Rev. sci. tech. Off. int. Epiz., 2010, **29** (3), 639-648

Swine vesicular disease in northern Italy: diffusion through densely populated pig areas

S. Bellini*, L. Alborali, G. Zanardi, D. Avisani, V. Bonazza & E. Brocchi

Italian Reference Centre for Vesicular Diseases – OIE Reference Laboratory for Swine Vesicular Disease – Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna – Via Bianchi 9, 25124 Brescia, Italy
*Corresponding author: silvia.bellini@izsler.it

Submitted for publication: 25 February 2009
Accepted for publication: 24 February 2010

Summary

At the end of 2006, a recrudescence of swine vesicular disease (SVD) was recorded in Italy and the disease spread widely throughout the northern regions. Lombardy, a densely populated pig area, was most affected and the presence of the disease caused heavy economic losses to the entire pig industry. Although SVD is considered only moderately contagious, the epidemic in the north was characterised by a rapid spread of the condition. Numerous difficulties were encountered in eradicating it.

Over the past decade, there has been a significant increase in the population of pigs in Lombardy, concentrated mainly in a few areas which were the most severely affected during the 2006 to 2007 SVD epidemic. Increases in both the pig population and animal movements, combined with weak biosecurity measures, increased the spread rate of the disease and hampered eradication activities.

Keywords

Biosecurity – Densely populated area – Eradication – Italy – Lombardy – Pigs – Surveillance – Swine – Swine vesicular disease.

Introduction

Swine vesicular disease (SVD) is an infectious disease of pigs, caused by an *Enterovirus* of the *Picornaviridae* family (11). Swine vesicular disease is characterised by vesicular lesions on the feet, snout, lips and tongue and may be difficult to distinguish from foot and mouth disease (FMD). For this reason, SVD was included in the former List A of diseases by the World Organisation for Animal Health (OIE). However, compared to FMD, SVD is considered to be only moderately contagious, morbidity is lower and the lesions are less severe.

Swine vesicular disease does not cause severe production losses but it is of major economic importance, since control and eradication measures are costly, and countries which are known to have the disease face embargoes on the export of pigs and pig by-products.

The first outbreak of SVD was recognised in Italy in 1966. The virus was isolated in Hong Kong in 1971 and the disease again occurred in the United Kingdom (UK) in 1972. Subsequent outbreaks were reported in a number of other European and Far Eastern countries in the 1970s, 1980s and 1990s. In Europe, outbreaks affected the Netherlands, Spain, Portugal and Italy in the early 1990s (5, 9). Since then, only Italy and Portugal have reported cases. Reports have been persistent in Italy while the disease has occurred only on two isolated occasions in Portugal (2003, 2007) (8). The last reported case of SVD from the Far East was in Chinese Taipei in 2000.

Eradication programmes against SVD have been implemented in Italy since 1995. Central and northern areas of Italy are recognised as SVD-free and have maintained this status since 1997; however, other regions, mainly in the south, have never attained disease-free status (3).

The last SVD epidemic in Lombardy was recorded in 2002 and brought under control in one month. Once eradication activities had been completed, extraordinary surveillance plans were implemented to verify the SVD-free status of the region (13).

At the end of 2006, a recrudescence of SVD was recorded in Italy and the disease spread widely in the northern regions of Italy. Lombardy, a densely populated pig area, was most affected. Fifty-three outbreaks were detected and some 150,000 pigs were culled (Figs 1 & 2). The epidemic in the north was characterised by rapid spread and difficulties were encountered in eradicating the disease. According to the epidemiological investigations carried out during the outbreaks, spread among farms principally occurred through typical routes of transmission. Nevertheless, in this small, densely populated area, SVD acquired an endemic trend and it was necessary to depopulate a group of pig farms to achieve eradication.

In this paper, the authors present some descriptive epidemiological features of the 2006 to 2007 SVD epidemic in Lombardy, including the most likely routes of SVD transmission. Sampling procedures conducted in suspected cases of SVD are described and the measures used to achieve eradication are discussed. The paper ends with some concluding remarks and lessons to be learned from this epidemic.

