

## Mini Review

### Bird Zoonotic Diseases

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#### Summary

The increasing progress of the poultry industry, on the one hand, and increasing the popularity and maintenance of pet birds in the home, on the other hand, has increased the need for research on diseases that can be transmitted from birds. People who deal with birds should be aware that some bird diseases can be transmitted to humans and, if necessary, know how to deal with them. Children, the elderly, and people with immunodeficiency are more likely to develop zoonotic diseases. Zoonoses can be parasitic, fungal, bacterial, or viral. The susceptibility to zoonotic disease depends on factors, such as age, health status, immune status, and primary treatment. The ability of a microorganism to cause disease depends on the severity of the agent and the way the pathogen enters the host's body. Therefore, this review will provide brief information on different diseases that can be passed from birds, including pet birds, industrial and backyard chickens to humans, which present on the basis of their etiology, independently.

**Keywords:** Public health, Poultry, Pet birds, Immunodeficiency, Microorganism.

#### Introduction

People contact with live poultry, both in industrial operations or in small household farms, is a distinct risk factor for disposal to avian commensals that can infect humans,

comprising bacteria like *Salmonella* spp., *Campylobacter* spp., and *Listeria monocytogenes*, as well as viruses such as avian influenza. Growing evidence of human infections with the strain of H5N1 avian influenza indicate that close interaction with

domesticated live poultry can be a risk factor for human infection with the virus (Babakir-Mina et al., 2007; van Boven et al., 2007). It is believed that people with specific medical conditions like immunodeficiency, a chronic illness, and pregnancy may be at higher risk of developing disease or complications from zoonotic disease. Briefly, the most important zoonotic diseases associated with birds that represent here include (Table) Newcastle disease (Swayne et al., 2019), Avian Influenza (Boroomand et al., 2019), Colibacillosis (Tivendale et al., 2010), Salmonellosis (Boroomand et al., 2018), Chlamydiosis (Smith et al., 2011), Avian tuberculosis (Rindi and Garzelli, 2014), Listeriosis (Firouzi et al., 2007), Spirochetosis (Bait-Merabet et al., 2008), Staphylococcal infections (Andersen, 2013), Streptococcus (Ivanics et al., 1984), Necrotic enteritis (Immerseel et al., 2004), Botulism (Skarin et al., 2013), Aspergillosis (Seyedmousavi et al., 2015), Cryptococcosis (Hanley et al., 2006). There are mainly two ways for human infection: 1) direct contact with live birds or their carcasses, 2) consumption of poultry products like meat or egg. Although zoonotic infections related to the birds in humans are commonly rare; there are considerable zoonotic risks from various poultry and poultry products that veterinarians and other related works should be aware of and keep in mind in their daily practice.

**Table- The most important bird zoonotic diseases associated with birds**

**Viral diseases**

*Newcastle disease*

*Avian Influenza*

**Bacterial diseases**

*Colibacillosis*

*Salmonellosis*

*Chlamydiosis*

*Avian tuberculosis*

*Listeriosis*

*Spirochetosis*

*Staphylococcal infections*

*Streptococcus*

*Clostridial infection*

*Botulism*

**Fungal diseases**

*Aspergillosis*

*Cryptococcosis*

**Parasitic diseases**

*Cryptosporidiosis*

*Sarcocystosis*

*Toxoplasmosis*

**Viral diseases**

*Newcastle disease* is one of the most serious viral diseases for the poultry industry in many countries worldwide. The virus is in the paramixoviridea family that presents with respiratory, neurological, and gastrointestinal

symptoms in birds. Isolation from humans is rare, although it occurs in individuals who have worked closely with different species of birds, or in the laboratory, or have been infected with live Newcastle disease vaccines (Boroomand et al., 2016 & 2018, Swayne et al., 2019). Following direct contact of infectious fluids with the eye, or the transmission of the virus through the aerosol, self-limiting conjunctivitis, without corneal involvement, is the most common clinical manifestation of the disease in individuals. Few reports of human-like flu-like clinical findings are available in Newcastle disease (Swayne et al., 2019). Accidental contact with infected or vaccinated birds is not risky for humans, but immunodeficiency may increase the risk of severe infection (Goebel et al., 2007). There are no reports of the virus spreading among people.

