



## **The Role of Factory Farming in the Cause and Spread of Swine Influenza**

### **A Report by Compassion in World Farming**

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The recent influenza outbreak has resulted in thousands of human casualties and over a hundred deaths. As the swine flu virus spreads through the world, creating risk of a global pandemic, we ask the question which scientists have been asking for years: could industrial farming practices be behind the spread of this dangerous and virulent disease?

Virologist Ruben Donis, chief of the molecular virology and vaccines branch at the U.S. Center for Disease Control and Prevention, has confirmed in an interview published by the American Association for the Advancement of Science (AAAS) (2009) that the virus behind the latest human influenza outbreak is “definitely of swine origin”. Its genetic components include those previously seen in swine viruses detected in pigs in North America and Asia. He also confirmed that it is similar to swine viruses that have been circulating in the United States since the 1990s and it is understood to have genetic components that are very similar to the H3N2 type virus which struck a North Carolina pig farm in 1998. Other virologists have reportedly confirmed similar findings, including those based at Edinburgh University and St. Jude’s Childrens’ Hospital (Mackenzie, 2009; Greger, 2009). Dr. Robert Webster, the director of the U.S. Collaborating Center of the World Health Organization, has stated “The triple reassortment in pigs [first discovered in the U.S. in 1998] seems to be the precursor.” (cited in Greger, 2009).

Swine influenza is a highly contagious viral infection in pigs. There are a number of subtypes of the virus, the most common ones being H1N1, H1N2 and H3N2, although other subtypes also exist (Maldonado, 2006). “Classical” swine influenza was first discovered in 1931. It was an H1N1 virus, related to the H1N1 that caused the 1918 human influenza pandemic in which 10-20 million people died worldwide. However, in the past decade the virus has undergone rapid change and now includes three additional virus subtypes. In 1998, a new virulent form of the virus was discovered on a pig farm in North Carolina. The virus was a “triple reassortment” – a mixture of pig, bird and human viruses. It soon became the dominant pig flu virus in North America.

Scientists have been warning for years that these type of viruses pose a real risk to human health as they are capable of making a “species jump” to humans and becoming a global pandemic. Pigs are susceptible to both human and bird influenza viruses and they can therefore function as intermediate hosts or “mixing vessels” in which new influenza viruses can arise through replication, recombination and reassortment of human, avian and pig viruses (Brown et al., 1998). In 2004, Webby et al. warned that “swine populations act as reservoirs of viruses with proven ability to infect humans”.

According to the American Association for the Advancement of Science (2003), “the North American swine flu virus has jumped onto an evolutionary fast track, churning out variants every year” (Wuerthe, 2003). Kothalawa (2006) explains that viruses undergo change through the process of antigenic drift and antigenic shift. Antigenic drift is a series of point mutations which results in a different variant of the virus. Antigenic shifts are dramatic changes where a new virus emerges from the reassortment of genes of two different viruses resulting in a new H or N component. Antigenic drift is well known in human viruses (hence the need to re-evaluate and replace existing human flu vaccines on a yearly basis). The rate of antigenic drift has been thought to be significantly slower in pigs than in humans, but now it is clear that antigenic drift as well as shift also occur in pig populations. Experts believe that this is a result of intensive farming practices.

## **Unnatural factory farmed conditions can facilitate the spread of dangerous pathogens**

The risks to human health posed by factory farming have been highlighted for years and led the American Public Health Association, one of the largest and oldest associations of public health professionals in the world, to call for a moratorium on factory farming in 2003 (American Public Health Association, 2003).

There are a number of factors which create a higher risk of dangerous pathogens emerging from intensive or factory farming units. In the last fifty years, poultry and pig farms have changed from small-scale farms to industrial-scale operations in which thousands of animal of similar genotypes are raised for food production (Otte et al., 2007). At least half of the world's pig meat is now produced from intensive systems. Around 1.3 billion pigs are slaughtered annually for meat worldwide. The majority of these are in East Asia, particularly China, which rears half of the world's pigs. This is followed by the European Union, North America and Brazil. Between 1994 and 2001, the market share of pigs produced in industrial production units in the USA increased from 10% to 72% (Graham et al., 2008). A similar expansion occurred in Asia; for example, in China, pork production increased from 41 million tons to 51 million tons between 2001 and 2006 alone (ibid.). In these systems, pregnant sows are often confined in narrow crates, unable to move freely. Pigs reared for meat are often mutilated, without anaesthetic, and kept in overcrowded and dimly lit concrete sheds, often without bedding.

