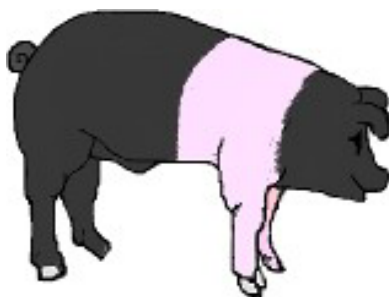




Animal &  
Plant Health  
Agency



# Great Britain pig quarterly report: disease surveillance and emerging threats

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**Volume 26: Quarter 1 of 2022 (January to March)**

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## Introduction and overview

This quarterly report reviews disease trends and disease threats for the first quarter of 2022, January to March. It contains analyses carried out on disease data gathered from APHA, Scotland's Rural College (SRUC) Veterinary Services and partner post-mortem providers and intelligence gathered through the Pig Expert Group networks.

In addition, links to other sources of information including reports from other parts of the APHA and Defra agencies are included. A full explanation of [how data is analysed](#) is provided in the annexe available on GOV.UK.

### Pig disease surveillance dashboard outputs

Diagnoses made in the first quarter of 2022 compared to the same quarter in 2021 through the Great Britain (England, Wales and Scotland) scanning surveillance network are illustrated in table 1. These can be interrogated further using the interactive pig [disease surveillance dashboard](#) which was launched in October 2017.

**Table 1: Great Britain scanning surveillance 15 most frequent diagnoses in quarter 1 of 2022 and quarter 1 of 2021**

15 most frequent diagnoses quarter 1 of 2022 (total 270)	15 most frequent diagnoses quarter 1 of 2021 (total 285)
1. <i>Lawsonia</i> sp. associated disease	1. <i>Streptococcus suis</i> disease
2. Rotavirus	2. Salmonellosis – <i>S. Typhimurium</i>
3. Porcine reproductive and respiratory syndrome (PRRS) - systemic	3. Rotavirus
4. Colibacillosis - enteric	4. PRRS - pneumonia
5. <i>Streptococcus suis</i> disease	5. Pneumonia – other cause
6. <i>Pasteurella multocida</i> pneumonia	6. <i>Lawsonia</i> sp. associated disease
7. Salmonellosis – <i>S. Typhimurium</i>	7. Colibacillosis - enteric
8. <i>Brachyspira pilosicoli</i>	8. PRRS - systemic
9. Salmonellosis – other serotype	9. Intestinal torsion
10. Swine influenza	10. <i>Mycoplasma hyopneumoniae</i> pneumonia
11. Colibacillosis - oedema disease	11. Swine influenza
12. Meningitis - streptococcal	12. Streptococcal infection
13. PRRS - pneumonia	13. <i>Pasteurella multocida</i> pneumonia
14. <i>Brachyspira hyodysenteriae</i> , swine dysentery	14. Colibacillosis - oedema disease
15. <i>Mycoplasma hyopneumoniae</i> pneumonia	15. Colisepticaemia

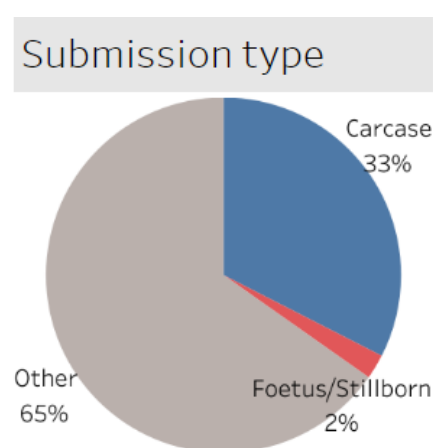
Note: that further diagnoses may be added for records for submissions made in quarter 4 of 2021 which are finalised at a later date.

**Figures 1a to 1d: summary data for 440 submission records in quarter 1 of 2022 (432 in quarter 1 of 2021)**

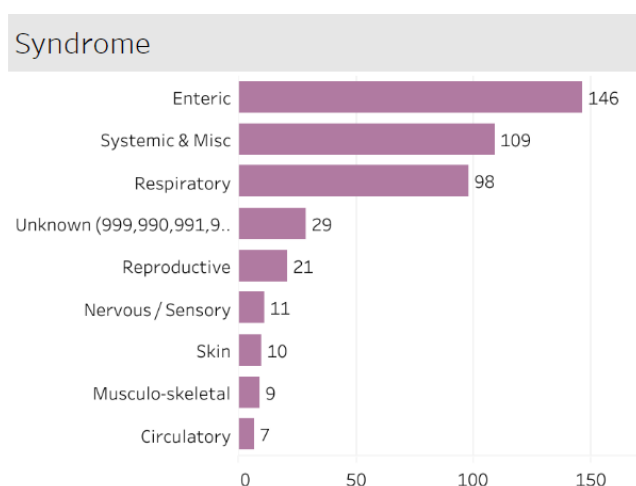
**Figure 1a: pig age**

Age Category	
Adult	73
Mixed	9
Neonatal	28
Postwean	231
Prewrite	35
Unknown/other	64

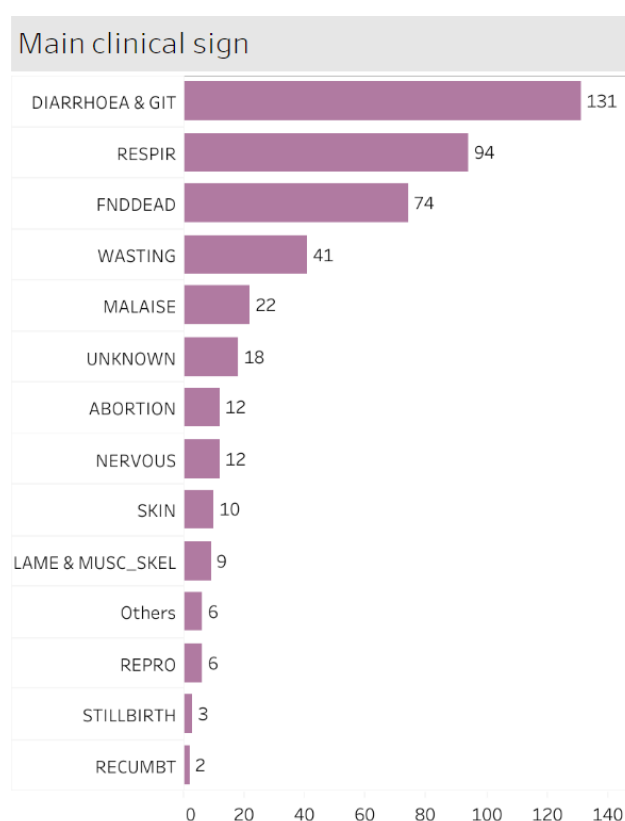
**Figure 1b: submission type**



**Figure 1c: disease syndrome**



**Figure 1d: main clinical sign reported**



These diagnostic submissions are voluntary and subject to several sources of bias. The profile of submissions for the first quarter of 2022 differs from that of the same quarter of 2021 (quarter 1) in that the most frequent clinical signs were diarrhoea and gastro-intestinal signs, rather than found dead. Also, the most frequent syndrome was enteric, rather than systemic and miscellaneous (Figure 1). Enteric syndrome is regularly the dominant disease syndrome investigated in pig diagnostic submissions and in this quarter,

awareness of outbreaks of swine dysentery (see details in this report on pages 14 to 15) is also suspected to have influenced surveillance for enteric disease.

Total Great Britain diagnostic submission records for quarter 1 of 2022 (440) were slightly higher than the total for the same quarter in 2021 (432), despite the effect of the financial and resource pressures that pig producers are currently facing. This was mainly due to an increase in non-carcase submissions to SRUC.

However, there was a change in balance in the type of submissions in quarter 1 of 2022; pig carcases for postmortem examination represented 33% of total submission records (Figure 1) compared to 40% in quarter 1 of 2021. In terms of numbers of carcase submissions, the GB total in quarter 1 of 2022 was not significantly different to the numbers in the same quarters in 2018 to 2021, although there was a reduction in carcase submissions to SRUC.

Enteric diagnoses represent three of the top five most frequent diagnoses made in quarter 1 of 2022. Three of the five most frequent diagnoses in quarter 1 of 2022 are also in the top five diagnoses in quarter 1 in 2021 (table 1), namely rotavirus, *Streptococcus suis* and porcine reproductive and respiratory syndrome (PRRS).

The total number of diagnoses made in quarter 1 of 2022 was slightly lower than in quarter 1 of 2021 (table 1), although more diagnoses may be added to the most recent quarter. The high surveillance value of carcase submissions, which allow full post-mortem examination and diagnostic investigation, is recognised. Post-mortem submissions are encouraged from unusual, severe or unresponsive disease incidents.

## New and re-emerging diseases and threats

### African swine fever summary

[Updated assessments continue to be published on African swine fever \(ASF\)](#) on GOV.UK.

Updates on the [ASF situation in Europe](#) were issued in January and two in May 2022. Figure 2 shows reported cases to 27 May 2022.

The developments of particular note in Europe in recent months are ASF detection in wild boar in two separate areas in mainland Italy, in domestic pigs in a farm in western Germany, and in North Macedonia.

Italy reported detection of ASF genotype 2 for the first time on 7 January 2022 in a wild boar found dead in north-west Italy, in the province of Alessandria (Piedmont Region), in mainland Italy (Figure 2). An infected zone was established in this mountainous region which is reported to have relatively low wild boar density. Searches for wild boar carcase have resulted in over 120 cases (as of 27 May 2022) of ASF-infected wild boar being confirmed, all within the infected zone. Two highways help define the infected area and fencing of these is being improved.

