1 Target diseases

About this module…

This module describes the diseases that can be prevented by vaccines in the immunization programmes of most countries. Since the last edition of *Immunization in practice*, more diseases have been added because effective new vaccines – against *Haemophilus influenzae* type b (Hib), for example – are now widely available.

Each country has its own policies as to which vaccines to use. Your country's policy may not include all of the vaccines described in *Immunization in practice,* and some vaccines, including those for yellow fever and Japanese encephalitis, are only used in certain regions of the world. We have included information about these diseases to make this module useful anywhere.

Some diseases, including polio, measles, and maternal and neonatal tetanus, have specific goals for eradication or elimination. These are covered in this module. It is important, however, to be aware that we have a global goal to improve immunization coverage of all vaccines, which is:

Ensure full immunization of children under one year of age at 90% coverage nationally with at least 80% coverage in every district or equivalent administrative unit.

This goal was set by the UN General Assembly's Special Session on Children in May 2002. It is supported by a large number of international partners and donors through the Global Alliance for Vaccines and Immunization (GAVI).

Contents

1 Diphtheria

1.1 What is diphtheria?

Diphtheria is caused by the bacterium *Corynebacterium diphtheriae.* This germ produces a toxin that can harm or destroy human body tissues and organs. One type of diphtheria affects the throat and sometimes the tonsils. Another type, more common in the tropics, causes ulcers on the skin.

Diphtheria affects people of all ages, but most often it strikes unimmunized children. In temperate climates, diphtheria tends to occur during the colder months. In 2000, 30 000 cases and 3000 deaths of diphtheria were reported worldwide.

1.2 How is diphtheria spread?

Diphtheria is transmitted from person to person through close physical and respiratory contact. It can cause infection of the nasopharynx, which may lead to breathing difficulties and death.

1.3 What are the signs and symptoms of diphtheria?

When diphtheria affects the throat and tonsils, the early symptoms are sore throat, loss of appetite, and slight fever. Within two to three days a bluish-white or grey membrane forms in the throat and on the tonsils. This membrane sticks to the soft palate of the throat and may bleed. If there is bleeding, the membrane may become greyish-green or black. The patient may either recover at this point or develop severe weakness and die within six to ten days. Patients with severe diphtheria do not develop a high fever but may develop a swollen neck and obstructed airway.

1.4 What are the complications of diphtheria?

During the early phase of the illness or even weeks later, patients may develop abnormal heartbeats, which can result in heart failure. Some patients with diphtheria experience inflammation of the heart muscle and valves, leading after many years to chronic heart disease and heart failure. The most severe complication of diphtheria is respiratory obstruction followed by death.

1.5 What is the treatment for diphtheria?

Children who develop diphtheria should be given diphtheria antitoxin and antibiotics, such as erythromycin or penicillin. They should be isolated to avoid exposing others

to the disease. About two days after starting antibiotic treatment patients are no longer infectious.

For confirmation of diagnosis, health workers should obtain throat cultures from suspect cases. However, treatment should begin without waiting for culture results.

1.6 How is diphtheria prevented?

The most effective way of preventing diphtheria is to maintain a high level of immunization in the community. In most countries, diphtheria toxoid vaccine is given in combination with tetanus toxoid and pertussis vaccines (DTP vaccine). More recently, some countries have been using a combination vaccine that includes vaccines for diphtheria, tetanus, pertussis, hepatitis B (hepB), and sometimes *Haemophilus influenzae* type b (Hib). Approximately every ten years, booster doses of the adult form of the vaccine, tetanus-diphtheria toxoids vaccine (Td), may be needed to maintain immunity.

Key points

Diphtheria is spread from person to person in airborne droplets.

Symptoms of the disease include sore throat, loss of appetite, and a slight fever.

Patients with the disease can experience complications such as abnormal heartbeats and inflammation of the heart muscle and valves.

Children with diphtheria should be treated with diphtheria antitoxin and antibiotics.

The most effective way of preventing the disease is to maintain a high level of immunization within a community.

2 Measles

2.1 What is measles?

Measles is a highly infectious disease caused by a virus. In 2001 it was estimated that there were 30 million measles cases and 745 000 measles-related deaths. Measles kills more children than any other vaccine preventable disease.

Because the disease is so infectious, it tends to occur as epidemics, which may cause many deaths especially among malnourished children.

2.2 How is measles spread?

Measles is spread through contact with nose and throat secretions of infected people and in airborne droplets released when an infected person sneezes or coughs.

A person with measles can infect others for several days before and after he or she develops symptoms. The disease spreads easily in areas where infants and children gather, for example in health centres and schools.

2.3 What are the signs and symptoms of measles?

The first sign of infection is a high fever which begins approximately 10–12 days after exposure and lasts several days. During this period, the patient may develop a runny nose, a cough, red and watery eyes, and small white spots inside his or her cheeks.

After several days, a slightly raised rash develops, usually on the face and upper neck. Over a period of about three days, the rash spreads to the body and then to the hands and feet. It lasts for five or six days and then fades. The incubation period from exposure to the onset of the rash averages 14 days, with a range of seven to 18 days.

2.4 What are the complications of measles?

Unimmunized children under five years of age, and especially infants, are at highest risk for measles and its complications, including death. Infected infants may suffer from severe diarrhoea, possibly causing dehydration. Children may also develop inflammation of the middle ear and severe respiratory tract infections.

Pneumonia is the most common cause of death associated with measles. This is usually because the measles virus weakens the immune system. The pneumonia may be caused by the measles virus itself or by secondary bacterial infection. Encephalitis, a dangerous inflammation of the brain, may also develop.

Severe measles is particularly likely in poorly nourished children, especially those who do not receive sufficient vitamin A, who live in crowded conditions, and whose immune systems have been weakened by HIV/AIDS or other diseases. Measles is a major cause of blindness among children in Africa and other areas of the world with endemic measles.

