Joint EPS-SIF International School

Epidemics, Pandemics and Global Health

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Italian Delegation, Horizon Europe (Health Cluster), European Commission

Pandemics and Global Health

1. The pandemics in human history
2. The concept of Global Health
3. Covid 19: Was it predictable ? What went wrong ?
4. An example: the response to HIV pandemic
5. What to do: be prepared for the «next one»

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Le grandi epidemie della storia

OUTBREAK

Deadliest Pandemics in History

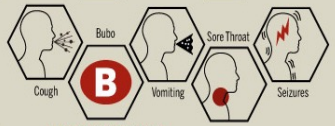
Because a virus doesn't care about state lines or national borders, it can wipe out millions and span multiple continents rapidly. Here is a look at the infectious diseases the world has battled throughout history.

What is a Pandemic?

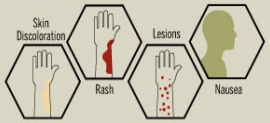
Derived from the Greek word *pandemos* meaning "pertaining to all people," a pandemic is a widespread disease that affects humans over a wide geographic area.

Key:

PANDEMIC YEAR | DEATH TOLL



A bubo is an abnormal swelling of the lymph nodes.



MEASLES
7th Century BC - 1963
200 million

HIV / AIDS
1981 - TODAY
25+ million

PLAGUE of JUSTINIAN
541 - 750
25 million

SMALLPOX
10,000 BC - 1979
300+ million

Bigpox?
In terms of an estimated death toll, smallpox is the deadliest pandemic in history. The highly contagious, rash-inducing infection has killed more than 500 million people. Some believe that 90 percent of the native population of the New World was wiped out by the disease.

SPANISH FLU
1918 - 1919
50-100 million

BLACK DEATH
1340 - 1771
75 million

Ring Around the Rosie, a Pocket Full of Plague
Legend says the Black Death plague inspired the children's rhyme "Ring Around The Rosy," which alluded to the rash-like rings and ashes of the deceased victims.

THIRD PANDEMIC 1855 | **12 million**

TYPHUS 430 BC - TODAY | **4 million**

CHOLERA 1817 - TODAY | **3 million**

HONG KONG FLU 1968 - 1969 | **1 million**

Honorable Mentions

Although the following viruses do not have a figure for total amount of lives claimed, they continue to terrorize various areas around the world.

MALARIA 1600 - Today

Common Symptoms

Chills, Headache, Fever, Jaundice, Muscle Pain, Nausea, Vomiting, Seizures

Death Toll

According to the World Health Organization's 2010 "World Malaria Report," an estimated 781,000 people are killed by the virus every year.

TUBERCULOSIS 700 BC - Today

Common Symptoms

Chest Pain, Cough, Fever, Chills, Fatigue

Death Toll

There are almost 2 million tuberculosis-related deaths worldwide every year.

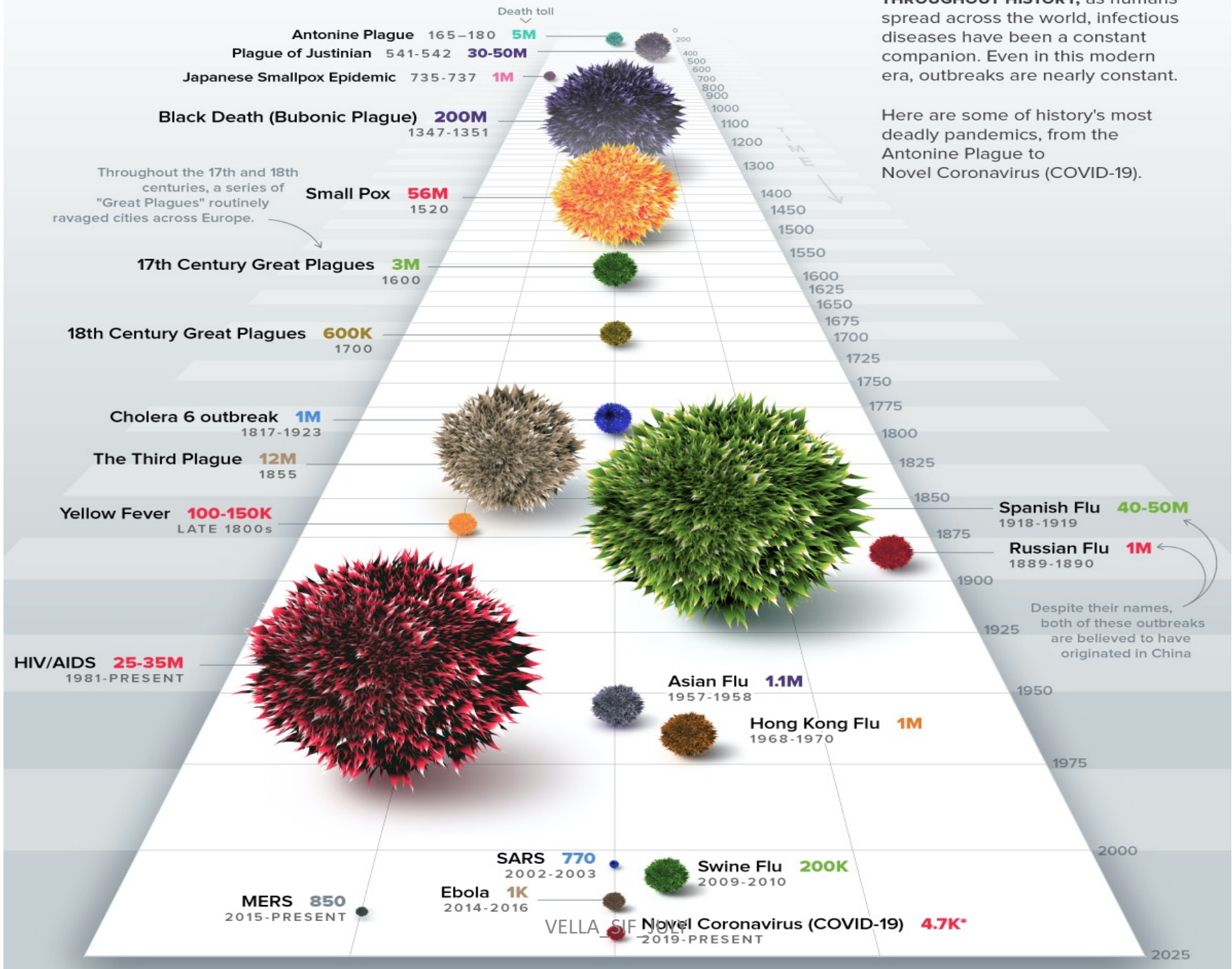
YELLOW FEVER 16th Century - Today

Common Symptoms

Bleeding, Fever, Nausea, Vomiting, Delirium, Seizures, Jaundice

Death Toll

Worldwide, 30,000 deaths are caused by the infection every year.

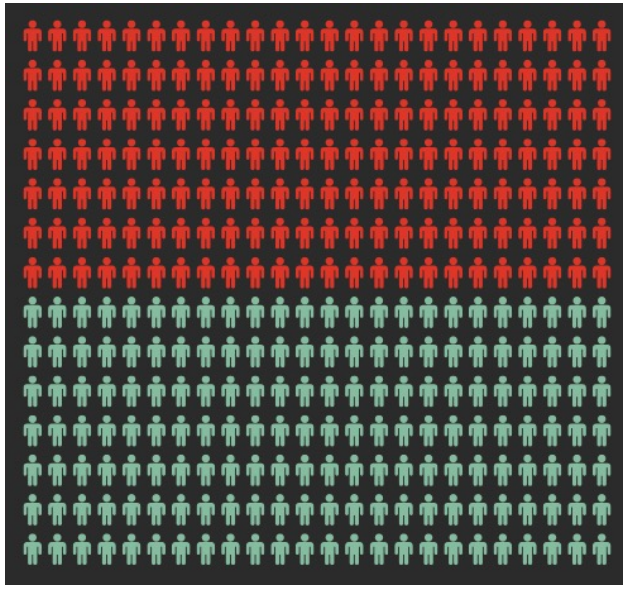


THROUGHOUT HISTORY, as humans spread across the world, infectious diseases have been a constant companion. Even in this modern era, outbreaks are nearly constant.

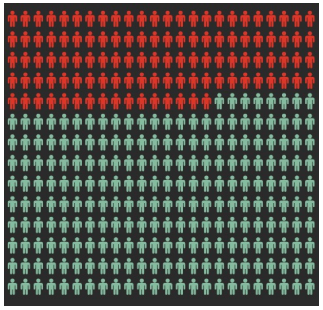
Here are some of history's most deadly pandemics, from the Antonine Plague to Novel Coronavirus (COVID-19).

Death toll vs population of the great epidemics

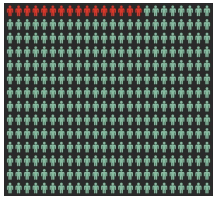
Peste di Giustiniano 541-542 DC
100 milioni di morti

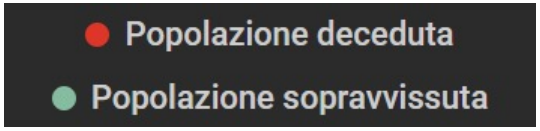


Peste nera 1346-1350
50 milioni di morti



Influenza Spagnola 1918-1920
20-30 milioni di morti





1. The plague

HISTORICAL SCOURGES

The Plague of Athens

By Josh Sanburn | Tuesday, Oct. 26, 2010

Collection Mix: Subjects RM / Getty Images

"A plague so great as this, and so dreadful a calamity, in human memory could not be paralleled." This passage comes courtesy of the Greek historian Thucydides in one of the well-known passages from his *History of the Peloponnesian War*. Granted, this was around 430 B.C. and the world had yet to witness, well, basically all of recorded history. But the Plague of Athens was catastrophic nonetheless, especially to Greek forces who were in the midst of a war with Sparta. Modern researchers have conjectured about the nature of the plague, with some saying it was typhoid, typhus fever, smallpox or even anthrax. But its true nature may never be known. Virtually all of the information we have comes from Thucydides, who traced its roots to Ethiopia and said a third of the city's people perished as a result. He's as good a source as any, considering Thucydides himself also contracted it.

Antonin plague (165 – 180 DC)

PLAGUE OF JUSTINIAN (541-542)

Death Toll: 25 million

Cause: Bubonic Plague

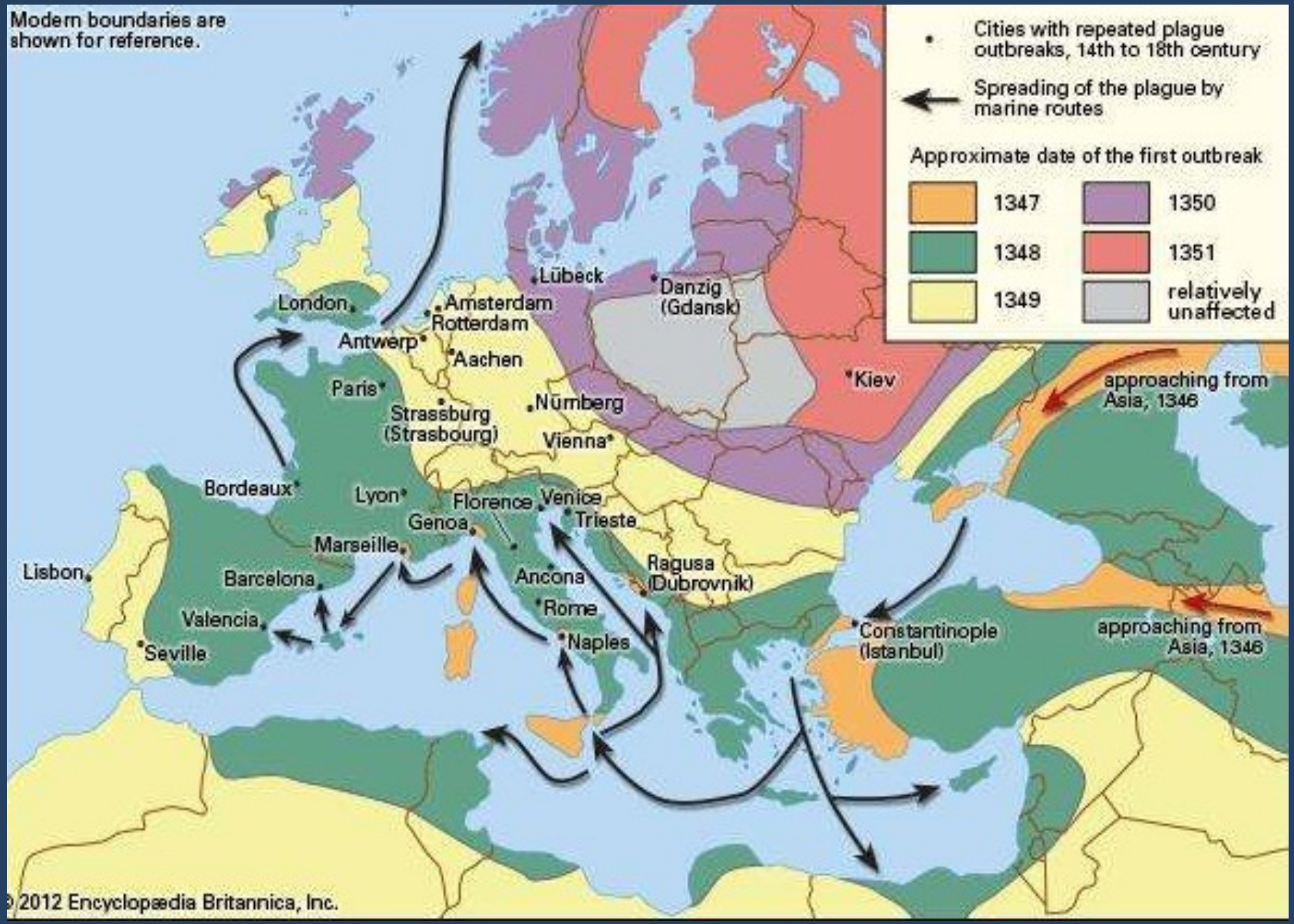
Thought to have killed perhaps half the population of Europe, the Plague of Justinian was an outbreak of the bubonic plague that afflicted the Byzantine Empire and Mediterranean port cities, killing up to 25 million people in its year long reign of terror. Generally regarded as the first recorded incident of the Bubonic Plague, the Plague of Justinian left its mark on the world, killing up to a quarter of the population of the Eastern Mediterranean and devastating the city of Constantinople, where at its height it was killing an estimated 5,000 people per day and eventually resulting in the deaths of 40% of the city's population.

THE BLACK DEATH (1346-1353)

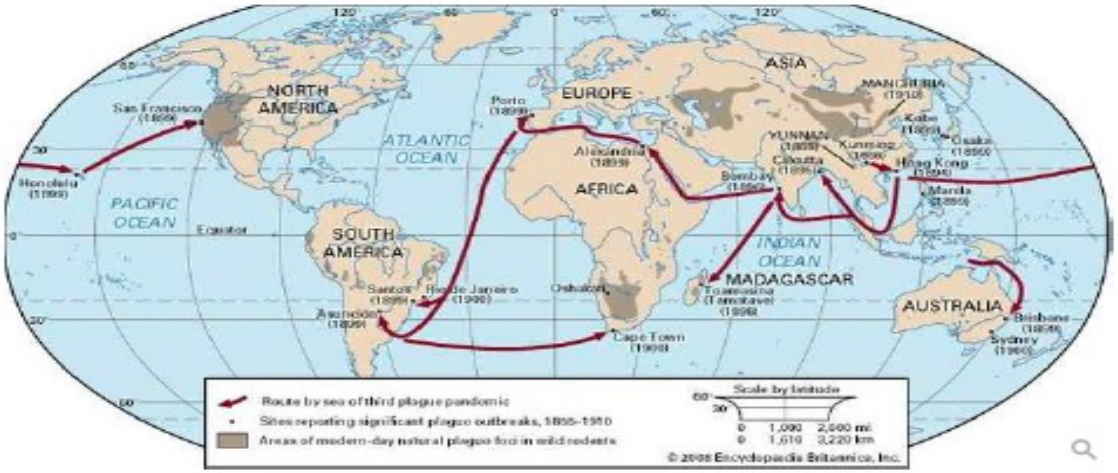
Death Toll: 75 – 200 million

Cause: Bubonic Plague

From 1346 to 1353 an outbreak of the Plague ravaged Europe, Africa, and Asia, with an estimated death toll between 75 and 200 million people. Thought to have originated in Asia, the Plague most likely jumped continents via the fleas living on the rats that so frequently lived aboard merchant ships. Ports being major urban centers at the time, were the perfect breeding ground for the rats and fleas, and thus the insidious bacterium flourished, devastating three continents in its wake.


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.

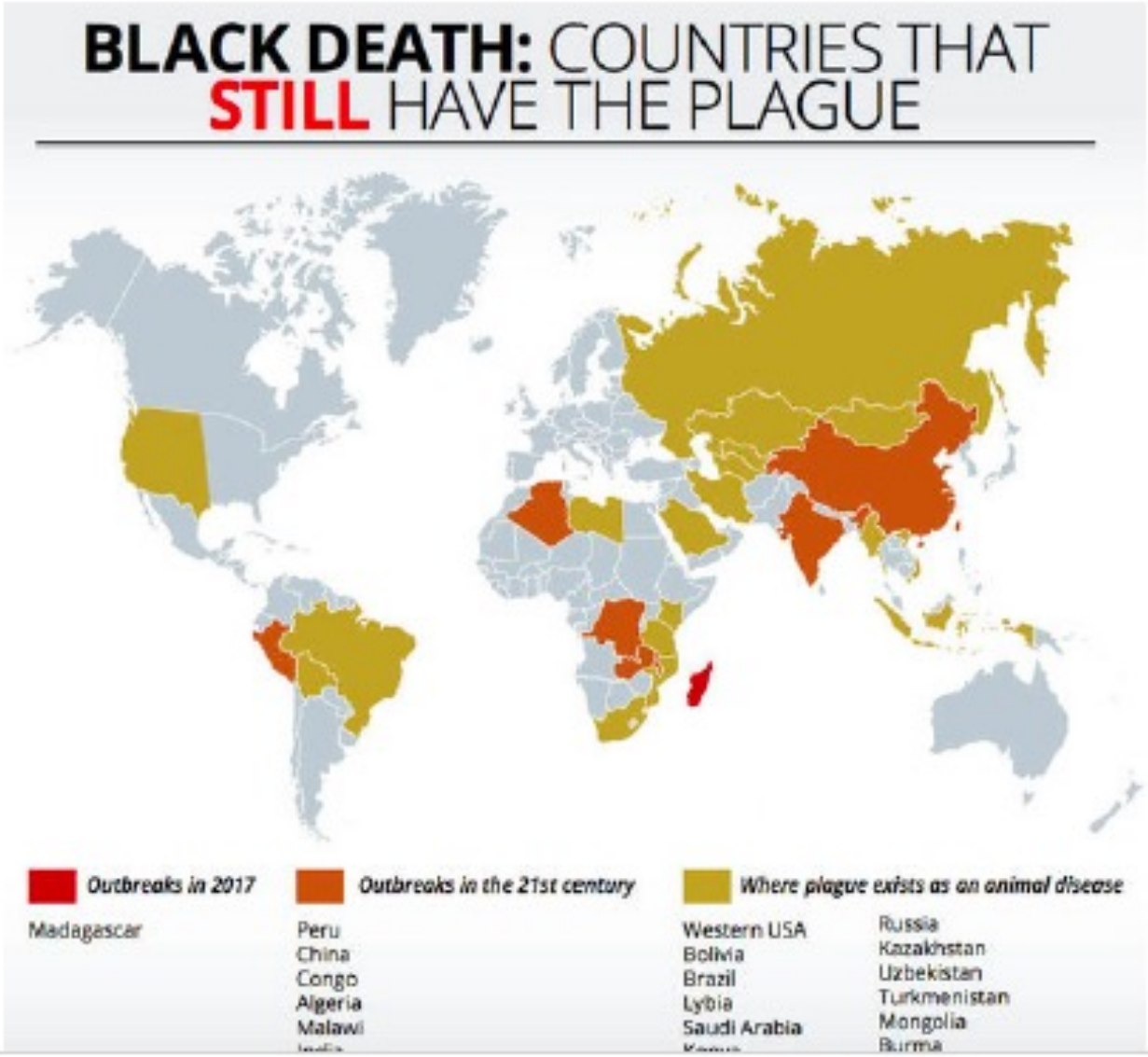
Quando la peste varcò gli oceani



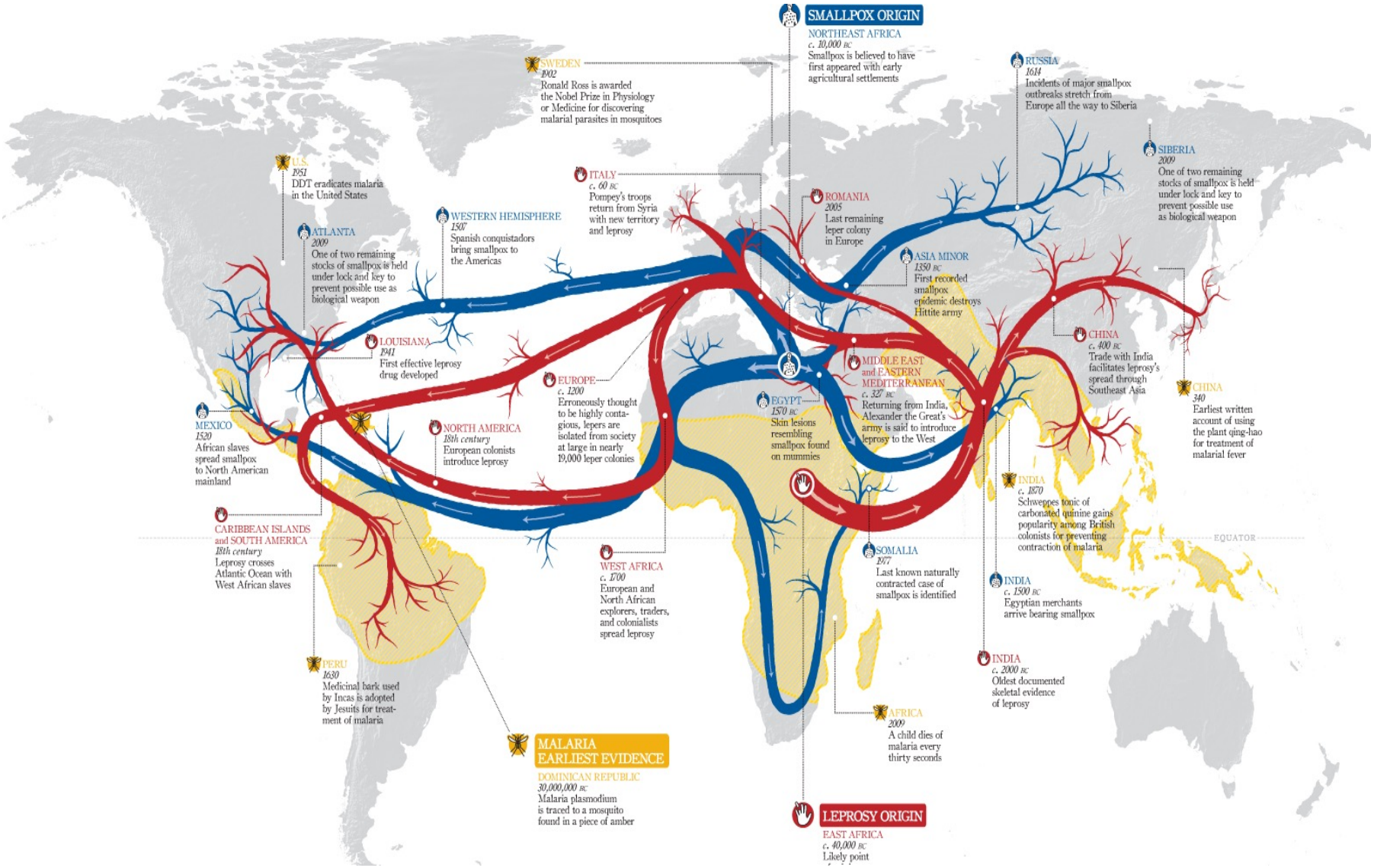
locations of plague outbreaks in the 1800s and early 1900s

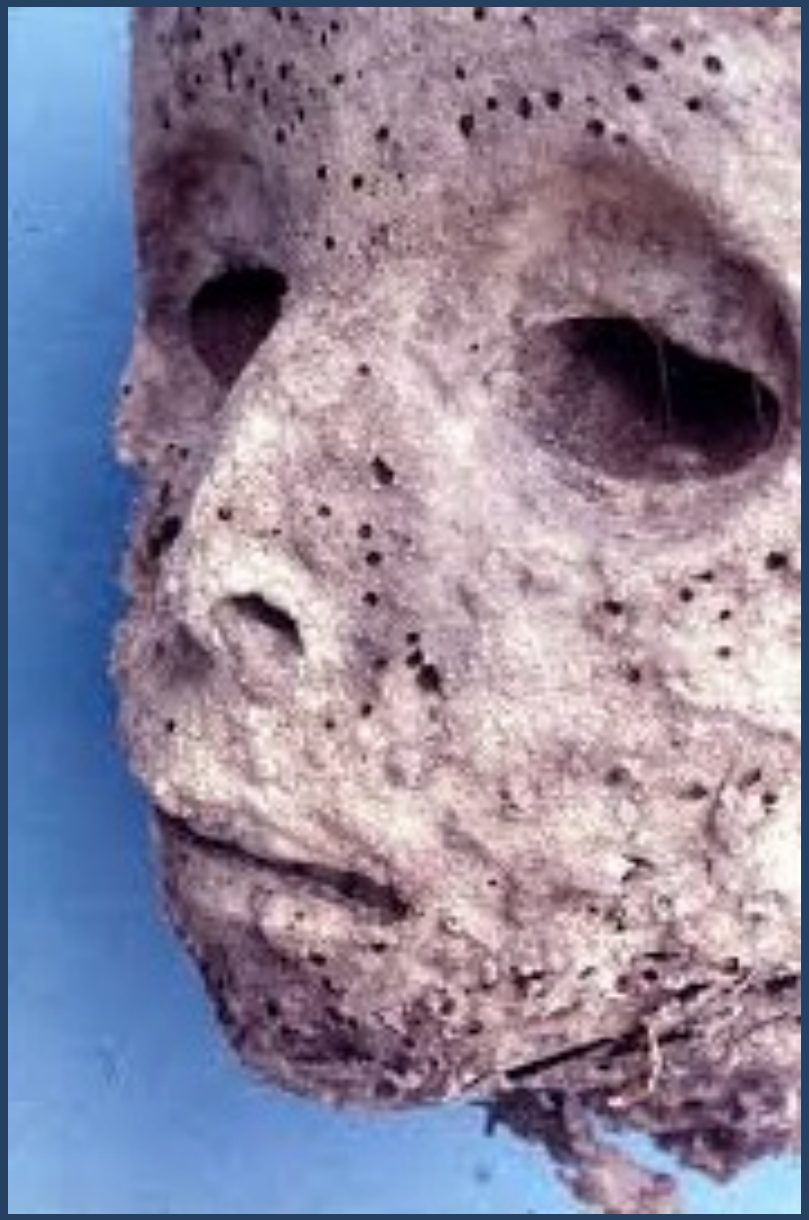
A map showing the locations of plague outbreaks in the 1800s and early 1900s.

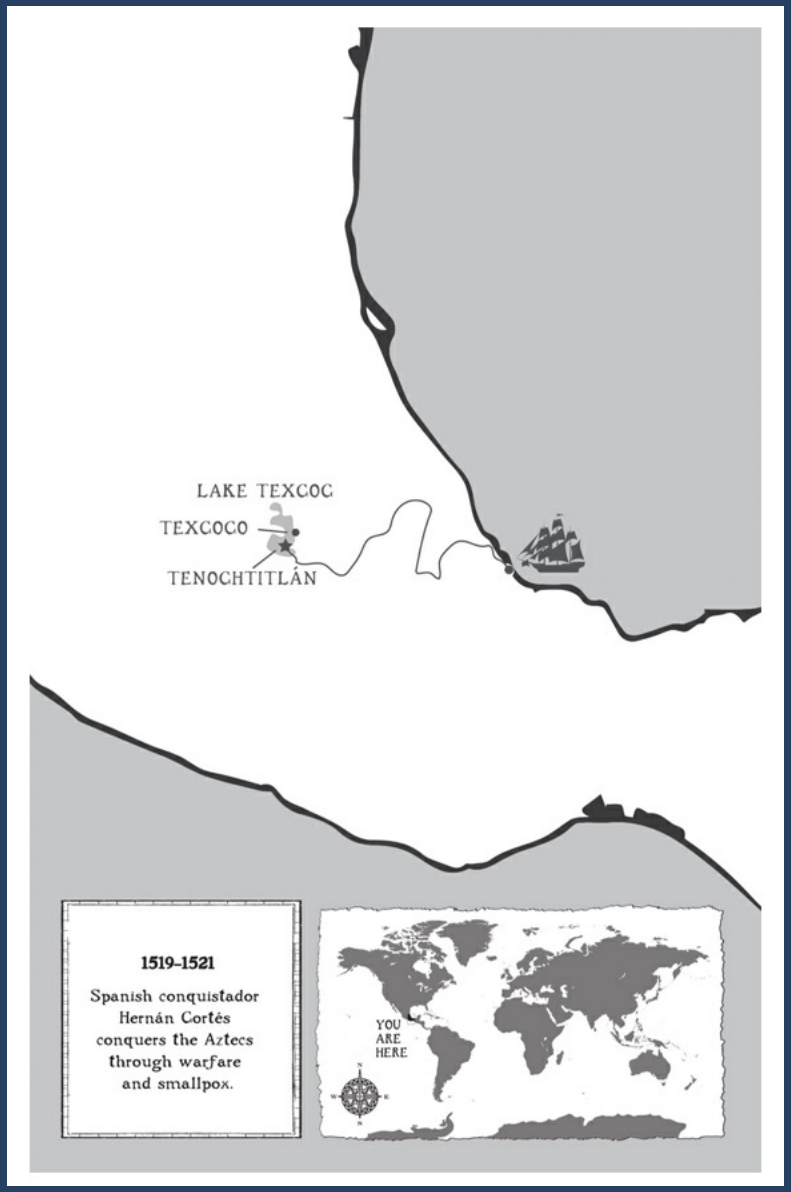
Encyclopaedia Britannica, Inc.

