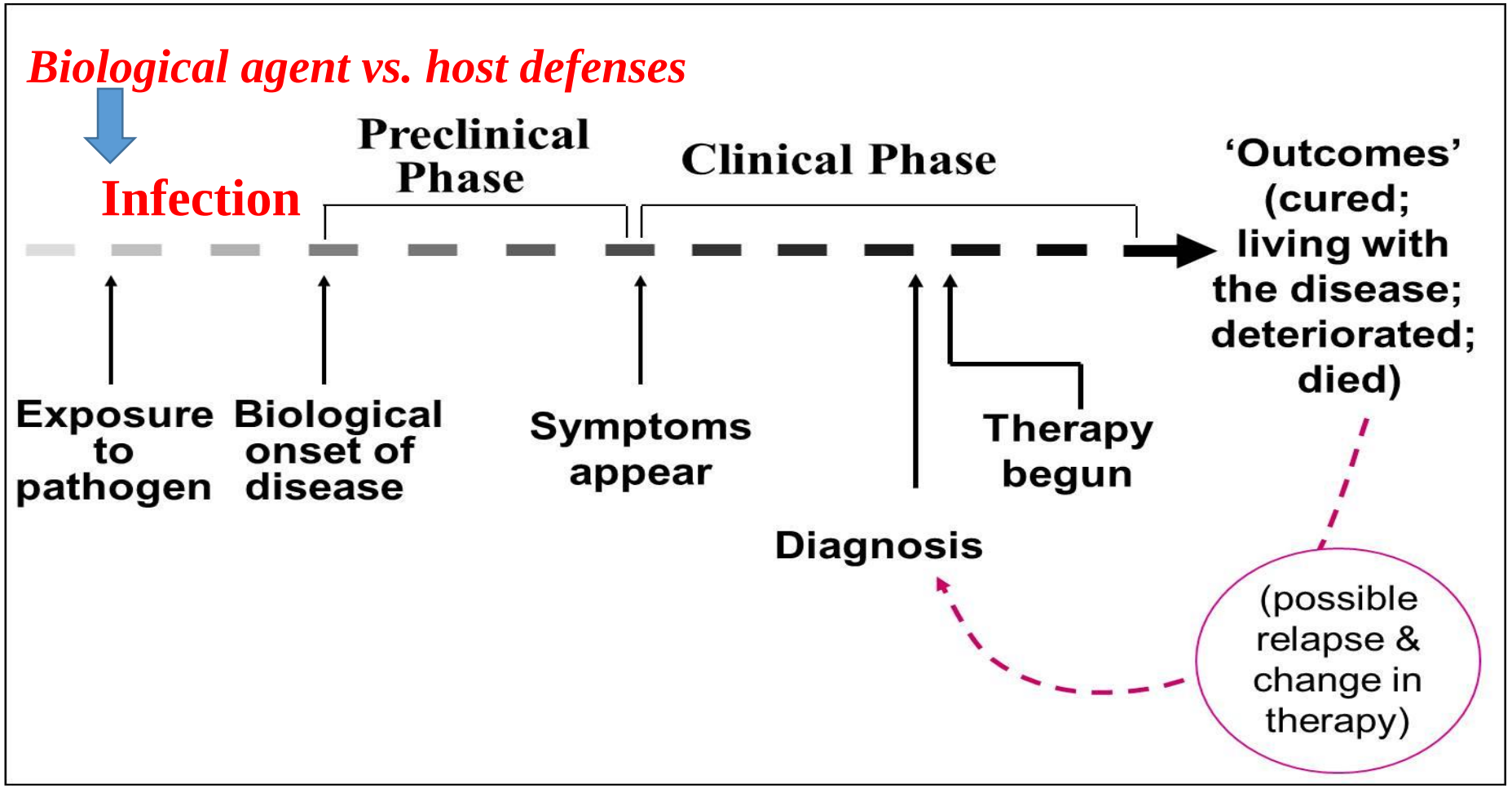
From previous lessons: remember…

Natural history of an infectious/communicable disease

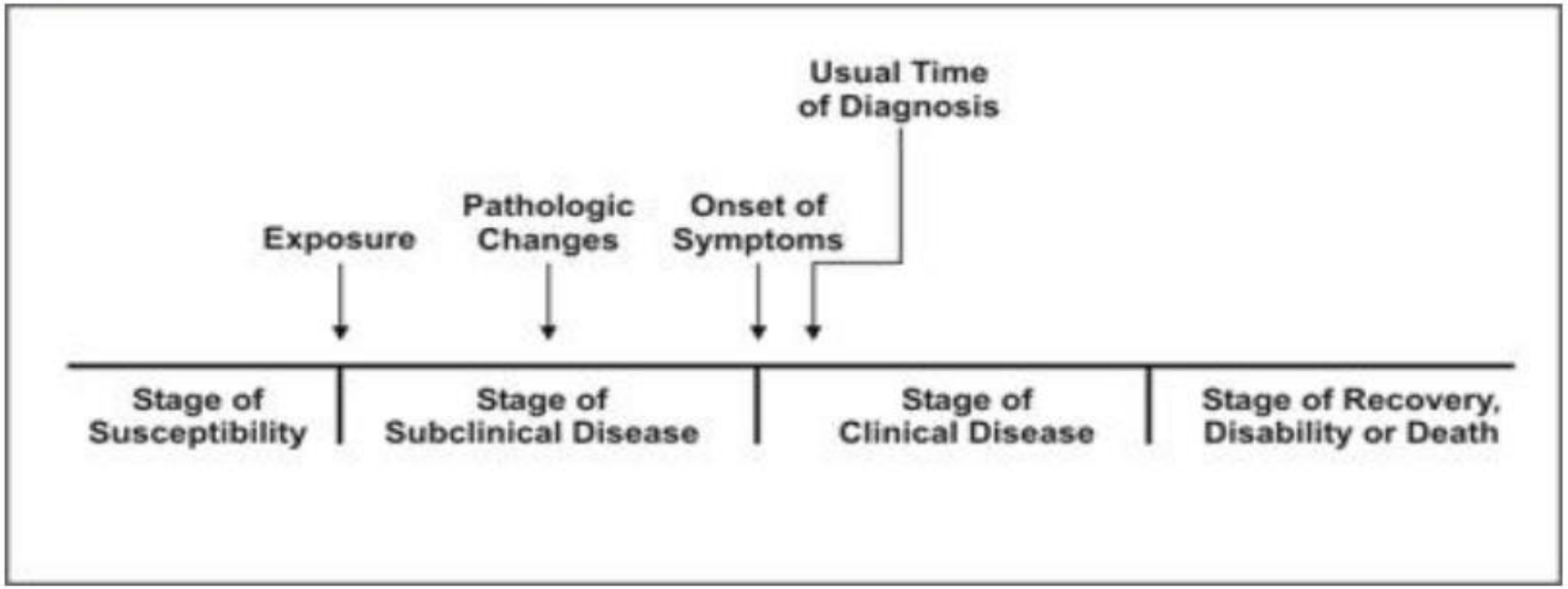


TIME:

Prognosis/duration: days, weeks, rarely more…

Natural history of a non-communicable/non-infectious disease

Figure 1.18 Natural History of Disease Timeline



TIME: → **Prognosis/duration: years, whole life**

Description: Timeline shows state of susceptibility, exposure, subclinical disease in which pathologic changes takes place, onset of symptoms, followed by usual time of diagnosis, clinical disease, followed by recovery, disability, or death

Source: Centers for Disease Control and Prevention. Principles of epidemiology, 2nd ed. Atlanta: U.S. Department of Health and Human Services;1992.

