Lumpy Skin Disease epidemics in Europe
Preventive and control measures for an effective control

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All the way from Africa.....

ASF vs LSD
Introduction

- Lumpy skin disease virus belongs to the *Capripoxvirus-genus* within the *Poxviridae*-family)
- Other members of the genus are *Sheeppox virus* and *Goatpox virus*
- LSD is characterized by fever, nodules on the skin, and it may lead to severe economic losses, especially when introduced into naive population
- Vector-borne LSD is notoriously difficult to eradicate without vaccination
- Large double-stranded DNA virus with or without an envelope
- Stable virus, survives well in the environment such as wintertime and drought
- Most disinfectants are effective but disinfection of the environment is difficult as the virus remains well protected inside scabs shed by infected animals
Substantial economic impact

- Sharp drop in milk yield and secondary mastitis, infertility and abortions, sterility in breeding bulls, reduced weight gain and permanently damaged skins and hides
- Long recovery period and **severely affected animals** may not regain the same level of production as before infection
- Restrictions to the trade of live cattle and their products - worse in those countries that export live cattle
- Costly control and eradication measures
  - Total or partial culling of infected herds and compensation to farmers
  - Large-scale vaccination campaigns
  - Active **clinical/virological/serological** surveillance post-outbreak
- Indirect costs due to the compulsory movement restrictions of cattle (vaccinated/unvaccinated) from affected regions for trade or slaughter
Clinical signs

- Incubation time varies from 4-7 days up to 5 weeks
- High fever (40-41°C), stop eating and giving milk – start of viraemic stage
- Easily noticed in dairy cattle – not noticed in free-ranging beef cattle
- Markedly enlarged lymph nodes (particularly prescapular and precrural)
- Skin lesions start to develop following days - often in many animals at the same time
- Excessive salivation, eye and nasal discharge due to the ulcerative lesions inside the mouth, also in nasal and ocular mucous membranes
- Later swellings in the leg and lameness may be detected
- Oedema of the dewlap
- Notice that not all affected animals show clinical signs although majority of them develop at least short-lasting viraemia
- Circular skin lesions of 1 to 5 cm in diameter (sometimes larger)
- Mild cases may show only a few lesions or lesions may cover the entire body in severely infected animals
- Within one to two weeks the top of the lesion forms a scab which then sloughs off, leaving a raw ulcer, prone to fly strike
- In some cases, the lesions remain for long (sitfasts)
Differential diagnosis

- Pseudo lumpy skin disease; BHV-2 (Bovine herpes virus) - more superficial lesions and shorter course of the disease
- Parapox lesions (bovine papular stomatitis) in the mucous membranes of the mouth
- Insect bites and allergic reactions (urticaria)
- Early ringworm lesions – often ringworm gets worse during LSD infection
- Demodicosis
- Besnoitiosis (widely distributed in Africa, recently also in central and western Europe)
- Onchocerciosis
LSD is transmitted by blood-feeding insects, such as certain species of flies and mosquitoes, or ticks. The virus could be transmitted also by direct contact, contaminated feed, water and equipment.

- Domestic cattle and Asian water buffalo are susceptible
- There is no epidemiological evidence/reports on susceptibility of small ruminants for LSD
- Wild ruminants as reservoir or susceptibility in Europe or Caucasus is not known
- Some evidence from Africa (Springbok, impala and giraffe can show clinical disease. Seropositive African buffaloes, blue wildebeest, eland, giraffe, impala and greater kudu.
Mechanical transmission of LSDV vectors

- Vectors are likely to vary between affected regions
- Vector must bite/feed frequently and change the host between feedings
- Finding PCR positive vectors from the environment indicates that they have been feeding on infected animal

Blood feeding insect vectors

- Transmission has been demonstrated by mosquito (*Aedes aegypti*) (Chihota *et al* 2001)
- Suspected transmission by stable fly (*Stomoxys calcitrans*) – transmission of sheeppox/goatpox virus was demonstrated by Kitching *et al* 1986
- *Tabanus spodopterus* – females (Bulgaria 2016)

