

Epidemiology

20.106, Brock Ch. 25

December 4th, 2006

Epidemiology

The study of the occurrence, distribution, and control of disease in a population.

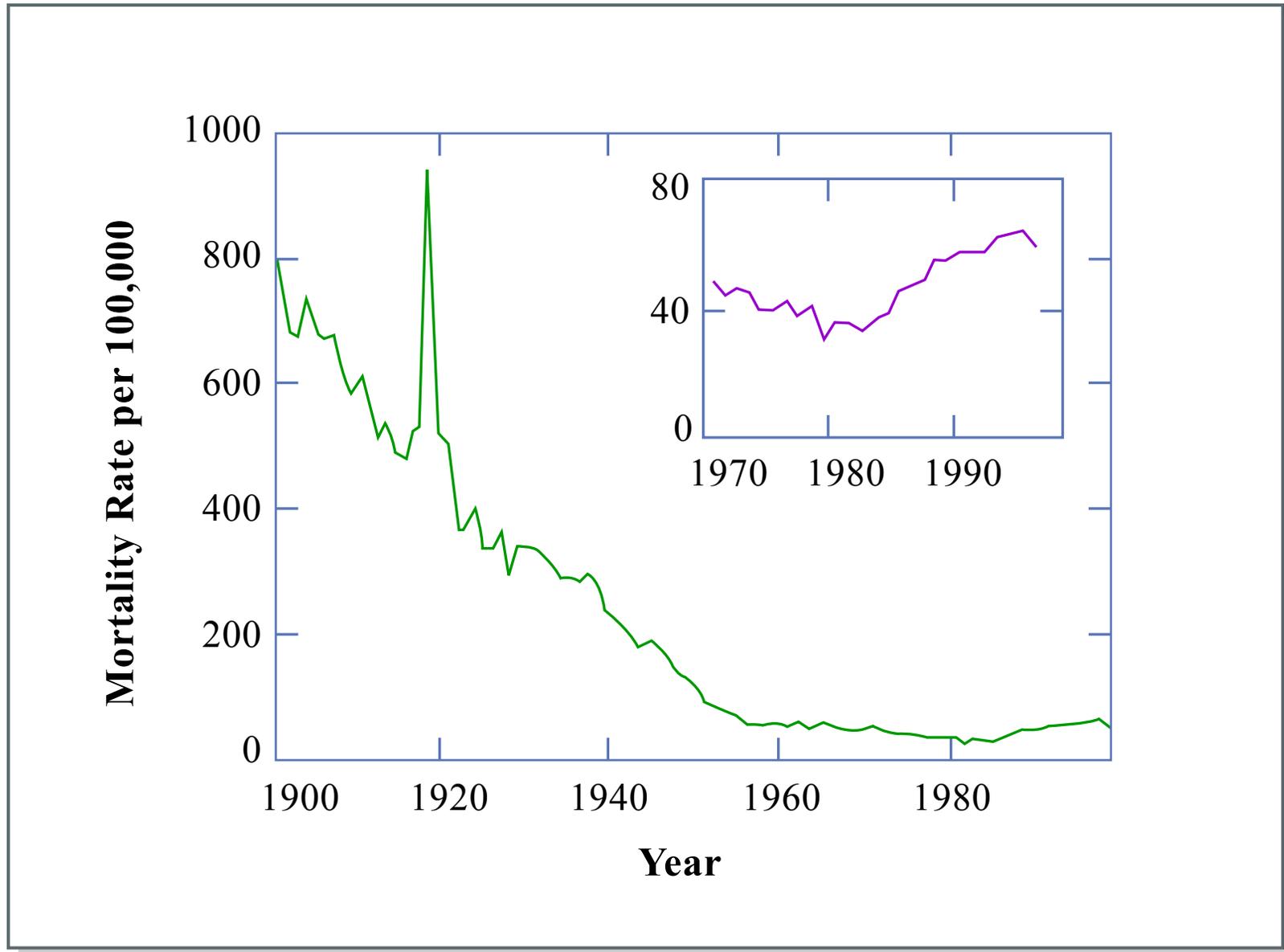
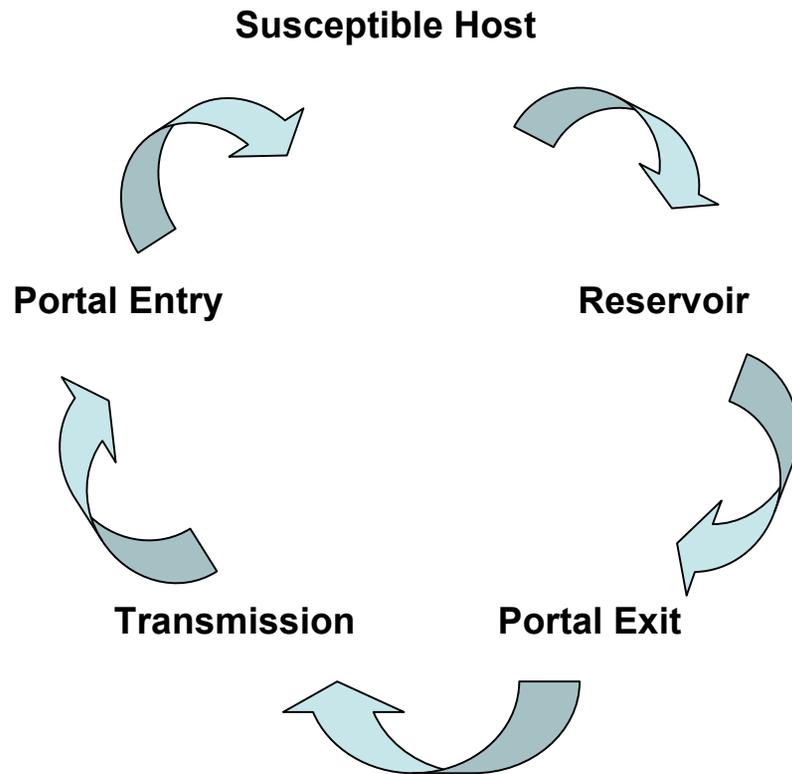


