Zika Virus

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Objectives

To understand the following:

• Zika virus infection, its history and basic epidemiology of the current outbreak
• How Zika virus is transmitted (and how it’s not)
• How to prevent Zika virus transmission
• Current recommendations for specific groups
• What is currently being done locally about Zika virus transmission?
• Remaining questions about Zika virus
Origins of the Zika Virus

• 1947, Zika Forest Uganda
  – Isolated from rhesus monkey
• 1954, Nigeria Africa
  – First human case
  – Testing demonstrated human exposure in Africa and Southeast Asia
• Spread over time resulted in 2 distinct lineages, African and Asian
Zika Transmission Cycle

Human – Mosquito – Human
Geographic Range, 1947-2006

The mosquito species implicated as predominant Zika vectors in both Africa and Asia are:

- *Aedes aegypti*
- *Aedes albopictus*
The first large documented Zika outbreak occurred on Yap Island in 2007.

Yap Island is in the Micronesian Island chain of the western Pacific Ocean.

Prior to this, only 14 documented human cases.
Yap Island Zika Outbreak, 2007

- Yap Island, ~7,000 residents
  - Serosurveys suggest attack rate of 75%
    - 18% of those, were symptomatic
  - Asian lineage strain
  - *Aedes hensilli* mosquito species
    - Only species common enough
    - Later proven as competent vector
Confirmed and Probable Cases of Zika Virus Disease on Yap among Persons Seeking Health Care, According to Week of Onset of Illness during the Period from April through July 2007.
Attack Rates for Confirmed and Probable Zika Virus Disease on Yap According to Age Group during the Period from April through July 2007.
Clinical Characteristics of 31 Patients with Confirmed Zika Virus Disease on Yap Island during the Period from April through July 2007.

<table>
<thead>
<tr>
<th>Sign or Symptom</th>
<th>No. of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macular or papular rash</td>
<td>28 (90)</td>
</tr>
<tr>
<td>Fever*</td>
<td>20 (65)</td>
</tr>
<tr>
<td>Arthritis or arthralgia</td>
<td>20 (65)</td>
</tr>
<tr>
<td>Nonpurulent conjunctivitis</td>
<td>17 (55)</td>
</tr>
<tr>
<td>Myalgia</td>
<td>15 (48)</td>
</tr>
<tr>
<td>Headache</td>
<td>14 (45)</td>
</tr>
<tr>
<td>Retro-orbital pain</td>
<td>12 (39)</td>
</tr>
<tr>
<td>Edema</td>
<td>6 (19)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>3 (10)</td>
</tr>
</tbody>
</table>

* Cases of measured and subjective fever are included.
From 2013 through 2014 there was large outbreak of Zika on the Islands of French Polynesia; this outbreak then spread to other Island groups including: New Caledonia, the Cook Islands, Vanuatu, Fiji, the Solomon Islands, and Easter Island.
The French Polynesian Zika Outbreak

- Largest Zika outbreak ever recorded
  - estimated 28,000 persons sought medical care (i.e. were symptomatic)
- 80% of persons infected with Zika asymptomatic
  - ~140,000 persons (possibly 51% of the French Polynesian population) were infected Asian lineage, related to the virus seen on Yap Island
- Aedes aegypti and Aedes polynesiensis likely vectors
  - Ae. aegypti most important
French Polynesian Outbreak, Zika Symptoms

- Fever
- Maculopapular rash, may be pruritic
- Arthralgia with swelling, often extremities
- Conjunctivitis

[Images of rashes and conjunctivitis]
Zika Symptoms

• Generally mild, self-limiting
  – Few hospitalizations
• 2-7 day duration
• 70 hospitalized
  – 38 with Guillain-Barre syndrome
  – 32 other neurologic
    • Encephalitis, paresthesias, facial paralysis
How Zika virus spread from Africa

1947: Discovered in Uganda

1977-78: Pakistan, Malaysia, Indonesia

2007: Yap, Micronesia

2013: French Polynesia

2014: Brazil

Source: Lancaster University
Zika Arrives in the Americas, 2014 - 2015

- May, 2015
  - Outbreak in northeastern states of Brazil
  - Spread to 18 states by December, 2015
  - Serosurvey confirms infections as early as February
- Asian lineage
- May have arrived during World Cup or Polynesian team attending international canoe competition
- *Ae. aegypti* and *Ae. albopictus* contributing
Geographic distribution of confirmed autochthonous cases of Zika virus (vector-borne transmission) in countries and territories of the Americas, 2015-2016

