History and particular features of dengue epidemiology in French Polynesia

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French Polynesia

Geography
120 islands, 5 archipelagoes

Inhabitants
> 259,000 inhabitants
(37.3% under 20 years)

Population flows
- 220,000 tourists/year
- cyclic renewal of one part of the “working population” (civil servants, teachers, militaries, coming from France and staying in FP for 3-6 yrs)

Climate
Hot and rainy season (November to April)
Cooler and dry season (May to October)
Introduction

Dengue

- Mosquito-borne disease affecting most of the tropical and subtropical regions
  2.5 billion people exposed, > 50 million cases/yr, > 500 000 hospitalizations/yr,
  >24 000 deaths (mostly children)

- Dengue virus belongs to the *Flavivirus* genus (family *Flaviviridae*)
  (West-Nile, Yellow Fever, Japanese Encephalitis)

- Four DV serotypes (DV1-4), each includes several genotypes
  (phylogenetic classification - Envelope gene)

- DV is transmitted by mosquitoes from the *Aedes* (*Stegomyia*) specie
  principally *Ae aegypti*
  endemic vectors (*Ae polynesiensis* in the polynesian triangle)

- Clinical spectrum of DV infection
  Dengue Fever (DF)
  Dengue Hemorrhagic Fever (DHF)
  Dengue Shock Syndrome (DSS)
Dengue in the South Pacific

- **Earliest dengue epidemics**: second part of the XIXth century (*1882 FP/NC*)
- **DV emergence in the Pacific**: after World War II
- **1943-44**: DV1, first reported dengue pandemic in the South Pacific, including FP
- **1965**: DV3 in FP

- **Since the 70s, whole chains of dengue epidemics occurred in the South Pacific**
  - **DV2** in the early 70s (first reported DHF cases in the South Pacific, in *FP* in 1971)
  - **DV1** in the late 70s (DHF cases in Tonga 1975)
  - **DV4** in the 80s
  - **DV1** and **DV3** in the 90s
  - **DV2** in the late 90s
  - **DV1** in 2000-03 and 2006-08, *currently circulating*
  - **DV4**, since 2008 *Nauru, Samoa, American Samoa, Kiribati, Fiji, Vanuatu, New Caledonia and French Polynesia* (imported cases detected in Cook islands, Wallis & Futuna.)
I. Dynamic of dengue epidemics in French Polynesia

- History of dengue virus circulation in French Polynesia

- Epidemiological features
  - Epidemic
    - emergence:  
      a) new introduction (Americas, SE Asia, Pacific)
      b) re-emergence of the endemic strain (molecular data)
    - season and climate (outbreaks can occur at any season)
    - epidemic duration (average: 8 mths)
    - epidemic pattern
I. Dynamic of dengue epidemics in French Polynesia

1996-97 DV2 Epidemic

2001 and 2006-07 DV1 Epidemics
I. Dynamic of dengue epidemics in French Polynesia

- History of dengue virus circulation in French Polynesia

- Epidemiological features
  - Inter-epidemic period
    - post-epidemic period and endemic transmission of DV strains
    - non-persistent co-circulation of serotypes
    - season and climate (outbreaks can occur at any season)
    - delay between epidemics
      - epidemics due to different serotypes: average 3 yrs
      - epidemics due to same serotype (different genotypes): average 21 yrs
      - re-emergence of an endemic strain: average 5 yrs
II. Attack rates and affected population

- Attack rates per year of birth for 5 successive dengue epidemics

- 7-15 yrs  mostly affected
  - <14 yrs  never exp. DV1 epidemic
  - > 5 yrs  exp. DV4 epid.
  - >18 yrs  exp. DV4, DV1, DV2 epid. asymptomatic

Infections
- 20-22 yrs  peak ?
- 37-39 yrs peak (new residents?)
II. Attack rates and affected population

- Attack rates per year of birth for 5 successive dengue epidemics

- 5-17 yrs mostly affected never exp. DV2 epid.
- >8 yrs exp. DV3, DV1 epid. asymptomatic IIIary
- >12 yrs exp. DV3, DV1, DV4 epid. asymptomatic IIIary or IVary infections
- 32-40, 47-51 yrs peaks (new residents?)
II. Attack rates and affected population

- Attack rates per year of birth for 5 successive dengue epidemics

- 3-13 yrs: mostly affected never exp. DV1 epid.
- >4 yrs: exp. DV2 epid.
- >13 yrs: exp. DV2, DV3, DV1 epid. asymptomatic IIIary or IVary infections
II. Attack rates and affected population

- Attack rates per year of birth for 5 successive dengue epidemics

- 3-17 yrs mostly affected
- >6 yrs exp. DV1 epid.
- >10 yrs exp. DV1, DV2 epid.
- >17 yrs exp. two DV1, DV2, DV3 epid.
- asymptomatic

III. Attack rates per year of birth for 5 successive dengue epidemics

- 27-37, 46, 53-57 yrs peaks (new residents?)
II. Attack rates and affected population

- Attack rates per year of birth for 5 successive dengue epidemics

Epidemics that emerged just after the introduction of a new serotype

- Most targeted population: 4-15 yrs
  (in majority children born after the previous epidemic of same serotype)

- Previous exposure to 1 heterologous serotype: no impact the attack rates
  (no heterotypic immune protection)

- Previous exposure to >1 heterologous serotype: under-estimate of the attack rates
  (occurrence of more asymptomatic infections)

- Peaks in ranges of ages corresponding to the “working population”: due to the cyclic renewal of one part of this population

The 2006-07 DV1 (genotype IV) re-emergence

- Mostly affected: 3-17 yrs old (a big part was born before the 2001 epidemic)
- There was a broad increase in attack rates for several ranges of ages

The 2006 re-emergence was based on the renewal of the susceptible population particularly due to new residents (families)
Conclusion

- Epidemiology in FP follows a recurrent model
  - introduction of a serotype that hasn’t circulated for years
  - epidemic
  - endemic transmission
  - re-placement by a new introduced serotype or re-emergence of the endemic strain (5-6 years after the 1st epidemic)

- How to explain
  - the re-emergence of an endemic strain?
  - the non-persistent co-circulation of serotypes?

- Why is this epidemiological situation of interest for dengue research?
  - studies on dengue infected patients
    (anti-DV memory immunity, human genetic factors and outcome of infection)
  - genetic evolution of dengue viruses

- What about the situation in the South Pacific region?
  - long term predominance of a specific serotype/genotype

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Conclusion

References


Laille M & Roche C (2004). The American Journal of Tropical Medicine and Hygiene 71(4), 478-84


Lepers C (2008). Inform’ACTION N°29

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Thank you for your attention