Then in early May 2022, a case of ASF genotype 2 was confirmed in a new region of mainland Italy, in a young wild boar found sick and euthanased in a nature reserve in

Rome (Figure 2). This is the first report of ASF in the region and is approximately 400km from the previously reported cases in wild boar in the north-eastern region described above. The likelihood is that the source of infection is likely to be human-mediated, with wild boar somehow gaining access to ASF-infected meat; there are significant numbers of wild boar in the city of Rome and there have also been issues with rubbish collection.

An 'Infected Zone' and an 'Attention Zone' have been implemented and control efforts are underway, including enhanced passive surveillance and active searching for wild boar carcasses, enhanced checks on pig movements, movement bans (other than to slaughter), regulation of outdoor activities, a pig census and communications to the public in the Infected Zone; with a hunting ban, pig census and active carcass searching in the Attention Zones. Since the first detection in Rome, further wild boar ASF cases have been confirmed and the infected zone has been enlarged as a result.

New restrictions introduced under Commission Implementing Regulation (EU) 2021/605 will prevent pig/pork imports to the UK from the infected region. No ASF has been reported in domestic pigs in Italy at the time of writing.

The ASF detections in mainland Italy are distinct from the strain of ASF (genotype 1) that has been endemic on the island of Sardinia since 1978. More details are given in the latest ASF in Europe outbreak assessment [latest ASF in Europe outbreak assessment](#).

A significant development in Germany in late May was the confirmation of ASF in a small domestic pig herd in a new region in the south-west of Germany, close to the border with France (Figure 2). This is approximately 600km from the nearest report of ASF in Germany, representing a significant westward geographic leap across the country. This appearance of ASF in a previously unaffected region, a long distance from affected areas, is likely to represent a human-mediated route, as occurred in Belgium in 2018 and more recently in mainland Italy. Apparently, there are casual and seasonal workers from a variety of countries picking fruit and vegetables on this farm.

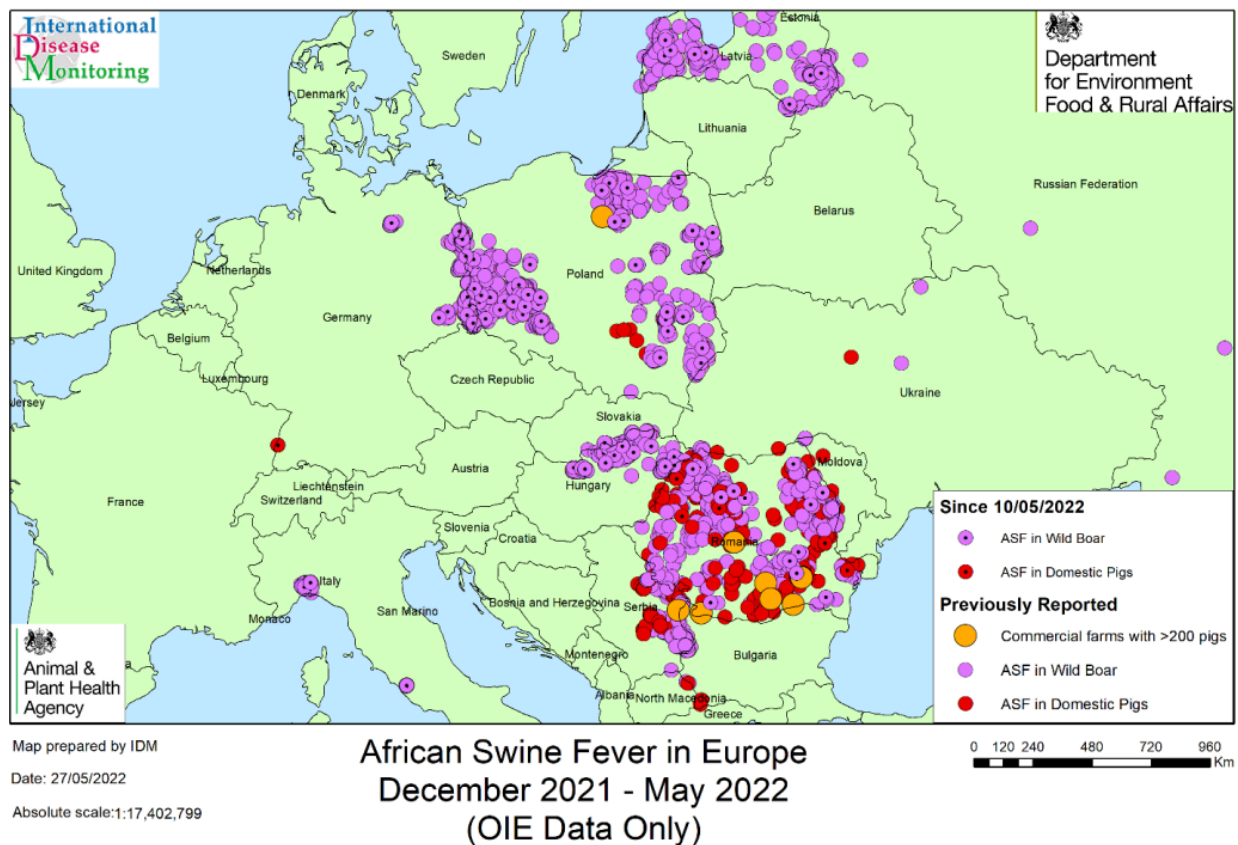
This outbreak in domestic pigs in Germany involved one farm with 35 animals, 16 of which died between 19 and 24 May 2022. Two restriction zones have been created around the farm at 3km and 10km from the infected premises. The working hypothesis of the German authorities is that this is the first case in the region rather than reflecting spread from other undetected domestic pigs or wild boar in the vicinity.

Epidemiological investigations to check there is no local ASF infection in wild boar and other domestic pigs are in progress, no nearby ASF cases have been detected to date.

Elsewhere in Germany there have been further reports of ASF in wild boar in the north-east of the country, near the border with Poland.

North Macedonia reported ASF in domestic pigs for the first time; a backyard farm was affected in the east of the country close to the Bulgarian border. Contact with infected wild boar is suspected to be the most likely source of infection. Protection and surveillance zones were established on 7 January and a stamping out policy was carried out among all pig holdings in the 3km area. One further outbreak of ASF in a backyard domestic pig premises has been reported to OIE since then, and North Macedonia also reported two cases of ASF infection in wild boar. All these ASF cases occurred in the north-east of the country, close to the border with Bulgaria.

**Figure 2: ASF reports in Europe for December 2021 to May 2022 (mapped 27 May 2022)**

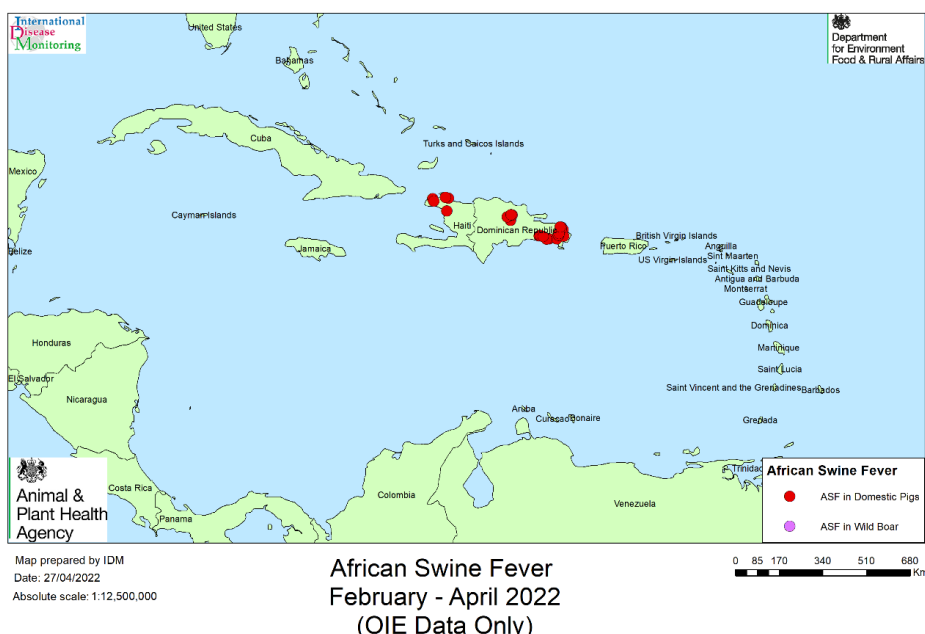


The updates on ASF in Europe also have details of ASF outbreaks in domestic pigs which continue to be reported in Moldova, Romania, Russia, and Ukraine, and ASF has also continued to be reported in wild boar across affected countries in Europe.

Maps showing information on the [EU ASF restriction zones](#) are available.

No new updates on the ASF situation in the Caribbean were issued by IDM since the previous IDM report in [September 2021](#). Both the Dominican Republic and Haiti continue to report ASF cases in domestic pigs and Figure 3 illustrates the situation from February to 27 April 2022.

