SWINE INFLUENZA

Swine influenza is a highly contagious viral infection of pigs. The disease in swine occurs within a herd either as an epizootic or enzootic form. In the epizootic form, the virus quickly moves through all phases of a swine unit with rapid recovery, provided there are not complicating factors such as secondary bacterial infections. In the enzootic form, clinical signs may be less obvious and not all pigs may demonstrate traditional clinical signs of infection. Morbidity rates can reach 100% with swine influenza infections, while mortality rates are generally low. The primary economic impact is related to retarded weight gain resulting in an increase in the number of days to reach market weight.

AETIOLOGY

Classification of the causative agent

Swine influenza is caused by influenza A viruses in the family Orthomyxoviridae. Influenza A viruses are further characterised by subtype by the two major surface glycoproteins, haemagglutinin and neuraminidase.

One relatively stable subtype, H1N1, was the etiologic agent of most swine influenza until the mid-1990s, and has been the strain historically most commonly associated with “classical swine influenza”. Since that time, established swine influenza viruses comprise various subtypes and variants, many of which are the result of substantial reassortment between influenza A viruses of several hosts. Currently circulating influenza viruses infecting swine also include genetic components, or entire viruses, of avian and human influenza viruses.

The most common subtypes of influenza virus in swine are H1N1, H1N2, and H3N2. Despite the same subtype classification, swine influenza viruses in Europe and the United States of America (USA) are genetically distinct. H3N1 influenza viruses have also been isolated from pigs in the USA and Korea (Rep. of), and H2N3 influenza viruses were detected in pigs in the USA but have not apparently become established in the pig population. Other novel reassortants of swine influenza viruses continue to be discovered. New subtypes have also been found in some populations, including reassortments with equine influenza viruses.

Resistance to physical and chemical action

Survival:	Influenza virus survival in the environment is influenced by temperature, pH, salinity and the presence of organic material. Although influenza viruses are enveloped, some of these viruses have been reported to survive for long periods in the environment, particularly when the temperature is low. Mammalian influenza viruses seem to be relatively labile, but can persist for several hours in dried mucus.
Temperature:	Influenza viruses can be inactivated by heat of 56°C (133°F) for a minimum of 60 minutes (or higher temperatures for shorter periods) as well as by ionising radiation.
pH:	Influenza viruses can be inactivated by low pH (pH 2).
Chemicals/ Disinfectants:	Influenza viruses are susceptible to a wide variety of disinfectants including sodium hypochlorite, 70% ethanol, oxidising agents, quaternary ammonium compounds, aldehydes (formalin, glutaraldehyde, formaldehyde), phenols, acids, povidone-iodine and lipid solvents. In the USA, disinfectants against microbes are licensed by the Environmental Protection Agency (EPA). Each product is licensed against all influenza A viruses because of the similarity in structure and physiochemical properties (http://www.epa.gov/oppad001/influenza-disinfectants.html). The host source (i.e. swine, avian, equine, human, etc.) and the subtype (e.g. H1N1, H5N1) do not change the basic chemical components and structure such that the inactivation properties are altered.

EPIDEMIOLOGY

- Swine influenza viruses are usually introduced into a herd by an infected pig. In a newly infected herd, up to 100% of the animals may become ill, but most animals recover within 3–7 days if there are no secondary bacterial infections or other complications. In uncomplicated cases, the case fatality rate ranges from less than 1% to 4%.

- Many infections in enzootically infected herds are subclinical; typical signs of influenza may occur in only 25% to 30% of the pigs.

Hosts

- Influenza viruses are found in a number of species including birds, humans, swine, horses and dogs.
- Swine influenza viruses are found mainly in pigs, but they have also been found in other species including humans, turkeys, and ducks.

Transmission

- Influenza viruses are readily transmitted between animals in the species to which they are adapted. Pigs may begin excreting swine influenza viruses within 24 hours of infection, and in the majority of cases shedding ceases by 7–10 days post infection.
- The primary route of virus transmission is through pig to pig contact via the nasopharyngeal route, most probably through none-to-nose contact or direct contact of mucus. The virus is shed in nasal secretions and disseminated through droplets or aerosols.

