

Vector-borne Zoonotic Diseases in Turkey: Rising Threats on Public Health

Türkiye’de Vektörlerle Bulaşan Zoonotik Hastalıklar: Halk Sağlığına Yönelik Artan Tehditler

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ABSTRACT

Vector-borne zoonotic diseases (VBZDs) are a major problem for public health and animal welfare all over the world. In recent years, there has been an alarming increase in VBZDs, mainly caused by new or re-emerging arboviruses, bacteria and parasites. The World Health Organization enumerated 10 threats to global health for 2019, notably emphasizing climate change and emerging pathogens as growing priorities. It is important to review potential threats and develop new control programs for rising threats against human health and safety. Changes in host and vector population diversity and density may affect pathogen transmission patterns and influence VBZD emergence processes. In addition to environmental and climate-related changes, human and animal migratory patterns pose future threats. The geographic location and habitat features of Turkey support the establishment of many arthropod species as vectors of various diseases. To date, a total of 107 zoonotic infections have been reported originating from Turkey. Arthropods transmit 19 of 107 such infections, including 2 mosquito-borne, 9 tick-borne, 1 sandfly-borne, 3 flea-borne, 1 simuliid-borne, 1 mite-borne and 2 fly-borne diseases. In this review, we focus on the present status of knowledge on VBZDs as a rising threat to public health in Turkey to provide a foundation for future control efforts.

Keywords: Vectors, zoonoses, vector-borne diseases, Turkey

ÖZ

Vektörlerle bulaşan zoonotik hastalıklar (VBZD), tüm dünyada halk sağlığı ve hayvan refahı açısından önemli bir sorundur. Son yıllarda, yeni veya yeniden ortaya çıkan arbovirüs, bakteri ve parazitlerin neden olduğu VBZD olgularında endişe verici bir artış görülmektedir. Dünya Sağlık Örgütü, özellikle iklim değişikliğini ve emerging patojenleri öne çıkararak, 2019 yılında küresel sağlık için 10 farklı tehdit belirlemiştir. Sağlık ve güvenlik açısından, artan tehditlere karşı potansiyel tehditleri gözden geçirmek ve yeni kontrol programları geliştirmek oldukça önemlidir. Konak ve vektör popülasyon çeşitliliği ve yoğunluğundaki değişiklikler, patojenlerin bulaşma dinamiklerini ve VBZD'nin oluşum süreçlerini etkileyebilmektedir. Çevresel ve iklim değişikliklerinin yanı sıra, insan ve hayvan hareketleri de gelecek için tehdit oluşturmaktadır. Türkiye, coğrafi konumu ve habitat özelliği nedeniyle çeşitli hastalıkların vektörlüğünü yapan birçok arthropodun barındığı bir ülkedir. Bugüne kadar, Türkiye’den toplam 107 zoonotik enfeksiyon rapor edilmiştir. Bu 107 enfeksiyonun 19’unu (ikisini sivrisinekler, dokuzunu keneler, birini tatarcıklar, üçünü pireler, birini simuliidler, birini akarlar, ikisini sinekler) arthropodlar nakletmektedir. Bu derlemede, gelecekteki kontrol mücadelelerine temel oluşturmak amacıyla, Türkiye’de halk sağlığı için artan bir tehdit olan VBZD’lerin güncel durumu hakkında bilgi verilmiştir.

Anahtar Kelimeler: Vektörler, zoonozlar, vektörlerle bulaşan hastalıklar, Türkiye



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INTRODUCTION

The geographic location of Turkey plays an important role as a natural bridge between Europe and Caucasus, Asia, Africa. Besides its economic significance, this geographic location also impacts the epidemiology of several zoonotic diseases for public health of regional significance (1,2).

Zoonotic diseases have gained increasing importance for public health with many of the most important ones involving wildlife and arthropod vectors, collectively called vector-borne and zoonotic diseases (VBZD) (3). VBZDs are caused by multifarious viruses, bacteria and parasites (4), that are transmitted by blood feeding insects, ticks as well as snails. Environmental changes (urbanization, etc), extreme natural events (tropical cyclones, flood, earthquakes, tsunami, etc), human factors (immigration and travels, international trades, etc), and climate change are among the factors favoring the potential emergence of new VBZDs or reemergence of old foes (5). Changes in global climate and habitat suitability influence the expansion and distribution of vector arthropods and enable otherwise geographically restricted pathogens to be transmitted to susceptible animals and humans living in new territories (6). The reproductive biology, behavioral activities, and population dynamics of the arthropod vectors, as well as development of pathogens in arthropod vectors are also affected by varying climatic factors, such as humidity, temperature, soil and vegetation status, among others. It is important to document and predict the potential effects of these changes on the interactions among pathogens and their hosts, including wild and domestic animals, and humans. Collectively, better understanding of these drivers and their effects on disease transmission are important for the development of appeasement strategies and will enable timely and effective responses for VBZD control (6,7).