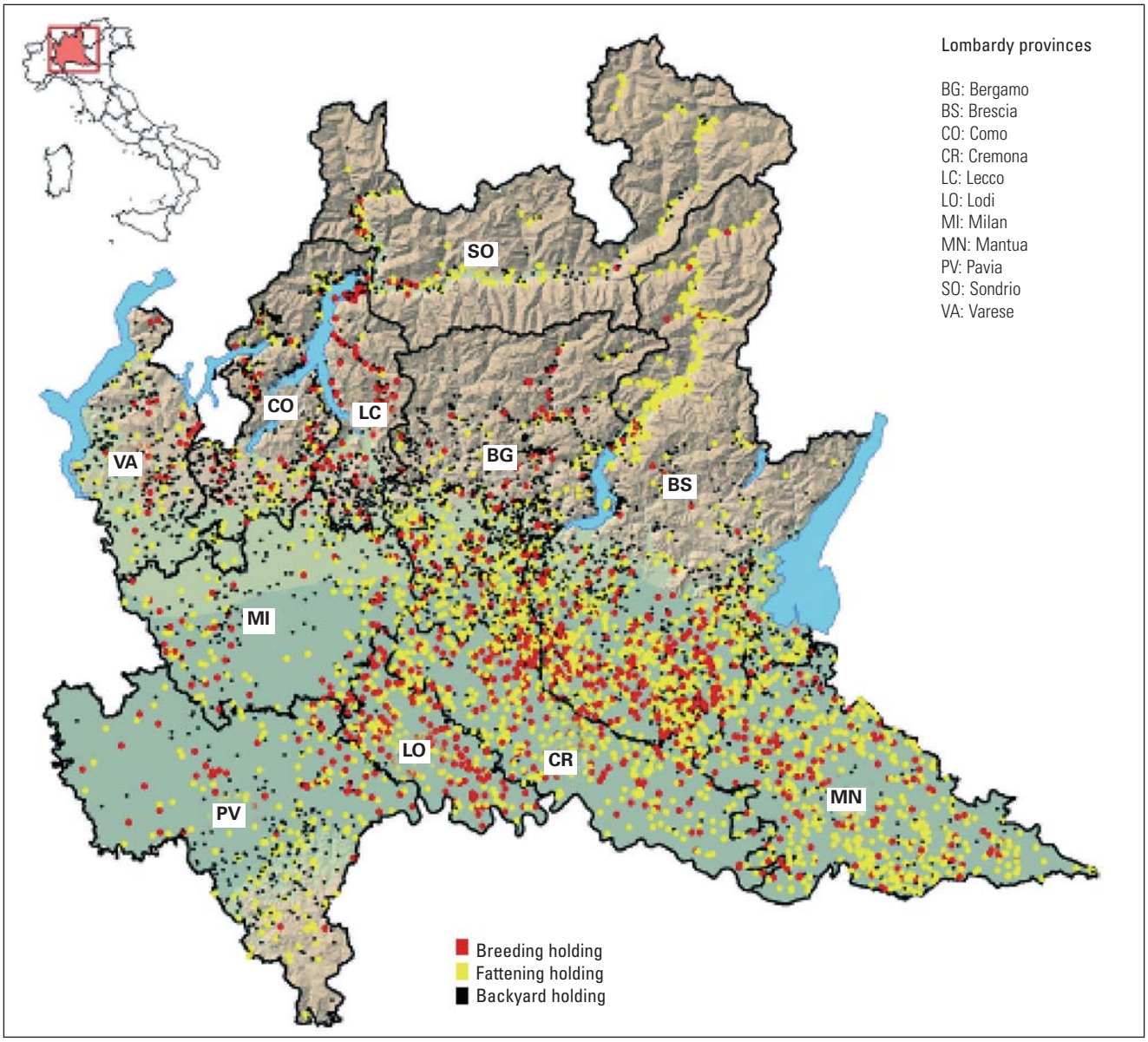

Fig. 1
Lombardy region by provinces – distribution of swine holdings

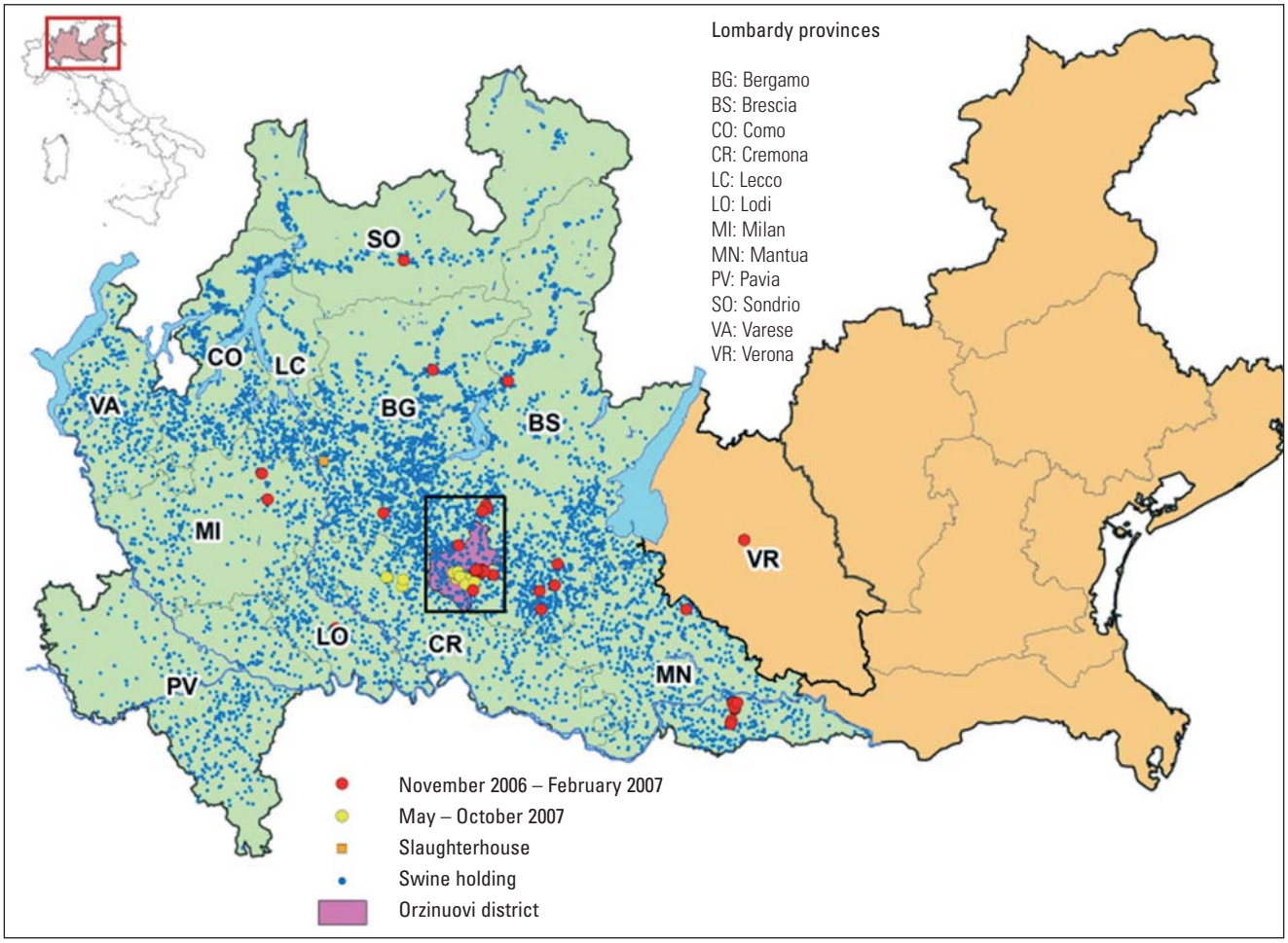

Fig. 2
Swine vesicular disease outbreaks in Lombardy region, 2006 to 2007 epidemic

Materials and methods

Description of the area: the Lombardy region

Lombardy is a region of the northern part of Italy, with intensive livestock husbandry. Pig production is one of the most important sectors of this livestock production. The region has a surface area of 23,860.62 km² and is divided into 11 provinces. The pig population is about five million, bred in 7,600 holdings, and represents 35% of the national pig population. The regional pig density is 186.6 animals per km². The most intensively farmed provinces are:

– Brescia (1,641 farms, 1,437,490 pigs)
– Mantua (766 farms, 1,229,858 pigs)
– Cremona (501 farms, 1,034,391 pigs).

The province of Brescia is the most densely populated and, in some areas, pig density is more than 2,500/km² (Fig. 1).

The national surveillance plan

Surveillance and eradication activities against SVD have been implemented in Italy and the aim of the programme is to achieve eradication. The national plan takes into account that the disease often takes a sub-clinical course; therefore, surveillance is based on laboratory testing.

Surveillance activities are differentiated according to the health status of the region (SVD-free or not) and also take into consideration the various production cycles. In fact, different farming operations play different roles in the spread of the disease (1, 3), depending on:

– their production cycle
– their animal management methods
– the frequency of their animal and vehicle movements.

The national surveillance plan is updated annually, according to the epidemiological situation, and submitted for approval to the European Union (EU) Commission.

To aid in collecting and analysing the data gathered during SVD surveillance, a web-based integrated information system was established to manage the national surveillance plan (2).

