Intestinal Illnesses and One Health

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ABSTRACT

Zoonotic diseases can be naturally transmitted from vertebrate animals to humans. These diseases are harmful for both animals and humans. Millions of people throughout the world are susceptible to zoonotic diseases caused by bacteria, viruses, fungi and parasites. Different pathogens are responsible for causing gastroenteritis. The pathogens spread from environment, infected persons, animals or from contaminated water/food. Food-borne zoonotic illnesses arise by the consumption of either infected water or contaminated food. Several pathogens are present in foods such as bacteria (e.g. Campylobacter and Salmonella), virus (e.g. norovirus), and parasites (e.g. Cryptosporidium). Ingestion of raw/undercooked meat or raw milk serves as major sources of zoonotic infections. Throughout the world, zoonotic infections are a matter of serious concern and developing countries are at greater risk. The One-Health approach seems to have a major role in the control and prevention of zoonotic illnesses. During the last three decades, new and re-emerging zoonotic diseases have been evolved partly because of our close connection with companion and food animals, along with our growing dependence on animals including their products. The One-Health functions at global, regional, national and local levels and emphasizes on the collaboration and team work of different sectors. This approach focuses on surveillance, management and eradication of diseases by encouraging collaboration between public health experts, veterinarians, and ecologists. This unifying and integrated approach can alleviate and prevent threats to health at the interface of the environment, humans, animals and plants. The international organizations have acknowledged the One Health as an important need for control of many zoonotic diseases especially intestinal diseases.

Key words: Gastroenteritis, Zoonotic diseases, Bacteria, Public Health, Intestinal health, Foodborne

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1. INTRODUCTION

Zoonoses are defined as the diseases which are naturally transmitted from vertebrate animals to humans. Zoonotic diseases are considered dangerous for both animal and human health. The transmission may occur either directly or indirectly through vectors. The seriousness of symptoms of zoonotic diseases ranges from mild to even life-threatening conditions. Generally, the zoonotic diseases can be transferred at the human-animal interface when there is direct exposure to animals (e.g. rabies), products of animal origin (e.g. salmonellosis, brucellosis), or their contaminated environment (e.g. echinococcosis) (Rantsios 2016).

Zoonotic diseases can emerge from either domestic animals or wild animals. The latter are gradually becoming a significant reservoir for human disease, as recognizable in susceptible groups of human, including hunters, and tourists camping in forests. Around the world, there are millions of people, who are at risk to acquire a number of viral, bacterial, fungal as well as parasitic zoonotic infections. Consequently, there are millions of new annual cases, considerate mortality rate, and cause burden in respect of agriculture, veterinary medicine, livestock production and national and local economies (Christou 2011).

The term gastroenteritis can be referred to the acute emergence of symptoms related to intestine. In accordance to the FoodNet definition, the frequency of gastroenteritis was higher in Canada as compared to the United States, Australia, and Ireland. While the occurrence was higher in the United States as compared to Ireland (Majowicz et al. 2008). The evaluation of the percentage of gastroenteritis of foodborne origin is dependent on the information of known pathogens (ingested by oral route) (Hall et al. 2010). Several pathogens are responsible for infectious gastroenteritis. These pathogens acquire particular characteristics and can be identified by different laboratory procedures. The pathogens spread from environment, infected persons, animals or from contaminated water/food (Hall et al. 2005). It has been reported that, annually up to 10% of the population of humans may suffer from foodborne zoonosis in industrialized countries (Shao et al. 2011).

One Health concept seems to be a cooperation between different sectors. These sectors include health of human, animal and environment. One Health strategy is essential for the successful surveillance, detection and control of different zoonotic diseases. Due to increased emerging infections, One Health concept is being considered as more beneficial to improve animal, human and environmental health by the control of emerging and zoonotic diseases (Shaheen 2022).

