Chlamydia in Australian wild birds

Fact Sheet

July 2024

Key points

- *Chlamydia* species can cause disease in birds, reptiles and mammals, including humans.
- *Chlamydia psittaci* is a significant pathogen in wild birds, commercial poultry and horses.
- *Chlamydia psittaci* is zoonotic, having the potential to cause significant and even fatal disease in humans.
- Little is known about the prevalence and host range of chlamydial species in wild Australian birds.
- *Chlamydia psittaci* infection (psittacosis) in humans is a nationally notifiable disease in Australia.

In this Fact Sheet, "avian chlamydiosis" refers to the disease in birds and "psittacosis" refers to disease caused by *C. psittaci* in humans.

Aetiology

Within the Chlamydiales order, the *Chlamydiaceae* are a family of non-motile, Gram-negative, obligate intracellular bacteria. *Chlamydia psittaci* has 9 genotypes with strains A to F isolated from birds [1]. The avian genotypes cluster according to host species [2, 3]. *Chlamydia psittaci* is the most common and widely studied avian chlamydial species [4]. Other chlamydial species found in birds include *C. pecorum*, *C. avium*, *C. gallinaceae,* avian *C. abortus, C. ibidis, C. buteonis* and *C. pneumoniae.*

One Health implications

Wildlife and the environment: *Chlamydia psittaci* and other chlamydial species can infect a wide range of bird species. *Chlamydia psittaci* can cause acute disease and death in birds, and may adversely affect otherwise vulnerable wild bird populations [5]. There are no confirmed reports of *C. psittaci* and *C. pecorum* transmission from birds to other native Australian species [4].

Domestic animals: *Chlamydia psittaci* can infect livestock and domesticated pets. Disease can involve either respiratory or reproductive systems. *Chlamydia* infections pose economic, health and welfare concerns within the poultry and equine industry [4, 6]. While there are no confirmed reports of *C. psittaci* and *C. pecorum* transmission from wild birds to domestic animals, it has been suggested that equine chlamydiosis may be the result of *C. psittaci* spillover from parrots and pigeons [6, 7].

Humans: people can acquire *C. psittaci* infection from birds. Disease can vary from mild flu-like illness to potentially fatal systemic disease with severe pneumonia [8, 9]. Immunocompromised

people are more susceptible to disease. Infection usually occurs when a person inhales the bacteria from droppings, mucous, feather dust or reproductive materials or through direct contact with infected animals. In appropriately treated humans, the disease is rarely fatal [10]. Both confirmed and probable cases of psittacosis in humans are nationally notifiable within Australia.

Natural hosts

Chlamydia species can cause disease in birds, reptiles and mammals, including humans. Infection has been detected in at least 30 orders and around 450 species of birds (both captive and wild).

Chlamydia psittaci has been found in birds, mammals and reptiles [11, 12]. Based on the diverse range of wild bird species in which *C. psittaci* infections have been documented, it can be assumed that all wild bird species are susceptible to the pathogen [13]. However, the nature of disease in infected birds will vary with the host and strain of bacteria.

World distribution and occurrences in Australia

Chlamydia psittaci is found worldwide and has been present in Australia at least since the 1930s [14]. [15]. *Chlamydia psittaci* is considered widespread in Australian captive bird populations [16]. *Chlamydia psittaci* and several other chlamydial species have been detected in a variety of Australian wild birds (see *Appendix*).

Epidemiology

Ingestion or inhalation of aerosolised bacteria (via nasal exudates, aerosolized faeces or airborne respiratory droplets) is thought to play the major role in transmission in wild birds [17, 18]. Persistent bacterial shedding may occur from both gastrointestinal tract and nasal mucosa. Other possible routes of infection include arthropod vectors, vertical transmission from mother to offspring (via the egg or regurgitant feeding) and consumption of infected carcasses by predators and scavengers [17, 19, 20].

