CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

July 10, 1998 / Vol. 47 / No. RR-10

MMWR™

Recommendations and Reports

MORBIDITY AND MORTALITY WEEKLY REPORT

Compendium of Measures To Control *Chlamydia psittaci* Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), 1998

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention (CDC)
Atlanta, Georgia 30333

The *MMWR* series of publications is published by the Epidemiology Program Office, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30333.

SUGGESTED CITATION

Centers for Disease Control and Prevention. Compendium of measures to control *Chlamydia psittaci* infection among humans (psittacosis) and pet birds (avian chlamydiosis), 1998. MMWR 1998;47(No. RR-10):[inclusive page numbers].

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Compendium of Measures To Control *Chlamydia psittaci* Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), 1998

Summary

Psittacosis — also known as parrot disease, parrot fever, and ornithosis — can cause severe pneumonia and other serious health problems among humans. Approximately 800 cases of psittacosis (infection with Chlamydia psittaci*) were reported to CDC from 1987 through 1996, and most resulted from exposure to pet birds, usually parrots, macaws, cockatiels, and parakeets. In birds,* C. psittaci *infection is referred to as avian chlamydiosis (AC). Infected birds shed the bacteria through feces and nasal discharges, which can remain infectious for several months. This compendium provides information about psittacosis and AC to public health officials, physicians, veterinarians, members of the pet bird industry, and others concerned about controlling these diseases and protecting public health. The recommendations in this compendium provide effective, standardized procedures for controlling AC in birds, a vital step to protecting human health.*

INTRODUCTION

Chlamydia psittaci is a bacterium that can be transmitted from pet birds to humans. In humans, the resulting infection is referred to as psittacosis (also known as parrot disease, parrot fever, and ornithosis). Psittacosis often causes influenza-like symptoms and can lead to severe pneumonia and nonrespiratory health problems. With proper treatment, the disease is rarely fatal. From 1987 through 1996, CDC received reports of 831 cases of psittacosis (*1*), which is an underestimate of the actual number of cases because psittacosis is difficult to diagnose.

During the 1980s, approximately 70% of the psittacosis cases with a known source of infection resulted from human exposure to caged pet birds; of these persons, the largest group affected (43%) included bird fanciers and owners of pet birds. Pet shop employees accounted for an additional 10% of cases. Other persons at risk include pigeon fanciers and persons whose occupation places them at risk for exposure (e.g., employees in poultry slaughtering and processing plants, veterinarians, veterinary technicians, laboratory workers, workers in avian quarantine stations, farmers, and zoo workers). Because human infection can result from brief, passing exposure to infected birds or their contaminated droppings, persons with no identified leisure-time or occupational risk can become infected.

In this report, *C. psittaci* infection in birds is referred to as avian chlamydiosis (AC). The bacterium *C. psittaci* has been isolated from approximately 100 bird species and is most commonly identified in psittacine birds such as parrots, macaws, cockatiels, and parakeets. Among caged, nonpsittacine birds, infection with *C. psittaci* occurs most frequently in pigeons, doves, and mynah birds. The incidence of infection in canaries and finches is believed to be lower than in other psittacine birds.

The recommendations in this compendium provide effective, standardized procedures for controlling AC in the pet bird population, an essential step in efforts to control psittacosis among humans. This compendium is intended to guide public health officials, physicians, veterinarians, persons in the pet bird industry, and others concerned with the control of *C. psittaci* infection and the protection of public health.

PART I. INFECTION AMONG HUMANS (PSITTACOSIS)

Transmission

Because several diseases affecting humans can be caused by other species of *Chlamydia*, the disease resulting from the infection of humans with *C. psittaci* frequently is referred to as psittacosis rather than chlamydia. Most *C. psittaci* infections in humans result from exposure to pet psittacine birds. Infection with *C. psittaci* usually occurs when a person inhales the organism, which has been aerosolized from respiratory secretions or dried feces of infected birds. Other means of exposure include bird bites, mouth-to-beak contact, and the handling of infected birds' plumage and tissues. Even brief exposures can lead to symptomatic infection; therefore, some patients with psittacosis may not recall or report having any contact with birds.

