Guidelines
for the early clinical and public health management of meningococcal disease in Australia

Endorsed October 2007
These guidelines are provided to assist primary care practitioners with the emergency management of cases of suspected meningococcal disease and public health practitioners with the prevention of further cases after a case of invasive meningococcal disease has been reported.

These guidelines capture the knowledge of experienced professionals, build on past research efforts, and provide advice on best practice based upon the best available evidence at the time of completion.

The guidelines are necessarily general and readers should not rely solely on the information contained within these guidelines. The information contained within these guidelines is not intended to be a substitute for advice from other relevant sources including, but not limited to, the advice from a health professional. These guidelines are intended for information purposes only.

The information contained within these guidelines is based upon best available evidence at the time of completion. The membership of the Communicable Disease Network Australia (‘CDNA’) and the Commonwealth of Australia (‘the Commonwealth’), as represented by the Department of Health and Ageing, does not warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, or process disclosed at the time of viewing by interested parties.

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Chapter 1: Introduction

1.1 Public health aims of the Guidelines on the early clinical and public health management of meningococcal disease in Australia (the Guidelines)

Invasive infection with *Neisseria meningitidis* (the meningococcus) occurs in endemic and epidemic forms. In Australia epidemic disease has not occurred for many years; endemic disease is at low levels of incidence and cases are generally unrelated to each other. Despite this, invasive meningococcal disease is of public health importance, is frequently a cause of public alarm and receives a high level of media attention. Responding to cases places heavy demands on clinical and public health disease control services. The primary aim of the *Guidelines* is to assist practitioners in meeting these demands.

The *Guidelines* were developed by consensus by the Meningococcal Disease Committee (MDC), a sub committee of the Communicable Diseases Network Australia (CDNA). CDNA has reviewed and endorsed the document.

In developing the *Guidelines*, the Meningococcal Disease Committee considered the literature, practices and published recommendations in Australia and overseas. On many issues there is limited published evidence to guide best practice. Public health interventions for invasive meningococcal disease are frequently required urgently, yet the evidence base for many of the interventions that are commonly applied is lacking. Often decisions must be guided by extrapolation from situations where evidence exists.

The *Guidelines* are intended primarily:

- to assist primary care practitioners with the emergency management of cases of suspected invasive meningococcal disease; and
- to assist public health practitioners with the prevention of further cases after a case of invasive meningococcal disease has been reported.

The *Guidelines* are not, and cannot be, exhaustive and do not cover every possible eventuality but aim to provide guidance on situations frequently encountered in practice.

Topics covered in the *Guidelines* include:

- emergency management of suspected invasive meningococcal disease in general practice;
- early (emergency department) hospital management of suspected invasive meningococcal disease;
- laboratory tests and their use;
- public health management of sporadic cases of invasive meningococcal disease;
- public health management of outbreaks of cases of invasive meningococcal disease; and
- reporting and public health surveillance of meningococcal disease.
1.2 What's new

This document is an updated version of the *Guidelines for the Control Meningococcal Disease in Australia*, published by the Communicable Diseases Network Australia in 2001, and differs in several respects including:

- incorporation of previously circulated updated advice on the role of saliva in transmission;
- an updated case definition incorporating new laboratory methods;
- recommendations for the use of vaccines for sporadic cases and outbreaks of vaccine preventable strains of meningococcal disease; and
- updated information on data and evidence supporting the recommendations.

1.3 Linkages with other documents and the World Wide Web


Other guidelines on the management of invasive meningococcal disease may be found at:

- USA
  [http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5407a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5407a1.htm)

- United Kingdom

- Canada
Chapter 2: Management prior to referral to hospital

Key points

- Meningococcal septicaemia has considerably greater mortality than meningococcal meningitis and is often characterised by a rapidly evolving petechial or purpuric rash that does not blanch under pressure. In the early stages of the disease, the rash may not be present or may be atypical. If present it may consist only of a few haemorrhagic spots located in a place such as the groin or feet (see Section 2.2).

- Meningococcal disease may have clinical features not normally expected in children with acute systemic illnesses (see Section 2.2).

- Practitioners should ensure that a patient with a systemic febrile illness, particularly a child, can be promptly reassessed should the need arise (see Section 2.2).

- All general practitioners should have benzylpenicillin in their surgeries and emergency bags, and should be ready to administer it immediately to patients with a systemic febrile illness and a petechial or purpuric rash (see Section 2.3). The doses are: children aged < 1 year — 300 mg; children aged 1–9 years — 600 mg; adults or children aged 10 years or over — 1200 mg.

- The early administration of benzylpenicillin on suspicion of meningococcal disease, followed by urgent transfer to hospital, can be life saving. Ceftriaxone is a suitable alternative if available.

- If clinical suspicion exists to warrant a referral for admission to hospital the patient should receive benzylpenicillin prior to transfer.

- A history of a rash following penicillin is not a contraindication for benzylpenicillin.

- The local public health unit should be notified immediately to enable an appropriate public health response.

2.1 Introduction

Meningococcal disease usually presents as meningitis or septicaemia, or a combination of the two. Septicaemia, with or without meningitis, can be particularly severe and has considerably greater mortality than meningococcal meningitis. Meningococcal septicaemia (also known as meningococcaemia) can have a fulminant and rapidly fatal course which causes meningococcal disease to be so feared.

2.2 Clinical presentation of invasive meningococcal disease

The most characteristic feature of meningococcal septicaemia is a haemorrhagic (i.e. petechial or purpuric) rash that does not blanch under pressure. However, a rash is not always present, especially in the early stages. In the early stage of development the rash may blanch with pressure thus resembling a viral exanthem. The rash can appear rapidly on any part of the body including the palms and soles. The petechial rash has discrete 1 to 2 mm in
diameter lesions that may proceed to form larger ecchymotic lesions. A petechial or purpuric rash was reported in 16 (70%) of the 23 deaths from meningococcal disease that occurred in New Zealand in 1998. As they commonly appear in clusters in areas where pressure occurs from elastic in underwear and stockings, general practitioners and other primary care practitioners should ensure that an acutely unwell patient with a systemic febrile illness is completely undressed so that a thorough search for a haemorrhagic rash can be undertaken (see also Section 3.2.2).

Less commonly, the rash has a maculopapular appearance, the discrete pink macules or papules blanching under pressure. They may progress to become haemorrhagic and non-blanching later or fade away (see also Section 3.2.2).

Meningococcal disease in children may have clinical features not normally expected in an acute systemic illness. For example, these children may show an unwillingness to interact or make eye contact, an altered mental state, or pallor despite a high temperature.

A recent study in children under 16 years of age has shown that leg pain, cold extremities, and abnormal skin colour are frequently seen in the first 12 h of meningococcal disease (median onset 7-12 hours), whereas the classic features (haemorrhagic rash, meningism, and impaired consciousness) are relatively late signs (median onset 13-22 hours).

These early features should therefore be looked for to aid the early recognition of invasive meningococcal disease in children under 16 years of age. These symptoms and signs however can be non-specific and some may be present with other bacterial and viral infections including self-limiting viral illnesses seen in primary care. No studies have been done to see how often these same signs are present with other infections. Thus we do not currently know the positive and negative predictive values of leg pain, cold extremities, and abnormal skin colour for the diagnosis of invasive meningococcal disease. Nevertheless, until this additional information is available, these signs and symptoms should be taken into account when assessing any patient with suspected meningococcal disease. Doctors should be encouraged to schedule clinical review within 4–6 hours if early meningococcal disease cannot be ruled out at the first assessment.

If a general practitioner decides that a patient with a non-specific febrile illness does not require referral to a hospital, the general practitioner should advise the carer to keep the patient under frequent and regular review. The carer should be told to call the general practitioner again urgently or go immediately to a hospital emergency department if the patient subsequently develops a rash or deteriorates in any way. Rarely, meningococcal disease may present as conjunctivitis. Primary meningococcal conjunctivitis may be associated with invasive disease and should be treated systemically.

2.3 Early antibiotic treatment (see also Section 3.3)

It is imperative that antibiotic therapy be commenced early if deaths from meningococcal septicaemia are to be avoided. Immediate administration of benzylpenicillin to suspected cases of meningococcal septicaemia by general practitioners was associated with reduced mortality in three retrospective studies in England. When the studies were aggregated (487 patients), it was calculated that those not given parenteral penicillin before hospital admission were 2 times more likely to die than those given penicillin. The greatest benefit of parenteral penicillin was seen in those who were most ill, i.e. those with a haemorrhagic rash.

For optimal benefit, benzylpenicillin should be given intravenously. However if general practitioners are unable to access the intravenous route, it is appropriate to administer benzylpenicillin by the intramuscular route.
Doses of benzylpenicillin: for suspected cases of meningococcal disease:

Children aged < 1 year: 300 mg
Children aged 1-9 years: 600 mg
Adults or children aged 10 years or over: 1200 mg

or

Ceftriaxone 50 mg/kg (up to 2g) IM or IV (all ages)

All general practitioners should have benzylpenicillin in their surgeries and emergency bags, and should be ready to administer it immediately to a patient with an acute systemic febrile illness and a petechial or purpuric rash. It is a concern if a person shows signs of sepsis or decreased level of consciousness.

Benzylpenicillin should be withheld only if an individual has a clear history of either an anaphylactic or an immediate hypersensitivity reaction (such as difficulty in breathing, angioedema, generalised urticarial rash) due to immunoglobulin E (IgE) mediated reactions after a previous dose of penicillin. Most people with a penicillin allergy do not have such a history and they can safely be given benzylpenicillin 12. If there is a history of either an anaphylactic or an immediate hypersensitivity reaction, urgent advice should be sought from the relevant on-call clinician at the referral hospital concerning possible alternatives.

Some general practitioners may have access to ceftriaxone. Ceftriaxone (see Table 1, page 11) is an acceptable alternative to benzylpenicillin for the empirical treatment of suspected meningococcal disease prior to transfer to hospital.

General practitioners need not be concerned that empirical benzylpenicillin will obscure the diagnosis for hospital clinicians. Certainly benzylpenicillin administered before blood and CSF specimens are taken reduces the proportion of positive blood or CSF cultures, but does not reduce the likelihood of detecting meningococcal DNA using PCR tests.

2.4 Transfer to hospital

General practitioners should arrange urgent transfer of the patient to the appropriate hospital and the ambulance service needs to be informed of the urgent and critical nature of the transfer. If the patient exhibits any signs of shock or impaired consciousness an ambulance officer experienced in managing the transfer of critically ill patients should be asked to accompany the patient.

It is strongly recommended that any patient with an acute systemic febrile illness be referred urgently to hospital if any of the following are present:

- a haemorrhagic rash;
- an impaired level of consciousness;
- signs of meningeal irritation;
- clinical features not normally expected in children with acute systemic febrile illnesses; or
• the patient is a close contact of someone who was recently diagnosed as having meningococcal disease even if the current patient received clearance antibiotics.

General practitioners should inform the relevant clinician at the referral hospital of the patient's impending arrival. This is crucial if delays in the emergency department are to be minimised. The hospital clinician should be informed, through the notes accompanying the patient to hospital, that benzylpenicillin, or another antibiotic, has already been given. In addition, the hospital clinician should enquire whether benzylpenicillin, or another antibiotic, has been given.

Practitioners in rural hospital or remote community settings should attempt to take blood cultures whenever possible prior to the administration of the first dose of antibiotic. The blood cultures, and any other clinical samples, should be sent with the patient at the time of transfer to the referral hospital. Blood cultures should not be refrigerated. Taking of cultures should not delay initiation of treatment or transfer to hospital.

References
Chapter 3: Management on arrival at hospital

Key points

- If a patient has clinical signs or symptoms suggestive of invasive meningococcal disease (meningitis or septicaemia) they should be given parenteral antibiotics immediately (see Section 3.3).

- Deferral of lumbar puncture may be appropriate (see Section 3.5.1).

- Therapy should not be delayed while awaiting results of diagnostic tests, such as a lumbar puncture or computed tomography (CT) scan.

- The local public health unit should be notified immediately so that a public health response can be determined.

- All patients with suspected meningococcal infection should have blood collected as soon as possible for PCR and culture, and blood for neutrophil and platelet counts. If petechiae are present or if frank bleeding is evident, formal coagulation studies should be undertaken.

- Penicillin treatment alone will not reliably eliminate nasopharyngeal carriage of meningococci and the patient will require treatment to clear organisms from the throat.

3.1 Introduction

Effective management of meningococcal infection requires early intervention, effective antibiotic therapy and careful attention to associated manifestations such as shock and coagulopathy.

If appropriate antibiotic and supportive therapy is implemented, case fatality rates should be less than 10 per cent when meningitis predominates. If septicaemia predominates, case fatality rates can be higher. Fatality rates of over 50% (and close to 100% in infants) occurred in the era before the introduction of effective therapy.¹²

3.2 Early Assessment

3.2.1 Prior assessment by a general practitioner

If a general practitioner sends a patient to the hospital with a suspicion of invasive meningococcal disease, the patient should be assessed urgently (refer section 3.2.2). If the general practitioner has made a presumptive diagnosis of invasive meningococcal disease then the patient should have received their first dose of benzylpenicillin prior to arrival at hospital. If they have not already received an injection of an antibiotic, then they should be given IV penicillin immediately on arrival at hospital (preferably after a blood culture is collected but this needs to be done immediately).

In some cases the general practitioner will have telephoned the on-call hospital clinician for advice but antibiotics may not have been given before transfer of the patient to the hospital (e.g. because of drug allergies). In these cases, it is essential that a doctor immediately assesses the patient on arrival and administers prompt IV antibiotics.
3.2.2 Triage in the emergency department

A triage nurse in the emergency department usually assesses patients who present directly to a hospital. If the triage nurse assesses that the patient is a potential case of invasive meningococcal disease (i.e. suspected septicaemia or meningitis) then they should be classified as high priority for assessment and review by the medical staff and seen urgently. These patients should always receive their first dose of antibiotics as soon as possible and no later than 30 minutes after arrival at the hospital when a presumptive diagnosis of invasive meningococcal disease has been made.

The most characteristic feature that permits presumptive early diagnosis of meningococcal disease is the appearance of a petechial rash. The rash, which occurs often, typically has progressively enlarging petechial spots that may coalesce into large ecchymotic lesions. The appearance of a petechial rash in association with fever, and drowsiness is highly suggestive of meningococcal disease. Alternatively, irrespective of meningeval symptoms, patients presenting with fever and a petechial rash should be evaluated for evidence of actual or incipient shock and a presumptive diagnosis of meningococcaemia should be made. Other indicators of severe disease include metabolic acidosis, low WBC count, coagulopathy, hypotension and decreased levels of consciousness.

A less distinctive maculopapular rash has also been associated with the early phase of meningococcal septicemia. This pink, maculopapular rash has been variously described as rubella-like or as similar to early varicella. Although it may last for as long as two days, it commonly fades rapidly. These lesions may be tender, or may be associated with myalgic pain that may be severe, but in most patients the rash is only recognised as meningococcal following development of more characteristic findings (see Section 2.2).

Early recognition of meningococcal infection is most of all dependent on the clinical suspicion of the physician involved and is most difficult with sporadic cases where there has not been heightened community or medical awareness of the problem.

A recent study of children under 16 years in the United Kingdom has shown that leg pain, cold extremities, and abnormal skin colour, are frequently seen in the first 12 hours of meningococcal disease, whereas the classic features (haemorrhagic rash, meningism, and impaired consciousness) are relatively late signs.

These early features may be indicative of early invasive meningococcal disease. However, these symptoms may be non-specific and some may be present with other bacterial and viral infections including self-limiting viral illnesses seen in primary care. No studies have been done to see how often these same signs are present with other infections. Thus we do not currently know the positive and negative predictive values of leg pain, cold extremities, and abnormal skin colour for the diagnosis of invasive meningococcal disease. Nevertheless, until this additional information is available, these signs and symptoms should be taken into account when assessing any patient with suspected meningococcal disease. Doctors should be encouraged to schedule clinical review within 4–6 hours if early meningococcal disease cannot be ruled out at the first contact.

<table>
<thead>
<tr>
<th>Classic signs</th>
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<tbody>
<tr>
<td>Haemorrhagic rash, meningism, impaired consciousness</td>
</tr>
<tr>
<td>Median onset 13–22 hours</td>
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</table>

<table>
<thead>
<tr>
<th>Newly identified signs and symptoms in children under 16 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg pain, cold extremities, abnormal skin colour</td>
</tr>
<tr>
<td>Median onset 7–12 hours</td>
</tr>
</tbody>
</table>
When meningococcal infection is suspected, particularly where actual or incipient shock is evident, immediate empirical therapy in the absence of a formal diagnosis is indicated (see Section 3.3.1). Treatment should commence immediately and not be withheld until *N. meningitidis* or another organism has been identified\(^6-8\), this is particularly important in patients with a haemorrhagic rash\(^6\). If bacterial meningitis is suspected therapy should be used which covers not only infection with *N. meningitidis* but also other invasive meningeal pathogens such as *Streptococcus pneumoniae* and *Haemophilus influenzae* type b (Hib).

### 3.3 Initiation of therapy in hospital

There should be no delays in the initiation of treatment before or after hospital admission. In many cases where bacterial meningitis is suspected, the causative organism or susceptibility is not yet known. In this situation empirical therapy which covers the three most common pathogens should be used. Appropriate regimes include ceftriaxone or cefotaxime and/or vancomycin.

For further information consult the *Therapeutic Guidelines: Antibiotic*\(^{10}\). Antibiotic regimes can be modified as microbiologic information becomes available.

After a diagnosis of suspected invasive meningococcal disease has been made it is essential that the patient receive a dose IV penicillin if antibiotics (parenteral penicillin or ceftriaxone) have not been administered prior to arrival. Invasive meningococcal disease is a medical emergency and therefore the first dose antibiotic should always be received by the patient as soon as possible and no later than 30 minutes after a presumptive diagnosis has been made.

