Foreign & Emerging Animal Diseases

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Foreign Animal Diseases “Grey Book”

- www.usaha.org/pubs/fad.pdf
The Foot-and-Mouth Disease Story
The West Nile Story
The “Bird Flu” Story
The Monkey Pox Story
The SARS Story
New Vocabulary:
Bioterrorism, Biodefense, Agroterrorism
No wonder we are concerned!
Foreign & Emerging Animal Diseases

- Definitions
- Factors in the appearance of foreign and emerging animal diseases
- Animal diseases & international trade
- Response to foreign and emerging disease outbreaks
- Current & future challenges
Foreign & Emerging Animal Diseases

Definitions
Foreign Animal Diseases (FADs)

- Diseases never present in the US or eradicated after intensive, expensive, and long duration campaigns
  - The US has eradicated 13 important animal diseases
  - There are >50 animal diseases foreign to the US

- Synonyms:
  - Exotic Animal Diseases
  - Transboundary Animal Diseases
Diseases Eradicated from the US.

- 1892 Contagious Bovine Pleuopneumonia
- 1929 Foot-and-mouth Disease
- 1929 Fowl Plague
- 1934 Glanders
- 1942 Dourine
- 1943 Texas cattle Fever
- 1959 Vesicular Exanthema
- 1959 & 1966 Screwworm (southeast & southwest)
- 1971 Venezuelan Equine Encephalomyelitis
- 1973 Sheep Scabies
- 1974 & 2003 Exotic Newcastle Disease
- 1978 Classical Swine Fever (Hog Cholera)
- 1985 & 2004 Highly Pathogenic Avian Influenza
Emerging Animal Diseases

- A totally new animal disease

"New Diseases"

- A known animal disease in a new area
- A known animal disease in a new population
- A known animal disease that re-emerges after a long time

"Known Diseases"

Based on the above definition, many FADs can be considered as “Emerging Diseases”
Emerging Animal Diseases

▸ A totally new animal disease

▸ A known animal disease in a new area

▸ A known animal disease in a new population

▸ A known animal disease that re-emerges after a long time

“New Diseases”

Also many “Foreign and Emerging Animal Diseases” are Zoonotic Diseases
Foreign & Emerging Animal Diseases

Factors in the emergence of animal diseases
Triad of Disease Causation

- Natural
- Accidental
- Deliberate
Triad of Disease Causation

Infectious Disease

Agent

Environment

Host
Number of Known Pathogens

- Humans: 1600
- Domestic Livestock: 1400
- Domestic Carnivores: 1200
- Wildlife: 1000

Number of Known Pathogens

Haydon, et. al. Emerg Infect Dis. 8: 1468-73, 2002
Number of Known Pathogens

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Haydon, et. al. Emerg Infect Dis. 8: 1468-73, 2002
Factors Associated to the Agent

- Microbial mutations
- Microbial recombination
- Genetic selection
- Crossing species boundaries
Factors Associated to the Agent

- Detection of new agents, or
- Previously unrecognized agents?
  - New diagnostic tools
  - Increased diagnostic capacity
The Triad of Disease Causation:

- Agent
- Environment
- Host

Infectious Disease

(Cornell University College of Veterinary Medicine)
Animal Production Issues

- Large animal population
- Increased animal density per unit
- Decreased genetic variability
- Poor husbandry practices
- Mixing of species
Increased Animal Density

**FIGURE 1C:** Cattle and calves: U.S. inventory on January 1 for selected years, 1869-2005.

**FIGURE 2:** Number of all cattle and beef cow operations, United States, 1989-2005.

USDA- Animal Health Report 2005
“Livestock Revolution”

Livestock to 2020

The Next Food Revolution

International Food Policy Research Institute

Food and Agriculture Organization of the United Nations

International Livestock Research Institute
The “Livestock Revolution”

- A global trend changing food production and consumption
  - Rapid rise in consumption of animal products
  - Substitution of animal products into starch based diets
  - Developing Countries will produce 60% of meat and 52% of milk in 2020
  - Transformation of world feed markets

