**COMMUNICABLE AND VECTOR BORNE DISEASES**

A **communicable disease** is one that is spread from one person to another through a variety of ways that include: **contact** with blood and bodily fluids; **breathing** in an airborne virus; or by being **bitten by an insect.**

Some infectious communicable diseases are also considered **contagious** diseases, meaning they are easily spread from person to person.

**Some ways in which communicable diseases spread**

1. **physical contact with an infected person**, such as through touch (staphylococcus), sexual intercourse (gonorrhea, HIV), fecal/oral transmission (hepatitis A), or droplets (influenza, TB)
2. **contact with a contaminated surface** or object (Norwalk virus), food (salmonella, E. coli), blood (HIV, hepatitis B), or water (cholera);
3. **bites from insects or animals capable of transmitting the disease** (mosquito: malaria and yellow fever; flea: plague); and
4. **travel through the air**, such as tuberculosis or measles.

**Principles of Communicable Disease Control**

**A communicable disease** is also **defined** as an illness that arises from transmission of an infectious agent or its toxic product from an infected person, animal or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or environment.

**Basic principles**

A **disease epidemic** or **outbrea**k **occurs when there are more people suffering from a particular illness than what would normally be expected.** Therefore, emergency control measures are needed. It is incorrectly assumed that ‘epidemics and plagues are inevitable after every disaster.’ The threat of communicable disease outbreaks is greater after a disaster than in non-emergency situations particularly when large populations have been displaced. However, an **epidemic or outbreak will only occur if the equilibrium is changed** between the **population’s susceptibility** (host or reservoir), the **virulence of the infectious agent** (bacteria, viruses, parasites, or fungi or their products) and the **environment** that promotes the exposure are upset.

POPULATION: Age, Genetic makeup, Poverty, Nutritional status, Previous exposure, Immunization status, General physical condition

AGENT: Virulence, Infectious dose, Susceptibility to drugs, Mode of transmission, Ability to adapt to change

ENVIRONMENT: Shelter, Altitude, Humidity, Sanitation, Food supply, Water supply, Climate change, Overcrowding, Essential services

Although each emergency situation is unique, all emergencies are surrounded by the same factors that **can upset the balance between the infectious agent, the host and the environment**, as follows:

**Agent**

Infectious disease agents are constantly developing where it is possible to multiply most easily either in **susceptible persons, vectors, animals or in the environment**. Because their **genes are mutated**/changed at random quite rapidly, new features appear that might be **better adapted** **to the environment** and able to **spread to new locations,** disappear to reappear and infect more vulnerable populations. Some infectious agents cause higher rates of illness and death because they have become **resistant to available treatment** (e.g., TB, malaria) or are more virulent, leading to major outbreaks (e.g., Shigella, Ebola, SARS).

Note: A disease outbreak will not occur if an infectious agent of a particular disease is not present in the environment and is not introduced after a disaster, even if environmental conditions are ideal for transmission.

**Population**

**Displaced persons** might **change the local environment or bring new or different strains of infectious agents.** Displaced persons might also have **low immunity** to infections caused by a **poor physical or nutritional status**, **underlying diseases or poverty**. Certain individuals are more vulnerable to infectious diseases or the more severe form of the illness. Immunity deprived persons like those with poor nutrition, TB or HIV are an example. **Children less than five years** of age (usually about 20% of the displaced population) and the **elderly** are at the **greatest risk of morbidity and mortality** from infectious diseases particularly the malnourished. Initial assessment and ongoing surveillance are critical to identify the most at risk groups so that they can be protected.

**Environment**

Opportunities for infection might increase because of **overcrowding, unhygienic conditions, a lack of safe drinking water, climate change, insecurity** etc. **Essential public health or medical services** might also have been **inadequate** before the disaster and, subsequently, disrupted or overwhelmed by the emergency situation as a result of the breakdown of the health infrastructure and displacement of skilled health workers who might also experience a loss of family, property etc. **Large population movements** from one malaria endemic area to another might increase the risk for severe malaria among the displaced as well as the host population if the malaria species affecting the two populations are somewhat different.

**Note:** Because communicable diseases respect no boundaries, Outbreaks occurring within the displaced population can spread to the host population, and vice versa. The above risk factors can apply to either population.

The **probability of communicable disease outbreaks** occurring depends, therefore, on the **type of infectious agents** existing within the **local environment** and the **displaced population’s physical condition and health status**. Sometimes it is easier to undertake control measures for disease outbreaks that affect a closed settlement such as a refugee or Internally Displaced Persons camp. Unfortunately for most epidemics related to natural disasters, people are not always in camps but dispersed within a host population. Targeting high risk persons in such a mixed setting might be challenging. Extreme poverty can also force these high-risk groups to eventually move to camp settings thus increasing their vulnerability.

**Communicable disease cycle**

Communicable diseases do not always develop in the same way in susceptible hosts. Some diseases **produce more non-clinical cases that experience vague, non-specific symptoms or none at all** (e.g., TB, cholera, polio) and thus **spread the disease without being aware.** Other diseases produce **more clinical cases with easily detectable symptoms** (e.g., measles). However, once exposed, people with as well as people without clinical or biological signs of infection are capable of spreading the disease to other susceptible persons. Such people are known as **carriers**. The figure below illustrates the cycle of communicable disease progression in susceptible hosts/persons. Understanding the unique pace of specific communicable diseases through the cycle helps to identify those individuals that are likely to transmit the disease as well as those at greatest risk of becoming ill or dying within the population.

 Host

**Host**



Environment

Agent

 E

Some diseases **spread very rapidly** (within a few hours), while other diseases spread insidiously, triggering a range of effects that might be felt on a wider scale. For example, cholera spreads rapidly and within a very short time, the whole community has been exposed. The opposite situation is that although less than 5% of a population might be infected with HIV, the effects will gradually spread from **the individual and household levels to the community**. Because People Living with HIV (PLHIV) infection progress from the asymptomatic phase to develop opportunistic infections, then AIDS and finally succumb to death, they might leave behind many other HIV infected family members and AIDS orphans. Analyzing each stage of a particular disease progression together with other sectors helps identify all possible points for disease control both more holistically and comprehensively.

**Vector:**  **a living organism that transmits an infectious agent from an infected animal to a human or another animal**. Vectors are frequently arthropods, such as mosquitoes, ticks, flies, fleas and lice.

**Epidemiology:** the study of the distribution (frequency, pattern) and determinants (causes, risk factors) of health-related states and events (not just diseases) in specified populations (neighborhood, school, city, state, country, global).

**Virulence:** degree of pathogenicity of a pathogen (bacteria, fungi, viruses) and is determined by its ability to invade and multiply within the host.

Pathogen: **an organism causing disease to its host**

**Pathogenesis:**  **the process by which a disease or disorder develops**. It can include factors which contribute not only to the onset of the disease or disorder, but also to its progression and maintenance.

**Morbidity:** Refers to having a disease or a symptom of disease, or to the amount of disease within a population. Morbidity also refers to **medical problems caused by a treatment**.

**Mortality:** Mortality rate, or death rate, is a **measure of the number of deaths** (in general, or due to a specific cause) in a particular population, scaled to the size of that population, per unit of time.

Disease: **any harmful deviation from the normal structural or functional state of an organism, generally associated with certain signs and symptoms and differing in nature from physical injury**. A diseased organism commonly exhibits signs or symptoms indicative of its abnormal state.

The **signs** of disease are **objective and measurable, and can be directly observed by a clinician**. Example: changes in body temperature, heart rate and breathing rate.

**Symptoms** of disease are **subjective, they are felt or experienced by the patient, but they cannot be clinically confirmed or objectively measured**. Examples: nausea, loss of appetite, and pain.

Signs and symptoms are essential in disease diagnosis.

**Measures taken to Prevention and Control of Communicable Diseases**

Communicable diseases can be controlled and prevented by adequate measures which involve:

1. Diagnosis 2. Notification 3. Isolation 4. Treatment 5. Quarantine 6. Investigation 7. Disinfection 8. Blocking of transmission 9. Immunization 10. Health education.

1. **DIAGNOSIS:**

It is first step in the control of a disease. The disease should be diagnosed and treated immediately and effectively. This will prevent the spread of an infection.

2. **NOTIFICATION**: As soon as a disease is detected, it should be notified immediately to the local health authority. This helps in taking immediate preventive measures to control the spread of the disease.

3. **ISOLATION**: The infected patient must be isolated in hospital or at home, if hospitalization is not possible. The period of isolation depends on the period of communicability of the disease. Isolation of the infected patient prevents the spread of infection.

4. **TREATMENT**: Treatment should be given to the infected patient and also to the carrier of the infection. Sometimes all the people in the community are treated, even if they do not have the disease. These measures effectively prevent the spread of infection.

5. **QUARANTINE**: It means isolation of healthy and normal persons till the incubation period of a disease is over. These healthy persons might have come in contact with the disease without actually suffering from it. So quarantine is necessary to prevent the spread of infection from these persons to others who have not been exposed to the disease. Quarantine is necessary for international travellers who have the possibility of carrying infections.

6. **INVESTIGATION**: The health authorities should conduct field investigation of infected person and also infected areas. Suspected and also infected cases must be confirmed by laboratory tests.

7. **DISINFECTION**: Disinfection of the excreta and articles used by the patient will prevent the spread of infection. Disinfection must be done both when the patient is suffering from the disease and after recovery or death.

8. **BLOCKING OF TRANSMISSION**: Most of the diseases spread through water, air and insect. So adequate measures should be taken to prevent the spread of infection through these channels. i) Water borne infections can be prevented by boiling water and also milk. ii) Air bone infections can be prevented by wearing masks, isolating the patient in a separate room, dust control and disinfection of air. iii) Insect borne diseases can be prevented by using suitable insecticides.

9. **IMMUNISATION**: It is a very effective and easy method by which communicable diseases can be prevented. The diseases which can be effectively controlled by immunization are small pox, poliomyelitis, diphtheria, whooping cough, tetanus, tuberculosis and measles.

10. **HEALTH EDUCATION**: The public should be taught about the importance of maintaining a clean environment, immunization etc. It involves the responsibility of paramedical persons and the co- operation of the public

**Tuberculosis**

Tuberculosis (TB) is caused by a bacterium called ***Mycobacterium tuberculosis****, Mycobacterium bovis, Mycobacterium avium*. The bacteria usually attack the lungs, but TB bacteria can attack any part of the body such as the kidney, spine, and brain. Not everyone infected with TB bacteria becomes sick. As a result, two TB-related conditions exist: latent TB infection (LTBI) and TB disease. If not treated properly, TB disease can be fatal.

**Classification**

Tuberculosis (TB) may be regarded in two categories: **active disease or latent infection**. The most common form of active TB is lung disease, but it may invade other organs, so-called "extrapulmonary TB.

**Active TB Disease**

Active TB is an illness in which the **TB bacteria are rapidly multiplying and invading different organs of the body**. The typical symptoms of active TB variably include cough, phlegm, chest pain, weakness, weight loss, fever, chills and sweating at night. **A person with active pulmonary TB disease may spread TB to others by airborne transmission of infectious particles coughed into the air**. If you are diagnosed with an active TB disease, be prepared to give a careful, detailed history of every person with whom you have had contact. Since the active form may be contagious, these people will need to be tested, as well.

Multi-drug treatment is employed to treat active TB disease. Depending on state or local public health regulations, you may be asked to take your antibiotics under the supervision of your physician or other healthcare professional. This program is called "Directly Observed Therapy" and is designed to prevent abandonment or erratic treatment, which may result in "failure" with continued risk of transmission or acquired resistance of the bacteria to the medications, including the infamous multi-drug resistant TB (MDR-TB).

**Miliary TB**

**Miliary TB** is a rare form of active disease that occurs when TB bacteria find their way into the **bloodstream**. In this form, the bacteria quickly spread all over the body in tiny nodules and affect multiple organs at once. This form of TB can be rapidly fatal.

**Latent TB Infection**

Many of those who are **infected with TB do not develop the disease**. They have no symptoms and their chest x-ray may be normal. The only manifestation of this encounter may be **reaction to the tuberculin skin test** (TST) or interferon-gamma release assay (IGRA). However, there is an ongoing risk that the latent infection may escalate to active disease. The risk is increased by other illnesses such as HIV or medications which compromise the immune system.

**Epidemiology**

TB occurs in every part of the world. In 2015, the largest number of new TB cases occurred in Asia, with 61% of new cases, followed by Africa, with 26% of new cases.

In 2015, 87% of new TB cases occurred in the 30 high TB burden countries. Six countries accounted for 60% of the new TB cases: India, Indonesia, China, Nigeria, Pakistan, and South Africa. Global progress depends on advances in TB prevention and care in these countries.

* Tuberculosis (TB) is the ninth leading cause of death worldwide and the leading cause from a single infectious agent, ranking above HIV/AIDS.
* In 2016, 2.5 million people fell ill with TB in the African region, accounting for a quarter of new TB cases worldwide.
* An estimated 417,000 people died from the disease in the African region (1.7 million globally) in 2016. Over 25% of TB deaths occur in the African Region.
* Seven countries account for 64% of the new TB cases in 2016, with India leading the count, followed by Indonesia, China, Philippines, Pakistan, Nigeria, and South Africa.
* In 2016, an estimated 1 million children became ill with TB and 250 000 children died of TB (including children with HIV associated TB).
* TB is a leading killer of HIV-positive people: in 2016, 40% of HIV deaths were due to TB.
* About 82% of TB deaths among HIV-negative people occurred in the WHO African Region and the WHO South-East Asia Region in 2016
* Multidrug-resistant TB (MDR-TB) remains a public health crisis and a health security threat. WHO estimates that there were 451,551 new cases with resistance to rifampicin in the African region – the most effective first-line drug.
* Globally, TB incidence is falling at about 2% per year. This needs to accelerate to a 4–5% annual decline to reach the 2020 milestones of the End TB Strategy.
* Globally an estimated 53 million lives were saved between 2000 and 2015 and 10 million lives were saved in the African Region between 2000 and 2014 through TB diagnosis and treatment.
* Ending the TB epidemic by 2030 is among the health targets of the newly adopted Sustainable Development Goals.

**Causative Organism**

TB is caused by *M tuberculosis,* *Mycobacterium bovis* and *Mycobacterium avium*. *Mycobacterium tuberculosis* is a slow-growing obligate aerobe and a facultative intracellular parasite. The organism grows in parallel groups called cords (as seen in the image below). It retains many stains after decoloration with acid-alcohol, which is the basis of the acid-fast stains used for pathologic identification.

Mycobacteria, such as *M tuberculosis*, are aerobic, non–spore-forming, nonmotile, facultative, curved intracellular rods measuring 0.2-0.5 μm by 2-4 μm. Their cell walls contain mycolic, acid-rich, long-chain glycolipids and phospholipoglycans (mycocides) that protect mycobacteria from cell lysosomal attack and also retain red basic fuchsin dye after acid rinsing (acid-fast stain).

**Mode of Transmission**

**Humans** are the only known **reservoir for *M tuberculosis***. The organism is spread primarily as an airborne aerosol from an individual who is in the infectious stage of TB (although transdermal and GI transmission have been reported).

In immunocompetent individuals, exposure to *M tuberculosis* usually results in a latent/dormant infection. Only about 5% of these individuals later show evidence of clinical disease. Alterations in the host immune system that lead to decreased immune effectiveness can allow *M tuberculosis* organisms to reactivate, with tubercular disease resulting from a combination of direct effects from the replicating infectious organism and from subsequent inappropriate host immune responses to tubercular antigens.

**Extrapulmonary spread**

Because of the ability of *M tuberculosis* to survive and proliferate within mononuclear phagocytes, which ingest the bacterium, *M tuberculosis* is able to invade local lymph nodes and spread to extrapulmonary sites, such as the bone marrow, liver, spleen, kidneys, bones, and brain, usually via hematogenous routes.

Although mycobacteria are spread by blood throughout the body during initial infection, primary extrapulmonary disease is rare except in immunocompromised hosts. Infants, older persons, or otherwise immunosuppressed hosts are unable to control mycobacterial growth and develop disseminated (primary miliary) TB. Patients who become immunocompromised months to years after primary infection also can develop late, generalized disease.

**Risk factors**

Generally, persons at high risk for developing TB disease fall into two categories:

* Persons who have been recently infected with TB bacteria
* Persons with medical conditions that weaken the immune system

Persons who have been Recently Infected with TB Bacteria

This includes:

* Close contacts of a person with infectious TB disease
* Persons who have immigrated from areas of the world with high rates of TB
* Children less than 5 years of age who have a positive TB test
* Groups with high rates of TB transmission, such as homeless persons, injection drug users, and persons with HIV infection
* Persons who work or reside with people who are at high risk for TB in facilities or institutions such as hospitals, homeless shelters, correctional facilities, nursing homes, and residential homes for those with HIV.

Persons with Medical Conditions that Weaken the Immune System

Babies and young children often have weak immune systems. Other people can have weak immune systems, too, especially people with any of these conditions:

* HIV infection (the virus that causes AIDS)
* Substance abuse
* Silicosis
* Diabetes mellitus
* Severe kidney disease
* Low body weight
* Organ transplants
* Head and neck cancer
* Medical treatments such as corticosteroids or organ transplant
* Specialized treatment for rheumatoid arthritis or Crohn’s disease

**Reference: CDC**

**Pathophysiology**

**Infection** occurs when a **person inhales droplet nuclei containing tubercle bacilli** that reach the alveoli of the lungs. These tubercle bacilli are **ingested by alveolar macrophages**; the majority of these bacilli are **destroyed or inhibited**. A small number may **multiply intracellularly and are released when the macrophages die**. If alive, these bacilli may spread by way of lymphatic channels or through the bloodstream to more distant tissues and organs (including areas of the body in which TB disease is most likely to develop: regional lymph nodes, apex of the lung, kidneys, brain, and bone). This process of dissemination primes the immune system for a systemic response.

Within 2 to 8 weeks, special immune cells called macrophages ingest and surround the tubercle bacilli. The cells form a barrier shell, called a granuloma, that keeps the bacilli contained and under control **(LTBI**).

If the immune system cannot keep the tubercle bacilli under control, the bacilli begin to multiply rapidly (**TB disease**). This process can occur in different areas in the body, such as the lungs, kidneys, brain, or bone.

Infection occurs when a person inhales droplet nuclei containing tubercle bacilli that reach the alveoli of the lungs

**Latent Tuberculosis Infection**

Persons with LTBI have M. tuberculosis in their bodies, but **do not have TB disease and cannot spread the infection to other people**. A person with LTBI is not regarded as having a case of TB. The process of LTBI begins when **extracellular bacilli are ingested by macrophages and presented to other white blood cells**. This triggers the immune response in which white blood cells **kill or encapsulate most of the bacilli, leading to the formation of a granuloma**. At this point, LTBI has been established. LTBI may be detected by using the **tuberculin skin test** (TST) or an interferon-gamma release assay (IGRA). It can take **2 to 8 weeks** after the initial TB infection for the **body’s immune system to be able to react to tuberculin** and for the infection to be detected by the TST or IGRA. Within weeks after infection, the immune system is usually able to halt the multiplication of the tubercle bacilli, preventing further progression.

**TB Disease**

In some people, the **tubercle bacilli overcome the immune system and multiply, resulting in progression from LTBI to TB disease**. Persons who have TB disease are usually **infectious and may spread the bacteria to other people**. The progression from LTBI to TB disease may occur at any time, from soon to many years later. Body fluid or tissue from the disease site should be collected for AFB smear and culture. Positive culture for *M. tuberculosis* confirms the diagnosis of TB disease. The table below indicates the differences between LTBI and TB disease.

|  |  |
| --- | --- |
| **Person with LTBI** | **Person with TB Disease (infection)** |
| Has a small amount of TB bacteria in his/her body that are alive, but inactive | Has a large amount of active TB bacteria in his/her body |
| Cannot spread TB bacteria to others | May spread TB bacteria to others |
| Does not feel sick, but may become sick if the bacteria become active in his/her body | May feel sick and may have symptoms such as a cough, fever, and/or weight loss |
| Usually has a TB skin test or TB blood test reaction indicating TB infection | Usually has a TB skin test or TB blood test reaction indicating TB infection |
| Radiograph is typically normal | Radiograph may be abnormal |
| Sputum smears and cultures are negative | Sputum smears and cultures may be positive |
| Should consider treatment for LTBI to prevent TB disease | Needs treatment for TB disease |
| Does not require respiratory isolation | May require respiratory isolation |
| Not a TB case | A TB case |

Reference Material: https://www.cdc.gov/tb/education/corecurr/pdf/chapter2.pdf

**Signs and Symptoms**

Although your body can harbor the bacteria that cause tuberculosis, your immune system usually can prevent you from becoming sick. For this reason, doctors make a distinction between:

* **Latent TB.** You have a TB infection, but the bacteria in your body are inactive and cause no symptoms. Latent TB, also called inactive TB or TB infection, isn't contagious. Latent TB can turn into active TB, so treatment is important.
* **Active TB.** Also called TB disease, this condition makes you sick and, in most cases, can spread to others. It can occur weeks or years after infection with the TB bacteria.

**Signs and symptoms of active TB** include:

* Coughing for three or more weeks
* Coughing up blood or mucus
* Chest pain, or pain with breathing or coughing
* Unintentional weight loss
* Fatigue
* Fever
* Night sweats
* Chills
* Loss of appetite

Tuberculosis can also affect other parts of your body, including the kidneys, spine or brain. When TB occurs outside your lungs, signs and symptoms vary according to the organs involved. For example, tuberculosis of the spine might cause back pain, and tuberculosis in your kidneys might cause blood in your urine.

See your doctor if you have a fever, unexplained weight loss, drenching night sweats or a persistent cough. These are often indications of TB but can also result from other conditions. Also, see your doctor if you think you've been exposed to TB.

The Centers for Disease Control and Prevention recommends that people who have an increased risk of tuberculosis be screened for latent TB infection. This recommendation includes people who:

* Have HIV/AIDS
* Use IV drugs
* Are in contact with infected people
* Are from a country where TB is common, such as several countries in Latin America, Africa and Asia
* Live or work in areas where TB is common, such as prisons or nursing homes
* Work in health care and treat people with a high risk of TB
* Are children who are exposed to adults at risk of TB

**Diagnosis**

Screening methods for TB include the following:

* [Mantoux tuberculin skin test](http://www.cdc.gov/tb/education/Mantoux/default.htm) [with purified protein derivative (PPD) for active or latent infection (primary method)](http://www.cdc.gov/tb/education/Mantoux/default.htm)
* In vitro blood test based on interferon gamma release assay (IGRA) with antigens specific for *Mycobacterium tuberculosis* for latent infection

Obtain the following laboratory tests for patients with suspected TB:

* Acid-fast bacilli (AFB) smear and culture using sputum obtained from the patient: Absence of a positive smear result does not exclude active TB infection; AFB culture is the most specific test for TB
* HIV serology in all patients with TB and unknown HIV status: Individuals infected with HIV are at increased risk for TB

Other diagnostic testing may warrant consideration, including the following:

* Specific enzyme-linked immunospot (ELISpot)
* Nucleic acid amplification tests
* Blood culture

Positive cultures should be followed by drug susceptibility testing; symptoms and radiographic findings do not differentiate multidrug-resistant TB (MDR-TB) from fully susceptible TB. Such testing may include the following:

* Direct DNA sequencing analysis
* Automated molecular testing
* Microscopic-observation drug susceptibility (MODS) and thin-layer agar (TLA) assays
* Additional rapid tests (eg, BACTEC-460, ligase chain reaction, luciferase reporter assays, FASTPlaque TB-RIF)

Obtain a chest radiograph to evaluate for possible associated pulmonary findings. The following patterns may be seen:

* Cavity formation: Indicates advanced infection; associated with a high bacterial load
* Noncalcified round infiltrates: May be confused with lung carcinoma
* Homogeneously calcified nodules (usually 5-20 mm): Tuberculomas, representing old infection
* Primary TB: Typically, pneumonialike picture of infiltrative process in middle or lower lung regions
* Reactivation TB: Pulmonary lesions in posterior segment of right upper lobe, apicoposterior segment of left upper lobe, and apical segments of lower lobes
* TB associated with HIV disease: Frequently atypical lesions or normal chest radiographic findings
* Healed and latent TB: Dense pulmonary nodules in hilar or upper lobes; smaller nodules in upper lobes
* Miliary TB: Numerous small, nodular lesions that resemble millet seeds
* Pleural TB: Empyema may be present, with associated pleural effusions

Workup considerations for extrapulmonary TB include the following:

* Biopsy of bone marrow, liver, or blood cultures
* If tuberculous meningitis or tuberculoma is suspected, perform lumbar puncture
* If vertebral ( [Pott disease](http://emedicine.medscape.com/article/226141-overview)) or brain involvement is suspected, CT or MRI is necessary
* If genitourinary complaints are reported, urinalysis and urine cultures can be obtained

**Management**

Physical measures (if possible or practical) include the following:

* Isolate patients with possible TB in a private room with negative pressure
* Have medical staff wear high-efficiency disposable masks sufficient to filter the bacillus
* Continue isolation until sputum smears are negative for 3 consecutive determinations (usually after approximately 2-4 weeks of treatment)

Initial empiric pharmacologic therapy consists of the following 4-drug regimens:

* Isoniazid
* Rifampin
* Pyrazinamide
* Either ethambutol or streptomycin

Special considerations for drug therapy in pregnant women include the following:

* In the United States, pyrazinamide is reserved for women with suspected MDR-TB
* Streptomycin should not be used
* Preventive treatment is recommended during pregnancy
* Pregnant women are at increased risk for isoniazid-induced hepatotoxicity
* Breastfeeding can be continued during preventive therapy

Special considerations for drug therapy in children include the following:

* Most children with TB can be treated with isoniazid and rifampin for 6 months, along with pyrazinamide for the first 2 months if the culture from the source case is fully susceptible.
* For postnatal TB, the treatment duration may be increased to 9 or 12 months
* Ethambutol is often avoided in young children

Special considerations for drug therapy in HIV-infected patients include the following:

* Dose adjustments may be necessary
* Rifampin must be avoided in patients receiving protease inhibitors; rifabutin may be substituted
* Considerations in patients receiving antiretroviral therapy include the following:
* Patients with HIV and TB may develop a paradoxical response when starting antiretroviral therapy
* Starting antiretroviral therapy early (eg, < 4 weeks after the start of TB treatment) may reduce progression to AIDS and death
* In patients with higher CD4+ T-cell counts, it may be reasonable to defer antiretroviral therapy until the continuation phase of TB treatment

**Multidrug-resistant TB**

Multidrug-resistant TB (MDR-TB) refers to isolates that are **resistant** to both isoniazid and rifampin (and possibly other drugs). When MDR-TB is suspected, start treatment empirically before culture results become available; obtain **molecular drug susceptibility testing**, if possible. **Modify the initial regimen**, as necessary, based on susceptibility results. Never add a single new drug to a failing regimen. Administer at least 5 drugs for the intensive phase of treatment and at least 4 drugs for the continuation phase (listed in order of preference), as follows:

* A fluoroquinolone: levofloxacin or moxifloxacin preferred
* Bedaquiline
* Linezolid
* Clofazimine (available only through Investigational New Drug application through FDA)
* Cycloserine
* An aminoglycoside: streptomycin or amikacin preferred
* Ethambutol
* Pyrazinamide
* Delamanid
* Ethionamide
* Para-aminosalicylic acid

Surgical resection is recommended for patients with MDR-TB whose prognosis with medical treatment is poor. Procedures include the following:

* Segmentectomy (rarely used)
* Lobectomy
* Pneumonectomy
* Pleurectomy for thick pleural peel (rarely indicated)

**Latent TB**

Recommended regimens for isoniazid and rifampin for latent TB have been published by the US Centers for Disease Control and Prevention (CDC): An alternative regimen for latent TB is isoniazid plus rifapentine as self-administered or directly observed therapy (DOT) once-weekly for 12 weeks; it is not recommended for children under 2 years, pregnant women or women planning to become pregnant, or patients with TB infection presumed to result from exposure to a person with TB that is resistant to 1 of the 2 drugs.

