Dengue 1 epidemic in French Polynesia, 1988–1989: surveillance and clinical, epidemiological, virological and serological findings in 1752 documented clinical cases

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Abstract

An epidemic of dengue 1 occurred in French Polynesia in December 1988 and June 1989. This paper records (i) the trend of the outbreak and its surveillance and (ii) the clinical, epidemiological and virological data obtained from 1752 documented cases. The epidemic reached its peak in February in Tahiti Island, 7 weeks after its recognition. Among 6034 suspect cases reported by sentinel physicians, 60·3% were <20 years old. The illness was classical dengue. No fatality or case of dengue haemorrhagic fever/dengue with shock syndrome was reported. Of 4792 patients subjected to laboratory testing, 41% were confirmed as positive. The serological attack rate was *c.* 40%. The estimated number of dengue infections in the Windward Islands was about 20 000. Transmission was associated with *Aedes aegypti*. Study of documented cases showed a higher confirmation rate in both the civilian population <15 years old (46·5%) and the susceptible French military population (47·6%) than in older civilians (31·1%, $P<0·05$). Furthermore, primary dengue infections were predominant in both of the first 2 groups. The diagnosis was mostly confirmed (i) by virus isolation on day <5 of illness and (ii) by detection of immunoglobulin (Ig) M on day ≥5 of illness. The study showed that adequate surveillance of an epidemic requires both clinically and laboratory-based systems.

Introduction

French Polynesia is situated in the south Pacific ocean and consists of 5 archipelagoes (Society, Tuamotu, Gambier, Austral and Marquesas Islands), comprising 120 islands of which only 66 are inhabited. Most of the population is distributed in the Society archipelago which is subdivided into the Windward and Leeward Islands. Tahiti, the largest island of the Windward group, contains the capital, Papeete. The total population was 188 814 in 1988: 145 000 in Tahiti, of whom 79·1% live in the Papeete agglomeration. About 2300 inhabitants live in French Polynesia on a temporary basis. In all areas the climate is hot and tropical. A hot rainy season

tion, and on the procedure to be adopted in the event of illness. Ultra-low volume (ULV) spraying of urban areas with malathion was started in the last week of 1988, and maintained until mid-March 1989.

Weekly data were collected from December 1988 to June 1989, and overall indicators were available except for the number of declared suspect cases during weeks 17–19 (1989).

The surveillance of the epidemic involved the following operations. (i) Weekly reporting, by 25 sentinel physicians located throughout French Polynesia, of the number of clinically suspect cases, their age and their

