NICOLAUS COPERNICUS
UNIVERSITY
IN TORUŃ
Faculty of Medicine
Collegium Medicum in Bydgoszcz

Immunizations

Krzysztof Buczkowski

Year 1900

Children got smallpox vaccintion

- Smallpox was probably the first disease people tried to prevent by purposely inoculating themselves with other infections and was the first disease for which a vaccine was produced.
- The smallpox vaccine was designed in 1796 by the British physician Edward Jenner
- Louis Pasteur furthered the concept through his pioneering work in microbiology.
- The immunization was called *vaccination* because it was derived from a **v**irus **a**ffecting **c**ows
- Smallpox was a contagious and deadly disease, causing the deaths of 20–60% of infected adults and over 80% of infected children.
- When smallpox was finally eradicated in 1979, it had already killed an estimated 300–500 million people during the 20th century alone.

Figure 15.1 Diphtheria cases and deaths, England and Wales (1914–2003)

Year 1960

Vaccines:

- Tuberculosis,
- Smallpox,
- Diphtheria,
- Tetanus,
- Pertussis (Whooping Cough),
- Poliomyelitis;

Year 1980

Vaccines:

- Tuberculosis,
- Diphtheria,
- Tetanus,
- Pertussis (Whooping Cough),
- Poliomyelitis
- Measels
- Mumps
- Rubella

Smallpox vaccination was stoped in the 70s

Modern Vaccines effectively prevent approximately 30 infectious diseases

Children immunisation

Adult immunization

Diphtheria Tetanus
Herpes zoster (shingles)
HPV
Measles Mumps
Meningococcal conjugate
Pertussis
Pneumococcal 23-valent polysaccharide (Pneu-P-23)
Polio
Rubella
Varicella (chickenpox)

Comparison of Pre-Vaccine and Current Reported Morbidity of Vaccine-Preventable Diseases and Vaccine Adverse Events, United States

Disease	Pre-vaccine Era*	2006**	% decrease
Diphtheria	175,885	0	100
Measles	503,282	55	99.9
Mumps	152,209	6,584	95.7
Pertussis	147,271	15,632	89.4
Polio (paralytic)	16,316	0	100
Rubella	47,745	11	99.9
Congenital Rubella Syn.	823	1	99.9
Tetanus	1,314	41	96.9
H. influenzae type b and unknown (<5 yrs)	20,000+	208	99.0
Total	1,064,854	22,532	97.9
Vaccine Adverse Events	N/A	15,484	+++

* Baseline 20th century annual morbidity

\+ Estimated because no national reporting existed in the pre-vaccine era

** Source: MMWR 2007;56(33):851-64

Routine immunizations are essential for the control and prevention of previously common childhood infectious diseases.

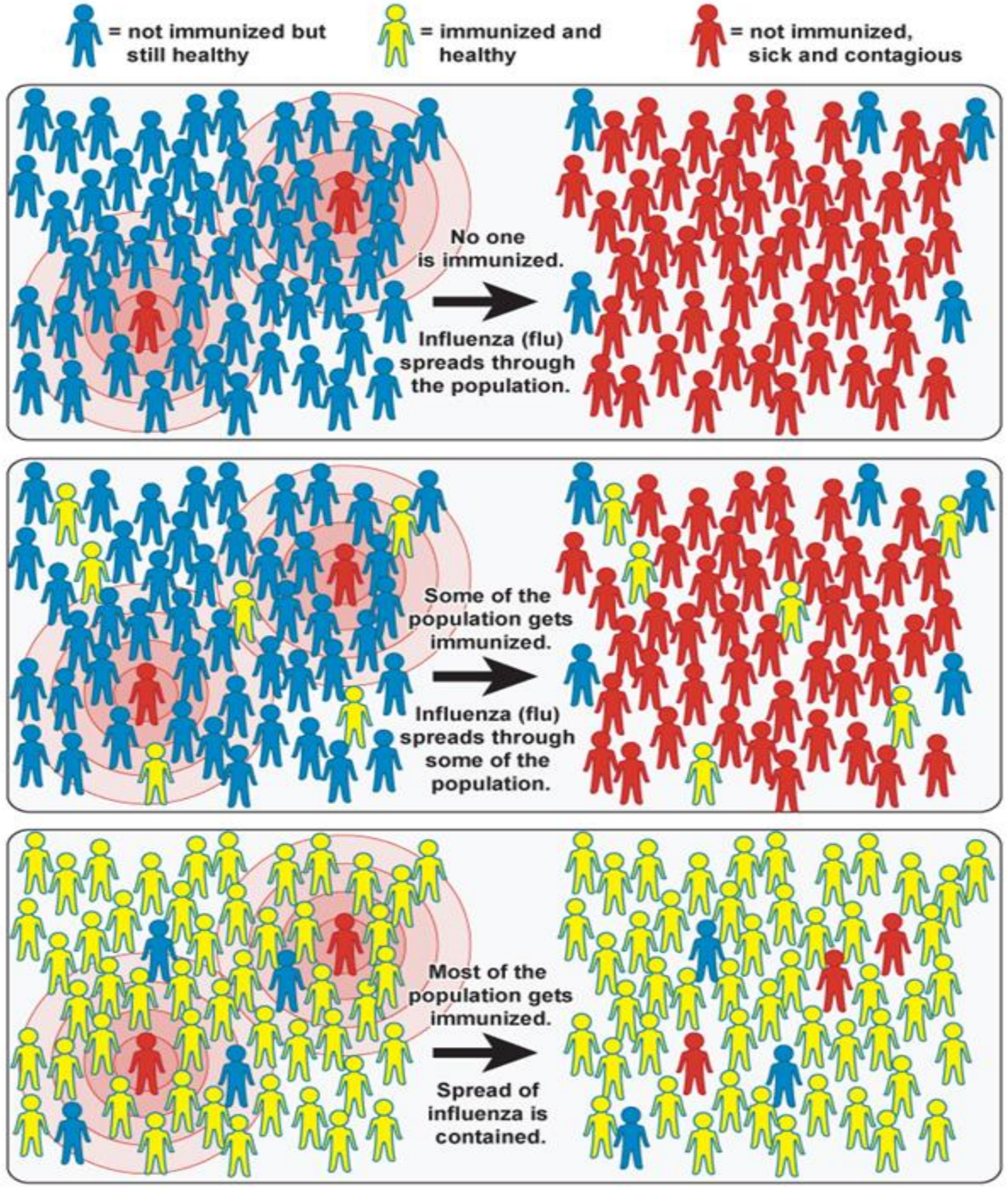
Progress in access to immunization- the greatest achievement of public health

- Vaccinations save lives annually 6 million people, including 3 million children

