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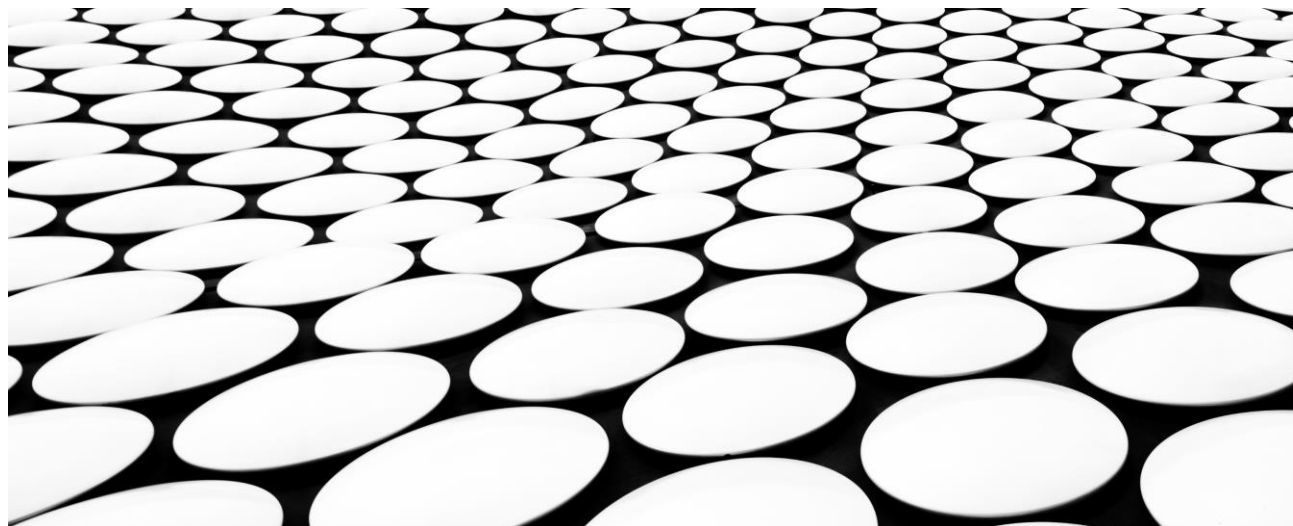


Hadassah  
University  
Hospital

Founded by Hadassah, the Women's Zionist Organization of America

# EPIDEMIOLOGY – NOT ONLY ABOUT EPIDEMICS

Ora Paltiel, MDCM, MSC.



האוניברסיטה  
העברית  
בירושלים  
THE HEBREW  
UNIVERSITY  
OF JERUSALEM

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## LET ME INTRODUCE MYSELF



# EPIDEMIOLOGY- WHAT IS IT?

The science of who gets sick, where, when and why, and how we can control it



E nsiere alerent chascū ior  
q' estia lor en est a besong  
q' out lor cōment aqere loing  
L i filz le roi furent ploze  
L uoz q' furent entere

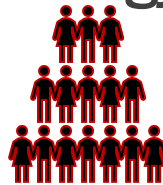
S argeus orent trop pa  
S ules multēt enz ambe  
V eles leur fiere haue  
E nteure furent riche

La plus belle testier  
S on cel que q' est

# ***DEFINITION OF EPIDEMIOLOGY- WHO***

“Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations and the applications of this study to the control of health problems.”

*John Last, Dictionary of Epidemiology*



# Outbreak of Cholera, London

## August-September 1854

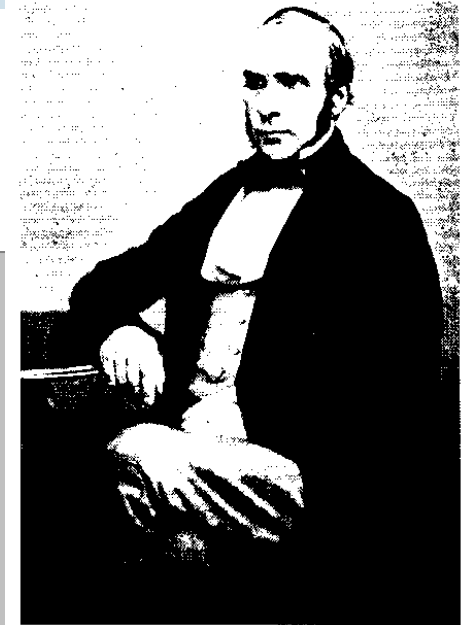
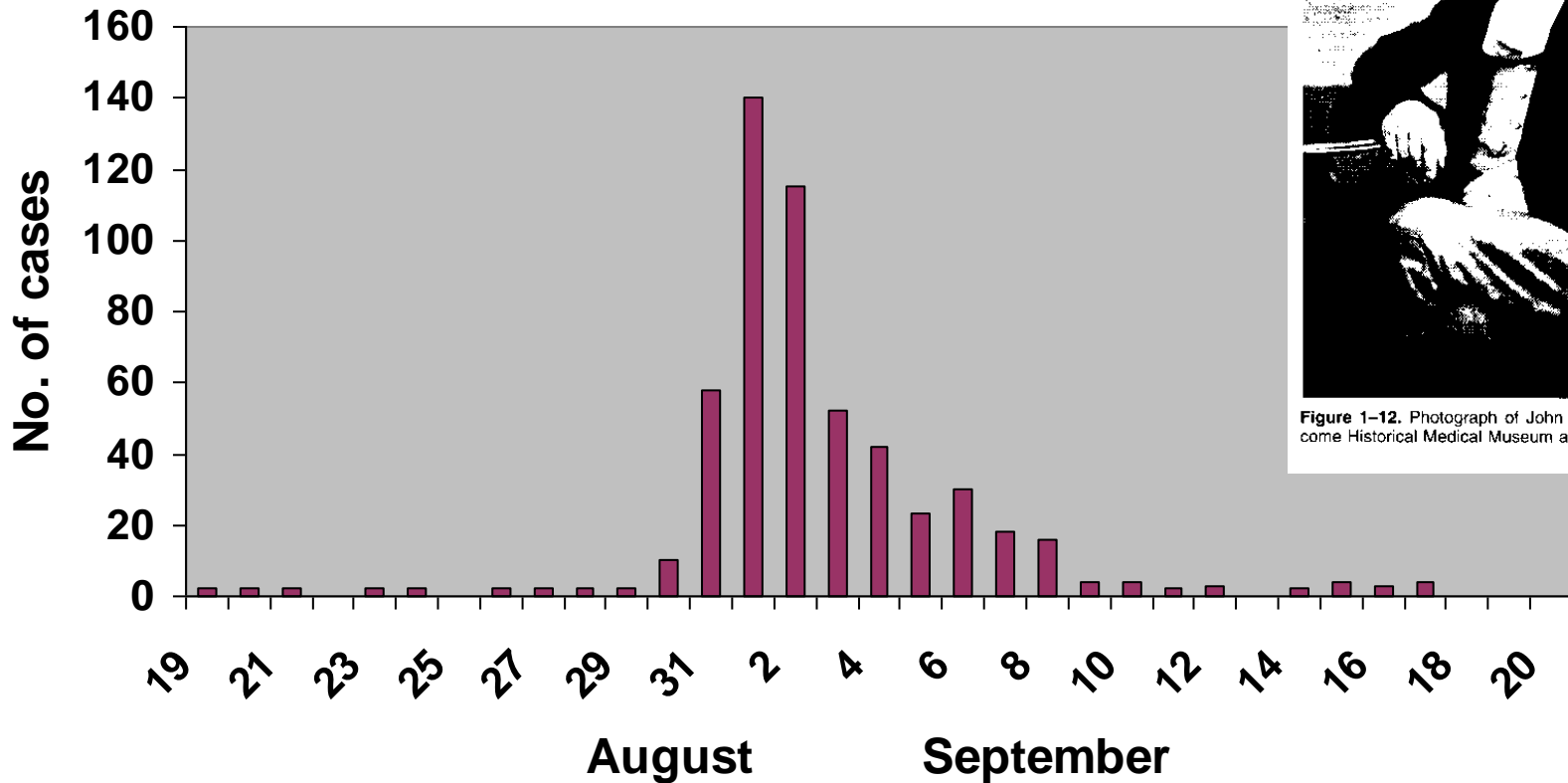
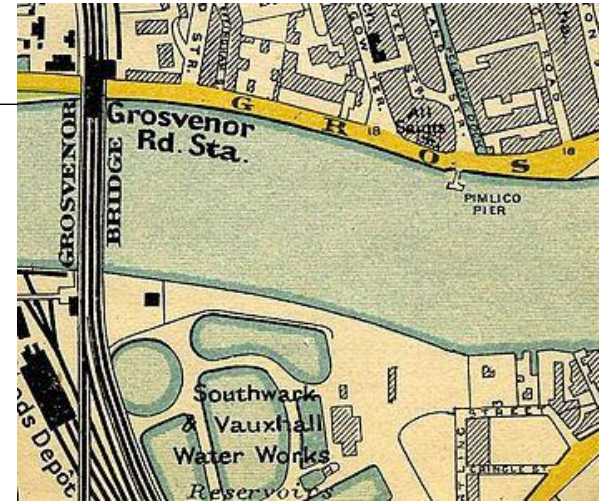


Figure 1-12. Photograph of John Snow. (From the Wellcome Historical Medical Museum and Library, London.)



# **Deaths from Cholera in Districts of London Supplied by Two Water Companies, 8 July - 26 August, 1854**

<b>Water supply company</b>	<b>Population 1851</b>	<b>No. of deaths from cholera</b>	<b>Cholera death rate per 1000 population</b>
<b>Southwark</b>	<b>167,654</b>	<b>844</b>	<b>5.0</b>
<b>Lambeth</b>	<b>19,133</b>	<b>18</b>	<b>0.9</b>



