

Community Mobilization in *Aedes aegypti* Control Programme by Source Reduction in Peri-Urban District of Lautoka, Viti Levu, Fiji Islands

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Abstract

A larval source reduction campaign in Fiji was evaluated using the vector surveillance programme of the Ministry of Health. Due to inadequate solid waste disposal, used tyres, trash and drums used for storage of water provide numerous breeding sites for dengue vectors because of intermittent water supply. With modest support from the Environmental Health Unit of the Ministry of Health, Fijian communities significantly reduced *Aedes aegypti* breeding sites. Prior to the intervention, 51% of tyres and 21% of drums contained *Aedes aegypti*. With active community participation, the number of container habitats for *Aedes aegypti* was significantly reduced during the nine months. As a result, Breteau indices dropped from 29 in January to below five in nine months after the start of the programme. Dengue and vector control programmes must convince people to remove breeding habitats or, alternatively, to prevent *Aedes aegypti* from having access to water containers and other household items that are its potential breeding sites.

Keywords: *Aedes aegypti*, used tyres, drums, community participation, Fiji Islands.

Introduction

Dengue haemorrhagic fever (DHF) first appeared in Fiji in 1975, with subsequent outbreaks occurring every 10 years (e.g. 1979-80, 1989-90 and 1997-98). The 1997-98 outbreak of dengue fever (DF) resulted in more than 24,000 reported cases and 13 deaths, when the disease also spread to rural areas⁽¹⁾. Fiji is unique because it is the only country in the world where four-to-six species of mosquitoes may transmit the

dengue viruses. The primary vector is *Aedes aegypti*, but secondary vectors include *Aedes albopictus*, *Aedes polynesiensis*, *Aedes pseudoscutellaris*, *Aedes horrescens* and *Aedes rotumae* (in Rotuma only)⁽¹⁾.

Aedes aegypti is recognized as the most efficient vector globally due to its close association with humans and its highly domestic breeding habitats in artificial containers in and around houses, thereby putting human populations at risk of disease transmission.

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In Fiji, for vector control, the primary emphasis is on "source reduction" through basic environmental sanitation, health promotion and community participation, backed by law enforcement. Chemical control is not used for routine dengue prevention in Fiji, but is reserved for the control of epidemics.

Aedes aegypti breeds in tyres, drums, plant containers and flower vases, miscellaneous containers such as tin cans, plastic food containers and, to a lesser degree, in coconut shells and old motor parts and, least of all, in ground pools⁽²⁾.

However, studies in Fiji have shown that tyres and drums comprise 10-20% of the total containers found positive for *Aedes* larvae and are responsible for 83-99% of the adult *Aedes* mosquito production⁽³⁾. The present study includes the results of community-based "source reduction" campaign to suppress *Aedes aegypti* population.

Study area

The dengue risk transmission or target areas included the Saweni, Lawaki, Viriba, and Tomuka squatter and Velovelo settlements with a population of approximately 17,000 in the peri-urban district of Lautoka, Viti Levu, Fiji Islands.

Methodology

Entomological surveillance

Health inspectors in all urban and rural areas carried out monthly *Aedes* larval surveys.

During each survey, at least 100 premises were inspected, which included residential, commercial and industrial zones in dengue transmission risk areas (target areas). Searches were conducted both indoors and outdoors within a 15-metre perimeter of house fences.

Nine monthly larval surveys were carried out from January to September 2002. Different types of wet containers, tyres, drums, tins, plant containers, etc., were inspected for *Aedes* breeding using the 10 immatures per container method.

Immatures were collected from water-filled containers at each house and put into a labelled vial with (Macgregor's) preserving solution and brought to the laboratory. The larvae collected from these sources were mounted on slides for species identification using the keys of Belkin⁽⁴⁾.

Survey results were expressed as the following indices:

- **Premises Index (PI):** The percentage of houses positive for larvae;
- **Container Index (CI):** The percentage of water-filled containers positive for larvae;
- **Breteau Index (BI):** The number of mosquito positive containers per 100 houses.

Source reduction campaign

The elimination of mosquito breeding sources constitutes the main environmental mosquito control measures used in Fiji. Health inspectors are authorized to enter and inspect premises for mosquito breeding

and harbourage and to advise on the elimination and destruction of breeding sites.

