



# FOCUS ON...

## Porcine reproductive and respiratory syndrome (PRRS) regional awareness

Prepared by FAO EMPRES

Contributors: Daniel Beltran-Alcrudo, EMPRES; Juan Lubroth, EMPRES Coordinator; Felix Njeumi, EMPRES; Julio Pinto, EMPRES; Klaus Depner, EMPRES; Stephane DeLaRocque, EMPRES; Vincent Martin, Senior technical adviser in China for avian influenza; William Amanfu, ECTAD-RAHC

Recent reports from the People's Republic of China and Southeast Asia have alerted the world to a new variant of porcine reproductive and respiratory syndrome (PRRS) virus. The disease produced by this virus is characterised by high morbidity and significant mortality that has devastated the pig industries of the affected countries (Fig. 1). The growing import/export activities in that part of the world and the many countries involved, have prompted EMPRES to issue an early warning message to those areas, and in particular to official veterinary services throughout Southeast Asia and parts of Africa, to be aware of this new variant of the PRRS virus and to offer advice on how to prevent the disease from establishing itself in new areas and how to effectively control outbreaks in the event that the virus does take hold.

### 1. INTRODUCTION

Porcine reproductive and respiratory syndrome (PRRS) is an infectious viral disease of swine that is easily transmitted through direct contact to susceptible pigs and vertically to foetuses. PRRS is considered the most economically important viral disease of intensive swine farms in Europe and North America. It is characterised by reproductive failure in sows and respiratory distress in piglets and fattening pigs, which, combined with its potential for rapid spread, can cause significant production and economic losses. PRRS, also known as Mystery Swine Disease, Blue Ear Disease, Porcine Endemic Abortion and Respiratory Syndrome (PEARS) and Swine Infertility Respiratory Syndrome (SIRS), is not known to be a zoonosis. The PRRS virus (PRRSV) is an enveloped positive-stranded RNA virus, classified in the order Nidovirales, family Arteriviridae, and genus Arterivirus (Zimmerman et al. 2006). Two major serotypes of the virus are currently described, the European and the American types. This classification is significant in that vaccines made for one serotype will not completely protect against the other.

### 2. GEOGRAPHICAL DISTRIBUTION

PRRS was first detected in North America in 1987 and in Europe in 1990 and has since then been recorded in most major pig-producing areas throughout the world (Table 1).

No. 2 - 2007

### TABLE OF CONTENTS

1. Introduction	1
2. Geographical distribution	1
3. Clinical signs and diagnosis	2
4. Epidemiology	3
5. Prevention and control	3
6. References	5

Only Australia, New Zealand and Switzerland are reportedly free from PRRSV infection. The most recent outbreaks have occurred in Sweden, South Africa, Russian Federation, Viet Nam and China.

**Table 1. Status of PRRS in affected countries (Source: OIE, WAHID)**

Status	Countries reporting
Infection present (with no clinical disease)	Czech Republic, Lithuania, Mexico, Slovakia
Infection present (with clinical disease)	Canada, Colombia, Costa Rica, France, Germany, Ireland, Japan, Republic of Korea, Netherlands, Philippines, Portugal, Spain, United Kingdom, United States of America.
Disease restricted to certain zone(s) / region(s) of the country	Bolivia, Chile, Dominican Republic, Romania

