

## Surveillance of Arbovirus Infections and Ehrlichiosis in Wisconsin

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 06/12/13



Protecting and promoting the health and safety of the people of Wisconsin

## Overview

- Diseases and characteristics.
- Data and statistics.
- Diagnosis and treatment.
- Disease control and prevention.

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## Arbovirus Infections

- In Wisconsin, arboviruses include La Crosse (LAC)/California encephalitis (CA), Jamestown Canyon (JC), West Nile virus (WNV), and Powassan (POW) virus infections.
- Mosquito transmitted infections (LAC, CA, JC, EEE, and WNV).
- Powassan virus is the only tick transmitted arboviral infection.
- Infections usually occur during warmer months when mosquitoes and ticks are active.

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## Arboviral Surveillance in WI, 2002-2011

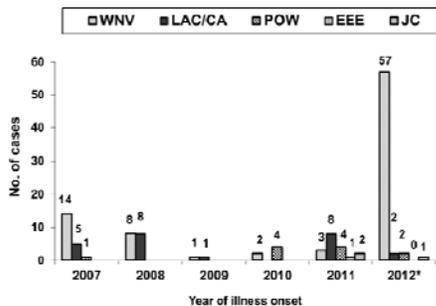
	Total Cases (%)	
Mosquitoborne infections/year	2011** (n=23)	2002-2010 (n=263)
• West Nile virus (WNV)	3 (13)	140 (53)
• La Crosse (LACV)/California virus group	8 (35)	69 (26)
• St. Louis, Eastern equine, and Western equine	1 (4.3)	0
• Jamestown Canyon	2 (8.7)	0
<b>Travel-related mosquitoborne infections</b>		
• Dengue*	5 (22)	45 (17)
• Chikungunya*	0	2 (0.8)
<b>Tickborne infections</b>		
• Powassan	4 (17)	7 (2.7)

\* Travel related infections

\*\*2011 numbers include confirmed and probable cases

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## Arboviral Diseases Reported in WI, 2007-2012 (n= 125)



Revised 02/13/2013

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## Arbovirus Diagnosis and Treatment

- Arboviral infections are diagnosed by clinical presentation and laboratory tests (blood and CSF).
- There is no specific treatment for arboviral infections; supportive care and relief of symptoms is all that is available.
- In general, infection with an arbovirus can provide life-long immunity to that specific virus.
- No available vaccines.

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## West Nile Virus



Primary vector for West Nile virus transmission is the female *Culex* mosquito

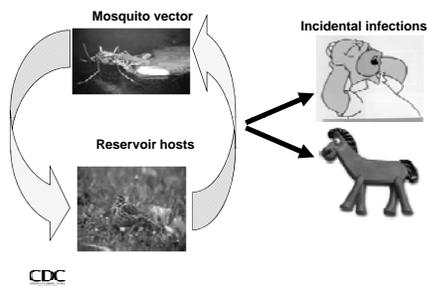
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## West Nile Virus (WNV)

- Originally isolated from *West Nile* province of Uganda in 1937.
- Introduced to US (NYC) in 1999.
- Now endemic to most of the United States.
- In 2002, first WNV outbreak in WI with 52 cases (average 10 cases/year in the last 10 years).

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## WNV Transmission Cycle



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## Wisconsin WNV Surveillance

### Statewide surveillance

- WNV surveillance includes 3 major components: monitoring for human illnesses, equine, dead corvid birds (crow, raven, and blue jay), and mosquito testing.
- Human surveillance is based on laboratory positive results, physicians and providers reports using electronic reporting to the Wisconsin Electronic Disease Surveillance System (WEDSS) or a hard copy of the case report form.
- Non-human activities are coordinated among numerous partners: local health departments, DNR, USDA-Wild Life Services, Wisconsin State Laboratory of Hygiene, UW-Vet Diagnostic Laboratory.
- All arbovirus activities are reported to CDC.

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## Local Levels

### Local Health Departments (LHDs)

- Submit dead birds to the Dead Bird Hotline for testing.
- Investigate cases, conduct public education, and perform mosquito control activities in their regions.
- In 2012, no federal funding was available for mosquito surveillance.
- Dane County was the only county to provide limited mosquito surveillance using their own funding.

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## WNV Infections

- WNV symptoms usually occur 3-14 days from a bite of an infected mosquito.
- About 20% of the people infected with WNV will have symptoms that can be mild and include headache, fever, fatigue, muscle aches and swollen lymph nodes; about 80% of the people may not have any symptoms.
- Severe neuroinvasive illness occurs in <1% of the people - paralysis, encephalitis (swelling of the brain) and meningitis, confusion, coma, and death.
- Children, the elderly, and people with compromised immune systems are at increased risk of severe disease.
- Other types of transmission- contaminated blood and blood products, organs and tissues, and breast milk.

