

Dengue

CDNA National Guidelines for Public Health Units

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The Series of National Guidelines ('the Guidelines') have been developed by the Communicable Diseases Network Australia (CDNA) and noted by the Australian Health Protection Principal Committee (AHPPC). Their purpose is to provide nationally consistent guidance to public health units (PHUs) in responding to a notifiable disease event.

These guidelines capture the knowledge of experienced professionals and provide guidance on best practice based upon the best available evidence at the time of completion.

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Dengue

CDNA National Guidelines for Public Health Units

1. Summary

Public health priority

Urgent for cases in dengue-receptive areas, where there is potential for onward local transmission. Routine within 48 hours for cases in areas not receptive to dengue transmission.

Case management

No specific treatment is available for dengue fever. Most cases are self-limiting, with oral fluids and analgesia given acutely. Dengue patients in receptive areas should be advised to avoid being bitten by mosquitoes until fever subsides.

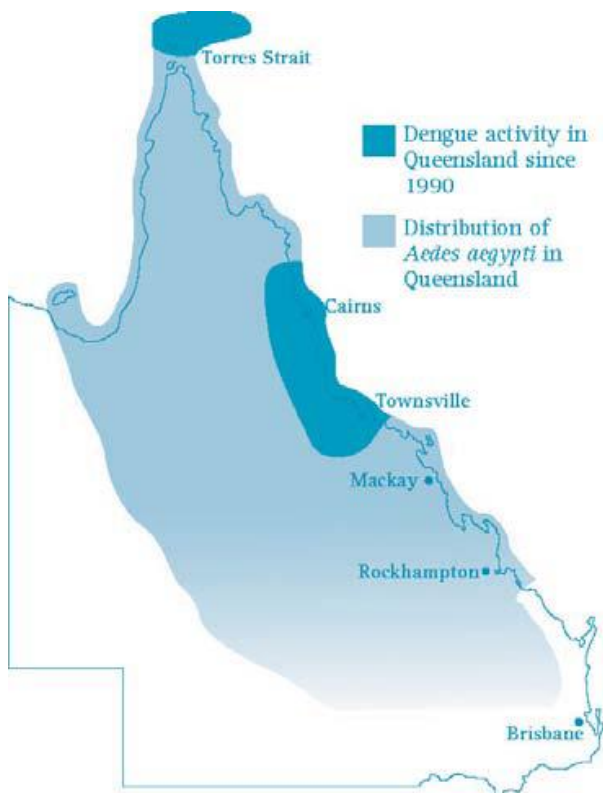
Contact management

In receptive areas only, contact tracing in the form of active case finding of persons in the same exposure area as the case, and recommend laboratory testing of any symptomatic persons.

Note

For the purposes of this document, **receptive areas** (darker shading in map below) for dengue are those residential parts (urban, regional or rural) of a defined geographical region in Australia where:

- *Aedes aegypti* or *Ae. albopictus* mosquitoes are thought to be present AND
- local transmission has occurred in the past 20 years, OR local public health and entomology authorities consider there to be a risk of local transmission.



*Note:

- Only urban or residential environments within the shaded areas are potential receptive areas
- Data on vector distribution are patchy and subject to change

Figure 1. The distribution of *Aedes aegypti* and dengue activity in Queensland* (Source: Queensland Dengue Management Plan 2010-2015).

2. The disease

Infectious agents

Dengue virus (DENV) is a flavivirus. Four serotypes of dengue viruses have been described - dengue 1, 2, 3 and 4. Each of the 4 serotypes is capable of causing the full spectrum of clinical manifestations following DENV infection. A fifth serotype was reported to have been identified in Malaysia in 2013; however the human impact of this serotype has not yet been determined and a full description is yet to be published.

Reservoir

Humans; non-human primates such as monkeys maintain the virus in limited forest settings of Asia and Africa.

Mode of transmission

There is no direct person to person transmission of dengue, but transfusion related cases can occur. Transmission is via the bite of an infective female mosquito, principally *Ae. aegypti*. *Ae. aegypti* is a highly domesticated urban mosquito found in the tropics and subtropics. In Australia it's geographical distribution is currently confined to parts of Queensland. Larvae develop in artificial water-holding containers close to or inside people's homes (such as buckets, tyres, pot-plant bases, roof gutters, rainwater tanks). *Ae. aegypti* is a day-biting species, with increased biting activity for 2 hours after sunrise and several hours before sunset. Humans are the preferred source of blood meals for *Ae. aegypti*.

Ae. albopictus can also transmit DENV, and is an aggressive day-biting species that also lives around people's homes. It is found in some temperate regions as well as the tropics and subtropics, and in Australia it is currently confined to the Torres Strait islands, but could potentially colonise large areas of the mainland. *Ae. albopictus* breeds in artificial containers and some naturally occurring sites such as tree holes and coconut shells. Adults prefer to rest in heavily-shaded outdoor sites; and the female takes blood from a range of mammals.

Vertical transmission from mother to child in utero has been described but is thought to be uncommon and would not be expected in Australia given the current level of dengue activity here. Vertical transmission from infected mosquitoes to their offspring (eggs) has been reported to occur but only at low frequencies. The ecological importance of this phenomenon to dengue persistence is not clear.

Incubation period

The illness typically starts from 4 to 7 days after a person is bitten by an infected mosquito, but ranges from 3-14 days.¹ The extrinsic incubation period (EIP) (the incubation period in the mosquito) is from 8-12 days, although shorter EIPs (as low as 5 days) have been reported, leading to explosive outbreaks.²

Infectious period

There is no direct person-to-person transmission of dengue (apart from through blood transfusion). A person with dengue can transmit the virus to mosquitoes from shortly before the onset of symptoms (and febrile period) to the cessation of symptoms: usually 3-5 days. However, to reliably trace possible infectiousness to local vectors, a longer duration of viraemia is assumed, from one day before until 12 days after the onset of symptoms in the case. An infected mosquito can transmit dengue until it dies.

