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REVIEW ON SWINE INFLUENZA: AN EMERGING VIRAL ZOONOSIS

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ABSTRACT

Swine influenza is a respiratory disease of pigs caused by SIV Subtypes (type A influenza virus commonly) Which belong to the *Orthomyxoviridae* family. It causes regular outbreaks in pigs resulting in significant economic losses in industry, primarily by causing poor growth, weight loss and extended time to market. Influenza virus was first isolated from pigs in North America in 1930 and recognized clinically during the summer of 1918 in the United States, at about the time of the Spanish influenza pandemic.The viruses can cause mild to severe illness sometimes resulting in death. In pigs, influenza infection produces fever, lethargy, sneezing, coughing (barking), difficulty breathing, depression, discharge from the nose or eyes, sneezing, eye redness or inflammation and decreased appetite.The gold standard for diagnosing swine influenza is a viral culture from the nasal secretion.The main route of transmission of the disease among pigs is through direct contact between infected and uninfected animals (Pigs) and possibly from contaminated objects moving between infected and uninfected pigs. Influenza virus infections in swine and poultry are potential sources of viruses for the next pandemic among humans. People with regular exposure to pigs are at increased risk of swine flu infection. Swine have receptors to which both avian and mammalian influenza viruses bind, which increases the potential for viruses to exchange genetic sequences and produce new reassortant viruses in swine.This means that they are thought to be “mixing vessels”. As a result, the use of control strategies, especially vaccination of pigs, is critical for the control of influenza virus infections among domestic animals, to reduce their potential as sources for outbreaks among humans. In addition, the vaccination of people who work with swine and poultry is encouraged to reduce the chance of human influenza viruses being spread to pigs.

KEYWORDS: *Pandemic, Respiratory disease, Swine Influenza, Vaccination, Zoonosis.*

INTRODUCTION

Swine influenza, also called swine flu, hog flu, pig flu and pig influenza is a respiratory disease of pigs caused by type-A influenza virus Subtypes Which belong to the *Orthomyxoviridae* family and cause regular outbreaks in pigs resulting in significant economic losses in industry, primarily by causing poor growth, weight loss and extended time to market. Influenza virus was first isolated from pigs in North America in 1930 and recognized clinically during the summer of 1918 in the United States, at about the time of the Spanish influenza pandemic (Reid and Taubenberger, 2003). It is common throughout pig populations worldwide and is characterized by low mortality (usually around 1–4 %) and high morbidity (approaching 100%) (Cynthia and Kahn, 2008). Basically, Swine flu is a disease of pigs, but some Swine influenza viruses can also cause disease in humans, birds, cats, dogs, ferrets and mink. In pigs, influenza infection produces fever, lethargy, sneezing, coughing, difficulty breathing, depression, discharge from the nose or eyes, sneezing, eye redness or inflammation and decreased appetite (Heinen, 2003).

Swine flu has been reported numerous times as a zoonosis in humans, usually with limited distribution, rarely with a widespread distribution. Isolation of a swine influenza virus from humans in 1974 confirmed that swine influenza viruses are zoonotic in nature (Brown, 2000). People with regular exposure to pigs are at increased risk of swine flu infection.The symptoms of zoonotic swine flu in humans are similar to those of seasonal influenza and of influenza-like illness in general, namely chills, fever, sore throat, muscle pains, severe, headache, coughing, weakness and general discomfort. Influenza virus infections in swine and poultry are potential sources of viruses for the next pandemic among humans. Swine influenza was responsible for the human outbreak in 1918-20 (Spanish flu pandemic) that caused an estimated 20-50 million deaths worldwide (Taubenberger and Morens, 2006). Therefore, the objective of this paper: to make an overview on the general accounts (mainly occurrence, mode of transmission, control and prevention) of swine influenza and to briefly point out the public health (zoonotic) and economic importance of swine flu.

LITERATURE REVIEW

Etiology

Swine influenza, also called, swine flu, is an infection caused by any one of several subtypes of swine influenza viruses in the family *Orthomyxoviridae*. Etiology of Swine Influenza is complex according to the high genetic variation of the causative viruses, mainly on two glycoprotein: heamagglutin (H) and neuramidase (N) (Cynthia *et al.*, 2008). Swine influenza virus (SIV) or Swine-origin influenza virus (S-OIV) is any strain of the influenza family of viruses that is endemic in pigs. As of 2009, the known SIV strains include influenza C and the subtypes of influenza A known as H1N1, H1N2, H2N1, H3N1, H3N2, and H2N3 with influenza A being common in pigs and influenza C being rare. Influenza B has not been reported in pigs (Heinen, 2003).

