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Pronounciation help:

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Lecture 1 : Introduction

Overview

- ✓ **Medical Geography Defined**
- ✓ **Geographical Approaches**
- ✓ **Medical Geog. Today (2 examples)**
- ✓ **Definition of Health and Disease**
- ✓ **Disease categories and Spread Mechanisms**
- ✓ **The Role of Infectious Diseases in Human Evolution**

Definitions

Medical Geography defined

"Medical Geography uses the concepts and techniques of the discipline of geography to investigate health related topics"

Geography Defined

Five Themes

- **Location**
- Absolute Location
- Relative Location
- **Place (characteristics of)**
- Physical Characteristics
- Human Characteristics
- **Human-Environmental Interactions**
- Humans adapt to the environment
- Humans modify the environment
- Humans depend on the environment
- **Movement**
- People
- Goods
- Ideas
- **Regions**
- Formal
- Functional
- Vernacular (perceptual)

Location

Absolute location: latitudinal/longitudinal (global location) or a street address (local location).

Relative locations are described by landmarks, time, direction or distance from one place to another and may associate a particular place with another.

Place

What kind of place is it? What do you think of when you imagine China? Japan? Russia (retired drunks)? Saudi Arabia (rickets-ridden women)?

Places have both **human** (clothing, food habits, etc.) and **physical** (rivers, sols, mountains, etc.) characteristics, as well as images.

Human/Environmental Interaction

How do humans and the environment affect each other? For example, floods in the mid-West, hurricanes in Florida, and earthquakes and fires in California.

People modify the environment (e.g. by heating and cooling buildings for comfort).

People adapt to the environment by wearing clothing that is suitable for summer and winter.

Movement

The movement of people, the import and export of goods, and mass communication have all played major roles in shaping our world.

People everywhere interact. They travel from place to place and they communicate. We live in a global village and global economy.

Movement is not limited to humans. Ideas, fashions , fads , etc. also move .

Region

A region is the basic unit of study in geography. It is an area that displays a coherent unity in terms of government, language, or possibly landforms. Regions are human constructs that can be mapped and analyzed.

There are three basic types of regions

Formal regions are those defined by governmental or administrative boundaries (i. e., United States, Birmingham, Brazil, Sonoma County). Physical regions also fall under this category (e.g., The Rockies, the Great Lakes States).

Functional regions are those defined by a function (e.g., TVA, Coal Country, Corn Country, United Airlines Service area or a newspaper service area). If the function ceases to exists, the region no longer exists.

Does Silicon Valley qualify?

