Royal College of Nursing

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Meningitis Research Foundation

Vital signs Vital issues

Recognition and prevention of meningitis and septicaemia

Help for community practitioners

Fourth Edition V2

Contents

Introduction

Vital signs, Vital issues has three objectives:

- to assist early recognition of meningitis and septicaemia;
- to inform about meningitis vaccines and the diseases they prevent;
- to help practitioners reassure parents about vaccine safety.

It was developed in response to requests from community practitioners for help in recognising meningitis and septicaemia, and help with talking to parents about vaccination. Practitioners said that they were regularly faced with misplaced anxiety and suspicion about vaccines, and need information to deal with this. The booklet addresses these concerns.

Scope

This booklet deals with severe bacterial infections that are important causes of meningitis and septicaemia. It does not attempt to deal with viral meningitis, which is generally a less serious disease. Before MMR vaccine was introduced, mumps was the main cause of viral meningitis. MMR vaccine is outside the scope of this booklet, although some of the topics in the Q & A section (pages 22-29) often arise in relation to MMR. For comprehensive coverage of MMR vaccination and the issues surrounding it, go to www.immunisation.nhs.uk/Vaccines/MMR.

Increasingly, parents need reassurance about vaccine safety, and **Vital signs, Vital issues** aims to help you deal with their concerns. **Please use this booklet to discuss the facts with parents.**

Early recognition of meningitis and septicaemia

Meningitis and septicaemia can kill in hours and take hundreds of lives in the UK each year. Meningococcal disease is a leading infectious cause of death in children, and fatality rates are even higher for other, less common types of bacterial meningitis. The two main clinical presentations, septicaemia and meningitis, can occur on their own but often appear together.

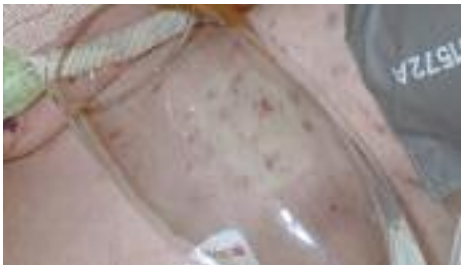
Septicaemia without signs of meningitis is more life-threatening.

Early recognition depends on knowing what to look for:

Observations[1]

- Temperature
- Heart rate
- Respiratory rate
- Capillary refill time: press for 5 seconds on the nail of the big toe or finger, the forehead or the sternum until it blanches, and count the seconds it takes for colour to return.
  - >2 seconds on forehead or sternum is abnormal, and
  - ≥4 seconds on peripheries, especially if heart rate/resps increased, suggests shock.
- Conscious level AVPU – Assess the best response patient can make:
  Alert? Remember, even an alert child may be very ill with septicaemia.
  Responds to Voice? Should be seen by doctor urgently
  Responds to Pain? Medical emergency
  Unresponsive? Medical emergency
- Check all over for rash
- Blood pressure: check this if other signs outside normal (in children, only if paediatric cuff available)
- Oxygen saturation (where pulse oximeter available)

Non-blanching rash – typical of septicaemia
If a non-blanching rash is pressed firmly with a glass tumbler, the marks will not fade. You will be able to see the marks through the glass.



The Tumbler Test

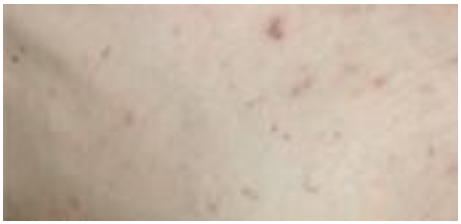
NORMAL VALUES OF VITAL SIGNS

Age (years)	Heart rate/ min	Respiratory rate/min	Systolic Blood Pressure
<1	110-160	30-40	70-90
1-2	100-150	25-35	80-95
2-5	95-140	25-30	80-100
5-12	80-120	20-25	90-110
12+	60-100	15-20	100-120

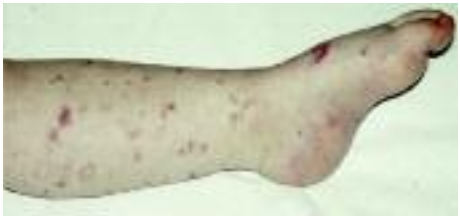
Oxygen Saturation: normal value is >95% in air.

From *Advanced Paediatric Life Support* manual

Watch out for red or brown pin-prick marks, purple blotches, bruises or blood blisters.



Scanty petechial rash of septicaemia



*Classic petechial/purpuric rash**

*Courtesy Dr A Riordan

Rash is the most common classic feature of meningococcal disease, but it may not appear early: in a recent study[2], 60% of children with the disease had a rash when seen in primary care. Rash may be scanty or absent in pure meningitis, and is rarely seen in other types of septicaemia. A rapidly evolving rash indicates very severe disease.

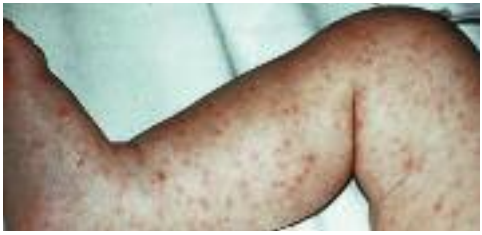
Findings

A recent study[2] found that the first symptoms reported by parents of children with meningococcal disease were common to many self-limiting viral illnesses. In children under five, **fever** was noticed first. In older children and adolescents, **headache** was noticed first. **Vomiting and nausea** were also reported. This period of non-specific symptoms lasted up to 4 hours in children but as long as 8 hours in adolescents, followed by the more specific and severe symptoms of meningitis and septicaemia.

Red Flag Symptoms

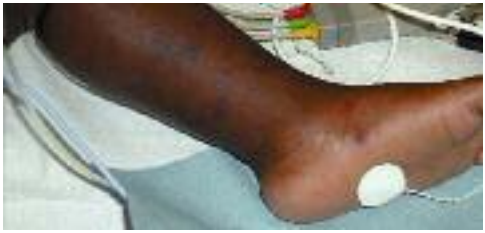
In all age groups, signs of septicaemia and circulatory shut-down were next to develop. These include limb pain, pale or mottled skin, and cold extremities. Younger children became drowsy and had rapid or laboured breathing and sometimes diarrhoea, older children became thirsty. The Red Flag symptoms appeared 5 or more hours earlier than the classic symptoms of rash, neck stiffness and photophobia. Rash was the first classic symptom to appear. Neck stiffness and photophobia were not reliable signs in babies and young children.

Up to 30% of cases start with a blanching macular rash.



*Early, blanching maculopapular rash with scanty petechiae**

The rash can be more difficult to see on dark skin, but may be visible in paler areas, especially the soles of the feet, palms of the hands, abdomen, conjunctivae or palate.



Purpuric rash on dark skin

SEPTICAEMIA

Septicaemia causes shock which can lead to multi-organ failure.

Look for

- Limb or joint pain – may be severe. Isolated limb pain is a well established symptom of septicaemia[2]
- Pallor, mottled skin
- Cold hands and feet
- Tachycardia
- Tachypnoea
- Rigors
- Conscious level
  - **early in shock**, children often alert & able to speak

Child lucid despite advanced septicaemia

  - **as shock advances**, babies – limp & floppy, older children & adults – unable to stand

Late signs

- Impaired consciousness – more likely to be late in children
- Hypotension
- Cyanosis

MENINGITIS

Meningitis causes raised intracranial pressure, which can lead to coning (brain stem herniation) and brain death.

Look for

- Neck stiffness, headache, photophobia in older children & adults
  - Neck stiffness, photophobia uncommon in young children – their absence should not be reassuring
- All children – poorly responsive, staring, difficult to wake. Parents may report poor eye contact
- Babies – irritable with a high pitched cry, particularly when handled
- Babies – stiff body, jerky movements, abnormal tone
- Teenagers & adults may be combative, confused or aggressive – you may suspect drug or alcohol use
- Seizures

Late signs

- Raised Intracranial Pressure:
  - Raised BP, slow pulse rate
  - Impaired consciousness
  - Dilated, unequal, or poorly reacting pupils
- In babies, tense/bulging fontanelle

Action

Suspected meningitis or septicaemia, with or without a rash

- In surgery or health centre: call doctor. Patient should be transferred to hospital by quickest means of transport, usually emergency ambulance. In suspected meningococcal disease, especially with a rash, antibiotics should be given whilst arranging the transfer of the patient to hospital[1,3]. Urgent transfer to hospital is the key priority.
- In the patient's home, summon urgent medical help, usually emergency ambulance, and stay with patient until help arrives.

Ambulance control and hospital staff need to know that meningitis/septicaemia is suspected, whether the patient has a non-blanching rash, and whether there are serious signs such as rapidly evolving rash, shock or impaired conscious level.

