Epidemics – A Threat to National Security

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Epidemic Intelligence Service

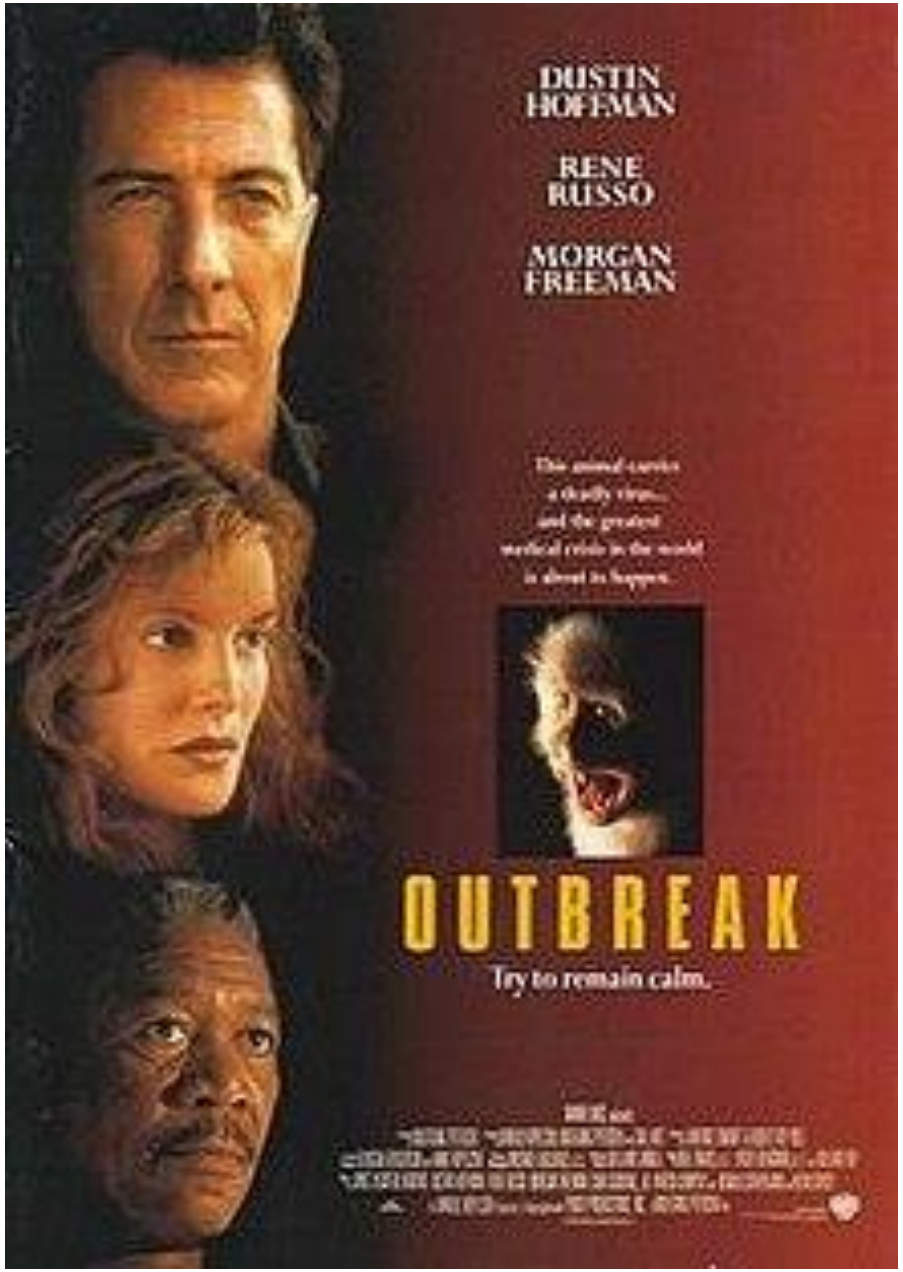
- 2 year program
- 70 EIS officers / Yr.

- On the job epidemiology and public health training

- Conduct epidemiologic investigations, public health research, and disease surveillance

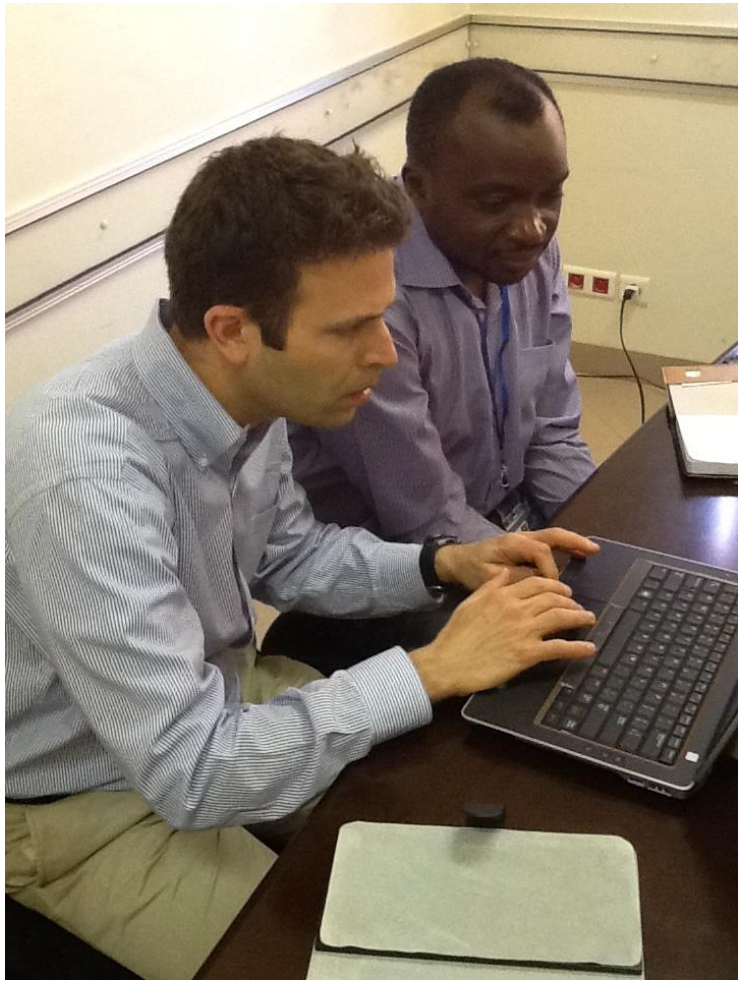
Outbreak Agents

Officers in the Epidemic Intelligence Service expend shoe leather and stamp out disease.


DUSTIN HOFFMAN
RENE RUSSO
MORGAN FREEMAN
OUTBREAK
Try to remain calm.


MARION COTILLARD
MATT DAMON
LAURENCE FISHBURNE
JUDE LAW
GWYNETH PALTROW
KATE WINSLET
CONTAGION


La vaccination de routine, socle de la lutte contre la poliomyélite



Objectives

1. Infectious disease burden in context
2. Introduction to outbreaks
3. Case studies
4. Public health tools

- Free discussion

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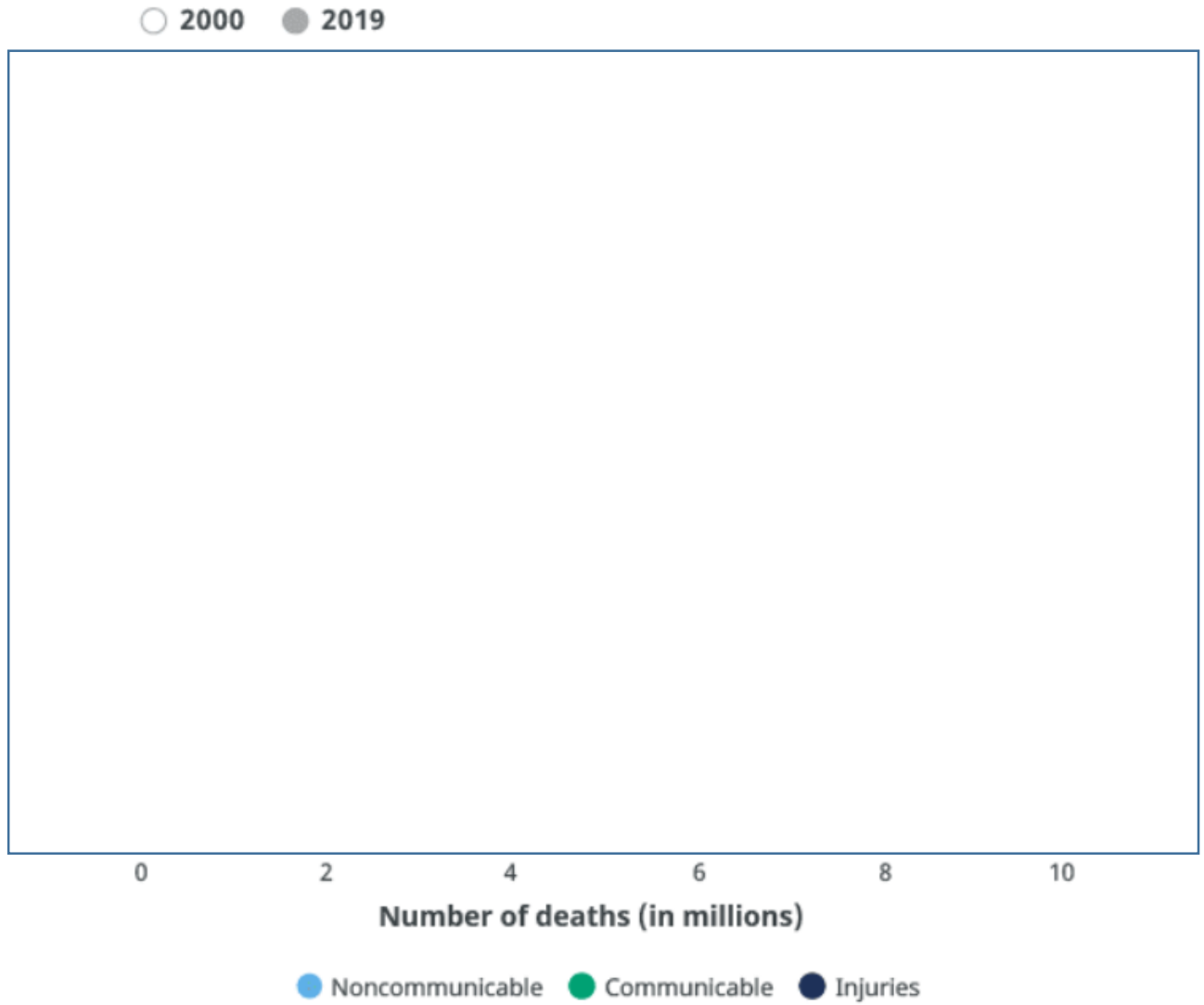
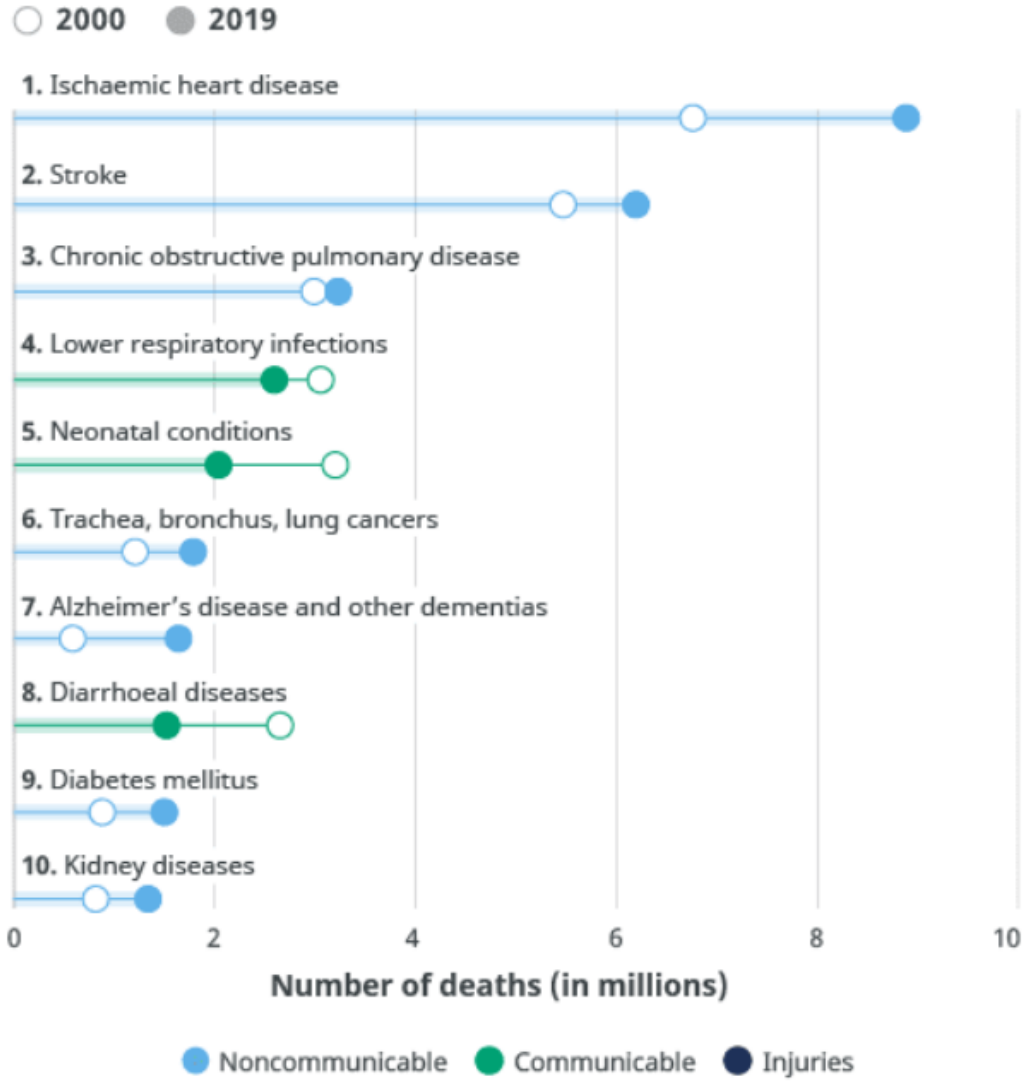
Leading causes of death globally



Source: WHO Global Health Estimates.

Leading causes of death globally



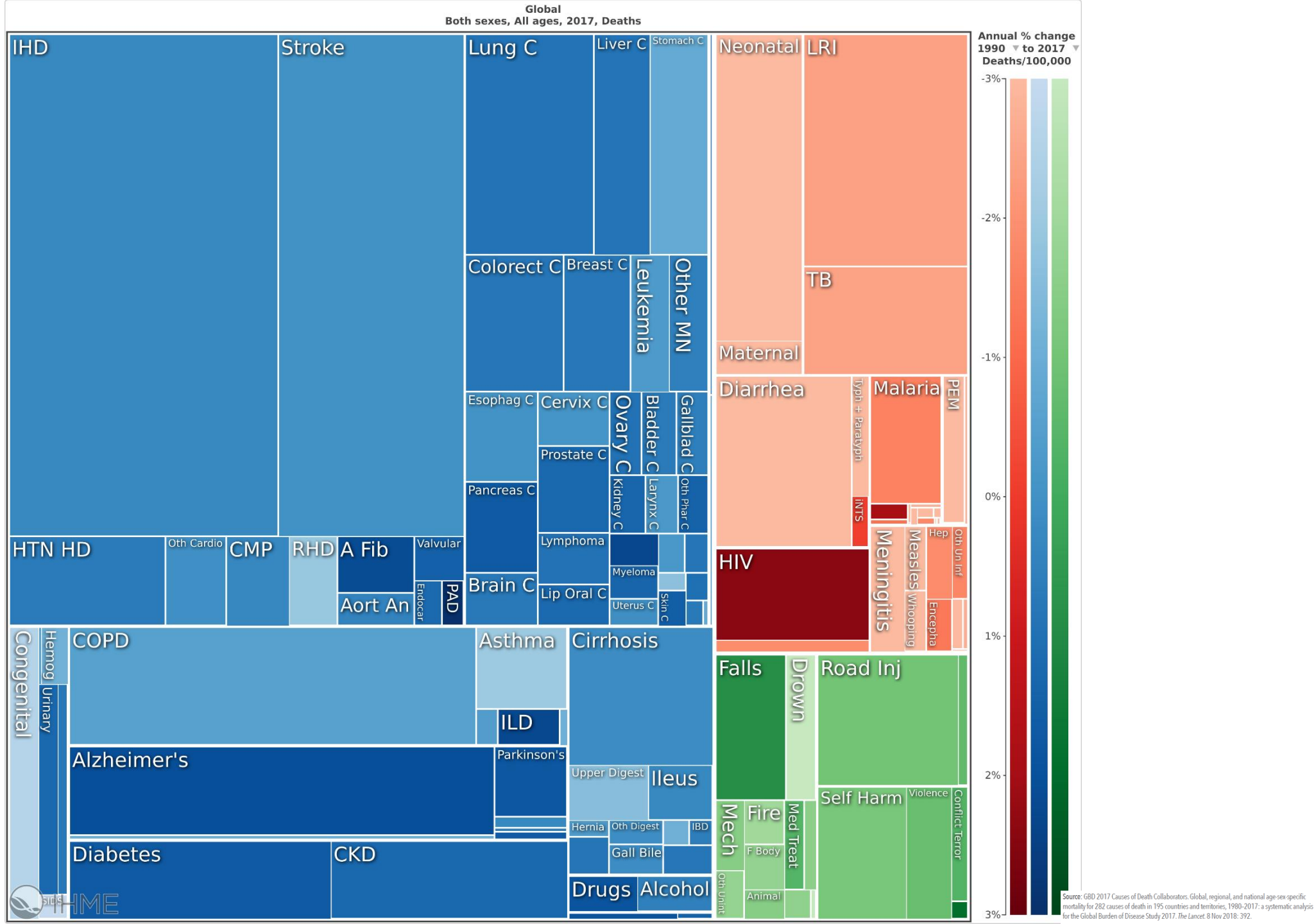
Source: WHO Global Health Estimates.

