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Review Article

A Review on Leptospirosis

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Leptospirosis is a globally prevalent, re-emerging zoonotic bacterial disease caused by spirochetes of the Leptospira, which poses a significant public health threat, particularly in tropical and subtropical regions. It is considered one of the most widespread, yet neglected, zoonosis, with an estimated global annual incidence of approximately 1 million cases and over 58,000 deaths. The disease is primarily transmitted to humans through direct contact with urine from infected animals (including rodents, cattle, pigs, and dogs) or, more commonly, through indirect contact with contaminated water or soil via skin abrasions or mucous membranes. Its prevalence is highly influenced by environmental factors such as heavy rainfall, flooding, poor sanitation, and the presence of infected reservoir hosts, highlighting the impact of climate change and urbanization on disease spread. Clinically, leptospirosis has a wide spectrum of manifestations, ranging from a mild, self-limited, flu-like illness (anicteric leptospirosis) to severe, life-threatening multi-organ failure (icteric leptospirosis or Weil's disease), which can involve the kidneys, liver, lungs, and central nervous system. Non-specific symptoms in the early stages often lead to misdiagnosis or underreporting, as they can mimic other febrile illnesses like dengue or influenza. A key clinical sign is conjunctival suffusion (red eyes without purulent discharge). Diagnosis is challenging and typically relies on a combination of clinical suspicion and laboratory tests. The microscopic agglutination test (MAT) is the gold standard for serological diagnosis, while molecular methods like PCR are increasingly used for early detection of the pathogen in the acute phase of illness. Management of severe cases requires prompt supportive care, potentially including dialysis for renal failure or mechanical ventilation for severe pulmonary hemorrhage syndrome, and early antibiotic therapy with agents like penicillin, doxycycline, or ceftriaxone. Preventive measures, including public awareness campaigns, use of personal protective equipment (PPE) for at-risk groups, improved sanitation, rodent control, and targeted animal vaccination programs, are crucial for mitigation. A "One Health" approach, integrating human, animal, and environmental health strategies, is increasingly advocated to effectively control the disease.

Keywords: Leptospira bacteria, zoonotic disease, animal urine, contaminated water/soil.

INTRODUCTION

Leptospirosis is an illness caused by an infection with the bacteria Leptospira. You can get infected with Leptospira through abrasions or cuts in your skin, or through your eyes, nose or mouth. Leptospirosis is a zoonotic disease, which means it's transmitted between animals and humans. You can get infected through:

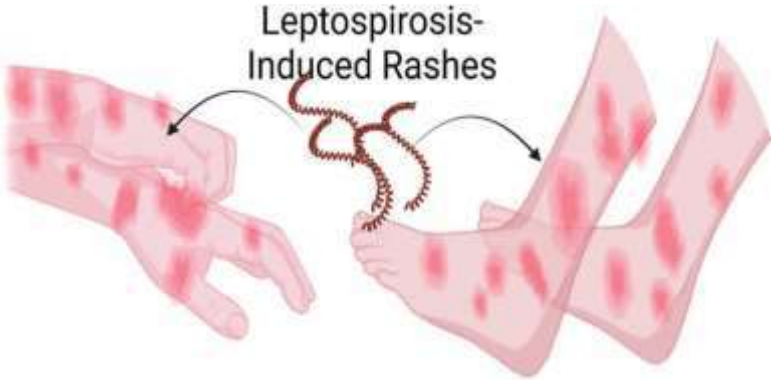
- Direct contact with pee (urine) or reproductive fluids from infected animals.
- Contact with contaminated water or soil.
- Eating or drinking contaminated food or water.

You can get leptospirosis no matter where you live, but it's most common in tropical areas and warmer climates with lots of rainfall each year. You're at an increased risk for leptospirosis if you live in or travel to these areas, including:

- Oceania (Australia, New Zealand and the Pacific Islands).
- The Caribbean.

- Parts of sub-Saharan Africa.
- Parts of Latin America.
- South and Southeast Asia.

Outbreaks of leptospirosis have occurred in the U.S. after flooding in Hawaii, Florida and Puerto Rico. Recreational freshwater activities, especially ones that put you in contact with contaminated water for long periods of time, put you at increased risk. This includes activities that put your head underwater or cause you to swallow water (for instance, white water rafting, swimming and boating). Your risk is even greater after heavy rainfall or flooding.



Leptospirosis consists of two phases:

The leptospiremic (acute) phase and the immune (delayed) phase. You may have mild symptoms or no symptoms in the leptospiremic phase. Some people develop severe symptoms in the immune phase.