The antibiotic of choice for the treatment of all types of invasive disease caused by *N. meningitidis* is benzylpenicillin. Treatment should begin with:

**Benzylpenicillin**\(^{10}\)

**Child:** 45 mg/kg (up to 1.8g) IV 4 hourly for 3 –5 days  
**Adult:** 1.8g IV 4 hourly for 3 –5 days

#### 3.3.1 Other empirical antibiotics

If bacterial meningitis is suspected, but the organism is unknown, empirical therapy that covers the three most common pathogens should be instituted. Treatment should begin as shown in Table 1.

**Table 1: Early empirical antibiotic treatment for three most common bacterial meningitis pathogens**\(^{10}\)

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Child: 50 mg/kg (up to 2 g) intravenously 6 hourly</th>
<th>Adult: 2 g intravenously 6 hourly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cefotaxime</strong></td>
<td><strong>or</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Ceftriaxone</strong></td>
<td><strong>Child:</strong> 50 mg/kg (up to 2 g) intravenously 12 hourly.</td>
<td><strong>Adult:</strong> 2 g intravenously 12 hourly.</td>
</tr>
<tr>
<td></td>
<td><strong>Plus either</strong></td>
<td></td>
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</tbody>
</table>
Benzylpenicillin

<table>
<thead>
<tr>
<th>Child: 60 mg/kg (up to 2.4g) intravenously 4 hourly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult: 2.4 g intravenously 4 hourly.</td>
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<tr>
<td>or</td>
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(Amox)ampicillin

<table>
<thead>
<tr>
<th>Child: 50 mg/kg (up to 2 g) intravenously 4 hourly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult: 2 g intravenously 4 hourly.</td>
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</table>

If Gram-positive diplococci are seen on Gram stain, vancomycin should be added to this regime. The appropriate antibiotic regime and duration of therapy should be reviewed and if necessary modified when a diagnosis is confirmed.

### Table 2: Summary of antibiotic therapy

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Empirical therapy prior to hospitalisation</th>
<th>Hospital treatment where <em>N. meningitidis</em> is the agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzylpenicillin</td>
<td>Child less than 1 year: 300 mg IV or IM single dose</td>
<td>Child: 45 mg/kg (up to 1.8 g) IV 4 hourly for 3 – 5 days</td>
</tr>
<tr>
<td></td>
<td>Child aged 1-9 years: 600 mg IV or IM single dose</td>
<td>Adult: 1.8 g IV 4 hourly for 3 – 5 days</td>
</tr>
<tr>
<td></td>
<td>Adult or child ≥ 10 years: 1.2 g IV or IM single dose</td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>50 mg/kg (up to 2 g) IV or IM (all ages)</td>
<td>Child: 100 mg/kg (up to 4 g) IV daily in 1 or 2 divided doses for 3 – 5 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adult: 2 g IV 12 hourly for 3 – 5 days</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td></td>
<td>Child: 50 mg/kg (up to 2 g) IV 6 hourly for 3 – 5 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adult: 2g IV 6 hourly for 3 to 5 days</td>
</tr>
</tbody>
</table>

These recommendations are derived from the *Therapeutic Guidelines: Antibiotic.*

### 3.3.2 Local policy for bacterial meningitis

Depending on the prevalence of penicillin resistance (and cephalosporin resistance) individual hospitals may have different protocols for the empirical therapy of bacterial meningitis while culture and sensitivity results are awaited (e.g. vancomycin to cover high level penicillin resistance in *Streptococcus pneumoniae*). However, it is essential that either penicillin or a cephalosporin is given to the patient. Both these agents will treat infections caused by the meningococcus. Other antibiotics used in empirical therapy for meningitis may not cover meningococcus (e.g. vancomycin). Once the organism has been identified and susceptibility tests are available, then either the penicillin or the cephalosporin should be ceased. A history of skin rash following the administration of penicillin is not a contraindication to the administration of ceftriaxone or cefotaxime at dosages described in Table 1.

Empirical therapy must be given parenterally, preferably intravenously. Intramuscular administration of antibiotics is not preferred in this setting as supervening shock and hypotension may lead to failure of absorption of the injected antibiotic from the injection site (see Table 2).

Collection of a blood sample for culture should be attempted prior to administration of antibiotics but should not delay treatment.
3.4 Supportive therapy

As well as antibiotics, other therapy should be used where medically appropriate and patients with meningococcaemic shock, or with the meningoencephalitic presentation, may require high-level intensive care therapy. Particular attention should be paid to maintenance of blood pressure and tissue perfusion and management of cerebral oedema. Patients may require artificial ventilation and other forms of support for prolonged periods and the complications of the coagulopathy, or intravascular coagulation abnormalities, may be severe.

3.5 Diagnostic studies

Therapy should not be delayed while awaiting results of diagnostic tests such as a lumbar puncture or computed tomography (CT) scan.

All patients with suspected meningococcal infection should have blood collected as soon as possible for culture and for neutrophil, platelet counts and serological studies. From any suspicious skin lesions (eg petechiae) a skin scraping should be done and sent for gram stain and culture. If petechiae are present, or if frank bleeding is evident, formal coagulation studies should be undertaken and additional investigations such as chest x-rays, electrolyte and acid-base balance studies should be undertaken where the clinical picture warrants. PCR testing of blood (and CSF if meningitis is present) should be considered as part of the routine diagnostic work up. Laboratory diagnosis is discussed in Chapter 4.

3.5.1 Role of lumbar puncture in diagnosis

Diagnostic lumbar puncture for the collection of CSF has been the traditional mainstay in the diagnosis of meningitis. Meningococcal meningitis and other CNS infections may be associated with increased intracranial pressure, cerebral oedema and swelling and possibly with focal swelling or mass lesions such as abscesses. Where evidence exists for increased intracranial pressure (e.g. clouded or impaired consciousness, papilloedema, focal neurological signs or vomiting), lumbar puncture should be deferred until therapy and supportive measures have been established and investigations, such as a CT scan, undertaken to define existing intracranial lesions. The patient's coagulation status should be considered prior to lumbar puncture owing to the potential risk of haemorrhage with concomitant coagulopathy. Deferral of lumbar puncture may be appropriate.

The administration of antibiotics should not be delayed unduly while awaiting the performance of the lumbar puncture. If the lumbar puncture cannot be performed and IV antibiotics given within 30 minutes of the arrival at a hospital of a patient with suspected meningitis or meningococcaemia, then IV antibiotics should be given before the CSF is collected.

3.6 Public health notification

The local public health unit should be notified as soon as possible (within 12 hours) so that contacts can be identified and an appropriate public health response determined (see Appendix 5 for contact details). This will include seeking other possibly epidemiologically related cases, the provision of clearance antibiotics and recommendations for vaccination where appropriate.

3.7 Infection control

Additional precautions (droplet transmission) should be applied for 24 hours after the initiation of specific therapy (see Infection Control Guidelines, Australian Government Department of Health and Ageing 2004, sections 2.4.3 and 2.3)
3.8 Therapy after Neisseria meningitidis is identified

After isolation of penicillin sensitive *N. meningitidis*, specific (narrow spectrum) therapy with benzylpenicillin can be continued as sole antibiotic to complete therapy. Ceftriaxone and cefotaxime are appropriate alternatives in patients allergic to penicillin. Therapy should be given for 3-5 days. Primary meningococcal conjunctivitis may be associated with invasive disease and should be treated systemically\(^\textsuperscript{11}\).

3.9 Duration of therapy

Patients with proven or probable meningococcal disease previously received at least five to seven days of therapy. However data from New Zealand is suggestive that shorter courses of therapy are sufficient, with 3 days for bacteraemia and meningitis.\(^\textsuperscript{12}\) Recommendations here are consistent the Therapeutic Guidelines Antibiotic, which recommends 3 to 5 days of therapy.

3.10 Eradication therapy and vaccination

Penicillin will not reliably eliminate nasopharyngeal carriage of meningococci\(^\textsuperscript{13,3}\). Patients who are treated with benzylpenicillin alone, and do not receive at least one adequate parenteral dose of a third generation cephalosporin (ie ceftriaxone), or ciprofloxacin, will therefore require antibiotic treatment on or before discharge to clear any organisms from the throat (doses are given in Section 8.5). It is recommended that this treatment be given early as it will be effective within 24 hours. Patients should not return to any child care facility, school or institution until their treatment is completed.

Cases of confirmed serogroup C disease who have previously been immunised with MenCCV (or polysaccharide) vaccines should be offered MenCCV vaccine at the time of discharge. Vaccine failure may relate to host factors or problems in the storage or administration of the vaccine. Immunological investigation of the case should be considered.

3.11 Antibiotic susceptibility

Isolates from cases of invasive meningococcal disease have been examined for antibiotic susceptibility in reference laboratories of the National Neisseria Network (NNN) since 1996 using standardised methods which allow comparison of results.

Meningococci isolated in Australia have generally remained sensitive to penicillins, but here and overseas, a gradual chromosomally mediated decrease in susceptibility to the penicillins has been observed. This has not as yet reached a level where treatment with these agents has been reported to fail and it is not sufficient to compromise treatment with penicillin. This situation is continually monitored. Additionally, there are a few overseas reports of beta-lactamase production in meningococci. These are rare events and have not been detected in Australia. There are no reports of resistance in meningococci to third generation cephalosporins.

References


11. Death from invasive meningococcal disease following close contact with a case of primary meningococcal conjunctivitis Langley, British Columbia. CCDR 1999 Volume 27–02.


Chapter 4: Laboratory Studies

**Key points**

- Antibiotic therapy should not be delayed while initiating or awaiting results of diagnostic tests.

- Meningococcal septicaemia often occurs without meningitis. In these cases the cerebrospinal fluid (CSF) may be normal.

- Negative findings on initial microscopy and biochemical examination of CSF do not exclude meningococcal meningitis. Positive cultures may be obtained in the following days.

- Culture of *Neisseria meningitidis* from a normally sterile site confirms the diagnosis. However, with early use of antibiotics and the likelihood of a negative culture, non-culture methods for diagnosis become more important.

- PCR tests to detect meningococcal DNA can be performed on blood and CSF, and have high sensitivity and specificity, even when prior antibiotics have been given (see Section 4.4).

- Strain differentiation by phenotyping, molecular typing, and gene sequencing is performed in National Neisseria Network laboratories to identify possibly related cases and for longer-term population studies of *N. meningitidis*.

### 4.1 Introduction

In situations where there is clinical suspicion of invasive meningococcal disease (IMD), antibiotic therapy must not be delayed while initiating or awaiting results of diagnostic tests.

All patients with suspected meningococcal infection should have blood collected as soon as possible for culture, serological studies and for neutrophil and platelet counts. The latter (anticoagulated blood) sample may be also used for polymerase chain reaction (PCR) testing for meningococcal DNA but it is preferable if a separate sample is collected (see below). It may be appropriate to take a sample of CSF. Serological studies should be considered as part of the routine diagnostic work up. Diagnosis is confirmed by the isolation of *N. meningitidis* or the detection of *N. meningitidis* DNA by PCR from CSF, blood, other normally sterile sites or skin lesions, or by the demonstration of Gram negative intracellular diplococci in blood or CSF (refer to Table 3, page 15).
Table 3: Specimens used for the diagnosis of meningococcal infection

- Blood for culture and PCR
- Aspirate from sterile sites for microscopy, culture, PCR as appropriate
- Aspirate from skin lesions for microscopy, culture and PCR (though this is not validated)
- CSF for microscopy, culture, PCR

(See also Table 4, page 20)

Early administration of antibiotics may prevent the confirmation of a clinical diagnosis by traditional culture methods. However, nucleic acid amplification assays such as PCR tests are now widely available in Australia for confirmation of invasive meningococcal disease. This examination requires the availability of uncentrifuged CSF or anticoagulated blood. For further details of specimen requirements, collection, handling and availability of testing which may vary between centres, contact the relevant laboratories (see Appendix 6—National Neisseria Network Laboratories).

Additionally, serum antibody tests are available for the diagnosis of invasive meningococcal disease. These are based on the demonstration of a single high IgM titre, or a rising IgM and/or IgG antibody titres to outer membrane protein antigens. Acute phase serum (5–7 days after onset of symptoms) or paired acute and convalescent sera are required. Diagnosis is retrospective but of public health relevance.

Urinary antigen tests are of doubtful clinical use in invasive meningococcal disease because of low sensitivity and specificity, and should not be performed. Similarly reliance should not be placed on latex particle agglutination tests to establish a diagnosis of IMD.

4.2 Microscopy

Microscopy, if positive for Gram negative intracellular diplococci from sites such as CSF or smears from skin lesions, is highly suggestive of IMD. The adequacy of specimen collection, stage of the disease, intercurrent use of antibiotics and experience of the microscopist affect the sensitivity and specificity.

4.2.1 Cerebrospinal fluid (CSF)

Classically the CSF from a case of meningococcal meningitis reveals a high neutrophil count, low glucose and high protein content. Gram negative diplococci, if observed within neutrophils, provide evidence of meningococcal meningitis.

There are numerous exceptions to this classical picture so that low or absent white cells do not exclude meningitis. In meningococcal disease with high white cell counts in CSF the number of organisms may be so low as to be undetectable. Initial CSF parameters may be normal in approximately 5% of cases where subsequent CSF specimens reveal characteristic changes of meningococcal meningitis.

Prior administration of antibiotics will remove or distort the microscopic appearance of the diplococci.

The sensitivity of the Gram stain in CSF is estimated to be about 65%. This is affected by the stage of disease, number of organisms present (which may vary considerably between patients) and timing of lumbar puncture in relation to antibiotic administration.
4.2.2 Aspirates of skin lesions and joint fluid
In the presence of a clinically compatible illness, Gram stains of aspirates from sterile sites provide strong evidence of invasive meningococcal disease (i.e. they are highly specific). However they are not sufficiently sensitive so that a negative result does not exclude invasive meningococcal disease (low negative predictive value).

Gram stains of skin lesion aspirates or biopsy specimens have a reported sensitivity of 30% to 70% but this varies with the form of meningococcal disease and type of skin lesion, being highest in haemorrhagic lesions of meningococcal septicaemia.1

Gram stains of skin biopsies may remain positive for long periods (about 48 hours) after antibiotic administration (thought to be due to poor penetration of antibiotics into poorly perfused lesions but the sensitivity at this time is not known). False positive Gram stain results may occur but the frequency is undefined.

4.3 Culture
Culture of *N. meningitidis* from blood, CSF or other normally sterile sites provides unequivocal confirmation of invasive meningococcal disease. Additionally, cultures provide isolate for strain differentiation and susceptibility testing.

In cases where meningococcal disease is suspected clinically, it is imperative that antibiotics be given before transfer to hospital and not withheld pending collection of diagnostic specimens. This decreases the likelihood of a positive culture but not to the same extent from all sampling sites. Collection of diagnostic samples should nevertheless still proceed even after administration of antibiotics as these samples may still yield a positive culture, but also may be used for non-culture diagnosis such as PCR.

4.3.1 Blood culture
Blood for culture should be obtained whenever possible. Several variables affect the sensitivity of blood cultures in invasive meningococcal disease: the number of blood cultures collected, the volume of the sample; and the prior use of antibiotics.

The sensitivity of blood culture is reported to be only about 50%, in untreated cases of invasive meningococcal disease, falling to about 5% or less if antibiotics have been used.

4.3.2 CSF culture
The sensitivity of CSF culture is about 95% in cases of untreated meningococcal meningitis. This percentage falls rapidly after treatment as viable meningococci are quickly cleared from CSF.

It is important to remember that a negative CSF culture does not exclude meningococcal septicaemia without meningitis.

4.3.3 Skin rash aspirate or biopsy
Culture of skin aspirates/biopsies is similar in sensitivity to Gram stain of the same lesion. Combined Gram stain/culture of skin lesions has a sensitivity of about 60%–65%.

4.3.4 Throat swabs
The taking of throat swabs is no longer recommended for cases of meningococcal disease. Similarly, they are of no value in deciding which contacts should receive clearance antibiotics. However, if throat swabs have been collected, these may yield a serogroup in the absence of another suitable specimen. There is a reasonable correlation between a nasopharyngeal isolate and an invasive isolate.
4.4 Non culture diagnostic tests—polymerase chain reaction (PCR)

More rapid treatment of suspected cases of meningococcal disease with effective antibiotics and reluctance to lumbar puncture mean that PCR tests are becoming more important in the laboratory diagnosis of invasive meningococcal disease. PCR tests may increase the laboratory diagnosis of cases of meningococcal disease by more than 30% and meningococcal DNA in CSF samples has been detected up to 72 hours after commencement of antibiotic treatment. A number of PCR-based assays for specific DNA sequences of *N. meningitidis* have been developed and primarily applied to CSF and blood/plasma/serum specimens. The sensitivity of PCR in CSF was 89% with a specificity of 100% in one Australian study. For all samples tested in a recent Australian study using real-time PCR, the sensitivity was 96% [95% CI 79 – 99%] and specificity 100% [95% CI, 96 – 100%]. PCR tests for serogroup determination should be performed both from a confirmatory and epidemiological point of view. PCR can detect and amplify genes specific for serogroups B, C, W135 and Y. Positive meningococcal DNA preparations should be stored (preferably at –70º C) for subsequent sequencing of outer membrane protein genes and multi locus sequence typing for epidemiological surveillance, if required.

4.5 Serodiagnosis

Serological testing, based on an enzyme immunoassay using outer membrane proteins as the antigen, was developed by the UK PHLS Meningococcal Reference Unit. The test has a sensitivity in excess of 97% in adults and older children (4 years or older) and reactions compatible with a recent meningococcal infection are a positive IgM test in a single sample or seroconversion if paired sera are available. The test has been evaluated for Australian conditions. Test specificity has been calculated at 95%. IgM reaches diagnostic levels about 5–7 days after onset, although the precise onset of invasive meningococcal disease is often difficult to determine. Currently there is an additional serological test for identifying serogroup C only, but only in unvaccinated subjects.

Because of its high negative predictive value, serology is most useful in excluding a diagnosis of IMD when a negative test is obtained with a suitable sample (7 – 21 days after onset) and where other laboratory tests were negative or not performed but the case was clinically notified. The timeliness of serology is not helpful in planning public health action. Serology should always be interpreted in the context of clinically compatible symptoms.

