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Risk analysis of lumpy skin disease in Turkey

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ABSTRACT

Lumpy Skin Disease (LSD) in Turkish cattle appeared suddenly two years ago. This study evaluates potential risks of LSD and recommends appropriate control measures. The World Animal Health Organization's protocol was used for the risk analysis. Likelihoods for disease release and exposure were estimated with a qualitative scale ranging from negligible to high. Outbreaks were recorded in nine provinces in Turkey. Total economic loss due to the disease was estimated to be $241.903.500 US dollars. The risk analysis suggests a greater than negligible risk. Therefore, disease prevention and control strategies should be considered by the Turkish Veterinary Authority.

Key words: Cattle, Lumpy skin disease, Risk analysis, Spread of bovine disease.

INTRODUCTION

LSD is an acute or unapparent cattle disease caused by lumpy skin disease virus (LSDV). The virus is of the genus Capripoxvirus in the subfamily Chordopoxvirinae and family Poxviridae (Buller *et al.*, 2005). LSD is associated with significant production losses and defined as a notifiable disease by the World Organization for Animal Health (OIE, 2010).

OIE categorises LSD as notifiable because of the substantial economic impact of an outbreak. The disease is more severe in cows during peak lactation and causes a sharp drop in milk yield, often leading to secondary bacterial mastitis. Temporary or permanent infertility may occur in cows and bulls. The emaciation of infected animals and a convalescence period lasting for several months causes a decreased growth rate in beef cattle (Brenner, 2006; Tuppurainen and Oura, 2012). The morbidity and mortality of the disease vary considerably, depending on the breed, immunological status of the cattle population, and the insect vectors involved in transmission, but morbidity rates are generally between 1% and 20% (Radostits *et al*,. 2007; Vorster and Mapham, 2008).

The global livestock sector is highly dynamic. It accounts for 40% of the global value of agricultural output and supports the livelihoods and food security of almost a billion people (Thornton, 2010). Restrictions on the global trade of live animals and their products, costly controls, eradication measures such as vaccination campaigns, and indirect costs due to compulsory limitations in animal movements cause significant financial losses on a national level (Rich and Perry, 2011; Tuppurainen and Oura, 2012). Many potential routes of LSD transmission have been identified, namely animal movements (Alemayehu *et al.*, 2013).

Our goal was to assess the epidemiology of LSD, its transmission mechanisms, and the potential role of risk factors. Qualitative estimates of the risk, spatial variation in risk, and the factors associated with the risk of LSD introduction and spread into animal markets are a prerequisite for developing specific policies to prevent or control epidemics. The first reports of LSD in Turkey were in mid-2013, but its epidemiological status and risk are poorly understood. A risk assessment of LSD in Turkey in particularly is needed. The aim of this study was to assess the risk of introducing LSD in animal movements and in the animal market.

MATERIALS AND METHODS

Study area and population: The study was conducted in nine different provinces in Turkey (Adana, Osmaniye, Hatay, Kahramanmaras, Adýyaman, Malatya, Sivas, Batman, and Hakkari). Information on LSD outbreaks, farms, and cattle movements were obtained from the animal registration system (MoFAL, 2014) and OIE. The study design included active disease follow-up and semi-structured interviews (SSI) from August 2013 to August 2014 in selected provinces. Data for the risk assessment parameters were obtained from secondary data, interviews with 354 farms owners, and personal field observations.

Methods of risk assessment: This study used the risk analysis recommended by the OIE (2004). It outlines four key steps that should be covered systematically. In this risk assessment, the hazard is defined as LSD. The probabilities were assessed and described.

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Release and exposure assessment: The risk question for release was, "What is the probability of cattle LSD being introduced to the animal market?" A scenario tree was designed to describe and evaluate the pathway of LSD beginning with illegal animal entry along the southeast national border. Scenario trees contain nodes that describe events from which event probabilities were derived; these probabilities were qualified according to the aforementioned terms. The overall probability of a release pathway was arrived at by combining the probabilities of the various stages. The same approach was used for exposure based on the question, "What is the probability cattle will be exposed to LSD?"

