Zika, a New Mosquito-borne Virus in the Americas, and Virginia’s Plans for Zika Prevention

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Zika virus was discovered in the Zika Forest, Uganda 1947
From 1947 – 2007, serological and other lab evidence of Zika virus infections had been found in people from Africa to Asia and the Western Pacific nations.
The first large Zika outbreak ever recorded - Yap Island, Micronesia in 2007.
A second large Zika outbreak - French Polynesia and other Pacific Islands 2013 –14.
Zika arrived in Brazil in 2014 and spread to other parts of the Americas 2015 – 2016.
A Brief History of Zika Virus and its Transmission

The Zika virus is transmitted in a “mosquito-to-human-to-mosquito cycle” and is known to have “African” and “Asian” variants.

The Zika virus variant that caused the 2007 outbreak on Yap Island, and all of the subsequent large outbreaks has been the “Asian variant”.

It is possible that the Asian variant of Zika virus has evolved the ability to cause much larger disease outbreaks than the African variant.

*Aedes aegypti* (yellow fever mosquito) was historically associated with Zika transmission, but other closely related *Aedes* mosquito species in “Stegomyia Subgenus” have also been associated with Zika transmission and include:

* Aedes hensilli - on Yap Island
* Aedes polynesiensis – in French Polynesia and other Polynesian Island chains and, *Aedes albopictus*, the Asian tiger mosquito in Gabon and in Singapore.

Asian tiger mosquitoes are very common throughout the southeastern U.S., but *Aedes aegypti* mosquitoes are only common in the most southern areas of the U.S. (Southern Florida and Southern Texas).
Investigators of the Yap Island outbreak were only able to observe and record Zika symptoms in 31 symptomatic patients that had laboratory confirmed Zika infections.

<table>
<thead>
<tr>
<th>Number of Patients (%)</th>
<th>Illness Sign or Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 (90 %)</td>
<td>Macular or papular rash</td>
</tr>
<tr>
<td>20 (65 %)</td>
<td>Fever</td>
</tr>
<tr>
<td>20 (65 %)</td>
<td>Arthritis or arthralgia</td>
</tr>
<tr>
<td>19 (55 %)</td>
<td>Conjunctivitis (red eyes)</td>
</tr>
<tr>
<td>15 (48 %)</td>
<td>Myalgia (body aches)</td>
</tr>
<tr>
<td>14 (45 %)</td>
<td>Headache</td>
</tr>
<tr>
<td>12 (39 %)</td>
<td>Pain behind eyes</td>
</tr>
<tr>
<td>6 (19 %)</td>
<td>Swelling of limbs</td>
</tr>
<tr>
<td>3 (10 %)</td>
<td>Vomiting</td>
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</table>

Up to 80% of persons infected with Zika do not develop symptoms.
French Polynesian Outbreak, Zika Symptoms

The much larger Polynesian outbreak provided an opportunity to obtain more details on Zika symptoms.

It was noted that persons with a rash could experience intense itching, and that joint pain occurred mostly in small joints of the extremities (e.g., hands, feet). Patients may also have swelling of the extremities.
Brazil Outbreak, Zika Identified as Possible Cause of Birth Defects and Guillain – Barre Syndrome

In October of 2015, Brazilian states that had the longest running and largest Zika outbreaks began to see a great increase in the number of babies born with microcephaly.

Microcephaly is a birth defect that results in babies with abnormally small brains and heads; it can result in the premature death of the baby, or in children that are mentally deficient and unable to function normally.

By January of 2016, Brazil had also counted 121 cases of Guillain-Barre Syndrome in persons that had Zika – like symptoms.
Recent Findings on the Clinical Outcomes for People and Human Fetuses infected with the Zika Virus

As Zika has continued to cause illness throughout the Americas, more details have emerged about its effects on human patients and fetuses.

