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# ASPERGILLOSIS -A ZOONOTIC ASPECT

## ABSTRACT

This chapter offers an in-depth exploration of Aspergillosis as a significant occupational zoonotic disease, focusing on the intricate connections between human activities, interactions with animals and the transmission of *Aspergillus* species. It emphasizes the zoonotic nature of the infection, primarily caused by inhaling *Aspergillus* spores and the considerable health risks it presents to individuals involved in animal-related professions. *Aspergillus* species are globally distributed and can affect humans, nearly all domestic animals and birds, as well as various wild species. They are responsible for a broad spectrum of conditions, ranging from localized infections to life-threatening systemic diseases and can also trigger allergic reactions due to inhalation of their spores (conidia). Several risk factors have been identified for Aspergillus infections in humans, including immunosuppression and tuberculosis. In animals, contributing factors include poor hygiene practices, physical trauma, skull anatomy and possible immune system deficiencies. The article highlights the fungi involved, factors influencing susceptibility and transmission, clinical symptoms in birds, human infections, diagnostic methods and strategies for prevention and control.

## INTRODUCTION

Aspergillosis is a fungal infection caused by *Aspergillus* that can impact a wide range of species, including humans, dogs, cats, horses, marine mammals, wild, domestic birds and even invertebrates like bees and corals. *Aspergillus* species are filamentous fungi that primarily live as saprophytes in soil, where they play a key role in decomposing organic matter. In vertebrates, the primary mode of transmission is through inhalation of airborne conidia found in the environment. The respiratory tract is typically the first anatomical site where the infection establishes itself (Marr*et al*., 2002).

Occupational exposure is a primary factor in the development of this disease, particularly in jobs involving contact with contaminated materials such as in agriculture, construction and healthcare. *Aspergillus* spores, commonly present in soil, decaying plant matter and animal waste, can be inhaled by both humans and animals, leading to infection.

Aspergillosis is classified as a zoonotic disease due to its ability to be transmitted between animals and humans in both directions. *Aspergillus fumigatus* is the most prevalent and potentially deadly airborne opportunistic fungal pathogen in humans, particularly posing a serious risk to individuals with weakened immune systems. When its spores (conidia) are inhaled into the lungs, they can lead to a range of diseases depending on the host's immune response. These conditions include invasive pulmonary aspergillosis, aspergilloma and various hypersensitivity-related disorders such as allergic asthma, hypersensitivity pneumonitis and allergic bronchopulmonary aspergillosis. Precise diagnosis of fungal infections in animals, especially in aspergillosis is crucial for assessing the likely outcome, selecting appropriate treatment measures and deciding on the most effective therapy. Aspergillosis prevention relies on maintaining proper workplace hygiene and safety measures to minimize occupational exposure, wearing personal protective equipment, ensuring timely diagnosis and treatment. While antifungal drugs can successfully treat most cases, surgery might be needed for more complicated infections (Azie*et al*., 2012).

## ZOONOTIC TRANSMISSION

Although aspergillosis is primarily an opportunistic fungal infection, it is recognized as having zoonotic potential. This means the disease can be transmitted between animals and humans, although direct transmission is relatively rare. *Aspergillus fumigatus* is the most frequently identified species of *Aspergillus* associated with human infections (Lamoth, 2016).

**The most common ways of transmission are: -**

- **Environmental Origin: -**

  Aspergillosis is primarily caused by *Aspergillus* species found in soil, decaying vegetation, animal bedding and droppings.

- **Indirect Zoonosis**:

  Zoonotic transmission is typically indirect, occurring through shared environmental exposure rather than direct contact between animals and humans.

- **Airborne Spores (Conidia)**:

  The primary mode of transmission is via inhalation of airborne spores, which can be released from contaminated environments or infected animals (especially birds).

- **At-Risk Occupations**:

  Individuals working closely with animals such as farmers, veterinarians, poultry workers, zookeepers and pet bird owners are at greater risk due to frequent exposure to contaminated environments.

- **Birds as a Major Source**:

  Birds, particularly those with respiratory aspergillosis, can release large quantities of *Aspergillus* spores into their surroundings, increasing risk for nearby humans.

- **One Health Concern**:

  Aspergillosis exemplifies the One Health concept, highlighting the interconnected health of humans, animals and their shared environment.

**SOURCES OF EXPOSURE: -**

1. **Contaminated Air (Airborne Spores)**

- The primary source of infection is inhalation of *Aspergillus***spores (conidia)** suspended in the air.
- These spores are easily aerosolized and can be present indoors and outdoors.

2. **Soil and Decaying Organic Matter**

- *Aspergillus* species naturally occur in soil, compost and decaying plant material.

- Activities like gardening, farming, or landscaping disturb soil and release spores into the air.