Mammals occasionally transmit *C. psittaci* to humans. Certain strains of *C. psittaci* infect sheep, goats, and cattle, causing chronic infection of the reproductive tract, placental insufficiency, and abortion in these animals. These strains of *C. psittaci* are transmitted to persons when they are exposed to the birth fluids and placentas of infected animals. Another strain of *C. psittaci*, feline keratoconjunctivitis agent, typically causes rhinitis and conjunctivitis in cats. Transmission of this strain from cats to humans appears to occur rarely.

Human-to-human transmission has been suggested but not proven. Standard infection-control precautions are sufficient for patients with psittacosis, and specific isolation procedures (e.g., a private room, negative pressure air flow, and masks) are not indicated.

Clinical Signs and Symptoms

For persons infected with *C. psittaci*, the onset of illness follows an incubation period of 5–14 days. The severity of this disease ranges from inapparent illness to systemic illness with severe pneumonia. Before antimicrobial agents were available, 15%–20% of persons with *C. psittaci* infection were reported to have died. However, <1% of properly treated patients now die as a result of the infection.

Persons with symptomatic infection typically have abrupt onset of fever, chills, headache, malaise, and myalgia. They usually develop a nonproductive cough that can be accompanied by breathing difficulty and chest tightness. A pulse-temperature dissociation (fever without elevated pulse), enlarged spleen, and rash are sometimes observed and suggest a diagnosis of psittacosis for patients with community-acquired pneumonia. Auscultatory findings may underestimate the extent of pulmonary involvement. Radiographic findings include lobar or interstitial infiltrates. The differential diagnosis of psittacosis-related pneumonia includes infection with *Coxiella burnetii, Mycoplasma pneumoniae, Chlamydia pneumoniae, Legionella* species, and

respiratory viruses such as influenza. *C. psittaci* can affect organ systems other than the respiratory tract and result in endocarditis, myocarditis, hepatitis, arthritis, keratoconjunctivitis, and encephalitis. Severe illness with respiratory failure, thrombocytopenia, hepatitis, and fetal death has been reported among pregnant women.

Diagnosis

A patient is considered to have a *confirmed* case of psittacosis if clinical illness is compatible with psittacosis and the case is laboratory confirmed by one of three methods: a) *C. psittaci* is cultured from respiratory secretions; b) antibody against *C. psittaci* is increased by fourfold or greater (to a reciprocal titer of ≥32 between paired acute- and convalescent-phase serum specimens collected at least 2 weeks apart) as demonstrated by complement fixation (CF) or microimmunofluorescence (MIF); or c) immunoglobulin M antibody against *C. psittaci* is detected by MIF (to a reciprocal titer of ≥16). A patient is considered to have a *probable* case of psittacosis if clinical illness is compatible with psittacosis and a) the case is epidemiologically linked to a confirmed case of psittacosis or b) a single antibody titer ≥32, demonstrated by CF or MIF, is present in at least one serum specimen obtained after onset of symptoms. CDC and the Council of State and Territorial Epidemiologists established these case definitions for epidemiologic purposes (*2*). These definitions should not be used as the sole criteria for establishing clinical diagnoses.

Until recently, the diagnosis almost always was established by using serologic methods in which paired sera were tested for *Chlamydia* antibodies by CF test. However, because *Chlamydia* CF antibody is not species-specific, high CF titers also may result from *Chlamydia pneumoniae* and *Chlamydia trachomatis* infection. Acute-phase serum specimens should be obtained as soon as possible after the onset of symptoms, and convalescent-phase serum specimens should be obtained ≥2 weeks after the onset of symptoms. Because treatment with tetracycline can delay or diminish the antibody response, a third serum sample might help confirm the diagnosis. All sera should be tested simultaneously at the same laboratory. If the patient's epidemiologic and clinical history indicate a possible diagnosis of psittacosis, MIF assays can be used to distinguish *C. psittaci* infection from infection with other chlamydial species. Information about laboratory testing often is available at state laboratories. The infectious agent also can be isolated from the patient's sputum, pleural fluid, or clotted blood during acute illness and before treatment with antimicrobial agents; however, culture of *C. psittaci* is performed by few laboratories because of technical difficulty and safety concerns.

