	Dec. 5	Y	8	*E. coli* O157
6	10 — 2	16	M	A	Dec. 6	Y	3	Not done
7	10 — 3	17	M	A	Dec. 7	Y	4	Not done

- The CDC has developed the **EpiInfo** computer software program, in which questionnaires can be created, data entered and analyzed, and line listings produced.
  - Epidemiologic information tool

- This program is currently in worldwide use because it is free, is easy to use, and is designed specifically for surveillance systems and outbreak epidemiology.

https://www.cdc.gov/epiinfo/index.html

Epidemic curve, or epi-curve

- Epidemiologic categorization based on
  - place
  - time

- **Spot maps of cases by residence,** site of care, or location in a facility can help explain the occurrence of cases.

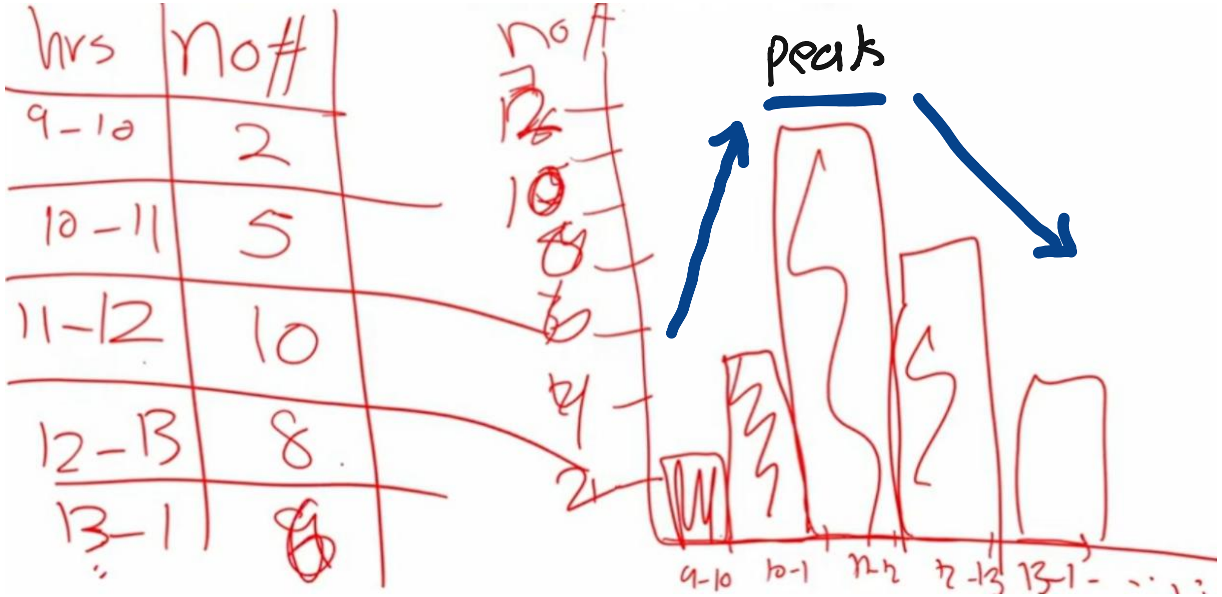
- **Epidemic curve:** depicts the frequency of cases over time by plotting the number of cases by date or time of onset.

  - This provides information regarding the nature and time course of the outbreak.
  - The epi-curve can **allow an estimate of the incubation time** of the infection, which may help in the identification of the organism.

How to draw an epi-curve?

- **Simply, it is a histogram** that consists of number of cases over time period (hours , days, months).
  - hours > in cases like poisoning case
  - months > in seasons variation
- ***Drawing an epidemic curve.*** To draw an epidemic curve, you first must know the time of onset of illness for each case.
  - For some diseases, date of onset is sufficient. For other diseases, particularly those with a relatively short incubation period, hour of onset may be more suitable.
- Using EXCEL: https://outbreaktools.ca/tools/documents/epidemic-curve-exercise/

- SO we have a table of cases for each time point.