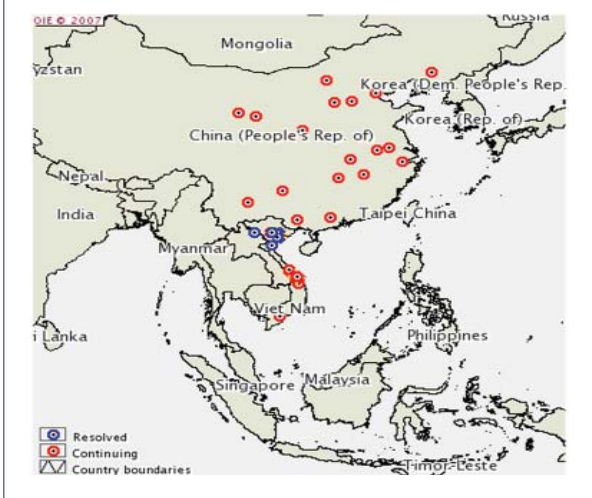
**Viet Nam:** Between March and August 2007, 44 outbreaks grouped into two main epidemics were reported; the first in northern provinces between March and May, and the second in southern provinces during June and July. About 44,000 pigs were affected, of which over 4,000 died (OIE, 2007a). At the end of August 2007, Viet Nam declared that the epidemic was under control. However, during August and September 2007, nine new PRRS outbreaks were reported in Khanh Hoa, Ca Mau and Lang Son provinces with mortalities of up to 24 per cent (OIE, 2007b). Preliminary clinical experiments suggest that secondary or concomitant infections have been the cause of high mortality and morbidity.

**China:** Two major (American-type) PRRS occurrences have been reported in China since the mid 1990s. From June to September 2006, an atypical form of PRRS affected over two million pigs, of which 400,000 died in 16 provinces according to the China Animal Disease Control

Center (CADC). Unlike other previous PRRS outbreaks in China and historical PRRS outbreaks worldwide, this form of the PRRS virus was more virulent and many adult pigs and pregnant sows died (Tian et al, 2007). Initially, a mixed infection of several agents (mainly PRRS, classical swine fever and porcine circovirus) was suspected (OIE, 2006). At the beginning of 2007, the disease re-emerged and since then, it is reported to have infected 310,000 pigs, of which more than 81,000 have died in 26 provinces (ProMED, 2007b). Provinces along the Yangtze River in the south of China have been the most affected (OIE, 2006). While the disease was initially reported in both the commercial and backyard sectors, it now seems to be concentrated in the latter, where control is a greater challenge, especially in remote areas. A compulsory PRRS vaccination policy has been implemented in high-risk areas and in high-value herds (breeding pigs and large-scale commercial farms), using a newly developed vaccine matching the circulating strain. As of 22 August 2007, the authorities had administered 314 million doses of vaccine to immunise more than 100 million pigs, one-fifth of the nation's total (Martin et al, 2007). The outbreak has caused considerable economic losses and a rise in pork prices in eastern China (ProMED, 2007a). On 29 October 2007, the Ministry of Agriculture announced that PRRS was under control (ProMED, 2007b)

**South Africa:** In Africa, the disease situation is unknown. The first official reports came from South Africa in June 2004, when a total of 2,407 pigs from 32 infected farms (31 small farmers and one commercial unit) were slaughtered in Western Cape Province (OIE, 2004). Two small outbreaks were reported in the same area in October 2005 (OIE, 2005). In August 2007, the same European strain was also reported in Western Cape, involving at least 21 farms and 8,000 pigs (ProMED, 2007c). This outbreak was considered a resurgence of the 2004 outbreak (FAO field officer).

**Figure 1. Porcine reproductive and respiratory Syndrome (PRRS) outbreaks reported to OIE in Asia during 2007 (OIE, 2007)**



### 3. CLINICAL SIGNS AND DIAGNOSIS

The pig (*Sus scrofa*), both domestic and feral, is the only species known to be naturally susceptible to PRRS (AHA, 2004). The incubation period is between 4 to 8 days experimentally, but can range from 3 to 37 days in natural outbreaks (AHA, 2004).

