

Avian Zoonotic Diseases

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Abstract: Birds are one of the most interesting and most colorful groups of animals, but they can also be a source of zoonotic factors dangerous for humans. This paper describes the threats to human health from contact with birds. The most vulnerable occupational groups associated with birds are veterinarians, owners of poultry farms, breeders of ornamental birds, zoo personnel, and poultry slaughterhouse workers. In any case, where people have contact with birds or their droppings and secretions, special precautions should be taken. This way the negative effects of birds on human health can be minimized or eliminated. The occurrence of Zoonoses depends on a number of factors, among which are: the duration of exposure, virulence of the pathogen and its survival, route of infection and transmission, vectors, etc. Human health problems resulting from contact with birds are associated with bacterial, viral, fungal, and allergenic agents.

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Introduction

Zoonoses are infectious diseases of animals (usually vertebrates) that can be naturally transmitted to humans (WHO, 2014). Zoonoses can be caused by a range of pathogens such as viruses, bacteria, fungi and parasites; of 1,415 pathogens known to infect humans, 61% were zoonotic (Taylor et al., 2001). Most birds are asymptomatic carriers of the zoonotic diseases though in young birds, diseases like Newcastle disease and avian influenza manifests with high morbidity and mortalities, which approaches 100% (Alexander, 2000).

Human transmission occurs through exposure to contaminated avian faecal material, oral and nasal discharges or consuming improper cooked avian meat or eggs. Humans also get infected with wild avian zoonotic diseases like West Nile Virus, avian influenza due to the interaction between carrier host and domestic birds, which get infected and act as a source of zoonoses.

Other major factor contributing to the transmission of new zoonotic pathogens in human population is the increased contact between humans and wildlife (Daszak et al., 2000).

Zoonoses are infectious or parasitic diseases transmitted from animals to humans, either directly (through contact with the animal organism) or indirectly (through contact with faeces or excretions (Plusa, 2012).

The most vulnerable occupational groups associated with birds are veterinarians from poultry farms, farms owners, and breeders of ornamental birds. Workers in zoological gardens and shops

stocking exotic birds could be also exposed. Additionally, the operating staff of fairs and exhibitions where birds are on display, employees of the poultry meat processing industry, and people not related to poultry but having casual contact with free-living birds and poultry prepared for consumption (Bosert et al., 2013).

Viral avian zoonotic diseases

Avian influenza

Avian influenza A is a zoonotic pathogen with natural reservoir entirely in birds. Influenza virus is a single stranded RNA virus of the family orthonomyxoviridae of which three types A, B and C are recognized and only influenza A and B occur in highly pathogenic form (Daszak et al., 2000). Influenza A virus is classified into subtypes determined by the prominent proteins –hemagglutinin (H) and neuraminidase (N) which are used for host cell entry by the virus during replication (Alexander, 2000). Influenza H5N1 virus affects birds' species but has been found infrequently in a range of other species of animals and humans. Influenza virus can be divided into two groups according to their pathogenicity (Alexander, 2000; Heeney, 2006) as follows: highly pathogenic avian influenza (HPAI) virus which causes severe illness and a mortality rate approaching 100% and low pathogenic avian influenza (LPAI) virus that do not produce clinical signs in birds (Alexander, 2000) The ability of LPAI virus to mutate into a HPAI virus particularly in poultry and diversity of virus circulating in wild bird population emphasize the importance of wild birds as a primary source of zoonotic introduction of influenza into human

population (**Baigent and MacCauley, 2003; Heeney, 2006**).

Disease is transmitted through ingestion of contaminated food or water with faeces from infected birds. Other avian influenza virus subtypes in addition to H5N1 have been known to infect humans (**Peiris, 2009; Kalthoff et al., 2010**). In 2002, H7N7 influenza virus caused massive poultry morbidity, mortality and culling and resulted in 80 humans' infection and one (1) fatality (**Fouchier et al., 2004**). Of concern now is the recently diagnosed LPAI H7N9 which was discovered in China that caused 129 human illnesses with an 18% mortality rate (**Jernigan, 2013**).