Acute diseases model

1. **One necessary cause (even if not sufficient): etiology model fairly simple**
2. **Short natural history and short treatment**
3. **Acute trend with sudden onset**
4. **Good chance of complete recovery**
5. **Therapeutic results well detectable**
6. ***Incidence greather than prevalence***
7. **Short-temporary suspension of daily activities**

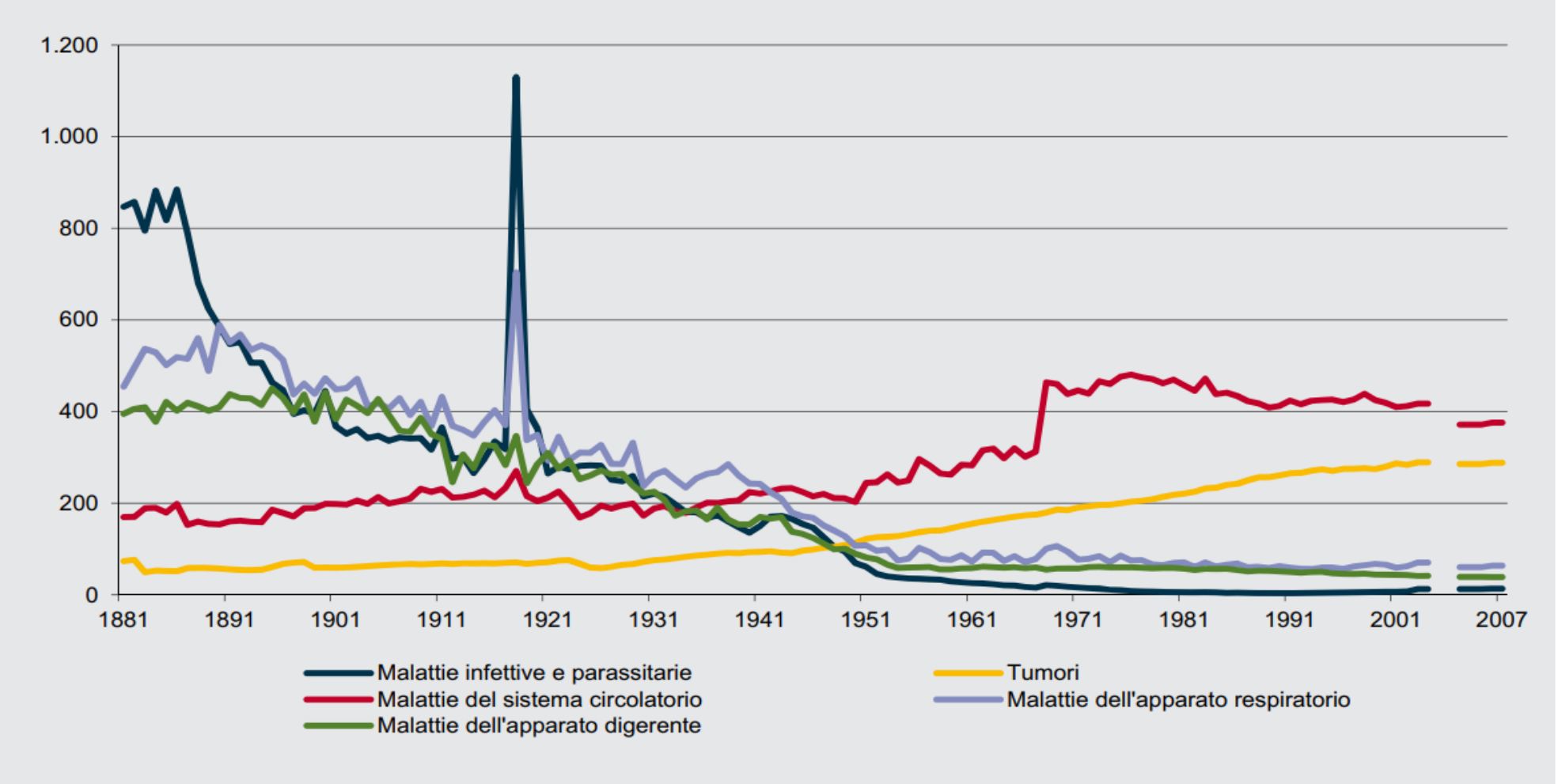
Chronic diseases model

1. **Multiple risk factors: Etiology model quite complex**
2. **Long natural history and long treatment**
3. **Chronic trend with insidious onset**
4. **Ingravescent trend, temporary recovery**
5. **Therapeutic results often not evident**
6. *Incidence lower than prevalence*
7. **Gradually disabling (initially no inlfluence), with different worsening speed**

Lesson 5

CD and NCD Mortality rate (/100.000 inhab)

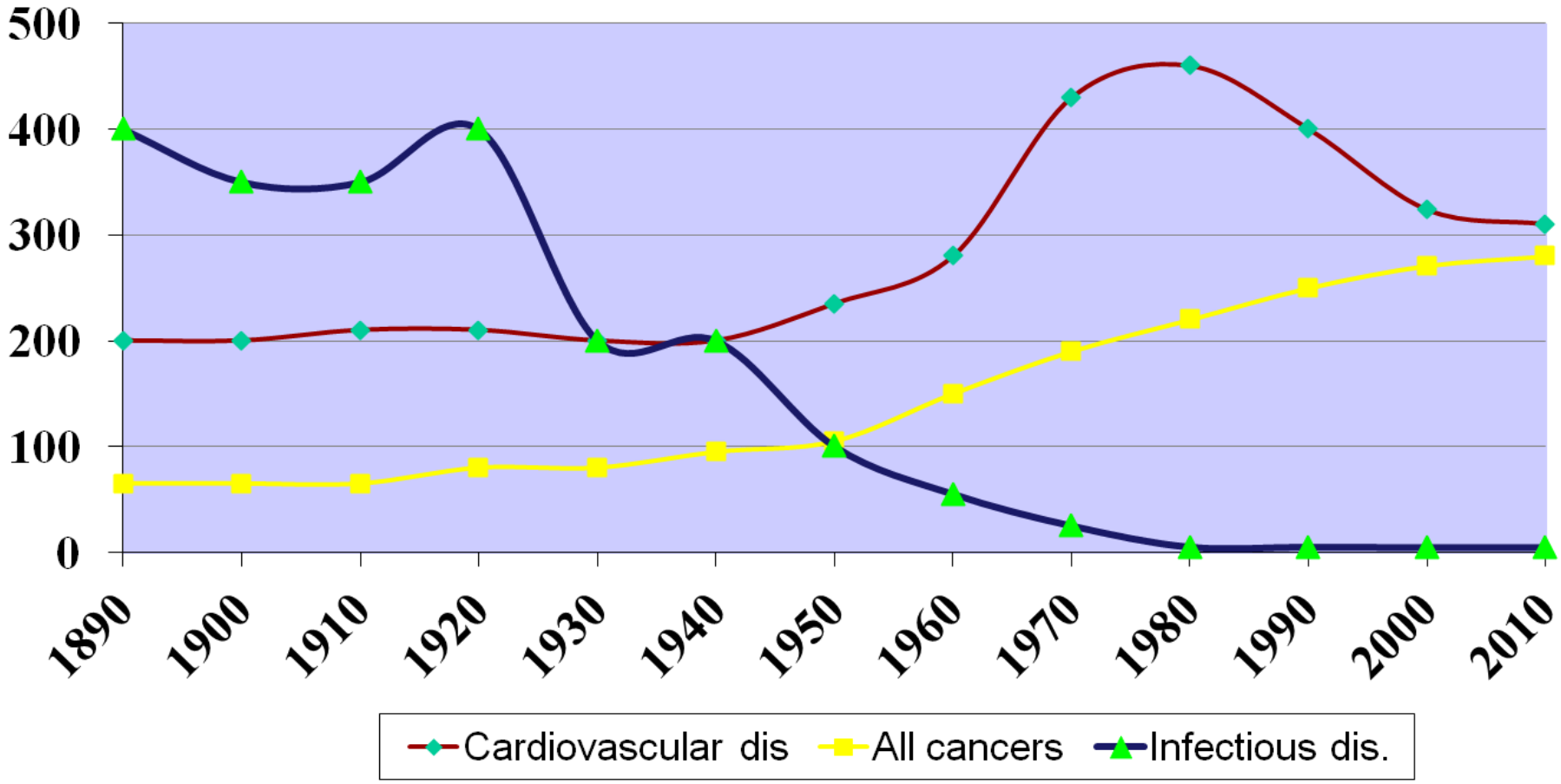
Figura 4.4 - Morti per alcuni gruppi di cause - Anni 1881-2007 (a) (tassi grezzi per 100.000 abitanti)



