

Avian Flu

by

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Condensed version

What is the nature of the highly pathogenic (infectious) avian influenza A virus H5N1 that has travelled from China across Asia to India, Africa and Europe, and if it is not already here, to Britain's borders?

Previously when such a virus (HPAI) outbreak occurred in domestic poultry it vanished once the infection was eliminated from domestic flocks. It appears not to have been sustained in wild bird populations- such was the case with the H7N7 outbreak in Dutch poultry in 2003. The lineage of the current avian HPAI H5N1 virus has been continuously present in China in domestic poultry for a decade. Several different genetic variants have emerged over this time in China, the epicentre of this epidemic, and have spread locally. It was first recorded in Hong Kong in 1997, and then SE Asia. The genetic variant of HPAI H5N1 now in Europe, was first identified in spring 2005 at Lake Qinghai in Northern China when some 2000 bar-headed geese and other birds died of it. In fact this virus is thought to have originated some 1000 miles south. The persistence and spread of this HPAI H5N1 strain is an extraordinary phenomenon without precedent.

The spread in China and SE Asia, and now into the Middle East, India and Africa has been very largely due to human intervention, moving infected poultry and its products. But it has also been aided by the UN's FAO approved practice of integrated farming, when poultry manure is used to feed farmed fish. This practice allows the spread of the virus to water birds, and ducks are particularly significant. Virus present in the water can be swallowed and establish an enteric infection in the ducks' gut. Unlike other bird species, ducks may shed avian influenza viruses for months, remaining well while persistently infected without producing antibody. Other aquatic birds are also considered to be the reservoir host for avian influenza viruses e.g. terns. It is clear that the variant of HPAI H5N1 from Qinghai has been spread across Western Europe by wild birds, giving rise to a trail of dead swans as well as other bird species in wetland areas.

Whilst some ducks have been found dead, other wild birds, passerines, geese, quail, pheasants, raptors etc are more likely to fall ill and die as a result of infection, as are domestic chickens, turkeys etc. The HPAI H5N1 virus gives rise to an acute infection via the respiratory tract in these birds with an incubation period before illness of a few days after exposure. The bird usually dies after a short illness. If there is recovery it is accompanied by a good antibody response, the antibody is protective.

The HPAI virus has at least two genetic changes, as compared with the low pathogenicity viruses that are the usual form of avian influenza found in wild birds. The changes allow the virus to replicate to very high levels in infected cells and in all tissues.

The HPAI form of avian influenza viruses is highly virulent and infectious and can be spread directly or indirectly by many contact means. By the time one domestic bird in a flock is sick or dead many others will already be infected and incubating the disease. They will also be shedding virus even before they are ill. The mortality rate can be as high as 100%. Thus the infected flock will be decimated or wiped out even if it is not culled.

Other animals can become infected such as felines and pigs. A 'laboratory' level of bio-security for domestic poultry will be hard to maintain for years in the face of the persistence of this virus in the wild bird population, or its repeated reintroduction into wild birds. Amplification of the risk of infection occurs with every outbreak of HPAI in domestic poultry when enormous quantities of the virus are generated. Safe disposal of infected manure is important. The source of the outbreak in a commercial turkey flock in France is thought may have been introduced by infected wild bird droppings on straw or a shoe. In Nigeria, Egypt and India infection occurred initially in commercial intensive poultry production units, but was very likely introduced by the international trade in eggs, birds or products incorporating or contaminated with poultry manure.

The influenza pandemic in humans that followed the First World War, the 1918 and 1919 pandemic, was caused by a virus that had all 8 gene segments derived from an avian H1N1 influenza A virus. A number of point mutations in several of the avian genes had to have taken place to humanise the avian virus sufficiently to pass from human to human. That virus also infected pigs and became host adapted; and it still circulates amongst them, albeit now distantly related to its ancestor. The H1N1 pig adapted virus is present worldwide in pigs.

