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Dengue fever epidemiology and related control strategies in French Polynesia 2006–2007

Epidemiology

Dengue fever transmission occurs throughout the year in French Polynesia in an endemo-epidemic mode. In contrast to what can be seen in other endemic regions, such as Southeast Asia, the link between climate (seasons) and the intensity of dengue fever transmission is more difficult to prove in French Polynesia. In fact, while the year is generally divided into two seasons, one hot and humid (November to April) and the other relatively cool and dry (May to October), climate data are generally not consistent from one year to another.

In any case, it seems that weather conditions allow dengue fever transmission throughout the year. The most recent dengue fever outbreaks did not all take place during the same season, i.e. the dengue 4 (DEN-4) outbreak in 1979 was from January to May, the dengue 1 (DEN-1) outbreak in 1988–89 was from December to June, the dengue 3 (DEN-3) outbreak in 1989–90 was from August to May, the dengue 2 (DEN-2) outbreak in 1996–97 was from September to April, and the DEN-1 outbreak in 2001 was from February to November. In addition, weather conditions probably do not have the same impact on transmission rates during outbreaks and during periods between outbreaks.

The dengue fever outbreaks recorded in French Polynesia have never involved more than one serotype. Following an outbreak, the serotype becomes endemic. Transmitted at very low levels, it disappears as soon as a new serotype gets a foothold, with a transitional period of co-circulation that can last from two to seven months (*1*). After the 2001 outbreak (DEN-1), which caused nearly 33,000 cases in the Society Islands and more than 800 cases in the other four island groups (*2*), French Polynesia experienced a period of low-level endemicity from 2002 to 2005. Since early 2006, there has been a resurgence in the number of DEN-1 cases. A total of 2477 positive cases had been recorded as at 19 August 2007, with 230 cases (including 28 with severe forms) requiring hospitalisation. This resurgence has been gradual, in contrast to the rapid appearance of the virus in 2001. It suggests that there has been enough turnover in the susceptible population, which has probably gone under the threshold of 70–80% immunised individuals – a threshold above which viral transmission drops off rapidly. This situation appears to be comparable to those in 1969 and 1985 (Table 1).

Table 1: Serotypes involved in the dengue fever outbreaks identified since 1944 and incidence rates per 100 inhabitants in the Windward Islands, Society Archipelago (*1,4*)

Year	1944	1964	1969	1971	1975	1979	1985	1989	1990	1997	2001	2006
Serotype	1	3	3	2	1	4	4	1	3	2	1	1
Incidence (%)	62	20	ND	50	25	25	ND	17	25	19	16	ND
Interval (years)	–	20	5	2	4	4	4	6	1	7	4	5

ND = unknown

Surveillance methods

The surveillance methods used were explained in detail in a previous article (*5*).

Case definitions

The clinical definition of suspected cases requires at least the following simultaneous symptoms:

- high fever (38.5°C), of a sudden onset, for less than one week;
- algic syndrome: headaches (retro-orbital pain in particular), arthralgia/myalgia; and
- absence of symptoms suggestive of another infection (particularly respiratory).

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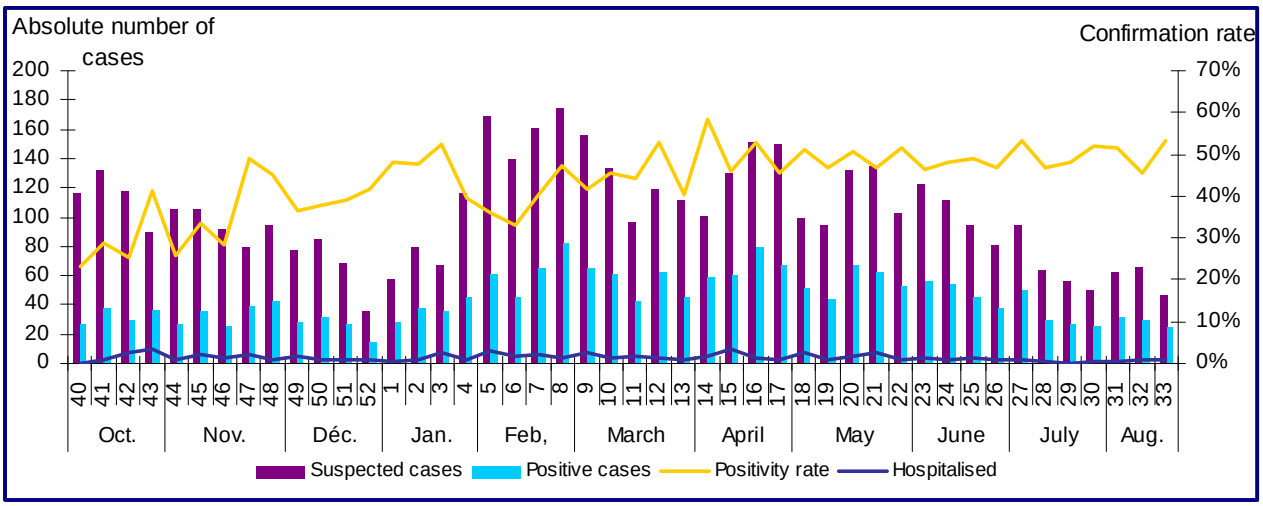
When a positive test result (RT-PCR+, NS1+, viral isolation or IgM+) is found, the patient becomes a positive case. Positive cases are reported either as probable (IgM+ on a single specimen) or confirmed (RT-PCR+, NS1+, viral isolation or sero-conversion on two repetitive specimens).

