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Risk of COVID-19 pneumonia in aquatic mammals

The ongoing newly emerged and highly infectious coronavirus disease 2019 (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) started from the Huanan seafood market located in Wuhan, China at the end of December 2019 (Khan et al., 2020a). The primary source for the SARS-CoV-2 is reported as a bat because it constitutes approximately, 31% of their virome as coronaviruses (CoVs), however, the intermediate host is not clear, still, some studies reported pangolin, snake, and turtles as possible intermediate hosts (Allocati et al., 2016; Nabi et al., 2020; Wong et al., 2020; Ji et al., 2020; Liu et al., 2020). As of April 20, 2020, the pandemic has infected more than 2.4 million individuals and killed more than 165,150 individuals globally (Walker, 2020). The pandemic has created health emergency, fear, and anxiety among global communities, and fighting against the COVID-19 aggressively (Khan et al., 2020b). The question what if the SARS-CoV-2 jump from human to wild animal species which then become reservoirs, affect the wildlife, and visit us in the near future has started a hot debate in the scientific community. As a result, several terrestrial animals were screened. A study by Shi et al. (2020) found that SARS-CoV-2 transmitted via droplet efficiently replicate in cats and ferrets, but poorly in ducks, chickens, pigs, and dogs. Recently, SARS-CoV-2 was detected in a tiger at the Bronx Zoo (Calma, 2020). What if other mammals, especially aquatic mammals can host SARS-CoV-2 need experimental verification. However, the Angiotensin-converting enzyme 2 (ACE2), a receptor for SARS-CoV-2 binding found in aquatic mammals can increase the vulnerability to SARS-CoV-2 infection (Luan et al., 2020).

The coronavirus subfamily; Coronavirinae is divided into four genera, *alpha*-, *beta*-, *gamma*-, and *delta* (α , β , γ , and δ) coronavirus. The α and β coronaviruses infect multiple species of mammals including humans, γ coronaviruses are found in birds and aquatic mammals including bottlenose dolphin and beluga whale, while δ coronaviruses are found both in birds and mammals including pigs (Durães-Carvalho et al., 2015; Mišek and Blicharz-Domańska, 2018). There are reports that α coronaviruses could also infect harbor seals (Schütze, 2016). The β coronavirus (SARS-CoV-2) bind to the host ACE2 through its receptor-binding domain (RBD) and regulate both human-to-human and cross-species transmissions of SARS-CoV-2 (Wan et al., 2020). Comparing the key amino acids in ACE2 for the binding ability to RBD in different species, ACE2 proteins from Cetacea, Primates, Cricetidae, and Bovidae were found capable to recognise RBD of SARS-CoV-2 by sustaining most of the key residues in ACE2 to connect with the SARS-CoV-2 RBD (Luan et al., 2020). This analysis indicates the vulnerability of aquatic mammals to COVID-19 infection.

The SARS-CoV-2 can survive on surgical masks and other plastic materials for several days (Chin et al., 2020). The ongoing COVID-19 pandemic has increased the demands for masks and gloves, which have been found floating in the open waters after disposal (Boyle, 2020). Globally, these protective covering as marine debris can introduce the SARS-CoV-2 from human to aquatic mammals. Furthermore, SARS-

CoV-2 via stools can enter into the sewage system and survive for several days (Wu et al., 2020). The sewage especially in developing countries directly go to the ocean without treatment and can transmit the virus to the ocean. Cetaceans establish herd and migrate to long-distance beyond the political and geographical boundaries (Van Bressemer et al., 2014). These characteristics can increase the chances of an outbreak if the highly infectious SARS-CoV-2 is introduced in their communities.

Although investigations are required, however, SARS-CoV-2 can possibly cause infection in marine mammals. Based on the literature, ample evidence is provided in several marine mammals which shows the devastating effects of pneumonia. Viral pneumonia and respiratory infection have been reported to cause deaths in a number of marine mammals including; mass mortalities of the seal at Orkney in 1813, 1836, and 1869–70 (McConnell, 1985), deaths of at least 1000 common seals during 1918 in Iceland (Dietz et al., 1989), death of 445 harbor seals along the New England seaboard in the United States during 1979–1980 (Geraci et al., 1982, 1984), and the death of 28 harbor porpoises died between 1990 and 1995 on the coasts of England and Wales (Kirkwood et al., 1997). Moreover, morbillivirus had also been linked with deaths of several mammals, for instance, the death of approximately, 18000 harbor seals (*Phocavitulina* L) in the North Sea and Baltic Sea in 1988 (Heide-Jørgensen et al., 1992), death of thousands of Baikal seals (*Phocasibirica*) in the Soviet Union in 1987 (Grachev et al., 1989; Osterhaus et al., 1989), and mass deaths of striped dolphins (*Stenellacoeruleoalba*) in the Mediterranean Sea (Lipscomb et al., 1996) and Spanish Mediterranean in 1990 (Duignan et al., 1992). Furthermore, in 2007, there was a recurrence of the virus which affected over 100 striped dolphins (Raga et al., 2008) and 60 long-finned pilot whales (*Globicephala melas*) (Fernandez et al., 2008). Nonetheless, pneumonia which can be caused by viruses or bacteria is the leading cause of death in dolphins throughout the world (Rubio-Guerri et al., 2013).

In summary, there is a need to increase surveillance on cetaceans and screen the individuals for COVID-19 infection if there is mass stranding or unusual behaviour. Special attention is required to the critically endangered, endangered, and other vulnerable populations. Further studies are needed in cetaceans to provide deeper insight into host specificity, as they are exposed continuously to escalating anthropogenic stressors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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