A small percentage of Zika virus patients may suffer from:
1. Guillain-Barre syndrome (immune system attacks the nervous system)
2. Acute disseminated encephalomyelitis (a disorder that attacks brain’s myelin; resulting in symptoms similar to multiple sclerosis)
3. Severe thrombocytopenia syndrome (a hemorrhagic disorder)

Zika virus infections of the fetus may cause:
1. Fetal death / miscarriage
2. Microcephaly
3. Other birth defects such as: intracranial calcifications, eye defects, hearing defects, clubfoot, congenital joint contractures, impaired growth, ventriculomegaly, and brain development disorders (lissencephaly and pachygyria).
Clinical Signs and Symptoms in Zika Virus Patients (N=683) in Puerto Rico, November 1, 2015 – April 14, 2016

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>No. of patients</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rash</td>
<td>505</td>
<td>74%</td>
</tr>
<tr>
<td>Myalgia (body pain)</td>
<td>462</td>
<td>68%</td>
</tr>
<tr>
<td>Headache</td>
<td>433</td>
<td>63%</td>
</tr>
<tr>
<td>Fever</td>
<td>429</td>
<td>63%</td>
</tr>
<tr>
<td>Arthralgia (joint pain)</td>
<td>428</td>
<td>63%</td>
</tr>
<tr>
<td>Eye pain</td>
<td>350</td>
<td>51%</td>
</tr>
<tr>
<td>Chills</td>
<td>344</td>
<td>50%</td>
</tr>
<tr>
<td>Sore throat</td>
<td>233</td>
<td>34%</td>
</tr>
<tr>
<td>Petechiae</td>
<td>213</td>
<td>31%</td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>137</td>
<td>20%</td>
</tr>
<tr>
<td>Nausea/Vomiting</td>
<td>123</td>
<td>18%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>115</td>
<td>17%</td>
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</tbody>
</table>

Symptoms seen in >50% of patients

Patients were aged 35 days – 89 years (median age ==34 years); Travel outside of Puerto Rico and U.S. in the 14 days before illness onset; All GBS patients were hospitalized; Signs and symptoms were reported by the patients’ clinicians.
Patients (N=683) with Zika Virus in Puerto Rico
November 1, 2015 – April 14, 2016

Patients were aged 35 days – 89 years (median age ==34 years)
Travel outside of Puerto Rico and U.S. in the 14 days before illness onset
All GBS patients were hospitalized
Defined as blood platelet levels < 100,000 cells/mm3
Sins and symptoms were reported by the patients’ clinicians

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. of patients</th>
<th>(%)</th>
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<tbody>
<tr>
<td>Female</td>
<td>436</td>
<td>64%</td>
</tr>
<tr>
<td>Pregnant</td>
<td>65</td>
<td>10%</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>17</td>
<td>2%</td>
</tr>
<tr>
<td>Severe Thrombocytopenia</td>
<td>9</td>
<td>&gt;1%</td>
</tr>
<tr>
<td>Suspected Guillain-Barre Syndrome</td>
<td>5</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Deaths (Severe Thrombocytopenia)</td>
<td>1</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
The Various Means of Zika Virus Transmission

Zika virus may be transmitted by:

1. Infectious mosquito bites; *Aedes aegypti* and *Aedes albopictus*.
2. Infection of unborn children by their infected mothers.
3. Sexual transmission of Zika virus in infected sperm.
4. Blood transfusions from asymptomatic, Zika - infected blood donors.

Zika virus reservoir hosts (the animals from whose blood, mosquitoes become infected):

1. Currently the only known reservoirs of Zika virus for mosquitoes are primates (i.e., apes, monkeys, or people).
2. It is not yet known if other mammals or animals participate in the Zika transmission cycle?
Two Mosquito Species are Capable of Transmitting the Zika Virus in Virginia

*Aedes aegypti*, the yellow fever mosquito are the most efficient vector of *Zika* because they feed almost exclusively on primates including humans, and as humans serve as reservoirs for this virus, this mosquito will only vector the virus from one person to another.

*Aedes albopictus*, the Asian tiger mosquito is a much less efficient *Zika* vector because although it likes to feed on people, it also likes to feed on a variety of other animals including dogs and cats (which are not known reservoir species), so it is less likely to become infected with the *Zika* virus, and is less likely to transmit *Zika* to a person if it is infected.
Currently, the most common urban/suburban pest mosquito in Virginia is the **Asian tiger mosquito**.*

* *Asian tiger mosquito - *Aedes albopictus*

**Aedes aegypti** mosquitoes are known to have an old established population on Capitol Hill in Washington D.C., and they are occasionally found at sites around northern Virginia, but so far, they have not become common in Virginia.
*Aedes aegypti* and Asian tiger mosquitoes lay eggs exclusively in artificial and natural containers of water.