Children who recover from measles are immune for the rest of their lives.

2.5 What is the treatment for measles?

General nutritional support and the treatment of dehydration with oral rehydration solution are necessary. Antibiotics should only be prescribed for ear infections and severe respiratory tract infections. It is important to encourage children with measles to eat and drink.

All children in developing countries diagnosed with measles should receive two doses of vitamin A supplements given 24 hours apart. Giving vitamin A can help prevent eye damage and blindness. Vitamin A supplementation reduces the number of deaths from measles by 50%.

Vitamin A treatment dosage

Age	Immediately on diagnosis	Next day	Follow-up
Infants less than 6 months old	50 000 IU	50 000 IU	Third dose 2–4 weeks later if there are signs of xerophthalmia
Infants aged 6–11 months	100 000 IU	100 000 IU	
Children aged 12 months and over	200 000 IU	200 000 IU	

2.6 How is measles prevented?

Measles is prevented by immunization with measles vaccine. Measles is highly transmissible; almost all non-immune children contract measles if exposed to infection. To reduce the risk of infection in hospitals, all children between the ages of six and nine months who have not received measles vaccine and who are admitted to a hospital should be immunized against measles. If the children's parents do not know whether they have received measles vaccine, the child should still be immunized. If a child has received measles vaccine before nine months of age, a second dose should be administered at nine months or as soon as possible after nine months.

2.7 Global accelerated disease control issues

In May 2003, the World Health Assembly at its 56th session adopted a resolution to reduce measles deaths by 50% by 2005 compared to 1999 levels.

The strategies recommended for reducing measles deaths include the following:

- A dose of measles vaccine should be provided to all infants at nine months of age or shortly thereafter through routine immunization services. This is the foundation of the sustainable measles mortality reduction strategy.
- All children should be provided with a second opportunity for measles immunization. This will assure measles immunity in children who failed to receive a previous dose of measles vaccine, as well as in those who were vaccinated but failed to develop such immunity following vaccination. The second opportunity may be delivered either through routine immunization services or through periodic mass campaigns.
- Measles surveillance should be strengthened through the integration of epidemiological and laboratory information.
- The clinical management of measles should be improved.

Key points

Measles is a highly infectious viral disease that kills more children than any other vaccine-preventable disease.

The disease is spread from person to person through sneezing, coughing, and close personal contact.

The first sign of infection is a high fever lasting one to seven days and a generalized rash develops after onset/ exposure to the virus.

Pneumonia is the most common cause of death associated with measles.

Severe complications can be avoided through proper case management, including vitamin A supplementation.

Measles can be prevented by immunization. All children should have two opportunities for immunization.

3 Mumps

3.1 What is mumps?

Mumps is an infection caused by a virus. It is sometimes called infectious parotitis, and it primarily affects the salivary glands.

Mumps is mostly a mild childhood disease. It most often affects children between five and nine years old. But the mumps virus can infect adults as well. When it does, complications are more likely to be serious. As more children receive mumps vaccine, it is expected that cases will become more common in older children than in younger ones.

3.2 How is mumps spread?

Mumps virus is present throughout the world. It is spread by airborne droplets released when an infected person sneezes or coughs and by direct contact with an infected person.

3.3 What are the signs and symptoms of mumps?

About a third of children infected with the mumps virus have no symptoms. If symptoms do appear, they usually begin 14 to 21 days after a person is infected. Swelling in the salivary glands, just below and in front of the ears, is the most prominent symptom. The swelling may occur on one or both sides of the neck. Other symptoms include pain when chewing or swallowing, fever, weakness, and tenderness and swelling in the testicles.

A person who has mumps can infect others from about six days before to about nine days after swelling in the neck appears.

3.4 What are the complications of mumps?

Complications from mumps are rare, but they can be serious.

In men and teenage boys, an inflammatory condition called orchitis may cause swelling in one or both testicles. Orchitis is painful and sometimes can cause sterility. Encephalitis, meningitis, and hearing loss are other rare complications that can occur in people infected at any age.

3.5 What is the treatment for mumps?

There is no treatment for mumps.

3.6 How is mumps prevented?

People who get mumps and recover are thought to have lifelong protection against the virus. Mumps vaccines are also highly effective and safe.

Key points

Mumps is transmitted in airborne droplets when infected people/children cough and sneeze.

About a third of people/children infected with mumps have no symptoms.

The most common symptom – if symptoms do develop – is swelling in the salivary glands.

Complications from mumps can be serious, but they are rare.

Mumps vaccine should be given in combination with measles and rubella vaccines (MMR).

4 Pertussis

4.1 What is pertussis?

Pertussis, or whooping cough, is a disease of the respiratory tract caused by bacteria that live in the mouth, nose, and throat. Many children who contract pertussis have coughing spells that last four to eight weeks. The disease is most dangerous in infants. In 2000, an estimated 39 million cases and 297 000 deaths occurred worldwide, due to pertussis.

4.2 How is pertussis spread?

Pertussis spreads very easily from child to child in droplets produced by coughing or sneezing. Children exposed to the germs become infected. In many countries the disease occurs in regular epidemic cycles of three to five years.

4.3 What are the signs and symptoms of pertussis?

The incubation period is five to 10 days. At first, the infected child appears to have a common cold with runny nose, watery eyes, sneezing, fever, and a mild cough. The cough gradually worsens, and involves many bursts of rapid coughing. At the end of these bursts the child takes in air with a high-pitched whoop. The child may turn blue because he or she does not get enough oxygen during a long burst of coughing. Vomiting and exhaustion often follow the coughing attacks, which are particularly frequent at night.

During recovery coughing gradually becomes less intense. Children usually do not have a high fever during any stage of the illness.

4.4 What are the complications of pertussis?

Complications are most likely in young infants. The most common and deadly complication is bacterial pneumonia.

