Scientific studies on SBV

- Studies co-financed by the Commission at the rate of 50 % of eligible costs for the period **1 April 2012** to **31 December 2013** for the following Member States:
  - Belgium, Germany, Spain, France, Italy, the Netherlands and UK
- The results of these studies are expected to be published in April 2014
  - Progress reports with preliminary results were provided in March 2013
  - Some of the results presented here are preliminary and have not yet been published in scientific journals
  - EFSA has not yet conducted any assessement of the available results
- The outcome of the studies must be made available to the Commission, all Member States and EFSA and presented at the Standing Committee on the Food Chain and Animal Health
- http://ec.europa.eu/food/animal/diseases/schmallenberg_virus/index_en.htm

Overview of ongoing studies

Pathology

- Pathogenicity at different gestation stages
- Pathogenicity in non pregnant animals
- Immunity
- Impact and risk factors

Epidemiology

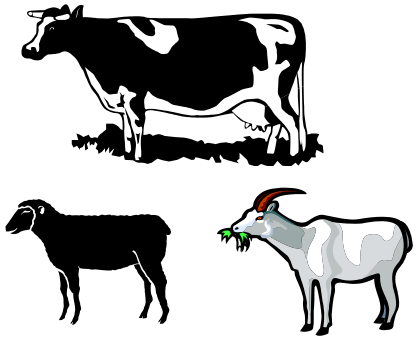
- Horizontal transmission
- Vectors
- Semen and Embryo
- Other species

Diagnostic

- ELISA
- RT-PCR

Pathogenesis studies

Pathogenicity at different gestation stages



Experimental infections at

d60, d90, d120, d150 (cattle) and

d20, d40, d60 (small ruminants)

Pathogenicity in non pregnant animals

Incubation period and viraemic period have been reported in several papers (incl. Wernike et al., 2013).

ON GOING

Pathogenesis studies

Immunity

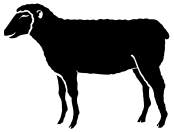
It could be shown, that re-infected cattle (experimental infection) were fully protected from viremia and that neither oral exposure nor contact infection could induce SBV-infection (no viremia, no seroconversion) (Wernicke et al., 2013)

What we know / assumptions

	SBV	Simbu Virus	Reference	Comment
Duration of viremia	2-6dpi		Hoffmann et al., 2012	(3 animals)
Incubation time	2-5 dpi		Hoffmann et al., 2012	(3 animals)
Virus distribution	Neurons of the gray matter		Varela et al., 2013	Mouse model- SBV synthetic
	cerebrum, spinal cord, umbilical cord, placental fluid		Bilk et al., 2012	Virus distribution in malformed newborns
Gestation susceptible period		Cattle 62 to 173 d Sheep 28 to 56 d	Worst case scenario EFSA 2012	
Virus shedding and possible **persistence**				
Duration of immunity		Long lasting	Taylor & Mellor, 1994	Akabane virus

Pathogenesis studies

Impact and risk factors



Belgium: almost every domestic ruminant has already been infected by the virus. All samples before August 2011 were found to be sero-negative

Netherlands: Outcome 1 – impact of the SBV infection on health and productivity of dairy cattle – Final report May 2013

Outcome 2 – impact of the SBV infection on health and productivity of sheep, potential risk factors - Final report August 2013

ON GOING

Seroprevalence

Country	Time of study	species	Within herd	Between Herd	Reference
Belgium	Nov2011-Apr 2012	1082 sheep 83 herds	84.31% (84.19-84.43)	98.03% (97.86-98.18)	Meroc et al., 2013
Belgium	Nov2011-Apr 2012	142 goats 8 herds	40.68% (23.57-60.4)		Meroc et al., 2013
Belgium	Jan- Mar 2012	11635 cattle 422 herds	86.3% (84.75-87.71)	99.76% (98.34-99.97)	Meroc et al 2013
Belgium	Oct - Dec 2011	red deer 313 and roe deer 211	43%		Linden et al., 2012
The Netherlands	Nov 2011 - Jan 2012	1123 Cattle	70-100%	72.5% (69.7-75.1)	Elbers et al., 2012
Sweden	After vector season 2012	Bulk milk test Cattle		72%	Chenais et al., 2013
Austria	Update to Dec 2012	Cattle Sheep Goats		90.77% 63.14% 71.68 %	Schiefer et al., 2013