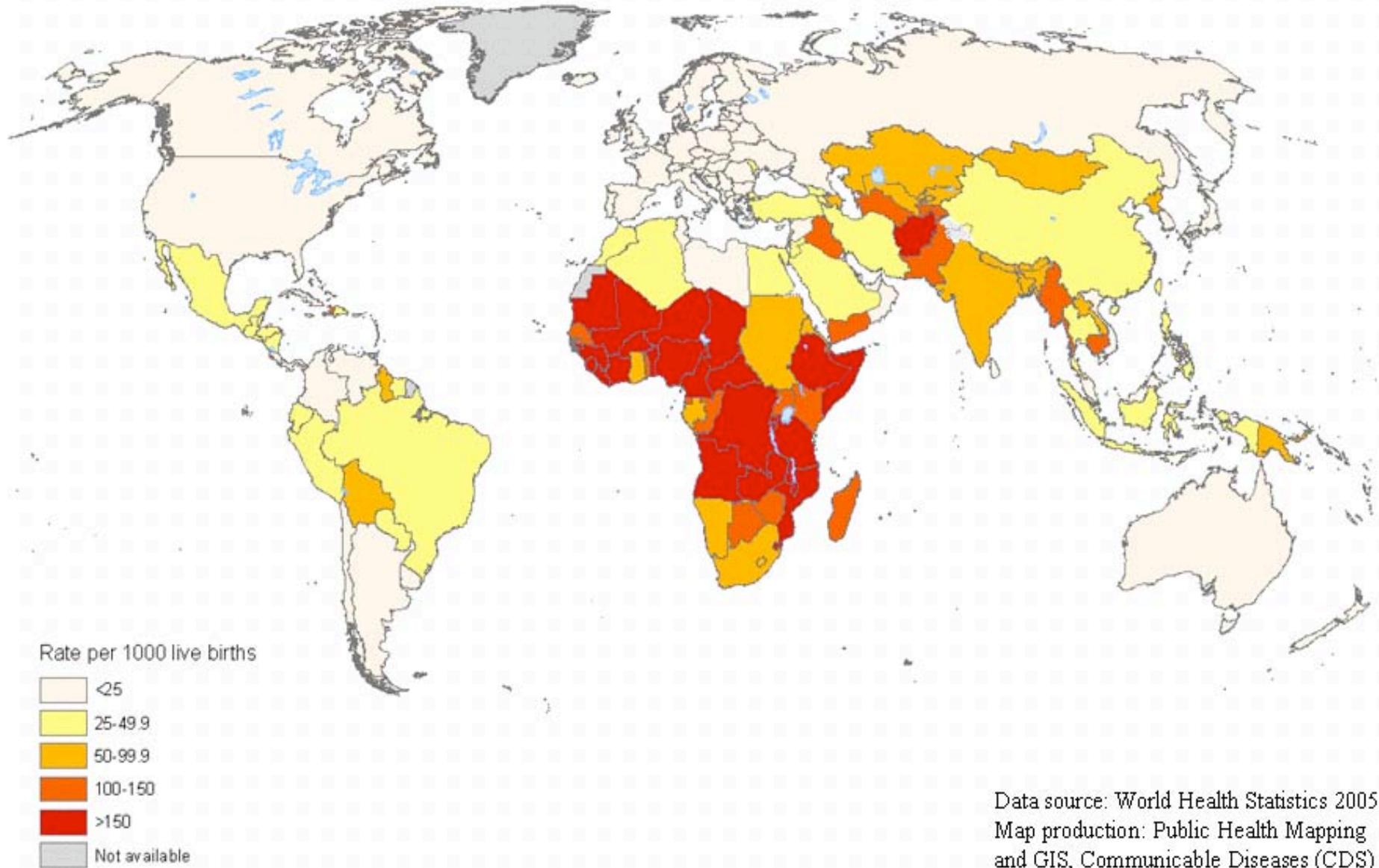
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Epidemiology Vocabulary



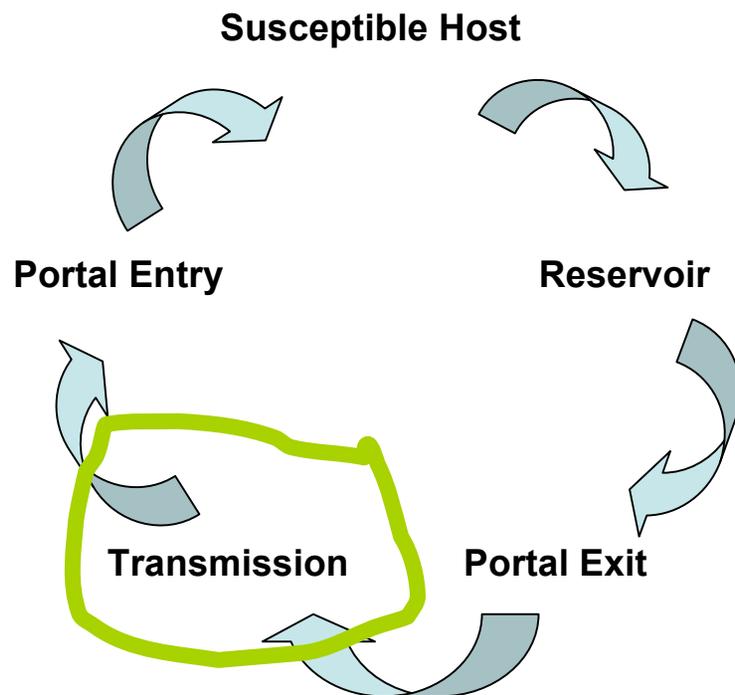
- Acute
- Chronic
- Carrier
- Reservoir
- Morbidity
- Mortality