**Complications**

Without treatment, tuberculosis can be fatal. Untreated active disease typically affects your lungs, but it can affect other parts of your body, as well.

Tuberculosis complications include:

* **Spinal pain.** Back pain and stiffness are common complications of tuberculosis.
* **Joint damage.** Arthritis that results from tuberculosis (tuberculous arthritis) usually affects the hips and knees.
* **Swelling of the membranes that cover your brain (meningitis).** This can cause a lasting or intermittent headache that occurs for weeks and possible mental changes.
* **Liver or kidney problems.** Your liver and kidneys help filter waste and impurities from your bloodstream. Tuberculosis in these organs can impair their functions.
* **Heart disorders.** Rarely, tuberculosis can infect the tissues that surround your heart, causing inflammation and fluid collections that might interfere with your heart's ability to pump effectively. This condition, called cardiac tamponade, can be fatal.

If you test positive for latent TB infection, your doctor might advise you to take medications to reduce your risk of developing active tuberculosis. Only active TB is contagious.

**Prevention and Control**

If you test positive for latent TB infection, your doctor might advise you to take medications to reduce your risk of developing active tuberculosis. Only active TB is contagious.

**Protect your family and friends**

If you have active TB, it generally takes a few weeks of treatment with TB medications before you're not contagious anymore. Follow these tips to help keep your friends and family from getting sick:

* **Stay home.** Don't go to work or school or sleep in a room with other people during the first few weeks of treatment.
* **Ventilate the room.** Tuberculosis germs spread more easily in small closed spaces where air doesn't move. If it's not too cold outdoors, open the windows and use a fan to blow indoor air outside.
* **Cover your mouth.** Use a tissue to cover your mouth anytime you laugh, sneeze or cough. Put the dirty tissue in a bag, seal it and throw it away.
* **Wear a face mask.** Wearing a face mask when you're around other people during the first three weeks of treatment may help lessen the risk of transmission.

**Finish your medication**

This is the most important step you can take to protect yourself and others from tuberculosis. When you stop treatment early or skip doses, TB bacteria have a chance to develop mutations that allow them to survive the most potent TB drugs. The resulting drug-resistant strains are deadlier and more difficult to treat.

In countries where tuberculosis is more common, infants often are vaccinated with bacille Calmette-Guerin (BCG) vaccine. Dozens of new TB vaccines are in various stages of development and testing.

**Leprosy (Hansen’s Disease)**

[Leprosy](https://www.webmd.com/skin-problems-and-treatments/guide/leprosy-symptoms-treatments-history) is an infectious disease that causes severe, **disfiguring**[**skin**](https://www.webmd.com/skin-problems-and-treatments/picture-of-the-skin)**sores and**[**nerve damage**](https://www.webmd.com/brain/nerve-pain-and-nerve-damage-symptoms-and-causes)**in the arms, legs, and skin areas around your body**. Leprosy has been around since ancient times. Outbreaks have affected people on every continent.

**Classification**

Leprosy is defined by the number and type of skin sores you have. Specific symptoms and treatment depend on the type of leprosy. The types are:

* **Tuberculoid.**A **mild, less severe form of leprosy**. People with this type have only one or a **few patches of flat, pale-colored skin** (paucibacillary leprosy). The affected area of skin may feel numb because of nerve damage underneath. Tuberculoid leprosy is less contagious than other forms.
* **Lepromatous.** A **more severe** form of the disease. It brings **widespread skin bumps and**[**rashes**](https://www.webmd.com/skin-problems-and-treatments/guide/common-rashes) (multibacillary leprosy), **numbness, and muscle weakness**. The nose, [kidneys](https://www.webmd.com/kidney-stones/picture-of-the-kidneys), and [male reproductive organs](https://www.webmd.com/sex-relationships/guide/male-reproductive-system) may also be affected. It is more contagious than tuberculoid leprosy.
* **Borderline.** People with this type of leprosy have symptoms of **both the tuberculoid and lepromatous forms**.

You may also hear doctors use this simpler classification:

* Single lesion paucibacillary (SLPB): One lesion
* Paucibacillary (PB): Two to five lesions
* Multibacillary (MB): Six or more lesions

**Epidemiology**

According to WHO figures based on reports from 159 countries, 208,619 new leprosy cases were reported globally in 2018. The worldwide prevalence reported at the end of 2018 was 184,212 cases (rate, 0.2/10,000). In 2018, Brazil, India, and Indonesia accounted for 79.6% of all new leprosy cases. In addition, 23 priority countries accounted for 96% of cases worldwide in 2018.

In 2015, according to the Centers for Disease Control and Prevention (CDC), 178 new cases of leprosy were reported in the United States.

Kenya is in the post elimination phase of leprosy control, having achieved the WHO elimination target of less than 1 case per 10,000 people in 1989. The number of new reported leprosy cases in the country declined steadily from 6,558 in 1986 to 131 cases in 2015. Despite the low number of reported cases, leprosy continues to cause high morbidity among those infected with 48% of new cases notified in 2013 having advanced disease with disability grade 1 and 2. In 2014, 133 Leprosy cases were notified, majority (90%) being multibacilary (MB) patients. This advanced form of the disease implies localized infection which continues to be spread in the communities as individuals stay for longer periods before being diagnosed. Additionally, childhood cases accounted for 11% and 2% of the cases diagnosed in the year 2014 and 2015 respectively, indicating ongoing active transmission.

**Causative Organism**

Leprosy is caused by a slow-growing type of bacteria called *Mycobacterium leprae*(*M. leprae*). Leprosy is also known as Hansen's disease, after the scientist who discovered *M. leprae* in 1873.

**Mode of Transmission**

It **isn’t clear exactly how leprosy is transmitted**. When a person with leprosy [**coughs**](https://www.webmd.com/cold-and-flu/overview)**or sneezes, they may spread droplets** containing the *M. leprae*bacteria that another person breathes in. **Close physical contact** with an infected person is necessary to transmit leprosy. It isn’t spread by casual contact with an infected person, like shaking hands, hugging, or sitting next to them on a bus or at a table during a meal.

[**Pregnant**](https://www.webmd.com/baby/default.htm)**mothers with leprosy can’t pass it to their unborn babies**. It’s not transmitted by sexual contact either.

**Pathophysiology**

[*Mycobacterium leprae*](https://www.wikidoc.org/index.php/Mycobacterium_leprae) has predisposition to [**infect**](https://www.wikidoc.org/index.php/Infect)[**macrophages**](https://www.wikidoc.org/index.php/Macrophages). It is usually collected inside these, in [intracellular](https://www.wikidoc.org/index.php/Intracellular) groups, called **globi**. This [organism](https://www.wikidoc.org/index.php/Organism) has an ideal growth temperature of **27-30ºC**, which explains why it usually [infects](https://www.wikidoc.org/index.php/Infection) areas such as the [**skin**](https://www.wikidoc.org/index.php/Skin)**,**[**upper respiratory**](https://www.wikidoc.org/index.php/Upper_respiratory)[**mucosa**](https://www.wikidoc.org/index.php/Mucosa)**and**[**peripheral nerves**](https://www.wikidoc.org/index.php/Peripheral_nerves). It is able to [infect](https://www.wikidoc.org/index.php/Infect) [cells](https://www.wikidoc.org/index.php/Cells), particularly due to 2 structures:

* [**Capsule**](https://www.wikidoc.org/index.php/Capsule) - target of intense **humoral immune response** (immunoglobulin M-mediated).
* [**Cell wall**](https://www.wikidoc.org/index.php/Cell_wall) - particularly the *lipoarabinomannan*, works as an [**antigen**](https://www.wikidoc.org/index.php/Antigen)**for the**[**macrophages**](https://www.wikidoc.org/index.php/Macrophages).

The [bacillus](https://www.wikidoc.org/index.php/Bacillus) is known to **target**[**Schwann cells**](https://www.wikidoc.org/index.php/Schwann_cells), specifically the G domain of the [laminin](https://www.wikidoc.org/index.php/Laminin)-α2 chain. This domain is predominantly expressed in the [**basal lamina**](https://www.wikidoc.org/index.php/Basal_lamina)**of**[**peripheral nerves**](https://www.wikidoc.org/index.php/Peripheral_nerves), thereby explaining the [**neuropathy**](https://www.wikidoc.org/index.php/Neuropathy)**felt** in this condition. The [pathogen](https://www.wikidoc.org/index.php/Pathogen) then **penetrates the**[**cell**](https://www.wikidoc.org/index.php/Cell), at which time it will multiply, until the [infected](https://www.wikidoc.org/index.php/Infected) [cell](https://www.wikidoc.org/index.php/Cell) is finally recognized by the [**immune system**](https://www.wikidoc.org/index.php/Immune_system)**and a an**[**inflammatory**](https://www.wikidoc.org/index.php/Inflammatory)**reaction is started**.

This mechanism explains the reason why the clinical manifestations of the disease will depend on the **immunologic status** of the patient and the **intensity of the response** developed following the [infection](https://www.wikidoc.org/index.php/Infection) of the host [cells](https://www.wikidoc.org/index.php/Cells).

**Immunologic Reactions**

**Systemic**[**inflammatory**](https://www.wikidoc.org/index.php/Inflammatory)**reactions** may occur before, during or after the [treatment](https://www.wikidoc.org/index.php/Therapy) of leprosy. These are thought to be related to changes in the [immune system](https://www.wikidoc.org/index.php/Immune_system), such as following stressful situations or leprosy medications. There are two different types of reactions, which are thought to have different underlying immunologic mechanisms:

**Type 1 Reactions or Reversal Reactions (RR)**

* Predominant in borderline [disease](https://www.wikidoc.org/index.php/Disease)
* Predominant [type IV hypersensitivity](https://www.wikidoc.org/index.php/Type_IV_hypersensitivity)
* Red patches developing in previous [skin lesions](https://www.wikidoc.org/index.php/Skin_lesions), commonly on the [face](https://www.wikidoc.org/index.php/Face) or [nerve](https://www.wikidoc.org/index.php/Nerve) trunks
* [Erythema](https://www.wikidoc.org/index.php/Erythema) of previous [skin lesions](https://www.wikidoc.org/index.php/Skin_lesions)
* [Inflammation](https://www.wikidoc.org/index.php/Inflammation) may lead to [nerve](https://www.wikidoc.org/index.php/Nerve) lesion and [paralysis](https://www.wikidoc.org/index.php/Paralysis)
* [Edema](https://www.wikidoc.org/index.php/Edema) of [hands](https://www.wikidoc.org/index.php/Hands) and [feet](https://www.wikidoc.org/index.php/Feet)
* [Arthralgia](https://www.wikidoc.org/index.php/Arthralgia), predominantly of smaller [joints](https://www.wikidoc.org/index.php/Joints)
* [Ulcerated](https://www.wikidoc.org/index.php/Ulcer) lesions
* [Pain](https://www.wikidoc.org/index.php/Pain) or [tenderness](https://www.wikidoc.org/index.php/Tenderness) on [lesions](https://www.wikidoc.org/index.php/Lesions)

**Type 2 reactions or Erythema Nodosum Leprosum (ENL)**

* Predominant in lepromatous disease
* Predominant [type III hypersensitivity](https://www.wikidoc.org/index.php/Type_III_hypersensitivity)
* Sudden occurrence of painful [nodules](https://www.wikidoc.org/index.php/Nodules)
* [Nodules](https://www.wikidoc.org/index.php/Nodules) may lead to [pustules](https://www.wikidoc.org/index.php/Pustules) or ulcers
* [Pustules](https://www.wikidoc.org/index.php/Pustules) may discharge [pus](https://www.wikidoc.org/index.php/Pus) containing [polymorphonuclear cells](https://www.wikidoc.org/index.php/Polymorphonuclear_cells) and degenerating [mycobacteria](https://www.wikidoc.org/index.php/Mycobacteria)
* After [lesions](https://www.wikidoc.org/index.php/Lesions) resolve, brawn [skin lesions](https://www.wikidoc.org/index.php/Skin_lesions) may remain
* Occasionallymayoccur: [orchitis](https://www.wikidoc.org/index.php/Orchitis), [muscle](https://www.wikidoc.org/index.php/Muscle) and [lymphadenopathy](https://www.wikidoc.org/index.php/Lymphadenopathy) [tenderness](https://www.wikidoc.org/index.php/Tenderness) and/or swollen [joints](https://www.wikidoc.org/index.php/Joints)
* Without treatment usually lasts for 2 weeks

**Signs and Symptoms**

Leprosy primarily affects your skin and nerves outside [your brain](https://www.webmd.com/brain/picture-of-the-brain) and spinal cord, called the peripheral nerves. It may also strike your [eyes](https://www.webmd.com/eye-health/picture-of-the-eyes) and the thin tissue lining the inside of your nose.

The main symptom of leprosy is disfiguring skin sores, lumps, or bumps that don’t go away after several weeks or months. The skin sores are pale-colored.

Nerve damage can lead to:

* Loss of feeling in the arms and legs
* Muscle weakness

It usually takes about 3 to 5 years for symptoms to appear after coming into contact with the bacteria that causes leprosy. Some people do not develop symptoms until 20 years later. The time between contact with the bacteria and the appearance of symptoms is called the incubation period. Leprosy's long incubation period makes it very difficult for doctors to determine when and where a person with leprosy got infected.

**Diagnosis**

If you have a skin sore that might be leprosy, the doctor will remove a small sample of it and send it to a lab to be examined. This is called a **skin**[**biopsy**](https://www.webmd.com/cancer/what-is-a-biopsy). Your doctor may also do a **skin smear test**. If you have **paucibacillary leprosy, there won’t be any bacteria in the test results**. If you have **multibacillary leprosy, there will be**.

You may need a **lepromin skin test to see which type of leprosy you have**. For this test, the doctor will inject a small amount of inactive leprosy-causing bacteria just underneath the skin of your forearm. They’ll check the spot where you got the shot 3 days later, and then again 28 days later, to see if you have a reaction. If you do have a reaction, you may have tuberculoid or borderline tuberculoid leprosy. People who don’t have leprosy or who have lepromatous leprosy won’t have a reaction to this test.

**Management**

**Antibiotic Therapy**

* **Multibacillary Leprosy (Skin smear positive)**
* Preferred regimen: [Dapsone](https://www.wikidoc.org/index.php/Dapsone) 100 mg/day PO **AND** [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 600 mg PO 4 times per week **AND** [Clofazimine](https://www.wikidoc.org/index.php/Clofazimine) 50 mg/day PO supplemented by [Clofazimine](https://www.wikidoc.org/index.php/Clofazimine) 300 mg PO loading dose monthly
* Pediatric regimen: [Dapsone](https://www.wikidoc.org/index.php/Dapsone) 1-2 mg/kg/day PO **AND** [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 450 mg PO <35 kg, 300 mg PO <20 kg, 150 mg PO <12 kg
* Length of treatment: 12-24 months
* **Paucibacillary Leprosy (Skin Smear negative)**
* Preferred regimen: [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 600 mg PO once a month for 6 months **AND** [Dapsone](https://www.wikidoc.org/index.php/Dapsone) 100 mg/day PO for 6 months
* **Erythema Nodosum Leprosum (ENL)**
* Continue anti-leprosy drugs throughout
* Mild
* Preferred regimen: Rest affect limb, analgesics, follow-up after every 2wks, check for iridocyclitis; [Chloroquine](https://www.wikidoc.org/index.php/Chloroquine) **OR** [Aspirin](https://www.wikidoc.org/index.php/Aspirin) may be useful
* 3.2 Severe (numerous nodules + fever, ulcerating / pustular ENL, visceral involvement, nodules + neuritis, recurrent ENL)
* Preferred regimen: [Prednisolone](https://www.wikidoc.org/index.php/Prednisolone) 30-40 mg/day PO (not to exceed 1 mg/kg) for 1-2 weeks **THEN** taper over 12 weeks
* Alternative regimen (1): (If unresponsive to corticosteroids or if risk of corticosteroids prevent administration). Start [Clofazimine](https://www.wikidoc.org/index.php/Clofazimine) 100 mg PO three times a day for maximum of 12 weeks, taper the dose to 100 mg PO two times a day for 12 weeks **THEN** 100 mg every day for 12-24 weeks
* Alternative regimen (2): (if not contraindicated) [Thalidomide](https://www.wikidoc.org/index.php/Thalidomide) 200-400 mg/day PO, reduced to 50-100 mg/day after 1-2 weeks
* 4. **Reversal Reaction**
* Preferred regimen: [Prednisolone](https://www.wikidoc.org/index.php/Prednisolone) start with 40 mg/day PO **THEN** taper by 10 mg twice a week for 12 weeks

**Prophylaxis**

* **Adult**
* 1.1 **35 kg and over**
* Preferred regimen: [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 600 mg PO single dose
* 1.2 **less than 35 kg**
* Preferred regimen: [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 450 mg PO single dose
* **Pediatric**
* 2.1 **for children older than 9 yrs**
* Preferred regimen: [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 450 mg PO single dose
* 2.2 **for children aged 5 to 9 yrs**
* Preferred regimen: [Rifampin](https://www.wikidoc.org/index.php/Rifampin) 300 mg PO single dose

**PO (meaning taken by mouth)**

**Complications**

Without treatment, leprosy can permanently damage your skin, nerves, arms, legs, [feet](https://www.webmd.com/pain-management/picture-of-the-feet), and [eyes](https://www.webmd.com/eye-health/eye-assessment/default.htm).

Complications of leprosy can include:

* Blindness or [glaucoma](https://www.webmd.com/eye-health/glaucoma-eyes)
* [Iritis](https://www.webmd.com/eye-health/iritis)
* [Hair loss](https://www.webmd.com/skin-problems-and-treatments/hair-loss/default.htm)
* [Infertility](https://www.webmd.com/infertility-and-reproduction/default.htm)
* Disfiguration of the face (including permanent swelling, bumps, and lumps)
* [Erectile dysfunction](https://www.webmd.com/erectile-dysfunction/default.htm) and [infertility](https://www.webmd.com/infertility-and-reproduction/guide/understanding-infertility-basics) in men
* Kidney failure
* Muscle weakness that leads to claw-like hands or a not being able to flex your feet
* Permanent damage to the inside of your nose, which can lead to [nosebleeds](https://www.webmd.com/first-aid/nosebleeds-causes-and-treatments) and a chronic stuffy nose
* Permanent damage to the nerves outside your brain and spinal cord, including those in the arms, legs, and feet

Nerve damage can lead to a dangerous loss of feeling. If you have leprosy-related nerve damage, you may not feel [pain](https://www.webmd.com/pain-management/default.htm) when you get cuts, [burns](https://www.webmd.com/first-aid/types-degrees-burns), or other injuries on your hands, legs, or feet.

**Prevention and Control**

[Prevention](https://www.medicinenet.com/prevention/article.htm) of contact with droplets from nasal and other secretions from patients with untreated *M. leprae* infection is currently the most effective way to avoid the disease. Treatment of patients with appropriate antibiotics stops the person from spreading the disease. People who live with individuals who have untreated leprosy are about eight times as likely to develop the disease, because investigators speculate that family members have close proximity to infectious droplets. Leprosy is not hereditary, but recent findings suggest susceptibility to the disease may have a genetic basis.

Many people have exposures to leprosy throughout the world, but the disease in not highly contagious. Researchers suggest that most exposures result in no disease, and further studies suggest that susceptibility depends, in part, on a person's genetic [makeup](https://www.medicinenet.com/beauty_quiz/quiz.htm). In the U.S., there are about 200-300 new cases diagnosed per year, with most coming from exposures during foreign travel. The majority of worldwide cases occur in the tropics or subtropics (for example, Brazil, India, and Indonesia). The WHO reports about 500,000 to 700,000 new cases per year worldwide, with curing of about 14 million cases since 1985.

There is no commercially available [vaccine](https://www.medicinenet.com/vaccination_faqs/article.htm) available to prevent leprosy. However, there are reports that using **BCG vaccine along with heat-killed *M. leprae* organisms, and other preparations may be protective, help to clear the infection or possibly shorten treatment**. Except for BCG being obtainable in some countries, these other preparations are not readily available.

Animals (chimpanzees, mangabey monkeys, and nine-banded armadillos) rarely transfer *M. leprae* to humans. Nonetheless, it is not advisable to handle such animals in the wild. These animals are a source for endemic infections.

**Typhoid**

Typhoid fever is an acute illness associated with fever caused by the *Salmonella enterica serotype Typhi* bacteria. It can also be caused by [*Salmonella*](https://www.webmd.com/food-recipes/food-poisoning/ss/slideshow-salmonella)*paratyphi*, a related bacterium that usually causes a less severe illness. The bacteria are deposited in water or food by a human carrier and are then spread to other people in the area.

**Classification**

There is no established classification system for typhoid fever. However, typhoid fever may be classified informally as follows.

**Duration of illness**

**Acute disease**

* Sudden-onset
* Severe in nature
* Lasts < 12 months
* Mostly symptomatic

**Chronic disease**

* Lasts > 12 months
* Less severe
* Asymptomatic
* Spread infection to others

**Severity of illness**

**Mild disease**

* Early diagnosis and treatment
* [Antibiotic](https://www.wikidoc.org/index.php/Antibiotic) susceptibility
* Absence of [complications](https://www.wikidoc.org/index.php/Complications)

**Moderate to severe disease**

* Late presentation
* Presence of [complications](https://www.wikidoc.org/index.php/Complications)
* [Antibiotic](https://www.wikidoc.org/index.php/Antibiotic) resistance

**Virulence factors**

**High virulence factors**

* PhoP/phoQ genes
* CdtB protein
* Vi antigen-positive strains

**Low virulence factors**

* Absence of above factors
* Presence of following host factors
* C282 mutation
* CFTR mutation

**Epidemiology**

Typhoid fever occurs worldwide, primarily in developing nations whose sanitary conditions are poor. Typhoid fever is endemic in Asia, Africa, Latin America, the Caribbean, and Oceania, but 80% of cases come from Bangladesh, China, India, Indonesia, Laos, Nepal, Pakistan, or Vietnam.Within those countries, typhoid fever is most common in underdeveloped areas. Typhoid fever infects roughly 21.6 million people (incidence of 3.6 per 1,000 population) and kills an estimated 200,000 people every year.