Assessment of the impact

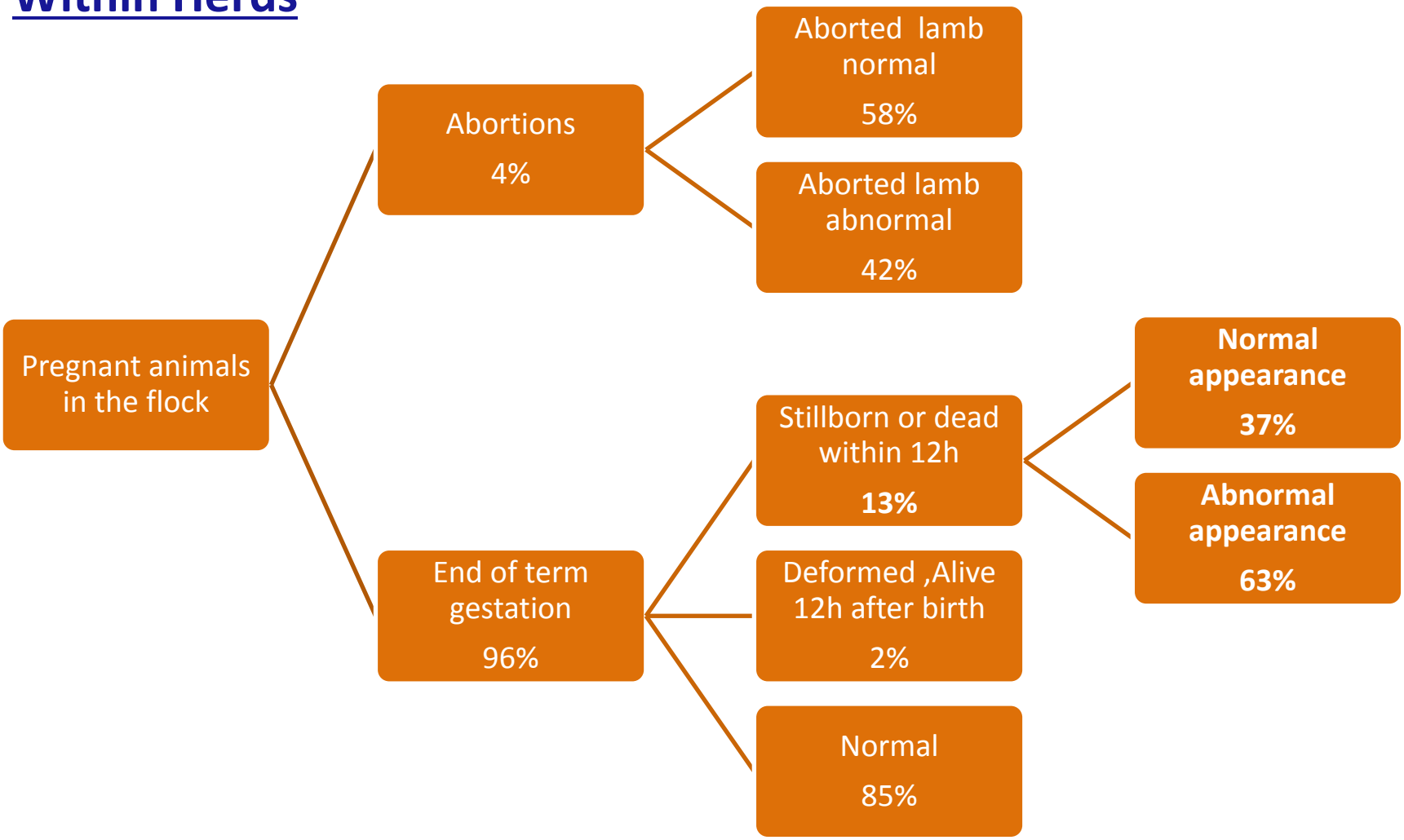
Within Herds

Country	Study period	Species		Reference
France	Mar 2012-?	362 (SBV+) sheep flocks, 40635 sheep 38 districts 6165 Abnormal birth	85% Normal birth 12%>95% Normal 10%<50% Normal 72% full term 28% abortion	*Dominguez et al., 2012
France	Feb-Sep 2012	510 (SBV+) cattle herds, 37504 cattle, 16017 cows gave birth to 16175 calves	2% abortions of which 