***ESCHERICHIA COLI***

**Key facts**

* *Escherichia coli* (*E. coli*) is a bacteria that is commonly found in the lower intestine of warm-blooded organisms. Most *E.coli* strains are harmless, but some can cause serious food poisoning.
* Shiga toxin-producing *E. coli* (STEC) is a bacterium that can cause severe foodborne disease.
* Primary sources of STEC outbreaks are raw or undercooked ground meat products, raw milk, and faecal contamination of vegetables.
* In most cases, the illness is self-limiting, but it may lead to a life-threatening disease including haemolytic uraemic syndrome (HUS), especially in young children and the elderly.

**Introduction**

*E. coli* are a large and diverse group of bacteria. Although most strains of *E. coli* are harmless, others can cause sickness. Some kinds of *E. coli* can cause diarrhea, while others cause urinary tract infections, respiratory illness and pneumonia, and other illnesses. Some other kinds of *E. coli* are used as markers for contamination in foods, especially in water.

*E. coli* bacteria were discovered in the human colon in 1885 by German bacteriologist Theodor Escherich. Dr. Escherich also showed that certain strains of the bacterium were responsible for infant diarrhea and gastroenteritis, an important public health discovery. Although *E. coli* bacteria were initially called Bacterium coli, the name was later changed to *Escherichia coli* to honor its discoverer.

*E. coli* is often referred to as the best or most-studied free-living organism. More than 700 serotypes of *E. coli* have been identified. The “O” and “H” antigens on the bacteria and their flagella distinguish the different serotypes. Pathogenic *E. coli* strains are categorized into 6 groups.

* **E**ntero**h**emorrhagic ***E****.* ***c****oli* (EHEC)
* **E**ntero**t**oxigenic ***E****.* ***c****oli* (ETEC)
* **E**ntero**p**athogenic ***E****.* ***c****oli* (EPEC)
* **E**ntero**a**ggregative ***E****.* ***c****oli* (EAEC)
* **E**ntero**i**nvasive ***E****.* ***c****oli* (EIEC)
* **D**iffusely **a**dherent ***E****.* ***c****oli* (DAEC)

Enteropathogenic *E. coli* is more common in newborns and children under 2 years of age and cause diarrhea. Most adults can carry the organism in their intestine but probably do not show symptoms because their immune system have sufficient. EPEC is epidemic in developing countries where sanitation conditions are poor, although it is seen all over the world, making up about 30% of diarrhea in children under 1 year old. Enteroinvasive *E. coli* is caused by dysentery-like bloody diarrhea in humans and animals. Infection is more common in hot summer months. The disease is particularly important in children in developing countries. However, EIEC also causes epidemic-severe food infections in adults. ETEC, which produces heat-sensitive (LT) or heat-stable (ST) toxin, is associated with two important clinical syndromes, one of which is children diarrhea and the other is tourist diarrhea. Enterotoxigenic *E. coli*, also known as touristic or passenger diarrheal disease, is generally seen in tourists, who are traveling to the countries that have inadequate hygienic conditions. EPEC, EIEC and ETEC can spread with the human feces, so humans are the main contamination source for this infections.

Enterohemorrhagic E. coli (EHEC) may also be referred to as Shiga toxin-producing E. coli (STEC) or Verocytotoxin-producing E. coli (VTEC) is the most important group that contains the serotype O157: H7, which is responsible for most foodborne infections resulting in death.

**STEC & *E.coli* O157:H7**

STEC, can cause severe foodborne disease. They produces toxins, known as Shiga-toxins because of their similarity to the toxins produced by *Shigella dysenteriae*. STEC can grow in temperatures ranging from 7 °C to 50 °C, with an optimum temperature of 37 °C. Some STEC can grow in acidic foods, down to a pH of 4.4, and in foods with a minimum water activity (aw) of 0.95.

*E. coli* O157:H7 was first recognized as a pathogen in 1982 during an investigation into an outbreak of hemorrhagic colitis associated with consumption of hamburgers from a fast food chain restaurant. *E. coli* O157:H7’s ability to induce infection in humans is a result of its ability to produce numerous virulence factors, most notably Shiga toxin (Stx), which is one of the most potent toxins known to man. Shiga toxin has multiple variants (e.g., Stx1, Stx2, Stx2c), and acts by inhibiting protein synthesis in endothelial and other cells. In addition to Shiga toxin, *E. coli* O157:H7 produces numerous other putative virulence factors, including proteins which aid in the attachment and colonization of the bacteria in the intestinal wall and which can lyse red blood cells and liberate iron to help support *E. coli* metabolism.