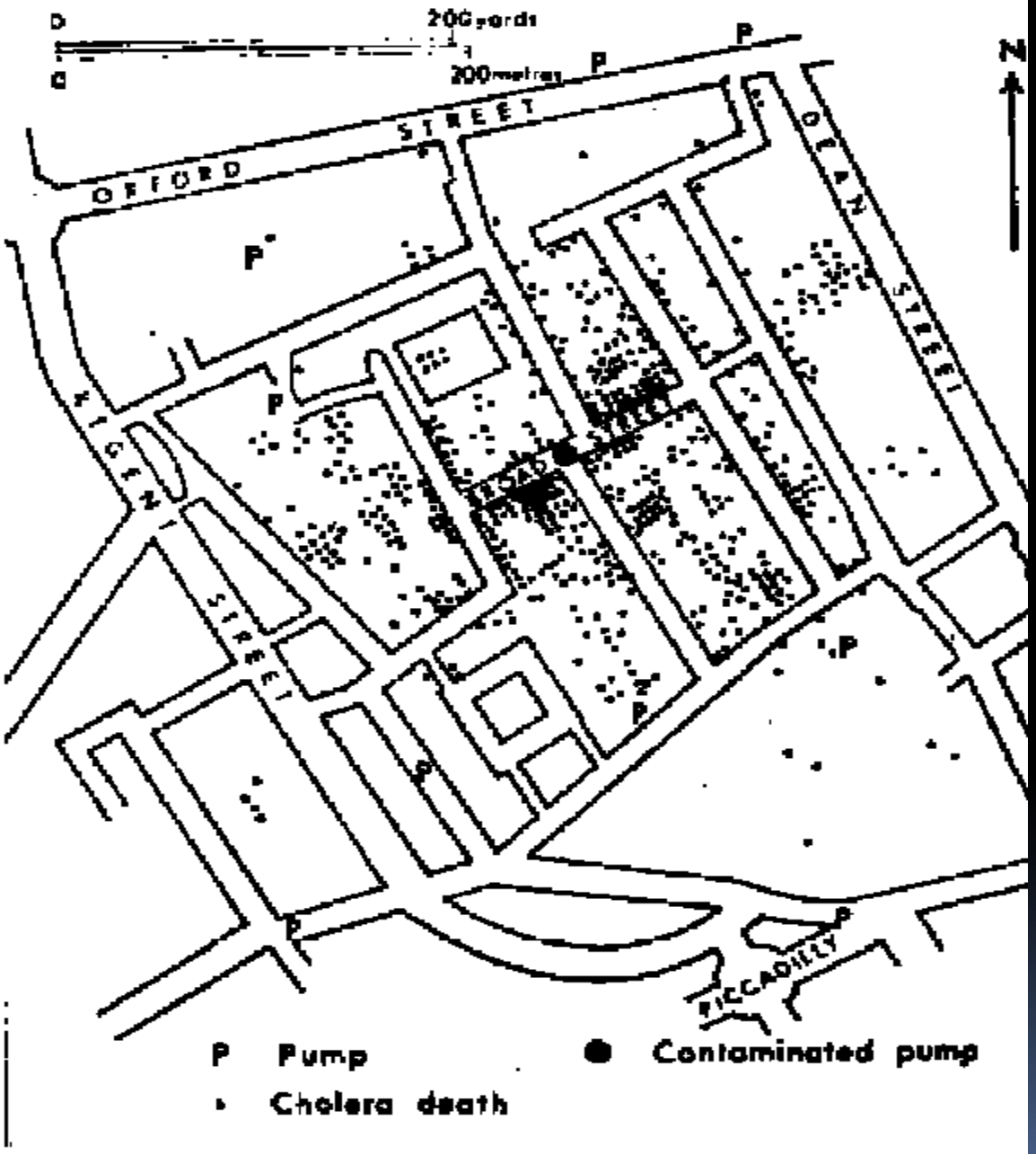
Vernacular regions are those loosely defined by people's perception (e.g.., The South, The Middle East).

The Role of Maps in Medical Geography

The first map known to have saved lives (1855):

"After the panic-stricken officials followed Snow's advice to remove the handle of the Broad Street Pump that supplied the water to this neighborhood, the epidemic was contained. Through mapping the locations of deaths related to Cholera, Snow was able to pinpoint one of the major sources of causation of the disease and support his argument relating to the spread of Cholera. Snow's classic study offers one of the most convincing arguments of the value of understanding and resolving a social problem through the use of spatial analysis."

See map



www.york.ac.uk/depts/maths/histstat/snow_map.htm)

Related disciplines (other names)

Geographic variation in health has long been studied under such interdisciplinary rubrics as:

- Geographic pathology
- Medical ecology
- Medical topography
- Geographical epidemiology
- Geomedicine

Names and dates of publications associated with early development of the field:

May, Jacques M. (1950) "Medical geography: Its methods and objectives".

May, Jacques M. (1958) "Medical Geography"

May, Jacques M. (1961) "Studies in Disease Ecology"

Barrett, Frank A. (1980, 1991, 1993, 1996, 1998)

Definitions of Health and Disease

"Health is more than the absence of disease"

"The problem remains of how to define health without reference to disease"

Health def. WHO 1946:

"Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity"

Medical Geography Today

New developments in technology
The globalizing world
Population aging and the increasing importance of degenerative diseases
Replacement of paper maps with digital maps (made possible by the advent of GIS and remote sensing)
Descriptive speculation about disease has been replaced with scientific analysis of spatial patterns of disease including hypothesis testing, multi-level modeling, and multivariate analysis.
Interdisciplinary in nature
A bridge between the biomedical and social sciences

GIS:

Provides a digital lens for exploring the dynamic connections between people, their health and well-being, and changing physical and social environments.

Permits identification and mapping of vulnerable populations, health outcomes, risk factors, and exploration of associations between them at varying scales.

Makes it easy to link disease data to other information about the environment including geographic distribution of risk factors.

Is a powerful tool for medical geographers.

Medical Geography Today. Example 1: Mosquitoes, where and why there?

