

## Psittacosis/avian chlamydiosis

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**P**sittacosis (also known as parrot fever or ornithosis) is a bacterial infection of humans that can result in severe pneumonia and death. It is caused by infection with an organism newly renamed as *Chlamydophila psittaci*.<sup>1</sup> Formerly, the organism was called *Chlamydia psittaci*. The disease in birds has been referred to as avian chlamydiosis. National guidelines on this disease are updated annually (most recently in 2002) by the National Association of State Public Health Veterinarians (NASPHV) in its "Compendium of measures to control *Chlamydophila psittaci* (formerly *Chlamydia psittaci*) infection among humans (psittacosis) and pet birds, 2002."<sup>2</sup> The compendium provides a practical summary of modes of transmission, clinical signs, case definitions, and methods of diagnosis, prevention, and treatment for humans and pet birds. Its purpose is to provide standardized procedures for controlling avian chlamydiosis in birds to protect humans. Updated listings of laboratories for testing human and avian specimens and sources of medication for avian chlamydiosis are provided. The annual compendium is made available nationwide to veterinarians and others in public health and clinical practice by the NASPHV, the Centers for Disease Control and Prevention, and the American Veterinary Medical Association.<sup>3</sup> This article provides a summary of additional information about chlamydial infections in animals, including birds, humans, and other mammals, rather than a repeat of information regularly updated in the compendium.

### Reclassification of Chlamydial Organisms

Members of the order *Chlamydiales* are obligate intracellular bacteria with a 2-stage developmental

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cycle of replication. After infection, the bacteria reside within a cytoplasmic inclusion where they replicate by binary fission, then break out of the host cell to be disseminated by aerosol or contact.<sup>1</sup>

In the new taxonomic classification for *Chlamydiales*, Family I, *Chlamydiaceae*, has 2 genera, *Chlamydia* and *Chlamydophila*.<sup>1</sup> *Chlamydia* encompasses *C trachomatis* and similar species and strains such as *muridarum* and *suis*. *Chlamydophila* includes species and strains previously labeled as *Chlamydia* that are distinct from *C trachomatis*, such as *abortus*, *caviae*, *felis*, *pecorum*, *pneumoniae* (including TWAR), and *psittaci*.

Only avian-like strains have been retained in *Chlamydophila psittaci*. The former *C psittaci* abortion, feline, and guinea pig strains have been reclassified as *Chlamydophila abortus*, *felis*, and *caviae*, respectively.<sup>1</sup> Currently, *C psittaci* has 8 known serovars, 6 of which have been isolated primarily from birds (A-F) and 2 (WC and M56) from mammals.<sup>1,4</sup> Identification of the serovar may help to pinpoint the source of an infection because most serovars are host specific.<sup>4</sup> Methods include the indirect fluorescent antibody test using serovar-specific monoclonal antibodies,<sup>5,6</sup> polymerase chain reaction (PCR)-restriction fragment length polymorphism,<sup>7</sup> or PCR-sequence analysis.<sup>8</sup>

### Infection in Birds

Chlamydial infections have been documented in an estimated 150 avian species,<sup>4</sup> including 57 species in the parrot family.<sup>9</sup> Serovars A and F are frequently isolated from psittacine birds.<sup>4</sup> The organism has also been identified in 13 species of shore birds,<sup>9</sup> pigeons (frequently serovars B and E),<sup>4</sup> and all species of domestic poultry.<sup>9</sup> A recent study of the prevalence of *C psittaci* in Australia documented shedding of the organism in 10 to 57% of birds from pigeon lofts and 5 to 42% of the psittacine birds from pet shops and private aviaries.<sup>10</sup>

Outbreaks have been reported on turkey and duck farms and have been linked to human infection.<sup>11</sup> Turkeys are more likely than other species to develop pneumonitis and myocarditis when infected.<sup>12-14</sup> Although serovars B, D, and E have caused outbreaks of disease in turkeys,<sup>6,11</sup> serovar D is considered to be the most virulent for turkeys, with morbidity of 50 to 80% and mortality of 5 to 30%.<sup>4</sup> Infection in domestic ducks is linked most often to serovar C, with morbidity from 10 to 80% and mortality from 0 to 30%; human cases in workers were also documented.<sup>4</sup> Serovar D has been isolated from egrets and gulls,<sup>4</sup> and serovar E has been isolated from rats.<sup>15</sup>

## Psittacosis in Humans

In humans with *C psittaci* infection, a wide spectrum of illnesses is possible, ranging from asymptomatic infections to mild influenza-like illness to a fulminate illness with involvement of several extra-pulmonary sites.<sup>16</sup> Thoracic radiography may reveal more severe abnormalities than the clinical signs or results of physical examination indicate. Occasional ocular infections, including a case of progressive follicular keratoconjunctivitis, have been documented in humans with bird contact.<sup>17</sup> Hepatic involvement and anemia has also been reported in a bird-acquired human case.<sup>18</sup> In a review of 13 human cases associated with a church-sponsored aviary, a substantial number of the patients had the typhoidal form of psittacosis without prominent respiratory symptoms; however, arthralgia and joint swelling was frequent, and a petechial rash was observed in one patient.<sup>19</sup> The case-fatality rate can be high, as in a pet shop-related outbreak with 7 human cases in which 2 of the elderly patients died.<sup>20</sup>