4.6 Polysaccharide antigen testing

These tests are not recommended.
Table 4: Summary of tests available to diagnose meningococcal disease

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gram stain</strong></td>
<td>CSF, joint fluid or other normally sterile site, or skin lesion.</td>
<td>Rapid, readily available.  Confirms diagnosis if positive from a sterile site in a clinically compatible case.  Sensitivity in CSF: 65%.  Sensitivity from skin lesions: 30%–70%.</td>
</tr>
<tr>
<td><strong>Culture</strong></td>
<td>a) CSF, blood, joint fluid or other normally sterile site, or skin lesion</td>
<td>Results in 24–48 hours. Positive result confirms diagnosis.  Sensitivity in CSF 95% if no prior antibiotics.  Sensitivity in blood 50% if no prior antibiotics, 5% if prior antibiotics</td>
</tr>
<tr>
<td><strong>PCR test</strong></td>
<td>CSF, blood</td>
<td>Positive result confirms diagnosis in a clinically compatible case. Can determine serogroup without a positive culture.  Sensitivity 96%, specificity up to 100%.</td>
</tr>
<tr>
<td><strong>Serology</strong></td>
<td>Blood</td>
<td>Single positive IgM or rising convalescent titre to outer membrane protein antigen confirms diagnosis in a clinically compatible case.  Serogroup C capsular polysaccharide antibody estimation available for confirmation in unimmunised individuals  Sensitivity in adults and older children &gt;97%.</td>
</tr>
<tr>
<td><strong>Antigen test</strong></td>
<td>CSF</td>
<td>Unreliable in its present form</td>
</tr>
</tbody>
</table>

4.7 Strain differentiation of *N. meningitidis*

Differential of meningococci from cases of invasive meningococcal disease is undertaken for public health reasons, e.g. to confirm or to exclude a suspected outbreak of cases. A true epidemiological link between cases can only be established by public health investigations. Laboratory typing results can confirm or exclude such a link, but do not establish one in the absence of these public health data.

A variety of typing techniques is available and different techniques are employed for different purposes at different times. One of the most widely used involves characterisation of surface structures in the capsule and outer cell membrane. Capsular polysaccharide antigens can be used to differentiate meningococci into 13 serogroups, with A, B, and C accounting for the majority of invasive infections worldwide and serogroup B and C most often encountered in Australia. Serogroup Y and serogroup W135 are also seen occasionally in Australia.

Further strain differentiation within the serogroups can be made by identification of outer membrane or porin proteins (OMPs). All meningococci have either class 2 or 3 OMPs. Using monoclonal antibodies reactive against epitopes present on the class 2/3 OMPs, isolates can be divided into serotypes by serological methods. Similarly, another set of monoclonal antibodies to class 1 OMP is available to define serosubtypes. The serogroup, serotype, and
serosubtype together describe the phenotype of an organism. For example, a commonly encountered phenotype in Australia is C:2a:P1.5.2. The organism has the serogroup C capsular polysaccharide, the 2a class 2/3 OMP serotype, and the P 1.5,2 class 1 OMP serosubtype.

Currently all isolates are typed by National Neisseria Network laboratories (see Appendix 5, page ….) by determining the serogroup as soon as practicable after receipt. Serotyping and serosubtyping are performed by batching of isolates and testing at regular intervals; less frequently in low incidence periods and more frequently in the winter/spring. These techniques can however be rapidly employed if an epidemiological link between cases is established or suspected and can quickly exclude the presence of clustering of cases. However, many serogroup B strains are non-typable and reagent stocks are finite. Molecular sequencing of \textit{porA} and \textit{porB} are now supplanting conventional phenotyping methods.

Other genotyping (molecular) procedures available include pulsed field gel electrophoresis (PFGE) and multi-locus sequence typing (MLST).

These techniques are used for different purposes, eg. PFGE and \textit{porA} sequencing are used for short-term studies of strain relatedness and MLST for longer term population studies of meningococci. PFGE methods are not uniform between laboratories. Further, PFGE patterns are usually considered of short-term use for differentiating suspected outbreaks under local conditions. Thus inter-laboratory comparisons of PFGE patterns are not suitable for distinguishing invasive meningococci separated temporally and/or geographically across Australia.

Similarly \textit{porA}/\textit{porB} typing can be applied for short term examination of possible outbreaks but is less also suited to long term longitudinal genotyping studies. A global standard nomenclature for \textit{porA} sequencing is being developed, meaning that greater comparability of strains can be achieved by this means.

MLST is currently a technique more appropriately used for long-term population studies of meningococcal populations as it examines more stable parts of the genome. Its use defines clonal complexes of invasive meningococci and related sequence types within these clonal complexes.

The application and development of these techniques in Australia is under constant review by the National Neisseria Network (NNN).

References


Chapter 5 Discharge and post discharge planning

**Key points**

- In most cases, with early diagnosis and prompt treatment, outcomes of meningococcal disease are good.

- Complications of meningococcal disease require appropriate discharge planning and specialised follow-up arrangements.

- Counselling and support for the patient, family members and health professionals involved in the care of the patient should be considered.

### 5.1 Outcomes of meningococcal disease

In most cases, with early diagnosis and prompt treatment, outcomes of meningococcal disease are good. On discharge from hospital the patient's general practitioner should be sent a discharge summary containing details of the follow-up required and the prognosis. If the patient makes an uncomplicated recovery then they can be discharged to the care of the general practitioner. Symptoms such as fatigue and headache may persist for months after the acute illness. Patients may need reassurance that this is common and that the outlook is good.\(^1\)

Complications of meningococcal disease such as brain injury, hearing loss, seizures and amputation will require appropriate discharge planning and specialised follow-up arrangements.\(^1\) If a patient had lateralised neurological signs or impaired conscious level at any stage of the illness then a least one outpatient review that includes a neurological review should be undertaken\(^1\). Deafness is the single most common permanent deficit in survivors of meningococcal meningitis. It occurs in 4%–6% of survivors, in half of whom it is severe and bilateral\(^2\). Deafness is more common in children than adults. All cases of meningitis require a formal hearing assessment.

Permanent motor deficits, retardation and hydrocephalus occur in less than 1% of survivors\(^3\). A significant proportion of survivors will have tissue damage that requires surgical treatment, such as skin grafts, or partial or full amputation of limbs. Where amputation has been required, assessment and follow-up physiotherapy and occupational therapy should be arranged.

The patient and/or members of the affected family are likely to seek explanation and support from health professionals for several months after the illness. Family members will require this especially if the patient died or has permanent disability. Appropriate counselling and support for the patient and family members should be arranged. Public health professionals should be aware of the distress that media attention can cause to patients and/or their families. The counselling needs of health professionals involved in the care of the patient should also be considered. There are a number of groups (see Appendix 7) that can provide support for people who have complications of meningococcal disease in particular for those who have hearing loss, epilepsy or other brain injuries.

### 5.2 Infection risk and cadavers
The most recent data indicate a mortality rate of 9.1% (see Section 7.4). Cadavers with meningococcal disease have traditionally been considered a possible infection risk however cases of transmission to autopsy workers are extremely rare. It is known that meningococci survive for long periods in some tissues, however, in cases where the deceased has been treated with an effective antibiotic for at least 24 hours prior to death; any risk to grieving relatives is virtually non-existent.

Pathologists and mortuary workers should use standard precautions for the handling of cadavers.

References
Chapter 6: Surveillance

Key points

- Clinicians and laboratories should notify all cases (see Section 6.4) of suspected meningococcal disease as soon as possible to the local public health unit without waiting for microbiological confirmation.

- Public health authorities should ensure that comprehensive information on all confirmed and probable cases is collected and recorded to enable prompt public health interventions, to allow the monitoring of epidemiological changes and to evaluate public health strategies.

- Data on invasive meningococcal disease should be reviewed on a regular basis at local, state and national levels to identify outbreaks of cases and epidemiological trends.

6.1 Surveillance of meningococcal disease

Surveillance is based on notification of cases by clinicians and laboratories. Cases should be notified on suspicion. Depending on the opinions of the treating doctor and the public health authorities, public health action may be taken before laboratory results are known.

6.2 Objectives of surveillance

The objectives of disease surveillance are:

- To ensure prompt identification of cases and appropriate public health responses;

- To ensure the prompt identification of outbreaks of invasive meningococcal disease to enable the rapid institution of control measures;

- To enable the monitoring of changes in the epidemiology of the disease across the country in relation to serogroup, serotype and antibiotic susceptibility; and

- To monitor the effectiveness of current control measures and to provide an evidence base for further review of national guidelines.

Notification of cases of invasive meningococcal disease to the relevant State/Territory health authority is the trigger for the public health responses. The public health system requirements are for timeliness and sensitivity. All clinicians and laboratories should immediately notify cases of suspected meningococcal infection by telephone. This should not be delayed until microbiological confirmation is obtained.
6.3 Surveillance case definitions

For surveillance purposes cases should be classified as probable or confirmed. The surveillance case definitions are:

**Confirmed case**
A confirmed case requires either:

1. **Laboratory definitive evidence**
   OR
2. **Laboratory suggestive evidence AND clinical evidence.**

**Laboratory definitive evidence**
1. Isolation of *Neisseria meningitidis* from a normally sterile site.
   OR
2. Detection of specific meningococcal DNA sequences in a specimen from a normally sterile site by nucleic acid amplification testing.

**Laboratory suggestive evidence**
1. Detection of Gram-negative diplococci in Gram’s stain of specimen from a normally sterile site or from a suspicious skin lesion
   OR
2. High titre IgM or significant rise in IgM or IgG titres to outer membrane protein antigens of *N. meningitidis*.

**Clinical evidence**
Disease which in the opinion of the treating clinician is compatible with invasive meningococcal disease.

**Probable case**
A probable case requires clinical evidence only.

**Clinical evidence**
A probable case requires:

1. The absence of evidence for other causes of clinical symptoms
   AND EITHER
2. Clinically compatible disease including haemorrhagic rash
   OR
3. Clinically compatible disease AND close contact with a confirmed case within the previous 60 days.

6.4 Notification of cases

These case definitions are for use by public health practitioners in managing notified cases, and for reporting cases to the National Notifiable Disease Surveillance System (NNDSS). The responsibility
of the treating clinician (GP or hospital doctor) and laboratory is to notify all cases in which a diagnosis of meningococcal infection is being considered. This will enable discussion of the case with staff in the communicable diseases control unit in the State or Territory health authority, or the local public health unit. Decisions can be made at this stage about public health action such as information for contacts and clearance antibiotics for close contacts. In general, public health action is appropriate where a case meets the criteria for confirmed or probable meningococcal disease. Immediate notification by telephone will enable discussion with clinicians about further measures to confirm the diagnosis.

6.5 Surveillance Data
For meaningful surveillance of meningococcal disease it is essential to have a data set which includes epidemiological, laboratory and clinical information. These data should be reviewed and analysed on a regular and frequent basis. Identification of outbreaks in time and place with the same risk factors or phenotypes is a particular cause for concern, as they may require the implementation of specific control measures.

6.6 The National Notifiable Diseases Surveillance System (NNDSS)
The following data items are to be collected by State and Territory Health Departments on all probable and confirmed cases of invasive meningococcal disease and will be used for national surveillance:

<table>
<thead>
<tr>
<th>CORE SET – Fields should be completed by States and Territories. (NNDSS Core dataset field specification version 8, December 2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• State/Territory</td>
</tr>
<tr>
<td>• Notification ID</td>
</tr>
<tr>
<td>• Disease Code</td>
</tr>
<tr>
<td>• Confirmation Status (i.e. confirmed or probable)</td>
</tr>
<tr>
<td>• Notification Received Date</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENHANCED INVASIVE MENINGOCOCCAL DISEASE SURVEILLANCE - Other information States and Territories collect for further information. (NNDSS Enhanced Invasive Meningococcal Disease Surveillance version 6, October 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Organism Code</td>
</tr>
<tr>
<td>• Organism Name</td>
</tr>
<tr>
<td>• Serotype and serosubtype</td>
</tr>
<tr>
<td>• Laboratory Diagnosis Method</td>
</tr>
<tr>
<td>• Specimen Site from which diagnosis was made</td>
</tr>
<tr>
<td>• Specimen collected</td>
</tr>
<tr>
<td>• Resident Postcode</td>
</tr>
</tbody>
</table>
- Resident Location
- Clinical/True onset date
- Specimen date
- Notification date
- Outbreak reference
- Date of Birth
- Age
- Gender
- Aboriginal and Torres Strait Islander status
- Occupation
- Clinical outcome (died/survived)
- Exposure Risk
  - Attendance at an institution (childcare, preschool, school, university or other tertiary institution, military barracks, prison)
  - Travel (interstate or overseas) in the 60 days prior to onset
  - Contact with another case in the 60 days prior to onset
- Vaccination status
- Vaccination Validation
- Vaccine Doses
- Vaccination Type:
  - menCCV
  - Meningococcal polysaccharide 4vMenPV
  - unknown
- Clinical Presentation:
  - meningitis
  - septicaemia
  - other invasive illness
  - unknown

It should be noted that the majority of the data items given above are required in all notifiable infections while a few of these specific to meningococcal infection.

### 6.7 Information for program management
Apart from the data items given above there will be other information on cases and contacts that may be required at the State or Territory level for program management purposes. It not intended that this information will become part of NNDSS.

This additional information may include the following:

- Notifier details—name and address
- Patient details—name and address
- Case seen by GP immediately prior to hospital admission—yes, no, unknown (if yes, date and time seen by GP)
- Date and time hospitalised—name of hospital
- Blood culture taken before first dose of antibiotics (yes/no/not known)
- Antibiotics given prior to hospital admission—yes, no, unknown (if yes, date and time antibiotic given)

- Contacts
  - number of contacts identified (names, addresses, phone numbers)
  - number offered clearance antibiotics
  - number accepted clearance antibiotics
  - number offered vaccine
  - number given surveillance letter only.

### 6.7 Vaccine Failure

The definition of conjugate meningococcal C vaccine (MenCCV) failure is:

Confirmed meningococcal C disease occurring more than 14 days after at least one dose of MenCCV given at 12 months of age or older;

All cases of possible vaccine failure should be properly investigated. Procedures for this process are currently under development.

### 6.8 Reports on meningococcal disease

Australia has a national database that includes both clinical and laboratory data on meningococcal disease. It is extremely important to ensure that changes in the epidemiology of the condition are closely monitored through regular reports based on analysis of NNDSS data.

A comprehensive annual report is published. Data are reviewed at a national level fortnightly and quarterly statistical reports are also produced.
Chapter 7: Epidemiology of meningococcal disease

Key points

- Meningococcal disease is an endemic infection with cyclical peaks of incidence in Australia.

- Meningococcal infections have a seasonal peak in winter-spring.

- The age groups 0–4 years and 15–25 years have the highest incidence rate.

- The availability of strain differentiation data nationally from the 1990s has greatly improved our understanding of the epidemiology and allowed comparison with other countries.

- Diverse serogroup B phenotypes have predominated in all States over the decade with no reports of hyperendemic disease.

- An increase of serogroup C disease occurred during the 1990s, particularly in New South Wales and, commencing in 1999, in Victoria. Cases of serogroup C infection were more common in adolescents and young adults.

- The phenotype C:2a:P1.5 was associated with outbreaks of cases in urban New South Wales affecting adolescents and young adults disproportionately. The increase in Victoria in 1999–2002 was associated with a new phenotype C:2a:P1.7,4. From 2001 – 2003, an increased incidence of serogroup C disease was also observed in southern Tasmania.

- Rates of invasive disease due to serogroup C are falling nationally after the introduction of universal childhood vaccination using conjugate vaccines in 2003.

- Non-culture diagnosis by PCR techniques and serology are making an important contribution to laboratory confirmation of the diagnosis of invasive meningococcal disease.

National surveillance of meningococcal disease

The National Notifiable Diseases Surveillance System (NNDSS) was established in its current form in 1991 under the direction of the Communicable Diseases Network Australia (CDNA). The NNDSS compiles annual reports on notifications of meningococcal disease made to State and Territory health authorities. There is also a national program of laboratory-based surveillance of meningococcal isolates from invasive disease, which began in 1994 as a component of the National Neisseria Network. This program is designed to supplement data from the NNDSS by adding information on strain serogroup, serotype and serosubtype as well as antibiotic sensitivity data. Table 5 indicates the number of reports of meningococcal infection collated by the NNDSS from 1994–2006 and the number of invasive isolates received by laboratories of the National Neisseria Network during that time. Positive cultures have been received and typed from over 65% of notified cases since 1995. Since 1999, results based on non culture techniques (serology and nucleic acid techniques) have been included.

While meningococcal disease in Australia may affect all age groups, there is a bimodal age distribution, with the highest rates in the 0–4 year age group and a second peak in the 15–25 year age group. Since the implementation of the National Meningococcal Vaccination Program, person aged 35 years or over now comprise approximately 18% of all notifications. There is a slight male preponderance (Figure 2).
Table 5: National Notifiable Diseases Surveillance System notifications of meningococcal disease, and National Neisseria Network Laboratory Notifications — 1994–2006* (NAT and serology included from 1999 onwards)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total NNDSS notifications*</th>
<th>NNN invasive notifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>527</td>
<td>216</td>
</tr>
<tr>
<td>1995</td>
<td>488</td>
<td>250</td>
</tr>
<tr>
<td>1996</td>
<td>580</td>
<td>297</td>
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<td>1997</td>
<td>500</td>
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<td>1998</td>
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<td>1999</td>
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<td>349</td>
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<tr>
<td>2005</td>
<td>392</td>
<td>345</td>
</tr>
<tr>
<td>2006</td>
<td>319</td>
<td>na</td>
</tr>
</tbody>
</table>

Source: National Notifiable Diseases Surveillance System (NNDSS) (Department of Health and Ageing, Canberra); Australian Meningococcal Surveillance Program

* 2006 provisional data

The annual notification rate per 100,000 population rose from 2.7 in 1995 to a maximum of 3.5 per 100,000 in 2001 and 2002 and fell to 1.4 per 100,000 by 2006. The highest State or Territory rate was 7.9 per 100,000 in the Northern Territory (in 1997).