Clinical presentation and outcome

Infection with DENV can produce a wide clinical spectrum of disease, ranging from a mild febrile illness through to a severe, even fatal condition such as dengue haemorrhagic fever (DHF) or severe dengue. The clinical syndrome experienced can be influenced by both age and immunological status.^{1, 3} Most children infected with DENV experience a mild, undifferentiated febrile illness or asymptomatic infection. For those who develop recognisable signs and symptoms, the clinical course and severity of the disease can be difficult to predict early in DENV infection.^{1, 3} Typical symptoms of classical dengue include the sudden onset of fever (up to 40°C) accompanied by headache, retro-orbital pain, muscle pains in back and limbs, and rash

(erythematous, maculopapular or petechial). Other symptoms include lethargy, weakness, depression, anorexia, taste aberrations (e.g., an unpleasant metallic taste), sore throat, cough, vomiting, abdominal pain and possibly minor haemorrhagic manifestations such as epistaxis, menorrhagia, haematuria and gingival bleeding. Hospitalisation may be required depending on signs of severity such as dehydration, bleeding or comorbidities. Hepatitis is a frequent complication. DHF and dengue shock syndrome (DSS) manifest generally as plasma leakage leading to shock and can be fatal, and occur more frequently among children and young adults.

There is no specific treatment for dengue, and care is largely supportive. Oral rehydration and analgesia are routinely used. Intravenous rehydration is the therapy of choice for severe cases, and can ensure that the case fatality rate remains below 1% for these severe cases.⁴ While the clinical course for dengue is difficult to predict, revised clinical criteria developed by the World Health Organization released in 2009 can aid in the decision making process.

The revised clinical criteria were tested and used in endemic countries (with limited laboratory facilities), to classify dengue cases.⁴ See Figure 2.

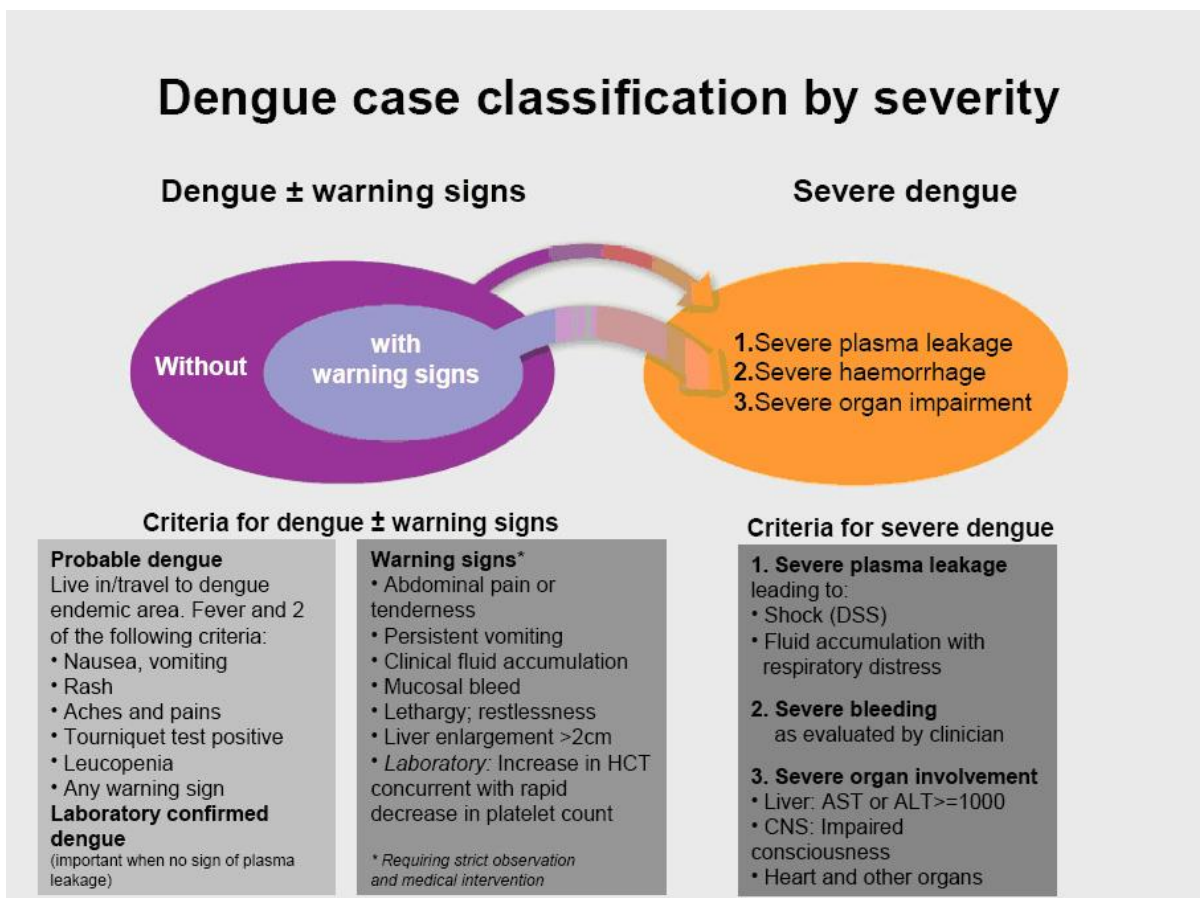


Figure 2. The revised WHO dengue case classification.⁴

Persons at increased risk of disease

Susceptibility to primary DENV infection appears universal. Recovery from infection with one DENV serotype provides lifelong immunity against that serotype but only short-term protection against other serotypes.¹ There is increased risk of DHF in secondary dengue virus infections with a different serotype to the primary infection which is thought to be due to differences in immune responses between primary and secondary dengue virus infections.¹

Disease occurrence and public health significance

There has been a global resurgence of dengue in the last three decades, with an estimated annual average of 96 million clinical cases occurring in recent years.⁵ Approximately 2.5 billion people live in areas at risk for

epidemic transmission of dengue, most of these in countries of South East Asia and central and South America.⁵ The global burden of DHF has been estimated at hundreds of thousands of cases each year with case-fatality rates between 1-20% depending on access to effective management.⁶ Most fatal cases are children and young adults.