A large-scale industrial farm is a perfect breeding ground for the emergence and spread of influenza viruses. The sheer numbers of animals on industrial farms facilitates the rapid transmission and mixing of viruses (Wuerthe, 2003, Gilchrist et al., 2007). Herd size is positively correlated with prevalence of infectious agents (Fablet, 2009). This may be because of increased risk of introduction of infectious pathogens from outside the herd as a greater number of new pigs are introduced to the herd and greater risk of

transmission within the herd (Gardner et al., 2002). According to Webster (1998, quoted in Wuerthe, 2003), the U.S. pig population of 60 million is an “increasingly important reservoir of viruses with human pandemic potential”.

The Pew Commission, in its 2008 report, concluded that industrialized animal agriculture posed “unacceptable” public health risks. The report stated: “Due to the large numbers of animals housed in close quarters in typical [industrial farm animal production] facilities there are many opportunities for animals to be infected by several strains of pathogens, leading to increased chance for a strain to emerge that can infect and spread in humans”.

It is not just the sheer numbers of animals which can result in the emergence of virulent pathogens; the conditions in which animals are kept also play a key role. Pigs on most European farms are severely overcrowded, and have significantly less space than recommended by welfare scientists (AHAW, 2005). Conditions are similar, or worse, on many North American farms. The negative impact of high stocking density on respiratory health has been well documented (Lindquist, 1974; Backstrom and Bremer, 1978; Stark et al., 1998). Overcrowding results in more opportunities for direct nose-to-nose contact between pigs. It also results in greater spread of pathogens in aerosol form between pigs in the same unit (Fablet, 2009). “Influenza [in pigs] is closely correlated with pig density,” said a European Commission-funded researcher studying the situation in Europe (Mackenzie, 1998).

In 1998, The European Commission’s agricultural directorate warned that the “concentration of production is giving rise to an increasing risk of disease epidemics.” (Mackenzie, 1998). The US Council for Agriculture, Science and Technology has warned that a major consequence of modern industrial livestock production systems is that they potentially allow the rapid selection and amplification of pathogens (CAST, 2005).

Overcrowding also results in stress, especially in subordinate pigs, which weakens pigs’ immune systems and makes them more susceptible to disease

(Fablet, 2002). The presence of dust particles in large pig units originating from feed, hair, dried urine and faeces can damage the lungs leading to infection as well as constituting an immunological burden (Webster, 1984). Dust can also carry micro-organisms such as bacteria and viruses resulting in a higher risk of infection (Takai et al., 2002).

### **Biosecurity – not necessarily greater on intensive farms**

Data collected by the Thai government during the 2004 avian influenza outbreak shows that the probability of viral outbreaks was significantly higher in large-scale poultry farms than in backyard flocks (Graham et al., 2008). Although it is often assumed that modern farming practices on intensive farms ensure a high level of biosecurity, thus reducing the risk of disease transfer, scientists have shown that intensive farms can result in a higher risk of a virus spreading.

Firstly, the confinement of thousands of animals requires ventilation with high volume fans in order to control heat and humidity. This results in considerable movement of air, potentially carrying pathogens, into the outside environment (Graham et al., 2008). The large volumes of waste produced by intensive farms are difficult to dispose of and may pollute surface and ground waters (Gilchrist et al., 2007). Manure lagoons can be another potential source, resulting in the transmission of pathogens through the air and through flies which may visit the lagoons (ibid.). In addition, multi-drug resistant pathogens are more likely to arise from farms which rely on routine use of non-therapeutic pharmaceutical products (Gilchrist et al., 2007).

Over the past 60 years, the geographic distribution of pig and poultry production has become more clustered, resulting in highly concentrated populations of pigs and poultry often in relatively close proximity of each other (Otte et al., 2007). The geographic concentration of many pig farms results in a higher risk of transmission between farms (Fablet, 2009). Several studies have shown that risk of disease spread is higher in areas of high pig concentration because the microbial load can be high in these areas and

there is also a higher risk of viruses spreading from herd to herd (Maes et al., 2000; Stark, 2000, Rose and Madec, 2002).

