

# Clinical Practice Guideline for PED in Thailand: 1<sup>st</sup> Edition



Thai Swine Veterinary Association



U.S. Department of Agriculture  
Animal and Plant Health Inspection Service

**Clinical Practice Guideline (CPG)  
for PED in Thailand: 1<sup>st</sup> Edition**

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Thai Swine Veterinary Association.

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# Preface

Porcine Epidemic Diarrhea (PED) is an infectious disease that causes the loss of pigs of all ages especially piglets. This disease has been found spreading across Thailand especially in areas with dense pig farming and caused significant economic losses in large, medium and small farms since 2007. Thai veterinarians from both government and private sectors continuously monitor, remedy and prevent the disease, however every year there are reports of PED outbreaks.

The Thai Swine Veterinary Association (TSVA) in association with the Thai Department of Livestock Development, Ministry of Agriculture and Cooperatives, recognizes that preparation of the Clinical Practice Guideline (CPG) for PED in Thailand would equip veterinarians in the field with a guideline for effective and uniform prevention and control of the disease throughout the country. Expert swine veterinarians from both fields and academics combined their knowledge and experience in preparing this manual for the Clinical Practice Guideline (CPG) for PED in Thailand. It is hoped that this CPG will be used as the prevent measures for PED at swine farms in Thailand and neighboring countries, and can reduce the economic losses from PED.

We gratefully thank United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) for the funding assistance in the printing of the CPG. We would also like to extend our sincere gratitude to all pig farm veterinarians for their contributions to the advancement and recognition of the veterinary profession among pig farmers.

The CPG Preparation Committee

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# List of Participating Committee

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# Chapter 1

## Epidemiology of PED



# Epidemiology of PED

## Incidences of PED overseas and in Thailand

Porcine epidemic diarrhea (PED), known in Thai as “PED disease”, is a digestive tract disease that causes diarrhea in pig of all ages. It was first reported in England in 1971 as diarrhea in fattening pigs. In 1976, incidence of PED was reported in Belgium, but the disease was found in pigs of all ages including breeding stock, suckling piglets and fattening pigs.

PED virus was isolated in 1978 and was found to be part of the Coronaviridae family. The virus was named Porcine epidemic diarrhea (PED) virus. The virus prototype is CV777. After the first report, PED has spread to pigs in various European countries such as Belgium, Germany, France, the Netherlands, and Switzerland. It has evolved becoming endemic disease and does not cause significant damage. As present, low antibody titers have been found indicating that PED outbreak in European countries is quite rare.

The spread of PED in Asian countries was first discovered in Korea and Japan between 1981 and 1983. Compared to the European outbreak, the outbreaks in Japan and Korea had much higher rates of infection and maturity rate at 30-100% in suckling piglets. At present, PED is considered a major epidemic disease and has evolved becoming endemic disease in many Asian countries like China, Korea, Japan, Taiwan, and Southeast Asian countries such as Thailand, Vietnam, and the Philippines causing chronic economic damages due to recurring PED outbreaks.

Between 2008 and 2012 PED was considered a major Asian epidemic disease. However, by mid-2013, PED was also reported in the United States and has currently spread throughout North and South America with reports of incidences in Canada, Mexico, Brazil, and other countries. There have been reports of severe PED outbreaks in Taiwan, Korea, and Japan in early 2014. For this reason, PED is now considered a major worldwide epidemic disease, except in European countries where severe outbreaks have not yet been reported.

The first case of PED in Thailand was in 1995 at a farm in the southern region, but it had not spread to swine farms in other regions until the end of 2007 when severe outbreak was found at a farm in Nakhon Prathom province. This recurrence caused extensive spread of PED in Thailand with over 90% of farms in the Eastern and Western parts of the country, resulting in serious damages to the economy. PED outbreaks were later reported in Laos, Cambodia, and Vietnam.

With the recurrence of PED in 2007, PED has become endemic in swine farms in Thailand, especially in the Eastern and Western parts of the country. Farms that have previously been hit usually see recurrences of the outbreak causing chronic damages. The death rate among suckling piglets was approximately 30% which was less than the reported rate in the initial outbreak. At the end of 2013, another severe PED outbreak in the Eastern region with death rates of approximately 80-100% was observed. Many farms were affected and the incidence raised the question of PED virus mutation.

