

# 22

## Meningococcal

### MENINGOCOCCAL MENINGITIS AND SEPTICAEMIA NOTIFIABLE

#### The disease

Meningococcal disease is the result of a systemic bacterial infection by *Neisseria meningitidis*. Meningococci are gram-negative diplococci, divided into antigenically distinct groups. There are at least 13 serogroups, of which groups B and C are the most common in the UK. Other less common serogroups include A, Y, W135, 29E and Z. The 13 serogroups can be further subdivided by serotyping and serosubtyping and by sulphonamide sensitivity. Increasing use of molecular-based methods is allowing further classification of the organism and identification of specific clonal complexes that appear to be associated with invasive disease.

Meningococcal infection most commonly presents as either meningitis or septicaemia, or a combination of both. Less commonly, individuals may present with pneumonia, myocarditis, endocarditis, pericarditis, arthritis, conjunctivitis, urethritis, pharyngitis and cervicitis (Rosenstein *et al.*, 2001).

The incubation period is from two to seven days, and the onset of disease varies from fulminant with acute and overwhelming features, to insidious with mild prodromal symptoms. Early symptoms and signs are usually malaise, pyrexia and vomiting. Headache, neck stiffness, photophobia, drowsiness or confusion and joint pains may occur variably. In meningococcal septicaemia, a rash may develop, along with signs of advancing shock and isolated limb and/or joint pain. The rash may be non-specific early on but as the disease progresses the rash may become petechial or purpuric and may not blanch. This can readily be confirmed by gentle pressure with a glass (the 'glass' test) when the rash can be seen to persist (Figure 22.1). In young infants particularly, the onset may be insidious and the signs be non-specific without 'classical' features of meningitis.

Health professionals should be alert to the possibility of meningococcal infection in a young child presenting with vomiting, pyrexia and irritability and, if still patent, raised anterior fontanelle tension. Clinical deterioration may be very rapid with poor peripheral perfusion, pallor, tachypnoea, tachycardia and the emergence of the meningococcal rash. In severe cases, patients may present with hypotension or in a coma.



Figure 22.1 The 'glass' test (picture courtesy of Meningitis Research Foundation)

Meningococcal bacteria colonise the nasopharynx of humans and are frequently harmless commensals. Between 5 and 11% of adults and up to 25% of adolescents carry the bacteria without any signs or symptoms of the disease. In infants and young children, the carriage rate is low (Cartwright, 1995). It is not fully understood why the disease develops in some individuals but not in others. Age, season, smoking, preceding influenza A infection, and living in 'closed' or 'semi-closed' communities, such as university halls of residence or military barracks, have been identified as risk factors (Cartwright, 1995).

Transmission is by aerosol, droplets or direct contact with respiratory secretions of someone carrying the organism. Transmission usually requires either frequent or prolonged close contact. There is a marked seasonal variation in meningococcal disease, with peak levels in the winter months declining to low levels by late summer.

The incidence of meningococcal disease is highest in children aged one to five years followed by infants under one year of age. The next highest risk group is young people aged 15 to 19 years.

Overall mortality remains around 10% in the UK (Ramsay *et al.*, 1997; Goldacre *et al.*, 2003). Case fatality ratios increase with age and are higher in