Marlborough Mews Pump

Carnaby St. Pump

Broad St. Pump

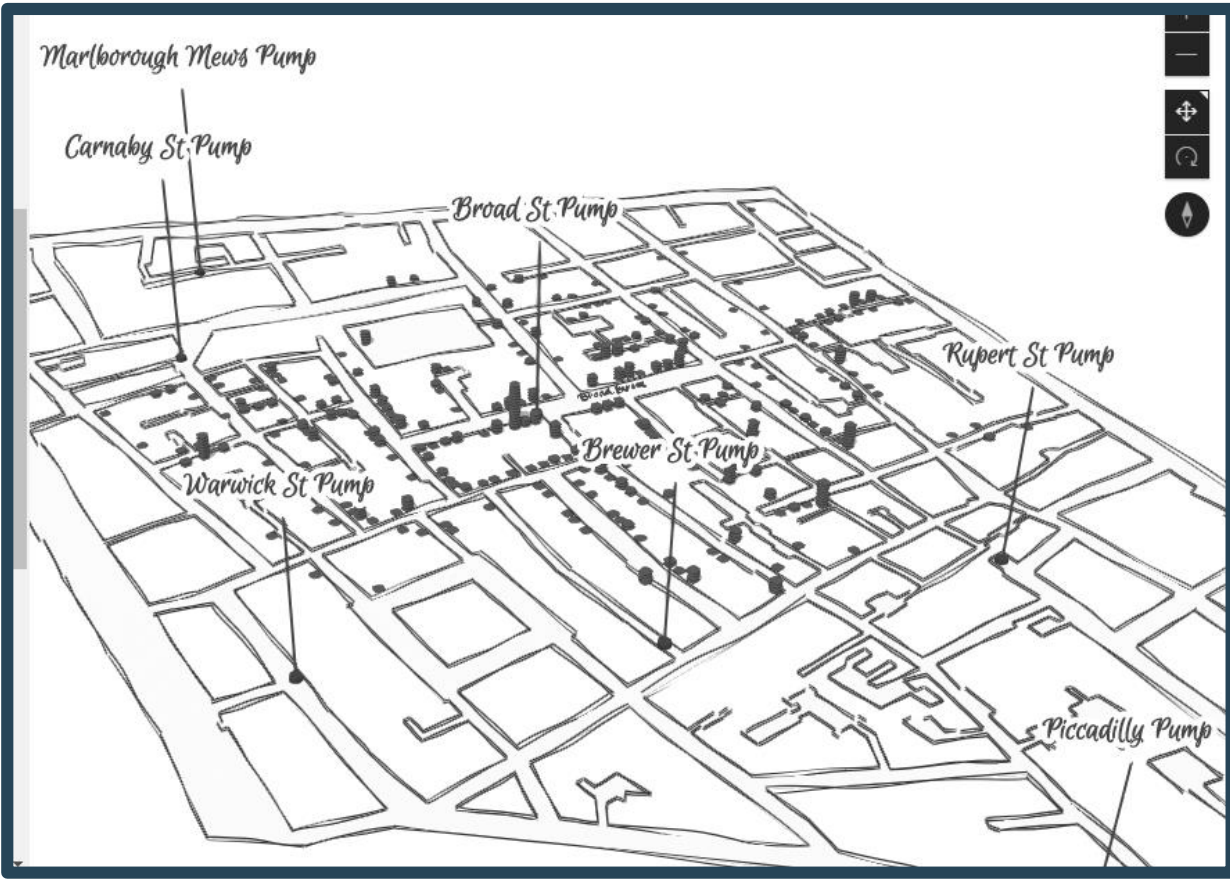
Rupert St Pump

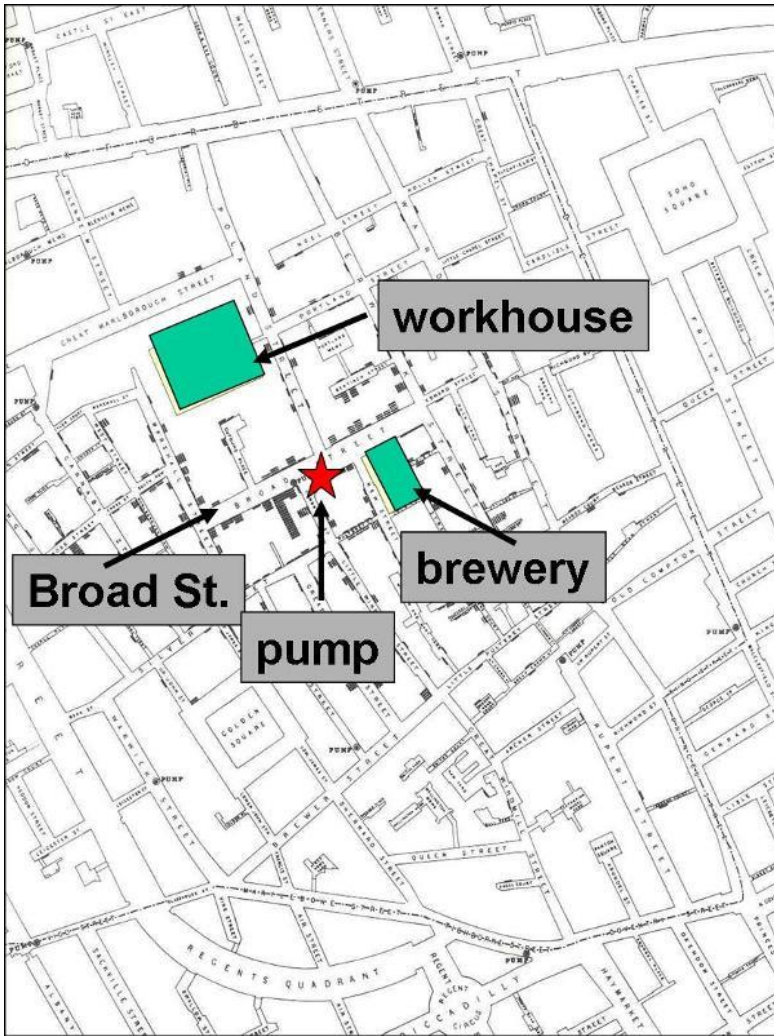
Brewer St. Pump

Warwick St Pump

Piccadilly Pump

# JOHN SNOW'S MAP OF CHOLERA CASES IN SOHO







# DEFINITION OF EPIDEMIOLOGY

“Epidemiology is the study of the distribution and determinants of **health-related states or events** in specified populations and the applications of this study to the control of health problems.”

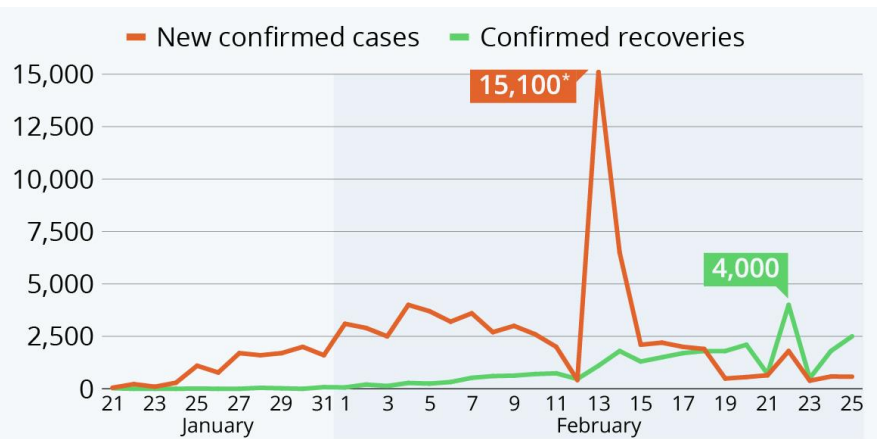
WHO

*John Last, Dictionary of Epidemiology*



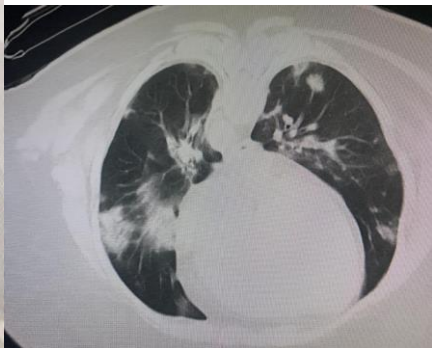
What are we  
measuring?

# What are we counting? What is a case?



\* China reported a massive increase of 15,000 confirmed cases in mid February due to a change in how the virus was identified. As of 10:00am CET on Feb 25, 2020.

Source: Johns Hopkins University

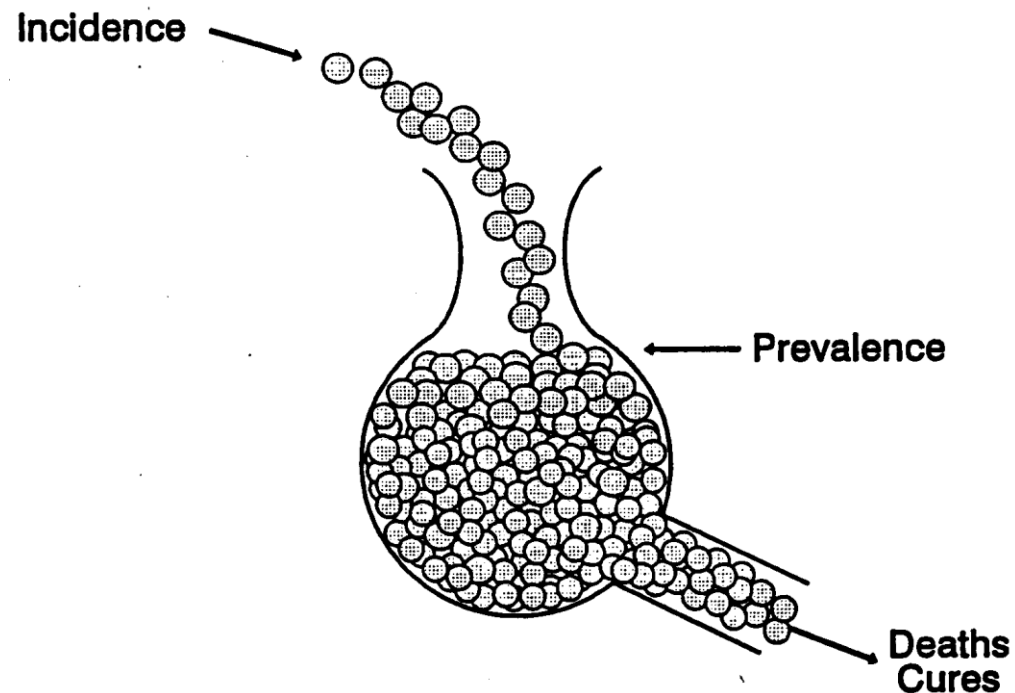


- Case definitions change
- What is a confirmed case?
- What is a death from Covid-19 disease?

Report
Positive 2019-nCoV
Inconclusive
Not Detected
Invalid

# What are we measuring?

- Numbers and Rates
- Numerators can be numbers of people, deaths, positive test
- Denominators? # in the population?, # of tests?
- Incidence of Disease (number of new cases/population\*time)
- Prevalence – how much is there the population
- Death rates
- Case fatality #died/#with disease



# ***DEFINITION OF EPIDEMIOLOGY***

How many?  
Where?  
When?

“Epidemiology is the study of the **distribution** and determinants of health-related states or events in specified populations and the applications of this study to the control of health problems.”

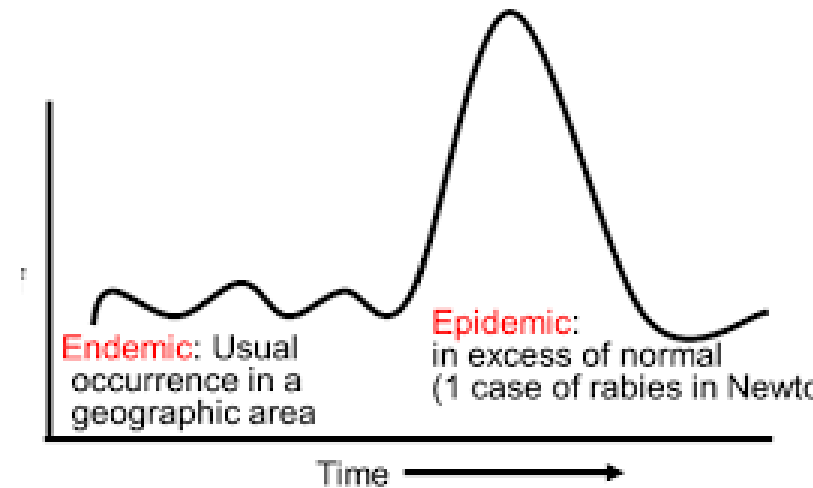
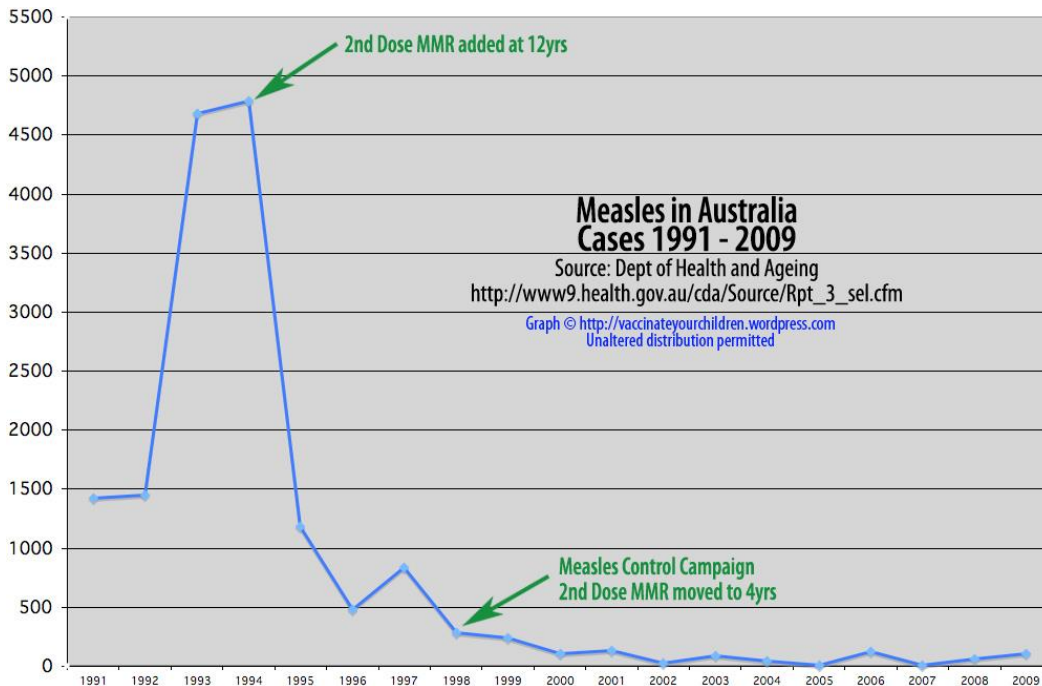
**WHO**

