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The Childhood Immunisation Programme

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The childhood immunisation programme

Availability of safe drinking water and immunisation have been the most cost effective public health measures. It is estimated that worldwide 2–3 million deaths are prevented annually due to immunisation. Herd immunity extends protection to the whole community but immunisation uptake needs to be high. This article aims to clarify the immunisation programme in the UK and to discuss the challenges GPs may face. Illustrative examples will demonstrate the challenges that practitioners may come across in their routine practice.

The GP curriculum and immunisation

Immunisation for children is covered in two areas of the GP curriculum.

Clinical statement 3.01: Healthy people: promoting health and preventing disease requires GPs to;

- Understand and promote the principles of prevention and preventative strategies
- Understand the principles of immunisation and vaccination and the UK's immunisation programmes
- Be familiar with the benefits and risks of immunisation and vaccination in order to reassure parents effectively
- Recognize and contend with the potential tension between the GP's health promotion role and parents' own agenda
- Understand the financial frameworks in which health care is given at practice level

Clinical statement 3.04: Care of children and young people includes immunisation within its knowledge base and specifically requires GPs to be aware of their role in promoting and organizing child immunisation.

What is immunisation?

Primary prevention is the process of reducing the incidence of disease in a population by reducing the risk of new cases arising. The childhood immunisation program is one of the best known examples of primary prevention.

Immunisation is the process of administering vaccines, which results in acquired immunity to an infectious disease. The term 'immunisation' originated from the work of von Behring and Kitasato on diphtheria and tetanus antitoxins in the late 19th century. It was von Behring who referred to the rabbit serum containing the antitoxins as 'immune serum' (Plotkin *et al.*, 2008).

Vaccines are preparations of killed or modified micro-organisms or their toxins that can stimulate an immune, i.e. antibody response and therefore prevent future disease by inducing active immunity and immunological memory. The term 'vaccination' originated from 'vaccinia', a procedure

used to protect people with the smallpox vaccine (Plotkin *et al.*, 2008).

History of immunisation

The first record of active immunisation can be traced back to the 7th century AD in India where Buddhist monks drank snake venom in an attempt to develop immunity (Plotkin *et al.*, 2008).

Modern day immunisation developed from the pioneering work of Edward Jenner (1749–1823) on smallpox vaccine. This arose from his observation that milkmaids did not generally get smallpox. Jenner postulated that the pus in the blisters received from cowpox (a disease similar to smallpox) protected the milkmaids from smallpox (Plotkin *et al.*, 2008). His observation and hypothesis were vital to the development of modern day vaccines.

In the UK, initial attempts at immunisation were given to the British troops when Almroth Wright gave 14 000 volunteers

killed typhoid vaccine during the Boer War in 1899. General typhoid immunisation was offered in the British Army by the beginning of the World War I in 1914; however, it was optional (Plotkin *et al.*, 2008). In the 1940s, during the Second World War, the complementary skills of military and industrial research scientists led to the development of new or significantly improved vaccines which resulted in 10 of the 28 vaccines routinely used to prevent disease today (Hoyt, 2006).

Mass immunisation became popular in the UK after World War II with increasing numbers of vaccines given routinely (Table 1) and ultimately resulting in the comprehensive childhood immunisation programme that we have today.

Table 1. Timeline of vaccine introduction in the UK

Vaccine introduced in the UK	Year of introduction
Diphtheria	1940
Pertussis	Mid 1950s
Injectable polio vaccine (Salk)	1956
Tetanus	1961
Oral polio vaccine (Sabin)	1962
Measles	1968
Rubella	1970
Measles, mumps and rubella (MMR)	1988
Haemophilus influenza B (Hib)	1992
Combined tetanus and diphtheria (Td) vaccination	1994
MMR second dose	1996
Meningitis C conjugate vaccine	1999
Acellular pertussis booster	2001
Inactivated polio virus (IPV) combination vaccines	2004
Haemophilus influenza B (Hib) booster	2006
HPV vaccine	2008

Why is immunisation necessary?

