

SPIROCHETES

Spirochetes are Gram negative bacteria that are long, thin, helical and motile. Axial filaments (a form of flagella) found between the peptidoglycan layer and outer membrane and running parallel to them, are the locomotory organelles.

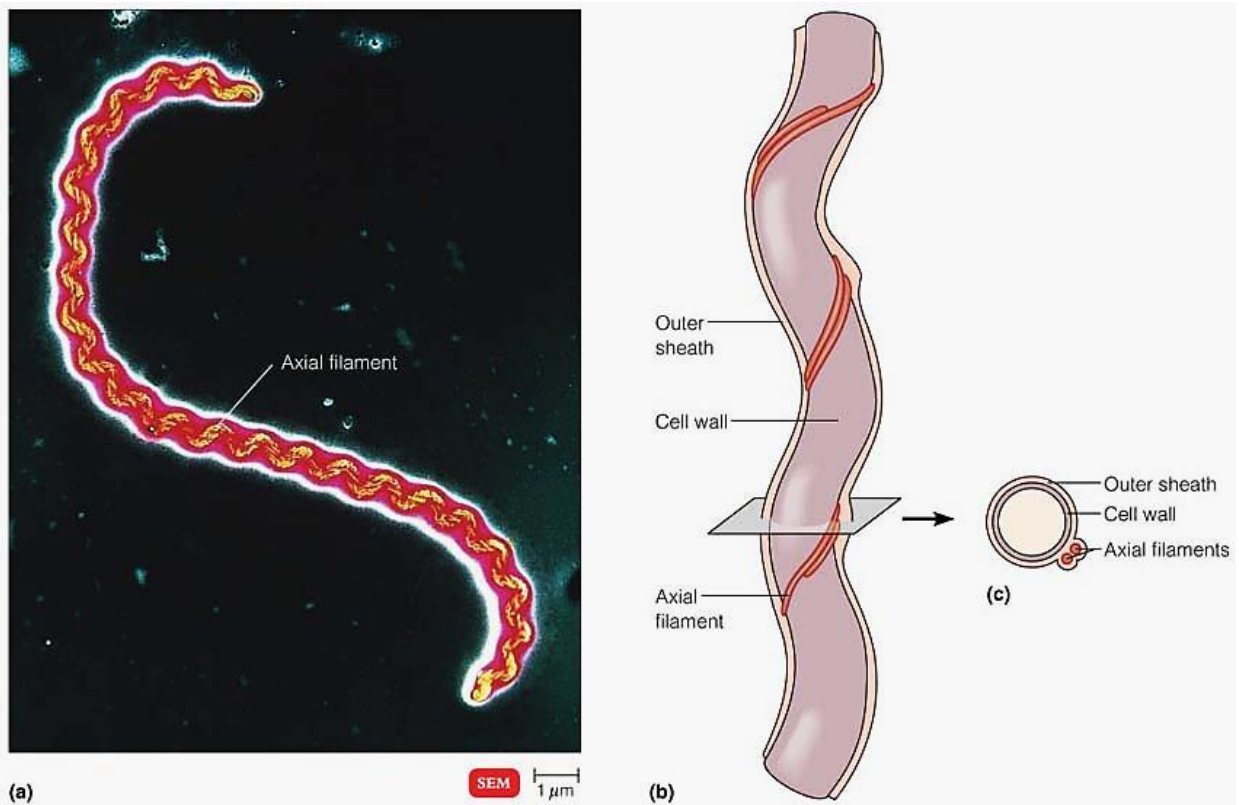


Figure : Axial Filaments of spirochetes.

Treponema pallidum and syphilis

T. pallidum is the causative agent of syphilis, a common sexually-transmitted disease found world-wide. It is generally transmitted by **genital/genital** contact. Transmission *in utero* or **during birth** can also occur.

Syphilis, chronic and slowly progressive, is the third most common sexually transmitted disease. After initial infection, a primary chancre (an area of ulceration/inflammation) is seen in genital areas or elsewhere within 10-60 days.

