The Arboviruses Next Door: Orphaned and Emerging Arboviruses of the US

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Orphaned arboviruses

Orphan ≠ neglected
**Orthobunyavirus** (Order *Bunyavirales*, Family *Peribunyaviridae*)

- Negative sense, single-stranded, segmented, RNA genome
  - Large (L) : RNA-dependent RNA polymerase
  - Medium (M) : structural polyprotein Gn-NSm-Gc
  - Small (S): nucleocapsid and NSs
- 20 serogroups
  - California (US/North America)
  - Bunyamwera (US/North America, South America, Africa)

Segment reassortment (rapid evolution)

- Superinfection of closely related viruses
  - Mosquitoes
- Increased pathogenesis
  - Ngari (Garissa) virus
  - Schmallenberg virus
- Vector/host expansion
- New ecological niches
- Prevalent in bunyaviruses

California serogroup

- Endemic viruses of public health importance
  - La Crosse virus – pediatric encephalitis
  - Jamestown canyon virus
  - Snowshoe hare virus
  - California encephalitis virus

- Human infection
  - Encephalitis
  - Febrile illness
  - Asymptomatic

- Mosquito borne
  - “strict” vector and small mammalian vertebrate host preferences

- Widely distributed
La Crosse virus

- **Aedes triseriatus** (treehole mosquito)
  - Aggressive daytime-biting

- Vertebrate hosts
  - Chipmunks and squirrels

- Human infection
  - Fever (low viremia), headache, nausea
  - Severe neuroinvasive disease
La Crosse virus

- **Changing distribution**
  - Historically upper Midwest, now central Atlantic
  - Widespread Midwest – Southeast

- **Clinical Lab Diagnosis**
  - Difficult to culture and identify with molecular methods
  - Serological diagnosis remains primary method

La Crosse disease 2007-2016 (ArboNet) (~70 per year)
La Crosse virus

- Changing distribution

DISPATCHES

La Crosse Virus in Aedes albopictus Mosquitoes, Texas, USA, 2009

Amy J. Lambert, Carol D. Blair, Mary D’Anton, Winnann Ewing, Michelle Harborth, Robyn Seiferth, Jeannie Xiang, and Robert S. Lanciotti

Predicted occurrence of Ae. albopictus

Kraemer et.al. eLIFE 2015: 4; e08347

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 16, No. 5, May 2010
Jamestown Canyon virus

- California serogroup
- *Aedes* and *Ochlerotatus*
  - 26 species of mosquito
  - 3 tabanid (horse) flies
- Vertebrate host
  - White-tailed deer (likely)
  - Wild ungulates and domestic livestock

- Human infection
  - Febrile, headache, nausea, photophobia
  - Respiratory symptoms
    - Not often reported
  - Meningitis and encephalitis
- Predominantly in adults
Jamestown Canyon virus

- **Widely distributed**
  - US and Canada
  - Likely under-reported
    - 15 reported in 2016

- **Clinical Lab diagnosis**
  - No human isolations to date
    - RT-PCR of S segment
  - Serological diagnosis primary method
    - Persistent IgM possible

Jamestown Canyon 2000-2013 (31 cases)

11 cases (2015), 15 (2016)
Cache Valley virus

- **Bunyamwera serogroup**
- **Anopheles**
  - >30 mosquito species
- **Vertebrate host**
  - White-tailed deer
- **Widely distributed**
  - North and Central America
- **Livestock disease**
  - Abortion and still birth

- **Human infection**
  - Neuroinvasive encephalitis
  - 5 human cases identified in US (2015 most recent)
  - 18% seropositive in Yucatan
    - Febrile illness

- **Clinical Lab diagnosis**
  - PRNT primary method
  - Virus isolated from CSF and serum
    - Real-time RT-PCR
Colorado tick fever (CTF)

- *Reoviridae, genus Coltivirus*
- Non-enveloped virion
- 12 segments
- Double-stranded RNA
- Tropism for hematopoietic stem cells
  - Mature erythrocytes
- Virus found in RBCs ~ 6 weeks after symptom onset
Colorado tick fever (CTF)

- **Dermacentor andersoni**
  - Rocky Mountain wood tick

- Vertebrate hosts
  - Chipmunks, squirrels, and mice

- Human infection
  - Febrile, head and body aches
  - Biphasic fever
  - Leukopenia
  - Rarely neuroinvasive
Colorado tick fever (CTF)

- Distributed widely in Western States (4,000-10,000 feet)
- Clinical lab diagnosis
  - Real-time RT-PCR
    - Sensitive <21 dpo
    - RNA detected up to 42 dpo
  - Delayed antibody response
    - PRNT
    - >15 dpo

Distribution of D. andersoni and CTF cases 2002-2012 (83)

www.cdc.gov/coloradotickfever
Emerging arboviruses
Heartland virus

- Order *Bunyavirales*, Family *Phenuiviridae*, genus *Phlebovirus*
  - Ukuniemi serogroup
- 3 segment, negative sense RNA genome
  - Ambisense S segment
- 2009, Missouri
- Genetically similar to Severe Fever with Thrombocytopenia Syndrome virus (SFTS)
  - 2009 China
Heartland virus

- Tick associated disease

- *Amblyomma americanum* (Lone star)
  - Virus isolation
  - Laboratory transmission

- Vertebrate host unknown
  - Seropositive: white-tailed deer, raccoon, coyote, moose

Riemersma and Komar 2015 EID
Heartland virus

- **Human infection**
  - Febrile, headache, nausea, muscle or joint pain, leukopenia, and thrombocytopenia
  - Often confused with ehrlichiosis

- **Clinical lab diagnosis**
  - Real-time RT-PCR
  - Serology
Bourbon virus

- **Orthomyxoviridae**, genus *Thogotovirus*
- 6 segments, negative stranded RNA genome
- Thogoto and Dhori viruses known human pathogens
  - Europe, Asia, Africa
  - Tick transmission
- Kansas 2014
Bourbon virus

- **Tick associated**
- **Amblyoma americanum (Lone star)**
  - Isolated in ticks from MO 2013 and KS 2015
  - Nymph and adult
- **Human infection**
  - Febrile, thrombocytopenia, leukopenia
- **Clinical lab diagnosis**
  - Real-time RT-PCR
  - PRNT

Distribution of A. americanum

www.cdc.gov
Yellow fever virus

- **Flavivirus**
  - Positive RNA genome
- **Aedes aegypti**
  - Urban transmission
- **Haemagogus and Sabethes**
  - Sylvatic transmission (most common)
- **Human infection**
  - Febrile ILI with jaundice
  - 12-15% severe disease
  - High fever, bleeding, shock, organ failure

- **Clinical lab diagnosis**
  - Serology
  - Real-time RT-PCR

[www.who.int/emergenices/yellow-fever](www.who.int/emergenices/yellow-fever)
Risk areas (vaccine recommended)

cdc.gov/yellowfever
Yellow fever virus

- **Recent notable outbreaks**
  - 2016 Angola, Democratic Republic of the Congo (3,137 suspect)
  - 2016/2017 Brazil (777 confirmed)
  - 2017 Nigeria (341 suspect)
  - 2018 Brazil (920 confirmed)
    - 11 international travelers
Thank you

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For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.