The clinical presentation and clinical signs of PRRS vary greatly between herds. In general, PRRS is characterised by reproductive failure of sows and respiratory distress of piglets and growing pigs. The characteristics of the reproductive failure are infertility, late foetal mummification, abortions, agalactia, stillbirths, and weak piglets that usually die shortly after birth due to respiratory disease and secondary bacterial infections, such as *Salmonella choleraesuis*, *Haemophilus parasuis*, *Streptococcus suis*, *Mycoplasma Hyopneumonia* and swine influenza virus (Hill, 1996). In young piglets, high mortality rates will occur and at the peak of an outbreak, losses from death may reach 60-70 percent (Hill, 1996) with 30-50 percent losses more common (Dee and Joo, 1994). The disease in weaned and fattening pigs is characterised by anorexia, lethargy, cutaneous hyperemia, dyspnea, rough hair coats, failure to thrive and an increase in mortality from secondary infections. Mortality rates are also elevated in the post-weaning period, varying between 4-20 percent. Depressions in post-weaning weight gain of up to 65 percent have been reported (Dee and Joo, 1994). Older pigs may show mild respiratory signs, which may also be complicated by secondary infections. Finishing pigs, boars, gilts and sows are often found to have sub-clinical infection (Zimmerman et al, 2006).

Antibodies generally confer limited protection, and serum titres for PRRS-infected finishing pigs often decline with advancing pig age. Infected pigs can remain viraemic and infectious for very variable periods. When the virus is cleared from the blood, it can remain in lymphoid tissues for up to 150 days after exposure (OIE, 2004; Zimmerman et al, 2006).

**Diagnosis and differential diagnosis:** Virological diagnosis of PRRS is difficult. Isolation of the virus can be done on porcine macrophages, ascitic fluids or tissue cultures from organs such as lung, tonsil, lymph node and spleen. Virus identification and characterisation are done by immunostaining with specific antisera. For laboratory confirmation, immunohistochemistry and in situ hybridisation on fixed tissues and reverse-transcription PCR (RT-PCR) are used (OIE, 2004).

The detection of antibodies to PRRSV can be done using a wide range of serological tests: the immunoperoxidase assay, the indirect immunofluorescence assay and commercial or in-house enzyme linked immunosorbent assays (ELISA) (OIE, 2004).

Reproductive signs need to be differentiated from leptospirosis, porcine parvovirus infection, porcine enterovirus infection, haemagglutinating encephalomyelitis, Aujeszky's disease, African swine fever and classical swine fever. For the respiratory and post-weaning form of the disease, differential diagnosis is needed for swine influenza, enzootic pneumonia, proliferative and necrotising pneumonia, *Haemophilus parasuis* virus infection,

*haemagglutinating encephalomyelitis* virus, porcine respiratory coronavirus infection, syncytial pneumonia and myocarditis, postweaning multisystemic wasting syndrome and Nipah virus infection (AHA, 2004).

#### 4. EPIDEMIOLOGY

The virus is shed in saliva (six weeks), urine (two weeks), semen (six weeks) and mammary gland secretions. Transmission can be by inhalation, ingestion (including ingestion of infected meat), coitus, transplacental, artificial insemination (also from vaccinated boars), pig bites and needles and other inanimate objects (equipment, instruments, clothing) or substances (water, food). Arthropod transmission has been suggested by some preliminary reports (Zimmerman et al, 2006). PRRSV is highly infectious and easily transmitted through direct contact among pen mates. Aerosol transmission is difficult, although it has been experimentally shown for distances of up to 2.5 meters (Zimmerman et al. 2006).

PRRSV is unstable outside the pH 5.5-6.5 range. Low concentrations of detergents and solvents such as chloroform and ether rapidly inactivate PRRSV. The virus survives in water for up to 11 days, but drying quickly inactivates it (Benfield et al, 1999a). As a result, the virus does not survive in the environment or on fomites under dry conditions.

PRRSV can be isolated from muscle and lymphoid tissues up to 24 hours after slaughter (even from muscle that had been frozen at -20°C for one month).

Nevertheless, the virus titres decrease with cooling, hardening and freezing, although PRRSV can survive several weeks at 4°C in bone marrow (Bloemraad et al, 1994). Cooking, curing and rendering are sufficient to inactivate PRRSV in meat, minimising the risk of spread in this way. The real threat occurs when unprocessed infected meat is fed to susceptible pigs (swill feeding) (AHA, 2004).