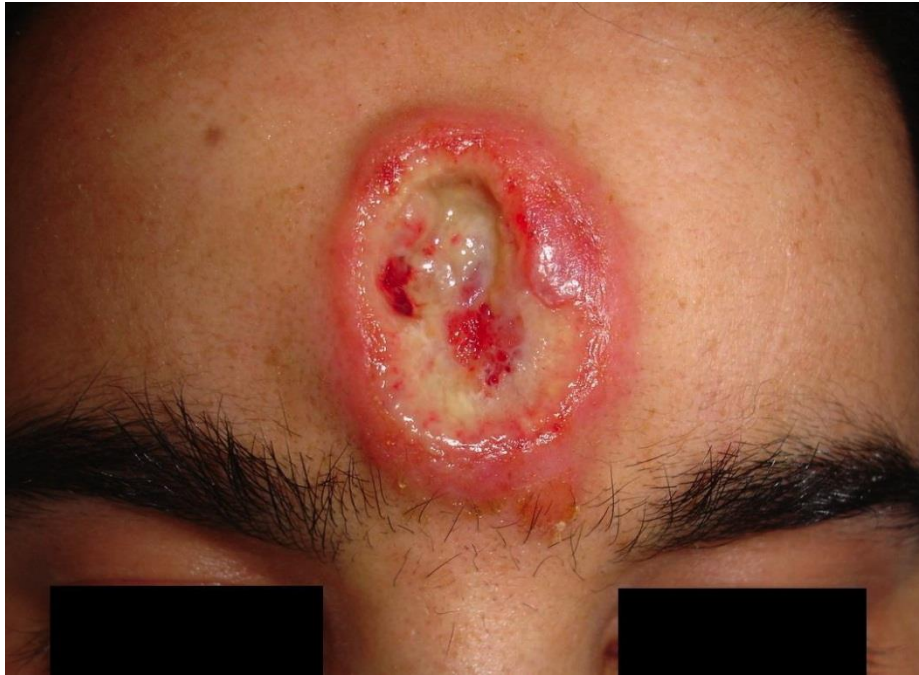


Figure : the primary chancre.

The organism, has penetrated and systemically spread. The patient has flu-like symptoms with secondary lesions particularly affecting the skin. These occur 2-10 weeks later. The final stage (if untreated) is tertiary syphilis (several years later). In primary and secondary syphilis organisms are often present in large numbers.

The organism **cannot be cultured** from clinical specimens. Thus, experimentally, syphilis is commonly studied in animal models. Also **microscopic** and **serological** methods are the only means of clinical diagnosis.

In **primary** syphilis (before immunity develops), the organisms are often present in sufficient numbers in **exudates** to be detected by dark field microscopy.

In conventional light microscopy, the light shines through the sample and thin treponemes cannot be visualized. In dark field microscopy, the light shines at an angle and when reflected from the organism will enter the objective lens. The actively motile organisms appears brightly lit against the dark backdrop. Alternatively fluorescent antibody staining is used.

Screening methods are based on detecting **serum antibodies** to **cardiolipin** in patients (including VDRL test).

No vaccine exists, but antibiotic therapy (usually penicillin G) is usually highly effective.

NEISSERIA

Neisseria are Gram negative diplococci (pairs of cocci). These bacteria grow best on **chocolate agar** (so-called because it contains heated blood, brown in color); a modified (selective) chocolate agar commonly used is **Thayer Martin**. The colonies are oxidase positive (i.e. produce cytochrome oxidase) which is demonstrated by flooding the plate with a dye which on oxidation changes color.