Newcastle disease

Newcastle disease (ND) is a highly contagious, fatal viral disease of poultry occurring worldwide. It is usually identified by its three virulence types as follows; mildly pathogenic (lentogenic), moderately pathogenic (mesogenic), and very pathogenic (velogenic) (**Barman, 2002**). It may also be classified according to the predilection site of the virus: pneumotropic (respiratory system), viscerotropic (gastrointestinal tract), or neurotropic (nervous system) (**Cardona and Msoffe, 2009**). It is caused by Newcastle disease virus (NDV) of the order *Mononegavirales*, family *Paramyxoviridae*, subfamily *Paramyxovirinae* and genus *Avulavirus* (**Mayo, 2002**). Newcastle disease is a disease that affects birds of all ages while at the same time infects mammals and humans (**Shankar, 2008; Njagi et al., 2010**). Newcastle disease usually presents with sudden onset of clinical signs: hoarse chirps in chicks, watery discharge from nostrils, and dyspnea as bird gasps for air, swelling of areas around the face, paralysis, trembling and twisting of the neck that may indicate central nervous system involvement (**Cardona and Msoffe, 2009**). Besides these manifestations, mortality rate ranges from 10% to 80% depending on pathogenicity of the infecting strain of the Newcastle Disease virus (**Shankar, 2008**).

Bacterial avian zoonotic diseases

Colibacillosis

Avian colibacillosis is an infectious disease of birds caused by *Escherichia coli* (*E. coli*) which is considered as one of the principal cause of morbidity and mortality associated with heavy economic losses to the poultry industry by its association with various disease conditions as primary pathogen or as secondary pathogen (**Calneck et al., 1997**). Some strains of avian *E. coli* are also associated with diarrhoea disease in humans (**Haider et al., 2004**). *E. coli* is a gram negative, non-acid fast uniform staining, non-spore forming, bacillus that grows aerobically or anaerobically and is considered as a normal flora in avian and mammals including humans (**Barness et al., 1997**). Avian strains of *E. coli* associated with avian

colibacillosis include 078.K80, 01.K1 and 02.K1 (**Rahman et al., 2004**) and strain 0157.H7 (**Bebora et al., 1993**) also 078 strains isolated from humans, poultry, cattle, sheep and pig (**Cherifi et al., 1994**). Transmission of the pathogen in avian is mostly through faecal oral route that results from contamination of feed and water with faeces of infected birds (**Dho-moulin et al., 1990**). Also faecal contamination of egg during passage through cloacae or after laying (**Barness et al., 1997**) can result in penetration of *E. coli* through the shell and may spread to the chick during hatching and is associated with high mortality rates (**Wigley et al., 2001**). Humans are infected by consumption of food and water contaminated with infected poultry faeces or by consumption of infected eggs and meat. Avian *E. coli* occurs as acute form characterized by septicaemia resulting in death or as sub-acute form (**Haider et al., 2004**). It causes a variety of diseases manifested as Omphalitis, respiratory tract infection, swollen head syndrome, septicaemia, polyserositis, enteritis, cellulitis and salpingitis (**Calneck et al., 1997**).

In 1994, seven cases of *E. coli* 0157:H7 infection were traced to a farm in Leicestershire United Kingdom. An epidemiological investigation into the outbreak revealed that the strains of *E. coli* 0157:H7 isolated from nine animals on the same farm were indistinguishable from the strain samples isolated from human (**Shanker et al., 2008**). Some strains also colonize the human intestinal tract and may contribute to a resistant gene to human endogenous flora (**Van den Bogaard et al., 2001**).

