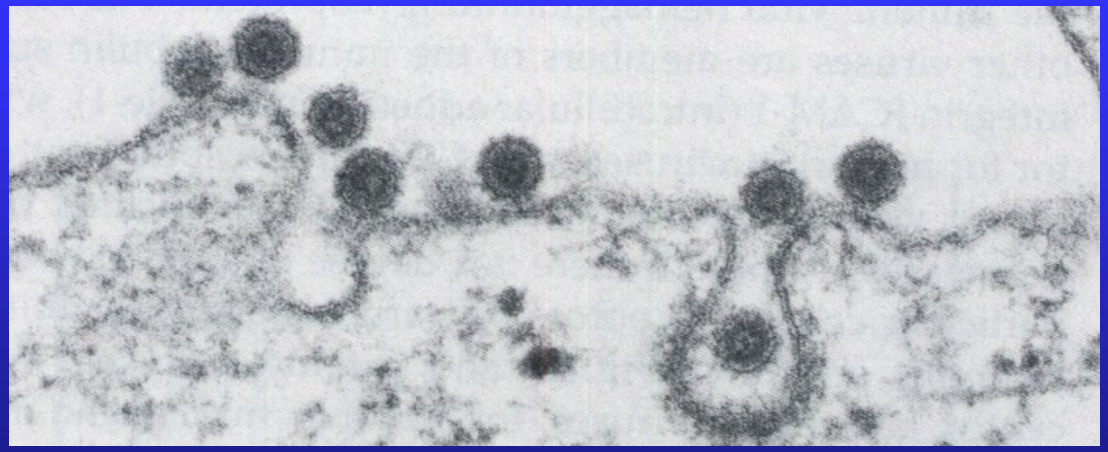
Chikungunya

John-Paul Mutebi, Ph.D.

Division of Vector-Borne Infectious Diseases
Centers for Disease Control and Prevention



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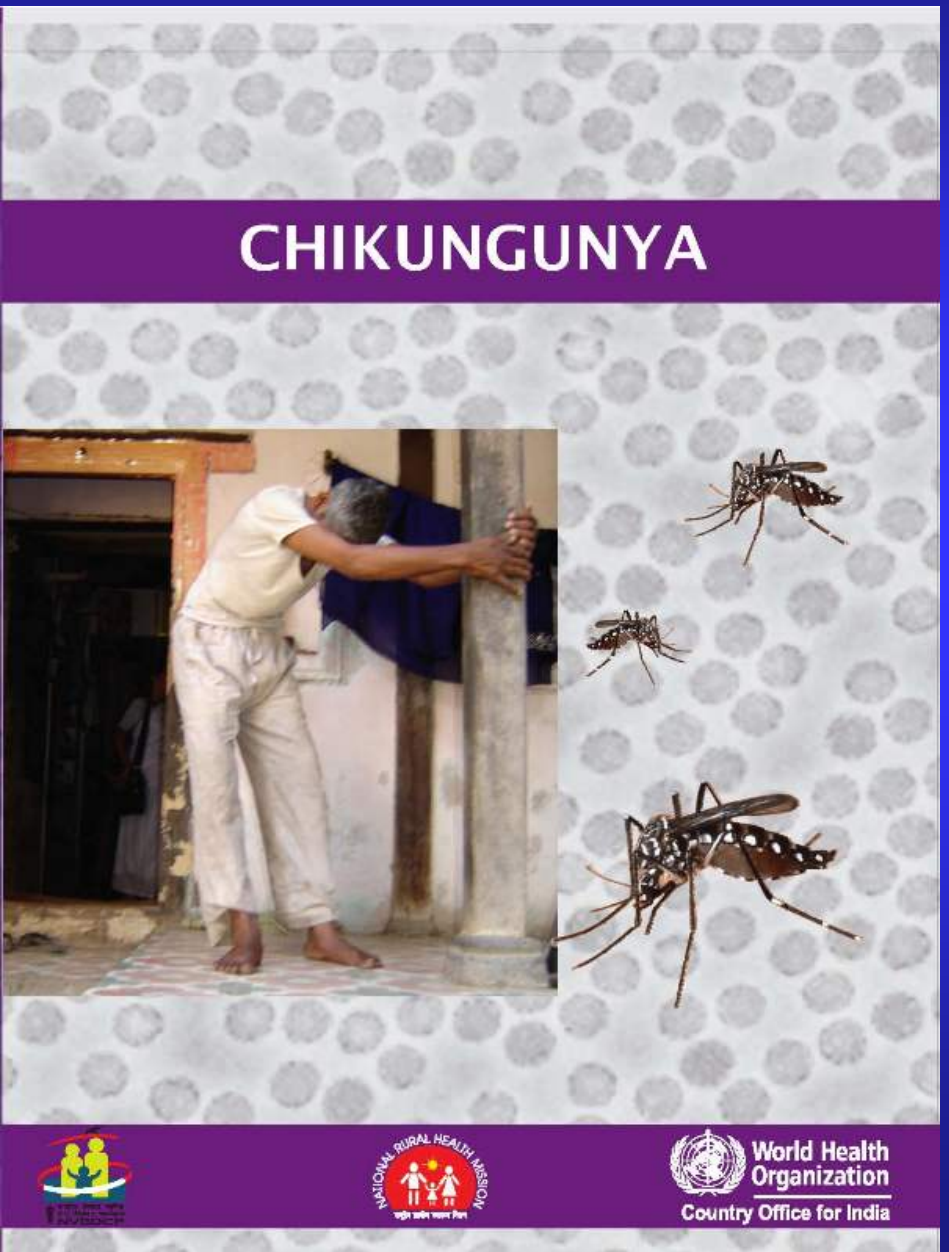
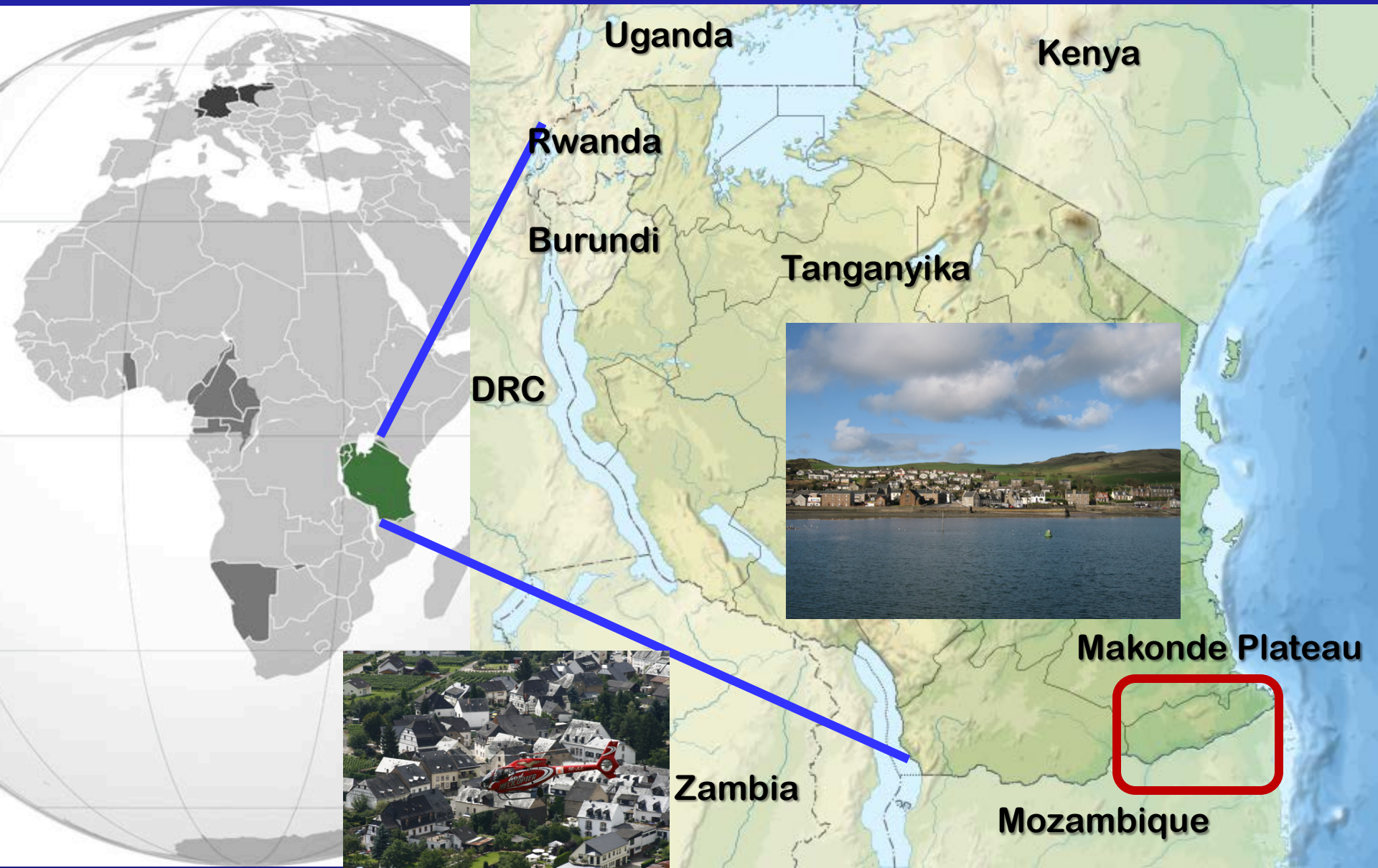
Chikungunya



- First recognized outbreak was in October 1952 in the Makonde Plateau in southeastern Tanganyika
- Chikungunya is Kimakonde for “that which bends up” in reference to the stooping posture

Tanganyika and Makonde Plateau



- The outbreak was explosive – affected several villages
- Spread was rapid – affected 60% – 80% of the population within 2 – 3 weeks
- In some groups of houses every inhabitant was infected
- Sporadic cases would occur after the main invasion, but usually modified and less severe
- The spread appeared greater in smaller units than in larger settlements' - larger settlements' had better water supply systems
- Incubation period 3 – 12 days
- Severe joint pains (large joints) in most patients

TRANSACTIONS OF THE ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE.
Vol. 49. No. 1. January, 1955.

COMMUNICATIONS

AN EPIDEMIC OF VIRUS DISEASE IN SOUTHERN PROVINCE, TANGANYIKA TERRITORY, IN 1952-53

I. Clinical Features

BY

MARION C. ROBINSON*

(*From Lulindi Hospital, Universities Mission to Central Africa*)

Dengue in epidemic form has been a relatively uncommon disease in eastern Africa. In Zanzibar, epidemics have been reported at intervals since 1870 (GODDING, 1890) and have been reported more recently in Portuguese East Africa (DE SOUSA, 1924), in Madagascar (CULLINAN, 1946), among troops in Ethiopia, Somalia, the Comoro Islands and Madagascar (MCCARTHY and WILSON, 1948), in the Belgian Congo (REUL and EERAERTS, 1949) and in Ethiopia (BUCCO, 1950).

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CLINICAL

Table 1. **Frequency of acute symptoms of CHIKV Infection.**[a]

Symptom or sign	Frequency range (% of symptomatic patients)
Fever	76–100
Polyarthralgias	71–100
Headache	17–74
Myalgias	46–72
Back pain	34–50
Nausea	50–69
Vomiting	4–59
Rash	28–77
Polyarthritis	12–32
Conjunctivitis	3–56

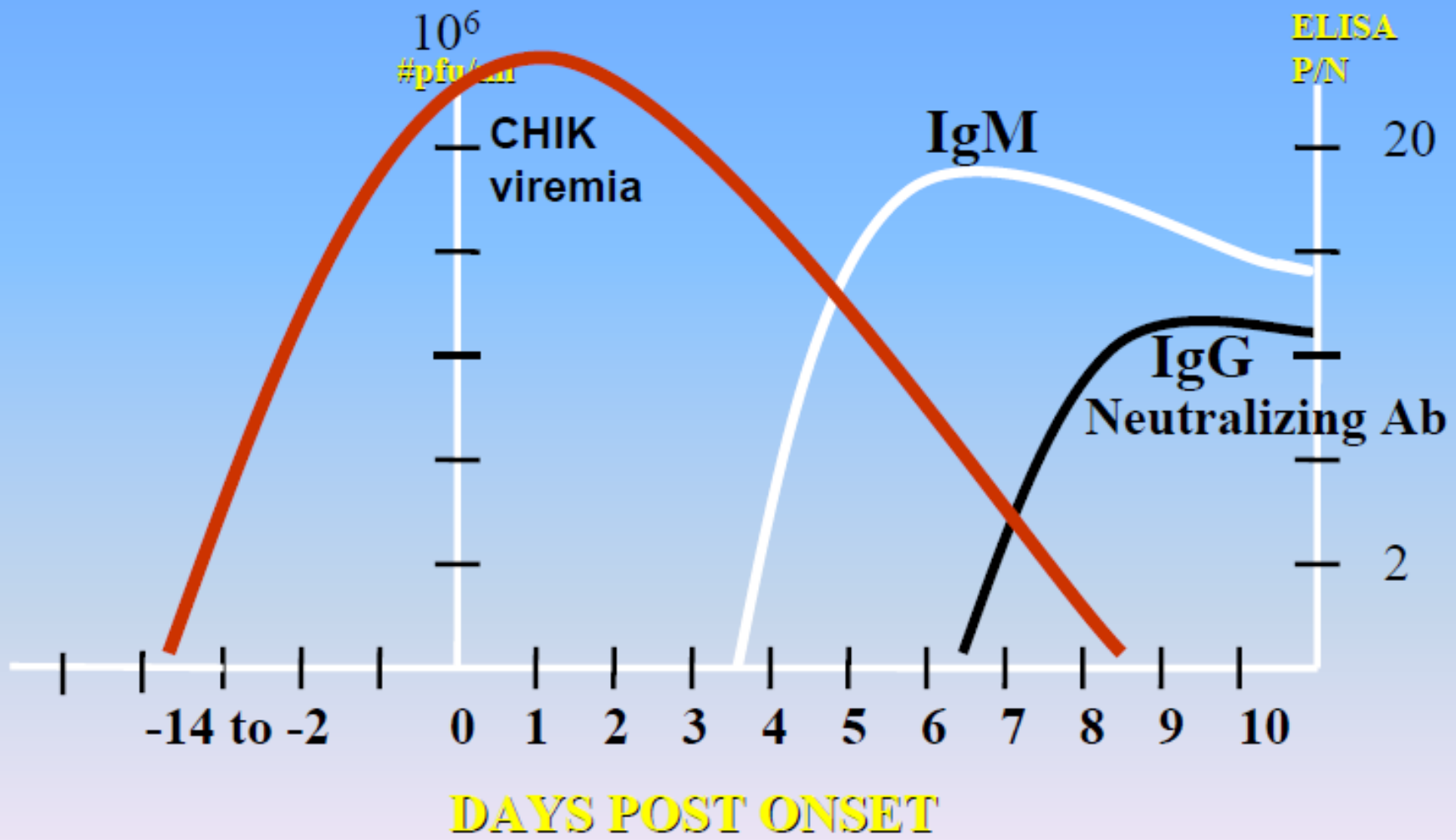
[a]Table compiled from a number of different studies.[8, 9, 12-17]

