***Bacillus anthracis*** :

is the etiologic agent of [anthrax](http://en.wikipedia.org/wiki/Anthrax) — a common disease of livestock and, occasionally, of humans — and the only obligate [pathogen](http://en.wikipedia.org/wiki/Pathogen) within the genus [*Bacillus*](http://en.wikipedia.org/wiki/Bacillus).[[1]](http://en.wikipedia.org/wiki/Bacillus_anthracis#cite_note-Spencer-1) *B. anthracis* is a [Gram-positive](http://en.wikipedia.org/wiki/Gram-positive), [endospore](http://en.wikipedia.org/wiki/Endospore)-forming, rod-shaped [bacterium](http://en.wikipedia.org/wiki/Bacterium) It can be grown in an ordinary nutrient medium under aerobic or anaerobic conditions.

## Symptoms and Complications of Anthrax:

**Inhaled anthrax is by far the most dangerous form of this infection, but also the rarest.** It causes symptoms that start out like the flu. These symptoms include fever, chest discomfort, malaise, tiredness, and dry cough. The signs of illness appear as early as 48 hours after the spores of the bacteria have been inhaled.

If the symptoms are not treated quickly, the infection can rapidly turn into a severe infection similar to *pneumonia* (inflammation of the lungs). Shortness of breath, high fever, fast heart rate, and heavy sweating then develop. *Meningitis* (swelling of the brain) and pain in the abdomen follow. Few survive more than a few days beyond the development of these types of symptoms. Fortunately, early treatment decreases the risk of death.

**Cutaneous anthrax is much less dangerous than the inhaled form of anthrax.**When infection occurs in this manner, the skin develops a raised, sometimes itchy bump that looks and feels like an insect or spider bite. Within a day or two, sores develop that usually turn black in the centre. Usually, people with cutaneous anthrax feel only mildly ill. Early antibiotic treatment is almost always successful in curing this type of anthrax.

If cutaneous anthrax is not treated, the bacteria may get into the bloodstream and cause more serious symptoms. Signs of spreading infection include fever, chills, and swollen lymph glands close to the area of the sore.

**Intestinal anthrax symptoms include** severe [abdominal pain](http://www.lifelabs.com/Lifelabs_ON/Services/Fecal_Calprotectin.asp), nausea, vomiting, severe [diarrhea](http://www.lifelabs.com/Lifelabs_ON/Services/Fecal_Calprotectin.asp), fever, and bleeding from the gastrointestinal tract (stomach and intestines).

**It is important to remember that anthrax is not passed from person to person.** It is very rare for a person to develop anthrax unless the spores get below the surface of the skin or the lining of the stomach or intestines. The inhaled form of anthrax develops only after thousands of spores are inhaled all the way down to the lungs.

**Pathogenicity of *Bacillus anthracis*:**

*Bacillus anthracis* clearly owes its pathogenicity to two major determinants of virulence: the formation of a **poly-D-glutamyl capsule**, which mediates the invasive stage of the infection, and the production of the multicomponent**anthrax toxin** which mediates the toxigenic stage.

**Poly-D-glutamyl capsule**

*Bacillus anthracis* forms a single antigenic type of **capsule** consisting of a poly-D-glutamate polypeptide. All virulent strains of *B. anthracis* form this capsule. Production of capsular material is associated with the formation of a characteristic mucoid or "smooth" colony type. "Smooth" (S) to "rough" (R) colonial variants occur, which is correlated with ability to produce the capsule. R variants are relatively avirulent.

**Anthrax Toxin**

**anthrax toxin:** has a lethal mode of the action. Death is apparently due to oxygen depletion, secondary shock, increased vascular permeability, respiratory failure and cardiac failure. Death from anthrax in frequently occurs suddenly and unexpectedly. The level of the lethal toxin in the

circulation increases rapidly quite late in the disease, and it closely parallels the concentration of organisms in the blood.

Factor **I** is the **edema factor (EF)** which is necessary for the edema producing activity of the toxin

Factor **II** is the **protective antigen (PA)**, because it induces protective antitoxic antibodies.

Factor **III** is known as the **lethal factor (LF)** because it is essential for the **lethal effects**of the anthrax toxin

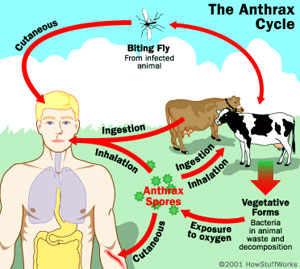
In summary, the virulence of *Bacillus anthracis* is attributable to Both the capsule and the anthrax toxin may play a role in the early stages of infection, through their direct effects on phagocytes. Virulent anthrax bacilli multiply at the site of the lesion. Phagocytes migrate to the area but the encapsulated organisms can resist phagocytic engulfment, or if engulfed, can resist killing and digestion. A short range effect of the toxin is its further impairment of phagocytic activity and its lethal effect on leukocytes, including phagocytes, at the site. After the organisms and their toxin enter the circulation, the systemic pathology, which may be lethal, will result.

**MODE OF TRANSMISSION:**

1-Infection of skin by contact with infected animal tissues and possible by biting flies feeding on such animals, or by contaminated hair, wool, hides or products made from them

2- inhalation anthrax results from inhalation of spores in contaminated soil areas, dried or processed skins and hides of infected animals

3-intestinal anthrax from ingestion of contaminated undercooked meat



**Diagnosis**

*B anthracis* is present in high numbers in appropriate specimens, and can be demonstrated by staining or culture. Laboratory personnel must take biohazard precautions to avoid contracting anthrax from specimens.

