

Emerging mosquito-borne disease in the Americas

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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

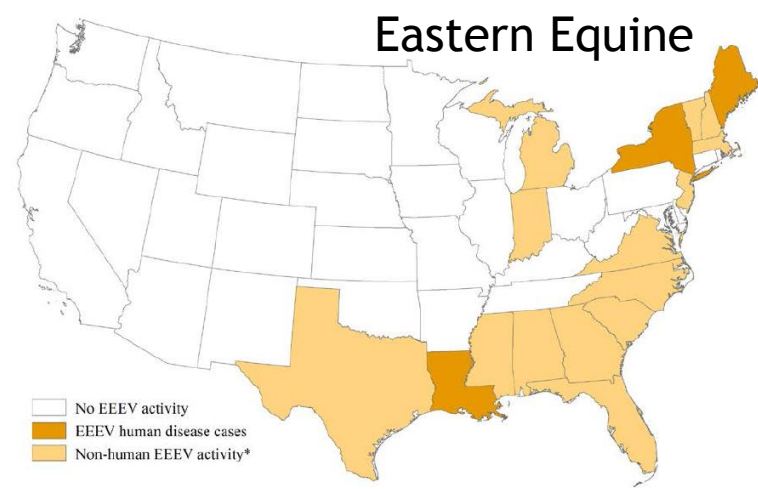
Arbovirus	National				Michigan			
	Neuro-invasive	Non-neuro-invasive	Deaths	Presumptive viremic blood donors	Neuro-invasive	Non-neuro-invasive	Deaths	Presumptive viremic blood donors
West Nile virus	1360	700	119	332	16	2	2	3
Eastern Equine Encephalitis	5	0	3	--	0	0	0	--
St. Louis Encephalitis	17	2	1	--	0	0	0	--
Jamestown Canyon Virus	3	5	0	--	0	0	0	--
LaCrosse Encephalitis	46	3	0	--	0	0	0	--



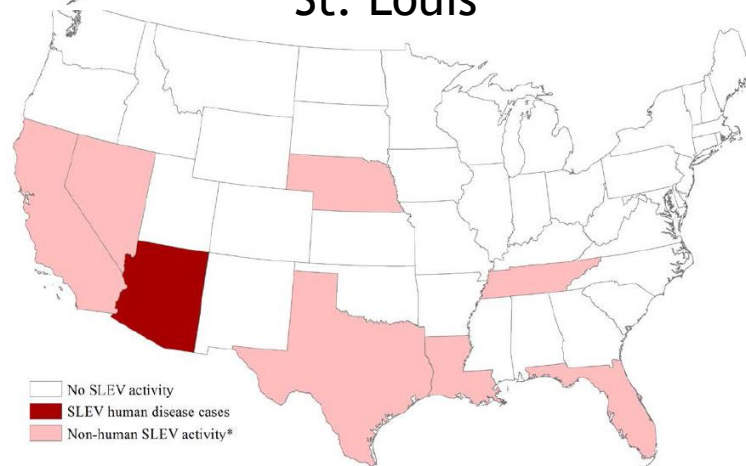
West Nile



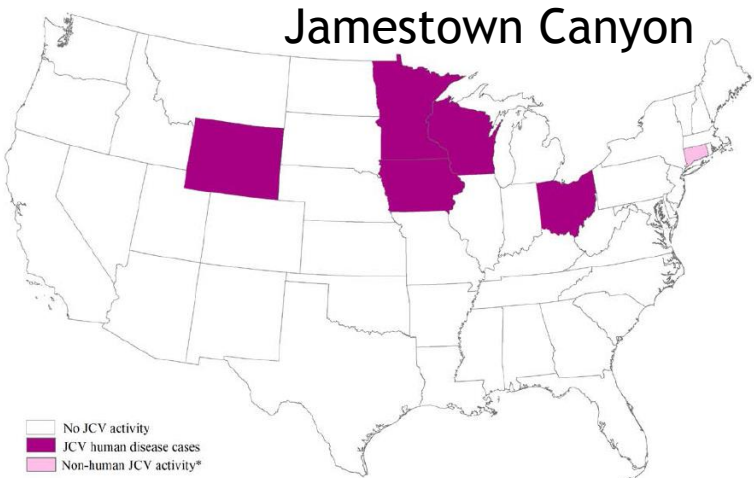
Eastern Equine



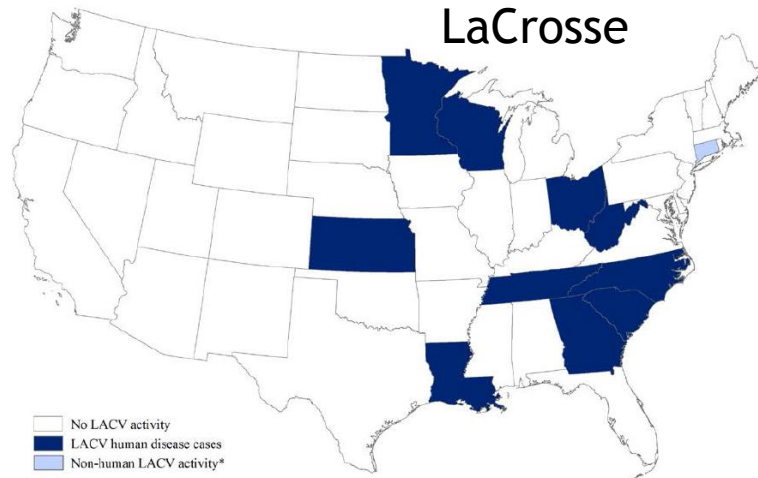
St. Louis



Jamestown Canyon



LaCrosse



Geographic distribution of arboviruses in Michigan

West Nile virus (WNV)

flavivirus, first detected in the state in 2001, now endemic

St. Louis Encephalitis virus (SLE)

