Modified by: Abdlhadi Okasha & Aysha Salameh
Corrected by: Ola Alahdab

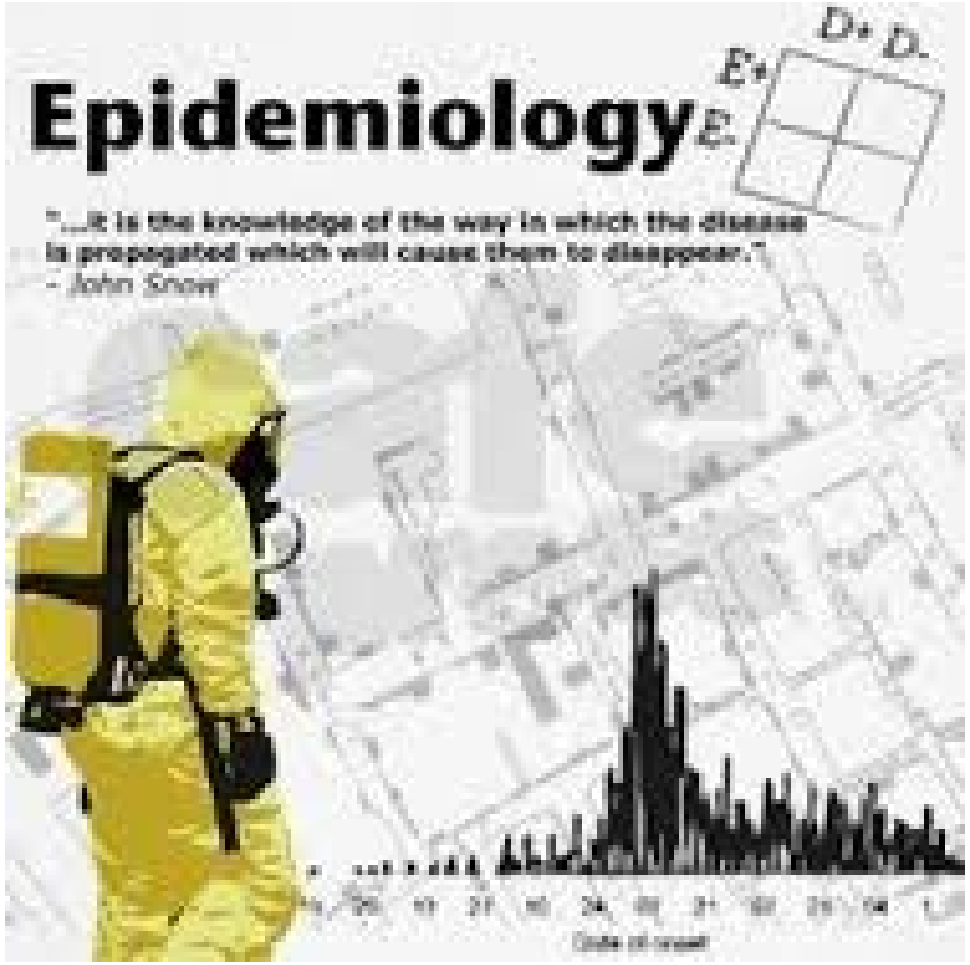
COMMUNITY MEDICINE

DOCTOR 2019 | MEDICINE | JU

Dr. SEREEN

COLOR OF SLIDES IN BLACK & DARK BLUE, AND COLOR OF DOCTOR INFORMATION IN GREEN & BLACK

Introduction to and History of Epidemiology



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Community Medicine, first semester 2020/ 2021

School of Medicine, The University of Jordan

Lecture Contents….

1. Epidemiology defined.
2. The components of epidemiology
3. Major examples of epidemiologic investigation.
4. History of epidemiology

Definitions…

→**Epidemiology : is a core science of public health.**

→ **Public health: (Was called before: community health)**

The science & art of Preventing disease, prolonging life, and promoting health & efficient through organized community effort (Winslow, 1920)

→ **We have a department in our country in school of medicine called Department of family and community that is specialized in studying public health , in western countries and united states public health is a very advanced science that has an independent school in universities as it's very important, they have a school of public health as we have a school of medicine**

Definitions

Health: A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO,1948)

Disease: A physiological or psychological dysfunction (the word disease is divided into two parts, "ease" that means to be normal, and "dis" is a prefix that gives a negative meaning)

Illness: A subjective state of not being well (the word ""subjective refers to the person that have disease, the person would say "I feel ill")

Sickness: A state of social dysfunction (This means that people around you say: you look sick)

بالمختصر

When you have a <u>disease</u>, you look <u>sick</u> and you feel <u>ill</u>

Definitions

Epidemiology (We have three defenitions)

1)The science of the mass phenomena of infectious diseases or the natural history of infectious diseases. (Frost 1927)

2)The science of infective diseases, their prime causes, propagation and prevention. (Stallbrass 1931.) (prevention is added, as we know what is the cause of the disease to prevent it)

3) The study of the distribution and determinants of health-related states or events in specified populations, and the application of the study to the control (prevention) of health problems".(J.M. Last 1988)

Epidemiology as a Science and a Method

(Greek origin of the word)

Epi = upon, among

Demos = people

Ology = science, study of

Epidemiology = the science or the study of diseases in populations

It is the scientific method of disease investigation

Typically, it involves the disciplines of <u>biostatistics</u> and <u>medicine</u>.

We study <u>biostatistics</u> in order to investigate the relationship between risk factors and diseases

Components of the definition

<u>Study</u>: Systematic collection, analysis and interpretation of data

Epidemiology involves collection, analysis and interpretation of health-related data

Epidemiology is a science

Components of epidemiology

Distribution: Epidemiology is concerned with the frequency and pattern of health events in a population:

Disease frequency: The core characteristics of epidemiology are to measure the frequency (number of cases) of diseases, disability ,death or any health-related issue in a specified population.

We first count the number then convert it to a rate, ratio and proportion.

This falls in the domain of biostatistics, which is a basic tool of epidemiology.

Components of epidemiology

Disease frequency:

E.g. Prevalence (the total number of people who have a disease right now), Incidence rates (the rate of new disease cases in the population) ,Death rate etc.

These rates are essential for comparing the disease frequency in different populations or subgroups of the same population

Components of epidemiology

Distribution….. The study of the pattern of a health event by person, place and time.

Epidemiology studies distribution of diseases among subgroups of the population (e.g. males and females) , in certain geographic areas, and also any increase or decrease over time (change in rate).

It answers the question who gets a disease (person), where does a disease happen more (place) and when does a disease occur more (time)? This is descriptive epidemiology.