Leptospiremic phase

During the leptospirosis phase (also called the septicemic phase) you may experience a sudden onset of flu-like symptoms. This usually starts within two to 14 days after a Leptospira infection. It lasts between three and 10 days. In this phase, bacteria are in your bloodstream and moving to your organs. Blood tests will show signs of infection.

Immune phase

In the immune phase, Leptospira bacteria have moved from your blood to your organs. The bacteria are most concentrated in your kidneys, which make pee (urine). Urine tests will show signs of the bacteria and you'll have antibodies to Leptospira in your blood. A small number of people will get very sick with Weil's syndrome in this phase. Weil's syndrome causes internal bleeding, kidney damage and severe yellowing of your skin and eyes (jaundice). In developing countries, the disease occurs most commonly in pest control, farmers, and low-income people who live in areas with poor sanitation. In developed countries, it occurs during heavy downpours and is a risk to pest controllers, sewage workers and those involved in outdoor activities in warm and wet areas. Diagnosis is typically by testing for antibodies against the bacteria or finding bacterial DNA in the blood. An estimated one million severe cases of leptospirosis in humans occur every year, causing about 58,900 deaths. The disease is most common in tropical areas of the world, but may occur anywhere. Outbreaks may arise after heavy rainfall. The disease was first described by physician Adolf Weil in 1886 in Germany. Infected animals may have no, mild, or severe symptoms. These may vary by the type of animal.

Life cycle of leptospirosis:

The life cycle of Leptospira bacteria involves an enzootic cycle in animal hosts and survival in the environment, with humans being incidental or accidental hosts. The cycle has two main stages: persistence in a reservoir host and environmental transmission.

1. Persistence in a Reservoir Host

Many wild and domestic mammals serve as natural, long-term reservoirs for Leptospira bacteria, usually without showing severe symptoms.

Colonization: After initial infection, the bacteria travel through the bloodstream and colonize the renal tubules of the kidneys.

Shedding: The infected animals (such as rodents, dogs, cattle, and pigs) continuously or intermittently excrete large amounts of viable bacteria in their urine into the environment for extended periods, sometimes years or their entire lives. This is the key mechanism by which the bacteria are maintained in nature.

2. Environmental Transmission

The Leptospira bacteria are able to survive for weeks to months in favourable environmental conditions, outside a host.

Survival conditions: The bacteria thrive in warm, moist, and stagnant freshwater or damp soil with a neutral to slightly alkaline PH. They are susceptible to drying, freezing, and high temperatures.

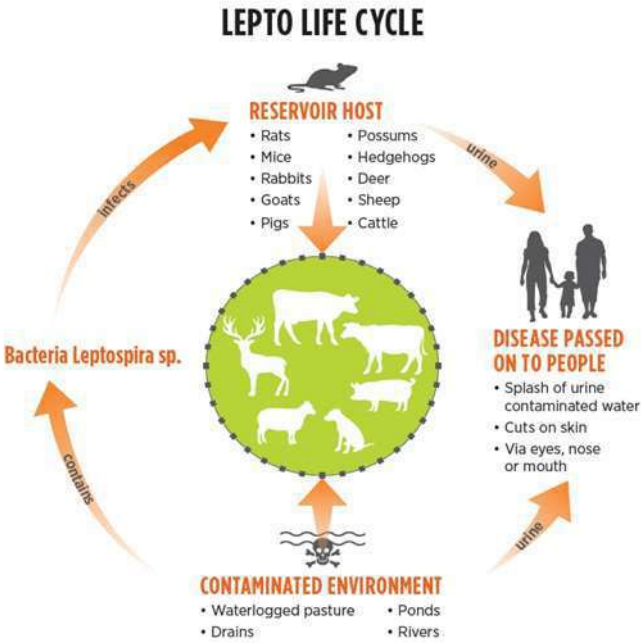
Transmission to new hosts: A new animal or human host becomes infected through direct contact with infected animal urine or indirectly through contact with a contaminated environment (water, soil, mud). The bacteria enter the body through cuts, abrasions, or intact mucous membranes (eyes, nose, mouth). Ingestion of contaminated water or food is also a possible route of infection.

3. Human Infection

Humans are considered accidental, dead-end hosts in the leptospirosis life cycle.

Biphasic illness: In humans, the infection typically manifests as a biphasic illness. The initial acute/leptospiremic phase involves the bacteria in the bloodstream and rapid dissemination to organs like the liver, kidneys, and lungs. The immune phase follows, where antibodies clear the bacteria from the blood but organ damage (e.g., kidney damage, liver failure, pulmonary haemorrhage) can occur due to the immune response.