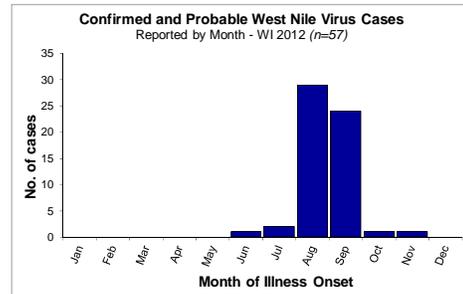
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## Human Disease Surveillance, WI

WNV characteristics	2011	2012
Total	3	57
Neuroinvasive	2	44/77%
Fever	1	13/23%
Age range (median)	44-65(60)	7-83(53)
Hospitalizations	2	35/61%
Deaths	0	5/9%
Males/Females	3/0	30/28%
Positive viremic donor	0	14

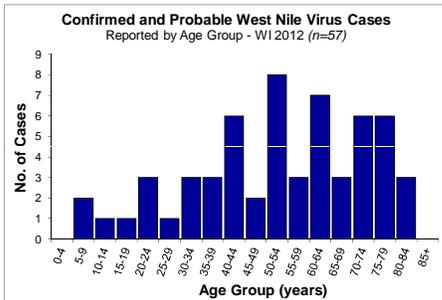
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Revised 01/22/13

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Revised 01/22/13

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## Human Disease Surveillance, 2012, WI

Case-patients using repellents	Total (%)
Most of the time	3 (5%)
Some of the time	12 (21%)
Never	16 (29%)
Don't remember	6 (11%)
Unknown	19 (34%)

Revised 02/13/13

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## Bird Surveillance Components

### Statewide Dead Bird Reporting Hotline 1-800-433-1610

- From May 1 - October 31: a total of 1,127 phone calls from citizens in 2012 compared to 308 calls in 2011 (almost a 4-fold increase).
- 30 (42%) out of 71 samples collected for testing were positive in 2012 compared to 17 (59 collected) positive birds in 2011.
- WNV activities in 25 counties.
- Also monitor for unusual large number of birds die-off (avian influenza).



crows



blue jays



ravens

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## Mosquito Surveillance



- Mosquito surveillance can be expensive and labor intensive.
- It can be helpful to know the different type of mosquito species circulating in Wisconsin but past experience showed that it is not a good system for early warning.
- Monitor for man-made or artificial habitat for mosquito species transmitting WNV and LAC viruses.
- Monitor for long term natural breeding areas- ditches, storm sewers, woodland, ponds, and wetland areas.
- Dane County and UW - Madison, Dept. of Entomology collected over 505 mosquito pools for testing in 2012 but no positive pools were identified.

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## WNV Infections National Data

As of December, 2012 –

- 5,387 human cases in 931 counties from 48 states reported human WNV cases in CDC ArboNet database.
- 2,734 (51%) reported neuroinvasive disease.
- 2,653 (49%) reported uncomplicated fever; many more cases are unrecognized and not reported.
- 243 (5%) deaths.
- 597 presumptive viremic blood donor; 16% developed clinical illness and are counted in the human disease cases.

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## Tickborne Diseases in Wisconsin

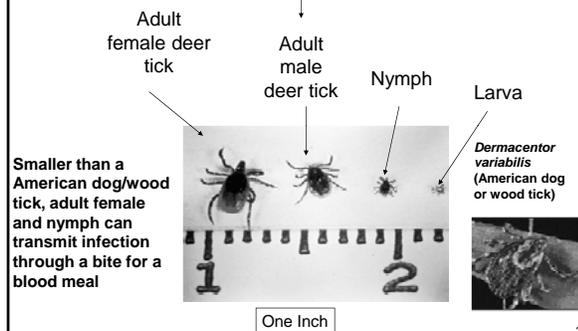
Powassan Virus and Novel *Ehrlichia* species



Courtesy of CDC

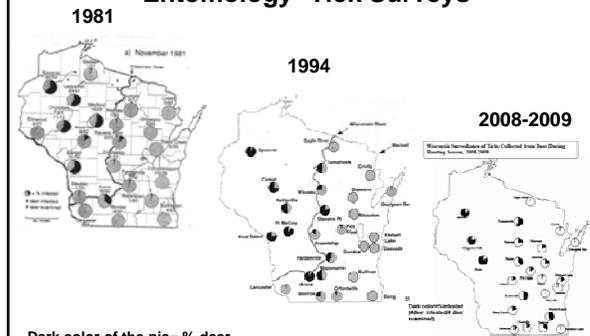
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## *Ixodes scapularis* (Blacklegged or Deer Tick)



