



 BIPARTISAN POLICY CENTER

Zika Virus: A Pandemic in Progress

Anthony S. Fauci, M.D.
 Director
 National Institute of Allergy and
 Infectious Diseases
 National Institutes of Health
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 The
**New England
 Journal of Medicine**
Established in 1812 as THE NEW ENGLAND JOURNAL OF MEDICINE AND SURGERY
published online January 13, 2016

Zika Virus in the Americas – Yet Another Arbovirus Threat

AS Fauci and DM Morens


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- Zika background
- Current outbreak in Caribbean and Latin America
- Zika and the USA
- Role of research and development
 - Basic science, epidemiology, natural history
 - Countermeasures: diagnostics, vaccines, therapeutics, vector control



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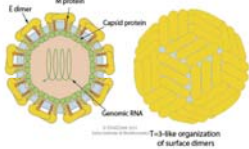
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Zika Virus

- Single-stranded, enveloped RNA virus
- Family *Flaviviridae*, genus *Flavivirus*
- Closely related to dengue, yellow fever, Japanese encephalitis and West Nile viruses
- Transmitted to humans primarily by *Aedes* mosquito species



Source: CDC


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 Transactions of the Royal Society of
 Tropical Medicine & Hygiene

Zika Virus. I. Isolations and Serological Specificity

GW Dick, SF Kitchen, AJ Hadow

September, 1952
 Vol. 46 No. 5





Zika forest
 Uganda

- Virus first isolated from a monkey in the Zika forest of Uganda in 1947

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Transactions of the Royal Society of Tropical Medicine & Hygiene

Zika Virus: A Report on Three Cases of Human Infection During an Epidemic of Jaundice in Nigeria

FN MacNamara

March, 1954
Vol. 48 No. 2

OXFORD
UNIVERSITY PRESS



Nigeria

■ First human cases reported in Nigeria in 1952

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Zika Virus Outbreaks Beyond Africa, 2007-2014

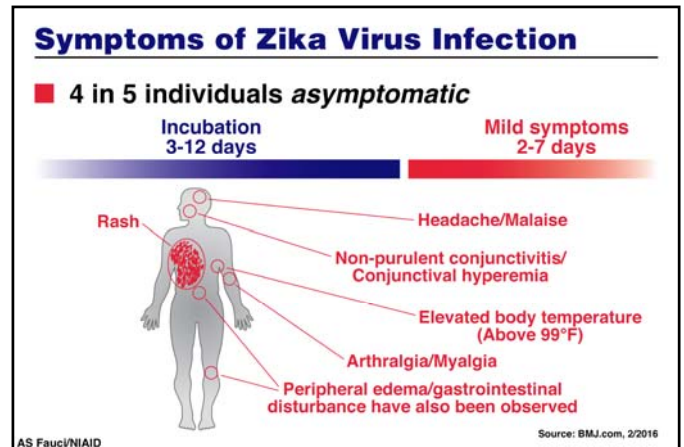
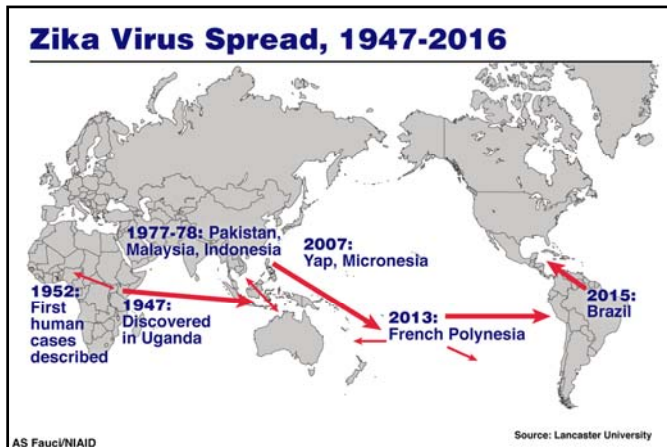
The New England Journal of Medicine
VOLUME 360 June 11, 2009 NUMBER 24

Volume 20 Number 6 June 2014
EMERGING INFECTIOUS DISEASES

Zika Virus Outbreak on Yap Island, Federated States of Micronesia
MR Duffy, TH Chen, EB Hayes, et al.

Zika Virus, French Polynesia, South Pacific, 2013
VM Cao-Lormeau, C Roche, D Musso, et al.

