Overview of Zoonotic Diseases in Turkey: The One Health Concept and Future Threats -3

Viral Zoonotic Diseases in Turkey Globally, a total of 95 zoonotic viruses have been identified and listed under the entitled “spillover and pandemic properties of zoonotic viruses with high host plasticity” and their general transmission categories were also grouped (248). Several zoonotic viruses that are transmitted to humans by direct or indirect route cause severe infections in Turkey (Table 1) as well as globally. These infections were categorized according to their clinical manifestations and epidemiological characteristics, as indicated by Venkatesan et al. (249) into groups (i) encephalitis, (ii) rash and arthralgia, (iii) hemorrhagic fever, (iv) emerging, (v) re-emerging (vi), rare zoonotic, and (vii) potential zoonotic viral infections. The specific diagnosis of these infections generally involve virologic tests, such as virus neutralization test, complement fixation and hemagglutination-inhibition, enzyme-linked immunosorbent assays; further analysis is required for molecular detection and characterization of the causative viruses (250, 251). Vaccines are not available for the majority of these diseases. However, recent advances and intense investigations toward the development of new generation vaccines are encouraging for the future of control programs against viral infections. Currently, some measures, such as prophylactic and therapeutic, are available for the control of limited number of viral infections, whereas the implementation of vector control programs are basically required for most of viral diseases. Encephalitis group zoonotic viruses are RNA viruses of the Rhabdoviridae, Flaviviridae, Togoviridae, Reoviridae, and Bunyaviridae families and are transmitted to humans by mosquitoes and ticks, except rabies virus in Rhabdoviridae family, which is transmitted by the bite of an infected host. The symptoms of viral encephalitis are associated with clinical manifestations of neurological disorders, headache, fatigue, aches in muscles, fever, vomiting, double vision, confusion, and agitation or hallucinations. The reported viral zoonotic infections with encephalitis manifestation in Turkey are shown in Table 1. Rabies is a lethal form of encephalitis caused by the Rabies lyssavirus belonging to the genus Lyssavirusvirus of the Rhabdoviridae family. The disease is still effective and has great zoonotic importance in Turkey. Confirmed 39 cases of human rabies were reported by the Ministry of Health in a 15-year period between 1992 and 2007. Of the cases, 29 (74%) were related to dog bites, while the others were closely connected with wild animals (252). Tick-Borne Encephalitis (TBE) is an important infection of humans caused by the tick-borne meningoencephalitis virus belonging to the genus Flavivirus in the family Flaviviridae. The infection is prevalent in a large endemic area of Asia and Europe, including Turkey. In Turkey, the seropositivity of the infection was reported in the range 1.4%-20.5% (10). West Nile Virus (WNV) is an infection that has a worldwide distribution. The infection is mainly transmitted by mosquitoes. The virus has been isolated from several mosquito species. Especially Culex species have found to be infected with the virus. In 2010, the first outbreak of WNV infection, including 12 laboratory-confirmed and 35 suspected cases, were identified in Turkey. The patients were from different provinces, mainly located in the western part of the country (253). In Turkey, the seropositivity of the infection was reported in the range 1%-16% in humans, while 1%-37.7% in domestic animals (35, 254). Rashes and arthralgia group viruses consist of a few viruses that belong to Alphavirus in Togaviridae family. Rashes and arthralgia are clinically seen in the virus-infected patients. In Turkey, the reported viral zoonotic infections causing rash and arthralgia are presented in Table 1. Chikungunya virus (CHIKV) infection is a mosquito-borne zoonotic disease with rashes and arthralgia characteristics caused by CHIKV belonging to the genus Alphavirus of the Togoviridae family. The infection is prevalent in Africa and Asia. However, in Ankara, a case of CHIKV infection was diagnosed in a 55-yearold Turkish woman who had lived in India, New-Delhi, for 3 years (255). More recently, Alphavirus was also found by molecular assays in pools of mosquitoes collected from the Thrace region of Turkey (256). Hemorrhagic fever group zoonotic viruses consist of 16 pathogens that belong to Arenaviridae, Bunyaviridae, Flaviridae, and Filoviridae families, causing infections generally associated with extensive bleeding. Most of viruses in this group are transmitted by vector arthropods, such as mosquitoes and ticks. In Turkey, the reported hemorrhagic fever viruses are shown in Table 1. Crimean-Congo Hemorrhagic Fever (CCHF) is a tick-borne zoonotic