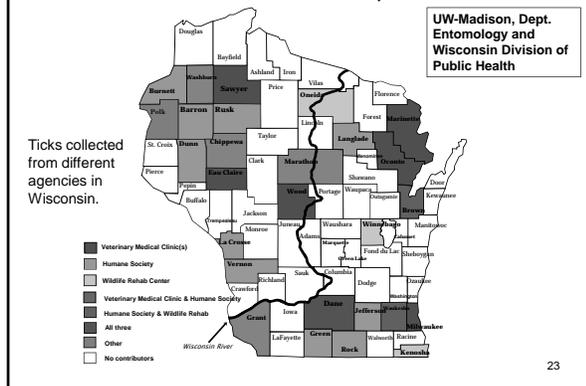
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## UW-Madison, Department of Entomology- Tick Surveys



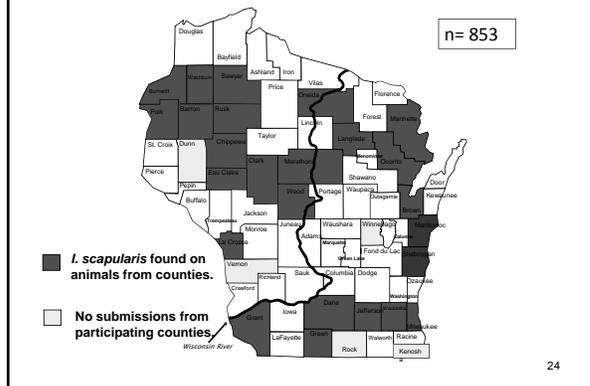
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## Wisconsin Tick Surveillance, 2011-2012



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## *I. scapularis* Found On All Animal Species, 2011-2012



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## Powassan Virus Infection



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## Powassan Virus (POWV) Infection

- Rare tickborne arbovirus infection.
- Initially isolated in 1958, in Northern Ontario.
- First case in US- New Jersey in 1970.
- Cases have been reported in northern regions of United States (Maine, Michigan, Minnesota, New York, Vermont, and Wisconsin).



- Reservoir- small mammals.
- Vector- *Ixodes scapularis*.



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## Powassan Virus Cases, WI, 2003 - 2012

Powassan Cases in WI, 2003-2012 (n=13)



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## Powassan- Clinical Diagnosis

- Incubation period is usually  $\geq$  1 week (range from 8-34 days).
- Acute onset of fever, muscle weakness, confusion, headache, nausea, vomiting, and stiff neck.
- Severe signs and symptoms- respiratory distress, tremors, seizures, gait unbalance, confusion, paralysis, and coma.
- Neuroinvasive disease- most of the cases reported meningoencephalitis leading to long-term neurologic sequelae.
- 10%-15% cases are fatal.
- Supportive treatment only and no vaccine is available.

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## Powassan virus (POWV) Testing

- There is no commercial test available for Powassan virus.
- CDC will perform testing for Powassan upon state's request if symptoms are consistent with an arbovirus-like illness.
- All commercial positive results for arbovirus agents need to be confirmed at Wisconsin State Laboratory of Hygiene (WSLH) and CDC.
- POWV IgM and IgG testing can be performed on serum or CSF using MAC-ELISA and plaque-reduction neutralization test (PRNT) at CDC.
- Physician should consider requesting POW testing if commercial tests resulted in non-specific reactivity to an arbovirus agent or a negative result and patient continues to exhibit signs and symptoms consistent with an arbovirus infection.

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## Anaplasmosis/Ehrlichiosis

- Prior to 2008, anaplasmosis and ehrlichiosis infections were referred to as human granulocytic ehrlichiosis (HGE) and human monocytic ehrlichiosis (HME), respectively.
- Since 2008, surveillance for human anaplasmosis and ehrlichiosis are classified as:
  - Anaplasmosis caused by the *A. phagocytophilum* bacteria (transmitted by the blacklegged tick).
  - Ehrlichiosis caused by *E. chaffeensis*, *E. ewingii* (transmitted by the *Amblyomma americanum* or lone star tick).
  - Anaplasmosis/Ehrlichiosis undetermined (species unknown) including the new species *E. muris*-like (EML).
- Increase in probable cases of *E. chaffeensis* (lone star tick vector not traditionally seen in Wisconsin.)
- In 2009, identified a cluster of novel *E. muris*-like cases.

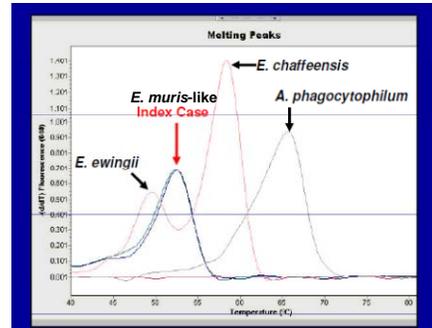
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### Investigation of Novel *E. muris*-like (EML) Cluster, 2009

- Index case: June 12, 2009.
- Male, 51 years.
- Clinical presentation: fever, headache, myalgia.
- Laboratory findings: lymphopenia (low lymphocytes), thrombocytopenia (low platelets), and elevated liver enzymes.
- Testing performed by Mayo labs- multiplex PCR, differentiated different agents by melting point curves.
- CDC confirmation- PCR and sequencing confirmed novel *Ehrlichia* species similar to *E. muris*, referred to as *E. muris*-like.
- From 2009-2012, Wisconsin identified 22 confirmed EML cases.