In Turkey, a total of 107 zoonotic infections (37 bacterial, 13 fungal, 29 viral, 28 parasitic) have been reported to date (Table 1). Among these, 19 are transmitted by arthropod vectors (Figure 1) (2,8). Furthermore, 21 of these zoonotic diseases are considered high priority in Europe and listed by the experts of Discontools (2).

Here, we review the current knowledge on the most important VBZDs for public health safety in Turkey (Table 1). This knowledge can provide a foundation for future studies that are aimed to design new preventive and control strategies that can benefit not only Turkey but also the larger region.

Mosquito-borne Zoonotic Diseases

Arguably, mosquitoes are involved in the transmission of the most devastating diseases to humans and animals. Among the mosquito transmitted zoonotic diseases, *Dirofilariasis* and West Nile virus (WNV) are of significance in Turkey. The species *Dirofilaria immitis* affects pulmonary arteries of dogs and cats and is the most prevalent parasite in human infections. Canine dirofilariasis is widespread in Turkey with prevalence rates reported as 0.2-30.0% (9-11). Molecular methods have determined *Aedes vexans* within the Culicidae family to be the main vector species responsible for *D. immitis* transmission in Kayseri region of Turkey (12). Some human cases were also reported as orbital dirofilariasis (13-15), premaseteric (16) and foot nodules (17).

WNV is a flavivirus (family Flaviviridae), affecting birds, humans and horses, and is maintained in a mosquito-bird transmission

cycle, with humans and horses considered dead-end hosts. Although most cases are asymptomatic, nearly 20% of infected humans become symptomatic (18). The first WNV outbreak in Turkey was reported as in 2010 with 47 cases diagnosed between 2010-2011, and international notification was mandated for the first time (19). WNV cases have been reported from several regions of the country with *Culex pipiens* mosquitoes being the primary vector responsible for transmission (2). The serologic prevalence rates were reported as 1-16% in humans (20) and 1-38% in domestic animals (21,22). Recent molecular epidemiological studies have detected WNV in horses in Central Anatolia region (23).

Tick-borne Zoonotic Diseases

In Turkey, ticks are prominent vectors involved in the transmission of VBZDs, including Babesiosis, Anaplasmosis, Ehrlichiosis, Crimean-Congo hemorrhagic fever (CCHF), Louping-ill, Lyme borreliosis (LB), Tularemia, Q-fever, and Dermatophilosis.

Babesiosis is the first described disease involving ixodid ticks in the *Ixodes* genus in Turkey. The infection is highly prevalent in domestic animals throughout the country and has a major significance for cattle industry, while no clinical cases have been reported in humans to date (8). However, serological analyses in humans have indicated seropositivity rates for *Babesia microti*, *B. divergens*, and *B. bovis* as 6.23% (24), 8% (25), and 18% (26), respectively.

Anaplasmosis is caused by obligate and intracytoplasmic bacteria in the order Rickettsiales. *Anaplasma phagocytophilum* is responsible for human granulocytic anaplasmosis and has been reported from farm animals (27) and humans (28) in Turkey. Furthermore, *A. phagocytophilum* was detected in *Ixodes ricinus* ticks obtained from humans (29). In addition, several bovine anaplasmosis outbreaks were reported from cattle (30-32), and an infection caused by *A. platys* was determined in a dog (33).

Ehrlichia chaffeensis is the most important species for human monocytotropic ehrlichiosis (HME), while *E. canis* is the major agent causing canine monocytotropic ehrlichiosis (CME), all being transmitted by ixodid ticks. Globally, HME cases have been on the rise reaching 3.4 per million in 2010 (34). In Turkey, studies on CME are limited to a few reports that describe seropositivity (35), clinical cases and treatment (36), and molecular prevalence (37,38), while there are no reports about HME. Based on serological studies reported from different provinces of Turkey, *E. canis* prevalence rates range from 4.8% to 41.5%, while no *E. ewingii* or *E. chaffeensis* cases have been recorded. The first clinical canine ehrlichiosis case was reported in Aydin province (33) and a molecular study from Kayseri region reported *E. canis* prevalence to be 15% (37).