Currently, the PED virus can be divided into 2 groups by the genetic diversity of the spike genes. The first PED group is the “classical variant” isolated from the virus found in Europe, China, Japan, and Korea while the other group is the “new variant” isolated from the virus found in China, Korea, Japan, Taiwan as well as countries in the American continents and Southeast Asia. Genetic analysis has revealed that PED virus outbreaks in Thailand from 2007 onwards are the new variant type of outbreaks with very little mutation.

## PED virus durability

PED virus has an envelop that does not have good resistance to various environmental factors. Experiments on PED virus durability at different temperatures and pH values found that:

- The virus is destroyed at temperatures higher than 65°C for 10 minutes.
- At 37°C,
  - the infectious period can be 8-10 days.
  - the virus can survive in the pH range of 6.5 -7.5.
- At 4°C,
  - the infectious period can be longer than 49 days.
  - the virus can survive in the pH range of 6.5 -7.5.

In addition, the virus was tested for durability in diverse environments:

- In swine feces,
  - the virus survived for up to 7 days at 40°C, 50°C, and 60°C temperature and 30%, 50%, and 70% relative humidity. It was

destroyed when subjected to temperatures higher than 65°C for 10 min.

- In septic tank,
  - the virus survived for at least 28 days at -20°C and 4°C (the study lasted only 28 days, but in reality the virus may survive for longer).
  - the virus survived for 14 days at 25°C.
- In drinking and recycled water,
  - the virus survived for at least 7 days at 25°C (the study lasted only 7 days, but in reality the virus may survive for longer).
- In animal feed,
  - The virus survived for up to 7 days in animal feed that had not been processed into pellets.
  - The virus is not infectious in animal feed that had undergone proper pelletizing.

## Distinctive characteristics of PED

PED is an enteric disease. Pigs of all ages are sensitive to infection and show similar clinical symptoms such as vomiting and diarrhea but have different severity. PED causes the most severe damage in suckling piglets younger than 1 week old and the death rate is as high as 100% during periods of acute outbreak. Distinctive clinical symptoms of infected suckling piglets include vomiting milk curds, diarrhea, and piglets laying on top of the sows. Severe diarrhea puts the piglets in a dehydrated state and causes death. Furthermore, it has been found that secondary infections from other pathogens such as bacteria or protozoa can occur. There is no change in the



death rate of pigs infected at older age, but their growth rate and weight uniformity in the herd are affected. Farm biosecurity is also affected because the infected pigs become carriers and the disease can spread to the breeding sows.

Sows infected during or after farrowing will have fever, stop eating, and develop post-partum fever symptoms which lead to agalactia and higher rate of piglet abandonment by the sows. Mated sows returned easily to estrus with reduced number of piglets in the next pregnancy.

## Immunological response to PED

PED infection mechanism will cause the immune system to stimulate mucosal immunity. Measuring the volume of lymphocytes, which produce IgA antibody secreting cells in the intestine, found that an increase of these cells can be observed from day 4 and with the highest number produced at day 21 after infection. This is similar to the increase found in the level of cell mediated immunity due to lymphocyte proliferative response at the mesenteric lymph node. The increase is also initially observed on day 4 and reaches the maximum level at day 21 after infection

With humoral immunity, antibodies in the blood can be detected by using the ELISA test at 1 week after infection; there are increases of both IgG and IgA antibodies. When viral neutralization test is used, the antibodies can be detected at approximately 1-2 weeks with the highest amount detected at 4-5 weeks after infection.

## Clinical symptoms

PED affects pigs of all ages and causes the following clinical symptoms:

- Suckling piglets are lethargic, weak, feverish with liquid and fishy smell stools. They vomit milk curds, become dehydrated, huddle together and eventually die. Diarrhea develops within 24 hours of being infected and the death rate is 30-50%. The death rate of infected piglets younger than 7 days may be as high as 100% in naïve farms.
- Weaned piglets and growing pigs may show signs of being lethargic, refusing food, diarrhea, and high rate of illness (but low death rate). Secondary bacterial infection may be found.

## Duration of PED viral shedding

Fecal shedding of the virus can be detected 48 hours after infection. The viral shedding is highest in the 5-6 days period. The virus can still be found in feces up to 21-35 days after infection.

PED virus can be detected in nasal cavity from 48 hours – 21 days after infection and in oral fluid from 48 hours – 28 days after infection.



