Wild Tiger Health Centre Information Sheet

Disease threat: SARS-CoV-2 (COVID-19)

COVID-19 is a new and emerging disease threat, but its significance to tigers is currently unclear. Regular updates will be provided as further data becomes available. (Updated 14-Sep-20)

Hazard description: COVID-19 is a rapidly emerging disease caused by the coronavirus SARS-CoV-2 - a beta-coronavirus closely related to the virus that caused the SARS outbreak of 2002-2003. The disease was first described in Wuhan, China, on the 31st of December 2019, following an outbreak of respiratory disease in people associated with a wet market. It is believed the disease first emerged in humans between late November and early December 2019 (Huang *et al*. 2020; Rambaut, 2020). Since then it has spread rapidly across the globe, and the World Health Organisation (WHO) declared it to be a pandemic on the 11th March 2020.

Host species: The full host range of SARS-CoV-2 is not yet known and is not likely to be known for some time. Since its emergence, the outbreak has predominantly affected people, with no evidence of ongoing or repeated spillover from animals (Rambaut, 2020). However, it has been shown that carnivores in the Felidae, Mustelidae and Canidae families are susceptible to infection. In felids, confirmed infections have been documented in domestic cats, lions, tigers and pumas and it would be prudent to presume that all non-domestic felids may be susceptible to productive infection with this novel coronavirus.. Experimentally, domestic cats can transmit SARS-CoV-2 to other cats (Bosco-Lauth *et al,* 2020; Shi *et al*. 2020) and the virus replicates well in domestic cats and ferrets (Shi *et al.* 2020). Clinical cases have been reported from a number of mink farms in the Netherlands, Denmark, Spain and the USA. Some non-human primates are also susceptible, and infection has been confirmed in domestic dogs. Research from the Erasmus University in Rotterdam suggests that rabbits are also susceptible.

Pathogenesis: There is incomplete understanding of the pathogenesis of SARS-CoV-2 in humans and even less is known about infections in animals. It is believed that people become infected via the oronasal route, often after touching their face following contact with a contaminated surface or through inhaling vaporised particles. SARS-CoV-2 can remain viable in aerosolised droplets for up to three hours and may be detected on surfaces for up to four days or longer (van Doremalen *et al.* 2020, Kampf *et al*. 2020). The route of infection is likely to be similar in other susceptible species.

Natural disease described so far in felids – domestic and non-domestic - appears to be relatively mild, with no reported fatalities to date. There is growing evidence that domestic cats can become infected with SARS-CoV-2 following close contact with infected humans. Sporadic cases have been reported from Belgium, China, France, Germany, Hong Kong, Spain, Russia, UK, and the USA. Not all infected individuals develop clinical signs. Symptoms in those that are affected include nasal discharge, respiratory distress, coughing, anorexia, vomiting or gastrointestinal disease, but these are generally mild and transient. Bosco-Lauth *et al* (2020) found that domestic cats develop a robust neutralizing antibody response that prevented re-infection to a second viral challenge. Serological evidence from Wuhan suggests more cats may have been exposed there, some of which were stray. However there is no evidence that infection in cats was circulating prior to the emergence in people (Zhang *et al.* 2020) and contact with an infected owner is the most likely way for cats to become infected.

One cluster of cases in captive tigers and lions has been reported in detail from Wildlife Conservation Society's Bronx Zoo in New York. The senior veterinarian for the collection, Dr Paul Calle, stated:

"On 3 April 2020, qPCR testing for SARS-Coronavirus-2 (SARS-CoV-2) on duplicate respiratory tract samples from a four year old female Malayan tiger (Panthera tigris jacksoni) with respiratory signs living at the Wildlife Conservation Society's (WCS) Bronx Zoo was performed at the Animal Health Diagnostic Center and New York State Veterinary Diagnostic Laboratory at Cornell University College of Veterinary Medicine and the University of Illinois College of Veterinary Medicine Veterinary Diagnostic Laboratory that yielded presumptive positive results that were confirmed by the USDA National Veterinary Services Laboratory on 4 April 2020. The index case was one of two Malayan tigers, two Amur tigers (Panthera tigris altaica), and three African lions (Panthera leo) that ***developed respiratory signs over the course of a week characterized by a dry cough and in some cases wheezing, but no dyspnea or nasal or ocular discharge. Mild anorexia was noted in some cases****. All of the cats are long term residents of the zoo, do not have chronic medical conditions, and there have been no new animal introductions to these groups for several years. ..... The source of infection is presumed to be transmission from a keeper who at the time of exposure was asymptomatically infected with the virus or before that person developed symptoms. The cats have received antibiotics and supportive care as needed, and all of the affected cats are doing well with no worsening of their clinical signs and daily gradual improvement. Enhanced PPE (masks, face shields, gloves, coveralls) use has been implemented for staff caring for all non-domestic felids in the four WCS zoos."*