Treatment

Tetracyclines are the drugs of choice for treating patients with psittacosis. Most persons respond to oral therapy (100 mg of doxycycline administered twice a day or 500 mg of tetracycline hydrochloride administered four times a day). For initial treatment of severely ill patients, doxycycline hyclate may be administered intravenously at a dosage of 4.4 mg/kg (2 mg/lb) body weight per day divided into two infusions per day (up to 100 mg per dose). In past years, tetracycline hydrochloride has been administered to patients intravenously (10–15 mg/kg body weight per day divided into four doses per day), but a preparation for injection is no longer available in the United

States. Remission of symptoms usually is evident within 48–72 hours. However, relapse can occur, and treatment must continue for at least 10–14 days after fever abates. Although its in vivo efficacy has not been determined, erythromycin probably is the best alternative agent for persons for whom tetracycline is contraindicated (e.g., children aged <9 years and pregnant women).

PART II. INFECTION AMONG BIRDS (AVIAN CHLAMYDIOSIS)

Transmission

Shedding of the infectious agent among birds with latent chlamydiosis may be activated by several stress factors, including shipping, crowding, chilling, and breeding. Birds can appear healthy but be carriers of *C. psittaci* and can shed the organism intermittently. When shedding occurs, the organism is excreted in the feces and nasal discharges of infected birds. The organism is resistant to drying and can remain infectious for several months.

Clinical Signs

For caged birds, the time between exposure to *C. psittaci* and the onset of illness ranges from 3 days to several weeks. However, latent infections are common among birds, and active disease may appear years after exposure. *C. psittaci* infection in birds can be asymptomatic or can result in an acute, subacute, or chronic clinical disease. Whether the bird exhibits clinical signs of illness or dies depends on the species of bird, virulence of the strain, infectious dose, stress factors, age, and extent of treatment or prophylaxis.

Birds with clinical signs of AC typically have manifestations (e.g., lethargy, anorexia, and ruffled feathers) consistent with those of other systemic illnesses. Other signs associated with AC include serous or mucopurulent ocular or nasal discharge, diarrhea, and excretion of green to yellow-green urates. Anorectic birds may produce sparse, dark green droppings. Birds can die soon after onset of illness or, as the disease progresses, can become emaciated and dehydrated before death.

Diagnosis

Several diagnostic methods are available for identifying AC in birds (Appendix A). A *confirmed* case of AC is defined as infection with *C. psittaci* on the basis of at least one of the following laboratory results: a) isolation of *C. psittaci* from a clinical specimen, b) identification of chlamydial antigen by immunofluorescence (fluorescent antibody [FA]) of the bird's tissues, c) a greater than fourfold change in serologic titer in two specimens from the bird obtained at least 2 weeks apart and assayed simultaneously at the same laboratory, or d) identification of *C. psittaci* within macrophages in smears stained with Gimenez or Macchiavellos stain or sections of the bird's tissues.

A *probable* case of AC is defined as *C. psittaci* infection in a bird that has clinical illness compatible with AC and at least one of the following laboratory results: a) a single high serologic titer in one or more specimens obtained after the onset of signs

or b) the presence of *C. psittaci* antigen (identified by enzyme-linked immunosorbent assay [ELISA] or FA) in feces, a cloacal swab, or respiratory or ocular exudates.

A *suspected* case of AC is defined as a) clinical illness compatible with AC that is epidemiologically linked to another case in a human or bird but that is not laboratory confirmed, b) an asymptomatic infection in a bird with a single high serologic titer or detection of chlamydial antigen, c) illness in a bird that has positive results for infection on the basis of a nonstandardized test or a new investigational test, or d) a clinical illness compatible with chlamydiosis that is responsive to appropriate therapy.