Salmonellosis

Avian salmonellosis is an important cause of clinical disease in avian and a source of food-borne disease in human. The etiological agent of fowl typhoid and pullorum disease is *Salmonella enterica* subspecies enteric, serovar Gallinarum which is divided into two distinct biovars under the serogroup D; *Salmonella gallinarum* and *Salmonella pullorum* respectively (**Shivaprashad, 1997**). Under the family Enterobacteriaceae the genus *Salmonella* is a facultative intracellular pathogen causing localized or systemic infection as well as chronic asymptomatic carrier state (**Shivaprasad, 1997**). Transmission is mostly through faecal-oral route. Chick may be infected early by vertical transmission either from infected ovary, oviduct or from infected egg during passage through the cloacae of infected or carrier birds (**Berchieri et al., 2007**). Humans get infected by eating raw chicken or egg products which are already infected by salmonella or food and water contaminated with faecal material of infected birds (**Fedde, 1998**). Fowl typhoid occurs as per acute, acute or chronic form of disease affecting mostly adult avian whereas pullorum disease affects the very young chicken

mostly two-three weeks of age and in adult, the disease tends to be chronic (Shivaprasad, 1997). Clinical signs in chicken include anorexia, drop in egg production, increased mortality, reduced fertility and egg hatchability (Shivaprasad, 1997). In humans, salmonella infection causes diarrhoea and destroys epithelium leading to gastro-intestinal ulceration.

Ornithosis

Avian chlamydiosis occur in more than 400 species of birds, often in an unapparent manner (Beeckman and Vanrompay, 2009). In poultry, a well-defined clinical disease syndrome is recognized only in turkeys, where it manifests as a mild respiratory infection. In other poultry species, the disease may be unapparent because there are several genotypes of *C. psittaci*, which tend to infect only certain species and these species-specific genotypes vary in their virulence for birds as well as humans. There are numerous reports of humans obtaining the infections from turkeys.

Infection, of either turkeys or humans, is through inhalation of contaminated aerosols. Infected birds, whether clinically ill or asymptomatic, will shed the organism in respiratory and ocular secretions, and faeces. The organism survives drying and will become aerosolized when environmental conditions allow. Data from slaughter plants indicate a very high rate of human infection, with up to 70% of turkey plant employees being seropositive ((Daszack, et al., 2000) Areas of greatest infection/exposure are in the receiving rooms of live birds and also in the evisceration stations. This is probably due to secretions from live birds and exposure to air sacs and respiratory tree at the evisceration stations. Studies from Belgium have indicated a high rate of positivity in chicken broilers as well; although, there seems to be less transmission to humans from broilers, probably because of difference in genotypes (Daszack, et al., 2000) In France, there have been documented cases of severe clinical disease in workers at duck farms with no evidence of disease in any of the ducks. Additionally, seropositivity of ducks was very low and yet they were intense shedders of *C. psittaci* (Laroucau et al., 2009).

Campylobacteriosis

Campylobacteriosis is a food borne gastroenteritis disease caused by zoonotic pathogen namely *Campylobacter jejuni*. *Campylobacter jejuni* is a micro-aerobic, non-spore forming gram negative bacteria that are motile, spiral shaped and moves by corkscrew motion (Bornello et al., 2005) It causes disease in humans, avian, cattle, pigs, sheep, dog, cats and rabbits (Fitzgerald and Nuchamkii, 2007). In humans, most often campylobacteriosis is caused by *Campylobacter jejuni*, which is also the leading cause of bacterial diarrhoea in developed countries and a

leading cause of diarrhoea in children under the age of 5 years in developing countries (Scallan et al., 2011). The organisms are common inhabitants of avian digestive tracts and poultry may support extensive colonization without any adverse effects (Berrang et al., 2000). Once present in a flock, the bacteria spread quickly; infecting more than 90% of birds within 2 weeks (Boulianne, 2013). The ubiquity of the bacteria in the environment makes eradication and prevention of infection at the farm level nearly impossible. During processing, one infected carcass can easily contaminate the entire production line and thus, much of the control measures in place focus on this stage of production (Friedman and Neimann, 2000). Over 70% of cases are linked to consumption of chicken meat (Allos, 2001).