*Livestock to 2020: The Next Food Revolution, a joint IFPRI, FAO, ILRI study.*
“Livestock Revolution”: 1983 - 2020
Meat Consumption

Million Metric Tons

Developed world
Developed world
World Meat Production

million tonnes

1983 | 1993 | 2020

Developed Countries

Developing Countries
World Poultry Production
Chickens (in thousands)
Livestock Production Systems
Developing Countries

SSA: Sub-Saharan Africa
WANA: West Asia & North Africa
CSA: Central & South America
“The Livestock Revolution will stretch the capacity of existing production and distribution systems and exacerbate environmental and public health problems.”
Decreased Genetic Variability

What population is more vulnerable to the JB Virus?

Jelly Blue Virus
Poor Husbandry Practices
Poor Sanitation

From: FAO/EMPRES
Lack of Biosecurity

From: Dr. Linda Logan
Wildlife Issues

- Wildlife disease reservoirs
- Livestock – Wildlife interactions
Biodiversity & Disease Reservoirs

- Evolutionary native fauna developed tolerance to many infectious organisms capable of causing severe morbidity and mortality in related domesticated species.
Wildlife Disease Reservoirs

Malignant Catarrhal Fever

African Horse Sickness
Wildlife Disease Reservoirs

African Swine Fever

Nipah Virus Disease
Livestock Wildlife Interactions

- Increased contact between domestic, feral and wild animals

Disease “Spill-Over” and “Spill-Back” transmission
Wildlife Trade and Global Disease Emergence

William B. Karesh,* Robert A. Cook,* Elizabeth L. Bennett,* and James Newcomb†

* Wildlife Conservation Society (WCS)
† Bioeconomic Research Associates

EID July 7, 2005
Scope of Global Wildlife Trade

- The illegal wildlife trade is estimated to be at least $8 billion to $10 billion a year in Southeast Asia alone.
- Up to 90,000 mammals sold per year in North Sulawesi, Indonesia
Animals traded at a live wildlife market in Guangzhou, China,

- Masked palm civets,
- Ferret badgers,
- Barking deer,
- Wild boars,
- Hedgehogs,
- Foxes,
- Squirrels,
- Bamboo rats,
- Gerbils,
- Various species of snakes
- Endangered leopard cat
- Domestic dogs, cats, and rabbits

After the 2003 outbreak of severe acute respiratory syndrome (SARS), 838,500 wild animals were reportedly confiscated from the markets in Guangzhou.
WCS survey of 4 markets in Bangkok in 2001

Of 36,537 observed birds sold, only 37% were native to Thailand, while 63% were nonnative species.
Risks of Global Wildlife Trade

It has been estimated that there are >1 billion direct and indirect contacts among wildlife, humans, and domestic animals resulting from the wildlife trade annually.
National Geographic Magazine
(October 2007)
Global Health Dynamics

Dasazak P. et.al.
Science 2000 287:443
Triad of Disease Causation

- Agent
- Environment
- Host

Infectious Disease
Environmental Issues

- Ecological degradation
- Global warming
- Water crisis
- International travel
- International trade
- Institutional structures
  - Weak public health
  - Weak veterinary services
Ecological Degradation

- Deforestation
- Slash & burn practices
- Changes in wildlife habitat
  - Migration of species with mixing of wildlife with domestic animals
Global Warming

- Expanding the range of arthropod vectors
- Overwintering of arthropod vectors

The World’s Most Dangerous Animal
Severe Water Crisis
Global Water Resources

TOTAL WATER

- Salt Water (97.5%)
- Fresh Water (2.5%)

FRESH WATER

- Polar Caps (70.0%)
- Soil Moisture (29.0%)
- Surface Water (1.0%)
Increased Travel & Trade

- “... in the context of infectious diseases, there is nowhere in the world from which we are remote and no one from whom we are disconnected.”