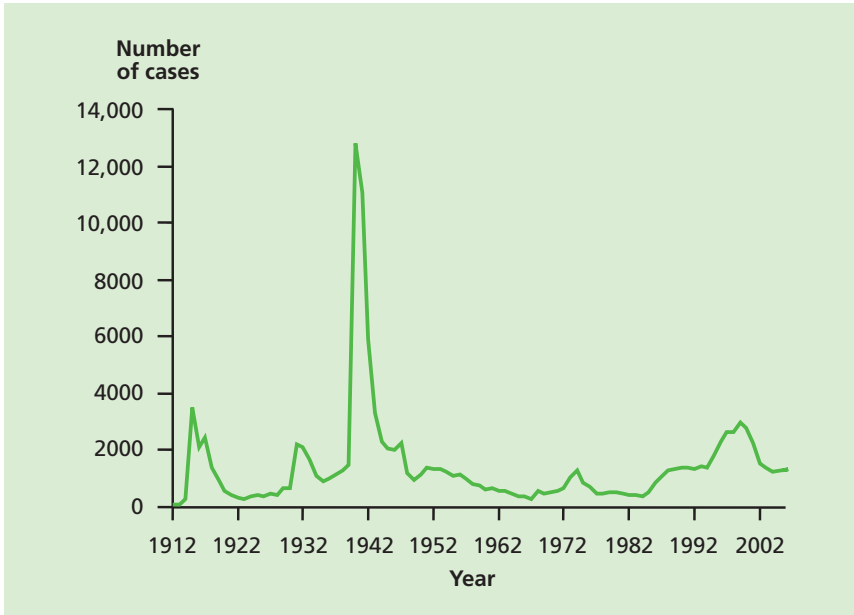


Figure 22.2 Notifications of meningococcal disease, England and Wales 1912–2004

individuals with serogroup C than with serogroup B infections (Ramsay *et al.*, 1997; Goldacre *et al.*, 2003) and also higher in those infected with strains with certain typing patterns (Trotter *et al.*, 2002). Mortality is higher in cases with septicaemia than in those with meningitis alone (Davison *et al.*, 2002). Recent studies in paediatric intensive care settings have indicated that prompt and active management may reduce fatality ratios (Booy *et al.*, 2001; Thorburn *et al.*, 2001). In those who survive, approximately 25% may experience a reduced quality of life, with 10–20% developing permanent sequelae (Erickson and De Wals, 1998; Granoff, *et al.*, 2004). The most common long-term effects are skin scars, limb amputation(s), hearing loss, seizures and brain damage (Steven and Wood, 1995; Lepow *et al.*, 1999).

## History and epidemiology of the disease

Large epidemics of meningococcal disease caused by serogroup A infections coincided with each of the two world wars (Figure 22.2) (Jones, 1995). After the Second World War, incidence declined. However, between 1972 and 1975, incidence increased temporarily, associated with a serogroup B serotype 2a strain. In 1985, another hyperendemic period began, associated with increased circulation of a hypervirulent B15:P1.16 strain. A further hyperendemic period started in 1995–96, associated with an increased proportion of disease due to

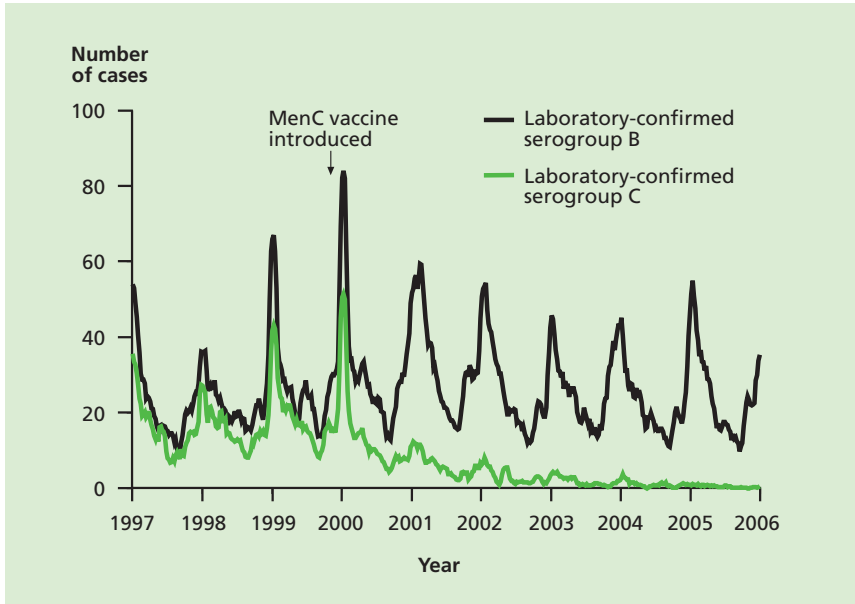


Figure 22.3 Laboratory-confirmed cases of meningococcal disease, England and Wales, five weekly moving averages: 1997 to 2006 (week 04)

serogroup C serotype 2a infection. There was a shift in age distribution towards teenagers and young adults, among whom case fatality rates are particularly high.

In the mid-1990s, vaccines based on the serogroup C polysaccharide provided only short-term protection to older children and adults and did not protect infants. New meningococcal C (MenC) conjugate vaccines were therefore developed that would provide longer-term protection and would be effective in infants. As the rate of meningococcal serogroup C infections continued to rise, the development of the new vaccines was accelerated.

In November 1999, a new MenC conjugate vaccine was introduced into the UK routine immunisation programme. All children and adolescents under the age of 18 years were immunised over a two-year period. In January 2002, the campaign was extended to include all adults under 25 years of age.

Following the MenC vaccine campaign, the number of laboratory-confirmed group C cases fell by over 90% in all age groups immunised (Figure 22.3) (Salisbury *et al.*, 2001; Trotter *et al.*, 2004). Cases in other age groups fell by

approximately two-thirds as a result of reduced carriage rates and indirect protection (Trotter *et al.*, 2003).

In 2006, following studies that showed that protection against meningococcal group C waned during the second year of life (Trotter *et al.*, 2004), a booster dose (combined with Hib as Hib/MenC) was introduced at 12 months of age.

Group B strains now account for over 80% of laboratory-confirmed isolates submitted to the Health Protection Agency (HPA) Meningococcal Reference Unit (Health Protection Agency) [www.hpa.org.uk/cdph/issues/CDPHVol15/no3/Meningococcal\\_Guidelines.pdf](http://www.hpa.org.uk/cdph/issues/CDPHVol15/no3/Meningococcal_Guidelines.pdf)

Meningococcal disease occurs in all countries. In the ‘meningitis belt’ of sub-Saharan Africa, the incidence of meningococcal infection rises sharply towards the end of the dry, dusty season when disease spreads rapidly, resulting in large epidemics within very short periods. These are predominantly due to serogroup A, but recent outbreaks have included serogroup W135.

