

# Unwelcome Guests: Human Diseases

Gresham College Lecture 2013

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SCHOOL of  
HYGIENE  
& TROPICAL  
MEDICINE



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for International  
Development

The tendency to assume infections can be stopped at national borders is natural, longstanding and almost always wrong.

'This fortress built by nature for herself against infection and the hand of war'

*Shakespeare*



# Global spread rapid even in pre-industrial times: plague



# Plague an example of the power of infectious disease to shape human history across space- and human capacity to respond.

- Plague reduced the world population from an estimated 450 million down to 350–375 million in the 14th century.
- 30-60% of Europe's population died.
- Risk of a plague epidemic now zero (WHO).



# Where there is trade, travel or war

Disease will follow

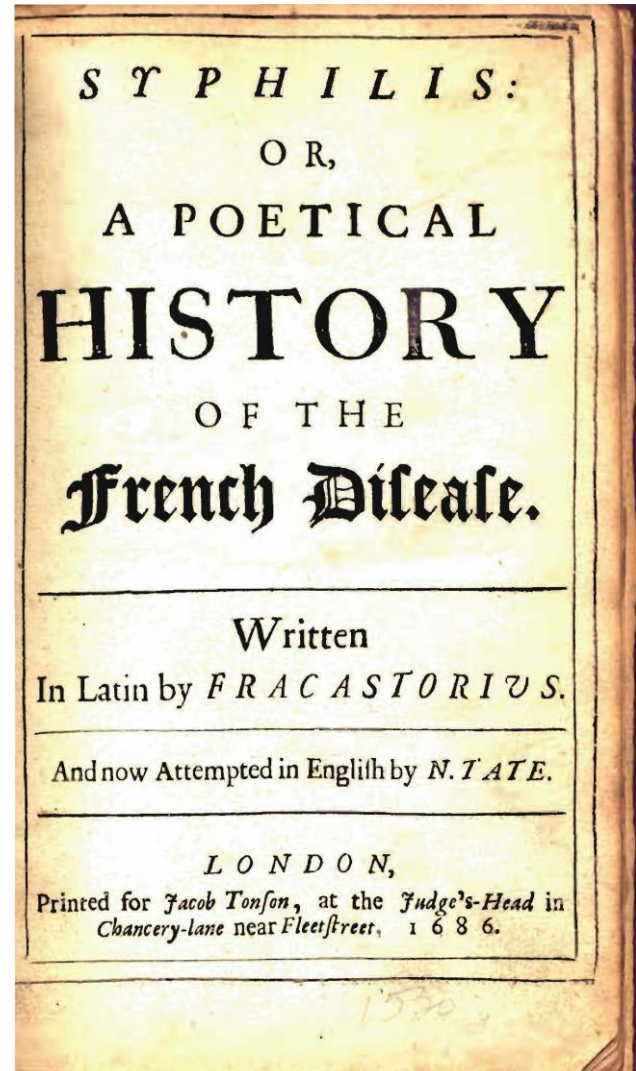
Syphilis:

- Arrived Europe C1493
- In Edinburgh by 1497

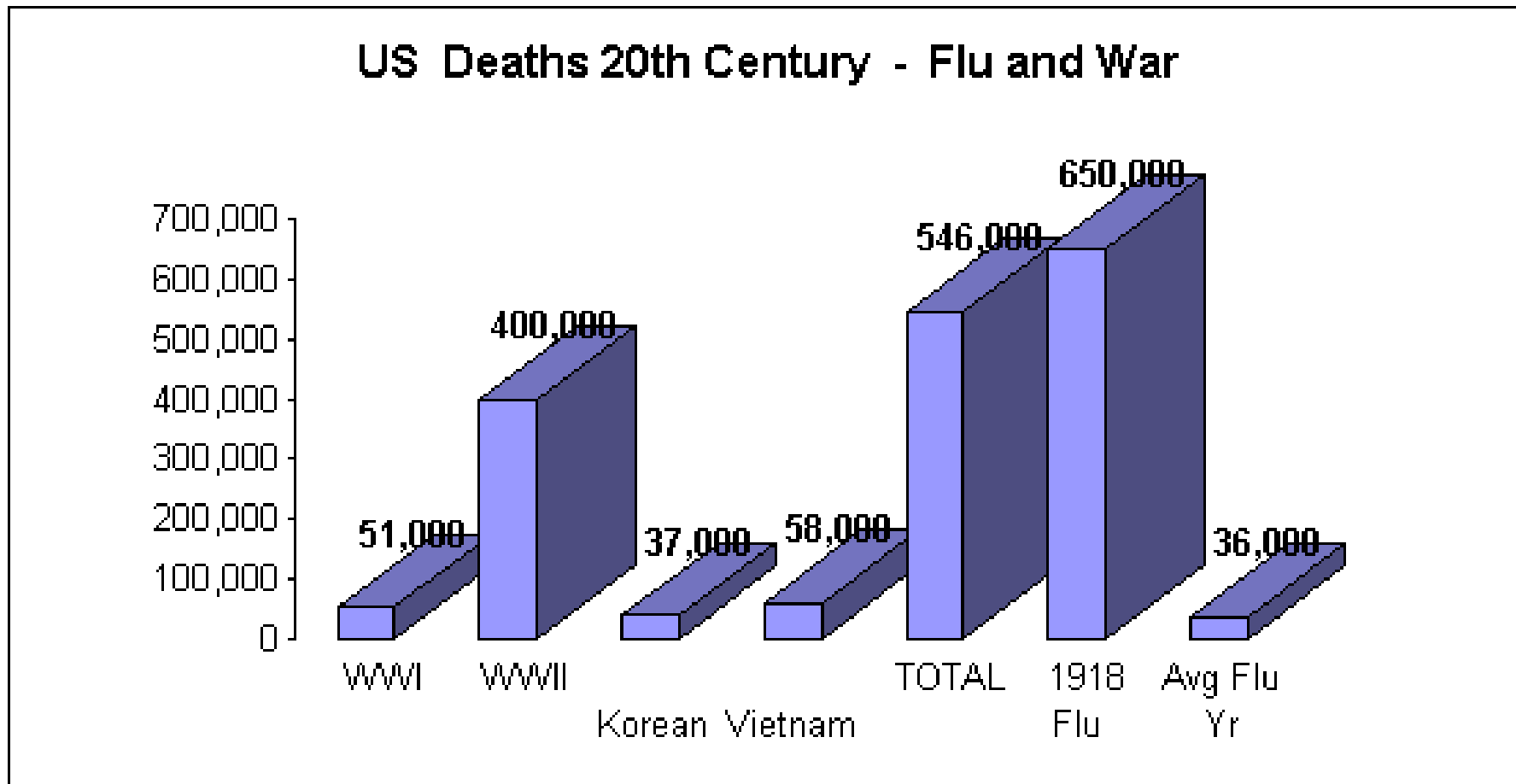


# Foreigners are often blamed, not always fairly...

- French Pox (Morbus Gallicus)
- Spanish pox
- Neapolitan disease
  
- German measles
- Spanish 'flu
- Mexican pig 'flu



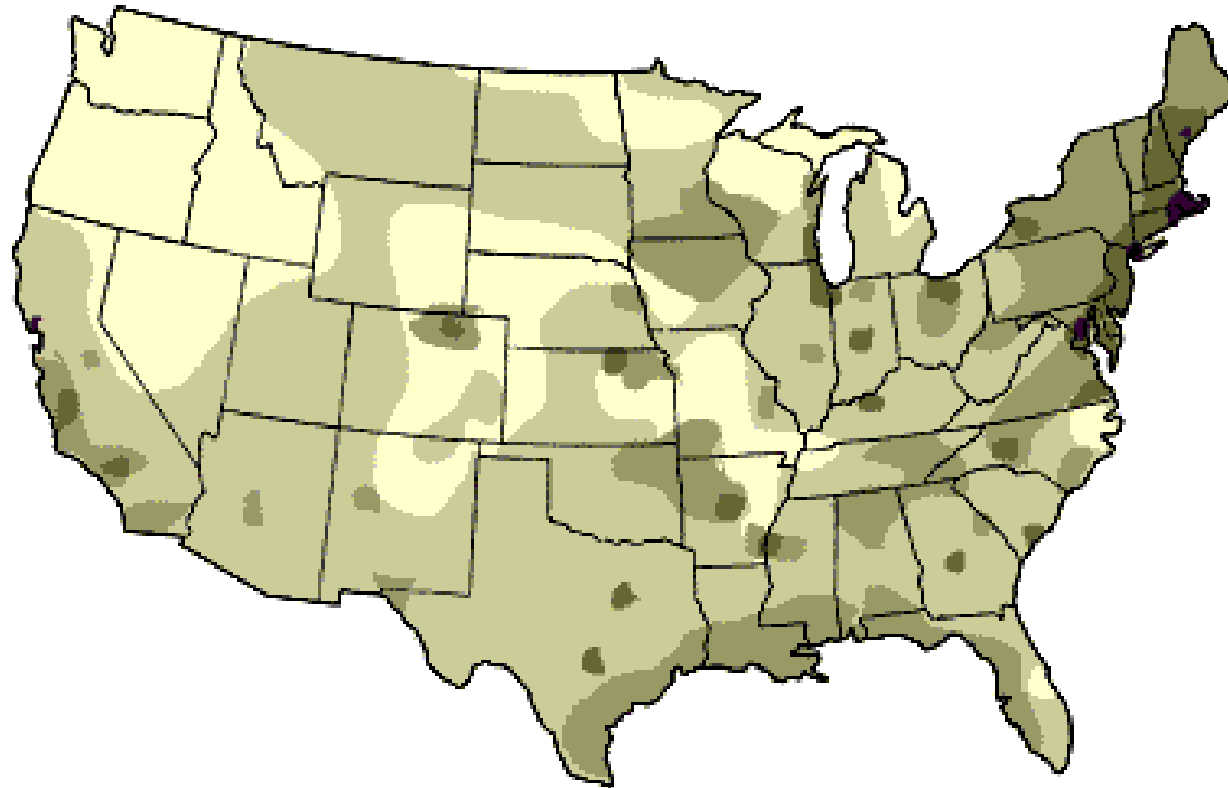
# Influenza killed more in 20<sup>th</sup> C than war- 22m in 1918-1922 alone