# Chapter 2

## Sample Collection and Diagnosis



## Sample Collection and Diagnosis

PED diagnosis can be carried out by taking outbreak history, checking for clinical symptoms and collecting samples for diagnosis with the help of laboratory examination such as pathological lesion examination, virus or genetic material detection, and collecting samples to test for immunity against the virus.

### Collecting samples for diagnosis

1. Collect 5-10 samples from pigs or intestines of pigs displaying the onset of clinical symptoms.



2. Immediately cool collected samples which should be sent to a laboratory within 6-8 hours after collection. Do not clean intestines with water that has been treated with chlorine.

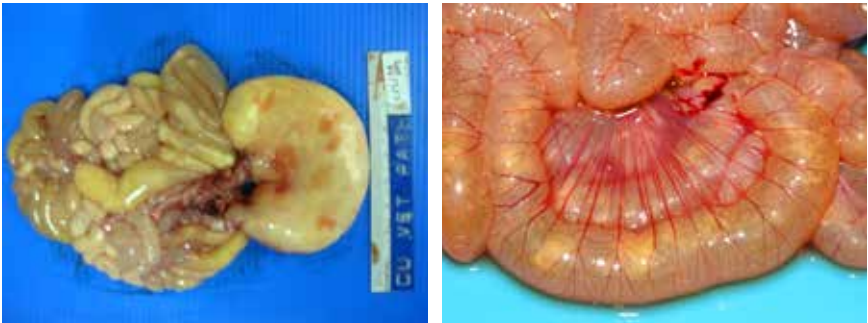


3. PED virus can be detected by RT-PCR and/or isolation.

## Diagnosis of pathological lesions

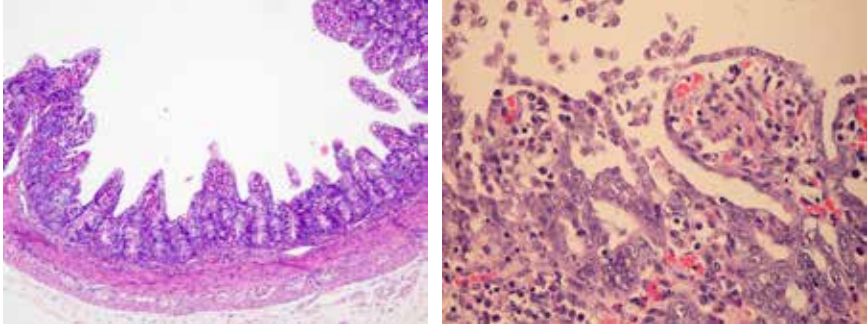
### Gross lesions

Milk curds are found in stomach and small intestine walls, yellow-green liquid are found in small and large intestines while there are enlarged mesenteric lymph nodes. No milk vein or lacteal ducts are found in suckling piglets (see figure below).



### Microscopic lesions

Detection of epithelium cell degradation and falling off in conjunction with inflammation of mononuclear cells that have penetrated into the lamina propria are commonly seen. Change in the shape of epithelium cells from columnar to squamous and shrinkage and congregation of villi at the jejunum and ileum are also observed (see figure next page).



## Laboratory examination

### 1. PED virus detection

PED virus isolation is the gold standard method performed by isolating the virus in Vero cells. However, this isolation technique requires experienced technicians and time consuming. Most laboratories do not offer this method.

### 2. PED genetic material detection

Detection of PED genetic material via reverse transcription polymerase chain reaction (RT-PCR) which is available in most laboratories. However, it has a disadvantage in that the test sensitivity varies from laboratory to laboratory and the genetic material is easily damaged if not stored correctly.



# Chapter 3

## Management and Control during an Outbreak



## Management and Control during an Outbreak

Since PED is a viral disease that currently has no direct treatment, therefore, for effective control of the disease, farm status is divided into 5 categories:

Farm \ Pig	Breeding stock and suckling piglets	Nursery pigs	Fattening pigs
1. Disease-free farms	-	-	-
2. Farms with outbreak in fattening pigs	-	-	++
3. Farms with sudden outbreak	+++	+	+
4. Farms with chronic infection	+	+	+
5. Relapse farms (more than one severe outbreak per year)	++	++	++

- *No problem*
- + *Low severity problem*
- ++ *Medium severity problem*
- +++ *High severity problem*

### Definition of farm categories

(mainly considering breeding stock herd and suckling piglets)

**Category 1 Disease-free farms** are farms with no history or incidence of outbreak. All pigs are tested negative for the virus.

