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# Information Flow –
## Zoonotic Disease Surveillance in Wildlife

***Farm Foundation:*** *Zoonoses: Understanding the Animal Agriculture and Human Health Connection*

*William B. Karesh, D.V.M.*
*23 September 2010*

**Local conservation.**
**Global health.**

# Most EIDs are Zoonotic

~ 50% of known human pathogens are zoonotic

**73% of *emerging* human pathogens are zoonotic, most originate in wildlife.**

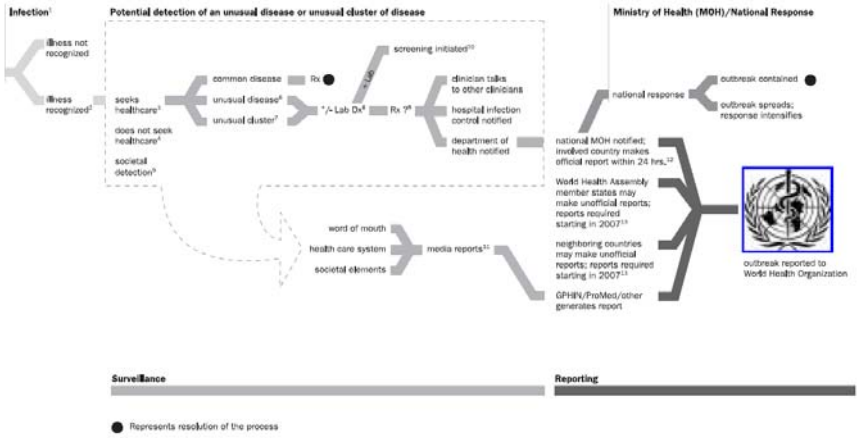
Rate of disease emergence is increasing (not just detection)

Complex process!




Taylor & Woolhouse, ICEID 2000, Jones et al *Nature* 2008

# Current Surveillance Systems focus on human or livestock outbreaks




Hitchcock ,et al.

Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science Volume 5, Number 3, 2007 © Mary Ann Liebert, Inc.

# Global Challenges to Wildlife Surveillance and Response to Emerging Zoonoses

<u>There is no agency responsible for global wildlife disease surveillance</u>

Laboratories in developing countries are unable to detect/diagnose wildlife disease or known zoonoses

Developing countries often lack expertise in wildlife health/disease

Inter-ministerial cooperation/comunication (Health, Agriculture, and Environment (wildlife)) is lacking

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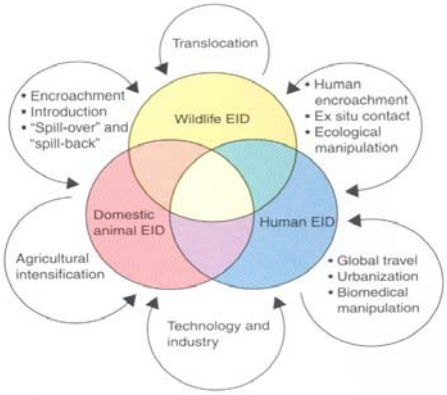
# Anthropogenic Drivers of Zoonotic Disease Emergence




- Agriculture – H5N1, Nipah virus
- Bushmeat hunting – HIV, Ebola
- Travel – SARS, WNV
- Trade –Monkeypox, SARS
- Urbanization – Rabies, Lyme, others…?

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# Zoonotic pathogens often don't cause disease in natural hosts

Hantavirus in mice
Nipah virus in bats
Herpes B in macaques
Marburg virus in bats

These pathogens cause severe disease in humans and other animal hosts

**Surveillance of "healthy" animals is important for identifying known or potential zoonotic agents**

*mouse photo: John Good*

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# Viruses can cause disease in non-reservoir animal species

