Vaccine Preventable Diseases
Objectives

• To describe each vaccine preventable disease
  – Epidemiology
  – Mode of transmission
  – Incubation period
  – Period of infectivity
  – Clinical features
  – Vaccine schedule in Ireland

[Link: www.immunisation.ie]
Diphtheria

www.immunisation.ie
Diphtheria

• **Bacterial infection**
  – *Corynebacterium diphtheriae* or *Corynebacterium ulcerans*
  – Only toxin producing strains cause severe disease

• **Populations most affected**
  – All ages susceptible if non-immunised
  – Disease most serious in young infants and the elderly

[www.immunisation.ie](http://www.immunisation.ie)
Diphtheria epidemiology

- Reservoir: Human carriers
  Usually asymptomatic

- Transmission: Respiratory
  Skin and fomites rarely

- Temporal pattern: Winter and spring

- Communicability: Up to 4 weeks
  in untreated individuals

www.immunisation.ie
Diphtheria clinical features

- **Incubation period**
  - 2-5 days (range 1-10 days)

- **May involve any mucous membrane (rarely skin)**

- **Severity of illness depends on**
  - extent of local disease
  - toxin related complications (myocarditis, neuritis)

- **Milder (atypical) infection**
  - in partially or fully vaccinated (waning immunity)
Pharyngeal and tonsillar diphtheria

- **Insidious onset exudative pharyngitis**
  - Mild fever, swollen neck glands, anorexia, malaise, cough

- **2-3 days later**
  - Exudate spreads and may form adherent membrane
  - May narrow or occlude the airway leading to respiratory distress
  - Fever usually not high, but patient appears toxic

- **Later**
  - Toxin can cause extensive organ damage, neurological and heart complications

- **Case fatality ratio**
  - 5-10% of respiratory cases, higher in young children and adults

[www.immunisation.ie](http://www.immunisation.ie)
Clinical features of Diphtheria

Photo courtesy of CDC
Notifications of Diphtheria 1948-2009

Source: HPSC, CIDR

[Graph showing the number of notifications of diphtheria from 1948 to 2009, with a peak in 1952/53 due to the introduction of the DTP vaccine.]

www.immunisation.ie
Diphtheria vaccination

- Diphtheria toxoid vaccine
  - inactivated toxin
  - stimulates immunity (antibody) to toxin (anti-toxin)
  - 1st developed 1921 but not widely available until 1930s
  - adjuvant used to stimulate immune response
  - combined with other vaccines

- Current guidelines advise minimum of 5 diphtheria doses given at appropriate intervals
  - 2, 4, 6 months – given as part of 6 in 1
  - 4-5 years – given as part of school booster – 4 in 1
  - 11-14 years – given as part of booster – Td

- Late entrants
  - Offer full course to all children if vaccination status unknown

www.immunisation.ie
Haemophilus influenzae type b

www.immunisation.ie
Haemophilus Influenzae

- Severe bacterial infection caused by
  - *Haemophilus influenzae*
    - 6 different serotypes (a-f)
    - In prevaccine era, 95% invasive disease caused by type b

- Pathogenesis
  - Colonises nasopharynx
  - In some cases invades bloodstream causing infection at distant site

- Populations most affected
  - Young children < 5 years of age
  - Immunocompromised individuals

www.immunisation.ie
Hib epidemiology

- Reservoir: Human carriers
  - Asymptomatic carriers

- Transmission: Respiratory droplet
  - Nasal and throat discharges

- Temporal pattern: Winter and spring

- Communicability: generally limited
  - Non-communicable after 24-48 hours antibiotics

www.immunisation.ie
Haemophilus Influenzae - Clinical features

- Incubation period
  - 1 - 4 days

- Meningitis common
  - usually sudden onset - fever, vomiting, lethargy, meningeal irritation

- Other presentations
  - Epiglottis, pneumonia, septic arthritis, cellulitis, pericarditis, empyema, osteomyelitis

- Complications
  - deafness, convulsions, intellectual impairment, death

- Case fatality ratio: 2-4%

www.immunisation.ie
Notifications of Hib 1987-2009

Source: HPSC, CIDR

www.immunisation.ie
Haemophilus influenzae type B (Hib) Ireland

- Hib conjugate vaccine
  - introduced in 1992
  - marked decline in incidence followed

- Increase in vaccine failures seen in 2004/2005
  - Attributed to waning immunity
  - Hib catch-up campaign 2005
    - Hib booster offered to all children 12 months - < 4 years of age
    - Routine Hib booster introduced September 2006
      - all children aged 12 months

www.immunisation.ie
Hib vaccination

- Current guidelines advise 3 doses in infancy and one booster dose at 13 months
  - 2, 4, 6 months (6 in 1 vaccine)
  - 13 months (Hib vaccine)

- Late entrants
  - 1 dose of single Hib vaccine for children over 12 months of age and up to 10 years of age

www.immunisation.ie
Hepatitis A

www.immunisation.ie
Hepatitis A

• Acute viral infection
  – Caused by Hepatitis A virus (HAV)
  – Humans only natural host
  – Environmentally stable for months
  – Inactivated by high temperature

