SECTION 2
GUIDE TO INVESTIGATION OF DISEASE SYNDROMES
### Vesicular diseases

The term ‘vesicular diseases’ refers to a group of highly infectious viral diseases of cloven-hooved animals.

Due to the animal production and international trade ramifications of vesicular diseases, particularly foot-and-mouth disease (FMD), early detection of vesicular diseases is crucial. Vesicular diseases can cause high morbidity, but typically present with very low to no mortality.

#### Clinical signs

Clinical signs of vesicular diseases are similar. They include:
- excessive salivation
- lameness
- reluctance to move, huddling together
- vesicles and ulcers on the feet, mouth, and teats
- hoof lesions including separation of corium
- pyrexia and depression
- unwillingness to eat.

In addition, secondary bacterial infections may lead to other clinical signs such as mastitis and reduced milk production in dairy cows.

#### Potential causes

A range of endemic and exotic infectious diseases present with vesicles and ulcerations, as well as several non-infectious diseases. Because of this, in addition to vesicles, you will need to consider other clinical signs present when determining a differential diagnosis list.

FMD is the most economically important vesicular disease for Australia and it affects multiple species (goats, sheep, cows and pigs). Because FMD is extremely contagious and an outbreak would have a significant economic impact to Australia, we must properly investigate and diagnose all vesicular diseases. Table 2.1.1 presents a list of vesicular diseases and the livestock species affected.
### TABLE 2.1.1 The vesicular diseases (all are exotic to Australia) and species clinically affected

<table>
<thead>
<tr>
<th></th>
<th>Cattle</th>
<th>Goats and sheep</th>
<th>Deer</th>
<th>Pigs</th>
<th>Horses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot-and-mouth disease</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Senecavirus A (Seneca Valley virus) infection</td>
<td>(antibodies only; no disease to date)</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Swine vesicular disease</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Vesicular exanthema of swine</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Vesicular stomatitis</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

A number of other **exotic diseases** have similar clinical signs to viral vesicular diseases, particularly during their more advanced clinical stages. These include:

- bluetongue disease
- peste des petits ruminants
- rinderpest (now recognised as globally eradicated by the World Organisation for Animal Health (OIE)).

**Endemic** diseases, which may cause similar clinical signs to viral vesicular diseases include, but are not limited to:

- bovine papular stomatitis
- foot rot
- Glässers disease (*Haemophilus parasuis*)
- infectious bovine rhinotracheitis
- malignant catarrhal fever (only sheep-associated malignant catarrhal fever is endemic)
- mucosal disease caused by bovine viral diarrhoea (BVD). Only BVD virus 1 is endemic in Australia.

Non-infectious causes of similar clinical signs to viral vesicular diseases include but are not limited to:

- chemical irritants and scalding
- dermatophilus and other types of mycotic stomatitis
- idiopathic vesicular disease in pigs
- insect bite hypersensitivity
- lesions of the mouth and feet due to trauma
- lameness due to bad or hard floors
- phototoxic dermatitis with vesicle formations from contact with the leaves of plants of the family *Umbelliferae* (parsley, parsnips and celery).

Some differential diagnoses may be eliminated by **taking a thorough history**, including environmental observations (such as possible trauma or exposure to parsnips or celery) and a thorough clinical examination (such as for chemical burn). Also important is information about the clinical picture of the herd (i.e. are single or multiple animals affected?).
Reporting requirements

If you suspect a case of vesicular disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on 1800 675 888, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

Investigation and sampling guidelines

Undertake a thorough physical examination of sick animals, including taking rectal temperatures. Speaking to the farmer and people who have cared for the animals will help establish the history for these cases. Conduct a post-mortem on any dead animals (but note that the vesicular diseases do not typically cause death). Animals may present with lameness and inappetence.

Investigate and sample of a range of animals, including at least 10 clinically healthy animals, to help identify new cases and determine the level of morbidity in the herd or flock.

Some differential diagnoses may be zoonotic and have public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

Samples required

Take samples from at least five affected animals in the herd, flock or group. These can be taken from lesions in the mouth or the feet, or at other sites with suitable lesions.