Majority (72-97%) of infected persons are symptomatic

Table 3. **Diseases or agents in the differential diagnosis of CHIK.**

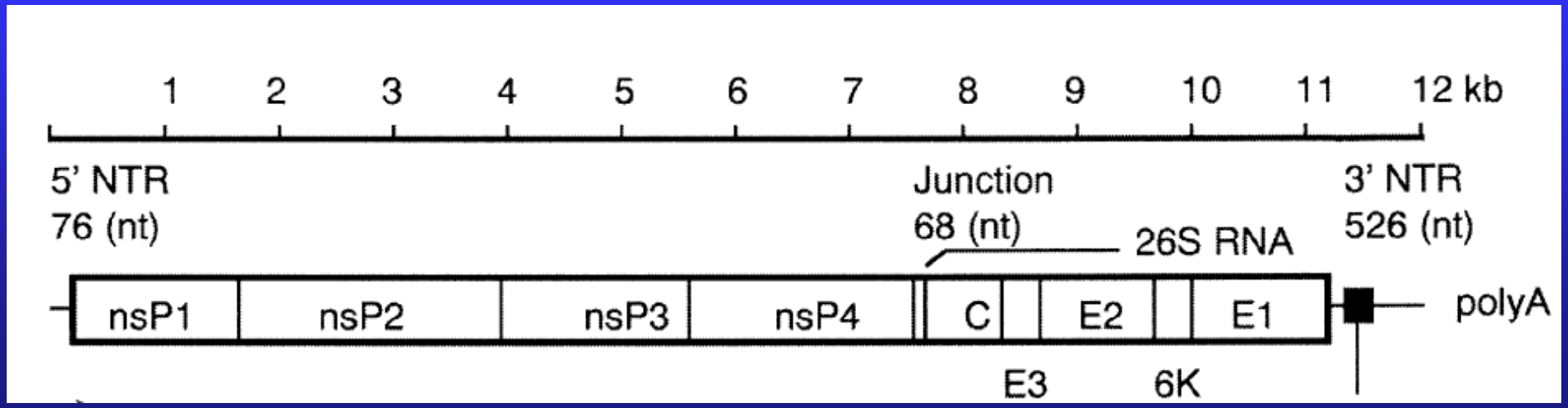
Disease or agent	Presentation
Malaria	Periodicity of fever and alteration of consciousness
Dengue fever	Fever and two or more of the following, retro-orbital or ocular pain, headache, rash, myalgia, arthralgia, leucopenia, or hemorrhagic manifestations. See section and table below for more information on dengue
Leptospirosis	Severe myalgia localized to calf muscles with conjunctival congestion/or subconjunctival hemorrhage with or without jaundice or oliguria. Consider history of contact with contaminated water
Alphaviral infections (Mayaro, Ross River, Barmah Forest, O'nyong nyong, and Sindbis viruses)	Similar clinical presentation as CHIK; utilize travel history and known areas of Mayaro in the Americas

Simplified Depiction of CHIK Human Viremia & Immune Response



Chikungunya Virus

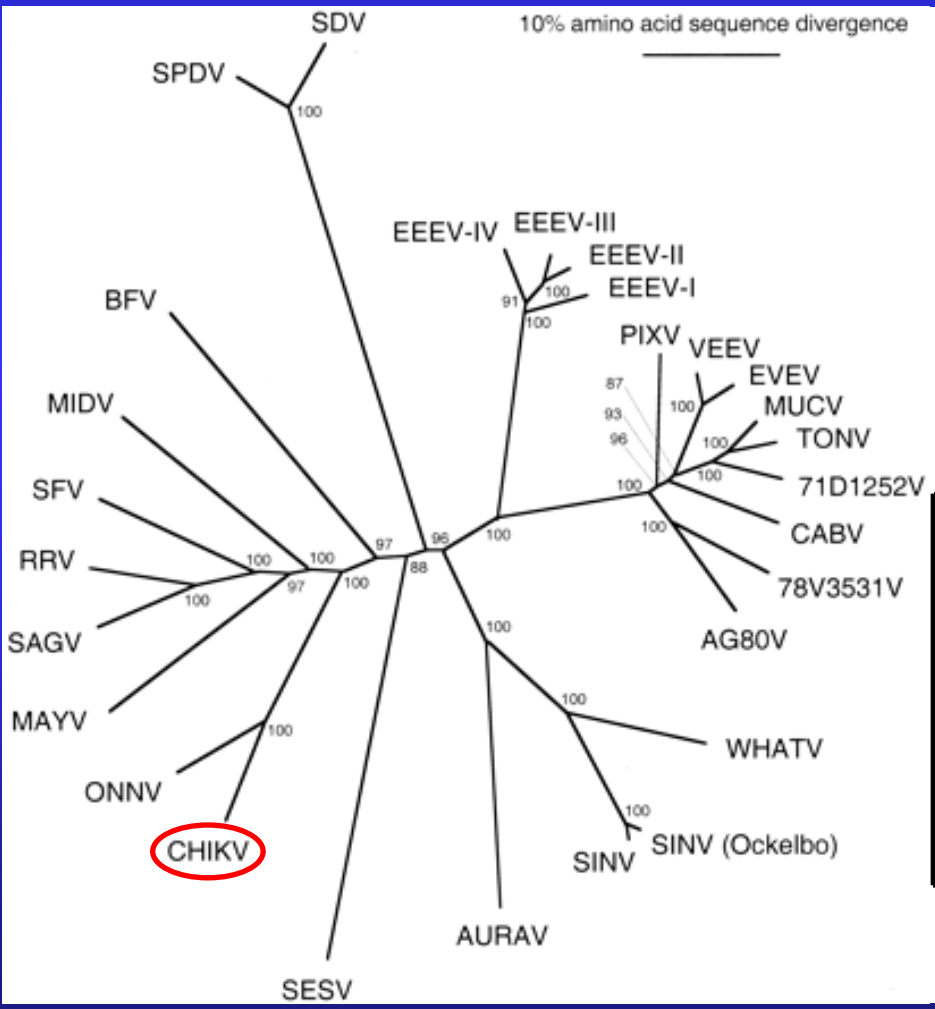
- Family *Togaviridae*, genus *Alphavirus*
  - Enveloped, single stranded RNA virus
  - Plus-sense, unsegmented genome of 11.5 -11.8 kilobases
  - 4 nonstructural proteins – 5’ (genome replication)
  - 5 structural proteins – 3’
  - Virions approx. 70nm in diameter

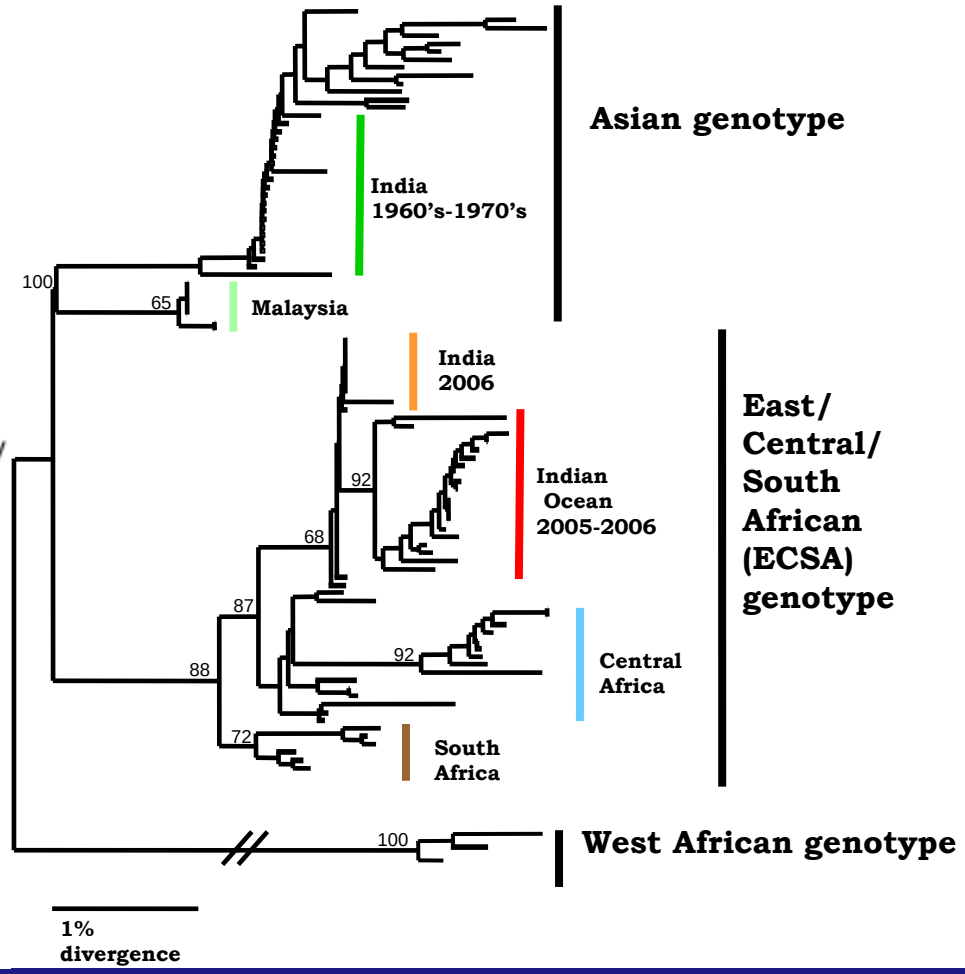


Alphavirus Species and Antigenic Relationships

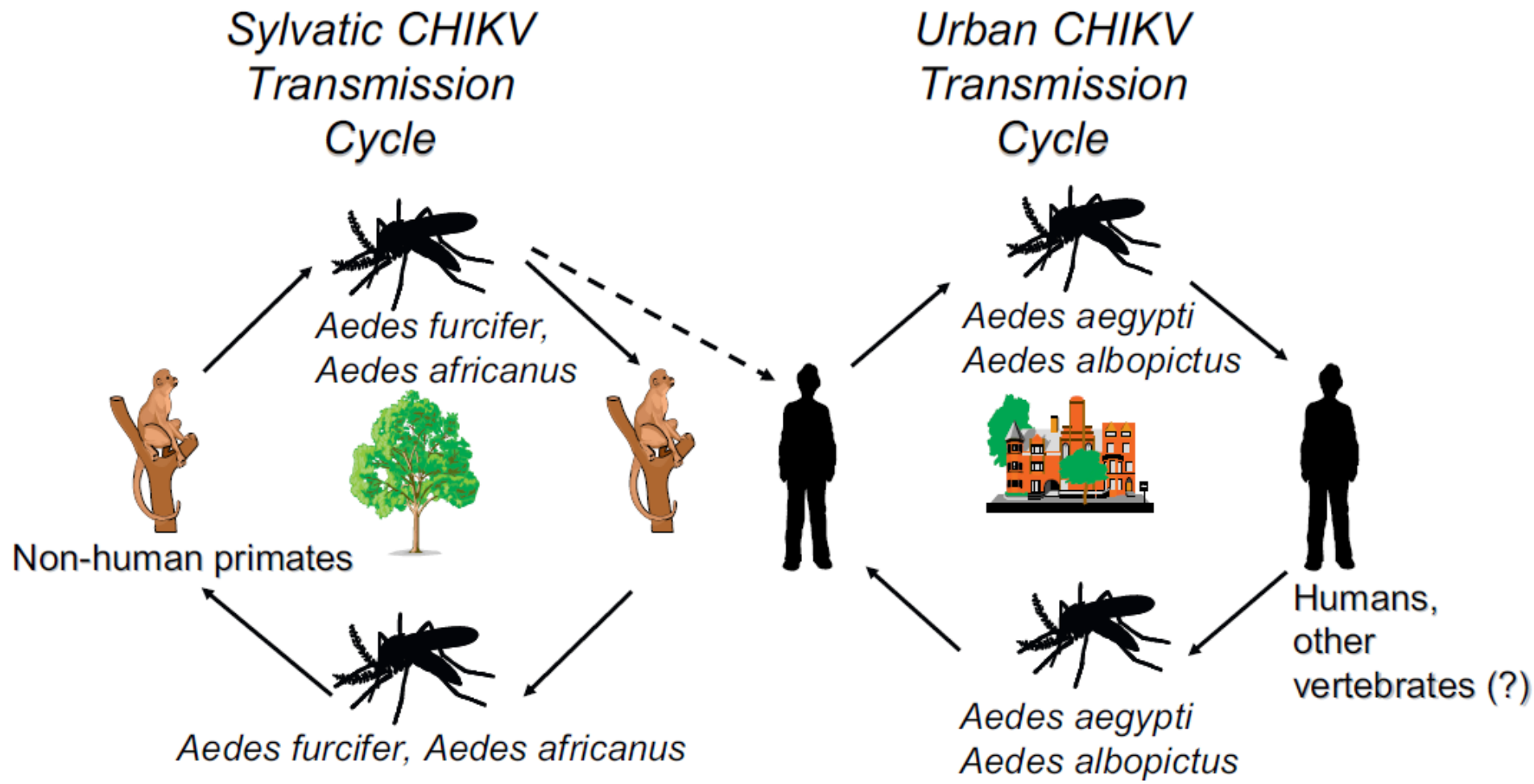
Antigenic Complex	Species
1. Barmah forest	Barmah forest virus (BFV)
2. Eastern Equine Encephalitis	Eastern equine encephalitis virus (EEEV)
3. Middelburg	Middelburg virus (MIDV)
4. Ndumu	Ndumu virus (NDUV)
5. Semliki Forest	Bebaru virus (BEBV), **Chikungunya virus (CHIKV),** Getah virus (GETV), Mayaro virus (MAYV), O'nyong nyong virus (ONNV), Ross River virus (RRV), Semliki Forest virus (SFV), Una virus (UNAV)
6. Venezuelan equine encephalitis	Venezuelan equine encephalitis (VEEV), Mosso das Pedras virus (MDPV), Everglades virus (EVEV), Mucambo virus (MUCV), Tonate virus (TONV), Pixuna virus (PIXV), Cabassou virus (CABV), Rio Negro virus (RNV)
7. Western equine encephalitis	Aura virus (AURAV), Sindbis virus (SINV), Whataroa virus (WHAV), Fort Morgan virus (FMV), Highlands J virus (HJV), Western Equine encephalitis (WEEV)
Unclassified	Trocara virus (TROV), Salmon pancreas disease virus (SPDV), Southern elephant seal virus (SESV)

