

Leptospirosis and One Health Perspective

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Abstract Zoonoses are primarily recognized as animal diseases that are transmitted to human beings through various routes. These diseases have a serious impact on public health as well as economy throughout the world. Leptospirosis is an emerging and re-emerging infectious zoonotic disease with global public health implications in terms of morbidity and mortality of humans and livestock. The disease can occur in sporadic as well as in epidemic forms. The source of infection is exogenous. Leptospirosis is a life threatening disease that causes 10.3 million cases and 58900 deaths each year worldwide. Rodents are considered the main reservoir of *Leptospira*. The contact of the skin with moist soil, water, and vegetation contaminated with urine of the infected animals and penetration of the organism to the skin, mucous membrane through abrasion, cut, and injury help in the transmission of the infection. Leptospirosis presents most important public health crisis that exists at the animals-humans-ecosystem interface. A strategic break in the relationship between the host-pathogen and their ecosystem could provide effective control of several possible zoonoses including leptospirosis. Global strategy to broaden interdisciplinary partnerships and coordination in all areas of health care for humans, livestock and the community is required.

Keywords: one health approach, environment, Leptospirosis, public health, Zoonosis

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1. Introduction

Zoonoses caused by varied etiologies, such as viruses, bacteria, fungi, and parasites, are significant causes of morbidity as well as mortality in humans and animals including birds [1,2,3,4,5]. Currently, over 300 zoonotic diseases are reported from developing and developed nations of the world [6]. Leptospirosis is a highly infectious zoonotic and waterborne disease that affects people all over the world [2,7,8]. *Leptospira spp.* belongs to the order *Spirochetales*. With over 260 antigenically distinct serovars, *Leptospira* organisms have been classified as pathogenic, intermediate, or saprophytic, with varying degrees of pathogenicity for animals and humans [9].

Global urbanization patterns are increasing the dissemination of neglected zoonotic infections like leptospirosis, and managing the infection in the animal reservoir is the only way to reduce the number of human cases of leptospirosis [10]. The pathogenic *Leptospira* are excreted in the urine of reservoir hosts and may lead to disease transmission either directly or indirectly by interaction with mucous membranes or penetration of another host's skin barrier. Disease is transmitted to humans either directly through animals or indirectly through polluted water or soil from an animal host [2,11]. It is an important occupational zoonosis of the agriculture

workers, butchers, veterinarians, dairy farmers, livestock handlers, sewer workers and others. Leptospirosis is a life threatening zoonotic disease, which is endemic in many countries of the world including India [8,12]. Globally, leptospirosis is responsible to cause 10.3 million cases and 58900 deaths annually [13].

Leptospirosis in humans should be diagnosed based on a combination of epidemiological and clinical evidence, with mandatory laboratory testing to validate the diagnosis [14]. Polymerase chain reaction (PCR) is a sensitive and precise approach for diagnosing *Leptospira* infection, and it has spawned a slew of techniques aimed at improving its sensitivity, specificity, and reliability [14].

For a global strategy to broaden interdisciplinary partnerships and coordination in all areas of health care for humans, livestock, and the community, close cooperation and coordination between veterinarians, occupational health doctors, and public health operators are very much needed. Leptospirosis involves rapid worldwide cooperation using a One Health solution that combines evidence from humans, wildlife, and the environment. This is crucial for designing efficient prevention mechanisms and avoiding the spread of disease [15].

Leptospirosis is a major public health problem that occurs at the animal-human-environment ecosystem interface, and is complex to geographic and host barriers. In the future, a strategic break in the relationship between the host, pathogen, and their ecosystem could provide

effective control of several possible zoonoses including leptospirosis. To avoid, monitor, and eradicate these neglected zoonotic infections, good intersectoral cooperation, and coordination between the animal and human health sectors at state, national, and international levels are highly essential [16]. This manuscript delineates the importance of One Health approach in the control leptospirosis, an enigmatic zoonosis of global public health concern.