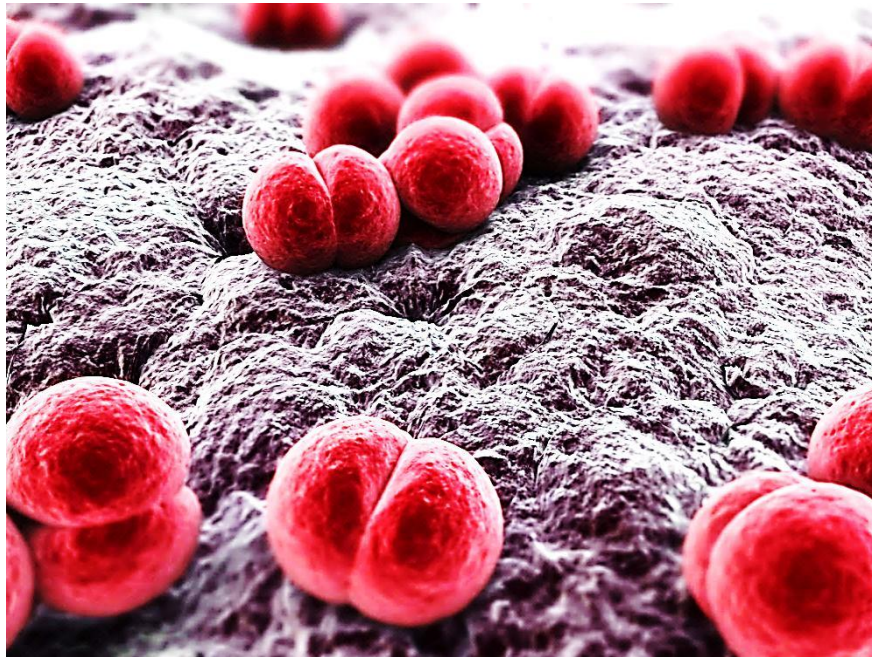


Figure: *Neisseria*.



Figure: gonococci penetrated polymorph nuclear cells.

***N. gonorrhoeae* (the "gonococcus")**

N. gonorrhoeae, found only in man, is the causative agent of gonorrhoea, the second most common venereal disease. The organism often causes an effusion of polymorphonuclear cells. A smear may show the presence of Gram negative cocci present in cells. However, culture is essential for definitive diagnosis.

A common feature of disseminated gonococcal disease is arthritis. Although commonly considered a form of septic arthritis, in many cases gonococci cannot be isolated from the joint. Dermatitis is also common.

Penicillin therapy is still usually effective. However, resistant strains producing beta lactamases are sufficiently common that alternatives are recommended for all gonococcal infections; this includes ceftriaxone (a beta lactamase-resistant cephalosporin). There is no vaccine since strains are highly variable in their external antigens (both outer membrane and pili). Both are involved in the initial adhesion of the organism to genital epithelium.

***N. meningitidis* (the "meningococcus")**

This organism resides only in man. The majority of cases are most commonly seen among young children. Outbreaks occur usually among adults living in confined and crowded conditions (e.g. army barracks). Initial infection of the upper respiratory tract (involving binding by pili) leads to invasion into the bloodstream and from there to the brain. Indeed, it is the second most common cause of meningitis (pneumococcus is the most common). It is usually fatal if untreated but responds well to antibiotic therapy. Thus, rapid diagnosis is important. The organism is often detectable in spinal fluid (Gram negative diplococci within polymorphonuclear cells) or antigenically. Culture on Thayer Martin (or similar) agar is essential for definitive diagnosis. Penicillin is the drug of choice.