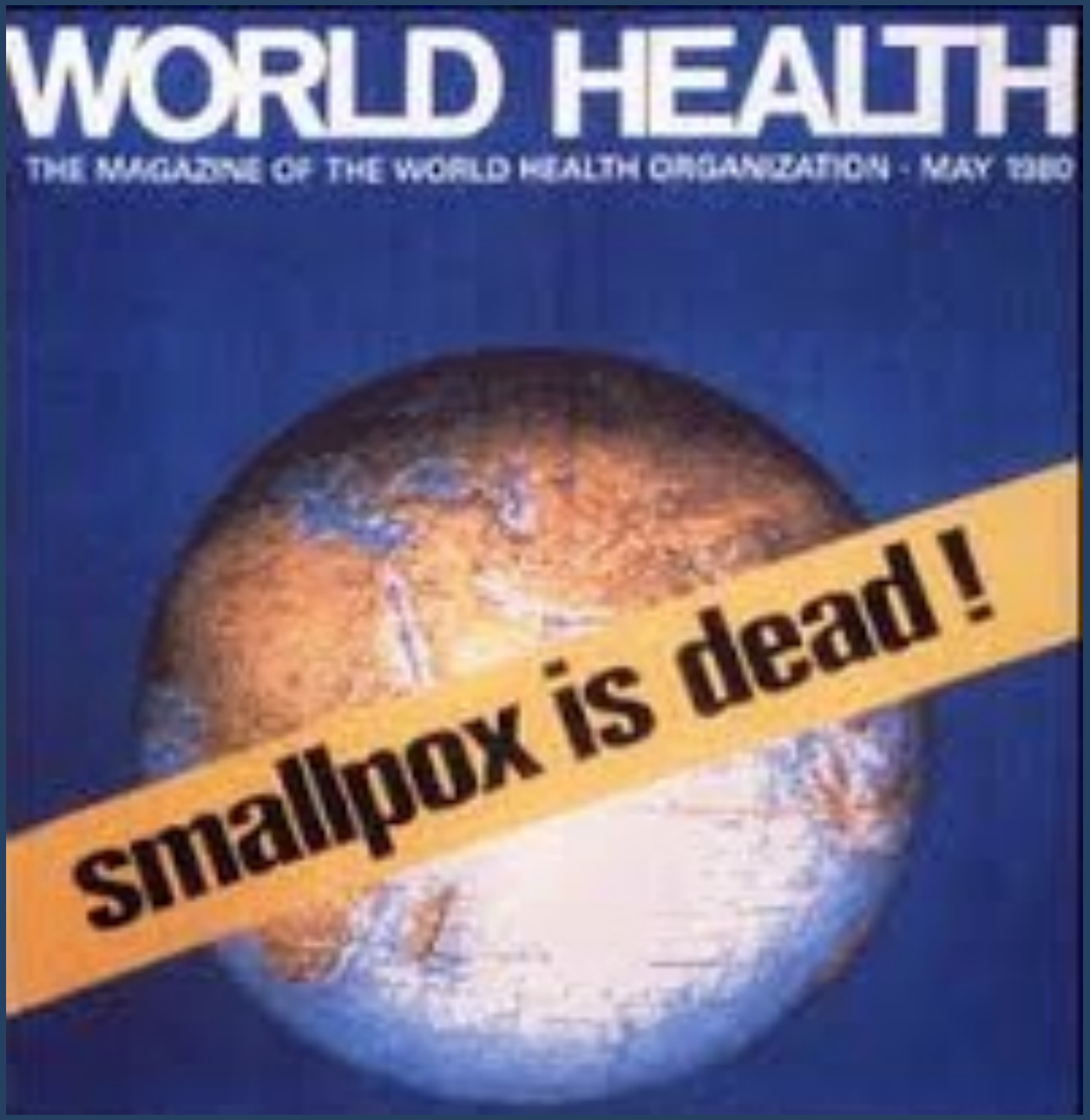

BLACK DEATH: COUNTRIES THAT STILL HAVE THE PLAGUE
Outbreaks in 2017
Madagascar
Outbreaks in the 21st century
Peru
China
Congo
Algeria
Malawi
Where plague exists as an animal disease
Western USA
Bolivia
Brazil
Lybia
Saudi Arabia
Russia
Kazakhstan
Uzbekistan
Turkmenistan
Mongolia
Burma

2. Smallpox


SMALLPOX ORIGIN
NORTHEAST AFRICA
c. 10,000 BC
Smallpox is believed to have first appeared with early agricultural settlements
SWEDEN
1902
Ronald Ross is awarded the Nobel Prize in Physiology or Medicine for discovering malarial parasites in mosquitoes
RUSSIA
1614
Incidents of major smallpox outbreaks stretch from Europe all the way to Siberia
SIBERIA
2009
One of two remaining stocks of smallpox is held under lock and key to prevent possible use as biological weapon
U.S.
1951
DDT eradicates malaria in the United States
ITALY
c. 60 BC
Pompey's troops return from Syria with new territory and leprosy
ROMANIA
2005
Last remaining leper colony in Europe
WESTERN HEMISPHERE
1507
Spanish conquistadors bring smallpox to the Americas
ATLANTA
2009
One of two remaining stocks of smallpox is held under lock and key to prevent possible use as biological weapon
ASIA MINOR
1350 BC
First recorded smallpox epidemic destroys Hittite army
LOUISIANA
1941
First effective leprosy drug developed
CHINA
c. 400 BC
Trade with India facilitates leprosy's spread through Southeast Asia
EUROPE
c. 1200
Erroneously thought to be highly contagious, lepers are isolated from society at large in nearly 19,000 leper colonies
MIDDLE EAST and EASTERN MEDITERRANEAN
c. 327 BC
Returning from India, Alexander the Great's army is said to introduce leprosy to the West
CHINA
340
Earliest written account of using the plant qing-hao for treatment of malarial fever
EGYPT
1570 BC
Skin lesions resembling smallpox found on mummies
MEXICO
1520
African slaves spread smallpox to North American mainland
NORTH AMERICA
18th century
European colonists introduce leprosy
INDIA
c. 1870
Schweppes tonic of carbonated quinine gains popularity among British colonists for preventing contraction of malaria
EQUATOR
CARIBBEAN ISLANDS and SOUTH AMERICA
18th century
Leprosy crosses Atlantic Ocean with West African slaves
WEST AFRICA
c. 1700
European and North African explorers, traders, and colonialists spread leprosy
SOMALIA
1977
Last known naturally contracted case of smallpox is identified
INDIA
c. 1500 BC
Egyptian merchants arrive bearing smallpox
PERU
1630
Medicinal bark used by Incas is adopted by Jesuits for treatment of malaria
INDIA
c. 2000 BC
Oldest documented skeletal evidence of leprosy
AFRICA
2009
A child dies of malaria every thirty seconds
MALARIA EARLIEST EVIDENCE
DOMINICAN REPUBLIC
30,000,000 BC
Malaria plasmodium is traced to a mosquito found in a piece of amber
LEPROSY ORIGIN
EAST AFRICA
c. 40,000 BC
Likely point




LAKE TEXCOC
TEXCOCO
TENOCHTITLÁN
1519–1521
Spanish conquistador Hernán Cortés conquers the Aztecs through warfare and smallpox.
YOU ARE HERE


WORLD HEALTH
THE MAGAZINE OF THE WORLD HEALTH ORGANIZATION - MAY 1980
smallpox is dead!

نحن أعضاء اللجنة العالمية للإشهاد الرسمى باستئصال الجدرى نشهد بأنه قد تم إستئصال الجدرى من العالم.

WE, THE MEMBERS OF THE GLOBAL COMMISSION FOR THE CERTIFICATION OF SMALLPOX ERADICATION, CERTIFY THAT SMALLPOX HAS BEEN ERADICATED FROM THE WORLD.

NOUS, MEMBRES DE LA COMMISSION MONDIALE POUR LA CERTIFICATION DE L'ÉRADICATION DE LA VARIOLE, CERTIFIONS QUE L'ÉRADICATION DE LA VARIOLE A ÉTÉ RÉALISÉE DANS LE MONDE ENTIER.

我们，全球扑灭天花证实委员会委员，证实扑灭天花已经在全世界实现。

МЫ, ЧЛЕНЫ ГЛОБАЛЬНОЙ КОМИССИИ ПО СЕРТИФИКАЦИИ ЛИКВИДАЦИИ ОСПЫ, НАСТОЯЩИМ ПОДТВЕРЖДАЕМ, ЧТО ОСПЫ В МИРЕ БОЛЬШЕ НЕТ.

NOSOTROS, MIEMBROS DE LA COMISION MUNDIAL PARA LA CERTIFICACION DE LA ERRADICACION DE LA VIRUELA, CERTIFICAMOS QUE LA VIRUELA HA SIDO ERRADICADA EN TODO EL MUNDO.

Frank Fenner

Keith Dumbell

Robert Kelle

Donald A. Henderson

Michał Lodyński

R. N. Basu

С. Марейникова

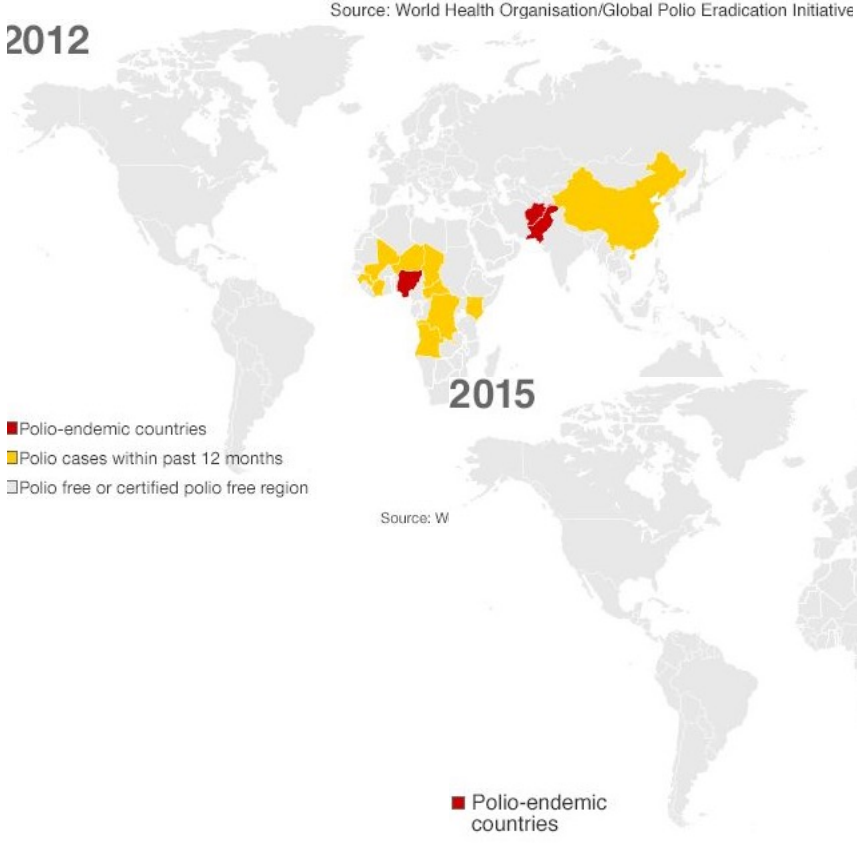
Genève, le 9 décembre 1979

Polio

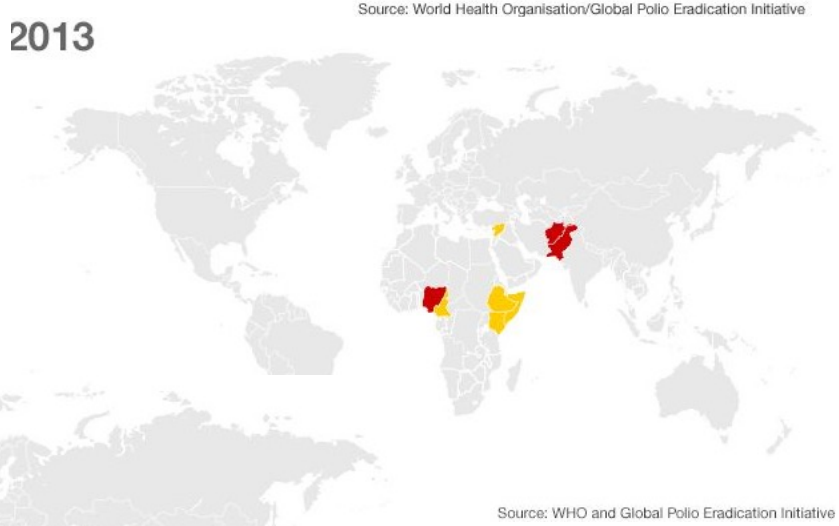
The history of polio

Source: World Health Organisation/Global Polio Eradication Initiative

Source: World Health Organisation/Global Polio Eradication Initiative



Source: W



Source: WHO and Global Polio Eradication Initiative

Source: World Health Organisation/Global Polio Eradication Initiative

TB

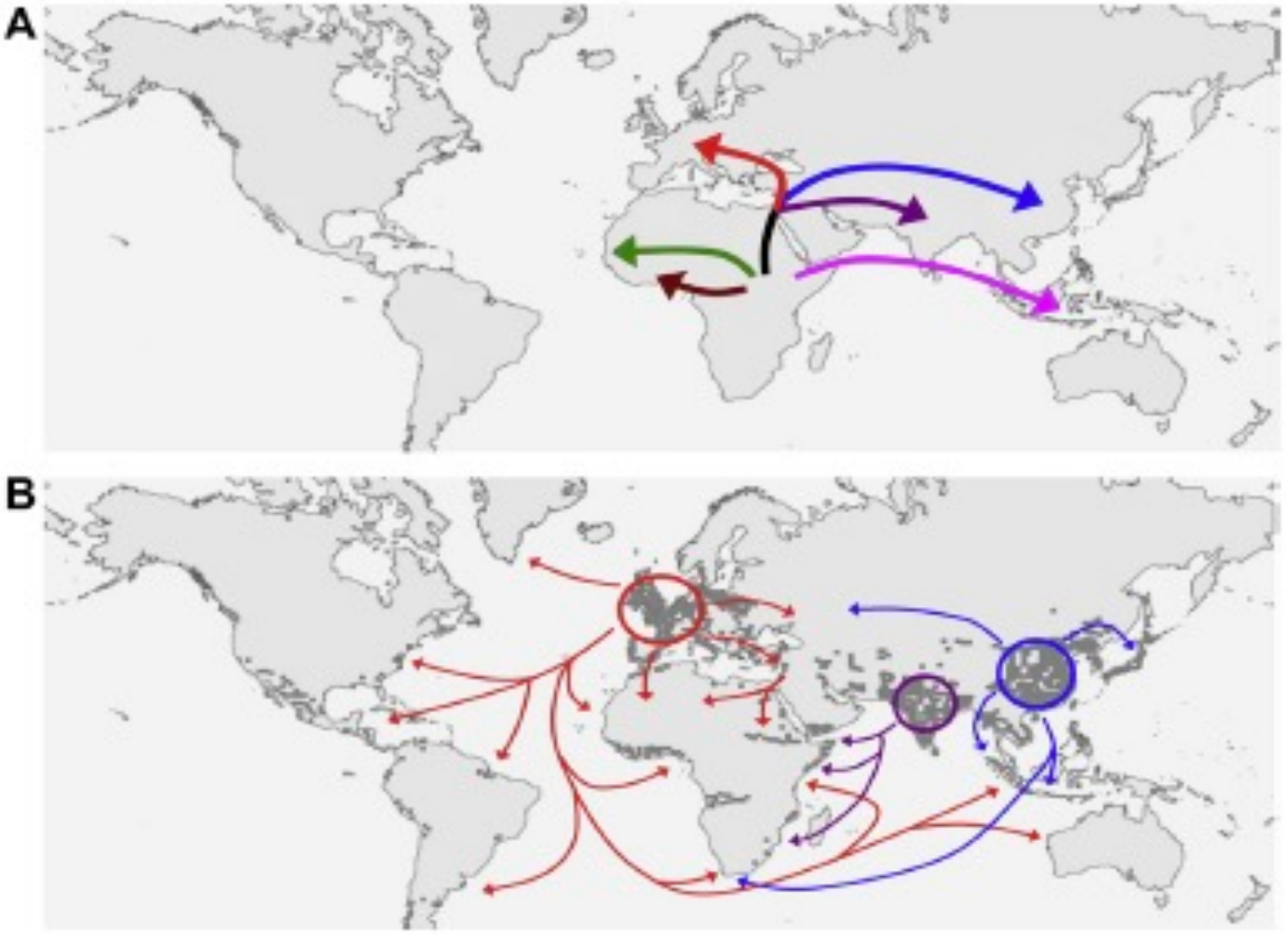
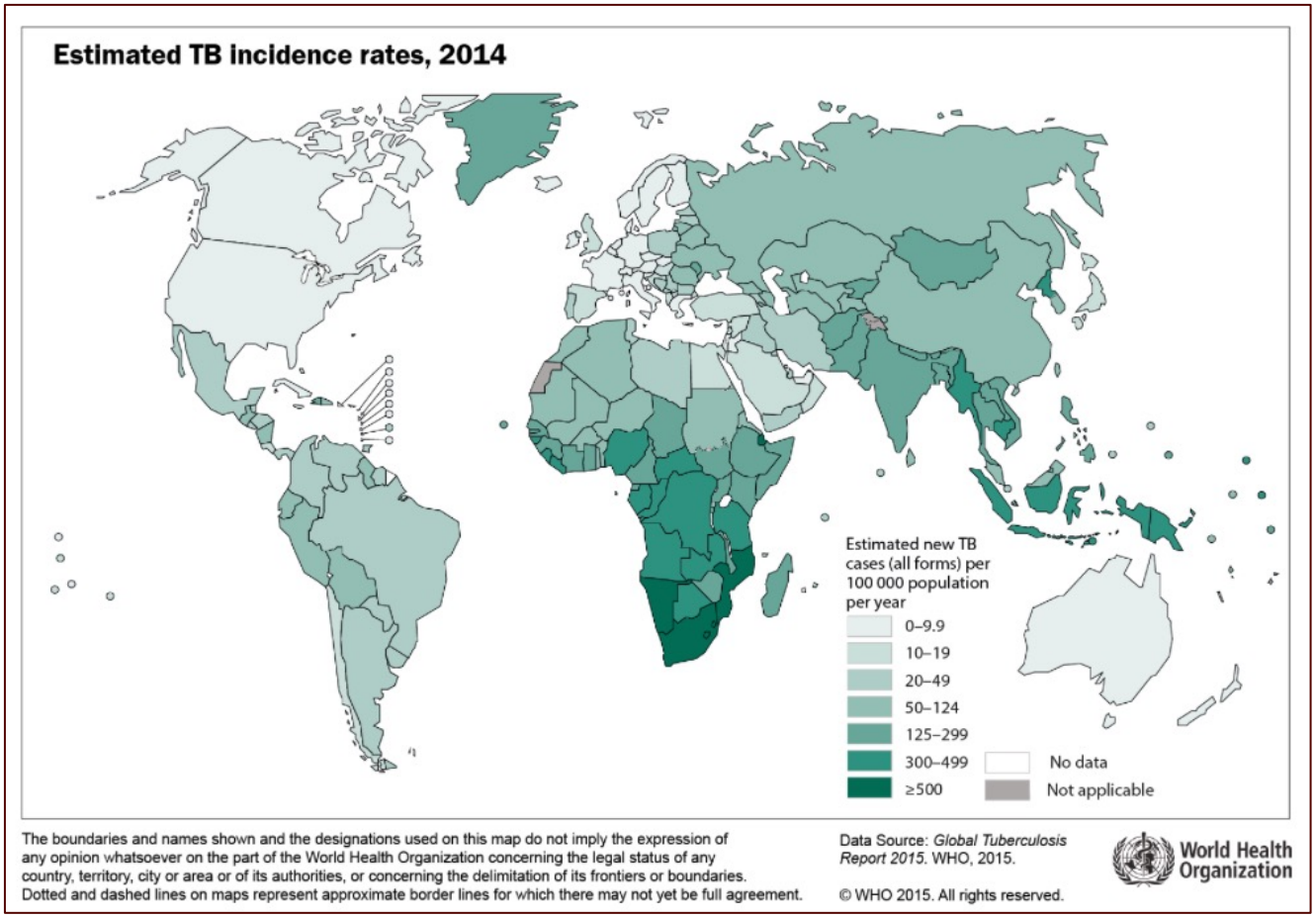
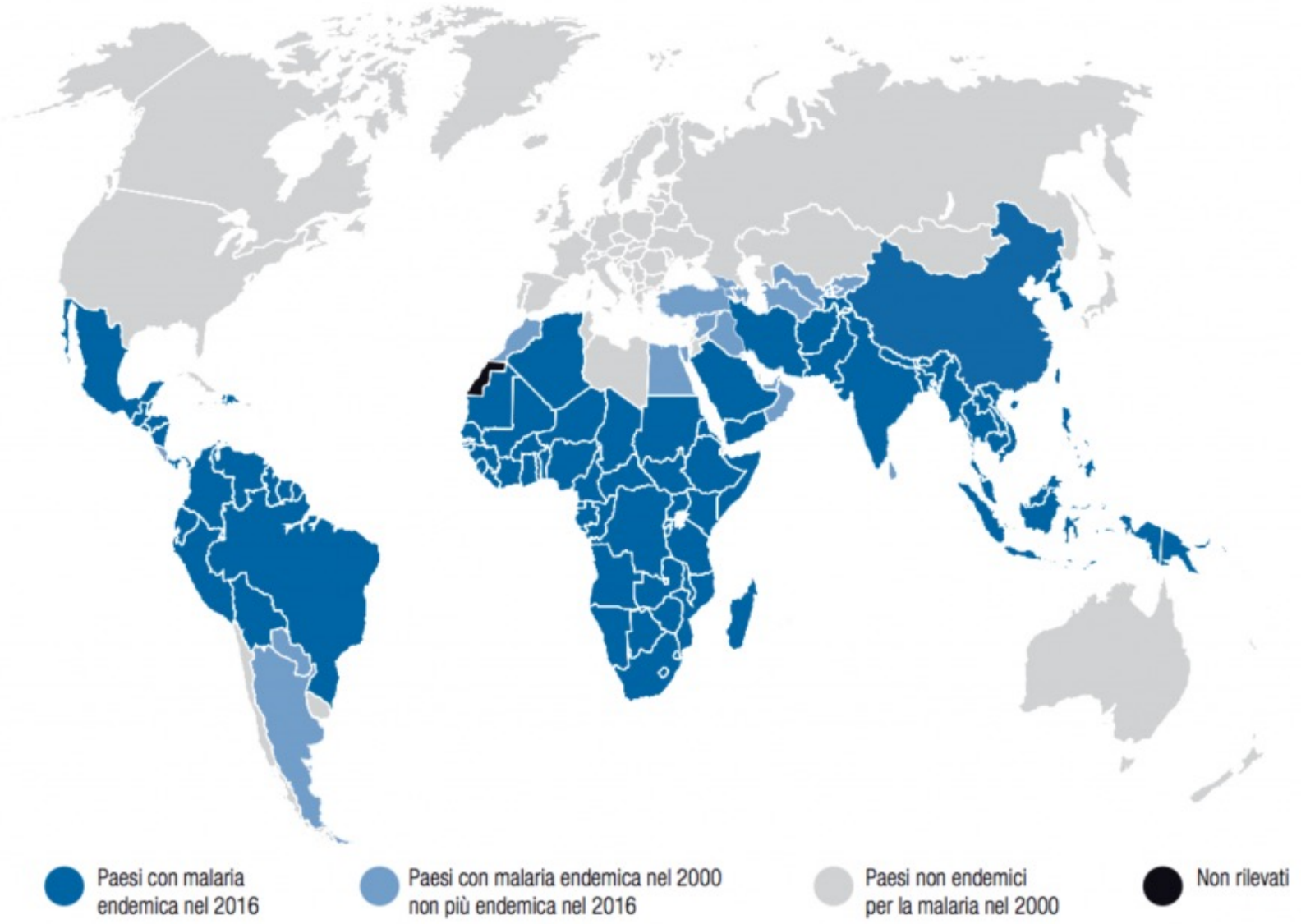


Fig. 1. Out-of-and-back-to-Africa. The evolutionary history of the out and back of TB to East Africa. MTBC originated in East Africa and some lineages accompanied the out and back Africa migrations of modern humans. The evolutionary modern MTBC lineages spread, and expanded with increases in human populations throughout the global regions (each *dark gray dot* corresponds to 1 million people) via exploration, trade, and conquest. In (*A*) the 3 colors represent the three evolutionary lineages. (*From* Hershberg R, Lipatov M, Small PM, et al. High functional diversity in *Mycobacterium tuberculosis* driven by genetic drift and human demography. PLoS Biol 2008;6(12):e311; with permission.)


Estimated TB incidence rates, 2014
Estimated new TB cases (all forms) per 100 000 population per year
0–9.9
10–19
20–49
50–124
125–299
300–499
≥500
No data
Not applicable
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.
Data Source: Global Tuberculosis Report 2015. WHO, 2015.
© WHO 2015. All rights reserved.
World Health Organization

MALARIA

Figura 1. Paesi a endemia malarica: confronto anni 2000-2016. Fonte: WHO, 2016.