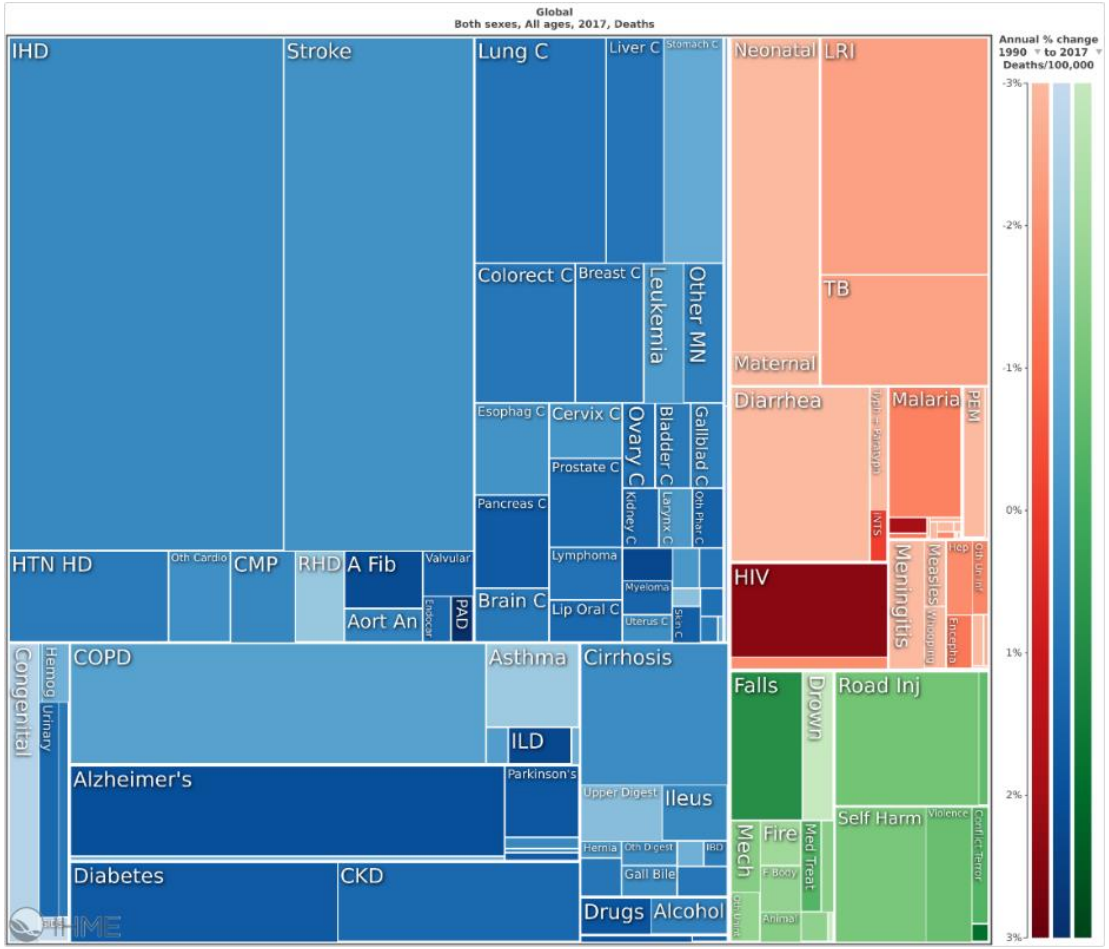
Annual Deaths, Global, all causes, 2017

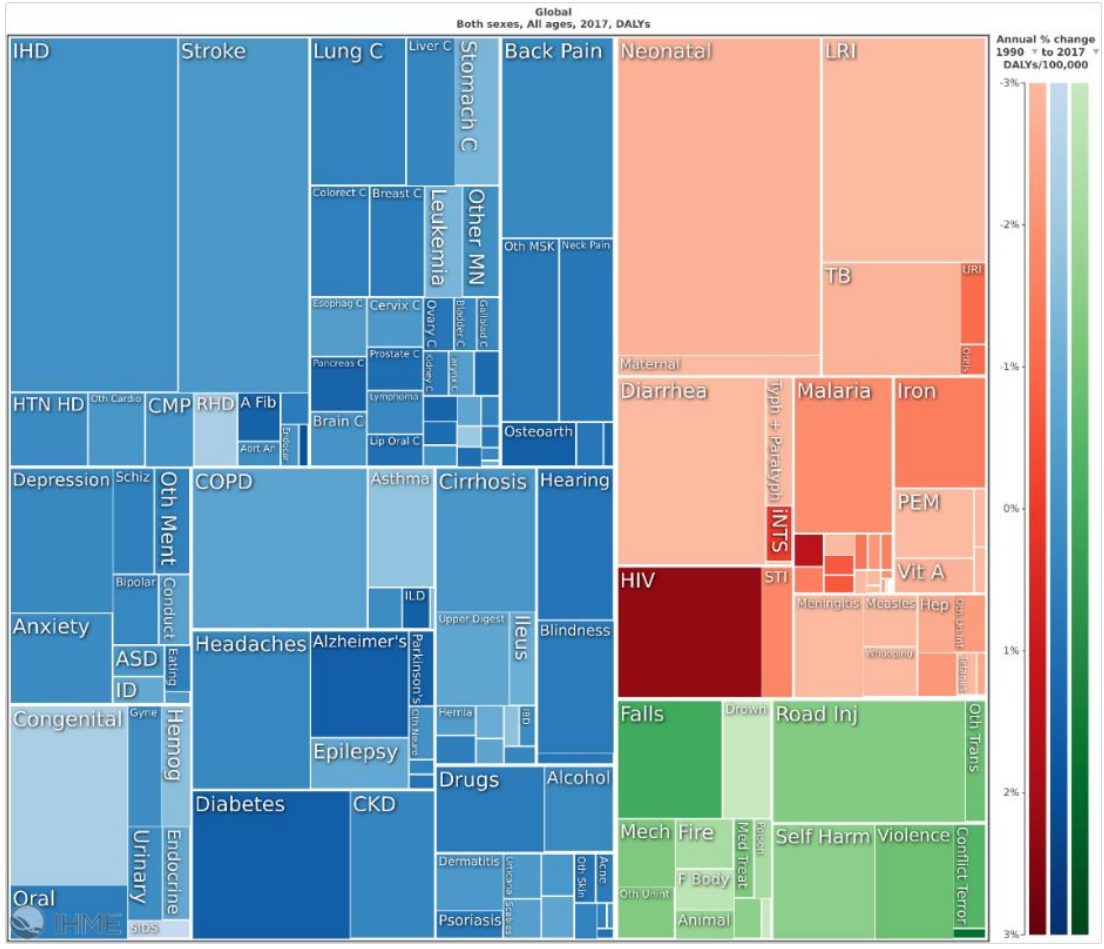
58 million/Yr

Blue – NCDs
Red – Infectious
Green – trauma

Darker – increase
Lighter – decrease







DALY=disability adjusted life year

Deaths

- **Most deaths due to NCDs**
- **CDs and Trauma effect younger persons (DALY + disease burden higher than deaths)**

What are the leading causes of death among children under age 5?

What are the leading causes of death among children under age 5?

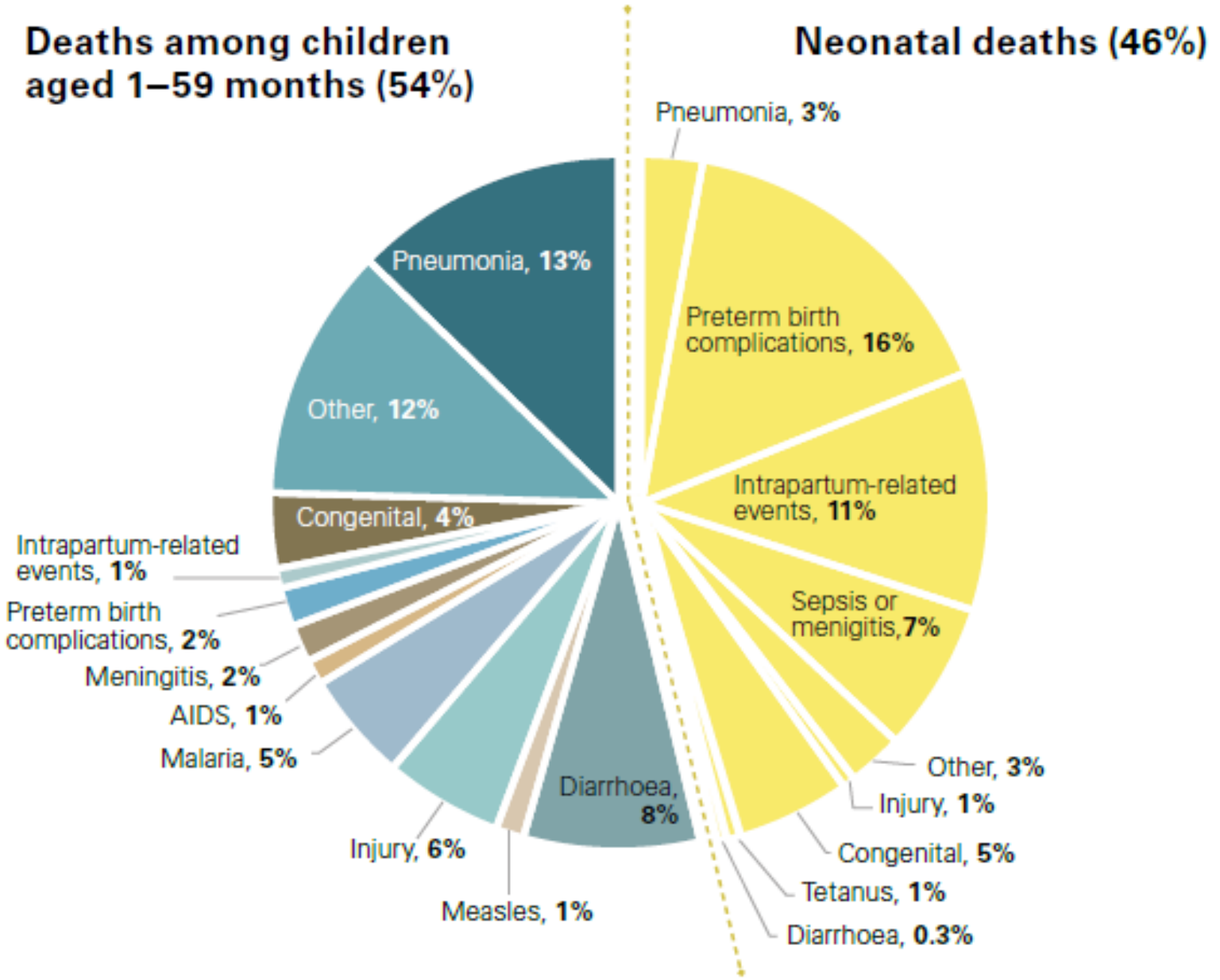
Prematurity 16%

Pneumonia 13%

Intrapartum complications 11%

Diarrhea 8%

A. Global distribution of deaths among children under age 5, by cause, 2016



Levels & Trends in
Child Mortality

Report 2017

Estimates Developed by the
UN Inter-agency Group for
Child Mortality Estimation

unicef | World Health Organization | WORLD BANK GROUP | United Nations

“Most under five deaths are caused by diseases that are readily preventable or treatable with proven, cost effective interventions.”

דירוג 10 סיבות המוות המובילות לפי מדינה, 2017

דירוג	ישראל	15 מדינות ה-EU	ארה"ב	קנדה
1	שאתות ממאירות	שאתות ממאירות	מחלות לב	שאתות ממאירות
2	מחלות לב	מחלות לב	שאתות ממאירות	מחלות לב
3	סוכרת	מחלות כלי דם במוח	מחלות של מערכת הנשימה התחתונה	דמנציה
4	מחלות כלי דם במוח	דמנציה	תאונות	מחלות כלי דם במוח
5	אלח דם	מחלות של מערכת הנשימה התחתונה	מחלות כלי דם במוח	מחלות של מערכת הנשימה התחתונה
6	דמנציה	תאונות	אלצהיימר	תאונות
7	מחלות כליה	דלקת ריאות ושפעת	דמנציה	דלקת ריאות ושפעת
8	מחלות של מערכת הנשימה התחתונה	אלצהיימר	סוכרת	סוכרת
9	דלקת ריאות ושפעת	סוכרת	דלקת ריאות ושפעת	אלצהיימר
10	תאונות	מחלות כבד	מחלות כליה	התאבדות

מוצגים נתונים של השנה האחרונה הזמינה.

גיל 0-4
זכרים

	סיבת מוות	2017	2016	2015	2014	2013	2012	2010	2005	2000
		שיעור ל-100,000 נפש								
	סה"כ	**84.0**	**84.5**	**83.5**	**85.9**	**86.9**	**96.5**	**99.4**	**120.4**	**157.7**
1	סיבות סב-לידתיות	28.4	34.6	32.5	29.2	31.6	34.7	40.1	41.2	62.1
2	מומים מולדים	27.9	23.7	23.9	25.9	25.8	28.3	26.5	34.9	29.8
3	תאונות	7.2	5.3	5.2	6.4	6.1	6.5	5.6	8.5	8.7
4	תסמונת המוות הפתאומי לתינוקות	(2.6)	(2.0)	(2.5)	6.2	(3.5)	(4.3)	(3.3)	(2.5)	8.1
5	שאתות ממאירות	(1.3)	(2.2)	(1.4)	(2.5)	(3.0)	(1.7)	(3.5)	(2.2)	(3.9)
6	דלקת ריאות ושפעת	..	1.8	..	..	..	(2.2)	..	(1.4)	..
7	רצח	..	..			..	..	..	..	(2.4)
8	אלח דם	..	..	..	..	..	..	..	..	(2.7)
9	סיבה לא ידועה	(3.7)	(4.2)	5.2	(3.9)	..	(4.1)	5.0	12.4	9.7
10	סיבות אחרות	10.9	9.5	11.7	10.6	14.3	14.1	13.4	16.2	29.2
		מספר מוחלט								
	סה"כ	**385**	**381**	**370**	**374**	**371**	**403**	**394**	**438**	**523**
1	סיבות סב-לידתיות	130	156	144	127	135	145	159	150	206
2	מומים מולדים	128	107	106	113	110	118	105	127	99
3	תאונות	33	24	23	28	26	27	22	31	29
4	תסמונת המוות הפתאומי לתינוקות	12	9	11	27	15	18	13	9	27
5	שאתות ממאירות	6	10	6	11	13	7	14	8	13
6	דלקת ריאות ושפעת	3	8	1	1	3	9	3	5	3
7	רצח	3	2			1	1	3	1	8
8	אלח דם	3	3	4	4	3	2	2	3	9
9	סיבה לא ידועה	17	19	23	17	4	17	20	45	32
10	סיבות אחרות	50	43	52	46	61	59	53	59	97

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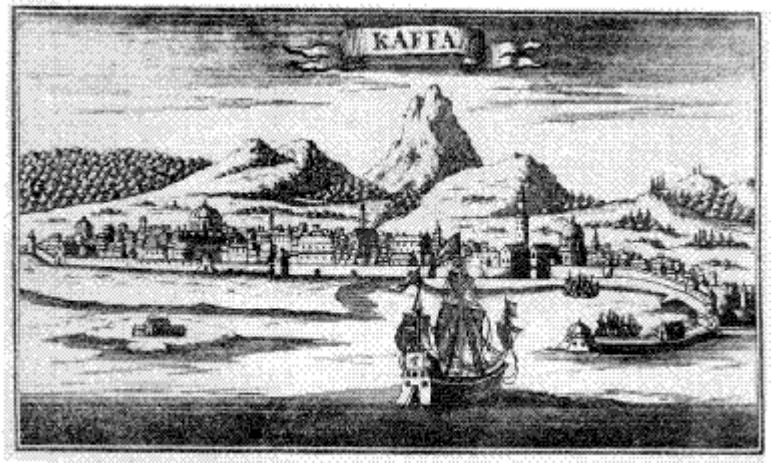
- Free discussion