What makes *E. coli* O157:H7 remarkably dangerous is its very low infectious dose, and how relatively difficult it is to kill these bacteria. *E. coli* O157:H7 in ground beef that is only slightly undercooked can result in infection. As few as 20 organisms may be sufficient to infect a person and, as a result, possibly kill them. And unlike generic *E. coli*, the O157:H7 serotype multiplies at temperatures up to 44 °C, survives freezing and thawing, is heat-resistant, resists drying, and can survive exposure to acidic environments.

**Sources and Transmission**

The reservoir of this pathogen appears to be mainly cattle. *E. coli* O157:H7 and other STEC mostly live in the intestines of cattle. In addition, other ruminants such as sheep, goats, and deer are considered significant reservoirs, while other mammals (such as pigs, horses, rabbits, dogs, and cats) and birds (such as chickens and turkeys) have been found infected.

*E. coli* O157:H7 is transmitted to humans primarily through consumption of contaminated foods, such as raw or undercooked ground meat products and raw milk. Faecal contamination of water and other foods, as well as cross-contamination during food preparation (with beef and other meat products, contaminated surfaces and kitchen utensils), will also lead to infection. Examples of foods implicated in outbreaks of E. coli O157:H7 include undercooked hamburgers, dried cured salami, unpasteurized fresh-pressed apple cider, yogurt, and cheese made from raw milk.

An increasing number of outbreaks are associated with the consumption of fruits and vegetables (including sprouts, spinach, lettuce, coleslaw, and salad) whereby contamination may be due to contact with faeces from domestic or wild animals at some stage during cultivation or handling. STEC has also been isolated from bodies of water (such as ponds and streams), wells and water troughs, and has been found to survive for months in manure and water-trough sediments. Waterborne transmission has been reported, both from contaminated drinking-water and from recreational waters.

Person-to-person contact is an important mode of transmission through the oral-fecal route. An asymptomatic carrier state has been reported, where individuals show no clinical signs of disease but are capable of infecting others. The duration of excretion of STEC is about 1 week or less in adults, but can be longer in children. Visiting farms and other venues where the general public might come into direct contact with farm animals has also been identified as an important risk factor for STEC infection.

**The Disease**

The colitis caused by *E. coli* O157:H7 is characterized by severe abdominal cramps, diarrhea that typically turns bloody within 24 hours, and sometimes fever. Inflammation caused by the toxins is believed to be the cause of hemorrhagic colitis, the first symptom of *E. coli* infection, which is characterized by the sudden onset of abdominal pain and severe cramps. The incubation period is usually reported as 3 to 4 days, but may be as short as 1 day or as long as 10 days. Infection can occur in people of all ages but is most common in children. *E. coli* symptoms also may include vomiting and fever, although fever is an uncommon symptom.

Unlike other *E. coli*, which remain on intestinal surfaces, Shiga toxin-producing bacteria, like O157:H7, are invasive. After ingestion, *E. coli* rapidly multiply in the large intestine and then bind tightly to cells in the intestinal lining. This snug attachment facilitates absorption of the toxins into the small capillaries within the bowel wall. Once in the systemic circulation, Shiga toxin becomes attached to weak receptors on white blood cells, thus allowing the toxin to transfer to the kidneys where Gb3 receptors that grasp and hold on to the toxin.

Most patients recover within 10 days, but in a small proportion of patients (particularly young children and the elderly), the infection may lead to a life-threatening disease, such as haemolytic uraemic syndrome (HUS). HUS is characterized by acute renal failure, haemolytic anaemia and thrombocytopenia (low blood platelets). It is estimated that up to 10% of patients with STEC infection may develop HUS, with a case-fatality rate ranging from 3 to 5%. Overall, HUS is the most common cause of acute renal failure in young children. It can cause neurological complications (such as seizure, stroke and coma) in 25% of HUS patients and chronic renal sequelae, usually mild, in around 50% of survivors.