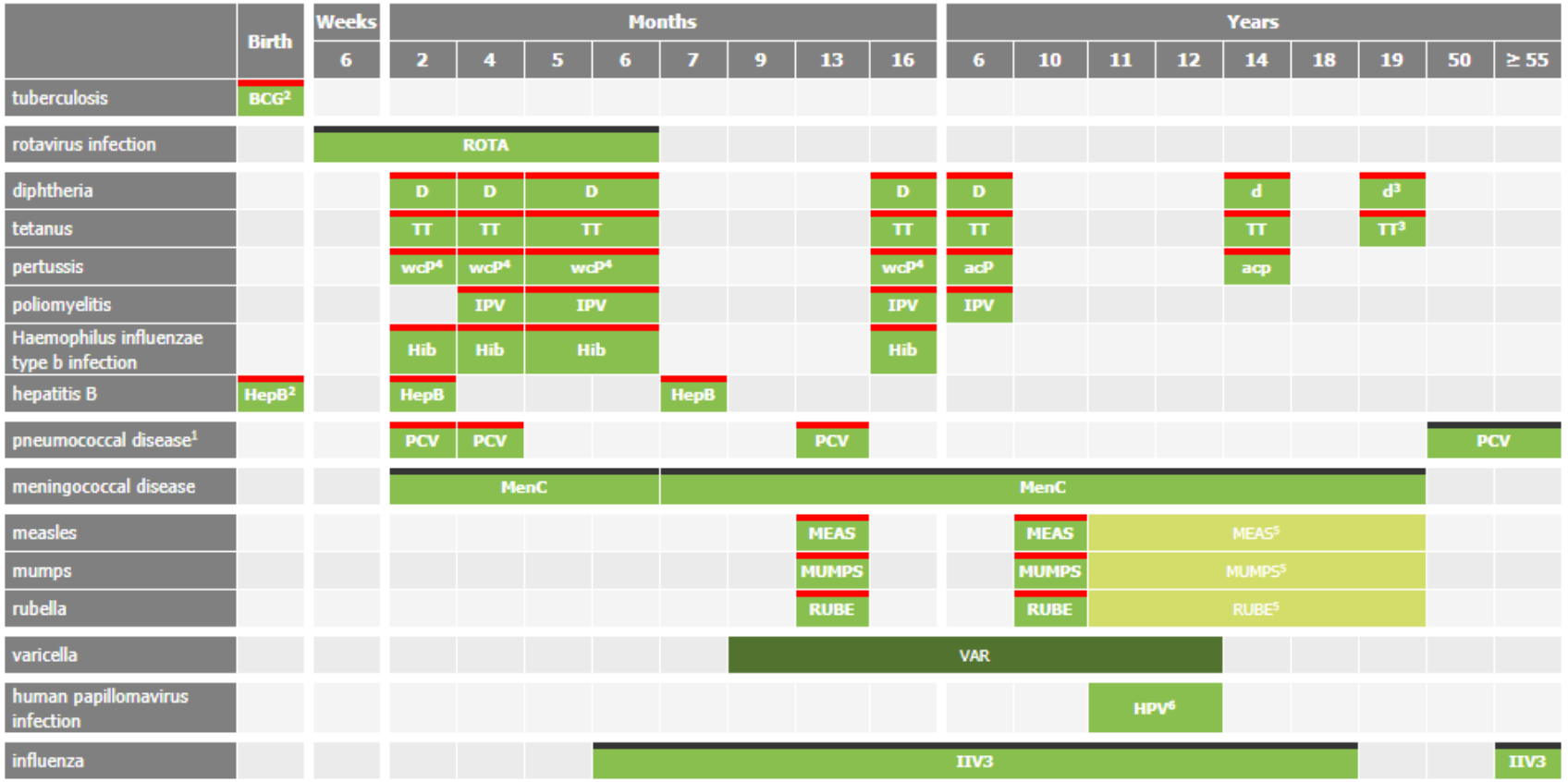
Progress in access to immunization- the greatest achievement of public health

- Vaccinations have revolutionized the prevention, medicine and modern civilizations
- Morbidity and mortality due to such diseases as diphtheria, measles and polio have been reduced in many countries by about 99%
- The biggest impact on the success of vaccination has **mass-performance** (high state immunization)

UK Department of Health. The Green Book. 2006.


= not immunized but still healthy
= immunized and healthy
= not immunized, sick and contagious
No one is immunized.
Influenza (flu) spreads through the population.
Some of the population gets immunized.
Influenza (flu) spreads through some of the population.
Most of the population gets immunized.
Spread of influenza is contained.

Poland: recommended vaccinations



Norway: recommended vaccinations

	Weeks	Months					Years				
	6	3	5	11	12	15	7	11	12	15	≥ 65
tuberculosis	BCG[1]										
rotavirus infection	RV1[2]	RV1[2]									
diphtheria		D	D		D		D			d	
tetanus		TT	TT		TT		TT			TT	
pertussis		acP	acP		acP		acP			acP	
poliomyelitis		IPV	IPV		IPV		IPV			IPV	
Haemophilus influenzae type b infection		Hib	Hib		Hib						
hepatitis B		HepB	HepB		HepB						
pneumococcal disease		PCV13	PCV13	PCV13							PPSV23[3]
measles						MEAS		MEAS			
mumps						MUMPS		MUMPS			
rubella						RUBE		RUBE			
human papillomavirus infection									HPV[4]		
influenza											IIV3

Version:

01-02-2017: Hep B vaccine introduction in the immunisation programme

Footnotes:

1. For specific at risk-groups only. 3 doses within the first year of life.
2. For those born from 1 September 2014. 2 doses at 6 weeks and 3 months of age
3. One dose if not vaccinated in the previous 10 years. Reimbursed for some at-risk groups.
4. Females only. 7th grade.

Sweden: recommended vaccinations

	Birth	Months					Years					
		3	5	6	12	18	5	6-8	10-12	14-16	64	≥ 65
tuberculosis				BCG[1]								
diphtheria		D	D		D		D			d[2]		
tetanus		TT	TT		TT		TT			TT[2]		
pertussis		acP	acP		acP		acP			acp[3]		
poliomyelitis		IPV	IPV		IPV		IPV					
Haemophilus influenzae type b infection		Hib	Hib		Hib							
hepatitis B	HepB[4]	HepB[5]	HepB[5]		HepB[5]							
pneumococcal disease		PCV	PCV		PCV							PPSV23
measles						MEAS		MEAS[6]				
mumps						MUMPS		MUMPS[6]				
rubella						RUBE		RUBE[6]				
human papillomavirus infection									HPV[7]			
influenza				IIV3								IIV3

Inactivated vaccines and live, attenuated vaccines

Inactivated vaccines

Acellular pertussis
Cholera and travellers' diarrhea
Diphtheria toxoid
Haemophilus influenzae type b (Hib)
Hepatitis A
Hepatitis B
Human papillomavirus (HPV)
Inactivated poliomyelitis
Japanese encephalitis
Meningococcal
Pneumococcal
Rabies
Tetanus toxoid-
Tick-borne encephalitis
Trivalent inactivated influenza (TIV)
Typhoid (injectable formulation)

Live, attenuated vaccines

Bacillus Calmette-Gérin (BCG)
Herpes Zoster (shingles)
Live attenuated influenza (LAIV)
Measles
Mumps
Rotavirus
Rubella
Smallpox
Typhoid (oral formulation)
Varicella (chickenpox)
Yellow fever

Inactivated vaccines and live, attenuated vaccines

- Live vaccinnes may be dangerous for people with impaired immunity (both vaccinated and residing in the vicinity of vaccinated)
- Inactivated vaccinnes are safe for people with impaired immunity
- Immunity is more stable after live vaccinnes
- Live vaccinnes need less doses

Guidelines for Spacing of Live and Inactivated Antigens

Antigen Combination	Recommended Minimum Interval Between Doses
>2 inactivated	None; can be administered simultaneously or at any interval between doses
Inactivated and live	None; can be administered simultaneously or at any interval between doses
>2 live parenteral*	28-day minimum interval, if not administered simultaneously

Adjuvants

- The method of administration of injectable vaccines depends in part on the presence of an adjuvant in some vaccines
- The term adjuvant refers to a vaccine component distinct from the antigen, which enhances the immune response to the antigen
- Vaccines containing an adjuvant (DTaP, DT, HPV, Td, Tdap, pneumococcal conjugate, Hib, hepatitis A, hepatitis B) should be injected into a muscle mass, because administration subcutaneously or intradermally can cause local irritation, induration, skin discoloration, inflammation, and granuloma formation.

Basic vaccination= primary + complementary

Booster doses

- all vaccines require a primary dose or series to ensure immunity
- some require periodic repeat, or booster, doses to maintain immunity

Combination vaccine

There are three different types of vaccine preparations based on how many and what types of immunizing antigens are contained in the vaccine:

- vaccines containing only one immunizing antigen against one disease (e.g., hepatitis A vaccine)
- vaccines containing immunizing antigens against more than one serogroup or serotype of the same disease (e.g., meningococcal vaccine, pneumococcal vaccines)
- vaccines containing immunizing antigen against more than one vaccine preventable disease (e.g., measles-mumps-rubella vaccine)