Limited shedding: While humans can shed the bacteria in their urine during the immune phase, this is typically for a much shorter duration (weeks to a couple of months) compared to reservoir animals, and person-to-person transmission is extremely rare.



Transmission to human:

Humans are accidental hosts, infected incidentally after animal or environmental exposure. Transmission of the organism to humans occurs via portals of entry, including cuts or abraded skin, mucous membranes, or conjunctivae Human exposures that lead to infection include contact with urine-contaminated soil or water (eg, floodwater, ponds, rivers, streams, sewage), ingestion of food or water contaminated by urine or urine-contaminated water, or direct contact with the urine or reproductive fluids from infected animals [10]. Transmission has also rarely occurred through animal bites. Controversy exists as to whether

Leptospira can penetrate intact skin. Human-to-human transmission is very rare but has been documented through sexual intercourse and breastfeeding reproductive tract, leading to transmission during mating.

Pathophysiology:

Leptospirosis pathophysiology involves bacteria entering the body through broken skin or mucous membranes, spreading via the bloodstream to organs like the liver and kidneys, and causing damage through direct bacterial action and a strong immune response. In severe cases (Weil's syndrome), this can lead to a life-threatening cascade of organ damage including jaundice, acute kidney injury (AKI), pulmonary hemorrhage, and a systemic inflammatory response that can include a cytokine storm followed by immunoparalysis.

Entry and spread

Entry: Leptospira bacteria enter the body, often through nonintact skin or mucous membranes, from contact with infected animal urine, contaminated water, or soil.

Spread: After entry, the bacteria travel through the lymphatic system before entering the bloodstream (bacteremia), from which they spread throughout the body.

Seeding: The bacteria colonize various organs, particularly the liver and kidneys, where they multiply.

Mechanisms of damage

Bacterial damage: The bacteria can cause direct damage to cells and tissues, including the endothelial lining of capillaries, which impairs blood flow. A protein called hemolysin SphH can form pores in cell membranes, leading to cell damage and hemorrhages.

Immune-mediated damage: The body's immune response is a major driver of tissue and organ damage.

Inflammatory response: The initial immune response involves cytokine production.

Cytokine storm and immune paralysis: In severe cases, an excessive and uncontrolled release of cytokines can lead to a "cytokine storm," followed by a state of immune paralysis, which is a feature of sepsis and can lead to organ failure.

Organ-specific effects

Liver: Direct damage to hepatocytes disrupts intercellular junctions, leading to liver dysfunction, jaundice, and elevated liver enzymes.

Kidneys: Bacteria colonize the renal tubules. This, along with the immune response, leads to renal damage and acute kidney injury (AKI). Renal failure is the most common cause of death.

Lungs: The condition can cause pulmonary hemorrhage, a leading cause of mortality in severe cases.

Other organs: The infection can manifest in various other ways, including nervous system damage, ocular problems, and hematological abnormalities.

Data/Statistics and History:

Leptospirosis occurs worldwide but is endemic mainly in countries with humid subtropical and tropical climates. Estimates indicate that there are more than 500,000 cases of leptospirosis each year worldwide. Leptospirosis is a disease of epidemic potential, especially after heavy rainfall or flooding. Cases have been reported in most countries of the Americas and outbreaks have been reported in Brazil, Nicaragua, Guyana and several other Latin American countries. The majority of reported cases have severe manifestations, for which mortality is greater than 10%. The number of human cases is not known precisely due to under- or misdiagnosis. Outbreaks can be associated with floods and hurricanes. Leptospirosis can also be an occupational hazard for people who work outdoors or with animals, such as rice and sugar-cane field workers, farmers, sewer workers, veterinarians, dairy workers, and military personnel. It is also a recreational hazard to those who swim or wade in contaminated water. Leptospirosis is a problem of human and veterinary public health. The numerous Leptospira strains can establish infections within a variety of animal hosts that includes rodents,

livestock, and other domestic animals while humans serve as incidental hosts. Wild and domestic animals in the carrier state may shed leptospires intermittently for many years or even a lifetime.

History:

Leptospirosis has a long history, recognized in ancient texts as "rice field jaundice" and other names before physician Adolf Weil formally described its severe form, Weil's disease, in 1886. The causative agent, a spiral-shaped bacterium, was discovered in 1907 by Stimson, and later identified independently in Japan and Germany in 1915. The role of rats as a vector was discovered in 1917.

Early observations and recognition

Ancient times: Diseases matching leptospirosis were described in ancient Chinese and Japanese texts as occupational hazards, particularly for rice field workers.

1812: The French physician Larrey described a similar disease, "fièvre jaune," among Napoleon's troops in Cairo.