• Pathogenesis
  – Entry into mouth
  – Virus replicates in liver
  – Virus present in blood and faeces 10-12 days after infection
  – Stools are highly infectious, virus excretion starts to decline at onset of clinical illness but may continue for 3 weeks

www.immunisation.ie
Hepatitis A epidemiology

- Reservoir: Human
- Transmission: Faecal-oral
- Temporal pattern: None
- Communicability: 2 weeks before to 1 week after

www.immunisation.ie
Hepatitis A - Clinical features

• Incubation period
  – 28 days (range 15-50 days)

• Symptoms are age dependent
  – Most children asymptomatic (70%), most adults symptomatic (70%)

• Acute illness
  – Fever, malaise, anorexia, nausea abdominal pain, dark urine, jaundice
  – Case fatality 0.1%-0.3% cases (~ 1.8% adults > 50 years)

• Illness duration
  – usually resolved subsided within 2 months
  – may persist or relapse in 10-15% cases for up to 6 months
  – Illness not specific for hepatitis A

• Laboratory diagnosis
  – required to differentiate from other viral hepatitis

www.immunisation.ie
Hepatitis A notifications 1988-2009

Source: HPSC, CIDR

www.immunisation.ie
Hepatitis A vaccination

• Vaccine recommended for high risk individuals/groups
  – Contacts of cases, travellers to countries with high endemicity, individuals with chronic liver or renal disease, blood clotting disorders, injection drug users, men who have sex with men, persons with learning disability, some occupational groups, homeless individuals/carers

• Not part of routine childhood immunisation programme

www.immunisation.ie
Hepatitis B

www.immunisation.ie
Hepatitis B

• Highly infectious viral infection
  – Caused by Hepatitis B virus (HBV)
  – numerous antigenic components
  – humans only known host
  – may retain infectivity for 7 days at room temperature
  – acute and chronic infection

• Pathogenesis
  – Parenteral or mucosal exposure to infected body fluids
  – Replicates in liver
  – Chronic infection may occur (age dependent)
Hepatitis B - Clinical features

- Incubation period
  - 2-3 months (range 6 weeks - 6 months)

- Prodrome
  - non-specific malaise, fever, headache, myalgia

- Illness not specific for hepatitis B

- At least 50% infections asymptomatic
Hepatitis B - Complications

- Fulminant hepatitis
  - 1-2% acute infections

- Chronic infection
  - Cirrhosis
  - Hepatocellular carcinoma

- Death
HBV - Chronic infection

• Follows acute infection, risk decreases with age
  – Infants infected at birth
    • ~ 90% become chronic
  – Children infected between 1-5 years of age
    • ~ 30-50% become chronic
  – Adults
    • ~ 5% become chronic

www.immunisation.ie
Hepatitis B - Epidemiology

- Reservoir: Human
- Transmission: Blood borne/body fluids
  sub-clinical cases transmit
- Communicability: may be up to 1-2 months
  before and after onset of symptoms
  Chronic carriers

www.immunisation.ie
Notifications Hepatitis B
1988-2009

Source: HPSC, CIDR

www.immunisation.ie
Hepatitis B vaccination

• Hepatitis B immunisation
  – Prior to 2007 recommended only for risk population groups
    • Health care workers, contacts of cases and others
  – In 2008 routine childhood immunisation introduced
• Increase in incidence seen in late 1990s
  – Highest incidence in individuals from endemic countries
  – increase mainly chronic but also acute cases
Hepatitis B vaccination

- Current guidelines advise 3 doses in infancy (routine)
  - 2, 4, 6 months (6 in 1 vaccine)

- If Hepatitis B vaccine given at birth continue with routine schedule

www.immunisation.ie
Human Papillomavirus (HPV)
Human Papillomavirus (HPV) infection

• Viral infection
  – Usually sexually transmitted
  – Infection with some “high risk type” strains is associated with cervical cancers

• Pathogenesis
  – Infection occurs at basal epithelium
  – Most infections resolve spontaneously, but some persist
  – Persistent infection is most important risk factor for cervical cancer precursor lesions
  – Infection with one type does not protect from infection with another type

www.immunisation.ie
HPV

Transmission

• Through vaginal, oral or anal sexual intercourse

• Genital contact with an infected person

• Non-sexual transmission from mother to baby in period immediately before and after birth

Risk factors

• Young age (less than 25 years)

• Increasing number of sex partners

• Early age at first sexual intercourse (16 years or younger)

• Male partner has (or has had) multiple sex partners

www.immunisation.ie
HPV - Clinical features

- ~50%-80% women infected at least once during lifetime
- Most infections are asymptomatic
- Clinical manifestations include
  - Ano-genital warts
  - Recurrent respiratory papillomatosis
  - Cervical cancer precursors (cervical intraepithelial neoplasia - CIN)
  - Cancer (cervical, anal, vaginal, vulvar, penile, and some head and neck)
HPV Clinical Features