61% normal and 39% deformed 98% full term of which 96% normal and 4% deformed	GDS 2012

* In their study, Dominguez and coll. do not confirm the link of causality between malformation and abnormalities and infection with SBV (Dominguez et al., 2012).

Assessment of the impact - Sheep

Within Herds



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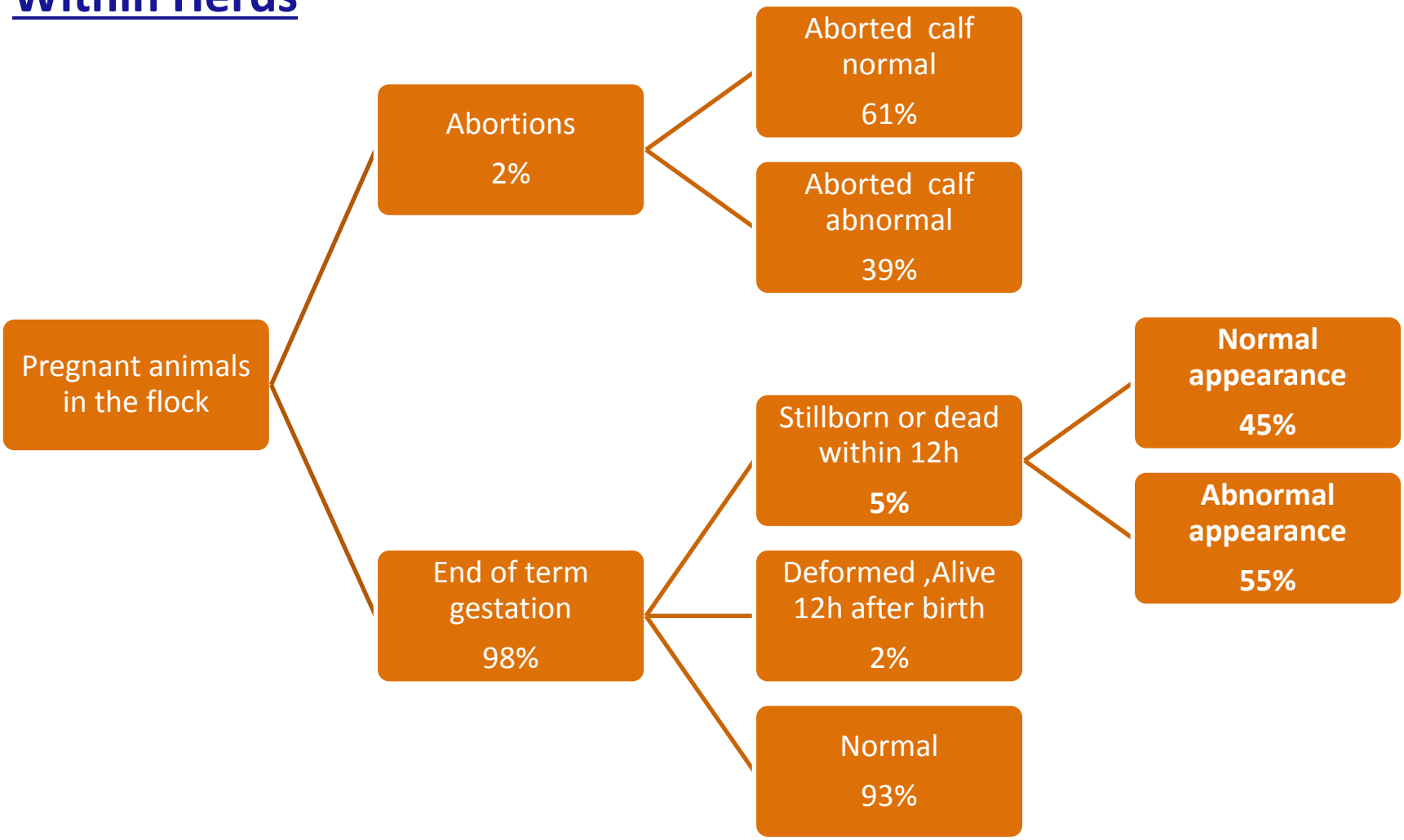
Assessment of the impact - Cattle