# Influenza 1918

## Approximate beginning of the epidemic, 1918

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before  
sept. 14

between  
sept. 14 - 21

between  
sept. 21 - 28

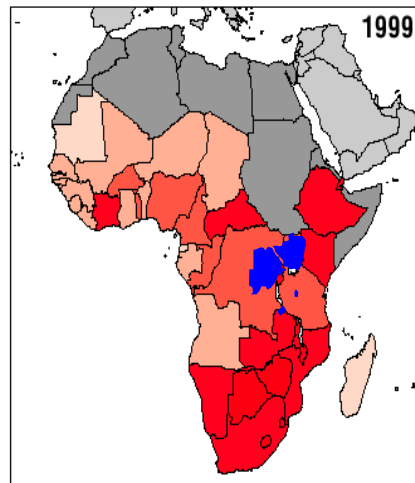
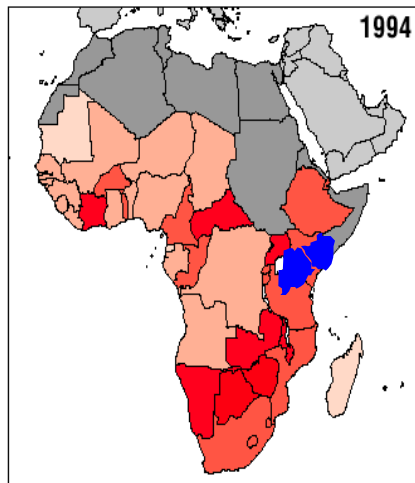
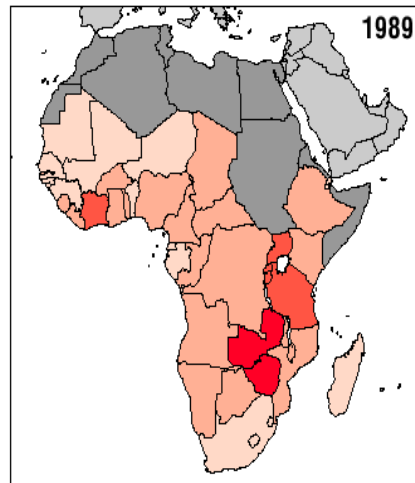
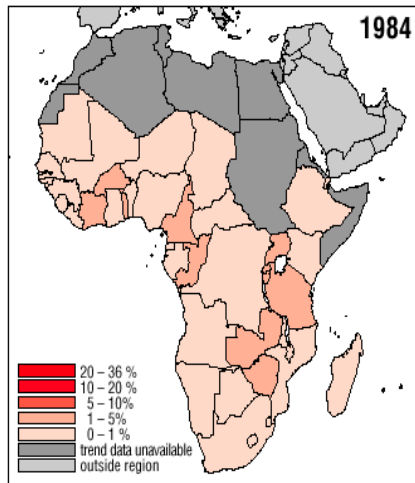
between  
sept. 28 - oct. 5

after  
oct. 5

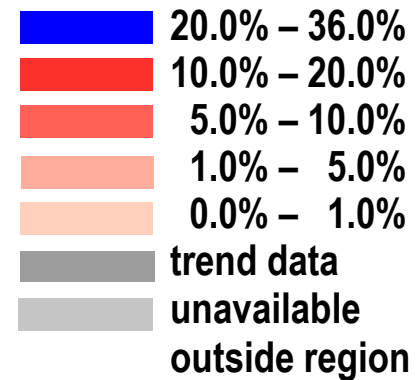
Source: *America's Forgotten Pandemic - The Influenza of 1918 - 1989*



# Spread of HIV in Africa, 1984 to 1999



Estimated percentage of adults (15-49) infected with HIV

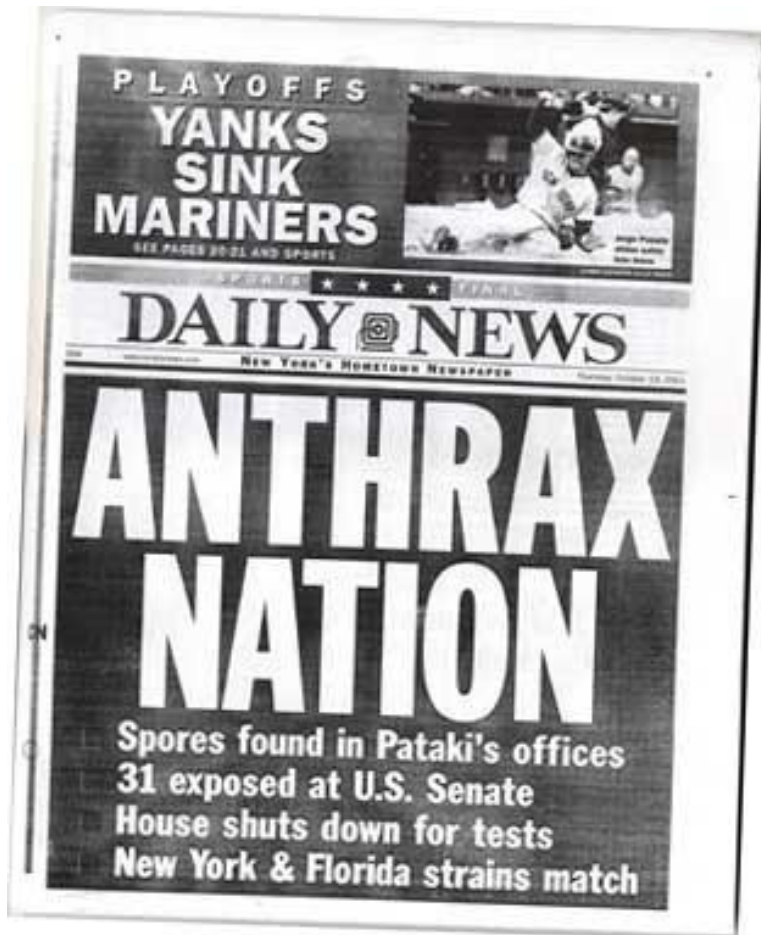


Complexity of networks and speed of travel increasing.



Infectious diseases often cause panic disproportionate to the real risk

2001- 5 dead. 650 people a week die on the roads

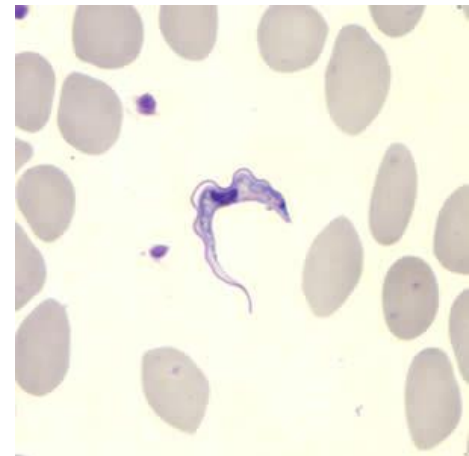
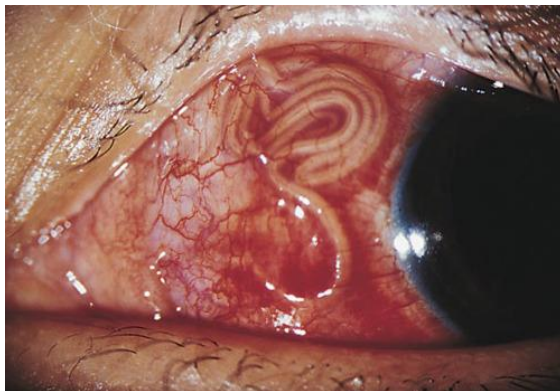


# Or because the risk is uncertain in a new disease: SARS, BSE

- Between November 2002 and July 2003 SARS caused 8,273 cases and 775 deaths in 37 countries.
- Around \$40bn cost to global economy
- cf around 100,000 smoking-related deaths in UK a year.



Many diseases you can catch overseas and import will not be transmitted because they need a tropical vector (eg malaria, dengue)



Or because you have to catch it from something you eat- especially uncooked exotic foods



Photo Credit: Leo G. Nico, USGS, Gainesville, FL



# Other things that can transmit infections

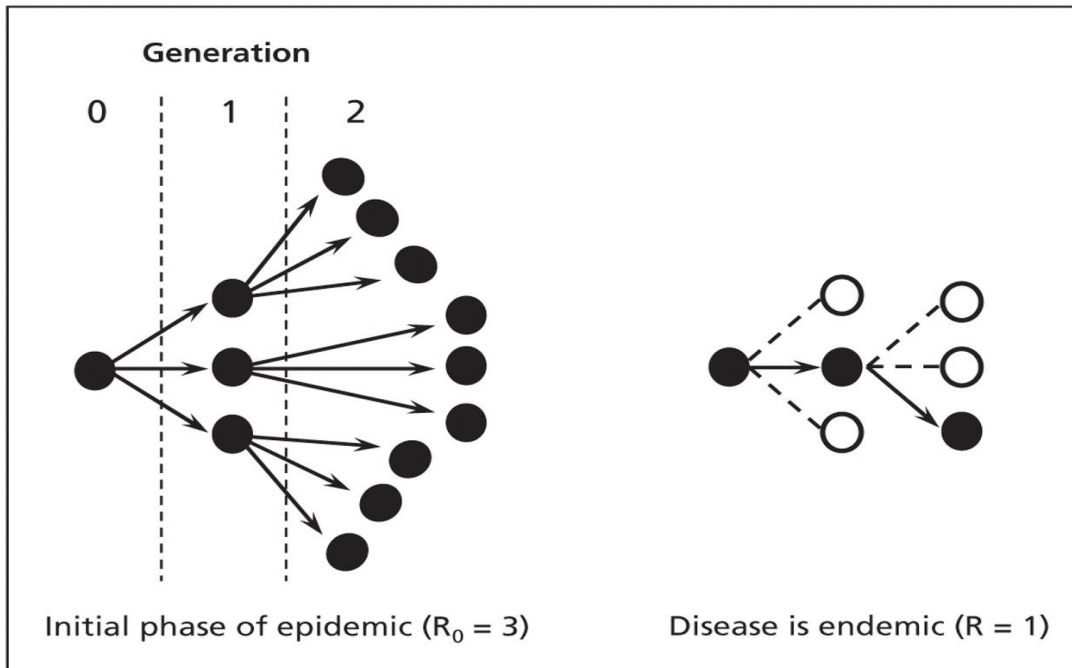
## UK citizens are as liable to do as others:

- Breathing
- Eating
- Drinking
- Touching
- Sex



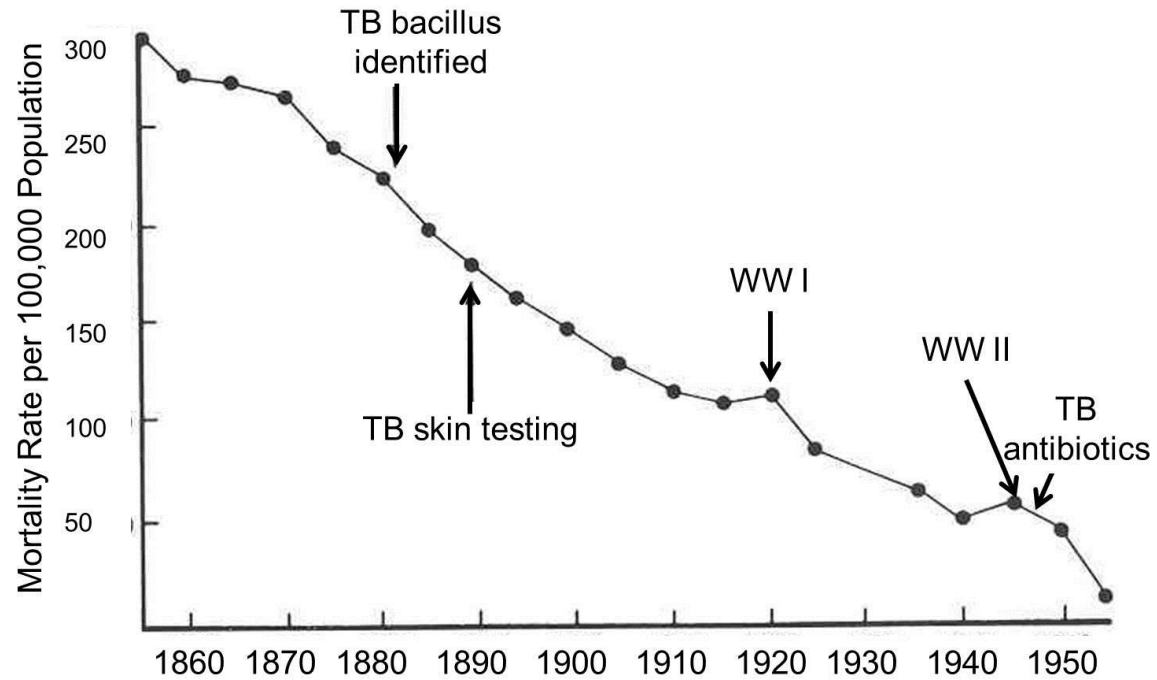
# The mathematics of transmission- $R_0$

- If greater than 1- increasing
- If 1 stable
- If less than 1- decreasing. Elimination possible.