Ebola virus
Bats are putative reservoir
Hemorrhagic disease in gorillas

95% mortality

Gorilla die-offs preceded human outbreaks in Congo

Photos: Fox news; Discover magazine

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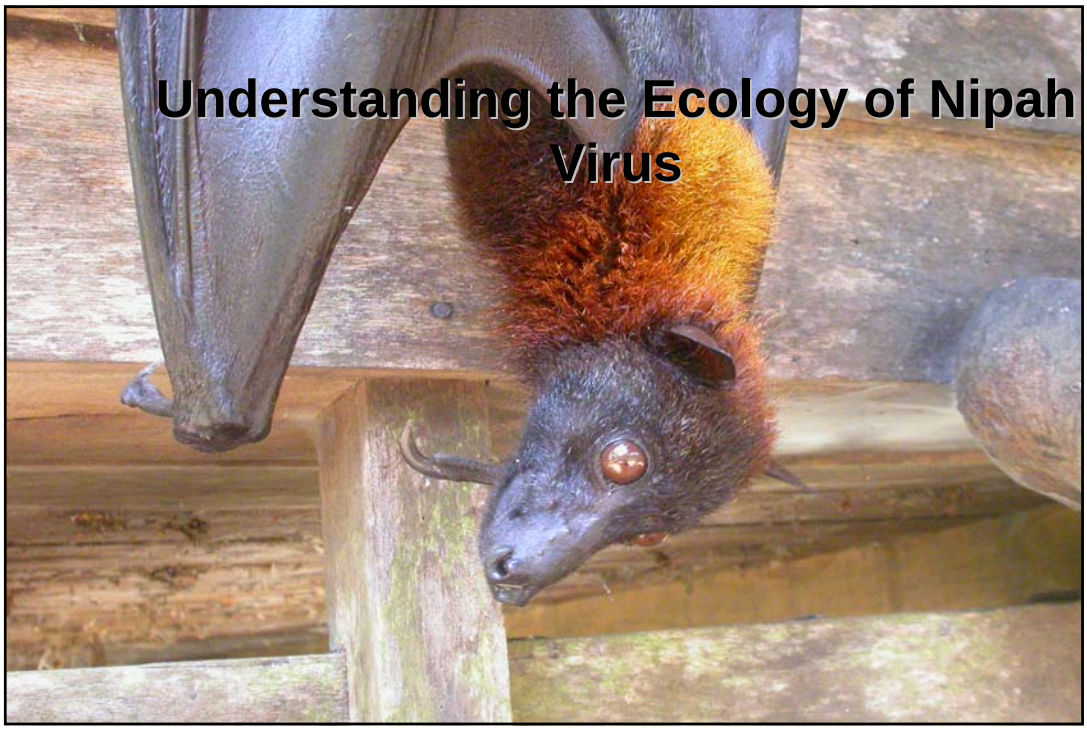
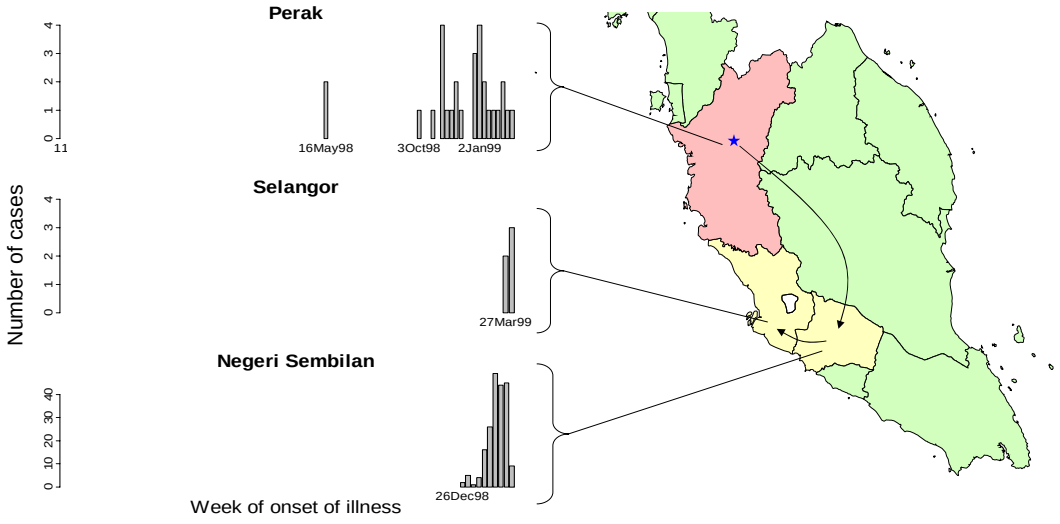


# Disease in Swine

- High morbidity, low mortality
- Abortions
- Respiratory disease – loud barking cough
- Paralysis, ataxia, fever
- Virus mainly in respiratory epithelium and meninges

Nipah virus in Malaysia, 1998-1999
Human encephalitic cases



## Nipah virus in Malaysia, 1998-1999

- Most human cases worked on infected pig farms
- > 1 million pigs culled
- 800 pig-farms demolished
- 36,000 jobs lost
- > $300 (US) million exports lost

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## Two hypotheses for emergence:

- **Climatic factors (1997 ENSO) and wildfires brought infected bats to Ipoh** (Chua et al, 2002)
- **Nipah virus is enzootic and widely distributed in *Pteropus* spp., and agricultural Intensification (large-scale pig farming) drove emergence**

