Zoonoses
Coupled to a highly connected complex world

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I. Introduction
II. Zoonoses - Background & Trends
III. Connecting disease to the world of today
IV. Zoonoses skyline
I. Introduction

Source: CDC, NCZVED
I. Introduction

New terms

- Social Media
- Globalization
- Collapsed spaces
- Public-private partnerships
- Citizen Science
- Working at the commons
- Resource ceilings
- Dilemmas
- Interconnectedness
- Pre-competitive space
- Smart mobs
I. Introduction
Pathogens cross political borders
I. Introduction

Globalized world and sanitary infrastructure
I. Introduction

Changing institutions, laws, and governments
I. Introduction

International spread of disease

- Asian avian flu virus
- Severe acute respiratory syndrome
- Swine flu
II. Background & Trends

- **Zoonoses**: Any infection or infectious disease transmissible under natural conditions to humans or those shared between humans and animals.

- 1,400 species of human pathogens are now recognized, and over 800 (nearly 60%) are known to be zoonotic.

II. Background & Trends

Source: New Scientist
II. Background & Trends

• The discovery of new human pathogen species continues at a rate of 3-4 species per year.

II. Background & Trends

Wildlife plays an important role

Zoonotic pathogens from wildlife

II. Background & Trends

- 75% of emerging diseases are zoonotic
- Zoonotic agents comprise more than 80% of the CDC-listed biothreat agents of concern:

<table>
<thead>
<tr>
<th>Zoonotic Agents</th>
<th>Biothreat Agents</th>
</tr>
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<tbody>
<tr>
<td>Anthrax (Bacillus anthracis)</td>
<td>Q fever (Coxiella burnetii)</td>
</tr>
<tr>
<td>Arenaviruses</td>
<td>Ricin toxin from Ricinus communis (castor beans)</td>
</tr>
<tr>
<td>Botulism (Clostridium botulinum toxin)</td>
<td>Salmonella species (salmonellosis)</td>
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<td>Brucella species (brucellosis)</td>
<td>Salmonellosis (Salmonella species)</td>
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<td>Chlamydia psittaci (psittacosis)</td>
<td>Shigella (shigellosis)</td>
</tr>
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<td>Cholera (Vibrio cholerae)</td>
<td>Smallpox (variola major)</td>
</tr>
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<td>Ebola virus hemorrhagic fever</td>
<td>Staphylococcal enterotoxin B</td>
</tr>
<tr>
<td>E. coli O157:H7 (Escherichia coli)</td>
<td>Tularemia (Francisella tularensis)</td>
</tr>
<tr>
<td>Emerging infectious diseases: Nipah virus and hantavirus</td>
<td>Typhoid fever (Salmonella Typhi)</td>
</tr>
<tr>
<td>Epsilon toxin of Clostridium perfringens</td>
<td>Typhus fever (Rickettsia prowazekii)</td>
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<tr>
<td>Food safety threats (e.g., Salmonella species, Escherichia coli O157:H7, Shigella)</td>
<td>Vibrio cholerae (cholera)</td>
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<tr>
<td>Glanders (Barkholderia mallei)</td>
<td>Viral encephalitis</td>
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<tr>
<td>Lassa fever</td>
<td>Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo])</td>
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<tr>
<td>Marburg virus hemorrhagic fever</td>
<td>Water safety threats (e.g., Vibrio cholerae, Cryptosporidium parvum)</td>
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<tr>
<td>Melioidosis (Barkholderia pseudomallei)</td>
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<tr>
<td>Plague (Yersinia pestis)</td>
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</tr>
</tbody>
</table>

Source: OIE, CDC, 2003a; IOM and NRC, 2008
II. Background & Trends

Significant global outbreaks since 1993

1993- Hanta virus  
1994- Plague (India)  
1995- Ebola (Zaire)  
1996- New variant of CJD (UK)  
1997- H5N1 (Hong Kong)  
1998- Nipah virus (Malaysia)  
1999- West Nile  
2000- Rift valley fever  
2001- Anthrax  
2002- Norwalk-like viruses  
2003- SARS  
2006- H5N1  
2009- Pandemic H1N1

Source: CDC
II. Background & Trends

• Preventative vaccination

• Culling animals

• Pasteurizing milk
II. Background & Trends

Size & scope

Source: UN World Tourism Organization, UNFAO, World Bank
II. Background & Trends

H5N1 falling off radar
II. Background & Trends

Nations Pledge $2 Billion to Combat Bird Flu

Wednesday, January 18, 2006
Associated Press

- 45% to be spent in Vietnam, Cambodia, Indonesia, Thailand and Laos
- EU pledged $121 million
- US pledged $334 million
- Japan donated $159 million
- China said it would donate $10 million

Source: AP/Fox News, 2006
II. Background & Trends
H5N1

Confirmed human cases of H5N1 2003-2010

Source: World Health Organization, 2010

63 Countries Report H5N1 Avian Influenza in Domestic Poultry/Wildlife 2003-2010

Source: OIE, WAHID, 2010
II. Background & Trends
Connecting disease to world of today

Confirmed human cases of Pandemic H1N1 in humans, 2010

Reported cases of H1N1 in swine, 2007-2009

II. Background & Trends

Origins of emerging infectious disease (EID) events from 1940-2004

II. Background & Trends

- Large gaps exist in disease surveillance networks, including coverage across species and across geographic space.