Fonte: Ministero di agricoltura, industria e commercio, Statistica sulle cause di morte (1881-1928); Istat, Indagine sulle cause di morte (dal 1929)
(a) I dati per gli anni dal 1881 al 1886 riguardano i soli comuni capoluoghi di provincia e di circondario.

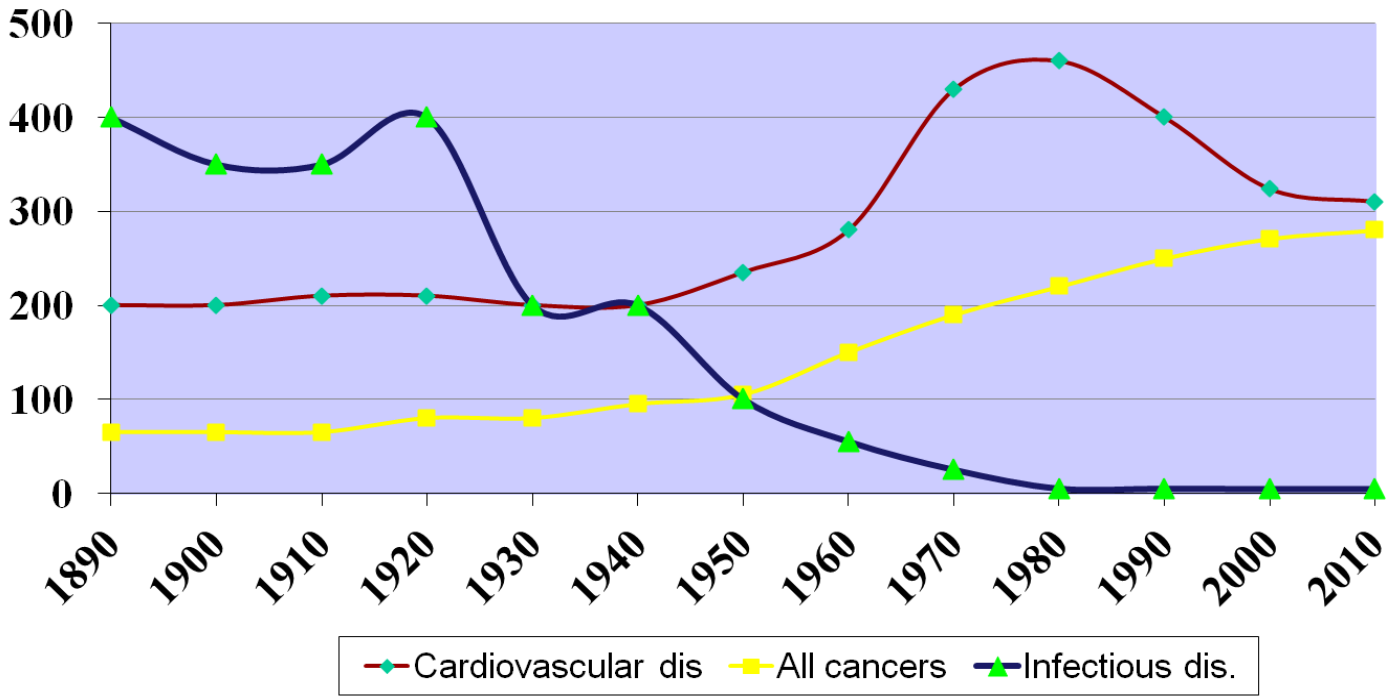
The epidemiologic transition in Italy

CD and NCD Mortality rate (/100.000 inhab)

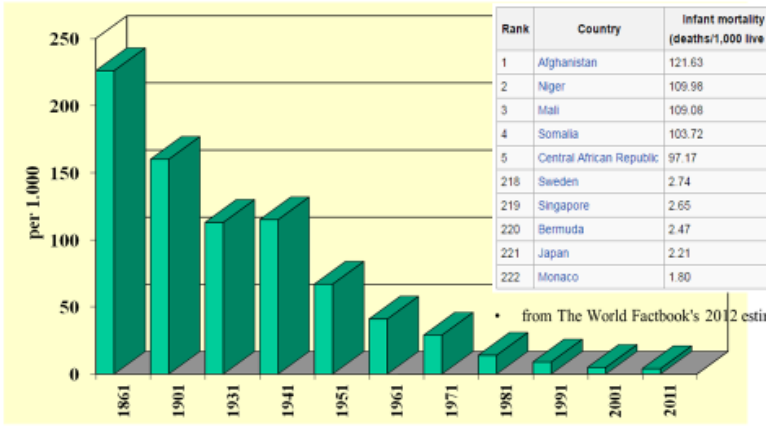


The epidemiologic transition in Italy

Mortality rate (/100.000 inhab)