**Figure 1: Notification rate of invasive meningococcal disease, Australia 1995-2006**

Source: National Notifiable Diseases Surveillance System (NNDSS) (Department of Health and Ageing, Canberra)

* 2006 provisional data
Figure 2: Notifications of invasive meningococcal disease, Australia 2006*, by age group and sex

Source: National Notifiable Diseases Surveillance System (NNDSS) (Department of Health and Ageing, Canberra)

* 2006 provisional data
Meningococcal disease characteristically has a seasonal pattern with a peak of incidence in the winter and spring months (see Figure 1). Influenza virus or *Mycoplasma pneumoniae* infections may predispose to invasive disease\(^\text{13}\). Other individual risk factors for invasive disease include age, crowding and lower socio-economic status, deep intimate kissing with more than one partner, being a student\(^\text{14}\) and exposure to cigarette smokers.\(^\text{15,17}\) In a study of risk factors for meningococcal carriage, attendance at pubs and clubs, intimate kissing and cigarette smoking were independently and strongly associated with increased risk for carriage.\(^\text{16}\) In addition, defects in humoral immunity, complement-mediated immunity and especially functional or anatomical asplenia predispose to invasive disease.\(^\text{15}\) The frequency of various serogroups varies by location and over time. Serogroup A meningococci cause outbreaks of infection in areas such as the meningitis belt of Africa where the incidence of meningococcal infection rises sharply towards the end of the dry season and declines rapidly with the onset of rains. The epidemics occur in 8–14 year cycles\(^\text{1,15}\). Similar epidemic patterns occurred in many countries during World War II, including Australia, as part of a serogroup A pandemic.\(^\text{18}\) In 1987 a large outbreak of serogroup A meningococcal disease occurred in Aboriginal central Australians.\(^\text{19}\) Similarly, there was an outbreak of serogroup A disease in New Zealand in the late 1980s.\(^\text{20,21}\)

Since 1990 New Zealand has been experiencing an epidemic of serogroup B meningococcal disease. In 2000 there were 480 cases of meningococcal disease reported giving a rate of 13.3 per 100,000. Of these cases 348 (72.5%) were confirmed giving a confirmed rate of 9.6 per 100,000 population. Age-standardised rates for Maori and Pacific Island people were three and six times higher respectively than for the European population. Meningococcal disease is more common in the upper North Island with a rate of 21.3 occurring in the Northern region. Meningococcal disease resulted in 17 deaths in 2000 giving a case fatality rate of 3.5%. In 2000 serogroup B meningococci accounted for 94.1% (241/256) of viable organisms from cases. As a proportion of serogroup B, isolates with the B:4:P1.4 phenotype represented 90.4% (217/240) of cases. At current rates, more than one in 50 South Auckland children of Pacific Island origin will develop invasive meningococcal disease before 5 years of age.\(^\text{20,21}\) Universal immunisation for all under 20 year olds using a tailored vaccine is being implemented.\(^\text{22}\)
In developed countries the pattern of meningococcal infection is one of sporadic cases with irregular peaks of incidence associated with small or large outbreaks of cases. Serogroup B meningococci are the major cause of sporadic disease or outbreaks with lower attack rates than seen with serogroup A infections. Serogroup C meningococci are usually associated with sporadic disease but can cause small or large outbreaks, with attack rates between those seen with serogroups A and B. However, there are significant variations across the globe, with a high preponderance of serogroup B disease in New Zealand, and a high rate of serogroup Y infection in the USA.\textsuperscript{23}

In a number of countries, including the United Kingdom\textsuperscript{26} and Australia\textsuperscript{1}, universal childhood vaccination using conjugate serogroup C vaccines has been associated with a reduction in the incidence of serogroup C disease in the last 4 years (Figure 3).

### 7.2 Trends in phenotypes seen in Australia

An understanding of the epidemiology of meningococcal disease in Australia has been greatly facilitated in the 1990s by the development of the NNDSS and the availability of standardised national data on serogroup, serotype, serosubtype and antibiotic susceptibility patterns of invasive meningococcal isolates through the National Neisseria Network of Laboratories. Prior to this, there was little information about strains of meningococci causing invasive disease.

Meningococcal disease has been an infection with cyclical peaks of incidence. Notification of "meningitis" reached a peak of 33.1 cases per 100,000 in 1942 (2,371 cases) as part of a pandemic of serogroup A disease during World War II.\textsuperscript{23} Apart from another peak of activity in the early 1950s, there was a steady decline of notifications to < 0.5 cases per 100,000 in 1987, when, in addition to the outbreak of serogroup A meningococcal disease amongst the Aboriginal populations of central Australia, there was a rise in the number of notifications of both serogroups B and C isolates.\textsuperscript{25} In the early 1990s outbreaks caused by serogroup C were reported in urban areas of NSW and in Aboriginal communities in Queensland and the Northern Territory. These serogroup C isolates had the phenotype C:2b:P1.2 and showed close genetic relatedness on DNA fingerprinting.\textsuperscript{27} The phenotype C:2b:P1.2 was also a common cause of sporadic disease in 1990–1994 in NSW.\textsuperscript{28} Serogroup C isolates also accounted for 70% of cases of invasive meningococcal disease in north Queensland between 1990–1994 during which time five outbreaks were identified.\textsuperscript{29}

From 1994 strain differentiation data for invasive meningococcal isolates were available nationally.\textsuperscript{2} In 1994 serogroup C strains predominated in NSW, but serogroup B meningococci were more common in all other States. In 1995 serogroup B strains predominated in all States.\textsuperscript{3} In 1996, the largest community outbreak of meningococcal disease reported in urban Australia to date occurred in western Sydney, with an initial association with attendance at a nightclub.\textsuperscript{30} The phenotype involved was C:2a:P1.5. Although strains of this phenotype had caused sporadic disease in NSW in the 1990s, there were no outbreaks identified until 1996. In Canada and Europe in the 1990s this phenotype had caused multiple outbreaks of infection with high attack rates and case mortality rates in young adults, followed by hyperendemic disease for several years thereafter.\textsuperscript{31} Rates of meningococcal disease in north western Sydney following the outbreak in 1996–1998 were up to 11.2 per 100,000 representing the largest, sustained, hyperendemicity recorded in urban Australia since the 1950s (J Brown, personal communication). The majority of isolates involved were phenotype C:2a:P1.5. The Australian C:2a:P1.5 isolates are closely related genetically to strains from Canada and Europe, belonging to the ET-15 clone of the ET-37 complex.\textsuperscript{23, 31, 32, 33, 34}

Phenotype data were available nationally for the first time in 1996.\textsuperscript{6} Serogroup B strains predominated in all States and Territories, although serogroup C strains accounted for 41% of isolates from NSW. The phenotype C:2a:P1.5 was most commonly isolated from NSW. In eastern States, the phenotype B:4:P1.4 was the commonest serogroup B strain. This phenotype caused an ongoing epidemic of serogroup B meningococcal disease in New Zealand in the 1990s, and has some genetic similarities to the Australian strains,\textsuperscript{1, 2, 35} although in Australia these strains have not been associated with ongoing, widespread outbreaks and only seen in small numbers.

In 1997, while serogroup B again predominated in all States except NSW, there was a substantial change in NSW, both in terms of phenotype and age distribution of cases.\textsuperscript{5} Most serogroup C isolates now came from NSW and caused disease especially in adolescents and young adults. The phenotype C:2a:P1.5 had become the most frequently encountered phenotype and caused further outbreaks of cases of serogroup C in urban areas. Amongst serogroup B strains, which predominated in the less than 4 year age group, the phenotypes B:4:P1.4 and B:15:P1.7, were prominent.\textsuperscript{23}
In 1998, while serogroup B organisms predominated in all States and Territories, New South Wales continued to have preponderance of the C:2a:P1.5 phenotype, especially in adolescents and young adults. No outbreaks were identified in 1998.

In 1999, the number of serogroup C organisms, and the incidence of serogroup C disease, increased significantly in Victoria and remained prominent in New South Wales, although diverse serogroup B isolates predominated all States and Territories again. A number of serogroup infections with a phenotype new to Australia, C:2a:P1.4(7) were noted in Victoria and, to a lesser extent, in New South Wales. Non-culture based diagnosis using nucleic acid amplification techniques and serology, made a significant contribution to laboratory-confirmed diagnosis, for the first time in 1999.

In southern Tasmania, the incidence of serogroup C disease increased over the years 2001 to 2003, with serogroup C predominating over serogroup B infections. Consistent with the rest of Australia (see below), the incidence of serogroup C disease began to fall from 2003. However, a community outbreak of four cases, three involving students at a high school, occurred in north-eastern Tasmania in 2004. Three of the cases were confirmed to be the C:2a:P1.7-2,4 phenotype (personal communication, A Misrachi).

From 2003 the incidence of invasive meningococcal disease has fallen, due to the implementation of the National Meningococcal C Vaccination Program. Serogroup C isolates have declined by 68% between 2003 and 2005. In addition, the number of untyped isolates and cases where no isolate was made has declined. The common phenotypes isolated in 2005 were C:2a:P1.5 and B:15:P1.7.

### 7.3 Mortality from invasive meningococcal disease

Mortality data are available for 2005 for 47% of the 345 laboratory confirmed cases (including culture, PCR and serology confirmed cases). Mortality was 8.5% for serogroup B infections (10 out of 117 cases), 15% for serogroup C infections (3 out of 20 cases), 4.4% for patients presenting with meningitis (2 out of 45 cases; both serogroup B) and 11% for patients presenting with bacteraemia (13 out of 118 patients; 8 serogroup B and 3 serogroup C). There was one death in 7 cases with serogroup Y infection, 1 death in 6 patients with serogroup W135 infection, and no deaths amongst 19 patients with ungrouped but laboratory confirmed infection.

### References


Chapter 8: Management of sporadic cases of meningococcal disease

Key points

- Nasopharyngeal carriage of meningococci is common; about 10% of the population carry meningococci at any given time.

- There is a well established increased risk of further cases among the household contacts, intimate kissing and sexual contacts of a case of meningococcal disease. Settings where the increased risk is lower than that of household contacts include those in very close contact with a case after the onset of symptoms, and in child-care facilities, schools or universities attended by a case.

- The public health response to meningococcal disease includes: providing contacts of a case with information about the disease; the provision of clearance antibiotics to selected contacts with advice on the possibility, albeit small, of disease occurring; explaining that there are no particular quarantine or behaviour requirements for contacts; the provision of vaccination to selected contacts and the maintenance of surveillance for further cases. (See Section 8.3 for definitions of ‘contacts’).

- The public health response should only include those who were in contact with a case in the 7 days preceding onset of the illness, and those in very close contact after the onset of symptoms.

- The main reason for giving clearance antibiotics is to eliminate meningococci from any carrier who may be in the network of contacts close to each index case. This reduces the risk to other susceptible individuals in the network, protecting them from acquiring the meningococcal strain, and possibly invasive disease, from the carrier.

- There are three antibiotics currently used for clearance in meningococcal disease; each agent has advantages and disadvantages and each is the preferred agent in specific circumstances. Ciprofloxacin is the preferred agent for women taking an oral contraceptive as rifampicin can affect the efficacy of oral contraceptives. Ceftriaxone is the preferred agent for pregnant women, and in rural and remote Aboriginal and Torres Strait Islander communities. Rifampicin is the antibiotic of choice for young children.

- Throat swabs have no role in the public health management of contacts of invasive meningococcal disease.

- A single case of serogroup A in an Aboriginal or Torres Strait Islander patient demands further attention; it may be the sentinel event of a community outbreak.

8.1 Transmission and carriage of meningococci

Respiratory droplets shed from the upper respiratory tract transmit meningococci from one person to another. Humans are the only natural hosts for meningococci. Nasopharyngeal carriage of meningococci is common; about 10% of the population carry meningococci, not all of which are virulent strains, at any given time.1 In North American and European populations the average duration of meningococcal carriage is about nine months; it is an immunising process with protective antibodies developing soon after acquisition. Factors associated with an increased risk of carriage include smoking and living in crowded circumstances.
8.2 Rationale for clearance antibiotics and vaccination

The rationale for a response to individual cases of invasive meningococcal disease is to prevent secondary cases. Contrary to popular belief, a patient with meningococcal disease is not an efficient transmitter of the meningococcus that is causing their illness. A study in England and Wales found three pairs of secondary infections probably caused by exposure to cases' respiratory droplets between 1982 and 1996, giving a rate 0.8 per 100,000 health care workers at risk, and a risk ratio of 25 times the general population. Contrary to popular belief, a patient with meningococcal disease is not an efficient transmitter of the meningococcus that is causing their illness. A study in England and Wales found three pairs of secondary infections probably caused by exposure to cases' respiratory droplets between 1982 and 1996, giving a rate 0.8 per 100,000 health care workers at risk, and a risk ratio of 25 times the general population. This ongoing risk, calculated as a risk ratio of between 8.2 and 11.9, is partially due to environmental exposure, but also has a genetic component, which may explain approximately 30% of the increased risk.

The main reason for giving clearance antibiotics is thus to eliminate meningococci from any carrier who may be in the network of contacts close to each index case. This reduces the risk to other susceptible individuals in the network, protecting them from acquiring the meningococcal strain, and possibly invasive disease, from the carrier.

There is a small but definite risk of transmission of meningococci from a case to health care workers. The risk is approximately 25 times the background risk, compared with household contacts who have 500 to 1200 times the background risk. Antibiotics are indicated for health care workers who are exposed to infectious respiratory droplets or secretions from a probable or confirmed case while undertaking airway management during resuscitation. Droplets and nasopharyngeal secretions are considered to be infectious from the onset of the acute illness until completion of 24 hours' treatment with systemic antibiotics.

The rationale for vaccination is to reduce the ongoing risk of invasive disease in close contacts.

8.3 Defining contacts for clearance antibiotics

Risk factors for invasive meningococcal disease (IMD) include age, crowding and lower socio-economic status, smoking and exposure to smokers, recent illness, a history of snoring and speech problems, sharing a bedroom and intimate kissing.

Throat swabs are of no value in determining who, among a case's close contacts, is the carrier of the implicated meningococcus. A single negative throat swab is unreliable for predicting the absence of meningococcal carriage.

Pragmatic decisions, based upon the known risks of further cases, have to be made in defining the network of contacts (of a case) that is likely to include the meningococcal carrier. The risk of further cases of meningococcal disease may be increased in certain discrete settings where close and prolonged contact with a carrier can occur.

8.3.1 Settings with a well established increased risk of secondary cases:

8.3.1.1 Households of a case

Studies carried out in Europe and America before the routine use of clearance antibiotics showed that people who lived in the same household as a case with meningococcal disease were at a 500- to 1200-fold greater risk of meningococcal disease than the general population. The risk was highest in the first week after a case and fell rapidly thereafter. A review in 2004 estimated that among household contacts provision of clearance antibiotics was 89% effective in preventing secondary cases, and that 218 household contacts needed treatment to prevent one secondary case.

A recent retrospective survey in England and Wales, has confirmed the markedly increased risk in household contacts, even in the era of clearance antibiotics. The absolute risk of further cases in the month following the index case was 210/100,000 household contacts. The survey also documented that the risk of further cases in household contacts is much greater in the first week than in subsequent weeks, but the increased risk remains for many weeks, even after the administration of clearance antibiotics. Approximately half of the further cases were co-primary, occurring within 24 hours of the diagnosis of the index.
A recent study has demonstrated a 4 fold increase in risk of invasive meningococcal disease in those with multiple (ie more than one) intimate kissing contacts in the previous fortnight. Hence, sexual and intimate kissing contacts should be treated as for household contacts.

8.3.2 Settings where the increased risk of secondary cases is lower than in household contacts:

8.3.2.1 Child-care facilities attended by a case
There is one published study available from Belgium published in 1981 which prospectively examined the risk of secondary cases occurring in day-care contact children. In this study, the subsequent disease risk for children under three years of age was similar to that for household contacts (of a similar age) of an index case.

A study in England and Wales from 1995 to 2001 analysed the risk of clusters of disease in pre-school settings (including day care, playgroups and other pre-school groups) based on surveillance data. The relative risk of a cluster was 27.6 in pre-school, compared with 5.4 in primary school and 3.6 in secondary school. However, the absolute risk of a cluster in days 2-28 in pre-school was 49.0 per 100,000 and thus 2000 pre-school children (about 70 groups) would require clearance antibiotics to prevent one cluster.

There is therefore limited evidence in favour of providing clearance antibiotics to child care contacts of a sporadic case of meningococcal disease. The recommendation for Australia is to consider the following types of contact as being similar to household level of contact and thus to provide clearance antibiotics:

- Family Day Care (where groups of children are cared for in a private home)
- Child care involving a group staying together in a single room for at least a four hour session.

8.3.2.2 Schools attended by a case
A study from Brazil, published in 1976, showed no increased risk of further cases among classroom contacts of cases during an epidemic of meningococcal disease.

However, recent surveys in both the United States and England and Wales have demonstrated a modestly increased risk of further cases in schools attended by index cases, particularly secondary schools. Subsequent cases are not necessarily in the same classroom as the index cases, with others occurring, for example, in contacts sharing extracurricular activities (such as sporting events) with index cases.

In the United States the relative risk of further cases among school students was about twice that of sporadic disease among children 5-18 years of age, whereas in England and Wales the absolute risk of secondary school students subsequently developing meningococcal disease was about 20 times less than that in household contacts. The authors of the former study concluded ‘mass clearance antibiotics following a single case of meningococcal disease in a school would therefore be an extremely inefficient way to reduce the burden of meningococcal disease among children’.

The recommendation for Australia is to provide information only to classroom contacts of cases.

