

# Risk assessment of acquiring Avian Influenza from Poultry Products: Hazard characterisation

## 3.1 Avian Influenza infections in humans

Although AI does not infect people easily and is not usually spread from person to person, there have been cases of infections in humans, with high mortality in some instances. The first laboratory-confirmed case in a human occurred in 1997, when H5N1 was detected in a patient in China (Wang et al., 2021). A majority of AI cases in humans come from the Western Pacific Region, including China, likely due to the widespread practice of keeping poultry in the backyard and the live poultry markets common in the region (Skufca et al., 2022). However, since 2003, AI has travelled out of the region and caused human infections all over the world (Wang et al., 2021).

AI H7N9 has caused the largest number of human infections worldwide, with 1,568 cases reported and 616 deaths, giving a 39% case-fatality rate; no human AI infections with an H7N9 strain have been reported since 2019 (EFSA, 2023; WHO, 2023). Following that, AI H5N1 has caused 868 cases worldwide in humans with 457 deaths, giving a 53% case fatality rate (WHO, 2022). AI H5N6 has also been associated with a high case fatality rate of 40% (83 cases and 33 deaths), although this strain has not been reported in humans outside of the Western Pacific Region (EFSA, 2023; WHO, 2023).

Other AI subtypes have been associated with human infections but either are not associated with a high case fatality rate or have caused a very small number of human infections worldwide. For example, AI H9N2 has been responsible for 115 human cases of AI but with only two reported fatalities. Between February and May 2003, an outbreak of H7N7 subtype in the Netherlands caused 89 human infections (Fouchier et al., 2004). H5N2 AI strain has caused 20 human cases in Japan in 2005 (De Nardi et al., 2014). H5N8 led to 7 human cases in Russia in 2021 (EFSA, 2023). A very small number of human cases (1-3 each) have been associated with the following AI strains: H3N8, H6N1, H7N2, H7N3, H7N4, H10N3, H10N7, and H10N8 (EFSA, 2023; Skufca et al., 2022; WHO, 2023).

In the current H5N1 outbreak, six infections in humans have been reported (WHO, 2022). Four of these have occurred in Europe and the USA; one of these was in the UK and is discussed below (UKHSA, 2022). These were all either asymptomatic or reported only fatigue (EFSA, 2023). One fatal human infection of H5N1 has been reported from China in October 2022 (EFSA, 2023).

In late February 2023, the death of a young girl in Cambodia from avian influenza was confirmed. Testing of close contacts of the girl revealed her father was also infected, who reported experiencing a fever and cough. Sequencing determined the girl was infected with H5N1 2.3.2.1c, which is not related to the strain causing the current outbreaks in poultry around the world. This strain has been circulating in poultry and last caused infections in humans in Cambodia in 2014. It is believed contact with infected poultry led to these infections and there is no evidence that human to human transmission was responsible for the two family members becoming infected (CDC, 2023; Mallapaty, 2023).

### **3.1.1 UK avian influenza cases in humans**

Infections with LPAI strains have been reported several times in the UK. The first case of AI reported in the UK was an LPAI H7N7 case in 1996 that resulted in conjunctivitis (CDC, 2022d; Wang et al., 2021). Sporadic cases of H7N2 and H7N3 were recorded in the UK between 2002 and 2007, which resulted in conjunctivitis and mild upper respiratory tract symptoms (CDC, 2022d; Wang et al., 2021).

The first human case of HPAI H5N1 avian influenza in the UK was confirmed in December 2021 (Oliver et al., 2022). The case was asymptomatic and only detected as the UKHSA had increased its surveillance of potentially exposed human contacts given the dramatic increase in H5N1 infections in birds in the UK. The individual was tested after a confirmed outbreak in their domestic flock of Muscovy ducks. The epidemiological investigation suggested that close contact with the flock and their contaminated environment was the likely source of infection (Oliver et al., 2022).

