

Fact sheet

Dengue integrated vector management project

Aim of the project

This project was set up to:

- Evaluate viable alternatives for dengue control methods in Cambodia, including the use of guppy fish, the insect growth regulator pyriproxyfen (PPF) and communication and behaviour change interventions
- Assess the acceptability of these control methods among the target villages and determine their willingness to employ and finance such interventions
- Assess the cost-effectiveness of the programme and evaluate the economic and disability costs averted
- Establish a set of useful evidence-based policy recommendations for the Cambodian Ministry of Health and the National Dengue Control Program (NDCP) in order to reduce *Aedes* mosquitoes and lower the burden of dengue in Cambodia

Benefits of the approach

The project uniquely combined and compared three interventions to reduce the dengue burden in one sustainable solution: guppy fish, a larvicide and behaviour change communications.

- This approach is a successful tool in combating dengue in Cambodia
- It is **cost-effective, sustainable and acceptable** to the community

Who was selected to be part of the study target group and why?

The province of Kampong Cham was selected as the site of the project as it has one of the highest dengue incidence rates in Cambodia. In Kampong Cham the environmental characteristics are similar to other dengue-endemic areas in the country. The study areas or clusters (containing one or more villages) were selected based on availability of surveillance data from previous surveys. To avoid spillover effects, clusters had to be at least 200 metres from the nearest household outside the cluster since *Aedes aegypti* in this region have an average flight range of 50-100 metres.

“The project addressed an urgent need to find an effective, low-cost, year-round and home-grown solution, and a sustainable and effective approach to reduce dengue vector populations”

Dr Jeffrey Hii, Malaria Consortium
Senior Vector Control Specialist

Dengue in Cambodia

Cambodia has one of the highest per-capita incidence rates in the region. Dengue was identified in Cambodia in 1963, and between 1998 and 2008, almost 200,000 cases were reported to the NDCP. The cost to society is estimated to be between US\$ 3.3 million and US\$ 14.5 million. Most of this cost is carried by families and it is estimated that 67 percent of affected households acquire debt to pay for their medical bills.

“Each year, many children contract this disease which creates a big burden on our hospitals. It especially affects the family’s living standards too”

Dr Hayra, Provincial Health District Dengue Supervisor in Kampong Cham Province

What does the threefold approach entail?

1. The *Aedes* mosquito mainly breeds in water containers near households. For large water storage containers, the use of **guppy fish** (*Poecelia reticulata*) to reduce dengue vector populations has shown promise.
2. For smaller containers (less than 50 litres) where guppy fish cannot effectively live and breed, Malaria Consortium trialled a **long lasting slow release larvicide SumiLarv® 2MR** based on the insect growth regulator PPF. PPF can prevent the emergence of the adult mosquitoes, thereby reducing the number of vectors which could carry dengue. The particular product we tested, manufactured by Sumitomo Chemical, is different to its predecessors as it remains effective for up to six months before needing to be replaced, and so can work for the duration of the rainy season.
3. Malaria Consortium used both these vector control methods alongside behaviour change methods. This strategy is called **Communication for Behavioural Impact (COMBI)**, which outlines a social mobilisation and communication approach that connects knowledge and behaviour, addresses the value of engaging in healthy behaviours, and recognises the gradual stages of behaviour change. Central to this approach is effective training of community health volunteers so they are able to go back to their communities and change the behaviours of their peers. By pursuing COMBI initiatives, Malaria Consortium sought to ensure that preventive measures are accepted and practiced by the local communities.

The **effectiveness of these different interventions** were monitored throughout the project in the form of quarterly entomology surveys, yearly knowledge, attitudes and practice surveys, and monthly meetings of health workers. In addition to the entomology analysis carried out in the Kampong Cham laboratories, the mosquitoes were also

sent to the US Naval Medical Research Unit 2 (NAMRU-2) where they were able to assess the proportion of mosquitoes which were carrying the dengue virus.

Is PPF safe?

PPF has been used widely in countries across the globe for more than 50 years. PPF was first registered for use in the United States in 1996 and is used extensively around the world in many household agricultural and veterinary products. PPF has been approved by the World Health Organization for use in drinking water for the control of mosquito larvae. Studies have showed it to be both safe and effective in different settings around the world including Argentina, Italy, Japan, Kenya, Malaysia, Mexico, Peru, Tanzania, Thailand, USA, Venezuela and Cambodia. Two studies completed in Cambodia also found PPF to be highly efficacious and no adverse effects were reported. There have been no reported incidents or adverse events from study participants whose water containers were treated with PPF.

How affordable are the guppies?

Once the approach is firmly embedded in the health system (using health centre staff and community health workers) there are no additional costs for guppy fish beyond the initial set-up costs. This is considerably cheaper than chemical interventions that require national level staff to procure and distribute the product.

How long do the fish live?

Guppy fish can survive from 1.5-3 years, and can reproduce approximately every 1-2 months.