Combination vaccines

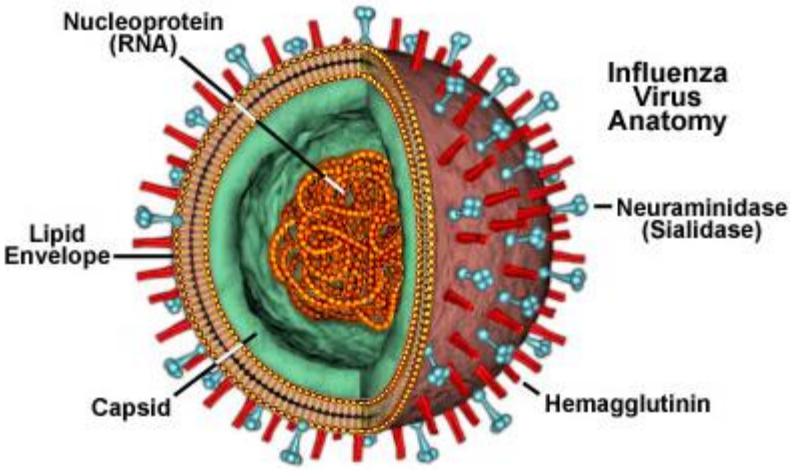
Antigens in vaccine	Vaccine abbreviation	Brand name
Diphtheria, tetanus, acellular pertussis, inactivated polio (pediatric)	DTaP-IPV	QUADRACEL®
Diphtheria, tetanus, acellular pertussis, inactivated polio, *Haemophilus influenzae* type b (pediatric)	DTaP-IPV-Hib	PEDIACEL®
Diphtheria, tetanus, acellular pertussis, hepatitis B, inactivated polio, *Haemophilus influenzae* type b (pediatric)	DTaP-HB-IPV-Hib	INFANRIX hexa™
Hepatitis A, hepatitis B	HAHB	TWINRIX® TWINRIX® Junior
Hepatitis A, typhoid (injection)	HA-Typh-I	ViVAXIM®
Measles, mumps, rubella	MMR	M-M-R® II PRIORIX®
Measles, mumps, rubella, varicella	MMRV	PRIORIX-TETRA®
Tetanus, diphtheria (reduced)	Td	Td ADSORBED
Tetanus, diphtheria (reduced), inactivated polio	Td-IPV	Td POLIO ADSORBED
Tetanus, diphtheria (reduced), acellular pertussis (reduced)	Tdap	ADACEL® BOOSTRIX®
Tetanus, diphtheria (reduced), acellular pertussis (reduced), inactivated polio	Tdap-IPV	ADACEL®-POLIO BOOSTRIX®-POLIO

The benefits of combination vaccines:

- improved adherence to immunization schedules because of a reduction in the number of immunization visits and injections required, leading to improved vaccine coverage rates
- increased opportunity for administration of catch-up or booster doses
- reduced stress for vaccines and vaccine providers related to multiple injections of separate vaccines

Influenza vaccination

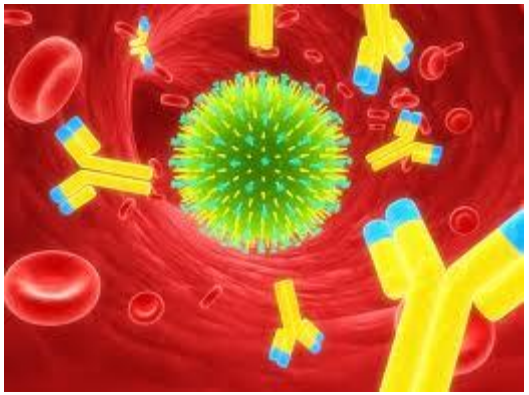
- Influenza is a vaccine preventable disease and influenza vaccines have been available for use in Europe since the 1960s
- A number of variants of the influenza viruses co-circulate each year
- Individuals can develop immunity to the different subtypes of influenza viruses, but there is little cross-immunity between subtypes
- This is why several influenza strains must be included into combination vaccines
- Currently all influenza vaccines contain three or four different influenza subtypes : two influenza A subtypes (H1N1, H3N2) and one or two influenza B subtypes


Nucleoprotein
(RNA)
Influenza
Virus
Anatomy
Neuraminidase
(Sialidase)
Lipid
Envelope
Capsid
Hemagglutinin

Influenza vaccination

- An update of seasonal influenza vaccines is needed regularly, since influenza viruses constantly evolve and sometimes recombine
- The match between the selected vaccine viruses and circulating viruses influence vaccine effectiveness and may therefore vary from year to year
- To overcome this, the precise vaccine viruses selected are reviewed annually by a strain selection meeting convened each year in February by the World Health Organization

- Influenza activity is monitored year round in Europe but more intensely with combined clinical and virological sentinel surveillance from early October (week 40) in one year to the end of May (week 20) in the next year. It is rare that the annual influenza epidemics season starts before mid November and though there are often rises in influenza like illness in November this is almost always caused by other respiratory viruses notably respiratory syncytial virus (RSV)
- After vaccination it is considered to take about 10 to 14 days before protection and an immune response develops



Types of seasonal influenza vaccine

- Injected **trivalent inactivated** influenza vaccines (TIVs) are most commonly used throughout the world. Influenza antigen preparation varies between manufacturers and the TIVs may contain either, whole influenza virions, split-influenza virus products, subunit influenza products or virosomes expressing the influenza antigens.
- **Quadrivalent inactivated**
- **live attenuated influenza vaccine** (LAIV) ~~for intranasal use not recomended for 2017/2018 season~~

Risk Groups

- The **Influenza Risk Groups** are people who are more likely than others to develop severe disease should they be infected

- Older adults
- All persons (over six months of age) with chronic conditions

Risk Groups

- respiratory system e.g. asthma
- cardiovascular system e.g. coronary artery disease
- endocrine system e.g. diabetes
- hepatic system e.g. cirrhosis
- renal system e.g. chronic renal failure
- neurological / neuromuscular conditions e.g. parkinsonism.

Risk Groups

- any condition compromising respiratory functions e.g. morbid obesity (BMI > 40), physical handicap in children and adults
- immunosuppression due to disease or treatment including due to haematological conditions and HIV infection
- pregnant women

Vaccination against tuberculosis

In Poland BCG vaccination is administred to all children within 24 hours after birth

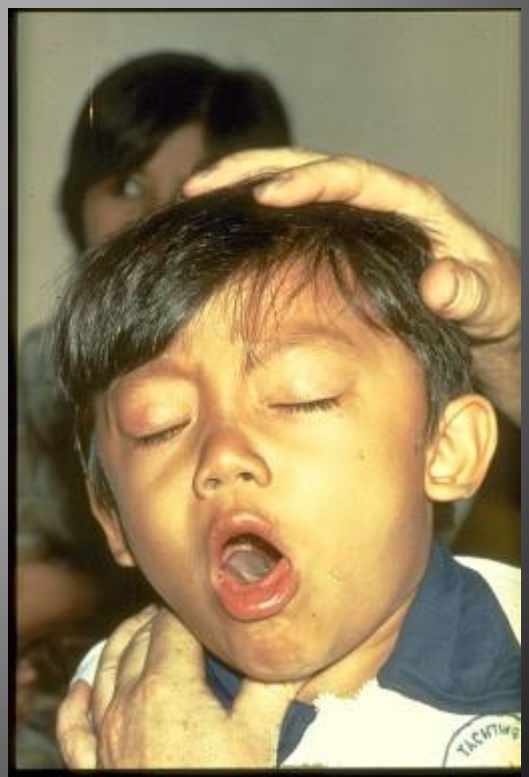
Contraindications to BCG vaccination:

- Body weight below 2000g (until the achievements of this value)
- Children of mothers with HIV - (until the exclusion of infection in a child)
- Suspected congenital immune disorders.

Norway: BCG vaccine was mandatory from 1947 to 1995. It is still available and recommended for high-risk groups.

Sweden: Recommended for children exposed to increased risk; The vaccine is usually given as a single dose from 6 months of age, but should be given earlier in case of high risk.

Vaccination against pertussis



- Pertussis is an acute bacterial infection of the respiratory tract caused by the bacterium Bordetella pertussis. The disease is characterised by a severe cough, lasting for two months or even longer.
- Humans are the only reservoir. Healthy carriers probably do not exist, but infected adults usually have only mild symptoms, but can shed bacteria for weeks. Following infection (by inhalation of droplets), susceptible individuals develop symptoms after an incubation period of about 10 days. The typical paroxysmal cough is usually seen in young children. Babies less than six months old do not cough, but they manifest dyspnea and paroxysmal asphyxia and are the most likely to die of the disease unless they receive suitable treatment.
- Affected children are also exposed to complications such as pneumonia, atelectasia, weight loss, hernia, seizures, encephalopathy (probably due to hypoxia). Antibiotics may reduce the duration of the disease, especially if administered in its early stages.