2. SIGNIFICANCE OF ZOONOSIS

Zoonoses impose multiple effects on the health of both humans and animals. The effects imposed by zoonoses can be assessed through various parameters like disease incidence, prevalence, mortality, morbidity and economic loss. The livestock sector can be greatly affected by the economic losses generated as a result of animal death caused by zoonotic infections. Although if the animal does not die, its health and productivity are still negatively affected. Therefore, it can lead to a considerable loss (can be more than 70%) in animal products like milk, meat, and eggs. Besides this, human nutrition and health are also influenced because of the decreased supply of high protein foods of animal origin. Different zoonotic diseases may affect differently, e.g. toxoplasmosis and brucellosis can result in weak offspring, abortion, and infertility. Zoonotic infections like avian influenza, anthrax, and BSE hinders the international trade of animal and their products (such as milk, meat and eggs) around the world. The economy is also greatly disturbed due to the measures essential for control and eradication of zoonoses (like surveillance, diagnosis, isolation, quarantine, restriction on transportation of animals, treatment, vaccination, biosecurity and inspection of milk and meat). The economic impact of zoonotic outbreaks has globally exceeded 120 billion USD from 1995 to 2008. In addition to this, different countries experienced extreme economic losses as a result of outbreaks of zoonotic foodborne pathogens (Rahman et al. 2020).

3. NON-FOODBORNE ZOONOTIC DISEASES

Zoonotic non-food borne diseases can be transmitted through:

- Direct Contact (e.g. Avian influenza and Q fever)
- Vectors (e.g. Malaria, Lyme disease, West Nile fever, and Leishmaniosis) (Rantsios 2016).

4. FOOD-BORNE ZOONOTIC DISEASES

Food-borne zoonotic illnesses are developed by the utilization of either infected water or contaminated food. Several pathogens are present in foods such as bacteria (e.g. *Campylobacter* and *Salmonella*), virus (e.g. norovirus), and parasites (e.g. *Cryptosporidium*). Food safety challenges have increased due to changes in food production, processing, distribution and the environment (Rantsios 2016).

4.1. GASTROINTESTINAL ZOONOTIC ILLNESSES

Humans and animals are affected by infectious gastrointestinal illnesses around the world. There are a variety of agents which have the potential to be transmitted (such as *Yersinia enterocolitica,* and *Campylobacter jejuni*). Consumption of raw milk or raw/undercooked meat seems to be major source for zoonoses (Tsegaye et al. 2022). Gastrointestinal illnesses can be caused as a result of the following zoonotic pathogens:

4.1.1. CAMPYLOBACTERIOSIS

Campylobacter spp. and *Salmonella* spp. are responsible for causing more than 90% of bacterial food-borne illnesses (Rahman et al. 2020).

4.1.1.1. ETIOLOGY

Campylobacter is a bacterium that causes campylobacteriosis. Since the 1980s, *C.jejuni* has been considered as a common zoonotic pathogen throughout the world (Shao et al. 2011).

4.1.1.2. TRANSMISSION

In the present time, it is the most commonly occurring foodborne zoonotic disease of bacterial origin throughout the world. The most common causes for campylobacteriosis include the ingestion of contaminated beef, pork or poultry. It was discovered that almost 30 percent cases of this infection were the consequence of consumption of contaminated poultry. Different reservoir for this pathogen include ruminants like sheep, goats and cattle (Chlebicz and Śliżewska 2018).

4.1.1.3. EPIDEMIOLOGY

The prevalence of *campylobacter* infection has become increased and serves as the most common reason for diarrhea in both the developed and developing countries. In the United States, in March 2013, the Centers for Disease Control and Prevention (CDC) revealed nearly 14 percent rise in the cases of *Campylobacter jejuni*. *Campylobacter* affects 1 percent of human population of Europe on yearly basis. The prevalence of this disease throughout the world shows the ability of this pathogen to live in different

variety of environments (Fischer and Paterek 2022). In China, the detection of *Campylobacter jejuni* is the most frequent in poultry having an average flock contamination rate and isolation rate as 86.67 % and 18.61 %, respectively. In Jiangsu province, the average incidence rate was reported as 8.70 %, 7.77 %, 5.02% and 4.84 % in heifers, cattle, milk cows and diarrheal patients, respectively (Shao et al. 2011).

4.1.1.4. SYMPTOMS

Campylobacteriosis in humans usually develops 1 to 5 days after exposure with the pathogen. The clinical signs include fever, vomiting, abdominal pain, watery and may be bloody diarrhea (Skarp et al. 2016).