- 90% of the cause of human infectious disease could not be identified, even in developed countries.

Source: Sustaining global surveillance and response to emerging zoonotic diseases, National Academies Press
II. Background & Trends

The J-curve
III. Connecting disease to world of today

Ecological risk and climate change

“Ecosystem services...have been estimated to be equivalent to the world gross domestic product, roughly $30 trillion. “ –E.O. Wilson

Source: Goldman Sachs analysis of WHO Data, NOAA
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Ecological risk and climate change

- Geographic changes will take place in water-borne and vector-borne disease.

- Increases in precipitation will lead to favorable habitats for vectors, intermediate and reservoir hosts, or warming that leads to expansion or ranges in low latitudes, oceans, or mountain regions.

Source: NASA, 2010
III. Connecting disease to world of today

Population dynamics

Source: UNEP/GRID

World Population Growth to 2050 Image credit: SustainableScale.org
III. Connecting disease to world of today

Population Dynamics

• In 2000, emerging market economies accounted for 56% of the global middle class

• By 2030, that figure is expected to reach 93%

• China and India alone will account for 2/3 of this expansion

Source: Sustaining global surveillance and response to emerging zoonotic diseases, National Academies Press
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Population Dynamics

Slum growth, 1990-2001

Source: United Nations
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Population dynamics

The smuggling of roosters into the country for cockfighting was responsible for a 2002 exotic Newcastle disease epidemic in California.

Source: AVMA
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World Population Growth

Source: A dynamic meat market towards 2020, Kennes, 2010
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World Population Growth

In 2008, an estimated 21 billion food animals were produced for a global population of 6.5 billion people.

In 2007, the Chinese consumer who ate 44 lbs of meat in 1985, consumed 110 lbs.

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Growing governance gap

– What governments can do and are expected to do
– Demands on social services vs. infrastructure projects
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Growing governance gap

- US 2010 Federal Budget
  Total: $3.55 trillion

[Pie chart showing budget distribution]

Source: OMB, 2010
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Growing governance gap

- Turnover in Ministries and leadership positions

- Limited expenditures for animal health, plant health and food safety

- Participation within the World Organization for Animal Health (OIE)

- Emerging growth of 3rd parties
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Global foodscapes

Global Meat Trade

Major global trade flows of dairy products, 2003

Source: GIRA

Source: ERS, USDA, 2005
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Global foodscapes

Trends in Poultry Production

Source: FAO, 2009
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Microbial networks

– Networks of microbes, humans, animals and technologies form to create new environments

NIPAH virus

SARS virus
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Microbial networks

Poultry population density  Human population density

Source: FAO, WHO, Rimsa, Mexico City April 2005
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Microbial networks

Source: UNWTO World Tourism Barometer, 2010
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Technology & social action

- People can organize around issues without being limited by geographic distance
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Technology & social action

Only India & China have larger populations than Facebook

We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run - Amara’s Law
III. Connecting disease to world of today

• Affected sectors:
  – Public health
  – Animal health
  – Goods
  – Services
  – Civil society
  – Education
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IV. Zoonoses skyline
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Language

Managing dilemmas
Collective challenge
Non-competitive space
Simple solutions
Individual issue
Controlled environment
Social networks
Experts
Linear problems
dilemmas
Complex issues
IV. Zoonoses skyline

Language

Linear problems          Complex issues
Controlled environment   Non-competitive space
Experts                  Network platforms
Individual issue         Collective challenge
Simple solutions         Managing dilemmas
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Issue Framing
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Shared Cooperation
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Governance Gap
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Pre-competitive space
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Societal engagement

World Cell Phone & Internet use per 100 people

Cell Phone

Internet
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Academic engagement
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Learning platforms
IV. Zoonoses skyline
IV. Zoonoses skyline

Incentives & sustainability

Bangladesh Rural Action Committee - the world’s largest non-governmental development organization
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Incentives & sustainability

The international avian influenza response: an actor-network diagram

Source: STEPS Centre
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Wildcards

Absence of evidence is not the same as the evidence of absence.
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Calvin and Hobbes by Bill Watterson

YOU KNOW, THE WORLD SHOULD'VE BEEN DESIGNED SO EVERYONE DIDN'T HAVE TO EAT EACH OTHER TO SURVIVE. THERE SHOULD JUST BE FEWER PEOPLE AND ANIMALS TO BEGIN WITH.
AND THE WORLD CERTAINLY COULDN'T HAVE USED A MORE EVEN DISTRIBUTION OF ITS RESOURCES, THAT'S FOR SURE.

Calvin and Hobbes by Bill Watterson
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