Virion structure

The influenza virion is roughly spherical. It is an enveloped, double-stranded RNA virus classified based on the composition of matrix proteins and nucleoproteins.The outer layer is a lipid membrane which is taken from the host cell in which the virus multiplies. Inserted into the lipid membrane are spikes (external proteins) actually glycoproteins, because they consist of protein linked to sugars known as HA (hemagglutinin) and NA (neuraminidase). These are the proteins that determine the subtype of influenza virus (Cynthia *et al.*, 2008).

The HA and NA are important in the immune response against the virus. Antibodies (proteins made to combat infection) against these spikes may protect against infection. The NA protein is the target of the antiviral drugs Relenza and Tamiflu. Also embedded in the lipid membrane is the M2 protein, which is the target of the antiviral adamantanes, amantadine and rimantadine (Gramer, 2005).The hemagglutinin (HA) and neuraminidase (NA) proteins are shown on the surface of the particle. The viral RNAs that make up the genome are shown as a particle bound to ribonucleoproteins (RNPs) (Kawaoka, 2006).

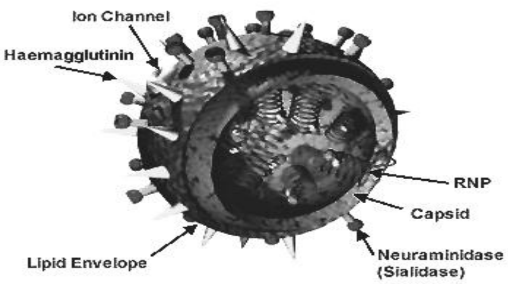

Figure 1. Structure of the influenza virion (*Orthomyxoviridae* Family). Source: (Kawaoka, 2006).

Virion classification

Of the three genera of influenza viruses that cause human flu, the two also (Influenza A and Influenza C) also cause influenza in pigs (Heinen, 2003).Influenza A is further categorized into subtypes: H1N1, H1N2, H2N3, H3N1, and H3N2 based on the type of two surface proteins Known as hemagglutinin (H) and neuraminidase (N). In pigs, four influenza A virus subtypes (H1N1, H1N2, H3N2 and H7N9) are the most common strains worldwide (Gramer *et al.*, 2007). Influenza C viruses infect both humans and pigs, but do not infect birds. Because of its limited host range and the lack of genetic diversity, influenza C does not cause pandemics in humans (Bouvier and Palese, 2008).

HISTORICAL OCCURRENCE OF SWINE INFLUENZA

General history

The presence of influenza in pigs was first recognized clinically during the summer of 1918 the United States, at about the time of the Spanish influenza pandemic. The first identification of an influenza virus as a cause of disease in pigs occurred about ten years later, in 1930 in North America (Brown, 2000). Swine influenza was first proposed to be a disease related to human flu during the 1918 flu (spanish Flu) pandemic in U.S., when pigs became ill at the same time as humans (Morens and Taubenberger, 2010).Swine influenza has been reported from North and South America (especially the U.S. Midwest and Canada), Europe, parts of Asia and Africa (Dee, 2012).

Outbreak history

The current outbreak of swine flu is a result of an influenza virus species that infected pigs, then reassort (swap) genes and the new virus emerging. Currently there are four main influenza type A virus subtypes, but the most recent influenza virus from pigs causing the outbreak have been H1N1 viruses.This new virus that has emerged is a mixture of swine, human and avian influenza viruses (CDC, 2009). In 1998, swine flu was found in pigs in four U.S. states.This outbreak confirmed that pigs can serve as a crucible where novel influenza viruses emerge as a result of the reassortment of genes from different strains (Bouvier and Palese, 2008).The 1976 pandemic was raised On February 5, 1976 in a United States army recruit at Fort Dix, New Jersey when an influenza outbreak is caused by cH1N1(“classic” H1N1) virus (Gaydos *et al.*, 2006).

Swine flu outbreak was reported in India in early 2015. The disease affected more than 20,000 people and claimed over a 1,000 lives.The largest number of deaths due to swine flu is in India's western part (Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Delhi, and Telengana). In 2015, the instances of Swine Flu substantially increased to five year highs with over 10,000 cases reported and 660 deaths in India (Iboyaima, 2015).