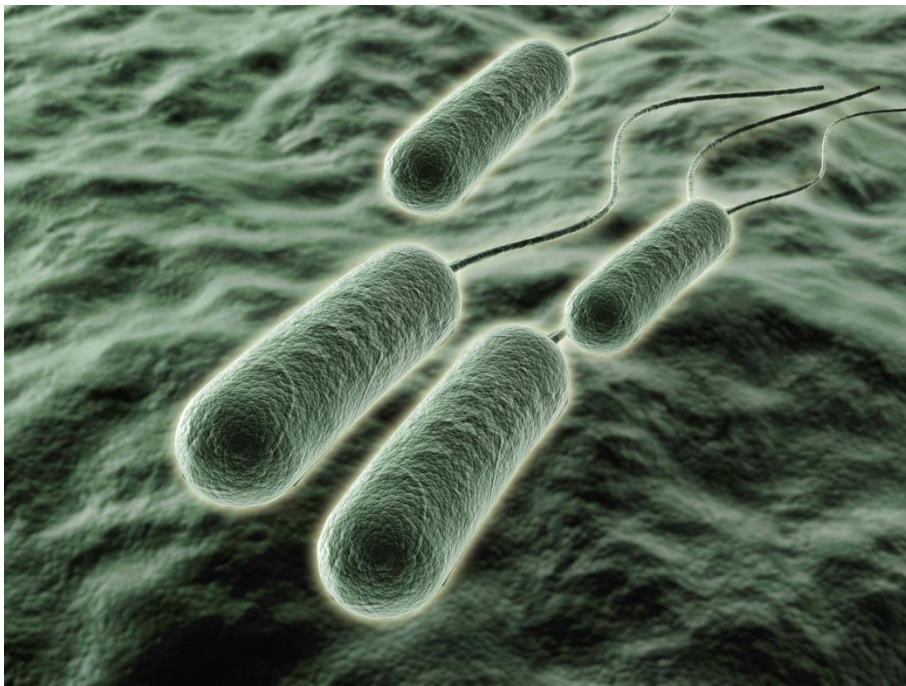
PSEUDOMONAS AERUGINOSA

Pseudomonads are aerobic, gram-negative rods with polar flagella. They are oxidase positive, in contrast to Enterobacteriaceae. These organisms are found in most environments including in water and soil and air. Among the genus *Pseudomonas*, the majority of human infections are caused by *P. aeruginosa*, although other related organisms also cause disease. Normally, individuals with compromised immune systems such as those infected with HIV, organ transplant recipients and burns patients are particularly prone to pseudomonad infections and mortality can be high (e.g. as much as 90% in heart infections). In burns and wounds, there is destruction of blood vessels which limits access of phagocytes that would normally clear the region of the pathogen. Cystic fibrosis patients are also at risk for infection since alteration of the respiratory epithelium commonly allows colonization and development of pneumonia.

Pseudomonads are opportunistic pathogens. Nosocomial infections by *P. aeruginosa* are particularly common in intensive care units and can lead to fatal

pneumonia in which the patient has a productive cough, chills, breathing difficulties. The problem is compounded by the often encountered resistance of pseudomonads to common antibiotics

Infections by *P. aeruginosa* are a common cause of bacteremia, that is bacterial blood infections. Heart valves, particularly of intravenous drug users, can also become infected.



Among other pseudomonad-caused infections are those of the urinary tract, often as a result of catheter use or surgery, the brain which can develop abscesses and meningitis, and the eyes and ears.

Identification of a pseudomonad infection includes pigment production: pyocyanin (blue-green) and fluorescein (green-yellow, fluorescent) and biochemical reactions (oxidase test). Cultures have fruity smell. Since hospitals are so commonly infected with pseudomonads, the presence of the organism is not sufficient to prove it as a source of the infection.

Resistance of pseudomonads to various antibiotics is a problem. Two such drugs simultaneously are often employed for up to 6 weeks, either by mouth or intravenously.

BRUCELLOSIS

Brucella are Gram-negative, nonmotile, coccobacilli. They are strict aerobes and grow very slowly (fastidious) on blood agar. In the host, they live as **facultative intracellular** pathogens.



Epidemiology, transmission and symptoms

Brucellosis is primarily a disease of animals and it affects organs rich in the sugar erythritol (breast, uterus, epididymis, etc.). The organism localizes in these animal organs and cause **infertility, sterility, mastitis, abortion** or resides as carriage. Humans in closed contact with infected animals (slaughterhouse workers, veterinarians, farmers, dairy workers) are at risk of developing **undulant fever**.

Four different species of *Brucella* are known to infect humans: *B. abortus* (cattle), *B. suis* (swine), *B. melitensis* (goats/sheep) and *B. canis* (dogs). Although brucellosis has been eradicated in most developed countries through animal vaccination, it persists in many underdeveloped and developing countries.

