Zika Virus
for Pediatric Providers

Charlotte J. Hsieh, MD FAAP
UCSF Benioff Children’s Hospital Oakland
Bay Area Infectious Disease Conference
for Perinatal and Pediatric Providers
January 24, 2018
Disclosures

• None

Disclaimer

Recommendations subject to change based on CDC and CDPH. See their websites for the most up to date information and recommendations:

• https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Zika.aspx
Objectives

1. Identify risks for Zika transmission and infection.
2. Recognize clinical features of Zika infection – congenital and pediatric
3. Use Zika testing algorithms to identify children at risk for congenital Zika infection and understand long term care of affected children.
THE RISE OF ZIKA VIRUS
Zika Virus – Origins

Zika Virus (I). Isolations and serological specificity
G. W. A. Dick, S. F. Kitchen, A. J. Haddow

Transactions of The Royal Society of Tropical Medicine and Hygiene, Volume 46, Issue 5, 1 September 1952, Pages 509–520, https://doi.org/10.1016/0035-9203(52)90042-4
Published: 01 September 1952

• 1947 – New virus identified in rhesus monkey placed in Zika forest of Uganda; named Zika virus (ZIKV).
• 1948 – Zika virus recovered from Aedes africanus mosquito caught in Zika forest.
• 1962-1963 – First human case of Zika virus infection – Uganda.

WHO – The History of Zika Virus timeline
Petersen et al, “Zika Virus”, NEJM, April 21, 2016
Gubler, et al, “History and Emergence of Zika Virus”, JID 2017:216
Zika Virus – History

- 1964 – Researcher in Uganda infected with Zika
  - Has “mild” febrile illness.
- 1960s-1980s – Human cases confirmed through blood tests.
  - No deaths or hospitalizations.
  - Disease moves from Uganda to western Africa and Asia.
- 1969-1983 – Zika virus detected in mosquitoes found in equatorial Asia
  - India, Indonesia, Malaysia, Pakistan

- Only 13 naturally acquired cases reported in 57 years.

WHO – The History of Zika Virus timeline
Petersen et al, “Zika Virus”, NEJM, April 21, 2016

Zika Virus – First Outbreak

Zika Virus Outbreak on Yap Island, Federated States of Micronesia
Duffy et al, NEJM, June 11 2009

- Apr-May 2007 – Yap Island, Federated States of Micronesia
- Outbreak of rash, conjunctivitis, arthralgia
- Zika virus RNA or specific ZIKV neutralizing antibody detected
- 49 confirmed, 59 probable cases of Zika virus disease
- ~73% Yap residents infected
  - ~18% symptomatic
- No deaths or hospitalizations.
- First cases outside Africa and Asia.

http://www.dankainmicronesia.com/islands.html
Zika Virus – Early Outbreaks

• More Outbreaks
  – French Polynesia (2013, 2014)
  – New Caledonia (2014)
  – Easter Island (2014)
  – Cook Islands (2014)

• Dec 2013, Feb 2014 – Evidence of perinatal transmission of ZIKV in French Polynesia
  – Two mothers and their newborns infected with ZIKV.
  – Suspected transplacental transmission or during delivery.

• March 2014 – ZIKV detected in blood of asymptomatic blood donors (French Polynesia)

WHO – The History of Zika Virus timeline
Besnard et al, EuroSurveill, April 2014
Zika Virus – The Americas

- March 2015 – Outbreak of exanthematous illness identified in Bahia, Brazil.
  - Campos et al – identified ZIKV in sera of patients
  - Outbreak Feb to June 2015
  - By Dec 2015 – estimated 1.3 million suspected cases
- By March 2016, spread to 33 countries and territories in the Americas

Campos et al, Emerg Inf Dis, Oct 2015
Petersen et al, “Zika Virus”, NEJM, April 21, 2016
Hills et al, “Epidemiology of Zika Virus Infection”, JID 2017:216
Microcephaly in Infants in Brazil

• By Sept 2015 – noted increase in infants born with microcephaly.
• By Feb 2016 > 4,300 cases of microcephaly.
  • Overlap with Zika outbreak areas.
  • Also noted in French Polynesia
  • WHO declares Public Health Emergency of International Concern

Petersen et al, “Zika Virus”, NEJM, April 21, 2016
Case report of severe fetal brain injury associated with Zika virus infection in a woman pregnant in Brazil in Feb 2015.

Woman sick during end of 1st trimester.

Abnormal fetal ultrasound at 29 weeks gestation.

ZIKV detected by RT-PCR in fetal brain tissue on autopsy.
“Sufficient evidence has accumulated to infer a causal relationship between prenatal Zika virus infection and microcephaly and other severe brain abnormalities.”

Zika virus exhibits neurotropism. Found evidence of Zika virus replication and persistence in fetal brain and placenta.
“Never before in history has there been a situation where a bite from a mosquito could result in a devastating malformation.”

Dr. Tom Frieden
CDC Director, April 13, 2016
ZIKA VIRUS AND TRANSMISSION
Zika Virus

• Single stranded RNA virus, *Flavivirus*
  – Arbovirus = *Arthropod-borne virus*
• Closely related to dengue, yellow fever, Japanese encephalitis, and West Nile viruses
• Mosquito-borne transmission – *Aedes sp.*
  – *Aedes aegypti* and *Aedes albopictus*

Daytime biting mosquitoes.
Feed indoors and outdoors.
ESTIMATED range of *Aedes aegypti* and *Aedes albopictus* in the United States, 2017*

- *Aedes aegypti* mosquitoes are more likely to spread Zika, dengue, chikungunya, and other viruses than other types of mosquitoes such as *Ae. 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 *Ae. aegypti* and *Ae. albopictus* in the United States
- Areas where mosquitoes are or have been previously found


As of Sept 20, 2017
No local mosquito-borne transmission of Zika virus in California to date.