Pandemic history

New strain of the influenza A (H1N1) virus was first identified in April 2009 and was soon considered to have pandemic potential. Incidence was highest in the 5-24 age group and lowest among the mature adults and elderly (CDC, 2009). The first influenza pandemic of the 21st century was started in May of 2009 and swept through the Northern Hemisphere (Taubenberger and Morens, 2006). As of June 22, 2009, WHO confirmed that more than 50,000 human cases of H1N1 had occurred in more than 80 countries and territories, including 231 deaths. As of 1 August 2010, worldwide more than 214 countries and overseas territories or communities reported laboratory-confirmed cases of pandemic influenza H1N1 2009 including over 18449 deaths (WHO, 2010).

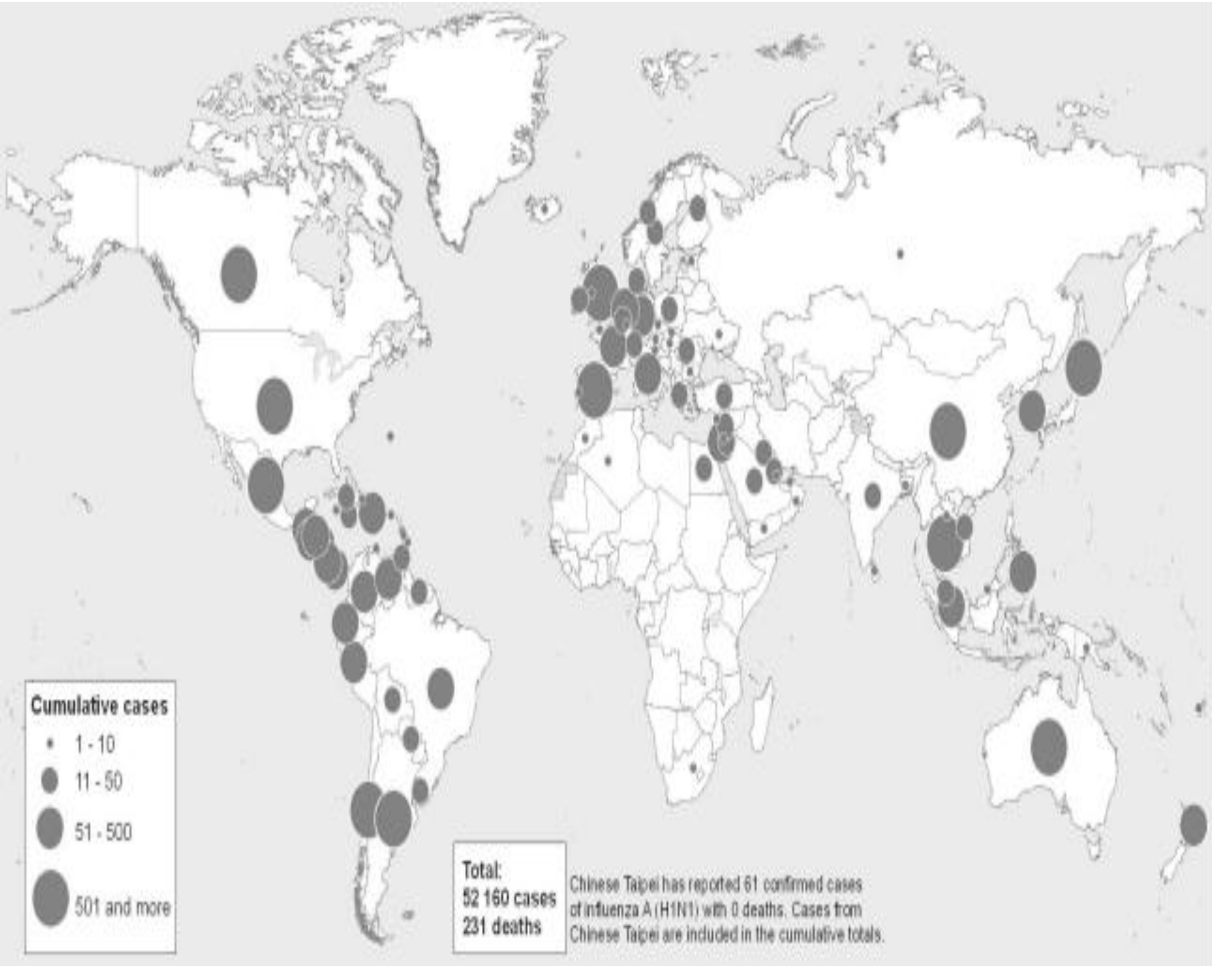

Figure 2. Map of Global Human H1N1 Cases as of June 22, 2009.

