

Lesson 3: Vaccine-preventable Diseases

Lecture Notes

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Underlined words are included on the “Vocabulary Words” list for this lesson.

Although washing your hands, covering your cough and maintaining a healthy lifestyle can help reduce your chances of getting sick, they do not always work and they are not able to protect you against specific diseases. Vaccines provide a way to protect you from specific diseases. This lesson focuses on diseases that can be prevented by vaccines.

Diseases caused by bacteria:

Diphtheria: Diphtheria is caused by *Corynebacterium diphtheria*, which causes an upper respiratory tract infection. It is transmitted through direct physical contact or breathing respiratory droplets produced when coughing or sneezing that are contaminated with the bacteria. Symptoms include sore throat, low fever and development of a pseudomembrane on the tonsils, pharynx and nasal cavity. The pseudomembrane can cause suffocation. The fatality rate of those infected is 5-10 percent but is higher in children under age 5 and adults over age 40.

***Haemophilus influenzae* type b:** Also known as Hib, this severe bacterial infection is transmitted through respiratory droplets from coughing and sneezing. Hib primarily occurs in children under the age of 5. Symptoms include meningitis, pneumonia, sepsis, epiglottitis (inflammation of the epiglottis), skin infections and arthritis. This illness results in loss of hearing or neurologic damage in 10-30 percent of those who have Hib meningitis. Death occurs in 2-5 percent of children with Hib meningitis.

Meningococcal disease: The bacterium *Neisseria meningitidis* is responsible for this potentially severe, acute infection, which is the leading cause of meningitis and sepsis in the United States. The bacteria are spread by exchanging respiratory and throat secretions when coughing or kissing. Classic signs of meningitis are sudden onset of fever, headache and stiff neck. Other symptoms include nausea, vomiting, sensitivity to light, and altered mental status such as confusion or disorientation. Older children and adults may have a skin rash. The risk is greatest in children younger than 2 and increases again during adolescence and early adulthood. Some activities increase this risk, such as sharing drinks, living in close quarters like dorms or camps, and going to bars or attending parties where the air is smoky and people are in close proximity.

Pertussis: This highly contagious respiratory infection is caused by the bacteria *Bordetella pertussis*. It is transmitted through coughing and sneezing. It causes uncontrollable, violent coughing and is also known as whooping cough because of the sound made when the infected person is trying to take a breath against a narrowed windpipe. A complication of pertussis includes fractured ribs from violent coughing. Adults may develop bacterial pneumonia. In infants the complications may include apnea (loss of spontaneous breathing), pneumonia, seizures, encephalopathy (abnormal brain functioning) and death.

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Diseases caused by bacteria: *continued*

Pneumococcal disease: The bacterium *Streptococcus pneumoniae* can infect different parts of the body, which may lead to pneumonia, bacteremia (blood infection), meningitis and otitis media (middle ear infection). The pneumococcus bacterium is transmitted in respiratory secretions

when coughing or sneezing. People who smoke are at an increased risk of developing this disease. Interest in developing a vaccine waned after the discovery of penicillin, but as the bacterium became resistant, a vaccine was pursued. This bacterium is “opportunistic” because it will be present and harmless in the nose and throat, but when the respiratory tract is compromised by other infections or activities — such as inhaling smoke — it will invade and cause infection. Elderly people are especially susceptible to pneumococcal infections after having influenza, which is why many elderly people die of pneumonia during influenza season.

Tetanus: Tetanus is a disease of the nervous system caused by toxins from the *Clostridium tetani* bacterium. This bacterium is commonly found in the top layers of soil and enters the body through a break in the skin. The symptoms are “lockjaw,” stiffness in the neck and abdomen, severe muscle spasms, and nervous system disorders. Death occurs in 10-20 percent of cases. Tetanus is the only vaccine-preventable disease that is not transmitted from person to person, so a vaccine will always be necessary. The chief engineer of the Brooklyn Bridge, John Roebling, died from tetanus.

Diseases caused by viruses:

Hepatitis A: This liver disease is caused by the hepatitis A virus and is transmitted by person to person contact (sexual or household) or ingesting infected water or food. In 70 percent of older children and adults, an abrupt onset of symptoms such as fever, malaise, nausea, jaundice and dark urine will be present.

Hepatitis B: This liver disease is caused by the hepatitis B virus. It is transmitted in bodily fluids through sexual contact and sharing items that may contain blood, such as drug-injecting equipment, toothbrushes or razors. Symptoms include fever, fatigue, loss of appetite, nausea, vomiting, abdominal pain, dark urine, clay-colored bowel movements, joint pain and jaundice (yellowing of the skin). Most people with chronic hepatitis B are symptom-free for as long as 20 to 30 years; about 15-25 percent of those with chronic hepatitis B develop cirrhosis or liver cancer.

Herpes zoster: The varicella zoster virus, a member of the herpesvirus group, causes shingles and chickenpox. Shingles most often affects people whose immune systems are compromised due to increasing age or illness. Shingles causes pain, itching or tingling of the skin followed by a painful rash. Usually the symptoms are localized to one side of the body, often the face or trunk. A fever, headache, chills or upset stomach may occur. Shingles infection may lead to neuralgia (lingering nerve pain), pneumonia, hearing problems, blindness, encephalitis (brain inflammation) or death. Anyone who has had chickenpox can develop shingles because the virus remains in the nerve cells after the chickenpox infection has cleared. People cannot get shingles from someone else who has shingles, but someone who has not had chickenpox can get chickenpox if they come into contact with the virus present in the shingles wound.