**Figure 3: ASF cases in domestic pigs in the Dominican Republic and Haiti February to April 2022 (mapped on 27 April 2022)**



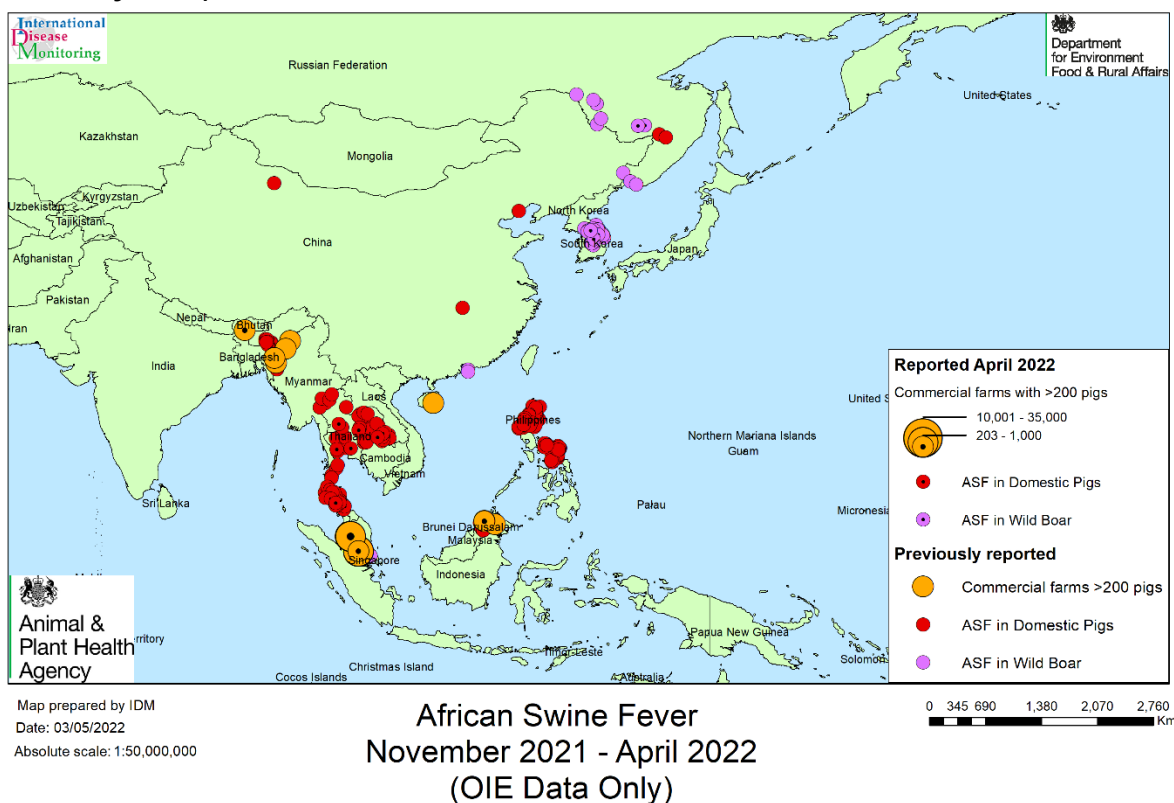


No further updates on the [ASF situation in Asia](#) have been issued since January 2022. Figure 4 illustrates outbreaks reported from November 2021 to April 2022.

Information from industry media ([Feed Strategy News – global ASF situation](#)) indicates continuing outbreaks of ASF in domestic pigs in the Philippines although, in other parts of the country, there is investment to expand pig production to help stabilise the pork market. There are also reports of ASF vaccine trials taking place. In Malaysia, wild boar and domestic pig ASF cases continue, these have been reported to be affecting the Malaysian peninsula also (Figure 4). ASF has spread in domestic pigs in north-eastern India and in neighbouring Bhutan, and Thailand has confirmed further outbreaks in village herds in the south and north-east of the country.

Wild boar and domestic pig ASF cases have been reported in South Korea and domestic pig cases continue in China. ASF has been detected again in domestic pigs in north-eastern Russia, according to an OIE report, in a region that had not reported cases since December 2020 (Figure 4).

**Figure 4: ASF cases reported in Asia from November 2021 to April 2022 (mapped on 3 May 2022)**



Global disease reports, produced monthly by the US Swine Health Information Center (SHIC), are also a good source of information. These can be viewed and received by email by signing up on the [SHIC Website](#).

Pig Progress held a webinar with Klaus Depner, a well-known expert on ASF, describing key features of ASF that influence its spread and control, and Elieen Claeys on biosecurity measures to control ASF. Both provided valuable information and the webinar can be accessed here: [Yes, Prevention Works, A Practical Approach to Combat African Swine Fever - Pig Progress](#)

A publication from China acknowledges the rapid spread of ASF through the country and the damage to the pig and related industries. It summarises key elements of the

strategies required to prevent and control the disease, and restore pig production in China (Liu and others, 2021).

A special edition of Transboundary and Emerging Diseases on [feed and feed ingredients as risk pathway for pathogen introduction](#) was published, bringing together a range of papers on this subject, many relevant to the risk of ASF introduction via this pathway, and possible mitigations.

A positive publication, with respect to future prospects for an ASF vaccine being developed, reported on the lack of reversion to virulence after five passages in pigs of the gene deleted ASF vaccine candidate (Tran and others, 2022). This is an essential prerequisite for authorities to be able to consider regulatory approval of its use.

The mission of Global ASF Research Alliance (GARA) is to establish and sustain global research partnerships that will generate scientific knowledge and tools to contribute to the successful prevention, control and, where feasible, eradication of ASF. Their news and activities are accessible on the [GARA website](#).

Information on ASF is disseminated to veterinary practices and Pig Veterinary Society members. The assistance of veterinary practitioners in raising awareness about ASF amongst their pig-keeping clients in UK is vital, together with advising them on resolving biosecurity weaknesses to reduce the risk of introduction.

The biggest risk for ASF virus entering the UK's pig population continues to be pigs or wild boar eating pork or pork products derived from infected animals. ASFV can survive for months in smoked, dried and cured meats, and for years in frozen meat.

Meat products brought into the UK from affected countries as personal imports represent the most significant risk of introduction, the commercial trade of such products is not permitted from ASF-affected areas.

Pig keepers are reminded that it is illegal to feed pigs catering, kitchen or domestic waste, or meat or meat products. Providing dedicated clothing and boots for staff and visitors, limiting visitors to a minimum, and preventing outside vehicles or equipment which may be contaminated from coming on to the farm, are also all valuable procedures to reinforce.

[Images of the clinical signs and pathology of ASF](#) are available. Suspect cases must be [reported promptly to APHA](#) and this is followed by an official veterinary investigation.

## **Porcine epidemic diarrhoea surveillance**

Porcine Epidemic Diarrhoea (PED) due to any PED virus strain remains notifiable in England and Scotland and suspicion of disease, or confirmation of infection, must be reported (Defra, 2015 and Scottish Government, 2016). The last diagnosis of PED recorded in the Great Britain diagnostic database (VIDA) was in 2002 on a farm in England.

A suspect incident of PED on a pig premises in England was reported by a private veterinary surgeon in May 2022, this was the first suspect PED case since January 2018. The affected pigs were six-weeks-old and housed and 50% of the group had



diarrhoea and poor growth, with one death. The high morbidity had prompted the concern about PED in accordance with guidance about what might lead someone to [suspect and report PED](#). Faecal samples were sent to APHA Weybridge for rapid PED PCR testing at no charge to the submitting vet or pig keeper. No PED virus was detected, thus PED was not confirmed. Differential diagnosis is in progress on samples from a piglet that was submitted for post-mortem examination (PME) to the University of Surrey, a partner PME provider and will be described in the next quarterly report.

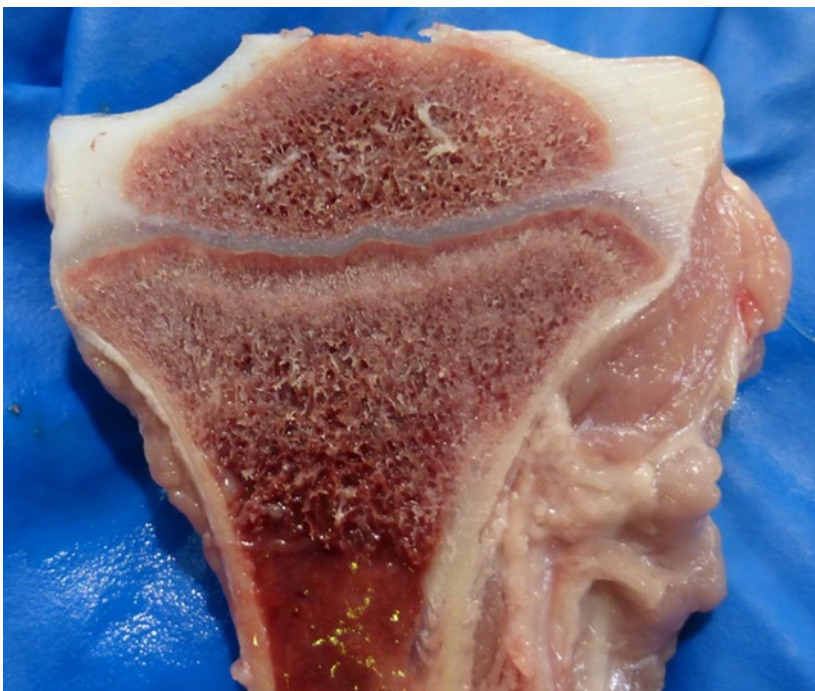
Enhanced surveillance for PED continues and diagnostic submissions from cases of diarrhoea in pigs (non-suspect) submitted to APHA are routinely tested by PCR for PED virus (PEDV) on a weekly basis. None have been positive for PED in over 1,350 diagnostic submissions tested under Agriculture and Horticulture Development Board (AHDB) Pork funding from June 2013 to March 2022.