Vaccination against pertussis

- The epidemiological data indicate that in countries with a good implementation of vaccination against whooping cough in infants, it has not been observed to increase the number of cases in this age group

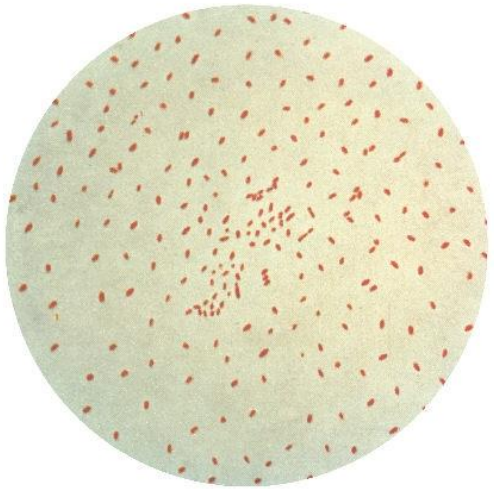
- Cases occur mainly in adolescents and adults, indicating a transient vaccine efficacy

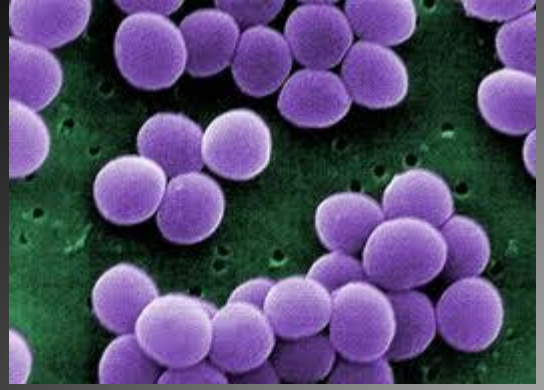
- Clinical observations indicate that the effective protection after vaccination against pertussis remains 5-8 years

Pertussis

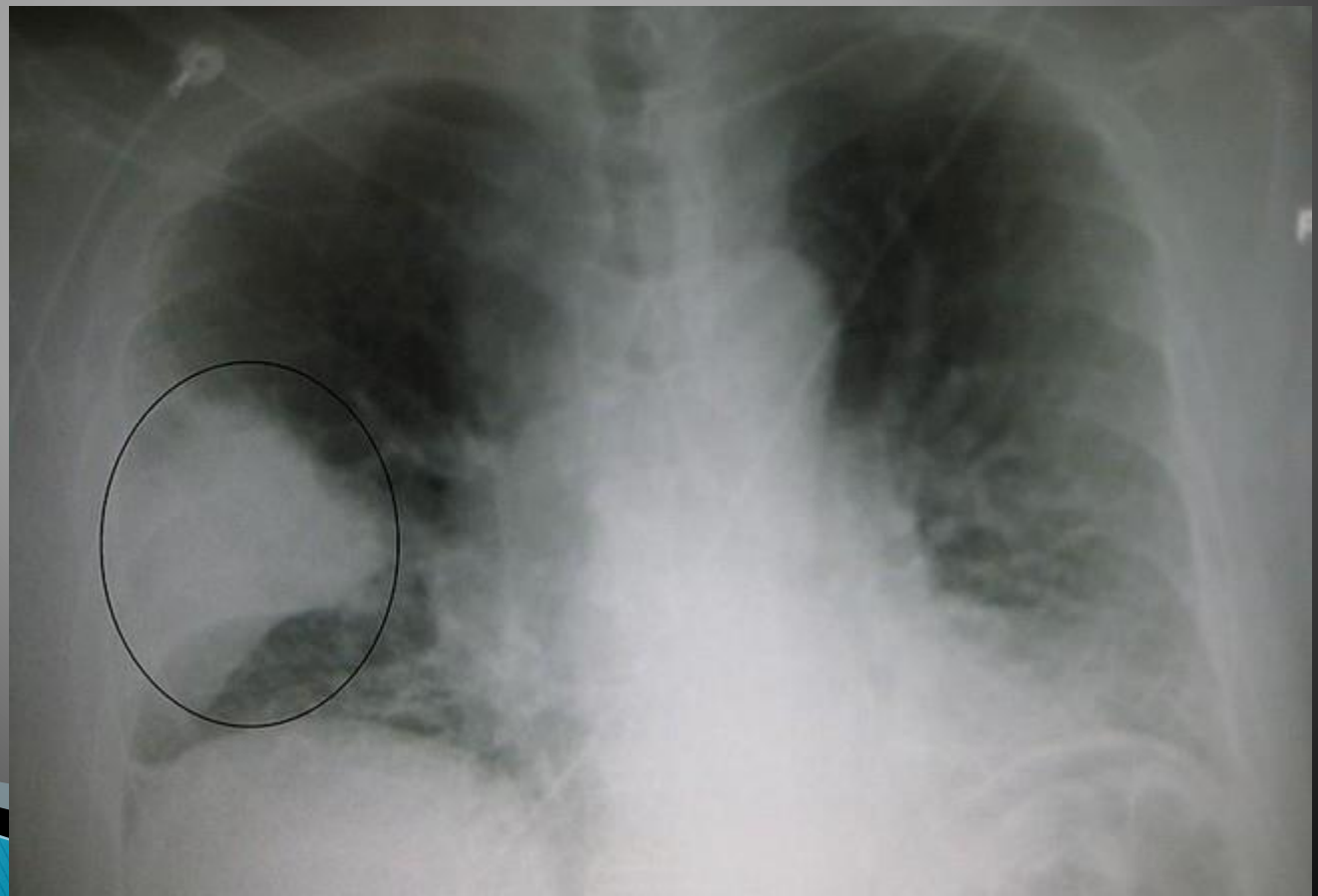
- Cases of pertussis in young infants generally relate to children with unfinished cycle of the primary vaccination, the source of infection is the close environment of the child (parents, siblings)

- The solution to this problem may be the administration of booster doses for older children, adolescents and adults





Vaccination against pneumococcal disease



- Despite good access to effective antibiotics, *Streptococcus pneumoniae* (pneumococci) is still a major cause of disease and death in both developing and developed countries.
- Pneumococci are the main cause of bacterial respiratory tract infections, such as pneumonia, middle ear infection, and sinusitis, in all age groups.
- The youngest and the elderly are those most prone to invasive pneumococcal infections, such as severe blood infection, meningitis and pneumonia.
- Carriage of pneumococci without symptoms in the nose of young children is common.

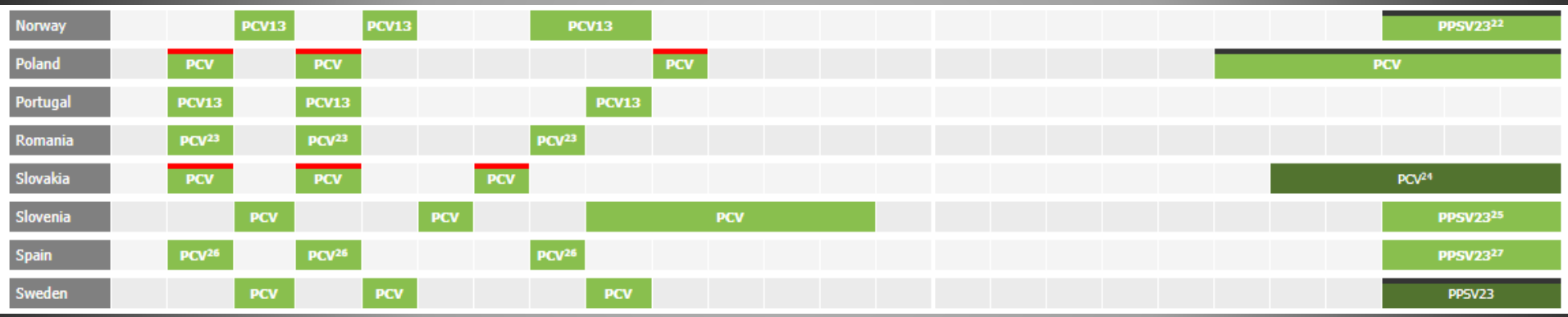
Invasive pneumococcal disease is defined as the isolation of S. pneumoniae from blood or another normally sterile site. Invasive pneumococcal disease is therefore not one condition but a group of pneumococcal infections in which the pathogen has penetrated the body's barrier defence and invaded normally sterile sites.

