Zika Virus

Stephen Higgs

Biosecurity Research Institute

Kansas State University

Mosquitoes pose a very significant health threat to much of the worlds population

Mosquito-borne Viruses of Significant Public Health Importance

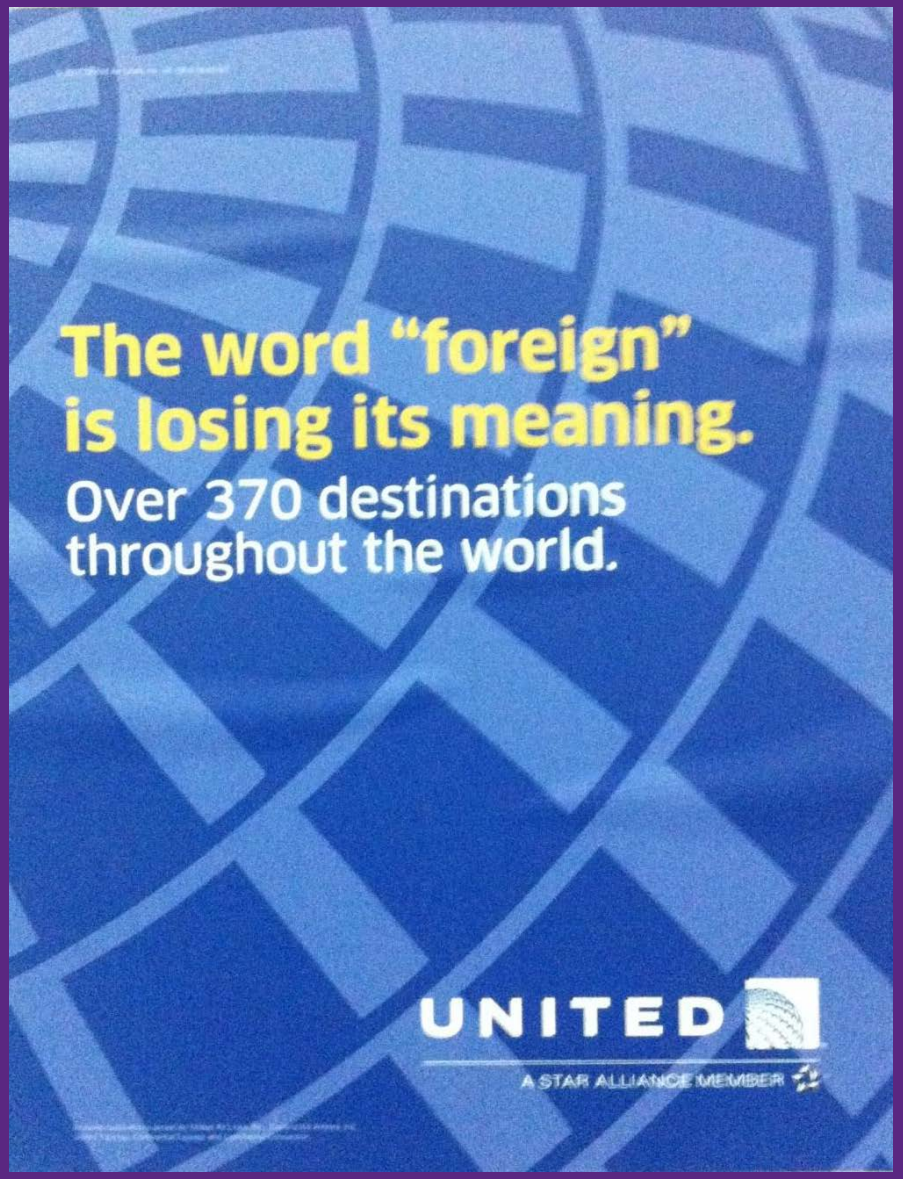
- Dengue fever
  50-100 M cases, > 500,000 DHF/DSS cases
  >20,000 deaths
  2.5-3 billion at risk in >100 countries
- Chikungunya fever
  Estimated >1.7M cases in Caribbean, S & C America (ongoing)
- Yellow fever
  Estimated 200,000 cases, 30,000 deaths
- Japanese encephalitis
  Estimated 35-50,000 cases, 10,000 deaths
- West Nile
  Estimated >2M infections in the USA between 1999-2015, 1,600 deaths

Factors Related to Arbovirus Emergence

- **Human demographics and behavior**
- **Technology and industry**
- **Economic development and land use**
- **International travel and commerce**
- **Microbial adaptation and change**
- **Breakdown of public health measures**

From: Emerging Infections. Microbial Threats to Health in the United States. Institute of Medicine, 1992.

Almost 2 billion people travel aboard commercial airlines every year



Lancet, 2009. Feb19 issue

Zika virus: Discovery

Rockefeller Foundation dedicated to arbovirus discovery 1947 (sentinel macaque),

1948 (mosquito),

1954 (human)

Zika virus: Discovery

Adapted from National Academy presentations by
R. Rosenberg (platform photo by B. Beard)
And presentation by Scott Weaver

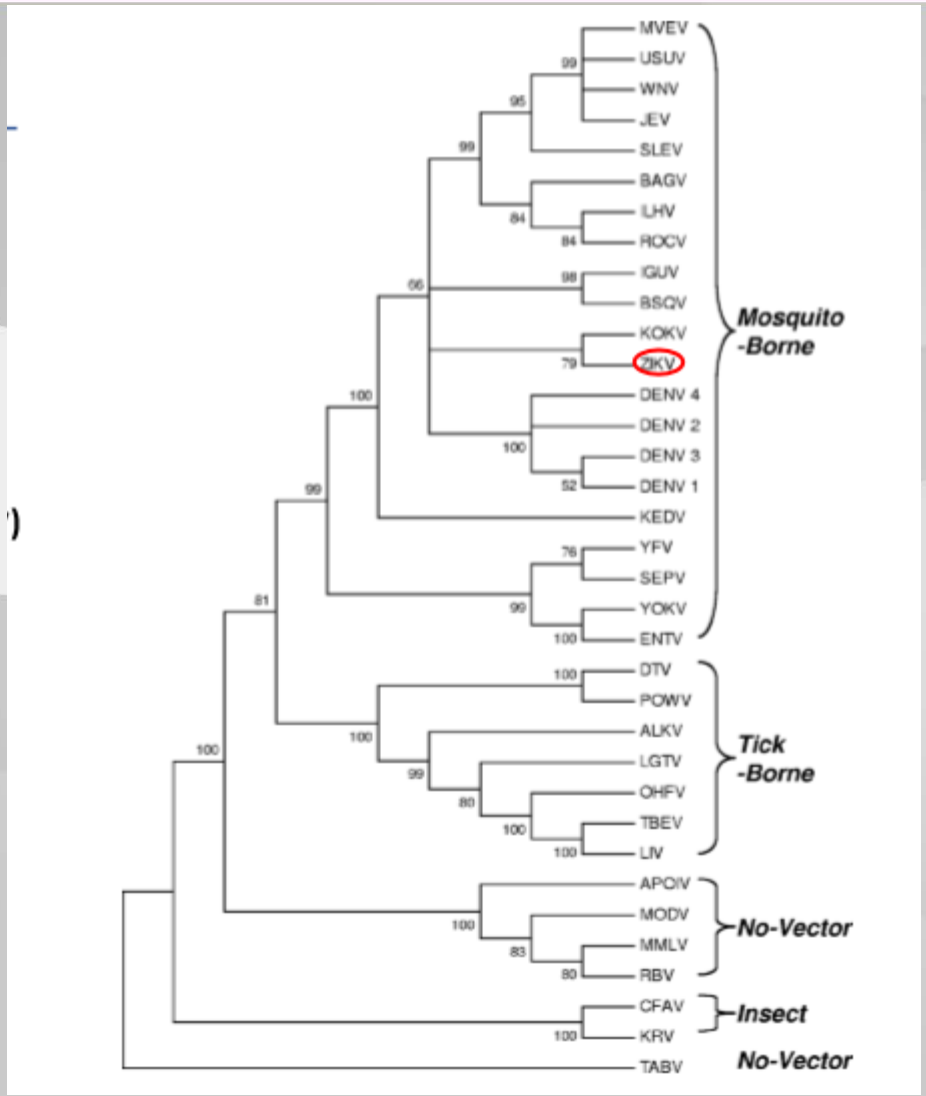
Zika virus: Genetics

A member of the Flaviviridae family of RNA viruses

Genome is single positive strand of RNA ~ 10,600 nt Transmitted by mosquitoes

Virus particle contains a lipid bilayer, one genome RNA, and three distinct types of viral proteins, : 1. E - envelope protein 2. M - membrane protein/prM – premembrane protein 3. C - capsid or core protein

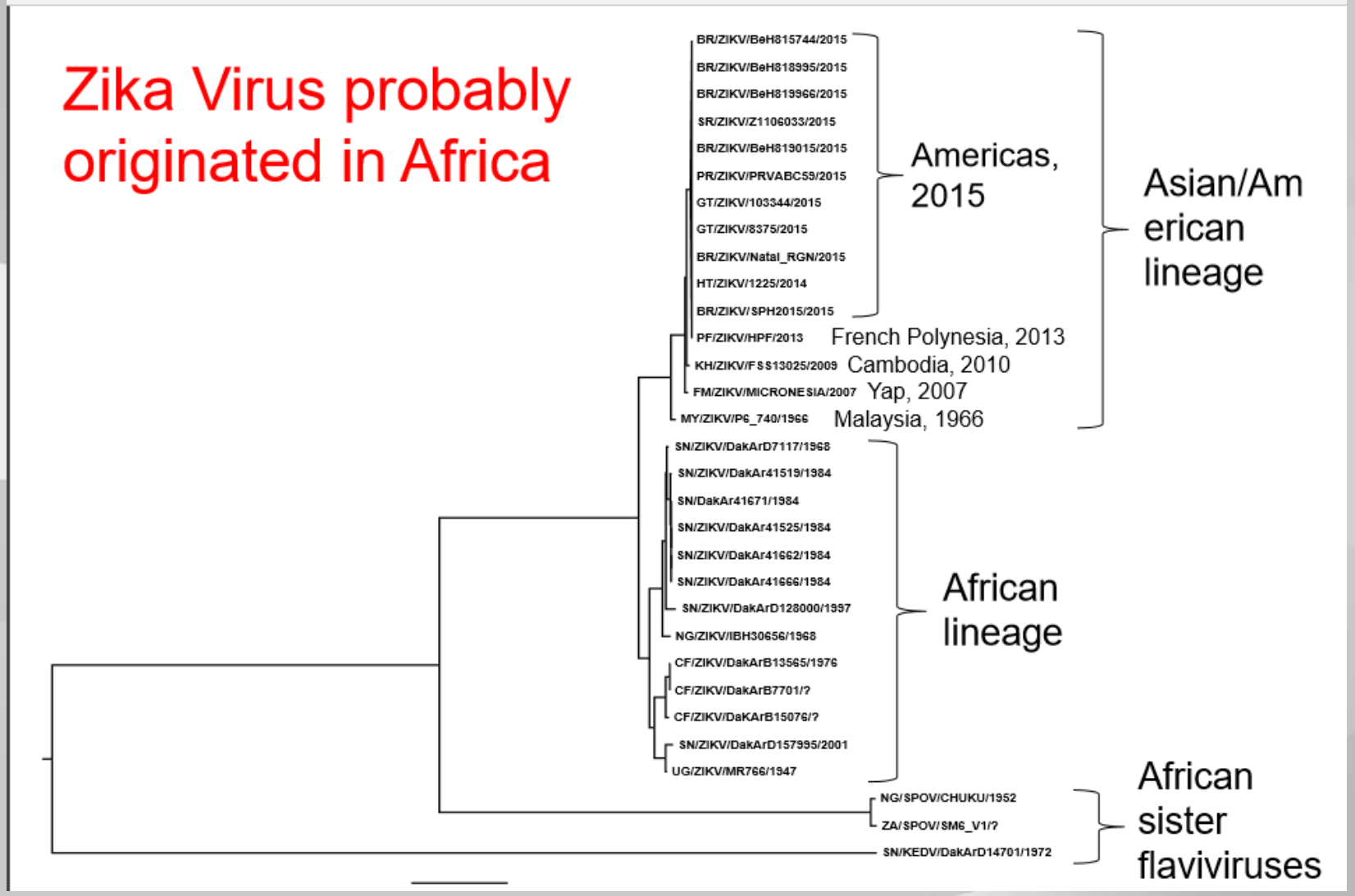
Zika virus: Genetics



Sequence: Kuno & Chang, January, 2007 (Arch. Virol. 152:687)

Adapted from National Academy presentation by R. Rosenberg

Zika virus: Genetics



Adapted from National Academy presentation by S. Weaver

Zika virus: Genetics

Faye *et al. BMC Proceedings* 2011, **5**(Suppl 1):P59
http://www.biomedcentral.com/1753-6561/5/S1/P59

BMC Proceedings

POSTER PRESENTATION **Open Access**

Molecular evolution of Zika virus, an neglected emerging disease in Africa and Asia

Oumar Faye[1*], Ousmane Faye[1], Caio César de Melo Freire[2], Juliana Velasco de Oliveira[2], Chen Rubing[3], Paolo M de Andrade Zanotto[2], Diallo Mawlouth[1], Amadou Alpha Sall[1]

From Institut Pasteur International Network Annual Scientific Meeting
Hong Kong. 22-23 November 2010

Zika virus (ZIKV) is an arbovirus transmitted by mosquitoes isolated for the first time in Zika forest, Uganda in 1947 and repeatedly isolated in sub-Saharan Africa and South East Asia. Until 2000, only few human cases were reported but in 2007, the first major human outbreak was notified in Yap Island, Micronesia leading to 99 cases. Despite the widespread distribution of Zika virus, very limited information is available on the genetic relationship between the circulating strains. Therefore, we undertook a study on phylogeny and phylodynamics ZIKV in Africa and Asia. Partial and full length genome sequences of 38 strains from Senegal, Ivory Coast, Burkina Faso, Central African Republic and Malaysia were analysed. Phylogenetic reconstructions and datation were performed while recombination and viral population migrations were investigated. Phylogenetic analysis of the E, NS5 and NS5/3'NC gene showed two strains. Asian strains may represent a divergent lineage related to a common ancestor with spread throughout Southeast Asia and the Pacific from Africa.

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Published: 10 January 2011

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Zika virus: Genetics

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PLoS NEGLECTED TROPICAL DISEASES

Genetic Characterization of Zika Virus Strains: Geographic Expansion of the Asian Lineage

Andrew D. Haddow[1]*, Amy J. Schuh[1], Chadwick Y. Yasuda[2], Matthew R. Kasper[2¤], Vireak Heang[2], Rekol Huy[3], Hilda Guzman[1], Robert B. Tesh[1], Scott C. Weaver[1]

1 Institute for Human Infections and Immunity, Center for Tropical Diseases, Department of Pathology, University of Texas Medical Branch, Galveston, Texas, United States of America, **2** United States Naval Medical Research Unit, No. 2, Phnom Penh, Cambodia, **3** National Dengue Control Program, Phnom Penh, Cambodia

Abstract

Background: Zika virus (ZIKV) is a mosquito-borne flavivirus distributed throughout much of Africa and Asia. Infection with the virus may cause acute febrile illness that clinically resembles dengue fever. A recent study indicated the existence of three geographically distinct viral lineages; however this analysis utilized only a single viral gene. Although ZIKV has been known to circulate in both Africa and Asia since at least the 1950s, little is known about the genetic relationships between geographically distinct virus strains. Moreover, the geographic origin of the strains responsible for the epidemic that occurred on Yap Island, Federated States of Micronesia in 2007, and a 2010 pediatric case in Cambodia, has not been determined.

Methodology/Principal Findings: To elucidate the genetic relationships of geographically distinct ZIKV strains and the origin of the strains responsible for the 2007 outbreak on Yap Island and a 2010 Cambodian pediatric case of ZIKV infection, the nucleotide sequences of the open reading frame of five isolates from Cambodia, Malaysia, Nigeria, Uganda, and Senegal collected between 1947 and 2010 were determined. Phylogenetic analyses of these and previously published ZIKV sequences revealed the existence of two main virus lineages (African and Asian) and that the strain responsible for the Yap epidemic and the Cambodian case most likely originated in Southeast Asia. Examination of the nucleotide and amino acid sequence alignments revealed the loss of a potential glycosylation site in some of the virus strains, which may correlate with the passage history of the virus.

Conclusions/Significance: The basal position of the ZIKV strain isolated in Malaysia in 1966 suggests that the recent outbreak in Micronesia was initiated by a strain from Southeast Asia. Because ZIKV infection in humans produces an illness clinically similar to dengue fever and many other tropical infectious diseases, it is likely greatly misdiagnosed and underreported.

Zika virus: Genetics

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PLOS | NEGLECTED TROPICAL DISEASES

Molecular Evolution of Zika Virus during Its Emergence in the 20th Century

Oumar Faye[1☯], Caio C. M. Freire[2☯], Atila Iamarino[2], Ousmane Faye[1], Juliana Velasco C. de Oliveira[2], Mawlouth Diallo[1], Paolo M. A. Zanotto[2], Amadou Alpha Sall[1]*

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Abstract

Zika virus (ZIKV) is a mosquito-borne flavivirus first isolated in Uganda in 1947. Although entomological and virologic surveillance have reported ZIKV enzootic activity in diverse countries of Africa and Asia, few human cases were reported until 2007, when a Zika fever epidemic took place in Micronesia. In the context of West Africa, the WHO Collaborating Centre for Arboviruses and Hemorrhagic Fever at Institut Pasteur of Dakar (http://www.pasteur.fr/recherche/banques/CRORA/) reports the periodic circulation of ZIKV since 1968. Despite several reports on ZIKV, the genetic relationships among viral strains from West Africa remain poorly understood. To evaluate the viral spread and its molecular epidemiology, we investigated 37 ZIKV isolates collected from 1968 to 2002 in six localities in Senegal and Côte d'Ivoire. In addition, we included strains from six other countries. Our results suggested that these two countries in West Africa experienced at least two independent introductions of ZIKV during the 20th century, and that apparently these viral lineages were not restricted by mosquito vector species. Moreover, we present evidence that ZIKV has possibly undergone recombination in nature and that a loss of the N154 glycosylation site in the envelope protein was a possible adaptive response to the *Aedes dalzieli* vector.

ZIKV transmission cycles

Pattas monkey
Erythrocebus patas
(wadi or hussar monkey)

SYLVATIC CYCLE

Primates

Vervet monkey
Chlorocebus sabaeus

Rodents?
gerbils, *Tutex indica,*
jirds, *Meriones hurriunue*
Sheep and goats?,

URBAN CYCLE

Ae. aegypti
Ae. albopictus
Ae. hensilli ?

Ae. africanus*, *Ae. apicoargenteus*, *Ae. dalzieli,
***Ae. furcifer* (Inc males), *Ae. hirsutus*, *Ae. luteocephalus*,**
***Ae. metallicus, Ae. unilinaetus, Ae. vitattus*.**
Anopheles coustani, An. gambiae s.l.
Mansonia uniformis, Culex perfuscus

Zika virus: Spread

1947
Discovery

Adapted from National Academy presentation by R. Rosenberg

Zika virus: Spread

1947
Discovery

1954
1st Human

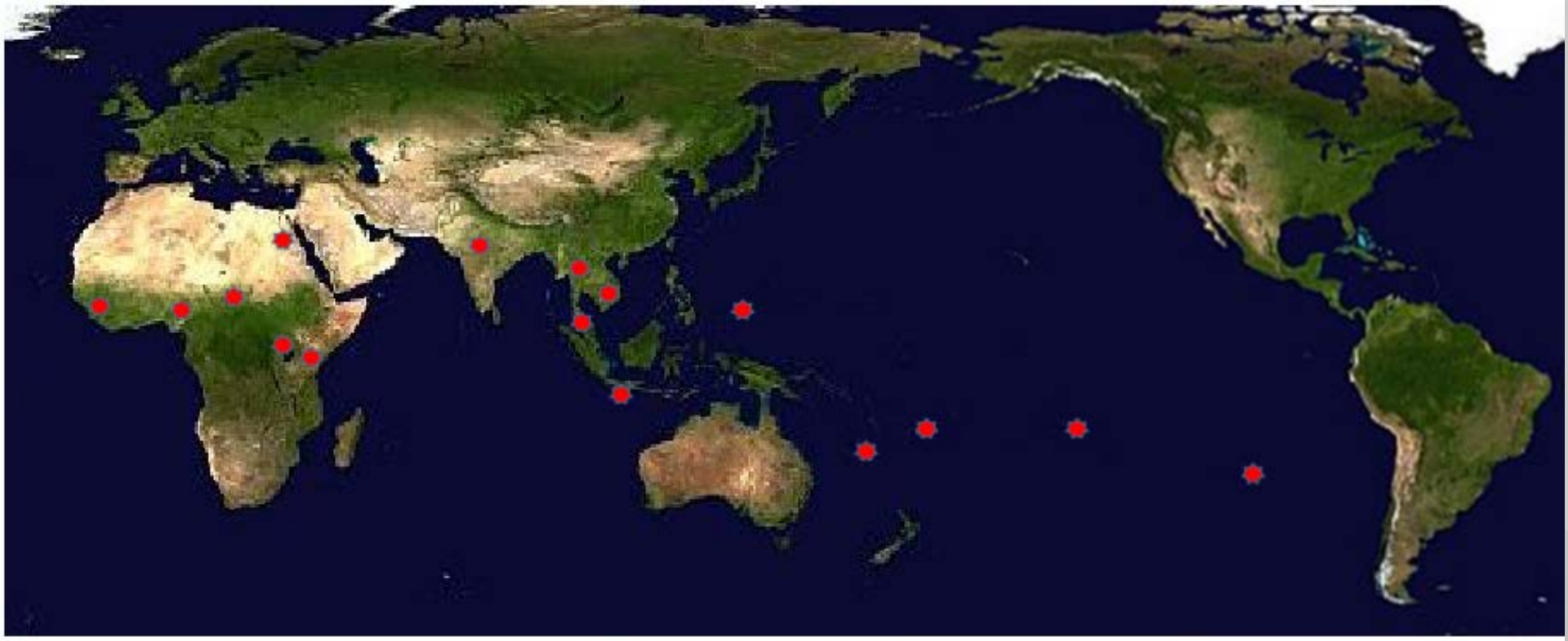
Adapted from National Academy presentation by R. Rosenberg

Zika virus: Spread

1947	1954	1954-2007
Discovery	1st Human	Asia

Adapted from National Academy presentation by R. Rosenberg

Zika virus: Spread



1947	1954	1954-2007	2007-2014
Discovery	1st Human	Asia	Pacific

Adapted from National Academy presentation by R. Rosenberg

Zika virus: Yap Island

Adapted from National Academy presentation by R. Rosenberg

Zika virus: Yap Island

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Zika Virus Outbreak on Yap Island, Federated States of Micronesia

Mark R. Duffy, D.V.M., M.P.H., Tai-Ho Chen, M.D., W. Thane Hancock, M.D., M.P.H., Ann M. Powers, Ph.D., Jacob L. Kool, M.D., Ph.D., Robert S. Lanciotti, Ph.D., Moses Pretrick, B.S., Maria Marfel, B.S., Stacey Holzbauer, D.V.M., M.P.H., Christine Dubray, M.D., M.P.H., Laurent Guillaumot, M.S., Anne Griggs, M.P.H., Martin Bel, M.D., Amy J. Lambert, M.S., Janeen Laven, B.S., Olga Kosoy, M.S., Amanda Panella, M.P.H., Brad J. Biggerstaff, Ph.D., Marc Fischer, M.D., M.P.H., and Edward B. Hayes, M.D.

