

Coronaviruses in Australian bats

Fact sheet

Introductory statement

Coronaviruses appear to be widespread and endemic in global bat populations. Recent work suggests a similar situation exists in Australian bats. These viruses do not cause disease in their bat hosts but their potential for cross-species transmission and their ability to evolve relatively rapidly makes them of interest to those charged with the identification and management of emerging infectious diseases in Australia. Several recently emerging coronavirus diseases, which are not found in Australia, such as Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) and novel 2019 coronavirus (Wuhan) [2019-nCoV], appear to have bats as their natural hosts.

Aetiology

Coronaviruses are single stranded, enveloped RNA viruses, 75-160 nm in diameter in the family *Coronaviridae*. All bat coronaviruses detected fall into the subfamily *Coronavirinae*, which is further divided into four genera alpha-, beta-, gamma-, and deltacoronavirus. All coronaviruses detected in bats are either alpha- or betacoronaviruses (Drexler et al. 2014). SARS, MERS and 2019-nCoV coronaviruses belong to the betacoronavirus genus and this genus is of greatest interest for those assessing the zoonotic potential of coronaviruses.

Natural hosts

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 deltacoronaviruses originate in birds (Wong et al. 2019).

Coronaviruses have been isolated worldwide from a range of bat species. At least 109 bat species have been surveyed for coronaviruses. Viruses were found in 36 species globally with antibodies detected in a further seven species (Smith et al. 2011). Coronaviruses have been detected in at least 11 of the 18 families of bats, across Asia, Africa, Europe, North and South America and Australia (Drexler et al. 2014).

Occurrences in Australia

There is NO evidence of SARS or SARS-like, MERS or MERS-like, 2019-nCoV or 2019-nCoV-like viruses in Australian wildlife (including bats).

A widespread study found two genotypes of alphacoronavirus and two genotypes of betacoronaviruses in seven species of Australian bats within five families, and in different regions of Australia. Anti-coronavirus antibodies were identified from an additional 18 species (Table 1). Evidence of infection was widespread, from central Queensland (CQ), far-north Queensland (FNQ), south-east Queensland (SEQ), Northern Territory (NT) and Western Australia (WA) (Smith et al. 2016).

Alphacoronaviruses were more widespread (by host species and by geographic spread) than betacoronaviruses in this study. No SARS-like betacoronaviruses were detected in Australia in this study. Viral genome and/or antibody prevalence was high (above 50%, and sometimes 100%) in insectivorous bat taxa (*Miniopteridae* and *Vespertilionidae*), including common species such as common bent-wing bats (*Miniopterus schreibersii*), little bent-wing bats (*M. australis*) and smaller horseshoe bats (*Rhinolophus megaphyllus*). No betacoronavirus genomes were detected in Australian *Rhinolophus* bats (a taxon of interest as SARS is believed to have originated from this genus) but the presence of antibodies in this genus indicated previous exposure to, or infection with, alpha- or betacoronaviruses (Smith et al. 2016).

A study in SW Western Australia found a low level of antibodies to coronaviruses in a range of Australian microbats from family Vespertilionidae and Molossidae. Faecal PCR revealed a number of (mostly novel) alphacoronaviruses. No betacoronaviruses were detected by PCR (Prada et al. 2019).

There is further evidence of coronavirus exposure from bats in near northern neighbouring countries (e.g. Papua New Guinea, Malaysia, East Timor, Indonesia). See Smith et al. (2016) for more details. A survey undertaken on feral camels in Australia found no serological evidence of infection with MERS (Crameri et al. 2015).

Epidemiology

Coronaviruses appear to have a relatively narrow host range, but 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). Coronaviruses are usually detectable in faeces and oral swabs but not blood or serum, which indicates a tropism for the intestinal system of the host (Smith et al. 2016). Routes of transmission between bats, and from bats to other hosts, including humans, are yet to be confirmed. There is evidence for persistent infections of coronavirus in at least one Australian bat, *Myotis macropus* (Jeong et al. 2017; Smith 2017).

Clinical signs

Coronaviruses are generally endemic in bat populations and cause no clinical signs.

Pathology, laboratory diagnostic specimens and procedures

Coronaviruses elicit no discernible clinical pathology in bats. Samples of faeces, oral swabs or serum should be collected and submitted. PCR can be used to detect virus in faeces or oral swabs. Competition ELISA has been

used to detect antibodies in serum but it does not differentiate between host response to alpha- or betacoronaviruses.

Treatment, prevention and control

Treatment of infected bats is not required. Prevention of coronavirus infection is not possible as the virus is endemic in bat populations.

Table 1: PCR and antibody evidence of coronavirus infection in Australian bats, including geographic location of sampling [from Smith et al. (2016)] [note only species with at least one positive result shown, for full results refer to Smith et al 2016].

