Wildlife Health Australia

COVID-19 (SARS-CoV-2 virus) Fact sheet

Preamble

This document will be updated periodically as new information becomes available. Please check the **WHA website** www.wildlifehealthaustralia.com.au for the current version.

Key points

- there have been **no** detections of SARS-CoV-2 or closely related viruses in Australian wildlife
- there is **no** evidence to suggest that any animals in Australia might be a source of COVID-19
- human-to-animal transmission of SARS-CoV-2 is rare
- it is safest to assume that any mammalian wildlife species **may** have the potential to be infected with SARS-CoV-2, following close exposure with an infected human (similar situations to those described as risky for human-to-human transmission)
- appropriate precautions are always recommended before, during and after contact with animals (see National Wildlife Biosecurity Guidelines and information on COVID-19 and interacting with bats)
- people diagnosed with COVID-19 should not have any contact with Australian wildlife
- if you care for wildlife, you should have a plan in place for the animals in your care in the event you become sick or have to self-isolate
- further information on COVID-19 and animals can be found at:
    - Australian Department of Agriculture, Water and the Environment (www.agriculture.gov.au/coronavirus/animals)
    - Australian Veterinary Association (www.ava.com.au/coronavirus)
    - OIE (www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus) and (www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals)
    - WHA - COVID-19 and Australian bats (www.wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx#COVIDBats)

Introductory statement

Coronaviruses are the cause of recently emerged diseases which cause significant respiratory symptoms in humans, including Severe Acute Respiratory Syndrome (SARS-CoV-1), Middle East Respiratory Syndrome (MERS-CoV) and COVID-19 (SARS-CoV-2). Evidence suggests bats are the maintenance hosts for both SARS and MERS coronaviruses. None of these viruses have been found in Australian wildlife (see WHA fact sheet "Coronaviruses in Australian Bats").

In December 2019 a novel coronavirus disease, named COVID-19, emerged in humans in China, and spread through the global human population. WHO declared COVID-19 a "Public Health Emergency of International Concern" in January 2020 (WHO 2020c). A range of animal species appear to be susceptible to infection acquired from humans who are shedding the virus. It appears that in at least one situation, farmed mink in Europe, that acquired the virus from infected humans may have spread infection back to close-contact humans (Munnink et al. 2020).

Public health concerns

COVID-19 disease is spread by human-to-human transmission. See WHO (www.who.int/emergencies/diseases/novel-coronavirus-2019) and the Australian government Department of Health for information on COVID-19 in humans (www.health.gov.au/news/health-alerts/novel-coronavirus-2019-ncov-health-alert).

Potential involvement of Australian animals

There is no evidence that Australian animals carry the SARS-CoV-2 virus and no evidence that they can be a source of infection for humans.

There are several reports globally of human-to-animal transmission of SARS-CoV-2 in felids, mustelids and dogs, but this appears to be rare. See https://kb.rspca.org.au/knowledge-base/what-information-do-we-have-about-the-novel-coronavirus-sars-cov-2-and-domestic-animals and www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals for regularly updated information on SARS-CoV-2 in domestic and wild animals.

In domestic settings, transmission between animals is self-limiting. In high density settings, such as farmed mink, there may be ongoing transmission between animals (Hobbs and Reid 2020). The only evidence of transmission from infected animals to humans is in farmed mink (Munnink et al. 2020).

Felids: domestic cats have been shown to be infected with SARS-CoV-2, probably from close contact with infected humans. Clinical signs include diarrhoea, vomiting and breathing difficulty however some confirmed virus-positive cats did not show signs (Chini 2020; EVNT 2020; Government of Hong Kong 2020a). Similar reports have been received from a range of countries (e.g. Germany, Belgium, the Netherlands, Russia and Spain). A study found that cats in Wuhan showed signs of previous infection (antibodies) after the start of the outbreak in humans, whereas no cats sampled before the outbreak had antibodies, indicating cats had been infected during the outbreak (Zhang Q et al. 2020).

A tiger at Bronx Zoo tested positive for SARS-CoV-2 in April 2020 and several other tigers and lions at the zoo showed signs of respiratory illness. It is thought an asymptomatically infected zoo keeper may have been

passed on the infection. The big cats had a dry cough, wheezing and some loss of appetite but were not severely affected. All affected big cats, and one asymptomatic tiger sharing the enclosure, subsequently tested positive to PCR on faecal samples. All cats appeared to recover uneventfully from the infection (USDA 2020; WCS 2020a, 2020b). Other tigers, lions and snow leopards in zoos in the USA and Europe have tested positive to SARS-CoV-2 after contact with infected humans (Davidson 2020; Dawson 2020).

