The routine childhood immunisation schedule

Feb 2017
Objectives

• Describe the routine childhood immunisation schedule

• Influenza immunisation of children

• Understand the rationale behind the schedule

• Understand the extent of the flexibility of the schedule
The routine immunisation schedule from Summer 2016

<table>
<thead>
<tr>
<th>Age due</th>
<th>Diseases protected against</th>
<th>Vaccine given and trade name</th>
<th>Usual site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight weeks old</td>
<td>Diphtheria, tetanus, whooping cough, polio and Haemophilus influenzae type b (Hi)</td>
<td>DTPA/Polio/Hi</td>
<td>Thigh</td>
</tr>
<tr>
<td></td>
<td>Preparations: Diphtheria vaccine (DTPA)</td>
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<tr>
<td></td>
<td>Polio vaccine (Polio)</td>
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<tr>
<td></td>
<td>Haemophilus influenzae type b (Hi)</td>
<td></td>
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<tr>
<td></td>
<td>MenBC</td>
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<td></td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twelve weeks old</td>
<td>Diphtheria, tetanus, whooping cough, polio and Hi</td>
<td>DTPA/Polio/Hi</td>
<td>Thigh</td>
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<tr>
<td></td>
<td>McKI</td>
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<tr>
<td>Thirty weeks old</td>
<td>Diphtheria, tetanus, whooping cough, polio and Hi</td>
<td>DTPA/Polio/Hi</td>
<td>Thigh</td>
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<td></td>
<td>Hi and HiC</td>
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<tr>
<td></td>
<td>Preparations: Diphtheria vaccine (DTPA)</td>
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<td></td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
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<tr>
<td>One year old</td>
<td>Hib and HiC</td>
<td></td>
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<tr>
<td></td>
<td>Hi and HiC</td>
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<tr>
<td></td>
<td>Preparations: Diphtheria vaccine (DTPA)</td>
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<td></td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
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<tr>
<td>Two to eight years old</td>
<td>Influenza (attenuated influenza vaccines)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Including children in school years 1, 2, and 3)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Hib and HiC</td>
<td></td>
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<tr>
<td></td>
<td>Hi and HiC</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Preparations: Diphtheria vaccine (DTPA)</td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
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<tr>
<td>Three years four months old</td>
<td>Hib and HiC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sisks aged 12 to 13 years</td>
<td>Hib and HiC</td>
<td></td>
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<tr>
<td>Cervical cancer</td>
<td>Cervical cancer</td>
<td></td>
<td></td>
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<tr>
<td>(Including melanoma)</td>
<td>HPV vaccines (HPV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High risk types 16 and 18)</td>
<td>HPV vaccines (HPV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nineteen years old</td>
<td>Tetanus, diphtheria and polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(School year 10)</td>
<td>MMRV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twenty years old</td>
<td>Preparations: MMRV</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forty years old</td>
<td>Polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifty years old</td>
<td>Polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All ages over 65 years old</td>
<td>Influenza (attenuated influenza vaccines)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hib and HiC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparations: Diphtheria vaccine (DTPA)</td>
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<tr>
<td></td>
<td>Polio</td>
<td></td>
<td></td>
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</tbody>
</table>

Selective immunisation programmes

<table>
<thead>
<tr>
<th>Target group</th>
<th>Age and schedule</th>
<th>Disease</th>
<th>Vaccines required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants born to hepatitis B infected mothers</td>
<td>At birth, four weeks, eight weeks and at one year</td>
<td>Hepatitis B</td>
<td>Hepatitis B vaccine (B)</td>
</tr>
<tr>
<td>Infants in areas of the country with HIV incidence &gt;40/100,000</td>
<td>At birth</td>
<td>Tuberculosis</td>
<td>BCG</td>
</tr>
<tr>
<td>Infants with a parent or grandparent born in a high incidence country</td>
<td>At birth</td>
<td>Tuberculosis</td>
<td>BCG</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>During flu season</td>
<td>Influenza</td>
<td>Inactivated flu vaccine</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>From 20 weeks gestation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional vaccines for individuals with underlying medical conditions