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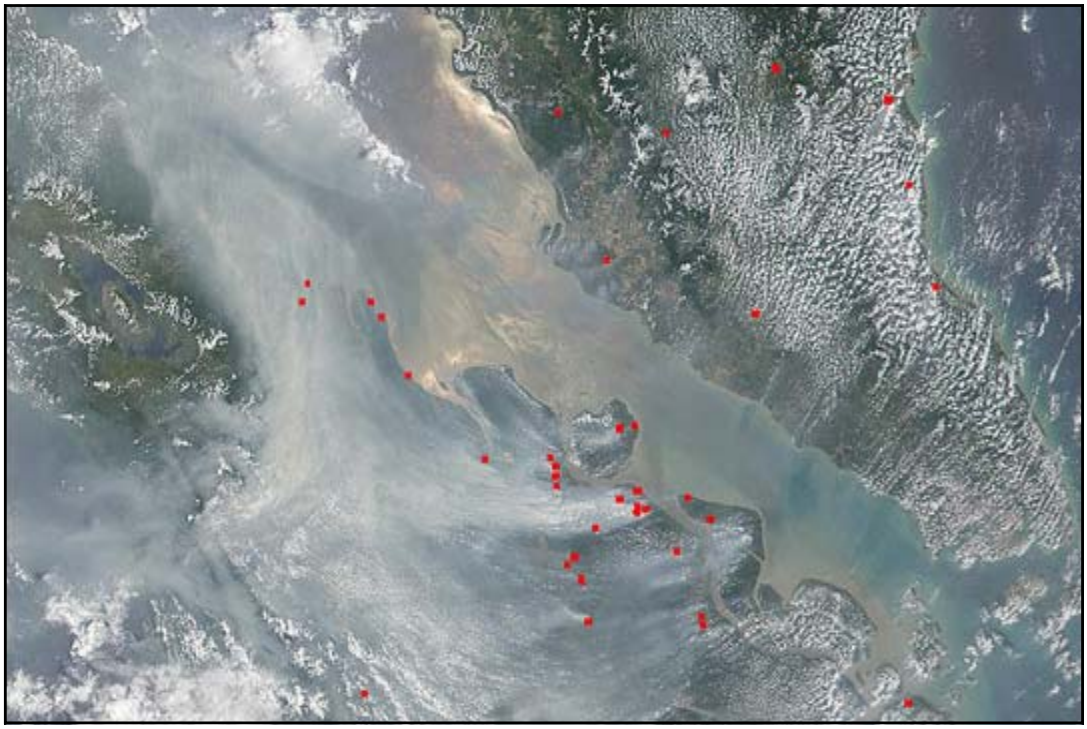

## Agricultural Intensification

**Index farm:**
**30,000+ pigs**
**adjacent to primary forest, fruit bat habitat**

**Network of other large farms close by**

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## Nipah Virus Emergence in Malaysia

**Complex!**

**Driven by pig farm expansion / intensification**

**Availability of cultivated fruit on farms**

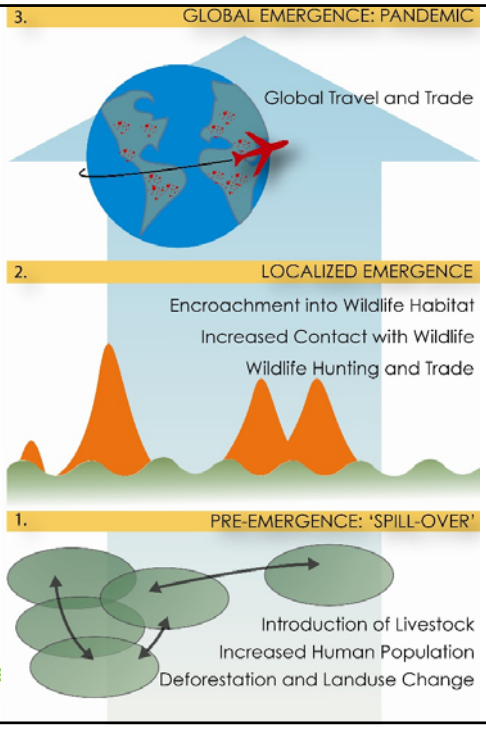
**Size and structure of pig farm was critical to emergence**

**Simple solution – remove fruit trees from pig farms (no new outbreaks)**

- Influenza
- HIV/AIDS
- SARS
- West Nile virus

- Nipah virus
- Ebola virus
- Undiagnosed outbreaks
- New human infections

- Wildlife die-offs
- Silent human infections
- Unknown pathogens

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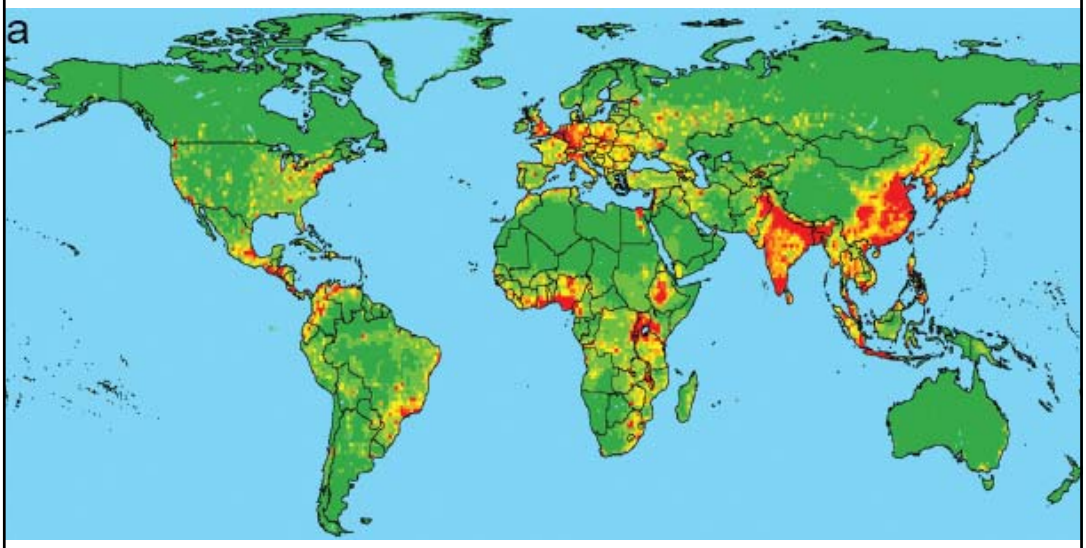
Aleksei Chmura, Wildlife Trust