4.1.1.5. DIAGNOSIS

Diagnosis can be made by adopting different methods. These methods include, culture test, stool antigen assays, and molecular techniques. These techniques have different specificity and sensitivity. Beside these, non-culture methods are also available for detection but these do not tell about the difference between *C. coli*, *C. jejuni* and other species of *Campylobacter* (Fitzgerald 2015).

4.1.1.6. TREATMENT

The campylobacteriosis infection is usually mild and self-limiting. Macrolide antibiotics serve as the best treatment option for *Campylobacter* infections. It is important to maintain the hydration status and electrolyte depletion of the patients. Depending on the degree of dehydration and the severity of the disease, the hydration can be either through oral or parenteral route (Fischer and Paterek 2022).

4.1.2. SALMONELLOSIS

Another food-borne zoonotic agent is *Salmonella* which causes Salmonellosis and affects humans and some of the warm blooded animals. In different provinces of China, the contamination of *Salmonella* in food of animal origin is common (Shao et al. 2011).

4.1.2.1. ETIOLOGY

For many years, *Salmonella* has been considered a reason for enteric diseases. The three species of *Salmonella* include *S. enterica*, *S. subterranean* and *S. bongori* (Chen et al. 2013).

4.1.2.2. EPIDEMIOLOGY

Salmonellosis is a major health concern globally and is the main reason for foodborne problems in the US and other parts of the world. The intestinal region of both cold and warm blooded animals acts as a reservoir for *Salmonella*. *Salmonella* has wide range of distribution because of its large number of reservoir hosts, shedding of pathogen in feces of carrier animals, and its persistence in the environment (Griffith et al. 2019).

4.1.2.3. TRANSMISSION

Other than the ingestion of contaminated food, the other less common transmission of this pathogen to humans can occur by direct contact with infected animal (either clinical or sub-clinical infection). In the United States, *Salmonella* infection in humans is often attained as a result of the ingestion of poorly

cooked contaminated poultry, beef, and eggs as compared to the ingestion of pork or by direct exposure with pigs (Griffith et al. 2019).

4.1.2.4. SYMPTOMS

Salmonellosis is generally followed by a self-limiting gastroenteritis and exhibits clinical signs such as fever, diarrhea and abdominal pain. Mortality in this case is rare and incubation period ranges between 4-72 hours (Antunes et al. 2016).

4.1.2.5. DIAGNOSIS

Different diagnostic procedures for the identification of this pathogen include serological and molecular techniques. However, blood culture method is primarily used for diagnostic purpose, although it is slow and not that much sensitive (MacFadden et al. 2016).

4.1.2.6. TREATMENT

This infection can be treated with different drugs which include cephalosporins and fluoroquinolones (ciprofloxacin) (Antunes et al. 2016).

4.1.3. CRYPTOSPORIDIOSIS

Cryptosporidium species are popular parasites of wild vertebrates, domestic animals and humans. Cryptosporidiosis has been considered as a zoonotic infection for some time as *Cryptosporidium* species have wide range of hosts (Xiao and Feng 2008).

4.1.3.1. ETIOLOGY

Among *Cryptosporidium* spp., *Cryptosporidium parvum* seems to be a major zoonotic agent (Dorny et al. 2009).

4.1.3.2. EPIDEMIOLOGY

In US, the incidence rate of cryptosporidiosis is higher in mid-western states. The case-control studies demonstrated that contact with cattle was a risk factor for cryptosporidiosis in humans in the United Kingdom, United States, Australia and Ireland (Xiao and Feng 2008).

4.1.3.3. TRANSMISSION

The oocysts are transmitted through fecal-oral path. In humans, direct transmission occurs from human to human or from animals to humans. Indirect transmission can occur through consumption of contaminated food or water. The management and prevention is only possible through profound knowledge of the transmission routes (Ryan et al. 2016).

4.1.3.4. CLINICAL SIGNS

In humans, *Cryptosporidium* is a main reason for moderate to severe diarrhea worldwide. Its infection is associated with water and foodborne outbreaks and can be zoonotic. Cryptosporidiosis in humans is

usually characterized by fever, vomiting, mal-absorption, abdominal cramps, and diarrhea which may be profuse and prolonged (Ryan et al. 2016).