Zika virus: Yap Island

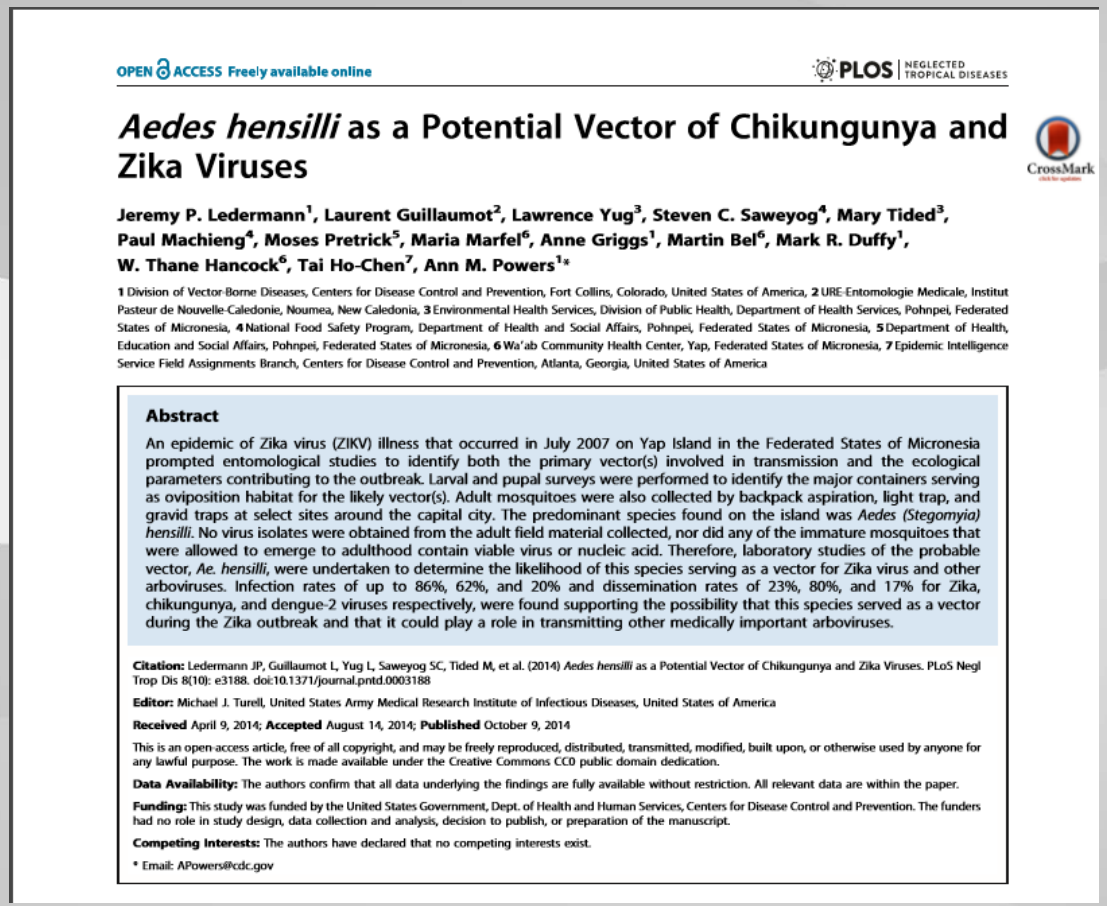
49 confirmed and 59 probable cases of Zika virus disease. Most patients had mild illness.

Rash, fever, arthralgia, and conjunctivitis were common symptoms. No hospitalizations, hemorrhagic manifestations, or deaths due to Zika virus were reported.

Estimated that 73% of Yap residents 3 years of age or older were infected with Zika virus (more than 900 people in total).

The mosquito vector was not identified but *Aedes hensilli* was the predominant mosquito species identified.

Zika virus: Yap Island



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PLOS | NEGLECTED TROPICAL DISEASES

Aedes hensilli as a Potential Vector of Chikungunya and Zika Viruses

Jeremy P. Ledermann[1], Laurent Guillaumot[2], Lawrence Yug[3], Steven C. Saweyog[4], Mary Tided[3], Paul Machieng[4], Moses Pretrick[5], Maria Marfel[6], Anne Griggs[1], Martin Bel[6], Mark R. Duffy[1], W. Thane Hancock[6], Tai Ho-Chen[7], Ann M. Powers[1]*

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Abstract

An epidemic of Zika virus (ZIKV) illness that occurred in July 2007 on Yap Island in the Federated States of Micronesia prompted entomological studies to identify both the primary vector(s) involved in transmission and the ecological parameters contributing to the outbreak. Larval and pupal surveys were performed to identify the major containers serving as oviposition habitat for the likely vector(s). Adult mosquitoes were also collected by backpack aspiration, light trap, and gravid traps at select sites around the capital city. The predominant species found on the island was *Aedes (Stegomyia) hensilli*. No virus isolates were obtained from the adult field material collected, nor did any of the immature mosquitoes that were allowed to emerge to adulthood contain viable virus or nucleic acid. Therefore, laboratory studies of the probable vector, *Ae. hensilli*, were undertaken to determine the likelihood of this species serving as a vector for Zika virus and other arboviruses. Infection rates of up to 86%, 62%, and 20% and dissemination rates of 23%, 80%, and 17% for Zika, chikungunya, and dengue-2 viruses respectively, were found supporting the possibility that this species served as a vector during the Zika outbreak and that it could play a role in transmitting other medically important arboviruses.

Citation: Ledermann JP, Guillaumot L, Yug L, Saweyog SC, Tided M, et al. (2014) *Aedes hensilli* as a Potential Vector of Chikungunya and Zika Viruses. PLoS Negl Trop Dis 8(10): e3188. doi:10.1371/journal.pntd.0003188

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Data Availability: The authors confirm that all data underlying the findings are fully available without restriction. All relevant data are within the paper.

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Competing Interests: The authors have declared that no competing interests exist.

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Infection rates of up to 86%, 62%, and 20% and dissemination rates of 23%, 80%, and 17% for Zika, chikungunya, and dengue-2 viruses respectively,

Zika virus: South Pacific Outbreaks

2013 – French Polynesia

- Estimated 28,000 (11% population) – clinically similar to Yap, but…
- First suspect association Guillan-Barré syndrome
- 2015 retrospective case review: increase in microcephaly
- 2014 – New Caledonia, Cook Islands, Solomons, Easter Island
- Asian genotype – Yap, Cambodia

Zika virus: Perinatal transmission

RAPID COMMUNICATIONS

Evidence of perinatal transmission of Zika virus, French Polynesia, December 2013 and February 2014

M Besnard[1], S Lastère[1], A Teissier[2], V M Cao-Lormeau[2], D Musso (dmusso@ilm.pf)[2]
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2. Institut Louis Malardé, Tahiti, French Polynesia

Citation style for this article:
Besnard M, Lastère S, Teissier A, Cao-Lormeau VM, Musso D. Evidence of perinatal transmission of Zika virus, French Polynesia, December 2013 and February 2014 . Euro Surveill. 2014;19(13):pii=20751. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20751

Article submitted on 20 March 2014 / published on 3 April 2014

A Zika virus (ZIKAV) outbreak started in October 2013 in French Polynesia, South Pacific. We describe here the clinical and laboratory features of two mothers and their newborns who had ZIKAV infection as confirmed by ZIKAV RT-PCR performed on serum collected within four days post-delivery in date. The infants' infection most probably occurred by transplacental transmission or during delivery. Attention should be paid to ZIKAV-infected pregnant women and their newborns, as data on the impact on them are limited.

Since October 2013, French Polynesia has experienced the largest outbreak of Zika virus (ZIKAV) infection ever reported, with an estimate of 28,000 ZIKAV infections in early February 2014 (about 11% of the population) [1,2]. We report here evidence of perinatal transmission of ZIKAV in French Polynesia in December 2013

for premature newborns was started due to hypoglycaemia and breastfeeding was started, in addition, from the third day post-delivery (day 3). On day 3, the mother presented a mild fever (37.5–38 °C) with pruritic rash and myalgia. The following day, after a three-hour ultraviolet light session for neonatal jaundice, the newborn presented transiently an isolated diffuse rash. Both mother and infant evolved favourably.

Laboratory features

All available samples collected from Mother 1 and Newborn 1 until day 3 and from Mother 2 and Newborn 2 until day 13 were tested for ZIKAV and dengue virus (DENV). No other pathogens were tested for, given the co-circulation of DENV (serotypes 1 and 3) [3] and ZIKAV.

Zika virus: Guillain-Barre

RAPID COMMUNICATIONS

Zika virus infection complicated by Guillain-Barré syndrome – case report, French Polynesia, December 2013

E Oehler (erwan.oehler@cht.pf)[1], L Watrin[2], P Larre[2], I Leparc-Goffart[3], S Lastère[4], F Valour[1], L Baudouin[5], H P Mallet[6], D Musso[7], F Ghawche[2]

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6. Bureau de veille sanitaire – Direction de la Santé, Papeete, Tahiti, French Polynesia
7. Louis Mallardé Institute, Papeete, Tahiti, French Polynesia

Citation style for this article:
Oehler E, Watrin L, Larre P, Leparc-Goffart I, Lastère S, Valour F, Baudouin L, Mallet HP, Musso D, Ghawche F. Zika virus infection complicated by Guillain-Barré syndrome – case report, French Polynesia, December 2013. Euro Surveill. 2014;19(9):pii=20720. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20720

Article submitted on 07 February 2014/ published on 06 March 2014

Zika fever, considered as an emerging disease of arboviral origin, because of its expanding geographic area, is known as a benign infection usually presenting as an influenza-like illness with cutaneous rash. So far, Zika virus infection has never led to hospitalisation. We describe the first case of Guillain–Barré syndrome (GBS) occurring immediately after a Zika virus infection, during the current Zika and type 1 and 3 dengue fever co-epidemics in French Polynesia.

elevated distal motor latency, elongated F-wave, conduction block and acute denervation, without axonal abnormalities. The administration of intravenous polyvalent immunoglobulin (0.4 g/kg/day for 5 days) allowed a favourable evolution, with no respiratory impairment necessitating tracheotomy or intensive care unit monitoring, and the patient was discharged home at Day 13. Paraparesis persisted after the end of hospitalisation, that imposed the use of a walking frame, and the facial palsy slowly disappeared. At Day

Zika virus: Spread

Adapted from National Academy presentation by R. Rosenberg

Zika Virus in Brazil, May 2015

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Brazil has confirmed cases of Zika virus infection

by WAYNE GHESQUIERE on MAY 19, 2015

Since May 14, 2015, Brazil's Ministry of Health has reported 16 Zika virus. This is the first report of this virus in Brazil.

Zika virus is spread to humans through the bite of infected mos mosquito is from the same family as the dengue mosquito (den breakbone fever". Symptoms usually appear 3-12 days followi days. Symptoms are generally mild and can include :

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SECTIONS

Opinion

Brazil

Ministry of Health Confirms 16 Cases of Zika Virus in Brazil

05/15/2015 - 08H54

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Brazil's Ministry of Health has confirmed that 16 patients were infected by the zika virus. The infectious agent, unprecedented in the country, is transmitted by the mosquito Aedes aegypti, the same vector as dengue fever.

According to the Health Minister, Arthur Chioro, eight patients are from Camaçari city, in the State of Bahia.

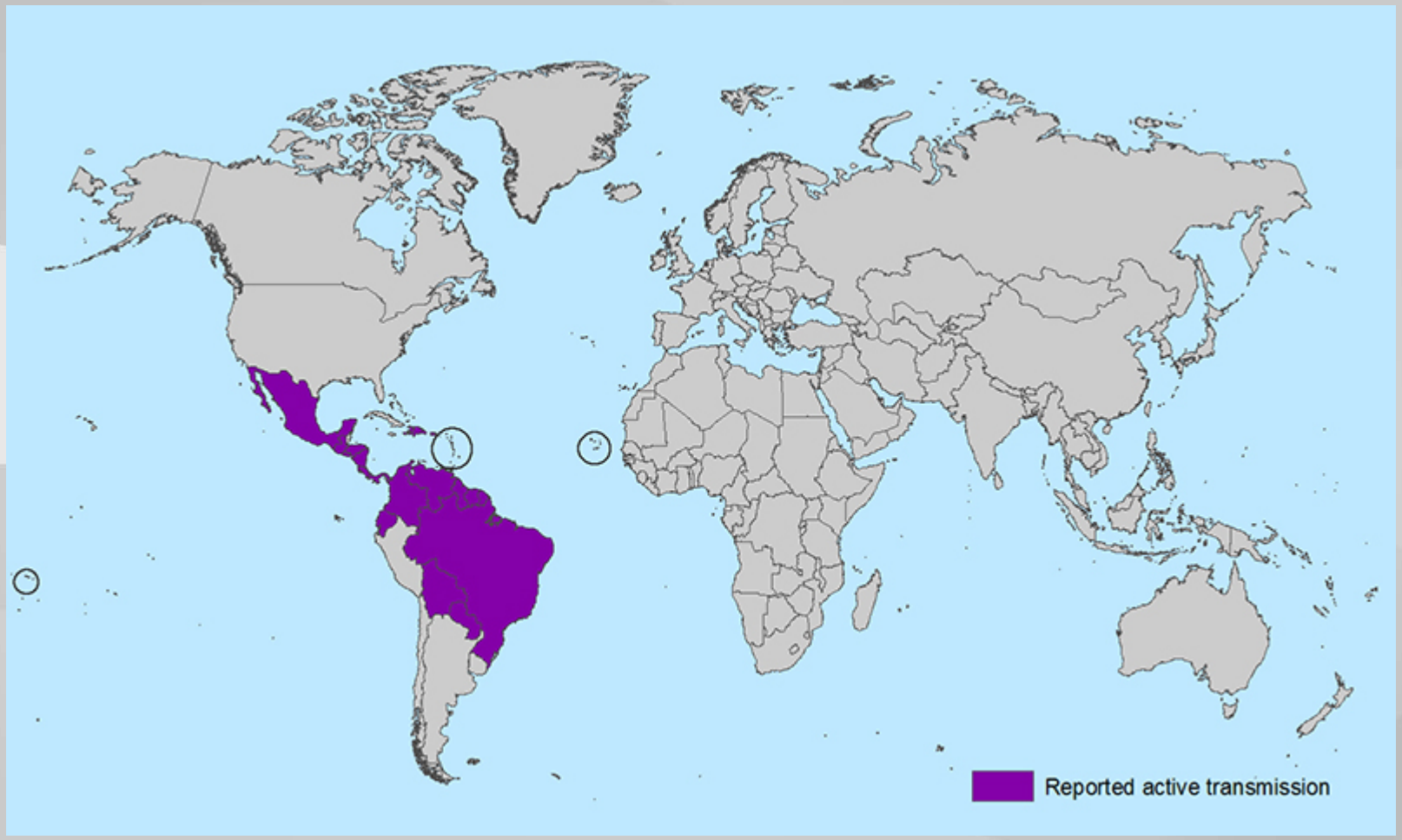
The other cases were confirmed in cities of Rio Grande do Norte. The number could rise, as other 1,200 cases, mostly in the Northeast, are still being investigated.

Researchers at the UFBA (Federal University of Bahia) who were investigating a "mysterious disease" in the Northeast - as **Folha** published in early May -, identified the virus.

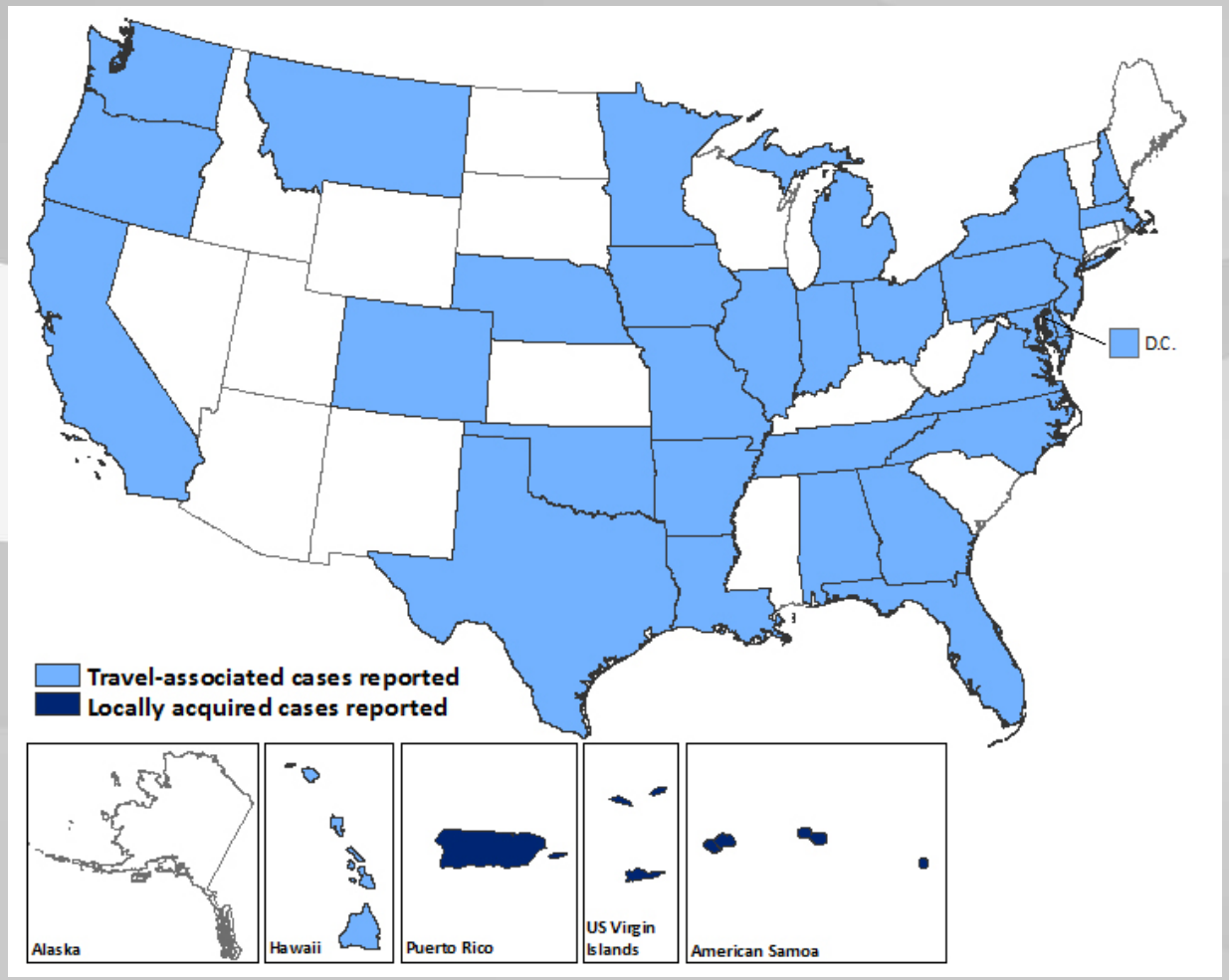
The suspicion is that it has arrived in Brazil with tourists at the World Cup.

Chioro believes the existence of confirmed cases of zika virus in the country "does not worry".

Zika Case Distribution: February 3, 2016



Zika Case Distribution by Week: March 9



193 travel associated cases
0 locally transmitted cases

US territories
1 travel
173 local

http://www.cdc.gov/zika/geo/united-states.html

Zika virus: Peru

Only 4 cases of Zika virus in Peru:
All are travel-related

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MOSQUITO INFECTIONS

ZIKV transmission cycles

Patas monkey
Erythrocebus patas
(wadi or hussar monkey)

SYLVATIC CYCLE

Primates

Vervet monkey
Chlorocebus sabaeus

Rodents?
gerbils, *Tutex indica,*
jirds, *Meriones hurriunue*
Sheep and goats?,

URBAN CYCLE

Ae. aegypti
Ae. albopictus
Ae. hensilli ?

Ae. africanus*, *Ae. apicoargenteus*, *Ae. dalzieli,
***Ae. furcifer* (Inc males), *Ae. hirsutus*, *Ae. luteocephalus*,**
***Ae. metallicus, Ae. unilinaetus, Ae. vitattus*.**
Anopheles coustani, An. gambiae s.l.
Mansonia uniformis, Culex perfuscus

Zika virus: Vectors

The first isolation of Zika virus from mosquito samples was made in 1948 from *Aedes africanus.,*

Lately, many other *Aedes* species have been surveyed for the detection of Zika virus, and thus far, Zika virus has been detected by RT-PCR or isolated from many mosquito species, human beings, and non-human primates.

Zika virus: Vectors

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PLOS | NEGLECTED TROPICAL DISEASES

Zika Virus in Gabon (Central Africa) – 2007: A New Threat from *Aedes albopictus*?

Gilda Grard[1]*, Mélanie Caron[1,2], Illich Manfred Mombo[1,2], Dieudonné Nkoghe[1,3], Statiana Mboui Ondo[1], Davy Jiolle[2,4], Didier Fontenille[2], Christophe Paupy[2,4], Eric Maurice Leroy[1,2]

1 UMVE, Centre International de Recherches Médicales de Franceville, Franceville, Gabon, **2** MIVEGEC, Institut de Recherche pour le Développement (IRD-224, CNRS-5290, Universités de Montpellier 1 & 2), Montpellier, France, **3** Ministère de la Santé Publique, Libreville, Gabon, **4** URES, CIRMF, Franceville, Gabon

Abstract

Background: Chikungunya and dengue viruses emerged in Gabon in 2007, with large outbreaks primarily affecting the capital Libreville and several northern towns. Both viruses subsequently spread to the south-east of the country, with new outbreaks occurring in 2010. The mosquito species *Aedes albopictus*, that was known as a secondary vector for both viruses, recently invaded the country and was the primary vector involved in the Gabonese outbreaks. We conducted a retrospective study of human sera and mosquitoes collected in Gabon from 2007 to 2010, in order to identify other circulating arboviruses.

Methodology/Principal Findings: Sample collections, including 4312 sera from patients presenting with painful febrile disease, and 4665 mosquitoes belonging to 9 species, split into 247 pools (including 137 pools of *Aedes albopictus*), were screened with molecular biology methods. Five human sera and two *Aedes albopictus* pools, all sampled in an urban setting during the 2007 outbreak, were positive for the flavivirus Zika (ZIKV). The ratio of *Aedes albopictus* pools positive for ZIKV was similar to that positive for dengue virus during the concomitant dengue outbreak suggesting similar mosquito infection rates and, presumably, underlying a human ZIKV outbreak. ZIKV sequences from the envelope and NS3 genes were amplified from a human serum sample. Phylogenetic analysis placed the Gabonese ZIKV at a basal position in the African lineage, pointing to ancestral genetic diversification and spread.

Conclusions/Significance: We provide the first direct evidence of human ZIKV infections in Gabon, and its first occurrence in the Asian tiger mosquito, *Aedes albopictus*. These data reveal an unusual natural life cycle for this virus, occurring in an urban environment, and potentially representing a new emerging threat due to this novel association with a highly invasive vector whose geographic range is still expanding across the globe.

Zika virus: Vectors

Aedes albopictus the Asian Tiger Mosquito (photo S. Higgs)

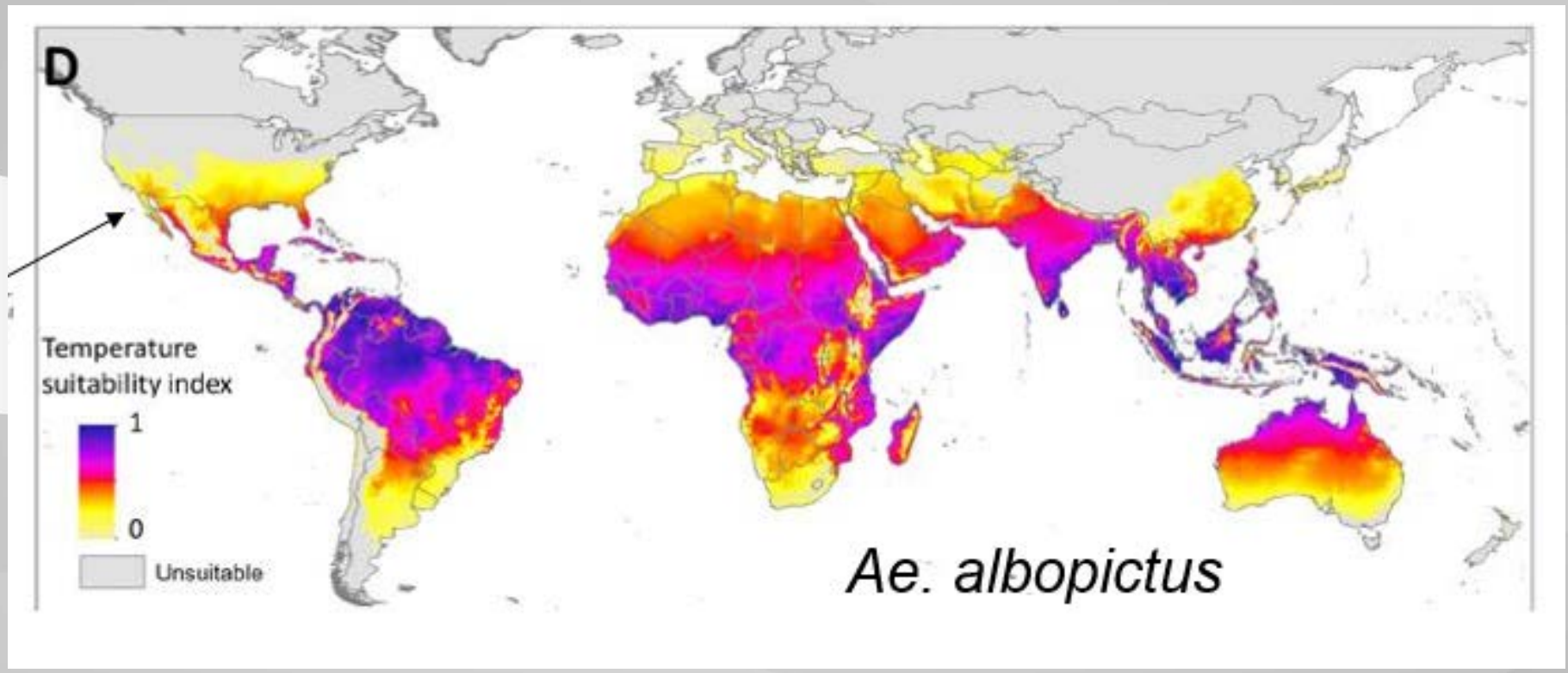
Introduced into: Europe (Albania, 1979), US (Houston, 1985), Brazil (86), Continental Africa, (Nigeria,1991), Italy (from US?, 1990), France (1999), UK (2014).

