Dengue in Florida & Implications for Georgia

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Dengue Virus

• Single-stranded RNA flavivirus
  – Same family as WNV, SLEV & YFV

• Four serotypes – DEN-1, 2, 3, 4
  – Infection provides lifelong immunity to the specific serotype

• Causes dengue and dengue hemorrhagic fever
Dengue Fever

- Often mild, non-specific
- Sudden onset of high fever
- Severe headache
- Pain behind the eyes
- Body aches and joint pains
- Nausea or vomiting
- Rash
Dengue Hemorrhagic Fever

- Severe abdominal pain
- Bleeding from the nose, mouth, and gums
- Frequent vomiting with or without blood
- Black stools
- Excessive thirst
- Pale, cold skin
- Restlessness or sleepiness
Transmission

*Aedes aegypti* and *Aedes albopictus*
Incubation/Viremic Periods

From CDC
Average annual number of DF/DHF cases reported to WHO and average annual number of countries reporting
Dengue Distribution
Modes of Introduction for Arboviruses

- Infected Human
  - Human-transported vector
  - Intentional Introduction
  - Storm-transported animal (bird)
  - Migratory Bird
  - Human-transported animal
Dengue in Florida

Imported dengue in Florida, 1993-2009
Imported Dengue, Florida 2010

- Brazil
- Colombia
- Costa Rica
- Dominican Republic
- Ecuador
- El Salvador
- Grenada
- Guatemala
- Haiti
- Honduras
- Jamaica
- Martinique
- Malaysia/ Bangladesh
- Nicaragua
- Panama/ Venezuela
- Philippines
- Puerto Rico
Florida Ecology Conducive to Arboviruses

- Warm Climate
- Regular Rainfall
- Vectors present
- Suitable Hosts for Amplification
- Historical Data
Outbreak Identification

• September 1, 2009 - Monroe County Health Department notified of a New York resident diagnosed with dengue after travel to Key West

• Index case: 34 year-old female visited Key West from August 2-9, 2009
  – No recent travel to dengue-endemic country
  – Onset August 10 of fever, headache, malaise, and chills
  – Visited physician multiple times over next few days, developed arthralgia, retro-orbital pain, and petechiae
  – Anti-dengue virus IgM antibodies, DENV-1.
• Key West
  – 129 miles SW of Miami
• Population 23,262
• > 2 million visitors annually
  – International Airport
  – Highway
  – Passenger cruise ships
• *Aedes aegypti* widespread; *Aedes albopictus* absent
More cases

• Due to public notification, self diagnosis by a 48-yr-old Key West resident with no recent travel history

• Wife became ill two weeks later, dengue infection was confirmed
  – Indicated *ongoing* transmission, multiple generations of mosquitoes
Dengue vs. Flu

- Fever
- Severe headache
- Pain behind the eyes
- Body aches
- Nausea or vomiting
- Rash
- Fatigue

- Fever
- Cough
- Sore throat
- Runny or stuffy nose
- Body aches
- Headache
- Chills
- Fatigue
- Nausea or vomiting
- Diarrhea
Medical record search criteria

- Dengue
- Dengue hemorrhagic fever
- Fever (persistent) +
- Infectious disease NOS
- Myalgia
- Bleeding (hemorrhage)
- Blood in urine
- Thrombocytopenia
- Rash
- Arthralgia
- Petechiae
- Leukopenia
- Generalized pain
- Eye Pain
- Exclude:
  - Influenza
  - Cough
  - Wheezing
Medical Record Search Results

- Search yielded 211 records
- Six were identified as possible cases
- Four were confirmed as dengue infections
Seroprevalence Survey Objectives

• Determine the prevalence of dengue in Key West
  – Blood collection

• Identify risk factors for infection
  – Household and individual questionnaires
Questionnaire

• Demographics
• Household level risk factors
  – Screened windows, A/C
  – Standing water around the house
• Individual risk factors
  – Time outside
  – Mosquito avoidance measures
• Medical history
• Travel history
Seroprevalence Survey Methods

• 3-5 teams at a time (September 23-27)
  – Interviewer
  – Phlebotomist
  – Member of mosquito control staff

• Obtained verbal consent for questionnaire and blood collection from household members older than 5
Survey Acceptance in Key West

- Final household list=911 residences
- 53% acceptance when able to contact
- 170 participating households
- 240 total samples
- 1.4 individuals per participating house
Lab Definitions

• Laboratory positive recent infection (occurring in prior 3 months)
  – DENV detected by RT-PCR or NS1 ELISA
  – Dengue-specific IgM by ELISA

• Presumptive recent infection
  – Recent febrile dengue-like illness and
  – No travel to dengue-endemic country in prior 3 months and
  – Positive IgG ELISA and PRNT\textsubscript{90}
Seroprevalence Results

• 8 laboratory positive recent infections
  – 2 acute
• 5 presumptive recent infections (IgG and PRNT+ with recent illness and no travel)
• Total=13 (5.4%) of 240 participants had evidence of recent infection
• Weighted estimate=4.9% (95% CI=1.8-7.9)
## Risk Factors