CCHF, caused by a Nairovirus in Bunyaviridae, is a reemerging tick-borne infection transmitted by either ixodid tick species (mainly by *Hyalomma marginatum*), or by direct contact with blood or tissues belonging to viremic patients or animals. CCHF has caused outbreaks especially in Turkey, Russia, Iran, Pakistan, and Afghanistan in the past two decades (39). In Turkey, CCHF first emerged in Tokat province of the Black Sea Region in 2002 and has subsequently spread throughout the country (40,41). An increase in CCHF cases was observed especially in 2008 and 2009. Since 2002, a total of 9,787 cases have been reported until 2015 (2,8,42) with 469 cases resulting in death in humans (4.79%).

Louping ill virus (LIV) is another tick-borne pathogen (genus

Table 1. Vector-borne zoonotic diseases, causative agents, hosts, and vectors in Turkey

Diseases	Pathogens	Hosts	Vectors	References
Anaplasmosis (human granulocytic anaplasmosis)	<i>Anaplasma phagocytophilum</i>	Ruminants, canines, horses, humans	Ixodid ticks (particularly <i>Ixodes</i> spp.)	(31)
Anthrax	<i>Bacillus anthracis</i>	Mammals, humans	Biting flies (<i>Hippobosca</i> spp., <i>Tabanus</i> spp., <i>Stomoxys calcitrans</i>) and non-biting flies (<i>Musca domestica</i> , <i>Calliphoridae</i> flies)	(88,89)
Babesiosis	<i>Babesia microti</i> , <i>B. divergens</i> , <i>B. bovis</i>	Humans, many animals	Ixodid ticks	(24-26)
Bartonellosis	<i>Bartonella</i> spp.	Humans, felids, canids, lagomorphs, rodents	Phlebotomine sand flies, lice, ticks, fleas	(77)
Crimean-Congo hemorrhagic fever	Nairovirus, CCHF virus	Wild and domestic animals, humans	Ixodid ticks (mainly <i>Hyalomma marginatum</i>)	(1)
Dermatophilosis	<i>Dermatophilus congolensis</i>	Horses, dogs, cats, ruminants, humans	Biting insects (particularly flies and ticks)	(66,67)
Dirofilariasis	<i>Dirofilaria</i> spp.	Dogs, humans	Mosquitoes	(11)
Ehrlichiosis (human and canine monocytotropic ehrlichiosis)	<i>Ehrlichia chaffeensis</i> , <i>E. ewingii</i> , <i>E. canis</i>	Dogs, humans	Ixodid ticks	(37,38)
Leishmaniasis	<i>Leishmania</i> spp.	Humans and several animals	Phlebotomine sand flies	(8,71)
Louping ill	<i>Flavivirus</i> , <i>LIV virus</i>	Sheep, cattle, horses, humans	Ixodid ticks (particularly <i>Ixodes ricinus</i>)	(1)
Lyme disease (lyme borreliosis)	<i>Borrelia burgdorferi</i>	Humans, domestic animals	Ixodid ticks (particularly <i>Ixodes</i> spp.)	(46,56)
Murine typhus	<i>Rickettsia typhi</i>	Rodents, humans	Fleas	(78)
Onchocerciasis	<i>Onchocerca</i> spp.	Humans and several animals	Black flies (<i>Simulium</i> spp.)	(82)
Plague (black death)	<i>Yersinia pestis</i>	Rodents, humans	Fleas (particularly <i>Xenopsylla</i> spp.)	(73)
Q Fever	<i>Coxiella burnetii</i>	Domestic animals	Ixodid and argasid ticks	(64)
Rickettsialpox	<i>Rickettsia akari</i>	Rodents, humans	Liponyssoides sanguineus (mouse mite)	(83)
Thelaziasis	<i>Thelazia</i> spp.	Humans, dogs and other canids, cattle, horses	Muscid flies (particularly <i>Musca</i> spp. and <i>Fannia</i> spp.)	(85,86)
Tularemia	<i>Francisella tularensis</i>	Humans, rabbits, hares, rodents	Ticks, mosquitoes, and some other arthropods	(60,61)
West Nile	Flavivirus, WN virus	Birds, horses, humans	Mosquitoes	(8)