*John Last, Dictionary of Epidemiology*

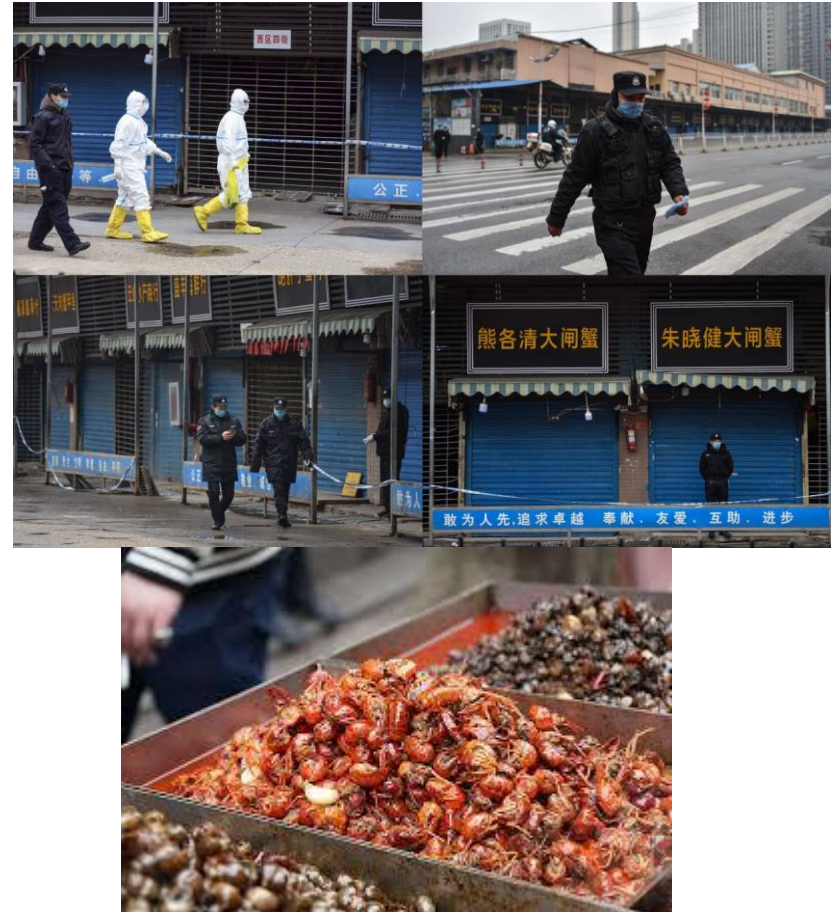
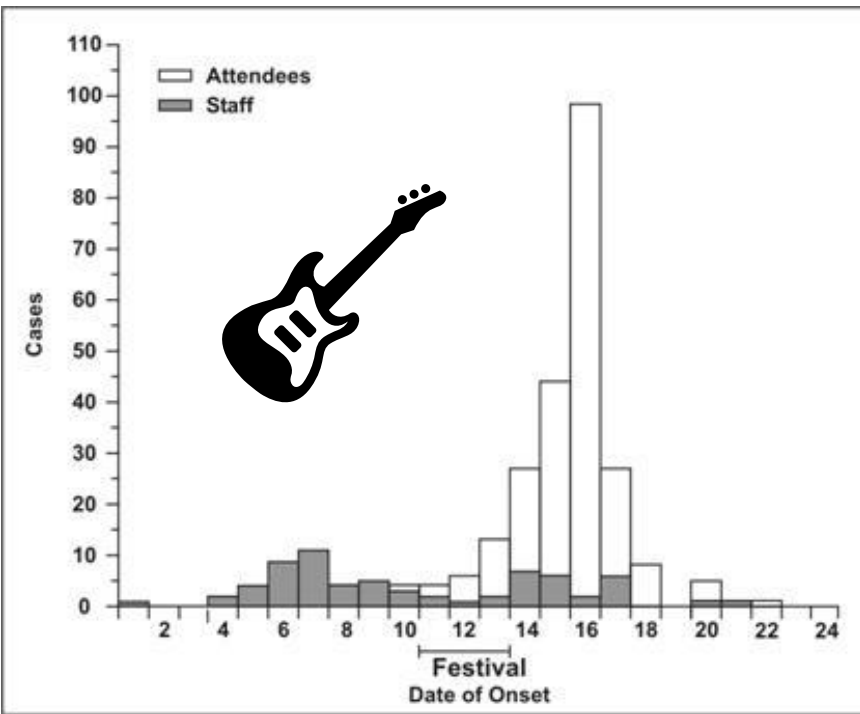


# DISTRIBUTION

## COUNTING CASES- SURVEILLANCE OVER TIME



# OUTBREAK



Lee et al; An outbreak of shigellosis at an outdoor music festival.

Am J Epidemiol 1991;133:608-15.

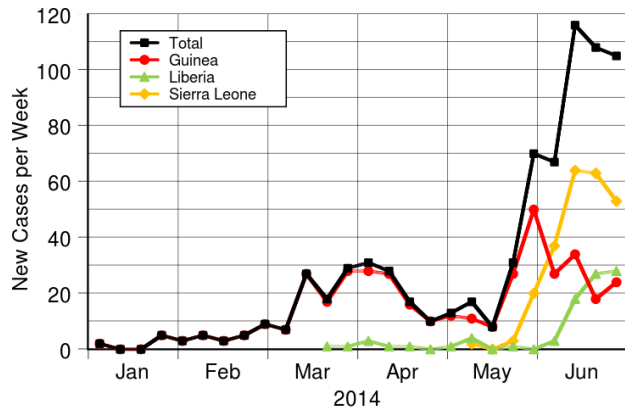
# OUTBREAK, EPIDEMIOLOGIC INVESTIGATION

- Identify investigation team and resources.
- Establish existence of an outbreak.
- Verify the diagnosis.
- Construct case definition.
- Find cases systematically and develop line listing.
- Perform descriptive epidemiology/develop hypotheses.
  - (Person,place, time)
- Evaluate hypotheses/perform additional studies as necessary.
- Implement control measures.
- Communicate Findings
- Maintain Surveillance