An important outcome of this step is formulation of etiological hypothesis, to have an idea about new hypothesis about what may cause this disease

PERSON DISTRIBUTION

- **In descriptive studies disease is further characterized by defining the persons who develop the disease by age, gender, ethnicity, religion, occupation, marital status, habits like smoking, social class & other host factors.**
- **These host (the person who gets disease) factors help us to understand the natural history of disease.**

PLACE DISTRIBUTION

- **Study of the geography of the disease (geographical pathology) is one of the important dimensions of epidemiology.**
- **With the geographical pathology we learn the differences in disease patterns between two geographical areas (e.g. international between countries, national in the same country, or urban/rural differences).**
- **These variations may be due to variations in population density, social class, deficiencies in health services, levels of sanitation, education & environmental factors.**

TIME DISTRIBUTION

- The pattern of a disease may be described by the time of occurrence
- The occurrence of disease changes over time
- Some of these changes occur regularly, while others are unpredictable.
- Two diseases that occur during the same season each year include influenza (winter) and West Nile virus infection (August– September).
- In contrast, diseases such as hepatitis B and salmonellosis can occur at any time.
- Some diseases occurs at a specific Day of the week or time of the day may be important in describing the health problem

TIME DISTRIBUTION

Epidemiologists have identified three kinds of time trends or fluctuations in disease occurrence:

1.Short term fluctuation: Single (one incubation period and one peak) (e.g. food poisoning) or multiple and continuous exposure (e.g. well of contaminated water-cholera, Minamata disease in Japan)

2. Periodic fluctuation: (related to specific time), it could be:

A) Seasonal: GI infection in Summer

B) Cyclic (not related to seasons): Influenza every 7-10 years..antigenic variations happens in the viruses).

(in 2019 we had covid-19, in 2012 we had MERS virus, and in 2003 we had the SARS that is a type of corona virus)

3. Long–term or Secular trend -that are chronic diseases and take years to develop at diseases-
(e.g. CVD (coronary cardiovascular diseases), lung cancer)

Components of the Definition of Epidemiology

Determinants: **(Risk times)**

Factors the influence (presence/absence) of which affect the occurrence and level of a health event.

Epidemiology studies what determines or influences health events:

- ✓ **It answers the question: how does the disease happen and why does it happen? When we answer them, this is called analytical epidemiology, it's more advanced than descriptive epidemiology that we talked about before.**
- ✓ **Epidemiology analyzes health events "analytical epidemiology". Here we test a hypothesis to prove right or wrong.**
- ✓ **Analytical strategies help in developing scientifically sound health programes, interventions & policies.**

Components…

Health-related states and events

Epidemiology is not only the study of diseases.

The focus of Epidemiology is not only patients' health as individuals, but anything in the environment that may affect their health (physiological, psychological, or social) and well-being in any way. (Not only pathologic), e.g. road accidents, fire-arm training people

- ✓ **It studies all health-related conditions**
- ✓ **Epidemiology is a broad science**

Components…

Specified population

Epidemiology diagnoses and treats communities/populations

- ✓ The unit of study is a population (groups of people for e.g. students in a specific university, it mustn't be a whole country or city)
- ✓ Clinical medicine diagnoses and treats patients after they get sick and go seek physician's help.
- ✓ Epidemiology is a basic science of public health

Components…

Application

Epidemiological studies have direct and practical applications for prevention of diseases & promotion of health

- ✓ Epidemiology is a science and practice
- ✓ Epidemiology is an applied science

Epidemiology provides data essential to the planning, implementation & evaluation of services for the prevention, control & treatment of disease.

e.g. when a patient want to get treated from cardiovascular disease, the physician would advise the patient to cut fat intake, play exercises..etc.

Objectives of Epidemiology

- Investigate the etiology of disease and modes of transmission
- Determine the extent of disease problems in the community
- Study the natural history and prognosis of disease
- Evaluate both existing and new preventive and therapeutic measures and modes of health care delivery
- Provide a foundation for developing public policy and regulatory decisions

*We'll discuss all of them in the next three weeks.

Epidemiology

In Epidemiology, we ask the following questions related to the health event:

What is the event? (The Health problem).

What is the magnitude? (big or small)

Where did it happen ?

When did it happen?

Who is affected?

Why did it happen?

Epidemiology

In Epidemiology, we ask the following questions related to the health action:

- **What can be done to reduce this problem and its consequences?**
- **How can it be prevented in future?**
- **What action should be taken by the community? By whom should these activities be carried out?**

Investigating an Outbreak

I Keep six honest serving-men:
(They taught me all I knew).
Their names are What and
Where and When And How and
Why and Who.

Rudyard Kipling (1865–1936)

Define **what** will be studied
Find out **where** the problem is
Who gets it , **When** it is occurring
Try to explain **why** the problem has such a distribution
Do specific studies to find out **how** the problem is occurring

Source: "The Elephant's Child" in Just So Stories by Rudyard Kipling

Photo source: http://www.online-literature.com/kipling

The Five Ws of Epidemiologic Studies

The Five Ws of Epidemiology Studies

- What = Clinical
- Who = Person
- Where = Place
- When = Time

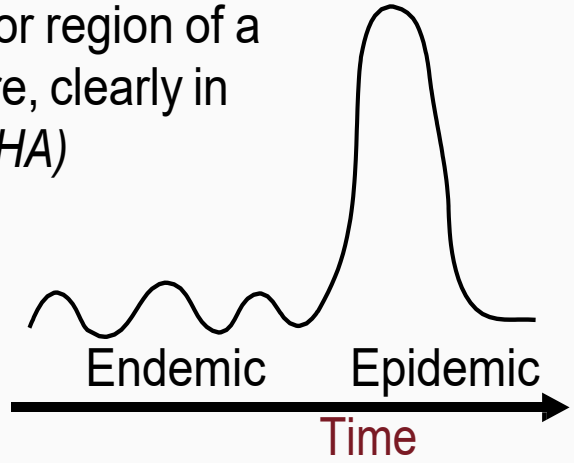
} Descriptive Epidemiology

- Why / How = Causes
  Risk factors
  Modes of transmission

} Analytic Epidemiology

Definition of Endemic, Epidemic, and Pandemic

- **Endemic**
  - The habitual presence of a disease within a given geographic area
  - May also refer to the usual prevalence of a given disease within such an area *(APHA)*
- **Epidemic**
  - The occurrence in a community or region of a group of illnesses of similar nature, clearly in excess of normal expectancy *(APHA)*
  - Outbreak
- **Pandemic**
  - A worldwide epidemic



Notes on the slide:

1) Endemic

the all-time normal level or prevalence disease of a population

habitual = usual

e.g. on endemic: it's endemic to have **malaria** in some African countries

2) Epidemic

eg: if we expect to see a hundred of cases in a population every year (normal),

we will see thousands in that year **(outbreak)**

→NOTE: Occurring of one case only may be epidemic, as in polio disease, because this disease cases have been zero for decades and the disease is very severe.

هاد المرض عدد حالاته بالأردن صفر من زمان، لذا حالة وحدة من المرض تعتبر epidemic.

