

Avian Chlamydiosis

Psittacosis,
Ornithosis, Parrot Fever

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Importance

Avian chlamydiosis is a zoonotic disease of birds caused by the intracellular bacterium *Chlamydophila psittaci*. This disease is called psittacosis in humans. It may be called either avian chlamydiosis or psittacosis in psittacine birds; the term avian chlamydiosis is generally used in other avian species. Infections are particularly common among psittacine birds and pigeons, but most or all species of birds are probably susceptible. Some birds carry this organism asymptotically. Others become mildly to severely ill, either immediately or after they have been stressed. Significant economic losses may be seen in turkeys and ducks, and high mortality can occur in clinically affected psittacines.

Humans are readily infected by *C. psittaci*. In 1929, exposure to imported pet psittacines caused a pandemic in the U.S. and Europe. Since that time, improved screening and control of avian infections have decreased the incidence of human disease. However, *C. psittaci* is difficult to eliminate entirely; sporadic cases and outbreaks continue to occur. Unusual sources of outbreaks have also been reported. In Australia, one cluster of cases was linked to outdoor activities in an environment contaminated by wild birds. In people, psittacosis is readily treated with antibiotics, but it can be fatal if it is left untreated.

Etiology

Psittacosis/ avian chlamydiosis results from infection by *Chlamydophila psittaci*, a Gram negative, coccoid, obligate intracellular bacterium in the family Chlamydiaceae. *C. psittaci* can be divided into serotypes/ serovars, or alternatively, into genotypes. At least six serotypes, named A through F, have been recognized with specific monoclonal antibodies. *C. psittaci* genotypes are based on genetic differences in the outer membrane protein A (ompA). Each genotype generally corresponds with the serotype of the same name. Genotyping also recognizes a seventh type, E/B, which is indistinguishable from types E or B using serology. Each genotype/ serotype tends to be associated with certain species of birds (see "Species Affected," below). Strains that cause severe disease in one avian species can be mildly virulent or asymptomatic in others. Humans can be infected with any of the genotypes.

The species *Chlamydophila psittaci* includes some but not all of the organisms that were previously called *Chlamydia psittaci*. In 1999, the Chlamydiaceae were reorganized, based on analyses of ribosomal RNA. The new genus *Chlamydophila* was established, and all avian strains of *Chlamydia psittaci* were reassigned to *Chlamydophila psittaci*. Most mammalian strains of *Chlamydia psittaci* were reclassified as *Chlamydophila abortus*, *Chlamydophila felis* or *Chlamydophila caviae*, but two mammalian isolates, WC and M56, were placed in *Chlamydophila psittaci*. WC was isolated from one epizootic in cattle, and M56 was found during a single outbreak in muskrats.

Species Affected

C. psittaci has been reported in at least 30 orders of birds. It is particularly common in the orders Psittaciformes (psittacine birds) and Columbiformes (pigeons and doves). Infections are infrequent in canaries and finches, which are members of the order Passeriformes. Among poultry, avian chlamydiosis is sometimes seen in ducks and turkeys but occurs rarely in chickens. Common wild bird reservoirs include gulls, ducks, herons, egrets, pigeons, blackbirds, grackles, house sparrows and killdeer. Infections have also been reported in raptors. Outbreaks have been reported in shorebirds and migratory birds. Gulls and egrets can be subclinical carriers for strains that are highly virulent for other birds.

Each genotype of *C. psittaci* tends to be associated with certain species of birds. Genotype A is usually found in psittacine birds, and can cause severe disease in these species. Genotype B is most often associated with pigeons, but it has also been reported in psittacines and turkeys. Genotype C occurs in ducks and geese. Genotype D has primarily been isolated from turkeys, and it is considered to be the most virulent type for this species. This genotype has also been found in egrets and gulls.

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Genotype E has a diverse host range: it occurs in pigeons, and has also been isolated from sick ratites (ostriches and rheas), ducks and turkeys. Genotype F, which has been found in one turkey and a psittacine bird, is apparently rare among domesticated species. Genotype E/B, which was first described in 2005, has been reported in ducks, turkeys and pigeons; additional hosts may be discovered.