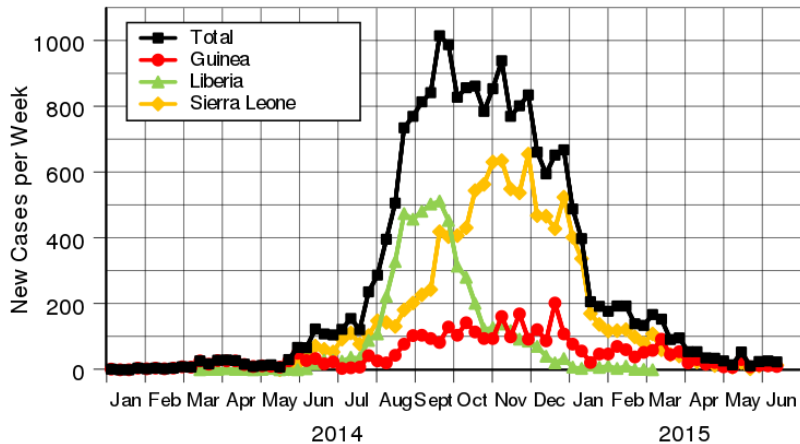


# EPIDEMIC, ENDEMIC, PANDEMIC

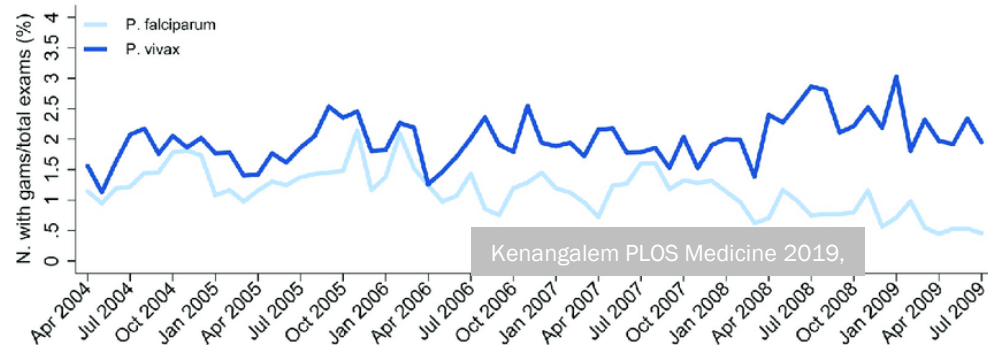
2014 West Africa Ebola Epidemic



2014 West Africa Ebola Epidemic

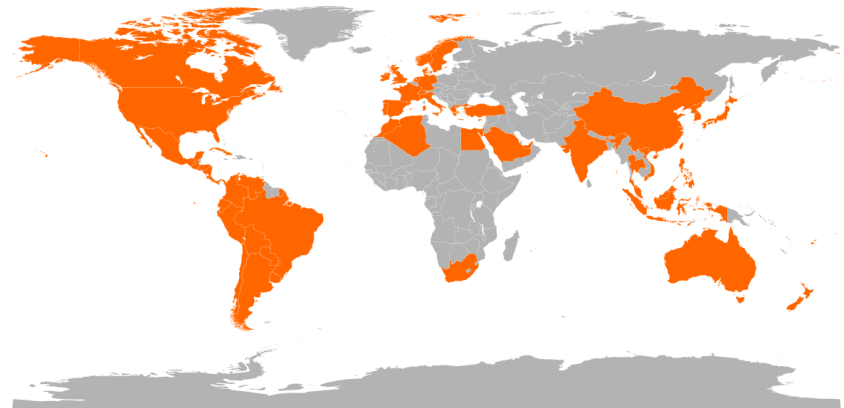


Malaria, Papua Indonesia



Kenangalem PLOS Medicine 2019,

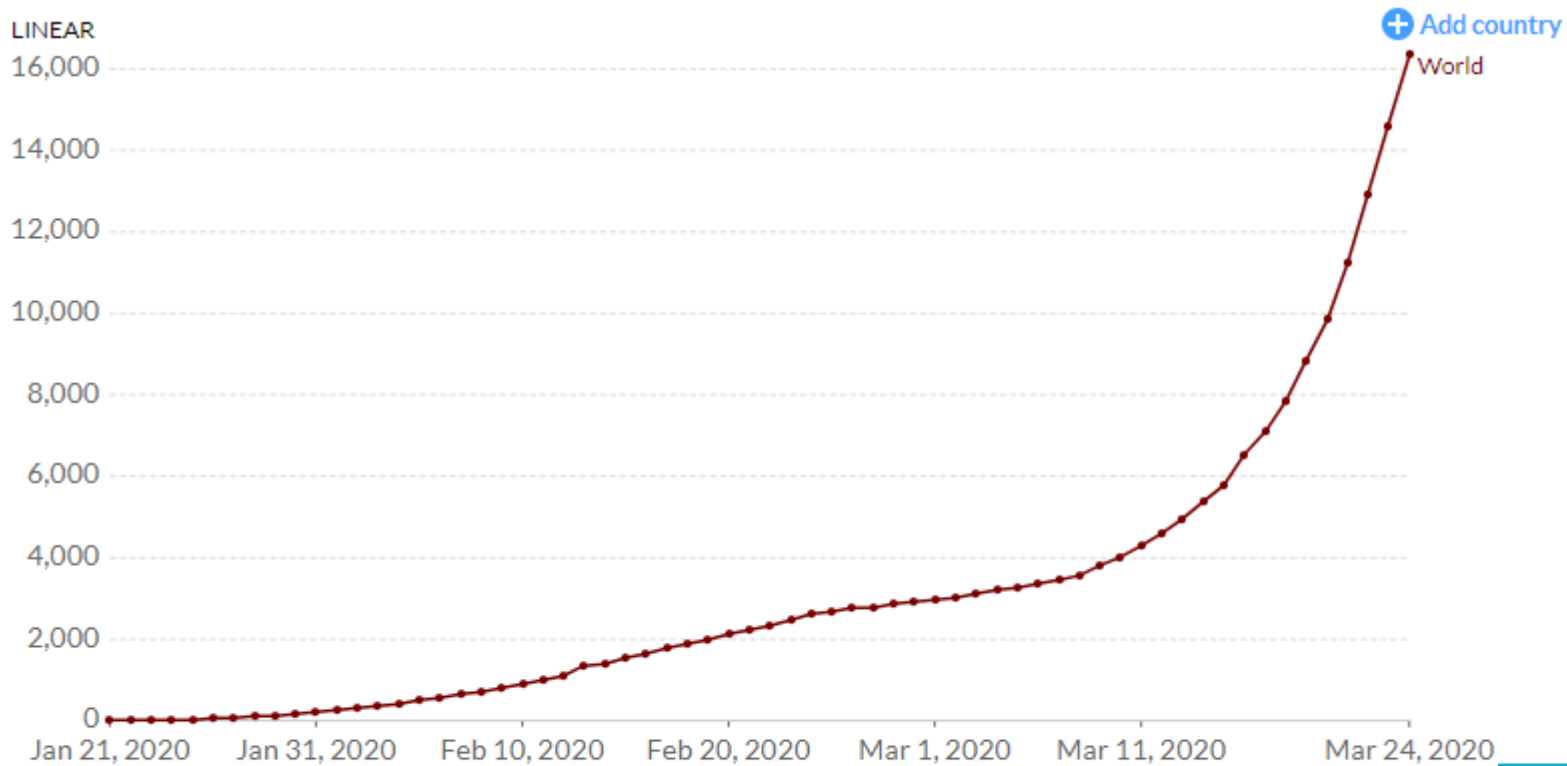
Pandemic Flu 2009 H1N1





# HOW DO WE KNOW WE'RE IN AN EPIDEMIC?

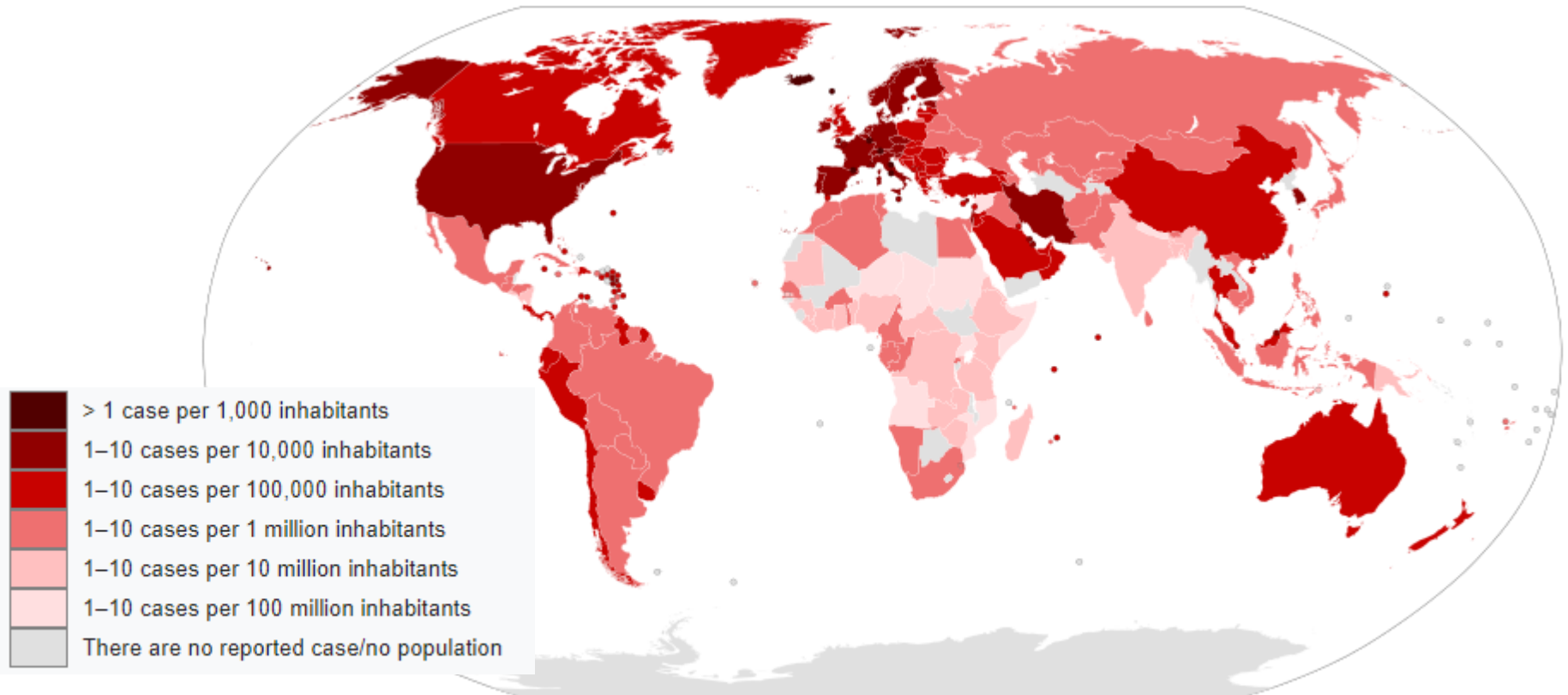
Time



Source: European CDC - Latest Situation Update Worldwide

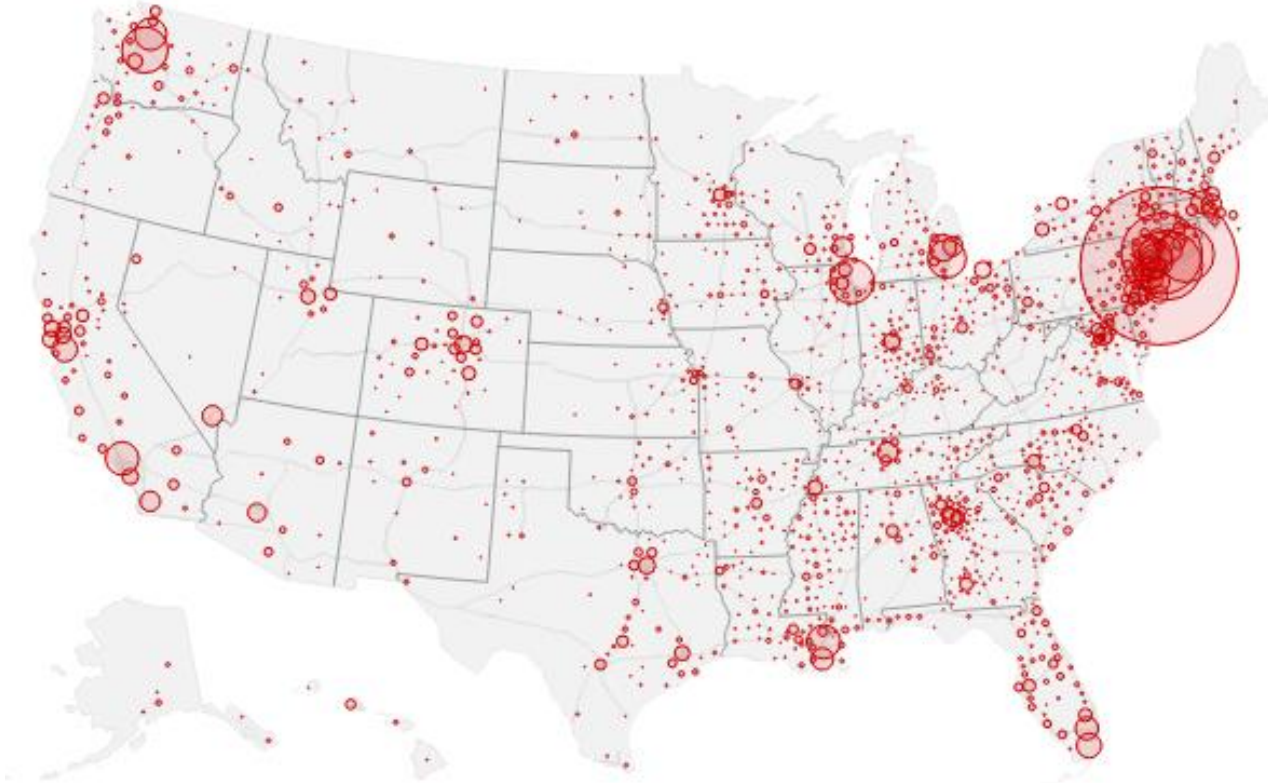
A **PANDEMIC** IS A TYPE OF *EPIDEMIC* (ONE WITH GREATER RANGE AND COVERAGE), AN OUTBREAK OF A DISEASE THAT OCCURS OVER A WIDE GEOGRAPHIC AREA AND AFFECTS AN **EXCEPTIONALLY HIGH PROPORTION** OF THE POPULATION.

: Map of the [COVID-19](#) outbreak per capita *as of 22 March 2020 Cases per population size*



# EPIDEMIOLOGY: DISTRIBUTION OF HEALTH-RELATED STATES OR EVENTS IN SPECIFIED POPULATIONS

Place



NY Times March 25, 2020

# EPIDEMIOLOGY: DISTRIBUTION OF HEALTH RELATED STATES OR EVENTS IN SPECIFIED POPULATIONS

- Hot spots in Newark
- . Back to John Snow

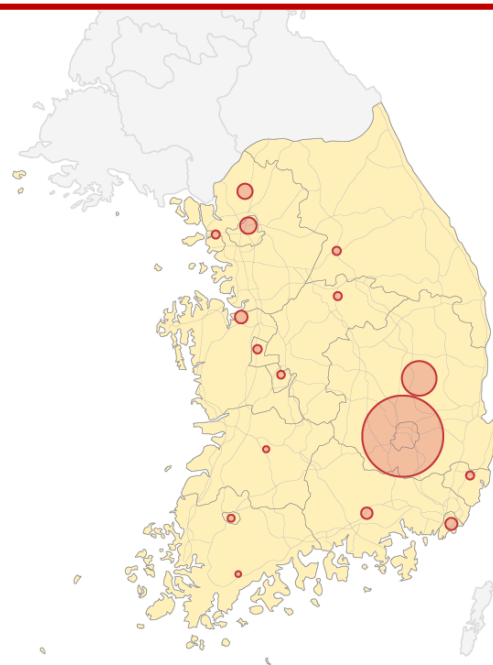


ABC March 23, 2020  
Hotspots in Newark



## EPIDEMIOLOGY: DISTRIBUTION OF HEALTH-RELATED STATES OR EVENTS IN SPECIFIED POPULATIONS

- Hot spots in Italy, Iran, Korea. Back to John Snow

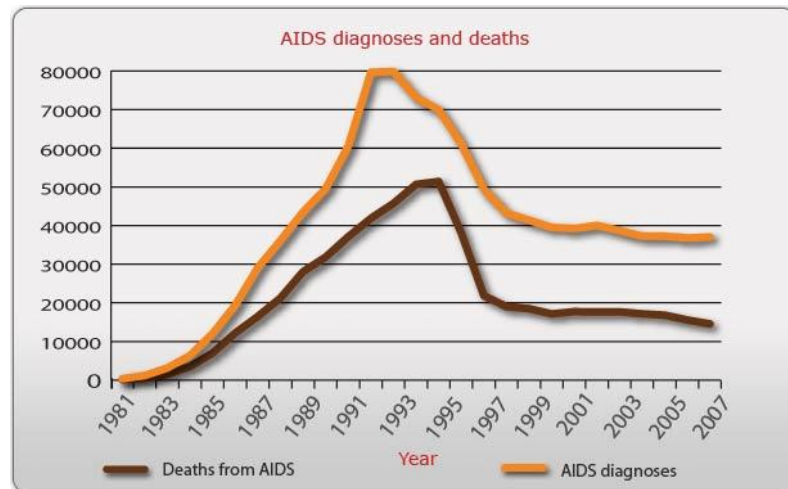


<https://www.nytimes.com/interactive/2020/world/coronavirus-maps-italy-iran-korea.html> March 12, 2020

# VARIABILITY OF CASE FATALITY RATE - CFR

## Recent Epidemics CFR

Disease	Estimated case fatality rate (CFR)
SARS-CoV	10% Venkatesh and Memish (2004) Munster et al. (2020)
MERS-CoV	34% Munster et al. (2020)
Seasonal flu (US)	0.1% US CDC
Ebola	50% 40% in the 2013-16 outbreak WHO (2020) Shultz et al. (2016)



## Case Fatality for SARS 2003

Country	No. of cases	No. of deaths	CFR
Canada	251	41	17
China	5327	349	7
Hong Kong	1755	300	17
Singapore	238	33	14
Taiwan	665	180	27

# Case Fatality Rates: COVID-19 vs. US Seasonal Flu

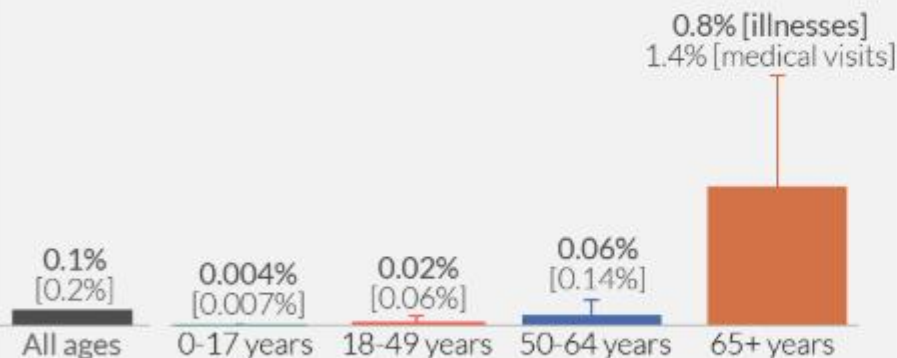
Case fatality rate (CFR) is specific to a location and time. It is calculated by dividing the total number of deaths from a disease by the number of confirmed cases.