The best samples for all vesicular disease exclusions are:

- vesicular fluid
- epithelium from unruptured vesicles (1–2 cm)
- epithelial tags from freshly ruptured vesicles (1–2 cm)
- nasal, oral and tonsillar swabs
- oropharyngeal fluid, collected with a probang or swabs if unavailable
- serum from affected, recovered and a selection of unaffected animals (minimum 7–10 ml; at least 10 animals per group).

Epithelium and granulation tissue from healing lesions that is difficult to detach and fibrin covered lesions are generally unsuitable for isolation of virus. If only older lesions are present, include samples from foot lesions as these tend to have higher concentrations of virus for longer periods than do lesions at other sites. To avoid bacterial contamination, you may need to wash animals’ feet and you may rinse epithelial samples from the foot in phosphate buffer before placing in sample vials.

In addition to samples from oral, foot and teat lesions, you should also collect fresh and formalin-fixed samples from several tissues (lymph nodes, thyroid and adrenal glands, kidney, spleen and heart) from dead animals.
Sample collection

The laboratory will be able to test for the presence of all vesicular viruses in samples. Refer to Table 2.1.2.

It is important to note that FMD virus is very sensitive to both acid and alkaline conditions and inappropriate buffer conditions can inactivate the virus making virus isolation difficult or impossible. To maximise chances of virus isolation:

- use phosphate buffered saline or virus transport media with a pH of 7.6.
- if a sample is to be submitted after 24 hours or more, glycerol should be added to the phosphate buffered saline
- oropharyngeal fluid collected with a probang should be diluted in an equal volume of phosphate buffered saline pH 7.6, and mixed vigorously for 1 minute.

Note that collection of samples in these buffers is optimal (for the growth of FMD virus) but not essential for RNA or antigen detection assays.

Collect:

- **serum**, 7–10 ml/animal in plain tubes
- **vesicular fluid**, carefully use a syringe and needle to aspirate the vesicular fluid from unruptured vesicles, and place in a sterile container. Alternatively, collect fluid from small vesicles onto a swab and place the swab in 500 µl of buffer, such as phosphate buffered saline or virus transport medium
- **fresh tissue**, epithelium, epithelial tags, oral, nasal and tonsillar swabs and oropharyngeal fluid and submit in phosphate buffered saline or virus transport medium, if available
- **fixed tissue**, a range of tissues (lymph nodes, thyroid and adrenal glands, kidney, spleen and heart) from dead animals.

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile tube (with viral transport media or phosphate buffered saline if available)</td>
<td>vesicle fluid, vesicle epithelium, nasal and oral swabs, oropharyngeal fluid collected with a probang or tonsillar swab</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
</tr>
<tr>
<td>Fresh and formalin-fixed samples</td>
<td>several tissues (lymph nodes, thyroid and adrenal glands, kidney, spleen and heart) collected from dead animals</td>
</tr>
</tbody>
</table>
Transport of samples

For transport:

• chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
• DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
• send samples with dry ice if the journey is expected to take several days
• formalin-fixed samples can be sent at room temperature.

Sample submission

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.
CHAPTER 2.2
Sudden death in pigs

Sudden death in pigs may be associated with a wide range of infectious diseases or non-infectious causes. Some of these infectious diseases are exotic to Australia and need to be excluded from the disease investigation.

Clinical signs

Sudden death can be defined as death occurring with little or no observed clinical signs. In most cases pigs will be found dead, often in good body condition. As such, there is increased importance placed on post-mortem evaluation and diagnostic testing as part of the disease investigation process. In addition, close observation of remaining animals may be useful in attempting to detect peracute clinical signs. Clinical signs (if observed) will depend on the aetiological agent involved and the age of the animals affected.

The epidemiological picture may also help to determine whether an exotic disease is involved with a sudden death incident. In most cases, an exotic disease will affect multiple animals and spread rapidly throughout the herd.

Potential causes

Exotic diseases that may cause sudden death in pigs include:

- African swine fever
- Aujeszky's disease
- classical swine fever (hog cholera)
- foot-and-mouth disease.

Note that while classical swine fever and Aujeszky's disease are not typically associated with sudden death, the acute form of these diseases may cause sudden death in young piglets.

Some strains of FMD virus can also cause peracute disease leading to sudden death in very young piglets.