Incidence

Since the intervals between outbreaks had never been longer than seven years over the past 40 years, there was a significant risk that a new dengue fever outbreak would emerge in 2006. For that reason, prescribing physicians were encouraged to request analyses, if possible before D5 of the illness, so as to reveal the dengue fever virus and identify its serotype through PCR. An agreement between the Health Department and Louis Malardé Institute allowed patients to get these analyses for free, and this certainly contributed a great deal to the increase in test requests. In October, doctors were again encouraged to prescribe lab tests as the risk of introduction of a new serotype was high. This led to a large increase in the number of test requests, and the number of positive cases rose steadily, with more than 25 new cases per week and peaks of more than 80 new cases in Week 8 and Week 16 (Chart 1).

Chart 1: Weekly evolution in the number of positive and suspected cases subject to lab tests from October 2006 to mid-August 2007



Laboratory surveillance data are undoubtedly influenced by calls to doctors to take samples. In particular, it is interesting to note that requests are systematically lower in number during the school holidays and increase again after children go back to school.

Laboratory monitoring of positive cases is an undeniable indicator of viral transmission, particularly in terms of identifying the serotype involved. However, the number of positive cases depends in large part on the number of lab tests done. In this regard, simply monitoring positive cases is not enough to measure the actual incidence of an outbreak. It must be supplemented by data collected by the sentinel doctor network. However, surveillance by this network did not make it possible to detect a resurgence in the number of cases of dengue fever, probably due to gaps in coverage. The network is currently being reorganised. The long-term goal will be to produce a weekly estimate of the number of suspected cases in the islands of the Society Group, then, using these estimates, set alert and outbreak thresholds.

In order to broaden sentinel surveillance, visits to the emergency room at the French Polynesia Hospital were recently included in surveillance efforts. With more than 36,000 visits each year and a very large coverage area, this source of information should contribute a great deal to identifying any resurgence in the number of cases of dengue fever. In retrospect, it can been seen that the number of visits to the emergency room for suspected cases of dengue fever began to rise in April 2006, i.e. Week 14 (Chart 2). These visits reached a peak in Weeks 7, 8 and 9, 2007. This analysis seems to indicate the timeliness of this indicator for supplementing the other two, i.e. positive cases and the sentinel network.