Health inspectors are responsible for conducting community awareness and participate in source reduction activities. This led to the following initiative in the Lautoka peri-urban district.

Dengue and its vector control messages were delivered to the communities through radio broadcasts and during personal visits to homes, with major emphasis on the creation of awareness in the communities about the serious threat of DF/DHF to children and families. Communities were trained for a planned intervention for the elimination of breeding foci.

Community awareness was conducted from February till mid-March. During this period, communities protected the potential breeding waters from ovipositing females and arranged for the elimination of mosquito breeding habitats. The communities also collected solid waste and trash in and around their houses and placed these along the roadside for collection and disposal from 18 to 21 March 2002. Loading machines and trucks were used to cart the solid waste to the dump site under the supervision of health inspectors.

Results

A summary of the number of *Aedes aegypti* breeding sites by types of containers as detected in the peri-urban district of Lautoka, Viti Levu, Fiji Islands, from January

to September 2002 are given in Table 1. The most abundant breeding sites were tyres and drums. Tins, flower vases, plant containers, shells and others (discarded household equipment, motor parts, etc.) were of secondary importance.

The number of primary positive containers for *Aedes aegypti* was the highest from January to March which being the wet months during the study period (refer to climatological information in Figure 1). In January, tyres represented 51%, drums 21%, tins and others were 10% and 18%, respectively, of the total breeding sites positive for *Aedes aegypti*. There was a considerable reduction in the number of positive containers, especially tyres and drums, from March after the clean-up operation, but some of these containers (tyres and drums) remained positive till August.

The percentage of primary positive containers for *Aedes albopictus* also reduced significantly from 33% to 5% for tyres and from 42% to 8% for drums (Table 2).

The Breteau index (Figure 2) dropped from 29 in January to nil in September when *Aedes aegypti* breeding was almost eliminated. A similar observation was made for *Aedes albopictus*, when the Breteau index dropped significantly from 44 in January to 4 in September. All three mosquito indices (PI, CI and BI) were considerably lower after the clean-up operation in March and remained below 5 thereafter. In September, *Aedes aegypti* was not found in the larval survey.

Table 1. Containers commonly found positive for *Aedes aegypti* larvae in peri-urban district of Lautoka, Viti Levu, Fiji Islands, for January – September 2002

Month	Primary breeding containers				Secondary breeding containers									
	Tyres		Drums		Tins		Flower vase		Plant containers		Shells		Others	
	S	P	S	P	S	P	S	P	S	P	S	P	S	P
Jan	58	31	36	13	12	6	16	-	31	4	8	4	21	11
Feb	30	16	10	3	22	10	-	-	24	9	3	-	20	3
Mar	36	11	22	4	47	9	5	1	13	2	9	-	23	4
Apr	22	8	25	6	6	1	29	-	6	3	4	-	8	6
May	16	8	7	-	13	5	-	-	6	-	-	-	20	2
Jun	18	6	6	3	15	3	-	-	2	1	-	-	15	-
Jul	16	5	20	4	10	-	4	-	22	1	5	-	14	1
Aug	16	5	23	2	1	1	3	-	5	-	1	-	6	2
Sep	22	-	24	-	4	-	4	-	7	-	-	-	6	-
Tot	234	90	173	35	130	35	61	1	116	20	30	4	133	29

S = Wet containers searched.

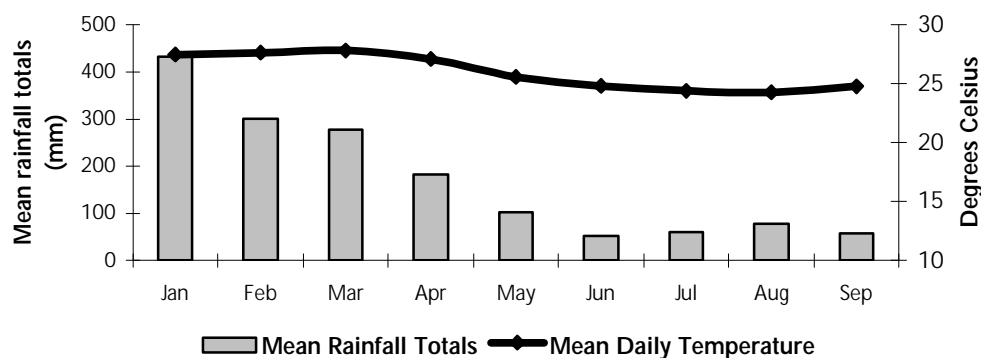
P = Containers found positive for *Aedes aegypti* larvae**Table 2.** Containers commonly found positive for *Aedes albopictus* larvae in peri-urban district of Lautoka, Viti Levu, Fiji Islands, 2002