Updated as of 12 May 2016

Country / territory
Aruba
Barbados
Belize
Bolivia
Bonaire
Brazil
Colombia
Costa Rica
Cuba
Curacao
Dominica
Dominican Republic
Ecuador
El Salvador
French Guiana
Grenada
Guadeloupe
Guatemala
Guyana
Haiti
Honduras
Jamaica
Martinique
Mexico
Nicaragua
Panama
Paraguay
Peru
Puerto Rico
Saint Barthélemy
Saint Lucia
Saint Martin
Saint Vincent and the Grenadines
Sint Maarten
Suriname
Trinidad and Tobago
United States Virgin Islands
Venezuela

Source: Cases reported by the IHR National Focal Points to the WHO IHR Regional Contact Point for the Americas and through the Ministry of Health websites, 2016.
Note: Further information regarding subnational geographic distribution of Zika virus cases is available on the Ministry of Health websites.
Map Production: PAHO/WHO AD CHA IR ARO
Zika Identified as a Cause of Birth Defects and Guillain – Barré Syndrome

Microcephaly – Brazil

Disease Outbreak News
20 November 2015

In October 2015, the Ministry of Health (MoH) of Brazil notified PAHO/WHO of an unusual increase in the number of cases of microcephaly among newborns in the state of Pernambuco, northeastern Brazil.

As of 17 November, a total of 399 cases of microcephaly were being investigated in seven states in the northeast of Brazil. Most of the cases were registered in Pernambuco state (268). Other states that reported microcephaly cases are Sergipe (44), Rio Grande do Norte (39), Paraiba (21), Piaui (10), Ceara (9) and Bahia (8).
• Brazil – 4,783 cases microcephaly during 2015
  – 404 confirmed
  – 709 revoked
  – 1113 suspect
• 96% of confirmed cases compatible with congenital infection
• 76 deaths due to congenital deformities
  – 5 with Zika virus infection
• Review of 2013-14 French Polynesia data, shows increase in congenital CNS abnormalities
• Imported congenital infection in Hawaii and Slovenia
ABSTRACT: To support the microcephaly research, from December 1st to 31st, 2015, the Network ran a task force and rescued the head circumference from 16,208 neonates. A much higher than expected incidence of microcephaly was observed, varying from 2% to 8% according to the utilized classification criteria. These findings raise questions about the condition’s diagnosis and its notification. An observed presentation’s seasonality might reflect that of infections carried on by the *Aedes aegypti* vector. However, the temporal fluctuation was documented since late 2012, before the allegedly entry of the ZIKV in Brazil, in mid-2014.
Evidence of Zika Virus Infection in Brain and Placental Tissues from Two Congenitally Infected Newborns and Two Fetal Losses — Brazil, 2015

Roosecelis Brasil Martines, MD, PhD; Julu Bhatnagar, PhD; M. Kelly Keating, DVM; Luciana Silva-Flannery, PhD; Atis Muehlenbachs, MD, PhD; Joy Gary, DVM, PhD; Cynthia Goldsmith, MS; Gillian Hale, MD; Jana Ritter, DVM; Dominique Rollin, MD; Wun-Ju Shieh, MD; Kleber G. Luz, MD, PhD; Ana Maria de Oliveira Ramos, MD, PhD; Helaine Pompeo Freire Davi, MD, PhD; Wanderson Kleber de Oliveira, MD; Robert Lanciotti, PhD; Amy Lambert, PhD; Sherif Zaki, MD, PhD

Brazil, for histopathologic evaluation and laboratory testing for suspected Zika virus infection. All four mothers had clinical signs of Zika virus infection, including fever and rash, during the first trimester of pregnancy, but did not have clinical signs of active infection at the time of delivery or miscarriage. The mothers were not tested for antibodies to Zika virus. Samples included brain and other autopsy tissues from the two newborns, a placenta from one of the newborns, and products of conception from the two miscarriages.

FFPE tissues were tested by Zika virus reverse transcription-
Prenatal Ultrasonographic Images and Photographs of Coronal Slices of Brain.
Physician Alert

Zika virus intrauterine infection causes fetal brain abnormality and microcephaly: tip of the iceberg?