Phylogenetics of Chikungunya Virus

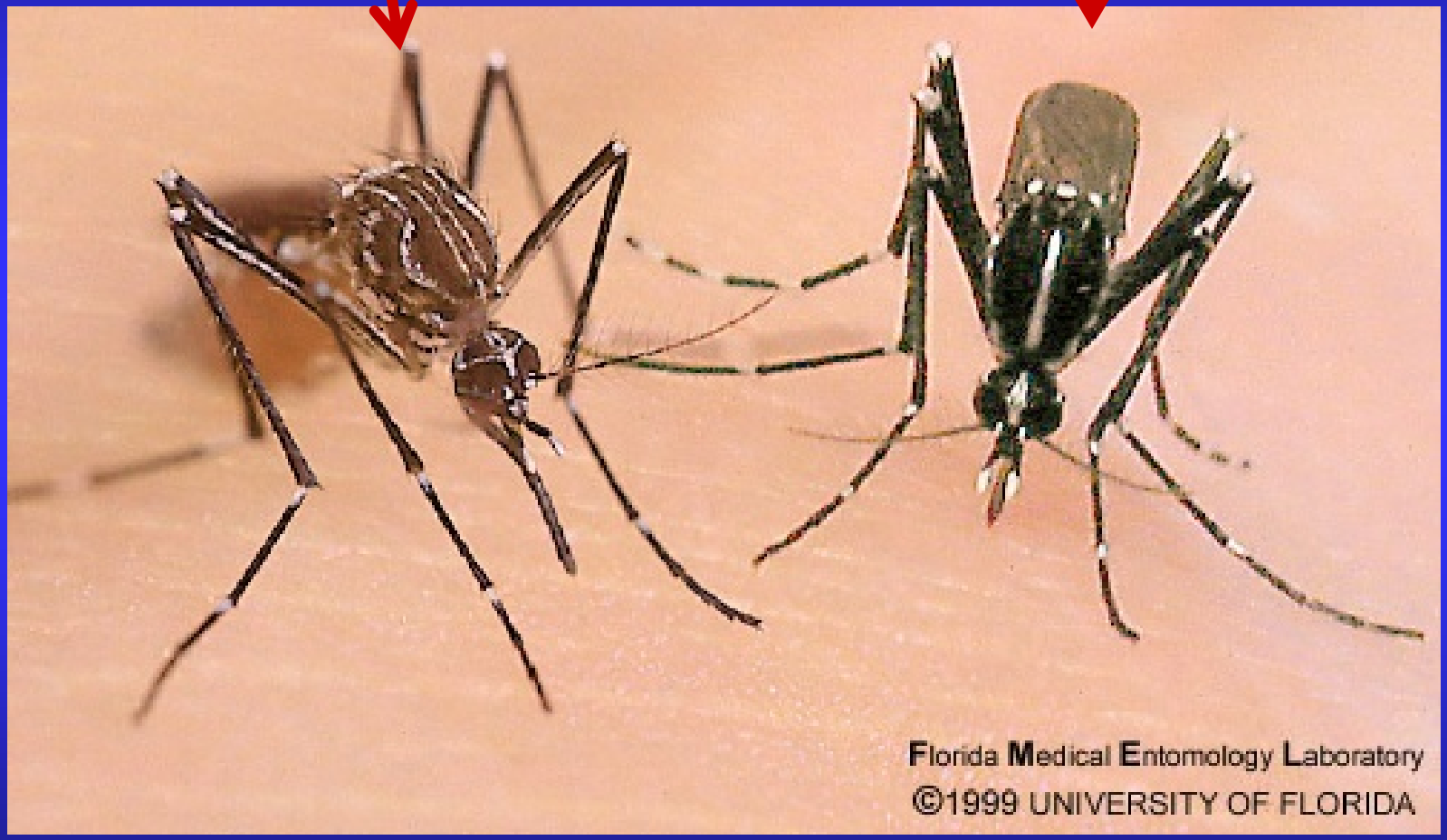




CHIKV: Sylvatic and Urban Transmission Cycles



Aedes aegypti and Aedes albopictus



Classic CHIKV Outbreak

TRANSACTIONS OF THE ROYAL SOCIETY OF
TROPICAL MEDICINE AND HYGIENE.
Vol. 63. No. 4. 1969.

THE 1964 CHIKUNGUNYA EPIDEMIC AT VELLORE, SOUTH INDIA, INCLUDING OBSERVATIONS ON CONCURRENT DENGUE

DONALD E. CAREY*
Rockefeller Foundation staff member, assigned to the Virus Research Centre, Poona, India
RUTH M. MYERS, C. M. DERANITZ, MALATI JADHAV
Christian Medical College and Hospital, Vellore
AND
RACHEL REUBEN†
Virus Research Centre, Poona

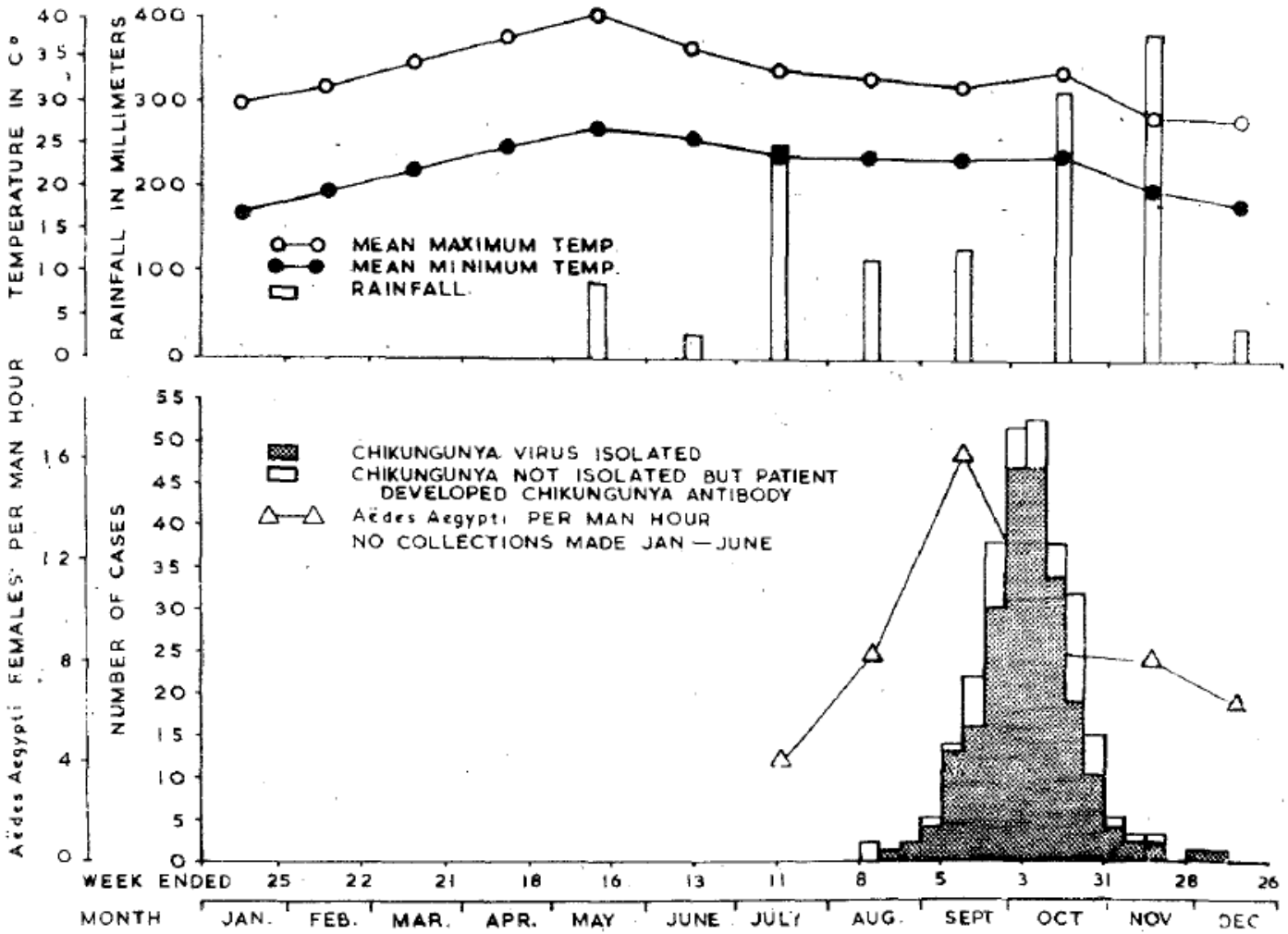


FIG. 1. Chikungunya cases by week, in relation to rainfall, temperature and numbers of *Aedes aegypti* collected, Vellore 1964.

During the rainy season

Self limiting

Different genotypes in different regions

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CHIKV: Location and Year of Human Outbreaks

(Jupp & McIntosh 1988)

Tanzania (Makonde)	1952-1953
Philippines (Manila, Amlan)	1954, 1956, 1968
South Africa (Transvaal Province)	1956, 1975, 1976, 1977
Thailand (Bangkok)	1958, 1962, 1963, 1964
Democratic Republic of Congo	1958
Zambia	1959
Senegal	1960, 1966, 1982
Kampuchea	1961, 1962
Uganda (Entebbe)	1961-1962, 1968
Zimbabwe	1962, 1971
India (various localities)	1963, 1964, 1965, 1973
Burma	1963, 1970-1972
Nigeria (Ibadan)	1964, 1969, 1974
Vietnam	1964
Sri Lanka	1965
Angola (Luanda)	1970-1971
Central African Republic	1978-1979

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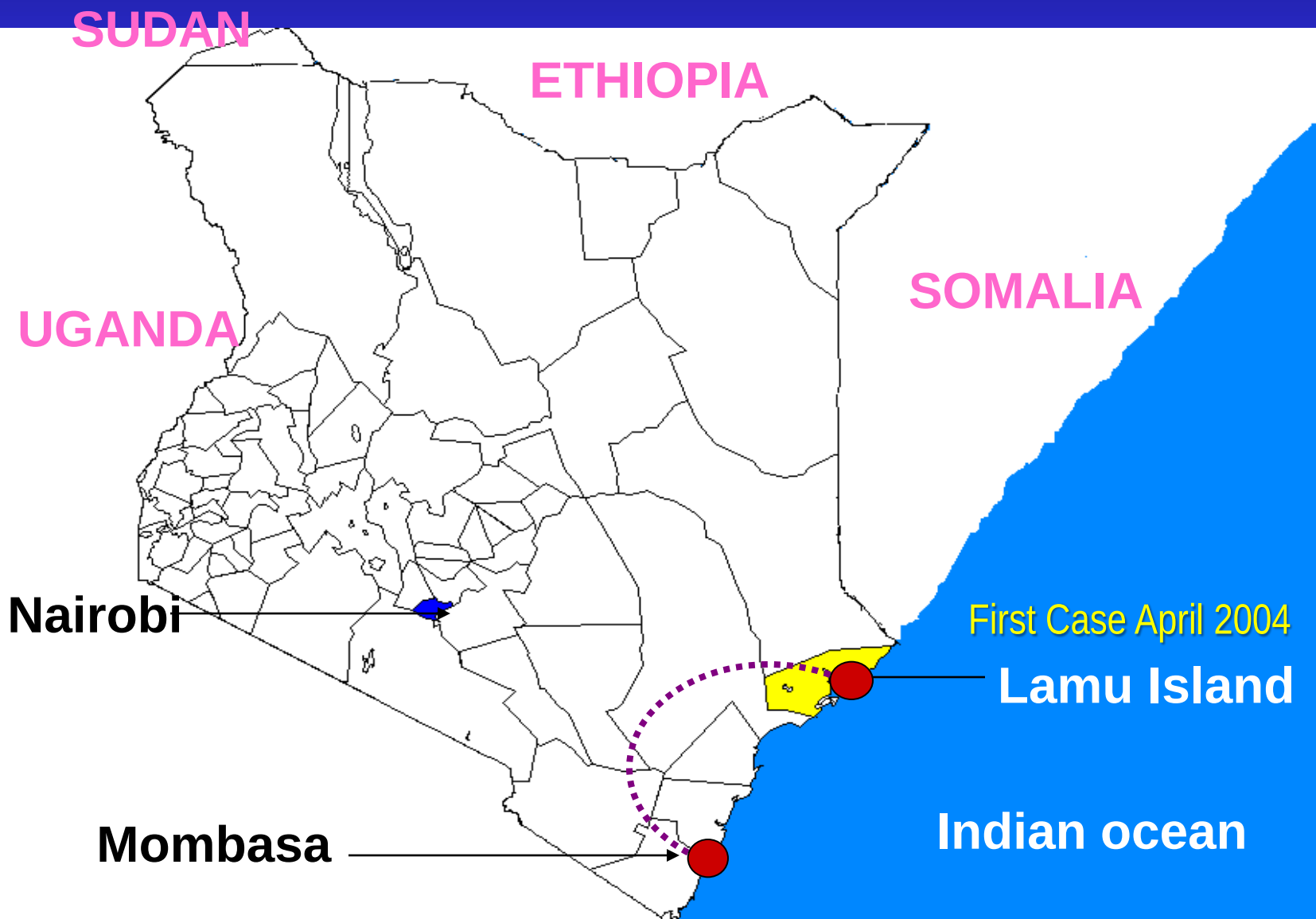
Kenya


SUDAN
ETHIOPIA
SOMALIA
UGANDA
Nairobi
First Case April 2004
Lamu Island
Mombasa
Indian ocean

Lamu Island Outbreak

- July 2004, unusual increase of “malaria” cases
- Severity of joint pains unusual
- 91% blood smears negative for Malaria

(Dr. F Simon)

Magnitude of Outbreak

- The attack rate was 75%.
- 13,500 persons (95% CI 12,458-14328) infected. (Lamu population=18,000)
- 86% of cases hospitalized/ stayed home in bed for a mean of 7 days (range 1-90).