# Tuberculosis UK- socioeconomic development.



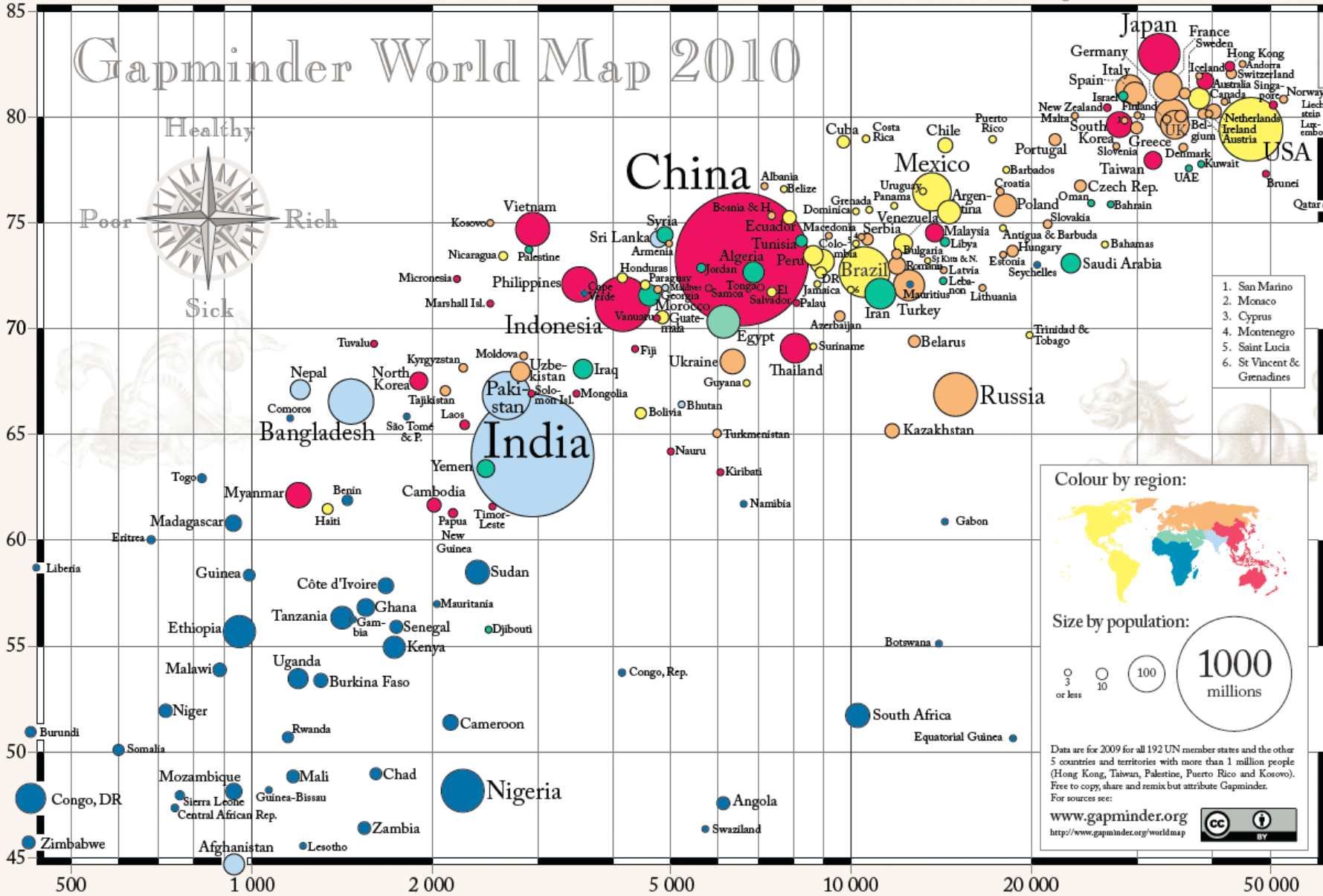
Low-income countries

Middle-income countries

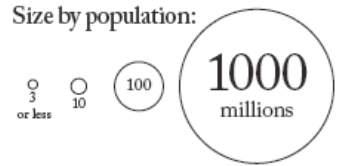
High-income countries

# Gapminder World Map 2010

Health Life expectancy at birth (years)



1. San Marino
2. Monaco
3. Cyprus
4. Montenegro
5. Saint Lucia
6. St Vincent & Grenadines



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) <http://www.gapminder.org/worldmap>

Money GDP per person in US dollars (purchasing power adjusted) (log scale)

GAPMINDER

Chart

Map

Gapminder World (April 7, 2011)



Color

Gapminder Geogra...

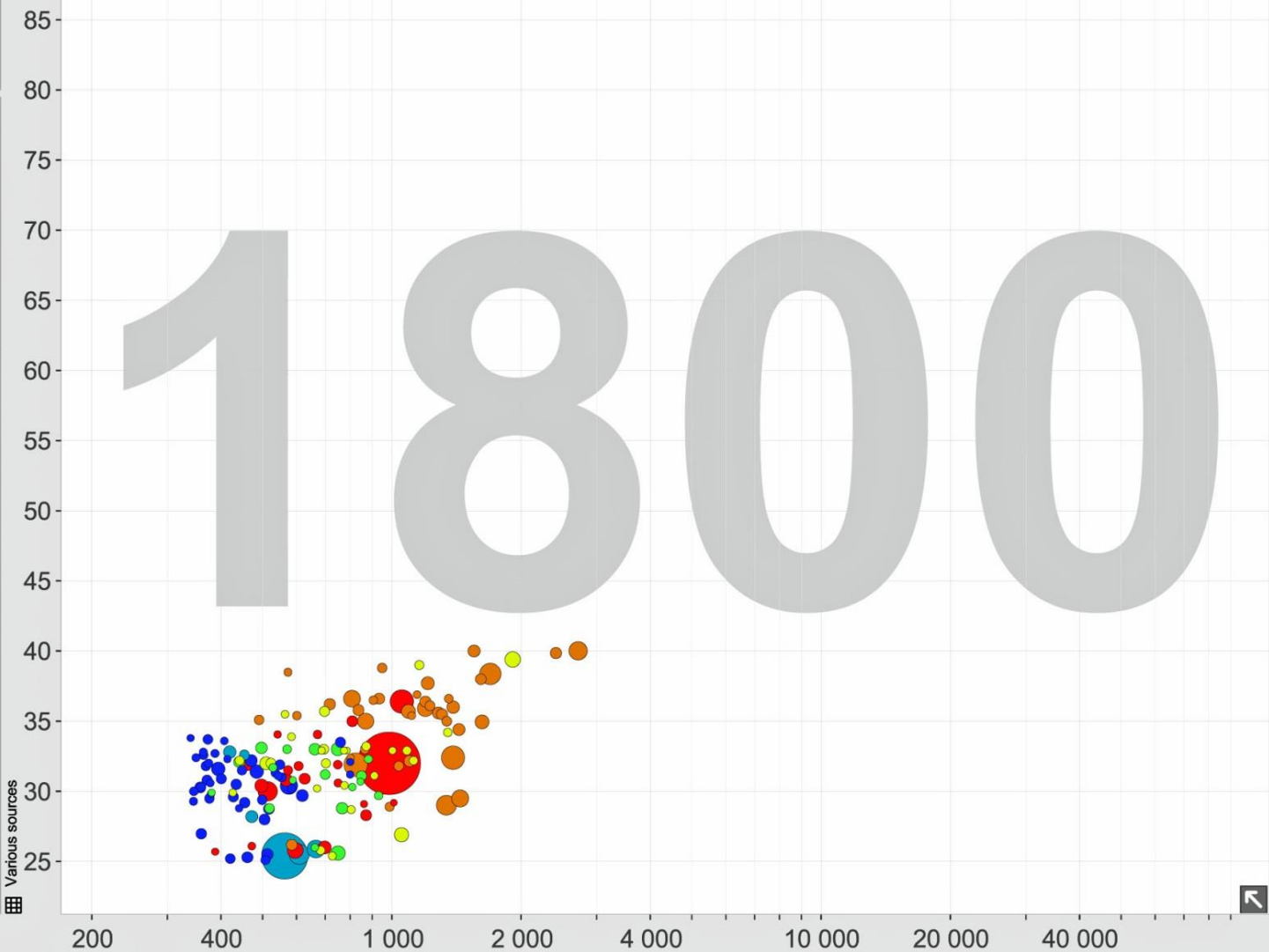


Select

- Afghanistan
  - Albania
  - Algeria
  - Angola
  - Argentina
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  - Aruba
  - Australia
  - Austria
  - Azerbaijan
  - Bahamas
  - Bahrain
  - Bangladesh
- Deselect all

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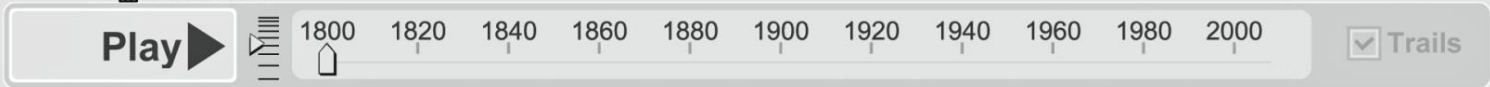
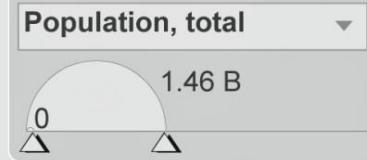
Life expectancy (years)



Income per person (GDP/capita, PPP\$ inflation-adjusted) log

Size

Various sources



Terms of use

© Google 2008

Chart

Map

Gapminder World (April 7, 2011)



Color

Gapminder Geogra...

