

Revised Second Draft

Briefing Note to the Water Industry on Avian Influenza (“Bird Flu”)

Background

This briefing note summarises the available information on the causal agent of this disease, focusing on any aspects likely to be of concern to water company operations.

A second version has been released to take account of the following information:

- **reports on the detection of avian influenza virus subtype H5N1 in the UK, and**
- **the latest available evidence on the risks to human health through water and sewage.**

There have been reports from a number of European countries about outbreaks of “bird flu”, and a number of measures are being taken by the health authorities in these countries to limit the spread of the disease.

Recently, avian influenza has been found in a dead swan in Fife (Scotland). DEFRA have imposed a 3km protection zone around the surrounding area with a 10km outer surveillance zone to protect poultry flocks near where the swan was found. Prior to this there had been only been one case of H5N1 reported recently in the UK in a parrot in quarantine. The previous outbreak of avian influenza in Great Britain was in 1991 where a flock of 8,000 turkeys in a single house in Norfolk was affected.

The Causal Agent

Birds can be infected with all 15 haemagglutinin and all 9 neuraminidase influenza A subtypes (1). The influenza A viruses infecting poultry can be divided into the highly pathogenic avian influenza (HPAI) which includes the subtypes H5 and H7 that cause severe disease. All the other viruses are classified as low pathogenicity avian influenza (LPAI) and cause a much milder, primarily respiratory disease. The current avian influenza is caused by a viral antigenic strain called H5N1, which is highly contagious to birds.

http://www.who.int/mediacentre/factsheets/avian_influenza/en/
http://www.hpa.org.uk/infections/topics_az/influenza/avian/situation_update.htm

Since December 2003 there have been substantial outbreaks of avian influenza associated with high mortality affecting poultry in various countries in central, east and south east Asia, Romania, Turkey and the Ukraine. These outbreaks

are caused by H5N1 subtype of the influenza A virus, the same subtype (but not identical to the virus) that caused an outbreak of HPAI in Hong Kong in 1997. The emergence of this strain in wild birds and poultry flocks in the Far East, followed by its spread to Turkey and on into Europe and Africa together with human infections that are that linked to close contact with infected chickens has raised concerns over recent months. These concerns relate to:

1. The transmission of the highly pathogenic H5N1 to wild birds in the UK that could cause significant morbidity and mortality to bird populations. So far, the occurrence of the H5N1 virus appears to be confined to a dead mute swan found on the 29th March 2006 on the coast at Cellardyke, Fife, Scotland. Mute swans are usually sedentary in the UK and only in severe winters do these birds migrate between mainland Europe and the UK. Provisional examination of the virus suggests that this isolate is very similar to those detected in wild birds in Europe and Germany in particular. Currently, the evidence from the intensive surveillance programme set up by DEFRA indicates no widespread infection of waterfowl in the UK although the possibility of undetected foci of infection cannot be ruled out.

http://www.defra.gov.uk/animalh/diseases/monitoring/pdf/hpai_scotland.pdf

2. The occurrence of H5N1 in poultry flocks. Although avian influenza A (H5N1) is a viral infection that usually affects wild birds it can infect and cause serious disease among poultry, such as chickens and ducks. This would be through the mixing of commercial and wild birds and is thought to be more likely in free-range birds. There is a website where the latest updates on the countries where the virus has been isolated are posted. http://www.oie.int/download/AVIAN%20INFLUENZA/A_AI-Asia.htm
3. The potential for contamination of other livestock, especially pigs, as well domestic animals with cats being particularly at risk from infection.
4. Human infections with this organism. While it is unusual for humans to get avian influenza virus infections directly from poultry or wild birds, a number of human infections caused by certain avian influenza A viruses have been documented since 1997. There was an outbreak in Viet Nam in January 2004, and in Hong Kong in 1997 the H5N1 strain infected 18 humans of whom 6 died. In February 2003 there were 3 further cases in Hong Kong caused by this strain. Also in February 2003 there was an outbreak in the Netherlands caused by the H7N7 strain in which one veterinarian died and 83 other humans had mild illness (conjunctivitis). In December 2003 there was an epidemic (in birds) of H5N1 in Korea. The H5N1 strain appears to cause a high mortality rate amongst those infected.