Children may also experience complications such as convulsions and seizures due to fever or reduction in oxygen supply to the brain. This is caused either by coughing attacks or by toxins released by the pertussis bacteria. They may also experience loss of appetite, inflammation of the middle ear, and dehydration.

4.5 What is the treatment for pertussis?

Treatment with an antibiotic, usually erythromycin, may make the illness less severe.

Because the medication kills bacteria in the nose and throat, the use of antibiotics also reduces the ability of infected people to spread pertussis to others.

Children infected with pertussis should get plenty of fluids to prevent dehydration.

4.6 How is pertussis prevented?

Prevention involves immunization with pertussis vaccine, which is usually given in combination with diphtheria and tetanus vaccines (DTP). More recently, some countries have been using a combination vaccine that includes vaccines for diphtheria, tetanus, pertussis, hepatitis B (hepB), and sometimes *Haemophilus influenzae* type b (Hib).

Key points

Pertussis, or whooping cough, is a disease of the respiratory tract.

Pertussis is a bacterial infection spread from person to person by sneezing and coughing.

Infants and young children are most likely to be infected, to have serious complications, and to die from the disease.

The most effective way to prevent pertussis is to immunize all infants with pertussis vaccine.

5 Poliomyelitis (polio)

5.1 What is poliomyelitis?

Poliomyelitis, or polio, is a crippling disease caused by any one of three related viruses, poliovirus types 1, 2 or 3. All member states of WHO agreed in 1988 to eradicate polio, and WHO aims to certify the world as free of the disease by 2005. Since the global initiative to eradicate polio was launched, the number of reported cases of polio has been reduced from an estimated 350 000 in 1988 to 483 cases associated with wild poliovirus in 2001.

5.2 How is polio spread?

The only way to spread poliovirus is through the faecal/oral route. The virus enters the body through the mouth when people eat food or drink water that is contaminated with faeces. The virus then multiplies in the intestine, enters the bloodstream, and may invade certain types of nerve cells, which it can damage or destroy. Polioviruses spread very easily in areas with poor hygiene.

Nearly all children living in households where someone is infected become infected themselves. Children are most likely to spread the virus between 10 days before and 10 days after they experience the first symptoms of the disease. It is important to know that the great majority of people who are infected do not have symptoms, but they can still spread the disease. The incubation period is six to 20 days.

5.3 What are the signs and symptoms of polio?

Most children infected by poliovirus never feel ill. Less than 5% of those infected may have general flu-like symptoms such as fever, loose stools, sore throat, upset stomach, headache, or stomach ache.

Most children who have a poliovirus infection without symptoms develop immunity and have lifelong protection against paralytic polio.

Paralytic polio begins with mild symptoms and fever. These symptoms are followed by severe muscle pain and paralysis, which usually develop during the first week of illness. Patients may lose the use of one or both arms or legs. Some patients may not be able to breathe because respiratory muscles are paralysed. Some patients who develop paralysis from polio do recover to some degree over time. But the degree of recovery varies greatly from person to person.

A diagnosis of polio is confirmed by laboratory testing of stool specimens.

5.4 What are the complications of paralytic polio?

Death may occur if the respiratory muscles of the chest are affected and no respirator is available to support breathing. Without adequate physiotherapy paralysed limbs will not regain full function, often leaving a child seriously crippled.

5.5 What is the treatment for polio?

While the initial symptoms – muscle pain and fever – can be relieved, no treatment exists to cure paralysis from polio. A respirator can help patients who have difficulty in breathing. Regular physical therapy, as well as orthopaedic treatment and operations and the use of braces, can help reduce the long-term crippling effects of polio.

5.6 How is polio prevented?

Polio can be prevented through immunization with oral polio vaccine (OPV) or inactivated polio vaccine (IPV).

OPV is recommended for both routine immunization and supplementary campaigns for polio eradication. IPV is also an effective vaccine. But OPV is less expensive, safe, and easy for health workers and volunteers to administer.

5.7 What are the eradication goals and strategies for polio?

In 1988, the Forty-first World Health Assembly launched a global initiative to eradicate polio.

There are four core strategies to stop transmission of the wild poliovirus and certify all WHO regions polio-free by the end of 2005:

- high infant immunization coverage with four doses of oral polio vaccine in the first year of life;
- supplementary doses of oral polio vaccine to all children under five years of age during national immunization days (NIDS);
- surveillance for wild poliovirus through reporting and laboratory testing of all cases of acute flaccid paralysis (AFP) among children under fifteen years of age;
- targeted "mop-up" campaigns once wild poliovirus transmission is limited to a specific focal area.

In the 15 years since the Global Polio Eradication Initiative was launched, the number of cases has fallen by over 99%, from an estimated 350 000 cases in 1988, to 1919 reported cases in 2002. The number of polio-infected countries has been reduced from more than 125 in 1988 to just 7 in 2002.

Key points

Polio is caused by any of three related polioviruses and can easily spread by the faecal/oral route.

Many people/children who are infected with poliovirus do not become paralysed but may still spread the disease to others.

Less than one in 100 non-immunized children infected by poliovirus develop paralysis.

The recommended method of prevention in children is immunization with oral polio vaccine (OPV).

6 Rubella and congenital rubella syndrome

6.1 What is rubella?

Rubella is an infection caused by a virus. Congenital rubella syndrome (CRS) is an important cause of severe birth defects. When a woman is infected with the rubella virus early in pregnancy, she has a 90% chance of passing the virus on to her fetus. This can cause the death of the fetus, or it may cause CRS. Even though it is a mild childhood illness CRS causes many birth defects. Deafness is the most common, but CRS can also cause defects in the eyes, heart, and brain. It is estimated that there are 700 000 deaths due to CRS each year.