As an intracellular bacterium, the organism has the ability to evade host defences, can be persistently shed by the host, and is resistant to desiccation outside the host. High population density, stress, concurrent infections or breeding may increase the risk of infection and shedding of the bacteria [21] and birds with persistent infections may resume shedding *Chlamydia* when stressed [22]. Apparently healthy birds can infect both the environment and in-contact birds [23, 24].

The true prevalence of *Chlamydia* species in healthy, wild bird populations is not well known. However, it is generally considered that under natural conditions, the prevalence of *C. psittaci* in Australian wild birds is relatively low, ranging from less than 1% to 9% [25, 26]. In Australian captive birds (domestic and non-domestic species) the prevalence of *C. psittaci* infection is substantially higher, ranging between 3-57% [25, 27].

A wide range of chlamydial organisms have recently been reported in wild Australian birds. [26, 28]. A Chlamydiales prevalence of 40% was detected across four wild Australian parrot species, and a 27% prevalence in a wild population of crimson rosella (*Platycercus elegans*) [5, 29]. This high prevalence could be due to a number of different variables affecting detection and prevalence such as

intermittent shedding, geographic location, host species, sample type, time of year or type of PCR assay used [5]. A lack of studies on the Chlamydiales order more broadly could also influence their perceived prevalence.

There have been several reports of *C. psittaci* outbreaks in Australian wild birds, specifically in Australian king parrots (*Alisterus scapularis*), Australian ringneck parrots (*Barnardius zonarius*), red-capped parrots (*Purpureicephalus spurius*), budgerigars (*Melopsittacus undulatus*) and rosellas. Many of these outbreaks involve mass mortalities of birds [30]. After the Black Summer bushfires, in 2020, a number of bird mortalities due to a range of diagnoses were reported in NSW, involving over 80 birds from several species. During this event, mortality due to chlamydiosis was confirmed in Australian king parrots and crimson rosellas. Over the same time period, 15 cases of human psittacosis were reported after being exposed to both pet and wild birds [31].

Clinical signs

Many chronically infected birds show no signs until stressed. Persistently infected birds are generally either clinically normal or show only mild signs. Infected psittacine birds often begin shedding *Chlamydia* and develop clinical signs after transportation and introduction to new environments. Most infected feral pigeons show no clinical signs, although depression, conjunctivitis, rhinitis and diarrhoea have been reported [21].

Affected birds may also be found moribund or dead with no prior signs. Avian chlamydiosis in domestic psittacines and production poultry can result in acute, subacute or chronic disease. In all cases, signs are non-specific but include anorexia, diarrhoea, lethargy, weight loss, dyspnoea, oculonasal discharge, conjunctivitis and ruffled feathers. In more severe cases, dark green faeces are accompanied by dehydration, emaciation and death, if left untreated [21, 32]. Emaciation appears to be a common clinical sign in Australian wild birds infected with *Chlamydiaceae* [26].

Diagnosis

Live bird: diagnosis of chlamydial infection in birds avian chlamydiosis can be difficult, especially in the absence of clinical signs and must be confirmed by laboratory tests. A single testing method may not give a definitive answer. A combination of tests, specifically antibody-detection and PCR, is recommended, particularly when only one bird is tested.

Haematology, blood biochemistry, radiology and endoscopy all provide supportive evidence of chlamydiosis. Polymerase chain reaction (PCR) is a sensitive and specific test for the detection of *C. psittaci* and other *Chlamydia* species.

Loop mediated isothermal amplification (LAMP) assays for point-of-care testing for species-specific *C. psittaci* and *C. pecorum* detection are in development although further assay work and evaluation is required to meet clinical needs [33].

Dead bird: the preferred method of diagnosis is PCR. Immunofluorescent antibody staining or immunohistochemical staining may be used on impression smears and histopathology of liver or spleen to highlight elementary bodies. Cross reaction with some bacteria and fungi are expected and an experienced interpretation is important for accurate analysis [34].