**Category 2 Farms with outbreak in fattening pigs** are the farms where clinical symptoms are detected and the virus is found only in fattening pigs.



**Category 3 Farms with sudden outbreak** are the farms undergoing severe outbreak with viral infection and shedding in pig population; high rates of illness and death.

**Category 4 Farms with chronic infection** are the farms where clinical symptoms are detected pig populations but not severely with existing viral infection and shedding.

**Category 5 Relapse farms** are the farms that was previously infected with no clinical symptoms have been detected for 6 months, but a repeat outbreak occurred.

## Management of different farm categories

**Category 1 Disease-free farms** should emphasize on biosecurity and replacement with gilts from disease-free farms only.

**Category 2 Farms with outbreak in fattening pigs** should emphasize on biosecurity and replacement with gilts from disease-free farms only. Prevent outbreaks among different units in the farm.

**Category 3 Farms with sudden outbreak** should emphasize biosecurity and replacement with gilts from disease-free farms only. Whole herd get feed back.

**Category 4 Farms with chronic infection** should emphasize on biosecurity, replacement with gilts from disease-free farms only and consultation with experts.

**Category 5 Relapse farms** should emphasize on biosecurity, replacement with gilts from disease-free farms only and consultation with experts.

*Note: Biosecurity (see Appendix B)*

## Management guidelines to reduce pig loss



- Diagnosis
- Intestinal feedback
- Blocking
- Cleaning and disinfection
- Culling
- Supportive treatment

## Gut feedback

After inspection and the pigs are diagnosed with PED, the first priority is to quickly stabilize herd immunity for all pregnant sows and gilts by the method called “gut feedback”, which involves feeding the intestine of piglets that are infected with the PED virus to all sows in the herd. Infected intestine may be fed to all sows in the herd or to sows that have been bred right until they are 14 week pregnant, depending on the discretion of the veterinarian in charge. Gut feedback procedures are as follows:

- Choose a piglet intestine that has been confirmed in the laboratory to be infected with PED.
- Finely chop or blend the whole intestine. Mix with clean, chlorine-free water at the ratio of 1 intestine per 1,000 cc of water. This amount can feed approximately 20 sows. Each sow will be fed with about 50 cc of the mixed liquid for 2-3 consecutive meals over 2-3 days. (The primary principle is that the sows that receive the mixed liquid must show symptoms of illness such as being lethargic, refusing food, or diarrhea to confirm that they are infected and will be subsequently immunized).
- After showing signs of illness, the sows are given supplemental antibiotics to prevent secondary infections especially from bacteria such as *E. coli*. The antibiotics are mixed with water or food and administered continuously for about 1 week.

## Blocking

- Quarantine sick pigs and their keepers to prevent the disease from spreading to other areas. Sick pigs and pigs that have been fed intestines are quarantined as well.
- Workers are strictly forbidden from entering pig pens beyond their responsibility, especially pregnant sow units.
- After entering pens with sick pigs, veterinarians or foremen are forbidden from visiting other units. They must bath, wash their hair, and change clothing before doing so.
- Wean piglets 14 days old onwards and put them in nursery pens or fattening pens within the farm.
- Stop transferring pigs, postpone fang/tail trimming session or piglet marking in farrowing pens for about 2 weeks.
- Worker clothing should be cleaned on the farm and worker must not bring their own clothes into the farm.
- Provide boots, to be used exclusively in a specific shed, in front of each shed.
- Dip feet in disinfectant and wash hands and arms before and after entering a shed.
- Sprinkle lime powder on the pathways around the sheds in both the outbreak areas and surroundings.
- Control animal feed or pig transport vehicles. Driver should not be allowed to get off the vehicle.
- Ban outside people from entering pig units especially during an outbreak.

## Cleaning and disinfecting

### Daily washing, cleaning and disinfecting

#### **Farrowing sheds**

- Walk paths must be cleaned and sprayed with disinfectant daily in groups of pig that do not show any symptoms of illness, and 2-3 times daily in groups that show symptoms by using disinfectant that are active against viruses.
- When culling sick pigs, bathe and spray disinfectant (that is not harmful to skin tissue) on sows before moving them to standing pens for sick pigs. Always clean farrowing pens and equipment with soap or detergent, clean, and spray with disinfectant.
- Flooring materials for farrowing pens should not be reused, especially during outbreaks as they may have come in contact with feces of sick pigs.
- Feeder for sows should be cleaned after each feeding or at least once a day.