Endemic diseases that may cause sudden death in pigs include:

- Actinobacillus suis in piglets
- bacterial endocarditis in piglets, weaners, growers and finishers
- Bungowannah virus in piglets
- colibacillosis (Escherichia coli) in piglets and weaners
- erysipelas (Erysipelothrix rhusiopathiae) in growers and finishers
- encephalomyocarditis (Encephalomyocarditis virus) in piglets
- Glässers disease (Haemophilus parasuis) in weaners, growers and finishers
- oedema disease (E. coli) in weaners, growers and finishers
- pleuropneumonia (Actinobacillus pleuropneumoniae) in weaners, growers and finishers
- streptococcal septicaemia in weaners, growers and finishers.
Non-infectious causes of sudden death in pigs include:
- electrocution
- endotoxic shock (e.g. from vaccines)
- gastric ulceration
- intestinal torsion
- mulberry heart disease (in weaners)
- overlay (in piglets)
- porcine stress syndrome (in growers and finishers)
- trauma.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on 1800 675 888, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

**Investigation and sampling guidelines**

Examine live pigs to detect early clinical signs. In cases of sudden death, undertake a thorough post-mortem examination of multiple pigs to narrow the diagnostic pathway and collect appropriate samples for diagnostic testing. Information about the housing environment, stocking rates, production flow and other rearing details can also help narrow the investigation.

Investigate and sample a range of animals, including at least 10 clinically healthy animals, to help identify new cases and determine the level of morbidity in the herd.

Some differential diagnoses may be zoonotic and have serious public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

Take samples from multiple dead pigs (at least five if possible) at post-mortem. Collect blood from at least 10 animals (if possible) that have clinical signs. Euthanise some animals for post-mortem examination and sample collection.
Sample collection

Table 2.2.1 details the sample collection required for sudden death in pigs.

**TABLE 2.2.1 Sample collection for sudden death in pigs**

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Collect from live pigs</th>
<th>Collect from dead pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDTA tube</td>
<td>blood</td>
<td>blood (if possible to collect from recently dead animals)</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
<td></td>
</tr>
<tr>
<td>Swabs in virus transport media</td>
<td>vesicular lesions (if present); nasal, oral cavity, tonsils</td>
<td>vesicular lesions (if present); nasal and oral cavity</td>
</tr>
<tr>
<td>Sterile tube</td>
<td>vesicular fluid (if vesicles present); faeces (if enteric disease suspected)</td>
<td>vesicular fluid (if vesicles present); faeces (if enteric disease suspected)</td>
</tr>
<tr>
<td>Sterile collection container (no media)</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
<tr>
<td>10% neutral buffered formalin</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
</tbody>
</table>

**Transport of samples**

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

**Sample submission**

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.
CHAPTER 2.3
Respiratory diseases in pigs

Respiratory pathogens are an important cause of morbidity, mortality and production losses in intensively reared pig herds. Multiple infectious diseases often occur concurrently or as a complex within a herd (known as the Porcine Respiratory Disease Complex), and diagnostic approaches should take this into consideration. Complex bacterial pneumonia is often the cause of death in cases of a porcine respiratory disease. However, diseases such as pneumonia often result from the confluence of multiple host, environmental, management and pathogen factors.

Clinical signs

In many cases, the clinical manifestations of infection and severity of disease is age-dependent (e.g. porcine reproductive and respiratory syndrome). General clinical signs associated with respiratory pathogens may include:

- anorexia/weight loss
- coughing and nasal discharge
- cyanosis, particularly the skin on the nose and ears
- pyrexia
- lethargy
- sudden death
- tachypnoea, dyspnoea, respiratory distress (increased respiratory effort/heaves, open mouth breathing).

Other body systems may be implicated:

- encephalitis (associated with Aujeszky’s disease and Nipah virus infection)
- lymphadenopathy (associated with porcine circovirus type 2 viruses)
- polyserositis (associated with Haemophilus parasuis)
- reproductive loss (associated with porcine reproductive and respiratory syndrome)
- seizures and neurological signs associated with meningitis (e.g. Strepococcus suis).

Potential causes

The presence of multiple concurrent pathogens often complicates investigation of porcine respiratory disease. Although clinical and pathology findings may be most consistent with a bacterial aetiology, you should also consider viral and mycoplasmal pathogens. Carefully consider both infectious and non-infectious causes.

