Co-circulation of dengue and chikungunya viruses

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Concerns with dengue and chikungunya viruses in the Americas

- Transmitted by same vectors
  - *Aedes aegypti*, *Ae. albopictus*, and other Stegomyia

- Both can cause large outbreaks of disease

- Can co-circulate in same location

- Cause similar clinical symptoms
  - Fever, myalgia, headache, arthralgia, rash
Geographic distribution of human chikungunya and dengue cases – Western Hemisphere
Geographic distribution of human chikungunya and dengue cases – Eastern Hemisphere
Methodology for describing co-circulation of dengue and chikungunya viruses

- Reviewed PubMed entries for “chikungunya and dengue”
- Selected papers exploring competency of *Ae. aegypti* or *Ae. albopictus* for both viruses
- Selected papers where viruses were noted to be affecting same population at same time
- Utilized references from paper to identify additional applicable studies
- Identified one antibody study involving non-human primates
Potential for co-circulation of chikungunya and dengue viruses in vectors

- *In vivo* and *in vitro* data suggest that *Ae. aegypti* not co-infected with viruses
- Limited data for *Ae. albopictus* suggest that co-infection can occur though infrequent
- Co-infection of *Ae. albopictus* document in:
  - Laboratory infected mosquitoes
  - In one mosquito (of 571) collected around household of person with co-infection
  - Only shown with ECSA strain with mutation in E1-226 (A → V)
Comparison of demographics for chikungunya and dengue human infections

- Age dependent on previous circulation of viruses in area
  - Age distribution of chikungunya cases tend to reflect general population though can be slightly older
  - Age distribution for dengue often similar to chikungunya or may be younger in endemic areas

- Chikungunya cases seen more frequent in males, females, or no difference to dengue
  - Influenced by differences in exposures, care seeking behavior, or biological difference
Determining frequency of human co-infections with chikungunya and dengue viruses

- Included only areas experiencing dual outbreaks of chikungunya and dengue

- Co-infection documented by:
  - Chikungunya and dengue viral RNA in same person
  - Four-fold rise in antibodies between acute and convalescent samples from same person
  - Did not include studies with only evidence of IgM antibodies as sign of acute infection
Data on human co-infection rates

<table>
<thead>
<tr>
<th>Location - Year</th>
<th>Total cases</th>
<th>Chik + cases (%)</th>
<th>Dengue + cases (%)</th>
<th>Co-infected (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabon – 2007</td>
<td>1057</td>
<td>297 (28)</td>
<td>68 (6)</td>
<td>9 (1) (2% of all positives)</td>
</tr>
<tr>
<td>Fever +1 symptom in clinics and hospitals</td>
<td>2826</td>
<td>1112 (39)</td>
<td>288 (10)</td>
<td>28 (1) (2% of all positives)</td>
</tr>
<tr>
<td>Gabon – 2010</td>
<td>1502</td>
<td>570 (38)</td>
<td>65 (4)</td>
<td>16 (1) (2% of all positives)</td>
</tr>
<tr>
<td>Same as above</td>
<td>797</td>
<td>28 (4)</td>
<td>54 (7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>St. Martin – 2013-4</td>
<td>15149</td>
<td>2305</td>
<td>420</td>
<td>0 (0% of all positives)</td>
</tr>
<tr>
<td>Cases meeting Chik case definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sri Lanka – 2007</td>
<td>797</td>
<td>28 (4)</td>
<td>54 (7)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Fever in ED, clinic, or hospital</td>
<td>NA*</td>
<td>2305</td>
<td>420</td>
<td>0 (0% of all positives)</td>
</tr>
<tr>
<td>Puerto Rico – 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever in ED, clinic, or hospital</td>
<td>NA*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NA = Not available; total number of suspected and lab confirmed cases is 15149
Suspected dengue cases by week of illness onset for 2014 compared to historical average in Puerto Rico

Reported number of chikungunya and dengue cases* per week in Puerto Rico – 2014

* Includes both suspected and confirmed cases
## Additional data on human co-infection rates

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<tr>
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<tbody>
<tr>
<td>India – 2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persons suspected of dengue AND chik</td>
<td>432</td>
<td>34 (8)</td>
<td>49 (11)</td>
<td>6 (1) (7% of all positives)</td>
</tr>
<tr>
<td>India – 2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persons suspected of dengue AND chik</td>
<td>69</td>
<td>11 (16)</td>
<td>42 (61)</td>
<td>6 (9) (11% of all positives)</td>
</tr>
<tr>
<td>India – 2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect dengue</td>
<td>713</td>
<td>NA</td>
<td>387 (54)</td>
<td>8 (1)</td>
</tr>
<tr>
<td>Madagascar – 2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever +3 symptoms</td>
<td>55</td>
<td>4 (7)</td>
<td>24 (44)</td>
<td>10 (18) (26% of all positives)</td>
</tr>
</tbody>
</table>

NA = Not available
Clinical features and outcomes of human co-infections with chikungunya and dengue viruses

- Limited clinical details on ~135 persons with reported co-infections (RNA and Ab)
- All reported fever; some noted biphasic fevers
- Arthralgia was reported in almost all cases
- 60 to 100% reported thrombocytopenia
- Most noted to recover quickly and described as “not severe”
- One death due to dengue hemorrhagic disease
Summary for dengue and chikungunya viruses co-circulation

- Chikungunya virus more likely than dengue virus to cause explosive outbreaks affecting all ages.
- Co-infections in vectors and humans appear uncommon.
- Clinical presentation of co-infections will be similar to that of both diseases; severity does not appear to be compounded.
- Testing will be needed to definitively differentiate between illnesses caused by these viruses.
Considerations for assessing dengue and chikungunya virus co-circulation

- Establish laboratory network capable of testing for both dengue and chikungunya
  - RT-PCR and antibodies

- Consider establishing sentinel sites or routine subset testing to determine disease trends
  - Sentinel sites - all patients meeting case definition have blood sample obtained and tested
  - Subset testing - testing proportion of patients (e.g., first two patients per day)

- Perform serosurvey at end of season/outbreak
Additional considerations for dengue and chikungunya virus co-circulation

- Determine testing thresholds and consider establishing testing prioritization schema
  - Determine when and if to switch from testing everyone to testing subset of patients
  - Prioritize testing more severe cases, cases with atypical presentation, cases in new locations

- Assess utility of vector testing versus vector control activities

- Assess potential role for non-human primates as virus reservoirs
Discussion

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.