3) pandemic الجائحة

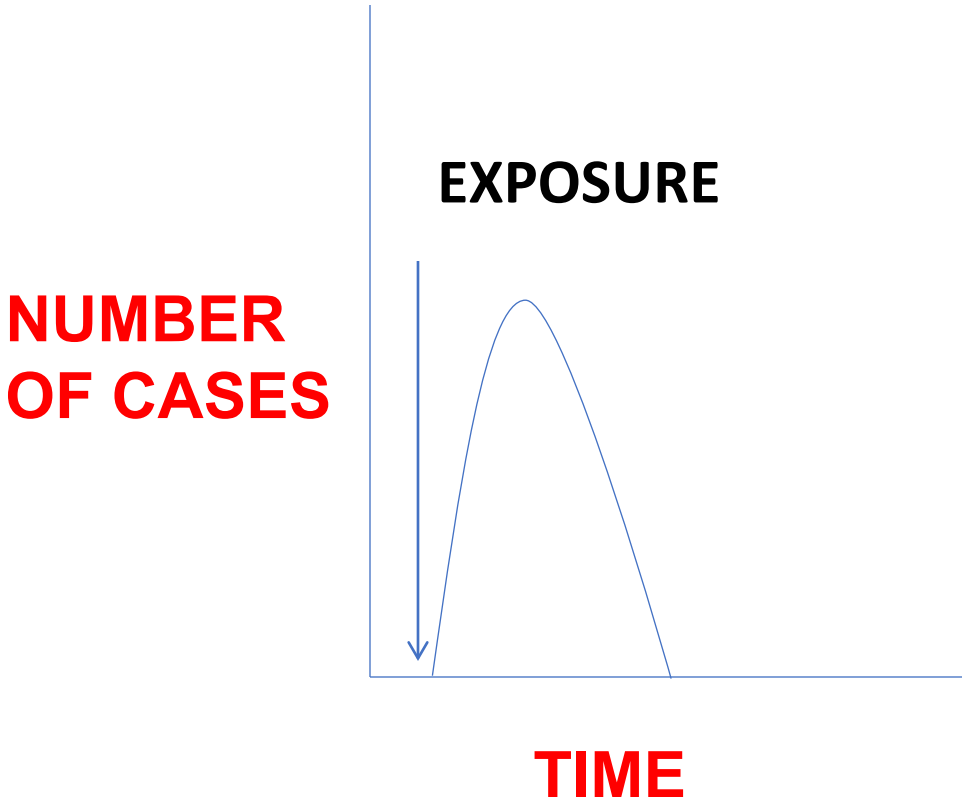
e.g. Covid-19

*we always plot the number of cases or rate of the disease on vertical access, and time on horizontal access

→ endemic level in the curve is normal, while epidemic level is in sudden severe rising of cases

EPIDEMIC CURVE

***for a certain disease you can see that the number of cases increased from the normal law level until the top of the curve then it's coming back down after the epidemic is **ended**



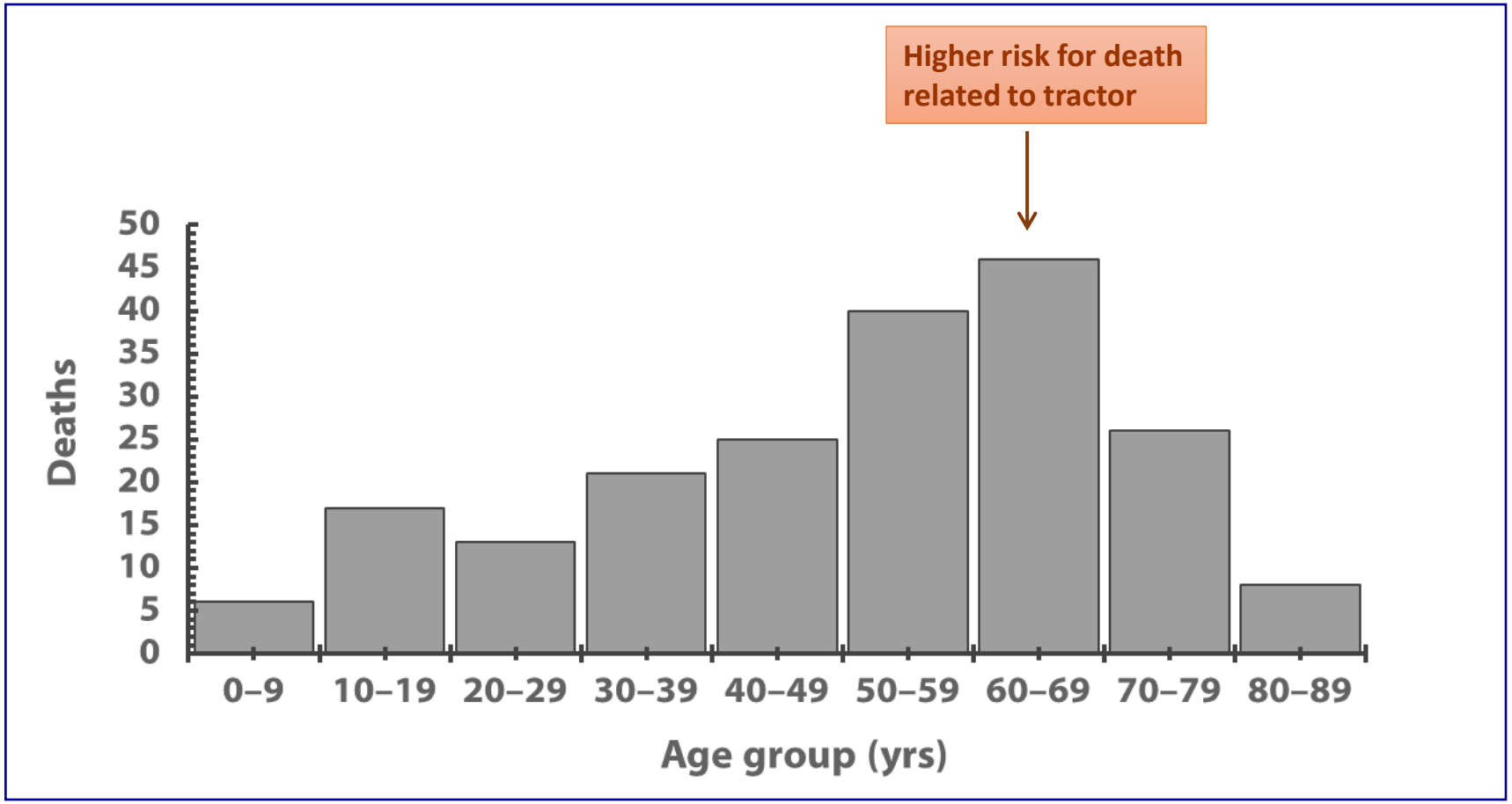
1 Fatalities Associated with Farm Tractors

In 1982, an epidemiologist studied the number of farm tractor-associated deaths in Georgia and described them in terms of **time**, **place**, and **person** by using death certificates and records from an existing surveillance system (All tractor related incidents between 1971-1981, **N=166 cases**).

He then generated a hypothesis for further study. Let's look at the descriptive epidemiology (Who, When and Where….)