Stratification – separating cases into categories such as:

- Exposures (e.g., those who attended an event versus those that did not)
- Geography (e.g., place of residence, patient location on hospital ward) Amman vs Irbid
- Personal characteristics (e.g., occupation – health care staff versus non-health care staff)

Key events that occur during an outbreak can be added to the epi curve Some examples include:

- Exposures (e.g., mass gathering event, implicated dinner)
- Public health measures (e.g., restaurant closure, product recall)
- Communications (e.g., media release warning public not to consume implicated food)

What do Epi-Curve tell us?

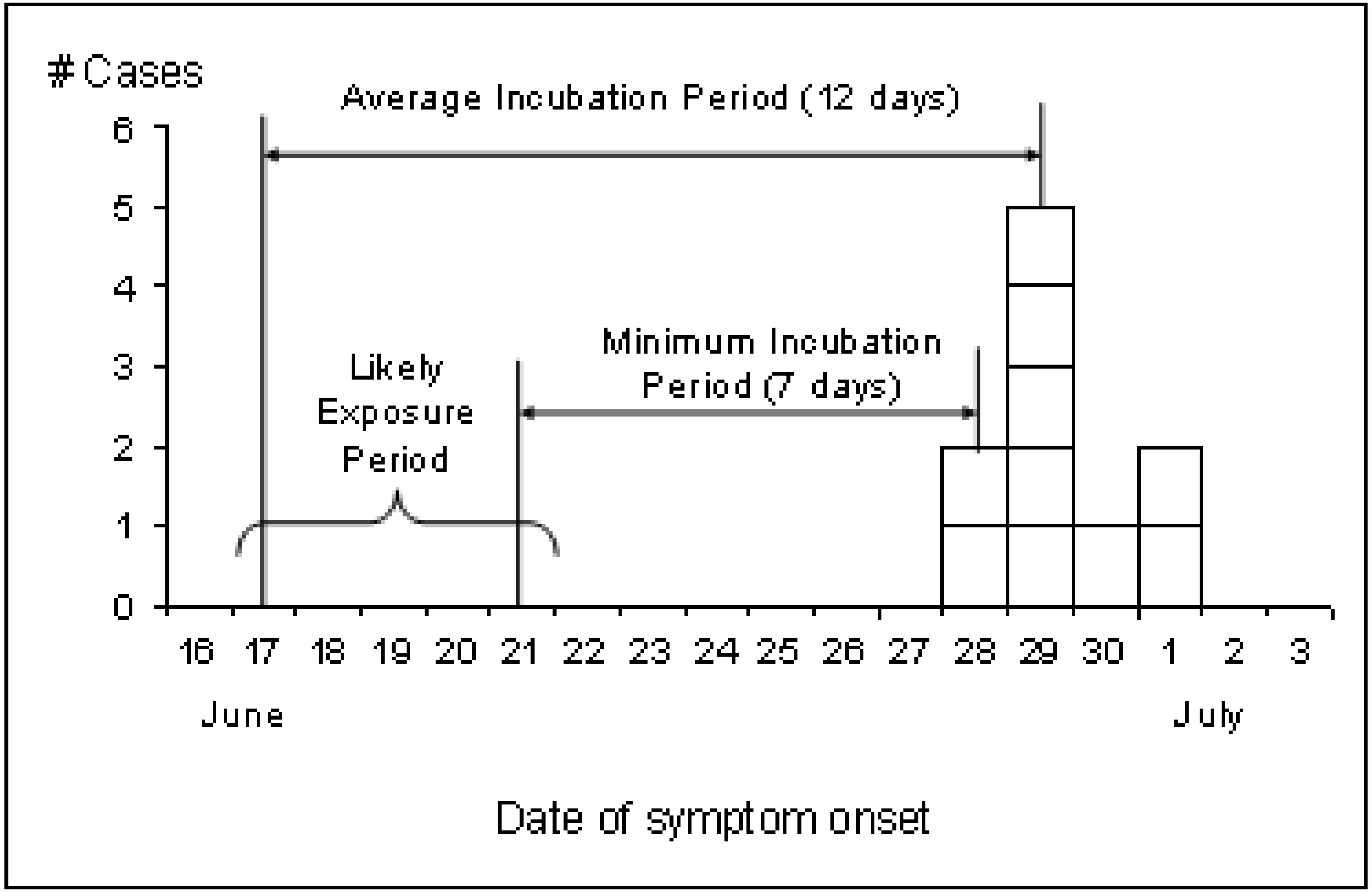
- **Size**
  - Whether it is increasing over time, stabilizing, or decreasing.

