

# Dengue in the Pacific: an updated story

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## Introduction

The occurrence of dengue in the Pacific has been mostly characterised by epidemics although it might be endemic in some places. Appearance of a dengue fever outbreak requires several elements: (a) the introduction (usually by one infected person) of one of the four types of dengue viruses; (b) the existence of a large enough population of suitable vectors (mosquitoes, usually *Aedes aegypti*, *Aedes albopictus* or *Aedes polynesiensis* in our region); (c) a large group of susceptible people, thus not immunised against the introduced type of dengue virus; and (d) appropriate environmental conditions favouring the contact between infected persons and the vectors, and in turn between infected mosquitoes and susceptible people (weather conditions, sanitation, type of housing, overcrowding, etc.).

The most important dengue vector is the *Aedes aegypti* mosquito; however, both *Aedes albopictus* and *Aedes polynesiensis* also transmit the disease (although less efficiently than *Aedes aegypti*). At least one of the three types of mosquito is present in each of the Pacific countries and territories. However, little is known beyond whether or not a certain species is present.

Since 1970, there have been four major Pacific-wide dengue fever outbreaks: type 2 in 1971 - 72, type 1 in 1975 - 78, type 4 in 1979 - 80 and different types of dengue in

1989<sup>1-6</sup>. This paper emphasises the importance of carefully monitoring the current spread of dengue 2 throughout the Pacific in order to be prepared for - and prevent - a possible 5<sup>th</sup> major regional epidemic.

## The current troublemaker: dengue 2

Table 1 shows the chronology of the current dengue 2 epidemic in the Pacific.

## Synopsis of current and historical descriptive data

During the 5<sup>th</sup> Conference of the Directors of Territorial Health Services organised by the South Pacific Commission in Port Moresby in February 1974, it was shown that prior to 1950, the presence of dengue was reported in a number of

places including American Samoa, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, New Caledonia, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu; between 1950 and 1970, only 2 outbreaks were reported, both of them from French Polynesia (in 1964 and 69).

The increasing frequency of dengue fever activity after the 1960s and the emergence of dengue haemorrhagic fever (DHF) in the Pacific in the 1970s demonstrate that the epidemiology of this disease is evolving.

Table 2 shows the major dengue outbreaks and the main types of dengue responsible for each outbreak after 1970. Historically, it must be also noticed that the first type 4 outbreak outside South East Asia started in Tahiti and Moorea in January 1979. In Table 2, the years of documented outbreaks are presented (shown as full line boxes), as well as the years of endemic transmission when reported (shown with dotted lines). The type of dengue is followed by the number of reported people affected. The figures, as well as estimates, are shown whenever available. These figures have to be cautiously considered, because there is no standard definition of a dengue (fever) case, and suspected cases are reported in some places, whereas in others only confirmed cases of dengue are notified. Nevertheless, all these figures

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**Table 1. Summary of present dengue 2 situation as reported by Pacific countries and territories (PICT)**

Country / Territory	Date current epidemic started	Month of ending (if ended)	Date of latest update	Total cumulative number of new clinical cases of dengue fever	Cumulative incidence rate per 1,000 inhabitants*	Deaths
French Polynesia	August 1996	May 1997	21/05/97	6,952	31.3	1
New Caledonia	Mid Dec. 1996		06/02/98	485** (DEN-1, -2 & -3)	2.4 (DEN-1, -2 & -3)	0
Cook Islands	Late Dec. 1996	June 1997	12/07/97	1,075	56.6	0
Samoa	September 1997		01/12/97	114	0.7	2
Tonga	August 1997		30/10/97	5	-	0
Fiji	September 1997		05/02/98	11,063	14.2	8

\* Population figures used: respective mid-1997 population estimates, South Pacific Commission Demography Programme.

\*\* Amongst the cases for which the type of dengue has been determined in 1997, 95% (146/154) were dengue 2, 5% (7/154) dengue 3 and 1 case was dengue 1. In 1998, all confirmed cases (i.e. 178) are dengue 2.

give an idea of the importance of dengue in the different Pacific islands.

### Historical data from the Pacific

- **French Polynesia: dengue 2 epidemic is over.** Before this last outbreak, a dengue 2 epidemic occurred in French Polynesia in 1971. Between August 1996, beginning of the epidemic, and May 1997, its end, the total number of reported clinical new cases of dengue fever was 6,952 and the provisional number of confirmed new cases 1,840. Only one death was recorded. Although the epidemic was officially considered as over in May 1997, sporadic cases of dengue 2 were still reported in French Polynesia until the end of 1997. As shown in Table 2, dengue may be considered as endemic in French Polynesia. The endemic transmission of type 3 dengue after 1989 outbreak was replaced by type 2 dengue transmission after 1996-97 outbreak.