• Most HPV infections are asymptomatic and result in no clinical disease

• Clinical manifestations of HPV infection include
  – anogenital warts
  – recurrent respiratory papillomatosis
  – cervical cancer precursors (cervical intraepithelial neoplasia, CIN)
  – cancer (cervical, anal, vaginal, vulvar, penile, and some head and neck cancer)
HPV infection - natural history

Initial HPV infection

Persistent infection

CIN 1

CIN 2/3

Up to 5 years

1 year

Decades

Cervical Cancer

CLEARED HPV INFECTION

www.immunisation.ie

CDC
Cervical cancer in Ireland

• ~72 women deaths from cervical cancer annually
  – Mean age at death; 56 years
  – Mean age at diagnosis; 44 years
• ~3100 women living with cervical cancer
• In 2007 there were:
  – 286 Cervical cancer cases
  – 59% of which were under the age of 39
  – 81 Cervical cancer deaths

2. National Cancer Registry Ireland, 2010: data on file

www.immunisation.ie
The nature of HPV vaccines

• First licensed in 2006
• Proteins, like those that coat the HPV virus, are made in either yeast or baculovirus (insect virus) cells using recombinant DNA technology.
• These purified antigenic proteins assemble into small spheres called virus-like particles (VLPs).
• VLPs cannot cause infection or cancer.
• HPV vaccination causes the body to mount an immune response against the antigens in the VLPs.
• Immunised individuals mount a rapid immune response when subsequently exposed to HPV.

www.immunisation.ie
HPV vaccines

Two licensed HPV vaccines:

• **Gardasil™ Sanofi Pasteur**
  - aged 9-15 years and females over 16 years – ***Sept 2010
  - quadrivalent
  - protects against premalignant genital lesions (cervical, vulvar and vaginal), cervical cancer and external genital warts related to HPV types 16/18 and 6/11

• **Cervarix™ GlaxoSmithKline**
  - females aged 10-25 years
  - bivalent
  - protects against premalignant cervical lesions and cervical cancer related to types 16/18 only

HPV Vaccines are not interchangeable

[www.immunisation.ie](http://www.immunisation.ie)
HPV vaccine schedules

• Gardasil™ Sanofi Pasteur
  – 3 dose schedule
  – 0, 2 and 6 months
  – Alternative schedule with one month between dose 1 and 2 and 3 months between Dose 2 and 3

  – Cervarix™ GlaxoSmithKline
  – 3 dose schedule
  – 0, 1 and 6 months

HPV Vaccines are NOT
  – recommended in pregnancy
  – not interchangeable

www.immunisation.ie
Influenza

www.immunisation.ie
Influenza

• Highly infectious viral illness
  – 3 types, determined by nuclear material
    • A, B, C
  – Subtypes of type A determined by haemagglutinin (H1, H2, H3) and neuraminidase (N1, N2)

• Pathogenesis
  – Respiratory transmission
  – Virus attaches to and penetrates respiratory epithelial cells in trachea and bronchi
  – Viral replicates and destroys host cells
  – Virus shed in respiratory secretions for 5-10 days

www.immunisation.ie
Influenza epidemiology

- Reservoir
  - Human, animals (type A only)

- Transmission
  - Respiratory, probably airborne

- Temporal pattern
  - Peak winter, early spring

- Communicability
  - 1 day before to 5 days after onset (adult)
Influenza clinical features

- Incubation period
  - 1-3 days (range 1-4 days)

- Severity of illness
  - depends on prior experience with related variants

- Abrupt onset of
  - fever, myalgia, sore throat, dry cough, headache

- Diagnosis
  - Clinical and epidemiological characteristics
  - Laboratory diagnosis (virus isolation, antigen testing, serology test demonstrating antibody rise)
Influenza complications

- Pneumonia
  - Secondary bacterial
  - Primary influenza viral (high case fatality)
- Reye syndrome
- Myocarditis
- Deaths
  - Most common in elderly, in individuals with chronic medical conditions
  - Case fatality ratio: 0.5-1 per 1,000 cases
Influenza notifications and rate of influenza like illnesses 2000-2010

Source: HPSC, CIDR

ILI rate per 100,000 population

Influenza season

Number of positive specimens


Pandemic (H1N1) 2009
Influenza A unsubtyped
Baseline ILI rate

Influenza A excluding pandemic (H1N1) 2009
Influenza B
ILI rate

Source HPSC

www.immunisation.ie
Influenza immunisation

• Influenza vaccine
  – The vaccine is manufactured with WHO recommended strains each season
    • uses virus strains similar to those considered most likely to circulate in the forthcoming season.
    • current vaccines are trivalent - antigens from two type A and one type B virus strains
  – ~70%-90% protective efficacy
Influenza vaccination

- Annual immunisation necessary
- One dose for those at risk each year unless < 9 years (two doses)
- High risk groups
  - Individuals $\geq 65$ years of age
  - Children on long term aspirin
  - Children and adults with chronic medical conditions
  - Pregnant women (from 2010/2011)
  - Health care workers
  - Carers of those at risk
  - Residents long term care institutions
  - Poultry workers, veterinary inspectors, park rangers