6.2 How is rubella spread?

Rubella is spread in airborne droplets when infected people sneeze or cough. Once a person is infected, the virus spreads throughout the body in about five to seven days. During this time, pregnant women may pass the virus on to their fetuses.

Infected people are most likely to pass on the virus when the rash is developing. But the virus may be spread from seven days before to about seven days after the rash appears.

Infants with CRS can transmit the virus for a year or more.

6.3 What are the signs and symptoms of rubella?

The time between first contact with the virus and the first sign of rubella is about 14 days. Symptoms are often mild, and between 20% and 50% of infected people may notice no symptoms at all.

In children, a rash is usually the first sign; other signs include low fever and swollen lymph nodes in the neck. The rash most often begins on the face and spreads from head to foot. It usually lasts for about three days. The rash is pink, and fainter than measles. Many rashes mimic rubella, and a rash should not be considered a sure sign of infection with the rubella virus.

Infants who are born with CRS usually show symptoms such as cataracts and loss of hearing in infancy, but they may not show symptoms for two to four years.

6.4 What are the complications of rubella?

Complications tend to occur more often in adults than in children. About 70% of adult women who are infected may develop pain in their joints or arthritis, especially in the

fingers, wrists, and knees. Encephalitis occurs in about one in 5000 cases and is most common in adult women. Problems with bleeding occur in about one in 3000 cases, usually among children.

Complications from CRS include deafness, cataracts, heart defects, and mental retardation.

6.5 What is the treatment for rubella?

There is no specific treatment for rubella or for CRS. Patients with rubella should drink plenty of fluids and may take medication to reduce mild fever. Infants with CRS are treated for their specific problems.

6.6 How is rubella prevented?

Rubella vaccines are safe and effective and for infant immunization are usually given in combination with measles/mumps vaccine as MMR. In some countries, mostly in the industrialized world, rubella has been nearly eliminated through childhood immunization programmes. However, it is important to ensure that coverage in infants is sustained at over 80% to avoid shifting of rubella transmission to older age groups. For prevention of CRS, women of childbearing age are the primary target group for rubella immunization. Immunizing women between the ages of 15 and 40 will rapidly reduce the incidence of CRS without affecting childhood transmission of the rubella virus.

Key points

Rubella is an infection caused by a virus.

Rubella is normally a mild childhood disease, but women who get rubella early in pregnancy can pass the virus on to their fetuses. This is called congenital rubella syndrome (CRS).

A rash is the most prominent symptom of rubella, especially in children.

Complications from rubella are rare. But complications from CRS are more serious and include deafness, cataracts, and mental retardation.

Rubella vaccines are safe and effective. But because conditions vary greatly from country to country, there is no universal recommendation on the use of vaccines.

If countries immunize against rubella, they generally use a combination vaccine that also guards against measles (MR) or measles and mumps (MMR).

It is important to ensure that coverage in infants is sustained at over 80% to avoid the shifting of rubella transmission to older age groups.

7 Tetanus

7.1 What is tetanus?

Tetanus is acquired through exposure to the spores of the bacterium *Clostridium tetani* which are universally present in the soil. The disease is caused by the action of a potent neurotoxin produced during the growth of the bacteria in dead tissues, e.g. in dirty wounds or in the umbilicus following non-sterile delivery.

People of all ages can get tetanus. But the disease is particularly common and serious in newborn babies. This is called neonatal tetanus. Most infants who get the disease die. Neonatal tetanus is particularly common in rural areas where most deliveries are at home without adequate sterile procedures. In 2000, WHO estimates that neonatal tetanus killed about 200 000 babies.

7.2 How is tetanus spread?

Tetanus is not transmitted from person to person. A person usually becomes infected with tetanus when dirt enters a wound or cut. Tetanus germs are likely to grow in deep puncture wounds caused by dirty nails, knives, tools, wood splinters, and animal bites. Women face an additional risk of infection if a contaminated tool is used during childbirth or during an abortion.

A newborn baby may become infected if the knife, razor, or other instrument used to cut its umbilical cord is dirty, if dirty material is used to dress the cord, or if the hands of the person delivering the baby are not clean.

Infants and children may also contract tetanus when dirty instruments are used for circumcision, scarification, and skin piercing, and when dirt, charcoal, or other unclean substances are rubbed into a wound.

7.3 What are the signs and symptoms of tetanus?

The time between getting the infection and showing symptoms is usually between three and 10 days. But it may be as long as three weeks. The shorter the incubation period the higher the risk of death.

In children and adults muscular stiffness in the jaw is a common first sign of tetanus. This symptom is followed by stiffness in the neck, difficulty swallowing, stiffness in the stomach muscles, muscle spasms, sweating, and fever. Newborn babies with tetanus are normal at birth, but stop sucking between three and 28 days after birth. They stop feeding and their bodies become stiff while severe muscle contractions and spasms occur. Death follows in most cases.

7.4 What are the complications of tetanus?

Fractures of the spine or other bones may occur as a result of muscle spasms and convulsions. Abnormal heartbeats and coma can occur, as can development of pneumonia and other infections. Death is particularly likely in the very young and in old people.

7.5 What is the treatment for tetanus?

Tetanus at any age is a medical emergency best managed in a referral hospital.

7.6 How is tetanus prevented?

Immunizing infants and children with DTP or DT and adults with Td prevents tetanus. More recently, some countries have been using a combination vaccine that includes vaccines for diphtheria, tetanus, pertussis, hepatitis B (hepB), and sometimes *Haemophilus inflenzae* type b (Hib).

Neonatal tetanus can be prevented by immunizing women of childbearing age with tetanus toxoid, either during pregnancy or outside of pregnancy. This protects the mother and enables tetanus antibodies to be transferred to her baby.

Clean practices are especially important when a mother is delivering a child, even if she has been immunized. People who recover from tetanus do not have natural immunity and can be infected again and therefore need to be immunized.