Laboratory diagnosis

In Italy, laboratory diagnosis is conducted according to the rules laid down in European Commission Decision 2000/428 (6) and the guidelines of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (12).

Eradication measures

Swine vesicular disease control measures follow the EU guidelines established by European Council Directive 92/119/EEC, Annex II (7).

Investigation into suspected cases of swine vesicular disease

A pig smallholding was considered to have suspected cases of SVD when:

– it contained animals with clinical signs of SVD

– animals testing seropositive for SVD were identified

– an epidemiological connection with a confirmed outbreak of SVD was established.

If pigs showed clinical signs of SVD, a differential diagnosis between FMD and SVD was immediately carried out to distinguish between the two diseases. Very sensitive and specific tests are now available for SVD diagnosis and to differentiate between the two viruses (12).

A pig holding suspected of having SVD was inspected by the official veterinarian to either confirm or rule out the presence of the disease. Any positive finding was immediately followed up, using appropriate clinical, epidemiological, serological and virological investigations.

In the case of a seropositive result, identifying the isotype of the antibody present in the sera was helpful in both the diagnosis and also in evaluating the epidemiological meaning of the results.

In fact, sera from recently infected pigs usually contain only specific immunoglobulin M (IgM). Subsequently, both IgM and IgG are found and, later, exclusively IgG can be identified. The presence of IgM, alone or together with IgG, is evidence of recent infection and indicates virus shedding, while detection of IgG alone suggests older exposure to infection (12).

Clinical examination

The aim of the clinical exam was to recognise clinical signs of SVD, such as:

– fever

– limping

– vesicular lesions on the limbs and/or snout.