4.1.3.5. DIAGNOSIS

The traditional method used to detect the presence of oocyst in feces is the examination through microscope. This can be done by wet mount and followed by staining with a specific dye (e.g. acid fast dye, fluorescence or immunofluorescence) to improve the sensitivity of detection. The oocytes stained with acid-fast stain are intermittently red having a size of about 4-6 um as well as containing crescent shaped sporozoites. Fecal culture techniques are carried out by sedimentation. Several immunological techniques have been evolved as an alternative ways for the identification and include direct fluorescent antibody, dipstick-like tests, ELISA and indirect ELISA (Pumipuntu and Piratae 2018).

4.1.3.6. TREATMENT

The most effective drug for the treatment of infected people include Nitazoxanide. Furthermore, it is the only anti-cryptosporidial drug approved by US Food and Drug Administration for the treatment of cryptosporidiosis in human beings (Pumipuntu and Piratae 2018).

4.1.4. AEROMONIASIS

Areomonas is a gram-negative bacterium in fish and its infection remains asymptomatic till weakness and environmental stress. *Aeromonas* specie is frequently present in freshwater fish (Ziarati et al. 2022).

4.1.4.1. ETIOLOGY

Fish are involved in the transmission of *Aeromonas* to humans. The species which are reported to have zoonotic potential involves *A. caviae*, *A. hydrophila*, *A. sorbia*, *A. veronii*, and *A. jandaei*. Among these, the most usual agent is *A. hydrophila* (Ziarati et al. 2022).

4.1.4.2. EPIDEMIOLOGY

Aeromonas hydrophila is commonly present in salt water, fresh water, sewage, fish tank, sludge, and water supplies. A study demonstrated that more than 50 per cent of samples of raw milk were contaminated with *Aeromonas hydrophila*. The amplification of organism may occur at the time of storage in refrigerated bulk tanks. Similarly, *A. hydrophila* has been isolated from meat, milk, poultry, fish and water. A number of workers of different countries have narrated the role of *A. hydrophila* in causing diarrhea especially in children of developing countries. The disease can occur in sporadic form and also in epidemic form. In China, *Aeromonas hydrophila* outbreak occurred during 1993. In this outbreak, 82 persons got affected, and this happened because the drinking water was contaminated with sewage. Similarly, again in China in 2012, a great foodborne outbreak involving *A. hydrophila* occurred which affected more than 200 college students (Pal 2018).

4.1.4.3. TRANSMISSION

Aeromoniasis is considered as a zoonotic disease and is caused by several species of *Aeromonas*. This infection can occur due to ingestion of contaminated water, fish and sea foods (Ahmed et al. 2018). *A.*

hydrophila has been isolated from vegetables, milk and dairy products, meat and meat products (Stratev and Odeyemi 2016).

4.1.4.4. SYMPTOMS

The clinical signs of infection involve edema to swelling at infection site. Moreover, the other symptoms in humans include gastroenteritis, respiratory infection, sepsis, bacteremia, diarrhea and urinary tract infections (Ziarati et al. 2022).

4.1.4.5. DIAGNOSIS

The diagnosis is based on the isolation of the causative agent i.e. *A. hydrophila* from clinical specimens particularly stool on microbial media (such as Pyan's medium, starch ampicillin agar and ampicillin dextrin agar). For the enrichment of the organism, it is suggested to use trypticase soy broth with ampicillin. Presently, molecular tools are available for the diagnosis of infection caused by *A. hydrophila*. For the isolation of this pathogen from the drinking water, membrane filtration technique has been used. Standard microbiological techniques should be employed to differentiate this bacterium from *Vibrio cholera*, *V. vulnificus*, and *Plesiomonas shigelloides* (Pal 2018).

4.1.4.6. TREATMENT

The persistent use of antibiotics to treat *Aeromonas* infection increases the level of antimicrobial drug resistance. Generally, *Aeromonas hydrophila* is resistant to β-lactam antibiotics. The strains of *Aeromonas* are sensitive to quinolones. Even though, rare resistance to these drugs has been reported (Stratev and Odeyemi 2016).

4.1.5. LISTERIOSIS (*LISTERIA MONOCYTOGENES* INFECTION)

L. monocytogenes causes invasive diseases in animals and humans, particularly Central Nervous System infection (Drevets and Bronze 2008).

