2012 ICEID

- Antimicrobial Resistance
- Bioterrorism and Preparedness
- Food-borne and Waterborne Illnesses
- Global Health
- Molecular Diagnostics and Epidemiology
- Nosocomial Infections
- Socio-economic and Political Factors
- Vector-Borne Diseases
- Zoonotic Diseases
What is an emerging disease?

- Newly discovered infectious pathogens that pose a disease threat to people or animals
- ‘Old’ diseases making a comeback
- Old diseases posing threats to new populations, spreading into new areas, infecting new reservoirs or being transmitted by new vectors

This presentation gives a global perspective on selected emerging vector borne & zoonotic disease threats. Because of international travel and trade, disease events in other parts of the world can affect us locally.
What percentage of new or emerging diseases that threaten human health today are zoonotic or vector-borne illnesses?

A) 10%
B) 25%
C) 50%
D) 75%
What percentage of all new or emerging diseases that threaten human health today are zoonotic or vector-borne illnesses?

D) 75 %!
Factors that contribute to the emergence of vector-borne & zoonotic diseases

- Animals, birds, arthropods & pathogens are being moved around the globe by natural means or human intervention.
- Ecological changes – deforestation, agriculture
- Invasive species
- Non-vectors becoming vectors
- International travel (~ 1 billion border crossings/yr)
- International trade
Factors that contribute to the emergence of vector-borne & zoonotic diseases

- Climate change / global warming
- Ongoing/expanding disease outbreaks
- Pathogen – changes at molecular level
- Pesticide resistance
- Antimicrobial resistance
- New diagnostic technologies
- People doing really dumb things
Vector-Borne & Zoonotic Emerging Disease Topics

- Bats as reservoirs for emerging diseases
- Bushmeat
- Malaria
- Dengue
- Plague
- SFTS (Severe Fever w/ Thrombocytopenia Syndrome)
- Tick-borne pathogens
- Pet imports
Bats as disease reservoirs

- *Bartonella* bacteria
- *Coronaviruses* (SARS)
- *Marburg virus*
- *Nipah viruses*
- *Lyssa viruses*
- *Rickettsiae*
Bartonella

- *Bartonella sp.* – gram negative intracellular bacteria
- Reservoirs are mammals: dogs, cats, rodents, humans
- Transmission is through bites, scratches, contact and vectors such as ticks, fleas, sandflies, lice.
Bartonella & Bats

- M. Kosoy, et al. CDC
- Blood was collected and cultured from 93 bats representing 7 species in four provinces in Thailand.
- *Bartonella sp* was isolated from 34 (36.6%) within five bat species.
- The high prevalence for *Bartonella* infection in bats in Thailand suggests bats may be significant natural reservoirs for this bacteria in nature.
- Implications to human health is unknown.
Bartonella in Bats

- The biggest public health concern associated with vampire bats (*Desmodus rotundus*) is rabies.
- A. Turmelle, et al.
- Studies in Guatemala in 2010 have also identified vampires as possible reservoirs for *Bartonella* bacteria.
- 48% of 31 *D. rotundus* tested positive for *Bartonella spp.*
- Survey: 490 people in Guatemala were interviewed to assess frequency of bat exposure.
- 10% reported bat→human exposure: bites or contact.
- 20% reported bat exposures to domestic animals.
- Per C. Rupprecht, CDC: the range of vampire bats has been expanding northward. We may yet see vampires in the U.S.
Bats & Coronavirus

- Severe Acute Respiratory Syndrome (SARS) is caused by a Coronavirus.
- 2003 pandemic – 8,000+ cases (770+ deaths) were reported in 24 countries in Asia, Europe, North America and South America. China was hardest hit.
- Source: spillover from bat → civet cat → humans.
Coronaviruses studies in Bats

- C. Conrardy, et al. - study 2006-2010
- Study to define prevalence & diversity of Coronaviruses found in bats in Kenya, Africa
- 2,200+ bats representing 17 genera sampled
- Fecal and oral swabs were tested using RT-PCR
- 10 -25% of bats were CoV RNA positive depending on year & location showing significant rates of infection
- Tremendous diversity of CoV found, including novel CoVs
- Diversity of CoV in bats, combined w/ human bat interactions raises concerns for new CoV introductions.
Marburg virus

