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LETTER TO THE EDITOR

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What are the risk levels of humans contracting SARS-CoV-2 from pets and vice versa?

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which is the causative agent of the 2019 coronavirus disease (COVID-19), appeared to have originated from bats. It can cause natural infection in humans and several animal species, including pets (e.g., cats, dogs, hamsters), farmed animals (e.g., mink), zoo animals (e.g., big cats), and wild animals (e.g., white-tailed deer), that can serve as potential reservoirs for transmission of the virus to humans. By some estimates, about 470 million pet dogs and 370 million pet cats are cohabitating with their human owners worldwide. Based on contact tracing and viral genetic data analysis, a recent report[1] indicated that a pet cat could transmit SARS-CoV-2 to its veterinarian during an office visit. However, it is important to note that animal-to-human transmission events of SARS-CoV-2 are considered rare. The only other known case of pet-to-human transmissions was in Hong Kong and involved a pet-shop worker and two hamster owners who appeared to have become infected by a pet hamster purchased from the pet shop.[2] Out of several hundred animals tested at the pet shop and the supplying warehouse in the Netherlands, 12 animals and three humans tested positive for the same Delta variant of SARS-CoV-2. This Delta variant (AY.127) had not been previously detected in the region (Hong Kong) and likely originated from the supplying warehouse in the Netherlands. Other known cases of animal-to-human transmissions of SARS-CoV-2 occurred in Denmark on a mink farm where two workers contracted the virus from the farmed mink, and the virus subsequently appeared in the local human population.[3] While these reported cases of animal-to-human SARS-CoV-2 transmission are noteworthy, it is important to realize that they are rare occurrences and that the relative risks of animals spreading SARS-CoV-2 to humans (i.e., zoonotic transmissions or spillover events) appear to be relatively low,[4] and so are cases of humans spreading SARS-CoV-2 to animals (reverse zoonosis or spillback events), as described below.

Since the start of the COVID-19 pandemic, there have been worldwide surveillance efforts to determine SARS-CoV-2 seroprevalence in companion, captive, wild, and farmed animals, which have been recently reviewed by us.[5] At the beginning of the COVID-19 pandemic, it was thought that household pet dogs and cats were not susceptible to SARS-CoV-2, but by February 2020, it became clear this was not the case, as the first cases of human-to-animal transmission of SARS-CoV-2 were recorded in Hong Kong.[6] Viral genetic sequences from two SARS-CoV-2-infected dogs were found to be identical to the virus detected in their respective human owners, supporting the role of reverse zoonotic transmission of this virus. Since then, other cases of SARS-CoV-2 natural infections of both pet dogs and cats have been reported and summarized.[5] While household pets are known to be susceptible to SARS-CoV-2 infection, their role in the virus transmission chain is unclear. A longitudinal approach was used to study the transmission dynamics of SARS-CoV-2.[7] The authors of this study found by using logistic regression analysis that pets who share a bed with the infected human owners were more likely to be associated with pet SARS-CoV-2 transmission, which supports the idea that increased proximity to pets with infected human owners increases the likelihood of SARS-CoV-2 transmission to companion animals. This finding was bolstered by a related study,[8] which found that households where the index COVID-19 patient decreased their interaction with pets after their COVID-19 diagnosis had zero pet transmission, whereas COVID-19 human patients with increased duration of interactions with pets had a higher chance of transmitting the virus to their pets. Another study of households with known human COVID-19 status found a positive correlation between the proportion of dogs that tested positive for SARS-CoV-2-neutralizing antibodies and the recorded COVID-19 disease burden in humans.[9] However, when those household pets were tested by the polymerase chain reaction (PCR) method, they were found to be negative for SARS-CoV-2, which appeared to contradict serology results. A potential explanation the authors provided was that although pets could seroconvert, they were only shedding viruses for a relatively short period of time.

Although not a pet, free-ranging white-tailed deer have been found to be highly susceptible to SARS-CoV-2 infection and are able to sustain transmission of the virus in nature. From January to March of 2021, 35.8% (129/360) of nasal swabs detected SARS-CoV-2 by reverse transcription-PCR in white-tailed deer in Ohio.[10] Hale et al.[10] were able to detect probable deer-to-deer transmission of SARS-CoV-2 variants (B.1.2, B.1.582, and B.1.596) that were dominant in human populations in Ohio at the time; however, no spillback to humans were observed at that time. The US Department of Agriculture (USDA) showed in January 2021 that fawns (young deer) in captivity could be infected with SARS-CoV-2 and that they are able to shed viruses and infect naïve fawns kept in adjacent pens.[11] Currently, 24 of the 30 US states sampled (and some Canadian provinces of Quebec, Ontario, Saskatchewan, Manitoba, New Brunswick, and

British Columbia) have found white-tailed deer that are positive for SARS-CoV-2.[12] How SARS-CoV-2 got into the free-ranging white-tailed deer population is unknown. Direct human contact with deer via feeding of wild deer has been considered, but it is noteworthy that pathogens transmission as a result of contact of humans with wildlife rarely results in a sustained transmission. Additionally, the interaction of farmed deer (who have a considerable amount of interaction with humans) with wild deer has also been considered, but these scenarios may not be sufficient to account for the hundreds of recorded cases of SARS-CoV-2 infection of free-ranging white-tailed deer so far.

While it is important to conduct SARS-CoV-2 surveillance studies to better define potential animal reservoir sources of the virus and its evolutionary and transmission dynamics, it is crucial to put these findings into perspective when it comes to public health concerns. At this point, the US Centers for Disease Control and Prevention has determined that these reverse zoonotic (human-to-animal) and zoonotic (animal-to-human) SARS-CoV-2 transmission events are rare, and therefore, do not pose a significant level of risk to humans at this time.[4] However, during the current pandemic, many different antigenic variants of SARS-CoV-2 have evolved in humans, and it is not inconceivable that similar genetic changes can also occur within infected animals to adapt to the host-specific selection pressure.[3] Therefore, reverse zoonotic and zoonotic SARS-CoV-2 transmission events could potentially become more common and could present a real risk to humans in the future.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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