4.1.5.1. ETIOLOGY

Listeria monocytogenes is considered a Gram positive bacterium and causes severe foodborne infection characterized by gastroenteritis, meningitis, and meningo-encepahlitis (Cossart and Toledo-Arana 2008).

4.1.5.2. EPIDEMIOLOGY

In 1980-1981, first proven foodborne outbreak appeared in Canada due to the consumption of contaminated coleslaw. In 2017 to 2018, 900 cases and 200 deaths were reported due to listeriosis outbreak in South Africa. Latest studies suggested that hospitalized patients are also susceptible of getting invasive listeriosis. Evidence from recent studies exhibited that sporadic cases of listeriosis are also foodborne (Schlech III 2019).

4.1.5.3. TRANSMISSION

Humans can get listeriosis by eating contaminated poultry meat/meat products, contact with infected birds or poultry and by means of fecal-oral route (Dhama et al. 2015).

4.1.5.4. SYMPTOMS

The implications associated with its infection include gastroenteritis, septicemia, and meningitis in immune-compromised people, elderly people and newborns/neonates having case fatality rate of 30 per cent to 40 per cent (Dhama et al. 2015).

4.1.5.5. DIAGNOSIS

Confirmatory diagnosis depends on the isolation and identification of the pathogen. Gram staining, biochemical test (such as catalase test), immunofluorescence test and DNA analysis are helpful in the identification of this bacterium. To make a confirmatory diagnosis of *Listeria* infection, combination of ELISA and PCR has been recommended to be used (Dhama et al. 2015).

4.1.5.6. TREATMENT

L. monocytogenes is susceptible to most β-lactam antibiotics except cephalosporins. The present treatment choice for all forms of *Listeria* infection is a combination of gentamicin and ampicillin. However, some studies also suggest that this therapy is harmful and not beneficial (Schlech III 2019).

4.1.6. *ESCHERICHIA COLI* INFECTION (*E. COLI* O157:H7)

Escherichia coli (*E. coli*) is a gram-negative, facultative anaerobic bacterium having rod like shape (Lim et al. 2010).

4.1.6.1. ETIOLOGY

E. coli O157:H7 is amongst the most threatening foodborne pathogens and causes abdominal pain, inflammation, diarrhea, hemorrhagic colitis, uremic syndrome and even death (Bai et al. 2022).

4.1.6.2. EPIDEMIOLOGY

In Europe, North America and other regions of the world, the infection caused by *E. coli* O157:H7 is considered as a chief public health concern. The total number of cases of this bacterium are less as compared to other enteric pathogens such as *Campylobacter* or *Salmonella* spp. Apart from this, the illness caused by *E. coli* O157:H7 indicated higher hospitalization and the fatality rates. The Centers for Disease Control and Prevention (CDC) has evaluated that, in the United States, the infections developed by this pathogen result in 73000 illnesses, 2200 hospitalizations and 60 deaths annually. The data about outbreak surveillance retrieved from CDC demonstrated that infections associated with this bacterium are declining after the peak in 1999. Despite that, substantial outbreaks and sporadic cases continue to arise (Lim et al. 2010).

4.1.6.3. TRANSMISSION

The zoonotic transmission of *E. coli* O157:H7 takes place after consumption of poorly cooked meat or improperly pasteurized dairy products or by contacting with contaminated fomites loaded with Shiga toxin entero-hemorrhagic *E. coli*. Other ways of transmission of Shiga toxin entero-hemorrhagic *E. coli* involves exposure to contaminated drinking water, lakes, swimming pools, contaminated food (such as

undercooked meat, improperly washed fruits and leafy greens), unpasteurized drinks and direct exposure to contaminated animal (Ameer et al. 2023).

4.1.6.4. SYMPTOMS

E. coli O157:H7 is an entero-hemorrhagic bacterial strain and infects alimentary tract inducing the symptoms of abdominal cramp with hemorrhagic diarrhea. *E. coli* O157:H7 infection also results in Hemolytic uremic syndrome and hemorrhagic colitis (Ameer et al. 2023). Patients suffering from hemorrhagic diarrhea are susceptible to develop major complications (Gambushe et al. 2022).