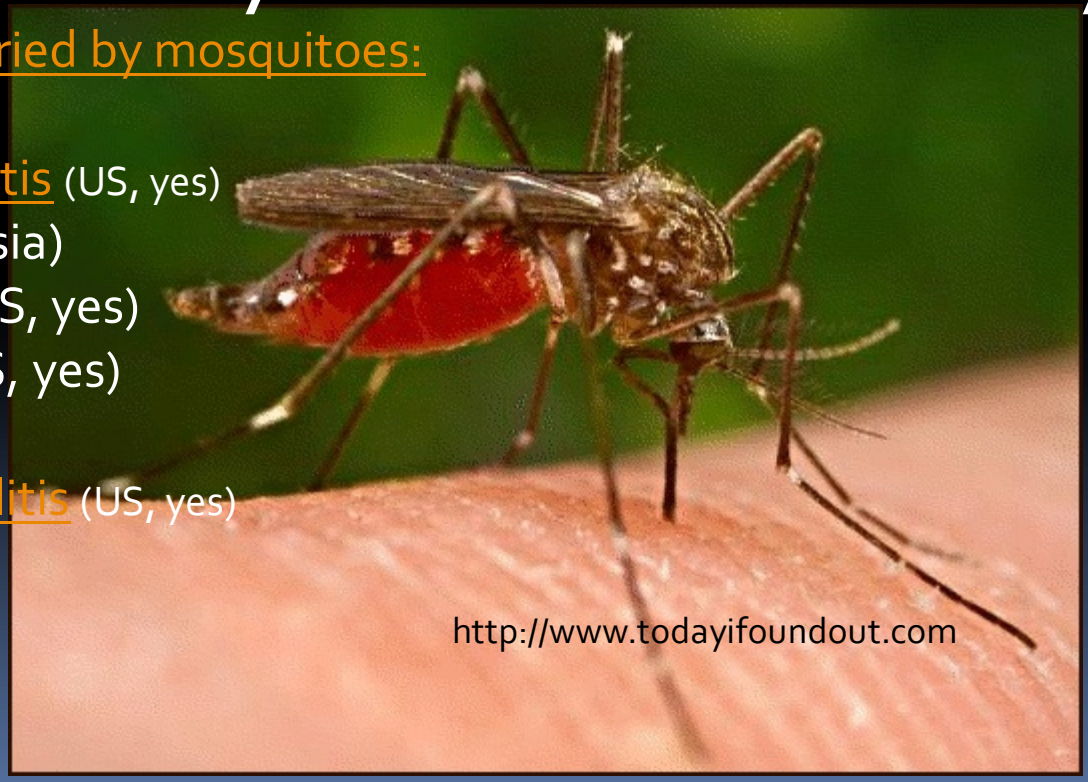
See sample articles (next slide)

Mosquitoes: Where? Why? Control efforts: History

Some of the diseases carried by mosquitoes:

Eastern equine encephalitis (US, yes)
Japanese encephalitis (Asia)
La Crosse encephalitis (US, yes)
St. Louis encephalitis (US, yes)
West Nile virus (US, yes)
Western equine encephalitis (US, yes)
Dengue Fever

Malaria
Rift Valley Fever
Yellow Fever



Research

Analysis of simultaneous space-time clusters of Campylobacter spp. in humans and in broiler flocks using a multiple dataset approach

Malin E Jonsson, Berit Tafjord Heier, Madelaine Norstrom, Merete Hofshagen
International Journal of Health Geographics 2010, 9:48 (22 September 2010)

Identifying risk factors for healthcare-associated infections from electronic medical record home address data

Jeffrey S Wilson, David C Shepherd, Marc B Rosenman, Abel N Kho
International Journal of Health Geographics 2010, 9:47 (17 September 2010)

Using Landsat satellite data to support pesticide exposure assessment in California

Susan K Maxwell, Matthew Airola, John R Nuckols
International Journal of Health Geographics 2010, 9:46 (16 September 2010)

A high resolution spatial population database of Somalia for disease risk mapping

Catherine Linard, Victor A Alegana, Abdisalan M Noor, Robert W Snow, Andrew J Tatem
International Journal of Health Geographics 2010, 9:45 (14 September 2010)

Spatial patterns of diabetes related health problems for vulnerable populations in Los Angeles

Andrew J Curtis, Wei-An Andy Lee
International Journal of Health Geographics 2010, 9:43 (27 August 2010)

Geographic Distribution of One Mosquito Species:

Aedes Aegypti

Diseases Transmitted by Mosquitoes

There are approximately 2,500 mosquito species.
A mere fraction of them feed on human blood.
Only the females suck blood, as they require blood to nourish their eggs.