Source: (WHO, 2009).

During the 20th century, new strains of Influenza A viruses resulted in three influenza pandemics in US.These were the Spanish Flu (1918-1919), the Asian Flu (1957-58) and the Hong Kong Flu (1968-1969) (Edwin, 2006).

The Spanish Flu (1918-1919) was an Influenza H1N1 pandemic which caused an estimated 20-50 million deaths worldwide and accounted for 675,000 deaths in the United States. It was also called as ”the Mother of all Influenza pandemics” (Edwin, 2006).

The A(H1N1) "Spanish" influenza epidemic, the first influenza pandemic of the 20th century, wrought havoc on the world population between May-June of 1918 and April of 1919. It killed at least 50 million people, five times as many as those who died fighting in the First World War (Kilbourne, 2006).The most striking characteristics of the 1918 pandemic were the unusually high death rate among the healthy age group of 15-34 year olds. More than 600,000 people died in the US directly or indirectly because of the epidemic.The 1918 flu pandemic in humans was associated with H1N1 and influenza appearing in pigs.This may reflect a zoonosis either from swine to humans, or from humans to swine (Taubenberger and Morens, 2006).

The Asian Flu (1957-58) was an Influenza H2N2 pandemic started in China in February 1957. By June 1957, it spread to United States, causing 70,000 deaths.The Hong Kong Flu (1968-1969) also called Influenza H3N2 pandemic, was started in Hong Kong in early 1968. Later in the year, it spread to the United States and caused 34,000 deaths. The Hong Kong Flu was the mildest pandemic of the 20th century (Kilbourne, 2006).

Table 1: Mortality during the three influenza pandemics of the 20th century in the United States.

Influenza A pandemics	Excess mortality during the pandemic season (all causes)	Excess mortality: gross for 100,000 inhabitants (all causes)
1918–1919 A(H1N1)	~ 500,000	530
1957–1958 A(H2N2)	~ 60,000	40
1968–1969 A(H3N2)	~ 40,000	18

Source: (Yin, 2006)

Species affected

Basically, Swine flu is a disease of pigs, but some Swine influenza viruses can also cause disease in humans, birds (specially turkeys), cats, dogs, ferrets and minks (Smith *et al.*, *2006*). Influenza virus was first isolated from pigs in North America in 1930 and recognized clinically during the summer of 1918 in the United States, at about the time of the Spanish influenza pandemic (Brown, 2000).The first isolation of a swine influenza virus from humans in 1974 confirmed that swine influenza viruses are zoonotic in nature (Reid and Taubenberger, 2003). In addition to transmission between humans and pigs, swine influenza viruses have been isolated from turkeys on a fairly regular basis, indicating transmission between pigs and avian species. The infection in cats, dogs, ferrets and minks has also been reported (Murray and Louise, 2009).

TRANSMISSION

Transmission among pigs

The main route of transmission is through direct contact between infected and uninfected animals (Pigs) and possibly from contaminated objects moving between infected and uninfected pigs (Kothalawala *et al.*, 2006).These close contacts are particularly common during animal transport. Intensive farming may also increase the risk of transmission, as the pigs are raised in very close proximity to each other (Saenz *et al.*, 2006).The direct transfer of the virus probably occurs either by pigs touching noses, or through dried mucus. Airborne transmission through the aerosols produced by pigs coughing or sneezing are also an important means of infection.Transmission may also occur through wild animals such as wild boar which can spread the disease between farms (Vicente *et al.*, 2002).

Transmission to humans (zoonosis)

Direct transmission of a swine flu virus from pigs to humans (zoonosis) is occasionally possible (Myers *et al.*, 2007). People who work with poultry and swine, especially those with intense exposures, veterinarians and meat processing workers are at increased risk of zoonotic infection with influenza virus endemic (Gray and Kayali, 2009).The swine influenza A (H1N1) virus in humans is likely to be transmitted in the same manner as the seasonal flu spreads (mainly via direct contact between infected and uninfected animals) and possibly from contaminated objects moving between infected and uninfected pigs. Swine influenza viruses are not transmitted by food. You cannot get swine influenza from eating pork or pork products. Eating properly handled and cooked pork and pork products is safe. Cooking pork to an internal temperature of 160°F (71^0c) kills the swine flu virus as it does other bacteria and viruses (Van, 2007).