1.1. General Overview of One Health

One Health is defined as a collective, multisectoral, and transdisciplinary approach for achieving optimal health outcomes by understanding the interconnections between humans, livestock, plants, and their common ecosystem at the local, state, national, and global levels [17]. One Health is a broad term that encompasses a variety of disciplines, occupations, and fields of concern, including animal health care, animal cruelty relief, livestock resource management, public health promotion, and medical awareness development. Since zoonoses can infect both humans and animals, it is therefore, imperative that medical and veterinary professionals should collaborate in clinical, public health, and laboratory settings [15].

One Health strategy seeks to improve global attempts to keep zoonoses and other diseases from spreading. The ability to coordinate capital across industries, as well as collaboration and intersectoral approaches across national (or international) veterinarian, environmental, and public health systems, is critical to preventing and managing a lot of neglected zoonotic diseases, such as anthrax, brucellosis, leptospirosis and others [17].

1.1.1. Veterinarian and One Health Approach

Veterinary medicine is the potential to be effective in several fields, including biomedical research, agro-terrorism, food safety and security, and public health. Veterinarians have a good knowledge of population wellbeing, comparative medicine, and preventative medicine [17].

The idea of One Health has become a rallying cry in response to our world's failing health care needs, and a lack of joint effort among our veterinary and human experts, who are focused on individualized health care ; and deeper exploration of biomedical science, has exacerbated the problem [16]. One Health approach allows veterinarians to work together with physicians, public health authorities, conservation experts, and environmental health practitioners and gain a greater understanding of diseases that impact humans and animals. Veterinarians detect, investigate, and monitor indirect zoonoses and non-zoonotic communicable diseases that impact human health in addition to controlling direct zoonotic diseases in animals [17].

The complexities of identifying resurgent infectious diseases and designing new therapeutics have placed a greater focus on handling and sustaining experimental animal colonies for the scientific and diagnostic purposes than ever before. Veterinarians are in charge of delivering these programs effectively and humanely [6,17]. The

importance of Public Health Veterinarians in all public health programmes to achieve One Health is emphasized by earlier researchers [1,18]

2. Leptospirosis and One Health Perspective

One Health is a philosophy that emphasizes the interconnectedness of human, animal, and environmental health. The interaction between humans, animals, and the environment, which include other living beings, such as plants, results in integrated health in a broad sense. The health of people is linked to the health of animals and the environment. According to the One Health approach, which is characterized as a concerted effort of multiple disciplines working locally, nationally, and globally to achieve optimal health for people, animals, and the environment [19]. Because of intensified interaction between animals and humans, as well as human encroachment into a natural habitat, leptospirosis is considered as an emerging zoonosis of global public health importance.

Human health, animal health, plant health, ecosystem health, and biodiversity must all be addressed in terms of health protection on a global scale and from a global and cross-cutting perspective. Integrated approaches to reducing leptospirosis pressure on a global scale must be pursued, based not only on sound One Health values, but also on economic facts, social equity principles, and global access to good healthcare for people and their animals and also environments [15]. Global changes are accelerated by human population growth, industrialization, and geopolitical concerns, resulting in substantial biodiversity loss, widespread habitat depletion, and the significant migratory movement of humans and other animals that leads to emerging of leptospirosis from wildlife [20].

Therefore, "One Health" initiative is a global policy that stresses the need for a comprehensive and transdisciplinary approach to coping with the health of people, livestock, and habitats that integrates multi-sector knowledge. The biology and ecology of *Leptospira*, their hosts, and their vectors all play a role in the emergence and re-emergence of the diseases [15]. A detailed understanding of ecosystem dynamics is needed, as it offers insight into the processes that contribute to the emergence or recurrence of *Leptospira*, as well as their spread and extinction in natural habitats. Understanding transmission cycles is critical from a One Health perspective, as is looking for pathways of transmission, prevention and mitigation that could be useful for potential risk conditions in the context of these neglected zoonotic diseases [20].

Due attention to public awareness and collaborative disease control strategies must be implemented in the right directions by various sectors and stake-holders and regulatory health agencies for implementing warranted interventions to effectively check the transmission and spread and to prevent the spread of leptospirosis [19].