Geographic regions



Select

- Afghanistan
- Albania
- Algeria
- Angola
- Argentina
- Armenia
- Aruba
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Deselect all

Size

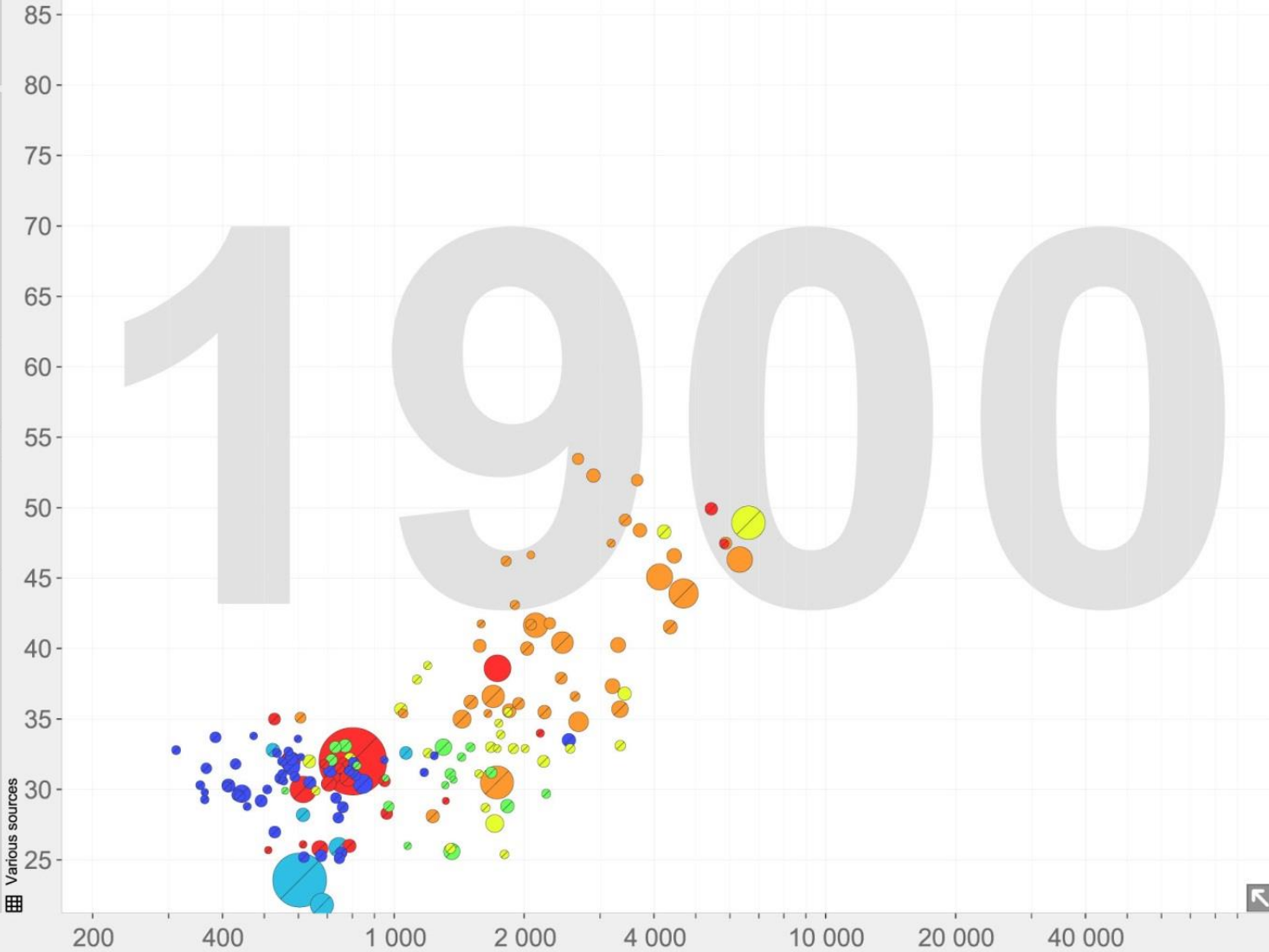
Various sources

Population, total



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Life expectancy (years)



Income per person (GDP/capita, PPP\$ inflation-adjusted)

log

Play

1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000

Trails

# Access to water and sanitation

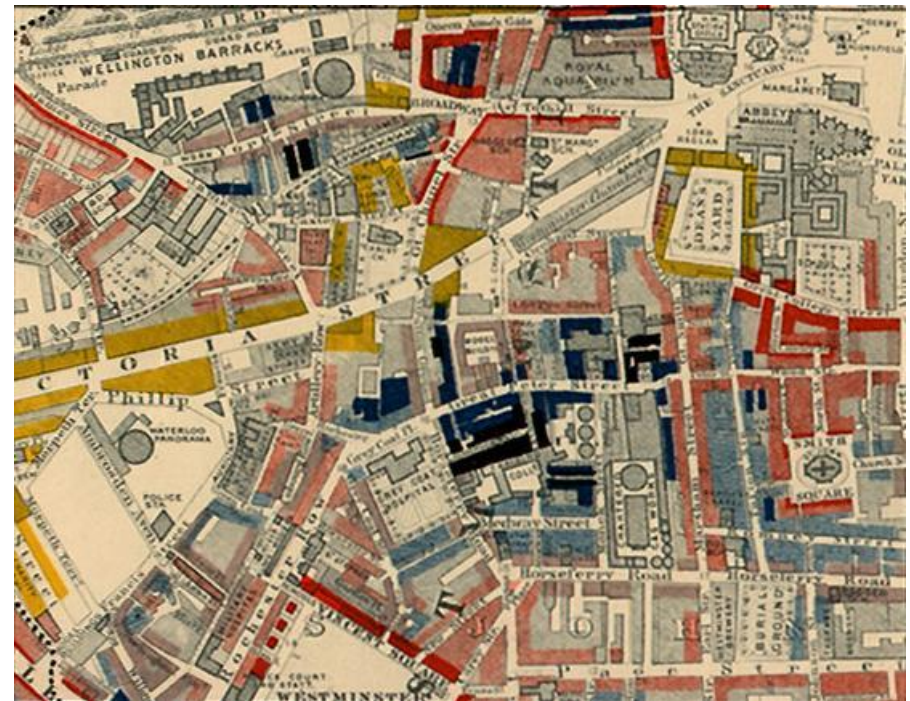
- Cholera
- Typhoid
- Polio
- Scabies
- Trachoma



# Better housing, less crowding; examples TB, typhus

[By the] Abbey of Westminster there lie concealed labyrinths of lanes and courts, and alleys and slums, nests ... of squalor, wretchedness, and disease; whose atmosphere is typhus, whose ventilation is cholera; in which swarms of huge and almost countless population... haunts of filth, which no sewage committee can reach.

*Cardinal Wiseman 1850*



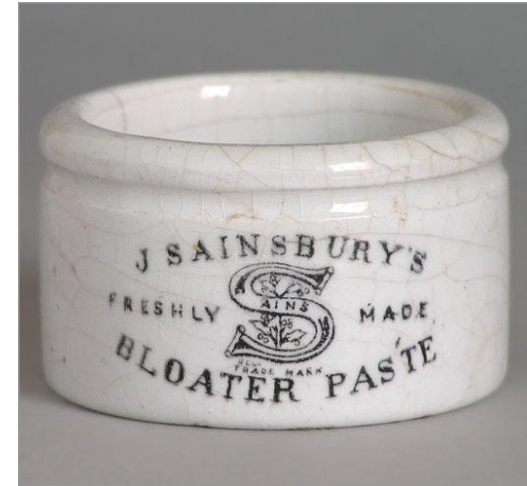


. HUT ON WHEELS, FORMERLY USED BY MIGRATOR  
LABOURERS IN THE ROMAN CAMPAGNA



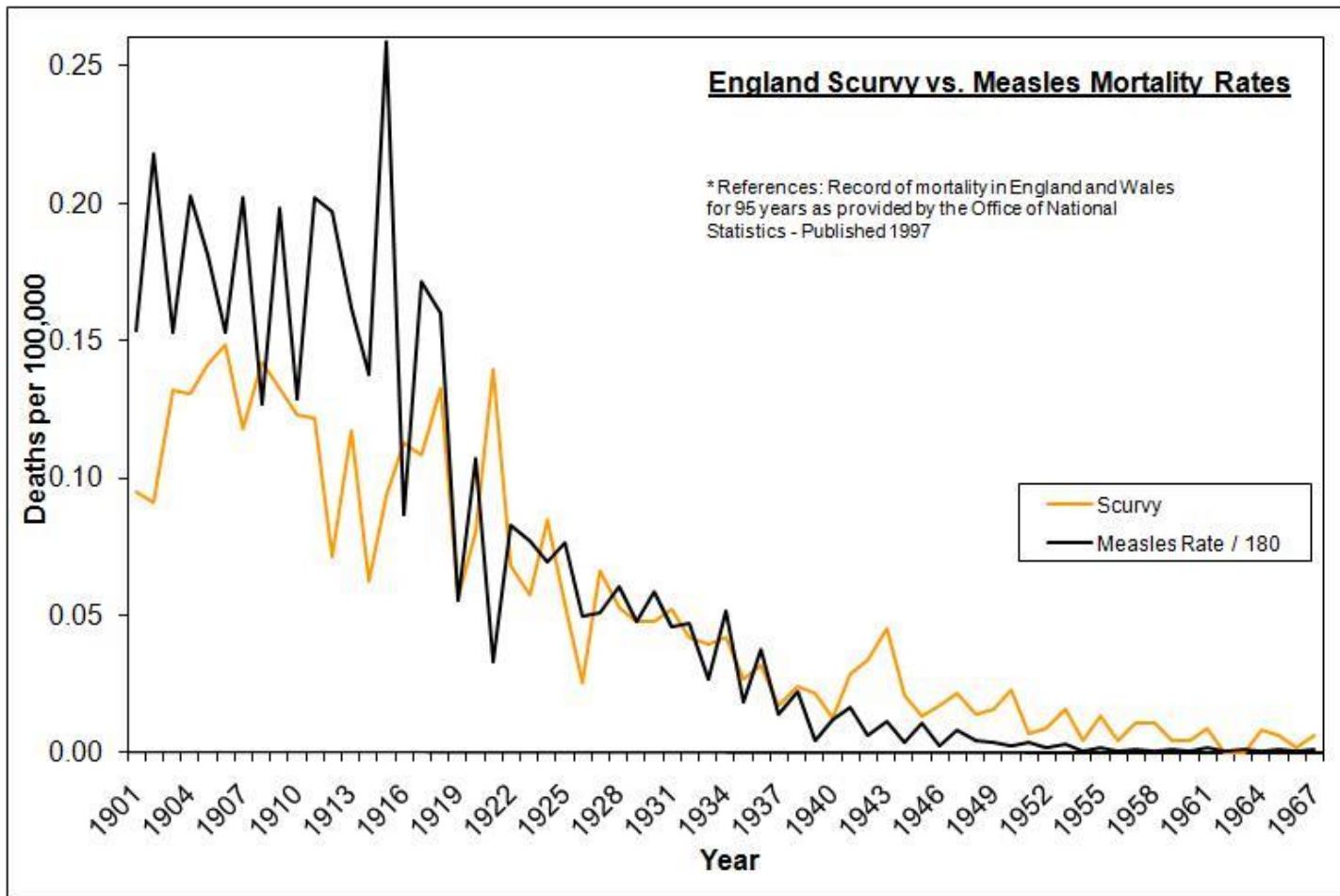
# Better nutrition

- Total protein-energy nutrition for most infections
- Specific deficiencies such as Vitamin A (measles) Vitamin D (TB)