In the United States, most cases of typhoid fever arise in international travelers. The average yearly incidence of typhoid fever per million travelers from 1999-2006 by county or region of departure was as follows:

* Western Hemisphere outside Canada/United States - 1.3
* Africa - 7.6
* Asia - 10.5
* India - 89 (122 in 2006)
* Total (for all countries except Canada/United States) - 2.2

Typhoid inflicts a significant public health burden in Kenya. The Global Burden of Disease estimates that in 2016, Kenya had 97,762 typhoid cases, 62% among children aged less than 15 years; and 1,075 typhoid deaths, 66% among children aged less than 15 years.

**Mortality / Morbidity**

With prompt and appropriate antibiotic therapy, typhoid fever is typically a short-term febrile illness requiring a median of 6 days of hospitalization. Treated, it has few long-term sequelae and a 0.2% risk of mortality.Untreated typhoid fever is a life-threatening illness of several weeks' duration with long-term morbidity often involving the central nervous system. The case fatality rate in the United States in the pre-antibiotic era was 9%-13%.

**Mode of Transmission**

Typhoid fever is contracted by drinking or eating the bacteria in contaminated food or water. People with acute illness can contaminate the surrounding water supply through stool, which contains a high concentration of the bacteria. Contamination of the water supply can, in turn, taint the food supply. The bacteria can survive for weeks in water or dried sewage.

About 3%-5% of people become carriers of the bacteria after the acute illness. Others suffer a very mild illness that goes unrecognized. These people may become long-term carriers of the bacteria -- even though they have no symptoms -- and be the source of new outbreaks of typhoid fever for many years.

**Risk Factors of Typhoid Fever**

Common risk factors in the development of typhoid fever are:

* Travel to [endemic](https://www.wikidoc.org/index.php/Endemic) areas
* Poor hygiene habits
* Poor sanitation conditions
* Proximity to flying insects feeding on feces
* Contact with someone who recently suffered from typhoid fever
* Recent use of antibiotics
* [Achlorhydria](https://www.wikidoc.org/index.php/Achlorhydria)
* [Immunosuppressive](https://www.wikidoc.org/index.php/Immunosuppressive) illnesses such as [AIDS](https://www.wikidoc.org/index.php/AIDS)
* Crowded housing
* Consumption of raw fruits and vegetables contaminated with sewage
* Prolonged illness
* Being a health care worker
* Being a clinical microbiologists who handles *Salmonella typhi*
* Childhood

**Pathophysiology**

Once consumed, typhoid bacteria cross the epithelial layer of the intestinal wall. They are then quickly consumed by macrophages and transported to the aggregates of lymphoid tissue in the small intestine (Peyer’s patches) where the immune function of the gut is most concentrated. The typhoid bacteria alter host cell signaling and function in such a way that host cells ultimately promote the survival and replication of S. *typhi* and *S*. *paratyphi*.

The incubation stage of a typhoid infection is characterized by the replication and transfer of*S. typhi* and *S. paratyphi* from the Peyer’s patches in the gastrointestinal system, through the lymphatics, to the organs of the reticuloendothelial system including the lymph nodes, spleen, bone marrow, and liver. Once in the gallbladder, *S. typhi* and *S. paratyphi* are secreted back into the gastrointestinal tract. Having been previously exposed to the organism, the Peyer’s patches respond with an intense inflammatory reaction leading to congestion and clogging of the microcirculation and capillaries with release of lytic lysosomal enzymes and other inflammatory mediators. This results in varying degrees of necrosis and ulceration of Peyer’s patches of which the clinical manifestation is bleeding and perforation. The terminal ileum is the most common site of perforation, but perforation has also been reported to occur anywhere from the duodenum to the colon including the gall bladder and appendix.



Depending on the strength of the host’s immune system and the size of the inoculum, the incubation phase may last 3 days to 3 weeks. During this interval, a patient may have no symptoms or vague complaints of fever and abdominal pain. Once the bacterial load reaches a critical mass, an individual is said to have an active typhoid infection.

**Content source: WFSA**

**Virulence Factors of *Salmonella typhi***

* PhoP/phoQ genes
* CdtB protein
* Vi antigen-positive strains

**The above are high virulence factors of the pathogen.**

**With low virulence, the pathogen lacks the above factors while the host has:**

* C282 mutation
* CFTR mutation

**Signs and Symptoms**

Although *S. typhi* is four times more common than *S. paratyphi*, in general, the clinical appearance of *S. typhi* and *S. paratyphi* infections are virtually indistinguishable. Signs and symptoms of the infection consist mostly of abdominal complaints including fever associated with frontal throbbing headache, nausea, vomiting, abdominal pain, anorexia, diarrhea, constipation, gastrointestinal bleeding and hepatosplenomegaly. Systemic complaints are also common and greater than 75% of patients report having flu-like symptoms. Neurologic problems include meningitis, Guillain-Barre syndrome and a delirium that features muttering and picking at clothes and imaginary objects. Disseminated intravascular coagulation, hemolytic uremic syndrome, renal failure, cardiac failure, and respiratory failure have all been reported as a consequence of severe infection. While no specific constellation of symptoms is pathognomonic of the disease, a transient skin rash, described as rose spots, can be biopsied to confirm the diagnosis.

The severity and duration of typhoid fever depends on several host factors including age, integrity of the immune system and GI tract, and alkalization of the stomach. It has been found that a more acidotic environment in the stomach is bactericidal, while a concomitant *Helicobacter pylori* infection, which increases gastric pH, promotes the disease.1 In untreated cases that self-resolve, up to 4% of patients will become asymptomatic carriers and continue to shed the bacteria in urine and stool.

**Diagnosis**

After the ingestion of contaminated food or water, the *Salmonella* bacteria invade the small intestine and enter the bloodstream temporarily. The bacteria are carried by white [blood cells](https://www.webmd.com/heart/anatomy-picture-of-blood) in the [liver](https://www.webmd.com/digestive-disorders/picture-of-the-liver), [spleen](https://www.webmd.com/digestive-disorders/picture-of-the-spleen), and bone marrow, where they multiply and reenter the bloodstream. People develop symptoms, including fever, at this point. Bacteria invade the [gallbladder](https://www.webmd.com/digestive-disorders/picture-of-the-gallbladder), biliary system, and the lymphatic tissue of the bowel. Here, they multiply in high numbers. The bacteria pass into the [intestinal tract](https://www.webmd.com/digestive-disorders/picture-of-the-intestines) and can be identified in stool samples. If a test result isn't clear, [blood](https://www.webmd.com/a-to-z-guides/rm-quiz-blood-basics) or urine samples will be taken to make a diagnosis.

**Management**

Typhoid fever is treated with [antibiotics](https://www.webmd.com/cold-and-flu/video/josephson-antibiotics) which kill the *Salmonella* bacteria. Prior to the use of antibiotics, the fatality rate was 20%. Death occurred from overwhelming infection, pneumonia, intestinal bleeding, or intestinal perforation. With antibiotics and supportive care, mortality has been reduced to 1%-2%. With appropriate antibiotic therapy, there is usually improvement within one to two days and recovery within seven to 10 days.

Several antibiotics are effective for the treatment of typhoid fever. Chloramphenicol was the original drug of choice for many years. Because of rare serious side effects, chloramphenicol has been replaced by other effective antibiotics. The choice of antibiotics is guided by identifying the geographic region where the infection was contracted (for instance, certain strains from South America show a significant resistance to some antibiotics.) If relapses occur, patients are retreated with antibiotics.

Those who become chronically ill (about 3%-5% of those infected), can be treated with prolonged antibiotics. Often, removal of the gallbladder, the site of chronic infection, will provide a cure.

For those traveling to high-risk areas, vaccines are now available.

**Complications**

**Intestinal bleeding or holes**

Intestinal bleeding or holes in the intestine are the most serious complications of typhoid fever. They usually develop in the third week of illness. In this condition, the small intestine or large bowel develops a hole. Contents from the intestine leak into the stomach and can cause severe stomach pain, nausea, vomiting and bloodstream infection (sepsis). This life-threatening complication requires immediate medical care.

**Other, less common complications**

* Inflammation of the heart muscle (myocarditis)
* Inflammation of the lining of the heart and valves (endocarditis)
* Infection of major blood vessels (mycotic aneurysm)
* Pneumonia
* Inflammation of the pancreas (pancreatitis)
* Kidney or bladder infections
* Infection and inflammation of the membranes and fluid surrounding your brain and spinal cord (meningitis)
* Psychiatric problems, such as delirium, hallucinations and paranoid psychosis

With quick treatment, nearly all people in industrialized nations recover from typhoid fever. Without treatment, some people may not survive complications of the disease.

**Prevention and Control**

Safe drinking water, improved sanitation and adequate medical care can help prevent and control typhoid fever. Unfortunately, in many developing nations, these may be difficult to achieve. For this reason, some experts believe that vaccines are the best way to control typhoid fever.

A vaccine is recommended if you live in or are traveling to areas where the risk of getting typhoid fever is high.

**Vaccines**

Two vaccines are available.

* One is given as a single shot at least one week before travel.
* One is given orally in four capsules, with one capsule to be taken every other day.

Neither vaccine is 100% effective. Both require repeat immunizations because their effectiveness wears off over time.

Because the vaccine won't provide complete protection, follow these guidelines when traveling to high-risk areas:

* **Wash your hands.** Frequent hand-washing in hot, soapy water is the best way to control infection. Wash before eating or preparing food and after using the toilet. Carry an alcohol-based hand sanitizer for times when water isn't available.
* **Avoid drinking untreated water.** Contaminated drinking water is a particular problem in areas where typhoid fever is endemic. For that reason, drink only bottled water or canned or bottled carbonated beverages, wine and beer. Carbonated bottled water is safer than non-carbonated bottled water.

Ask for drinks without ice. Use bottled water to brush your teeth, and try not to swallow water in the shower.

* **Avoid raw fruits and vegetables.** Because raw produce may have been washed in contaminated water, avoid fruits and vegetables that you can't peel, especially lettuce. To be absolutely safe, you may want to avoid raw foods entirely.
* **Choose hot foods.** Avoid food that's stored or served at room temperature. Steaming hot foods are best. And although there's no guarantee that meals served at the finest restaurants are safe, it's best to avoid food from street vendors — it's more likely to be infected.
* **Know where the doctors are.** Find out in advance about medical care in the areas you'll visit, and carry a list of the names, addresses and phone numbers of recommended doctors.

**Prevent infecting others**

If you're recovering from typhoid fever, these measures can help keep others safe:

* **Take your antibiotics.** Follow your doctor's instructions for taking your antibiotics, and be sure to finish the entire prescription.
* **Wash your hands often.** This is the single most important thing you can do to keep from spreading the infection to others. Use hot, soapy water and scrub thoroughly for at least 30 seconds, especially before eating and after using the toilet.
* **Avoid handling food.** Avoid preparing food for others until your doctor says you're no longer contagious. If you work in the food service industry or a health care facility, you won't be allowed to return to work until tests show that you're no longer shedding typhoid bacteria.

**Amoebiasis**

Amebiasis is a [parasitic infection](https://www.healthline.com/health/parasitic-infections) of the intestines caused by the amoeba *Entamoeba histolytica*, or*E. histolytica*. Amebiasis is common in tropical countries with underdeveloped sanitation. It’s most common in the Indian subcontinent, parts of Central and South America, Mexico, and parts of Africa. It’s relatively rare in the United States.

People with the greatest risk for amebiasis include:

* people who have traveled to tropical locations where there’s underdeveloped sanitation
* immigrants from tropical countries with underdeveloped sanitary conditions
* people who live in institutions with underdeveloped sanitary conditions, such as prisons
* men who have sex with other men
* people with [suppressed immune systems](https://www.healthline.com/health/immunodeficiency-disorders) and other health conditions

**Classification**

**Classification Based on Responsible Organism**

* ***E. histolytica***

Responsible for all symptomatic amoebiasis

May casuse either luminal (asymptomatic) or invasive infection (symptomatic)

* ***E. dispar***

Responsible for the majority of colonization cases

Only causes luminal infection (asymptomatic)

**Classification Based on Invasion**

* **Luminal amoebiasis**: parasite localized to the intestines, patients are asymptomatic
* **Invasive amoebiasis**: parasite was able to damage the integrity of the intestinal wall, patients symptomatic
* *Invasive intestinal*: parasite causes intestinal manifestations
* *Invasive extraintestinal*: parasite spreads to distant organs and causes extraintestinal manifestations

**Epidemiology**

* Amoebiasis is a worldwide infection whose incidence is highly dependent on sanitation practices.
* Worldwide, the annual incidence of amoebiasis is approximately 50 million cases.
* Prevalence of amoebiasis ranges from approximately 4% in the USA to 50% in certain regions in developing countries.
* It is thought that the prevalence of *E. dispar* is much higher than that of *E. histolytica*, but *E. dispar* is frequently undiagnosed because colonized individuals are almost always asymptomatic. Worldwide, approximately 500 million individuals are thought to be colonized by *E. dispar*.
* In the USA, amoebiasis is more common among immigrants (Hispanic, Asian, or from Pacific Islands) than other groups.
* Worldwide, amoebiasis is associated with 100,000 deaths each year and a case-fatality rate of approximately 200 per 100,000 cases.
* Fewer than 10 amoebiasis-related deaths are reported annually in the USA.
* Elderly patients and young children are at higher risk of developing amoebiasis than adults.
* Adults are at higher risk of developing amoebic liver abscess than children (the incidence of amoebic liver abscess is up to 10x higher in adults than in children).
* The incidence of amoebiasis is higher in developing countries than in developed countries, particularly in regions with poor sanitation systems.
* The incidence of amoebiasis may reach up to 50% in certain regions.
* The incidence of amoebiasis is much lower in developed countries than in developing countries. The lower incidence is attributed to access to safe drinking water and food handling.

In Kenya, there is no continuous surveillance system to combat amoebiasis hence its real prevalence remains unknown in most parts of the country despite majority of the rural population living in areas at risk of infection due to inadequate sanitation and lack of save water for domestic use.

**Causative Organism**

Amoebiasis is caused by parasite *Entamoeba histolytica*. Several protozoan species in the genus *Entamoeba* colonize humans, but not all of them are associated with disease.  It exists in two forms- Vegetative (trophozoite) and cystic forms (cyst). Trophozoites multiply and encyst in the colon. The cysts are excreted in stool and are infective to humans. Cysts remain viable and infective for several days in faeces, water, sewage and soil in the presence of moisture and low temperature.

**Mode of Transmission**

*E. histolytica* is a single-celled protozoan that usually enters the human body when a person ingests cysts through food or water. It can also enter the body through direct contact with fecal matter.

The cysts are a relatively inactive form of the parasite that can live for several months in the soil or environment where they were deposited in feces. The microscopic cysts are present in soil, fertilizer, or water that’s been contaminated with infected feces.

Food handlers may transmit the cysts while preparing or handling food. Transmission is also possible during anal sex, oral-anal sex, and [colonic irrigation](https://www.healthline.com/health/digestive-health/pros-cons-colon-cleanse).

When cysts enter the body, they lodge in the digestive tract. They then release an invasive, active form of the parasite called a trophozoite. The parasites reproduce in the digestive tract and migrate to the large intestine. There, they can burrow into the intestinal wall or the colon.

**Pathophysiology**

*E histolytica* is a pseudopod-forming, non-flagellated protozoal parasite that causes proteolysis and tissue lysis (hence the species name) and can induce host-cell apoptosis. Humans and perhaps nonhuman primates are the only natural hosts.



Life cycle of *Entamoeba histolytica*

Ingestion of *E histolytica* cysts from the environment is followed by excystation in the terminal ileum or colon to form highly motile trophozoites. Upon colonization of the colonic mucosa, the trophozoite may encyst and is then excreted in the feces, or it may invade the intestinal mucosal barrier and gain access to the bloodstream, whereby it is disseminated to the liver, lung, and other sites. Excreted cysts reach the environment to complete the cycle.



*Entamoeba histolytica* trophozoite. Image courtesy of CDC

**Invasion of Intestinal Mucosa**

* *E. histolytica* trophozoites secrete proteases, which induce the release of mucin from goblet cells, resulting in glandular hyperplasia.
* *E. histolytica* is also thought to contain glycosidases that cleave glycsolyated mucin molecules, resulting in mucin degradation.
* Once the mucin layer is degraded, *E. histolytica* then adheres to the enterocyte plasma membrane and uses lectins, amebapores, and proteases to cause damage by a characteristic "hit and run" phenomenon.
* **Lectin**: responsible for adhesion of the parasite on Gal-GalNAc residues of the enterocyte
* **Amebapore**: Protein that forms channels that induce cytolysis in a process similar to perforin-mediated cytolysis of cytotoxic T-cells
* **Protrease**: Enzymes that metabolize cellular proteins
* As the trophozites creates interglandular lesions and degrades the extracellular matrix, it is propelled forward by locomotion.

**Activation of Host Immune System**

* As the trophozoites invade, IL-8 and TNF-alpha secretion is upregulated, and the host immune cells are activated.
* Neutrophils migrate to the site of invasion and contribute to the inflammatory damage induced by *E. histolytica*, but are generally incapable of destroying the organism. The mechanism may which *E. histolytica* evades neutrophils is unknown.
* Once neutrophils are recruited, macrophages and eosinophils are also activated.
* The tropohozites can then invade into the bloodstream, whereby they can ingest red blood cells (erythrophagocytosis) and migrate into distant organs (e.g. liver, brain, lungs).

**Signs and Symptoms**

According to the Centers for Disease Control and Prevention (CDC), only about [10 to 20 percent Trusted Source](http://www.cdc.gov/parasites/amebiasis/general-info.html) of people who have amebiasis become ill from it.

While most people have no symptoms, amebiasis can cause [bloody diarrhea](https://www.healthline.com/health/digestive-health/red-diarrhea), [colitis](https://www.healthline.com/health/colitis), and tissue destruction. The person can then spread the disease by releasing new cysts into the environment through infected feces.

When symptoms do occur, they tend to appear 1 to 4 weeks after ingestion of the cysts. Symptoms at this stage tend to be mild and include loose stools and [stomach cramping](https://www.healthline.com/health/abdominal-pain). In a rare complication of the disease, the trophozoites may breach the intestinal walls, enter the bloodstream, and travel to various internal organs. They most commonly end up in the liver, but may also infect the heart, lungs, brain, or other organs.

If trophozoites invade an internal organ, they can potentially cause:

* abscesses
* infections
* severe illness
* death

If the parasite invades the lining of the intestine, it can cause amebic dysentery. Amebic dysentery is a more dangerous form of amebiasis with frequent watery and [bloody stools](https://www.healthline.com/health/bloody-or-tarry-stools) and severe stomach cramping.

Another very rare complication is fulminant necrotizing amoebic colitis, which can destroy bowel tissue and lead to bowel [perforation](https://www.healthline.com/health/gastrointestinal-perforation) and [peritonitis](https://www.healthline.com/health/peritonitis). The liver is a frequent destination for the parasite, where it can cause a collection of pus called an amebic liver abscess. Symptoms include [fever](https://www.healthline.com/health/fever) and tenderness in the upper-right part of the abdomen.

**Diagnosis**

Your doctor may suspect amebiasis after asking about your recent health and travel history.

It can be difficult to diagnose amebiasis because *E. histolytica* looks a lot like other parasites, such as *E. dispar*, which is [occasionally Trusted Source](https://www.cdc.gov/dpdx/amebiasis/index.html) seen with *E. histolytica* but is generally considered nonpathogenic, meaning it’s not associated with disease.

To detect *E. histolytica* and rule out other possible infections, your doctor may order tests such as stool samples and antigen testing.

The following tests may be performed to check for the presence of *E. histolytica*:

* Most commonly, you may have to provide stool samples for several days that will be screened for the parasite. This is because the number of amoebas may vary from day to day and may be too low to detect from just one stool sample.
* A stool test called enzyme-linked immunosorbent assay (ELISA) is often performed to detect *E. histolytica* [antigens](https://www.healthline.com/health/infection/antigen-vs-antibody).
* Using a blood sample or nasal swab, a molecular polymerase chain reaction (PCR) test may be performed to distinguish *E. histolytica* from other infections.
* Your doctor may also order blood tests to help determine if the infection has spread beyond your intestines to another organ, such as your [liver](https://www.healthline.com/health/liver-function-tests).
* When the parasites spread outside the intestine, they may no longer show up in your stool. Your doctor may order an [ultrasound](https://www.healthline.com/health/abdominal-ultrasound) or [CT scan](https://www.healthline.com/health/abdominal-ct-scan) to check for lesions on your liver.
* If lesions appear, your doctor may need to perform a needle [aspiration](https://www.healthline.com/health/aspiration) to see if the liver has any abscesses. An abscess in the liver is a serious consequence of amebiasis.
* Finally, a [colonoscopy](https://www.healthline.com/health/colonoscopy) may be necessary to check for the presence of the parasite in your large intestine (colon).

**Management**

If tests detect the presence of *E. histolytica*, amebiasis needs to be treated regardless of whether you’re experiencing symptoms or not.

If tests only detect *E. dispar*, another amoeba that may cause amebiasis, treatment is generally not warranted since it’s nonpathogenic.

The treatment generally consists of the following:

* If you have symptoms, you’ll follow a 10-day course of the anti-amoebic drug [metronidazole](https://www.healthline.com/health/metronidazole-oral-tablet) (Flagyl) that you’ll take as a capsule, followed by an antibiotic such as diloxanide furoate or paromomycin.
* Your doctor may also prescribe medication to control nausea if you need it.
* If you do not have symptoms, you may be treated with antibiotics.
* If the parasite is present in your intestinal tissues, the treatment must address the organism as well as any damage to your infected organs.
* Surgery may be necessary if the colon or peritoneal tissues have perforations.

**Complications**

* Fulminant or necrotizing colitis
* Toxic megacolon
* Amoeboma
* Rectovaginal fistula

Complications of amoebic liver abscess include the following:

* Intraperitoneal, intrathoracic, or intrapericardial rapture, with or without secondary bacterial information
* Direct extension to pleura or pericardium
* Dissemination and formation of brain abscess

Other complications due to amoebiasis include the following:

* Bowel perforation
* Gastrointestinal bleeding
* Stricture formation
* Intussusception
* Peritonitis
* Empyema

**Prevention and Control**

Proper sanitation is the key to avoiding amebiasis. As a general rule, thoroughly wash your hands with soap and water after using the bathroom and before handling food.

If you’re traveling to places where the infection is common, follow this regimen when preparing and eating food:

* Thoroughly wash fruits and vegetables before eating.
* Avoid eating fruits or vegetables unless you wash and peel them yourself.
* Use bottled water and soft drinks from sealed containers.
* If you must drink [tap water](https://www.healthline.com/nutrition/how-to-filter-water), boil it for at least 1 minute, or use a store-bought “absolute 1 micron” filter and add disinfecting chlorine, chlorine dioxide, or iodine tablets to the filtered water.
* Avoid ice cubes or fountain drinks.
* Avoid peeled fresh fruit or vegetables.
* Avoid milk, cheese, or other unpasteurized dairy products.
* Avoid food sold by street vendors.

**Cholera**

Cholera is an intestinal infection caused by *Vibrio cholerae*. The hallmark of the disease is profuse secretory diarrhea. Cholera can be endemic, epidemic, or pandemic. Despite all the major advances in research, the condition still remains a challenge to the modern medical world. Although the disease may be asymptomatic or mild, severe cholera can cause dehydration and death within hours of onset.

**Classification**

[*Vibrio cholerae*](https://www.wikidoc.org/index.php/Vibrio_cholerae) has many different types, or "serogroups." Only two of these serogroups can cause epidemic cholera because they also produce the [cholera toxin](https://www.wikidoc.org/index.php/Cholera_toxin). Those two serogroups include:

* Serogroup O1
* Serogroup O139 (found only in Asia)

Serogroups which can cause a less severe diarrheal disease and does not have epidemic potential include:

* Non-O1 and non-O139 [*Vibrio cholerae*](https://www.wikidoc.org/index.php/Vibrio_cholerae) (third most commonly reported group of *Vibrio* bacteria)

**Epidemiology**

The number of patients with cholera worldwide is uncertain because most cases go unreported. Likely contributory factors are as follows:

* Most cases occur in remote areas of developing countries where definitive diagnosis is not possible
* Reporting systems often are nonexistent in such areas
* The stigma of cholera, which has direct adverse effects on commercial trade and tourism, discourages reporting
* Many countries with endemic cholera do not report at all

In 1990, fewer than 30,000 cases were reported to the WHO. Reported cases increased more than 10-fold with the beginning of the Latin American epidemic in 1991. In 1994, the number of cases (384,403) and countries (94) reporting cholera was the largest ever registered at the WHO. Even Europe experienced a 30-fold increase in cholera from 1993-1994, with reported cases increasing from 73 to 2,339 and deaths increasing from 2 cases to 47.

According to the WHO, the number of cases surged again in 2005. From 2005 to 2008, 178,000-237,000 cases and 4000-6300 deaths were reported annually worldwide.However, the actual global burden is estimated to be 3-5 million cases and 100,000-130,000 deaths per year. The 2008 outbreak in Zimbabwe lasted longer than a year, with more than 98,000 cases and more than 4000 deaths.Outbreaks in Guinea and Yunnan province in China contributed to this increase.

In mid-October 2010, a cholera epidemic broke out in Haiti, which has been worsened by heavy rains in 2011. As of June 20, 2011, 363,117 cases of cholera and 5,506 deaths have been reported. The epidemic is the first in Haiti in at least a century, and the source may have been a United Nations peacekeeping team from Nepal that came to Haiti after the catastrophic earthquake that hit the Caribbean nation on January 12, 2010.