Lederberg, Shope and Oaks, IOM, 1992
International Travel

International Travel

International Tourist Arrivals

Million

<table>
<thead>
<tr>
<th>Year</th>
<th>Arrivals (Million)</th>
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<tbody>
<tr>
<td>1950</td>
<td>0</td>
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<tr>
<td>1960</td>
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<tr>
<td>1970</td>
<td>400</td>
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<tr>
<td>1980</td>
<td>600</td>
</tr>
<tr>
<td>1990</td>
<td>800</td>
</tr>
<tr>
<td>2000</td>
<td>1000</td>
</tr>
</tbody>
</table>

WTO Data
Foreign Garbage and Animal Disease Spread

Pathogens

FMD Virus
Increased International Trade

Imports to the US by Country (millions of $)
Global Food Trade

“Each day, the average American eats food that originated in over 30 countries.”

American Veterinary Medical Association
The Global Meat Trade

Source: Center for Global Food Issues
International spread of diseases

- Historically, diseases have spread across international borders due to the movement of animals and animal products

- More than 75% of all FADs are caused by movement (legal or illegal) of animals or animal products
Sources of Foot-and-Mouth Disease Outbreaks

1870 – 1968 (558)
- Meat, meat products or garbage: 70%
- Livestock Importations: 25%
- Vaccines: 23%
- Airborne (wind) or migrating birds: 9%
- Contaminated objects or persons: 4%
- Wildlife: 3%

1969 – 1993 (69)
- Meat, meat products or garbage: 23%
- Livestock Importations: 24%
- Vaccines: 3%
- Airborne (wind) or migrating birds: 9%
- Contaminated objects or persons: 4%
- Wildlife: 3%

USDA, APHIS, VS Data
Foreign & Emerging Animal Diseases

Animal diseases & international trade
Animal Health is a Global Economic Issue

- Animal health plays a key role in developed and developing world economies
- Trade is based on freedom from disease
- Transparency is essential
International Trade Rules

GATT Agreements
1947 - 1994

World Trade Organization

Agreement on the Application of Sanitary and Phytosanitary Measures
SPS Agreement

Food Safety
Animal Health
Plant Health
World Organization for Animal Health
Formerly: Office International des Epizooties

- Created in 1924 in Paris
- Independent international agency
- Functions:
  - Disease information system
  - Improve disease surveillance and control
  - International trade regulations
- Web Site: www.oie.int
172 Member Countries (5 Regions)
International Animal Health Standards

- Terrestrial Animal Health Code
- Aquatic Animal Health Code
- Manual of Standards for Diagnostic Tests and Vaccines
- Diagnostic Manual for Aquatic Animal Diseases
OIE - Disease Lists & Notifications

- List A and B – ended in 2004
- Single list of notifiable diseases (117):
  - Multiple species diseases – 23
  - Cattle Diseases – 15
  - Sheep & Goat Diseases – 11
  - Equine Diseases – 13
  - Swine Diseases – 7
  - Avian Diseases - 14
  - Logomorph Diseases - 2
OIE - Disease Lists & Notifications

- Single list - OIE Listed Diseases: (cont...)
  - Bee Diseases – 6
  - Fish Diseases – 10
  - Mollusk Diseases – 7
  - Crustacean Diseases – 7
  - Other – 2
OIE - Multiple species diseases (23)

- Anthrax
- Aujeszky's disease
- Bluetongue
- Brucellosis (Brucella abortus)
- Brucellosis (Brucella melitensis)
- Brucellosis (Brucella suis)
- Crimean Congo haemorrhagic fever
- Echinococcosis/hydatidosis
- Foot and mouth disease
- Heartwater
- Japanese encephalitis
- Leptospirosis

- New world screwworm (Cochliomyia hominivorax)
- Old world screwworm (Chrysomya bezziana)
- Paratuberculosis
- Q fever
- Rabies
- Rift Valley fever
- Rinderpest
- Trichinellosis
- Tularemia
- Vesicular stomatitis
- West Nile fever