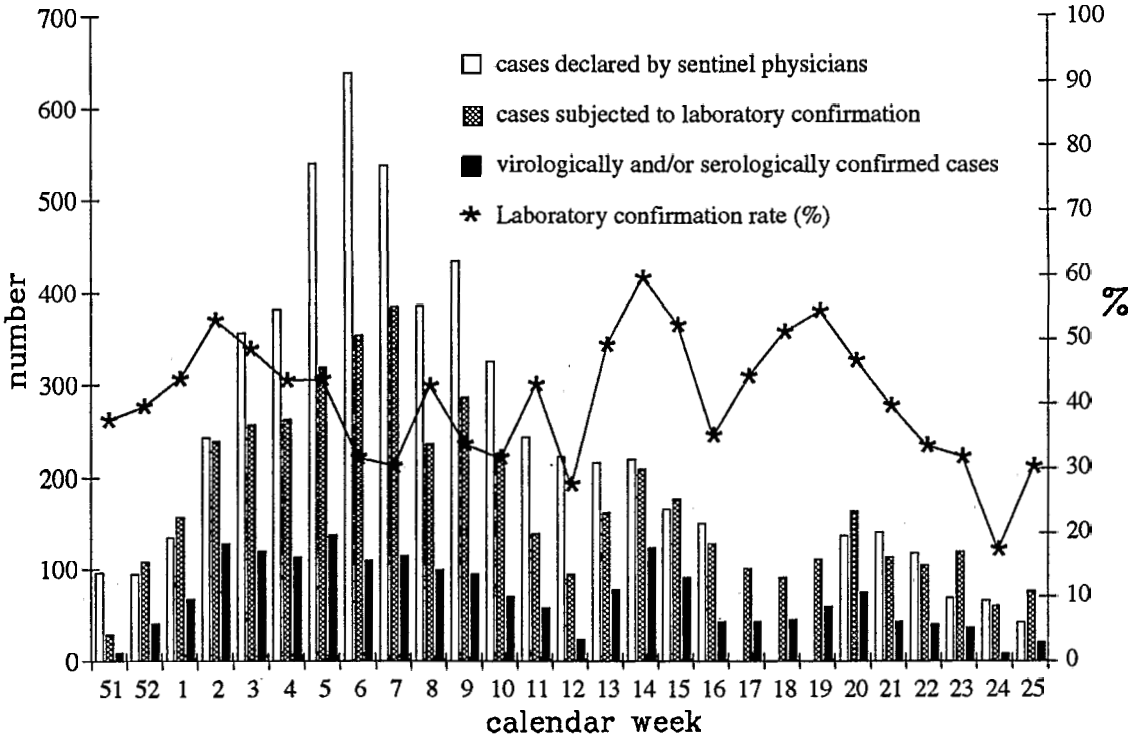

Fig. 1. Weekly surveillance of dengue 1 epidemic according to different indicators.

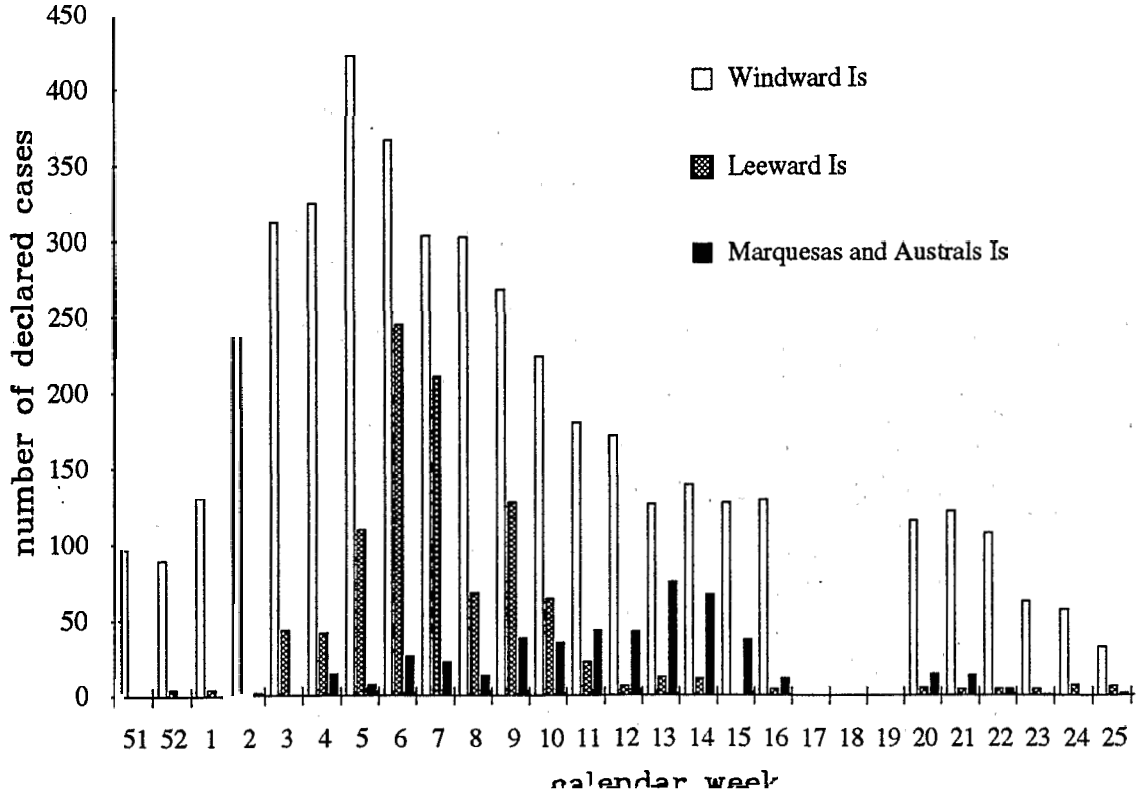

Fig. 2. Weekly number of clinically suspect cases of dengue 1 reported by sentinel physicians, according to island group.