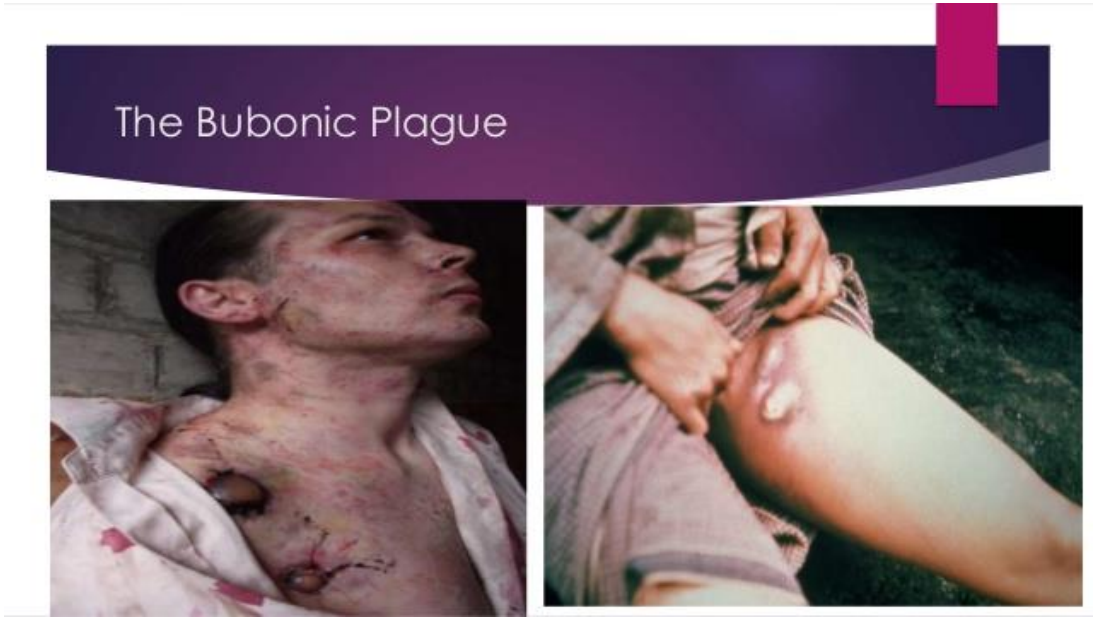
Year 1346

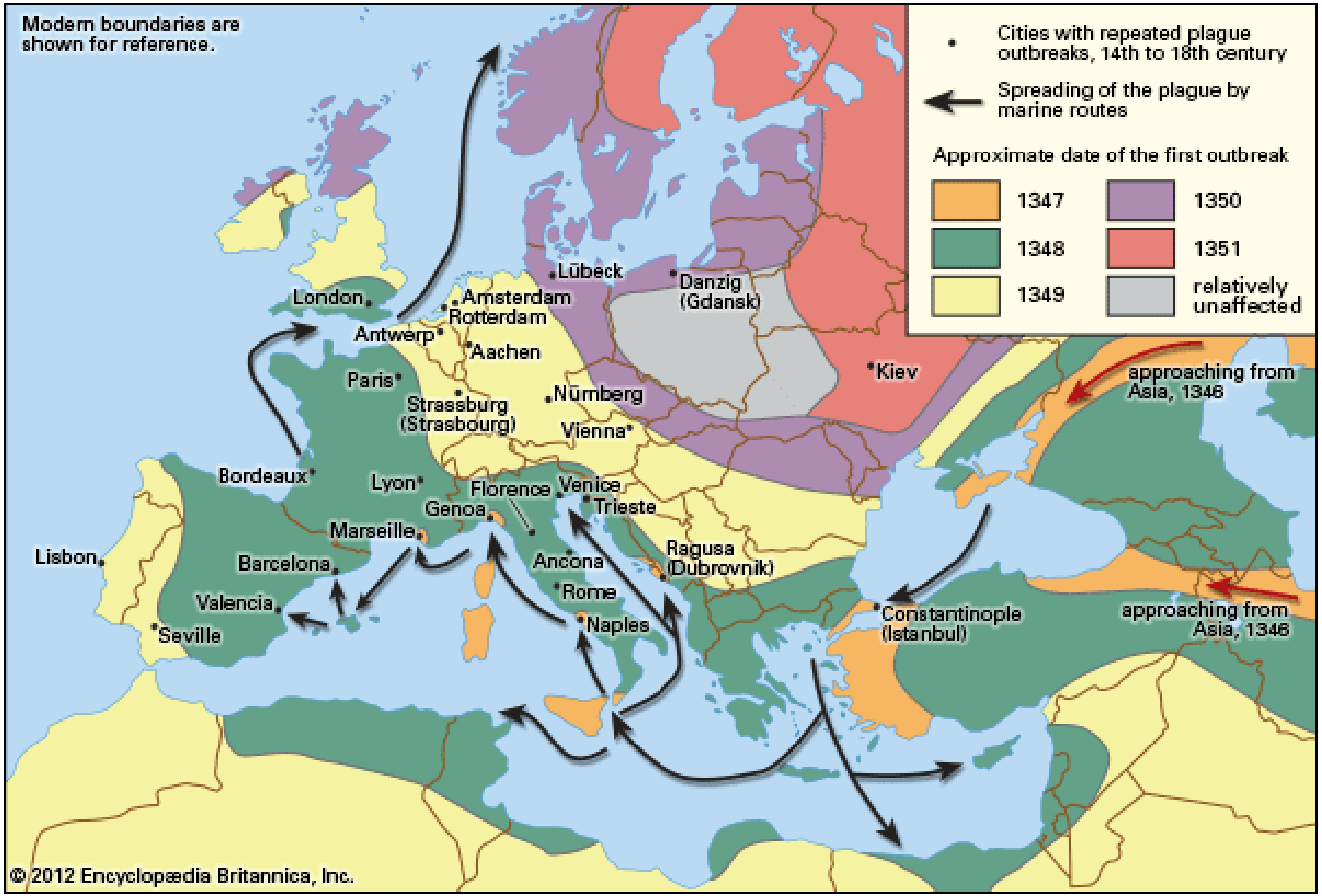
- Jani Beg (Mongol) puts Kaffa (Crimea) under siege
- Genoese traders flee to Sicily
- Bring a disease with them



Year 1346

- Jani Beg (Mongol) puts Kaffa (Crimea) under siege
- Genoese traders flee to Sicily
- Bring a disease with them
  - Plague
  - Highly contiguous
  - High mortality




Modern boundaries are shown for reference.
Cities with repeated plague outbreaks, 14th to 18th century
Spreading of the plague by marine routes
Approximate date of the first outbreak
1347
1348
1349
1350
1351
relatively unaffected
London
Amsterdam
Rotterdam
Antwerp
Aachen
Lübeck
Danzig (Gdansk)
Kiev
Paris
Strassburg (Strasbourg)
Nürnberg
Vienna
approaching from Asia, 1346
Bordeaux
Lyon
Florence
Venice
Trieste
Genoa
Marseille
Lisbon
Barcelona
Ancona
Ragusa (Dubrovnik)
Rome
Valencia
Seville
Naples
Constantinople (Istanbul)
approaching from Asia, 1346
© 2012 Encyclopædia Britannica, Inc.

1347-1351

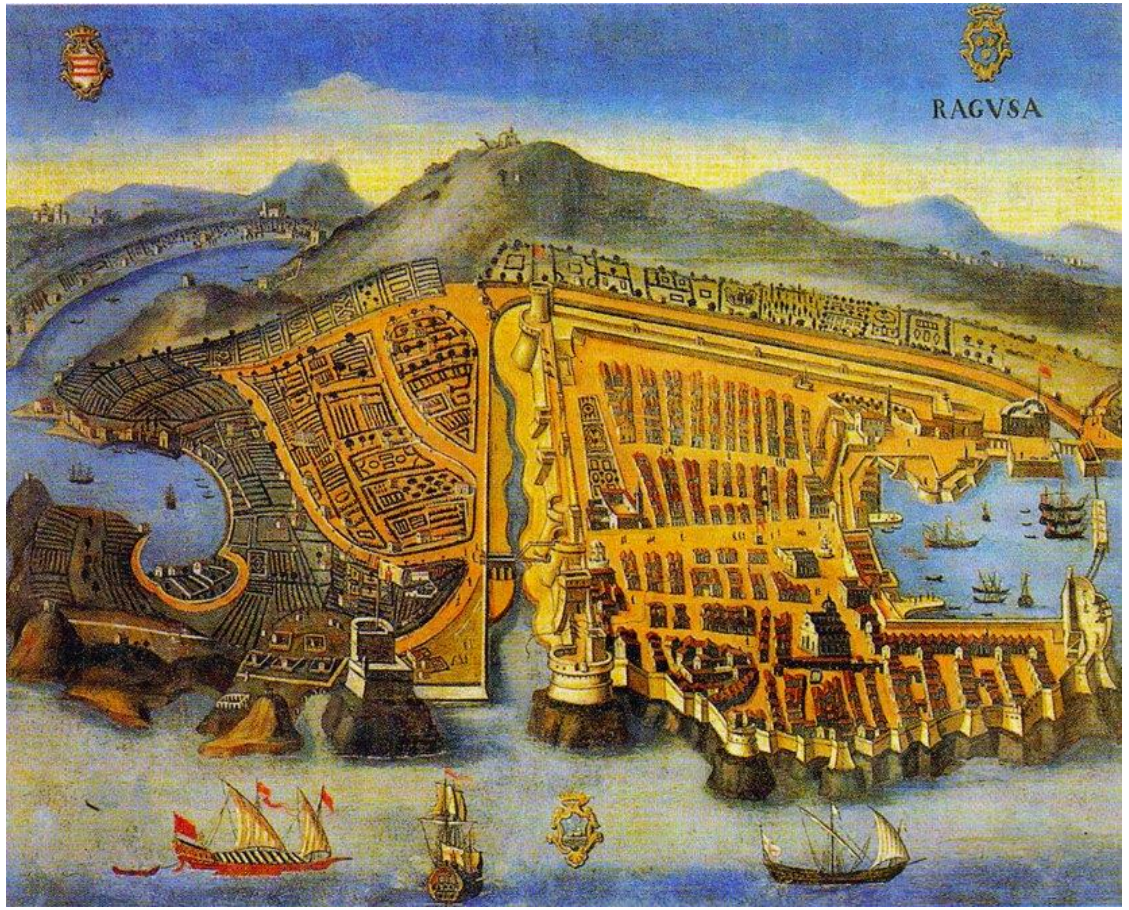
- Kills 30-60% of Europe population
  - World population
  - 450 million ->350 million

Ragusa (Dubrovnik) - Quarantine

Quaranta Giorni= 40 Days

- Ships would wait 40 days outside port

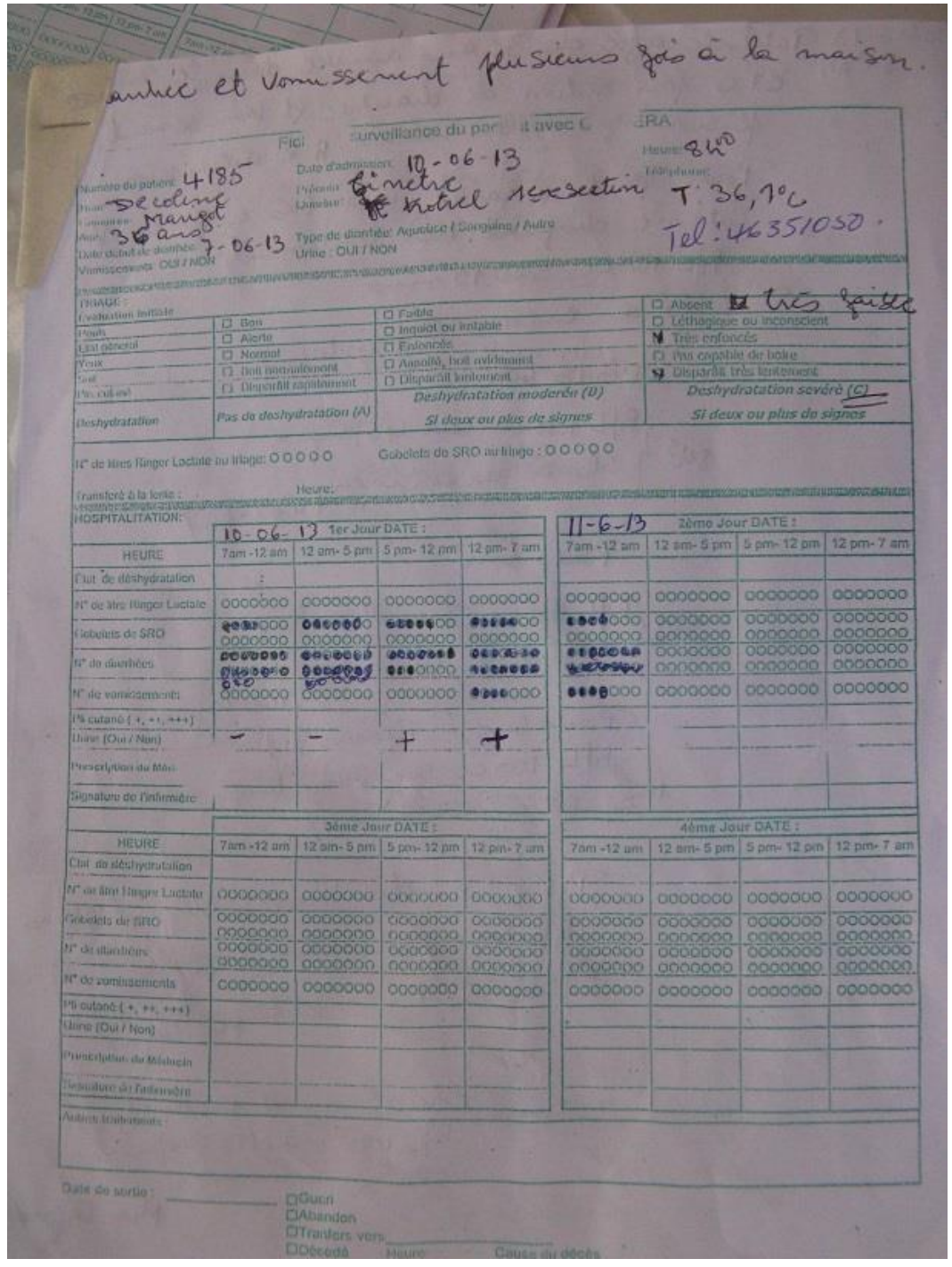
- Bubonic plague
  - Time from infection to death up to 37d



John Snow, 1813-1858

Cholera reached England in 1831.

It was thought to be spread by "miasma," a fog emanating from a body of water.



Diarrhée et Vomissement plusieurs fois à la maison.

Fiche de surveillance du patient avec DRA

Numéro du patient: 4185
Nom: Decoling
Prénom: Margot
Age: 36 ans
Date début de diarrhée: 7-06-13
Vomissements: OUI / NON

Date d'admission: 10-06-13
Diagnostic: Diarrhée
Lieu de résidence: Hôtel 1ère section
Heure: 8h00
Température: T° 36,7°C
Tel: 46351050.

Type de diarrhée: Aqueuse / Sanglante / Autre
Urine : OUI / NON

TRIAGE : Evaluation initiale			
Yeux	☐ Bon	☐ Faible	☐ Absent ☒ très faible
Soif	☐ Alerte	☐ Inquiet ou irritable	☐ Léthargique ou inconscient
Etat général	☐ Normal	☐ Enfoncés	☒ Très enfoncés
Pli cutané	☐ Boit normalement	☐ Assoiffé, boit avidement	☐ Pas capable de boire
	☐ Disparaît rapidement	☐ Disparaît lentement	☒ Disparaît très lentement
Déshydratation	Pas de déshydratation (A)	Déshydratation modérée (B) Si deux ou plus de signes	Déshydratation sévère (C) Si deux ou plus de signes

N° de litres Ringer Lactate au triage: ○○○○○ Gobelets de SRO au triage : ○○○○○

Transféré à la toilette : Heure:

HOSPITALITATION:

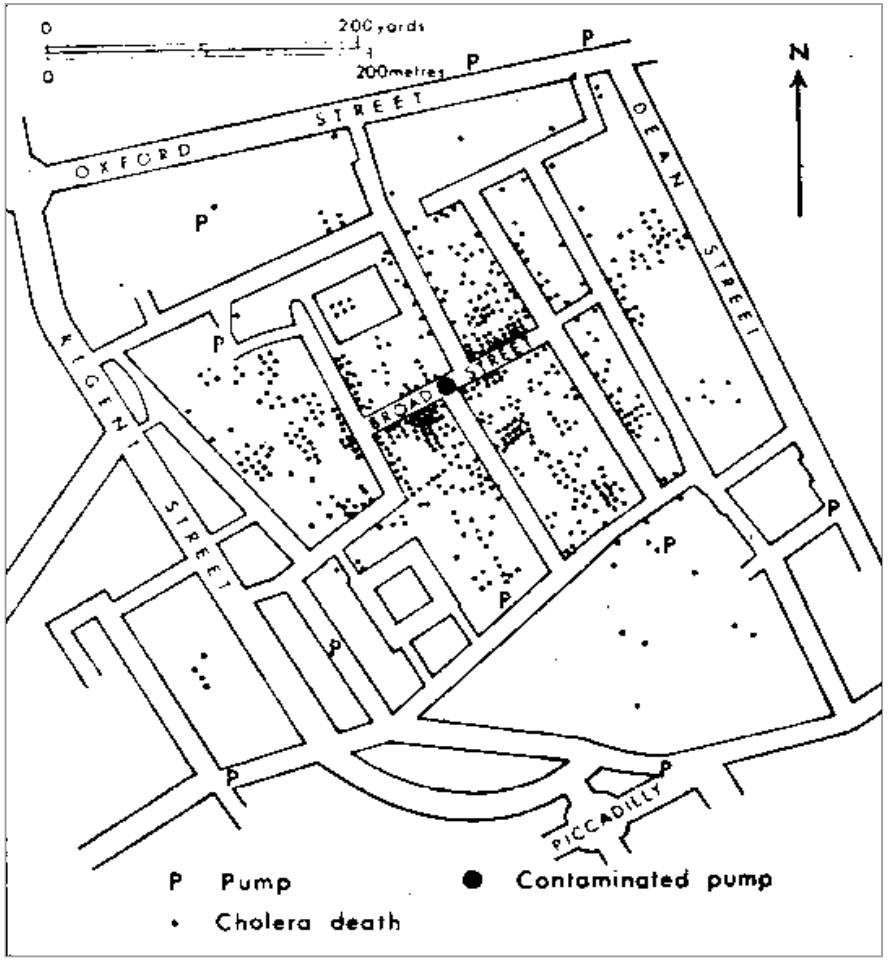
10-06-13 1er Jour DATE :				11-6-13 2ème Jour DATE :			
HEURE	7am -12 am	12 am- 5 pm	5 pm- 12 pm	12 pm- 7 am	7am -12 am	12 am- 5 pm	5 pm- 12 pm	12 pm- 7 am
Etat de déshydratation								
N° de litre Ringer Lactate	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○
Gobelets de SRO	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○
N° de diarrhées	○○○○○○○ ○○○○○○○ ○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○
N° de vomissements	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○
Pli cutané (+, ++, +++)								
Urine (Oui / Non)	-	-	+	+				
Prescription du Médecin								
Signature de l'infirmière								