7.7 Global accelerated disease control issues

WHO, UNICEF and UNFPA agreed to set the year 2005 as the target date for worldwide elimination of neonatal tetanus. This implies the reduction of neonatal tetanus incidence to below one case per 1000 live births per year in every district. This goal was reaffirmed by the United Nations General Assembly Special Session (UNGASS) in 2002. Because tetanus survives in the environment, eradication of the disease is not feasible and high levels of immunization have to continue even after the goal has been achieved.

To achieve the elimination goal, countries implement a series of strategies:

- Improve the percentage of pregnant women immunized with vaccines containing tetanus toxoid.
- Administer vaccines containing tetanus toxoid to all women of childbearing age in high-risk areas. This is usually implemented through a three round campaign approach.
- Promote clean delivery and childcare practices.
- Improve surveillance and reporting of neonatal tetanus cases.

Key points

Tetanus is caused by bacteria found in the environment.

Infection occurs during unclean delivery of babies, when contaminated objects are used to cut the umbilical cord, or anytime tetanus bacteria enter a puncture or cut in the skin.

Neonatal tetanus remains a serious problem in countries with poor immunization coverage and unclean practices at childbirth.

Most newborns with tetanus die.

The best way to prevent tetanus is to immunize with tetanus toxoid and to clean wounds thoroughly and remove dead tissue.

The best way to prevent neonatal tetanus is to immunize women of childbearing age (or pregnant women) and to ensure clean delivery practices.

8 Tuberculosis (TB)

8.1 What is tuberculosis?

Tuberculosis (TB) is caused by the bacterium *Mycobacterium tuberculosis* which usually attacks the lungs, but can also affect other parts of the body, including the bones, joints, and brain.

Not everyone who is infected with tuberculosis bacteria develops the disease. People who are infected may not feel ill and may have no symptoms. The infection can last for a lifetime, but the infected person may never develop the disease itself. People who are infected but who do not develop the disease do not spread the infection to others.

In 2001, approximately two million people worldwide died of tuberculosis.

8.2 How is TB spread?

TB is spread from one person to another through the air often when a person with the disease coughs or sneezes. TB spreads rapidly, especially in areas where people are living in crowded conditions, have poor access to health care, and are malnourished. A variety of TB called bovine tuberculosis is transmitted by consuming raw milk from infected cattle.

People of all ages can contract tuberculosis. But the risk of developing TB is highest in children younger than three years old and in older people. People with TB infection who have weakened immune systems (for example, people with HIV/AIDS) are more likely to develop the disease.

8.3 What are the signs and symptoms of TB?

The period from infection to development of the first symptoms is usually four to 12 weeks, but the infection may persist for months or even years before the disease develops. A person with the disease can infect others for several weeks after he or she begins treatment.

The symptoms of TB include general weakness, weight loss, fever, and night sweats. In TB of the lungs, called pulmonary tuberculosis, the symptoms include persistent cough, coughing up of blood, and chest pain. In young children, however, the only sign of pulmonary TB may be stunted growth or failure to thrive. Other signs and symptoms depend on the part of the body that is affected. For example, in tuberculosis of the bones and joints there may be swelling, pain, and crippling effects on the hips, knees, or spine.

8.4 What are the complications of TB?

TB can present in many ways and may be very difficult to diagnose. Untreated pulmonary TB results in debility and death. This may be more rapid in persons infected with HIV/AIDS.

8.5 What is the treatment for TB?

People with TB must complete a course of therapy, which usually includes taking two or more anti-tuberculosis drugs for at least six months. This is often called DOTS, for Directly Observed Treatment Schedule. Unfortunately, some people fail to take the medications as prescribed or to complete their course of therapy. Some may be given ineffective treatments. This can lead to multidrug-resistant TB, which can be extremely dangerous if it spreads to other people. When people who have developed TB fail to complete standard treatment regimens or are given the wrong treatment regimen, they may remain infectious.

8.6 How is TB prevented?

Immunization of infants with Bacille Calmette-Guérin vaccine (BCG) can protect against TB meningitis and other severe forms of TB in children less than five years old. BCG vaccine is not recommended after 12 months of age because the protection provided is variable and less certain.

Key points

TB usually affects the lungs but can also affect other parts of the body, including the bones, joints, and brain.

TB is spread through the air.

The symptoms of TB include general weakness, weight loss, fever, and night sweats.

People who develop TB must complete a course of drug therapy or they can spread the disease to others.

The recommended method of prevention for children who are younger than 12 months old is to immunize them as soon after birth as possible with BCG vaccine.

9 Hepatitis B

9.1 What is hepatitis B?

Hepatitis B is caused by a virus that affects the liver. Adults who get hepatitis B usually recover. However most infants infected at birth become chronic carriers i.e. they carry the virus for many years and can spread the infection to others. In 2000, there were an estimated 5.7 million cases of acute hepatitis B infection and more than 521 000 deaths from hepatitis B-related disease.

9.2 How is hepatitis B spread?

The hepatitis B virus is carried in the blood and other body fluids. It is usually spread by contact with blood in the following ways:

- Through an unsafe injection or needle stick. Unsterilized needles or syringes can contain hepatitis B virus from an infected person, for example from a patient or a needle user.
- Transmission of the virus by mothers to their babies during the birth process, when contact with blood always occurs.
- Transmission between children during social contact through cuts, scrapes, bites, and scratches.
- Transmission during sexual intercourse through contact with blood or other body fluids.

9.3 What are the signs and symptoms of hepatitis B?

The incubation period averages six weeks but may be as long as six months.

Infection in young children usually is asymptomatic. However, a larger proportion of children may become chronic carriers compared to adults.

People who do show symptoms may feel weak and may experience stomach upsets and other flu-like symptoms. They may also have very dark urine or very pale stools. Jaundice is common (yellow skin or a yellow colour in the whites of the eyes). The symptoms may last several weeks or months. A laboratory blood test is required for confirmation.

