Reproductive diseases in sows (*Sus scrofa domestica*): A Review

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ABSTRACT

Almost all the fertility parameters in sows (reproductive and productive) may be affected by different infectious diseases. Changes in reproductive parameters may also occur without the appearance of appreciable pathological findings or with clinical signs often overlapping or similar to different diseases or pathogens. All the clinical aspects and the pathological findings should be taken into account to address a tentative diagnosis with the support of laboratory findings. All the pathologic material available in the course of reproductive problems in sows should be taken into account for laboratory investigations, including examination of reproductive and urinary tract of reformed sows from the abattoir. Laboratory investigations include pathogen identification or isolation, antibody titer evaluations, chemical investigations of toxins with activity on the reproductive tract and tissue histology. For the control of reproductive diseases in sows, antibiotic therapy, prophylaxis and immunization programs should be taken into account.

Key words: Sow, reproductive disease, abortion, vaccination.

INTRODUCTION

In a previous review, the general concepts of fertility and productive parameters in domesticated sows and the general output of sows in modern pigs farming were presented (1). "Standard performances", low performance boundaries or "alarm levels" were identified for each reproductive and productive parameter at the herd level. In general, deviations from fertility, reproductive and productive parameters in the swine industry constitute "alarm levels" for which intervention of the veterinarian may be required.

The purpose of this review was to summarize from a practical veterinary perspective:

- the infectious diseases affecting the reproductive output in sows;
- the different reproductive stages affected by infectious diseases;
- the availability of biological material for laboratory investigations and diagnosis;
- the available tools to control reproductive diseases in sows.

The starting point is the overall evaluation of the reproductive and productive outputs of sows in a herd, with indication of parameters which are potentially affected by infectious diseases. This review does not cover reproductive dysfunctions as a result of physiologic reproductive activity (1).

REPRODUCTION AND DISEASES IN SOWS

As a general consideration, almost all the fertility parameters in sows in respect to reproduction and production may be affected by different infectious diseases. These often affect similar parameters and/or targets in the reproductive cycle and induce a corresponding clinical picture.

When approaching a problem of reproductive diseases in breeding herds, the veterinarian is generally requested to solve problems of:

- reduction of reproductive / fertility parameters: pregnancy rate; farrowing rate; increase of empty animals (back to estrus; empty sows at farrowing date);

- changes in productive parameters: reduction of piglets; increase of stillbirth;
- occurrence of pathological signs: appearance-increase of mummified piglets; abortions; vaginal discharges.

Variations of many parameters may occur without the appearance of appreciable pathological findings (such as abortions, mummification or discharges), however the output of a breeding herd may be severely affected.

Table 1 sets out to summarize reproductive and productive standards in sows, with parameters affected by infectious diseases.

Table 1: reproductive and productive parameters in sows potentially affected by infectious diseases

Reproductive parameters		**Standard**	**Target for Reproductive Disease**
Age of gilts at insemination (days)		210-230	Yes / No
Weaning-Oestrus interval (days)		< 7	Yes — increase
Farrowing rate		85%	Yes — decrease
Back in oestrus (after insemination)		9%	Yes — increase
of which:	# regular (18-22days)	6%	Yes
	# irregular (> 23 days)	3%	Yes
Abortions		0,8-1%	Yes — increase
Empty sows at expected farrowing date		2%	Yes — increase
Infertile sows		3%	Yes — increase
Sows mortality		2,5-3%	Yes / No
Productive parameters		**Standard**	**Target for Reproductive Disease**
Piglets live per farrowing; 1st parity		9,5-10	Yes — decrease
Piglets live per farrowing; multiparous		10,5-11	Yes — decrease
Stillborn fetuses		5%	Yes — increase
Mummified fetuses		0,5%	Yes — increase
Farrowing per sow per year		2,2-2,25	Yes — decrease
Piglets weaned per sow per year		21	Yes — decrease

The presence or absence of appreciable pathological signs depends on the stage of the occurrence of the disease along with embryo or fetal development, or even may be connected to the complete failure of embryo development, when, for example, inflammatory processes involve the uterine mucosa.