the size of the outbreak(number of cases)

كل ما كان عريض كل ما كانوا الافراد اكثر

- **Time component**
  - Start day.of the outbreak
  - End day.of the outbreak
  - Disease duration.
  - Outbreak peak.
  - Probable exposure period (not precise method). when the exposure for people happened we care about it in incubation period or to know the pathogen just by knowing the approximate incubation period
  - https://www.cdc.gov/training/quicklearns/exposure/

Probable exposure period



From the record:

if the incubation period is 7-12 days from the epi curve :

-the peak is 12 days so it starts in 12 June

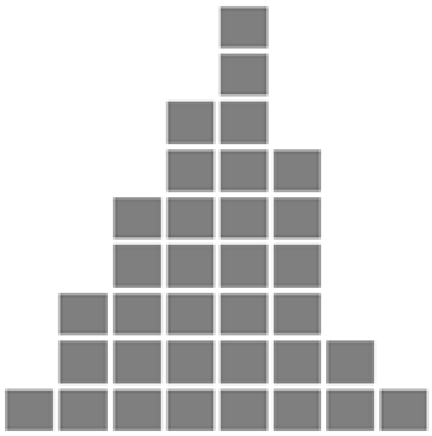
-the lower limit is 7 days so it starts in 21JUNE

so we can say that the exposure for the outbreak was from 12-21 June

وهيك قدرت اعرف متى الايام اللي صار فيها ال exposure

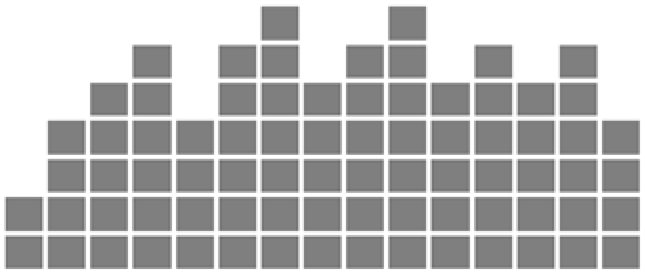
• Pattern of spread

- **Point source** – Persons are exposed to the same common source over a brief period of time, such as through a single meal or event attended by all cases; number of cases rise rapidly to a peak and falls off gradually; majority of cases occur within one incubation period.



Point source

- **Continuous common source –** Exposure is not confined to one point in time (prolonged over a period of days, weeks or longer); as such, cases are spread over a greater period of time depending on how long the exposure persists; lasts more than one incubation period.



Continuous source

from the record:

point source :one curve, one peak

زي التسمم الغذائي بمطعم بصير مرة وحدة بعدين بروح ما بيرجع مرة ثانية

when there is food poisoning from one restaurant.