## Unusual diagnoses or presentations

### Nutritional osteodystrophy in growing pigs on home-mix diet

Nutritional osteodystrophy was diagnosed when a three-month-old gilt was submitted to Shrewsbury VIC to investigate shifting lameness in growing pigs, with larger pigs most affected and some going off their hind legs. The pigs were fed a diet of home-grown rolled wheat and soya, with no mineral, vitamin or trace element supplementation, apart from access to general livestock mineral blocks. Gross examination found that bones were softer and easier to saw than normal; the skull bones and ribs were particularly pliable, and ribs did not snap when bent. Bone ash in a long bone and rib shaft was significantly reduced and histopathology revealed changes indicative of nutritional osteodystrophy, including reduced mineralisation and disturbed osteogenesis (rickets), and increased osteoclasia and myelofibrosis (fibrous osteodystrophy). A similar case of nutritional osteodystrophy in a pig is illustrated in Figure 5.

**Figure 5: Widened epiphysis of long bone with subtle growth plate irregularity in a case of nutritional osteodystrophy**



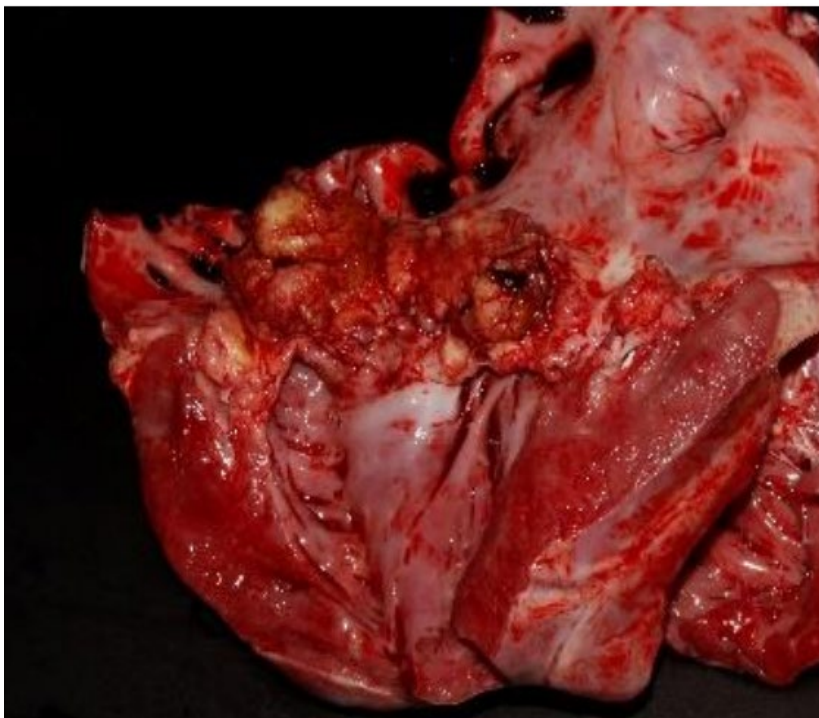
Skeletal development involves a complex interplay of nutritional, genetic and other environmental factors. Low dietary vitamin D and calcium were likely to be involved in this case, with deficiency or imbalances of various other minerals or trace elements (eg copper, phosphorous) also possible. Liver analysis confirmed concurrent hypocuprosis in this pig.

A review of the diet was implemented, particularly to address inadequate trace element and mineral provision. Histopathological examination of epiphyseal growth plates is important in confirming nutritional osteodystrophy, together with the gross evidence of softer and more pliable bones, bone analysis, the clinical picture on farm and, in this case, clear dietary risk factors relating to the home-mix ration. This case was described in the April 2022 Veterinary Record surveillance report (APHA, 2022a).

### ***Mannheimia* species isolated from endocarditis case**

Wasting, lethargy, cyanosis and respiratory signs were described in six of 200 six-month-old outdoor pigs. A poor response to antibiotic and anti-inflammatory treatment was reported. Two were submitted which had gross lesions consistent with heart failure due to severe valvular chronic and active vegetative endocarditis (Figure 6).

**Figure 6: Vegetative endocarditis in pig from which a *Mannheimia* species was isolated**



Cultures were sterile from one pig and from the other yielded a pure growth of a *Mannheimia* species. This was confirmed as such by 16S rRNA gene fragment sequencing. It had highest match (98.24%) to *Mannheimia varigena*. There is minimal literature on *Mannheimia* species infection in pigs, although Dee (2021) mentions *Mannheimia haemolytica* isolated from aborted fetuses, and septicaemia in adult pigs. The pathogenesis is stated to be obscure and porcine strains of *M. haemolytica* are often untypeable and do not belong to the common ovine and bovine serotypes. The pigs were kept outdoors but had no direct or indirect contact with ruminants. This may well have been an incidental finding and it is also possible that a more common cause of endocarditis, such as erysipelas or *S. suis*, was involved earlier and the antibiotic treatment affected its isolation in culture.

## ***Staphylococcus sciuri* arthritis in single preweaned pig**

*Staphylococcus sciuri* is usually considered non-pathogenic in pigs. There have only been occasional pig submissions over past years from which *Staphylococcus sciuri* has been isolated by APHA where it was thought to be clinically significant; an outbreak of septicaemia was diagnosed in finishers (APHA, 2020a). There is also a report in the literature of a case of greasy pig disease with septicaemia in pigs due to this organism (Chen and others, 2007).

In this case, the isolation of *Staphylococcus sciuri* in pure growth from the joint of one of three pigs suggests that it was of clinical significance in that pig, but given its absence in other joints and pigs, and that *Streptococcus suis* was obtained from the joint of another pig in the batch, it was thought unlikely to be of primary clinical significance to the disease on farm. Submission of further typically affected untreated pigs was recommended if the problem continued on farm.

In units with ongoing low-grade joint-ill in pre-weaned pigs, it is not uncommon to isolate different pathogens from the joints of different pigs - the predisposing factors are common to these (colostral immunity, hygiene, navels, floor type, trauma and any interventions breaching mucosal surfaces or skin). In outbreaks of joint ill, it can be more common to find a predominant or single polyarthritis-associated pathogen (such as *S. suis*, *S. dysgalactiae*, *Glaesserella parasuis*).

## **Intestinal listeriosis**

Intestinal contents and fixed intestinal tissues from an on-farm postmortem examination were submitted to SRUC from a 12-week-old grower pig which died after showing acute haemorrhagic diarrhoea. Several pigs within the batch were similarly affected. *Salmonella* and *Brachyspira* cultures, *Brachyspira* PCR and clostridial toxin ELISAs were completed, with negative results. Histopathology was undertaken on multiple sections of jejunum, ileum and colon, and mesenteric lymph nodes. All intestinal sections showed widespread congestion and mucosal haemorrhage associated with multifocal areas of acute necrotising enteritis and colitis. Affected areas had intense neutrophil infiltrates and fibrin exudation associated with bacterial infection. Oedema of the mesocolon and haemorrhagic lymphadenitis were also present. There was no evidence of proliferative enteropathy or spirochaetal-type colitis.

Gram-stained sections of the intestine revealed gram-positive intracellular bacteria in the lesions. Immunohistochemistry for *Listeria* species showed labelled bacteria within the lumen of the gut and within groups of sloughed enteric cells amidst mucus and inflammatory material. Cultures of the colonic contents were repeated to attempt isolation of *Listeria* species, these were unsuccessful due to overgrowth by contaminant organisms.

These findings suggest that the haemorrhagic enteritis was associated with listeriosis, similar to that described in sheep. Further information confirmed that pigs had been given poor quality silage surplus to requirement on the farm, and this was believed to be the source of infection.

## Changes in disease patterns and risk factors

### Enhanced surveillance for porcine circovirus-3 myocarditis

Porcine circovirus 3 (PCV3)-associated myocarditis is a relatively recently recognised systemic manifestation of PCV3 infection, however its frequency in postnatal pigs and contribution to disease outbreaks in Great Britain is not known. Enhanced surveillance for cases, using myocarditis as an initial screen, was undertaken in 2021. Hearts from pigs or plucks received for PME and diagnostic testing were examined by histopathology from over 400 submissions, excluding reproductive/perinatal cases. In those with non-suppurative myocarditis, PCV3 in situ hybridisation (ISH), PCV2 immunohistochemistry (IHC) and RT-PCRs were performed. Non-suppurative myocarditis, often with periarteritis, associated with PCV3 nucleic acid labelling by ISH and, usually, moderate to high viral loads (based on PCR Ct values) was detected in only seven submissions (Table 2). PCV2 was not detected in these pigs by IHC. Only single pigs in batches of two or three were affected in these submissions.

**Table 2: Details of individual postnatal pigs with myocarditis associated with PCV3**

Month 2021	PCV3 PCR Ct	Body condition	Pig age	Other diagnoses made
February	21.24	Not known (plucks)	5 weeks	<i>Actinobacillus pleuropneumoniae</i> disease
May	25.17	POOR	9 weeks	Swine influenza (H1N2). Also PRRSV PCR positive (vaccine-like strain)
June	25.42	Not known (plucks)	8 weeks	Porcine reproductive and respiratory syndrome (PRRS)
July	17.92	FAIR	5 weeks	<i>Actinobacillus pleuropneumoniae</i> disease
September	18.13	POOR	6 weeks	No other diagnosis in PCV3 myocarditis pig. Rotavirus, salmonellosis, enteric colibacillosis in other pigs in batch
October	17.46	GOOD	3 weeks	<i>Klebsiella pneumoniae</i> septicaemia
October	30.59	FAIR	14 weeks	Pig with PCV3 was anaemic with gastric ulcer and diarrhoea (no cause identified). Another pig in same batch had PCV2-associated disease.