CA Dept Public Health

https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/AedesDistributionMap.pdf
Risk of Local Zika Virus Transmission by County

- Extremely Low Risk
- Very Low Risk
- Low Risk
- Moderate Risk

County with *Aedes* mosquitoes detected*

*Zika virus vectors: *Aedes aegypti* and/or *Aedes albopictus*

Local risk is based on the following factors within a given county:
1) distribution and abundance of *Aedes* mosquitoes
2) number of travel-associated Zika cases
3) population of county
4) distance from U.S.–Mexico border

Risk of local transmission in a county may change in response to factors 1 and 2, or if local Zika virus transmission increases in northern Mexico.

Seasonal Risk of Local Zika Virus Transmission in California

https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/LocalZikaRiskMap.pdf
PROTECT YOUR FAMILY AND COMMUNITY

HOW ZIKA SPREADS

Most people get Zika from a mosquito bite

1. A mosquito bites a person infected with Zika virus.
2. The mosquito becomes infected.
3. The infected mosquito bites a person and infects them with Zika.
4. Other mosquitoes bite that person and become infected.
5. More members of the community become infected when they are bitten by those infected mosquitoes.

Other ways people get Zika

- During pregnancy: A pregnant woman can pass Zika virus to her fetus during pregnancy. Zika infection during pregnancy can cause serious birth defects and is associated with other pregnancy problems.
- Through sex: Zika virus can be passed through sex from a person who has Zika to his or her sex partners.
- Through blood transfusion: Zika virus may be spread through blood transfusion.


Zika Transmission - Mosquitoes

A. Climatic changes

- Forest-dwelling Aedes spp., Culex spp., Mansonia spp., Anopheles?
- Small villages
- Urban transmission

B. Human invasion of the forests

- Urban mosquitoes: Ae. aegypti, Ae. albopictus

Slavov et al, “Overview of Zika virus infection in regards to Brazilian epidemic,” Brazilian Journal of Medical and Biological Research, 2016.
Zika Transmission – Maternal-Child

- In utero / transplacental
  - Confirmed
  - Mothers with evidence of infection.
  - Fetus can be affected.

- Peripartum
  - Two cases in French Polynesia 2013-2014
  - Mothers sick around time of delivery, infants infected (one asymptomatic, one transient hepatitis)

- Breastfeeding ??
  - Zika virus detected in breast milk
  - No transmission documented yet

Zika Transmission - Horizontal

• Sexual transmission
  – Male to female, female to male, male to male
  – Vaginal, anal, oral, sex toys
• Time to loss of detectable virus:

<table>
<thead>
<tr>
<th>Source</th>
<th>Median</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td>2 weeks</td>
<td>54 days</td>
</tr>
<tr>
<td>Urine</td>
<td>8 days</td>
<td>39 days</td>
</tr>
<tr>
<td>Semen</td>
<td>34 days</td>
<td>81 days</td>
</tr>
</tbody>
</table>

– Semen: virus detected in one case up to 188 days after illness onset!

• Urine, saliva – no cases of transmission

• Abstinence / condoms after illness onset
  – Women: 8 weeks
  – Men: 6 months

Paz-Bailey et al, NEJM, Feb 14, 2017
Nicastri et al, Euro Surveill, 2016 Aug 11
Zika Transmission – Other

• Blood transfusion ??
  – No confirmed cases in US
  – Rare reports of blood/platelet transmission in Brazil
    • under investigation
  – French Polynesia outbreak:
    • 2.8% of asymptomatic blood donors tested positive for Zika virus
  – Zika virus screening of blood supply in US

No confirmed reported Zika virus transmission in healthcare settings in U.S.
• One lab-acquired case as of June 15, 2016 (Penn – needle stick injury).

CDC
Gregory et al, “Modes of Transmission of Zika Virus,” JID 2017:216
States:
5,102 symptomatic Zika virus cases reported
4,830 cases from returning travelers from affected areas
224 cases from local mosquito-borne transmission (in Florida and Texas)
48 cases from other routes (46 sexual, 1 lab, 1 person-to-person)

territories:
36,079 cases
142 travelers
35,937 mosquito
0 other routes
Zika in the US 2017

States:
- 407 symptomatic Zika virus cases reported
- 398 cases from returning travelers from affected areas
- 4 case from local mosquito-borne transmission
- 5 cases from sexual transmission

Territories:
- 631 cases
- 1 travelers
- 630 mosquito
- 0 other routes
## CDPH Monthly Update on Number of Zika Virus Infections in CA as of January 5, 2018

### Travel-associated infections with Zika virus in CA residents during 2015-2017

<table>
<thead>
<tr>
<th></th>
<th>2015-2016</th>
<th>2017</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Infections</td>
<td></td>
<td></td>
<td>634</td>
</tr>
<tr>
<td>Cumulative number of infections due to sexual transmission</td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Cumulative number of infections in pregnant women</td>
<td></td>
<td></td>
<td>168</td>
</tr>
<tr>
<td>Cumulative number of completed pregnancies</td>
<td></td>
<td></td>
<td>142</td>
</tr>
<tr>
<td>Live-born infants with birth defects</td>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

### Snapshot of Bay Area County residents with Zika Virus Infection during 2015-2017

<table>
<thead>
<tr>
<th>County</th>
<th>2015-2016</th>
<th>2017</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda</td>
<td>32</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>City of Berkeley</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>26</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>San Francisco</td>
<td>29</td>
<td>11</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>90</strong></td>
<td><strong>25</strong></td>
<td><strong>115</strong></td>
</tr>
</tbody>
</table>

[https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/TravelAssociatedCasesofZikaVirusinCA.pdf](https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/TravelAssociatedCasesofZikaVirusinCA.pdf)
ZIKA VIRUS DISEASE, DIAGNOSIS AND MANAGEMENT
Incubation and Viremia

- Incubation period: ~3 - 14 days
- Viremia: a few days to 1 week
  - Longer in some pregnant women
- Virus remains in semen and urine longer than in blood.