- Filovirus
- Affects humans and other primates.
- Causes severe hemorrhagic fever w/ 25% fatality rate.
- First recognized in 1967 in lab workers that worked with primates in Germany.
- Marburg virus has been found in fruit bats and primates in Uganda, Congo, Zimbabwe, Kenya, Angola
Marburg Virus

- Human cases & outbreaks of Marburg virus occurred in miners in Uganda and Congo and also in tourists visiting Python Cave, Queen Elizabeth National Park in Uganda in 2008.
- Source of infection was three species of *Pteropus* fruit bats that roosted in the caves. Bat urine & feces are presumed to be infectious.
Nipah Virus

- *Henipavirus sp.*, (Family Paramyxoviridae)
- Affects human and animals
- First recognized in 1999 in an outbreak among pig farmers in Malaysia.
- Causes encephalitis and/or severe respiratory disease.
- Transmissible animal to human and human-to-human.
Nipah Viruses & Bats

- A. Chakrabort, et al.
- Since 2001, seasonal (December – April) outbreaks of Nipah virus (NiV) infection occur in humans in central and northwest Bangladesh.
- Significant risk factor for cases was drinking raw date palm sap which is used to make a beverage - ‘Tari.’
- Subsequent human-to-human transmission would follow.
- Health official investigated 42 cases (90+% - fatal) between December 2010 – March 2011.
- 24 of 42 NiV case patients drank raw sap, 4 drank fermented sap (Tari). Other cases included healthcare workers, hospital visitors, etc. who had contact w/patients.
Nipah Virus & Bats

- S. Chowdhury, et al.
- Source of NiV was contamination of the date palm sap by the feces of *Pteropus giganteus* fruit bats.
- Sap was collected by scoring the trees and hanging pots to catch the sap.
- Fruit bats were also know to feed on the collected sap, and contaminated the sap with saliva, urine and feces. Dead bats would sometimes be found in the sap pot. Pot and sap would not be discarded.
Lyssa Viruses in Bats

- C. Rupprecht, CDC
- Bats are reservoirs for Lyssaviruses.
- Lyssa viruses are a diverse group: examples include Lagos bat virus, Mokola virus, Duvenhage, and of course – Rabies virus
- Lyssa virus infections in mammals cause rabies-like disease.
- Rabies is believed to have originated from bats having spilled-over into other mammals and then diverging into new variants. We see this happening today (e.g. Flagstaff, AZ).
From Bats to Bushmeat
Bushmeat

- Bushmeat is an example of emerging disease threat related to international trade and travel and ecological changes (logging).
- Bushmeat is raw or “processed” (usually smoked or dried) wild animal meat or parts from hunted animals in Sub Saharan Africa.
- Bushmeat comes from a wide variety of wild species. Examples: cane rats, non-human primates, duiker antelope, bats, reptiles.
- Bushmeat hunting is source of animal proteins for families and a source of income.
- Logging practices has created road access into remote forest areas.
- Bushmeat trade has been increasing in recent decades resulting in more human exposures to unknown emerging diseases.
Bushmeat

- Bushmeat is a ‘taste from home’ for some immigrants from Africa and is considered a delicacy and treat for special occasions (reunions, holidays, etc.)
- Bushmeat is also believed to have health benefits.
- Importing bushmeat into the U.S. is illegal.
- Untold thousands of pounds of bushmeat are smuggled into the U.S. yearly.

- Rodents and monkeys make up the majority of seized bushmeat.
Bushmeat disease risks?

- Non-human primates share lots of diseases w/ humans.
- Hunting, handling, skinning, and consuming bushmeat exposes persons to blood, tissues, saliva, urine, feces, etc. via many routes of inoculation (skin & mucous membrane contact, ingestion, inhalation).
- Excellent potential for transmitting new pathogens into the human population.
Bushmeat

- T.R. Bell, et al. CDC
- 96% of bushmeat comes from Africa.
- Peak season for bushmeat imports- late spring & early summer which often corresponds with African holidays, customs, celebrations.
- CDC/USDA conducts “blitzes” to intercept bushmeat during certain times of year
- 2006 – 2010: 540+ bushmeat confiscations
- 50%+ was rodent. 68% came from Ghana
- Documented confiscations accounts for small portion. Lots of bushmeat (estimated 4x) still gets through.
Bushmeat Testing