Consequence assessments: Farms with reported outbreaks were observed by a veterinarian and any suspected cases of LSD were examined. Direct economic losses were calculated based on mortality and the rate of destroyed or slaughtered animals due to LSD. Total economic losses were estimated as: , where

PAR=Total number of cattle at risk of infection in and around these provinces during an outbreak, P=Average cattle price, and AR=Average death rate (Mortality + Destroyed + Slaughtered).

Risk estimation and management: The risk estimate for LSD was made according to the OIE prosedure. The consequence estimate was based on the biological and economic impact of LSD in the herds. The movement of infected cattle, cattle products, or contaminated items is an significant vector. As these movements take place within established chains, the question is how to proceed with risk management. Knowledge of the usual patterns of movement of cattle, products, materials, people, and vehicles can be combined with risk analysis to better understand how LSD could spread.

Data management and analysis: Data were stored in a Microsoft Excel spread sheet and then transferred to an R dataset. Statistical analyses were performed using R version 3.1.2 (R Development Core Team, 2014). Data were screened for errors. Mismatches were re-checked and corrected where possible.

RESULTS AND DISCUSSION

Release assessment

Possibility 1: Probability of a farm being infected: In the nine infected provinces, the disease was present in 624 of 187.199 farms, an exposure rate of 0.33%. According to the probability chart, there was a medium risk of a farm being infected. In the Osmaniye province, the disease occurred in 289 of 15.451 farms, an exposure rate of 1%. This constitutes a high risk.

Possibility 2: Probability of an infected animal at a farm: In 2013–2014, 860 of 131.708 cattle were infected in 624 farms in nine provinces, so the disease frequency was 0.65%. The highest outbreak rate of 28.57% was reported in the Hakkari province, but LSD spread to two of seven susceptible cattle so the result may be misleading. The lowest outbreak rate, 0.14%, was reported in the Sivas province. Consequently, for the P2 possibility, there was a medium risk of an animal being infected. If only the outbreaks in 2013 are considered, LSD infected 438 of 11.331 susceptible cattle and the spread of the disease was 3.86%. This corresponds to high risk.

Possibility 3: Not detecting LSD in non-certified and infected cattle: LSD's incubation period in natural outbreaks is estimated to be 1–4 weeks (Tuppurainen and Oura, 2012). All ages and types of cattle are vulnerable (Radostits *et al*., 2007; Vorster and Mapham, 2008). According to semi-structured interviews, the likelihood of an infected animal without symptoms in the animal market chain is high. Veterinarians performed pre-purchase inspection and selection for quality assurance and certification for live cattle. Cattle were not subjected to tests before they were moved to farms. About 73.4% of interviewed farm owners tend to buy animals in groups, which increases the probability of an infected animal passing undetected. The first outbreak on May 8th, 2014 was likely associated with the illegal movement of infected animals to the country (FAO, 2013). An additional 87 outbreaks were reported over the next nine months, 70% of which were in the first four months of 2014. This shows that the disease can spread to non-infected areas easily. It spread to nine province in nine months, meaning additional outbreaks are possible despite precautions taken by the veterinary service authority. Considering the incubation period varies from 1 to 4 weeks, infected animals without symptoms can be easily introduced to market. Hence the risk is high that an infected animal is introduced to the market.

Possibility 4: Introducing the disease to non-infected provinces through animal movement: Due to animal movements from neighbouring infected provinces, the following provinces have a high risk of infection: Kayseri, Düzce, Kirsehir, Izmir, Konya and Gaziantep. Kayseri province borders three infected provinces (Sivas, Kahramanmaraþ, and Adana) and Gaziantep borders four infected provinces (Adiyaman, Kahramanmaras, Osmaniye, and Hatay). Additionally, provinces such as Izmir, Sanliurfa, Kirklareli, and Diyarbakir and their neighbouring provinces are under high risk. Hence there is a high risk of disease outbreak in non-infected areas. Depending on specific risk factors, the probability of an outbreak may be medium or high (Table 1).

Exposure assessment

Risk pathway 1: Probability of cattle being exposure to LSDV from seasonal migration: The transmission of LSDV is believed to occur mainly by blood-feeding arthropods (Yeruham *et al*., 1995; Chihota *et al*., 2001; EFSA , 2006).