To detect the disease, a statistically significant number of pigs (P: 5%, c.i.: 95%) were checked. The choice of which pigs to test was guided by the results of laboratory testing and the epidemiological findings. Clinical examinations were made on pigs that:

– had tested seropositive or been in contact with seropositive animals. Sera from pigs in the acute phase of SVD usually contain IgM. Thus, clinical examination was targeted at IgM-positive animals and pigs living in their proximity;

– had been in contact or were otherwise epidemiologically associated with a confirmed outbreak of SVD, plus pigs in contact with these animals.

Clinical exams were carried out on both breeder and grower pigs. When pigs were housed in a dirty environment, it was necessary to clean their skin, using running water. When light was poor, a torch was used.

Sampling procedure

The following procedures were adopted.

In a pig holding with a suspected clinical case:

– samples were taken from the epithelium and vesicular fluid was taken from unruptured or freshly ruptured vesicles for virological testing;

– a faecal sample was taken for virological testing, from the floor of the pen containing animals suspected of having SVD, and/or faecal samples from live pigs with suspected SVD. Two to four samples were recommended, in addition to the epithelium;

– blood samples were taken from the suspect animals for serological testing, as well as from a statistically significant number of pigs (P: 5%, c.i.: 95%). These included samples from in-contact pigs, living in the same pens or in neighbouring pens.

In a pig holding where a pig tested seropositive for SVD:

– blood samples were taken for serological testing from a statistically significant number of pigs (P: 5%, c.i.: 95%).

These included blood samples from animals which tested seropositive during the previous sampling, as well as in-contact animals;

– faecal samples were taken for virological testing from the floor of the pen containing suspect animals, as well as faecal samples from seropositive pigs. If the sera contained IgM, suggesting acute infection, faecal samples were collected from both IgM-positive animals and the pens in which they were housed. Collection of up to ten samples was recommended.

In a holding epidemiologically connected with an SVD outbreak:

– blood samples were taken for serological testing from the suspected cases (those linked to the confirmed outbreak), plus a statistically significant number of pigs (P: 5%, c.i.: 95%). These included samples from animals which had been in contact with the suspected cases;

– faecal samples were taken for virological testing from the pigs which had been in contact, or were otherwise epidemiologically associated, with a confirmed outbreak. Samples were also taken from the floor of the pen where they had been housed, if the pigs themselves were no longer present.

Declaration of an outbreak of swine vesicular disease

The declaration of an SVD outbreak follows the rules laid down in Council Directive 92/119/EEC (7).

Epidemiological investigation

When SVD was detected, the official veterinarian carried out an epidemiological investigation to establish:

– the length of time for which SVD may have been present on a holding before being suspected or notified

– the possible origin of the disease on the holding and the identification of other holdings where there were animals suspected of being infected or contaminated

– the movement of animals, vehicles, people, carcasses, equipment or other items likely to have carried the disease agent to or from the holdings in question (7).

A specific form was developed for the epidemiological investigation and is included in the national surveillance plan for SVD.

Results

The swine population in Lombardy

Over the last decade, an increase in the pig population has been recorded in Lombardy. As a matter of fact, about three million pigs were bred in 1997, as opposed to five million in 2008, meaning that, in ten years, the pig population has increased by two-thirds. In the same period, pig density varied from 120.7 to 186.6 pigs/km^2. In Brescia, about 1,500,000 pigs are bred and thus this province has the highest pig and herd densities in Italy. Intensive breeding predominates in some areas of the province, where the density of pigs may reach 3,000/km^2 (Fig. 1).

Surveillance and eradication activities

On 2 October 2006, after SVD had been absent from the region for four years, 11 pigs tested seropositive in a slaughterhouse in the province of Bergamo, which processed animals from various sources. Although the detection of IgM in these animals was suggestive of a recent infection, the attempt to identify SVD virus (SVDV) in the abattoir did not succeed. In fact, the lairage facility of the slaughterhouse, where the seropositive animals were stabled before slaughtering, had already been cleaned and disinfected by the time that floor faecal samples were collected. The holdings from which the seropositive pigs came were investigated for SVD. A dealer's premises in the province of Verona (the Veneto region) were eventually shown to be the source of the virus (Fig. 2). While tracing back from the dealer's premises, outbreaks were also identified in Veneto and Lombardy. The disease was promptly eradicated in Veneto, while in Lombardy it spread for more than one year.

Based on epidemiological investigations and serological findings, SVD had probably been present in Lombardy since August 2006. However, official investigations were unable to definitively identify the primary outbreak. Moreover, SVD often takes a sub-clinical or undisclosed course, and tracing the origin of an infection may be difficult. As a matter of fact, SVD was recognised in Lombardy because of an active surveillance programme based on laboratory testing.

In the period between November 2006 and October 2007, 53 outbreaks were detected in Lombardy and 142,705 pigs were culled. The size of the mean outbreak was 2,784 animals (minimum: 15; maximum: 8,844). Forty-nine percent of these outbreaks were identified on breeding farms, 43.3% on fattening farms, 5.6% on dealers' premises and one outbreak was detected in a slaughterhouse.

The SVD outbreaks reported in Lombardy from 2006 to 2007 may be grouped in two epidemic periods: the first one lasted from November 2006 to February 2007; the second from May 2007 to October 2007 (Fig. 2).

