Virginia Arboviral Surveillance 2019

Virginia Mosquito Control Association
Virginia Beach
January 28th 2020

Slides prepared by: Elena Diskin, MPH
## VA Human Infections from Arboviral Diseases

<table>
<thead>
<tr>
<th>Arboviral Condition</th>
<th>2019</th>
<th>3 yr avg. trend</th>
<th>3 yr avg.</th>
<th>2018</th>
<th>2017</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Crosse virus, neuroinvasive</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>West Nile infection, neuroinvasive</td>
<td>4</td>
<td>19</td>
<td>38</td>
<td>12</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>West Nile infection, non-neuroinvasive</td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Chikungunya virus diseases</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Dengue virus</td>
<td>19</td>
<td>16</td>
<td>8</td>
<td>12</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Zika virus, disease</td>
<td>1</td>
<td>39</td>
<td>1</td>
<td>6</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>62</td>
<td></td>
<td>73</td>
<td>44</td>
<td>172</td>
<td></td>
</tr>
</tbody>
</table>
Imported Arboviral Disease Cases in VA in 2019

Chikungunya (9 travel-related cases)
- India (4), Brazil (1), Congo (1), DRC (1), Ethiopia (1), Maldives (1)
Imported Arboviral Disease Cases in VA in 2019

Dengue (19 travel-related cases)

- India (10), Guatemala (2), DR (2), Jamaica (2), Cuba (1), Mexico (1), Nicaragua (1)
Imported Arboviral Disease Cases in VA in 2019

Zika (28 travel-related cases)
- Honduras (13), El Salvador (10), Guatemala (2), India (3)
West Nile Virus in US in 2018

As of Jan 8th, 2,544 WNV human cases found in 48 states and DC.

- 447 more WNV cases than 2017, 395 more than 2016
- 63% classified as neuroinvasive (meningitis or encephalitis)
- 37% classified as non-neuroinvasive (febrile illness)
- 357 WNV presumptive viremic donors reported from 35 states
- 137 fatalities (5.3% CFR) reported from 35 states
West Nile Virus in US in 2019

As of Jan 7th, 917 WNV human cases found in 43 states and DC.

- Over 60% decrease from 2018 cases
- 66% classified as neuroinvasive (meningitis or encephalitis)
- 34% classified as non-neuroinvasive (febrile illness)
- 100 WNV presumptive viremic donors reported from 23 states
- 51 fatalities (5.5% CFR) reported from 35 states
West Nile in VA in 2019

6 WNV human cases in 4 jurisdictions

- 66% (4 cases) neuroinvasive
- 33% (2 cases) non-neuroinvasive
- 1 fatality reported
98% reported fever
65% reported headache
61% reported altered mental status
33% reported stiff neck
50% reported nausea/vomiting
48% reported muscle weakness
26% reported arthralgia (joint pain)
30% reported rash

17% (n=9) reported as fatal
38/54 encephalitis/meningitis

**54 cases total (42 neuro, 12 non-neuro)**
There were **316,021** mosquitoes trapped and tested in **9,166** pools during 2019 surveillance.
Of 8,501 pools, **1.99%** (n=169 pools) were **WNV** positive.
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Of 2,051 pools, 0.39% (n=8 pools) were EEE positive.
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MOSQUITO SPECIES TESTED FOR WNV
(2019, n=8,501 pools)

- Cx. pip./res.: 63.36%
- Cx. sal.: 2.24%
- Cx. err.: 3.94%
- Cs. mel.: 11.01%
- Ae. albo.: 19.01%

165 Cx. pip./res. pools WNV+
4 Cs. mel. pools WNV+

MOSQUITO SPECIES TESTED FOR EEE
(2019, n=2,051 pools)

- Cs. mel.: 73.22%
- Cx. pip./res.: 18.29%
- Cx. sal.: 1.88%
- Ae. albo.: 6.41%

8 Cs. mel. pools WNV+
Minimum Infection Rate: \( \left( \frac{\text{number of positive pools}}{\text{total specimens tested}} \right) \times 1000 \), with the data representing a single species or species group collected over a time period and geographic area relevant to the goals of the surveillance program. - CDC
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<table>
<thead>
<tr>
<th>Year</th>
<th>Human WNV Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>21</td>
</tr>
<tr>
<td>2016</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td></td>
</tr>
</tbody>
</table>