contagious disease caused by a virus belonging genus Nairovirus in Bunyaviridae family, which is transmitted by tick species of the Ixodidae family. Wild and livestock animals serve as amplifiers of the CCHF virus in field conditions. The infection occurs in a large area of sub-Saharan Africa, Eastern Europe, Russia, the Middle East and western China. In Turkey, it was reported that the infection was first observed in 2002 in the Black Sea region and then spread to the rest of the country (10, 257). Dengue fever (DENF) is a zoonotic infection caused by DENF virus (DEN-1, DEN-2, DEN-3, and DEN-4 serotypes) belonging to genus Flavivirus of the Flaviviridae family. The infection is transmitted to humans by Aedes aegypti mosquitoes and occurs worldwide. In Turkey, a case of DENF virus was diagnosed in a 40-year-old patient who has visited India and the virus was identified as DEN-3 serotype (258). Emerging group zoonotic viruses: An emerging disease means previously unknown and newly identified infectious agent that causes public and animal health problems either locally or globally. This group has serious potential threats for human health with economic impacts, and their current trends have been going upwards. Thus, these viruses have been defined as “a zoonosis that is newly recognized or newly evolved or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range” by the WHO/ Food and Agriculture Organization of the United Nations (FAO)/ World Organization for Animal Health (OIE) in Geneva (259). The last 30 years have seen a significant increase in emerging viral diseases in humans, and almost 70% of the infections were categorized as zoonotic infections (2, 260). The major source of emerging zoonotic viruses is increasing wildlife, particularly bats which play important epidemiologic roles for some viruses, such as Hendra and Nipah, SARS, and MERS virus. Toward the investigation of these viruses and to prevent current diseases (or possible infections), the One Health approach has been developed. In this scope, it was reported that a horse vaccine also called “One Health Vaccine” can be used to prevent the transmission of Hendra virus from horse to human (261). In Turkey, the reported emerging zoonotic viruses are shown in Table 1. Middle East Respiratory Syndrome Coronavirus (MERS-CoV) is a zoonotic infectious disease caused by a virus belonging to genus Betacoronovirus in the subfamily Coronovirinae of the Coronaviridae family, and MERS-CoV was isolated from bats. Infected patients with MERS-CoV commonly have fever, cough and shortness of breath as clinical symptoms, and in most of the cases, gastrointestinal symptoms, such as diarrhea, have also reported. There is no vaccine or medication that protects against MERS-CoV (243), and close dromedary camel contact is a major risk for human infection (262). In 2015, 971 laboratory-confirmed cases of human infection with MERS-CoV were reported to WHO, including at least 356 deaths. Most of these cases have been reported from several Middle East countries including Turkey (263). Avian Influenza (H5N1) is a zoonotic infection caused by viruses adapted to birds that serve as a natural reservoir for the infection. Although influenza A is adapted to birds, it can also stably adapt and sustain person-to person transmission. The transmission of the infection is mainly by contact between infected and healthy birds, although it can also be spread indirectly through contaminated equipment. The virus can be found in the secretions and droppings of the infected birds. A highly pathogenic infection is spread to people often through direct contact with infected poultry, such as during slaughter or plucking. The infection occurs as global avian influenza pandemics and cause big economic losses (261). The infection is also prevalent in Turkey, and its economic impact was reported at almost 7.5 million US dollars/per day and total loss was expressed as over 231 million US Dollars for 2 months in 2006 (264). A total of 625 patients with suspected H5N1 virus infection were treated at the University Hospital between 2005 and 2006 in the Van province, and eight of them were diagnosed as H5N1 positive. At the same period, additional four confirmed cases of H5N1 were reported from different areas of Turkey, including the Black Sea region and central, southeast, and eastern Anatolia (265). Swine Influenza is a highly contagious respiratory zoonotic viral infection caused by influenza A viruses of the Orthomyxoviridae family. The most common subtypes of influenza virus in swine are H1N1, H1N2, and H3N2. The disease in swine occurs within a herd either as an epizootic or enzootic form, which infect the respiratory tract of pigs and result in a barking cough, decreased appetite, nasal secretions, and listless behavior; the virus can be transmitted to humans. Swine flu viruses may mutate so that they are easily transmissible