**New Caledonia: dengue 2 epidemic has intensified since December 1997.** The first case of dengue 2 since 1972 was notified in mid December 1996. Between this date and 6 February 1998, 485 new cases of dengue were reported.

- In 1997, there has been a low level transmission all over the year, with 243 new cases reported; amongst the cases for which the type of dengue has been determined, 95% (146/154) were type 2 dengue, 5% (7/154) type 3 dengue and 1 case was type 1 dengue (imported from Thailand).
- In December 1997, the weekly number of new cases started to increase, and 238 cases were notified from 1 January to 6 February 1998. That represented nearly the same amount as for the whole previous year; all confirmed cases (i.e. 178) were type 2 dengue.

No deaths were registered. Since the 1995 type 3 dengue outbreak, dengue may be considered as endemic in New Caledonia. It must be noticed as well there was a small outbreak of dengue 4 during the peak of dengue 3 outbreak in 1996 (12 confirmed cases in March-April 1997).

- **Cook Islands: dengue 2 epidemic is over.** Between 28 December 1996 and June 1997, 1,075 new clinical cases of dengue were reported in the Cook Islands (Rarotonga). All the positive samples collected in April 1997 were for dengue 2 virus. Although more than a hundred cases were admitted to Rarotonga hospital, no haemorrhagic forms and no deaths have occurred.
- **Samoa: confirmed dengue 2 outbreak.** The current outbreak started in September 1997, with 2 deaths notified, out of a total of 17 reported cases for the month. A total number of 114 new cases was reported from September till November 1997.
- **Tonga.** There were 5 confirmed new cases of dengue fever in August 1997 and no fatalities. No other new cases have been reported since then. The type of dengue has not been reported. Before this, there was one case reported in 1994.
- **Fiji: dengue 2 epidemic peaking up.** From the beginning of the epidemic to 6 February 1998, 11,063 clinical new cases of dengue fever and 569 hospital admissions were reported. Some of the cases have shown signs of dengue haemorrhagic fever, with eight deaths reported, all from CWM Hospital. While the epidemic appears to be more severe than the 1989-90 epidemic (40 deaths, approximately 4,000 new cases of dengue seeking treatment at government facilities), the overall mortality rate appears to be lower. As at the beginning of February, the outbreak

is expected to continue and to worsen unless everybody act quickly and decisively to destroy mosquito breeding sites. Clean-up campaigns have continued; spraying activity temporarily ceased in some areas after an intensive spraying campaign. Local media have strongly supported a nation-wide public awareness campaign.

- **Guam.** There have been no more outbreaks of dengue in Guam since the *Aedes aegypti* was eliminated from the island in 1944. In April 1995, an entomological survey found no *Aedes aegypti* on the island. However, *Aedes albopictus* is abundant. The fact that there have been no outbreaks in recent years puts Guam at higher risk (as shown in Table 3) because a very high proportion of the population is susceptible to the 4 types of dengue.
- **Northern Mariana Islands.** There is no dengue history information available for CNMI. However, the risk of dengue outbreak is significant because *Aedes aegypti* is present, and the country has not recently had a dengue outbreak. Frequent travels of infective people between epidemic areas (e.g. Palau in 1995) and other endemic ones such as neighbouring South-East Asia may also be a risk factor.
- **Papua New Guinea.** Although there was no reported dengue outbreak since 1983, the Tropical Public Health Unit in Cairns, Australia has reported in 1995 two cases of dengue acquired in Papua New Guinea, 1 case of DEN-3 from Lae and another one from Port Moresby caused by DEN-2. Scarcity of surveillance data at regional level makes the assessment of the dengue situation difficult.
- **Solomon Islands.** No reports of previous dengue outbreaks are available although an outbreak was reported in 1982 in Honiara.
- **Wallis and Futuna.** In 1995, 1 imported and 4 indigenous cases of type 3 dengue were notified.

## Which type 2 dengue virus? Where does it come from?

Laboratory techniques have steadily improved since Albert Sabin discovered the first two types of dengue viruses, and in particular the New Guinea C strain of dengue type 2 during the Second World War. Laboratories of virology, make it possible to explore potential spreading ways of the epidemic.