In non-endemic areas, the incidence of infection is similar in all age groups, although adults are less likely to become symptomatic than children. The exception is breastfed children, who are protected against severe disease because of less exposure and because of the antibodies to cholera they obtain in breast milk.

According to WHO, the epidemiology of cholera for Kenya in 2017 is characterized by continuous transmission in affected communities coupled with outbreaks in camp settings and institutions or during mass gathering events. Continuous transmission in the community accounts for around 70% of the total cases with the majority of cases coming from the capital county, Nairobi. Transmission in camp settings occurred mainly within Garissa and Turkana counties, accounting for around 23% of the total reported cases. Both counties host big refugee camps, namely Dadaab and Kakuma refugee camps. Refugees in these camps come from countries currently experiencing complex emergencies and large cholera outbreaks. Seven percent of cases occurred in institutions and mass gathering events, where a number of people get infected from a point source.

**Mode of Transmission**

A person can get cholera by drinking water or eating food contaminated with cholera bacteria. In an epidemic, the source of the contamination is usually the feces of an infected person that contaminates water or food. The disease can spread rapidly in areas with inadequate treatment of sewage and drinking water. The infection is not likely to spread directly from one person to another; therefore, casual contact with an infected person is not a risk factor for becoming ill.

**Pathophysiology**

Cholera is mainly caused by two pathogenic serotypes of *V. cholerae*: O1 and O139. The pathogenesis underlying acute [diarrheal](https://www.wikidoc.org/index.php/Diarrheal) illness is as follows:

* *V. cholerae* is usually transmitted via the [fecal-oral route](https://www.wikidoc.org/index.php/Fecal-oral_route) to the human host.
* Following [ingestion](https://www.wikidoc.org/index.php/Ingestion), the *V. cholerae* must overcome host defense mechanisms such as gastric acidity, intestinal inhibitory factors, and changes in temperature and [osmolarity](https://www.wikidoc.org/index.php/Osmolarity).
* Infective dose varies from 102-106.
* The [incubation period](https://www.wikidoc.org/index.php/Incubation_period) varies from a few hours to a few days.

**Colonization**

* After gaining access to [small intestine](https://www.wikidoc.org/index.php/Small_intestine), *V. cholerae* uses [flagella](https://www.wikidoc.org/index.php/Flagella) to propagate through the mucus layer covering [small intestine](https://www.wikidoc.org/index.php/Small_intestine) and colonizes the small intestinal cells using toxin-coregulated pilus (TCP) forming a [biofilm](https://www.wikidoc.org/index.php/Biofilm).

**Enterotoxin**

* [Diarrheal](https://www.wikidoc.org/index.php/Diarrheal) illness in human host is mainly caused by production of [enterotoxin](https://www.wikidoc.org/index.php/Enterotoxin).
* The production of [enterotoxin](https://www.wikidoc.org/index.php/Enterotoxin) protein in the small intestinal cells is the main mechanism responsible for causing acute [diarrheal](https://www.wikidoc.org/index.php/Diarrheal) illness.
* It has 5B subunits and 2A subunits.
	+ B subunits bind the [enterocytes](https://www.wikidoc.org/index.php/Enterocytes) via GM1 [ganglioside](https://www.wikidoc.org/index.php/Ganglioside) receptors and cause internalization of A subunits in the cells via [endocytosis](https://www.wikidoc.org/index.php/Endocytosis).
	+ A subunits then bind and activate the [adenylate cyclase](https://www.wikidoc.org/index.php/Adenylate_cyclase) enzyme in the enterocytes, increasing the levels of [cAMP](https://www.wikidoc.org/index.php/CAMP).
* Increased levels of [enterotoxin](https://www.wikidoc.org/index.php/Enterotoxin) cause activation of the [cystic fibrosis transmembrane conductance regulator](https://www.wikidoc.org/index.php/Cystic_fibrosis_transmembrane_conductance_regulator) (CFTR), causing increased secretion of water, [sodium](https://www.wikidoc.org/index.php/Sodium), and [chloride](https://www.wikidoc.org/index.php/Chloride) from [enterocytes](https://www.wikidoc.org/index.php/Enterocytes), which causes watery [diarrhea](https://www.wikidoc.org/index.php/Diarrhea).

**Virulence factors**

The different [virulence factors](https://www.wikidoc.org/index.php/Virulence_factors) involved in the pathogenesis of [*V. cholerae*](https://www.wikidoc.org/index.php?title=V._cholerae&action=edit&redlink=1) involve activation of [transcription factors](https://www.wikidoc.org/index.php/Transcription_factors) such as ToxR, TcpP, and ToxT. Different toxins expressed by these [transcription factors](https://www.wikidoc.org/index.php/Transcription_factors) include:

* Zona occludens toxin (zot, causes invasion by decreasing intestinal tissue resistance)
* Accessory cholera toxin (ace, increases fluid secretion)
* Toxin-coregulated pilus (tcpA, essential colonization factor and receptor for the CTXf phage)
* NAG-specific heat-labile toxin (st)
* Outer membrane porin proteins (ompU and ompT)

**Signs and Symptoms**

Cholera infection is often mild or without symptoms, but can be severe. Approximately 1 in 10 people who get sick with cholera will develop severe symptoms which, in the early stages, include:

* profuse watery diarrhea, sometimes described as “rice-water stools”
* vomiting
* thirst
* leg cramps
* restlessness or irritability

[Health care providers](https://www.cdc.gov/cholera/healthprofessionals.html) should look for signs of dehydration when examining a patient with profuse watery diarrhea. These include:

* rapid heart rate
* loss of skin elasticity
* dry mucous membranes
* low blood pressure

People with severe cholera can develop severe dehydration, which can lead to kidney failure. If left [untreated](https://www.cdc.gov/cholera/treatment/index.html), severe dehydration can lead to shock, coma, and death within hours.

**Diagnosis**

To test for cholera, doctors must take a stool sample or a rectal swab and send it to a laboratory to look for the cholera bacteria.

Rapid cholera dipstick tests enable doctors in remote areas to quickly confirm a cholera diagnosis. Quick confirmation helps to decrease death rates at the start of cholera outbreaks and leads to earlier public health interventions for outbreak control.

**Management**

Cholera requires immediate treatment because the disease can cause death within hours.`

* **Rehydration.** The goal is to replace lost fluids and electrolytes using a simple rehydration solution, oral rehydration salts (ORS). The ORS solution is available as a powder that can be made with boiled or bottled water.

Without rehydration, approximately half the people with cholera die. With treatment, fatalities drop to less than 1%.

* **Intravenous fluids.** Most people with cholera can be helped by oral rehydration alone, but severely dehydrated people might also need intravenous fluids.
* **Antibiotics.** While not a necessary part of cholera treatment, some antibiotics can reduce cholera-related diarrhea and shorten how long it lasts in severely ill people.
* **Zinc supplements.** Research has shown that zinc might decrease diarrhea and shorten how long it lasts in children with cholera.

**Complications**

Cholera can quickly become fatal. In the most severe cases, the rapid loss of large amounts of fluids and electrolytes can lead to death within hours. In less extreme situations, people who don't receive treatment can die of dehydration and shock hours to days after cholera symptoms first appear.

Although shock and severe dehydration are the worst complications of cholera, other problems can occur, such as:

* **Low blood sugar (hypoglycemia).** Dangerously low levels of blood sugar (glucose) — the body's main energy source — can occur when people become too ill to eat. Children are at greatest risk of this complication, which can cause seizures, unconsciousness and even death.
* **Low potassium levels.** People with cholera lose large quantities of minerals, including potassium, in their stools. Very low potassium levels interfere with heart and nerve function and are life-threatening.
* **Kidney failure.** When the kidneys lose their filtering ability, excess amounts of fluids, some electrolytes and wastes build up in the body — a potentially life-threatening condition. In people with cholera, kidney failure often accompanies shock.

**Prevention and Control**

Be aware of whether cholera cases have recently occurred in an [area you plan to visit](https://wwwnc.cdc.gov/travel/destinations/list). However, the risk for cholera is very low for people visiting areas with epidemic cholera when simple [prevention steps](https://www.cdc.gov/cholera/preventionsteps.html) are taken.

All visitors or residents in areas where cholera is occurring or has occurred should follow recommendations to prevent getting sick:

* Drink only bottled, boiled, or chemically treated water and bottled or canned beverages. When using bottled drinks, make sure the seal has not been broken. Carbonated water may be safer than non-carbonated water. Avoid tap water, fountain drinks, and ice cubes.
* To disinfect your own water, **choose one** of the following options:
	+ Boil it for 1 minute, **or**
	+ Filter it and add either ½ an iodine tablet **or**2 drops of household bleach per liter/quart of water, **or**
	+ Use commercial water chlorination tablets according to the manufacturer’s instructions.
* Wash your hands often with soap and clean water, especially before you eat or prepare food and after using the bathroom.
	+ If no water and soap are available, use an alcohol-based hand sanitizer with at least 60% alcohol.
* Use bottled, boiled, or chemically treated water to wash dishes, brush teeth, wash and prepare food, and make ice.
* Eat foods that are packaged or that are freshly cooked and served hot.
	+ Do not eat raw or undercooked meats and seafood, or raw or undercooked fruits and vegetables unless they are peeled.
* Dispose of feces in a sanitary manner to prevent contamination of water and food sources.

**Bacillary Dysentery**

Bacillary dysentery is the most common type of dysentery. It results from bacteria called Shigella. The disease is called shigellosis.

**Classification**

*Shigella* species are classified into four serogroups:

* Serogroup *A*: [*S. dysenteriae*](https://www.wikidoc.org/index.php/Shigella_dysenteriae) (12 [serotypes](https://www.wikidoc.org/index.php/Serotype))
* Serogroup *B*: [*S. flexneri*](https://www.wikidoc.org/index.php/Shigella_flexneri) (6 serotypes)
* Serogroup *C*: [*S. boydii*](https://www.wikidoc.org/index.php/Shigella_boydii) (23 serotypes)
* Serogroup *D*: [*S. sonnei*](https://www.wikidoc.org/index.php/Shigella_sonnei) (1 serotype)

**Epidemiology**

Although individuals of all age groups may acquire shigellosis, the majority of affected individuals are children between the age of 2 to 5. There is no gender or racial predominance of shigellosis. More than 160 million cases are reported annually, of which more than 95% are reported in the developing countries. *Shigella sonnei* accounts for the majority of shigellosis cases in the developed (industrialized) countries, while *Shigella flexneri* accounts for the majority of shigellosis cases in the developing countries.

In 2013, the average annual incidence of shigellosis in the United States was 4.82 cases per 100,000 individuals

* Individuals of all age groups may acquire shigellosis.
* Children between the age of 2 to 5 and elderly patients are most susceptible to acquire shigellosis.
* Approximately 60% to 70% of all cases are reported in childcare/school settings or among families with small children.

The total incidence of shigellosis in the developed countries is estimated to be approximately 1.5 million cases per year.

Approximately 14,000 laboratory confirmed cases of shigellosis and an estimated 448,240 total cases occur in the United States each year. The majority of cases reported in USA are caused by *Shigella sonnei* (approximately 77%).

The incidence of shigellosis in the developing world is estimated to exceed 160 million cases per year, among which shigellosis is responsible for approximately 1.1 million deaths per year. In the developing world, the most common cause of shigellosis is *S. flexneri* (approximately 60%). Epidemics of *S. dysenteriae* type 1 have been reported in Africa and Central America with case fatality rates that range between 5 to 15%.

Kenya has been experiencing a significant increase in acute bloody diarrhoea cases especially in Coast, Western, Nyanza and Nairobi regions. The cases reported through the weekly Integrated Disease Surveillance and Response System (IDSR) increased from 48,272 in 2009 to 64,107 in 2010.

**Causative Organism**

Bacillary dysentery is an intestinal infection caused by a group of *Shigella* bacteria which can be found in the human gut.

**Mode of Transmission**

Bacillary dysentery is transmitted directly by physical contact with the faecal material of a patient or carrier (including during sexual contact), or indirectly through consumption of contaminated food and water. Infection may occur after consuming a small number of the bacteria. Therefore, the disease is highly contagious and many outbreaks are related to childcare settings and schools. The incubation period is usually 1 - 3 days, but can be up to 7 days.

**Pathophysiology**

The small inoculum may be attributed to the following features of the organism:

* *Shigella* contains acid resistance systems that enable the organism to survive the acidic environment in the [stomach](https://www.wikidoc.org/index.php/Stomach).
* *Shigella* can downregulate the expression of antibacterial proteins released by the host (human) [intestinal mucosa](https://www.wikidoc.org/index.php/Intestinal_mucosa).

**Phase 1: Transcytosis Using M Cells as Entry Ports**

*Shigella* migrates to the [large intestine](https://www.wikidoc.org/index.php/Large_intestine), where it causes infection via invasion of the epithelial barrier of the large intestine. Initially, *Shigella* uses [M cells](https://www.wikidoc.org/index.php/M_cell) from the basolateral side of the intestinal epithelium as entry port. M cells are specialized cells that sample the gut lumen for pathogenic antigens and delivers these antigens to mucosal [lymphoid tissue](https://www.wikidoc.org/index.php/Lymphoid_tissue) to activate an adequate [immune response](https://www.wikidoc.org/index.php/Immune_response). *Shigella* is [transcytosed](https://www.wikidoc.org/index.php?title=Transcytosed&action=edit&redlink=1) across the epithelial layer of the intestinal M cells.

**Phase 2: Uptake by Macrophages**

* Following transcytosis, *Shigella* enters macrophages and induces cellular [apoptosis](https://www.wikidoc.org/index.php/Apoptosis).
* Macrophage apoptosis results in the release of [proinflammatory cytokines](https://www.wikidoc.org/index.php?title=Proinflammatory_cytokine&action=edit&redlink=1) (IL-1-beta and IL-18), which signal intestinal inflammation and consequent activation of the [innate immune system](https://www.wikidoc.org/index.php/Innate_immune_system).

**Phase 3: Release from Apoptotic Macrophages**

* Following apoptosis and inflammation, *Shigella* is released from the macrophages.
* Invasion of the intestinal epithelium continues from the basolateral side, and the bacteria further spreads to adjacent epithelial cells and avoids extracellular exposure by using intercellular [actin polymerization](https://www.wikidoc.org/index.php?title=Actin_polymerization&action=edit&redlink=1) processes (rocket propulsion).

**Phase 4: Infiltration of Polymorphonuclear Neutrophils**

* As *Shigella* infiltrates the epithelial cells, activation of nuclear factor kappa-B (NF-KB) by *Shigella* generates [IL-8](https://www.wikidoc.org/index.php/IL-8), which in turn mediates the recruitment of polymorphonuclear neutrophils (PMN) to the site of inflammation.
* PMN destroy the integrity of the intestinal epithelial barrier and allow more *Shigella* organisms to directly and more easily invade the intestinal epithelium. The loss of the intestinal epithelial cells results in impaired adsorption of other nutrients and fluids and leads to clinical manifestations of shigellosis (diarrhea).
* *Shigella* enterotoxin 1 (ShET1) and enterotoxin 2 (ShET2) are synthesized during the inflammatory process and are thought to account, at least in part, for fluid secretion that results in shigellosis-associated diarrhea.
* Other Shigella toxins, such as *Shigella dysenteriae* serotype 1 toxin, results in cytotoxicity and development of vascular lesions at the level of the colon, the kidneys, and the central nervous system. The cytotoxic activity of the toxin is thought to cause shigella-associated complications, such as hemolytic uremic syndrome (HUS).

Ultimately, more PMNs are recruited and *Shigella* organisms are killed.

**Signs and Symptoms**

Symptoms can show up 1-3 days after you get infected. In some people, the symptoms take longer to appear. Others never get symptoms.

Bacillary dysentery causes symptoms like:

* Diarrhea with belly cramps
* [Fever](https://www.webmd.com/first-aid/fevers-causes-symptoms-treatments)
* [Nausea and vomiting](https://www.webmd.com/digestive-disorders/digestive-diseases-nausea-vomiting)
* [Blood](https://www.webmd.com/heart/anatomy-picture-of-blood) or [mucus](https://www.webmd.com/allergies/features/the-truth-about-mucus) in the diarrhea

Young children, travelers to developing countries and men who have sex with men are more likely to acquire bacillary dysentery. People who have weakened immune systems may develop a more serious illness.

**Diagnosis**

Hematology

* [Leukocytosis](https://www.wikidoc.org/index.php/Leukocytosis) with [left shift](https://www.wikidoc.org/index.php/Left_shift) is common, but [leukopenia](https://www.wikidoc.org/index.php/Leukopenia) has also been reported.
* [Anemia](https://www.wikidoc.org/index.php/Anemia)
* [Thrombocytopenia](https://www.wikidoc.org/index.php/Thrombocytopenia)

Electrolytes

* [Hyponatremia](https://www.wikidoc.org/index.php/Hyponatremia)

**Blood Glucose**

* [Hypoglycemia](https://www.wikidoc.org/index.php/Hypoglycemia)

**Inflammatory Markers**

* Elevated [C-reactive protein](https://www.wikidoc.org/index.php/C-reactive_protein) (CRP)
* Elevated [erythrocyte sedimentation rate](https://www.wikidoc.org/index.php/Erythrocyte_sedimentation_rate) (ESR)

**Renal Function**

* [Azotemia](https://www.wikidoc.org/index.php/Azotemia) (elevated blood urea nitrogen)
* Elevated concentration of serum [creatinine](https://www.wikidoc.org/index.php/Creatinine)

**Liver Function**

* Mild elevation in [bilirubin](https://www.wikidoc.org/index.php/Bilirubin)

**Blood Culture**

* Multiple [blood cultures](https://www.wikidoc.org/index.php/Blood_culture) are usually withdrawn and may be positive for *Shigella* in cases complicated with [bacteremia](https://www.wikidoc.org/index.php/Bacteremia).

**Stool Examination**

**Stool Analysis**

* [Fecal blood](https://www.wikidoc.org/index.php?title=Fecal_blood&action=edit&redlink=1)
* [Fecal leukocytes](https://www.wikidoc.org/index.php?title=Fecal_leukocytes&action=edit&redlink=1)

**Microscopic Evaluation**

* Microscopic evidence of leukocytes on stool smear with [methylene-blue stain](https://www.wikidoc.org/index.php?title=Methylene-blue_stain&action=edit&redlink=1)

**Stool culture**

* Multiple [stool cultures](https://www.wikidoc.org/index.php/Stool_culture) are needed and may be positive for *Shigella* in the minority of cases, especially early during the disease.
* Stool samples typically cultured using agars such as: [MacConkey agar](https://www.wikidoc.org/index.php/MacConkey_agar), [Hektoen enteric agar](https://www.wikidoc.org/index.php?title=Hektoen_enteric_agar&action=edit&redlink=1), [Salmonella-Shigella agar](https://www.wikidoc.org/index.php?title=Salmonella-Shigella_agar&action=edit&redlink=1), [eosin-methylene blue agar](https://www.wikidoc.org/index.php?title=Eosin-methylene_blue_agar&action=edit&redlink=1), or [xylose-lysine-deoxycholate agar](https://www.wikidoc.org/index.php?title=Xylose-lysine-deoxycholate_agar&action=edit&redlink=1). Stool cultures typically demonstrate colorless colonies that do not ferment lactose.

**Management**

Many people with bacillary dysentery don’t need medical treatment. The symptoms often get better in a few days to a week. Those people should:

* Avoid antidiarrhea medications, which can worsen symptoms.
* Drink plenty of fluids to prevent [dehydration](https://my.clevelandclinic.org/health/treatments/9013-dehydration) (common with diarrhea).
* Isolate themselves from other people for at least two full days after the last episode of diarrhea.
* Take over-the-counter medications to reduce pain and fever.

For those who require medical attention, treatment often includes:

* [Antibiotics](https://my.clevelandclinic.org/health/drugs/16386-antibiotics).
* [IV fluids](https://my.clevelandclinic.org/health/treatments/21635-iv-fluids).
* Less often, [blood transfusion](https://my.clevelandclinic.org/health/treatments/14755-blood-transfusion).

**Complications**

**Intestinal Complications**

* [Rectal prolapse](https://www.wikidoc.org/index.php/Rectal_prolapse)
* [Proctitis](https://www.wikidoc.org/index.php/Proctitis)
* [Toxic megacolon](https://www.wikidoc.org/index.php/Toxic_megacolon)
* [Intestinal obstruction](https://www.wikidoc.org/index.php/Intestinal_obstruction)
* [Colonic perforation](https://www.wikidoc.org/index.php?title=Colonic_perforation&action=edit&redlink=1)

**Systemic Complications**

* [Post-infectious arthritis](https://www.wikidoc.org/index.php/Post-infectious_arthritis) (Reiter's syndrome)
	+ Approximately 2% of individuals infected with *S. flexneri* develop [Reiter's syndrome](https://www.wikidoc.org/index.php/Reiter%27s_syndrome) (triad of [arthritis](https://www.wikidoc.org/index.php/Arthritis), [uveitis](https://www.wikidoc.org/index.php/Uveitis), and [urethritis](https://www.wikidoc.org/index.php/Urethritis)).
	+ Post-infectious arthritis may persist for several weeks to months and may become chronic.
	+ Individuals with [HLA-B27](https://www.wikidoc.org/index.php/HLA-B27) subtype are predisposed to development of Reiter's syndrome following shigellosis.
* Concomitant infections
	+ Patients with dysentery lose proteins, including immune factors, in stools and are predisposed to concomitant infections that are not related to shigellosis.
* [Bacteremia](https://www.wikidoc.org/index.php/Bacteremia)
	+ Bacteremia is common among immunocompromised individuals, such as HIV-positive individuals and individuals with cancer and malnutrition.
* [SIADH](https://www.wikidoc.org/index.php/SIADH) and SIADH-associated [hyponatremia](https://www.wikidoc.org/index.php/Hyponatremia)
* [Seizure](https://www.wikidoc.org/index.php/Seizure)
	+ Among children less than 2 years of age.
* [Encephalopathy](https://www.wikidoc.org/index.php/Encephalopathy)
	+ Among children less than 2 years of age.
* [Reactive arthritis](https://www.wikidoc.org/index.php/Reactive_arthritis)
* [Hemolytic uremic syndrome](https://www.wikidoc.org/index.php/Hemolytic_uremic_syndrome) (HUS)
	+ HUS is mediated by Shiga toxin that is typically present in *S. dysenteriae*.
	+ HUS is characterized by the triad [microangiopathic hemolytic anemia](https://www.wikidoc.org/index.php/Microangiopathic_hemolytic_anemia) (MAHA), [thrombocytopenia](https://www.wikidoc.org/index.php/Thrombocytopenia), and [acute kidney injury](https://www.wikidoc.org/index.php/Acute_kidney_injury)
* [Bronchopneumonia](https://www.wikidoc.org/index.php/Bronchopneumonia)
* [Disseminated intravascular coagulopathy](https://www.wikidoc.org/index.php?title=Disseminated_intravascular_coaguloapathy&action=edit&redlink=1) (DIC)
* [Cholestatic hepatitis](https://www.wikidoc.org/index.php?title=Cholestatic_hepatitis&action=edit&redlink=1)
* [Myocarditis](https://www.wikidoc.org/index.php/Myocarditis)
* [Coma](https://www.wikidoc.org/index.php/Coma)
* [Death](https://www.wikidoc.org/index.php?title=Death&action=edit&redlink=1)

**Prevention and Control**

1. Maintain good personal hygiene

* Perform hand hygiene frequently, especially before handling food or eating, and after using the toilet or handling faecal matter.
* Wash hands with liquid soap and water, and rub for at least 20 seconds. Then rinse with water and dry with a disposable paper towel or hand dryer. If hand washing facilities are not available, or when hands are not visibly soiled, hand hygiene with 70 to 80% alcohol-based handrub is an effective alternative.
* Refrain from work or school, and seek medical advice when suffering from gastrointestinal symptoms such as diarrhoea.

2. Maintain good food hygiene

* Adopt the 5 Keys to Food Safety in handling food, i.e. Choose (Choose safe raw materials); Clean (Keep hands and utensils clean); Separate (Separate raw and cooked food); Cook (Cook thoroughly); and Safe Temperature (Keep food at safe temperature) to prevent foodborne diseases.
* Drink only boiled water from the mains or bottled drinks from reliable sources.
* Avoid drinks with ice of unknown origin.
* Purchase fresh food from hygienic and reliable sources. Do not patronize illegal hawkers.
* Eat only thoroughly cooked food.
* Wash and peel fruit by yourself and avoid eating raw vegetables.
* Exclude infected persons and asymptomatic carriers from handling food and from providing care to children, elderly and immunocompromised people.

**Check the differences between Bacillary Dysentery and Amoebic Dysentery (handled in class)**

**Rabies**

Rabies is a viral illness spread via the saliva of an infected animal by the rabies virus (genus *Lyssavirus*). Rabies exposure occurs usually through biting a human or another infected animal. Transmission can also occur through saliva touching an [open wound](https://www.medicinenet.com/first_aid_pictures_slideshow_caring_for_wounds/article.htm) or touching mucous membranes.