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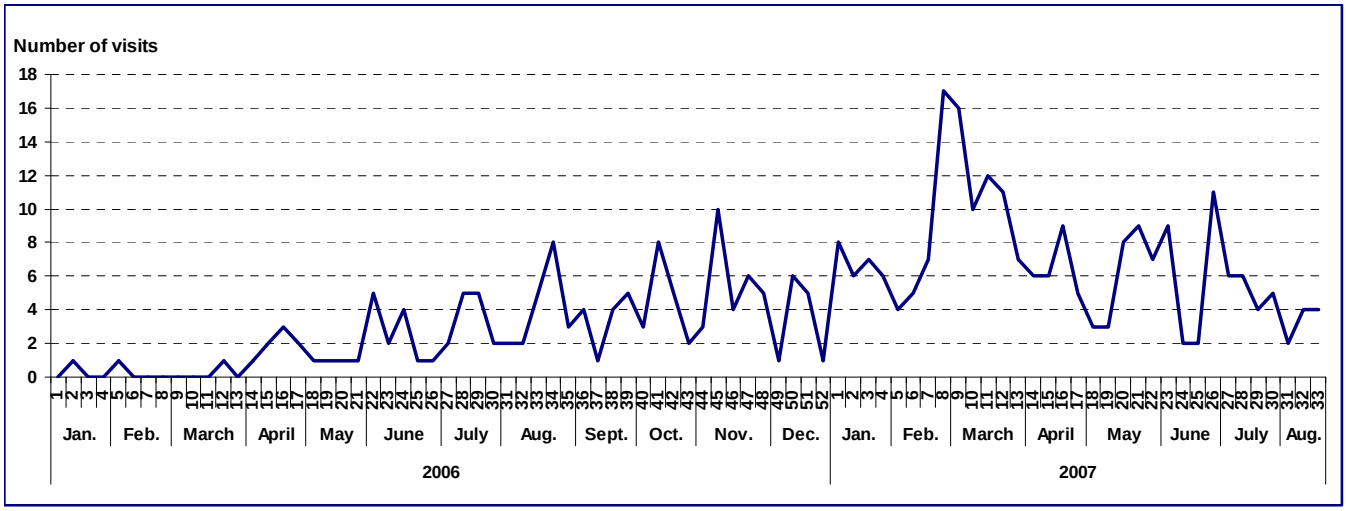
Chart 2: Weekly number of visits to the emergency room at the French Polynesia Hospital for suspected cases of dengue fever, from January 2006 to mid-August 2007

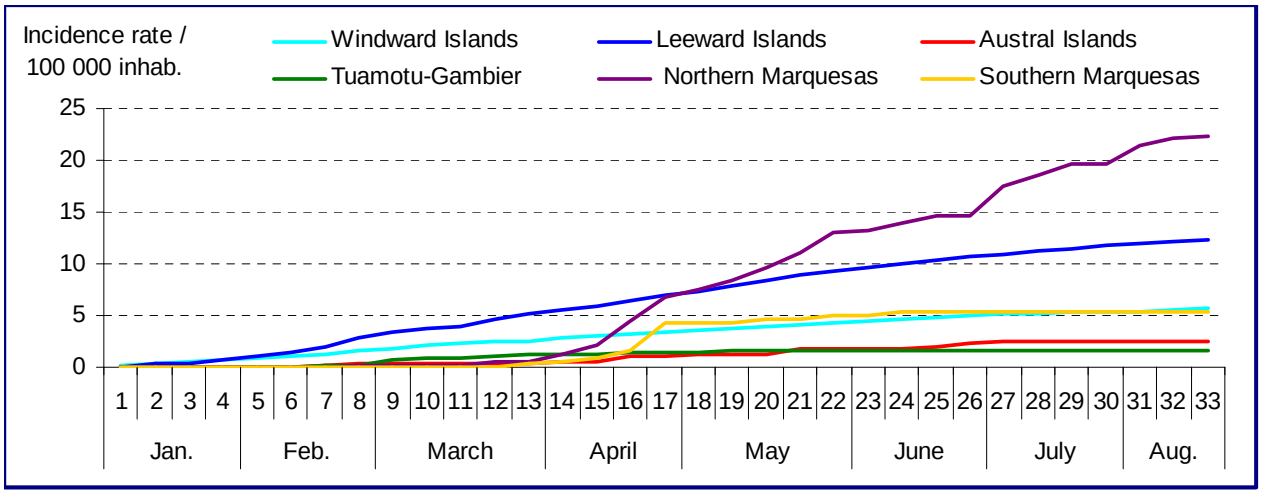


Temporal and spatial trends

The chart showing aggregate incidence rates, by island group and referenced to the population (Chart 3), makes it possible to roughly follow the timeline of the spread of this disease. The slope of the curves gives an idea of the intensity of transmission. It is clearly shown that, as in previous outbreaks, the point of departure was in the Society Islands group, with a rapid spread to all the islands in that group, undoubtedly promoted by frequent flights and people travelling within the group.