among humans. Swine flu is transmitted from person to person by inhalation or ingestion of droplets containing virus from sneezing or coughing. In Turkey, a study was conducted to investigate the seroprevalence following the first wave of pandemic influenza A (H1N1) in 2009, the pandemic H1N1 seropositivity was found to be 24.1% for Ankara and 27.7% for Diyarbakir (266). Hemorrhagic Fever with Renal Syndrome (HFRS) virus is a group of clinically similar diseases caused by various viruses, such as Hantaan, Dobrava, Saaremaa, Seoul, and Puumala, belonging to genus Hantavirus in Bunyaviridae family. HFRS comprises several diseases, such as Korean hemorrhagic fever, epidemic hemorrhagic fever, and nephropathia epidemica. Rodents are reservoirs for Hantaviruses, and humans can become infected by direct contact with infected rodents. Although individual transmission is possible, it is extremely rare. HFRS occurs commonly in a large area of Asia, Southeast Asia, and Europe (261). An outbreak of HFRS with 23 confirmed cases was reported as an emerging disease from Zonguldak and Bartin provinces in the Northwest part of Turkey in 2009 (267, 268). Hepatitis E is a liver disease caused by hepatitis E virus, which is a small RNA virus with at least 4 genotypes. The transmission of the disease is possible by the fecal-oral route, principally via contaminated water. Hepatitis E virus occurs worldwide, although the prevalence is highest in East and South Asia (261). In Turkey, limited epidemiological studies on hepatitis virus have been conducted in children in various provinces. The seropositivity of hepatitis E virus was 2.1% in Ankara of Central Anatolia (269), 12.4% in the Denizli province of the Agean region (270), and 4.2% in the Van province of Eastern Anatolia (271). Parainfluenza viruses (PIVs) belong to the Paramyxoviridae family and have 5 subtypes, such as Parainfluenza 1, 2, 3, 4a, and 4b. Nosocomial infections are also common, particularly among young infants. Human parainfluenza viruses (hPIVs) can be transferred through direct person-to-person contact (with infected secretions) and via respiratory droplets (261). In Turkey, outbreaks were reported in children in the Izmir province between 2000 and 2005, and Parainfluenza type 3 was isolated from 96 of the 178 (53.9%) viral specimens (272). In another study, the seropositivity of Parainfluenza 3 was found to be 18% in 15 dairy cattle farms in East and Southeast Anatolia regions of Turkey (273). Re-emerging group zoonotic viruses: Re-emerging infectious diseases include infectious agent that had fallen to such low levels that it was no longer considered a danger for public and animal health problem, but became reactive again and showed an upward trend in the incidence or prevalence in humans and animals both locally and worldwide. Re-emerging zoonotic viral infections can emerge when viruses expand their host range (for example monkey poxvirus and equine morbillivirus) or the disease can be a result of intrinsic properties of the virus itself, such as high mutation rate (ie, influenza A virus and foot and mouth disease [FMD] virus) (274). Most re-emerging viral zoononeses involve infections with hemorrhagic and neuropathological viruses that are arthropod-borne (yellow fever virus; Zika virus) (275), by rodents (Hanta virus), or by nosocomial infections (Ebola virus). The re-emergence and increase of these group of infections are also a consequence of anthropogenic environmental changes, such as distortion of the ecological balance and major agricultural changes (276). Additionally, complex interactions among ecology, socioeconomic and demographic structures, health care, and human/animal behaviors also affect the re-emergence of zoonotic viral disease (249). The reported re-emerging viral zoonotic infections from Turkey are listed in Table 1. Orf virus infection or Ecthyma contagiosum is one of the re-emerging zoonotic viral infections caused by a virus belonging to genus Parapoxvirus (PPV) in Chordopoxvirus subfamily of the Poxviridae family. The Orf virus often affects different hosts, such as wild and domesticated cattle, sheep, goats, and humans. The disease is transmitted to humans by direct or indirect contact with the infected material. The first case of Orf in humans was clinically manifested as solitary skin lesion in 1934 (277). In Turkey, the Orf virus infection has reemerged during the last two decades, and case reports and Orf outbreaks related to Orf in both animals and humans are available (278, 279). The human case of Orf virus infection with a pyoderma-like lesion on the left indicator finger was diagnosed in a 37-year-old man in 2011 in Ankara, and the virus was molecularly characterized (280). Later another case of Orf virus infection with similar manifestations on the right hand thumb was reported from a child (281). Rare Viral Zoonotic Infections group: Various viral