Foreign Animal Disease
FAD – Some Strains
### OIE - Cattle diseases (15)

- Bovine anaplasmosis
- Bovine babesiosis
- Bovine genital campylobacteriosis
- **Bovine spongiform encephalopathy**
- Bovine tuberculosis
- Bovine viral diarrhoea
- **Contagious bovine pleuropneumonia**
- Enzootic bovine leukosis

- **Haemorrhagic septicaemia**
- Infectious bovine rhinotracheitis (infectious pustular vulvovaginitis)
- **Lumpky skin disease**
- Malignant catarrhal fever (wildebeest)
- Theileriosis
- Trichomonosis
- **Trypanosomosis** (tsetse-transmitted)

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**Foreign Animal Disease**

**FAD – Some Strains**
OIE - Sheep and goat diseases (11)

- Caprine arthritis encephalitis
- Contagious agalactia
- Contagious caprine pleuropneumonia
- Enzootic abortion of ewes (ovine chlamydiosis)
- Maedi-visna
- Nairobi sheep disease
- Ovine epididymitis (*Brucella ovis*)
- Peste des petits ruminants
- Salmonellosis (S. abortusovis)
- Scrapie
- Sheep pox and goat pox
### OIE - Equine diseases (13)

<table>
<thead>
<tr>
<th>African horse sickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contagious equine metritis</td>
</tr>
<tr>
<td>Dourine</td>
</tr>
<tr>
<td>Equine encephalomyelitis (Eastern)</td>
</tr>
<tr>
<td>Equine encephalomyelitis (Western)</td>
</tr>
<tr>
<td>Equine infectious anaemia</td>
</tr>
<tr>
<td>Equine influenza</td>
</tr>
<tr>
<td>Equine piroplasmosis</td>
</tr>
<tr>
<td>Equine rhinopneumonitis</td>
</tr>
<tr>
<td>Equine viral arteritis</td>
</tr>
<tr>
<td>Glanders</td>
</tr>
<tr>
<td>Surra (Trypanosoma evansi)</td>
</tr>
<tr>
<td>Venezuelan equine encephalomyelitis</td>
</tr>
</tbody>
</table>

**Foreign Animal Disease (FAD) – Some Strains**
OIE - Swine diseases (7)

- African swine fever
- Classical swine fever
- Nipah virus encephalitis
- Porcine cysticercosis
- Porcine reproductive and respiratory syndrome
- Swine vesicular disease
- Transmissible gastroenteritis
OIE - Avian diseases (14)

- Avian chlamydiosis
- Avian infectious bronchitis
- Avian infectious laryngotracheitis
- Avian mycoplasmosis (*M. gallisepticum*)
- Avian mycoplasmosis (*M. synoviae*)
- Duck virus hepatitis
- Fowl cholera

- Fowl typhoid
  - Highly pathogenic avian influenza
  - Infectious bursal disease (Gumboro disease)
  - Marek's disease
    - Newcastle disease
  - Pullorum disease
  - Turkey rhinotracheitis
OIE - Lagomorph diseases (2)

- Myxomatosis
- Rabbit haemorrhagic disease
OIE - Bee diseases (6)

- Acarapisosis of honey bees
- American foulbrood of honey bees
- European foulbrood of honey bees
- Small hive beetle infestation (*Aethina tumida*)
- *Tropilaelaps* infestation of honey bees
- Varroosis of honey bees
OIE - Fish diseases (10)

- Epizootic haematopoietic necrosis
- Infectious haematopoietic necrosis
- Spring viraemia of carp
- Viral haemorrhagic septicaemia
- Infectious pancreatic necrosis
- Infectious salmon anaemia

- Epizootic ulcerative syndrome
- Bacterial kidney disease (*Renibacterium salmoninarum*)
  - Gyrodactylosis (*Gyrodactylus salaris*)
  - Red sea bream iridoviral disease

Foreign Animal Disease

FAD – Some Strains
## OIE - Mollusk diseases (7)