4.1.6.5. DIAGNOSIS

The early laboratory evaluation involves a complete blood count (CBC) to check out leukocytosis, thrombocytopenia, and hemolysis. The evaluation of metabolic profile will be helpful to determine the dehydration status, electrolytes imbalance and uremia. Most of the patients affected with *E. coli* O157:H7 colitis will exhibit the white blood cells count above 10,000 per microL. Initial diagnosis can be performed by making a stool culture of diarrheal sample during the early days after onset. Confirmatory diagnosis involves the testing of stool for the presence of *E. coli* O157:H7 antigens or toxin genes with polymerase chain reaction (PCR). Enzyme-linked immunosorbent assays are available commercially to detect Shiga toxin in hemorrhagic stool sample (Ameer et al. 2023).

4.1.6.6. TREATMENT

The treatment of gastrointestinal infection associated with *E. coli* O157:H7 is based on supportive care and maintaining the hydration status of the patient. Most of the entero-hemorrhagic *E. coli* patients suffering from diarrhea recover without treatment within a period of ten days other than fluid replacement. The antibiotic treatment has not a favorable effect in the prevention of complications of *E. coli* O157:H7 (Ameer et al. 2023).

4.1.7. YERSINIOSIS

Y. enterocolitica is a bacterium having zoonotic potential and causes yersiniosis (Chlebicz and Śliżewska 2018).

4.1.7.1. ETIOLOGY

Y. enterocolitica is a gram negative and non-spore forming bacterium with rod shape (Chlebicz and Śliżewska 2018).

4.1.7.2. EPIDEMIOLOGY

Infections associated with *Yersinia* are generally sporadic. While outbreaks have also been documented. Pigs act as a reservoir for *Yersinia enterocolitica* strains. In the United States, pasteurized milk and contaminated tofu were detected as the vehicle for *Yersinia enterocolitica* in outbreaks. YE comprise strains of varying pathogenicity: YE biotypes 1B and 2-5 are known as pathogenic, while biotype 1A generally thought to be non-virulent (Huovinen et al. 2010).

4.1.7.3. TRANSMISSION

Mainly, the infection is transferred by means of fecal-oral route. Consumption of pork, particularly, poorly cooked or raw pork products are causes for yersiniosis. In New Zealand and Norway, outbreaks have been reported due to the consumption of water contaminated with this bacterium. Cases of this infection have also been reported in which the infection is being transferred from an infected household pet and by means of transfused blood products (Aziz and Yelamanchili 2018).

4.1.7.4. SYMPTOMS

Most commonly, YE infection is manifested in the form gastroenteritis which is self-limiting (Huovinen et al. 2010). Major clinical signs include acute diarrhea, terminal ileitis, mesenteric adenitis, and pseudo-appendicitis. It can rarely cause sepsis (Aziz and Yelamanchili 2018).

4.1.7.5. DIAGNOSIS

Generally, cultural methods are used to isolate and detect this bacterium from food. The introduction of molecular and serological methods has refined the detection of *Y. enterocolitica* in food. These methods include ELISA, colony hybridization, IMS, PCR, microarray and LAMP methods (Gupta et al. 2015).

4.1.7.6. TREATMENT

The treatment of yersiniosis is to provide supportive care with nutritional support and hydration. The drug of choice for its treatment include trimethoprim-sulfamethoxazole or aminoglycosides. Additional effective drugs include quinolones, cephalosporins and tetracycline (not in children) (Aziz and Yelamanchili 2018). Table 1 highlights some zoonotic diseases, their pathogens and symptoms.

5. ONE HEALTH

The One Health which functions at global, regional, national and local levels is an interdisciplinary, collaborative and multi-sectoral approach. Its objective is to ensure optimal health by recognizing the connections among environment, humans, animals, and plants. This unifying and integrated approach can alleviate and prevent threats to health at the interface of the environment, humans, animals and plants. The One Health approach encourages several sectors, disciplines and communities at different levels to work together to fight against ecosystem and health threats. Its aim is to address the collective need for clean water, safe and nutritious food, energy and air, taking action on climatic change and thus contributing to sustainable development. In terms of legislation and policy, the One Health approach can be enforced to implement programs, policies and legislation through communication across several sectors working together to achieve better health (Erkyihun and Alemayehu 2022).