There have been large epidemics of meningococcal disease linked to the annual hajj pilgrimage to Mecca in Saudi Arabia, resulting in importations into a number of countries, including the UK. These were predominantly serogroup A epidemics and immunisation against this strain became a requirement for entry to Saudi Arabia. In 2000 and 2001, there was an increase in W135 infections at the hajj and quadrivalent (serogroups A, C, Y, W135) vaccine became an entry requirement in 2002. Following this recommendation, W135 cases returned to very low levels in the UK.

## The meningococcal vaccination

### MenC conjugate vaccine

The MenC conjugate vaccines are made from capsular polysaccharide that has been extracted from cultures of group C *Neisseria meningitidis*. The polysaccharide is linked (conjugated) to a carrier protein, according to the manufacturer’s method. In the UK, MenC vaccines have been used that have been conjugated with either CRM<sub>197</sub> (a non-toxic variant of diphtheria toxin) or tetanus toxoid. The conjugation increases the immunogenicity, especially in young children in whom the plain polysaccharide vaccines are less immunogenic.

MenC vaccine confers no protection against other types of meningococcal disease, such as serogroups B, A or W135.

## Meningococcal

### Hib/MenC conjugate vaccine

The Hib/MenC conjugate vaccine is made from capsular polysaccharides of *Haemophilus influenzae* type b and group C *Neisseria meningitidis*, which are conjugated to tetanus toxoid. The vaccine has been shown to elicit booster responses to both Hib and MenC when given in the second year of life to children who were primed in infancy with Hib and MenC conjugate vaccines.

### Quadrivalent (ACWY) polysaccharide vaccine

The polysaccharide (non-conjugated) vaccine is made from the outer capsules of serogroups A, C, W135 and Y *Neisseria meningitidis* organisms.

Young infants respond to group A, Y and W135 polysaccharide from three months of age. However, protection is not long-lasting (Cadoz *et al.*, 1985; Peltola *et al.*, 1985; Al-Mazrou *et al.*, 2005).

Vaccine-induced immunity lasts approximately three to five years in older children and adults; in younger children, a more rapid decline in antibody has been noted (Frasch, 1995). The response is strictly serogroup-specific and confers no protection against group B organisms.

The above vaccines do not contain thiomersal. They are inactivated, do not contain live organisms and cannot cause the diseases against which they protect.

**At present there is no available vaccine effective against group B organisms.**

### Storage

Vaccines should be stored in the original packaging at +2°C to +8°C and protected from light. All vaccines are sensitive to some extent to heat and cold. Heat speeds up the decline in potency of most vaccines, thus reducing their shelf life. Effectiveness cannot be guaranteed for vaccines unless they have been stored at the correct temperature. Freezing may cause increased reactogenicity and loss of potency for some vaccines. It can also cause hairline cracks in the container, leading to contamination of the contents.

### Presentation

#### MenC conjugate

The MenC conjugate vaccine is available either as a lyophilised powder for reconstitution with a diluent or as a suspension in a syringe. After reconstitution of the lyophilised suspension, the vaccine must be used within one hour.

Discard any vaccine that is unused one hour following reconstitution.

Note: The diluent must not be frozen.

### **Hib/MenC conjugate**

Hib/MenC is supplied as a vial of white powder and 0.5ml of solvent in a pre-filled syringe. The vaccine must be reconstituted by adding the entire contents of the pre-filled syringe to the vial containing the powder. After addition of the solvent, the mixture should be well shaken until the powder is completely dissolved. After reconstitution, the vaccine should be administered promptly, or allowed to stand between +2° and +8° and be used within 24 hours.

### **Quadrivalent (ACW135Y) polysaccharide vaccine**

The quadrivalent A, C, W135 and Y polysaccharide vaccine should be reconstituted immediately before use with the diluent supplied by the manufacturer. After reconstitution, the vaccine must be used within one hour. Discard any vaccine that is unused one hour following reconstitution.

Note: The diluent must not be frozen.

## **Dosage and schedule**

### **MenC vaccine**

Infants under one year of age:

- First dose of 0.5ml of MenC vaccine.
- Second dose of 0.5ml, one month after the first dose.
- A third dose of 0.5ml of MenC-containing vaccine should be given at the recommended interval (see below).

Children over one year and adults under 25 years of age should have a single dose of MenC-containing vaccine.

### **Quadrivalent (ACWY) polysaccharide vaccine**

Children over three months of age and under two years:

- First dose of 0.5ml.
- Second dose of 0.5ml three months after the first dose.

Children over two years of age and adults:

- Single dose of 0.5ml.