2.1. Risk Factors

2.1.1. Wild Animals

Over the last three decades, it has become increasingly clear that the majority of the novel, emerging zoonotic infectious diseases originate in animals, especially wildlife, and that the primary drivers of their emergence are human activities, such as changes in habitats and land use, agricultural intensification, urbanization, and international travel and trade [1,2,21].

Because of the vast range of wild and domestic animal species that can serve as natural or unintended hosts, leptospirosis is a globally dispersed, re-emerging zoonosis [6,8]. Domestication of animals has assisted in the spread of infectious agents from livestock to human beings [2]. The majority of emerging infectious diseases that are considered to be important in terms of public health have a zoonotic cause [1], with wild animals accounting for nearly three-quarters of all cases [22].

Leptospirosis is a bacterial infection that affects both domestic and wild animals, as well as humans [2,23]. The natural infection has been described in buffalo, camel, cat, cattle, deer, fox, goat, horse, pig, rodent, sea-lion, and sheep [2,23]. Many wild animals serve as reservoirs for *Leptospira*. However, the true position of wildlife animals as a source of infection in livestock and humans, as well as the most significant reservoirs and leptospiral strains, is unknown. Wild animals play a different function as hosts for leptospiral strains that can infect domestic animals as well as humans. Although some studies indicate that free-living species are primary sources of infection for other species in some cases, other studies say that strains circulating in the wild animal population are unlikely to pose a disease threat to domestic animals [24].

Many wild animals could serve as reservoirs; leptospire colonize the proximal renal tubules of carrier and maintenance hosts, and the bacteria are excreted in the urine regularly. Despite this, infections in livestock are rarely lethal, with abortion being the most common clinical indication [25].

2.1.2. Environmental Factors

The degree of transmission of leptospirosis can be affected by the climate change and its related environmental changes. Several outbreaks of leptospirosis have been linked to flooding and heavy rainfall around the world. Extreme weather events, such as cyclones and floods are predicted to increase in frequency and severity as a result of global climate change, possibly leading to an increase in disease incidence and the size of leptospirosis outbreaks [26].

Warm-blooded animals, mostly mammals, are preferred by leptospire. The organism is extremely adaptable to its surroundings and can live in the water and wet soil for long periods. Weather factors that benefit disease transmission include heavy rain, floods, and high temperatures. Water sports, environmental disasters, and occupational exposure have all been related to the outbreaks of leptospirosis. Because of their ability to live in the wet conditions, leptospire pose a high risk of contamination when they come into contact with dirty water [27].

Owing to favorable climatic conditions and lower hygienic measures, the prevalence of leptospirosis in the tropical and developing countries is usually higher than in the temperate and developed countries [21]. The natural disasters including cyclones and flooding raise the prevalence of disease, and a vast number of animals serve as carriers. Sub-clinically infected animals with host-adapted serovars function as long-term carriers and persistent shedders of the bacteria, mostly by their urine. Furthermore, the soil exposure by this bacterium found in the animal excreta is a cause of the infection for humans, making the farm workers, animal handlers, livestock keepers, pet owners, and occupational workers at risk of the infection [23,28].

3. Conclusion and Recommendations

One Health approach consists three tiers that incorporate human, animal and environment. The risk of zoonoses rises from time to time in the environment as a result of the behavioral and demographic shifts in response to human needs. The consequences of neglected zoonoses are not limited to human and animal health risks; social consequences are also important. It is emphasized that better coordination and cooperation between veterinarians, physicians, and public health officials are highly imperative. The impact of zoonoses grows with time, and the severity of the health crisis in humans and animals grows exponentially.

Therefore, based on the above conclusions the following recommendations are forwarded:

- Health institutions, government agencies, medical, environmental industry, and veterinary care all need to work together more closely to achieve the target of One Health.
- Knowledge and public awareness should be created on the economic and health significance of leptospirosis.
- Further research should be conducted into zoonotic importance, detection, and potential prevention and control strategies.

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Contribution of Authors

All the authors contributed equally. They read the final version, and approved it for the publication.

Conflict of Interest

The authors declare that they do not have conflict of interest.

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