Types of vaccines against pneumococcal disease

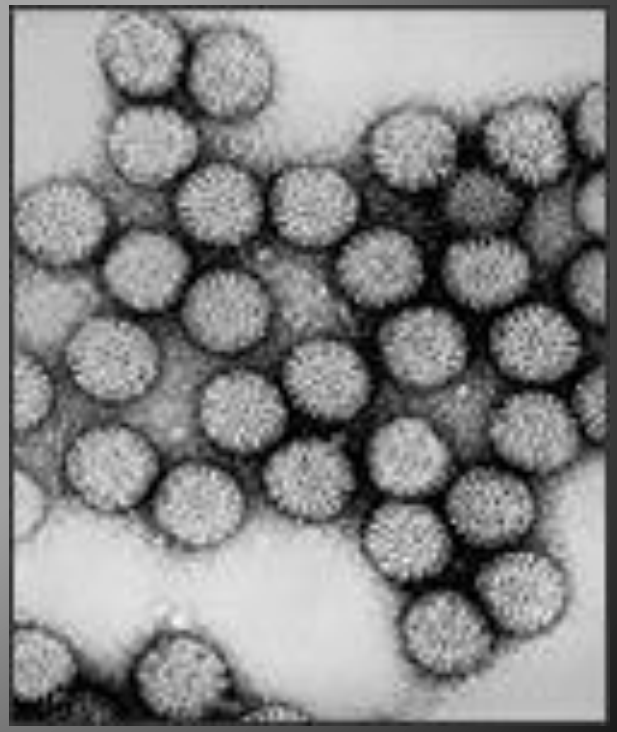
- PPSV23- Polysaccharide vaccines are registered throughout the world. They protect against invasive pneumococcal disease in adults. Such vaccines, instead, have little effect in children under five years of age and do not prevent the carriage without symptoms

- PCV 13- A new generation of (conjugated) vaccines appears to be highly efficient against invasive disease and it also prevents nasopharyngeal carriage. These vaccines cover the types of the bacteria commonly seen in childhood invasive disease and also those associated with antimicrobial resistance.

Recommended for pneumococcal disease

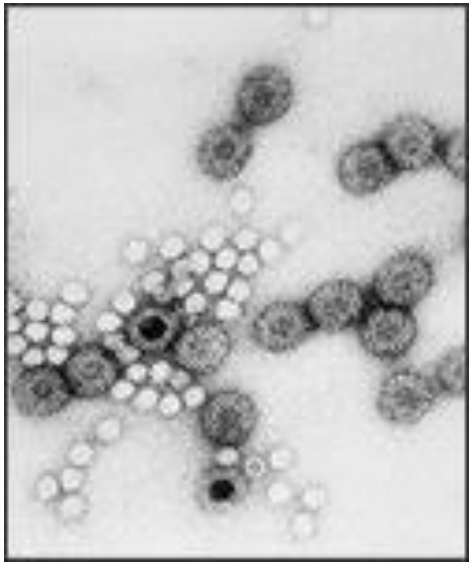


Vaccination against rotavirus



Rotavirus

- first identified as a cause of diarrhea in 1973roku
- most common cause of severe diarrhea in infants and children
- applies to the majority of children under 5 years
- responsible for 500,000 deaths annually in the world



No typical risk groups. All children in the first years of life are threatened

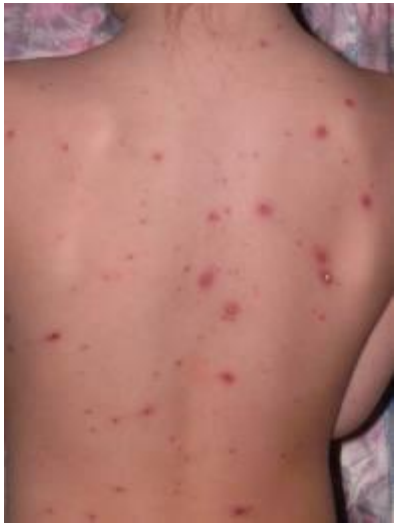
Vaccination against chickenpox

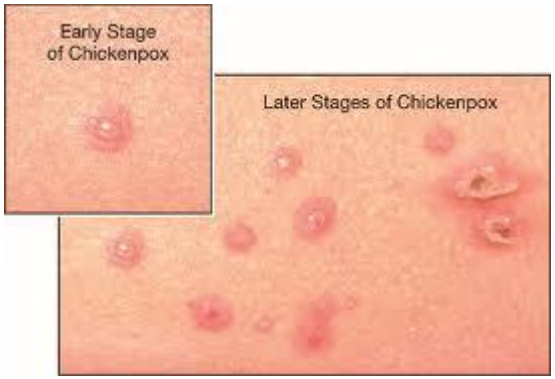
Varicella (chickenpox) is caused by the varicella-zoster virus (VZV), which also causes **shingles**. The virus spreads through the body into the skin causing rashes to appear.

Varicella- Symptoms

Varicella may begin with cold-like symptoms, followed by a high temperature and a very itchy, blister-like rash. Clusters of spots appear over 3-5 days, mostly on the trunk of the body with some on the limbs. Symptoms vary in severity from person to person. It is possible to have chickenpox and have no symptoms

Chickenpox

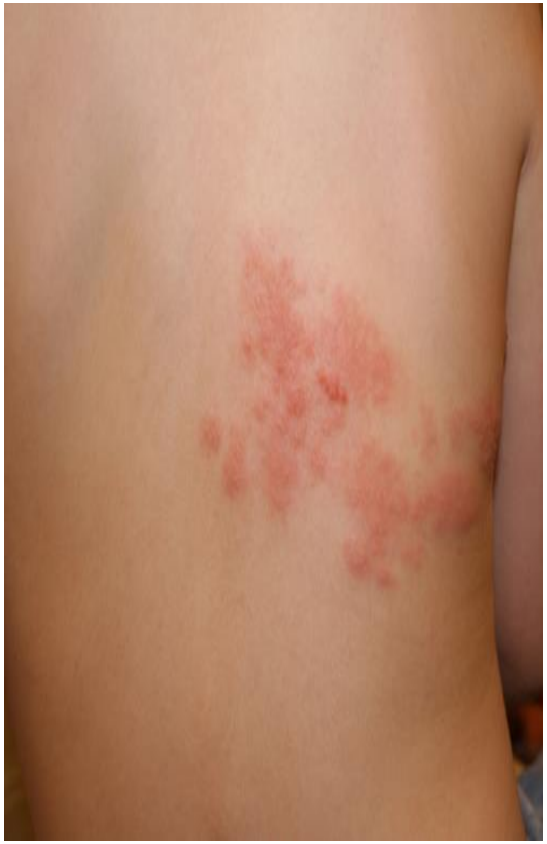


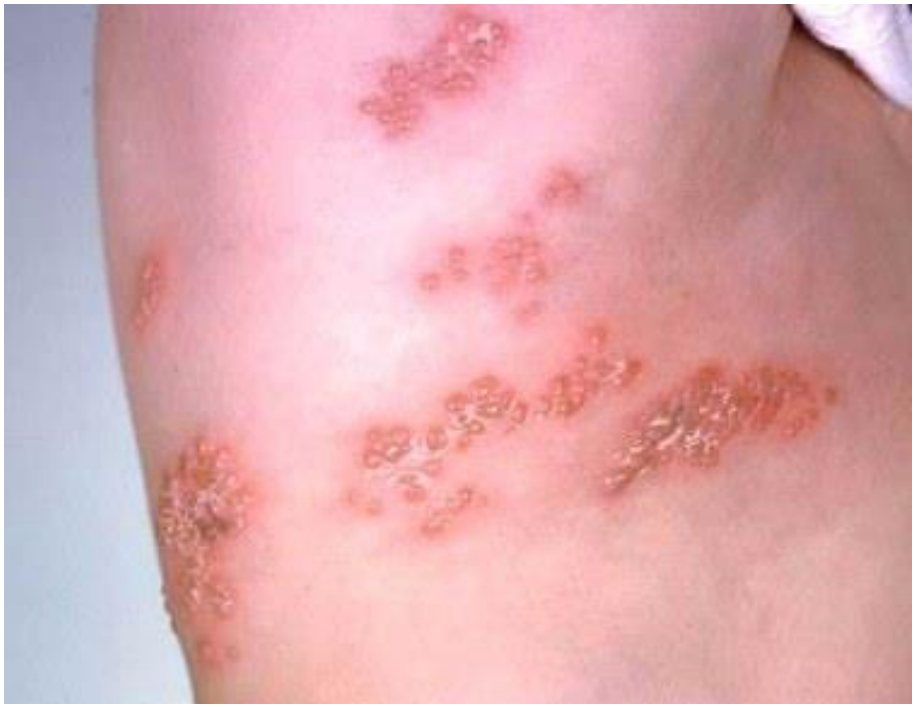


Shingles- Symptoms

You can only get shingles if you have previously had varicella and the virus is reactivated in your body. Shingles symptoms in older people usually start with a pain in the area of the nerve which is affected — often the chest. A rash of blisters then appears in the affected area, usually only on one side of the body. The rash usually lasts around seven days but the pain can last for longer. Someone with shingles can give the virus to someone who hasn't had chickenpox and is not immune, but not the other way around: a child with varicella cannot give shingles to another person.