**Classification**

There are two classic forms of rabies: **encephalitic and paralytic**. Each of these forms evolve through five general stages: **incubation, prodromal, acute neurological, coma, and death**.

**Epidemiology**

Rabies is present on all continents of the world with the exception of the Antarctica; however, more than 95% of human deaths due to the disease occur in Asia and Africa. Human mortality from canine rabies is estimated to be 60,000 per year worldwide, with about 56% of the cases occurring in Asia and 43.6% in Africa, mostly in rural areas. This translates to 1 death due to rabies every 10 minutes in the two continents. Official data on human rabies deaths submitted to World Health Organization (WHO) from Africa are a gross under-estimate of the true burden of the disease. The reasons for this include: rabies victims are often too ill to travel to hospital or die before arrival; families recognize the futility of medical treatment for rabies; misdiagnosis of rabies and laboratory confirmation of clinically suspected cases is difficult.

Timely and specific information about the global occurrence of rabies is often difficult to find. Surveillance levels vary, and reporting status can change suddenly as a result of disease reintroduction or emergence. The rate of rabies exposures in travelers is at best an estimate and may range from 16 to 200 per 100,000 travelers.

In Kenya, it is estimated that up to 2,000 human deaths occur annually due to rabies. Progress in preventing human rabies through control of the disease in the dogs has been slow due to a number of barriers including; limited information and awareness about the extent of the problem, lack of suitable diagnostic and managerial capacity, lack of appropriate and sustainable strategy for prevention and control, lack of inter-sectoral collaboration, organizational and financial challenges.

**Causative Organism**

Caused by rabies virus. In addition to rabies virus, the *Lyssavirus*genus includes 14 other viruses that all cause the disease rabies. Nonrabies lyssaviruses are found in Europe, Asia, Africa, and Australia; although they have caused human deaths, nonrabies lyssaviruses contribute relatively little to the global rabies burden compared to rabies virus.

**Mode of Transmission**

**Common route of transmission**

* Various carnivorous animal species have been identified as the source of [*rabies virus*](https://www.wikidoc.org/index.php/Rabies_virus) (RV)
* In Africa and Asia, domestic dogs are the main reservoirs of [infection](https://www.wikidoc.org/index.php/Infection) from [*rabies virus*](https://www.wikidoc.org/index.php/Rabies_virus)
* In the United States, racoons, foxes, skunks, coyotes, possums and bats rather than dogs spread the [infection](https://www.wikidoc.org/index.php/Infection) through [bites](https://www.wikidoc.org/index.php/Bites)
* Three stages of rabies have been known to occurr in dogs. The first stage is a one to three day period characterized by behavioral changes and is known as the [prodromal stage](https://www.wikidoc.org/index.php/Prodrome). The second stage is the excitative stage, which lasts three to four days. It is this stage that is often known as *furious rabies* due to the tendency of the affected dog to be hyper-reactive to external stimuli and [bite](https://www.wikidoc.org/index.php/Bite) at anything near. The third stage is the [*paralytic*](https://www.wikidoc.org/index.php/Paralysis)*stage* and is caused by damage to [motor neurons](https://www.wikidoc.org/index.php/Motor_neuron). Incoordination is seen due to rear [limb paralysis](https://www.wikidoc.org/index.php/Paralysis) and [drooling](https://www.wikidoc.org/index.php/Drooling) and [difficulty swallowing](https://www.wikidoc.org/index.php/Dysphagia) is caused by [paralysis](https://www.wikidoc.org/index.php/Paralysis) of [facial](https://www.wikidoc.org/index.php/Facial_muscles) and [throat](https://www.wikidoc.org/index.php/Throat) [muscles](https://www.wikidoc.org/index.php/Muscles). Death is usually caused by [respiratory arrest](https://www.wikidoc.org/index.php/Respiratory_arrest).
* Transmission of the [*rabies virus*](https://www.wikidoc.org/index.php/Rabies_virus) starts when a human is bit by an animal harboring the virus in its [salivary glands](https://www.wikidoc.org/index.php/Salivary_glands)
* The RV remains cell-free after initial [inoculation](https://www.wikidoc.org/index.php/Inoculation) so, rigorous [wound](https://www.wikidoc.org/index.php/Wound) cleaning may reduce the chances of [infection](https://www.wikidoc.org/index.php/Infection)
* RV infects [peripheral nerves](https://www.wikidoc.org/index.php/Peripheral_nerves) and then reaches the [central nervous system (CNS)](https://www.wikidoc.org/index.php/CNS) via retrograde [axonal](https://www.wikidoc.org/index.php/Axonal) transport

**Less common routes of transmission**

* Less common routes of transmission of [rabies virus](https://www.wikidoc.org/index.php/Rabies_virus) include:
	+ [Contamination](https://www.wikidoc.org/index.php/Contamination) of [mucous membranes](https://www.wikidoc.org/index.php/Mucous_membranes) (i.e., [eyes](https://www.wikidoc.org/index.php/Eye), [nose](https://www.wikidoc.org/index.php/Nose), [mouth](https://www.wikidoc.org/index.php/Mouth))
	+ [Aerosol](https://www.wikidoc.org/index.php/Aerosol) transmission
	+ [Corneal](https://www.wikidoc.org/index.php/Corneal) and other [organ transplantation](https://www.wikidoc.org/index.php/Organ_transplantation) from [infected](https://www.wikidoc.org/index.php/Infected) donor

**Pathophysiology**

**Incubation period and eclipse phase**

* The [incubation period](https://www.wikidoc.org/index.php/Incubation_period) may vary from a few days to several years, but is typically 1 to 3 months
* After gaining entry into human host, the [RV](https://www.wikidoc.org/index.php/RV) enters into an eclipse phase, during which, the host [immune](https://www.wikidoc.org/index.php/Immune) defenses may confer [cell-mediated immunity](https://www.wikidoc.org/index.php/Cell-mediated_immunity) against [viral infection](https://www.wikidoc.org/index.php/Viral_infection) because RV is a good [antigen](https://www.wikidoc.org/index.php/Antigen)

**Neuromuscular junction invasion**

* The [neuromuscular junction](https://www.wikidoc.org/index.php/Neuromuscular_junction) is the major site of entry into [neurons](https://www.wikidoc.org/index.php/Neurons)
* The RV uses the [acetylcholine receptors](https://www.wikidoc.org/index.php/Acetylcholine_receptors) and other [receptors](https://www.wikidoc.org/index.php/Receptors) such as the neutral [cell adhesion](https://www.wikidoc.org/index.php/Cell_adhesion) [molecule](https://www.wikidoc.org/index.php/Molecule) (NCAM) to gain entry into the [neuron](https://www.wikidoc.org/index.php/Neuron) via [endocytosis](https://www.wikidoc.org/index.php/Endocytosis)
* Fusion of the [viral](https://www.wikidoc.org/index.php/Viral) membrane with [endosomal membranes](https://www.wikidoc.org/index.php/Endosomal_membrane) liberates the [viral](https://www.wikidoc.org/index.php/Viral) [nucleocapsid](https://www.wikidoc.org/index.php/Nucleocapsid) into the [cytosol](https://www.wikidoc.org/index.php/Cytosol), where [transcription](https://www.wikidoc.org/index.php/Transcription) and [replication](https://www.wikidoc.org/index.php/Replication) occur

**Inter-neuronal spread**

* The main mechanism involved in the neuroinvasion of RV is trans-synaptic [neuronal](https://www.wikidoc.org/index.php/Neuronal) spread
* The following [proteins](https://www.wikidoc.org/index.php/Proteins) lead to the spread of [virus](https://www.wikidoc.org/index.php/Virus) between the [neurons](https://www.wikidoc.org/index.php/Neurons), once the [virus](https://www.wikidoc.org/index.php/Virus) gains entry into the [body](https://www.wikidoc.org/index.php/Body):
	+ [Rabies virus](https://www.wikidoc.org/index.php/Rabies_virus) [G protein](https://www.wikidoc.org/index.php/G_protein) ([glycoprotein](https://www.wikidoc.org/index.php/Glycoprotein)): RV to spread from the [post-synaptic](https://www.wikidoc.org/index.php/Post-synaptic) site to the pre-synaptic site
	+ [Rabies virus](https://www.wikidoc.org/index.php/Rabies_virus) P protein (a [cofactor](https://www.wikidoc.org/index.php/Cofactor_%28biochemistry%29) for [RNA](https://www.wikidoc.org/index.php/RNA) [polymerase](https://www.wikidoc.org/index.php/Polymerase)): important determinant of retrograde transport of the [virus](https://www.wikidoc.org/index.php/Virus) within [axons](https://www.wikidoc.org/index.php/Axons)

**CNS invasion**

* Trans-synaptic [neuronal](https://www.wikidoc.org/index.php/Neuronal) spread leads to spread of [infection](https://www.wikidoc.org/index.php/Infection) to the [CNS](https://www.wikidoc.org/index.php/CNS) from the [peripheral nerves](https://www.wikidoc.org/index.php/Peripheral_nerves)
* RV forms [cytoplasmic](https://www.wikidoc.org/index.php/Cytoplasmic) [inclusion bodies](https://www.wikidoc.org/index.php/Inclusion_bodies) called [Negri bodies](https://www.wikidoc.org/index.php/Negri_bodies) in the [neurons](https://www.wikidoc.org/index.php/Neurons), which are composed of the [viral](https://www.wikidoc.org/index.php/Viral) N and P proteins (all [viral](https://www.wikidoc.org/index.php/Viral) [RNAs](https://www.wikidoc.org/index.php/RNA) [genome](https://www.wikidoc.org/index.php/Genome), antigenome, and every [mRNA](https://www.wikidoc.org/index.php/MRNA) have been known to be found inside the [inclusion bodies](https://www.wikidoc.org/index.php/Inclusion_bodies)- suggesting that they play a role in [viral replication](https://www.wikidoc.org/index.php/Viral_replication) and life cycle)
* RV infects [neurons](https://www.wikidoc.org/index.php/Neurons) and leads to [degeneration](https://www.wikidoc.org/index.php/Degeneration_%28medical%29) of the [neuronal](https://www.wikidoc.org/index.php/Neuronal) processes by disrupting [cytoskeletal](https://www.wikidoc.org/index.php/Cytoskeletal) integrity
* The [hypothalamus](https://www.wikidoc.org/index.php/Hypothalamus) is understood to be affected most severely by [RV](https://www.wikidoc.org/index.php/Rabies_virus) [infection](https://www.wikidoc.org/index.php/Infection)

**Signs and Symptoms**

Symptoms of human rabies can occur as fast as within the first week of the infection.

The early symptoms of rabies are much generalized and include [weakness](https://www.medicinenet.com/weakness/symptoms.htm), [fever](https://www.medicinenet.com/aches_pain_fever/article.htm), and [headaches](https://www.medicinenet.com/headache/article.htm). Without a history of a potential exposure to a rabid animal, these symptoms would not raise the suspicion of rabies as they are very similar to the common [flu](https://www.medicinenet.com/influenza/article.htm) or other viral syndromes.

The disease can then take two forms:

1. With paralytic rabies (approximately 20% of cases), the patient's muscles slowly become paralyzed (usually starting at the site of the bite). This is the less common form and ends in [coma](https://www.medicinenet.com/coma/article.htm) and death.
2. With furious rabies (about 80% of cases), the patient exhibits the classic symptoms of rabies, such as
	* [Anxiety](https://www.medicinenet.com/anxiety/article.htm) and [confusion](https://www.medicinenet.com/confusion/symptoms.htm) (The patient is often overly active.);
	* [encephalitis](https://www.medicinenet.com/encephalitis/article.htm), causing [hallucinations](https://www.medicinenet.com/hallucinations/symptoms.htm), confusion, and [coma](https://www.medicinenet.com/coma_symptoms_and_signs/symptoms.htm);
	* hyper salivation;
	* hydrophobia (fear and avoidance of water);
	* [aerophobia](https://www.medicinenet.com/phobias_picture_slideshow/article.htm) (fear of fresh air);
	* [Difficulty swallowing](https://www.medicinenet.com/swallowing/article.htm).

Once the clinical signs of rabies occur, the disease is nearly always fatal

**Diagnosis**

Several tests are necessary to diagnose rabies before death occurs in humans; no single test is sufficient. Tests are performed on samples of saliva, serum, spinal fluid, and skin biopsies of hair follicles at the nape of the neck. Saliva can be tested by virus isolation or reverse transcription followed by polymerase chain reaction (RT-PCR). Serum and spinal fluid are tested for antibodies to rabies virus. Skin biopsy specimens are examined for rabies antigen in the cutaneous nerves at the base of hair follicles.

**Management**

Medical care is recommended if a health care professional thinks that someone was exposed to a potentially rabid animal.

If the animal is a pet or farm animal that has no symptoms, the animal can be isolated and observed for 10 days. Wild animals that can be captured can be killed and tested for the virus. If the animal can't be found, it is best to consult with the health department.

The U.S. Centers for Disease Control and [Prevention](https://www.medicinenet.com/prevention/article.htm) (CDC) recommends prophylaxis (protective treatment) after a wildlife bite from an animal suspected to have rabies.

The general pathway to determine post-exposure prophylaxis for rabies requires the following information:

* Bite: Did a bite occur, and where is the location of the bite? (Any penetration of the skin is considered a bite; although bites to the face and hands carry the highest risk, all bites need to be considered for prophylaxis.)
* Non-bite incident: Did the saliva touch an open [wound](https://www.medicinenet.com/cuts_scrapes_and_puncture_wounds/article.htm) or a mucous membrane?
* Animal risk factors: No cases of rabies infection have been reported in the U.S. from fully vaccinated domestic animals (dogs or cats). If bitten, it is important to determine if the bite was provoked or unprovoked. A provoked bite includes any circumstances during which the person touched, threatened, scared, fed, or otherwise interacted with the animal prior to the bite. If no such interaction occurred, the bite is considered unprovoked, and it increases the likelihood that the animal may have rabies.
* Bats: A health care professional should evaluate any contact with a bat that leads to a potential scratch, bite, or mucous membrane exposure to saliva. If prolonged exposure to a bat is discovered (sleeping in a room where a bat is found), post exposure prophylaxis needs to be considered.

As rabies is a fatal disease, if it is suspected, it is often best to start treatment until further information is available.

A health care professional administers a series of injections. The first is a rabies immune globulin (human rabies immune globulin [HRIG]), which health care professionals only give to previously unvaccinated individuals, as well as the rabies [vaccine](https://www.medicinenet.com/vaccination_faqs/article.htm). Those who have been previously vaccinated or are already receiving pre-exposure vaccination should only receive the vaccine. Over the next 2 weeks, health care professionals administer three additional rabies vaccine injections during follow-up visits on days 3, 7, and 14. Health care professionals give the first of these [vaccines](https://www.medicinenet.com/immunizations/article.htm) as soon as possible after exposure. Doctors give these rabies vaccinations as intramuscular injections, and the [vaccines](https://www.medicinenet.com/vaccination_faqs/article.htm) help the body fight the virus.

The treatment regimen for previously vaccinated individuals is different, with no HRIG given and only two doses of the rabies vaccine.

**Complications**

Common complications of rabies include:

* [Psychosis](https://www.wikidoc.org/index.php/Psychosis)
* [Seizures](https://www.wikidoc.org/index.php/Seizures)
* [Aphasia](https://www.wikidoc.org/index.php/Aphasia)
* [Muscular](https://www.wikidoc.org/index.php/Muscular) twitching
* Restlessness
* [Delirium](https://www.wikidoc.org/index.php/Delirium)
* [Death](https://www.wikidoc.org/index.php?title=Death&action=edit&redlink=1)

**Prevention and Control**

Rabies is a serious disease, but individuals and governments can take steps to [prevent infections](https://www.cdc.gov/rabies/prevention/people.html).

Strategies include:

* regular rabies vaccinations for pets and domestic animals
* bans or restrictions on the import of animals from certain countries
* widespread vaccinations of humans in some areas
* educational information and awareness
* enhanced access to medical care to people who receive bites

In rural Canada and the U.S., agencies have dropped bait containing an oral vaccine to [reduce the number](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5610451/) of wild animals with rabies.

Rabies vaccine: HDCV (Human Diploid Cell Culture Vaccine)

**Individual precautions**

Individuals should follow some safety rules to reduce the chance of contracting rabies.

* **Vaccinate pets:** Find out how often to vaccinate cats, dogs, ferrets, and other domestic or farm animals, and keep the vaccinations up to date.
* **Protect small pets:** Some pets cannot have vaccinations, so their owners must prevent contact with wild animals.
* **Keep pets confined:** Owners should confine pets safely while at home or supervise them.
* **Report strays to local authorities:** Contact local animal control officials or police departments regarding stray animals.
* **Do not approach wild animals:** Animals with rabies are likely to be less cautious than usual and may approach people.
* **Keep bats out of the home:** Seal houses to prevent bats from nesting and call an expert to remove any bats present.

In the U.S., vaccinations can control rabies in domestic dogs. Nevertheless, between [30,000 and 60,000](https://www.cdc.gov/rabies/location/usa/surveillance/human_rabies.html) people seek rabies post exposure prophylaxis every year, following contact with suspect animals.

People report between 60 and 70 dogs and around 250 cats as rabid each year in the U.S. Most of these have not been vaccinated and encountered the virus through wild animals, such as bats.

**Dengue**

Dengue (DENG-gey) fever is a mosquito-borne illness that occurs in tropical and subtropical areas of the world. Mild dengue fever causes a high fever and flu-like symptoms. The severe form of dengue fever, also called dengue hemorrhagic fever, can cause serious bleeding, a sudden drop in blood pressure (shock) and death.

**Classification**

The World Health Organization classifies dengue into 2 major categories: **dengue (with / without warning signs) and severe dengue**. The sub-classification of dengue with or without warning signs is designed to help health practitioners triage patients for hospital admission, ensuring close observation, and to minimize the risk of developing the more severe dengue.

**Epidemiology**

The global incidence of dengue has grown dramatically with about half of the world's population now at risk. Although an estimated 100 - 400 million infections occur each year, over 80% are generally mild and asymptomatic.

Dengue epidemics have been reported in Africa since the 19th century, in countries including Zanzibar (1823, 1870), Burkina Faso (1925), Egypt (1887, 1927), South Africa (1926–1927), and Senegal (1927–1928). Between 1960 and 2010, 20 laboratory-confirmed outbreaks were reported in 15 African countries, with most occurring in Eastern Africa. All four dengue virus (DENV) serotypes have been isolated in Africa, with DENV2 reported to cause the most epidemics.

Available data suggest that dengue is endemic to 34 countries across all regions of Africa of these, 22 have reported local transmission, which is laboratory-confirmed in 20 countries, while two (Egypt and Zanzibar) do not have laboratory confirmation. The remaining 12 countries have only diagnosed dengue in travelers who had returned to non-endemic regions.

The first suspected cases of the outbreak were reported in January and February 2021 in Lamu and Mombasa counties respectively. According to the County Department of Health in Mombasa, the first Dengue cases were confirmed in early March 2021, with Lamu County also reporting an increase in cases over April 2021.

**Causative Organism**

Dengue fever is an illness in which a person has a high fever, joint pain and severe headaches. It occurs most commonly in tropic and subtropic areas of the world. Complications can be deadly, potentially resulting in dengue hemorraghic fever in which an individual has a failure of the circulatory system.

**Mode of Transmission**

* 1. **Mosquito bites**

Dengue viruses are spread to people through the bites of infected *Aedes* species mosquitoes (*Ae. aegypti*or*Ae. albopictus*).  These are the same types of mosquitoes that spread [Zika](https://www.cdc.gov/zika) and [chikungunya](https://www.cdc.gov/chikungunya) viruses.

* These mosquitoes typically lay eggs near standing water in containers that hold water, like buckets, bowls, animal dishes, flower pots, and vases.
* These mosquitoes prefer to bite people, and live both indoors and outdoors near people.
* Mosquitoes that spread dengue, chikungunya, and Zika bite during the day and night.
* Mosquitoes become infected when they bite a person infected with the virus. Infected mosquitoes can then spread the virus to other people through bites.
	1. **From mother to child**
* A pregnant woman already infected with dengue can pass the virus to her fetus during pregnancy or around the time of birth.
* To date, there has been one documented report of dengue spread through breast milk. Because of the benefits of breastfeeding, mothers are encouraged to breastfeed even in [areas with risk of dengue](https://www.cdc.gov/dengue/areaswithrisk/index.html).

Through infected blood, laboratory, or healthcare setting exposures

Rarely, dengue can be spread through blood transfusion, organ transplant, or through a needle stick injury.

**Pathophysiology**

The pathophysiology of DENV and the immune response of the host are not fully understood. Primary manifestations of disease include capillary leak syndrome (plasma leakage due to DHF-specific endothelial cell dysfunction), thrombocytopenia (seen in all types of DENV infection, but extreme in DHF), hemorrhagic tendencies, and leukopenia. It is known that the major viral envelope (E) of glycoprotein in the virus helps to bind the host cells, followed by viral replication. Data suggest that monocytes are the primary target. Infected monocytes induce the production of interferon-a (IFN-a) and IFN-b. Envelope (E), precursor membrane protein (pre-M), and nonstructural protein 1 (NS1) are the major DENV proteins targeted by antibodies as part of the host immune response. Studies have shown that DENV-specific CD4+ and CD8+ T lymphocytes attack infected cells and release IFN-g, tumor necrosis factor-a (TNF-a), and lymphotoxin. Primary infection induces a lifetime immunity of the individual to that particular serotype, but not to secondary infection by another serotype.

The pathophysiology is summarized in the following steps:

1. Bite by Aedes Aegypti
2. The virus penetrates the skin
3. The virus infects and replicates inside langerharns cells (immunity of the skin)
4. Langerhans cells release interferon to limit spread of infections
5. Infected langerhan cells go to the lymphatic system to make the immune system alert
6. It then goes into the circulation
7. Viremia results
8. Activation of the immune response leading to increase in lymphocytes
9. Decrease in neutrophils and white blood cells
10. Release of pyrogen that causes fever and increases blood pressure in vessels resulting in rashes
11. Dengue fever

[**https://www.intechopen.com/chapters/72691**](https://www.intechopen.com/chapters/72691) **(pathophysiology of dengue)**

**Signs and Symptoms**

Many people experience no signs or symptoms of a dengue infection.

When symptoms do occur, they may be mistaken for other illnesses such as; the flu, and usually begin four to 10 days after you are bitten by an infected mosquito.

Dengue fever causes a high fever, 104 F (40 C), and any of the following signs and symptoms:

* Headache
* Muscle, bone or joint pain
* Nausea
* Vomiting
* Pain behind the eyes
* Swollen glands
* Rash

Most people recover within a week or so. In some cases, symptoms worsen and can become life-threatening. This is called severe dengue, dengue hemorrhagic fever or dengue shock syndrome.

Severe dengue happens when your blood vessels become damaged and leaky. And the number of clot-forming cells (platelets) in your bloodstream drops. This can lead to shock, internal bleeding, organ failure and even death.

Warning signs of severe dengue fever, which is a life-threatening emergency, can develop quickly. The warning signs usually begin the first day or two after your fever goes away, and may include:

* Severe stomach pain
* Persistent vomiting
* Bleeding from your gums or nose
* Blood in your urine, stools or vomit
* Bleeding under the skin, which might look like bruising
* Difficult or rapid breathing
* Fatigue
* Irritability or restlessness

**Diagnosis**

Nucleic acid amplification tests (NAATs)

* For patients with suspected dengue virus disease, NAATs (Nucleic Acid Amplification Test) are the preferred method of laboratory diagnosis.
	+ NAATs should be performed on serum specimens collected 7 days or less after symptom onset.
	+ Laboratory confirmation can be made from a single acute-phase serum specimen obtained early (≤7 days after fever onset) in the illness by detecting viral genomic sequences with rRT-PCR or dengue nonstructural protein 1 (NS1) antigen by immunoassay.
	+ Presence of virus by rRT-PCR or NS1 antigen in a single diagnostic specimen is considered laboratory confirmation of dengue in patients with a compatible clinical and travel history.

**Serologic tests**

* IgM antibody testing can identify additional infections and is an important diagnostic tool. However, interpreting the results is complicated by cross-reactivity with other flaviviruses, like Zika, and determining the specific timing of infection can be difficult.
	+ Later in the illness (≥4 days after fever onset), IgM against dengue virus can be detected with MAC-ELISA. For patients presenting during the first week after fever onset, diagnostic testing should include a test for dengue virus (rRT-PCR or NS1) and IgM.
	+ For patients presenting >1 week after fever onset, IgM detection is most useful, although NS1 has been reported positive up to 12 days after fever onset. In the United States, both MAC-ELISA and rRT-PCR are approved as in vitro diagnostic tests.
	+ IgM in a single serum sample strongly suggests a recent dengue virus infection and should be presumed confirmatory for dengue if the infection occurred in a place where other potentially cross-reactive flaviviruses (such as Zika, West Nile, yellow fever, and Japanese encephalitis viruses) are not a risk.
* PRNTs can resolve false-positive IgM antibody results caused by non-specific reactivity, and, in some cases, can help identify the infecting virus. However, in areas with high prevalence of dengue and Zika virus neutralizing antibodies, PRNT may not confirm a significant proportion of IgM positive results. PRNT testing is available through several state health departments and CDC.