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### Melting Point Curve- PCR (Courtesy of Mayo Labs)



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### Investigation of *E. muris*-like Cluster (cont.)

- Obtained all acute and convalescent samples of all reported *Ehrlichia* cases for testing at CDC.
- Obtained and reviewed medical records.
- Standardized investigation questionnaire to interview patients regarding potential exposures.



- All EML patients had exposure to ticks at home and/or in another county in WI.
- Many reported seeing deer and wild animals in their backyard.

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### Reported cases of novel *E. muris*-like infections in Wisconsin residents, 2009-2012 (n= 22)



- It is uncertain how widely spread the *E. muris*-like infections are in Wisconsin because of the limited testing available.
- DPH is currently working with laboratories to bring the multiplex PCR testing on board.

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### Novel *Ehrlichia* Species, *E. muris*-like (EML)

- In 2009, EML was first identified in a cluster of four case-patients from Wisconsin (3) and Minnesota (1). This atypical *Ehrlichia* had never before been identified in North America.
- From 2009-2012, a total of 33 confirmed EML cases have been identified from both states and one case-patient was cultured positive.
- No EML positive results were found in 7,827 patients resided in other states tested by Mayo Labs using the multiplex PCR.
- Species is closest to *E. muris* associated with the white-footed mouse (*Peromyscus leucopus*) in Japan.
- The test of choice is PCR, no commercial serology tests are yet available.
- 38 *I. scapularis* ticks and two white-footed mice were PCR positive for EML, no other tick vectors have been identified.

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### Avoid Mosquito Bite to Prevent Infection

- Limit time spent outdoors at dawn and dusk.
- Avoid shady areas where mosquito may be resting.
- Wear protective clothing.
- Apply insect repellent (DEET, Picaridin, IR3535, oil of lemon eucalyptus), follow product instructions.
- Permethrin can be used on clothing and can be purchase at sporting good stores, follow label instructions.
- For CDC repellents information, visit this website <http://www.cdc.gov/ncidod/dvbid/westnile/RepellentUpdates.htm>

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## Effective Mosquito Control Methods

- Prevent mosquitoes from getting inside of your homes by making sure window screens don't have any holes.
- Remove breeding sites such as containers filled with water, toys, pots, wading pools, or discarded tires.
- Change the water in birdbaths and pet dishes at least every three days.
- Clean roof gutters and downspouts for proper drainage.
- Landscape to prevent water from pooling, trim tall grasses, weeds and vines.

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## Mosquito Products

**Repellents that work:** CDC recommends EPA registered products.

- DEET
- Picaridin
- Oil of lemon eucalyptus
- IR3535

**Products that do not work:**

- Carbon dioxide baited mosquito traps
- Citrosa plants
- Eating garlic or taking vitamin B
- Scented personal products
- Alcohol

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## Don't Get Bitten by a Tick

- Check for ticks after being outdoors.
- Take showers to wash off crawling ticks.
- When in wooded areas, walk on cleared pathways and trails to reduce the chance of coming in contact with ticks.
- Wear protective clothing, long pants and sleeves.
- Tuck shirts into pants and pants into socks or boots to prevent ticks from crawling under clothing and attaching to skin.
- Use repellents per label instructions (20-30% DEET).
- Permethrin spray for clothing.

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## Environmental Tick Control

- Integrated pest management.
- Landscape to create tick safe areas.
- Remove leaf litters.
- Trim bushes and shrubs.
- Spray acaricides - EPA registered companies.
- Apply natural products with biocidal activities (nootkatone - yellow cedar, grapefruit and orange peel) or botanical products (oil of rosemary).

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## References

- **Hoang Johnson DK**, Staples JE, Sotir MJ, Warshauer DM, **Davis JP**. Tickborne Powassan Virus Infections Among Wisconsin Residents. *Wisconsin Medical Journal* 2010;109(2):91-97.
- Pritt BS, Sloan LM, **Hoang Johnson DK**, et al. Emergence of a new pathogenic *Ehrlichia* species, Wisconsin and Minnesota, 2009. *N Engl J Med* 2011; 365:422-427.
- Division of Public Health Arbovirus website:  
<http://www.dhs.wisconsin.gov/communicable/ArboviralDiseases/Index.htm>

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## Additional Questions

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