1886: Adolf Weil published his description of the severe form of the disease, which became known as Weil's disease, noting the symptoms of jaundice, fever, hemorrhage, and kidney failure.

1907: The spiral-shaped bacterium was first observed in the kidneys of a patient with Weil's disease by Stimson, who named it Spirochaeta interrogans.

1915-1916: Scientists in both Japan and Germany independently demonstrated that the Spirochaeta interrogans was the cause of the disease.

Later discoveries and control

1917: The role of rats as a source of human infection was discovered.

1940s: The disease became a known occupational hazard for sewer workers and others exposed to contaminated water.

Mid-1900s: Researchers developed vaccines to help prevent the disease.

Today: Leptospirosis is recognized as a global zoonotic disease and a significant public health concern, particularly in tropical regions.

In ancient China, a disease that was certainly leptospirosis was recognized as an occupational hazard of rice harvesters. In Japan, leptospirosis was called akiyami, or autumn fever, a term still used for this disease. In the West, leptospirosis was described by Larrey in 1812 as fièvre jaune among Napoleon's troops at the siege of Cairo. The disease initially was believed to be related to the plague but not as contagious. Throughout the remainder of the 19th century, leptospirosis was known in Europe as bilious typhoid. Leptospirosis was recognized as an occupational disease of sewer workers in 1883. In 1886, Adolph Weil published his historic paper describing the most severe form of leptospirosis that would be later known as Weil disease. Weil described the clinical manifestations in 4 men who had severe jaundice, fever, and hemorrhage with renal involvement. In 1907, Stimson used special staining techniques in the postmortem examination of a kidney from a person with Weil disease and found a spiral organism with hooked ends, which was named Spirochaeta interrogans because its shape resembled that of a question mark. Inada et al identified the causal agent of infectious jaundice in Japan in 1916, naming the organism Spirochaeta icterohaemorrhagiae.

Case Description:

We report a case of leptospirosis with tick-borne typhus coinfection in an abattoir worker who presented with a short history of fever, myalgia, jaundice, nonoliguric renal failure, diffuse petechial rash, and altered sensorium. His lab investigations showed leukocytosis, raised C-reactive protein (CRP), elevated transaminases and creatinine, mild pleocytosis, and mildly raised proteins in cerebrospinal fluid (CSF). Serology for Leptospira IgM was positive by enzyme-linked immune sorbent assay (ELISA). A paired Weil-Felix test (WFT) showed a fourfold increase in OX19 and OX2 titers. The patient responded well to IV antibiotic therapy and was discharged. This is the first time that leptospirosis and Indian tick-borne typhus coinfection has been reported from western India.

Taxonomy and classification:

Leptospirosis is classified in two main ways: by genotype (based on DNA) and by serovar (based on antigenic properties). Genetically, the genus Leptospira is divided into species, with some being pathogenic and others non-pathogenic. Antigenically, a more traditional classification groups serovars into serogroups, though this doesn't align perfectly with genetic classifications. For example, Leptospira interrogans was once the species for all pathogenic strains, but modern classification uses more specific species based on DNA.

Classification by genotype

Genus: Leptospira

Species: There are 21 species, with 9 being pathogenic and 5 intermediates. The pathogenic strains are typically classified under L. interrogans.

Clades/Subclades: Based on genomic sequences, Leptospira are further divided into two clades and four subclades (P1, P2, S1, and S2).

The P1 subcase contains species that can cause severe disease.

Classification by serovar and serogroup

Serovar: Defined by serological (antigenic) testing, not DNA. There are around 240 identified serovars, of which only a few are pathogenic.

Serogroup: A grouping of serovars that are antigenically related.

Serogroups have been useful for epidemiological purposes but do not have official taxonomic standing, as genetically different strains can sometimes fall into the same serogroup.

Nomenclature: The accepted taxonomic format is Genus species serovar name (e.g., Leptospira interrogans serovar Ballum).

Traditional vs. modern classification

Historically: Leptospira interrogans was used for all pathogenic strains, and L. biflexa for all saprophytic strains.

Modern: Genomic and genetic data have led to the current, more complex classification system, which acknowledges more species and better distinguishes between pathogenic and non-pathogenic strains.

Animal and environmental reservoirs:

Mammals act as the primary reservoir for Leptospira organisms. The environment can serve as a reservoir if it becomes contaminated by the urine of infected mammals.

- Animal reservoir – Approximately 160 mammalian species have been identified as natural carriers of pathogenic Leptospira species [11]. The organism lives in the renal tubules of infected mammals and is shed in the urine.