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Zika Virus: Modes of Transmission

- Mosquito bites
- Intrauterine and perinatal transmission
- Sexual transmission
- Blood transfusion
- Other

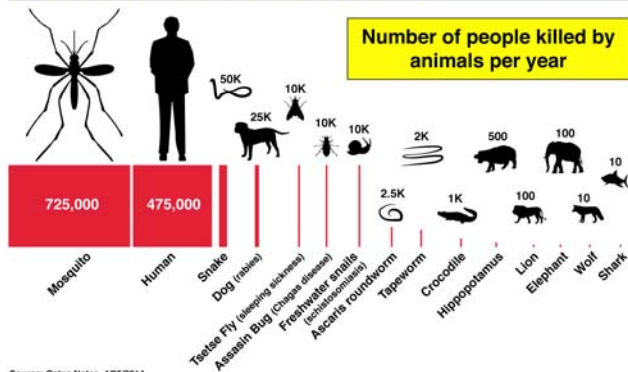
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World's Deadliest Animals



Source: Gates Notes, 4/25/2014

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Vectors of Zika Virus Infection



Aedes aegypti
"Yellow fever mosquito"



Aedes albopictus
"Asian tiger mosquito"

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Mosquito Control

- Larvicides, insecticides
- Remove standing water
- Screens & air conditioning
- Proper clothing
- Mosquito repellent (30% DEET for all ≥ 2 mos old)



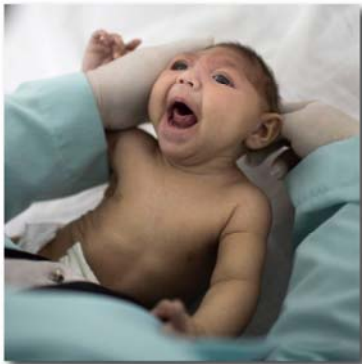
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Baby Born With Microcephaly



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Transmission of Zika Virus Through Sexual Contact with Travelers to Areas of Ongoing Transmission — Continental United States, 2016

- 13 confirmed sexually transmitted cases in the U.S. (CDC, 6/29/16)
- 10 countries have reported probable sexually transmitted cases (WHO, 6/30/16)

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Suspected Female-to-Male Sexual Transmission of Zika Virus — New York City, 2016

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- Sexual transmission
- Blood transfusion
- Other

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Potential for Zika Virus Transmission through Blood Transfusion Demonstrated During an Outbreak in French Polynesia, November 2013 to February 2014

D Musso, J Broult et al.

- 3% of blood donors, asymptomatic at the time of blood donation, were found positive for Zika virus by PCR

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- Blood transfusion
- Other

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The New York Times

June 10, 2016

Lab Worker in Pittsburgh Is Accidentally Infected With Zika Virus

THE WALL STREET JOURNAL

July 19, 2016

Son of Utah Man With Zika-Related Death Contracted the Virus

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Countries and Territories with Active Zika Virus Transmission – July 2016



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Source: WHO, CDC; Reports as of July 26, 2016

~300 Million People in the Americas Live in Areas Environmentally Suitable for Zika Virus Transmission

- >5.4 million births/year occur in these areas



Source: JP Messina et al. eLife, 4/19/2016.

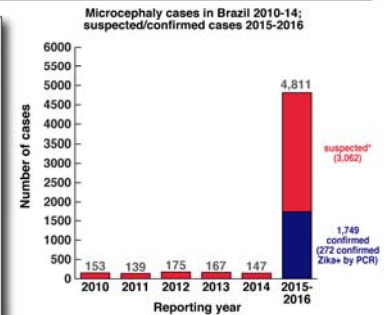
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Marked Increase in Microcephaly Cases in Brazil

Associated Press

November 30, 2015

Brazil Links Mosquito-Borne Zika Virus to Microcephaly Birth Defect



*does not include 3,892 cases investigated and discarded

Source: Brazilian MOH; data as of July 23, 2016

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Microcephaly Attributed to Zika



Normal infant brain and head size



Microcephaly, Colombia 2015

Images: LatinAmericanScience.org

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The New England Journal of Medicine

Published online May 25, 2016

Zika and the Risk of Microcephaly

MA Johansson, SL Hills, et al.



- Microcephaly risk associated with Zika infection is 1-13% in first trimester

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Neonatal Manifestations of Congenital Zika Virus Infection

- Microcephaly
- Intracerebral calcifications (mostly periventricular)
- Hearing loss
- Vision abnormalities
- Lissencephaly
- Pachygyria
- Ventricular enlargement
- Arthrogryposis
- Muscular atrophy

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Source: RW Steele; Clin. Pediatr., 3/21/2016.

Infant with Microcephaly and Arthrogryposis in Legs and Arms, Brazil



Source: D Miranda-Filho, et al. AJPH 106:598, 2016.

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THE LANCET

Published Online February 29, 2016

Guillain-Barré Syndrome Outbreak Associated with Zika Virus Infection in French Polynesia: A Case-Control Study

VM Cao-Lormeau, F Ghawché et al.

- 98% of 42 pts with GBS had anti-Zika virus IgM or IgG, and all (100%) had neutralizing antibodies against Zika virus compared with 56% of 98 pts in control group w/nAbs ($p < 0.0001$)
- 88% of 42 patients with GBS reported symptoms of Zika virus infection ~6 days before onset of neurological symptoms
- Based on attack rate for Zika virus of 66% in French Polynesia, risk of GBS in the general population during the outbreak was 24 /100,000 infections

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The New York Times

March 19, 2016

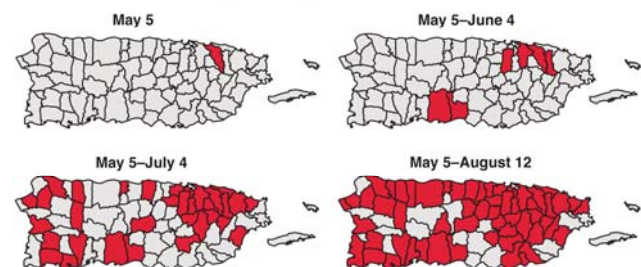
Puerto Rico Braces for Its Own Zika Epidemic

A quarter of the island's 3.5 million people will probably get the Zika virus within a year, and eventually 80 percent or more may be infected.