The Tahitian, Cook Islands, New Caledonian, and Samoan viral strains show very great similarity between each other and are very close to the dengue 2 virus responsible for the

1992-1993 epidemic in far north Queensland. As shown in Table 1, it looks very likely that the epidemic spread from French Polynesia to New Caledonia, Cook Islands, and, later, to Samoa and Fiji (typing was not done for the cases in Tonga and nucleotides sequencing is in progress for the DEN-2 virus from Fiji). Beyond the apparent sophistication of this kind of laboratory techniques there is a real case for emphasising the very 'human way' of spreading that dengue 2 utilises, wandering along economic routes (and other dengue viruses alike). However, the link between far north Queensland and French Polynesia is more distant, time-wise in particular.

## Who is currently at risk?

As one gets a life-long immunity against a type of dengue after having been infected by this type, the people at risk for an infection by a given type of dengue<sup>1, 2, 3 or 4</sup> are those who have not previously been infected by that particular type. According to the data available on the previous and current outbreaks, we have attempted in Table 3 a risk assessment for large dengue outbreaks, mainly based on the time elapsed since the last sizeable outbreak of a given type of dengue. In reality, other factors must be taken into account as well, like the rainfalls and the presence of mosquitoes breeding sites, the type of mosquito and their potential to be an efficient vector, the flow of travellers from dengue infected countries and the real proportion of the population affected by the previous outbreak of a type of dengue.

Nevertheless, from the results shown in Table 3, the prediction that most of the

Pacific is at very high risk for dengue is reliable whatever type of dengue is considered. So no Pacific country should be complacent in the prevention and surveillance activities.

**WHO and SPC have resources available to PICTs ... to facilitate the development of control strategies, and response to outbreaks.**

## Discussion

It is interesting to notice in Table 1 that in those places where the current DEN-2 outbreak is considered as over (i.e. French Polynesia and Cook Islands), 3% of the population (French Polynesia, where the disease remained endemic) to 6% (Cook Islands) were reported to have been sick with dengue. These reported figures depend on:

- the size of the population susceptible to the type of dengue in cause (and thus the size and year of the previous outbreak),
- the representativeness and accuracy of the reporting system,
- the proportion of infections that have no or very few symptoms (the 'virulence' of the viral strain - related, e.g., to human host susceptibility to the virus, or vector susceptibility to and selection of the viral strain).

**Table 2. Dengue by country/territory, serotype and year, 1971-97**

Country	71	72	73	74	75	76	77	78	79	80	81
American Samoa*		DEN-2			DEN-1						
Cook Islands*						DEN-1 > 2000?				DEN-4 357	
Fed. St. Micronesia (Yap)*											
Fiji		DEN-2 3400			DEN-1 16203					DEN-4 127	DEN-1 8
French Polynesia		DEN-2 > 40000			DEN-1 (82) > 1000				DEN-4 > 7000		DEN-4 673
Guam											
Kiribati		DEN-2		DEN-1						DEN-4 915	
Marshall Islands				DEN-1							
Nauru		DEN-2 3000		DEN-1 3500						DEN-4 538	
New Caledonia		DEN-2 40000				DEN-1			DEN-4 11000		
Niue		DEN-2 790								DEN-4 (2) 749	
Northern Marianas											
Palau											
Papua New Guinea		DEN-2 > 1119				DEN-?					
Samoa		DEN-2			DEN-1 > 1000				DEN-4 1035		11
Solomon Islands											
Tokelau											
Tonga	DEN-2?			DEN-2 15000	DEN-1 772				DEN-4 6670	DEN-4 398	
Tuvalu		DEN-2		DEN-1						DEN-4 15	
Vanuatu		DEN-2			DEN-1 400				DEN-? 31	DEN-4 16	7
Wallis & Futuna						DEN-1 363			DEN-4 222		1

References: for details, see Table 3.

In French Polynesia, at the time of the current outbreak, the population at risk susceptible to dengue 2 was roughly estimated at 50% of the total population as the previous major outbreak of the same type of dengue occurred in 1971. It means that around 6% of the population at risk were reported as sick, the rest either was sick but not reported (seen by non reporting private doctors or not seen at all), or got infected but not sick, or not infected at all.

In places endemically affected by dengue, infection by dengue viruses is reported to be asymptomatic or 'oligosymptomatic' (with little and mild symptoms, not recognised as dengue fever) in around 50 to more than 90% of the affected populations<sup>22, 25, 26</sup>. How far this is true in (some of) the PICT requires further assessment of the dengue situation.