- Most infections are asymptomatic (~80%).
Clinical Disease

• Usually mild illness:
  – Acute onset fever
  – Maculopapular rash
  – Joint pain / arthralgia
  – Conjunctivitis
  – (Headache)
  – (Muscle pain / myalgia)

• Symptoms last several days to a week.

• Severe disease uncommon.

• Fatalities rare.

• Once infected, likely protected.

• Guillain-Barre syndrome reported
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>

Yap Island, 2007
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>

Rabe, Ingrid MBChB, MMed “Zika Virus- What Clinicians Need to Know?” (presentation, Clinician Outreach and Communication Activity (COCA) Call, Atlanta, GA, January 26 2016)
Zika virus and Pregnancy

• Pregnant women can be infected by
  – Mosquito bite
  – Unprotected sex with infected partner (with or without symptoms).

• No evidence of increased susceptibility or more severe disease.
  – Clinical disease is similar in pregnant and nonpregnant persons.

• Previous infection may confer immunity for future pregnancies.

• Avoid travel to Zika virus risk areas.

CDC
Clinical Management

• No antiviral treatment available.

• Supportive care
  – Rest
  – Drink fluids to prevent dehydration
  – Antipyretics – acetaminophen
  – Avoid aspirin and NSAIDs until dengue ruled out (due to risk of bleeding)
Diagnosis

• Based on clinical features, places and dates of travel, and activities.

• Laboratory diagnosis – detecting viral nucleic acid or specific IgM and neutralizing antibodies.

• Reporting: Nationally notifiable condition.
  – Report suspected cases to state or local health departments.
Contact local public health dept for testing.

Suspect cases: VRDL tests for Zika, Chikungunya, Dengue

RT-PCR
- Serum/blood, CSF – w/in 14 days of illness onset (symptomatic case) or last potential exposure (asymptomatic pregnant woman)
- Urine – w/in 21 days of illness onset (SC), w/in 14 days of last exposure (APW)
- Amniotic fluid (amniocentesis)

IgM and PRNT
- Asymptomatic pregnant women – 2 to 12 weeks after last possible exposure
- Symptomatic cases: >3 days after illness onset, up to 12 weeks after

https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/ZikaLaboratoryTestingGuidance_VRDL.pdf
No Asymptomatic:
- Men
- Children
- Non-pregnant women

Aug 25, 2017
August 2, 2017

Updated Guidance for Health Care Providers Caring for Pregnant Women with Possible Zika Virus Exposure

Background

On July 24, 2017, CDC released updated Interim Guidance for Health Care Providers Caring for Pregnant Women with Possible Zika Virus Exposure – United States and U.S. Territories (https://www.cdc.gov/mmwr/volumes/66/wr/mm6629e1.htm). These recommendations update the prior CDC guidance in response to two developments in the Zika outbreak. First, the number of people with Zika infection in the Americas is declining and therefore a lower occurrence of disease could lead to a higher proportion of false-positive test results. Second, emerging data show that Zika virus IgM antibodies can persist for months in some pregnant women, making it difficult for healthcare providers to use Zika IgM test results to determine whether an infection occurred during or before the current pregnancy. Both the CDC and CDPH emphasize a shared-decision making model for testing and screening pregnant women, with testing decisions considered in accordance with patient preferences, risk tolerance, and clinical judgement and in line with state or local jurisdictional recommendations.

CDC has updated recommendations in four areas, and CDPH is updating the following Zika testing recommendations accordingly, with one notable discretionary difference:

August guidance differed from CDC with respect to pregnant women without ongoing exposure.

As of January 10, 2018, CDPH and CDC recs are now aligned.

Updated Guidance for Health Care Providers: Assessment and Testing for Zika Virus Infection in Pregnant Women and their Newborns

I. Background: The impact of Zika virus infection in pregnancy remains a great concern. Pregnant women should have access to Zika virus testing, including testing of asymptomatic pregnant women when appropriate.

Nearly half of all California Zika cases to date have reported travel to Mexico and many others have reported travel to other Central and South American countries. In 2017, Mexico has reported declining numbers of cases and the incidence of new Zika infections in California has substantially declined. These factors together lead to a lower pre-test probability of infection when considering testing pregnant women and their newborns. As of November 24, 2017, 162 pregnant women with travel-associated Zika infection have been reported in California since 2015. Of these, 136 women have had completed pregnancies and 9 infants have been born with microcephaly and other Zika-associated anomalies. More than half of the infants born in California with Zika-associated birth defects were born to Zika-exposed mothers who were asymptomatic for Zika infection.

Based on the changing epidemiology of Zika virus infections in California since 2015, together with input from specialty organizations, CDPH is updating recommendations for the assessment and testing of pregnant women and their newborns for Zika virus infection. These updates align CDPH recommendations with current CDC interim guidance. See the CDPH Zika webpage for tools and resources to implement this guidance in California.
FOR INFANTS

INFANT ZIKA VIRUS TESTING FOR SUSPECTED CONGENITAL ZIKA VIRUS INFECTION

Indications for testing include maternal exposure history plus any of the following:
• Maternal laboratory evidence of Zika virus infection
• Infant findings consistent with congenital Zika syndrome regardless of maternal test results

Newborn specimen collection:
• Zika virus NAT testing on infant serum and urine and Zika virus IgM antibody testing on infant serum. If non-negative IgM and negative Zika virus NAT, confirm with PRNT.
• If CSF is collected for other purposes, NAT and IgM antibody testing should be performed on CSF.
• For infants with findings consistent with congenital Zika syndrome with unknown etiology, consider CSF for Zika virus NAT and IgM antibodies.