Transmission among humans

Swine influenza viruses are not usually transmitted efficiently in human populations. Most infections are limited to the person who had contact with pigs.The swine flu in humans is most contagious during the first five days of the illness although some people, most commonly children, can remain contagious for up to ten days (Gramer *et al.,* 2007). Swine influenza (novel H1N1 and H3N2v) spreads from person to person, either by inhaling the virus or by touching surfaces contaminated with the virus, then touching the mouth or nose. Human-to-human transmission of swine flu can also occur in the same way as seasonal flu occurs in humans. This would be mainly through the coughs or sneezes of infected people. Close contact and closed environments favor transmission among humans (CDC, 2014).

Pathogenesis

Pathogenesis in swine

When influenza virus is introduced into the respiratory tract of pigs, by aerosol or by contact with saliva or other respiratory secretions from an infected individual, it attaches to and replicates in epithelial cells.The virus replicates in cells of both the upper and lower respiratory tract, but prefers the lungs (Dee, 2005). Both SIV subtypes (H1N1 and H3N2) were able to induce the flu-like symptoms (cough, fever, lethargy and anorexia) and SIV-associated gross lung lesions lesions compatible with viral pneumonia in the cranioventral areas and were able to cause broncho-interstitial pneumonia (Landolt *et al.*, 2004). Gross lesions observed in pigs are characterized by multifocal well-demarcated purplish-red lesions in the cranioventral areas of lung lobes known as a checker-board lung. SIV-induced microscopic lesions consist of epithelial disruption (desquamation) and attenuation in the bronchioles with later found hyperplastic proliferation and bronchiolitis obliterans (Thacker *et al.,* 2001).

Pathogenesis in humans

After entry into the respiratory tract, the virus replicates in cells of both the upper and lower respiratory tract.Viral replication combined with the immune response to infection lead to destruction and loss of cells lining the respiratory tract. Influenza complications of the upper and lower respiratory tract are common. These include otitis media, sinusitis, bronchitis, and croup. Pneumonia is among the more severe complications of influenza infection most frequently observed in children or adults. Combined viral-bacterial pneumonia is common. In secondary bacterial pneumonia, the patient appears to be recovering from uncomplicated influenza but then develops shaking chills, pleuritic chest pain, and coughs up bloody or purulent sputum.The most common bacteria causing influenza-associated pneumonia are *Streptococcus pneumoniae*, *Staphylococcus aureus*, and *Hemophilus influenza* (Killingray, 2003).

Signs and symptoms

Signs in swine

In pigs, influenza infection produces fever, lethargy, sneezing, coughing, difficulty breathing, depression, discharge from the nose or eyes, sneezing, eye redness or inflammation and decreased appetite. In some cases the infection can cause abortion. Although mortality is usually low, the virus can produce weight loss and poor growth, causing economic loss to farmers. Infected pigs can lose up to 12 pounds of body weight over a three to four week period (Cynthia and Kahn, 2008). Herds with continuous swine flu infections and herds that are vaccinated against swine flu may have sporadic disease, or may show only mild or no symptoms of infection (Kothalawala *et al*., 2006).The severity of clinical illness is dependent up on: the strain of influenza virus involved, the age of the pig, the immune status of the pig,

Environmental conditions and the presence or absence of concomitant stress factors the presence or absence additional respiratory tract bacterial and/or viral pathogens (Janke, 2013).

Signs in humans

According to the CDC, the symptoms of the 2009 swine flu H1N1 virus (zoonotic swine flu) in humans are similar to those of influenza and influenza-like illness in general, namely chills, fever, sore throat, muscle pains (fatigue), severe headache, coughing, weakness and general discomfort.The 2009 outbreak has shown an increased percentage of patients reporting diarrhea and vomiting (Gramer *et al.*, 2007).

Diagnosis

Clinical diagnosis

Historically, swine influenza has been considered relatively easy to diagnose. In its classical and epizootic (outbreak) form, which induces a harsh barking cough and high fever, the infection could be identified on the basis of clinical signs alone. However, recently, the enzootic form of the infection is not clinically dramatic or unique and diagnostic testing is often necessary to detect the infection (Janke, 2000).