An unexpected upsurge in diagnosis of fetal and pediatric microcephaly has been reported in the Brazilian press recently. Cases have been diagnosed in nine Brazilian states so far. By 28 November 2015, 646 cases had been reported in Pernambuco state alone. Although reports have circulated regarding the declaration of a state of national health emergency, there is no information on the imaging and clinical findings of affected cases. Authorities are considering different theories behind the ‘microcephaly outbreak’, including a possible association with the emergence of Zika virus disease within the region, the first case of which was detected in May 2015.

Zika virus is a mosquito-borne disease closely related to
• Increase in Guillain-Barre Syndrome
  – Reported by Brazil, Colombia, El Salvador, Suriname and Venezuela
  – Few confirmed with Zika virus infection
  – 2013-14 French Polynesia outbreak, all 42 GBS cases were positive for both Zika and dengue
  – Relationship between Zika virus infection and GBS remains unknown
Potential Sexual Transmission of Zika Virus

Didier Musso, Claudine Roche, Emilie Robin, Tuxuan Nhan, Anita Teissier, Van-Mai Cao-Lormeau

In December 2013, during a Zika virus (ZIKV) outbreak in French Polynesia, a patient in Tahiti sought treatment for hematосpermia, and ZIKV was isolated from his semen. ZIKV transmission by sexual intercourse has been previously suspected. This observation supports the possibility that ZIKV could be transmitted sexually.

Probable Non–Vector-borne Transmission of Zika Virus, Colorado, USA


Author affiliations: Colorado State University, Fort Collins, Colorado, USA (B.D. Foy, K.C. Kobylinski); Poudre Valley Hospital, Fort Collins (J.L.C. Foy); Iowa State University, Ames, Iowa, USA (B.J. Blitvich); University of Texas Medical Branch, Galveston, Texas, USA (A. Travassos da Rosa, A.D. Haddow, R.B. Tesh); and Centers for Disease Control and Prevention, Fort Collins (R.S. Lanciotti)

Clinical and serologic evidence indicate that 2 American scientists contracted Zika virus infections while working in Senegal in 2008. One of the scientists transmitted this arbovirus to his wife after his return home. Direct contact is implicated as the transmission route, most likely as a sexually transmitted infection.

DOI: 10.3201/eid1705.101939


Dallas reports case of Zika spread through sex; CDC urges condom use

By Lena H. Sun, Brady Dennis and Ariana Eunjung Cha February 3

Dallas health officials said Tuesday that a local resident was infected with the Zika virus by having sex with a person who had contracted the disease while traveling in Venezuela.

The Zika virus, explained

Everything you ever wanted to know about the Zika virus and its spread across North and South America. (Daron Taylor, Claritza Jimenez/The Washington Post)
Zika Transmission Cycle

Sexual partner → Human → Mosquito → Human → Developing fetus
FDA allows use of investigational test to screen blood donations for Zika virus

Use of investigational test allows blood establishments in Puerto Rico to resume collecting Whole Blood and blood component donations

For Immediate Release
March 30, 2016
Current Recommendations for Pregnant Women

• **Women that are pregnant or trying to become pregnant** should avoid travel to areas with known *Zika virus transmission* OR be vigilant about avoiding mosquito bites.

• Test pregnant women with travel to an area with known Zika virus transmission whether or not they reported symptoms.
FIGURE 1. Updated Interim guidance: testing algorithm*⁺,⁺⁺⁺ for a pregnant woman with history of travel to an area with ongoing Zika virus transmission

Pregnant woman with history of travel to an area with ongoing Zika virus transmission

Test for Zika virus infection

Positive or inconclusive for Zika virus infection
Consider serial fetal ultrasounds
Consider amniocentesis for Zika virus testing

Negative for Zika virus infection
Fetal ultrasound to detect microcephaly or intracranial calcifications

Microcephaly or intracranial calcifications present
Microcephaly or intracranial calcifications not present

Retest pregnant woman for Zika virus infection
Consider amniocentesis for Zika virus testing
Routine prenatal care
Updated interim guidance for women of reproductive age

<table>
<thead>
<tr>
<th>Symptomatic <strong>women</strong> diagnosed with Zika virus or experiencing symptoms of possible exposure</th>
<th><strong>8 weeks</strong> after symptom onset before trying to get pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic <strong>men</strong> diagnosed with Zika virus or experiencing symptoms of possible exposure</td>
<td><strong>6 months</strong> after symptom onset before having unprotected sex</td>
</tr>
<tr>
<td>Asymptomatic men and women with possible exposure to Zika virus from recent travel or sexual contact</td>
<td><strong>8 weeks</strong> after possible exposure before trying to get pregnant, men should wear a condom during all sexual contact</td>
</tr>
<tr>
<td>Asymptomatic men and women who live in an area with active Zika transmission</td>
<td>CDC recommends healthcare providers talk with their patients about pregnancy plans</td>
</tr>
</tbody>
</table>
Remaining Questions