Cholera

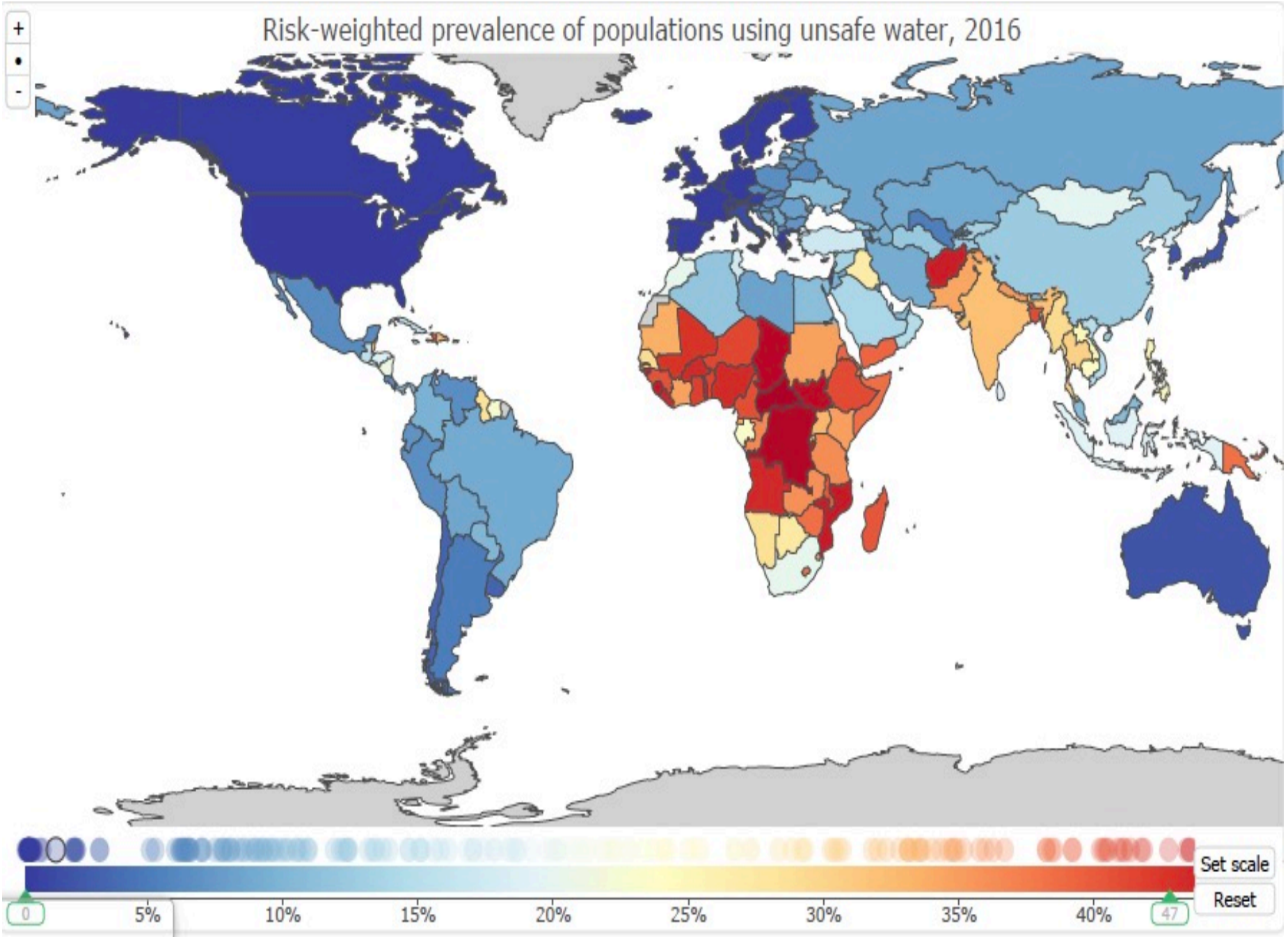
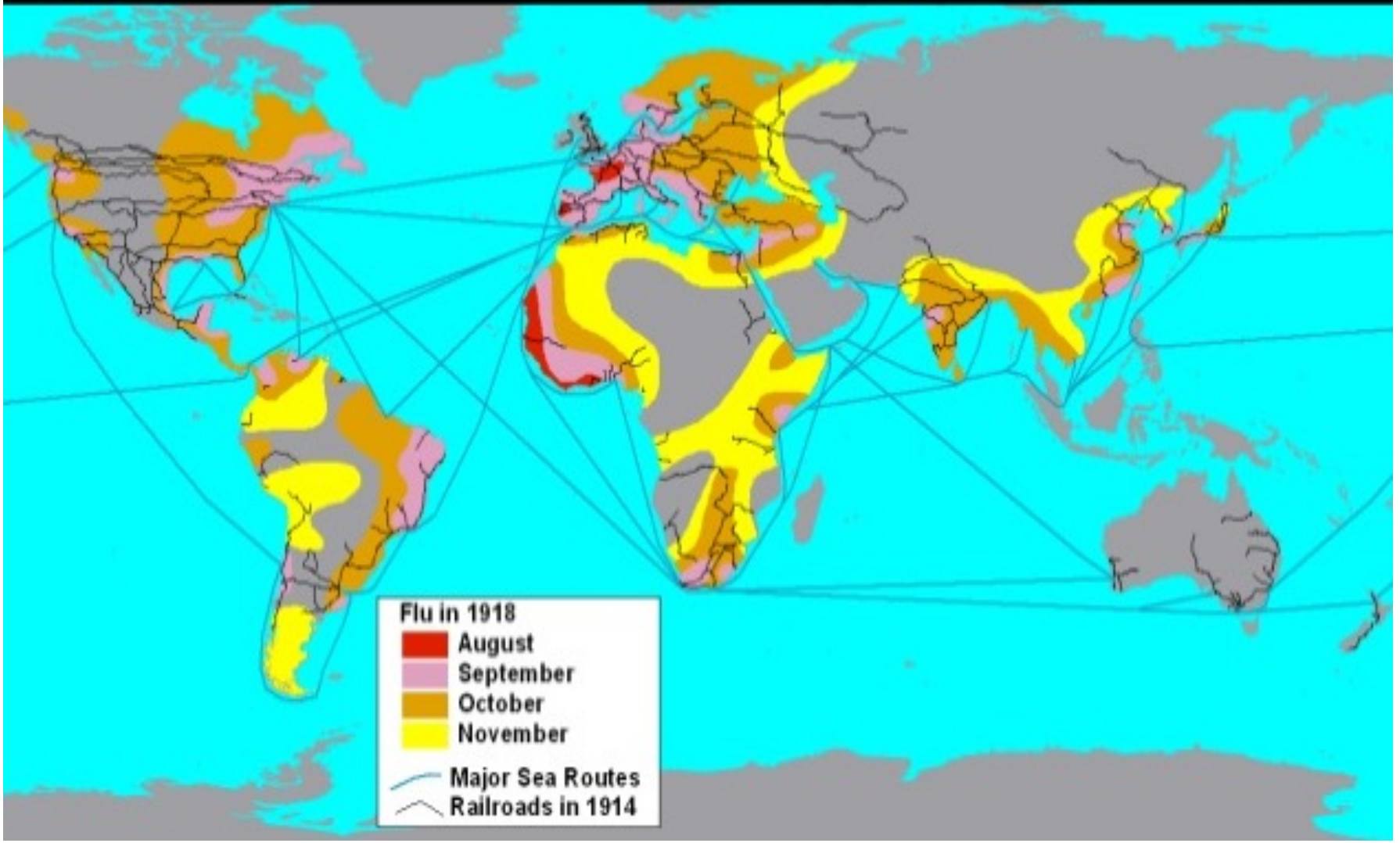

Risk-weighted prevalence of populations using unsafe water, 2016
+
•
-
0
5%
10%
15%
20%
25%
30%
35%
40%
47
Set scale
Reset

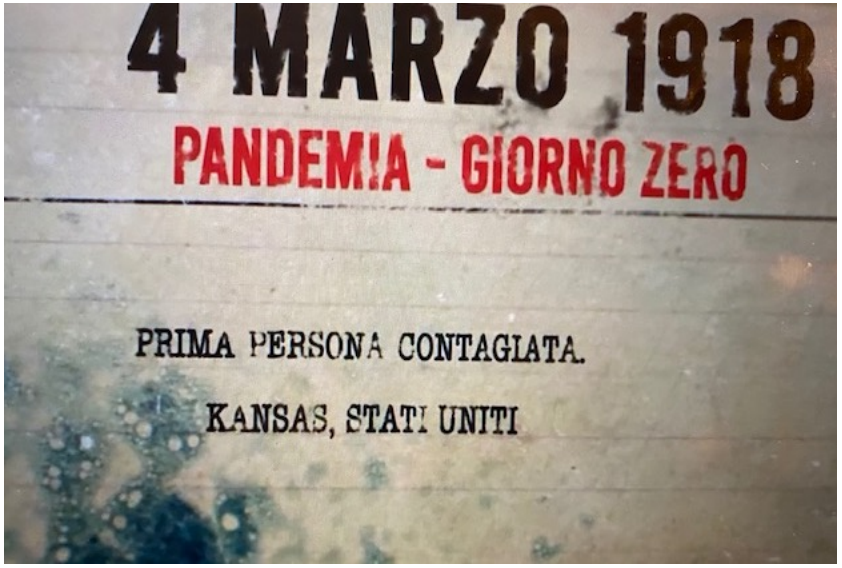
Fig. 3.4
Countries reporting cholera deaths and imported cases, 2016

Flu

the prototype of modern pandemics

Flu Pandemic of 1918

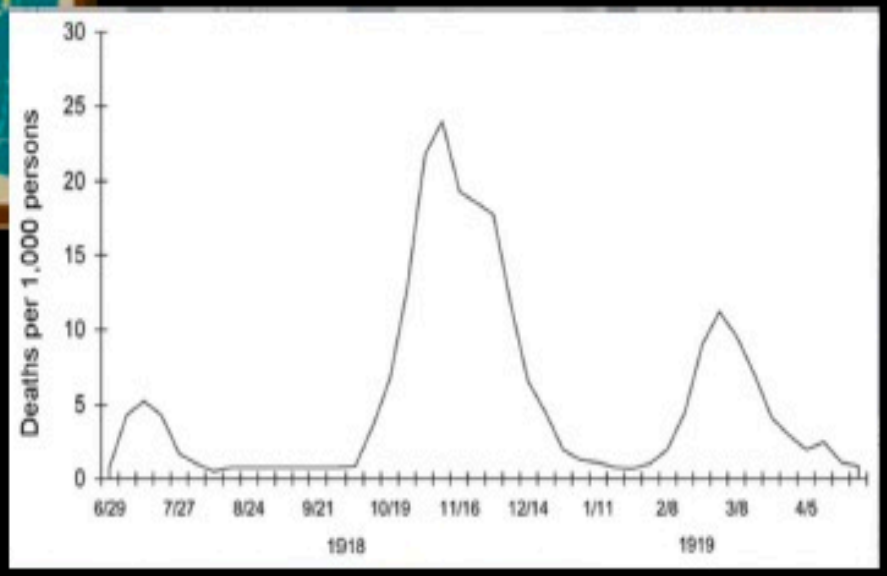


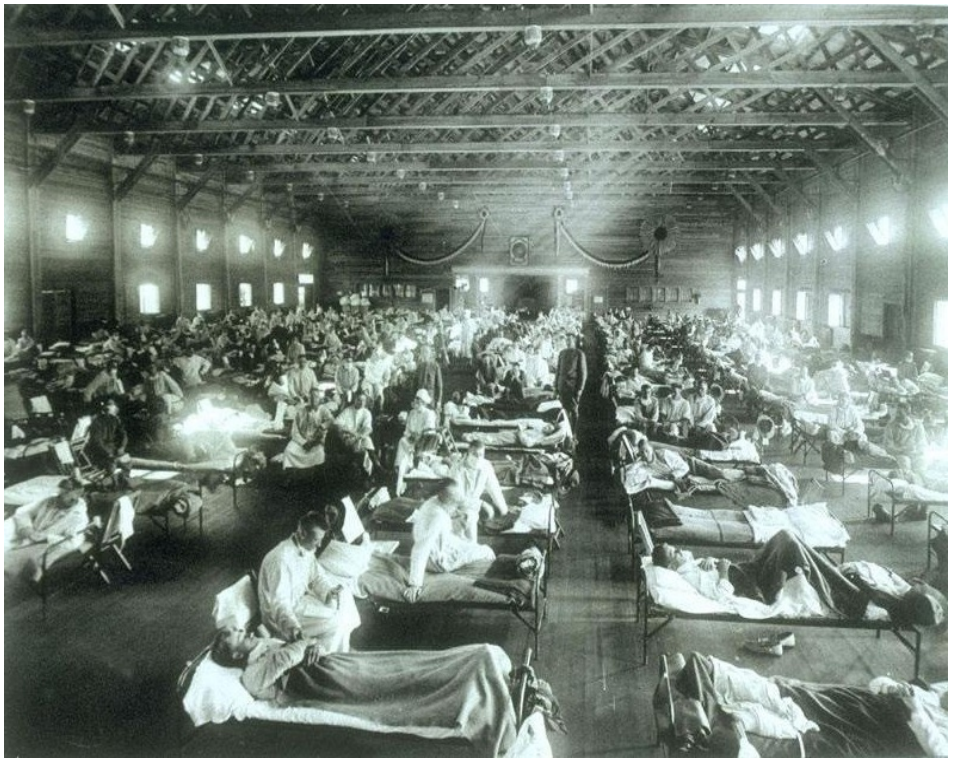

4 MARZO 1918
PANDEMIA - GIORNO ZERO
PRIMA PERSONA CONTAGIATA.
KANSAS, STATI UNITI


APRILE 1918
40° GIORNO DI PANDEMIA
CONTAGIATI: 20 MILIONI
MORTI: 20.000


LUGLIO 1919
500° GIORNO DI PANDEMIA
BILANCIO GLOBALE DELLE VITTIME:
FINO A 100 MILIONI

The Spanish Flu came in Three Waves



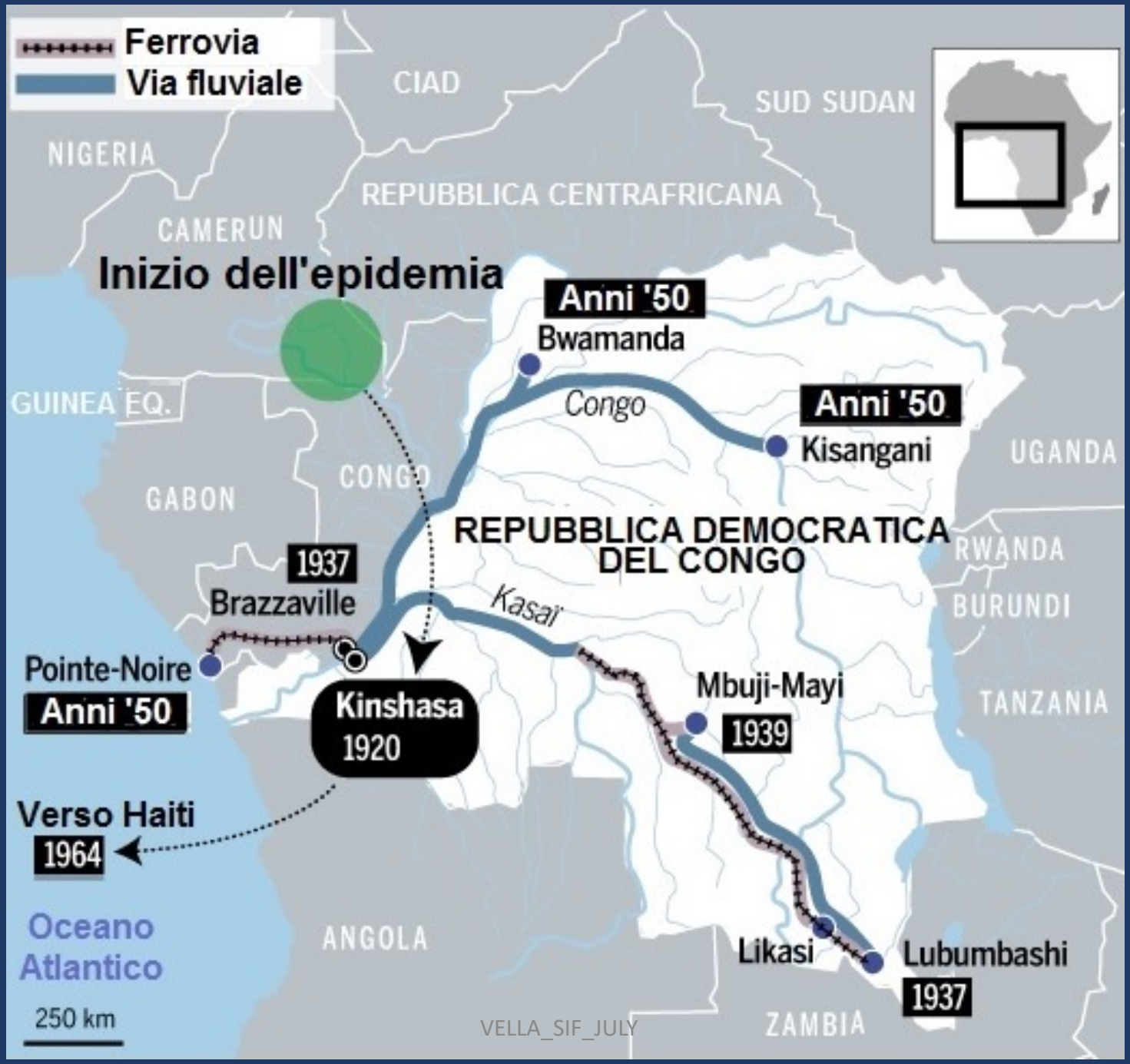


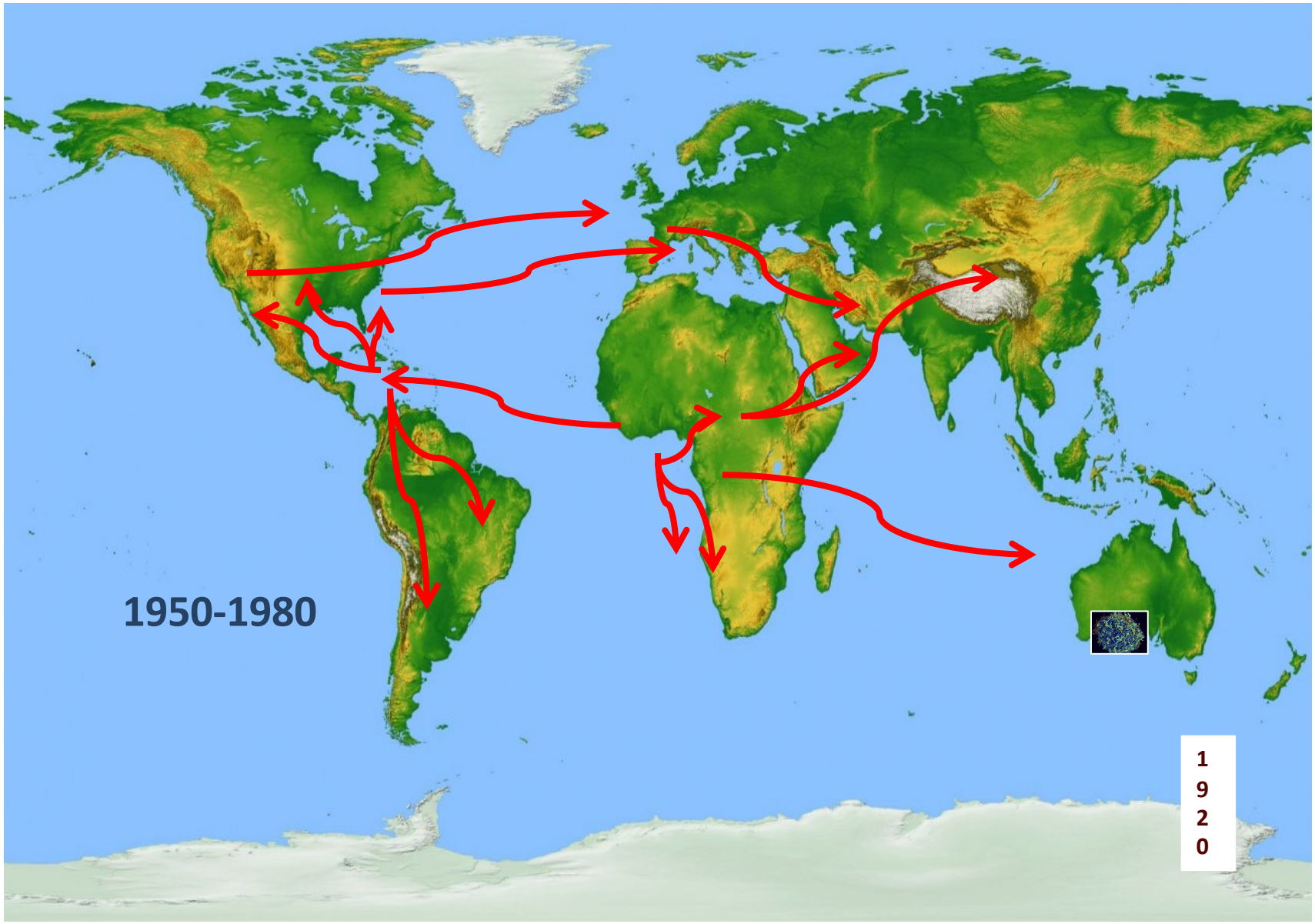
Flu Pandemics in the 20th Century

- 1918 Spanish Flu (H1N1)
- 1947 (a "pseudopandemic", primarily on military bases)
- 1957 Asian Flu (H2N2)
- 1968 Hong Kong Flu (H3N2)
- 1976 Swine Flu (H1N1) (Restricted to Fort Dix but led to panic vaccination of 43,000,000; later associated with Guillain-Barré syndrome)
- 1977 Russian ("Red") Flu (H1N1). Predominantly affected <25 year-olds. Unexplained reappearance of H1N1, absent in humans since 1957. Inadvertent release of biological weapon?
- 1997 Bird Flu (H5N1): particularly dangerous as there was some direct bird-to-human transmission and high mortality.

HIV/AIDS


1920


Ferrovia
Via fluviale
CIAD
SUD SUDAN
NIGERIA
REPUBBLICA CENTRAFRICANA
CAMERUN
Inizio dell'epidemia
Anni '50
Bwamanda
Congo
Anni '50
Kisangani
GUINEA EQ.
UGANDA
GABON
CONGO
REPUBBLICA DEMOCRATICA DEL CONGO
RWANDA
1937
Brazzaville
Kasai
BURUNDI
Pointe-Noire
Anni '50
Kinshasa
1920
Mbuji-Mayi
1939
TANZANIA
Verso Haiti
1964
Oceano Atlantico
ANGOLA
Likasi
Lubumbashi
1937
250 km
ZAMBIA


1950-1980
1920

Ebola

Ebola is back — and the top White House official in charge of pandemics is gone

There's a new outbreak in the Democratic Republic of the Congo.

By Julia Belluz | @juliaoftoronto | julia.belluz@voxmedia.com | May 11, 2018, 11:40am EDT

13, 2017, in Mumo, Democratic Republic of the Congo, during the country's last outbreak. The | AFP/Getty Images

_SIF_JULY

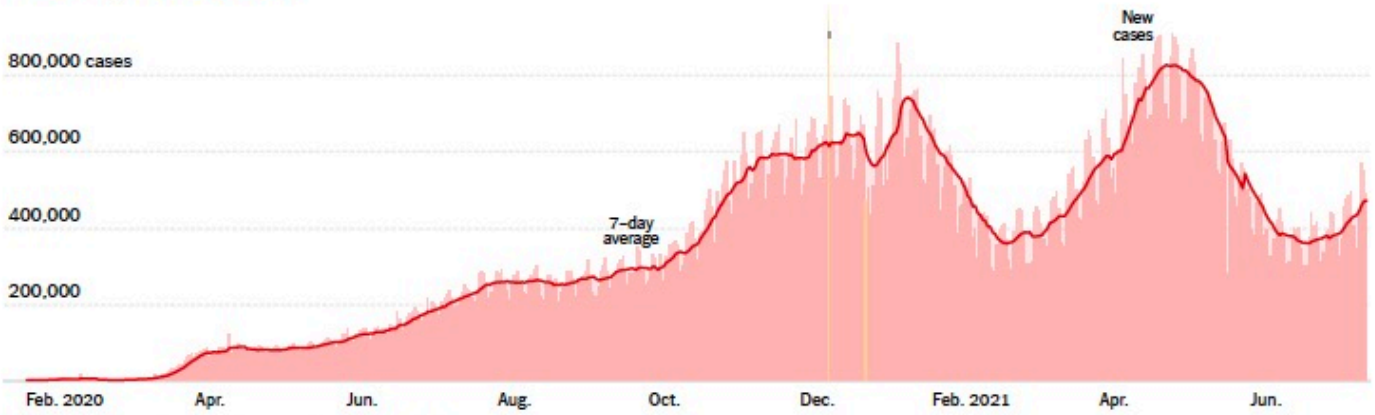
SarsCov2 / COVID

The New York Times | https://nyti.ms/2t6WE75

Coronavirus World Map: Tracking the Global Outbreak

Updated July 15, 2021

New reported cases



These are days with a reporting anomaly. Read more here.

	AVG. ON JUL. 15	14-DAY CHANGE	TOTAL REPORTED

Pandemics and Global Health

1. The pandemics in human history

2. The concept of Global Health

3. Covid 19: Was it predictable ? What went wrong ?

4. An example: the response to HIV pandemic

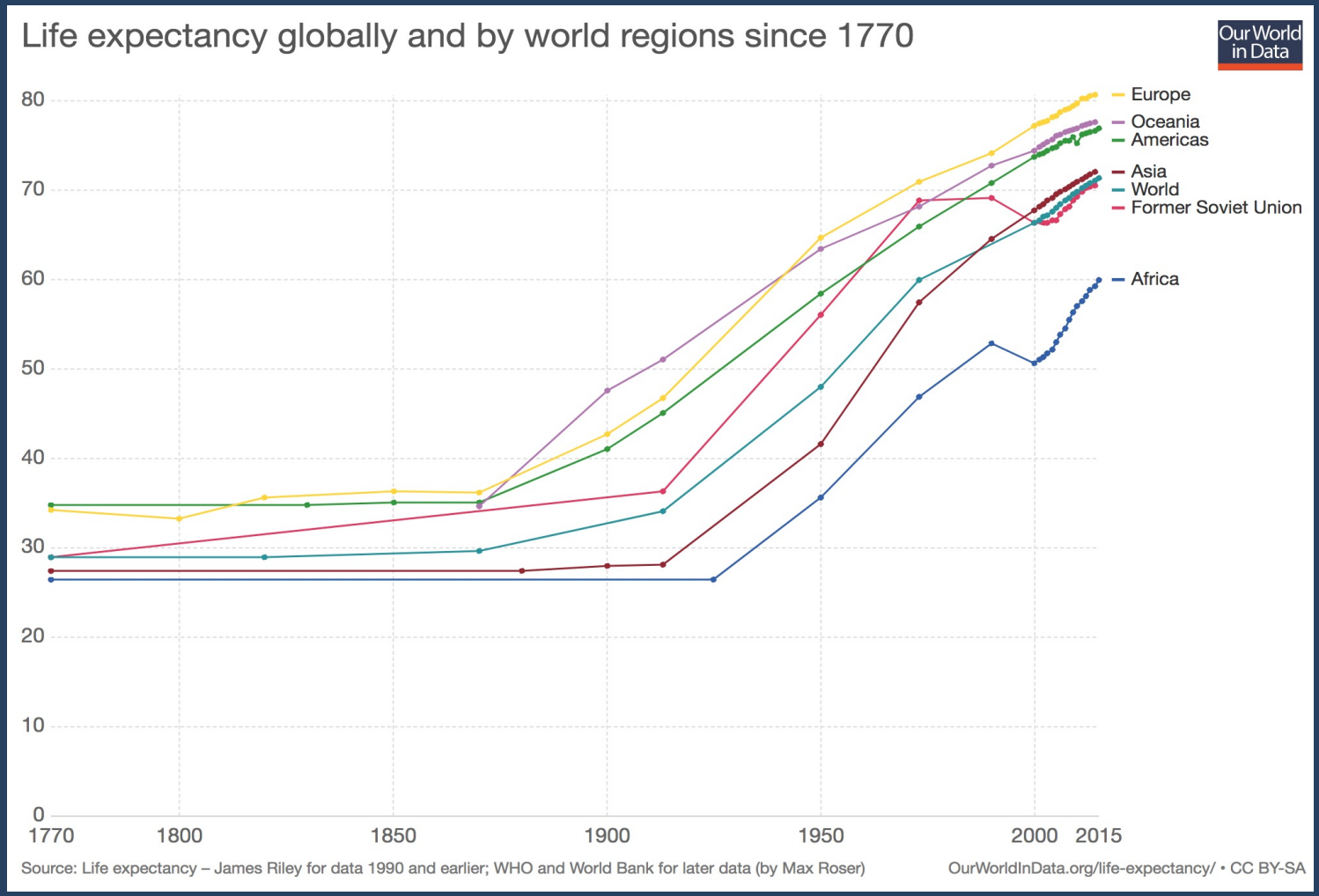
5. What to do: be prepared for the «next one»

What Global Health is not

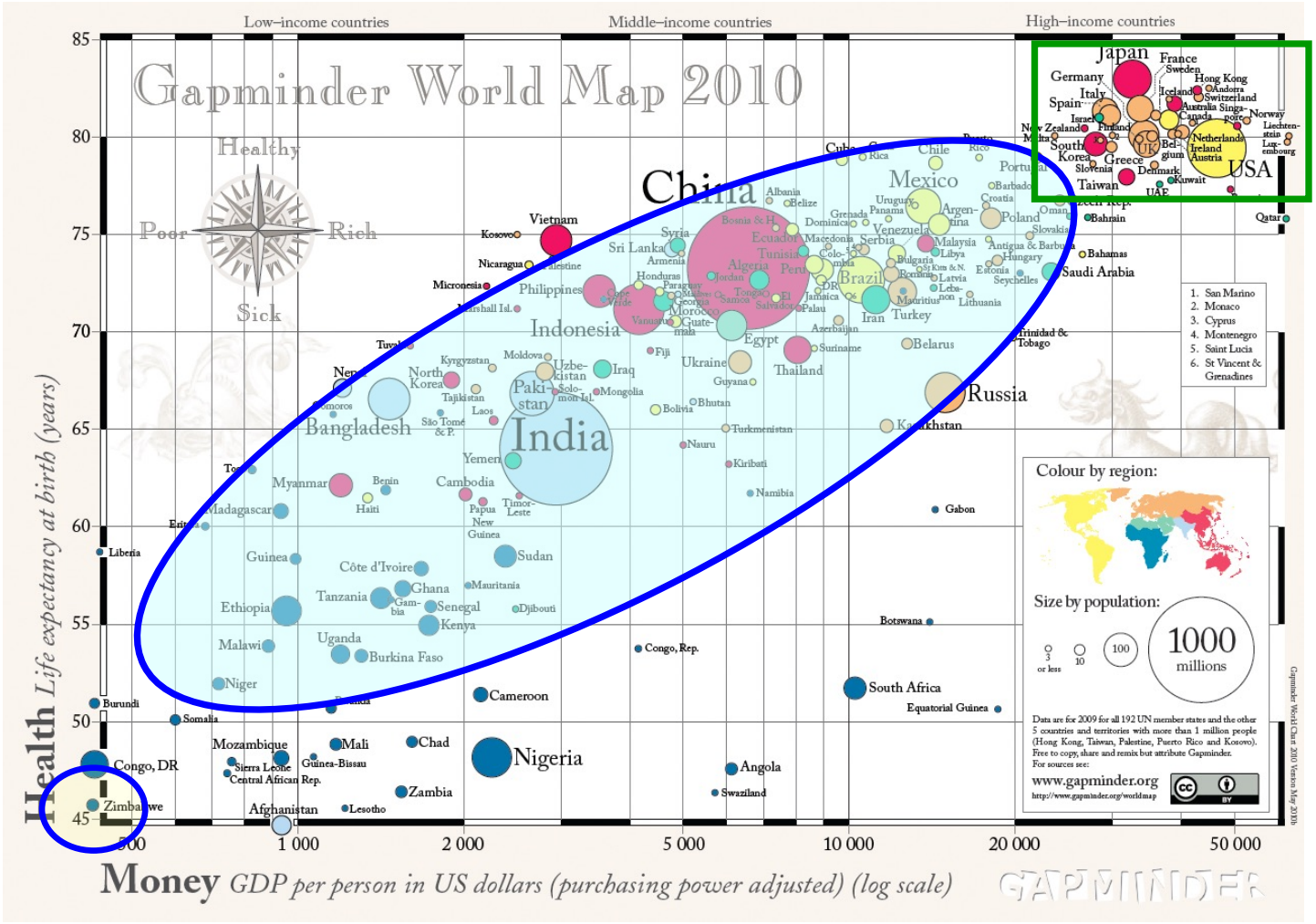
Millions die **prematurely** every year in developing countries for lack of adequate access to basic health care. **They die for causes that are very often preventable or treatable.**

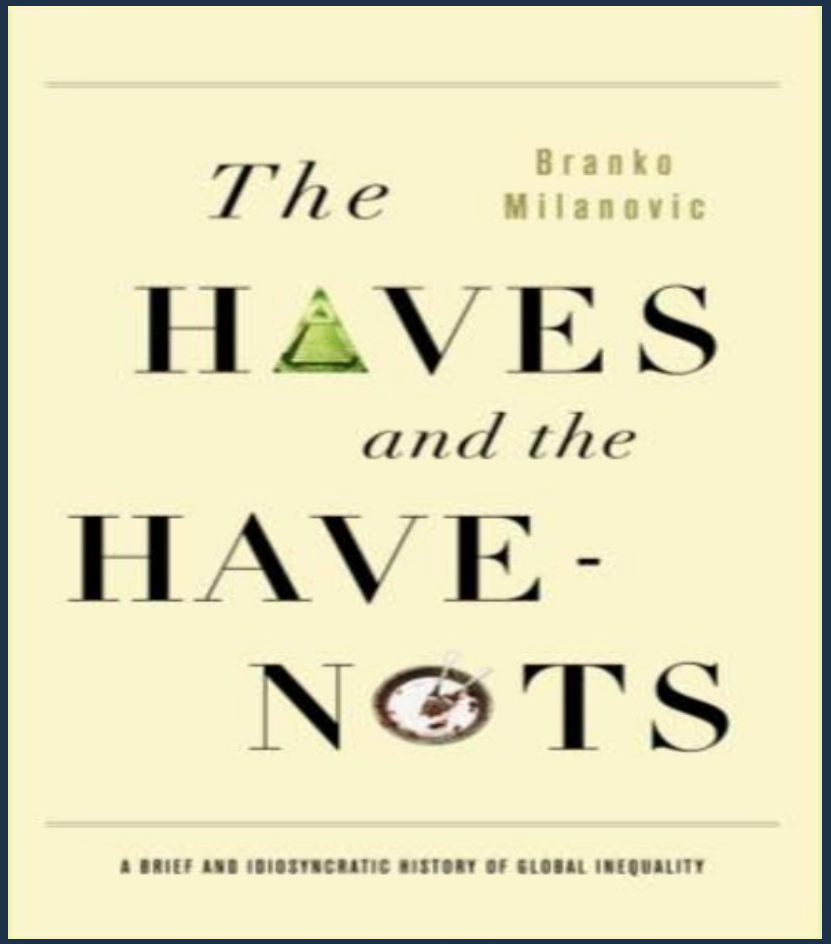
Despite the convergence on the concept of health as a human right, there still exist intolerable global inequalities in accessing health and health services and in terms of life expectancy and morbidity and mortality from **communicable and non-communicable diseases.**

The persistence of inequalities in terms of health - **not only between rich and poor countries, but also between different regions in the same country -** is also a contradiction to science, given the growing geographic interdependence of the **biomedical causes and of the social determinants of health and diseases**.



ma queste sono.....medie !!!