Most acute infections in adults are followed by complete recovery. However, many children become chronic carriers. People who recover from acute hepatitis B (and who do not become chronic carriers) are protected from becoming infected again throughout their lives.

9.4 What are the complications of hepatitis B?

A small portion of acute infections can be severe and lead to death. The most serious complications, including chronic hepatitis, cirrhosis, liver failure, and liver cancer, occur in people with chronic infection.

9.5 What is the treatment for hepatitis B?

There is no treatment for the acute condition. Supportive treatment is indicated. In chronic infection the disease can sometimes be stopped with medications.

9.6 How is hepatitis B prevented?

It is recommended that all infants receive three doses of hepatitis B vaccine during the first year of life. More recently, some countries have been using a combination vaccine that includes vaccines for diphtheria, tetanus, pertussis, hepatitis B (hepB), and sometimes *Haemophilus inflenzae* type b (Hib). Programmatically, it is usually easiest if the three doses of hepatitis B vaccine are given at the same time as the three doses of DTP. In countries where hepatitis B is highly endemic, where feasible, a birth dose of hepB is included in the schedule to prevent perinatal hepatitis B infection.

Some countries also recommend immunizing adolescents, health workers and other risk groups.

Key points

There are about 350 million carriers of hepatitis B virus worldwide. Most of them are unaware they are carriers.

People who carry the virus often have no symptoms.

The hepatitis B virus is spread through unsafe injection practices and needle stick injuries.

The younger a person is when infected, the less likely it is that symptoms will occur. But it is more likely that he or she will become a carrier of the disease.

Most infants born to mothers who are carriers are at risk of being infected.

All children should receive hepatitis B vaccine starting at birth or at the age of four to six weeks, when the first visit to a clinic takes place.

A chronic carrier is more likely to develop severe chronic liver disease or liver cancer in later life.

10 Haemophilus influenzae type b (Hib)

10.1 What is Haemophilus influenzae type b?

Haemophilus influenzae type b (Hib) is one of six related types of bacterium. In 2000, *H.influenzae* type b (Hib) was estimated to have caused two to three million cases of serious disease, notably pneumonia and meningitis, and 450 000 deaths in young children.

10.2 How is Hib spread?

The Hib bacterium is commonly present in the nose and throat. Bacteria are transmitted from person to person in droplets through sneezing, coughing. Infected children may carry Hib bacteria without showing any signs or symptoms of illness, but they can still infect others. The risk of disease is highest for children between six months and two years of age.

10.3 What are the signs and symptoms of Hib?

Pneumonia and meningitis are the most important diseases caused by Hib bacteria. In developing countries, pneumonia is more common than meningitis in children with Hib disease. Hib disease should be suspected in the case of any child with signs and symptoms of meningitis or pneumonia.

10.4 What are the complications of Hib?

Children who survive Hib meningitis may develop permanent neurological disability, including brain damage, hearing loss, and mental retardation. 15% to 30% of children who survive Hib disease are at risk for these disabilities. 5% to 10% cases of Hib meningitis are at risk of dying.

10.5 What is the treatment for Hib?

Hib disease can be treated with specific antibiotics.

10.6 How is Hib prevented?

Several Hib conjugate vaccines are available. All are effective when given in early infancy, and have virtually no side effects except occasional temporary redness or swelling at the injection site. To reduce the number of injections, Hib vaccine is sometimes given in combination vaccines, DTP-hepB+Hib.

Key points

Hib's victims are mainly children younger than five years old.

Hib bacteria are commonly present in the nose and throat. The bacteria are transmitted from person to person in droplets through sneezing, coughing.

Infected children may carry Hib bacteria without showing any signs or symptoms of the disease, which may kill up to 5% to 10% of infected children. Others suffer permanent disabilities.

Hib disease can cause pneumonia and meningitis.

Hib disease can be treated with antibiotics.

Hib disease can be prevented with vaccine given early in infancy.

11 Japanese encephalitis (JE)

11.1 What is Japanese encephalitis?

Japanese encephalitis (JE) is caused by a virus carried by mosquitoes. It is found in Asia, Pacific Islands and Northern Australia. JE is the most important form of viral encephalitis in Asia, causing an estimated 15 000 deaths in 2001, mostly among children. In recent decades outbreaks of JE have occurred in several areas previously non-endemic for the disease.

11.2 How is JE spread?

JE is spread by mosquitoes. The virus normally infects birds and domestic animals, especially pigs and wading birds. Children get the disease when a mosquito that has bitten an infected animal then bites a person.

In tropical and subtropical areas, the incidence of disease is highest during and shortly after the rainy season. People living in rural areas, especially where rice is grown, are at risk of getting the disease.

11.3 What are the signs and symptoms of JE?

The majority of infections result only in mild symptoms or no symptoms at all. On average, only one in 300 people infected with the virus has a symptomatic illness. Symptoms, which usually appear within four to 14 days after infection, are flu-like, with sudden onset of fever, chills, headache, tiredness, nausea, and vomiting. In children, gastrointestinal pain may be the most prominent symptom during the early stage of the illness. Signs of confusion or coma occur after three or four days. Children often have seizures.

11.4 What are the complications of JE?

The illness can progress to a serious infection of the brain (encephalitis) and is fatal in about 20% of cases. Of those who survive the disease, 30% to 50% will have brain damage and paralysis. In areas where the disease exists all the time, about 85% of cases occur in children younger than 15 years old.

Although JE is often a mild disease, leading to an uneventful recovery, some cases rapidly progress to severe encephalitis with mental disturbances, and progressive coma. Of the approximately 50 000 cases of JE officially reported each year, about 10 000 die, and a very high percentage of the survivors are left with neurological and psychiatric

sequelae, requiring extensive care. Most fatalities and residual sequelae occur in children aged over 10 years.

