

## ASPERGILLOSIS

| Animal Group(s) Affected   | Transmission   | Clinical Signs   | Severity  | Treatment   | Prevention and Control  | Zoonotic  |
|----------------------------|--|--|---|---|---|---|
| Vertebrates, invertebrates | Environment -acquired via spores. It is not considered contagious. | Primarily respiratory but can become systemic. Occasionally a cutaneous disease. | May cause severe disease in immune-compromised hosts. | Antifungal drugs - polyenes, azoles, allylamines, pyrimidines | Minimize environmental accumulation of fungus; prevent immune-suppression of host; prophylactic treatment | Only if spore-forming conidiospores are present |

**Fact Sheet compiled by:** Joseph A. Smith

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**Fact Sheet Reviewed by:** Mark Mitchell, Mark Papich, Patrick Redig, James Wellehan

**Susceptible animal groups:** Vertebrates and invertebrates can be affected. However, it affects primarily immunocompromised individuals (e.g. those young, geriatric, stressed, affected by concurrent disease, or undergoing management changes). Higher incidence of disease is associated with penguins, waterfowl, raptors, sea birds, and galliforms. Birds from polar or pelagic environments tend to be more susceptible. High environmental load of fungal spores is a predisposing factor for the development of disease, but exposure to ambient levels can also result in disease. Prolonged corticosteroid and antibiotic use have both been associated with increased risk of disease.

**Causative organism:** Primarily *Aspergillus fumigatus*, a saprophytic mold; occasionally *A. flavus*, *A. nidulans*, *A. niger*, and *A. terreus*. *A. flavus* traditionally is more associated with mycotoxin production (aflatoxicosis). Fungi use a nomenclature inconsistent with the rest of biology as separate names for asexual anamorph stages and sexual teleomorph stages of the same organism exist, resulting in multiple species names and paraphyletic taxa. The anamorph genus *Aspergillus* is the same fungus as several teleomorph genera, including *Neosartorya*, *Eurotium*, and *Emericella*.

**Zoonotic potential:** Aspergillosis is reported in people, but the infections usually are acquired from environmental exposure. Immunocompromised humans are more susceptible. Theoretically, any lesions where spore-forming conidia are present (e.g., some air sac granulomas in birds) may release spores into the environment which could be inhaled, and thus pose some zoonotic potential. In immunocompetent humans, the most common clinical presentation is fungal sinusitis.

**Distribution:** Worldwide distribution; ubiquitous in the environment. The fungus proliferates in soil, decaying vegetation, and moist environments with poor ventilation. Pre-formed spores can also be easily aerosolized in dry, dusty environments. Contaminated ventilation systems have been a risk factor for disease.

**Incubation period:** Highly variable. May cause acute disease or prolonged chronic infections. Clinical progression depends primarily on immune response and degree of environmental exposure.

**Clinical signs:** Primarily affects the respiratory system and may cause dyspnea, stridor, cyanosis, coughing, vocalization changes, and sneezing. The most common site of infection in mammals is the upper respiratory tract. The organism frequently infects cavities, such as sinuses, air sacs, guttural pouches, and similar locations. Signs of disseminated disease depend on the organs affected. Fungal plaques on large blood vessels may cause rupture and fatal hemorrhage. Nonspecific signs of disease such as lethargy, weakness, and weight loss are common. In birds, aspergillosis can result in marked leukocytosis.

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**Post mortem, gross, or histologic findings:**

Gross-Rhinitis, sinusitis, tracheitis, air sacculitis, pneumonia, disseminated granulomatous lesions in any organ. Lesions are yellow to pale pyogranulomatous or granulomatous nodules or plaques. In some air sac lesions, white or green, cottony spore-forming conidiospores can be observed.

Histologic-Granulomatous inflammation with intralesional fungal hyphae measuring 3-6 µm with parallel walls, evenly distributed septa, and progressive dichotomous branching at acute angles. Angioinvasion with thrombosis.

**Diagnosis:** Fungal culture combined with cytology or histopathology of affected tissues is the gold standard for a definitive diagnosis. The fungus can be cultured from normal tissues without pathologic lesions, so it is important to combine culture with microscopic evaluation. Fungi can be enhanced with special stains (e.g. periodic acid-Schiff [PAS], Grocott's methenamine silver [GMS]) or immunohistochemical labels to aid in microscopic evaluation. Other supportive diagnostics include PCR, serology, antigen blood tests (e.g. galactomannan), endoscopy, radiology, protein electrophoresis, and complete blood counts. Because of the ubiquity of this genus, serological results correlate poorly with disease.

**Material required for laboratory analysis:** Swabs or biopsies of affected tissues for culture, cytology, histopathology, and PCR. Serum or plasma for serology, antigen blood tests, and protein electrophoresis.

**Relevant diagnostic laboratories:** Almost any commercial diagnostic lab can perform fungal cultures, cytology, or histopathology. *Aspergillus* is readily cultured on a Sabaroud's dextrose plate incubated at 37° C for 48 hours. An *Aspergillus* diagnostic panel consisting of ELISA serology, galactomannan antigen testing, and protein electrophoresis is offered by the University of Miami Avian and Wildlife Laboratory.

