The transmission of animal and human pathogens through global trade

“Turning the microscope upside down”
Ann Marie Kimball, MD, MPH, FACPM
February 11, 2009, Washington DC
Dimensions of Globalization: Would Darwin Recognize this World?

- Political
- Cultural
- National Security
- Financial
- Development
- Homogenization
- Environmentalism

- The nation state?
- Universal values?
- Peace or War?
- Where is the money?
- What is progress?
- “One size fits all”
- Which shade of Green?

Thomas Freidman, *The Lexus and the Olive Tree*, 1999

Based on “The Lexus and the Olive Tree” by Thomas L. Freidman
Risky Trade
Infectious Disease in the Era of Global Trade

Ann Marie Kimball, University of Washington, USA

The current value of global trade has reached a staggering $14 trillion per annum across borders at the same time raising fears for global health. Yet, investment in public health infrastructure and disease control was never envisaged to cope with the international scale of this volume and diversity. Indeed, most health systems lag far behind, especially in poor countries. This has created new vulnerabilities for global populations to the introduction and amplification of infectious disease through trade. Public fears have been further heightened by frightening news reports of deadly diseases such as SARS and swine influenza.

Risky Trade: Infectious Disease in the Era of Global Trade provides a thorough examination of the actual risks posed by epidemic disease in the modern age of globalization. The author draws on the experiences of international trade and epidemiology to explore the health issues arising from the enormous increase in global trade and travel. Issues covered include:

- The scale of the problem with particular reference to the SARS outbreak of 2003; global SARS; avian influenza; HIV/AIDS; and other important international epidemics of disease;
- Trade in particular controversies – livestock and viral infections; highly infectious agents; and enviral risk; and; health agents;
- Global dissemination of outbreaks as a result of human travel and trade;
- Prevention, surveillance and control;
- The future health of global trade and the hopes for population safety worldwide.

In addition to highlighting the problems, the book also assesses some of the potential benefits the new globalisation can bring to epidemic control through surveillance, diagnosis, treatment and investigation. An empirical approach takes together existing descriptions of epidemic disease and case studies of epidemic disease building a comprehensive framework for examining new events and considering historical experience with infectious outbreaks.

The volume will be a valuable guide to students, academics, practitioners, and policy makers in the areas of international trade, health economics, epidemiology, international public health and disease control.

This book is a must-read for policy makers in health and trade, and for captures a high-level view of the global trade and the health risks it poses. It addresses the need to keep their ships sailing smoothly in a world where infectious diseases are increasingly more important to the global economy and society.

David L. Heymann, M.D., Executive Director, Communicable Disease, World Health Organization

At a time when world leaders are increasingly aware of public health's importance to society, economics, development, and human dignity, Professor Kimball's Risky Trade: Infectious Disease in the Era of Global Trade illustrates with a master's touch the complexities of what is a defining 21st-century challenge—managing globalization in an age-old struggle between people and pathogens.
What was Darwin’s Greatest Tool?

Scope of the Science

- Macro social level
  - Global economic and geopolitical level
  - National and state level
  - Community and workgroup level
  - Individual, family, and social group level
- Micro biological level
  - Organ level
  - Cellular level
  - Molecular level
  - Genomic level

Figure 1. Health as a continuum between biological and social factors across the lifespan. (Adapted from Glass & McAtee, 2006).
Factors of Emergence-Related to Human activity

- Demographic, population
- Behavior
- PH Infrastructure breakdown
- Travel
- Technology, Trade

- Microbial Change
- Climate Change
- War
- Intentional Release
- Land Use

Institute of Medicine
“Trade Related Infection”

- An infection which emerges as a result of consolidation, changes in manufacture due to global market pressures OR
- An infection which is amplified geographically through product (or animal) trade OR
- An infection which results in economic damage from trade embargoes of affected products (or animals)

*Kimball, Arima, Hodges, 2005*
### A sampling of costs of epidemics

---

**Kimball, Davis 2001**

<table>
<thead>
<tr>
<th>Event</th>
<th>Sources of Costs</th>
<th>Estimated Amounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avian Influenza Hong Kong 1997</td>
<td>Trade restrict. Loss of poultry Preferred breeds</td>
<td>$13 million US</td>
</tr>
<tr>
<td>Plague, Surat, India 1994</td>
<td>Trade. Tourism, diamonds</td>
<td>$1.3 billion US</td>
</tr>
<tr>
<td>E. Coli 9157H:7 Sakai, Japan 1996</td>
<td>Inspection, import market, compensation</td>
<td>$1.5 million market only</td>
</tr>
<tr>
<td>Cholera, Lima, Peru 1993</td>
<td>Trade, Tourism</td>
<td>$700m-$1.5b</td>
</tr>
</tbody>
</table>
KOREA unveils $130 billion estimate for Avian Influenza in Asia, 2004