Rodents are the most important reservoirs for maintaining transmission in most settings. Infection in small rodents (eg, rats) usually occurs in utero, during birth, or during infancy from environmental contamination of the nest [12]. Once infected, rodents are asymptomatic carriers and shed the organism in their urine intermittently or continuously throughout life, resulting in contamination of the environment, particularly water In addition to rodents, the organism infects a variety of both wild and domestic mammals, especially cattle, swine, dogs, horses, sheep, and goats. It rarely occurs in cats. Animals can be asymptomatic carriers or can develop clinical infection, which may be fatal. Mortality in dogs is estimated at approximately 10 percent. Spontaneous abortion is a common outcome of leptospirosis in cattle, swine, sheep, and goats.

- Environmental reservoir – Organisms can survive for days to months in urine-contaminated soil and fresh water [10].

Contamination of water with animal urine can occur via several mechanisms:

• Following heavy rainfall or flooding that allows mixing of urine-contaminated soil or sewage with water, especially in areas with poor housing and

sanitation/sewage conditions that propagate high rodent population's Animal excretion of urine into wet soil or bodies of fresh water, such as ponds, lakes, rivers, and streams

• Drainage of urine-contaminated soil or water into bodies of fresh water

Causes:

Leptospirosis is caused by contact with bacteria called Leptospira, which are spread through the urine of infected animals, most commonly rodents, livestock, and pets. The bacteria can enter the body through broken skin, cuts, mucous membranes (like the eyes, nose, or mouth), or by consuming contaminated food or water. High-risk activities include agricultural work, working in sewers, and recreational activities like swimming in contaminated fresh water. A lot of people can get leptospirosis at once (an outbreak) after heavy rains and flooding. The floodwaters wash into rivers, lakes and canals, bringing bacteria with them. A lot of people can get leptospirosis at once (an outbreak) after heavy rains and flooding. The floodwaters wash into rivers, lakes and canals, bringing bacteria with them.

- **Through contaminated water or soil:**

The bacteria survive in fresh water and damp soil contaminated with infected animal urine.

- **Direct contact with infected animals:**

Touching animals that carry the bacteria or their bodily fluids can transmit the infection.

- **Consumption of contaminated food:**

Eating food or drinking water contaminated with the urine of infected animals can cause infection.

- **Contact with contaminated surfaces:**

The bacteria can be transmitted by touching surfaces that are contaminated with infected animal urine.

Symptoms and signs:

- Fever
- Headache
- Chills
- Body or muscle aches
- Vomiting or nausea
- Yellowed skin and eyes (jaundice)
- Red eyes

- Stomach pain
- Diarrhea
- Rash
- Loss of appetite
- Meningitis
- Kidney failure
- Internal bleeding such as nose bleeding of blood in urine
- Conjuctival redness

Diagnosis:

Direct Detection Methods

(Detect the organism or its DNA/antigen)

i. Dark-field microscopy

- Visualizes motile spirochetes in blood, CSF, or urine.
- Advantages: Rapid, low-cost.
- Limitations:
- Poor sensitivity (requires $\geq 10^4$ organisms/mL)
- Cannot differentiate Leptospira from other spirochetes
- Not recommended as a sole diagnostic method.

ii. Culture

- Media: Fletcher's, EMJH (Ellinghausen-McCullough-Johnson-Harris), Stuart media.
- Specimen
- Blood and CSF in 1st week
- Urine from 2nd week onward.
- Incubation: 28–30°C for up to 6–13 weeks.
- Advantages: Definitive diagnosis, useful for epidemiology and serovar identification.
- Limitations: Slow, low sensitivity (10–60%), requires specialized lab.

iii. PCR (Polymerase Chain Reaction)

- Detects Leptospira DNA (e.g., lipL32, secY genes).
- Specimens: Blood, CSF, urine.
- Advantages:
- Early detection (before antibodies appear)
- High sensitivity and specificity.
- Limitations: Cost, need for molecular facilities, not available everywhere.

iv. Immunostaining / Immunohistochemistry

- Used in tissue samples (autopsy) to detect Leptospira antigens.

Indirect Detection Methods (Serology)
(Detect host antibodies against Leptospira)

i. Microscopic Agglutination Test (MAT) – Gold Standard

- Detects agglutinating antibodies against live Leptospira of different serovars.
- Positive test:
- Single titer ≥1:100–1:400 (depending on background prevalence)
- Or a fourfold rise in titer between acute and convalescent sera (7–14 days apart).
- Advantages: Serovar identification, high specificity.
- Limitations:
- Requires live cultures of many serovars (biosafety risk).
- Late positivity (after 7–10 days).
- Needs paired sera.

ii. ELISA (IgM ELISA)

- Detects anti-Leptospira IgM antibodies (appear by day 5–7).
- Advantages:
- Early diagnosis.
- Simpler, faster, safer than MAT. Limitations:
- May cross-react with other infections (e.g., dengue, syphilis).
- Cannot identify serovar.

iii. Latex agglutination test

- Dipstick/rapid test
- Indirect hemagglutination
- These are simpler but less specific than MAT or ELISA.