## Relative risk of a new zoonotic EID from wildlife




Global distribution of relative risk of any EID event
0 – green to 1 – red

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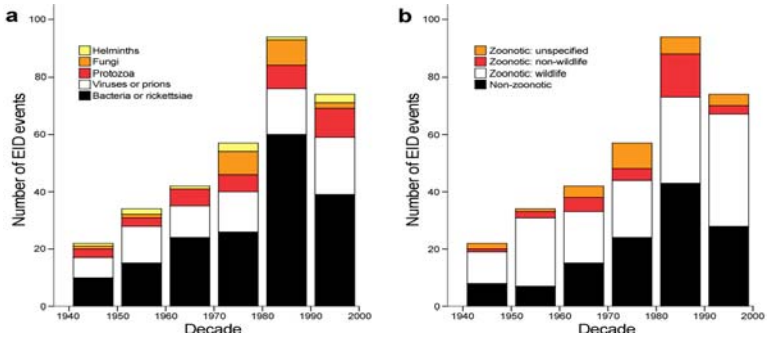
Jones *et al*. in review

# Temporal patterns in EID events




- Significant increase since 1940 (controlling for reporting effort), reaching a peak in 1980s – AIDS/HIV?
- Zoonotics from wildlife are causing the majority of events in recent decade and are significantly increasing

Jones *et al*. 2008 *Nature*

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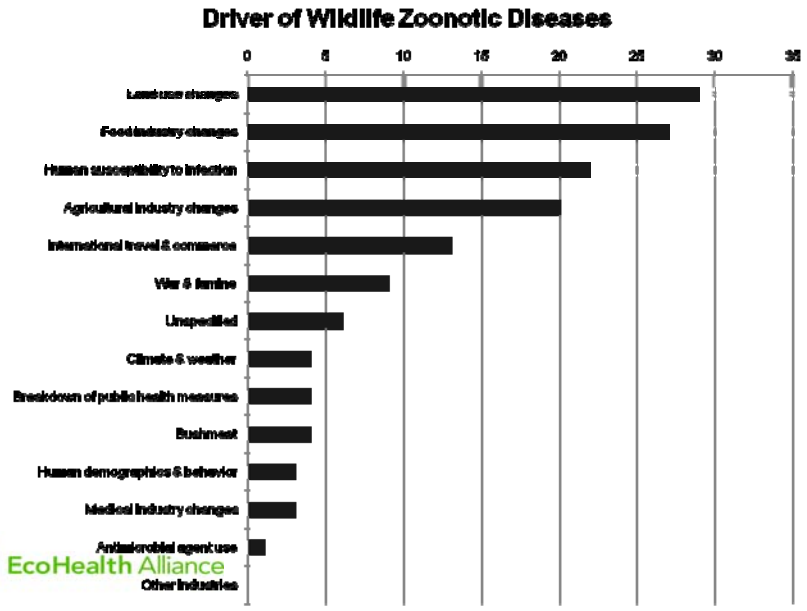
# Drivers of EIDs

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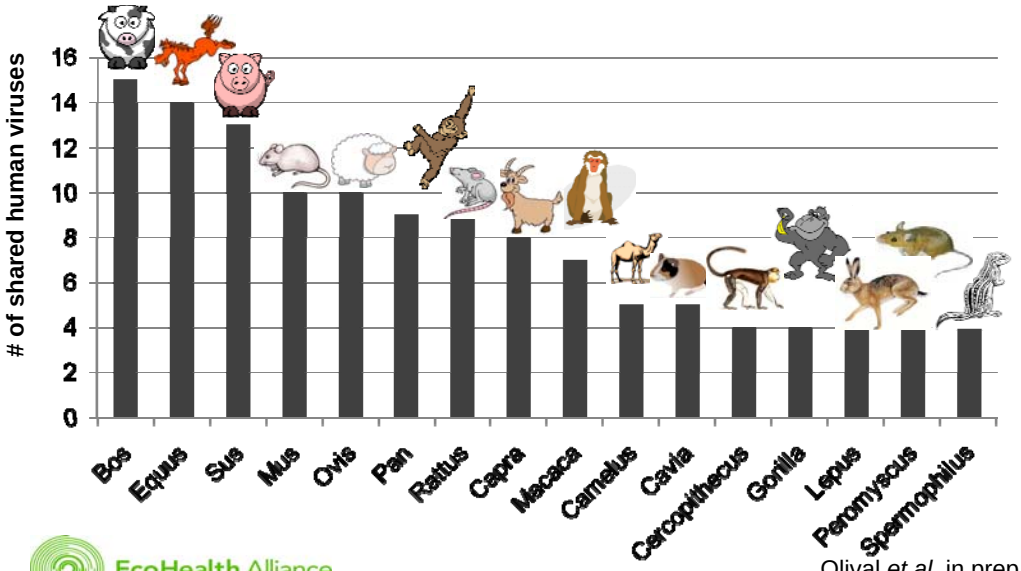
## Top 16 mammal Genera, # of viruses shared with humans