Patients with meningococcal septicaemia are likely to become very ill within the first 24 hours of symptoms starting, leaving a very narrow window of opportunity to obtain life-saving treatment. A patient seen early in the course of meningitis or septicaemia may be very difficult to distinguish from someone with a milder self-limiting illness. In this situation, the patient may be sent home with information about symptoms of serious illness (see back page for contact details to order **free** patient information). When this happens, the patient or parent should be positively encouraged to seek medical help again if the patient gets worse, even if this is shortly after the patient was seen[1].

BENZYLPENICILLIN

In suspected meningococcal disease, pre-hospital benzylpenicillin can be given by GPs or ambulance paramedics[4].

Dosage (BNF):

Adult and child aged 10 or older: 1200mg

Child 1-9 years: 600 mg

Infant: 300mg

Route:

IV if possible or IM into a part of the limb that is warm and well-perfused.

Recommended unless there is a history of immediate allergic reaction after previous penicillin administration[5].

Preventing transmission: role of public health

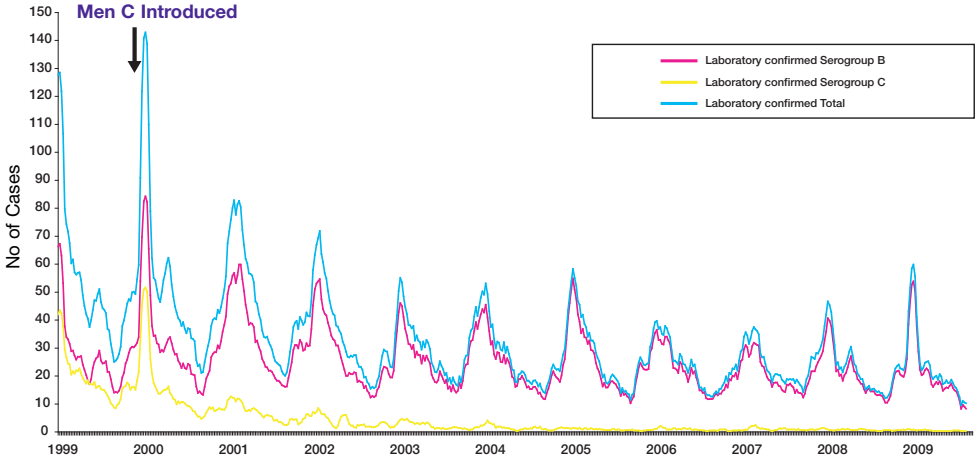
- Meningitis causes widespread alarm in communities even though the disease is relatively uncommon and the chance of a second case occurring in the same surroundings is small; 97% of meningococcal cases are isolated[6].
- Doctor immediately notifies any suspected case of meningitis or meningococcal septicaemia by phone to the Consultant in Communicable Disease Control (CCDC), Consultant in Public Health Medicine (CPHM) in Scotland, or on-call Public Health Specialist. This is the legal duty of the doctor who makes or suspects the diagnosis – usually the hospital doctor, but surgeries/health centres may wish to check that it has been done.
- After a single case, only close contacts living in the same household as the case in the seven days before disease onset, or kissing contacts need antibiotic prophylaxis[5,7]. This is only required when meningococcal or (in some cases) Hib disease is the most likely diagnosis – it is not necessary in suspected viral cases being treated "just in case". Prophylaxis is not necessary in viral meningitis or after a single case of pneumococcal meningitis or other invasive pneumococcal disease.
- When two or more confirmed or probable cases of meningococcal, Hib, or invasive pneumococcal disease occur in the same setting within a short period of time, health protection teams make careful and rapid assessment to determine whether the cases are linked. Public health action, including offering wider prophylaxis, may be required depending on the cause of disease, institutional setting, and the interval between the cases[5,7,8].
- Healthcare staff only require prophylaxis if their mouth or nose has been splattered (clearly felt) with large particle droplets/secretions from the respiratory tract of a patient with meningococcal disease, or if conjunctivitis develops within 10 days of exposure[9]. This is unlikely to occur except when using suction during airway management, inserting an oro/nasopharyngeal airway, intubating, or if the patient coughs in your face.
- Public Health, usually the CCDC/CPHM arranges for prophylactic antibiotics to be prescribed to contacts as necessary. For meningococcal prophylaxis, rifampicin, ciprofloxacin (not in children under 2 or in pregnancy) or ceftriaxone are all recommended. Rifampicin or ceftriaxone can be given to pregnant contacts. Rifampicin interferes with the oral contraceptive pill and stains body fluids – including urine and saliva – orange, and permanently stains soft contact lenses. Some individuals may experience rash or stomach upset. For Hib prophylaxis rifampicin is recommended. For pneumococcal prophylaxis, amoxicillin is the drug of choice, with azithromycin and rifampicin as second-line alternatives.
- Antibiotic prophylaxis should eliminate carriage[10], but if the contact is already incubating the bacteria, he or she can still get the disease. Close contacts of a case (or their parents or carers) should be advised that they are at increased risk of meningitis and septicaemia, alerted to the symptoms, and given a leaflet on meningitis and septicaemia (see back page).
- The CCDC/CPHM will:
  - arrange for the next of kin to be interviewed to establish other close contacts and will arrange prophylaxis for them, and for later immunisation of all close contacts if indicated;
  - ensure information is disseminated to appropriate local schools, work places and general practitioners;
  - be responsible for early detection of clusters and outbreaks of disease.

Preventing meningitis and septicaemia

Immunisation saves more lives than any other action that can be taken in primary care. Along with clean water, it is the public health intervention that has the most positive impact on the world's health[11].

Vaccines are a tremendous success story: for example, before the MenC vaccine was introduced Group C meningococcal disease killed 150 people in the UK each year and left many more permanently disabled. Now it has virtually disappeared in this country.

Graph 1: Impact of MenC vaccine on Group C meningococcal disease in England and Wales



Reproduced with kind permission from HPA Northwest, Manchester Laboratory.

What are meningitis and septicaemia?

Bacterial meningitis and septicaemia occur when bacteria enter the bloodstream by breaking through the protective lining of the nose and throat (or in neonatal meningitis, through vertical transmission from mother to baby). Once in the bloodstream, bacteria multiply rapidly, and begin to produce toxins. In some people, the bacteria cross the blood-brain barrier, causing meningitis. In others, overwhelming septicaemia happens so quickly that there is no time for meningitis to develop.

Meningitis vaccines in the routine infant immunisation schedule and the diseases they prevent

Every injection in the routine infant immunisation schedule protects against some form of meningitis and septicaemia, so the single most important thing that can be done to protect children from meningitis is to make sure that they are up to date with their routine immunisations.

Table 1: Routine Infant Immunisation Schedule

2 months	3 months	4 months	12 months*	13 months* (15 months in Northern Ireland)
DTaP/IPV/Hib	DTaP/IPV/Hib	DTaP/IPV/Hib		
Pneumococcal conjugate		Pneumococcal conjugate		Pneumococcal conjugate
	MenC	MenC		
			Hib/MenC Booster	
				MMR

* Can be given together. See **Importance of Boosters** below

Further details of the schedule can be found at www.immunisation.nhs.uk.

Ensuring all children are immunised

Seeing a patient for any reason provides a chance to check their vaccine status and bring them up-to-date with immunisations. Children under age 10 can be started on the routine schedule at any time, even if they are older than the recommended age. There is no limit to the number of vaccines that can be given at a time[12], and this enables some flexibility in immunising patients where there are obstacles to attending scheduled visits.

Children with unknown or incomplete immunisation status

If immunisation history is unknown, it is not safe to assume that a child is fully protected against any infection, and a full course of immunisation should be offered. The Health Protection Agency (HPA) algorithm, Vaccination of Individuals with Uncertain or Incomplete Immunisation Status[13], is useful for planning catch up schedules in cases like this.

Children coming to the UK who have completed vaccinations in their country of origin may not have been immunised against all of the infections the UK schedule is designed to prevent. Country-specific immunisation information can be obtained from the World Health Organization (WHO) http://tinyurl.com/globalvaccines but this is not always up to date. In the absence of a written record, it may be best to start again, or at least seek advice.

More detailed information on all aspects of immunisation in the UK can be found in the 'Green Book' Immunisation Against Infectious Disease. Chapters are available on the web, along with updates since 2006: http://snipurl.com/c6v0.

Meningitis vaccines

The vaccines against bacterial meningitis used in the routine infant immunisation schedule are conjugate vaccines (see Box 1 overleaf). Research has shown that conjugate vaccines provide longer lasting protection if a dose is given in the second year of life[14]. The current schedule ensures that protection provided by all conjugate vaccines is boosted after the child reaches 1 year of age.