The UKHSA are working together with the APHA and Defra, to investigate the risk to human health of AI H5N1 in England. Between 1 October 2022 and 15 December 2022, UKHSA health protection systems have recorded 2,085 human exposure episodes of a person being directly exposed to an infected bird, with no detection of AI viruses in humans in 2022 (UKHSA, 2022). There have been no severe human cases associated with H5N1 virus detected in the UK. There is insufficient information to judge the risk of asymptomatic or mild disease due to the limited testing in human contacts with infected birds (UKHSA, 2022).

### **3.1.2 Symptoms of avian influenza infection in humans**

In humans, AI symptoms vary, depending on the virus strain. Symptoms range from a mild flu-like illness, sometimes with conjunctivitis (red, sore, discharging eyes), diarrhoea and abdominal pain, to a severe respiratory illness with breathing difficulties and pneumonia. Human infections may be fatal (NHS, 2018).

The clinical symptoms associated with LPAI infections in humans included: conjunctivitis, mild upper respiratory tract symptoms, lower respiratory tract symptoms or disease, encephalitis, pneumonia, severe pneumonia with respiratory failure, and multi-organ failure. A few deaths have also been associated with LPAI strains (CDC, 2022c).

For HPAI, confirmed human cases of H5 subtypes were associated with mild upper respiratory tract symptoms, lower respiratory tract disease, severe pneumonia with respiratory failure, encephalitis, and multi-organ failure. For human cases from HPAI H7 subtypes, symptoms include: conjunctivitis, mild upper respiratory tract symptoms, lower respiratory tract disease, severe pneumonia with respiratory failure, and multi-organ failure (CDC, 2022c). As noted in Section 3.1, there has been significant case fatalities associated with H5 and H7 AI viruses.

### **3.1.3 Incubation period in humans**

The incubation period in humans is generally 3-5 days but can be longer (NHS, 2018). The UK Health and Safety Executive recommends that anyone who has been in contact with infected birds or their faeces and who develops a flu-like illness should seek medical attention (HSE, 2018).

### **3.1.4 Infectious dose in humans**

Although it is unknown what the infectious dose of AI is for humans, several studies have investigated oral and intranasal inoculation of AI in animals (O'Brien et al., 2021). A study by

Bertran and Swayne in 2014 in which ferrets were exposed to different HPAI viruses (H5 and H7 subtypes) through consumption of infected chicken meat, showed that the dose of virus needed to infect ferrets through consumption was much higher (108.9-109.2 EID50 (50% Egg Infectious Dose) compared to 107 EID50) than via respiratory exposure and varied with the virus strain (Bertran and Swayne, 2014).

A 2012 study by Reperant et al showed that intragastric inoculation of domestic cats at a level of 107.8TCID50 (50% Tissue Culture Infective Dose) resulted in fatal systemic infection (Reperant et al., 2012). In 2011, Shinya et al showed that the inoculation of hamsters with H5N1 directly into the digestive tract at a level of 107.1-107.3 TCID50 allowed the virus to enter the bloodstream through the digestive lymphatic system (Shinya et al., 2011).

Since there is a lack of data on AI prevalence and concentration in poultry products and the dose-response relationship in humans, assumptions are made during modelling when performing quantitative risk assessments (Bosch et al., 2018). To support the 2010 FDA/FSIS risk assessment, a dose response relationship was modelled using dose data (Bauer et al., 2010). Their results suggesting that the human EID50 for intranasal exposure could range from approximately 107.8 - 109.5 EID50 (Bauer et al., 2010).

### 3.2 Avian Influenza incidents in poultry recorded by FSA

To support a One Health approach, detections of AI in livestock are reported to the FSA whether or not they pose a direct food safety risk. Table 2 provides detail on the number of AI incidents recorded by the FSA per year since 2014 through to December 2022. Despite the increase in incidents reported to the FSA by UK animal health agencies, only five incidents related to poultry and their products have been referred to the FSA Microbiological Risk Assessment team for comment or review (2 in late 2019, and three in November 2021).

**Table 2: Avian influenza reported to the FSA**

Year	AI-related livestock incidents recorded by FSA
2014	2
2016	2
2018	1
2019	2
2020	12
2021	54
2022 (to 5 December)	172