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Comoros Island Outbreak

Comoros Island Outbreak

- Suspected Dengue outbreak reported in February 2005.
- 25 Sera analyzed
  - All negative for Dengue
  - 9 positive for IgM CHIK Antibodies
  - 6 positive for CHIK by PCR
- >89% cases with fever & joint pain
- 63% population seropositive prior to peak of epidemic

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Magnitude of Outbreak

- Attack rate of infection was 63%
- 214,830 persons (95% CI 196,757-233,244 persons) infected on Island.
- 79% of cases hospitalized/ stayed at home in bed, mean = 6 days (range 1-30 days)

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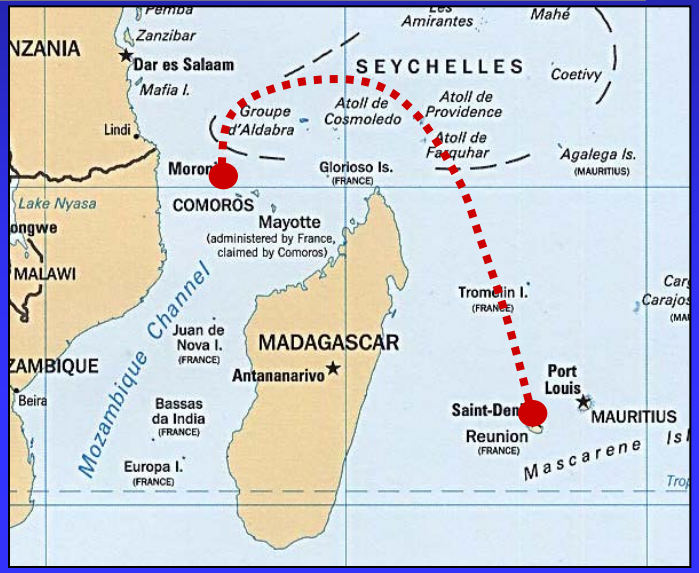
La Reunion Outbreak



- First cases: March 2005
- Major increase in cases during summer rainy season (mid-December – April, 2006)
- Total number of cases estimated at 244,000
- Switch of vectors

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Aedes albopictus as a vector of CHIKV

OPEN ACCESS Freely available online PLoS one

Two Chikungunya Isolates from the Outbreak of La Reunion (Indian Ocean) Exhibit Different Patterns of Infection in the Mosquito, *Aedes albopictus*

Marie Vazeille[1], Sara Moutailler[2], Daniel Coudrier[2], Claudine Rousseaux[3], Huot Khun[4], Michel Huerre[4], Julien Thiria[5], Jean-Sébastien Dehecq[5], Didier Fontenille[6], Isabelle Schuffenecker[7], Philippe Despres[8], Anna-Bella Failloux[2]*

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A Single Mutation in Chikungunya Virus Affects Vector Specificity and Epidemic Potential

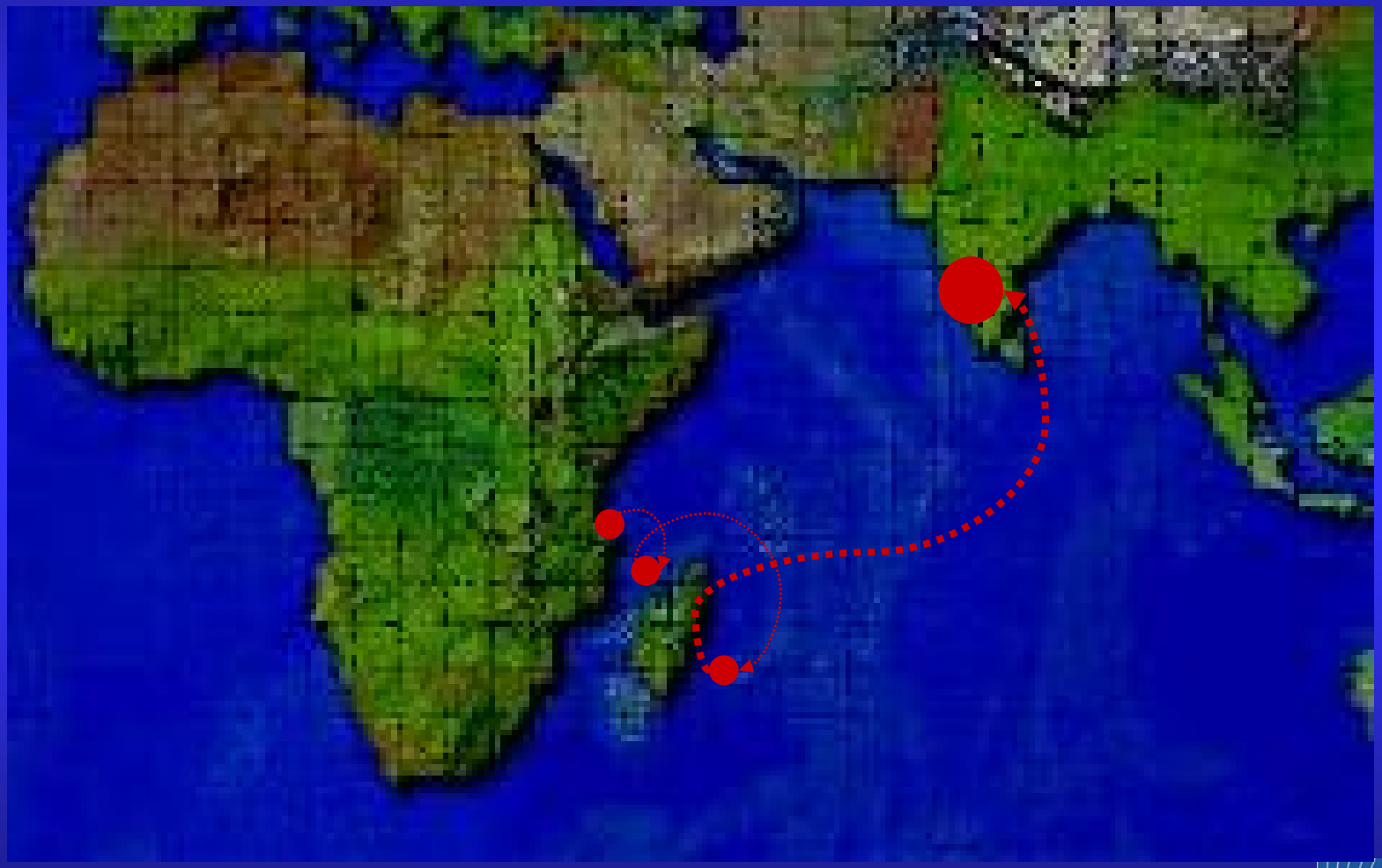
Konstantin A. Tsetsarkin, Dana L. Vanlandingham, Charles E. McGee, Stephen Higgs*

Table 2. Relevant Amino Acid Changes Identified between Indian Ocean Isolates versus a Selection of Alphavirus Sequences

Protein	Non-Structural Proteins														Structural Proteins								
	nsP1	nsP1	nsP2	nsP2	nsP2	nsP2	nsP3	nsP3	nsP3	nsP3	nsP3	nsP4	nsP4	nsP4	E2	E2	E2	E2	E2	6K	E1	E1	E1
Polypeptide position[a]	301	488	589	909	1177	1328	1550	1670	1691	1793	1804	1938	2117	2363	471	489	637	700	711	756	1035	1078	1093
Protein position[a]	301	488	54	374	642	793	217	337	358	460	471	75	254	500	146	164	312	375	386	8	226	269	284
05.115, 05.61 (Genotype 1)	T	R	N	Y	Y	V	H	I	S	E	S	A	A	L	Q	T	M	T	A	I	A	V	E
06.21 (Genotype 2)	T	R	N	Y	Y	V	H	I	S	E	S	A	A	L	Q	T	M	T	A	I	V	V	E
06.27 (Genotype 3)	I	R	N	Y	N	V	H	I	S	del	S	A	A	L	Q	T	M	T	A	I	V	V	E
06.49 (Genotype 4)	T	R	N	Y	Y	V	H	I	S	E	S	A	A	L	Q	T	M	T	A	I	V	V	E
05.209 (Genotype 5)	T	R	N	Y	Y	V	H	I	P	E	S	A	A	L	R	T	M	T	A	I	A	V	E
S27	T	Q	S	H	C	A	Y	T	S	L	P	T	T	Q	Q	A	T	S	V	I	A	M	D
Ross	T	Q	S	H	C	A	Y	T	S	L	P	T	T	Q	Q	A	T	S	V	V	A	M	D
37997 (West-African phylogroup)	T	K	S	H	Y	A	Y	T	S	P	P	T	T	Q	Q	A	T	S	V	A	A	V	D
Nagpur (Asian phylogroup)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Q	A	T	S	G	V	A	M	D
ONNV	S	Q	S	N	H	A	Y	[c]	S	[c]	[c]	T	T	E	H	A[b]	T	S	L[b]	T[b]	A	V	D
EEV	S	Q	S	N	E	R	N	[c]	[c]	[c]	[c]	I	V	E	E	G[b]	S	A	T[b]	D[b]	A	E	D
SFV	V	S	N	H	Y	A	L	[c]	S	[c]	[c]	T	T	E	H	V[b]	T	S	C[b]	A[b]	P	M	D
RRV	V	N	S	H	Y	G	S	[c]	[c]	[c]	[c]	V	T	E	H	D[b]	D	S	C[b]	A[b]	P	M	D
SINV	V	M	S	H	E	R	K	[c]	[c]	[c]	[c]	I	T	E	V	A[b]	V	T	V[b]	S[b]	A	V	N

PLoS Med. 2006 , 3:1058-70

Movement to Asia



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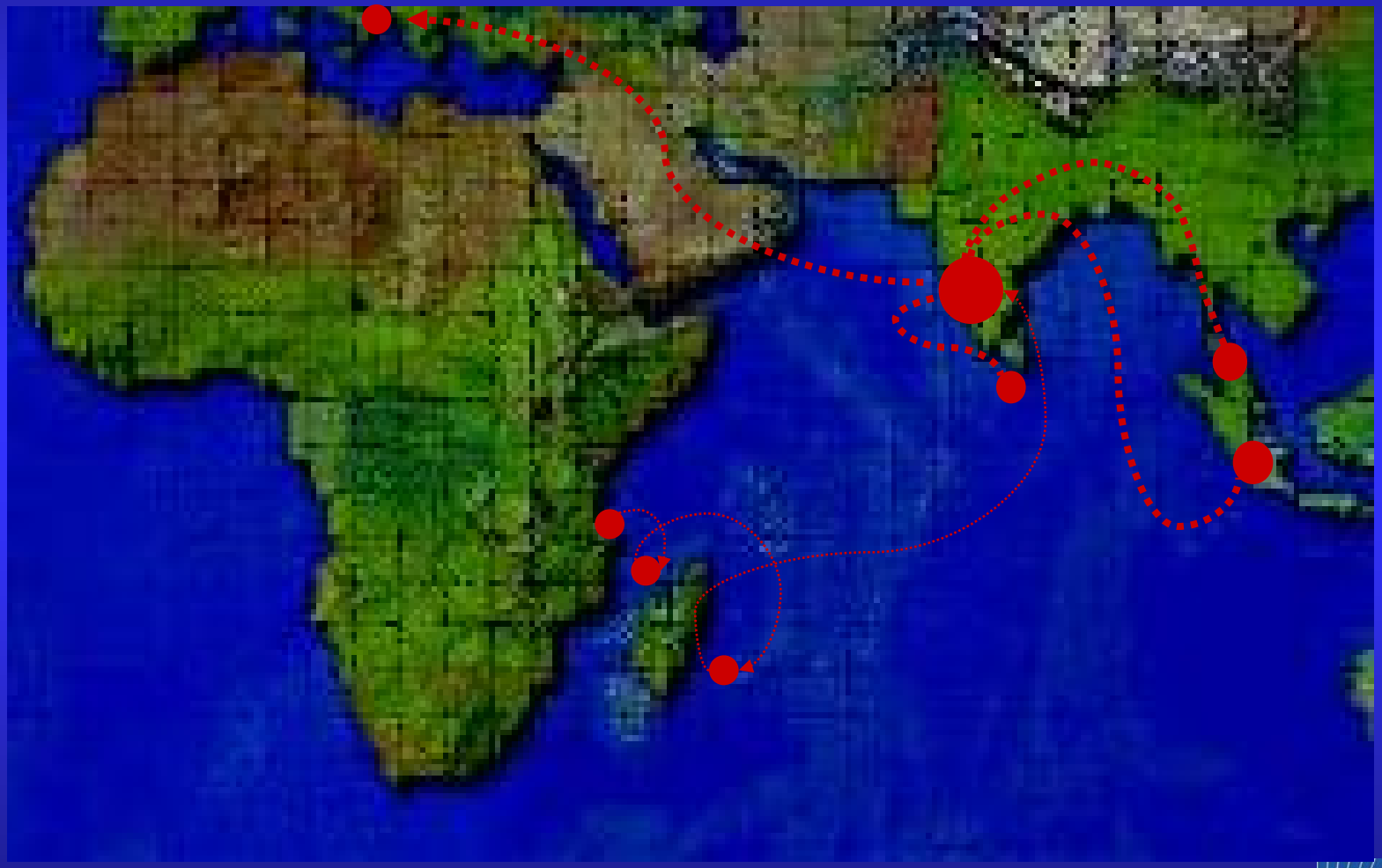
India outbreaks

- 13 states affected in 2005-2006 after 32 year interepidemic period
- Estimated 1.3 million cases
- Introduction of the Central/East African genotype into Asia
- Exported cases

Exportations



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2007– Chikungunya outbreak (local transmission) in Italy

An outbreak of chikungunya fever in the province of Ravenna, Italy

R Angelini[1] AC Finarelli[2], P Angelini[2], C Po[2], K Petropulacos[3], P Macini[2], C Fiorentini[4], C Fortuna[4], G Venturi[4], R Romi[4], G Majori[4], L Nicoletti[4], G Rezza[4], A Cassone (cassone@iss.it)[4]

1. Dipartimento Sanità Pubblica, Azienda Unità Sanitaria Locale (Department of Public Health, Local Health Unit), Ravenna, Italy
2. Servizio di Sanità Pubblica, Regione Emilia-Romagna, Bologna, Italy
3. Servizio Presidi ospedalieri, Regione Emilia-Romagna, Bologna, Italy
4. Department of Infectious, Parasitic and Immunomediated Diseases, Istituto Superiore di Sanità, Rome, Italy

Chikungunya fever is a viral disease transmitted by *Aedes spp* The infection is endemic in parts of Africa, South-east Asia Indian sub-continent. Since 2005, large outbreaks have been several islands in the Indian Ocean and in India [1]. Travellers affected by chikungunya have been diagnosed with chikungu several European countries, including Italy [2], but local involving mosquitoes has not occurred so far.

