***STAPHYLOCOCCUS AUREUS***

**Key Facts**

* *Staphylococcus aureus* is found on the skin and in the nose of about 25% of healthy people and animals.
* The name of the infection actually comes from two Latin words. The first part of the name, “staph,” is a reference clusters of grapes. The “coccus” part of the name simply refers to the round shape of the bacteria.
* *Staphylococcus aureus* is both a commensal bacterium and a human pathogen and can cause many forms of infection.
* Some *Staphylococcus aureus,* known as Methicillin-Resistant *Staphylococcus aureus* or MRSA are resistant to certain antibiotics, sometimes making this type of bacteria harder to treat.

**Introduction**

*Staphylococcus* was first described in 1884 as a separate line within the *Micrococcaceae* family. In the new classification, staphylococci take part in the *Staphylococcaceae* family. *Staphylococci* are Gram-positive cocci about 0.5 – 1.0 μm in diameter. They grow in clusters, pairs and occasionally in short chains. Bacteria in the genus *Staphylococcus* are pathogens of man and other mammals. Traditionally they were divided into two groups on the basis of their ability to clot blood plasma (the coagulase reaction). The coagulase-positive staphylococci constitute the most pathogenic species *S. aureus.* The catalase test is important in distinguishing streptococci (catalase-negative) from staphylococci, which are catalase positive. They can grow in aerobic conditions.

The main sources of staphylococcus are humans and animals. *Staphylococci* are found in the normal skin and mucosal flora of humans and animals. Many people (30-50%) periodically have *Staphylococcus* living on their skin and have no symptoms or illness at all. This is called being “colonized”. Sometimes, though, *Staphylococcus* bacteria can enter the body through a break in the skin, a cut, or an abrasion and then cause an infection.

*Staphylococcus aureus* can produces a wide array of toxins, thus causing various types of disease symptoms. The *S. aureus* enterotoxins (SEs) are potent gastrointestinal exotoxins synthesized by *S. aureus* throughout the logarithmic phase of growth (> 105 cfu/g). SEs are a family of major serological types of heat stable enterotoxins SEA through SEE and SEG through SEJ. SEs function both as potent gastro-intestinal toxins as well as super antigens that stimulate non-specific T-cell proliferation. They are active in high nanogram to low microgram quantities, and are resistant to conditions (heat treatment, low pH) that easily destroy the bacteria that produce them, and to proteolytic enzymes, hence retaining their activity in the digestive tract after ingestion. SEA is the most common toxin implicated in food poisoning.

**Source and Transmission**

*Staphylococcus aureus* belongs to the normal flora found on the skin and mucous membranes of mammals and birds. Transfer of *S. aureus* to food has two main sources: human carriage during food processing and dairy animals in case of mastitis.

Food handlers carrying enterotoxin-producing *S. aureus* in their noses or on their hands are regarded as the main source of food contamination, via manual contact or through respiratory secretions. In fact, *S. aureus* is a common commensal of the skin and mucosal membranes of humans, with estimates of 20–30% for persistent and 60% for intermittent colonization.

Because *S. aureus* does not compete well with indigenous microbiota in raw foods, contamination is mainly associated with improper handling of cooked or processed foods, followed by storage under conditions which allow growth of *S. aureus* and production of the enterotoxin(s). However, *S. aureus* is also present in food animals, and dairy cattle, sheep and goats, particularly if affected by subclinical mastitis, are likely contaminants of milk. Air, dust, and food contact surfaces can also serve as vehicles in the transfer of *S. aureus* to foods.

Foods that have been frequently incriminated in staphylococcal intoxication include meat and meat products, poultry and egg products, milk and dairy products, salads, bakery products, particularly cream-filled pastries and cakes, and sandwich fillings. Salted food products, such as ham, have also been implicated, according to the capacity of *S. aureus* to grow at relatively low water activity (aw = 0.86). Although bacteria are easily killed by cooking, the toxins are resistant to heat and so cannot be destroyed by cooking.

**The disease**

*S. aureus* is a leading cause of bacteremia and infective endocarditis (IE) as well as osteoarticular, skin and soft tissue, pleuro pulmonary, and device-related infections. Staphylococcal food poisoning is an intoxication that results from the consumption of foods containing sufficient amounts of enterotoxin. Staphylococcal toxins are fast-acting, symptoms usually develop within 30 minutes to 6 hours and include nausea, violent vomiting, and abdominal cramping, with or without diarrhea. The disease is usually self-limiting and typically resolves within 24–48 h after onset. Occasionally it can be severe enough to warrant hospitalization, particularly when infants, elderly or debilitated people are concerned. The most important treatment is plenty of fluids. Medicines may be given to decrease vomiting and nausea. Patients with severe illness may require intravenous fluids in a hospital. Patients with this illness are not contagious because the toxins are not transmitted from one person to another.