*Avian Influenza virus* is classified in the family of orthomyxoviridae and genus A of the influenza virus. Infection in domestic poultry causes a wide range of clinical symptoms, including respiratory disease and decreased egg production, and even severe systemic disease with nearly 100 percent mortality. Explaining the importance of this virus in public health, according to the published theory, the influenza virus is one of the factors that may cause the destruction of

life on Earth or part of it (Boroomand et al., 2017, 2018, 2019; Mayahi et al., 2018). The experience in Southeast Asia shows that the virus is not easily transmitted to humans, and infection has not been proven by eating cooked chicken meat or eggs. Human cases of the disease are more common in rural areas. Causes of human infection in the following cases:

- Direct contact with infected birds
- Direct contact with the infected bird carcasses

Factors related to poultry concentration, as well as the poultry production system, which appears to be diverse in different countries, may affect the possibility of the disease in humans. The avian influenza virus has a greater tendency to bind to the  $\alpha 2, 3$ -linked sialic acids (SA $\alpha 2, 3$ ) receptor at the surface of bird epithelial cells. While the receptor on the surface of human epithelial cells is  $\alpha 2, 6$ -linked sialic acids (SA $\alpha 2, 6$ ), which is widely present on the surface of epithelial cells, in the meantime, pigs have both receptors and can act as a mixing vessel (Swayne et al., 2013; Shinya et al., 2006).

Symptoms of avian influenza in humans confine from common flu-like symptoms (such as fever, cough, sore throat, and muscle

aches) to acute respiratory signs, diarrhea, and other severe and life-threatening problems.

### **Bacterial diseases**

**Colibacillosis** is a disease of birds. There are several serotypes of *Escherichia coli* in domestic animals and birds. *E. coli* is a gram-negative bacillus of the Enterobacteriaceae family and an opportunistic organism, in which only a few serotypes are pathogenic in humans, birds, and domestic animals. *E. coli* is a natural flora of the digestive tract of birds. Contamination of poultry products with different serotypes of *E. coli* is important for public health in different ways. These products can act as a source of Shiga toxin-producing enterohaemorrhagic *E. coli*, such as O157H7. These serotypes are dangerous for humans, *E. coli* can reason excessive, watery diarrhea, colic, and vomiting. The main transmission method is fecal/oral. Prevention is done by wearing protective clothing when handling birds or products (Boroomand et al., 2018a, 2018b; Tivendale et al., 2010). There is a possibility that the poultry contaminated with *E. coli* is a reservoir of foodborne *E. coli* that has been transmitted to humans. This organism can cause urinary tract infections, meningitis, and other extra-intestinal infections in humans (Boroomand et al., 2018a). In terms of public health, the second major problem with *E. coli* in the presence of

plasmids carrying virulence and drug resistance genes. These plasmids can be transported between different serotypes, and it may cause resistance to various drugs (Boroomand et al., 2018b).

**Salmonellosis.** The genus *Salmonella* belongs to the Enterobacteriaceae family, containing more than 2,500 variants that differ from each other in terms of antigenic properties. In poultry, *Salmonella* Infections cause acute and chronic diseases that are very important because of the economic damage in the poultry industry and endangering the health of meat and egg consumers (Boroomand et al., 2018b). People with salmonellosis usually develop diarrhea, fever, and abdominal cramps 12 to 72 hours after infection. The disease usually lasts 4 to 7 days. Most patients recover without treatment. Immunocompromised individuals are likely to develop severe disease and need treatment with antibiotics (Shivaprasad et al. 2013).

**Non-motile salmonella.** In adult birds, the gastrointestinal tract may rarely be affected by Non-motile salmonella. That's why it's rare for these bacteria to enter the human food chain. Few cases of *Salmonella pullorum* have been reported in humans following highly contaminated food consumption or experimental contamination. A clear sign of

infection in humans is the onset of acute enteritis that resolves quickly without any treatment. *Salmonella gallinarum* is rarely isolated from humans and is less important in terms of public health (Shivaprasad et al. 2013).

**Motile Salmonella**, paratyphoid salmonella is a common cause of foodborne illness in humans. In 2010, cases of human salmonella infections were confirmed in the USA. Salmonella paratyphoid was more common than any other foodborne pathogen (Centers for Disease Control and Prevention, 2011). More than 70% of human Salmonella infections in the United States are due to the consumption of infected chickens, turkeys, quails, or eggs (Boroomand et al., 2018b). In most parts of the world, eggs and egg-containing foods are the main routes of transmission of Salmonella enteritidis infections (Greig and Ravel, 2009). Very recently, a paratyphoid infection caused by *Salmonella* Typhimurium has been reported in a pigeon flock (*Columbia livia*) in Iran (Ranjbar et al., 2020). Many of the most common Salmonella serotypes in humans, especially Salmonella enteritidis and Salmonella typhimurium, are similarly common in poultry.