Infant (0-1 yr) mortality rate (IMR) in Italy, 1861-2011



Laurea / B.A.
in Global Governance

Mortality, Italy 1861-2011

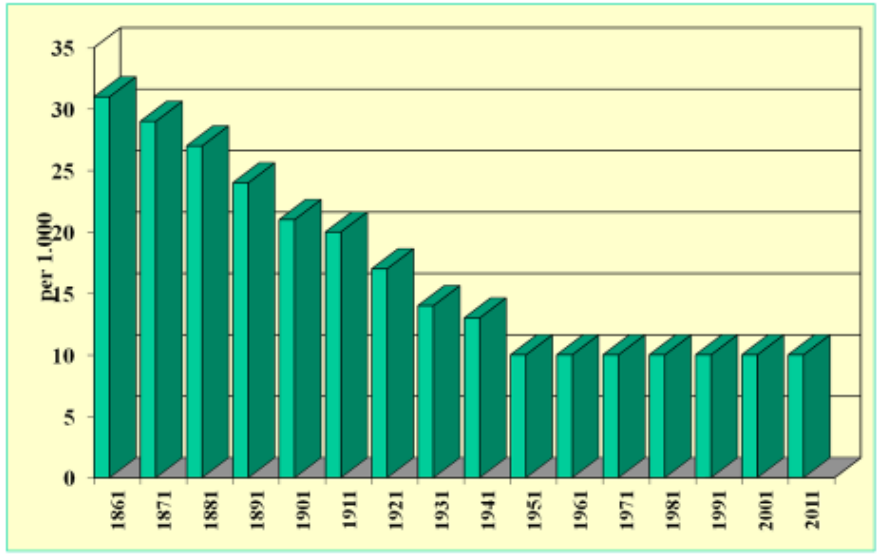


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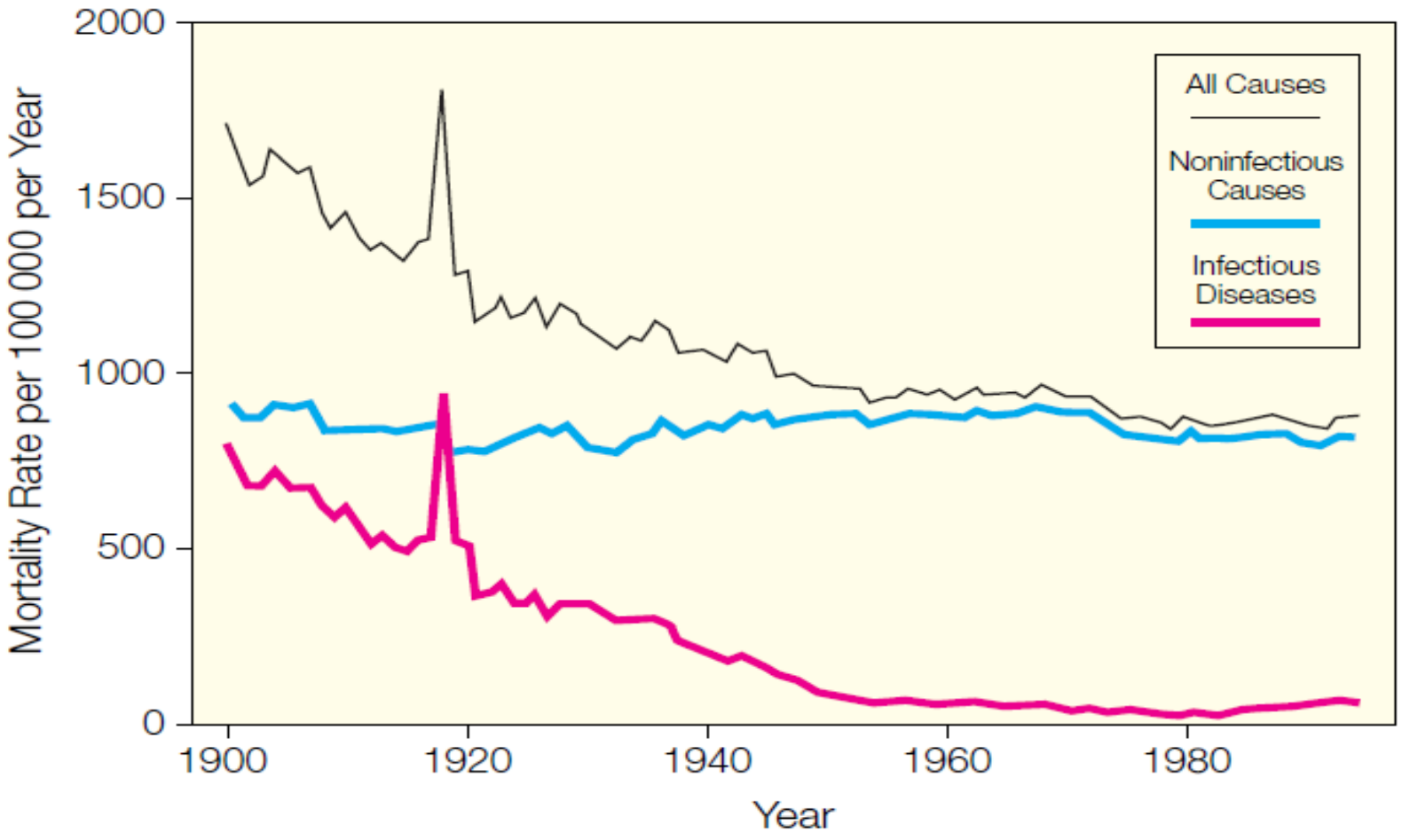
Figure 2. Crude Mortality Rates for All Causes, Noninfectious Causes, and Infectious Diseases



Source: Armstrong GL, Conn LA, Pinner RW. Trends in Infectious Disease Mortality in the **United States During the 20th Century.** JAMA. 1999;281(1):61–66. doi:10.1001/jama.281.1.61

Epidemiology

Epidemiology is a relatively new science that emerged, as such, during the **nineteenth century**. **At that time and up to the first half of the twentieth century it mainly investigated infectious diseases and epidemics (see the stories of Semmelweis and Snow**

Today it is involved in the study of all types of pathology:

Oncological and cardiovascular diseases

Other non communicable diseases

HIV/AIDS and infectious disease epidemics

Determinants of health

Pharmacovigilance (adverse reactions)

Healthcare services

And so on…

Epidemiology: definitions

Epi - (above) demos (population) - logos (study)

- The study of events, their **distribution** and disease control in the **population**
- The study of the correlations of the various factors that determine the **frequency** and **distribution** of diseases in the **human community**
- The study of diseases in **human populations**
- The study of **frequency**, **distribution** and behavior in communities
- The study of the **factors** that impact **health and disease**

WHO and CDC definitions

- Epidemiology is the study of the **distribution** and **determinants** of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems. Various methods can be used to carry out epidemiological investigations: surveillance and descriptive studies can be used to study distribution; analytical studies are used to study determinants. **(WHO)**

- Epidemiology is the study of the **distribution** and **determinants** of health-related states or events (*e.g. diseases*) in specified **populations**, and the application of this study to the control of health problems. **(CDC)**

frequency: indicates both how often ('HOW MUCH') the disease appears, and the 'temporal pattern' ('WHEN');

distribution: indicates both the geographic pattern ('WHERE') of appearance or presence of the disease and the characteristics of the host population (age, sex, various categories, etc.); is different from the trend or trend.

determinant: to be considered as synonymous with risk factor or causal factor

health/disease: epidemiology studies, in addition to the sick, also the healthy; better, sick in comparison with healthy. There are factors that contribute to maintaining health or healing: why did this person get sick? why did this other stay healthy?

population: a set of individuals who have one or more characters in common (eg they are present in the same geographical area, or have the same age, or other). The term therefore has a different meaning from the more common one.

Two basic epidemiological assumptions

1. Human diseases doesn't occur at **random** or by **chance**

1. Human diseases have **causal** and **preventive** factors

Prevalence and incidence

Relationship between prevalence, incidence and duration of disease

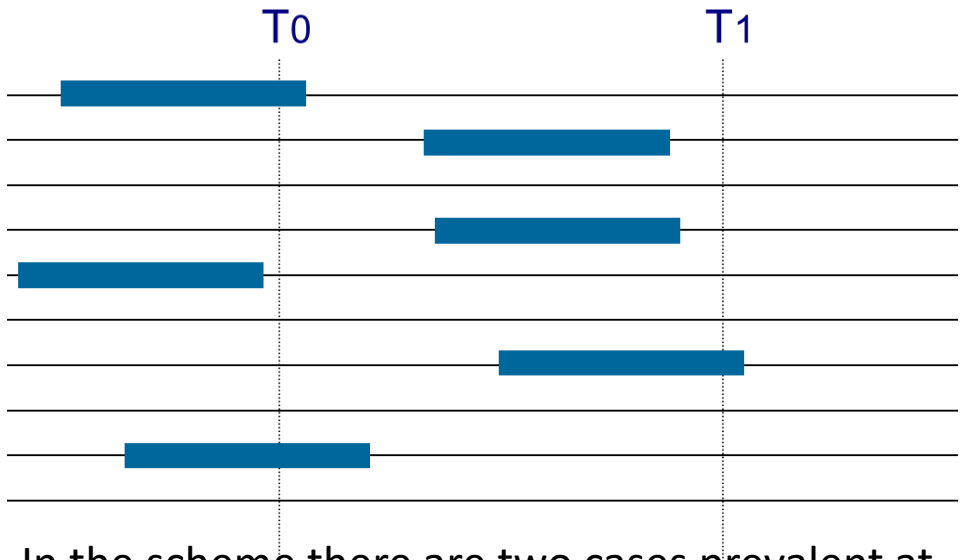
There is a close relationship between the prevalence, incidence and duration of the disease.
If the prevalence is low and does not vary significantly over time, the relationship is:

Prevalence = Incidence x average duration of disease

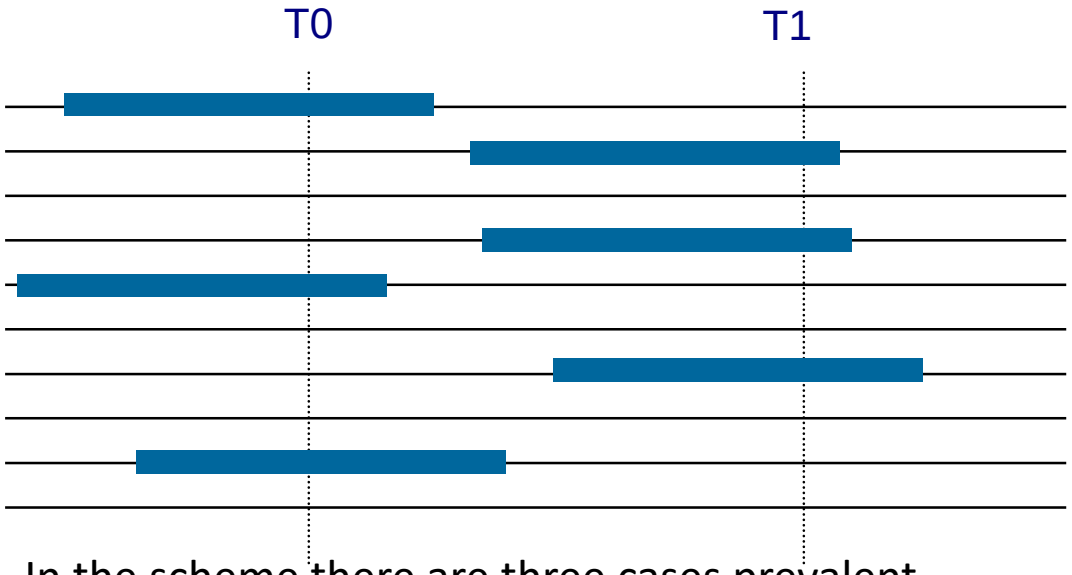
As the incidence and/or the duration of the disease increases, the prevalence also increases.

The epidemiologist's bathtube

Relationship between prevalence, incidence and duration of disease



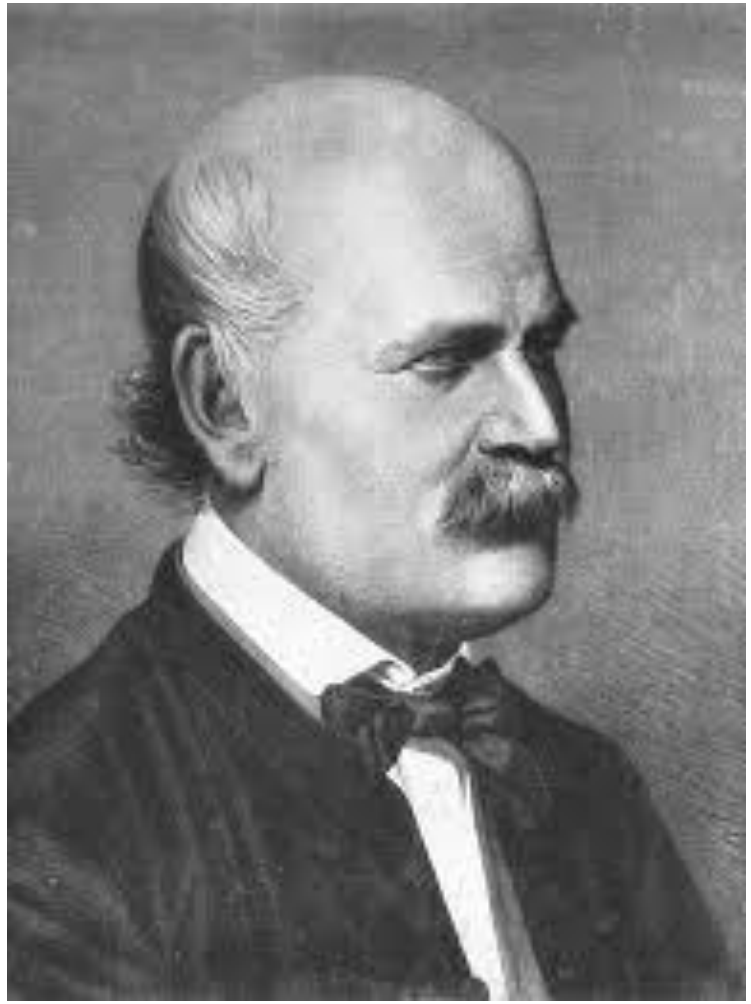
In the scheme there are two cases prevalent at time T0, only one at time T1, while the cases occurring (incidence) in the period considered (T0-T1) are three



In the scheme there are three cases prevalent at time T0, and three at time T1, while the cases occurring (incidence) in the period considered (T0-T1) are three

If the duration of the disease increases, with the same incidence, the prevalence will be higher

The down of epidemiology



«The savior of mothers»