Treatment

Veterinarians can choose from three types of methods for treating birds with AC — medicated feed (chlortetracycline), oral or parenteral treatment (doxycycline or oxytetracycline), and experimental treatment (fluoroquinolones, late-generation macrolides, pharmacist-compounded injectable doxycycline, and doxycycline-medicated feed) (Appendix B). Although these protocols are usually successful, knowledge about AC treatment is evolving, and no treatment protocol guarantees safe treatment or complete elimination of infection by the etiologic agent *C. psittaci* in all bird species. Therefore, treatment should be supervised by a licensed veterinarian.

PART III. RECOMMENDATIONS AND REQUIREMENTS

Recommendations for Controlling Infection Among Humans and Birds

To prevent the transmission of *C. psittaci* to persons and other birds, the following control measures are recommended for physicians, veterinarians and their staffs, and members of the pet bird industry:

- Take measures to protect persons at high risk from becoming infected. All persons in contact with infected birds should be informed about the nature of the disease. If a person who has been exposed develops respiratory illness, the physician should initiate early and specific treatment for psittacosis. Persons at risk should be instructed to wear protective clothing, gloves, a paper surgical cap, and a respirator with an N95 rating or a higher-efficiency respirator when cleaning cages or handling infected birds. Surgical masks may not be effective in preventing transmission of *C. psittaci*. When necropsies are performed on potentially infected birds, additional precautions should be taken, including a) wetting the carcass with detergent and water to prevent aerosolization of infectious particles and b) working under an examining hood that has an exhaust fan.
- Maintain accurate records of all bird-related transactions to aid in identifying sources of infected birds and potentially exposed persons. Records should include the date of purchase, species of birds purchased, source of birds, and any identified illnesses or deaths among birds. In addition, when birds are sold by a store, the seller should record the name, address, and telephone number of the customer; the date of purchase; the species of birds purchased; and the band numbers if applicable.

- Do not purchase or sell birds that have signs of AC (e.g., ocular or nasal discharge, diarrhea, or low body weight).
- Quarantine newly acquired birds for 30–45 days, and test or prophylactically treat them before adding them to a group.
- Consider birds that have been to shows, exhibitions, fairs, and other events as newly acquired birds, and quarantine them upon return to the facility.
- Test birds for AC before they are to be boarded or sold on consignment, and house them in a room separate from other birds.
- Practice preventive husbandry. Position cages to prevent the transfer of fecal matter, feathers, food, and other materials from one cage to another. Do not stack cages, and be sure to use solid-sided cages or barriers if cages are adjoining. The bottom of the cage should be made of wire mesh, and litter that will not produce dust (e.g., newspapers) should be placed underneath the mesh. Clean all cages and food and water bowls daily. Soiled bowls should be emptied, cleaned with soap and water, rinsed, placed in a disinfectant solution, and rinsed again before reuse. Between occupancies by different birds, cages should be thoroughly scrubbed with soap and water, disinfected, and rinsed in clean, running water. Exhaust ventilation should be sufficient to prevent accumulation of aerosols.
- Prevent the spread of infection. If AC is confirmed, probable, or suspected, birds requiring treatment should be held in isolation. Rooms and cages where infected birds were housed should be cleaned immediately and disinfected thoroughly to eliminate chlamydial organisms from the environment. When the cage is being cleaned, transfer the bird to a clean cage. Thoroughly scrub the soiled cage with a detergent to remove all fecal debris, rinse the cage, disinfect it (allowing at least 5 minutes of contact with the disinfectant), and rerinse the cage to remove the disinfectant. Discard all items that cannot be adequately disinfected (e.g., wooden perches, nest material, and litter). While birds are being treated, minimize the circulation of feathers and dust by taking precautions such as wet-mopping the floor frequently with disinfectants and preventing air currents and drafts within the area. Reduce contamination from dust by spraying the floor with a disinfectant or water before sweeping it. Do not use a vacuum cleaner, because vacuuming can cause aerosolization of infectious particles. Frequently remove waste material from the cage (after moistening the material), and burn or double-bag the waste for disposal. When possible, care for healthy birds before handling isolated birds.
- Use disinfection measures. Because *C. psittaci* has a high lipid content, it is susceptible to most disinfectants and detergents. In the clinic or laboratory, a 1:1,000 dilution of quaternary ammonium compounds (e.g., Roccal® or Zephiran®) is effective, as is 70% isopropyl alcohol, 1% Lysol®, 1:100 dilution of household bleach (i.e., 2.5 tablespoons per gallon [10 mL/L]), or chlorophenols. (*C. psittaci* is susceptible to heat but is resistant to acid and alkali.) Many disinfectants are respiratory irritants and should be used in a well-ventilated area. Avoid mixing disinfectants with any other product.