[www.immunisation.ie](http://www.immunisation.ie)
Measles

www.immunisation.ie
Measles

- Highly infectious viral disease
  - caused by *Morbillivirus, Measles*
  - one antigenic type
  - rapidly inactivated by heat and light

- Populations affected
  - near universal infection of childhood in pre-vaccine era
  - still common and often fatal in developing countries

[www.immunisation.ie](http://www.immunisation.ie)
Measles - Clinical features

- Incubation period
  - 10-12 days (range 7-21 days)
- Prodrome
  - stepwise increase in fever
  - cough, coryza (runny nose), conjunctivitis,
  - Koplik spots on buccal mucosa
- Measles illness
  - 2-4 days after prodrome (14 days post exposure)
  - rash begins face and head, progresses downwards
  - maculopapular at first, becomes confluent
  - rash lasts 4-7 days
  - fades in order of appearance
Measles - Complications

- **Otitis media**
  - 1 in 20
- **Pneumonia**
  - 1 in 25
- **Convulsion**
  - 1 in 200
- **Diarrhoea**
  - 1 in 6
- **Meningitis/encephalitis**
  - 1 in 1000
- **Late onset SSPE**
  - 1 in 8000 under 2 years
- **Death**
  - 1 in 2000

www.immunisation.ie
Measles - Epidemiology

- Reservoir: Human
- Transmission: Respiratory Airborne
- Temporal pattern: peak in later winter-spring
- Communicability: 4 days before to 4 days after rash onset

www.immunisation.ie
Notifications of Measles
1948-2009

Source: HPSC, CIDR

Measles vaccine introduced in 1985

MMR\(_1\) introduced in 1988

MMR\(_2\) introduced in 1992

MR campaign 1995

Source HPSC www.immunisation.ie
Measles in Ireland

• Outbreaks common before vaccine introduced
  – Last major outbreak in 2000
    • With 3 associated deaths
  – Current outbreak commenced August 2009

• Measles immunisation
  – introduced in 1985 as measles vaccine
  – 1988 MMR introduced
  – 1992 2nd dose MMR introduced for 10-14 years
  – 1995 MR catch-up campaign 5-12 year olds
  – 1999 age of 2nd dose MMR reduced to 4-5 year olds
  – 2002 age of 1st dose administration reduced 12-15 months

• MMR uptake still too low – outbreaks likely

www.immunisation.ie
Measles vaccination

- As part of Measles-Mumps-Rubella vaccine (MMR)
- Live vaccine
  - Not recommended in pregnancy
- Current guidelines advise 2 doses
  - 12 months
  - 4-5 years
- Single vaccines not recommended
- Late entrants
  - Unvaccinated children require 2 doses of MMR vaccine 1 month apart

www.immunisation.ie
Measles rash

This child shows a classic day 4 rash with measles.


www.immunisation.ie
Meningococcal disease
Meningococcal Disease

• Severe acute bacterial infection
  – *Neisseria Meningitidis*
  – most invasive disease caused by A, B, C, Y, W-135
  – Most common serogroups in Ireland are B and C

• Pathogenesis
  – organism colonises nasopharynx
  – May invade blood stream and spread

• Populations most affected
  – young children, young adults, immunocompromised
Invasive Meningococcal Disease (IMD) - Epidemiology

- **Reservoir**: Human
- **Transmission**: Respiratory droplets
- **Temporal pattern**: Peak in later winter-early spring
- **Communicability**: Usually to close contacts, highest during 7 days before onset illness

[www.immunisation.ie](http://www.immunisation.ie)
IMD - Clinical features

• Incubation period
  – 3-4 days (range 2-10 days)
• Meningitis most common presentation
  – Fever, headache, stiff neck
• Meningococcaemia
  – bacteraemia, with or without meningitis
  – fever
  – petechial or purpuric rash
  – hypotension, circulatory collapse
  – coma
  – Multi-organ failure
• Case fatality ratio: ~ 10%

www.immunisation.ie
Notifications of IMD by serogroup 1999-2009

Source: HPSC, CIDR

www.immunisation.ie
IMD in Ireland

- Ireland has high endemicity rates for IMD
- Before introduction of Men C vaccine serogroup B and C predominated
- Men C vaccine introduced in 2000
  - 3 doses at 2, 4, 6 months
  - Catch-up campaign at that time for all children and young adults < 23 years of age
  - Followed by marked decline in Men C disease

www.immunisation.ie
Men C vaccination

- Current guidelines advise 3 doses
  - 4, 6 months
  - 13 months

- Late entrants
  - Offer one dose to all unvaccinated children between 12 months and 23 years of age
Meningococcal rash

Courtesy Centers for Disease Control and Prevention

www.immunisation.ie
Mumps

• Acute viral illness
  – *Caused by paromyxovirus, Mumps*
  – one antigenic type
  – rapidly inactivated by chemical agents, heat and ultraviolet light