Under-five mortality rate, 2003



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Transmission



- Direct Host-host transmission occurs when infected host transmits to susceptible host
- Indirect Host-host transmission occurs when pathogens are spread from infected host to susceptible host via a vector (arthropods or vertebrates), fomites (inanimate objects) or vehicle (food or water)

Clinical Disease Progression

1. **Infection** organism begins to multiply in host
2. **Incubation period** time between infection and onset of clinical disease symptoms
3. **Acute period** height of clinical disease
4. **Decline period** subsiding of clinical disease symptoms
5. **Convalescent period** return to prior health and strength

Classification of Disease Incidence

Prevalence versus Incidence

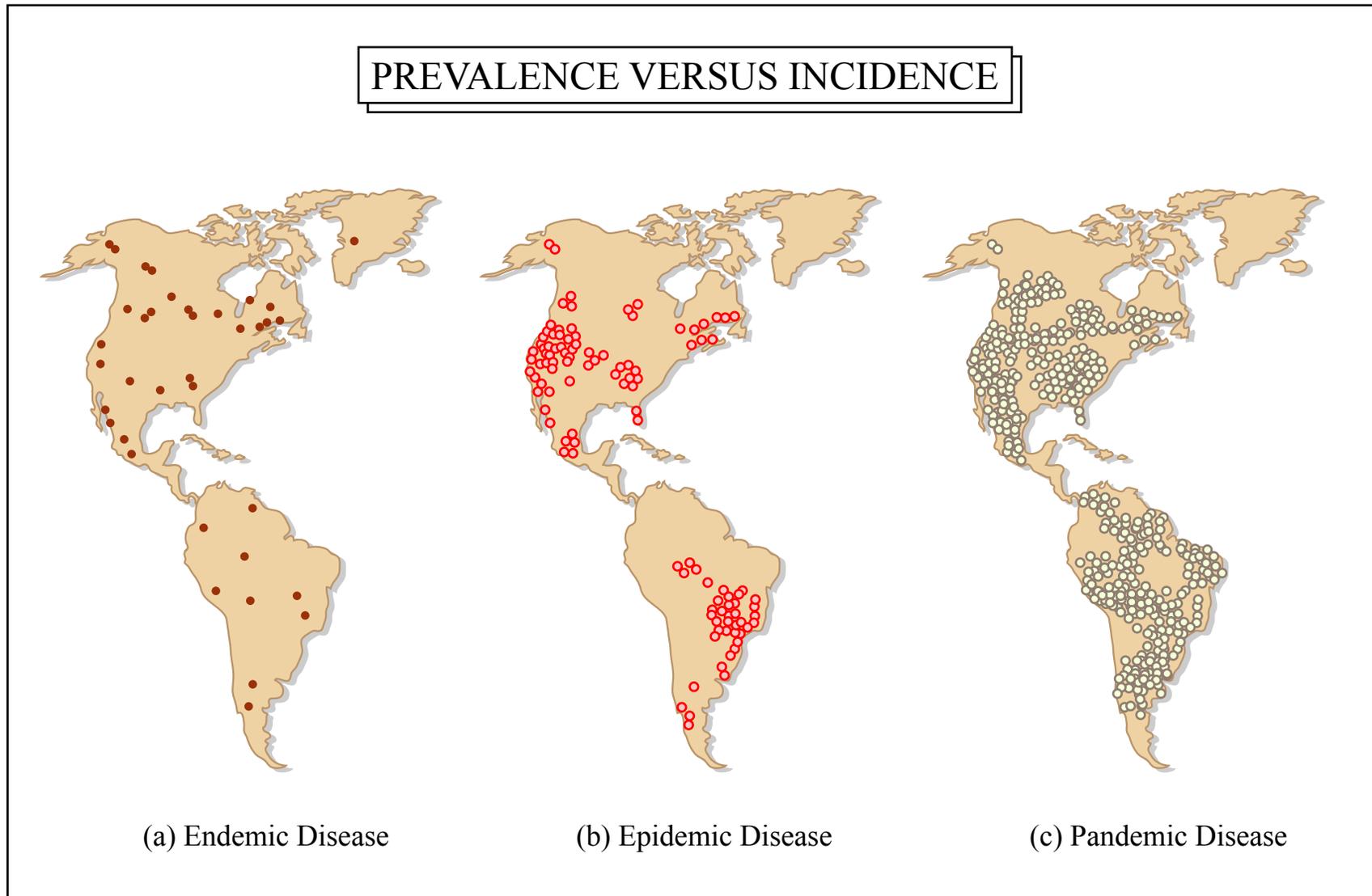
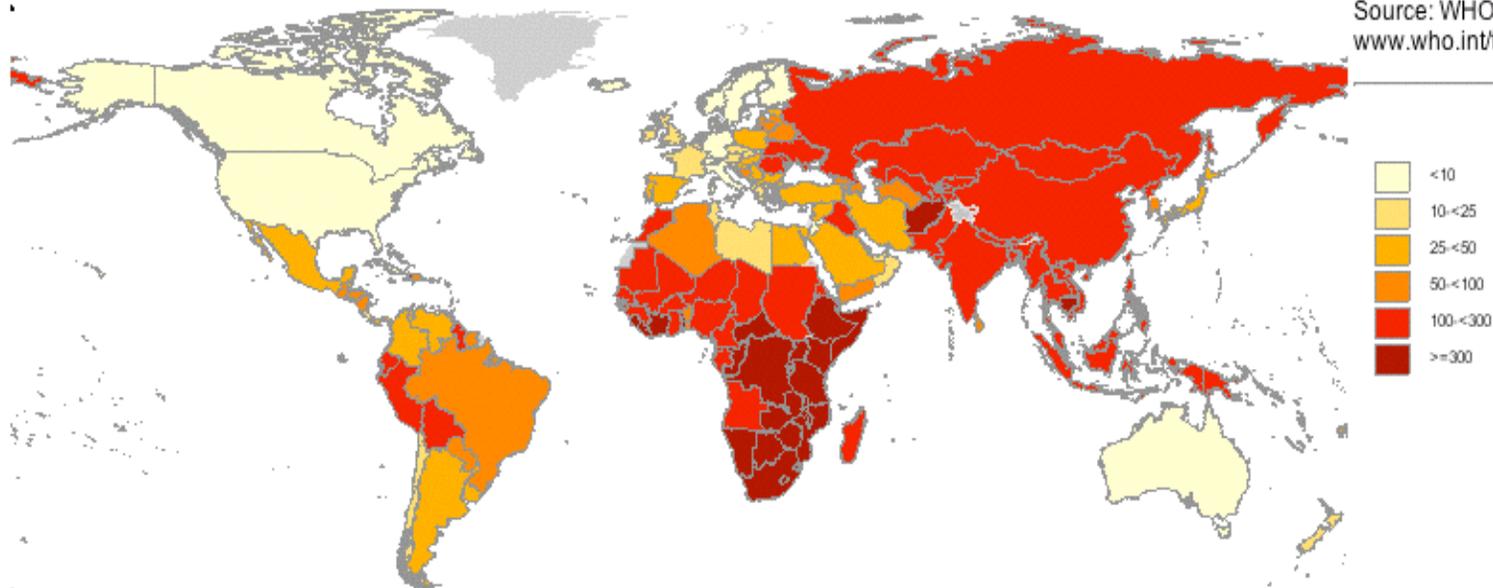


