Vaccine preventable disease

Feb 2017
Objectives

• Know for each vaccine preventable disease:
  - Signs and symptoms
  - Complications
  - Impact of immunisation
Diphtheria
Diphtheria cases and deaths, England and Wales, 1914 - 2008
Tetanus
Eradication and herd immunity is not possible
Who is at risk?
Paralytic Polio

Photo courtesy of WHO
Polio Eradication Progress, 1988 – 2008

1597 cases in 2009
974 cases in 2010
627 cases in 2011
222 cases in 2012
417 cases in 2013
358 cases in 2014
71 cases in 2015
35 cases in 2016
Type 2 eradicated in 1999

Certified Polio-free regions (114 countries)
Not Certified but non-endemic (73 countries)
Endemic with wild polio virus (4 countries)

Source: WHO/POLIO database, as of September 2009
And

This year, as at today, 21st February 2017:

ONLY ONE CASE!
“These vaccines are meant to destroy our nation,” said Khan, a 42-year-old lawyer in the city of Peshawar. “The [polio] drops make men less manly, and make women more excited and less bashful. Our enemies want to wipe us out.”
20th Dec 2012 NBC News
Violence against those giving polio immunisations in Pakistan because of the belief by the Taliban that the programme is a cover for espionage

70 people have been killed in the past 4-5 years
Pertussis

Photo courtesy of WHO
Pertussis cases and vaccine coverage
England and Wales 1940-2012
Clinical presentation of meningococcal disease: it can be difficult to recognise and can progress rapidly

<table>
<thead>
<tr>
<th>Babies and toddlers</th>
<th>Children and young adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever with poor peripheral perfusion</td>
<td>Fever with poor peripheral perfusion</td>
</tr>
<tr>
<td>Poor feeding, refusing food or vomiting</td>
<td>Vomiting</td>
</tr>
<tr>
<td>Tense, bulging fontanelle and photophobia</td>
<td>Severe headache and photophobia</td>
</tr>
<tr>
<td>Fretful, unusual cry, moaning or rapid breathing</td>
<td>Confusion and irritability</td>
</tr>
<tr>
<td>Neck stiffness</td>
<td>Neck stiffness and muscle pain</td>
</tr>
<tr>
<td>Pale blotchy complexion &amp;/or non blanching rash that does not fade when a glass is rolled over it</td>
<td>Pale blotchy complexion &amp;/or non blanching rash that does not fade when a glass is rolled over it</td>
</tr>
<tr>
<td>Drowsy &amp; loss of consciousness</td>
<td>Drowsy &amp; loss of consciousness</td>
</tr>
</tbody>
</table>

Symptoms can appear in any order, some may not appear at all.
Potential complications of meningococcal disease

• Meningococcal disease is associated with significant case-fatality, ranging from around 5% in infants and young children to 25% in older adults.

• Around a quarter of survivors of meningococcal disease will suffer serious long-term complications after recovering from the infection.

• Complications can vary in severity and can either be temporary or permanent. The more severe the disease, the greater the risk of complications.

• Complications can include:
  • Loss of hearing, loss of vision, loss of memory and/or concentration, difficulties in coordination and balance, epilepsy, cerebral palsy, limb amputations.
Vaccines available for routine childhood immunisation

• **Men C** - programme started in 1999

• **Men B** - programme for infants started in September 2015

• **Men W** - programme for adolescents started in summer 2015
Men C: prior to 1999

- 1500 cases a year
- 150 deaths
- 150 disabilities
Immunisation introduced in 1999

• Offered to everyone aged 2m-18y

• Since then extended to include everyone up to and including the age of 24y

• Cases fell by 90% in immunised age groups and by nearly 2/3rds in NON-immunised age groups because of reduced carriage rates
Number of laboratory confirmed cases of invasive serogroup C meningococcal disease in England and Wales between July 1993 and June 2012, before and after introduction of MenC vaccine into the UK routine immunisation schedule in 1999.