In Australia, cases of locally acquired dengue (those acquired in Australia) and *Ae. aegypti* mosquitoes have historically been reported from most mainland Australian states,⁷ but recently transmission has been limited to north Queensland. The potential for transmission of the virus is limited by the distribution of the principal vector, *Ae. aegypti* in urban areas of north Queensland, and *Ae. albopictus* on some islands of the Torres Strait. There are also increasing number of viraemic travellers arriving into north Queensland. However, a risk of dengue transmission also exists in other parts of central and southern Queensland where *Ae. aegypti* is currently found, but which are not densely populated by people. In these areas, transmission risk may increase if there is an increase in human population size and where viraemic travellers are present, which may particularly occur in areas with a significant and regular influx of overseas workers such as mining communities. Since 1990, dengue activity initiated by imported cases has increased in north Queensland, with more than 40 discrete outbreaks involving all 4 serotypes and a range of 1-900 reported cases per outbreak.⁸ In 2008-09 more than 1000 cases of locally acquired dengue encompassing all four serotypes were notified in north Queensland.⁹ Deaths from DHF occurred in both 2004 and 2008-09 outbreaks after an absence of fatalities for over a century.¹⁰ There is a risk dengue could become endemic within Australia, particularly in Cairns. This would increase the likelihood of cases being exported into other towns in the same region and complicate efforts to control the disease.

Notifications of overseas acquired dengue cases have increased over the past few years. The number and proportion of overseas acquired dengue cases in Australia in 2010 and 2011 increased by 298% and 155% respectively. More than half of these cases were acquired in Indonesia, particularly Bali.¹¹

The extent of dengue transmission activity overseas may be a determinant of risk of local transmission in Australia. Overseas acquired dengue is reported annually from most Australian jurisdictions, but there is only a risk of local transmission when overseas-acquired cases reside for a period of time in a dengue-receptive region in Australia. In recent decades, the Australian dengue-receptive region comprises settlements of north Queensland (Fig. 1). However, the range of the dengue vector *Ae. aegypti* extends further south than this, and thus represents some small but finite risk of transmission in certain circumstances.

3. Routine prevention activities

Current prevention activities for dengue depend on reducing human exposure and mosquito control measures. There is no vaccine registered for use in Australia, although a candidate vaccine (developed by Sanofi-Pasteur) is currently in Phase III trials.

Travel advice

Travellers to endemic countries should be advised to take precautions to prevent dengue including:

- ensuring hotel (or any other accommodation) rooms are free of mosquitoes by closing window screens, using insecticide sprays indoors, using bed nets if no window screens etc
- wearing light coloured, long sleeved clothing in urban or residential areas to minimise skin exposure to day-biting mosquitoes
- wearing permethrin impregnated fabrics
- using an appropriate mosquito repellent containing DEET or picaridin on all exposed skin, and applying frequently and thoroughly according to the manufacturer's recommendations
- seeking medical advice, as soon as practicable, if they become unwell with a high fever during or soon after travel

Information on dengue endemic countries can be found on the [HealthMap web site](http://www.healthmap.org/dengue/index.php) (<http://www.healthmap.org/dengue/index.php>).

Mosquito surveillance and control measures

Dengue control aims to break the cycle of transmission through detecting and reducing vector populations. In North Queensland towns with established *Ae. aegypti* populations, year-round work is done to educate and support the population to remove domestic container habitats. Mosquito surveillance is required to monitor the presence and numbers of *Ae. aegypti* (and *Ae. albopictus*) in risk areas, ports and airports. These activities require a joint effort from local government, quarantine officers from the Australian Government Department of Agriculture, health authorities and the public. Mosquito killing traps (e.g. lethal ovitraps) and sprays may be added in high risk spots and schools.

For any dengue cases occurring outside north Queensland and not related to exposures overseas, it is imperative that the identity of the vector is determined promptly. This will consist of collection of larvae from flooded artificial containers in yards within 100-200 metres of the case, and collection of adult mosquitoes using traps such as the Biogents Sentinel (BGS) trap or the Gravid Aedes Trap (GAT) within 50 metres of the case's place of residence. The presence of *Ae. aegypti* and *Ae. albopictus* is suggestive of dengue transmission risk.

Most outbreaks occur during the summer wet season when vector numbers increase; however, in recent years outbreaks have continued throughout the autumn and winter months.

In dengue receptive areas, an outbreak prompts urgent and intensive mosquito control activities around the addresses where the cases may have been viraemic. This aims to kill infected adult females within a radius of about 200 metres – the distance a vector might fly.⁸ The primary vector of dengue, *Ae. aegypti*, is highly domestic and blood-feeds and harbours within premises. Thus, where *Ae. aegypti* is present, control measures include indoor residual spraying using synthetic pyrethroid insecticides such as bifenthrin and deltamethrin. Outdoor truck mounted ultra-low volume (ULV) or thermal foggers are not effective against *Ae. aegypti* hidden indoors. Water filled containers are treated with insect growth regulators (e.g., methoprene), Bti or pesticide sprays. Tipping out or removal of containers (source reduction) is effective but laborious and not efficient during large outbreaks. The response when an outbreak occurs is outlined in Section 12 and documented in the [Queensland Dengue Management Plan](http://www.health.qld.gov.au/dengue/documents/dengue-mgt-plan.pdf)⁸ (<http://www.health.qld.gov.au/dengue/documents/dengue-mgt-plan.pdf>).

If the exotic *Ae. albopictus* is thought to be the vector, outdoor ULV and harbourage/barrier sprays using residual pyrethroids are effective. Larvae should be controlled as for *Ae. aegypti*.

4. Human Disease Surveillance objectives

- To detect and respond promptly to imported cases of dengue into receptive areas.
- To detect and respond promptly to locally acquired cases of dengue in Australia.
- To monitor the epidemiology of dengue to inform development of better prevention and control strategies.

5. Data management

Both confirmed and probable cases should be reported to the local Public Health Unit. All notified cases should be entered onto the notifiable diseases database within one working day of confirmation. For all cases the Place of Acquisition field should be completed in accordance with the national data dictionary.

6. Communications

- For confirmed and probable cases in receptive areas (Figure 1), report the case (on same day of notification) to state/territory Communicable Diseases Branch by email including case details, onset date and geographical areas of exposure.

- For cases acquired in north Queensland or other receptive areas in Queensland that are notified elsewhere, the PHU should notify the Communicable Disease Unit in Brisbane (phone: 07 3328 9724 fax: 07 3328 9782) as soon as possible.
- For cases imported from overseas and diagnosed in non-receptive areas, routine data entry is sufficient.