Spread of the disease to the other island groups, in particular the Tuamotu-Gambier and Marquesas Islands, is slower, and the Austral Islands are often spared, relatively speaking, due to their cooler climate and a drop in temperature to a level that seems to bring about a halt in transmission. It is also interesting to note that transmission in the Marquesas, Tuamotu-Gambier and Austral Islands began in Weeks 11, 12 and 13, which coincide with the school holidays in March when boarding students go home for three weeks.

Chart 3: Weekly aggregate incidence rates of positive cases recorded by laboratories from January 2007 to mid-August 2007



Incidence by age group

The distribution of positive cases by age group shows a particularly high incidence rate in the 5–9 age group and the 10–19 age group (Table 2). These are the groups that may have been exposed to the DEN-1 outbreak in 2001 but not to the 1989 outbreak.

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In children under the age of five, who were born after the 2001 outbreak and are, in large part, susceptible to the disease, incidence was lower than children in other age groups. A similar situation was noted in 2001, and one of the suggested explanations was a supposedly higher frequency of forms with little or no symptoms in young children (*2*). However, the most affected at-risk age groups seem to vary from one outbreak to another (*6,7,8*).

Table 2: Distribution by age group of positive cases since early 2007 (as at 31 July 2007)

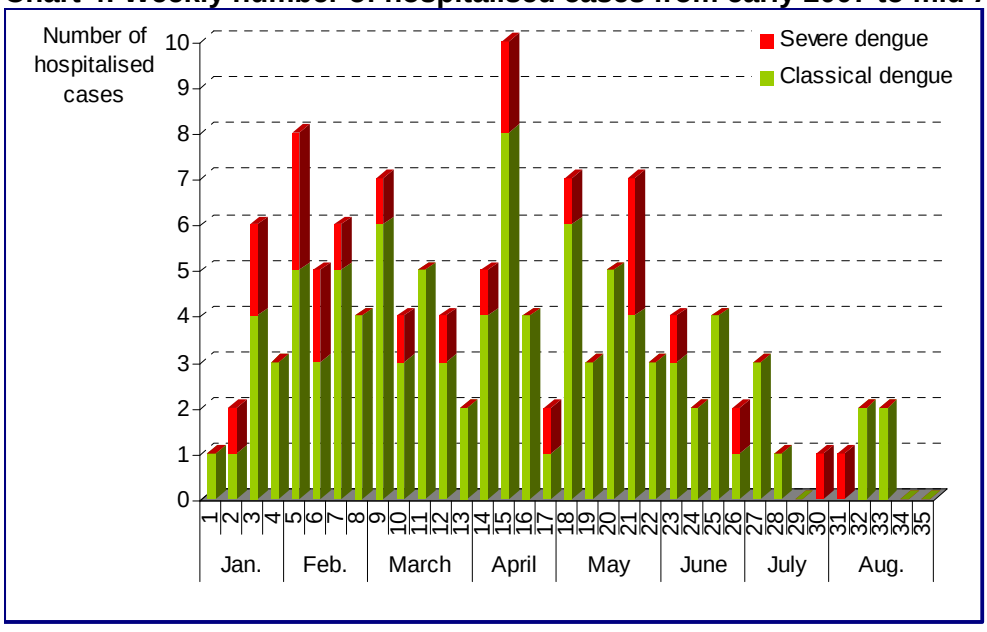
Age group	No. of positive cases	Rate per 1000 inhabitants
< 5 years	152	6
5–9 years	202	8
10–19 years	487	9
20–29 years	148	4
30–39 years	201	5
40–59 years	283	6
60 years and +	70	4
Total	**1543**	**6**

Incidence of hospitalised cases

The trend in the weekly number of hospitalised cases (Chart 4) follows that of positive cases recorded by laboratories (to within a week). Most of the cases were hospitalised in the medical or paediatric wards at the French Polynesia Hospital.

Severe forms were mainly found in the 10–19 age group, who may have been previously exposed to other serotypes (outbreaks of DEN-3 in 1989–90 and DEN-2 in 1996–97). It should be noted that, as in 2001, strict application of the WHO criteria for defining severe cases was not easy, since certain obviously severe forms were categorised as conventional forms and other cases as severe forms even though they rapidly evolved in a favourable manner (*2,9,10*). Among the hospitalised cases of dengue fever, two patients immediately had severe haemorrhagic dengue fever profiles, including a 13-year-old girl whose clinical condition required a gastrectomy to stop the bleeding. In addition, a five-month-old infant died of septic shock linked to a secondary bacterial infection.

