**Post Graduate Diploma in WASH**

**Assignment number 2**

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**Assignment 2 - WASH**

1. **Consider a disease known as diabetes mellitus, which is characterized by an increase in the blood sugar level. Infectious agents may contribute to the development of the disease in early childhood, but are not the main cause of the disease. Can it be classified as communicable? Explain your reasons:**

**No. Diabetes mellitus is not** communicable; rather it is non-communicable for the following reasons:

* The main cause of the disease is not an infectious agent. It cannot be transmitted from a person with diabetes mellitus to another person.

SAQ 1.2 (tests Learning Outcome 1.2)

* Diabetes Mellitus Type 2 is the most common type of diabetes. It is a chronic problem in which blood glucose (sugar) can no longer be regulated. There are two reasons for this. First, the cells of the body become resistant to insulin (insulin resistant). Insulin works like a key to let glucose (blood sugar) move out of the blood and into the cells where it is used as fuel for energy. When the cells become insulin resistant, it requires more and more insulin to move sugar into the cells, and too much sugar stays in the blood. Over time, if the cells require more and more insulin, the pancreas can’t make enough insulin to keep up and begins to fail.

Insulin resistance is the inability of cells to use the insulin hormone, which inhibits the cell’s capability to absorb and then use glucose in metabolic processes.  This is of primary concern in cells that are typically high in metabolic function, such as muscle, liver, and adipose tissues.  Since insulin is responsible for the cellular uptake of glucose, the sugar molecules will remain in the bloodstream.

The pancreatic beta cells, which are responsible for producing and releasing insulin, may also dysfunction in type 2 diabetes mellitus.  If the insulin supply diminishes entirely, the individual will be dependent upon exogenous insulin.

Whether insulin is not present due to hypo-secretion, or if the hormone is rendered useless because of insulin resistance, the end result will be hyperglycemia.  Hyperglycemia, or elevated glucose levels within the blood, is the hallmark of type 2 diabetes mellitus.  Hyper-glycemia, and the associated inflammatory processes lead to the micro and macro-vascular changes that are seen as complications of diabetes mellitus.

### The Causes of Diabetes Mellitus.

Type 2 diabetes – the most common form of diabetes is caused by several factors, including lifestyle factors and genes.

**Overweight, obesity, and physical inactivity**

You are more likely to develop type 2 diabetes if you are not physically active and are overweight or obese. Extra weight sometimes causes insulin resistance and is common in people with type 2 diabetes. The location of body fat also makes a difference. Extra belly fat is linked to insulin resistance, type 2 diabetes, and heart and blood vessel disease. To see if your weight puts you at risk for type 2 diabetes, check out these Body Mass Index (BMI) charts.

**Insulin resistance**

Type 2 diabetes usually begins with insulin resistance, a condition in which muscle, liver, and fat cells do not use insulin well. As a result, the body needs more insulin to help glucose enter cells. At first, the pancreas makes more insulin to keep up with the added demand. Over time, the pancreas can’t make enough insulin, and blood glucose levels rise.

**Genes and family history**

As in type 1 diabetes, certain genes may make you more likely to develop type 2 diabetes. The disease tends to run in families and occurs more often in these racial/ethnic groups.

1. **How would you classify pulmonary tuberculosis using the epidemiologic method? What is the main importance of such classification?**

The “Diagnostic Standards and Classification of Tuberculosis in Adults and Children” is a joint statement prepared by the American Thoracic Society and the Centers for Disease Control and endorsed by the Infectious Disease Society of America. The Diagnostic Standards are intended to provide a framework for and understanding of the diagnostic approaches to tuberculosis infection/disease and to present a classification scheme that facilitates management of all persons to whom diagnostic tests have been applied.

**The specific objectives of this revision of the Diagnostic Standards are as follows.**

1. 1. To define diagnostic strategies for high- and low-risk patient populations based on current knowledge of tuberculosis epidemiology and information on newer technologies.
2. 2. To provide a classification scheme for tuberculosis that is based on pathogenesis. Definitions of tuberculosis disease and latent infection have been selected that (*a*) aid in an accurate diagnosis; (*b*) coincide with the appropriate response of the health care team, whether it be no response, treatment of latent infection, or treatment of disease; (*c*) provide the most useful information that correlates with the prognosis; (*d*) provide the necessary information for appropriate public health action; and (*e*) provide a uniform, functional, and practical means of reporting. Because tuberculosis, even after it has been treated adequately, remains a pertinent and lifelong part of a person's medical history, previous as well as current disease is included in the classification.

This edition of the Diagnostic Standards has been prepared as a practical guide and statement of principles for all persons involved in the care of patients with tuberculosis. References have been included to guide the reader to texts and journal articles for more detailed information on each topic.

Tuberculosis remains one of the deadliest diseases in the world. The World Health Organization (WHO) estimates that each year more than 8 million new cases of tuberculosis occur and approximately 3 million persons die from the disease ([1](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Ninety-five percent of tuberculosis cases occur in developing countries, where few resources are available to ensure proper treatment and where human immunodeficiency virus (HIV) infection may be common. It is estimated that between 19 and 43% of the world's population is infected with Mycobacteriumtuberculosis, the bacterium that causes tuberculosis infection and disease ([2](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)).

In the United States, an estimated 15 million people are infected with M. tuberculosis ([3](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Although the tuberculosis case rate in the United States has declined during the past few years, there remains a huge reservoir of individuals who are infected with M. tuberculosis*.* Without application of effective treatment for latent infection, new cases of tuberculosis can be expected to develop from within this group.

Tuberculosis is a social disease with medical implications. It has always occurred disproportionately among disadvantaged populations such as the homeless, malnourished, and overcrowded. Within the past decade it also has become clear that the spread of HIV infection and the immigration of persons from areas of high incidence have resulted in increased numbers of tuberculosis cases.