Ignaz Semmelweis

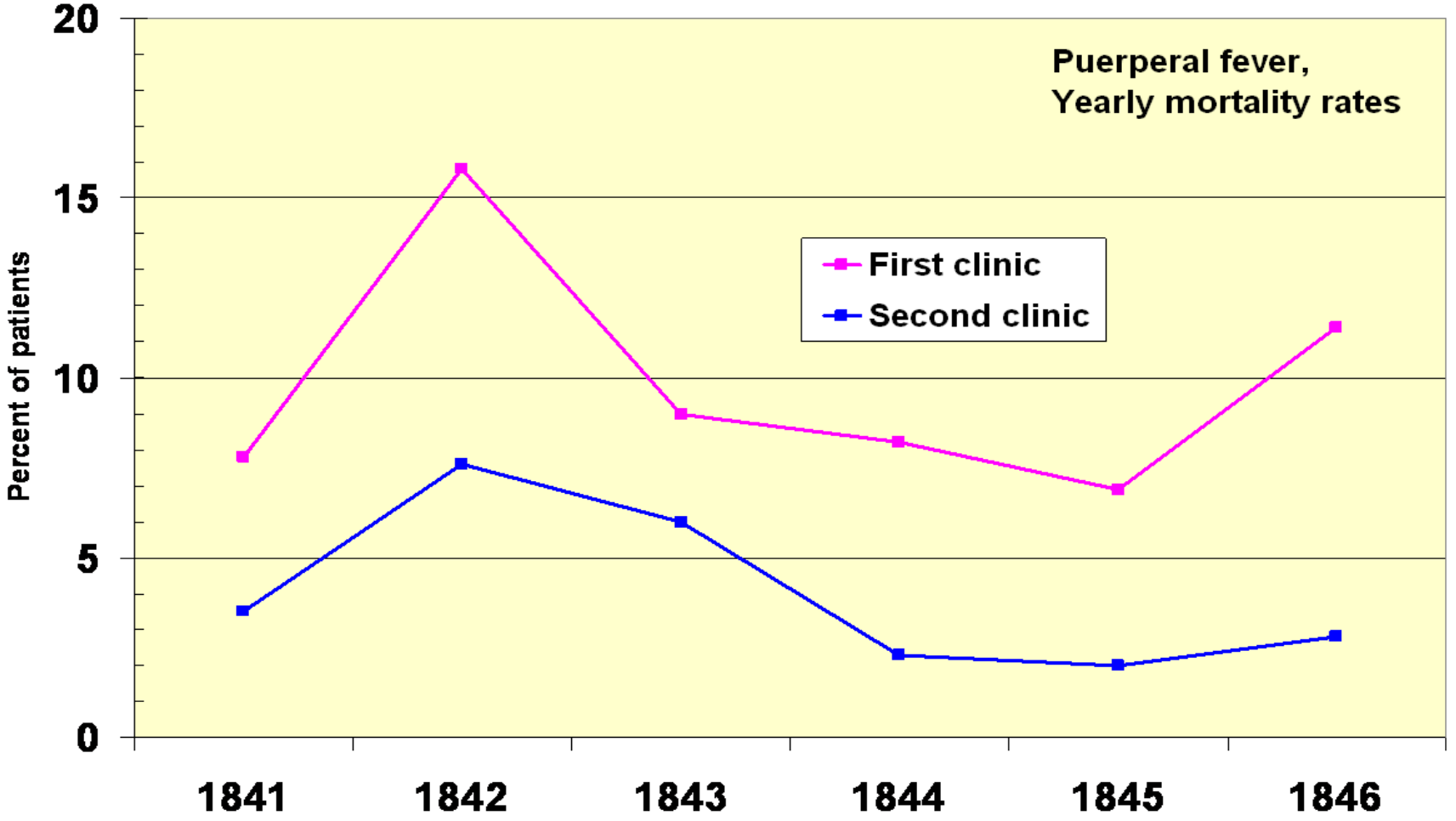
1 July1818
13 August 1865

Ignaz Philipp Semmelweis (1818 – 1865) was a Hungarian physician of German extraction now known as an early pioneer of antiseptic procedures.

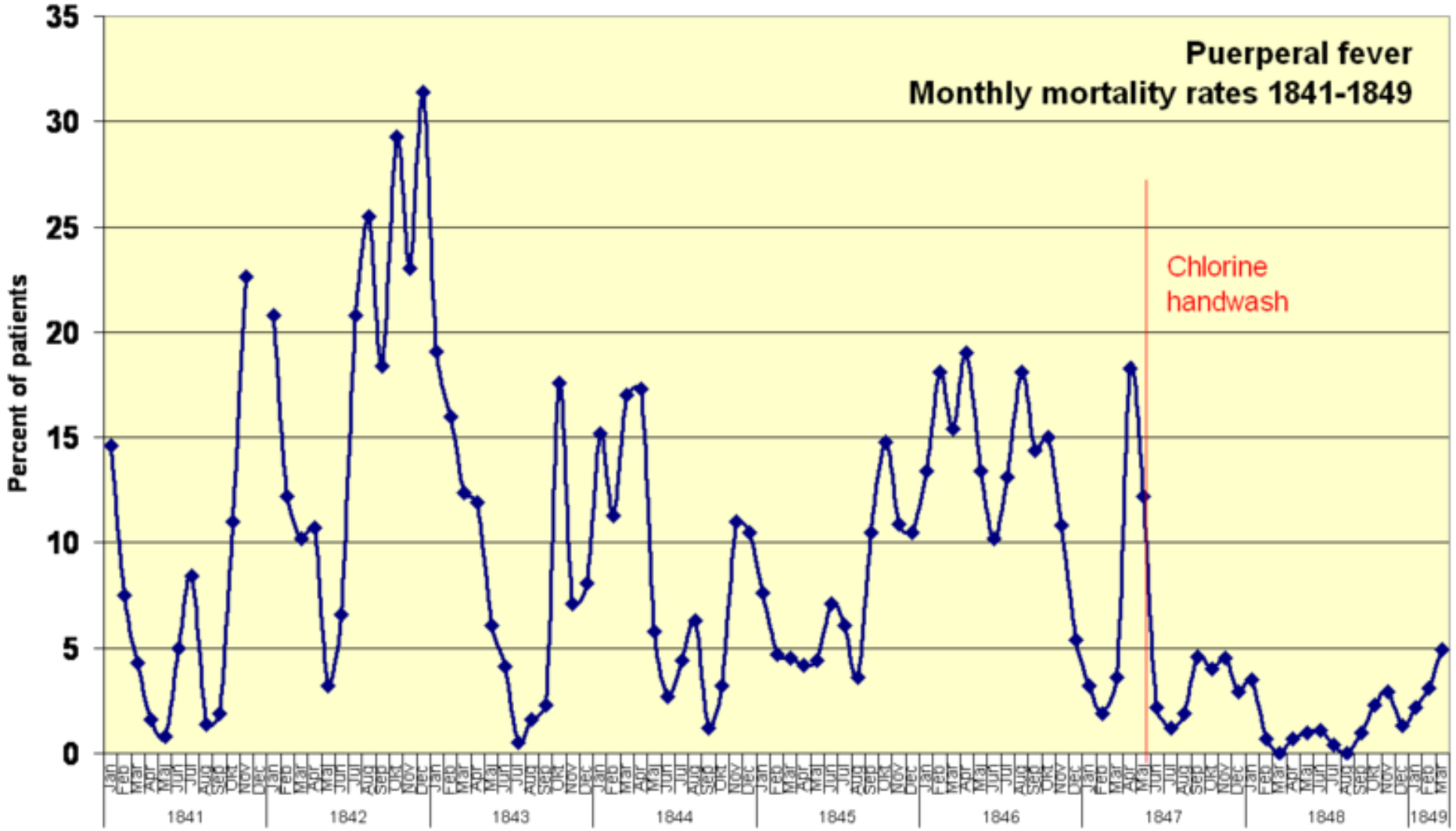
Described as the "*savior of mothers*", Semmelweis discovered that the **incidence of puerperal fever** (also known as "childbed fever") **could be drastically cut by the use of hand disinfection** in obstetrical clinics.

Puerperal fever was common in mid-19th-century hospitals and often fatal, with **mortality at 10%–35%.**

Semmelweis proposed the practice of washing hands with chlorinated lime solutions in 1847 while working in Vienna General Hospital's First Obstetrical Clinic, **where doctors' wards had three times the mortality of midwives' wards.**



Two maternity clinics were at the Viennese hospital. The First Clinic had an average **maternal mortality rate of about 10%** due to puerperal fever. The Second Clinic's rate was considerably lower, averaging **less than 4%.**


Puerperal fever
Monthly mortality rates 1841-1849
Percent of patients
35
30
25
20
15
10
5
0
Chlorine
handwash
1841
1842
1843
1844
1845
1846
1847
1848
1849