Laboratory diagnosis

This involves all the diagnostic measures including detection of the virus, Antigen detection, Serological tests, Immunohistochemistry (IHC) and a gel-based multiplex RT-PCR assay (Radostits *et al.*, 2007). Detection of the virus is a laboratory identification of the agent in the nasopharyngeal area by taking nasal swabs. The most common method for diagnosing influenza is the Rapid Flu Test. Depending on the type of test used, it can identify influenza A and B. Proper sample collection is critical for testing. Because the tests rely on detecting the virus shed in the respiratory secretions of the infected person, the test must be done during the first few days of illness when there is viral shedding. The best sample is a nasal aspirate, but nasopharyngeal swabs are most frequently used (Thacker *et al.*, 2001).

The gold standard for diagnosing influenza is a viral culture. The virus from the nasal secretion is grown and identified in the laboratory. The advantage of a viral culture is that the specific viral strain and type can be identified. Such detailed information is critical in detecting influenza outbreaks (including surveillance for the pandemic strain) and for developing vaccines. The major disadvantages are that the results take about three to ten days and not all labs are equipped to perform a viral culture. Antigen detection involves PCR-test to detect the virus in the nasal swab specimen. Serological tests mainly include HI test and an ELISA-based test.The primary serological test for detection of SIV antibodies is the HI test and it is subtype specific (Heinen, 2003).

Additional serological tests that have been described but not commonly used are the virus neutralisation, agar gel immunodiffusion test, and indirect fluorescent antibody test. Immunohistochemistry (IHC) is applied recently on fixed tissue mostly for bronchial and bronchiolar epithelial cells. A gel-based multiplex RT-PCR assay is developed recently to detect H1 and H3 subtypes of SIV (Thacker *et al.*, 2001).

Differencial diagnosis

According to the CDC, the symptoms of the 2009 swine flu H1N1 virus in humans are similar to those of seasonal influenza and of influenza-like illness in general. Therefore, it is important to note that the flu is different from a common cold or seasonal allergies. The flu differs from the common cold in that it lasts longer (about two weeks) and can be temporarily debilitating even in healthy individuals. Because these symptoms are not specific to swine flu, a differential diagnosis of probable swine flu requires not only symptoms, but also likelihood of swine flu due to the person's recent history (CDC, 2009).The most common differentials of swine influenza in pigs include: porcine reproductive and respiratory syndrome virus, Aujeszky's disease (pseudorabies) virus, porcine respirator coronavirus, Enzootic pneumonia, hog cholera, atrophic rhinitis, inclusion body rhinitis, *Actinobacillus pleuro-pneumoniae* (in the acute form), *Mycoplasma hyopneumoniae* and other bacterial agents that may cause respiratory disease in pigs (Heinen, 2003).

Treatment

Treatments (both in swine and humans) are not aimed at treating swine influenza, but rather at reducing the severity of symptoms and the duration of illness, controlling possible secondary infections like bacterial pneumonia and other bacterial complications, and the viral shedding and thus the degree of contagion (spread) (Dee, 2012).

Treatment in swine

As swine influenza is rarely fatal to pigs, little treatment beyond rest and supportive care is required. Instead, veterinary efforts are focused on preventing the spread of the virus throughout the farm, or to other farms. Vaccination and animal management techniques are most important in these efforts. Antibiotics like penicillins, Sulfadimidine and other broad spectrum antibiotics are also used to control possible secondary infections like bacterial pneumonia and other bacterial complications in influenza-weakened herds, although they have no effect against the influenza virus. Antiviral drugs used in human influenza treatment are not generally administered to swine (Kothalawala *et al*., 2006).

Treatment in humans

If a person becomes sick with swine flu, antiviral drugs if taken at the onset of the illness (within 48 hours) can make the severity of illness milder and may decrease duration of the illness and make the patient feel better faster.They may also prevent serious flu complications. However, there is no definitive treatment for influenza (Yassine *et al*., 2007). Antivirals do not help if given beyond 48 hours of onset. Four antiviral medications are approved (licensed for use) by the U.S Food and Drug Administration (FDA) for treatment and prevention of influenza: Tamiflu (oseltamivir), Elena (zanamivir), Symmetric (amantadine) and Flumadine (rimantadine). A patient may develop resistance to one or all antivirals. Thus, for the swine flu specifically, the CDC recommends the use of Tamiflu (oseltamivir) or Credenza (zanamirvir) for the treatment and (or prevention) of infection with swine influenza viruses (CDC, 2009).

Prevention and control

Prevention of swine influenza has three components: prevention in swine, prevention of transmission to humans, and prevention of its spread among humans (Ramirez *et al.*, 2006).