Infections with *Chlamydophila psittaci* have been reported occasionally in mammals including dogs, cats, horses, cattle (WC strain) and muskrats (M56 strain).

Geographic Distribution

C. psittaci can be found worldwide. This organism is particularly common among psittacine birds in tropical and subtropical regions.

Transmission

C. psittaci can be transmitted between birds by the inhalation of infectious dust or airborne particles such as feathers, and by the ingestion of infectious material including carcasses. Large quantities of this organism are excreted in feces, and can become aerosolized when the fecal material dries. *C. psittaci* is also found in respiratory and oral secretions. Some birds carry the organism asymptotically, and can shed it intermittently for long periods. Shedding can be stimulated by concurrent infections or stressors such as nutritional deficiencies, handling, overcrowding or egg laying. *C. psittaci* can also be transmitted on fomites including contaminated feed or water. The infectious form found outside cells, which is called the elementary body, is resistant to drying and can remain viable for months if protected by organic debris. It is reported to survive in bird feed for up to two months, on glass for 15 days, and in straw for 20 days. Biting flies, mites and lice may be involved in mechanical transmission.

Vertical transmission has been reported in turkeys, ducks, chickens, parakeets, seagulls and snow geese, but appears to be infrequent. More often, young birds may be infected in the nest via regurgitated food from the parents, by exposure to environmental contamination, or from ectoparasites. Nestlings that survive can become carriers. Epizootics tend to occur when large numbers of birds are in close contact.

Dogs can be infected with *C. psittaci* if they eat bird carcasses or feces. Mammals are probably also infected via inhalation.

Incubation Period

The incubation period in cage birds is usually three days to several weeks. In carriers, active disease can occur any time, and may be seen years after infection.

Clinical Signs

C. psittaci produces a systemic disease in birds. Depending on the strain of the organism and the species, age and condition of the bird, infections may be asymptomatic or result in mild to severe clinical signs.

Acute or chronic disease can be seen in psittacines. Many infected birds remain asymptomatic until they become stressed. The clinical signs may include anorexia, lethargy, ruffled feathers, serous or mucopurulent oculonasal discharge, and weight loss. Some birds develop respiratory signs ranging from sneezing to respiratory distress. Conjunctivitis and diarrhea with green to yellowish droppings may also be seen. Neurological signs can be found, especially in subacute to chronic cases; torticollis, opisthotonos, tremors, convulsive movements, and flaccid paralysis or paresis of the legs have been reported. Severely affected birds may become emaciated and dehydrated before death. Recurrent keratoconjunctivitis, often without generalized signs of disease, has been seen in small Australian parakeets. Conjunctivitis, with or without other signs, is also common in some finches. Residual disturbances in feathering may be apparent in survivors.

The clinical signs are similar in other species of birds. Turkeys are especially likely to develop pneumonitis and myocarditis when infected. Egg production is decreased. Conjunctivitis, blepharitis and rhinitis are common in pigeons. Neurological signs may include transient ataxia in pigeons, and trembling or gait abnormalities in ducks. One study has linked *C. psittaci* with cystic oviducts among laying hens; this remains to be confirmed.

Infections are reported occasionally among mammals that have been in contact with birds. In horses, *Chlamydophila psittaci* has been linked to some abortions. A variety of syndromes have been attributed to this organism in dogs. *Chlamydophila psittaci* genotype C, possibly acquired from a pet bird, was isolated from a group of dogs with recurrent respiratory and reproductive problems, including episodes of severe dyspnea and keratoconjunctivitis. These dogs produced litters that were smaller than normal, with unusually large numbers of dead pups. In another outbreak, the introduction of an infected cockatiel into a household caused illness in two of three dogs. One dog developed acute disease with fever, shivering, coughing, retching, dyspnea and a slight oculonasal discharge. Another dog had a mild fever, lethargy, anorexia, congestion of the mucous membranes, and evidence of bacterial endocarditis, which resolved upon antibiotic treatment. A third dog was clinically unaffected but seropositive. Bird-associated isolates of *Chlamydia psittaci* were reported from a 5-month-old dog with fever, pleural effusion and shifting leg lameness, and from a dog with a spasmodic exercise-induced cough and