Diseases:

Malaria, yellow fever, dengue, and Rift Valley fever.
encephalitic viral diseases (such as West Nile virus, St. Louis encephalitis, and Eastern Equine encephalitis) that cause inflammation of the brain's lining.
Different mosquito species transmit different diseases. For example, only the genus *Anopheles* transmit the malaria parasite. (Note: A genus is a subcategory of a species.)
Save for Antarctica, these mosquitoes exist everywhere on the planet.

"Some mosquito-borne diseases are **spreading geographically**, and given the **required temperature** for the **pathogens**, it would seem that many of these diseases should spread with **warmer global temperatures**. However, it isn't that simple.

Take inadequate mosquito control for example. West Nile virus originally appeared in the Western Hemisphere in 1999 in New York City. The virus was **first isolated in Uganda in 1937** and was typically found in Africa, the Middle East, West Asia, and Europe. No one knows how the virus crossed the Atlantic. But once in New York City, it **exploded across the United States**. It didn't help that New York City drastically cut its **mosquito-control program** for almost a decade prior to the outbreak, with the pest control unit of the New York City Department of Health cut so severely that any **surveillance** or control of the disease-carrying mosquitoes was minimal."

"Surprisingly, the shipping and dumping of **used tires** also contributes to the spread of mosquito-borne diseases. A 1992 Institute of Medicine report ("Emerging Infections: Microbial Threats to Health in the United States") found that the United States generates 250 million used tires each year and imports several million more. Fewer than 5 percent of these tires are recycled. As it turns out, used tires are perfect mosquito incubators; once water gets inside of them, it's virtually impossible to remove it. In 1985, the Asian tiger mosquito, which can transmit yellow fever, dengue, and viral encephalitides, was found to have hidden in a shipment of scrap tires from Japan to the United States. The mosquito is now established in 26 U.S. states. A year later, it was found in Brazil for the first time. Since then, it's also been found in Mexico, Guatemala, and the Caribbean. To date, there are no federal laws dealing with scrap tires."

http://www.thebulletin.org/web-edition/columnists/laura-h-kahn/the-spread-of-mosquito-borne-diseases

Example 2 : If you can map it, it is geography.

Medical Geography of Retiring Baby-boomers

Baby-boomers will start retiring this year (and qualify for FREE medical treatment – Medicare).

The geographic distribution of retiring Baby-boomers and the health implications of:

Their medical histories (map)

Their wealth-status (map)

Careers they have had (map)

Family support groups – children, siblings, and friends (map)

Retirement resources – pensions, 401k (map)

Future plans (proportion planning to move) (map)

Future plans (proportions planning to keep working)

Disease Categories

Two main types of diseases:

1. Infectious / transmissible /contagious/communicable /pathogenic.

Can be transmitted from person to person (or between species).

Usually involve a causal agent (e.g. bacteria or virus), but may be genetic.

2. Degenerative / non-infectious /non-transmissible /non-communicable.

Traditionally assumed to be associated with the ageing process (i.e. risks increase as body degenerates with age). **See animations (p16)**

Infectious diseases:

- ✓Were the major cause of death throughout history.
- ✓Declined as the major cause of death in developed countries mid-19th century to mid-20th century.
- ✓Non-infectious diseases are now the major cause of death, but infectious diseases are making a comeback (example **MRSA** - methicillin-resistant Staphylococcus aureus, or **staph** infections).

- Most infectious diseases are caused by a particular species of microorganism (or microbes), but some larger organisms also cause disease.
- Microorganisms are ubiquitous. Only a small minority of microorganisms are pathogenic (i.e. disease causing).
- Pathogens do not have malicious intent.

Diseases are 'merely the by-product of an accidental collision between two or more forms of life, each pursuing its own destiny'.
Jacques May (1950)

Pathogenic Factors

1. **Hosts - the human (or other organism)** infected.
2. **Causal agents – the organism that** causes the disease.
3. **Vectors – organisms (usually an** arthropod) which transmit the causal agent from one infected host to a new host.

4. **Intermediate hosts - organisms (usually molluscs, fish or mammals) which are essential to the life cycle of the causative agent.**
5. **Reservoirs – other species which act as a host to the causal agent.**

Cross-species infections. Example:

"Influenza A viruses have infected many different animals, including ducks, chickens, pigs, whales, horses, and seals. However, certain subtypes of influenza A virus are specific to certain species, except for birds, which are hosts to all known subtypes of influenza A. Subtypes that have caused widespread illness in people either in the past or currently are H3N2, H2N2, H1N1, and H1N2. H1N1 and H3N2 subtypes also have caused outbreaks in pigs, and H7N7 and H3N8 viruses have caused outbreaks in horses.