Laboratory diagnostic specimens and procedures

In live birds, the best sites for the collection of samples are the conjunctiva, choana and cloaca in combination, as well as coelomic or air sac exudate [35]. Sample contamination may lead to false positives. If bacterial isolation is the goal, faeces, choanal and cloacal samples should be collected for 3 to 5 consecutive days and the samples should be pooled and sent to the laboratory [8]. A full sample set should be collected from dead birds for histology as well as fresh liver, lung and spleen for culture. Impression smears should be made from the cut surface of the liver and spleen.

Clinical pathology

Clinical pathology of chlamydiosis will vary depending on the organs affected and severity of disease [36].

Pathology

In systemic chlamydiosis with multiple organ involvement, gross lesions are consistent across all avian species [37]. The severity and distribution of the lesions, however, depends on factors including host species and susceptibility, virulence of the strain, concurrent infection and route of exposure. In overwhelming infections with virulent strains of the bacterium, lungs show diffuse congestion and the coelomic cavity may contain fibrinous exudate. The pericardium may be thickened, congested and coated with fibrinous exudate. The heart may be enlarged, and its surface may be covered with thick fibrin plaques or encrusted with yellowish, flaky exudate. In most species, the liver is enlarged and discoloured and may be coated with thick fibrin. The spleen is enlarged, dark and soft, and may be covered with grey-white spots [21].

Histopathological lesions also vary between strains and susceptibility of host. Psittacines consistently show multifocal hepatic and splenic necrosis with splenic lymphocytes being markedly depleted and replaced by swollen, reactive macrophages. Fibropurulent air sacculitis may be mild to severe and may be seen in conjunction with conjunctivitis and pericarditis [37].

Differential diagnoses

Differential diagnoses for avian chlamydiosis include gastrointestinal and respiratory infections (of both the upper and lower respiratory tract), caused by bacteria, fungi or viruses; vitamin A deficiency and wasting disease.

Treatment

Mass treatment of wild birds is not recommended or feasible, however there may be merit in the prophylactic treatment of at-risk populations or birds being brought into captivity. In this situation, antibiotic-medicated feed or water may be considered, which may also reduce the human health risk of *C. psittaci*. Antibiotic treatment options available for cage and aviary birds include oral or injectable doxycycline [38]. Because of the intracellular nature of *Chlamydia*, prolonged courses of treatment are required and it is not guaranteed that birds will clear the infection.

Prevention and control

Prevention of infection in wild birds is not possible given the widespread and endemic nature of the pathogen. Controlling disease in wild bird populations is similarly difficult, however, it is possible to mitigate concurrent stressors and help to limit the spread of the disease amongst populations. Encouraging natural foraging behaviours and preventing congregations of large flocks of wild birds at feeding stations or single point water sources will help to control the spread of disease amongst wild birds. See also WHA Fact Sheet "Biosecurity Concerns in Feeding Wild Birds". Where chlamydiosis mortalities have occurred in wild birds, actions will depend on the species involved and government regulations.

Prevention and control of avian chlamydiosis in captive birds relies on the identification, isolation and treatment of affected birds, quarantine and prophylactic treatment of potentially infected birds and detection of carriers of the disease [30]. *Chlamydia psittaci* is susceptible to most disinfectants including alcoholic iodine solutions, bleach, 70% ethanol and hydrogen peroxide [39]. Frequent, routine, disinfection appears to be the most suitable means of controlling the disease spread [40].

Risk factors for psittacosis include any activities which aerosolise particles from animal products such as lawn mowing, or direct handling of pet or wild birds, or horses or their products (e.g. through cleaning, feeding activities, handling of equine fetal membranes) [9, 41, 42]. Field personnel should wear protective gear and handle carcasses appropriately to prevent zoonotic spread, contamination of the environment and mechanical transmission of the organism on equipment and vehicles.