<table>
<thead>
<tr>
<th>Medical condition</th>
<th>Diseases protected against</th>
<th>Vaccines required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asplenia or splenic dysfunction</td>
<td>Haemophilus influenzae type b (Hi)</td>
<td>Haemophilus B, MenB, MenC, HiB, HiVi</td>
</tr>
<tr>
<td>Chronic respiratory and heart conditions</td>
<td>Preparations: Diphtheria vaccine, Haemophilus influenzae type b (Hi)</td>
<td>Preparations: Diphtheria vaccine, Haemophilus B, MenB, MenC, HiB, HiVi</td>
</tr>
<tr>
<td>Chronic neurological conditions</td>
<td>Preparations: Diphtheria vaccine, Haemophilus influenzae type b (Hi)</td>
<td>Preparations: Diphtheria vaccine, Haemophilus B, MenB, MenC, HiB, HiVi</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
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<tr>
<td>Chronic liver conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemophiliacs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunocompromised due to disease or treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complement disorders</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The routine immunisation schedule is designed to protect against a range of diseases, including diphtheria, tetanus, whooping cough, polio, and Haemophilus influenzae type b. Note: All vaccines are given intramuscularly unless stated otherwise.
* The schedule is reviewed and revised annually to ensure the most up-to-date information is provided.
* The schedule is based on the latest published guidelines as of 1st May 2015.
* All vaccines are recommended for routine use. However, some vaccines may be contraindicated in certain circumstances.
* The use of vaccines is supported by evidence-based research and recommendations from the UK's Joint Committee on Vaccination and Immunisation (JCVI).

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1. When there are no serious reactions associated with a vaccine, it should be given at the same time. When this is not possible, the vaccine should be given at the earliest appropriate time.
2. For some vaccines, the second dose is recommended at 12 months of age.
3. Dates of first and second doses are based on the latest guidelines provided by the UK's Health Protection Agency.
4. The use of Booster pack vaccines is recommended for certain groups at risk of infection.
5. The use of vaccines is supported by evidence-based research and recommendations from the UK's Joint Committee on Vaccination and Immunisation (JCVI).
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The schedule for routine immunisation 2017

At 2, 3, 4, months (chronological, not gestational age)
The “5 in one” = DTaP/IPV/Hib:
- Diphtheria (D)
- Tetanus (T)
- Acellular pertussis (whooping cough) (aP)
- Polio (IPV)
- Haemophilus influenzae type b (Hib)

Plus:
- Meningococcus group B (2+4 months) (MenB)
- Pneumococcus (2+4 months) (PCV)
- Rotavirus (2+3 months)
After first birthday

- Boosters for
  - Haemophilus influenzae b (in Hib/MenC)
  - Meningitis B
  - Pneumococcus

- First dose of measles, mumps and rubella (MMR)

- First dose of Men C (in Hib/Men C)
Preschool booster

- 3 years 4 months
- Second dose of MMR
- DTaP/IPV = first boosters of:
  - Diphtheria
  - Tetanus
  - Pertussis
  - Polio
At school

Td/IPV = second boosters of:
  - Tetanus
  - Diphtheria (d=low dose to minimise adverse reactions)
  - Polio

Men ACWY

Human Papilloma Virus (HPV) Vaccine

In some schools: MMR for those young people who have not had 2 doses
In autumn

• A single dose of live nasal influenza vaccine for individuals aged 2-16 years annually

• Programme is being rolled out gradually

• Injectable inactivated vaccine if the live virus is contraindicated

• But if refuse the nasal, not entitled to the injectable
What age? What vaccine? How many doses?
What are the issues?

• What age?
  - In an at-risk category: 6 months and older
  - Not in an at-risk category: 2–16 years inclusive

• Which vaccine? Live nasal or injectable?
  - Age: nasal vaccine not licensed for those under 24m and is not used for adults (ie anyone aged 18 years or over)
  - Medical contra-indications (because nasal vaccine is a live viral vaccine)

• How many doses? One or two? Determined by:
  - Age (is the child aged 9 years or more?)
  - Whether the child is in an at-risk category
  - Whether the child has had the vaccine before
### How many doses?

<table>
<thead>
<tr>
<th>In an at-risk category</th>
<th>NOT in an at-risk category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aged 9 years or more OR had a previous dose</strong></td>
<td>One *</td>
</tr>
<tr>
<td><strong>Aged under 9 years AND has not had a previous dose</strong></td>
<td>Two doses 4 weeks apart</td>
</tr>
</tbody>
</table>
What are the at-risk categories?