Eradication and control of serious life-threatening diseases, such as smallpox, polio, diphtheria and tetanus, have been possible due to large-scale immunisation in the 20th century. Immunisation is a very effective way of preventing disease in an individual. However, when a population has a high level of immunity, non-immunised individuals also gain protection. This is known as 'herd immunity'.

For herd immunity to develop, over 90% of the population needs to be immunised. This is particularly important for children. An unimmunised child can pass on the infection to other young children who have not yet been vaccinated or in whom vaccination has not been effective or elderly people who may not have been immunised. Some children in the community may be undergoing treatment, which causes immunosuppression (such as chemotherapy) and cannot be immunised. Herd immunity decreases their risk of contracting a potentially fatal disease in an immunosuppressed state (John & Samuel, 2000; Paul, *et al.*, 2011).

Parents opting for no immunisation or alternative vaccines (e.g. homeopathic vaccines) may harm their own child (Polling, 2010). Moreover, they may also cause indirect harm to others by reducing the level of herd immunity. With the declining incidence of infectious diseases, it is important that all health care professionals should possess a high level of knowledge and a positive attitude to immunisation in order to help to maintain high vaccine uptake (Paul *et al.*, 2011).

Types of vaccine

It is important to be aware of the different types of vaccines used as there may be questions raised regarding the timing of administration of vaccines. Decisions about when to administer vaccines, which ones to give together and how long to wait for the next vaccine depend on this knowledge.

Live-attenuated vaccines are made from organisms, which have retained their antigenicity but lost virulence. These vaccines may still pose a risk to the immune compromised, e.g. children with human immunodeficiency virus (HIV) or malignancies. It is also important to remember that live vaccines should either be administered together or should be spaced by a gap of at least 4 weeks (Plotkin *et al.*, 2008).

Inactivated (killed) vaccines contain inactivated bacteria or viruses. These vaccines may also contain adjuvants, such as aluminium hydroxide or aluminium phosphate. The adjuvants enhance the antibody response. Inactivated vaccines can be administered at the same time as live vaccines or can be administered afterwards on a different date. However, subsequent doses of the same inactivated vaccine should have a gap of 4 weeks.

Toxoid vaccines contain specific toxin antigens for immune protection and do not contain any virus or bacterial particles. These different types of vaccine are summarized in Box 1.

2012 UK immunisation schedule

The current immunisation schedule in the UK (Table 2) covers 11 infectious diseases for boys and 12 for girls who additionally receive human papillomavirus (HPV) vaccination. These vaccinations are offered free to every child in the UK.

Box 1. Types of vaccines

Live attenuated

Bacille Calmette–Guérin (BCG)
Measles, mumps, rubella (MMR)
Oral polio vaccine (Sabin type)
Yellow fever and oral typhoid (Travel vaccines)

Inactivated preparations

Rabies
Influenza

Detoxified exotoxins

Tetanus

Extracts of the organism/virus (sometimes termed 'fragment') with adjuvan

Diphtheria
Pertussis ('acellular' vaccine)
Hepatitis B
Meningococcus, pneumococcus and haemophilus
Human papillomavirus (HPV)

Adapted from the Green Book, 2007

Case study 1

A 9-week-old child has come to your practice immunisation clinic for his first routine immunisations. He is of Indian origin and received the BCG vaccination at the hospital BCG clinic 2 days ago. The practice nurse asks your advice about whether the child can be immunised today.

How would you respond?

The child can be immunised today.

BCG is a live-attenuated vaccine and the recommendation about spacing out of vaccines applies only if there is another live vaccine to be administered. The only live vaccine given in the routine vaccination schedule is measles, mumps, and rubella (MMR) and this is not administered until 12 months of age. Therefore, it is not necessary to delay immunisation.

Administration of vaccines is carried out at GP surgeries usually by practice nurses or trained immunisers. The National Minimum Standards for Immunisation Training (HPA, 2005) recommend that anyone involved with the immunisation process should

- be registered with a professional body such as the Nursing and Midwifery Council or General Medical Council
- receive specific training in immunisation
- attend regular updates

The minimum basic training is 2 days with provision for annual updates. The new immuniser should attend two supervised clinical sessions before being allowed to practice alone.