Suborder	Family	Genus	Species	Location ¹	PCR positive ²	Antibody positive
<i>Pteropodiformes</i>	<i>Hipposideridae</i>	<i>Hipposideros</i>	<i>H. ater</i>	FNQ	-	-
				NT	-	+
				WA	N/T	-
		<i>Rhinonictis</i>	<i>R. aurantia</i>	NT	+	-
	<i>Megadermatidae</i>	<i>Macroderma</i>	<i>M. gigas</i>	NT	-	+
				WA	N/T	+
	<i>Pteropodidae</i>	<i>Pteropus</i>	<i>P. alecto</i>	SEQ	+	+
			<i>P. conspicillatus</i>	FNQ	N/T	+
			<i>P. poliocephalus</i>	SEQ	-	+
			<i>P. scapulatus</i>	NT	N/T	+
	<i>Rhinolophidae</i>	<i>Rhinolophus</i>	<i>R. megaphyllus</i>	FNQ	+	+
				SEQ	-	+
<i>Vespertilioniformes</i>	<i>Emballonuridae</i>	<i>Taphozous</i>	<i>Taphozous</i> spp.	WA	N/T	+
	<i>Miniopteridae</i>	<i>Miniopterus</i>	<i>M. australis</i>	CQ	+	+
				FNQ	+	+
				SEQ	+	+
				WA	N/T	+
			<i>M. schreibersii</i>	NT	+	+
				SEQ	+	+
	<i>Molossidae</i>	<i>Chaerephon</i>	<i>C. jobensis</i>	WA	N/T	+
		<i>Mormopterus</i>	<i>M. beccarii</i>	SEQ	-	+
	<i>Vespertilionidae</i>	<i>Chalinolobus</i>	<i>Chalinolobus</i> spp.	WA	N/T	+
		<i>Myotis</i>	<i>M. macropus</i>	FNQ	-	+
				SEQ	+	N/T
		<i>Scotorepens</i>	<i>Scotorepens</i> spp.	SEQ	N/T	+
		<i>Vespadelus</i>	<i>V. pumilus</i>	SEQ	+	N/T
			<i>V. troughtoni</i>	FNQ	-	+

¹ Central Queensland (CQ), far-north Queensland (FNQ), south-east Queensland (SEQ), Northern Territory (NT) and Western Australia (WA)

² Positive (+), negative (-), not tested (N/T)

Surveillance and management

Wildlife disease surveillance in Australia is coordinated by the Wildlife Health Australia. The National Wildlife Health Information System (eWHIS) captures information from a variety of sources including Australian government agencies, zoo and wildlife parks, wildlife carers, universities and members of the public. Coordinators in each of Australia's States and Territories report monthly on significant wildlife cases identified in their jurisdictions. There is no targeted surveillance program for bat coronaviruses and no records of bat coronavirus in eWHIS.

NOTE: access to information contained within the National Wildlife Health Information System dataset is by application. See the WHA website for more information:

www.wildlifehealthaustralia.com.au/ProgramsProjects/eWHISWildlifeHealthInformationSystem.aspx#requests.

We encourage those with laboratory confirmed cases of this condition in native Australian or feral animals to submit this information to the national system for consideration for inclusion in the national database. Please contact us at admin@wildlifehealthaustralia.com.au.

Statistics

A survey of 2,195 Australasian bats, sampled between 1997 and 2009 from Queensland, the Northern Territory and Western Australia, as well as neighbouring countries, identified coronaviruses in seven species and detected anti-coronavirus antibodies from an additional 18 species (Table 1). The authors also identified a population of Australian bats that were infected with a coronavirus prevalence of at least 17% (Smith et al. 2016).

A survey of 11 species of insectivorous bats in SW WA undertaken 2016-2018 examined 571 faecal samples and over 640 serum samples and found both molecular and serological evidence of coronaviruses (Prada et al. 2019).

A survey of 213 bent-winged bats (*Miniopterus orianae*) from different locations in SE Australia during 2015-2017 did not find evidence of coronavirus on molecular testing of oral swabs (Holz et al. 2018).

Research

Key questions include:

- What are the human health risks associated with Australian bat coronaviruses?
- Are these viruses endemic to Australian bats or is there potential for new viruses to be introduced via bats residing outside Australia?
- What is the potential for cross species infection with Australian bat coronaviruses?
- Does 2019 novel coronavirus occur in Australian bats?

To assist in answering these questions and gain a more complete epidemiological picture of coronavirus infections, where resources allow, Australian bats should continue to be tested, with results entered into the national Wildlife Health Information System. Knowledge of the prevalence of infection and the range of bat species involved will also assist.

Human health implications

In other parts of the world, coronaviruses can cause a range of disease syndromes including respiratory and gastrointestinal disease in humans and gastrointestinal, neurological and hepatic disease in animals.

While SARS, MERS and 2019-nCoV have caused serious disease in humans, the coronaviruses isolated from Australian bats are **not** closely related to the causative agents of these diseases. No human health implications have been identified to date.

Conclusions

Coronaviruses appear to be widespread and endemic in the world's bat populations. While relatively little work has been carried out on Australian bats, preliminary data indicates that a similar situation exists here. As humans continue to move into new areas it is likely that contact with novel coronaviruses will increase. The risk remains unknown.

Acknowledgements

We are extremely grateful to the many people who had input into this fact sheet and would specifically like to thank Drs Peter Holz, Craig Smith, Hume Field and other agencies and organisations that provided expert knowledge, comment and external review. Without their ongoing support production of these fact sheets would not be possible.

Updated: February 2020

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