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Review Article

# Waterborne Major Bacterial Zoonoses

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**A B S T R A C T**

**Background/Aim:** Reports of case investigations just as assessments of disease determinants in local and territorial populaces give us examples of diseases that are dependent upon an assortment of local, ecological, cultural, and biological impacts. Environmental conditions are fundamentally impacted thusly by the atmosphere and organic activities. These impacts can be exceptionally variable, bringing about altogether different examples of disease burden among populaces. To treatment and prevention strategies for outbreaks that occur with the environmental and public health effects of waterborne zoonotic agents, each bacterial agent should be examined individually first.

**Conclusion:** The present review inspects specific zoonotic bacterial agents that transmit from faeces to a contaminated host and are facilitated by waterborne transmission.

*Key words: Waterborne Zoonoses, Escherichia coli, Salmonella sp., Lepstospira sp.*

# Su Kaynaklı Başlıca Bakteriyel Zoonozlar

**Ö Z E T**

**Özbilgi/Amaç:** Vaka raporu incelemelerinin yanı sıra, yerel ve bölgesel popülasyonlardaki hastalık determinantları, bize çeşitli çevresel, toplumsal ve biyolojik etkilere maruz kalan hastalık modellerini sunmaktadır. Çevresel koşullar, iklim ve organik faaliyetlerinden sırasıyla etkilenmektedir. Bu etkilerin tümü oldukça değişkenlik gösterebilmekte, bu durum da popülasyonlar arasında çok farklı hastalık kaynaklarını ortaya çıkarmaktadır· Su kaynaklı zoonotik ajanların çevre ve halk sağlığı etkileri ile birlikte ortaya çıkan salgınların tedavi ve koruma stratejilerinin geliştirilebilmesi için her bakteriyel ajan öncelikle bireysel olarak incelenmelidir.

**Sonuç:** Bu derlemede, dışkı ile kontaminasyon yoluyla konakçıya geçen ve suyla taşınan spesifik zoonotik bakteriyel ajanları incelenmiştir.

*Anahtar kelimeler: Su Kaynaklı Zoonozlar, Escherichia coli, Salmonella sp., Lepstospira sp.*

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## Introduction

Diarrhoeagenic *E. coli* is a significant agent of waterborne maladies. Water-related transmission of VTEC (verotoxigenic *Escherichia coli*), specifically *E. coli* O157, from zoonotic host is very much archived, basically in developed countries. Recreational waters, private and civil drinking-water sources have been embroiled as sources of outbreaks and causes of sporadic disease. The existence of low levels of target microorganisms in water makes microbiological confirmation difficult.

The *Salmonella* are basically intestinal microorganisms of humans and numerous other species, including wild avians, pets, and rodents. The existence of *Salmonella* in various ecosystems (water, food, nature) is clarified by faecal contamination. Under appropriate ecological conditions, they live for a considerable length of time in weeks and years in soils. Just as control strategies to guarantee conveyance of hygienic water and non-pathogenic food, global and national reconnaissance plots and concentrated composing research centre offices must be set up and kept up to screen and identify slants in infectious enteric malady. (Deshmukh et al., 2016).

Leptospirosis is a significant bacterial zoonosis all through the world. *Leptospira* are transmitted in the urine of wild or domestic animal reservoirs and contaminate the nature, as well as surface fountains. The course of disease for domestic animals is by contact of the agent with mucosal membranes, including eye, nose, and mouth (Srisawat and Sitprija, 2019).

## *Escherichia coli*

In excess of 400 different serotypes of *E. coli* secrete verocytotoxins, and the majority of these serotypes cause disease in humans. *Escherichia coli* O157: [H7] is the most common VTEC serotype. VTEC was first seen in 1982 as an outbreak of bloody diarrhoea in a nursing home in Canada and a fast food restaurant chain. presently perceived as a significant reason for food and water-related diseases in some of the developed and developing countries. Infection commonly occurs as a diarrheal disease with bloody faeces. Approximately 8% of patients progress to infection haemolytic uremic syndrome (HUS). HUS is a perilous condition. It is identified by thrombocytopenia, microangiopathic haemolytic anaemia and renal failure. In North America and the United Kingdom, the most common VTEC serotype is O157: [H7], whereas non-O157 VTEC serotypes are mostly prevalent in continental European countries and Australia. O26, O103, O111 and O145; O157 VTEC is one of the important non-O groups. Infections caused by these species cause serious diseases such as HUS (Tarr et al., 2005).