8.3.2.3 Universities (or other tertiary education facilities) attended by a case
Although the incidence of meningococcal disease in college students in the United States does not seem to be greater than that in the general population of the same age, this is not the situation in the United Kingdom where the incidence is certainly greater in university students. In the latter study, disease rates were shown to be highest in students, often in their first year, living on campus. Regardless of the increased incidence of sporadic cases, the absolute risk of a university or college student in England and Wales becoming a case in the month after the diagnosis of an index case in the same university or college is low. Clearance antibiotics would only be recommended for those contacts who are, in effect, household-like contacts.
8.3.2.4 Among those in very close contact with a case after the onset of symptoms but prior to the commencement of antibiotics (See Table 8).
Although, as stated above, a case is not an efficient transmitter, on rare occasions cases have been documented to transmit the implicated meningococcus to very close contacts after the onset of the illness. The risk to health care workers is estimated to be 0.8 per 100,000 health care workers at risk, ie a risk 25 times that of the general population. The excess risk is small and inappropriate use of clearance antibiotics should be avoided.2,18, 19

8.3.2.5 The role of saliva in the transmission of meningococci
Although salivary contact has in the past been regarded as a means of transmission of meningococci, there is little evidence to support this view. Indeed, the available evidence indicates that neither saliva nor salivary contact is important in the transmission of meningococci.

Saliva has been shown to inhibit the growth of meningococci. The inhibitory property is due to the presence of other bacteria in saliva, streptococci in particular. As a result, meningococci can only rarely be isolated from saliva. In a study in the United Kingdom three swabs, one from the posterior nasopharyngeal wall, another from the tonsillar area, and the third from the front of the mouth, were taken from 258 college students and cultured for meningococci. 32% of the nasopharyngeal swabs and 19% of the tonsillar swabs cultured N. meningitidis. However, only one swab (0.4% of those collected from the front of the mouth) cultured the organism.21

Invasive meningococcal disease has not been shown to be associated with salivary contact. A case-control study from Auckland found no increased risk (p=0.07) of invasive meningococcal disease in children <8 years of age who had shared an item of food, drink or pacifier in the 2 weeks prior to hospitalisation.23 A case-control study of college students in the United States found no association (in multivariate analysis) between invasive meningococcal disease and kissing 2 or more contacts on the mouth in the month prior to the onset of the illness.24 Clusters of IMD in people who have had a low level of salivary contact (eg. footballers who have shared drink bottles, churchgoers who have shared a communion cup) appear to be very rare. Although clusters have been described, for example, in association with sporting events25 and sports clubs,26 the reported details indicate that point-source salivary transmission was not involved. Secondary cases in situations where dribbling of saliva is common (eg. child care centres) are also rare.

The evidence, then, supports the transmission of meningococci (which may then lead to invasion) through intimate kissing, but not through lower level salivary contact. Clearance antibiotics given to a contact of a case are primarily aimed to eliminate the carrier state in him/her, if s/he was the source of the index case's illness. Additionally, if the close contact has recently acquired carriage from the same source responsible for the index case, then the antibiotics would be expected to eliminate carriage and prevent potential disease in recipients. If invasion has already commenced, however, then clearance antibiotics will not prevent the development of clinical disease. As mentioned above, an index case is not an efficient transmitter of disease, therefore health care staff caring for patients in hospital require only a mask to be worn, and are not recommended to have clearance antibiotics.

8.3.3 Risk of disease over time
Finally, a network of close contacts has to be defined in time as well as place. Because most patients with meningococcal disease acquired the invading meningococcus within the seven days preceding the onset of the illness27, the network need only include people who have been in close and prolonged contact with the case during that time.

8.4 The public health response
A public health response is required as soon as possible following the diagnosis of a probable or confirmed case of invasive meningococcal disease, or of severe confirmed meningococcal conjunctivitis. In a suspected case, a judgement needs to be made by the public health physician in conjunction with the responsible clinician about whether to proceed with a public health response immediately.

Public health staff will normally provide the public health response activities directly. It may sometimes be necessary for public health staff to delegate these tasks to another person (for example, a clinician managing the case). Where tasks are delegated, public health staff should ensure that the person taking them on understands the various tasks involved (ie information,
counselling, provision of clearance antibiotics and vaccination) and agrees to undertake each required task.

For the purposes of public health intervention severe conjunctivitis is included because, on occasion, it may precede invasive disease, or invasive meningococcal disease in a contact. A proportion of meningococcal conjunctivitis is due to non-encapsulated strains which are unlikely to cause invasive disease. However clearance antibiotics should be considered as soon as a meningococcus is isolated and the isolate is known to be encapsulated.

Meningococci coincidentally isolated from superficial sites (eg. from oropharyngeal, genital or anal swabs) are of no public health consequence, and therefore do not require any public health responses.

The public health response includes:

**Providing information**

Providing information to the network of contacts (or to the responsible guardians of young children in the network) about the disease and how it is spread. A ‘fact sheet’, appropriate to the cultural and literacy needs of recipients, should be provided.

**Providing clearance antibiotics**

Providing clearance antibiotics (ie. a specific antibiotic) in appropriate dosages to each person in the network. The rationale for clearance antibiotics must be explained, and the possible adverse reactions and interactions with other medications (see below) need to be discussed. Ideally, clearance antibiotics should be given as soon as possible (within 24 hours) after the diagnosis of the index case. Although either diagnosis or notification may occasionally be delayed, there is no purpose in administering clearance antibiotics if more than 4 weeks have lapsed following the most recent contact with the case.

Emphasising that clearance antibiotics do not exclude the possibility, albeit small, of a person developing meningococcal disease despite perfect compliance with clearance antibiotics. Because the early recognition and treatment of someone with meningococcal disease can be life-saving, the symptoms and signs of the disease must be explained (Appendices 2A, 2B & 2C), and the need to seek urgent medical advice should they become unwell, should be stressed to each contact or their guardian.

Explaining that there is no need for an asymptomatic person who is taking clearance antibiotics to be ‘quarantined’ in any way (eg. a child can continue to attend child-care). Similarly there is no need to change practices or behaviours: family members (not taking clearance antibiotics) can still nurse/handle a child (on clearance antibiotics) in the normal manner, and couples (at least one of whom is taking clearance antibiotics) need not modify any aspect of their physical (kissing, sexual intercourse) relationship.

Following even a single case of meningococcal disease there may be considerable demands from parents or others for public health authorities to administer clearance antibiotics, in a liberal manner. These demands are likely to be intense, and parents understandably agitated, if the case dies.

It is important that public health personnel do not acquiesce to demands from concerned members of the public for the more liberal use of clearance antibiotics. The further one goes outside the household or immediate network of contacts the lower the chance of finding the carrier of the virulent meningococcus, and the greater the potential for inadvertently doing harm because:

- all antibiotics have side effects, adverse reactions and drug interactions;
- the liberal use of antibiotics encourages the emergence of resistant bacteria; rifampicin resistance can emerge rapidly and rifampicin-resistant meningococci and other organisms can subsequently cause invasive disease; and
- the prevalence of carriage of *Neisseria lactamica*, a non-pathogenic but closely related bacterium, is very high among infants and young children. *N. lactamica* is able to induce
natural immunity to invasive meningococcal disease\textsuperscript{33} and therefore the unnecessary use of antibiotics, which can eliminate this important organism, is to be avoided. 

It is recommended that when a case of meningococcal disease occurs in a child who attends a child care centre that public health personnel make an on-site visit to meet with parents and staff. The messages that should be communicated to the parents of children who have had brief and inconsequential contact with a case (and are therefore outside the case’s immediate network of contacts) are:

- secondary cases of meningococcal disease are rare in Australia;
- antibiotics are not guaranteed to either prevent colonisation or abort incubating disease in your child;
- your child is unlikely to have been the carrier who was the source of infection in the index case or to subsequently have become a carrier;
- antibiotics are primarily given to prevent those children who may be carriers from passing the infection on to other children; and
- therefore antibiotics are not recommended for your child.

**Providing vaccination**

Public health authorities should provide all unvaccinated eligible contacts (as defined in Table 8) of confirmed cases of vaccine-preventable invasive meningococcal disease with an information sheet that strongly recommends that they visit their usual health care provider at the next available opportunity to receive meningococcal vaccination with the appropriate vaccine. This should occur if contact has been in the 7 days before onset for up to 4 weeks after the most recent contact with the case. At 4 weeks, the risk is approaching background levels, and vaccination should only be offered where necessary to catch up the national immunisation program schedule. Vaccination is intended to reduce the risk of secondary cases in the ensuing weeks where the risk of secondary cases is above the background risk. It is a proactive step towards ensuring continuing high coverage with MenCCV, and is intended to prevent other serogroups, such as W135 and Y, becoming established in the community.

If a household contact of a confirmed case of any meningococcal serogroup is aged 12 months or over, and was born after 1 January 2002, ensure that he/she has received one dose of MenCCV. If unvaccinated, promote vaccination through the contact’s usual immunisation provider.

For household contacts of confirmed cases of meningococcal disease, confirm the meningococcal serogroup. If the case is serogroup C, immunise all unvaccinated household contacts with MenCCV. If the case is a non-B, non-C serogroup, immunise all household contacts with 4vMenPPV.

Cases of confirmed serogroup C disease who have previously been immunised with MenCCV (or polysaccharide) vaccines should be offered MenCCV vaccine at the time of discharge. Vaccine failure may relate to host factors or problems in the storage or administration of the vaccine. Immunological investigation of the case should be considered.

**Maintaining surveillance**

Maintaining surveillance for any subsequent cases. A single case of serogroup A meningococcal disease in an indigenous patient demands further attention; it may be the sentinel event of a pending community outbreak. Where there is the possibility of cases in other jurisdictions, eg where a case has attended a gathering or been travelling on public transport for more than 8 hours with others, other jurisdictions should be advised as soon as practicable to enhance surveillance for new cases. A media release is not usually considered necessary, as this may cause unnecessary alarm in the community.

States and territories should continue to educate medical practitioners and hospital staff on the early signs and symptoms of meningococcal disease, in order to maximise the chances of early diagnosis.
8.5 Public health interventions

**Household contacts**

The household contacts of a case, including recent visitors who have stayed overnight in the 7 days preceding the onset of the case’s illness should receive clearance antibiotics and vaccination. It is not unusual for up to 20 such contacts to be identified in an indigenous family. Those who share the same dormitory, military barrack or hostel bunkroom as a case are, in effect, household contacts.

**Travel contacts**

Those passengers seated in the seat immediately adjacent to the case (not across an aisle) on any flight/journey of more than 8 hours’ duration should receive clearance antibiotics.

**Sexual contacts**

Sexual partner(s) of the case should receive clearance antibiotics and vaccination. As intimate kissing has been shown to be associated with a risk of disease, intimate kissing partners should be identified and treated as close contacts.

**Childcare contacts**

Only the children and staff in the same room group at a child-care facility attended by the index case. Only those who were in the same room group for any one period of 4 hours or longer in the 7 days preceding the onset of the case’s illness require clearance antibiotics. Although there may have been some intermingling of all the children at the facility at the beginning and end of the day, this is usually of a short duration only, and not enough to justify extending the clearance antibiotics.

Children attending Family Day Care should be regarded as household contacts and receive clearance antibiotics.

**School and university contacts**

Only those school or university (or other tertiary education facility) colleagues who have been, in effect, household contacts of a case, such as children who have undertaken a ‘sleep over’ at the house of the case, or dormitory contacts at a boarding school, should receive clearance antibiotics. At a university hall of residence, those contacts who are household-like contacts should be administered clearance antibiotics.

Information on the disease may need to be given to a wider network of contacts, due to the difficulty in defining epidemiological groups in these situations, eg a student in the final year(s) of secondary school may mix with multiple classes.

**Nightclubs**

Casual contacts who have attended the same nightclub as a case will usually be impossible to identify, apart from the case’s close friends. Clearance antibiotics are not indicated for casual contacts in a nightclub; however, information should be provided to any nightclub contacts who are able to be traced.

**Health care worker contacts**

*Only* medical personnel who are directly exposed to a case’s nasopharyngeal secretions (ie. the person who either intubated the case (but only if a facemask was not worn), or performed mouth-to-mouth resuscitation on the case require clearance antibiotics. Other healthcare staff managing the patient do not require clearance antibiotics.

**Other contacts**

Clearance antibiotics are *not* indicated for the following contacts of a case of invasive meningococcal disease unless they are either household-like, child-care or other very close contacts (eg. sexual contacts):
• non-intimate kissing on the cheek or lips;
• food, drink (including drink bottle) sharing contacts;
• cigarette sharing, bong sharing contacts;
• communion cup, lip balm, wind instrument, referee’s whistle sharing contacts; or
• any other similar low-level salivary contacts.
• Contacts of contacts.

Table 8: Summary of public health responses in defined settings in which a single case of invasive meningococcal disease has occurred

<table>
<thead>
<tr>
<th>Setting</th>
<th>Clearance antibiotics</th>
<th>Vaccination</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household of a case (including sexual contacts)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Child-care facilities</td>
<td>Children and staff in the same room for 4 or more hours at one time in the 7 days prior to the onset of the case’s illness</td>
<td>No</td>
<td>All other children and staff at the facility</td>
</tr>
<tr>
<td>Family day care</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Schools and Universities</td>
<td>Students who are “household–like” contacts</td>
<td>Students who are “household–like” contacts (see footnote (d))</td>
<td>All other students in the same classroom (schools) or tutorial groups (universities)</td>
</tr>
<tr>
<td>Those exposed to a case after the onset of symptoms</td>
<td>Health Care workers who have either intubated the case without a face mask or done mouth to mouth resuscitation</td>
<td>No</td>
<td>All others concerned that they may have had contact with the case after the onset of symptoms</td>
</tr>
<tr>
<td>Those in seats adjacent to a case during long duration (&gt;8 hours) travel</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

a The disease, including the common signs and symptoms, must be described and the mode of transmission explained (refer Appendix 2). Appropriate action if symptoms suggestive of meningococcal infection occur should be detailed.

b Only those in close and prolonged contact with a case in the 7 days prior to the onset of symptoms, and only very close contacts after the onset of the case’s symptoms, require clearance antibiotics. The possible adverse reactions and drug interactions should be described. It must be emphasised that meningococcal disease can occur (rarely) despite clearance antibiotics. It should be explained that those taking clearance antibiotics need neither be quarantined nor adopt any specific behaviours.

c Immunisation history should be checked and vaccination offered to all household contacts of a case with a vaccine-preventable strain. MenCCV should be offered for contacts of serogroup C disease (Infants < 6 months of age require 2 doses of 0.5 ml, given at least 8 weeks apart, followed
by a booster dose at 12 months of age. Children 6-11 months require one dose of 0.5 ml, followed by a booster dose at 12 months of age. Persons 12 months of age or older require one dose of 0.5 ml only.) 4MenPPV is recommended for household contacts of cases of serogroup W135, A and Y disease. This vaccine is approved for use in children aged ≥ 2 years of age.

d ‘Households’ include those in the same dormitory, military barracks or hostel bunkroom in the seven days prior to the onset of the case’s symptoms. Sexual contacts should be managed as household contacts.

The opportunity should be taken to catch up any children who are eligible for meningococcal C vaccination under the National Immunisation Program and who have not yet been vaccinated.

8.6 Antibiotics used for clearance, and vaccines

A systematic review of retrospective cohort studies and trials showed a reduction of risk in household contacts of 89% where suitable antibiotics were given. The number needed to treat to prevent one secondary case was 218 (95% confidence intervals 121 to 1135). The same review noted a lack of reliable evidence about non-household contacts, such as pre-school settings. It would be virtually impossible to conduct such studies now, given the very low secondary attack rates in non-household settings and the ethical objections that would be raised by the need to withhold prophylaxis from a control group.

Although evidence from randomised trials is lacking, there is evidence from cohort studies on the microbiological clearance of meningococci following the administration of clearance antibiotics. There are three antibiotics currently used for clearance antibiotics of meningococcal disease; each agent had advantages and disadvantages, and each is the preferred agent in specific circumstances. A recent review by the Cochrane group compared the relative effectiveness of the three antibiotics used for clearance, and found that ciprofloxacin, rifampicin and ceftriaxone were effective in eliminating *N. meningitidis* after treatment.

8.6.1 Ceftriaxone

A study has shown that not only was a single dose of intramuscular ceftriaxone very effective (97%) in eradicating pharyngeal meningococci from carriers but also that it appeared to be more effective than rifampicin (75-81%).

Ceftriaxone is very well tolerated and there are no adverse reactions or drug interactions of particular importance. It should be dissolved in 1% lignocaine to reduce pain at the injection site. The recommended doses for clearance antibiotics are 250 mg IM for adults and 125 mg IM for children younger than 12 years of age, as a single dose. Ceftriaxone should not be used for clearance antibiotics in infants in the first 4 weeks of life.

Ceftriaxone is the preferred agent for pregnant women. Because compliance is likely to be good and because it is readily available, it should also be considered as the preferred agent in rural and remote communities, especially in Indigenous communities. Although there has not been a registered indication for use of ceftriaxone as a clearance antibiotic for meningococci in Australia, it is recommended for this indication in many countries, and this approach is endorsed by the Communicable Diseases Network Australia.

8.6.2 Ciprofloxacin (see Appendix 2D)

A single oral dose of 500mg of ciprofloxacin was shown to be 97% effective in eradicating pharyngeal meningococci from 336 adult carriers. Iron, sucralfate, highly buffered drugs (e.g. antiretrovirals) and antacids containing magnesium, aluminium and calcium interfere with the absorption of ciprofloxacin. Interactions may occur with probenecid, anticoagulants, cyclosporin, glibenclamide, NSAIDs, and theophylline. The stimulatory effects of caffeine may be increased. Ciprofloxacin is contraindicated in pregnancy and in children less than 12 years of age.

Allergic reactions, although very uncommon, have been reported in about one in one thousand people following single-dose ciprofloxacin.
Ciprofloxacin is the preferred clearance antibiotic for women on the contraceptive pill. Because it is easy to administer it should also be considered when a large number of adult contacts, some of whom are likely to be taking an oral contraceptive (eg. university students), require clearance antibiotics.

Public health personnel administering ciprofloxacin en masse should have, on site, an anaphylaxis management protocol, tuberculin syringes and adrenaline.

Although there has not been a registered indication for use of ciprofloxacin as a clearance antibiotic for meningococci in Australia, it is recommended for this indication in many countries, and this approach is endorsed by the Communicable Diseases Network Australia.