MRSA is methicillin-resistant *Staphylococcus aureus*, a type of bacteria that is resistant to many antibiotics. In a healthcare setting, such as a hospital or nursing home, MRSA can cause severe problems such as bloodstream infections, pneumonia and surgical site infections. If not treated quickly, MRSA infections can cause sepsis and death. Anyone can get MRSA on their body from contact with an infected wound or by sharing personal items, such as towels or razors that have touched infected skin. Also, people who carry MRSA but do not have signs of infection can spread the bacteria to others. In general 2 in 100 people carry MRSA. MRSA infection risk can be increased when a person is in activities or places that involve crowding, skin-to-skin contact, and shared equipment or supplies. People including athletes, daycare and school students, military personnel in barracks, and those who recently received inpatient medical care are at higher risk.

Sometimes, people with MRSA skin infections first think they have a spider bite. However, unless a spider is actually seen, the irritation is likely not a spider bite. Most staph skin infections, including MRSA, appear as a bump or infected area on the skin that might be: red, swollen, painful, warm to the touch, full of pus or other drainage, accompanied by a fever.

**Prevention**

Staphylococcal food poisoning can be prevented by preventing the contamination of food with the bacteria. The following food safety tips can help;

* Wash hands and under fingernails thoroughly with soap and water before handling and preparing food.
* Do not prepare food if you are ill.
* If you have wounds or infections on your hands or wrists, wear gloves while preparing food.
* Keep kitchens and food serving areas clean.
* If food is to be stored longer than two hours, keep hot foods hot (warmer than 60°C) and cold foods cold (4°C or colder).
* Store cooked food in a wide, shallow container and refrigerate as soon as possible.

Milking animals should be careful about udder health. Milk must be pasteurized and after the pasteurization, contamination should be prevented and the temperature controls should be done regularly.

For preventing MRSA infections;

* Keep wounds covered with clean, dry bandages until healed.
* Clean your hands often. Especially after changing the bandage or touching the infected wound.
* Do not share personal items. Personal items include towels, washcloths, razors and clothing, including uniforms.
* Wash used sheets, towels, and clothes with water and laundry detergent.
* Wash clothes according to manufacturer’s instructions on the label. Clean your hands after touching dirty clothes.

***CLOSTRIDIUM BOTULINUM***

**Key facts**

* Botulism is a rare but serious illness caused by *Clostridium botulinum* which generally occurs in soil.
* Botulinum toxins are one of the most lethal substances known.
* Botulinum toxins block nerve functions and can lead to respiratory and muscular paralysis.
* Human botulism may refer to foodborne botulism, infant botulism, wound botulism, and inhalation botulism or other types of intoxication.
* Homemade canned, preserved or fermented foodstuffs are a common source of foodborne botulism and their preparation requires extra caution.

**Introduction**

*Clostridium botulinum* is a rod-shaped, gram-positive anaerobic bacterium. The bacteria form protective spores when conditions for survival are poor. The spore has a hard protective coating that encases the key parts of the bacterium and has layers of protective membranes. Within these membranes and the hard coating, the dormant bacterium is able to survive for years. It is a mesophile, with minimum and optimum growth temperatures of 12 °C and 37 °C, respectively *C. botulinum* is responsible for a disease called botulism. Spores produced by *Clostridium botulinum* are heat-resistant and exist widely in the environment, and in the absence of oxygen they germinate, grow and then excrete toxins.

Each of the seven serotypes of this bacterium (A, B, C, D, E, F and G) produce a unique form of botulinum neurotoxin. Types A, B and E are commonly involved in human botulism and found in terrestrial, marine and fresh water environments. Botulinum toxin is a high molecular weight protein of 150,000 daltons with noncovalent proteins that protect it from digestive enzymes, thereby making it a highly dangerous food poison. The toxin is destroyed by heating at 80°C for at least one minute. Botulinum neurotoxins are the most potent naturally-occurring substance, with as little as 30–100 ng of neurotoxin sufficient to cause human botulism.

All botulinum toxins have a similar mode of action, that affects the central nervous system, whereby they interfere with the transmission of nerve impulses by inhibiting the release of the acetylcholine neurotransmitter from nerve terminals at the neuromuscular junction. The effect is long lasting but also reversible, as new nerve terminals sprout to replace the formerly inhibited ones.

Foodborne botulism is a serious, potentially fatal disease. However, it is relatively rare. It is an intoxication usually caused by ingestion of potent neurotoxins, the botulinum toxins, formed in contaminated foods.

**Sources and Transmission**

*C. botulinum* is prevalent in soil and marine sediments worldwide, most commonly as spores. These spores are found everywhere. The growth of the bacteria and the formation of toxin occur in products with low oxygen content and certain combinations of storage temperature and preservative parameters. This happens most often in lightly preserved foods and in inadequately processed, home-canned or home-bottled foods.