Impact of Men B and Men W programmes

- Can’t be sure for some years

- Men B was expected to be effective against 88% of Men B strains

- In the 10 months since the Men B programme began – only 37 cases (42% lower than predicted from previous trends)
Haemophilus influenzae type b

Bacterium - 6 types

Droplet spread
Commonest presentation (60%) is meningitis

Also

- Epiglottitis (15%)
- Septicaemia (10%)
- Septic arthritis,
  osteomyelitis, cellulitis,
  pneumonia, pericarditis

Serious sequelae inc deafness,
fits, brain damage (10%), death
(5%)
Hib disease in England and Wales

Before 1992:

- 1 child in 600 developed some form of Hib disease by 5th birthday
- Hib meningitis caused 30 deaths each year
- Approximately 80 children a year were left with deafness or permanent brain damage

The importance of herd immunity:
- Six year old unimmunised child on holiday in Spain died in summer 2010
Impact of Hib immunisation

Confirmed cases of invasive Hib disease in England and Wales 1990-2008

- Hib vaccine introduced
- Hib booster at 12 months introduced into the routine immunisation programme
- Hib Catch-up
- Hib Catch-up

Year:
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

Lines:
- All ages including under five years
- Under five years
The Clinical Spectrum of Pneumococcal Infection

- Otitis Media: 1 in 3 children each year, 25-30% pneumococcal
- Sinusitis: common
- Invasive Pneumococcal Disease
- Meningitis
- Pneumonia: most common cause of Community Acquired Pneumonia, 35-40,000 hospital admissions each year
- Soft Tissue Infection: rare
- Arthritis: rare
- Peritonitis: rare
Ear infections
Pneumococcal disease is more common in people under the age of 2 years and over the age of 65 years.

Invasive infection, England & Wales,
Incidence per 100,000 by age group 2000/01 to 2004/05.
How big was the impact of pneumococcal disease?

• 2\textsuperscript{nd} commonest cause of bacterial meningitis in UK.

• 1 in 6 of these children died (about 50 a year)

• More than half of the survivors left with a disability
Number of cases of invasive pneumococcal disease of the serotypes in PCV13 in children under 2 years (as at 13th Feb 2017)
Measles
Measles

Symptoms

- Fever
- Coryza
- Conjunctivitis
- Malaise
- Cough

- Then: rash
Measles

- Highly infectious: without vaccination everyone is likely to get measles (160,000-800,000 cases a year before an immunisation became available in 1968 with 100 deaths a year)
- For every 5,000 children who get measles, 1500 would develop complications, including:
  - 1-2 child will die
  - 5 will have encephalitis
  - 25 will have fits
  - 50 admitted to hospital
  - Around 400 will have diarrhoea
  - Up to 300 will have chest infections
  - Up to 500 will have ear infections
  - 1 child may develop SSPE
Measles

- 1087 cases in E&W in 2011
- 2030 cases in E&W in 2012
- Highest since 1994
- Especially unvaccinated individuals aged 10-19 years
- Catch-up campaign launched April 2013
Laboratory confirmed cases of measles in England by date of onset (January 2011 to June 2016)
Mumps

Fever
Headache
Malaise
Anorexia
Myalgia
Complications of mumps

- Aseptic meningitis (1 in 6)
- Inflammation of the testicles (1 in 4 males)
- ...and of the ovaries (1 in 20 females)
- Profound deafness (1 in 15,000)
- Rare: encephalitis, death
Impact of immunisation

• Before vaccine available:
  - 85% adults had evidence of infection
  - 1200 hospital admissions a year
  - Commonest cause of viral meningitis in children
Laboratory confirmed cases of mumps by quarter, England, 2003-2016
Rubella

- Fever
- Malaise
- Coryza
- Conjunctivitis
- Lymphadenopathy
- Then: rash
Complications

- Thrombocytopenia (1/3000)
- Encephalitis (1/6000)

- Congenital rubella syndrome:
  - Eye defects eg cataracts
  - Deafness
  - Cardiac defects
  - Microcephaly
  - Intra-uterine growth retardation
  - Inflammatory lesions of brain, liver, lung, bone marrow

- 90% of fetuses are affected if infection is caught in the first 10 weeks of pregnancy
Congenital rubella births and rubella associated terminations 1971-2008
(8 cases in total in 2002-11)
Beating cervical cancer

For more information, talk to your school nurse or GP surgery, or go to www.nhs.uk/hpv

The HPV vaccination that protects against cervical cancer is recommended for all girls from the age of 12 years up to their 18th birthday.

