Slide 1

Classical Swine Fever

Hog Cholera,
Peste du Porc,
Colera Porcina,
Virusschweinepest

Slide 2

Overview

- Organism
- Economic Impact
- Epidemiology
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control
- Actions to Take

Classical swine fever, also known as hog cholera, is a highly contagious viral disease of pigs. In today's presentation, we will cover information regarding Classical swine fever (CSF), including the organism that causes the disease as well as its epidemiology. We will also talk about the economic impact the disease has had in the past and could have in the future. Additionally, we will talk about how it is transmitted, the species it affects, the clinical signs and necropsy findings, as well as the diagnosis and treatment of the disease. Finally, we will provide prevention and control measures for the disease and actions to take if CSF is suspected.

[Photo: Swine rearing unit. Source: Dr. Alex Ramirez, Iowa State University VMPM]

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THE ORGANISM

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Classical Swine Fever Virus

- Family Flaviviridae
  - Genus Pestivirus
- Lipid-enveloped, single-stranded RNA virus
- Varies in virulence
- Environmentally stable
  - In tissues (meat)
  - Cold temperatures

Classical swine fever virus (CSFV) is a lipid-enveloped RNA virus that belongs to the family Flaviviridae, genus *Pestivirus*. Only one CSFV serotype has been found, but there is minor antigenic variability between strains. The virus can range from high to low virulence, resulting in acute, subacute, chronic and persistent forms of the disease in infected swine. The virus is closely related to bovine viral diarrhea virus 1 (BVDV-1), BVDV-2 and the ovine border disease virus. CSFV may survive for 3 to 15 days in the environment (or longer periods in cold conditions). In a protein-rich environment, the virus is quite stable and can survive in refrigerated meat (for months) and frozen meat (for years). The virus is not inactivated by smoking or salt curing.

[Photo: An electron micrograph of a Flavivirus (West Nile virus). Sour e: Cynthia Goldsmith/CDC Public Health Image Library]

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IMPORTANCE

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History

- First confirmed in US, 1833
  - Endemic in late 19th and 20th century
  - Eradicated by late 20th
- Reported in the UK, 1864
- Recognized in 36 countries
- Eradication
  - Australia, Canada, New Zealand, and the US
  - Most of western and central Europe

Classical swine fever (CSF) was first described in the United States in the early 19th century (1833, in Ohio) and was endemic throughout the late 19th and 20th centuries. The disease was confirmed in the UK in 1864, and spread rapidly until 1878 when steps were taken to control the disease. CSF was eradicated from Great Britain in 1966. Constant progress toward eradication has been made in Eastern Europe, stemming from guidelines developed for CSF control in individual states of Eastern Europe in 1980. In 1989, CSF was recognized in 36 countries, and was suspected of being present in two additional countries. CSF has been successfully eradicated in Australia, Canada, the United States, New Zealand and most of western and central Europe.

[Photo: Historical depiction of pig undergoing vaccination. Source: US Department of Agriculture]

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Economic Impact

- Impact on production
- Loss of import and export markets
  - Pigs and pork products
- Example: The Netherlands, 1997-8
  - 400 herds affected
  - 12 million pigs euthanized
  - Cost of $2.3 billion
- Control
  - Quarantine and slaughter

While CSF has been eradicated from many countries, re-introduction is always a possibility. CSF can have a major impact on production, resulting in excessive morbidity and possibly mortality, as we as infertility and other deleterious health effects at the herd level. Additionally, classical swine fever is an OIE 'priority' disease for international trade. Confirmed cases can lead to a ban on the import and export of pigs and pork products to many different countries. For example, in 1997-1998, an outbreak of CSF in the Netherlands spread to more than 400 herds in the country. Over 12 million pigs were euthanized (some in eradication efforts, most for welfare reasons) at an estimated cost of $2.3 billion. Similar re-introductions of the disease have occurred in the United Kingdom (2000), and other European countries (2001). On the farm, control will require quarantine and slaughter of affected and exposed swine.