• Any long term health condition, eg
  - Respiratory diseases such as asthma
  - Liver, kidney, heart, neurological diseases
  - Diabetes
  - Immunosuppression
  - Asplenia/splenic dysfunction
  - Learning disability

• OR any child you think might benefit because of other risk factors
What are the contra-indications to the live nasal vaccine?

• To any vaccine:
  - Febrile illness
  - Anaphylactic reaction to constituents

• To a live vaccine
  - Pregnancy
  - Anti-virals within previous 48 hours
  - Unrepaired cranio-facial malformations
  - Immunosuppression as a result of treatment (eg high dose steroids) or disease (eg leukaemia)
  - Anyone in the household who is severely immunosuppressed
  - Treatment with salicylates
  - Anaphylaxis to egg that has required intensive care
  - SEVERE asthma (defer if active wheezing)
Some of the vaccines are one-offs or short courses

At birth (if required): Hep B (and then at 4 and 8 weeks), BCG (if required)

At 2 months: “5 in one” + pneumococcus + Men B + rotavirus
At 3 months: “5 in one” + rotavirus
At 4 months: “5 in one” + pneumococcus + Men B

At 12-13 months: Hib/Men C + MMR + pneumococcus + Men B (+ hep B if required)

Pre-school: Dip, tet, po, pert + MMR (+ hep B if required)

School year 8: HPV x 2 doses 6-12 months apart (girls aged 12-13 years, 3 doses if start the course aged 15 years or over)

School year 9: Dip, tet, po + Men ACWY
Most span several years

At birth (if required): Hep B (and then at 4 and 8 weeks), BCG (if required)

At 2 months: “5 in one” + pneumococcus + Men B + rotavirus
At 3 months: “5 in one” + rotavirus
At 4 months: “5 in one” + pneumococcus + Men B

At 12-13 months: Hib/Men C + MMR + pneumococcus + Men B (+ hep B if required)

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School year 8: HPV x 2 doses 6-12 months apart (girls aged 12-13 years, 3 doses if start the course aged 15 years or over)

School year 9: Dip, tet, po + Men ACWY
The schedule is not set in stone

Once you understand the rationale behind schedule you will understand the extent to which you can be flexible with it
Summary

Vaccination of individuals with uncertain or incomplete immunisation status

Infants from two months of age up to first birthday
- DTap/IPV/Hib* + PCV** + MenB** + rotavirus***
- Four week gap
- DTap/IPV/Hib* + PCV** + MenB** + rotavirus***
- Four week gap

Children from first up to second birthday
- DTap/IPV/Hib* + PCV** + HibMen C1 + MenB** + MMR
- Four week gap
- DTap/IPV/Hib*
- Four week gap

Children from second up to tenth birthday
- DTap/IPV/Hib* + HibMen C1 + MenB** + MMR
- Four week gap
- DTap/IPV/Hib*
- Four week gap
- DTap/IPV/Hib*

From tenth birthday onwards
- TdIPV + MenACWY + MMR
- Four week gap
- TdIPV + MMR
- Four week gap
- TdIPV

Booster + subsequent vaccination
- First booster of DTap/IPV or DTaP/IPV can be given as early as one year following completion of primary course. Additional doses of DTap/IPV- containing vaccines given under three months of age or some other countries do not count as a booster to the primary course and should be discounted. Second booster as per UK schedule.

Booster + subsequent vaccination
- MMR – from first birthday onwards
  - Doses of MMR(measles vaccine given prior to 12 months of age should not be counted)
  - For infants <18 months of age a minimum interval of three months should be left between first and second doses.
  - For individuals >18 months of age a minimum interval of two months should be left between first and second doses.
  - Two doses of MMR should be given irrespective of history of measles, mumps or rubella infection and age.