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loss of condition. An avian strain of *Chlamydia psittaci* was isolated from the 5-month old dog, while the latter case was linked to the ingestion of infected budgerigar carcasses and infectious feces. Cats are generally infected with *Chlamydophila felis* rather than *Chlamydophila psittaci*; however, one case of conjunctivitis was apparently acquired from a macaw.

Post Mortem lesions

Post-mortem lesions in birds may include nasal adenitis, congestion of the lungs, fibrinous pneumonia, fibrinous airsacculitis, splenomegaly and hepatic enlargement with multifocal hepatic necrosis. Fibrinous peri-hepatitis, pericarditis, peritonitis and vascular congestion may also be seen. In some turkeys, an enlarged and congested spleen may be the only gross lesion. Enteritis, hepatomegaly, airsacculitis and conjunctivitis with swollen and encrusted eyelids are common in pigeons. Asymptomatically infected birds often have no gross lesions .

Morbidity and Mortality

C. psittaci is frequently found in psittacine birds and pigeons. The reported prevalence is 16-81% in psittacines and 23-85% in pigeons, with a seroprevalence rate of 10-96% in feral pigeons. In some regions, this organism is also common in domesticated ducks and turkeys.

Morbidity and mortality rates vary with the host species, condition of the bird, and virulence of the isolate. In psittacine birds, which are often infected with virulent genotype A strains, the mortality rate can be 50% or higher. Clinical signs tend to be less severe in pigeons, which are usually infected with the milder genotypes B and E, and deaths are often caused by secondary infections. In turkeys, the mortality rate for untreated infections is 5–40%. Genotype D is the most virulent type in this species, with an overall morbidity rate of 50–80% and a mortality rate of 5–30% or higher. In broiler turkeys, up to 80% of infections with this genotype may be fatal. Other genotypes in turkeys usually result in 5–20% morbidity, with much lower mortality rates. In ducks, genotype C has a morbidity rate of 10–80% and a mortality rate of 0–30%. Some duck farms are infected with few or no clinical signs. Outbreaks of severe disease have also been seen in shorebirds and migratory birds. Concurrent infections or stress increase the severity of the disease in all species. Age can also be a factor; young birds tend to be more susceptible than older birds.

C. psittaci is uncommonly reported in mammals, and the morbidity and mortality rates are unknown.

Diagnosis

Clinical

Chlamydiosis can be difficult to diagnose; however, it should be considered in a bird that is lethargic and has nonspecific signs of illness. A high index of suspicion should be maintained in recently purchased pet birds.

Differential diagnosis

In turkeys, the differential diagnosis includes influenza, aspergillosis, fowl cholera, and *Mycoplasma gallisepticum* infections. In cage birds, infections with herpesviruses, paramyxovirus, avian influenza, and the Enterobacteriaceae should be considered. Samples from all birds should be cultured for *Salmonella*, *Pasteurella*, *Mycoplasma*, and other bacteria and viruses.

Laboratory tests

C. psittaci infections can be diagnosed by culture, the detection of antigens or nucleic acids, histochemistry, immunohistochemical staining and serology. A combination of techniques may be necessary, especially when only one bird is tested. It is easier to make a diagnosis in birds that are acutely ill.

C. psittaci can be cultured only in laboratories with biosafety level 3 facilities. This organism may be isolated in many cell types including buffalo green monkey, McCoy, HeLa, Vero and L-929 cells. It can also be recovered in 6 to 7 day old embryonated eggs. It is often identified by immunofluorescence or immunoperoxidase staining, but genetic techniques can also be used. Isolates can be serotyped with monoclonal antibodies, or genotyped with genotype-specific real-time PCR, DNA microarrays or DNA sequencing. Isolation may be unsuccessful in birds treated with antibiotics during the 2 to 3 weeks before testing.