Birthing hospitals may consider collecting infant specimens for concurrent Zika virus testing if maternal testing is being done: www.bit.ly/CABirthingHospitals

See CDPH guidance for lab testing: www.bit.ly/VRDLZikaGuidance
For more Zika information for health professionals, see: www.bit.ly/CDPHZikaHCPs
For questions about Zika virus testing or test results, contact your local health department: www.bit.ly/LHDContactInfo

https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/ZikaAlgorithmPoster.pdf
<table>
<thead>
<tr>
<th>Who to Test?</th>
<th>When and with what tests?</th>
</tr>
</thead>
</table>
| **Non-pregnant symptomatic** patient with possible Zika exposure  
  - recent travel to area with risk of Zika virus or  
  - recent unprotected sexual contact with recent traveler to area with risk of Zika virus (male w/in 6 months, female w/in 8 weeks) | • NAT testing of serum <2 wks and urine <3 wks since symptom onset  
  • IgM antibody testing <12k wks since symptom onset  
  • If non-neg IgM and ZIKV NAT neg, confirm with PRNT |
| **Symptomatic pregnant** woman with possible Zika exposure | • Concurrent ZIKV NAT in serum and urine and IgM antibody testing if ≤12 wks since symptom onset  
  • If non-neg IgM and ZIKV NAT neg, confirm with PRNT |

## CDPH: Who to test? (adults)

<table>
<thead>
<tr>
<th>Who to Test?</th>
<th>When and with what tests?</th>
</tr>
</thead>
</table>
| Asymptomatic pregnant woman with an episode of Zika exposure (without ongoing exposure) | • Do not routinely test, but assess carefully for risk factors that increase likelihood of Zika infection. Test based on risk tolerance.  
  • If choosing to test, follow instructions for Symptomatic Pregnant Woman |
| • Risk Factors                                                            | • Local Zika transmission at time of exposure  
  • Unprotected sexual exposure to partner with travel to Zika-risk area  
  • Longer duration of travel (>4wk) or multiple sexual exposures  
  • Higher risk activities (outdoor)  
  • Known mosquito bites  
  • Lack of protective clothing and insect repellent on regular basis  
  • Compromised integrity of housing  
  • Other household members with Zika infection  
  • High risk patient occupation (lab worker)  
  • Recipient of recent transfusions or transplants                         |
## CDPH: Who to test? (adults)

<table>
<thead>
<tr>
<th>Who to Test?</th>
<th>When and with what tests?</th>
</tr>
</thead>
</table>
| **Asymptomatic Pregnant** Woman with ongoing (daily or weekly) possible Zika exposure | • NAT testing of serum and urine 3 times during pregnancy. Consider qTrimester testing.  
• IgM testing may be considered with NAT testing, but may have difficult interpretation depending on exposure history. |
| **Pregnant** woman with recent possible Zika exposure and **fetal prenatal ultrasound** with findings consistent with **congenital Zika virus syndrome**. | • Testing to include both NAT and IgM tests.  
• If amniocentesis performed, send NAT testing of amniotic fluid. |
| Case by case: 1) Symptomatic mothers with probable Zika virus infection and 2) mother with infant/fetus with possible Zika virus-associated birth defects but no definitive diagnosis of Zika virus infection during pregnancy. | • Pathology testing of placental tissues  
• Placental Zika virus testing – on a case by case basis in consultation with Public Health. |
Case

- 25 yo woman had positive pregnancy test in Sept 2015 in El Salvador.
- Developed fever and rash in Oct 2015, lasting about 2 weeks, recovered completely.
- First trimester ultrasound revealed twin pregnancy but single fetal demise.
- Fetal MRI Feb 2016:
Case

- TORCH evaluation negative
- Zika IgM equivocal
- Infant born full term via NSVD, Apgars 8 and 9
- HC 28.5 cm (<<5%)
- Other abnormalities on exam
• Data for pregnant women in the US Zika Pregnancy Registry (USZPR).

• Women with lab evidence of possible Zika infection:
  – About 6% of fetuses or infants had birth defects potentially related to Zika virus.
  – Birth defects similar for symptomatic and asymptomatic women: ~6%
  – Birth defects in ~11% of women with exposure or symptoms in 1st trimester.
Congenital Zika Syndrome

Distinct pattern of congenital anomalies and problems unique to fetuses and infants infected with Zika virus before birth - five main features:

1. Severe microcephaly in which skull has partially collapsed
2. Decreased brain tissue with a specific pattern of brain damage, including subcortical calcifications
3. Damage to the back of the eye, including macular scarring and focal pigmentary retinal mottling
4. Congenital contractures, such as clubfoot or arthrogryposis
5. Hypertonia restricting body movement soon after birth
• Cranial Morphology: Fetal brain disruption sequence (FBDS)
  – Severe microcephaly
  – Overlapping cranial sutures
  – Prominent occipital bone

  – Redundant scalp skin (excess nuchal skin)
  – Severe neurological impairment
  – Can have craniofacial disproportion with depression of frontal bones and parietal bones.
  – Suspected due to loss of brain volume and decrease in intracranial pressure.

Moore et al, JAMA Pediatrics, March 2017
Congenital Zika Syndrome

• Brain Anomalies
  – Diffuse, primarily subcortical calcifications
  – Increased fluid spaces (ventricular, extra-axial)
  – Marked cortical thinning with abnormal gyral patterns (polymicrogyria)
  – Hypoplasia or absence of corpus callosum
  – Decreased myelination
  – Cerebellar or cerebellar vermis hypoplasia

Moore et al, JAMA Pediatrics, March 2017

• Case: Postnatal ultrasound
  – Marked hydrocephalus and thinning of cortical mantle
  – Redundant skin in posterior neck
Congenital Zika Syndrome

- Ocular Anomalies
  - Structural eye anomalies (microphthalmia, coloboma)
  - Cataracts
  - Intraocular calcifications
  - Posterior ocular findings, macular scarring
  - Chorioretinal atrophy, focal pigmentary mottling of retina, optic nerve atrophy/anomalies

- Congenital contractures
  - Arthrogryposis multiplex congenita, arthrogryposis
  - Clubfoot
  - Bilateral congenital hip dislocation