7. Case definition

Both confirmed and probable cases are notifiable. The full surveillance case definition is set out below. Current surveillance case definitions can also be found on the [Department of Health web site](http://www.health.gov.au/casedefinitions) (www.health.gov.au/casedefinitions).

Reporting

Both **confirmed** cases and **probable** cases should be notified.

Confirmed case

A confirmed case requires:

Laboratory definitive evidence and **clinical evidence**

Laboratory definitive evidence¹

- Isolation of dengue virus
- OR
- Detection of dengue virus by nucleic acid testing
- OR
- Detection of non-structural protein 1 (NS1) antigen in blood by EIA
- OR
- IgG seroconversion or a significant increase in antibody level or a fourfold or greater rise in titre to dengue virus, proven by neutralisation or another specific test
- OR
- Detection of dengue virus-specific IgM in cerebrospinal fluid, in the absence of IgM to Murray Valley encephalitis, West Nile virus /Kunjin, or Japanese encephalitis viruses

Clinical evidence

- A clinically compatible illness (e.g. fever, headache, arthralgia, myalgia, rash, nausea/vomiting)

Probable case

A probable case requires:

Laboratory suggestive evidence and **clinical evidence** and **epidemiological evidence**

OR

Clinical evidence and **household epidemiological evidence**

Laboratory suggestive evidence

- Detection of NS1 antigen in blood by a rapid antigen test²
- OR
- Detection of dengue virus-specific IgM in blood

Clinical evidence - as for confirmed case

Epidemiological evidence

- Exposure, between 3 and 14 days prior to onset, in
Either
- a country with known dengue activity
- OR

- a dengue-receptive area³ in Australia **where** a locally-acquired or imported case has been documented with onset within a month
Household epidemiological evidence
- Living in the same house⁴ as a locally-acquired case in a dengue-receptive area³ of Australia within a month of the onset in the case.

AND

- At least one case in the chain of epidemiologically linked cases (which may involve many cases) is laboratory confirmed.

8. Laboratory testing

Testing for dengue is recommended in persons who have a clinically compatible illness and have travelled to an area with known dengue activity during the exposure period (3-14 days prior to onset of symptoms). The suitability of laboratory tests for dengue depends on the timing of a blood sample collected during the illness (see Figure 3). The timing of laboratory tests for dengue is outlined in Table 1.

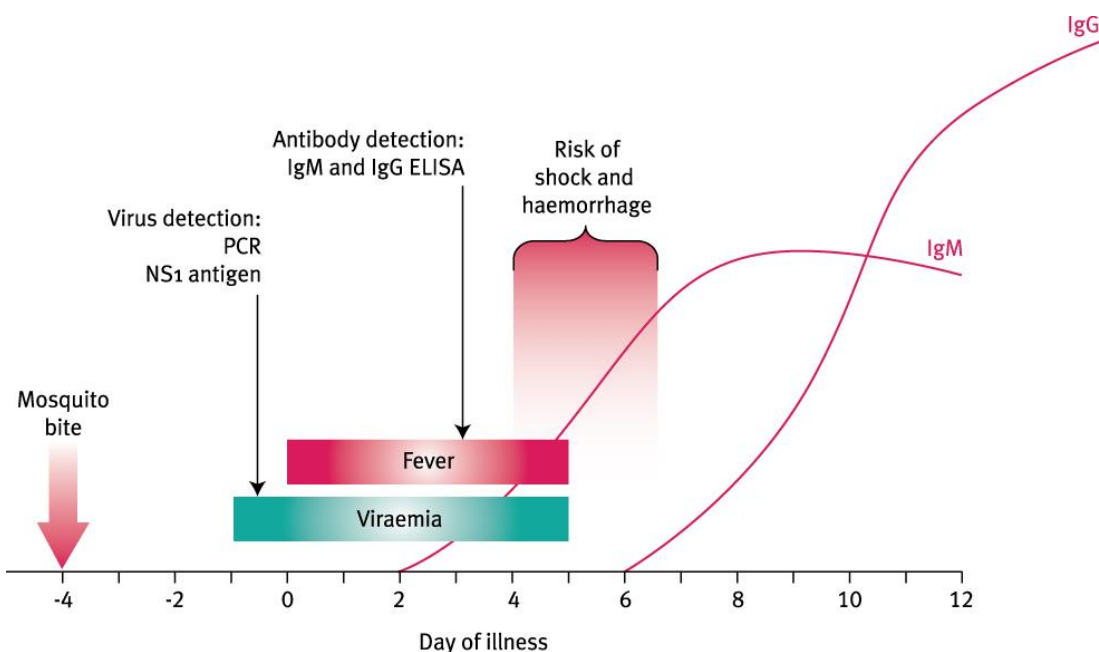


Figure 3: Typical primary dengue infection with timing of diagnostic tests [Source: Tropical Regional Services, Queensland Health]

Table 1. Laboratory tests for dengue

Symptom timeline	Recommended Laboratory test	Comments
Up to day 9 from onset of symptoms	PCR and/or NS1 (non-structural protein 1) AND serology	PCR and NS1 are likely to be negative after 7 days, but detections are possible for longer. Serology is likely to be negative in the first 5 days, but it is often helpful to have the earlier blood to show seroconversion
From day 10 onwards	Serology	Serology may have to be repeated

* Adapted from Appendix 1: Specific dengue tests, Queensland Dengue Management Plan, 2010-2015⁸

The pattern of virus, antigen and antibody production in secondary dengue infections (subsequent infection with a different serotype) is different to primary infections. In secondary infections the predominant immunoglobulin is IgG, and IgM levels are lower than in primary infections. Both antigen detection and PCR are less sensitive in secondary dengue. For people who have previously been infected with dengue there is a particular need to avoid subsequent infections. Public Health laboratories should note that diagnoses of secondary episodes of dengue can be problematic and laboratories should seek expert advice.

Confirmation of the laboratory result by a second arbovirus reference laboratory is required if the case was likely to have been acquired in Australia outside known dengue receptive areas. A list of arbovirus reference laboratories appears in Appendix 1. Virus culture is used for genotyping but is not sensitive enough for routine diagnostic testing.