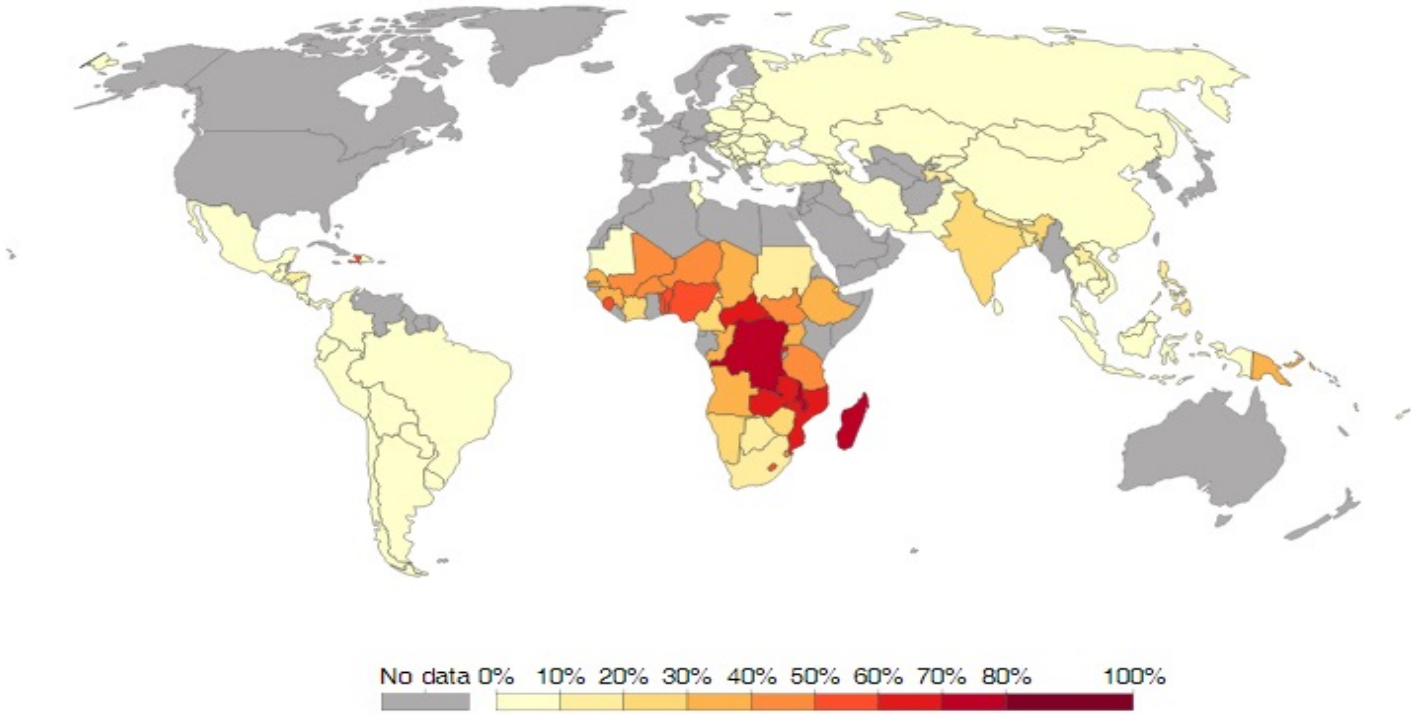

Low–income countries
Middle–income countries
High–income countries
Gapminder World Map 2010
Healthy
Poor
Rich
Sick
China
India
Indonesia
Brazil
Russia
Nigeria
USA
Japan
Health Life expectancy at birth (years)
Money GDP per person in US dollars (purchasing power adjusted) (log scale)
85
80
75
70
65
60
55
50
45
500
1 000
2 000
5 000
10 000
20 000
50 000
1. San Marino
2. Monaco
3. Cyprus
4. Montenegro
5. Saint Lucia
6. St Vincent & Grenadines
Colour by region:
Size by population:
3 or less
10
100
1000 millions
Data are for 2009 for all 192 UN member states and the other 5 countries and territories with more than 1 million people (Hong Kong, Taiwan, Palestine, Puerto Rico and Kosovo).
Free to copy, share and remix but attribute Gapminder.
For sources see:
www.gapminder.org
http://www.gapminder.org/worldmap
Gapminder World Chart 2010 Version May 2010b
GAPMINDER


Branko
Milanovic
The
HAVES
and the
HAVE-
NOTS
A BRIEF AND IDIOSYNCRATIC HISTORY OF GLOBAL INEQUALITY

Share of the population living in extreme poverty, 2014

Extreme poverty is defined as living with per capita household consumption below 1.90 international dollars per day (in 2011 PPP prices). International dollars are adjusted for inflation and for price differences across countries.

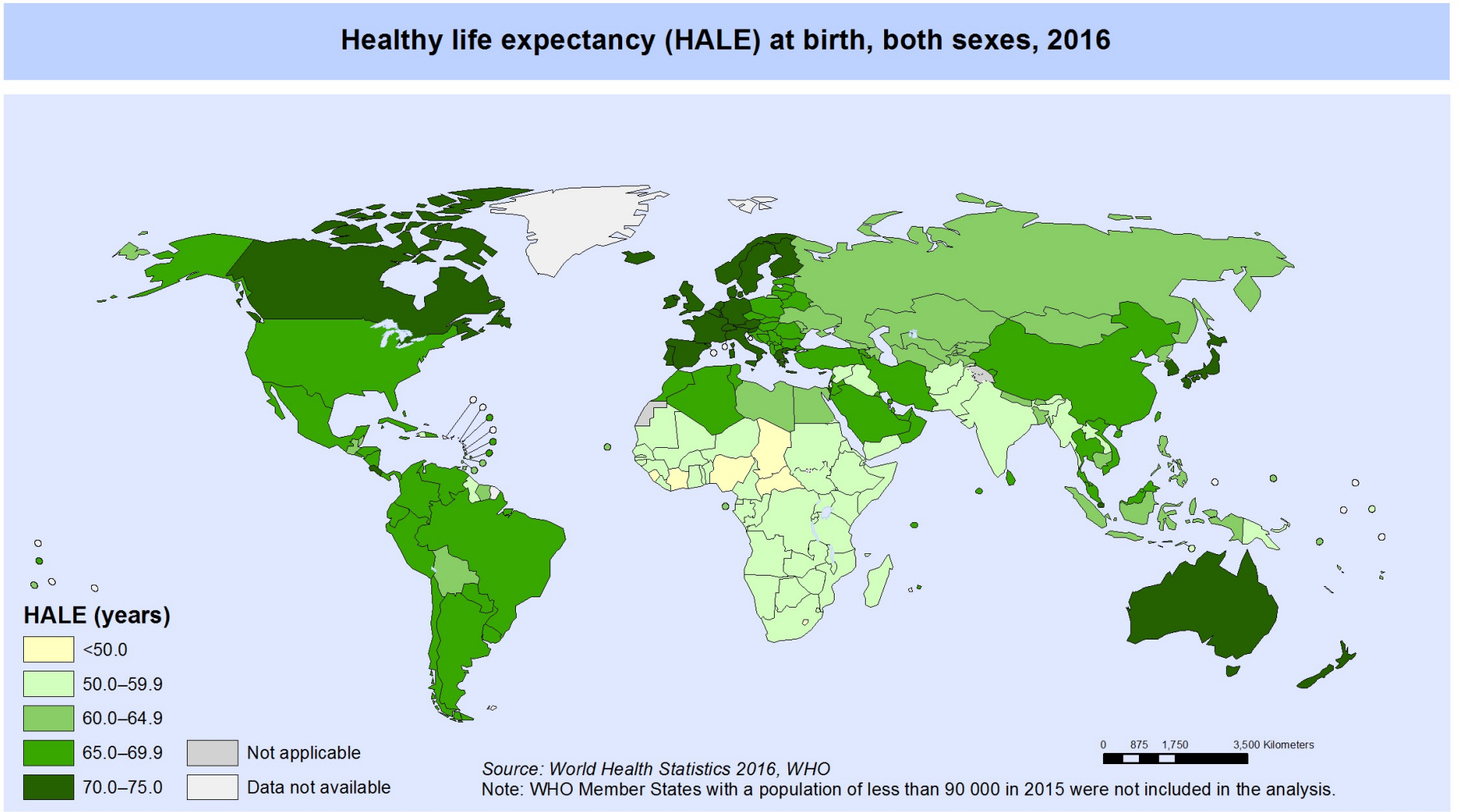
Our World in Data



Source: World Bank

OurWorldInData.org/extreme-poverty/ • CC BY-SA

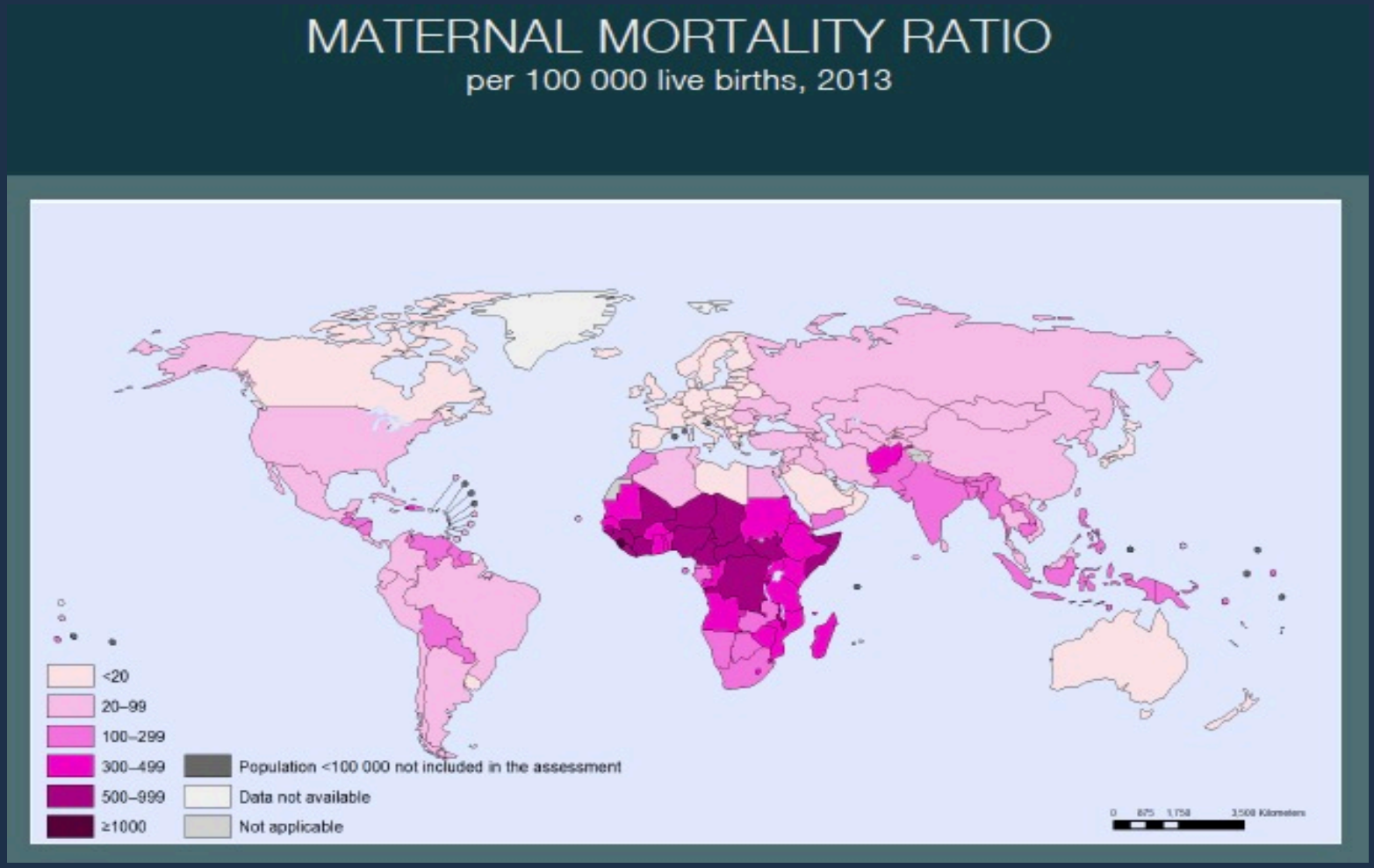
The unequal rise of «healthy» life expectancy



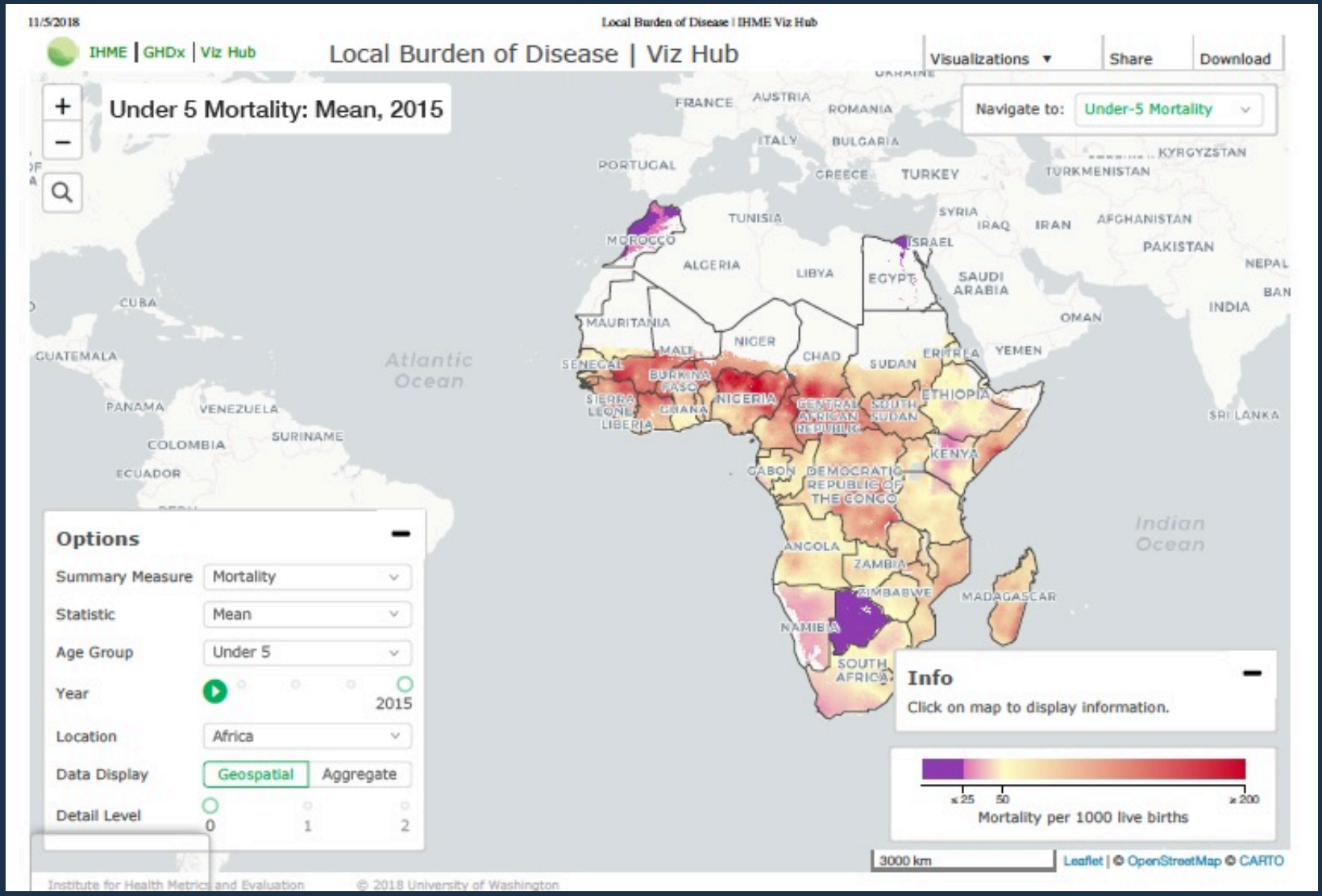
Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

World Health Organization

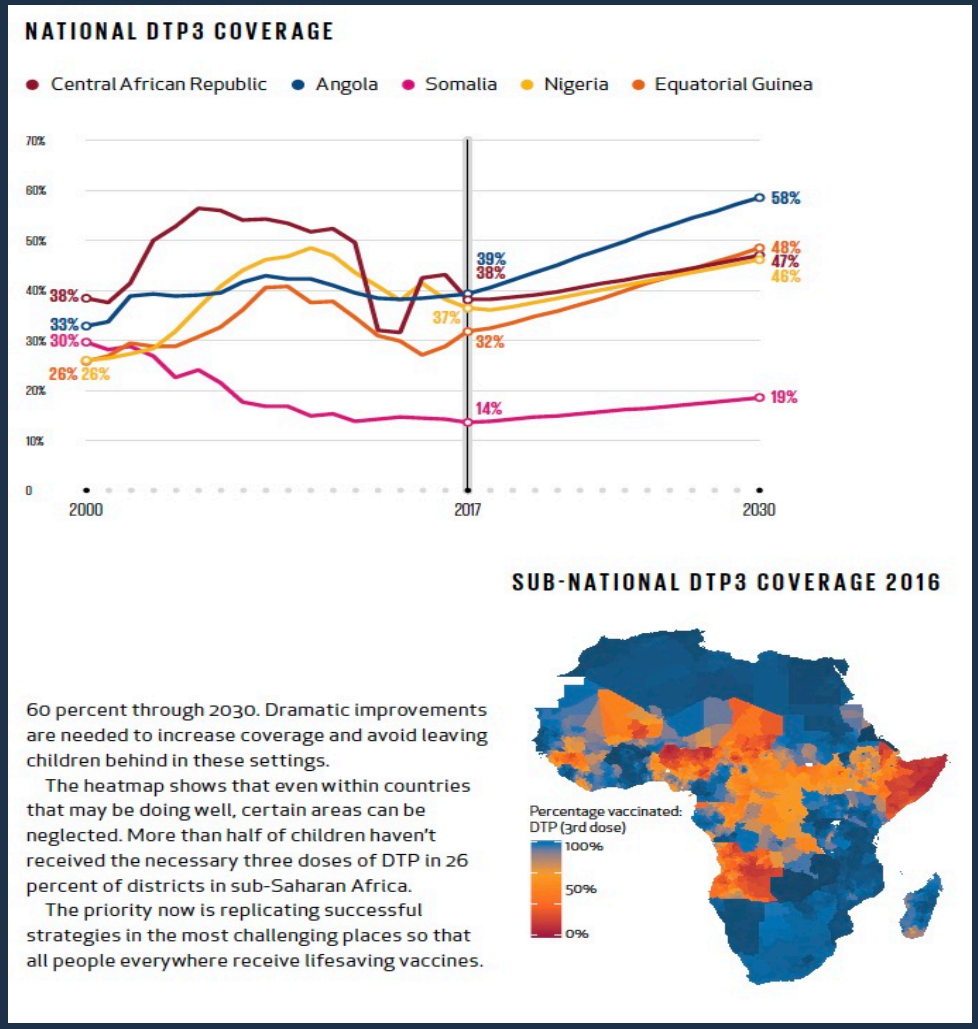
What Global Health is….not



What Global Health is….not



Poor vaccine coverage



60 percent through 2030. Dramatic improvements are needed to increase coverage and avoid leaving children behind in these settings.

The heatmap shows that even within countries that may be doing well, certain areas can be neglected. More than half of children haven't received the necessary three doses of DTP in 26 percent of districts in sub-Saharan Africa.

The priority now is replicating successful strategies in the most challenging places so that all people everywhere receive lifesaving vaccines.

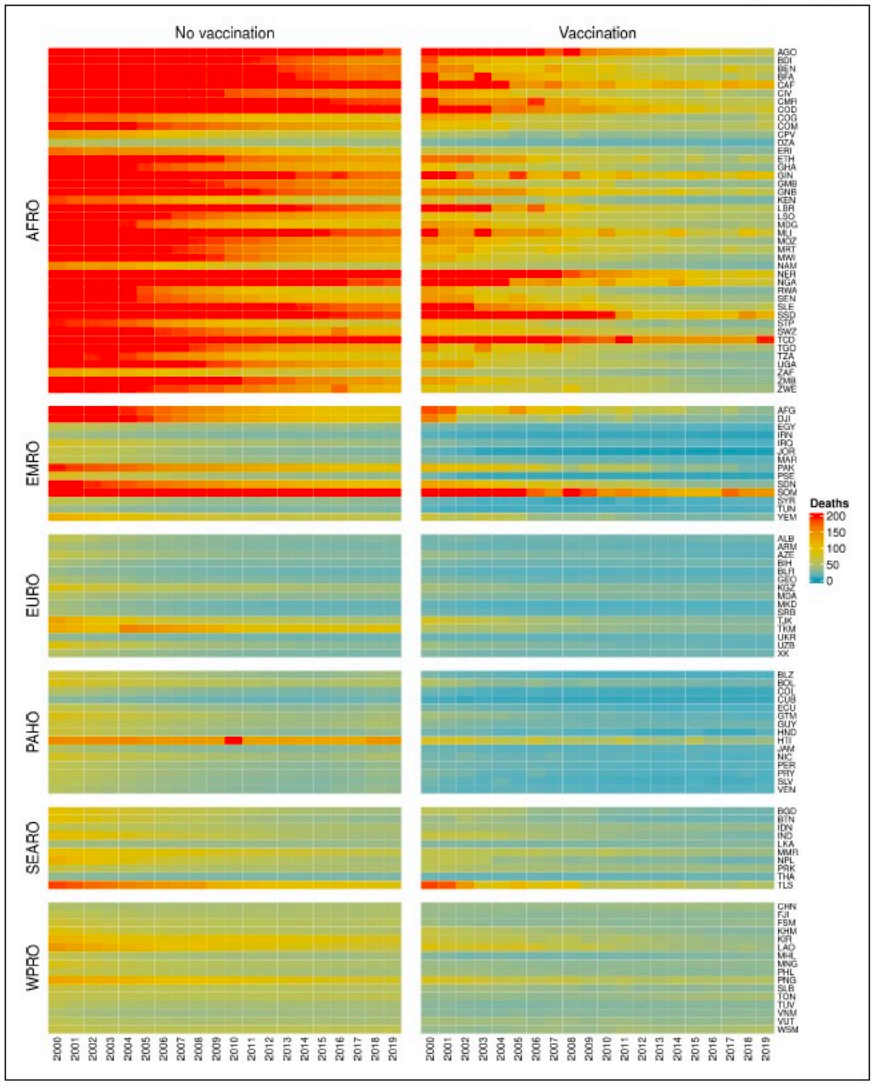


Figure 1. Mean predicted deaths due to the 10 Vaccine Impact Modelling Consortium (VIMC) pathogens per 100,000 population per country for years 2000–2019 under the no vaccination and with vaccination (routine immunisations; RI only) scenarios. Countries are arranged by World Health Organisation (WHO) African (AFRO), Eastern Mediterranean (EMRO), European (EURO), Pan American (PAHO), South-East Asian (SEARO), and Western Pacific (WPRO) regions. The difference (i.e. deaths averted) between these two scenarios are shown in ***Table 2*** and ***Figure 2***.

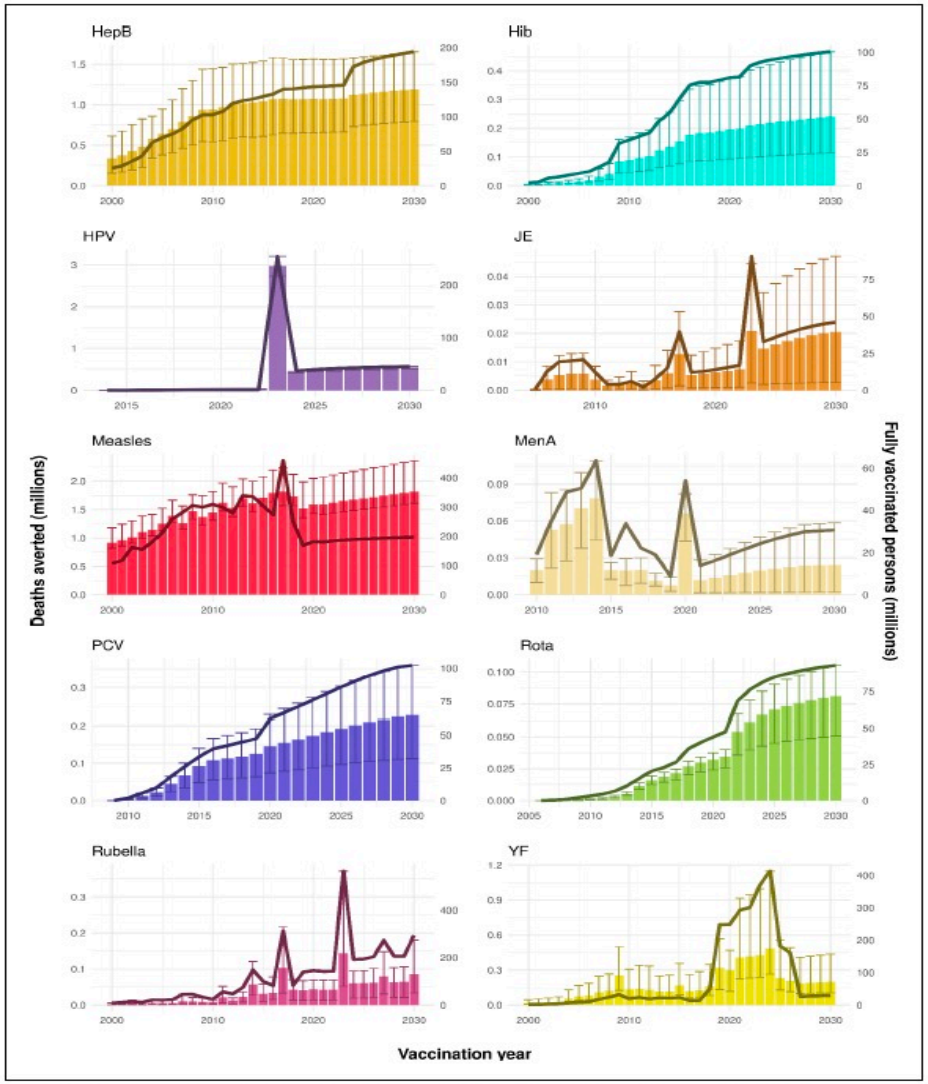


Figure 2. Deaths averted per year of vaccination for hepatitis B (HepB), *Haemophilus influenzae* type b (Hib), human papillomavirus (HPV), Japanese encephalitis (JE), measles, *Neisseria meningitidis* serogroup A (MenA), *Streptococcus pneumoniae* (PCV), rotavirus (Rota), rubella, and yellow fever (YF). The bars show the number of deaths averted (in millions) in each vaccination year. Error bars indicate 95% CI. The line shows the number of fully vaccinated persons (FVPs; in millions) achieved in each year's vaccination activities.