The Fungus Testing Laboratory  
 Department of Pathology, Room 329E. Mail Code 7750  
 The University of Texas Health Science Center at San Antonio  
 San Antonio, Texas 78229-3900  
 210-567-4131  
 210-567-4076

**Treatment:** Antifungal drug classes that have been used to treat aspergillosis include polyenes (amphotericin B), azoles (voriconazole, itraconazole, ketoconazole), allylamines (terbinafine), and pyrimidines (flucytosine). Newer echinocandins (caspofungin) and azoles (posaconazole, ravuconazole) are being used in human medicine. The effectiveness of azoles varies widely. Most isolates tested are susceptible to voriconazole. Terbinafine is synergistic with voriconazole, and a terbinafine/voriconazole combination is the current treatment of choice. Supportive care, treatment of concurrent disease, and removing any sources of stress or immunosuppression are also important components of treatment.

**Prevention and control:** Because clinical disease caused by *Aspergillus* spp. is typically caused by either high environmental exposure with or without immunosuppression, methods at prevention and control should be aimed at controlling these predisposing factors. Environmental sanitation, adequate ventilation, and air filtration can all help to reduce environmental fungal spore loads. Ensuring that substrates that support fungal growth, such as dead plant materials, are not present in the enclosure will reduce exposure. Enilconazole can be considered when environmental treatment is indicated. Commercial formulations of enilconazole (e.g., Clinafarm EC) have been developed to disinfect poultry facilities. Minimizing stress and concurrent disease can help reduce disease caused by immunosuppression. Prophylactic treatment using antifungal drugs (e.g., itraconazole) has been used during periods of stress or prolonged antibiotic use for highly susceptible species. Animals with aspergillosis should be investigated for other causes of immunosuppression.

**Suggested disinfectant for housing facilities:** Bleach is the most effective disinfectant. Efficacy of other classes of disinfectants is variable and may be species and strain dependent.

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**Notification:** Not a reportable disease.

**Measures required under the Animal Disease Surveillance Plan:** None.

**Measures required for introducing animals to infected animal:** Aspergillosis is not considered a contagious disease. However, case clusters that mimic "outbreaks" can be caused by common environmental predisposing factors such as high environmental spore loads or environmental stressors. These environmental factors should be considered when introducing animals to the environment of an infected animal.

**Conditions for restoring disease-free status after an outbreak:** Not applicable.

**Experts who may be consulted**

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**References**

1. Burek, K., 2001. Mycotic diseases. *In*: Williams, E.S., and I.K. Barker (eds). *Infectious Diseases of Wild Mammals*, 3<sup>rd</sup> ed. Blackwell Publishing, Ames, Iowa. Pp. 514-531.
2. Converse, K.A., 2007. Aspergillosis. *In*: Thomas, N.J., D.B. Hunter, and C.T. Atkinson (eds). *Infectious Diseases of Wild Birds*. Blackwell Publishing, Ames, Iowa. Pp. 360-374.
3. Cray, C., T. Watson, and K.L. Arheart. 2009. Serosurvey and diagnostic application of antibody titers to *Aspergillus* in avian species. *Avian Dis.* 53(4): 491-494.
4. Cray, C., T. Watson, M. Rodriguez, and K.L. Arheart. 2009. Application of galactomannan analysis and protein electrophoresis in the diagnosis of aspergillosis in avian species. *J. Zoo Wildl. Med.* 40(1): 64-70.
5. Disomma, A., T. Bailey, C. Silvanose, and C. Garcia-Martinez. 2007. The use of voriconazole for the treatment of aspergillosis in falcons (*Falco* species). *J. Av. Med. Surg.* 21: 307-311.
6. Duncan, M., 2003. Fungal diseases in all taxa. *In*: Fowler, M.E., and R.E. Miller (eds.). *Zoo and Wild Animal Medicine*, 5<sup>th</sup> ed. Elsevier Science, St. Louis, Missouri. Pp. 727-732.
7. Dykstra, M.J., and K. Reininger. 2007. Aviary air-handler design and its relationship to fungal spore loads in the air. *J. Zoo. Wild. Med.* 38: 540-547.
8. Gupta, A.K., I. Ahmad, and R.C. Summerbell. 2002. Fungicidal activities of commonly used disinfectants and antifungal pharmaceutical spray preparations against clinical strains of *Aspergillus* and *Candida* species. *Med. Mycol.* 40: 201-208.
9. Kunkle, R.A., 2003. Fungal infections. *In*: Saif, Y.M. (ed.). *Diseases of Poultry*, 11<sup>th</sup> ed. Iowa State University Press, Ames, Iowa. Pp. 883-902.
10. Pare, J.A., L. Sigler, K.L. Rosenthal, and D.R. Mader. 2006. Microbiology: fungal and bacterial diseases of reptiles. *In*: Mader, D.R. (ed). *Reptile Medicine and Surgery*, 2<sup>nd</sup> ed. Saunders Elsevier, St.

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Louis, Missouri. Pp. 217-238.

11. Reidarson, T.H., J.F. McBain, L.M. Dalton, and M.G. Rinaldi. 1999. Diagnosis and treatment of fungal infections in marine mammals. *In*: Fowler, M.E., and R.E. Miller (eds.). Zoo and Wild Animal Medicine Current Therapy 4. W.B. Saunders Company, Philadelphia, Pennsylvania. Pp. 478-485.