Table 1: Summary of release and exposure assessment for LSD for cattle in Turkey

Risk pathway (release assessment)	Risk category
Possibility 1: probability of a farm being infected	Medium–High
Possibility 2: probability of an infected animal at a farm	Medium–High
Possibility 3: not detecting LSD in non-certified and infected cattle	High
Possibility 4: introducing the disease to non-infected provinces through animal movement	High
Overall risk estimate for release	High
Risk pathway (exposure assessment)	
Risk pathway 1: Probability of cattle being exposure to LSDV from seasonal migration	High
Risk pathway 2: probability of exposing cattle to LSD from veterinary equipment	Medium
Overall risk estimate for exposure	High

In addition, the Tigris and Euphrates rivers in Iraq have a potential to be hot spots for vector transmission. There is village-based sedentary pastoralism and pastoralism with vertical and horizontal movements. Movements may take the form of local transhumance, normal movement (cattle are based in the villages of the plain and ascend the mountain pastures in summer), or reverse movement (cattle are based in mountain villages and come down during the winter to lowland pastures). Movements may also include regional or interregional trips, sometimes with double migration (cattle based in villages in the foothills descend to lowland pastures in winter and climb to mountain pastures in summer). Transhumance is carried out by semi-nomads or nomads on foot, truck, or a mixture of both (Thevenin, 2011). The likelihood of exposing cattle to LSDV from seasonal migration is considered to be high (Fig.1).