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EPIDEMIOLOGY

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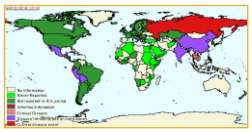
Geographic Distribution

- South & Central America, Mexico
- Parts of Africa and Caribbean islands
- Much of Asia
- Recent outbreaks
  - Russia
  - Bulgaria



Classical swine fever is found in much of Asia, some Caribbean islands and African countries and much of South and Central America. The disease has also been reported in parts of Mexico. The disease has been eradicated from the United States, Canada, New Zealand, Australia and most of western and central Europe. Recent outbreaks have occurred in Russia and central Europe.

[Photo: This figure shows the OIE CSF disease outbreak map from 2006 to 2010. Red indicates a current disease event, purple indicates disease limited to one or more zones, dark green indicates disease not reported in this period, and light green indicates disease never reported. Source: World Organization for Animal Health (OIE) at http://www.oie.int/wahis/public.php?page=disease_status_map]

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Morbidity and Mortality

- Age and immune status important
- Varies with viral strain
  - Acute
    - High mortality (up to 100%)
  - Subacute
    - Lower morbidity and mortality rates
  - Chronic
    - Few animals affected – always fatal
  - Some cases are asymptomatic

The severity of classical swine fever varies. The age and immune status of the animals also affects the disease outcome. Younger animals often have higher mortality rates than adult pigs. Disease from highly virulent strains most commonly result in acute infection with high morbidity and mortality rates; the case fatality rate can approach 100%. Subacute disease usually has lower case-fatality rates compared to acute cases; mild cases of illness have lower mortality rates. Less virulent strains may be more difficult to detect as can chronic infections of CSF. Only a few animals in the herd may show signs of illness and these signs can resemble other swine diseases. Some infections of CSF can by asymptomatic; these animals may serve as carriers for further dissemination of the disease.

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TRANSMISSION

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Animal Transmission

- Highly contagious
  - Blood, saliva, urine, feces, tissues
- Transmission
  - Ingestion of contaminated garbage or meat products
  - Direct or indirect contact (fomites)
  - Less common: aerosol, semen, vectors
- Infected pigs are the only reservoir

Classical swine fever virus is highly contagious. Sources of virus include blood and all tissues, secretions and excretion (saliva, urine, feces, semen) of sick and dead animals. Transmission primarily occurs from ingestion of the virus. This can occur following feeding of contaminated garbage or meat products. Transfer of the virus can also occur through direct contact of pigs with infected animals; this can occur through the mucous membranes, conjunctiva, and skin abrasions. Transfer of the virus by contaminated objects (fomites), such as boots, vehicles, equipment is also possible. Aerosol spread can occur in confined spaces; however the virus does not travel long distances in the air. This is a less common route of transmission as is transfer by insect vectors. Infected pigs are the only reservoir of virus.

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ANIMALS AND CLASSICAL SWINE FEVER

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Clinical Signs

- CSFV only infects pigs
- Incubation period: 2 to 14 days
- Disease variable
  - Acutely fatal to asymptomatic
- Persistent viremia
  - Congenitally infected piglets
  - Shed the virus for months
- Signs mimic other swine diseases

Classical swine fever only affects domesticated and wild pigs. The incubation period ranges from 2 to 14 days. The clinical signs of CSF vary with the strain of the virus and the susceptibility of the pigs. More virulent strains cause acute disease, while less virulent strains can result in a high percentage of chronic, mild, or asymptomatic infections. Highly virulent strains were once more prevalent, but most epizootics are now caused by mild to moderately virulent strains. Clinical signs of CSF can resemble US endemic swine diseases, and are clinically indistinguishable from those of African swine fever.

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Clinical Signs: Acute Disease

- High fever (105°F)
- Huddling, weakness
- Anorexia
- Conjunctivitis
- Diarrhea
- Staggering
- Cyanosis
- Skin hemorrhages
- Death

In acute infections, common clinical signs include a high fever, dullness, weakness, drowsiness, tendency to huddle, anorexia, and constipation followed by diarrhea. Several days after the first signs appear, the abdomen, inner thighs and ears may become cyanotic (purplish discoloration). Hemorrhages can also occur in the skin. Incoordination, staggering, posterior paresis, and convulsions may be seen in the terminal stages, and recovery is rare.