Mustelids: large numbers of farmed mink (Mustelidae, in the same taxonomic family as ferrets and weasels) across several countries in Europe and in the USA have become infected following exposure from infected humans (Hobbs and Reid 2020; Oreshkova et al. 2020). Although risk of transmission from mink back to humans was initially considered very low (MANFQ 2020), there is now evidence that farmed mink can act as a reservoir of SARS-CoV-2, passing the virus between themselves, and also pose a risk for virus spillover from mink to humans (Munnink et al. 2020; PROMED 2020b; WHO 2020b). A strain of SARS-CoV-2 found in some farmed mink (and associated humans) has some viral mutations which have not been detected elsewhere. Further work is underway to investigate the possible significance of these viral variations (Munnink et al. 2020). In mid-December 2020, the USDA found SARS-CoV-2 by real time RT-PCR and sequencing of a nasal swab collected from a free-ranging, wild mink sampled in Utah; this is the first report of a free-ranging, native wild animal confirmed with SARS-CoV-2. The wild mink was sampled close to an infected mink farm. There is no evidence that SARS-CoV-2 is circulating or has been established in wild populations surrounding the infected mink farms. Several other wildlife species were sampled, but all others tested negative. (DeLiberto 2020).

OIE has published guidance on working with farm animal species susceptible to SARS-CoV-2 infection (www.oie.int/fileadmin/Home/MM/Draft_OIE_Guidance_farmed_animals_cleanMS05.11.pdf).

Canids: there is evidence that domestic dogs may become infected with SARS-CoV-2 after close contact with infected humans, but dogs typically have no signs of disease associated with infection (Government of Hong Kong 2020b; Hobbs and Reid 2020).

Infection trials: early results from laboratory-based infection trials with SARS-CoV-2 suggested ferrets and cats are more susceptible to infection than dogs, and that pigs and poultry are not susceptible. Cats may be able to pass the infection on to other cats. These studies do not necessarily reflect the situation outside a laboratory setting (Hobbs and Reid 2020; PROMED 2020a; Shi et al. 2020).

A laboratory study with intranasal inoculation of Egyptian fruit bats (*Rousettus aegyptiacus*) (n=9) resulted in a transient respiratory infection and virus replication. Infected animals did not show any clinical signs. Virus was also detected in one of three in contact bats, which were not directly inoculated. The infected bats shed virus orally and in faeces. Viral RNA was found in respiratory tissues and other body organs. Infectious virus was only isolated from one bat in tracheal and nasal samples, 4 days after inoculation. Low levels of neutralising antibodies were found in infected bats. The infection in this species of bat appeared to be primarily intranasal (PROMED 2020a; Schlottau et al. 2020).

There are published studies of other coronaviruses in Australian animals, with a focus on bats (see WHA fact sheet “Coronaviruses in Australian Bats”). Although some coronaviruses have been found in a variety of Australian bat species, there have been no detections to date of SARS-CoV-1, MERS-CoV, SARS-CoV-2 or closely related viruses in Australian bats or other wildlife. Serological evidence of exposure to a coronavirus antigenically related to SARS-CoV-1 (“SARS-CoV-1-like”) has been found in various bat species (Smith et al. 2016b; Prada et al. 2019; Boardman et al. 2020; Peel et al. 2020).

SARS-CoV-2 is not closely related to any known Australian bat coronaviruses and there is no suggestion that SARS-CoV-2 is present in Australian wildlife, although further surveillance and studies are recommended to better understand endemic coronaviruses of Australian wildlife.

Further studies are needed to understand if and how different animals could be affected by SARS-CoV-2.

There is no evidence to support restrictions to movement or trade of animals (OIE 2020).

Testing of animals for SARS-CoV-2

The OIE has published considerations for sampling, testing and reporting of SARS-CoV-2 in animals (www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/COV-19/Sampling_Testing_and_Reporting_of_SARS-CoV-2_in_animals_final_7May_2020.pdf) which includes advice for wildlife and zoo animals, as well as livestock and companion animals.

Australia's Animal Health Committee (www.agriculture.gov.au/animal/health/committees/ahc) advises that diagnostic testing and surveillance in Australian animals for COVID-19 is only recommended on the advice of human and animal health authorities. If testing is undertaken, confirmatory testing should be performed at the CSIRO Australian Centre for Disease Preparedness (the former Australian Animal Health Laboratory). Veterinarians considering testing their patients for SARS-CoV-2 must consult with their state or territory animal health authorities in the first instance (Animal Health Committee 2020).

Precautions when in contact with Australian wildlife

There is no evidence to suggest that any animals (livestock, pets or wildlife) in Australia might be a source of infection of SARS-CoV-2.

Evidence suggests a wide range of distantly-related mammals are likely susceptible to SARS-CoV-2. Until more is known, it is safest to assume that any mammal wildlife species may have the potential to be infected with SARS-CoV-2, from close exposure to an infected human (similar situations to those described as risky for human to human transmission) (Gryseels et al. 2020). Appropriate precautions are always recommended before, during and after contact with animals (including wildlife) and their food, supplies and excreta. This includes, for example washing hands and cleaning of equipment, clothing and boots and maintaining "physical distance" (minimum of 1.5 m) wherever possible [see National Wildlife Biosecurity Guidelines](Animal Health Committee 2020).