*Escherichia coli* O157: [H7] is alike to many other *E. coli* by lactose utilization. However, it cannot ferment sorbitol rapidly, which helps diagnose *E. coli* O157: [H7] on sorbitol-MacConkey. *E. coli* O157: NM species fermenting sorbitol has been introduced in Europe, especially in Germany. *E. coli* O157: [H7] generally has haemolytic activity on enterohaemolisin agar. Most VTECs that are not O157 readily utilize sorbitol as other *E. coli*. This is one of the variables anticipating general monitoring for non-O157 VTEC. *E. coli* O157: [H7] does not grow at 44 °C, the ideal temperature for evaluating thermotolerant *E. coli* in water. *E. coli* O157: [H7] endures well in acidic conditions such as fermented sausages and cider. *E. coli* O157: [H7] was found to live, particularly in weeks of cold water. Additionally, the bacteria can keep on living in environments such as soil, fertilizer, manure etc. for a long time (Wang and Doyle, 1998).

*E. coli* O157: [H7] almost always produces a high proportion of VT2 as well as VT1. In addition, most other VTEC include LEE (enterocyte legend locus) pathogenicity. These genes are a collection of genes already found in A/EEC that have adhesion to enterocytes, destroy microvilli and affect the formation of actin-rich cup-like bases that are affected by bacteria. LEE contains the *eae* gene, the outer membrane adhesin protein essential for binding, among other genetic loci. Clinically, the most important VTEC is both VT2-producing and LEE (*eae*) (Griffin et al., 2002).

The transmission of *E. coli* O157: [H7] and other VTEC is worldwide. In countries with monitoring systems, the incidence of VTEC infections varies. This indicates differences in diagnostic activity, reporting, and the event itself. It has been reported to be high in Canada, Scotland, and Argentina. In numerous European countries and the United States, the yearly frequency fluctuates from one to four contaminations for every 100.000 populaces. Few institutes are testing for non-O157 VTEC and therefore cannot be diagnosed. Human cases of VTEC infections usually occur in the summer and are most common in young children (Friedrich et al., 2005). Sources of human infection with *E. coli* O157: H7 are mostly contaminated meat products, contaminated fruit juice, drinking water, and recreation water, individual transmission and raw vegetables (Byrne, 2003).

Healthy ruminants such as cattle, goats, sheep and deer transmit VTEC species. Bovine ruminants are considered as primer reservoir for VTEC and especially for E. coli O157. *E. coli* O157 and other VTEC species have also become increasingly common in ruminants such as pigs, rabbits, marsupials, and waterfowl. These discoveries might be because of transient transport or might be a sign that sources are bigger than recently suspected (Ferens and Hovde, 2011).

Non-O157 VTEC can cause diseases such as oedema and diarrhoea in some domestic animals such as pigs and calves. Not enough data is available for other animal species. Non-O157 VTEC, which causes disease in animals, has been associated with a limited number of serotypes that cause disease in humans. For instance, VTEC diseases in cattle are often serotypes such as O145: NM, O26: H11, O5: NM, and O103: [H2] (Farrokh et al., 2013).

In endemic zones, for example, the United Kingdom, E. coli O157 might be available in half of herd, but it is possible to find this rate higher than intended using more sensitive methods. Various non-O157 VTECs are mostly present in cattle and other ruminants. However, as highlighted above, not all species are human pathogens. The faecal spread of *E. coli* O157: H7 is frequent in freshly calf calves in summer. Some production methods that reduce costs in cattle breeding can lead to the emergence of *E. coli* O157: H7 (Caprioli et al., 2005).

VTECs such as *E. coli* O26: H11 and O157: H7 are transmitted at low doses. This makes water an effective means of transporting the disease. Specifically, areas where domestic or wild animals may enter may increase the risk of contamination. Therefore, wells or small water systems that feed rural towns are often the cause of waterborne outbreaks. Besides, recreational waters have also been shown to cause outbreaks. Sources of pollution include human and animal faeces or sewerage mixing. The small number of bacteria results in difficult microbiological identification. Therefore, epidemiological evidence plays an important role in epidemic research. Low doses of *E. coli* O157: H7 may pose a serious risk of infection, even in waters that meet the standards for indicator organisms. In cases where conventional methods are not successful in the diagnosis of *E. coli* O157: H7, accurate molecular methods such as polymerase chain reaction are effective (Bopp et al., 2003).

In industrialized countries, despite water contamination with VTEC O157, the risk of waterborne infection is relatively low due to the organism's susceptibility to the water treatment process (Chalmers et al., 2000).

## *Salmonella* sp.

Salmonellae are intestinal pathogens found primarily in humans, as well as in animals such as wild birds, domestic animals and rodents. It can also be found in the blood and internal organs. They are frequently found in sewage, rivers and other waters. They are also found in the soil but do not grow rapidly here. Along these lines, the existence of *Salmonella* in other ecosystems (water, food, nature) is clarified by faecal contamination. Under appropriate environmental conditions, they can endure for weeks in water and years in the soil. They are found in many foodstuffs such as fruits and vegetables. In addition, animal protein is important contaminant of feed supplements. They are pathogenic for many animal species, causing typhoid-like diseases and enteritis. In the greater part of the world, the incidence of salmonellosis relies upon on water resources, waste disposal, food production, preparation practices, and climate. Factors, for example intensive livestock production, expanding the versatility of groceries just as human and creature populaces caused an overall increment in the pace of food contamination. (Lightfoot, 2004).