infections, which originate from animal pathogens, can sometimes cause nonspecific febrile illness in humans. The transmission of these diseases are commonly possible by contact with infected animal (FMD particularly serotype O, buffalo pox), by handling of such organisms in laboratory conditions (bluetongue and Newcastle disease), by sexual contact (simian immune deficiency virus), by bite or scratch (monkey B virus), via vectors (semliki forest virus, African horse sickness, and louping ill [LI]), or through food or water (caliciviruses, such as swine vesicular exanthema, feline calicivirus, and rabbit hemorrhagic disease virus). Recently, it was reported that animal rotaviruses and the Eyach virus cause mild infections in humans (249). The reported rare viral zoonotic infections in Turkey are listed in Table 1. African Horse Sickness (AHS) is a vector-borne and non-contagious disease of equids caused by the African horse sickness virus belonging to the genus Orbivirus within the Reoviridae family. The virus is transmitted to the hosts Culicoides species (282). The disease occurs in a large area of Africa, Asia, and Middle East region and has been reported in Europe (Iberian Peninsula). The infection was seen in a limited period between 1959 and 1966 in Turkey (283). Bluetongue (BTV) is an insect-borne and non-contagious viral infection of ruminants caused by the Bluetongue virus (BTV) belonging to the genus Orbivirus of the Reoviridae family. The infection has a global distribution between latitudes of approximately 40–50°N and 35°S in Africa, Europe, Middle East, and the Mediterranean regions, Indian subcontinent, the Americas, and Asia (284). The global distribution and nature of BTV infection has changed significantly in recent years, and climate change, particularly global warming has been implicated as a potential cause of this dramatic event. BTV pandemics with devastating economic impact on the cattle industry have been especially seen due to the populations of different new Palearctic vectors, such as Culicoides chiopterus, C. dewulffi, C. obsoletus, C. scotius, and C. pulcaris, expanding their range in some parts of Europe (285). It was reported that BTV infection is a prevalent disease with almost 30% seropositivity among the herds of sheep, goats, and cattle in many parts of Turkey (286), but zoonotic transmission of the infection has not been recorded in the country until today. Borna Disease (BD) is a viral infection with neurological and psychiatric syndromes of animals and humans caused by BD viruses (BDV) 1 and 2 of the Bornaviridae family. BDVs have a wide host range and have been determined in some domesticated animals, such as horses, sheep, cattle, dogs, and cats as well as wild life. The transmission of these viruses is probably via intranasal exposure to contaminated saliva or nasal secretions (287). A correlation between BDV infection in animals and humans was demonstrated via autopsy in human brains (288). In Turkey, antibodies to BDV were first detected in the sera of 82 of 323 (25%) clinically healthy horses in the Marmara region (289). Recently, the seropositivity of the infection in the distinct regions of Turkey was reported as 4.9% in horse, 12% in sheep, 4% in goats, 14% in cattle, and 6.6% in cats (290). There is no official report on the cases of human BDV infection in Turkey. Feline Calicivirus (FCV) infection is a widespread respiratory disease of cats caused by a virus of the genus Vesivirus of Caliciviridae family. Cats can be infected after coming into con tact with other infected cats in shelters. The disease can occur in cats of any age, but younger kittens under 6 weeks are most susceptible (291). In Istanbul, Turkey, FCV was detected in 17 of 220 (8%) cats that had clinical oral lesions (292). There is no official report related to FCV infections in humans in Turkey. Foot and Mouth Disease is a widespread and most contagious and notifiable disease of cattle, water buffalo, sheep, goats, and pigs caused by a virus (seven serotypes: O, A, C, SAT1, SAT2, SAT3, and Asia1) belonging to the genus Aphthovirus of the Picornaviridae family. The infection can be very rapidly spread among animals by aerosols of infected animals and contaminated equipment. The disease occurs worldwide as outbreaks and can occasionally be fatal and cause huge economic losses (293). Rare cases of human FMD may be observed due to close contact with infected animals. The highest risk to European Union countries is through legal and illegal imports of infected live animals and contaminated meat or dairy products from infected countries that are consumed by animals. International travelers bringing back food from endemic countries could also spread the disease. The FMDV can survive for long periods in a range of fresh, partially cooked, cured, and smoked meats and in inadequately pasteurized dairy products (294). The control