Had my cervical cancer jab 2day, no probs, c u l8r x x

Don’t miss out!

Beating cervical cancer
What is HPV?

• Small DNA virus
• More than 100 types
• Common
• Transmitted by intimate contact
• Either
  - No risk – infection is cleared by the body
  - Low risk – warts
  - High risk – cancer
HPV infection and cancer - how strong is the link?

Clinical studies have shown that in 99.7% of cases, cervical cancer is caused by HPV.
Also linked to other cancers

<table>
<thead>
<tr>
<th>Site</th>
<th>Percentage attributable to HPV infection</th>
<th>Percentage of which, HPV16 and/or 18</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervix</td>
<td>&gt;99</td>
<td>&gt;75</td>
<td>Smith et al., 2007, Howell-Jones et al., 2010</td>
</tr>
<tr>
<td>Penis</td>
<td>47</td>
<td>74</td>
<td>Miralles-Guri et al., 2009</td>
</tr>
<tr>
<td>Vulva, vagina</td>
<td>42</td>
<td>90</td>
<td>Vuyst et al., 2003</td>
</tr>
<tr>
<td>Anus</td>
<td>84</td>
<td>93</td>
<td>Vuyst et al., 2003</td>
</tr>
<tr>
<td>Mouth</td>
<td>16</td>
<td>95</td>
<td>Kreimer et al., 2005 (European specific)</td>
</tr>
<tr>
<td>Oropharynx*</td>
<td>28</td>
<td>89</td>
<td>Kreimer et al., 2005 (European specific)</td>
</tr>
</tbody>
</table>
Which types of HPV cause most problems?

High risk
• Types 16 & 18 account for ~75% of cervical cancers in Europe

Low risk
• Types 6 & 11 account for 90% of genital warts
• Takes many years for persistent infection to develop into cancer

• *Cases of cervical cancer peak in women in late 30s*

• 3000 cases a year in UK

• 1000 deaths a year in UK
Despite the fact that:

- The NHS cervical screening programme is recognised as world leading
- Cervical cancer incidence fell by 42% between 1988 and 1997 (England and Wales). This fall is believed to be directly related to an organised cervical screening programme which was introduced in 1988

Of course:
Prevention is better than cure
Percentage of 15 year old girls who have had sexual intercourse by country

Impact?

• In Australia – “near disappearance of genital warts in young women” 4 years after HPV programme started

• Protects heterosexual men – herd immunity

• World-wide there is evidence of a fall in the incidence of pre-cancerous lesions

• Indications are that protection is long-lasting

• The vaccine provides cross-protection against some non-vaccine strains
Uptake in England

- Dose 1: over 90%
- Dose 2: approx 86%
- Estimate: 400 lives saved a year
What about the boys?

- They are immunised in Australia, USA, Austria and parts of Canada
- Reduction the rates of genital warts and some cancers
- Decision will be based on cost-effectiveness
Pilot running in GUM clinics for MSM

The human papillomavirus (HPV) vaccine is being made available through GUM & HIV clinics as a pilot to MSM who are up to and including 45 years of age.

The vaccine will help to prevent HPV infection which can cause genital warts and HPV-associated cancers. It is especially important for those who are living with HIV, and those who have multiple sexual partners.

**HPV vaccination record**
Record your HPV vaccinations below to ensure that you don’t miss out on protection against genital warts and HPV related cancers.

<table>
<thead>
<tr>
<th>HPV vaccine dose</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st dose</td>
<td></td>
</tr>
<tr>
<td>2nd dose</td>
<td></td>
</tr>
<tr>
<td>3rd dose</td>
<td></td>
</tr>
</tbody>
</table>

Remember to be protected, you need all three doses (if you are under 15 years old there is a two dose schedule)

HPV vaccination pilot for men who have sex with men (MSM)
Protecting yourself against warts and cancer
Caused by human papillomavirus
Hepatitis B

• Babies born to mothers who are hepatitis B positive are at risk of developing hepatitis B themselves.