Affected pigs were 3 to 14 weeks old and some, but not all, were in poor body condition. Other significant diseases were diagnosed in the pigs and in others in the batches examined. These included swine influenza, *Actinobacillus pleuropneumoniae*, *Klebsiella pneumoniae* septicaemia and PRRS. No systemic PCV3-associated disease outbreaks affecting multiple postnatal pigs were diagnosed.

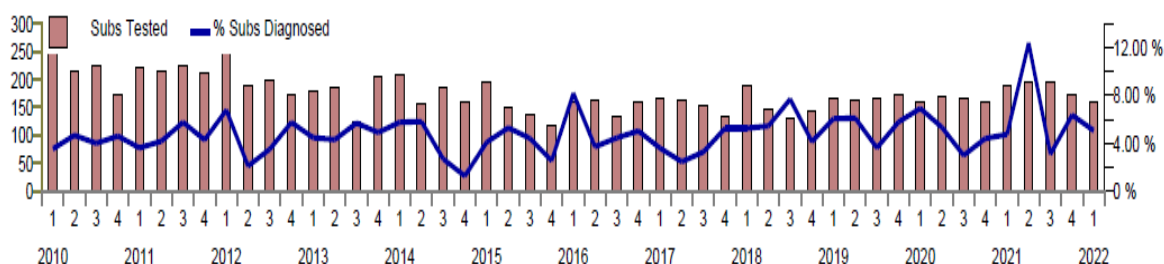
The clinical significance of the PCV3 and lesions detected in these individual pigs and herds remains uncertain. These findings suggest a low incidence of systemic PCV3 disease in English pigs at present and provide a baseline from which to monitor changes; continued surveillance is merited. This is a different manifestation to PCV3-associated foetopathy/perinatal disease which has been diagnosed previously in England involving multiple stillborn and/or neonatal piglets, two further incidents of which were diagnosed in England during 2021. A poster was presented at the European Symposium for Porcine Health Management 2022 in Budapest describing these findings (Williamson and others, 2022).

A useful review of information on PCV3 accumulated since its first report in 2016 was published (Kroeger and others, 2022), this also highlighted gaps in knowledge meriting further research. The Swine Health Information Centre updated their PCV3 factsheet to reflect more recent findings, this included (SHIC, 2022a).

## Swine influenza outbreaks with severe pulmonary pathology

The diagnostic rate by quarter for swine influenza is shown in Figure 7. Diagnoses in quarter 1 of 2022 have involved pandemic H1N1 2009 virus (pH1N109) and H1N2 strains, with the pandemic strain predominant.

**Figure 7: seasonality of swine influenza diagnoses as a percentage of diagnosable submissions to the Great Britain scanning surveillance network**

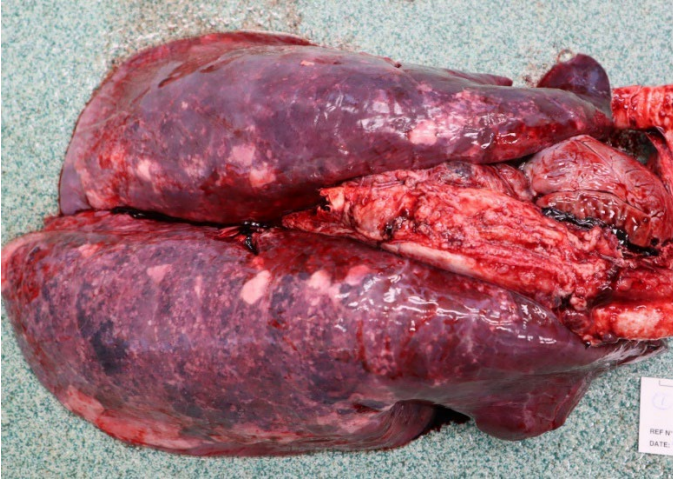


Two swine influenza outbreaks involving pandemic H1N1 2009 strain were diagnosed in the last 12 months in older pigs of finishing age. The severity of necrosis in the lungs of these cases raised concern about porcine reproductive and respiratory syndrome (PRRS) involvement, however PRRS was not confirmed by PCR or immunohistochemistry. In the January 2022 incident, there was acute onset respiratory disease, including coughing, in 20 per cent of a group of outdoor-reared 21-week-old finisher pigs, with two per cent dying. Pigs were submitted with pneumonias of varying severity. In one, all lung lobes were swollen, dark red and rubbery (Figure 8).

Another pig had severe mucosal necrosis of the mid trachea (Figure 9) and a fibrinous polyserositis. These pigs had enlarged dark red tracheobronchial nodes and had not been eating. *Pasteurella multocida* was isolated from both pigs, with *Mycoplasma hyorhinis* detected in a peritoneal swab from the pig with polyserositis; both pathogens were likely secondary and were contributing to the pathology. This case was described in the March 2022 Veterinary Record surveillance report (APHA, 2022c).



**Figure 8: Pig lungs affected with acute swine influenza with pulmonary pasteurellosis**

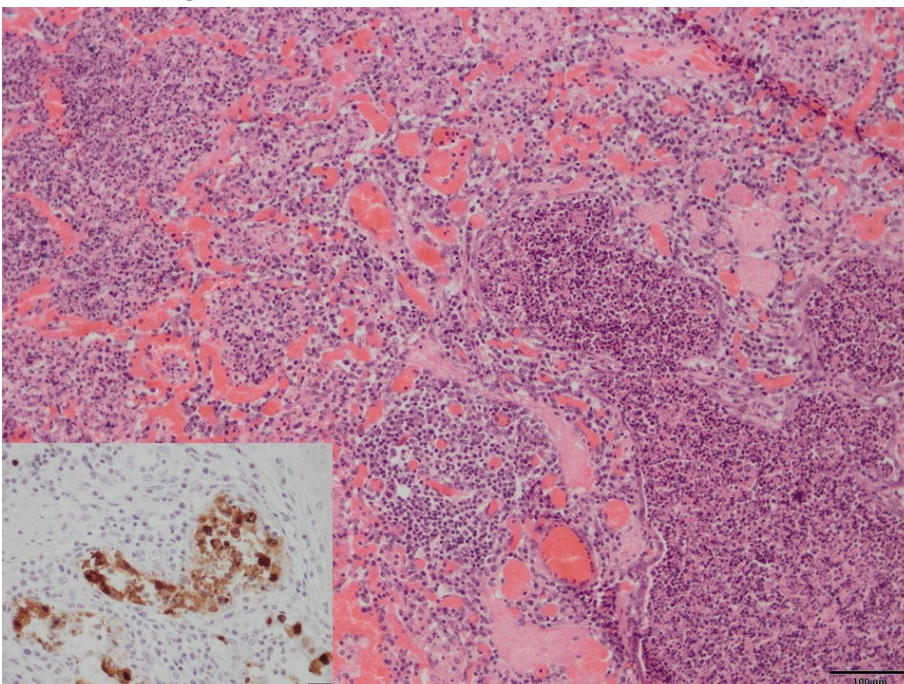


**Figure 9: Diptheresis in trachea in pig with acute swine influenza**



Respiratory tissues were PCR-positive for swine influenza A virus (SwIAV) and histopathology revealed severe necrotising bronchointerstitial pneumonias, with immunohistochemistry confirming its involvement (Figure 10).

**Figure 10: Severe necrotising bronchointerstitial pneumonia due to swine influenza. Inset shows immuno-histochemistry for influenza virus with labelling of epithelium of a bronchial submucosal gland**





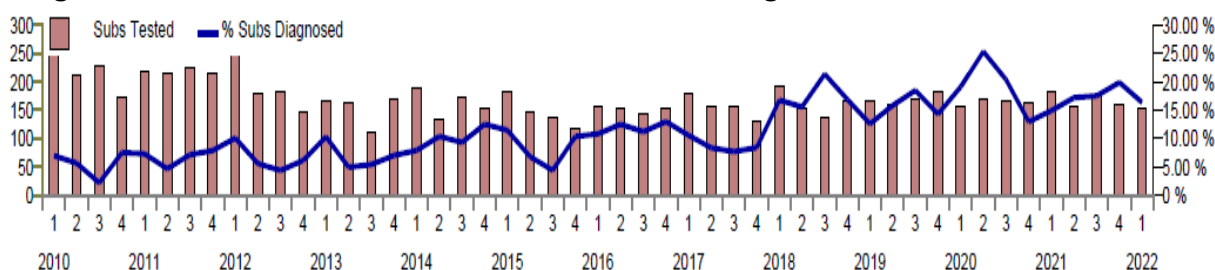
Subtyping PCRs identified pandemic H1N1 2009 virus (pH1N109) as the infecting strain and whole genome sequencing is in progress to investigate further. As the pigs had been a stable static group since weaning, with no obvious pig source of infection, reverse zoonosis from an infected person was considered a possible explanation for introduction of this virus strain to the pigs near to finishing. The outbreak resulted in significantly higher than usual condemnations at slaughter due to residual respiratory tract lesions in recovered pigs. Defra-funded swine influenza surveillance at APHA enables PCR testing of nasal swabs or respiratory tissues for SwIAV, at no charge to the submitting veterinarian as detailed here:

<http://apha.defra.gov.uk/documents/surveillance/diseases/Swine%20influenza%20surveillance%20vets%20Dec2020.pdf>

## Porcine reproductive and respiratory syndrome diagnoses

The diagnostic rate for incidents of porcine reproductive and respiratory syndrome (PRRS), diagnosed through the Great Britain scanning surveillance network in the first three months of 2022, fell slightly from the previous quarter. However, PRRS remains a significant endemic disease affecting pig health and productivity (Figure 11). All PRRS incidents diagnosed in Great Britain in quarter 4 of 2021 involved PRRS virus-1 (PRRSV-1). PRRSV-2 has not been detected in pigs in Great Britain to the time of writing and is now immediately reportable to APHA with premises details.