Ae. albopictus movement between countries

Between 1989 and 1994, 7.5M tyres imported into USA, (5M from 14 Asian Countries including 4.7M from Japan). 6M were exported from the USA.

Ae. albopictus movement within countries

Zika virus: Vectors



Brady et al Parasites and Vectors 2014, 7:338

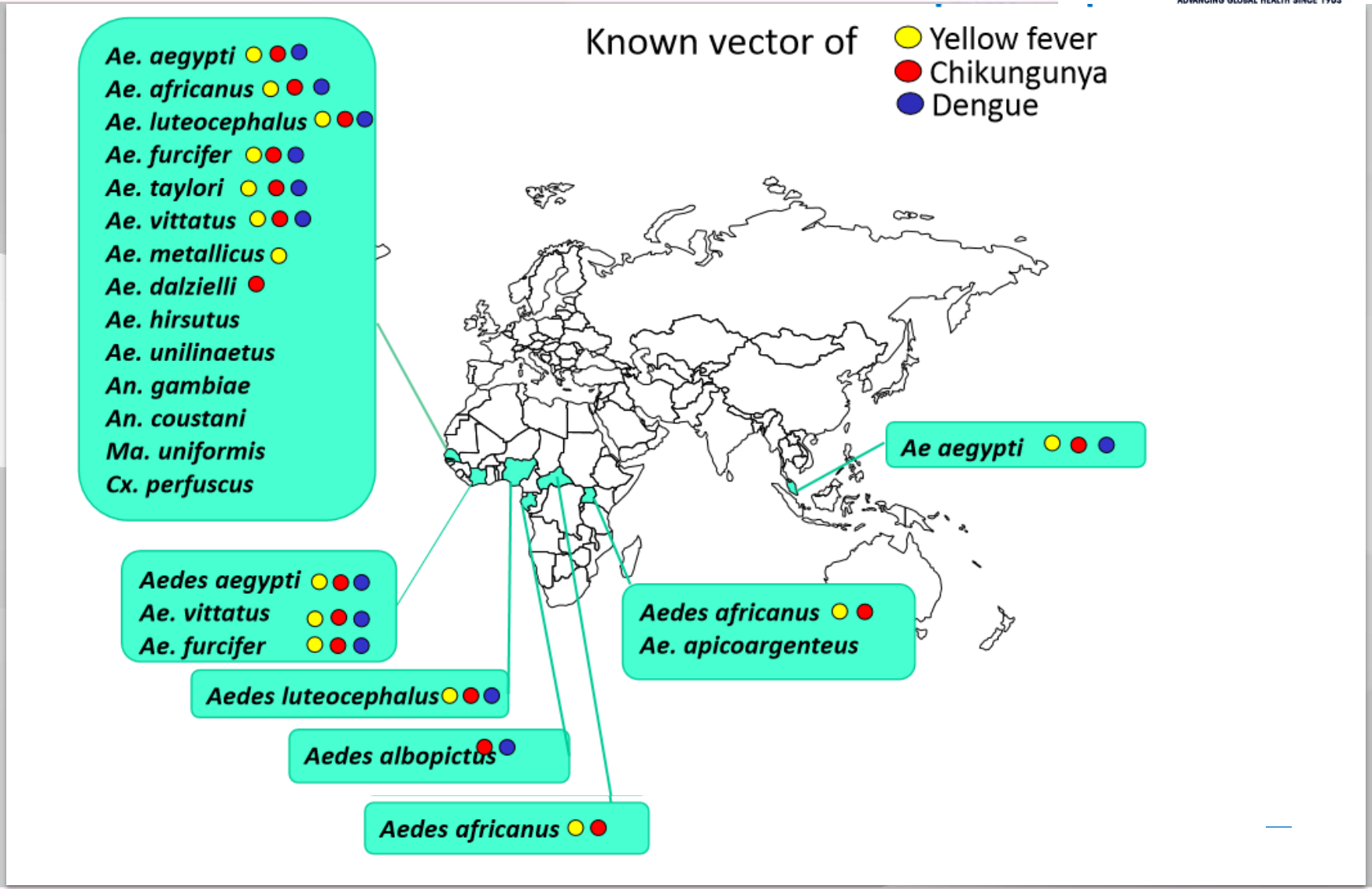
Adapted from National Academy presentation by T. Monath

ZIka virus/viral RNA have been detected in a number of \ species of mosquitoes in several genera

Aedes aegypti,
Ae. africanus,
Ae. apicoargenteus,
Ae. dalzieli
Aedes furcifer (includimg males)
Ae. hirsutus
Ae. luteocephalus
Ae. metallicus
Ae. unilinaetus
Ae. vitattus.
Anopheles coustani,
An. gambiae s.l
Mansonia uniformis
Culex perfuscus

Studies show that the extrinsic incubation period in mosquitoes is about 10 days.

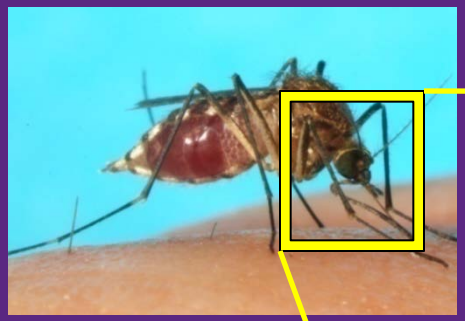
Zika virus: Vectors

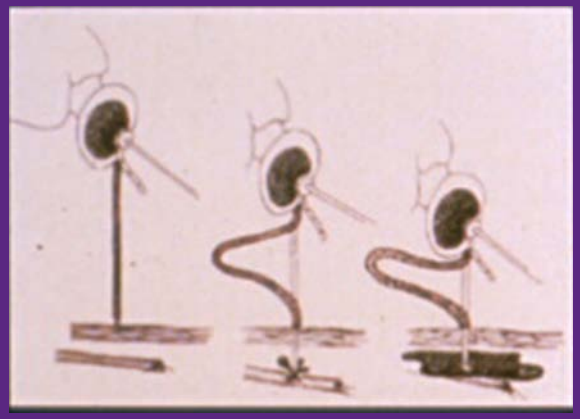


Adapted from National Academy presentation by T. Monath

Aedes albopctus

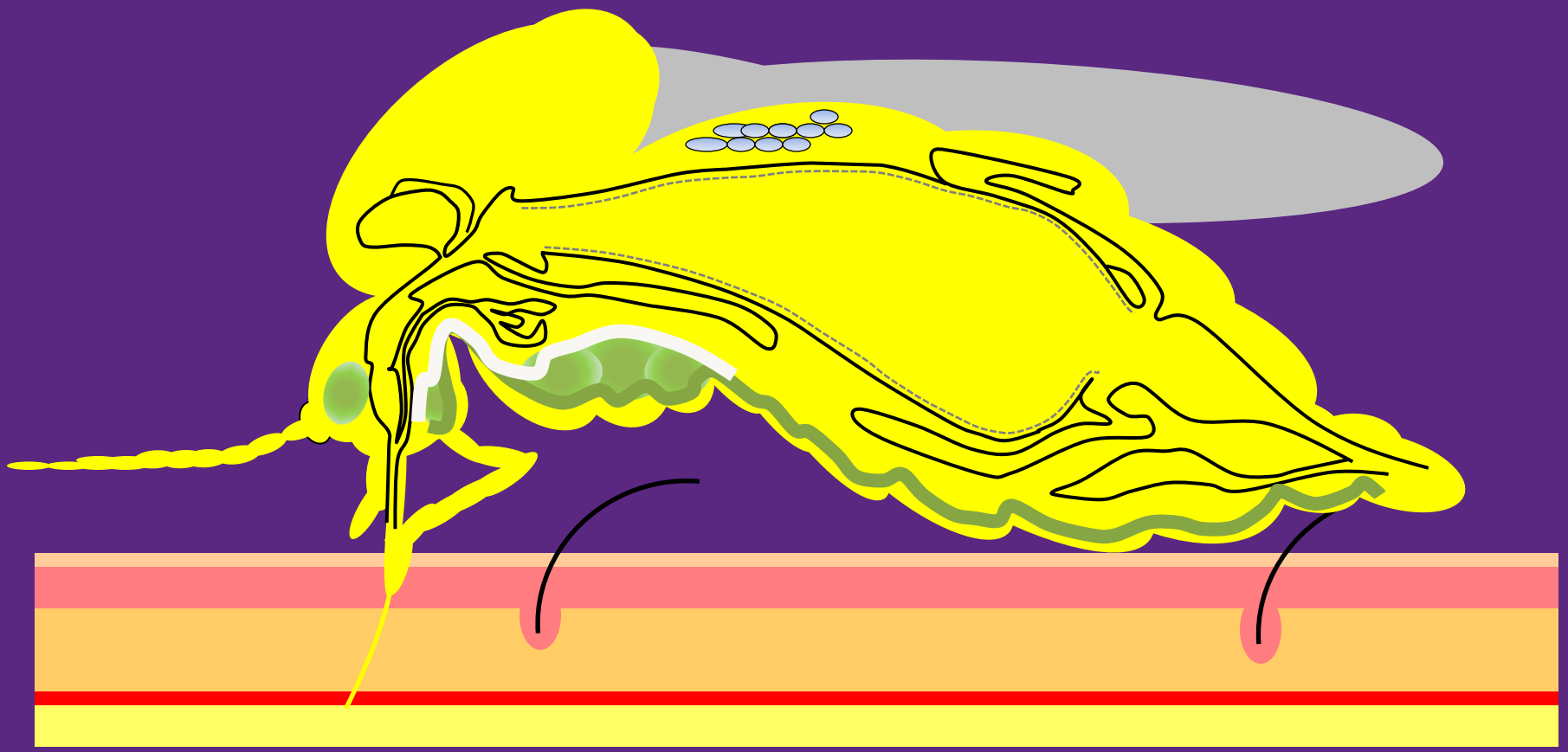
A Female Mosquito Typically Becomes Exposed Naturally to a Virus When Feeding on a Viraemic Host



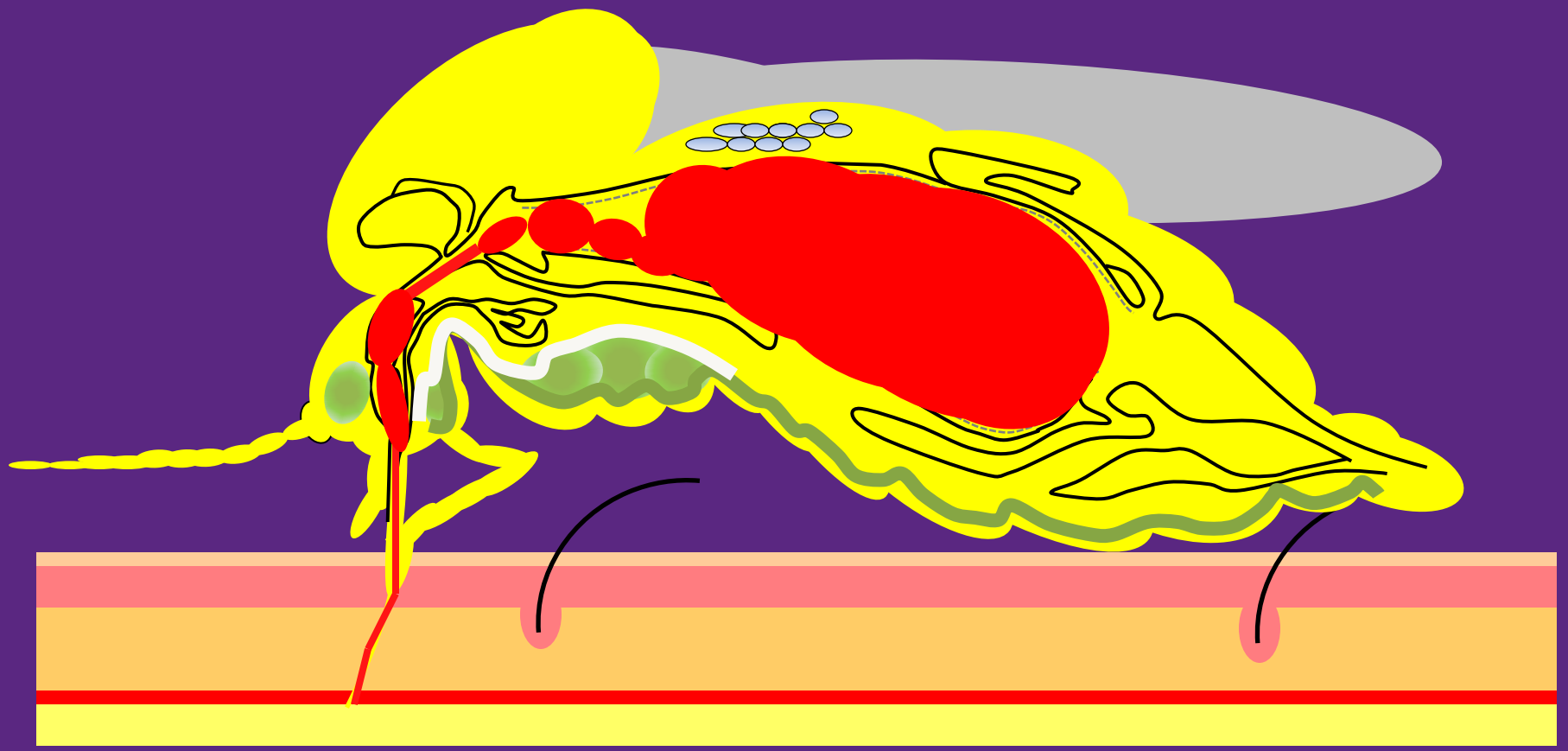


Labium (sheath) fold back as the stylets penetrate the skin to obtain blood

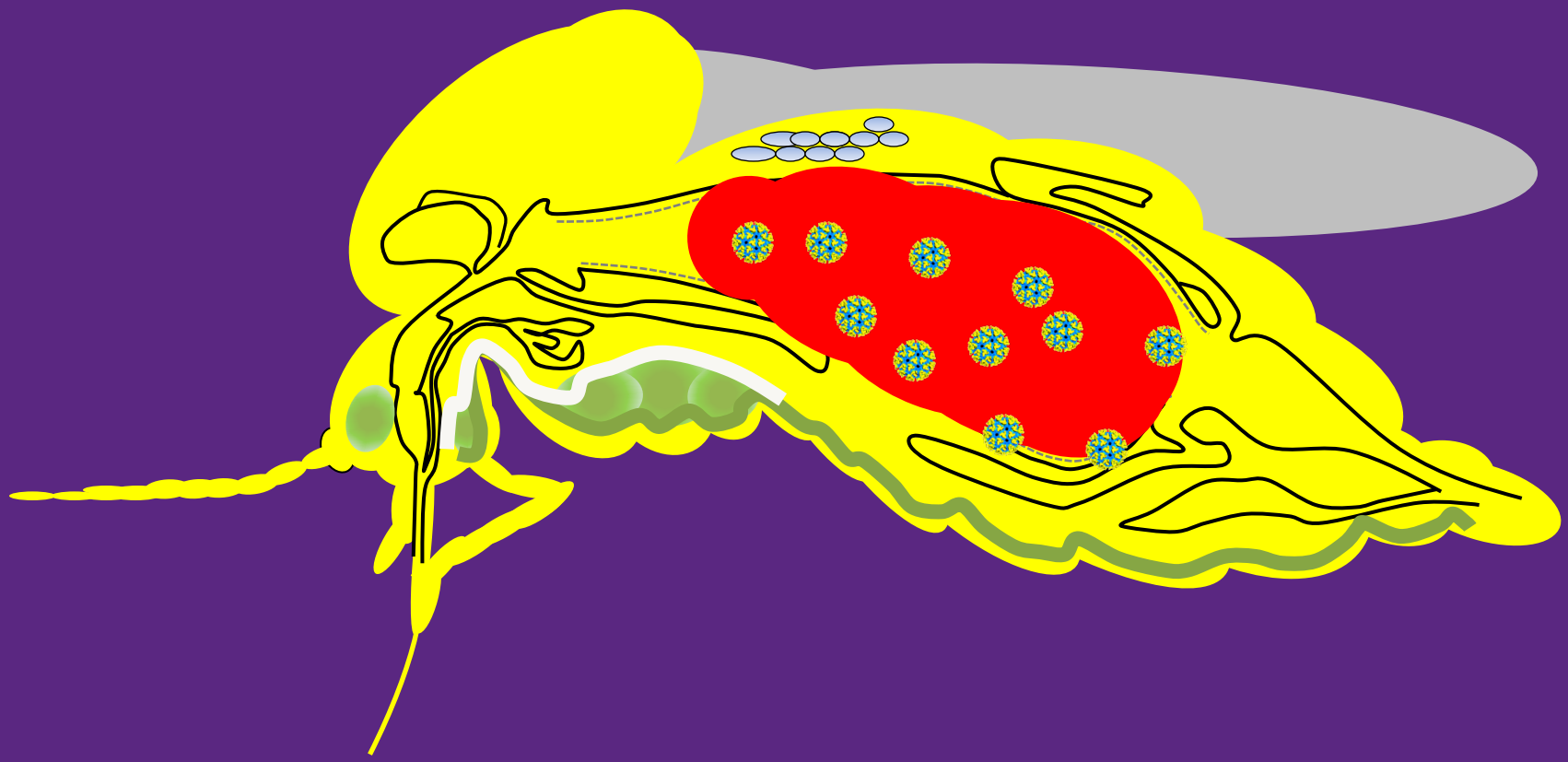
Engorgement of blood



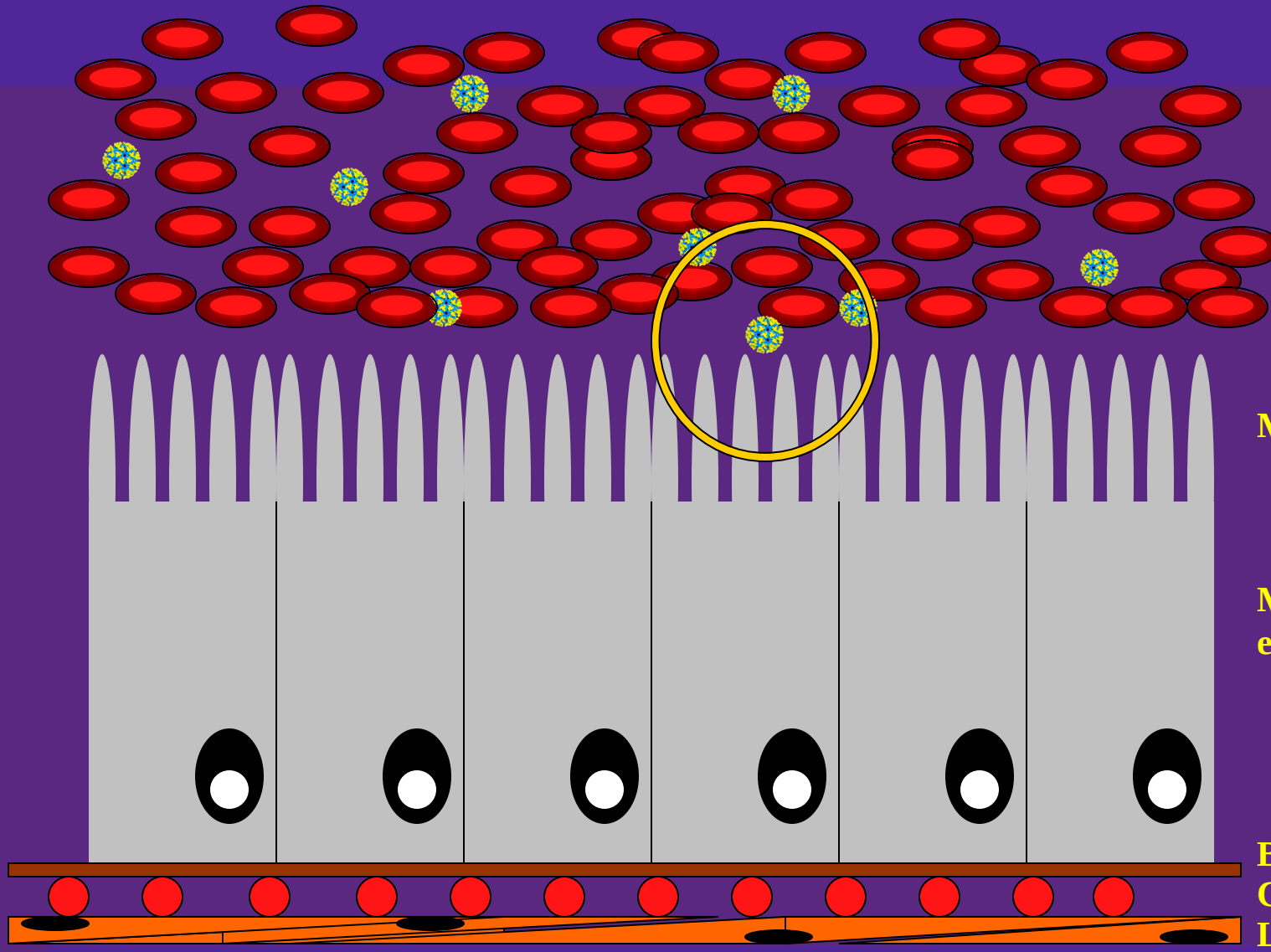
Engorgement of blood



Engorgement of blood from a viremic vertebrate



Engorgement of blood from a viremic vertebrate



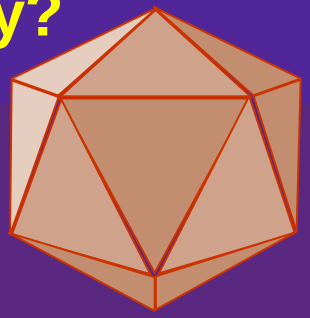
Hemocoel – “open” circulatory system in which organs are suspended

Virus Entry into Midgut Cells

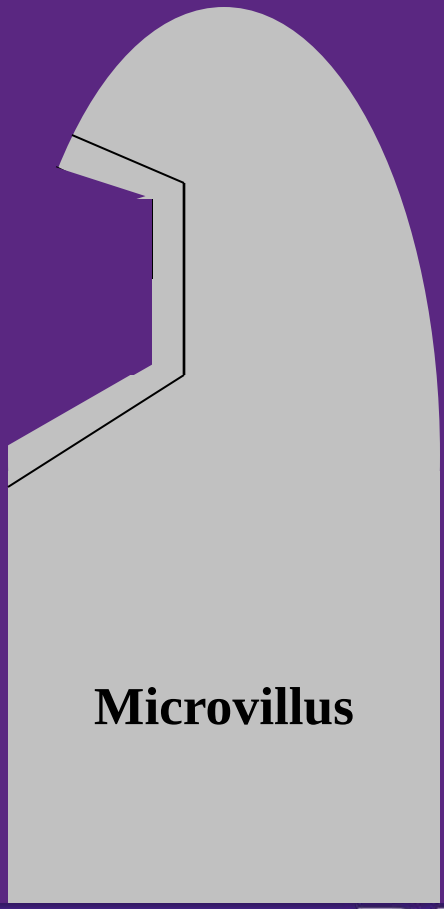
For the enveloped arboviruses, it is generally assumed that the surface structural proteins interact with receptors on the midgut epithelial cell membrane and following attachment, fusion of the viral envelope and cellular membrane occurs.