Immunisation must be conducted in clinics where resuscitation facilities are available. Suitably trained staff must be at hand to deal with such emergencies. Immunisers must be trained to identify early signs of an anaphylactic or allergic reaction and initiate basic resuscitation. It is important that the GP is available in the practice during immunisation sessions for advice and to provide support to immunisers.

The cold chain

Vaccines used for the childhood immunisation programme are delivered directly to the GP surgery. Vaccines must be kept within a low temperature range. To maintain the 'cold chain', the vaccines should be transported and stored according to the manufacturer's recommended temperature range of +2 to +8°C. This must be maintained to the point of administration of the vaccine.

Exposure to heat speeds up the decline in potency of most vaccines and reduces the shelf life. Freezing below the recommended temperature may cause increase in reactogenicity and loss of potency for some vaccines. The manufacturer does not have liability for any adverse effects if the cold chain is broken. Vaccines should also be protected from light as exposure to ultraviolet light may cause loss of potency of the vaccines (DH, 2007).

Diseases covered by routine immunisation

Diphtheria

Diphtheria is caused by the bacterium, *Corynebacterium diphtheriae*. It produces a toxin that affects the heart and nervous system. The bacteria can also cause a membranous pharyngitis, referred to as a 'pseudo-membrane', which can obstruct the airway. It is highly infectious and spread via respiratory droplets, i.e. coughing or sneezing or by contact with soiled articles (e.g. a handkerchief). The incubation period is 2–5 days. Asymptomatic carriage is known and the only effective way of preventing the disease is by immunisation.

Haemophilus influenza type b

Haemophilus influenza disease is caused by the bacterium, *Haemophilus influenza type b* (Hib). Hib is spread via respiratory droplets. The incubation period is 2–4 days. Invasive Hib infection can manifest in various different ways, including meningitis, septicaemia, pneumonia and epiglottitis. Epiglottitis is a medical emergency as it causes airway obstruction. One in 20 children who develop Hib meningitis die and long-term sequelae, even after adequate treatment, are relatively common. Hib was the most common cause of bacterial meningitis in children under 5 years of age before Hib vaccine was introduced in the UK in 1992.

Meningococcal group C disease

Meningococcal group C disease is caused by the bacterium, *Neisseria meningitidis group C*, and can lead to meningitis, septicaemia or both. One in 10 people are asymptomatic

Table 2. UK immunisation schedule from Spring (2010)

Age at immunisation	Diseases protected against	Vaccines administered	Site of injection
2 months	Diphtheria, tetanus, pertussis (DTP); polio, Haemophilus influenzae type b (Hib) and pneumococcal disease	DTaP/IPV/Hib (5 in 1) Pneumococcal conjugate vaccine (PCV)	Thigh
3 months	DTP, polio, Hib and Meningococcal group C (MenC)	DTaP/IPV/HibMenC	Thigh
4 months	DTP, polio, Hib, MenC and pneumococcal disease	DTaP/IPV/HibMenCPCV	Thigh
12–13 months	Hib, MenC, pneumococcal disease, mumps, measles and rubella	Hib/MenCPCVMMR	Upper arm or thigh
3–5 years	DTP, polio, mumps, measles and rubella	DTaP/IPVMMR (confirm that the child has had first dose)	Upper arm
12–13 years for girls	Cervical cancer caused by HPV	HPV (three injections)	Upper arm
13–18 years	Tetanus, diphtheria and polio	Dt/IPVCheck MMR status	Upper arm

Notes: In addition, BCG vaccine should be given at birth to babies who might be at increased risk of TB. Hepatitis B vaccine should be given at birth if the mother is identified as HBsAg positive on antenatal screening. A course of three hepatitis B vaccines should be given at 0, 1 and 6 months. If the mother is detected to be HBeAg positive (in addition to HBsAg), the baby should receive Hepatitis B immunoglobulin with or before the first dose of Hepatitis B vaccine. Infants born to Hepatitis C positive mothers and babies of intravenous drug users should also be offered the Hepatitis B vaccine.

nasopharyngeal carriers. It is transmitted via respiratory droplets, i.e. coughing or sneezing or by close contact with an index case or carrier of the disease. The incubation period is 2–3 days.