Figure by MIT OCW.

Outbreak: number of cases are observed in short period of time in area previously only having sporadic cases

Communicable Diseases -> Tuberculosis (as of 22 March 2006) -> Estimated TB -> Estimated TB incidence --> TB incidence, all forms (per 100 000 population per year), Total, Max of all Periods, 2004

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Source: WHO Stop TB Department, website: www.who.int/tb



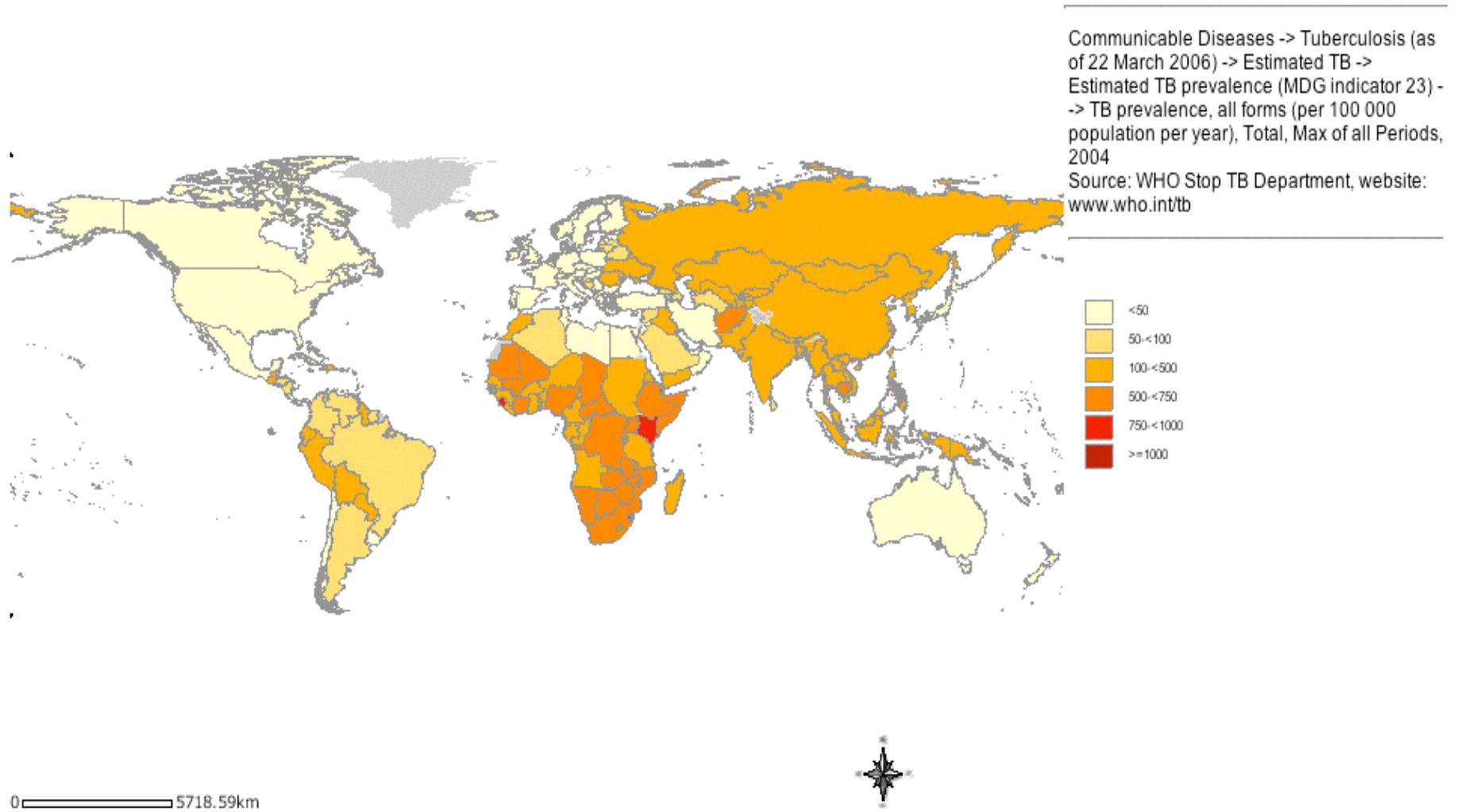
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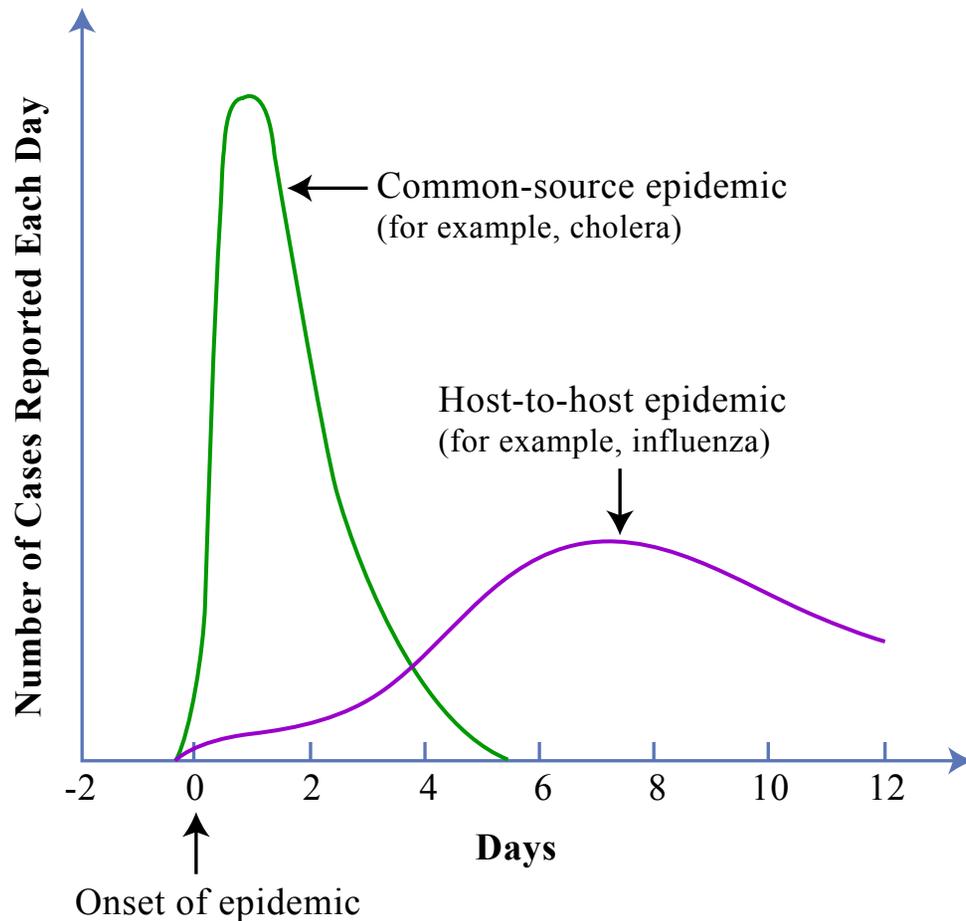
Communicable Diseases -> Tuberculosis (as of 22 March 2006) -> Estimated TB -> Estimated TB prevalence (MDG indicator 23) --> TB prevalence, all forms (per 100 000 population per year), Total, Max of all Periods, 2004