* Blood culture and Gram stain (for patients with systemic symptoms)

**Treatment of anthrax**

* Cutaneous anthrax – 7-14 days of outpatient therapy with oral doxycycline, or ciprofloxacin in patients who are unable to take penicillin

***Clostridium* spp:**

is a [genus](http://en.wikipedia.org/wiki/Genus) of [Gram-positive](http://en.wikipedia.org/wiki/Gram-positive) . They are [obligate anaerobes](http://en.wikipedia.org/wiki/Obligate_anaerobe) capable of producing [endospores](http://en.wikipedia.org/wiki/Endospore). Individual cells are [rod-shaped](http://en.wikipedia.org/wiki/Bacillus_(shape)).

*Clostridium* contains around 100 species[[](http://en.wikipedia.org/wiki/Clostridium#cite_note-3) that include common free-living bacteria, as well as important [pathogens](http://en.wikipedia.org/wiki/Pathogen). The five main species responsible for [disease](http://en.wikipedia.org/wiki/Disease) and pathogenisity in humans are:

* 1-[***C. botulinum***](http://en.wikipedia.org/wiki/Clostridium_botulinum) can produce [botulinum toxin](http://en.wikipedia.org/wiki/Botulinum_toxin) in food or wounds and can cause [botulism](http://en.wikipedia.org/wiki/Botulism).[[5]](http://en.wikipedia.org/wiki/Clostridium#cite_note-Baron_b-5)  The toxin eventually paralyzes the infant's breathing muscles.. This same toxin is known as "Botox" and is used [cosmetically](http://en.wikipedia.org/wiki/Cosmetic_surgery) to paralyze facial muscles to reduce the signs of aging; it also has numerous [therapeutic](http://en.wikipedia.org/wiki/Therapeutic) uses.
* 2-[***C. perfringens***](http://en.wikipedia.org/wiki/Clostridium_perfringens), formerly called *C. welchii*, causes a wide range of symptoms,
* from [food poisoning](http://en.wikipedia.org/wiki/Foodborne_illness) to [gas gangrene](http://en.wikipedia.org/wiki/Gas_gangrene).
* It also causes [enterotoxemia](http://en.wikipedia.org/wiki/Enterotoxemia) .
* **A-Clostridial gas gangrene** is a highly lethal necrotizing soft tissue infection of skeletal muscle caused by toxin- and gas-producing Clostridium species . Spores found in soil, human skin, intestine
* **Predisposing factors** – surgical incisions, compound fractures, diabetic ulcers, septic abortions, puncture wounds, gunshot wounds
* **Virulence factors**
* toxins – alpha toxin – causes RBC rupture, edema and tissue destruction
* collagenase
* Conditions **(dead tissue and anaerobic conditions )** stimulate spore germination, vegetative growth and release of exotoxins, and other virulence factors.
* Fermentation of muscle carbohydrates results in the formation of gas and further destruction of tissue.
* ***B-* C. perfringens enterotoxin (CPE)** produced by C. perfringens spores in the small intestine , which can germinate in foods such as meat and poultry . consumption of large amounts of C. perfringens is considered an important cause of watery diarrhea . Main symptoms of the disease are nausea, abdominal pain, and diarrhea . Main symptoms of the disease are nausea, abdominal pain,
* and diarrhea. Although C. perfringens may live normally in the human intestine, illness is caused by eating food contaminated with large numbers of C. perfringens bacteria that produce enough toxin in the intestines to cause illness. C. perfringens spores can survive high temperatures. During cooling and holding of food at temperatures from (12°C -- 60°C), the spores germinate and then the bacteria grow.
* **3-**[***C. tetani***](http://en.wikipedia.org/wiki/Clostridium_tetani) is the causative organism of [tetanus](http://en.wikipedia.org/wiki/Tetanus). :  due to the violent spasms caused by *C. tetani* infection. Tetanus is an acute, often fatal, disease caused by an exotoxin produced by the bacterium Clostridium tetani. It is characterized by generalized rigidity and convulsive spasms of skeletal muscles. The muscle stiffness usually involves the jaw (lockjaw) and neck and then becomes generalized
* **4-**[***C. sordellii***](http://en.wikipedia.org/wiki/Clostridium_sordellii) can cause a fatal infection in exceptionally rare cases after medical abortions.
* **5-**[***C. difficile***](http://en.wikipedia.org/wiki/Clostridium_difficile) can flourish(increase) when other [bacteria in the gut](http://en.wikipedia.org/wiki/Gut_flora) are killed during [antibiotic](http://en.wikipedia.org/wiki/Antibiotic) therapy, leading to [pseudomembranous colitis](http://en.wikipedia.org/wiki/Pseudomembranous_colitis) (a cause of antibiotic-associated diarrhea).

One of the most common types of Clostridia infections is called Clostridium difficile or C. difficile. It is the most common nosocomial infection (infection acquired in a hospital, nursing home, or other medical facility) and nosocomial cause of death. Infants lack receptors on the mucosa surfaces of the intestine that bind Clostridia so they do not have severe symptoms even when colonized

**MODE OF TRANSMISSION**:

Contamination of wound sites and breaches in gastrointestinal tract; spontaneous cases can also occur

## LABORATORY DIAGNOSIS:

Isolation of Clostridia from wound, pus, blood or faeces, along with toxin and serological assays aid in the diagnosis of clostridial infections. Clinical diagnosis is especially important in infections such as gas gangrene in which demonstration of clostridial myonecrosis is critical in the diagnosis

**Treatment**:

C. perfringens, as well as most other Clostridium spp. are generally, but not universally susceptible to penicillin-G, amoxicillin, ticarcillin, cephalosporins, chloramphenicol