	3ème Jour DATE :				4ème Jour DATE :			
HEURE	7am -12 am	12 am- 5 pm	5 pm- 12 pm	12 pm- 7 am	7am -12 am	12 am- 5 pm	5 pm- 12 pm	12 pm- 7 am
Etat de déshydratation								
N° de litre Ringer Lactate	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○
Gobelets de SRO	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○
N° de diarrhées	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○	○○○○○○○ ○○○○○○○
N° de vomissements	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○	○○○○○○○
Pli cutané (+, ++, +++)								
Urine (Oui / Non)								
Prescription du Médecin								
Signature de l'infirmière								

Autres traitements :

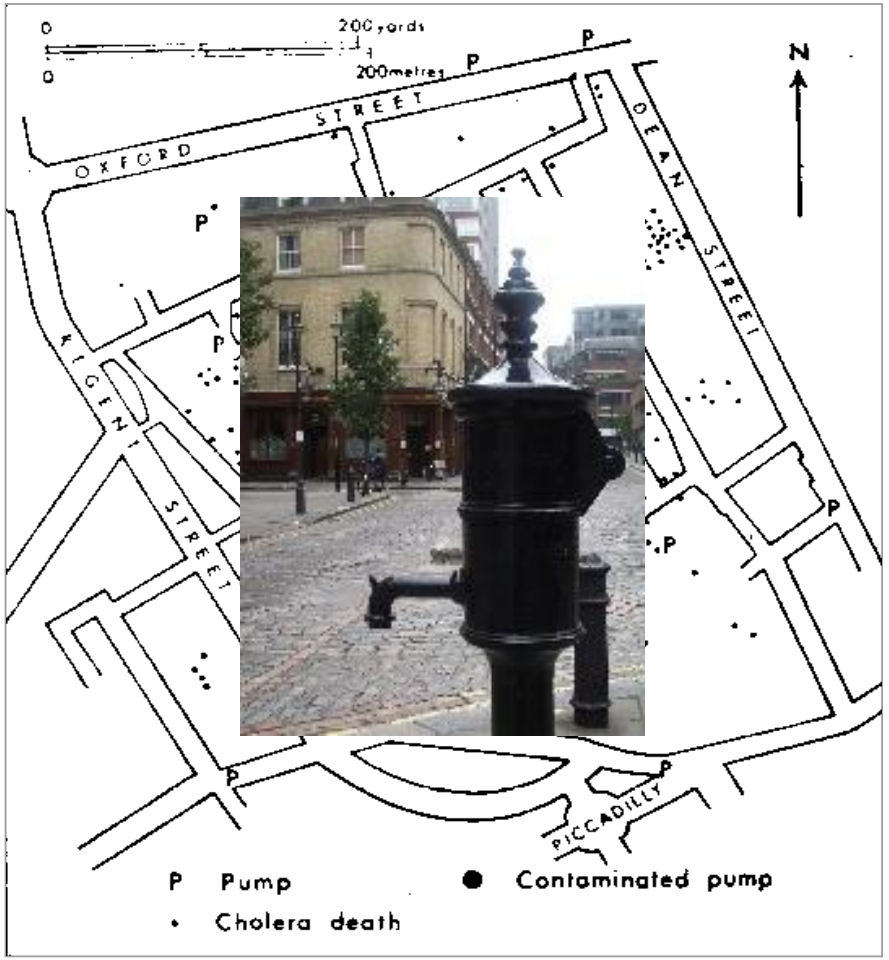
Date de sortie : _____
☐Guéri
☐Abandon
☐Transfert vers _____
☐Décédé Heure: Cause du décès

Snow’s cholera map of London, 1849



Presented at Epidemiologic Society of London, December 5, 1854

Snow’s cholera map of London, 1849



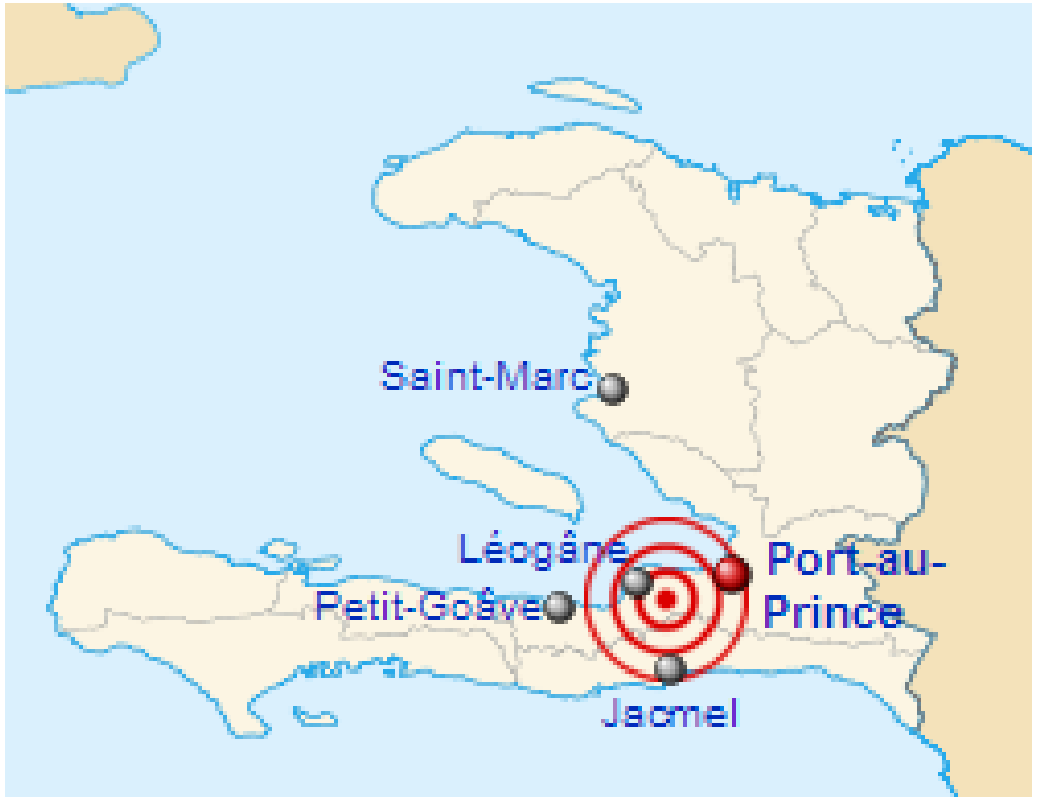
Presented at Epidemiologic Society of London, December 5, 1854

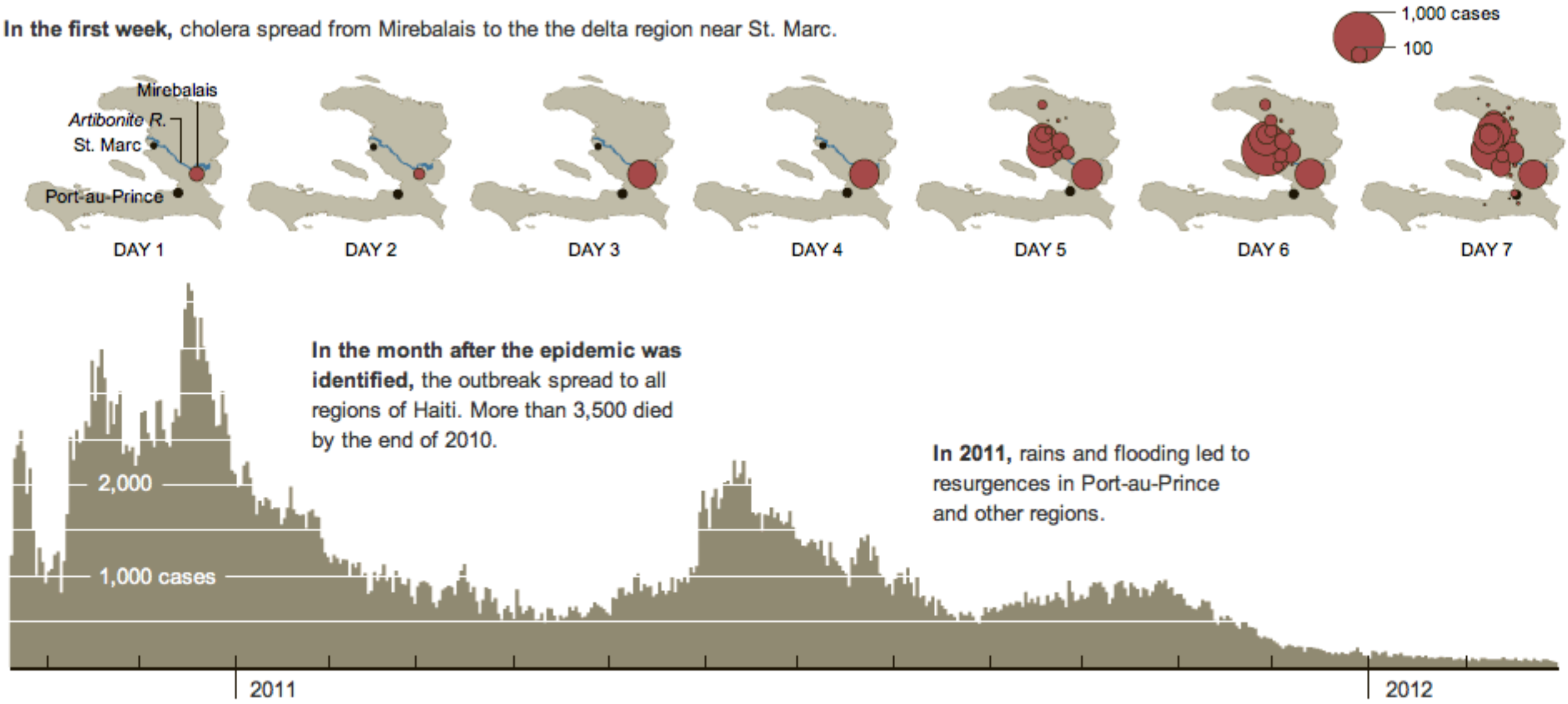
Cholera mortality rates in London by water supply (John Snow, 1849)

TABLE IX.

	Number of houses.	Deaths from Cholera.	Deaths in each 10,000 houses.
Southwark and Vauxhall Company	40,046	1,263	315
Lambeth Company . . .	26,107	98	37
Rest of London	256,423	1,422	59

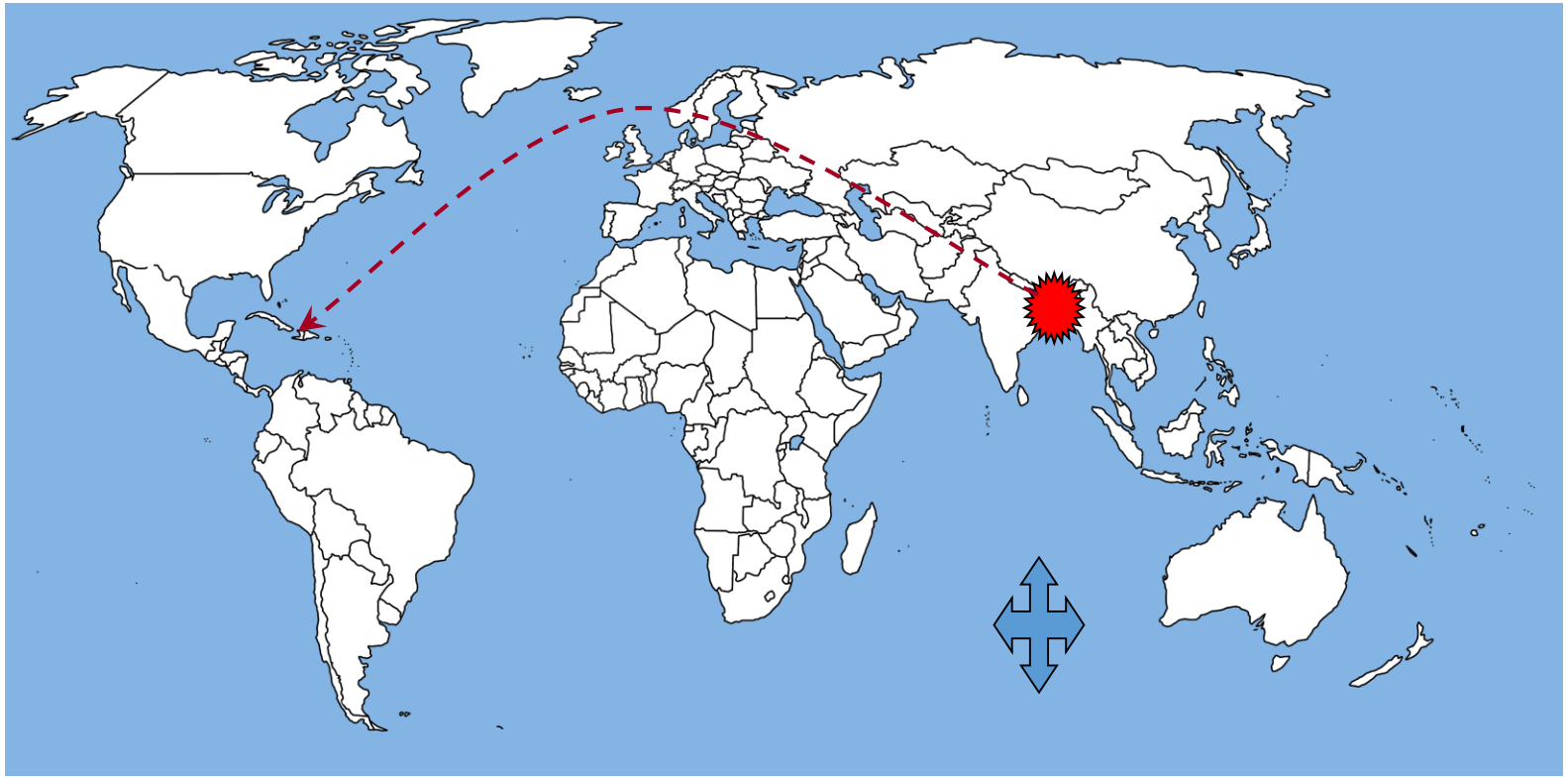
2010 Haiti Earthquake




In the first week, cholera spread from Mirebalais to the the delta region near St. Marc.
1,000 cases
100
Mirebalais
Artibonite R.
St. Marc
Port-au-Prince
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5
DAY 6
DAY 7
In the month after the epidemic was identified, the outbreak spread to all regions of Haiti. More than 3,500 died by the end of 2010.
2,000
1,000 cases
In 2011, rains and flooding led to resurgences in Port-au-Prince and other regions.
2011
2012

The Origin of the Haitian Cholera Outbreak Strain NEJM DEC 2010

"there is a close relationship between the Haitian isolates and variant *V. cholerae* El Tor O1 strains isolated in Bangladesh in 2002 and 2008."



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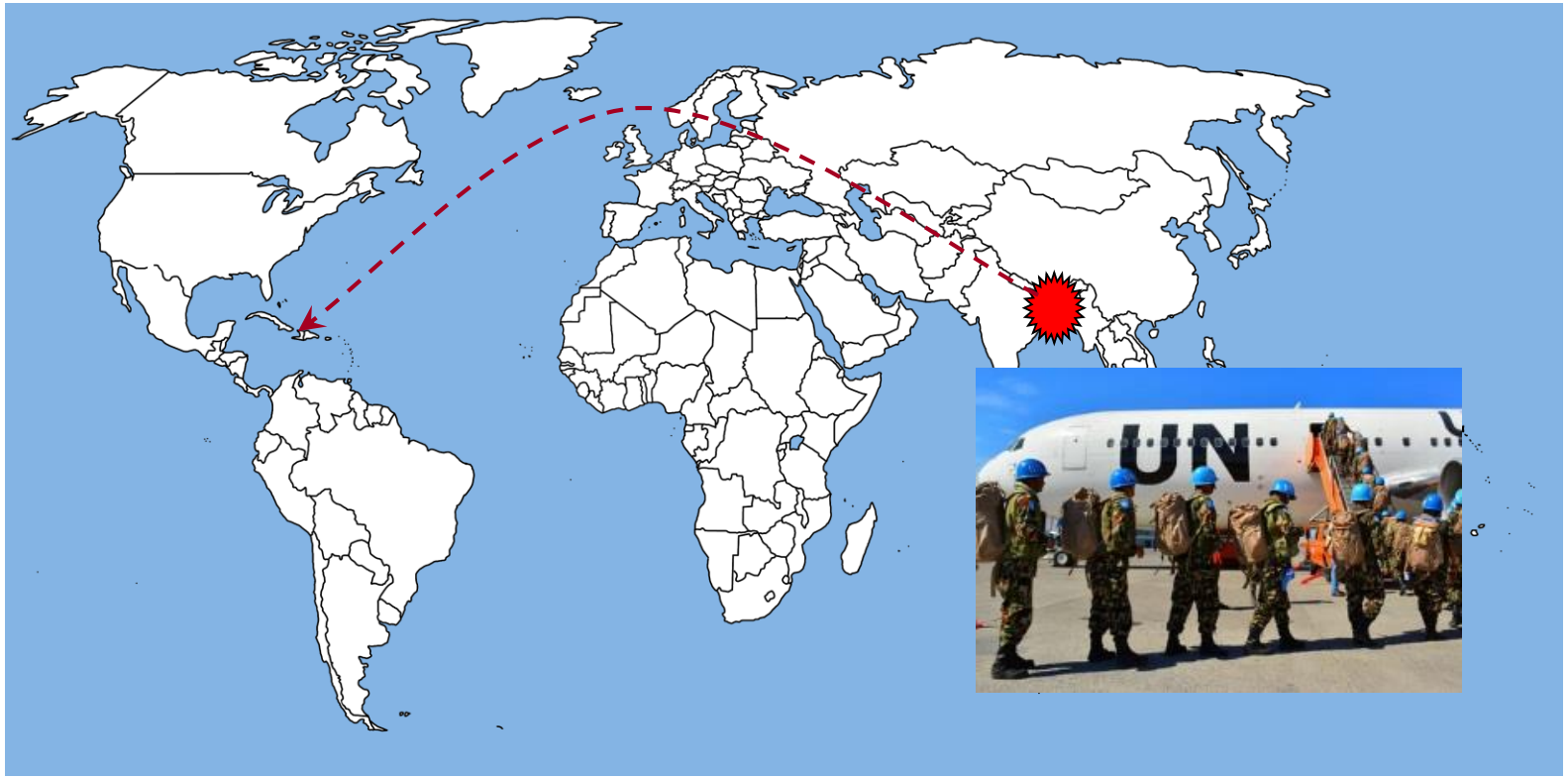



על מות בת נעורים
נפש היפה רכה וענוגה
מ' נחמה גיטיל
אר יצחק
טויסטער שיחי'
בה"ר יהושע חיים הלוי
לדרכרג ז"ל
נולדה ביום ה' טבת תרנ"א
ונקטפה בעצם עלומיה
ממחלת החולירע האכזריה
ביום ח' תמוז תרע"ו
תנצב"ה

כולרה בישראל

- מגיפה ראשונה מדווחת 1831
- המגיפות הגדולות :1865, 1902 (ממצרים לעזה ולישראל)
- התגברות המגיפות בזמן מלה"ע הראשונה.
- דווח אחרון 1918 בטבריה.

