Emerging Pandemic Threats Program

PREDICT • RESPOND • PREVENT • IDENTIFY
The Rising Threat of Zoonotic Diseases

The Use of “Risk-Based” Strategies to Build a Global “One Health” System for Surveillance and Response

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The Rise of Zoonotic Diseases

- The emergence of the HPAI H5N1 virus and the more recent H1N1 pandemic virus are part of a broader dynamic that has given rise to a stream of new and increasingly deadly zoonotic diseases.

- Of these new zoonotic diseases, nearly three-quarters have been caused by pathogens originating in wildlife
  - SARS emerged in *civet cats* in Guangdong Province, China;
  - Nipah virus in *bats* in Perak State, Malaysia; and
  - HIV in *non-human primates* in Central Africa.

- The threat from zoonotic diseases is not new but is intensifying
  - Many long-standing diseases in humans (e.g. hepatitis, malaria, measles) caused by microbes originally from animals
  - The rate of pathogen emergence is projected to increase 5 fold between 2000 - 2030 as animal-human interactions intensify
Avian Flu

has proven a critical window for understanding the forces driving the emergence of new infectious diseases and what’s needed for their control
Specific lessons from H5N1 Influenza

**Emergence**
- Wild birds are primary reservoir for emergence
- Inadequate livestock "biosecurity" facilitates "amplification"
- Poorly regulated commercial trade major route for spread

**Characteristics**
- Highly virulent
- Efficient transmission among poultry
- Limited transmission between humans
- Continues to "evolve"

**Response**
- A coordinated "One Health" - multi-sectoral response spanning animal and human health is critical
- Highly dynamic changes in disease patterns requires programmatic flexibility
- Vigilance

**Overall Lessons learned**
- Effective control of H5N1 and other zoonotic diseases is dependent on:
  - Early detection in animals
  - Local capacities for outbreak investigation and response
  - Reduction of human behaviors and practices that enable the spread of and exposure to the virus
The “Drivers” Behind the “Rising Threat”

Disease emergence is closely linked to factors that intensify animal-human interactions.

- **Population Pressures**: 7 billion and counting
- **Changing Habitats**: Climate Change
- **Globalization**: “It’s not local anymore.”
- **Food Security**: Search for arable land; trade in bush meat
- **Economic Growth**: Expanding extractive industry; increased demand for animal protein
Emergence is a “Rare” Event

- Even as the risk of new zoonotic diseases is increasing, their emergences remain relatively rare events that occur at unpredictable times and places.

- One of the biggest challenges to early detection of these diseases is the lack of sufficient, sensitive surveillance capacity geared toward rapid and reliable detection of highly unusual pathogens.
Using “Risk-Based” Strategies to Target Interventions

• Recent advances in the understanding of factors that drive the emergence of zoonotic diseases have led to new risk-based models for forecasting new zoonotic diseases - opening opportunities to bring greater focus to emergent-disease surveillance.

• The origins of newly emergent diseases have been found to strongly correlate with specific:
  – geographic areas
  – animal hosts
  – microbial agents
  – “high risk” human populations.
Geographic “Hot Spots”

Identifying New Threats “Before” They are Diseases

The Challenge
• H5N1 highlights the importance of not “waiting” for human infections. Monitoring for new zoonotic threats in animals is critical for an “early” detection.

• HIV illustrates the challenge of early identification of emergent zoonotic diseases whose primary infection is not closely linked temporally to clinical symptoms.

The Opportunity
• Early detection will require both strengthening “syndromic surveillance” and the development of novel surveillance models that exploit advances in genomics and informatics to identify microbial threats before they fully emerge as infectious diseases.

• With most new diseases coming from animal reservoirs these new surveillance “models” will need to be able to characterize microbes on their potential for “jumping” the species barrier and posing future threats to humans.