Chart 4: Weekly number of hospitalised cases from early 2007 to mid-August 2007



Control strategies

There is currently no vaccine or specific treatment for the causative virus. Controlling the disease consists solely of strengthening the vector control activities carried out by specialised personnel but also, and most especially, by the community itself.

Vector control
In French Polynesia, the Centre for Hygiene and Public Sanitation (CHSP) is currently in charge of vector control. Townships do not have any mosquito control services and are not specifically involved in mosquito control. CHSP's Vector Control Department has very limited human resources (five agents responsible for vector control) and physical resources.

It must be admitted that the vector control activities have had little effect on the intensity of transmission. Spraying seems to be effective mainly in containing foci while they are still limited in size. In that regard, such actions were effective in avoiding the appearance of secondary cases after the diagnosis of a case of DEN-2 in early January 2007. In contrast, spraying does not seem to have any noticeable effect on foci that are already widespread, apart from the reassuring nature of the involvement of public authorities in the eyes of the community. This reassuring effect can, moreover, be counterproductive as it allows people to suppose there is no need to eliminate larval breeding areas on an individual basis since treatments to eliminate adult mosquitoes are being carried out.

Community-based larval breeding area control
An agreement was signed in 2006 between the French Government and the Government of French Polynesia on mosquito control through group efforts designed to control larval breeding areas in the two municipal districts on Tahiti. The decision was made to set up community-based control efforts so as to pool the resources and expertise of the French Polynesia Government (Health Department and CHSP) and the townships and their populations. It is through the knowledge the townships have of their neighbourhoods and associations that CHSP will be able to implement effective joint larval breeding area control efforts.

The goal is, then, to work in partnership with the townships to mobilise the community en masse to eliminate larval breeding areas and lead to lasting changes in behaviour, even if community-based control is difficult to assess and its real impact has rarely been demonstrated (*11*). One of the issues is understanding community expectations and, through that, better adapting prevention messages.

The initial approach to the townships of Faa'a and Papeete has been promising, demonstrating that the inhabitants are open to the importance of vector control. Nevertheless, all the town stakeholders (elected officials, heads of technical services) had to be made aware of the importance of vector control efforts and persuaded to take part in this community activity. The following arguments were used:

- the significant risk of a dengue fever epidemic (given the current pre-alert situation);
- inadequate local mosquito control resources (in spite of the various prevention and insect removal campaigns as well as research on new, more effective control techniques, etc.);
- townships are ideal partners for creating a link between the French Polynesia Government and the population due to their inhabitants' knowledge of their neighbourhoods and populations, involvement in grassroots activities, logistical support (municipal technical services) and human support (elected officials, township agents, neighbourhood contacts, members of associations, etc.) and, finally, jurisdiction over the prevention of epidemic-prone or contagious diseases (French Polynesia township code);
- the two pilot townships are 'traffic hubs' due to the international airport in one (Faa'a) and the port in the other (Papeete), and both could facilitate transmission of the disease throughout French Polynesia and internationally;
- the status of 'pilot community' allows the two townships to serve as an example for all other townships in French Polynesia; and
- vector control is another step towards making a commitment to a health and environmental policy in their town.

One township (800 homes, nearly 3000 inhabitants) wanted to integrate the issue of vector control into a large-scale awareness campaign about the lack of public spirit with regard to the coastline. This campaign would make it possible to bring home the realities of topics ranging from waste

management and wastewater treatment to noise pollution and risky behaviour (raising farm animals in urban areas, etc.). It is based on a large number of neighbourhood meetings involving all the concerned partners (townships, the French Polynesia Government and French Government departments).

As a follow-up, a training session in health prevention and mosquito control techniques is planned for municipal workers and, if possible, for contact people from associations. A town technical guide is also under discussion by a variety of partners, such as CHPS and the Union for the Promotion of the Townships.

Information activities

In March 2007, the Health Department organised a media-based communications campaign about eliminating mosquito breeding areas and protecting oneself from mosquitoes so as to encourage the community to adopt steps designed to eradicate dengue fever. The slogan 'We all have superpowers when it comes to fighting mosquitoes' was devised to show the community that it is easy to control mosquitoes, that everyone can do it and that it should be part of our daily lives.