There is concern that either of these two courses, reassortment or a number of point mutations, might change the avian HPAI H5N1 virus, enabling it to pass efficiently between humans. This has not happened yet. However the emergence of a new human pandemic virus has never been observed under close scrutiny before, but has simply appeared as a 'fait accompli'. Humans have been infected by the current avian HPAI H5N1 strains by close contact with an infected bird. The mortality may not be quite as high as 50% if cases are presented early for treatment and intensive care. Living with the sick birds or handling them, particularly preparing them for eating such as plucking gutting and so on, has given rise to human infections. There have been clusters but most are thought to be from a point source, an infected bird, and there have been very few instances of spread between humans. Both anti-virals and vaccines are being stockpiled and developed in case of the emergence of a human pandemic strain of H5N1.

It is considered inappropriate to treat birds with anti-virals, so as not to induce resistance, but to reserve these for the treatment of human cases. What about vaccines to protect domestic flocks from infection, whether housed or free range, or totally free range pheasants should bio-security fail?

Both Haemagglutinin (H) and Neuraminidase (N) are important in raising immunity but of the two Haemagglutinin is the most important in providing protection against infection of the respiratory tract. The Dutch vaccine is an H5N2 virus and has been inactivated. Thus the vaccine is not infectious and harmless to eat. Two shots two weeks apart are needed to produce a good level of immunity. This is typical of an inactivated vaccine when sufficient quantity of protein must be introduced to the immune system to prime and then boost the antibody response to a protective level. Whatever vaccine is used the H5 in the vaccine must be sufficiently closely related to the H5 in the virus strain now present in Europe to provide a protective immunity. A distantly related H5 will not induce a solid protective immunity.

A number of other vaccines will be in development now in response to the world pandemic of avian HPAI H5N1. The protection given by vaccination may not be complete in all vaccinated animals exposed to a high infective dose. No vaccine is perfect and the influenza vaccines are not very good. There is some evidence of infection a non-vaccinated animals by vaccinated animals e.g vaccinating horses against influenza which is normally very successful. Also some vaccine strains have had to be updated because of drift, the accumulation of point mutations over years resulting in the current strain being too distant from the vaccine strain, so that protective immunity is not evoked by vaccination, as occurs more rapidly in human influenza when the vaccine is updated annually to ensure its efficacy.

Of note is the fact that vaccination of all domestic poultry against the H5N1 strains infecting poultry in Vietnam appears to have been successful in eradication of outbreaks in poultry and put a stop to human cases of infection. Diseased flocks were culled. It is said that 150 million doses of vaccine were given. If a vaccinated bird is infected it is asymptomatic so must therefore have a limited infection, perhaps confined to the respiratory tract, and shed a lesser amount of virus. In the context of a fully vaccinated flock the HPAI infection must peter out. This would mean the overall viral load and contamination of the environment is less, it is safer for humans, and does not allow infection to amplify in local wild birds and reach other vaccinated poultry flocks. An epidemic infection is eliminated when one infected individual cannot infect as much as even one other on average.

Vaccination of domestic poultry may be the only way of eliminating the HPAI H5N1 virus from wild bird populations in the long-term. The annual reproductive rate of wild birds ensures there are large annual populations of young birds susceptible to infection. The use of poultry manure to feed fish in lakes must be prohibited. International movement of poultry and its products such as manure must be controlled and prohibited as much as possible.

Pheasants and free-range poultry would seem to be especially vulnerable to infection from wild birds. In the case of pheasants these are shot in the autumn and winter, for the most part less than one year old, and then plucked and prepared by individuals taking part in the shoot as well as local

Outbreaks of infection in commercial domestic flocks will result in loss of consumer confidence. Whilst DEFRA have not chosen vaccination as part of their strategy to combat this pandemic of HPAI H5N1, at least they have moved forward on diagnosis, in contrast to the 2001 FMD outbreak. A bird or flock will not be declared infected unless a positive viral diagnosis has been made. The means of diagnosis is by PCR and the products are probed or sequenced in order to define the type and strain of influenza virus. Progress indeed. Why not vaccinate free- range poultry and pheasants as well as hold vaccine in reserve to ring vaccinate an outbreak in a domestic flock? Vaccination may be found necessary in bio-secure flocks to prevent breakdowns of infection in intensive poultry systems. If we do not order or make any vaccine for birds then we can never use it. Are we heading for another disaster on the scale of 2001?