**Cross-reactive flaviviruses**

* If infection is likely to have occurred in a place where other potentially cross-reactive flaviviruses circulate, both molecular and serologic diagnostic testing for dengue and other flaviviruses should be performed.
* People infected with or vaccinated against other flaviviruses (such as yellow fever or Japanese encephalitis) may produce cross-reactive flavivirus antibodies, yielding false-positive serologic dengue diagnostic test results.

IgG antibody testing

IgG detection by ELISA in a single serum sample is not useful for diagnostic testing because it remains detectable for life after a dengue virus infection.

**Management**

There’s [no medication](https://www.who.int/en/news-room/fact-sheets/detail/dengue-and-severe-dengue) or treatment specifically made for dengue infection.

If you believe you may have dengue, you should use over-the-counter pain relievers to reduce your fever, headache, and joint pain. However, you should avoid aspirin and ibuprofen, as they can cause more bleeding.

Your doctor will perform a medical exam, and you should rest and drink plenty of fluids. If you feel worse after the first 24 hours of illness — once your fever has gone down — you should be taken to the hospital as soon as possible to check for complications.

**Complications**

A small percentage of people who have dengue fever can develop a more serious form of disease known as [dengue hemorrhagic fever](https://www.cdc.gov/dengue/resources/denguedhf-information-for-health-care-practitioners_2009.pdf).

**Dengue Hemorrhagic Fever**

The risk factors for developing dengue hemorrhagic fever include having [antibodies](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4784057/) to dengue virus from a previous infection and a [weakened](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5857271/) immune system.

This rare form of the disease is characterized by:

* high fever
* damage to the lymphatic system
* damage to blood vessels
* bleeding from the nose
* bleeding under the skin
* internal bleeding
* bleeding from the gums
* liver enlargement
* circulatory system failure

The symptoms of dengue hemorrhagic fever can trigger dengue shock syndrome, which is also [characterized by](https://www.cdc.gov/dengue/resources/denguedhf-information-for-health-care-practitioners_2009.pdf) low blood pressure, weak pulse, cold, clammy skin, and restlessness. [Dengue shock syndrome](https://www.sciencedirect.com/topics/medicine-and-dentistry/dengue-shock-syndrome) is severe and can lead to excessive bleeding and even death.

**Prevention and Control**

* Prevent dengue by [avoiding mosquito bites](https://www.cdc.gov/zika/prevention/prevent-mosquito-bites.html).
* All four dengue viruses are spread primarily through the bite of an infected *Aedes* species (*Ae. aegypti* and *Ae. albopictus*) mosquito. These mosquitoes also spread [chikungunya](https://www.cdc.gov/chikungunya/index.html) and [Zika](https://www.cdc.gov/zika/index.html) viruses.
* The mosquitoes that spread dengue are found in most tropical and subtropical regions of the world, including many parts of the United States.
* *Ae. aegypti* and *Ae. albopictus* bite during the day and night.
* A [dengue vaccine](https://www.cdc.gov/dengue/prevention/dengue-vaccine.html) is now recommended for U.S. territories of American Samoa, Puerto Rico, and the U.S. Virgin Islands, and freely associated states, including the Federated States of Micronesia, the Republic of Marshall Islands, and the Republic of Palau.

**Anthrax**

Anthrax is an important domestic animal disease, occurring in goats, cattle, sheep, and horses. Anthrax also occurs in wildlife, such as hippos, elephants, and Cape buffalo. It is rare in humans and occurs mainly in countries that do not prevent industrial or agricultural exposure to infected animals or their products (eg, hides, carcasses, hair). The incidence of natural infection has decreased, particularly in the developed world.

However, the potential use of anthrax as a biological weapon has increased fear of this pathogen. Spores have been prepared in very finely powdered form (weaponized) to be used as [agents of warfare and bioterrorism](https://www.msdmanuals.com/professional/injuries-poisoning/mass-casualty-weapons/biological-agents-as-weapons); in anthrax bio attacks of 2001, spores were spread in envelopes delivered via the United States Postal Service.

**Classification**

The type of illness a person develops depends on how anthrax enters the body. Typically, anthrax gets into the body through the skin, lungs, or gastrointestinal system. All types of anthrax can eventually spread throughout the body and cause death if they are not treated with antibiotics.

## Cutaneous anthrax

Cutaneous anthrax is the most common form of anthrax infection, and it is also considered to be the least dangerous. Infection usually develops from 1 to 7 days after exposure.

When anthrax spores get into the skin, usually through a cut or scrape, a person can develop cutaneous anthrax. This can happen when a person handles infected animals or contaminated animal products like wool, hides, or hair. Cutaneous anthrax is most common on the head, neck, forearms, and hands. It affects the skin and tissue around the site of infection.

Without treatment, up to 20% of people with cutaneous anthrax die. However, with proper treatment, almost all patients with cutaneous anthrax survive.

## Inhalation anthrax

Inhalation anthrax is considered to be the deadliest form of anthrax. Infection usually develops within a week after exposure, but it can take up to 2 months.

When a person breathes in anthrax spores, they can develop inhalation anthrax. People who work in places such as wool mills, slaughterhouses, and tanneries may breathe in the spores when working with infected animals or contaminated animal products from infected animals. Inhalation anthrax starts primarily in the lymph nodes in the chest before spreading throughout the rest of the body, ultimately causing severe breathing problems and shock.

Without treatment, inhalation anthrax is almost always fatal. However, with aggressive treatment, about 55% of patients survive.

## Gastrointestinal anthrax

Infection usually develops from 1 to 7 days after exposure. When a person eats raw or undercooked meat from an animal infected with anthrax, they can develop gastrointestinal anthrax. Once ingested, anthrax spores can affect the upper gastrointestinal tract (throat and esophagus), stomach, and intestines, causing a wide variety of symptoms.

Without treatment, more than half of patients with gastrointestinal anthrax die. However, with proper treatment, 60% of patients survive.

## Injection anthrax

Recently, another type of anthrax infection has been identified in heroin-injecting drug users in northern Europe.

Symptoms may be similar to those of cutaneous anthrax, but there may be infection deep under the skin or in the muscle where the drug was injected. Injection anthrax can spread throughout the body faster and be harder to recognize and treat. Lots of other more common bacteria can cause skin and injection site infections, so a skin or injection site infection in a drug user does not necessarily mean the person has anthrax.

**Epidemiology**

Anthrax is a zoonotic disease primarily affecting ruminant herbivores such as cattle, sheep, goats, antelope, and deer that become infected by ingesting contaminated vegetation, water, or soil; humans are generally incidental hosts. Anthrax is most common in agricultural regions in Central and South America, sub-Saharan Africa, central and southwestern Asia, and southern and eastern Europe. Although outbreaks still occur in livestock and wild herbivores in the United States, Canada, and Western Europe, human anthrax in these areas is now rare.

Worldwide, the most commonly reported form of anthrax in humans is cutaneous anthrax (95%–99%). Anthrax can occur after playing or handling drums made from contaminated goatskins. Although the risk of acquiring anthrax from drums imported from anthrax-endemic countries appears low, life-threatening or fatal disease is possible. Cases of cutaneous, ingestion, and inhalation anthrax have been reported in people who have handled, played, or made drums; others who have been in the same place as people who participated in these activities have also been infected.

In 2006, a case of travel-associated anthrax (the cutaneous form of the disease) was reported in a woman who traveled with a small group of tourists to Namibia, Botswana, and South Africa. Outbreaks of cutaneous and ingestion anthrax have been associated with handling infected animals and butchering and eating meat from those animals. Most of these outbreaks have occurred in endemic areas in Asia and Africa.

Severe soft-tissue infections, including cases complicated by sepsis and systemic infection, are suspected to be due to recreational use of heroin contaminated with *B. anthracis* spores. No associated cases have been identified in people who have not taken heroin.

Inhalation exposure was historically associated with the industrial processing of hides or wool (hence, “woolsorters’ disease”). More recently, bioterrorist activities were implicated as a source of inhalation exposure. Occasional anthrax cases have occurred, in the United States and elsewhere, in which the exposure source remains unidentified.

**Causative Organism**

Anthrax is caused by the Gram-positive *Bacillus anthracis*, which are toxin-producing, encapsulated, facultative anaerobic organisms. Anthrax, an often fatal disease of animals, is transmitted to humans by contact with infected animals or their products.

**Mode of Transmission**

People get infected with anthrax when spores get into the body. When this happens, the spores can be activated and become anthrax bacteria. Then the bacteria can multiply, spread out in the body, produce toxins (poisons), and cause severe illness.

People get anthrax by:

* Breathing in spores,
* Eating food or drinking water that is contaminated with spores, or
* Getting spores in a cut or scrape in the skin.

**Anthrax is NOT contagious.** You cannot catch anthrax from another person the way you might catch a cold or the flu. In rare cases, person-to-person transmission has been reported with cutaneous anthrax, where discharges from skin lesions might be infectious.

**Risk factors**

To contract anthrax, you must come in direct contact with anthrax spores. This is more likely if you:

* Are in the military and deployed to an area with a high risk of exposure to anthrax
* Work with anthrax in a laboratory setting
* Handle animal skins, furs or wool from areas with a high incidence of anthrax
* Work in veterinary medicine, especially if you deal with livestock
* Handle or dress game animals — while anthrax is rare in the United States, there are occasional outbreaks in domestic cattle and wild animals such as deer
* Inject illegal drugs, such as heroin

**Pathophysiology**

[*B. anthracis*](https://www.wikidoc.org/index.php/B._anthracis), the causative agent of anthrax, is a [spore](https://www.wikidoc.org/index.php/Spore)-forming [bacterium](https://www.wikidoc.org/index.php/Bacterium). The [spores](https://www.wikidoc.org/index.php/Spores) of [*B. anthracis*](https://www.wikidoc.org/index.php/B._anthracis), which can remain dormant in the environment for decades, are the [infectious](https://www.wikidoc.org/index.php/Infectious) form, but this vegetative form of [*B. anthracis*](https://www.wikidoc.org/index.php/B._anthracis) rarely causes disease. The [bacterium](https://www.wikidoc.org/index.php/Bacterium) causes disease through 2 mechanisms: [toxemia](https://www.wikidoc.org/index.php/Toxemia) and [bacterial infection](https://www.wikidoc.org/index.php/Bacterial_infection). [Spores](https://www.wikidoc.org/index.php/Spores) introduced through the [skin](https://www.wikidoc.org/index.php/Skin) lead to [cutaneous](https://www.wikidoc.org/index.php/Cutaneous) or injection anthrax; those introduced through the [gastrointestinal](https://www.wikidoc.org/index.php/Gastrointestinal) tract lead to gastrointestinal anthrax; and those introduced through the [lungs](https://www.wikidoc.org/index.php/Lungs) lead to inhalation anthrax. After entering a human or animal, [*B. anthracis*](https://www.wikidoc.org/index.php/B._anthracis) [spores](https://www.wikidoc.org/index.php/Spores) are believed to germinate locally or be [phagocytosed](https://www.wikidoc.org/index.php/Phagocytosed) by [dendritic cells](https://www.wikidoc.org/index.php/Dendritic_cells) and [macrophages](https://www.wikidoc.org/index.php/Macrophages). These will then carry the [spores](https://www.wikidoc.org/index.php/Spores) to the [lymph nodes](https://www.wikidoc.org/index.php/Lymph_nodes), where they germinate. [*B. anthracis*](https://www.wikidoc.org/index.php/B._anthracis) begins to produce [toxins](https://www.wikidoc.org/index.php/Toxins) within hours of germination. Protective antigen (PA) and edema factor (EF) combine to form edema toxin (ET), and PA and lethal factor (LF) combine to form lethal toxin (LT). After binding to surface receptors, the PA portion of the complexes facilitates translocation of the [toxins](https://www.wikidoc.org/index.php/Toxins) to the [cytosol](https://www.wikidoc.org/index.php/Cytosol), in which EF and LF exert their toxic effects. [*Bacillus anthracis*](https://www.wikidoc.org/index.php/Bacillus_anthracis) disseminate to multiple organs including [spleen](https://www.wikidoc.org/index.php/Spleen), [liver](https://www.wikidoc.org/index.php/Liver), [intestines](https://www.wikidoc.org/index.php/Intestines), [kidneys](https://www.wikidoc.org/index.php/Kidneys), [adrenal glands](https://www.wikidoc.org/index.php/Adrenal_glands), and [meninges](https://www.wikidoc.org/index.php/Meninges), affecting their normal functions and leading to systemic [infection](https://www.wikidoc.org/index.php/Infection) with a potentially fatal outcome.

The [virulence factors](https://www.wikidoc.org/index.php/Virulence_factors) of [*Bacillus anthracis*](https://www.wikidoc.org/index.php/Bacillus_anthracis) are:

* [Antiphagocytic](https://www.wikidoc.org/index.php/Antiphagocytic) [capsule](https://www.wikidoc.org/index.php/Capsule)
* [Toxins](https://www.wikidoc.org/index.php/Toxins):
* PA
* LF
* EF

**Bacterial Toxins**

In order to [infect](https://www.wikidoc.org/index.php/Infect) the body, [*Bacillus anthracis*](https://www.wikidoc.org/index.php/Bacillus_anthracis) must produce [toxins](https://www.wikidoc.org/index.php/Toxins). These toxins have 3 main toxic effects: [edema](https://www.wikidoc.org/index.php/Edema), [hemorrhage](https://www.wikidoc.org/index.php/Hemorrhage), and [necrosis](https://www.wikidoc.org/index.php/Necrosis). Besides their direct [toxic](https://www.wikidoc.org/index.php/Toxic) effects responsible for tissue damage, [anthrax](https://www.wikidoc.org/index.php/Anthrax) [toxins](https://www.wikidoc.org/index.php/Toxins) are also responsible for interfering with [cellular](https://www.wikidoc.org/index.php/Cellular) pathways, in such way that defense functions of the host's [immune system](https://www.wikidoc.org/index.php/Immune_system) are affected. This will ultimately allow initial systemic [infection](https://www.wikidoc.org/index.php/Infection) by interfering with the [immune system](https://www.wikidoc.org/index.php/Immune_system).

When isolated, the 3 structural elements of the anthrax [exotoxins](https://www.wikidoc.org/index.php/Exotoxins) are non-toxic. However, when combined, they form [virulent](https://www.wikidoc.org/index.php/Virulent) [exotoxins](https://www.wikidoc.org/index.php/Exotoxins):

* LF + PA = LT (Lethal Toxin)
* EF + PA = ET (Edema Toxin)

The PA is responsible for attaching the [toxin](https://www.wikidoc.org/index.php/Toxin) to the [cell](https://www.wikidoc.org/index.php/Cell), while the LF and the EF are responsible for the [toxicity](https://www.wikidoc.org/index.php/Toxicity).

* Edema toxin is a calmodulin-dependent [adenylyl cyclase](https://www.wikidoc.org/index.php/Adenylyl_cyclase), known to increase [intracellular](https://www.wikidoc.org/index.php/Intracellular) [cAMP](https://www.wikidoc.org/index.php/CAMP) through the conversion of [ATP](https://www.wikidoc.org/index.php/ATP) into [cAMP](https://www.wikidoc.org/index.php/CAMP), thus affecting several [intracellular](https://www.wikidoc.org/index.php/Intracellular) pathways.
* Lethal toxin is a zinc-dependent metaloproteinase known to interfere with the mitogen-activated protein kinase (MEK), thereby hampering multiple [intracellular](https://www.wikidoc.org/index.php/Intracellular) mechanisms.

**Signs and Symptoms**

The symptoms of anthrax depend on the type of infection and can take anywhere from **1 day to more than 2 months** to appear.  All types of anthrax have the potential, if untreated, to spread throughout the body and cause severe illness and even death.

**Cutaneous Anthrax Symptoms**

* A group of small blisters or bumps that may itch
* Swelling can occur around the sore
* A painless skin sore (ulcer) with a black center that appears after the small blisters or bumps
	+ Most often the sore will be on the face, neck, arms, or hand

**Inhalation Anthrax Symptoms**

* Fever and chills
* Chest Discomfort
* Shortness of breath
* Confusion or dizziness
* Cough
* Nausea, vomiting, or stomach pains
* Headache
* Sweats (often drenching)
* Extreme tiredness
* Body aches

**Gastrointestinal Anthrax Symptoms**

* Fever and chills
* Swelling of neck or neck glands
* Sore throat
* Painful swallowing
* Hoarseness
* Nausea and vomiting, especially bloody vomiting
* Diarrhea or bloody diarrhea
* Headache
* Flushing (red face) and red eyes
* Stomach pain
* Fainting
* Swelling of abdomen (stomach)

**Injection Anthrax Symptoms**

* Fever and chills
* A group of small blisters or bumps that may itch, appearing where the drug was injected
* A painless skin sore with a black center that appears after the blisters or bumps
* Swelling around the sore
* Abscesses deep under the skin or in the muscle where the drug was injected

Injection anthrax symptoms are similar to those of cutaneous anthrax, but injection anthrax can spread throughout the body faster and be harder to recognize and treat than cutaneous anthrax. Skin and injection site infections associated with injection drug use are common and do not necessarily mean the person has anthrax.

**Diagnosis**

* Gram stain and culture
* Direct fluorescent antibody (DFA) test and polymerase chain reaction (PCR) assay

Occupational and exposure history is important.

Cultures and Gram stain of samples from clinically identified sites, including cutaneous or mucosal lesions, blood, pleural fluid, cerebrospinal fluid, ascites, or stool, should be done. Sputum examination and Gram stain are unlikely to identify inhalation anthrax because airspace disease is frequently absent. A PCR test and immunohistochemical methods (eg, DFA) can help.

Nasal swab testing for spores in people potentially exposed to inhalation anthrax is not recommended because the negative predictive value is unknown. Although a positive nasal swab culture indicates exposure, a negative nasal swab does not mean that exposure has not occurred.

Chest x-ray (or CT) should be done if pulmonary symptoms are present. It typically shows widening of the mediastinum (because of enlarged hemorrhagic lymph nodes) and pleural effusion. Pneumonic infiltrates are uncommon.

[Lumbar puncture](https://www.msdmanuals.com/professional/neurologic-disorders/neurologic-tests-and-procedures/lumbar-puncture-spinal-tap) should be done if patients have meningeal signs or a change in mental status.

An enzyme-linked immunosorbent assay (ELISA) can detect antibody in serum, but confirmation requires a 4-fold change in antibody titer from acute to convalescent specimens.

**Management**

Doctors have several options for treating patients with anthrax, including antibiotics and antitoxins. Patients with serious cases of anthrax need to be hospitalized. They may require aggressive treatment, such as continuous fluid drainage and help breathing through mechanical ventilation.

**Antibiotics**

All types of anthrax infection can be treated with antibiotics, including intravenous antibiotics (medicine given through the vein). If someone has [symptoms](https://www.cdc.gov/anthrax/symptoms/index.html)of anthrax, it’s important to get medical care as quickly as possible to have the best chances of a full recovery. Doctors will select antibiotics that are best for treating anthrax and that are best for the patient based on their medical history.

**Antitoxin**

When anthrax spores get inside the body, they can be “activated.” When they become active, anthrax bacteria can multiply, spread out in the body, and produce toxins—or poisons. Anthrax toxins in the body cause severe illness.

After anthrax toxins have been released in the body, one possible treatment is antitoxin. Antitoxins target anthrax toxins in the body. Doctors must use antitoxin together with other treatment options.

Currently, there are a few types of antitoxins that can be used for treating anthrax.

**Complications**

The most serious complications of anthrax include:

* Your body being unable to respond to infection normally, leading to damage of multiple organ systems (sepsis)
* Inflammation of the membranes and fluid covering the brain and spinal cord, leading to massive bleeding (hemorrhagic meningitis) and death

**Prevention and Control**

There is a [vaccine](https://www.cdc.gov/anthrax/prevention/vaccine/index.html) licensed to prevent anthrax, but it is only recommended for routine use in certain groups of at-risk adults (for example, some members of the military and laboratory workers).

Certain antibiotics can be used to prevent illness from developing for those who have been exposed to anthrax but do not yet have symptoms.

Visitors to areas where anthrax is common or where an outbreak is occurring in animals can get sick with anthrax if they have contact with infected animal carcasses or eat meat from animals that were sick when slaughtered. They can also get sick if they handle animal parts, such as hides, or products made from those animal parts, such as animal hide drums. If you are visiting these areas, do not eat raw or undercooked meat and avoid contact with livestock, animal products, and animal carcasses.

International travelers should be aware of regulations concerning (and restrictions against) the importation of prohibited animal products, trophies, and souvenirs.

Imported animal hides have been associated with a number of anthrax cases in the United States. Cases have occurred in drum makers using these hides. Cases have also occurred in people who have handled or been near the drums or in the environment where they were made. Some imported hides may contain anthrax spores, and although this is rare, there is no way to test for the presence of spores on hides.

To protect against anthrax spores, be sure to use hides that came from animals that were imported with an international veterinary certificate showing that they have undergone the appropriate government inspection

**Chikungunya**

Chikungunya fever is a self-remitting febrile viral illness that has been associated with frequent outbreaks in tropical countries of Africa and Southeast Asia. The illness has only recently become a concern in Western countries and temperate zones around the world.

The term “Chikungunya” often refers to both the virus (CHIKV) and the illness or fever (CHIKF) caused by this virus.

**Epidemiology**

Numerous Chikungunya epidemics have been reported in several countries in Southern and South East Asia. Distinct strains of Chikungunya virus within varying transmission cycles have been reported from different locations. The African variant has managed to persist over the years with frequent outbreaks due to a sylvatic cycle maintained between monkeys and wild mosquitoes. Conversely, the Asian variant causes epidemics that are maintained by an urban cycle, characterized by long inter-epidemic quiescence for more than 10 years or so.

The first Asian epidemic was reported in Bangkok, Thailand, in 1958; continued until 1964; reappeared after a hiatus in the mid-1970s; and declined again in 1976. Major outbreaks were also reported from northwestern and southern parts of India, Sri Lanka, Myanmar, and Thailand in the early 1960s. The cases then declined before sporadic outbreaks were later reported in the Philippines and Indonesia in 1980s and Malaysia in the 1990s.

The next major outbreak occurred in 2001 on islands in the Indian Ocean (Mauritius, Mayotte, Madagascar, Reunion Island). The most severe Chikungunya fever outbreak was reported in 2006 on Reunion Island, where one third of the population was infected, resulting in 237 deaths. Around the same time, an historic outbreak on the Indian subcontinent involved 1.42 million people, with high morbidity rates.

By 2007, the disease was no longer considered a tropical illness, as it had spread to several non-tropical and temperate areas, including Singapore. According to figures from 2013-2014 from the Centers for Disease Control and Prevention (CDC), European Center for Disease Prevention and Control (ECDC), and the Pan American Health Organization (PAHO), several imported cases of travel-related Chikungunya fever have been reported in the United States, Caribbean islands, Britain, France, Germany, Sweden, Portugal, Canary Islands, and the archipelagos off the coast of Western Africa. Chikungunya virus emerged in the Americas in late 2013 and has continued to spread to neighboring countries. As of 2017, about 1.8 million cases had been reported from 44 countries.

In 2018, a literature review group published one of the largest seroprevalence studies (mostly based on IgG ELISA and/or multiplex assay) that included data from 2000-2018. Continents included in these studies included Africa (46%) and Asia (24%). Most reports were from Kenya, Madagascar, India, and French Polynesia. Among these regions, the highest seroprevalence was noted among the general population in Lamu Island, Kenya (72%); pregnant women in Thailand (71.2%); the general population in French Polynesia (76%); and children in Haiti (75.6%).

**Causative Organism**

Chikungunya virus belongs to the family *Togaviridae*, genus *Alphavirus*. Alphavirus infections can either cause arthralgic or neuroinvasive disease. Other medically important alphaviruses found in the Americas include eastern equine encephalitis virus (neuroinvasive) and Mayaro virus (arthalgic). Chikungunya virus has a single-stranded, positive-sense RNA genome. The virus particles are enveloped icosahedral capsids and have a diameter of 60-70 nm.

**Mode of Transmission**

Chikungunya virus is primarily transmitted to people through the bite of an infected mosquito, mainly *Aedes aegypti* and *Aedes albopictus*. People are the primary host of chikungunya virus during epidemic periods. Mosquitoes become infected when they feed on a person who already has the virus.

Blood-borne transmission of chikungunya virus is possible; cases have been documented among laboratory personnel handling **infected blood** and a healthcare provider drawing blood from an infected patient.

Rare *in utero* transmission has been documented, mostly during the **second trimester**. Intrapartum transmission has also been documented when the mother was viremic around the time of delivery. Chikungunya virus has not been found in breast milk and there have been **no reports** to date of infants acquiring chikungunya virus infection through breastfeeding. Because the benefits of breastfeeding likely outweigh the risk of chikungunya virus infection in breastfeeding infants, mothers should be encouraged to breastfeed even if they are infected with chikungunya virus or live in an area with ongoing virus transmission.

The risk of a person transmitting chikungunya virus to a biting mosquito or through blood is highest when the patient is viremic during the first week of illness.