Importance of boosters: Uptake of the 12 and 13 month boosters tends to be lower than for primary doses. It is very important for parents to understand that without boosters, their children aren't protected. Evidence considered by the Joint Committee on Vaccines and Immunisations (who advise government on vaccine policy) in June 2009 has

shown that MMR, PCV and Hib/Men C vaccines can be given at the same time. Although the routine childhood schedule remains unchanged, practitioners can now deliver all three vaccines at 12 months, or at 13 months, or keep to the schedule[15], providing flexibility. See Box 4 on page 15 on three injections in one visit.

Box 1: Conjugate vaccines

Conjugate vaccines are made by linking a tiny fragment from the bacteria's sugar coat, (which an infant's immune system cannot respond to), to a protein (which an infant can respond to). In this way, the immune system is able to recognise the bacteria that cause serious diseases like meningitis. These conjugate vaccines are effective in babies as young as two months of age and trigger a long-lasting immune response.

Meningococcal disease

Meningococcal disease can kill in hours. Most often it strikes without warning at healthy children.

- The meningococcus (*Neisseria meningitidis*), is the most common cause of bacterial meningitis in the UK. Meningococcal infection usually presents either as meningitis or septicaemia, or a combination of both.
- Of the 13 meningococcal serogroups, A,B,C,W135 and Y cause most disease.
- B & C cause most cases in industrialised countries, Central / South America
- A causes epidemics in sub-Saharan Africa and sometimes Asia
- W135 causes worldwide outbreaks in the early 2000's associated with Hajj; important in Middle East
- Y currently causes one-third of cases in the US, one-fifth of cases in Canada.
- About 1,500 lab-confirmed cases are recorded in the UK every year; although the true numbers are probably higher[16]. Approximately 85% are due to serogroup B, which is not yet preventable.
- On average one in ten of us carries meningococcal bacteria in our nasopharynx and for most of us this is harmless[17]. Carriage is unusual in young children, but the proportion of carriers increases with age, peaking in adolescents and young adults, about a quarter of whom carry the bacteria[17,18]. The bacteria are passed from person to person by droplets or respiratory secretions (e.g. coughing, sneezing, kissing) generally during prolonged close contact.
- The disease can affect anyone of any age, but mainly affects babies, small children and adolescents. Risk factors include season (with more cases occurring in the winter months – see graph 1), exposure to smoke[19] or smokers[20], recent influenza A infection[21], and living in 'closed' communities, such as university halls of residence and military barracks[22].
- Whilst fewer than 5%[23] of people affected die of meningococcal meningitis, the case fatality rate for meningococcal septicaemia is nearer 20% and can rise to 50% if the patient is already in shock when they reach medical help[24].
- People who recover may be left with disabilities that dramatically alter their lives, including brain damage, deafness, seizures, amputations, and severe skin scars. A quarter of survivors report a reduced quality of life due to the disease[25].

MenC vaccine

MenC conjugate vaccine was introduced in the UK in 1999/2000.

- It provides excellent protection against meningitis and septicaemia caused by Group C meningococcal bacteria, and has reduced cases by over 95%[26].
- Before it was introduced, clinical trials involving over 25,000 people demonstrated its safety. Since 1999, over 36 million doses of MenC vaccine have been given in the UK alone[27]. As with all licensed drugs, safety is continuously monitored.
- MenC vaccine is offered to those most at risk at a crucial time: before the age of peak incidence for meningococcal disease.
- Originally, MenC was offered to babies at 2, 3 and 4 months of age, but this was changed in 2006 after research showed that two doses given before 12 months of age protect as well as three doses[28] and that in babies immunised at less than 12 months of age, immunity to MenC disease begins to decline one year after immunisation[14].
- MenC is now given at 3 and 4 months of age with a combined Hib/MenC booster (see Box 3 overleaf) at 12 months.
- The success of the MenC vaccine has been largely due to its impact on carriage[29] and transmission, leading to herd immunity[30] (see Box 2 below). For these reasons, the risk of MenC disease for babies under 3 months of age now remains very low even though the first dose of MenC has been moved to 3 months[31].

Box 2: Herd Immunity

MenC and other conjugate vaccines directly protect those who are vaccinated. However, because these vaccines also reduce the number of people who are carrying and potentially transmitting the bacteria, people who are not vaccinated also benefit from indirect protection. This is called herd immunity.

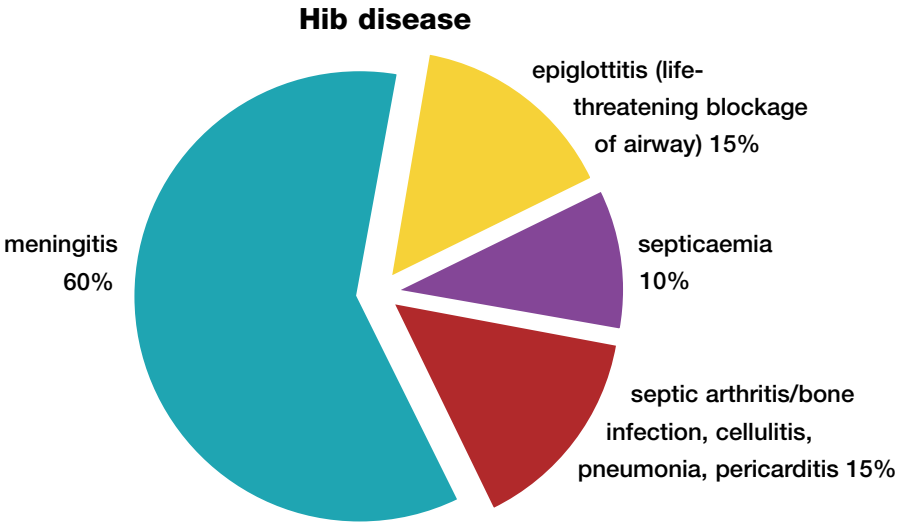
MenC protection beyond the routine schedule

- Anyone under 25 is eligible for MenC vaccination if they have not already had it. University students not previously immunised, regardless of their age, should get MenC before they enrol at university or as soon as possible afterwards. This is particularly relevant for overseas students coming from countries that do not vaccinate against MenC.
- **At-risk conditions:** MenC vaccine should also be offered to people with particular health conditions like asplenia and splenic dysfunction that increase their risk of infection. See pages 17-18 for more information about 'at risk' individuals.
- Anyone who gets meningococcal C infection despite being fully vaccinated should be offered MenC vaccine after a sample of convalescent serum has been taken for testing[5].
- Contacts of cases of meningococcal C infection prescribed antibiotic prophylaxis by public health (see page 5) should also be offered MenC vaccine if not vaccinated against MenC within the previous year.

MenC vaccine has been enormously successful. However, it is important to remember that **it cannot prevent all forms of meningitis and septicaemia**. For decades, Group B has been the most common kind of meningococcal disease in the UK. As yet there is no available vaccine that would protect against the majority of strains circulating in the UK, but a great deal of research is underway to develop MenB vaccines.

Hib (*Haemophilus influenzae* b) meningitis

Hib causes a range of potentially fatal illnesses[32]



- Those most at risk are children under age 4, especially babies 6 to 12 months of age[33].
- Hib is transmitted by coughing and sneezing, aerosols, droplets or close contact with a carrier or infected person.
- Before Hib vaccine was introduced around 10% of children under 5 carried the bacteria in their nose and throat[34], but after the vaccine was introduced Hib carriage fell below the level of detection[35]. This herd immunity effect protects the whole population (see Box 2 on page 9). More recently, school-aged children have been shown to be a significant reservoir for Hib bacteria, with a carriage rate of 4%[36].
- Five percent of people who get Hib meningitis die[37], and 26% of survivors will have long-term neurological damage, including deafness, intellectual impairment, seizures, and blindness according to a meta-analysis of studies from industrialised countries[38].
- Hib disease is a global problem; it is more common in developing countries, where Hib vaccine is less commonly used, and fatality rates from Hib meningitis can be as high as 30%[39].