**Exotic** diseases that may cause porcine respiratory disease include:

- Aujeszky’s disease
- influenza A viruses in pigs (exotic strains)
- Nipah virus infection
- porcine reproductive and respiratory syndrome.
**Endemic** diseases that may cause porcine respiratory disease include:

- *Actinobacillus pleuropneumoniae*
- atrophic rhinitis (*Bordatella bronchiseptica*)
- inclusion body rhinitis (porcine cytomegalovirus)
- miscellaneous opportunistic bacterial infections (*Haemophilus parasuis*, *Pasteurella multocida*, *Streptococcus suis*)
- mycoplasmal pneumonia (*Mycoplasma hyopneumoniae*, *Mycoplasma hyorhinis*)
- porcine circovirus type 2 associated diseases
- influenza A viruses (human-origin strains, subtypes H1N1, H1N2 and H3N2).

A non-infectious contributing factor to the development of porcine respiratory disease complex is poor air quality, such as high levels of dust and ammonia. In addition, pneumonia associated with ingested toxins (e.g. pyrrolizidine alkaloids, paraquat) is an uncommon cause of respiratory disease in pigs.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on **1800 675 888**, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

**Investigation and sampling guidelines**

Undertake a thorough physical examination of sick animals, including taking rectal temperatures. Speaking to the farmer and people who have cared for the animals will help establish the history for these cases. Information concerning housing, environment, stocking rates, production flow and other rearing details can also help narrow the investigation. Conduct a post-mortem on any dead animals.

Some differential diagnoses may be zoonotic and have serious public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

Collect samples from multiple animals, particularly when multiple pathogens are suspected. Aim to collect blood from at least 10 animals and other samples from at least five animals.
Sample collection

Table 2.3.1 details the sample collection required for respiratory diseases in pigs.

**TABLE 2.3.1 Sample collection for respiratory disease in pigs**

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Collect from live pigs</th>
<th>Collect from dead pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDTA tube</td>
<td>blood</td>
<td>blood (if possible to collect from recently dead animals)</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
<td></td>
</tr>
<tr>
<td>Swabs in virus transport media</td>
<td>vesicular lesions (if present); nasal, oral cavity, tonsils</td>
<td>nasal and oral cavity, tonsils, trachea</td>
</tr>
<tr>
<td>Sterile swabs for bacterial culture</td>
<td>vesicular fluid (if vesicles present); faeces (if enteric disease suspected)</td>
<td>pleural cavity, lung, pericardial fluid, brain</td>
</tr>
<tr>
<td>Sterile collection container (no media)</td>
<td>–</td>
<td>tonsil, trachea, lymph nodes (bronchial), heart, lung, brain, kidney, ileum</td>
</tr>
<tr>
<td>10% neutral buffered formalin</td>
<td>–</td>
<td>tonsil, trachea, spleen, lymph nodes (bronchial), heart, lung (representative sections of all lobes, any lesions), brain, kidney, ileum</td>
</tr>
</tbody>
</table>

**Transport of samples**

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

**Sample submission**

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery toCSIRO-AAHL.
Neurological diseases in pigs

A large number of conditions affect the porcine nervous system, and many of these can cause sudden onset or acute outbreaks. The presenting signs of many of these conditions do not allow clinical differentiation, and diagnostic gross changes are infrequently found in the brain and spinal cord. Several emergency animal diseases can cause neurological disease in pigs so careful workup of these conditions is necessary.

Clinical signs

It is difficult to undertake all but the simplest neurological examination of a pig, and few diseases of the nervous system have localising signs. Clinical signs of neurological disorders in pigs include:

- ataxia
- blindness
- circling
- convulsions
- hyperaesthesia
- nystagmus
- paralysis/paresis
- recumbency
- tremor.

Potential causes

Consider other clinical signs present when determining a differential diagnosis as many emergency animal diseases of pigs cause neurological disease.