In May 2007, the Health Department began to distribute information pamphlets at the airport (on the arrival of international flights) to inform arriving passengers, particularly tourists, about transmission of the virus on Tahiti and in the islands. Travel agencies have also been contacted so that prospective tourists are informed, before their departure, that the virus is currently being transmitted in French Polynesia.

Prospects

Given the above, our objective remains detecting the emergence of a dengue fever outbreak as early as possible and, primarily, avoiding the introduction of a new serotype. So, our priorities are to:

- maintain and strengthen viral surveillance through viral serotyping and genotyping in order to detect the introduction of a new serotype as quickly as possible;
- combine these data with those from the sentinel network, whose scope has been widened to include the emergency room at the French Polynesia Hospital;
- ensure ongoing information and training for health professionals in order to facilitate early warning about suspected cases of dengue fever from endemic areas;
- strengthen alert measures, particularly on those islands most visited by tourists, so as to allow perifocal control activities to be carried out as systematically as possible while at the same time strengthening local teams and equipment;
- promote greater and more lasting involvement by townships and their populations in all activities designed to eliminate breeding areas, so as to get the lowest possible mosquito densities on an ongoing basis and, in that way, limit the risks of introduction of a new serotype;
- conduct a 'Knowledge, Attitudes, Practices' study to evaluate the impact of prevention and larval breeding area control messages and better adapt those messages in order to bring about changes in behaviour;
- implement, evaluate and then widen the scope of pilot projects on community-based control of larval breeding areas; and
- implement vector surveillance in zones where a specific risk of introduction exists.

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References

1. Chungue, E., Deparis, X. and Murgue, B. 1998. Dengue in French Polynesia: Major features, surveillance, molecular epidemiology and current situation. Pacific Health Dialog 5:154–62.
2. Hubert, B. 2002. Bilan de l'épidémie de dengue 1 en Polynésie française de 2001. Direction de la Santé Polynésie française.
3. Chungue, E., Marche, G., Plichart, R., Boutin, J.P. and Roux, J. 1989. Comparison of immunoglobulin G enzyme-linked immunosorbent assay (IgG-ELISA) and haemagglutination inhibition (HI) test for the detection of dengue antibodies: Prevalence of dengue IgG-ELISA antibodies in Tahiti. Transactions of the Royal Society of Tropical Medicine and Hygiene 83:708–11.
4. Cao-Lormeau, V.M., Roche, C. and Teyssou, R. 2007. Standardisation d'outils moléculaires pour la surveillance entomologique et biologique de la dengue et autres arboviroses en Polynésie française. BISES 6:5–6.
5. Wiegandt, A., Lastère, S., Hirschauer, C. and Loncke, S. 2006. Provisional findings of dengue epidemiological surveillance in French Polynesia 2006. Inform'ACTION 25: 12–18.
6. Chungue, E., Burucoa, C., Boutin, J.P., Philippon, G., Laudon, F., Plichart, R., Barbazan, P., Cardines, R. and Roux, J. 1992. Dengue 1 epidemic in French Polynesia, 1988–1989: Surveillance and clinical, epidemiological, virological and serological findings in 1752 documented clinical cases. Transactions of the Royal Society of Tropical Medicine and Hygiene 86:193–197.
7. Deparis, X., Chungue, E., Pauck, S., Roche, C., Murgue, B. and Gleize, L. 1998. Surveillance épidémiologique spécifique de la dengue: Méthode et intérêt lors de l'épidémie de dengue 2 en Polynésie française en 1996. Tropical Medicine and International Health 3:566–570.
8. Guha-Sapir, D. and Schimmer, B. 2005. Dengue fever: New paradigms for a changing epidemiology. Emerging Themes in Epidemiology 2:1.
9. Murgue, B., Deparis, X., Chungue, E., Cassar, O. and Roche, C. 1999. Dengue: An evaluation of dengue severity in French Polynesia based on an analysis of 403 laboratory-confirmed cases. Tropical Medicine and International Health 4:765–73.
10. Rigau-Perez, J.G. 2006. Severe dengue: The need for new case definitions. Lancet Infectious Diseases 6:257–302.
11. Heintze, C., Velasco-Garrido, M. and Kroeger, A. 2007. What do community-based dengue control programmes achieve? A systematic review of published evaluations. Transactions of the Royal Society of Tropical Medicine and Hygiene 101:317–325.

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