

African Swine Fever

*Pesti Porcine Africaine,
Peste Porcina Africana,
Pestis Africana Suum,
Maladie de Montgomery,
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Afrikaanse Varkpes,
Afrikanische Schweinepest*

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Importance

African swine fever (ASF) is a serious viral disease of pigs, endemic in Africa. The African swine fever virus (ASFV) is highly contagious, and can spread very rapidly in pig populations by direct or indirect contact. This virus can persist for long periods in pig products and the environment. It can also become endemic in feral or wild Suidae, and in *Ornithodoros* ticks. ASFV isolates vary in virulence from highly pathogenic strains that cause near 100% mortality to low-virulence isolates that can be difficult to diagnose. There is no vaccine or treatment.

African swine fever is a serious problem in many African countries. Disease outbreaks have also occurred in Europe, South America, and the Caribbean; the cost of eradication has been significant. During outbreaks in Malta and the Dominican Republic, the swine herds of these countries were completely depopulated. In Spain and Portugal, ASFV became endemic in the 1960s and complete eradication took more than 30 years. Changes in production practices and increased globalization have increased the risk of African swine fever being introduced into North America.

Etiology

African swine fever results from infection by the African swine fever virus. Formerly classified as a member of the family Iridoviridae, this virus is currently the sole member of the new genus *Asfivirus* in the family Asfarviridae. ASFV is the only DNA virus transmitted by arthropods. Distinct antigenic types have not been identified for this virus, but restriction enzyme analysis has been used to identify viral genotypes. ASFV isolates can vary greatly in their virulence, from highly virulent isolates that kill most pigs to viruses that result only in seroconversion.

Species Affected

African swine fever affects members of the pig family (Suidae). Species that can be infected include domesticated swine, European wild boars, warthogs (*Phacochoerus africanus*), bush pigs (*Potamochoerus porcus*), giant forest hogs (*Hylochoerus* spp.), and peccaries (*Tayassu* spp.). Symptomatic infections occur in domesticated pigs, feral pigs, and European wild boars. ASFV infections are generally asymptomatic in warthogs, bush pigs, and giant forest hogs; these species are thought to be the reservoirs for the virus in Africa. Other species that may be able to carry the virus asymptotically include the collared peccary (*Tayassu tajacu*) and the white-lipped peccary (*Tayassu albirostris*), both found in the Americas.

Geographic Distribution

African swine fever is endemic in most of sub-Saharan Africa, including the island of Madagascar; the highest incidence of disease is seen from the equator to the northern Transvaal. Outbreaks have been reported periodically outside this region; however, in most cases, the disease was eventually eradicated. Outside Africa, ASFV is currently endemic only in feral pigs in Sardinia, Italy.

Transmission

African swine fever can be transmitted by direct contact with infected animals, indirect contact on fomites, and tick vectors. Transmission during direct contact is usually by oronasal spread. Aerosol transmission is thought to be unimportant, and only seems to occur over short distances when pigs are in close contact. African swine fever virus can be found in all tissues and body fluids, but particularly high levels are found in the blood. Massive environmental contamination may result if blood is shed during necropsies or pig fights, or if a pig develops bloody diarrhea. The virus can also spread on fomites, including vehicles, feed, and equipment. There is evidence that some pigs may become carriers.

African swine fever often spreads to new areas when pigs are fed uncooked scraps that contain ASFV-infected pork. In one outbreak, pigs became infected after being fed the intestines of guinea fowl that had eaten infected ticks. The African swine fever virus is highly resistant to environmental conditions. It can survive for a year and a half in blood stored at 4°C (39°F), 11 days in feces at room temperature,

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and at least a month in contaminated pig pens. The virus will also remain infectious for 150 days in boned meat stored at 3.9°C (39°F), 140 days in salted dried hams, and several years in frozen carcasses.

African swine fever is also spread through the bite of infected *Ornithodoros* spp. soft ticks. In tick populations, transstadial, transovarial, and sexual transmission occur. In Africa, ASFV is thought to cycle between newborn warthogs and the soft ticks (*Ornithodoros moubata*) that live in their burrows. Individual ticks can apparently remain infected for life, and infected soft tick colonies can maintain this virus for years. *Ornithodoros erraticus* became infected with ASFV when the virus was enzootic in Spain and Portugal, and additional *Ornithodoros* spp have been infected in the laboratory.

Other bloodsucking insects, such as mosquitoes and biting flies, may also be able to transmit the virus mechanically. Stable flies (*Stomoxys calcitrans*) can carry high levels of the virus for two days. Under experimental conditions, these flies could transmit ASFV 24 hours after feeding on infected pigs.

Incubation Period

The incubation period is 5 to 19 days after direct contact with infected pigs, but can be less than 5 days after exposure to ticks. Acute disease typically appears in 5 to 7 days.

Clinical Signs

African swine fever can be a peracute, acute, subacute or chronic disease. Highly virulent strains produce peracute or acute disease, and may affect the entire herd within a few days. Less virulent strains produce milder symptoms that are easily confused with other diseases, and can take several weeks to spread through the herd.