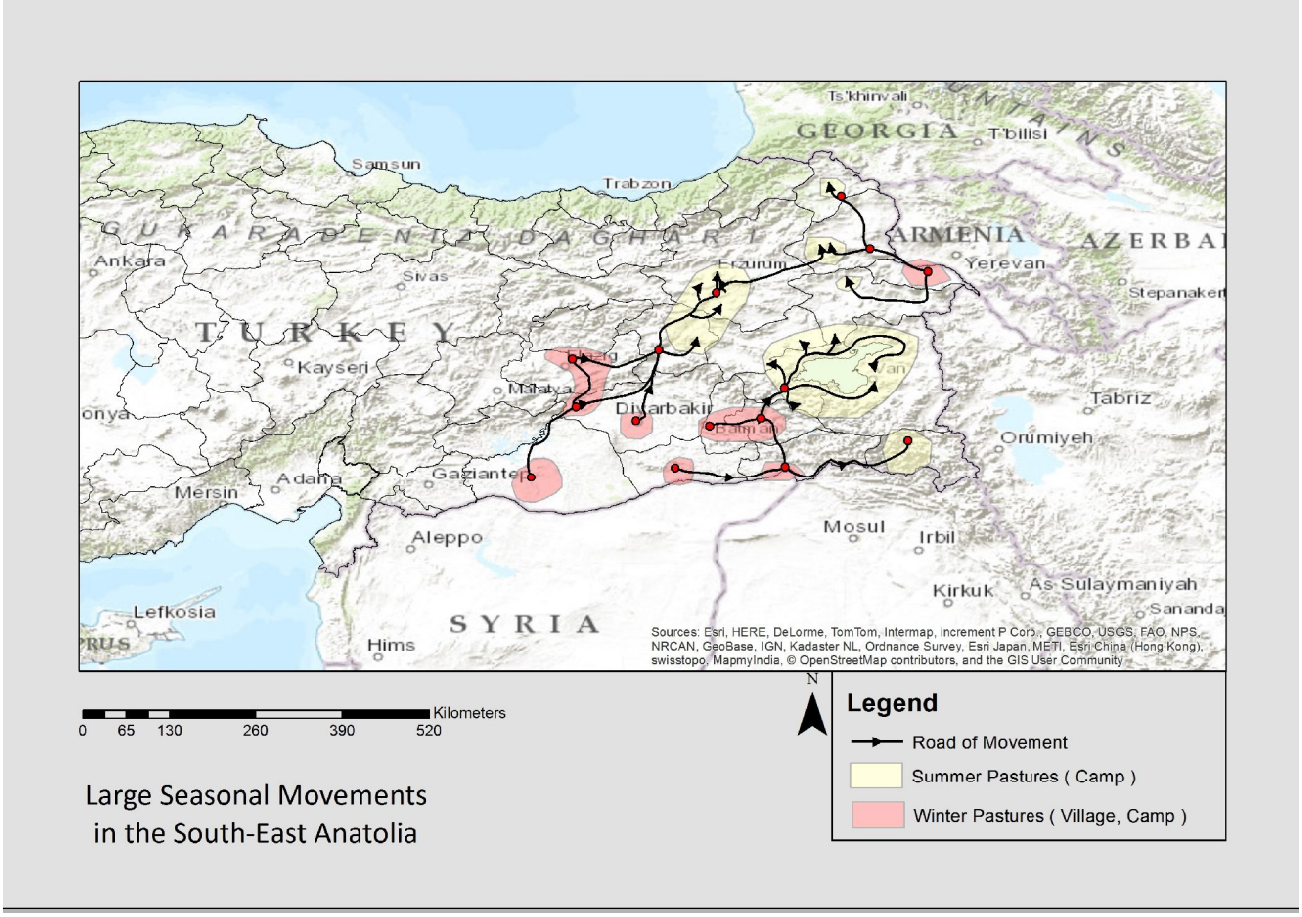

Fig 1: Large Seasonal Movements inthe South- East Anatolia

Risk pathway 2: Probability of exposing cattle to LSD from veterinary equipment: SSIs indicated that 75% of farm owners receive consulting agriculture services (TARGEL) from mobile drovers and veterinarians who may use contaminated equipment. LSDV is remarkably stable and survives for long periods at ambient temperatures, especially in dried scabs (Rovid, 2008). Without proper needle hygiene, LSDV may spread during vaccination (Magori-Cohen *et al.*, 2012; Tuppurainen and Oura, 2012). At most farms, equipment was not disinfected. The likelihood of LSDV exposure from traveling veterinarians is therefore considered to be medium.

The risk estimates for all the exposure pathways are presented in Table 1. The probabilities in the pathways are high. The overall risk estimate for exposure is thus high. Exposure of LSDV to cattle occurs very often.

Consequence assessment: Of the 88 total outbreaks, 85 outbreaks of these (95.6%) occurred in seven provinces: Kahramanmaras, Malatya, Sivas, Adiyaman, Osmaniye, Hatay, and Adana. Three outbreaks (3.5%) occurred in two provinces: Batman and Hakkari. In 2013, there were 18 outbreaks (24.5%) and in 2014, 70 outbreaks (79.5%). Outbreaks were concentrated in three provinces: Osmaniye, Adana, and Kahramanmara^{o}, with 45 (51.14%), 23 (26.14%), and 9 (10.23%), respectively. As mentioned above, 0.33% of farms were infected, in which there were 1,269,976 susceptible cattle. In these farms, 860 susceptible cattle out of 131,708 were infected (PR=0.65%) and 249 cattle died (MR=0.19%), for a case fatality rate (CFR) of 28.95%.

Direct economic loss was estimated from the average rate of LSD (0.28%) and at-risk cattle (511.675). Terminal market surveys indicated that an average animal of 400 kg was sold for an average of $1.500 US dollars (4.035,000 Turkish Lira). Hence the total economic loss from LSD outbreaks was estimated to be $214.903.500 US dollars.

Risk estimation and management: Risk assessment revealed a high likelihood of introducing LSD to farms from infected cattle in the animal market. The likelihood of infection as a consequence of exposure is also considered to be high. Therefore, the probability of LSD in farms from release and exposure is also high. The probability of an LSD in non-infected areas is medium and high. It is important that measures are taken to decrease risk of further infection. Recommended precautions for infected areas are:

- Strict quarantines to prevent the introduction of infected cattle to non-infected herds
- Isolate and destroy sick animals
- Adequately dispose of infected and dead animals
- Disinfection and hygiene (buildings, tools, equipment, etc.)
- Vector controls for farms, animal markets, and during animal movements

Recommended precautions for non-infected areas are:

- Increase controls that regulate animal movement
- Raise awareness
- Improve means of tracking disease symptoms in the field
- Improve laboratories' ability to diagnose the disease
- Implement an early warning system and national rapid reporting system

Risk analyses is comparatively new and since agreement on sanitary and phytosanitary measures, discipline in the animal and veterinary public health fields has evolved significantly in recent years (OIE, 2004). Even so, it is feasible to use other risk decisions and other areas to control the animal disease (Wooldridge *et al.*, 2006; Fahrion *et al.*, 2008; FAO, 2010; FAO, 2011). In this assessment, the overall risk of LSD is considered to be high as a result of frequent exposure to LSDV during animal movement. In addition to these logical and biological arguments, the results obtained in the present study agree with previous country-specific risk assessments.

Infection might be related to animals' origin, certification in the animal market, facilities that exclude risk, farm owner's risk awareness, and biosecurity measures in farms (Coetzer, 2004; Brenner *et al.*, 2006; Gari *et al.*, 2010; Kumar, 2011; Salib and Osman, 2011. The LSD prevalence at the animal level was 0.65%, which is in agreement with the previous findings from Ethiopia of 6.1% (Alemayehu *et al.*, 2013) and 8.1% (Gari *et al.*, 2010). Mortality (1.19%) during these two years was similar to previous reports by Salib and Osman (2011) in Egyptian cattle and Alemayehu *et al.* (2013) in Ethiopia bulls.

Transhumant flocks moving along migratory routes are at especially high risk, especially during long-distance movements. Moreover, awareness-raising campaigns and training for farmers and veterinary staff in recognising the disease under field conditions should be considered, especially for regions at a higher risk of LSD begin introduced. If non-biological transmission and other transboundary animal diseases change, the risk of LSD introduction should be accordingly reassessed.

The total economic loss due to LSD death was estimated at $ 214.903.500 US dollars. The study's pathway-specific results also provide interesting information on risk management. Findings suggest possible benefits of a coordinated national program for preventing and controlling the disease. The outcomes obtained with this study can be used to inform targeted risk-management measures in Turkey by implementing preventive measures in pathways with higher risk scores.

LSD is widespread in the southern part of Turkey. It is advisable to make efforts to increase awareness and promote vaccines. The implementation of appropriate biosecurity measures in herd management could also reduce infection rates and economic losses incurred by farmers. Awareness-raising campaigns for farmers and veterinary staff to improve recognition of LSD should be considered. The cooperation of Turkey with neighbouring countries should be encouraged to prevent spread of the disease across national boundaries.

REFERENCES

Alemayehu, G., Zewde, G., Admassu, B. (2013). Risk assessments of lumpy skin diseases in Borena bull market chain and its implication for livelihoods and international trade. *Trop Anim Health Prod* **45:** 1153–1159

Brenner, J., MHaimovitz, E., Oron, Y., Stram, O., Fridgut, V., Bumbarov, L., Kuznetzova, Z., Oved, A., Waserman, S., Garazzi, S., Perl, D., Lahav, N., Edery and Yadin H. (2006). Lumpy skin disease (LSD) in a large dairy herd in Israel. *Israeli Journal of Veterinary Medicine*, **61:** 73–77

Buller, R.M., Arif, B.M., Black, D.N., Dumbell, K.R., Esposito, J.J., Lefkowitz, E.J., McFadden, G., Moss, B., Mercer, A.A., Moyer, R.W., Skinner, M.A. and Tripathy, D.N. (2005). The Eighth Report of the International Committee on Taxonomy of Viruses. Elsevier/Academic Press, London. Pp: 117–133

Chihota, C.M., Rennie, L.F., Kitching, R.P., Mellor, P.S. (2001). Mechanical transmission of lumpy skin disease virus by Aedes aegypti (Diptera: Culicidae). *Epidemiology and Infection*, **126:** 317–321

Coetzer, J.A.W. (2004). Lumpy skin disease. In: Infectious Diseases of Livestock. 2nd Ed. Coetzer, J.A.W. and RC Justin (eds). Oxford University Press, Cape Town, South Africa, pp:1268–1276, 2004