Recommendations for Treating and Caring for Infected Birds

All birds with confirmed or probable AC should be isolated and treated, preferably under the supervision of a veterinarian (Appendix B). Birds with suspected AC or birds previously exposed to AC should be isolated and retested or treated. Because treated birds can be reinfected with *C. psittaci* after treatment, such birds should not be exposed to untreated birds or other potential sources of infection. To prevent reinfection from environmental sources, aviaries should be thoroughly cleaned and sanitized. No vaccine against chlamydiosis in birds is available.

The following general recommendations should be followed by bird owners and dealers when treating and caring for birds with confirmed, probable, or suspected cases of AC:

- Protect birds from undue stress (e.g., chilling or shipping), poor husbandry, or malnutrition. These problems reduce the effectiveness of treatment and promote the development of secondary infections with other bacteria or yeast.
- Observe the birds daily, and weigh them every 3–7 days. If the birds are not maintaining weight, have them reevaluated by a veterinarian.
- Do not administer antimicrobial agents to birds through drinking water, and avoid the use of high dietary concentrations of calcium or other divalent cations.
- Isolate birds that are to be treated in clean, uncrowded cages, segregated by sex.
- Clean up all spilled food promptly; wash food and water containers daily.
- Provide fresh water and appropriate vitamins daily.
- Continue medication for the full treatment period to avoid relapses. Birds may appear clinically improved and have reduced shedding after 1 week.

Responsibilities of Veterinarians and Physicians

Veterinarians should be aware that AC is not a rare disease among pet birds and should consider a diagnosis of AC for any lethargic bird that has nonspecific signs of illness, especially if the bird was purchased recently. If AC is suspected, the veterinarian should submit appropriate laboratory specimens to a veterinary diagnostic laboratory to confirm the diagnosis. Both laboratories and attending veterinarians should follow local and state regulations or guidelines regarding case reporting. Veterinarians should work closely with authorities who conduct investigations in their jurisdictions. When appropriate, veterinarians should inform clients that infected birds should be isolated and treated. In addition, they should educate clients about the public health hazard posed by AC and the appropriate precautions that should be taken to avoid the risk for transmission. Persons exposed to the birds should seek medical attention if they develop influenza-like symptoms or other respiratory illness.

Most states require physicians to report cases of psittacosis among humans to the appropriate health authorities. Timely diagnosis and reporting may help identify the source of infection and control the spread of disease. Because single-serum titers are both insensitive and nonspecific for diagnosis of psittacosis, confirmation with paired acute- and convalescent-phase sera is recommended. Birds that are suspected

sources of human infection should be referred to veterinarians for evaluation and treatment. Local and state authorities may conduct epidemiologic investigations and institute additional disease-control measures (see Local and State Epidemiologic Investigations).

Quarantine of Birds

The appropriate animal and public health authorities may issue a quarantine for all affected and susceptible birds on a premises where *C. psittaci* infection has been identified. The purpose of imposing a quarantine is not to discourage disease reporting but to prevent further disease transmission (*3*). Because of the severe economic impact of quarantines, reasonable economic options should be made available to the owners and operators of pet stores. For example, with the approval of state or local authorities, the owner of quarantined birds may choose to a) treat the birds in a separate quarantine area to prevent exposure to the public and other birds or b) euthanize the infected birds. After completion of the treatment or removal of the birds, a quarantine can be lifted when the infected premises are thoroughly cleaned and disinfected. The area can then be restocked with birds.

