Relationship between *Aedes aegypti* infestation and *E. coli* contamination in domestic water containers in rural and suburban villages in Thailand and Laos

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Diarrhea and Dengue (DIADEN) Midterm Workshop 2012
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Introduction: *Aedes aegypti*

- Transmit dengue, yellow fever and chikungunya
- White markings on legs and thorax
- Originated from Africa
- Domesticated and breed in natural and artificial containers
- Bite at dusk and dawn
- Females attracted to lay eggs by chemicals from bacteria
Introduction contd: *E. coli*

- Gram negative and rod-shaped
- Found in intestines of warm blooded animals
- Most strains are harmless but some serotypes can cause food poisoning in humans
- Transmission via fecal – oral route; from contaminated food/water and poor hygiene
- Survive outside the body for limited time hence ideal indicators of fecal contamination
Poor access to safe water is still a major problem.

- 669 million without safe drinking water in SE Asia
- Traditional water storage practices still persist
- Most domestic containers do not meet acceptable water quality standards
- Domestic water containers constitute >80% of Ae. aegypti larval habitats
- A relationship will provide insight to the development of interventions that target health problems associated with both fecal contamination and Ae. aegypti infestations
Aim

Determine the relationship between *Aedes aegypti* infestation and fecal contamination in domestic water containers in Thailand and Laos
Objectives

- Determine *Aedes aegypti* productivity and levels of *E. coli* contamination in domestic water storage containers
- Identify key *Aedes aegypti* producing domestic containers, key *E. coli* contaminated domestic containers, and key *Aedes aegypti* and *E. coli* shared containers.
- Determine the influence of village setting on the presence and abundance of each of *Aedes aegypti* and *E. coli* in domestic water storage containers.
- Determine the influence of *Aedes aegypti* and *E. coli* co-infestations on the presence and abundance of each of *Aedes aegypti* and *E. coli* in domestic water storage containers.
- Compare results within and between countries
Materials and methods

Study design

- 1 rural and 1 suburban village/country
- 130 houses per village were selected
- Cross sectional survey from Feb 2011 – June 2011

Sample collections

- All water holding domestic containers were examined for immature mosquitoes
- Pupae from positive containers were collected, counted, preserved in labeled whirlpak bags containing 70% ethanol and brought back to the lab for identification
- Water samples from all current drinking water containers and mosquito positive containers were examined for E. coli using the IDEXX Colisure – quantitray method, and results expressed as CFU/100ml
Data analyses

- Data obtained were entered into SPSS version 19 and the data base was used to calculate the summary statistics.
- Mann–Whitney U tests were conducted to determine the influence of co-occurrence of *Aedes aegypti* and *E. coli* on individual abundances of *Aedes aegypti* and *E. coli*.
- Binary logistic regression analyses were run to test the following likelyhoods:
  a) that domestic water storage containers in more developed settings are more likely to be infested with *Aedes aegypti* than those in less developed settings
  b) that domestic water storage containers in less developed settings are more likely to be contaminated with *E. coli* than those in more developed settings.
Data analyses contd.

- Multinomial regression analyses to test the following likelyhoods:
  
  a) That domestic water storage containers in less developed settings have higher *E. coli* contamination levels than those in more developed settings
  
  b) That domestic water storage containers in more developed settings have higher *Aedes aegypti* infestation levels than those in less developed settings
## Results so far

Table showing general findings from house surveys

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thailand</th>
<th>Laos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Suburban</td>
</tr>
<tr>
<td>No of houses inspected</td>
<td>122</td>
<td>128</td>
</tr>
<tr>
<td>No and (%) of houses with wet containers</td>
<td>121 (99.2)</td>
<td>124 (96.9)</td>
</tr>
<tr>
<td>No. of wet containers encountered</td>
<td>1118</td>
<td>737</td>
</tr>
<tr>
<td>Average wet containers per house</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>
## Results continued

Table showing *Aedes aegypti* indices

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thailand</th>
<th>Laos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Suburban</td>
</tr>
<tr>
<td><em>Aedes aegypti</em> container indices</td>
<td>16</td>
<td>23.2</td>
</tr>
<tr>
<td><em>Aedes aegypti</em> House indices</td>
<td>71.3</td>
<td>76.6</td>
</tr>
<tr>
<td><em>Aedes aegypti</em> breteau indices</td>
<td>146.7</td>
<td>133.6</td>
</tr>
<tr>
<td>No. of <em>Aedes aegypti</em> pupae per person</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>No. Of <em>Aedes aegypti</em> pupae per house</td>
<td>8.3</td>
<td>8.2</td>
</tr>
</tbody>
</table>
Results contd.