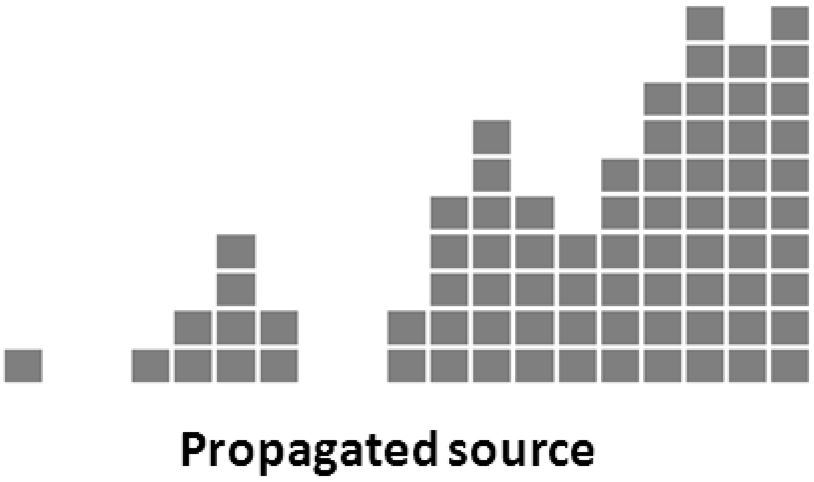
In chain restaurants, there is a factory that deliverers items for them,so the infection may not be related to one restaurant but to all restaurant chain or to all the restaurants that deal with a certain factory (the contamination source is the factory).

continuous common source: continuous of exposure of the disease there is no peak

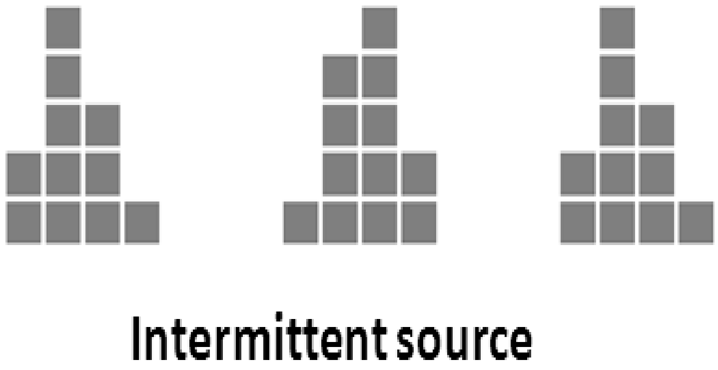
like waterborn disease we dont know the source of infection and the people still coming to the ER after drinking water

تقريبا بكون شكله مستقيم

- **Propagated source –** does not have a common source but instead caused by spread of pathogen from one susceptible person to another; transmission may occur directly (person-to-person) or via an intermediate host; tends to have a series of irregular peaks reflecting the number of generations of infection; multiple peaks separated by approx. one incubation period; e.g., **person-to-person spread** of shigellosis.



- **Intermittent –** similar to continuous but exposure is intermittent; multiple peaks – length: no relation to the incubation period (reflects intermittent times of exposure) e.g., contaminated food product sold over period of time



from the record

propagated source :specific for human , there is increase in cases even if there is multiple peaks but they propagate

mainly when it spread from person to person like in corona the curve was like that before vaccine

4مثلا وغيره بيعدي 5زي الانفلونزا الناس بيتحركوا وبيطلعوا من بيوتهم فشخص بيعدي وهكذا فهي زي الشبكة بتبلش بشخص وبصيروا ثنين وبضلوا يزيدوا الا اذا عملنا اشي يوقفها مثل التباعد الاجتماعي او الماسكات

in propagated source the line keeps propagating unless we take action to stop person-person transmission, like: social distancing and facial masks.

intermittent source :

-variation in the peaks (seasonal or annual etc)(peak -herd immunity -peak -herd immunity)

-it may reflect as intermittent time of exposure : means that the incubation period is so long that it takes time to manifest

In intermittent source there is variation in the peaks(peak-decline-peak-decline and so on).e.g.,the seasonal variation of the flu, when we make the curve based on the cases by year, the flu curve will have variation in the peaks(but if we plot the cases by day during winter on a curve it will be propagated).