Although infection is probably a receptor-mediated event, no specific receptor has been identified in the mosquito midgut.

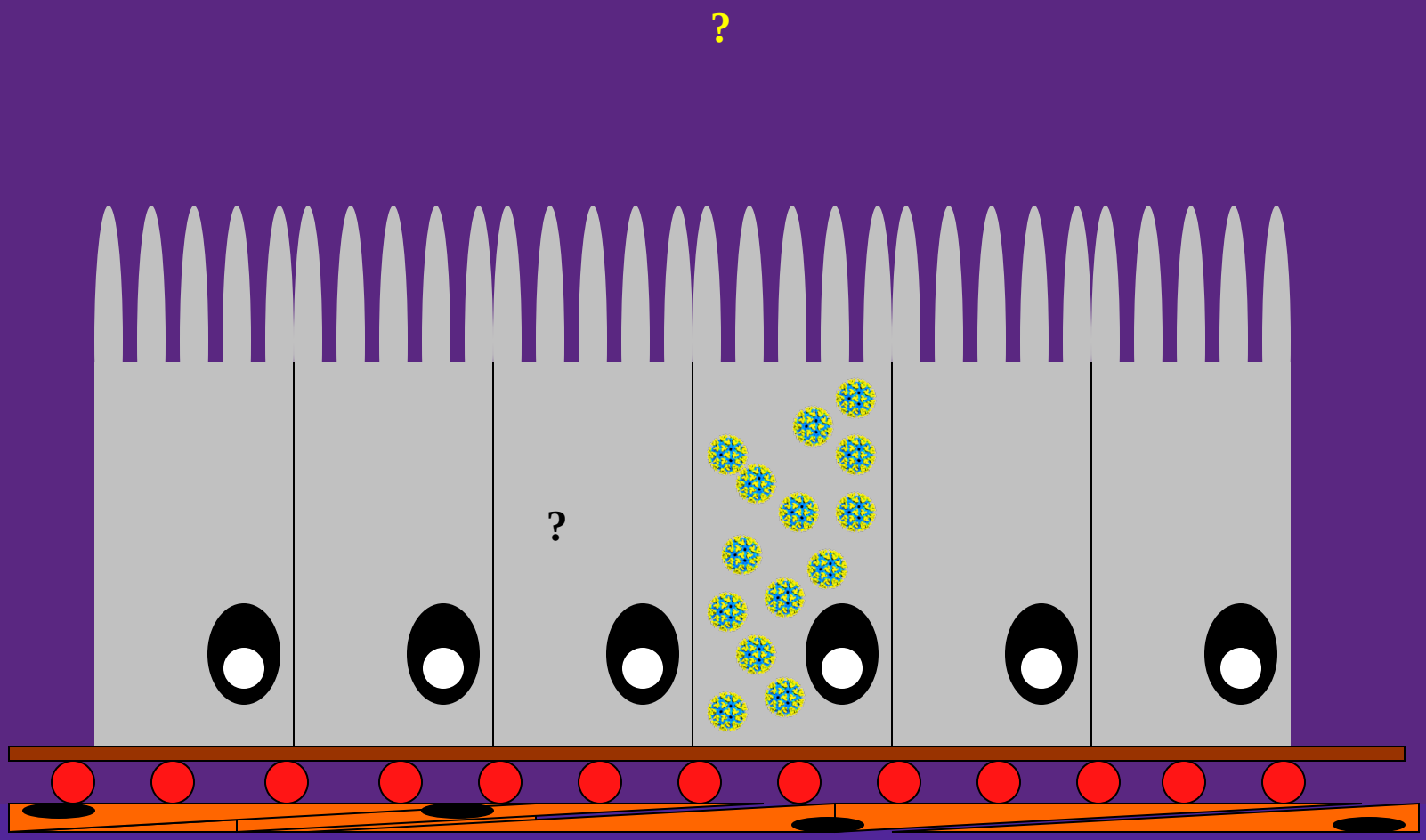
Virus infection: binding to receptor?
The basis of specificity?



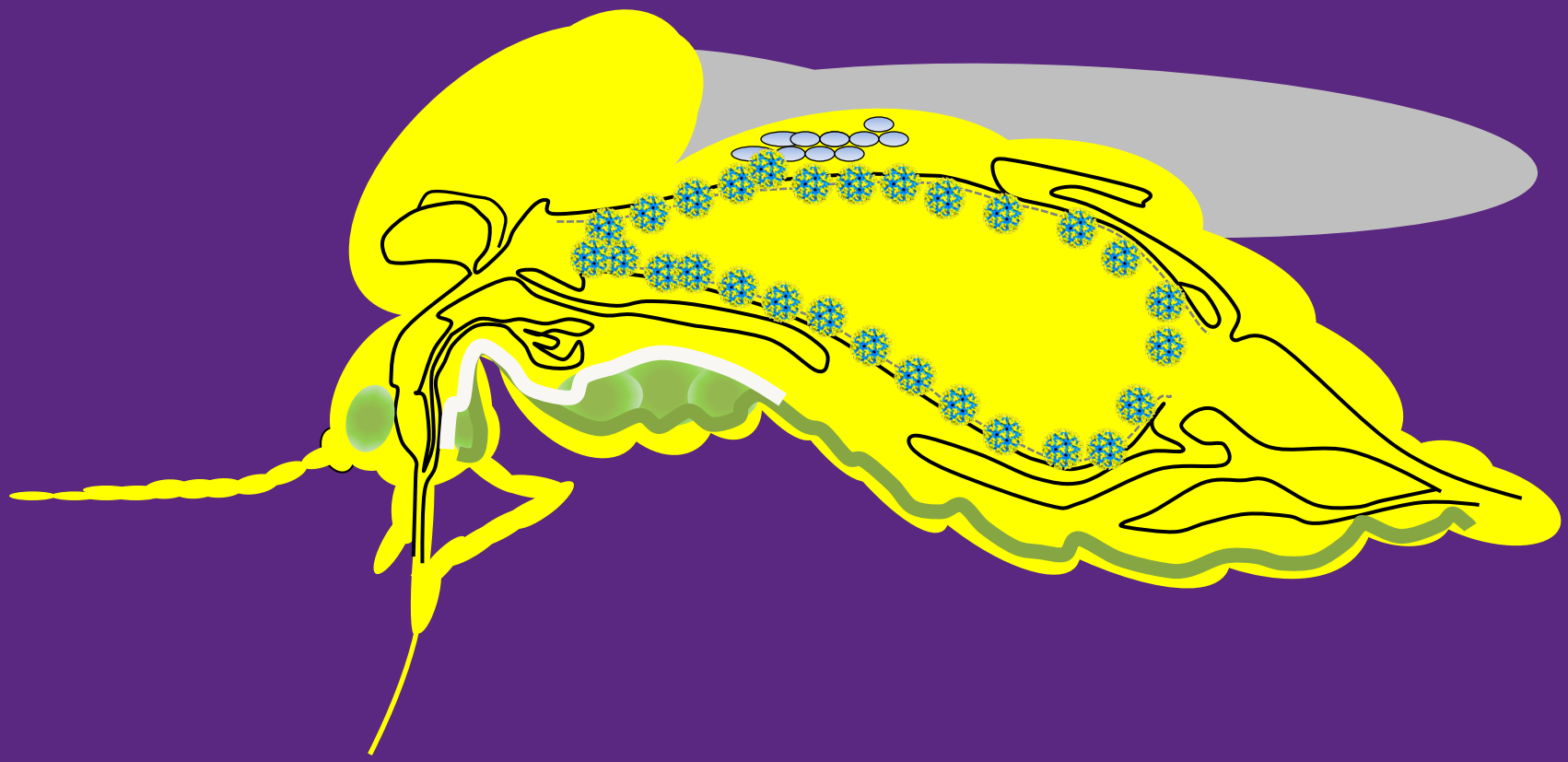
ZIKV and *Aedes aegypti/albopictus*



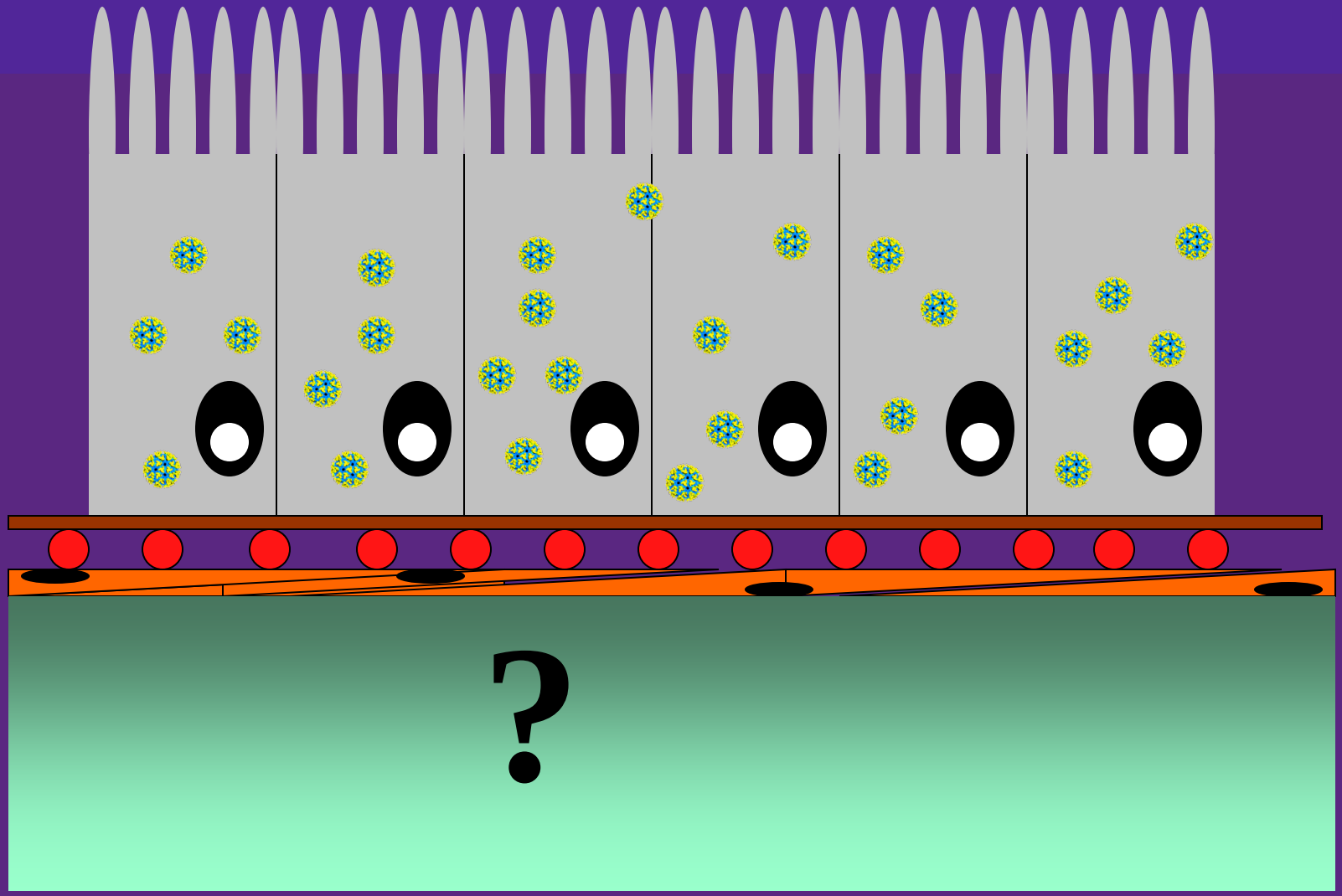
Virus replication and spread



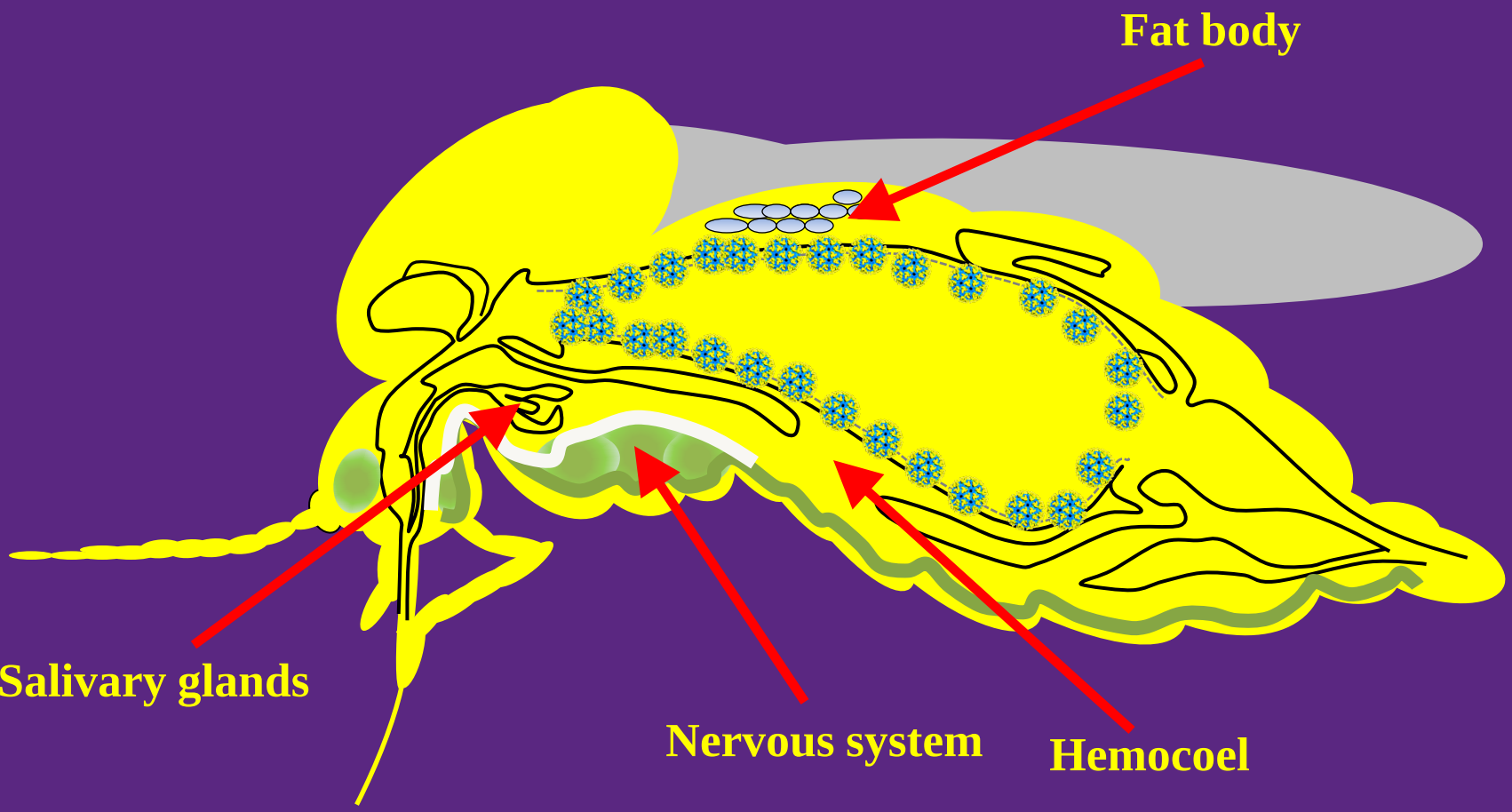
Spread of virus within midgut



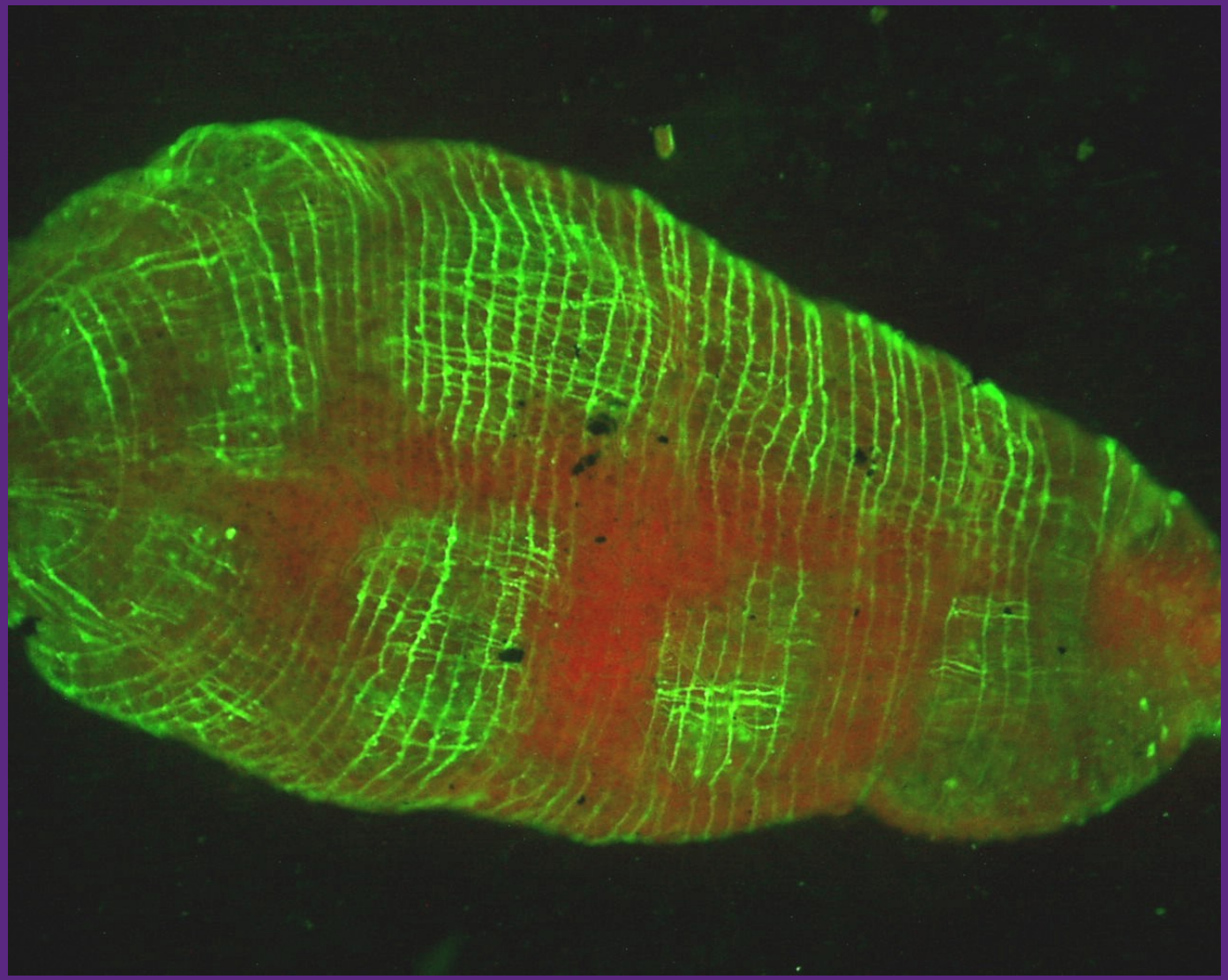
Dissemination from the midgut into the hemocoel



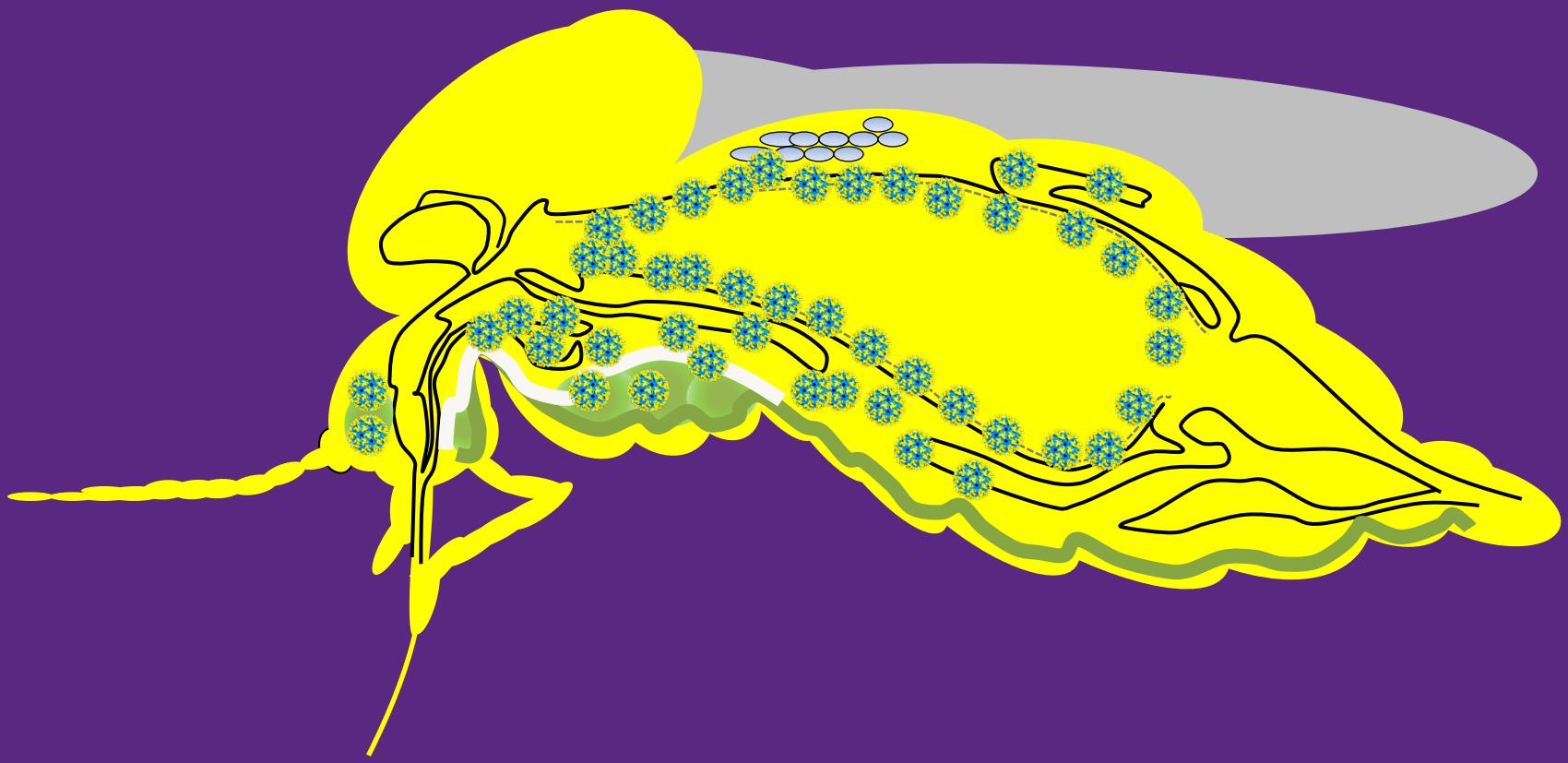
Dissemination from the midgut into the hemocoel