Table showing summary of *E. coli* results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Thailand</th>
<th>Laos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural</td>
<td>Suburban</td>
</tr>
<tr>
<td>No. Of wet containers examined for <em>E. coli</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>435</td>
<td>343</td>
</tr>
<tr>
<td>No and (%) of containers positive for <em>E. coli</em></td>
<td>242 (55.6)</td>
<td>174 (50.7)</td>
</tr>
<tr>
<td>No and (%) of containers positive for <em>E. coli</em> and <em>Aedes aegypti</em></td>
<td>130 (29.9)</td>
<td>121 (35.3)</td>
</tr>
</tbody>
</table>

*Only samples from drinking water containers that were currently in use and containers with immature mosquitoes (irrespective of use) were examined for *E. coli***
Results contd.
Pupal productivity in Thailand and Laos by container type, use and material
Pupal productivity in Thailand by container type, use and material
Pupal productivity in Laos by container type, use and material

- Type
  - Jar
  - Tank
  - Drum
  - Pot
  - Bucket
  - Bottle
  - Jug
  - Miscellaneous

- Material
  - Cement
  - Earthen
  - Tiled cement
  - Plastic
  - Steel/aluminum
  - Glass

- Use
  - Drinking
  - Cooking
  - Bathing
  - Brushing teeth
  - Toilet
  - Washing dishes
  - Laundry
  - Gardening
  - Fish/turtle/frog/crab storage
  - Pet drinking water
  - Flower pot
  - Abandoned/no use
  - Multiple uses

Legend:
- Blue: rural
- Red: suburban
Summary of Mann-Whitney U tests

- Overall, abundance of *Aedes aegypti* pupae was higher in domestic containers co-infested with *E. coli* than in containers that were infested with only *Aedes aegypti* ($Z = -12.393, p = 0.000$).

- Similar results was found in the abundance of *E. coli* in relation to *Aedes aegypti* ($Z = -14.716, p=0.000$).

- At country level, similar trends of higher *Aedes aegypti* pupal abundance in relation to *E. coli* (Thailand; $Z= -8.889, p=0.000$, and Laos; $Z= -8.694, p=0.000$) and higher *E. coli* abundance in relation to *Aedes aegypti* (Thailand; $Z= -12.453, p=0.000$, and Laos; $Z= -7.959, p=0.000$) in domestic water storage containers was shown. This trend continued down to the village level.
Summary of regression analysis for Aedes aegypti infestation

- Overall, containers in suburban villages were 1.6 times more likely to be infested with Aedes aegypti than those in rural villages. OR = 1.614 (CI: 1.283 – 2.030), p = 0.01

- Same trend was shown in Thailand and Laos;
  - Thailand; OR = 1.411 (CI: 1.061 – 1.876), p = 0.01
  - Laos; OR = 2.066 (CI: 1.399 – 3.050), p = 0.01

- Same model run for E. coli at both country and village levels were not statistically significant
Future study for 2012

- Relationship between Aedes aegypti larval gut flora and bacterial flora in domestic water containers in Thailand and Laos
- Effects of diarrhea causing bacteria on the development, size and fecundity of Aedes aegypti
Appreciation

- Research Council of Norway
- Department of Entomology, Kasetsart University,
- Disease Prevention and Control, Region 6, Thailand
- Provincial Health office, Khon Kaen, Thailand
- District Health office, Manchakiri
- District hospital, Manchakiri
- Ministry of Health, Vientiane, Laos
- Ministry of Health Champasak, Laos
- Vientiane Water Supply Company, Laos
- District hospital, Lakhonpeng
- Heads and VVs of Ban Wailum, Ban Han, Ban Okadnavien and Ban Lakhonsey