Research

Further research is required into the prevalence and strains of *C. psittaci* and other chlamydial species in wild birds in Australia, including the potential risk and subsequent management, especially where human disease outbreaks are possible. Targeted investigation into the presence of *C. psittaci* in a broader host range, such as Australian marsupials would improve the understanding of the potential risk of chlamydial transmission between birds and other native species [12].

Further research is required into the transmission of *C. psittaci* to horses and the potential role of wild birds [12].

Surveillance and management

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information https://wildlifehealthaustralia.com.au/Our-Work/Surveillance and https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/eWHIS-Wildlife-Health-Information-System.

WHA is interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. Negative data are also valuable. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Appendix: Wild Australian native birds found to be positive on PCR for *Chlamydia* species

*Unknown method of *C. psittaci* detection
Identified via IHC or antibody testing
^ Genetically similar to avian *Chlamydia abortus*

Chlamydia species	Avian species	References
Chlamydia psittaci	Little corella (*Cacatua sanguinea*) Superb lyrebird (*Menura novaehollandiae*) Crimson rosella (*Platycercus elegans*) Major Mitchell's cockatoo (*Ca. leadbeateri*)* Red-rumped parrot (*Psephotus haematonotus*) Tawny frogmouth (*Podargus strigoides*)* Masked lapwing (*Vanellus miles*) Pacific emerald-dove (*Chalcophaps longirostris*) Sacred kingfisher (*Todiramphus sanctus*) Australian bustard (*Ardeotis australis*) Australasian figbird (*Sphecotheres vieilloti*) Sooty shearwater (*Ardenna grisea*) Galah (*Eolophus roseicapilla*) Sulphur-crested cockatoo (*Ca. galerita*) Pale-headed rosella (*Pl. adscitus*) Rainbow lorikeet (*Trichoglossus moluccanus*)	Anstey et al. 2021 [12] Amery-Gale et al. 2020 [25] Wildlife Health Australia 2020 [31] Kasimov et al. 2022 [26]
Chlamydia pecorum	Tawny frogmouth Bar-shouldered dove (*Geopelia humeralis*) Brown cuckoo-dove (*Macropygia phasianella*) Pacific emerald-dove Crested pigeon (*Ocyphaps lophotes*) Wonga pigeon (*Leucosarcia melanoleuca*) Laughing kookaburra (*Dacelo novaeguineae*) Sacred kingfisher Eastern koel (*Eudynamys orientalis*) Shining bronze-cuckoo (*Chrysococcyx lucidus*) Spangled drongo (*Dicrurus bracteatus*) Australian white ibis (*Threskiornis moluccus*) Short-tailed shearwater (*Puffinus tenuirostris*) Galah Sulphur-crested cockatoo Australian king-parrot Rainbow lorikeet	Kasimov et al. 2022 [26]