אחוז תמותה בישובים בזמן מגיפת כולרה

שנה	מקום	מס' תושבים	% תמותה
1865	ירושלים	14,000	10
1902	לוד	1,000	50
1902	טבריה	6,000	10
1902	עזה	18,000	16
1911	חיפה	360 (מטופלים)	33

Objectives

1. Infectious disease burden in context
2. Introduction to outbreaks
3. **Case studies**
4. Public health tools

- Free discussion

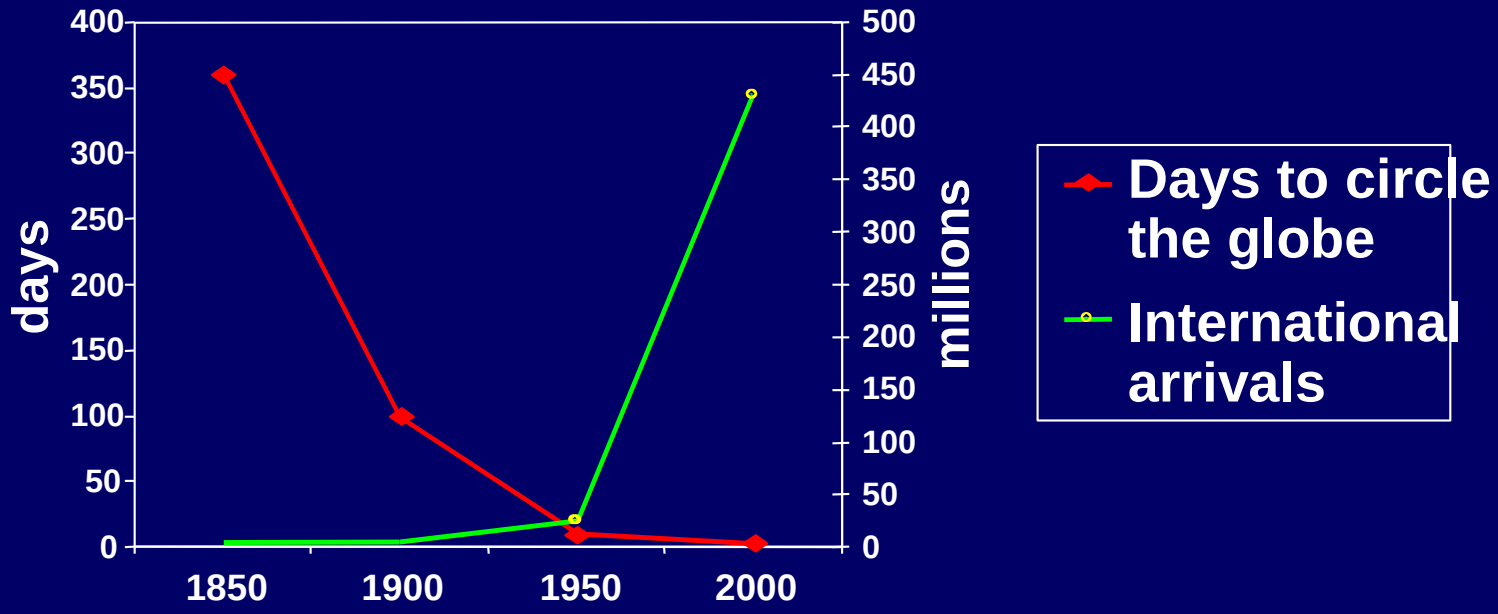
Epidemics – 20th Century

Spanish Flu (1918)
50 Million deaths

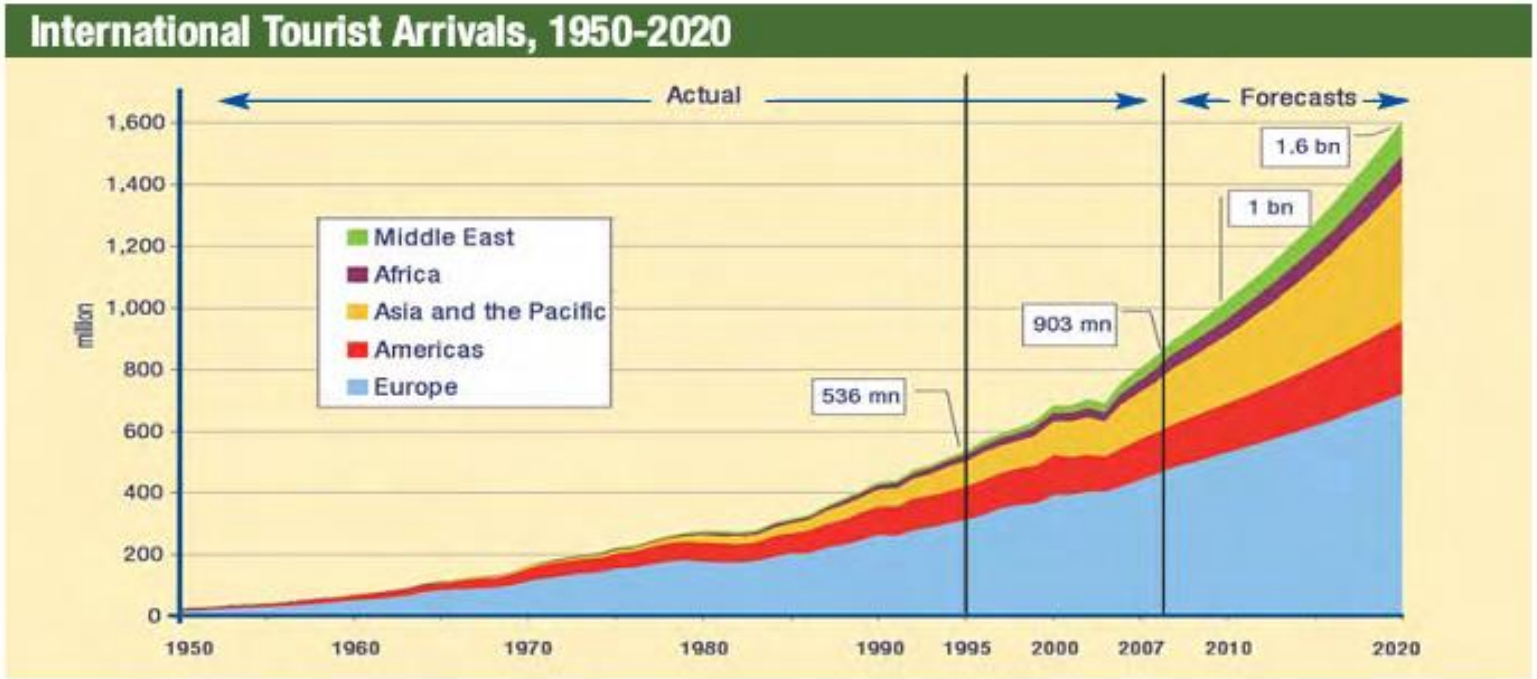
Polio (1950s)
500,000 dead and paralyzed
Every year

HIV (1980)
75 Million infected
32 Million dead

Around the world in 80 days



World Tourism Organization prediction



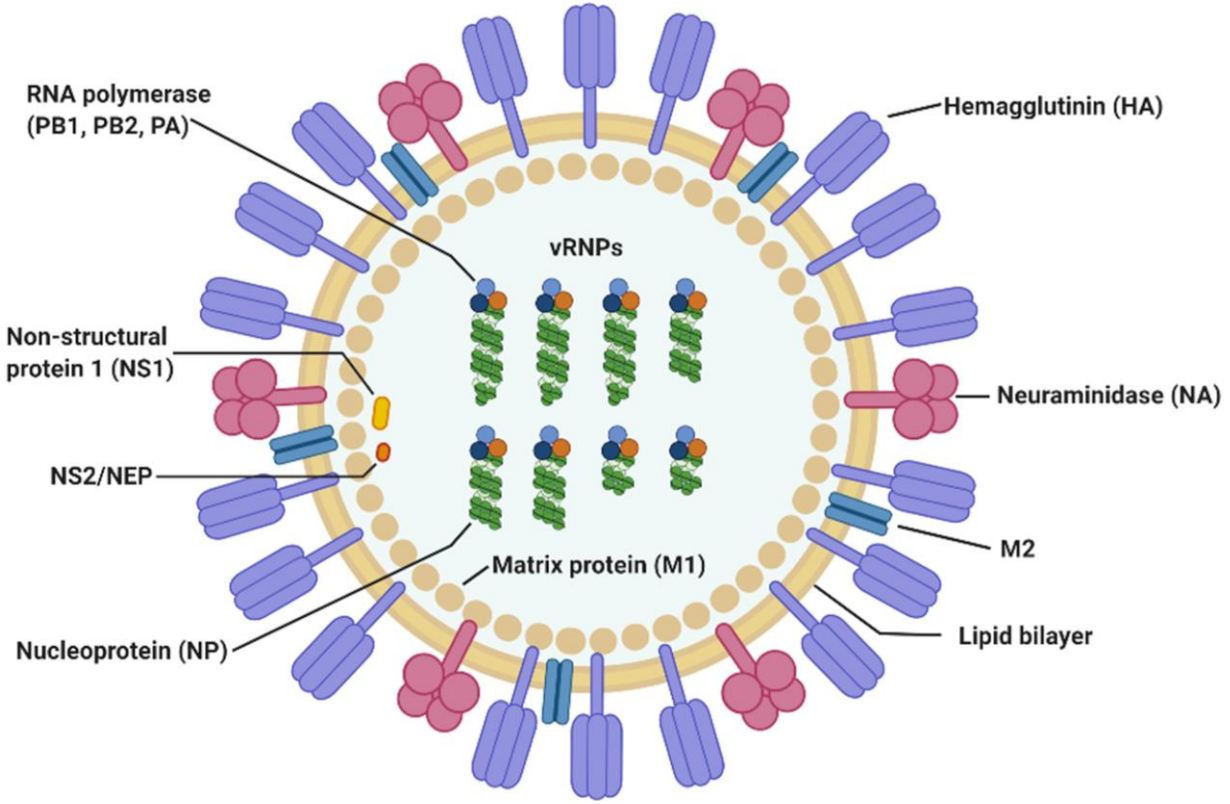
Source: World Tourism Organization (UNWTO) ©

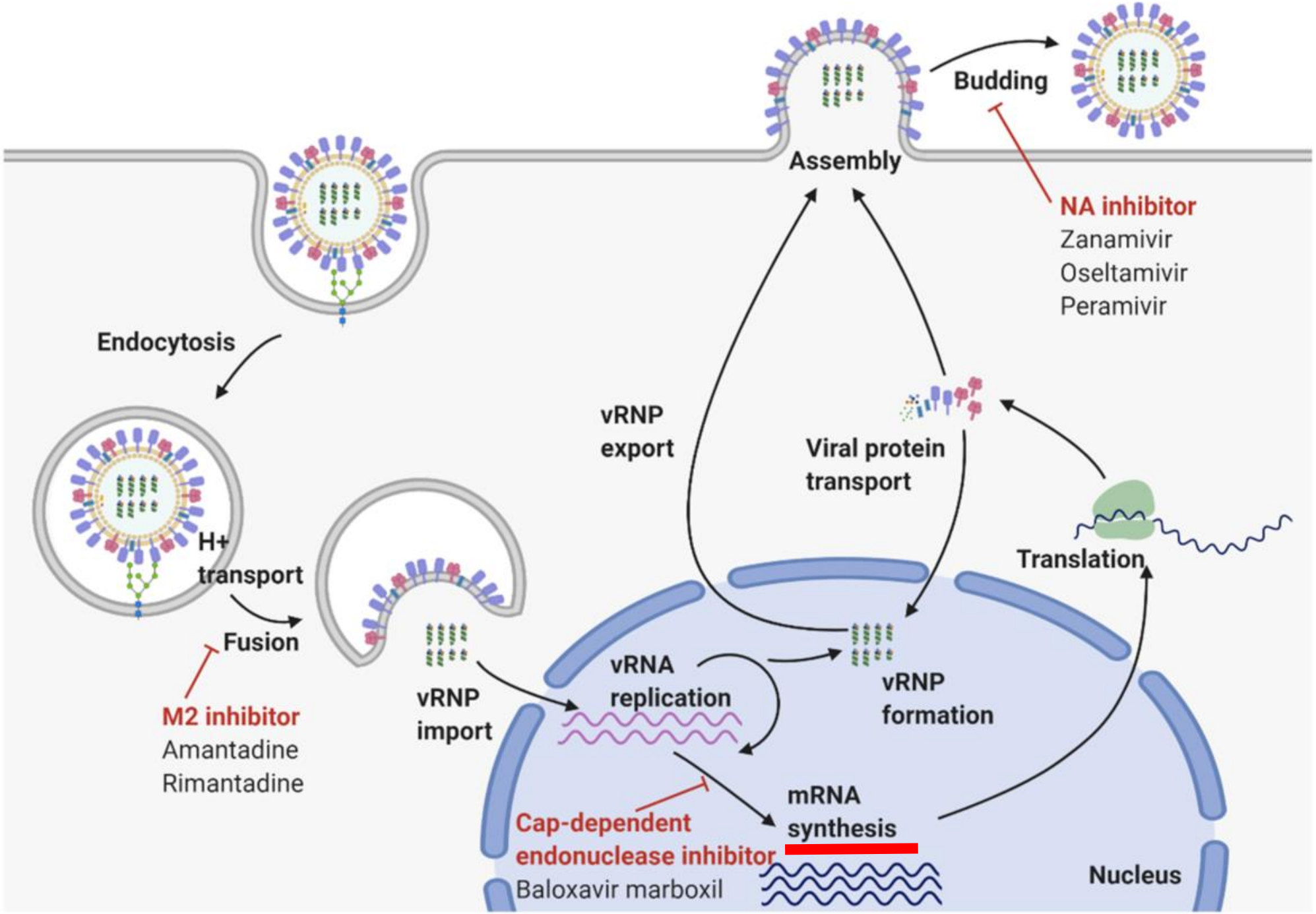
1 billion people crossing borders /year

Influenza

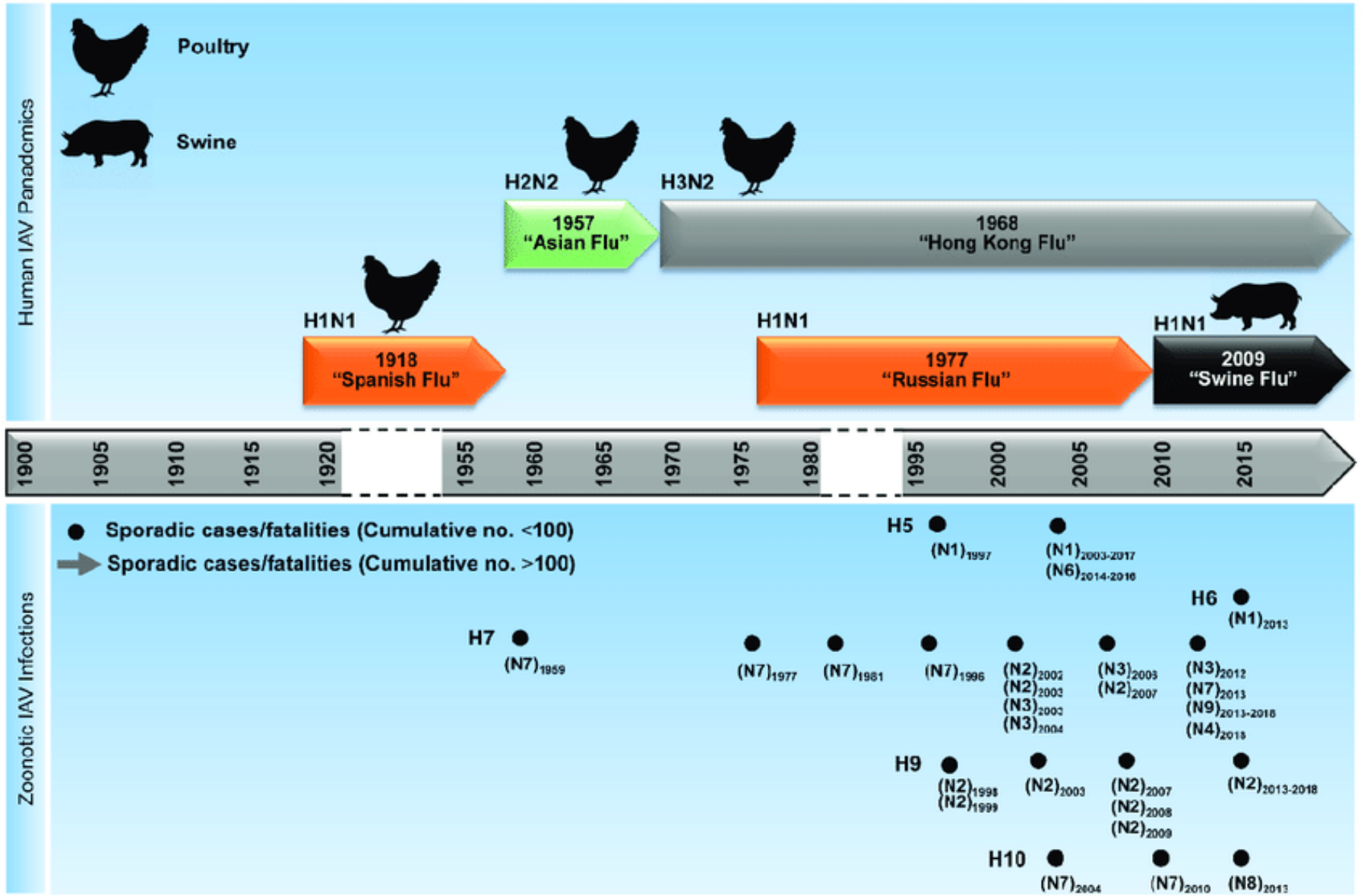
- RNA virus
- Orthomyxoviridae

- Hemagglutinin (HA 1-18)
  - Humans H1,2,3
- Neuroaminidase (NA 1-11)
  - Humans N1,2