Persons who experience bloody diarrhoea or severe abdominal cramps should seek medical care. Antibiotics are not part of the treatment of patients with STEC disease and may possibly increase the risk of subsequent HUS. Therefore, apart from supportive care, such as close attention to hydration and nutrition, there is no specific therapy to halt *E. coli* symptoms.

**Prevention**

The prevention of infection requires control measures at all stages of the food chain, from agricultural production on the farm to processing, manufacturing and preparation of foods in both commercial establishments and household kitchens.

The number of cases of disease might be reduced by various mitigation strategies for ground beef (for example, screening the animals pre-slaughter to reduce the introduction of large numbers of pathogens in the slaughtering environment). Good hygienic slaughtering practices reduce contamination of carcasses by feces, but do not guarantee the absence of STEC from products. Education in hygienic handling of foods for workers at farms, abattoirs and those involved in the food production is essential to keep microbiological contamination to a minimum.

Preventive measures for *E. coli* O157:H7 infection are similar to those recommended for other foodborne diseases. The only effective method of eliminating STEC from foods is to introduce a bactericidal treatment, such as heating (for example, cooking or pasteurization) or irradiation.

Cook meats thoroughly, the center of the food should reaches at least 70 °C. Make sure to wash fruits and vegetables carefully, especially if they are eaten raw. If possible, vegetables and fruits should be peeled. Vulnerable populations (such as small children and the elderly) should avoid the consumption of raw or undercooked meat products, raw milk, and products made from raw milk.

Be careful to avoid cross contamination when preparing and cooking food, especially if beef is being served. This requires being very mindful of the surfaces (especially cutting boards) and the utensils used during meal preparation that have come in contact with uncooked beef and other meats.

Regular hand washing, particularly before food preparation or consumption and after toilet contact, is highly recommended, especially for people who take care of small children, the elderly or immunocompromised individuals, as the bacterium can be passed from person to person, as well as through food, water and direct contact with animals.

A number of STEC infections have been caused by contact with recreational water. Therefore, it is also important to protect such water areas, as well as drinking-water sources, from animal waste. Avoid swallowing water when swimming or playing in lakes, ponds, streams, swimming pools, and backyard “kiddie” pools.

***LISTERIA***

**Key Facts**

* Listeriosis is a serious but rare infection, mainly caused by eating food contaminated with the bacteria *Listeria monocytogenes*.
* It is considered an emerging food-borne infection due to changing food habits, technological advancements for longer shelf-life of food products.
* Unlike most bacteria, *Listeria* can grow and multiply in some foods in the refrigerator.
* The disease primarily affects pregnant women, newborns, older adults, and people with weakened immune systems and has a high fatality rate in the susceptible population.

**Introduction**

*Listeria* species are found in soil, water, effluents, a large variety of foods, and the feces of humans and animals. *Listeria* is a family of bacteria that contains six species (*L. monocytogenes, L. ivanovii, L.* *innocua, L. seeligeri, L. welshimeri, L. grayi)*. However, only *Listeria monocytogenes* and, rarely, *L. ivanovii* are pathogenic for humans. *L. monocytogenes* has 13 serotypes, but serotypes 1/2a, 1/2b and in some cases 4b are predominant serotypes that cause human listeriosis.

*L. monocytogenes* was first described by Murray et al., who named it *Bacterium monocytogenes* because of a characteristic monocytosis found in infected laboratory rabbits and guinea pigs. It was renamed *Listerella hepatolytica* by Pirie in 1927 and given its present name by him in 1940. The first confirmed isolations of the bacterium from infected individuals, following its initial description, were made in 1929 by Gill from sheep and by Nyfeldt from humans. Since then, sporadic cases of listeriosis have been reported, often in workers in contact with diseased animals. As a result of food-borne outbreaks, interest in the organism grew rapidly in the 1980s.

*L. monocytogenes* is a gram-positive, non-spore forming, facultatively anaerobic rod which grows between 0 and 50°C. The organism possesses peritrichous flagella, which give it a characteristic tumbling, motility, occurring only in a narrow temperature range. When the organism is grown between 20 and 25°C, flagellin is both produced and assembled at the cell surface, but at 37°C flagellin production is markedly reduced. Unlike many other food‑borne bacteria, *Listeria* survives in salty environments and cold temperatures, as low as 2 to 4 °C.