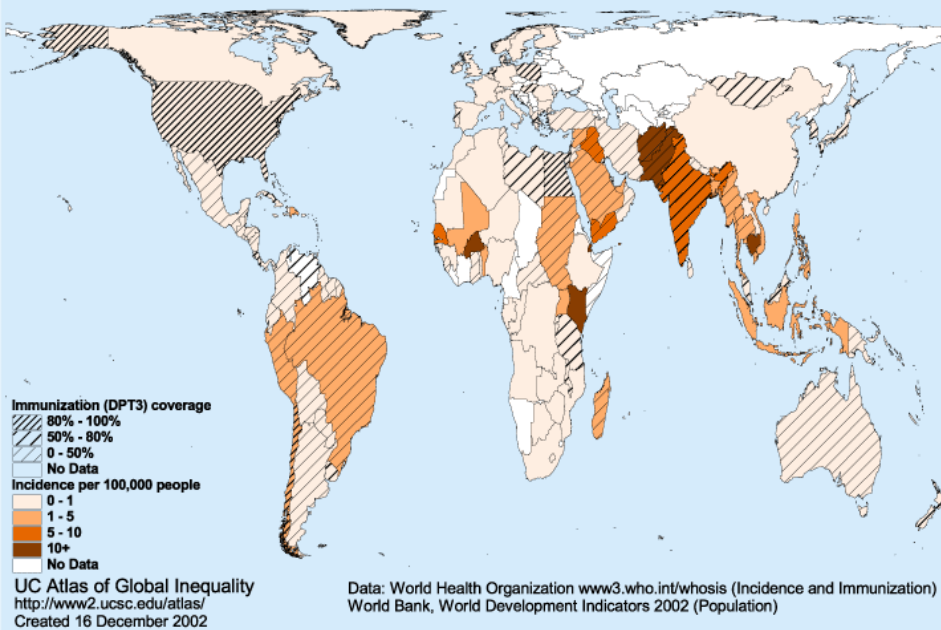


# Scurvy (as a proxy for nutrition) and measles mortality, England 1901-1967

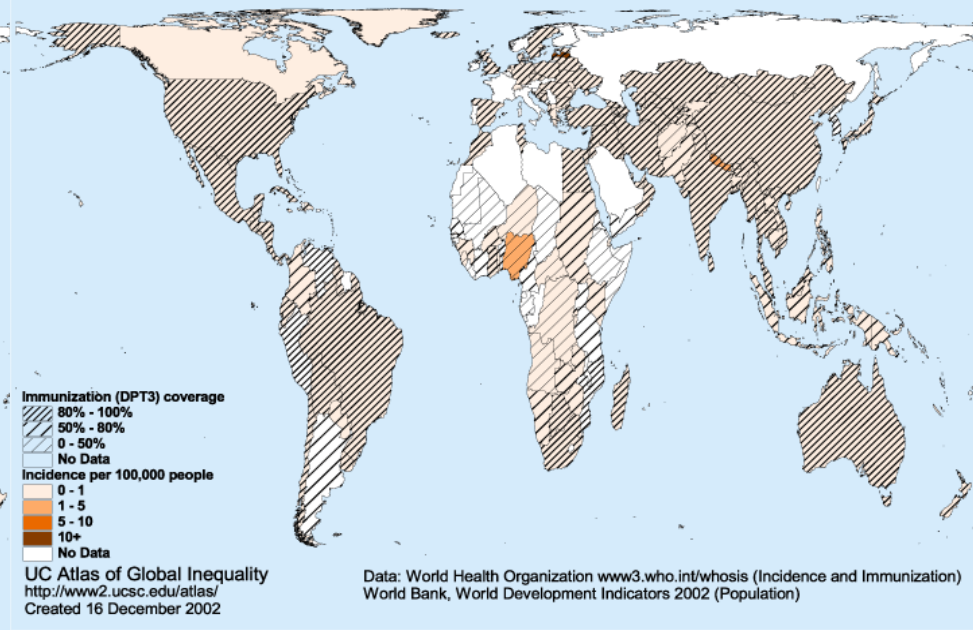


# Vaccines

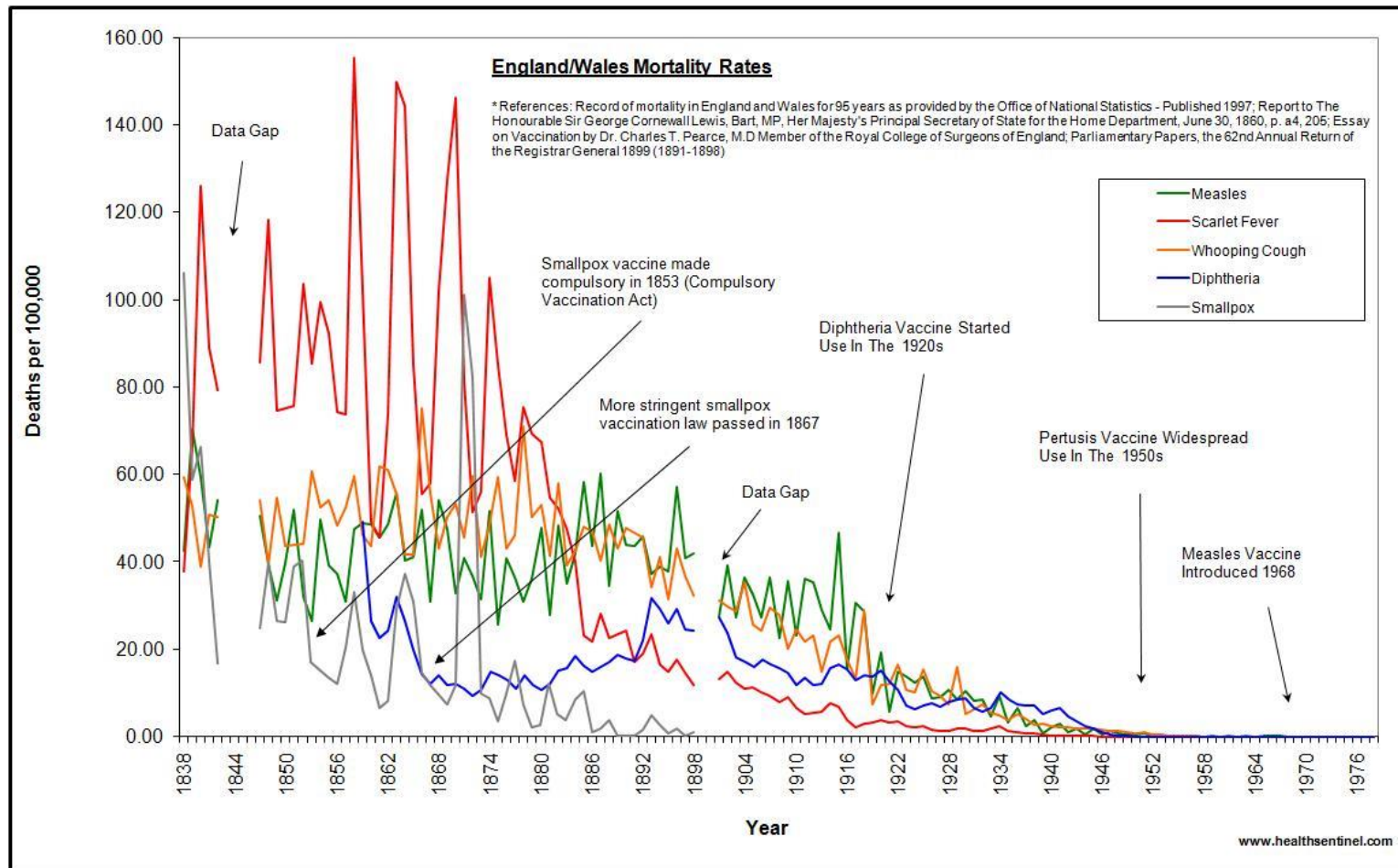
## Diphtheria 1980: Incidence and Immunization