Measles

Measles is one of the most infectious viruses known. It is transmitted via respiratory droplets. The incubation period is about 10 days. Deaths from measles are common in developing countries. Pregnant women who contract measles have an increased risk of premature onset of labour or miscarriage. Complications occur in approximately one child out of every 15 with measles and include ear infections, bronchitis, pneumonia, febrile convulsions and encephalitis. A rare and often fatal complication is subacute sclerosing panencephalitis (SSPE), which can occur years after the initial measles infection.

Mumps

Mumps is caused by the mumps virus and is characterized by the unilateral or bilateral swelling of the parotid glands. It can also cause orchitis in boys and pancreatitis. It is a common cause of unilateral sensorineural deafness. Mumps is highly infectious and is spread via respiratory droplets. The incubation period is 14–21 days.

Pertussis

Pertussis is caused by the bacterium *Bordetella pertussis* and affects the respiratory tract resulting in paroxysmal coughing and vomiting. It has a high mortality rate in very young babies. Pertussis is spread via respiratory droplets. The incubation

period is 6–20 days. The illness can last for up to 3 months, causing significant morbidity. Antibiotic treatment may prevent the spread of infection but does not reduce the length of the illness or the cough. Serious complications include convulsions, lung damage, pneumonia and brain damage.

Pneumococcal disease

Pneumococcal disease is caused by the bacterium, *Streptococcus pneumoniae*. This causes serious invasive disease, including pneumonia, septicaemia and meningitis. The incubation period is 1–3 days. Pneumococcus is the second most commonly reported cause of bacterial septicaemia and meningitis in the UK after Meningococcus group B. Complications are most common in children less than 2 years of age and in the elderly. Invasive pneumococcal disease is a major cause of morbidity and mortality. An increase in pneumococcal antibiotic resistance has been reported worldwide. This has further increased the importance of the pneumococcal immunisation.

Poliomyelitis

Polio is caused by a virus, which attacks the nervous system. It is spread by faeco-oral route or via respiratory droplets from an infected person. The incubation period is 3–21 days. It can cause temporary or permanent paralysis, generally of the lower limbs and respiratory muscles, which may result in death. It can also cause viral meningitis. The World Health Organization (WHO) aims to eradicate polio worldwide and campaigns are in place to target the remaining countries where polio is still prevalent.

Rubella

Rubella is caused by a virus and is usually a mild infectious disease. It is spread by respiratory droplets. The incubation period is 14–21 days. If contracted in early pregnancy, rubella causes severe fetal damage in up to 90% of cases. Babies may be stillborn or suffer one or multiple defects, including blindness, cataracts, deafness or impaired hearing, heart damage, intrauterine growth retardation, developmental retardation and inflammatory lesions of the brain, liver, lungs and bone marrow.

Tetanus

Tetanus (lockjaw) is caused by the anaerobic bacterium, *Clostridium tetani*, which exists as spores in soil or manure. Tetanus can be contracted through a small wound such as a scratch, puncture wound or burn through which the organism can get into the body. The incubation period is 4–21 days. The bacteria, in favourable conditions within a wound, produce a toxin, causing painful muscle spasms and can be fatal.

Human papillomavirus

HPV is a double-stranded DNA virus that infects squamous epithelia, including the skin and mucosa of the upper respiratory and anogenital tract. There are approximately 100 types of HPV of which about 40 types are known to infect the female genital tract. Although most infections are asymptomatic and self-limiting, genital infections by HPV are associated with genital warts and anogenital cancers in both men and women. HPVs are classified as either 'high-risk' or 'low-risk' types depending on their association with the development of cancer. Genital HPVs are transmitted by sexual contact with an infected individual, primarily through sexual intercourse. The risk increases with increasing number of multiple sexual partners. HPV vaccine provides immunity to the HPV types most commonly associated with cervical cancer. It is given to girls before they become sexually active with the aim of reducing the prevalence of cervical cancer in future years.