Antigen detection

Detection of non-structural protein 1 (NS1) can provide a sensitive and specific alternative to PCR and is also useful for dengue diagnosis during the first week of illness (as early as 1 day post-infection) particularly before the development of dengue-specific IgM or IgG. However, as an antigen test it cannot detect past (historical) infections (> 18 d). Due to its specificity, the non-structural antigen (NS1) test can be used to differentiate dengue from other suspected flavivirus infections. NS1 detection is by enzyme immunoassay either in plate assay or on lateral flow immunoassays (rapid antigen tests). The NS1 antigen is usually less labile and thus less susceptible to suboptimal storage and transport conditions. It does not differentiate between dengue serotypes.

Nucleic acid testing

PCR diagnosis for dengue is now common and is performed by many reference laboratories. PCR can provide a rapid result (within a day of receipt) and allows the infecting serotype to be identified. Its sensitivity is high (80-100%) in detecting virus during the acute phase of the disease although the viral RNA may be affected by transport and storage conditions. Therefore specimens of whole blood, serum, plasma and tissues for PCR need to be refrigerated at 4 to 8°C. A 'detected' dengue PCR test is confirmation of a recent dengue virus infection. A 'not detected' result however, must be interpreted with caution and in conjunction with antigen detection, IgM and IgG results.

Serology

Enzyme linked immunosorbent assay (ELISA) kits for DENV antibodies can provide a rapid result but are not specific for dengue; a positive result could indicate a cross-reaction or a recent flavivirus infection other than dengue. IgG ELISA is used for detection of recent or past dengue infections in acute and convalescent paired sera but is not specific for dengue and should be interpreted carefully within the context of the clinical illness and exposure history.

In Australia, much of the testing of human sera for evidence of DENV infection in state pathology and private diagnostic laboratories involves the use of commercially-available antibody kits. Detection of IgM by enzyme immunoassay (EIA) is usually positive if samples are taken 5 days or more after onset of fever, and it persists for several months. Dengue IgG appears shortly afterwards and persists indefinitely. Whilst these kits measure antibodies to DENV, flavivirus IgG is highly cross-reactive, so the tests will also be positive for other flavivirus infections. IgM is more specific, but still shows substantial cross-reactivity with IgM due to other flavivirus infections. A significant rise in IgG or seroconversion indicates recent infection, but is not specific for dengue unless confirmed by a specific IgG test such as neutralizing antibody titres. Neutralizing titres can also be used to identify the infecting serotype and to distinguish between primary and secondary dengue. In the latter situation the acute serum will contain antibody to the previously infecting serotype, while the convalescent serum will demonstrate a rise in antibody to the currently infecting serotype. Advice on diagnosis of suspected secondary dengue should be sought from diagnostics experts.

Test results should be interpreted carefully within the context of the clinical illness and exposure history. These kits are useful for diagnosing DENV infection in regions where the virus is endemic or during proven epidemics, when the likelihood of illness being due to dengue is relatively high. In Australia, where DENV is not endemic and prevalence of past infection is much lower, the use of such kits with low specificity increase the risk of false positive results that may be misleading for health authorities. Wherever possible these results should be confirmed by NS1 antigen or PCR positivity.

In-house EIAs have been developed in some Australian laboratories and the interpretation depends on the design and performance characteristics of those assays. Currently there are no EIA assays that can reliably distinguish between dengue antibody and that due to other flaviviruses.

9. Case management

Response times

Investigation should begin on the same day of notification of a confirmed or probable case, in order to determine whether a response is required from the local Public Health Unit to prevent further local transmission. If any case is suspected to be acquired in Australia but diagnosed outside the jurisdiction where it was acquired, the communicable diseases control branch in the state or territory of acquisition should be notified on the same day to ensure case/contact management and mosquito control measures can begin promptly.

Response procedure

Case investigation

Investigate using the dengue investigation form (see example form, Appendix 2).

PHU staff should ensure that action has been taken to:

- confirm the onset date, travel history and symptoms of dengue illness
- confirm results of laboratory tests
- where possible seek the doctor's consent to contact the case or relevant care-giver
- interview the case or carer and determine source of dengue infection. See Exposure investigation. *For locally acquired cases, consult with the relevant jurisdiction to determine who is best placed to interview the case in detail about likely place of acquisition.*

Exposure investigation

If possible determine whether the case, during the exposure period (3-14 days prior to onset of symptoms) travelled to regions where DENV is endemic.

If a case has not travelled outside the local area during the exposure period (3-14 days prior to onset of symptoms) consider local transmission of dengue. One case of locally acquired dengue in a receptive area constitutes an outbreak (See Section 12 Special situations).

If a case who is considered viraemic stays in, or travels to, a receptive area:

- identify where the case lived/worked/visited while viraemic
- advise the case and household/work contacts to prevent bites and kill mosquitoes for at least as long as the case is febrile and unwell
- share appropriate case information between local communicable disease, medical entomology and senior environmental health staff
- consider urgent house to house mosquito control and surveys to detect further cases, in conjunction with local government
- consider alerts to general practitioners, laboratories, emergency departments (EDs) and the public.

Case treatment

Case treatment is the responsibility of the attending doctor. No specific treatment for dengue is available.

Education

Cases and other potentially exposed people should be provided with written information on dengue to help them prevent or manage dengue infection. The Queensland Health Mosquito-borne Diseases website has specific resources that can be accessed, including links to the [Queensland Health dengue fact sheet](http://www.health.qld.gov.au/mozziediseases/) (<http://www.health.qld.gov.au/mozziediseases/>).

Isolation and restriction

Infected people in receptive areas should be advised to avoid being bitten by mosquitoes for up to twelve days from onset of illness to avoid passing dengue virus onto mosquitoes, which can facilitate further transmission to humans. Advise to use mosquito repellent, wear protective clothing, use window screens or insecticide treated bed nets and plug-in insecticide vaporisers where possible within the home. Spatial repellents designed for indoor use (typically plug-in emanation devices containing synthetic pyrethroids such as d-allethrin) should be encouraged for use in rooms where infected people are resident.

Active case finding

Active case finding should occur following identification of a case acquired or present while viraemic in receptive areas. The purpose is to quickly establish whether an outbreak is occurring and direct control efforts to new areas where cases are found. The methods used to actively find more cases include:

- active case finding among residents in the exposure area who are or have been symptomatic and advising any symptomatic residents to see their doctor for appropriate dengue testing
- alerting GPs, laboratories and EDs to the case requesting consideration of dengue in recent and future cases with dengue compatible illness and ensuring appropriate dengue tests are ordered for those cases that may arise
- providing information to institutional settings such as schools, aged care, prison, workplaces in the exposure area, to elicit more cases.