Influenza A viruses normally seen in one species sometimes can cross over and cause illness in another species. For example, until 1998, only H1N1 viruses circulated widely in the U.S. pig population. However, in 1998, H3N2 viruses from humans were introduced into the pig population and caused widespread disease among pigs. Most recently, H3N8 viruses from horses have crossed over and caused outbreaks in dogs.

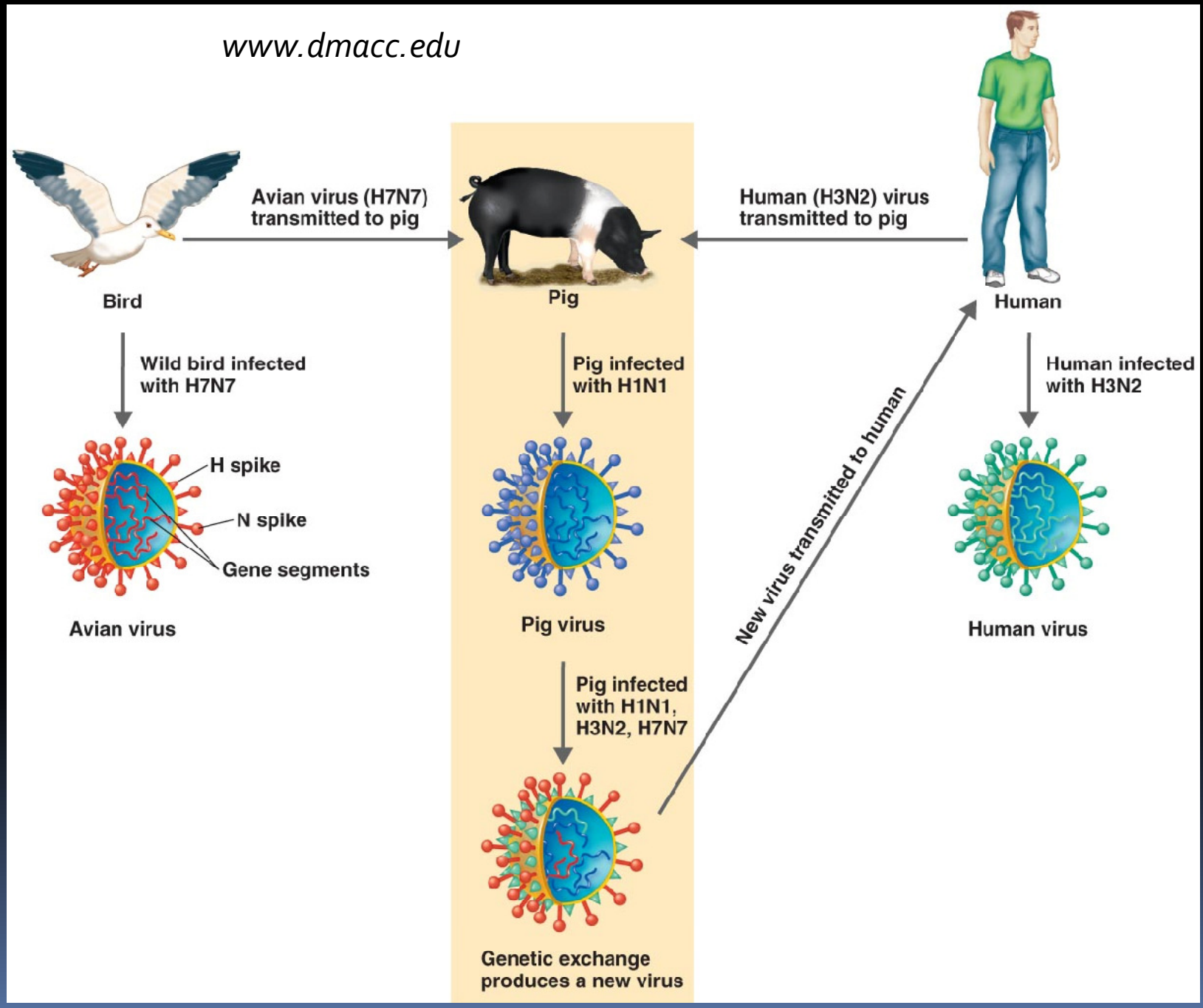
Avian influenza A viruses may be transmitted from animals to humans in two main ways:

Directly from birds or from avian virus-contaminated environments to people.