Box 3: Hib/MenC Booster

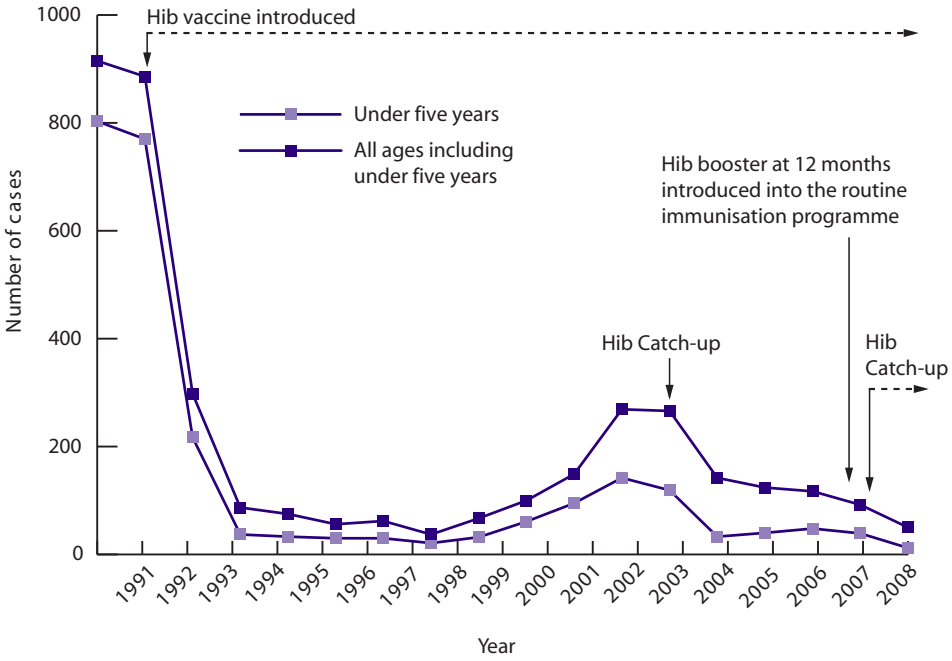
Research shows that protection from conjugate vaccines wanes during infancy[14,40]. To provide longer-lasting protection from disease, babies are offered a booster containing Hib and MenC vaccine at 12 months of age. This combination vaccine was licensed in the UK in 2005 but its ingredients are not new; they are used in other vaccines[41]. Its routine use since 2006 has further established its safety record. Trials of this vaccine have shown that it is as safe as other vaccines that are currently in use and provides a level of immunity to MenC and Hib diseases that is similar to other MenC and Hib vaccines currently in use[42,43].

Hib vaccine

Before introduction of the conjugate Hib vaccine, Hib was the most common cause of bacterial meningitis in children, causing about 800 cases each year[44]. Hib meningitis killed 30 people every year, and left at least 80 with long-term neurological damage[45].

- When Hib conjugate vaccine was introduced in 1992, confirmed cases in children under 5 fell by 98%[46] (see graph 2).
- After 1998, there was a small, but significant resurgence of Hib disease, although cases were still much lower than before Hib vaccine was introduced. As an interim measure to boost immunity in children and reverse this trend, there was a catch-up campaign in 2003, in which all children between 6 months and 4 years of age were offered an extra Hib vaccine.
- As a long-term solution to Hib disease, Hib conjugate vaccine is now given to babies at 2, 3 and 4 months of age as part of the 5-in-1 DTaP/IPV/Hib vaccine and immunity is boosted at 12 months with the combined Hib/MenC vaccine (see Box 3).
- A Hib pre-school catch-up campaign ran from Sept 2007 to March 2009 to ensure that children who were too young to have had a booster during the 2003 Hib catch-up campaign, and too old to have had the routine Hib/MenC booster after it was introduced in 2006, were adequately protected against Hib disease.

Graph 2. Impact of Hib vaccine on invasive Hib disease in England and Wales, 1990-2008



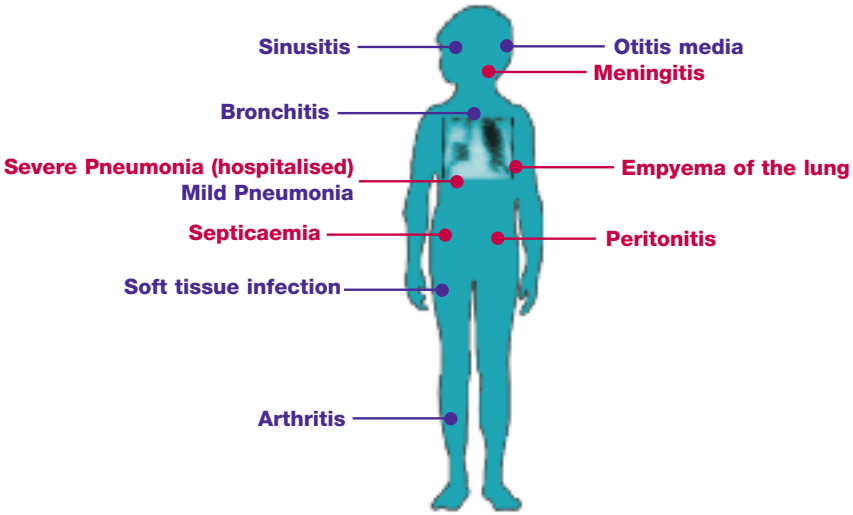
Reproduced with kind permission of HPA Haemophilus Reference Unit.

- Millions of doses of Hib vaccines given to children worldwide over nearly two decades have established an excellent safety record.
- DTaP/IPV/Hib vaccine, which has been used in the UK for primary prevention of Hib since 2004, also protects against diphtheria, tetanus, whooping cough and polio. Trials of the DTaP/IPV/Hib vaccine in the UK and elsewhere prior to introduction showed it to be safe[47]. In addition, over 10 million doses of a very similar DTaP/Hib/IPV vaccine have been given in Canada, where it has been used since 1997. Further evidence of DTaP/IPV/Hib vaccine safety has accumulated through its routine use in this country for several years.
- The acellular pertussis component of the DTaP/IPV/Hib vaccine causes fewer of the common, troublesome but minor reactions such as fever and soreness at the injection site than the previously used whole-cell pertussis vaccine formulation[47,48].
- Beyond the routine infant immunisation programme, Hib/MenC should be offered to people without a spleen or splenic dysfunction (see page 18).
- Any child under 10 who gets Hib infection should complete their course of immunisations, or if fully vaccinated, should be offered a Hib-containing vaccine when they recover, and antibody levels tested before and after re-vaccination[7].
- Close contacts of cases of Hib infection aged <10 who are prescribed antibiotic prophylaxis by public health (see page 5) should also be given a Hib-containing vaccine if not previously vaccinated, or if they previously received only three doses of Hib vaccine in infancy[7].

Pneumococcal disease

Pneumococcal disease describes a wide range of illnesses from life-threatening, invasive disease to common, non-invasive illness.

Spectrum of pneumococcal infection



Adapted with permission from an illustration by Prof David Goldblatt

Pneumococcal infection is more common in young children and elderly people. Young children are at more risk from all types of pneumococcal infection, including meningitis, while in older adults, bacteraemia and pneumonia predominate. People with immunodeficiency or certain other health conditions are also at higher risk of contracting pneumococcal disease.

- Following the success of the Hib and MenC vaccines, pneumococcal infection became the second most frequent cause of acute bacterial meningitis in children in the UK.
- There are about 90 different serotypes of pneumococcal bacteria (*Streptococcus pneumoniae*), but most serious pneumococcal disease in the UK is caused by only a few types[49].
- Many people, especially children under 5 years of age, carry pneumococcal bacteria in their nasopharynx[8]. The bacteria are transmitted from person to person in droplets by coughing and sneezing.
- It is the most life-threatening major form of meningitis, 15-20% of those affected will die[50,38]. Before routine vaccination, serious pneumococcal infections killed approximately 50 children under 2 years of age each year, about two-thirds of them from meningitis[51].
- Survivors have a higher rate of after effects, including deafness, intellectual impairment, speech and language problems, paralysis, cerebral palsy, epilepsy and blindness, than from other types of meningitis – half are left with some level of permanent disability[52]. Even those who appear to recover well from pneumococcal meningitis have substantial risk of neuropsychological problems[53].
- Globally, invasive pneumococcal disease kills around 1.6 million people each year[54], including up to one million young children and infants.

Pneumococcal conjugate vaccine

Approximately 6,000 cases of invasive pneumococcal disease were reported every year in the UK before childhood pneumococcal vaccine was introduced, including around 300 cases of meningitis. One-third of cases of pneumococcal meningitis were in children under 2.

Pneumococcal conjugate vaccine (PCV) was added to the routine infant immunisation schedule in September 2006 as a 7-valent vaccine, PCV7 (Prevenar®). PCV7 was replaced with PCV13 (Prevenar13®) during the spring of 2010. This vaccine:

- is now routinely offered to all babies at 2, 4 and 13 months of age (15 months of age in Northern Ireland), although practitioners can also deliver all of the vaccines scheduled for 12 and 13 month in a single visit.
- is based on the same conjugate vaccine technology used for the successful Hib and MenC vaccines (see box 1 on page 8)
- protects against the 13 major types of pneumococcal bacteria that in 2007/8 accounted for 74% of severe pneumococcal disease in children under age 5 in the UK[55].
- is also recommended for children under 5 with health conditions that put them at higher risk from pneumococcal disease (see page 16).