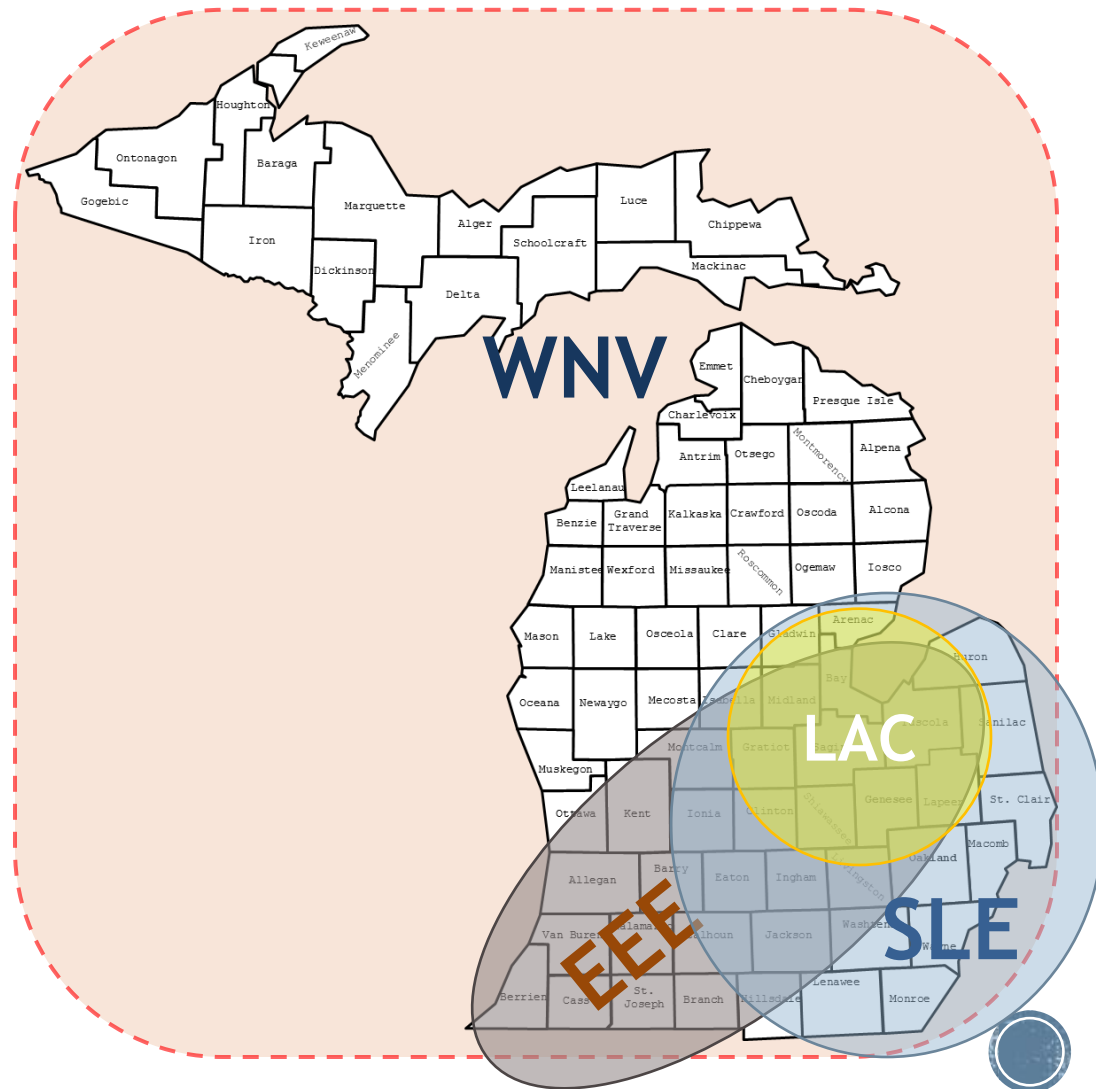
flavivirus, historic outbreak in the 1970's, sporadic cases

