"Schmallenberg" virus: Analysis of the epidemiological data and assessment of Impact

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OUTLINE

• Context of the report
• SBV current knowledge
• Assessment based on reported data
• Assessment based on modelling predictions:
  – Spread Models
    • Geographical Spread
    • Within Holding Transmission
  – Assessment of Impact
A preliminary analysis of the likely epidemiological scenarios – Guidance on data collection in Member States, 6 February 2012

An analysis of the epidemiological data already available, first report 31 March 2012, second report 30 April 2012

A report on the overall assessment of the impact of SBV on animal health, animal production and animal welfare together with a characterisation of the pathogen, 31 May 2012
SBV – Sequencing

• In Nov 2011 a previously unknown Orthobunyavirus was detected by metagenomic analysis at the FLI

• Analysis of the RNA sequences of SBV can provide information on the identity of the virus as well as on its reassortant nature, which both relate to the question of its origin.
SBV – Susceptible species

- Viral detection: Sheep, Cattle, Goats and Bison
- Ab detection: Red Deer and Roe Deer

- New studies support the initial assessment undertaken by the European Centre for Disease Control and Prevention, that it is very unlikely that SBV poses a risk to humans.
The vulnerable gestation period for the various susceptible species to SBV infection is not yet determined.

A worst case scenario of 28 to 56 for sheep and 62 to 173 for cattle was used for the purpose of this report.

Table 5.2  Relationship between stage of gestation and effect of Akabane virus infection in calves

<table>
<thead>
<tr>
<th>Stage of pregnancy at infection</th>
<th>Effect of infection with Akabane virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception–77 days</td>
<td>No damage known</td>
</tr>
<tr>
<td>78–103 days</td>
<td>Hydranencephaly</td>
</tr>
<tr>
<td>104–172 days</td>
<td>Arthrogyrosis</td>
</tr>
<tr>
<td>173–224 days</td>
<td>Polioencephalomyelitis</td>
</tr>
<tr>
<td>225 days–birth</td>
<td>Encephalitis</td>
</tr>
</tbody>
</table>
SBV – Transmission

- Transplacental.
- Vector borne:
  - *Culicoides*, isolation of SBV in C. obsoletus group

The temporal distribution of reported cases and the detection of SBV in different culicoides pools all seem to indicate that the most likely route of transmission is, as with all other viruses of the same group, vector borne.
• Long lasting immunity was demonstrated in animals infected with Akabane virus.
The estimation of the true rate of infection can only be achieved by serological investigation.

<table>
<thead>
<tr>
<th>Country</th>
<th>Within herd Prevalence</th>
<th>Country level</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Max 100% min 7.5% (sheep)</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Gradient North to South and West to East (high to low)</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>70-95% (sheep) and 70-100% (cattle)</td>
<td>70% (cattle)</td>
</tr>
<tr>
<td>Spain</td>
<td>40-100%</td>
<td></td>
</tr>
</tbody>
</table>

Most studies in confirmed herds
Tests available: VNT and ELISA
Accuracy?
In Europe mid May 2012, 3745 holdings have been reported with SBV cases confirmed.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reported Holdings</th>
<th>Holdings SBV not confirmed</th>
<th>Holdings SBV confirmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>231</td>
<td>0</td>
<td>231</td>
</tr>
<tr>
<td>Denmark</td>
<td>38</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>France</td>
<td>3279</td>
<td>1836</td>
<td>1443</td>
</tr>
<tr>
<td>Germany</td>
<td>1443</td>
<td>0</td>
<td>1443</td>
</tr>
<tr>
<td>Ireland</td>
<td>56</td>
<td>56</td>
<td>0</td>
</tr>
<tr>
<td>Italy</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>32</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1634</td>
<td>1287</td>
<td>347</td>
</tr>
<tr>
<td>Norway</td>
<td>9</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Spain</td>
<td>17</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Sweden</td>
<td>19</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>446</td>
<td>189</td>
<td>257</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7215</strong></td>
<td><strong>3470</strong></td>
<td><strong>3745</strong></td>
</tr>
</tbody>
</table>
• Approximately the same number of sheep holdings and cattle numbers were reported.

• Twice as many sheep holdings were found to have SBV confirmed cases compared to cattle holdings.
Reported data

• Three countries Italy, Spain and Netherlands provided the extended dataset of individual animal results.