## Diphtheria 2000: Incidence and Immunization



# Mortality from selected infectious diseases, England and Wales 1840-1970



# Better access to cure- antibiotics



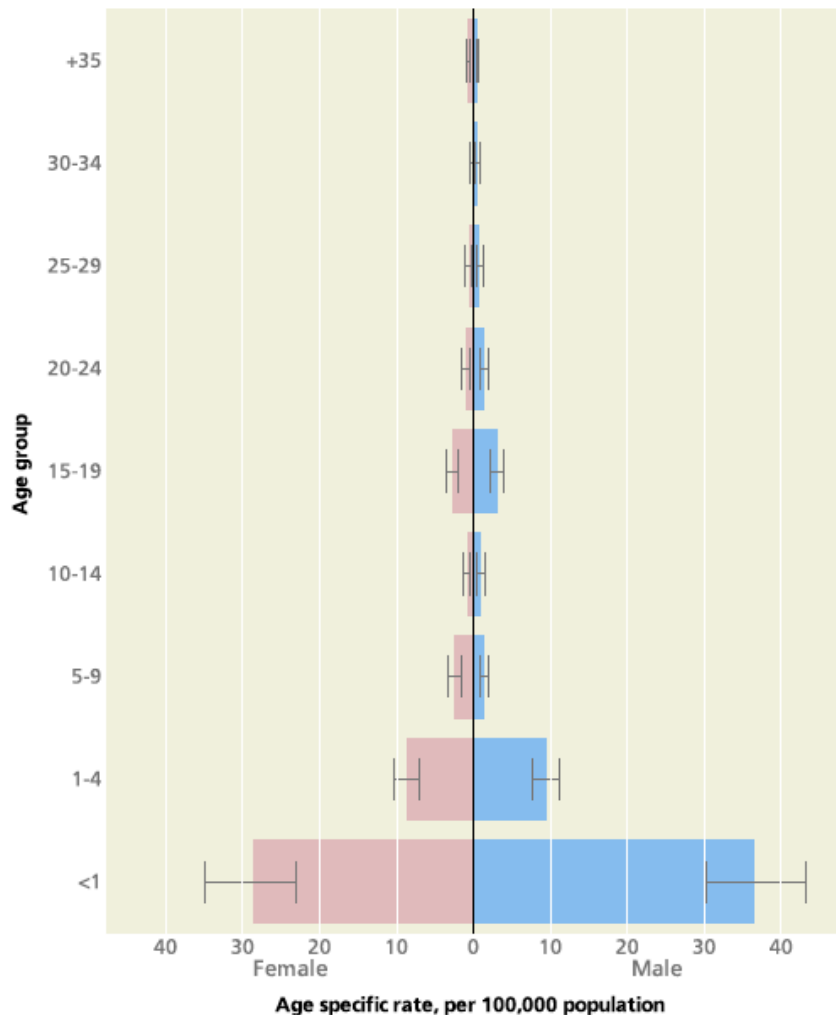
# The herd effect

- What is good for my neighbour is also good for me



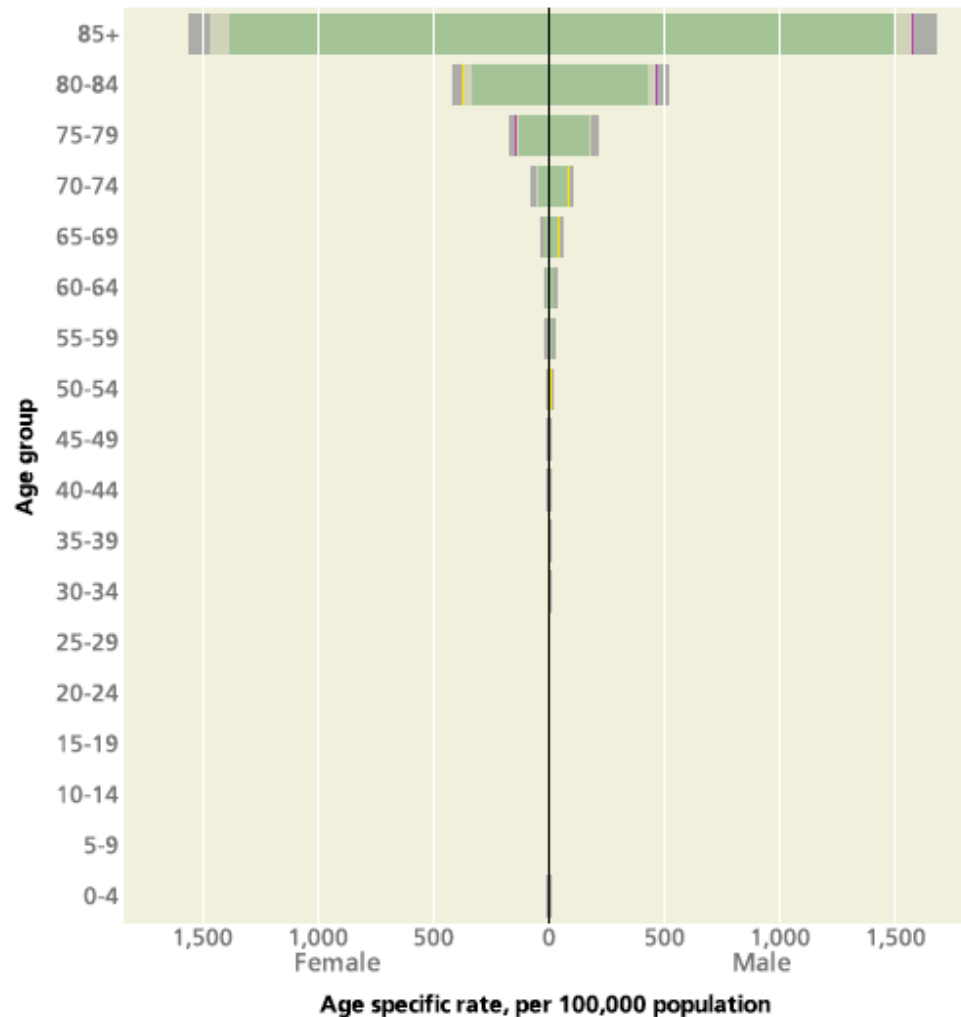
# Infectious disease at the extremes of life. CMO

Meningococcal Reference Unit isolates of *Neisseria meningitidis* rates by age and sex, England, 2010



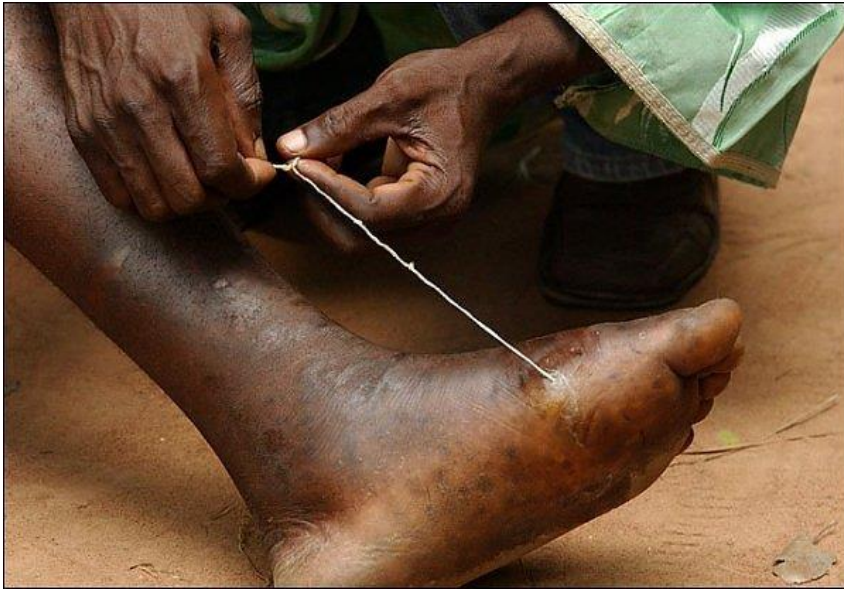
Source: Meningococcal Reference Unit, HPA. 2010 population estimates, ONS. (Analysis by HPA)

Average annual mortality rate due to infectious and parasitic diseases (and sub-categories) by age and sex, England, 2008-10

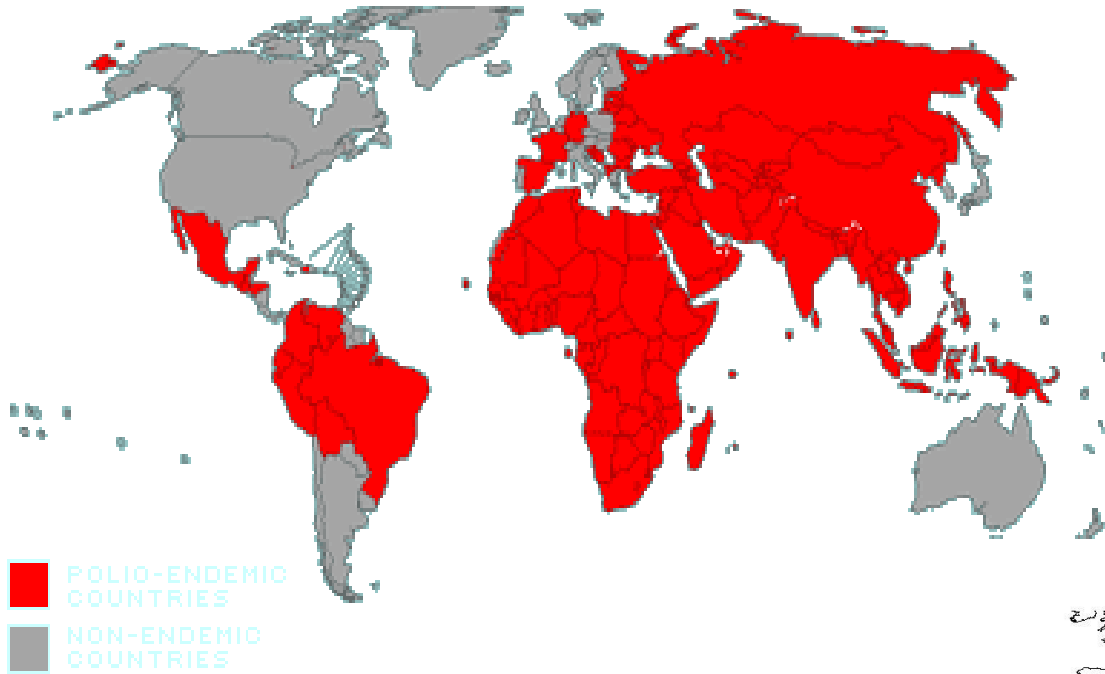


Age specific rate, per 100,000 population

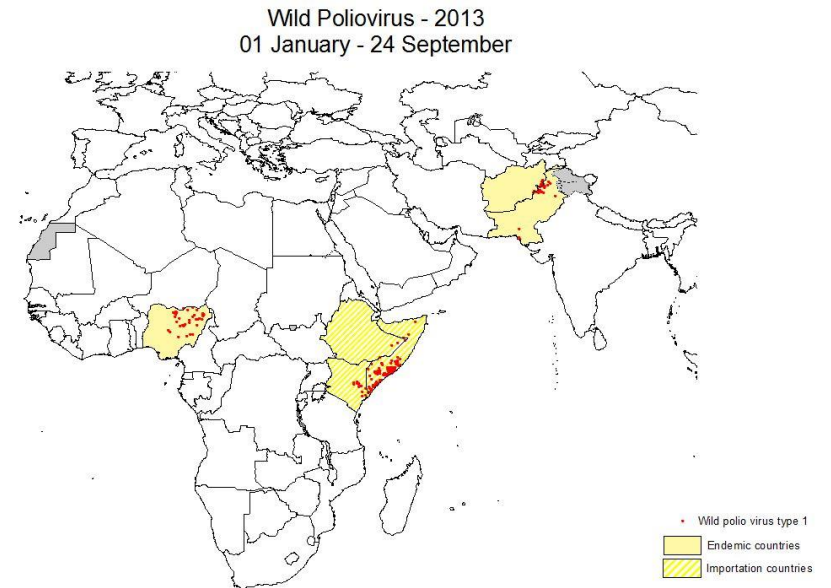
# Deliberate action to eradicate disease



# Polio 1988-2013



## Polio endemic countries



Excludes vaccine derived polioviruses and viruses detected from environmental surveillance.



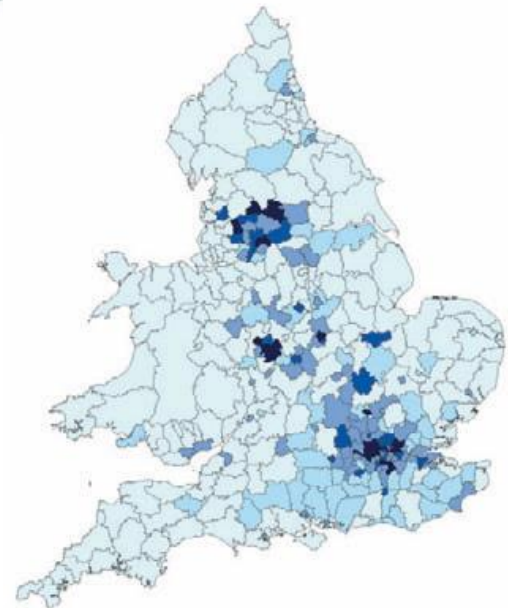
# Malaria 1948





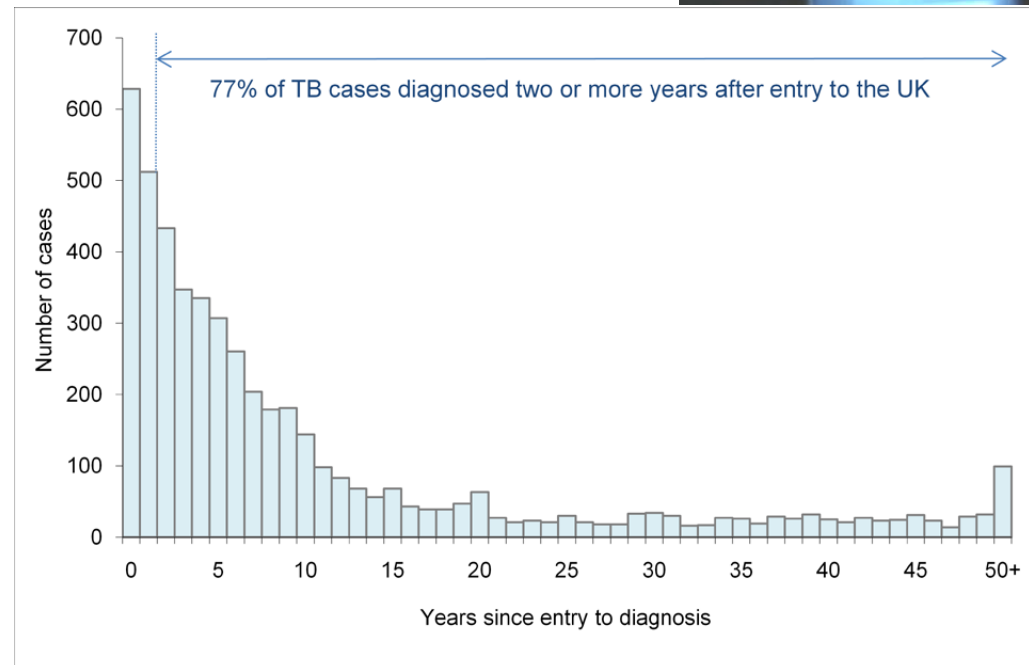
# Migrants often highly concentrated geographically (HPA/PHE)

- Clustering within urban centres, and often specific areas.
- Top- West and Central African born
- Bottom South Asian born.