The greatest source of salmonellosis in humans is poultry. Poultry and many other animals are usually carriers, infected, but asymptomatic or rarely clinically ill. Poultry is often infected by many different serovars. The infection medium is mostly the gastrointestinal tract and *Salmonella* sp. is usually found in the faeces of birds. This makes a huge reservoir and source of contamination for other species and the environment. Horizontal spreading of *Salmonella* sp. may occur during the incubation of chickens, including aerosols containing Salmonella, feeds contaminated with *Salmonella* sp., water or rodents. There is a definite relationship between chicken age and spread and the number of organisms required for infection to be detected (range 102-1010) (Poppe, 2000). Infected ovarial follicles or infected eggs developing in the egg channel are called vertical spread. Serovars specific to poultry such as *Salmonella* Gallinarum and *S.* Pullorum are vertically spreading primer serotypes. Other serotypes that can cause transovarial infection, including *S.* Heidelberg, *S.* Enteritidis, and *S.* Typhimurium (İzgür, 2010; Çarlı and Kahya, 2011).

The utilization of animal manure on farmland presents potential health risks for pets and people. Animal feed activities, which require the detainment of cattle in little zones, lead to the generation of faeces equal to the domestic waste excrements of small urban areas. In bovine feeding activities, the animal number per square kilometer can approach 4000 animals (nearly 39 per hectare). The fact that animals are very close to each other in these feeding operations can accelerate the spread of diseases such as salmonellosis amongst a healthy flock of livestock. In addition, the removal of animal faeces under these restrictions is a primal activity. If manure is not discharged into a lake or dump, the storm flow will bring a large amount of faecal pollution to the drainage area. Faecal wastes of poultry can lead to similar problems as they are likely to carry Salmonella sp. (Lammerding, 2006).

## Leptospirosis

Leptospirosis is globally a significant bacterial zoonosis. The distribution of disease in animals and humans varies according to various regions of the world. However, the disease is generally endemic in the tropical zones and is more seasonal in temperate atmosphere. This is a real example of a zoonosis. Infection is maintained in the wild. Humans and pets are only infected when there is indirect or direct contact with the animal reservoir. Individual transmission is nonfrequent. *Leptospira* sp. is spilled through urine from wildlife or pet reservoirs and contaminates the nature, including surface waters. The organism can endure for a period time under humid environment, protection from direct sunlight and neutral pH conditions. For mammals, infection occurs when the organism comes into contact with mucous membranes in the eyes, nose and mouth. Therefore, Leptospirosis infections have been implicated with water contact in numerous parts of the world (Bharti et al., 2003; Adler and Faine, 2006).

Outbreaks of Leptospirosis in animals and people are frequently related with uncommon precipitation events or floods (Simbizi et al., 2016). In particular, significant outbreaks of leptospirosis have been related with El Niño precipitation and hurricanes in the western hemisphere (Trevejo et al., 1998; Sanders et al., 1999). Increasing utilization of clean water has significantly increased the risk of exposure to leptospirosis, and many outbreaks resulting therefrom have been recorded (Haake et al., 2002; Morgan et al., 2002; Sejvar et al., 2003).

It is not practical to prevent environmental contamination with *Leptospira* sp. due to the widespread use of carriers. Prophylactic treatment using antimicrobials in cases of leptospirosis associated with flood and recreational use may reduce the effects of the disease. However, in tropical regions of endemic Leptospirosis, simple measures such as avoiding animals away from areas where people live or preparing food, vaccination of animals properly, and the use of protective clothing can provide significant benefits (Haake et al., 2002).

## Conclusion

Zoonotic microorganisms are found in environmental sources. Intensive breeding of food animals; pollution of pastures by animals; fruits and vegetables are grown in areas with low water hygiene and transport operations; elimination of bacteria contaminated wastes; enormous amounts of industrial and animal waste; elements such as food movement around the world contribute to the contamination of the environment with contagious bacteria. For these reasons, these microorganisms will need significantly further examination to decide the pathogenic condition for people, the act of animal hosts in the transmission to people, and the act of water in dissemination or transmission in the nature. It depends on the reason that the entirety of the means and procedures are related and start with water source assurance and end with giving lingering disinfectant to the water dissemination framework and safe transport to the individuals. Great procedures to lessen the potential for exposure of infection through circulation systems include routine upkeep strategies, for example, sterile procedures to distinguish potential sources of contamination and cleaning, fix, and substitution of broken channels, valves, and so on. To provide the distribution of hygienic water and nonpathogenic food, national and international monitoring operations and special experimental laboratories have been established to monitor and identify infectious enteric diseases.

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