During the month of August, local health authorities of the Ravenna, Region Emilia-Romagna, Italy, detected an unusually of cases of febrile illness in Castiglione di Cervia and Castiglione two small villages divided by a river. At the end of the month, epidemiological investigations carried out by the local Hea collaboration with the Region and the Reference Laboratory of Superiore di Sanità in Rome, suggested an arbovirus as the po of the outbreak. Serological testing and PCR confirmed the

Eurosurveillance weekly releases 2007 > Volume 12 / Issue 9

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Table 2. Chronological order of documented outbreaks of CHIKV

Those countries in italics represent cases involving individuals from those countries but infected elsewhere and do not represent epidemics nor endemicity in those countries.

Year of outbreak(s)	Country	Genotype
1952	Tanzania	Central/East African
1958, 1971, 1985	Uganda	Central/East African
1960, 1999–2000	DRC	Central/East African
1960, 1962–1964, 1988, 1991–1993, 1995*	Thailand	Asian
1961, 1963	Zimbabwe	Central/East African
1963	Cambodia	Asian
1963–1965, 1973, 2006*	India	Asian & Central/East African*
1965, 1967	Vietnam	Asian
1965–1969, 1998–1999, 2006*	Malaysia	Asian
1966, 1982, 1996–1997	Senegal	West African
1967, 2006*	*Taiwan*	Asian & Central/East African
1969, 1974–1975, 1980	Nigeria	West African
1970	South Africa	Central/East African
1970	Kenya	Central/East African
1973	Burma	Asian
1973, 1980, 1983–1984, 1998–1999*, 2000–2005*	Indonesia	Asian
1980–1982	Burundi	Central/East African
1982	Gabon	Central/East African
1983	Pakistan	Asian
1985–1986	Philippines/USA	Asian
1987–1989	Malawi	Central/East African
1990, 2006	*Australia*	Asian & Central/East African
1992	Guinea	West African
2003*	Timor	Asian
1999–2000	CAR	Central/East African
2004, 2005	Kenya	Central/East African
2005*, 2006*	Comoros	Central/East African
2005*, 2006*	Réunion	Central/East African
2005*	Seychelles	Central/East African
2005*, 2006*	Mauritius	Central/East African
2006*	Mayotte	Central/East African
2006*	Madagascar	Central/East African
2006	Cameroon	Central/East African
2006*	*Canada*	Central/East African
2006*	*Hong Kong*	Central/East African
2006*	*UK*	Central/East African
2006*	*Belgium*	Central/East African
2006*	*Czech Republic*	Central/East African
2006*	*Germany*	Central/East African
2006*	*Norway*	Central/East African
2006*	*Switzerland*	Central/East African
2006*	*France*	Central/East African
2006*	*Italy*	Central/East African
2006*	*Corsica*	Central/East African
2006*	*Sri Lanka*	Central/East African
2006*	*Singapore*	Central/East African
2006*	*USA*	Central/East African
2007*	*Spain*	Central/East African
2007*	*Japan*	Central/East African
2007*	*Gabon*	Central/East African

*Data sourced from the International Society for Infectious Disease's Program for Monitoring Emerging Diseases ProMED-mail, Eurosurveillance, CDC-MMWR and WHO; these data are based on a compilation of reported, suspected and confirmed cases of CHIKV infection.

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Continued CHIKV activity – 2009/2010

- 2009: Malaysia: ~4400 cases
  Thailand: ~49,000 cases (south only)
- 2010: Malaysia: > 750 cases
  India: > 16,800 cases
  China (Guangdong): 38 cases + 166 suspect cases
  Myanmar
  Taiwan
  Indonesia
  Maldives
  Madagascar, La Reunion: ~150 cases
  France: 2 cases
  Gabon

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Continued CHIKV activity - 2011

2011:

- New Caledonia
  - Outbreak due to Asian genotype
  - ~27 cases
- Republic of Congo (Brazzaville)
  - Over 7000 cases
  - Central/East African genotype; <u>not</u> 2004-2010 epidemic lineage
- France – localized transmission
- India
- Bangladesh
- Indonesia
- Mauritius

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Continued CHIKV activity - 2012

2012:

- Cambodia
  - 45% of residents of one village CHIKV positive
  - Outbreak started after unusually large rainfall
  - Vector = *Ae. aegypti*.
- Bhutan
- Philippines
- Papua New Guinea: >600 cases in one local area
- Malaysia
- Yemen
- Democratic Republic of the Congo (Kinshasa)
- Sierra Leone
- Ongoing: India, Indonesia, Gabon, Mauritus

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Continued CHIKV activity - 2013

- Philippines: several islands, several hundred cases
- Australia: Imports from PNG, Bali, Singapore – 107 cases
- Papua New Guinea
  - 1st detected summer 2012, spread in 2013 to multiple provinces
  - Indian Ocean genotype
- New Caledonia
  - 4 cases – 1 past cool season -→ continuous transmission?
  - During dengue outbreak
- India
- Japan: Airport detection in tour group from Cambodia
- Cambodia
- Indonesia: At least 3 islands affected
- Taiwan: Imports from at least 4 countries in region
- Singapore: 500 cases in 2013

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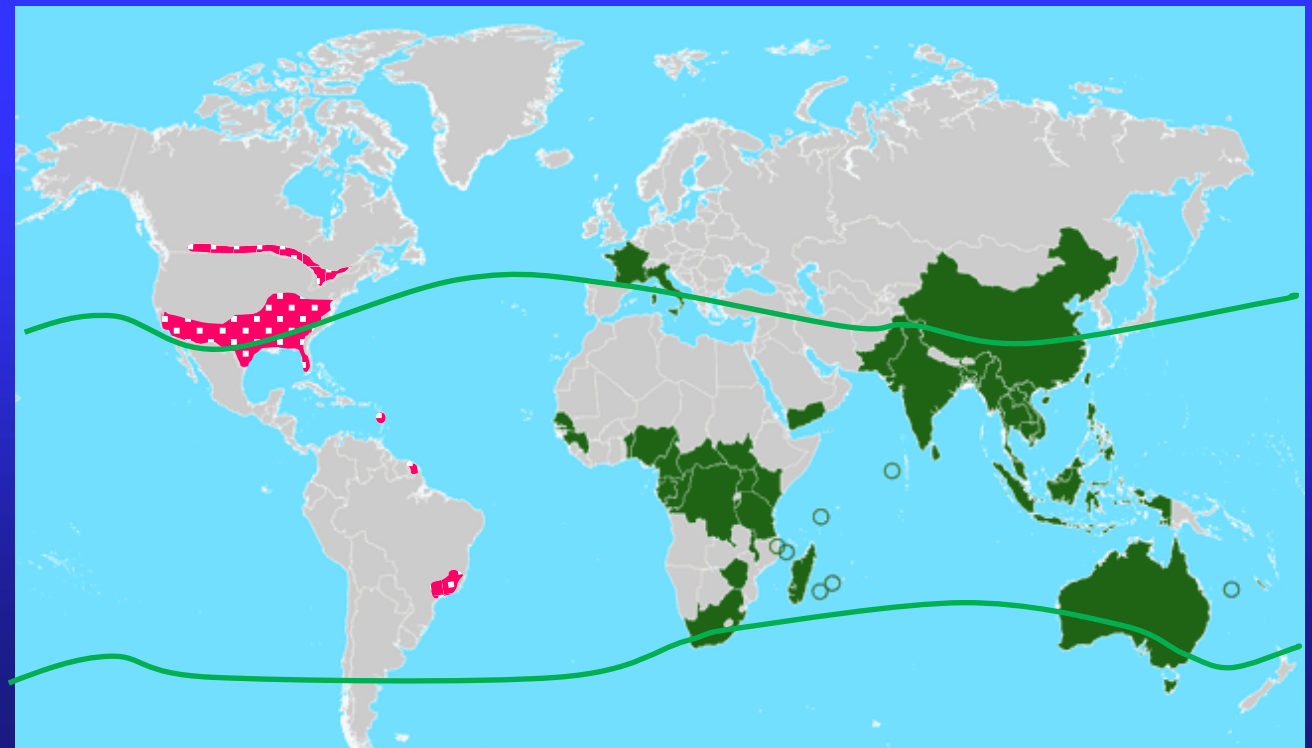
Imported to western hemisphere

- French Guiana – 2006 (Madagascar)
- French West Indies – 2006-2009
- US – 2005 – 2012
- Canada - 2006
- Brazil – 2010



Chikungunya Fever in the United States: A Fifteen Year Review of Cases

(CID 2011, 52: e121-e126)

Katherine B. Gibney,[1,2] Marc Fischer,[1] Harry E. Prince,[3] Laura D. Kramer,[4] Kirsten St. George,[4] Olga L. Kosoy,[1] Janeen J. Laven,[1] and J. Erin Staples[1]

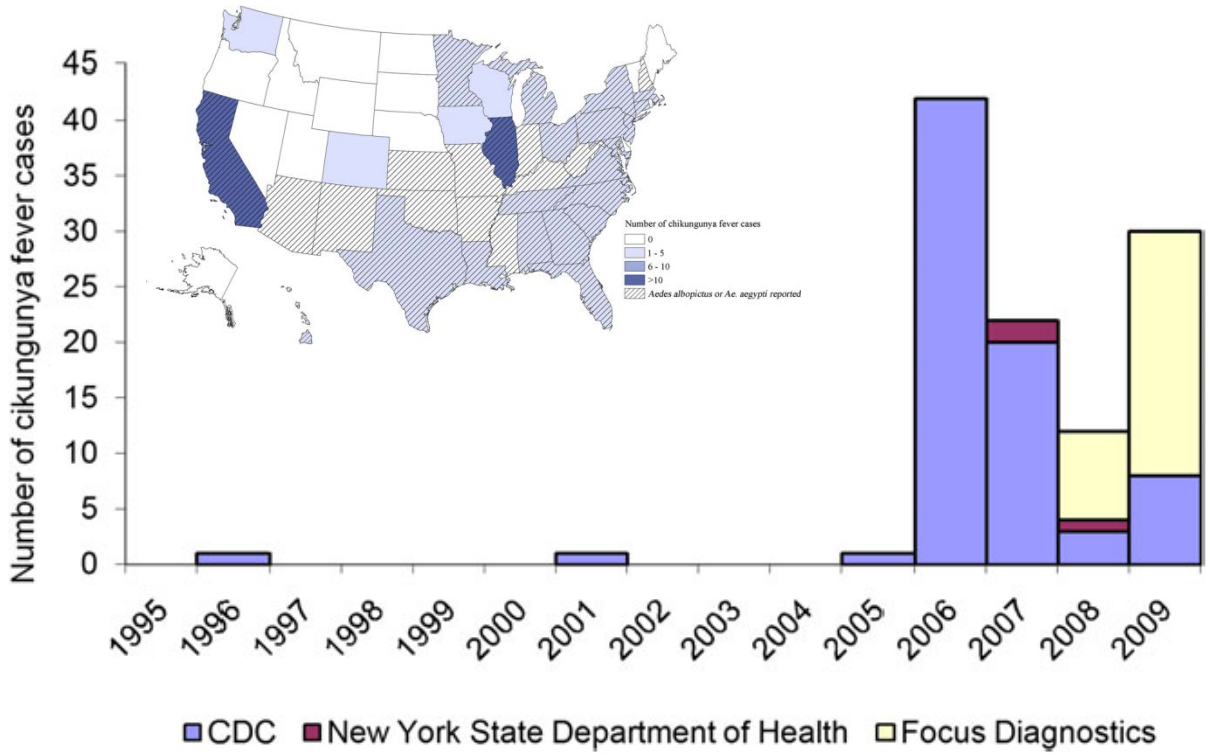


Figure 1. Chikungunya fever cases by testing laboratory and year, 1995–2009.