Estimate from Oxford Forecasting Group, 2004
Microbial Transportation: The Global Express

- Travel in or on humans or human derived products
- Travel in or on animals or animal derived products
- Contamination of seeds or fruits or vegetables
- “Hitchiking” by arthropods bearing vector borne disease
Known transnational cases of drug-resistant TB diagnosed among individuals recently living in Peru.
SARS: international amplification and transmission by guests at Hotel M, Hong Kong, 21 February–26 March

- Hospital 2 Hong Kong: 4 HCW + 2
- Hospital 3 Hong Kong: 3 HCW
- Hospital 1 Hong Kong: 99 HCW
- Hospital 4 Hong Kong
- 4 other Hong Kong hospitals: 28 HCW
- Index case from Guangdong
- Canada: 12 HCW + 4
- USA
- Ireland
- Singapore: 34 HCW + 37
- Germany: HCW + 2
- New York
- 219 HCW
- 30 non-HCW

Source: WHO/CDC
PANDEMIC

Tertiary:
Geographically Dispersed Clusters

Secondary:
Local extension

Primary:
Point of Emergence
Species jumping, Ecological pressure

Levels of Prevention: Levels of Microbial Traffic

Mechanisms

Trade, Travel

Direct Contagion

STATE OF THE ART
RISKY TRADE, 2006
“The first reported illness associated with the outbreak began on August 5, the most recently reported case had onset of illness on September 5.

The states that have reported cases are WI (29), UT (11), NY (7), OH (7), MI (6), NM (5), OR (5), IN (4), ID (3), KY (3), PA (3), CT (2), ME (2), CA (1), MN (1), NV (1), TN (1), VA (1), WA (1), and WY (1).

Spinach is the source,”

CDC update, September 15, 2006
PANDEMIC
Tertiary:
Geographically
Dispersed Clusters

Secondary:
Local extension

Primary:
Point of Emergence
Species jumping, Ecological pressure

Levels of Prevention: Levels of Microbial Traffic

WHAT'S MISSING FROM THIS PICTURE? Local Health Containment option

Mechanisms
Trade, Travel
Direct Contagion

TRANSNATIONAL TRAFFIC
Risky “unconscious” pressures on microbial pathogen populations

- Human, animal population number and density
- Lack of even access to water, sanitation
- “ramping up” production to meet global appetites
- Use of antimicrobials as growth promoters
WORLD POPULATION

World Population: 1950-2050

Source: U.S. Census Bureau, International Data Base 5-10-00.
Human population density in Asia is five fold greater (on average) than density in North America.

In many population centers poultry and livestock are co-located with humans.

Population Density:

- China: 6,436.7
- Hong Kong: 330.7
- India: 135.7
- Indonesia: 116.6
- Thailand: 117.3
- Vietnam: 243.3
Hosts and crowding and “ramping up”

- Poultry outbreaks have occurred throughout Asia
- Human “bird flu” has occurred in China, Hong Kong, Thailand, Vietnam, Cambodia, Indonesia
World urban population

Urban Population Growth

Most of the urban population will be in developing countries

Urban population (billions)

- Developing countries
- Developed countries
- World total

- 1965
- 1975
- 1985
- 1995
- 2005
- 2015
- 2025
Uncontrolled Urbanization
RISK: population density, poor water and sanitation infrastructure = “Planetary Overload”

- High co-located populations of humans, swine and poultry
- Poor sanitary infrastructure
As new arrivals come into the city, they bring their food animals with them.

Contact intensifies, largely local consumption, creates biosecurity risk for industrial agricultural

Superimposition of industrial farming in crowded areas enhances risk of new pathogen emergence
The Pressures of the Global Marketplace and Global Trade work in “unconscious selection” of pathogens

- “ramping up” and shifting production temporally correlates with emergence of new pathogens
- Extended production chains, transportation disseminates pathogens and stymies local control
- Limited population safety net in place

Charles Darwin - “I Love Fools Experiments; I am always making them”
A Five Fold Increase in Poultry Exports in Fifteen Years
What is intensive agriculture?