Chlamydia pneumoniae	Black kite (*Milvus migrans*) Laughing kookaburra	Kasimov et al. 2022 [26]
Chlamydia gallinaceae	Galah Crimson rosella	Stokes et al. 2019 [43] Stokes et al. 2021 [29]
Chlamydia ibidis	White-faced heron (*Egretta novaehollandiae*)	Kasimov et al. 2022 [26]
Avian *Chlamydia abortus*	Torresian crow (*Corvus orru*) Sulphur-crested cockatoo^ Masked lapwing^ Australasian figbird^ Short-tailed shearwater^ Magpie-lark^ Australian pied oystercatcher (*Haematopus longirostris*)^ White-faced heron^	Kasimov 2023 [4] Kasimov et al. 2022 [26]
***Chlamydiaceae* family**	Australian ringneck (*Barnardius zonarius*)# Carnaby cockatoo (*Z. latirostris*) Black-shouldered kite (Elanus axillaris) Collared sparrowhawk (*Accipiter cirrocephalus*) Pacific baza (*Aviceda subcristata*) Wedge-tailed eagle (*Aquila audax*) Osprey (*Pandion haliaetus*) Australian wood duck (*Chenonetta jubata*) Pacific black duck (*Anas superciliosa*) Plumed whistling-duck (*Dendrocygna eytoni*) Bush stone-curlew (*Burhinus grallarius*) Black noddy (*Anous minutus*) Caspian tern (*Hydroprogne caspia*) Greater crested tern (*Thalasseus bergii*) Silver gull (*Chroicocephalus novaehollandiae*) Wompoo fruit-dove (*Ptilinopus magnificus*) Azure kingfisher (*Alcedo azurea*) Channel-billed cuckoo (*Scythrops novaehollandiae*) Pheasant coucal (*Centropus phasianinus*) Brown falcon (*Falco berigora*) Brown quail (*Coturnix ypsilophora*) Purple swamphen (*Porphyrio porphyrio*) Pied butcherbird (*Cracticus nigrogularis*) Pied currawong (*Strepera graculina*) Blue-faced honeyeater (*Entomyzon cyanotis*) Lewin's honeyeater (*Meliphaga lewinii*) Little friarbird (*Philemon citreogularis*) Little wattlebird (*Anthochaera chrysoptera*) Noisy friarbird (*Ph. corniculatus*) Noisy miner (*Manorina melanocephala*) Olive-backed oriole (*Oriolus sagittatus*) Striated pardalote (*Pardalotus striatus*) Cattle egret (*Bubulcus ibis*) Great cormorant (*Phalacrocorax carbo*)	Wildlife Health Australia 2009 [30] Le Souëf et al. 2024 [44] Kasimov 2022

	Brown booby (*Sula leucogaster*) Yellow-tailed black-cockatoo (*Zanda funerea*) Scaly-breasted lorikeet (*Tr. chlorolepidotus*) Southern boobook (*Ninox boobook*) Eastern barn owl (*Tyto javanica*)	

Acknowledgements

We are grateful to the people who contributed to this Fact Sheet and would specifically like to thank Hamish Baron and David Phalen, who prepared an earlier version of this Fact Sheet.

Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

Please cite this Fact Sheet as: Wildlife Health Australia (2024) "*Chlamydia* in Australian wild birds – Fact Sheet", published by Wildlife Health Australia, Canberra, available at https://wildlifehealthaustralia.com.au/Resource-Centre/Fact-Sheets

Updated: July 2024

References and other information

1. Lent SV, Piet JR et al. (2012) Full genome sequences of all nine *Chlamydia psittaci* genotype reference strains. *Journal of Bacteriology*, **194**(24): 6930-6931
2. Pannekoek Y, Dickx V et al. (2010) Multi locus sequence typing of *Chlamydia* reveals an association between *Chlamydia psittaci* genotypes and host species. *PLoS One*, **5**(12): e14179
3. Geens T, Desplanques A et al. (2005) Sequencing of the *Chlamydophila psittaci* ompA gene reveals a new genotype, E/B, and the need for a rapid discriminatory genotyping method. *Journal of Clinical Microbiology*, **43**(5): 2456-2461
4. Kasimov V (2023) Emerging threats at the intersection of wildlife and public health: investigating the epidemiology of *Chlamydia psittac*i and viral coinfections in Australian birds. thesis, University of the Sunshine Coast, Queensland
5. Stokes HS, Martens JM et al. (2020) Species, sex and geographic variation in chlamydial prevalence in abundant wild Australian parrots. *Scientific Reports*, **10**(1)
6. Jenkins C, Jelocnik M et al. (2018) An epizootic of *Chlamydia psittaci* equine reproductive loss associated with suspected spillover from native Australian parrots. *Emerging Microbes & Infections*, **7**(1): 1-13
7. Jelocnik M, Jenkins C et al. (2018) Molecular evidence to suggest pigeon-type *Chlamydia psittaci* in association with an equine foal loss. *Transboundary and Emerging Diseases*, **65**(3): 911-915
8. CDC (2010) Compendium of measures to control *Chlamydia psittaci* infection among humans (psittacosis) and pet birds (avian chlamydiosis). [cited 2017 12 January 2017]; Available from: http://www.nasphv.org/Documents/Psittacosis.pdf.
9. Branley JM, Weston KM et al. (2014) Clinical features of endemic community-acquired psittacosis. *New Microbes and New Infections*, **2**(1): 7-12