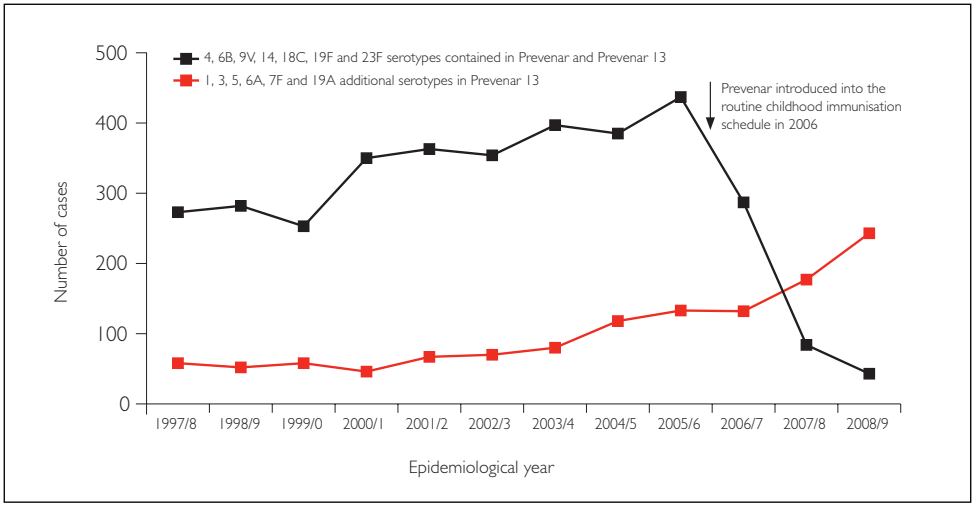
At first PCV was only offered to children with 'at-risk' health conditions. However, many children affected by pneumococcal disease had none of these risk factors, and even children who did were often not given the vaccine.

The widespread use of PCV7 in over 100 countries, with over 300 million doses distributed worldwide[39], established a solid safety record. Clinical trial data from studies involving more than 7000 children show that PCV13 has a similar safety profile to PCV7.

Impact of pneumococcal vaccine (PCV) on invasive pneumococcal disease

In the first two and a half years after the introduction of PCV7, it has been estimated that 959 cases of serious illness and 53 deaths due to invasive pneumococcal disease were prevented[57]. This is because PCV7 has been very successful at preventing the seven strains of pneumococcal infection it covers. By 2007/8[58] there had been a 90% reduction in vaccine-type IPD in under 2's and a 67% decrease in 2-4 year olds. Meanwhile, as disease caused by the seven strains covered by Prevenar decreased, cases caused by other strains of pneumococcal bacteria had been increasing (see graph below).

Graph 3: Invasive pneumococcal disease in the under 5s caused by strains in pneumococcal conjugate vaccine



Graph reproduced with kind permission of HPA Centre for Infections

Before PCV7 was introduced, cases of pneumococcal disease caused by vaccine and non-vaccine types were on the rise, and after the introduction of PCV7, non-vaccine types continued to rise. The 13-valent replacement vaccine (PCV13) was therefore introduced to give broader protection to children.

Data from the US, the first country to introduce PCV7 in 2000, provided strong evidence of its efficacy and effect on herd immunity[59,60] (see Box 2, page 9). By 2005, there was a 73% decline in vaccine-type pneumococcal meningitis in the entire population[60]. As of 2003, the vaccine had prevented more than twice as many cases of IPD indirectly in un-vaccinated older people through herd immunity as it did directly in vaccinated children[59]. So far the UK has not seen the same herd immunity effect as the US – the reduction in pneumococcal disease in unvaccinated age groups has been partly counter-balanced by non-vaccine type pneumococcal disease.

Cases of non-vaccine type IPD have risen in many countries, both with and without PCV7[62,63] including some serotypes not covered by PCV13. This highlights the necessity for protection against additional serotypes and for detailed surveillance to evaluate the impact of improved vaccines.

There are limits to the potential coverage conjugate pneumococcal vaccines can provide. They are an important defence against a devastating disease, but with more than 90 known strains, over many more years, the solution they provide may prove to be temporary. Further research is needed into pneumococcal vaccine components that could provide universal protection, and there are a number of significant efforts towards this goal taking place around the world.

Box 4: Three injections in one visit?

Since the introduction of pneumococcal conjugate vaccine, babies receive three separate injections at 4 months of age (see schedule on page 7) and this has proven to be acceptable to parents and to immunisers. Giving all three injections at the same visit is the safest way to protect - postponing an injection prolongs a child's exposure to life threatening illnesses. Three simultaneous injections do not cause any more adverse effects than they would if given on separate visits[64].

Previously, three injections were also given during the same visit to pre-school children in the MenC catch-up campaign in 2000 (MenC, DT booster and a second dose of MMR). The situation was similar during the Hib booster campaign in 2003. The routine infant schedule in the USA includes up to four injections at one visit[65].

At the 4-month visit, all three injections are given into the thigh: two of the three injections into the same thigh. Babies are too small for intramuscular vaccines to be administered safely into their arms, and injecting into the buttock is less safe because of the risk of sciatic nerve damage. Injections should be given at least 2.5cm apart[66] and the site at which each vaccine is given recorded. In the USA it has been routine practice for many years to deliver two vaccinations into the same thigh.

Guidance on giving three injections at once, and in-depth information about all aspects of administering the schedule is available in the Green Book and the HPA website: http://tinyurl.com/immunisationtraining.

Prevention of meningitis outside the routine childhood schedule

Pneumococcal polysaccharide vaccine (PPV)

Polysaccharide pneumococcal vaccine has been available since the 1980s. It:

- provides a level of protection in most adults, against invasive disease caused by the top 23 types of pneumococcal bacteria, which in 2005/6 accounted for 91% of cases http://tinyurl.com/mcdhzp
- is not effective in children under age 2, and is less effective in people with immunodeficiencies and children under age 5
- is routinely offered to all those over 65 years of age
- has been recommended since 1992 for people over 2 years of age with 'at-risk' conditions

Immunisation for people with 'at risk' health conditions

Immunisation is important for people with certain medical conditions that put them at higher risk from bacterial infection. Community nurses need to be aware of the recommendations listed in Table 2 below, which were updated in July 2006. These individuals may require additional vaccines, or extra doses of vaccine. Not all patients in these categories will be under the care of a paediatrician or other specialist.

Table 2: Clinical Risk Factors for Pneumococcal Vaccination

Asplenia or splenic dysfunction including, e.g. sickle cell disorder, coeliac disease
Immunodeficiency / Immunosuppression due to disease or treatment
Some immunocompromised patients may have a sub-optimal response to vaccination
Chronic respiratory disease, also neuromuscular disease (e.g. cerebral palsy) with risk of aspiration in children.
Chronic heart disease
Chronic kidney disease
Chronic liver disease
Diabetes mellitus that is not diet controlled
Cochlear implantation Immunisation must never delay implantation
Cerebrospinal fluid leak, e.g. after injury or surgery

For detailed recommendations on clinical risk factors, see Table 25.2 in the Green Book

People who fall into one of the categories in Table 2 should be offered pneumococcal vaccination with PCV, PPV or both depending on their age.

- At-risk children under 12 months should be immunised according to the routine schedule. Those who are late should be offered the routine immunisations, with doses of PCV two months apart and a further dose at 13 months of age.
- At-risk children over 12 months and under 5 years of age who have not completed their immunisations should be offered a single dose of PCV. If immunocompromised (including those with asplenia or splenic dysfunction) they should be offered a second dose at least two months later.
- Children under 5 who develop immunosuppression (including splenic dysfunction/asplenia) more than one year after completing their routine immunisations should be offered an additional dose of PCV.
- At-risk children aged 2 or more years of age should be offered a single dose of PPV at least two months after their final dose of PCV.
- At-risk children aged older than 5 and adults should be offered a single dose of PPV, but PCV is not currently recommended, although this may change as more broadly protective pneumococcal conjugate vaccines become available[67].
- The JCVI has recently recommended that PCV rather than PPV should be offered to people with HIV, people who receive bone marrow transplants and people who have chronic renal disease. HIV positive and those receiving bone marrow transplants should receive two doses of PCV with an interval of two months between doses (in line with the current advice for children aged 12 months to 5 years who are immunosuppressed). People who have chronic renal disease should receive two doses of PCV followed by a booster dose every five years[67].
- Re-immunisation with PPV every five years is recommended for people with asplenia and splenic dysfunction, because antibody levels decline rapidly in these individuals.

All children under 5 years of age who have had invasive pneumococcal disease should be offered conjugate pneumococcal vaccine regardless of vaccination history. They should be investigated for immunological risk factors to seek a possible treatable predisposing condition[68]. If they fall into one of the risk groups in Table 2, they should be offered pneumococcal polysaccharide vaccine after age 2 (but note exception in point 6 above).