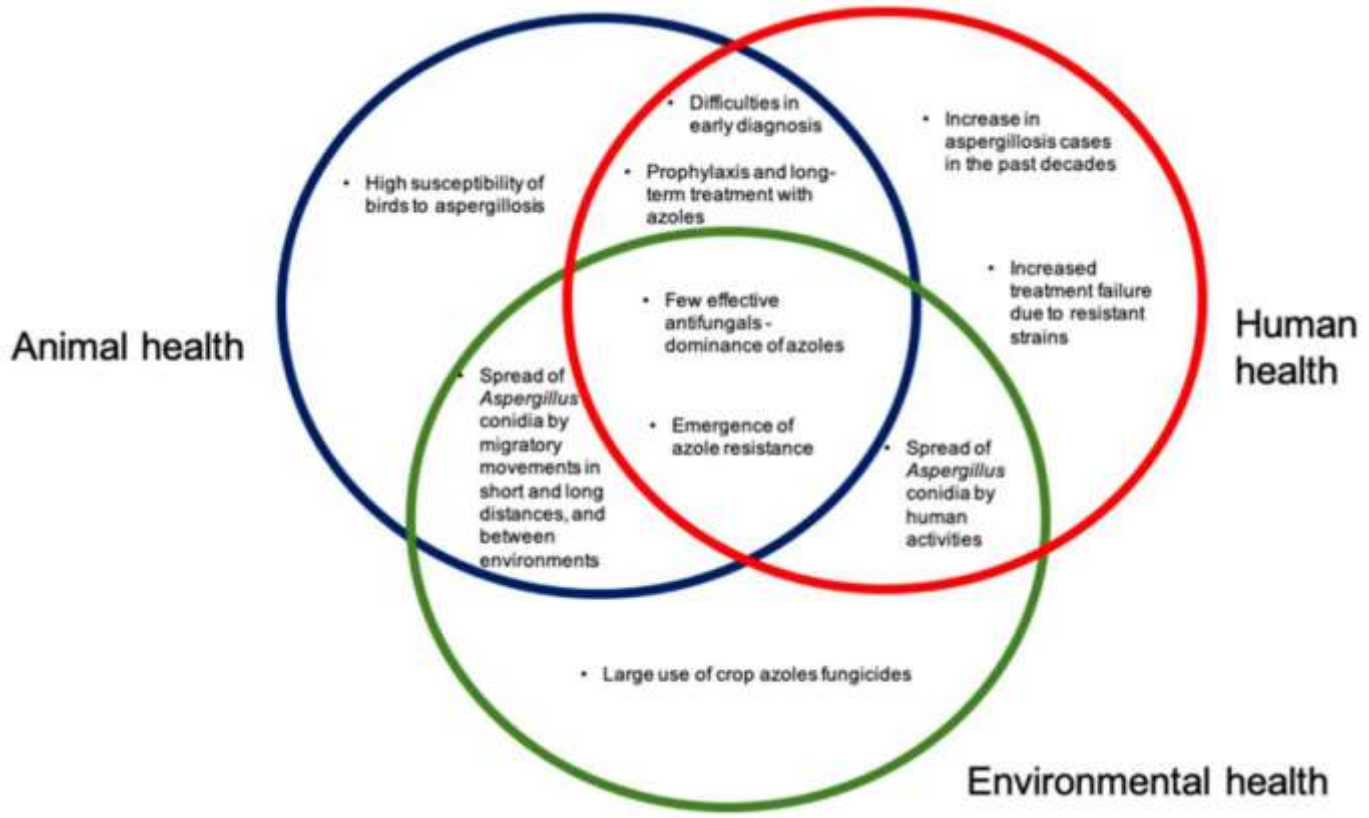
3. **Animal Bedding and Droppings**
- Used animal bedding, especially in poultry farms or bird cages, can harbour large amounts of spores.
- Accumulated droppings, especially in damp environments are the significant source.

4. **Moldy Feed and Stored Grains**
- Spoiled animal feed, stored grains and hay can become colonized by *Aspergillus*.
- Handling or feeding Mold-contaminated material increases risk for both animals and humans.

**Figure 2.** The One Health scheme, demonstrating the implications for *Aspergillus* and aspergillosis, in the environment, in animal health (with emphasis on birds) and in human health.

5. **Hospitals and Healthcare Settings**
- Various items have been identified as potential sources of *Aspergillus* infection, including syringes, spinal needles and a liquid nitrogen tank located near an operating room. Other materials such as gauze used to cover venepuncture sites, wound dressing supplies, latex finger stalls and electronic equipment in surgical areas have also been implicated in the spread of the fungus.
- Immunocompromised patients may be exposed through contaminated ventilation systems or dust from nearby construction.
- Strict air filtration and environmental control are necessary in such settings.

6. **Infected Animals**
- Animals with aspergillosis, especially birds, may shed spores into the air through breathing or droppings.
- Close contact with infected animals can increase risk of exposure, especially in enclosed areas.



## PATHOGENESIS AND CLINICAL MANIFESTATIONS

*Aspergillus* species release a variety of secondary metabolites into their surroundings, commonly referred to as mycotoxins. These powerful compounds play a significant role in the pathogenic potential of *Aspergillus* in animals. They are believed to act as a chemical defence mechanism, protecting the fungus from competing microbes and predators. Mycotoxins are also considered important virulence factors, as they can suppress the host's immune response, thereby increasing the fungus's ability to cause infection (Sayedmousavi *et al*., 2015).