![Graph showing Cx. plp./res. Minimum Infection Rate (MIR) over weeks from 2012 to 2019, with a peak in 2015.](image-url)
Minimum Infection Rate: \( \left( \frac{\text{number of positive pools}}{\text{total specimens tested}} \times 1000 \right) \), with the data representing a single species or species group collected over a time period and geographic area relevant to the goals of the surveillance program. - CDC
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Minimum Infection Rate: [(number of positive pools / total specimens tested) x 1000], with the data representing a single species or species group collected over a time period and geographic area relevant to the goals of the surveillance program. - CDC
Weekly Cx. pip./res. MIR 2012-2019

<table>
<thead>
<tr>
<th>Year</th>
<th>Human Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>30</td>
</tr>
<tr>
<td>2013</td>
<td>6</td>
</tr>
<tr>
<td>2014</td>
<td>7</td>
</tr>
<tr>
<td>2015</td>
<td>21</td>
</tr>
<tr>
<td>2016</td>
<td>8</td>
</tr>
<tr>
<td>2017</td>
<td>13</td>
</tr>
<tr>
<td>2018</td>
<td>48</td>
</tr>
<tr>
<td>2019</td>
<td>6</td>
</tr>
</tbody>
</table>
Influence of *Cx. pipiens/restuans* annual WNV minimum infection rate (MIR) on the count human WNV cases in VA.
Linking Mosquito and Human WNV Data

“Holy grail of WNV mosquito surveillance”~John Orr
Birds?

Influence of *Cx. pipiens/restuans* annual WNV minimum infection rate (MIR) on the count human WNV cases in VA.

https://www.allaboutbirds.org/guide/American_Robin/overview
https://www.birdnote.org/show/how-long-does-robin-live
“An American Robin can produce three successful broods in one year. On average, though, only 40 percent of nests successfully produce young. Only 25 percent of those fledged young survive to November. From that point on, about half of the robins alive in any year will make it to the next. Despite the fact that a lucky robin can live to be 14 years old, the entire population turns over on average every six years.”

https://www.allaboutbirds.org/guide/American_Robin/overview
https://www.birdnote.org/show/how-long-does-robin-live
2003 26 WNV cases

2004 5 WNV cases

2005 0 WNV cases

2006 5 WNV cases

2007 5 WNV cases

2008 1 WNV cases

2009 5 WNV cases

2010 5 WNV cases

2011 9 WNV cases

2012 30 WNV cases

2013 6 WNV cases

2014 7 WNV cases

2015 21 WNV cases

2016 8 WNV cases

2017 13 WNV cases

2018 48 WNV cases

https://www.ncdc.noaa.gov/cag/statewide/background
Increased transmissibility of Emergent Genotypes of West Nile virus in New York State


The Arborvirus Laboratory, Wadsworth Center, New York State Department of Health, Albany, NY, United States of America

Department of Medicine, Vanderbilt University Medical Center, Nashville, Tennessee, USA.

Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI USA.

Department of Biomedical Sciences, State University of New York at Albany School of Public Health, Albany, NY, United States of America

**HIGHLIGHTS**

- Phylogenetic and selection analyses of over 1200 full-genome WNV sequences, focusing on ~500 newly sequenced NYS WNV isolates from 1999-2018
- Identified 13 positions in the WNV genome under positive selection in the US, including 7 in NYS
- Novel genotypes with shared, positively selected sites have emerged in NYS over the last decade: NY07 and NY10
- Genotype displacement was concurrent with increased WNV activity from 2010-18
- NY10 strains are more infectious and transmissible by Cx. pipiens and American robins, supporting the hypothesis that adaptive evolution drove WNV displacement and contributed to increased WNV activity
Increased transmissibility of Emergent Genotypes of West Nile virus in New York State

Highlights

WNV genotypes in NYS-1999 to 2018
Figure 4. Eastern equine encephalitis virus (EEEV) activity reported to ArboNET, by state — United States, 2019 (as of January 7, 2020)

Table 2. Eastern equine encephalitis virus human disease cases reported to ArboNET, United States, 2019