During the first period, 36 outbreaks were identified. The provinces affected were:

– Brescia (20)
– Mantua (10)
– Bergamo (2)
– Lodi (1)
– Milan (2)
– Sondrio (1).

By February, the outbreak seemed to have been controlled and eradication achieved. However, in May, after an epidemiological silence of about three months, the disease reappeared on a farm in Cremona, a province not affected in the previous epidemic period.

During the second epidemic period, 17 outbreaks were identified. The provinces involved were:

– Brescia (12)
– Cremona (4)
– Bergamo (1).

During this second period, apart from the outbreak identified in the slaughterhouse at Bergamo, all the outbreaks occurred in a limited area, partially covering the provinces of Brescia and Cremona. Brescia was most severely affected in both periods; in all, 98,425 animals were culled.

During the two epidemic periods, there were marked differences in the success rate of tracing the origin of the infection. According to epidemiological investigations, during the first epidemic period, the source of the infection was established in 94.4% (34/36) of outbreaks. These sources included:

– the introduction of infected pigs (in 12 outbreaks)

– the introduction of contaminated haulage vehicles (11)

– proximity to other outbreaks (in the same epidemiological unit or the use of contaminated manure as fertiliser on agricultural land) (8)

– visits from contaminated personnel: veterinarians, inseminators, workers (3).

In two cases the origin of the infection remained unknown.

During this first period, an important role in the spread of the disease was played by a 'multi-site management system' operation. The disease was introduced onto site one (breeding unit), with a weekly turnover of piglets, and caused 12 secondary outbreaks. In all, 40,494 pigs were culled. The development of such a specialised production system brought about improvements in pig farming and in managing certain pathologies. However, the extreme specialisation of the system implied a fragmentation of the production cycle with an increase in animal movements, one of the main risk factors for the spread of disease.

During the second epidemic period, the source of infection was established in only 35.3% (6/17) of cases. These sources were related to:

– outbreaks occurring on different sites of the same epidemiological unit (5)

– visits from contaminated personnel: veterinarians, inseminators and workers (1).

With one exception, the origin of infection could only be established when other holdings owned by the same company were checked and found positive. In 11 (64.7%) of the outbreaks, the source of infection remained unknown. Eight primary outbreaks were located in a small area (27 km^2) of the province of Brescia, the Orzinuovi District, and the municipalities involved were those most densely populated with pigs (more than 3,000 pigs per km^2). In this area, the average minimum distance between the outbreaks was 0.78 km (minimum: 0.57 km; maximum: 1.01 km) (Fig. 2).

Even though the possibility of infection at the trough, through the ingestion of contaminated meat, is reported in the literature, swill feeding was not found to be among the causes of disease spread in this epidemic. Swill feeding is prohibited in Italy and, in any case, it is not customary in intensive pig farming.

During the epidemiological investigation, biosecurity measures adopted during the outbreaks were checked and some farm operations were found to have weak biosecurity measures.

Over the first epidemic period, SVD spread among farms through typical routes of transmission and the measures established by Council Directive 92/119/EEC succeeded in eradicating the disease (Fig. 3). During the second period, however, the disease acquired an endemic trend in a small area of the Orzinuovi District, where it spread despite control measures, including a ban on animal movement (Fig. 4). The main risk factor for these outbreaks was proximity to a previous outbreak. In this area, it was necessary to depopulate 15 farms (42,205 pigs) considered at risk of infection, to eradicate the disease. Other holdings were located in the area but they were empty at the time of the epidemic (Fig. 5).

Once eradication had been achieved in the depopulation area, each pig holding in Brescia had to regain its SVD-free

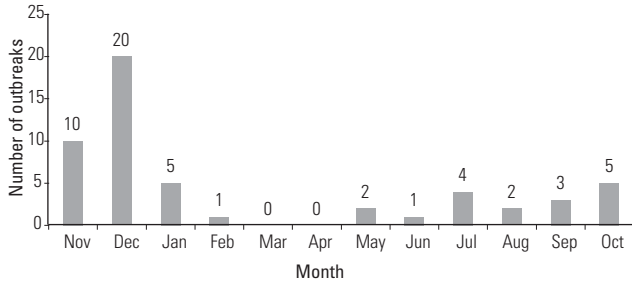

Fig. 3
Swine vesicular disease outbreaks in Lombardy: November 2006 to October 2007

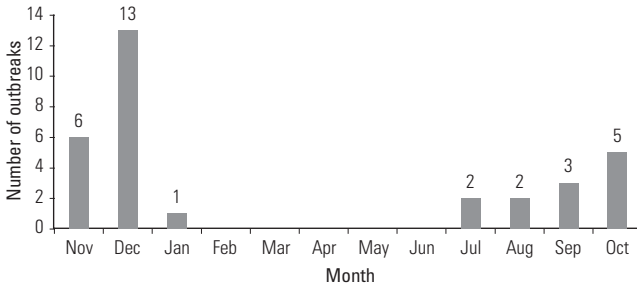

Fig. 4
Swine vesicular disease outbreaks in Brescia province: November 2006 to October 2007

status, through two rounds of serological testing, 28 to 40 days apart (P: 5%, c.i.: 95%). In the depopulation area, restocking was allowed only after a six-month 'stand-still' period and only those holdings that met the established biosecurity guidelines were authorised to restock.