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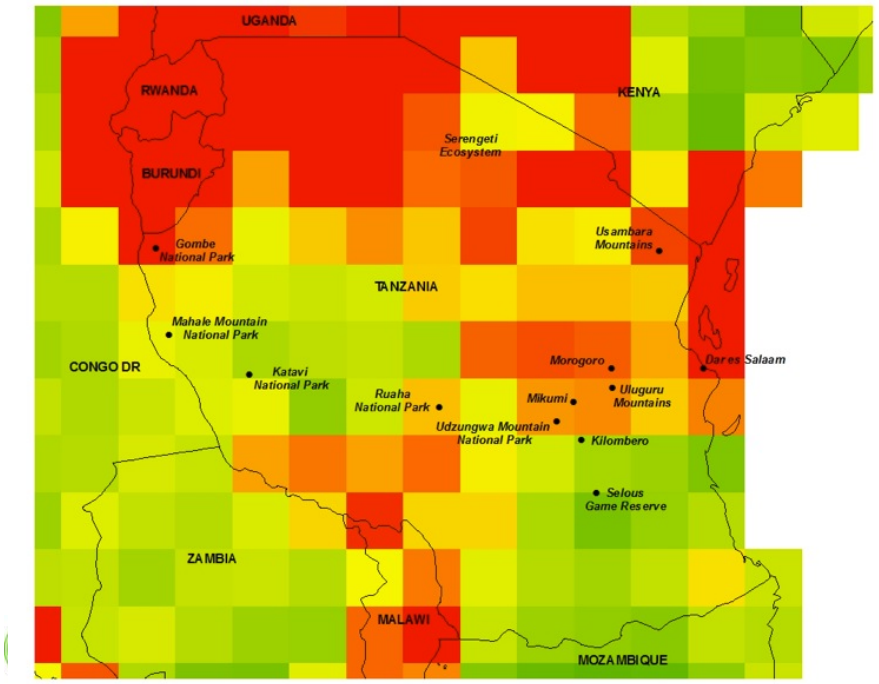
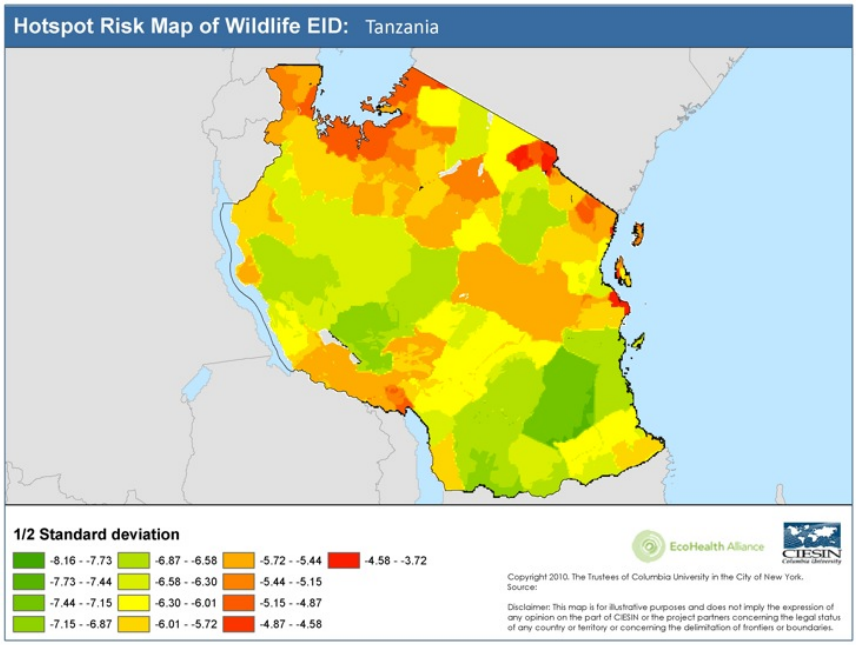
Olival *et al.* in prep




Hotspot Risk Map of Wildlife EID: Tanzania
1/2 Standard deviation
-8.16 - -7.73
-7.73 - -7.44
-7.44 - -7.15
-7.15 - -6.87
-6.87 - -6.58
-6.58 - -6.30
-6.30 - -6.01
-6.01 - -5.72
-5.72 - -5.44
-5.44 - -5.15
-5.15 - -4.87
-4.87 - -4.58
-4.58 - -3.72
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CIESIN
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Source:
Disclaimer: This map is for illustrative purposes and does not imply the expression of any opinion on the part of CIESIN or the project partners concerning the legal status of any country or territory or concerning the delimitation of frontiers or boundaries.