(NB: Three additional tigers and three lions at the Bronx Zoo have also been confirmed as SARS-CoV-2 positive by rRT-PCR testing since this statement was made. All were symptomatic. An additional asymptomatic Amur tiger also tested positive. These tests were carried out on faecal samples. All affected individuals were clinically normal by early May 2020.)

There are still many unknowns. It is not yet clear whether all the affected cats at the Bronx Zoo were infected from the same source (i.e. the keeper) or whether secondary cat to cat transmission occurred, although it is most probable that SARS-CoV-2 infections that occur in captive non-domestic felids will be due to spread from humans. It is known that people can carry and transmit the virus without even knowing that they are infected, but whether cats (domestic or non-domestic) can also carry and shed significant amounts of virus without showing clinical signs is unknown. Given that only one episode in tigers has so far been reported, it is also unknown whether the clinical signs described from the Bronx Zoo are typical of infected tigers or whether others could suffer more serious disease or remain symptomless.

Recent, as yet unpublished, laboratory research indicates that the SARS-CoV-2 can replicate in domestic cats, that some domestic cats develop mild respiratory disease, and that domestic cats may be able to infect other domestic cats via aerosolised droplets (Halfmann *et al.* 2020; Shi *et al.* 2020). It is not known whether infected tigers can infect other tigers yet, but in close contact it seems likely. The risk that infected cats can pass SARS-CoV-2 to people is thought to be low, but a transmission chain of human-cat-human cannot be ruled out. Transmission from mink to humans has been demonstrated in the Netherlands.

Diagnosis: Testing of wildlife samples is likely to fall under the jurisdiction of local wildlife authorities and those seeking to get samples tested should contact the relevant government authority for specific guidance as to where samples should be submitted.

In humans, diagnosis is currently based on RT-PCR detection of the viral RNA. Testing in cats should also be based on the detection of SARS-CoV-2 viral RNA via PCR (typically a reverse transcriptase quantitative PCR assay (RT-qPCR) or equivalent. Many serological assays are under development and will likely be available soon.

Suggested samples to be collected & tested by for viral RNA from live tigers suspected of being infected include oral and nasal swabs and tracheal washes. Faecal samples may also be useful and have the advantage of being non-invasive but negative findings from faeces should be interpreted with caution. A recent transmission study found faecal shedding appeared to be relatively short lived, with virus being detected in the tissues several days after faecal shedding had stopped (Shi *et al.* 2020).

Given the low morbidity and short shedding periods described above, serology may be the most effective method of diagnosis in the live animal, particularly if sequential samples are available to show when animals have sero-converted. Validated serological tests are not currently available for non-domestic felids.

Post-mortem sampling of experimentally infected domestic cats demonstrated viral RNA in several sites, most consistently the nasal turbinate, soft palate and tonsils. Some tracheal and small intestinal samples also tested

positive. Importantly, and perhaps counterintuitively, none of the lung samples were positive (Shi et al., 2020). While we would continue to advocate that lung is routinely collected at post mortem (as part of a comprehensive tissue set) this may not prove useful in the diagnosis of COVID-19 and practitioners should ensure they have a full set of respiratory tissues (including those tissues listed above).

Vaccination: None at present although considerable effort is being put into the development of human vaccines.

Free-ranging tiger occurrence: To date there have be no confirmed reports of disease in free-ranging tigers, and only one report of SARS-CoV-2 related disease in captive tigers at the Bronx Zoo in New York.