• “Predictive” surveillance would be intended to complement “syndromic” surveillance to build a comprehensive surveillance model for early detection of new emergent threats.
Standard Model for Outbreak Detection and Response

- Detection
- Lab Confirmation
- Response
- First Case

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One Health – Public health as part of the “ecosystem”

- Human Cases
- Wild Animal
- Domestic Animal

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Wildlife Surveillance/Forecasting

Animal Amplification

Early Detection and Control Opportunities

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Pre-empting the threats from zoonotic diseases

Two important aspects of the EPT strategy

- Promotes a “One Health” approach that builds first on existing platforms
- Focus on strengthening country capacities – consistent with IHRs and OIE standards

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Wildlife pathogen detection
- Surveillance to identify specific microbes that may cause serious disease in humans

Risk determination
- Characterize risk that a microbe may pose to humans and its method of transmission from animals to humans

Outbreak response capacity
- Strengthen country capacity to detect and respond to outbreaks in animals and humans

Risk reduction
- Develop and implement behavior change interventions to minimize disease threat for specific high-risk populations
Contribution of EPT Program to Disease Detection and Control

**CASES**

**IDENTIFY**
- timely laboratory confirmation

**PREVENT**
- minimizing “high risk” practices

**RESPOND**
- early and effective control

**PREDICT**
- forecasting and early detection

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SMART Surveillance
Wildlife SMART Surveillance

1. Initial Surveillance Targeting
   - Targeting Surveillance: risk modeling, identifying interfaces, species considerations, remote sensing, situational analysis

2. Potential Pathogen Detected
   - Diagnostics: clinical & pathological examination, screening for viral families & normative pathogens, number of individuals affected

3. Virulence & Pathogenicity Determination
   - Rapid Epidemiologic Analysis & Modeling: incidence, host & number of species affected, demographics, location & spread

4. Significance Screening
   - Molecular Characterization & Modeling: relatedness to human pathogens, transmissibility factors, opportunity for spillover & spread, pathogenic potential in new hosts & ability to counteract host

5. Prioritize for Response & Follow-up
Developing a **Targeted** Surveillance Strategy

*in high risk locations for emergence*
Developing a **Targeted Surveillance Strategy**

*along high risk disease transmission interfaces*

- Hunting
- Markets/trade
- Wildlife/livestock conflict
- Extraction
- Land use change
- Water availability
- Global transportation
Developing a **Targeted** Surveillance Strategy

*for wildlife species of highest risk*
Developing a **Targeted** Surveillance Strategy

*using global information real-time*
Developing a **Targeted** Surveillance Strategy

*responsive to potential pathogen emergence*
Wildlife SMART Surveillance

Initial Surveillance Targeting:
- Geospatial Risk Modeling
- High Risk Transmission Interfaces
- Species of Special Concern
- Digital Surveillance & Information Network
- Undiagnosed Human or Animal Event

Potential Pathogen Detected:
- Virulence & Pathogenicity Determination:
  - Known Pathogen Causing Disease
  - Uncharacterized Virus Causing Disease
  - Known Pathogen Unknown or No Disease
  - Uncharacterized Virus No Disease

Significance Screening:
- Disease at a Significant Level in Multiple Species, including Humans
- Disease in New Host Species
- Disease Unknown but New/Multiple Hosts
- Disease at a Higher than Expected Level in Known Host
- Disease at an Expected or Low Level in Known Host
- No Disease

Pathogen of Potential High Human Pathogenicity and Rapid Consequence:
- Prioritize for Response & Follow-up:
  - Pathogen of Pandemic Potential in Need of Further Characterization
  - Pathogen Unlikely to have Pandemic Potential or to Spillover to Humans

Outbreak Investigation:
- Further Characterization
- Notification
- Intensified Surveillance
- Control Modeling
- Risk Reduction

Diagnostics: clinical & pathological examination, screening for viral families & normative pathogens, number of individuals affected
Rapid Epidemiologic Analysis & Modeling: incidence, host & number of species affected, demographics, location & spread
Molecular Characterization & Modeling: relatedness to human pathogens, transmissibility factors, opportunity for spillover & spread, pathogenic potential in new hosts & ability to counteract host defenses, emergence & evolutionary history
EPT: Targeting “Hot Spots”

**Southeast Asia**
- Cambodia
- China
- Indonesia
- Laos
- Malaysia
- Philippines
- Thailand
- Vietnam

**South Asia**
- Bangladesh
- India
- Nepal

**Amazon**
- Bolivia
- Brazil
- Colombia
- Ecuador
- Mexico
- Peru

**Congo region**
- Angola
- Burundi
- Cameroon
- CAR
- Congo
- DR Congo
- Eq. Guinea
- Gabon
- Rwanda
- Tanzania
- Uganda

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