Humans typically become infected by inhaling these spores, which then settle in the bronchioles or alveolar spaces of the lungs. Under normal conditions, the body's first line of defence have mucociliary clearance, epithelial cells and alveolar macrophages has works to eliminate these spores. Alveolar macrophages play a key role in engulfing the conidia and signalling neutrophils to the site of infection. However, if the spores evade destruction by macrophages, they begin to germinate. The resulting fungal structures (hyphae) are then targeted by infiltrating neutrophils. Infection occurs when these immune defences fail or are impaired, allowing *Aspergillus fumigatus* to grow and establish itself within the lung tissue (Morris *et al.*, 2000).

The clinical symptoms of aspergillosis in humans vary depending on how extensively the fungus colonizes or invades tissues, as well as the strength of the individual's immune response. The disease can manifest as either allergic reactions or severe invasive infections. Individuals with underlying conditions such as chronic granulomatous disease, organ or bone marrow transplants, prolonged neutropenia, AIDS or extended use of corticosteroids and other immunosuppressants are at heightened risk for invasive aspergillosis (IA). Mortality from acute IA can be as high as 80% within the first year after diagnosis. Recent research highlights the growing significance of IA in intensive care settings, where its incidence has surged over the past few decades. In some cases, particularly among patients with influenza, those undergoing advanced chemotherapy and individuals with COVID-19 have mortality rates can reach 100% (Melo *et al.*, 2020).

## DIAGNOSIS AND TREATMENT

A preliminary diagnosis of aspergillosis is typically based on a combination of the patient's medical history, clinical symptoms and observed lesions.

A confirmed diagnosis of Aspergillus infection relies on either isolating the fungus through culture or identifying it through microscopic examination.A background of unfavourable environmental conditions such as poor litter quality, inadequate ventilation and high humidity along with severe respiratory symptoms or sudden bird losses, may suggest aspergillosis. However, the clinical signs are not specific and can be mistaken for other diseases. The detection of white, granulomatous nodules or caseous plaques in the lungs and air sacs can support the suspicion of the disease(Dahlhausen *et al*., 2004).

Aspergillus infection can also be diagnosed through biochemical and haematological analyses. Serological tests such as enzyme-linked immunosorbent assay (ELISA), immunohistochemistry, galactomannan assay and plasma protein electrophoresis are useful diagnostic tools. For confirmation, the use of monoclonal or polyclonal antibodies is employed. Additionally, radiographic imaging of particularly lateral and ventrodorsally views of suspected birds may reveal signs consistent with aspergillosis (Rizwan *et al*., 2023).

Currently, there is no definitive cure for mycotoxicosis in animals. In cases of Aspergillus-related keratitis and dermatitis in reptiles, topical antifungal medications such as azoles along with supportive care are ty pically recommended. However, prolonged treatment is often required to

achieve effective and satisfactory results (Girling & Fraser, 2009).

## PREVENTION AND CONTROL

It is recommended that effective cleaning, disinfection and fumigation should involve the use of formaldehyde or antifungal agents such as thiabendazole, applied at concentrations ranging from 120 to 360 g/m³. Additionally, the use of azole compounds for disinfecting environments and decontaminating bedding materials is a common practice.An effective treatment with copper sulphate involves administering it at a dilution of 1:2000 via drinking water or incorporating it into feed for a duration of six days. This should be combined with one or more antifungal agents, such as itraconazole, miconazole, enilconazole, clotrimazole, ketoconazole, fluconazole, amphotericin B or fungicidin.

Proper control measures are essential, including the use of gloves and masks when handling birds, ensuring adequate ventilation and providing Mold-free feed. If an infection is identified on the farm, prompt diagnosis, appropriate treatment and swift disposal of dead birds are crucial to minimize the spread of the disease.

To minimize fungal growth in poultry farms, it's crucial to avoid dust as well as Mold-contaminated litter or feed. Bedding materials, like feeders, should be kept clean and dry at all times. Proper ventilation must also be maintained to control relative humidity and prevent litter from becoming damp. In addressing mycotoxins and mycotoxicosis in dairy cattle, effective feed management strategies are essential to minimize mycotoxin contamination. (Sayedmousavi *et al*., 2015).

## CONCLUSION

Aspergillosis is a widespread opportunistic fungal disease affecting humans, animals, and even invertebrates, with *Aspergillus fumigatus* bein g the most pathogenic species. Transmission primarily occurs through inhalation of airborne spores from contaminated environments, posing significant risks to immunocompromised individuals and those in high-exposure occupations.

Clinical outcomes vary based on host immunity, and while antifungal treatments exist, diagnosis and management remain challenging, particularly in animals. Prevention focuses on environmental hygiene, protective measures, and early detection. A One Health approach is essential to address the zoonotic and occupational dimensions of aspergillosis and to improve control strategies across human and animal populations.

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