LaCrosse virus (LAC)

bunyavirus, sporadic cases

Eastern Equine Encephalitis virus (EEE)

alphavirus, sporadic cases, occasional outbreaks particularly in horses

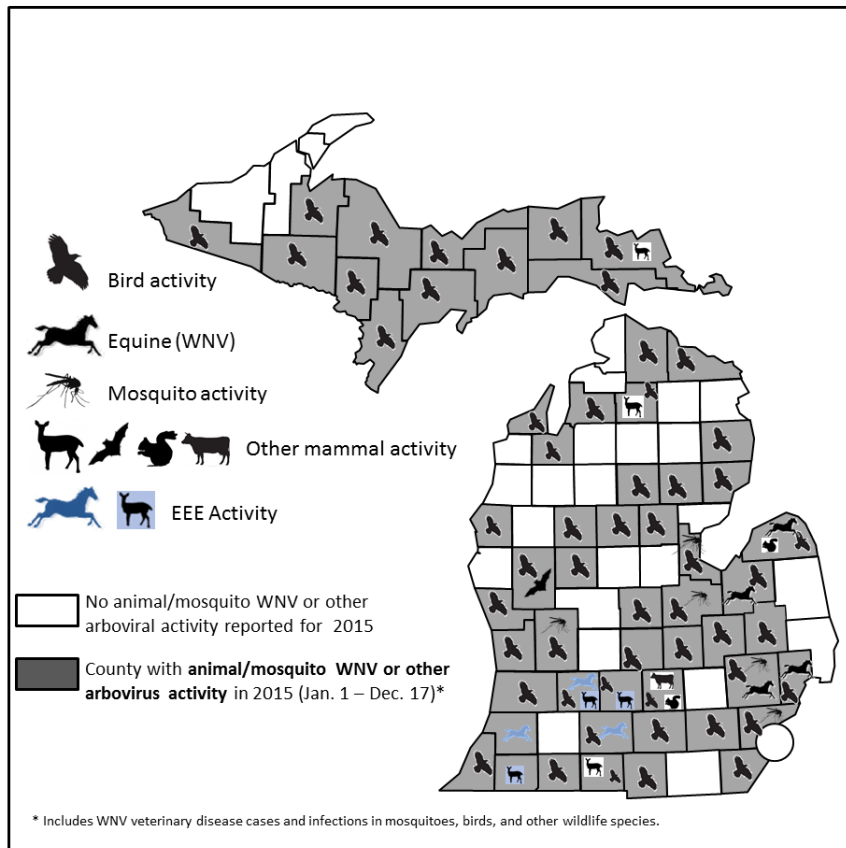


Mosquito-borne virus illness (general)

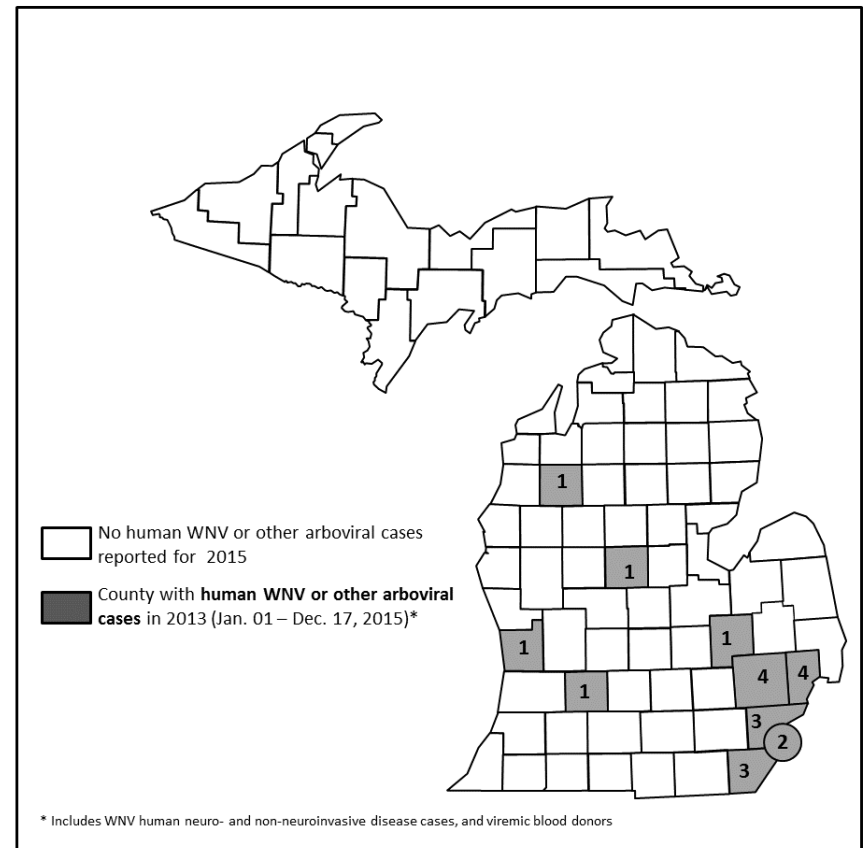
- Various viruses with different abilities to cause clinical illness
 - West Nile: 1 in 5 morbidity/ <1% severe/3-15% severe illness results in death
 - EEE: rare, but high mortality ~33%
 - Chikungunya: >70% morbidity, rarely fatal
- Symptoms range from acute febrile illness, to neuroinvasive disease, to painful arthritis
- Treatment is supportive
- Some vaccines exist (yellow fever, JE)