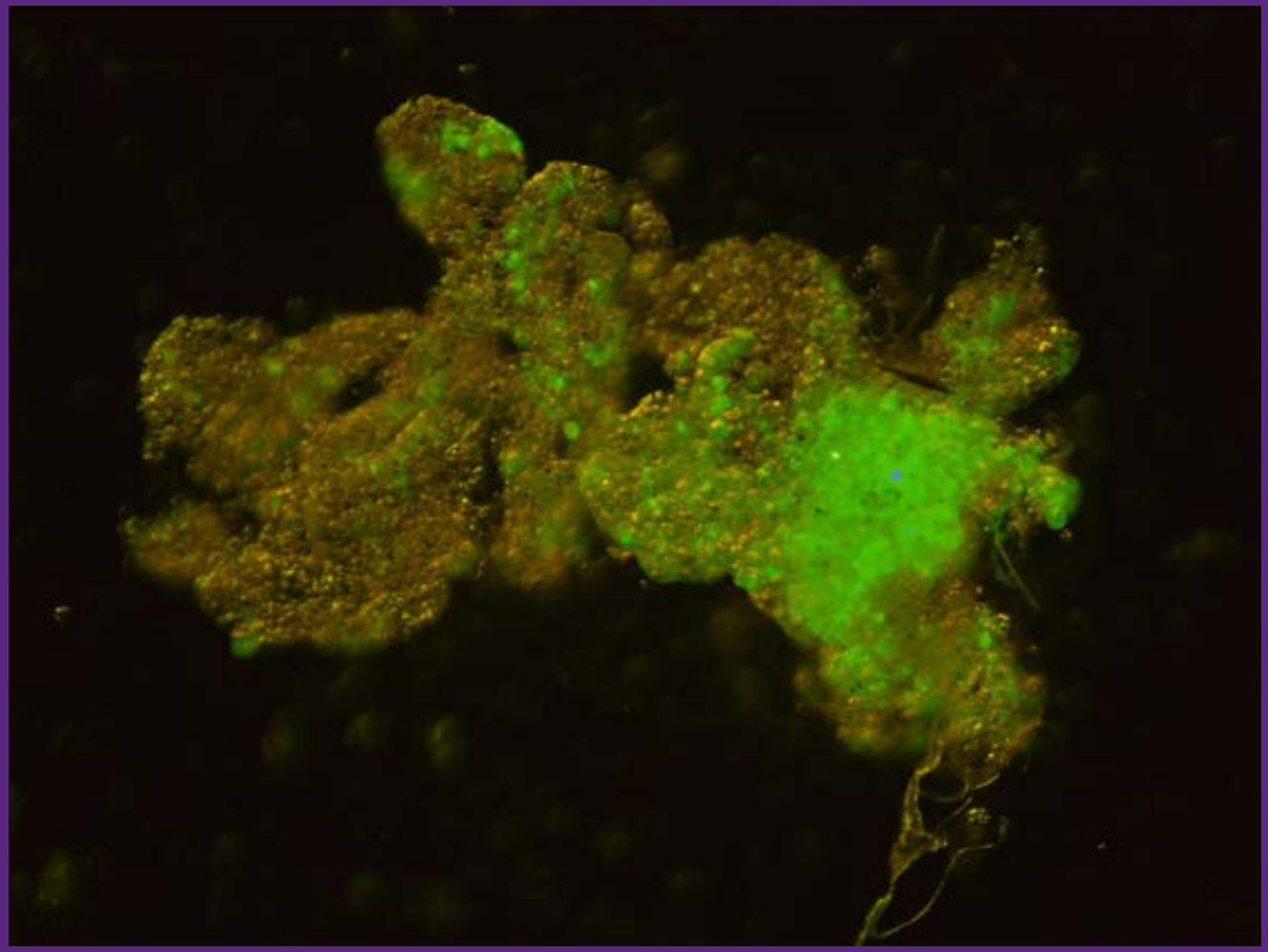
West Nile virus: Infection of muscles around the midgut



Virus replication in secondary tissues

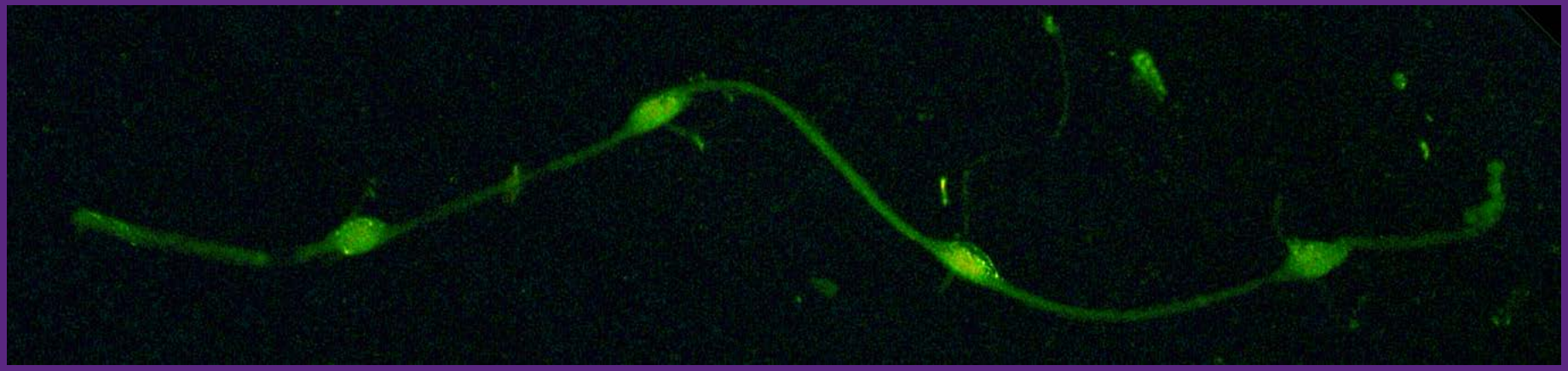


Infection of the fat body by Sindbis virus

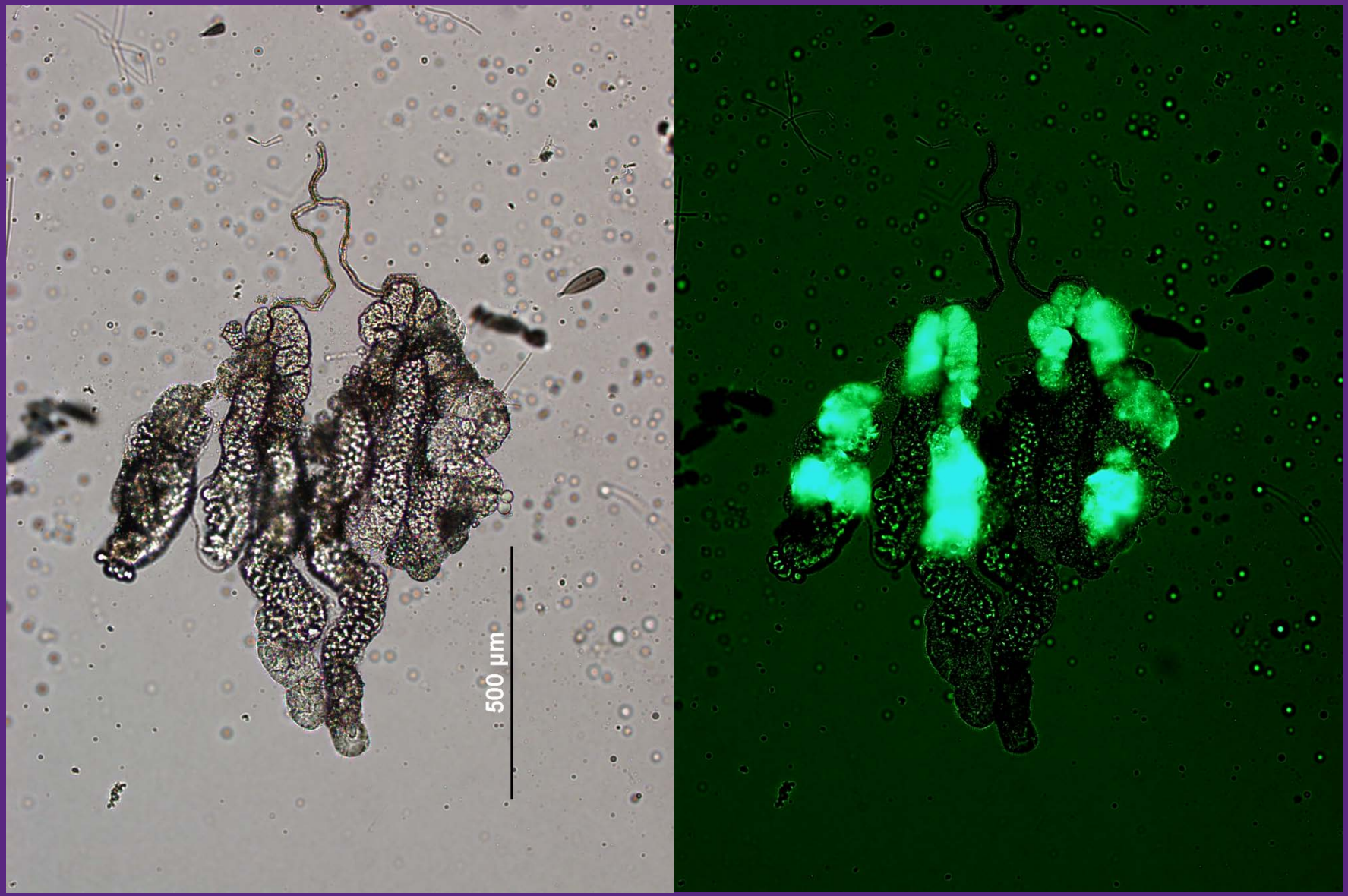


WNV in Nervous System of *Cx.p.q.* at 14 days pi

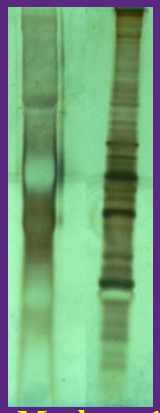
SINDV in the Ventral Nerve Chord & Abdominal Ganglia



CHIKV 5'GFP in a Pair of *Ae. albopictus* Salivary Glands



Collection of Saliva from Individual Mosquitoes for Viral or Protein Analysis.



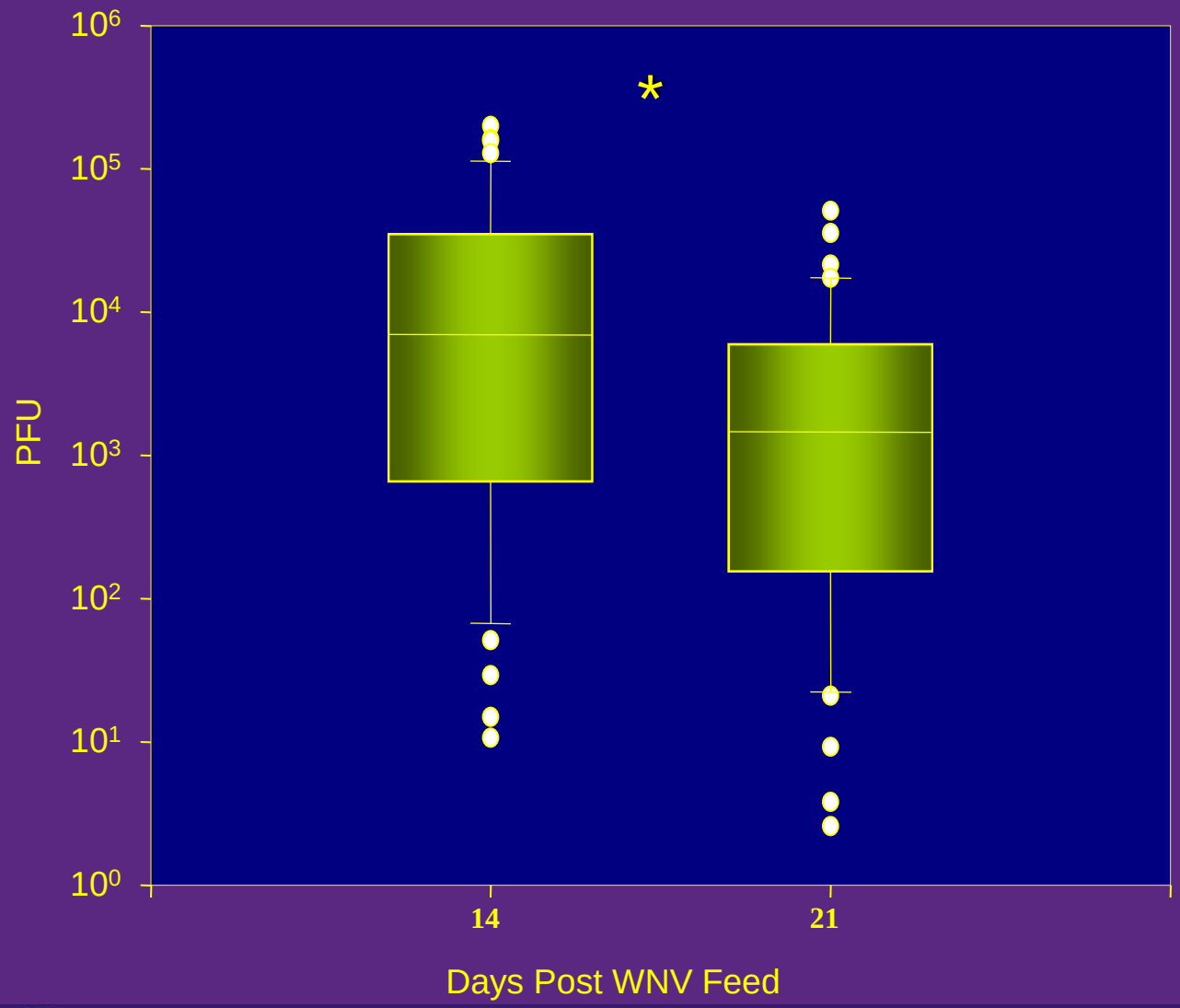
Marker 1 Female

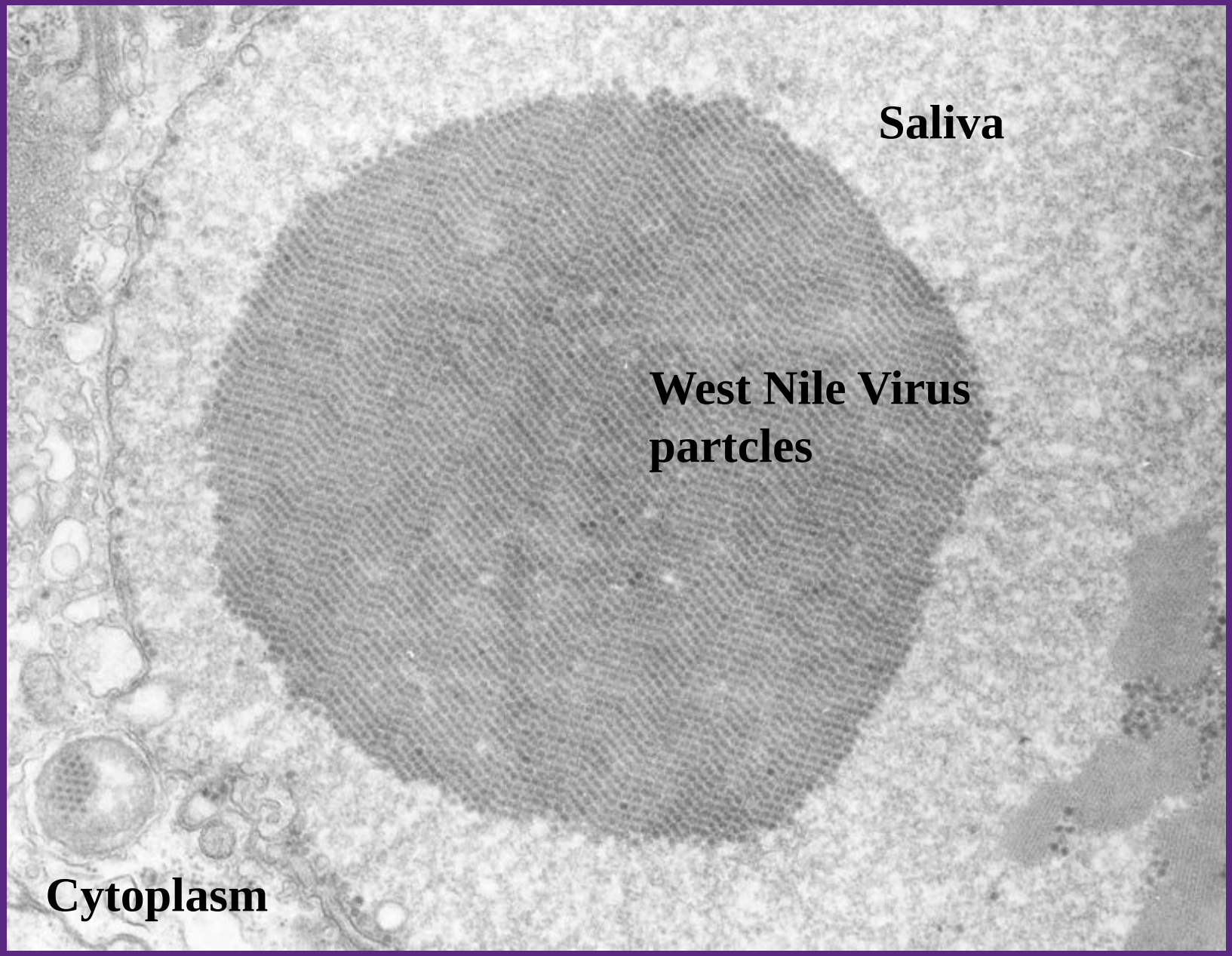
Amylase (97kDa)
Apyrase (68kDa)
Glucosidase (68kDa)

- D7 protein (37kDa)
-Sialokinin I (1.4kDa)

Salivary glands of *Aedes aegypti* 10% PAGE, silver stained

West Nile Virus in *Culex pipiens quinquefasciatus* Saliva




Saliva
West Nile Virus partcles
Cytoplasm

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HUMAN INFECTIONS

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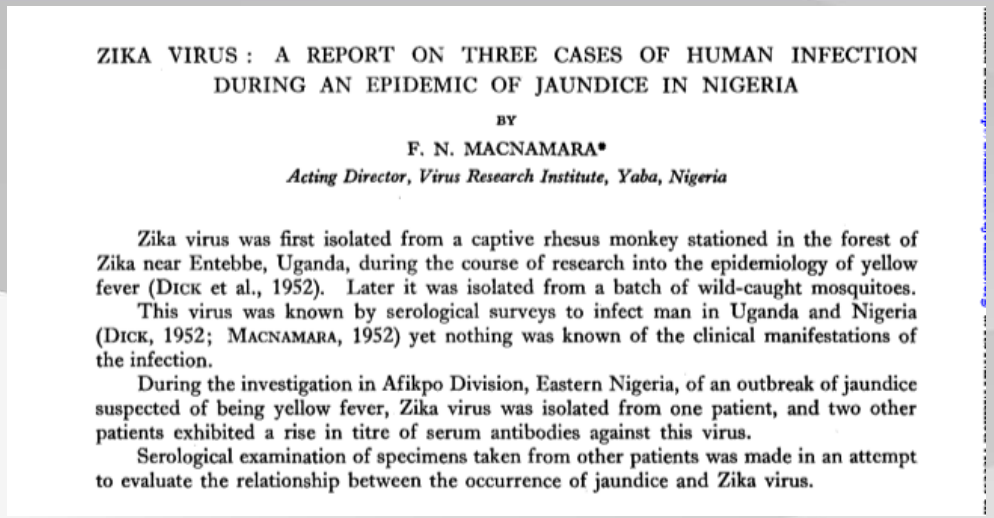
Zika virus: Human infections



ZIKA VIRUS : A REPORT ON THREE CASES OF HUMAN INFECTION DURING AN EPIDEMIC OF JAUNDICE IN NIGERIA

BY

F. N. MACNAMARA*

Acting Director, Virus Research Institute, Yaba, Nigeria

Zika virus was first isolated from a captive rhesus monkey stationed in the forest of Zika near Entebbe, Uganda, during the course of research into the epidemiology of yellow fever (DICK et al., 1952). Later it was isolated from a batch of wild-caught mosquitoes.

This virus was known by serological surveys to infect man in Uganda and Nigeria (DICK, 1952; MACNAMARA, 1952) yet nothing was known of the clinical manifestations of the infection.

During the investigation in Afikpo Division, Eastern Nigeria, of an outbreak of jaundice suspected of being yellow fever, Zika virus was isolated from one patient, and two other patients exhibited a rise in titre of serum antibodies against this virus.

Serological examination of specimens taken from other patients was made in an attempt to evaluate the relationship between the occurrence of jaundice and Zika virus.

SUMMARY

During an epidemic of jaundice in Eastern Nigeria infection with Zika virus was shown to have occurred in three patients, one by isolation of the virus and two by a rise in serum antibodies. Two of these patients gave evidence of liver damage. Serological studies indicate a relationship between jaundice and the development of virus neutralizing bodies in the serum

Zika virus: Human infections

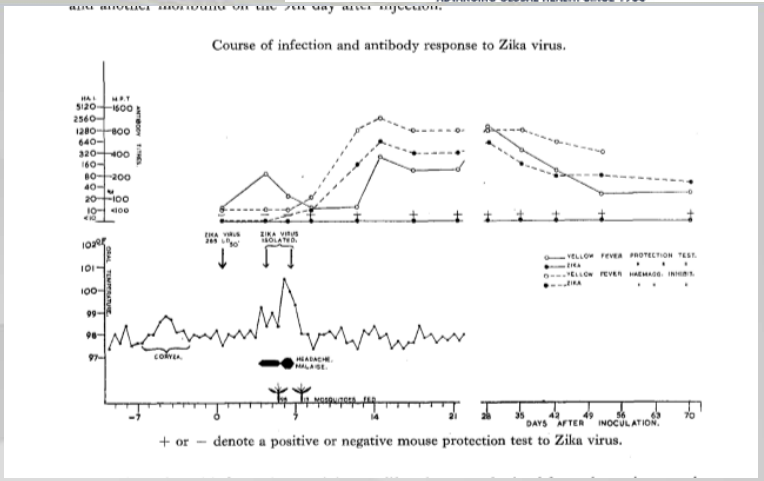
TRANSACTIONS OF THE ROYAL SOCIETY OF
TROPICAL MEDICINE AND HYGIENE.
Vol. 50. No. 5. September, 1956.

ZIKA VIRUS INFECTION EXPERIMENTALLY INDUCED IN A HUMAN VOLUNTEER

BY

W. G. C. BEARCROFT*

West African Council for Medical Research Laboratories, Lagos, Nigeria.



+ or − denote a positive or negative mouse protection test to Zika virus.

SUMMARY

(1) has been inoculated with the Eastern Nigerian strain of Zika virus.

(2) Following an incubation period of 82 hours a mild, short-lived febrile condition occurred without evidence of involvement of any particular tissue or viscus.

(3) (3) Zika virus was isolated from the blood during the febrile period.

(4) Aedes aegypti fed at the times of virus isolation failed to transmit the infection to infant white mice.

(5) A rise in serum antibody to both Zika and yellow fever viruses was demonstrated by both mouse protection and haemagglutination inhibition tests.

Zika virus: Human infections

DOI: 10.3201/eid1705.101939

Suggested citation for this article: Foy BD, Kobylinski KC, Foy JLC, Blitvich BJ, Travassos da Rosa A, Haddow AD, et al. Probable non–vector-borne transmission of Zika virus, Colorado, USA. Emerg Infect Dis. 2011 May; [Epub ahead of print]

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

Brian D. Foy, Kevin C. Kobylinski, Joy L. Chilson Foy, Bradley J. Blitvich, Amelia Travassos da Rosa, Andrew D. Haddow, Robert S. Lanciotti, and Robert B. Tesh

Zika virus: Human infections

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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 hematospermia, 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.

Zika virus (ZIKV) is a mosquitoborne arbovirus in the family *Flaviviridae*, genus *Flavivirus*. It was first isolated in 1947 from a rhesus monkey in the Zika forest of Uganda (*1*). Sporadic human cases were reported from the 1960s in Asia and Africa. The first reported large outbreak occurred in 2007 on Yap Island, Federated States of Micronesia (*2*). The largest known ZIKV outbreak reported started in October 2013 in French Polynesia, South Pacific (*3*), a territory of France comprising 67 inhabited islands; an estimated 28,000 persons (11% of the population) sought medical care for the illness (*4*). The most common symptoms of Zika fever are rash, fever, arthralgia, and conjunctivitis. Most of the patients had mild disease, but severe neurologic complications have been described in other patients in French Polynesia (*5*).

The Study

In early December 2013, during the ZIKV outbreak, a 44-year-old man in Tahiti had symptoms of ZIKV infection: asthenia, low grade fever (temperature from 37.5°C to 38°C) and arthralgia. Symptoms lasted 3 days. Eight weeks later, he described a second episode of symptoms compatible with ZIKV infection: temperature from 37.5°C to 38°C, semen confirmed hematospermia. We extracted RNA using the NucliSENS easyMAG system (bioMérieux, Marcy l'Etoile, France) from 200 µL of blood and from 500 µL of semen and urine; both were eluted by 50 µL of elution buffer. We used 5 µL of RNA extracted for amplification. We tested blood and semen RNA extracts using real-time reverse transcription PCR (rRT-PCR) as described using 2 primers/probe amplification sets specific for ZIKV (*3*). The rRT-PCR results were positive for ZIKV in semen and negative in blood, and confirmed by sequencing of the genomic position 858–1138 encompassing the prM/E protein coding regions of ZIKV. The generated sequence (GenBank accession no. KM014700) was identical to those previously reported at the beginning of the ZIKV outbreak (*3*). Three days later, we collected a urine sample, then a second set of blood and semen samples. Semen and urine from this second collection were not found to contain traces of blood by both direct and macroscopic examinations. rRT-PCR detected ZIKV RNA in the semen and urine, but not in the blood sample.