# When do the infectious potential of being a migrant wane? Generally very rapidly.

- Not until diagnosed or treated: HIV, Hepatitis B.
- Potentially not for some years: TB.
- Within a few weeks: Almost all acute bacterial and viral infections.



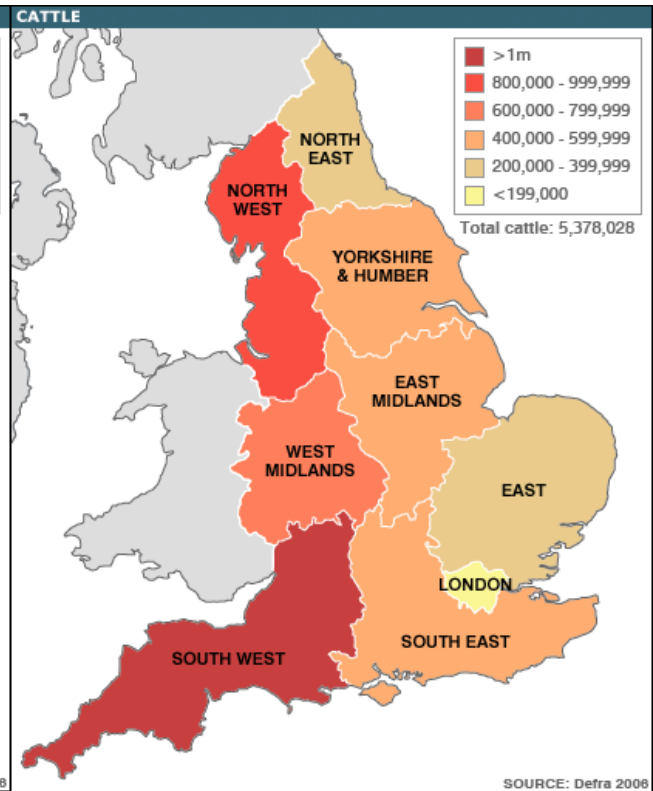
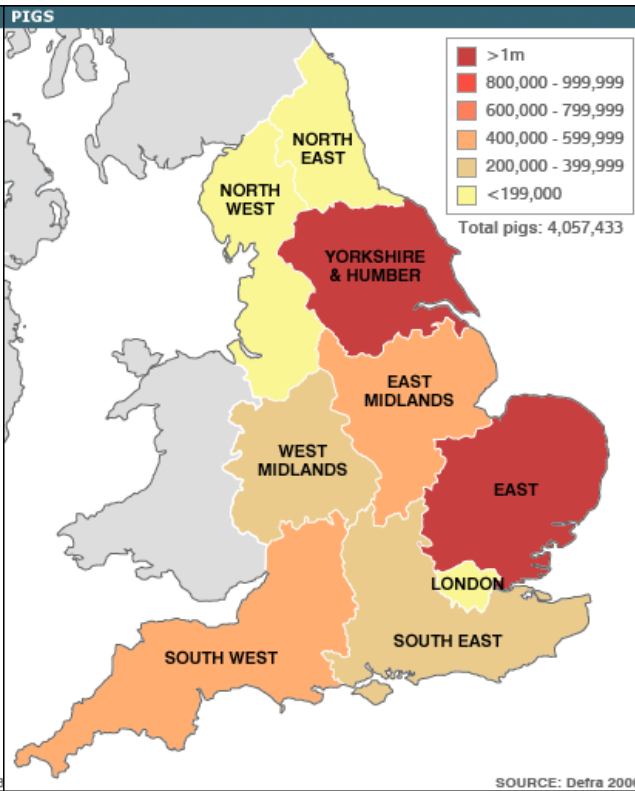
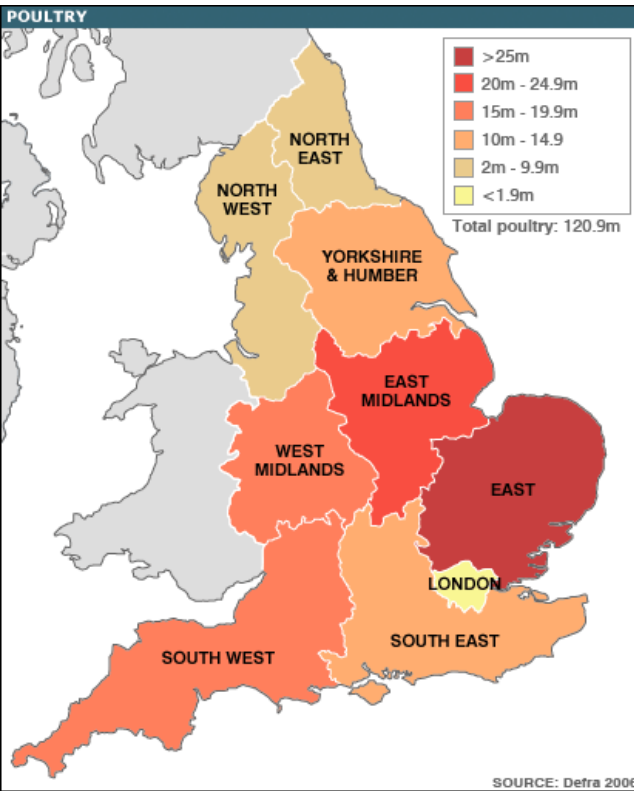
# Most new and emerging infections from animals



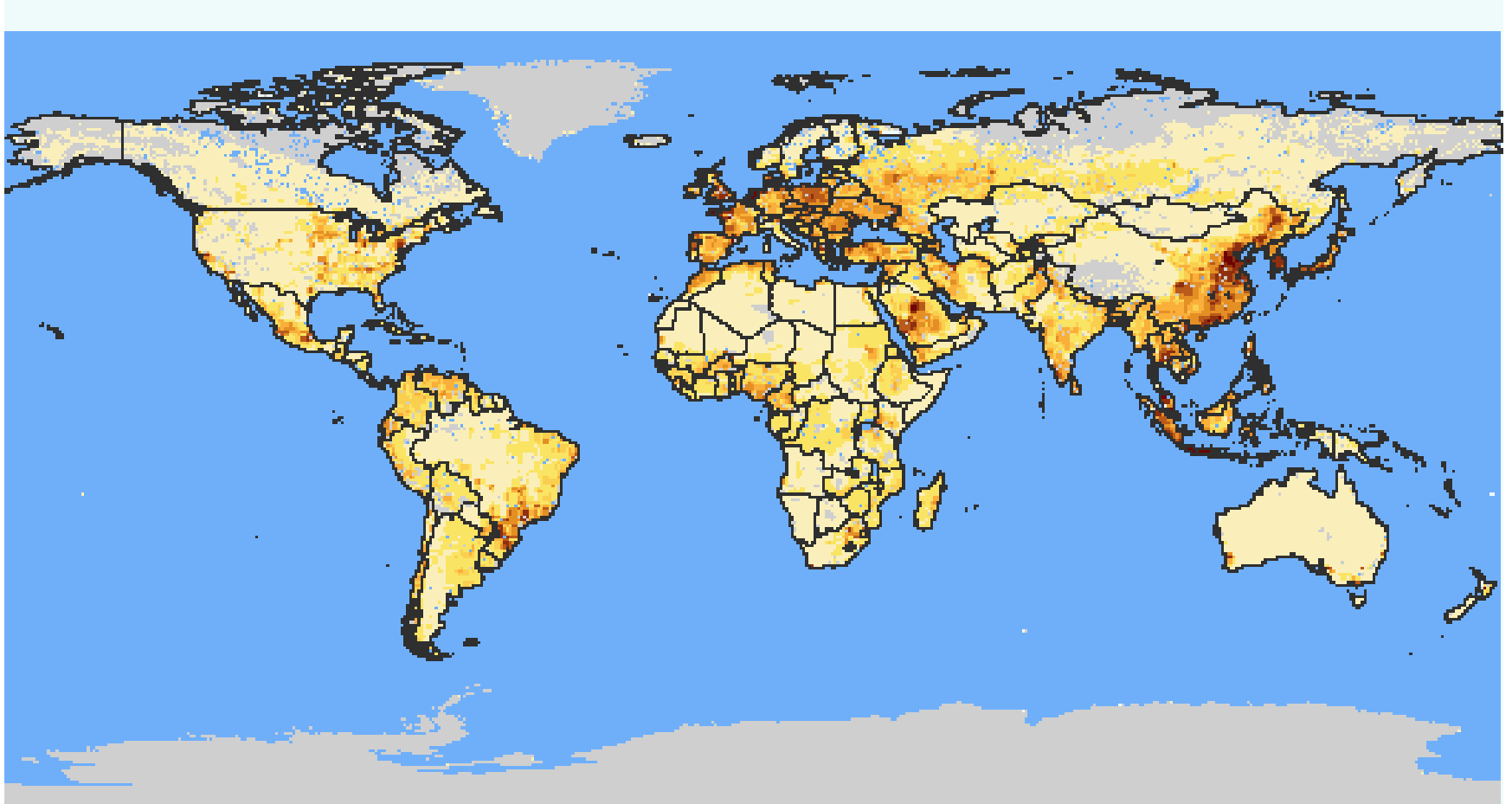
# Animals transmitting to humans: avian influenza H5N1.



# Poultry, pig and cattle density, England



# Global poultry population density (FAO)





# Gradual reduction in human/animal contact



# Antimicrobial resistance- probably the greatest current risk of imported infections

- Antibiotic resistance to bacteria.
- Antituberculous drugs. TB
- Antiviral drugs. HIV, influenza.
- Antiparasitic drugs. Malaria.
- Driven by poor medical and vet practice, weak regulation, low adherence- not generally poverty.