• Pathogenesis
  – Respiratory transmission
  – Replication in nasopharynx and regional lymph nodes
  – Viraemia 12-25 days after exposure
  – Multiples tissues infected during viraemia

www.immunisation.ie
Mumps - Clinical features

• Incubation period
  – 14-18 days (range 14-25 days)
• Prodrome
  – Non-specific myalgia, malaise, headache, low-grade fever
• Swelling of salivary glands common
  – Parotitis in 30%-40% cases
• Asymptomatic infections ~30%
• Most severe in adults
• Symptoms usually resolve after 10 days

www.immunisation.ie
Mumps complications

- Pancreatitis: 1 in 25
- Oophoritis: 1 in 20
- Orchitis: 25%-40% post-pubertal males
- Meningitis: up to 15%
- Encephalitis: 0.02-0.3%
- Deafness: 1 in 20,000
- Nephritis, cardiac abnormalities, death: rare

www.immunisation.ie
Mumps Epidemiology

- **Reservoir**: Human
  - Asymptomatic may transmit

- **Transmission**: Respiratory droplet

- **Temporal pattern**: Peak in late winter-early spring

- **Communicability**: 3 days before – 4 days after onset
Notifications of Mumps 1988-2009

Source: HPSC, CIDR

www.immunisation.ie
Mumps immunisation

• Mumps immunisation
  – 1988 MMR introduced
  – 1992 2\textsuperscript{nd} dose MMR introduced for 10-14 years
  – 1999 age of 2nd dose MMR reduced to 4-5 year olds
  – 2002 age of 1st dose administration reduced 12-15 months
  – Since national outbreak MMR recommended for new entrants to colleges

• Large national mumps outbreak in 2008-2009
  – Students in third level colleges at highest risk
    • inadequate MMR vaccination coverage

www.immunisation.ie
Mumps vaccination in Ireland

- As part of Measles-Mumps-Rubella vaccine (MMR)
- Live vaccine
  - Not recommended in pregnancy
- Current guidelines advise 2 doses
  - 12 months
  - 4-5 years
- Single vaccines not recommended
- Late entrants
  - Offer two doses to all children if vaccination status unknown
- College students
  - one dose to all new entrants if two doses not already received

www.immunisation.ie
Child with Mumps

•Courtesy of Centers for Disease Control and Prevention

www.immunisation.ie
Pertussis

www.immunisation.ie
Pertussis

- Bacterial respiratory infection caused by
  - *Bordeteilla pertussis*
  - Highly contagious

- Pathogenesis
  - primarily toxin mediated
  - inflammation occurs, interferes with clearance of pulmonary secretions

- Populations most affected
  - Most severe in children under 1 year
  - Mild illness in adolescents and adults, frequently undiagnosed and pose a risk to young children

www.immunisation.ie
Pertussis Epidemiology

- Reservoir
- Transmission
- Communicability

- Human
- Adolescents and adults
- Respiratory droplets
- produced by coughing or sneezing
- maximum in catarrhal stage
- 6 days post-exposure to
- 3 weeks after cough onset
- 2\textsuperscript{nd} ary attack rate up to 80%

www.immunisation.ie
Pertussis – Clinical features

• Incubation period
  – 6-20 days (range 4 - 21 days)

• Disease
  – insidious onset, similar to minor upper respiratory infection with non-specific cough
  – fever usually minimal throughout course of illness
  – often atypical presentation in adolescents/adults

www.immunisation.ie
Stages of pertussis disease

- Catarrhal stage
  - runny nose, sneezing, mild temp
  - 1-2 weeks

- Paroxysmal cough stage
  - paroxysms of coughing with inspiratory whoop
  - 1-6 weeks

- Convalescence stage
  - gradual recovery over 2-3 weeks (may extend to 3 months)
  - weeks to months

www.immunisation.ie
## Pertussis - Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>5.2%</td>
</tr>
<tr>
<td>Seizures</td>
<td>0.8%</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>0.1%</td>
</tr>
<tr>
<td>Hospitalisation</td>
<td>20%</td>
</tr>
<tr>
<td>Death</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

[www.immunisation.ie](http://www.immunisation.ie)
Notifications Pertussis, Ireland, 1948-2009

Source: HPSC, CIDR

www.immunisation.ie
Pertussis immunisation

• Pertussis vaccine
  – introduced in 1952-1953 as part of DPT
  – Decline in incidence following vaccine introduction
  – Pertussis scare in 1970s affected vaccine uptake
  – Continued risk to young infants as a result of waning immunity in adolescents and adults who can transmit to infants

www.immunisation.ie
Pertussis vaccination Ireland

- Current guidelines advise 3 doses in infancy plus 2 booster doses
  - 2,4,6 months (6 in 1 vaccine)
  - 4-5 years (4 in 1)
  - 11-14 years (Tdap)

- Late entrants
  - Offer full course to all children if vaccination status unknown

[www.immunisation.ie](http://www.immunisation.ie)
Child with pertussis

Courtesy of Centers for Disease Control and Prevention

www.immunisation.ie
Pneumococcal Disease

www.immunisation.ie
Pneumococcal disease

• Bacterial infection
  – caused by *Streptococcus pneumoniae*
  – more than 90 known serotypes
  – polysaccharide capsule important virulence factor
  – Serotype specific antibody is protective

• Pathogenesis
  – Carriage common ~ 5-70% of healthy adults carry
    • Carriage often higher in children
  – Invasion may occur in some individuals
  – Invasive pneumococcal disease (IPD) causes most severe problems

