Emerging mosquito-borne disease in the Americas

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Michigan Department of Health & Human Services
Outline

- Endemic mosquito-borne disease in the United States: 2015
- Endemic mosquito-borne disease in Michigan: 2015
- Emerging mosquito-borne disease in the Americas: 2015
- Zika virus
### Endemic mosquito-borne disease in the United States: 2015

<table>
<thead>
<tr>
<th>Arbovirus</th>
<th>National</th>
<th>Michigan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neuro-invasive</td>
<td>Non-neuro-invasive</td>
</tr>
<tr>
<td>West Nile virus</td>
<td>1360</td>
<td>700</td>
</tr>
<tr>
<td>Eastern Equine Encephalitis</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>St. Louis Encephalitis</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Jamestown Canyon Virus</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>LaCrosse Encephalitis</td>
<td>46</td>
<td>3</td>
</tr>
</tbody>
</table>
West Nile
Eastern Equine
St. Louis
Jamestown Canyon
LaCrosse

- West Nile
- Eastern Equine
- St. Louis
- Jamestown Canyon
- LaCrosse
West Nile virus (WNV)
flavivirus, first detected in the state in 2001, now endemic

St. Louis Encephalitis virus (SLE)
flavivirus, historic outbreak in the 1970’s, sporadic cases

LaCrosse virus (LAC)
bunyavirus, sporadic cases

Eastern Equine Encephalitis virus (EEE)
alphavirus, sporadic cases, occasional outbreaks particularly in horses
Mosquito-borne virus illness (general)

- Various viruses with different abilities to cause clinical illness
  - West Nile: 1 in 5 morbidity/ <1% severe/ 3-15% severe illness results in death
  - EEE: rare, but high mortality ~33%
  - Chikungunya: >70% morbidity, rarely fatal

- Symptoms range from acute febrile illness, to neuroinvasive disease, to painful arthritis

- Treatment is supportive

- Some vaccines exist (yellow fever, JE)
West Nile: Michigan, 2015
Onset Dates: 7/27 - 9/21
56% Male
Age Range: 22 - 85
Median Age: 63
A Tale of Two Seasons

* Includes WNV veterinary disease cases and infections in mosquitoes, birds, and other wildlife species.

* Includes WNV human neuro- and non-neuroinvasive disease cases, and viremic blood donors.
2015 Michigan Arboviurs Activity by MMWR Week

- **Animal Cases**
- **Human Cases**
- **Mosquito Pools**

May 29 to October 22
Michigan WNV Outbreak Geography

Historically the Grand Rapids and Detroit Metro Areas account for a significant percentage of annual WNV cases.
2015 WNV Mosquito Surveillance

2015 Mosquitoes tested for WNV

Statewide
Total # Pools: 2238
Total # Mosquitoes: 24,091
# Positive Pools: 15

Local Health Departments Project
Total # Pools: 402
Total # Mosquitoes: 8,598
# Positive Pools: 8
# Emerging mosquito-borne disease in the Americas: 2015

<table>
<thead>
<tr>
<th>Arbovirus</th>
<th>National</th>
<th>Michigan</th>
<th>Travel locations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Travel-Associated</td>
<td>Locally-Acquired</td>
<td>Locations</td>
</tr>
<tr>
<td>Dengue</td>
<td>513</td>
<td>173</td>
<td>Florida, Hawaii, Puerto Rico, US Virgin Islands</td>
</tr>
<tr>
<td>Chikungunya</td>
<td>679</td>
<td>202</td>
<td>Puerto Rico &amp; US Virgin Islands</td>
</tr>
</tbody>
</table>
"I am now declaring that the recent cluster of microcephaly and other neurological abnormalities reported in Latin America following a similar cluster in French Polynesia in 2014, constitutes a public health emergency of international concern."

- Margaret Chan, WHO Director General, 02/01/2016
Zika Virus

- Single stranded RNA Virus
- Genus Flavivirus, Family Flaviviridae
- Closely related to dengue, yellow fever, Japanese encephalitis and West Nile viruses
- Transmitted to people primarily by *Aedes* species mosquitoes
- First discovered in 1947 in Uganda
Aedes aegypti

“In essence, the tropics are not facing a Zika emergency nearly as much as they are facing an Aedes aegypti emergency.”

- Andrew Revkin, NYTimes

Japanese Society of Tropical Medicine

E. A. Goeldi (1905)
**Principle Zika vectors**

**Aedes aegypti**
Yellow fever mosquito
- Occupies urban areas with or without vegetation
- Bites, rests, and lays eggs indoors and outdoors
- Desiccation resistant eggs
- Sneaky biter
- Preference for human feeding, less from domestic and wild vertebrates
- Short flight range ~400m

**Aedes albopictus**
Asian tiger mosquito
- Associated with thickets and arboreal vegetation
- Mostly an outdoor (garden) mosquito
- Desiccation resistant eggs
- Aggressive biter
- Bites people, but also domestic and wild vertebrates
- Short flight range ~200m
Global map of the predicted distribution of *Ae. aegypti* (A) and *Ae. albopictus* (B):
http://dx.doi.org/10.7554/eLife.08347.008.
Arbovirus transmission cycles

Transmission cycles typical of all U.S. endemic arboviruses

Transmission cycle typical of Dengue, Chikungunya, and Zika
Zika virus incidence and attack rates

- Infection rate: 73% (95%CI 68-77)
- Symptomatic attack rate among infected: 18% (95%CI 10-27)
- All age groups affected
- Adults more likely to present for medical care
- No severe disease, hospitalizations, or deaths