Reinforcing doses should be given at recommended intervals (see below).

## Meningococcal

### Administration

The vaccines are routinely given intramuscularly into the upper arm or anterolateral thigh. This is to reduce the risk of localised reactions, which are more common when the vaccine is given subcutaneously (Mark *et al.*, 1999; Diggle and Deeks, 2000; Zuckerman, 2000). However, for individuals with a bleeding disorder, vaccines should be given by deep subcutaneous injection to reduce the risk of bleeding.

Meningococcal vaccines can be given at the same time as other vaccines such as pneumococcal, measles, mumps and rubella (MMR), diphtheria, tetanus, pertussis, polio and Hib. The vaccines should be given at a separate site, preferably a separate limb. If given in the same limb, they should be given at least 2.5cm apart (American Academy of Pediatrics, 2003). The site at which each vaccine is given should be noted in the child's record.

### Disposal

Equipment used for vaccination, including empty vials or ampoules, should be disposed of at the end of a session by sealing in a proper, puncture-resistant 'sharps' box (UN-approved, BS 7320).

## Recommendations for the use of the MenC conjugate vaccines

The objective of the immunisation programme is to protect those under 25 years of age, and individuals outside this age range who may be at elevated risk from meningococcal C disease.

### Primary immunisation

#### Infants under one year of age

The primary course of MenC vaccination consists of two doses, with an interval of one month between each dose. The recommended age for vaccination is at three and four months of age. If the primary course is interrupted it should be resumed but not repeated (see below).

The currently available MenC vaccines are now licensed for use in a two-dose schedule from two months of age. Although the licence states that two doses should be given at least two months apart, evidence from UK studies shows that immunogenicity is adequate in children immunised at a one-month interval (Southern *et al.*, 2006).

## Children from one year of age and adults

The primary course of MenC vaccine for this age group is one dose. If the primary course in children under one year was not completed, then a single booster dose of Hib/MenC vaccine should be given, at least one month after the last dose.

All individuals under 25 years and other individuals at elevated risk, regardless of their age, should be immunised with a single dose of MenC. Any unprotected individual attending university, irrespective of age, should be immunised before they enrol or as soon as possible thereafter.

## Reinforcing immunisation

A reinforcing (booster) dose of Hib/MenC is recommended at 12 months of age for children who have received a complete primary course of two doses of MenC vaccine. The Hib/MenC vaccine can be given at the same time as the pneumococcal conjugate and MMR vaccines.

## Individuals with unknown or incomplete vaccination histories

Where a child born in the UK presents with an inadequate immunisation history, every effort should be made to clarify what immunisations they may have had (see Chapter 11). Children coming to the UK who have a history of completing immunisation in their country of origin may not have been offered protection against all the antigens currently used in the UK, and they may not have received MenC-containing vaccines in their country of origin ([www-nt.who.int/immunization\\_monitoring/en/globalsummary/countryprofileselect.cfm](http://www-nt.who.int/immunization_monitoring/en/globalsummary/countryprofileselect.cfm)).

Children coming from developing countries, from areas of conflict, or from hard-to-reach population groups may not have been fully immunised. Where there is no reliable history of previous immunisation, it should be assumed that they are unimmunised and the full UK recommendations should be followed (see Chapter 11).

A child who has not completed the primary course (and is under one year of age) should have the outstanding doses at appropriate intervals (see above). If an individual is coming into the UK to attend university and has not previously been immunised against group C disease (with either polysaccharide or conjugate vaccine) they should receive one dose of MenC vaccine as soon as possible.

### Children and adults with asplenia or splenic dysfunction

Children and adults with asplenia or splenic dysfunction may be at increased risk of invasive meningococcal infection. Such individuals, irrespective of age or interval from splenectomy, may have a sub-optimal response to the vaccine (Balmer *et al.*, 2004).

Children under one year of age should be vaccinated according to the UK schedule, receiving two doses in infancy and a booster dose at 12 months of age.

Children over one year of age and adults should be given two doses of Hib/MenC vaccine two months apart.

Children and adults who have been fully immunised with MenC as part of the routine programme, but who then develop splenic dysfunction, should be offered an additional dose of MenC (usually as combined Hib/MenC vaccine).

If travelling to a country where there is an increased risk of serogroup A, W135 or Y disease, such individuals should also receive the quadrivalent polysaccharide vaccine (see below).

### Recommendations for the use of the quadrivalent (ACWY) polysaccharide vaccine

#### Primary immunisation

##### Children over three months and under two years of age

The primary course consists of two doses with an interval of three months between doses.

##### Children over two years of age and adults

The primary course consists of a single dose.

#### Reinforcing immunisation

A reinforcing dose should be given every five years to those at continued risk.

Children who were under five years when they were first vaccinated, should be given a booster dose after 2–3 years if they remain at high risk.

Visa entry requirements should be checked for travel to individual countries.