Fatalities Associated with Farm Tractors (person)

This graph describes **Who** gets affected (that person part of descriptive study)

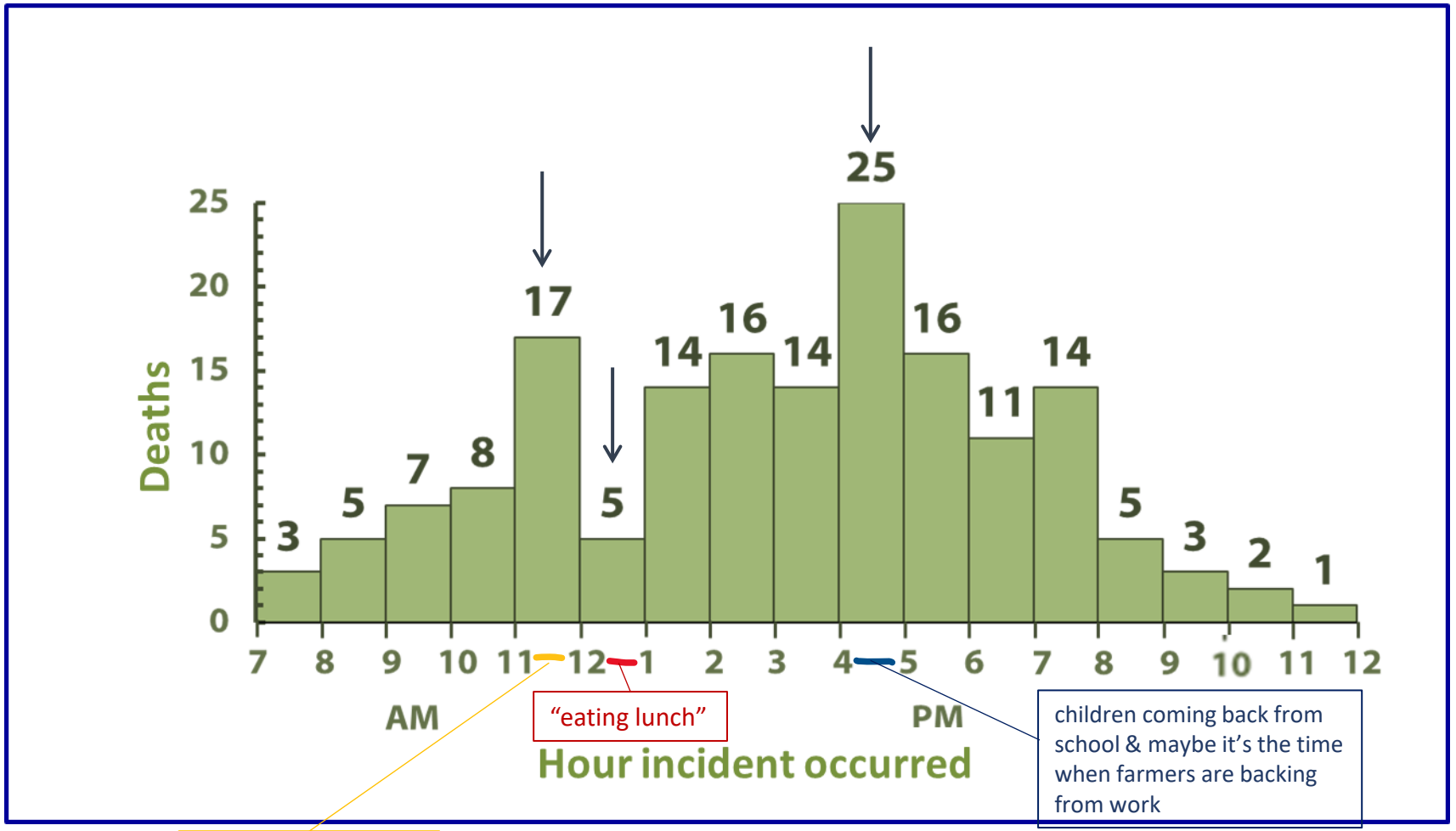


Goodman RA, Smith JD, Sikes RK, et al. Fatalities associated with farm tractor injuries: an epidemiologic study. Public Health Rep 1985;100: 329–33.

The **more older** age group = the **higher the risk**

Fatalities Associated with Farm Tractors (time)

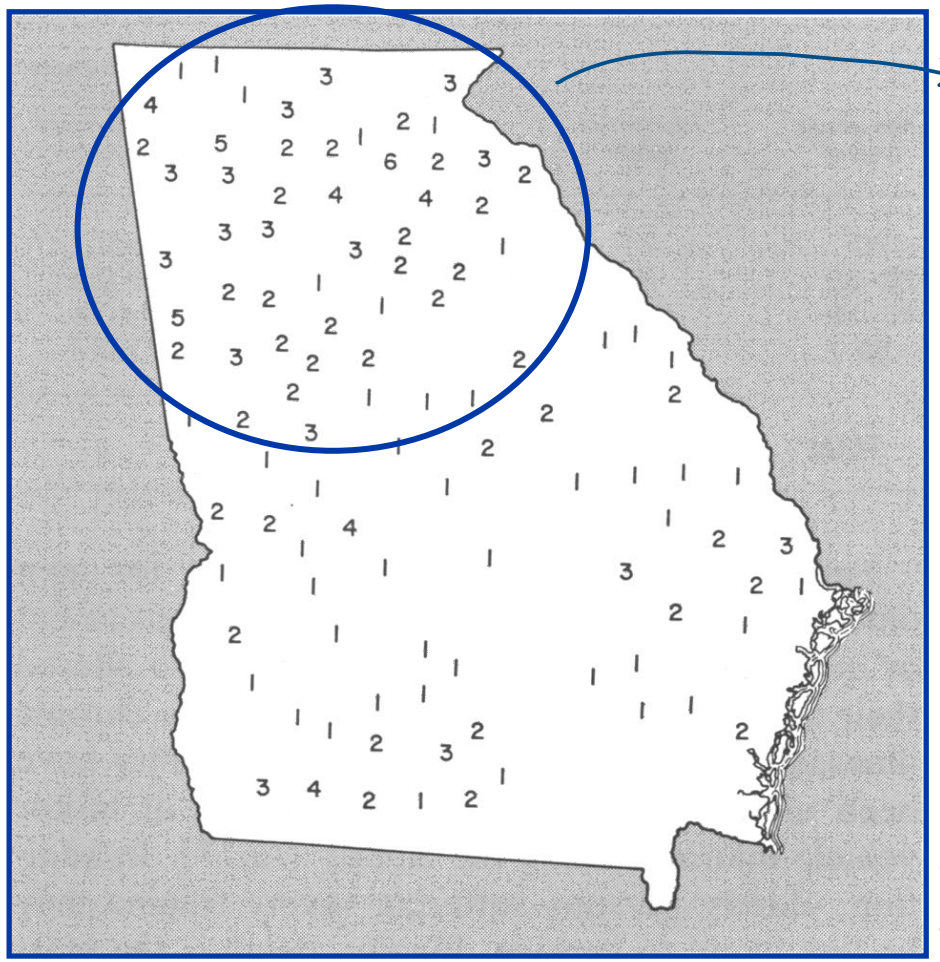
when tractor-related accidents occurred



Goodman RA, Smith JD, Sikes RK, et al. Fatalities associated with farm tractor injuries: an epidemiologic study. Public Health Rep 1985;100:329–33.

