Arboviruses

• Refers to viruses transmitted by arthropods, usually mosquitoes
• Traditionally a low priority for research, but perceptions of importance changing in recent years
• Unprecedented emergence of epidemics in last 50 years – chikungunya, Zika, yellow fever, dengue, West Nile
• Many viruses maintained in enzootic cycles that can spillover into humans or other species
Geography and Vectorborne Disease

• Endemic diseases vary by geography
• Not all diseases are found everywhere – need to have the right host and vector species, as well as environmental conditions for disease to occur
• Risk not always consistently distributed, even in relatively small areas
Jamestown Canyon Virus

- Single-stranded RNA virus
- Genus *Bunyavirus*
- Member of the California serogroup of viruses
- First isolated from a mosquito from Jamestown Canyon, Colorado in 1961
- Rarely reported as a cause of human disease – nationally notifiable since 2004

Image: https://www.colorado.com/cities-and-towns/jamestown
Jamestown Canyon Virus Ecology

• Principal amplification host in nature is the white-tailed deer
  – Other large mammals may also participate in maintenance cycle
• Several species of mosquito may be vectors – seems to differ based on geography and time of year
• Serosurveys indicate virus is present throughout continental United States and Canada
• Human infections more common in northern states
Mosquito Vectors

• Isolated from a variety of boreal mosquito species, although vector competence for many is unknown

• Important potential vectors in Minnesota include several Aedes species and Coquillettidia perturbans

• Also possible transmission from Anopheles, Culex, and Culiseta species

Image source: [https://bugguide.net/node/view/49884](https://bugguide.net/node/view/49884) (top) and [https://bugguide.net/node/view/1414384/bgimage](https://bugguide.net/node/view/1414384/bgimage) (bottom)
Jamestown Canyon Virus Disease

• Similar to other arboviruses, clinical syndromes range from fever without neurologic involvement to meningitis and encephalitis
  – Prodome of upper respiratory infection sometimes reported
• Longer risk season than other endemic mosquitoborne arboviruses – cases occur from late spring into early fall
• Likely under-recognized due to limited options for diagnostic testing
Jamestown Canyon Virus in Minnesota

- 35 cases in Minnesota since 2013
  - 1 fatality in 2017
- Onsets from April to October
- Median age of 58 years (range, 10 – 95), 71% male
- 63% of cases hospitalized
- Most cases to date acquired in eastern half of Minnesota
Jamestown Canyon Virus Cases, 2013-2017

n = 35 cases

Source: MN Department of Health
MN JCV Cases by Month of Onset, 2013 – 2017
## Clinical Syndromes for JCV Cases in Minnesota

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<th>Clinical syndrome</th>
<th>N (%)</th>
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Powassan Virus
Powassan Virus

- Flavivirus in the tick-borne encephalitis virus complex
- POWV Lineage I (prototype POWV)
  - Transmitted by *Ixodes cookei* and *Ixodes marxi*
- POWV Lineage II (Deer tick virus)
  - Antigenically indistinguishable from Lineage I
  - Transmitted by *I. scapularis*
- Lineages are ecologically distinct
- Readily transmitted from infected ticks in as little as 15 minutes
Epidemiology of Powassan Virus

• First identified in 1958 in a fatal pediatric encephalitis case in Powassan, Ontario
• Cases reported from eastern Canada/northeastern U.S. and Upper Midwest
• In recent years, the number of reports has increased, and in the late 2000s, the first cases were reported in the Midwest (MI, WI)
• No reported cases west of WI prior to 2008
Powassan Virus Disease

• Typically presents as encephalitis or meningitis
  – Likely that some infections are asymptomatic or mild
  – Roughly half of known cases experience long-term sequelae, and many require prolonged hospitalizations and rehabilitation

• Prodrome of rash, fever, malaise, headache, vomiting, sore throat, muscle and joint aches, and disorientation

• Recommended treatment is supportive care

• Incubation period of 1 – 5 weeks

• Case-fatality rate reported in literature of 10-15%
Powassan Virus in Minnesota

• 34 cases in Minnesota since 2008
  – 2 fatalities, one in 2011 and one in 2016
• Onsets from April to November
• Median age of 60 years (range, <1 – 75), 76% male
• 94% of cases hospitalized
• Most cases to date acquired in north central and northeastern Minnesota
Powassan Virus Cases, 2008-2017

Source: MN Department of Health

n = 34 cases
MN POW Cases by Month of Onset, 2008 – 2017

Number of Cases

Year

January
February
March
April
May
June
July
August
September
October
November
December
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Conclusions and Next Steps

- Increased awareness among clinicians and more widely available testing will likely increase case finding
- Seems to be a true increase in arboviral activity in recent years
- Development of new/better diagnostics needed
- Long-term persistence of IgM antibody response for most arboviruses not well understood – impacts understanding and interpretation of results
- Long-term sequelae of infections?
Acknowledgements

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  • Anna Strain
  • Sara Vetter
• CDC Arboviral Diseases Branch Epidemiology and Laboratory staff
Thank you!

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www.health.state.mn.us
Arboviral Disease

• Infections often asymptomatic or very mild
• Many symptoms non-specific
  – Fever, headache, rash, fatigue
  – Severe disease often manifests with neuroinvasive symptoms
• No specific treatments or vaccines available for endemic arboviruses
• Rely on laboratory methods and known epidemiology of different viruses to help distinguish infections
First JCV Case in Minnesota, 2013

• 49-year old male with 1-week history of myalgia, fatigue, nausea

• Hospitalized after sudden onset of fever, disorientation, and aphasia

• Specimens submitted to Minnesota Department of Health Public Health Laboratory (MDH)

• Follow-up testing at CDC Arboviral Diseases Laboratory identified JCV IgM and neutralizing antibodies
MN Jamestown Canyon Virus Cases, 2013 – 2017

Number of Cases

Year

2013 2014 2015 2016 2017
First POW Case in Minnesota, 2008

• June: previously healthy 10-year-old boy had urticarial rash followed by sore throat, headache, and fever
• Lived on wooded farm in northern Minnesota
  – Multiple tick exposures and known tick bite
• Hospitalized with dysarthria, facial weakness, drooling, lethargy, right hemiplegia, 78 WBCs in CSF; intubated
• Discharged 3 weeks later with persistent phonation difficulties; dysphonia 1 year later
MN Powassan Virus Cases, 2008 – 2017

![Bar chart showing the number of MN Powassan Virus cases from 2008 to 2017.]
Minnesota Ecology

• Convergence of several ecosystems
  – Northern Forest, Eastern Temperate Forest, Great Plains
• Major influences on vector populations and distribution
Life Cycle of *Ixodes scapularis*