[Photos: (Top) Weak, huddling pigs. (Middle) cyanotic ears; (Bottom) Hemorrhages in the skin. Source: Dr. R. Thanawongnuwech, Veterinary Pathology-Chulalongkorn University with permission]

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Clinical Signs: Subacute/Chronic Disease

- Subacute
  - Similar to acute form, but symptoms less severe
  - Pigs may survive
- Chronic
  - Anorexia, depression, fever, diarrhea
  - Poor reproductive performance including abortions, stillbirths, and deformities
  - Persistently infected piglets

The subacute disease form may resemble acute disease, but symptoms are usually less sever. Infected pigs may also survive. Chronic disease symptoms include fever, anorexia, stunted growth, and alopecia; these symptoms may wax and wane for months. Chronic infections are almost always fatal. Reproductive symptoms may also be seen with any level of virulence. Infected sows may give birth to persistently infected piglets; they typically die before one year of age.

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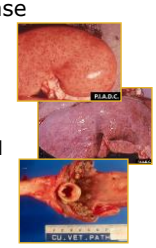
Post Mortem Lesions: Acute Disease

- Highly variable
- Hemorrhage
- Necrotic foci in tonsils
- Petechiae/ecchymoses on serosal and mucosal surfaces
  - Kidney, larynx, trachea, intestines, spleen, lungs



The post mortem lesions of CSF are highly variable. With acute infection, the most common lesion is hemorrhage, often seen on serosal and mucosal surfaces (particularly the kidney, urinary bladder, epicardium, larynx, intestines, spleen, and lungs). Necrotic foci are common in the tonsils, sometimes with pustules and severe congestion.

[Photos: (Top) Pig, kidney. There are numerous disseminated cortical petechiae ("turkey egg kidney"). Source: From Plum Island Animal Disease Center/CFSPH. (Middle) Pig, lung. The cortex contains multiple petechiae and pale infarcts surrounded by hemorrhage. Source:

Plum Island Animal Disease Center/CFSPH; (Bottom) Necrotic tonsils. Source: Dr. R. Thanawongnuwech, Veterinary Pathology-Chulalongkorn University]

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Post Mortem Lesions: Chronic Disease

- Necrotic foci ("button ulcers")
  - Intestinal mucosa
  - Epiglottis
  - Larynx
- Congenital infection
  - Cerebellar hypoplasia, thymic atrophy, hemorrhages, deformities

The lesions of chronic disease are less severe, and may be complicated by secondary infections. "Button" ulcers may be found in the intestinal mucosa (shown in the bottom photo in the colon), epiglottis, and larynx. In congenitally infected piglets, common lesions include cerebellar hypoplasia, thymic atrophy, ascites, hemorrhages, and deformities of the head and legs.

[Photo: Pig, colon. The mucosa is reddened and contains multiple discrete ("button") ulcers surrounded by zones of hemorrhage. Source: Dr. R. Panciera, Oklahoma State University, School of Veterinary Medicine, Noah's Arkive/CFSPH]

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Differential Diagnosis

- African swine fever
- Acute PRRS
- Porcine dermatitis and nephropathy syndrome
- Erysipelas
- Salmonellosis
- Eperythrozoonosis
- Actinobacillosis
- Glasser's disease
- Aujeszky's disease (pseudorabies)
- Thrombocytopenic purpura
- Warfarin poisoning
- Heavy metal toxicity

The differential diagnoses for CSF include African swine fever, acute porcine reproductive and respiratory syndrome (PRRS), erysipelas, salmonellosis, eperythrozoonosis, actinobacillosis, Glasser's disease (*Haemophilus parasuis* infection), Aujeszky's disease (pseudorabies), thrombocytopenic purpura, warfarin poisoning, heavy metal toxicity, and other generalized septicemic or hemorrhagic conditions.