Sudden deaths with few lesions are characteristic of the peracute form, and may be the first sign of an infection in a herd. Acute disease is characterized by a high fever, moderate anorexia, lethargy, weakness, recumbency, and erythema that is most apparent in white pigs. Some pigs develop cyanotic skin blotching on the ears, tail, lower legs, or hams. Pigs may also have abdominal pain, constipation, or diarrhea; the diarrhea is initially mucoid and later may become bloody. Generalized hemorrhages can occur in the skin or internal organs. Dyspnea, vomiting, nasal and conjunctival discharges, and neurologic signs have also been reported. Pregnant animals frequently abort; in some cases, abortions may be the first signs of an outbreak. Leukopenia can be seen in laboratory tests. In acute African swine fever, death often occurs within 7 to 10 days.

Subacute African swine fever, which is caused by moderately virulent isolates, is similar to acute ASF but less severe. In this form of the disease, the death rate is generally lower in adult swine, but may still be very high in very young animals. In subacute disease, fever, throm-

bocytopenia, and leukopenia may be transient, and affected pigs usually die or recover within 3 to 4 weeks.

Animals infected with isolates of low virulence may seroconvert without symptoms, abort, or develop chronic African swine fever. The symptoms of chronic disease include an intermittent low fever, appetite loss, and depression. Pigs may become emaciated, and develop respiratory problems and swollen joints. Coughing is common, and diarrhea and occasional vomiting have been reported. Ulcers, reddened or raised, necrotic skin foci may appear over body protrusions and other areas subject to trauma. In some cases, the only symptoms may be emaciation and stunting. Chronic African swine fever can be fatal.

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

The gross lesions of African swine fever are highly variable, and are affected by the virulence of the isolate and the course of the disease.

In pigs with peracute or acute disease, the carcass is often in good condition. Animals that die peracutely may have few or poorly developed lesions. In acute disease, there may be bluish-purple discoloration and/or hemorrhages in the skin, and there may be signs of bloody diarrhea or other internal hemorrhages. The major internal lesions are hemorrhagic, and occur in the spleen, lymph nodes, kidneys, and heart. In animals infected with highly virulent isolates, the spleen can be very large, friable, and dark red to black. The lymph nodes are often swollen and hemorrhagic and may look like blood clots; the nodes most often affected are the gastrohepatic and renal lymph nodes. Petechiae are common on the cortical and cut surfaces of the kidneys, as well as in the renal pelvis. Perirenal edema may also be present. Hydropericardium with hemorrhagic fluid may also be noted.

Less consistent clinical signs include hemorrhages, petechiae, and ecchymoses in other organs including the urinary bladder, lungs, heart, stomach, and intestines. Congestion or edema may be noted in the liver, gall bladder or lungs. The pleural and peritoneal cavities may contain straw-colored or blood-stained fluid. The brain and meninges may be congested, edematous, or hemorrhagic. Aborted fetuses may be anasaricous, have a mottled liver, and have petechiae or ecchymoses in the skin and myocardium. Petechiae can also be found in the placenta.

Similar but less pronounced lesions are seen in pigs infected with moderately virulent isolates. The spleen may be enlarged but not friable, and the color may be closer to normal. The lymph nodes are typically enlarged and can be hemorrhagic, and slight petechiation may be found on the kidneys.

In animals with chronic African swine fever, the carcass may be emaciated. Other possible post-mortem lesions are focal areas of skin necrosis, skin ulcers, consolidated lobules in the lung, caseous pneumonia, nonseptic fibrinous pericarditis, pleural adhesions, generalized lymphadenopathy, and swollen joints.

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Morbidity and Mortality

In domesticated pigs, the morbidity rate approaches 100% in naïve herds. The mortality rate depends on the virulence of the isolate, and can range from 0% to 100%. Highly virulent isolates can cause nearly 100% mortality in pigs of all ages. Less virulent isolates are more likely to be fatal in pigs with a concurrent disease, pregnant animals, and young animals. In subacute disease, the mortality rate may be as high as 70-80% in young pigs but less than 20% in older animals. Mild disease or asymptomatic infections are usually seen in warthogs and bush pigs.

Diagnosis

Clinical

African swine fever should be suspected in pigs with a fever, and when the necropsy findings include a very large, friable, dark red to black spleen and greatly enlarged and hemorrhagic gastrohepatic and renal lymph nodes. Less virulent isolates can be difficult to diagnose clinically or at necropsy, and often resemble other diseases.

Differential diagnosis

The differential diagnosis includes classical swine fever (hog cholera), acute porcine reproductive and respiratory syndrome, porcine dermatitis and nephropathy syndrome, erysipelas, salmonellosis, eperythrozoonosis, actinobacillosis, Glasser's disease (*Haemophilus parasuis* infection), Aujeszky's disease (pseudorabies), thrombocytopenic purpura, warfarin poisoning, other generalized septicemic or hemorrhagic conditions, and heavy metal toxicity.