### Natural Containers
- tree holes

### Artificial Containers
- wheel barrows
- bird baths
- buckets
- wading pools / trash

These container breeding habitats are most often found around homes, and populations of these mosquitoes can be abundant in shady neighborhoods.
The most effective and environmentally sound method of eliminating Asian tiger mosquitoes and *Ae. aegypti* is to eliminate, dump, or treat their container habitats.

As the containers used by these mosquitoes are mostly found on people’s private property, this method of control can only be accomplished with the complete cooperation and assistance of the public.
Virginia’s Plan for Zika Prevention

In 2016, the Virginia Department of Health (VDH) put together a Zika Response Plan to prevent the local spread of Zika virus.

In 2016, Zika case surveillance by health department epidemiologists identified Zika cases and determined if they:

1. contracted the virus outside of Virginia, or in Virginia;
2. were likely to still be viremic (had virus circulating in their blood); based on exposure dates, laboratory test results, and illness onset dates.
3. had mosquitoes around their homes, or exposure to mosquitoes at home or elsewhere in VA.

Patients who were likely to have contracted Zika in Virginia, or who were likely to be viremic, and who had exposure to mosquitoes or to mosquito bites in VA, were asked if mosquito surveillance personnel could visit their home and any other sites where they had been exposed to mosquitoes.
Virginia’s Plan for Zika Prevention

When patients consented to a home site inspection, mosquito surveillance personnel would inspect the property, set traps to collect mosquitoes, and dump, treat or recommend treatment for any containers present.

If significant mosquito populations were found, adulticide - ULV or barrier treatments would be made, or recommended, and inspection for control of container habitats and/or adult mosquito control may be extended to neighboring properties.

If no significant mosquito population was found on a property, the patient would be counseled to avoid mosquito bites for several weeks.

For patients with imported Zika infections, surveillance and control effort would focus on immediate area around the patient’s home.

For patients who were likely to have contracted Zika in Virginia, mosquito surveillance and control operations may be extended out into the surrounding neighborhood in a radius of up to 1,500 ft.
Virginia’s Plan for Zika Prevention

In jurisdictions that had mosquito surveillance and control capabilities, home site visits were performed by local mosquito control personnel.

In jurisdictions that had no mosquito surveillance and control capabilities, patient home site inspections were performed by Health Department - Environmental Health (EH) Personnel or by contract “roving mosquito surveillance personnel” who worked out of the VDH central office in Richmond.

As EH personnel and roving surveillance personnel had no license/certification to apply insecticides, they would provide “consumer packaged larvicide products” to homeowners that had mosquito breeding containers that could not be dumped and they would recommend contract adult mosquito control for the properties that had excessive adult mosquitoes.
Mosquito control programs are found primarily in some of Virginia’s most heavily populated jurisdictions.
Virginia’s Plan for Zika Prevention

During the course of 2016, the Virginia Department of Health put out a bid for contract proposals by mosquito control companies, and established contracts with two companies to conduct mosquito control in Virginia jurisdictions without control capability.

Contracted mosquito control activities would include:

1. Door to door educational outreach in a target neighborhood,
2. Mosquito trapping/surveillance,
3. Identification, dumping and or treatment of container habitats,
4. Adulticide treatments (ULV, or barrier treatments in yards),
5. Truck-mounted ULV adulticide treatments if necessary,
6. Aerial (aircraft) application of ULV adulticides if necessary
7. Aerial (aircraft) application of larvicide droplets if necessary*

* The contract is currently being modified to add truck-mounted application of aerosol larvicides
Virginia’s Plan for *Zika* Prevention

In addition to mosquito surveillance and control activities, VDH also worked to improve public education about mosquito prevention and *Zika* avoidance through public information campaigns.

This outreach activity included:

1. The Printing and distribution of educational materials such as door hangers, flyers, and educational materials for pregnant women.

2. The Screening of short Zika prevention videos on TV screens in Virginia’s international airports, and on movie theater screens around VA.

3. Distribution of self-protection kits containing prevention literature, condoms, and mosquito repellents to be handed out to pregnant women by clinics around VA.
Questions?