<table>
<thead>
<tr>
<th>Gender</th>
<th></th>
<th>p=0.099</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>101</td>
</tr>
<tr>
<td>Recent</td>
<td>9 (69%)</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>130 (57%)</td>
<td>97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Asian</th>
<th>p=0.0237</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>186</td>
<td>19</td>
<td>29</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Recent</td>
<td>8 (62%)</td>
<td>3 (23%)</td>
<td>1 (8%)</td>
<td>1 (8%)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>178 (78%)</td>
<td>16 (7%)</td>
<td>28 (12%)</td>
<td>4 (2%)</td>
<td></td>
</tr>
</tbody>
</table>
## Risk Factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Recent Infections</th>
<th>Others</th>
<th>Crude OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioning &gt;50% of time</td>
<td>37%</td>
<td>75%</td>
<td>0.20</td>
<td>0.06-0.69</td>
</tr>
<tr>
<td>Windows open &gt;50% of time</td>
<td>41%</td>
<td>15%</td>
<td>3.85</td>
<td>0.94-15.87</td>
</tr>
<tr>
<td>Vegetation covers &gt;50% of yard</td>
<td>59%</td>
<td>30%</td>
<td>3.40</td>
<td>0.91-12.71</td>
</tr>
<tr>
<td>Bird bath in yard</td>
<td>41%</td>
<td>11%</td>
<td>5.64</td>
<td>1.32-24.13</td>
</tr>
<tr>
<td>Empty water from containers</td>
<td>6%</td>
<td>36%</td>
<td>0.12</td>
<td>0.02-0.79</td>
</tr>
<tr>
<td>Outside in evenings</td>
<td>86%</td>
<td>67%</td>
<td>3.12</td>
<td>0.92-10.57</td>
</tr>
<tr>
<td>Bitten at work/school</td>
<td>32%</td>
<td>14%</td>
<td>2.95</td>
<td>0.97-9.02</td>
</tr>
<tr>
<td>Use bite prevention measures</td>
<td>26%</td>
<td>52%</td>
<td>0.32</td>
<td>0.13, 0.79</td>
</tr>
<tr>
<td>Use repellent with DEET</td>
<td>20%</td>
<td>41%</td>
<td>0.36</td>
<td>0.14, 0.94</td>
</tr>
<tr>
<td>Traveled outside FL in past 3 months</td>
<td>12%</td>
<td>38%</td>
<td>0.23</td>
<td>0.05-0.99</td>
</tr>
</tbody>
</table>
Case total

• 27 confirmed and presumptive cases
  – Index case
  – Physician and county health department submissions
  – Medical record review
  – Seroprevalence survey

• July 26 – October 19, 2009
Viral Sequencing

- Two human samples and two mosquito pools were sequenced.
- DENV-1 found to be genetically related to 2007 Mexican DENV-1.
- Mexico was the top U.S. international destination in 2008.
Strengths and Limitations of Surveillance

• **Strengths**
  – Largest sample of U.S. residents for dengue serosurvey
  – Conducted in a timely manner
  – Multifaceted approach

• **Limitations**
  – Large number of unoccupied households
  – Census data
  – Small number of cases = wide confidence intervals for risk factors
  – Resistance to testing by some local physicians
CHD Response

• Public outreach via newspapers, radio, TV, public forum, and flyers
• Visitors to Key West targeted through messaging at hotels and guest houses
• Messaging for physicians through personal visits, and letters
• Developing online physician training on clinical diagnosis and management with CDC Dengue Branch
• Syndromic surveillance being used to supplement passive reporting
Mosquito Control Response

• Door to door environmental assessments focused on eliminating breeding sites
  – Additional inspectors hired
• Public outreach campaign
• Liquid larvicides used to treat inaccessible properties
• FKMCD attorney sends certified letters to homeowners unwilling to cooperate
• Implementing experimental lethal ovitraps
Current status

• Late 2009-early 2010, no new cases were reported
• 41-yr-old male, onset April 6, no travel history but lived in military housing
• May, multiple IgM+ results from commercial labs
• Monroe CHD and Florida Keys Mosquito Control District reinvigorated their control measures
• As of October 15, 2010: 53 autochthonous cases have been identified in Florida; 52 in Key West
• Broward County case was DEN-3
Epi Curve, Dengue fever, Key West 2009-2010.
... and what about Georgia?

☑ International travel
☑ Suitable climate

Vectors?
Reynosa, Mexico
O’ Meara’s Zones (1994-2001)

Ae. albopictus

Ae. albopictus + Ae. aegypti

Ae. aegypti
Vector Differences & Recent Outbreaks

• Tamaulipas, Mexico 1995
  – Cases & positives limited to *Aedes aegypti* areas

• Hawaii 2001-2002
  – Outbreak associated with *Aedes albopictus* less severe than in Society Islands (*Aedes aegypti*)

• Florida
  – Keys are the last bastion of *Aedes aegypti*
Dengue

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