10. Environmental Risk Management

Urgent determination of the risk of further dengue transmission is important when a case is notified. If the case is not known to have been imported (i.e. there is no travel history for the patient), local transmission should be suspected.

Evaluating the risk for further dengue transmission should be done by a public health clinician in consultation with the medical entomologist and/or local environment health authority and should include assessment of locations a viraemic case has been during the incubation period (to ascertain place of acquisition) and also visited while infectious (to ascertain risk of transmission). The aim of this assessment is to identify areas where transmission is possible, actively search for any further cases and to direct mosquito elimination activities. This includes identifying common breeding sites and elimination of both larval and adult populations of *Ae. aegypti* and *Ae. albopictus*.

Such investigations should include the recommended vector surveillance and control activities specifically detailed in the [Framework for surveillance and control of dengue virus infection in Australia](#), and the Queensland Health Dengue Management Plan, available from the Queensland Health website. In brief, these include surveillance of both larval and adult *Ae. aegypti* within a 100m radius of a case house, and control of mosquito larvae and adults within a 200 m radius of the home of each case. Special attention should be paid to nearby residences (including tourist accommodation) considered to be high risk for mosquito breeding.

11. Contact management

Contacts of an infected person cannot be infected by person-to-person transmission, but may be infected through a mosquito transferring virus from one person to another. Therefore, this section provides details on the public health response for co-exposed persons.

Contact management is ONLY required where the disease is acquired or thought to be acquired in an Australian receptive area OR where the disease is acquired overseas and the case spent time in an Australian receptive area while viraemic.

Identification of contacts

Although there is no direct person to person transmission (apart from through blood transfusion), there is a need to follow up persons who have had the same exposure as the case in receptive areas.

Contact definition

Persons who are epidemiologically linked and may have the same exposure as the case, including household members and persons who work or travelled with the case. This might lead to identification of the index or imported case.

Prophylaxis

Not applicable.

Education

Written information should be made available to people who have been potentially exposed to dengue to advise them of appropriate measures to prevent and/or manage dengue infection.

Isolation and restriction

Not applicable unless symptomatic, then the same precautions apply as case management i.e. avoid being bitten by mosquitoes during the first 5 days of illness.

12. Special situations

Outbreaks

As dengue is not endemic to Australia, local dengue outbreaks in receptive areas usually begin with a single imported case. A confirmed case of locally acquired dengue anywhere in Australia, or a confirmed or probable case in dengue receptive areas (i.e. case has no history of travel beyond the local area within the exposure period for dengue: 3-14 days prior to onset of symptoms) requires an outbreak response. An interval of approximately two weeks is expected between generations of human cases due to the incubation periods in infected mosquitoes and subsequently infected humans, however, the shortest possible interval is 8 days (see 2. The Disease, Incubation period). In an outbreak, an incident management team including a medical entomologist and local government representatives should be formed and the outbreak managed according to current dengue management plans.⁷ Once the outbreak is established, the focus is on a community level approach to eliminating mosquitoes.

Some additional issues the PHU should address during an outbreak are:

- informing the wider public health network, local government and the Department of Agriculture of the outbreak to increase surveillance and prepare for outbreak response
- communicating regularly with GPs, hospital emergency departments and local pathology laboratories to ask them to be alert for dengue cases
- maintaining epidemiological information of cases e.g. timeline and mapping of cases

- regular communication with medical entomologists and any charged with vector control responsibilities so that vector control measures can be appropriately directed
- case finding in new dengue areas may become the priority as the outbreak develops
- using media alerts and updates to communicate key messages during the outbreak
- liaising with the Australian Red Cross Blood Service as blood donation services in outbreak locations may be restricted.

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11. Knope K, National Arbovirus and Malaria Advisory Committee, Giele, C.,. Increasing notifications of dengue related to overseas travel, 1991 to 2012. *Commun Dis Intell* 2013;Vol 37 (1).

14. Appendices

Appendix 1. List of arbovirus reference laboratories

Appendix 2. Disease investigation form

Appendix 3. Dengue factsheet

Appendix 4. PHU checklist

15. Jurisdiction specific issues

Links to [state and territory public health legislation, the *Quarantine Act 1908* and the *National Health Security Act 2007*](http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-state-legislation-links.htm) (<http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-state-legislation-links.htm>).

Appendix 1 Public health reference laboratories for diagnosing human infections, and entomology reference laboratories for confirmation of vector identification

Commonwealth Scientific and industrial Research Organisation (CSIRO)

CSIRO Australian Animal Health Laboratory
Private Bag 24 (5 Portarlington Road)
Geelong Victoria 3220
Phone: (03) 5227 5000

[Web site](http://www.csiro.au/Organisation-Structure/National-Facilities/AAHL.aspx) (<http://www.csiro.au/Organisation-Structure/National-Facilities/AAHL.aspx>)

New South Wales

Serology Section, CIDMLS
Institute of Clinical Pathology and Medical Research (ICPMR)
Westmead Hospital
Locked Bag 9001
Westmead NSW 2145
Phone: (02) 9845 6255

Department of Medical Entomology, CIDMLS
Institute of Clinical Pathology and Medical Research (ICPMR)
Westmead Hospital
Locked Bag 9001
Westmead, New South Wales 2145
Phone:(02) 9845 7265

[Web site](http://medent.usyd.edu.au/) (<http://medent.usyd.edu.au/>)

Northern Territory

Department of Primary Industries and Fisheries (DPIF)
Makagon Rd, Berrimah, Darwin
Northern Territory 0828
Phone: (08) 8999 5511

[Web site](http://www.nt.gov.au/d/Primary_Industry/) (http://www.nt.gov.au/d/Primary_Industry/)

Medical Entomology
Department of Health
Royal Darwin Hospital
PO Box 41326
Casuarina NT 0811

Queensland

Qld Health Forensic and Scientific Services
39 Kessells Road
Coopers Plains
PO Box 594 Archerfield Qld 4108
Phone: (07) 3274 9151

