Human to Animal Transmission of COVID-19: A Two-Way Road

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Sir,

The origin of the novel Coronavirus, the SARS-CoV-2, that resulted in the ongoing COVID-19 pandemic with over eleven million confirmed cases as of July 2020 has been traced to the Huanan Seafood Wholesale Market in Wuhan, China. Genomic evolutionary analysis suggests that homologous recombination may have occurred between a bat coronavirus and an origin-unknown coronavirus within the viral spike glycoprotein gene.¹ A similar CoV with an 85 – 92% nucleotide homology with the SARS-CoV-2 has been detected in Pangolins (Scaly anteaters) during the surveillance of the wild animals sold at the market.² However, the sequence divergence between the two makes it unlikely that this virus was the direct source of the SARS-CoV-2, which remains unknown to date.

Recently, several tigers in the Bronx Zoo of New York, one of the largest foci of the pandemic, have been infected by the SARS-CoV-2. They were housed in the same area, so it is unclear if they each got infected by a single human source, or if this was an incidence of active animal-to-animal spread. In
another instance, a pet dog had been infected in Hong Kong. However, no serological response was seen, and viral culture was negative. This indicates that the dog could be contagious over many weeks without effectively clearing the virus. Goumenou et al. hypothesize that dogs may act as intermediate hosts for the virus. They further propose that dogs may have played a role in the exponential rate of infection in Northern Italy. Their findings are bolstered by the existing knowledge that the virus can infect the cells of many other mammals, including Chinese horseshoe bats, civets, and pigs in *in-vitro* studies.  

A similar picture was seen in the SARS outbreak of 2003-05, which was traced back to masked palm civets. The infected civets were asymptomatic, despite high viral loads, consequently behaving as amplifier hosts for the virus. The near-complete homology of the civet CoV with the SARS-CoV (~99.6%) indicated that they were unlikely to be the natural hosts, later determined to be the horseshoe bats. Animal testing in other species revealed the presence of the virus in various other mammals such as raccoon dogs, red foxes, wild boars, pigs, cats, and rats. Infected chickens showed the presence of viral RNA but did not mount an antibody response. No viruses could be cultured from them. This is similar to the COVID-19 infection reported in the dog in Hong Kong. Furthermore, it was seen that experimentally infected cats and ferrets could transmit the virus to other wild animals housed with them. This might potentially provide a clue to the SARS-CoV-2 outbreak in tigers at the Bronx Zoo by indicating the possibility of animal-to-animal propagation. In addition, for another related virus, the MERS-CoV, Dromedary camels, Alpacas, and Llamas act as amplifier hosts.

The current understanding of the epidemiology of COVID-19 in animals is limited. The susceptibility, route of infection and infectivity of animals is unknown. With the nations facing a critical shortage in manufacturing and import of diagnostic tests, the capacity for ecological surveys in animals is limited. It is probable that some animals may behave as asymptomatic carriers, super-spreaders, natural reservoirs, or may suffer from symptomatic disease. Isolation of such hosts could be fundamental in curtailing the spread of the disease.

In such a situation, surveillance of pets using pooled samples from hotspots should be considered. Monitoring contacts of infected animals and genomic analysis for sequence homology between humans and animals could shed light on the direction of spread. Cautionary practices could be instated to limit animal-human contact for pet-owners, herders, zoos, and wildlife sanctuaries. Removal of pangolins and civets in particular from markets, and potentially even closing down the wet markets would prevent further zoonotic spread. In the long term, reduction of human invasion of wildlife ecological niches will be vital in reducing the emergence of new zoonotic infections. The development of an animal vaccine for reservoir hosts could prove to be instrumental in curbing infections, as was attempted with camels during the MERS outbreak.

In conclusion, the bilateral transmission of COVID-19 between humans and animals poses significant risk and needs to be interrupted to limit the spread of this deadly pandemic.

**Contributions of Authors**

Dr. Prema Garg: Literature search, Data Interpretation, Writing; Dr. Umang Arora: Data Interpretation, Writing; Dr. Shreya Garg: Literature search, Data Interpretation; Dr. Manish Soneja: Data Interpretation.

**References**