5. The current H5N1 strain appears to have little ability to either infect or transmit from human to human. There is concern that this strain might become more transmissible between people, making control more difficult. The investigation of people infected with H5N1 has indicated that close contact with infected animals was the primary cause although there has been some evidence of family transmission. There has been no evidence of any environmental routes of transmission (food or water) being involved.
6. The fear that the common occurrence of this virus in bird populations in many countries and increasing numbers of human and animal infections, makes the possibility of the emergence of a new pandemic influenza strain much more likely. All strains of influenza virus are subject to genetic change through mutation that causes "genetic drift", but can also occasionally recombine with a different influenza virus to produce a completely new strain in a process called "genetic shift". Genetic drift causes gradual change in the antigenicity of the virus, allowing it to survive in a population that has been exposed to the original strain. Genetic shift causes a new virus to be created that has a novel combination of antigens. The strains caused by genetic shift can cause worldwide pandemics in humans because people have no immunity to them.
7. Experts at WHO and elsewhere believe that the world is now closer to another influenza pandemic than at any time since 1968, when the last of the previous century's three pandemics occurred. WHO uses a series of six phases of pandemic alert as a system for informing the world of the seriousness of the threat and of the need to launch progressively more intense preparedness activities. The designation of phases, including decisions on when to move from one phase to another, is made by the Director-General of WHO. Each phase of alert coincides with a series of recommended activities to be undertaken by WHO, the international community, governments, and industry. Changes from one phase to another are triggered by several factors, which include the epidemiological behaviour of the disease and the characteristics of circulating viruses. The world is presently in phase 3: a new influenza virus subtype is causing disease in humans, but is not yet spreading efficiently and sustainably among humans.

http://www.who.int/csr/disease/avian_influenza/phase/en/index.html
http://www.who.int/csr/resources/publications/influenza/GIP_2005_5Eweb.pdf

Characteristics of the H5N1 Virus

The virus is excreted in high numbers in the faeces and the nasal and eye discharges of infected birds. Direct contact with these materials is the primary

vehicle by which the disease spreads. However, indirect contact through drinking water in poultry houses contaminated with the virus by infected birds (faeces, nasal and eye discharges) is also thought to occur. Farmers may spread the disease from one farm to another via contaminated equipment or the faecal material of infected birds on clothing. Transmission through eggs has never been indicated although the egg shell can be contaminated.

There have been only limited studies on the survival in the environment of avian influenza viruses in general and H5N1 in particular. This work has primarily focused on survival in faeces and other material associated with the poultry environment. The virus can survive for at least 35 days at 4 °C in manure, several days in carcasses at ambient temperature and up to 23 days if refrigerated. In water the virus has been found to survive for 4 days at 22 °C and 30 days at 0 °C. However, no information is available about the experimental conditions used for these studies and as a consequence the data should be regarded as approximate.

The virus is inactivated at temperatures above 56 °C, in acidic conditions and it is susceptible to oxidising agents, disinfectants and even detergents. Again it seems likely that much of this work was done with materials with a high organic content which would lessen the effect of the agents.

H5N1 and the Water Industry

Open bodies of water where migratory waterfowl gather may become contaminated with the virus if infected birds are present. At present there is only a single reported occurrence of H5N1 in a wild bird in the UK. However, where the water is abstracted for producing drinking water the traditional methods of water treatment, coagulation and filtration followed by disinfection, will reduce any virus present in the water to insignificant numbers (http://www.who.int/water_sanitation_health/emerging/avianflu/en/index.html).

Although viruses have been demonstrated to be more tolerant to disinfectants than vegetative bacteria, the avian influenza virus has an outer protein envelope that is susceptible to damage by oxidants such as chlorine. This will allow the infectivity of the virus to be destroyed. As a consequence, it is likely to be more susceptible to disinfectants than viruses that do not have an envelope such as adenoviruses and enteroviruses. Doses of 0.5 to 0.9 mg/l of free chlorine give 99% reduction in these viruses. As a consequence, it is extremely unlikely that public drinking water supplies could provide a means of transmission of avian influenza.

This is further supported by a quantitative risk assessment of avian influenza infection through water that was recently conducted in the Netherlands (<http://www.rivm.nl/bibliotheek/rapporten/703719012.html>). Using data from the literature and taking into account the large amount of uncertainty in the data, the

authors concluded that well treated drinking water would lead to a negligible risk of infection to either individual chickens or humans although poultry farms were seen to be at greater risk. However, maintaining an effective disinfectant residual in the water supply is an adequate control measure and the Queensland Government recommends that drinking water in poultry houses contains a free chlorine residual of 1-2 mg L⁻¹.