Infections occurring in different reproductive stages may have different clinical presentations:

- embryos affected before the second week after insemination: sows may return to estrus 19-24 days or multiples, 42 - 45 days. This may occur without any other appreciable clinical signs.
- embryos affected in the third-fourth week of pregnancy: if the sows are kept on a full floor, expelled small embryonic vesicles may be found; this finding may be missed in the case of a slatted floor.
- starting with the second month of pregnancy: aborted fetuses begin to be clinically appreciated; cases of mummification may be present.

The period of 67-70 days into fetal development is considered an important threshold: the fetus becomes immunecompetent with the possibility to produce specific antibodies against infectious pathogens. In fact, the swine placenta prevents antibody transfer from the sow to the fetus (2) so that the presence of specific antibodies may be investigated in the laboratory for disease diagnosis and as a consequence of fetus infection.

Mummification (with liquid absorption) or maceration (with an increase in liquid) may occur between the end of first month of pregnancy and until 90 days. Generally, mummified or macerated fetuses may be retained until farrowing or expelled during abortions. According to the pathogen involved, abortion may occur at almost all stages of pregnancy and until the very last days of pregnancy. An abortus may be composed of normally developed fetuses only, or mixed with mummified fetuses at the same or different stage of development or with macerated fetuses. All these aspects, and some pathological findings at necropsy for apparently normal fetuses, may be of great help in addressing a tentative diagnosis which will be later confirmed with laboratory support (3).

Table 2 correlates between: stages of pregnancy; main stages in fetal development; consequences of infection at the fetal level and at the sow level; main clinical and pathological findings (from reference 4, modified).

There are several viral and/or bacterial pathogens which are able to affect the reproductive apparatus of sows and interfere with all the stages of the reproductive cycle. Table 3 presents the varied pathogens of swine in Western Countries with the infectious diseases present in Israel indicated.

Table 2: Stage of pregnancy; embryo development and main clinical and pathological findings

Days from AI	**0-14**	**14 - 30**	**30 – 70**	**> 67**	**105-115**	**farrowing**
stage of development	*morula*	*before calcification*	*bones calcification begins*	*immunocompetence*		
infections induced	embryo death	embryo-death absorption expulsion, early abortion	fetal death mummification fetal liquids reabsorbed abortion	fetal death mummification or maceration abortion	late abortion. early farrowing	still birth pre-partum or intra-partum death
clinical findings	none	may find small vesicles	may find small vesicles	abortion	abortion. early farrowing	still birth actelectasic lungs
	RIE	RIE	may retain mummies until farrowing			
	in cycle	in cycle and not		mummies may be present		

AI: Artifical insemination; RIE return in estrus

Table 3: Infectious diseases responsible of reproductive pathology; main clinical signs.

Diseases	**Clinical signs**	**Infertility**	**Abortion**		**Mummification**	**Still**	**Early**
		RIE	**early**	**late**	**maceration**	**birth**	**mortality**
Viral	Aujeszky disease (AD)	Y	Y	Y	M	Y	Y
	family Herpesviridae; *sub-family Alpha-herpesvirus*						
V	Parvovirosis (PPV)	Y	Y		M	Y/N	
	Parvovirus; *family Parvoviridae*						
	Porcine Resp. Reprod. Syndrome (PPRS)		Y	Y	M	Y	Y
	Arterivirus; *family Arteriviridae*						
	Enterovirosis (Teschen - Talfan) (PEV)	Y	Y		M	Y	Y
	Enteroviruses; *family Picornaviridae*						
V ??	Encephalomyocarditis (EMC)	Y		Y	M	Y	Y
	Enterovirus; *family Picornaviridae*						
V	Porcine Circovirus type 2 (PCV2)	Y				Y	Y
	family Circoviridae						
	Swine Influenza (SIV)		Y/N	Y			
	Influenza A virus; *family Orthomyxoviridae*						
V	Classical Swine Fever (CSF)	Y	Y	Y	Y	Y	Y
	family Flaviviridae						
Bacterial V	Leptospirosis	Y		Y	M m	Y	Y
	genus Leptospira; *family Leptospiraceae*						
V	Erysipelas			Y		Y	Y
	Erysipelotrix rhusiopathiae;						
	Brucellosis			Y	M		
	genus Brucella; *species Brucella suis*						
Mixed V	Streptococcosis	Y	Y	Y			Y
	Streptococcus suis ; *spp.*						
V	Staphylococcosis	Y	Y				
	Staphylococcus aureus ; *spp.*						
V	*Escherichia coli* infections	Y	Y				Y