What gives us an intermittent source curve shape if we take the cases by days?a disease with a long incubation period(the gaps between the peaks represent the incubation period).e.g., in food borne infections, the incubation period is 27 days, so we will have a cluster of cases and then after 27 days we will have another cluster of cases and so on if they continued eating the same contaminated item.

When do we notice the herd immunity in the curve?when we analyze the curve by year mainly.

a question from a student

The difference between the incubation period and the probable exposure period? The probable exposure period is the period in which we got exposed to the pathogen while the incubation period is the period after we get exposed and haven’t developed any symptoms yet.

Epidemiologic Map (Spot map)

- A spot map is a simple and useful technique for illustrating where cases live, work, or may have been exposed.

John Snow,

Photo: London School of Hygiene and Tropical Medicine

Cluster of Cholera Cases and Pump Site Locations

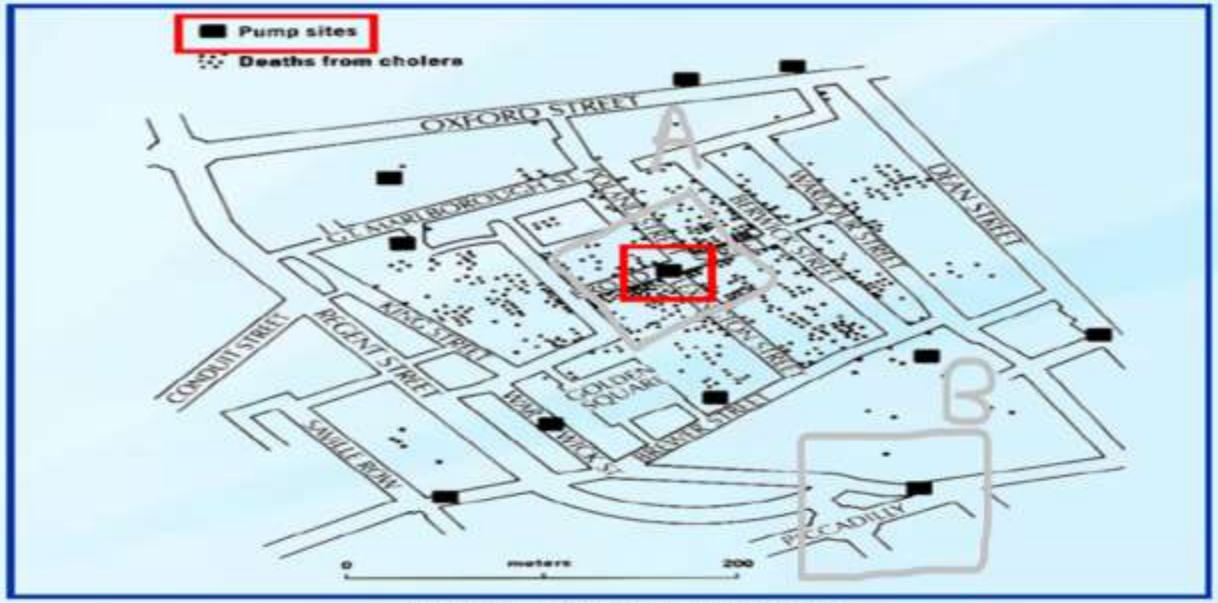


Image: The Geographical Journal

From the record,

- For the geographic explanation of the outbreak we use the "spot map"; we see the distribution of cases by area(it may be a neighborhood ,a small city or a number of cities).
- john snow is the person who invented the spot map(he is the father of geographical epidemiology).
- john snow and cholera: in London , there were water pumps in every street (the black squares on the picture above) and each pump was controlled by a specific company. So , as john snow was working in a hospital in that area , he noticed an increase in the number of cholera cases (cluster of cholera cases) which means there is an outbreak.
- As john mapped the cases based on the area, he continued to map the cases based on the street that they lived in. He found out that the cluster of cases in A was more than the cases in B.