A Tale of Two Seasons



ECOLOGIC

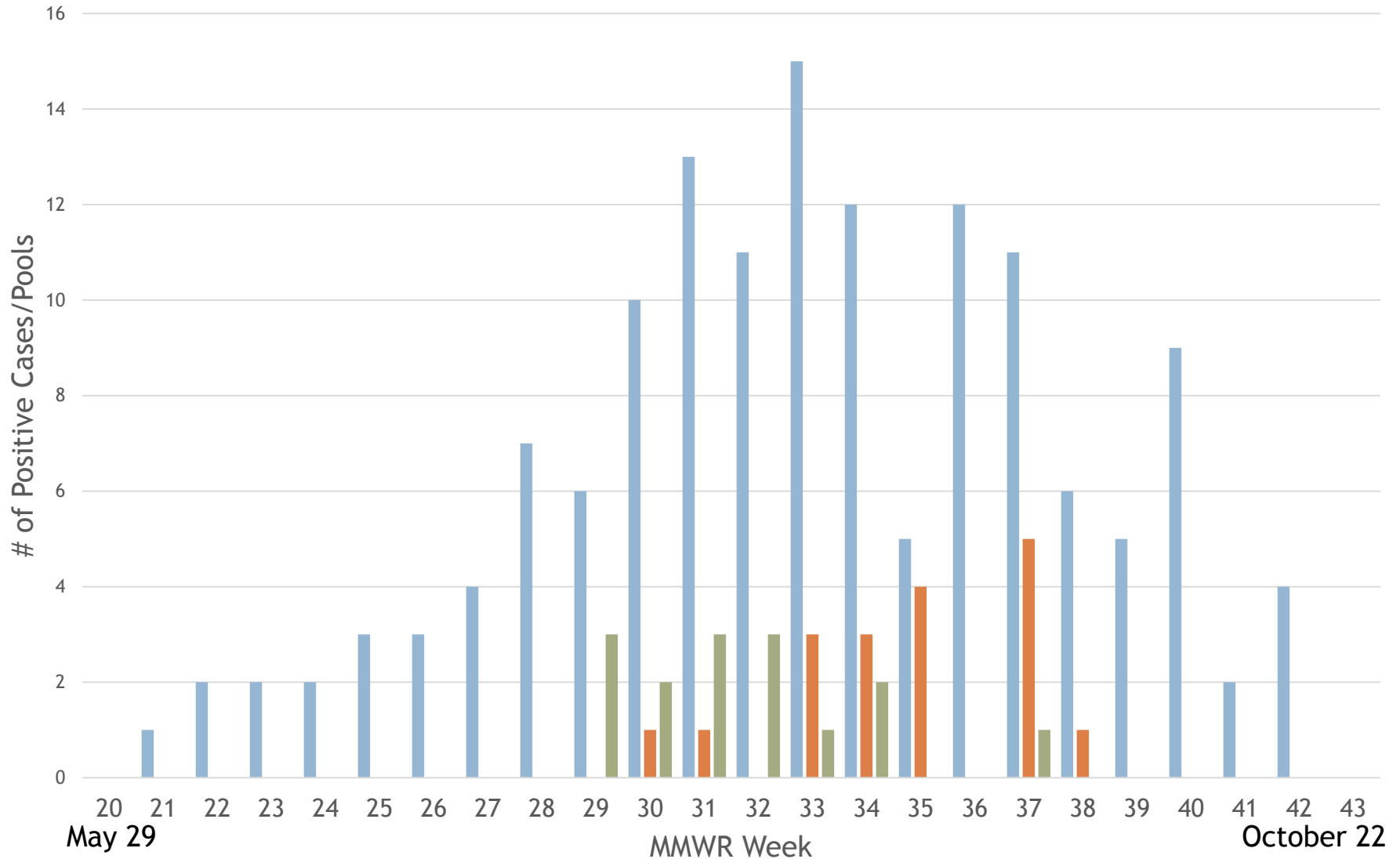


HUMAN



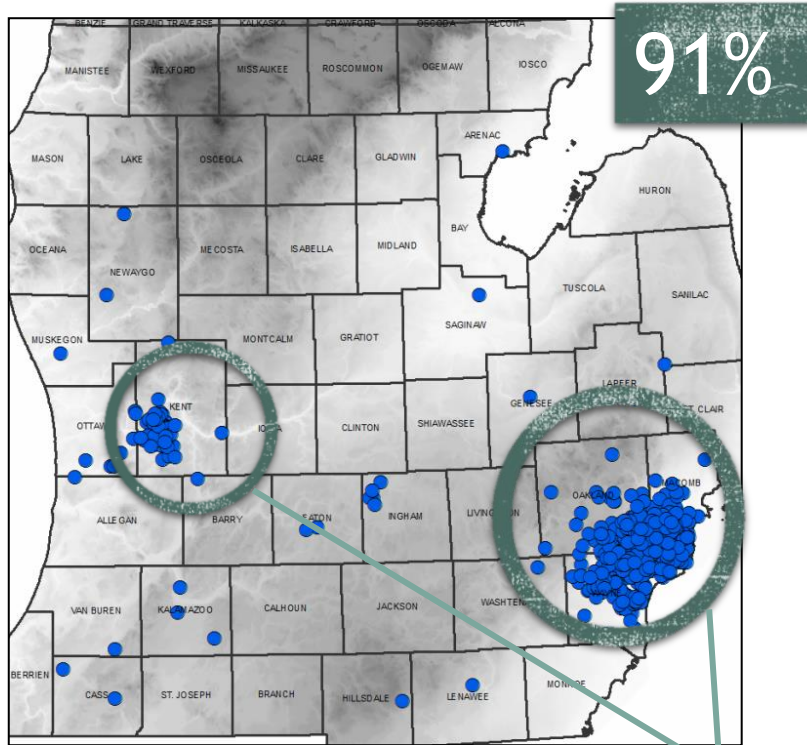
2015 Michigan Arboviurs Activity by MMWR Week