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Epidemics



- Common source epidemic
 - Infection of a large number of people from contaminated common source
- Host-to-host epidemic
 - May be started by one individual
 - Numbers of reported cases gradually, and continually rise

Figure by MIT OCW.



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Meningococcal disease in Sudan

21 November 2006

From 1 September to 8 November 2006, 231 suspected cases and 16 deaths of meningococcal disease have been reported in Greater Yei County, Central Equatorial State of South Sudan.

The epidemic threshold was crossed in this county during the last week of October. Five cerebral spinal fluid specimens have tested positive for *Neisseria meningitidis* serogroup A by latex test.

An outbreak investigation was conducted by the Ministry of the Central Equatorial State with the support of WHO's Early Warning and Response Network (EWARN) team and the US Centers for Disease Control and Prevention. A national multisectoral task force established earlier this year which includes county health authorities, UNICEF, WHO and nongovernmental organizations is coordinating the outbreak response.

Enhanced surveillance, case management, and social mobilization are underway, as well as the preparation of a vaccination campaign targeting c.294,000 people in the affected area.

Eradication & Elimination

Control--reduction of disease incidence, prevalence, morbidity or mortality to a **locally** acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. i.e.. diarrheal diseases

Elimination of disease--reduction to zero of the incidence of a specified **disease** in a defined geographical area as a result of deliberate efforts; continued intervention measures are required i.e.. neonatal tetanus

Elimination of infection--reduction to zero of the incidence of **infection** caused by a specific agent in a defined geographical area as a result of deliberate efforts; continued measures to prevent reestablishment of transmission are required. i.e.. Measles, poliomyelitis

Eradication--permanent reduction to zero of the **worldwide** incidence of infection caused by a specific agent as a result of deliberate efforts; intervention measures are no longer needed. i.e.. smallpox

Extinction--specific infectious agent no longer exists in nature or in the **laboratory**. i.e.. nothing

Eradication

International Task Force for Disease Eradication list of diseases targeted for eradication:

Poliomyelitis

Dracunculiasis (Guinea worm disease)

Lymphatic filariasis

Onchocerciasis (river blindness)

