Efficacy of guppies, community engagement, and pyriproxyfen on dengue vectors in Cambodia: a cluster randomized trial

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Dengue

- 3.6 billion at risk with 390 million infections each year of which 96 million are symptomatic (70% in Asia)
- In Cambodia there were 13,018 reported cases (35 Deaths) through week 40 this year
- No vaccine or therapeutic treatment, so prevention relies on vector control
Vector Control in Cambodia

Challenges

• Reliance on temephos, which is now resistant in most provinces tested\(^1\), and *Bacillus thuringiensis* israelensis (Bti)

• Little evidence available for effectiveness and acceptability of other vector control methods for *Aedes* in Cambodia

Opportunities

• Demonstrate the impact of a combination of previously proven & new vector control tools to sustainably reduce *Aedes* populations and thus reduce dengue transmission

\(^1\) (Polson et al. 2001, Khun et al. 2007)
## Container Surveys in Kampong Cham, Cambodia

<table>
<thead>
<tr>
<th>Container Type</th>
<th>Baseline (297)</th>
<th></th>
<th>Baseline (251)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Pupae</td>
<td>No.</td>
<td>Pupae</td>
</tr>
<tr>
<td>Drum</td>
<td>120</td>
<td>148</td>
<td>173</td>
<td>247</td>
</tr>
<tr>
<td>Concrete water jar</td>
<td>896</td>
<td>9,804</td>
<td>595</td>
<td>7,496</td>
</tr>
<tr>
<td>Concrete tank</td>
<td>162</td>
<td>692</td>
<td>73</td>
<td>550</td>
</tr>
<tr>
<td>Small pot</td>
<td>165</td>
<td>284</td>
<td>123</td>
<td>490</td>
</tr>
<tr>
<td>Flower vase</td>
<td>51</td>
<td>29</td>
<td>76</td>
<td>24</td>
</tr>
<tr>
<td>Tires</td>
<td>79</td>
<td>251</td>
<td>75</td>
<td>158</td>
</tr>
<tr>
<td>Tin can</td>
<td>189</td>
<td>129</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>Broken pot</td>
<td>283</td>
<td>72</td>
<td>121</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>293</td>
<td>290</td>
<td>191</td>
<td>127</td>
</tr>
<tr>
<td>Total</td>
<td>2,238</td>
<td>11,699</td>
<td>1,474</td>
<td>9,106</td>
</tr>
</tbody>
</table>

**Pupal biomass:**

- Water jars, drums, and concrete tanks (>50L) $\approx$ 90%
- Small containers (<50L): $\approx$ 10%

Source: Chang et al. 2008

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Interventions

Vector control tools:

• Larvivorous fish (Guppies) (>50 L)
• Slow-release juvenile hormone analogue (Pyriproxyfen) (<50L)
• Communication for Behavioral Impact (COMBI)
Vector Control
Guppy Fish

Source: WHO, 2013
Pyriproxyfen – Sumilarv© 2MR

Source: Sumitomo
Pyriproxyfen – Sumilarv© 2MR

Untreated

Treated

Copyright Sumitomo Chemical Company Ltd
Communication for Behavioral Impact

Provides a social mobilization and communication approach that:
- Connects knowledge and behaviour
- Addresses the cost and value of engaging in healthy behaviours
- Recognizes the gradual stages of behaviour change
- Creates a supportive environment for behaviour change
Cluster Randomized Trial

The trial will aim to evaluate the efficacy of three interventions over 12 months (October 2015-September 2016) and will have three arms:

1. Guppies + PPF resin matrix + COMBI
2. Guppies + COMBI
3. Control

Each arm will have 10 clusters of approximately 300-500 HHs
Site Selection – Kampong Cham
Data Collection

• Entomology Survey (Every 4 months)
  ➢ Adult Mosquito Collection
  ➢ Larvae and Pupae Collection
  ➢ Container Survey
  ➢ Premise Condition Index
• Knowledge, Attitudes, and Practice Survey (Baseline & Endline)
• Acceptability Survey (Endline)
• Adult Emergence Inhibition Assays
• CHW monthly monitoring (coverage)
Outcome Measures

Primary Outcome Measure:
Density of resting adult female Aedes aegypti in the household as measured by entomology surveys at BL, 4, 8, 12 months after start of intervention

Secondary Outcome Measures:
• House index
• Container index
• Breteau index
• Pupae per house
• Pupae per person
• Percentage of indoor resting mosquitoes positive for dengue virus
Future

- Assess acceptability and cost-effectiveness to make solid policy recommendations
- Share results among the scientific community, local communities, and government stakeholders
- If mosquito densities plateau above zero consider possible additional interventions available in the future (auto-dissemination traps, vaccines, or genetic control of mosquitoes)
Acknowledgements
Thank you
Jar Covers
Jar Covers

Long lasting insecticidal water container covers

Figure 1. Mean number of indoor resting female Ae. aegypti per house in the intervention and control areas. Chang et al. 2008
Jar Covers

- Despite correct high utilization rates (88%), cost of $1.20 is prohibitive to most rural Cambodians
- Container cover not 100% insect-proof due to incorrect closure allowing mosquito entry and exit
- Harsh outdoor tropical environment degrade fabric & netting of water jar covers; more improvements are needed
- Potential insecticide resistance development → safe alternatives to pyrethroids
- What is the strategy for the “last mile”?
<table>
<thead>
<tr>
<th></th>
<th>Cambodia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention</strong></td>
<td></td>
</tr>
<tr>
<td>Ae aegypti</td>
<td></td>
</tr>
<tr>
<td>female per house</td>
<td>2.47</td>
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<tr>
<td></td>
<td>(3.13)</td>
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<tr>
<td>Ae aegypti</td>
<td></td>
</tr>
<tr>
<td>female per person</td>
<td>0.68</td>
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<tr>
<td></td>
<td>(1.08)</td>
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<tr>
<td><strong>Control</strong></td>
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<tr>
<td>Ae aegypti</td>
<td></td>
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<tr>
<td>female per person</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>(0.73)</td>
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<tr>
<td>Ae aegypti</td>
<td></td>
</tr>
<tr>
<td>female per house</td>
<td>1.26</td>
</tr>
<tr>
<td></td>
<td>(2.57)</td>
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