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Diseases caused by viruses: *continued*

Human papillomavirus (HPV): HPV is the most common sexually transmitted disease in the United States. At least 50 percent of sexually active people will have HPV at some point in their lives. There are more than 40 types of HPV. Most people who are infected do not have any symptoms. However, in some people the infection persists for many years without them knowing and causes changes to the cells, which can lead to cancer. Pap tests are performed on females to evaluate cells from the cervix under a microscope to look for abnormal changes that if left untreated may develop into cervical cancer. Also, an HPV test can be done to look for the virus. Farrah Fawcett died of cancer caused by HPV.

Influenza: The “flu” is a highly contagious respiratory illness that is transmitted through droplets of coughs and sneezes or contaminated surfaces or objects. There are three viruses that cause influenza: A, B and C. Influenza A causes the greatest number of serious complications, including death. Yearly epidemics are responsible for thousands to tens of thousands deaths and 200,000 hospitalizations in the United States. In February 2010, the Advisory Committee on Immunization Practices recommended influenza vaccinations for all people in the United States age 6 months of age and older. The symptoms of influenza appear suddenly and may include fever, cough, sore throat, runny or stuffy nose, body aches, headache, chills, and, less commonly, diarrhea and vomiting.

- **Epidemic:** An epidemic occurs when the number of new cases or the incidence rate of a disease is much greater than is expected based on rates over the past few years.
- **Pandemic:** A pandemic is an epidemic of an infectious disease that spreads through human populations across a large region, such as a continent.

Measles: Measles is a highly contagious viral disease that is transmitted through droplets when coughing or sneezing. If a person has measles, 90 percent of the people who come into contact with that person will get infected if they are not immune. Symptoms of measles include fever, runny nose, cough, conjunctivitis and a full-body rash that begins at the hairline and spreads to the face and upper neck. The rash gradually moves downward and outward — reaching the hands and feet within three days — and then fades in order of appearance. About one out of 10 of those infected will have an ear infection and one in 20 will get pneumonia. Of every 1,000 children who contract this disease, one or two will die. Measles can be very dangerous for pregnant women because it can cause miscarriage, premature delivery or death of the fetus.

Mumps: Mumps is a viral disease that is transmitted through droplets produced when coughing or sneezing. Symptoms of mumps include fever, headache, muscle aches, tiredness, loss of appetite, and swollen or tender salivary glands under the ears or jaw. Complications can occasionally cause encephalitis, meningitis and temporary or permanent deafness. In males who have reached puberty, inflammation of the testicles, which is called orchitis, may occur. In females, inflammation of the ovaries (oophoritis) or breasts (mastitis) can be a result of infection with mumps. Children with mumps are often said to look like chipmunks because of their swollen glands.

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Diseases caused by viruses: *continued*

Polio: Polio is a highly contagious infectious disease caused by polio virus. The virus is transmitted through direct contact with infected stool or throat secretions. Most people with polio do not even realize they have been infected; however, the symptoms of polio include headache, nausea, vomiting and fever. Some people also experience muscle weakness, tremors, fever, stiffness and difficulty swallowing due to invasion of the central nervous system by the virus. Some people who had polio develop a syndrome called post-polio syndrome later in life, experiencing renewed muscle weakness and pain. World health authorities are trying to eradicate polio with disease surveillance and vaccine use. To date, only three countries have not stopped the transmission of polio: Nigeria, Pakistan and Afghanistan. In early 2012, India celebrated one year without transmission of wild-type polio for the first time in its history. Travelers to these countries can then spread the disease to other countries.

Rotavirus: Rotavirus is caused by a virus that is transmitted by contaminated hands and objects. The symptoms include fever, diarrhea and vomiting, which may lead to dehydration. Most often it affects infants and young children and is seen most frequently in the winter and spring. Before there was a vaccine, virtually all children had rotavirus infections by the age of 5. In countries where medical care is not readily accessible, many children die from dehydration caused by rotavirus. Each year rotavirus causes more than 500,000 deaths.

Rubella: Rubella is a viral disease that is transmitted when coughing or sneezing. The symptoms include a low-grade fever, red rash, coughing, sneezing and malaise, which is a vague feeling of body weakness or discomfort. Occasionally arthritis will be present. Outcomes from rubella are worse among pregnant woman; the severity of complications depends on the time of gestation when the infection occurs. Approximately 85 percent of fetuses infected in the first trimester will have some form of defect of the eyes, heart, brain, hearing and bones. Babies born with a rubella infection suffer from congenital rubella syndrome. These infants may have cataracts, heart defects, deafness, jaundice, bone disease or deformities. Initially thought to be a form of measles, rubella was first described as a separate disease in the German medical literature in 1814, which is why this disease is also sometimes called German measles.

Varicella: The varicella virus is highly contagious and is transmitted through coughing or sneezing or through direct contact. The symptoms of this disease include a skin rash of blister-like lesions covering most of the body, especially the face, scalp and trunk. Occasionally a fever will develop when the rash appears. Complications most often occur in adolescents and adults and include a painful bacterial infection of the skin, swelling of the brain or pneumonia. The chickenpox vaccine is very effective; eight to nine of every 10 people who receive the vaccine are completely protected against chickenpox. Because many parents remember chickenpox as a mild disease, some do not think the vaccine is necessary. Some parents have chickenpox parties to expose their children without getting the vaccine. Unfortunately, complications from chickenpox can be severe and even fatal.