#### **Pregnancy, Nursery, and Fattening sheds**

- Spray disinfectant along the walk paths, between pens, along paths connecting sheds daily for normal groups and 2-3 times a day for sick groups.
- Spray disinfectant (that is not dangerous to skin ) around the animals 1-2 times daily or after cleaning.

## Steps in cleaning farrowing sheds after weaning or when all fattening pigs have been sold

1. Remove equipment such as farrowing boxes and food feeders for cleaning and disinfecting.
2. Sweep feces, food scraps, and dirty materials off the pen and spray with water.
3. Wash (with high pressure head) the walls and floor of the pen with washing detergent and leave for 30-60 min.
4. Wash off with clean water and leave to dry.
5. Spray disinfectant and leave to dry.
6. Sprinkle lime powder or spray lime water inside the sheds. Wash off before placing the pigs in the sheds as lime can irritate pig skin and hooves.
7. Leave the units for free 5-7 days.
8. The units should be sprayed with disinfectant 1 day before placing new pigs.

## Steps in washing and disinfecting vehicles transporting pigs and carcasses

1. Sweep feces, food scraps, and dirty material off and spray with water.
2. Wash (with high pressure head sprayer) walls and floors with liquid detergent and leave for 30-60 minutes.
3. Wash off with clean water and leave to dry.
4. Spray disinfectant and leave to dry.
5. Leave the units free at least 8 hours.

## Selecting and using disinfectant

Some disinfectants that are effective against viruses can cause skin irritation in pigs and humans and, therefore, should be chosen to suit the work. Highly corrosive disinfectant should only be used on walk paths and in pens that do not contain pigs. Antiseptic type of disinfectants should be selected for work that come into contact with the skin.

The amount of disinfectant to be used in each area should always be calculated to ensure that their full potency and effectiveness will be achieved.

### Examples of disinfectant types against viruses.

(McDonnell & Russell, Clin. Microbiol. Rev. 1999, 12(1):147)

Disinfectant Type*	General use	Use only on walk paths when no animal is present
Alcohol: ethanol, isopropanol	+	
Aldehyde: glutaraldehyde, formaldehyde		+
Biguanides: Chlorhexidine	+	
Halogen-releasing agents: chlorine compounds, iodine compounds	+	
Peroxygens: hydrogen peroxide, peracetic acid	+	
Phenol and cresol		+
Quaternary ammonium compounds (QAC): cetrimide, benzalkonium chloride	+	

\* Effectiveness of disinfectants used in farms depends on their durability against organics, heat, sunlight, and other environmental factors.

## Culling

Proper management should be implemented in accordance with the biosecurity guidelines (see Appendix B).

## Supportive treatment

- a. Administer medicine to prevent secondary bacterial infections by mouth pumping with Colistin or Enrofloxacin in piglets with diarrhea in conjunction with kaolin or pectin to reduce and heal intestinal inflammations.
- b. Give electrolytes orally or by abdominal injection (under veterinarian supervision) to reduce dehydration and body acidity.
- c. Sows, gilts, and piglets that have diarrhea should be treated with broad spectrum antibiotics such as Amoxicillin in conjunction with medication to treat pain and fever on the first day of treatment. Sows should be treated with diarrhea as soon as possible so that they can resume feeding as soon as possible and produce milk for piglets.





# Appendices



## Appendix A

### Collecting blood samples to test for PED immunity

#### Operational steps

1. All imported pigs from overseas should be individually tested for PED immunity.
2. For gilts imported from known local farms that are regularly replaced and health records from originating farms are known, it is recommended that 10 blood samples should be collected from each batch for testing.
3. For gilts imported from new local farms or farms without health history, it is recommended that 30 blood samples should be collected from each batch for testing.
4. If breeding sows need to be tested for PED immunity in order to identify PED contamination of the breeding herd, 30 blood samples should be collected for testing. Divide the samples into 6 parities, 5 in each parity.

## Appendix B

### Biosecurity

#### Biosecurity

This principle is based on the Ministry of Agriculture and Cooperatives Notification on Thai Agricultural Standard: Good Agricultural Practices for Pig Farms, issued under the Agricultural Product Standards Act B.E. 2551 (2008), dated 30 September 2009. The following information are emphasized and added for more appropriate prevention and control of PED.