Within Herds



* In their study, Dominguez and coll. do not confirm the link of causality between malformation and abnormalities and infection with SBV (Dominguez et al., 2012).

Assessment of the impact

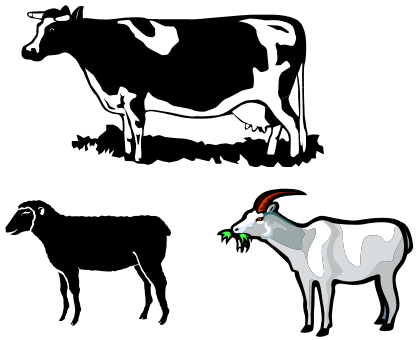
For all affected countries, the number of SBV confirmed herds is low compared with the total number of herds. The maximum proportion of **confirmed sheep herds per region is 6.6% and 4% for cattle herds.**

Other measures of impact are necessary:

- Within herd impact
- Reduced fertility
- Reduced milk production
- Dystocia rates and welfare …

Epidemiology studies

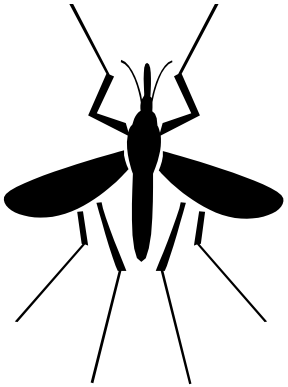
Horizontal transmission



In experimental infection studies, antibody responses in non-inoculated control which were kept in contact with inoculated animals, were not observed, neither in cattle, nor in sheep or goat. There were no indications for direct horizontal transmission of SBV.

Epidemiology studies

Vectors



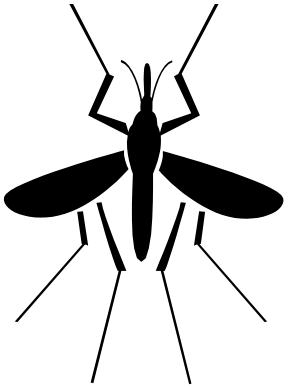
"…prevalence of SBV in midges was 5-10 times higher when compared to BTV detection in *Culicoides* in Europe during 2002-2008.

Vector biology was positively influenced by climatological circumstances in 2011 with a prolonged vector season (several weeks due to higher temperatures than normal) and a higher survival rate and increased vector abundance (rain in summer and higher temperatures than normal in autumn)(Elbers et al., 2012; Regge.et al., 2012). "

ON GOING

Epidemiology studies

Vectors



Criteria for the recognition of a vector :
i) recovery of virus from wild-caught specimens free from visible blood,
ii) demonstration of ability to become infected by feeding on a viraemic vertebrate host or on an artificial substitute,
iii) demonstration of ability to transmit biologically by bite and
iv) accumulation of field evidence confirming the significant association of the infected arthropods with the appropriate vertebrate population in which disease or infection is occurring

Activity areas:
1. Mosquito colony trials and testing *Culicoides for SBV infection*
2. Screening of *Culicoides and mosquito field populations for SBV infections*
3. Artificial infection of *Culicoides and mosquito field populations with SBV*
4. Vertical transmission of SBV

ON GOING

Preliminary results seem to indicate that mosquito are not able to support viral replication. Also, no evidence of vertical transmission was obtained so far.