Moore et al, JAMA Pediatrics, March 2017
MMWR October 20, 2017
Congenital Zika Syndrome

- Neurological Sequelae and Prognosis
  - Likely to be severely impaired.
  - Motor, cognitive disabilities, seizures, swallowing difficulties -> failure to thrive, vision loss, sensorineural hearing loss
  - Irritability, excessive crying, hypertonia and spasticity, dysphagia, occasionally hypotonia.
  - Abnormal EEG, tremors and posturing (extrapyramidal dysfunction), epilepsy, abnormal tone or movements

Moore et al, JAMA Pediatrics, March 2017
MMWR October 20, 2017
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- Infant findings consistent with congenital Zika syndrome regardless of maternal test results

Newborn specimen collection:
- Zika virus NAT testing on infant serum and urine and Zika virus IgM antibody testing on infant serum. If non-negative IgM and negative Zika virus NAT, confirm with PRNT.
- If CSF is collected for other purposes, NAT and IgM antibody testing should be performed on CSF.
- For infants with findings consistent with congenital Zika syndrome with unknown etiology, consider CSF for Zika virus NAT and IgM antibodies.

Birthing hospitals may consider collecting infant specimens for concurrent Zika virus testing if maternal testing is being done: www.bit.ly/CABirthingHospitals

See CDPH guidance for lab testing: www.bit.ly/VRDLZikaGuidance
For more Zika information for health professionals, see: www.bit.ly/CDPHZikaHCPs
For questions about Zika virus testing or test results, contact your local health department: www.bit.ly/LHDContactInfo

https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/ZikaAlgorithmPoster.pdf
<table>
<thead>
<tr>
<th>Who to Test?</th>
<th>Collect tests within first 2 days of life:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Infants born to mothers with laboratory evidence of possible Zika virus infection during pregnancy</td>
<td>• NAT of serum and urine and IgM concurrently.</td>
</tr>
<tr>
<td>2) Infants with clinical findings suggestive of congenital Zika syndrome and possible maternal Zika virus exposure during pregnancy, regardless of maternal testing results.</td>
<td>• If non-neg IgM and negative Zika virus NAT, confirm with PRNT.</td>
</tr>
<tr>
<td></td>
<td>• If CSF collected for other purposes, send for NAT and IgM antibody testing.</td>
</tr>
<tr>
<td></td>
<td>• For infants with clinical findings consistent with congenital Zika syndrome with unknown etiology, consider testing CSF for Zika virus NAT and IgM antibodies.</td>
</tr>
</tbody>
</table>
Infant Zika Testing

• Collect samples within 2 days of life (ideally).

• Consider sending infant specimens for concurrent testing if maternal testing is to be done.

• Consider Placental storage/fixation if needed for testing
ZIKA VIRUS: COLLECTION AND SUBMISSION OF SPECIMENS FOR ZIKA VIRUS TESTING AT TIME OF BIRTH

General Information

Laboratory testing for congenital Zika virus infection is recommended for infants born to mothers with laboratory evidence of Zika virus infection during pregnancy, and for infants who have abnormal clinical findings suggestive of congenital Zika virus syndrome and a maternal epidemiologic link suggesting possible transmission, regardless of maternal Zika virus test results.

For infants born to mothers with risk factors for maternal Zika virus infection (travel to or residence in an area of Zika virus transmission or sex with a partner with travel to or residence in such an area) for whom maternal testing was not performed before delivery: assessment of the infant, including comprehensive physical exam and careful measurement of head circumference, neurologic assessment as well as newborn hearing screen should be performed. In addition, based on the level of possible maternal Zika virus exposure (e.g., duration and type of exposure, use of prevention measures, intensity of Zika virus transmission at the location of travel), the provider should consider whether further evaluation of the newborn for possible congenital Zika virus infection is warranted, in which case a head ultrasound and ophthalmologic assessment should be considered. Based on results of the evaluation, testing of the infant for Zika virus infection could be considered.

Testing of placental tissue specimens by Zika virus reverse-transcription polymerase chain reaction (RT-PCR) is conducted at CDC’s Infectious Diseases Pathology Branch (IDPB). Zika virus RT-PCR on placental tissues from women with possible Zika virus exposure can be considered for diagnostic purposes for symptomatic pregnant women and women with infants with possible Zika virus–associated birth defects without a definitive diagnosis of laboratory-confirmed Zika virus infection during pregnancy. For asymptomatic pregnant women who have recent possible Zika virus exposure but without ongoing possible exposure, similar to the updated recommendations for testing of non-tissue clinical specimens (e.g., serum and urine), testing of placental tissues is not routinely recommended.

IMPORTANT: Pre-approval is required prior to submission of any tissue specimens. For pre-approval please contact pathology@cdc.gov.

Healthcare Providers:

• Please make sure that your state, territorial, tribal, or local health department has been notified and has received pre-approval from CDC for submission and shipment of tissue specimens before they are collected and sent.
  » Institutions with surgical pathology available: Please consult surgical pathology regarding appropriate collection and processing of tissue specimens for Zika virus testing.
  » Institutions without surgical pathology available: Please see table below for general guide on collection of tissue specimens for Zika virus testing.

• Specimens should ONLY be sent to CDC directly from health departments. CDC’s Zika Pregnancy Hotline (770-488-7100; or email zikapregnancy@cdc.gov) is available 24/7 to healthcare providers and health departments for consultation regarding management of pregnant women and infants with possible

• Pre-approval is required prior to submission of all tissue specimens (i.e., placenta, umbilical cord). Please contact pathology@cdc.gov to obtain pre-approval. Additional clinical and epidemiologic information may be requested, see https://www.cdc.gov/zika/laboratories/test-specimens-tissues.html for minimum required information for pre-approval. If you have additional questions for the Infectious Diseases Pathology Branch, please call 404-639-3133.

• If you have additional questions for the Arboviral Diseases Branch, please call 970-221-6400.