Typical Diagnostic Approach (Stepwise)

Stage of illness	Preferred test	Notes
0–5 days (acute)	PCR, culture (blood, CSF)	Before antibodies appear
5–10 days	PCR + IgM ELISA	Overlap of leptospiremic and immune phase
>10 days	Serology (ELISA or MAT), PCR (urine)	Antibodies detectable

5. Supportive Laboratory Findings (Nonspecific)

- CBC: Leukocytosis with left shift, thrombocytopenia.
- LFT: Elevated bilirubin (predominantly conjugated), mild/moderate transaminase elevation.
- RFT: Elevated urea and creatinine (renal involvement).
- Urinalysis: Proteinuria, pyuria, hematuria.
- CSF: Aseptic meningitis picture (mild pleocytosis, raised protein, normal glucose).

Diagnostic Criteria (WHO/CDC)

A probable or confirmed case is based on:

Clinical evidence:

- (fever, headache, myalgia, jaundice, conjunctival suffusion, renal/hepatic failure)

Laboratory evidence:

- Isolation of Leptospira, or
- Positive PCR, o
- Fourfold rise in MAT titer, or
- Positive IgM ELISA with compatible illness.

Management:

- The management of leptospirosis depends on the severity: mild cases are treated with oral antibiotics like doxycycline and supportive care, while severe cases require hospitalization and intravenous (IV) antibiotics, supportive care, and intensive monitoring. Early antibiotic treatment is crucial for both mild and severe cases to improve outcomes. Severe cases can lead to organ damage and require intensive care for issues like respiratory failure (mechanical ventilation) or kidney failure (dialysis).

Mild leptospirosis:

- Oral antibiotics: A doctor may prescribe oral antibiotics such as doxycycline, amoxicillin, or ampicillin. Doxycycline is a common choice, but alternatives exist for those who cannot take it.
- Supportive care: Focus on pain and fever relief, and stay hydrated.
- Outpatient management: Mild cases without organ involvement can be managed at home, but they require regular follow-up to monitor for complications.
- Special considerations: Pregnant patients or those with contraindications to doxycycline may be treated with erythromycin.

Severe leptospirosis:

- Hospital admission: Patients with severe symptoms or organ involvement (like jaundice, difficulty breathing, or kidney damage) need to be admitted to the hospital.
- Intravenous (IV) antibiotics: Intravenous penicillin G is often the first-line treatment. Other options include third-generation cephalosporins like ceftriaxone or cefotaxime.
- Supportive therapy: This is critical and may include:
- Intravenous hydration and electrolyte replacement.
- Mechanical ventilation if respiratory failure occurs.
- Dialysis for kidney failure.
- Intensive monitoring: Patients need close monitoring in an intensive care unit (ICU) for potential cardiovascular, respiratory, or other organ complications.
- Important considerations for all cases

Early treatment:

Initiate antibiotic treatment as soon as leptospirosis is suspected, without waiting for lab results, as this can reduce the severity and duration of the illness.

- Jarisch-Herxheimer reaction: Be aware that an initial worsening of symptoms, such as fever, headache, and muscle pain, can occur within the first 24 hours of antibiotic treatment.
- Medical team: Management is best handled by an interprofessional team that may include emergency department physicians, infectious disease experts, and primary care providers.

Prevention:

Rates of leptospirosis can be reduced by improving housing, infrastructure, and sanitation standards. Rodent abatement efforts and flood mitigation projects can also help to prevent it.Proper use of personal protective equipment (PPE) by people who have a high risk of occupational exposure can prevent leptospirosis infections in most cases.

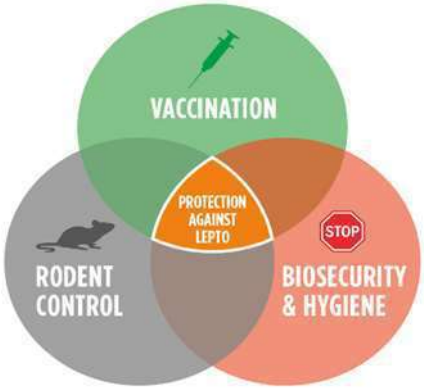
- Doxycycline is given once a week as a prophylaxis and is effective in reducing the rate of leptospirosis infections amongst high-risk individuals in flood-prone areas.