What Global Health is….not

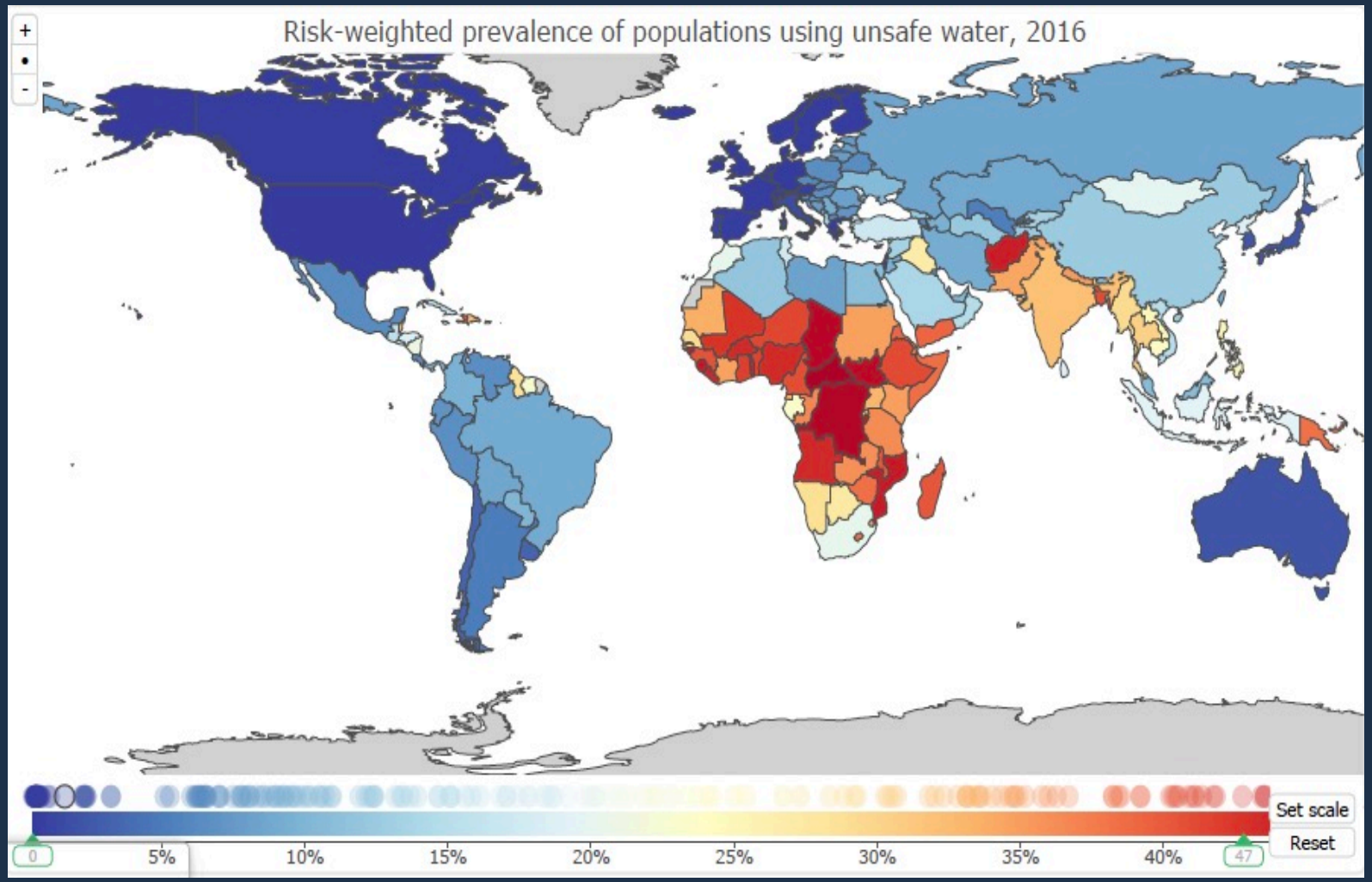
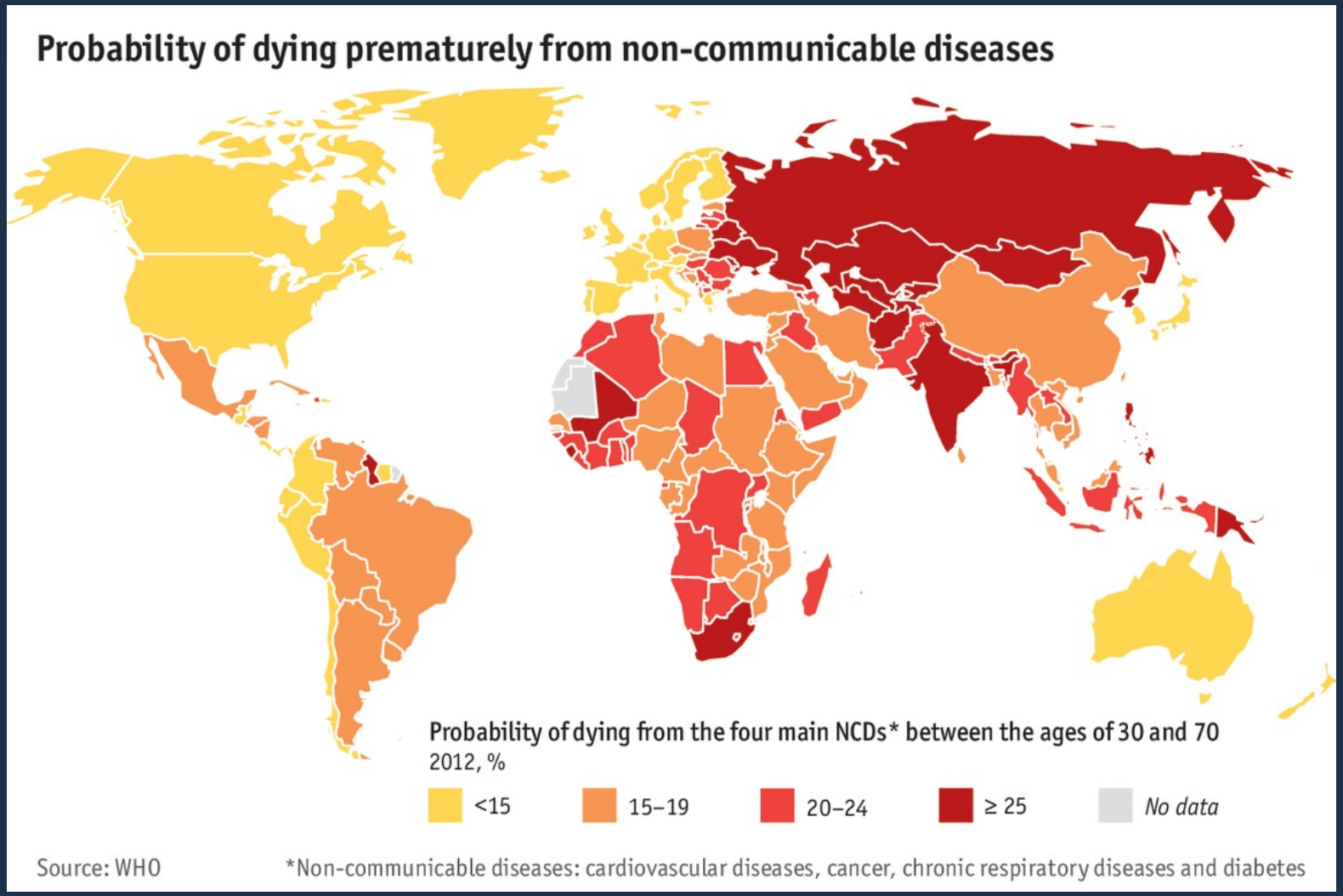


Fig. 3.4
Countries reporting cholera deaths and imported cases, 2016

What Global Health is….not



Pandemics and Global Health

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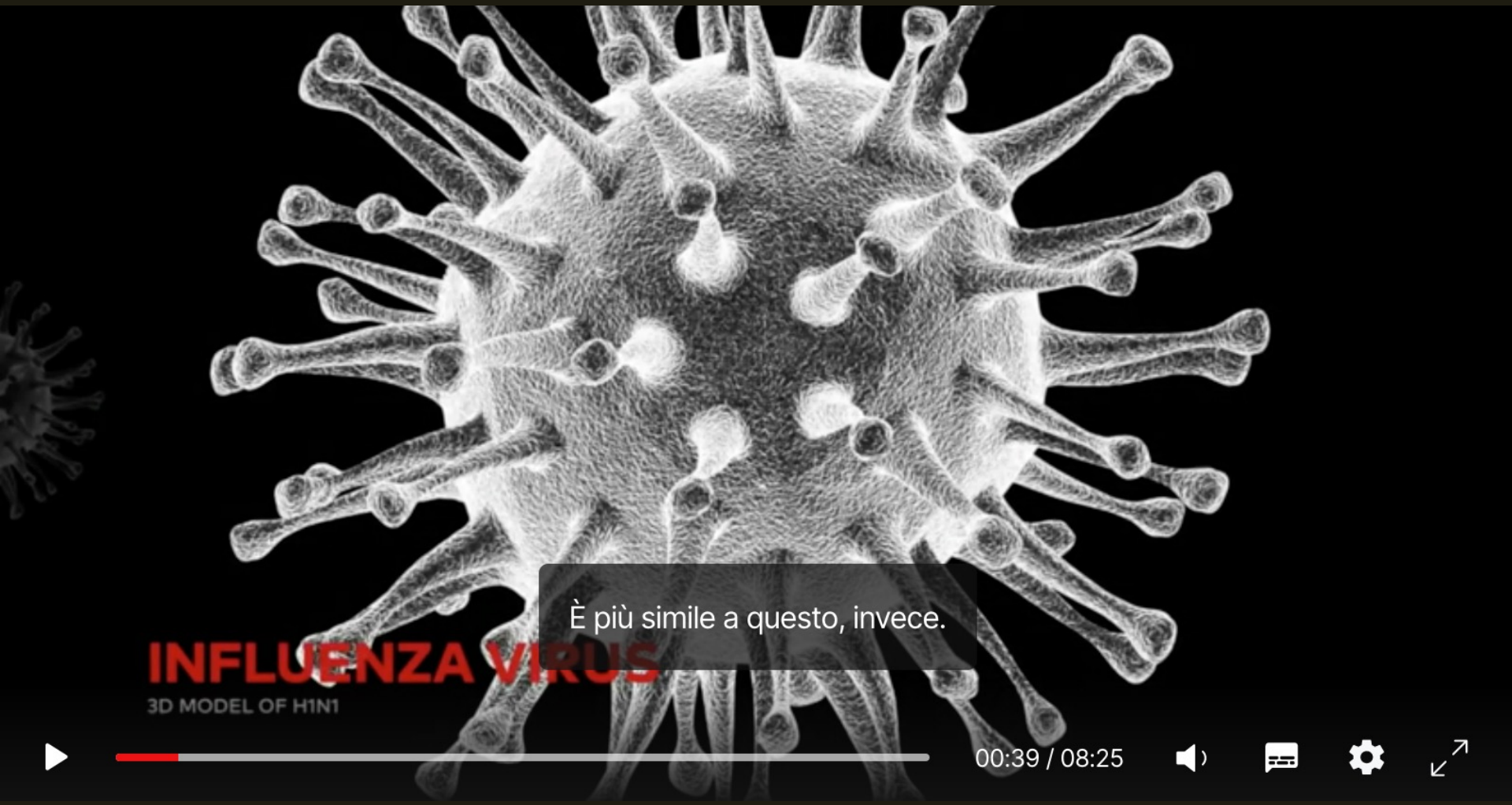
il disastro di cui ci si preoccupava
di più era la guerra nucleare.
00:14 / 08:25


non è più questo.
00:35 / 08:25


Oggi il più grande rischio
di catastrofe globale
RECORDED AT TED
00:32 / 08:25

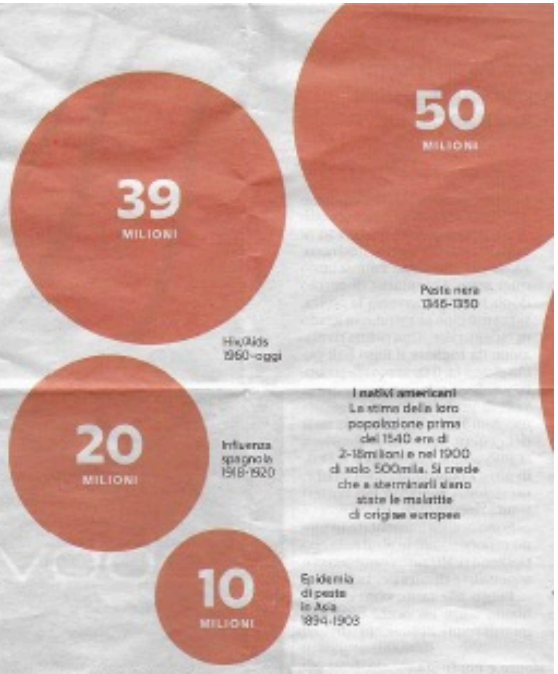

È più simile a questo, invece.
INFLUENZA VIRUS
3D MODEL OF H1N1
00:39 / 08:25

Epidemie

Qualcosa accadrà e saranno guai

di STEFANO VELLA

Dalla peste a Hiv: le infezioni colpiscono per colpa di globalizzazione, povertà e carestie. Ma oggi possiamo intercettarle prima che accada il peggio



Non sarà per il 2018. Ma prima o poi accadrà: qualche virus nuovo passerà dagli animali all'uomo e verrà trasportato in giro per il mondo grazie alla globalizzazione. Vediamo come e perché accadrà.

Partendo dalla peste di Giustiniano che causò oltre 100 milioni di morti nel 542 dC arriviamo al 1346. Quando un marinaio da un porto della Crimea si imbarcò con un topo grigio su un mercantile pieno di tessuti diretto prima a Costantinopoli e poi a Messina. Il marinaio non sapeva che quella nave avrebbe dato origine a una delle più spaventose epidemie della storia: la peste nera che tra il 1346 e il 1353 decimò la popolazione europea con 50 milioni di morti. Ma le epidemie di peste si susseguirono numerose anche nei secoli a venire. E la ragione vera, a parte i topi infestati dalle pulci portatrici del bacillo della peste, è stata la globalizzazione: i grandi movimenti di uomini e merci. Ma le grandi epidemie sono e sono state amplificate anche dalle condizioni di guerra e di povertà. È il caso dei molti focolai di malattie infettive, come il colera, che ancora riemergono nelle zone dove infuriano guerre e carestie e dove manca l'acqua pulita.

Per capire le epidemie che verranno, e i meccanismi che potrebbero causarle, bisogna parlare dell'Aids. Il virus passò dalla scimmia all'uomo verso il 1920. Viveva nelle scimmie senza creare troppi danni. Purtroppo però è un virus capace di mutare con grande velocità, e uno dei "mutanti" fece il "salto di specie", cioè riuscì a infettare un essere umano, molto probabilmente a causa dell'abitudine di macellare le scimmie. Il virus era così diventato l'Hiv. Se ne stette silente per decenni, infettando però per via sessuale milioni di persone. Ma è soltanto agli inizi degli anni 60, con la crescita della mobilità e degli scambi commerciali con l'Africa, che cominciò a girare il mondo. Abbiamo dovuto aspettare fino al 1981 prima che la medicina si accorgesse che una nuova malattia stava uccidendo giovani vite. E in circa 30 anni ne ha uccise 40 milioni e infettate altrettante.

Ma l'Hiv non è l'unico virus che ha fatto "un salto di specie" e solo recentemente ci siamo accorti di patogeni che giravano da un bel po': Ebola era stato descritto negli anni 60 e il virus Zika è stato isolato nel 1947. Colpivano popolazioni "lontane e povere" e così nessuno credeva al rischio diffusione, e quindi nessuno ha pensato per tempo a produrre un vaccino.

E altre malattie son balzate agli onori della cronaca da poco: Mers, Sars, quelle dovute al virus Chikungunya, al virus della febbre emorragica della Crimea e al Nipahvirus. Molte di queste malattie "emergenti" sono trasmesse all'uomo a partire da serbatoi animali, dei quali il più preoccupante è il pipistrello (Ebola dai pipistrelli viene).

Insomma, se ripercorriamo la storia delle grandi epidemie, ci accorgiamo di quanti errori son stati fatti all'inizio e soprattutto della sottovalutazione dei rischi rappresentati dai milioni di agenti infettivi che vivono intorno a noi (e negli animali selvatici che ci circondano). Soprattutto se non ci preoccupiamo della capacità di virus e batteri di adattarsi ed evolvere, dei fattori legati alla crescente mobilità umana, dell'impatto dei conflitti e delle crescenti disuguaglianze di accesso alla salute.

Per affrontare le emergenze ci vuole un lavoro di "intelligence", bisogna mettere insieme virologi, infettivologi, epidemiologi ed esperti di sanità pubblica. Come bisogna usare bene i vaccini e crearne di nuovi. Per il vaiolo il giovane Jenner inventò il vaccino nel 1798: la malattia è stata eradicata nel 1977. Ci sono voluti 200 anni. Speriamo oggi di fare più in fretta.

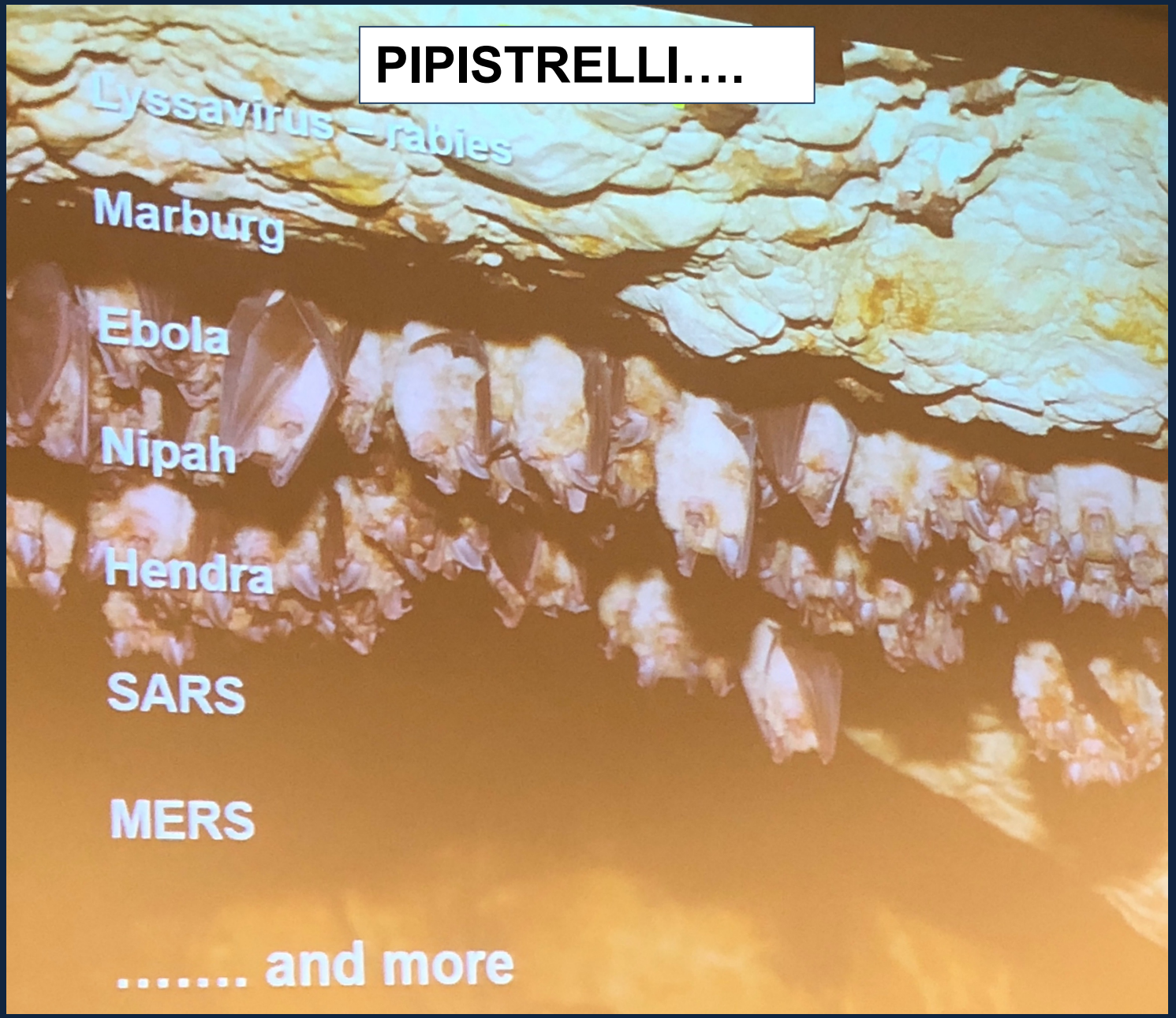
Direttore Centro per la salute globale - Ist. presidente Aifa

Repubblica, 2 gennaio 2018

WHAT WENT WRONG

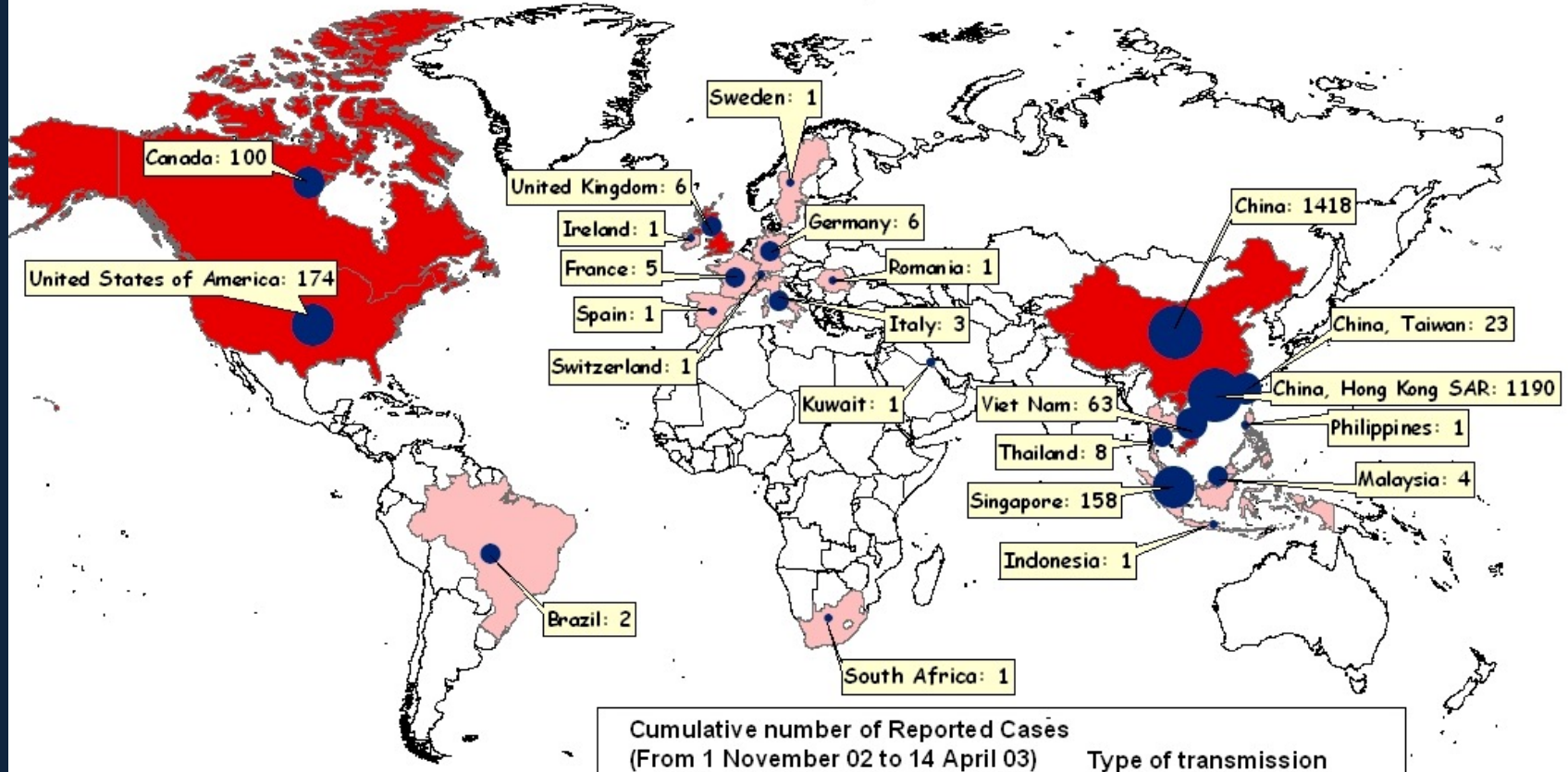
Key findings – Early failings

- **The world had been warned** of an inevitable pandemic threat, but many countries were not prepared and had not learnt from the past
- **Valuable time was lost** as the formal notification and emergency declaration procedures under the International Health Regulations were much too slow to generate the rapid and precautionary response required
- **Too many countries took a 'wait and see' approach rather than enacting an aggressive containment strategy** following the declaration of the Public Health Emergency of International Concern (PHEIC)
- Countries with **delayed responses** were also characterized by a lack of coordination, inconsistent or non-existent strategies, and the devaluing of science in guiding decision-making


PIPISTRELLI….
Lyssavirus – rabies
Marburg
Ebola
Nipah
Hendra
SARS
MERS
…….. and more

SARS : Cumulative Number of Reported Probable* Cases

Total number of cases: 3169 as of 14 Apr 2003, 16:00 GMT+2



*Due to differences in the case definitions being used at a national level, probable cases are reported by all countries except the United States of America, which is reporting suspect cases under investigation.

Data Source: World Health Organization
Map Production: Public Health Mapping Team
Communicable Diseases (CDS)

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Key findings – Global impact

- The **lack of planning and gaps in social protection** have resulted in the **pandemic widening inequalities** with a disproportionate socio-economic impact on
  - Women and vulnerable and marginalized populations, including migrants and workers in the informal sector.
  - Health impacts have been compounded for people with underlying health conditions.
  - Education for millions of the most disadvantaged children has been terminated early by the pandemic.

Key findings – Some successes

- Health workers have been stalwart in their efforts
- Open data and open science collaboration were central
- Vaccines were developed at unprecedented speed
- Successful national responses
- Country wealth was not a predictor of success

Recommendations

Recommendations - *for immediate actions*

High income countries with a vaccine pipeline for adequate coverage should, alongside their scale up, **commit to provide** to the 92 low- and middle-income countries of the Gavi COVAX Advance Market Commitment,

- **at least one billion vaccine doses no later than 1 September 2021 and**
- **more than two billion doses by mid-2022**, to be made available through COVAX and other coordinated mechanisms.

Recommendations - *for immediate actions*

The World Trade Organization (WTO) and WHO should convene major vaccine-producing countries and manufacturers **to agree to voluntary licensing and technology transfer for COVID-19 vaccines**.

G7 countries should immediately commit to provide 60% of the US$ 19 billion required for ACT-A in 2021 for vaccines, diagnostics, therapeutics, and strengthening of health systems.

Every country should apply non-pharmaceutical public health measures systematically and rigorously at the scale the epidemiological situation requires, with an explicit evidence-based strategy agreed at the highest level of government to curb COVID-19 transmission.

The current pandemic trajectory, particularly when combined with increases in seasonality in the northern hemisphere, suggests that COVID-19 is not over, and we expect substantial mortality in the months ahead.

Southeast Asia is experiencing major surges in several locations including Indonesia, Malaysia, Thailand, Cambodia and Vietnam.

In sub-Saharan Africa, the Delta variant is driving surges in many countries including Malawi, Mozambique, Zimbabwe, Nigeria and Senegal. However in some countries including Uganda, Zambia and Rwanda, the surge has already peaked.

In Europe, some of the countries with major surges are the United Kingdom, Spain, Greece, Cyprus and the Netherlands, while other countries have smaller increases or continued declines in cases.

In South Asia, Bangladesh continues to experience a huge surge while in Pakistan cases are beginning to increase and in India reported cases are staying steady.

In Mexico and the United States, cases are increasing in most states due to the Delta variant as well as the nearly complete removal of social distancing mandates and plummeting mask use.

In South America, although the death toll is still high, transmission is declining overall.

In Central America and the Caribbean, transmission is increasing in some countries, most notably Cuba, while it is decreasing in others.