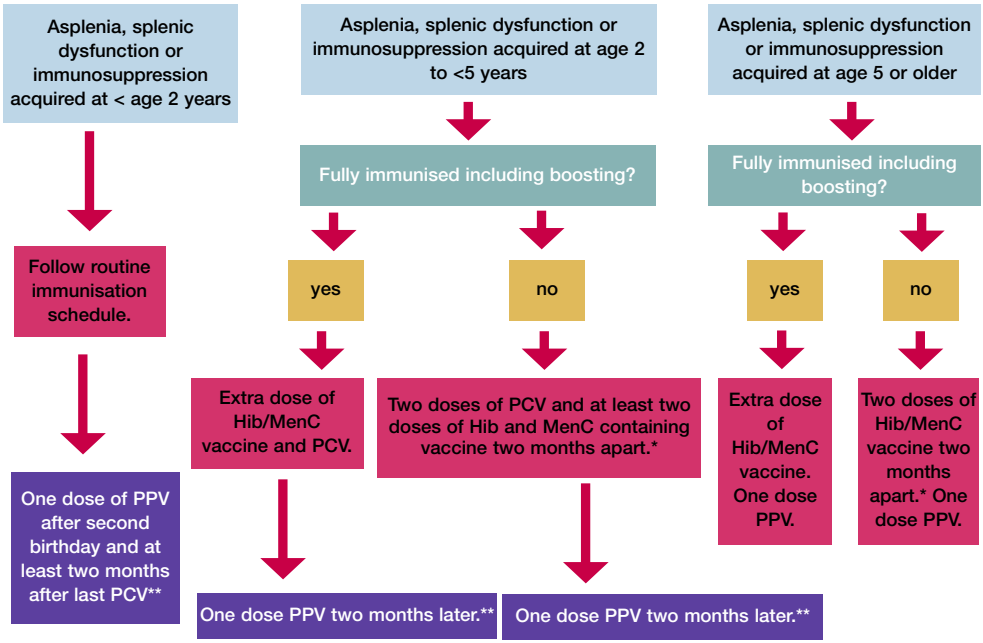
Patients about to have splenectomy, radiotherapy or chemotherapy should be vaccinated beforehand if possible: ideally four to six weeks, but at least two weeks before surgery or treatment[69]. However, splenectomy or cancer therapy should never be delayed if immunising beforehand is not possible. Immunisation or re-immunisation of immunosuppressed patients (with pneumococcal, Hib/MenC and certain other vaccines) may be required after immunosuppressive treatment (see following page).

Protecting asplenic/immunosuppressed people from meningitis

Ideally, the vaccination course should begin four to six weeks but at least two weeks before surgery or immunosuppressive treatment. If not possible, vaccination can begin at least two weeks after splenectomy by which time antibody responses improve. For timing of vaccines after other immunosuppressive treatment see chapters 7 and 25 in the Green Book.

Hyposplenic or asplenic individuals, are at an increased lifelong risk of infection from pneumococcal, meningococcal and Hib bacteria, which the spleen would normally help fight[70,71].

The incidence of disease in this group is up to 10-50 times higher than that within the normal population[72]. Such individuals should therefore be offered the Hib/MenC combination vaccine as well as pneumococcal vaccine.



Adapted from Table 7.1 of the Green Book

*As children <10 should complete primary immunisations[32,13] more doses of Hib may be given as DTaP/IPV/Hib.

** But see exception (page 17) for people with HIV, bone marrow transplant and chronic renal disease.

Close contacts of immunosuppressed individuals should also be fully immunised according to the routine schedule to minimise the risk of infection.

Travel and pilgrimage: Protection against other serogroups of meningococcal disease

- Globally, meningococcal disease affects up to 1.2 million people each year, with 135,000 deaths[73]. The highest burden of disease is in the "Meningitis Belt" of

sub-Saharan Africa, where epidemics, primarily due to serogroup A, can strike up to a quarter of a million people in a single year, with tens of thousands of deaths. Pandemics have also occurred in Asia.

- After a serogroup A outbreak that affected more than 1,800 Hajj pilgrims to Mecca in 1987, vaccination with AC polysaccharide vaccine became routine for Hajj pilgrims[74].
- In 2000, there were outbreaks of serogroup W135 meningococcal disease among Hajj pilgrims, and world-wide after pilgrims returned to their own countries[75]. The particular strain involved originated in sub-Saharan Africa[76], and went on to cause epidemics in the African meningitis belt. After further Hajj-associated outbreaks in 2001, quadrivalent ACWY vaccine became compulsory for pilgrims going to Mecca on Hajj.

Meningococcal ACWY quadrivalent vaccine

Vaccination with quadrivalent meningococcal vaccine is now an entry requirement into Saudi Arabia for pilgrims on Hajj or Umrah and for seasonal workers in Hajj areas.

- This protects against four meningococcal strains: A, C, W135 and Y.
- A conjugate meningococcal ACWY vaccine, Menveo®, was licensed in Europe in 2010 for people aged 11 and older. Both the older polysaccharide ACWY (ACWY Vax) and conjugate ACWY (Menveo®) vaccines are now available. The Green Book now recommends that Menveo® should be used off-label in children under age 5 rather than ACWY Vax because it has been shown to be safe and the immune response is better. In children aged over five years and adults, Menveo® should be used in preference to ACWY Vax to provide better and longer lasting protection.
- Babies aged less than 1 year require 2 doses of Menveo® 1 month apart. For people older than 1 year, 1 dose is sufficient. Children over one year of age who were vaccinated with Menveo® as infants should be offered an additional dose before travelling to an area that puts them at risk from meningococcal infection.
- On arrival in Saudi Arabia, Hajj pilgrims must present a certificate of vaccination issued at least 10 days, but not more than 3 years before they get there.

Quadrivalent meningococcal vaccine is also recommended for travel to high-risk countries in sub-Saharan Africa, particularly for travellers living or working with local people or visiting during the dry season, or during an outbreak. Occasionally outbreaks of meningococcal disease occur in other parts of the world, particularly in Asia, and vaccination may be recommended for travellers to countries affected. An up-to-date list of countries with potential risk from meningococcal disease can be obtained from The National Travel Health Network and Centre http://www.nathnac.org/pro/clinical_updates/meningitis_update.htm

Contacts of cases of probable or confirmed meningococcal A,W135 or Y infection prescribed antibiotic prophylaxis by public health (see page 5) are also offered Menveo® if over 2 months of age. If under 1 year old, they will require a second dose 1 month later.

TB meningitis

There has been a steady rise in TB worldwide in recent years. TB is now the second most commonly notified kind of meningitis in England and Wales, with 320 notifications in 2007[79].

- Tuberculosis is caused by infection with mycobacteria. The infection usually begins elsewhere in the body (frequently the lungs), but in a small number of cases the bacteria spread to the meninges to cause TB meningitis. TB is spread by prolonged and close contact; usually with someone with sputum smear positive pulmonary TB.
- In contrast to acute bacterial meningitis, TB meningitis usually develops slowly; with vague non-specific symptoms lasting for several weeks before symptoms typical of meningitis occur. This makes diagnosis difficult and illness is often advanced before treatment begins.
- Since the 1980s, the epidemiology of TB in the UK changed from a disease of the general population to one predominantly affecting high risk groups with 40% of cases occuring in London[80].
- Although 70-85% of people with TB meningitis survive, one quarter may have long-term disability, partly because it is so difficult to recognise the disease in its early stages.

TB vaccination: BCG

Immunisation with BCG vaccine provides 70-80% protection against TB meningitis in children[81] and until recently children were routinely vaccinated at school. BCG immunisation recommendations were altered in 2005 to target specific risk groups in line with changes in epidemiology[80].

The vaccine is currently offered to the following risk groups[81]:

- All infants living in areas where the incidence of TB is high (40 per 100,000 or greater).
- Infants and previously unvaccinated children whose parents or grandparents were born in a country with a TB incidence of 40 per 100,000 or higher.
- Previously unvaccinated new immigrants under age 16 from high prevalence countries for TB.
- People with jobs where there is high risk of contact with infected patients, animals or clinical materials e.g. health care workers, care home staff.
- People under age 16, not previously vaccinated, who are going to visit, live or work for more than three months in a country with high rates of TB.

An up-to-date list of countries with potential risk from TB can be obtained from The National Travel Health Network and Centre http://www.nathnac.org.

For full recommendations on the prevention of TB please see the Chapter 32 of the Green Book http://tinyurl.com/p3qmf8 and the NICE Clinical Guidelines: http://www.nice.org.uk/nicemedia/pdf/word/CG033NICEguidelineword.doc.

After effects – what community nurses need to know

Most survivors of meningitis and septicaemia make a full recovery without permanent after effects, but some are left with disabilities or problems that require long term medical follow up, and educational and social support. An estimated 25% of survivors are left with problems ranging from serious disabling after effects to more subtle cognitive and coordination problems, that have a significant impact on their quality of life[82].

Potential sequelae include:

- Hearing loss and other sensory disabilities
- Neurological damage including learning, motor and neuro-developmental problems and epilepsy
- Orthopaedic damage including amputation, growth plate damage and arthritis
- Post necrotic tissue/skin loss requiring reconstructive surgery
- Permanent damage to major organs (e.g. kidney, lungs)
- Psychiatric and behavioural problems, including post-traumatic stress disorder.