■ Animal Cases ■ Human Cases ■ Mosquito Pools

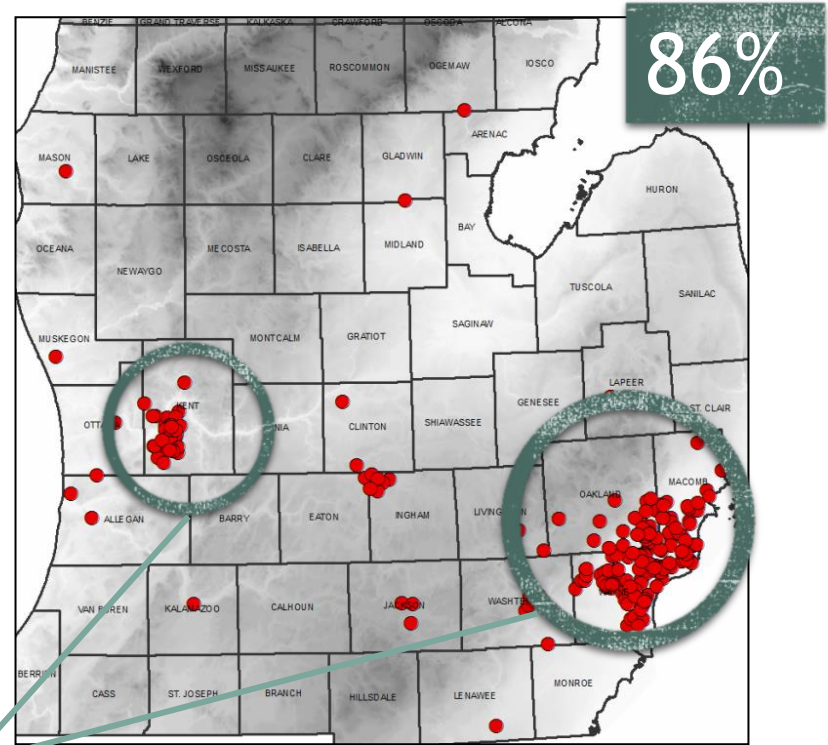


Michigan WNV Outbreak Geography

2002 MI WNV Outbreak



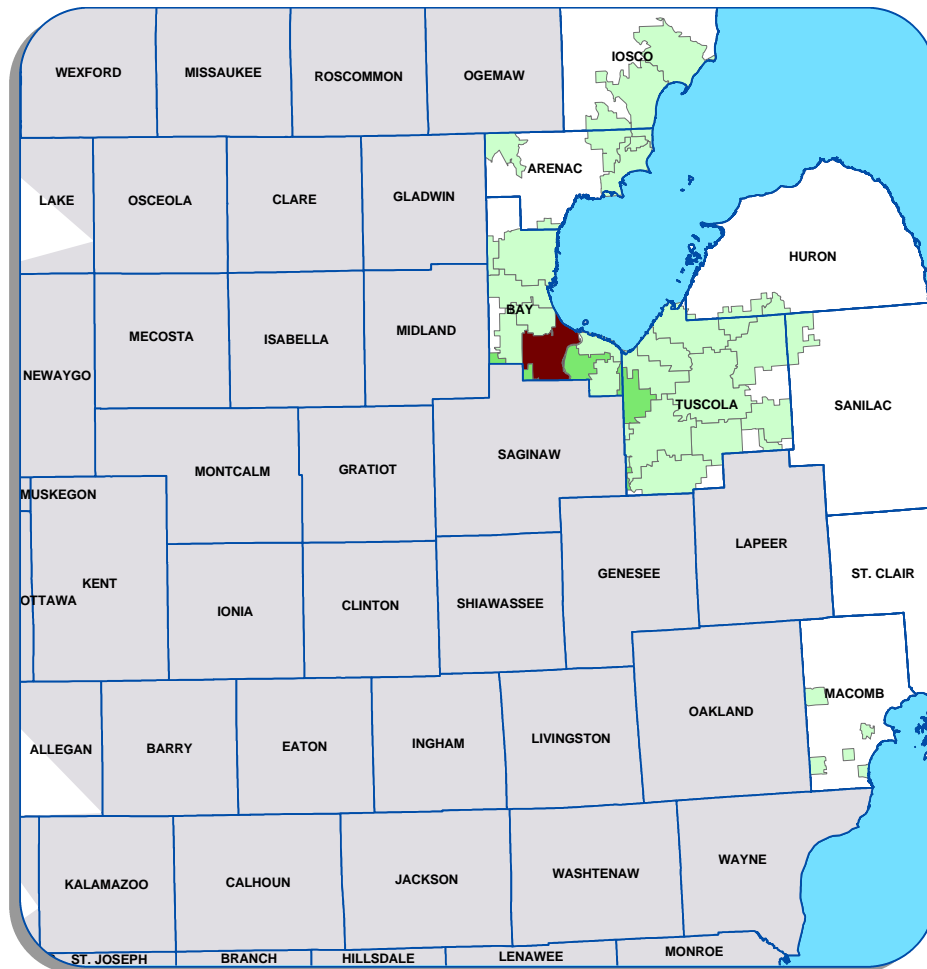
2012 MI WNV Outbreak



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

	National			Michigan		
Arbovirus	Travel-Associated	Locally-Acquired	Locations	Travel-Associated	Locally-Acquired	Travel locations
Dengue	513	173	Florida, Hawaii, Puerto Rico, US Virgin Islands	14	0	Michigan residents with travel to South America, Caribbean, SE Asia
Chikungunya	679	202	Puerto Rico & US Virgin Islands	8	0	Michigan residents with travel to South America, Caribbean, India