**II. Transmission of Mycobacterium tuberculosis**

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Tuberculosis is spread from person to person through the air by droplet nuclei, particles 1 to 5 μm in diameter that contain M. tuberculosis complex ([4](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Droplet nuclei are produced when persons with pulmonary or laryngeal tuberculosis cough, sneeze, speak, or sing. They also may be produced by aerosol treatments, sputum induction, aerosolization during bronchoscopy, and through manipulation of lesions or processing of tissue or secretions in the hospital or laboratory. Droplet nuclei, containing two to three M. tuberculosis organisms ([5](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)), are so small that air currents normally present in any indoor space can keep them airborne for long periods of time ([6](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Droplet nuclei are small enough to reach the alveoli within the lungs, where the organisms replicate. Although patients with tuberculosis also generate larger particles containing numerous bacilli, these particles do not serve as effective vehicles for transmission of infection because they do not remain airborne, and if inhaled, do not reach alveoli. Organisms deposited on intact mucosa or skin do not invade tissue. When large particles are inhaled, they impact on the wall of the upper airways, where they are trapped in the mucous blanket, carried to the oropharynx, and swallowed or expectorated.

**Four factors determine the likelihood of transmission of M. tuberculosis:**

(*1*) The number of organisms being expelled into the air,

(*2*) The concentration of organisms in the air determined by the volume of the space and its ventilation,

(*3*) The length of time an exposed person breathes the contaminated air, and

(*4*) presumably the immune status of the exposed individual.

HIV-infected persons and others with impaired cell-mediated immunity are thought to be more likely to become infected with M. tuberculosis after exposure than persons with normal immunity; also, HIV-infected persons and others with impaired cell-mediated immunity are much more likely to develop disease if they are infected. However, they are no more likely to transmit *M.* tuberculosis.

Techniques that reduce the number of droplet nuclei in a given space are effective in limiting the airborne transmission of tuberculosis. Ventilation with fresh air is especially important, particularly in health care settings, where six or more room-air changes an hour is desirable. The number of viable airborne tubercle bacilli can be reduced by ultraviolet irradiation of air in the upper part of the room. The most important means to reduce the number of bacilli released into the air is by treating the patient with effective anti-tuberculosis chemotherapy. If masks are to be used on coughing patients with infectious tuberculosis, they should be fabricated to filter droplet nuclei and molded to fit tightly around the nose and mouth. Measures such as disposing of such personal items as clothes and bedding, sterilizing fomites, using caps and gowns and gauze or paper masks, boiling dishes, and washing walls are unnecessary because they have no bearing on airborne transmission.

There are five closely related mycobacteria grouped in the M. tuberculosis complex: M. tuberculosis, M. bovis, M. africanum, M. microti, and M. canetti ([11](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141), [12](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Mycobacterium tuberculosis is transmitted through the airborne route and there are no known animal reservoirs. *Mycobacterium bovis* may penetrate the gastrointestinal mucosa or invade the lymphatic tissue of the oropharynx when ingested in milk containing large numbers of organisms. Human infection with *M.* bovis has decreased significantly in developed countries as a result of the pasteurization of milk and effective tuberculosis control programs for cattle ([13](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Airborne transmission of both *M.* bovis and *M.* africanum can also occur ([14-16](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Mycobacterium bovis BCG is a live-attenuated strain of *M. bovis* and is widely used as a vaccine for tuberculosis. It may also be used as an agent to enhance immunity against transitional-cell carcinoma of the bladder. When used in this manner, adverse reactions such as dissemination may be encountered, and in such cases *M. bovis* BCG may be cultured from non-urinary tract system specimens, i.e., blood, sputum, bone marrow, etc

III. **PATHOGENESIS OF TUBERCULOSISTop of Form**

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After inhalation, the droplet nucleus is carried down the bronchial tree and implants in a respiratory bronchiole or alveolus. Whether or not an inhaled tubercle bacillus establishes an infection in the lung depends on both the bacterial virulence and the inherent microbicidal ability of the alveolar macrophage that ingests it. If the bacillus is able to survive initial defenses, it can multiply within the alveolar macrophage. The tubercle bacillus grows slowly, dividing approximately every 25 to 32 h within the macrophage. Mycobacterium tuberculosis has no known endotoxins or exotoxins; therefore, there is no immediate host response to infection. The organisms grow for 2 to 12 wk, until they reach 103 to 104 in number, which is sufficient to elicit a cellular immune response that can be detected by a reaction to the tuberculin skin test.

Before the development of cellular immunity, tubercle bacilli spread via the lymphatics to the hilar lymph nodes and thence through the bloodstream to more distant sites. Certain organs and tissues are notably resistant to subsequent multiplication of these bacilli. The bone marrow, liver, and spleen are almost always seeded with mycobacteria, but uncontrolled multiplication of the bacteria in these sites is exceptional. Organisms deposited in the upper lung zones, kidneys, bones, and brain may find environments that favor their growth, and numerous bacterial divisions may occur before specific cellular immunity develops and limits multiplication.

In persons with intact cell-mediated immunity, collections of activated T cells and macrophages form granulomas that limit multiplication and spread of the organism. Antibodies against *M. tuberculosis* are formed but do not appear to be protective. The organisms tend to be localized in the center of the granuloma, which is often necrotic. For the majority of individuals with normal immune function, proliferation of *M. tuberculosis* is arrested once cell-mediated immunity develops, even though small numbers of viable bacilli may remain within the granuloma. Although a primary complex can sometimes be seen on chest radiograph, the majority of pulmonary tuberculosis infections are clinically and radio-graphically in-apparent ([18](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Most commonly, a positive tuberculin skin test result is the only indication that infection with *M. tuberculosis* has taken place. Individuals with latent tuberculosis infection but not active disease are not infectious and thus cannot transmit the organism. It is estimated that approximately 10% of individuals who acquire tuberculosis infection and are not given preventive therapy will develop active tuberculosis. The risk is highest in the first 2 years after infection, when half the cases will occur. The ability of the host to respond to the organism may be reduced by certain diseases such as silicosis, diabetes mellitus, and diseases associated with immunosuppression, e.g., HIV infection, as well as by corticosteroids and other immunosuppressive drugs. In these circumstances, the likelihood of developing tuberculosis disease is greater. The risk of developing tuberculosis also appears to be greater during the first 2-yr of life.