[Web site](http://www.health.qld.gov.au/qhcss/qhss/) (<http://www.health.qld.gov.au/qhcss/qhss/>)

South Australia

Mosquitoes and Public Health Research Group (entomology)
School of Pharmacy and Medical Sciences
University of South Australia
North Terrace Adelaide
South Australia 5001
Phone: (08) 8302 1906

[Web site](http://www.unisa.edu.au/research/sansom-institute-for-health-research/research-at-the-sansom/research-concentrations/mosquitoes-and-public-health-research-group/) (<http://www.unisa.edu.au/research/sansom-institute-for-health-research/research-at-the-sansom/research-concentrations/mosquitoes-and-public-health-research-group/>)

Victoria

Victorian Infectious Diseases Reference Laboratory (Human)
10 Wreckyn Street
North Melbourne Victoria 3051
Phone: (03) 9342 2600
[Web site](http://www.vidrl.org.au/) (<http://www.vidrl.org.au/>)

Department of Economic Development, Jobs, Transport and Resources
AgrioBio, Latrobe University
5 Ring Road
Bundoora Victoria 3086
Phone: (03) 9208 3333

[Web site](http://www.economicdevelopment.vic.gov.au) (www.economicdevelopment.vic.gov.au)

Western Australia

PathWest Laboratory Medicine WA
Division of Microbiology and Infectious Diseases (Human)
Hospital Avenue
Nedlands Western Australia 6009
Phone: (08) 9346 3122

[Web site](http://www.pathwest.com.au/index.asp) (<http://www.pathwest.com.au/index.asp>)

Arbovirus Surveillance and Research Laboratory
Discipline of Microbiology and Immunology (animal/vector)
School of Pathology and Laboratory Medicine
The University of Western Australia
35 Stirling Highway
Crawley Western Australia 6009
Phone: (08) 9346 2212

[Web site](http://www.marshallcentre.uwa.edu.au/research/arbovirus) (<http://www.marshallcentre.uwa.edu.au/research/arbovirus>)

Appendix 2 Disease investigation form

DENGUE CASE REPORT

ID NUMBER: _____ ACQUIRED WHERE: _____
 CASE STATUS: PROBABLE / CONFIRMED / REJECTED
 Date & time notified: _____ Notified By: _____
 Organisation/Hospital: _____ Phone: _____
 Date response: _____ Time response: _____
 Date Vector control team notified (if applicable): _____

PAT **Figure 1**

First Name: _____ Surname: _____ Ph (H): _____
 Address: _____ Ph (W): _____
 _____ Ph (Mob): _____

DOB: _____ Age: ___ yrs ___ months Sex: M / F Aboriginal TSI Aboriginal and TSI
 Occupation: _____ Non-indigenous Unknown

LABORATORY CRITERIA Date: _____ Lab: _____
 Lab Number/s: _____ Day _____ blood (day of onset)

Test	Yes	No	Equiv	Pending
NSI +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ELISA IgM +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ELISA IgG +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flavi IgM +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flavi IgG +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PCR +ve	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suspected clinically, no bloods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Case Confirmed?
 Yes / No
 Serotype _____
 WCC:
 Platelets:
 LFTs:
 Added Tests:

CLINICAL DETAILS

Date of onset: _____ Date of first consultation: _____

Fever	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Itchiness	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Headache	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Abnormal taste	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Rash	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Nausea/Vomiting	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Aches / Pains	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Diarrhoea	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Retro-orbital pain	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Abnormal bruising/bleeding	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Lethargy	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Other _____		
Hospitalised:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Hospital: _____	UR: _____	
Past history of dengue:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown		

EXPOSURE PERIOD (Onset -12 days) to (Onset -3 days) ___/___/___ to ___/___/___

During this time did the person: Travel overseas Yes No Date of arrival in Queensland:/...../.....
Place Queensland Other Australian state/territory specify _____
Acquired: Unknown Other country specify _____
Places travelled and dates: _____

For cases acquired overseas or have not travelled to an Australian receptive area - proceed to Notes/Comments
For cases acquired in Australia or travelled to receptive area in Australia while viraemic - complete remainder of form:

Home Address: _____ screens/air con/mossies

Work Address: _____ screens/air con/mossies

Other significant daytime address:

1. _____ screens/air con/mossies

2. _____ screens/air con/mossies

3. _____ screens/air con/mossies

VIRAEMIC PERIOD (Onset -1day) to (Onset +12 days) ___/___/___ to ___/___/___

Home Address: _____ screens/air con/mossies

Other main daytime address:

1. _____ screens/air con/mossies

2. _____ screens/air con/mossies

3. _____ screens/air con/mossies

4. _____ screens/air con/mossies

WORK DURING THIS PERIOD: Yes No Dates _____

If Yes, name of work place: _____

Address: _____

CONTACTS:	Name	Age	Recent possible dengue illness	
_____	_____	_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes	<input type="checkbox"/> No

NOTES/COMMENTS:

Mosquito precautions discussed: Yes No Fact sheet sent: Yes No Date: _____

Other: _____

Appendix 3 Dengue factsheet and other resources

Dengue

What is Dengue?

- Dengue is a viral disease transmitted by the *Aedes aegypti* mosquito. Dengue affects most tropical areas of the world, including outbreaks in north Queensland, where this type of mosquito exists.
- Travellers returning from overseas may bring dengue into Australia.
- An outbreak happens if dengue starts being transmitted between people by local *Aedes aegypti* mosquitoes. It does not spread from person to person.
- There are four types of dengue viruses known to cause disease in humans- dengue 1, 2, 3 and 4. A person infected with one type of dengue will only become immune to that type. They will not be immune to other types of dengue, and could be at higher risk of severe disease if they contract another type.

What are the symptoms?

Dengue causes illness ranging from a mild fever to a severe, even fatal condition, i.e. dengue haemorrhagic fever or dengue shock syndrome. In some people, such as children, it may be subclinical (no apparent symptoms). Most adults and older children get sick.