ZIKA



Aedes aegypti

"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

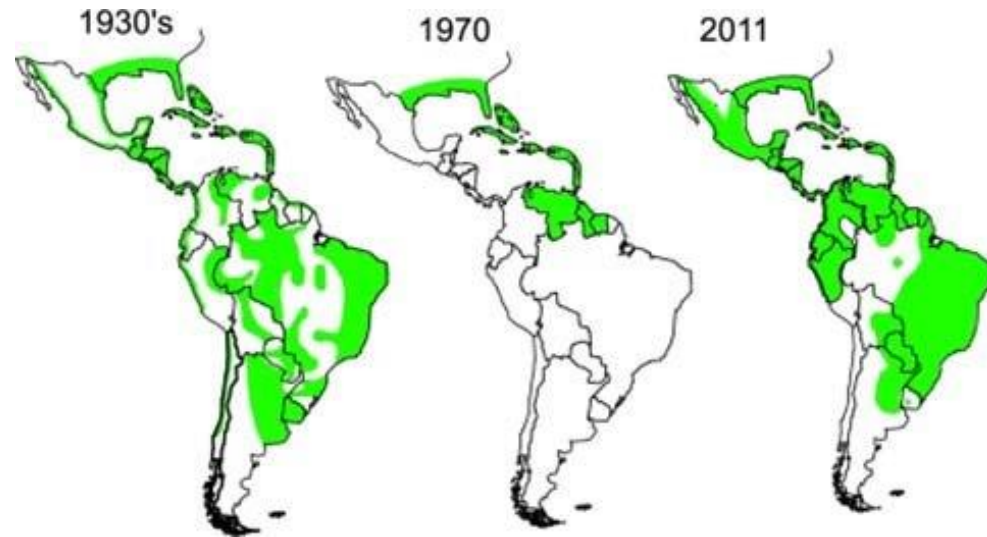
- Single stranded RNA Virus
- Genus Flavivirus, Family Flaviviridae
- Closely related to dengue, yellow fever, Japanese encephalitis and West Nile viruses
- Transmitted to people primarily by *Aedes* species mosquitoes
- First discovered in 1947 in Uganda