Budding
Assembly
NA inhibitor
Zanamivir
Oseltamivir
Peramivir
Endocytosis
vRNP
export
Viral protein
transport
Translation
H+
transport
Fusion
M2 inhibitor
Amantadine
Rimantadine
vRNP
import
vRNA
replication
vRNP
formation
mRNA
synthesis
Cap-dependent
endonuclease inhibitor
Baloxavir marboxil
Nucleus

Flu Epidemics – 20th Century



NATIONAL STRATEGY FOR

PANDEMIC INFLUENZA

HOMELAND SECURITY COUNCIL

NOVEMBER 2005

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports / Vol. 63 / No. 6
September 26, 2014

Updated Preparedness and Response Framework for Influenza Pandemics

Continuing Education Examination available at http://www.cdc.gov/mmwr/cme/conted.html.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Influenza Symptoms
Cold or Flu?

- **FEVER**
  - **Abrupt**
- **Chills**
- **Myalgia**
- **Headache**

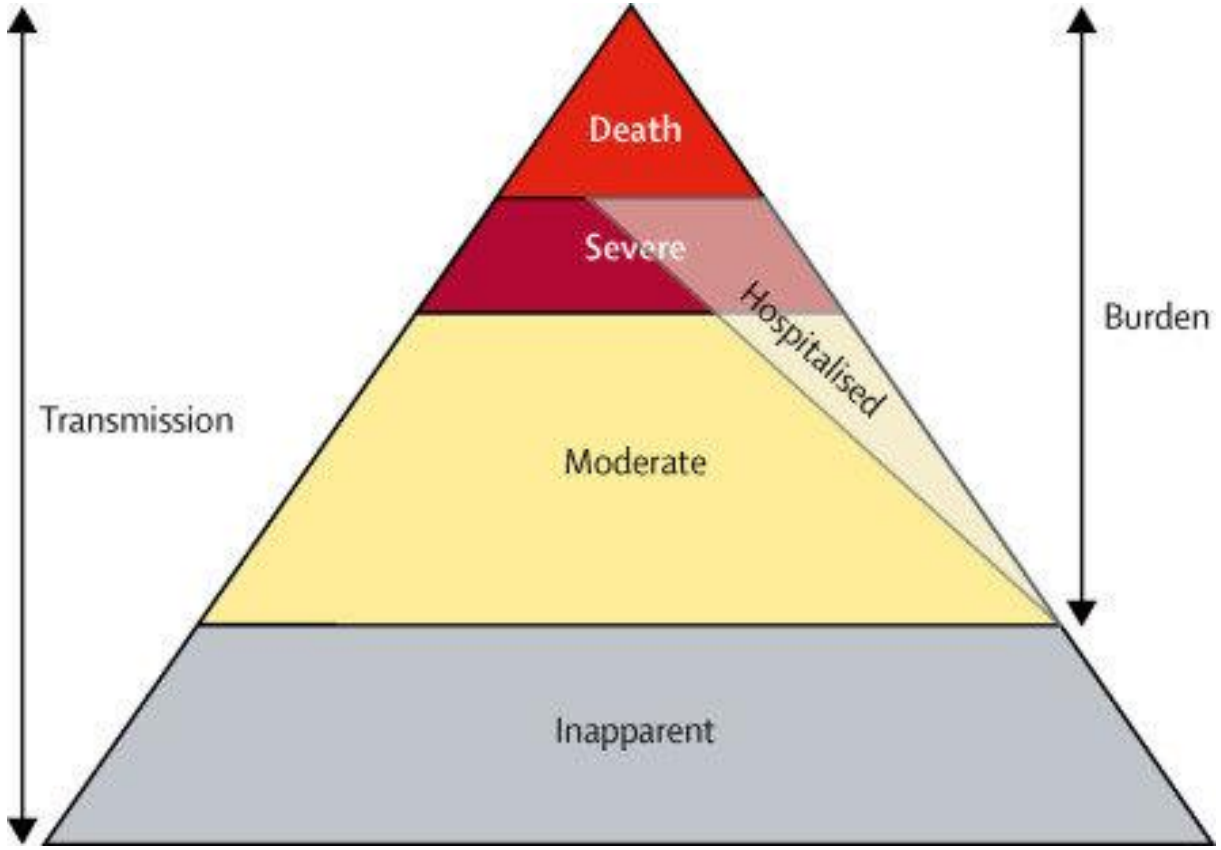
- **Cough**
- **Chest discomfort**

SIGNS AND SYMPTOMS	COLD	FLU
Symptom onset	Gradual	Abrupt
Fever	Rare	Usual
Aches	Slight	Usual
Chills	Uncommon	Fairly common
Fatigue, weakness	Sometimes	Usual
Sneezing	Common	Sometimes
Chest discomfort, cough	Mild to moderate	Common
Stuffy nose	Common	Sometimes
Sore throat	Common	Sometimes
Headache	Rare	Common

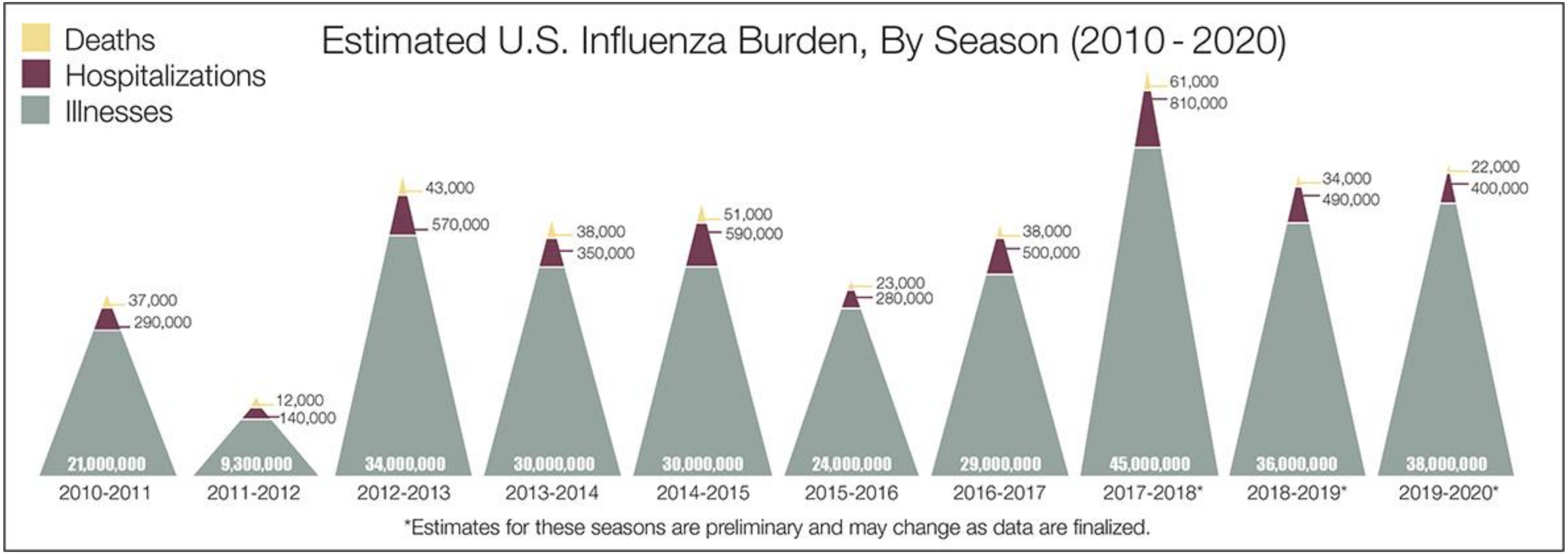
Influenza Epidemiology

- Infected
  - 20-30% Children
  - 5-10% Adults

- Annual Burden (Global)
  - 1 Billion cases
  - 3-5 Million severe cases
  - 290,000-650,000 Deaths



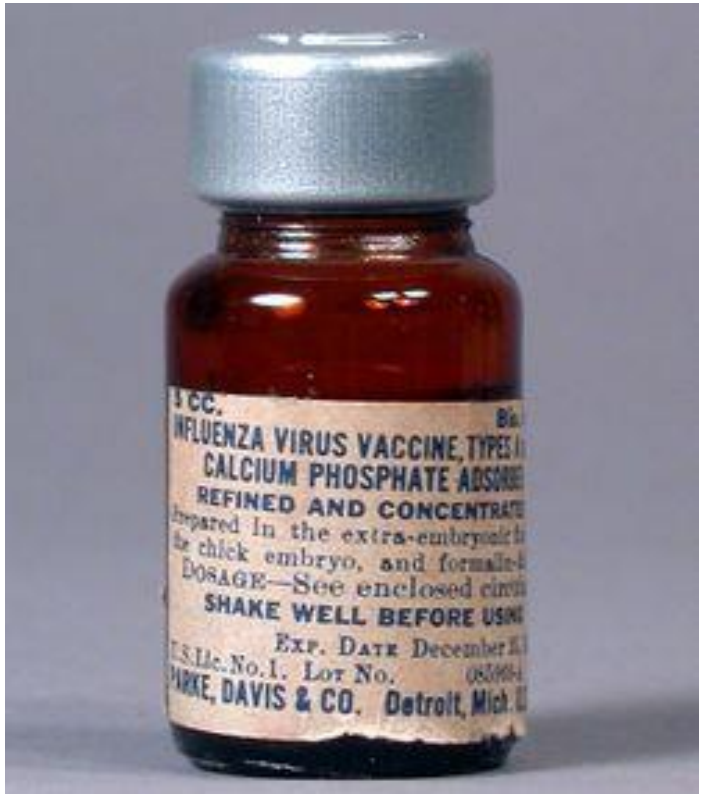
Influenza in the US, 2010-20 Seasons



Influenza Vaccine

- **Approved in 1945 (US military)**

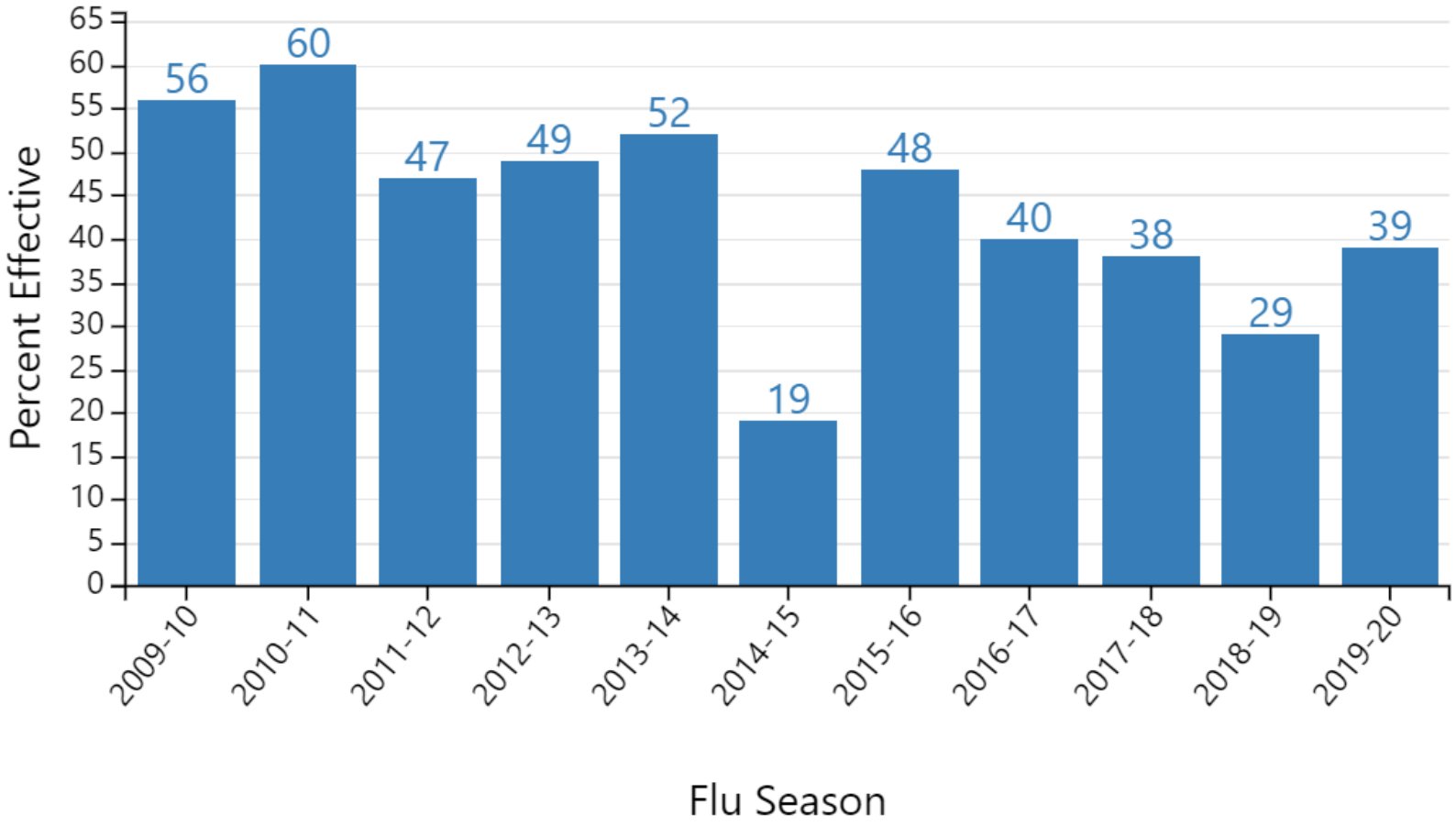
- **Inactivated Vs. Live Attenuated**
- **Trivalent Vs. Quadrivalent**
- **Standard Vs. High dose**
- **Chicken egg based Vs. Cell culture**
- **Adjuvanted**
- **Recombinant**



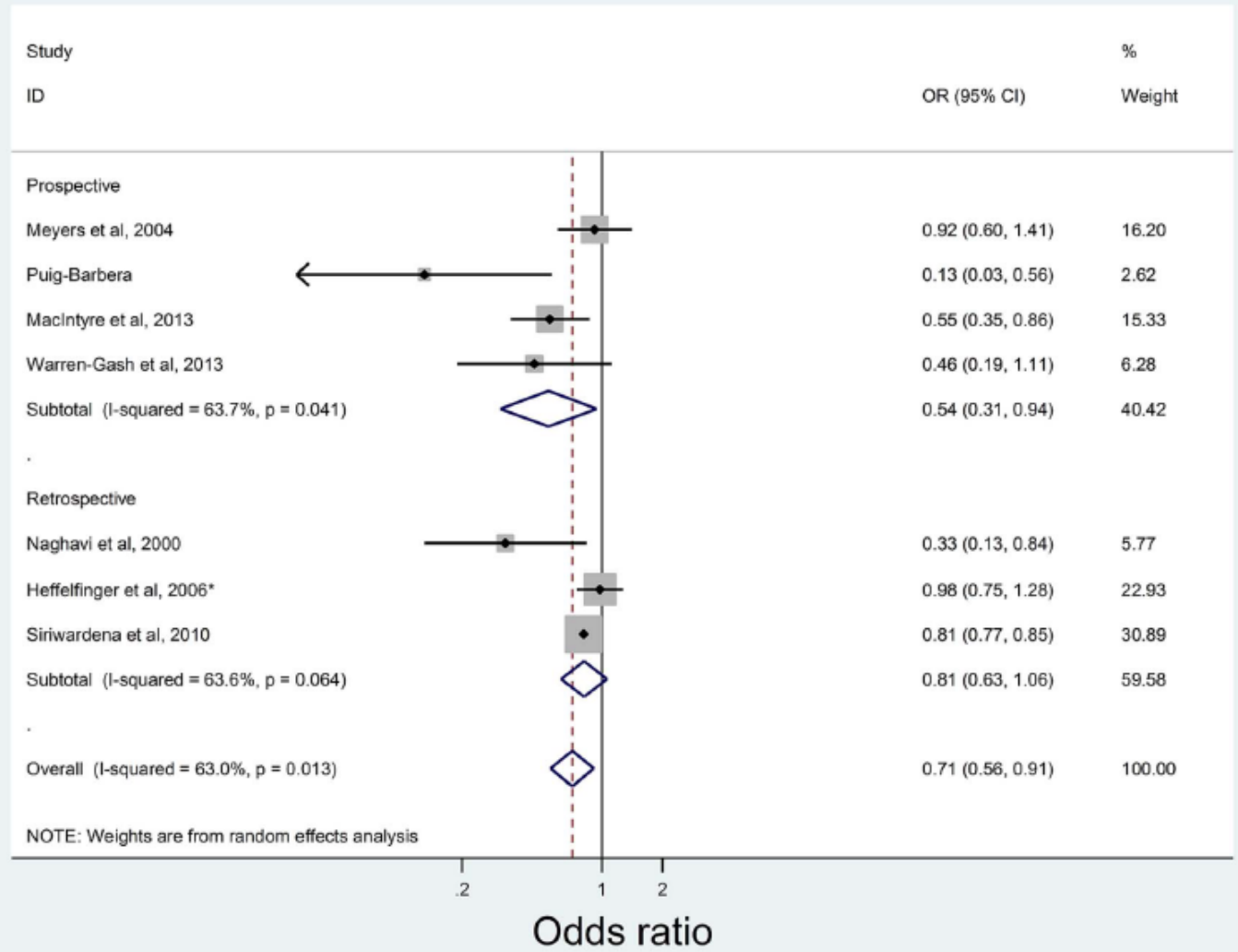
Indications for Flu Vaccine

- **High risk groups:**
  - **Children age 6-59 months**
  - **Adults aged 55 years and older**
  - **Pregnant women and three months post partum**
  - **Chronic illness**
    - **Heart**
    - **Lung**
    - **Metabolic**
    - **Obese**
  - **Long term care facilities**
  - **Healthcare workers and caregivers**

Seasonal Flu Vaccine Effectiveness



Acute myocardial infarction and influenza: a meta-analysis of case–control studies



Vaccine Effectiveness 29%

To cite: Barnes M, Heywood AE, Mahimbo A, *et al*. *Heart* 2015;**101**:1738–1747.