Through an intermediate host, such as a pig. CDC

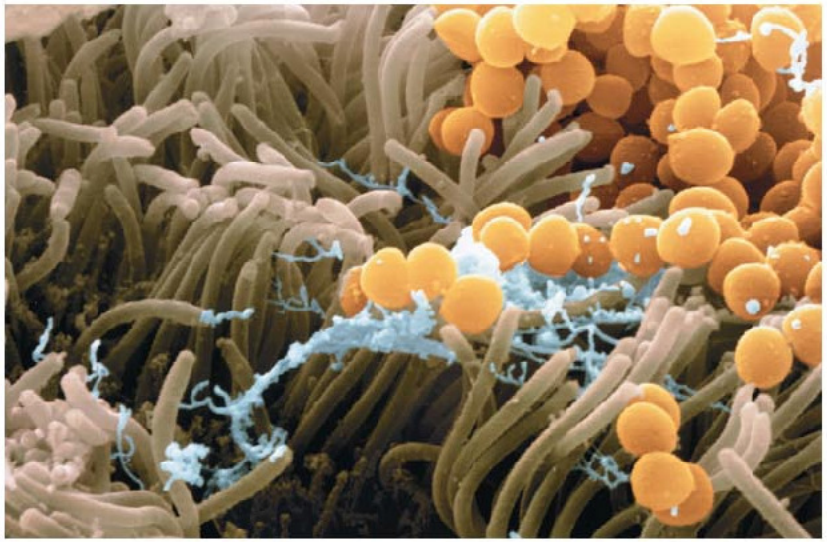
http://www.cdc.gov/flu/avian/gen-info/transmission.htm

www.dmacc.edu



Class of Agents

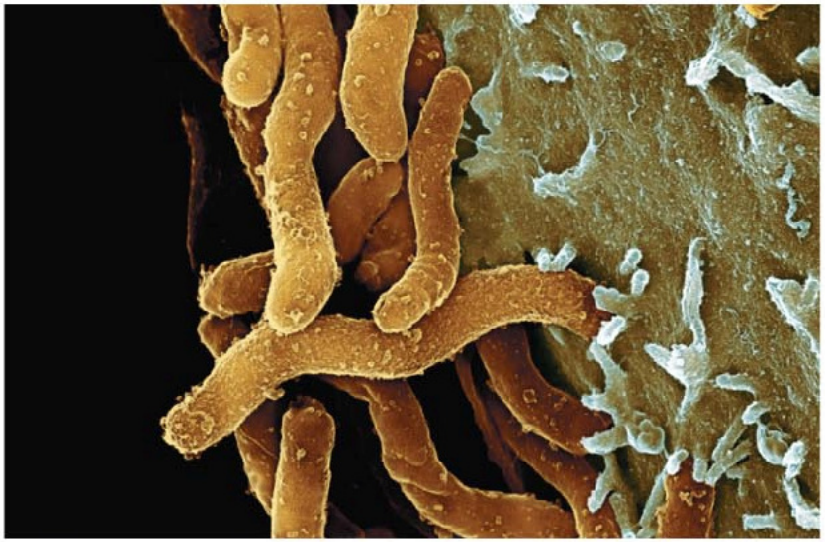
Infectious	Non-infectious (examples)
Bacteria	Chemicals used everyday
Viruses	Environmental pollutants
Protozoa	(Including noise?)
Fungus	Social stressors (mental health)
Riketsia	



