Emerging Infectious Disease Threats: Are We Prepared?

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Emerging Threats: Biological Risk Management
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Overview of Threat

- Pathogens know no boundaries and international travelers and goods can spread a contagious disease quickly to persons in other nations
- Increasing volume of international trade and migration requires enhanced global surveillance networks to meet associated public health challenges
- Early-warning surveillance, followed by prompt sharing of findings, plus a rapid and robust response, are public health and national security imperatives

1999-2004
The Public Awakens to Links Between Animal and Human Health

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- GAO/HEHS-00-180
- WEST NILE VIRUS OUTBREAK
  Lessons for Public Health Preparedness

Zoonoses – Importance September 2000 GAO Report

- Of >1,700 known pathogens affecting humans, 49% are zoonotic
- Of the 156 pathogens associated with emerging diseases, 73% are zoonotic
- Many of the high priority BT agents are zoonotic
- Many zoonotic pathogens become established in wildlife before transmission to humans and domestic animals
Emerging and Re-emerging Zoonoses
1996–2004 (Source: WHO)

Recent outbreaks
- Influenza / Madagascar
- COHF / Afghanistan, Iran
- Tularemia / USA, Kosovo
- Yellow fever / Ivory Coast
- Brucellosis / Mongolia
- E. coli O157 / Canada
- Hantavirus / US
- Nipah virus / Malaysia
- Avian Influenza / Hong Kong
- West Nile / USA, Canada
- Ebola / Gabon, Congo
- BSE / Canada
- Monkeypox / DR Congo
- SARS / Global
- Avian Influenza H5N1
- Nipah virus / Bangladesh

Biological Agents That Merit Priority Attention

- Category A
  - B. anthracis, Y. pestis, C. botulinum toxin, F. tularensis, VHF’s, Variola major
- Category B
  - C. burnetii, Brucella sp., B. mallei, alphaviruses, Ricin toxin, SEB + additional food & waterborne pathogens
- Category C
  - Nipah & hantaviruses, multidrug-resistant TB, yellow fever, & other agents

Overall Goal
HHS Public Health Emergency Program

To ensure sustained public health and medical readiness for our communities and our nation against:
- bioterrorism
- infectious disease outbreaks
- other public health threats and emergencies

Agents of Concern
Public Health Security and Bioterrorism Preparedness and Response Act of 2002

- Provides for the regulation of certain biological agents and toxins by the DHHS and USDA

1) DHHS Select Agents
2) USDA-HHS Overlap Agents
3) USDA High Consequence Livestock Pathogens and Toxins

Overlap Agents of Concern

- Bacillus anthracis
- Brucella abortus, melitensis, suis
- Burkholderia mallei, pseudomallei
- Avian influenza virus (highly pathogenic)
- Clostridium botulinum
- Coccidioides immitis
- Coxiella burnetii
- Eastern equine encephalitis
- Equine morbillivirus (Hendra virus)
- Francisella tularensis
- Rift Valley fever virus
- Venezuelan equine encephalitis virus

Overlap agents of concern - Toxins

- Aflatoxins
- Botulinum toxins
- Clostridium perfringens epsilon toxin
- Shigatoxin
- Staphylococcal enterotoxin
- T-2 toxin
Zoonotic Diseases of Concern in the Americas*

- **Current**
  - West Nile fever, bat and wildlife rabies, equine encephalitis, hantavirus, nipah virus, monkeypox, avian influenza, q-fever, plague, anthrax, Lyme, leptospirosis, bartonellosis, leishmaniasis, echinococcus, BSE, coccidiomycosis

- **Future**
  - Yellow fever, SARS, hepatitis E, poxviruses, Rift Valley Fever, melodiosis, rift valley fever, potential for transmission of Chronic Wasting Disease

*As identified by Regional Surveillance Working Group from WHO/FAO/OIE Consultation on Emerging Zoonoses, 3/5/04

Priorities to Strengthen Preparedness and Response

- Improve capability and capacity to detect, report, conduct surveillance and respond to infectious diseases
- Conduct disease outbreak investigations
- Strengthen laboratory capability and capacity to identify and characterize biological agents
- Develop communications systems for sharing health advisories, clinical/lab info, risk communication to address community needs
- Training to develop expertise for disease detection, diagnostics, outbreak investigation, communications
- Bioscience research and development effort for civilian biodefense

Defining Public Health Readiness Conceptual Framework

**Standard 1:** An all hazards public health response system that can rapidly respond to escalating or multiple emergencies

**Standard 2:** Conditions of public health importance are detected, diagnosed, and reported early, providing opportunities for early intervention