**Figure 11: Seasonality of PRRS in pigs to quarter 1 of 2022 as a percentage of diagnosable submissions to the Great Britain scanning surveillance network**

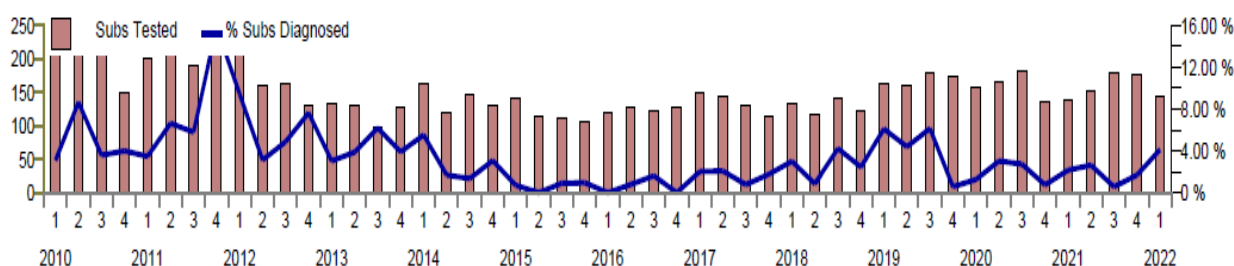


In each PCR-positive diagnostic submission to APHA, one sample is sequenced under pig disease surveillance funding to support surveillance of PRRSV diversity. ORF-5 gene sequences from 57 submissions in 2022 did not suggest introduction of PRRSV-1 strains new to GB, although those sequence fall into multiple (around 12) clusters showing the diversity of the virus strains found here which, as other countries with PRRSV have found, is increasing with time. Around 16% of the strains sequenced showed close similarity (>98.5%) to one of the live vaccine virus strains, which is a lower proportion than in previous years (2018-2021), although this is based on a smaller number of sequences at this stage of the year.

## Several swine dysentery diagnoses in the first quarter of 2022

There were seven diagnoses of swine dysentery recorded at SRUC and APHA in the first three months of 2022, compared to 11 diagnoses during the whole of 2021, suggesting an increase in the diagnostic rate in early 2022 which is supported by the data (Figure 12). These diagnoses have been in different regions of Great Britain (Table 3). Further diagnoses have been made in the second quarter of 2022 with some alerts issued by the Significant Diseases Charter (<https://ahdb.org.uk/knowledge-library/significant-diseases-charter>).

**Figure 12: Seasonality of swine dysentery as a percentage of diagnosable submissions to the Great Britain scanning surveillance network from 2010 to quarter 1 of 2022**



*Brachyspira hyodysenteriae* isolates obtained from these 2022 outbreaks are undergoing whole genome sequencing (WGS) and antimicrobial sensitivity minimum inhibitory concentration testing, under APHA's pig disease and antimicrobial resistance surveillance projects respectively.

**Table 3: Swine dysentery diagnoses in the first quarter of 2022 made through the Great Britain scanning surveillance network**

Month of submission	County	Clinical signs
February	Cornwall	Diarrhoea
February	Cleveland & Darlington	Diarrhoea with blood and mucus
March	Lincolnshire	Loose faeces
March	East Riding and North Lincolnshire	Diarrhoea
March	Cheshire	Diarrhoea with blood and mucus
March	North Yorkshire	Diarrhoea
March	East Riding and North Lincolnshire	Diarrhoea

An APHA presentation on *Brachyspira* whole genome sequencing was given at the Pig Veterinary Society November 2021 conference, alongside a presentation on veterinary field experiences with *Brachyspira*, both of which are available to members on the PVS website.

The [B. hyodysenteriae MLST dashboard](#) provides more information about sequence types detected over time and in different counties, with their antimicrobial resistance gene profiles.

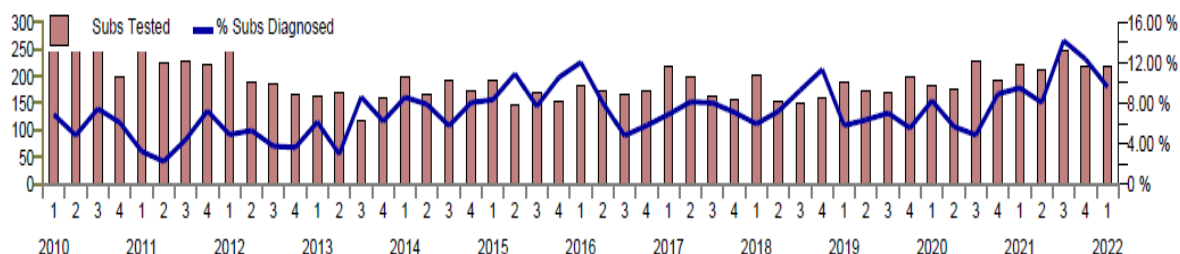
Advice on swine dysentery and its control can be found on these links together with information about the pig industry's Significant Diseases Charter:

- [ADHB guidance on swine dysentery](#)
- [ADHB significant diseases charter](#)
- [APHA information note on swine dysentery \(PDF\)](#)
- [NADIS guidance on swine dysentery](#)

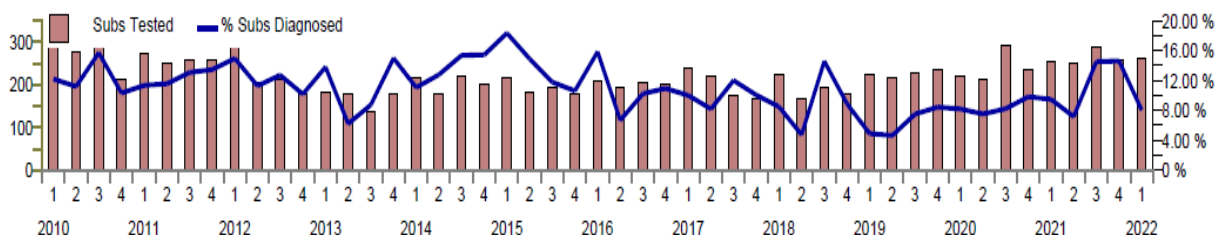
## Salmonellosis and colibacillosis diagnostic rates reduce

The upward trend in diagnostic rates for disease due to *Escherichia coli* and salmonellosis seen in the last six months of 2021 has not continued in the first three months of 2022 (Figures 13 and 14).

**Figure 13: Seasonality of *E. coli* disease incidents in pigs to quarter 1 of 2022 as a percentage of diagnosable submissions to the Great Britain scanning surveillance network**



**Figure 14: Seasonality of incidents of salmonellosis in pigs to quarter 1 of 2022 as a percentage of diagnosable submissions to the Great Britain scanning surveillance network**



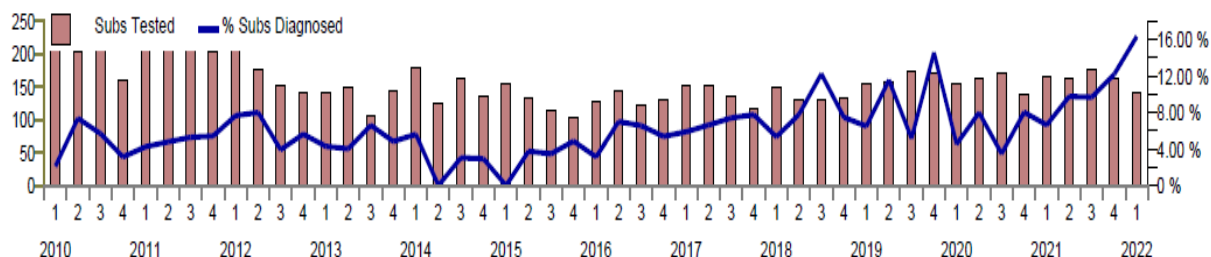
On pig farms where backlogs of pigs exist, enteric and other diseases may have been exacerbated as measures usually taken to control disease may be adversely impacted, for example, managing pig flows, vaccination timing, effective cleaning and disinfection, adequate turnaround times, and avoiding mixing pigs of different ages. Although the back logs are being alleviated, this is happening at different rates for different producers. Superimposed on the back log issues, pig producers now face increased feed costs due to the conflict in Ukraine. There may be further effects on enteric disease trends as a result, for example due to variation in feed ingredients and dietary changes, and the diagnostic rates will be kept under review.

Between January and March 2022, *Salmonella* Typhimurium and its monophasic variants collectively remained the most common serovars isolated from pigs, though there was a decrease in the number of isolations involving these serovars compared to the equivalent periods in 2020 and 2021. As in previous years, most isolations of monophasic *S. Typhimurium*-like variant involved phage type DT193 but there were also two of UNTY and one of DT120. In contrast, the most common phage type of *S. Typhimurium* isolated from pigs during this period was DT9, followed by DT193, and there was just one incident involving U299. This differs from the previous two years when the most common phage type was U288. Advice on control measures for salmonellosis in pigs is provided on the APHA Vet Gateway.