Sources of virus

- Infected (clinical or asymptomatic) pigs. Within a herd, it is suggested that the virus is maintained in a herd by passing it to young susceptible animals or new introductions into the herd. There is little evidence for a true long-term carrier state in pigs.
- Infected humans in contact with pigs. Human-origin H1N1 and H3N2 strains have been identified in swine populations.
- Other species may serve as source of influenza viruses capable of infecting pigs, including birds, humans, and horses.

Occurrence

- Influenza is a major cause of acute respiratory disease in finishing pigs, and is considered ubiquitous among swine populations world wide.
- Approximately 25–33% of 6–7 month-old finishing pigs and 45% of breeding pigs have antibodies to influenza viruses in the USA. High seroprevalence rates to swine influenza viruses have also been reported in other countries.

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE World Animal Health Information Database (WAHID) interface [http://www.oie.int/wahis/public.php?page=home] or refer to the latest issues of the World Animal Health and the OIE *Bulletin*.

DIAGNOSIS

Clinical diagnosis

- An acute upper respiratory disease characterised by fever, lethargy, anorexia, weight loss, nasal discharge, and laboured breathing. Coughing, sneezing, and nasal discharge are commonly seen. Conjunctivitis is a less common clinical sign.
- Decreased semen production in boars and abortions in sows may also occur due to secondary effects of fever. Some strains can circulate in pigs with few or no clinical signs.
- Complications may include secondary bacterial or viral infections. Severe, potentially fatal bronchopneumonia is occasionally seen.
- All three virus subtypes (H1N1, H3N2, H1N2) have been associated with disease. Swine influenza viruses can also contribute to more chronic, multifactorial respiratory disease problems in combination with other viruses or bacteria.

Lesions

- In uncomplicated infections, the gross lesions are mainly those of a viral pneumonia and are usually confined to the respiratory tract. Affected parts of the lungs are clearly demarcated, and are atelectic or consolidated, and dark red to purple-red. The lesions may be found distributed throughout the

lungs but tend to be more extensive and confluent ventrally. Other areas of the lung may be pale and emphysematous. The airways are often dilated and filled with copious mucopurulent exudate. The bronchial and mediastinal lymph nodes are typically oedematous but not congested. Pulmonary oedema may also be seen.

- Some strains of swine influenza viruses produce more marked lesions than others. Generalised lymphadenopathy, hepatic congestion and pulmonary consolidation were reported in one outbreak of severe disease in swine.
- Histologically, the fully developed lesions are primarily those of an exudative bronchiolitis with necrosis, metaplasia, or attenuation of the bronchiolar epithelial cells and varying degrees of some interstitial pneumonia. Exudative tracheitis and rhinitis may also be present.

Differential diagnosis

Swine influenza virus is one of the several agents involved in acute respiratory disease in pigs, and can frequently be accompanied by other respiratory diseases such as PRRS virus, Aujesky's disease virus, porcine circovirus type 2, A*ctinobacillus pleuropneumoniae, Bordetella bronchiseptica, Pasteurella multocida*, and *Mycoplasma hyopneumoniae*.

Laboratory diagnosis

- Identification of the agent: Virus identification is best accomplished by collection of samples within 24–48 hours after development of clinical signs. The animal of choice is an untreated, acutely ill pig with an elevated rectal temperature. Virus can readily be detected in lung tissue and nasal swabs; deep nasal swabs are recommended. Virus isolation can be conducted on continuous cell lines and in embryonated chicken eggs. Isolated viruses can be subtyped using the haemagglutination inhibition (HI) and the neuraminidase inhibition tests, or by reverse transcription-polymerase chain reaction assays. Immunohistochemistry can be conducted on formalin-fixed tissue and a fluorescent antibody test can be conducted on fresh tissue. Enzyme-linked immunosorbent assays (ELISA) may be available for detection of type A influenza viruses, but may have variable performance depending on the circulating strains.
- The primary serological test for detection of swine influenza virus antibodies is the HI test conducted on paired sera. The HI test is subtype and strain specific. Collection of paired sera is generally recommended 10–21 days apart. A four-fold or greater increase in titre between the first and second sample is suggestive of a recent swine influenza virus infection. Additional serological tests that have been described are the agar gel immunodiffusion test, indirect fluorescent antibody test, virus neutralisation, and ELISA.
- Newer molecular methods, particular RT-PCR (both real time and conventional) are used. Common screening real-time RT-PCRs used in North America for influenza diagnostics are directed against the Matrix protein or Nucleoprotein of the influenza virus.