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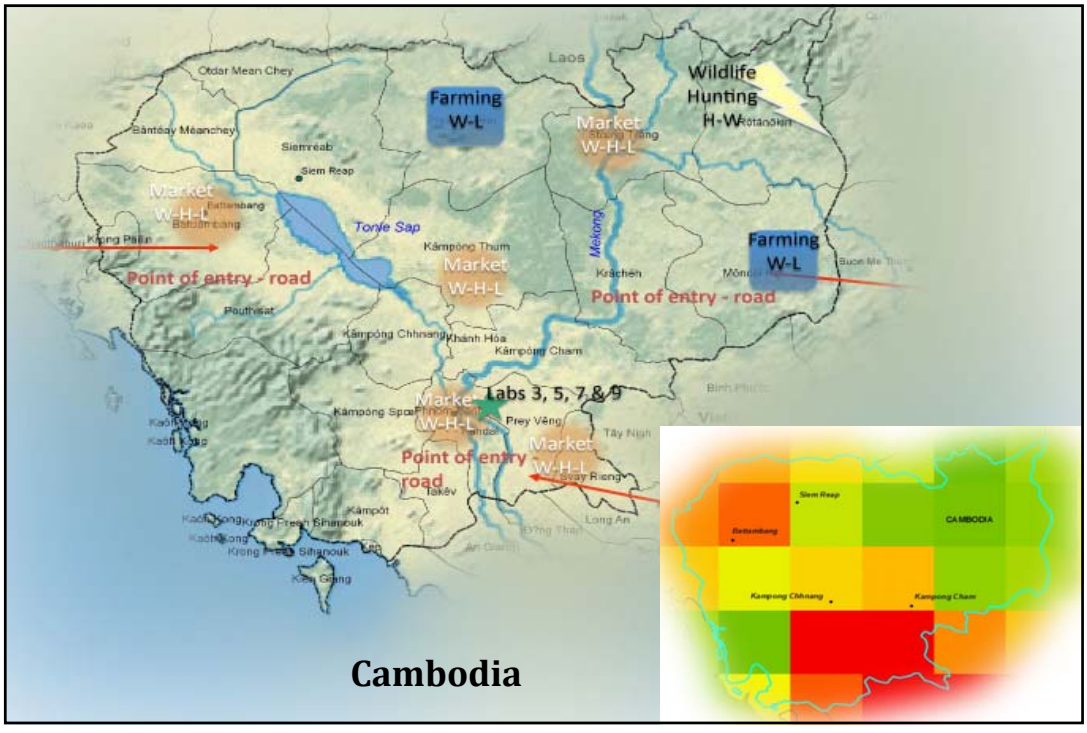