[www.immunisation.ie](http://www.immunisation.ie)
Pneumococcal clinical features

• Incubation period
  – 1-3 days

• Pneumonia
  – Abrupt onset usual
  – Case fatality ratio 20%-60%

• Bacteraemia
  – most common clinical presentation
  – leading cause of meningitis among children < 5 years of age
  – common cause otitis media

• Meningitis
  – case fatality ratio 30%-80%

• Common cause of acute otitis media

www.immunisation.ie
Pneumococcal Epidemiology

- Reservoir: Human carriers
- Transmission: Respiratory autoinoculation
- Temporal pattern: Winter and early spring
- Communicability: Unknown, probably as long as organism in respiratory secretions

www.immunisation.ie
Age distribution of IPD notifications, 2004-2009

Source HPSC

www.immunisation.ie
Pneumococcal immunisation, Ireland

- Two different types of vaccines available
  - Pneumococcal conjugate vaccine - 13 valent (PCV)
    - protects against 13 most common serotypes
    - replaced PCV 7 in December 2010
  - Pneumococcal polysaccharide vaccine - 23 valent (PPV)
    - adults > 65 yeas of age
    - high risk adults and children < 65 years of age
    - not recommended in children < 2 years (poorly immunogenic)
PCV vaccination

- Current guidelines advise 2 doses in infancy
  - 2, 6 months (PCV)
  - 12 months (PCV)
- Late entrants
  - One dose for unvaccinated children from 12-<24 months

www.immunisation.ie
Impact of PCV7 on the incidence of IPD caused by PCV7 vaccine serotypes in <2 year olds

Data source: IPD Typing Project  www.immunisation.ie
Impact of PCV7 on the incidence of IPD caused by PCV7 vaccine serotypes in ≥2 year olds

Data source: IPD Typing Project [www.immunisation.ie](http://www.immunisation.ie)
PPV vaccination

- Medically at risk
- 65 years and older
- Revaccination not **normally required**.
- Booster vaccination is recommended for
  - those aged 65 years and older if they received vaccine more than 5 years before and were less than 65 years of age at the time of the first dose
  - 5 years after the first vaccination for people under 65 years
    - whose antibody levels are likely to decline rapidly e.g. asplenia, splenic dysfunction,
    - with immunosuppression or chronic renal disease.
  - 3 months after treatment if given during chemotherapy or radiotherapy.

Reimmunisation with PPV23 can produce severe local reactions especially if given within 5 years of previous injection.

[www.immunisation.ie](http://www.immunisation.ie)
Poliomyelitis (Polio)
Poliomyelitis (Polio)

- **Acute viral illness**
  - Caused by enterovirus
  - Three serotypes: 1, 2, 3
  - Minimal heterotypic immunity between serotypes
  - Inactivated by heat, chemical agents and UV light

- **Pathogenesis**
  - Entry via mouth
  - Replication in pharynx, GI tract, local lymphatics
  - Haematologic spread to lymphatics and central nervous system
  - Virus spreads along nerve fibres
  - Destruction of motor neurons

[www.immunisation.ie](http://www.immunisation.ie)
Polio epidemiology

- Reservoir: Human
- Transmission: Faeco-oral, Oral-oral possible
- Communicability: 7 to 10 days before onset, Virus present in stool 3-6 weeks

www.immunisation.ie
Polio – Clinical features

- Incubation period
  - 6-20 days (range 3-35 days)
- Initial symptoms
  - Up to 95% asymptomatic
  - Fever, fatigue, loose stools, sore throat, stomach upset, headache, vomiting
  - Aseptic meningitis
  - Paralysis (bulbar, facial, limbs)

www.immunisation.ie
Polio Epidemiology in Ireland
1948-2009

Source: HPSC, CIDR
Polio epidemiology in Ireland

- Polio outbreaks common before vaccine introduced
  - Polio still problem world-wide, elimination programme on-going
- Oral polio vaccine (OPV)
  - introduced in 1957
  - Inactivated polio vaccine (IPV) replaced OPV in 2001
- Decline in incidence since introduction
  - Last cases reported 1977 (n=5)
- Acute flaccid paralysis (AFP) surveillance
  - hospital based surveillance of acute flaccid paralysis all children < 15 years of age
  - See www.HPSC.ie for more information on AFP

www.immunisation.ie
Polio vaccination

- Current guidelines advise 3 doses in infancy
  - 2, 4, 6 months (6 in 1)
  - 4-5 years of age (4 in 1)

- Late entrants
  - Offer full course to unimmunised with appropriate time intervals
Rotavirus

www.immunisation.ie
Rotavirus infection

• Viral infection
  – Most common cause of severe diarrhoeal disease in children
  – nearly all children infected by 5 years of age
• Pathogenesis
  – Faecal-oral route
  – Replicates in epithelium of small intestine
  – Isotonic diarrhoea
  – Re-infection can occur at any age, usually less severe

www.immunisation.ie
Rotavirus - Epidemiology

• Reservoir
  Human
  -gastrointestinal tract and stools

• Transmission
  Faecal-oral route
  -person-person, food, water and fomites (toys, environment)