program requires a close collaboration among veterinary office, health service, and local authorities. The control measures of FMD depend on restricting the movement of farm animals in the endemic region and immunization with vaccines in a vaccination regime. Several outbreaks of FMD have been reported in Turkey (295, 296). The official FMD status of Turkey has been shown in the list of OIE (297). Louping Ill is a tick-borne infection of sheep and goats caused by the LI virus (LIV) belonging to the genus Flavivirus of the Flaviviridae family. The LIV characteristically causes encephalomyelitis of sheep. The epidemiological occurrence of the disease is closely related to the distribution of its primary vector tick Ixodes ricinus (298). The disease has been reported from various European countries, including England, Norway, Greece, and Bulgaria, as well as Turkey (10). There is no report human LIV infection cases in Turkey. Newcastle Disease (ND) is a widespread, contagious, and notifiable infection of aves caused by a virulent strain of paramyxovirus type 1 (APMV-1) belonging to the genus Avulavirus of the Paramyxoviridae family. The transmission of the disease is possible by direct contact with affected birds and inhalation or ingestion of contaminated material. The virus survives in the environment, especially in the feces. It is an essential requirement for workers and staff to wear gloves, mask, and coveralls and to use of disinfected equipment and supplies to minimize the potential risk of zoonotic transmission of the disease. The infection occurs worldwide and causes devastating economic losses in the poultry sector (299). In Turkey, a total of 549 cases of ND in poultry have been reported from various regions between 2007 and 2014 (300). There is no report on the cases of human ND in Turkey. Cowpox (CPX) is presently a rare zoonotic viral infection caused by Cowpox virus belonging to the genus Orthopoxvirus of the Poxviridae family. The zoonotic transferal of the infection is first seen in milkers, who touch the udders of infected cows. The infection is mostly restricted to small mammals rather than cattle (301). The transmission of the disease from pet rats to humans has also been observed in four different cases in France (302). It was reported that cases of cowpox are seen in European countries and also in Eurasia including Turkey (303). Pseudocowpox virus (PCPV) Infection is a zoonotic viral skin disease caused by PCPV belonging to Parapoxvirus within the Chordopoxvirinae subfamily of the Poxviridae family. The virus is widespread worldwide and is transmitted to humans by direct contact with infected cows. The infection affects particularly milkers and farm workers. Clinically, the mild sores can be seen on udders and teats of the infected cows, and on hands of the infected milkers. Most recently, the isolation and identification of Pseudocowpox virus was performed from an infected Angus bull with lesions on the surface of the penis in Idaho, USA (304). In Turkey, PCPV was first isolated and characterized both from an infected cow and from a milker in a farm near the Milas district of Mugla (305). Bovine papular stomatitis (BPS) is a zoonotic infection caused by Bovine popular stomatitis virus (BPSV) belonging to the genus Parapoxvirus of the Poxviridae family, and occurs worldwide in cattle. The infection has occupational zoonotic spreading among farmers, veterinarians, and butchers. The zoonotic transmission of the infection is through direct or indirect contact with infected animals (306). BPS virus infection is clinically seen with erosive lesions on the muzzle, lips, hard palate, oral mucosa, tongue, and esophagus in infected calves. In human, BPSV infection is often associated with nodules and pustules on the hands and rarely on the face (307). In Turkey, an outbreak of BPSV infection has been reported in a dairy herd in the town of Tire near Izmir (308). Rotavirus diseases are epidemiologically important viral zoonotic infections for public health, particularly in children as well in calves and foals. Rotavirus infections are characterized by acute watery dehydrating diarrhea in various hosts, including birds and mammals. The infections are caused by different types of viruses belonging to the genus Rotavirus within the Reoviridae family. Rotaviruses are enteric pathogens that cause a large number of child deaths each year in developing countries, and rotavirus infections are mainly acquired by the fecaloral route, including fomites and person-to-person contact with contaminated objects (309). However, the cases of Rotavirus-associated enteritis are most frequently seen in calves and in foals, and to combat against Rotavirus infections, vaccines are available for infants and children (310, 311). In Turkey, a study was conducted to investigate the etiology of diarrhea cases between September 2004 and December 2005. At the end