<table>
<thead>
<tr>
<th>State</th>
<th>Neuroinvasive disease cases</th>
<th>Non-neuroinvasive disease cases</th>
<th>Total cases*</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Connecticut</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Georgia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Indiana</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Michigan</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>New Jersey</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Tennessee</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>38</strong></td>
<td><strong>0</strong></td>
<td><strong>38</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

*Includes confirmed and probable cases.
“Rapid unplanned urbanization, changing land use patterns and increased international travel and trade have brought people into more frequent contact with vectors; climate and other environmental changes have added to their spread.” - PAHO

**Figure 1.** Distribution of reported dengue cases and proportion of severe dengue cases, by year of report. Region of the Americas, 1999-2019 (up to EW 42 of 2019).

**Source:** Data entered into the Health Information Platform for the Americas (PLISA, PAHO / WHO) by the Ministries and Institutes of Health of the countries and territories of the Region.
Accomplishments/Reminders


• Mosquito data is available on ArboNET for current year

• Attending TRAST, NMMM

• No mosquito testing at DCLS for 2020

• Enter IR data to MosquitoNET PLZ

• NEVBD CoE Newsletter interest
Questions?

MANY THANKS TO:
• West Nile Virus Northern VA Managers Meeting
• TRAST
• VMCA
• Chesapeake Mosquito Control
• Fairfax County Dept. of Health- Vector Borne Diseases Program
• Hampton Mosquito Control
• Henrico County Mosquito Control
• Norfolk Dept. of Health Vector Control
• Suffolk Mosquito Control
• Virginia Beach Mosquito Control
• Portsmouth Mosquito Control
• York County Mosquito Control
• Prince William County Vector Control
• The Virginia Division of Consolidated Laboratory Services (DCLS)
• Fairfax County Dept. of Health Laboratory
• The Virginia Dept. of Agriculture and Consumer Services (VDACS) Veterinary Laboratories
• Alex Ciota & New York Health Dept. Wadsworth Lab
• VDH- Vector-borne Team
• VDH- Regional and District Epidemiology Staff
Veterinary Arboviral in VA in 2018

8 reported WNV equine cases
  • Fauquier, Warren, Prince George, Page, Loudoun, Rappahannock, Smyth, Clarke

2 reported EEE equine cases
  • Suffolk, Virginia Beach
Time series species-specific WNV MIR from May 1-Dec 4.

\[ MIR = \left( \frac{\text{Number of Positive Pools}}{\text{Number of Mosquitoes}} \right) \times 1,000 \]

*Only includes fully identified mosquito species with ≥1,000 mosquitoes trapped/tested (excludes Ae. tris., Ae. jap., Ae. atl., Cq. per., Cx. spp.)*
**Cx. pip./res.** WNV MIR peaked at 14.18 MIR during week 32 (Aug 5th-12th).

*MIR = \( \frac{\text{Number of Positive Pools}}{\text{Number of Mosquitoes}} \) \times 1,000*

*Only includes fully identified mosquito species with ≥1,000 mosquitoes trapped/tested (excludes Ae. tris., Ae. jap., Ae. atl., Cq. per., Cx. spp.)*
There were **316,021** mosquitoes trapped and tested in **9,166** pools during 2019 surveillance.
16% of *Cx. pip./res.* pools were WNV positive for a species-specific 4.99 WNV MIR.
1% of *Cs. mel.* pools were EEE positive for a species-specific 0.29 EEE MIR.
Ongoing Projects at VDH

New Arboviral page in statewide disease surveillance system
  • Better data collection

Arboviral Investigation Guidelines- Mosquito Control Communication Toolkit
  • Provide contact list and protocol for those in jurisdictions with MC
  • LHD should notify MCD on positive WNV IgM

New mosquito surveillance data collection system
  • Dropbox sheets

Monthly mosquito surveillance and arboviral disease report on VDH website
  • Build public facing interactive and PDF report
The Northeast Regional Center for Excellence in Vector Borne Diseases (NEVBD) is initiating a pesticide resistance monitoring program for the 2019 field season

- A specimen submission system will be available, whereby live mosquitoes can be sent directly to Cornell University for resistance testing
- Kits for mosquito collection and pesticide resistance testing will be available
- We will provide education for conducting pesticide resistance testing