The proximity of intensive pig farms and intensive poultry farms increases the risks of viral recombination and the emergence of new virulent flu strains. For example, interactions between poultry flocks and swine herds were documented during a study of the 1997-1998 swine fever outbreak in the Netherlands (Graham et al., 2008).

The Food and Agriculture Organisation of the United Nations 2007 report on Industrial Livestock Production and Global Health Risks shows that industrial livestock production plays an important part in the emergence of highly pathogenic influenza and other diseases. The paper notes that “Industrial pig and poultry production with its geographic intensity and being coincident for the two species, and with the regular movement of animals between production stages provides significant opportunities for interactions between large populations of confined poultry and/or pigs and thus has potential consequences for the development and transmission of some zoonotic disease agents” (Otte et al., 2007).

Dr. Robert Webster, one of the world’s leading experts on influenza virus evolution, blames the emergence of the North American 1998 virus on the “recently evolving intensive farming practice in the USA, of raising pigs and poultry in adjacent sheds” (Webster et al., 2004).

### **Long distance transport results in the spread of disease**

The rapid dissemination of the virus throughout America has been blamed by experts on long distance transport. Animals can be transported over long distances and also undergo substantial mixing with animals from different herds and geographical areas during transport, creating a higher risk of pathogen transmission. The open-truck transport of animals from farms to slaughterhouses creates a biosecurity risk (Graham et al. 2008). In addition, the stress which animals experience during transport can weaken their

immune systems and make them more susceptible to disease (Fablet, 2009). Following the 1998 influenza outbreak in North Carolina, the virus spread rapidly through America and is now one of the most common causes of respiratory disease on North American pig farms. The primary reason behind this is believed to be the long-distance transport and mixing of pigs (Wuerthe, 2003).

In addition, on large-scale intensive farms, different production stages are often undertaken at different sites. This can lead to significant movement of animals across the country and across international borders (Otte et al., 2007). In 2001, 27% of pigs were moved across state boundaries (Henessy, 2004, quoted in Otte et al., 2007).

### **Vaccination can exacerbate the problem**

The recent wide-scale vaccination for swine influenza may be another crucial factor in the evolutionary surge of the virus. Vaccination of breeding sows is now the norm and they in turn pass on their antibodies to their progeny (Wuerthe, 2003). Today, more than half of all sows are vaccinated against both H1N1 and H3N2 viruses. However, vaccination does not provide 100% protection as viruses can spread without being detected. Vaccines which are ineffective can also create strong selective pressure for new strains which are immune to the vaccine (Wuerthe, 2003).

Swine flu is not recognised as a notifiable disease by the World Organisation for Animal Health (OIE) and, according to the United States Centers for Disease Control and Prevention (CDC), "no formal national surveillance system exists to determine what viruses are prevalent in the US swine population." The same is true of many other countries.

## **Surveillance and pig flu**

Human influenza viruses can infect pigs and pig-to-pig transmission has been demonstrated (Brown, 2000). There is therefore a risk of animals, including pigs, being infected with the current human form of the virus. According to the OIE, “urgent scientific research must be started in order to know the susceptibility of animals to this new virus, and if relevant to implement biosecurity measures including possible vaccination to protect susceptible animals”. The OIE adds that “if this virus would be shown to cause disease in animals, virus circulation could worsen the regional and global situation for public health.” Should this happen, emergency measures including mass slaughter of animals may be deemed necessary, as was the case during the 2001 Foot and Mouth outbreak in the UK.

Previous large scale animal disease outbreaks have resulted in such mass slaughter of animals in order to control the disease. Compassion in World Farming is concerned that should disease control measures be necessary in this case, they may result in significant animal suffering. Compassion in World Farming is therefore in communication with world animal health authorities to ensure that any emergency slaughter of animals is not only swift and efficient, but also humane.

In conclusion, the risks posed to human health as a result of factory farming have been highlighted for many years by the scientific and public health communities. Compassion in World Farming calls for a thorough investigation of the source of the latest influenza outbreak. Furthermore, it is surely time for a thorough re-examination of intensive farming practices that are not only inhumane, but which may have the potential for such damaging impacts on human health.