The most likely path of entry into a farm or country is asymptotically infected pigs, via semen and swill feeding. If these are imported from countries where PRRS is known to be present, appropriate procedures such as herd freedom certification, serological testing and quarantine should be followed. It would be very difficult to contain the disease if the feral pig population became affected (AHA, 2004).

#### 5. PREVENTION AND CONTROL

The key elements of a PRRS control and eradication programme are early disease detection and rapid laboratory confirmation; quick identification of the infected farms; and control of the infection through different stamping out strategies. Control options will depend on pig density, the degree of multi-site structure of farms, the movement of pigs, and whether infected pig meat is processed by cooking. Because PRRS is transmitted by direct contact, control measures are advisable although not critical at slaughter plants, meat processing plants and sale yards (AHA, 2004).

### PREVENTION AND CONTROL MEASURES FOR PRRS AND OTHER INFECTIOUS DISEASES OF SWINE

#### 5.1. Surveillance

The first step is to assess the extent of the infection. Veterinary officers or inspection teams should perform clinical examination of pigs, take blood samples from a statistically significant number of pigs, and examine production records for evidence of reproductive problems, such as abortions and neonatal mortalities. Special attention should be paid to farms with a recent history of pig purchases, sale of breeding or grower stock, and artificial insemination. Serosurveillance is particularly valuable in asymptomatic herds and in those in contact with feral pigs, if such populations become infected (AHA, 2004). Whenever an infected pig herd is found, its origin should be traced back and contacts should be investigated. Passive surveillance and reporting should be encouraged among pig owners through awareness campaigns. Because programmes of investigation are often not implemented at local government and village levels, it is recommended that epidemiological investigation should be carried out in villages by field veterinary staff and extension personnel asking a single question: "Have you seen this disease before?".

#### 5.2. Quarantine and movement controls

Quarantine should be imposed on all farms with known or suspected infection. In a free-ranging or village situation, pigs should be enclosed. Movement of pigs in and out of farms/villages should be prohibited, other than for those animals destined for immediate slaughter.

Movement controls should be applied to pigs and carcasses (for further processing by cooking) inside and out of the infected zone. Vehicles used to transport infected pigs should be decontaminated (see 5.6 Cleaning and disinfection).

#### 5.3. Biosecurity

Farmers should be encouraged to enhance their biosecurity levels: new animals only from PRRS-free herds, visitors kept to a minimum, perimeter fencing, removal of effluent, pig-loading facilities located at perimeter fences, and cleaning and disinfection of pig-carrying trucks after unloading (AHA, 2004). Perimeter fencing will prevent the spread of disease from domestic to feral pigs and vice versa. The access of wild pigs to domestic food scraps should be prevented (AHA, 2004). Village settings, where pigs may roam freely, present additional biosecurity challenges although the same biosecurity principles apply. Equipment and premises should be periodically cleaned and disinfected. Pigs should be kept in fenced enclosures, whenever possible. Sharing of equipment between farms/villages should be discouraged, unless proper decontamination is performed. Pig owners/workers should avoid contacting other pig populations and dedicated work clothing should be pro-

moted. Replacement breeding stock should come from PRRS-free and trusted sources. Casual visitors, particularly those who have contact with pigs, should be discouraged. A sign at the farm/village entrance advising visitors not to come close to pigs is also recommended. Entrails and other discarded parts of slaughtered pigs should be disposed of in an appropriate manner such as composting, burying or burning. When the disease is present in an area, decontamination instruments should be made available at village entry and exit points (disinfectant, brush and a bucket of water or a foot bath).

#### **5.4. Zoning**

If the disease is endemic in only part of a country it is possible to establish diseased and disease-free zones and enforce tight controls on the movement of pigs and products between zones (AHA, 2004).