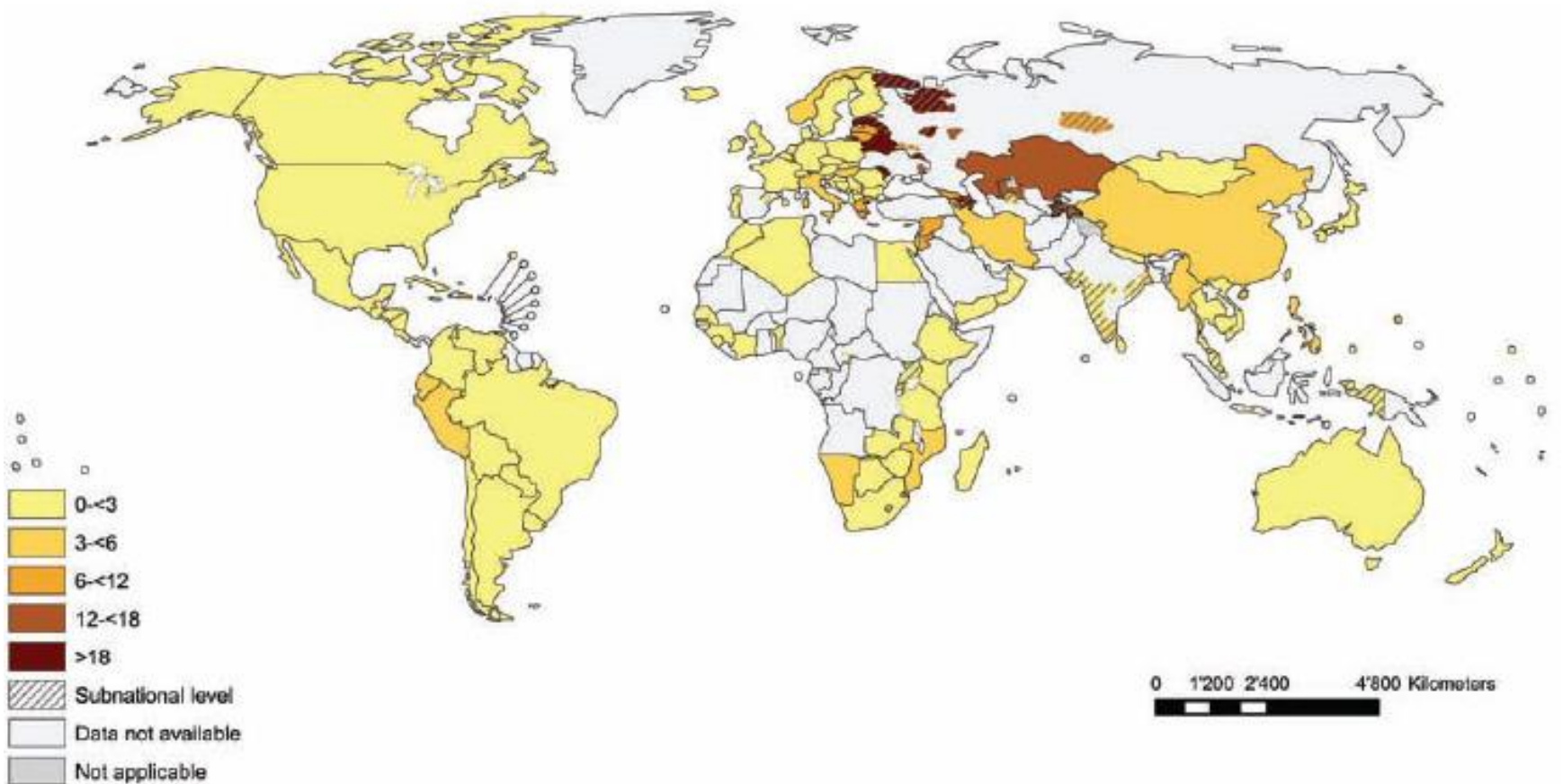


**THE DRUGS  
DON'T WORK**  
A GLOBAL THREAT

**PROFESSOR DAME  
SALLY C. DAVIES**

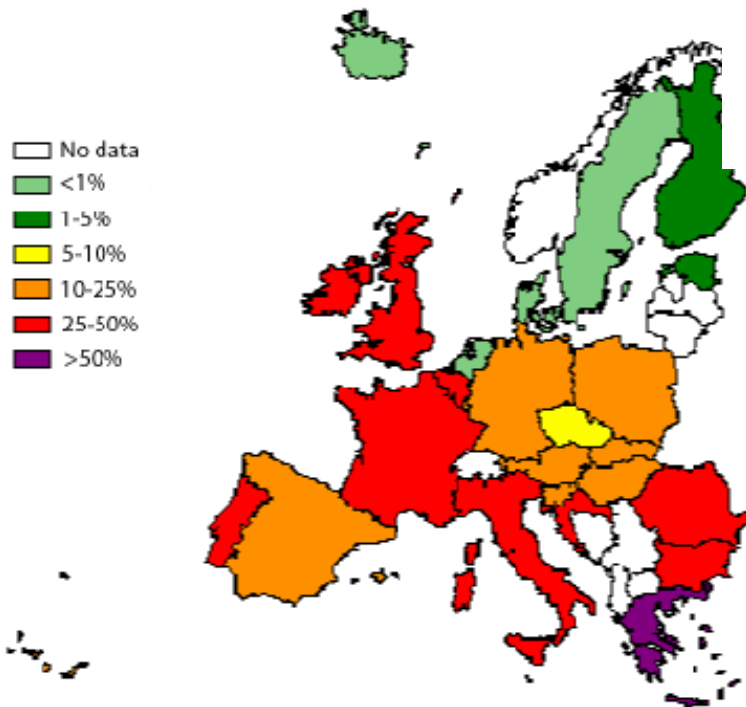


# Percentage of new patients with multidrug resistant tuberculosis (MDR-TB). (Zignol et al 2012)



# Hospital infections: MRSA, Clostridium difficile

## MRSA data from 2003, now improving. (Lyytikäinen et al 2004)



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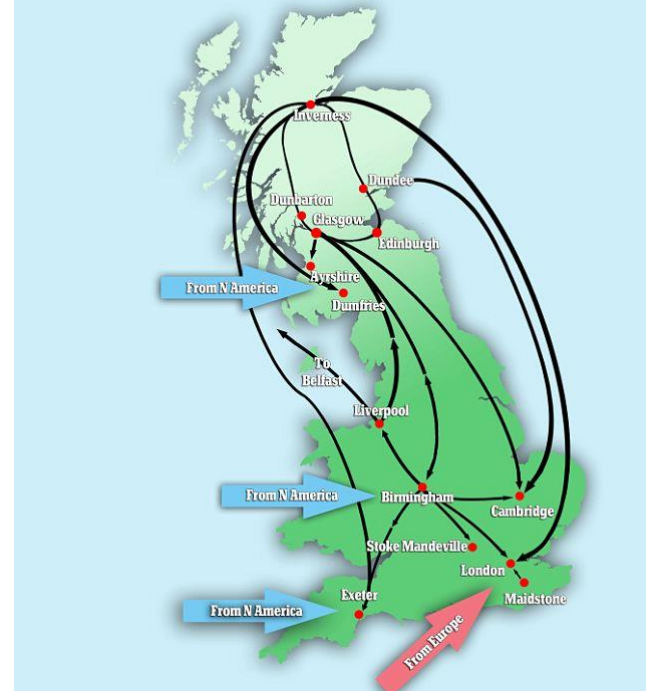
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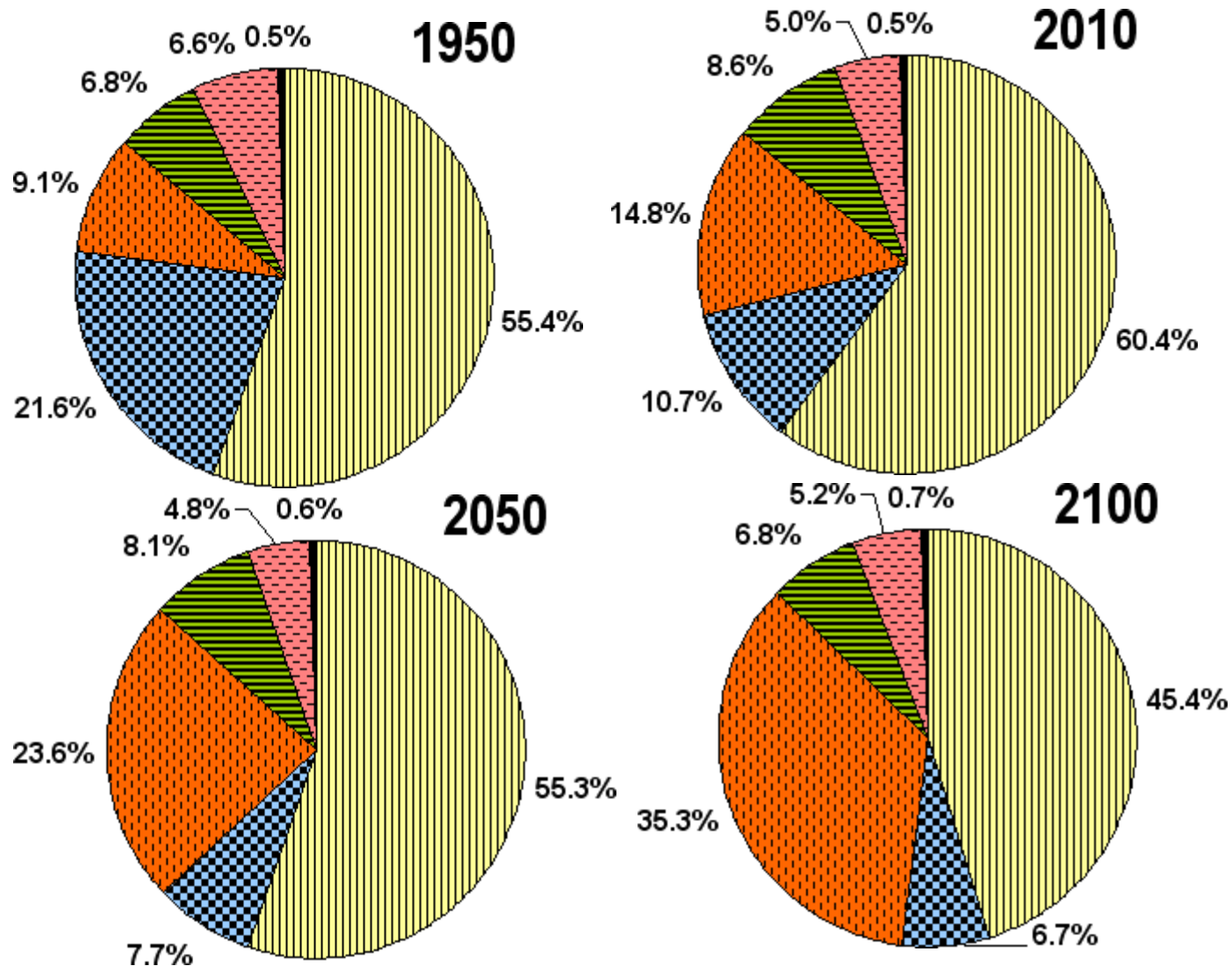
## Deadly hospital super-bug started in North America, say DNA detectives

• C.difficile sparked a global epidemic in hospitals in the early 2000s

### Spread of C. difficile around U.K.



The greatest protection to us is development where the large populations live. *(UN population projections)*



# UK has contributed substantially to the reduced risk of infections worldwide- research



“Africa is experiencing some of the biggest falls in child mortality ever seen, anywhere.”

*(Economist 2012)*

- In Africa, Asia and Latin America incidence of many major infectious diseases falling fast over the last decade.
- This will not stop the emergence of new diseases- but substantially reduces the risk of old ones.



# A broadly optimistic picture.

- Infections have always been imported; some have been devastating.
- Travel is increasing- however:
- Better water, sanitation, housing and nutrition make risks much lower than historically.
- Preventive and curative medicine reduce risk further.
- Many imported infections cannot be transmitted.
- Most new infections from animals- either here or overseas.
- The spread of antimicrobial resistance a serious risk.
- What is good for my neighbour is good for me- increasing prosperity and health worldwide.