Shingles





The risk of getting sick after contact with chickenpox

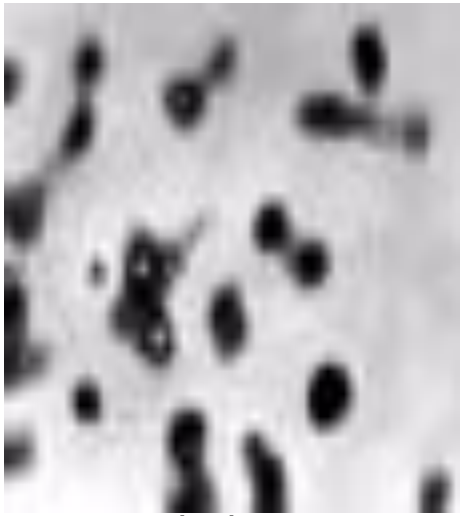
- The household relations, closed environments- 80%

- What is the risk of infection by the guardian of the child suffering from shingles?

  When the lesions on exposed parts of the body 20-40%

- Can you resick chickenpox?

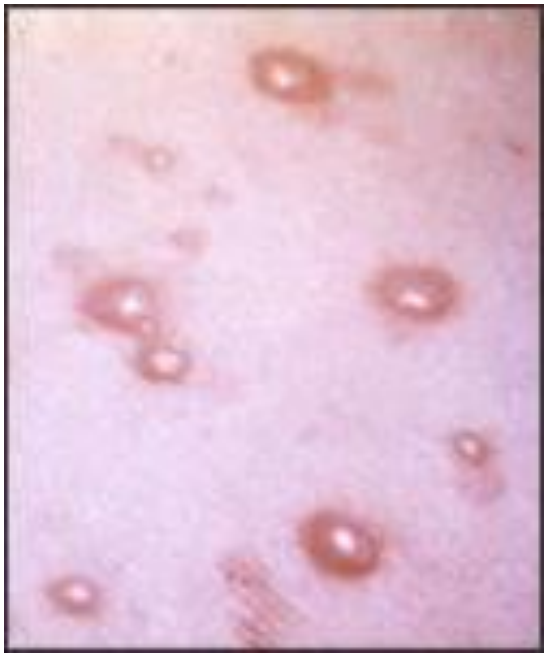
  You can, but it happens very rarely



Gershon A. Varicella-Zoster Virus Infections. Pediatrics in Review, 2008. Vol29 No1 Przedruk PpD 2009 vol13 Nr 4:54-59

Mayers M ee. Al.. NelsonTextbook of Pediatrics, 18th ed. 2007:1366-1372

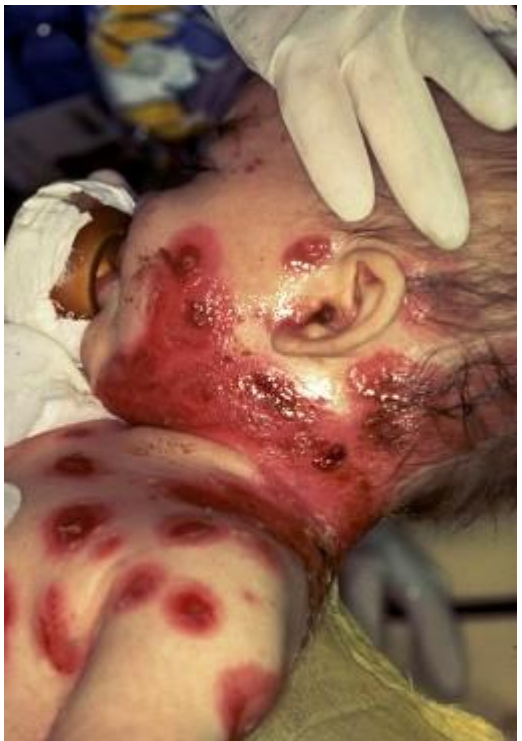
Who is at risk of severe chickenpox?



- youth and adults
- chronic skin diseases (atopic dermatitis)
- chronic lung diseases
- very severe course:
  - newborns
  - pregnant women
  - patients with cancer
  - congenital or acquired immunodeficiency
  - immunosuppressive therapy including systemic chronic high dose glucocorticoid therapy

Perinatal infection

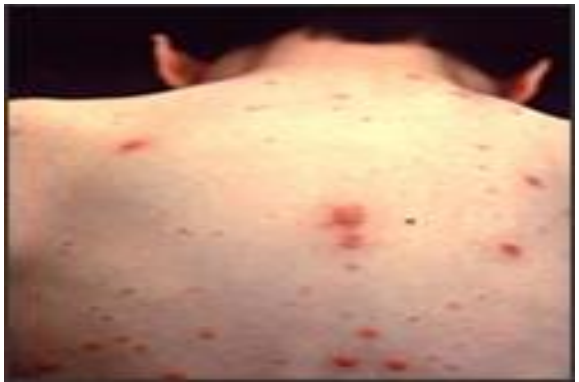
- mother's illness chickenpox within 5 days before giving birth to two days after birth is particularly dangerous for a newborn!
- high risk of varicella spread within the organ- the necessary passive immunoprophylaxis in the newborn (VZIG)



CDC.MMWR;2007/56(RR04);1-40

Indications for vaccination

- healthy people, the vaccine registered from 9 months of age
- WHO recommends vaccination of children 13-14 months of age and older, adolescents and adults
- people around immunocompromised patients
- chronically ill patients
- healthcare system and education staff , who did not have chickenpox and have not been vaccinated
- women in the reproductive period who did not have chickenpox and have not been vaccinated