## Seasonal Flu

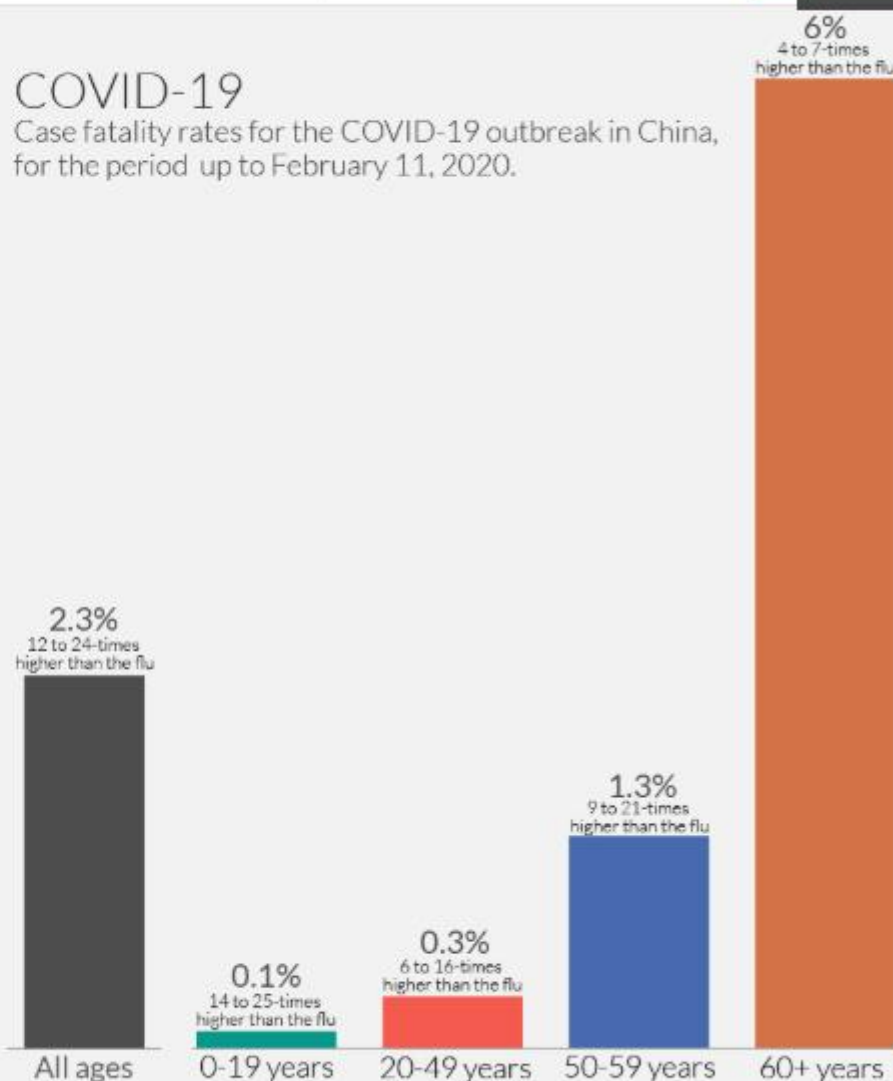
Case fatality rates for the influenza season 2018-19 in the USA.

Symptomatic cases are calculated based on models which aim to account for underreporting – figures based on medical visits are therefore also shown in square brackets, which may be a closer comparison to COVID-19 case fatality rates.



## COVID-19

Case fatality rates for the COVID-19 outbreak in China, for the period up to February 11, 2020.



Data: Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, Vital surveillances: the epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)—China, 2020. China CDC Weekly. US influenza data is sourced from the US Centers for Disease Control and Prevention (CDC).

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Licensed under CC-BY by the authors Hannah Ritchie and Max Roser.



# Definition of Epidemiology

“Epidemiology is the study of the distribution and **determinants** of health-related states or events in specified populations and the applications of this study to the control of health problems.”

WHO

*John Last, Dictionary of Epidemiology*

Why them and not everyone else?

Search for risk factors, causal and non-causal associations

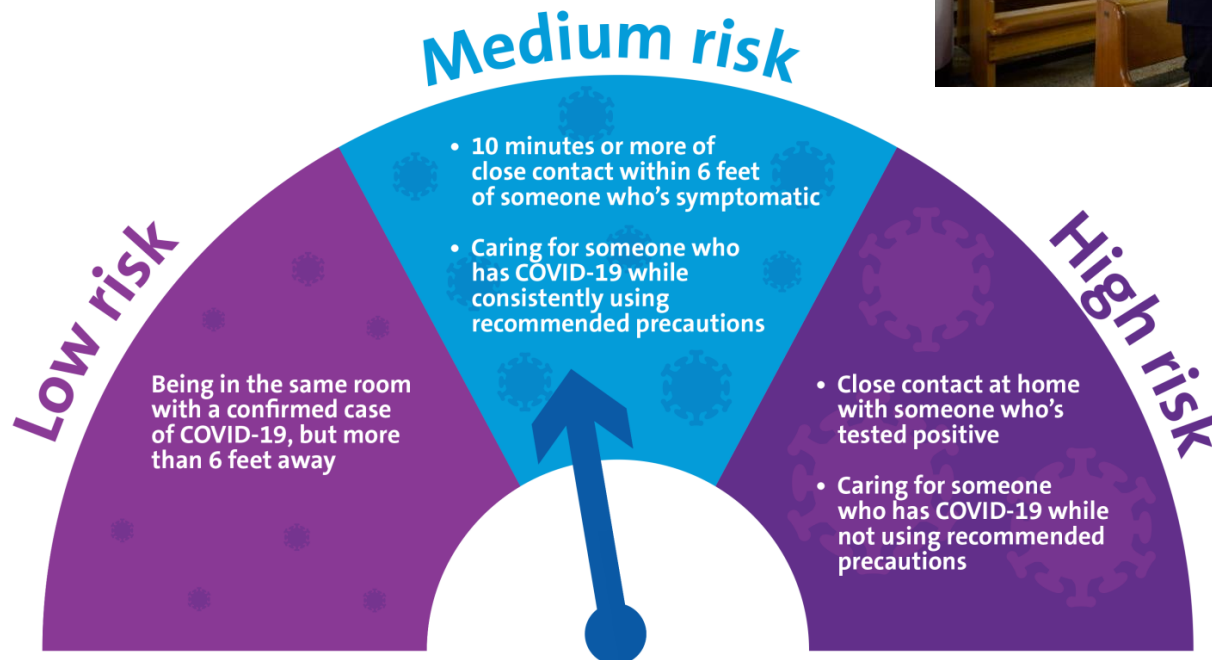


# DETERMINANTS – CAUSE

## RISK FACTORS- WHO IS MORE LIKELY TO GET THE DISEASE

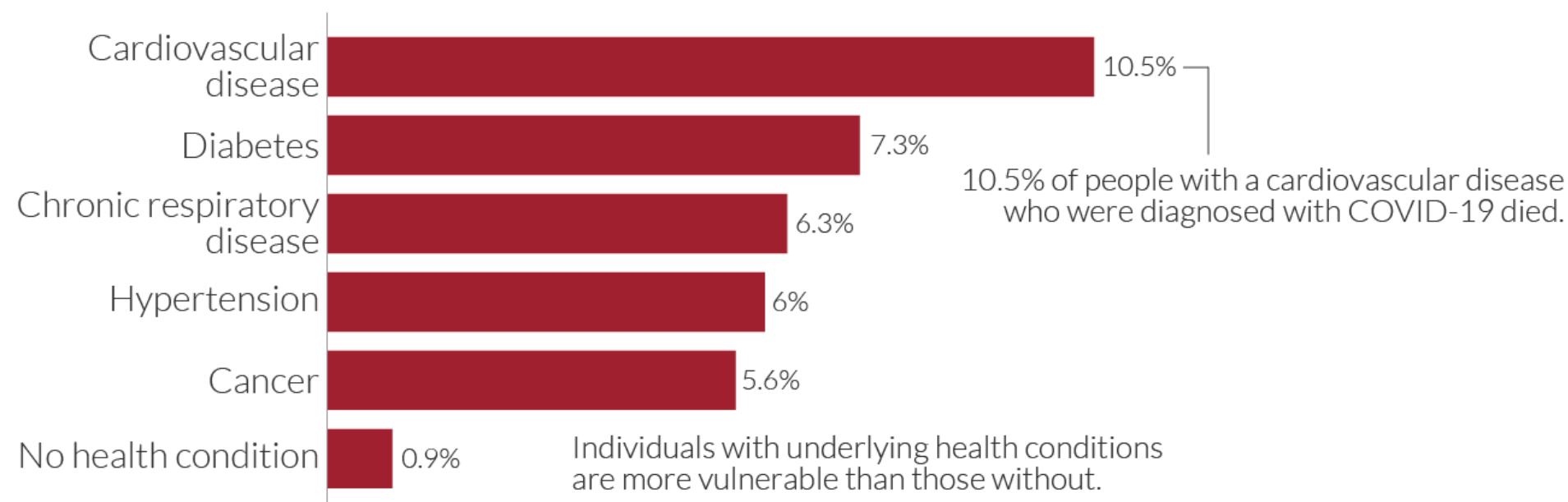


Cause



# Coronavirus: early-stage case fatality rates by underlying health condition in China

Case fatality rate (CFR) is calculated by dividing the total number of deaths from a disease by the number of confirmed cases. Data is based on early-stage analysis of the COVID-19 outbreak in China in the period up to February 11, 2020.



Data source: Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. *Vital surveillances: the epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)—China, 2020*. China CDC Weekly.

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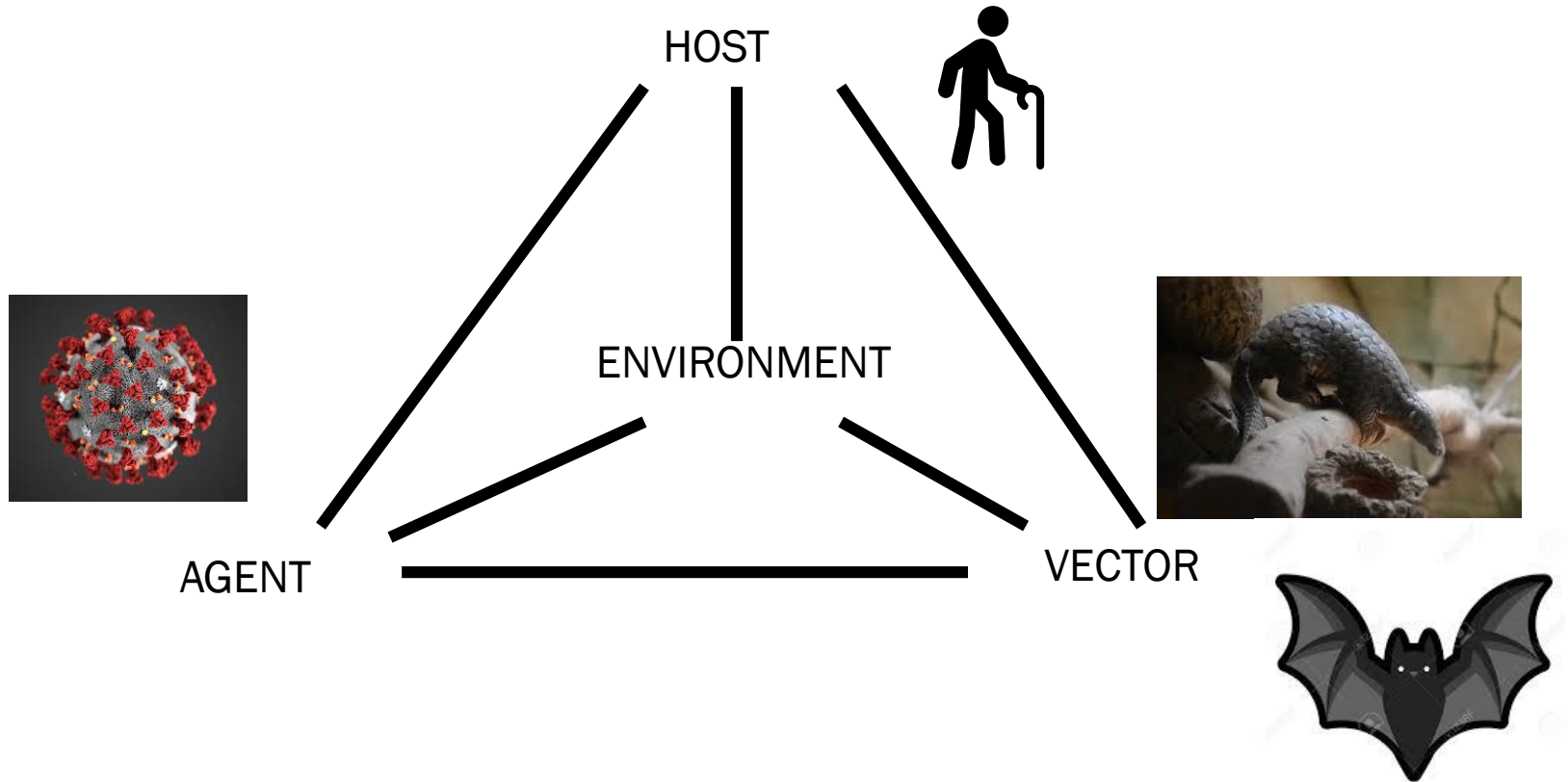
## RISK FACTORS FOR DEATH AND COMPLICATIONS