1. Although the evidence for this is weak as clinical studies have been heterogeneous in design and mostly underpowered. Among more than 700 individuals in the Andaman Islands (a highly endemic setting in Southeast Asia where outbreaks of leptospirosis related to flooding are common) randomized to prophylaxis with doxycycline 200 mg orally weekly or placebo, clinical infection rates were lower among those who received doxycycline, although there was no difference in seroconversion rates
2. In another study including more than 900 soldiers deployed for jungle training in Panama, fewer cases of leptospirosis were observed among those who received doxycycline prophylaxis (200 mg orally every week for two to three weeks and at the end of exposure) compared with placebo (1 versus 20 cases)

- The prevention of leptospirosis from environmental sources like contaminated waterways, soil, sewers, and agricultural fields is disinfection used by effective microorganisms, which is mixed with bokashi mudballs for the infected waterways & sewers
- There is no human vaccine suitable for worldwide use. Only a few countries, such as Cuba, Japan, France, and China, have approved inactivated vaccines with limited protective effects. Side effects such as nausea, injection site redness and swelling have been reported after the vaccine was injected. Since the immunity induced by one Leptospiraserovar is only protective against that specific one, trivalent vaccines have been developed. They do not confer long-lasting immunity to humans or animals.
- The most important control measures for preventing human leptospirosis include avoiding potential sources of infection such as stagnant water and animal farm water runoff, rodent control, and protection of food from animal contamination.

Caution:

Children under 8 are usually not allowed to take doxycycline due to the potential for side effects, such as the permanent staining of their unerupted teeth, and so in cases where young patients must receive prophylaxis we often give a short course of penicillin instead. It's not as simple to administer as a single tablet, but just as effective.



Treatment:

Early treatment with antibiotics is crucial and can sig nificantly reduce the severity of the disease and prev ent complications. Common antibiotics used include **doxycycline** and **penicillin**.

- **Antibiotic:** - Types of antibiotics that treat leptospirosis include doxycycline, amoxicillin, ampicillin, penicillin-G and ceftriaxone. Your provider will decide which to use based on how sick you are and your medical history.

- **Other:** -Pregnant women with severe leptospirosis may be treated with penicillin, ceftriaxone, cefotaxime, or azithromycin. Doxycycline appears to be safer in pregnancy than other tetracycline's; it should be considered if the diagnosis of leptospirosis is not certain and murine typhus is a possible alternative diagnosis (since murine typhus does not respond as well to azithromycin as to doxycycline

- **Mechanical ventilation.** If your lungs are infected with bacteria, you may have a hard time breathing and need the help of a machine to breathe for you. Your provider will give you medication to keep you asleep while you're connected to the machine.

- **Plasmapheresis.** Also called plasma exchange, plasmapheresis might help you if you're at risk for organ damage from leptospirosis. During this procedure, your provider removes your blood using a tube attached to a vein. A machine separates your plasma from your blood and replaces it with a plasma substitute. Your blood is then returned to your body through another tube.

- **Role of corticosteroids and plasmapheresis** — Use of intravenous corticosteroid therapy has been proposed given the vasculitic nature of severe leptospirosis, particularly in the setting of pulmonary involvement; thus far, there is insufficient evidence for routine use of corticosteroids. Some reports have suggested a possible benefit to use of steroids as an adjunct to antibiotic therapy in severe disease, further study is needed.

- Supportive Care: In severe cases, supportive care may be necessary, including intravenous fluids, dialysis for kidney failure, and oxygen therapy for respiratory distress.

That include: -

1. **Hydration and electrolytes**: IV fluids and electrolyte supplements are given as needed.

2. **Mechanical ventilation**: May be necessary if the patient has respiratory failure.

3. **Dialysis**: Can be required if there is kidney failure.

4. **Other therapies**: In severe cases, other treatments like diuretics, ophthalmic drops, or inotropic agents might be used.

Important considerations

- Treatment with antibiotics may cause a temporary acute febrile reaction known as a Jarisch-Herxheimer reaction within the first 24 hours.
- Antibiotics are most effective when started as soon as possible, ideally when the infection is suspected, without waiting for definitive lab results.
- In some high-risk situations (e.g., short-term exposure during an outbreak or adventure travel), healthcare providers may recommend prophylactic (preventative) doxycycline.
- There is no human vaccine widely available in the United States, so prevention relies mainly on avoiding exposure to contaminated water or soil and using protective gear when necessary

Future Directions:

Future aspects for leptospirosis control and research are centered on a **multidisciplinary "One Health" approach** that integrates human, animal, and environmental health strategies. Key areas of focus include:

- **Enhanced Surveillance and Modeling**

- **Integrated Surveillance Systems:** Establishing comprehensive, inter-sectoral surveillance systems that involve public health, veterinary, and environmental departments to track the disease in humans, domestic animals, and wildlife.