10. Smith KA, Bradley K et al. (2005) Compendium of measures to control *Chlamydophila psittaci* (formerly *Chlamydia psittaci*) infection among humans (psittacosis) and pet birds. *Journal of the American Veterinary Medical Association*, **226**: 532–539

11. Spickler A (2017) Psittacosis/Avian chlamydiosis. Available from: https://www.cfsph.iastate.edu/Factsheets/pdfs/psittacosis.pdf

12. Anstey SI, Kasimov V et al. (2021) *Chlamydia psittaci* ST24: Clonal strains of one health importance dominate in Australian horse, bird and human infections. *Pathogens*, **10**(8): 1015

13. Kaleta EF and Taday EMA (2003) Avian host range of *Chlamydophila* spp. based on isolation, antigen detection and serology. *Avian Pathology*, **32**(5): 435-462

14. Burnet FM (1935) Enzootic psittacosis amoungst wild Australian parrots. *The Journal of Hygiene*, **35**: 412-420

15. Beech MD and Miles JAR (1953) Psittacosis among birds In South Australia. *Australian Journal of Experimental Biology and Medical Science*, **31**(5): 473-480

16. Rosenwax A 2017 *Chlamydia psittaci* in Australian captive bird populations. Personal communication

17. Meyer KF (1965) Ornithosis. In 'Diseases of Poultry.' (Eds Biester and Schwarte) pp. 670–675. (Iowa State University Press: Ames)

18. Thierry S, Vorimore F et al. (2016) Oral uptake of *Chlamydia psittaci* by ducklings results in systemic dissemination. *PLoS One*, **11**(5): e0154860

19. Wittenbrink MM, Mrozek M et al. (1993) Isolation of *Chlamydia psittaci* from a chicken egg: Evidence of egg transmission. *Journal of Veterinary Medicine, Series B*, **40**(1-10): 451-452

20. Brand CJ (1989) Chlamydial infections in free-living birds. *Journal of the American Veterinary Medical Association*, **195**(11): 1531

21. Andersen A and Vanrompay D (2009) Avian Chlamydiosis. In 'Diseases of Poultry.' (Eds Y.M. Saif, A.M. Fadly, J.R. Glisson, L.R. McDougald, L.K. Nolan and D.E. Swayne) pp. 978-981. (Wiley: Hoboken)

22. Ward ME (1999) Mechanisms of *Chlamydia*-induced disease. In 'Intracellular Biology, Pathogenesis and Immunity.' (Ed R.S. Stephens) pp. 171-210. (American Society for Microbiology: Washington, D.C.)

23. Donati M, Laroucau K et al. (2015) *Chlamydia psittaci* in Eurasian collared doves (*Streptopelia decaocto*) in Italy. *Journal of Wildlife Diseases*, **51**(1): 214

24. Magnino S, Haag-Wackernagel D et al. (2009) Chlamydial infections in feral pigeons in Europe: Review of data and focus on public health implications. *Veterinary Microbiology*, **135**(1): 54-67

25. Amery-Gale J, Legione AR et al. (2020) Surveillance for *Chlamydia* spp. with multilocus sequence typing analysis in wild and captive birds in Victoria, Australia. *Journal of Wildlife Diseases*, **56**(1): 16-26

26. Kasimov V, Dong Y et al. (2022) Emerging and well-characterized chlamydial infections detected in a wide range of wild Australian birds. *Transboundary and Emerging Diseases*, **69**(5): e3154-e3170

27. McElnea CL and Cross GM (1999) Methods of detection of *Chlamydia psittaci* in domesticated and wild birds. *Australian Veterinary Journal*, **77**(8): 516-521