Reporting of Results:

Figure: Collecting placental specimen

- Infant serum
- Placental and fetal membranes
- Umbilical cord
- Infant urine
Case – Infant testing results

• VRDL:
  – Zika IgM >1:10 detected, PCR not detected
  – Dengue IgM not detected, PCR not detected

• CDC:
  – Zika PRNT >1280 (positive)
  – Dengue PRNT >1280 (positive)
MANAGEMENT OF NEWBORNS EXPOSED TO ZIKA VIRUS
• Most up to date recommendations by CDC so far.
• CDPH refers to CDC recommendations for management and evaluation.
More recent findings

- Eye findings in infants without microcephaly or other brain anomalies.
- Postnatal onset microcephaly in infants born with normal head circumferences.
- Postnatal onset hydrocephalus in infants born with microcephaly.
- Abnormalities on sleep EEG in some infants with microcephaly who did not have recognized seizures.
- Diaphragmatic paralysis in infants born with microcephaly and arthrogryposis.
## Updated management for possible maternal Zika virus exposure scenarios

<table>
<thead>
<tr>
<th>Who needs further testing/evaluation?</th>
<th>Who does not?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants with clinical findings consistent with congenital Zika syndrome regardless of maternal testing results</td>
<td>Infants without clinical findings consistent with congenital Zika syndrome who were born to mothers without laboratory evidence of possible Zika virus • Routine pediatric care</td>
</tr>
<tr>
<td>Infants without clinical findings consistent with congenital Zika syndrome who were born to mothers with laboratory evidence of possible Zika infection</td>
<td></td>
</tr>
</tbody>
</table>
Standard Evaluation

• All infants born to mothers with possible Zika virus exposure during pregnancy should receive a standard evaluation at birth and at each subsequent well-child visit:
  – Comprehensive physical exam (with growth parameters)
  – Age-appropriate vision screening and developmental monitoring and screening using validated tools
  – Newborn hearing screen at birth (preferably ABR)
CDC’s Response to Zika

MEASURING HEAD CIRCUMFERENCE

- Use a measuring tape that cannot be stretched
- Securely wrap the tape around the widest possible circumference of the head
  - Brodest part of the forehead above eyebrow
  - Above the ears
  - Most prominent part of the back of the head
- Take the measurement three times and select the largest measurement to the nearest 0.1 cm
- Head circumference measurements should be taken on the first day of life because commonly-used birth head circumference reference charts by age and sex are based on measurements taken before 24 hours of age

For more information: www.cdc.gov/zika
### TABLE. Interpretation of results of laboratory testing of infant’s blood, urine, and/or cerebrospinal fluid for evidence of congenital Zika virus infection

<table>
<thead>
<tr>
<th>Infant test result*</th>
<th>NAT</th>
<th>IgM</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Any result</td>
<td>Confirmed congenital Zika virus infection†</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>Nonnegative</td>
<td>Probable congenital Zika virus infection§,¶</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>Negative</td>
<td>Congenital Zika virus infection unlikely§,**</td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:** IgM = immunoglobulin M; NAT = nucleic acid test.

* Infant serum, urine, or cerebrospinal fluid.

† Distinguishing between congenital and postnatal infection is difficult in infants who live in areas where there is ongoing transmission of Zika virus and who are not tested soon after birth. If the timing of infection cannot be determined, infants should be evaluated as if they had congenital Zika virus infection.

§ Laboratory results should be interpreted in the context of timing of infection during pregnancy, maternal serology results, clinical findings consistent with congenital Zika syndrome, and any confirmatory testing with plaque reduction neutralization testing.

¶ If Zika virus plaque reduction neutralization test is negative, this suggests that the infant’s Zika virus IgM test is a false positive.

** Congenital Zika virus infection is unlikely if specimens are collected within the first few days after birth and the clinical evaluation is normal; however, health care providers should remain alert for any new findings of congenital Zika virus infection.
EVALUATION FOR INFANTS WITH POSSIBLE CONGENITAL ZIKA VIRUS INFECTION


MMWR: https://www.cdc.gov/mmwr/volumes/66/wr/mm6641a1.htm?s_cid:mm6641a1_w

Ask about possible maternal Zika virus exposure*  

Possible Zika virus exposure

Does infant have findings consistent with congenital Zika syndrome (CZS)?

- YES
- NO

Is there laboratory evidence of maternal Zika virus infection during pregnancy?

- Laboratory evidence of possible maternal Zika virus infection during pregnancy

- Laboratory evidence of congenital Zika virus infection (Refer to Table 1)

- No laboratory evidence of possible maternal Zika virus infection during pregnancy

- No laboratory evidence of congenital Zika virus infection

- Testing and clinical evaluation for congenital Zika virus beyond a standard evaluation is not routinely recommended.

- If findings suggestive of CZS are identified at any time, refer to appropriate specialists and evaluate for congenital Zika virus infection.

* Possible Zika virus exposure includes travel to, or residence in an area with mosquito-borne Zika virus transmission or sex without the use of condoms with a partner who has traveled to or resides in an area with mosquito-borne Zika virus transmission.

** Laboratory evidence of possible Zika virus infection during pregnancy is defined as 1) Zika virus infection detected by a Zika virus RNA NAT on any maternal, placental, or fetal specimen (referred to as NATConfirmed), or 2) diagnosis of Zika virus infection, timing of infection cannot be determined or unspecified flavivirus infection, timing of infection cannot be determined by serologic tests on a maternal specimen (i.e., positive/equivocal Zika virus IgM and Zika virus PRNT titer ≥10, regardless of dengue virus PRNT value; or negative Zika virus IgM, and positive or equivocal dengue virus IgM, and Zika virus PRNT titer ≥10, regardless of dengue virus PRNT titer). The use of PRNT for confirmation of Zika virus infection, including in pregnant women, is not routinely recommended in Puerto Rico.