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Diagnosis

- Suspect CSF in pigs with
  - Septicemia and high fever
  - History of garbage/scrap feeding
- Diagnosis impossible without laboratory confirmation
- Tonsil samples should be sent with every submission to your state diagnostic lab

CSF should be suspected in pigs with septicemia and a high fever. Other previously described clinical signs may be noted. History of the pigs or recent traffic onto the farm is also important. Potential introduction should be considered if the history includes feeding uncooked or undercooked scraps or garbage, particularly meat products, addition of new or returning animals to the herd, recent international travel of personnel on the farm, the presence of foreign visitors or workers, and/or lack of response by ill pigs to routine treatments. Diagnosis is impossible without laboratory confirmation, and tonsil is the preferred sample.

Slide 21	**Sampling** • Before collecting or sending any samples, 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	Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities (state and/or federal veterinarian) should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.
Slide 22	**Diagnostic Tests** • Detect virus, antigens, nucleic acids – Tissue samples (tonsils, spleen, kidneys, distal ileum) – Whole blood – ELISA or direct immunofluorescence • Serology – ELISA or virus neutralization – Comparative neutralization test**	Differentiation of classical swine fever from other diseases (especially African swine fever, from which CSF is clinically indistinguishable) requires laboratory testing. CSF can be distinguished by detecting the virus or its antigens in whole blood or tissue samples. CSF surveillance most commonly uses rRT-PCR (real-time reverse transcriptase polymerase chain reaction) testing on tonsils and nasal swabs. Virus antigens in tissue may also be detected by direct immunofluorescence or ELISAs. Serology can also be used for diagnosis; the most commonly used serological tests are virus neutralization tests and ELISAs. The definitive test for differentiation is the comparative neutralization test.
Slide 23	**Treatment** • No treatment should be attempted • Actions needed will be directed by state and/or federal animal health authorities • Slaughter • Area restrictions on pig movements • Vaccination?	No treatment should be attempted for pigs suspected with CSF. The state veterinarian or Federal Area Veterinarian in Charge (AVIC) should be contacted immediately upon suspicion of disease. Actions needed will be directed by these animal health authorities. Confirmed cases and in-contact animals should be slaughtered, and measures taken to protect other pigs in the area. This may entail complete herd slaughter combined with area restrictions on pig movements, or vaccination (depending on local disease control regulations). **Note: Producers will only receive indemnity for animals destroyed under the order of animal health officials.** In countries where classical swine fever is endemic, vaccines may be used to protect animals. Both modified live and subunit (marker) vaccines are manufactured, although availability varies with the country.
Slide 24	**CLASSICAL SWINE FEVER IN HUMANS** Humans are not susceptible	Humans are not susceptible to classical swine fever infection.

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PREVENTION AND CONTROL

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Recommended Actions

- IMMEDIATELY notify authorities
- Federal
  - Area Veterinarian in Charge (AVIC)
    http://www.aphis.usda.gov/animal_health/area_offices/
- State
  - State veterinarian
    http://www.usaha.org/StateAnimalHealthOfficials.pdf
- Quarantine

If you suspect a case of Classical swine fever, state or federal authorities should be notified immediately. Animals suspected with CSF should be isolated, and the farm should be quarantined until definitive diagnosis is determined.

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U.S. Surveillance

- USDA-APHIS-VS
- Passive reporting
  - FADD dispatch
- Active monitoring
  - High risk populations
  - Tissue sampling (tonsils, nasal swabs)
  - Serology

Currently, Veterinary Services (VS) relies on three surveillance programs for detection of CSF. Passive reporting is conducted by private practitioners (or producers, diagnosticians, slaughter plant inspectors) of suspicious cases with clinical signs similar to a foreign animal disease such as CSF. Once reported to the Area Veterinarian in Charge (AVIC), a Foreign Animal Disease Diagnostician (FADD) is dispatched to investigate the case and collect samples for shipment to the Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island, New York. Additionally, active surveillance is conducted and involves specimen collection from high risk populations, such as waste feeding operations along the Texas – Mexico border. Serum testing for diagnosis has declined dramatically as the focus has shifted to testing tissue samples (e.g., tonsils, nasal swabs) for antigen. The December, 2003 CSF surveillance plan provides the rationale for this transition.