Surveillance conducted in Lombardy indicated that the two epidemic periods were not completely separate. In fact, the detection of seropositive holdings in the provinces of Lecco, Brescia, Cremona and Bergamo between the two periods supports the hypothesis that eradication was not completely achieved during the first period and residual infection remained in the region. Nucleotide sequencing was performed on the viral protein 1-coding and 3D-coding regions of six SVDV isolates from the first epidemic period and 12 isolates from the second. Phylogenetic analysis provided evidence that the SVDV isolates from the two periods were strictly related, despite forming two distinguishable clusters (E. Brocchi, unpublished findings). All belonged to the genetic lineage that typically evolved only in Italy, from known ancestral viruses, and which is clearly distinguishable from other simultaneously circulating strains, including recent isolates from Italy and Portugal (4).

Only three outbreaks were detected on the basis of clinical signs of disease. However, according to the official reports,

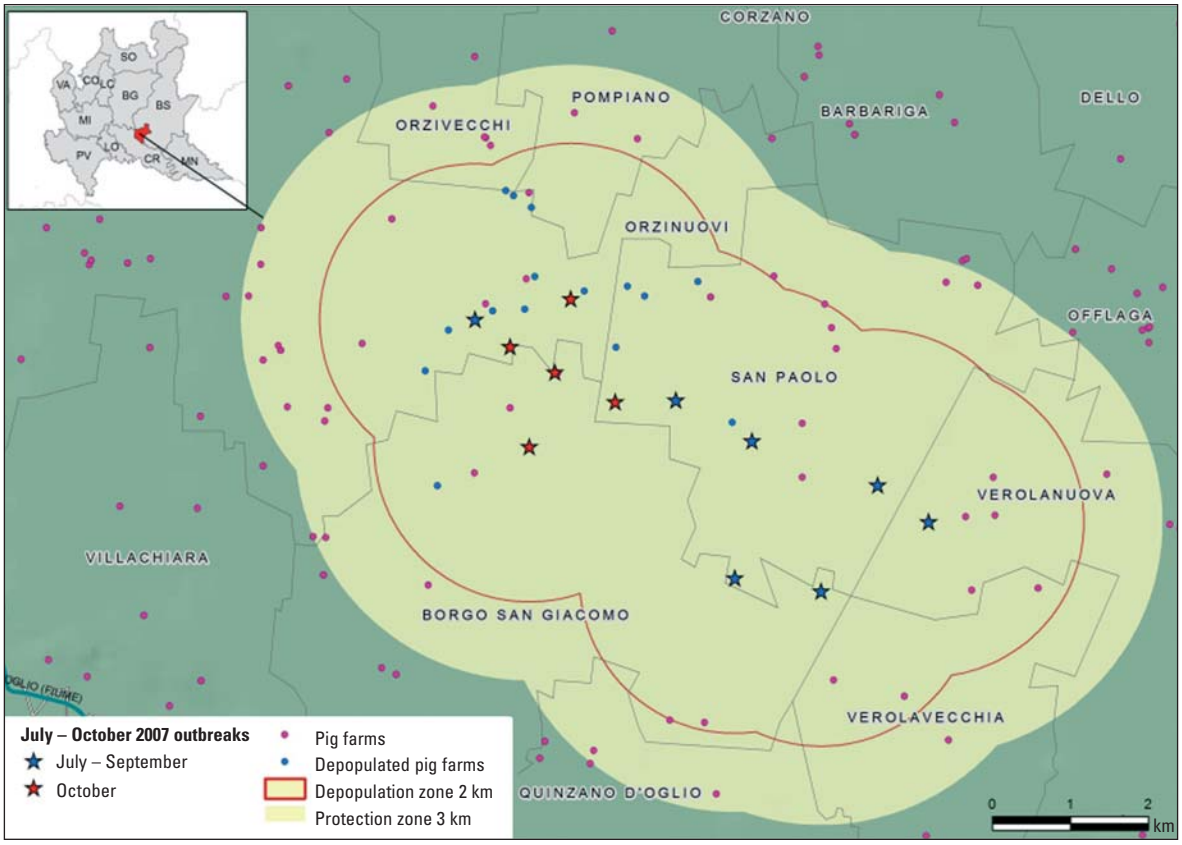

Fig. 5
Orzinuovi District – depopulation area

during the official inspection clinical signs were observed in 27 outbreaks (50.9%). The farms in the areas selected for examination were chosen on the results of laboratory testing and/or evidence of a correlation with a previous outbreak. In the 32 outbreaks detected in the province of Brescia, a clinical exam, carefully conducted on an individual basis, was carried out on at least 59 animals (P: 5%, c.i.: 95%). In some outbreaks, all of the animals were checked. Vesicular lesions on the snout and/or limbs were detected in 22 outbreaks (68.7%).

In some large fattening holdings, where the production cycle did not involve the movement of pigs within the farm, infection remained limited to particular pens. Sometimes the sampling protocol for serological testing (P: 5%, c.i.: 95%) was unable to detect such infection, especially when the disease was in its early stages. For these operations, it was necessary to undertake more sensitive sampling and a scheme to sample the pens was provided.