• Temporal pattern
  Autumn and winter, spring
  (temperate areas)

• Communicability
  2 days before to 10 days (30 days in immunodeficient) after onset
Rotavirus - Clinical features

- Incubation period: 1-3 days
- Variable clinical presentation
  - Asymptomatic to severe diarrhoeal disease with fever and vomiting
  - 1\textsuperscript{st} infection after 3 months usually most severe
  - 1/3 cases have fever > 39\textdegree C
  - Gastrointestinal symptoms usually resolve in 3-7 days
  - Clinical presentation is non-specific
- Confirmation
  - Requires laboratory diagnosis

[www.immunisation.ie](http://www.immunisation.ie)
Rotavirus - Complications

- Severe diarrhoea
- Dehydration
- Electrolyte imbalance
- Metabolic acidosis
- Immunodeficient children may have more severe or persistent disease
Rotavirus notifications in Ireland 2001-2009

Source HPSC  www.immunisation.ie
Rotavirus vaccination*

- Two vaccine currently available- both are oral vaccines
- Rotarix
  - Live attenuated human vaccine
  - 2 dose schedule at 2 and 4 months of age
- Rotateq
  - Live attenuated human bovine reassortment vaccine
  - 3 doses at 2, 4, 6 months
- *Not currently recommended as part of routine childhood immunisation programme
Rubella

www.immunisation.ie
Rubella

- Acute viral illness
  - One antigenic type
  - Rapidly inactivated by chemical agents, heat, UV light, low pH

- Pathogenesis
  - Respiratory transmission
  - Replication in nasopharynx and regional lymph nodes
  - Viraemia 5-7 days after infection, spreads to tissues
  - Placenta and foetus infected during viraemia

www.immunisation.ie
Rubella epidemiology

- Reservoir: Human
- Transmission: Respiratory
- Temporal pattern: Peak late winter, spring
- Communicability: 7 days pre- to 5-7 days post rash onset (CRS infants may shed for > 1 year)
Rubella - Clinical features

• Incubation period
  – 14-21 days (range 12-23 days)

• Symptoms often mild
  – ~ 50% infections sub-clinical
  – Prodrome 1-5 days after exposure
    – low fever, malaise, conjunctivitis, upper respiratory symptom
  – Maculopapular rash 14-17 days after exposure
    • Rash usually first sign in children
    • Starts on head and moves down body, lasts ~ 3 days
    • Lymphadenopathy begins before rash onset and may last several weeks

www.immunisation.ie
Rubella - Complications

- Arthralgia or arthritis
  - Common in adult female (~70%)
  - Rare in children
- Thrombocytopenic purpura: 1/3,000 cases
- Encephalitis: 1/6,000 cases
- Neuritis: rare
- Orchitis: rare
Congenital Rubella Syndrome (CRS)

- Foetal damage depends on gestational age at time of infection
  - 1st 10 weeks ~ 90% foetuses affected
  - 11-16 weeks ~10%-20%
  - Rare after 20 weeks
- Infection may affect all organs
- May lead to foetal death or premature delivery

[www.immunisation.ie](http://www.immunisation.ie)
CRS - Description

- Deafness
- Cataracts
- Heart defects
- Microcephaly
- Bone alterations
- Liver and spleen damage

www.immunisation.ie
Rubella clinical pictures

Infant with CRS

Courtesy of Centers for Disease Control and Prevention

www.immunisation.ie
Rubella notifications
1948-2009

Source: HPSC, CIDR

www.immunisation.ie
Rubella immunisation

• Rubella vaccine
  – introduced in 1971 for girls only
  – Large outbreak in 1983
    • 2395 cases
    • Most recent outbreak 1996, 602 cases
  – MMR introduced for all children 1988
    • marked decline in incidence since then
Rubella vaccination

- As part of Measles-Mumps-Rubella vaccine (MMR)
- Live vaccine
  - Not recommended in pregnancy
- Current guidelines advise 2 doses
  - 12 months
  - 4-5 years
- Single vaccines not recommended
- Late entrants
  - Offer two doses to all children if vaccination status unknown
- College students
  - one dose to all new entrants if two doses not already received

www.immunisation.ie
Tetanus
Tetanus

• Acute often fatal bacterial disease
  – Caused by exotoxin produced by tetanus bacillus, *Clostridium tetani*

• Pathogenesis
  Spores contaminate wounds, grows anaerobically at site of injury

• Populations at risk
  – All ages susceptible if non-immunised
  – High risk groups in Ireland are elderly non-vaccinated and injecting drug users
# Tetanus epidemiology

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir</td>
<td>Soil and intestine of animals and humans</td>
</tr>
<tr>
<td>Transmission</td>
<td>Spores enter contaminated wounds, tissue injury</td>
</tr>
<tr>
<td>Temporal pattern</td>
<td>Peak in summer or wet season</td>
</tr>
<tr>
<td>Communicability</td>
<td>Not contagious</td>
</tr>
</tbody>
</table>