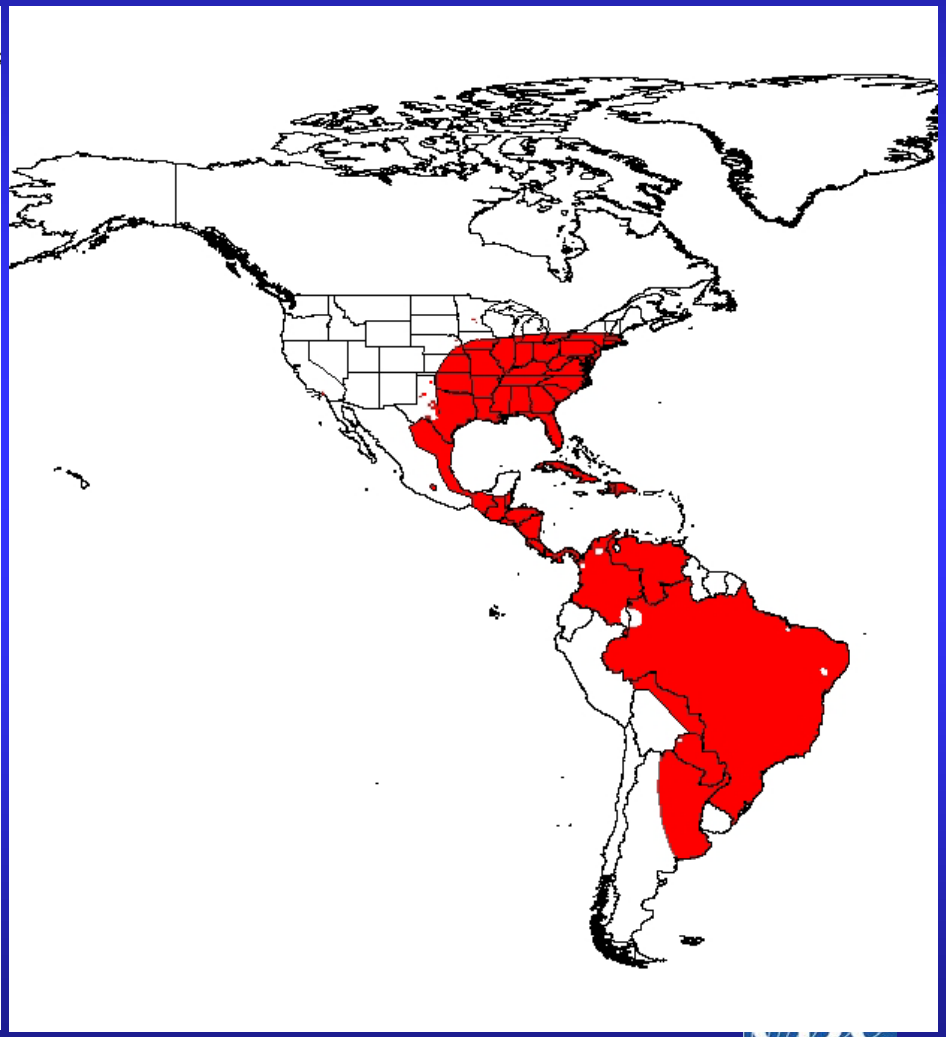
- 1995-2012: 122 cases (all travel associated)
- 25 states with cases
- 61% likely viremic when entering U.S.

Vector Presence in the Americas

Ae. aegypti

Adapted from Arias JR. Dengue: How are we doing? *Celebrating 100 Years of PAHO*. Washington, D.C.: PAHO; 2002.

Ae. albopictus



Adapted from Benedict MQ, et al. Spread of the tiger: global risk of invasion by the mosquito *Aedes albopictus*. *Vector Borne Zoonotic Dis.* Spring 2007;7(1):76-85.

Jamaica CHIK-DEN meeting intro 5-2012- Nasci Final.pdf - Adobe Acrobat Pro
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CHIK in the Caribbean: Public Health Emergency of International Concern

- Is the public health impact serious?
- Is the event unusual or unexpected?
- Is there a significant risk of international spread?

Required to inform WHO under provisions of IHR 2005

CHIKV Preparedness Activities

- *Goals:* early detection of CHIKV introduction and limiting potential spread of the disease

- Pan American Health Organization (PAHO), with the support of the Division of Vector-borne Diseases of the United States Centers for Disease Control and Prevention (DVBD, CDC), created a working group and convened a meeting in Lima, Peru, on July 21−23, 2010 to discuss the threat this virus represents and to examine measures that might be taken to mitigate this threat

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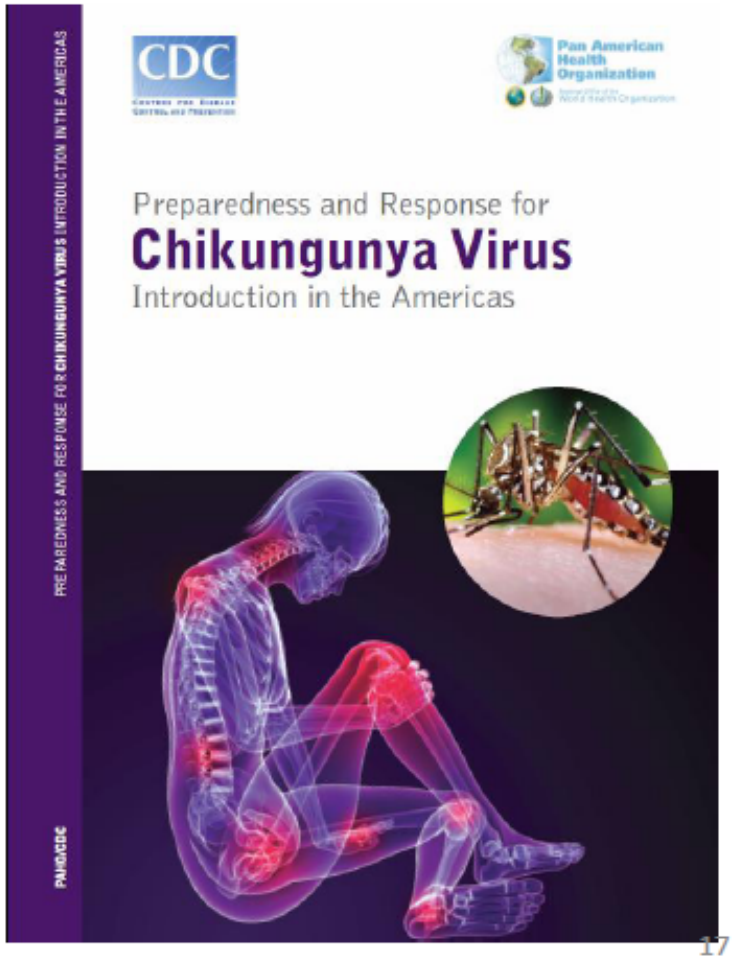
Pan American Health Organization
Regional Office of the World Health Organization

Preparedness and Response for Chikungunya Virus Introduction in the Americas

Topics

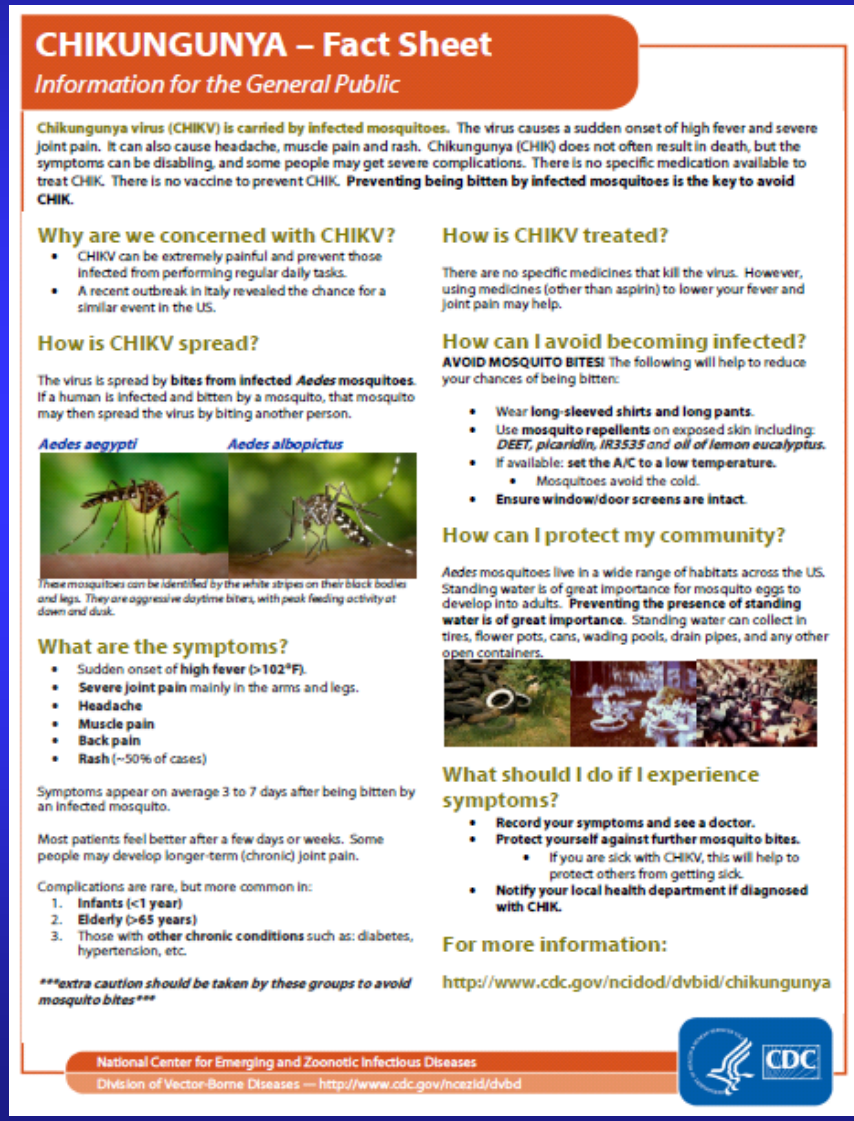
- Epidemiology
- Clinical
- Laboratory
- Case Management
- Surveillance and Outbreak Response
- Vector Surveillance and Control
- Risk and Outbreak Communication



http://new.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=16984&Itemid

Development of Toolkit

- Based on needs identified in preparedness plan, countries developing specific tools
  - Fact sheets for various stakeholders (general public, health care providers, etc.)
  - Slide sets for clinicians
  - Short overriding communication messages



CHIKUNGUNYA – Fact Sheet

Information for the General Public

Chikungunya virus (CHIKV) is carried by infected mosquitoes. The virus causes a sudden onset of high fever and severe joint pain. It can also cause headache, muscle pain and rash. Chikungunya (CHIK) does not often result in death, but the symptoms can be disabling, and some people may get severe complications. There is no specific medication available to treat CHIK. There is no vaccine to prevent CHIK. **Preventing being bitten by infected mosquitoes is the key to avoid CHIK.**

Why are we concerned with CHIKV?

- CHIKV can be extremely painful and prevent those infected from performing regular daily tasks.
- A recent outbreak in Italy revealed the chance for a similar event in the US.

How is CHIKV spread?

The virus is spread by **bites from infected *Aedes* mosquitoes**. If a human is infected and bitten by a mosquito, that mosquito may then spread the virus by biting another person.

Aedes aegypti ***Aedes albopictus***

These mosquitoes can be identified by the white stripes on their black bodies and legs. They are aggressive daytime biters, with peak feeding activity at dawn and dusk.

What are the symptoms?

- Sudden onset of **high fever (>102°F)**.
- **Severe joint pain** mainly in the arms and legs.
- **Headache**
- **Muscle pain**
- **Back pain**
- **Rash** (~50% of cases)

Symptoms appear on average 3 to 7 days after being bitten by an infected mosquito.

Most patients feel better after a few days or weeks. Some people may develop longer-term (chronic) joint pain.

Complications are rare, but more common in:

1. **Infants (<1 year)**
2. **Elderly (>65 years)**
3. Those with **other chronic conditions** such as: diabetes, hypertension, etc.

******extra caution should be taken by these groups to avoid mosquito bites******

How is CHIKV treated?

There are no specific medicines that kill the virus. However, using medicines (other than aspirin) to lower your fever and joint pain may help.

How can I avoid becoming infected?

AVOID MOSQUITO BITES! The following will help to reduce your chances of being bitten:

- Wear **long-sleeved shirts and long pants**.
- Use **mosquito repellents** on exposed skin including: ***DEET, picaridin, IR3535*** *and* ***oil of lemon eucalyptus.***
- If available: **set the A/C to a low temperature.**
  - Mosquitoes avoid the cold.
- **Ensure window/door screens are intact.**

How can I protect my community?

Aedes mosquitoes live in a wide range of habitats across the US. Standing water is of great importance for mosquito eggs to develop into adults. **Preventing the presence of standing water is of great importance.** Standing water can collect in tires, flower pots, cans, wading pools, drain pipes, and any other open containers.

What should I do if I experience symptoms?