One study in the United Kingdom reviewed the records of 219 patients with a 4-fold change in *C psittaci* antibodies from 1965 to 1989.<sup>21</sup> Although respiratory infections with constitutional symptoms were predominant, gastrointestinal, hepatic, cardiac, and neurologic syndromes were also reported. Avian contact preceded infection in 62% of the cases. In 41% of the bird-associated cases, the birds had been ill or had died, and in 15%, the birds had been newly acquired. Most of the birds were household pets (such as budgerigars and parrots) or were housed in garden aviaries or pigeon lofts. Poultry was implicated in only one of the cases. Infection with *C pneumoniae* (TWAR) rather than *C psittaci* was not ruled out for the cases without bird contact, and other studies of human cases in Norway indicate this is an important variant for human pneumonia.<sup>22</sup>

When avian chlamydiosis is widespread in a group of pet birds, the prevalence of human infections can be quite high. In 1995, birds from a shipment of more than 700 birds sent to 9 Atlanta-area pet stores were reported to be dying. Clinical psittacosis or serologic evidence of *C psittaci* infection was found in 30.7% of households with birds from that infected flock.<sup>23</sup> Although people with the greatest bird contact were more likely to become infected, most of the illnesses were mild or the infections were asymptomatic.

A number of cases of gestational psittacosis in humans have been reported.<sup>24</sup> Two cases in the United States were secondary to the mother's exposure to infected psittacine birds (a parakeet and a parrot).<sup>25,26</sup> Eleven cases in the United Kingdom and France were associated with infected sheep or goats (primarily with assisting in fetal deliveries)<sup>24</sup>, and 1 in Montana was reported related to assisting with lamb deliveries.<sup>25</sup> These cases were reported prior to the reclassification of chlamydial organisms, and testing to the serovar level was not reported. However, test results indicated the implicated organisms were not in the *C pneumoniae* group. Thus, it appears that the bird-associated cases may have been caused by *C psittaci* and the sheep and goat-related cases caused by *C abortus*.

Human chlamydial infection remains an important occupational hazard to those in the poultry industry, even those employees who only handle defeathered, eviscerated, and chilled turkey carcasses. Of 186 suspected human cases among turkey industry workers during a 6-month period in Minnesota, 122 cases were confirmed serologically.<sup>27</sup> The cases occurred in 3 turkey processing plants, 2 rendering plants, 1 farm, and 1 plant where meat is removed from eviscerated carcasses to make consumer products such as roasts. Infection in turkeys was also confirmed, but the specific mode of transmission was not identified. In North Carolina, 60 suspected human cases were reported related to a turkey-processing plant; 40 infections were confirmed with laboratory testing.<sup>28</sup> A flock of turkeys at the plant had a carcass condemnation rate of 25% because of air sacculitis (compared with a usual condemnation rate of 1 to 3%) prior to the development of symptoms in humans. Medical costs for the patients exceeded \$124,000.

## Other Zoonotic Chlamydiaceae Infections in Mammals

Infections with *Chlamydiaceae* have been documented in many mammalian species. These organisms are often shed via the enteric route and discharged placenta.<sup>29</sup> Because of limited human case reports with these organisms, it has been postulated that the mammalian organisms are of low infectivity for human beings, compared with avian strains. However, the mammalian strain considered to have the greatest human exposure is the feline.<sup>29</sup>

Feline strains of *C psittaci* are now classified separately as *C felis*. In cats, *Chlamydiaceae* have been linked to pneumonia<sup>30</sup> and conjunctivitis.<sup>31,32</sup> *Chlamydophila felis* infection has been associated with abnormal liver function, malaise, and cough in a person who had a pet cat with a cough,<sup>33</sup> as well as a person who also had endocarditis and glomerulonephritis.<sup>34</sup> One recent study in Japan found higher chlamydial microimmunofluorescence antibody concentrations in stray cats (60.2%) than in pet cats (20.5%), with some cats having evidence of infection with avian or feline strains and others with antibodies to both strains.<sup>35</sup> Of sera from 16 small animal veterinarians and 35 members of the general population reacting with chlamydial antigens in the same study, 15 (29%) reacted only to the feline strain, 17 (33%) reacted only to the avian strain, and 19 (37%) reacted to both strains. In addition, 1 study reported conjunctivitis in a pet cat caused by *C psittaci* that developed after that cat was housed with an infected macaw,<sup>36</sup> and cases of chlamydial conjunctivitis in cat owners have been attributed to feline transmission.<sup>37</sup>

Previous *C psittaci* isolates associated with miscarriages in ruminants are now classified as *C abortus*. Cases have been documented in sheep, cattle, goats,<sup>5</sup> and a pig.<sup>38</sup> In the new classification of *C psittaci*, serovar WC has been associated with cattle, and serovar M56 has been associated with muskrat and snowshoe hares.<sup>4</sup>

## Summary

Considerable progress continues to be made in understanding chlamydial organisms, their host species, diagnosis, and treatment.<sup>1,3</sup> Thus, national guidelines are updated annually to provide a standardized approach to handling infections in humans and birds.<sup>2,3</sup> Prior to development of these guidelines, considerable variation in approach by state agencies has been documented.<sup>39</sup> A more recent national assessment of state regulations and procedures has not been conducted.

Decreasing imports of birds and increasing education may contribute to a reduction in human risk from avian infections. Keeping new birds separate from old birds in aviaries and poultry production facilities may reduce the incidence of avian chlamydiosis. Although wide-scale testing of birds may not be cost effective,<sup>28</sup> focal testing and treatment may help reduce human risk. The recent loss of a major source for pelleted feed for small birds, such as budgerigars, was a severe setback for veterinarians and local agencies in managing this disease. However, new medication formulas under development may help to address this problem.<sup>2,3</sup>

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