**Standard 3:** Resources are in place to investigate and respond to naturally occurring or intentional threats to the public’s health

**Standard 4:** Efforts to recover from public health emergencies are coordinated and comprehensive

Public Health’s System of Preparedness, Response, and Recovery

- **Preparedness**
  - Planning
  - Command and Control
  - Exercising
  - Partnering
  - Training
  - System Building
  - Testing
  - Surveillance
  - Clinician Training
  - Laboratory Diagnostics
  - Reporting

- **Detection**
  - Communicating
  - Public Health
  - General Public
  - Concern
  - Responders

- **Response**
  - Intervention
  - Medical therapies
  - Quarantine
  - Contact tracing
  - Coordination

- **Recovery**
  - Monitoring health impact
  - Community mental health
  - Lessons learned – continuous response improvement

Public Health’s Tiered System of Response

- **Local Response**
  - Public Health—Health care—Emergency Medical

- **State Assets**
  - Emergency Management - Public Health

- **Federal Assets**
  - Dept. Homeland Security - HHS

Defending Against Biological Threats

- U.S. has pursued aggressively a broad range of activities to confront biological weapons threat
- President asked his cabinet to review efforts and find new and better ways to secure America
- Result is Biodefense for the 21st Century
  - Presidential directive builds on past accomplishments
  - Roles and responsibilities shared across government agencies
  - Integration of national and global security, public health, intelligence, and law enforcement
Essential Pillars of U.S. Biodefense Strategy

• Threat awareness and assessment
  – Improving our ability to collect, analyze, and disseminate information
  – Ensure an integrated and focused effort to anticipate and respond to emerging threats

• Prevention and Protection
  – Demonstrating political and financial support for nonproliferation and threat reduction programs translates into proactive prevention
  – Assessing vulnerability of and protecting critical infrastructure protection

Essential Pillars of U.S. Biodefense Strategy (cont.)

• Surveillance and Detection
  – Early warning, detection and reporting systems to rapidly recognize and characterize dispersal of biological agents
  – Enhancing deterrence by improving attribution capabilities by improving capabilities to perform forensic analysis

• Response and Recovery
  – Plans for mass casualty care and risk communication
  – Accelerated development of countermeasures
  – Strategies, guidelines and plans for decontamination of persons, equipment, and facilities

Some Examples of Strategy at Work

• Proliferation Security Initiative to stem WMD trafficking
• State and local public health and hospital preparedness
• Expanded National pharmaceutical stockpile
• Biowatch: a network of biological sensors to improve surveillance
• Enhanced protection against contamination of agricultural/food systems
• Enhanced research to speed development and acquisition of new medical countermeasures against biological weapons
• International initiatives to strengthen national, regional, global programs

Biodfense: Complementary Roles within HHS and Coordination with Others Agencies

NIH
• Build Research Infrastructure
• Conduct Basic Research
• Develop Medical Countermeasures

DoD
• Regulatory Approval
  o Vaccines
  o Therapeutics
  o Diagnostics

FDA
• Strategic National Stockpile (DHS)
• Train Local Response Teams
• Surveillance and Detection
• Public Health Response

CDC
• DHS

Project BioShield

• Establishes a secure funding source for purchase of critical biomedical countermeasures.
  • Provides $890 million in discretionary funds in FY2004 and created a discretionary reserve of $5.6 billion to fund the program through FY2013
• Increases HHS/NIH authorities and flexibility to expedite research and development of critical biomedical countermeasures.
• Establishes a HHS/FDA Emergency Use Authorization for critical biomedical countermeasures.

Why Veterinarians Must Play a Key Role in Preparedness

• 75% of emerging infectious diseases are zoonoses
• Humans have served as sentinels for emerging zoonotic infectious diseases; need to reverse the trend
• Recent global events reinforce the need for increased partnerships between human and animal health
• Surveillance for zoonotic disease in the US is not well coordinated
• Integration of human and animal surveillance requires multidisciplinary approach
• 2002 Public Health Security and Bioterrorism Act serves as platform for integration of human and animal surveillance
What Are We doing to Address the Need for Human-Animal Health Linkages?

