

# Classical Swine Fever

*Hog Cholera, Swine Fever,  
Peste du Porc, Colera Porcina,  
Virusschweinepest*

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## Importance

Classical swine fever (CSF) is a highly contagious and economically significant viral disease of pigs. The severity of this disease varies with the strain of the virus, the age of the pig, and the immune status of the herd. Acute infections, which are caused by highly virulent isolates and have a high mortality rate, are likely to be diagnosed rapidly. However, infections with less virulent isolates can be more difficult to recognize, particularly in older pigs. These infections may be relatively mild, and can resemble septicemias caused by other agents, as well as other diseases. In some herds, the only symptom may be poor reproductive performance or the failure of some pigs to thrive. The wide range of clinical signs and similarity to other diseases can make classical swine fever challenging to diagnose.

Although classical swine fever was once widespread, many countries have eradicated this disease from domesticated swine. Reintroduction of the virus can be devastating. In 1997-1998, an outbreak in the Netherlands spread to involve more than 400 herds and cost \$2.3 billion to eradicate. Approximately 12 million pigs were killed, some in eradication efforts but most for welfare reasons associated with the epidemic. The United Kingdom experienced an outbreak in 2000, and minor outbreaks were reported in Romania, Slovakia, Spain and Germany in 2001. North America is also at risk for the introduction of this disease, which is still endemic in much of South and Central America.

## Etiology

Classical swine fever (hog cholera) results from infection by classical swine fever virus (CSFV), a member of the genus *Pestivirus* and family *Flaviviridae*. Only one CSFV serotype has been found, but minor antigenic variability has been demonstrated between viral strains. This virus is closely related to the ruminant pestiviruses that cause bovine virus diarrhea and border disease. Other pestiviruses have also been described recently.

## Species Affected

Classical swine fever affects domesticated and wild pigs. All feral and wild pigs, including European wild boar and collared peccaries, are thought to be susceptible.

## Geographic Distribution

Classical swine fever is found in much of Asia, some Caribbean islands, the African countries of Madagascar and Mauritius, and much of South and Central America. This disease has been eradicated from the United States, Canada, New Zealand, Australia and most of western and central Europe.

CSFV is endemic in wild boar in parts of Europe; the significance for domesticated pigs is controversial.

## Transmission

Classical swine fever is highly contagious. Infected pigs are the only reservoir of virus. Blood, secretions and excretions (including oronasal and lacrimal secretions, urine, feces and semen) and tissues contain infectious virus. Virus shedding can begin before the onset of clinical signs, and occurs throughout the course of acute or subclinical disease. Chronically or persistently infected pigs can shed virus continuously or intermittently for months.

Transmission between pigs occurs mainly by the oral or oronasal routes, via direct or indirect contact. CSFV is often spread by feeding uncooked contaminated garbage. Animals can also be infected through the mucus membranes, conjunctiva and skin abrasions. CSFV can be spread by genital transmission or artificial insemination. Infected carrier sows may give birth to persistently infected pigs. The virus can also be spread on fomites, and mechanical spread by insects, birds and other wild or domesticated animals may occur. Airborne transmission seems to be possible over short distances; however, the maximum distance the virus can spread is unclear. While aerosol transmission occurred only within a radius of 250 meters in one study, transmission could occur up to 1 km in another.

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CSFV is moderately fragile in the environment; this virus is reported to survive for 3 days at 50°C and 7 to 15 days at 37°C. Estimates of its survival in pens and on fomites under field conditions vary. Some studies suggest that virus inactivation occurs within a few days, while others describe survival, under winter conditions, for up to four weeks.

CSFV can remain infectious for nearly three months in refrigerated meat and for more than four years in frozen meat. In this proteinaceous environment, this virus does not appear to be inactivated by smoking or salt curing. Reported virus survival times in cured and smoked meats vary with the technique, and range from 17 to more than 180 days.

## Incubation Period

The incubation period can range from 2 to 15 days, depending on the virulence of the strain, the route of inoculation and the dose. Under field conditions, disease may not become evident in a herd for 2 to 4 weeks or longer.

## Clinical Signs

The symptoms of classical swine fever vary with the strain of virus, and the age and susceptibility of the pigs. More virulent strains cause acute disease; less virulent strains can result in a high percentage of chronic, mild or asymptomatic infections. Although highly virulent strains were once more prevalent, most epizootics are now caused by moderately virulent strains. Older animals are less likely to show severe symptoms than younger pigs. Some breed-specific differences have also been reported.

Acute swine fever is the most severe form of the disease. In this form, common symptoms include a high fever, huddling, weakness, drowsiness, anorexia, conjunctivitis, and constipation followed by diarrhea. Pigs may be incoordinated or exhibit an unsteady, weaving or staggering gait, which progresses to posterior paresis. Some pigs may vomit yellow, bile-containing fluid, or develop respiratory signs. The abdomen, inner thighs, ears and tail may develop a purple cyanotic discoloration. Hemorrhages can also occur in the skin. Severe leukopenia usually occurs soon after disease onset, and convulsions may be seen in the terminal stages. Pigs with acute classical swine fever often die within one to three weeks.