## Individuals who are travelling or going to reside abroad

In some areas of the world the risk of acquiring meningococcal infection particularly of developing group A disease, is much higher than in the UK. Individuals who are particularly at risk are visitors who live or travel 'rough', such as backpackers, and those living or working with local people. Large epidemics of both group A and group W135 meningococcal infection have occurred in association with hajj pilgrimages to Saudi Arabia, and vaccination against A, C, W135 and Y serogroups is now a visa entry requirement.

Epidemics, mainly group A and more recently W135 infections, occur throughout tropical Africa, particularly in the savannah during the dry season, which varies from country to country and can be unpredictable. Immunisation is recommended for long-stay or high-risk visitors to sub-Saharan Africa, for example those who will be living or working closely with local people, or those who are backpacking.

From time to time, outbreaks of meningococcal infection may be reported from other parts of the world, including the Indian sub-continent and other parts of Asia (see, for example, [www.hpa.org.uk/cdr/archives/2005/cdr1905.pdf](http://www.hpa.org.uk/cdr/archives/2005/cdr1905.pdf) [www.who.int/csr/don/2005\\_01\\_28a/en/index.html](http://www.who.int/csr/don/2005_01_28a/en/index.html)). Where such outbreaks are shown to be due to vaccine-preventable serogroups, vaccination may be recommended for certain travellers to the affected areas. More detailed country by country information is contained in *Health information for overseas travel* (Department of Health, 2001).

Note. MenC conjugate vaccine protects against group C disease only. Individuals travelling abroad (see above) should be immunised with the quadrivalent polysaccharide vaccine, even if they have previously received the MenC conjugate vaccine.

### Contraindications

There are very few individuals who cannot receive meningococcal vaccines. When there is doubt, appropriate advice should be sought from a consultant paediatrician, immunisation co-ordinator or consultant in communicable disease control, rather than withhold immunisation.

The vaccines should not be given to those who have had:

- a confirmed anaphylactic reaction to a previous dose of the vaccine

## Meningococcal

- a confirmed anaphylactic reaction to any constituent of the vaccine, including meningococcal polysaccharide, diphtheria toxoid or the CRM<sub>197</sub> carrier protein, or tetanus toxoid.

Confirmed anaphylaxis after immunisation is extremely rare, with anaphylaxis reactions reported in approximately one in every 500,000 doses ([www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf](http://www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf)). Other allergic conditions, may occur more commonly and are not contraindications to further immunisation. A careful history of the event will often distinguish between anaphylaxis and other events that are either not due to the vaccine or not life threatening. In the latter circumstance, it may be possible to continue the immunisation course. Specialist advice must be sought on the vaccines and circumstances in which they could be given. The risk to the individual of not being immunised must be taken into account.

### Precautions

Minor illnesses without fever or systemic upset are not valid reasons to postpone immunisation. If an individual is acutely unwell, immunisation may be postponed until they have recovered fully. This is to avoid confusing the differential diagnosis of any acute illness by wrongly attributing any signs or symptoms to the adverse effects of the vaccine.

### Pregnancy and breast-feeding

Meningococcal vaccines may be given to pregnant women when clinically indicated. There is no evidence of risk from vaccinating pregnant women or those who are breast-feeding with inactivated virus or bacterial vaccines or toxoids (Granoff *et al.*, 2004). In cases where meningococcal immunisation has been inadvertently given in pregnancy, there has been no evidence of fetal problems.

### Premature infants

It is important that premature infants have their immunisations at the appropriate chronological age, according to the schedule. The occurrence of apnoea following vaccination is especially increased in infants who were born very prematurely. The potential risk of apnoea and the need for respiratory monitoring for 48-72 hours should be considered when administering the primary immunisation series to infants who were born very prematurely (born  $\leq$  28 weeks of gestation) and particularly for those with a previous history of respiratory immaturity (Pfister *et al.*, 2004; Ohlsson *et al.*, 2004; Schulzke *et al.*, 2005; Pourcyrus *et al.*, 2007; Klein *et al.*, 2008).

The first immunisation of a child born very prematurely should be administered in hospital. If the child reacts to the first immunisation, they should return to hospital for their second immunisation.

As the benefit of vaccination is high in this group of infants, vaccination should not be withheld or delayed.

## Immunosuppression and HIV infection

Individuals with immunosuppression and human immunodeficiency virus (HIV) infection (regardless of CD4 count) should be given meningococcal vaccines in accordance with the routine schedule. These individuals may not make a full antibody response. Re-immunisation should be considered after treatment is finished and recovery has occurred. Specialist advice may be required.

Further guidance is provided by the Royal College of Paediatrics and Child Health ([www.rcpch.ac.uk](http://www.rcpch.ac.uk)), the British HIV Association (BHIVA) *Immunisation guidelines for HIV-infected adults* (BHIVA, 2006) and the Children's HIV Association of UK and Ireland (CHIVA) immunisation guidelines ([www.bhiva.org/chiva](http://www.bhiva.org/chiva)).