The disease lasts about a week. Some people may experience a resurgence of fever and other symptoms that may continue another 2-3 days. Typical symptoms include:

- sudden onset of fever
- intense headache (especially behind the eyes)
- muscle and joint pain (ankles, knees and elbows)
- loss of appetite, vomiting, diarrhoea, abdominal pain, a metallic taste in the mouth
- flushed skin on face and neck, fine red skin rash as fever subsides
- rash on arms and legs, severe itching, peeling of skin and hair loss
- minor bleeding (nose or gums) and heavy menstrual periods
- extreme fatigue

Dengue haemorrhagic fever (DHF) or shock syndrome:

DHF and dengue shock syndrome are rare complications of dengue and can affect both adults and children:

- same symptoms as dengue fever
- 2-5 days after onset of fever, rapid deterioration and cardio-vascular disturbance
- can lead to collapse and sometimes death

See a doctor immediately if you or anyone in your family has any symptoms of dengue.

How is it spread?

- In Australia, dengue virus is spread by a species of mosquito, *Aedes aegypti*, which lives around houses. It may also be spread by *Aedes albopictus* which is found on some islands of the Torres Strait.
- Female *Aedes aegypti* and *Aedes albopictus* mosquitoes may become infected with dengue after biting sick humans who have dengue virus in their blood
- The time from being bitten by an infected mosquito to becoming unwell (the incubation period) ranges from 3-14 days
- The day before developing symptoms and up until 12 days after is the period when a dengue mosquito can bite you and pick up the dengue virus
- Approximately 10 days later (this can range from 5 to 12 days), the mosquito can then bite someone else and infect them with the dengue virus
- Vertical transmission from mother to child in utero has been described but is thought to be uncommon and would not be expected in Australia given the current level of dengue activity.
- Vertical transmission from infected mosquitoes to their offspring (eggs) has been reported to occur but only at low frequencies. The importance of this to dengue persistence is unknown.

Who is at risk?

Persons travelling to or living in countries with known dengue activity are at risk of being bitten by dengue infected mosquitoes. The only way to reduce the risk is to avoid being bitten by mosquitoes.

How is dengue prevented (where *Aedes aegypti* or *Aedes albopictus* exists)?

- By removing breeding sites in risk areas: Dengue mosquitoes are different from bush or swamp mosquitoes - they only breed in containers and junk in your yard. The best form of control is to remove all dengue mosquito breeding sites around the home.
- Get rid of any containers that hold water. These include buckets, tarpaulins, tyres, pot plant bases, vases, boats and coconut shells. Roof guttering, rainwater tanks and palm fronds are also potential breeding sites.
 - o check in and around your home and throw out old containers that are not needed
 - o store containers in a dry place
 - o tip out containers that are holding water
 - o clean out roof gutters
- Dengue mosquitoes hide in and around the house and bite during the day. Kill dengue mosquitoes with surface insecticide - spray monthly in dark hiding places, behind and under furniture, in and under the house
- Use personal insect repellent containing DEET or picaridin and reapply according to the label
- Use mosquito coils and plug-in mozzie zappers inside
- Wear protective, light coloured clothing
- Screen living and sleeping areas

- If one person in the community has dengue fever, infected mosquitoes in or near your home could make other people sick. If someone in your home has dengue fever, it is even more important that you do the things listed above i.e. remove all breeding sites, use surface insecticide sprays and plug-in mozzie zappers, and get everyone to apply personal insect repellent regularly.

How is it diagnosed?

Dengue is diagnosed by blood tests that identify the virus or antibodies to the virus. Everyone who has an illness similar to dengue, and has travelled to an area with known dengue activity in Australia or overseas should be tested.

How is it treated?

- see a doctor immediately if you suspect you have dengue fever
- rest at home and wear insect repellent so you don't spread the disease
- make sure you get enough to drink, even if you cannot eat
- have someone stay home to look after you
- use paracetamol (alone or with codeine) for headaches and pains, and don't take more than the recommended dose
- do not take aspirin, ibuprofen or other anti-inflammatory drugs because they increase the chance of bleeding

If your symptoms get worse:

- Ring or visit your local doctor if you have unexpected bleeding or bruising, severe abdominal pain or vomiting, confusion with restlessness or drowsiness, collapse or signs of shock (pale, cold, clammy and blotchy skin), weak pulse, or are unable to drink
- Some people with dengue need hospital treatment for complications
- All patients with dengue haemorrhagic fever need to be hospitalised for fluid replacement and monitoring. Dengue shock syndrome is a medical emergency requiring urgent fluid replacement and close observation.

What is the public health response?

Hospitals and laboratories will notify cases of dengue to the local public health unit. Public health unit staff will contact your doctor to ask permission to interview you, and will investigate the likely source and determine whether others may be at risk of infection. Doctors should contact their public health unit for advice on the management of people presenting with dengue symptoms.

Further information

For further information on dengue illness, please contact your local doctor, community health centre or nearest public health unit:

For further information regarding mosquito control/complaints contact your nearest council.

Other Qld Health resources:

Suspected dengue fever: care at home brochure available from the [Queensland Health website](http://www.health.qld.gov.au/dengue/) (<http://www.health.qld.gov.au/dengue/>)

Appendix 4 PHU Checklist

PHU Dengue Checklist

Patient ID number: _____

Contact the patient's doctor to:

- Obtain patient's history
- Confirm results of relevant pathology tests or recommend that the tests be done
- Inform the doctor you will have to contact patient or care giver

Contact the patient (or care giver) to:

- Confirm onset date and symptoms of the illness
- Confirm travel history
- If no overseas travel, identify location/s of patient during exposure period (3-14 days prior to onset of symptoms)
- Complete *Dengue Investigation Form*
- Provide with *Dengue Factsheet*

If patient is in receptive area:

- Recommend the patient (and their household contacts) avoid being bitten by mosquitoes while febrile (first 5 days of symptoms)
- Identify known contacts and obtain contact details
- Contact patients contacts to determine current symptoms and recommend testing if necessary
- Provide contacts with *Dengue Factsheet*

Contact laboratory to:

- Obtain any outstanding results

Where local transmission is suspected:

Contact local Environmental Health Authority (vector control team) to:

- Inform them of case details and exposure information
- Work collaboratively to direct vector control activities

Other issues:

- Assess information against case definition to confirm case
- Enter case data onto notifiable diseases database
- Report details of case and action plan to state/territory CDB
- Initiate active case finding

- ❑ Consider alerting local doctors, EDs, laboratories
- ❑ Consider local media release