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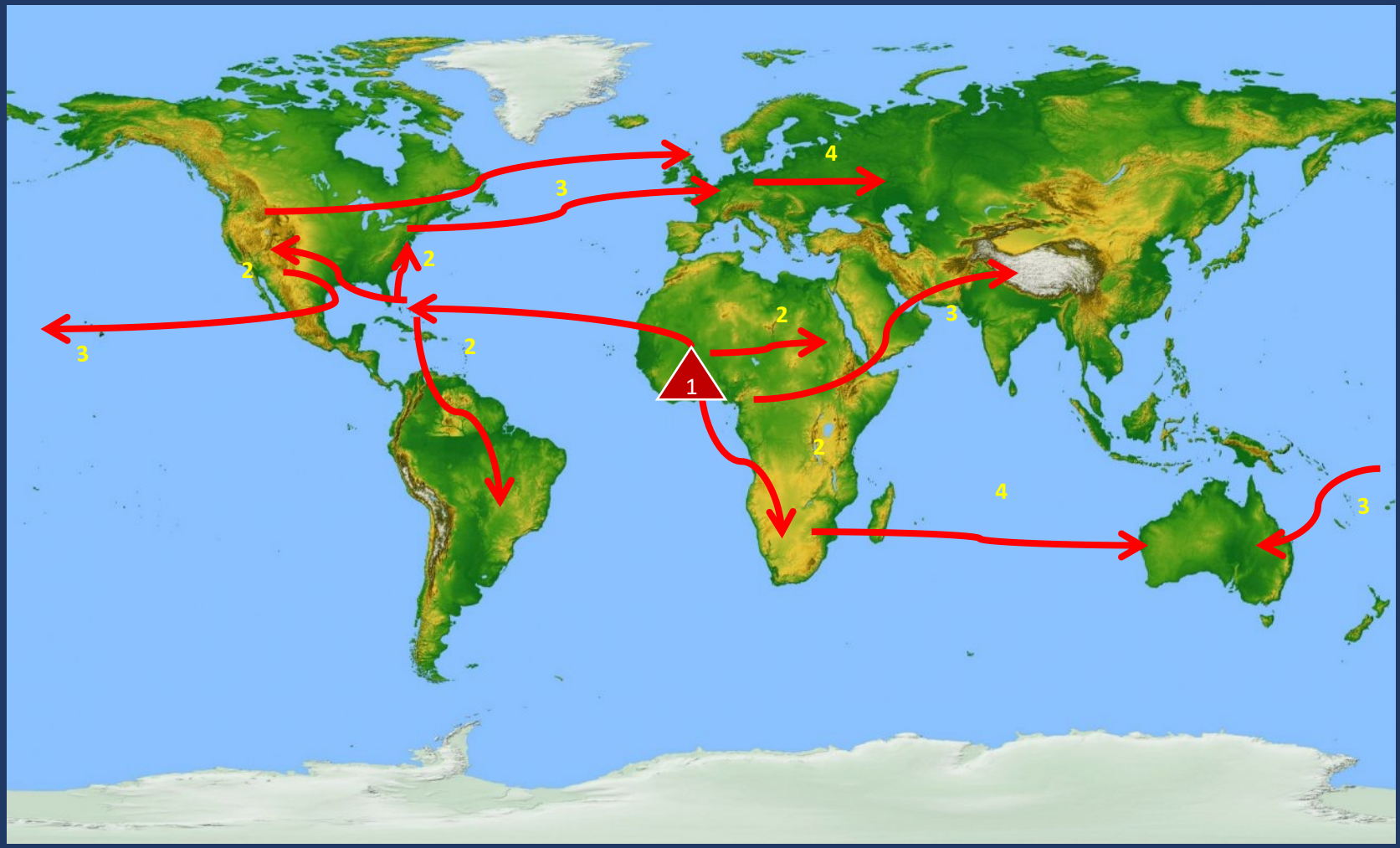
The spread of HIV

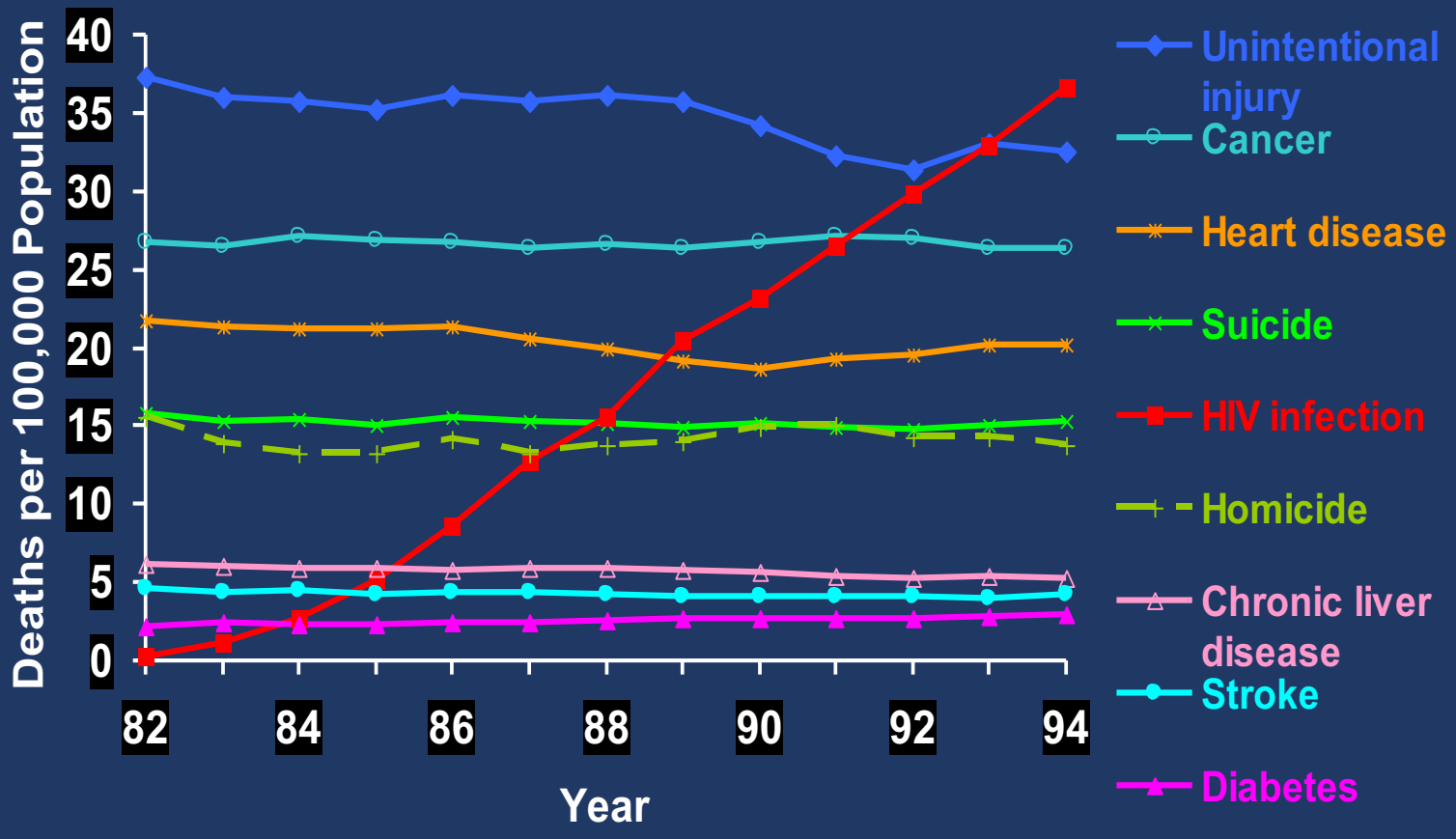


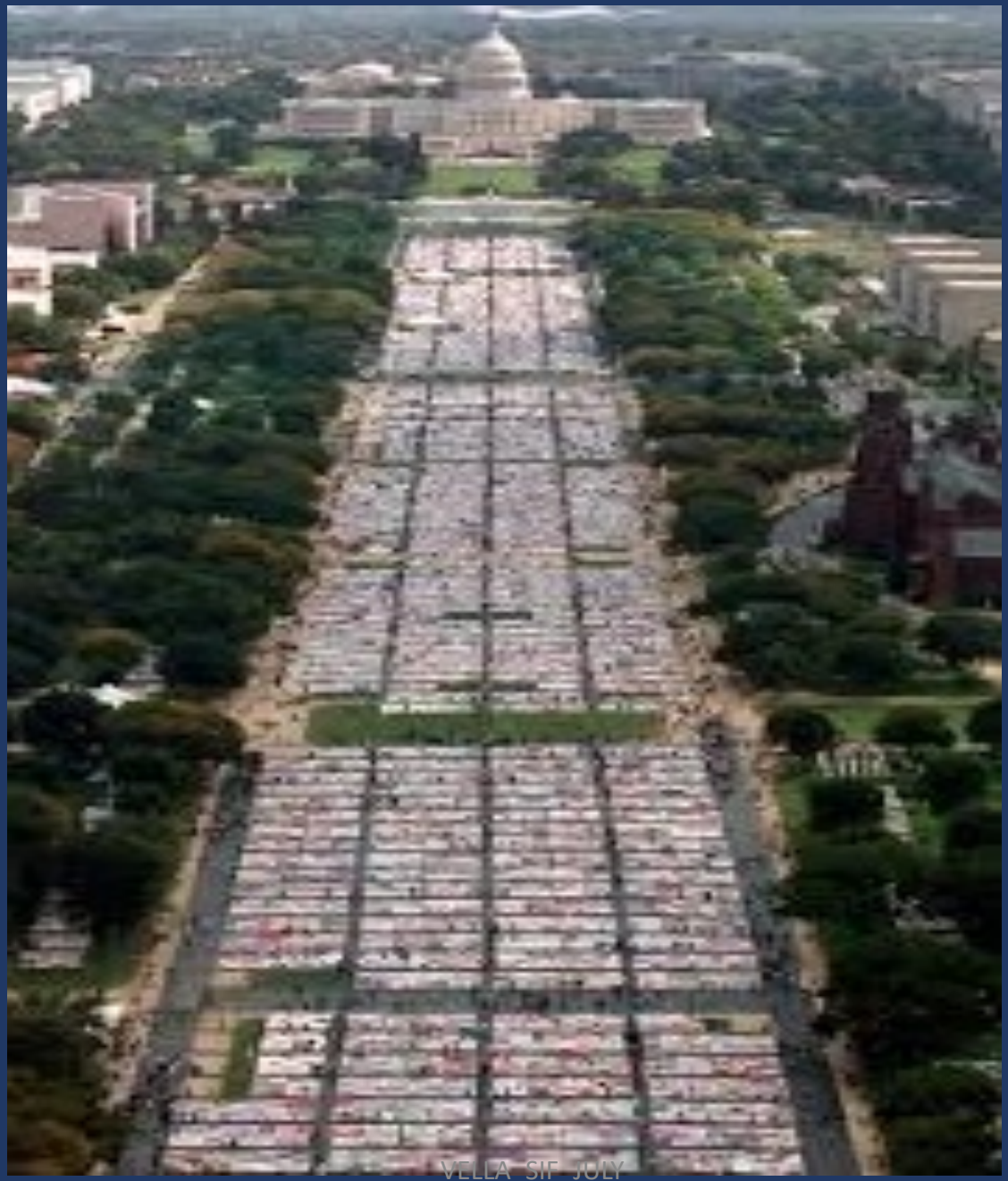
AIDS: a devastating impact in just a few years

50 million deaths

50 million living with HIV

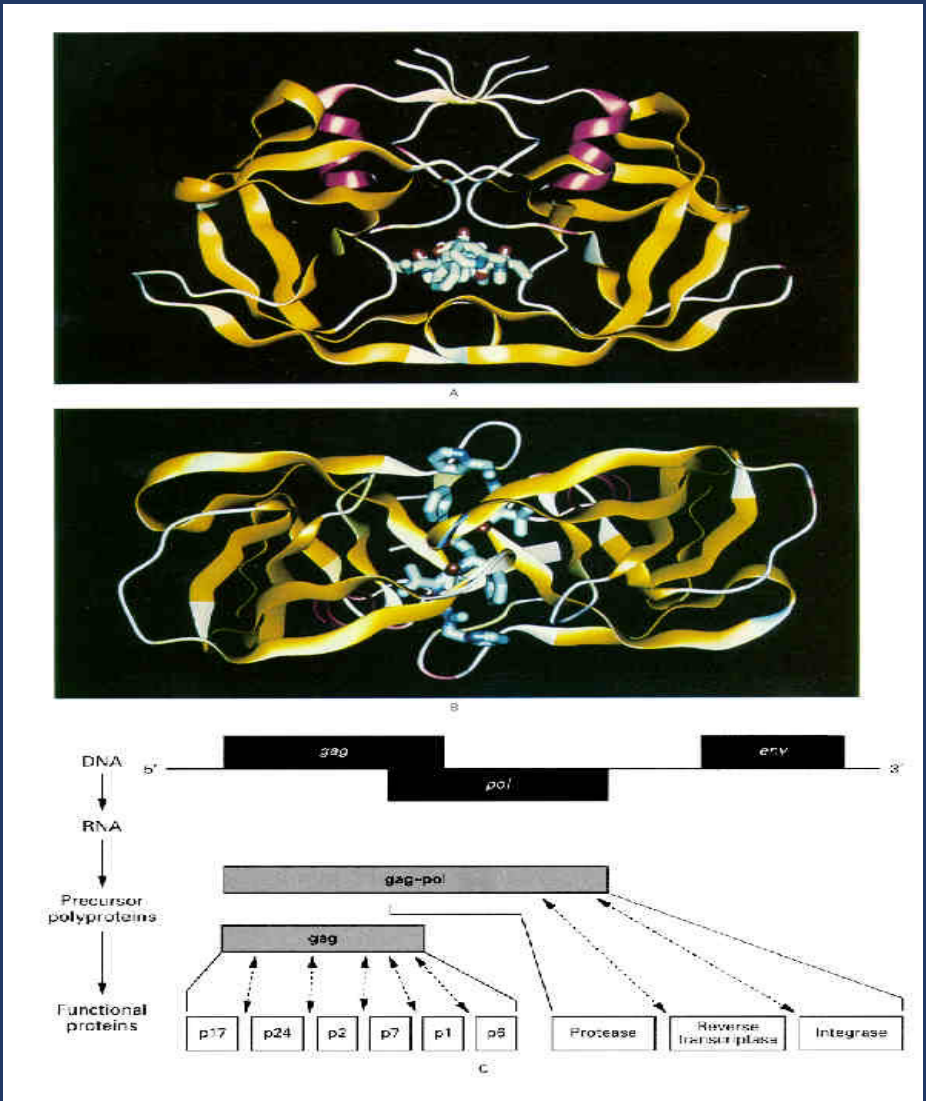
Trends in Annual Rates of Death from Leading Causes of Death Among Persons 25-44 Years Old, USA





VELLA_SIF_JULY

The arrival of protease inhibitors (1992-1995)



Antiretroviral Therapy for HIV Infection in 1996

Recommendations of an International Panel

Charles C. J. Carpenter, MD; Margaret A. Fischl, MD; Scott M. Hammer, MD; Martin S. Hirsch, MD; Donna M. Jacobsen; David A. Katzenstein, MD; Julio S. G. Montaner, MD; Douglas D. Richman, MD; Michael S. Saag, MD; Robert T. Schooley, MD; Melanie A. Thompson, MD; Stefano Vella, MD; Patrick G. Yeni, MD; Paul A. Volberding, MD; for the International AIDS Society–USA

Objective.—To provide clinical recommendations for antiretroviral therapy for human immunodeficiency virus (HIV) disease with currently (mid 1996) available drugs. When to start therapy, what to start with, when to change, and what to change to were addressed.

Participants.—A 13-member panel representing international expertise in antiretroviral research and HIV patient care was selected by the International AIDS Society–USA.

Evidence.—Available clinical and basic science data, including phase 3 controlled trials, clinical endpoint data, virologic and immunologic endpoint data, interim analyses, studies of HIV pathophysiology, and expert opinions of panel members were considered. Recommendations were limited to drugs available in mid 1996.

Process.—For each question posed, 1 or more member(s) reviewed and presented available data. Recommendations were determined by group consensus (January 1996); revisions as warranted by new data were incorporated by group consensus (February-May 1996).

Conclusions.—Recent data on HIV pathogenesis, methods to determine plasma HIV RNA, clinical trial data, and availability of new drugs point to the need for new approaches to treatment. Therapy is recommended based on $CD4^+$ cell count, plasma HIV RNA level, or clinical status. Preferred initial drug regimens include nucleoside combinations; at present protease inhibitors are probably best reserved for patients at higher progression risk. For treatment failure or drug intolerance, subsequent regimen considerations include reasons for changing therapy, available drug options, disease stage, underlying conditions, and concomitant medication(s). Therapy for primary (acute) infection, high-risk exposures to HIV, and maternal-to-fetal transmission are also addressed. Therapeutic approaches need to be updated as new data continue to emerge.

JAMA. 1996;276:146-154

From Brown University School of Medicine, Providence, RI (Dr Carpenter); the University of Miami (Fla) School of Medicine (Dr Fischl); Harvard Medical School, Boston, Mass (Drs Hammer and Hirsch); The International AIDS Society–USA, San Francisco, Calif (Ms Jacobsen); Stanford (Calif) University Medical Center (Dr Katzenstein); St Paul's Hospital, Vancouver, British Columbia (Dr Montaner); University of California San Diego, and San Diego Veterans Affairs Medical Center (Dr Richman); the University of Alabama at Birmingham (Dr Saag); the University of Colorado School of Medicine, Denver (Dr Schooley); AIDS Research Consortium of Atlanta (Ga) (Dr Thompson); Istituto Superiore di Sanità, Rome, Italy (Dr Vella); Hôpital Bichat-Claude Bernard, X. Bichat Medical School, Paris, France (Dr Yeni); and the University of California San Francisco (Dr Volberding).

Financial disclosures appear at the end of this article.

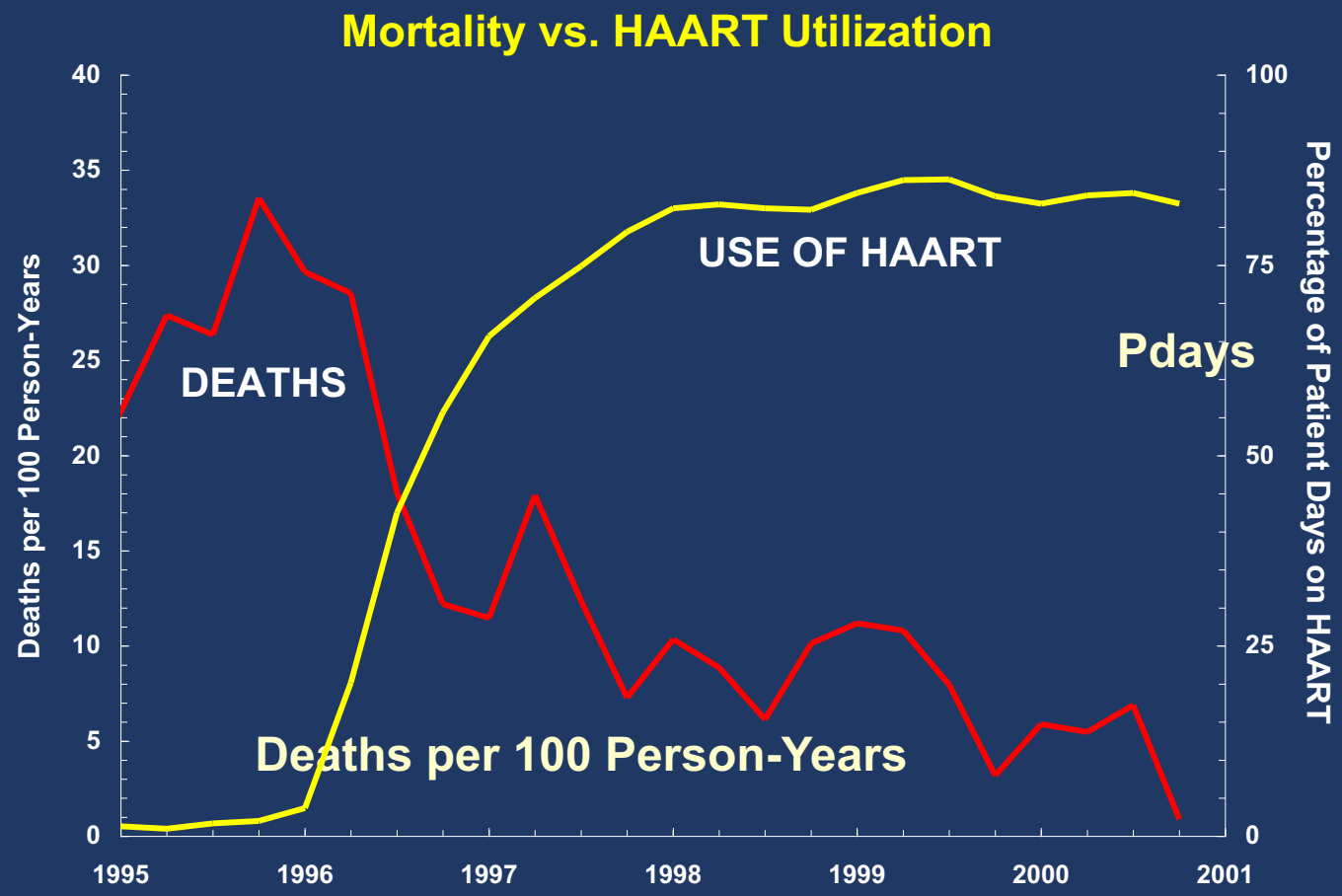
Reprints: International AIDS Society–USA, 353 Kearny St, San Francisco, CA 94108.

IMPORTANT ADVANCES in understanding the biology and treatment of human immunodeficiency virus (HIV) infection have occurred during the past 18 months. As a result, new scientifically sound approaches to therapy have been developed that offer new options for persons with HIV infection. The relevant recent advances fall into 4 major categories: (1) a better understanding of the replication kinetics of HIV throughout all stages of disease; (2) the development of assays to determine the viral load in individual patients; (3) the availability of several new effective drugs; and (4) the demonstration that combination therapy is more effective than zidovudine monotherapy.

In light of these advances, the recommendations of earlier state-of-the-art guidelines[1,2] are no longer applicable to clinical decision making in 1996. Therefore, an international panel of clinical investigators experienced in HIV patient care was selected and convened by the International AIDS Society–USA to develop current recommendations for the clinical management of HIV-infected individuals.

The panel addressed 4 central questions about antiretroviral therapy: when to initiate therapy, which types of drugs to use, when to change therapy, and which types of drugs to use when a change in therapy is indicated. In addition, the treatment of primary HIV infection, prevention of vertical transmission, and postexposure prophylaxis were addressed. The recommendations are not solely based on the results of controlled clinical trials with well-defined clinical endpoints. Developing clinical guidelines in the HIV field at this time requires an approach firmly anchored in data from controlled, double-blind clinical trials when available, but must also include information from trials in progress and available virologic and immunologic endpoint data, as well as extrapolations from studies of the pathophysiology of HIV infection. Clinical decisions must be made for best use of up to 8 available antiretroviral drugs, at a time when long-term studies with clinical endpoints have been completed for only a few possible combinations.

The recommendations herein reflect the panel's agreement on the importance of plasma HIV RNA measurements for predicting risk of clinical progression as well as of the recent demonstration from clinical trials of combination therapies that reductions in plasma HIV RNA



Palella F et al, HOPS Study

The battle for access to treatment and care for HIV in resource limited setting

Per Stefano Vella la prospettiva di cura è in un cocktail di farmaci dai costi elevatissimi

Ma la terapia sarà solo per pochi

GIANCARLO ANGELONI

È una bella o brutta notizia quella di Robert Gallo, secondo cui «entro dieci anni si curerà l'Aids»? È un'uscita elusiva e generica, che presta il fianco ad una certa disinformazione disinvolta, interessata solo a conoscere «date» e «linee di traguardo», oppure contiene intuizioni autentiche dello scienziato? Certo, è strano che ad ogni anno che passa, ci si debba muovere a fare il gioco delle scommesse: e tanto più in questo 1995 che, anche a seguito della sospensione di tutte le sperimentazioni umane dei vaccini, ha fatto agli inizi pensare al peggio. Facciamo un sano passo indietro, hanno detto alcuni. Sì, per ricominciare e capire, hanno risposto altri: così, faremo due passi in avanti. E, in effetti, se le cose nuove nascono davvero dalle crisi, il ripensamento ha funzionato. Quasi inaspettatamente, due fatti, negli studi sulla patogenesi della malattia e sul fronte della terapia, hanno riportato un po' di sereno. «Ma non è ancora il cielo terso e azzurro – avverte Stefano Vella, direttore del reparto retrovirus nel laboratorio di virologia dell'Istituto superiore di sanità – perché non si devono scambiare i risultati ottenuti, pur importanti, con la cura dell'Aids: a dieci anni e più dall'inizio della pandemia, il ruolo dell'infiammazione equilibrata in questo campo è ancora un problema non risolto».

Nelle ultime settimane, Stefano Vella è stato invitato ad entrare, come uno dei tre membri per l'Europa, nell'organo di governo dello Ias, l'International Aids Society, che sovrintende alle conferenze internazionali, attualmente a cadenze biennali. Lo scorso anno ha temuto, alla conferenza internazionale sull'Aids a Yokohama, la lettura inaugurale sulle terapie. E, di recente, al Congresso europeo di Copenaghen sull'Aids, ha discusso dei risultati dello studio europeo-australiano Delta, che ha impegnato, fin dal '92, lo stesso Istituto superiore di sanità, e che si è allineato a un altro «trial» molto importante, l'Actg 175, condotto negli Stati Uniti dal National Institutes of Health. Ora, a distanza di un paio di mesi da quell'incontro di Copenaghen, Stefano Vella ricorda: «C'è stato un momento in sala, in cui tra i ricercatori è prevalsa l'emozione. Sì, proprio l'emozione che prova un medico quando si accorge di poter cambiare finalmente la vita del proprio paziente, di essere sulla strada giusta».

E qual è questa strada, dottor Vella?

Noi abbiamo diviso lo studio Delta in due parti: nella prima abbiamo sperimentato una terapia combinata, Azt e ddI o Azt e ddC, su pazienti mai trattati in precedenza con antiretrovirali; nella seconda abbiamo invece arruolato, sempre per la stessa terapia combinata, pazienti che avevano avuto un trattamento con Azt di almeno tre mesi precedente all'arruolamento. Bene, sia per la progressione verso l'Aids, sia per la sopravvivenza, i risultati nel primo gruppo sono stati molto più lusinghieri che nel secondo, tanto che nei pazienti mai trattati prima attraverso la monoterapia con Azt, la riduzione di mortalità, mediante l'uso della terapia di combinazione, è stata stimata intorno al 40 per cento. Il confronto, dunque, è stato tra monoterapia e terapia di combinazione, ma il risultato vero dello studio Delta è stato quello di aver ottenuto una risposta sul «come cominciare»: occorre iniziare subito, e a dose piena, con la terapia di combinazione, perché questa, al contrario della monoterapia, ha mostrato di poter modificare la storia naturale della malattia e ha stabilito, in un rapporto di causa ed effetto, che la replicazione del virus e la progressione della malattia sono legate tra di loro.

Ma, nella prospettiva, ci sono altre opzioni terapeutiche?

Certo. Lo studio Delta e quello americano hanno tenuto conto solo degli antiretrovirali già disponibili e non di quelli, sempre appartenenti alla famiglia dell'Azt, in via di approvazione da parte dell'Fda e delle stesse autorità europee, come il 3Tc e il D4t. Senza pensare, poi, che in «trial» molto avanzati ci sono gli inibitori delle proteasi, di diversa concezione e di potenza di gran lunga superiore agli analoghi dell'Azt, e che in futuro, forse, si potrà contare su altri inibitori, come quelli dell'integrasi. La prospettiva, dunque, è quella di usare tre o quattro farmaci contemporaneamente, e poi di cambiare le combinazioni, regolamentandole, però, secondo un uso mirato e non selvaggio. Purtroppo, c'è da dire che questa prospettiva riguarderà solo il 5 per cento di coloro che nel mondo sono infetti, perché per le moltitudini dei sieropositivi che vivono in Africa e in Asia nelle condizioni di miseria che sappiamo, i costi molto alti delle terapie di combinazione saranno semplicemente una cosa lunare.

E non c'è nessun altro intervento possibile?

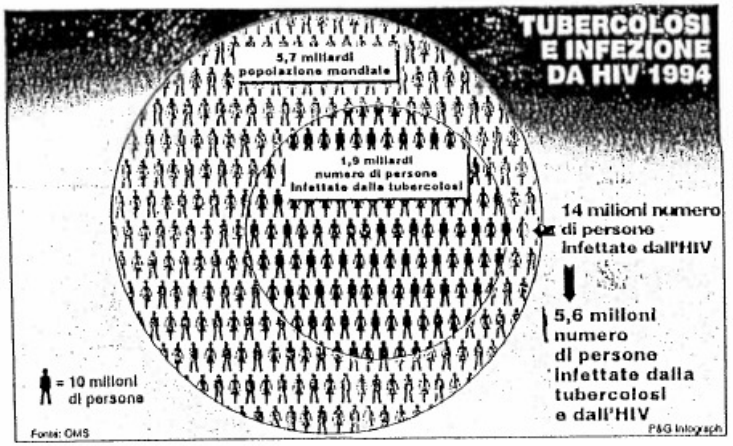
Allo stato dei fatti, l'unico intervento di tipo farmacologico è la prevenzione della trasmissione materno-fetale del virus, come sta cercando di verificare uno studio molto ampio, coordinato dall'Oms, in pratica, si vuol vedere se, somministrando farmaci antiretrovirali nelle fasi più vicine al parto, si riesce ad evitare la trasmissione dell'Hiv nel neonato. Il «trial» prevede una somministrazione che non superi i dieci giorni, perché questo è il limite che le disponibilità economiche pongono.

Diversa sarebbe la situazione se ci fosse un vaccino?