The Big Question: Does biological transmission occur?
Transmission by tick vectors

- Mechanical transmission has been experimentally demonstrated
- African tick species: male *Rhipicephalus appendiculatus* (and *Amblyomma hebraeum*) ticks
- *Rhipicephalus (Boophilus) decoloratus* – venereal transmission during the copulation process – more evidence required to demonstrate biological transmissions

**Bulgaria 2016: LSDV found in**
- *Hyalomma marginatum* - females
- *Rhipicephalus bursa* - males + females
What is needed for LSD?

- LSD Virus
- Susceptible species
- Environment
- Vectors
✓ Morbidity rate varies between 5 to 45% and mortality rate usually remains below 10%
✓ The first (index) case is usually associated with cattle movements
✓ Particularly in Europe, the outbreaks are seasonal - more common (but not limited to) warm and wet seasons with abundance of blood-feeding arthropods
✓ Originally affecting cattle across Africa, the disease has spread outside the continent in late 80's when it made incursion into the Middle East. Further LSD outbreaks were registered in Israel and Lebanon in 2012–2013 and most recently (2013–2016) epizootics in Egypt, Bahrain, Kuwait, Oman, Yemen, the West Bank, Lebanon, Jordan, Iran, Iraq, Syria, Saudi Arabia, Turkey, Cyprus, Greece, the Balkans, Kazakhstan, and the Russian Federation were reported.

Epidemiology in nutshell and geographical spread of LSD

Map: Countries that have reported LSD
Movie: Spread of LSD (Feb 2014 - Aug 2016)
LSD in the region in 2016
LSD in the region in 2017
LSD control strategies

A
- A **total stamping-out** policy of the affected holdings (stamping out the whole herd after detection of an infected case)
- **Vaccination** using live homologous vaccines
- Movement restrictions

B
- **Partial stamping out**
- **Vaccination**
- Movement restrictions

C
- Vaccination
- Movement restrictions?

Israel
FYR of Macedonia
Albania,
Kosovo
Serbia,
Turkey?

Bulgaria
Greece
Choosing a vaccine against LSD

- Only live vaccines currently available against LSDV – none of them authorised for use within the European Union
- Superiority of live attenuated vaccines compared to the killed ones
- A replicating poxvirus generates better immunity than inactivated vaccines
- Only vaccines with demonstrated efficacy should be used – vaccine challenge experiment at CODA CERVA
- Live attenuated LSDV containing vaccine provides best protection
- Protection provided by attenuated SPPV vaccines is not as good for LSDV but can be used if sufficient herd immunity is created (all animals are vaccinated)
- Other appropriate control measures such as movement restrictions are in place
Vaccination regime and adverse reactions

- Regional vaccinations preferred over ring-vaccination (radius > 50 km diameter)
- Annual vaccinations with >80% vaccination coverage (all animals)
- All animals are of all ages vaccinated including pregnant females and young calves
- Calves form vaccinate mothers to be vaccinated above 4 months of age
- Local reaction at the vaccination site should be accepted
- Attenuated LSDV vaccines cause a general reaction in a minority of vaccinated animals (Neethling disease)
- Attenuated SPPV and GTPV vaccines only rarely cause adverse reactions
Adverse reactions
The example of Bulgaria
The 1st month of LSD epidemic in Bulgaria - Apr 2016

- 34 outbreaks (affected herds)
- 5 regions
- 26 settlements
- 46 affected bovines
- 994 bovines in the affected herds
The 2\textsuperscript{nd} month of LSD epidemic in Bulgaria - May 2016

- 92 outbreaks (affected herds);
- 8 regions
- 52 settlements;
- 115 affected bovines;
- 1170 bovines in the affected
The 3rd month of LSD epidemic in Bulgaria - Jun 2016