Flu vaccine (during flu season)
- Those aged 65yrs and older (including those becoming age 65 yrs by 31/3/17)
- Children aged 2, 3 or 4yrs on or before 31/8/18 (DOF on 1/9/17 and on or before 31/8/14)
- Children of school years 1 (6-7yrs), 2 (7-8yrs) and 3 (7-8yrs) (given in school or primary care according to local arrangements)

Pneumococcal polysaccharide vaccine (PPV)
- Those aged 6yrs and older
- Those aged 2yrs and older in the defined clinical risk groups (see green book, influenza chapter)

Shingles vaccine
- One dose for
  - Those aged 70 and 78
  - In addition, individuals who have or have become eligible since the start of the shingles programme in September 2015 are eligible with their 50th birthday (see eligibility chart on BSH website)

Current immunisations
- Unless there is a reliable vaccine history, individuals should be assumed to be unimmunised and a full course of immunisations planned.
- Individuals coming to UK part way through their immunisation schedule should be transferred onto the UK schedule and immunised as appropriate for age.
- If the primary course has been started but not completed, continue where left off - no need to repeat doses or restart course.
- Plan catch-up immunisation schedule with minimum number of visits and within a minimum course timeframe - aim to protect individuals in shortest time possible.

HPV vaccine for girls from twelfth up to eighteenth birthday
- Those aged 10 years or over who have previously received a MenACWY-containing vaccine should be offered MenACWY.

* DTap/IPV can be given if DTap/IPV/MenB not available.
** All live or incompletely immunised children require one dose of Hib, MenC and PCV.
*** Doses of HibMenC-containing vaccine at monthly intervals (3, 4, or 6) if DPVr was also required or
**** Doses of HibMenC-containing vaccine if no other components required.
***** Doses of PCV and MenB should ideally be given two months apart but can be given one month apart if necessary to ensure the immunisation schedule is completed (i.e. if schedule started at 10 months of age).
****** Vaccination with rotavirus should not be started for infants aged 15 weeks or older.
******* First dose to be given only if infant is more than 6 weeks and under 15 weeks.
******** Second dose to be given only if infant is less than 24 weeks old.
********* MMR (measles, mumps and rubella) vaccine.
********** All doses of MMR are effective if given at least two years apart.
*********** Doses of rotavirus should be given at monthly intervals (2, 4, or 6) if DTap/IPV was also required or
************ Doses of DTap/IPV- containing vaccines at monthly intervals (3, 4, or 6) if DTap/IPV was also required or
Why does the schedule look like it does?

A number of factors are taken into account:

- **Age of the child**
- **Spacing** needed between doses of the vaccine
- **Compatibility** with other vaccines given at same time
- Whether the vaccine can be **combined** with another
- **Number of doses** that need to be given for protective response to be made
- Whether **booster** doses are needed and if so, when and how many
Age of the child

Vaccines need to be given as early in life as possible so children are protected when at highest risk of complications from the diseases.

Vaccines are recommended for the youngest age group at risk of experiencing the disease for whom the vaccine’s efficacy and safety have been demonstrated.

They must be avoided when there is potential interference with the immune response by passively transferred maternal antibody: MMR.
Can we change the age at which a course is started, starting earlier or later than 8 weeks?

Can we start early? Yes, if necessary

- The first set of primary immunisations can be safely and effectively given from age 6 weeks if necessary e.g. for travel

- BUT giving primary vaccinations before 6 weeks of age is not recommended routinely as the immune response may be suboptimal

- MMR can be given from the age of 6 months to protect a child if there is an outbreak but this dose must be disregarded and further doses given at 12 months and 3 years 4 months

Can we start late? It is best not to as we want to protect the baby as soon as possible.
The effect of age

- Primary courses of *Hib, Men B, pneumococcus* - before the age of 1 year gives good early protection but not long term protection

- For longer term protection a single dose only is required after the age of 1 year - no need to give the primary course if it was missed

- After the age of 2 years - *pneumococcus* and *Men B* no longer required - the risk of disease has diminished.

- After the age of 10 years - *haemophilus influenzae b and pertussis* no longer required.
Spacing between doses
Antibodies levels
Can we change the gap between the doses of a course?
Can we change the gap between the doses of a course?

• Dose 1 and dose 2 of the same inactivated vaccine - 4 weeks

• Dose 1 and dose 2 of the same live vaccine - 4 weeks
Can we change the gap between the doses of a course?

- Dose 1 and dose 2 of the same inactivated vaccine – 4 weeks

- Except pneumococcal vaccine (8 weeks) and Men B (8 weeks)

- Because the immunity from 2 doses 2 months apart is as good as the immunity from 3 doses each 1 month apart
Can we change the gap between the doses of a course?

- Dose 1 and dose 2 of the same live vaccine – 4 weeks

- Exception: MMR in children under 18 months – then leave 3 months. If child has the first dose over 18m – then can have a gap of 4 weeks
Can we change the gap between the doses of a course?

