International Systems for Monitoring Viral Chatter

The interface of human and animal health: Identifying threats before they emerge.

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Where is the frontline in the battle against infectious diseases?
Scanning for fever in response to swine flu, Singapore
HIV screening and counseling activities
Cameroon
Taiwanese hospital during SARS outbreak
Centers for Disease Control and Prevention
Gorilla found dead

bushmeat
Brazzaville, Congo

1929
HUMAN VIRUSES HAVE ANIMAL ORIGINS (Wolfe, Panosian and Diamond, 2007, Nature)

VIRAL CHATTER

Human Exclusive

Human Adapted

Weakly Human Adapted

Transmissible

Not Human Adapted

Rabies

Yellow Fever

SARS/Ebola

Influenza

HIV-1
Human-Livestock-Wildlife Interface

- Majority of emerging infectious diseases (EIDs) in people are of animal origin (zoonotic)
- 75% of emerging zoonoses have wildlife origins
- Human activities at the interface linked to EIDs (Nipah virus, SARS, Ebola)
- Annual population growth among highest in buffers to protected areas near wildlife
Current Outbreak Detection and Response

Adapted from J. Davis, Climate Adaptation Workshop, Nov. 2003
Effective Health Early Warning

First Case Detection/Reporting Lab Confirmation Response

Surveillance, Observations and Monitoring Information

Opportunity for control

Adapted from J. Davis, Climate Adaptation Workshop, Nov. 2003
A successful EID outbreak alert and response system

**Predictive modeling**

**Early Detection**

**Rapid Response**

- **Animal outbreak**
- **Human outbreak**

**Amplification:**
Wildlife outbreak

**Control Opportunity**

**TIME**

**Number of Cases**
PREDICT: Building a global early warning system for emerging diseases that move between wildlife and people
Where do we start?

*How many species are there?*

~9,000,000 ‘species’

Mora et al. 2011 PLoS Biology
Developing a Targeted Surveillance Strategy

for wildlife species of highest risk

Phylogenetic distance from humans

- primates
- rodents
- bats
Developing a Targeted Surveillance Strategy

- Strategic selection of geographic locations for surveillance
- Strategic selection of species for surveillance

[Map of the world with color-coded regions]

[Magnified map of Southeast Asia with color-coded regions]

[Images of bats and gorillas]
Risk-based Approach to Surveillance in hotspot regions around the world

- Sample along high risk disease transmission pathways
  - Hunted animals, animals in wildlife trade, (wildlife destined for human consumption, local and international trade)
- People have a high level of sustained and direct contact with pathogens from these sources
Targeted Approach to Surveillance of wild caught free-ranging animals

- Sample wild caught free-ranging wildlife in areas where disease emergence is promoted by:
  - landscape change,
  - land use,
  - anthropogenic activities,
  - sharing of limited resources, and
  - incursion of domestic animals

- Identify natural reservoirs for zoonotic pathogens
Longitudinal Studies of Individuals Occupationally Exposed to Animals
Self-collected animal
dried blood spots

ID Guide for Central African Hunters

DBS from Chinese Wet Market
Active Collections from Wildlife

Wildlife Sanctuary Work

Wild animal capture
Humans: n = 27,186
Animals: n = 27,267

Over 60,000

Over 120,000

Pie chart showing the distribution of different animal categories.
RESULTS AFTER 10 YEARS

IDENTIFIED NEW VIRUSES, INCLUDING RETROVIRUSES

COLLECTED >100k HUMAN & >50k ANIMAL SAMPLES

DOCUMENTED VIRAL JUMPS FROM ANIMALS TO HUMANS
NEW AGENTS DISCOVERED INCLUDE:

- HTLV-3, HTLV-4
- NOVEL STLV & SFV LINEAGES
- RETROVIRUSES – LIKE HIV

- *Plasmodium*
- NOVEL PRIMATE LINEAGES
- MALARIA PARASITES

- NOVEL CLADE OF EBOLA
- FILOVIRUSES

Various new/divergent paramyxoviruses, coronaviruses, adenoviruses, astroviruses, poxviruses, rhabdoviruses, etc.
Adaptive Surveillance Strategy
to identify situations requiring enhanced surveillance

- Ongoing epidemiologic analysis of data
  - To describe zoonotic pathogens in wildlife in each hotspot region
  - Identify zoonotic disease threats that require further investigation
  - Refine our sampling strategies

- Digital feedback
  - Use triggers that signal a high potential for zoonotic pathogen outbreaks
    - Unusual outbreaks in humans and domestic animals with zoonotic pathogens of possible wildlife origin
EPIDEMIC RESPONSE UNITS
RESEARCH COLLABORATORS

• ACMS/PSI International Cameroon Program
• Blood Systems Research Institute
• Centre International de Recherches Médicales de Franceville (CIRMF)
• Care and Health Program Cameroon (CHP)
• CARE International
• Catholic Relief Services (CRS)
• Centers for Disease Control and Prevention (CDC)
• Centers for Disease Control and Prevention of Guangdong Province
• Centre Pasteur, Cameroon
• Columbia University
• Department of Orang Asli, Malaysia
• Department for Veterinary Services, Malaysia
• EcoHealth Alliance (EHA)
• FHI 360
• Guangdong Entomological Institute (GDEI)
• Institut Congolais pour la Conservation de la Nature (ICCN)
• Institut de Recherche pour le Développement (IRD)
• Institut Pasteur, Cambodia
• Kinshasa School of Public Health (KSPH)
• Lola ya Bonobo Sanctuary
• Ministry of Health of Cambodia
• Ministry of Public Health of Cameroon
• Ministry of Health of the People’s Republic of China
• Ministry of Health of Democratic Republic of Congo
• Ministry of Health of Gabon
• Ministry of Health of Malaysia

• Ministry of Health of Laos
• Ministry of Health & Sanitation of Sierra Leone
• Ministry of Water and Forests of Gabon
• National Institute for Biomedical Research (I.N.R.B.)
• National Public Health Laboratory (NPHL)
• Naval Medical Research Unit -2 (NAMRU-2), Phnom Penh
• PERHILITAN (Malaysian Wildlife Department)
• Robert Koch-Institute (RKI)
• Smithsonian Institute
• Stanford University
• University of California, Davis
• Tropical Medicine Research Program of Oxford University
• Tulane University
• University of California, Davis
• University of California, Los Angeles
• University of California, San Diego
• University of California, San Francisco
• University of Edinburgh
• University of Massachusetts, Amherst
• University of Oxford
• US Army Medical Research Institute of Infectious Diseases (USAMRIID)
• US Centers for Disease Control (CDC)
• US Department of Defense Threat Reduction Agency (DTRA)
• World Health Organization (WHO)
• World Health Organization (WHO), Sierra Leone Country Office
OUR MISSION
To mitigate the risk of microbial threats
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