Trachoma

Schistosomiasis

Criteria for Eradication

Scientific feasibility

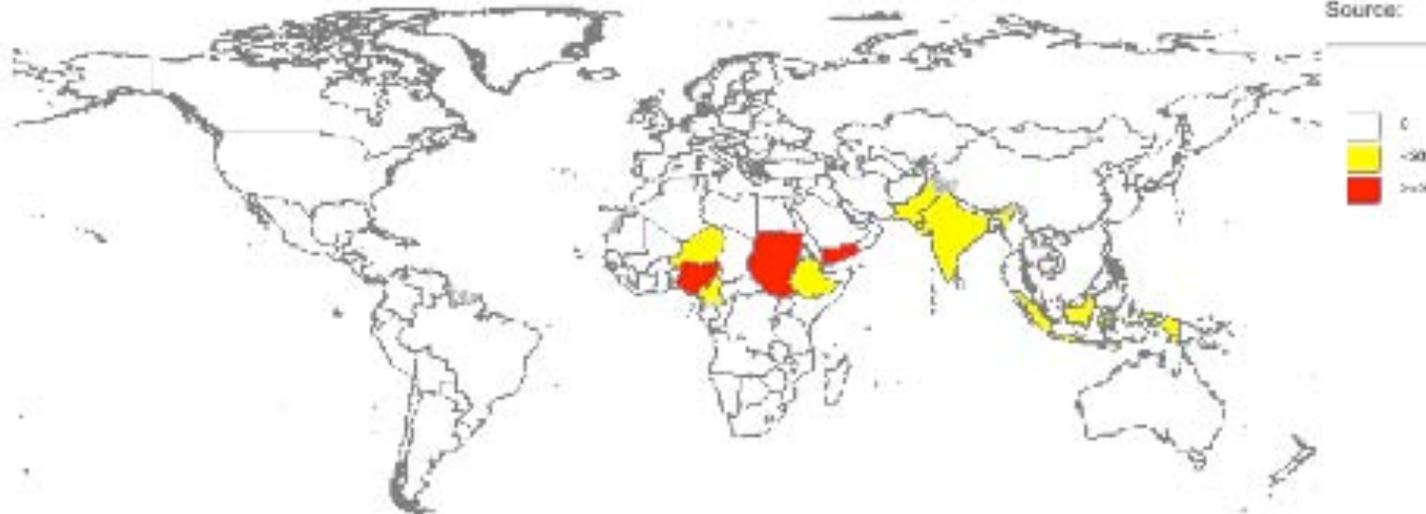
Political will/popular support

Early attempts at hookworm and yellow fever **FAILED!**

Polio May 2005

Communicable Diseases -> Polio (as of 11 May 2005) --> Number of polio cases, Total, Sum over all periods, For Latest available data

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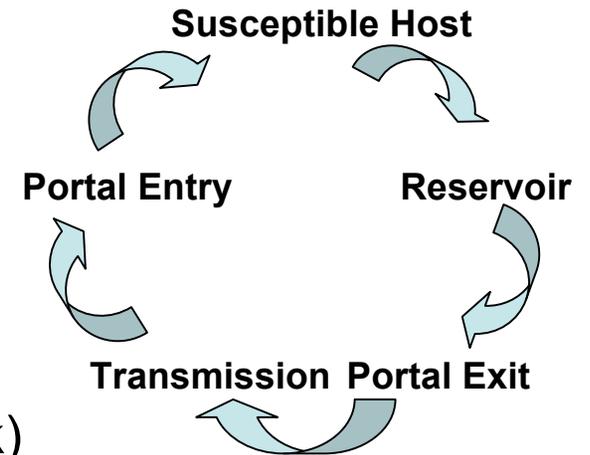
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Control Measures

- Against reservoir
 - eliminate infection in domestic animals
 - No control over wild animals
 - Prevent contact or eliminate insect vectors
- Against transmission
 - Prevent contamination of vehicle (water, milk)
- Immunization
- Quarantine
 - Restrict movement and contact of infected individuals with general population
 - Time limit is longest period of communicability of the disease

International required quarantine for smallpox, cholera, plague, yellow fever, typhoid fever and relapsing fever
- Surveillance
 - Observation, recognition, and reporting of diseases as they occur
 - Typically pathogens with potential for epidemic