#### **5.5. Stamping out**

Stamping out strategies can be considered depending on the epidemiological situation. It should only be carried out in the first stage of the infection when the infected area is limited and the number of pigs to kill is still low. Traditional stamping out has its limits in developing countries because of the lack of funds for compensation. Without compensation, stamping out is often rejected by pig owners, and this may contribute to more rapid dissemination of the disease through illegal movement of sick animals. A flexible stamping out approach is required. Modified stamping out consists of an initial quarantine followed by slaughter of all marketable pigs at an abattoir. For the remaining pigs, several options are available: 1) destroy unsaleable on-farm pigs and offer compensation 2) allow growing pigs to grow to market size, and/or 3) allow pregnant sows to wean their litters. Diseased pigs cannot be sent to abattoirs; they must be destroyed or quarantined until the symptoms pass (AHA, 2004). The carcasses of destroyed pigs must be disposed of in a safe manner after stamping out is completed. Reference should be made to the [FAO Manual on procedures for disease eradication by stamping out](http://www.fao.org/DOCREP/004/Y0660E/Y0660E00.HTM) (<http://www.fao.org/DOCREP/004/Y0660E/Y0660E00.HTM>) for more information on on-site slaughter and disposal procedures.

#### **5.6. Cleaning and disinfection**

For the decontamination of farms, vehicles and equipment, routine cleaning and disinfection with almost any chemical is enough due to the low resistance of PRRSV. Phenolic or organic acid disinfectants, chlorine, quaternary ammonium compounds and lipid solvents (detergents) have all been reported to be highly effective in inactivating PRRSV (AHA, 2004; Zimmerman et al, 2006). Either replace or put aside equipment which cannot be easily disinfected.

#### **5.7. Vaccination**

Vaccination is one of the most effective tools to control PRRS, although it does not prevent PRRSV infection. Vaccines should contain the specific antigenic type to be effective. Experience shows that vaccination with a homologous strain is more effective than vaccination with a heterologous strain. In the United States there are approved modified-live virus (MLV) vaccines for the reproductive and respiratory forms of PRRS. MLV vaccines are used in piglets from three weeks of age or sows and gilts 3-6 weeks prior to breeding. In Europe and United States, an inactivated virus vaccine against the reproductive form of PRRS is also available on the market (OIE, 2004). One recommended strategy is the vaccination of seronegative replacement breeding stock 60-90 days before introduction (AHA, 2004).

Animals vaccinated with MLV vaccines shed the vaccine strain virus, which is then transmitted in the field, complicating the problem of detecting infection with wild-type virus, both through virology and serology (Zimmerman et al, 2006).

#### **5.8. Sentinel and restocking**

A minimum 14-day period after decontamination is required before restocking to avoid reinfection. Serology on restocked animals should be carried out after two months and again six weeks later (AHA, 2004). Given husbandry practices in many parts of the world (Africa, Latin America and Asia), there is a potential danger that restocking aimed at re-establishing former pig populations could contribute to creating the conditions for a new outbreak..

#### **5.9. Public awareness**

PRRS outbreaks should be well publicised, emphasising the dangers of swill feeding, particularly to small pig holdings. Commercial farms should be encouraged to enhance their biosecurity levels (AHA, 2004). In African, Eastern European and many Asian countries, an early warning system encouraging early reporting, and consequently early reaction, should be implemented in every state or region and at national level. Ensuring the cooperation of pig owners can be facilitated through information/sensitisation events at village level meetings. Civil administrative authorities should also be put on a state of alert with periodical epidemiological information.

The reluctance of villagers to implement control measures is motivated by a number of different considerations, including the following:

- 1) Village pig populations play an important role in cleaning up human leftovers.
- 2) Pigs are a good source of income for families.
- 3) Villagers do not understand why, after having lost most of their pigs, they are asked to kill those remaining.
- 4) Pigs have an important social function because they are slaughtered to meet family needs or ritual/traditional ceremonies.
- 5) Villagers always harbour the hope that the disease will stop by itself and that some of their pigs will escape death because they believe that there is no disease capable of killing all the pigs.