Month	Primary breeding containers				Secondary breeding containers									
	Tyres		Drums		Tins		Flower vase		Plant containers		Shells		Others	
	S	P	S	P	S	P	S	P	S	P	S	P	S	P
Jan	58	19	36	15	12	7	16	0	31	2	8	3	21	7
Feb	30	3	10	2	22	5	-	0	24	8	3	0	20	2
Mar	36	8	22	3	47	6	5	0	13	1	9	0	23	3
Apr	22	0	25	5	6	0	29	0	6	1	4	0	8	0
May	16	3	7	0	13	0	-	0	6	0	-	0	20	2
Jun	18	3	6	0	15	0	-	0	2	1	-	0	15	0
Jul	16	4	20	4	10	0	4	0	22	1	5	0	14	0
Aug	16	2	23	2	1	0	3	0	5	0	1	0	6	0
Sep	22	1	24	2	4	0	4	0	7	1	-	0	6	0
Total	234	43	173	33	130	18	61	0	116	15	30	3	133	14

S = Wet containers searched

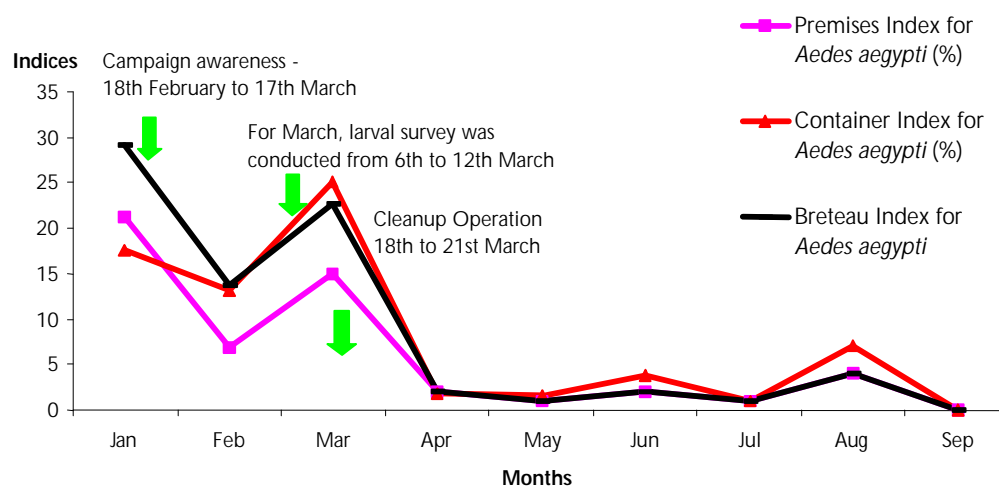
P = Containers found positive for *Aedes albopictus* larvae

Figure 1. Climatological Information for District of Lautoka, Viti Levu, Fiji Island, from January to September 2002



Data Source: Fiji Metriological Station, Nadi, Fiji Island

Figure 2. Premises Index, Container Index and Breteau Index for *Aedes aegypti* for peri-urban district of Lautoka, Viti Levu, Fiji Islands, 2002



Discussion and conclusions

All over the world, the *Aedes* mosquito population is probably higher today than ever before, because nearly all consumer goods are now packed in non-biodegradable plastics or tin containers and refuse

collection services and waste disposal practices are grossly deficient. On the other hand, the proliferation of drums and tyres increases the population of *Aedes aegypti* and hence the risk of dengue fever and dengue shock syndrome in towns and cities.