Distribution: Worldwide. On the 14th September 2020 infections had been reported in over 29.2 million people from 217 countries and territories worldwide, with over 930,000 confirmed human deaths (Worldometer figures). The true figures are likely to be much higher. As seen over the past weeks and months this is a virus which is capable of spreading extremely rapidly and, whilst there are ongoing global efforts to reduce transmission, it is likely many areas may experience several waves of infection before the pandemic is brought under control.

Assumptions: None

Limitations: Given the recent emergence of this disease there remains a lot that is unknown. There is a significant amount of research effort currently being undertaken, but the majority of this is understandably targeted at human health.

Treatment of affected tigers: No specific treatment is available at present. Symptomatic and supportive care is appropriate.

Useful information sources:

https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/SA_One_Health/sars-cov-2-animals-us

https://promedmail.org/

https://www.worldometers.info/coronavirus/

European Association of Wildlife Vets – COVID information
https://wildtigerhealthcentre.org/wp-content/uploads/2020/04/EAZWV-covid19_faq_v6_28_april_2020.pdf

https://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/COV-19/A_Factsheet_SARS-CoV-2.pdf.

REDUCING THE RISKS TO FREE-RANGING TIGERS DURING THE PANDEMIC:

The Bronx Zoo case demonstrates that tigers can become infected with SARS-CoV-2 (probably from close contact with infected people) and develop relatively mild clinical signs of respiratory disease. Until other cases are reported we do not know whether more severe clinical disease may develop in other infected individuals.

Whether the virus poses a major threat to wild tiger populations has yet to be determined, but given current knowledge of how this virus spreads, its environmental persistence, its clinical impact on tigers, their solitary nature and natural tendency to "socially distance" themselves from humans, it seems unlikely.

Although the direct risk to free-ranging tigers from infection with SARS-CoV-2 may be small, by far the greater impact on wild tiger populations will probably be the effect it has on protected area and national park and reserve staff, anti-poaching personnel, human-tiger conflict response teams etc. Where staff numbers are depleted, tigers may be more vulnerable than ever to poaching and perhaps also retaliatory killing following unresolved conflict incidents.

Tigers involved in human-tiger conflict situations could be at slightly greater risk as contact rates with humans and infected material would presumably be somewhat greater. However, tigers at the greatest risk of infection would be those handled in the field for conflict resolution, research radio-collaring etc, and those temporarily housed in rehabilitation centres. Staff involved with these activities will have close contact with the cats, and there is clearly a risk of infection from human to tiger in these circumstances. It should be remembered that in the Bronx Zoo case transmission of virus was likely to have been from a non-symptomatic person in the early stages of infection. Everyone should act as if they might be shedding the virus even if they feel well.

Suggested precautions to protect free-ranging tigers from infection with SARS-CoV-2 include:

- The temporary closure of tiger reserves, especially where close contact (within 5 metres) between visitors and semi-habituated tigers could occur as in some Indian sites. If this is not possible, all visitors and staff should wear face masks. and drivers instructed to minimise contact distance.

- No visitors exhibiting any of the signs of COVID-19 should be allowed to enter tiger reserves (high temperature, coughing especially).

- Spitting by anyone visiting or working in tiger reserves must be vigorously prevented.

- All National Park and Protected Area staff should be familiar with symptoms of COVID-19 and exclude themselves from duty if they develop symptoms.

- Research activities that require the handling of tigers should be suspended for a period.

- Everyone involved with handling free-ranging tigers should apply rigorous biosecurity measures such as:
    - Limiting the number of people coming within 2 – 3 metres of the cat to the absolute minimum.
    - Self-exclusion of anyone with a fever or a cough (or people that have been in contact with others that have symptoms of COVID-19).
    - Thorough washing of hands before and after handling tigers and any equipment used.
    - Wearing such personal protective equipment as is available such as disposable gloves, face masks, coveralls etc.
    - Personal protective equipment may be in short supply due to the requirements of human health services, but **the two most important biosafety measures are likely to be rigorous hand washing before and after handling tigers & equipment, and the wearing of face masks during handling.**
    - In other words, all those measures that are being implemented to prevent spread between people should be applied to preventing virus spread from people to tigers.