Conclusions

There has been a significant increase in the population of pigs in Lombardy over the past decade. The animals are concentrated in a limited number of areas and, in some municipalities, the pig density reaches more than 3,000 pigs/km^2. The development of densely populated livestock areas has considerable economic advantages. Nevertheless, it has also increased the risk of the introduction and spread of major epidemic diseases.

Swine vesicular disease was included on the former List A of notifiable diseases by the OIE, although the disease is considered to be only moderately contagious, even between pens of the same infected holding (9). However, the 2006 to 2007 epidemic of SVD in Lombardy was characterised by a rapid spread among farms, which created serious difficulties in eradicating the disease. During this epidemic, the most densely populated areas were also the most affected.

Spread among the farms occurred mainly by the typical routes of transmission. Nevertheless, in a small area (27 km^2), with a high stocking density, SVD acquired an endemic trend and the measures established by Council Directive 92/119/EEC did not succeed in eradicating the disease. Eradication was achieved instead by depopulating a group of pig farms. In this area, the main risk factor for the outbreaks was proximity to a previous outbreak.

Epidemiological investigations carried out during the outbreaks indicated that biosecurity measures were weak and farms were sometimes exposed to different routes of infection. The increase of both the pig population and animal movements, combined with weak biosecurity measures, probably increased the rate of disease spread and hampered eradication measures.

Signs of SVD were observed in 50.9% of the outbreaks. Clinical exams were undertaken, according to the results of laboratory testing and the outcome of epidemiological investigation. Only on three occasions was a suspected outbreak identified on the basis of clinical signs; the remaining 50 outbreaks were detected during surveillance and eradication activities, which are based on laboratory testing. This could be due to the mild course of the disease, even though there was evidence of active infection on the pig farms.

According to Council Directive 92/119/EEC, implemented in 1992 and never afterwards updated, suspicion of SVD and related control measures should be based on clinical evidence (7). This is no longer adequate. In fact, due to the sub-clinical course of the disease, clinical examination is often ineffective and unsuited for surveillance of SVD. Swine vesicular disease virus infection can only be detected or excluded through laboratory investigation. Therefore, serosurveillance is essential to detect sub-clinical or undisclosed clinical infection and to demonstrate the absence of the virus.

Intensification of pig farming has exerted great pressure on the health status of pigs and respiratory diseases constitute one of the main causes of economic loss for the farmer. In certain intensive breeding areas, an integrated system has been developed for pig production. This system, when compared to the traditional cycle, is considered more specialised and has improved the management of swine holdings, reducing health problems related to post-weaning and reproductive diseases, such as porcine circovirus diseases, porcine reproductive and respiratory syndrome and multifactorial diseases (10). However, the extreme specialisation of this system implies a fragmentation of the production cycle, with an increase in animal movement, which is one of the main risk factors for disease spread. To take full advantage of the undisputed benefits brought by this production system, it is essential to strengthen biosecurity measures. This safeguard is particularly important when these holdings are located in densely populated areas.

The national surveillance programme activities have been updated and reviewed, taking into consideration the crucial points highlighted during the 2006 to 2007 epidemic. Biosecurity guidelines for pig holdings have been included in the programme.

The presence of SVD in northern Italy during the period 2006 to 2007 caused heavy economic losses to the entire pig industry, due to controlling and eradicating the disease

and also as a consequence of the ban on the exportation of live animals and pork products. Scenarios could have been catastrophic if, instead of SVD, a more contagious disease had been introduced. The events in northern Italy during this epidemic provide a sobering example of the serious risks that may be encountered by the pig industry, when highly contagious diseases are introduced into densely populated areas. Interventions must be rapid and effective, and these adjustments must be made in 'peace time'.

■

La maladie vésiculeuse du porc en Italie septentrionale : propagation dans les zones à forte densité porcine

S. Bellini, L. Alborali, G. Zanardi, D. Avisani, V. Bonazza & E. Brocchi

Résumé
À la fin de l'année 2006, une recrudescence de la maladie vésiculeuse du porc a été enregistrée en Italie, avec un taux élevé de propagation dans les régions septentrionales. La région la plus affectée, à savoir la Lombardie, possède une importante population porcine. La maladie a eu des répercussions économiques graves sur tout le secteur porcin. Bien que la maladie vésiculeuse du porc soit considérée comme étant modérément contagieuse, l'épidémie dans le nord du pays s'est caractérisée par une propagation rapide. L'éradication s'est heurtée à de nombreuses difficultés.
En Lombardie, la population porcine a considérablement augmenté durant les dix années écoulées, avec une forte concentration dans quelques zones circonscrites qui ont aussi été les plus gravement touchées par l'épidémie de 2006 et 2007. Cette augmentation de la population de porcs, associée à un nombre accru de déplacements d'animaux et à un niveau médiocre de biosécurité explique la hausse du taux de propagation de la maladie et a rendu les mesures d'éradication plus difficiles à appliquer.