## 6. REFERENCES

- Animal Health Australia (2004).** *Disease strategy: Porcine reproductive and respiratory syndrome (Version 3.0)*. Australian Veterinary Emergency Plan (AUSVETPLAN), Edition 3, Primary Industries Ministerial Council, Canberra, ACT.
- Benfield DA, Collins JE, Dee SA, Halbur PG, Joo HS, Lager KM, Mengeling WL, Murtaugh MP, Rossow KD, Stevenson GW and Zimmerman JJ (1999).** Porcine reproductive and respiratory syndrome. *Diseases of Swine* 18:201–232.
- Bloemraad M, de Kluijver EP, Petersen A, Burkhardt GE and Wensport G (1994).** Porcine reproductive and respiratory syndrome: temperature and PH stability of Lelystad virus and its survival in tissue specimens from viraemic pigs. *Veterinary Microbiology* 42:361–371.
- Dee S. A. and H. S. Joo. (1994).** Prevention of the spread of porcine reproductive and respiratory syndrome virus in endemically infected pig herds by nursery depopulation. *Veterinary Record* 135: 6-9.
- Hill, H. (1996).** PRRS: Practical strategies for prevention and management of a positive herd. *Proceedings of the 1996 North Carolina Pork Producers Conference*, pp. 1-7, January 9-10, 1996, Fayetteville, North Carolina.
- OIE (2004).** Porcine reproductive and respiratory syndrome. *In Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*, Part 2, Section 2.6., Chapter 2.6.5. [https://www.oie.int/eng/normes/MANUAL/A\\_00099.htm](https://www.oie.int/eng/normes/MANUAL/A_00099.htm)
- OIE (2005).** Porcine reproductive and respiratory syndrome in South Africa. Follow-up report No. 2. Disease Information (Weekly info), 21 September 2006, Vol. 19, No. 38.
- OIE (2006).** Miscellaneous: “Swine high fever disease” in pigs in China (People’s Rep. of), Disease Information (Weekly info), 11 November 2005, Vol. 18, No. 45.
- OIE (2007a).** Report reference: 20071004 TY-DT, OIE Ref: 5840, Report Date: 01/08/2007, Country: Viet Nam.
- OIE (2007b).** Porcine reproductive and respiratory syndrome, Viet Nam, (Follow-up report No. 3) 03/10/2007.
- ProMED-mail (2006).** Undiagnosed disease, porcine - China (03): OIE; 24 Sep: 20060924.2732. <http://www.promedmail.org>. Accessed 19 Aug 2007.
- ProMED-mail (2007a).** Porcine reproductive and respiratory syndrome - China (06); 14 Sep: 20070914.3058 <http://www.promedmail.org>. Accessed 17 Sept 2007.
- ProMED-mail (2007b).** Porcine reproductive and respiratory syndrome - China (08); 30 Oct: 20071030.3523 <http://www.promedmail.org>. Accessed 30 Oct 2007.
- ProMED-mail (2007c).** Porcine reproductive and respiratory syndrome - South Africa (Western Cape); 31 Aug: 20070831.2867 <http://www.promedmail.org>. Accessed 19 Sept 2007.
- Tian K, Yu X, Zhao T, Feng Y, Cao Z, et al. (2007)** Emergence of Fatal PRRSV Variants: Unparalleled Outbreaks of Atypical PRRS in China and Molecular Dissection of the Unique Hallmark. *PLoS ONE* 2(6): e526. doi:10.1371/journal.pone.0000526
- Zimmerman J, Benfield D, Murtaugh M, Osorio F, Stevenson G, Torremorell M. 2006.** Porcine reproductive and respiratory syndrome virus. In: *Diseases of Swine* (9th edition). Straw BE, D’Allaire S, Zimmerman J, Taylor DJ (eds). Blackwell Publishing Company, Ames Iowa