Figure 3 Pooled results for the analysis of vaccination studies by study type and acute myocardial infarction diagnosis.

COVID-19

November 2020, Wuhan, Hubei Province, China

Wet Market, Wuhan

Pangolin

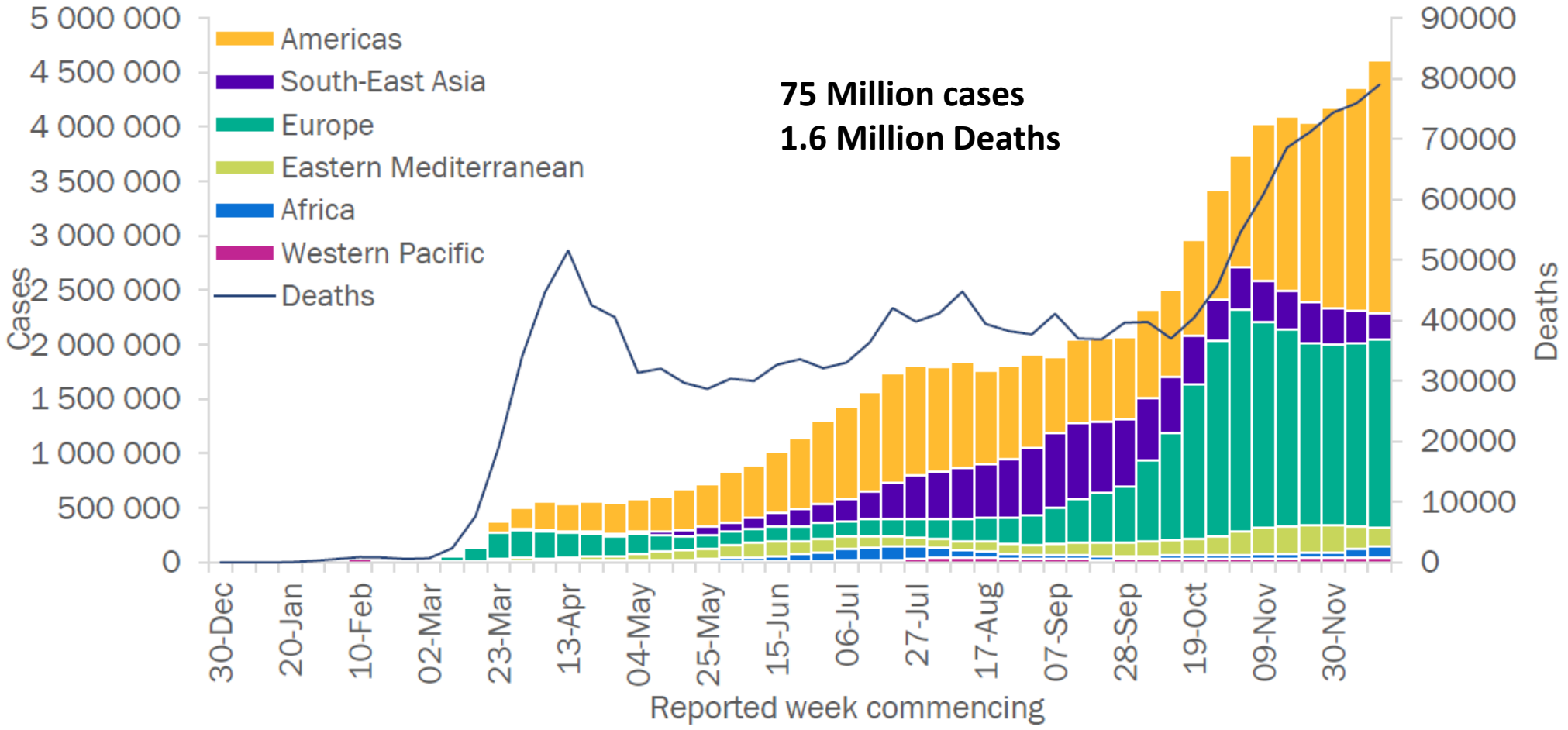
COVID-19

November 2020, Wuhan, Hubei Province, China –
The COVID-19 Pandemic

Pangolin

Global Situation COVID-19

Figure 1: COVID-19 cases reported weekly by WHO Region, and global deaths, as of 20 December 2020**



Search by Country, Territory, or Area

Overview Data Table Explore

Global > Israel

Data last updated: 2021/1/2, 6:30pm CET

Back to top

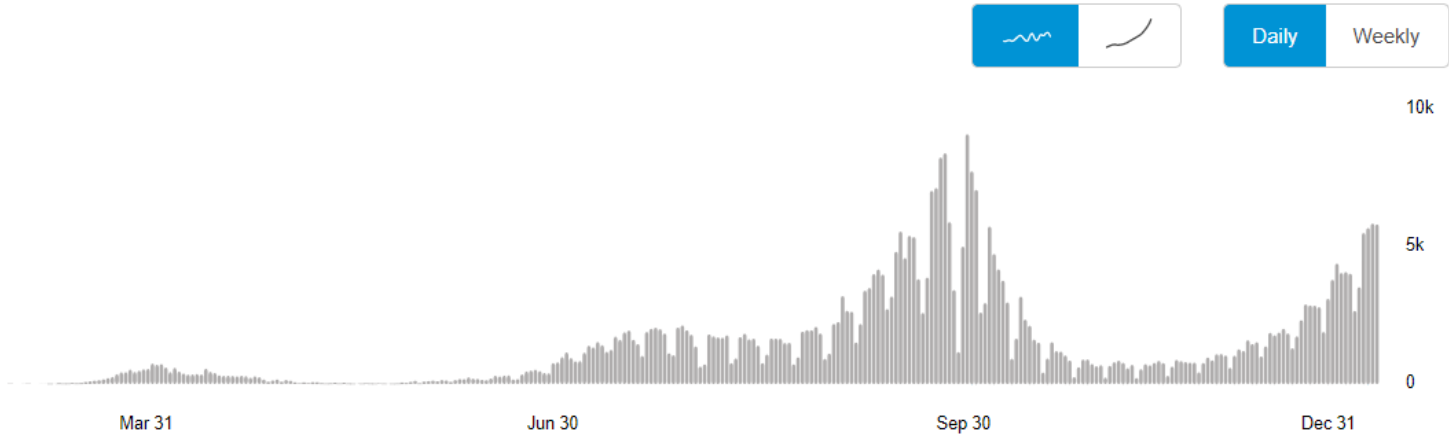
In **Israel**, from **Jan 3** to **6:30pm CET, 2 January 2021**, there have been **425,582 confirmed cases** of COVID-19 with **3,338 deaths**.

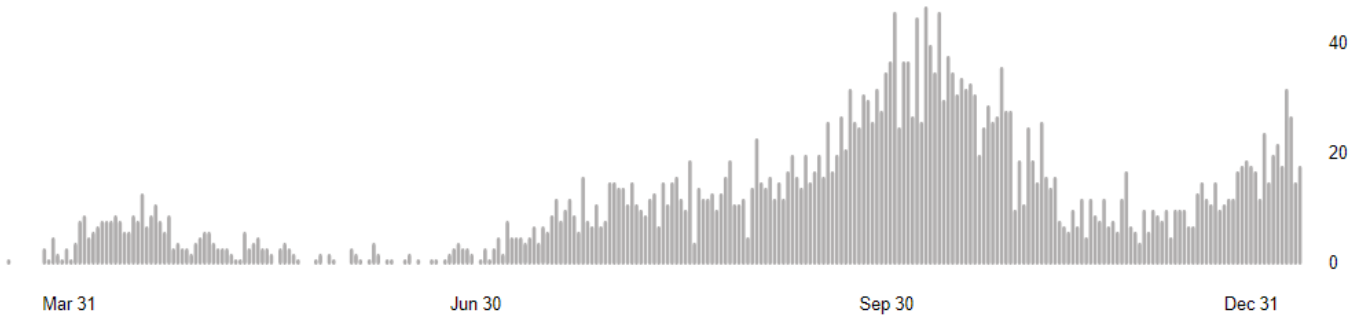
Israel Situation

425,582
confirmed cases

3,338
deaths

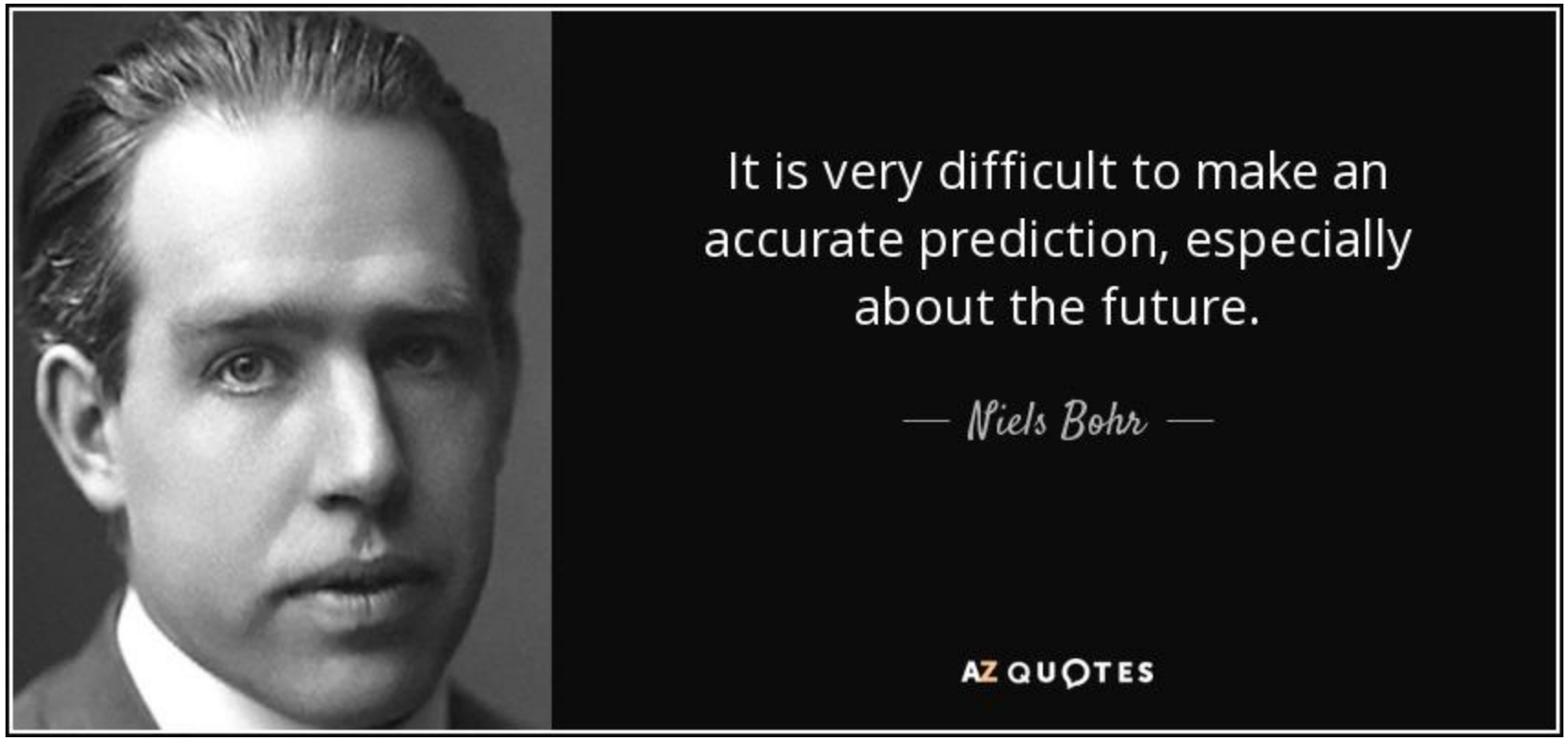
Source: World Health Organization





What to Expect This Winter?

What to Expect This Winter?



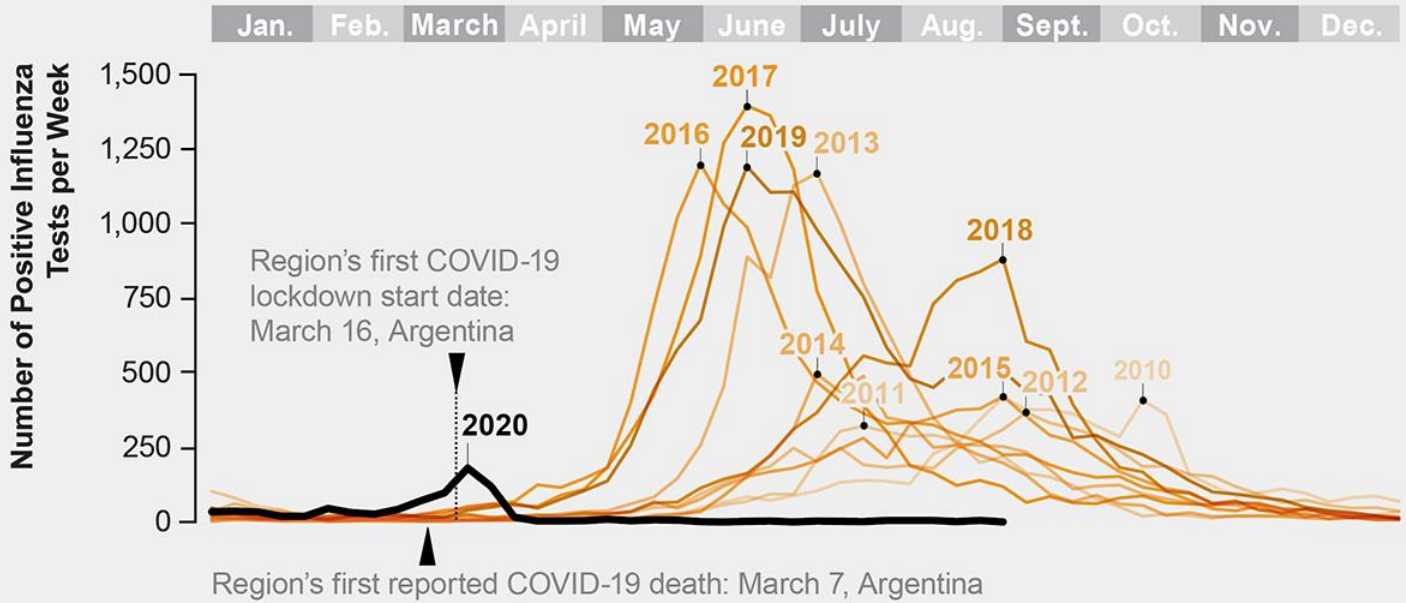
Influenza Cases, by Region (2010–2020)

The World Health Organization tracks influenza activity in 18 transmission zones. Three of those regions appear here. Only people who get tested for influenzalike illnesses—typically about 5 percent of those who fall ill—are tallied.