**Chlamydiosis.** In industrial poultry, Chlamydia is related to public health. The

strains of chlamydia that infect birds are newly identified in the genus *Chlamydiophila psittasi*. Because the first cases of diagnosis of the disease occurred in parrots and humans associated with them. The disease was initially been called psittacosis in humans and birds. This infection can rarely lead to death in patients who receive appropriate treatment. The main source of infection in humans is caged birds. Most cases of infection in humans occurs following inhalation of contaminated particles. The incubation period of the disease in humans is 14 days (Smith et al., 2011). The disease in humans can range from latent infection to a severe general illness or pneumonia. The disease is often accompanied by nausea, headache, chills, and muscle aches, with or without signs of respiratory involvement. Secondary transmission of the infection from a sick person to others is rare (Andersen and Vanrompay, 2008).

**Avian tuberculosis.** *Mycobacterium avium*, is the main cause of avian tuberculosis. The growth of these bacteria and the following characteristics are complicated and sometimes leads to misidentification. The inscription includes cases in which *M. avium* was claimed to be responsible for human tuberculosis. In 1938 the first case of human tuberculosis (with sufficient evidence) was

reported in the USA (Falkinham, 1994). With the decrease in the prevalence of *M. tuberculosis*, the interest in other mycobacteria, like *M. avium* (Wiesenthal et al., 1982), has increased. Also, in immunocompromised patients, such as those with AIDS, *M. avium* infection is common. Symptoms of avian tuberculosis in humans include asymptomatic, night sweats, weight loss, abdominal pain, fatigue, diarrhea, and cough in people with immunosuppression or previous lung damage (Nightingale et al., 1992). One of the specific serovars of *M. avium* was isolated from wild birds and AIDS patients (Horsburgh et al., 1985). According to pulsed-field gel electrophoresis (PFGE), *M. avium* human isolates are more related to pig isolates than birds (Feizabadi et al., 1996). Poultry strains are completely molecularly different from humans (Rindi and Garzelli, 2014). Consequently, it seems that most *M. avium* infections in humans are more likely to be because of human-to-human or environment rather than to avian.

**Listeriosis** is caused by *Listeria monocytogenes*, which occurs in birds in the form of septicemia, spleen enlargement, multiple foci of necrosis in the liver, and so on. In humans, *Listeria* can cause a variety of symptoms, depending on the person and the part of the body that is affected by the

infection. *Listeria*, like other foodborne pathogens, can cause fever and diarrhea, but this type of *Listeria* infection is rarely diagnosed. *Listeria* infection can cause a variety of symptoms, including Fever, chills, diarrhea, nausea, and muscle aches (Orndorff et al., 2006). The bacterium has 13 serotypes. The majority of infections in humans and animals are caused by serotypes 4b, 1/2 a, and 1/2 b (Firouzi et al., 2007). This organism is important in terms of public health because the infection can be caused by contact with infected birds or eating poultry products, especially those that are pre-cooked and ready to eat (Cox, 1999).

**Spirochetosis.** Intestinal spirochetosis of birds is a large population of intestinal spirochetes belonging to the genus *Brachyspirapilosicoli* makes a colony in the cecum or rectum, causing gastrointestinal symptoms in the bird. *Brachyspira pilosicoli* cause diarrhea in broilers, and the presence of these spirochetes in the blood has been reported in humans (Bait-Merabet et al., 2008). Intestinal spirochetosis is an uncommon human disease characterized by the colonization of *Brachyspira pilosicoli* anaerobic spirochetes on the surface of colon epithelial cells (Vipani and Yang, 2019).

*Staphylococcal infections* are common among poultry and are a global problem for chickens and turkeys. It is an important organism for poultry diseases, and approximately 50% of *Staphylococcus aureus* species produce an enterotoxin, which can cause food poisoning in humans (Harvey et al., 1982). The cause of this food poisoning can be related to carcass contamination in their processing. Poultry processing sites are thought to be often contaminated with *Staphylococcus aureus* species or carcass contamination by worker hands (Andersen, 2013).