Fatalities Associated with Farm Tractors (place)

Where did Fatalities associated with farm tractors accidents happen:



northern region

we could explain the reasons in many different ways :

-مثلا المناطق الشمالية أراضيها وعرة و صعب الجرارات تمشي فيها

-المناطق الشمالية فيها أراضي زراعية كثيرة لذلك في استخدام كبير للجرارات فيها

Goodman RA, Smith JD, Sikes RK, et al. Fatalities associated with farm tractor injuries: an epidemiologic study. Public Health Rep 1985;100:329–33.

The map of Georgia

2 Legionnaire's disease outbreak

هون القصة

- Members of the American Legion gathered for the annual American Legion Convention held July 21 through 24, 1976, in Philadelphia.
- Soon after the convention began, a substantial number of attendees were admitted to hospital emergency departments or were examined in doctors' offices with acute onset of fever, chills, headache, malaise, dry cough, and muscle pain.
- More troublesome is that during July 26 to August 1, a total of 18 conventioneers died, reportedly from pneumonia.
- On the morning of August 2, a nurse at a veterans' hospital in Philadelphia called **CDC**(Centers for diseases control and prevention) to report cases of severe respiratory illness among convention attendees.
- Subsequent conversations that day with public health officials uncovered an additional 71 cases among persons who had attended the convention.
- The goal was to find out why these conventioneers were becoming ill and, in some cases, dying!!!

Legionnaire's disease outbreak

وهون تلخيص للقصة

American Legion Convention, Philadelphia, Pennsylvania

Health care provider at a veterans' hospital in Philadelphia calls CDC to report cases of severe respiratory illness among attendees of the American Legion Convention

July 21–24 — July 26–Aug 1 — August 2 (Morning) — August 2 (Evening)

18 deaths reported among conventioneers

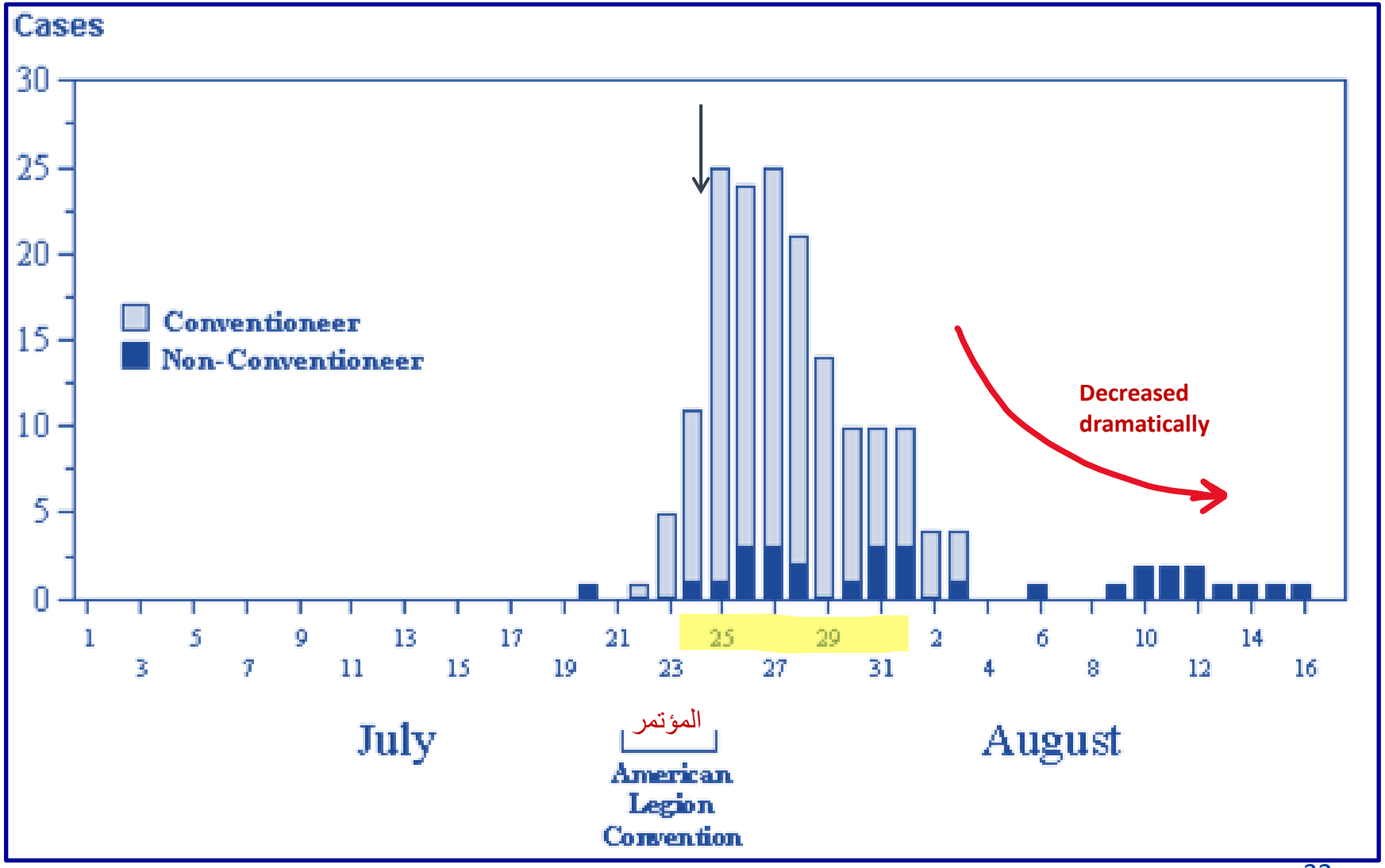
هاي الفترة اللي رجعوا فيها من المؤتمر لبيوتهم بعد ما انصابوا بالمؤتمر و بلشت الاعراض تظهر عليهم

Latency period

71 additional cases reported

Fraser DW, Tsai, T, Orenstein W, et al. Legionnaires' disease: description of an epidemic of pneumonia. New Engl J Med 1977;297:1189–97.

Epidemic curve for **Legionnaires' Disease Cases, by Day**



Fraser DW, Tsai, T, Orenstein W, et al. Legionnaires' disease: description of an epidemic of pneumonia. New Engl J Med 1977;297:1189–97.