Herd Immunity

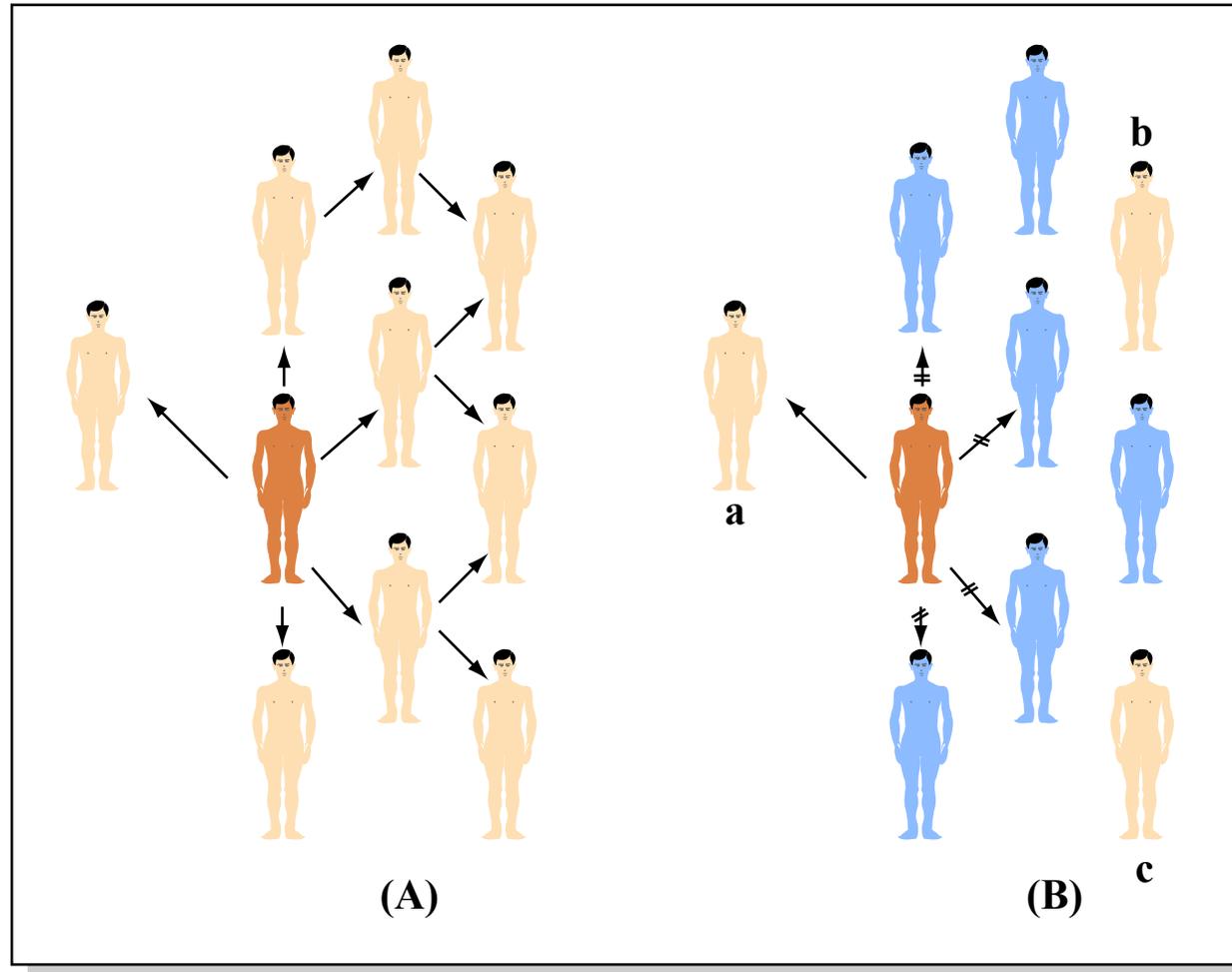
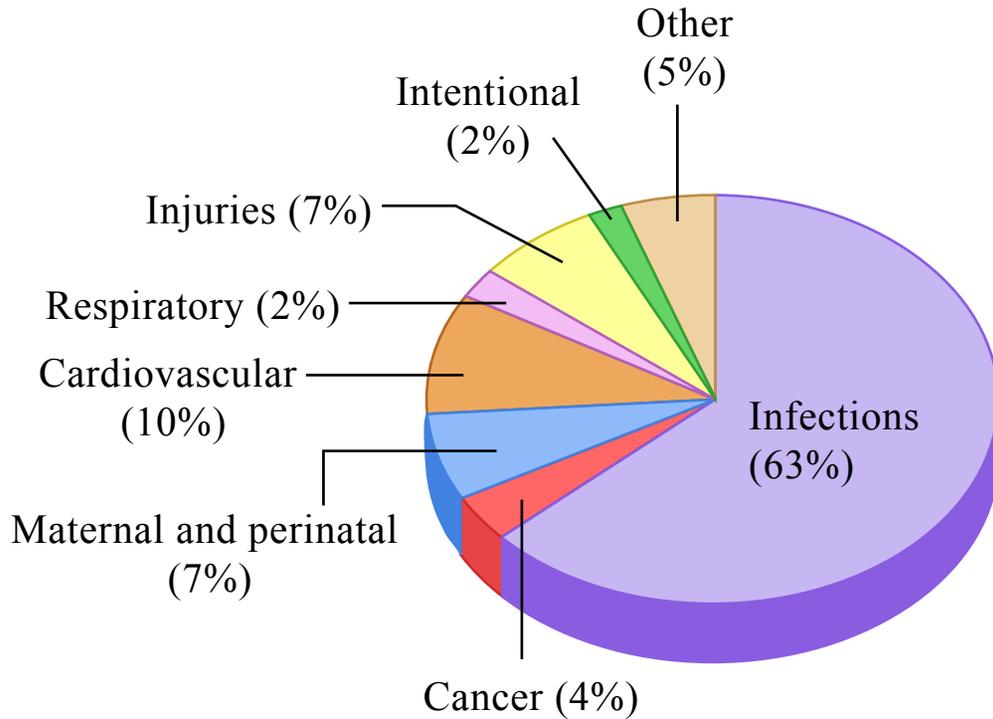


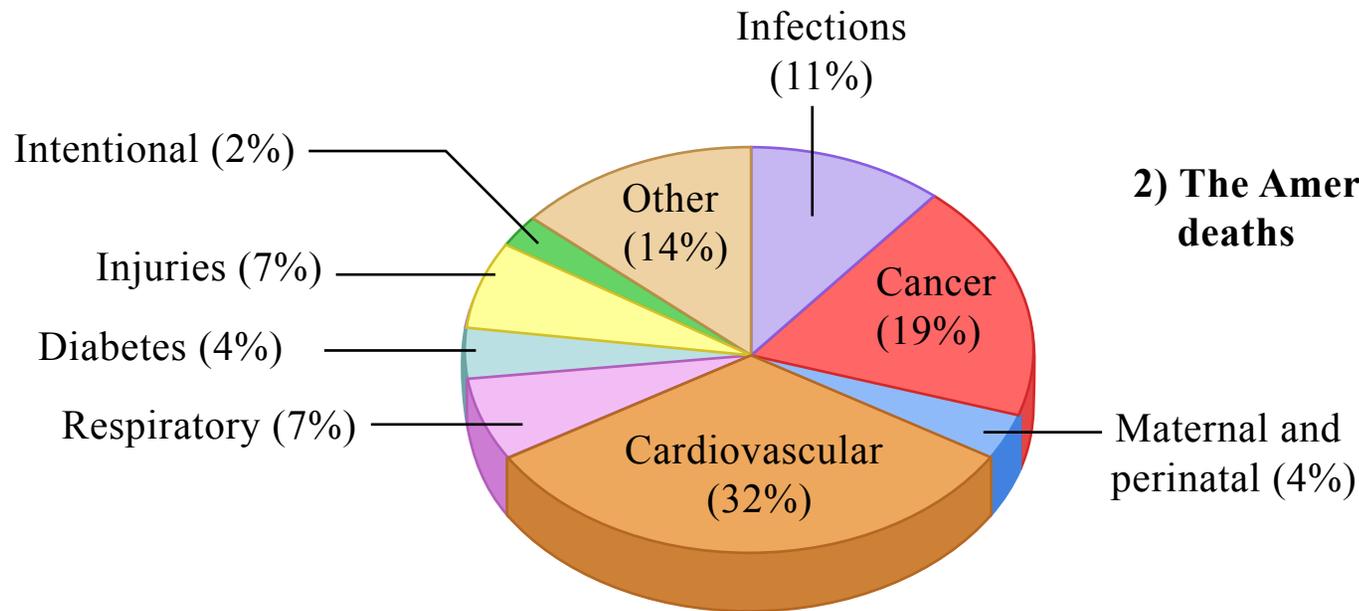
Figure by MIT OCW.