Subacute disease can be caused by moderately virulent strains of CSFV. It may also occur in older pigs. The subacute form is similar to acute classical swine fever; however, the symptoms are less severe, and the fever may persist for two to three weeks. Some pigs with subacute classical swine fever may survive; others die within a month.

Chronic disease tends to be seen with less virulent strains or in partially immune herds. In the initial stages, chronic disease can resemble acute or subacute disease, with anorexia, depression, elevated temperatures,

leukopenia, and periods of constipation or diarrhea. Affected pigs usually improve after several weeks; however, after a period where they appear relatively normal, they develop recurrent symptoms that may include intermittent fever, anorexia, periods of constipation or diarrhea, wasting or stunted growth, alopecia and skin lesions. Immunosuppression may lead to concurrent infections. The symptoms of chronic infections can wax and wane for weeks to months, and may affect only a few animals in the herd. Affected pigs may survive for one to three months, but chronic infections are always fatal.

In some breeding herds infected with less virulent strains, poor reproductive performance may be the only sign of disease. Sows may abort or give birth to stillborn, mummified, malformed, weak or dead piglets. Some piglets may be born with a congenital tremor or congenital malformations of the visceral organs and central nervous system. Other piglets may be asymptomatic at birth, but persistently infected. These animals are persistently viremic and become clinically ill after several months (“late onset” disease). The symptoms can include inappetence and depression, as well as stunted growth, dermatitis, diarrhea, conjunctivitis, ataxia or posterior paresis. Although affected pigs usually survive for more than six months, all typically die within a year. Congenital infections may be limited to a few piglets in the herd.

## Post Mortem Lesions [Click to view images](#)

The lesions of classical swine fever are highly variable. During outbreaks, the likelihood of observing the characteristic necropsy lesions is better if four or five pigs are examined. In acute disease, the most common lesion is hemorrhage. The skin may be discolored purple and the lymph nodes may be swollen and hemorrhagic. Petechial or ecchymotic hemorrhages can often be seen on serosal and mucosal surfaces, particularly on the kidney, urinary bladder, epicardium, larynx, trachea, intestines, subcutaneous tissues, and spleen. Straw-colored fluid may be found in the peritoneal and thoracic cavities and the pericardial sac. Severe tonsillitis, sometimes with necrotic foci, is common. Splenic infarcts are occasionally seen. The lungs may be congested and hemorrhagic. In some acute cases, lesions may be absent or inconspicuous.

The lesions of chronic disease are less severe and may be complicated by secondary infections. In addition, necrotic foci or “button” ulcers may be found in the intestinal mucosa, epiglottis and larynx. In growing pigs that have survived for more than a month, bone lesions can also occur at the costochondral junction of the ribs and the growth plates of the long bones.

In congenitally infected piglets, common lesions include cerebellar hypoplasia, thymic atrophy, ascites, and deformities of the head and legs. Edema and petechial hemorrhages may be seen in the skin and internal organs.

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## Morbidity and Mortality

The severity of the disease varies with the viral strain; while some strains cause acute disease with high mortality rates, others can result in mild or even subclinical disease. The morbidity and mortality rates are high during acute infections, and the case fatality rate can approach 100%. Morbidity and mortality are lower in subacute disease. Chronic infections are always fatal, but may affect only a few animals in a herd. The age and immune status of the animals also affects the course of disease, with lower mortality rates in adult pigs than younger animals.

## Diagnosis

### Clinical

Classical swine fever should be suspected in pigs with signs of septicemia and a high fever, particularly if uncooked scraps have been fed, unusual biological products have been used, or new animals have been added to the herd. This disease may also be considered in herds with other symptoms, including breeding herds with poor reproductive performance and disease in piglets. It can be difficult to differentiate classical swine fever from other diseases without laboratory testing.

### Differential diagnosis

The differential diagnosis varies with the form of the disease, and includes African swine fever, porcine dermatitis and nephropathy syndrome, postweaning multisystemic wasting syndrome, hemolytic disease of the newborn, porcine reproductive and respiratory syndrome, thrombocytopenic purpura, anticoagulant (e.g. warfarin) poisoning, salt poisoning, Aujeszky's disease and parvovirus infections. Septicemic diseases such as erysipelas, eperythrozoonosis, salmonellosis, pasteurellosis, actinobacillosis, and *Haemophilus suis* infections must also be considered. Congenital infection with the pestiviruses that cause bovine virus diarrhoea or border disease can resemble classical swine fever.

### Laboratory tests

Classical swine fever can be diagnosed by detecting the virus, its antigens or nucleic acids in whole blood or tissue samples. Viral antigens are detected by direct immunofluorescence (FAT or FATST test) or enzyme-linked immunosorbent assays (ELISAs). The virus can also be isolated in several cell lines including PK-15 cells; it is identified by direct immunofluorescence or immunoperoxidase staining. Reverse transcriptase polymerase chain reaction (RT-PCR) tests are used in some laboratories.