How long is SumiLarv® 2MR effective?

SumiLarv® 2MR is a long lasting larvicide that can provide up to six months of control.

“I went to each house in my village twice a month to teach basic knowledge of dengue and how to prevent it. During each visit I checked the guppy fish in the water containers. If the guppy fish were not present, I would replace them with new ones.”

Sen Sokky, Chor Chork community health volunteer



Community health volunteer Sen Sokky makes regular village visits to provide health education and guidance



Guppy fish ready for community health volunteers to pick up and deliver to the villages

What was the level of acceptability?

Knowledge, attitudes and practice surveys, focus group discussions and in-depth interviews with community members, volunteers and health centre staff in the study area revealed that the project has increased community participation in dengue control. Most community members noticed that there were fewer dengue mosquitoes thanks to the guppy fish and PPF. People are more aware now and participate in the dengue activities. There is a huge demand for guppy fish in the communities and people are willing to pay for the guppy fish to continue to avoid mosquitoes.

The project is innovative because

Malaria Consortium's dengue integrated vector management project is the first project to:

- Assess the costs community-based vector control communication activities
- Run a cluster randomised trial to evaluate the effectiveness of guppy fish in reducing the number of mosquitoes
- Evaluate the wide scale use of the new SumiLarv® 2MR product, a long lasting slow release larvicide based on the insect growth regulator PPF, to reduce mosquito populations in the field
- Successfully test guppies, PPF and COMBI activities in combination

The project is unique because

The project is designed to fill the knowledge gaps needed for scale-up and for the sustainability of a dengue control programme. This trial has the potential to inform the strategic application of community-based distribution of PPF and larvivorous fish in an outbreak, during inter-epidemic periods or for broad scale application.

The project is necessary because

The most appropriate, effective and rational dengue control measures for Cambodia are vector control and the avoidance of mosquito bites.

Although a number of promising vaccine candidates are in development and methods of genetic control of mosquitoes are being developed, they are years from operational roll-out in Cambodia and are unlikely to provide universal protection.

Due to day-time transmission, killing the mosquito or source reduction are the most effective methods.

At the start of the project, there was an urgent need to find an alternative, low-cost solution for controlling the *Aedes* vector which is effective and feasible for routine use by the NDCP. Previously used interventions for vector control are expensive and may be ineffective due to resistance to temephos (e.g. Abate, a larvicide) and pyrethroids (e.g. permethrin and deltamethin) in three provinces and in Phnom Penh city.



Community health volunteers use posters to promote healthy behaviours in the village



A community health volunteer talks to his peers about engaging in healthy behaviours. He provides information on dengue and how to prevent it.

Recommendations

The evidence from this project can help in identifying the most effective methods of controlling the dengue vectors and changing behaviours that can be used to help drive the policies of the NDCP moving forward.

- Scale up of the interventions that are proven to work most effectively into more districts and provinces across Cambodia.
- Expand recommended interventions to a larger area and look not only at entomology but also disease surveillance. This entails addressing challenges associated with developing disease surveillance systems for monitoring dengue trends and identifying dengue outbreaks.
- Identify a final impact/outcome measure as this may determine the threshold of mosquito density and human population movement to evaluate a community-based intervention.
- Shift from responding to isolated outbreaks of dengue on an *ad-hoc* basis and focus on developing long-term, integrated programming, including community-level initiatives leading to sustainable behaviour change.
- Continue to develop and evaluate novel and cost-effective tools for prevention and control of the dengue virus, such as insecticide-treated clothing, genetically-modified mosquitoes, diagnostics, vaccines, Wolbachia-infected mosquitoes, insecticides.
- The Ministry of Health (MOH)/NDCP should encourage basic preventive measures against the bite of the mosquito that transmits dengue through national policies. At a more strategic level, governments should work to coordinate dengue control activities and health emergency responses across the country, and provide public health leadership on matters of national importance.
- The MOH/NDCP should involve the community in dengue prevention and control strategies, as the activities needed to tackle dengue – such as source reduction (which requires the removal of water holding containers), environmental management and vector control – need to be carried out by communities themselves if they are to be sustainable and effective.
- Districts and provinces should develop, strengthen and maintain the capacity of the health sector to detect, report and respond to dengue outbreaks; to maintain communication networks with agencies and organisations within their jurisdictions to ensure an effective response to public health events; and to receive information about events requiring a nationally coordinated public health response.
- The MOH/districts/provinces need to sustain community-based guppy fish activities by supporting distribution networks, farms and monthly meetings.

Combining the efforts of international organisations (e.g. World Health Organization, UNICEF), national and sub-national government programmes (e.g. National Center for Parasitology, Entomology and Malaria Control, provincial health departments), and non-government partners (e.g. Malaria Consortium, Institut Pasteur du Cambodge, NAMRU-2) we can achieve the World Health Organization target of reducing dengue mortality by at least 50 percent and reducing dengue morbidity by at least 25 percent by 2020.

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