*Streptococcus*. The genus *Streptococcus* is a spherical gram-positive bacterium and the species *Streptococcus mutans*, which is present in the human oral cavity, is associated with sepsis and mortality in geese (Ivanics et al., 1984).

*Clostridial infection. Necrotic enteritis* is a disease that primarily affects young poultry and is caused by a toxin produced by *Clostridium perfringens* type A and C and is considered the most important intestinal disease of poultry clinically. In addition to producing the toxin that causes necrotic enteritis in poultry, *Clostridium perfringens* type A and C produce enterotoxin during sporulation, which can lead to foodborne

disease in humans. Each of the two types of *Clostridium perfringens* causes a separate disease in humans. *Clostridium perfringens* type A causes ascites, and *Clostridium perfringens* type C causes necrotic enteritis in humans (Immerseel et al., 2004). Reports indicate that following the processing of poultry carcasses, a large percentage of them become infected with *Clostridium perfringens* (Craven et al., 2003). The occurrence of type A food poisoning has been reported following the consumption of poultry meat (Hook et al., 1996).

*Botulism* is a paralysis disease in birds caused by intoxication with neurotoxin produced by *Clostridium botulinum*. The importance of type C is minimum in terms of public health because so far, only a few cases of botulism type C have been reported in Humans (Skarin et al., 2013).

### **Fungal diseases**

*Aspergillosis*. The wide range of diseases caused by *Aspergillus* species, is named Aspergillosis that is not a zoonotic or transmittable disease. Aspergillosis is found in animals (birds) and humans (Kunkle, 2003). Depending on the body's immune status, the breathing of Aspergillose spores could reason various diseases in humans, as well as invasive pulmonary aspergillosis in

immunocompromised patients but also various forms of allergic diseases, for example, asthma or pneumonitis (Seyedmousavi et al., 2015). Thus, we must be careful to stay away from intense exposure to fungal spores. Facial masks are preferred when removing hay, feed, and bedding from poultry shelters and when performing autopsies on severely injured animals (Converse 2008.).

**Cryptococcosis** is caused by *Cryptococcus neoformans* or *Cryptococcus gattii.*, and *C. neoformans* can be localized in the intestines of birds, and often the infection is not accompanied by clinical symptoms. This organism is spread through the feces of pet birds (e.g., pigeons, psittacine, and passerine species). Symptoms of Cryptosporidiosis in immunocompromised humans include digestive problems such as diarrhea, lethargy, weight loss, and respiratory problems (Hanley et al., 2006).

### Parasitic diseases

**Cryptosporidiosis** is an important protozoal infection in humans and other animals, but there is no evidence that *Cryptosporidium baileyi*, the avian species, causes any infection in other animals. Moreover, *C. parvum*, which is well known as the predominant human pathogen, is not frequently found in poultry.

Interestingly, it seems that *C. meleagridis*, an occasional but highly pathogenic species in turkeys, may actually be similar to *C. parvum* (McDougald, 2013).

**Sarcocystosis** is not economically considerable to the poultry industry; however it finds extensively in wild ducks and other birds. Many infected game birds are discarded by hunters for visual reasons. It seems that this parasitic disease from birds does not seem to be a public health hazard. Cooking and storage at subfreezing temperatures can readily kill this parasite (Bermudez, 2013).

**Toxoplasmosis** is a parasitic infection caused by *Toxoplasma gondii* worldwide. Only sporadic reports of toxoplasmosis have been reported in chickens and turkeys (Bermudez, 2013). Indeed, the infection is infrequent in chickens and is of little consideration to the health of commercial poultry. Importantly, it is a notable zoonotic disease and a human health obstacle of growing importance due to increasing immunodeficient people (Dubey, 2010). Humans are clearly exposed to the disease through the ingestion of oocysts shed by felids, congenital infection, or the eating of raw or under-cooked meat products (Tenter et al., 2000). Until now, emerging evidence indicated that poultry products were not implicated as a remarkable risk factor;



however the consumption of any raw meat product, comprising uncooked poultry meat or eggs, is a potential source of human infection (Dubey, 2010).

### Conclusion

Although zoonotic infections related to the birds in humans are commonly rare; there are considerable zoonotic risks from various poultry and poultry products that veterinarians and other related works should be aware of and keep in mind in their daily practice.

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### Ethical approval

No applicable

### Conflicts of interest

The authors declare that they have no conflicts.

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