CCHF: Crimean-Congo hemorrhagic fever, WN: West Nile, LIV: Louping ill virus

Flavivirus and family Flaviviridae) affecting mainly sheep but also cattle, horses, and humans. The main vector of LIV is *Ixodes ricinus* (43). The LIV was reported from different European countries, as well as from the northwestern part of Turkey (44). While there are no reports of human LIV infections in Turkey, an acute encephalomyelitis case was detected in sheep caused by the Louping ill/Russian Spring Summer virus complex. This virus was afterwards defined as Turkish sheep encephalitis virus and abbreviated as TTE80 strain. Thereafter, TTE80 strain was also described as a subgroup in tick-borne viruses of the family Flaviviridae by antigenic, pathogenic and molecular analyses (44). LB caused by *Borrelia burgdorferi* affects dogs and humans and is

mainly transmitted by ticks in the *Ixodes* genus (45). *Bor. burgdorferi* was first identified in *I. ricinus* ticks collected from cattle in the Black Sea region in 1998 (46). In addition, a novel *Borrelia* sp. was isolated from *Hyalomma aegyptium* samples obtained from tortoises (47), and the spirochete was entitled as *Bor. turcica* sp. nov (48). A clinical lyme case was detected in a dog in 2007 (49), and anti-*Bor. burgdorferi* antibodies were also determined in dogs and horses (50). Few reports on LB cases in humans have been documented (51-54). However, the seropositivity rate was reported as 17% in people in Central Anatolia region (55), and 20% of patients (n=50) reported symptoms compatible with LB Erciyes University Hospital in the Kayseri province (56). In the



Figure 1. Vector-borne zoonotic diseases in Turkey

Marmara region, three LB cases have been confirmed serologically (54). Meanwhile, *Bor. burgdorferi* was also isolated from questing *I. ricinus* ticks sampled from parks and rural areas in the Thrace region of Turkey (57). In the same region, another similar field study was performed on ticks collected from tortoises and *Rickettsia* spp. and *Bor. burgdorferi* s.l. were molecularly detected (58). In addition, *Bor. burgdorferi* sensu stricto was found in unusual tick species, such as *H. excavatum*, *H. marginatum* and *Haemaphysalis parva* (59). Epidemiologically, these results reveal that Turkey has a high-risk potential for zoonotic LB.

Tularemia is caused by the gram-negative bacterium *Francisella tularensis* and ticks are the biological vectors of the agent. Tularemia is widespread in the northern hemisphere (60,61) and is endemic in Turkey. The first tularemia epidemic in Turkey was recorded in 1936 in Thrace region followed by two outbreaks in 1945 and 1953 from Thrace and southern regions. A total of 507 cases were reported between 1988-2004. Tularemia was instated in the list of nationally notifiable diseases in 2005, and approximately 4824 cases have been recorded between 2005 and 2011. Despite the many human tularemia cases that have been reported, no *F. tularensis* was detected in ticks in a comprehensive study conducted in Kayseri region by molecular techniques (60,61).

Q fever, which is endemic in Turkey, is an acute zoonotic infection caused by the obligate gram-negative bacterium *Coxiella burnetii*. Ixodid and argasid ticks can play a role as vectors (62). Some domestic animals (cows, sheep, goats, and dogs) have been reported as the reservoir of *C. burnetii*, and *Ornithodoros lahorensis* ticks are implicated in disease transmission in Turkey (2). However, human cases are relatively rare (63). A study on *C. burnetii* seropositivity in the Black Sea region in women with a history of abortion versus women with healthy births reported 15.6% and 11.1%, respectively (64).

The skin disease Dermatophilosis, caused by the gram-positive actinomycete *Dermatophilus congolensis*, is transmitted by biting insects, particularly flies and ticks, via the mechanical transmission route (65). The disease affecting domestic and wild

animals is of economic significance for wool production from sheep in many parts of the world. In Turkey, several cases of dermatophilosis in animals (66), and humans have been reported (67).