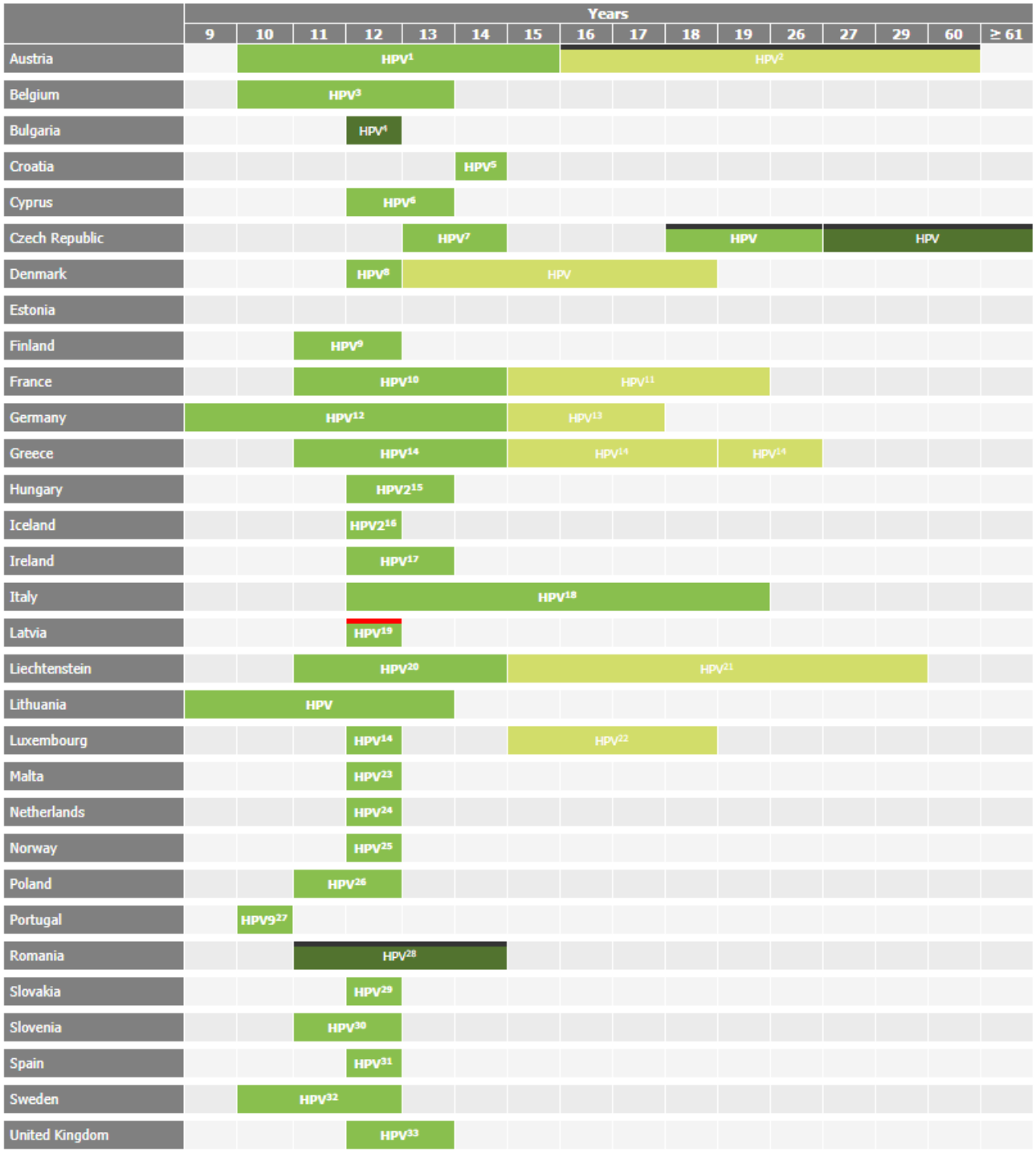
Vaccination against Human Papiloma Virus (HPV)

Vaccine types

- HPV: 16, 18
- HPV: 6, 11, 16, 18
- HPV: 6, 11, 16, 18, 31, 33, 45, 52, 58

Vaccine types

- HPV: 16, 18
- HPV: 6, 11, 16, 18
- HPV: 6, 11, 16, 18, 31, 33, 45, 52, 58
  (Gardasil 9)


Years
9
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29
60
≥ 61
Austria
HPV1
HPV2
Belgium
HPV3
Bulgaria
HPV4
Croatia
HPV5
Cyprus
HPV6
Czech Republic
HPV7
HPV
HPV
Denmark
HPV8
HPV
Estonia
Finland
HPV9
France
HPV10
HPV11
Germany
HPV12
HPV13
Greece
HPV14
HPV14
HPV14
Hungary
HPV2 15
Iceland
HPV2 16
Ireland
HPV17
Italy
HPV18
Latvia
HPV19
Liechtenstein
HPV20
HPV21
Lithuania
HPV
Luxembourg
HPV14
HPV22
Malta
HPV23
Netherlands
HPV24
Norway
HPV25
Poland
HPV26
Portugal
HPV9 27
Romania
HPV28
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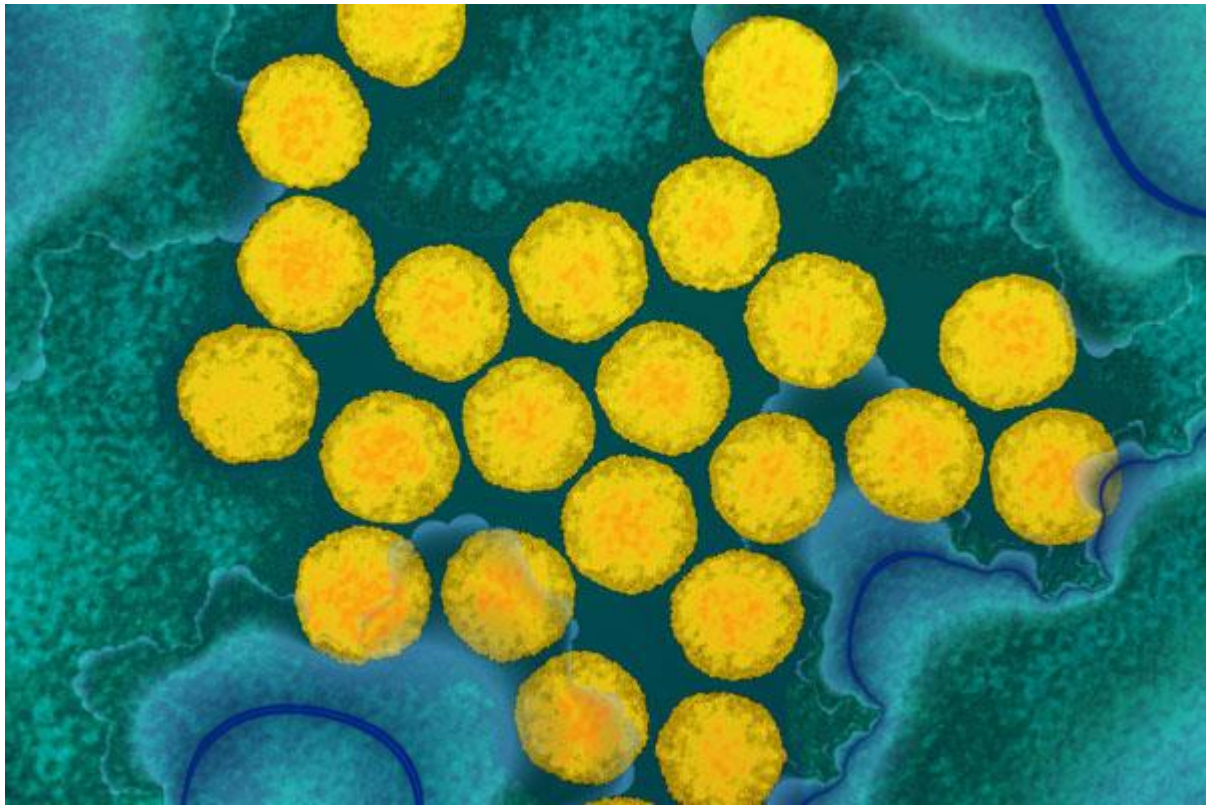
Spain
HPV31
Sweden
HPV32
United Kingdom
HPV33