**TABLE.** Risk Factors for Severe Adverse Events<sup>3,a</sup>

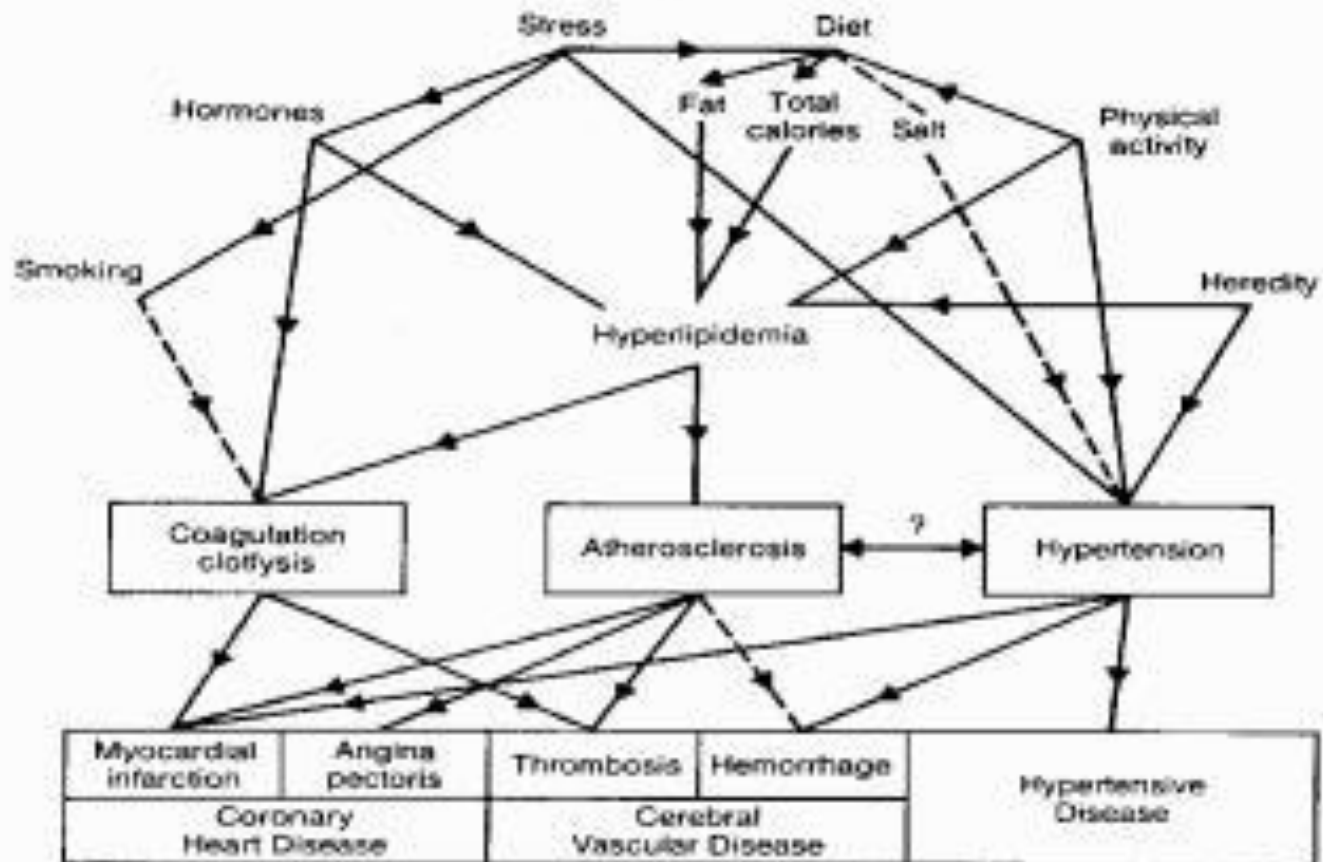
Risk Factor	Odds Ratio	P Value
Cancer	5.399	.003
Chronic Obstructive Pulmonary Disease	3.397	.008
Diabetes Mellitus	2.206	.002
Hypertension	1.878	.004
Age	1.048	< .001
Sex (Female vs. Male)	0.613	.018

<sup>a</sup>A forward conditional logistic model was used to identify risk factors. Other variables including smoking and additional comorbidities were removed during modeling.

# **DETERMINANTS: THE EPIDEMIOLOGIC TRIAD**



## Web of Causation for the Major Cardiovascular Diseases





# DEFINITION OF EPIDEMIOLOGY

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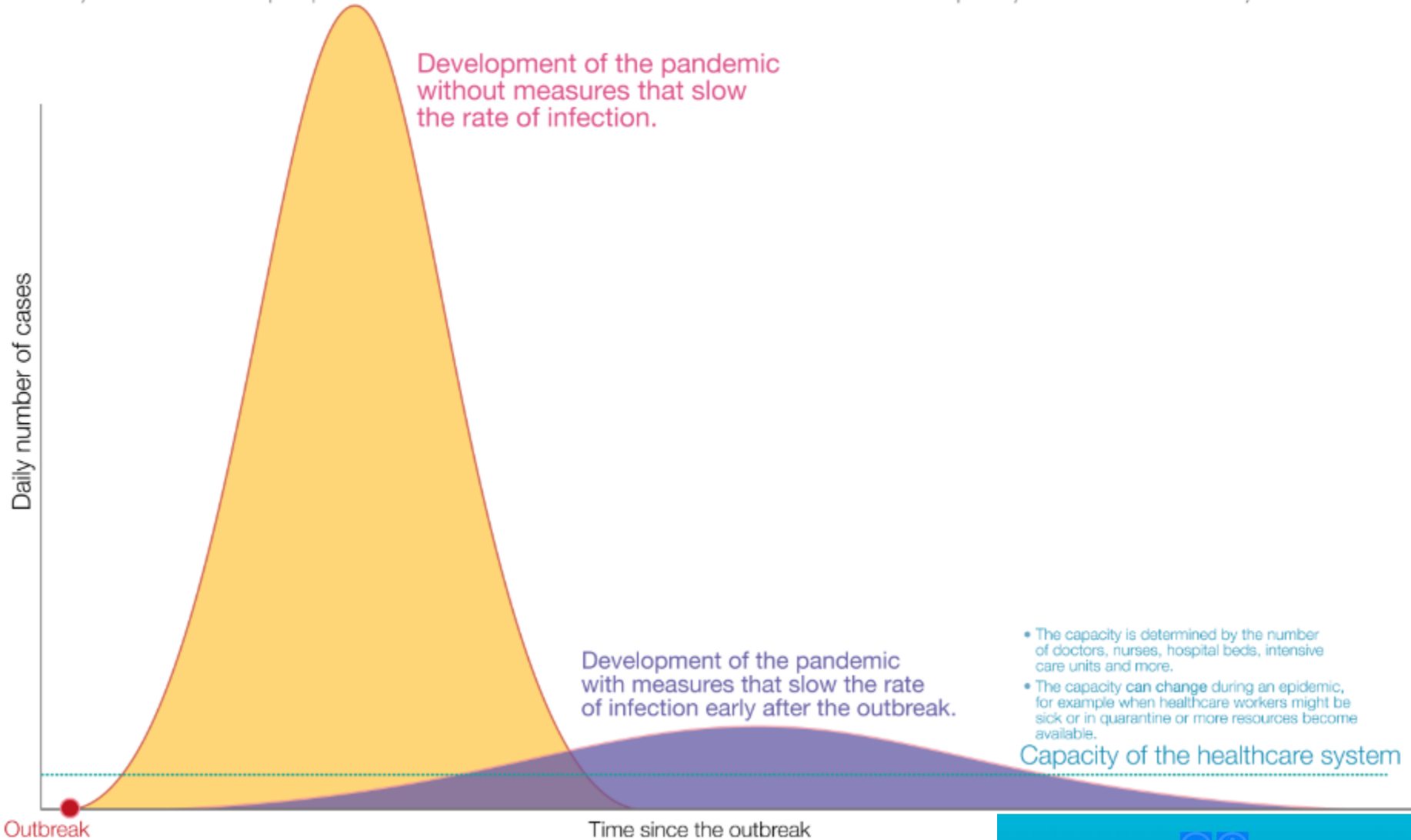
WHO

*John Last, Dictionary of Epidemiology*

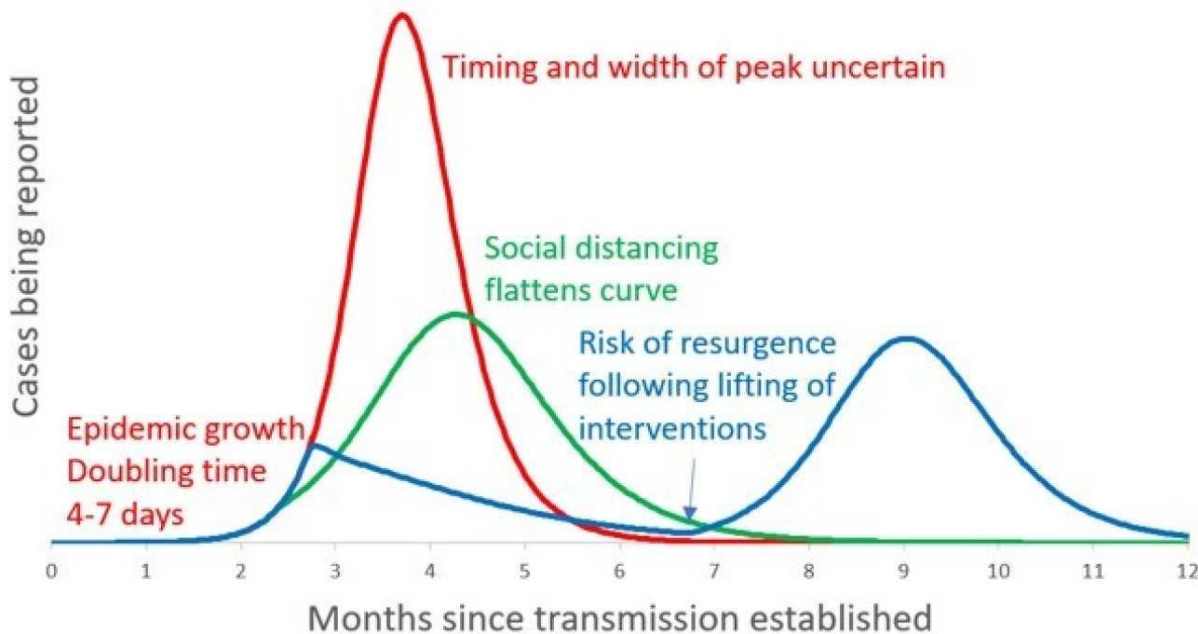
How well  
are we  
doing?

# In the outbreak of an epidemic *early* counter measures are important

Their intention is to 'flatten the curve': to lower the rate of infection to spread out the epidemic. This way the number of people who are sick at the *same time* does not exceed the capacity of the healthcare system.



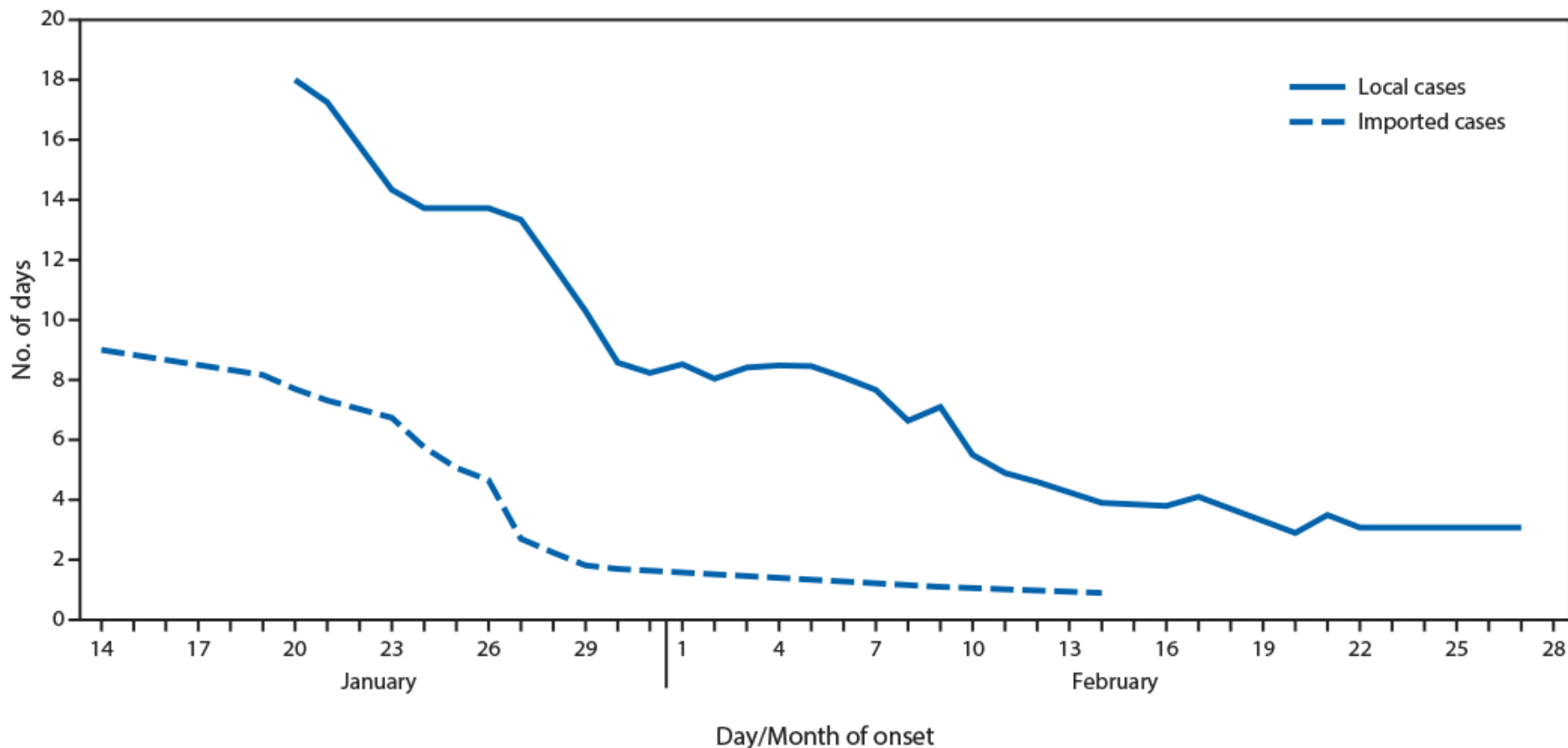
## MEASURES TAKEN IN AN EPIDEMIC



- Prevention
- Containment
  - Mitigation
  - Self isolation
- Social Distancing
  - Quarantine
  - Treatment?
  - Vaccine