Note: Rates based on serosurvey on Yap Island, 2007 (population 7,391) 
Zika virus clinical disease

- Clinical illness usually mild
- Symptoms last several days to a week
- Severe disease requiring hospitalization uncommon
- Fatalities are rare
- Guillain-Barré syndrome reported in patients following suspected Zika virus infection
  - Relationship to Zika virus infection is not known
## Reported clinical symptoms among confirmed Zika virus disease cases

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macular or papular rash</td>
<td>28</td>
<td>90%</td>
</tr>
<tr>
<td>Subjective fever</td>
<td>20</td>
<td>65%</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>20</td>
<td>65%</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>17</td>
<td>55%</td>
</tr>
<tr>
<td>Myalgia</td>
<td>15</td>
<td>48%</td>
</tr>
<tr>
<td>Headache</td>
<td>14</td>
<td>45%</td>
</tr>
<tr>
<td>Retro-orbital pain</td>
<td>12</td>
<td>39%</td>
</tr>
<tr>
<td>Edema</td>
<td>6</td>
<td>19%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>3</td>
<td>10%</td>
</tr>
</tbody>
</table>

Note: Rates based on serosurvey on Yap Island, 2007 (population 7,391)  
Clinical features: Zika virus compared to Dengue and Chikungunya

<table>
<thead>
<tr>
<th>Features</th>
<th>Zika</th>
<th>Dengue</th>
<th>Chikungunya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Rash</td>
<td>+++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Myalgia</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Headache</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>-</td>
<td>++</td>
<td>-</td>
</tr>
<tr>
<td>Shock</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Zika Virus epidemiology

- First isolated from a monkey in Uganda in 1947
- Prior to 2007, only sporadic human disease cases reported from Africa and southeast Asia
- In 2007, first outbreak reported on Yap Island, Federated States of Micronesia
- In 2013-2014, >28,000 suspected cases reported from French Polynesia
- In May 2015, the first locally-acquired cases in the Americas were reported in Brazil
- Currently, outbreaks are occurring in many countries or territories in the Americas, including the Commonwealth of Puerto Rico and the US Virgin Islands
- WHO estimates 0.5 - 1.5 million cases already, projecting 3-4 million within a year
Countries & territories with active Zika transmission

Source: WHO 24-30 Jan 2016
If clinical illness is mild, why are we so concerned?

- Reports of a substantial increase in the number of babies born with microcephaly in 2015 in Brazil; true baseline unknown
  - Zika virus infection identified in several infants born with microcephaly (including deaths) and in early fetal losses
  - Some of the infants with microcephaly have tested negative for Zika virus
- Incidence of microcephaly among fetuses with congenital Zika infection is unknown
Rates of microcephaly over time

Comparison of the rates of microcephaly in the Americas and Caribbean from 2010-2014 and 2015

Updated as of Epidemiological Week 52
(December 27, 2015 – January 2, 2016)

Microcephaly rates by state in Brazil
(cases per 1,000 live births)

- 0.1-1.0
- 1.1-15.0
- 15.1-30.0
- 30.1-45.0
- 45.1-88.6

Countries with Zika confirmed cases

Data Source:
Reported from the IHR National Focal Points and through the Ministry of Health websites.

Map Production:
PAHO-WHO AD CHA IR ARO

Zika: Other modes of transmission

- Maternal-fetal
  - Intrauterine
  - Perinatal

- Other
  - Sexual
  - Blood transfusion
  - Laboratory exposure

- Theoretical
  - Organ or tissue transplantation
  - Breast milk
Zika virus prevention measures

- No vaccine or medication to prevent infection or disease
- Primary prevention measure is to reduce mosquito exposure
- Pregnant women should consider postponing travel to areas with ongoing Zika virus outbreaks
- Protect infected people from mosquito exposure during the first week of illness to prevent further transmission
Possible future course of Zika virus in the Americas

- Virus will continue to spread in areas with competent vectors
  - Transmission increasing in Central America, Mexico, and Caribbean
  - Anticipate further spread in Puerto Rico and U.S. Virgin Islands

- Travel-associated cases will introduce virus into U.S. states
  - Imported cases will result in some local transmission and outbreaks
  - Air conditioning may limit the size and scope of outbreaks
  - Colder temperatures will interrupt and possibly stop further spread

- Experience from Dengue might be predictive
  - From 2010-2014, 1.5 million dengue cases reported per year to PAHO
  - 558 travel-related, and 25 locally transmitted cases in U.S. states
What is being done?

- Increased education and communication to the public regarding mosquito bite prevention, and travel advisories
- Increased surveillance efforts for Zika cases, especially in pregnant women
- CDC is testing returning travelers that are symptomatic for virus or antibodies to Zika
- Increased mosquito control, and coordination of health and mosquito management efforts
- In Brazil, uniformed services activated to distribute health information, repellents, and remove standing water
What can we do in Michigan?

- Remain vigilant
- Continue to educate the public regarding mosquito-bite prevention, and integrated mosquito management
- Quickly identify symptomatic, returning travelers
  - Obtain diagnostic testing
  - Advise regarding mosquito-bite prevention and potential for other modes of transmission
- Continue mosquito-borne disease surveillance for endemic disease
  - Allows us to potentially capture *Aedes albopictus* if emergent in the region
- Enhanced surveillance?
Where to find information?

**ZIKA**

Centers for Disease Control and Prevention
www.cdc.gov/zika

Pan American Health Organization
www.paho.org

**Arboviruses in Michigan**

Michigan Department of Health & Human Services
www.michigan.gov/westnile

USGS Maps
http://diseasemaps.usgs.gov