Despite the fact that data on cases and outbreaks are sometimes not really complete or even available, it is striking to see that most of the outbreaks were not isolated ones but spread out as major Pacific-wide epidemics.

- In 1971-72, (at least) 11 PICT suffered the dengue 2 epidemic, 2 in 1974-75 and 3 in 1988-89.
- In 1974-78, dengue 1 epidemic spread through 13 PICT, and 5 PICT were affected by a second wave in 1988-89.
- In 1979-80, it was the turn of dengue 4, with 12 PICT reportedly affected.
- Dengue 3 was more modest in 1989 and only hit 4 PICT, plus one before and after (in 1986 and 1991).

Table 2. Dengue by country/territory, serotype and year, 1971-97 (cont.)

83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
												DEN-3		
								DEN-3 1776				DEN-3 756		DEN-2 1045
					DEN-2							DEN-4		
	DEN-? 190	DEN-? 31	DEN-? 269	1	DEN-? 22	DEN-1(& -3) >3600		DEN-? 65	DEN-? 349					DEN-2 63
DEN-4 1546	DEN-4 453	DEN-4 142	DEN-4 229	DEN-4 232	DEN-4 & -1 133	DEN-1& -3 8754				DEN-3				DEN-2 69,2
					DEN-1									
						DEN-?								
						DEN-1 -2, -3 & -4 85 5 134	DEN-3 (&1) 2475	318	20	10	4	11	DEN-1(-2) 4333	DEN-2 10,275
		47			DEN-3 269	6	4	DEN-2						
						DEN-2 1254						DEN-4 85		
							6	DEN-? > 336						DEN-2
								DEN-?						
575	180	11		1		6		5						
								DEN-3 58			DEN-?			
								DEN-1						
								DEN-3 2361					DEN-3-5	

We are now in the midst of another dengue 2 epidemic which has already affected 6 PICT. It is worth notice the low case-fatality rate: out of approximately 20,000 reported cases, only 11 deaths were notified (1 in French Polynesia, 2 in Samoa, 8 in Fiji).

Table 3 suggests the risk for an outbreak of dengue, by PICT; attention must be paid to the risk for DEN-2 as this type of dengue is circulating now in the Pacific. This is especially true for islands shifting from a cool and dry season towards - or being amidst - a rainy and warm season. All countries in the Pacific have at least one competent mosquito vector of dengue. The ease and frequency of travels in the Pacific makes the spread of dengue by viraemic travellers quite easy, especially during holidays periods or other large regional

gatherings such as political, professional, or churches meetings.

Appropriate public health measures must focus on the triad of mosquito, human and environment. All PICTs should be presumed to be at risk of outbreaks of DF/DHF, both in the present situation and in the future. To minimise the risk of an outbreak, aggressive reduction of Aedes breeding sites should be undertaken, especially in ports, airports, urban and peri-urban areas, using an intersectoral approach involving both government and non-government groups. Ideally, this should be an annual routine, including years with no epidemic activity. This should be coupled with surveillance of mosquito populations (to monitor effectiveness of source reduction campaigns, and to target mosquito control measures),

Table 3. Risk assessment by country and territory for DEN-1, DEN-2, DEN-3 and DEN-4 outbreaks, January 1998

Country	Years of last outbreaks of dengue				DEN-3 Reference	DEN-4 Reference	Reference	DEN-3	DEN-4	Reference	?	References	Risk of outbreak of dengue type**			
	DEN-1	References*	DEN-2	References*									DEN-3	Reference	DEN-4	Reference
American Samoa	75	1	72	20, 29	95†	27							+++	+++	-?	+++
Cook Islands	76	4, 29, 34	96-97 <sup>a</sup>	PACNET	91, 95	4, 29, 8	80	5					+++	+++	-	++
Fed. St. Micronesia			88***	6, 27			95†	27					+++	+++	+++	+++
Fiji	75, 89-90	15, 28, 29, 34	71-72, 82 & current	14, 18, 34, 5, 29, PACNET			80	5					+	+++	+++	++
French Polynesia	75-76, 88-89	10, 12, 33	71-72, (75-76), 96-97	5, 13, 14, 29, 34, PACNET	89	10, 12, 29	79-80	5, 29					+	+	+	++
Guam													+++	+++	+++	+++
Kiribati	74, 88	32, 10	71-72	18, 29, 32, 34			80-81	5, 30		89	10		++	+++	+++	++
Marshall Islands	74	28											+++	+++	+++	+++
Nauru	74	28	72	28, 29			80	5					+++	+++	+++	++
New Caledonia	75-78, 89	2, 9, 29	71-72 & current	2, 9, 28, 29, 34, PACNET	89, 95-96	10, 19, 29	80, (96†)	2, 5, 29					+	+++	-	++
Niue			72, 89	18, 29, 34, 10	86	6, 10, 16	80	5, 30					+++	+	++	++
Northern Marianas													+++	+++	+++	+++
Palau			86	3, 10			95	1, 19					+++	+	+++	-
Papua New Guinea			71-72 †	17, 34	****	1				76, 83	1, 29, 34		+++	+++	+++	+++
Samoa	75-76	9	72 & current	18, 29, PACNET			79-80	5		89	10, 19		+++	+++	+++	++
Solomon Islands										82	6		+++	+++	+++	+++
Tokelau										89	19		+++	+++	+++	+++
Tonga	75	29, 34	74	28, 29, 34			80-81	5, 30		81, 97	30, PACNET		+++	+++	+++	++
Tuvalu	74	32	71-72	18, 29, 32, 34	89	10	80	5		92	19		+++	+++	+	++
Vanuatu	75, 89	34, 10	72	18, 29, 34			80	5					+	+++	+++	++
Wallis & Futuna	76	29, 34			89, (96†)	10, 1	79	5, 30, 31					+++	+++	+	++