- Working Group tasked to address coordination of human and animal disease surveillance
  - Mandated by 2002 Public Health Security and Bioterrorism Act
  - Identify needed elements and essential partners
  - Develop a system of communication and triggers for action
  - Reduce duplication, divide workload to maximize efficiency
- Evaluation of pilot animal sentinel surveillance systems

The Missing Piece - Animals as Sentinel Surveillance for Emerging Zoonoses

- CDC - Purdue University Banfield Pet Hospital Syndromic Surveillance Project
- CDC - Cornell Zoo Surveillance System
- USDA - Food animals
- Live bird markets, exotic animal markets - to be developed

Expertise in Different Areas of Veterinary Medicine Needed

- Eradication of animal pathogens that impact human health or are economically important to trade or production
- Prevention of foreign animal disease introduction into the United States
- No single federal agency is responsible for all animal diseases
- Protecting human health vs trade

New Partnerships

- Health and agriculture
- Wildlife agencies and organizations
- Wildlife veterinarians
- Veterinary pathologists
- Ecologists; Wildlife Biologists
- Entomologists
- Zoo Associations
- Companion animal hospitals
- Veterinary schools
- Other / more

Regional Centers of Excellence for Biodefense and Emerging Infectious Disease Research

- Animal rule creates dependence on animal models
- Need to develop and improve understanding of models and aspects of comparative pathology
- Build upon knowledge base of veterinary sciences and use translational research capacity to make next generation therapeutics, vaccines, diagnostics (e.g., FMD, influenza, SARS, etc)
- Collaborative research with local, state and federal agencies required

Improving Surveillance in Asia: Our Response to the H5N1 Pandemic Threat

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- Build upon knowledge base of veterinary sciences and use translational research capacity to make next generation therapeutics, vaccines, diagnostics (e.g., FMD, influenza, SARS, etc)
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Avian Influenza A (H5N1): A Persistent Threat

- Hong Kong, 1997
  - First evidence of direct avian-to-human infection and serious human disease
  - 18 confirmed cases, 6 deaths
- Hong Kong, 2002
  - H5N1 causes mortality in wild birds
- Hong Kong, 2003
  - HK residents returning from southern China
  - 2 confirmed cases, one death

Human H5N1 Cases, 2004

<table>
<thead>
<tr>
<th>Country</th>
<th>H5N1 Cases</th>
<th>Deaths</th>
<th>Case Fatality</th>
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<tbody>
<tr>
<td>Thailand</td>
<td>10</td>
<td>7</td>
<td>70%</td>
</tr>
<tr>
<td>Vietnam</td>
<td>23</td>
<td>15</td>
<td>65%</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>22</td>
<td>67%</td>
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Epizootic of Influenza A (H5N1) in Asia, 2003-04

- Largest epizootic of highly pathogenic avian influenza in poultry ever described
- Very complex epizootic due to back yard flocks and infection of wild birds—rapid eradication of virus impossible
- Eight countries reported poultry outbreaks
  - Over 100 million birds died or destroyed so far

Identification of Gaps in Information

- Very large gaps in critical information
  - What surveillance is in place?
  - How are people becoming infected? What does poultry exposure mean?
  - What are the properties of the viruses causing outbreaks in all of the different countries (limited access to viruses from some countries, e.g., China)

Early Warning = Preparedness

The Critical Need to Improve Surveillance

- Surveillance (early warning) is essential for an effective response to pandemic influenza
  - Epidemiology
    - Understanding pattern of disease and at-risk groups
  - Virological – Human and Animal
    - Subtyping antigenic and molecular/genetic analysis
- Vaccines:
  - Can’t be stockpiled
  - Must be developed to match the pandemic strain
- Antiviral drugs:
  - Antiviral susceptibility

H5N1 Avian Influenza in Asia: Future Directions

“’The recent outbreak of AI throughout Asia is unprecedented and reminds us just how much more work we have to do before we are prepared nationally and globally. We need to work together more to strengthen our influenza surveillance, reporting and control capabilities.”

Secretary Tommy T. Thompson,
World Health Assembly, May 18, 2004
**HHS Activities to Build Capacity for Influenza Surveillance in Asia**

- Build country surveillance networks
- Country assessments, training (biosafety), personnel, purchase of supplies and equipment, etc. (Cooperative agreements with WHO)
- Coordination of WHO’s Animal Influenza Network, strengthen communications and interactions between public health and veterinary agencies
- Earlier access to critical virus isolates from Asia, both from humans and from birds for vaccine production
- Funding for shipment of influenza isolates and other specimens to WHO CCs

**Monkeypox**

First Described in Primate Outbreak in 1958 – So Named

**The Burden of Human Monkeypox in DR Congo, 1970–2001**

- An Orthopoxvirus, clinically similar to SMALLPOX, occurring naturally in the population leaving in the rain forests of Africa
- Disease Viral exanthem & lymphadenopathy, ~ 10% case fatality rate, 28% cases sub-clinical