If you are interested in participating in our program please visit the NEVBD website: neregionalvectorcenter.com/resistance

- The site is still under development, but please include your contact information and we will notify you of program developments

If you have questions about the program please contact James Burtis

jb766@cornell.edu
## Mosquito Species Tested for WNV

<table>
<thead>
<tr>
<th>Mosquito Species</th>
<th>Number of Mosquitoes Tested</th>
<th>Number of Pools Tested</th>
<th>WNV Positive Pools</th>
<th>WNV MIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2017</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cx. pipiens/restuans</em></td>
<td>201,641</td>
<td>5,810</td>
<td>744</td>
<td>3.690</td>
</tr>
<tr>
<td><em>Cs. melanura</em></td>
<td>141,913</td>
<td>2,005</td>
<td>5</td>
<td>0.035</td>
</tr>
<tr>
<td><em>Ae. albopictus</em></td>
<td>67,905</td>
<td>1,814</td>
<td>8</td>
<td>0.118</td>
</tr>
<tr>
<td><em>Cx. erraticus</em></td>
<td>21,459</td>
<td>674</td>
<td>3</td>
<td>0.140</td>
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<tr>
<td><em>Cx. salinarius</em></td>
<td>13,103</td>
<td>429</td>
<td>8</td>
<td>0.611</td>
</tr>
<tr>
<td><em>Ae. vexans</em></td>
<td>8,976</td>
<td>323</td>
<td>3</td>
<td>0.334</td>
</tr>
<tr>
<td><em>Cx. spp.</em></td>
<td>5,477</td>
<td>413</td>
<td>17</td>
<td>3.104</td>
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<tr>
<td><em>Ae. japonicus</em></td>
<td>432</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ae. triseriatus</em></td>
<td>346</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>An. quadrrimaculatus</em></td>
<td>319</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cq. perturbans</em></td>
<td>79</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>An. crucians</em></td>
<td>41</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>An. punctipennis</em></td>
<td>28</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>461,719</td>
<td>11,535</td>
<td>788</td>
<td></td>
</tr>
</tbody>
</table>

## 2018

<table>
<thead>
<tr>
<th>Mosquito Species</th>
<th>Number of Mosquitoes Tested</th>
<th>Number of Pools Tested</th>
<th>WNV Positive Pools</th>
<th>WNV MIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cx. pip./res.</em></td>
<td>191,173</td>
<td>6,047</td>
<td>953</td>
<td></td>
</tr>
<tr>
<td><em>Ae. albo.</em></td>
<td>83,372</td>
<td>2,210</td>
<td>21</td>
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</tr>
<tr>
<td><em>Cs. mel.</em></td>
<td>59,179</td>
<td>1,316</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Cx. err.</em></td>
<td>20,051</td>
<td>754</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td><em>Cx. sal.</em></td>
<td>16,620</td>
<td>641</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><em>Ae. vex.</em></td>
<td>12,231</td>
<td>484</td>
<td>1</td>
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</tr>
<tr>
<td><em>Cx. spp.</em></td>
<td>8,892</td>
<td>659</td>
<td>19</td>
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</tr>
<tr>
<td><em>Ae. tris.</em></td>
<td>666</td>
<td>44</td>
<td>0</td>
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</tr>
<tr>
<td><em>Ae. jap.</em></td>
<td>628</td>
<td>41</td>
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</tr>
<tr>
<td><em>Cq. per.</em></td>
<td>378</td>
<td>9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Ae. atl.</em></td>
<td>97</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td><em>An. punct.</em></td>
<td>39</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>393,326</td>
<td>12,208</td>
<td>1,009</td>
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</tr>
</tbody>
</table>
Culex pipiens/restuans, Aedes albopictus, & Culiseta melanura accounted for 94% of all tested mosquitoes.

- WNV+ Pools: 165 Cx. pip./res.
- EEE+ Pools: 8 Cs. Mel.

- Cx. sal. 2%
- Cx. err. 4%
- Ae. albo. 17%
- Cs. mel. 20%
- Cx. pip./res. 57%
- Ae. atl.
- Ae. jap.
- <1%
- Ae. tris.
- Ae. vex
- An. qua.
Combined Sewage Systems?