of the study, the prevalence of Rotavirus was determined as 39.7%, and the serotype G1P of Rotaviruses was also found as dominant (312). Norovirus infection is a very contagious disease caused by the Norwalk virus belonging to the genus Norovirus of the Caliciviridae family. Humans can be infected via different ways, such as contaminated food or water, or by touching contaminated surfaces, or by contact with an infected person who has norovirus illness, or by fecal-oral, or through aerosol route. The infection leads to acute gastroenteritis characterized by nausea, vomiting, watery diarrhea, and abdominal pain (313). In Turkey, norovirus was found positive in samples of mussels in the Izmir city of the Agean region (314) and in some samples of ready-toeat food items in Istanbul of the Marmara region (315). Additionally, a large multipathogenic gastroenteritis outbreak was reported from Erzurum located in the Eastern part of the country in 2012, and etiologic agents of the outbreak were identified as astrovirus, norovirus, Shigella sonnei, and E. coli (316). In contrast, bovine norovirus was detected through molecular techniques in calves (317). Astrovirus infection is caused by a type virus belonging to the genera Astrovirus and Mamastrovirus in the family Astroviridae. The main mode of astrovirus transmission is by contaminated food and water, and it cause gastroenteritis in humans, particularly in children and the elderly individuals (318). In Turkey, astrovirus was identified as an agent in large multipathogenic outbreak, which was seen in Erzurum in 2012 (316). Potential zoonotic viral infections group Expansions of human interest in nature damages the ecological balance among animal–human ecosystems. The emergence of zoonotic diseases due to changes in animal/human host interface is considered e a major threat for public health (319). The trend of increasing zoonotic virus emergence is expected to continue (259). In this scope, the foamy retroviruses of bovine, feline, and equine can be given as examples of potential viral zoonotic disease transmission to humans (319, 320). Moreover, a novel tick-borne phlebovirus with zoonotic potential was isolated from ticks in Australia and shown to be closely related to two other newly discovered zoonotic phleboviruses Severe Fever with Thrombocytopenia Syndrome Virus and Hunter Island Group Virus, which were responsible for severe disease and deaths in humans in four separate countries from Asia and North America (321). However, the zoonotic status of Lumpy Skin Disease (LSD) virus is still controversial. LSD was propounded as “potential for zoonotic spread to humans” (322), whereas the disease was shown as “not zoonose” in the list of EFSA (323, 324). The potential zoonotic viral diseases in Turkey are given in Table 1. Hepaciviruses belong to the genus Hepacivirus in Flaviviridae family, and include hepatitis C and hepatitis GB virus B (HCV and GBV-B) types. Humans serve as natural hosts for these viruses. HCV is transmitted by infected blood transfusion between humans. HCV was also identified in domestic cattle from Germany (325). However, the zoonotic transmission of Hepaciviruses was investigated using Hepacivirus NS3/4A proteases (interfere with mitochondrial antiviral-signaling protein [MAVS] signaling) in both cognate animal hosts and humans. Human MAVS was found as susceptible to cleavage by these non-human viral proteases, indicating that it does not pose a barrier for zoonotic transmission to humans (326). In Turkey, the seropositivity of HCV was detected as 1.5% in sera collected from 1374 people who live in five distinct regions of the country (327). Phlebovirus contains known disease agents of animals, including humans, that can be carried by different vectors (eg, phlebotomine sandflies, mosquitoes, and ticks) (328). Four serotypes of phleboviruses, sand fly Sicilian virus, sand fly Cyprus virus, sand fly Naples virus, and Toscana virus have been circulating in the Mediterranean Basin including Turkey (21). Lumpy Skin Disease (LSD) is a pox disease of the cattle characterized with nodules on the skin and transmitted mechanically via blood-feeding arthropods, including some hard ticks. Rhipicephalus (Boophilus) decoloratus, Rhi. appendiculatus, and Amblyomma hebraeum ticks serve trasmitters in the epidemiology of LSD in the endemic areas (329). An LSD outbreak was first recognized in cattle associated with the nodular clinical symptoms in August 2013 in Turkey (330). In the following months, the infection has spread countrywide, and a total of 3504 LSD cases were recorded between August 2013 and December 2014 (331). Recently, an LSD outbreak with huge economic devastation has been reported by official government veterinarians in May and June of 2016 in the Aegean region of Turkey, and more than 500 cattle infected with LSD virus have been culled for the control of the disease (10).