Legionnaires' Disease Attack Rates by Place

when we look at the **absolute** numbers of cases it is **not** always very informative when we analyze data for an epidemic so we always need to calculate a **rate** of:
-diseases in **certain hotel**
or
-diseases in certain **age group** in a certain hotel

Who	Hotel A			Hotel B			Hotel C			places (where)
Age (yrs)	Ill	Total	Percent ill	Ill	Total	Percent ill	Ill	Total	Percent ill	
≤39	3	44	6.8	3	116	2.6	6	160	3.7	
40–49	9	160	5.6	11	232	4.7	20	392	5.1	
50–59	27	320	8.4	25	523	4.8	52	843	6.2	
60–69	12	108	11.1	19	207	9.1	31	315	9.8	
≥70	11	54	20.4	5	76	6.5	16	130	12.3	
Unknown	0	2	0	0	7	0	0	9	0	
Total	62	688	9.0	63	1,161	5.4	125	1,849	6.8	

rate=
#of sick people (in certain hotel / age group)

Total people in (that hotel /that age group)

*****Those who stayed in Hotel A have the highest percentage of illness — 9.0% versus 5.4% and 6.8 at other hotels (% Ill in Hotel A= 62 / 688 = 9.0%). The age group that has the highest percentage of ill persons is those aged 70 years or older (% Ill in >70y in Hotel A = 11 / 54 = 20.4%)**

Legionnaires' Disease Rate by Age Group

rate=

#of sick people (in certain hotel / age group)

Total people in (that hotel /that age group)

Hotel "A" Residents

Time: July 21–24, 1976

	Frequency	Unit	Rate
Age (yrs)	**Sick**	**Total**	**Percentage**
≥39	3	44	6.8
40–49	9	160	5.6
50–59	27	320	8.4
60–69	12	108	11.1
≥70	11	54	20.4
Unknown	0	2	0

Those who stayed in Hotel A have the highest percentage of illness — 9.0% versus 5.4% and 6.8 at other hotels (% Ill in Hotel A= 62 / 688 = 9.0%)..

The age group that has the highest percentage of ill persons is those aged 70 years or older (% Ill in >70y in Hotel A = 11 / 54 = 20.4%)

Legionnaires' Disease

The age group that has the highest percentage of ill persons is those aged 70 years or older, regardless of where they were staying.

Combining all age groups, those who stayed in Hotel A have the highest percentage of illness — 9.0% versus 5.4% at other hotels.

After calculating these rates we got deeper into analyzing **who** and **where**

We can infer, therefore, that a connection exists between staying in Hotel A and becoming ill; we can also infer that <u>older persons are somehow more susceptible to the disease.</u>

تكملة القصة

Legionnaires' Disease

name of disease that refers to this **severe respiratory infection** that happened to those who attended the Legion convention

- Five months after the first cases of Legionnaires' disease occurred, results of the case-control study indicated that spending time in the lobby of Hotel A was a risk factor for illness
- In January 1977, the *Legionella* bacterium was finally identified and isolated and was found to be **breeding in the cooling tower of the hotel's air-conditioning system**; the bacteria then spread through the building whenever the system was used.
- Similar bacteria grew in warm waters in nature, such as hot springs, and also had been identified in air-conditioning cooling towers.
- The finding from this outbreak investigation lead to development of new regulations worldwide for air conditioning systems.

3 London Smog Disaster, 1952

- Air pollution causes respiratory illnesses and death.
- When fog and soot from coal burning created a dense smog in Winter, 1952, in London, the smog was around for five days from December 5–10.
- There was a substantial increase in mortality
- The death rate in London in the previous week was around 2,062
- In the week of the smog, 4,703 died Without any explained reasons

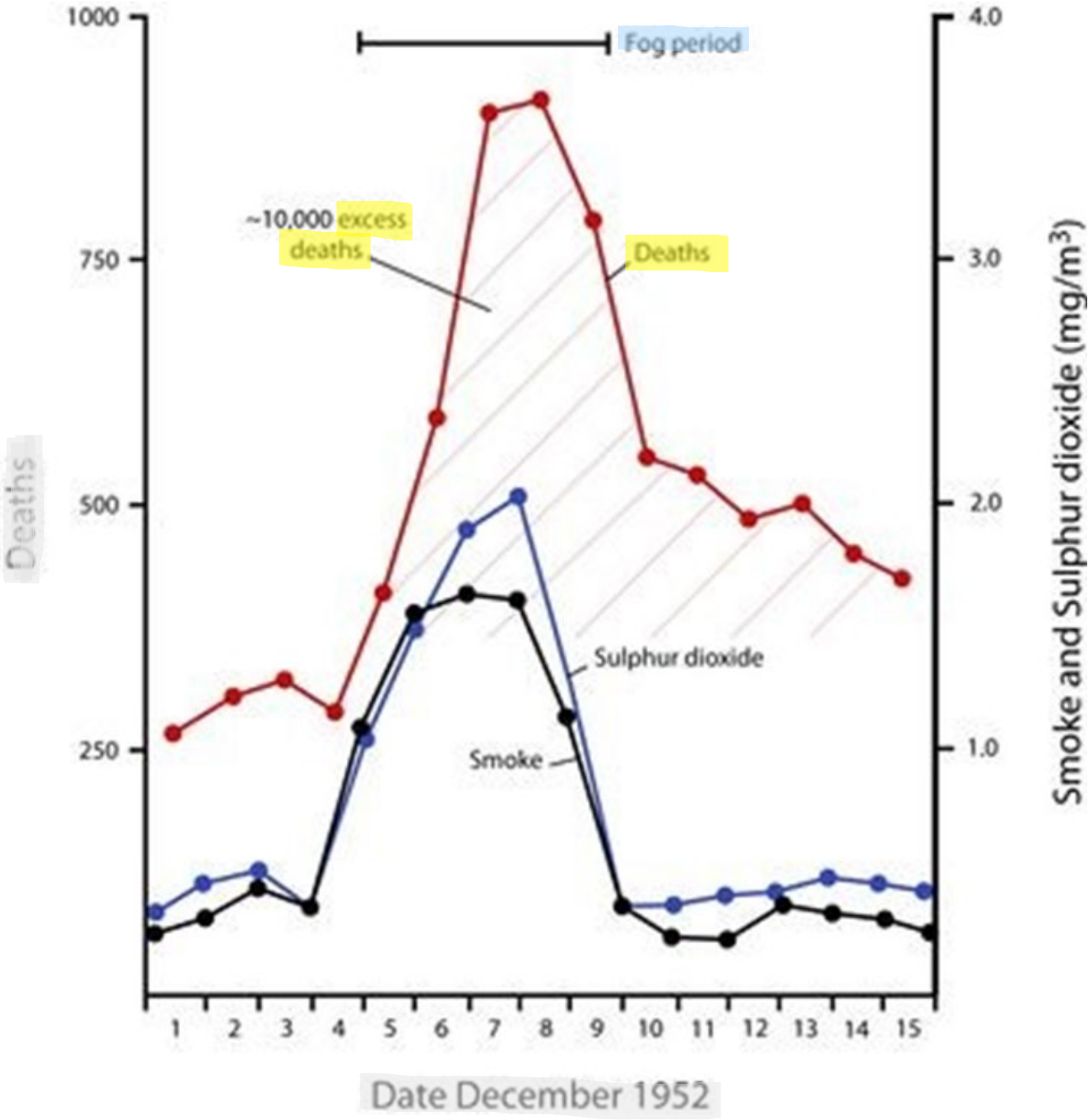
This is the epidemic curve that they prepared to study the reason for those deaths

We can see the **number of deaths** in the **vertical axis** & the **days of December** of that year in the **horizontal axis**

when they plotted **the number of cases of deaths** with the **increase in the level of smoke + sulfur dioxide** in the air in London during that week …

and also plotted the **excess number** of deaths during that same week

the connection was a very clear a *sudden sharp* increase in the **number of deaths** was **associated** at the same time with sudden increase in **smog** that *resulted* from *sulfur dioxide* and *smoke* interaction during that week ....