Shorter intervals?

Not recommended as this can result in a reduced immune response due to immune interference.

BUT if you see an infant travelling before the next set of immunisations can be given, the interval can be reduced to 3 weeks.

This dose counts as a valid dose and does not need to be repeated as long as no more than 1 dose is given early in a 3 dose schedule.
Can we change the gap between the doses of a course?

**Longer intervals?**

Not ideal to have a bigger gap than recommended because that would delay protection.

But if any course is interrupted, it should be **resumed** and completed as soon as possible.

It is not necessary to restart the course as immunological memory ensures response to subsequent doses is not impaired (even after an extended interval).
What about leaving gaps between different types of vaccines?

• No specific intervals need be observed between:
  - live and inactivated vaccines eg MMR and Hib/MenC
  - doses of different inactivated vaccines eg Hib/MenC and pneumococcal vaccines

• This means an inactivated vaccine can be administered either simultaneously or at any time before or after a different inactivated vaccine or live vaccine.
Live and inactivated vaccines in the routine programme

OK = no specific time gap

<table>
<thead>
<tr>
<th>First vaccine</th>
<th>Second vaccine</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactivated vaccine</td>
<td>Inactivated vaccine</td>
<td>OK</td>
</tr>
<tr>
<td>Inactivated vaccine</td>
<td>Live injectable vaccine</td>
<td>OK</td>
</tr>
<tr>
<td>Live injectable vaccine</td>
<td>Inactivated vaccine</td>
<td>OK</td>
</tr>
</tbody>
</table>
Table: Recommendations for giving more than one live attenuated vaccine in current use in the UK

<table>
<thead>
<tr>
<th>Vaccine combinations</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Fever and MMR</td>
<td>A four week minimum interval period should be observed between the administration of these two vaccines. Yellow Fever and MMR should <strong>not</strong> be administered on the same day.</td>
</tr>
<tr>
<td>Varicella (and zoster) vaccine and MMR</td>
<td>If these vaccines are not administered on the same day, then a four week minimum interval should be observed between vaccines.</td>
</tr>
<tr>
<td>Tuberculin skin testing (Mantoux) and MMR</td>
<td>If a tuberculin skin test has already been initiated, then MMR should be delayed until the skin test has been read unless protection against measles is required urgently. If a child has had a recent MMR, and requires a tuberculin test, then a four week interval should be observed.</td>
</tr>
<tr>
<td>All currently used live vaccines (BCG, rotavirus, live attenuated influenza vaccine (LAIV), oral typhoid vaccine, yellow fever, varicella, zoster and MMR) and tuberculin (Mantoux) skin testing.</td>
<td>Apart from those combinations listed above, these live vaccines can be administered at any time before or after each other. This includes tuberculin (mantoux) skin testing.</td>
</tr>
</tbody>
</table>
Number of doses needed for a primary course and is a booster required?
Diphtheria, tetanus and polio

- Needs three doses as a primary course, at monthly intervals

- A booster 3 years later

- A second booster 10 years later

- Five doses are sufficient for life-long immunity
Pertussis

• 3 doses in primary course at monthly intervals

• A booster 3 years later

• Not needed after aged 10 years

• Except pregnant women
Haemophilus influenzae b

- 3 doses at monthly intervals
- Booster at 12 months
- If primary course missed then the single dose at a year suffices
- No more needed after aged 10 years
Pneumococcal vaccine

• 2 doses 2 months apart

• Booster at 12 months

• If primary course missed then the single dose at a year suffices

• No more needed after aged 2 years
Measles, mumps and rubella

• 2 doses needed
  - 3 months apart if the first dose is given under the age of 18 months
  - 4 weeks apart if the first dose is given at the age of 18 months or more

• Aim for the first dose to be at 12 months
Meningitis C

• Single dose needed at 12 months

• Single dose in early adolescence to give long term protection (if missed previous dose – do not need catch-up dose)
Meningitis B

• 2 doses 2 months apart under the age of 12 months

• Booster at 12 months

• Not needed over the age of 24 months
Men B

- If miss one or both infant doses, child under 2 years needs 2 doses a month apart

- Eligible if born on or after 1st July 2015
Compatibility and combinations

• Something that is determined in clinical trials

• Safe to give many vaccines simultaneously