CS284238 October 19, 2017


This group includes women who were never tested during pregnancy as well as those whose test result was negative because of issues related to timing or sensitivity and specificity of the test. Because the latter issues are not easily discerned, all mothers with possible exposure to Zika virus during pregnancy who do not have laboratory evidence of possible Zika virus infection, including those who test negative with currently available technology, should be considered in this group.

* Automated ABR by 1 month of age if newborn hearing screen passed but performed with otoacoustic emission (OAE) methodology.

" If CSF is obtained for other purposes, Zika virus NAT and IgM antibody testing should be performed on CSF.
Infants with abnormalities consistent WITH congenital Zika syndrome born to mothers with possible Zika exposure in pregnancy

Infants with abnormalities consistent WITH congenital Zika syndrome born to mothers with possible Zika exposure in pregnancy

**YES**

**INITIAL EVALUATION**

- Standard evaluation *(Refer to Box 1).*
- Zika virus NAT (serum and urine) and IgM (serum) testing within a few days after birth, if possible.^^
- Consider Zika virus NAT and IgM testing on cerebrospinal fluid (CSF).
- Head ultrasound by 1 month of age.
- Comprehensive ophthalmologic exam by 1 month of age.
- Automated auditory brainstem response (ABR) by 1 month of age.**
- Evaluate for other causes of congenital anomalies.

Refer to developmental specialist and early intervention. Provide family support services. Consider additional consultations with specialists based on clinical findings of infant *(Refer to Box 2).*

**ABR needed if initial was otoacoustic emissions methodology.**
Infants with abnormalities consistent WITH congenital Zika syndrome born to mothers with possible Zika exposure in pregnancy

Management

• Refer to developmental specialist and early intervention services.
• Provide family support services.
• Consider additional consultations with:
  – Infectious diseases specialist
  – Clinical geneticist
  – Neurologist
  – Other clinical specialists based on clinical findings of infant
Infants with abnormalities consistent WITH congenital Zika syndrome born to mothers with possible Zika exposure in pregnancy

Consult with Specialists

- **Infectious Diseases** – r/o congenital infections, help with Zika testing/counseling
- **Neurologist** – by 1 mo, comprehensive evaluation, consider advanced neuroimaging, EEG
- **Ophthalmologist** – by 1 mo, comprehensive eye exam
- **Geneticist** – confirm phenotype, evaluate for other causes of microcephaly or congenital anomalies
- **Early intervention and developmental specialists**
- **Family and supportive services**

Other specialists as indicated:

- **Endocrine** – hypothalamic or pituitary dysfunction, thyroid testing
- **Orthopedist, psychiatrist, PT** – hypertonia, clubfoot, arthrogryposis
- **Pulmonologist, ENT** – aspiration concerns
Local Services

• Early Start – CA
  –  http://www.dds.ca.gov/earlystart/index.cfm

• Regional Center – CA

• California Children’s Services
  –  http://www.dhcs.ca.gov/services/ccs/Pages/default.aspx

• Family Resource Centers Network of California
  –  http://www.frcnca.org/

• Maternal, Child and Adolescent Health (CDPH)
  –  https://www.cdph.ca.gov/Programs/CFH/DMCAH/Pages/default.aspx

• Regional Perinatal Programs of CA (CDPH)
  –  https://www.cdph.ca.gov/Programs/CFH/DMCAH/RPPC/Pages/Default.aspx
Infants with abnormalities consistent WITH congenital Zika syndrome born to mothers with possible Zika exposure in pregnancy

Further management

• Respiratory distress/failure or fails to wean from ventilator - > evaluate for diaphragmatic paralysis
• Monitor feeding for swallowing dysfunction, dysphagia
• Signs of increased ICP -> neuroimaging for postnatal hydrocephalus
• Establish medical home for coordination of care and to ensure abnormal findings are addressed
  – Routine pediatric care with standard evaluation, immunizations, etc.
• f/u eye exams as needed as per ophthalmologist
• No need for 4-6 mo ABR
  – no delayed-onset hearing loss noted thus far

MMWR October 20, 2017
Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with lab evidence of possible Zika virus infection during pregnancy
Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with lab evidence of possible Zika virus infection during pregnancy

**Initial Evaluation**

- Standard evaluation (PE incl. growth parameters [wt/ht/HC], vision and developmental screen, newborn hearing screen)
- Zika virus NAT and IgM testing
- Head ultrasound by age 1 month
- Comprehensive ophthalmologic exam by age 1 month
- Automated ABR by age 1 month
  - if initial screen was otoacoustic emission methodology

If initial evaluation is not normal, follow recommendations for infants with congenital Zika syndrome findings.
INITIAL EVALUATION

- Standard evaluation (Refer to Box 1).
- Zika virus NAT (serum and urine) and IgM (serum) testing within a few days after birth, if possible.
- Consider Zika virus NAT and IgM testing on cerebrospinal fluid (CSF).
- Head ultrasound by 1 month of age.
- Comprehensive ophthalmologic exam by 1 month of age.
- Automated auditory brainstem response (ABR) by 1 month of age.
- Evaluate for other causes of congenital anomalies.

Refer to developmental specialist and early intervention. Provide family support services. Consider additional consultations with specialists based on clinical findings of infant (Refer to Box 2).

Laboratory evidence of possible maternal Zika virus infection during pregnancy†

INITIAL EVALUATION

- Standard evaluation (Refer to Box 1).
- Zika virus NAT (serum and urine) and IgM (serum) testing within a few days after birth, if possible.
- Head ultrasound by 1 month of age.
- Comprehensive ophthalmologic exam by 1 month of age.
- Automated ABR by 1 month of age.

Is initial evaluation normal?