HIV-infected persons, especially those with low CD4+ cell counts, develop tuberculosis disease rapidly after becoming infected with M. tuberculosis; up to 50% of such persons may do so in the first 2 yr after infection with M. tuberculosis ([24](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)). Conversely, an individual who has a prior latent infection with M. tuberculosis (not treated) and then acquires HIV infection will develop tuberculosis disease at an approximate rate of 5–10% per year. In a person with intact cell-mediated immunity, the response to infection with the tubercle bacillus provides protection against reinfection. The likelihood of reinfection is a function of the risk of re-exposure, the intensity of such exposure, and the integrity of the host's immune system. In the United States the risk of re-exposure to an infectious case is low. Furthermore, in an otherwise healthy, previously infected person, any organisms that are deposited in the alveoli are likely to be killed by the cell-mediated immune response. Exceptions may occur, but in immuno-competent individuals, clinical and laboratory evidence indicates that disease produced by the inhalation of a second infecting strain is uncommon. However, reinfection has been documented to occur both in persons without recognized immune compromise and in persons with advanced HIV infection ([27-29](https://www.atsjournals.org/doi/full/10.1164/ajrccm.161.4.16141)).

1. Describe four or more bacterial vaccine-preventable diseases that have the same modes of transmission.

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| --- | --- | --- | --- | --- | --- |
| S/no | Diseases | Bacteria causes | Modes of transmission | Symptoms | Prevention and control methods |
| 1 | Tuberculosis | Mycobacterium Tuberculosis | Respiratory by coughing or sneezing | Chronic cough, weigh loss, fever, decreased appetite. | BCG vaccine, Chemoprophylaxis, early diagnose and treatment. |
| 2 | Diphtheria | Corynebacterium diphtheriae and its toxin | Respiratory by coughing or sneezing | Sore throat, loss of appetite and slight fever. | Diphtheria vaccine,combine with other diphtheria vaccines against tetanus, etc. |
| 3 | Pertussis | Bordetella pertussis | Respiratory by coughing or sneezing | Runny nose, watery eyes, sneezing, fever, and continuous cough, followed by vomiting | Diphtheria vaccine, combined with two or four other vaccines against pertussis, tetanus, BCG, etc. |
| 4 | Meningitis (infection of the brain or spinal cord) | Neisseria meningitidis | Respiratory by coughing or sneezing | Fever, headache, neck stiffness, coma | Meningococcal vaccine and treatment by antibiotics |
| 5 | Pneumonia (infection of the lungs) | *Streptococcus pneumoniae* | Respiratory by coughing or sneezing | Cough, fast breathing/difficult breathing. | Treatment by antibiotics; |

**Description of bacterial vaccine-preventable diseases with the same modes of transmission**

**1 - Tetanus**

**Definition, cause and occurrence of tetanus**

**Tetanus** is a neurological disorder, that is, a disorder of the nervous system. Symptoms of tetanus are tight muscles that are difficult to relax, and muscle *spasms* (muscle contractions that occur without the person wanting them to). These problems with the muscles are caused by a toxin (poison) produced by the bacteria called *Clostridium tetani*.

Tetanus is among the top ten causes of illness and death in newborns in Ethiopia. Tetanus in newborns is called **neonatal tetanus**. Nine out of every 1,000 newborns in Ethiopia have neonatal tetanus. More than 72% of the newborns who have tetanus will die.

Tetanus is also common among older children and adults who are susceptible to the infection. Unvaccinated persons are at risk of the disease, and people who have a dirty wound which favours the growth of the bacteria that cause tetanus are especially vulnerable.

**3.3.2  Mode of transmission of tetanus**

People can get tetanus through exposure to tetanus bacteria (*Clostridium tetani*) which are always present in the soil. The bacteria can be transmitted directly from the soil, or through dirty nails, dirty knives and tools, which contaminate wounds or cuts. A newborn baby can 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. Unclean delivery is common when mothers give birth at home in poor communities, but it can be prevented by skilled birth attendants (Figure 3.2).

**Clinical manifestations of tetanus**

The time between becoming infected with *Clostridium tetani* bacteria and the person showing symptoms of tetanus disease is usually between three and 10 days, but it may be as long as three weeks.

* What is the name given to the gap in time between infectious agents entering the body, and the first appearance of the disease they cause? (You learned this in Study Session 1.)
* It is called the **incubation period**.

In cases of tetanus, the shorter the incubation period, the higher the risk of death. In children and adults, muscular stiffness in the jaw, which makes it difficult or impossible to open the mouth (called ‘locked jaw’) is a common first sign of tetanus. This symptom is followed by neck stiffness (so the neck cannot be bent), difficulty in swallowing, sweating, fever, stiffness in the stomach muscles, and muscular spasms (involuntary contraction of the muscles).

Babies infected with tetanus during delivery appear normal at birth, but they become unable to feed by suckling from the breast at between three and 28 days of age. Their bodies become stiff, while severe muscle contractions and spasms occur (Figure 3.3). Death follows in most cases.

**Treatment, prevention and control of tetanus**

Once a person has tetanus, he or she will be treated by an antibiotic drug. **Antibiotics** are medicines that destroy bacteria, or stop them from multiplying in the body. However, many people who have tetanus die despite the treatment. Hence, prevention is the best strategy, and vaccination is the best way to prevent tetanus.

**Tetanus toxoid (TT) vaccination**

The tetanus vaccine contains inactivated tetanus toxoid (poison), which is why it is often called TT vaccine. Tetanus toxoid vaccination is given routinely to newborns and infants as part of the threefold DPT vaccine (with diphtheria and pertussis vaccines), or the pentavalent (fivefold) vaccine, which includes vaccines for diphtheria, tetanus, pertussis, Hepatitis B (a virus), and a bacterium called *Haemophilus influenzae* type B (Hib). Neonatal tetanus can also be prevented by vaccinating women of childbearing age with tetanus toxoid vaccine, either during pregnancy or before pregnancy. This protects the mother and enables anti-tetanus antibodies to be transferred to the growing fetus in her uterus

* The transmission from mother to fetus is called *transplacental transmission* because the mother’s antibodies pass across the placenta and into the baby.