(a) Bacteria (orange spheres) on the surface of the nasal epithelium

SEM

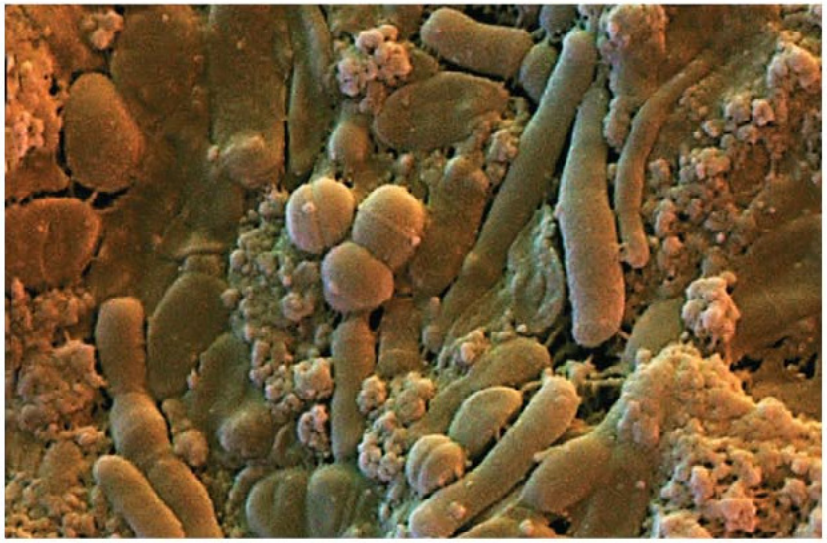
2 μm



(b) Bacteria on the lining of the stomach

SEM

2 μm



(c) Bacteria in the large intestine

SEM

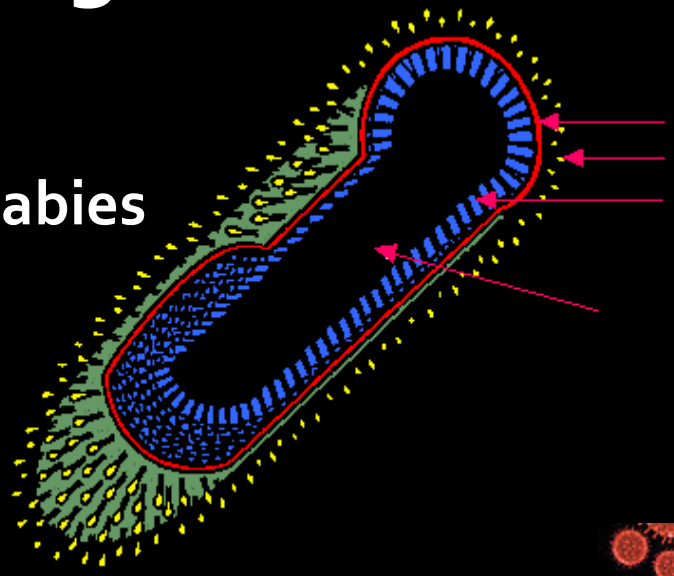
2 μm

Bacteria: Images

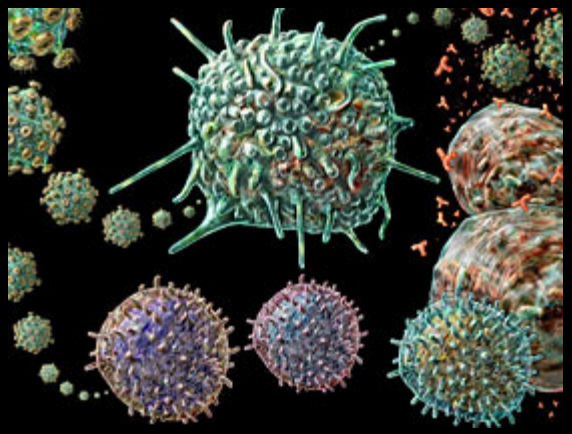
www.dmacc.edu

Virus: images

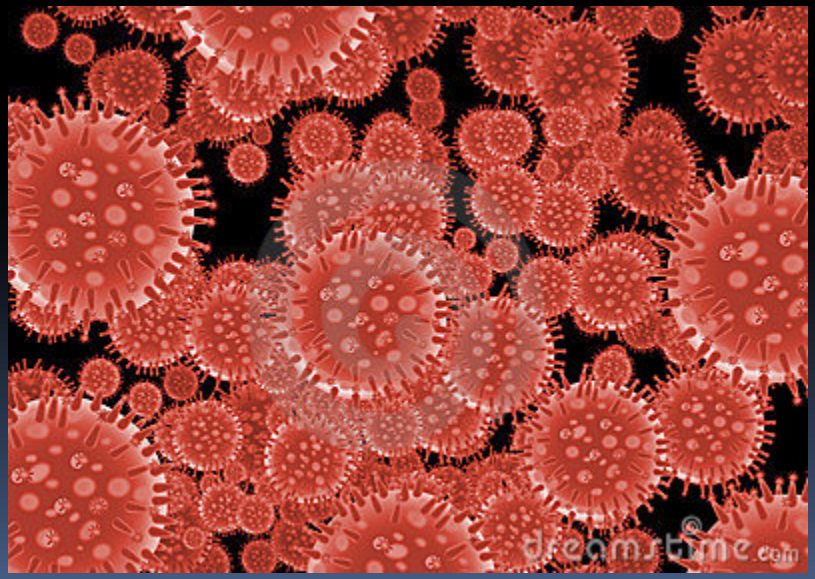
Rabies



HIV-AIDS



Influenza A



Vectors

Mosquitoes
Flies
Fleas
Louse
Ticks
Spiders
Mites

Arthropods: An arthropod is an invertebrate animal having an exoskeleton (external skeleton), a segmented body, and jointed appendages.