- Infection with *Bonamia ostreae*
- Infection with *Bonamia exitiosa*
- Infection with *Marteilia refringens*
- Infection with *Mikrocytos mackini*
- Infection with *Perkinsus marinus*
- Infection with *Perkinsus olsenii*
- Infection with *Xenohaliotis californiensis*
OIE - Crustacean diseases (7)

- Taura syndrome
- White spot disease
- Yellowhead disease
- Tetrahedral baculovirosis (*Baculovirus penaei*)
  - Spherical baculovirosis (*Penaeus monodon*-type baculovirus)
- Infectious hypodermal and haematopoietic necrosis
- Crayfish plague (*Aphanomyces astaci*)
OIE - Other diseases (2)

- Camelpox
- Leishmaniosis

Foreign Animal Disease
FAD – Some Strains
OIE - Disease Notifications

- 24 Hour Notification:
  - First case of a Listed Disease or Infection
  - Re-occurrence of a Listed Disease after outbreak has ended
  - New strain of a Listed Disease Agent
  - Changes in Morbidity/Mortality
  - Changes in Pathogenicity or Host Range
  - An Emerging Disease
OIE - Disease Notifications

- **Weekly:**
  - Follow up reports from emergency notifications (24-hour reported event) until disease clears or until it becomes endemic

- **6 Month Reports:**
  - Epidemiology of endemic Listed Diseases

- **Yearly:**
  - A questionnaire with information of significance to other countries.
Foreign & Emerging Animal Diseases

Response to disease outbreaks
“Governments will no longer be judged on whether or not they have incursions of foreign diseases, but rather on how they respond to them.”

Dr. Alex Thiermann,

President, Terrestrial Animal Health Commission, OIE
Strategies Against FEDs

Prevention

Eradication

Control
Strategies Against FEDs

Prevention

Mitigations

Eradication
No Agent

Control
No Disease
Strategies Against FEDs

- Prevention
- Mitigations

- Eradication
  - No Agent

- Control
  - No Disease
FED – Prevention Strategies

- Import activities
  - Live animals (domestic & wild)
    - Arthropod vectors
  - Embryos & semen
  - Animal products (including bush meat)
    - Control of foreign garbage & garbage feeding

- WTO and the OIE Code Regulations
  - SPS Agreement
  - Increased international trade
FED – Prevention Strategies

- On farm biosecurity practices
  - Movement of vehicles & people
  - Housing controls
  - Feed & waste management
  - Husbandry practices
  - Preventive medicine programs
NYSCHAP – Biosecurity Module

- New York State Cattle Health Assurance Program (NYSCHAP)
FED – Prevention Strategies

- Surveillance
  - Passive
  - Active
  - Syndromic

- Monitoring
  - Production parameters
  - Disease intelligence
  - International events
  - Global weather
FED – Prevention Strategies

▶ Vector control
  - Biological vectors
  - Mechanical vectors
  - Inanimate vectors (fomites)
FED – Prevention Strategies

- Environmental Protection
  - Water
  - Air (wind)
  - Feed
  - Manure
  - Soil
  - Buildings
  - Carcasses
FED – Prevention Strategies

- Host Interventions
  - Quarantines
  - Compartmentalization
    - By age, type, production mode, etc.
  - Animal removal & relocation
  - Pre-empty slaughter
    - Societal acceptance?
FED – Prevention Strategies

- Prophylactic Interventions
  - Active immunization
    - MLV, Killed, Sub-unit, DIVA vaccines
  - Passive immunization
  - Chemical prophylaxis
    - Anti-bacterials
    - Anti-Virals
FED – Prevention Strategies

- Therapeutic Interventions
  - Anti-bacterials
  - Anti-virals
  - Other therapies
Strategies Against FEDs

- Prevention
- Mitigations
- Eradication
- No Agent
- Control
- No Disease
FED – Control Strategies