- M. Peeters, et al.
- Wild monkeys commonly used for bushmeat were sampled in Cameroon, West Central Africa.
- SIV (simian immunodeficiency virus) was found in 131 / 788 monkey sera (16.6%).
- SIV Ab were found in 13 out of 16 monkey species
- SIV is closely related to HIV.
- Human exposure to SIV is no-doubt common among bushmeat hunters.
- This human – NHP interface creates an environment for emergence of new infections.
- Case in point: the human HIV pandemic (now at 40+ million cases) originated from primates in Africa.
From Bushmeat to Vectors
Malaria News – Vaccine Development

- Malaria infects 300 million people worldwide.
- 225 million new cases occur in Africa annually.
- 700,000 children die in Africa each year.
- Vaccine to protect against *Plasmodium falciparum* malaria - RTS,S/AS01 – is in field trials.
- 6,000 children in age groups 6-12 weeks and 5-17 months have been immunized and efficacy is being compared to untreated populations.
- Preliminary data suggests that ~ 730 infections are prevented per 1,000 vaccinations.
- Severe clinical infections were cut by half.
Malaria News - Treatment

- The biggest challenge to treating malaria infections is the propensity for *Plasmodia* parasites to develop drug resistance.
- Antimalarial drugs used to rx *P. falciparum* have worked for a while and then failed.
- Chloroquine (1950s – 70s)
- Sulfadoxime-pyrimethamine (Fansidar®) – (1970s-2000s)
- Evidence of drug resistance - the time for parasite clearance from the blood gets longer-and-longer.
Malaria News - Treatment

- Artemisinin-based Combination Therapy (ACTs) is the current rx regime used in many *P. falciparum* endemic regions.
- There are now signs of ACT resistance appearing in SE Asia (Cambodia).
- Period of parasite clearance in the blood has increased from 16 hrs to 120 hrs following initiation of ACT.
- But, there is some good news! In areas where chloroquine has not been used in years/decades (e.g. Malawi) – chloroquine is effective again.
- Some of the old drugs may have new life again.
Aedes aegypti Control News

- Field trials underway in Cayman Islands, Caribbean
- 3 million genetically engineered male Aedes aegypti mosquitoes have been released (‘Oxitec mosquitoes’)
- Mosquitoes are homozygous for a semi-lethal gene that causes hatched female mosquitoes to have underdeveloped flight muscles.
- Altered males mate with females which lay eggs and produce generation of flightless mosquitoes.
- Treated populations showed an 80% ↓ compared to untreated.
- Study is not without controversy.
T. Rocke, USGS

Black-tailed Prairie Dogs and Black Footed Ferrets (BFF) are very susceptible to *Yersinia pestis* infection. Plague epizootics are a major threat to endangered species recovery programs.

Oral plague vaccine has been developed and is field trials in Colorado to immunize test populations of prairie dogs.

Attenuated plague + raccoon pox vector vaccine is distributed in PD towns in sweet potato or peanut butter baits.

Challenge studies in mice showed 60% survival with consumption of one bait, and 85% survival with two baits.

Plague vaccine is also administered to BFF pups.

More to come....
What disease vector ranks #1 in pathogen diversity?

A) Mosquitoes
B) Ticks
C) Fleas
D) Lice
What disease vector ranks #1 in pathogen diversity?

B) Ticks

Ticks can transmit viruses, bacteria, rickettsiae, protozoans, etc.
Emerging Tick-Borne Diseases

- The world of tick-borne diseases is dramatically changing!
- “Old” tick diseases are expanding.
- New vectors are emerging.
- With new diagnostics technology – new tick-borne pathogens are being identified.
Emerging Tick-borne Diseases

- Severe Fever with Thrombocytopenia Syndrome
- *Rickettsia parkeri* – ‘Tidewater Spotted Fever’
- Powassan Virus
- New tick-borne virus in the U.S.?
SFTS

- Severe Fever w/ Thrombocytopenia Syndrome (SFTS)
- Novel tick-borne *Phlebovirus* (Bunyaviridae)
- First reported in Central China 2009
- Hemorrhagic fever like disease
- Multiorgan failure in severe cases
- Case fatality rate – 30%
- Tick vector – *Haemaphysalis longicornis*
- Multi-host tick - lots of potential animal reservoirs
- Rural areas / farmers at higher risk
New Tick-Borne Rickettsia