## References

- AHAW (2005). Welfare aspects of weaners and rearing pigs: effects of different space allowances and floor types. Scientific Opinion of the Panel on Animal Health and Welfare. Question no. EFSA-Q-2004-077. European Food Safety Authority. The *EFSA Journal*, 268: 1-19.
- American Public Health Association. 2003. Precautionary moratorium on new concentrated animal feed operations. Policy number 20037. [www.apha.org/advocacy/policy/policysearch/default.htm?id=1243](http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1243).
- Backstrom, L and Bremer, H, 1978. The relationship between disease incidences of fatteners registered at slaughter and environmental factors in herds. *Nordic Veterinary Medicine* 30:526-533.
- Brown IH. 2000. The epidemiology and evolution of influenza viruses in pigs. *Veterinary Medicine* 74:29-46. <http://BirdFluBook.org/resources/Brown29.pdf>.
- CAST. Animal Agriculture and the Global Food Supply. *Task Force Report* 135, 1999; 92pp
- Fablet C. 2009. An overview of the impact of the environment on enzootic respiratory diseases in pigs. In: Aland A, Madec F (eds.). Sustainable animal production. Wageningen Academic Publishers.
- Gardner, LA, Wilberg, P and Mousing, J, 2002. Empirical and theoretical evidence for herd size as a risk factor for swine diseases. *Animal health research reviews/ Conference of research workers in animal diseases* 3: 43-55.
- Gilchrist et al., 2007. The Potential Role of Concentrated Animal Feeding Operations in Infectious Disease Epidemics and Antibiotic Resistance. *Environmental Health Perspectives* 115: 313-316.
- Graham et al., 2008. The Animal-Human interface and Infectious Disease in Industrial Food Animal Production: Rethinking biosecurity and Biocontainment. *Public Health Reports* 123: 282.
- Greger, 2009. CDC Confirms Ties to Virus First Discovered in U.S. Pig Factories. Available at: [http://www.hsus.org/farm/news/ournews/swine\\_flu\\_virus\\_origin\\_1998\\_042909.html](http://www.hsus.org/farm/news/ournews/swine_flu_virus_origin_1998_042909.html)
- Kothalawa et al., 2006. An overview of swine influenza. *Veterinary Quarterly* 28:45-53.
- Lindquist, JO, 1974. Animal health and environment in the production of fattening pigs. *Acta Veterinaria Scandinavica* 51: 1-78.

MacKenzie D. 1998. This little piggy fell ill. *New Scientist*, September 12, p. 1818.

Mackenzie, D, 2009. Pork industry is blurring the science of swine flu. *New Scientist*, 30 April 2009.

<http://www.newscientist.com/blogs/shortsharpscience/2009/04/why-the-pork-industry-hates-th.html>

Maes et al., 2000. Herd factors associated with the seroprevalences of four major respiratory pathogens in slaughter pigs from farrow-to-finish pig herds. *Veterinary Research* 31: 313-327

Maldonado, J et al., 2006. Evidence of the concurrent circulation of H1N2, H1N1 and H3N2 influenza A viruses in densely populated pig areas in Spain *The Veterinary Journal* 172 (2006) 377–381.

Pew Commission on Industrial Farm Animal Production. 2008. Putting meat on the table: industrial farm animal production in America. Executive summary, p. 13. [www.ncifap.org/ images/PCIFAPSmry.pdf](http://www.ncifap.org/images/PCIFAPSmry.pdf). Accessed August 26, 2008.

Rose, N and Madec, F, 2002. Occurrence of respiratory disease outbreaks in fattening pigs: relation with the features of a densely and a sparsely populated pig area in France. *Veterinary Research* 33: 179-190.

Stark et al., 1998. Risk factors for respiratory disease in New Zealand pig herds. *New Zealand Veterinary Journal* 46:3-10.

Takai H et al., 2002. Ammonia contents and desorption from dusts collected in livestock buildings. *Agricultural Engineering International: CIGR, Commission Internationale du Genie Rural E-journal* 4: available at: <http://hdl.handle.net/1813/10266>.

Webby et al., 2004. Multiple lineages of antigenically and genetically diverse influenza A virus co-circulate in the United States swine population. *Virus Research* 103: 67–73

Webster RG and Hulse DJ. 2004. Microbial adaptation and change: avian influenza. *Revue Scientifique et Technique* 23(2):453-65.

Wuethrich B. 2003. Chasing the fickle swine flu. *Science* 299:1502-5. <http://birdflubook.org/resources/WUETHRICH1502.pdf>.