Exotic diseases that may cause neurological disorders in pigs include:

- [African swine fever](https://www.ginzo.com/)
- [Aujeszky's disease](https://www.vetmed.ucdavis.edu/)
- blue eye disease (paramyxovirus)
- [classical swine fever](https://www.ncbi.nlm.nih.gov/pubmed/25790724) (hog cholera)
- eastern equine encephalomyelitis
- enteroviral encephalomyelitis
- [Japanese encephalitis](https://www.cdc.gov/ncidod/dvbd/japanese.html)
- [porcine reproductive and respiratory syndrome](https://www.cdc.gov/prrs/
- rabies
- Teschen/Talfan disease.
Endemic diseases that may cause neurological disorders in pigs include but are not limited to:

- congenital tremors (exact cause yet to be determined)
- encephalomyocarditis virus (EMC)
- enteroviral encephalomyelitis
- Glässer’s disease (*Haemophilus parasuis*)
- haemagglutinating encephalomyelitis virus (HEV)
- Menangle virus
- oedema disease
- streptococcal meningitis
- tetanus.

Non-infectious causes of neurological disorders in pigs include:

- congenital defects
- hypoglycaemia
- iron toxicity
- middle ear infection
- nutritional deficiencies (e.g. pantothenic acid)
- poisons such as arsenic, mercury, monensin and organophosphorus compounds
- porcine stress syndrome
- water deprivation or salt poisoning.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on 1800 675 888, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

**Investigation and sampling guidelines**

Undertake a thorough physical examination of sick animals. Speak to the farmer and people who have cared for the animals to establish the case history. Information about housing, environment, stocking rates, production flow and other rearing factors could be particularly useful. Conduct a post-mortem on any dead animals.

Some differential diagnoses may be zoonotic and have serious public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

Take samples from several pigs. Aim to collect blood samples from at least 10 pigs and other samples from at least five pigs. Investigate and sample a range of animals, including clinically healthy or suspicious animals.

Take a complete set of tissue samples for histopathology from recently deceased or euthanased untreated animals.
Sample collection

Table 2.4.1 details the sample collection required for neurological pigs.

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Collect from live pigs</th>
<th>Collect from dead pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDTA tube</td>
<td>blood</td>
<td>blood (if possible to collect from recently dead animals)</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
<td></td>
</tr>
<tr>
<td>Sterile collection container (no media)</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, spinal cord, kidney, ileum</td>
</tr>
<tr>
<td>10% neutral buffered formalin</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, spinal cord, kidney, ileum</td>
</tr>
</tbody>
</table>

Transport of samples

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

Sample submission

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.
CHAPTER 2.5

Diarrhoea in pigs

Pigs of all ages are susceptible to enteric diseases, and diarrhoea is a clinical sign common to nearly all enteric disorders. Of all the diseases in the sucking piglet, diarrhoea is the most common and probably the most important. In some outbreaks it is responsible for high morbidity and mortality. In a well-run herd there should be less than 3 per cent of litters at any one time requiring treatment and piglet mortality from diarrhoea should be less than 0.5 per cent.

Clinical signs

Diarrhoea in pigs may occur with little or no other signs or it may be a striking clinical sign of a specific disease. In addition to diarrhoea, clinical signs can include:

- pyrexia (rectal temperature recorded at >39.5°C)
- lethargy
- reduced food intake
- reluctance to move, huddle together
- sunken eyes
- sudden death in young pigs
- wetness and discoloration of skin around the anus and tail.

Potential causes

Diarrhoea in a herd may be due to a single agent but concurrent infections are common and less than ideal environmental conditions can exacerbate these.

Exotic diseases that may cause diarrhoea in pigs include:

- African swine fever
- classical swine fever (hog cholera)
- porcine epidemic diarrhoea
- post-weaning multisystemic wasting syndrome
- transmissible gastroenteritis.

Endemic diseases that may cause diarrhoea in pigs include but are not limited to:

- clostridium
- coccidiosis
- colibacillosis
- internal parasites
- porcine circovirus 2 infection
- proliferative enteropathy (ileitis)
- rotavirus infection
- salmonellosis
- swine dysentery
- yersiniosis.
Non-infectious causes of diarrhoea in pigs include:
- copper poisoning
- fluoride toxicity
- fungal/toxic mould poisoning
- iron toxicity in piglets
- lead poisoning
- mercury toxicity
- organochlorine toxicity
- organophosphate toxicity
- overfeeding
- pantothenic acid deficiency
- paraquat poisoning
- phosphorus toxicity
- salt poisoning
- zinc deficiency.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the **Emergency Animal Disease Watch Hotline on 1800 675 888**, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

**Investigation and sampling guidelines**

A thorough physical examination of sick animals, including taking rectal temperatures, is advised. Speaking to the farmer and people who have cared for the animals will help establish the history for these cases. Conduct post-mortems on dead animals.