## Adverse reactions

### MenC conjugate vaccine

Pain, tenderness, swelling or redness at the injection site, and mild fevers are common in all age groups. In infants and toddlers, crying, irritability, drowsiness, impaired sleep, reduced eating, diarrhoea and vomiting are commonly seen. In older children and adults, headaches, myalgia and drowsiness may be seen.

Confirmed anaphylaxis after immunisation is extremely rare, with anaphylaxis reactions reported approximately one in every 500,000 doses ([www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf](http://www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf)). Other allergic conditions may occur more commonly and are not contraindications to further immunisation.

Neurological reactions such as dizziness, febrile/afebrile seizures, faints, numbness and hypotonia following MenC are very rare.

### Hib/MenC conjugate

Mild side effects such as irritability, loss of appetite, pain, swelling or redness at the site of the injection, and slightly raised temperature commonly occur. Less commonly crying, diarrhoea, vomiting, atopic dermatitis, malaise and fever over 39.5°C have been reported.

## Meningococcal

### Quadrivalent (ACW135Y) polysaccharide vaccine

Generalised reactions are rare although pyrexia occurs more frequently in young children than in adults.

Injection site reactions occur in approximately 10% of recipients and last for approximately 24 to 48 hours.

Confirmed anaphylaxis after immunisation is extremely rare, with anaphylactoid reactions reported approximately one in every 500,000 doses ([www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf](http://www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf)). All suspected adverse reactions to vaccines occurring in children after the administration of the MenC conjugate vaccine should be reported to the Commission on Human Medicines using the Yellow Card scheme (see Chapter 9 for more information). Serious suspected adverse reactions to vaccines in adults should be reported through the Yellow Card scheme.

All suspected adverse reactions to vaccines occurring in children, or in individuals of any age after vaccination with vaccines labelled with a black triangle (▼), should be reported to the Commission on Human Medicines using the Yellow Card scheme. Serious suspected adverse reactions to vaccines in adults should be reported through the Yellow Card scheme.

## Management of suspected cases, contacts, carriers and outbreaks

### Management of cases

Current expert advice endorses the importance of early recognition, prompt antibiotic treatment and speedy referral to hospital for all suspected cases. Benzylpenicillin is the antibiotic of choice and should be administered by the general practitioner before transfer to hospital, unless there is a history of immediate allergic reactions after previous penicillin administration. The recommended dose is 1200mg for adults and children aged 10 years or over, 600mg for children aged one to nine years, and 300mg for those aged under one year. Although benzylpenicillin may reduce the chance of isolating the causative organism, this is outweighed by the benefit to the patient, and new techniques are available that facilitate the diagnosis of meningococcal disease even after antibiotics have been given.

Guidelines for the management of meningococcal disease are available at [www.hpa.org.uk/cdph/issues/CDPHVol5/no3/Meningococcal\\_Guidelines.pdf](http://www.hpa.org.uk/cdph/issues/CDPHVol5/no3/Meningococcal_Guidelines.pdf)

## Management of contacts

For public health management of contacts of cases and outbreaks, advice must be sought from your local health protection unit.

Household contacts of cases of meningococcal infection are at increased risk of developing the disease. This risk is highest in the first seven days following onset in the index case but persists for at least four weeks. Immediate risk can be reduced by the administration of antibiotic prophylaxis to the whole contact group.

The recommended schedule for prophylaxis is:

Rifampicin 600mg every 12 hours for two days in adults, 10mg/kg dose for children over one year of age, and 5mg/kg for children less than one year.

Ciprofloxacin as a single dose of 500mg is an alternative for adults (250mg for children aged five to 12 years) but is not yet licensed in the UK for this purpose.

Rifampicin 600mg twice daily for two days or intramuscular ceftriaxone 250mg should be given to pregnant contacts.

Unless the index case received ceftriaxone treatment in hospital, chemoprophylaxis should also be given to the patient before discharge.

For confirmed serogroup C infection, MenC vaccination should be offered to all close contacts (of all ages) previously unimmunised with MenC vaccine. Close contacts who are not, or are only partially, immunised should complete a course of MenC vaccination. Those who completed a course more than one year before should be offered a booster.

If the index case has been previously vaccinated, a booster dose of MenC vaccine is recommended.

For confirmed serogroup A infection, vaccination with quadrivalent (ACW135Y) polysaccharide vaccine should be offered to all close contacts over two months of age.

## Meningococcal

For confirmed serogroup W135 or Y infections, vaccination with quadrivalent (ACW135Y) polysaccharide vaccine should be offered to all close contacts over two years of age.

For probable cases with serogroup A, C, W135 or Y isolated from nasopharyngeal swab, quadrivalent vaccine should be offered to close contacts. Individuals should be immunised with either the quadrivalent vaccine (group A, W135 and Y infection) or MenC vaccine (group C infection) as appropriate.