8.6.3 Rifampicin (see also Appendix 2E)
A two day course of rifampicin given orally eradicates nasopharyngeal meningococci in 75 - 95% of carriers. Side effects include headache, dizziness and gastrointestinal symptoms. It can cause orange colouration of urine, orange staining of contact lenses and, because it induces liver microsomal enzymes, it can reduce the efficacy of the oral contraceptive pill. Rifampicin can also reduce the efficacy of phenytoin, warfarin, corticosteroids, cyclosporin, dapsone, diltiazem, quinidine, sulfonylureas, theophylline, tricyclic antidepressants, verapamil, beta-blockers, and methadone. It may interact with antiviral agents. Antacids reduce the bioavailability of rifampicin. Interactions with other drugs should be considered. Rifampicin is contraindicated in pregnancy, alcoholism and severe liver disease.

Women taking an oral contraceptive should continue to take it, omitting any pill free interval, while taking rifampicin and for the seven days after the last dose of rifampicin. They should also use additional barrier contraception while taking rifampicin and for four weeks after the last dose of rifampicin. Rifampicin is the antibiotic of choice for young children (eg. in child day-care settings), but other alternatives should be considered for women taking an oral contraceptive.
The recommended schedule for rifampicin is 600 mg every 12 hours for 2 days for adults; 10 mg/kg/dose for children over one month of age every 12 hours for 2 days; and 5 mg/kg/dose for children aged less than one month every 12 hours for 2 days. This can be simplified\(^3\) to:

<table>
<thead>
<tr>
<th>Age</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 months</td>
<td>1ml syrup* (20 mg)</td>
</tr>
<tr>
<td>3-11 months</td>
<td>2ml syrup* (40 mg)</td>
</tr>
<tr>
<td>1-2 years</td>
<td>5ml syrup* (100 mg)</td>
</tr>
<tr>
<td>3-4 years</td>
<td>7.5 ml syrup (150 mg)</td>
</tr>
<tr>
<td>5-6 years</td>
<td>10 ml syrup (200 mg)</td>
</tr>
<tr>
<td>7-12 years</td>
<td>300mg capsule</td>
</tr>
<tr>
<td>&gt; 12 years</td>
<td>600mg capsule</td>
</tr>
</tbody>
</table>

*Rifampicin syrup contains 100mg / 5ml

Note: The Product Information recommends a once-daily four-day regimen of rifampicin for clearance antibiotics of meningococcal disease. The two-day regimen above is recommended by the Communicable Diseases Network Australia in accordance with the Cochrane review.\(^41\)

8.7 Vaccination

Due to the prolonged risk of secondary cases in household settings, vaccination is indicated for unimmunised household and sexual contacts of cases of confirmed vaccine-preventable meningococcal disease. Vaccination should be offered to these contacts as soon as the serogroup is confirmed, and within 4 weeks of onset of disease in the case. For confirmed serogroup C disease, MenCCV should be used (it is registered for use in Australia from 6 weeks of age).\(^42, 43\) 4vMenPV should be used in persons aged 2 years and over for confirmed cases of serogroups A, W135 or Y. Cases of serogroup C disease should be offered MenCCV as immunisation with conjugate vaccines appears to induce better sustained immunity than natural infection.\(^3\)

If 4MenPPV is to be administered after MenCCV, a period of ≥ 2 weeks should elapse before 4MenPPV is given. There are limited data available on the length of time that should lapse before administration of MenCCV after giving 4vMenPV. The NHMRC recommends a period of 6 months before the conjugate vaccine is given.

Household contacts (or equivalent) of cases of vaccine-preventable strains should be provided with a letter advising that they should receive vaccination, and that they should visit their usual health care provider at the earliest opportunity to receive this.

The tetravalent meningococcal polysaccharide vaccines induce antibodies in 10-14 days in 90% of recipients over the age of 2 years. Immunity decreases markedly during the first 3 years following a single dose of vaccine, particularly in infants and young children.\(^44\) However, clinical protection persists for at least 3 years in school children and adults. Polysaccharide vaccines have no impact on carriage of meningococci.

In studies in the United Kingdom, 98% to 100% of infants given 3 doses of meningococcal group C conjugate vaccine on a 2, 3, 4 month schedule developed serum bactericidal antibody (SBA) titres ≥ 1/8 one month after the third dose.\(^42, 43\) In children over 12 months of age, a single dose of the vaccine appears sufficient to induce protective antibody responses. In children 12–18 months of age receiving a single dose of meningococcal group C conjugate vaccine, 91% to 100% achieved SBA titres ≥ 1/8. In older children, seroconversion rates increase with age: 96% of 3 year olds, and 98% of 4-5 year olds and 98% of 14-17 year olds achieve SBA titres ≥ 1/8 after a single dose.\(^42\) Antibody concentrations decline rapidly after primary immunisation in infants and children, but booster responses to meningococcal C polysaccharide immunisation are observed.

References


Chapter 9 Management of outbreaks of meningococcal disease

**Key Points**

- An organisation based outbreak is the occurrence of two or more cases of meningococcal disease with an onset within a 4-week interval in a grouping that makes epidemiological sense, and where the available microbiological characterisation of the organisms is the same. Groupings can occur in schools, universities, classmates, yearmates, members of the same workgroup and community. Co-primary and secondary cases are excluded in the calculation of an outbreak.

- A community based outbreak is the occurrence of three or more cases of confirmed meningococcal disease within a 3-month interval, which brings the rate of invasive disease in the community to 10 or more per 100,000 total population in a 3 month period, in a geographical area that makes epidemiological sense and where available microbiological characterisation of the organisms is the same.

- The objective of public health management of outbreaks is to interrupt the transmission of disease and prevent further cases occurring. This can be achieved by establishing a response team, making a site visit if appropriate, undertaking intensified surveillance, providing adequate information and initiating appropriate use of clearance antibiotics and/or vaccination.

- In responding to organisation based outbreaks of cases, clearance antibiotics should be considered for a wider group than solely close contacts.

- Those who receive clearance antibiotics or vaccination should receive written information on meningococcal disease, the benefits and adverse events associated with clearance antibiotics and vaccination, and procedures (including after hours contact phone numbers) for answering questions or resolving problems. It is important to emphasise that further cases may occur even if clearance antibiotics or vaccination has been given. Where outbreaks occur in institutions or organisations, written information on meningococcal disease should also be given to those who do not require clearance antibiotics or vaccination. This is to inform them of the lower level of risk, and to advise what actions to take should they develop symptoms suggestive of meningococcal infection.

- Meningococcal vaccination, in addition to the use of clearance antibiotics, should be considered if an outbreak is due to a vaccine preventable strain. In Australia tetravalent polysaccharide vaccines against A, C, Y and W135 serogroups of *N. meningitidis* (4MenPPV) are available as well as a conjugate Group C vaccine (MenCCV).

### 9.1 Introduction

Outbreaks of cases of meningococcal infection are some of the most challenging situations for public health authorities due to the intense public concern and media interest they generate, the potential for severe morbidity and mortality among cases and the limited published evidence to guide best practice. Outbreaks may occur in the general community or in institutional settings such as schools and universities. The public health actions for each of these settings may vary and will depend on the identification (or otherwise) of epidemiological links between cases.

The term ‘outbreak’ is taken to mean the occurrence of more cases than expected for the population or group under consideration. Outbreaks of invasive meningococcal disease need to be distinguished...
from increases of sporadic and epidemiologically unlinked cases. Such increases may occur in the
general community or within institutions such as schools and child care centres.

The objective of public health management of such outbreaks of invasive meningococcal disease is to
interrupt transmission and prevent further cases. Once an outbreak is either suspected or recognised
there is an immediate need to initiate a coordinated response. Elements of this response include:

- A situation review to determine if there is an outbreak and its extent;
- The establishment of a response team(s) and, if possible, a site visit;
- Ensuring the institution of clearance antibiotics and/or immunisation as required for the
  setting, and the provision of information to all contacts and other persons involved;
- Establishment of heightened surveillance;
- Determination of the population at risk and calculation of age-specific and region-specific
  attack rates;
- Decisions on what action is to be taken;
- Provision of adequate information to health care providers, affected communities, the media
  and the general public; and
- Review of all actions taken and the preparation and dissemination of final documentation and
  a report.

Actions should be tailored to the setting. It is generally accepted that outbreaks of cases require more
intensive and extensive management than sporadic cases, however the evidence base for many of
the interventions that are commonly applied is lacking and decisions must be guided by
extrapolation from situations where evidence exists.

9.2 Definitions

**Sporadic case** — A single case in the absence of previous known close contact* with another case.

**Primary case** — A case that occurs in the absence of previous known close contact* with another
case.

**Co-primary case** — A close contact* who develops disease within 24 hours of onset of illness in a
primary case.

**Secondary case** — A close contact* who develops disease more than 24 hours after onset of illness
in a primary case where the available microbiological characterisation of the organisms is the same.

**Organisation based outbreak** — Two or more probable cases with onset in a four week interval in a
grouping which makes epidemiological sense; or two or more confirmed cases with onset in a four
week interval where the available microbiological characterisation of the organisms is the same in a
grouping which makes epidemiological sense.

**Community outbreak** — Three or more confirmed cases with onset in a 3 month interval, where the
available microbiological characterisation of the organisms is the same, and incidence at least 10 per
100,000 total community population in a 3 month interval.

* See Section 8.5 for a definition of close contact.
9.3 Identification of outbreaks

Surveillance data on invasive meningococcal disease should be reviewed on a continuous basis to identify cases and to identify outbreaks of cases. The following changes in epidemiology of meningococcal disease are suggestive of an outbreak:

- An increased rate of disease. In small populations, it may be more useful to focus on the number of cases rather than the rate;
- Clustering of patients in an age group or a shift in the age distribution of cases; and
- Phenotypic and genetic similarity among strains causing disease in the population. For serogroups B and C, the likelihood that two strains are related increases as one goes from serogroup in common to serotype and serosubtype in common, to nucleic acid in common. Investigation of serotype and serosubtype may help in the identification of outbreaks.

Serogroup A *N. meningitidis* was associated with large outbreak of meningococcal disease in central Australian indigenous communities during 1987–91. A single patient with group A meningococcal infection in an Aboriginal and Torres Strait Islander community should therefore alert health workers to the potential for a large outbreak.

Suspected outbreaks should be reviewed in order to identify the microbiological features of the cases and any epidemiologic links between cases. Microbiological investigation should focus on confirmation of the diagnosis (see Table 3) and rapid characterisation of organisms in as much detail as locally possible. Cases close in time and place, but infected with different serogroups (or serotypes or serosubtypes if known), should be managed as sporadic cases (see Chapter 8). The identification of possible epidemiological links should include a search for contacts in common, particularly in childcare, educational institutions or other groupings or organisations. Examples include attendance at nightclubs or parties.

9.4 Management of outbreaks

Following the identification of an outbreak of cases as defined above, the public health actions that follow include: the establishment of a response team; making a site visit appropriate; intensified surveillance; communication with involved parties.

9.4.1 Establishment of a response team

Setting up a small response team or planning committee is useful. Depending on the circumstances such a group might include a public health physician, a medical microbiologist, an infectious diseases clinician, a paediatrician, a public health nurse, surveillance officer and a media liaison adviser.

A reporting system must be established to ensure that key individuals, including those from other organisations (e.g. local government, educational and medical organisations), are kept informed.

The size of the response team and the frequency of meetings will vary according to the nature and extent of the outbreak.

9.4.2 Site visit

A site visit is useful:

- to gather first hand information on the outbreak;
- to assess the capability of local infrastructure and the availability of resources for implementation of strategies such as vaccination, should they be required;
- to meet local doctors and other health workers to give accurate advice;
- if necessary, to hold a public meeting to discuss community concerns; and
- to establish a list of health workers, school officials, environmental health officers, reporters and others who might play a part in local management of the outbreak.
9.4.3 Intensified surveillance
Surveillance should be intensified to identify further cases, and to collect relevant data on cases\textsuperscript{3, 7, 12}.

The following steps should be considered:

- active laboratory surveillance through daily contact with laboratories;
- active clinical surveillance through daily contact with hospital emergency departments, clinicians and admission offices;
- intensified passive surveillance through communication with laboratories, clinicians and hospitals to emphasise the need for immediate notification by a rapid reliable means (i.e. telephone) on suspicion of the diagnosis;
- collection and rapid analysis of epidemiological data on patients as; for sporadic cases (the case definitions for routine surveillance from Section 6.3 should be used), cases should be classified as ‘probable’ or ‘confirmed’ on the basis of diagnostic information to hand\textsuperscript{3, 7};
- collection of information for contact tracing;
- collection of microbiological data on cases. Serogrouping and antibiotic sensitivity test results should be collected for all \textit{N. meningitidis} isolates; microscopy and PCR results should be compiled for patients for whom an isolation was not made\textsuperscript{7}. Testing should include a full range of specimens — including blood for culture and PCR.
- development of a feedback mechanism for the timely dissemination of information, initially to persons participating in surveillance and control, and later more widely; and
- maintenance of intensified surveillance until incidence rates have returned to pre-outbreak levels.

9.4.4 Communication
Communication with the public, health care professions and affected communities is of utmost importance\textsuperscript{4}. A communication strategy should be considered at the initial meetings of the response team. Communication should be targeted to:

- individuals at risk, such as contacts or organisation members in organisation based outbreaks;
- health care professionals;
- the general community; and
- the media.

The communication requirements of these groups differ.

9.4.4.1 Individuals at risk
It is important to give information on meningococcal infection to people identified as being at risk.

9.4.4.2 Health care professionals
The health care community needs to be informed of the likely existence of an outbreak of cases, and that further cases could occur. Consideration should be given to direct communication with health professionals in the area. A letter to emergency departments and medical practitioners would emphasise the need for early diagnosis, empirical treatment and prompt notification of suspect cases. General practitioners should be aware of the treatment guidelines (for cases of invasive meningococcal disease) and have the appropriate drug available (see Section 2.3). General practitioners, emergency department clinicians and other primary health care providers diagnosing cases should be encouraged to collect blood cultures before administration of the first dose of antibiotics\textsuperscript{3}. Specimens should be sent at the same time as the patient is sent to hospital. Treatment and evacuation should, however, never be delayed if specimen collection is problematic. Several communication methods should be considered for disseminating information including websites, faxes, hotlines, mail or deliveries conducted by pathology companies.
9.4.4.3 The community at large
Consideration should be given to the establishment of information systems for the general community. In addition to communication through the mass media, websites, community meetings and help lines may be helpful.

9.4.4.4 The media
Outbreaks of cases of meningococcal disease generate intense media interest and a professional approach to communication through the media is required. It is usually better to have a single spokesperson who is experienced in dealing with the media, is authoritative, and is able to present the facts clearly. Where several institutions (hospitals, public health units etc) are involved, there should be agreement on the messages to be given. It is often helpful to hold press conferences when there is major media interest, both to reduce the time given to dealing with media enquiries (thus maximising the time available for the response team to do their work) and to ensure a consistent message is given to the media.

9.5 Response related to specific settings

9.5.1 Organisation-based outbreaks
In household-like settings, such as child care centres, the population at risk is a natural grouping that makes epidemiological sense and has meaning for the people concerned. Identification of populations at risk in other organisational settings, where comparability to a household varies such as schools, universities and workplaces, is more difficult. If microbiologic data are available to show that cases are of different serogroups, serotypes or serosubtypes, this enables them to be regarded as sporadic cases and managed accordingly (see Chapter 8). These data also have implications for assessment of vaccination status and its effect on management by the available interventions of clearance antibiotics and vaccination.

9.5.1.1 Clearance antibiotics
Clearance antibiotics should be considered for a wider group than close contacts in organisational outbreaks, even though the evidence for clearance antibiotics preventing further cases is not strong. Clearance antibiotic recommendations are the same as those for sporadic cases (refer to Chapter 8).

Unless microbiological evidence shows otherwise, co-primary or secondary cases (as defined in section 9.2) are assumed to have acquired infection through close contact with primary cases. Other than in household-like settings, co-primary or secondary cases should not be counted when determining whether criteria for organisation-based clearance antibiotics have been met. For example, two probable cases in university students in the same class who share accommodation do not define a university-based outbreak, since the risk is assumed to arise from the household-like setting of the shared accommodation.

9.5.1.2 Vaccination for organisation-based outbreaks
The use of meningococcal vaccine(s) in addition to clearance antibiotics should be considered if the outbreak is due to a vaccine-preventable strain.

The meningococcal vaccines available in Australia are of two types – conjugate vaccines (against serogroup C (MenCCV) and polysaccharide vaccine which is tetravalent (against serogroups A, C, Y and W135 - 4vMenPV). In most areas of Australia, serogroup B is most common, but in Victoria and Tasmania prior to the National Meningococcal Vaccination Program, serogroup C had become the most common strain. No vaccine is currently available against serogroup B, although in New Zealand a vaccination program to protect against a specific subgroup of B:4:P1.7,4 was commenced in 2005. The most common scenario where vaccination is indicated will be an outbreak where Neisseria meningitidis serogroup C has been identified, as serogroups A, W135 or Y are responsible for less than 5% of cases nationally.

Children may be immunised against serogroup A using 4vMenPPV from three months of age but, in those less than 18 months of age, a second dose of vaccine should be given three months later if there is continuing risk of disease. In children 18 months and older, a single dose of vaccine is
In practice, outbreaks of group A meningococcal disease are rare in Australia and, in recent times, have only occurred in remote Aboriginal communities.

For outbreaks caused by serogroup C disease, MenCCV should be used. 4MenPPV should be used in outbreaks caused by serogroups W135, Y or A.

In Australia, routine vaccination with MenCCV commenced on 1 January 2003 with a single dose given in the National Immunisation Program Schedule at 12 months of age. In addition, a catch up program was offered from 1 January 2003 to 31 December 2005 in which all those aged 1-19 years during 2003 were eligible for a single dose of MenCCV. Hence, the immunised cohort will move further up the age band each year. In children under the age of 7 years, documentation of Meningococcal C conjugate vaccine will usually be available from the ACIR. In older recipients, the availability of records will vary. Although many older immunised persons may not have a record of immunisation, it is prudent in an outbreak setting to withhold vaccine only from those where vaccination is documented by a written record.