V present in Israel; **V**?? suspected to be present in Israel, not confirmed; **Y** yes; **N** no; **M** mummification; **m** maceration; **RIE** Return In Estrus

In general, both for viral and bacterial diseases, return in estrus (RIE) either in cycle or not, as a consequence of early embryonic death (2nd week of development) or early abortion (before 6th week of development), is the predominant clinical sign.

Classical Swine Fever virus (CSFV), Encephalomyocarditis (EMC), Porcine Enterovirus (PEV), Porcine Parvovirus (PPV), Porcine Circovirus type 2 (PCV2), Aujeszky Disease virus (ADV) are able to penetrate the reproductive tract and/or embryonic tissues and also replicate in embryonic tissues (5). These viruses can reach the embryos either with insemination (infected semen) or, as a consequence of viremia, via the blood stream (5). Porcine Respiratory Reproductive Syndrome virus (PRRSV), instead, replicates in the fetal implantation sites and causes apoptosis in infected macrophages and surrounding cells at the last stage of gestation (6). Penetration of the placenta is thought to occur via infected lymphocytes (ADV, CSF, PCV2) from the blood circulation, or cell-free viruses (PRRSV, PPV, EMCV, PEV) which are able to infect lymphocytes when these adhere to placenta endothelium and, from this point, reach the embryonic tissues. During Swine Influenza virus (SIV) outbreaks, *Actinobacillus pleuropneumoniae* (App) or *Haemophilus parasuis* (Glasser disease) infections, abortion is the consequence of severe general symptoms (high temperature, anorexia) while the massive replication of SIV at the respiratory level induces the release of pro-inflammatory cytokines.

Among bacterial pathogens, *Brucella suis* may infect sows via the genital tract at insemination, which leads to early abortion (2-3 weeks of pregnancy) while infection acquired in already pregnant animals, generally lead to abortions 35-40 days later (7). In the genital tract, *B. suis* replicates heavily in the placental tissues but rarely induces endometrial inflammation. Clinically abnormal uterine discharges are rarely observed and generally occur just before and after abortion. In Leptospirosis, transplacental infection may be the result either of the transient leptospiremia in sows following primary infection (*L. pomona*) or from a suspect vaginal infection (*L. bratislava*) (8).

Abortion at all pregnancy stages is typical of AD, PRRS, CSF and SIV. In Leptospirosis, abortions may occur mainly at late stage of pregnancy (3). Abortion may also appear in EMC and in PCV2 infections, even if abortion is not the typical clinical sign for the latter (9). In fetuses younger than 70 days, low-virulence CSF strains may induce teratogenic lesions and immuntolerance with birth of infected and virus-shedding piglets (10).

Mummification is primarily typical of viral diseases but it appears also in the course of Leptospirosis, when other than *L. bratislava* serovariants are involved, and in Brucellosis. The degree and diffusion of mummification may vary from disease to disease: in AD, fetuses are infected almost all together at same stage of pregnancy, so that they appear of same size or developmental stage; in PPV, PEV, Leptospirosis, fetuses may be affected at differing times and at different stages of pregnancy, so that they will appear of different size and different levels of reabsorption. In Leptospirosis mummification can also be accompanied by maceration and liquid retention in some fetuses. Increase of mummified piglets is a signal also in EMC (11).