Midyear Spikes

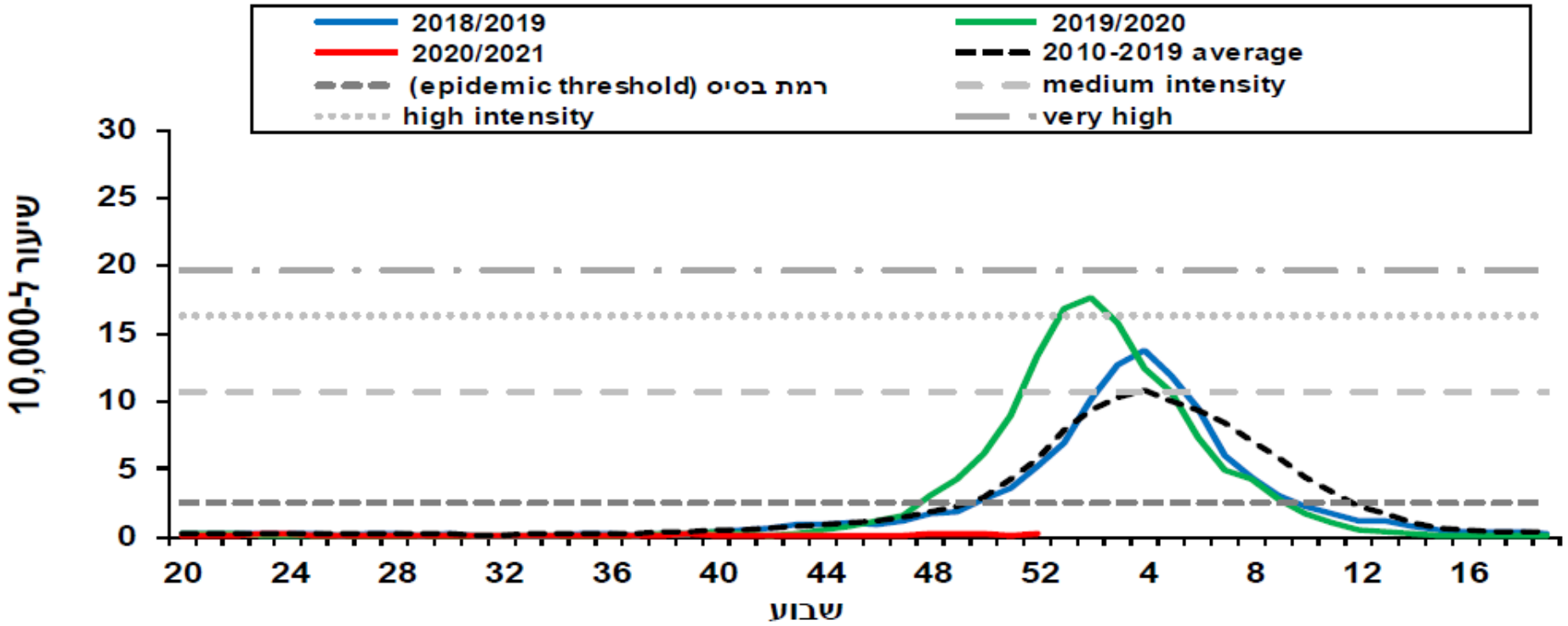
Flu cases rise each winter in temperate latitudes. In the Southern Hemisphere, flu season stretches from May to October. In southern South America, weekly cases peaked in 2017.

Temperate South America
(Argentina, Chile, Paraguay, Uruguay)



What to Expect This Winter?

Maccabi Healthcare Services: Incidence of weekly visits due to Influenza Like Illness compared with multi year average



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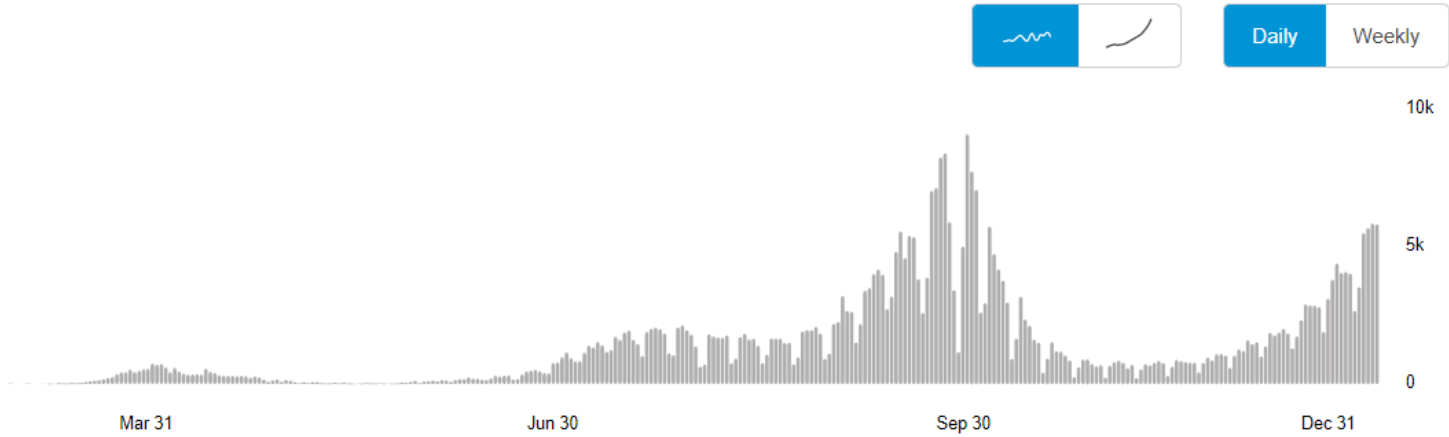
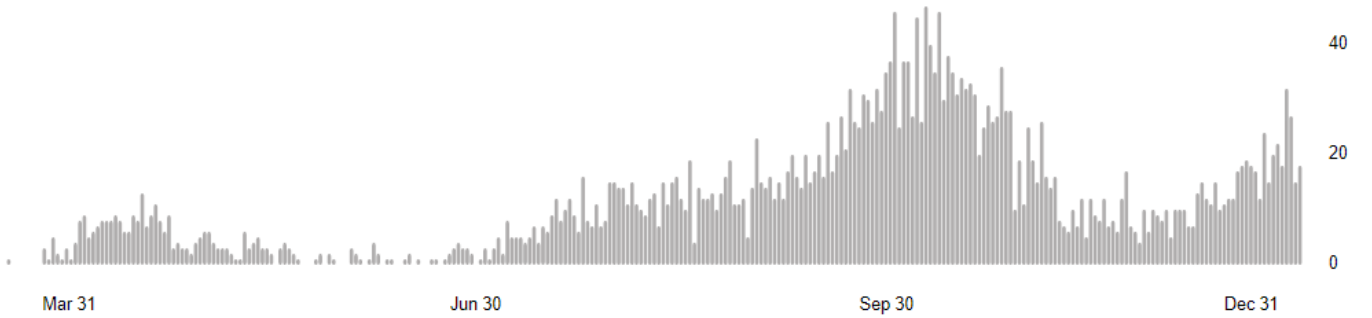


3,338
deaths



Source: World Health Organization

Objectives

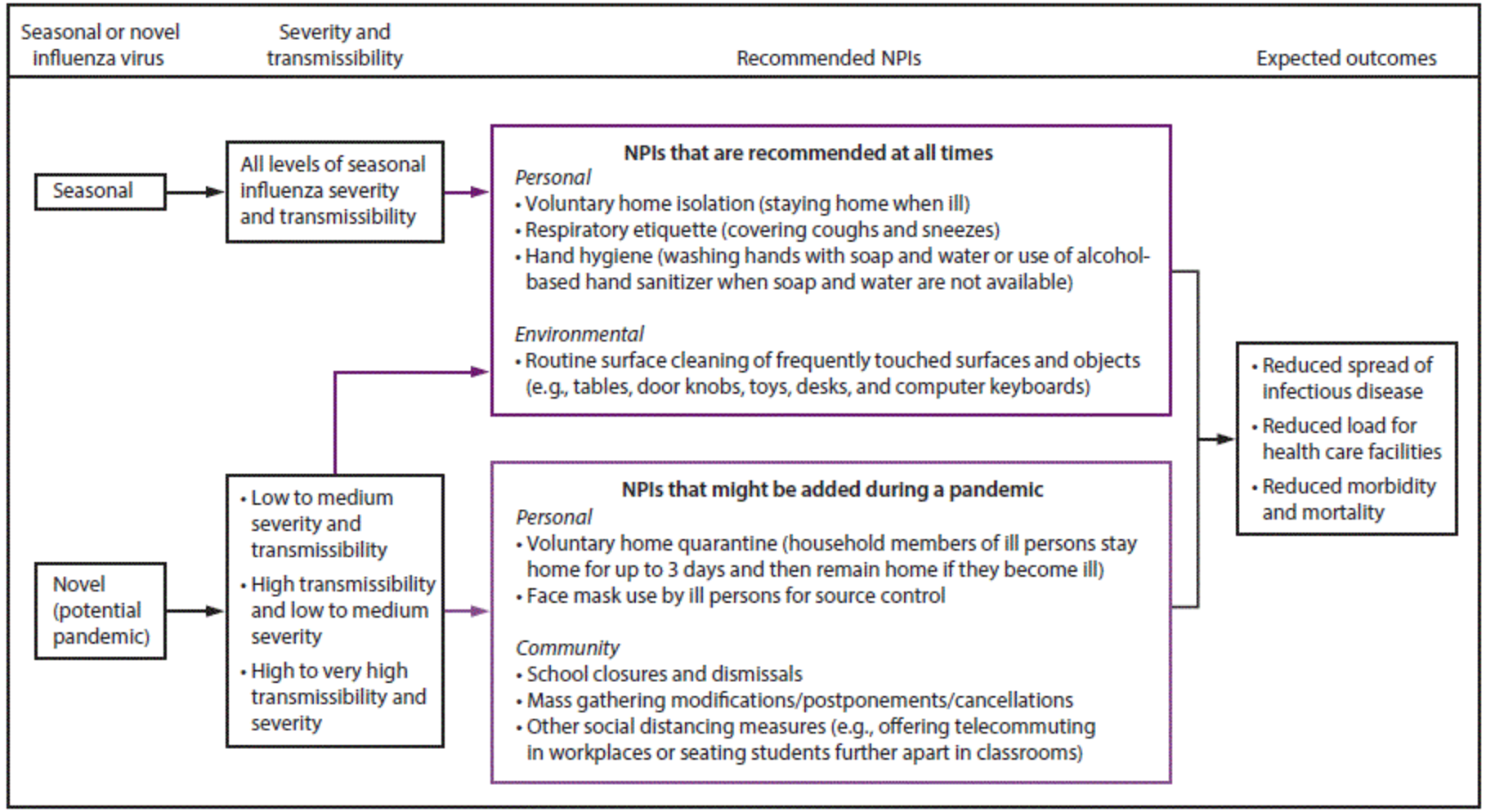
1. Infectious disease burden in context
2. Introduction to outbreaks
3. Case studies
4. **Public health tools**

- Free discussion

Classic Public Health Measures to Control Outbreaks

- Prevent **person-to-person** spread of disease by separating people to interrupt transmission

- **Isolation**
- **Quarantine**
- **Community Containment**
  - Increasing social distancing
  - Community wide quarantine


Seasonal or novel influenza virus
Severity and transmissibility
Recommended NPIs
Expected outcomes
Seasonal
All levels of seasonal influenza severity and transmissibility
NPIs that are recommended at all times
Personal
• Voluntary home isolation (staying home when ill)
• Respiratory etiquette (covering coughs and sneezes)
• Hand hygiene (washing hands with soap and water or use of alcohol-based hand sanitizer when soap and water are not available)
Environmental
• Routine surface cleaning of frequently touched surfaces and objects (e.g., tables, door knobs, toys, desks, and computer keyboards)
Novel (potential pandemic)
• Low to medium severity and transmissibility
• High transmissibility and low to medium severity
• High to very high transmissibility and severity
NPIs that might be added during a pandemic
Personal
• Voluntary home quarantine (household members of ill persons stay home for up to 3 days and then remain home if they become ill)
• Face mask use by ill persons for source control
Community
• School closures and dismissals
• Mass gathering modifications/postponements/cancellations
• Other social distancing measures (e.g., offering telecommuting in workplaces or seating students further apart in classrooms)
• Reduced spread of infectious disease
• Reduced load for health care facilities
• Reduced morbidity and mortality

Treatment Capacity

- Ventilators
- Healthcare surge
- Drugs

Vaccines

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine

Table 2. Vaccine Efficacy against Covid-19 at Least 7 days after the Second Dose.*

Efficacy End Point	BNT162b2		Placebo		Vaccine Efficacy, % (95% Credible Interval)‡	Posterior Probability (Vaccine Efficacy >30%)§
	No. of Cases	Surveillance Time (n)†	No. of Cases	Surveillance Time (n)†		
		(N=18,198)		(N=18,325)		
Covid-19 occurrence at least 7 days after the second dose in participants without evidence of infection	8	2.214 (17,411)	162	2.222 (17,511)	95.0 (90.3–97.6)	>0.9999
		(N=19,965)		(N=20,172)		
Covid-19 occurrence at least 7 days after the second dose in participants with and those without evidence of infection	9	2.332 (18,559)	169	2.345 (18,708)	94.6 (89.9–97.3)	>0.9999

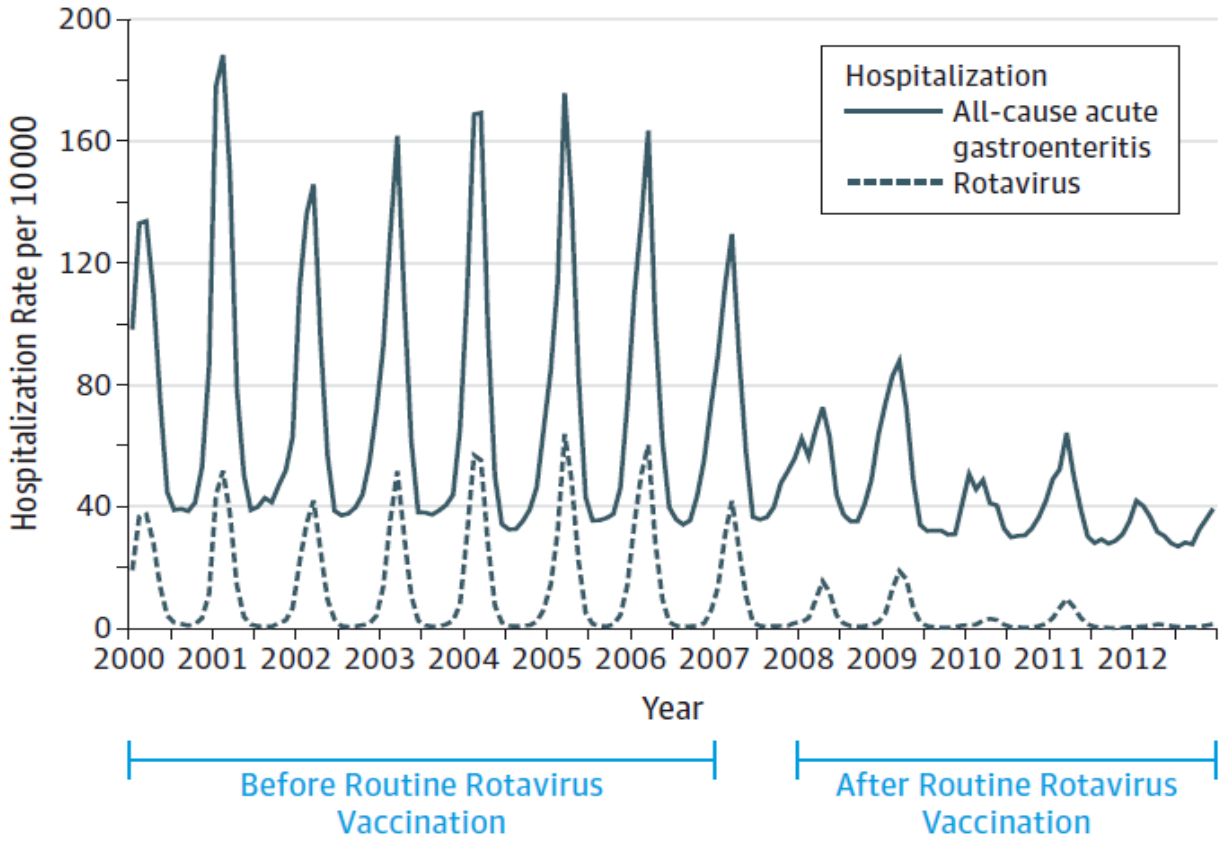
This article was published on December 10, 2020, and updated on December 16, 2020, at NEJM.org.

How Well Will COVID Vaccines Work?

Acute Gastroenteritis Hospitalizations Among US Children Following Implementation of the Rotavirus Vaccine

Rotavirus Vaccine Impact in the US

Figure. Monthly Acute Gastroenteritis and Rotavirus-Coded Hospitalization Rates Among Children Younger Than 5 Years in 24 States During January 2000 Through December 2012



JAMA June 9, 2015 Volume 313, Number 22

Explaining the world, daily

The Economist explains

The Economist explains

What is Disease X?

The WHO has created a name for a disease that may not even exist

Mar 23rd 2018

BY R.J.

Since 2015 the World Health Organisation has released an annual list of up to 10 "blueprint priority diseases" requiring immediate attention based on their

Prioritizing diseases for research and development in emergency contexts

Worldwide, the number of potential pathogens is very large, while the resources for disease research and development (R&D) is limited. To ensure efforts under WHO's R&D Blueprint are focused and productive, a list of diseases and pathogens are prioritized for R&D in public health emergency contexts.

A WHO tool distinguishes which diseases pose the greatest public health risk due to their epidemic potential and/or whether there is no or insufficient countermeasures.

At present, the priority diseases are:

- COVID-19
- Crimean-Congo haemorrhagic fever
- Ebola virus disease and Marburg virus disease
- Lassa fever
- Middle East respiratory syndrome coronavirus (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS)
- Nipah and henipaviral diseases
- Rift Valley fever
- Zika
- "Disease X"*

Conclusions