EFSA (2006). Scientific Report on Migratory Birds and their Possible Role in the Spread of Highly Pathogenic Avian Influenza, 2006

Fahrion, A., Richa, K., Jamir, L., Begum, S., Rutsa, V., Ao, S., Padmakumar, V. and Grace, D. (2008) Risk assessment in the pork meat chain in Nagaland, International Livestock Research, India. 2008

FAO (2010). Value chain analysis as a tool for avian influenza control. Situation Update 71. Rome. 2010

FAO (2011). A value chain approach to animal diseases risk management. Technical foundations and practical framework for field application. Animal Production and Health Guidelines 4, Rome, 2011.

FAO (2013). Agricultural Livelihoods and Food Security Impact Assessment and Response Plan for the Syria Crisis in the Neighbouring Countries of Egypt, Iraq, Jordan, Lebanon and Turkey. Mission assessment report, 2013

Gari, G.A., Waret-Szkuta Grosbois, V., Jacquiet, P. and Roger, F. (2010). Risk factors associated with observed clinical lumpy skin disease in Ethiopia. *Epidemiology and Infection*. **138:** 1657–1666

Kumar, S.M. (2011).. An outbreak of lumpy skin diseases in Holstein dairy herd in Oman. A clinical case report. *Asian Journal af Animals and Veterinary Advances*, **6:** 851–859

Magori-Cohen, R., Louzoun, Y., Herziger, Y., Oron, E., Arazi, A., Tuppurainen, E., Shpigel, N., Klement, E. (2012). Mathematical modelling and evaluation of the different routes of transmission of lumpy skin disease virus. *Veterinary Research*, **43:** 1-5

MoFAL.2014. Annual Animal Health Meeting (2014/03). Ministry of Food Agriculture Livestock www.tarim.gov.tr Accessed 10/11/2014

OIE (2004). Handbook on import risk analysis for animals and animal products. Vol. 1, Introduction and qualitative risk analysis. Paris,World Organisation for Animal Health, 2004

OIE (2010). Terrestrial Animal Health Code Article 14.10.2. OIE, Paris, 2010

R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available online: http://www.R-project.org, 2014

Radostits, M., Gay, C., Hinchcliff, W., Constable, D. (2007). Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats, 10th Ed. Saunders Ltd, Philadelphia, USA,1424–1426

Rich, K.M., Perry, B.D. (2011). The economic and poverty impacts of animal diseases in developing countries: new roles, new demands for economics and epidemiology. *Preventive Veterinary Medicine*, **101:** 133–147

Rovid, SA. (2008). Lumpy Skin Disease The center for food security and public health, Iowa State University. College of Veterinary Medicine. http://www.cfsph.iastate.edu. Accessed at April 2012

Salib, F.A., Osman, A.H. (2011). Incidence of lumpy skin disease among Egyptian cattle in Giza Governorate, *Egypt. Veterinary World*, **4:** 162–167

Thevenin, M. (2011). Kurdish Transhumance: Pastoral practices in South-east Turkey Pastoralism: Research, Policy and Practice **V(1):** 1-23

Thornton, P.K. 2010. Livestock production: recent trends, future prospects. *The Royal Society*, **365:** 2853-2867

Tuppurainen, E.S.M., Oura, C.A.L. (2012). Review: Lumpy skin disease: An Emerging Threat to Europe, the Middle East and Asia. *Transboundary and Emerging Diseases*, **59:** 40–48

Vorster, H., Mapham, H. (2008). Pathology of lumpyskin disease. *Livest. Hlth Prod. Rev*., 1, Jaargang, **10:** 16–21

Wooldridge, M., Hartnett, E., Cox, A., Seaman, M. (2006). Quantitative risk assessment case study: smuggled meats as disease vectors. *Revue Scientifique et Technique de l'Office International des Epizooties*, **25:** 105–117

Yeruham, I., Nir, O., Braverman, Y., Davidson, M., Grinstein, H., Haymovitch, M., Zamir, O. (1995). Spread of lumpy skin disease in Israeli dairy herds. *Veterinary Record*, **137:** 91–93