4 Epidemiology and Polio Vaccine

In April, 1955, Dr. Thomas Francis, director of Poliomyelitis Vaccine Evaluation Center at the University of Michigan, announced that the two-year field trial of the Salk vaccine against polio was up to 90% effective

That was the cornerstone and prevention of diseases for the human being

“The results announced by Francis effectively marked the beginning of the end of polio as the most life-threatening and debilitating public health threat to the children of the United States“.

نطاق

Scope of Epidemiology

Originally, Epidemiology was concerned with investigation & management of ***epidemics*** of **communicable** diseases

Infectious diseases

Lately, Epidemiology was extended to endemic **communicable** diseases and **non-communicable** diseases

Chronic diseases

Recently, Epidemiology can be applied to ***all*** **diseases** and *other health related events*

History of Epidemiology

Seven landmarks in the history of Epidemiology:

1) **Hippocrates (460BC):** he concluded that **Environment & human behaviors affects health**
2) **John Graunt (1662): Quantified** -Making lists and counting- **births, deaths and diseases.**
3) **Lind (1747): Scurvy - deficiency of vitamin C - could be treated with fresh fruit**

ما كانت هاي المعلومة قبل.. لكن ليند اجى و عمل
Very critical observation for people who got scurvy & who not
و كيف ممكن تكون طرق العلاج و اكتشف انه ممكن يكون عن طريق الفواكه

4) **William Farr (1839): Established application of vital statistics -**For birth, deaths and diseases - **for the evaluation of health problems.**
5) **John Snow (1854): tested a hypothesis on the origin of an epidemic of cholera in London.** قصته مهمة و حنحكي عنها بعد قليل 😉
6) **Alexander Louis (1872): Systematized application of numerical thinking (quantitative reasoning)**+Doing more analysis to statistics related to health
7) **Bradford Hill (1937): Suggested criteria for establishing causation.** A new era of Epidemiology started with him

Criteria that may apply to relationship between **risk factor** and a **disease** can establish the connection between the factors and diseases and may indicate causality

History…

- ✓ **Epidemiological thought emerged in <u>460 BC</u>**
- ✓ **Epidemiology flourished as a scientific discipline in 1940s** After Bradford Hill established the criteria

قصة
John Snow

John Snow (1813–1858)

- An English physician and modern-day father of epidemiology
- He used scientific methods to identify the cause of the epidemic of cholera in London in 1854
- He believed that it was the water pump on Broad Street that was responsible for the disease
  - The removal of the pump handle ended the outbreak

Photo source of two color images: Sukon Kanchanaraksa
Photo source of portrait: http://www.ph.ucla.edu/epi/snow/fatherofepidemiology.html. Public Domain

History of epidemiology

John Snow conducted a series of investigations in London. Snow conducted his classical study in **1854** "مهم"when an epidemic of cholera developed in the golden square of London.

Before or During the time of microscope development, snow conducted studies of cholera outbreak both to discover the cause of cholera and how to prevent its recurrences.

During that time Farr and Snow had major disagreement about the cause of cholera. Farr adhered to what was called the **miasmatic theory** of diseases, according to this theory, which was commonly held at that time, diseases were transmitted by **Contacting** a miasma or a cloud with bad smell that clung low on the earth surface.

This is how they explained Contagious or infections diseases transmission at that time

History of epidemiology

- However, Snow did not agree, he believed that cholera is transmitted through contaminated water. He began his investigation by determining where in this area in London persons with cholera lived and worked. He then used this information to map for distribution of diseases. “each small black dot represents a case of cholera.”
- Snow believed that **water** was the source of infection for cholera. He marked the location and searched the relationship between cases and water sources (water pumps). “ black circles in the map”
- He found most cases clustered around the Broad Street pump.
- So, he decided to break the pump handle, which stopped the outbreak.
- He found that cholera was transmitted though contaminated water. This was a major achievement in epidemiology.

