Lumpy skin disease epidemics in Europe; assessment of disease spread and vaccination effectiveness

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Lumpy skin disease (LSD) is a cattle disease caused by a capripoxvirus and characterized by fever, nodules on the skin, on the mucosal membranes and the internal organs. The disease is mainly transmitted by mechanical blood-feeding arthropod vectors like flies, mosquitoes and ticks. It can cause a reduction in milk production, sterility in bulls, abortion and damage to hides, leading to significant economic loss. Mortality can be up to 10% and presence of the disease is associated with trade restrictions. Originally affecting cattle across Africa, the disease had spread in recent years outside the African continent with outbreaks in Middle East (Israel, Jordan and Lebanon) in 2012-13, and further spread into and through Turkey in 2013, where it is now considered endemic. In 2015 the first ever European outbreaks occurred in Greece, and, subsequently, the disease quickly spread across the Balkan region with over 7000 outbreaks reported by the end of 2016.

Most transmission occurs over short distances (<5 km), but with an appreciable probability of transmission at longer distances. There is a clear seasonal variation in the force of infection associated with temperature, possibly through its influence on the relative abundance of the stable fly, *Stomoxys calcitrans*. These two results together are consistent with LSDV being transmitted by the bites of blood-feeding insects, though further work is required to incriminate specific species as vectors.

Data from the LSD epidemics in six Balkan countries (Bulgaria, Greece, Serbia, Montenegro, Former Yugoslav Republic of Macedonia (FYROM) and Albania) affected during 2016 were analyzed to determine vaccine effectiveness (VE) and risk factors for LSD infection at the farm level. Vaccination with the homologous Neethling vaccine was performed along the occurrence of the epidemics and VE and other possible risk factors were established using a mixed effects Cox proportional hazard regression model. The results indicated an average VE of 79.8% (95% CI: 73.2-84.7). Analysis of time from vaccination to development of protective immunity showed that VE mostly developed during the first 14 days after vaccination. Data from Greece showed that the vaccination adjusted hazard ratio for LSD was 5.7 higher in grazing farms compared to non-grazing farms.

The experience obtained during the control of LSD epidemics indicates that in future LSD spread can be effectively halted by vaccination, provided that appropriate surveillance plans and vigilance remains in place in the areas at risk of re-incursion, especially those bordering endemic countries.