Abortion may occur in sows that contract *Erysipelotrix rhusiopathiae* in the acute or subacute form, while stillbirth and small litter size may accompany farrowing (3). Increased incidence of pre- and post-partum vulva discharges, increased weaning-to-estrus intervals, decreased farrowing rates, reductions of total piglets born, reduction of (live-born) litter size, are also reported to be associated with *E. rhusiopathiae*.

67-70 days of fetal development is the threshold for immune-competence in swine embryos (2): if infections occur later than this period, the possibility of an immuno-response by the fetus progressively increases and also the possibility of survival.

DIAGNOSIS OF REPRODUCTIVE DISEASES IN SOWS

A variety of biological material is suitable for laboratory diagnostic confirmation: vaginal-vulva discharges, abortive material, fetuses, placenta and blood. Veterinarians requested to investigate reproductive problems should take into account the full range of possibilities. The pathologic material available in the course of reproductive problems in sows often is collected in a non-optimal environment and may already be in the process of autolysis. Collection of this material should be rapid in order to avoid putrefaction, cannibalism and evisceration of internal organs from fetuses and piglets. In the case of abortion, it is recommended to collect all the fetuses from each sow and avoid freez-

Table 4: Clinical signs in sow during first and second pregnancy-half and pathologic material available for laboratory investigation (3, modified)

First half of pregnancy	Material available	Pathogen possibly involved
Return in estrus Embryo-deaths and absorption	Swabs from vaginal discharges	PRRS PPV AD *E. rhusiopathiae* Other bacterial
Return in estrus – Anaestrus	Feed	Zearalenone
Return in estrus Vaginals discharges	Swabs from vaginal discharges Concentrated boar semen or diluted	PRRS PPV AD *E. rhusiopathiae* Other bacterial
	Blood / Oviduct	*Leptospira bratislava*
Second half of pregnancy		
Abortions Stillbirths Sub-vital piglets	Fetuses Placenta Blood Nasal swabs	PRRS PPV AD PCV2 SIV *E. rhusiopathiae* *Leptospira spp.* Other bacterial
Stillbirths	Blood	Hypoxia
Post-partum; puberal gilts		
Anaestrus	Feed Genital system of reformed sow Boars' semen	Zearalenone Management failure Bacterial / viral agents
Any stage		
Vaginal discharges Sudden deaths	Urine (about 20% of cases) Urinary tract	Bacterial infections

Table 5: laboratory investigations currently utilized for the diagnosis of reproductive diseases in sows

Disease	Laboratory methods	Reference
PRRS	Polymerase Chain Reaction–Real Time (RT-PCR); ELISA	13, 14
PPV	Haemagglutination inhibition (HI); PCR	15, 16
AD	PCR / ELISA	17
E. rhusiopathiae	Bacteriological	3,12,18,19
Zearalenone	Chemical examination	3
Leptospirosis	Micro Agglutination Test (MAT); PCR; ELISA	20
PCV2	PCR ; RT-PCR; ELISA	21, 22
SIV	ELISA; HI; PCR	17, 23, 24
Brucellosis	ELISA ; PCR	25
Bacterial	Bacteriological	3, 12
CSF	RT-PCR; ELISA	26, 27, 28
EMCV	Virus isolation ; ELISA ; PCR	29, 30, 31

ing the collected samples in order to preserve tissues for histology (12). The collection of fetuses or other material should be accompanied by a blood sample from affected sows (13) for antibodies profile and Polymerase Chain Reaction-Real Time (RT-PCR) when available. Collection of blood samples from healthy sows at the same reproductive stage may be of help for antibody profiles comparison (13) as well repeat sampling from the same subjects at 21-30 days interval (3) along with an accurate anamnesis and data collection (3,12). Table 4 summarizes the possible material available at pregnancy and the pathogens possibly involved. Non-infective agents (derived by feed contamination; hypoxia at farrowing) have been also considered.