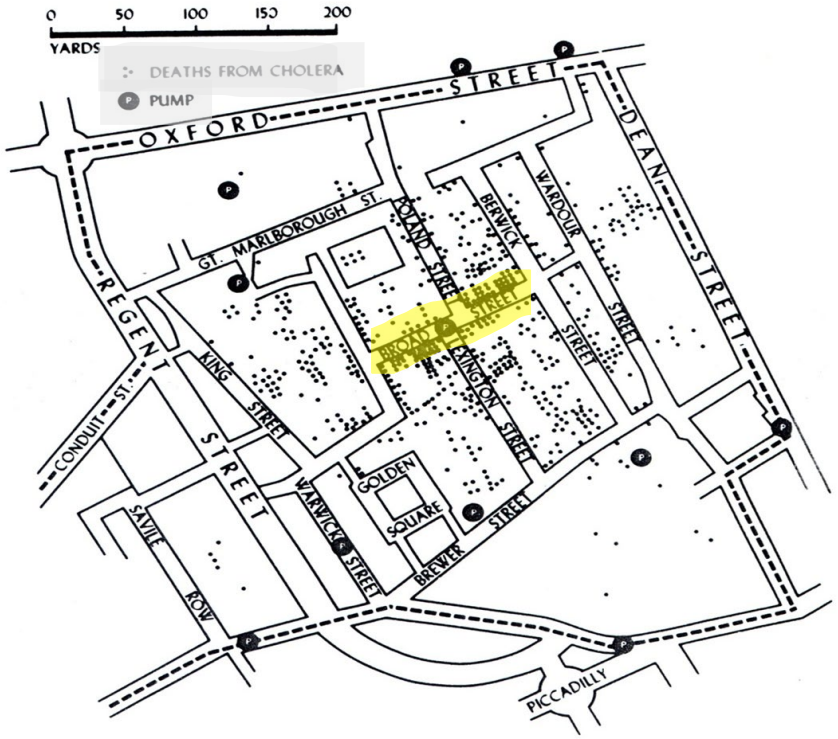
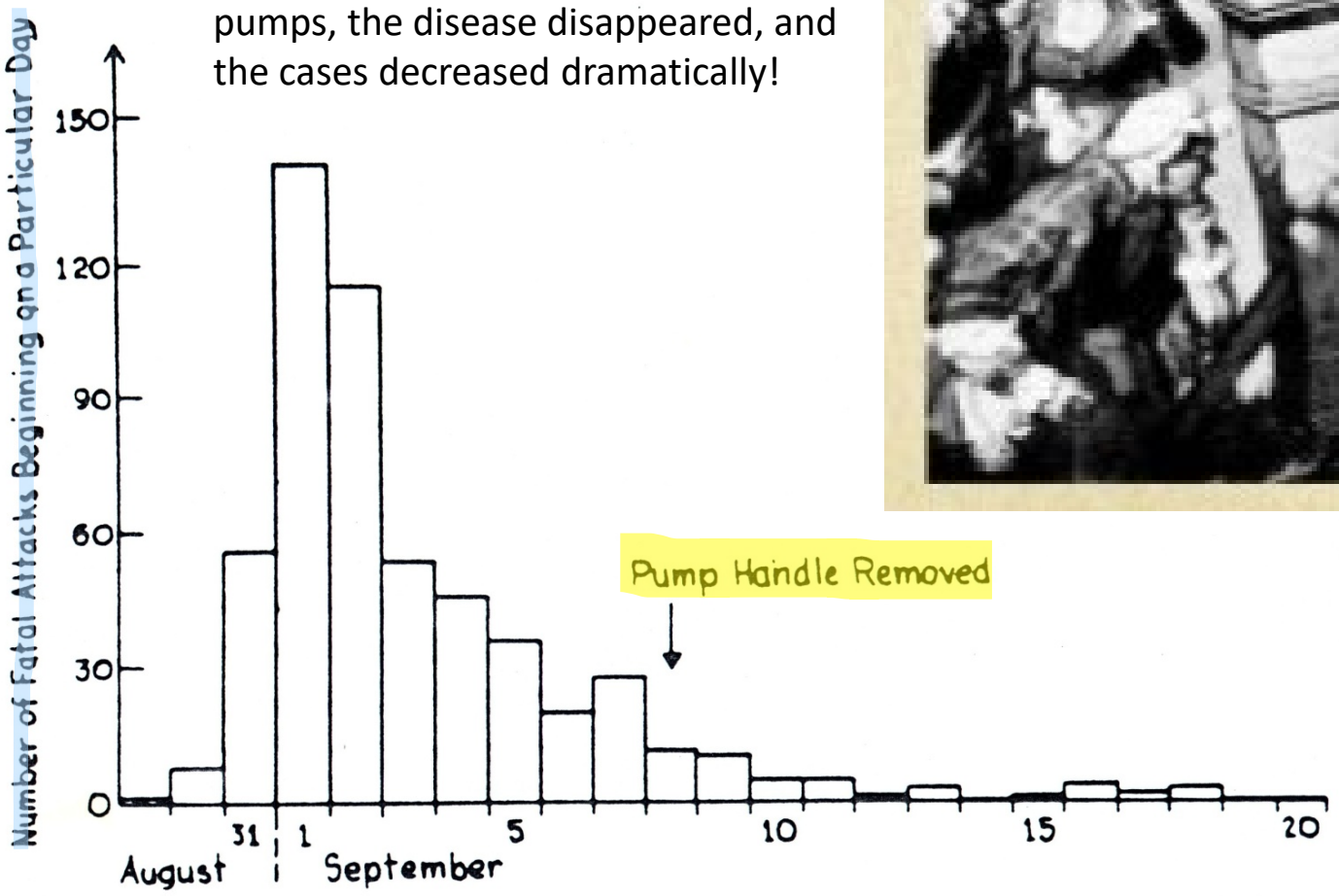


Figure 5-4 John Snow's Map of Cholera Deaths in the Soho District of London, 1848. *Source:* Adapted from *Health Care Delivery: Spatial Perspectives* by G. Shannon and G.E.A. Dever, p. 3, McGraw-Hill Book Company, 1974, and from *Some Aspects of Medical Geography* by L.D. Stamp, p. 16, Oxford University Press, 1964.

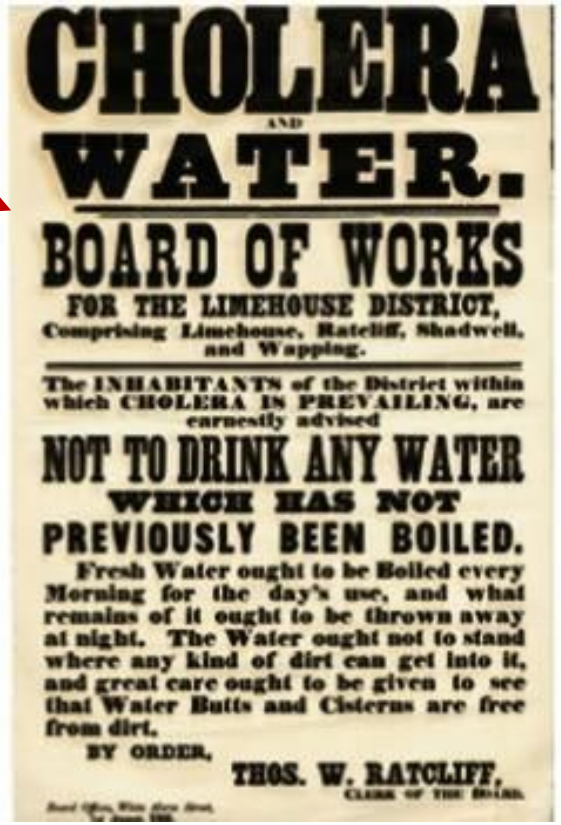
هاد الحكي لسة قبل ما يخترعوا المايكروسكوب ويكتشفوا الMicroorganisms
Which can not be seen by the bare eyes, but They are alive & can multiply in wood water or food & cause disease if they ingested

He broke the handle of the water pumps, the disease disappeared, and the cases decreased dramatically!



Snow's Epidemic Curve

Now sciences and authorities started to believe his theory and made announcements not to drink any without BOILING it !



CHOLERA AND WATER.

BOARD OF WORKS

FOR THE LIMEHOUSE DISTRICT,

Comprising Limehouse, Ratcliff, Shadwell, and Wapping.

The INHABITANTS of the District within which CHOLERA IS PREVAILING, are earnestly advised

NOT TO DRINK ANY WATER WHICH HAS NOT PREVIOUSLY BEEN BOILED.

Fresh Water ought to be Boiled every Morning for the day's use, and what remains of it ought to be thrown away at night. The Water ought not to stand where any kind of dirt can get into it, and great care ought to be given to see that Water Butts and Cisterns are free from dirt.

BY ORDER,

THOS. W. RATCLIFF, CLERK OF THE BOARD.

after solving the mystery of what caused cholera (the cholera water)

John snow became the father of epidemiology

Dr. John Snow (1813-1858) was the first man to link Cholera with water-supply. His research, and subsequent action in disabling a Soho water pump, helped end the massive 'King Cholera' outbreak of 1854. The John Snow pub stands adjacent to the pump's location on Broadwick St. in Soho, London.

the old water pump still standing in London until today & it became a landmark
and near this water pump there is John snow pub, it was made to honor John snow and his achievement.