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## Role of Migratory Birds in the Spread of Zoonoses

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### Abstract

**M**igratory birds are special creatures in nature as they travel throughout the globe for their survival and breeding by exploiting various seasonal opportunities. While travelling across the national and international borders these birds may also carry various disease-causing pathogens along with them. It includes different species of bacteria, viruses, fungi and endoparasites. These pathogens can be transmitted directly or indirectly to humans and domestic animals when there is a close association between them. Hence, they play an important role in the spread of pathogenic microorganisms in the ecosystem. So, it is very important to understand the dynamics of migratory birds and their ecology to mitigate and prevent the transmission of zoonotic disease. It can be achieved through collective and collaborative efforts from all the sectors by one health approach.

### Introduction

**M**igratory birds are usually regarded as visible indicators of diverse and healthy environments. However, from a public health perspective, the positive view is not always valid. Wild birds are responsible for fecal pollution and they can carry a wide range of viral, bacterial, fungal and protozoan zoonotic agents either being themselves diseased or being healthy carriers, or the hosts of infected vectors. Their ability to fly freely over long distances during annual migrations, wild birds potentially plays a role in the epidemiology of human-associated zoonoses. Further climatic change also potentiates the transmission. They can transport variety of viruses like avian influenza virus, JE virus, WN virus, CCHF virus, etc. and bacterial agents of campylobacteriosis, cholera, salmonellosis, lyme borreliosis, etc. (Parin *et al.*, 2018) and fungal agents include *Aspergillus* spp. and *Candida* spp. Endoparasites like *Giardia* spp., *Cryptosporidium* spp., etc are also carried by migratory birds. These birds also serve as a reservoir of antimicrobial resistant bacteria. MDR *Campylobacter* spp. and *Salmonella* spp. have also been isolated from wild bird feces. In recent decades, migratory birds and wildlife have been incriminated in and associated with emergent and resurgent diseases. Prevention and control strategies should be taken to prevent zoonotic diseases from migratory birds. Serological sampling and study of movements of high-risk migratory bird species need to be intensified, especially at strategic sites on the migration route. Satellite based tracking and global positioning systems (GPS) have to be exploited. One health approach and interdisciplinary collaborations could improve the detection of emerging pathogens of avian migrants. Furthermore, the implementation of strict bio-security measures that reduce contact with migratory birds will limit the transmission of pathogens.

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## Travel Associated with Transmission of Pathogens

**B**iological carriers transport many viruses, bacteria, fungi and endoparasites which multiply in the body. The infection of birds can be acute, chronic, latent or asymptomatic. Viruses that can possibly be transported include the many arboviruses such as Eastern equine encephalitis, West Nile virus, Newcastle disease virus, duck plague virus, avian pox virus, Sindbis or St Louis encephalitis virus and influenza A virus. In addition, the causative agents of ornithosis, mycoplasmosis, erysipelas, avian cholera, coxiellosis, avian tuberculosis, Lyme borreliosis, colibacillosis, campylobacteriosis, cholera, yersiniosis, salmonellosis and listeriosis can also be carried. Likewise, drug-resistant enteropathogens can be transported as can fungi and endoparasites, such as *Aspergillus* spp., *Leucocytozoon* spp., *Candida* spp., *Haemoproteus* spp., *Toxoplasma* spp., *Cryptosporidium* spp. And *Sarcocystis* spp. Mechanical carriers transmit either external or internal microbial pathogens. External pathogens, like fungal spores, are located on the body of the bird and can survive for approximately 12 days on the feathers of migratory birds. Internal pathogens do not multiply in the avian body but it can pass through the digestive tract and are viable when they are excreted. Foot and mouth disease virus is thought to be transmitted through mechanical carriers.