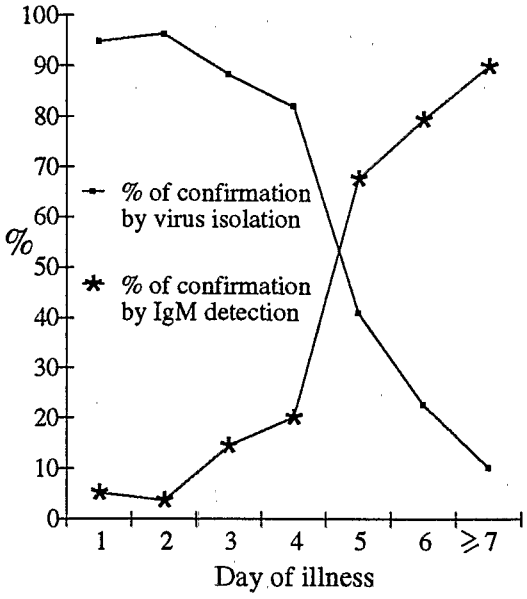

Fig. 3. Percentages of confirmation of dengue 1 diagnosis by virus isolation or detection of anti-dengue IgM antibodies according to day of illness (virus isolation was not attempted in 38 serum specimens collected after 12 days of illness).

Table 1. Distribution of clinically suspect cases of dengue reported by sentinel physicians by island group

Island group	No. of declared cases	General population	Incidence rate (%)
Windward Is.	4483	140341	3·2
Leeward Is.	1048	22232	4·7[b]
Marquesas and Austral Is.	503	13967	3·6[b]
Total	6034	175540[a]	3·4

[a]Total population except Tuamotu and Gambier Is.
[b]Significantly different from the Windward island incidence rate ($P<0·01$).

Table 3. Frequency of clinical symptoms observed in 701 laboratory-confirmed dengue patients

Clinical symptoms	Frequency (%)
Fever/headache/myalgia	98·3
Adenopathies	22·9
Macular rash	20·9
Digestive signs (vomiting, nausea, diarrhoea)	19·2
Taste alterations	16·1
Pruritis/paresthesia	9·9
Haemorrhagic signs (epistaxis, petechia, purpura)	5·1
Hepatalgia/hepatomegaly	5·0
Papular rash	4·7

the maintenance medium were used. After incubation at 30°C for 7–10 d, the cells were screened by an indirect fluorescent antibody test (IFAT) using dengue 2 hyperimmune ascitic fluid (American Type Culture Collection) and fluorescein isothiocyanate-conjugated sheep anti-mouse IgG (Diagnostics Pasteur). Subsequent identification was achieved by IFAT using serotype-specific monoclonal antibody (HENCHAL *et al.*, 1983).

Female adult *Ae. aegypti* and *Ae. polynesiensis* were captured using the human bait collection technique (BONNET & CHAPMAN, 1958) and starved for 24–48 h before being killed by freezing. Pools of up to 50 mosquitoes were constituted according to species and locations. To each pool of mosquitoes were added 100 µl per mosquito of chilled phosphate-buffered saline (0·05 M, pH 7·6) containing 20% heat-inactivated foetal calf serum and antibiotics. The material was then ground using an appropriately sized tissue grinder in an ice bath and centrifuged at 800*g* for 20 min at 4°C. The clarified homogenate was processed similarly to serum specimens at a dilution 1:10 in maintenance medium.

Serological methods

IgM capture enzyme-linked immunosorbent assay (ELISA). This was performed as previously described (CHUNGUE *et al.*, 1989a), using 4 serotype antigens. For routine serodiagnosis of dengue fever, patients with an IgM reciprocal titre ≥400 for any of the 4 antigens were considered as serologically confirmed cases. For serological surveys, all subjects with titres ≥100 were considered positive since IgM may persist at a low level (<400) for

Table 4. Numbers and percentages of cases confirmed in the laboratory by age group in civilian and military populations among 1752 documented cases

Study population	No. of confirmed cases[a]/no. patients tested <15 years	≥15 years	Significance (*P* value)	All ages
Civilian				
Males	167/347 (48·1%)	163/434 (37·1%)	<0·001	330/781 (42·2%)
Females	146/311 (46·9%)	92/374 (24·6%)	<0·001	238/685 (34·7%)
Total	313/658 (47·6%)	255/808 (31·6%)	<0·001	568/1466 (38·7%)
Military[b]				
Males	10/20 (50·0%)	86/179 (48·0%)	>0·3	96/199 (48·2%)
Females	8/15 (53·3%)	29/72 (40·3%)	>0·3	37/87 (42·5%)
Total	18/35 (51·4%)	115/251 (45·8%)	>0·3	133/286 (46·5%)

[a]Virologically and/or serologically confirmed.
[b]Including family members.

Table 5. Numbers and percentages of primary infections by age group in civilian and military populations from whom a positive diagnosis was obtained by virus isolation

Age group	No. primary infections/no. sera tested Civilian population	Military population[a]
<15 years	91/120 (75·8%)	10/12 (83·3%)
≥15 years	66/119 (55·5%)	67/78 (85·8%)
Total	157/239 (65·7%)	77/90 (85·5%)

[a]Including family members.

shown in Fig. 1.