Child receiving immunisation.

Assessment of a child prior to immunisation

The assessment of a child's fitness and suitability for immunization must be made on the day of the administration of the vaccines and should be based on the following:

- The child's health on the day of the immunisation
- Any recent significant illness, such as meningitis or pneumonia
- Any previous serious reaction to a vaccine

In most practices, this assessment is made by the practice nurse running the vaccination clinic. If there is any doubt about a child's suitability or fitness for the immunisation, the GP should be consulted.

Immunisation may need to be deferred until the child is deemed fit for immunisation. The period of deferral should be kept to a minimum as this leaves the child unimmunised and at an increased risk of contracting the disease.

Case study 2

A 15-month-old child comes in for his first measles, mumps and rubella (MMR) immunisation. He is well and afebrile but has a florid maculopapular viral rash. You are asked by the practice nurse whether she should give him the vaccination?

You examine the child and find him to be clinically well with no clinical signs of an acute illness.

What would you advise?

Minor illnesses, as in this case, without fever or systemic upset, are not valid reasons to postpone immunisation (DH, 2007). You advise the practice nurse to go ahead with the MMR immunisation. However, you document the presence of the rash and the clinical findings in the child's medical notes to avoid confusion in case the child is brought back for a consultation with a health professional in the next few days. This will avoid the rash being put down to the immunisation and being diagnosed as a case of measles or rubella.

Consent for immunisation

There is no legal requirement for written consent for immunisation. However, a signed consent form serves as a record about the decision and the discussions that have taken place between the person administering the vaccine and the parent giving the consent on the child's behalf. The giving and obtaining consent should be viewed as an ongoing process. Verbal consent should be sought on each occasion a child attends the immunisation clinic.

Vaccine failure

No vaccine can provide 100% protection; therefore, a small proportion of immunised individuals may contract the

disease. Vaccine failure can be classed into two categories: primary or secondary.

Primary vaccine failure occurs when an individual fails to raise an immunological response to the vaccine. These individuals are at risk of infection even after immunisation. For example, around 5–10% of children fail to respond to the measles component of the first dose of MMR vaccine. This risk can be reduced by giving an additional dose of the vaccine before starting school.

Secondary vaccine failure occurs when an individual makes the antibodies in response to vaccination, but the protection wanes over a period of time due to decreasing antibody levels. These individuals generally suffer from a milder illness and are unlikely to suffer from serious complications. A good example of this is pertussis immunisation. Protection against whooping cough after three initial doses is high but declines over the next few years. This is overcome by giving a fourth (booster) dose before starting school (DH, 2007).

Vaccine reaction

All vaccines have potential side effects. The Green Book (2007) and its updates published by the Department of Health (DH) describe both common and rare adverse effects following immunisation (DH, 2007). Common adverse effects are typically not severe and include an area of erythema at the injection site, systemic reactions such as mild fever, malaise, myalgia, headache and loss of appetite. The child may feel a little unwell for a week after the immunisation.

There are rare but more serious adverse reactions to immunisation. These include idiopathic thrombocytopenic purpura (ITP), anaphylaxis and convulsions. A true anaphylactic reaction is, however, very uncommon.

After the five in one diphtheria, tetanus, acellular pertussis/injectable polio vaccine/haemophilus influenza B (DTaP/IPV/Hib) immunisation, a child may rarely develop a high pitched inconsolable cry. This may last for more than 3 hours. It is associated with neurological irritation and specialist advice should be sought for the next immunisation.

Any adverse reaction which is considered to be vaccine related must be reported by the yellow card scheme on the form included at the back of the British National Formulary and sent to the Medicines and Healthcare Products Regulatory Agency. Reporting can also be done online (<http://yellowcard.mhra.gov.uk>).