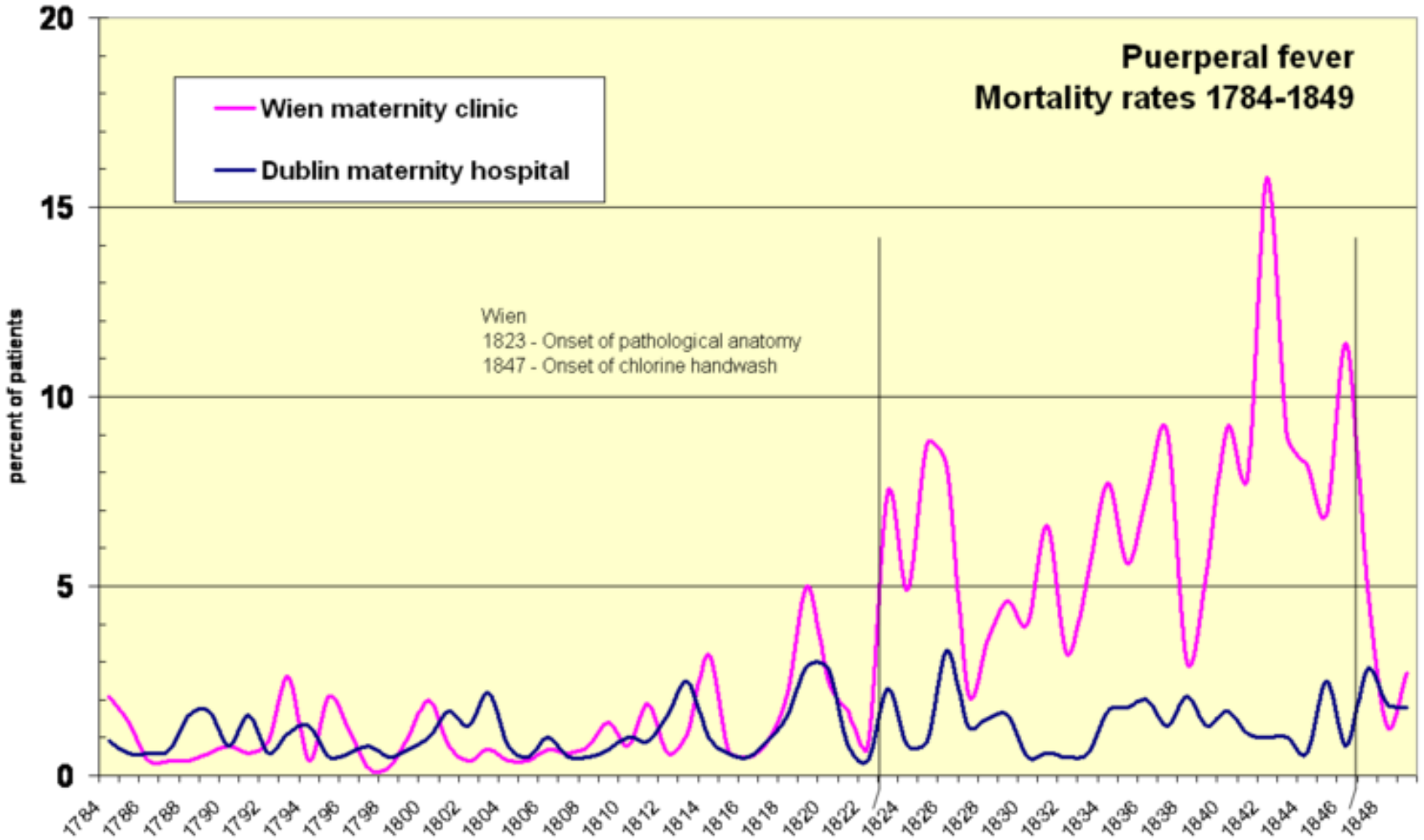
- The two clinics used almost the same techniques, and Semmelweis **started a meticulous process of eliminating all possible differences *(comparing*!)**, including even religious practices.
- **The only major difference was the individuals who worked there:** The First Clinic was the teaching service for medical students, while the Second Clinic had been selected for the instruction of midwives only.

He excluded "**overcrowding**" as a cause, since the Second Clinic was always more crowded and yet the mortality was lower ***(comparing!)***.

The breakthrough occurred in 1847, following the death of his friend Jakob Kolletschka, who had been accidentally poked with a student's scalpel while performing a post mortem examination. Kolletschka's own autopsy showed a pathology similar to that of the women who were dying from puerperal fever.

Semmelweis immediately **proposed a connection between cadaveric contamination and puerperal fever** ***(association!)***.

He concluded that he and the medical students carried "cadaverous particles" ***(hypotized risk factor!)*** on their hands from the autopsy room to the patients they examined in the First Obstetrical Clinic. This explained why the student midwives in the Second Clinic, who were not engaged in autopsies and had no contact with corpses ***(hypotized protective factor!)***, saw a much lower mortality rate.



Semmelweis demonstrated that the advent of pathological anatomy in Wien in **1823 (vertical line)** was accompanied by the increased incidence of fatal puerperal fever. The **second vertical line** marks **introduction of chlorine hand washing in 1847**. *Rates for the Dublin maternity hospital, which had no pathological anatomy, are shown for comparison*

Despite various publications of results where hand washing reduced mortality to below 1%, Semmelweis's observations conflicted with the established scientific and medical opinions of the time and his ideas were rejected by the medical community.

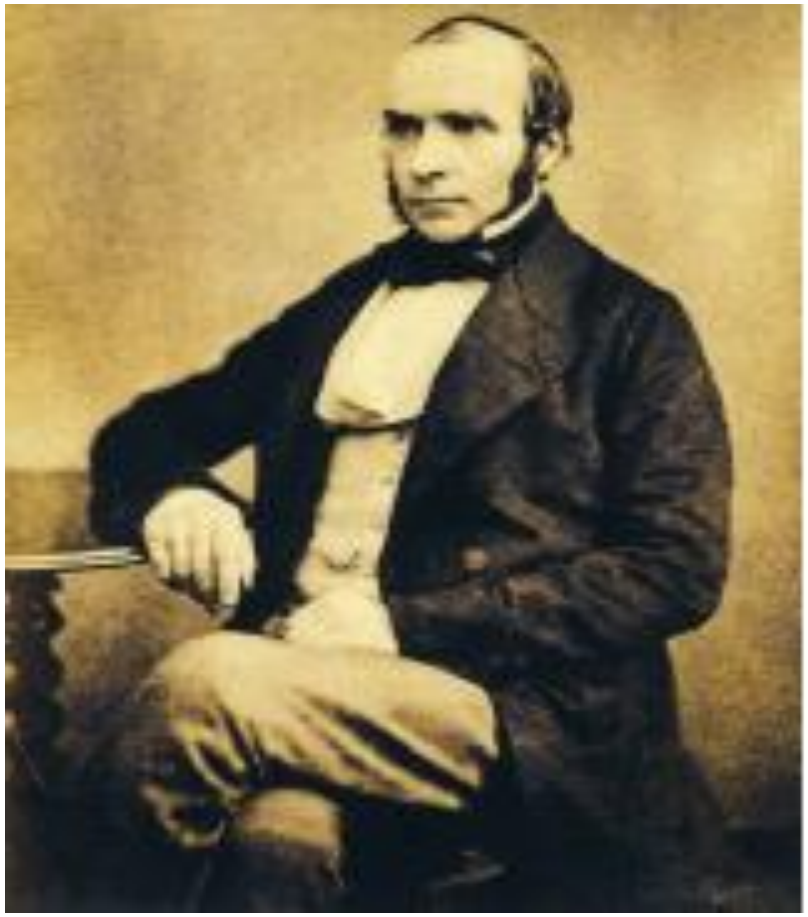
Some doctors were offended at the suggestion that they should wash their hands and Semmelweis could offer no acceptable scientific explanation for his findings.

In 1865, Semmelweis was committed to an asylum, where he died at age 47 of pyaemia, after being beaten by the guards, only 14 days after he was committed.

Semmelweis's practice earned widespread acceptance only years after his death, when Louis Pasteur confirmed the germ theory and Joseph Lister practiced and operated, using hygienic methods, with great success.

John Snow and the cholera epidemic in London

The historical moment corresponds to the mid-nineteenth century, **before the bacteria were recognized as agents of disease and before the "discovery" of what will be called the Vibrio cholera**, and at that time named “a poison”



John Snow and the cholera epidemic in London Summary

One of the first examples of an epidemiological approach comes from **London, 1854**, where **John Snow** first proposed the **mechanism for the transmission of cholera** ***(without knowing the cause – vibrio cholera)***.