- NO
- YES

Is there laboratory evidence of maternal Zika virus infection during pregnancy?
Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with lab evidence of possible Zika virus infection during pregnancy

Further Management

• Standard evaluations
  – Routine pediatric care, immunizations, etc.
  – Be vigilant for signs associated with congenital Zika syndrome, refer if concerned.
    • Impaired visual acuity/function
    • Hearing problems
    • Developmental delay
    • Delay in head growth

MMWR October 20, 2017
Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with lab evidence of possible Zika virus infection during pregnancy

Further Management

• If laboratory evidence of congenital Zika virus infection (positive Zika virus NAT or nonnegative Zika virus IgM with confirmatory neutralizing antibody testing)
  – Follow recommendations for infants with clinical findings of congenital Zika syndrome, even in absence of clinical abnormalities.

• If no laboratory evidence of congenital Zika virus infection:
  – Congenital Zika virus infection is unlikely.
  – Continue routine care. Remain alert for new findings of congenital Zika virus infection.
Laboratory evidence of possible maternal Zika virus infection during pregnancy

INITIAL EVALUATION
- Standard evaluation (Refer to Box 1).
- Zika virus NAT (serum and urine) and IgM (serum) testing within a few days after birth, if possible.**
- Head ultrasound by 1 month of age.
- Comprehensive ophthalmologic exam by 1 month of age.
- Automated ABR by 1 month of age.**
- Evaluate for other causes of congenital anomalies.

Is initial evaluation normal?

NO

Is there laboratory evidence of congenital Zika virus infection? (Refer to Table 1)

YES

Laboratory evidence of congenital Zika virus infection

No laboratory evidence of congenital Zika virus infection

Testing and clinical evaluation for congenital Zika virus beyond a standard evaluation is not routinely recommended.

- If findings suggestive of CZS are identified at any time, refer to appropriate specialists and evaluate for congenital Zika virus infection.

Congenital Zika virus infection is unlikely.

Infant should continue to receive routine care, and health care providers should remain alert for any new findings of possible congenital Zika virus infection.

Additional consultations with specialists based on clinical findings of infant (Refer to Box 2).
Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with possible Zika virus exposure during pregnancy but without lab evidence of possible Zika virus infection during pregnancy

Infants WITHOUT findings consistent with congenital Zika syndrome born to mothers with possible Zika virus exposure during pregnancy but without lab evidence of possible Zika virus infection during pregnancy

Initial and Further Management

• Standard evaluation (PE incl. growth parameters [wt/ht/HC], vision and developmental screen, newborn hearing screen)

• Zika testing not routinely recommended unless abnormal findings are identified.

• If any findings consistent with congenital Zika syndrome are identified, refer to appropriate specialists and perform evaluation for infants with findings consistent with congenital Zika syndrome.
Reporting Zika

• Zika virus infections are nationally notifiable conditions.

• Report lab confirmed and symptomatic cases of Zika to local health departments.
  – They should report to ArboNET.

• US Zika Pregnancy Registry
General patient advice about Zika virus

• Avoid traveling to Zika risk areas while pregnant.
• There is no treatment or vaccine for Zika (yet).
  – Treat symptoms with supportive care.
• Prevent mosquito bites while traveling to Zika risk areas.
  – Keep skin covered (long sleeves, etc.), sleep under mosquito bed or in air conditioned rooms.
  – Use mosquito repellent (DEET, etc.)
PROTECT YOURSELF from MOSQUITO BITES
Mosquitoes spread Zika and other viruses

Daytime is the most dangerous
Mosquitoes that spread Zika are aggressive daytime biters. They can also bite at night.

Use insect repellent
It works!
Look for the following active ingredients:
• DEET • PICARIDIN • IR3535
• OIL OF LEMON EUCALYPTUS
• PARA-MENTHANE-DIOL

Wear protective clothes
Wear long-sleeved shirts and long pants or use insect repellent. For extra protection, treat clothing with permethrin.

Mosquito-proof your home
Use screens on windows and doors. Use air conditioning when available. Once a week empty and scrub, turn over, cover, or throw out items that hold water outside your home.

For more information: www.cdc.gov/zika
www.cdph.ca.gov/zika

Distributed by:
U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

CDPH California Department of Public Health
Insect Repellent: What Pregnant & Breastfeeding Women Need to Know

Protect your family - prevent insect bites

Repellents will keep mosquitoes and other insects from biting you. This will reduce your chance of getting a disease like Zika, which can cause severe birth defects in your unborn baby.

Insect repellents registered by the Environmental Protection Agency (EPA) are safe and effective to use, even for pregnant and breastfeeding women, when used as directed by the label instructions.

Do:
- Read and follow label directions before applying repellent
- Use only enough repellent to cover your clothes and exposed skin
- Apply sunscreen first if you are going outdoors, then apply repellent
- Apply repellent for children—spray on your own hands first and then put it on the child
- Wash your clothes and bathe after using insect repellent and returning indoors

Don’t:
“Top 5 Things Everyone Needs to Know About Zika” [CDC]

1. Zika primarily spreads through infected mosquitoes. You can also get Zika through sex.
2. The best way to prevent Zika is to prevent mosquito bites.
3. Zika is linked to birth defects.
4. Pregnant women should not travel to areas with risk of Zika.
5. Returning traveler’s infected with Zika can spread the virus through mosquito bites and sex.

Figure 1. Suspected and confirmed cases of Zika by epidemiological week. Brazil. EW 48 of 2015 to EW 22 of 2017.¹

Source: Data provided by the Brazil Ministry of Health to PAHO/WHO²
Figure 6. Total confirmed cases of congenital syndrome associated with Zika virus infection by EW. Brazil. EW 32 of 2015 to EW 22 of 2017.

Source: Data provided by the Brazil Ministry of Health to PAHO/WHO¹⁰
For more information:

Centers for Disease Control and Prevention (CDC)

CA Dept of Public Health (CDPH)
• https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Zika.aspx
Additional Sources

Additional Sources


• NICASTRI et al, “Persistent detection of Zika virus RNA in semen for six months after symptom onset in a traveler returning from Haiti to Italy, February 2016,” Euro Surveill, v21(32), 2016 Aug 11.