- **Climate-Based Risk Mapping:** Utilizing advanced hydrologic and climatic models to create region-specific risk maps. This can help predict outbreaks following heavy rainfall, floods, and other extreme weather events that are becoming more frequent with climate change, allowing for proactive interventions.

- **Environmental Monitoring:** Conducting more detailed field studies to understand the exact conditions (soil type, pH, nutrient levels, water quality) under which pathogenic Leptospira survive, persist, and potentially reproduce in natural environments.

Clinical Manifestations:

- Human leptospirosis has diverse clinical manifestations. Clinical illness in humans can range from a mild, self-limiting acute febrile illness to a severe, life-threatening condition with multiple organ dysfunction.1, 2 Many organ systems can be involved, to varying degrees, and an array of atypical or unusual manifestations and complications have also been described. The clinical features of leptospirosis are similar to those seen in many other febrile illnesses, especially diseases seen in the tropics, such as dengue and other haemorrhagic fevers, rickettsial infection, malaria, and bacterial sepsis. While the majority present with uncomplicated fever, approximately 10% develop severe disease.2, 3, 4, 5, 6, 7, 8, 9 The classical presentation with conjunctival suffusion, jaundice, and acute kidney injury constitutes Weil's syndrome.2 Pulmonary haemorrhage has recently been shown to be an important cause of mortality.2, 3, 4, 5, 6, 7, 8, 9, 10
- The incubation period shows wide variation, from 2-20 days, usually 7-12 days. A biphasic illness is seen in some patients. The clinical course of leptospirosis has been classically divided into a ‘leptospiraemic phase’ or acute phase, followed by an ‘immune phase’.11 The initial ‘leptospiraemic phase’ is said to last for three to nine days, and presents as a non-specific acute febrile illness. Fever, chills, myalgia and headache are present. Conjunctival suffusion is a characteristic finding, developing on the third to fourth day. Myalgia can be severe, and can usually involves the calf, abdomen (mimicking acute abdomen) and paraspinal muscles (resulting in meningism). The ‘leptospiraemic’ or ‘septicaemic’ phase is followed by an immune phase, where IgM antibodies appear in the blood, and organisms are excreted in the urine. Presumably, the organisms settle in higher concentrations in the proximal tubules of the kidney (and other organs) during this phase. Depending on the degree of organ involvement and the virulence of the organism, serious

manifestations occur during this stage. In practice, this differentiation into phases is arbitrary, and while there can be a brief period of defervescence between these phases, there often is overlap between them. While recovery takes place in the majority of patients, in a small number of infected individuals there is persistent high fever, with the development of jaundice, acute kidney injury and other serious organ dysfunction.

- The pathogenesis of severe leptospirosis is poorly understood; however, it is thought to be due to a form of vasculitis. As with other bacterial infections, both direct damage to tissues by leptospira and immune-mediated mechanisms are responsible for tissue and organ damage, deranged tissue microcirculation and endothelial dysfunction. Although jaundice is a prominent feature, death often results from complications of acute kidney injury, myocardial involvement or pulmonary haemorrhage. Pulmonary involvement, in extreme forms with pulmonary haemorrhage, other haemorrhagic manifestations, and myocarditis are important, serious manifestations resulting in high mortality. A myriad of atypical or unusual manifestations have been reported with human leptospirosis, including nervous system involvement (acute disseminated encephalomyelitis, hydrocephalus and raised intracranial pressure, encephalitis-induced coma, intracranial vascular events; intracranial bleeding and thrombosis, cerebellar syndrome, transverse myelitis, Guillain-Barré syndrome, mononeuritis and mononeuritis multiplex including cranial nerve palsies), ocular manifestations (uveitis, optic neuritis, retinal phlebitis), haematological involvement (pancytopaenia, haemolytic anaemia, haemolytic uremic syndrome and thrombotic thrombocytopenic purport) and gastrointestinal involvement (pancreatitis, cholecystitis).

CONCLUSION:

Leptospirosis is a widespread, yet often neglected, **zoonotic disease** with a broad range of clinical manifestations, from asymptomatic or mild flu-like illness to severe, potentially fatal multi-organ failure (Weil's disease). Its primary transmission occurs through contact with the urine of infected animals, either directly or via contaminated water and soil, and its global burden is likely underestimated due to non-specific symptoms and diagnostic challenges.

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