Cleanliness is also very important, especially when a mother is delivering a baby, even if she has been vaccinated with TT vaccine.

People who recover from tetanus do not have increased natural immunity and so they can be infected again. Therefore they will need to be vaccinated.

The World Health Organization (WHO) and UNICEF set a goal to eliminate neonatal tetanus by 2005. **Elimination** in this case would mean that the number of neonatal tetanus cases would have to be reduced to below one case per 1,000 live births per year in every district. Notice that elimination of a communicable disease does not mean there are *no* cases — just very few right across a country or region. **Eradication** means the total and sustained disappearance of the disease from the population.

**Strategies to prevent and control tetanus**

* *Vaccinating* a higher percentage of pregnant women against tetanus with vaccines containing tetanus toxoid (TT).
* *Vaccinating* all females of childbearing age (approximately 15–45 years) with TT vaccine in high-risk areas where vaccination coverage is currently low.
* *Outreach vaccination campaigns* where health workers go to rural villages and give TT vaccine, usually three times at intervals (known as a ‘three-round’ vaccination campaign).
* *Promoting clean delivery and childcare practices*, through better hygiene and care of the newborn’s umbilicus.
* *Improving surveillance and reporting* of cases of neonatal tetanus. The case finding and reporting will help us to give appropriate treatment and vaccination to children.

**2 - Meningococcal meningitis**

**Definition and cause of meningococcal meningitis**

**Meningococcal meningitis** is an infection of the brain and spinal cord by the bacterium *Neisseria meningitidis* (also known as the meningococcus bacterium).

The disease is caused by several groups of meningococcus bacteria, which are given distinguishing codes such as type A, B, C, Y and W135.

In populations over 30,000 people, a meningitis epidemic is defined as 15 cases per 100,000 inhabitants per week; or in smaller populations, five cases in one week or an increase in the number compared to the same period in previous years.

The disease occurs globally, but in sub-Saharan Africa, meningitis epidemics occur every two to three years. An **epidemic** is a sudden and significant increase in the number of cases of a communicable disease, which may go on rising for weeks, months or years. Meningitis epidemics are common in many countries of Sub-Saharan Africa, including Ethiopia. In Ethiopia, these epidemics are usually caused by group A and C type meningococcus bacteria, and are more common in western Ethiopia. The disease is most common in young children, but it also can affect young adults living in crowded conditions, in institutions, schools and refugee camps.

**3.4.2  Mode of transmission and clinical symptoms**

Meningococcal meningitis is transmitted to a healthy person by airborne droplets from the nose and throat of infected people when they sneeze or cough. The disease is marked by the sudden onset of intense headache, fever, nausea, vomiting, sensitivity to light and stiffness of the neck. Other signs include lethargy (extreme lack of energy), coma (loss of consciousness), and convulsions (uncontrollable shaking, seizures). Box 3.2 summarises the *general* signs of meningitis, which may also be caused by some other serious conditions, and the more *specific* signs which are characteristic of meningitis.

**Box 3.2  General and more specific signs of meningitis in infants**

General signs of meningitis:

* Drowsy, lethargic or unconscious
* Reduced feeding
* Irritable
* High pitched cry.

More specific signs of meningitis:

* Convulsion (fits)
* Bulging fontanelle in infants.

**Prevention and control of meningococcal meningitis**

Next we describe how to prevent meningococcal meningitis from spreading in a community.

**Strategies to prevent and control meningitis**

* Early identification and prompt treatment of cases in the health facility and in the community.
* Education of people in the community on the symptoms of meningitis, the mode of transmission and the treatment of the disease.
* Reporting any cases of meningitis to the District Health Office; and avoiding close contact with the sick persons. Your health education messages should tell everyone about this.
* Vaccination against meningococcus bacteria of types A, C, Y and W135, as described in the Immunization Module.

A mass immunization campaign that reaches at least 80% of the entire population with meningococcus vaccines can prevent an epidemic. However, these vaccines are not effective in young children and infants, and they only provide protection for a limited time, especially in children younger than two years old. A single case of meningitis could be a warning sign for the start of an epidemic. As a community Health Extension Practitioner, you will need to educate your community about the symptoms of meningitis and how it is transmitted. All cases should be reported to the District Health Office.

**3 - Tuberculosis**

Tuberculosis is an infectious disease that usually affects the lungs. Compared with other diseases caused by a single infectious agent, tuberculosis is the second biggest killer, globally.

In 2015, 1.8 million people died from the disease, with 10.4 million falling ill.

In the 18th and 19th centuries, a tuberculosis epidemic rampaged throughout Europe and North America, before the German microbiologist Robert Koch discovered the microbial causes of tuberculosis in 1882.

Following Koch's discovery, the development of vaccines and effective drug treatment led to the belief that the disease was almost defeated. Indeed, at one point, the United Nations, predicted that tuberculosis (TB) would be eliminated worldwide by 2025.

However, in the mid-1980s, TB cases began to rise worldwide, so much so, that in 1993, the World Health Organization (WHO) declared that TB was a global emergency; the first time that a disease had been labeled as such.

**Fast facts on tuberculosis**

Here are some key points about tuberculosis. More detail and supporting information is in the main article.