From the record,

- In his period of time , the theory of infection wasn’t the germ theory but it was the miasma theory (the disease is the result of a contamination in the air , water or the ground) so he looked at the sources of water and found that all people who are diseased drink water from the pump in the red square .Then he went to the factory that pump water in that area and knew that they take water from the downstream of the river while the source of water in the other pump was from the upstream of the river and in the middle of the river there was a factory that throw the sewage in it .

- After that , he shut down the pump in the red sqaure and the number of cholera cases declined (he proved his theory that the water is the cause of the disease and controlled the cases without knowing the pathogen , but just by mapping the cases).

From the record,

- Mapping cases is important in environmental exposure mainly (air pollution , water contamination).

- Spot map is another tool in addition to the epi curve that can be used in order to solve an outbreak.

Other things to do in outbreak investigation:

Perform Laboratory Analysis

- To identify the etiologic agent, the collection of laboratory specimens needs to be appropriately timed. Examples of specimens include food and water samples, other environmental samples (e.g., air settling plates), and clinical specimens (e.g., stool, blood, sputum, or wound specimens) from cases and controls.

-Collect samples and perform lab analysis (test for positive pathogen to know the etiologic agent).

Conduct an Environmental Investigation

(if there is an environmental exposure)

- The environmental investigation assists in answering the *how* and *why* questions. This includes an inspection of the facility, a review of practices and procedures for the operation, and an assessment of employee illness.

Develop hypotheses (in order to test it)

- Depending on the outbreak, the hypotheses may address:
  - The source of the agent,
  - The mode (and vehicle or vector) of transmission, and
  - The exposures that caused the disease.
  - E.g. ,when covid-19 first appeared they made a hypothesis that it is transmitted via droplets so the control measure was the face mask. After applying the face mask and social distancing they saw that there was a drop in the cases so their hypothesis was considered correct.
  - E.g., At the beginning of covid-19 outbreak there was a hypothesis that it isn't an airborne disease (until now) , but some hypothesis stated that it is airborne , so some tests were made to see how does the droplets spread and how far it goes to see if its airborne or not . As a result, they found that the droplet size is small that made it spread very fast (close to airborne diseases).

- Given recent concerns about **bioterrorism**, investigators should consider intentional dissemination of an infectious or chemical agent when trying to determine the cause of an outbreak.
- When we can't explain an outbreak with biological reasoning we need to look for bioterrorism.
- Example, Investigators of an outbreak of salmonellosis in Oregon, were stumped when they were able to implicate salad bars in several local restaurants, but **could not identify any common ingredients or distribution system**. A year later, a member of a local cult **admitted that the cult had intentionally contaminated** the salads bars with *Salmonella* organisms.

"When the epidemiology does not fit the natural pattern, think unnatural, i.e., intentional. "

Measure of Risk – ATTACK RATE

- The measure of risk used in outbreaks investigated using cohort design is the **Risk-specific attack rate** (e.g., the food-specific attack rate for foodborne outbreaks), **which is the number of persons who became ill who reported the risk behavior divided by the total number of people who reported that risk behavior.**
- **We can also use the relative risk (somehow close to the attack rate) but to simplify the case we rely on the AR.**

Method for calculating risk ratio:

- Attack rate (risk) in exposed group / Attack rate (risk) in unexposed group

Attack Rate

An attack rate is defined as:

$$\frac{\text{Number of people at risk in whom a certain illness develops}}{\text{Total number of people at risk}} \times 100\%$$

a *food-specific attack rate*. It is calculated by:

$$\frac{\text{Number of people who ate a certain food and became ill}}{\text{Total number of people who ate that food}}$$

- From the record,

Specific attack rate;

- Food specific attack rate , e.g., we measure the attack rate for everyone who ate salad and the attack rate for everyone who ate mayonnaise and compare them. When the attack rate of one of them is very high we suspect that this certain item is the contaminated source of the outbreak.