Water company staff visiting natural waters, such as lakes and reservoirs, used as sources of drinking water or workers at wastewater treatment works may come into contact with migratory waterfowl. At this stage there is only one reported occurrence of the H5N1 virus present in a dead bird in UK but staff should be vigilant and treat any dead waterfowl with suspicion. Should the situation deteriorate then precautionary measures may be needed to protect staff visiting these sites and restricting access to members of the public where recreational activities are permitted.

An unusually high number of deaths generally involves several birds of one species, or a larger number of birds from several species. Advice currently being provided by DEFRA states that the occurrence of one or more dead swans/wild fowl (ducks and geese), more than 3 dead birds of the same species or more than 5 dead birds of different species, in the same place should be treated as suspicious and reported to DEFRA.

<http://www.defra.gov.uk/animalh/diseases/notifiable/disease/ai/wildbirds/index.htm>

It would be prudent for water companies to update their risk assessments and provide guidance for activities that may bring employees into contact with dead birds. Regardless of the threat from avian influenza, it should be recognised that wild birds can carry several diseases that are infectious to people including other respiratory infections as well as gastrointestinal infections such as *Salmonella* and *Campylobacter*.

The possibility of post treatment contamination needs to be considered. In this context the supply to intensive poultry farming units would pose the most significant risk and water companies should ensure that these supplies are adequately protected against contamination from back flow events occurring in the supply to poultry houses.

Where there is an outbreak of avian influenza, the virus could potentially enter into sewage from the faeces of infected humans and animal wastes. Under most circumstances the numbers of viruses are likely to be low although discharges from abattoirs and poultry processing plants may contain significant numbers of the H5N1 virus if infected birds are allowed to enter the processing system. However, the surveillance and control measures being put in place by DEFRA should prevent this from happening.

Sewage treatment processes will reduce virus numbers by about 90 per cent. Sewage sludge will contain higher numbers than secondary effluents, but mesophilic anaerobic digestion will reduce numbers by between 90 and 99% and lime treatment will give a reduction of about 5 orders of magnitude. If the virus spreads to the human population the numbers of H5N1 virus in sewage will increase, as the virus appears to be excreted in the faeces of infected individuals.

Sewage biosolids will present a much lower risk than manures and litter from poultry houses. However, it should be noted that composting for more than 100 days should eliminate the virus and so the current guidelines for farm manure handling in the UK of storage for 90 days should provide a high degree of destruction. Disposal to land with direct and immediate incorporation will provide a further barrier to the spread of infection particularly if the conditions provided for by the Safe Sludge Matrix are followed.

If UK farms become infected with the H5N1 strain they will be subject to quarantine procedures similar to those in force during a Foot and Mouth outbreak. The litter from broiler houses and faecal material from intensive egg production units will be disposed of by special means to prevent the spread of the virus by these materials. Land spreading of the material will not be carried out and so surface waters should not become contaminated.

Contingency plans for the mass disposal of carcasses of infected birds are not known. Water Companies may therefore wish to discuss with DEFRA and the Environment Agency if mass burial or pyres would be used and identify where these could best be placed so as not to jeopardise source water quality in both the short and long term.

Food

Avian influenza is not transmitted through cooked food and to date; no evidence indicates that anyone has become infected following the consumption of properly cooked poultry or poultry products. The European Union has banned the importation of poultry and poultry products from affected areas, therefore in the United Kingdom it is safe to eat poultry or food containing poultry products as usual, although it is always recommended that the item should be cooked properly and basic hygiene precautions followed.

Conclusion

Influenza H5N1 is not particularly infectious to humans and not easily transmissible from person to person. Human infection occurs through airborne transmission or direct contact with mucous membranes of the eye or nasal

passages although there is some evidence to indicate that infection may also occur through ingestion. However, on the basis of newly available information transmission through water company sewage treatment or drinking water supply operations remains unlikely.

Reference List

- (1) Alexander DJ. A review of avian influenza in different bird species. *Vet Microbiol* 2000; 74(1-2):3-13.