[www.immunisation.ie](http://www.immunisation.ie)
Tetanus- Clinical features

• Incubation period
  – 8 days (range 3-21 days, rarely months)
• 3 forms
  – Local (rare), cephalic (rare), generalised (80%)
• Initial presentation
  • muscle stiffness of the jaw (“Lockjaw”) - 50% cases
  – Followed by
    • neck stiffness, difficulty swallowing, muscle rigidity, spasms, sweating and fever
    • Complete recovery may take months
Tetanus - Complications

- Fractures,
- Hypertension
- Laryngospasm
- Pulmonary embolism
- Aspiration
- Death
Tetanus - Clinical features

Photo courtesy of CDC

Photo courtesy of WHO

www.immunisation.ie
Tetanus notifications
1982-2009

Source: HPSC, CIDR

www.immunisation.ie
Tetanus vaccination in Ireland

• Tetanus immunisation available since 1930s
  ▪ Guidelines advise minimum of 5 tetanus toxoid doses given at appropriate intervals
    ▪ 2,4,6 months (6 in 1)
    ▪ 4-5 years (4 in 1)
    ▪ 11-14 years (Tdap)
• Identify and vaccinate non- or incompletely vaccinated individuals
• Early recognition of potential tetanus wounds
• Early treatment with tetanus immunoglobulin (TIG) for tetanus prone wounds may be required for incompletely immunised
Tuberculosis

www.immunisation.ie
Tuberculosis (TB)

• Bacterial infection
  - caused by *Mycobacterium tuberculosis* (most common), less common M. bovis, M. africanum, M. canetti
  - Infection of lungs and or other organs
  - Characterised by long incubation period
  - Produces chronic disease with risk of reactivation
  - Without treatment often fatal

www.immunisation.ie
Tuberculosis – Epidemiology

- **Reservoir**
  Primarily humans

- **Transmission**
  Respiratory airborne droplet nuclei (coughing, sneezing, singing)

- **Communicability**
  As long as viable bacilli discharged in sputum, dependent on number, virulence, type of contact, susceptibility of contact

[www.immunisation.ie](http://www.immunisation.ie)
National TB notifications, rate and 3-year moving average 1991-2009*

*2009 provisional data
Tuberculosis - Clinical features

• Incubation period
  – ~ 3-12 weeks (development of significant tuberculin reaction)
  – Symptomatic infection
    • most likely in 1st 2 years after infection (but may occur many years later)
  – Symptoms depend on organ infected
    – Lung 2/3rd cases – cough, blood stained sputum, chest pain
    – Laryngeal TB - hoarseness
    – Constitutional symptoms – fatigue, night sweats, weight loss

www.immunisation.ie
BCG Vaccination

• Bacille Calmette Guerin
  – Live attenuated vaccine
  – derived from *Mycobacterium Bovis*
  – Most effective against TB meningitis and miliary TB
• First introduced 1937
• Dramatic decline in TB in past 40 years
• BCG administered intradermally to
  – Neonates
  – Unvaccinated children under 16 years of age and at at risk individuals

[www.immunisation.ie](http://www.immunisation.ie)
Varicella

www.immunisation.ie
Varicella

• Acute viral infection
  – Caused by varicella-zoster virus (VZV)
  – Primary infection causes chickenpox (varicella)
  – Recurrent infection causes shingles (herpes zoster)

• Pathogenesis
  – Enters through respiratory tract and conjunctiva
  – Replication in nasopharynx and regional lymph nodes
  – Primary viraemia 4-6 days after infection, spreads to liver, spleen, nerves
  – Secondary viraemia with spread to skin

www.immunisation.ie
Varicella Epidemiology

- Reservoir: Human
- Transmission:
  - Airborne droplet
  - Direct contact with skin lesions
- Temporal pattern: Peak in winter and early spring
- Communicability:
  - 1-2 days before to 4-5 days after onset of rash. May be longer in immunocompromised
Varicella - Clinical features

- Incubation period
  - 14-16 days (range 10-21 days)
- Mild prodrome for 1-2 days
  - Vesicular rash
    - Rash usually appears first on head; most concentrated on trunk
    - Successive crops over several days with lesions present in several stages of development
- Herpes zoster (shingles)
  - Reactivation of chickenpox virus
  - Transmission to non immune (causes chickenpox)
Varicella complications

• Bacterial infection of skin lesions
• Pneumonia (viral or bacterial)
• Central nervous system manifestations
• Reye’s syndrome
Varicella vaccine

- Varicella vaccine
  - Live vaccine
    - Not recommended in pregnancy
  - Recommended for at risk groups
    - Non immune
      - Health care workers
      - Laboratory staff who may be exposed to virus at work
      - Close household contacts of immunocompromised individuals

www.immunisation.ie
Acknowledgements

• Much of this material and photos were obtained from Centres for Disease Control (CDC) materials
  http://www.cdc.gov/vaccines/pubs/pinkbook/default.htm

• Health Protection Surveillance Centre (HPSC) scientists and specialists www.hpsc.ie

• Many thanks to HSE health protection staff – administrators, scientists, nurses, doctors, for providing data