Disease Prevention

- All infectious diseases require at least two factors (**host + agent**).
- Many require additional factors (i.e. **vector**, **intermediate host**, or **reservoir**).
- Each factor has its own 'geography'.

These geographies must overlap for the disease to be present.

- Diseases may be prevented by eliminating one of the factors.
- This is not only difficult, but it may have unforeseen ecological consequences.

Means of Transmission

- Most infectious diseases are associated with a particular means of transmission.
- There are numerous means of transmission, but a few broad categories may be identified.


(d) Droplet transmission

Airborne

- Agents present in nasopharynx or respiratory tract are disseminated in salivary droplets during coughing, sneezing or breathing.
- The droplets are very small and soon evaporate leaving the agent floating in the air.
- They are breathed in by the next victim.
- Diseases spread in this manner include mumps, measles, chicken pox, colds, and influenza (viral); and whooping cough, diphtheria and tuberculosis (bacterial).

Water- and Food-borne

- Food may become contaminated (e.g. *Salmonella, Clostridium botulinum).*
- Agents passed in faeces may find their way into the water supply (the faecal-oral route). Cholera and typhoid are transmitted in this manner.
- Sanitary reforms in the late-19th century reduced the risk of these diseases by ensuring clean water supplies.
- Risks of infection may be reduced by good personal hygiene, but infection is still easier than might be realized.

Direct Physical Contact

- Venereal diseases (e.g. syphilis, gonorrhoea, genital herpes) are transmitted by direct contact during sexual intercourse.
- A few diseases (e.g. leprosy, yaws) may be transmitted by direct contact of a non-sexual nature.

(a) Direct contact transmission

(b) Food www.dmacc.edu

Indirect Physical Contact

- The causal agent may be transmitted via an inanimate object (fomite).
- Sharp instruments which penetrate the skin may carry infection (e.g. surgical intruments, syringes, razor blades, needles).
- Dust and soil carrying an infectious agent may gain access through a cut to cause diseases such as tetanus *Clostridium tetani) or gas gangrene (Clostridium perfringens).*

The role of Diseases in Human Evolution

1. Descent from the trees – exposure to new vectors and agents.
2. Omnivorous diet – exposure to zoonoses.
3. Expansion into new regions – new zoonoses, but fewer helminths.
4. Low population density and mobility provided protection against extinction.
5. Palaeolithic hunter gatherer societies had a balanced diet and probably enjoyed good health.
6. Population densities were low. This prevented many diseases becoming endemic.
7. Population numbers were kept in check by food supplies.
8. Life expectancy was probably around 40.
9. The world's population is estimated as:

   4 million by 10,000BC 5 million by 5,000BC

There were two major developments:

✓ The **Neolithic revolution** / agricultural revolution

✓ The **urban revolution**

• The agricultural revolution began in the hilly regions of the Middle East about 9,000 to 7,000 BC.

After the revolution: Various factors contributed to worsening health:

1. **Population density: Agriculture supported much** higher population densities – 10x to 100x hunter gathering.

2. **Diet: Diets deteriorated due to dependence upon** cereals, resulting in beri-beri (thiamine deff.), pellagra (niacine deff.), riboflavin deficiency (vitam. deff. - cracked lips), rickets, and kwashiorkor.

3. **Permanent settlements: water-borne infections due** to sewerage contamination of water supplies; rodent transmission of disease due to stored food.
4. **Animal contacts: Diseases such as flu, the common** cold, smallpox, measles, and mumps mutated from animal diseases. Increase in helminth infestations.
5. **Land clearances: Mosquito transmitted diseases** such as yellow fever, malaria, dengue and several kinds of viral encephalitis.
6. **Scrub: Rickettsial diseases transmitted by ticks (e.g.** scrub typhus, endemic typhus).
7. Fertilisers: Night soil increased faecal bacterial and worms.