

How could we conclude cat-to-human transmission of SARS-CoV-2?

To the editor:

Although human-to-human transmission is maintaining SARS-CoV-2 (the virus that causes COVID-19) in the world's human population (World Health Organization, 2020), the role of animals in spreading the disease is unclear (Office International des Epizooties, 2020). Of the commonly owned companion animals, cats appear to be particularly susceptible to the virus, and cat-to-cat transmission of SARS-CoV-2 has been demonstrated under experimental conditions (Shi et al., 2020). Additionally, in Germany a cat was reported to have contracted the virus from its infected owner (Schulz et al., 2020). As veterinarians, we are often asked: Can cats transmit the virus to people? Although human-to-cat transmission has been reported, there is, as yet, no evidence that transmission in the opposite direction (i.e. cat-to-human transmission) has occurred. But since human-to-human is the main route of transmission (i.e. the most likely source of a human infection is another infected human), our question is, what would constitute definitive evidence that cat-to-human transmission has occurred? Ethical considerations preclude conducting an experiment exposing an uninfected person to an infected cat; therefore, we must rely on evidence from real-world situations.

The essential criteria required to demonstrate cat-to-human transmission are as follows:

1. An effective quarantine period, followed by negative PCR and serologic testing that eliminates the potential for undetected infection in the person,
2. The person must remain isolated from all other sources of SARS-CoV-2 from the start of the effective quarantine period, through exposure to the infected cat, development of symptoms and diagnosis.

Using the above criteria, we propose two hypothetical scenarios in which cat-to-human transmission could be conclusively demonstrated in the natural setting. These scenarios do not represent an exhaustive list of all possible scenarios for which cat-to-human transmission can be demonstrated. In these scenarios, transmission of the virus from the cat(s) to the people occurs via petting, giving kisses or licks, or sharing food; these transmission routes have been identified as potential routes of SARS-CoV-2 transmission from humans to animals (CDC, 2020). All cats are sampled via nasal, deep oropharyngeal and rectal swabs. Blood is sampled for serological analysis. The humans are sampled via nasal or throat swabs. The SARS-CoV-2 diagnostic test used is RT-PCR. Viral isolation is used to demonstrate

that live virus is being shed. The virus in the infected cats and the virus in the infected humans are confirmed to be an identical match via genomic sequencing of the viral RNA, allowing a chain of transmission from human to cat to human to be demonstrated.

1 | SCENARIO ONE

A person, who has no contact with any other people or animals (except for an indoor-outdoor cat that they own), completes a 14-day quarantine, subsequently tests negative for SARS-CoV-2 by both PCR and serology and continues to quarantine themselves. Their cat then goes outside, where it contacts an infected person living in the neighbourhood, perhaps a person who sometimes provides the cat with its 'second breakfast'. The cat could contract the virus through close contact (e.g. cuddling) with this other person. The cat would then bring the infection back and infect its owner. In this case, genetic sequencing of the virus isolated from the owner would indicate that the virus originated from the second-breakfast supplier in the neighbourhood.

2 | SCENARIO TWO

A cat owner returns from an international vacation. On returning to her country, she self-quarantines in her apartment (where she lives alone and which no one has entered in her absence) for 14 days, after which, she tests negative for SARS-CoV-2. At the end of the quarantine period, the woman does a curbside pick-up of her cat from a local cattery where the cat has been staying in her absence. The cat had become infected with SARS-CoV-2 while at the cattery. Sometime after the cat returns home, the woman (who has continued to isolate from other people and animals, apart from her cat) develops symptoms of COVID-19. She tests positive, as does her cat. Testing of other cats at the cattery reveals two cats, kept in the same room as the woman's cat, also test positive for the virus. Virus from the cats at the cattery, the woman's cat and the woman are identical genetic matches. Three other cats kept in the same room at the cattery show antibodies to SARS-CoV-2, indicating exposure. (Indirect cat-to-cat transmission between cats kept in the same room has been demonstrated in an experimental setting, Shi et al., 2020.)

Speculation about the role of animals in the transmission of disease is natural during this SARS-CoV-2 pandemic. However, as veterinary epidemiologists, we wanted to point out that it seems extremely

unlikely, due to ethical and study design considerations, that direct evidence of cat-to-human transmission will ever be obtained.

CONFLICT OF INTEREST

S. C. Totton declares no conflict of interest. A. M. O'Connor is an associate editor of *Zoonoses and Public Health*. J. M. Sargeant is on the Editorial Board of *Zoonoses and Public Health*.

ETHICAL STATEMENT

Ethical approval for this research was not obtained as it did not involve human or animal subjects.

Sarah Ceridwen Totton¹ 

Jan Merrill Sargeant¹

Annette Maree O'Connor² 

¹Department of Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, ON, Canada

²Department of Large Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI, USA

Correspondence

Sarah Ceridwen Totton, 63 College Ave W, Guelph ON N1G 1S1, Canada.

Email: sarah.totton@gmail.com

ORCID

Sarah Ceridwen Totton  <https://orcid.org/0000-0003-2624-9405>

Annette Maree O'Connor  <https://orcid.org/0000-0003-0604-7822>

REFERENCES

- Centers for Disease Control and Prevention (CDC) (2020). *Evaluation for SARS-CoV-2 testing in animals*. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/animals/animal-testing.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fphp%2Fanimal-testing.html
- Office International des Epizooties (2020). *Questions and answers on the COVID-19*. Retrieved from <https://www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/>
- Schulz, C., Schoierer, R., Grundl, L., Juric-Neubauer, A., Sutter, G., Hartmann, K., von Kockritz-Blickwede, M., Beer, M., & Volz, A. (2020). *SARS-CoV-2 infection, cat, Germany*. Retrieved from <https://promedmail.org/promed-post/?id=7332909>
- Shi, J., Wen, Z., Zhong, G., Yang, H., Wang, C., Huang, B., Liu, R., He, X., Shuai, L., Sun, Z., Zhao, Y., Liu, P., Liang, L., Cui, P., Wang, J., Zhang, X., Guan, Y., Tan, W., Wu, G., ... Bu, Z. (2020). Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS-coronavirus 2. *Science*, 368, 1016–1020. <https://doi.org/10.1126/science.abb7015>
- World Health Organization (2020). *Q&A on coronaviruses (COVID-19)*. Retrieved from <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-coronaviruses>