Some differential diagnoses may be zoonotic and have serious public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

Take samples from several pigs. Aim to collect blood samples from at least 10 pigs and other samples from at least five pigs. Investigate and sample a range of animals, including clinically healthy or suspicious animals.

Take a complete set of tissue samples for histopathology from recently deceased or euthanased untreated animals.
Sample collection

Table 2.5.1 details the sample collection required for pigs with diarrhoea.

**TABLE 2.5.1 Samples to collect for pigs with diarrhoea**

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Collect from live pigs</th>
<th>Collect from dead pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDTA tube</td>
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<td>blood (if possible to collect from recently dead animals)</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
<td>faeces</td>
</tr>
<tr>
<td>Sterile tube</td>
<td>faeces</td>
<td>faeces</td>
</tr>
<tr>
<td>Sterile collection container (no media)</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
<tr>
<td>10% neutral buffered formalin</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
</tbody>
</table>

**Transport of samples**

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- **DO NOT FREEZE SAMPLES** at −20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

**Sample submission**

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.
CHAPTER 2.6

Acute lameness in ruminants and pigs

Acute lameness is a condition with a wide variety of potential causes which can be accompanied by many other clinical signs. It is important to differentiate between lameness and neurological weakness, or ataxia, since the main differential diagnoses of each vary widely. Due to the significance of some of the infectious causes, in particular the vesicular diseases, it is essential for them to be ruled out early.

Clinical signs

Acute lameness conditions can manifest in numerous different ways. Clinical signs that may be evident include:

- abnormal posture and/or conformation
- abnormal limb position
- abrasions, lacerations, puncture wounds
- areas of swelling, heat, erythema, pain, haemorrhage, ecchymosis
- drop in milk production
- drop in conception rates
- hoof lesions including, but not limited to, interdigital dermatitis, ulcers, abscesses, vesicles, cracks
- isolation from the herd
- increased time in sternal and/or lateral recumbency
- odour of the hoof
- reluctance to move
- swollen joints
- sudden onset of mild to severe abnormal gait (affecting one or more limbs)
- weight loss and/or dehydration.

If acute lameness is secondary to a systemic condition, signs that may be evident include (but are not limited to):

- diarrhoea
- drooling
- generalised lesions present elsewhere on the body
- pyrexia
- systemic bacterial infections including acidosis, mastitis and metritis.

Potential causes

Acute lameness is associated with a range of infectious (both endemic and exotic) and non-infectious conditions. The systems most often associated with acute lameness are the musculoskeletal and nervous systems. In addition to acute lameness, consider other clinical signs when determining a differential diagnosis list.
Exotic diseases that may cause lameness in pigs and/or ruminants are:

- bluetongue disease
- foot-and-mouth disease
- goat pox
- lumpy skin disease
- Senecavirus A (Seneca Valley virus) infection
- sheep pox
- swine vesicular disease
- vesicular exanthema of swine (not seen since 1956)
- vesicular stomatitis.

Endemic diseases that may cause lameness in pigs and/or ruminants include but are not limited to:

- bacterial infections causing acute arthritis, such as *Erysipelothrix rhusiopathiae*, *Haemophilus parasuis*, *Streptococcus* spp, *Actinobacillus suis*, *Mycoplasma hyosynoviae*, *Mycoplasma hyorhinis*, *Arcanobacterium pyogenes*, *Chlamydia psittaci*, *Streptococcus suis*
- botulism
- bovine cysticercosis (beef measles)
- bovine ephemeral fever
- bovine papular stomatitis
- *Brucella suis*
- caprine arthritis encephalitis
- clostridial myositis/blackleg (*Clostridium chauvoei*)
- contagious pustular dermatitis (orf)
- digital dermatitis
- flavivirus infection
- footrot
- Glässers disease (*Haemophilus parasuis*)
- malignant catarrhal fever
- osteomyelitis
- tetanus.