11.5 What is the treatment for JE?

There is no treatment for Japanese encephalitis. Supportive treatment is indicated. Antibiotics are not effective against the JE virus.

11.6 How is JE prevented?

Immunization is the single most important measure to control Japanese encephalitis. There are three types of JE vaccines. However, only one (mouse-brain-derived inactivated vaccine) is commercially available.

No effective method of environmental control of JE transmission is known. Although socioeconomic improvements and changes in agricultural practices are likely to reduce viral transmission in some places, large-scale vaccination of affected populations with effective and affordable vaccines appears to be the logical control measure, at least in the short term.

Key points

JE is found in Asia, Pacific Islands and Northern Australia.

The majority of people living in areas where JE occurs are infected with the virus before they are 15 years old.

The disease is spread by infected mosquitoes.

In tropical and subtropical areas, disease incidence is highest during and shortly after the rainy season.

The illness can progress to a serious infection of the brain (encephalitis) and is fatal in 20% of cases. It can also cause paralysis and brain damage.

There is no treatment for JE.

Immunization with JE vaccine is the single most important measure to control JE.

12 Meningococcal meningitis

12.1 What is meningococcal meningitis?

Meningococcal meningitis is an infection of the brain and spinal cord. It is caused by the bacterium *Neisseria meningitidis* (the meningococcus). The disease is divided into several types. Types A, B, C, Y and W135 cause most cases of meningoccal meningitis. More recently types Y and W135 are gaining importance.

The disease occurs globally, but in sub-Saharan Africa meningitis epidemics occur every two to three years. Since the 1980s the intervals between major epidemics have become shorter and more irregular. The disease is most common in young children, but it also can be found in children and young adults living in crowded conditions, such as institutions or barracks. In 2000 it is estimated that there were 300 000 cases and 25 000–30 000 deaths from meningococcal meningitis.

12.2 How is meningococcal meningitis spread?

Transmission of bacteria is from person to person through airborne droplets from the nose and throat of infected people.

12.3 What are the signs and symptoms of meningococcal meningitis?

Meningococcal meningitis is marked by the sudden onset of intense headache, fever, nausea, vomiting, sensitivity to light, and stiff neck. Other signs include lethargy, delirium, coma, and convulsions. The appearance of a rash composed of small spots of bleeding into the skin is an important sign. Infants may have illness without a sudden onset and stiff neck. They may only appear to be slow or inactive, to be irritable, to vomit, or to be feeding poorly.

12.4 What are the complications of meningococcal meningitis?

In children, if meningitis is not treated, mortality is 50%; with early treatment mortality is reduced to between 5% to 10%. Even with treatment early in the disease, between 5% and 10% of children who are infected die. About 10%–15% of those surviving meningococcal meningitis will suffer from complications, including mental disorders, deafness, palsies and seizures. A less common but more severe and often fatal form of meningococcal disease is meningococcal septicaemia, which is characterised by rapid circulatory collapse and a haemorrhagic rash.

12.5 What is the treatment for meningococcal meningitis?

Because meningococcal disease is often fatal, each case should always be considered a medical emergency and should be referred to a hospital. Several types of antibiotic are effective.

12.6 How is meningococcal meningitis prevented?

Vaccines are available to protect against types A, C, Y, and W135.

Epidemic control relies on good surveillance with early detection and treatment. A mass immunization campaign that reaches at least 80% of the entire population with types A & C vaccine can prevent an epidemic. These vaccines are not effective in young children and infants and only provide protection for a limited time, especially in children younger than two years old.

Key points

Meningococcal meningitis is caused by bacteria.

The disease is most common in young children.

Transmission is by contact with an infected person, including respiratory droplets from the nose and throat of the infected person.

The symptoms of meningococcal meningitis include a sudden onset of an intense headache, fever, nausea, vomiting, sensitivity to light, and stiff neck.

Meningococcal meningitis is potentially fatal and should always be viewed as a medical emergency.

The recommended method of prevention is immunization.

The vaccine is not effective in young children and infants and so may not be part of routine childhood immunization programmes.

13 Yellow fever (YF)

13.1 What is yellow fever?

Yellow fever is caused by the yellow fever virus, which is carried by mosquitoes. It is endemic in 33 countries in Africa and 11 countries in South America. In 2000 it is estimated that there were 200 000 cases of yellow fever, resulting in about 30 000 deaths worldwide.

13.2 How is yellow fever spread?

The yellow fever virus can be transmitted by mosquitoes which feed on infected animals in forests, then pass the infection when the same mosquitoes feed on humans travelling through the forest. The greatest risk of an epidemic occurs when infected humans return to urban areas and are fed on by the domestic vector mosquito Aedus aegypti, which then transmits the virus to other humans.

13.3 What are the signs and symptoms of yellow fever?

The illness may be so mild that it is not noticed or diagnosed. Three to six days after a person is infected, he or she suddenly develops fever, chills, headache, backache, general muscle pain, upset stomach, and vomiting. As the disease progresses, the person becomes slow and weak. There may be bleeding from the gums and blood in the urine. Jaundice (yellowing in the white part of the eyes or yellowing of the skin and palms) and black vomiting may also occur.

The diagnosis of yellow fever is difficult to make because its signs and symptoms are similar to other diseases, such as hepatitis, malaria, dengue, and typhoid fever. As a result, any person who develops jaundice within two weeks of the start of a fever should be considered to be a possible case of yellow fever. To confirm the diagnosis of yellow fever, a blood sample should be taken and sent to a laboratory for testing.

13.4 What are the complications of yellow fever?

If the illness is severe, the patient may experience convulsions or a coma. The disease usually lasts two weeks, after which the patient either recovers or dies. In areas where the disease is endemic mortality is about 5%. However, up to half of infected people may die during epidemics.