Resistance of a group to infection due to immunity of a high enough proportion of the members of the group.
Typically >70% of population must have protective immunity
Highly infectious agents require up to 95% protection
Protective immunity, not solely immunization

GLOBAL COMPARISON



1) Africa 2002: 10.7 million deaths



2) The Americas 2002: 6.0 million deaths

Emerging & Reemerging ID

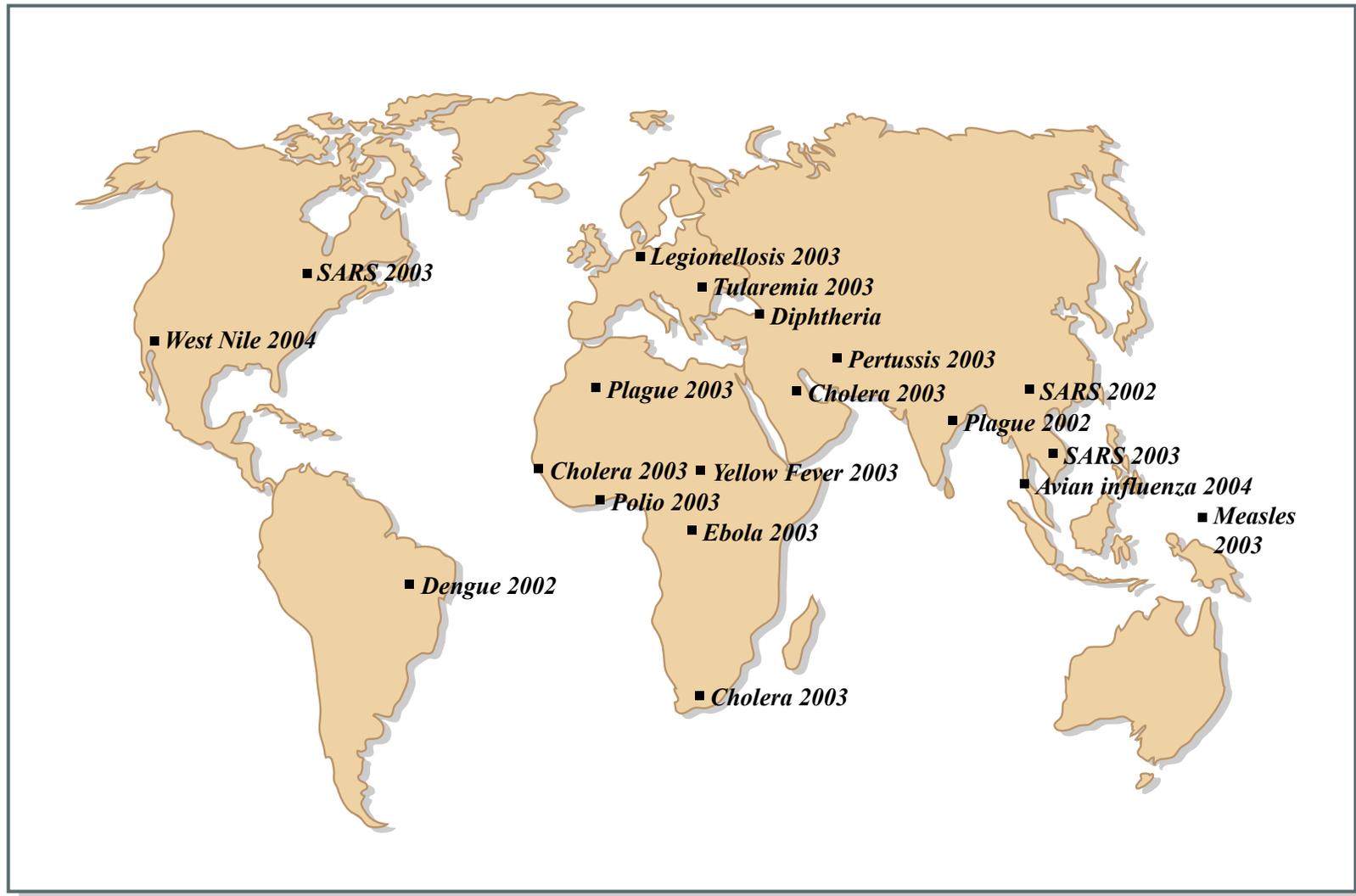


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Emergence Factors

1. Demographics
2. Technology and industry
3. Economic development and land use
4. International travel and commerce
5. Microbial adaptation and change
6. Breakdown of public health measures
7. Abnormal natural occurrences

Biological Warfare and Biological Weapons

Candidates: highly pathogenic and infectious agents or toxins that are easy to produce and deliver, safe for use by offensive soldiers, and able to incapacitate or kill individuals reproducibly and consistently

Delivery: aerosolized agents or preformed toxins in drinking water

Prevention: vaccine stockpiles, monitoring of possession and use of potential bioterrorism agents, better diagnostics to rapidly identify exposure

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See Figure 25-12a in Madigan, Michael, and John Martinko.

Brock Biology of Microorganisms. 11th ed.

Upper Saddle River, NJ: Pearson Prentice Hall, 2006. ISBN: 0131443291.