Antipyretic use

Fever is a part of the normal inflammatory response and often occurs after immunisation, but it is usually low grade and self-limiting in nature. It is not necessary to give an antipyretic, such as paracetamol prophylactically. Prophylactic paracetamol does not prevent febrile convulsions and may have a negative effect on the antigenicity of the vaccines by significantly reducing the antibody response. For high-grade fevers or for symptoms that parents have concerns about,

medical attention should be sought (NICE, 2007; Prymula *et al.*, 2009; Paul Whibley, 2010).

Special circumstances

Hepatitis B vaccine

The WHO recommends that all countries should include the hepatitis B immunisation as part of the childhood immunisation programme. In the UK, the Department of Health recommends that every pregnant woman is screened for hepatitis B. Immunisation is offered for babies born to infected mothers with hepatitis B surface antigen (HBsAg)-positive status. The Department of Health also recommends Hepatitis B immunisation for individuals who are at increased risk of Hepatitis B due to their lifestyle, occupation or because of close contact with a case or carrier.

Bacillus Calmette-Guérin vaccine

The Department of Health introduced a new policy for BCG immunisation to provide protection from tuberculosis (TB) on 1 September 2005. This replaced the previous policy of vaccinating all children with BCG vaccine at age 13 years. The new programme is aimed at providing an improved targeted immunisation programme (DH, 2005).

Intradermal BCG vaccination is offered to all babies, infants and children at high risk of contracting TB (Box 2). Prior tuberculin testing may be needed for older children and those who have been in contact with known cases of TB (Box 2); immunisation is given if the test is negative. Prevalence rates for tuberculosis in the UK and elsewhere in the world can be found on the Health Protection Agency (HPA, 2012) website.

Box 2. Current guidelines for BCG immunisation

Without prior tuberculin testing

- All infants (aged 0–12 months) living in areas of the UK where the annual incidence of TB is 40/100 000 or greater, e.g. parts of London
- All infants (aged 0–12 months) with a parent or grandparent who was born in a country where the annual incidence of TB is 40/100 000 or greater, e.g. Asian or African countries
- Previously unvaccinated children aged 1–5 years with a parent or grandparent who was born in a country where the annual incidence of TB is 40/100 000 or greater

With prior tuberculin testing: immunisation is given if the test is negative

- Previously unimmunized children aged 6 to less than 16 years with a parent or grandparent who was born in a country where the annual incidence of TB is 40/100 000 or greater
 - Previously unimmunized individuals under 16 years of age who are contacts of cases of respiratory tuberculosis
 - Previously unimmunized individuals under 16 years of age who were born in or who have lived for a prolonged period (at least 3 months) in a country with an annual TB incidence of 40/100 000 or greater
- Adapted from DH (2011)

Influenza vaccination

Children with chronic lung, liver, renal, heart or neurological disease and those who are immunosuppressed are in high-risk groups for influenza infection. They and their carers are eligible for annual influenza vaccination.

Case study 3

A 9-week-old boy has come for his first vaccinations. He was born at 33 weeks and stayed in the local neonatal unit for 2 weeks. He is breast feeding well.

The practice nurse asks your advice about whether the child should be immunized now as he is only 2 weeks of age when his age is corrected for prematurity.

How would you respond?

The boy should be immunised today. Babies should receive their first vaccinations 2 months after birth regardless of their gestational age when born.

Premature babies

Babies who are born early should receive their immunisations 2 months after their date of birth in the same way as babies born at term are immunised, regardless of their corrected gestational age. Babies born before 30 weeks gestation have missed out on the transfer of maternal antibodies. This group of babies has negligible passive immunity from the transplacental transfer of maternal antibodies and is therefore a particularly high-risk group for whom vaccination at the correct time is extremely important (Crawford & Buttery, 2010; Paul *et al.*, 2011). There is no evidence that premature babies are at an increased risk of adverse reactions from vaccines.

Very premature infants (born at less than 28 weeks gestation) who are still in hospital should have respiratory monitoring for 48–72 hours after administration of the vaccines as apnoeic episodes have been reported. If the child has apnoea, bradycardia or desaturations after the first immunisation, the second immunisation should preferably be given in hospital, with respiratory monitoring for a period of 48–72 hours (Klein *et al.*, 2008).