Sì, per i suoi bassi costi. Ma, allo stato attuale, non c'è davvero molto da sperare che il problema venga risolto, perché, nel caso dell'Hiv, il sistema immunitario, pur funzionando, non è in grado di contrastare il virus con una risposta efficace. E poi, un'ulteriore complicazione è costituita dalla via di trasmissione, che è generalmente sessuale. Si dovrebbe costituire, insomma, una protezione alla porta di ingresso del virus, cioè al livello delle mucose genitali. Ciò che oggi si pensa, in realtà, è che se un vaccino ci sarà, si tratterà di un «vaccino minore», che impedirà solo la progressione dell'infezione. In questo modo si rallenterebbe il corso della malattia, ma il paziente continuerebbe ad essere infettante.

Un ultimo punto: la patogenesi. Quali conoscenze nuove hanno portato i lavori pubblicati da «Nature» nel gennaio scorso, di cui si è tanto parlato?

Hanno riconvolto l'infezione Hiv in un quadro infettivo più classico, secondo un'immagine dinamica che è più vicina alla realtà patologica, e hanno dimostrato che non è vero che il sistema immunitario non funziona a dovere. Anzi, esso regge benissimo all'attacco del virus, e lo fa fino a quando, dopo anni, l'Hiv non riesce a sfondare le linee. Se non fosse così, la persona infetta morirebbe entro quali che mesi. In questo senso, il sistema immunitario va visto come l'alleato essenziale della terapia.

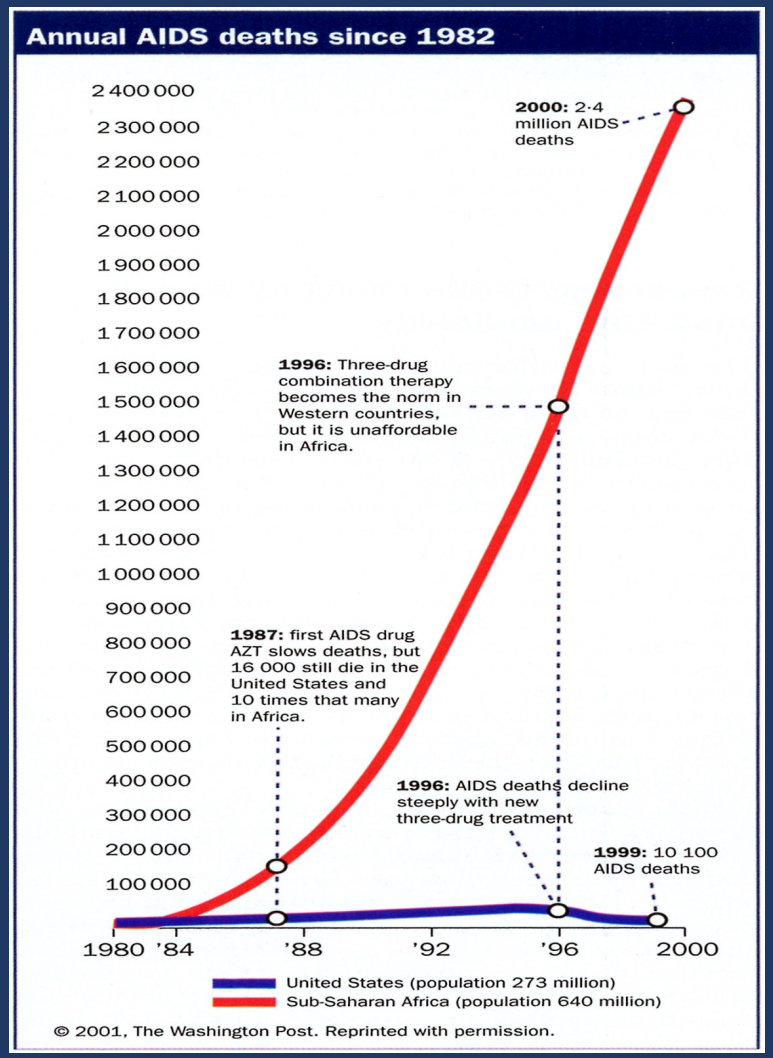


Tubercolosi più Hiv, il «doppio problema» di domani

È stata definita «the double trouble», il doppio problema. Sì, perché l'associazione «infezione da Hiv più infezione da tubercolosi» crea molti grattacapi alle autorità sanitarie. E ne creerà sempre di più.

L'infezione da tubercolosi è molto diffusa: colpisce nel mondo una persona al secondo e si stima che nei prossimi dieci anni ucciderà 30 milioni di persone. Ma solo il 10 % degli infettati ha il 10 % di probabilità di sviluppare la malattia nel corso della vita. Il rischio però aumenta enormemente se la persona è infettata dal virus dell'Aids. In quel caso la probabilità di ammalarsi aumenta fino al 5 % all'anno. E qui si innesta un circolo vizioso. Il contagio della tbc avviene tramite una persona ammalata, questo vuol dire che un aumento del numero di malati (tra i sieropositivi) comporta un aumento della circolazione della tbc anche nella popolazione «sana». Negli Usa si è calcolato che l'aumento di Tbc verificatosi dall'85 è dovuto per il 30 % alla diffusione dell'Hiv (le altre cause sono l'aumento di povertà, quello dei senza tetto e il difficile accesso alle cure dei soggetti marginali). In alcuni paesi dell'Africa i casi di tubercolosi sono addirittura raddoppiati. In Italia, secondo uno studio condotto sul nostro territorio, questo fenomeno potrebbe portare a un aumento di circa 2.000 casi l'anno.

L'Unità – 1 dicembre 1995



Millions were dying for a treatable disease

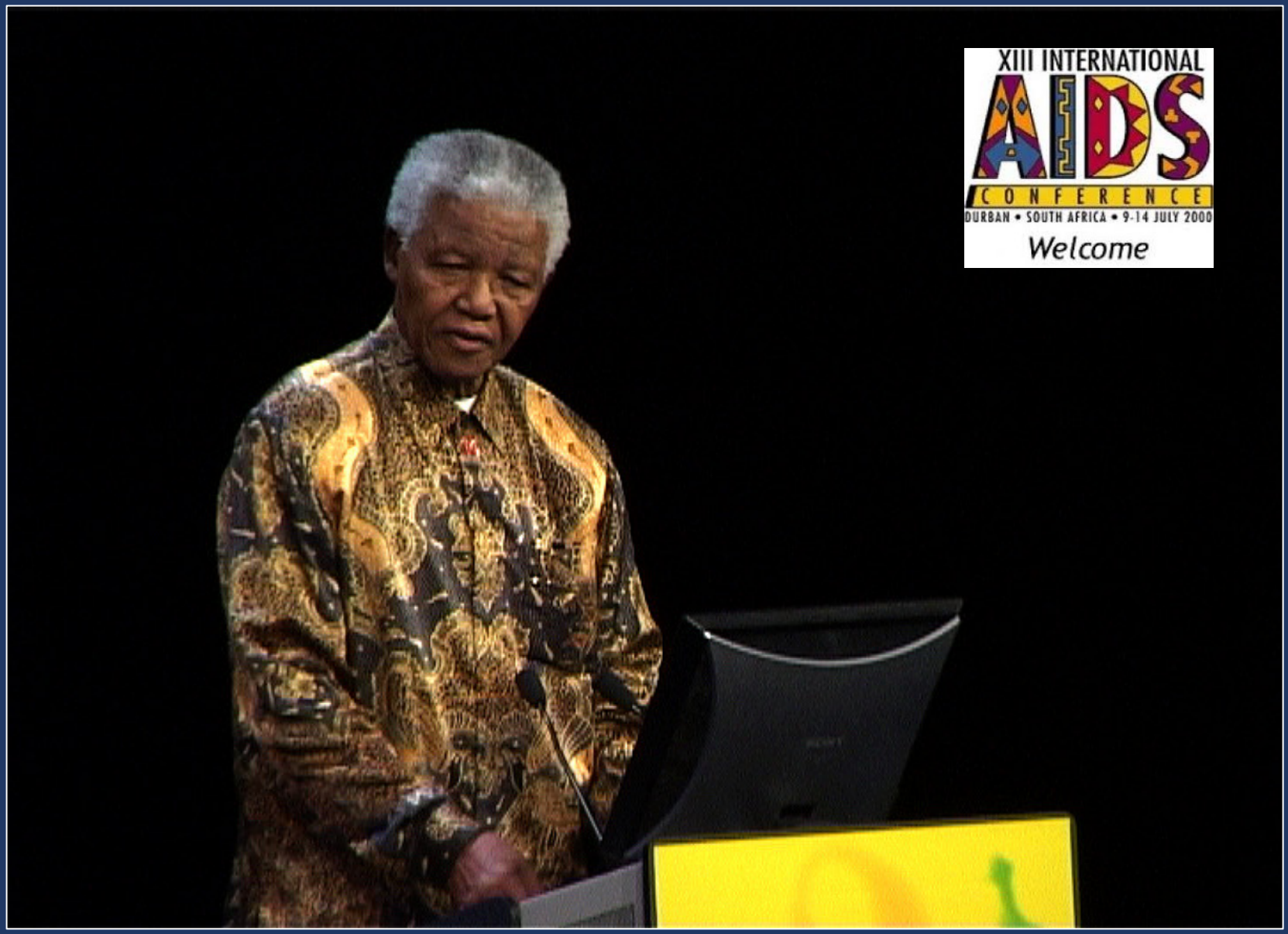
We had two choices:

accept it

or.....

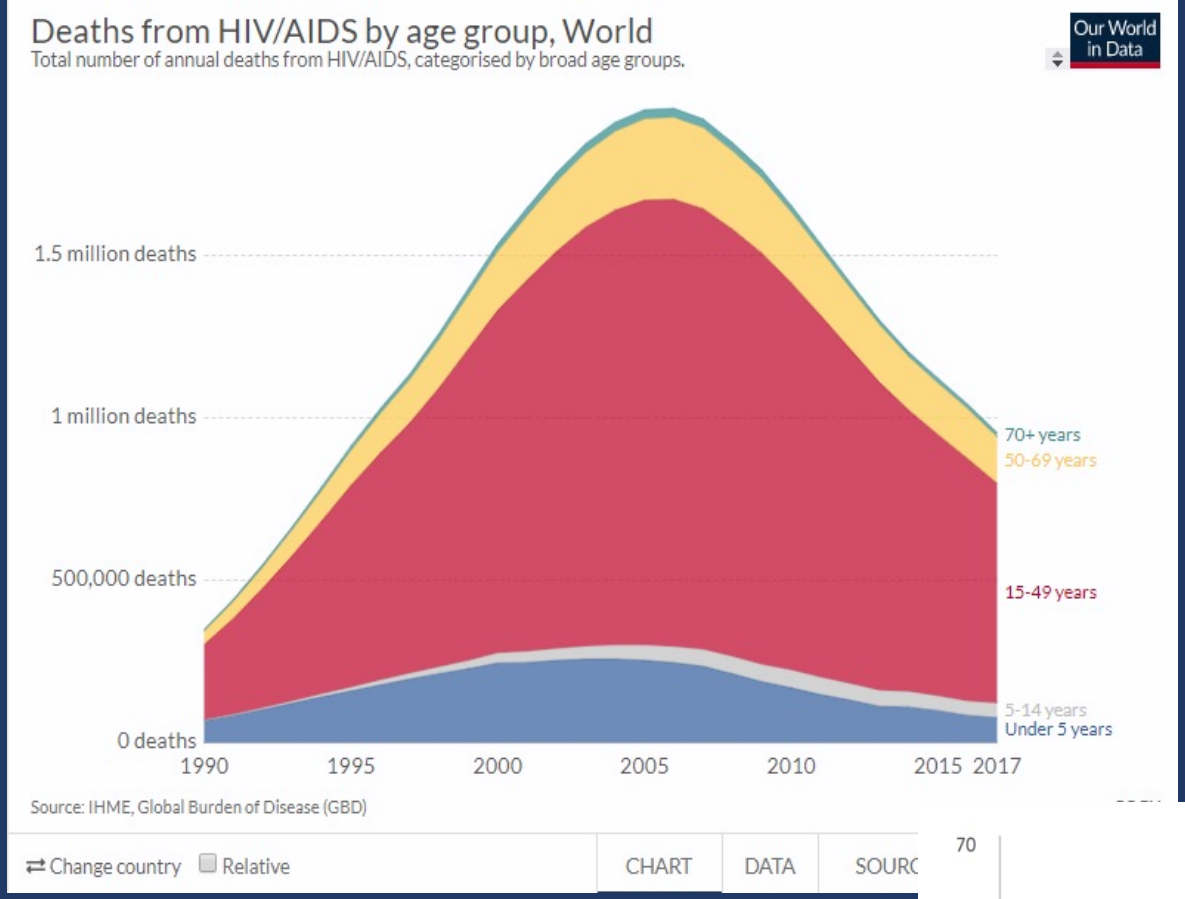
fight !

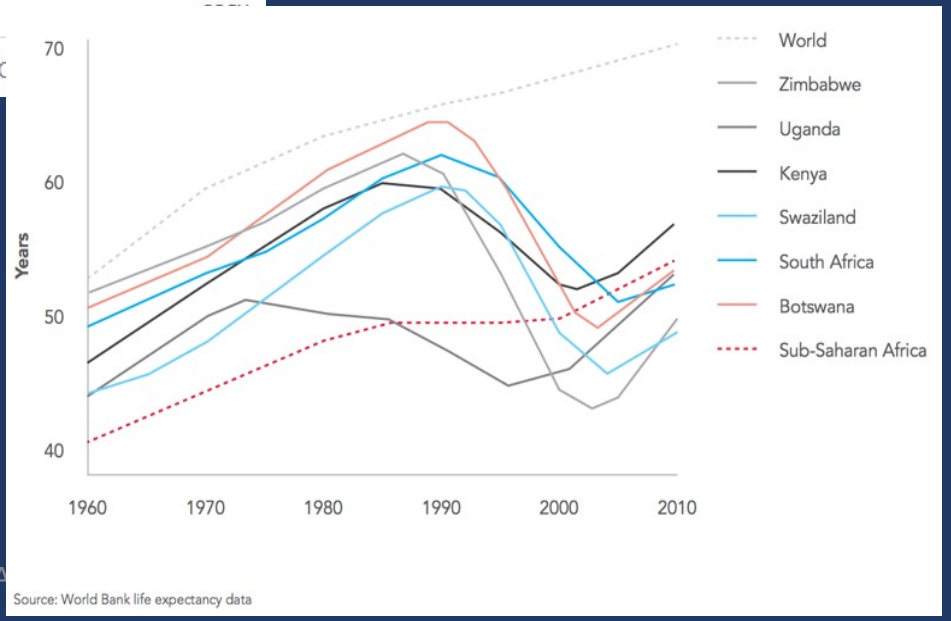

220 MPS
HOLD THE LIVES OF
32 MILLION
KENYANS AT
Life
before
profit!!
MPs save
our lives!!
Access to medicine
United Civil Society Organisations Coalition on


XIII INTERNATIONAL
AIDS
CONFERENCE
DURBAN • SOUTH AFRICA • 9-14 JULY 2000
Welcome

2001 – Global Commitment

Schwartländer et al, Science, June 2001


Deaths from HIV/AIDS by age group, World
Total number of annual deaths from HIV/AIDS, categorised by broad age groups.
Our World in Data
1.5 million deaths
1 million deaths
500,000 deaths
0 deaths
1990
1995
2000
2005
2010
2015
2017
70+ years
50-69 years
15-49 years
5-14 years
Under 5 years
Source: IHME, Global Burden of Disease (GBD)
Change country
Relative
CHART
DATA
SOURC


70
60
50
40
Years
1960
1970
1980
1990
2000
2010
World
Zimbabwe
Uganda
Kenya
Swaziland
South Africa
Botswana
Sub-Saharan Africa
Source: World Bank life expectancy data

WORLD TRADE ORGANIZATION

WT/MIN(01)/DEC/1
20 November 2001

(01-5859)

MINISTERIAL CONFERENCE
Fourth Session
Doha, 9 - 14 November 2001

MINISTERIAL DECLARATION

Adopted on 14 November 2001

"Each member has the right to grant compulsory licences and the freedom to determine the grounds upon which such licences are granted" and

"to determine what constitutes a national emergency or other circumstances of extreme urgency".

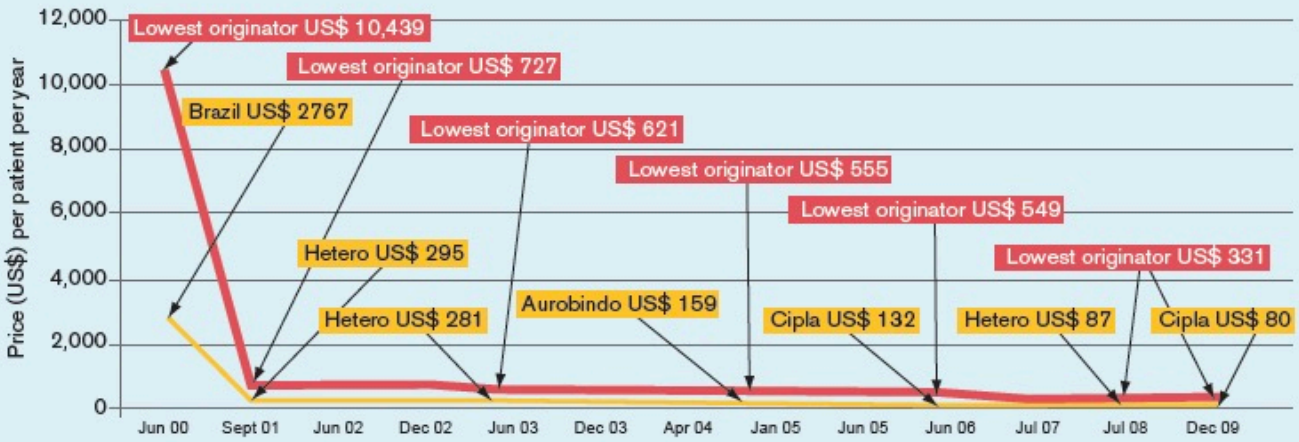
Public health crises include "those relating to HIV/AIDS, tuberculosis, malaria and other epidemics" and "other circumstances of extreme urgency".

HIV DRUG PRICING INNOVATION

Box 4: Access to medicines and the Doha Declaration on TRIPS and Public Health

Measuring access to medicines is a complex task, but price is one key factor among others. The Doha Declaration on TRIPS and Public Health recognized concerns about effects on prices while noting the need for innovation. Since the Declaration was adopted in 2001, prices for many treatments have fallen significantly, in part due to generic competition and tiered pricing schemes (see graph below). Surveys also show a marked increase in the use of TRIPS flexibilities to promote access to medicines.

Falling prices of first-line combinations of some first-line anti-retroviral therapies for HIV-AIDS since 2000



Source: Extract from MSF, *Untangling the Web of Price Reductions*, January 2010 at http://www.msfaccess.org.

Access to medicines: lessons from the HIV response

Just two decades ago, HIV/AIDS treatments were prohibitively expensive and accessible in only a few affluent countries. But remarkable reductions in costs have enabled treatment expansion that has reduced mortality and transmission. Today, first-line HIV drugs cost less than US$100 per person per year, a 99% reduction from more than $10 000 in 2000. The number of people receiving HIV treatment doubled in just 5 years, from 9 million in 2011 to more than 18 million today.[1]

In a world facing growing inequalities, the HIV response has lessons for low and middle-income countries (LMIC)—but also for high-income countries—on access to care and treatment for communicable diseases and for non-communicable chronic diseases, a global pandemic that dwarfs the HIV epidemic in scale.[2]

The transformative power of the HIV response was underpinned by moral rather than technical arguments. A unique coalition of activists, scientists, celebrities, and religious and community leaders from all over the world argued that no one should be denied life-saving treatment because of area of residence or income. The moral imperative was operationalised by activism for more urgent drug discovery, regulatory approval, and voluntary and compulsory licensing, followed by shifts towards large-scale generic production. Economies of scale underpinned a drive towards more efficient, cheaper production, and drove prices down. Major donors such as the Global Fund to Fight AIDS, Tuberculosis, and Malaria and the US President's Emergency Plan for AIDS Relief bought generic drugs. The Clinton Health Access Initiative negotiated price-volume discounts

Vella S, Wilson D. Access to medicines: lessons from the HIV response.
Lancet HIV. 2017 Apr;4(4):e147-e149. doi: 10.1016/S2352-3018(17)30052-8.

HIV AS A MODEL FOR GLOBAL HEALTH

1. HIV drew together - with the common objective of fighting HIV health inequality - a multisectoral group of dedicated people

2. It recognized the **supranational character of problems of disease** and their amelioration, and the fact that no individual country can adequately address diseases in the face of the movement of people, trade, microbes, and risks.

3. It mobilized innovative drug production, pricing and procurement, both from generic and proprietary manufacturers

HIV AS A MODEL FOR GLOBAL HEALTH

4. it focused on deeper knowledge of the burden of disease to **identify key health disparities and develop strategies for their reduction**.

5. it recognized that **people affected by disease have a crucial role in the discovery and advocacy of new modes of treatment and prevention and their equitable access**

6. It based the action on **ethical and moral values that recognize that equity and rights are central** to the larger goals of preventing and treating diseases worldwide.

7. It introduced the concept of health as a common good

The concept of “public good”

non exclusive: anyone can use them

non competitive: their use will not limit others to use them

The concept of “public good”

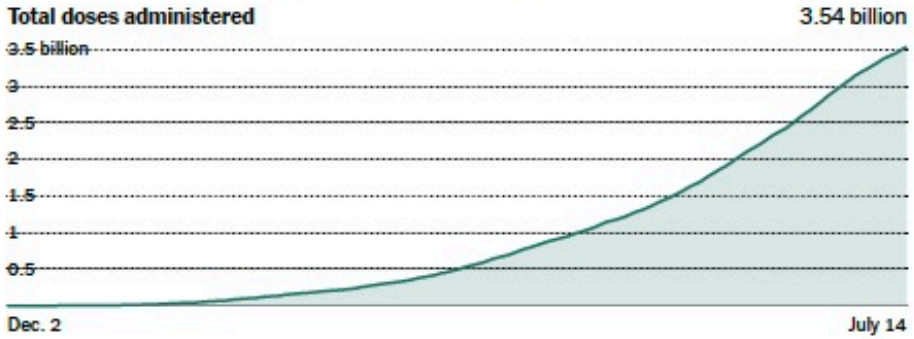
Progress of medicine and essential medicines (including vaccines) shall be considered as global public goods and be accessible to all human beings living on our planet

The New York Times https://nyti.ms/2Yqfz92

U.S.A. World Health

Tracking Coronavirus Vaccinations Around the World

By Josh Holder Updated July 15, 2021

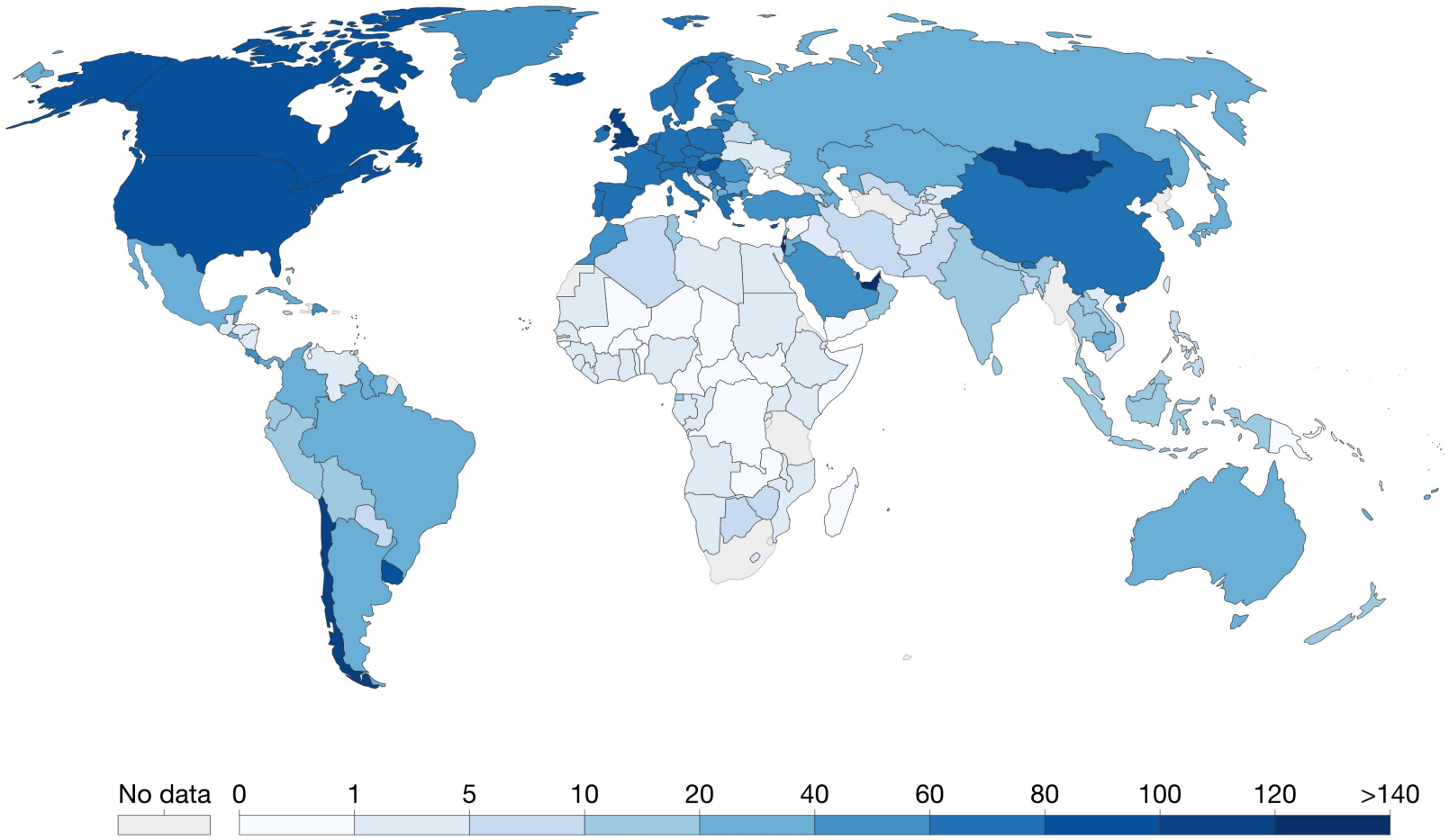


More than 3.54 billion vaccine doses have been administered worldwide, equal to 46 doses for every 100 people. There is already a stark gap between vaccination programs in different countries as this map shows.

COVID-19 vaccine doses administered per 100 people

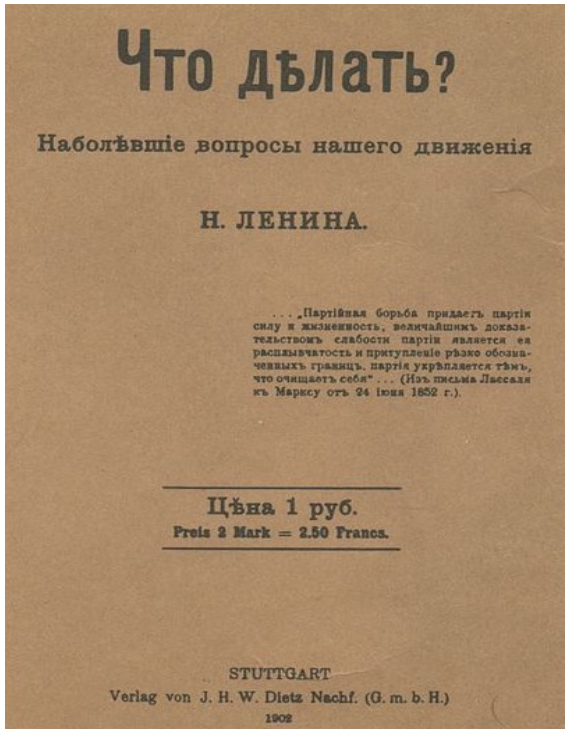
Our World in Data

Total number of vaccination doses administered per 100 people in the total population. This is counted as a single dose, and may not equal the total number of people vaccinated, depending on the specific dose regime (e.g. people receive multiple doses).



Pandemics and Global Health

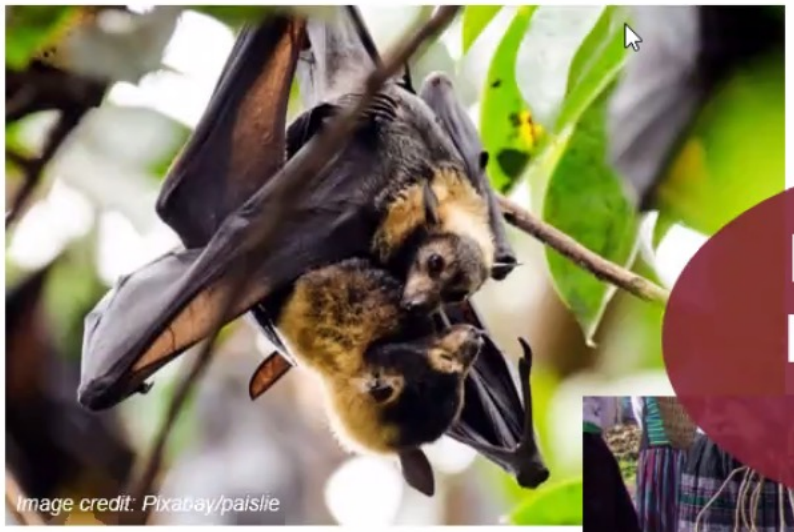
1. The pandemics in human history
2. The concept of Global Health
3. Covid 19: Was it predictable ? What went wrong ?
4. An example of pandemic response: the HIV pandemic
5. What to do: be prepared for the «next one»



What can we do ?