We quantified ZIKV RNA loads using an RNA synthetic transcript standard that covers the region targeted by the 2 primers/probe sets. RNA loads were: 2.9×10^7 copies/mL and 1.1×10^7 copies/mL in the first and second semen samples, respectively, and 3.8×10^3 copies/mL in the urine sample.

We cultured semen and urine as described for dengue virus cultured from urine (*6*). Briefly, 200 µL of each sample diluted in 200 µL of 1% fetal calf serum (FCS) minimum essential medium (MEM) were inoculated

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ZIKV IN THE AMERICAS

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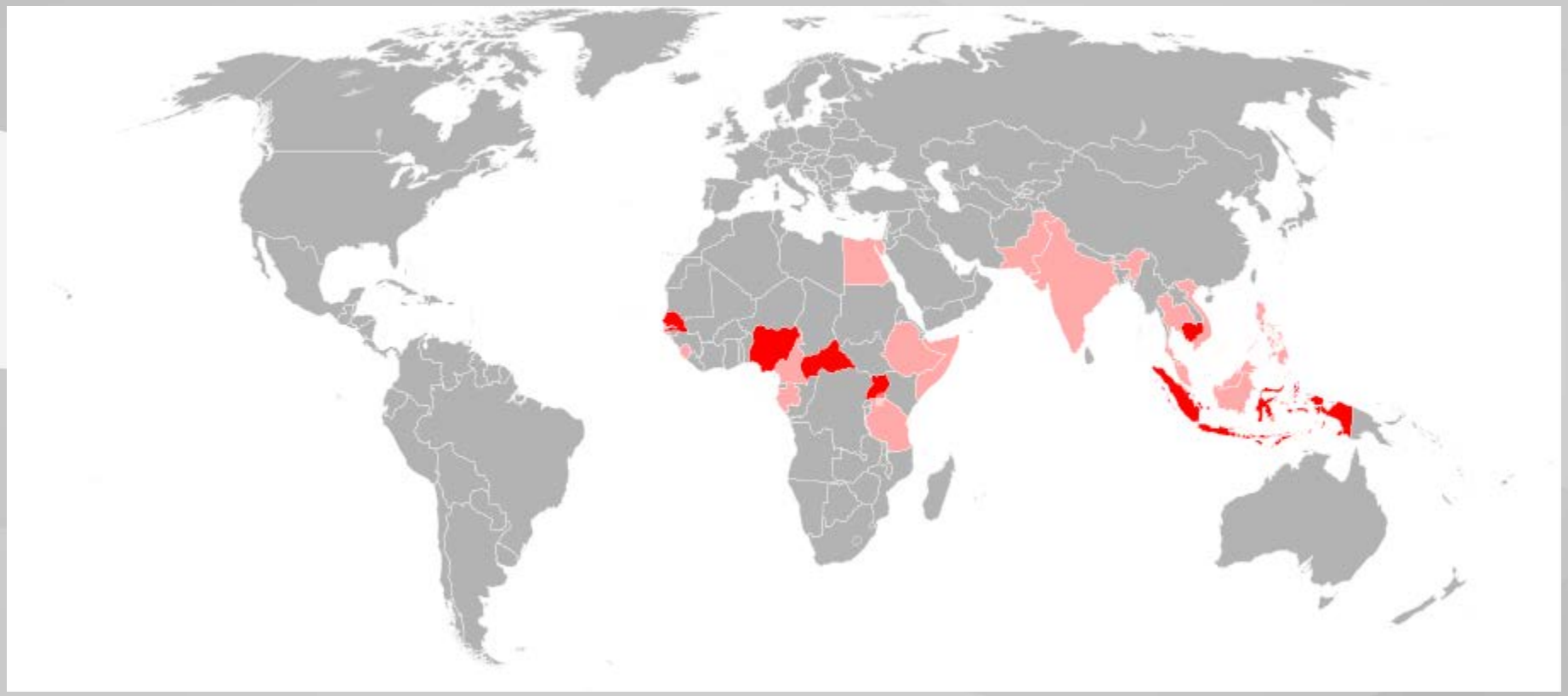
Zika Virus Global Distribution before May 2015



Zika Virus in Brazil, May 2015

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Brazil has confirmed cases of Zika virus infection

by WAYNE GHESQUIERE on MAY 19, 2015

Since May 14, 2015, Brazil's Ministry of Health has reported 16 Zika virus. This is the first report of this virus in Brazil.

Zika virus is spread to humans through the bite of infected mos mosquito is from the same family as the dengue mosquito (den breakbone fever". Symptoms usually appear 3-12 days followi days. Symptoms are generally mild and can include :

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June 2 at 2:30pm

SECTIONS

Opinion

Brazil

Ministry of Health Confirms 16 Cases of Zika Virus in Brazil

05/15/2015 - 08H54

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FROM BRASÍLIA

Brazil's Ministry of Health has confirmed that 16 patients were infected by the zika virus. The infectious agent, unprecedented in the country, is transmitted by the mosquito Aedes aegypti, the same vector as dengue fever.

According to the Health Minister, Arthur Chioro, eight patients are from Camaçari city, in the State of Bahia.

The other cases were confirmed in cities of Rio Grande do Norte. The number could rise, as other 1,200 cases, mostly in the Northeast, are still being investigated.

Researchers at the UFBA (Federal University of Bahia) who were investigating a "mysterious disease" in the Northeast - as **Folha** published in early May -, identified the virus.

The suspicion is that it has arrived in Brazil with tourists at the World Cup.

Chioro believes the existence of confirmed cases of zika virus in the country "does not worry".

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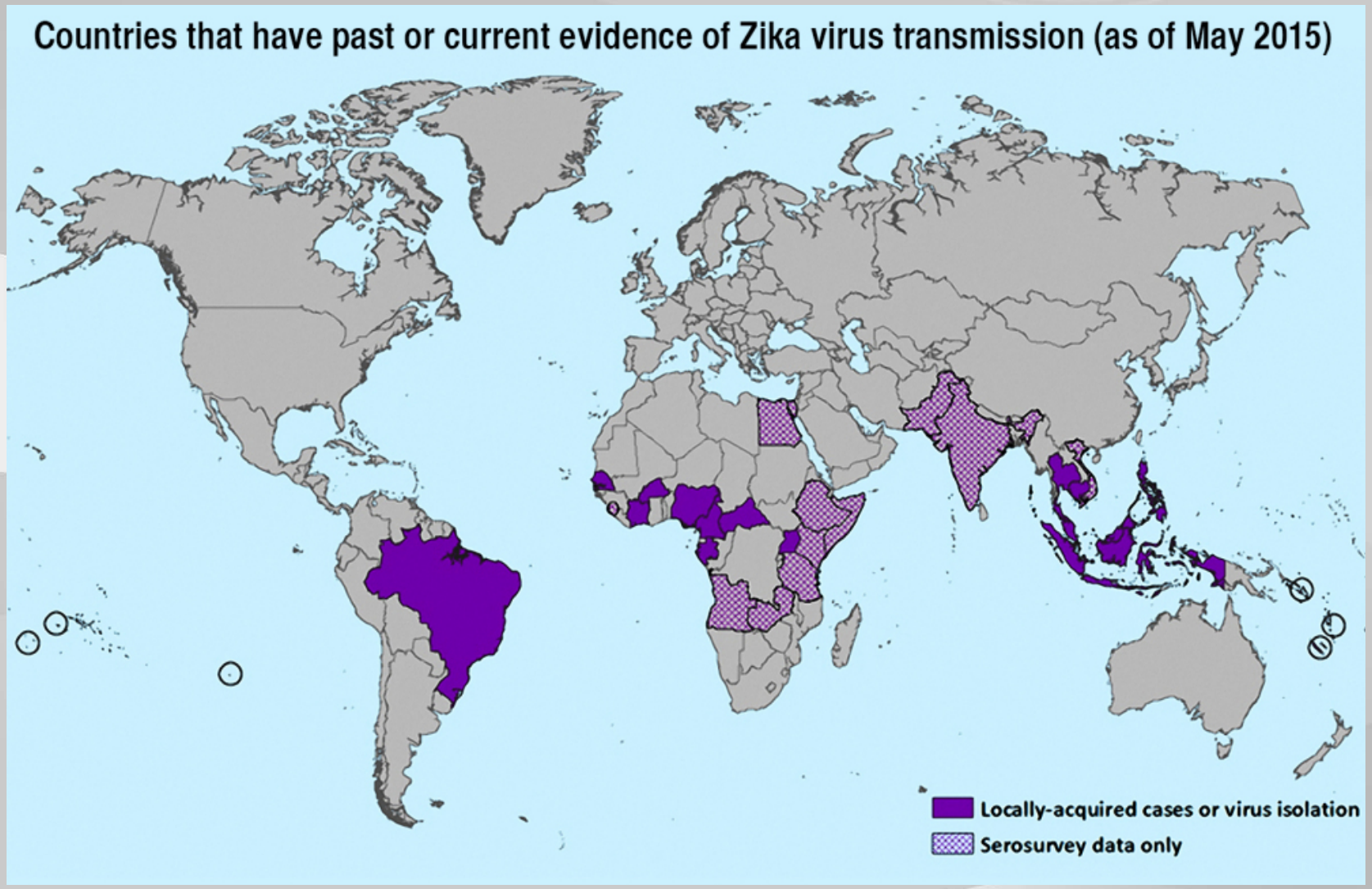
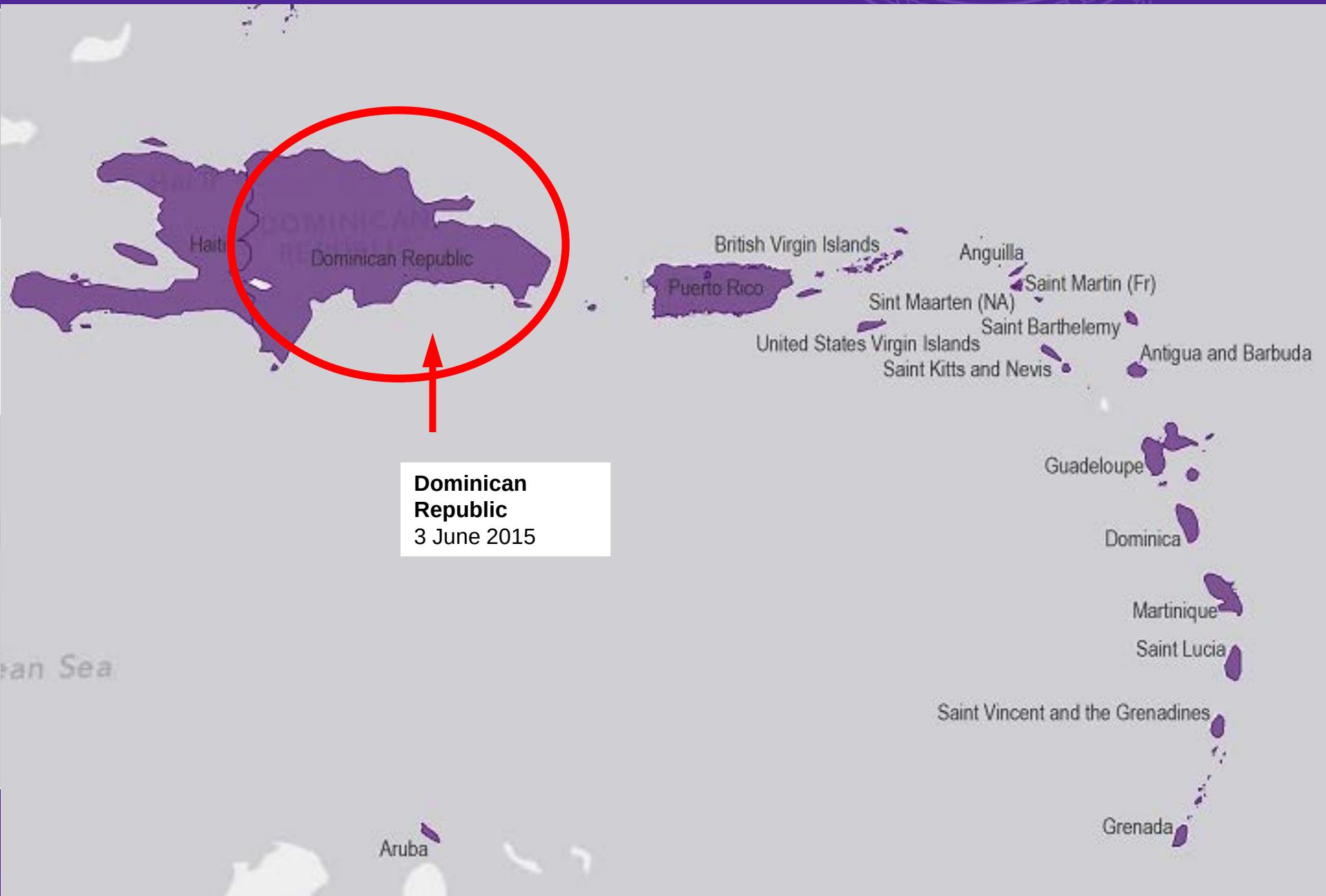
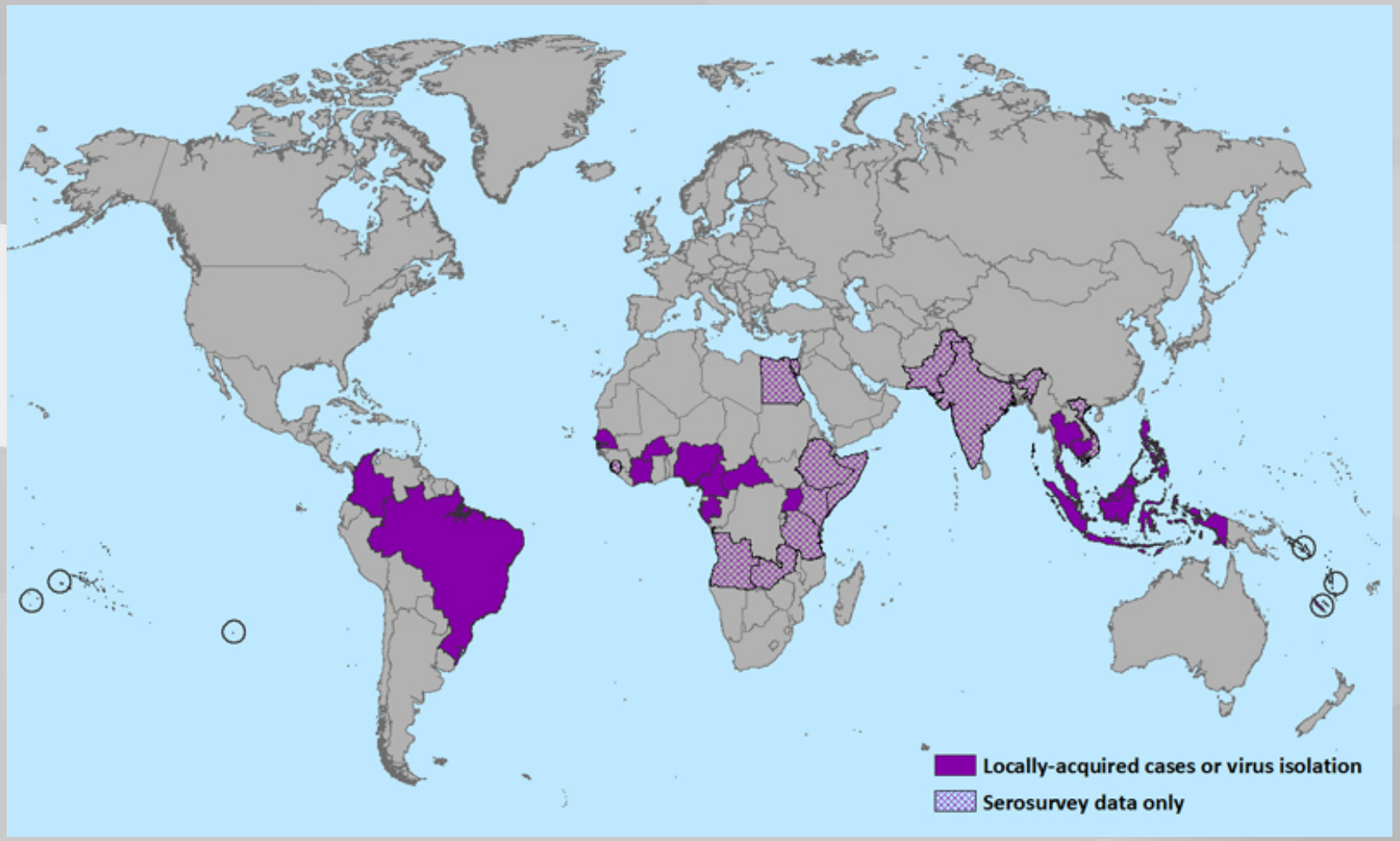
Zika Virus in Brazil, May 2015

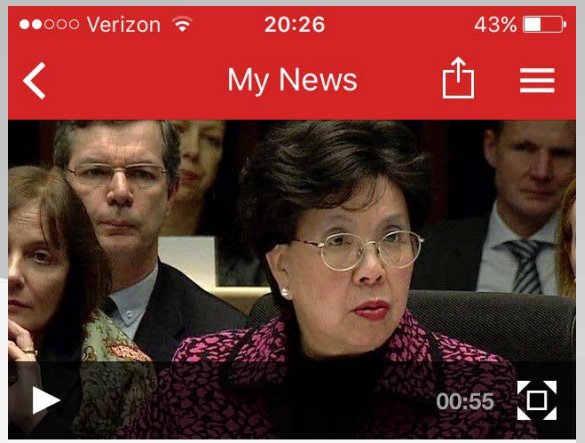


Zika Virus in Dominican Republic, 3 June 2015



Zika Virus in Brazil, October 2015





WHO director general Dr Margaret Chan: "The level of concern is high as is the level of uncertainty"

Zika virus: Up to four million Zika cases predicted

James Gallagher
Health editor, BBC News website

4 hours ago | Health

Three to four million people could be infected with Zika virus in the Americas this year, the World Health Organization (WHO) predicts.

Updated: **2 MINUTES AGO**

Zika "spreading explosively," global health experts warn

January 27 **8:25 PM EST**

Watchdog questions Wounded Warrior Project's outlays

Updated: **10 MINUTES AGO**

The virus is linked to thousands of cases of microcephaly in Brazil

Zika-linked condition: WHO declares global emergency

Michelle Roberts
Health editor, BBC News online

16 hours ago | Health

A disease linked to the Zika virus in Latin America poses a global public health emergency requiring a united response, says the World Health Organization.

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WHAT IS HAPPENING WITH ZIKA VIRUS IN THE AMERICAS?

- Evidence from small case series in outbreak settings
- Majority of cases are asymptomatic.
  Clinical attack rate: 18%
- Self-limiting illness (immunocompetent)
- Viremia short but shedding may be prolonged in urine (15d) and semen (62d)
- Knowledge gaps:

  Duration of viremia and viral shedding.
  Implications of prolonged shedding

Where Zika Virus Is In The Americas

Countries and territories with CDC travel alerts related to the Zika virus

Mexico
Honduras
Guatemala
El Salvador
Haiti
Puerto Rico
Saint Martin
Guadeloupe
Martinique
Barbados
Cape Verde (off the coast of West Africa)
Panama
Venezuela
Colombia
Guyana
Suriname
French Guiana
Ecuador
Brazil
Bolivia
Paraguay
Samoa (islands in the Pacific)

Zika virus is transmitted:

By mosquitos of the *Aedes* genus
The same mosquitos that spread dengue and chikungunya viruses.

From mother to child
It's rare, but a woman infected with Zika can pass the virus to her child during birth, or possibly to the fetus during pregnancy.

***Possibly* through blood or sexual contact**
This link is not confirmed.

Source: WHO, CDC

Alissa Scheller/The Huffington Post

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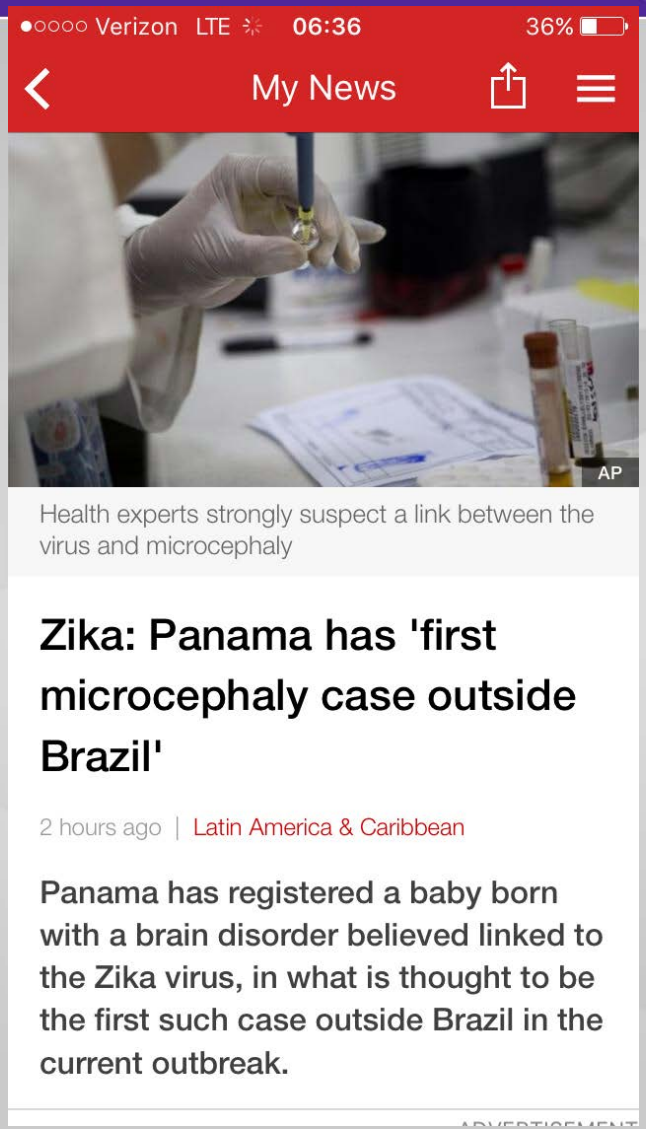
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Health experts strongly suspect a link between the virus and microcephaly
Zika: Panama has 'first microcephaly case outside Brazil'
2 hours ago | Latin America & Caribbean
Panama has registered a baby born with a brain disorder believed linked to the Zika virus, in what is thought to be the first such case outside Brazil in the current outbreak.

- Evidence with Guillain-Barré Syndrome (GBS).
  42 cases during outbreak in French Polynesia (pop. 270,000).
  100-200 GBS among ~400k-1m cases during Brazil epidemic.
  One confirmed case (Oehler et al, Eurosurveiilance, 2014)
- Knowledge gaps
  Association? Barrier of diagnosing post infectious process in populations previously exposed to flaviruses
- • Clinical presentation and outcomes? Anecdotal experience: classic GBS, responsive to IVIG
- • Risk after exposure, either symptomatic or asymptomatic infection?
- • Confounding with chikungunya
- • Other neurological manifestations?: isolated sensory disturbances, encephalitis, ADEM

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CONTROL OF ZIKA VIRUS IN THE AMERICAS

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Arbovirus Control = Vector Control (+/- Vaccination)

Public awareness: repellants, avoidance

“Alternative Approaches to Control Dengue and Chikungunya”

Alternative approaches to control dengue and chikungunya

Transgenic mosquitoes

As an alternative to established approaches, it has been suggested that reducing the incidence of arboviral diseases may be accomplished through the genetic engineering of mosquito vectors to reduce their ability to transmit pathogens, or by manipulating the total vector population using engineered mosquitoes. This article discusses recently developed genetic approaches, their potential for successful implementation and sustainability, as well as concerns related to risk assessment, since there are no binding international standards equivalent to those required for evaluating vaccines/drugs.