The botulinum toxin has been found in a variety of foods, including low-acid preserved vegetables, such as green beans, spinach, mushrooms, and beets; fish, including canned tuna, fermented, salted and smoked fish; and meat products, such as ham and sausage. The food implicated differs between countries and reflects local eating habits and food preservation procedures. Occasionally, commercially prepared foods are involved. Spore-contaminated honey has been associated with a number of cases.

Though spores of *C. botulinum* are heat-resistant, the toxin produced by bacteria growing out of the spores under anaerobic conditions is destroyed by boiling (for example, at internal temperature greater than 85 °C for 5 minutes or longer). Therefore, ready-to-eat foods in low oxygen-packaging are more frequently involved in cases of foodborne botulism.

**The Disease**

There are three major types of botulism in humans; infant/intestinal (adult) botulism, wound botulism and foodborne botulism. And according to some sources there is a fourth form called ıatrogenic botulism.

Infant botulism: Occurs mostly in infants under 6 months of age. Different from foodborne botulism caused by ingestion of pre-formed toxins in food, it occurs when infants ingest *C. botulinum* spores, which germinate into bacteria that colonize in the gut and release toxins. In most adults and children older than about 6 months, this would not happen because natural defenses in intestines that develop over time prevent germination and growth of the bacterium. *C. botulinum* in infants include constipation, loss of appetite, weakness, an altered cry and a striking loss of head control. Although there are several possible sources of infection for infant botulism, spore-contaminated honey has been associated with a number of cases. Parents and caregivers are therefore warned not to feed honey to the infants before the age of 1 year.

Wound botulism: Wound botulism is rare and occurs when the spores get into an open wound and are able to reproduce in an anaerobic environment. The symptoms are similar to the foodborne botulism, but may take up to 2 weeks to appear.

Foodborne Botulism: Foodborne botulism is characterized by descending, flaccid paralysis that can cause respiratory failure. Early symptoms include marked fatigue, weakness and vertigo, usually followed by blurred vision, dry mouth and difficulty in swallowing and speaking. Vomiting, diarrhea, constipation and abdominal swelling may also occur. The disease can progress to weakness in the neck and arms, after which the respiratory muscles and muscles of the lower body are affected. There is no fever and no loss of consciousness. Death is usually caused by respiratory failure and airway obstructions. The symptoms are not caused by the bacterium itself, but by the toxin produced by the bacterium. Symptoms usually appear within 12 to 36 hours (within a minimum and maximum range of 4 hours to 8 days) after exposure. Incidence of botulism is low, but the mortality rate is high if prompt diagnosis and appropriate, immediate treatment (early administration of antitoxin and intensive respiratory care) are not given. The disease can be fatal in 5 to 10% of cases.

Iatrogenic Botulism: *C. botulinum* is the same bacterium that is used to produce Botox, a pharmaceutical product predominantly injected for clinical and cosmetic use. Botox treatments employ the purified and heavily diluted botulinum neurotoxin type A. Treatment is administered in the medical setting, tailored according to the needs of the patient and is usually well tolerated. Although occasional side effects are observed if too much botulinum toxin is injected for cosmetic reasons, such as for wrinkles, or medical reasons, such as for migraine headaches.

Antitoxin should be administered as soon as possible after a clinical diagnosis. Early administration is effective in reducing mortality rates. Severe botulism cases require supportive treatment, especially mechanical ventilation, which may be required for weeks or even months. Antibiotics are not required (except in the case of wound botulism). A vaccine against botulism exists but it is rarely used as its effectiveness has not been fully evaluated and it has demonstrated negative side effects.

**Prevention**

Prevention of foodborne botulism is based on good practice in food preparation particularly during heating/sterilization and hygiene. Foodborne botulism may be prevented by the inactivation of the bacterium and its spores in heat-sterilized (for example, retorted) or canned products or by inhibiting bacterial growth and toxin production in other products. The vegetative forms of bacteria can be destroyed by boiling but the spores can remain viable after boiling even for several hours. However, the spores can be killed by very high temperature treatments such as commercial canning.

To prevent foodborne botulism:

* Use approved heat processes for commercially and home-canned foods (i.e., pressure-can low-acid foods such as corn or green beans, meat, or poultry).
* Discard all swollen, gassy, or spoiled canned foods. Double bag the cans or jars with plastic bags that are tightly closed.
* Do not taste or eat foods from containers that are leaking, have bulges or are swollen, look damaged or cracked, or seem abnormal in appearance.
* Refrigerate all leftovers and cooked foods within 2 hours after cooking
* honey should not be given to the infants before the age of 1 year