The ruminant pestiviruses that cause bovine virus diarrhoea and border disease can occasionally infect pigs. Serum neutralization tests, or immunoperoxidase procedures that use monoclonal antibodies, can differentiate CSFV from these viruses. They can also be distinguished using genetic methods such as RT-PCR.

Serology is used for diagnosis and surveillance. Antibodies develop after 2 to 3 weeks, and persist lifelong. For this reason, serology is most useful in herds thought to have been infected 30 or more days previously. It is particularly helpful in herds infected with less virulent strains, where viral antigens may be more difficult to find. The most commonly used tests are virus neutralization tests, which include the fluorescent antibody virus neutralization (FAVN) test and the neutralizing peroxidase-linked assay (NPLA), and various ELISAs. Antibodies against ruminant pestiviruses may be found in breeding animals; only tests that use monoclonal antibodies can differentiate between these viruses and CSFV. The definitive test for differentiation is the comparative neutralization test. Congenitally infected pigs are immunotolerant and are negative on serology.

Companion ELISAs have been developed for marker vaccines, but have limitations in their sensitivity and/or specificity.

### Samples to collect

**Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.**

Blood (collected into EDTA), or tissue samples taken at necropsy, should be taken from a few febrile animals for virus isolation, antigen detection or nucleic acid detection. Additionally, whole blood samples may be taken from a larger group of pigs.

Serum samples are particularly useful in herds that have been infected for 30 days or more. Antibodies usually develop during the second or third week after infection, and persist for life. Serum samples should be taken from convalescent or recovered animals, or sows that have been in contact with suspected cases.

At necropsy, the tonsils should be submitted for virus isolation or antigen detection. Other organs to collect include the maxillary, submandibular and mesenteric lymph nodes, spleen, kidneys, and the distal part of the ileum. Samples for antigen detection and virus isolation should be refrigerated but not frozen; they should be kept cold during shipment to the laboratory.

## Recommended actions if classical swine fever is suspected

### Notification of authorities

**Classical swine fever should be reported immediately upon diagnosis or suspicion of the disease.**

Federal: Area Veterinarians in Charge (AVICS)

[http://www.aphis.usda.gov/animal\\_health/area\\_offices/](http://www.aphis.usda.gov/animal_health/area_offices/)

State Veterinarians:

<http://www.aphis.usda.gov/vs/sregs/official.html>

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## Control

CSFV is moderately fragile in the environment. This virus is sensitive to drying and ultraviolet light. It is stable at pH 5-10, but is rapidly inactivated by pH 3 or less, or pH greater than 11. Sodium hypochlorite and phenolic compounds are effective disinfectants. Detergents, organic solvents, quaternary ammonium compounds, and aldehydes (formaldehyde, glutaraldehyde) are also reported to destroy this virus.

CSFV can survive for several months in refrigerated meat and years in frozen meat. In this proteinaceous environment, the virus is not inactivated by smoking or salt curing. However, it can be destroyed by cooking. Techniques reported to be effective include heating the meat to 65.5°C or greater for 30 minutes, or 71°C for one minute. The virus can also be inactivated in swill by heat treatment. Many countries have completely banned the practice of feeding swill to pigs.

In countries where classical swine fever is endemic, vaccines may be used to protect animals from clinical disease. Vaccines can also be used to reduce the prevalence of infections during an eradication program. Both modified live and subunit (marker) vaccines are manufactured, although availability varies with the country.

Quarantines, movement bans and good surveillance are important in controlling outbreaks. Strict biosecurity on a farm can reduce the risk of infection. During an outbreak, confirmed cases and contact animals may be slaughtered. Although CSFV can be spread over long distances by animal transportation and other forms of dissemination, farms within a 500 meter radius of an infected farm have a particularly high risk of infection. Culling of all pigs in an area may be practiced, due to this 'neighborhood effect.' Infected premises are thoroughly cleaned and disinfected. Vaccination may be used as a tool to assist in controlling an outbreak and eradicating the disease. In countries free of classical swine fever, periodic serologic sampling is necessary to monitor for the potential reintroduction of disease.

Controlling endemic infections in wild populations is difficult. Oral vaccination has been attempted in wild boar in Germany. Contact between domesticated herds and wild pigs should be avoided.

## Public Health

Classical swine fever does not affect humans.

## Internet Resources

- The Merck Veterinary Manual  
<http://www.merckvetmanual.com/mvm/index.jsp>
- United States Animal Health Association.  
Foreign Animal Diseases  
<http://www.usaha.org/pubs/fad.pdf>

World Organization for Animal Health (OIE)

<http://www.oie.int>

OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals

[http://www.oie.int/eng/normes/mmanual/a\\_summry.htm](http://www.oie.int/eng/normes/mmanual/a_summry.htm)

OIE International Animal Health Code

[http://www.oie.int/eng/normes/mcode/A\\_summry.htm](http://www.oie.int/eng/normes/mcode/A_summry.htm)

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\*Link defunct as of February 2007.