A Global Overview of the Chikungunya Virus Problem

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Centers for Disease Control and Prevention
Chikungunya Virus

- **Family Togaviridae, genus Alphavirus**
  - Enveloped, single stranded RNA virus
  - Plus-sense, unsegmented genome of 11.5-11.8 kilobases

- First isolated from human serum during outbreak in Tanganyika - 1953

- Distinct biological and transmission patterns between African and Asian strains

- Classical clinical presentation
  - Fever
  - Severe joint pain
  - Rash (maculopapular)
Sylvatic CHIK Transmission Cycle

- Aedes furcifer, Aedes africanus
- chimpanzees, monkeys, baboons
Urban CHIK Transmission Cycle

Aedes aegypti
Aedes albopictus

Aedes albopictus
Aedes aegypti
Distribution of CHIKV – prior to 1999
Recent Outbreaks of CHIKV


1999-2000 2005

2005-2006

2004

2006-2009

2008-2009

Re-emergence of CHIKV: 2004-2006
Timeline

First cases identified in East Africa
Lamu Island Outbreak

- July 2004, unusual increase of “malaria” cases
- Severity of joint pains unusual
- 91% blood smears negative for Malaria
- Out of 10 sera, IgM Ab to CHIK detected in 3 sera
Early Findings

- At least 1300 suspected cases counted
- IgM ELISAs negative for Dengue, Yellow Fever, West Nile, RVF, and Sindbis
- CHIK infection diagnosis by
  - IgM ELISA (60 cases)
  - Virus isolation (22 cases)
- CHIK confirmed by genomic sequencing
- No deaths reported
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).
Nature of Virus

- Central / East African genotype
- Less than 3% divergent at nucleotide level from closest historical relative
Timeline

First cases identified in East Africa

April, 2004

April, 2005

April, 2006

April, 2007

Virus moves to Comoros

April, 2008
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
Investigation started
**Antibody Testing Results**

*(N=331)*

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<tr>
<td><strong>Positive</strong></td>
<td>89 (27%)</td>
<td>198 (60%)</td>
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<td><strong>Negative</strong></td>
<td>242 (73%)</td>
<td>133 (40%)</td>
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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).
Nature of Virus

Central / East African genotype

Virtually identical to isolates from Mombasa and Lamu

KARIUKI et al., 2008. JOURNAL OF GENERAL VIROLOGY. 89
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Timeline

First cases identified in East Africa

April, 2004

Virus identified in nearby Reunion

Virus moves to Comoros

April, 2005

April, 2006

April, 2007

April, 2008

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
Timeline

Epidemic peaks in La Reunion: 40,000 cases/wk

Cases identified in Mauritius, Seychelles, Madagascar, Maldives

First cases identified in East Africa

Virus moves to Comoros

Virus identified in nearby Reunion

April, 2004

April, 2005

April, 2006

April, 2007

April, 2008
La Reunion – changing patterns?

- New, “virulent” genotype?
- Neurological involvement
- Intrauterine transmission (?) / neonatal disease
- CHIKV-associated deaths (underlying conditions)
- Transmission by alternate vector (?)
Possible increase in virulence?

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Aedes albopictus as a vector of CHIKV

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

Marie Vazeille¹, Sara Moutailler², Daniel Coudrier⁷, Claudine Rousseaux³, Huot Khun⁴, Michel Huere⁵, Julien Thiria⁶, Jean-Sébastien Dehecq⁵, Didier Fontenille⁶, Isabelle Schuffenecker⁷, Philippe Despres⁸, Anna-Bella Failloux²*

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

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

Outbreaks occur in India, Malaysia, Sri Lanka, Indonesia

April, 2004:
First cases identified in East Africa

April, 2005:
Virus moves to Comoros

April, 2006:
Virus identified in nearby Reunion
Epidemic peaks in La Reunion

April, 2007:
Several Indian Ocean islands

April, 2008:
Institute Pasteur CHIKV research
Science reports

Institute Pasteur CHIKV research
Science reports
Movement to Asia
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
Imported Cases of CHIKV

- Canada
- Hong Kong
- UK
- Belgium
- Czech Republic
- Germany
- Norway
- Switzerland
- Australia
- France
- Italy
- Corsica
- Sri Lanka
- Singapore
- USA
- Spain
- Japan
- Taiwan
Timeline

- First cases identified in East Africa
- Virus identified in nearby Reunion
- Virus moves to Comoros
- Epidemic peaks in La Reunion
- CHIKV research
- Outbreaks occur in India, Malaysia, Sri Lanka, Indonesia
- Science reports
- CHIKV research
- Several Indian Ocean islands
- Outbreak resurges in India
- Outbreaks occur in India
- CHIKV identified in nearby Reunion
- CHIKV moves to Comoros
- CHIKV identified in Reunion
- Outbreak explodes in India
- Outbreak resurges in India
- CHIKV in Italy
- CHIKV in Italy
Confirmed cases of CHIKV in Italy

Number of confirmed chikungunya cases in Emilia-Romagna by locality of exposure as of 21 September 2007

- 1 case
- 2.5 cases
- 31 cases
- 75 cases

Source: CNESPS with E-R region
Movement to Italy
Figure 1. Distribution of suspected chikungunya fever cases by date of onset of symptoms, region of Emilia-Romagna, 15 June - 21 September 2007 (n = 292)
Timeline

First cases identified in East Africa
April, 2004
Virus identified in nearby Reunion
April, 2006
Virus moves to Comoros
April, 2005
Epidemic peaks in La Reunion
April, 2007
Several Indian Ocean islands
Imported cases documented
April, 2008
Outbreaks occur in India, Malaysia, Sri Lanka, Indonesia
Institute Pasteur CHIKV research
Outbreak explodes in India
CHIKV in Italy
Outbreak resurges in India
A albopictus
Outbreaks continue in SE Asia, India
April, 2004
April, 2005
April, 2006
April, 2007
April, 2008
Timeline

Outbreaks continue in SE Asia, India

Continued & renewed activity in Thailand, India, Malaysia, La Reunion….
Factors Affecting Emergence/Outbreaks

???
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
Gracias!