Prevention in swine

Methods of preventing the spread of influenza among swine include facility management, herd management, and vaccination. Facility management includes using disinfectants and ambient temperature to control viruses in the environment. Because SIVs are unlikely to survive outside living cells for more than two weeks, except in cold (but above freezing) conditions, and are readily inactivated by disinfectants (De *et al.*, 2007). Herd management includes not adding (isolating) pigs carrying influenza to herds that have not been exposed to the virus (Dee, 2005). Carrier pigs are usually responsible for the introduction of SIV into previously uninfected herds and countries, so new animals should be quarantined. After an outbreak, as immunity in exposed pigs wanes, new outbreaks of the same strain can occur. Because much of the illness and death associated with swine flu involves secondary infection by other pathogens, control strategies that rely on vaccination may be insufficient (Cynthia and Kahn, 2008).

The vaccination of pigs is a common practice used by the swine industry to increase and prolong maternally derived antibody levels in young pigs, to protect them against clinical disease. However, the presence of maternal antibodies reduces vaccine efficacy, making it difficult to vaccinate pigs prior to exposure to the virus and resulting in an increased incidence of disease among pigs as their maternal antibodies decay and they become susceptible to virus infection and disease (Wesley *et al.*, 2004). To prevent human influenza viruses (including 2009 pandemic H1N1 virus) from entering a herd, swine workers and others who have influenza-like illnesses should avoid contact with pigs, and the public should be restricted from entering swine operations (Torremorell *et al.*, 2012). The use of human seasonal influenza vaccines may decrease the risk of introducing these viruses to pigs, as well as the risk of recombination between human and swine influenza viruses (CDC, 2014).

Prevention of pig-to-human transmission

The transmission from swine to humans is believed to occur mainly in swine farms, where farmers are in close contact with live pigs. Although strains of swine influenza are usually not able to infect humans, this may occasionally happen, so farmers and veterinarians are encouraged to use face masks when dealing with infected animals (Ramirez *et al.*, 2006). The use of vaccines on swine to prevent their infection is a major method of limiting swine-to-human transmission. Risk factors that may contribute to swine-to-human transmission include smoking and, especially, not wearing gloves when working with sick animals, thereby increasing the likelihood of subsequent hand-to-eye, hand-to-nose or hand-to-mouth transmission. Vaccination of People who work with poultry and swine, especially those with intense exposures, against influenza and surveillance for new influenza strains among this population may therefore be an important public health measure (Gray *et al.*, 2007).

The H1N1 swine flu viruses are antigenically very different from human H1N1 viruses and, therefore, vaccines for human seasonal flu would not provide protection from H1N1 swine flu viruses.There is no vaccine to protect humans from swine flu.The seasonal influenza vaccine will likely help provide partial protection against swine H3N2, but not swine H1N1 viruses (CDC, 2009).Therefore, use of human seasonal influenza vaccines may decrease the risk of introducing these viruses to pigs, as well as the risk of recombination between human and swine influenza viruses (Torremorell *et al*., 2012).

Prevention of human-to-human transmission

Influenza spreads between humans when infected people cough or sneeze, then other people breath in the virus or touch something with the virus on it and then touch their own face. Avoid touching your eyes, nose or mouth. The swine flu in humans is most contagious during the first five days of the illness, although some people, most commonly children, can remain contagious for up to ten days (CDC, 2009). Recommendations to prevent spread of the virus among humans include using standard infection control, which includes frequent washing of hands with soap and water or with alcohol-based hand sanitizers, especially after being out in public (De *et al.,* 2007).

Chance of transmission is also reduced by disinfecting household surfaces, which can be done effectively with a diluted chlorine bleach solution. Alcohol-based gel or foam hand sanitizers work well to destroy viruses and bacteria. Anyone with flu-like symptoms, such as a sudden fever, cough or muscle aches, should stay away from work or public transportation, and should contact a doctor for advice (CDC, 2014).

Vaccination strategies for the control of swine influenza virus infection

Control of swine influenza is primarily through the vaccination of pigs. Control of influenza virus infection in poultry and swine is critical to the reduction of potential cross-species adaptation and spread of influenza viruses, which will minimize the risk of animals being the source of the next pandemic in humans (Torremorell *et al*., 2012).The vaccination of pigs is a common practice used by the swine industry to increase and prolong maternally derived antibody levels in young pigs, to protect them against clinical disease. However, the presence of maternal antibodies reduces vaccine efficacy, making it difficult to vaccinate pigs prior to exposure to the virus and resulting in an increased incidence of disease among pigs as their maternal antibodies decay and they become susceptible to virus infection and disease. As a result, influenza viruses potentially can circulate in swine herds on a regular basis (Wesley *et al*., 2004).