Sandfly-borne Diseases

Leishmaniasis is caused by parasitic *Leishmania* species that are transmitted by phlebotomine sandflies. Several animals and humans have been found as natural reservoir hosts of *Leishmania* species. The infection mostly occurs in three forms: visceral leishmaniasis (VL), cutaneous (CL), and mucocutaneous leishmaniasis. Although VL, also known as kala-azar, is fatal if remained untreated, CL causes skin lesion that can heal spontaneously (68). Zoonotic visceral leishmaniasis is endemic and caused by *Leishmania infantum* in the Aegean and Mediterranean regions of Turkey, usually observed in infants consistent with Mediterranean type. *Leishmania* isolates obtained from humans and dogs in various regions were described as *L. infantum* MON-1 and MON-98 with multilocus enzyme electrophoresis assay (8). *Leishmania tropica* and *L. infantum* are the responsible etiological agents for CL leishmaniasis (CL) in Turkey, especially prevalent in southeastern, eastern regions (8). Recently, *L. major* and *L. donovani* were also identified as causative agents of CL in different regions (69). According to the official Ministry of Health records, 46,003 CL cases were reported between 1990 and 2010. Among those cases, 96% of them were reported from Sanliurfa, Adana, Osmaniye, Hatay, Diyarbakir, Icel and Kahramanmaraş provinces. The recent migrations from Syria where the disease is highly prevalent increased the relevance of CL as a public health threat in Turkey (8). In a study performed to demonstrate the effects of Syrian civil war on the epidemiology of CL in the Gaziantep province in southeast part of Turkey, a total of 567 people were hospitalized with the suspicion of CL, and 263 (46.4%) were found positive by parasitological examination (70). Overall, 174 (66.1%), 88 (33.5%), and 1 (0.4%) of the positive patients belonged to Turkish, Syrians, and Afghan ethnicity, respectively. *Leishmania tropica* was determined as the etiological agent in most of the cases, while only a few cases were caused by *L. infantum* (70). Canine Leishmaniasis (CanL) in dogs and wild canids is another serious form of the infection and has veterinary importance. The most common form of CanL is viscerocutaneous leishmaniasis caused by *L. infantum*. CanL is especially prevalent in Mediterranean and Aegean regions of Turkey. After 1993, the epidemiological studies were carried out in 22 different provinces and the prevalence ratios were found between 1.45% and 27.5%. The overall prevalence of CanL was detected as 11.32% in Turkey (71).

Flea-borne Diseases

Plague (Black Death) is a fatal VBZD of rodents and humans caused by the gram-negative bacterium, *Yersinia pestis* and transmitted by infected fleas. The disease was the deadliest epidemic infection in the human history with very high mortality. From 2010 to 2015, there were 3,248 cases reported worldwide, including 584 deaths according to the World Health Organization (WHO) (72). In Turkey, the last reported cases included 32 patients from Akcakale, a town located on the Turkish-Syrian border, in 1947 (73).

Bartonellosis is caused by gramnegative bacteria, *Bartonella* species transmitted by various arthropod vectors, including

sand flies, lice, ticks, and fleas. Natural hosts are humans, felids, canids, lagomorphs, and rodents. Humans are the only known reservoir hosts for *B. bacilliformis* and *Bar. quintana*. Cat scratch disease caused by *Bar. henselae* is transmitted by bites or scratches of infected cats to human (74). In Turkey, *Bar. henselae* seropositivities were reported as 7.9-41% in cats (75) and 6-22% in humans (76) while seropositivity for *Bar. vinsonii subsp. berkhoffii* was 6.6% in dogs (77).

Murine typhus (endemic typhus) caused by *Rickettsia typhi* (previously known as *R. mooseri*) is mainly transmitted by fleas from rodents to people. Most of the cases have been recorded from Southeast Asia, the Mediterranean region, and the United States with only two clinical murine typhus cases reported in Istanbul to date (78).

Simuliid-borne Diseases

Onchocerciasis is caused by the filarial worms *Onchocerca* spp. and transmitted by *Simulium* flies. Globally, there are at least 120 million people at risk for onchocerciasis caused by *O. volvulus* worldwide, of which 96% live in Africa. According to the WHO, 6.5 million people who have the disease suffer from dermatologic manifestations and 270,000 are blind (79). In Turkey, the first human case with *O. caecutienuis* was reported in 1976 (80). In addition, an ocular human onchocercosis with *O. lupi* was reported by molecular analyses from Edirne region (81). The prevalence of bovine onchocercosis with *O. armillata* is 86% (82). In the past decade, a simuliid outbreak occurred in Central Kizilirmak Basin and the potential risk of onchocerciasis was revealed with a detailed molecular analyze of vector Simuliid flies in Kayseri region (8).