* The World Health Organization estimates that 9 million people a year get sick with TB, with 3 million of these "missed" by health systems
* TB is among the top 3 causes of death for women aged 15 to 44
* TB symptoms (cough, fever, night sweats, weight loss, etc.) may be mild for many months, and people ill with TB can infect up to 10-15 other people through close contact over the course of a year
* TB is an airborne pathogen, meaning that the bacteria that cause TB can spread through the air from person to person

**Causes of tuberculosis**

* The Mycobacterium tuberculosis bacterium causes TB. It is spread through the air when a person with TB (whose lungs are affected) coughs, sneezes, spits, laughs, or talks.
* TB is contagious, but it is not easy to catch. The chances of catching TB from someone you live or work with are much higher than from a stranger. Most people with active TB who have received appropriate treatment for at least 2 weeks are no longer contagious.
* Since antibiotics began to be used to fight TB, some strains have become resistant to drugs. Multidrug-resistant TB (MDR-TB) arises when an antibiotic fails to kill all of the bacteria, with the surviving bacteria developing resistance to that antibiotic and often others at the same time.
* MDR-TB is treatable and curable only with the use of very specific anti-TB drugs, which are often limited or not readily available. In 2012, around 450,000 people developed MDR-TB.

**Prevention**

* If you have active TB, a face mask can help lower the risk of the disease spreading to other people.
* A few general measures can be taken to prevent the spread of active TB.
* Avoiding other people by not going to school or work, or sleeping in the same room as someone, will help to minimize the risk of germs from reaching anyone else.
* Wearing a mask, covering the mouth, and ventilating rooms can also limit the spread of bacteria.

**TB vaccination**

* In some countries, BCG injections are given to children to vaccinate them against tuberculosis. It is not recommended for general use in the U.S. because it is not effective in adults, and it can adversely influence the results of skin testing diagnoses.
* The most important thing to do is to finish entire courses of medication when they are prescribed. MDR-TB bacteria are far deadlier than regular TB bacteria. Some cases of MDR-TB require extensive courses ofchemotherapy, which can be expensive and cause severe adverse drug reactions in patients.

## Treatment

The majority of TB cases can be cured when the right medication is available and administered correctly. The precise type and length of antibiotic treatment depend on a person's age, overall health, potential resistance to drugs, whether the TB is latent or active, and the location of infection (i.e., the lungs, brain, kidneys).

People with latent TB may need just one kind of TB antibiotics, whereas people with active TB (particularly MDR-TB) will often require a prescription of multiple drugs.

Antibiotics are usually required to be taken for a relatively long time. The standard length of time for a course of TB antibiotics is about six Months

TB medication can be toxic to the liver, and although side effects are uncommon, when they do occur, they can be quite serious. Potential side effects should be reported to a doctor and include:

* Dark urine
* Fever
* Jaundice
* Loss of appetite
* Nausea and vomiting

It is important for any course of treatment to be completed fully, even if the TB symptoms have gone away. Any bacteria that have survived the treatment could become resistant to the medication that has been prescribed and could lead to developing MDR-TB in the future.

Direct Observed Therapy (DOT) may be recommended. This involves a healthcare worker administering the TB medication to ensure that the course of treatment is completed.

**4 - Diphtheria.**

Diphtheria is a rare bacterial infection that affects the mouth, nose and the throat. Formation of a thick grey mass is formed over the affected areas is a characteristic feature of diphtheria. Individuals living in tropical areas and areas with poor sanitation are at a risk of developing cutaneous diphtheria.

Diphtheria is extremely contagious and is found to be fatal in 5-10% of the total reported cases. Vaccination against diphtheria has drastically reduced the risk of morbidity and mortality among children and adults.

In certain individuals, cutaneous diphtheria occurs when Corynebacterium diphtheria affects the skin. The bacteria commonly inhabit the mucous membrane of the skin and spreads through cuts open wounds of the skin.

**Causes, symptoms, treatment and prevention of diphtheria**

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## What Causes Diphtheria?

Diphtheria is caused by the infection of Corynebacterium diphtheria. The infection is transmitted from person to person through respiratory droplets, coughing or sneezing. It is also spread through sharing of tissues or cup/glass of an infected person.

Diphtheria is a highly contagious infection that is transmitted from direct contact of an infected person. However, the infection may not spread from the infected person in the initial days of acquiring the infection.

The infection can be transmitted by the following means:

* Inhaling the cough droplets which an infected person has released in air.
* It can also be caused by touching the objects of the infected individual such as toys, tissues, glasses and so on.
* Rarely occurs by touching the sores or wound (skin lesions) of the infected person with cutaneous diphtheria.

## What are the Symptoms of Diphtheria?

Diphtheria infection produce symptoms after 2-5 days of acquiring the infection. Although, most individuals are asymptomatic on acquiring the infection, others do exhibit symptoms of common cold. The formation of a thick grey coating on the throat is common sign that differentiates diphtheria over other conditions.

The **common** **signs and symptoms** of diphtheria include:

* Swollen glands around the face and neck
* Fever
* Chills
* Sore throat
* Intense coughing
* Bluish skin
* Generalized weakness
* Uneasiness and discomfort

The **signs and symptoms** **advanced stages** of diphtheria infection include:

* Visual disturbances
* Slurred speech
* Difficulty in breathing
* Difficulty in swallowing
* Increased heartbeat
* Pale or skin discoloration
* The signs of cutaneous diphtheria include:
* Pain, redness and swelling of the skin
* Skin ulcers

## The Risk Factors of Diphtheria

Lack of proper nutrition and sanitation in underdeveloped and developing nations is the most common risk factor increasing the susceptibility of diphtheria infection. However, this is an opposite trend in developed nations due to adherence to proper nutrition and widespread availability of diphtheria vaccination.