The recommended procedure for obtaining consent prior to vaccination as outlined in the current Australian Immunisation Procedures Handbook should be used. Prior to vaccination, the person being vaccinated or, in the case of a child, the child’s parent or care giver should be given adequate information about the risks and benefits so as to be able to make an informed decision. It is preferable that printed information is available to supplement any oral explanations.

Vaccination of children in schools or similar venues should proceed only after written consent from the parent or guardian has been obtained. Such consent should be based on information adequate to enable the person to make an informed decision. If a child is old enough to adequately understand the benefits and risks of the proposed vaccination, and refuses the vaccination in spite of such understanding, their wish should be respected. In such situations, this should be discussed further with the parents.

In preparing for a vaccination program at a school or university the response team should ensure that, prior to the day selected for vaccination: the consent forms and information have been distributed and arrangements made for their collection; adequate supplies of vaccines ordered and arrangements made for cold chain maintenance; adequate consumables (syringes, needles, swabs, etc) ordered with arrangements for disposal; a suitable venue with sufficient space for staff, volunteers, groups awaiting vaccination etc; sufficient staff on hand for the numbers expected; and, arrangements made for handling members of the media who may turn up.

Immediately prior to vaccination, the health professional should assess the health status of the person to ensure the appropriate vaccine can be given.

Whenever mass vaccination is implemented, the target population must be carefully defined and a conscious effort made to adhere to that definition. If the defined target population includes children and adolescents, schools can be used as a venue for efficient and rapid mass vaccination. The criteria for vaccination should be clearly defined and firmly stated, for example, “all those born after 1 January 1980”.

9.5.2 Community outbreaks

These outbreaks are difficult to define and manage and have to be distinguished from a general increase in incidence caused by more than one serogroup. Table 10 lists public health actions for a community outbreak. A community outbreak is defined as:

- the occurrence of three or more confirmed cases of invasive meningococcal disease due to a single serogroup (and serotype and serosubtype if characterisation to this level is available) in a 3 month period; and
- there is an incidence of this type of at least 10 per 100,000 total community population in the 3 months.

At risk populations are usually defined geographically by using natural or political boundaries that most closely fit the residence data for the majority of the outbreak patients. School districts or town borders have been used to demarcate populations for preventive measures. However, physical or political boundary lines obviously do not limit factors that contribute to the increasing risk of meningococcal disease, and accurate identification of the at-risk population should not be inappropriately constrained by them.
Vaccination should be offered to selected age groups within the community population depending on the age-specific incidence, which will generally be clear from the available data.

### 9.5.2.1 Clearance antibiotics

Community-wide clearance antibiotics should not be used. The widespread use of clearance antibiotics in community outbreaks has not been shown to be of value. It may result in:

- the eradication of benign strains of *Neisseria meningitidis* and bacteria of other species that induce protective antibodies,
- the generation of drug resistant strains; and
- an increase in the prevalence of drug-related adverse events.

### 9.5.2.2 Vaccination for community outbreaks

The decision to vaccinate a large population is a difficult one for several reasons:

- when the issue is first raised, there are usually a small number of patients with a relatively low attack rate in the total population;
- cases may be widely dispersed in time and space, making it difficult to determine whether this is an outbreak of a fluctuation, within expected limits for sporadic disease; and
- the cost of the vaccine and other resources required to vaccinate the group are considerable.

A community-wide vaccination program should be considered if there are 3 or more confirmed cases. The steps in preparing for mass vaccination are 7:

- nominate a person to be responsible for coordinating the vaccination campaign;
- arrange adequate supplies of vaccine;
- arrange transport, cold chain and storage facilities for large quantities of vaccine;
- deploy adequately trained personnel to assist with the mass vaccination campaign;
- arrange venues for vaccination clinics;
- prepare a schedule for a phased campaign so that the clinics are not overwhelmed (including ‘catch-up’ clinics for those who missed out on the first round of vaccination);
- set up an adequate communication network (telephone, facsimile) linking the coordinating office, the supervisory public health office and the vaccination clinics;
- establish a system to record relevant details of those receiving the vaccine (names, sex, address, date of birth, date of vaccination, vaccine batch number, address of vaccination clinic) so that vaccine uptake (and perhaps ultimately vaccine efficacy) can be determined;
- prepare the necessary information and consent material, translated into several languages if necessary; and
- plan for maintenance of routine immunisation programs and clinic services while the vaccination program is in progress.
If public statements about eligibility for vaccination are unclear, there is a risk that individuals at minimal risk will also demand vaccination, and people may become confused, angry, or even aggressive. Persons whose children fall outside the announced criteria will often seek vaccination for their children (or for themselves). It is preferable that a single official (normally the coordinator of the vaccination program) be responsible for all decisions to grant or not to grant exemptions in such cases.

9.5.3 Aboriginal and Torres Strait islander communities
The risk of sustained transmission of invasive meningococcal disease in Aboriginal and Torres Strait Islander communities, especially remote communities, is high. For this reason, a low threshold should be used to determine the necessity for control measures. Interventions targeted to all community members should be implemented if there are 2 or more cases in a remote Aboriginal or Torres Strait Islander community in a 4–week period.

Interventions aimed to prevent further cases should include:

- educational materials and information for all community members. Such information should be in a form which is appropriate to the community and should include contact procedures (including after hours procedures) for people with queries;
- clearance antibiotics for close contacts, as for sporadic cases;
- where cases are confirmed as serogroup A, C, Y or W135, vaccination is indicated for all community members in the age groups designated by the local public health unit; and
- monitoring resistance patterns in sustained outbreaks in Aboriginal and Torres Strait Islander communities.

9.6 Documentation and review
It is important to adequately document outbreaks and the actions taken. A structured review should always be undertaken of each outbreak and its management with a view to improving performance. Documentation and reviews provide an evidence base for refining policy.

References


## Appendix 1

### Summary of public health responses in defined settings in which a single case of invasive meningococcal disease has occurred

<table>
<thead>
<tr>
<th>Setting</th>
<th>Clearance antibiotics(^b)</th>
<th>Vaccination(^c)</th>
<th>Information(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household(^d) of a case (including sexual contacts)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Child-care facilities</td>
<td>Children and staff in the same room for 4 or more hours at one time in the 7 days prior to the onset of the case's illness</td>
<td>No</td>
<td>All other children and staff at the facility</td>
</tr>
<tr>
<td>Family day care</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Schools and Universities</td>
<td>Students who are &quot;household –like&quot; contacts</td>
<td>Students who are &quot;household –like&quot; contacts (see footnote (d))</td>
<td>All other students in the same classroom (schools) or tutorial groups (universities)</td>
</tr>
<tr>
<td>Those exposed to a case after the onset of symptoms</td>
<td>Health Care workers who have either intubated the case without a face mask or done mouth to mouth resuscitation</td>
<td>No</td>
<td>All others concerned that they may have had contact with the case after the onset of symptoms</td>
</tr>
<tr>
<td>Those in seats adjacent to a case during long duration (&gt;8 hours) travel</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\(^a\) The disease, including the common signs and symptoms, must be described and the mode of transmission explained (refer Appendix 2). Appropriate action if symptoms suggestive of meningococcal infection occur should be detailed.

\(^b\) Only those in close and prolonged contact with a case in the 7 days prior to the onset of symptoms, and only very close contacts after the onset of the case's symptoms, require clearance antibiotics. The possible adverse reactions and drug interactions should be described. It must be emphasised that meningococcal disease can occur (rarely) despite clearance antibiotics. It should be explained that those taking clearance antibiotics need neither be quarantined nor adopt any specific behaviours.

\(^c\) Immunisation history should be checked and vaccination offered to all household contacts of a case with a vaccine-preventable strain. MenCCV should be offered for contacts of serogroup C disease (Infants < 6 months of age require 2 doses of 0.5 ml, given at least 8 weeks apart, followed by a booster dose at 12 months of age. Children 6-11 months require one dose of 0.5 ml, followed by a booster dose at 12 months of age. Persons 12 months of age or older require one dose of 0.5 ml only). 4MenPPV is recommended for household contacts of cases of serogroup W135, A and Y disease. This vaccine is approved for use in children aged ≥ 2 years of age.
‘Households’ include those in the same dormitory, military barracks or hostel bunkroom in the seven days prior to the onset of the case’s symptoms. Sexual contacts should be managed as household contacts. The opportunity should be taken to catch up any children who are eligible for meningococcal C vaccination under the National Immunisation Program and who have not yet been vaccinated.
Appendix 2

Sample Documentation Page

Meningococcal disease information
  2A Information for the public
  2B Meningococcal symptom chart — older children and adult
  2C Meningococcal symptom chart — baby

Antibiotic Fact Sheets
  2D Ciprofloxacin fact sheet
  2E Rifampicin fact sheet

Meningococcal disease contact letters
  2F Clearance antibiotics and vaccination letter
  2G Information letter to contacts
Appendix 2A

MENINGOCOCCAL DISEASE:

Information for the public

(This information sheet can be adapted to different settings)

What is the 'meningococcus'?
The meningococcus is a bacterium that can be found at the back of the throat or in the nose in about 10% of the community at any given time. Although most people who carry this germ in their throat or nose remain quite well, they are able to spread it to others, a few of whom may subsequently become very ill. It is spread in the fine droplets that are shed through coughing, sneezing and spluttering.

What is meningococcal disease?
Meningococcal disease is a severe infection that occurs when the meningococcal germ 'invades' the body from the throat or nose. It does not occur in people who carry the germ but rather occurs in people who have very recently (within the previous 7 days) acquired the germ from a healthy 'carrier'.

Meningococcus is spread in two main forms or it can occur as a combination of these two forms. Meningococcal septicaemia occurs when the germ invades the bloodstream and causes blood poisoning. Meningococcal meningitis occurs when the germ infects the outer lining around the brain and spinal cord.

Meningococcal septicaemia, also known as meningococcal meningitis, can be very serious and cause death. The patient is usually very ill, has a fever and may have marked joint or muscle pains; and there is often a rash. The rash may start anywhere on the body as tiny red or purple spots but they soon spread and enlarge to look like fresh bruises; the rash does not fade when pressure is applied to it, e.g. with the thumb.

The rash must be taken seriously as the person requires urgent medical attention.
The typical symptoms of meningococcal meningitis include fever, a stiff neck, severe headache, dislike of bright lights, vomiting, joint or muscle pains, drowsiness and even coma; there may also be a rash with the same features as those described above. The symptoms of meningococcal meningitis in young babies may differ from those detailed above and include: refusing feeds, vomiting, a high pitched moaning cry, irritability and a dislike of being handled, a blank staring expression, lethargy or drowsiness and a pale blotchy complexion.

How easy is it to catch meningococcal disease?
Although the germ is spread in droplets that are shed from the nose or throat it is not, fortunately, easy to catch the disease. This is because the meningococcal germ does not survive for long outside the body. Close and prolonged contact with a carrier is usually required for the germ to spread to other people.

Because the germ is not easily spread, meningococcal disease is uncommon. Young children under 5 years of age, and young adults (15–24 years of age) are at highest risk of acquiring meningococcal disease, and there is usually a seasonal increase in the winter to early spring months.

Even though it is hard to catch and uncommon, meningococcal disease is a feared infection that is often featured in the media. This is because it can be fatal, even in healthy young adults and because outbreaks of meningococcal disease, although very infrequent, can occur.
How can meningococcal disease be prevented?

Cigarette smoking, both active and passive, appears to increase the risk of a person developing meningococcal disease. This is yet another reason to stop smoking and to stop adults smoking near young children.

There is a small, but real, risk for those who live in the same house as a person with meningococcal disease to also develop the disease. This is because the carrier who infected the patient is able to spread the germ to others. There is no accurate and quick test to identify the carrier so all of the household contacts of the patient are regarded as potential carriers.

Instead, public health authorities attempt to contact these household contacts to explain to them the nature of the disease and to dispense a short course of an antibiotic. The purpose of the antibiotic is to eliminate the germ from the nose or throat of the carrier. Cases of disease may occur despite taking the antibiotic so the contacts must also be told to be aware for the symptoms of the disease.

Sometimes other contacts are also identified by public health authorities and given the above-mentioned advice and antibiotic. However it is very important that the public health authorities are involved in the identification of other contacts because the antibiotic should be used very carefully.

Is there a vaccine against meningococcal disease?

Yes, there is a vaccine against the C strain of the disease, which has been routinely given to all children in Australia at 12 months of age since January 2003. From 2003 to 2006, there was also a large program to vaccinate all persons aged 1 to 19 years with this vaccine. This has resulted in the number of cases due to the C strain decreasing substantially. The vaccine does not protect against the commonest strain of the meningococcal germ, known as the group B strain, which commonly occurs in Australia. For further information contact your local public health authority.
Appendix 2B Meningococcal Symptom Chart

How can you tell if someone has meningococcal disease?

Not all these symptoms may show at once

- Fever
- Headache
- Drowsiness or confusion-coma
- Neck stiffness, joint pains
- Rash of red-purple spots or bruises
- Dislike of bright lights
- Vomiting
Appendix 2C Meningococcal Symptom Chart

How can you tell if a baby has meningococcal disease?

Not all these symptoms may show at once

- Fever
- Fretfulness
- Child is difficult to wake
- Pale or blotchy skin
- Rash of red-purple spots or bruises
- High pitched moaning cry
- Refusing feeds or vomiting
Appendix 2D

CIPROFLOXACIN:

an antibiotic for contacts of a person with a meningococcal infection

Ciprofloxacin is an antibiotic that is sometimes given to those in close contact with a person who has developed a meningococcal infection. The purpose of this antibiotic is to get rid of any meningococcal germs being 'carried' in the throat of contacts so that they cannot lead to further infections. The antibiotic cannot treat someone who is already developing the infection: you need to know what signs (of meningococcal infections) to look out for regardless of taking ciprofloxacin.

The dose of ciprofloxacin is a single dose of 500 mg taken in tablet form.

You should not take this medicine if:

• You have had a previous allergic reaction to ciprofloxacin.
• You are pregnant or breast-feeding.

Before taking this medicine, you should check with your doctor if you are taking any other medications. It is quite safe to take ciprofloxacin if you are taking the oral contraceptive pill. Ciprofloxacin is not recommended for use in children under 12 years of age.

It is important that you take your tablet as follows:

• The tablet should be swallowed whole with a full glass of water.
• Do not take the tablet if you have taken antacid/indigestion medicines or medicines containing iron or mineral supplements within the previous 4 hours.

You may also feel tired or develop a stomach ache but these effects usually settle quickly and are not cause for concern.

A very uncommon side effect is an allergic reaction with facial swelling. This might happen soon after taking the tablet; if it happens, you should seek medical attention immediately (see the doctor if you are at a hospital, or ring 000).
RIFAMPICIN:

an antibiotic for contacts of a person with meningococcal disease

Rifampicin is an antibiotic drug that is sometimes given to those in close contact with a person who has developed a meningococcal infection. The purpose of this antibiotic is to get rid of any meningococcal germs being 'carried' in the throat of contacts so that they cannot lead to further infections. The antibiotic cannot treat someone who is already developing the infection: you need to know what signs (of meningococcal infections) to look out for regardless of taking rifampicin.

Rifampicin should not be taken by a person who

- has severe liver impairment (including yellow jaundice);
- is an alcoholic; or
- is pregnant.

Rifampicin is taken twice a day for 2 days (a total of four doses). It should be taken on an empty stomach: half an hour before or two hours after food. A few people feel 'off' after taking rifampicin: stomach upset, headache and dizziness can occur.

Rifampicin can also make urine and tears a pink-orange colour. This discolouration is harmless and stops when the medication is discontinued. Rifampicin can permanently stain soft contact lenses so use during treatment should be avoided.

Interactions with other medicines

If you are taking any of the following prescription drugs: anticoagulants such as warfarin, steroids, several drugs for heart disease, tablets to control diabetes, tablets for epilepsy, tablets for asthma, methadone, antiviral agents, antidepressants and cyclosporin — notify your doctor that you will be taking rifampicin as the dosage of your other medication may need adjustment.

Rifampicin can reduce the effectiveness of oral contraceptives. Women taking the oral contraceptive pill should continue to take it, omitting any pill-free or sugar pill interval, while taking rifampicin and for the seven days after the last dose of rifampicin. They should also use additional barrier contraception, such as condoms, while taking rifampicin and for four weeks after the last dose of rifampicin.
Appended 2F

Letter to close contacts regarding clearance antibiotics and vaccination

NOTE FOR PHU — Please copy this text onto PHU letterhead, or otherwise provide contact details.

Dear

I believe you have recently been in close contact with a person who has meningococcal infection.

Meningococcal infection is caused by a bacterium that is carried, usually harmlessly, in the nose and throat by up to 10% of people. However, occasionally carriers may pass it on to others who have been in close contact with them. Only a very small number of people in contact with carriers develop meningococcal disease. Once exposed to the bacterium it may take up to ten days for the infection to develop.

As you have been in contact with a person who has this infection you may be a carrier of meningococcal bacteria. For this reason you should take a short course of antibiotics. This is intended to eliminate the bacteria you may be carrying and to prevent further infections. The antibiotic may not always prevent disease in a person who is already developing the infection. Whilst on the medication it is not necessary for you to avoid contact with family members and children and you do not need to be isolated or excluded from school, or work.

Depending upon the strain of meningococcal bacteria, your local Public Health Unit may recommend vaccination for household contacts of the person with meningococcal infection. Your Public Health Unit will advise you if this is necessary. It is important that you should seek medical advice immediately if you develop any of the following symptoms listed below, or if you are unwell. Please take this letter with you if you need to see your doctor or the emergency department of a hospital.