Biological material submitted to laboratory is investigated for different pathogens according to techniques described above in Table 5.

When SIV, PCV2, PRRS are suspected on farms with reproductive failure and abortions, histological examination is also suggested for stillborn and weak piglets, as it may reveal specific lesions. In fact, in the case of SIV, PCV2, PRRS cardiac lesions may be revealed (30), while specific necrotic foci may be revealed on liver in course of AD (Figure 1).

CONTROL OF REPRODUCTIVE DISEASES IN SOWS

A comprehensive approach for the control of reproductive diseases should necessarily include stringent bio-security measures. These should take into account strict control movements for personnel, visitors and suppliers; implementation of cleaning and / or disinfection of humans and vehicles; systematic sanitary tests on imported animals (breeding stock sale between farmers) and semen; isolation from other farms and where this is not applicable due to intensive farming in restricted areas, implementation of common minimal prophylactic and control measures between all the farms (32). All the above mentioned actions

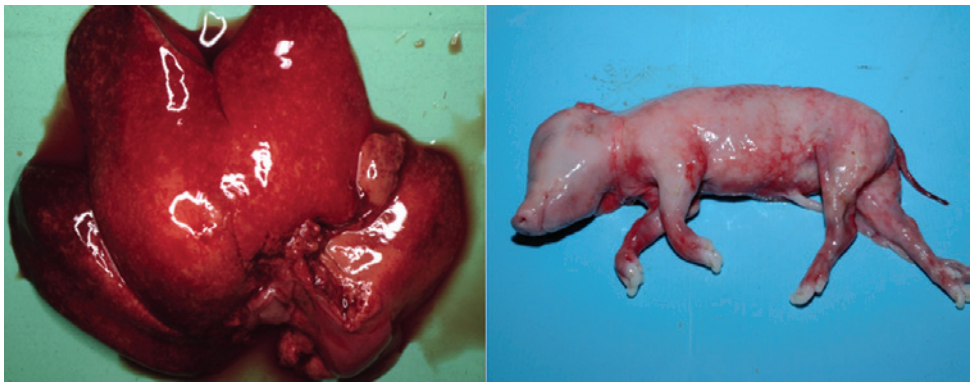

Figure 1: Livers of fetuses with necrotic foci induced by Aujeszky Disease Virus

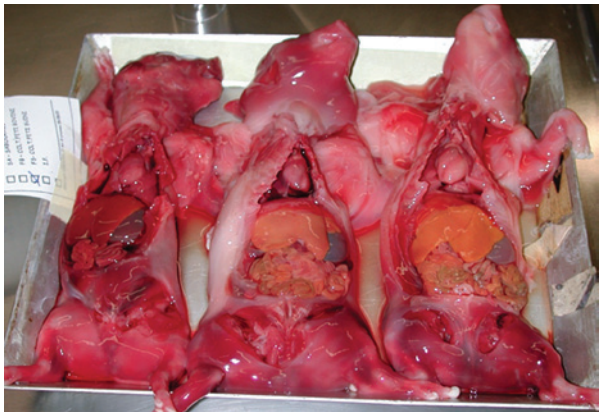

Figure 2: Fetuses from Porcine Reproductive Respiratory Syndrome Virus infection

Figure 4: Fetuses: abortions due to *Leptospira spp*.infection

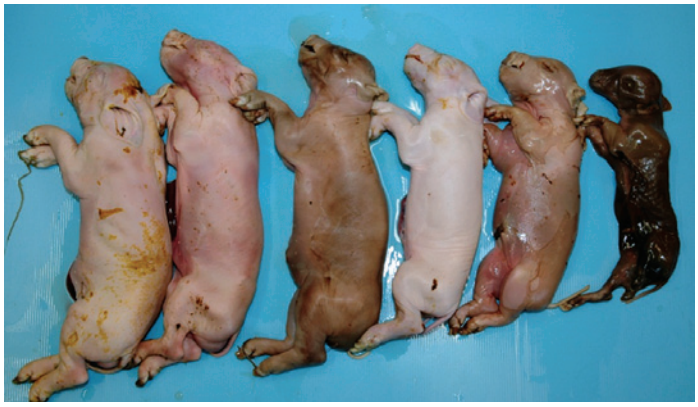

Figure 3: Aborted fetuses in the course of Classical Swine Fever outbreak

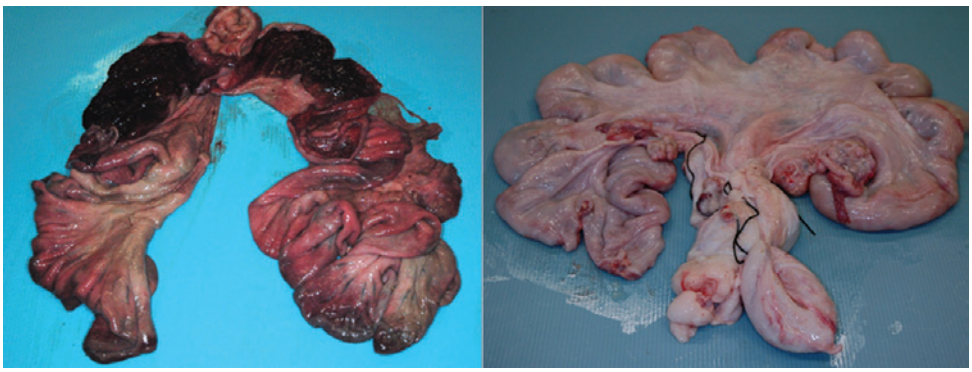

Figure 5: Uterine tracts of sows with infertility problems: endometritis