- 2004 – U.S. serviceman in the Tidewater Region of East VA developed illness with fever, headache, malaise, myalgias, arthralgias, and eschar lesions on the lower extremities.
- Illness was thought to be RMSF & tested positive on Spotted Fever Group (SFG) serologic tests.
- But, a different rickettsia – *R. parkeri* was isolated from a biopsy of the eschar.
- Another serviceman case - 2006 – same Region.
- Since then – 25+ cases of Tidewater Spotted Fever have been reported in the U.S. and in South America.
Emerging Tick-Borne Diseases

- *Rickettsia parkeri*– new Spotted Fever Group (SFG) pathogen – intracellular bacteria
- Vector: *Amblyomma maculatum* – the Gulf Coast Tick
- *R. parkeri* rickettsiosis, American Boutonneuse Fever, Tidewater Spotted Fever
- Causes illness similar to RMSF, but usually milder
- Causes eschar – lesions
- U.S. cases - reported in CA, FL, & Atlantic Seaboard.
Rickettsia parkeri surveys

- *Amblyomma maculatum* ticks have been collected and tested from at least seven states (AR, GA, FL, KY, MS, SC, VA).
- Ticks were tested via RT-PCR.
- *R. parkeri* infections in these ticks varied from 5 – 28% depending on sample location. *R. parkeri* infected ticks were common and widespread.
Rickettsia parkeri

- Gulf Coast Ticks are known to occur in 12+ states.
- Commonly used diagnostic tests (serologic assays) for RMSF would cross react w/ other SFGR.
- Some of the “RMSF” cases reported in past years in the Atlantic seaboard and southern states may have actually been *R. parkeri* infections. How many???
- Newer assays / technologies (e.g. PCR) can tease-out the various rickettsia whereas older assays could not.
Powassan Virus

- M. Kemperman, et al.  MN DPH
- Powassan (POWV) is a tick-borne flavivirus (related to WNV) that can cause neuroinvasive infections (meningitis, encephalitis)
- From 1999-2009, 25 cases were reported in the U.S.
- In 2010 – 2011, MNDPH enhanced POWV surveillance by re-testing WNV specimens (CSF and serum) for POWV.
- 12 POWV cases were identified/confirmed.
- 87% POWV cases were neuroinvasive disease.
- All cases occurred in areas w/ Ixodes scapularis ticks.
- POWV is more common than previously thought.
New Tick-Borne Virus in U.S.?

- *Rickettsia*-like illnesses reported in MO
- Fever, ↓ platelets, ↓ sodium, etc.
- Hx of tick bite reported, but ticks not saved for ID.
- Lab tests = negative on *Rickettsia* assays
- Infections did not respond to doxycycline.
- Electron Microscope studies point to a new virus.
- What comes next? Enhanced case surveillance, tick collection & testing, animal reservoir studies, etc.
- Stay Tuned!
From Ticks to Dogs: Pet Imports
Pet Imports

- J. sinclair, et al CDC QARS
- An estimated 287,000 dogs are imported into the U.S. each year from around the globe.
- Concerns for incoming infectious diseases like rabies, leptospirosis, leishmaniasis, roundworms, etc.
- Most common dog imports are “toy breeds” and 70% are ≤ 4 months of age.
- Importers of un-vaccinated dogs are required to confine the dog until immunized and an addition 30 days.
- 144 dogs were described as ill or dead upon arrival.
- Ill dogs came in from 28 countries, 21 of which are rabies endemic.
- Causes of illness not always known. Many were ill from dehydration or hypoglycemia.
Dog Imports - Arizona

- Many shipments of Yorkshire Terriers ("Yorkies") are imported through L.A., CA into Arizona each year.
- Source – breeders (‘puppy mills’) in Korea.
- True age is often mis-represented on paperwork as they appear to be younger than documented.
- Yorkies are advertised on the internet. At least one Yorky importer advertises his dogs as “locally bred.”
- This raises concerns on rabies vaccination status/immunity as these puppies may be getting vaccinated too early (before 3 months).
- Problem is lax importation laws.
Closing Comments

- The ICEID meeting was very worthwhile - an eye opener.
- The next meeting is in Atlanta in 2014.
- There a lots of emerging diseases out there! And most EDs are zoonotic.
- There are lots of activities and practices by people around the world that provide avenues for introducing new diseases from animals (“Disease X”) into the human population.
- We must keep a wary eye on the global disease picture.