Migratory birds can be carriers of infected haematophagous ectoparasites which sometimes serve as vectors for several diseases. Infected immature argasid and ixodid ticks are transported in such a way from one place to another and even from one continent to another. The mode of transmission of all these microorganisms can either be direct or indirect. Direct transmission is caused by the migratory bird itself through intimate contact, contact by inhalation of discharged respiratory droplets from coughing or sneezing or by infectious feces. Indirect transmission occurs via arthropods such as a flea, mite, mosquito, sand fly or tick, or an inanimate vehicle like food, water, soil, etc. In addition, the air-borne spread by droplet nuclei, dust etc. is considered to be an indirect mode of transmission. The mode of transportation of pathogens by migratory birds depends on the route of transmission.

## Factors Influencing Transmission of Pathogens

**A**nthropogenic factors like agricultural expansion, habitat destruction, urbanization, trade of exotic or domestic animals and global travel comprise major drivers of the emergence of zoonotic disease (Milton et al., 2020). The effective transmission of pathogens by migratory birds can be predisposed by different factors. One of these is seasonality during migration. An example is the increased number of mosquitoes that prevail during the summer and early autumn when migratory birds return. Another example is the influence of seasonal temperatures on certain pathogens,

such as the avian influenza virus which remains infectious in water at a lower temperature from late autumn to early spring when major congregations of migratory waterfowl pass through (Rocke, 2007). Another favorable factor that is effective in causing transmission is the immense stress caused by migration on birds. Fatigue diminishes their resistance to infections, increases the shedding rate of infectious agents and the duration or the level of viraemia/ bacteraemia in migrating birds that are already infected. The migration of birds started several millions of years ago and has always been followed by a number of unavoidable consequences, such as these birds being carriers or hosts in the transmission of pathogens. Questions have been raised regarding whether or not it is possible to interrupt this natural sequence of pathogen circulation and transmission. It is not possible to break this sequence but the risks of occurrence of transmissible zoonotic pathogens could perhaps be minimized by controlling migratory birds and preventing dangerous situations.

## Measures to be adopted for Prevention, Control and Eradication

**T**he main goal of the first step, prevention, is to hinder the introduction of disease agents. The second step, control, involves the adoption of measures to reduce disease frequency and severity to a tolerable level. Eradication aims at eliminating the agent from a population or from a geographic area and, in particular, from reservoirs. Prevention and control must be complemented by surveillance, diagnostics and an early warning system. Although the surveillance of migratory birds is very difficult, it must include wetlands, stopover places, places of destination and wintering regions. In all countries associated with the migratory flyways, national programmes must be designed and applied to ensure the surveillance of migratory birds. This should be planned jointly by ornithologists who work in close liaison with veterinary experts. Additional data and information on existing water bird ringing is needed, as are the routes and timing of migration, especially those of the scarcely documented intra-African migrants and the Asia-Pacific and Neotropical flyways which will enable the high-risk periods to be identified.

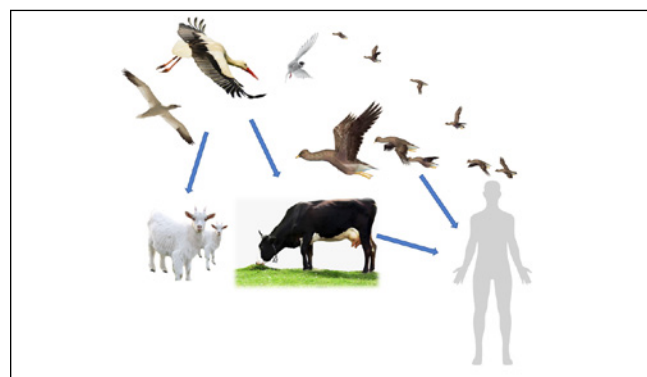


Figure 1: Transmission pattern of zoonotic diseases through migratory birds

## Conclusion

**F**or effective mitigation, the collaboration of all scientific and other groups involved at the national and international levels is needed. Additional research into pathogens transmitted by migratory birds, the modes of transmission and the toll these pathogens have on the countries involved would be valuable. Among topics that need to be documented more comprehensively are the following: the exact flyways, stopover places, places of destination and period of departure of the birds. Research efforts must be designed so that they clearly demonstrate the relationships between hosts and pathogens and their environment. The migration ecology in every country should be known and those that are unknown should be scheduled for study in future to tackle the problem.

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