**Concerns for Control**

- Laboratory evidence suggests multiple animals and species of imported rodents infected
  - All rodents from shipment potentially infected
- Unknown incubation period, length of transmissibility, potential for asymptomatic infection and transmission
- Types of susceptible species unknown
  - Cannot exclude the possibility of infection in other mammals that contacted PDs or imported rodents
- Many animals not traceable – no records

**Prairie Dogs**

- White-tailed prairie dog
  - C. leucurus
- Gunnison’s prairie dog
  - C. gunnisoni
- Utah prairie dog
  - C. pavidens

**April 4 Shipment from Ghana to Texas**

- 28 Gerbils
- 2 palm civets
- 53 rope squirrels
- 510 Dormice
- 47 tree squirrels
- 50 Gambian giant rats
- 20 Guineas
- 2 brush-tailed porcupines
- 100 striped mice
Examples of Emerging Infectious Diseases Surveillance Systems in Humans

- Emerging Infection Program Sites
  - Foodnet – 11 sites
  - Unexplained Death and Critical Illness Project; 4 sites
  - EMERGE ID NET - Infectious disease syndrome surveillance in 11 hospital emergency rooms
- IDSA Emergency Infections Network – internet-based system linking 500 infectious disease practitioners
- GeoSentinel – 22 linked travel medicine clinics in US and abroad to monitor disease among returning travelers

Surveillance of Disease Syndromes in Humans, U.S.

- "Drop in" – Short term, for a defined event
  - World Trade Organization meetings
  - Presidential Inauguration
  - Republican National Convention
- More sustained - DoD Global Emerging Infections System – 7 syndromes in 313 military facilities
- BioSense
  - Lab response network, clinical lab orders, Prescription records, bioWatch data, more – new data streams

Integrated Surveillance Systems

- Early detection of disease in animal populations with timely communication between sectors important for prevention and control of disease in humans
- Challenges:
  - Little linking of veterinary to human data to date
  - Multiple surveillance systems run by different agencies with little cross coordination
  - Duplication of efforts, inefficient use of resources
  - Not all zoonotic organisms are well addressed by surveillance systems nor are diagnostic tests available for wildlife
  - No action plan for what will trigger a response

Linking public health and veterinary diagnostic laboratories

- CDC's Laboratory Response Network
- USDA-APHIS National Animal Health Laboratory Network

Global and US Government Partners

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<tr>
<th>Multilateral</th>
<th>US Government</th>
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<tbody>
<tr>
<td>WHO/ HQ &amp; Regional</td>
<td>Department of Health and Human Services (Centers for Disease Control &amp; Prevention, National Institutes of Health, Food and Drug Administration, Office of the Secretary)</td>
</tr>
<tr>
<td>OIE / FAO</td>
<td>U.S. Agency for Int'l Dev't Department of Defense</td>
</tr>
<tr>
<td>TEPHINET</td>
<td>U.S. Department of Agriculture Department of State</td>
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WHO’s Global Outbreak Alert & Response Network

- Global technical partnership among Ministry of Health, scientific institutes, international, nongovernmental organizations
- Mobilize and connect global resources for the control of known and newly emerging disease outbreaks that threaten both national and global health security
- Focused on rapid and effective field support
- Electronic notification of outbreaks and request for assistance
- Consensus on agreed standards to international response
- Contribute to long-term outbreak preparedness
International Health Regulations

- WHO Member States working with WHO to finalize first major revision to WHO’s International Health Regulations in over 30 years
- Target date for completion: 2005 WHA
- Emphasis on immediately reporting to WHO any potential public health emergency of international concern
- Strengthened abilities required for early warning surveillance, detection, response to infectious diseases

Data from Private Veterinarians

- Legal requirements to report certain diseases to authorities
- Providing information when submitting samples to the laboratory
- Reasons for early detection and reporting need to be understood

Client Awareness

- Train local livestock owners in disease recognition
- Encourage industry and pet owners to report the presence of any suspicious clinical signs
- Incentives for evidence leading to disease discovery
- Cost effective means for improving the quality of disease surveillance

Need a Plan to Achieve Measurable Milestones

- Documentation indicating achievement of critical benchmarks
- Brief proposals for other objectives:
  - plan for approach
  - measurable milestones
  - estimated budget
- Action, well-defined and achievable objectives
- Measurable outcomes that indicate enhanced preparedness and capacity to respond

Veterinarians Needed to Strengthen our Preparedness

- Identify and prioritize needs and develop mechanisms to fill gaps
- Become familiar with existing resources, programs, and where most value can be added
- Define leadership and avoid competing agendas
- Enhance communication tools and facilitate information sharing and coordination
- Strengthen existing and build new partnerships wherever opportunity exists

A Little Help Can go a Long Way