- Vertically integrated system
- “Integrator” owns stock from birth or hatching through slaughter,
- “Integrator” controls all aspects of animal husbandry
- Environmental concerns “externalized” by limited market power of grower

“Putting Food on the Table: Industrial Farm Animal Production In America, April 2008”
And we are intensifying our food animal practices

- Introduction of intensive vertically integrated poultry agriculture into Thailand mid 1960s, (Charoen Pokphanol, Thailand and Arbor Acres Food US)
- Introduction into China 1978 by CP corp
- Poor biosecurity in backyard farms despite biosecurity of facilities
- With Avian Influenza risk compounded by free ranging ducks (asymptomatic reservoir for virus)

Model Poultry Farm, Ho Chi Minh city
What is next with Avian Influenza?

- Active Surveillance in place, sub-regional exercises in pandemic preparedness
- High human mortality, poor transmission
- 166 deaths in 272 cases worldwide (63 deaths in 81 cases in Indonesia)
- “Threshold” for pandemic is not known.
Human cases and deaths, Avian Influenza 2003-2007 (WHO data, April 11, 2007)
So What is the Global Regime for Pandemic control?

- Positive obligation of countries to control disease within their borders, assist others to do the same
- New regulations at air and seaports
- US concurred December 2006 in line with federal system
- New definition of “Public Health Emergency of International Concern” (all hazards approach.)
Is the event serious?
- Yes
- No

Is the event unexpected?
- Yes
- No

Could it (or has it) spread internationally?
- Yes
- No

Risk for international sanctions?
- Yes
- No

Notify the event under the International Health Regulations

Reassess when more information available
## Tools of the Trade

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Nexus with Emergence Paradigm</th>
<th>Manner of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>GATT</td>
<td>May encourage enterprises to “gear up” to enter global marketplace, or to consolidate</td>
<td>Commitment to tariff reduction may necessitate enhanced efficiency</td>
</tr>
<tr>
<td>TBT</td>
<td>Potential detection/tracking of “stealth” infections in biologicals: STANDARDS</td>
<td>Notification of trade change due to human health concerns</td>
</tr>
<tr>
<td>SPS</td>
<td>Potential detection/tracking of zoonotic, food-related infections: STANDARDS</td>
<td>Notification of trade change due to human health concerns</td>
</tr>
</tbody>
</table>
## Tools of the Trade

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Nexus with Emergence Paradigm</th>
<th>Manner of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIPS</td>
<td>Innovation, development of pharmaceutical treatments for new infections; access issues.</td>
<td>Protects intellectual property of new products; allows compulsory licensing in Public Health emergencies.</td>
</tr>
<tr>
<td>GATS</td>
<td>Consumption Abroad and Medical Tourism</td>
<td>Unknown risk of microbe and resistance traffic.</td>
</tr>
</tbody>
</table>
URGENT NOTIFICATIONS

- SPS mandates notification of urgent trade restrictions.
- TBT mandates notification of urgent trade restrictions.
- In both instances, human health concerns are the leading rationale for notification.
TBT urgent measure notifications by Year, 1995-2005

The majority of urgent measures are filed for reasons of “human health”
The Pressure of entering the “Global Market”: Case study: BSE/nvCJD Disease

- Major contributor to disruption of beef trade
- Correlation with UK entry into WTO, reduction of tariffs required increased efficiency of “cottage” beef market
- Change in husbandry practice implicated
- Novel agent, long latency
Superimposed Epidemics

- Long incubation period of up to 10 years allowed extensive circulation of MBM infected product in the global market prior to identification of risk.
Identification of nvCJD with BSE in cows devastated the UK beef export market.

Hypothesis of causal link in 1996, still under scientific dispute. Not under "commercial" dispute.
The Great Recycling
From horns to tails, industries recuperate everything. Many products find their way back into the food chain (human and animal). Safe? Not so sure. Even for cosmetics or medical products the threat from prions cannot be disregarded.

Stock farming

Stock farming

Slaughterhouse

Salvage
Knackers process non-edible animal remains: bones, skin, blood, feathers, rind, offal, as well as bodies of animals collected from farms. The waste is mixed and cooked using methods which are not always guaranteed to be effective against prions.