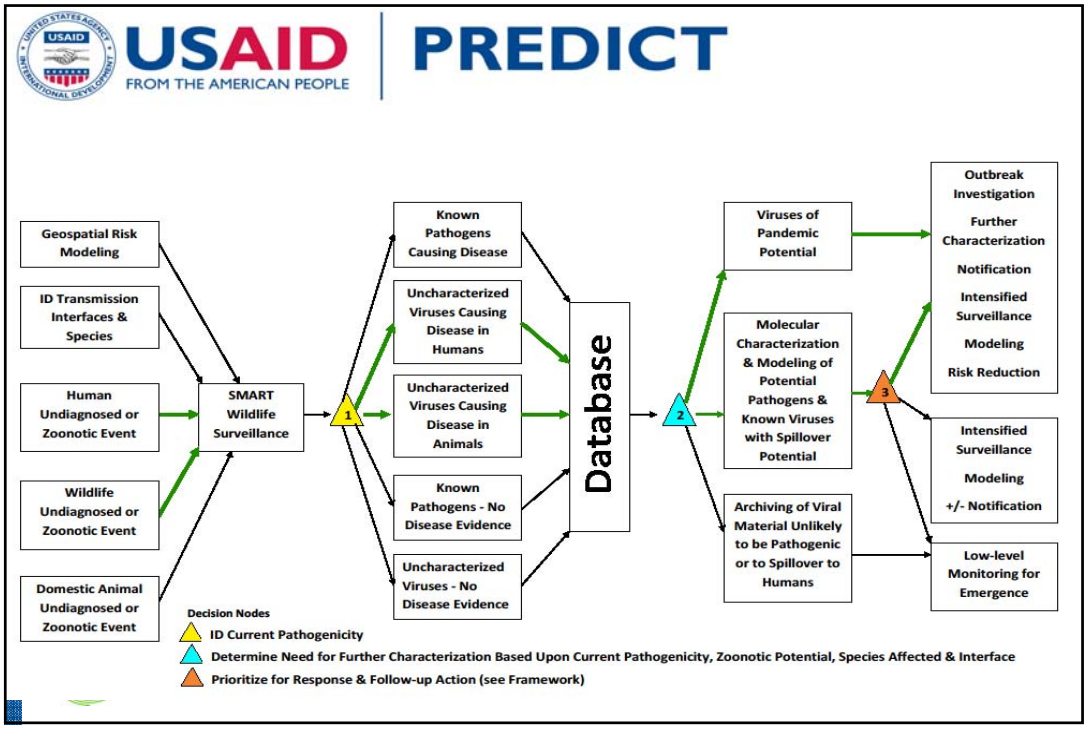
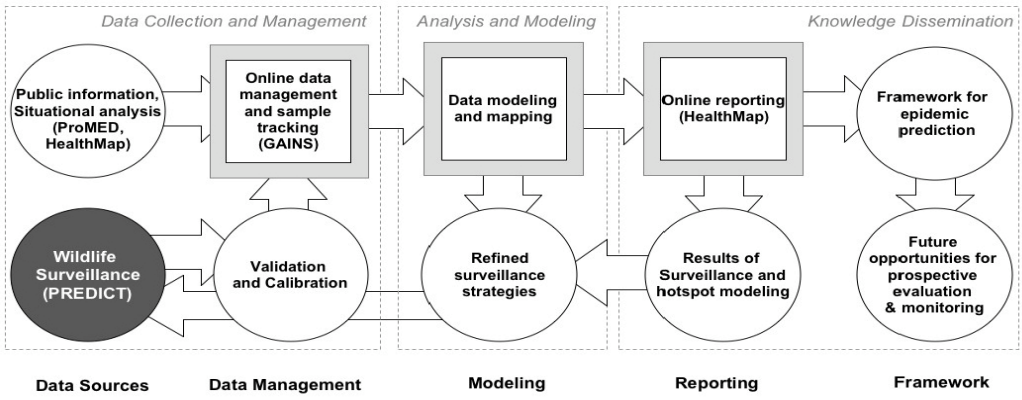
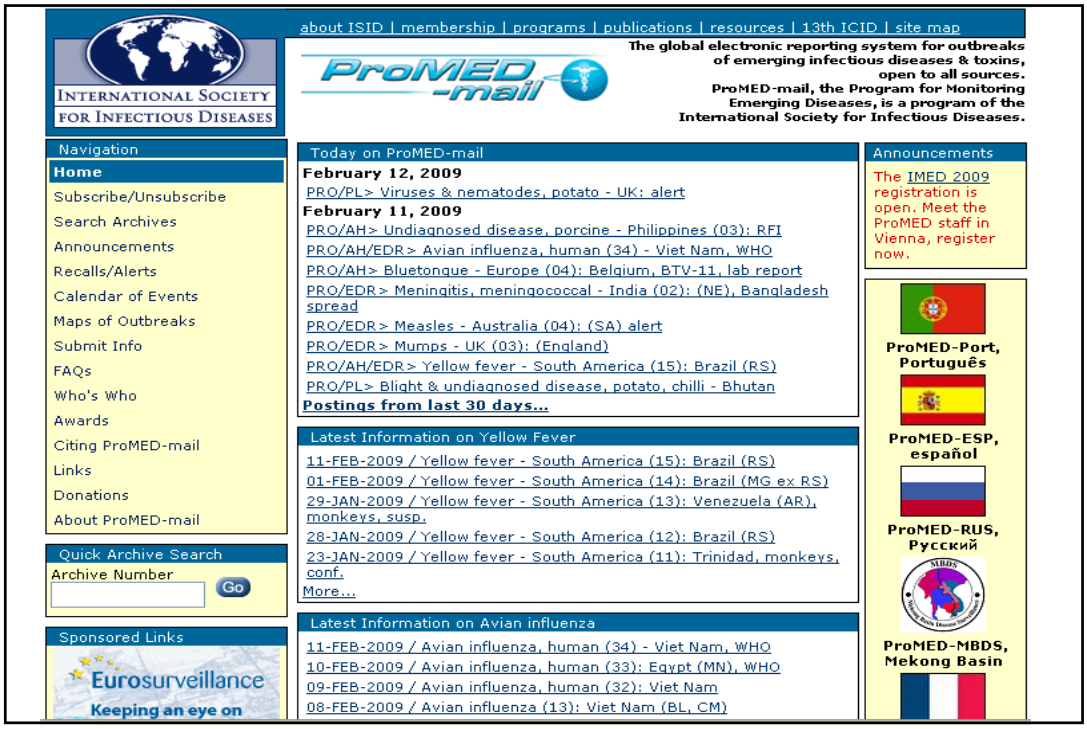