Careful and early follow up of patients discharged from hospital after meningitis and septicaemia is important, and may involve primary care as part of a co-ordinated care plan. Hearing should be tested as soon as possible, within four weeks of being well enough to be tested[83] as further damage to the inner ear can limit the chances of successful cochlear implantation if there is profound hearing loss[84]. Hearing tests may need to be repeated and may require referral from primary care. This is especially important in young children who are learning language skills.

Psychological follow up is important and children may have difficulty readjusting after discharge. Early referral to Child and Adolescent Mental Health Services may be necessary. Parents as well as children may be prone to post-traumatic stress disorder[85].
In some cases, sequelae do not become evident until years after the illness, long after routine follow up has ceased:

- learning impairment and coordination difficulties are sometimes only noticed when children reach school age
- distorted bone growth due to growth plate damage may take years to become apparent[86]

In such cases, children need referral from primary care for assessment and follow up care.

Meningitis Research Foundation offers in-depth information, befriending and support to families and individuals affected, see back page for details.

Vaccine safety

The safety of meningitis vaccines is carefully established in clinical trials before they are introduced. However, some adverse reactions are so rare that they cannot be identified during clinical trials and only become apparent after introduction. Therefore it is vital that the safety of every vaccine continues to be monitored as long as it is used. A comprehensive monitoring system builds up further evidence of safety as millions of doses are given over the years. This is called pharmacovigilance, and it is coordinated in the UK by the Medicines and Healthcare Products Regulatory Agency http://tinyurl.com/n8swhv.

Almost all meningitis vaccines now in use in the UK are also used in other countries, which further contributes to the enormous bank of safety data.

As with nearly all drugs, vaccines can cause side-effects – mostly local injection-site reactions, low-grade fevers, and irritability. Very rarely, serious reactions are reported. It is never possible to be certain that a child will not react seriously to any medicine or vaccine, but the risk of anaphylactic reaction to childhood vaccines is tiny – about one per million immunisations[87]. **Having children vaccinated is far safer than not having them vaccinated.**

Contraindications to vaccination

The routine childhood vaccines against bacterial meningitis are inactivated vaccines. A confirmed anaphylactic reaction to a vaccine or any component of a vaccine or to its packaging (latex in the syringe or vial of some vaccines) is the only contraindication to any inactivated vaccine[88]. Asthma, eczema, breast-feeding, premature birth and family history of reaction to vaccination are often mistakenly thought to be contraindications to routine immunisation. For a list of other common false contraindications to vaccination refer to Chapter 6 of the Green Book http://snipurl.com/c6v0.

Vaccination should be postponed[88] in cases of

- Acute illness – not because it isn't safe, but to avoid falsely associating a pre-existing illness with the vaccine.
- Unstable/unexplained seizures or neurological disease to avoid confusion about what is or is not a side-effect of vaccination.

Reassuring parents about vaccine safety

In recent years speculative media stories have raised parental anxiety about vaccination. Nurses are now increasingly faced with parents who are concerned that vaccination is in some way more hazardous than the diseases themselves. This is not correct. This section of the booklet aims to deal with these concerns and some of the myths that have developed.

Q: Do multiple vaccines, either combinations or separate vaccines given at the same time weaken or overload a baby's immune system?

No – every day of their life, babies are naturally exposed to far more immune challenges from the environment around them than from all of the vaccines contained in the routine immunisation schedule added together. They are able to deal with these immune challenges just as they are able to deal with the vaccinations we give them.

- From the moment a baby emerges from the nearly sterile environment of the womb – through the cervix and birth canal – he or she enters a world teeming with bacteria and other microbes.
- Within hours of birth, a baby's gastro-intestinal and respiratory tracts are heavily colonised with bacteria[89].
- A baby's contact with other people exposes him or her to multiple immune challenges – on average there are[90]:
  - 1,000 bacteria on each cm^2 of your skin
  - 1,000,000 bacteria on each cm^2 of your scalp
  - 100,000,000 bacteria per gram of saliva
  - 10,000,000 bacteria per gram of nasal mucus

In fact the bacteria in your body outnumber your own cells: the human body is composed of 10 trillion cells, and contains 100 trillion bacteria.

- Our immune systems respond to antigens – these can be proteins found on the surface of bacteria and other microbes, or may be contained in vaccines. Bacteria that babies are commonly exposed to have many more antigens than all the vaccines in the routine schedule:
  - Streptococcus – 1,838 protein antigens
  - Staphylococcus – 2,467 protein antigens
- When a baby gets a cold, its immune system has to respond to 4-10 antigens. When its intestines are colonised by just one bacterial strain, its immune system must respond to 15-50 antigens[91].
- A baby's immune system has an enormous capacity to fight the thousands of bacteria, viruses and other pathogens that it is bombarded with every day – a baby could, in theory, respond to around 10,000 vaccines at any one time[92].
- Even babies who are unwell can produce protective immune responses to vaccines[93].
- If multiple vaccines overloaded the immune system we would expect vaccinated children to be less able to fight off bacterial and viral infections. However, research has shown no increase in hospitalisation due to bacterial or viral infections following immunisation with multiple vaccines or concurrent immunisation with routine childhood vaccines[94,95,96]. In some studies recent vaccination was associated with lower risk of such infection.

A: It is a misconception that the immune system can be overloaded. Far from overwhelming the immune system, by providing protection against potentially fatal infections, vaccines help stimulate and strengthen the immune system.

Q: There seem to be so many new vaccines. Shouldn't I wait until they've been in use for a few years and my child is older before getting her immunised?

Hib, meningococcal and pneumococcal polysaccharide vaccines have been around for decades (see box below). What is fairly new is our ability to take these older vaccines, link them to proteins (which themselves have been around for many years) and make conjugate vaccines. By doing this we can protect the younger age groups that are so vulnerable to these diseases.

When babies are exposed to meningococcal, pneumococcal or Hib bacteria, they are much more likely to develop disease than older children and adults. Each of these bacteria is covered in a sugar (polysaccharide) coat, and although the infant immune system responds very well to protein antigens, it cannot respond very well to sugar antigens. This is partly why babies are particularly susceptible to Hib, meningococcal and pneumococcal infections.

The vaccines we now have for children against meningococcal C, Hib and pneumococcal infections are conjugate vaccines. **Conjugate** vaccines are made by linking a tiny fragment from the bacterial sugar coat (which the infant's immune system cannot respond to) to a protein (which the infant's immune system can respond to). In this way the immune system is able to recognise meningitis bacteria. Thus, conjugate vaccines are effective in babies as young as 2 months of age and trigger a long-lasting immune response.

A: Many of the vaccines in the UK programme are not actually new but are improved formulations. Rigorous clinical trials have ensured these are safe to give to babies. Babies need protection early – their greatest risk of getting meningitis and septicaemia is in the first 12 months of life. To delay vaccination is to put them at risk.

Meningitis vaccines - year of first licence

1970s	Haemophilus influenzae type b (Hib) polysaccharide
1972	Meningococcal polysaccharide
1977	Pneumococcal polysaccharide
1984	23-type Pneumococcal polysaccharide
1987	Haemophilus influenzae type b (Hib) conjugate
1999	Group C Meningococcal conjugate
2000	7-type Pneumococcal conjugate
2005	Hib/MenC conjugate combination

Q: Isn't it better for babies to develop natural immunity to serious childhood diseases? Isn't this a safer alternative to vaccination?

No. For diseases that can kill or cause serious disability this is a very risky way to develop immunity. It is far safer to be vaccinated.

There are two kinds of immunity: active and passive.

- Active immunity is when your immune system has been stimulated to make its own antibodies.
- Passive immunity is when you are given someone else's antibodies either in the form of immunoglobulin or naturally, as from mother to baby.

Babies naturally get passive immunity when:

- Maternal antibodies cross the placenta – mainly during the 3rd trimester of pregnancy.
  - This provides some protection against infections to which mother is already immune, but this immunity quickly wanes.
  - Since antibodies are mostly passed to the baby late in pregnancy, premature babies receive less protection than full-term babies. These infants need the protection of vaccinations even more – waiting until they are bigger is not the right thing to do.
- They are breast-fed. Breast milk and colostrum mainly provide a class of antibody called IgA[92], which guards mucosal surfaces – important because it helps protect against gastrointestinal and respiratory[97] bugs. This provides limited protection against invasive infections like meningococcal, pneumococcal[98] and Hib[99] disease. Therefore whilst breast-feeding has a great many health benefits, it is not a replacement for immunisation.

Compared to active immunity, passive immunity is short-lived.

Active immunity is acquired through:

- natural exposure to infections
- vaccination, which mimics the process of acquiring active immunity by natural infection.