Premature child receiving immunization in the hospital.

Immigrant children

Different countries may have slightly different immunisation schedules and may also administer different vaccines. Box 3 summarizes some general rules when assessing and immunizing children who were previously resident in other countries (DH, 2007).

Box 3. Guidance for immunizing immigrant children

- Unless there is a reliable history of previous immunization, children arriving from overseas and staying in the UK should be presumed to be unimmunized and offered immunisation according to the UK immunization schedule
- On occasions, a child arriving in the UK from abroad may have received an additional fourth dose of diphtheria, tetanus, pertussis or polio around the age of 18–24 months. The routine UK schedule should be applied regardless of this additional dose
- If a person attends for a booster dose and has a history of receiving a vaccine following a tetanus-prone wound, try to identify which vaccine was given. If it was given at an appropriate time for the required booster and included the same antigens as the currently required vaccine, there is no need to give an additional dose of the vaccine
- Some children may have been immunised against measles before their first birthday. In view of the presence of maternal antibodies at that time, the child should be offered the MMR vaccine as per the UK schedule at the relevant age

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Case study 4

A 7-year-old girl joins the practice. She has lived in Afghanistan until now. She has had a single diphtheria, pertussis, tetanus, polio and MMR immunisation but does not appear to have received any other vaccines.

Her parents attend your surgery to ask for advice about whether she needs any other vaccines as they have heard from a family friend that children in the UK gets lots of vaccinations.

How would you respond?

It is important that if the course of immunisation is interrupted, it should be resumed and completed as soon as possible regardless of the child's age. It is not necessary to start any course of immunisation again.

You offer the girl catch-up diphtheria, tetanus, pertussis, polio, MMR, pneumococcal, Hib and meningitis C immunisation. You also advise tuberculin testing with subsequent BCG vaccination if needed.

Immunosuppression

Live vaccines are contraindicated if a child is immunosuppressed due to a disease, condition or therapy. Children who have been on a low or moderate dose of immunosuppressant therapy or alternate day steroid treatment may receive immunisation but specialist advice should be sought.

Children receiving high doses of systemic corticosteroid (i.e. at least 2 mg/kg/day or 20 mg/day of prednisolone or its equivalent) for less than 14 days can receive live vaccines after cessation of therapy. However, children who have received high-dose steroid therapy for 14 days or more should not be immunised with live vaccines until at least 1 month and preferably 3 months after cessation of the therapy.

Children who have received a bone marrow transplant should wait 12 months for immunisation. However, specialist advice must be sought before any immunisation takes place as inactivated vaccines may be ineffective in this patient group (DH, 2007; Plotkin *et al.*, 2008; Paul *et al.*, 2011).

Contraindications to immunisation

Vaccines are contraindicated in those who have had

- A confirmed anaphylactic reaction to a previous dose of a vaccine containing the same antigens or
- A confirmed anaphylactic reaction to another component contained in the relevant vaccine, e.g. neomycin, streptomycin or polymyxin B (which may be present in trace amounts in some vaccines).

The conditions listed in Box 4 are not contraindications to routine immunisation. However, additional precautions may be warranted.

Box 4. Immunisation is not contraindicated under the following scenarios

- Family history of any adverse reactions following immunisation
- Previous history of the disease (with the exception of BCG for people who have evidence of past exposure to tuberculosis)
- Contact with an infectious disease
- Premature birth (common misperception that immunisation should be delayed)
- Stable neurological conditions such as cerebral palsy and Down's syndrome
- Asthma, eczema or hay fever
- Mild self-limiting illness without fever, e.g. viral upper respiratory tract infections
- Recent treatment with oral antibiotics
- Child's mother or someone in the household is pregnant

