

## Solomon Islands dengue seroprevalence study – previous circulation of dengue confirmed

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### SUMMARY

Since there were no confirmed outbreaks of dengue on record an extensive search of available records and a seroprevalence study were undertaken to determine if there was evidence of past dengue virus infections in the Solomon Islands. Hospital and Health Department records revealed a suspected dengue outbreak in 1982 and deaths attributed to dengue in 1995 and 1996. Serum samples from blood donors were analyzed for the presence of IgG antibodies specific for flavivirus and dengue virus. A total of 39% of the 515 samples, predominantly from adult males from Honiara, demonstrated IgG antibodies specific for dengue; 28% (26 of 93) were monotypically positive by plaque reduction neutralization test for dengue 2 antibody and the remaining samples had antibodies to more than one dengue serotype. A good correlation was found between the presence of flavivirus and dengue IgG confirming that dengue virus had circulated in the past in the Solomon Islands.

### Introduction

Dengue fever is caused by a flavivirus transmitted to humans via a mosquito vector. In the Pacific region dengue is known to occur in epidemics but to date there has been no recorded confirmed evidence of dengue virus transmission in the Solomon Islands. A search of hospital and Health Department records revealed a suspected dengue outbreak in the Solomon Islands in 1982 (1,2) and deaths attributed to dengue in 1995 and 1996 (3). Vector surveys performed in the 1920s and 1940s identified the vector *Aedes aegypti* in several islands of the Solomon Islands (4-7), but its presence has since been noted only once

as an uncommon finding in Honiara during several later Solomon Islands surveys (1,2,7,8, and T. Thornleigh, unpublished report, 1997). However, surveys since 1978 have found *Aedes albopictus* (2,8,9), another known vector for dengue virus (10,11), and the vector proposed as responsible for the cases in 1982 (1). The presence of *Aedes albopictus* is in contrast to Belkin's prediction that *A. albopictus* would be unlikely to become established in the South Pacific (5). It has in fact become widely established, possibly through carriage on ships between the South Pacific and the Asian continent (12).

The possibility is therefore strong that

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dengue virus infections could have occurred in Solomon Islands. A known vector, *Aedes albopictus*, is found in high numbers. Although there has not been an established program for the systematic monitoring of, or identification of, dengue cases, there have been anecdotal reports of clinically suspected dengue. Many neighbouring countries – with which there are easy travel links – have reported outbreaks of dengue fever in the past (3).

In Solomon Islands there is a high fever incidence which could make an outbreak of dengue difficult to detect. Although a good percentage of fever cases can be attributed to malaria, which is endemic, more than 50% of the fever cases are of unknown origin (13).

In late 1997, in response to these concerns and as dengue epidemics were occurring in other Pacific countries – New Caledonia, Samoa, Cook Islands (3,11), French Polynesia (14), Tonga (3,15), Fiji (14,15) and Vanuatu (3) – a two-part study was undertaken to determine the situation in the Solomon Islands. Firstly, a vector survey in Honiara was performed which confirmed the presence of *Aedes albopictus* in large numbers, with Breteau indices in excess of 50 not being uncommon (T. Thornleigh, unpublished report, 1997). The second part was to perform a seroprevalence study to assess past exposure to dengue virus in the Solomon Islands. In addition to the seroprevalence study a search of available medical and laboratory records on clinical dengue infection was undertaken.

## Methods and Materials

### Literature search

A review of World Health Organization (WHO) and other in-house documents and monographs was performed. Literature searches were performed using the Medline, National Library of Australia Catalogue, Hawaii Medical Library, Catalogues of WHO, Foreign and Commonwealth Offices and Annual Reports of the British Solomon Islands.

### Collation of available records

Collation was made of information found in the record books at the National Referral

Hospital, in particular those kept in the Microbiology Department for the samples sent for testing overseas. A search of hospital data on diagnosis was performed. Attempts were made to recall inpatient records for those patients tested for dengue in previous years (1993-1997).

### Seroprevalence survey

The samples analyzed in this study were 515 stored sera taken from blood bank donors presenting to the National Referral Hospital, Honiara during 1994 and 1995. They were predominantly from adult males and all lived in and around the Honiara municipality, the capital of the country.

Permission to analyze the samples for presence of antibodies to dengue and other arboviruses was granted by the Solomon Islands Government.

Samples were screened for the presence of flavivirus IgG antibodies by an in-house enzyme-linked immunosorbent assay (ELISA) technique (Arbovirus Reference Laboratory, Brisbane, Australia) and for dengue IgG antibodies by a commercial dengue ELISA kit (PanBio Company, Brisbane, Australia).

Cut-off points were determined according to standard laboratory procedures or the kit instructions. All specimens with equivocal results were retested.

Plaque reduction neutralization assays (PRNT) were performed on a selection of dengue IgG-positive samples in an attempt to identify which serotypes had circulated.