Laboratory tests

African swine fever can be diagnosed by virus isolation. Blood and tissue samples from suspect pigs are inoculated into pig leukocyte or bone marrow cultures for virus isolation. Porcine alveolar macrophages and blood monocyte cultures also support ASFV replication. Most isolates of ASFV induce hemadsorption of pig erythrocytes to the surface of infected cells. A few non-hemadsorbing isolates can be missed with this test; most of these viruses are avirulent, but some do produce symptomatic disease. ASFV can also be detected in peripheral blood leukocytes from infected pigs using a hemadsorption "autorosette" test.

African swine fever virus antigens can be found in tissue smears or cryostat sections and in the buffy coat, by the fluorescent antibody test (FAT). The World Organization for Animal Health (OIE) does not consider this test alone to be sufficient for diagnosis, although it is useful in conjunction with other assays. Nucleic acids can be detected with a polymerase chain reaction (PCR) assay or by the hybridization of nucleic acid probes to tissue sections. PCR is particularly useful in putrefied samples that cannot be used for virus isolation and antigen detection. A rapid, real time PCR technique using tonsil scraping samples has recently been published. This test can detect the virus a few days before the onset of symptoms.

Serology is also useful for diagnosis, particularly in endemic regions. Antibodies to ASFV persist for long periods of time after infection. Many serologic tests have been developed for the diagnosis of African swine fever, but only a few have been standardized for routine use in diagnostic laboratories. These tests include the enzyme-linked immunosorbent assay (ELISA), immunoblotting, indirect fluorescent antibody (IFA), and counter immunoelectrophoresis (immuno-electro-osmophoresis) tests. The ELISA is prescribed for international trade.

Animal inoculation, performed in pigs, was used in the past to distinguish African swine fever from classical swine fever. This test is no longer recommended by the OIE due to humane considerations and the complexity of the test.

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.

For virus isolation from live animals, blood should be collected into an anticoagulant (heparin or EDTA). At necropsy, samples of the spleen, kidney, tonsils, and lymph nodes should be collected. ASFV is not found in aborted fetuses; in cases of abortion, a blood sample should be collected from the dam. Samples for virus isolation should be transported as cold as possible, but kept from freezing. If a cold chain is impossible to maintain, samples may be submitted in glycerosaline, although this can result in a small decrease in the probability of virus identification.

Tissue samples should also be submitted for the FAT histology. Serum and/ or tissue fluids should be submitted for serology. Paired samples are useful when they are available.

Recommended actions if African swine fever is suspected

Notification of authorities

African swine fever should be reported to state or federal authorities immediately upon diagnosis or suspicion of the disease.

Federal: Area Veterinarians in Charge (AVIC):

http://www.aphis.usda.gov/animal_health/area_offices/

State Veterinarians:

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

Control

To prevent introduction of the African swine fever virus into areas free of the disease, all garbage fed to pigs should be cooked. Unprocessed meat must be heated to at least 70°C (158°F) for 30 minutes to inactivate the virus; 30 minutes at 60°C (140°F) is sufficient for serum and bodily fluids.

African swine fever is a highly contagious disease. Eradication is by slaughter of infected and in-contact animals, and disposal of carcasses, often by burying, rendering, or burning. Rapid diagnosis and the prevention of disease spread to feral or wild pigs is very important. Strict quarantines must be imposed. ASFV can survive for long periods on fomites and in the environment, and sanitation and disinfection are important in preventing further spread. Many common disinfectants are ineffective; care should be taken to use a disinfectant specifically approved for African swine fever. Sodium hypochlorite and some iodine and quaternary ammonium compounds are effective.

Potential tick vectors should be controlled with acaricides. In outbreaks, a detailed entomological investigation should be conducted to investigate the possible role of local soft tick vectors and their potential for becoming long term carriers. Although *Ornithodoros moubata* is an important long-term vector in Africa, and *Ornithodoros erraticus* became chronically infected in Spain and Portugal, *Ornithodoros* ticks never became chronically infected during outbreaks in South America. In addition, biting insects that may be able to transmit the virus mechanically should be controlled. No treatment or vaccine exists for this disease, and an ASF vaccine is unlikely to be developed soon.

Public Health

Humans are not susceptible to African swine fever virus.

Internet Resources

- Food and Agriculture Organization of the United Nations.
Recognizing African Swine Fever. A Field Manual.
<http://www.fao.org/docrep/004/X8060E/X8060E00.HTM>
- Manual for the Recognition of Exotic Diseases of Livestock
<http://www.spc.int/rahs/>
- The Merck Veterinary Manual
<http://www.merckvetmanual.com/mvm/index.jsp>
- United States Animal Health Association.
Foreign Animal Diseases
http://www.vet.uga.edu/vpp/gray_book02/fad/index.php
- 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
- OIE Terrestrial Animal Health Code
http://www.oie.int/eng/normes/mcode/A_summry.htm

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* link defunct as of 2006