- History of jaundice or phototherapy after birth
- Under a certain weight at the time of immunisation
- Being over the age recommended in the routine childhood immunisation schedule
- Personal history of febrile convulsions or epilepsy
- Close family history (parent or sibling) of febrile convulsions or epilepsy
- Being a sibling or close contact of an immunosuppressed individual
- Recent or imminent elective surgery
- Imminent general anaesthesia
- Unknown or inadequately documented immunisation history of adverse reactions
- Topical or inhaled steroid therapy

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Egg allergy

MMR vaccine can be safely given to children with a previous history of egg allergy in the GP surgery. For the small number of individuals who have a history of confirmed anaphylactic reaction to egg, specialist advice should be sought with a view to immunisation under controlled hospital conditions. Seasonal flu vaccine is contraindicated for those with severe anaphylactic hypersensitivity to egg products (DH, 2011).

Case study 5

An 8-week-old girl attends the immunisation clinic. Her older sister has a history of febrile convulsions and had an electroencephalogram (EEG) at the hospital last week. The parents do not know the result as yet. They ask you for advice:

- Is it sensible to delay immunisation until the result of the EEG is known?
- Should they give paracetamol before vaccine administration to prevent febrile convulsion?

What is your response?

A family history of febrile convulsions or epilepsy in another sibling is not a contraindication for immunisation. You advise that this child can be safely immunised. However, the decision to immunise has ultimately to be taken by the parents. Febrile convulsions are not prevented by paracetamol. Recent evidence suggests that paracetamol decreases the antigenicity of vaccines and should not be given prophylactically to infants before or with immunisation as it may make the vaccination less effective.

Funding of the immunisation programme

GP practices are paid for giving vaccines under two payment streams. Under the General Medical Services (GMS) contract,

childhood and pre-school booster immunisation services are classified as 'Additional Services'. GP practices are assumed to give vaccines and thus, this is paid for within their Global Sum. However, there is an option to opt out (BMA, 2010) and this results in a reduction in the global sum.

In addition, there are payments available as a Direct Enhanced Service to meet vaccination targets with two levels of payment depending on the proportion of eligible children immunised.

Negative campaigns

In the past, there have been several negative campaigns concerning vaccine safety. One of the earliest campaigns was the 1970s scare about pertussis (whooping cough) vaccine causing encephalopathy and subsequent brain damage in children. This resulted in a fall in uptake of the vaccine, which led to a rapid rise in cases of whooping cough and many children died or suffered severe complications of the disease.

More recently, a link was suggested between MMR vaccine and autism. This resulted in a steep fall in MMR uptake. The paper published in the *Lancet* was subsequently discredited and withdrawn (Paul *et al.*, 2011). There is no proven association between the MMR vaccine and autism and no proven benefit to giving the three elements of this vaccine (measles, mumps and rubella) as separate vaccinations (DH, 2007).

Box 5. Summary of the evidence that suggests there is no link between MMR and autism

- No clustering of the onset of symptoms of autism in the period following MMR vaccination (Taylor, 1999, De Wilde, 2001).
- Increase in the reported incidence of autism preceded the use of MMR in the UK (possibly secondary to increased awareness of the symptoms among parents, educational and health professionals) (Taylor, 1999)
- The incidence of autism continued to rise after 1993 in Japan despite the withdrawal of MMR vaccine (Honda, 2005)
- No differences were noted between the proportion of children developing autism after MMR who have a regressive form compared with those who develop autism without immunisation (Fombonne, 2001)
- No vaccine viruses were detected in children with autism using the most sensitive methods available (Afzal, 2006)

Adapted from DH (2007)

Adverse campaigns and parents' search for safer or 'natural' remedies often makes them look at alternative therapies. One alternative is 'homeopathic vaccines'. However, there is no evidence that these vaccines raise an immune response and any 'protective' effect claimed is likely to be due to herd immunity.

Key points

- Immunisation is one of the most cost effective public health strategies
- GPs need to address parental concerns and misconceptions regarding immunisation and provide reassurance
- Specialist advice must be sought for children who have suffered a significant adverse reaction to vaccines previously or anaphylaxis to vaccine components
- The cold chain is essential to preserve the efficacy of vaccines

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