Avian chlamydiosis can also be diagnosed by demonstrating *C. psittaci* directly in clinical samples, using immunohistochemistry or PCR. Antigen capture ELISAs for use with human clinical samples can be employed in birds; however, their sensitivity and specificity in avian species is unknown, and they are best used in conjunction with other tests. Histochemistry can give a tentative diagnosis or be used to support other diagnostic techniques. Chlamydiae are small coccoid organisms that stain red or pink against a counterstained blue or green background. They can be detected in tissues with Giemsa, Gimenez, Ziehl–Neelsen and Macchiavello's stains.

Serological tests include complement fixation, ELISAs, latex agglutination, elementary body agglutination (EBA), microimmunofluorescence, and agar gel immunodiffusion tests. The EBA test detects only IgM and can be used to diagnose current infections. A four-fold rise in titer should be seen in paired samples. A

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presumptive diagnosis can be made if single high titers are found in several birds in a population.

Samples to collect

Chlamydiosis is a zoonotic disease; samples should be collected and handled with all appropriate precautions. Samples should be wrapped securely, and shipments should conform with all biohazard regulations.

C. psittaci can be detected in a variety of secretions, excretions and tissues. The samples to be taken vary with the disease signs and necropsy lesions. In live birds that are ill, pharyngeal or nasal swabs are preferred for culture, but feces, cloacal swabs, conjunctival scrapings and peritoneal exudate can also be collected. At necropsy, *C. psittaci* may be isolated from blood, ocular or nasal exudates, inflammatory exudates, and tissue samples from the liver, spleen, lung, kidney, pericardium and colon contents. Repeated fecal sampling over 3 to 5 consecutive days is helpful in birds suspected to be carriers. A single negative culture can be misleading in these birds, as they may shed *C. psittaci* only intermittently. Samples for culture should be submitted in special transport media to prevent the loss of infectivity during shipping and storage. They should be refrigerated and sent on ice, but not frozen. Isolation may be unsuccessful in birds treated with antibiotics during the 2 to 3 weeks before testing.

Recommended actions if chlamydiosis is suspected

Notification of authorities

Chlamydiosis is a reportable disease. State or federal authorities should be consulted for more specific information.

Federal: Area Veterinarians in Charge (AVIC):
http://www.aphis.usda.gov/animal_health/area_offices/
State Veterinarians:
<http://www.aphis.usda.gov/vs/sregs/official.html>

Control

No vaccine is available for avian chlamydiosis, and complete eradication appears to be impractical due to the large number of potential hosts. However, steps can be taken to reduce the risk of infection. To prevent the introduction of avian chlamydiosis into a facility, new birds should be examined for signs of illness, quarantined for at least 30 days, and tested for *C. psittaci*. Birds that have returned from events such as shows or fairs are also isolated. Wild birds should be excluded from the facility, and wild rodents, which might act as mechanical vectors, should be controlled. Regular cleaning and disinfection of the premises and equipment also aids control. Cages should be positioned so that nothing including feces, food or feathers is readily transferred between them. Cross-

contamination between areas or units should be minimized. Good exhaust ventilation can help reduce the build-up of aerosols and prevent cross-contamination. All-in/all-out management of units, where appropriate, can be helpful. The routine use of prophylactic antibiotics is discouraged, because it may favor the development of antibiotic-resistant strains of *C. psittaci* and other bacteria. Records should be kept of bird-related transactions for at least one year. Breeders can also participate in a voluntary certification program for pet birds.

