Spirochetes are a large, heterogeneous group of spiral, motile bacteria.
- One family Spirochaetaceae consists of two genera whose members are human pathogens, Borrelia and Treponema.
- Treponema pallidum are long, slender, helically coiled, spiral shaped bacilli. T. pallidum has an outer sheath or glycosaminoglycan coating. Inside the sheath is the outer membrane, which contains peptidoglycan and maintains the structural integrity of the organisms.
- Endoflagella (axial filaments) are the flagella-like organelles in the periplasmic space encased by the outer membrane. Inside the endoflagella is the inner membrane (cytoplasmic membrane) that provides osmotic stability and covers the protoplasmic cylinder.
- Treponemes reproduce by transverse fission.
The genus Treponema includes:
- T. pallidum subspecies pallidum, which causes syphilis
- T. pallidum subspecies pertenue, which causes yaws
- T. pallidum subspecies endemicum, which causes endemic syphilis (also called bejel)
- T. carateum, which causes pinta.

Treponema pallidum and Syphilis

-T. pallidum are slender spirals with spiral coils spaced at a distance of 1 μm from one another. The spirals are so thin that they are not readily seen unless immunofluorescent stain or dark-field illumination is used.
- The organisms are actively motile, rotating steadily around their endoflagella.
- They can be seen in tissues when stained by a silver impregnation method.

Culture

- Pathogenic T. pallidum has never been cultured on artificial media, in fertile eggs, or in tissue culture.
- T. pallidum is a microaerophilic organism; it survives best in 3–5% oxygen.
- Nonpathogenic treponemes (Reiter strain) can be cultured anaerobically in vitro.
- T. pallidum is a microaerophilic organism; it survives best in 3–5% oxygen.
- Drying kills the spirochete rapidly, as does elevation of the temperature to 42°C.
- Treponemes are rapidly immobilized and killed by trivalent arsenical, mercury, and bismuth.
- Penicillin is treponemicidal in minute concentrations, but the rate of killing is slow (estimated GT is 30 hours).

Antigenic Structure

T. pallidum subspecies pallidum produce
1. Hyaluronidase that breaks down the hyaluronic acid in the ground substance of tissue and presumably enhances the invasiveness of the organism.
2. Endoflagella are composed of three core proteins, plus sheath protein.
3. Cardiolipin is an important component of the treponemal antigens.
**Pathogenesis, Pathology, & Clinical Findings**

- Human infection is usually transmitted by sexual contact, and the infectious lesion is on the skin or mucous membranes of genitalia.

*T pallidum* can probably penetrate intact mucous membranes, or the organisms may enter through a break in the epidermis. Spirochetes multiply locally at the site of entry, and some spread to nearby lymph nodes and then reach the bloodstream. Within 2–10 weeks after infection, a papule develops at the site of infection and breaks down to form an ulcer with a clean, hard base ("hard chancre"). The inflammation is characterized by a predominance of lymphocytes and plasma cells. This "primary lesion" always heals spontaneously.

The "secondary" lesions appeared 2-10 weeks later. These consist of a red maculopapular rash anywhere on the body, including the hands and feet. "Condylomasنتوءات جلدية صلبة" occurs in about one-third of secondary syphilis patients and is characterized by painless, mucosal, and warty erosions. They tend to develop in warm, moist sites of the genitals and perineum. The patient may also have syphilitic meningitis, chorioretinitis, hepatitis, nephritis (immune complex type), or periostitis. The secondary lesions also subside spontaneously.
Both primary and secondary lesions are rich in spirochetes and are highly infectious.

Syphilitic infection may remain subclinical, and the patient may pass through the primary or secondary stage (or both) without symptoms or signs yet “develop tertiary lesions”.

- In about **30% of cases**, early syphilitic infection progresses spontaneously to **complete cure without treatment**.
- In another **30%**, the untreated disease remains **latent** (principally evident by positive serologic test results).
- In the remainder, the disease progresses to **the “tertiary stage”** characterized by the development of **Granulomatous lesions (Gummas)** in the skin, bones, and liver; degenerative changes in the CNS (meningovascular syphilis); or cardiovascular lesions (aortitis, aortic aneurysm, aortic valve insufficiency).

**Congenital Syphilis**
- A pregnant syphilitic woman can transmit *T. pallidum* to the fetus through the placenta beginning in the 10th to 15th weeks of gestation. Some of the infected fetuses die, miscarriages result; others are stillborn at term. Others are born live but develop the **signs of congenital syphilis**: interstitial keratitis, Hutchinson's teeth, saddlenose, periostitis, and a variety of CNS anomalies.
Serologic Tests for Syphilis

These tests use either nontreponemal or treponemal antigens.

1. Nontreponemal tests measured antibody to a mixture of (cardiolipin, cholesterol, lecithin) as a non specific antigen. The Venereal Disease Research Laboratory (VDRL) and unheated serum reagin (USR) tests require microscopic examination to detect flocculation. In addition, rapid plasma reagin (RPR) and toluidine red unheated serum test (TRUST) could be used.

2. Treponemal antibody tests—The treponemal tests measure antibodies against T. pallidum antigens. The T pallidum-particle agglutination (TP-PA) test is perhaps the most widely used treponemal test. Treponemal antibody tests using the EIA for T pallidum (enzyme immunoassay format) are also available. The fluorescent treponemal antibody absorbed (FTA-ABS) test is the treponemal antibody test employed for many years.

Immunity
The various immune responses usually fail to eradicate the infection or arrest its progression.

Treatment
Penicillin in concentrations of 0.003 U/mL

Epidemiology, Prevention, and Control
Syphilis is acquired through sexual exposure. Reinfection in treated persons is common. An infected person may remain contagious for 3–5 years during “early” syphilis. “Late” syphilis, of more than 5 years’ duration, is usually not contagious.