He did this by **systematically collecting data** regarding the affected individuals; in doing so he discovered an **association** between cholera diffusion and a local public water pump.

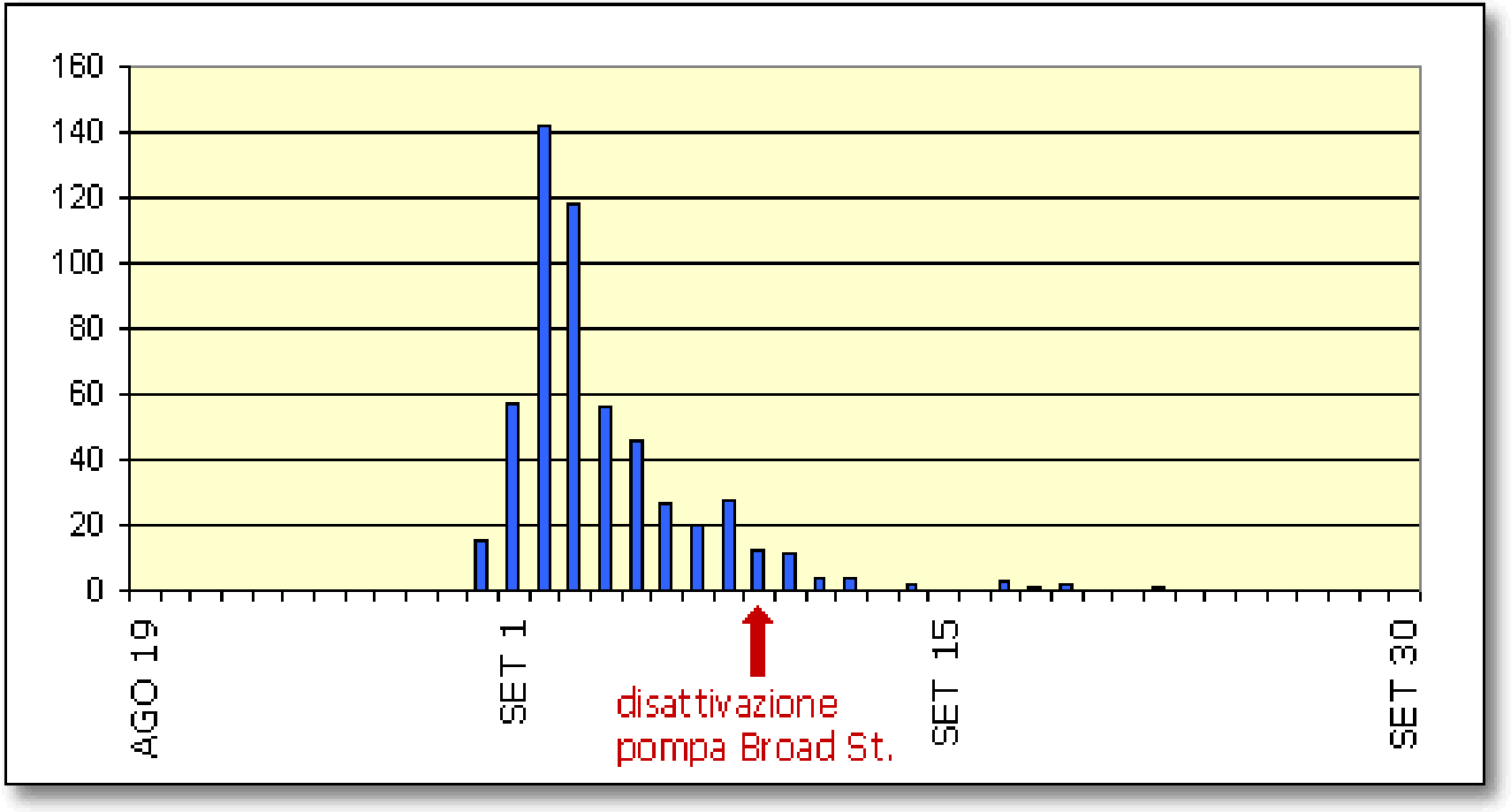
Prior to the discovery of bacteria, Snow pushed the local health authorities to close the water pump, eventually resulting in the end of the epidemic.

The cholera epidemic in London in 1848

Londra, 1854. Epidemia di colera. Mappa di John Snow.
Le barre rosse indicano la frequenza dei casi di colera. I cerchi blu indicano le pompe dell'acqua. In giallo: Broad Street. In grigio: distilleria.

The cholera epidemic in London in 1848

Numero di morti per colera nelle vicinanze della pompa di Broad St. nel periodo 19 agosto - 30 settembre 1854.



The cholera epidemic in London in 1848

- Cholera was certainly transmitted from sick individuals to healthy ones;
- transmission should be through some "poison" that could "multiply" in the individual sick;
- the "poison" could be brought through some way, and then cause disease at a distance; it was not necessary to have a close contact with the sick nor inhale its "emanations";
- the "poison" was to be introduced into the body by ingestion of some substance, and not in other ways, being diarrhea the first and the main manifestation of the disease;
- drinking water represented the peculiar, even if not exclusive, way of spreading the "poison" to healthy people.

The cholera epidemic in London in 1848

"There is a beer brewery in Broad St., close to the pump, and after learning that **none of those workers had died of cholera**, I called the owner, Mr. Huggins.

He informed me that they have used in the distillery about 70 people, and that **none of them has contracted cholera** - at least in severe form - and that only two have suffered a mild illness in the period in which the disease was prevalent…

Mr. Huggins believes that **they do not drink water at all** and is absolutely certain that they have never supplied with water from the pump of the road. In fact, within the factory there is a deep well "...

Modern Epidemiology

Modern Epidemiology

Modern epidemiology starts in late 1940s, with a more systematized body of principles for the design and evaluation of epidemiological studies.

The largest formal human experiment ever conducted was the Salk vaccine field trial in 1954, the results of which laid the foundation for the prevention of paralytic poliomyelitis.

In recent years, epidemiologic research has steadily attracted public attention, with the news media boosted by increasing social concern on about health issues.

Examples are **H1N1 influenza**, **hormone replacement therapy and heart disease**, the **effectiveness of mammography screening** in the prevention of breast cancer, and many others.

Source: Oxford Handbook of Public Health Practice, 2013

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Purpose and scope of Epidemiology

- The ultimate purpose of Epidemiology is prevention of diseases and promotion of health

- How?
  1. Elucidation of natural history of diseases
  2. Description of health status of population
  3. Establishing risk factors/determinants of diseases
  4. Evaluation of interventions (Public Health)

Cause, risk factor, determinant

The concept of risk factor/determinant is associated with a **concept of "cause"** different from that traditionally understood, where by cause we mean any factor, element, circumstance that gives rise to an effect (disease) or to a sequence of events that lead to the effect.

Through terms as "determinant", “risk factor” or “causal factor”, the concept of cause is introduced as a **"factor capable of increasing the probability" of the disease**.

Cause, risk factor, determinant

The causal or risk factors or determinants can be:

<u>necessary or not necessary; sufficient or not sufficient.</u>

For non-infectious, chronic-degenerative diseases, individual causative factors are generally neither necessary nor sufficient.

Instead, they are **associated with an increased likelihood of developing the disease (increased risk) and are therefore referred to as risk factors**

Some risk factors

Environmental factors: exposures

Genetic factors (hereditary factors, are mostly non-modifiable)

Individual non-hereditary factors: age, sex, presence of diseases (they are mostly non-modifiable)

Individual factors due to lifestyle: smoking, diet, physical activity, etc. (they are mostly modifiable)