Bird Importation Regulations

The Veterinary Services of the Animal and Plant Health Inspection Service, U.S. Department of Agriculture (USDA), regulates the importation of pet birds to ensure that exotic poultry diseases are not introduced into the United States. These regulations are set forth in the Code of Federal Regulations, Title 9, Chapter 1 (*3*). Because of the possibility of smuggled pet birds, these import measures do not guarantee that AC cannot enter the United States. In general, current USDA regulations regarding the importation of birds include the following requirements:

- Before shipping the birds, the importer must obtain an import permit from the USDA and a health certificate issued and/or endorsed by a veterinarian of the national government of the exporting country.
- A USDA veterinary inspection must be conducted at the first port of entry in the United States and a quarantine be imposed for a minimum of 30 days at a USDA-approved facility, to determine whether the birds are free of evidence of communicable diseases of poultry. In addition, the birds must be tested to ensure they are free of exotic Newcastle disease and pathogenic avian influenza.
- During the 30-day U.S. quarantine, psittacine birds must receive a balanced, medicated feed ration containing ≥1% chlortetracycline (CTC) with ≤0.7% calcium for the entire quarantine period as a precautionary measure against AC. The USDA recommends that importers continue CTC prophylactic treatment of psittacine birds for an additional 15 days (i.e., for 45 continuous days).

Local and State Epidemiologic Investigations

Public health or animal health authorities at the local or state level may need to conduct epidemiologic investigations to help control the transmission of *C. psittaci* to humans and birds. An epidemiologic investigation should be initiated if a) a bird with

confirmed or probable AC was procured from a pet store, breeder, or dealer within 60 days of the onset of signs of illness, b) a person has confirmed or probable psittacosis, or c) several suspect avian cases have been identified from the same source. Other situations may be investigated at the discretion of the appropriate local or state public health departments or animal health authorities.

Investigations involving recently purchased birds should include a visit to the site where the infected bird is located and identification of the location where the bird was originally procured (e.g., pet shop, dealer, breeder, or quarantine station). During such investigations, authorities should consider documenting the number and types of birds involved, the health status of potentially affected persons and birds, locations of facilities where birds were housed, relevant ventilation-related factors, the treatment protocol, and the source of medicated feed, if such treatment is initiated. To help identify multistate outbreaks of *C. psittaci* infection, local and state authorities should report suspected outbreaks to the Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, CDC, telephone (404) 639-2215.

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Appendix A

METHODS FOR DIAGNOSING AVIAN CHLAMYDIOSIS

Histopathologic Findings

In birds that have avian chlamydiosis (AC), cloudy air sacs and an enlarged liver and spleen usually are observed, but no specific gross lesion is pathognomonic. The chromatic or immunologic staining of tissue-impression smears can be used to identify organisms.

Culture Technique

Isolation of the etiologic agent, *Chlamydia psittaci*, from the bird's spleen, liver, air sacs, pericardium, heart, or intestines is the optimal means for verifying the diagnosis. *Chlamydia* organisms are obligate intracellular bacteria that must be isolated in tissue culture, mice, or chick embryos. Specialized laboratory facilities and training are necessary both for reliable identification of chlamydial isolates and for adequate protection of microbiologists. Consequently, few laboratories perform chlamydial cultures.

In live birds, depending on which clinical signs they exhibit, combined cloacal and choanal-swab specimens should be collected, refrigerated, and sent to the laboratory packed in ice, but not frozen. The proper handling of samples is critical for maintaining the viability of organisms for culture, and a special transport medium is required. Veterinarians should contact their specific diagnostic laboratory for procedures required for submission of specimens for isolation.

Live birds being screened for *C. psittaci* might not shed the microorganism daily. Therefore, to reduce laboratory costs, serial specimens should be collected for 3–5 consecutive days and pooled before being cultured. Tissue samples from the bird's liver and spleen are the preferred necropsy specimens for isolation of *C. psittaci*. When legal actions may result from chlamydiosis cases, use of culture is recommended to avoid limitations associated with other tests.