- **Record your symptoms and see a doctor.**
- **Protect yourself against further mosquito bites.**
  - If you are sick with CHIKV, this will help to protect others from getting sick.
- **Notify your local health department if diagnosed with CHIK.**

For more information:

http://www.cdc.gov/ncidod/dvbid/chikungunya

National Center for Emerging and Zoonotic Infectious Diseases
Division of Vector-Borne Diseases — http://www.cdc.gov/ncezid/dvbd

CDC

Laboratory Training

- PAHO - Caribbean Sub-Regional Training Workshop – Jamaica
- CDC Laboratory Diagnostic Methods Training – Puerto Rico
- Proficiency Testing: 10 laboratories in Caribbean and Latin America

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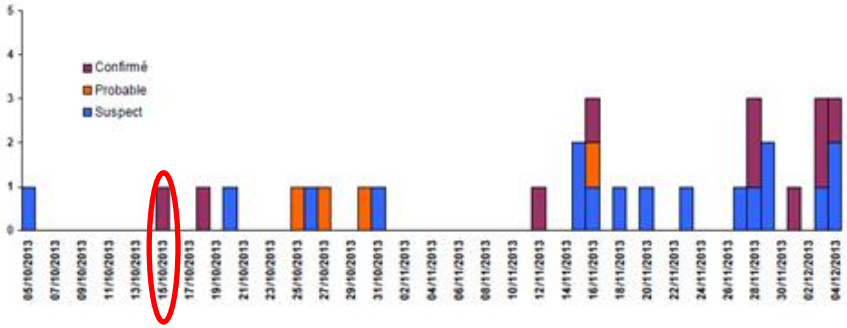
Locally Acquired CHIKV in the Caribbean

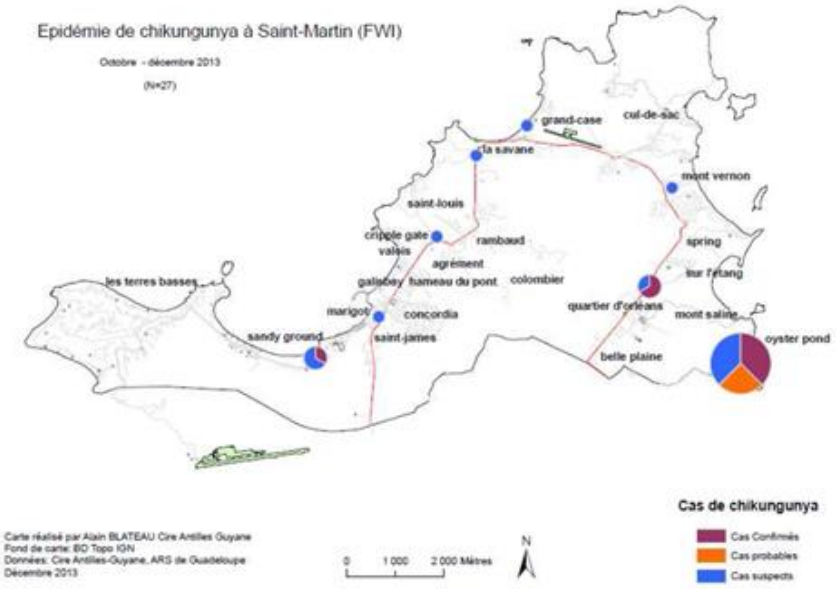
Epidemic curve chikungunya cases by date of onset of symptoms occurring in Saint-Martin from 5 October and 4 December 2013. Data available for 31 cases.
(source: ARS and InVS)

| Figure 1 |

Courbe épidémique des cas de chikungunya selon la date de début des signes, survenus à Saint-Martin entre le 5 octobre et le 4 décembre 2013. Données disponibles pour 31 cas.



Geographical distribution of cases of chikungunya occurred in St Martin between October 5 and December 4, 2013. Data available for 27 cases.
(source: ARS and InVS)



First report:
Dec 6, 2013
Saint Martin

Western Hemisphere - 2013

(All likely locally acquired cases)

- St. Martin: 66 confirmed, 14 probable, 167 suspected
- St. Barthelemy: 11 suspected;
- Guadeloupe: 1 confirmed, 21 suspected;
- Martinique: 3 confirmed, 27 suspected;

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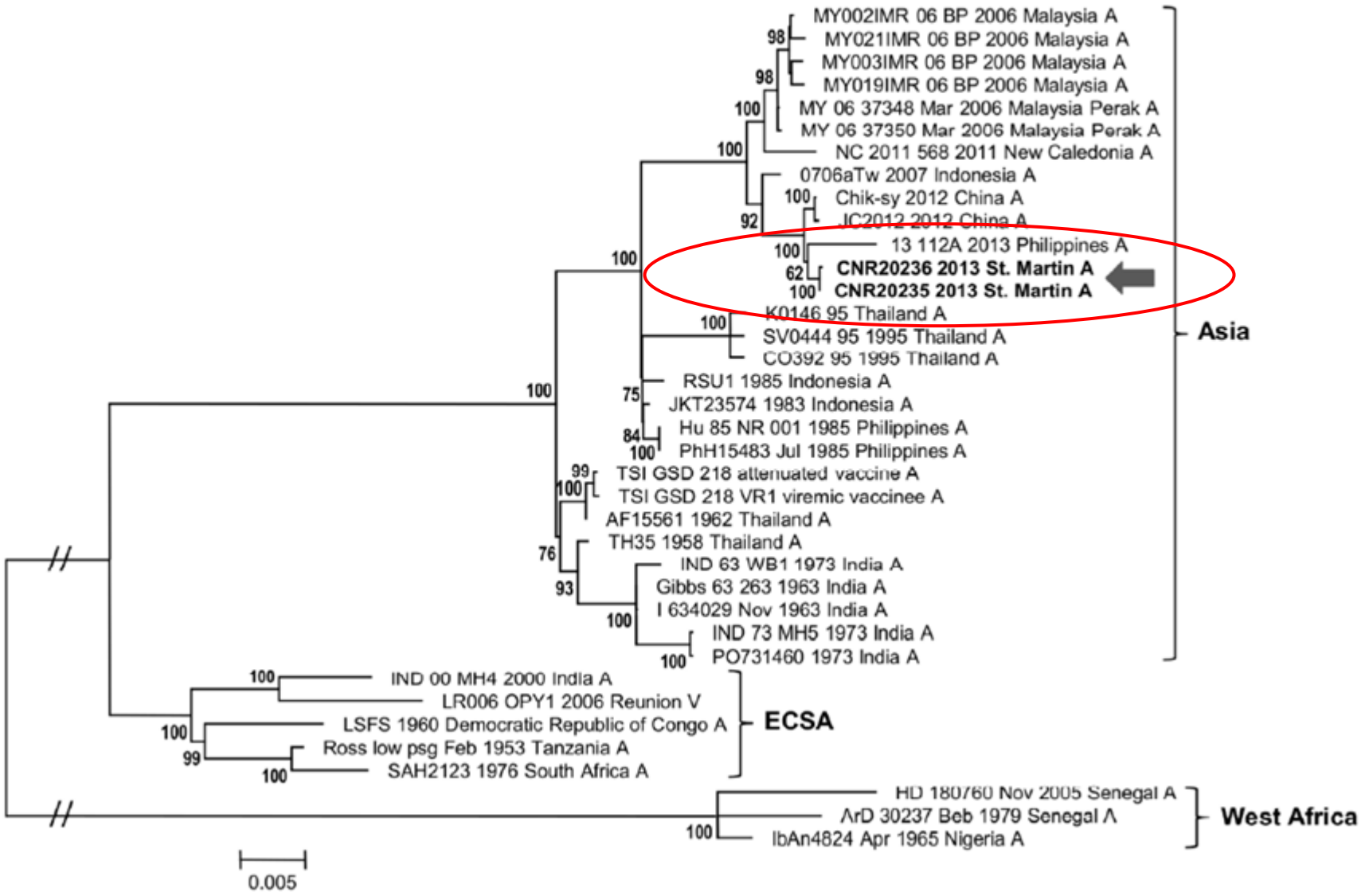
Sequence information for each virus corresponds to virus strain name / date and country of isolation / amino acid residue at position E1-226. Viral genotypes (Asia / ECSA / West-Africa) are indicated.



Reported Transmission of Chikungunya Virus in the US

First chikungunya cases acquired in the U.S. reported

Michelle Healy, USA TODAY 6:20 p.m. EDT July 17, 2014

(Photo: James Gathany, CDC)

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Florida Health officials Thursday confirmed the first locally acquired cases of the mosquito-borne virus chikungunya. The two cases are the first instances in the U.S. in which the virus was not contracted during Caribbean travel, according to the Florida Department of Health.

The infected individuals were described as a 41-year-old woman in Miami-Dade County who began experiencing symptoms on June 10, and a 50-year-old man in Palm Beach County, who first noticed symptoms July 1.

Puerto Rico announces epidemic of mosquito-borne virus chikungunya

Published time: July 18, 2014 17:03 Get short URL

Reuters / Ricardo Rojas

956 | 282 | 1

Puerto Rican health officials declared Thursday an epidemic of chikungunya, a mosquito-borne virus that has shown up in more than 200 confirmed cases across the island as of late last month.

Tags
Biology, Caribbean basin, Health, Medicine, North America, USA

Health Secretary Ana Rius said the majority of those cases were reported in the capital of San Juan and nearby areas.

Chikungunya virus in the United States

Updates of chikungunya case counts are publically released every Tuesday evening (MT).

- Chikungunya is not a nationally notifiable disease in the United States. However, chikungunya cases can be reported to ArboNET, the national surveillance system for arthropod-borne diseases.
- From 2006–2013, studies identified an average of 28 people per year in the United States with positive tests for recent chikungunya virus infection (Range 5–65 per year). All were travelers visiting or returning to the United States from affected areas, mostly in Asia. Only a quarter of the cases were reported to ArboNET.
- Beginning in 2014, cases have been identified in travelers returning from the Caribbean. As of July 15, a total of 357 chikungunya cases have been reported to ArboNET from U.S. states and territories (Table). One hundred twenty-three locally-transmitted cases have been reported from Puerto Rico and the US Virgin Islands. All other cases occurred in travelers returning from affected areas in the Caribbean and South America (N=230), the Pacific Islands (N=3), or Asia (N=1). To date, no local transmission has been identified in the continental United States.
- With the recent outbreaks in the Caribbean and the Pacific, the number of chikungunya cases among travelers visiting or returning to the United States from affected areas will likely increase. These imported cases could result in local spread of the virus in the continental United States.

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State or territory	Travel-associated cases†‡ (N=234) No. (%)	Locally-transmitted cases (N=123) No. (%)
Arizona	1 (<1)	0 (0)
Arkansas	2 (1)	0 (0)
California	11 (5)	0 (0)
Connecticut	9 (4)	0 (0)
Florida	73 (31)	0 (0)
Georgia	6 (3)	0 (0)
Illinois	1 (<1)	0 (0)
Indiana	1 (<1)	0 (0)
Kansas	2 (1)	0 (0)
Kentucky	7 (3)	0 (0)
Louisiana	3 (1)	0 (0)
Maryland	5 (2)	0 (0)
Massachusetts	2 (1)	0 (0)
Michigan	4 (2)	0 (0)
Minnesota	7 (3)	0 (0)
Mississippi	3 (1)	0 (0)
Nebraska	2 (1)	0 (0)
Nevada	1 (<1)	0 (0)
New Hampshire	1 (<1)	0 (0)
New Jersey	12 (5)	0 (0)
New York	20 (9)	0 (0)
North Carolina	9 (4)	0 (0)
Ohio	7 (3)	0 (0)
Oklahoma	6 (3)	0 (0)
Oregon	1 (<1)	0 (0)
Pennsylvania	3 (1)	0 (0)
Puerto Rico	0 (0)	121 (98)
Rhode Island	7 (3)	0 (0)
Tennessee	13 (6)	0 (0)
Texas	4 (2)	0 (0)
US Virgin Islands	2 (1)	2 (2)
Virginia	8 (3)	0 (0)
West Virginia	1 (<1)	0 (0)

Chikungunya Human Disease Cases Reported to ArboNET as of July 15th 2014

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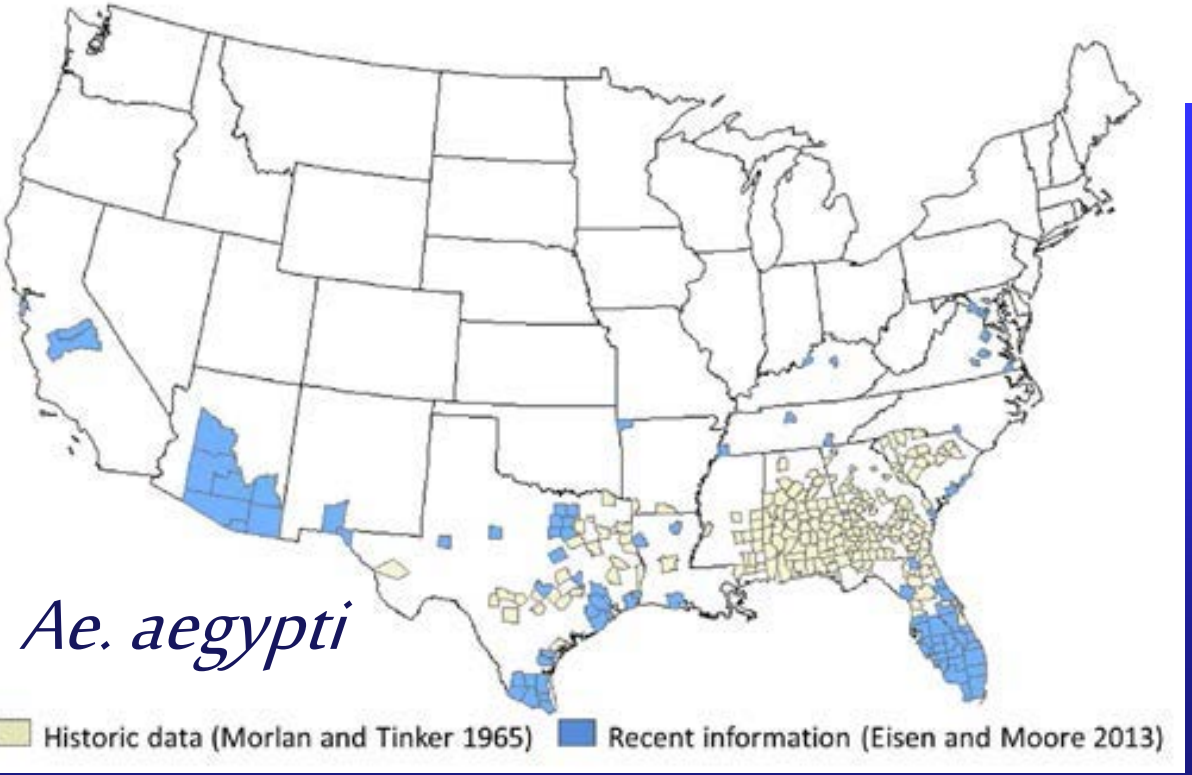
Vector Presence in the Americas



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Western Hemisphere - 2014

As of 18 July 2014, PAHO/WHO

- North America – 236
- Central American Isthmus - 1,717
- Latin Caribbean – 431,135
- Andean States – 0
- Non-Latin Caribbean – 3,676
- **Total Number of Cases – 436,586**