**Pathophysiology**

**Cellular Tropism**

Following transmission through bites by infected mosquito (*[Aedes aegypti](https://www.wikidoc.org/index.php/Aedes_aegypti)* or *[Aedes albopictus](https://www.wikidoc.org/index.php/Aedes_albopictus)*), Chikungunya [virus](https://www.wikidoc.org/index.php/Virus) (CHIKV) replicates in the [skin](https://www.wikidoc.org/index.php/Skin) and [fibroblasts](https://www.wikidoc.org/index.php/Fibroblasts), enters the [bloodstream](https://www.wikidoc.org/index.php/Bloodstream), and disseminates to the [liver](https://www.wikidoc.org/index.php/Liver), [muscle](https://www.wikidoc.org/index.php/Muscle), [joints](https://www.wikidoc.org/index.php/Joints), [lymphoid tissues](https://www.wikidoc.org/index.php/Lymphoid_tissue), and [brain](https://www.wikidoc.org/index.php/Brain). After an incubation period of two to four days, affected individuals typically experience an abrupt onset of symptoms including high [fever](https://www.wikidoc.org/index.php/Fever), [rigors](https://www.wikidoc.org/index.php/Rigors), [headache](https://www.wikidoc.org/index.php/Headache), [photophobia](https://www.wikidoc.org/index.php/Photophobia), incapacitating [arthralgia](https://www.wikidoc.org/index.php/Arthralgia), and [rash](https://www.wikidoc.org/index.php/Rash) characterized by [petechiae](https://www.wikidoc.org/index.php/Petechiae) and/or [maculopapular](https://www.wikidoc.org/index.php/Maculopapular) lesions. Unlike other members of arthritogenic [alphavirus](https://www.wikidoc.org/index.php/Alphavirus), Chikungunya [virus](https://www.wikidoc.org/index.php/Virus) may also cause symptoms of [meningoencephalitis](https://www.wikidoc.org/index.php/Meningoencephalitis) and [hemorrhagic](https://www.wikidoc.org/index.php/Hemorrhage) disease

**Innate Immunity**

In parallel with the development of acute symptoms, the upsurge of [viral load](https://www.wikidoc.org/index.php/Viral_load) triggers the activation of the [innate immune response](https://www.wikidoc.org/index.php/Innate_immune_response), hallmarked by the robust release of type I [interferons](https://www.wikidoc.org/index.php/Interferon) and other proinflammatory [cytokines](https://www.wikidoc.org/index.php/Cytokines) and [chemokines](https://www.wikidoc.org/index.php/Chemokines), which may be crucial to the control of CHIKV replication. Transient [lymphopenia](https://www.wikidoc.org/index.php/Lymphopenia) during acute infection may also be explained by the effects of type I [interferons](https://www.wikidoc.org/index.php/Interferon) rather than direct [cytotoxicity](https://www.wikidoc.org/index.php/Cytotoxicity) of CHIKV,since [B lymphocytes](https://www.wikidoc.org/index.php/B_lymphocyte) and [T lymphocytes](https://www.wikidoc.org/index.php/T_lymphocyte) are not susceptible to CHIKV infection.

**Adaptive Immunity**

In addition to the [innate arm](https://www.wikidoc.org/index.php/Innate_immune_response) of the [immune response](https://www.wikidoc.org/index.php/Immune_response), [T cells](https://www.wikidoc.org/index.php/T_cells) and [antibody](https://www.wikidoc.org/index.php/Antibody)-mediated responses may also be involved in the rapid viral clearance that occurs approximately a week after infection. Relapsing [rheumatic](https://www.wikidoc.org/index.php/Rheumatic) symptoms including [polyarthritis](https://www.wikidoc.org/index.php/Polyarthritis) and [tenosynovitis](https://www.wikidoc.org/index.php/Tenosynovitis) have been reported in infected patients and may be related to the induction of [autoimmunity](https://www.wikidoc.org/index.php/Autoimmunity) caused by [molecular mimicry](https://www.wikidoc.org/index.php/Molecular_mimicry) between viral and host antigens.

**Signs and Symptoms**

* Most people infected with chikungunya virus will develop some symptoms.
* Symptoms usually begin 3–7 days after an infected mosquito bite you.
* The most common symptoms are fever and joint pain.
* Other symptoms may include headache, muscle pain, joint swelling, or rash.
* Death from chikungunya is rare.
* Most patients feel better within a week. However, joint pain can be severe and disabling and may persist for months.
* People at risk for more severe disease include newborns infected around the time of birth, older adults (≥65 years), and people with medical conditions such as high blood pressure, diabetes, or heart disease.
* Once a person has been infected, he or she is likely to be protected from future infections.

**Diagnosis**

Several methods can be used for diagnosis of chikungunya virus infection. Serological tests, such as enzyme-linked immunosorbent assays (ELISA), may confirm the presence of IgM and IgG anti-chikungunya antibodies. IgM antibody levels are highest 3 to 5 weeks after the onset of illness and persist for about 2 months.

The virus may be directly detected in the blood during the first few days of infection as well. As such, samples collected during the first week of illness should be tested by both serological and virological methods (particularly reverse transcriptase–polymerase chain reaction (RT–PCR)). Various RT–PCR methods are available but with variable sensitivity. Some are suited to clinical diagnostics. RT–PCR products from clinical samples may also be used for genotyping of the virus, allowing comparisons with virus samples from various geographical sources.

**Management**

* There is currently no vaccine to prevent or medicine to treat chikungunya.
* Treat the symptoms:
	+ Get plenty of rest.
	+ Drink fluids to prevent dehydration.
	+ Take medicine such as acetaminophen (Tylenol®) or paracetamol to reduce fever and pain.
	+ Do not take aspirin and other non-steroidal anti-inflammatory drugs (NSAIDS) until dengue can be ruled out to reduce the risk of bleeding.
	+ If you are taking medicine for another medical condition, talk to your healthcare provider before taking additional medication.
* If you have chikungunya, [prevent mosquito bites](https://www.cdc.gov/chikungunya/prevention/index.html) for the first week of your illness.
	+ During the first week of illness, chikungunya virus can be found in the blood. The virus can be passed from an infected person to a mosquito through mosquito bites.
	+ An infected mosquito can then spread the virus to other people.

**Complications**

Chikungunya infection outbreaks result in large epidemics that can cause significant morbidity. Post infection rheumatism with joint pain lasting months to years has been reported in the literature. Symptoms can range from transient arthritis with joint pains to severe joint destruction requiring antirheumatic therapy. It also has been shown to exacerbate pre-existing rheumatological conditions, resulting in impaired quality of life. Chronic pain and rheumatism have been shown to affect the mental health of patients.

Although neurologic complications have been controversial, a range of neurologic manifestations were reported from La Reunion Island, with 24 patients diagnosed with Chikungunya-related encephalitis. In addition, severe acute hepatitis, heart failure, respiratory insufficiency, cutaneous effects, and renal failure were also identified during this outbreak.

So far, Chikungunya infection in pregnant people has not been directly linked to congenital malformations. However, vertical transmission at the time of birth has been described in neonates, resulting in neurologic complications and cognitive developmental delays.

**Prevention and Control**

Chikungunya virus is spread to people through the bite of an infected mosquito. Mosquitoes bite during the day and night. There is no vaccine to prevent chikungunya virus infection. The best way to prevent chikungunya is to protect yourself from mosquito bites. Use insect repellent, wear long-sleeved shirts and pants, treat clothing and gear, and take steps to control mosquitoes indoors and outdoors.

If you know you have chikungunya, avoid getting further mosquito bites during the first week of illness. Virus may be circulating in the blood during this time, and therefore you may transmit the virus to new mosquitoes, who may in turn infect other people.

The proximity of mosquito vector breeding sites to human habitation is a significant risk factor for chikungunya as well as for other diseases that *Aedes* mosquito species transmit. At present, the main method to control or prevent the transmission of chikungunya virus is to combat the mosquito vectors. Prevention and control rely heavily on reducing the number of natural and artificial water-filled container habitats that support breeding of the mosquitoes. This requires mobilization of affected and at-risk communities, to empty and clean containers that contain water on a weekly basis to inhibit mosquito breeding and the subsequent production of adults. Sustained community efforts to reduce mosquito breeding can be an effective tool to reduce vector populations.

During outbreaks, insecticides may be sprayed to kill flying mosquitoes, applied to surfaces in and around containers where the mosquitoes land, and used to treat water in containers to kill the immature larvae. This may also be performed by health authorities as an emergency measure to control the mosquito population.

For protection during outbreaks of chikungunya, clothing which minimizes skin exposure to the day-biting vectors is advised. Repellents can be applied to exposed skin or to clothing in strict accordance with product label instructions. Repellents should contain DEET (N, N-diethyl-3-methylbenzamide), IR3535 (3-[N-acetyl-N-butyl]-aminopropionic acid ethyl ester) or icaridin (1-piperidinecarboxylic acid, 2-(2-hydroxyethyl)-1-methylpropylester).

For those who sleep during the daytime, particularly young children, or sick or older people, insecticide-treated mosquito nets afford good protection, because the mosquitoes that transmit chikungunya feed primarily during the day. Basic precautions should be taken by people travelling to risk areas and these include use of repellents, wearing long sleeves and pants and ensuring rooms are fitted with screens to prevent mosquitoes from entering.

**SARS**

Severe acute respiratory syndrome (SARS) is a serious, potentially life-threatening viral infection caused by a previously unrecognized virus from the Coronaviridae family.This virus has been named the SARS-associated coronavirus (SARS-CoV). Previously, Coronaviridae was best known as the second-most-frequent cause of the common cold.

**Epidemiology**

In November 2002, an unusual epidemic of severe pneumonia of unknown origin in Guangdong Province in southern China was noted. There was a high rate of transmission to health care workers (HCWs). Some of these patients were positive for SARS-CoV in the nasopharyngeal aspirates (NPA), whereas 87% patients had positive antibodies to SARS-CoV in their convalescent sera. Genetic analysis showed that the SARS-CoV isolates from Guangzhou had the same origin as those in other countries, with a phylogenetic pathway that matched the spread of SARS to other parts of the world.

The 2002-2003 SARS outbreak predominantly affected mainland China, Hong Kong, Singapore, and Taiwan. In Canada, a significant outbreak occurred in the area around Toronto, Ontario. In the United States, 8 individuals contracted laboratory-confirmed SARS. All patients had traveled to areas where active SARS-CoV transmission had been documented.

The worldwide number of SARS cases from the original outbreak (November 2002 through July 31, 2003) reached more than 8000 persons, including 1706 healthcare workers. Of those cases, 774 resulted in death, with a case fatality ratio of 9.6% deaths, and 7295 recoveries. The majority of these cases occurred in mainland China (5327 cases, 349 deaths), Hong Kong (1755 cases, `299 deaths), with Taiwan (346 cases, 37 deaths), and Singapore (238 cases, 33 deaths).

In North America, there were 251 cases, with 43 resulting in death (all in Canada).

**Mode of Transmission**

Most respiratory illnesses, including SARS, spread through droplets that enter the air when someone with the disease coughs, sneezes or talks. Most experts think SARS spreads mainly through close personal contact, such as caring for someone with SARS. The virus may also be spread on contaminated objects — such as doorknobs, telephones and elevator buttons.

**Pathophysiology**

**Structure:** Proteins that contribute to the overall structure of all coronaviruses are the **spike (S), envelope (E), membrane (M) and [nucleocapsid](https://www.wikidoc.org/index.php/Nucleocapsid) (N).**

Early in infection, SARS-CoV-2 targets cells, such as nasal and bronchial epithelial cells and pneumocytes, through the viral structural spike (S) protein. The type 2 transmembrane serine protease (TMPRSS2), present in the host cell, promotes viral uptake and entry into host cells.

Profound lymphopenia may occur in individuals with COVID-19 when SARS-CoV-2 infects and kills T lymphocyte cells. In addition, viral inflammatory response, consisting of both the innate and the adaptive immune response impairs lymphopoiesis and increases lymphocyte apoptosis.

In later stages of infection, when viral replication accelerates, epithelial-endothelial barrier integrity is compromised. SARS-CoV-2 also infects pulmonary capillary endothelial cells, accentuating the inflammatory response and triggering an influx of monocytes and neutrophils resulting in diffuse thickening of the alveolar wall with mononuclear cells and macrophages infiltrating airspaces and endothelialitis. Interstitial mononuclear inflammatory infiltrates and pulmonary edema develops filling the alveolar spaces. Early-phase acute respiratory distress syndrome (ARDS) is experienced. Collectively, endothelial barrier disruption, dysfunctional alveolar-capillary oxygen transmission, and impaired oxygen diffusion capacity are characteristic features of COVID-19.

In severe COVID-19, activation of coagulation and consumption of clotting factors occur. Inflamed lung tissues and pulmonary endothelial cells may result in microthrombi formation and contribute to the high incidence of thrombotic complications, such as deep venous thrombosis, pulmonary embolism, and thrombotic arterial complications (eg, limb ischemia, ischemic stroke, myocardial infarction) in critically ill patients. The development of viral sepsis, defined as life-threatening organ dysfunction caused by a dysregulated host response to infection, may further contribute to multi organ failure.

Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. JAMA. 2020;324(8):782–793.

**Role of Spike Proteins**

* They induce neutralizing antibody.
* They are important in relating host cell tropism.
* [Hemagglutination](https://www.wikidoc.org/index.php/Hemagglutination).
* They mediate the cell to cell or cell to viral fusion by the interaction between [viral envelope](https://www.wikidoc.org/index.php/Viral_envelope) and the specific receptor of host [cell membrane](https://www.wikidoc.org/index.php/Cell_membrane).

**Signs and Symptoms**

The clinical course of SARS generally follows a typical pattern. Stage 1 is a flulike prodrome that begins 2-7 days after incubation, lasts 3-7 days, and is characterized by the following:

* Fever (>100.4°F [38°C])
* Fatigue
* Headaches
* Chills
* Myalgias
* Malaise
* Anorexia

Less common features include the following

* Sputum production
* Sore throat
* Coryza
* Nausea and vomiting
* Dizziness
* Diarrhea

Stage 2 is the lower respiratory tract phase and is characterized by the following:

* Dry cough
* Dyspnea
* Progressive hypoxemia in many cases
* Respiratory failure that requires mechanical ventilation in some cases

**Diagnosis**

Initial tests in patients suspected of having SARS include the following:

* Pulse oximetry
* Blood cultures
* Sputum Gram stain and culture
* Viral respiratory pathogen tests, notably influenza A and B viruses and respiratory syncytial virus
* *Legionella* and pneumococcal urinary antigen testing should also be considered

Data from the 2002-2003 outbreak indicate that SARS may be associated with the following laboratory findings:

* Modest lymphopenia, leukopenia, and thrombocytopenia: Series have shown white blood cell (WBC) counts of less than 3.5 x 109/L and lymphopenia of less than approximately 1 x 109/L
* Mild hyponatremia and hypokalemia
* Elevated levels of lactate dehydrogenase, alanine aminotransferase, and hepatic transaminase
* Elevated creatine kinase level

According to guidelines from the Centers for Disease Control and Prevention (CDC), the laboratory diagnosis of SARS-CoV infection is established on the basis of detection of any of the following with a validated test, with confirmation in a reference laboratory:

* Serum antibodies to SARS-CoV in a single serum specimen
* A 4-fold or greater increase in SARS-CoV antibody titer between acute- and convalescent-phase serum specimens tested in parallel
* Negative SARS-CoV antibody test result on acute-phase serum and positive SARS-CoV antibody test result on convalescent-phase serum tested in parallel
* Isolation in cell culture of SARS-CoV from a clinical specimen, with confirmation using a test validated by the CDC
* Detection of SARS-CoV RNA via reverse transcriptase polymerase chain reaction (RT-PCR) assay validated by the CDC, with confirmation in a reference laboratory, from (1) two clinical specimens from different sources or (2) two clinical specimens collected from the same source on 2 different days.

Chest radiography results in SARS are as follows:

* In one study, abnormalities were found on initial studies in approximately 60% of patients and were observed in serial examinations in nearly all patients by 10-14 days after symptom onset
* Interstitial infiltrates can be observed early in the disease course
* As the disease progresses, widespread opacification affects large areas, generally starting in the lower lung fields

High-resolution computed tomography (HRCT) scanning is controversial in the evaluation of SARS but may be considered when SARS is a strong clinical possibility despite normal chest radiographs.HRCT findings consistent with SARS include the following:

* In early-stage SARS, an infiltrate in the retrocardiac region
* Ground-glass opacification, with or without thickening of the intralobular or interlobular interstitium
* Frank consolidation

**Management**

No definitive medication protocol specific to SARS has been developed, although various treatment regimens have been tried without proven success. The CDC recommends that patients suspected of or confirmed as having SARS receive the same treatment that would be administered if they had any serious, community-acquired pneumonia.

The following measures may be used:

* Isolate confirmed or suspected patients and provide aggressive treatment in a hospital setting
* Mechanical ventilation and critical care treatment may be necessary during the illness.
* An infectious disease specialist, a pulmonary specialist, and / or a critical care specialist should direct the medical care team
* Communication with local and state health agencies, the CDC, and World Health Organization is critical

**Complications**

Many people with SARS develop pneumonia, and breathing problems can become so severe that a mechanical respirator is needed. SARS is fatal in some cases, often due to **respiratory failure**. Other possible complications include **heart** and **liver failure**.

People older than 60, especially those with underlying conditions such as diabetes or hepatitis, are at the highest risk of serious complications.

**Prevention and Control**

Researchers are working on several types of vaccines for SARS, but none has been tested in humans. If SARS infections reappear, follow these safety guidelines if you're caring for someone who may have a SARS infection:

* **Wash your hands.** Clean your hands frequently with soap and hot water or use an alcohol-based hand rub containing at least 60% alcohol.
* **Wear disposable gloves.** If you have contact with the person's body fluids or feces, wear disposable gloves. Throw the gloves away immediately after use and wash your hands thoroughly.
* **Wear a surgical mask.** When you're in the same room as a person with SARS, cover your mouth and nose with a surgical mask. Wearing eyeglasses also may offer some protection.
* **Wash personal items.** Use soap and hot water to wash the utensils, towels, bedding and clothing of someone with SARS.
* **Disinfect surfaces.** Use a household disinfectant to clean any surfaces that may have been contaminated with sweat, saliva, mucus, vomit, stool or urine. Wear disposable gloves while you clean and throw the gloves away when you're done.

Follow all precautions for at least 10 days after the person's signs and symptoms have disappeared. Keep children home from school if they develop a fever or respiratory symptoms within 10 days of being exposed to someone with SARS.

**Ebola**

[Ebola](https://www.webmd.com/a-to-z-guides/ss/slideshow-visual-guide-to-ebola) is a rare but deadly virus that causes fever, body aches, and diarrhea, and sometimes bleeding inside and outside the body. As the virus spreads through the body, it damages the [immune system](https://www.webmd.com/cold-and-flu/cold-guide/10-immune-system-busters-boosters) and organs. Ultimately, it causes levels of [blood](https://www.webmd.com/heart/anatomy-picture-of-blood)-clotting cells to drop. This leads to severe, uncontrollable bleeding. The disease was known as [Ebola](https://www.webmd.com/a-to-z-guides/rm-quiz-ebola-facts) hemorrhagic [fever](https://www.webmd.com/first-aid/fevers-causes-symptoms-treatments) but is now referred to as *[Ebolavirus](https://www.webmd.com/a-to-z-guides/video/fauci-on-ebola)*[.](https://www.webmd.com/a-to-z-guides/video/fauci-on-ebola) It kills up to 90% of people who are infected.

**Classification**

*Ebolavirus* has five species: ***Zaire ebolavirus*** with type virus Ebola virus (EBOV), ***Bundibugyo*** *ebolavirus* with type virus *Bundibugyo virus* (BDBV), ***Reston ebolavirus*** with type virus *Reston virus* (RESTV), ***Sudan ebolavirus*** with type virus *Sudan virus* (SUDV), and ***Taï Forest ebolavirus*** (also known as *Cote d'Ivoire ebolavirus*) with type virus *Taï Forest virus* (TAFV). Among them, EBOV has up to 90% case-fatality rate in some epidemics.

**Epidemiology**

The first cases of *Ebolavirus* infection were reported in Zaire (now known as the Democratic Republic of the Congo [DRC]) in 1976. There were 318 cases and 280 deaths, an 88% case fatality rate. Transmission in this outbreak was traced back to the use of contaminated needles in an outpatient clinic at Yambuku Mission Hospital. Since then, frequent outbreaks have occurred in Central and Western Africa.

The most common species of Ebola virus responsible for outbreaks is the *Zaire ebolavirus*, the second most common species being the *Sudan ebolavirus*.

The *Zaire ebolavirus* was responsible for the outbreak that started in West Africa in 2014 and finished in 2016. It was first reported in March 2014, and is the largest outbreak since the virus was first discovered in 1976. Genetic sequencing has shown that the virus isolated from infected patients in the 2014 outbreak is 97% similar to the virus that first emerged in 1976. It is also responsible for smaller outbreaks in the DRC from 2017-2021. The *Zaire ebolavirus* has a reported case fatality rate of up to 90% in previous outbreaks. Direct comparison of case fatality rates between different Ebola treatment centers and outbreaks should be interpreted with caution as many variables can introduce bias and skew even large cohort data. The case fatality rate during the 2014 outbreak was up to 64.3% in hospital admissions, falling to 31.5% in some treatment centers in West Africa, and around 20% in patients managed outside West Africa.

In contrast to this, the *Sudan ebolavirus* has a lower case fatality rate of 53% to 65% in previous outbreaks, with the largest outbreak occurring in 2000 in Uganda (425 cases). There has only been one outbreak of *Bundibugyo ebolavirus*: in 2007 in western Uganda, and this outbreak had a case fatality rate of 25%.

Recent outbreaks

* 2021: the thirteenth outbreak in the DRC started on the 8th October 2021 in the North Kivu province and was declared over on the 16th December 2021, with a total of 11 cases and 9 deaths (case fatality rate 82%).
* 2021: a small outbreak was reported in Guinea on 14th February 2021 and was declared over on 19th June 2021, with a total of 23 cases and 12 deaths (case fatality rate 52%). This was the first outbreak in Guinea since the 2014-2016 West Africa outbreak.
* 2021: the twelfth outbreak in the DRC started on the 7th February 2021 in the North Kivu province and was declared over on the 3rd May, with a total of 12 cases and 6 deaths (case fatality rate 50%).
* 2020: the eleventh outbreak in the DRC started on the 1st June in the Équateur province and was declared over on the 18th November, with a total of 130 cases and 55 deaths (case fatality rate 42%).
* 2018-2020: the world’s second largest outbreak in the north Kivu and Ituri provinces of the DRC in 2018 was declared over on the 25th June 2020, with a total of 3481 cases and 2299 deaths (case fatality rate 66%).
* 2018: small outbreak in the DRC with 54 cases and 33 deaths (case fatality rate 61%).
* 2014-2016: the world’s largest outbreak started in the DRC in 2014 and finished in 2016, with over 28,000 cases and 11,000 deaths (case fatality rate 46%).

**Mode of Transmission**

Scientists think people are initially infected with *Ebolavirus* through contact with an infected animal, such as a fruit bat or nonhuman primate. This is called a spillover event. After that, the virus spreads from person to person, potentially affecting a large number of people.

The virus spreads through direct contact (such as through broken skin or mucous membranes in the eyes, nose, or mouth) with:

* Blood or body fluids (urine, saliva, sweat, feces, vomit, breast milk, amniotic fluid, and semen) of a person who is sick with or has died from Ebola virus disease (EVD).
* Objects (such as clothes, bedding, needles, and medical equipment) contaminated with body fluids from a person who is sick with or has died from EVD.
* Infected fruit bats or nonhuman primates (such as apes and monkeys).
* Semen from a man who recovered from EVD (through oral, vaginal, or anal sex). The virus can remain in certain body fluids (including semen) of a patient who has recovered from EVD, even if they no longer have symptoms of severe illness. There is no evidence that Ebola can be spread through sex or other contact with vaginal fluids from a woman who has had Ebola.

When people become infected with Ebola, they do not start developing [signs or symptoms](https://www.cdc.gov/vhf/ebola/symptoms/index.html) right away. This period between exposure to an illness and having symptoms is known as the incubation period.A person can only spread Ebola to other people after they develop signs and symptoms of Ebola.

Additionally, Ebola virus is not known to be transmitted through food. However, in certain parts of the world, Ebola virus may spread through the handling and consumption of wild animal meat or hunted wild animals infected with Ebola. There is no evidence that mosquitoes or other insects can transmit Ebola virus.

**Risk Factors**

* Health workers who do not use proper infection control while caring for Ebola patients, and family and friends in close contact with Ebola patients, are at the highest risk of getting sick. Ebola can spread when people come into contact with infected blood or body fluids.
* Ebola poses little risk to travelers or the general public who have not cared for or been in close contact (within 3 feet or 1 meter) with someone sick with Ebola.

**Pathophysiology of *EbolaVirus***

**Tropism**

Ebola virus enters the patient through mucous membranes, breaks in the skin, or parenterally and infects many cell types, including monocytes, macrophages, dendritic cells, endothelial cells, fibroblasts, hepatocytes, adrenal cortical cells, and epithelial cells. The incubation period may be related to the infection route (6 days for injection versus 10 days for contact). Ebola virus migrates from the initial infection site to regional lymph nodes and subsequently to the liver, spleen, and adrenal gland.