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Quarantine

- Suspicion or diagnosis
  - Confirmed cases, contact animals slaughtered
  - Strict quarantine imposed to prevent spread of disease

When there is diagnosis or suspicion of CSF, confirmed cases and contact animals are slaughtered and strict quarantine is imposed to prevent the spread of disease.

[Photo: Farm entrance blocked by closed gate. Source: Katie Steneroden/Iowa State University, CFSPH]

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Disease Control

- Disinfectants
  - Sodium hypochlorite
  - Phenolic compounds
- Virus sensitive to
  - Drying
  - Ultraviolet light
  - pH <3 or >11
- Killed at high temperatures
  - 150°F for 30 minutes; 160°F 1 minute

CSFV is moderately fragile in the environment. The virus is sensitive to drying and ultraviolet light. It is rapidly inactivated by pH 3 or less or pH greater than 11. The virus is stable at pH 5 to 10. Sodium hypochlorite and phenolic compounds are effective disinfectants. The virus can be destroyed by cooking at temperatures of 65.5 ^{o}C (150 ^{o}F) for greater than 30 minutes or 71 ^{o}C (160 ^{o}F) for one minute.

[Photo: Disinfectant bottle. Source: Danelle Bickett-Weddle, Iowa State University/CFSPH]

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Prevention

- Do not feed uncooked garbage or meat products to swine
- Minimize visitors on the farm
  - Especially those who have traveled internationally in the last 5 days
- Implement biosecurity measures
  - Clean/disinfect boots
  - Clean coveralls

To prevent the introduction of CSF into the U.S., pigs should not be fed uncooked or undercooked garbage (swill) or meat products. Since the CSFV is stable in the tissues of infected animals, feeding these materials may transfer the virus to susceptible swine. Additionally, visitors onto the farm should be minimized. This is especially important for those who have traveled internationally within the last 5 days. Some visitors are essential to the continued operation of the farm. These individuals should check in with farm personnel upon arrival and follow biosecurity measures while on the farm (e.g., wear clean coveralls and clean and disinfect boots before entering and after leaving animal areas).

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Prevention

- Monitor animals for illness or signs of disease
  - Inspect animals daily
  - Report sick animals
- Clean and disinfect
  - Vehicles
  - Equipment
  - Boots and clothing

Prompt recognition of the disease is essential to minimize spread. Monitor and inspect animals daily for signs of illness or disease. Farm personnel should be familiar with signs to look for and who to contact when signs are noted. Vehicles and equipment can serve as fomites for the spread of the virus. They should be cleaned after each use. Additionally, boots should be disinfected, and clean clothing should always be worn when coming in contact with pigs.

[Photo: Disinfecting a trailer. Source: Danelle Bickett-Weddle, Iowa State University/CFSPH]

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Prevention

- Isolate ill animals immediately
- Quarantine newly introduced animals
  - Minimum of 30 days
  - New purchases, returning animals
- Keep health records on every animal

Animals infected with CSF can rapidly spread the virus to other susceptible pigs. Therefore, any animals showing signs of illness should be isolated immediately. Additionally, because pigs can be asymptomatic or can shed the virus before clinical signs are seen, newly purchased or returning animals should be quarantined a minimum of 30 days prior to introduction into the herd. Keeping health records on every animal is equally important, as it will help in the history and possible trace back (if needed) for animals in the herd.

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Vaccination

- Available in endemic countries
  - Protects from disease
  - Does not eliminate infection
- Helpful in outbreak control
- We all need to do our part
  - Keep our pigs healthy and free of disease

Vaccines are available in endemic countries. While vaccination can protect animals from clinical disease, it does not eliminate infection, and therefore may be inappropriate in countries with an eradication policy. In countries free of CSF, periodic surveillance is necessary to confirm freedom from infection.

[Photo: Pig. Source: Lance Cheung/USDA]

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Additional Resources

- World Organization for Animal Health (OIE)
  - www.oie.int
- U.S. Department of Agriculture (USDA)
  - www.aphis.usda.gov
- Center for Food Security and Public Health
  - www.cfsph.iastate.edu
- USAHA Foreign Animal Diseases ("The Gray Book")
  - www.usaha.org/pubs/fad.pdf

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