• There are reports of neonates being born without AHS clinical signs but testing positive by RT-PCR and neonates presenting AHS type clinical signs with negative RT-PCR.
Reported data - Temporal distribution

All Species
- Cattle
- Goats
- Sheep

Cattle
- Belgium
- France
- Germany
- Italy
- Luxembourg
- Netherlands
- Spain
- United Kingdom

Goats

Sheep
- Belgium
- France
- Germany
- Italy
- Luxembourg
- Netherlands
- Spain
- United Kingdom

Week of report
Reported data - Temporal distribution

Random draw within vulnerable interval

Estimation of week of infection dams considering gestation period and possible stage of vulnerability (sheep/goats 28-56 days cattle 62-173 days).
Reported data – Spatial spread

- SEP
- DEC
- FEB
- APR
## Reported data - Impact

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Holdings</th>
<th>Percent Holdings Affected</th>
<th>Maximum Affected for NUTS 2 Region</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sheep</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>3890</td>
<td>3.98%</td>
<td>6.21%</td>
</tr>
<tr>
<td>Germany</td>
<td>28080</td>
<td>2.96%</td>
<td>7.62%</td>
</tr>
<tr>
<td>Spain</td>
<td>79120</td>
<td>0.01%</td>
<td>0.07%</td>
</tr>
<tr>
<td>France</td>
<td>66060</td>
<td>1.70%</td>
<td>6.73%</td>
</tr>
<tr>
<td>Italy</td>
<td>75390</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>220</td>
<td>2.73%</td>
<td>2.73%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>13830</td>
<td>0.78%</td>
<td>4.32%</td>
</tr>
<tr>
<td>UK</td>
<td>76670</td>
<td>0.28%</td>
<td>5.00%</td>
</tr>
<tr>
<td><strong>Cattle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>28460</td>
<td>0.26%</td>
<td>0.52%</td>
</tr>
<tr>
<td>Germany</td>
<td>169700</td>
<td>0.32%</td>
<td>0.97%</td>
</tr>
<tr>
<td>Spain</td>
<td>124030</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>France</td>
<td>219970</td>
<td>0.15%</td>
<td>0.80%</td>
</tr>
<tr>
<td>Italy</td>
<td>147020</td>
<td>0.00%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1480</td>
<td>0.74%</td>
<td>0.74%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>35260</td>
<td>0.66%</td>
<td>1.32%</td>
</tr>
<tr>
<td>UK</td>
<td>94650</td>
<td>0.04%</td>
<td>0.92%</td>
</tr>
</tbody>
</table>
Impact is assessed as the proportion of confirmed SBV holdings in relation to the total number per holdings per species in the country and at the regional level.

No data is available to allow for the determination of impact at herd level or the impact on animal welfare and on animal production.
Spread Models

• Geographical Spread
  – Data:
    • NUTS2 regions
    • Demographic data
    • Epidemiological data

• Within Holding Spread
  – Data:
    • Climate data from 1983 – 2011
    • Model Parameters from BTV
The model has three components:

- duration of risk
- transmission between regions
- within-region transmission
**Transmission Between Regions**

- Force of infection depends on:
  - distance between region centroids
  - number of cattle and sheep holdings in region
  - seasonal vector activity (Sanders et al. 2011)

- Cattle and sheep holdings assumed to be equally susceptible/infectious

- Population density dependent
Within-Region Transmission

- It depends on:
  - Force of infection
  - Duration of **RISK**
  - Number of Holdings
Geographical Spread: Results
Geographical Spread: Prediction

SBV Overwintering P = 0.01
Geographical Spread: Prediction

SBV Overwintering P = 0.1
Within-Holding Transmission
Assessment of Impact

- **Data:**
  - *Lambing* and *calving* monthly percentages
  - *Reconstruct holding size* based on UK distribution (*Demographic* data)
  - *Force of Infection* from geographical spread model
  - *Period* in which *holdings* are at *risk* in each region
  - *Within holding* transmission based on *BTV* model
Impact: Seasonal Distribution

- Cattle
- Sheep
Impact: Prediction

- Cattle
- Sheep
Conclusions

- 3745 holdings have been reported with SBV cases confirmed.

- This assessment of impact should be interpreted with caution, since the report levels are dependant of the disease regulatory framework (notifiable or not) in different countries, the level of awareness of different stakeholders and the diagnostic capability in the MS. No information is currently available on the within herd impact.
Conclusions

• The geographical spread model is proved to fit well the reported data.

• However, estimates depend critically on the level of under-ascertainment of infected holdings, which sero-prevalence data suggest could be substantial.
Conclusions

• If the virus overwinter, the model predicts that SBV is likely to re-emerge between mid-April and the end of May and is likely to be of a similar size to the one occurred in 2011, though in regions previously unaffected.

• The most likely affected areas for next season are expected to be at the south and east regions of the previously-affected areas.
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