Infected premises are usually quarantined. Poultry may be euthanized. Infected pet birds and their contacts can be isolated and treated. During treatment, measures such as frequent wet-mopping of the floor with disinfectants can reduce the circulation of dust and feathers. Dead birds should be immersed in disinfectant solutions to reduce the risk of aerosolization. Before restocking or releasing treated birds from quarantine, the premises should be thoroughly cleaned and disinfected. *C. psittaci* is susceptible to many disinfectants including quaternary ammonium compounds, chlorophenols, iodophore disinfectants, formaldehyde, glutaraldehyde, isopropyl alcohol and sodium hydroxide (bleach). This organism is resistant to acid or alkali. It is susceptible to moist heat of 121°C (250°F) for a minimum of 15 minutes, and dry heat of 160-170°C (320-338°F) for one hour or longer.

Prevention and testing programs in birds help protect humans. Pet birds should be bought from reputable suppliers, and examined by a veterinarian when they are first acquired. Good hygiene, including frequent hand washing, should be used when handling birds. Birds and cages should be kept in a well-ventilated area to prevent the accumulation of infectious dust. Cages should be cleaned regularly to prevent the build-up of wastes. Dampening the cage first with cleaning solution or disinfectant reduces aerosolization. Any bird that has regular contact with the public (e.g., birds in schools and long-term care facilities) should be routinely screened for *C. psittaci*.

Public Health

The risk of psittacosis is highest among people who are exposed to birds or their tissues; this group includes bird owners, veterinarians, laboratory workers, pet shop employees and poultry workers (including workers in processing plants). Infections can occur after transient exposure. Humans usually become infected after inhaling contaminated dust, feathers or aerosolized secretions and excretions. Direct contact with infected birds, including bites, can also spread the disease.

Some cases are asymptomatic. Clinical cases vary from a mild, flu-like illness to severe atypical pneumonia

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with dyspnea. In uncomplicated infections, the illness usually lasts approximately 7 to 10 days, and may be self-limiting. Complications can also occur. Pregnant women may give birth prematurely, and fetal death is possible. Endocarditis, myocarditis, renal disease, hepatitis, anemia, and neurologic signs may also be seen. Before the use of antibiotics, the case fatality rate was 15-20% in the general population and it was as high as 80% in pregnant women; however, treated cases are rarely fatal. Convalescence may be slow after severe disease.

Humans can be infected during a transient exposure, and precautions should be taken during any contact with infected birds. Personal protective equipment (PPE) should be used when handling birds or cleaning their cages. A respirator (N95 or higher rating) protects the wearer from inhaled organisms; surgical masks might not be effective. Gloves and protective clothing should also be worn. Carcasses, tissues and contaminated fomites should be handled carefully. Dead birds should be immersed in disinfectant solutions to reduce the risk of aerosolization. Carcasses should be wet with disinfectant, or detergent and water, during necropsy. Necropsies should be done in a laminar flow hood. If a hood is unavailable, PPE should be worn. Construction workers and others should also use PPE when removing accumulations of pigeon feces. Wetting the wastes before removal decreases aerosolization. Children should be warned not to touch sick or dead birds.

Because asymptomatic birds can shed *C. psittaci*, anyone who has been in contact with birds and develops symptoms consistent with psittacosis should consult a physician.

Internet Resources

Centers for Disease Control and Prevention (CDC).

Psittacosis.

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/psittacosis_t.htm

Medical Microbiology

<http://www.gsbs.utmb.edu/microbook>

National Association of State Public Health Veterinarians (NASPHV)

<http://www.nasphv.org>.

NASPHV Compendium of Measures to Control

Chlamydophila psittaci Infection among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis)

<http://www.nasphv.org>.

The Merck Manual

<http://www.merck.com/pubs/mmanual/>

The Merck Veterinary Manual

<http://www.merckvetmanual.com/mvm/index.jsp>

Public Health Agency of Canada. Material Safety Data Sheets

<http://www.phac-aspc.gc.ca/msds-ftss/index.html>

World Organization for Animal Health (OIE)

<http://www.oie.int/>

OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals

http://www.oie.int/eng/normes/mmanual/a_summry.htm

OIE Terrestrial Animal Health Code

http://www.oie.int/eng/normes/mcode/en_sommaire.htm

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*Link defunct as of 2009.