Avian tuberculosis

Avian tuberculosis is a highly contagious and chronic disease characterized by granulomatous lesions and a variety of clinical presentation (Hermoso, 2002). The etiologic agent is *Mycobacterium avium* highly resistant, acid-fast bacillus (Charlton, et al., 2006). *Mycobacterium avium* may infect different animal species like swine, cattle, deer, sheep, goat, horses, cat, dogs and humans (Thorel et al., 1997; Aranaz et al., 2003). Transmission to all animals is through ingestion and inhalation of aerosolized infectious organisms which are mostly found in soil and water contaminated by faecal material from infected birds (Fulton and Thoen 2003). In birds, avian tuberculosis manifests as a primary intestinal and hepatic disease with dissemination to other organs including lungs, air sac, spleen, bone marrow and skin (Thorel et al., 1997; Fulton and Thoen, 2003). It is clinically manifested as progressive weight loss, depression, white diarrhoea with soiled feathers, increased thirst, respiratory distress, fatigue and decreased egg production (Dhama et al., 2007). In humans, high risk is seen in immunocompromised people such as those on chemotherapy, infected with human immunodeficiency virus (HIV), the elderly and children (Lederberg et al., 1992). Human infections occur through contact with infected bird or ingestion of food or water contaminated with faecal material from infected birds (Lederberg et al., 1992).

Listeriosis

Listeriosis is a disease that causes septicaemia or encephalitis in humans, animals and birds. The causative agent is *Listeria monocytogenes*. *Listeria monocytogenes* is a medium sized gram positive rod, non-spore forming and non-acid fast bacteria (Quinn et al., 1994). Most indigenous chicken are carriers of *Listeria monocytogenes* (Njagi et al., 2004). Cattle also are carriers of the bacteria where they shed it in milk asymptotically as well as symptomatically as a result of listeria-related mastitis) abortion or

encephalitis (**Farber et al.,1990**). Humans are infected by the bacteria through contact with affected birds, and consumption of their product and unpasteurized milk. About 2500 cases of food borne listeriosis in humans has been reported in United States each year (**Stapleton, 2002**). Most cases and deaths occur in pregnant women, newborns, the elderly and immunosuppressed adults (**Stapleton, 2002**). In avian, all age group are susceptible but the disease is primarily of the young birds where it causes a septicaemia with focal necrosis in the liver, myocardium, pericarditis and occasionally encephalitis manifested as torticollis in broiler chicken (**Cooper, 1989**). In human, meningitis is the most common of the three forms of listeriosis (**WHO,2014**).

Fungal avian zoonotic diseases

Aspergillosis

Aspergillosis is a fungal infection caused by *Aspergillus fumigatus* but also *Aspergillus flavus* and *Aspergillus niger* (**Barton et al.,1992; Perelman and Kuttin, 1992; Joseph, 2000**). The reason why *Aspergillus fumigatus* is the predominant species of air borne fungal infection might be that the spores are much smaller than the spores of other *Aspergillus species* (**Richard and Thurston,1983**). Predisposing factor to infection is due to an increase in concentration of spores in the environment as a result of warm environment, humidity and poor ventilation (**Phalen, 2000**), poor sanitation (**Oglesbee, 1997**), long term storage of feed and factorim pairing immunity e.g. long term administration of tetracycline (**Oglesbee, 1997**), long term steroids inadequate diet (**Bauk et al.,1992**). Transmission is through inhalation of the fungi spores (**Fedde, 1998**). In avian, aspergillosis can manifest as acute or chronic; acute is due to inhalation of overwhelming number of spore while chronic aspergillosis is generally associated with immune suppression (**Vanderheyden, 1993**). Nasalaspergillosis cause exudative rhinitis, accompanied by malformation of nostril and beak (**Bauk et al., 1992; Tsai et al., 1992**).

While it's not possible for humans to contract aspergillosis from eating the meat of infected bird, it is possible for humans to contract this disease from inhaling the spores that are present in the air sacs and lungs (**Denning et al., 2013**). Majority of the cases occur in people with underlying illness such as tuberculosis (**Denning et al., 2013**) or chronic obstructive pulmonary disease (**Smith and Denning, 2011**).

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