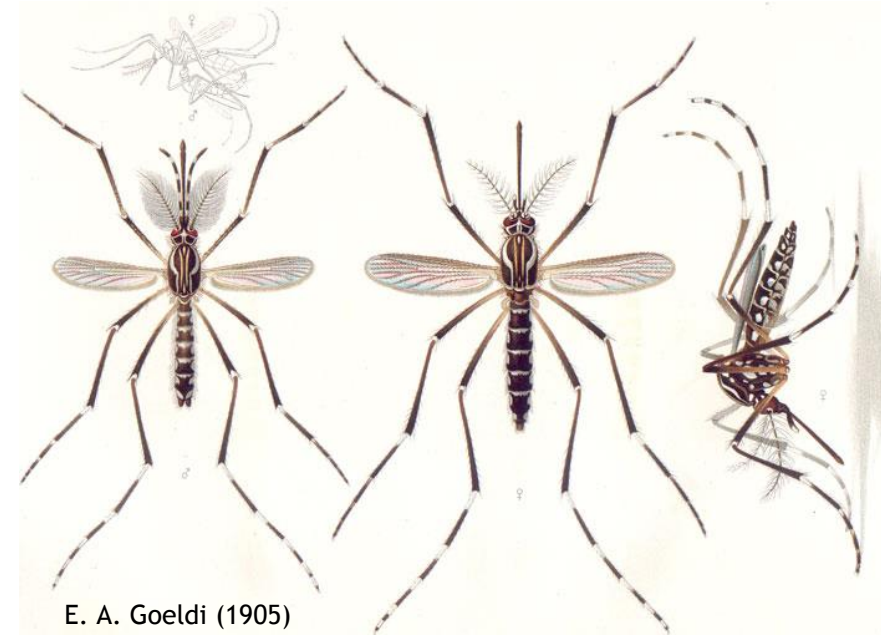
Aedes aegypti

“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



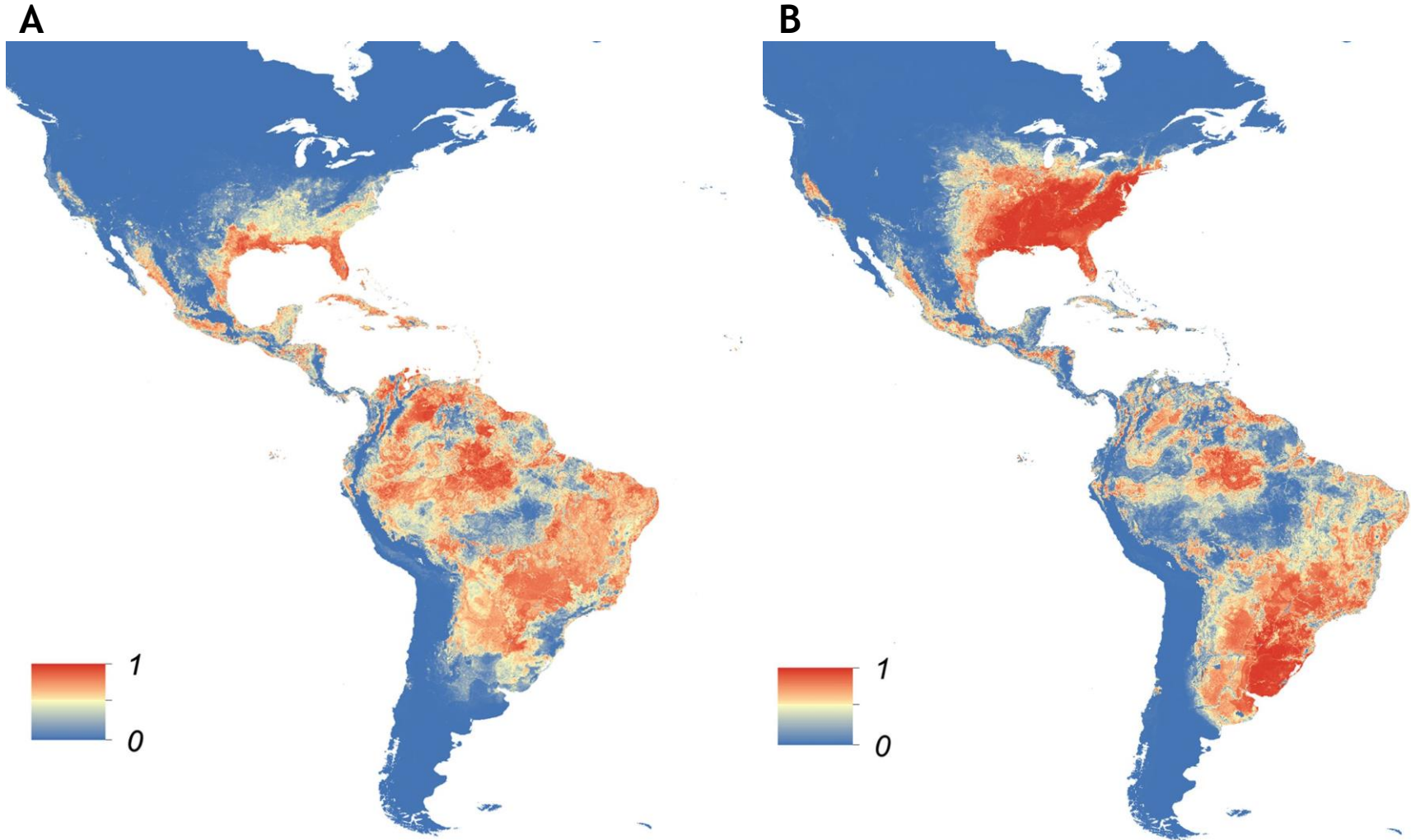
Aedes albopictus

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



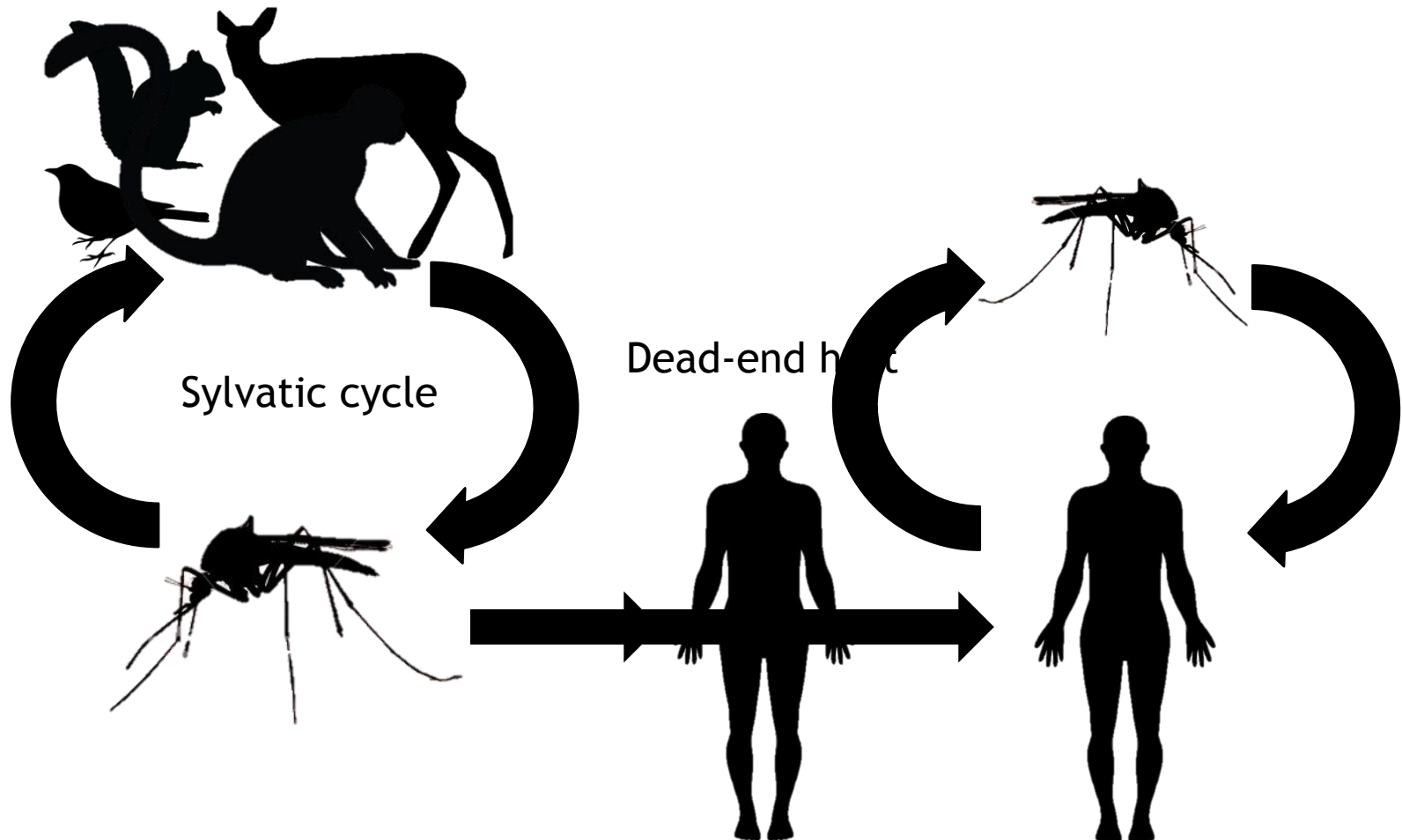
Global map of the predicted distribution of *Ae. aegypti* (A) and *Ae. albopictus* (B):
<http://dx.doi.org/10.7554/eLife.08347.008>.



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)

Duffy M. N Engl J Med 2009



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

Symptoms	N (n=31)	%
Macular or papular rash	28	90%
Subjective fever	20	65%
Arthralgia	20	65%
Conjunctivitis	17	55%
Myalgia	15	48%
Headache	14	45%
Retro-orbital pain	12	39%
Edema	6	19%
Vomiting	3	10%

Note: Rates based on serosurvey on Yap Island, 2007 (population 7,391)
Duffy M. N Engl J Med 2009



Clinical features: Zika virus compared to Dengue and Chikungunya

Features	Zika	Dengue	Chikungunya
Fever	++	+++	+++
Rash	+++	+	++
Conjunctivitis	++	-	-
Arthralgia	++	+	+++
Myalgia	+	++	+
Headache	+	++	++
Hemorrhage	-	++	-
Shock	-	+	-



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



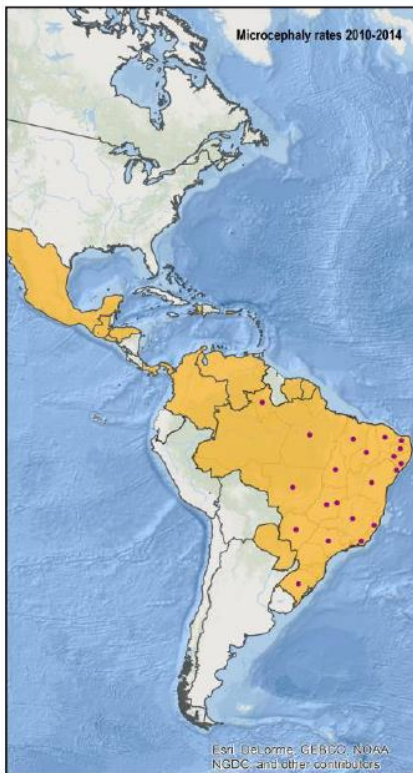
If clinical illness is mild, why are we so concerned?

- 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

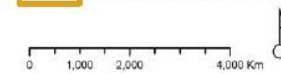
□ Countries

Countries with Zika confirmed cases

■ Epi Week 52 2015

□ Country limits

□ Brazil State Boundaries



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

Map Production:
PAHO-WHO AD
CHA IR ARO

Source: Pan American Health Organization, Epidemiological update, 17 January 2016



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

Rare brain defect in babies in Brazil rises after sudden outbreak of Zika virus

Brazil's health officials say the jump in cases of microcephaly is linked to mosquito-borne disease, and the best prevention is to remove stagnant water



📷 A health agent from São Paulo's Public Health Secretary shows an army soldier mosquito larvae found during a clean-up operation against the insect, which is a vector for transmitting the Zika virus, in São Paulo, Brazil, on Wednesday. Photograph: Andre Penner/AP

Brazil's president declares war on mosquitoes to slow spread of Zika virus

220,000 troops to be deployed to scour for mosquito breeding grounds after nearly 4,000 babies since September were born with condition linked to virus



📷 Brazilian army soldiers inspect for mosquito breeding sites at a home on 27 January 2016 in Recife, Brazil. Photograph: Mario Tama/Getty Images

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>