• Once infected, 90% will become carriers.

• A high proportion will go on to develop cirrhosis or liver cancer.
SO

• We identify the Hep B+ mothers antenatally

• Work out the level of risk
  • Higher risk
  • Lower risk

• Immunise the babies appropriately
1. **Standard schedule:** 0 1 6 months
   
   Good levels of protection

   Not fast enough to be sure of protecting the babies

   Booster after 5 years if at continued risk

2. **Accelerated schedule:** 0 1 2 months

   Protection achieved quickly

   But ultimate antibody levels not as high as standard schedule

   Boosters at 12 months and 3 years 4 months of age
Immunoglobulin for the higher risk babies

- These babies are exposed to a high level of rapidly replicating virus
- They received no antibodies from their mother
- So they need a dose of immunoglobulin as near to the exposure time as possible and certainly no later than 24 hours after birth
- The lower risk babies do not need immunoglobulin because they were exposed to lower levels of virus and may have got some antibody protection from their mothers
Tuberculosis
BCG vaccine

- Is TB a public health problem?
- Is there a safe and effective vaccine?
- Who are we going to immunise?
### Table 1: Number of TB case notifications, rates and annual percentage change, UK, 2000-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of cases</th>
<th>Rate per 100,000 (95% CI)</th>
<th>Annual change in case numbers (%)</th>
<th>Annual change in rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>6,696</td>
<td>11.4 (11.1 - 11.6)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2001</td>
<td>6,760</td>
<td>11.4 (11.2 - 11.7)</td>
<td>1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2002</td>
<td>7,291</td>
<td>12.3 (12.0 - 12.6)</td>
<td>7.9%</td>
<td>7.9%</td>
</tr>
<tr>
<td>2003</td>
<td>7,219</td>
<td>12.1 (11.8 - 12.4)</td>
<td>-1.0%</td>
<td>-1.6%</td>
</tr>
<tr>
<td>2004</td>
<td>7,589</td>
<td>12.7 (12.4 - 12.9)</td>
<td>5.1%</td>
<td>5.0%</td>
</tr>
<tr>
<td>2005</td>
<td>8,283</td>
<td>13.7 (13.4 - 14.0)</td>
<td>9.1%</td>
<td>7.9%</td>
</tr>
<tr>
<td>2006</td>
<td>8,307</td>
<td>13.7 (13.4 - 14.0)</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2007</td>
<td>8,260</td>
<td>13.5 (13.2 - 13.8)</td>
<td>-0.6%</td>
<td>-1.5%</td>
</tr>
<tr>
<td>2008</td>
<td>8,491</td>
<td>13.7 (13.4 - 14.0)</td>
<td>2.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>2009</td>
<td>8,870</td>
<td>14.2 (14.0 - 14.5)</td>
<td>4.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>2010</td>
<td>8,397</td>
<td>13.4 (13.1 - 13.7)</td>
<td>-5.3%</td>
<td>-5.6%</td>
</tr>
<tr>
<td>2011</td>
<td>8,919</td>
<td>14.1 (13.8 - 14.4)</td>
<td>6.2%</td>
<td>5.2%</td>
</tr>
<tr>
<td>2012</td>
<td>8,714</td>
<td>13.7 (13.4 - 14.0)</td>
<td>-2.3%</td>
<td>-2.8%</td>
</tr>
<tr>
<td>2013</td>
<td>7,866</td>
<td>12.3 (12.0 - 12.5)</td>
<td>-9.7%</td>
<td>-10.2%</td>
</tr>
<tr>
<td>2014</td>
<td>7,025</td>
<td>10.9 (10.6 - 11.1)</td>
<td>-10.7%</td>
<td>-11.4%</td>
</tr>
<tr>
<td>2015</td>
<td>6,240</td>
<td>9.6 (9.3 - 9.8)</td>
<td>-11.2%</td>
<td>-11.9%</td>
</tr>
</tbody>
</table>
Is TB a public health problem?