The rising trend in the diagnostic rate of disease due to *Lawsonia intracellularis* noted since quarter 1 of 2021 continues as illustrated in Figure 15. An increase in the diagnostic

rate of *Lawsonia*-associated disease in 2017 prompted a Pig Veterinary Society member survey. The responses suggested that a number of different reasons may account for the increase, some of these may remain relevant in addition to the effects of the backlogs of pigs on farms. A [summary of the Pig Veterinary Society \*Lawsonia\* survey findings](#) is available.

**Figure 15: Seasonality of *Lawsonia*-associated disease incidents to quarter 1 of 2022 as a percentage of diagnosable submissions to the Great Britain scanning surveillance network**



## Reduced susceptibility to penicillin in *Streptococcus suis* isolate

An untypeable *Streptococcus suis*, isolated from the meninges of a 10-week-old pig found dead, was found to be resistant to penicillin by disc diffusion testing. Histopathology confirmed the presence of a bacterial meningitis. This resistance was investigated further by minimum inhibitory concentration (MIC) testing under APHA's antimicrobial resistance surveillance project. The isolate had a benzyl penicillin MIC of 0.5 µg/ml; the Clinical and Laboratory Standards Institute veterinary clinical breakpoint for benzyl penicillin and *S. suis* (respiratory) in pigs, issued in 2020, is susceptible ≤ 0.25 µg/ml and resistant ≥ 1 µg/ml, indicating that this isolate was not fully susceptible to benzyl penicillin. The isolate was also resistant to lincomycin and tetracycline but was sensitive to several other antimicrobials including trimethoprim/sulphamethoxazole.

Penicillin resistance in *S. suis* isolates from clinical infections of pigs has been found previously in APHA diagnostic submissions, but is unusual compared to tetracycline resistance which is common in clinical isolates of *S. suis*, with over 80 per cent being tetracycline-resistant in 2018-2020 data (VMD, 2021). The main clinical problem in the pigs in this incident was sudden death and nervous signs. Three further pigs were submitted in which post-mortem findings were similar and included polyserositis and polyarthritis and meningeal congestion. However, *S. suis* serotype 2 was isolated from multiple organ sites, including meninges, from these pigs, confirming this serotype as the main cause of disease on farm. The serotype 2 isolates were all sensitive to penicillin by disc diffusion testing. Pigs with nervous signs typical of meningitis were reported to still be responding well to amoxicillin or penicillin treatment. However, the submitting veterinarian was advised that the presence of resistant untypeable *S. suis* could remain a risk due to selective pressure for the occurrence of resistant *S. suis* from penicillin usage, and because streptococci are usually competent at taking up DNA from their environment and incorporating it into their genome (transformation). The untypeable *S. suis* could thus, in theory, provide a source of resistance genes (encoding altered penicillin binding proteins) for the *S. suis* type 2. This might be important where both organisms are occurring together, as in the tonsil where it is known that several *S. suis* strains can co-exist in pigs. Monitoring sensitivity and additional disease control measures were recommended to minimise the need for antimicrobial treatment. This case was described in the April 2022 Veterinary

## Livestock-associated MRSA in pig with arthritis

Livestock-associated methicillin-resistant *Staphylococcus aureus* (LA-MRSA) was identified in an APHA scanning surveillance submission of pigs on a farm in England. The *Staphylococcus aureus* isolate was obtained in pure growth from a five-week-old weaned pig, which was in poor body condition and lame, with a severe fibrinopurulent joint infection. Pigs colonised by LA-MRSA usually show no clinical signs but opportunistic staphylococcal infections such as these occasionally occur. The LA-MRSA was considered incidental to the main cause of disease on the farm and was isolated from a single pig; two other pigs were submitted at the same time with PRRS, these were not lame and did not have disease associated with LA-MRSA. Antimicrobial sensitivity testing of the isolate was carried out within APHA's "Monitoring of Antimicrobial Resistance in Bacteria from Animals and their Environment" project. Characterisation of the isolate by whole genome sequencing is in progress. This isolation represents one of very few occasions that LA-MRSA has been detected associated with disease, specifically skin or joint disease, in APHA pig scanning surveillance submissions. The first was in late 2014 from a case of skin disease (Hall, Kearns and Eckford, 2015). In quarter 1 of 2020, cases of joint ill associated with LA-MRSA were described in preweaned piglets (APHA, 2020b). Guidance is available for those working with livestock to reduce the risk of LA-MRSA infection:

(<https://www.gov.uk/government/publications/lamrsa-information-for-people-who-work-with-livestock>).

The Veterinary Medicines Directorate, which is the policy lead for antimicrobial resistance, provides updates on LA-MRSA isolations from animals in the UK. A review of LA-MRSA isolates from animals and animal products in the UK was published in 2019 (Anjum and others, 2019).

## Coccidiosis in diarrhoeic replacement breeding pigs

The Thirsk Veterinary Investigation Centre diagnosed coccidiosis as the main cause of diarrhoea in replacement breeding gilts. Five of 35 in-pig gilts developed diarrhoea soon after arriving on the unit. Very high coccidial oocyst counts were found in all three faeces submitted (around 500,000 oocysts per gram), while one also had *Salmonella* Reading isolated by direct culture and *Brachyspira pilosicoli* was identified by culture and PCR in one other. No porcine epidemic diarrhoea virus was detected. Coccidiosis is an unusual diagnosis in older post-weaned pigs; diagnoses within the GB scanning surveillance network are occasionally made in a well-recognised epidemiological scenario involving young adult replacement breeding pigs following their introduction to another unit, and move into contaminated pens or training paddocks. Clinical signs are of diarrhoea, sometimes also with wasting, lethargy and even deaths. Such cases are due to *Eimeria* species infection, rather than *Cystoisospora suis* which causes diarrhoea in young piglets. Speciation is recommended when high oocyst counts are encountered in this clinical and epidemiological scenario. *Eimeria deblickei* is often the main species detected, although a mix of other *Eimeria* species may also be detected (including *E. suis*, *E. deblickei*, *E. perminuta*, *E. polita*). These coccidiosis outbreaks are thought to occur when replacement breeding gilts or boars, reared in hygienic environments leaving them naïve to *Eimeria* species, are then moved to ground heavily contaminated with



oocysts. The exposure to high challenge results in disease usually within two weeks, and often concurrent with salmonellosis (Figure 16).

**Figure 16: Diphtheritic enteritis in a past case of coccidiosis due to *Eimeria* species with concurrent salmonellosis in replacement breeding pigs**



The features of these outbreaks have been highlighted previously (APHA, 2015) and a past outbreak was described by Gaudie and others (2005). Diarrhoea in replacement breeding pigs post-introduction merits diagnostic investigation while the pigs are still in isolation from the main herd, to ensure that pathogens such as *B. hyodysenteriae* (the cause of swine dysentery) are not introduced. This case was included in the May 2022 Veterinary Record surveillance report (to be published). This included guidance on diagnostic testing for infectious causes of diarrhoea in replacement breeding pigs which develop disease after their introduction.

## Horizon scanning

### Japanese encephalitis virus in pigs in south-east Australia

Detection of the zoonotic virus, Japanese encephalitis virus (JEV), in pig farms in south-eastern Australia was confirmed in February 2022. This is first time that the virus has reached Victoria, New South Wales and Queensland.

JEV is a notifiable zoonotic mosquito-borne disease. The virus is part of the flavivirus family, closely related to West Nile, Zika, Murray Valley encephalitis, dengue and yellow fever. In endemic regions, the virus is maintained in a cycle between mosquitoes and water birds. JEV causes disease in humans throughout Asia and the western Pacific region and effective vaccines are available. The virus also infects and can cause neurological disease in pigs and horses and reproductive failure in pigs. JEV is not present in the UK. In 1995 the virus entered the most northern part of Australia which is nearest to Papua North Guinea and persisted until 2004. The recent cases of mosquito-borne viruses in animals and people such as JEV, West Nile virus and Kunjin virus in New South Wales and Western Australia could reflect the warm, wet La Niña weather patterns in the country, encouraging infected water birds into areas, and coinciding with conditions favouring large numbers of mosquitoes. More information on JEV



and the current outbreaks in pigs in Australia is available on these links: [Japanese encephalitis in pigs in Australia](#) and [an SHIC JEV webinar](#).

As of 20th April 2022, the World Health Organisation indicated that JEV had been detected in 73 pig farms across the states of New South Wales, Queensland, Victoria, and South Australia. Several people have been hospitalised and a few have died due to JEV infection. Unlike humans and horses, which are considered dead-end hosts, pigs have a sufficiently high viraemia to infect the mosquito vectors. Some of the affected pig farms experienced late term abortions, delayed farrowing, stillbirths and mummifications, and abnormalities in the delivered piglets including arthrogryposis, brain defects and shaky incoordinate piglets with no suck reflex that died. These signs reflect *in utero* infection and indicate that JEV infection of the pregnant sows had likely occurred in late 2021. Boars may show orchitis and infertility. Mosquito surveillance for JEV and mosquito control are required on affected pig farms and people are offered JEV vaccination. Movements of live pigs and semen out of infected premises are only allowed after appropriate risk-assessment and mitigating actions are put in place at both the departure and the destination premises.