- Why has microcephaly been reported more from some places than other?
- When is maternal infection most risky?
- How often does vertical transmission occur?
- Are there co-factors that precipitate the birth defects/fetal losses?
- How often is Zika virus found in semen?
  - How long can it be found there?
  - How common is sexual transmission?
Working with Providers and Hospitals

- to identify pregnant women with possible Zika virus exposure and test them in order to either rule out infection or to provide the information about the evidence of infection to the healthcare provider so they can make monitoring and management decisions with their patient
- to test samples any time a woman with potential exposure to Zika virus has an unexpected or poor birth outcomes
Calls to 24/7 Epidemiology Number

Weekly Call Volume to Epidemiology Program During Business Hours, January 11, 2016-Present

- Total Calls
- Zika Calls
Testing Capacity in Massachusetts

• Currently some testing being done at MA State Public Health Laboratory

• Zika virus testing issues
  – Significant cross-reactivity with other flaviviruses (dengue, WNV, yellow fever)
  – Antibody testing is complex and difficult to interpret
  – Limiting it to protect the most vulnerable population
Samples Submitted to MSPHL

Includes testing provided for the NH State Public Health Laboratory
Birth Defects Surveillance

• Coordinating with Birth Defects surveillance
  – Microcephaly occurring in ~1.5 births per every 10,000. (Expectation of 10-15 babies born per year).
  – Causes of microcephaly include genetic abnormalities, infection with certain viruses such as cytomegalovirus, rubella, toxoplasmosis and varicella, severe malnutrition, and exposure to alcohol or drugs.
  – Assisting with medical chart review for mothers and infants with evidence of Zika virus exposure
Ae. aegypti map

Temp. suitability 58%; Urban accessibility 18%; NDVI 12%

https://github.com/SEEG-Oxford/seegSDM
Ae. albopictus map

- Major contributing factors:
  - Temp. suitability: 40%
  - Urban accessibility: 31%
  - NDVI: 20%

https://github.com/SEEG-Oxford/seegSL...
Aedes aegypti mosquitoes are more likely to spread viruses like Zika, dengue, chikungunya and other viruses than other types of mosquitoes such as Aedes albopictus mosquitoes.

These maps DO NOT show:
- Exact locations or numbers of mosquitoes living in an area
- Risk or likelihood that these mosquitoes will spread viruses

These maps show:
- CDC’s best estimate of the potential range of Aedes aegypti and Aedes albopictus in the United States
- Areas where mosquitoes are or have been previously found
Additional Mosquito Surveillance

- Coordinating with MCPs to identify areas at risk for *Aedes albopictus* introduction
  - Surveillance
- Incorporating phases of establishment of *Ae. albopictus* and associated recommended public health actions
- Communication with Local Health Departments
Aedes albopictus Surveillance

Stadium Cup Ovitrap
As of May 11, 2016 (5 am EST)

- Zika virus disease and Zika virus congenital infection are nationally notifiable conditions.
- This update from the CDC Arboviral Disease Branch includes provisional data reported to ArboNET for January 1, 2015 - May 11, 2016.

US States
- Travel-associated cases reported: 503
- Locally acquired vector-borne cases reported: 0
- Total: 503
  - Pregnant: 48
  - Sexually transmitted: 10
  - Guillain-Barré syndrome: 1

US Territories
- Travel-associated cases reported: 3
- Locally acquired cases reported: 698
- Total: 701
  - Pregnant: 65
  - Guillain-Barré syndrome: 5

Laboratory-confirmed Zika virus disease cases reported to ArboNET by state or territory – United States, 2015–2016 (as of May 11, 2016)
Personal Prevention for Travelers

Take steps to prevent mosquito bites.

• Be aware that these mosquito vectors are active during the day
• Wear long-sleeved shirts and long pants.
• Stay in places with air conditioning and window and door screens to keep mosquitoes outside.
• Use Environmental Protection Agency (EPA)-registered insect repellents. When used as directed, these insect repellents are proven safe and effective even for pregnant and breastfeeding women.
• Remove or stay away from mosquito breeding sites, like containers with standing water.