Table 6: Infectious diseases; vaccines availability; stages of pregnancy, categories of animals for whose protection we vaccinate.

	Disease considered	**Vaccination or treatment is intended to protect:**					
	type of vaccines available	**I third***	**II third***	**III third***	**sow**	**boar**	**offspring ****
Viral	Aujeszky disease (AD)	∨	∨	∨			∨ 10 w
	*MLV*****; *inactivated*; *marker*						
	Parvovirosis (PPV)	∨	∨				
	inactivated						
	Porcine Resp. Reprod. Syndrome (PRRS)	∨	∨	∨	∨	∨	∨ 4 w
	*MLV*****; *inactivated*;						
	Enterovirosis (Teschen - Talfan) (PEV)		∨	∨			∨ 4 w
	inactivated (*experimental vaccine*; *Germany*)						
	Encephalomyocarditis (EMC)	∨	∨	∨			∨ 4 w
	inactivated (*USA*)						
	Porcine Circovirus type 2 (PCV2)	∨					∨ 3 w
	sub-unit; *inactivated*						
	Swine Influenza (SIV)			∨	∨		
	inactivated; *different sub-types*						
	Classical Swine Fever (CSF)	∨	∨	∨	∨	∨	∨ 4-5 w
	*MLV****; *inactivated*; *marker*						
Bacterial	Leptospirosis		∨	∨			
	inactivated; *different sero-vars used*; *antibiotics*						
	Erysipelas			∨	∨	∨	∨ 1-2 w
	inactivated; *antibiotics*						
	Brucellosis			∨		∨	
	attenuated (*different strains used*); *inactivated*; *antibiotics not proven efficacious*						
Mixed bacterial diseases	Streptococcosis	∨					∨ 3-4 w
	inactivated; *different strains used*; *antibiotics*						
	Staphylococcosis	∨					∨ 3- 4 w
	vaccines not available; *antibiotics*						
	Escherichia coli infections	∨					∨ 1 w
	only for piglets protection against enteric diseases; *antibiotics*						

Notes: * third of pregnancy; ** protection of offspring until the indicated week of age; ***MLV: modified — attenuated live

is a subject on its own and therefore this review will focus on the therapeutic and prophylactic measures required in respect to the previously mentioned infectious diseases.