Non-infectious causes of lameness in pigs and/or ruminants include:

- bad/hard floors
- degenerative causes—degenerative joint disease, arthritis, osteochondrosis, cervical spondylopathy
- inflammatory causes—laminitis, septic arthritis
- nutritional causes—white muscle disease (selenium deficiency), acidosis (laminitis), vitamin and mineral excesses and deficiencies leading to metabolic bone disease which predisposes fractures (osteomalacia, osteoporosis). Deficiency in vitamin D, biotin, manganese or zinc, as well as mineral excesses, may all lead to metabolic bone disease.
• overgrown claws

• traumatic causes—hoof lesions (such as cracks, erosions, ulcers, abscesses), fractures, luxations and subluxations, nerve damage due to trauma or toxicity, soft tissue injuries.

Some of the differential diagnoses may be eliminated by taking a good history (e.g. possible trauma, nutrition) and by undertaking a thorough clinical examination. Information about the clinical picture in the herd (i.e. single or multiple animals affected) is also important.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on 1800 675 888, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

Bluetongue, malignant catarrhal fever, *Brucella suis*, virulent footrot and the vesicular diseases are all notifiable diseases in Australia. If you suspect the presence of any of these diseases in any livestock you are required to report it to your relevant state department. Virulent footrot must be reported within 48 hours.

**Investigation and sampling guidelines**

Undertake a thorough physical examination of sick animals, including taking rectal temperatures, as many conditions present as acute lameness. Speaking to the farmer and people who have cared for the animals will help establish the history for these cases. Conduct a post-mortem on any dead animals (but note that lameness does not typically cause death).

Some differential diagnoses may be zoonotic and have public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

You will only need samples from animals with acute lameness if you suspect infectious, inflammatory or nutritional causes. Physical examination alone will generally diagnose traumatic causes (such as a fracture or sole abscess). Sample collection depends on the clinical signs present and your physical examination findings.

Take samples from several affected animals in the herd, flock or group. Aim for blood samples from at least 10 animals and other samples from at least five animals.

**Sample collection**

Carefully aspirate the vesicular fluid from unruptured vesicles by syringe and needle, and place in a sterile container. Alternatively, collect fluid from small vesicles on a swab and place the swab in 500 µl of buffer, such as phosphate buffered saline or virus transport medium.

Submit epithelium, epithelial tags, oral, nasal and tonsillar swabs, and oropharyngeal fluid in phosphate buffered saline or virus transport medium, if available. Table 2.6.1 details the samples to collect for acute lameness in pigs and ruminants.
TABLE 2.6.1 Samples to collect for acute lameness in pigs and ruminants

<table>
<thead>
<tr>
<th>Additional clinical signs</th>
<th>Sample</th>
<th>Collection container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesicles</td>
<td>vesicle fluid, vesicle epithelium, nasal and oral swabs, oropharyngeal fluid collected with a probang or tonsillar swab blood for serology</td>
<td>sterile tube (with viral transport medium or phosphate buffered saline if available) plain tube</td>
</tr>
<tr>
<td>pyrexia, acidosis, mastitis, metritis, generalised lesions, drooling, diarrhoea</td>
<td>blood for serology whole blood</td>
<td>plain tube EDTA tube</td>
</tr>
<tr>
<td>Lesions (non-vesicular)</td>
<td>tissue material/epithelium</td>
<td>swab or scrape using scalpel if infectious aetiology is included in the differential diagnosis, use viral transport media</td>
</tr>
<tr>
<td>Joint effusion, localised swelling, or effusion</td>
<td>fluid aspirate from affected joint or area paired serology</td>
<td>sterile container plain tube</td>
</tr>
<tr>
<td>Interdigital dermatitis</td>
<td>epithelium from affected skin or advancing underrun lesions</td>
<td>2–3 mm, modified Stuart transport medium</td>
</tr>
</tbody>
</table>

Transport of samples

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

Sample submission

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.
CHAPTER 2.7
Reproductive problems in pigs

Viral infections are the most common infectious cause of reproductive problems in pigs. Porcine reproductive and respiratory syndrome currently accounts for nearly 60 per cent of infectious abortions in the United States. Infection of the foetus is common, although maternal illness can be a primary or contributing cause of abortion with a number of viruses.