People who are unwell, including those with COVID-19 like symptoms, should avoid contact with wildlife, wherever possible. People diagnosed with COVID-19 or identified as a close contact of a COVID-19 case should not have any contact with wildlife. If you care for wildlife, you should have a plan in place for the animals in your care in the event you become sick or have to self-isolate. Wherever possible, apply the same precautions recommended for prevention of human-to-human transmission to your interactions with wildlife.

If an animal tests positive for SARS-CoV-2, it should be kept away from unexposed susceptible animals and contact with the infected animal should be avoided (OIE 2020).

NSW Department of Primary Industries has developed a document summarising advice on SARS-CoV-2 and Animals in Mass Care and Group Settings: www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/1218322/Animals-in-Mass-Care-and-Group-Settings-Advice-Summary.pdf.

There is no justification in taking measures against animals which may compromise their welfare (OIE 2020).

Wildlife Health Australia, working with a group of government and non-government representatives, has developed information for bat carers, researchers and others interacting with bats (see www.wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx#COVIDBats). A series of COVID-specific biosecurity practices are recommended to reduce the risk of transmission of SARS-CoV-2 to bats. WHA has also undertaken a rapid, qualitative risk assessment, to assess the risk of SARS-CoV-2 establishing in an Australian bat population following human-to-bat transmission. The risk was assessed to be low, but with a high level of uncertainty around the estimate due to information gaps and variability across bat populations and human activities. As the risk will vary with individual circumstances, case-by-case assessments are recommended and restricting, postponing or cancelling activities may be advisable for higher risk situations. The risk assessment may need to be revisited if COVID-19 prevalence increases in Australia (Wildlife Health Australia 2020).

Aetiology and possible origin

Coronaviruses are single stranded, enveloped RNA viruses, 75-160 nm in diameter in the family *Coronaviridae*. The subfamily *Coronavirinae* is further divided into four genera: alpha-, beta-, gamma-, and deltacoronavirus. SARS and MERS coronaviruses belong to the betacoronavirus genus and all coronaviruses detected in bats are either alpha- or betacoronaviruses (Drexler et al. 2014). Coronaviruses have been shown to have the potential for cross-species transmission and an ability to evolve relatively rapidly, which makes them of interest as potential emerging infectious diseases (Peel et al. 2020).

Only some coronaviruses are considered to be zoonotic (passed from animals to humans) (WHO 2020a). While coronaviruses infect a wide range of bird and mammal species, bats appear to be the natural hosts of many coronaviruses. There is evidence to suggest that all coronaviruses recognised in other species originally derived from bats (Vijaykrishna et al. 2007), although others suggest that alpha- and betacoronaviruses originated in bats and gamma- and deltacoronviruses originate in birds (Wong et al. 2019). Previous emerging betacoronaviruses causing respiratory disease in humans (SARS-CoV-1, MERS-CoV) have been shown to have recently moved from a bat host, via an intermediate animal host, to humans.

The virus responsible for COVID-19 (SARS-CoV-2), is also a betacoronavirus and is presumed to have transferred to humans from an (as yet) unidentified animal host.

Many experts consider bats to be the most plausible and probable original host of SARS-CoV-2. SARS-CoV-2 is closely related to a known bat coronavirus (96% genome homology) and is less closely related to SARS-CoV-1 (~80% homology) (e.g. Lu et al. 2020; Zhou et al. 2020). A possible snake origin based on viral genetics was quickly refuted by other virologists (Ji et al. 2020; Lu et al. 2020; Luan et al. 2020; Robertson 2020; Zhou et al. 2020). Many scientists believe an intermediate host has likely been involved in the original movement of the virus from bats into humans. Pangolins have been proposed as a possible intermediate host from bats to humans (e.g. Cyranoski 2020; Zhang T et al. 2020) but this has been questioned by others (Frutos et al. 2020; e.g. Lee et al. 2020; Liu et al. 2020). Others suggest that Bovidae and Cricetidae (New World rodents) should be considered as possible intermediate hosts for SARS-CoV-2, based on genetic studies (Luan et al. 2020). Rodents in Australia, including introduced house mice, black and brown rats, and native rodents fall in the Old World rodent group, and are not Cricetidae.

Routes of transmission between bats, and from bats to other hosts, including humans, are yet to be confirmed for coronaviruses (Smith et al. 2016a).

Epidemiology

Although coronaviruses appear to have a relatively narrow host range, one bat species may be infected with multiple different coronaviruses. This potential mixing of viral species, along with their high mutation rate, permits significant genetic recombination allowing coronaviruses to change and evolve relatively rapidly (Woo et al. 2007).

There is no clear evidence of how SARS-CoV-2 moved from bats into humans and whether an intermediate host species was involved in transmission of the emergent disease in humans, as was shown to be the case for both SARS-CoV-1 (civets) and MERS-CoV (camels) (Peel et al. 2020).

Conclusion

SARS-CoV-2 has most likely moved from a natural bat host into humans, possibly via an unidentified intermediate animal host. There have been no detections of SARS-CoV-2 or closely related viruses in Australian wildlife although there is evidence from overseas that animals can become infected when exposed to an infected human. Good hygiene and infection control practices are always recommended when interacting with animals. This fact sheet will be updated as new information becomes available.

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