5.1. THE IMPORTANCE OF THE ONE HEALTH APPROACH

The One Health approach is used to carry out joint surveillance of disease, control and prevent outbreaks of zoonotic diseases, improve food safety and security, and lessen antimicrobial resistant infections to make better human and animal health. The One Health promotes strong collaboration among various sectors. The One Health approach provides strength to the disease surveillance system, diagnostic laboratory systems, and the network for early response and detection of zoonotic infections.

Table 1: Some zoonotic diseases, their pathogens, hosts and major symptoms in humans (Rahman et al. 2020)

Zoonotic Diseases	Pathogen	Hosts	Symptoms in Humans
Viral			
Ebola Hemorrhagic Fever	Ebola virus	Monkeys, apes, and gorillas	Fever, weakness, headache, muscle ache, diarrhea, vomiting, sore throat, and hemorrhage
Marburg Viral Hemorrhagic Fever	Marburg virus	Monkeys and Fruit bats	Watery diarrhea, muscle ache, hemorrhage, pain in abdomen, fever and non-itchy rash
Bacterial			
Campylobacter enteritis	*C. jejuni, C. coli*	Chicken, turkeys, cats, dogs, cattle, sheep and pigs	Enteric disorder
Campylobacter fetus infection	*C. fetus* subsp. *fetus*, *C. fetus* subsp. *testudinum*	Sheep, goats and cattle	Enteric disorder
Enterohemorrhagic *Escherichia coli* infections	*E. coli* O157:H7	Sheep, dogs, poultry, cattle, pigs	Hemolytic uremic syndrome (HUS) and enteritis
Salmonellosis	*S. bongor, S. enterica*	Birds, dogs and domestic animals	Enteritis
Vibriosis	*V. parahaemolyticus*	Farm animals	Enteritis
Parasitic			
Trichinellosis	*Trchinella* spp.	Cats, dogs, rats, pigs and other wild species	Gastrointestinal disease, pain in abdomen, nausea, vomiting, and diarrhea
Cryptosporidiosis	*Cryptosporidium parvum*	Sheep, goats, horses, deer, cattle, and pigs	Pain in abdomen, diarrhea, nausea, slight fever and malaise
Visceral larva migrans	*Baylisascaris procyonis*, *Toxocara canis*, *Toxocara cati*, and *Ascaris suum*	Cats, prairie dogs, rabbits, birds, and woodrats etc.	Gastrointestinal, abdominal pain, coughing, fever and shortness of breath

This approach works to improve the zoonotic disease prevention and control and ensures effectual and coordinated public health emergency preparedness, in which all strategies contribute to the effective reduction of zoonotic infections. Generally, the One Health approach strongly supports international health security by its efficacious multi-sectoral collaboration, coordination and information communication at the interface between relevant sectors by addressing common health threats, such as zoonoses, antimicrobial resistance, food safety and security issues (Erkyihun and Alemayehu 2022).

5.2. THE ROLE OF ONE HEALTH IN THE CONTROL OF ZOONOTIC DISEASES

Zoonotic infections are of great concern globally and there are more risks for developing countries. Brucellosis and rabies are common zoonotic illnesses and cause annual human deaths (Kheirallah et al. 2021). The One Health approach has an important role to prevent and control zoonotic diseases. The World Health Organization (WHO) has observed that about 75 % of the new emerging human infectious diseases are considered zoonotic (it means that they may be transmitted from vertebrate animals to human by natural means). During the last three decades, new and re-emerging zoonotic diseases have been evolved partly because of our close connection with companion animals, along with our growing dependence on animals including their products. The One Health approach engaging surveillance of disease, management, and eradication by the collaboration between veterinarians

(dealing with livestock and wild animal populations) ecologists (examining ecosystem biodiversity) and public health experts, may have yielded a more rapid resolution to the outbreak. The application of the One Health approach has been acknowledged as an important need by international organizations. It is also a preferred approach for addressing global health issues (Bidaisee and Macpherson 2014).

6. CONCLUSION

Different pathogens can be transmitted from animals to humans. Most of these pathogens are acquired by the consumption of contaminated food and cause severe gastrointestinal illnesses in humans. These pathogens also affect the health of animals and can also cause mortality in some cases. It is the need of the hour to adopt necessary precautions to prevent and manage these zoonotic gastrointestinal diseases. The One Health approach plays an important role in this regard and aids in the prevention and control of zoonotic diseases.

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