**The Disease**

Epidemiological studies in the last 25 years have revealed that epidemic listeriosis is a foodborne infection and the intestinal tract is the primary point of entry. *L. monocytogenes* typically enters the host through the intestines and infects the liver first. In the liver, the bacteria multiplies until the host's immune system tackles it; at this stage, the vast majority of infections end. However, in immunocompromised or other at-risk individuals, the infection may continue and eventually move to the brain.

Adults who are healthy and have strong immune systems are less at risk of listeriosis. The following are associated with an increased risk of *Listeria* infection:

* age over 65 years
* pregnant women
* new-borns
* AIDS (acquired immune deficiency syndrome)
* existing kidney disease
* chemotherapy
* cirrhosis
* diabetes
* surgical removal of the spleen
* anti-rheumatoid arthritis medication and immunosuppressant drugs

Listeriosis can cause a variety of symptoms, depending on the person and the part of the body affected. *Listeria* can cause fever and diarrhea similar to other foodborne germs, but this type of *Listeria* infection is rarely diagnosed. The incubation period for this disease also varies from about 3 days to 3 months in humans depending on the immun status and the number of cells ingested. It causes three forms of disease; gastrointestinal form, systemic listeriosis and abortion and neonatal listeriosis.

In gastrointestinal form, exact mechanism is not known. However, it appears that the organism causes damage to the absorptive villi affecting absorption of nutrients and promoting fluid secretion. The gastroenteritis symptoms are characterized by fever, headache, nausea, vomiting, abdominal pain and diarrhea. Diarrhea is non-bloody but watery.

Listeriosis can lead to a serious blood infection, septicemia. If the listeriosis infection spreads to the brain, the outcomes can be severe and may include; meningitis, encephalitis, cranial nerve palsies, cerebral abscesses. The infection will spread to the nervous system where symptoms might include: headache, confusion, stiff neck, tremors and convulsions, loss of balance.

Infection during pregnancy usually occurs during the last 3 months of pregnancy. In pregnancies the course of the disease is influenza-like, fever, headache, myalgia and sometimes gastrointestinal symptoms can be seen. Complications of a listeria infection may be most severe for an unborn baby. Early in pregnancy, a listeria infection may lead to miscarriage. Later in pregnancy, a listeria infection may lead to stillbirth, premature birth or a potentially fatal infection in the baby after birth-even if the mother becomes only mildly ill.

*Listeria monocytogenes* can also be transmitted directly through the eye and skin. This contamination is more common in laboratory staff, animal carers and veterinarians.

**Source and Transmission**

*Listeria* are widely found in nature because of their ubiquitous nature.They can isolated from soil, plants and water. Animals, including cattle, sheep and goats, can also carry the bacteria. Vegetables can become contaminated from the soil or from manure used as fertilizer. Animals can carry the bacteria and can contaminate meats and dairy products. Processed foods, such as soft cheeses and cold cuts, can be contaminated after processing. Unpasteurized (raw) milk or foods made from unpasteurized milk can be contaminated.

The high incidence of *Listeria* in animals in some countries is due to mistakes related to the silage production technique. In this context, there is air contact and insufficient silage resulting mold contamination. Depending on the development of molds, lactic acid is rising and *L. monocytogenes* develops by this increased pH value of the silage.

**Prevention**

Although listeriosis is rare, there are a number of ways to further reduce the chances of becoming infected;

People with Normal Immune Systems

* Thoroughly cook raw food from animal sources, such as beef, pork, or poultry
* Wash raw vegetables before eating them
* Keep uncooked meats separate from vegetables and cooked foods
* Avoid products made with unpasteurized milk
* Wash hands and cooking utensils after handling uncooked foods
* Consume perishable and read-to-eat foods as soon as possible

People at High Risk

* Do not eat hot dogs or lunch meats unless they are heated to a temperature sufficient to kill *Listeria*
* Wash hands after handling hot dogs and lunch and deli meats
* Do not eat soft cheeses (e.g. feta, Brie, Camembert, blue cheese, and queso blanco) unless the label clearly states that they are pasteurized
* Do not eat refrigerated pâté or meat spread, only canned or shelf-stable ones
* Do not eat refrigerated smoked seafood, sometimes labeled as “nova-style,” “lox,” “kippered,” or “jerky.” Canned or shelf-stable smoked seafood should prefered.