## HOW DO WE ASSESS “CONTROL”

FIGURE 2. Interval from symptom onset to isolation or hospitalization (7-day moving average), of coronavirus disease 2019 (COVID-19 cases) (N = 100), by importation status — Singapore, January 14–February 28, 2020



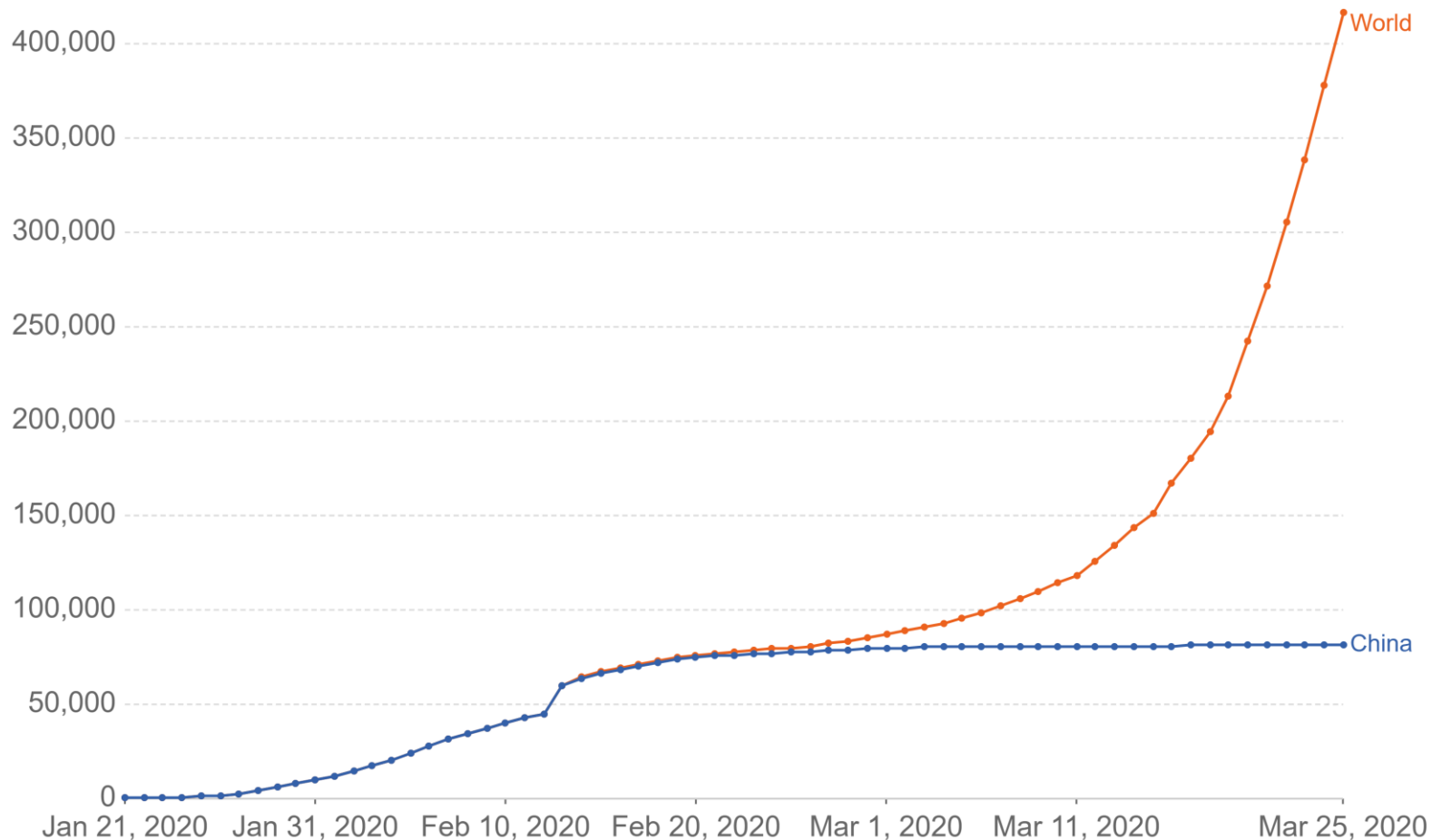
Ng Y, Li Z, Chua YX, et al. Evaluation of the Effectiveness of Surveillance and Containment Measures for the First 100 Patients with COVID-19 in Singapore — January 2–February 29, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:307-311.

# How Do We Assess “Control”?

## Total confirmed COVID-19 cases

The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing.

Our World  
in Data



Source: European CDC – Latest Situation Update Worldwide

OurWorldInData.org/coronavirus • CC BY

Note: The large increase in the number of cases globally and in China on Feb 13 is the result of a change in reporting methodology.

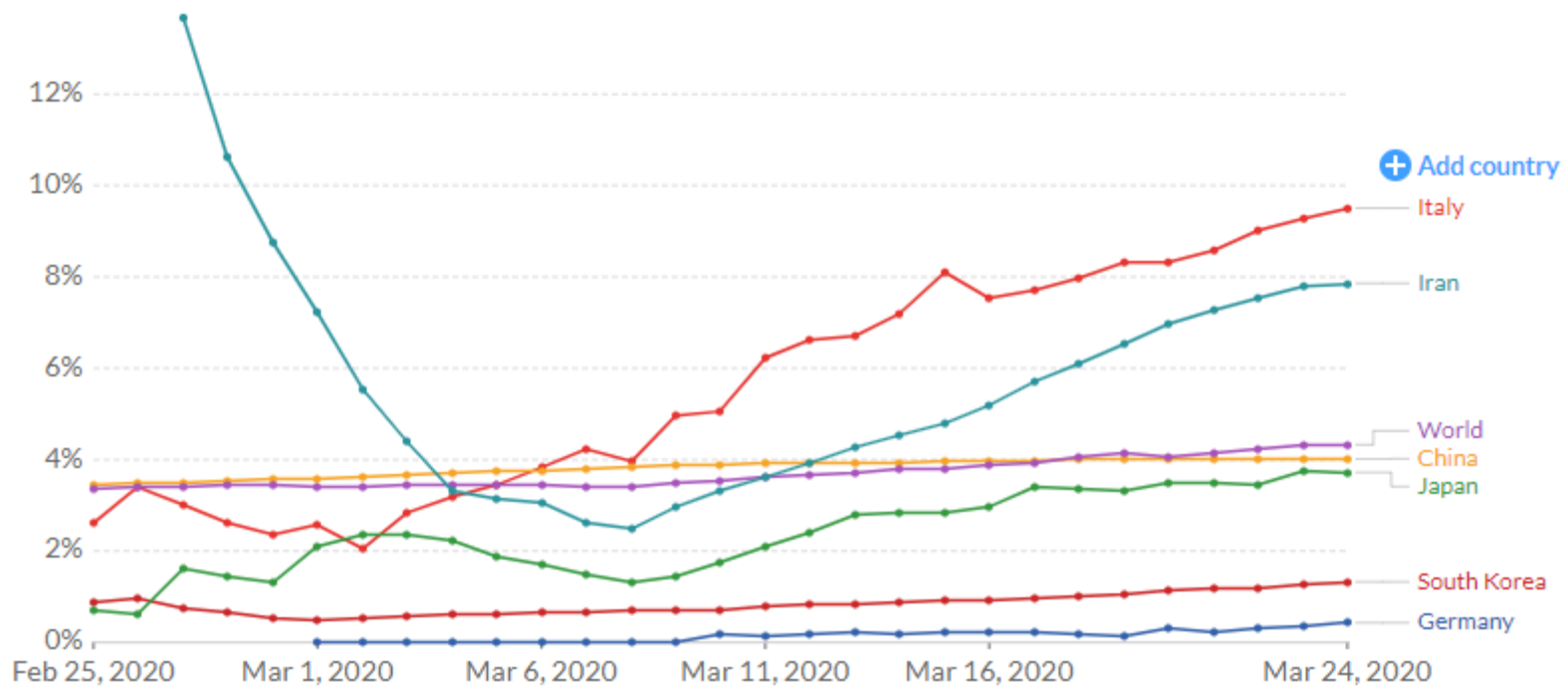


# How Do We Assess “Control”?

Our World  
in Data

## Case fatality rate of the ongoing COVID-19 pandemic

The Case Fatality Rate (CFR) is the ratio between confirmed deaths and confirmed cases. During an outbreak of a pandemic the CFR is a poor measure of the mortality risk of the disease. We explain this in detail at [OurWorldInData.org/Coronavirus](https://ourworldindata.org/coronavirus)



Source: European CDC - Latest Situation Update Worldwide  
Note: Only countries with more than 100 confirmed cases are included.

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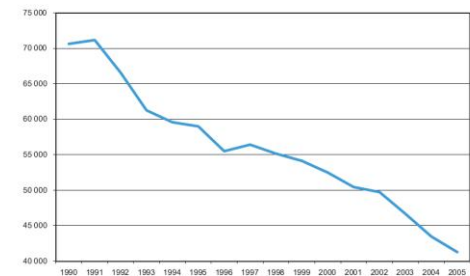
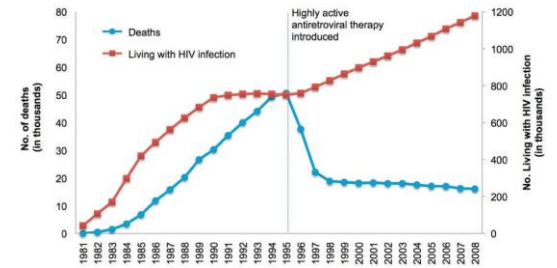


**WE NEED MORE DATA, AND TIME TO DIGEST IT**



# TAKING THE LONG TERM VIEW

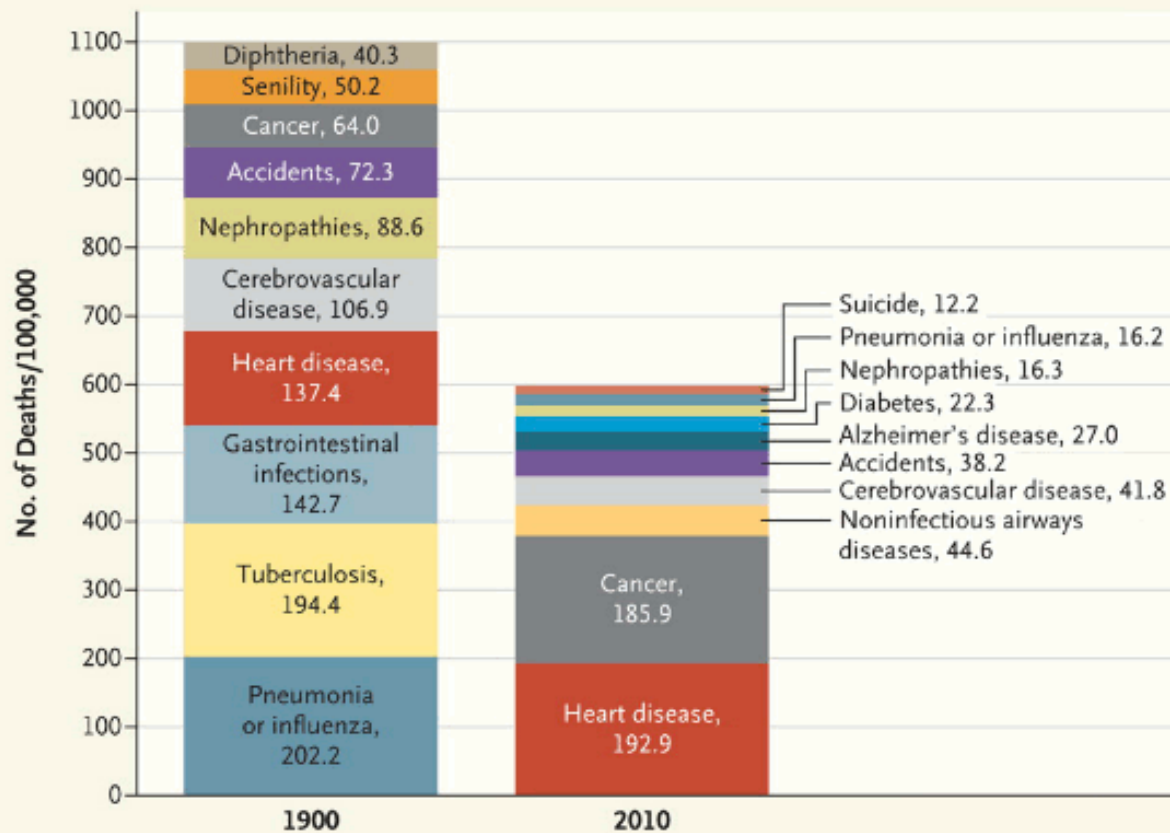
EPIDEMIOLOGY IS A DYNAMIC FIELD ADAPTING TO CHANGING HEALTH REQUIREMENTS OF THE POPULATION



Source: DG Energy and Transport

\*All fatalities on the road: car drivers and passengers, bus and coach occupants, powered two-wheelers' riders and passengers, cyclists, pedestrians, commercial vehicle drivers, etc.