Chemoprophylaxis should be given first, and the decision to offer vaccine should be made when the results of serogrouping are available. **Vaccine does not protect against serogroup B meningococcal infection, but any case provides an opportunity to check the MenC vaccine status of the index case and contacts, and to ensure that individuals under the age of 25 years have been fully immunised according to the UK schedule.**

## Management of local outbreaks

In addition to sporadic cases, outbreaks of meningococcal infections can occur particularly in closed or semi-closed communities such as schools, military establishments and universities. Advice on the management of such outbreaks should be obtained from the local health protection unit.

Advice on the use of meningococcal vaccines in outbreaks is available from:

Health Protection Agency  
(Tel: 020 8200 6868)  
or HPA regional units  
Health Protection Agency,  
Meningococcal Reference Unit  
(Tel: 0161 276 5698)  
Health Protection Scotland  
(Tel: 0141 300 1100)  
Scottish Meningococcal and Pneumococcal Reference Laboratory  
(Tel: 0141 201 3836).

**Meningococcal vaccine has no part to play in the management of outbreaks of group B meningococcal meningitis.**

## Supplies

Meningitis C conjugate:

- Meningitec – manufactured by Wyeth Pharmaceuticals
- Menjugate – manufactured by Novartis Vaccines
- NeisVac-C – manufactured by Baxter Healthcare
- Menitorix (Hib/MenC) – manufactured by GlaxoSmithKline.

These vaccines are supplied by Healthcare Logistics (Tel: 0870 871 1890) as part of the national childhood immunisation programme.

In Scotland, supplies should be obtained from the local childhood vaccine holding centres. Details of these are available from Scottish Healthcare Supplies (Tel: 0141 282 2240).

Quadrivalent A,C,W,Y polysaccharide vaccine – manufactured by GlaxoSmithKline (Tel: 0808 100 9997).

## References

Al-Mazrou Y, Khalil M, Borrow R *et al.* (2005) Serologic responses to ACYW135 polysaccharide meningococcal vaccine in Saudi children under 5 years of age. *Infect Immun* **73**(5): 2932–9.

American Academy of Pediatrics (2003) Active immunization. In: Pickering LK (ed.) *Red Book: 2003 Report of the Committee on Infectious Diseases*, 26th edition. Elk Grove Village, IL: American Academy of Pediatrics, p 33.

Balmer P, Falconer M, McDonald P *et al.* (2004) Immune response to meningococcal serogroup C conjugate vaccine in asplenic individuals. *Infect Immun* **72**(1): 332–7.

Bohlke K, Davis RL, Marcy SH *et al.* (2003) Risk of anaphylaxis after vaccination of children and adolescents. *Pediatrics* **112**: 815–20.

Booy R, Habibi P, Nadel S *et al.* (2001) Reduction in case fatality rates from meningococcal disease associated with improved healthcare delivery. *Arch Dis Child* **85**: 386–90.

British HIV Association (2006) *Immunisation guidelines for HIV-infected adults*: [www.bhiva.org/pdf/2006/Immunisation506.pdf](http://www.bhiva.org/pdf/2006/Immunisation506.pdf).

Cadoz M, Armand J, Arminjon F *et al.* (1985) Tetravalent (ACYW135) meningococcal vaccine in children: immunogenicity and safety. *Vaccine* **3**(3): 340–2.

Canadian Medical Association (1998) Pertussis vaccine. In: *Canadian Immunisation Guide*, 5th edition. Canadian Medical Association.

Cartwright K (1995) Meningococcal carriage and disease. In: Cartwright K (ed.) *Meningococcal disease*. Chichester, UK: John Wiley & Sons, pp 115–46.

## Meningococcal

Davison KL, Ramsay ME, Crowcroft NS *et al.* (2002) Estimating the burden of serogroup C meningococcal disease in England and Wales. *Commun Dis Public Health* **3**: 213–19.

Committee on Safety of Medicines (2002) Report of the Committee on Safety of Medicines Expert Working Group on Meningococcal Group C Conjugate Vaccines. [www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf](http://www.mhra.gov.uk/home/groups/pl-p/documents/websiteresources/con2022528.pdf)

Diggle L and Deeks J (2000) Effect of needle length on incidence of local reactions to routine immunisation in infants aged 4 months: randomised controlled trial. *BMJ* **321**(7266): 931–3.

Department of Health (2001) *Health information for overseas travel*, 2nd edition. London: TSO.

Erickson L and De Wals P (1998) Complications and sequelae of meningococcal disease in Quebec, Canada, 1990–1994. *Clin Infect Dis* **26**(5): 1159–64.

Frasch CE (1995) Meningococcal vaccines: past, present and future. In: Cartwright K (ed.) *Meningococcal disease*. Chichester, UK: John Wiley & Sons pp 245–83.

Goldacre MJ, Roberts SE and Yeates D (2003) Case fatality rates for meningococcal disease in an English population, 1963–98: database study. *BMJ* **327**: 596–7.