28. Kasimov V, Wille M et al. (2023) Unexpected pathogen diversity detected in Australian avifauna highlights potential biosecurity challenges. *Viruses*, **15**(1): 143

29. Stokes HS, Martens JM et al. (2021) Chlamydial diversity and predictors of infection in a wild Australian parrot, the Crimson Rosella (*Platycercus elegans*). *Transboundary and Emerging Diseases*, **68**(2): 487-498

30. Wildlife Health Australia (2009) Australian Wildlife Health Network. *Animal Health Surveillance Quaterly Report*, **14**(4)

31. Wildlife Health Australia (2020) Chlamydiosis and other causes of mortality in wild birds in New South Wales. *Animal Health Surveillance Quaterly Report*, **25**(2)

32. Cong W, Huang SY et al. (2014) *Chlamydia psittaci* exposure in pet birds. *Journal of Medical Microbiology*, **63**(Pt 4): 578

33. Jelocnik M, Islam MM et al. (2017) Development and evaluation of rapid novel isothermal amplification assays for important veterinary pathogens: *Chlamydia psittaci* and *Chlamydia pecorum. PeerJ*, **5**: e3799

34. Schmidt RE, Reavill DR et al. (2015) 'Pathology of Pet and Aviary Birds.' Vol. 2nd. (Wiley: Hoboken)

35. Andersen A (1996) Comparison of pharyngeal, fecal, and cloacal samples for the isolation of *Chlamydia psittaci* from experimentally infected cockatiels and turkeys. *Journal of Veterinary Diagnostic Investigation*, **8**(4): 448-450

36. Van Wettere A (2020) Avian chlaymydiosis. [cited 2024 12 July]; Available from: https://www.msdvetmanual.com/poultry/avian-chlamydiosis/avian-chlamydiosis

37. Suwa T, Touchi A et al. (1990) Pathological studies on chlamydiosis in parakeets (*Psittacula krameri manillensis*). *Avian Pathology*, **19**(2): 355-355

38. CFSPH (2017) Psittacosis/Avian chlamydiosis. [cited 2024 16 May]; Available from: https://www.cfsph.iastate.edu/Factsheets/pdfs/psittacosis.pdf

39. Jonston WB (2000) Compendium of measures to control *Chlamydia psittaci* infection among humans (psittacosis) and pet birds (avian chlamydiosis). *Morbidity and Mortality Weekly Report* (July 14): 1-17

40. Hulin V, Bernard P et al. (2016) Assessment of *Chlamydia psittaci* shedding and environmental contamination as potential sources of worker exposure throughout the mule duck breeding process. *Applied and Environmental Microbiology*, **82**(5): 1504

41. Monaghan K, Durrheim D et al. (2007) Human psittacosis associated with purchasing birds from, or visiting, a pet store in Newcastle, Australia. *Environmental Health*, **7**(2): 52-61

42. Telfer BL, Moberley SA et al. (2005) Probable psittacosis outbreak linked to wild birds. *Emerging Infectious Diseases*, **11**(3): 391-7

43. Stokes H, Martens J et al. (2019) Identification of *Chlamydia gallinacea* in a parrot and in free-range chickens in Australia. *Australian Veterinary Journal*, **97**(10): 398-400

44. Le Souëf AT, Bruce M et al. (2024) Health parameters for wild Carnaby's cockatoo (*Zanda latirostris*) nestlings in Western Australia: results of a long-term study. *Conservation Physiology*, **12**(1): coae005

To provide feedback on Fact Sheets

Wildlife Health Australia welcomes your feedback on Fact Sheets. Please email admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and are interested in creating or updating a WHA Fact Sheet. A small amount of funding is available to facilitate this.

Disclaimer

information in this Fact Sheet. Persons should accordingly make and rely on their own assessments and enquiries to verify the accuracy of the information provided.

Find out more at www.wildlifehealthaustralia.com.au
Email admin@wildlifehealthaustralia.com.au
Or call +61 2 9960 6333