The weekly distribution of declared cases according to their geographical location is shown in Fig. 2. Table 1 shows the incidence rates of declared cases by island group. Furthermore, amongst 6034 declared cases, 60·3% were <20 years old.

Overall, virological and/or serological positive results were obtained for 1966 of 4792 patients subjected to laboratory testing (41·1%). Confirmation was obtained by virus isolation for 1196 patients (24·9%) and by IgM capture ELISA (in first serum or paired sera) for 770 patients (16·1%). Dengue 1 was the main serotype isolated since December 1988, May 1988 being the last time dengue 4 was recovered. However, between mid-April 1989 and

differ according to the age groups in either civilian or military populations ($P>0·05$, Table 4). Table 4 shows the age and sex distribution of the confirmed cases in both populations. Table 5 shows that 75·8% of civilian children <15 years old and 85·5% of the total military population were primary infections.

The percentage of cases confirmed by virus isolation or detection of anti-dengue IgM antibodies among 701 confirmed cases according to day of illness is shown in Fig. 3. Of 522 laboratory confirmations in patients who had blood taken before day 5 of illness, 90·6% were obtained by virus isolation, 8·2% by IgM detection, and 11% by both methods. Conversely, on or after day 5 of illness, 19·5% were obtained by virus isolation, 77·1% by IgM detection and 3·3% by both methods.

Total leucocyte and platelet counts were obtained for 280 confirmed cases. Leucopenia (total leucocytes $<4\times10^9$/litre) was recorded in 62·5% of the confirmed cases (≥15 years). Thrombocytopenia ($<150\times10^9$/litre) was observed in 27·2% of the confirmed cases.

Discussion

Surveillance of the epidemic

Dengue has occurred in French Polynesia as suc-

at a lower level (CHUNGUE *et al.*, 1990). Since French Polynesia had experienced 2 extensive dengue 1 epidemics in the past (ROSEN, 1958; KAUEFFER *et al.*, 1976), the proportion of the population infected with dengue 1 in late 1990 would be around 70%. Thus, the decline of epidemic transmission may be related to the increasing level of immunological coverage of the general population. Although community-based vector control has been maintained constantly, the impact of control efforts on the course of the epidemic is difficult to evaluate and will be discussed elsewhere (P. Barbazan, personal observations). Nevertheless, virus isolation from mosquitoes provided evidence that dengue 1 was transmitted by *Ae. aegypti*, which is widely distributed in French Polynesia.

Study of documented cases

The proportion of confirmed cases was higher in both civilians <15 years old (46·5%) and in the overall military population (47·5%) when compared to that observed in civilians ⩾15 years old (31·1%, $P<0·05$). These results confirmed the susceptibility to dengue infection of children born after the previous dengue 1 epidemic (KAUEFFER *et al.*, 1976) and individuals living in French Polynesia on a temporary basis. Moreover, primary infections were predominant in children <15 years old and in the total military population (Table 5).

The proportion of confirmed cases among patients aged 15 years or more was higher in male civilians (Table 4; $P<0·001$). That difference was not observed in the military population. We have not, so far, an adequate explanation for these observations. Work habits causing male civilians to be more exposed to mosquitoes might be related to the higher infection rate. Some authors have reported a predominance of men among dengue sufferers (LE GONIDEC *et al.*, 1982; CHAN *et al.*, 1977; GUARD *et al.*, 1984), while others have reported a higher frequency in females (GUZMAN *et al.*, 1984). These discrepancies may have arisen because the population studied was not fully representative of the total susceptible population.

Most of the patients consulted a physician during the febrile phase and had blood taken for laboratory confirmation at that time. This observation emphasizes the importance of early diagnosis. Before day 5 of illness, the diagnosis was mostly confirmed by virus isolation. Conversely, on or after day 5 it was usually confirmed by the eases, and clinically-based surveillance may result in over estimation (DIETZ *et al.*, 1990). However, in our attempt to describe the epidemiological pattern and to monitor the surveillance of the epidemic, satisfactory results concerning time, age and geographical distributions were obtained. The weekly number of requests submitted for laboratory confirmation of diagnosis together with the level of the confirmation rate appeared to be a good alternative for estimating case distribution time trends. Finally, this study emphasized the need for lab-oratory-based dengue surveillance systems to measure the real incidence of the disease.

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