Photo: CDC (Centers for Disease Control and Prevention)

Mosquito-borne viruses such as the four dengue serotypes (DENV 1-4), yellow fever (YFV) and chikungunya (CHIKV) are responsible for millions of human infections and significant morbidity and mortality each year. Also the geographic range of these viruses in particular is expanding. An article by Nathan[35] on CHIKV *(see PHJ No. 18)* discussed the significance of the 2005-2006 outbreaks in the Indian Ocean islands. Targeting the vector has been used to reduce the incidence of arboviral diseases in endemic areas since the 1870's. With the spread of insecticide resistance in mosquito populations *(see PHJ No. 18)*, control of vector-borne diseases really requires an integrated strategy that targets multiple components of the transmission cycle.

Vaccines and vector control

Understanding the transmission cycle is vital and an important difference between YFV and DENV/CHIKV is that unlike YFV, neither DENV nor CHIKV have a significant sylvatic/zoonotic component to their transmission cycles. This actually means that compared with YFV, a vaccine-based approach targeted at protecting humans from DENV/CHIKV infections should be more effective at breaking the transmission cycle because, unlike YFV, neither of these viruses can be sustained in the absence of human infections.

OXITEC'S TECHNOLOGY modifies the genes of the *Aedes aegypti* mosquito, which transmit both dengue and yellow fever.

Several promising vaccine candidates for DENV are in advanced stages of evaluation; however, the process is long, rigorous and highly regulated, with international oversight by

Release of Insects carrying a Dominant Lethal gene (RIDL)

***Wolbachia spp* – infected mosquitoes.** Intracellular bacteria that infects multiple tissues including ovaries and salivary glands.

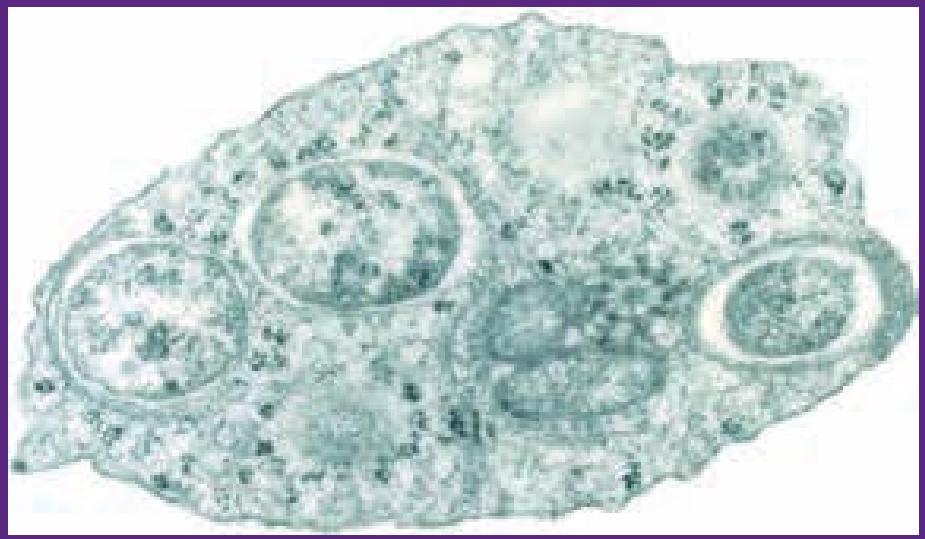


Photo: © Public Library of Science / Scott O’Neill

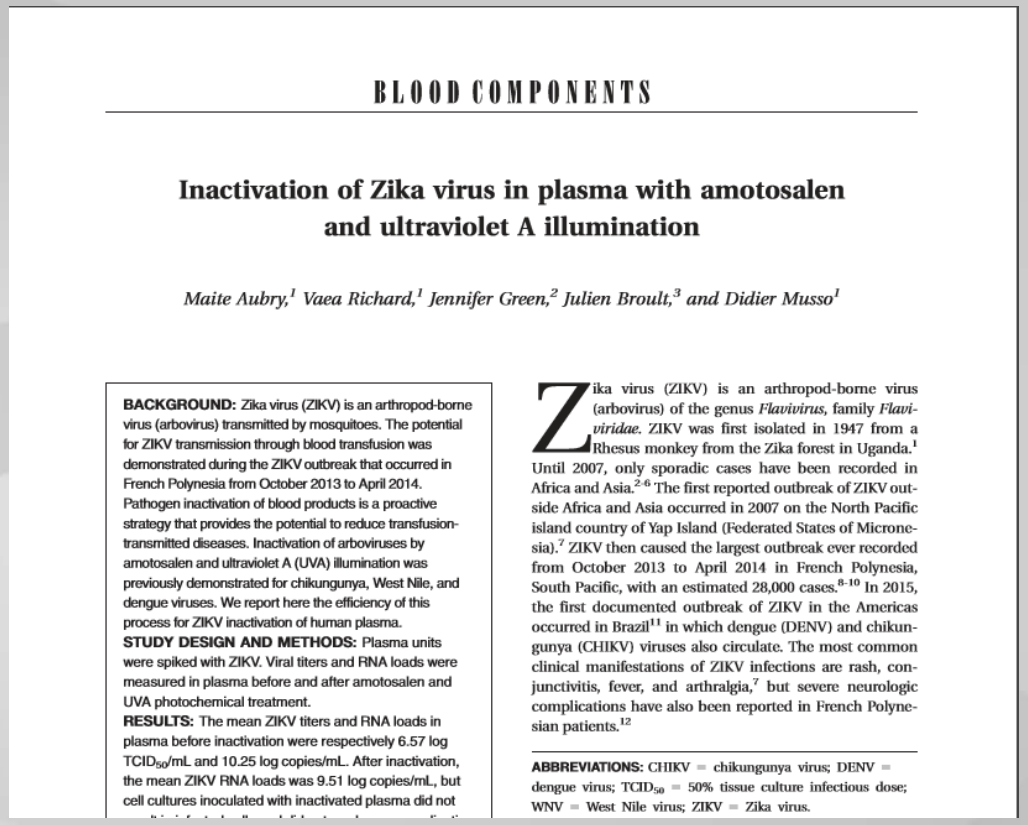
Higgs, 2013

RIDL mosquitoes

Transfusion and transplant risks

In French Polynesia, 42 of 1 505 (3%) blood donors, although asymptomatic at the time of blood donation, were found positive for Zika virus genome by PCR.

Media in Brazil reported a case of transfusion-transmitted Zika virus infection in March 2015 from an asymptomatic 52-year-old donor in of Campinas (Unicamp)



BLOOD COMPONENTS

Inactivation of Zika virus in plasma with amotosalen and ultraviolet A illumination

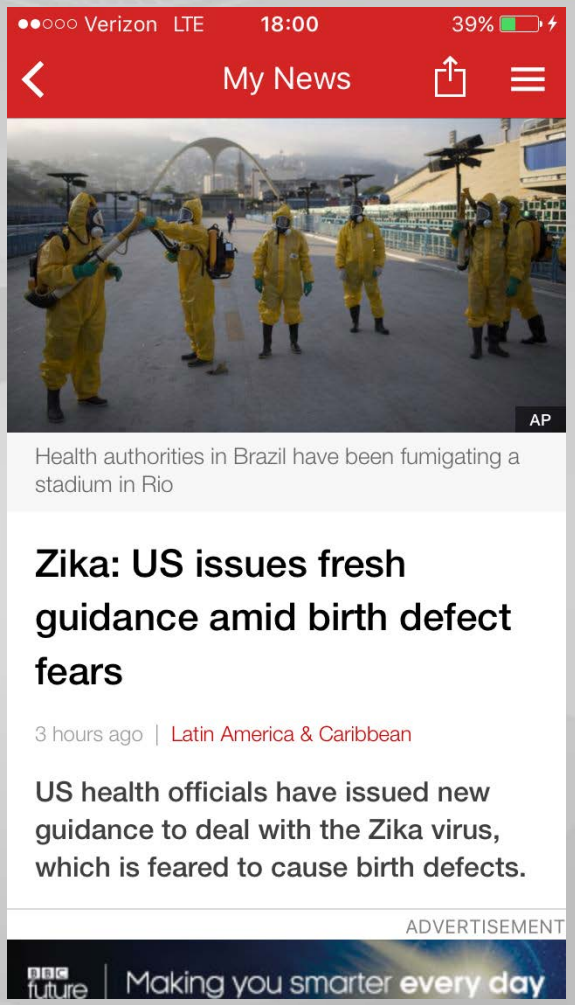
Maite Aubry,[1] Vaea Richard,[1] Jennifer Green,[2] Julien Broult,[3] and Didier Musso[1]

BACKGROUND: Zika virus (ZIKV) is an arthropod-borne virus (arbovirus) transmitted by mosquitoes. The potential for ZIKV transmission through blood transfusion was demonstrated during the ZIKV outbreak that occurred in French Polynesia from October 2013 to April 2014. Pathogen inactivation of blood products is a proactive strategy that provides the potential to reduce transfusion-transmitted diseases. Inactivation of arboviruses by amotosalen and ultraviolet A (UVA) illumination was previously demonstrated for chikungunya, West Nile, and dengue viruses. We report here the efficiency of this process for ZIKV inactivation of human plasma.
STUDY DESIGN AND METHODS: Plasma units were spiked with ZIKV. Viral titers and RNA loads were measured in plasma before and after amotosalen and UVA photochemical treatment.
RESULTS: The mean ZIKV titers and RNA loads in plasma before inactivation were respectively 6.57 log $TCID_{50}$/mL and 10.25 log copies/mL. After inactivation, the mean ZIKV RNA loads was 9.51 log copies/mL, but cell cultures inoculated with inactivated plasma did not

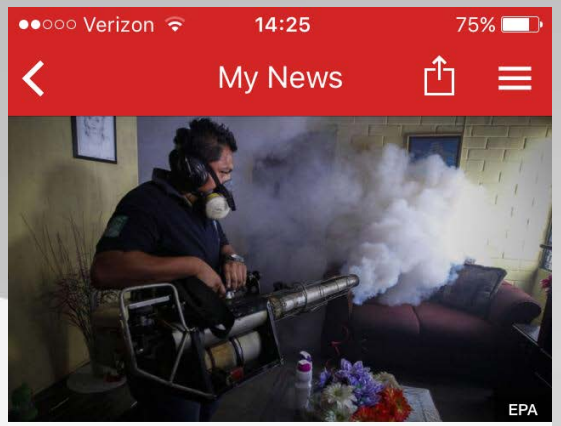
Zika virus (ZIKV) is an arthropod-borne virus (arbovirus) of the genus *Flavivirus*, family *Flaviviridae*. ZIKV was first isolated in 1947 from a Rhesus monkey from the Zika forest in Uganda.[1] Until 2007, only sporadic cases have been recorded in Africa and Asia.[2-6] The first reported outbreak of ZIKV outside Africa and Asia occurred in 2007 on the North Pacific island country of Yap Island (Federated States of Micronesia).[7] ZIKV then caused the largest outbreak ever recorded from October 2013 to April 2014 in French Polynesia, South Pacific, with an estimated 28,000 cases.[8-10] In 2015, the first documented outbreak of ZIKV in the Americas occurred in Brazil[11] in which dengue (DENV) and chikungunya (CHIKV) viruses also circulate. The most common clinical manifestations of ZIKV infections are rash, conjunctivitis, fever, and arthralgia,[7] but severe neurologic complications have also been reported in French Polynesian patients.[12]

ABBREVIATIONS: CHIKV = chikungunya virus; DENV = dengue virus; $TCID_{50}$ = 50% tissue culture infectious dose; WNV = West Nile virus; ZIKV = Zika virus.

Public awareness



Public awareness: travel warnings

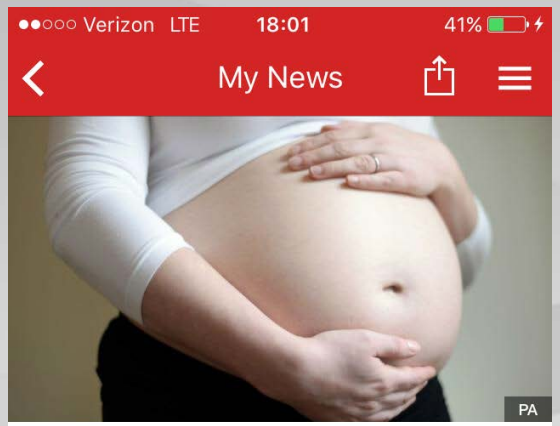


In El Salvador - one of the 23 countries or territories covered by a travel warning - houses are fumigated against mosquitoes

Zika virus travel warnings spread to Africa and Oceania

12 mins ago | Latin America & Caribbean

Travel warnings to pregnant women have been extended to eight more countries or territories amid concerns over an illness causing severe birth defects.

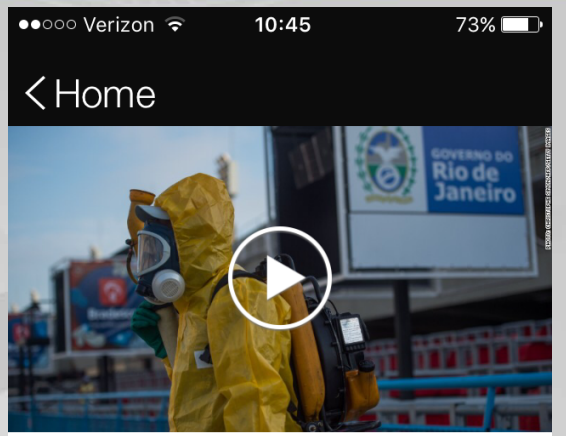


Pregnant Britons' Zika travel warning

Michelle Roberts
Health editor, BBC News online

7 hours ago | Health

Pregnant Britons are being advised to reconsider travel to areas where Zika virus outbreaks are happening.



Updated 09:52, Jan 27

Zika virus: Airlines are refunding tickets to Latin America

Jim Boulden

London (CNNMoney) -- Airlines are starting to offer refunds to passengers who have booked flights to countries in central and south America caught up in the Zika virus

Funding


Verizon LTE 06:50 99%
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Top Stories
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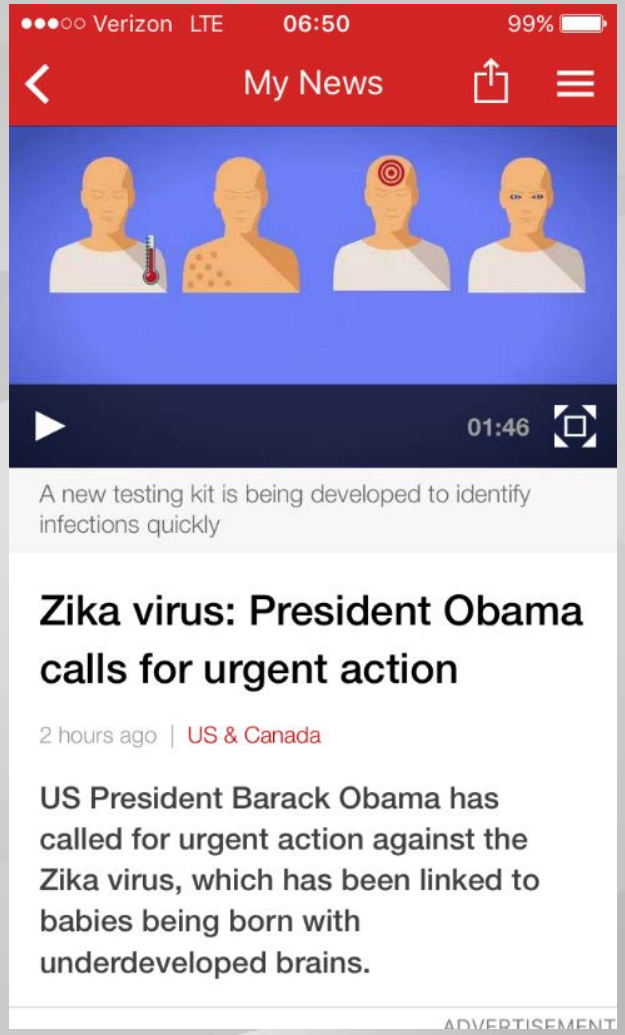
Most Read
World >
Obama calls for urgent action on Zika
2h


Verizon LTE 06:50 99%
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01:46
A new testing kit is being developed to identify infections quickly
Zika virus: President Obama calls for urgent action
2 hours ago | US & Canada
US President Barack Obama has called for urgent action against the Zika virus, which has been linked to babies being born with underdeveloped brains.
ADVERTISEMENT

Diagnostic test kits

ZIKV: WHAT IS LEFT TO DO?

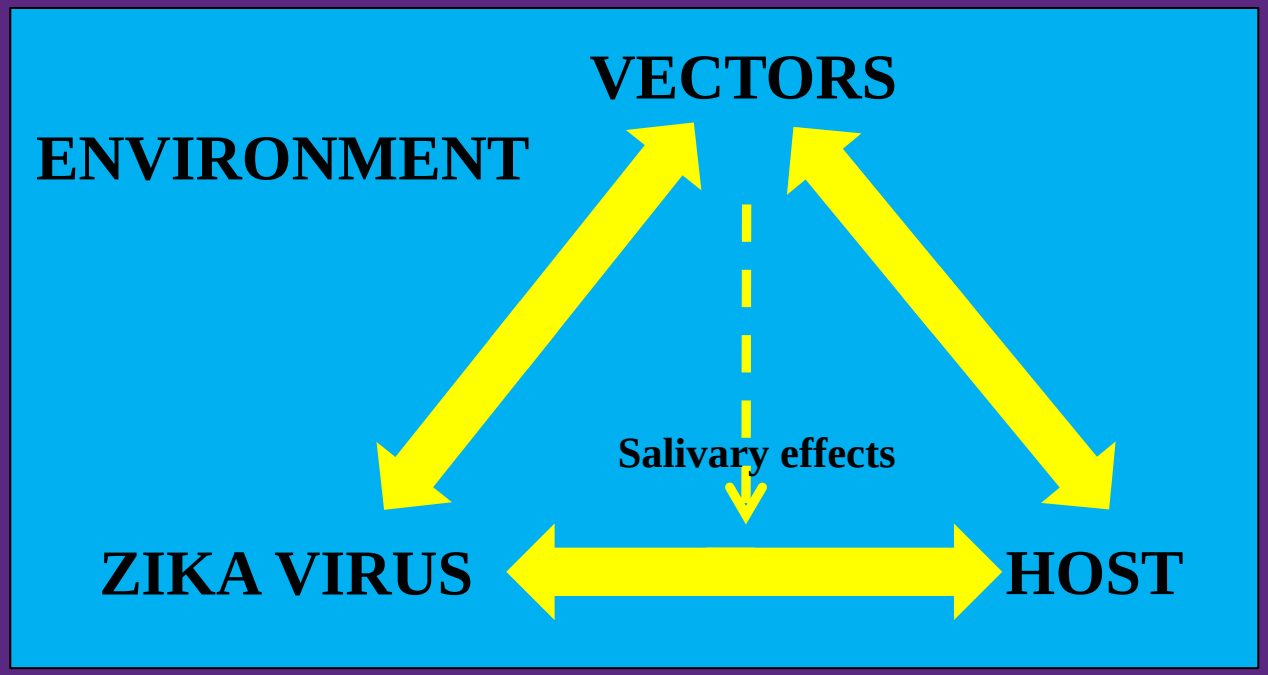
Surveillance
Predictive models

New vectors in the Americas
New control (RIDL, *Wolbachia*)
Insecticides
Repellants

Reagents

Detection

Diagnostics (differential)



New Vertebrates
(NW primates, rodents, livestock)

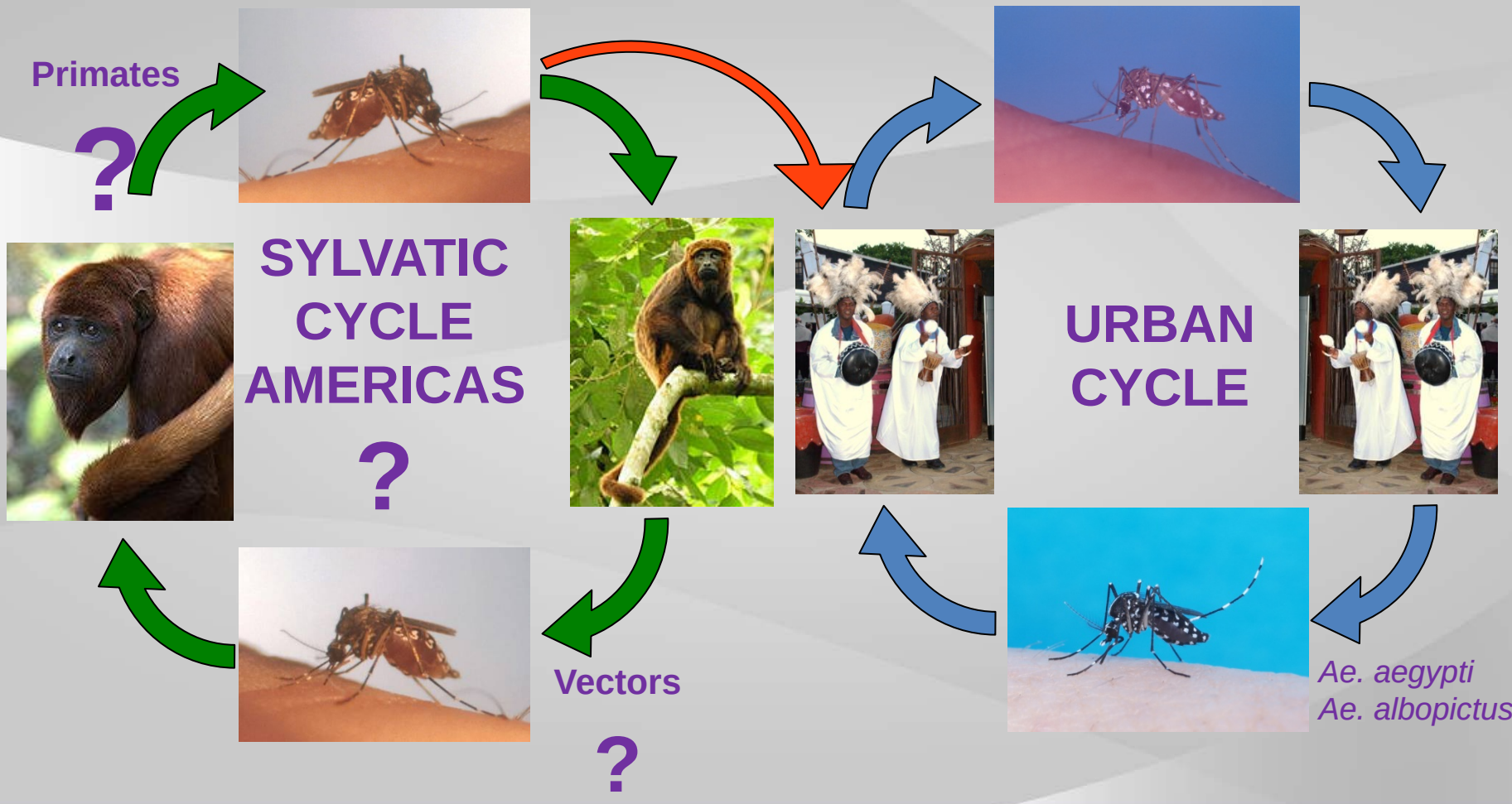
Viral genetics:
Asian vs African
infectivity
pathogenicity

Disease
Guillain-Barre
microcephaly
sexual transmission
persistence

Treatments
Vaccines

Animal Models

ZIKV transmission cycles in the Americas?



New World Primates (135 spp.)