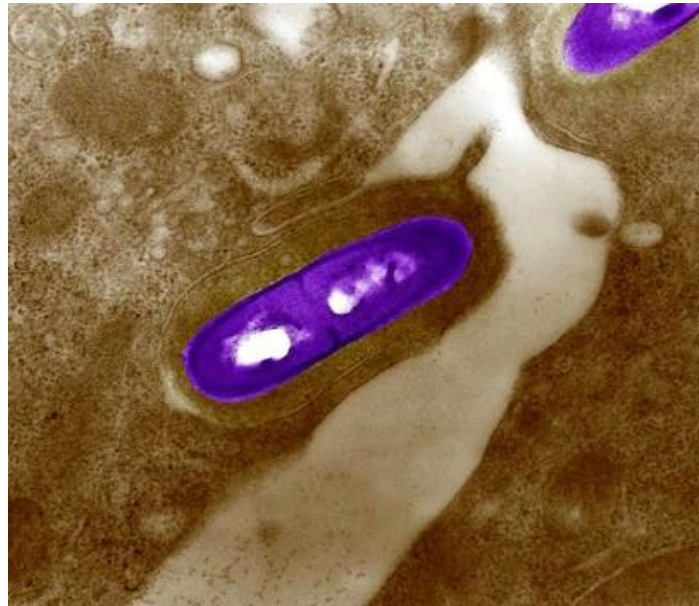
Usually infection occurs by **direct contact with infected material**, although it may also occur by ingestion of **milk or milk products**. The bacteria are engulfed by neutrophils and monocytes and localize in the regional lymph nodes, where they proliferate **intracellularly**. If the *Brucella* organisms are not destroyed or contained in the lymph nodes, the bacteria are released from the lymph nodes resulting in septicemia. The organisms migrate to other lympho-reticular organs (spleen, bone marrow, liver, testes) producing granulomas and/or micro abscesses. Symptoms include fever, chills, sweats, fatigue, myalgia, profound muscle weakness, and anorexia. Joint involvement occurs often. Brucellosis may be either acute or chronic. Fatalities (0-3%) generally are due to endocarditis.

Diagnosis

Diagnosis is based on prolonged (at least a week) presence of undulating fever, myalgia, arthralgia and the history of exposure (contact with animals or consumption of unprocessed material from infected animals). Definitive diagnosis can be made by culturing blood samples on blood enriched media.

LISTERIOSIS

L.monocytogenes is a facultative intracellular, **Gram-positive, coccobacillus** which often grows in short chains. It is different from other Gram-positive organisms in that it contains a molecule chemically and biologically similar to the classical lipopolysaccharide, the **listerial LPS**.



The organism forms beta hemolytic colonies on blood agar plates and blue-green translucent colonies on colorless solid media.

Epidemiology and symptoms

Listeria monocytogenes is a ubiquitous organism found in the soil, vegetation, water, and in the gastrointestinal tract of animals. Exposure to the organism can lead to asymptomatic **miscarriage** or disease in humans.

At greatest risk for the disease are the fetus, neonates, cancer patients and immunocompromised persons. In the U.S., a number of recent outbreaks have been traced to cheese, cole slaw (cabbage), milk, and meat. The organisms can grow at 4

degrees C which means that organism **replication continues in refrigerated foods**.
Laboratory isolation can employ a **cold enrichment technique**.

Listeriosis has been categorized in two forms:

1) neonatal disease and 2) adult disease.

Neonatal Disease:

Exposure on vaginal delivery results in the late onset disease resulting in **meningitis** or **meningo-encephalitis** with **sepsis** within 2 to 3 weeks.

Adult Disease:

Infection in normal adults results in self-resolving **flu-like symptoms** and/or mild **gastrointestinal disturbance**.

Diagnosis

Listeriosis is indicated when blood and CSF monocytosis is observed. The organism can be isolated on most laboratory media.

Treatment and control

Penicillin (ampicillin) alone or in combination with gentamycin have been effective. Immunity is cell-mediated.