Mite-borne Diseases

Rickettsialpox is caused by *Rickettsia akari* transmitted by the mouse mite *Liponyssoides sanguineus* from rodents to humans. Rickettsialpox was firstly described in New York City in USA and then reported from Europe, Asia, Africa, and South America. Currently, rickettsialpox is not a notifiable disease. A clinical human rickettsialpox case was identified in a 9-year-old boy in Nevşehir region in Turkey (83).

Fly-borne Other Diseases

Thelaziasis is a dipteran-borne disease caused by parasitic eyeworms of the genus *Thelazia* transmitted primarily by muscid flies in the genera *Musca* and *Fannia*. *Thelazia callipaeda*, *T. californiensis* and *T. gulosa* have been reported in humans, dogs and cats. However, *T. rhodesii* infecting cattle is the most pathogenic species (84). In Turkey, bovine thelaziasis with *T. rhodesii* was reported as 5.5-22.0% in cattle (8,85) and 1.2% in buffalo (86).

Anthrax is an ancient and zoonotic infection in humans and animals caused by gram-positive bacteria, *Bacillus anthracis*. Biting flies (*Hippobosca* spp., *Tabanus* spp., *Stomoxys calcitrans*) and non-biting flies (*Musca domestica*, *Calliphoridae* flies) were demonstrated experimentally to transmit anthrax by several researchers (87). In Turkey, 464 animal cases were reported from Eastern part of the country between 1992 and 2004 (88). A total of 26,954 human anthrax cases were recorded by the Turkish Ministry of Health between 1960-2005, of which 6,861 were reported between 1990 and 2005 (89). Although the incidence of human anthrax is decreasing in Turkey, regional outbreaks are still reported with

the great majority of cases being of the CL form (90). Recently, an animal anthrax case was reported from two pumas which died at the zoo in Kayseri province of Turkey in 2017 (2).

CONCLUSION

In this review, we summarized the present state of knowledge on VBZDs in Turkey. To date, 107 zoonotic bacterial, viral, parasitic and fungal diseases have been identified as rising threats for public health in Turkey, and almost one-fifth of these diseases are transmitted by arthropod vectors. Turkey is considered to be of medium-risk for climate change effects, but weather and climate-related extreme events have already been increasing in many regions in Turkey. These extreme conditions constitute new ecological habitats for vectors, with significance for epidemiological implications for distribution of VBZDs. Recent examples of VBZDs, such as leishmaniasis, Crimean-Congo haemorrhagic fever and West Nile, have been observed in regions of the country where these diseases were previously undetected. Currently, climate change is one of the priorities in sustainable development goals for Turkey as a member of the sixth global environment outlook assessment for the Pan-European region (91). In Turkey, a national program for mitigating the negative impacts of climate change on health have been prepared to protect the people from the adverse health effects to be caused by climate change in Turkey by Ministry of Health (92).

For controlling VBZDs and reducing the risks for emergence, a broad multidisciplinary network that includes the target public, clinicians, veterinarians and public health officials is essential following the One Health approach. This network can enhance awareness of the risk factors among all parties and oversee the implementation of the most appropriate strategies to manage and prevent vector-borne zoonotic infections. In accordance with the One Health concept, the development of advanced research projects for controlling VBZDs by expert researchers from all related scientific disciplines should also be a top priority. In addition, international cooperation and regional collaborations are very important for the prevention and control of the VBZDs and should be encouraged. We recommend that all responsible persons should carry out routine surveys not only in the endemic regions, but also in vector and pathogen free areas to determine the potential risk of the emergence of vectors and associated pathogens through human and animal mobility. Furthermore, we also suggest that a regional program utilizing the One Health Concept that considers an inter-disciplinary approach could be imperative to combat zoonotic infections as well as newly emerged fatal coronavirus pandemic, especially across country borders. In this regard, Turkey could provide leadership to bring together the necessary agencies and appropriate researchers under the auspices of international organizations to help shape a global policy for VBZD control in the middle-east region.

Recently, an administrative and political decision was taken, and "Turkey Zoonotic Diseases National Committee" was established by Ministry of Health in Turkey in 2019. This committee is tasked to prepare "Turkey Zoonotic Diseases Action Plan 2019-2023". Among the future objectives of this action plan are to raise public awareness about zoonotic diseases and prevention, to conduct risk analysis and to detect the threats, to develop and ensure the effectiveness of zoonotic disease diagnosis laboratories throughout the country, and to keep the treatment of diseases updated.

*** Ethics**

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*** Authorship Contributions**

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