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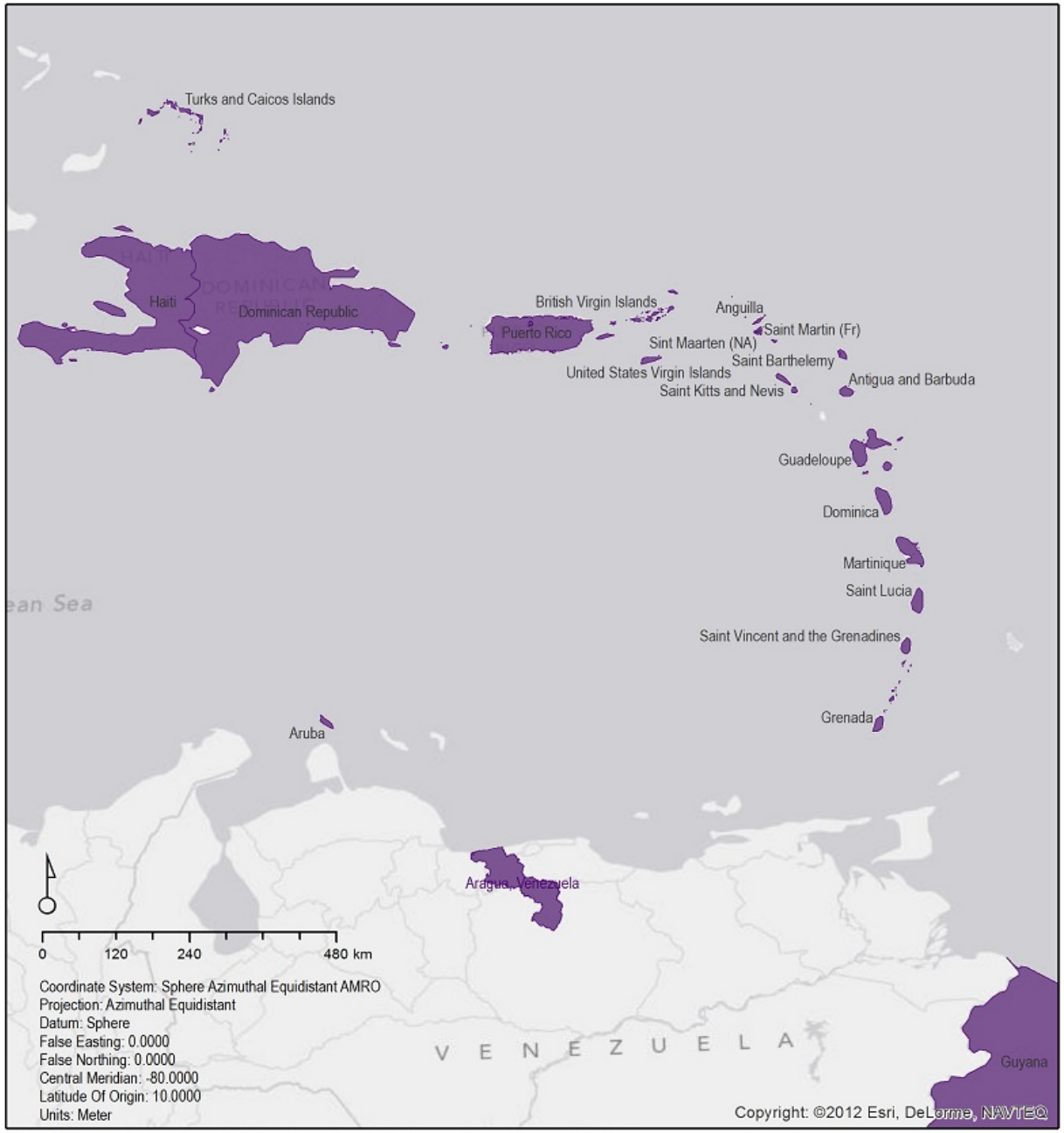
Pan American Health Organization

World Health Organization
REGIONAL OFFICE FOR THE Americas

Countries/territories with autochthonous transmission of Chikungunya in the Americas, EW 29, 2014



Legend

Countries/Territories with autochthonous transmission *

Countries/Territories with imported cases but no autochthonous transmission

Data source:
PAHO/WHO. Number of reported cases of Chikungunya Fever in the Americas
http://www.paho.org/chikungunya

Map production:
PAHO\CHA\IR\ARO

* Note: Entire countries have been shaded on the map though there is no evidence of country-wide disease presence

VECTOR-BORNE AND ZOONOTIC DISEASES
Volume 10, Number 5, 2010
© Mary Ann Liebert, Inc.
DOI: 10.1089/vbz.2009.0106

Vector Competence of Australian Mosquitoes for Chikungunya Virus

Andrew F. van den Hurk,[1,2] Sonja Hall-Mendelin,[2] Alyssa T. Pyke,[1] Greg A. Smith,[1] and John S. Mackenzie[3]

Table 2. Susceptibility of Five Australian Mosquitoes to Chikungunya Virus Determined by Probit Analysis

Species	*Log_{10} ID_{50}/mosquito*[a]	*95% CI*[b]	*df*	χ^2	p
Aedes aegypti	2.6	2.3–2.9	2	1.45	0.484
Ae. albopictus	1.7	0.9–2.2	2	1.58	0.453
Ae. notoscriptus	2.6	2.2–3.0	2	0.37	0.830
Ae. procax	0.6	0.1–0.9	2	0.06	0.972
Ae. vigilax	2.1	1.8–2.3	2	0.82	0.664

[a]The $\log_{10}$ cell culture infectious dose required to infect 50% of the mosquitoes.
[b]CI, confidence interval.

Table 3. Infection, Dissemination and Transmission Rates in 10 Australian Mosquito Species Exposed to a 2006 Reunion Island Strain of Chikungunya Virus

Species	*Virus titer*[a]	*% Infection*[b]		*% Dissemination*[c]		*% Transmission*[d]		*% Transmission/ dissemination*[e]	
Aedes aegypti	4.0	92	(23/25)	92	(23/25)	64	(16/25)	70	(16/23)
Ae. albopictus	3.9	92	(23/25)	92	(23/25)	32	(8/25)	35	(8/23)
Ae. notoscriptus	4.1	87	(26/30)	23	(7/30)	20	(6/30)	86	(6/7)
Ae. procax	3.5	100	(25/25)	96	(24/25)	64	(16/25)	67	(16/24)
Ae. vigilax	3.6	100	(25/25)	100	(25/25)	76	(19/25)	76	(19/25)
Coquillettidia linealis	3.7	81	(13/16)	75	(12/16)	75	(12/16)	100	(12/12)
Culex annulirostris	3.5	20	(5/25)	20	(5/25)	12	(3/25)	60	(3/5)
Cx. quinquefasciatus	4.1	0	(0/11)	0	(0/11)	0	(0/11)	0	(0/11)
Cx. sitiens	3.5	8	(2/25)	4	(1/25)	4	(1/25)	100	(1/1)
Verrallina funerea	3.0	72	(18/25)	28	(7/25)	12	(3/25)	43	(3/7)

[a]Titer ($\log_{10}CCID_{50}$/mosquito) of the infectious blood meal to which mosquitoes were exposed.
[b]Percentage of mosquitoes containing virus in their bodies (number positive/number tested).
[c]Percentage of mosquitoes containing virus in their legs and wings (number positive/number tested).
[d]Percentage of mosquito expectorates in which virus was detected (number of positive expectorates/number tested).
[e]Percentage of mosquitoes with a disseminated infection in which virus was detected in the expectorate (number of positive expectorates/number disseminated).

Female mosquitoes collected using CDC light traps and CDC gravid traps during an outbreak of West Nile virus in Maricopa County, Arizona, July 31—August 9, 2010.

Species	Outbreak sites	Control sites	Total
Ps. columbiae	5,092 (73.5)*	1,834 (26.5)	6,926 (100) *(74.2)*†
Cx. quinquefasciatus	1,420 (72.3)	544 (27.7)	1964 (100) *(21.1)*
Ae. aegypti	5 (3.0)	194 (97.0)	199 (100) *(2.0)*
Cx. tarsalis	115 (59.0)	79 (41)	194 (100) *(2.0)*
Ae. vexans	19 (100)	0 (0)	19 (100) *(0.2)*
Cx. sp	9 (64)	5 (36)	14 (100) *(0.2)*
An. franciscanus	0 (0)	5 (100)	5 (100) *(<0.1)*
Ae. sp	4 (80)	1 (20)	5 (100) *(<0.1)*
An. sp	1 (33)	2 (67)	3 (100) *(<0.1)*
Total	6,665 (71.4)	2,664 (28.6)	9329 (100) *(100)*

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Factors Affecting Emergence/Outbreaks

- Environmental/ecological conditions
- Abundance of mosquito egg laying habitats
- Completely naïve pop
- Alternate vector(s), new ecological niches involved
- Viral genetics / mutations

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Acknowledgements

- ADB Diagnostic Laboratory
- ADB Epidemiology Activity
- ADB Alphavirus Laboratory
- PAHO
- CARPHA
- Caribbean Island MOH's
- DGHP/CGH

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Thank you
&
Questions?

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention

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Chikungunya Fever, Mauritius, 2006

Sanjay Beesoon,*
Ellen Funkhouser,†
Navaratnam Kotea,*
Andrew Spielman,‡[1]
and Rebecca M. Robich‡
*University of Mauritius, Reduit, Mauritius; †University of Alabama at Birmingham School of Medicine, Birmingham, Alabama, USA; and ‡Harvard School of Public Health, Boston, Massachusetts, USA

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 14, No. 2, February 2008

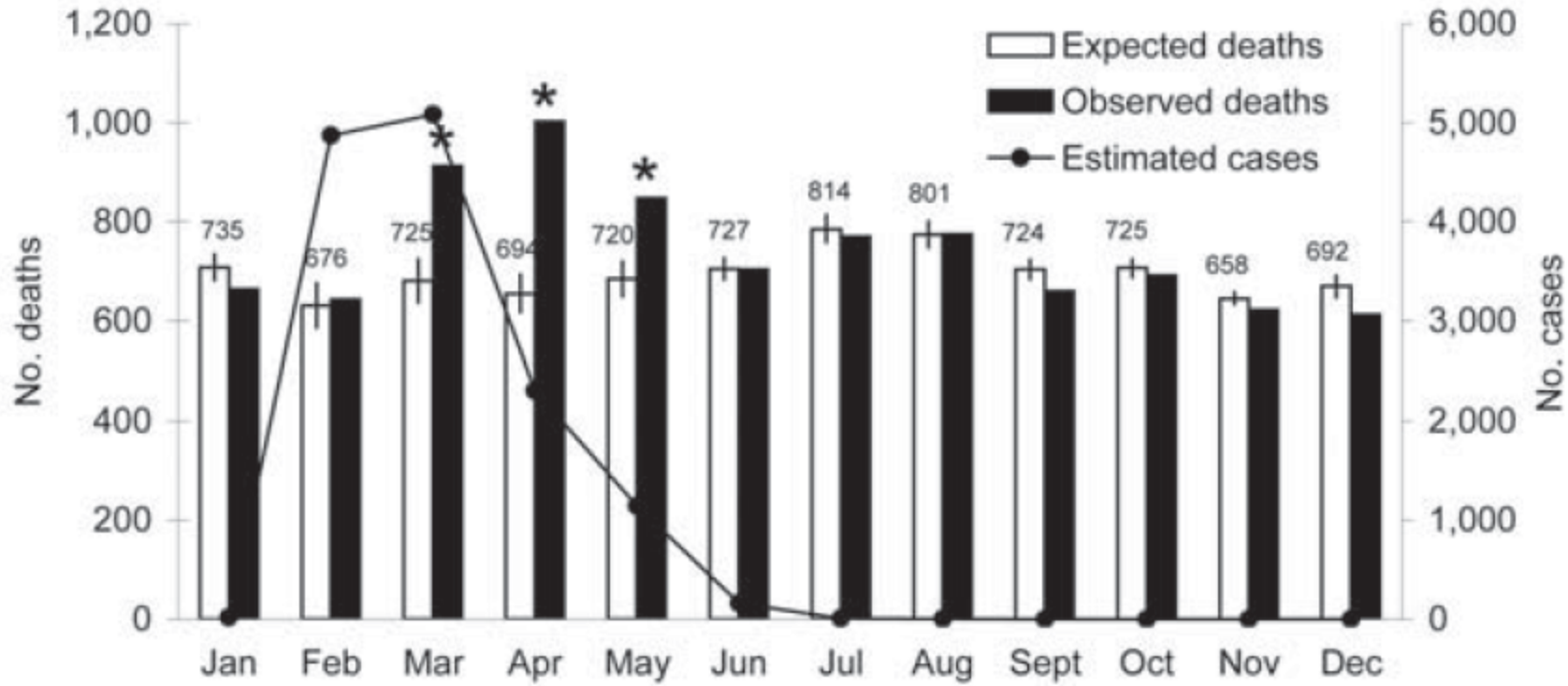

Figure. Expected and observed numbers of deaths and estimated number of chikungunya cases on Mauritius Island. Asterisks indicate a statistically significant ($p<0.01$) difference between expected and observed number of deaths for the specified months. Vertical lines show 95% confidence intervals; upper confidence limits are shown numerically.

Increased Mortality Rate Associated with Chikungunya Epidemic, Ahmedabad, India

Dileep Mavalankar,* Priya Shastri,* Tathagata Bandyopadhyay,* Jeram Parmar,* and Karaikurichi V. Ramani*

In 2005–2006, Réunion Island in the Indian Ocean reported ≈266,000 cases of chikungunya; 254 were fatal (case-fatality rate 1/1,000). India reported 1.39 million cases of chikungunya fever in 2006 with no attributable deaths; Ahmedabad, India, reported 60,777 suspected chikungunya cases. To assess the effect of this epidemic, mortality rates in 2006 were compared with those in 2002–2005 for Ahmedabad (population 3.8 million). A total of 2,944 excess deaths occurred during the chikungunya epidemic (August–November 2006) when compared with the average number of deaths in the same months during the previous 4 years. These excess deaths may be attributable to this epidemic. However, a hidden or unexplained cause of death is also possible. Public health authorities should thoroughly investigate this increase in deaths associated with this epidemic and implement measures to prevent further epidemics of chikungunya.

EID 14:412-415, 2008

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