Immunisation against poliomyelitis



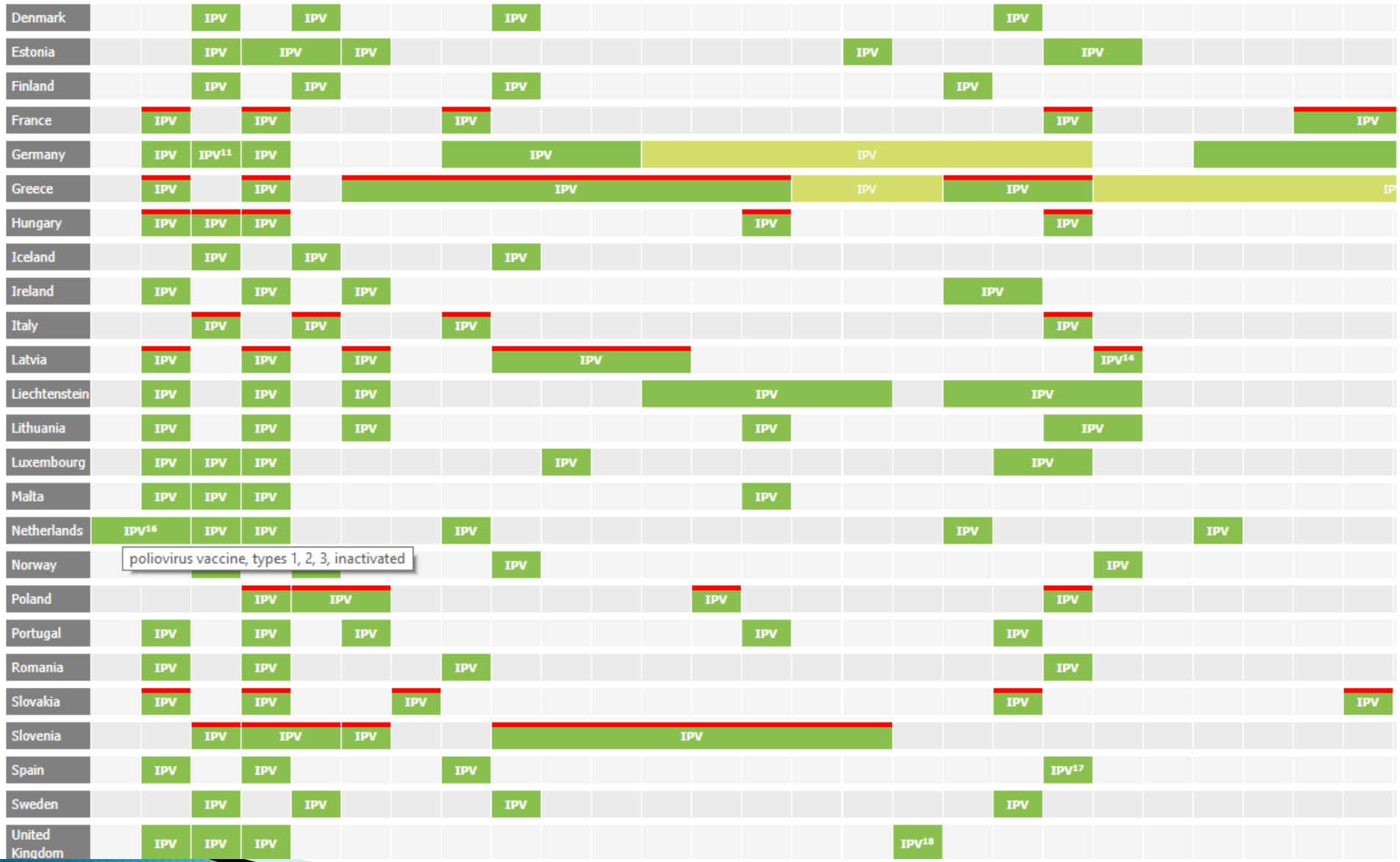
Poliomyelitis

- Polio is caused by polioviruses, classified into types 1, 2 and 3. Humans are the only reservoir of infection: the poliovirus is found in the bowel and in the throat of infected individuals. Transmission occurs via the oral-faecal route or contact with saliva.

- Most infections remain completely without symptoms, while 10% of cases develop mild symptoms only, such as fever, malaise, nausea, and vomiting. However, after exposure and an incubation period of about one to two weeks the virus can spread from the digestive tract to the central nervous system, resulting in meningitis and neural damage with paralysis (the latter in less than 1% of cases). No specific therapy is available against the virus.

Poliomyelitis

- Childhood immunisation programmes with live weakened oral poliovirus vaccine (OPV) or with inactivated, injectable poliovirus vaccine (IPV) has been very effective.
- On the European continent, the last case of paralysis caused by polio was reported from Turkey in November 1998.
- In June 2002, the WHO European region was declared polio free.
- Since the virus is still present in other parts of the world, importation of cases remains possible and travellers to endemic areas should be adequately counselled.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Romania
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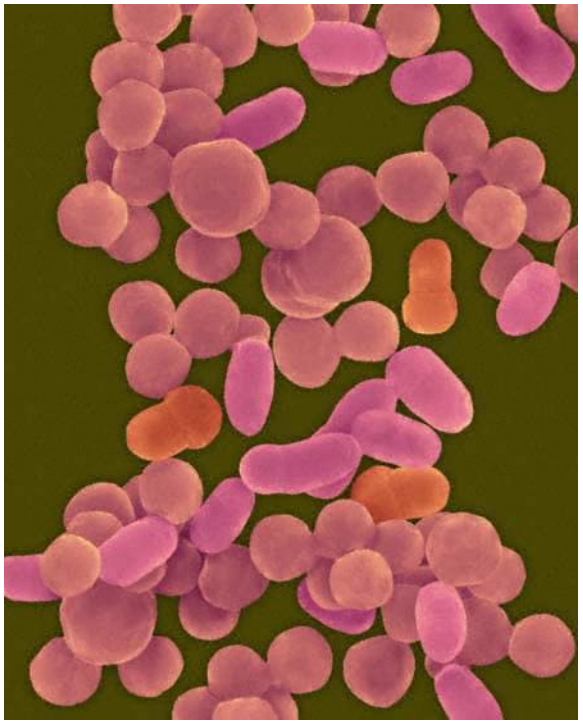
Spain
Sweden
United Kingdom
IPV
IPV11
IPV14
IPV16
IPV17
IPV18
poliovirus vaccine, types 1, 2, 3, inactivated

Vaccination against Haemophilus influenzae disease



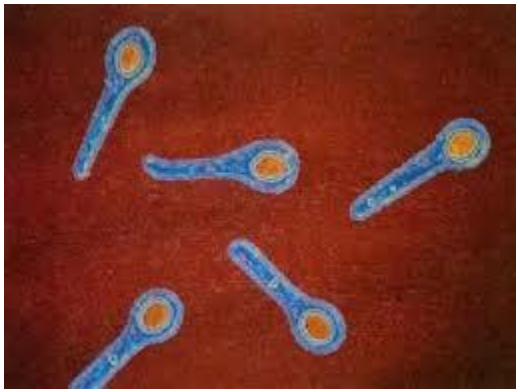
- Haemophilus influenzae is a gram negative coccobacillus
- Haemophilus influenzae serotype b is the most pathogenic for humans, responsible for respiratory infections, ocular infection, sepsis and meningitis
- Haemophilus influenzae serotype b (Hib) is the most common cause of bacterial meningitis in children aged two months to five years, in those countries where suitable vaccination programmes are not in place
- Children start showing symptoms of meningitis after a probable incubation period of about 2–4 days and clinical manifestations tend to evolve rapidly. Even with adequate and prompt antibiotic treatment, mortality can reach up to 10% of cases

Recommended immunisations for Haemophilus influenzae type b infection

Export as spreadsheet

	Months													Years
	2	3	4	5	6	10	11	12	13	14	15	16	18	23	2
Austria		Hib		Hib				Hib[1]							
Belgium	Hib	Hib	Hib								Hib				
Bulgaria	Hib	Hib	Hib									Hib			
Croatia	Hib		Hib		Hib			Hib							
Cyprus	Hib		Hib		Hib			Hib							
Czech Republic	Hib	Hib	Hib			Hib									
Denmark		Hib		Hib				Hib							
Estonia		Hib	Hib		Hib										Hib
Finland		Hib		Hib				Hib							
France	Hib		Hib				Hib								
Germany	Hib	Hib[2]	Hib				Hib				Hib[3]				
Greece	Hib		Hib		Hib			Hib							
Hungary	Hib	Hib	Hib										Hib		
Iceland		Hib		Hib				Hib							
Ireland	Hib		Hib		Hib				Hib						
Italy		Hib		Hib			Hib								
Latvia	Hib		Hib		Hib			Hib							
Liechtenstein	Hib		Hib		Hib						Hib				
Lithuania	Hib		Hib		Hib								Hib		
Luxembourg	Hib	Hib	Hib						Hib						
Malta	Hib	Hib	Hib										Hib		
Netherlands	Hib	Hib	Hib				Hib								
Norway		Hib		Hib				Hib							
Poland	Hib	Hib		Hib								Hib			
Portugal	Hib		Hib		Hib								Hib		
Romania	Hib		Hib		Hib			Hib							
Slovakia		Hib		Hib			Hib								
Slovenia		Hib	Hib		Hib			Hib							
Spain	Hib		Hib		Hib								Hib		
Sweden		Hib		Hib				Hib							
United Kingdom	Hib	Hib	Hib					Hib[4]							

Immunisation against tetanus



Tetanus

- Tetanus is an often fatal disease, which is present worldwide. It is a consequence of a toxin produced by the bacterium *Clostridium tetani*
- Most cases of human disease occur as a result of a wound being contaminated by earth or dust
- After an incubation period averaging two weeks (sometimes longer), the toxin produced by the bacteria in the wound is absorbed and starts producing its effects
- Non-specific early signs (fever, irritability) are followed by the appearance of localised muscular contractions (lockjaw)
- Finally, generalised spasms may occur, often leading to death from heart and lung failure
- The overall death rate is close to 50%, depending on the clinical presentation, patient's age and medical support

Recommended immunisations for tetanus

Export as spreadsheet