Attack rate= number of cases / total number of specific exposure or risk factor.

Risk Factor Present	*Cases N = 35*	*Not Cases N = 100*	*Risk-Specific Attack Rate (AR)*
Swimming	15	39	$\frac{15}{54} = 27.7\%$
Volleyball	5	20	$\frac{5}{25} = 20.0\%$
Ate box lunch	20	95	$\frac{20}{115} = 17.3\%$
Ate evening hors d'oeuvres	30	40	$\frac{30}{70} = 42.9\%$

Figure 5-11 Example of attack rates in a typical outbreak

The relative risk (RR) is the attack rate among those exposed to the risk factor / the attack rate in those who were not exposed.

2x2 table

		Case	Not Case	AR	
Swimming	Yes	15	39	$\frac{15}{54} = 27.7\%$	Relative Risk $= \frac{27.7\%}{24.7\%} = 1.1$
	No	20	61	$\frac{20}{81} = 24.7\%$	

		Case	Not Case	AR	
Ate hors d'oeuvres	Yes	30	40	$\frac{30}{70} = 42.9\%$	Relative Risk $= \frac{42.9\%}{7.7\%} = 5.6$
	No	5	60	$\frac{5}{65} = 7.7\%$	

Figure 5-12 Follow-up analysis to determine the risk of disease according to specific exposures