Clinical signs

Reproductive problems in pigs can present in many different ways, but can include:

- abortions
- congenital abnormalities
- embryonic death
- embryonic death and resorption
- foetal malformations
- foetal mummification
- increased neonatal mortality
- poor conception rates
- small litters and decreased litter size
- stillbirths
- weak pigs.

Potential causes

**Exotic** diseases that may cause reproductive problems in pigs include:

- Aujeszky's disease
- classical swine fever (hog cholera)
- influenza A viruses in pigs (exotic strains)
- Japanese encephalitis
- Nipah virus infection
- porcine reproductive and respiratory syndrome.

**Endemic** diseases that may cause reproductive problems in pigs include:

- bovine viral diarrhoea (BVD) or border disease
- Brucella suis
- chlamydiosis
- encephalomyocarditis virus infection
- influenza A viruses in pigs (human-origin strains, subtypes H1N1, H1N2 and H3N2)
- Menangle virus infection
- porcine parvovirus infection
- porcine cytomegalovirus infection
- porcine rubulavirus (blue-eye disease)
- Teschen/Talfan disease
Non-infectious causes of reproductive problems in pigs include:

- carbon monoxide poisoning
- poor management
- poor nutrition
- zearalenone poisoning.

**Reporting requirements**

If you suspect an emergency animal disease, report it immediately by phoning the Emergency Animal Disease Watch Hotline on **1800 675 888**, wherever you are in Australia. Alternatively, contact a government veterinarian in your state or territory.

**Investigation and sampling guidelines**

Conduct a thorough physical examination of sick animals (including taking rectal temperatures). Speak to the farmer and people who have cared for the animals to establish the history for these cases. Consider conducting post-mortems on any available dead animals.

Some differential diagnoses may be zoonotic and have serious public health implications. Take extra precautions investigating such diseases, including using appropriate personal protective equipment, to prevent infecting personnel by ingesting, inhaling infected aerosols, or contaminating mucous membranes or abraded skin.

**Samples required**

Since most infectious abortions are the result of foetal infections that occur more than 14 days after the sow became infected, sows may have antibodies at the time of the abortion. However, seroconversion in a sow aborting due to acute illness will not yet have occurred at the time of abortion.

Collect samples from several pigs (at least 10 animals for blood samples and at least five animals for other samples). Investigating and sampling a range of animals, including clinically healthy animals, can assist to identify new cases and determine the level of morbidity in the herd.
**Sample collection**

Table 2.7.1 details the sample collection required for pigs with reproductive problems.

**TABLE 2.7.1 Samples to be collected from pigs with reproductive problems**

<table>
<thead>
<tr>
<th>Collection container</th>
<th>Collect from live pigs</th>
<th>Collect from dead pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDTA tube</td>
<td>blood</td>
<td>blood (if possible to collect from recently dead animals)</td>
</tr>
<tr>
<td>Plain tube</td>
<td>blood for serology</td>
<td></td>
</tr>
<tr>
<td>Swabs in virus transport media</td>
<td>nasal and oral cavity, tonsils</td>
<td>nasal and oral cavity, tonsils, trachea</td>
</tr>
<tr>
<td>Sterile swabs for bacterial culture</td>
<td>–</td>
<td>abdominal cavity, uterus peritoneal fluid</td>
</tr>
<tr>
<td>Sterile collection container (no media)</td>
<td>–</td>
<td>foetus, tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
<tr>
<td>10% neutral buffered formalin</td>
<td>–</td>
<td>tonsil, spleen, lymph nodes, lung, brain, kidney, ileum</td>
</tr>
</tbody>
</table>

**Transport of samples**

For transport:
- chill blood samples and unpreserved tissue samples at either 4°C, or with frozen gel packs
- DO NOT FREEZE SAMPLES at –20°C; it reduces the sensitivity when used for virus isolation and molecular diagnostic tests
- send samples with dry ice if the journey is expected to take several days
- formalin fixed tissue can be sent at room temperature.

**Sample submission**

The relevant state or territory laboratory should coordinate sample packaging and consignment for delivery to CSIRO-AAHL.