The higher risk of acquiring diphtheria infection is observed in individuals with:

* Incomplete or no prior vaccination
* Weak immune system
* Immune system disorders such as [HIV/AIDS](https://www.medlife.com/web/hiv-aids-causes-symptoms-treatments-prevention/)
* Living in overcrowded areas or areas that lack proper sanitation
* Visiting a country that lacks poor immunization

## What are the Complications of Diphtheria Infection?

Untreated diphtheria infection can increase the risk of complications, such as:

* **Breathing problems:** Diphtheria infection produces harmful toxins that affect the other tissues surrounding the nose and throat. The thick grey mass formation obstructs the airway passages, thus making it difficult to breathe.
* **Heart damage:** The diphtheria toxin passes through the bloodstream and causes inflammation of the tissue and organs in the body. When the toxin affects the heart, it causes myocarditis (inflammation of the heart muscle).
* **Nerve damage:** The nerves supplying the throat, arm, feet and respiratory tract may be affected producing the following complications:

|  |  |
| --- | --- |
|  | **Associated complications** |
| Throat | Difficulty in swallowing food |
| Arms and feet | Muscle weakness thus making it difficult to walk |
| Respiratory tract | Difficulty in breathing and respiratory paralysis |

## How is Diphtheria Infection Diagnosed?

Laboratory tests such as blood test, culture test and other imaging scan confirm diphtheria infection

* **Sputum culture:** Sputum samples are collected and the infection causing bacteria is made to grow under specialized conditions. The presence of bacterium in the sputum confirms diphtheria infection.
* **Imaging scan:** Imaging scans such as x-ray scan, magnetic resonance imaging (MRI) scan, and computed tomography (CT) scan are performed in advanced stages of diphtheria infection to check the spread of infection to the surrounding tissues and organs.
* **Cutaneous diphtheria test:** Tissue samples of the infected skin (skin rash) is collected and cultured to detect the presence of bacterium.

## Treatment of Diphtheria Infection.

Diphtheria should be treated as an emergency condition to prevent the spread of infection. Antitoxin and antibiotic therapy is recommended for better treatment and cure of diphtheria infection.

### Antitoxin Therapy:

On suspecting diphtheria infection, the antitoxin injection is injected either into the vein or the muscle. The antitoxin helps in neutralizing the effect of the toxin in the bloodstream. Prior to the administration of diphtheria antitoxin, a skin allergy test is performed to check for allergic reactions.

In individual’s having allergic skin reactions for the test antitoxin, initial care should be taken to desensitize the administered antitoxin before testing for another antitoxin.

### Antibiotics Therapy:

Antibiotics such as penicillin and erythromycin are used to destroy bacterial growth and prevent the further bacterial infection. Antibiotic therapy is also recommended to the patient’s caregivers to prevent the spread of infection.

(In some cases, the doctor may remove a part of the thick, grey covering over the throat to ease breathing.)

Preventive Measures for Diphtheria Infection

The treatment for diphtheria requires a compulsory hospital stay to prevent the spread of infection among family and friends. During this period, the patient is isolated from other patients to prevent the spread of infection to other immunized or non-immunized patients.

Diphtheria infection can be prevented by spreading awareness about vaccinations. Diphtheria vaccine is administered through single shots, mostly in combination with pertussis and tetanus vaccines. Vaccinating your child for diphtheria infection help prevent the onset of infection by up to 10 years of age. However, administering a booster dose for every ten years can help in long term prevention of diphtheria.

**5 - Pertussis (whooping cough)**

**Whooping cough is caused by a type of bacteria called Bordetella pertussis.** When an infected person coughs or sneezes, tiny germ-laden droplets are sprayed into the air and breathed into the lungs of anyone who happens to be nearby.

Whooping cough, also called pertussis, is a serious respiratory infection caused by a type of bacteria called Bordetella pertussis. The infection causes violent, uncontrollable coughing that can make it difficult to breathe.

While whooping cough can affect people at any age, it can be deadly for infants and young children.

According to the Centre for Disease Control and prevention (CDC) Trusted source, before a vaccine was available, whooping cough was a major cause of childhood deaths in the United States. The CDC trusted source reports the total number of cases of pertussis in 2016 was just under 18,000, with 7 deaths reported.

## Whooping cough symptoms

The incubation period (the time between initial infection and the onset of symptoms) for whooping cough is about 5 to 10 days, but symptoms might not appear for as long as three weeks, according to the CDC trusted source.

Early symptoms mimic the common cold and include a runny nose, cough, and fever. Within two weeks, a dry and persistent cough may develop that makes breathing very difficult.

Children often make a “whoop” sound when they try to take a breath after coughing spells, though this classic sound is less common in infants.

This type of severe cough can also cause:

* vomiting
* Dehydration
* blue or purple skin around the mouth
* low-grade fever
* breathing difficulties

Adults and teenagers typically experience milder symptoms, such as a prolonged cough without the “whoop” sound.

## Diagnosing and treating whooping cough

If you or your child experience symptoms of whooping cough, seek medical attention right away, especially if members of your family haven’t been immunized.

Whooping cough is highly contagious — bacteria can become airborne when an infected person coughs, sneezes, or laughs — and can quickly spread to others.

### Diagnosis

To diagnose whooping cough, your doctor will perform a physical exam and take samples of mucus in the nose and throat. These samples will then be tested for the presence of the B. pertussis bacteria. A blood test may also be necessary to make an accurate diagnosis.

### Treatment

Many infants and some young children will need to be hospitalized during treatment, for observation and respiratory support. Some may need intravenous (IV) fluids for dehydration if symptoms prevent them from drinking enough fluids.

Since whooping cough is a bacterial infection, antibiotics are the primary course of treatment. Antibiotics are most effective in the early stages of whooping cough. They can also be used in the late stages of the infection to prevent it from spreading to others.

While antibiotics can help treat the infection, they don’t prevent or treat the cough itself.

However, cough medicines aren’t recommended — they have no effect on whooping cough symptoms and may carry harmful side effects for infants and small children.

Most doctors suggest using humidifiers in your child’s bedroom to keep air moist and help alleviate symptoms of whooping cough.

## Possible complications

Infants with whooping cough require close monitoring to avoid potentially dangerous complications due to lack of oxygen. Serious complications include:

* brain damage
* Pneumonia
* Seizers
* bleeding in the brain
* apnea (slowed or stopped breathing)
* convulsions (uncontrollable, rapid shaking)
* death

If your infant experiences symptoms of infection, call your doctor immediately.