Although current influenza vaccines for poultry and swine are inactivated and adjuvanted, ongoing research into the development of newer vaccines, such as DNA, live-virus, or vectored vaccines, is being done (Heinen, 2003). Two primary obstacles that confound programs for successful influenza vaccination of pigs are namely, viral antigenic shift and drift and the effect of maternally derived antibodies on vaccine efficacy. A number of swine influenza vaccines are made commercially; however, vaccines may not be available for all viruses, or combinations of viruses, present in an area (Anderson *et al*., 2013). Present vaccination strategies for SIV control and prevention in swine farms typically include the use of one of several bivalent SIV vaccines commercially available in the United States. Influenza vaccines do not always prevent infections or virus shedding, but the disease is usually milder if it occurs, and the amount of virus shed may be decreased (Thacker and Janke, 2008).

PUBLIC HEALTH AND ECONOMIC IMPORTANCE OF SWINE INFLUENZA

Economic impotance

Outbreaks in swine are common and cause significant economic losses in industry, primarily by causing stunting and extended time to market. For example, this disease costs the British meat industry about £65 million every year (Kay *et al*., 1994). In some cases the infection can cause abortion. Although mortality is usually low (around 1-4%), the virus can produce weight loss (usually up to 12 pounds of body weight over a three to four week period), delayed weight gain and poor growth, causing economic loss to farmers. Costs of control and prevention causes a great economic losses to the Farmers, country, and world also (Cynthia and Kahn, 2008).

Public health impotance

Humans can also be infected with zoonotic or variant influenza viruses that are routinely circulating in animals, such as avian influenza virus subtypes A(H5N1) and A(H9N2) and swine influenza virus subtypes A(H1N1) and (H3N2). Influenza virus infections in swine and poultry are potential sources of viruses for the next pandemic among humans. Swine influenza was responsible for the 1918-20 outbreak (Spanish flu pandemic) in human that caused an estimated 20-50 million deaths worldwide and accounted for 675,000 deaths (five times as many as those who died fighting in the First World War) in the United States (Taubenberger and Morens, 2006). Isolation of a swine influenza virus from humans in 1974 confirmed that swine influenza viruses are zoonotic in nature (Reid and Taubenberger, 2003). People who work with poultry and swine, especially those with intense exposures, are at increased risk of zoonotic infection with influenza virus endemic in these animals.Vaccination of these workers against influenza and surveillance for new influenza strains among this population may therefore be an important public health measure (Gray *et al.*, 2007).

CONCLUSION AND RECOMMENDATIONS

Swine influenza is a respiratory disease of pigs characterized by low mortality (1-4%) and high morbidity (100%). Outbreaks in swine are common and cause significant economic losses in swine farm industries, primarily by causing poor growth, weight loss and extended time to market. The main route of transmission of swine flu is through direct contact between infected and uninfected animals and possibly from contaminated objects and via wild animals, such as wild boar. Influenza virus infections in swine and poultry are potential sources of viruses for the next pandemic among humans. People who work with poultry and swine, especially those with intense exposures, like veterinarians, swine farmers and meat processing workers, are at increased risk of zoonotic infection with influenza virus. A number of swine influenza vaccines are made commercially; however, vaccines may not be available for all viruses, or combinations of viruses, present in an area.

Basedon the above conclusion, the following recommendations are forwarded:

- Awarness raising with special focus on the modes of transmission should be provided to the societies, not only to people who work with poultry and swine but also to others.
- To decrease the risk of introducing human influenza viruses to pigs, vaccination of the workers at risk (with influenza virus) against human seasonal influenza is very necessity.

- Facility management, herd management, and vaccination of pigs are critical for the control and prevention strategy of influenza virus infections among domestic animals and to reduce their potential as sources for outbreaks among humans.
- Biosecurity plans including avoiding contact with wild and feral pigs, wild birds and people who have influenza-like illnesses are recommended to be implemented.
- Early detection of outbreaks and then isolate and quarantine the infected animals as soon as possible.
- Researches should be continue on the availability and development of newer vaccines, such as DNA, live-virus, or vectored vaccines.

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