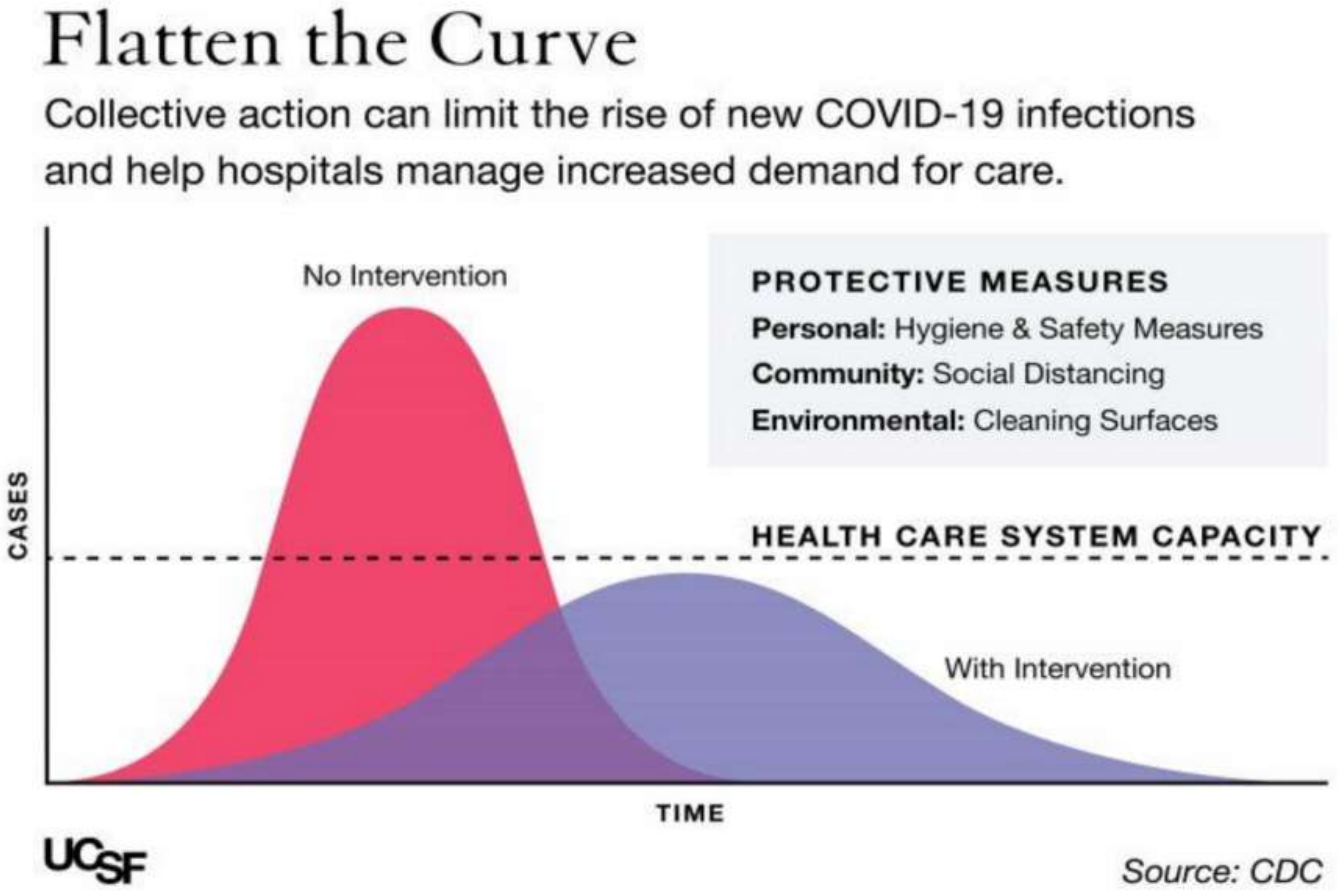
Implement Control Measures

- As soon as preliminary data indicate the magnitude and severity of the outbreak, a hypothesis should be developed regarding the time, place, and person; the suspected etiologic agent(s); and the mode of transmission.

- Remove source of contamination
- Remove persons from exposure
- Inactivate / neutralize the pathogen
- Isolate and/or treat infected persons
- Interrupt transmission
- Modify host response(e.g., vaccination)

"If we can't stop it, we can slow it"

Mitigation is to slow the disease spread to give time for vaccine or treatment develop ment(better control measures)



Communicate findings

- The final task is to summarize the investigation, its findings, and its outcome in a report, and to communicate this report in an effective manner.

Methods to communicate findings:

- **An oral briefing for local authorities.**

- **A written report**

BOX 2.2 STEPS IN INVESTIGATING AN ACUTE OUTBREAK

A summarization of the lecture

Investigating an acute outbreak may be primarily deductive (i.e., reasoning from premises or propositions proved previously) or inductive (i.e., reasoning from particular facts to a general conclusion), or it may be a combination of both.

Important considerations in investigating an acute outbreak of infectious diseases include determining that an outbreak has in fact occurred and defining the extent of the population at risk, determining the measure of spread and reservoir, and characterizing the agent.

Steps commonly used are listed below, but depending on the outbreak, the exact order may differ.

1. Define the outbreak and validate the existence of an outbreak
   a. Define the "numerator" (cases)
      1) Clinical features: Is the disease known?
      2) What are its serologic or cultural aspects?
      3) Are the causes partially understood?
   b. Define the "denominator": What is the population at risk of developing disease (i.e., susceptible)?
   c. Determine whether the observed number of cases clearly exceeds the expected number
   d. Calculate the attack rates
2. Examine the distribution of cases by the following:
   a. Time } Look for time–place interactions
   b. Place }
3. Look for combinations (interactions) of relevant variables
4. Develop hypotheses based on the following:
   a. Existing knowledge (if any) of the disease
   b. Analogy to diseases of known etiology
   c. Findings from investigation of the outbreak
5. Test hypotheses
   a. Further analyze existing data (case-control studies)
   b. Refine hypotheses and collect additional data that may be needed
6. Recommend control measures
   a. Control of current outbreak
   b. Prevention of future similar outbreaks
7. Prepare a written report of the investigation and the findings
8. Communicate findings to those involved in policy development and implementation and to the public

Questions