Mots-clés
Biosécurité – Éradication – Italie – Lombardie – Maladie vésiculeuse du porc – Porc – Porcin – Surveillance – Zone à forte densité animale.

■

Difusión de la enfermedad vesicular porcina en zonas de elevada densidad de población porcina del norte de Italia

S. Bellini, L. Alborali, G. Zanardi, D. Avisani, V. Bonazza & E. Brocchi

Resumen
A finales de 2006 se registró en Italia un recrudecimiento de la enfermedad vesicular porcina y su diseminación generalizada por las regiones septentrionales del país. Lombardía, una zona de elevada densidad de población porcina, fue la región más afectada, con graves pérdidas económicas en todo el sector porcino a causa de la enfermedad. Aunque se considera que esta patología es moderadamente contagiosa, una de las características de la epidemia en el norte de Italia fue su rápida propagación. Hubo muchas dificultades para erradicarla.

En el último decenio la población porcina ha aumentado considerablemente en Lombardía, concentrándose sobre todo en unas pocas zonas que fueron las más afectadas durante la epidemia de 2006 a 2007. El crecimiento de la cabaña porcina y la intensificación del movimiento de animales, aunados a la debilidad de las medidas de seguridad biológica, acrecentaron el ritmo de propagación de la enfermedad y dificultaron las acciones de erradicación.

Palabras clave
Cerdo – Enfermedad vesicular porcina – Erradicación – Italia – Lombardía – Porcino – Seguridad biológica – Vigilancia – Zona de elevada densidad de población.

References

1. Bellini S., Boldini M. & Zanardi G. (2006). – Swine vesicular disease: biosecurity measures to apply in farms to avoid virus incursion and diffusion. *In* Proc. 11th Symposium of the International Society for Veterinary Epidemiology and Economics (ISVEE), 13-15 August, Cairns, Australia.

2. Bellini S., Ferrarini N. & Santucci U. (2006). – Implementation of an integrated information system for the management of surveillance activities for swine vesicular disease in Italy. *In* 1st OIE International Conference on 'Use of Geographic Information Systems (GIS) in Veterinary Activities', 8-11 October, Silvi Marina, Teramo, Italy. OIE, Paris.

3. Bellini S., Santucci U., Zanardi G., Brocchi E. & Marabelli R. (2007). – Swine vesicular disease: considerations on the surveillance and eradication activities carried out in Italy. *Rev. sci. tech. Off. int. Epiz.*, **26** (3), 585-593.

4. Brocchi E., Grazioli S., Barbieri I., Bugnetti M., Wilsden G. & Knowles N.J. (2007). – Molecular epidemiology of swine vesicular disease viruses isolated in Italy over 15 years (1992-2006). *In* Proc. 1st Annual Meeting Network of Excellence for Epizootic Disease Diagnosis and Control (EPIZONE), 30 May – 1 June, Lublin, Poland, 58 pp.

5. Dekker A. (2000). – Pathogenesis, diagnosis and epizootiology of swine vesicular disease. A PhD thesis submitted to Utrecht University, Netherlands.

6. European Commission (2000). – Commission Decision 2000/428/EC of 4 July 2000 establishing diagnostic procedures, sampling methods and criteria for the evaluation of the results of laboratory tests for the confirmation and differential diagnosis of swine vesicular disease. *Off. J.*, **L 167**, 7/7/2000, 22-32.

7. European Council (1992). – Council Directive 92/119/EEC of 17 December 1992 introducing general Community measures for the control of certain animal diseases and specific measures relating to swine vesicular disease. *Off. J. Eur. Communities*, **L 62**, 69-86.

8. Knowles N.J., Wilsden G., Reid S.M., Ferris N.P., King D.P., Paton D.J., Fevereiro M. & Brocchi E. (2007). – Reappearance of swine vesicular disease virus in Portugal. *Vet. Rec.*, **161** (2), 71.

9. Lin F. & Kitching R.P. (2000). – Swine vesicular disease: an overview. *Vet. J.*, **160** (3), 192-201.

10. Madec F., Rose N., Grasland B., Cariolet R. & Jestin A. (2008). – Post-weaning multisystemic wasting syndrome and other PCV2-related problems in pigs: a 12-year experience. *Trans. emerg. Dis.*, **55** (7), 273-283. E-pub.: 10 July 2008.

11. Nardelli L., Lodetti E., Gualandi G.L., Burrow R., Goodridge D., Brown F. & Cartwright B. (1968). – A foot and mouth disease syndrome in pigs caused by an Enterovirus. *Nature*, **219** (5160), 1275-1276.

12. World Organisation for Animal Health (OIE) (2008). – Swine vesicular disease, Chapter 2.8.9. *In* Manual of standards for diagnostic tests and vaccines, 6th Ed. OIE, Paris, 1139-1145.

13. Zanardi G., Bellini S., Tranquillo V.M., Avisani D. & Bonacina C. (2003). – Epidemiological features of swine vesicular disease (SVD) outbreaks in the Lombardy region (Italy) in 2002. *In* Proc. 10th Symposium of the International Society for Veterinary Epidemiology and Economics (ISVEE), 17-21 November, Viña del Mar, Chile.