Epidemiology studies

Semen and Embryo

SBV has been detected in semen (straws) by FLI, CVI and ANSES (ProMed 21 Dec 2013), 0-4% of semen batches were SBV positive by RT-PCR.

Excretion levels of SBV in bovine semen have been monitored in several SBV seropositive bulls.

Subcutaneous inoculation of 6 calves with SBV positive semen (different Ct values) was performed resulting in viraemia in 2 (of 6) calves. It still needs to be proven if the virus can be transmitted via insemination.

ON GOING

Experimental inoculation in two semen producing bulls performed at CVI, resulted in SBV positive semen in both animals at different times after inoculation.

Epidemiolgy studies

Other species

Experimental infection in pigs and poultry were performed.

According to these first **preliminary results pigs do not seem** to be a replication host for SBV.

Also chicken are **not susceptible** for Simbu, Sabo, Sathuperi and Schmallenberg virus.

ON GOING

SBV antibodies have been detected in various wildlife species and high seroprevalences have been observed in roe deer (46%, CVI; 40%, FLI), wild boar (17%, FLI), moufflon (72% FLI), red deer (52%, FLI), fallow deer (33%, FLI; 42%,CVI), Sika deer (15%, FLI)

What we know / assumptions

	SBV	Simbu Virus	Reference	Comment
Routes of transmission	Transplacental transmission of SBV has been demonstrated	Vectors – Culicoides, Horizontal animal to animal transmission has not been reported for Simbu serogroup viruses	Garigliany et al. 2012a,b; van den Brom et al. 2012	
SBV vectors	*C. Obsoletus* sensu stricto, *C. scoticus, C. chiopterus* and *C. dewulfi*		Elbers et al 2013 De Regge et al 2012	*vector competence?*
Transmission rate vector to host		0.78/ Beta(7.38,2.13)	Baylis et al. 2008	based on an analysis of data on the transmission of bluetongue virus to sheep by *C. sonorensis*
Transmission rate host to vector	0.014/Beta(2.9,210.5) SBV-prevalence in Culicoides was 0.25% (15 per 6,100 midges tested). Obsoletus Complex : 0.56% (13 per 2,300). C. chiopterus : 0.14% (2 per 1,440).			Belgian data: two pools out of 23 tested (each of 10 midges) positive for SBV Elbers et al., 2012
Extrinsic incubation period		BTV 9 estimate	Carpenter et al. 2011	

What we know / assumptions

	SBV	Simbu Virus	Reference	Comment
transmission of SBV via semen and embryos		Akabane virus could not be detected in semen.	Parsonson et al., 1981	viraemic bulls experimentally infected
		Akabane virus could not be isolated from bovine embryos	Singh et al., 1982	Donor cows exposed to viral infection
	Detection of SBV-genome in semen 6 calves were experimentally inoculated , no clinical symptoms, 2/6 PCR positive		Preliminary results EU research	**Subcutaneous inculation**
Host range	cattle, sheep, goats, and bison		FLI, 2012	
Reservoirs	red deer, roe deer, moufflon and alpacas		Jack et al., 2012 Meroc et al., 2012	

Diagnostic

ELISA

All ELISAs and VNT assays in the participating laboratories (De, Fr, NL, Be, UK) showed a rather good performance. There were few inter-laboratory differences. Less differences between participating laboratories were observed for the VNT and in general the VNT was more sensitive than ELISA (scientific publication in preparation).

Conclusion

The EU has demonstrated its capacity for rapid response to SBV in terms of scientific investigation and research

Preliminary results from studies co-financed by the EC and Member States confirm assumptions used in the EFSA assessments

Further information will be made available towards the end of 2013