#### Farm components

1. Located not less than 5 kilometers from a residential community, abattoir, and live animal market.
2. Pig houses/pens must be enclosed with fences to prevent accessibility of other types of animal. Warning sign about entry/exit precautions must be posted at all gates.
3. Farm's accommodations, kitchens and office buildings must be located in an especially assigned area. No habitation is allowed in animal houses/pens.
4. Animal feed mixing sheds and raw material storages must be located separately from pig-raising areas.
5. A quarantine building for animal acclimatization must be provided and located at a far distance from pig houses/pens.
6. Pig trading area must be located outside and clearly separated from the farm's pig-raising areas for convenience of cleaning and disinfection.

7. Strict segregation of workers in the quarantine house and pig sales staff from workers in other production units.

## Transportation management

1. Outside animal feed/raw material transport vehicles are prohibited from entering the pig-raising areas. When it is necessary to transport animal feeds to the pig-raising areas the vehicles must be sprayed with disinfectant
2. Outside transport or pig trading vehicles are strictly prohibited from entering the farm.
3. Transport vehicles for use within the farm must be cleaned, sprayed with disinfectant, and left to dry after each use.

## Animal health management

Efficient disease monitoring, control and prevention systems, including disinfection measures before entering and after leaving the farm, must be set up to prevent accumulation of disease inside the farm, the spreading of disease to the outside as well as to enable quick control and mitigation of disease.

1. Disinfection measures before entering and leaving the farm
  - Outside vehicles and visitors entering or leaving the farm must go through a disinfectant spray station.
  - Outside visitors entering the pig-raising areas must not have visited other pig farms at least within the past 48 hours.
  - Persons entering the pig-raising areas should bathe and change their clothing and change into the shoes provided by the farm.

2. Disposal of dead animals

- A special area within the farm, outside the pig-raising areas, must be assigned for disposal of dead animals.
3. Since pigs brought from outside to raise in a farm can be PED carriers, they should come from a single trustworthy breeding farm.

## Environmental management

A proper waste elimination or waste treatment system must be set up. Wastes from pig farming must be disposed of in the assigned dead animal disposal area.

## Disease prevention measures

All farms should add the following disease prevention measures:

1. All types of transport vehicles for pig purchasing, especially those with pigs from other farms onboard, should not be allowed into the farm. Farm workers should not be permitted to have any contact with such vehicles as they may be contaminated with disease from previous transportation of sick pigs through their visits to many pig farms in a single day. In general, these vehicles are not properly cleaned and sprayed with disinfectant.
2. No service should be obtained from transport vehicles between farms with no known history of transportation and resting periods after previous use. This practice applies to transport vehicles for breeding stock, nursery and fattening pigs since the animal may be contaminated with disease from sick pigs transported on the vehicles on previous trips despite the fact that there is no contamination in the origin farm.

3. Washing, cleaning, and disinfectant spraying measures should be strictly imposed. There must be service timeout between a trip to an abattoirs and the next pickup trip of pigs from farms as there is a high risk of contamination from abattoirs.
4. Outside visitors or persons with history of past contact with sick pigs or persons with high contamination probability should not be allowed to enter a farm in all cases, except when they have undergone a quarantine period of at least 72 hours.
5. Sick pigs should be disposed of by burial or cremation only. Farms are not permitted to move sick pigs elsewhere while the remaining pigs can only be moved to abattoirs. This measure is implemented to prevent a spread of the disease.
6. In case of smallholders, they are advised to closely follow news of a spread of the disease. If their farms are located in an infectious area, they must stop all movement of pigs. For example, they must stop replacing pigs or introducing piglets from other sources into the farms, stop purchasing semen from breeding stock farms with no known history of pig sickness, and stop selling pigs. They may sell pigs but must not allowing pig purchasing vehicles to enter pig house areas. Pig farmers in such farms must stop visiting each other and prohibit other pig farmers to enter their farms until the spread of the disease has subsided.
7. Strict control measures for the management of pig feces that contain and can spread PED by disposing, cleaning, and spraying with disinfectant around the pig pens especially farrowing pens. Fire from gas burners can be used to provide heat to further disinfect the pens before bringing in new sows for farrowing.





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