- Quarantines
  - Animal (generic or species-specific)
  - Products
  - Stop movement
  - People
- Immunization
  - (Same strategies as for prevention)
- Indemnity provisions
Control Zones

- Protection zones
  - 3 km
- Surveillance zones
  - 10 km
FED – Control Strategies

- Zoning / Regionalization
FED – Control Strategies

- Compartmentalization
  - e.g. Wildlife disease in a national park
FED – Control Strategies

- Compartmentalization
  - e.g. Clean farms under same management
FED – Control Strategies

- Prevent mixing of species
  - Livestock & wildlife interactions
- Test & removal
  - To slaughter or to disposal
- Surveillance & monitoring
Strategies Against FEDs

Prevention
Mitigations

Eradication
No Agent

Control
No Disease
FED – Eradication Strategies

- Depopulation (Stamping out)
  - Massive or targeted (cohorts)
  - Pre-empty slaughter
  - Welfare slaughter
- Carcass & product disposal
  - Most challenging task
- Decontamination
FED – Eradication Strategies

- Immunization
  - Vaccinated to live
  - Vaccinated to slaughter
  - Use of DIVA vaccines

- Verification of agent-free status
  - Environmental testing
  - Use of sentinel animals
FED – Eradication Strategies

- Restocking of affected areas
- Restoration of international trade
- Long term surveillance & monitoring
FED – Eradication Strategies

- Indemnity compensation
  - 100% fair market value
  - Fixed price per animal type
  - Cost of disease eradication activities
    - Depopulation & disposal

- No indemnity for
  - Loss business
    - Real or potential
Non-Controllable Sources of FEDs

- Natural disasters
- Serious economic crisis
- Civil unrest & wars
- Illegal trade of goods, people & animals
- Intentional introductions
  - Bioterrorism
  - Biological warfare
Bioterrorism Challenges

- Difficulties in preventing terrorist acts
- Bioterrorist action may not be evident for quite some time
- Natural outbreaks may be very similar to intentional ones
- Best strategy is to respond rapidly to any animal health event, regardless of its origin
Strategies Against FEDs

Prevention
Mitigations

Eradication
No Agent

Control
No Disease
Foreign & Emerging Animal Diseases

Current & future challenges
Current & Future Challenges

- Increased animal production
  - “Livestock revolution” will continue
  - Pressure to increase food security

- Deficiencies in Animal Health investment
  - Deficient budgets
  - Deficient physical infrastructure
  - Lack of qualified personnel
Current & Future Challenges

- Deficiencies in Animal & Public Health Infrastructure
  - Knowledge and awareness
  - Privatization of services
  - Diagnostic technologies
  - Diagnostic capacity
  - Effective response
Current & Future Challenges

- Deficiencies in Veterinary Education
  - Deficient education regarding foreign and emerging animal diseases
  - Global proliferation of private veterinary colleges
  - Lack of international standards
  - Lack of regulatory systems
  - Devaluation of the veterinary profession
The Veterinary Medicine Gap

Our Cornell University Hospital for Animals (CUHA) has better medical facilities than human hospitals in many parts of the world.
Lack of effective communication and cooperation between sectors:

- Animal Health
- Human Health
- Agriculture
- Wildlife
There is a need for effective communication, integration and cooperation:
One Health Initiatives
Renewed Global View
Concluding Remarks

- Our historical well-being dependency on animals is as strong as ever.
- We will continue to experience outbreaks of emerging or foreign animal diseases.
- International travel, trade and economic globalization will continue to shape global health events.
Concluding Remarks

- Environmental degradation and global warming will contribute to the spread of animal, human and plant diseases
- There is increasing need for cooperation between agencies and disciplines at the national and international levels
  - Animal, human and wildlife health
Concluding Remarks

► We must be better prepared to respond to adverse animal, human or wildlife health events.

► Current global health challenges will require innovative sustainable partnerships between governments, international agencies, NGOs, academic institutions and producers.
How Peaceful is our Kingdom?

Eduard Hicks - 1833
Real Doctors heal more than one species...