Globalization of Infectious Diseases
Origin of Some Infectious Disease Agents

Ebola
West Nile
Lassa
Norwalk
Coxsackie
Lyme
Hanta
Ecological Factors Influencing the Emergence of Infectious Diseases

- Geography
- Climate
- Weather
- Animal Migration
- Human Encroachment and Forced Migration
- Natural Disasters (floods, fire, hurricanes, etc.)
- Vector Biology
Basic Sciences:

- Geology
- Ecology
- Oceanography
- Hydrology
- Biochemistry and Molecular Biology
- Physics
- Atmospheric Sciences
- Chemistry
- Remote Sensing
Applied Sciences:

- Biostatistics
- Medical Sciences
- Epidemiology
- Anthropology
- Environmental Health Sciences
- Agronomy
- Socio-Medical Sciences
- Toxicology
- Medical Geography
To learn more, log on to:

www.medicalecology.org
Host-Agent Interactions

Contact with host - route of entry

Dose - how many organisms does it take to infect?

Frequency - how often must the host be exposed?

Adherence - what are the host receptor molecules

Adaptability of agent- e.g., antigenic variation, interference with host immune system
Cholera
Cholera Pandemics
Cholera
Then and Now

John Snow
Rita Colwell
Distribution Of Estuaries

- Major river deltas
- Freshwater lakes of more than 5,500 sq miles
Trophic Relationships Of The Mangrove Estuary

From: E. Odum Fundamentals Of Ecology
Ecology of Cholera Epidemics

Numbers increase during monsoons due to phytoplankton blooms

Filter-feeding crustacea

Copepod

Throw net fishing for crustacea after the monsoons in Bay of Bengal

Fecal contamination of freshwater and human activities
Monsoons

1. lower the salinity of the estuary
2. bring nutrients to the estuary
3. raise the ambient water temperature of the estuary
Common and Not So Common Strains of the Influenza Virus

Influenza A Evolution

1874 --- (H3N8)  
1890 --- (H2N2) ..................Pandemic  
1902 --- (H3N2)  
1918 --- (H1N1) ..................Pandemic  
1933 --- (H1N1) ..................First strains isolated  
1947 --- (H1N1) ..................Variation detected  
1957 --- (H2N2) .................."Asian" Flu pandemic  
1968 --- (H3N2) .................."Hong Kong" Flu pandemic  
1976 --- (H1N1) .................."Swine" Flu, non-epidemic  
1977 --- (H1N1) + (H3N2) ........"Russian" Flu epidemic  

H5N1 - 2004 “Avian” influenza  
All ages susceptible
In 1918-1919, Influenza killed some 40-100 million people, worldwide.
Influenza Virus:

Structure and Function
Hemagglutinin Subtypes of Influenza A Virus

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Adapted with permission from Levine AJ. Viruses. 1992; 165.
Spread of Avian Influenza Virus

Courtesy BBC
Asian Waterfowl Flyways
**On the fly.** Flyways might seem to connect the dots of H5N1 outbreaks, but the timings and locations aren't a perfect fit with known migratory patterns.
Human Cases

Jul-Nov 11 2005 Human total: Cases 17 (125) Deaths 10 (64)

EAST ATLANTIC
BLACK SEA/MEDITERRANEAN
EAST AFRICA/WEST ASIA
CENTRAL ASIA
THAILAND
Cases: 3 (20)
Deaths: 1 (13)
CAMBODIA
Cases: 0 (4)
Deaths: 0 (4)
INDONESIA
Cases: 9 (9)
Deaths: 5 (5)
VIETNAM
Cases: 5 (92)
Deaths: 4 (42)

Courtesy BBC
Hanoi Chicken Farmer Going to Market

Courtesy Andrew Rosenblatt
What will happen next?
World Air Routes
World Distribution of Rabies

Countries where rabies* is present
Rabies-free countries
No information

*Rabies in this manual is defined as a disease caused by Lyssaviruses belonging to serotype/genotype 1.

Source: WHO, 2002
Rabies vectors and carriers
Vampire Bat
rabies virus

Did you know?
30% of all mammalian species are bats
Hematophagous (vampire) bats are proliferating because of forest devastation in the state of Maranhao, northeastern Brazil. 20 cases of fatal rabies have been clinically documented. The population in the area is protecting their houses with wire nets to prevent bat bites.

Dr. Luciano Goldani  
Infectious Diseases Unit  
Universidade Federal do Rio Grande do Sul  
Brazil
Live virus vaccine in oral baits
Control of rabies by oral bait-vaccine

3.1 Rabies Situation and Rabies Control in the Czech Republic 2000 – 2002

by O. Matouch1 and J. Vlasek2
1State Veterinary Institute, Liberec 30, CZ
2State Veterinary Administration, Prague, CZ

1. Oral vaccination of foxes

The field trial of oral immunization of foxes was started in the Czech Republic in spring 1989. The first application of the oral rabies vaccine (SAD B19-Tübingen) was carried out in the districts Klášov, Domažlice, Tachov adjacent to the German border in spring 1989. During the course of the next campaigns the treated area was extended covering 44 districts in autumn 1992. In the autumn 1993 the whole territory of the Czech Republic, with exception of rabies free districts bordering Germany, was included.

Since 1995 only the Czech made vaccine LYSVULPEN manufactured by BIOVITA Brno/vice with the SAD B19 vaccine virus strain has been used in the Czech Republic.

The “Bavarian model” was applied during all vaccination campaigns. Voluntary hunters distributed the vaccine baits by hand in their hunting preserves. The strategy of two vaccination campaigns per year, one in spring and one in autumn, was applied. From 1996 aerial distribution of the vaccine baits was selectively used on a restricted territory (4 – 6 districts). In the last years, the aerial vaccination was extended to 50% of the treated territory (28 districts) in 2002 (see Map). More than nineteen million of vaccine baits were used from 1989 till the autumn 2002.
Yellow Fever

Distribution of Yellow Fever

“A man, a plan, a canal. Panama”
Aedes aegypti
the yellow fever mosquito
Copyright © 1995 Leonard E. Munstermann
Panama Canal: The Early days
Canopy Transmission
By Haemogogus sp.
Ecology of Transmission Of Yellow Fever

Ecotone

YF transmission patterns

Monkeys

Jungle mosquitoes

Humans in transition (emergence) zone

Humans in City

Aedes aegypti
Occupations at High Risk

- Rubber
- Coffee
- Sugar cane
- Revolutionary
African Trypanosomiasis
East African Savanna
West African River
Riverine Tsetse and agriculture
Civil Unrest and War - 2005

Liberia
Côte-d’Ivoire
Sudan
Ethiopia
Nigeria
Sierra Leone
Guinea
Ghana
Burundi
Burkina Faso
Cameroon
Gambia
Rwanda
Swaziland
Mauritania
Zambia
Central African Republic
Namibia
Democratic Republic of Congo

Cases - 400,000/yr
Deaths - 60,000/yr

Refugees
What’s Next??
Without a global ecological perspective on infectious disease transmission, we will forever remain sitting ducks!