- Total number of cases is falling
- The majority of cases live in London
- 4.4% aged less than 15 years - mostly ethnic minorities
- Three quarters born abroad (approx 70/100,000)
- Very low rates in the indigenous population (4/100,000)
- Risk factors: homelessness, drug/alcohol use, time in prison
- Commonest presentation: pulmonary
• Little transmission from immigrant to indigenous community

• Children get TB from the adults they are living with: prolonged close contact

• Children almost never transmit TB to other children: they are less infectious than adults
TB is a public health problem in some communities by virtue of their connections with parts of the world where prevalence is high

AND

In some communities because of homelessness, alcohol and drug abuse, imprisonment
BCG: does it work and is it safe?
BCG: Does it work?

• MMR - 2 doses - 99% effective
• BCG
  - Only one dose possible
  - Protection 0-80%
  - Less good against respiratory TB
  - Little evidence >16yo
  - Virtually no evidence >35yo
  - Length of protection - no data beyond 15 years
Quarterly laboratory reports of Hib CSF and blood isolates, 1989-1999*

* Provisional

Source: PHLS Communicable Disease Surveillance Centre
Number of TB case notifications, England and Wales, 1913-2015
BCG: is it safe?

• We used to do a Heaf test to screen out those who are hypersensitive

• Even so, unpleasant reactions not uncommon – ulcers, abscesses, lymphadenitis, BCG-osis
Who should be offered BCG vaccine?

- Babies whose parents or grandparents were born in a high prevalence country (>40/100,000)

- Babies of parents in another at-risk category eg homeless, travellers, drug users
Who else is offered BCG?

- Children aged less than 16 years who have a parent or grandparent born in a high prevalence country
- Contacts of cases as part of outbreak control
- New entrants from a high prevalence country aged under 16 years
- People at occupational risk aged under 35 years
- People aged under 16 years who are intending to live or work in a high prevalence country for more than 3 months
BCG is not recommended for people who do not have risk factors. This is because for them the risks outweigh the benefits.
Best way to control TB

- Improve public health
- Case finding
- Treatment
- Prevent spread
- BCG - least important measure
Chicken pox

- Malaise, fever, rash

- More serious in
  - adults (esp smokers and pregnant women - pneumonia, death)
  - neonates and the immunosuppressed (disseminated varicella)
  - the fetus (long term damage, death)

- Shingles
Chicken pox

- Recommendations:
  - Aged 12 months or over: 2 doses 4-8 weeks apart
  - For non-immune healthcare workers
  - For healthy close household contacts of an immunosuppressed individual
Rotavirus

- Very robust virus and only need 10-100 virus particles to cause illness

- Can be exposed because of faeco-oral, contaminated surfaces, dirty hands, nappies as well as respiratory droplets including coughing and sneezing

- Severe diarrhoea and vomiting for 3-8 days with fever and cramps

- Can lead to dehydration and to hospitalisation for nasogastric or intravenous fluids

- The younger the child - the more severe the symptoms are likely to be
Who is most at risk?

Numbers of laboratory confirmed cases of rotavirus infection in E&W  July 2000-June 2012

The infant rotavirus vaccination programme
Disease burden in England and Wales before the vaccine was available

- 130,000 children were taken to their GP
- 12,700 children were admitted to hospital
- Very few deaths in UK - tend to be in children who are already unwell
- Estimated that rotavirus caused about half the D&V seen in children under 5y
Has the vaccine worked in the UK?

• 94% of babies have 1 dose

• 90% have 2 doses
The impact of rotavirus vaccine
(as at 15th February 2017)
Indirect impact on older children

<table>
<thead>
<tr>
<th>Age</th>
<th>Decline in rotavirus hospitalization rate (2008 vs. 2006)</th>
<th>Rotavirus vaccine coverage in 2008 (≥1 dose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 year</td>
<td>66%</td>
<td>56%</td>
</tr>
<tr>
<td>1 - &lt;2 years</td>
<td>95%</td>
<td>44%</td>
</tr>
<tr>
<td>2 - &lt;3 years</td>
<td>85%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

This age cohort was NOT eligible to receive rotavirus vaccine