## Results

### Literature search and in-house documents

Literature searches for dengue and Solomon Islands produced no references on clinical disease. A careful study of all in-house monographs and working papers revealed references to an outbreak occurring in 1982. The WHO Dengue Newsletter gave details of 1800 dengue-like cases from an examination of outpatients over a 3-day period. Isolation of dengue 3 and determination of *Aedes*

*albopictus* as the vector were also stated in the report (1). No further details are given in the article and no other record, memory or other reference could be found. A further reference to 1 death attributed to dengue in 1995 and 3 in 1996 was found in an appendix to a WHO summary document for the Western Pacific (3); however, the source data for these reports in the Solomon Islands could not be found.

**Collation of available records**

Analysis of hospital records revealed that 125 serum samples were sent overseas for viral screening during the period 1993-1997. Analyses requested were a mixture of viral studies including investigation for dengue or arboviral infection. Flavivirus IgG antibodies were detected in 27 samples (22%) and flavivirus IgM in 7 (6%). Specific dengue serotyping was performed for those positive by IgM and 4 demonstrated dengue activity when analyzed by ultracentrifugation though no clear serotype pattern emerged.

Records were only available from 1990 onwards. Therefore no review was possible for the samples analyzed during the reported outbreak of dengue in 1982. Physicians employed at that time or during 1993, when 6 dengue cases with positive IgM antibodies were detected, could not be contacted.

Review of hospital diagnosis records kept on computer and patient records revealed no evidence of clinical dengue cases having been admitted.

**Seroprevalence study**

Results of the seroprevalence study are presented in Table 1. 36% (186/515) of the

samples were positive for flavivirus and 39% (202/515) positive for dengue virus. 32% (164/515) of the serum samples were positive in both the flavivirus and dengue ELISA tests and 57% (291/515) were negative in both tests, giving a concordance of 88%. 19% (38/202) of the dengue ELISA IgG-positive samples were negative for flavivirus antibody and 12% (22/186) of flavivirus antibody-positive samples were negative for dengue IgG by ELISA.

Monotypic dengue 2 antibody was detected by PRNT in 28% (26/93) of the dengue IgG-positive samples. Neutralizing antibody to more than one dengue serotype was detected in the remaining samples.

**Discussion**

This review of available literature, laboratory records and hospital records reveals that the presence of dengue has been confirmed in the past. In particular there are details of an outbreak in 1982 and dengue IgM-positive cases during 1993. 34 of the 83 requests made during 1993 specifically requested dengue as an investigation, 10 requests were for arbovirus and the remaining 39 for ‘virus studies’ thus indicating some clinical awareness of symptomatic dengue. However, there is no indication as to whether the infections found in 1993 were acquired in the Solomon Islands or while travelling overseas.

The patient computer archives are complete only from 1995 thus it is not possible to review those records for patients shown positive for dengue in 1993.

The hospital computer record system does

**TABLE 1**

SEROPREVALENCE OF FLAVIVIRUS AND DENGUE IN THE SOLOMON ISLANDS

Flavivirus ELISA	Dengue ELISA		Total
	Positive	Negative	
Flavivirus Positive	164	22	186
Flavivirus Negative	38	291	329
<b>Total</b>	202	313	515

not include dengue as a possible diagnosis at this time and as there was a belief that dengue did not occur in this country no active collection of data was made. Haemorrhage and shock, although active clinical indicators for severe dengue fever, may not have been observed in the Solomon Islands.

Without adequate recording systems it is impossible to accurately determine what may have happened in 1982 and 1993.

### Seroprevalence study

The 88% concordance between the flavivirus ELISA and specific dengue ELISA provides evidence that dengue infections have occurred in the Solomon Islands. Conclusive evidence is provided by the presence of dengue 2 neutralizing antibody which would be consistent with the hypothesis that dengue 2 virus circulated widely. It is unclear which other serotypes have been active since there is no clear corroborating evidence to confirm past circulation of dengue type 3. Although no travel history is available for the individuals whose samples were tested, it is unlikely that more than a few of those would have travelled out of the country.

Of particular interest is that 22 out of 186 samples positive for the presence of flavivirus IgG antibody were quite clearly negative for dengue. Further studies are now being undertaken to determine which flavivirus antibodies are present in these samples.

### Conclusion

This work provides evidence that there have been episodes of dengue virus circulation in the Solomon Islands, at least since 1982. Further, the seroprevalence survey has demonstrated a 39% past exposure rate to dengue in the adult male population in Honiara, Solomon Islands.

The absence of *Aedes aegypti* would reduce the risk and perhaps the severity of an outbreak; however, outbreaks have been recorded in other Pacific Islands without this vector (16-18). The presence of high numbers of an adequate secondary vector *Aedes albopictus*, together with confirmed known

past exposure of the population to dengue and the continuing occurrence of outbreaks in the Pacific Region, indicates that the Solomon Islands is potentially at risk of future outbreaks of dengue fever.

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