**Endothelial cells:** Glycoprotein (GP) on the virion envelope allows introduction of its content into the endothelial cells, which induces a cytopathic effect and damage to the endothelial barrier function that, together with effects of TNF-α released by the infected mononuclear cells, leads to the loss of vascular integrity and increased leakage.

**Liver:** causes hepatocellular necrosis which could impair the synthesis of proteins of the coagulation system. Damage to the liver, combined with massive viremia, leads to disseminated intravascular coagulopathy. The virus eventually infects microvascular endothelial cells and compromises vascular integrity.

**Adrenal cortex:** Affects the synthesis of enzymes responsible for the synthesis of steroids, leading to hypotension, fluid and electrolyte disturbances.

**Lymphatic system:** Necrosis of the spleen, lymphnodes and thymus; Apoptosis of lymphocytes leading to lymphopenia.

**Immune response**

The virus activates the [macrophages](https://www.wikidoc.org/index.php/Macrophages) synthesis of [interleukins](https://www.wikidoc.org/index.php/Interleukins) (IL), which leads the [Th1](https://www.wikidoc.org/index.php/Th1)/[Th2](https://www.wikidoc.org/index.php/Th2) balance towards a more pronounced [Th1](https://www.wikidoc.org/index.php/Th1)-[cell](https://www.wikidoc.org/index.php/Cell) mediated response.

Some inflammatory mediators produced during the [ebola virus](https://www.wikidoc.org/index.php/Ebola_virus) infection include: [interferon](https://www.wikidoc.org/index.php/Interferon) (IFN)-alpha, [IFN](https://www.wikidoc.org/index.php/IFN)-beta, [IL-2](https://www.wikidoc.org/index.php/IL-2), [IL-6](https://www.wikidoc.org/index.php/IL-6), [IL-8](https://www.wikidoc.org/index.php/IL-8), [IL-10](https://www.wikidoc.org/index.php/IL-10), [interferon](https://www.wikidoc.org/index.php/Interferon)-inducible protein 10; monocyte chemo attractant protein 1; regulated upon activation normal T cell expressed and secreted ([RANTES](https://www.wikidoc.org/index.php/RANTES)); [TNF-alpha](https://www.wikidoc.org/index.php/TNF-alpha); and [reactive oxygen](https://www.wikidoc.org/index.php/Reactive_oxygen) and [nitrogen species](https://www.wikidoc.org/index.php/Nitrogen_species).

Some viral proteins, such as [VP35](https://www.wikidoc.org/index.php?title=VP35&action=edit&redlink=1) and [VP24](https://www.wikidoc.org/index.php?title=VP24&action=edit&redlink=1), block the type I [interferon](https://www.wikidoc.org/index.php/Interferon) response, which plays a key role of the [pathogenesis](https://www.wikidoc.org/index.php/Pathogenesis) of the [disease](https://www.wikidoc.org/index.php/Disease).

The [reactive oxygen](https://www.wikidoc.org/index.php/Reactive_oxygen) (from metabolism of oxygen; play a role in cell signaling) and [nitrogen species](https://www.wikidoc.org/index.php/Nitrogen_species) contribute to the [cell](https://www.wikidoc.org/index.php/Cell) and [tissue](https://www.wikidoc.org/index.php/Tissue) damage, and therefore [vascular](https://www.wikidoc.org/index.php/Vascular) and [organ](https://www.wikidoc.org/index.php?title=Organ&action=edit&redlink=1) damage.

The [nitric oxide](https://www.wikidoc.org/index.php/Nitric_oxide) (there is abnormal production of nitric oxide as the disease progresses) is known to be an important [vasodilator](https://www.wikidoc.org/index.php/Vasodilator), therefore it plays and important role in the development of hypotension and shock.

**Coagulation system**

Ebola infection is associated with hemorrhage in 50% of patients.

Alterations of the [coagulation](https://www.wikidoc.org/index.php/Coagulation) system are induced by the *[ebolavirus](https://www.wikidoc.org/index.php/Ebola_virus)*, and are thought to be mediated by the production of [tissue factor](https://www.wikidoc.org/index.php/Tissue_factor):

* Consumption of [clotting factors](https://www.wikidoc.org/index.php/Clotting_factors)
* Increased concentrations of [fibrin](https://www.wikidoc.org/index.php/Fibrin) degradation products
* [Disseminated intravascular coagulopathy](https://www.wikidoc.org/index.php/Disseminated_intravascular_coagulopathy)

Typically, Ebola virus infection runs its course within 14 to 21 days. Infection initially presents with nonspecific flu-like symptoms such as fever, myalgia, and malaise. As the infection progresses, patients exhibit severe bleeding and coagulation abnormalities, including gastrointestinal bleeding, rash, and a range of hematological irregularities, such as lymphopenia and neutrophilia. Cytokines released when reticuloendothelial cells encounter virus, contribute to exaggerated inflammatory responses that are not protective. The terminal stages of Ebola virus infection usually include diffuse bleeding, and hypotensive shock accounts for many Ebola virus fatalities**.**

**Signs and Symptoms**

Early on, Ebola can feel like the [flu](https://www.webmd.com/cold-and-flu/cold-or-flu-quiz) or other illnesses. Symptoms show up 2 to 21 days after infection and usually include:

* High fever
* [Headache](https://www.webmd.com/migraines-headaches/migraines-headaches-migraines)
* Joint and muscle aches
* [Sore throat](https://www.webmd.com/cold-and-flu/understanding-sore-throat-basics)
* Weakness
* [Stomach pain](https://www.webmd.com/pain-management/guide/abdominal-pain-causes-treatments)
* Lack of appetite

As the disease gets worse, it causes bleeding inside the body, as well as from the [eyes](https://www.webmd.com/eye-health/picture-of-the-eyes), [ears](https://www.webmd.com/cold-and-flu/ear-infection/picture-of-the-ear), and nose. Some people will vomit or [cough](https://www.webmd.com/cold-and-flu/cough-relief-12/slideshow-cough-treatments) up [blood](https://www.webmd.com/a-to-z-guides/rm-quiz-blood-basics), have bloody [diarrhea](https://www.webmd.com/digestive-disorders/digestive-diseases-diarrhea), and get a [rash](https://www.webmd.com/skin-problems-and-treatments/guide/common-rashes).

**Diagnosis**

It can be difficult to clinically distinguish EVD from other infectious diseases such as malaria, typhoid fever and meningitis. Many symptoms of pregnancy and Ebola disease are also quite similar. Because of risks to the pregnancy, pregnant women should ideally be tested rapidly if Ebola is suspected.

Confirmation that symptoms are caused by Ebola virus infection are made using the following diagnostic methods:

* antibody-capture enzyme-linked immunosorbent assay (ELISA)
* antigen-capture detection tests
* serum neutralization test
* reverse transcriptase polymerase chain reaction (RT-PCR) assay
* electron microscopy
* Virus isolation by cell culture

**Management**

In the 2018-2020 Ebola outbreak in the Democratic Republic of the Congo, the [first-ever multi-drug randomized control trial](https://www.who.int/news/item/26-11-2018-democratic-republic-of-the-congo-begins-first-ever-multi-drug-ebola-trial) was conducted to evaluate the effectiveness and safety of drugs used in the treatment of Ebola patients under an ethical framework developed in consultation with experts in the field and the DRC.

Two monoclonal antibodies ([Inmazeb](https://www.fda.gov/news-events/press-announcements/fda-approves-first-treatment-ebola-virus) and [Ebanga](https://www.fda.gov/drugs/drug-safety-and-availability/fda-approves-treatment-ebola-virus)) were approved for the treatment of Zaire ebolavirus (Ebolavirus) infection in adults and children by the US Food and Drug Administration in late 2020.

**Supportive Care**

Whether or not other treatments are available, basic interventions can significantly improve chances of survival when provided early. These are referred to as supportive care, and include:

* Providing fluids and electrolytes (body salts) orally or through infusion into the vein (intravenously).
* Using medication to support blood pressure, reduce vomiting and diarrhea, and to manage fever and pain.
* Treating other infections, if they occur.

**Complications**

Ebola hemorrhagic fever often has many complications; **organ failures**, severe bleeding, [jaundice](https://www.medicinenet.com/image-collection/jaundice_picture/picture.htm), [delirium](https://www.medicinenet.com/delirium/symptoms.htm), [shock](https://www.medicinenet.com/shock/article.htm), [seizures](https://www.medicinenet.com/seizures_symptoms_and_types/article.htm), [coma](https://www.medicinenet.com/coma/article.htm), and death (about 50%-100% of infected patients). Those patients fortunate enough to survive Ebola hemorrhagic fever still may have complications that may take many months to resolve. Survivors may experience weakness, [fatigue](https://www.medicinenet.com/causes_of_fatigue_pictures_slideshow/article.htm), [headaches](https://www.medicinenet.com/headache/article.htm), [hair loss](https://www.medicinenet.com/hair_loss/article.htm), [hepatitis](https://www.medicinenet.com/viral_hepatitis/article.htm), sensory changes, and inflammation of organs (for example, the testicles and the eyes). Some may have Ebola linger in their semen for months and others may have the virus latently infect their eye(s).

Male patients may have detectable Ebola viruses in their semen for as long as six months after they survive the infection. Researchers consider the chance of being infected with Ebola from semen is very low; however, they recommend utilizing [condoms](https://www.medicinenet.com/condoms/article.htm) for six months; some experts suggest a longer time.

**Prevention and Control**

When living in or traveling to a region where Ebola virus is potentially present, there are a number of ways to protect yourself and prevent the spread of EVD.

* Avoid contact with blood and body fluids (such as urine, feces, saliva, sweat, vomit, breast milk, amniotic fluid, semen, and vaginal fluids) of people who are sick.
* Avoid contact with semen from a man who has recovered from EVD, until testing shows that the virus is gone from his semen.
* Avoid contact with items that may have come in contact with an infected person’s blood or body fluids (such as clothes, bedding, needles, and medical equipment).
* Avoid funeral or burial practices that involve touching the body of someone who died from EVD or suspect EVD.
* Avoid contact with bats, forest antelopes, and nonhuman primates (such as monkeys and chimpanzees) blood, fluids, or raw meat prepared from these or unknown animals (bush meat).

These same prevention methods should be used when living in or traveling to an area experiencing an Ebola outbreak. After returning from an area experiencing an Ebola outbreak, people should monitor their health for 21 days and seek medical care immediately if they develop [symptoms of EVD](https://www.cdc.gov/vhf/ebola/symptoms/index.html).

**Ebola Vaccine**

The U.S. Food and Drug Administration (FDA) approved the Ebola vaccine rVSV-ZEBOV (called Ervebo®) on December 19, 2019. This is the first FDA-approved vaccine for Ebola.

This vaccine is given as a single dose vaccine and has been found to be safe and protective against *Zaire ebolavirus*, which has caused the largest and most deadly Ebola outbreaks to date.

On February 26, 2020, the Advisory Committee on Immunization Practices (ACIP) [recommended](https://www.cdc.gov/vaccines/acip/recommendations.html) pre-exposure prophylaxis vaccination with rVSV-ZEBOV for adults ≥ 18 years of age in the U.S. population who are at potential occupational risk of exposure to *Zaire ebolavirus*. This recommendation includes adults who are

* Responding or planning to respond to an outbreak of EVD;
* Laboratorians or other staff working at biosafety-level 4 facilities that work with live Ebola virus in the United States; or
* Healthcare personnel working at federally designated [Ebola Treatment Centers](http://www.phe.gov/Preparedness/planning/hpp/reports/Documents/RETN-Ebola-Report-508.pdf)

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A two-dose vaccine regimen of a different vaccine that was also designed to protect against the Zaire ebolavirus species of Ebola was used under a research protocol in 2019 during an Ebola outbreak in the Democratic Republic of the Congo. The two doses of this vaccine use two different vaccine components (Ad26.ZEBOV and MVA-BN-Filo) and the regimen requires an initial dose and a “booster” dose 56 days later. This vaccine has not yet been approved by the FDA for routine use.

**H1N1**

The H1N1 flu, commonly known as swine flu, is primarily caused by the H1N1 strain of the flu (influenza) virus. H1N1 is a type of influenza A virus, and H1N1 is one of several flu virus strains that can cause the seasonal flu. Symptoms of the H1N1 flu are the same as those of the seasonal flu.

In the spring of 2009, scientists recognized a particular strain of flu virus known as H1N1. This virus is a combination of viruses from pigs, birds and humans that causes disease in humans. During the 2009-10 flu season, H1N1 caused the respiratory infection in humans that was commonly referred to as swine flu. Because so many people around the world got sick, in 2009 the World Health Organization (WHO) declared the H1N1 flu to be a pandemic. In August 2010, WHO declared the pandemic over. After the pandemic was over, the H1N1 flu virus became one of the strains that cause seasonal flu.

The flu vaccine can now help protect against the H1N1 flu (swine flu). The H1N1 flu virus strain is included in the seasonal flu vaccine, including the vaccine for 2020-21.

**Classification**

Swine influenza may be classified according to the genera of the infective agent into either influenza A (common) or influenza C (rare). Influenza B has not been associated with development of swine influenza.

Influenza A subtypes include the following:

* H1N1
* H1N2
* H2N3
* H3N1
* H3N2

A new strain of H1N1, A/Veracruz/2009, emerged in 2009 and was responsible for the 2009 swine influenza outbreak in humans

**Epidemiology**

Swine influenza usually occurs in outbreaks/pandemics, and the incidence may vary greatly from one year to another.

The 2009 H1N1 global infection rate was 11% to 21%.

During the 2009 swine influenza outbreak, the incidence in the USA was approximately 18,000 per 100,000 individuals (a total of 60 million cases) with approximately 265,000 hospitalizations reported.

The exact case fatality rate is unknown.

During the 2009 swine influenza outbreak, initial reports stated that a total of 15,000-18,000 individuals died worldwide, the majority of whom were under 65 years of age. However, reports published three years later speculated that more than 280,000 - 500,000 individuals may have died due to the 2009 swine influenza. The initial underestimation was thought to be caused by not counting individuals with no access to healthcare in developing countries.

Individuals of all age groups may be affected by swine influenza.

Compared to the elderly, younger individuals are at higher risk of developing swine influenza. It is thought that older individuals may have a higher degree of cross-protection against influenza infection.

Small children and the elderly are at higher risk of developing swine flu-related complications.

**Causative Organism**

Influenza viruses such as H1N1 infect the cells that line your nose, throat and lungs. The virus enters your body when you inhale contaminated droplets or transfer live virus from a contaminated surface to your eyes, nose or mouth.

You can't catch swine flu from eating pork.

**Mode of Transmission**

Swine influenza (novel H1N1 and H3N2v) spreads from person to person, either by inhaling the virus or by touching surfaces contaminated with the virus, then touching the mouth or nose. Infected droplets are expelled into the air through [coughing](https://www.emedicinehealth.com/coughs/article_em.htm) or sneezing. H3N2v does not spread as easily from person to person as H1N1. This poor transmission rate is likely why there have been so few individuals infected with H3N2v.

Research suggested that H1N1 swine influenza is about as [contagious](https://www.emedicinehealth.com/contagious_quiz_iq/quiz.htm) as the usual human influenza. If one person in a household gets swine flu, anywhere from 8%-19% of household contacts likely will get infected. Reports from the southern hemisphere suggest that swine influenza caused slightly more infections than would be normal for an influenza season.

**Pathophysiology**

Data regarding the exact pathogenesis of swine influenza infection in hosts is limited, but is thought to be similar to other influenza viruses (human avian influenza viruses).

H1N1 swine flu is an acute disease that infects the upper respiratory tract and can cause inflammation of the upper respiratory passages, trachea, and possibly the lower respiratory tract. The known incubation period for H1N1 swine flu ranges from 1 to 4 days, with the average around 2 days in most individuals, but some individuals, it may be as long as 7 days. The contagious period for adults starts about 1 day before symptoms develop and lasts around 5 to 7 days after the person develops symptoms. The contagious period may be longer in individuals with weakened immune systems and children (e.g., 10 to 14 days).

Novel H1N1 viruses are thought to have evolved from older influenza viruses by reassortment of formerly triple-reassortant swine flu viruses.

Swine influenza virus is usually transmitted from asymptomatic carrier pigs to humans.

Human-to-human transmission of swine influenza is thought to occur by either aerosols of respiratory secretions or by the fecal-oral route.

**Mechanism of Infection**

Hemagglutinin, neuraminidase, polymerase proteins, nucleoproteins, and matrix proteins are involved in the pathogenesis of swine influenza:

* **Hemagglutinin (HA)**: Surface protein that acts as a receptor binding site. HA is targeted by host antibodies to neutralize the virus.
* **Neuraminidase (NA)**: Cleaves progeny virions from host cell receptors.
* **Polymerase proteins**: PB1, PB2, PA, and PB1-F2. These proteins form the polymerase complex. Together with the NP protein, form the ribonucleoprotein (RNP) complex to **induce replication and transcription**. Additionally, PB1-F2 has a role in **inducing apoptosis**.
* **Nucleoprotein (NP)**: Together with the polymerase proteins, NP forms the RNP complex to **induce replication and transcription**.
* **Non-structural proteins**: NS1 and NS2. **NS1 processes mRNA and helps the virus evade the host immune responses.** NS2 controls the exporting process of RNP from the host nucleus.
* **Matrix proteins**: M1 and M2. M1 has a role in **viral assembly**. M2 controls pH in the Golgi body.

**Viral Fusion with Host Cell:**

* The exact pathogenesis of swine influenza in humans is not fully understood.
* The HA protein (receptor binding site) on the viral surface **binds to host receptors** that contain sialic acid.
* The precursor HA molecule undergoes **proteolytic activation** and cleaves to produce 2 molecules: HA1 and HA2.
* Following **proteolytic activation, the virus fuses with the host cell**.
* Following fusion, viral replication typically takes place within 1 day in the upper and lower respiratory tracts, including the nasopharynx, trachea, and lungs. Less commonly, replication occurs in extrapulmonary organs, including the intestines, brain, heart, or placenta.
* Similar to human and avian influenza, swine influenza is thought to replicate intracellularly via cytolytic or apoptotic mechanisms.
* M2 provides the adequate pH in the Golgi apparatus for the viruses to replicate and assemble. Mutations in M2 protein have been associated with adaptive mechanisms of the virus to infect new hosts.

Following infection, the expression of cytokines and chemokines in the lungs significantly increases. The exaggerated up-regulation of these cytokines and chemokines may partly be responsible for the tissue injury associated with the influenza virus. The expression of the following proteins increases with influenza infection:

* Tumor necrosis factor-α
* Macrophage inflammatory protein 1-α
* Interferon-γ and interferon-β
* IL-6

It is thought that following infection, the TRAIL death receptor ligand is activated and is responsible for triggering apoptosis.

**Signs and Symptoms**

The signs and symptoms of flu caused by the H1N1 virus are similar to those of infections caused by other flu strains and can include:

* Fever, but not always
* Chills
* Cough
* Sore throat
* Runny or stuffy nose
* Watery, red eyes
* Body aches
* Headache
* Fatigue
* Diarrhea
* Nausea and vomiting

Flu symptoms develop about one to three days after you're exposed to the virus. If you have emergency signs and symptoms of the flu, get medical care right away. For adults, emergency signs and symptoms can include:

* Difficulty breathing or shortness of breath
* Chest pain
* Ongoing dizziness
* Seizures
* Worsening of existing medical conditions
* Severe weakness or muscle pain

Emergency signs and symptoms in children can include:

* Difficulty breathing
* Blue lips
* Chest pain
* Dehydration
* Severe muscle pain
* Seizures
* Worsening of existing medical conditions

**Diagnosis**

There are several tests used to diagnose influenza, but not everyone who has the flu needs to be tested. Your doctor may diagnose you with influenza based on your signs and symptoms. In most cases, knowing that someone has the flu doesn't change the treatment plan. Doctors are more likely to use a test to diagnose flu if:

* You're already in the hospital
* You're at high risk of complications from the flu
* You live with someone who is at greater risk of flu complications

Your doctor may also use a test to determine whether a flu virus is the cause of your symptoms, or if you have or are showing signs of another problem besides the flu, such as:

* Heart problems, such as heart failure or an infection of the heart muscle
* Lung and breathing problems, such as asthma or pneumonia
* Brain and nervous system problems, such as encephalopathy or encephalitis
* Septic shock or organ failure

In some cases, your doctor may suggest that you be tested for influenza. He or she may use various tests to diagnose influenza. Polymerase chain reaction (PCR) testing is becoming more common in many hospitals and labs. This test may be done while you're in your doctor's office or in the hospital. PCR testing is more sensitive than other tests and may be able to identify the influenza strain.

During the COVID-19 pandemic, it's possible to have a test to diagnose both influenza and COVID-19. It's possible to have both COVID-19 and influenza at the same time.

**Management**

Most people with flu, including H1N1 flu (swine flu), require only symptom relief. Supportive care such as drinking liquids, taking pain relievers for fever and headache, and resting may be helpful. If you have a chronic respiratory disease, your doctor may prescribe additional medications to help relieve your symptoms.

Antiviral drugs are sometimes prescribed within the first day or two of symptoms. They can reduce the severity of symptoms and possibly the risk of complications. The U.S. Food and Drug Administration has approved these four drugs:

* Oseltamivir (Tamiflu)
* Zanamivir (Relenza)
* Peramivir (Rapivab)
* Baloxavir (Xofluza)

But flu viruses can develop resistance to these drugs.

To make development of resistance less likely and maintain supplies of these drugs for those who need them most, doctors reserve antivirals for people at high risk of complications and those who are in close contact with people who have high risk of complications.

People at higher risk of flu complications include people who:

* Are in a hospital, nursing home or other long-term care facility.
* Are younger than 5 years of age, particularly children younger than 2 years.
* Are 65 years old or older.
* Are pregnant or within two weeks of delivery, including women who have had pregnancy loss.
* Are younger than 19 years of age and are receiving long-term aspirin therapy. Using aspirin during a viral illness increases the risk of developing Reye's syndrome, a rare but potentially life-threatening condition, in these individuals.
* Have a body mass index above 40, which is defined as morbid obesity.
* Have certain chronic medical conditions, such as asthma, emphysema, heart disease, diabetes, neuromuscular disease, or kidney, liver or blood disease.
* Are immunosuppressed due to certain medications or HIV.
* Are of American Indian or Alaska Native heritage.

Lifestyle and home remedies

If you develop any type of flu, these measures may help ease your symptoms:

* **Drink plenty of liquids.** Choose water, juice and warm soups to prevent dehydration.
* **Rest.** Get more sleep to help your immune system fight infection.
* **Consider pain relievers.** Use an over-the-counter pain reliever, such as acetaminophen (Tylenol, others) or ibuprofen (Advil, Motrin IB, others).

Use caution when giving aspirin to children or teenagers. Though aspirin is approved for use in children older than age 3, children and teenagers recovering from chickenpox or flu-like symptoms should never take aspirin. This is because aspirin has been linked to Reye's syndrome, a rare but potentially life-threatening condition, in such children.

If you have the flu, you can give it to others. Stay home for at least 24 hours after your fever is gone.

**Complications**

Influenza complications include:

* Worsening of chronic conditions, such as heart disease and asthma
* Pneumonia
* Neurological signs and symptoms, ranging from confusion to seizures
* Respiratory failure

**Prevention and Control**

The Centers for Disease Control and Prevention (CDC) recommends annual flu vaccination for everyone age 6 months or older. Each year's seasonal flu vaccine protects against the three or four influenza viruses that are expected to be the most common during that year's flu season. The flu vaccine can reduce your risk of the flu and its severity and lower the risk of having serious illness from the flu and needing to stay in the hospital.

Flu vaccination is especially important in the 2020-21 flu season because the flu and coronavirus disease 2019 (COVID-19) cause similar symptoms. Flu vaccination could reduce symptoms that might be confused with those caused by COVID-19. Preventing the flu and reducing the severity of flu illness and hospitalizations could also lessen the number of people needing to stay in the hospital.

The flu vaccine is available as an injection and as a nasal spray. The nasal spray is approved for use in healthy people ages 2 through 49 years old. The nasal spray isn't recommended for some groups, such as pregnant women, children between 2 and 4 years old with asthma or wheezing, and people who have compromised immune systems.

These measures also help prevent the flu and limit its spread:

* **Wash your hands thoroughly and frequently.** Use soap and water, or if they're unavailable, use an alcohol-based hand sanitizer.
* **Cover your coughs and sneezes.** Cough or sneeze into a tissue or your elbow. Then wash your hands.
* **Avoid touching your face.** Avoid touching your eyes, nose and mouth.
* **Clean surfaces.** Regularly clean often-touched surfaces to prevent spread of infection from a surface with the virus on it to your body.
* **Avoid contact.** Stay away from crowds if possible. Avoid anyone who is sick. If you're at high risk of complications from the flu — for example, you're younger than 5 or you're 65 or older, you're pregnant, or you have a chronic medical condition such as asthma — consider avoiding swine barns at seasonal fairs and elsewhere.

During the COVID-19 pandemic, both COVID-19 and the flu may be spreading at the same time. Your local health department and the CDC may suggest other precautions to reduce your risk of COVID-19 or the flu. For example, you may need to practice social distancing (physical distancing) and stay at least 6 feet (2 meters) from others outside your household. You may also need to wear a cloth face mask when around people outside your household.