## **Spillover of canine parvovirus from wildlife to pigs in USA**

The identification of canine parvovirus type 2 (CPV02) by metagenomic sequencing on archived lung of a pig submitted for diagnostic investigation was described in the scanning surveillance report for quarter 3 of 2021. The detection prompted a study which confirmed wider evidence of spill-over of CPV-2 from canines to pigs in South Dakota by PCR, sequencing, in situ hybridization, and serology. The results of this study have been published (Temeeyasen et al., 2022) and genetic analysis suggests the spillover is from wildlife. Only coyotes are common in the agricultural areas of the upper US Midwest and are peridomestic; the authors hypothesise that CPV-2–infected coyote faeces are a source of infection to pigs. As foxes come into indirect contact with outdoor pigs in the UK, this finding may have relevance here, however, it is not yet known whether CPV-2 can cause disease in pigs. Experimental studies are likely to follow in the US. CPV emerged as a cause of severe enteritis in dogs in the late 1970s, following a spillover event from feline panleukopenia virus (FPV) from cats, demonstrating its potential for a change of host.

## **Experimental infection with porcine circovirus 4 in China**

Porcine circovirus type 4 (PCV4) was newly identified in pigs in 2019 in a farm in Hunan province, China (Zhang and others, 2019) and was described in the APHA surveillance report for quarter 1 of 2020. Since then, PCV4 has been detected in pigs in other parts of China and in South Korea. To date, PCV4 virus has not been isolated in cell culture from field samples, hindering investigations. A group from China has now reported construction of infectious PCV4 from the DNA sequence, which has shown infectivity for two five-week-old pigs infected intranasally and monitored for 35 days post-infection (Niu and others, 2022). No pyrexia or clinical signs were noted however, histopathology revealed changes, mainly inflammatory in nature, suggesting that the virus may be pathogenic, although the clinical impact is not known. Viraemia and antibodies peaked at 21 and 28 days post-infection respectively. This PCV4 construct will contribute to further studies on the pathogenesis of PCV4.

APHA virus discovery methods have the capability of detecting PCV4 and can be used to investigate undiagnosed significant disease outbreaks of suspected infectious aetiology. There are now four circovirus species identified in pigs within the genus *Circovirus*: non-pathogenic porcine circovirus 1 (PCV1), pathogenic PCV2, and the more recently identified PCV3 and PCV4 about which there is uncertainty regarding their contribution to clinical disease in the field. There is no zoonotic concern reported relating to porcine circoviruses.

## ***Actinobacillus pleuropneumoniae* serotype 15 outbreaks in USA**

*Actinobacillus pleuropneumoniae* (APP) is a well-recognised cause of pneumonia and pleurisy in pigs and occurs globally. Since November 2021, there have been severe APP outbreaks in the upper Midwest of the United States (US) due to serotype 15 which has previously been a relatively uncommon serotype in the US. Epidemiological investigations have shown evidence of a high rate of spread between farms within a narrow geographic radius. Mortality up to 51% has been reported.

Investigations include analysis for changes in virulence genes that might explain the high pathogenicity and transmission for lateral transmission of this APP serotype 15. A high degree of genetic similarity has been confirmed between isolates from different farms involved in the current outbreak. Interestingly, historic endemic APP serotype 15 isolates examined so far differ genetically from the current outbreak isolates; further analysis is in progress. The SHIC led epidemiological investigations aim to identify the most likely route of APP serotype 15 transmission between unrelated sites, and a possible geographic and temporal origin for the prevalent strain (SHIC, 2022b). In the past, APP serotype 15 was associated with high virulence outbreaks in Australia but was not previously typically associated with severe disease in the United States. SHIC and the American Association of Swine Veterinarians held a webinar to discuss these [APP serotype 15 outbreaks](#).

## **References**

- Anjum MF; Marco-Jimenez F; Duncan D; Marin C; Smith RP; Evans S (2019). Livestock associated Methicillin-resistant *Staphylococcus aureus* from animals and animal products 17 in the UK. *Frontiers in Microbiology* 10 Article 2136  
<https://doi.org/10.3389/fmicb.2019.02136>
- APHA (2015). Features of coccidiosis in older pigs. GB Emerging Threats Quarterly Report Pig Diseases. Volume 19: Q2 page 6  
[https://webarchive.nationalarchives.gov.uk/ukgwa/20200806095807mp\\_/https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/458908/pub-survrep-p0215.pdf](https://webarchive.nationalarchives.gov.uk/ukgwa/20200806095807mp_/https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/458908/pub-survrep-p0215.pdf)
- APHA (2020a). *Staphylococcus sciuri* in septicæmic finishers. GB pig quarterly report: Disease surveillance and emerging threats. Volume 24: Q2 – April to June 2020 page 8  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/918903/pub-survrep-p0220.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918903/pub-survrep-p0220.pdf)
- APHA (2020b). Scanning surveillance detections of LA-MRSA in joint disease. GB pig

- quarterly report: Disease surveillance and emerging threats. Volume 24: Q1 – January to March 2020 page 13  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/889984/pub-survrep-p0120.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/889984/pub-survrep-p0120.pdf)
- APHA (2021). Canine parvovirus (CPV) 2 spillover to pigs in the USA. Great Britain pig quarterly report: disease surveillance and emerging threats. Volume 25: Quarter 3 – July to September 2021 page 18  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1040652/pub-survrep-p0321.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040652/pub-survrep-p0321.pdf)
- APHA (2022a). Nutritional osteodystrophy. Disease surveillance in England and Wales, April 2022. Veterinary Record, 190: 356-360. <https://doi.org/10.1002/vetr.1757>
- APHA (2022b). Reduced susceptibility to penicillin in untypable *Streptococcus suis* causing meningitis. Disease surveillance in England and Wales, April 2022. Veterinary Record, 190: 356-360. <https://doi.org/10.1002/vetr.1757>
- April (2022c). Respiratory disease in growing pigs with different primary viral causes. Disease surveillance in England and Wales, March 2022. Veterinary Record, 190: 276-280.  
<https://doi.org/10.1002/vetr.1652>
- Chen Shixi, Wang Yu, Chen Fuyong, Yang Hanchun, Gan Menghou and Zheng Shijun J. (2007). A Highly Pathogenic Strain of *Staphylococcus sciuri* Caused Fatal Exudative Epidermitis in Piglets. PLoS One. 2007; 2(1): e147.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1764720/>
- Dee S. A. (2021). Pasteurellosis in Pigs - Respiratory System - MSD Veterinary Manual Content last modified Sep 2021. <https://www.msdsvetmanual.com/respiratory-system/respiratory-diseases-of-pigs/pasteurellosis-in-pigs>
- Defra (2015). [Porcine epidemic diarrhoea: how to spot and report the disease.](#)
- Gaudie, C.M., Evans, R.J. and Done, S.H. (2005). Coccidiosis in replacement gilts. Veterinary Record 157:17 517-518
- Hall S., Kearns A. and Eckford S. (2015). Livestock-associated MRSA detected in pigs in Great Britain. Veterinary Record 2015 176: 151-152
- Kroeger, M., Temeeyasen, G., Piñeyro, P.E. (2022). Five years of porcine circovirus 3: What have we learned about the clinical disease, immune pathogenesis, and diagnosis. Virus Research 314: 198764 <https://doi.org/10.1016/j.virusres.2022.198764>
- Liu Y, Zhang X, Qi W, Yang Y, Liu Z, An T, Wu X, Chen J. Prevention and Control Strategies of African Swine Fever and Progress on Pig Farm Repopulation in China. Viruses. 2021; 13(12):2552. <https://doi.org/10.3390/v13122552>
- Niu, G., Zhang, X., Ji, W., Chen, Si, Li, X., Yang, L., Zhang, L., Ouyang, H., Li, C., & Ren, L. (2022). Porcine circovirus 4 rescued from an infectious clone is replicable and pathogenic in vivo. Transboundary and Emerging Diseases, 00, 1– 10. <https://doi.org/10.1111/tbed.14498>

Scottish Government (2016). The Specified Diseases (Notification) Amendment(Scotland) Order 2016. <http://www.legislation.gov.uk/ssi/2016/41/contents/made>

SHIC (2022a). Porcine circovirus 3 factsheet. <https://www.swinehealth.org/wp-content/uploads/2022/03/shic-factsheet-porcine-circovirus3-2022Mar30.pdf>

SHIC (2022b). SHIC APP15 outbreak investigation – Preliminary Lab Report. <https://www.swinehealth.org/shic-app15-outbreak-investigation-preliminary-lab-report/>

Temeeyasen, Gun, Tamer A. Sharafeldin, Chun-Ming Lin, and Ben M. Hause (2022). Spillover of Canine Parvovirus Type 2 to Pigs, South Dakota, USA, 2020. Emerging Infectious Diseases 28, no. 2: 471 <https://doi.org/10.3201/eid2802.211681>

Tran, X.H.; Phuong, L.T.T.; Huy, N.Q.; Thuy, D.T.; Nguyen, V.D.; Quang, P.H.; Ngõn, Q.V.; Rai, A.; Gay, C.G.; Gladue, D.P.; Borca, M.V. (2022). Evaluation of the Safety Profile of the ASFV Vaccine Candidate ASFV-G-ΔI177L. Viruses 2022, 14, 896. <https://doi.org/10.3390/v14050896>

VMD (2021). Zoonotic pathogens: *Streptococcus suis*. Chapter 4 Clinical Surveillance. Veterinary Antimicrobial Resistance and Sales Surveillance 2020 page 99 <https://www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2020>

Williamson, S., Bidewell, C., Floyd, T., Grierson S. (2022). Cases of myocarditis associated with porcine circovirus-3 detected by enhanced surveillance. European Symposium for Porcine Health Management 2022 in Budapest. Poster VVD-PP-15

Zhang, H-H, Hu, W-Q, Li, J-Y, et al. (2019). Novel circovirus species identified in farmed pigs designated as Porcine circovirus 4, Hunan province, China. Transboundary and Emerging Diseases. 00: 1– 5. <https://doi.org/10.1111/tbed.13446>



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