Millions of tonnes of animal waste recycled each year

Various extracts
Elastine, collagen beauty creams; glycerine in toothpaste, lipstick, some softdrinks; keratine in shampoos

Animal feed
Millions of tonnes are produced each year. Prohibited for cattle and sheep, reserved for pigs and poultry (and also fish), for which it is presumed that there is no risk.

Gelatine
From sweets to patés, desserts to medicines, even for the preparation of table wines

Tallow, animal fats
Omnipresent in foodstuffs (biscuits, ice-creams, stock, cooking oil). Also used for making soaps.
The number of BSE-related SPS urgent notifications as of December 2003
The 3 trillion dollar question…

Why is there no working group on Health at WTO?
Ministerial Conference

General Council meeting as Dispute Settlement Body

General Council meeting as Trade Policy Review Body

Appellate Body
Dispute Settlement panels

Committees on
- Trade and Environment
- Trade and Development
- Subcommittee on Least-Developed Countries
- Regional Trade Agreements
- Balance of Payments
- Restrictions
- Budget, Finance and Administration

Working parties on
- Accession

Working groups on
- Trade, debt and finance
- Trade and technology transfer

(Inactive: Relationship between Trade and Investment)
- Trade and Competition Policy
- (Transparency in Government Procurement)

Council for Trade in Goods

Committees on
- Market Access
- Agriculture
- Sanitary and Phytosanitary Measures
- Technical Barriers to Trade
- Subsidies and Countervailing Measures
- Anti-Dumping Practices
- Customs Valuation
- Rules of Origin
- Import Licensing
- Trade-Related Investment Measures
- Safeguards

Working party on
- State-Trading Enterprises

Council for Trade in Services

Committees on
- Trade in Financial Services
- Specific Commitments

Working parties on
- Domestic Regulation
- GATS Rules

Plurilaterals
- Trade in Civil Aircraft Committee
- Government Procurement Committee

Doha Development Agenda: TNC and its bodies

Trade Negotiations Committee

Special Sessions of
- Services Council / TRIPS Council / Dispute Settlement Body / Agriculture Committee / Trade and Development Committee / Trade and Environment Committee

Negotiating groups on
- Market Access / Rules / Trade Facilitation

Key
- Reporting to General Council (or a subsidiary)
- Reporting to Dispute Settlement Body
- Plurilateral committees inform the General Council or Goods Council of their activities, although these agreements are not signed by all WTO members
- Trade Negotiations Committee reports to General Council

The General Council also meets as the Trade Policy Review Body and Dispute Settlement Body
Global animal husbandry has included use of antibiotics as “growth promoters”

Use in US estimated at 12 million kg to 70 million kg annually (Jameson et al 1993, Asrestrup 2001)

May be common in developing countries

“Integrated Fish Farming” using farm animal waste as fodder potentially source of enhanced resistance particularly in the tropics (Peterson A et al, 2002)
THE NEW IMPERATIVE FOR GLOBAL POPULATION SAFETY

Levels of Prevention: Levels of Microbial Traffic

Primary:
Point of Emergence
Species jumping, Ecological pressure

Secondary:
Local extension

Tertiary:
Geographically Dispersed Clusters

Mechanisms
Trade, Travel
Direct Contagion

Remedies
WHO-IHR, WTO (International)
National Agencies, Local Public Health

TRANSNATIONAL PUBLIC HEALTH PRACTICE

TRANSNATIONAL TRAFFIC
Problem Statement

- The Globalization of Health and the protection of the world's populations has lagged behind the globalization of economies and societies in other domains.

- The globalization of commercial production and Globalization is market driven, Public Health is not.

- The medical market concept has proven dysfunctional for population coverage: It relies on population purchasing power.
Conclusion

“Variability is not actually caused by man; he only unintentionally exposes organic beings to new conditions of life and then nature acts on the organization and causes it to vary”—Darwin

We have an imperative to understand the population risks posed by global commerce and to systematically assure population safety.
Acknowledgments

This research has been supported by W.H.O, Fulbright New Century Scholar Program, Guggenheim Foundation, Asia Pacific Economic Cooperation, Department of State, Centers for Disease Control

W.T.O collaborated in the urgent measures assessments,

For more information:
- Dr. Ann Marie Kimball: akimball@u.washington.edu
- APEC EINet: apecein@u.washington.edu ; http://depts.washington.edu/einet

Thank you!