\* "Reference" and numbers refer to the references at the end of the article

\*\* Legend for risk information:

- < 5 years since the last outbreak  
 + 5 to 9 years since the last outbreak  
 ++ 10 to 19 years since the last outbreak  
 +++ 20 or more years since the last outbreak or no previous known outbreak

\*\*\*\* 1988 outbreak was in Yap only. The current risk for a dengue 2 outbreak is + in Yap, +++ in the other states.

\*\*\*\* One case of type 3 dengue imported from PNG reported in Australia in 1995.

1 Outbreak of dengue 4 in Yap in 1995. The current risk for a dengue 4 outbreak is - in Yap.

+++ in the other states

2 Fourteen confirmed cases of dengue 4 during dengue 3 epidemic peak in 1996

3 One imported and 4 indigenous cases of type 3 dengue.

α Risk +++ for the outer islands not affected by the 1997 outbreak.

† Risk depends on the size of the 1995 outbreak.

‡ Plus one case of type 2 dengue imported from PNG reported in Australia in 1995.

and surveillance of human populations for the first evidence of the arrival of the virus. Rapid methods of screening for dengue antibodies are now available and are being trialled in a number of PICT. Experience has shown that dengue is often mistaken for an outbreak of measles, or even influenza. It is for this purpose that clinical surveillance for dengue would best be integrated into an overall fever surveillance system, covering these 3 illnesses. Further operational research is required into these areas to strengthen current activities. WHO and SPC have resources available to PICTs (such as technical expertise, equipment) to facilitate the development of control strategies, and response to outbreaks. These and other resources can be also reached through PACNET, the listserver of the Pacific Public Health Surveillance Network.

### Acknowledgements

This is an update of an article previously written in August 1995 in the South Pacific Epidemiological Health Information System (SPEHIS) newsletter<sup>1</sup>. In addition to the attached list of references, the main sources of the compiled information are from the Pacific Island countries and territories, either through monthly reporting or PACNET, the listserver of the Pacific Public Health Surveillance Network<sup>1</sup>.

Our special thanks to all PACNET information providers, especially the for the following countries and territories: Dr Eti Enosa, Director of Health, Samoa; Dr M. Germain, Director of Health, New Caledonia; Dr Fr. Laudon, Director of Health, French Polynesia; Ngari Munokoa, Health Statistician, Cook Islands; Dr Taniela Palu, Medical Superintendent, Vaiola Hospital, Tonga; Dr B.P. Ram, Epidemiologist, & Dave Saunders, Assistant Epidemiologist, Fiji. Laboratories: Eliane Chungue, Director, Malardé Institute, French Polynesia; Prof. J. MacKenzie, Dept of Microbiology, Queensland University, Australia; Debbie Phillips, WHO Collaborating Center for Arbovirus Reference & Research, Queensland, Australia.

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**... other factors must be taken into account as well, like the rainfalls and the presence of mosquitoes breeding sites, the type of mosquito and their potential to be an efficient vector, the flow of travellers from dengue infected countries and the real proportion of the population affected by the previous outbreak of a type of dengue.**

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Epidemics have often been more influential than  
statesman and soldiers in shaping the course of political  
history, and diseases may color the moods of civilization.

*Rene and Jean Dubos*

The White Plague