For reproductive diseases of sows there are viral and bacterial vaccines available and, in some cases, the integration with prophylactic use of antibiotics may be necessary.

The aim is to stimulate the immune system adequately and in advance to the expected risk period (33). This applies both to sows and boars but with some exceptions:

- reproductive cycle of the sow is short (2.2 – 2.4 cycles per year) compared to other livestock (1);
- some pathogens / diseases can affect the reproductive cycle of the sow in different periods;
- some pathogens / diseases can affect both the reproductive cycle of the sow and the offspring;
- immune response to vaccinations and/or "booster" by natural infection can vary considerably between pathogens;
- duration of immunity (DOI) against different pathogens induced by vaccines can vary considerably;
- for young breeders (mainly gilts and young boars) an "acclimatization" period with exposure – before breeding – to local pathogenic strains (33) in order to develop a local strain-specific immunity may be necessary. For some pathogens like PRRS, vaccination only may not be adequate.

Table 7: Stages of the reproductive cycle in young and adult breeders; vaccination schemes; alternative mass vaccination schemes for some antigens.

Vaccination according to reproductive stage & specific disease / pathogen				**Mass vaccination**
Weeks before insemination	**Comments**	**Gilts**	**Young Boars**	
10-12 weeks	first vaccination at 2 months age	CSF	Y	
8 weeks	can be combined together	*E.rhusiopathiae*	Y	boars only; 1 time year
		PPV	Y	
		Leptospira spp	Y/N	
6- 5 weeks	can be combined together	*E.rhusiopathiae*	Y	
		PPV	Y/N	
		Leptospira spp.	Y	
2-3 weeks	at least two antigens may be combined; all the three antigens require a prime vaccination at young age	AD	Y	1 booster in boars at 6 -7 months of age
		PRRS	Y	
		PCV 2	Y/N	
Days of pregnancy		**Gilts & Sows**	**Boars in service**	
85 – 90	can be combined together. (PCV2 not always practised)	AD	Y	3 times year; MLV better
		PCV2	Y	boars only; 2 times year
	(PRRS inactivated only!)	PRRS	Y	3 - 4 times year; MLV better
Days of lactation		**Sows**		
2nd week	MLV or inactivated	CSF		MLV: 1 time year; not in last month of pregnancy. Inactivated: 2 times year
3rd week	can be combined together	*E.rhusiopathiae*		
		PPV		
		Leptospira spp.		periodic antibiotic treatments
3rd to 4th week	not always practised; in alternative to pre-farrowing	PCV2		

Y=Yes & N = No

Table 6 above summarizes vaccinations and antibiotic treatments for each pathogen / disease.

The application of a plan to control reproductive infectious diseases in sows must take into account the presence or the specific disease, the economic rationale, the possibility to discriminate between animals positive from vaccination or infection (e.g. ADV, CSF) and the reproductive stage of the animals. For most of the diseases it is necessary to immunize young or future breeders well in advance with respect to the beginning of their reproductive life, e.g. first insemination (for example *E. rhusiopathiae*, PPV, AD and PPRS where present). For some diseases like AD, PPRS, mass immunization of all the breeding-stock at once, irrespective of pregnancy status, with quarterly or semiannual boosters, is considered more efficacious than vaccination of breeding stock according to their reproductive phases (32). For this type of choice, generally, vaccination schemes with modified live vaccine are considered of higher efficacy than inactivated vaccines; in the case of PRRS a combination of both live and inactivated vaccine would be the best approach (32).