Tests for Antibody

A major problem with serologic testing is the interpretation of results. A positive serologic test result is evidence that the bird was infected by *C. psittaci* in the past, but it does not prove that the bird currently has active disease. False-negative results may occur for birds that have acute infection when they are sampled before seroconversion. Treatment with an antimicrobial agent may diminish the antibody response.

A single testing method may not be adequate because of the diversity of reactions with immunoglobulins from the various avian species. Therefore, the use of a combination of antibody- and antigen-detection methods for the diagnosis of chlamydiosis is recommended, particularly when only one bird is tested. When specimens are obtained from a single bird, serologic testing is most useful when a) signs of disease and the history of the flock or aviary are considered and b) serologic results are compared with the white blood cell counts and liver-enzyme activities. A greater than

fourfold increase in titer of paired samples or a combination of a titer and antigen identification is needed to confirm a diagnosis of chlamydiosis. Some of the advantages and disadvantages of two serologic tests for antibodies are described in the following paragraphs.

Direct Complement-Fixation (CF) Test

Direct CF is more sensitive to antibody activity than are agglutination methods. No commercial antigen is available. False-negative results are possible in specimens from small psittacine birds (e.g., budgerigars, young African grey parrots, and lovebirds). High titers may persist after treatment and complicate interpretation of subsequent tests. Modified direct CF is more sensitive than direct CF.

Elementary-Body Agglutination (EBA)

EBA is commercially available and can detect early infection. Titers ≥10 in budgerigars, cockatiels, and lovebirds and titers ≥20 in larger birds indicate current infection. However, positive titers may persist after treatment is completed, and EBA is performed only by one U.S. laboratory.

Tests for Antigen

Immunofluorescent-Staining Tests

Monoclonal or polyclonal antibodies, fluorescein-staining techniques, and fluorescent microscopy are used to identify infectious agents in impression smears from dead birds. When used with cloacal or fecal smears, the sensitivity and specificity of the test are questioned by some authorities. The test is most useful if the bird is shedding antigen. Its advantages are that it gives rapid results and does not require live, viable organisms. Laboratory experience is important for accurate interpretation of immunofluorescent stains.

Enzyme-Linked Immunosorbent Assay (ELISA)

ELISA tests (i.e., IDEIA®) now used to identify C. psittaci were originally developed for identification of the lipopolysaccharide antigen on *Chlamydia trachomatis*, which is a human pathogen. The exact sensitivity and specificity of these tests for identifying *C. psittaci* are not known. Although the test is most useful in clinically ill birds, the sensitivity may be low in asymptomatic birds because of intermittent shedding. Moreover, some tests may be falsely positive because of cross-reaction with other bacteria. The test results must be evaluated in conjunction with other clinical findings. If a bird has a positive ELISA result but is clinically healthy, the veterinarian should attempt to verify that the bird is shedding antigen through isolation of the organism. When a clinically ill bird has a negative ELISA result, a diagnosis of AC cannot be excluded without further testing (e.g., isolation, serologic testing, or fluorescent antibody).

Additional Tests

Additional diagnostic techniques are in use or under development, including polymerase chain reaction tests. Readers are encouraged to research peer-reviewed reports on such tests before use.

Laboratories that Test for *C. psittaci*

The National Association of State Public Health Veterinarians (NASPHV) can provide a list of laboratories that offer testing for *C. psittaci*. Address requests to NASPHV, RSA Tower, Suite 1310, P.O. Box 303017, Montgomery, AL 36130-3017.