Symptoms in infants include

- Fever
- Refusing to take feeds
- Fretfulness
- Child difficult to wake
- Rash of reddish-purple spots or bruises
- High pitched or moaning cry
- Pale or blotchy skin

Symptoms in older children and adults include

- Headache
- Fever
- Vomiting
- Neck stiffness and joint pains
- Drowsiness or confusion
- Rash of reddish-purple spots or bruises
- Discomfort when looking at bright lights

Yours sincerely,

Director

Public Health Unit
Appendix 2G

Information letter to contacts

NOTE FOR PHU — Please copy this text onto PHU letterhead, or otherwise provide contact details.

Dear

I believe you have recently been in contact with a person who has meningococcal infection.

Meningococcal infection is caused by a bacterium that is carried, usually harmlessly, in the nose and throat by up to 10% of people. However, occasionally carriers may pass it on to others who have been in close contact with them. Only a very small number of people in contact with those that carry the infection develop meningococcal disease. If a carrier passes the bacterium to another person it may take up to 10 days for the infection to develop.

It is not necessary for you to take any antibiotic medication, or avoid contact with family members or children, and you do not need to be isolated or excluded from school or work. While your risk of developing infection is very low, it is important that you seek medical advice immediately if you develop any of the symptoms listed below, or if you become unwell. Please take this letter with you if you need to see your doctor or the emergency department of a hospital.

Symptoms in infants include

- Fever
- Refusing to take feeds
- Fretfulness
- Child difficult to wake
- Rash of reddish-purple spots or bruises
- High pitched or moaning cry
- Pale or blotchy skin

Symptoms in older children and adults include

- Headache
- Fever
- Vomiting
- Neck stiffness and joint pains
- Drowsiness or confusion
- Rash of reddish-purple spots or bruises
- Discomfort when looking at bright lights

Yours sincerely,

Director

Public Health Unit
Appendix 3

Communicable Diseases
Case Questionnaire
Meningococcal Disease

Final classification:
- Confirmed – serogroup
- Probable (i.e. clinically compatible)
- Rejected

SECTION 1: DEMOGRAPHIC DATA

Surname: ________________________________

Given names: ____________________________

Street Address: __________________________

Suburb/Town: ____________________________  Postcode: ____________________________

Telephone: H: (_____ ) ________________  W: (____) ________________

Date of Birth: / /  or Age: _______  Sex: Male / Female

Country of Birth: __________________________

Aboriginality: Aboriginal       Torres Strait Islander (TSI)       Aboriginal & TSI
(Tick as appropriate):
Not A/TSI       Not Stated/Unknown/Question unable to be asked

Occupation: __________________________

Name / Address of: __________________________

Employer or School or Child Care Attended:

Telephone: __________________________  Facsimile: __________________________

Date Last Attended: / /

SECTION 2: TREATING DOCTOR / HOSPITAL

Name of Treating Doctor or Hospital (if admitted): __________________________

Street Address: __________________________  UR No: __________________________

Suburb/Town: __________________________  Ward: __________________________

Telephone: __________________________  Facsimile: __________________________

Date of Admission: / /  Date of Discharge / Death: / /  Date of Death: / /

Was the patient brought to hospital by ambulance?  no    yes

_______________________________________
SECTION 3: ILLNESS SUMMARY

Onset Date (first symptom) / / Incubation period from: / / (7 days before onset)

Symptom Checklist:
- Fever / Chills
- Headache
- Rash
- Photophobia
- Neck stiffness
- Arthralgia Myalgia
- Abdominal Pain
- Vomiting
- Diarrhoea
- Ataxia

Laboratory Results:
- Blot WCC: Neutrophils: CRP: Culture: Growth No Growth
- CSF: WCC: Protein: Glucose: Culture: Growth No Growth

Details (onset, description and location of rash etc) and other symptoms, treatment details.

Has the case received appropriate clearance antibiotics? yes (Ceftriaxone, Ciprofloxacin, Rifampicin) no

Does the patient have a spleen? no yes

Smoking risk? Smoker Smoker in household Non-smoker

SECTION 4: EPIDEMIOLOGICAL CONTACT QUESTIONS

Previous meningococcal vaccination? no yes Date Verified by: (e.g. doctor, case, family)
- Conjugate Serogroup C / / ...
- Polysaccharide (A/CYW135) / / ...

Previous contact with a family member, a friend, school contact or work colleague with a similar illness?
- no yes

Attended childcare in the 7 days prior to onset?
- no yes not applicable

Attended any special functions / parties in the 7 days prior to onset?
- no yes

Has the case travelled in the 7 days prior to onset?
- no yes
**SECTION 5: CONTACT DETAILS**

For single, sporadic cases, clearance antibiotics should be given to:
- All household contacts (including overnight guests who stayed in the same house with the case during the cases incubation period)
- Child care and family day care attendees (children and staff who spent >4 hours in the same room with the case),
- Those who have had intimate contact with the case (including sexual contacts), and
- 

Antibiotics supplied by State Health Department (SHD) should also be recorded on a Departmental consent form as well as this log sheet.

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<tr>
<th>Relation to case</th>
<th>Name</th>
<th>Age</th>
<th>Clearance Antibiotics Recommended?</th>
<th>Type Used</th>
<th>Given By: (SHD / Hospital / GP)</th>
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**SECTION 6: COMMENTS OR CONCLUSIONS**

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<th>Epidemiological classification</th>
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<th>cluster</th>
<th>co-primary</th>
<th>outbreak</th>
<th>secondary</th>
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</table>

Related Cases Reference:

- Name: ________________________________  date: __/__/____
- Creche or School notified  Name: ________________________________  date: __/__/____
- Workplace notified  Name: ________________________________  date: __/__/____
- Ambulance service notified  Name: ________________________________  date: __/__/____
- Name: ________________________________  date: __/__/____

Please attach copy to cases file.

**Officer Signature:**  date: __/__/____

(Also print name)
Appendix 4

**Meningococcal Disease Committee**  
*(a sub committee of the Communicable Diseases Network Australia)*

**Dr Rosemary Lester** (Chair)  
Assistant Director, Communicable Diseases Section  
Department of Human Services, Melbourne  
Victoria

**Professor Peter McIntyre**  
Co Director, National Centre for Immunisation Research and Surveillance  
The Children’s Hospital at Westmead, Sydney  
New South Wales

**Professor Robert Booy**  
Co Director, National Centre for Immunisation Research and Surveillance  
The Children’s Hospital at Westmead, Sydney  
New South Wales

**Professor Peter Collignon**  
Director, Infectious Diseases Department  
The Canberra Hospital  
Australian Capital Territory

**Professor John Tapsall**  
Director, WHO Collaborating Centre for STD and HIV  
The Prince of Wales Hospital, Sydney  
New South Wales

**Dr Brad McCall**  
Brisbane Southside Population Health Unit  
Queensland Health  
Brisbane  
Queensland

**Dr Dale Badham**  
Department of Health  
Canberra  
Australian Capital Territory

**Dr Diana Martin**  
Principal Scientist  
Institute of Environmental Science and Research Ltd  
New Zealand

**Ms Sandra Gebbie**  
Director, Communicable Disease Health risk Policy Section  
Australian Government Department of Health and Ageing  
Canberra  
Australian Capital Territory

**Ms Maureen Watson**  
Department of Health  
Adelaide  
South Australia

**Secretariat**  
**Mr Paul Gorman**  
Communicable Disease Health Risk Policy Section  
Australian Government Department of Health and Ageing  
Canberra

**Ms Jacqui Kane**  
Communicable Disease Health Risk Policy Section  
Australian Government Department of Health and Ageing  
Canberra
Appendix 5

Public Health Unit List

Contact Details for Commonwealth Agencies

Chief Medical Officer – 02 6289 8408

CDNA Secretariat – 02 6289 3832

Contact Details for State and Territory Public Health and Communicable Disease Units

The following numbers should be contacted by medical practitioners for the reporting of communicable disease cases and for assistance in the management of disease outbreaks:

State and Territory Health Department Communicable Disease Contacts

<table>
<thead>
<tr>
<th>Australian Capital Territory</th>
<th>(02) 6205 2155</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Australia</td>
<td>(08) 8226 7177</td>
</tr>
<tr>
<td>Tasmania</td>
<td>1800 671 738</td>
</tr>
<tr>
<td>Victoria</td>
<td>1300 651 160</td>
</tr>
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Queensland

The reporting of communicable disease cases in the Queensland is facilitated by the individual Public Health Units listed below:

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<thead>
<tr>
<th>Public Health Unit</th>
<th>Phone</th>
<th>Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brisbane Southside</td>
<td>(07) 3000 9148</td>
<td>(07) 3000 9130</td>
</tr>
<tr>
<td>Gold Coast</td>
<td>(07) 5509 7222</td>
<td>(07) 5561 1851</td>
</tr>
<tr>
<td>Darling Downs</td>
<td>(07) 4631 9888</td>
<td>(07) 4632 8563</td>
</tr>
<tr>
<td>Brisbane Northside</td>
<td>(07) 3624 1111</td>
<td>(07) 3624 1199</td>
</tr>
<tr>
<td>Sunshine Coast</td>
<td>(07) 5409 6600</td>
<td>(07) 5443 5488</td>
</tr>
<tr>
<td>Wide Bay</td>
<td>(07) 4120 6000</td>
<td>(07) 4120 6009</td>
</tr>
<tr>
<td>Rockhampton</td>
<td>(07) 4920 6989</td>
<td>(07) 4920 6865</td>
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<tr>
<td>Bundaberg</td>
<td>(07) 4150 2780</td>
<td>(07) 4150 2729</td>
</tr>
<tr>
<td>Mackay</td>
<td>(07) 4968 6611</td>
<td>(07) 4968 6610</td>
</tr>
<tr>
<td>Townsville</td>
<td>(07) 4753 9000</td>
<td>(07) 4753 9001</td>
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<tr>
<td>Mt Isa</td>
<td>(07) 4744 4846</td>
<td>(07) 4745 4573</td>
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<tr>
<td>Cairns</td>
<td>(07) 4050 3600</td>
<td>(07) 4031 1440</td>
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Western Australia

The reporting of communicable disease cases in the Western Australia is facilitated by the individual Public Health Units listed below:

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<tr>
<th>Public Health Unit</th>
<th>Phone</th>
<th>Fax</th>
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<tbody>
<tr>
<td>North Metropolitan Area Health Service</td>
<td>(08)9224 7064 (08)9224 1605 (08)9224 1612</td>
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<tr>
<td>Population Metropolitan Health &amp; Ambulatory Care</td>
<td></td>
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<tr>
<td>North Metropolitan Area Health Service</td>
<td>(08)9345 7100 (08)9224 1603 (08)9349 9822 (08)9224 1932</td>
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<tr>
<td>Health Unit (Zone A)</td>
<td></td>
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<tr>
<td>North Metropolitan Area Health Service</td>
<td>(08)9224 1663 (08)9224 1649 (08)9224 8012</td>
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<tr>
<td>Health Unit (Zone B)</td>
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<tr>
<td>South Metropolitan Area Health Service</td>
<td>(08)9431 0206 (08)9431 0217 (08)9431 0223</td>
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<tr>
<td>Wheatbelt</td>
<td>(08)9622 4320 (08)9881 0388 (08)9622 5752</td>
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<tr>
<td>Goldfields</td>
<td>(08)9080 8200 (08)9080 8201</td>
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<tr>
<td>Great Southern</td>
<td>(08)9842 7531 (08)9842 2643</td>
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<tr>
<td>Kimberly</td>
<td>(08)9194 1642 (08)9194 1631</td>
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<tr>
<td>West/Gascoyne</td>
<td>(08)9956 1985 (08)9956 1991</td>
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<tr>
<td>Pilbara</td>
<td>(08)9172 8333 (08)9172 8360</td>
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<td></td>
</tr>
<tr>
<td>Southwest</td>
<td>(08)9781 2355 (08)9781 2382</td>
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</table>

Northern Territory

The reporting of communicable disease cases in the Northern Territory is facilitated by the individual Public Health Units listed below:

<table>
<thead>
<tr>
<th>Public Health Unit</th>
<th>Phone</th>
<th>Fax</th>
</tr>
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<tbody>
<tr>
<td>Darwin Communicable Disease Centre</td>
<td>(08) 8922 8044 (08) 8922 8310.</td>
<td></td>
</tr>
<tr>
<td>Katherine Communicable Disease Centre</td>
<td>(08) 8973 9049 (08) 8973 9048</td>
<td></td>
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<tr>
<td>Barkly Communicable Disease Centre</td>
<td>(08) 8962 4259</td>
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<tr>
<td>Alice Spring Communicable Disease Centre</td>
<td>(08) 8951 6907 (08) 8951 7900</td>
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<tr>
<td>East Arnhem Communicable Disease Centre</td>
<td>(08) 8987 0357 (08) 8987 0355</td>
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New South Wales

The reporting of communicable disease cases in New South Wales is facilitated by the individual Public Health Units listed below:

<table>
<thead>
<tr>
<th>Public Health Unit</th>
<th>Phone</th>
<th>Fax</th>
</tr>
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<tbody>
<tr>
<td>Northern Sydney/Central Coast PHU</td>
<td>(02) 9477 9400</td>
<td>(02) 9482 1650</td>
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<tr>
<td>Sydney South West PHU</td>
<td>(02) 9515 9420</td>
<td>(02) 9515 9440</td>
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<tr>
<td>Justice Health Service PHU</td>
<td>(02) 8372 3006</td>
<td>(02) 9289 2494</td>
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<tr>
<td>Greater Western Broken Hill PHU</td>
<td>(08) 8080 1419</td>
<td>(08) 8080 1683</td>
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<tr>
<td>Hunter/New England PHU</td>
<td>(02) 4924 6477</td>
<td>(02) 4924 6490</td>
</tr>
<tr>
<td>South Eastern Sydney/Illawarra PHU</td>
<td>(02) 9382 8333</td>
<td>(02) 9382 8334</td>
</tr>
<tr>
<td>Greater Western Dubbo PHU</td>
<td>(02) 6841 5569</td>
<td>(02) 6884 5571</td>
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<tr>
<td>North Coast Pt Macquarie PHU</td>
<td>(02) 6588 2750</td>
<td>(02) 6588 2837</td>
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<td>Greater Western Bathurst PHU</td>
<td>(02) 6339 5601</td>
<td>(02) 6339 5173</td>
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<tr>
<td>Hunter/Tamworth PHU</td>
<td>(02) 6767 8630</td>
<td>(02) 6766 3003</td>
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<tr>
<td>North Coast Lismore PHU</td>
<td>(02) 6620 7500</td>
<td>(02) 6622 2151</td>
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<tr>
<td>Northern Sydney/Gosford PHU</td>
<td>(02) 4349 4845</td>
<td>(02) 4349 4850</td>
</tr>
<tr>
<td>South Eastern Sydney/Illawarra PHU</td>
<td>(02) 9382 8333</td>
<td>(02) 9382 8334</td>
</tr>
<tr>
<td>South Eastern Sydney/Woonona PHU</td>
<td>(02) 4221 6700</td>
<td>(02) 4221 6722</td>
</tr>
<tr>
<td>Greater Southern PHU Queanbeyan</td>
<td>(02) 6124 9934</td>
<td>(02) 6214 9946</td>
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<tr>
<td>Greater Southern PHU Albury</td>
<td>(02) 6021 4799</td>
<td>(02) 6021 4899</td>
</tr>
<tr>
<td>Greater Southern/Goulburn PHU</td>
<td>(02) 4824 1837</td>
<td>(02) 4824 1831</td>
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<tr>
<td>Sydney West PHU Nepean</td>
<td>(02) 4734 2022</td>
<td>(02) 4734 3300</td>
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<tr>
<td>Sydney West PHU Parramatta</td>
<td>(02) 9840 3603</td>
<td>(02) 9840 3608</td>
</tr>
</tbody>
</table>

These Public Health Unit Contact Details were correct at the time of printing.

Appendix 6

National Neisseria Network (NNN) Laboratories

Queensland
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Public Health Microbiology
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Western Australia
Mr. C. Richardson/Ms K. Stowe/Mr. P. Campbell
Department of Microbiology
Princess Margaret Hospital for Children
1 Thomas Street
SUBIACO WA 6008

Tasmania
Mr Mark Gardam/Dr Alister McGregor
Department of Microbiology and Infectious Diseases
Royal Hobart Hospital
GPO Box 1061 L
HOBART TAS 7001

New South Wales
A/Prof. J. Tapsall
Microbiology Department, The Prince of Wales Hospital
High Street
RANDWICK NSW 2031

A/Prof Rosemary Munro
Department of Microbiology and Infectious Diseases
SWAPS
Locked Mail Bag 90
LIVERPOOL NSW 2170

Australian Capital Territory
A/Prof. P. Collignon/Mr R Southwell.
Department of Microbiology
Royal Canberra Hospital
Level 4 Pathology Building
Gilmore Crescent
GARRAN ACT 2606

South Australia
Mr A. Lawrence
Microbiology Department
Women's and Children's Hospital
72 King William Road
NORTH ADELAIDE SA 5006

Victoria
Dr J Griffith/Dr G Hogg
Microbiological Diagnostic Unit
University of Melbourne
PARKVILLE VIC 3052

Northern Territory
Dr G. Lum
Microbiology Laboratory
Royal Darwin Hospital
TIWI NT 0810
Appendix 7

Information and Support Groups

Information and support is available from the following groups

Australia

The Meningitis Centre
http://www.ichr.uwa.edu.au/affiliations/meningitis/

TVW Telethon Institute for Child Health Research
PO Box 855, West Perth WA 6872
Phone: (08) 9489 7791
Fax: (08) 9489 7705 or (08) 9489 7700.
Freecall: 1800250223
E-mail: meningitis@ichr.uwa.edu.au

Meningococcal Australia Inc
PO Box OURIMBAH NSW 2258
Phone: (02) 4362 8854. Fax: (02) 4362 8864.
Mobile: 0404 023 006.
E-mail: mhsanig@bigpond.com

International

Meningitis Research Foundation (United Kingdom)
http://www.meningitis.org.uk/

National Meningitis Trust (United Kingdom)
http://www.meningitis-trust.org.uk/

Meningitis Research Foundation of Canada
http://www.meningitis.ca/

Meningitis Foundation of America (USA)
http://www.musa.org/