When a child is naturally exposed to meningococcal, pneumococcal or Hib bacteria, the child may:

- carry the bacteria harmlessly in the back of their throat for a few weeks or months, or
- develop meningitis, septicaemia, or one of the less life-threatening diseases these infections can cause.

Both outcomes, carriage and disease, stimulate the production of antibodies against that particular strain of bacteria. If the child survives the infection, the antibodies they have produced should protect them against further infection with that strain. The immune system should 'remember' that infection, and produce specific immune memory cells, so that the immune system can respond very quickly, producing protective antibodies, if ever the child meets that particular strain of the infection again.

BUT the child may not survive the infection, or may be permanently affected by deafness, blindness, cerebral palsy, paralysis, amputations, scarring or one of the many other after effects these diseases can cause.

Natural infection is less reliable than vaccination for providing protective immunity against meningitis. Children who have had pneumococcal meningitis and septicaemia still need pneumococcal vaccination – any immunity they have acquired from the infection will be specific to the strain they had, and there are 90 different strains of pneumococcal bacteria. Children who recover from Hib[32] and all who recover from meningococcal C[5] disease also need to be vaccinated.

A: For serious, life-threatening childhood illnesses, acquiring active immunity through vaccination is a much safer way to protect babies and children than risking exposure to the diseases.

Q: My baby was born prematurely. Surely he is too young to be vaccinated, as his immune system is not fully developed?

Babies who are born early are at greater risk from infections than full-term babies. This is because their immune systems are less mature, and also they do not have as much antibody passed on to them from their mothers during pregnancy. Therefore premature babies need protection from immunisation even more than most babies[100], and it is important that they have their vaccines at the correct time as part of the routine schedule – there is no reason to delay.

Except for very premature babies (gestational age under 30 weeks or birthweight less than 1500g), protection from immunisation is the same as for full-term babies[100]. Additional doses of vaccine may need to be considered for very premature infants[101] and booster doses are especially important to maintain long-term protection[102]. Babies born very early may still be in hospital when they are 8 weeks old and can start their immunisations before they go home.

Very premature babies may be born before their lungs have matured sufficiently to breathe properly. In these cases immunisations can be started in hospital where respiratory monitoring should be undertaken for 48-72 hours after administering the first immunisation. If the child has apnoea, bradycardia or desaturations after the first immunisation, the second immunisation should also be given in hospital where respiration can be monitored[32].

A: The very young are most at risk from infections like meningitis and their need for vaccinations is greatest.

Q. We use homeopathic remedies. Can't we use a homeopathic medicine instead of vaccines?

Many people do use homeopathic and other alternative remedies, however there is no evidence that they prevent the diseases against which we immunise. The Faculty of Homeopathy, which represents medical and allied healthcare professionals and veterinary surgeons who integrate homeopathy into their practice, recommends that immunisation should be carried out in the normal way using the conventional and approved vaccines unless there is a genuine medical contraindication[103,104]. Where there is a medical contraindication to conventional vaccines (in practice there are very few), or where a patient may otherwise remain unprotected, they suggest it may be appropriate to consider use of a homeopathic prophylactic (preventative medicine) specific to the disease. The Society of Homeopaths which represents professional homeopaths, "acknowledges that the evidence to support the use of homeopathic prophylactics is largely anecdotal and therefore the use of this method is currently speculative"[105].

Some homeopaths advise against the use of the MMR vaccine, but their professional organisations do not back them up on this as there is no evidence that homeopathy prevents the disease for which there are vaccinations[106]. The Society advises patients to discuss immunisation with their GP and homeopath[107].

A: There is no evidence that homeopathic remedies can protect against the diseases that vaccines are designed to prevent. There is very little support from professional organisations that represent homeopaths for substituting vaccines with homeopathic remedies.

Q: What about all the things added to vaccines. Aren't these dangerous?

Additives are materials added to vaccines by the manufacturer for a specific purpose – to make them work better or to ensure safety. They might include:

- **Adjuvants:** these enhance and direct the immune response. The only adjuvants in UK vaccines are aluminium salts.
  - Aluminium is one of the most common elements on earth and is present in air, food and water, so all infants are exposed to it in the environment.
  - It is present in many foods: breast milk contains about 40 µg/l[108].

- **Stabilisers:** materials that help protect the vaccine from adverse conditions such as the freeze-drying process or heat; or stop the vaccine from sticking to the sides of the vial.
  - Can be sugars (e.g. lactose), amino acids, proteins or buffers.
  - Some parents worry about lactose-containing vaccines in lactose-intolerant children, but lactose is only a problem for these children when it is ingested. Vaccines are given intramuscularly, and this does not bring on symptoms of lactose intolerance.
- **Preservatives:** prevent growth of bacteria & fungi.
  - Until recently, the mercury-based preservative, thiomersal was used in DTP combination vaccines. It was there to prevent contamination when we used to use multi-dose vials which were repeatedly punctured when drawing up doses. The safety of thiomersal in vaccines has been firmly established through its use for over 70 years, and by several large studies in the UK and US[109]. However, as part of a global goal to reduce the exposure of children to mercury from any avoidable source, there has been an international effort to eliminate thiomersal from vaccines where possible. None of the vaccines in the routine childhood immunisation programme[44], nor any meningitis vaccine used in the UK[110], now contains thiomersal.
- **Residuals:** traces of substances used to make or inactivate vaccine components may remain in the final product.
  - Antibiotics: neomycin, polymyxin B, and streptomycin are used to prevent bacterial contamination during manufacturing and may be found in trace amounts in some childhood vaccines[108]. Allergic reactions to these are very rare, but a previous confirmed anaphylactic reaction to one of these antibiotics is one of the very few contra-indications to receiving DTaP/Hib/IPV vaccine[111]. It is important to remember that reported allergy to penicillin, for example, or to 'antibiotics' in general, is not a contra-indication to vaccination.
  - Formaldehyde is used to inactivate viruses or toxins used in the manufacture of some vaccines. It is also naturally present in the human body – our bodies need it to make amino acids and DNA. The barely detectable quantities of formaldehyde that may remain in some vaccines are less than one-tenth of the levels that circulate naturally in the bloodstream of a 2-month old baby[108].
  - Materials derived from cattle, such as agar, casein and casamino acids, are used during the early stages of manufacture of Men C vaccines and pneumococcal conjugate vaccine, but are not detectable in the finished product. All manufacturers source these products from countries certified BSE-free – not the UK[112].

A: In the light of recent vaccine scare stories, it is not surprising that there may be public concern about vaccine additives. However, additives are only used when they are necessary and they are not dangerous. To vaccinate against the serious diseases of childhood is much safer than not to vaccinate.

Q: There are so many children with allergies and asthma. Could this be due to all the vaccinations?

Asthma and allergies are on the rise in children in industrialised countries. The 'hygiene hypothesis', suggesting that improved hygiene and reduced exposure to infections promote allergic illness, has been proposed to explain this increase. The theory is that dealing with early infections occupies a baby's immune system and directs it along an infection-fighting pathway. Conversely, in a 'clean world' where babies are less exposed to infections, the immune system shifts to a different pathway – instead of fighting infections, the immune system over-reacts to allergens in the environment. Although epidemiological evidence supports the hygiene hypothesis, evidence for the scientific basis of the hypothesis is contradictory[113].

The theory has led people to ask whether, by preventing infections in babies, immunisation could increase the risk of allergies and asthma. This is implausible because even fully vaccinated babies and toddlers frequently get coughs and colds and tummy bugs that we do not vaccinate against. In fact vaccines work by stimulating the immune system in much the same way that infection does, but in a more controlled manner without the complications of a serious infection. Many studies, in very large populations, have looked for evidence that immunisations might cause allergies. The overwhelming evidence is against any such link[114,115,116,117,118].

A: Well-controlled studies in large populations have found no link between allergies or asthma and vaccination. Asthma, eczema, hay fever and atopy are not contraindications to immunisation.

This booklet aims to enrich nurses' knowledge about preventing meningitis and septicaemia through immunisation. Research has found that parents are more likely to choose immunisation for their child if they can discuss concerns with a practitioner they trust who is knowledgeable and able to discuss vaccine issues[119,120].

Myths about vaccination continually appear in the media and it would be all too easy for media coverage to cloud our professional judgement about the safety of vaccines. We owe it to the families and children that we care for to correct these myths and misunderstandings and to confidently deliver positive messages about immunisation.

Prevention through vaccination is the only way to defeat meningitis and septicaemia.

Vaccination is the safer alternative to these devastating diseases.

Please use this booklet to discuss the facts with parents.

Always remember that we do not yet have vaccines to protect us against every cause of meningitis and septicaemia, so recognition and early treatment are crucial.

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This booklet is produced by Meningitis Research Foundation and can also be downloaded as a PDF from our website. It was written by Linda Glennie, Linda Diggle, Claire Knight, Rachel Perrin, Nelly Ninis, and Linda Bailey with additional input from Helen Bedford and Richard Roberts.

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