13.5 What is the treatment for yellow fever?

There is no specific treatment for yellow fever. Supportive treatment is indicated. Dehydration and fever can be treated with oral rehydration salts and medication. Any accompanying bacterial infection should be treated with an antibiotic. Intensive supportive care may improve the outcome for seriously ill patients.

13.6 How is yellow fever prevented?

Immunization is the single most important measure to control yellow fever.

The main strategies to control yellow fever are based on a combination of immunization for protection against the disease and surveillance, and are outlined below.

- Prevention
  - administering yellow fever vaccine as part of routine infant immunization;*
  - preventing outbreaks in high-risk areas through mass campaigns;*
  - control of Aedus aegypti in urban centres.

  * *Both these strategies should ensure a minimum coverage of at least 80%.*
- Control
  - instituting a sensitive and reliable YF surveillance system including laboratory capacity to analyse samples and confirm suspected cases;
  - emergency response to outbreaks through mass campaigns.

Key points

Yellow fever causes about 30 000 deaths annually.

Mosquitoes transmit the yellow fever virus.

33 African countries and 11 South American countries are at highest risk for the disease.

The symptoms of yellow fever are unspecific and can be confused with many other diseases.

There is no specific treatment for yellow fever.

There is a safe and effective vaccine against the disease.

14 Vitamin A deficiency (VAD) and EPI plus

Immunization not only protects infants from several vaccine preventable diseases, but also provides a platform for delivering other health interventions, a strategy commonly known as ***EPI plus.*** *Other interventions that can be integrated with the immunization services include vitamin A supplementation, insecticide treated nets (ITNG) for malaria prevention and anti- helmintics.*

The most success has been achieved with integrating vitamin A supplementation with routine immunization services. Any immunization contact is an opportunity to screen mothers and infants for eligibility to receive vitamin A, particularly if immunizations have been delayed and the child is six months or older. Check your national policy on including vitamin A supplements with routine immunization services.

14.1 Vitamin A and vitamin A deficiency

What is vitamin A?

Vitamin A is a substance that is required by the human body. Vitamin A:

- strengthens resistance to infection;
- increases a child's chances of surviving an infection;
- promotes growth; and
- protects the transparent part of the eye, called the *cornea.* If a person does not have enough vitamin A in his or her body, the person may have difficulty seeing in dim light.

The body cannot make vitamin A, so all of the vitamin A we need must come from the food we eat. Vitamin A is present in the following foods:

- breast milk;
- liver, eggs, meat, fish with liver;
- milk, cheese, and other dairy products;
- yellow and orange fruits, e.g. mangoes and papayas;
- yellow and orange vegetables, e.g. pumpkins and carrots;
- dark green, leafy vegetables;
- red palm oil.

Vitamin A can be added to foods, such as sugar, vegetable oil, and wheat flour, during processing. This is called *food fortification*.

14.2 What is vitamin A deficiency (VAD)?

Vitamin A deficiency occurs when a person does not eat enough food containing vitamin A or when it is used up too fast by the body. This often happens during an illness, during pregnancy and lactation, and when children's growth is most rapid, i.e. from age six months to five years.

14.3 What are signs and symptoms of VAD?

Vitamin A deficiency (VAD) reduces resistance to infections, leading to more severe and prolonged illnesses and therefore increasing the risk of death. It can cause eye damage, such as corneal lesions, and when severe, can cause blindness. Generally, the first clinical sign of vitamin A deficiency is night blindness (impaired vision in dim light). However, because vitamin A deficiency reduces the body's resistance to infection, it is a threat even before any direct signs become apparent. Vitamin A deficiency can also cause anaemia. Vitamin A deficiency has been shown to increase a woman's risk of dying during pregnancy and the first three months after delivery.

Children suffering from vitamin A deficiency are more likely to get infections, such as measles, diarrhoea, and fevers; and their infections are more likely to be severe, sometimes resulting in death.

14.4 What is vitamin A supplementation?

When diets do not contain food with enough vitamin A, it is possible to increase vitamin A levels in the body by periodically taking a concentrated dose or supplement in the form of a capsule. This is called *supplementation*. When given to children, vitamin A capsules are cut open and the drops of liquid inside are squeezed into the mouth.

Vitamin A supplementation can be combined with immunization services for children and women when health officials know or suspect that vitamin A deficiency is present in an area or among a certain population.

In addition, vitamin A supplements are also given for treatment of measles and eye damage (xerophthalmia). See "Using vitamin A for Treatment" in Section 2 (Measles) of this module.

14.5 Are there any contraindications to vitamin A supplements?

There are no contraindications to vitamin A supplements for children and post-partum women if they are given according to the schedules provided in Section 14.7.

Vitamin A may be given at the same time as immunization.

14.6 Are there any side effects to vitamin supplements?

Usually, there are no side effects. However, on rare occasions a child may experience headache, loss of appetite, or vomiting. These symptoms will pass by themselves, and no treatment is necessary. Parents should be advised that this is normal. See Module 6 for information on vitamin A supplementation: screening, schedule, administration, handling and storage.

14.7 What are the opportunities to link vitamin A and routine immunization?

Target for vitamin A	Immunization contact	Vitamin A dose
Mothers within 6–8 weeks of delivery, if they have not received vitamin A at delivery *Infants benefit via breast milk*	1st contact BCG, OPV-o, DTP-1 contact up to 6–8 weeks after delivery	200 000 IU
Infants 6–11 months	Measles/yellow fever Polio NIDs	100 000 IU
Children 12 months and older	Other EPI campaigns Boosters	200 000 IU
Children 12–59 months	Booster doses Delayed primary immunization	200 000 IU

Note: The optimal interval between doses is 4–6 months. The minimum recommended safe interval between doses is one month. The interval between doses can be reduced to treat clinical vitamin A deficiency and measles cases. Follow the appropriate measles treatment schedule.