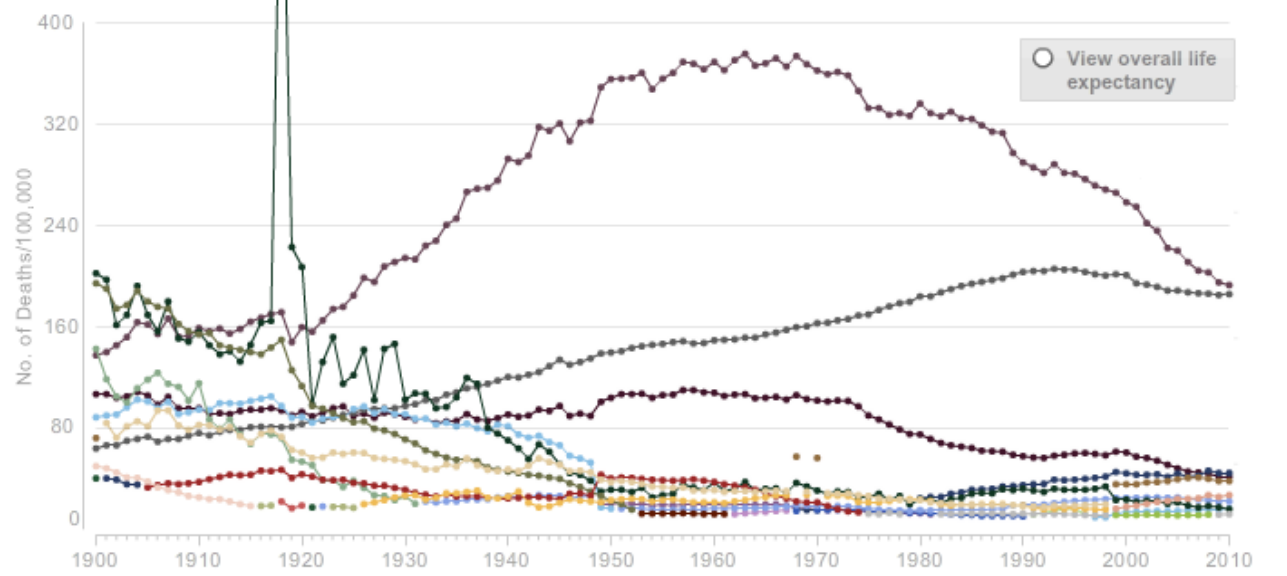
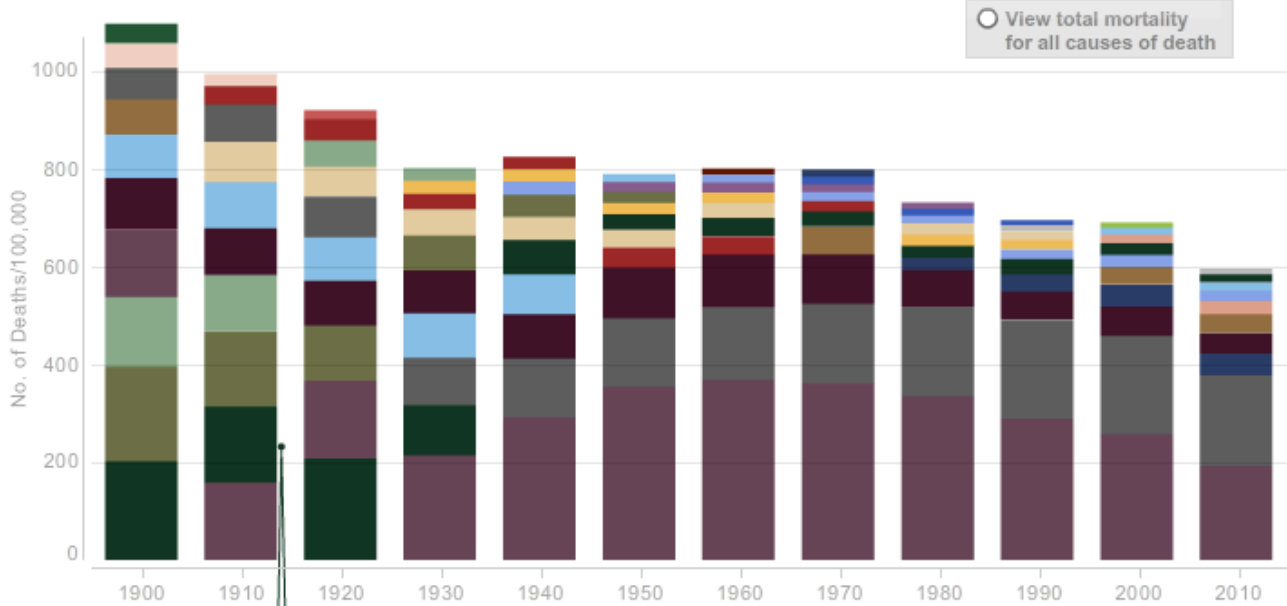
# LEADING CAUSES OF DEATH 1900 AND 2010



INTERACTIVE GRAPHIC | Top 10 Causes of Death in the United States, 1900–2010.

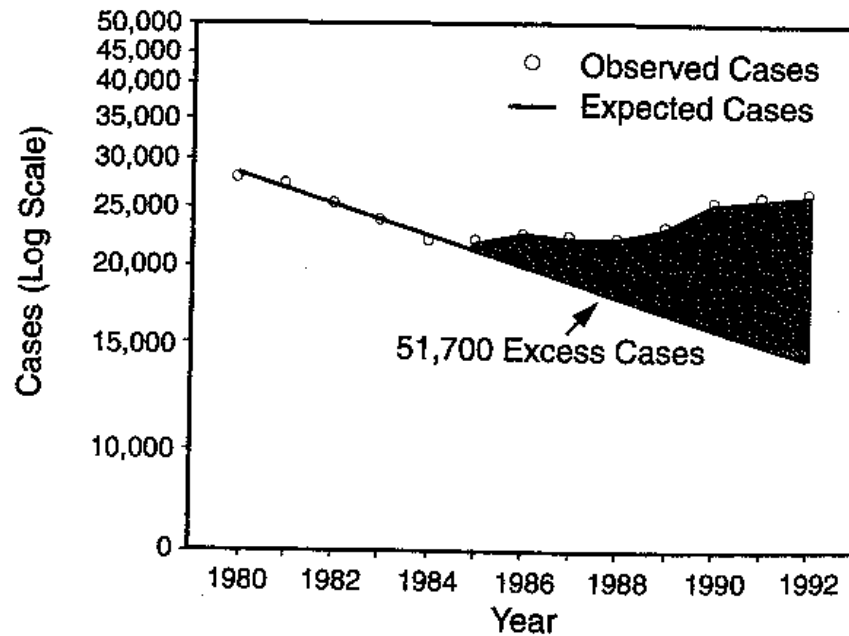
DESELECT ALL CAUSES OF DEATH

- Cerebrovascular disease
- Heart disease
- Vascular disease
- Other diseases of the circulatory system
- Cancer
- Chronic airways diseases
- Cirrhosis
- Diabetes
- Nephropathies
- Influenza and pneumonia
- Diphtheria
- Gastrointestinal infections
- HIV
- Septicemia
- Syphilis
- Tuberculosis
- Congenital malformations
- Diseases of early infancy
- Puerperal conditions
- Alzheimer's disease
- Senility
- Suicide
- All accidents
- Motor-vehicle accidents
- Non-motor-vehicle accidents



# HUMILITY

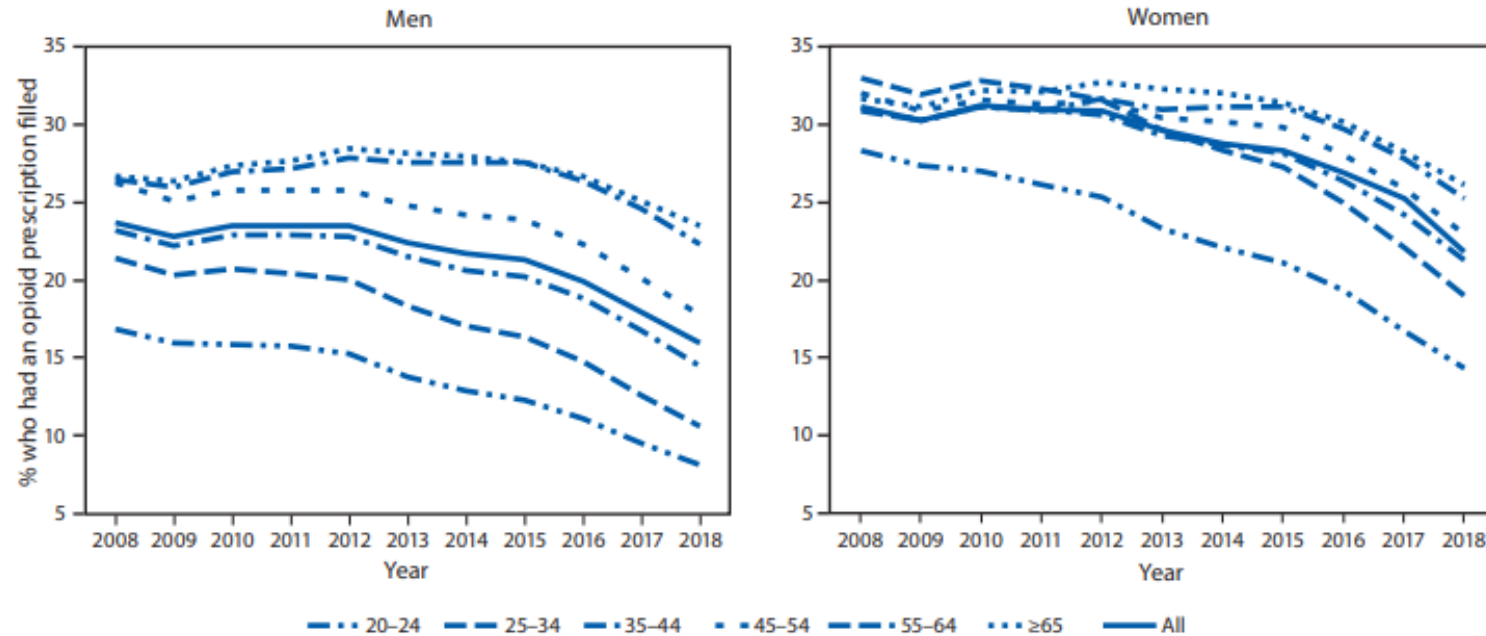
## OBSERVED AND EXPECTED NUMBER OF TUBERCULOSIS CASES US 1980-92





# HABITS CHANGE – Role of media, litigation, legislation

FIGURE 1. Comparison of trends\*<sup>†</sup> in the annual percentage of adults aged ≥20 years who had an opioid prescription filled, by age group and sex — United States, 2008–2018



\* Indicates that average annual percentage change during 2008–2018 was significantly different from zero at the alpha = 0.05 level by using Joinpoint regression analysis.  
<sup>†</sup> Indicates that two trends in terms of average annual percentage change compared between men and women of the same age group were parallel and identical, using parallelism or coincidence test that examines whether two regression mean functions (slope of the change in trend) are similar or identical in direction at p<0.05.



**Keep well  
Wash your hands  
Stay home unless you  
are having acute  
symptoms**

**Thanks!**