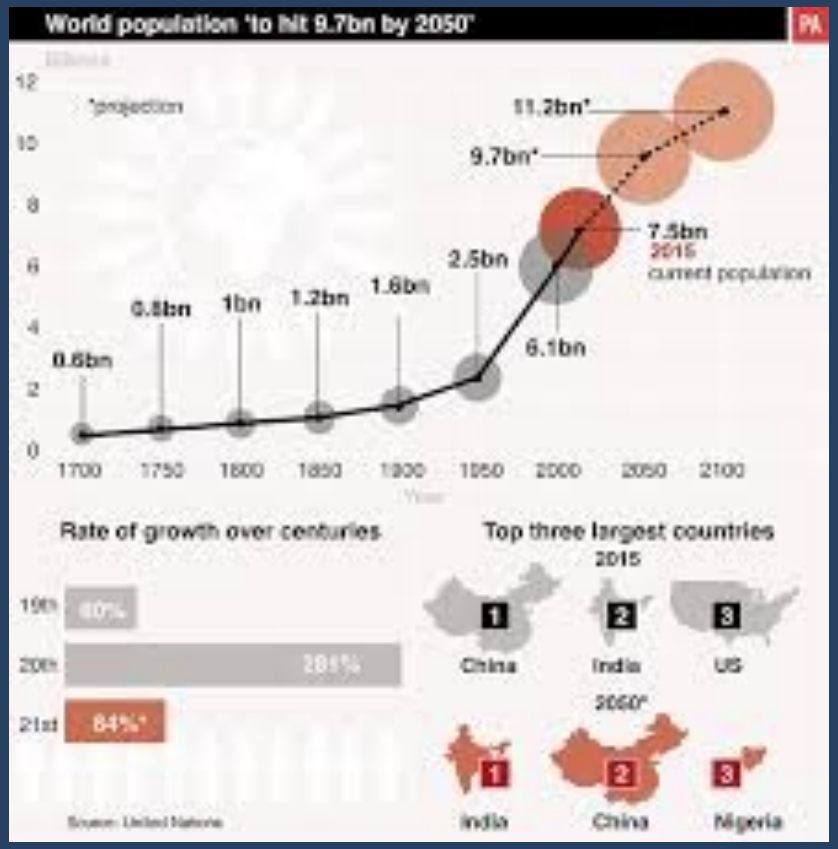
Be Prepared !!

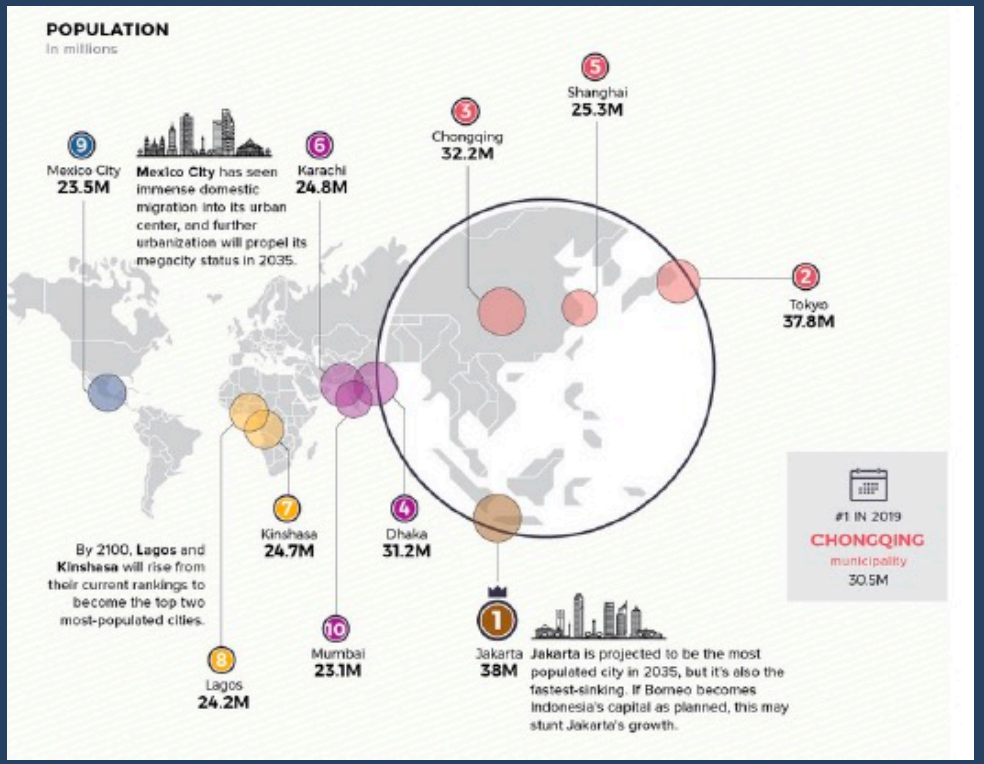
Emerging Infectious Diseases: a complex One Health system



Emerging Infectious Diseases

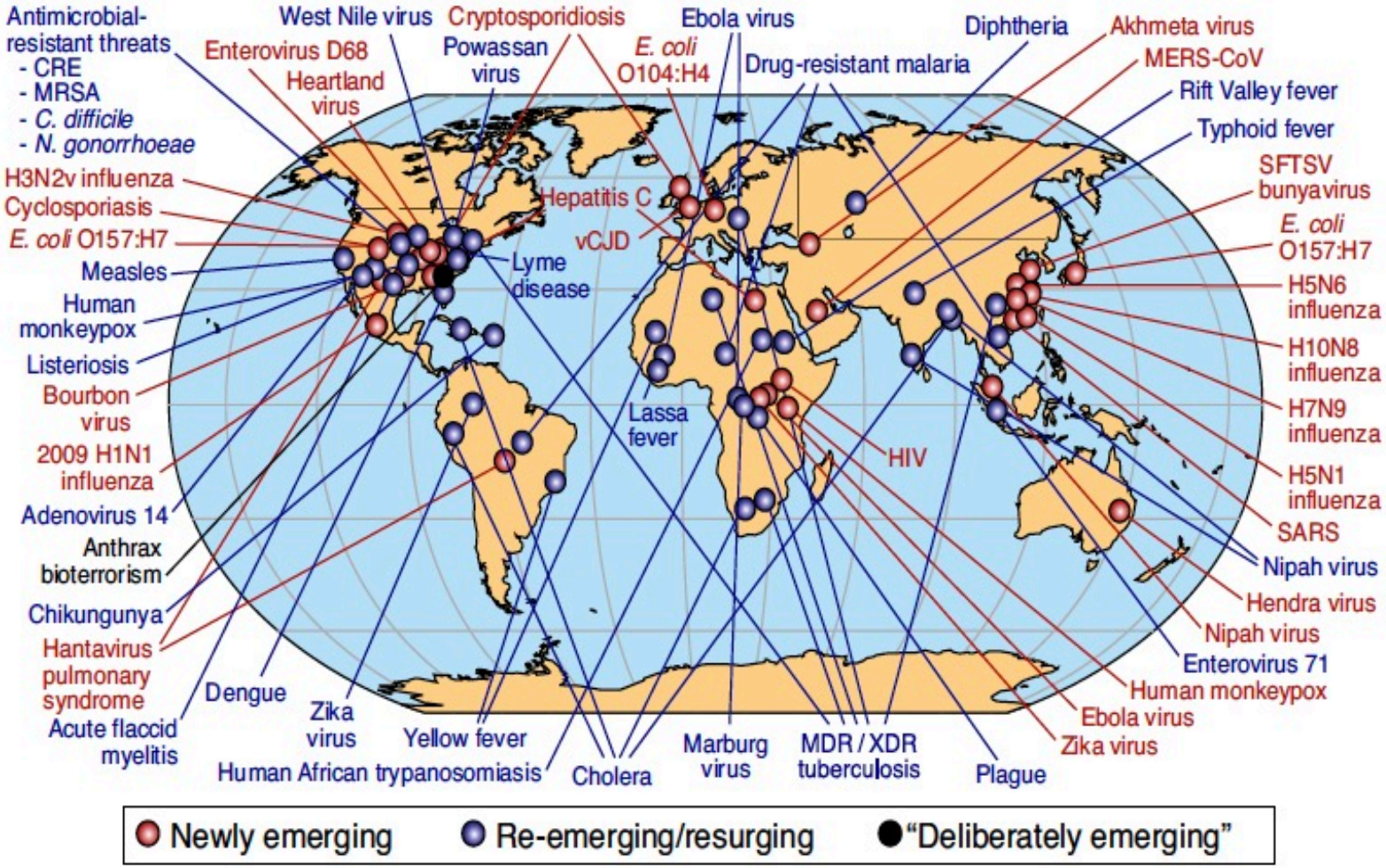
1. CONSIDER THE GROWTH OF THE HUMAN POPULATION





2. and, where we live.....

FIGURE 1 Global examples of emerging and re-emerging diseases



POLICY FORUM

Scientists prepare to collect a blood sample from a *Rousettus sp.* fruit bat in Thailand to test for novel viruses. The Global Virome Project aims to identify and characterize the majority of currently unknown viruses in key wildlife groups, including rodents, nonhuman primates, and bats.

INFECTIOUS DISEASES

The Global Virome Project

Expanded viral discovery can improve mitigation

By **Dennis Carroll, Peter Daszak, Nathan D. Wolfe, George F. Gao, Carlos M. Morel, Subhash Morzaria, Ariel Pablos-Méndez, Oyewale Tomori, Jonna A. K. Mazet**

Outbreaks of novel and deadly viruses highlight global vulnerability to emerging diseases, with many having massive health and economic impacts. Our adaptive toolkit—based largely on vaccines and therapeutics—is often ineffective because countermeasure development can be outpaced by the speed of novel viral emergence and spread. Following each outbreak, the public health community bemoans a lack of prescience, but after decades of reacting to each event with little focus on mitigation, we remain only marginally better protected against the next epidemic. Our ability to mitigate disease emergence is undermined by our poor understanding of the diversity and ecology of viral threats, and of the drivers of their emergence. We describe a Global Virome Project (GVP) aimed to launch in 2018 that will help identify the bulk of this viral threat and provide timely data for public health interventions against future pandemics.

Nearly all recent pandemics have a viral etiology with animal origins, and with their intrinsic capacity for interspecies transmission, viral zoonoses are prime candidates for causing the next great pandemic (*1*, *2*). However, if these viruses are our enemy, we do not yet know our enemy very well. Around 263 viruses from 25 viral families are known to infect humans (*3*) (see the figure), and given the rate of discovery following identification of the first human virus (yellow fever virus in 1901), it is likely many more will emerge in the future (*4*). We estimate, from analysis of recent viral discovery data (*5*), that ~1.67 million yet-to-be-discovered viral species from key zoonotic viral families exist in mammal and bird hosts—the most important reservoirs for viral zoonoses (supplementary text).

By analyzing all known viral-host relationships (*3*, *6*), the history of viral zoonoses (*7*), and patterns of viral emergence (*1*), we can reasonably expect that between 631,000 and 827,000 of these unknown viruses have zoonotic potential (supplementary text). We have no readily available technological countermeasures to these as-yet-undiscovered viruses. Furthermore, the rate of zoonotic viral spillover into people is accelerating, mirroring the expansion of our global footprint and travel networks (*1*, *8*), leading to a nonlinear rise in pandemic risk and an exponential growth in their economic impacts (*8*).

PROMISING PILOT, CHALLENGING SCALE

Since 2009, the U.S. Agency for International Development (USAID) has conducted a large-scale pilot project, spanning more than 35 countries over 8 years at a cost of around $170 million, to evaluate the feasibility of preemptively mitigating pandemic threats. Other previous studies had begun to conduct targeted viral discovery in wildlife (*9*), and develop mitigation strategies for the emergence of avian flu, for example. However, the USAID Emerging Pandemic Threats (EPT) PREDICT project is the first global-scale coordinated program designed to conduct viral discovery in wildlife reservoir hosts, and characterize ecological and socioeconomic factors that drive their risk of spillover, to mitigate their emergence in people (*10*).

Working with local partners and governments, wildlife and domestic animals and at-risk human populations in geographic hotspots of disease emergence (*1*) are sampled, and viral discovery conducted. A strategy to identify which novel viruses are most at risk of spillover has been developed (*11*), and further work is conducted on these to characterize them prior to, or in the early stages of, spillover. Metadata on the ecology of wildlife–livestock–human transmission interfaces, and on human behavioral patterns in communities, are concurrently analyzed so that strategies to reduce spillover can be developed (supplementary text). To date, EPT PREDICT has discovered more than 1000 viruses from viral families that contain zoonoses, including viruses involved in recent outbreaks (*12*), and others of ongoing public health concern (*13*). The focus of EPT PREDICT on capacity building, infrastructure support, training, and epidemiological analysis differs substantially from the GVP's emphasis on large-scale sampling and viral discovery. However, to discover the bulk of the projected remaining 167 million unknown viruses in animal reservoirs and characterize the majority of 631,000 to 827,000 viruses of highest zoonotic potential requires overcoming some challenges of scale.

The first challenge is cost. To estimate this, we analyzed data on field sampling and laboratory expenditures for viral discovery from (*5*, *10*), and estimates of unknown viral diversity in mammalian and avian hosts (supplementary text). We estimate that discovery of all viral threats and characterization of their risk for spillover, using currently available technologies and protocols, would be extremely costly at over $7 billion (supplementary text). However, previous work shows that viral discovery rates are vastly higher in the early stages of a sampling program, and that discovering the last few, rare, viruses is extremely costly and time-consuming owing to the number of samples required to find

The list of author affiliations is provided in the supplementary materials. Email: daszak@ecohealthalliance.org

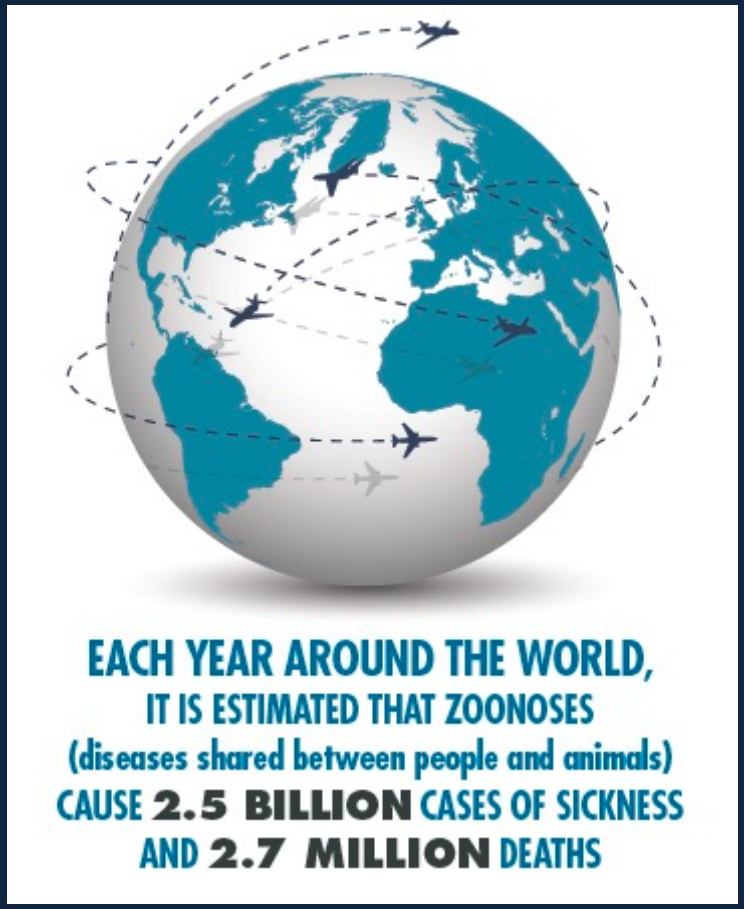
111 viral families have been discovered globally to date.

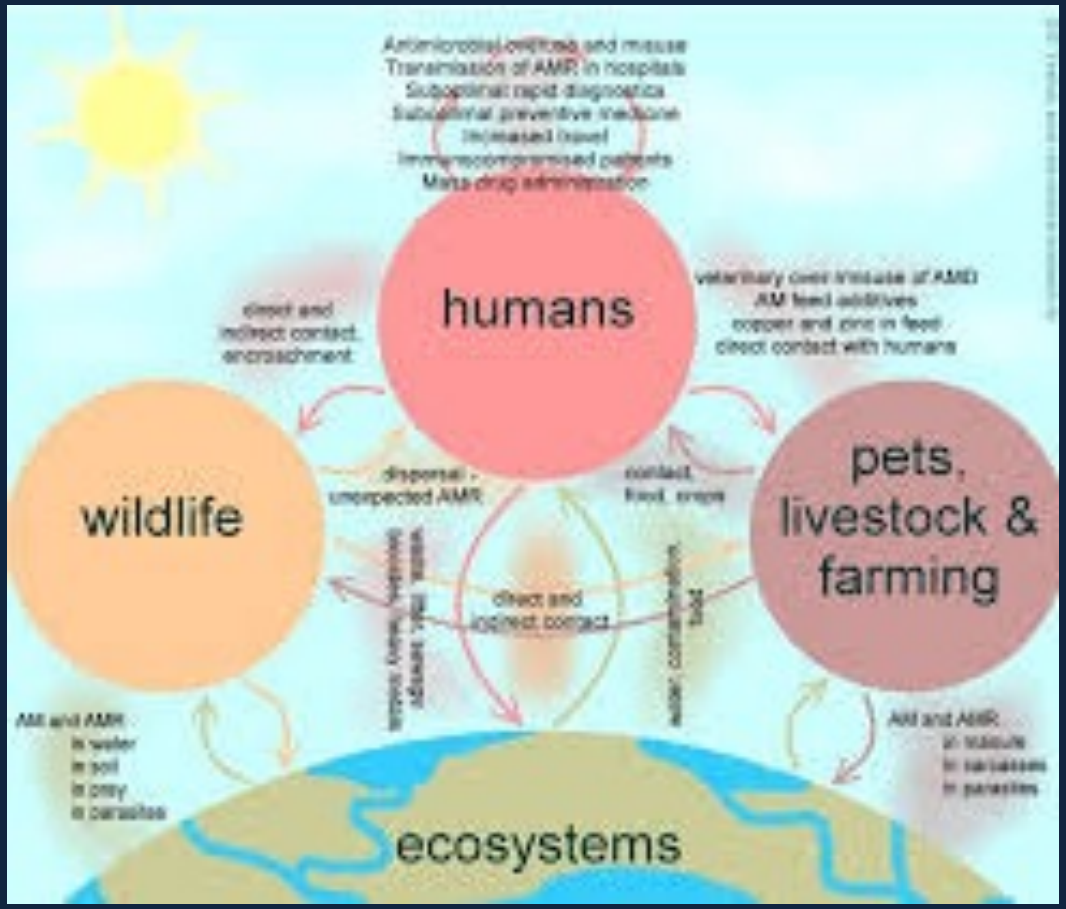
Of these 111 viral families, the GVP will target **25** containing viruses known to infect (or to have substantial risk of infecting) people.

In these 25 families, an estimated **1.67 million** unknown viruses exist in mammals and birds—hosts that represent 99% of the risk for viral emergence.

Of these 1.67 million viruses, an estimated **631,00 to 827,000** likely have the capacity to infect people.

4. The one health approach

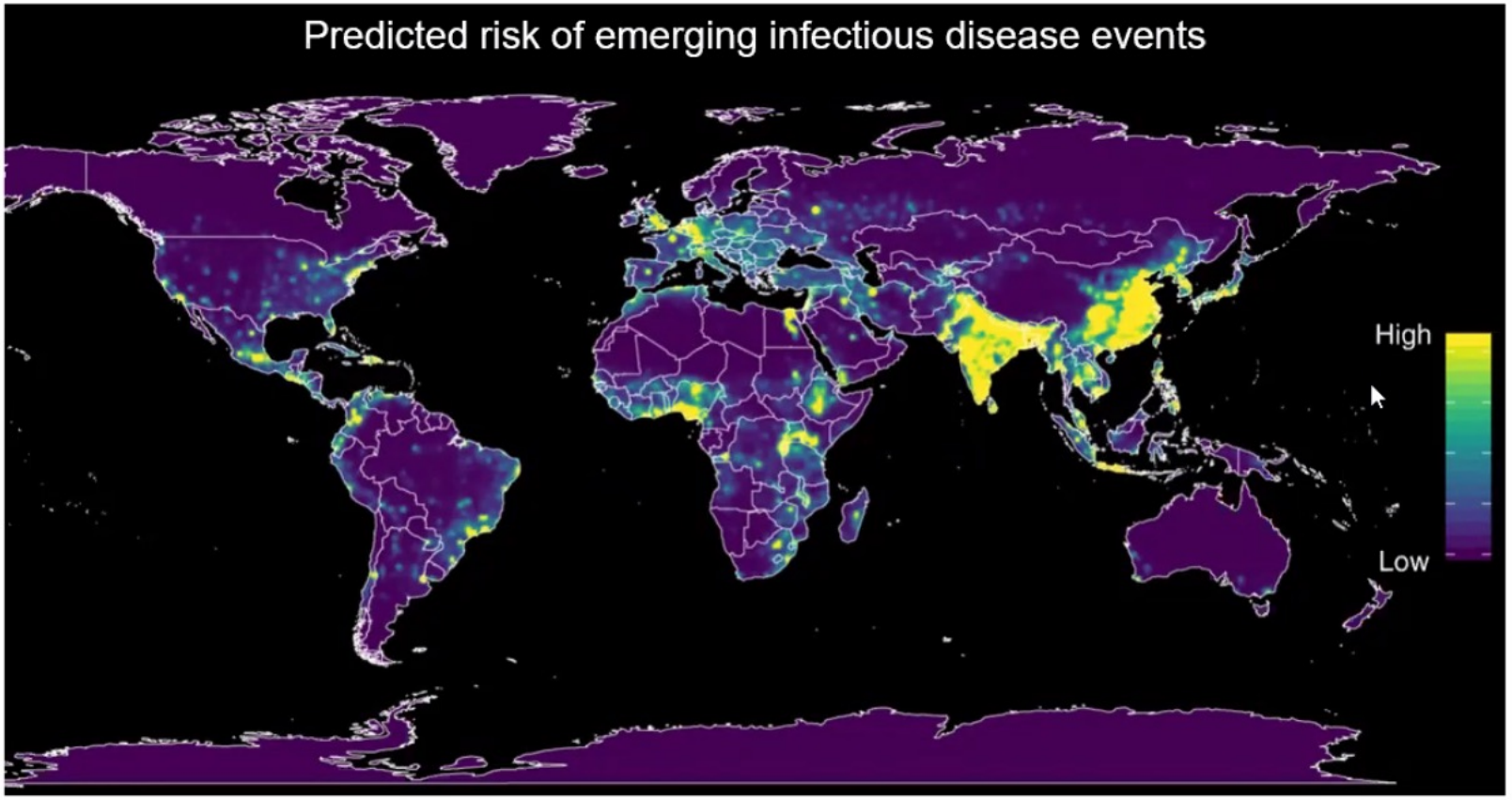




Sustainable Development must account for pandemic risk

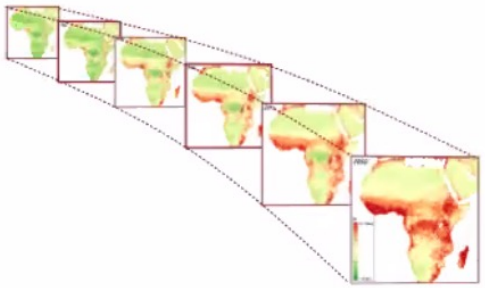
Di Marco, Baker, Daszak, De Barro, Eskew, Godde et al. (2020) PNAS, 117:3888-3892

Risk of emerging infectious disease (zoonotic)



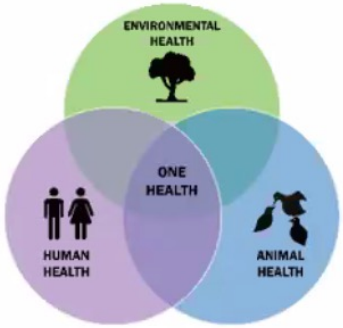
Allen, Murray, Zambrana-Torrelio, Morse, Rondinini, Di Marco, Breit, Olival, Daszak (2017) Nature Communications 8(1):1124.

One Health Preparedness: Prevent → Detect → Respond → Recover



Invest in multidisciplinary environmental science to predict and forecast risk → use predictions to inform socio-economic planning

Prevent environmental/biodiversity loss in areas of high EID risk; regulate both wildlife AND livestock trade and farming



Establish an international One Health Fund with a strong biodiversity component and a science-policy mandate

Center for Global Development

Financing the Global Commons for PANDEMIC PREPAREDNESS AND RESPONSE

The Challenge

The COVID-19 pandemic, catastrophic as it is, is **not a one-off event**.

We must **plan for an endemic COVID-19 as well as the future risk** of more frequent and severe pandemics.

Vaccinating a majority of the population in all countries is the most urgent priority of the international community today.

Preventing future pandemics is also a race against time, and has to be a central obligation of national and global governance.

We must ensure that the world is better equipped to detect, prevent and counter another major outbreak. It could be worse than COVID-19.

Plugging Four Major Global Gaps

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1	Global surveillance and R&D: to prevent and detect emerging infectious diseases
2	Resilient national systems: to strengthen a critical foundation for global pandemic prevention, preparedness and response (PPR)
3	Supply capacity for medical countermeasures: to radically shorten the response time in a pandemic
4	Global governance: to ensure that the system is tightly coordinated, properly funded and with clear accountability for outcomes

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Financing Pandemic PPR: the Basic Approach

Pandemic PPR is fundamentally not about aid, but investment in global public goods for which all nations benefit.

- Pandemic PPR should be anchored in enhanced multilateral funding.
  - Prevention and Preparedness require predictable and sustainable funding
  - IFIs' financing of response must be scaled up and enable timely access
  - Discretionary bilateral funding as an important complement and a catalyst for action
  - All funding flows must show clear accountability for outcomes

Recommendations – *for bold and vital reforms*

1. **Elevate leadership to prepare for and respond to global health threats to the highest levels to ensure just, accountable and multisectoral action**
   - Establish a high-level ***Global Health Threats Council*** led by Heads of State and Government.

Recommendations – *for bold and vital reforms*

2. Strengthen the independence, authority and financing of WHO

- ***Focus WHO's mandate on normative, policy, and technical guidance***; empower WHO to take a leading, convening, and coordinating role in operational aspects of an emergency response.
- Establish the ***financial independence of WHO*** based on fully unearmarked resources, and on an increase in Member States' fees to two-thirds of the WHO base Programme Budget.
- Strengthen the authority and independence of the Director-General, including by having ***a single term of office of seven years with no option for re-election***.
- ***Resource and equip WHO Country Offices*** sufficiently to respond to technical requests from national governments to support pandemic preparedness and response, including support to build resilient equitable and accessible health systems and universal health coverage.

Recommendations – *for bold and vital reforms*

3. Invest in preparedness now to prevent the next crisis

- ***All national governments to update their national preparedness plans*** against targets and benchmarks to be set by WHO within six months, ensuring that there are appropriate and relevant skills, logistics and funding available to cope with future health crises.
- ***WHO to formalize universal periodic peer reviews*** as a means of accountability and learning between countries.
- The ***IMF should routinely include a pandemic preparedness assessment***, including an evaluation of economic policy response plans, as part of the ***Article IV consultation*** with member countries.

Recommendations – *for bold and vital reforms*

4. A new agile and rapid surveillance information and alert system

- ***WHO to establish a new global system for surveillance, based on full transparency*** by all parties, using state-of-the-art digital tools.
- ***The World Health Assembly to give WHO both the explicit authority to publish information*** about outbreaks with pandemic potential immediately without requiring the prior approval of national governments, and the power to ***investigate pathogens with pandemic potential*** with short-notice access to relevant sites, provision of samples, and standing multi-entry visas for international epidemic experts to outbreak locations.
- ***Future declarations of a public health emergency of international concern should be based on the precautionary principle*** where warranted, as in the case of respiratory pathogens, and on clear, objective, and published criteria.

Recommendations – *for bold and vital reforms*

5. Establish a pre-negotiated platform for tools and supplies

- ***Transform the current ACT-A into a truly global end-to-end platform*** to deliver the global public goods of vaccines, therapeutics, diagnostics, and essential supplies.
- ***Secure technology transfer and commitment to voluntary licensing*** in all agreements where public funding has been invested in research and development.
- ***Establish stronger regional capacities for manufacturing, regulation, and procurement*** of needed tools for equitable and effective access to vaccines, therapeutics, diagnostics, and essential supplies, as well as for clinical trials.

Recommendations – *for bold and vital reforms*

6. Raise new international financing for pandemic preparedness and response

- ***Create an International Pandemic Financing Facility*** to raise additional reliable funding for pandemic preparedness, and for rapid surge financing for response, with the capacity to mobilize long term (10-15 year) contributions of approximately US$5-10 billion per annum to finance preparedness and the ability to disburse up to US$50-100 billion at short notice in the event of a crisis.
- There should be ***an ability-to-pay formula adopted*** whereby larger and wealthier economies will pay the most, ***preferably from non-ODA budget lines*** and additional to established ODA budget levels.
- The ***Global Health Threats Council will have the task of allocating and monitoring funding*** from this instrument.

Thank you for lessoning...

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