Laos
Otdar Mean Chey
Farming
W-L
Wildlife
Hunting
H-W
Market
W-H-L
Bântéay Méanchey
Siemréab
Siem Reap
Market
W-H-L
Battambang
Tonle Sap
Kâmpóng Thum
Market
W-H-L
Mekong
Farming
W-L
Kratié
Point of entry - road
Point of entry - road
Pouthisat
Kâmpóng Chhnang
Khánh Hòa
Kâmpóng Cham
Labs 3, 5, 7 & 9
Market
W-H-L
Prey Vêng
Tây Ninh
Point of entry -
road
Takév
Market
W-H-L
Svay Rieng
Kâmpôt
Long An
Krong Preah Sihanouk
Kaôh Kong
Cambodia


USAID
FROM THE AMERICAN PEOPLE
PREDICT
Geospatial Risk Modeling
ID Transmission Interfaces & Species
Human Undiagnosed or Zoonotic Event
Wildlife Undiagnosed or Zoonotic Event
Domestic Animal Undiagnosed or Zoonotic Event
SMART Wildlife Surveillance
1
Known Pathogens Causing Disease
Uncharacterized Viruses Causing Disease in Humans
Uncharacterized Viruses Causing Disease in Animals
Known Pathogens - No Disease Evidence
Uncharacterized Viruses - No Disease Evidence
Database
2
Viruses of Pandemic Potential
Molecular Characterization & Modeling of Potential Pathogens & Known Viruses with Spillover Potential
Archiving of Viral Material Unlikely to be Pathogenic or to Spillover to Humans
3
Outbreak Investigation
Further Characterization
Notification
Intensified Surveillance
Modeling
Risk Reduction
Intensified Surveillance
Modeling
+/- Notification
Low-level Monitoring for Emergence
Decision Nodes
ID Current Pathogenicity
Determine Need for Further Characterization Based Upon Current Pathogenicity, Zoonotic Potential, Species Affected & Interface
Prioritize for Response & Follow-up Action (see Framework)


Data Collection and Management
Analysis and Modeling
Knowledge Dissemination
Public information, Situational analysis (ProMED, HealthMap)
Online data management and sample tracking (GAINS)
Data modeling and mapping
Online reporting (HealthMap)
Framework for epidemic prediction
Wildlife Surveillance (PREDICT)
Validation and Calibration
Refined surveillance strategies
Results of Surveillance and hotspot modeling
Future opportunities for prospective evaluation & monitoring
Data Sources
Data Management
Modeling
Reporting
Framework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The global electronic reporting system for outbreaks of emerging infectious diseases & toxins, open to all sources.
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Eurosurveillance
Keeping an eye on
Today on ProMED-mail
February 12, 2009
PRO/PL> Viruses & nematodes, potato - UK: alert
February 11, 2009
PRO/AH> Undiagnosed disease, porcine - Philippines (03): RFI
PRO/AH/EDR> Avian influenza, human (34) - Viet Nam, WHO
PRO/AH> Bluetongue - Europe (04): Belgium, BTV-11, lab report
PRO/EDR> Meningitis, meningococcal - India (02): (NE), Bangladesh spread
PRO/EDR> Measles - Australia (04): (SA) alert
PRO/EDR> Mumps - UK (03): (England)
PRO/AH/EDR> Yellow fever - South America (15): Brazil (RS)
PRO/PL> Blight & undiagnosed disease, potato, chilli - Bhutan
Postings from last 30 days...
Latest Information on Yellow Fever
11-FEB-2009 / Yellow fever - South America (15): Brazil (RS)
01-FEB-2009 / Yellow fever - South America (14): Brazil (MG ex RS)
29-JAN-2009 / Yellow fever - South America (13): Venezuela (AR), monkeys, susp.
28-JAN-2009 / Yellow fever - South America (12): Brazil (RS)
23-JAN-2009 / Yellow fever - South America (11): Trinidad, monkeys, conf.
More...
Latest Information on Avian influenza
11-FEB-2009 / Avian influenza, human (34) - Viet Nam, WHO
10-FEB-2009 / Avian influenza, human (33): Egypt (MN), WHO
09-FEB-2009 / Avian influenza, human (32): Viet Nam
08-FEB-2009 / Avian influenza (13): Viet Nam (BL, CM)
Announcements
The IMED 2009 registration is open. Meet the ProMED staff in Vienna, register now.
ProMED-Port, Português
ProMED-ESP, español
ProMED-RUS, Русский
ProMED-MBDS, Mekong Basin


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Global Health, Local Information
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Enter a disease or location
Go
Advanced Search
Fullscreen
Map
Satellite
Earth
Terrain
Activity Index
Country Level
Low
High
Province or Local Level
Alerts Now Showing
SOURCE
DATE
DISEASE
OUTBREAK / ALERT
LOCATION
SEE ALSO
5 Feb
Pneumonia
PRO/AH/EDR> Pneumonia, ovine - USA (05): (MT) bighorn sheep
26 Jan
Pneumonia
Pneumonia Confirmed In Lower Rock Creek Bighorn Sheep
Missoula, Montana, United States
26 Jan
Pneumonia
Pneumonia Confirmed In Lower Rock Creek Bighorn Sheep
24 Jan
Pneumonia
PRO/AH> Pneumonia, ovine - USA (03): (MT), bighorn sheep
24 Jan
Pneumonia
PRO/AH> Pneumonia, ovine - USA (03): (MT), bighorn sheep
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GVFI Global Viral Forecasting Initiative
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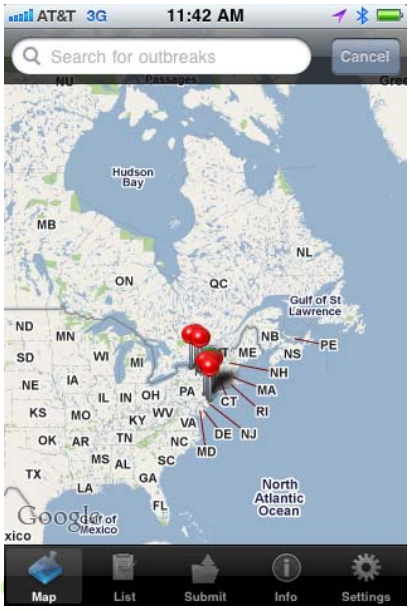
# Outbreaks Near Me



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