Appendix B

TREATMENT OPTIONS FOR PET BIRDS WITH AVIAN CHLAMYDIOSIS

The following methods are established as effective treatments for avian chlamydiosis (AC). All birds with AC should be treated for 45 days, except as noted below:

Medicated Feed

Medicated feed should be the only food provided to the birds during the entire treatment. Birds' acceptance of medicated feed is variable. Thus, food consumption should be monitored. Acceptance may be enhanced by first adapting the birds to a similar, nonmedicated diet. Treatment begins when the birds accept the medicated feed as the sole food in their diet. The following options are available:

- Medicated mash diets (i.e., ≥1% chlortetracycline [CTC] with ≤0.7% calcium) prepared with corn can be used.*
- White millet seed impregnated with 0.5 mg CTC/g of seed (Keet Life®) should be used for budgerigar parakeets and finches only. It should be used for 30 days. Hartz Mountain (Secaucus, New Jersey) is the only manufacturer.
- Pellets and extruded products containing 1% CTC can be used. They are available and appropriate for use with most pet birds. Select a pellet size appropriate for the size of bird being treated.
- A special diet might be necessary for lories and lorikeets, which feed on nectar and fruit in the wild.

The National Association of State Public Health Veterinarians (NASPHV) can provide a list of companies that sell medicated feed. Address requests to NASPHV, RSA Tower, Suite 1310, P.O. Box 303017, Montgomery, AL 36130-3017.

Oral or Parenteral Treatments

Three treatments available include oral doxycycline, injectable doxycycline, and injectable oxytetracycline.

Oral Doxycycline

Doxycycline is the drug of choice for oral treatment; either the monohydrate or calcium-syrup formulations can be used. Based on nonpeer-reviewed studies, dosage recommendations are as follows: 40–50 mg/kg body weight by mouth once a day for cockatiels, Senegal parrots, and blue-fronted and orange-winged Amazon parrots; and 25 mg/kg body weight by mouth once a day for African grey parrots, Goffin's cockatoos, blue and gold macaws, and green-winged macaws. Precise dosages

*The recommended recipe is 2 pounds of rice, 2 pounds of hen scratch feed, and 3 pints of water, cooked for 15 minutes at full pressure in a pressure cooker. Add 10 mg chlortetracycline/g of feed after the cooked feed cools. Note that birds may find this diet unpalatable and may not accept it.

cannot be extrapolated for untested species; however, 25–30 mg/kg body weight administered by mouth once a day is the recommended starting dosage for cockatoos and macaws, and 25–50 mg/kg by mouth once a day is recommended for other psittacine species. If the bird regurgitates the drug, another treatment method should be used.

Injectable Doxycycline

Intramuscular (IM) injection into the pectoral muscle is often the easiest method of treatment, but not all injectable-doxycycline formulations are suitable for IM injection. All available formulations can cause irritation at the injection site. The Vibrovenos® formulation (Pfizer Laboratories, London, Ontario, Canada) is available in Canada and Europe and is effective if administered at doses of 75–100 mg/kg body weight IM every 5–7 days for the first 4 weeks and subsequently every 5 days for the duration of treatment. Anecdotal reports indicate that pharmacist-compounded, injectable-doxycycline products have been used successfully in the United States. However, data are insufficient to determine precise dosage schedules. The injectable-hyclate formulation labeled for intravenous use in humans in the United States is not suitable for IM use in birds because severe tissue reactions will occur at the site of injection.

Injectable Oxytetracycline

Limited information exists for the use of an injectable, long-acting oxytetracycline product (LA-200®; Pfizer Laboratories, Exton, Pennsylvania). Current dosage recommendations are as follows: subcutaneous injection of 75 mg/kg body weight every 3 days in Goffin's cockatoos, blue-fronted and orange-winged Amazon parrots, and blue and gold macaws. This dosage may be suitable for but has not been tested on other species. This product causes irritation at the site of injection and is best used to initiate treatment in ill birds or those that are reluctant to eat. After stabilization with oxytetracycline treatment, the birds should be switched to another form of treatment to reduce the muscle irritation that is caused by repeated oxytetracycline injection.

Experimental Methods

Treatment protocols using fluoroquinolones, late-generation macrolides, pharmacist-compounded injectable doxycycline, and doxycycline-medicated feed are under investigation. Information about these treatment protocols may be available in the scientific literature or from avian veterinary specialists.

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