- 75 outbreaks (affected herds)
- 14 regions
- 46 settlements
- 126 affected bovines
- 470 bovines in the affected herds
The 4th month of LSD epidemic in Bulgaria - Jul 2016

- 16 outbreaks (affected herds)
- 7 regions
- 13 settlements
- 873 affected bovines
- 180 bovines in the affected
LSD situation in Bulgaria in 2016

- Date of first outbreaks: 13 Apr
- Date of last outbreak: 01 Aug
- 217 outbreaks in total
- 17 regions affected
- 2814 bovines in the affected herds
- 366 bovines with clinical signs
LSD outbreaks/affected settlements per month

- **Outbreaks**
- **Settlements**

<table>
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<tr>
<th>Month</th>
<th>Outbreaks</th>
<th>Settlements</th>
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<tbody>
<tr>
<td>April</td>
<td>26</td>
<td>34</td>
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<tr>
<td>May</td>
<td>92</td>
<td>52</td>
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<td>June</td>
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<td>July</td>
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<td>13</td>
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<tr>
<td>August</td>
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LSD outbreaks per herd size

Small herds (up to 10 animals) with low biosecurity are mainly affected
Control measures based on:

- Commission Implementing Decision (EU) 2016/645 of 22 April 2016 concerning certain protective measures against Lumpy skin disease in Bulgaria;
- Commission Implementing Decision (EU) 2016/1183 of 14 July 2016 approving the emergency vaccination programme against lumpy skin disease of bovine animals in Bulgaria and amending the Annex to Implementing Decision (EU) 2016/645;
- National legislation
Control measures applied

✓ Total stamping out
✓ Compensation schemes and immediate payments to the farmers
✓ Restriction zone established - at the beginning South part of Bulgaria, then the whole territory of the country
✓ Intensified clinical surveillance
✓ Reinforced biosecurity measures
✓ Movement control as per the provisions of Decision (EU) 2016/645 and Decision 2016/1183 and before that
✓ Vector control and desinsectisation over vector biotopes (along main rivers, valley and paddy fields).
✓ Vaccination in 2016, 2017.............
Two weeks after completion of vaccination no new outbreaks in the vaccination area
Direct costs...of about €5,785,289.49

Economic impact

Indirect cost: To be calculated: Real losses due to trade restriction with live bovines trade and commodities (milk, meat, semen, embryos, hides, etc.)
Surveillance in wildlife in Bulgaria in 2016 - 2017

- No studies if LSDV affects European wildlife
- LSD detected in saliva from affected cattle with generalized form of the disease, while blood was already negative
- Non-invasive sampling with salt lick type of baits was performed to collect saliva from red deer and follow deer and to be tested for LSD
- The NI sampling was performed in area where the disease was present in domestic cattle
- Results: no evidence that LSDV affects red and follow deer. Non invasive surveillance for LSD works well for cattle
- Surveillance in wildlife is being continued...
Key challenges and problems faced

✓ New disease and lack of experience
✓ Quick response to many outbreaks at the same time
✓ Vaccine delivery – tender procedures; EC vaccine bank
✓ Outbreaks after vaccination
✓ Laboratory capacity
✓ Trade restrictions
✓ The social factor
Lessons learnt

✓ LSD is clearly a regional problem that requires high level of awareness at technical and political level, involving many countries and can only be dealt with through coordinated international efforts.

✓ The main risks of LSD transmission are associated with transfer of virus by blood-feeding vectors and possibly direct contact between infected and naive animals as well as non-controlled animal movements.

✓ Priority actions to prevent transmission are immediate culling and safe destruction of infected animals, safe mass vaccination to reduce disease spread, and movement controls to avoid long distance spread via direct contact with affected animals.

✓ Vaccination of cattle is the most effective option for controlling the spread of LSD especially if applied before the virus enters a region or a country.

✓ A lot of uncertainties and questions

✓ Researches needed
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