FAMILY	COMMON NAME	NUMBER of SPECIES
Family Callitrichidae	Marmosets and Tamarins	20 marmosets 22 tamarins
Family Cebidae	Capuchins and Squirrel monkeys	9 capuchins 5 squirrel
Family Aotidae	Night/Owl monkeys	11
Family Pitheciidae	Titis, Sakis and Uakaris	29 titis 10 sakis 5 uakari
Family Atelidae	Howler, Spider, Wooly spider & Wooly	10 howler 7 spider 2 wooly spider 5 woolly

Zika virus: importance of “other” vertebrates

Transactions of the Royal Society of Tropical Medicine and Hygiene, Vol. 77, No. 4, 442-445 (1983)

A sero-epidemiological survey for certain arboviruses (Togaviridae) in Pakistan

Medhat A. Darwish[1]*, Harry Hoogstraal[2]**, Thomas J. Roberts[3], Ismat P. Ahmed[3] and Ferial Omar[4]

[1]*Faculty of Medicine, Ain Shams University, Cairo, Arab Republic of Egypt;* [2]*United States Naval Medical Research Unit Number Three (NAMRU-3), American Embassy, Cairo;* [3]*Vertebrate Pest Control Centre (VPCC), Karachi, Pakistan;* [4]*Egyptian Organization for Biological Products and Vaccines, Cairo*

Summary

Complement-fixation test reactions to eight viruses of the family Togaviridae were studied in 372 serum samples (157 rodents, 172 domestic animals, 43 humans) from Pakistan. Antibodies to each tested virus were detected. The highest over-all prevalence rates were for West Nile (WN) (7·8%), Japanese encephalitis (JE) (3·2%) and Zika (ZIKA) (2·4%) viruses, followed by Sindbis (SIN), Chikungunya (CHIK), Uganda S (UGS) and Royal Farm (RF) viruses (1·6 to 1·3%). One human serum (male, age 58 years) reacted with Dengue-1 (DEN) virus antigen (titre 1:32). Antibodies to each virus except RF were detected in human sera; antibodies to RF viru
rodent and domestic animal sera. The roles of rodents in the epidemiology
viruses should be investigated. At least six of these eight viruses cause feve
unknown origin comprise about one third of the febrile episodes record

Results Over-all prevalence rates were highest for WN, DEN and JE viruses (3.2% to 7.8%) followed by ZIKA (2.4%) and the other four viruses (Table I). CF titres were high (1:16 and/or 1:32) for certain samples of each virus except CHIK (Table II). All ZIKA and RF titres were 1:8 or higher. Between 60% and 70% of the WN, JE, SIN, and UGS titres were 1:8 or higher. In rodent sera, 72% (18 of 25) reacted to one virus and 28% (7 of 25) reacted to two or more (mostlv two) viruses. High eF titres (1: 16 and/or ’ 1:32)- were obtained with WN, JE, SIN, ZIKA, and RF viruses (Table III).

SOURCES FOR MORE INFORMATION

FEBRUARY 16, 2016: NATIONAL ACADEMIES HOLDS WORKSHOP ON ZIKA

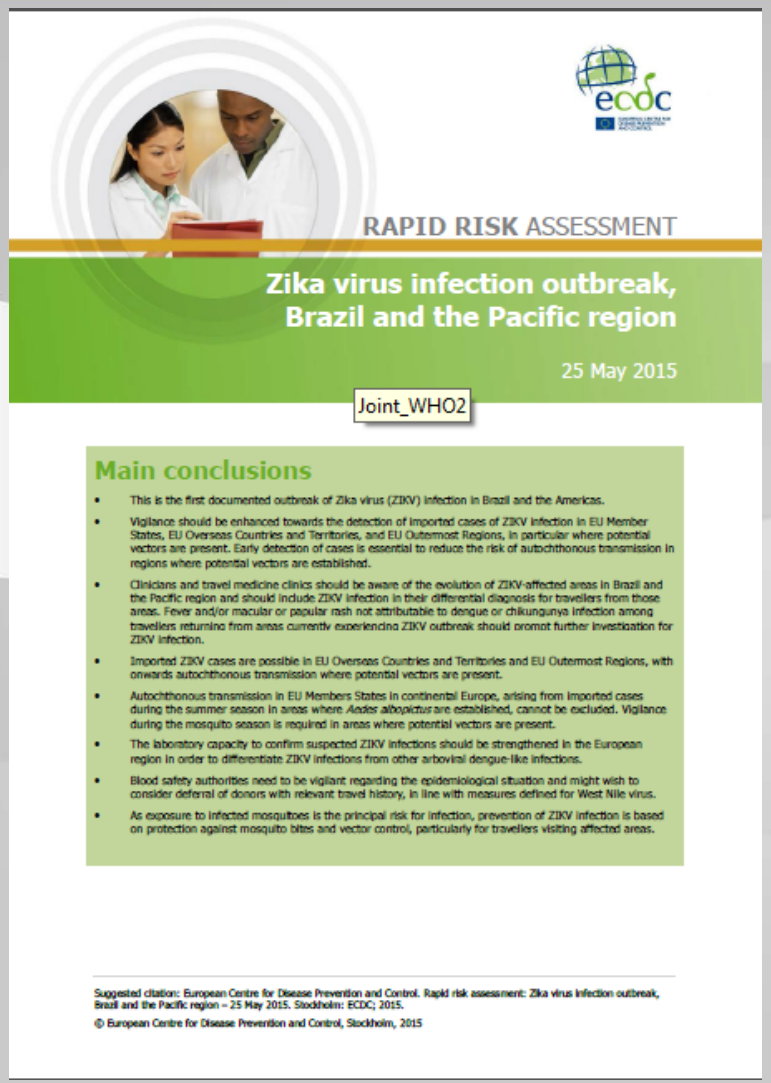
The National Academies of SCIENCES • ENGINEERING • MEDICINE

On Tuesday, February 16, 2016, the National Academies of Sciences, Engineering and Medicine is hosting a national workshop entitled Research Priorities to Inform Public Health and Medical Practice for Domestic Zika Virus at the National Academies of Science in Washington, DC. This workshop is in response to a fast-track workshop request from the HHS Assistant Secretary of Preparedness and Response as a result of the emergence of the Zika virus in the U.S. While the focus will be domestic in nature, an international perspective on the emergence of the virus cannot be overlooked. The specific workshop focus is to identify the research priorities associated with this virus that will inform public health and medical practice moving forward.

Several ASTMH experts are participating including, President Steve Higgs, PhD, FRES, FASTMH, former presidents Duane Gubler, ScD, and Tom Monath, MD, FACP, FASTMH, and former councilors Scott Weaver, PhD, FASTMH, and Mary E. Wilson, MD. See the complete agenda and speakers here.

Plenary sessions and discussions will be available via live video webcast. Following the event, a brief written document based on the presentations and discussions held at the workshop will be prepared. No consensus findings or recommendations will be issued.

European CDC website



ecdc

RAPID RISK ASSESSMENT

Zika virus infection outbreak, Brazil and the Pacific region

25 May 2015

Joint_WHO2

Main conclusions

- This is the first documented outbreak of Zika virus (ZIKV) infection in Brazil and the Americas.
- Vigilance should be enhanced towards the detection of imported cases of ZIKV infection in EU Member States, EU Overseas Countries and Territories, and EU Outermost Regions, in particular where potential vectors are present. Early detection of cases is essential to reduce the risk of autochthonous transmission in regions where potential vectors are established.
- Clinicians and travel medicine clinics should be aware of the evolution of ZIKV-affected areas in Brazil and the Pacific region and should include ZIKV infection in their differential diagnosis for travellers from those areas. Fever and/or macular or papular rash not attributable to dengue or chikungunya infection among travellers returning from areas currently experiencing ZIKV outbreak should prompt further investigation for ZIKV infection.
- Imported ZIKV cases are possible in EU Overseas Countries and Territories and EU Outermost Regions, with onwards autochthonous transmission where potential vectors are present.
- Autochthonous transmission in EU Members States in continental Europe, arising from imported cases during the summer season in areas where *Aedes albopictus* are established, cannot be excluded. Vigilance during the mosquito season is required in areas where potential vectors are present.
- The laboratory capacity to confirm suspected ZIKV infections should be strengthened in the European region in order to differentiate ZIKV infections from other arboviral dengue-like infections.
- Blood safety authorities need to be vigilant regarding the epidemiological situation and might wish to consider deferral of donors with relevant travel history, in line with measures defined for West Nile virus.
- As exposure to infected mosquitoes is the principal risk for infection, prevention of ZIKV infection is based on protection against mosquito bites and vector control, particularly for travellers visiting affected areas.

Suggested citation: European Centre for Disease Prevention and Control. Rapid risk assessment: Zika virus infection outbreak, Brazil and the Pacific region – 25 May 2015. Stockholm: ECDC; 2015.

Main conclusions

• This is the first documented outbreak of Zika virus (ZIKV) infection in Brazil and the Americas.

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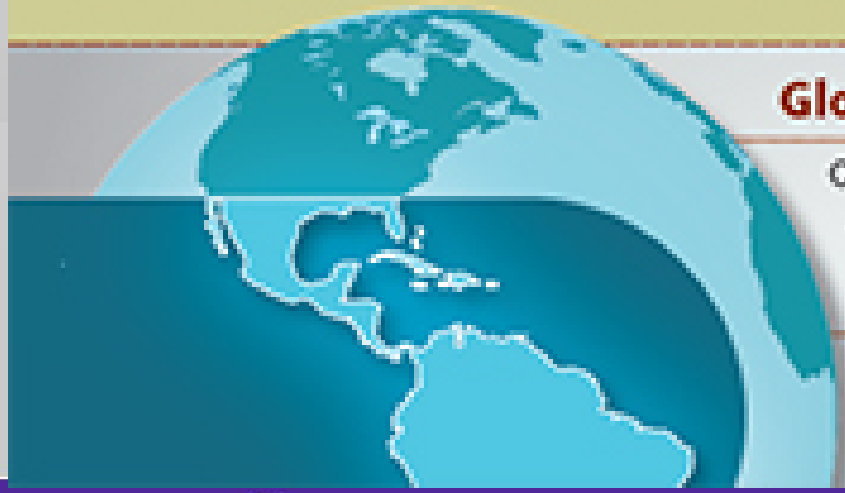
Zika Virus:
What you need to know

Zika is:

- A virus spread through *Aedes* species mosquito bites. *Aedes* mosquitoes also spread dengue and chikungunya viruses.
- A risk to anyone traveling to a region of the world where Zika virus is found.



Global risk

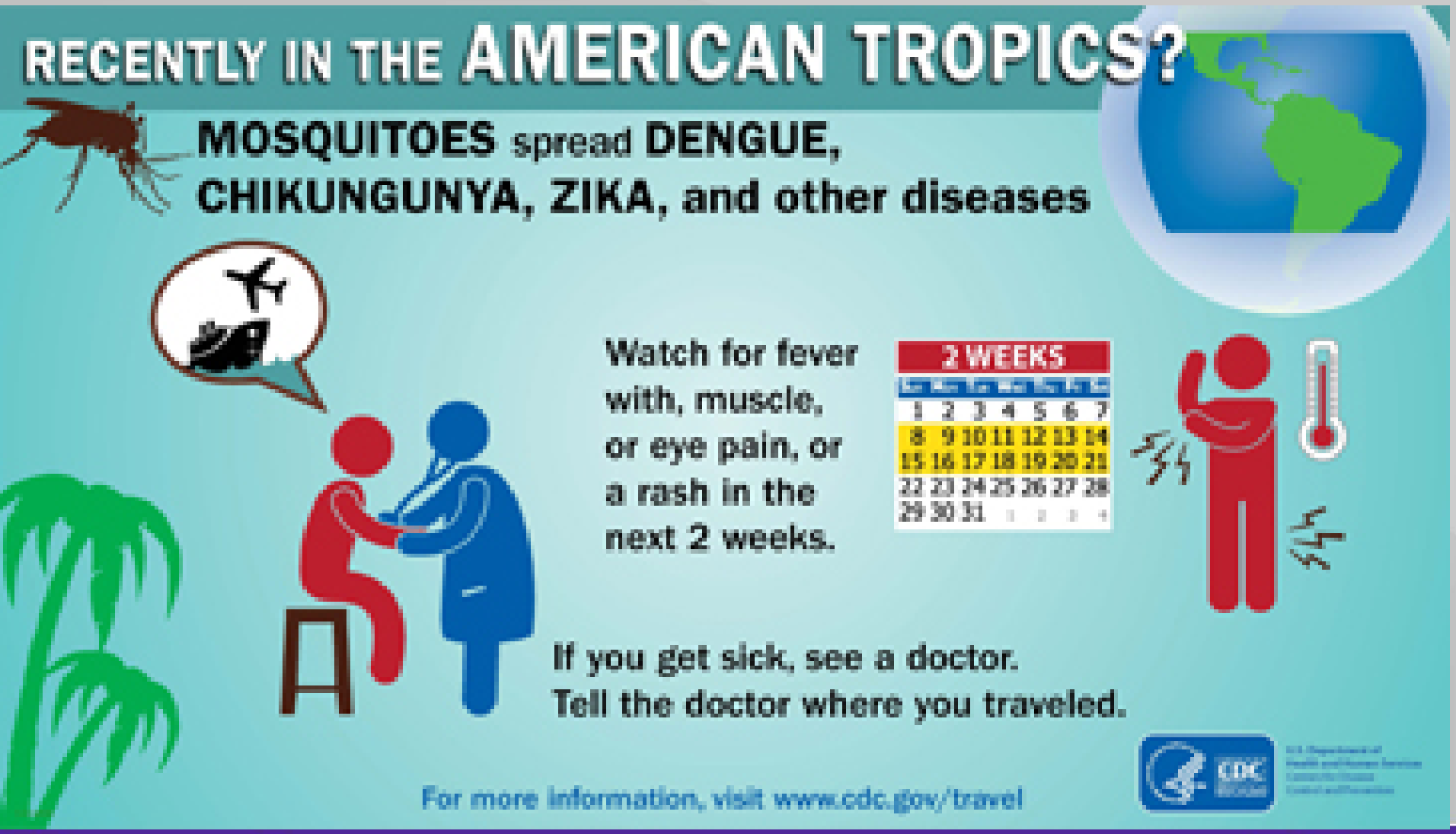
Outbreaks have occurred in parts of Africa, Southeast Asia, and the Pacific Islands. In May 2015, Brazil reported the first outbreak of Zika virus in the Americas.

Zika virus is not currently found in the United States. However, cases of Zika have been previously reported in returning travelers.

KANSAS STATE UNIVERSITY

BRI
Biosecurity Research Institute

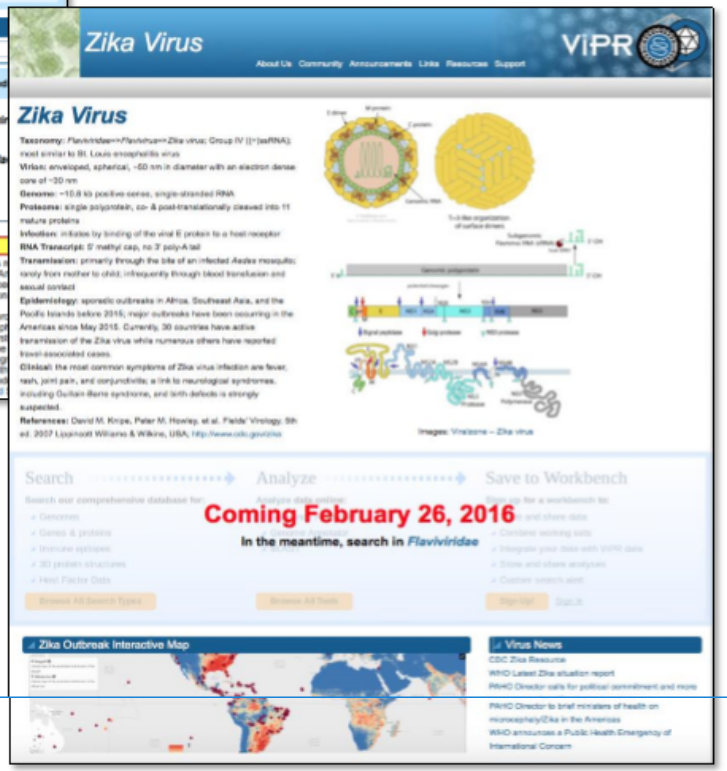
US CDC website



ViPR Zika portal website

ViPR Zika Portal
12 FEB 2016

www.viprbrc.org



- Easy rapid access to Zika-related news and data
- Consistent annotation of mature peptide predictions
- Zika genotype annotations
- Comparative genomics tools for all Flaviviruses
- Personal workspaces for storing private data and analysis results

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New & Noteworthy

ASTMH/ACAV STATEMENT on Zika Virus

"Many of us in the research community are very concerned that Zika has the potential to spread further and become permanently established in the Americas," said Stephen Higgs, PhD, FRES, FASTMH, President of the American Society of Tropical Medicine and Hygiene and Director, Biosecurity Research Institute at Kansas State University. "Given the successful spread and establishment of chikungunya virus in the Americas by the same mosquitoes that carry Zika, it is vital that people take steps to avoid being bitten by them."

More

New President Discusses Goals for ASTMH Over the Next Year

Newly elected ASTMH President Stephen Higgs, PhD, FASTMH, recently took part in a Q&A about his vision for ASTMH, its strengths and weaknesses, and what he plans to focus on during the next 12 months. He spoke about what he is hoping to achieve as the new ASTMH President, his vision for ASTMH, the Society's strengths and some of its weaker points--and his plans to make those weaker points stronger.

More

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¿Hasta dónde puede llegar la epidemia de zika?

Publicado por gonzalolopez el feb 5, 2016

Compartir 51

Algunos virus pueden pasar desapercibidos durante decenas de años. Pero en un momento dado, los movimientos de población o el contacto con animales pueden convertirlos en los impulsores de enfermedades emergentes. Entonces, estos minúsculos microbios pueden cruzar océanos y colonizar nuevos continentes, transformando todo a su paso y a veces generando nuevas e impredecibles enfermedades.

Stephen Higgs Foto: Universidad de Kansas

Stephen Higgs es experto en enfermedades infecciosas. Además de investigador en la Universidad de Kansas, es presidente de la «**American Society of Tropical Medicine and Hygiene**» y editor jefe de la revista «Vector-Borne and Zoonotic Diseases». En concreto, su trabajo se ha centrado en las interacciones entre mosquitos y vertebrados, por lo que conoce bien el comportamiento de virus similares al zika que usan los insectos como vectores. En esta ocasión, respondió a varias preguntas sobre el zika a través de correo electrónico:

posible rol

American Committee on Arthropod-Borne Viruses (ACAV)

Member Q&A: Kathryn A. Hanley (ACAV) and Stephen J. Thomas Discuss Zika Virus

Posted 16 February 2016

"ASTMH has a long history of scientists and physicians working on mosquito-borne diseases … It will be important to expand these studies of Zika virus into the Americas." – Kathryn A. Hanley, PhD, ACAV Chair

Kathryn A. Hanley, PhD, American Committee on Arthropod-borne Viruses (ACAV) Chair, Adjunct Associate Professor at the University of New Mexico School of Medicine and Adjunct Associate Professor at the University of Texas at El Paso. The Hanley Lab at New Mexico State investigates the molecular biology, evolution and ecology of emerging RNA viruses like dengue and influenza, with the goal of using this basic knowledge to design better methods to control their spread.

Stephen J. Thomas, MD, FACP, FIDSA, FASTMH, serves as the Deputy Commander for Operations at the Walter Reed Army Institute of Research (WRAIR). He also sits on scientific advisory committees and boards for the Department of Defense, NIH, non-governmental organizations, and numerous pharmaceutical companies working on flavivirus vaccine development efforts. In addition, he is a member of the WHO's Dengue Vaccine Working Group advising the Strategic Advisory Group of Experts (SAGE) on immunizations.

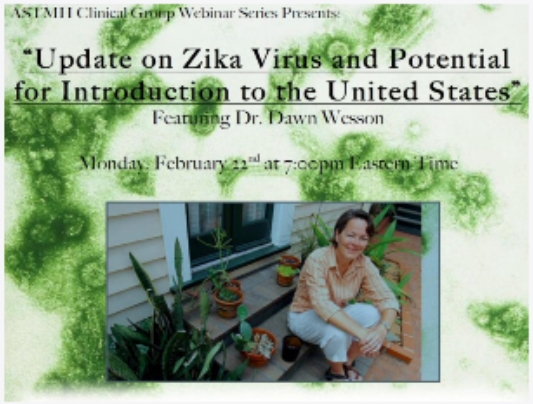
What is Zika virus? Where did it originate and how has it spread?

American Committee on Clinical Tropical Medicine and Travelers' Health (ACCTMTH)

VIEW WEBINAR: ASTMH CLINICAL TRAINEE/STUDENT LEADERSHIP GROUP ON ZIKA VIRUS

On February 22, 2016, Society member and expert in vector biology, Dawn Wesson, PhD, Tulane University, and Susan McLellan, MD, MPH, FASTMH, Past-President of the Clinical Group, held a webinar on the Zika virus and its potential to spread in the US.

This one-hour webinar includes Q&A.View the archived webinar here.



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Q&A with Member Scott Weaver, PhD, FASTMH, on Zika

Posted 15 March 2016

"With emerging viral diseases we just seem to be moving from emergency to emergency without a kind of sustained effort needed to maintain our capabilities, and to figure out a way to control vectors like Aedes aegypti, and Aedes albopictus." *- Scott Weaver, PhD, FASTMH*

Scott Weaver, PhD, FASTMH, a former ASTMH Councilor, is a leading expert on arboviruses—viruses transmitted by mosquitoes, ticks, or other arthropods. His research includes mechanisms of emergence from enzootic cycles, evolution, mosquito-virus interactions, and vaccine development.

Acknowledgements

Many of the slides in this presentation were obtained from open source material and PowerPoints from the National Academies website. Slides were from presentations by Albert Ko, Richard Kuhn, Tom Monath, Ron Rosenberg (some original pictures by Ben Beard), and Scott Weaver. Refer to website for original images.

Many journals have provided open access to articles about Zika virus, for example Lancet, and Trans. R.S.T.M.H.

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Sexta Conferencia Anual ASTMH Latinoamérica en Perú

"ALAN J. MAGILL"

21- 23 de Marzo del 2016

Centro de convenciones de Lima

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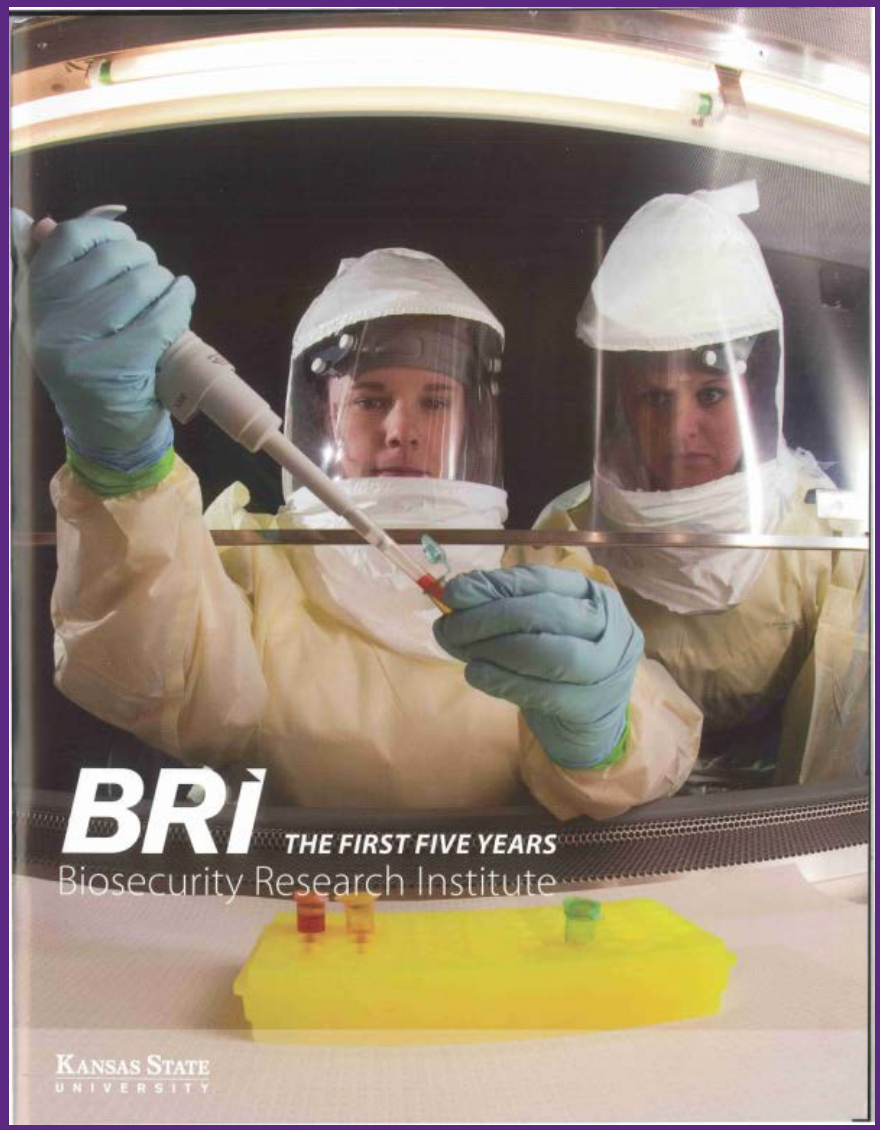
THANK YOU

GRACIAS



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