Older children and adults can experience complications as well, including:

* difficulty sleeping
* Urinary incontinence (loss of bladder control)
* pneumonia
* rib fracture

1. **What are the causes and methods for preventing bacterial meningitis?**

## What Is Bacterial Meningitis?

### Summary

Meningitis describes inflammation of the meninges, the layers of membranes that surround the brain and spinal cord. Viruses, fungi, bacteria, and other rare causes can lead to meningitis. Streptococcus, Neisseria, Listeria, and Haemophilus are common bacterial causes of meningitis.

Symptoms escalate quickly and may include a headache, fever, stiff neck, nausea and vomiting, confusion, and sensitivity to light. Bacterial meningitis can lead to sepsis and permanent brain damage and is a life-threatening medical emergency. If it is suspected, take the patient to the emergency room or call 911.

Antibiotics are the predominant treatment for bacterial meningitis. Vaccines can also help protect against bacterial meningitis.

### Recommended care

You should seek care urgently at the nearest Emergency Room. Tests need to be run as soon as possible in order to determine the cause of the infection, and treat as soon as possible to avoid lasting complications. Early diagnosis and treatment with antibiotics is vital for the treatment of meningitis.

## Bacterial Meningitis Symptoms

The diagnosis of bacterial meningitis is made through physical examination and a spinal tap (lumbar puncture or LP) to obtain a sample of the cerebrospinal fluid. Meningitis can lead to a variety of symptoms that present differently in different individuals.

### Main symptoms

At least one of these three symptoms is present in 99 percent of people with meningitis [1].

* **Fever**
* **Neck stiffness (menigismus)**
* **Altered mental status:** Such as confusion and lethargy

### Other symptoms

Other symptoms or signs of increased intracranial pressure from swelling of the meninges may include the following.

* **Headache**
* **Nausea**
* **Vomiting**
* **Sensitivity to light (photophobia)**
* **Rashes:** These are common in several forms of bacterial meningitis.

### Symptoms in babies and children

In babies, less specific symptoms may appear, and neck stiffness may be difficult to detect. These include:

* **Irritability:** A sharp increase in crying and fussiness may be the first sign of infection.
* **Tiredness and slowness:** The child may appear less active than usual.
* **Poor feeding:** The child may vomit or refuse food.
* **Seizures:** These are more common in children with meningitis.

### Complications

Complications of bacterial meningitis may include [2]:

* **Hydrocephalus:** Increased fluid surrounding the brain.
* **Stroke:** Inflammation of arteries and veins in and around the brain can lead to decreased blood flow and damage to the brain.
* **Double vision:** Inflammation of the abducens nerve can impair eye movements.
* **Hearing loss:** Due to damage to the ear and auditory nerve.
* **Brain herniation:** Increased pressure in the skull can lead the brain to be pushed against solid structures in the skull. This is the most common cause of death during acute meningitis.
* **Systemic complications:** These may include sepsis (body inflammation and organ damage), disseminated intravascular coagulation (a blood clotting disorder), and hyponatremia (low levels of sodium in the blood).

## Bacterial Meningitis Causes

Infants and young people, especially those exposed to group settings such as daycare or dormitories, are the most susceptible to contracting meningitis. However, anyone can become infected. Disease-causing bacteria can be transmitted through casual contact such as coughing, sneezing, or kissing, or by eating contaminated food.

### Common bacteria

Meningitis is caused by bacteria in the central nervous system (CNS). In the U.S., the most common causes of bacterial meningitis include [3,4]:

* **Streptococcus pneumonia (S. pneumo):** Common cause among all age groups and more commonly causes pneumonia and sinus infections.
* **Group B Streptococcus (GBS):** Common cause among all age groups.
* **Neisseria meningitides (N. meningitides):** Common cause among adolescents and adults that has led to epidemics in communal settings.
* **Haemophilus influenza (Hib):** Common cause among children and the elderly.
* **Listeria monocytogenes (Listeria):** Common cause among newborns and the elderly, and the bacteria can be found in cheese and meat products.

### How spread occurs

Most bacteria are spread in the community and then reach the central nervous system via the bloodstream or through defects in the skull or spine [2,3].

* **Person-to-person:** Many of the bacteria above can be carried by people who never become sick, but still spread the bacteria to others. This can occur during childbirth, in which mothers can pass GBS or E. coli to babies; coughing and sneezing can spread S. pneumo and Hib; saliva and spit can spread N. meningitis due to close living spaces or kissing.
* **Foodborne:** E. coli and Listeria can be spread by contaminated food.

### Risk factors for bacterial meningitis

The following are the main risk factors for developing meningitis.

* **Age:** Although meningitis can occur at any point throughout the lifespan, babies are at highest risk.
* **Skipping vaccinations:** Child and adult vaccines are critical to reducing the risk of this potentially deadly condition [4].
* **Communal settings:** Meningitis can spread among large groups, such as college students, military bases, and during pilgrimages such as in Mecca [3].
* **Medical conditions:** Certain medical conditions that compromise immunity, such as HIV/AIDS, organ transplants, alcoholism, diabetes, and sickle cell disease, increase the risk of developing bacterial meningitis [4]. Neurosurgical procedures, such as ventricular shunts, can also predispose people to meningitis [2]

## Treatment Options and Prevention for Bacterial Meningitis

The best course of treatment can be determined by your medical provider. Prompt care is important as the likelihood of developing complications, such as hearing loss, increases if treatment is delayed.

### Medical treatments

The following treatment options will likely be started promptly once you seek attention to address various symptoms.

* **Antibiotics:** Intravenous antibiotics must be started as soon as possible to control the infection. Antibiotics may be adjusted when the precise causative organism is identified.
* **Steroids:** Early treatment with steroids to reduce inflammation around the brain has been found effective in reducing mortality and neurologic complications in people with S. pneumo meningitis [6].
* **Intravenous fluids:** IV fluids are often offered to prevent dehydration and electrolyte abnormalities [1].

### Prevention

Methods for preventing the contraction and spread of meningitis include the following.