Granoff DM, Feavers IM and Borrow R (2004) Meningococcal vaccines. In: Plotkin SA and Orenstein WA (eds) *Vaccines*. 4th edition. Philadelphia: WB Saunders Company, pp 959–88.

Jones D (1995) Epidemiology of meningococcal disease in Europe and the USA. In: Cartwright K (ed.) *Meningococcal disease*. Chichester, UK: John Wiley & Sons, pp 147–58.

Klein NP, Massolo ML, Greene J *et al.* (2008) Risk factors for developing apnea after immunization in the neonatal intensive care unit. *Pediatrics* **121**(3): 463–9.

Lepow ML, Perkins BA, Hughes PA and Poolman JT (1999) Meningococcal vaccines. In: Plotkin SA and Orenstein WA (eds) *Vaccines*, 3rd edition. Philadelphia: WB Saunders Company, pp 711–27.

Mark A, Carlsson RM and Granstrom M (1999) Subcutaneous versus intramuscular injection for booster DT vaccination of adolescents. *Vaccine* **17**(15–16): 2067–72.

Ohlsson A and Lacy JB (2004) Intravenous immunoglobulin for preventing infection in preterm and/or low-birth-weight infants. *Cochrane Database Syst Rev*(1): CD000361.

Peltola H, Safary A, Kayhty H *et al.* (1985) Evaluation of two tetravalent (ACYW135) meningococcal vaccines in infants and small children: a clinical study comparing immunogenicity of O-acetyl-negative and O-acetyl-positive group C polysaccharides. *Pediatrics* **76**(1): 91–6.

Pfister RE, Aeschbach V, Niksic-Stuber V *et al.* (2004) Safety of DTaP-based combined immunization in very-low-birth-weight premature infants: frequent but mostly benign cardiorespiratory events. *J Pediatr* **145**(1): 58–66.

Plotkin SA and Orenstein WA (eds) (2004) *Vaccines*, 4th edition. Philadelphia: WB Saunders Company, pp 959–88.

Pourcyrous M, Korones SB, Arheart KL *et al.* (2007) Primary immunization of premature infants with gestational age <35 weeks: cardiorespiratory complications and C-reactive protein responses associated with administration of single and multiple separate vaccines simultaneously. *J Pediatr* **151**(2): 167–72.

Ramsay M, Kaczmarski E, Rush M *et al.* (1997) Changing patterns of case ascertainment and trends in meningococcal disease in England and Wales. *Commun Dis Rep CDR Rev* **7**(4): R49–54.

Ramsay ME, Andrews NJ, Trotter CL *et al.* (2003) Herd immunity from meningococcal serogroup C conjugate vaccination in England: database analysis. *BMJ* **326**(7385): 365–6.

Rosenstein NE, Perkins BA, Stephens DS *et al.* (2001) Meningococcal disease. *NEJM* **344**: 1378–88.

Salisbury D, Miller E and Ramsay M (2001) Planning, registration, and implementation of an immunisation campaign against meningococcal serogroup C disease in the UK: a success story. *Vaccine* **20** (Suppl 1): S58–67.

Schulzke S, Heining U, Lucking-Famira M *et al.* (2005) Apnoea and bradycardia in pre-term infants following immunisation with pentavalent or hexavalent vaccines. *Eur J Pediatr* **164**(7): 432–5.

Southern J, Crowley-Luke A, Barrow R *et al.* (2006) Immunogenicity of one, two and three doses of a meningococcal C conjugate to tetanus toxoid, given as a three-dose primary vaccination course in UK infants at 2, 3 and 4 months of age with acellular pertussis-containing DTP/Hib vaccine. *Vaccine* **24**: 215–19.

Steven N and Wood M (1995) The clinical spectrum of meningococcal disease. In: Cartwright K (ed.) *Meningococcal disease*. Chichester, UK: John Wiley & Sons, pp 177–206.

Thornburn K, Baines P, Thomson A and Hart CA (2001) Mortality in severe meningococcal disease. *Arch Dis Child* **85**: 382–5.

Trotter CL, Fox AJ, Ramsay ME, *et al.* (2002) Fatal outcome from meningococcal disease – an association with meningococcal phenotype but not with reduced susceptibility to benzylpenicillin. *J Med Microbiol* **51**(10): 855–60.

Trotter CL and Gay NJ (2003) Analysis of longitudinal carriage studies accounting for sensitivity of swabbing: an application to *Neisseria meningitidis*. *Epidemiol Infect* **130**(2): 201–5.

Trotter CL, Andrews NJ, Kaczmarski EB *et al.* (2004) Effectiveness of meningococcal serogroup C conjugate vaccine 4 years after introduction. *Lancet* **364**(9431): 365–7.

Zuckerman JN (2000) The importance of injecting vaccines into muscle. Different patients need different needle sizes. *BMJ* **321**(7271): 1237–8.