Pigs naturally infected by certain viruses may serve as carriers of the pathogens over a long period of time (as in CSF) or even enduringly (as in AD), and therefore serving as a threat for the herd. This is particularly true for breeders (sows and boars) which remain in the herd for a relatively long time and perpetuate the shedding to their offspring. When a "vaccinate – test – removal" strategy is adopted in order to individuate (and eliminate) carrier animals and reduce their number (or percentage) in the herd, the use of so called "marker vaccines" is a priority. These vaccines are made with a virus that lacks specific glycoproteins (most commonly gE-, or gG- or gC-deleted vaccines) (33). Or, alternatively, they employ a single glycoprotein as immunogen (34) and the vaccines, therefore, do not contain any other virus component with immunogenic activity (34). These gene-deleted marker vaccines have the advantage over conventional whole

Table 8: Bacteriological investigations results in uterine horns in 43 farms (3, modified)

Pathogens	Farms examined	% of farms affected
E. coli	7	16.3
Proteus spp.	1	2.3
Staphylococcus spp.	1	2.3
Streptococcus spp.	6	14.0
Positive	15	34.9
Negative	28	65.1

virus vaccines making it possible to distinguish non-infected vaccinated animals from those with field infection (33, 34). This is done by testing for the antibodies directed against the proteins coded by the deleted (or missing) genes, which will be absent in non-infected marker vaccinated pigs but present in field infected pigs (33, 34). Regular and intensive vaccination plans with marker vaccines accompanied by routine serological tests to identify breeders which were in contact with the wild virus, allows their elimination from the unit and substitution with pathogen-free young breeders.

For some diseases like leptospirosis vaccination alone is only able to induce agglutination and neutralization antibodies, while those bacteria harbored in the kidneys remain unexposed to the immune response. When antibody titers decrease, *Leptospira* may recirculate in the blood, reaching the pregnant uterus and colonizing the fetuses, inducing embryonic death, abortion or still-birth. In such circumstances repeated prophylactic mass treatments (5 days of treatment every 45-60 days) with tetracyclines as feed medication at high dosages (1200 to 1800 ppm) or 10g/head/day for 15 days every 3 months (36) are necessary. Elimination of kidney-carrriers or "attack" therapy in course of an outbreak may be achieved with parenteral treatments with Streptomycin (25mg/kg), Tylosin (44mg/kg), Erythromycin (25mg/kg) for 3-5 days (8).

When mass vaccination is preferred, for some modified live vaccines, the vaccination in last month or phase of pregnancy is not recommended (e.g. CSF, PRRS). In this case breeders in last stage of pregnancy skip the vaccination and receive it after farrowing or immediately before weaning or at the end of lactation period.

Table 7 above presents vaccinations systems according to the reproductive cycle or as mass-vaccination, in young and adult breeders against the most common reproductive diseases.

It should be emphasized that bacterial infections play a significant role in the incidence of reproductive diseases (12, 13) and for these pathogens hardly any vaccines are available. Table 8 above, as an example, summarizes the incidence of bacterial diseases in farms examined for reproductive problems in North Italy in 2004-2006 (3). One third of examined farms were positive to all the pathogens examined, while for two thirds the results were inconclusive, leaving the therapeutic approach to the specific knowledge of the farm to the Veterinarian, or in extreme cases, eliminating chronically unsuccessful breeders. In general, sows submitted to therapy for reproductive problems and still failing to conceive three consecutive times at insemination are definitely classified as "unproductive" and reformed.

CONCLUSION

In this article we have summarized the main reproductive problems in sows, with particular reference to different reproductive phases. While a great part of reproductive problems still remain linked with good management practices (32, 35), the main infectious diseases and pathogens involved in reproductive failures have been illustrated.

It should be emphasized that observation of urinary and reproductive tracts from retired breeders at slaughter, may successfully integrate the collection of further data for a more precise diagnosis of reproductive failures and disease in sows.

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