* **Vaccines:** Vaccines have contributed to a significant reduction in cases of severe meningitis over the decades. Several dangerous causes of meningitis are preventable with vaccines, including N. meningitidis, S. pneumo, and Hib. Ask your physician if you and/or your child are up to date with recommended vaccines.
* **Prenatal care:** Pregnant women can reduce their newborn's risk of meningitis by getting tested for GBS during the third trimester and by [avoiding certain foods during pregnancy](https://www.acog.org/Patients/FAQs/Listeria-and-Pregnancy), such as unpasteurized dairy products, luncheon meat, and smoked seafood [3,5].
* **Prophylactic antibiotics:** Physicians or your public health department may recommend that close contacts of people who develop meningitis, such as roommates or family members, take a short course of antibiotics to prevent themselves from developing the infection. This recommendation varies depending on the causative bacterium [3].
* **Practice good hygiene:** Careful hand washing before eating and after using the bathroom and covering your mouth and nose when you sneeze or cough can help protect you and others from infections [4].

### Prognosis

Most people recover from meningitis, but without prompt treatment, death can occur within hours of developing symptoms [3]. Prognosis is better among younger individuals [2].

1. **Explain two characteristics that illustrate how the Anopheles larvae are different from other mosquito larvae. Using illustration is advised**

**Understanding the Difference Between Anopheles And Culex Mosquito**

Culex mosquito is a genus of mosquitoes, several species of which serve as vectors of one or more important diseases of birds, humans and other animals. Diseases they vector include arbovirus infections such as west Nile virus, Japanese encephalitis, filariasis and avian malaria. The general characteristic of these mosquitoes include:

**Eggs**

* The eggs of Culex mosquito are laid vertically in clusters on the surface of the water.
* The eggs of Culex are cigar-shaped eggs.
* Culex eggs do not have lateral air floats.
* The eggs of Culex are laid in dirty water.

**Larva**

* The larva of Culex mosquito is a bottom feeder.
* The head of the Culex larva is round.
* The respiratory siphon of Culex larva is long and it forms an angle inside water.

**Pupa**

* The larva of Culex is colorless in color.
* The respiratory trumpets of Culex pupa are long and narrow.
* The abdomen of Culex pupa is less bent.
* The Culex pupa has a large head.

**Adult**

* The Culex pupa has transparent wings that can fly for a long distance.
* The Culex mosquito has a small palpi near proboscis.
* The Culex pupa has a body with stouter legs.
* The adult Culex transmits filarial parasites.
* When at rest, the Culex adult body lies parallel to the surface.

## Anopheles Mosquito

Anopheles is a genus of mosquito, and is best known for being the primary vector of malaria in humans and heartworm in dogs. Some of the general features of anopheles mosquito include:

* 

**Eggs**

* Eggs are laid singly and horizontally on the surface of water.
* Eggs of anopheles mosquito are boat-shaped.
* Eggs have two lateral floats, which help them to float on water.
* Eggs are laid on clean water.

**Larva**

* The anopheles is a surface feeder.
* The head of the anopheles larva is broad.
* The respiratory siphon of anopheles is short and it remains parallel to the water surface.

**Pupa**

* The anopheles pupa is green in color.
* The respiratory trumpets of anopheles pupa are short and wide.
* The abdomen of anopheles pupa is more bent.
* The anopheles pupa has a small head.

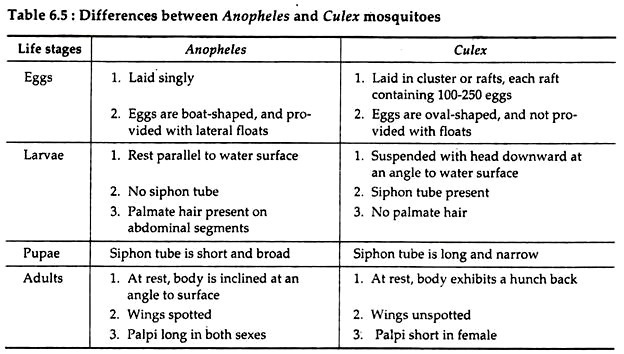
**Adult**

* The adult anopheles has wings with dark spots that cannot fly for long distance.
* The adult anopheles does not have a palpi near proboscis
* The legs of an adult anopheles are delicate.
* The adult anopheles transmits malarial parasite fever).
* At rest, the body is inclined at an acute angle to the surface.

## Difference between Anopheles and culex larvae in tabular form

|  |  |  |
| --- | --- | --- |
| **BASIS OF DIFFERENCE** | **ANOPHELES MOSQUITO** | **CULEX MOSQUITO** |
| **EGG** | Eggs are laid singly and horizontally on the surface of water. Eggs of anopheles mosquito are boat-shaped. Eggs have two lateral floats, which help them to float on water. Eggs are laid on clean water. | The eggs of Culex mosquito are laid vertically in clusters on the surface of the water. The eggs of Culex are cigar-shaped eggs.Culex eggs do not have lateral air floats. The eggs of Culex are laid in dirty water. |
| **LARVA** | The anopheles is a surface feeder. The head of the anopheles larva is broad. The respiratory siphon of anopheles is short and it remains parallel to the water surface. | The larva of Culex mosquito is a bottom feeder. The head of the Culex larva is round. The respiratory siphon of Culex larva is long and it forms an angle inside water. |
| **PUPA** | The anopheles pupa is green in color. The respiratory trumpets of anopheles pupa are short and wide. The abdomen of anopheles pupa is more bent. The anopheles pupa has a small head. | The larva of Culex is colorless in color. The respiratory trumpets of Culex pupa are long and narrow.  The abdomen of Culex pupa is less bent.  The Culex pupa has a large head. |
| **ADULT** | The adult anopheles has wings with dark spots that cannot fly for long distance. The adult anopheles does not have a palpi near proboscis The legs of an adult anopheles are delicate. The adult anopheles transmits malarial parasite fever). At rest, the body is inclined at an acute angle to the surface. | The Culex pupa has transparent wings that can fly for a long distance. The Culex mosquito has a small palpi near proboscis. The Culex pupa has a body with stouter legs. The adult Culex transmits filarial parasites. When at rest, the Culex adult body lies parallel to the surface. |





**The End**

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