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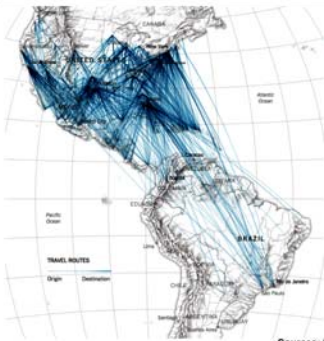
Geographic Distribution of Laboratory-Positive Chikungunya Cases – Puerto Rico, May 5-August 12, 2014



Source: MMWR 63: 1121, 2014.

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Potential for Imported Cases of Zika in the United States



■ ~216 million passenger journeys to U.S. annually from areas with local Zika virus transmission

- 34 M by air
- 173 M by land
- 9 M by sea

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Sources: B Nelson et al. PLoS Currents Outbreaks, 5/31/2016; NY Times.

Estimated Range of *Aedes aegypti* and *Aedes albopictus* Mosquitoes in the United States, 2016

Aedes aegypti



Aedes albopictus



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Source: CDC

Reported Cases of Zika Virus Disease in the United States, 2015–2016

■ U.S. States / District of Columbia

– **1,658 cases** (1,657 travel-associated, 1 laboratory acquired)

- 15 sexually transmitted
- 5 Guillain-Barré syndrome

■ U.S. Territories

– **4,750 cases** (4,729 locally acquired, 21 travel-associated)

- 17 Guillain-Barré syndrome

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Source: CDC, data as of July 27, 2016

Zika-Affected Pregnancies and Outcomes in the United States, 2015-2016

■ U.S. States / District of Columbia

– **433 pregnancies**

- 13 liveborn with birth defects
- 6 pregnancy losses with birth defects

■ U.S. Territories

– **422 pregnancies**

- 0 liveborn infants with birth defects
- 1 pregnancy loss with birth defect

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Source: CDC, data as of July 21, 2016

The Miami Herald

July 19, 2016

Miami May Have Florida's First Locally Acquired Case of Zika Virus



July 28, 2016

Florida Officials Now Investigating 4 Possible Non-Travel-Related Zika Cases

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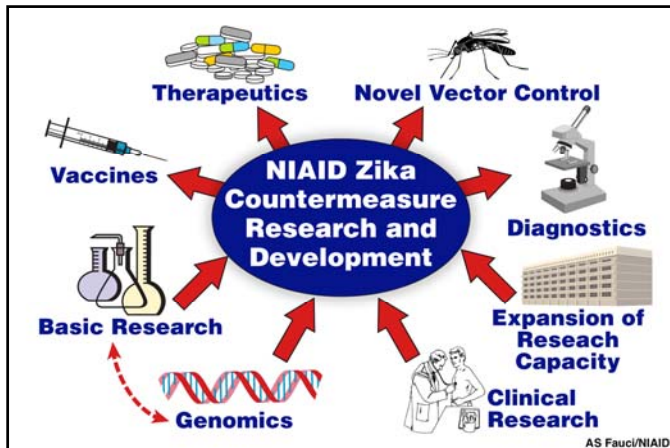
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Zika in Infants and Pregnancy (ZIP) Study

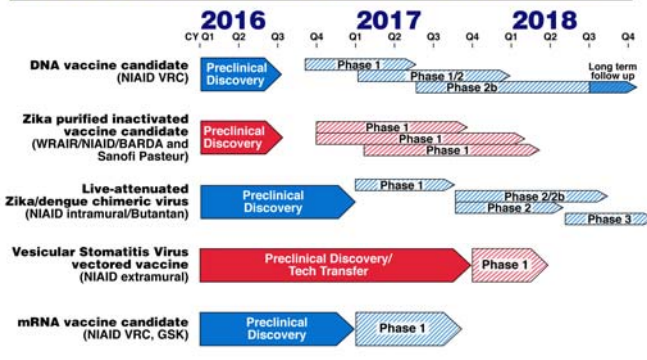
- Sponsored by NIH and Oswaldo Cruz Foundation (Fiocruz) of Brazil
- Prospective cohort study of 10,000 pregnant women
- Following women for incidence of Zika infection
- Following infants through at least one year of age
- Key endpoints: pregnancy outcomes, congenital anomalies, other developmental abnormalities



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*additional areas to be added

Zika Vaccine Development Timeline



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Volume 6, Issue 11
November 2008
THE LANCET Infectious Diseases

Emerging Infections: A Perpetual Challenge

DM Morens, GK Folkers & AS Fauci



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