In Fiji, squatter settlements are growing in peri-urban areas and housing problems are becoming acute⁽⁵⁾. Higher urban population densities, urban water storage practices and poor or non-existent mechanisms for waste water and solid waste disposal create numerous breeding sites for vectors. In the study community water storage drums remains a significant factor for oviposition, as there are no specific or regulated methods employed to cover them. The population normally covers drums with plastic or nylon sheeting to prevent oviposition. Other crude covers include corrugated iron sheets or wooden boards, which contributed to lower indices observed between April and August despite less rainfall at the conclusion of the programme. Regular visits of health inspectors and health awareness had created considerable awareness among populations to be more cautious about avoiding oviposition by mosquitoes. The intervention by the health officials in association with community participation had reduced the observed wet and dry containers, but was unable to clearly associate the change with the weather pattern. The community awareness programme in January 2002 was started to reduce the number of breeding containers. The *Aedes aegypti* control programme in Fiji aims to make people aware of the threat that dengue haemorrhagic fever poses to their health, and to educate them on how they can reduce this threat by either eliminating the domestic containers which harbour the mosquito larvae or by preventing mosquitoes from having access to water-holding containers for egg-laying that are used in or around houses.

In Fiji, automobile tyres discarded, stored or used around people's homes provide perfect larval habitats for the dengue mosquito. It should be noted that water storage often occurs in the presence of piped water systems because of intermittent water supply and collected rainwater. House-owners are legally required to prevent mosquito breeding in Fiji. The numbers of drums breeding *Aedes aegypti* were reduced after community consultation and intervention messages. Recent KAP studies on dengue fever and dengue mosquitoes in Fiji suggested that to mobilize communities, campaigns must address community concerns. In addition, health inspectors must demonstrate the need to cover drums to prevent mosquito breeding, and they must also help communities to manage and destroy containers⁽⁶⁾. Targeted source reduction is one way of selectively attacking the most important types of containers⁽⁷⁾.

Dengue control programmes must include surveillance of mosquito populations to assess the effectiveness of source reduction campaigns, and targeted mosquito control measures. The success of any prevention programme depends on either convincing individuals to change their behaviour or changing the environment to remove factors that place individuals at risk of disease.

For dengue control activities, community education programmes may not be sufficient to generate sustainable behavioural change, unless other factors are taken into consideration as part of the overall strategy. In this peri-urban district, refuse collection was a key requirement for the control of larval production sites. Because of water shortage problems, there is a need to

design appropriate covers or biological control methods for water storage containers as an important component of a sustainable control programme. If community participation is viewed as a means to shift responsibility and costs from the government to residents without the provision of adequate services to support residents in their ability to carry out the recommended control measures, the prospects for sustainability may not be realistic.

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References

1. Prakash G, Raju AK and Koroivueta. DF/DHF Control in Fiji. *Dengue Bulletin*, 2001: 21-27.
2. Goettel MS, Toohey MK and Pillai JS. The urban mosquitoes of Suva, Fiji: Seasonal incidence and evaluation of environmental sanitation and ULV spraying for their control. *Journal Trop Med Hyg*, 1980, 83: 165-171.
3. Kay BH, Prakash G and Andre RG. *Aedes albopictus* and other *Aedes (Stegomyia)* species in Fiji. *Journal of Am Mosq Control Assoc*, 1995, 11: 230-234.
4. Belkin JN. The Mosquitoes of the South Pacific. California: University of California Press. Volume 2, 1962: 1-5.
5. Government of Fiji (GOF)/United Nations Children's Fund (UNICEF). A situation analysis of children and women in Fiji. Suva, Fiji: UNICEF, 1996, 41-42.
6. Secretariat of the Pacific Community. Rising to the challenge! A report of the first community-based study of knowledge, attitudes and practices regarding dengue fever and dengue mosquitoes in Fiji. Noumea: Secretariat of the Pacific Community, Pacific Regional Vector Borne Diseases Project, 1999.
7. Focks DA, Brenner RJ, Hayes J and Daniels E. Transmission thresholds for dengue in terms of *Aedes aegypti* pupae per person with discussion of their utility in source reduction efforts. *Am J Trop Med Hyg*, 2000, 62(1): 11-18.