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 2.8.8 Swine influenza in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Diagnostic Techniques".

PREVENTION AND CONTROL

Biosecurity

- A biosecurity plan for swine influenza must identify potential pathways for the introduction and spread of disease. Because swine influenza virus is spread predominantly through the respiratory route, and is highly transmissible between pigs, effective biosecurity can be difficult to achieve.
- Once swine influenza is established on a farm, it can be very difficult to completely eradicate without complete depopulation. Partial depopulation, segregation of early weaned piglets, all-in all-out systems, combined with good hygiene practices, are steps that can be taken to control the incidence and minimise the economic impact on an affected farm.
- Because cross-species transmission of influenza viruses can occur between humans and pigs, biosecurity measures must also take into account human–pig interactions, particularly the exposure of pigs to persons with influenza-like illness.

Vaccination

- Development of a vaccine should be elaborated according to OIE guidelines published in the Terrestrial Manual, and should always start with seed management. Identity of the seed should be well documented, including the source and passage history of the organism. All defining characteristics such as haemagglutinin and neuramindase subtypes and genetic origins should be established. Vaccine candidates should be shown to be pure, safe, potent, and efficacious. Inactivated vaccines may not protect against a new strain that appears to be antigenically different than the vaccine strain(s).
- An effective immunisation programme will likely need to induce protection against both H1 and H3 subtypes. Immunisation with vaccines to antigenically different strains of a similar subtype may confirm partial protection by minimising the clinical signs, yet still allow a limited period of virus shedding.
- Commercial vaccines currently available are either whole virus or split virus, and are adjuvanted, inactivated, whole-virus vaccines prepared typically from virus propagated in embryonated hen eggs or in cell lines. These vaccines have a major drawback in that they do not consistently confer cross-protection against new subtypes. Individual farms may develop autogenous multivalent inactivated vaccines specific to the influenza strains circulating in their swine populations. In the USA, this is only permitted for use on the farms for which the vaccine was created.
- Currently, modified live-influenza virus vaccines are not available for swine, although results of recent studies of gene-deleted vaccines have been reported. Modified live-virus vaccines provide enhanced stimulation of cell-mediated immunity as compared with inactivated vaccines, thus providing more heterosubtypic immunity (i.e., protection across subtypes). The potential for reassortment between field strains and the vaccine virus producing new reassortant viruses is a concern for attenuated live-virus vaccines.
- Recombinant, DNA-based vaccines have been evaluated experimentally and may provide greater cross-protection in the face of infection with heterologous swine influenza viruses than conventional killed vaccines, and are not as risky as live vaccines. Initial studies have not clearly shown adequate performance in swine, and these are not yet available for commercial use in swine.
- Immunisation of sows will induce maternally derived antibodies in piglets, which can both affect development of natural immunity and response to post-weaning vaccination.

Other medical prophylaxis

- No feasible therapeutic options exist for swine influenza. Supportive therapy includes provision of adequate water to maintain hydration and antipyretics (non-steroidal anti-inflammatory drugs) for reduction of fever.
- Swine influenza virus is a primary respiratory pathogen in pigs, but clinical illness can be exacerbated by the presence of secondary bacterial infections. Environmental management and disease control programmes to minimise the potential for synergistic co-infections such PRRS or secondary bacterial infections may mitigate the clinical course of swine influenza. Appropriate antimicrobial therapy to control secondary bacterial infections can also lessen the clinical course of swine influenza.

For more detailed information regarding vaccines, please refer to Chapter 2.8.8 Swine influenza in the latest edition of the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animal*s under the heading "Requirements for Vaccines and Diagnostic Biologicals".

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific and Technical Department (scientific.dept@oie.int). Last updated June 2009.