- All tiger deaths should be thoroughly investigated, and samples submitted for testing to the appropriate national laboratories. As with other infectious disease, it is possible infection may result in behavioural change, which could pre-dispose animals to other incidents, such as conflict, poaching attempts and road traffic accidents. From the point of view of staff safety, all post-mortem cases should be treated as potentially infectious until proven otherwise, attendance should be limited, and appropriate PPE should be worn.

- The most efficient disinfectants against SARS-CoV-2 are alcoholic compounds, but with appropriate contact time: propanol (100% or 70%) or ethanol (70%) for a minimum of **30 sec**. For quaternary ammonium or phenolic compounds, the necessary contact time to inactivate the virus is usually **10 minutes.** Other disinfectants that could be used include wine vinegar (1 minute), sodium hypochlorite (1-2 minutes), hydrogen peroxide (usually 2 minutes) (Kampf *et al.* 2020; Lecu *et al.* 2020). Commonly used veterinary disinfectants like povidone-iodine 7.5% or chlorhexidine 0.05% inactivate the virus within 5 minutes.

The Wildlife Health Specialist Group of the IUCN, and the OIE (the World Association for Animal Health) have issued guidelines to minimise the risk of SARS-CoV-2 transmission from people to free-ranging wild mammals.
This can be downloaded from http://www.iucn-whsg.org/COVID-19GuidelinesForWildlifeResearchers

REDUCING THE RISKS TO CAPTIVE TIGERS DURING THE PANDEMIC:

Although the risk of virus transmission from humans to tigers is considered low, it is clearly not zero. Staff looking after tigers in captivity and visitors often come into close contact with the animals, and the health status of visitors cannot be guaranteed.

Suggested precautions to protect captive tigers from infection with SARS-CoV-2 include:

- Zoos and other facilities where tigers are held should be closed to the public.

- Staff should maintain 2- 3 metres distance from animals as well as from each other.

- Any member of staff having symptoms of COVID-19 should not be allowed to work and should put themselves in self-isolation in accordance with the recommendations from their local authorities

- Staff self-surveillance by taking body temperatures twice daily should be considered.

- Staggered work schedules to reduce the number of employees on site at any one time should be considered.

- The number/ frequency of staff in tiger areas should be minimised. All human-tiger contact should be reduced to a minimum: activities that will particularly need evaluating are hand-feeding, training and moving of animals. If these are not essential, they should not be performed. Interactions between staff should also be minimised.

- Hands should be washed thoroughly (at least 30 seconds with warm water and soap) and regularly before and after each task when working in an animal section, including food preparation and handling supplies. Use hand sanitiser when soap is not available.

- Personal Protective Equipment (PPE) should, if available, be worn when preparing food, cleaning the enclosures or equipment, and when in close contact to the animals (e.g. when providing food, water, enrichment items or medicines). The wearing of face masks by all staff is recommended to reduce the possibility of spread from humans to tigers or to other staff members. Disposable gloves should be worn when preparing animal feed and when cleaning. Rubber boots (that are not shared with other colleagues) should be worn in the animal service areas and a disinfectant foot bath should be used at the entrance and exit of facilities.

- Personal protective equipment may be in short supply due to the requirements of human health services, but **the two most important biosafety measures are likely to be rigorous hand washing before and after working in tiger facilities or handling tigers, and the wearing of face masks at all times during the work.**

- Where close contact is necessary (during anaesthesia for example) full personal protection equipment must be worn. This includes close fitting face masks, disposable gloves and overalls or gowns. Rubber boots should be worn and disinfected before after the interaction.

- Equipment should not be taken out of the areas it is used in. Where this is not possible it should be disinfected between enclosures.

- Regular cleaning and disinfection of all surfaces and commonly touched items such as tables, door handles, light switches, telephones etc.

- No eating, drinking or spitting should be allowed in animal service areas

- Animals should continue to be allowed to use their outside enclosures daily whenever possible.

- If any animal develop a cough, or other respiratory symptoms a vet should be contacted. It is important to remember that non-domestic felids are susceptible to a wide range of other respiratory pathogens.

- SARS-CoV-2 is likely to be inactivated by heat (10 minutes at 56°C or 5 minutes at 70^{0}C).

- The most efficient disinfectants against SARS-CoV-2 are alcoholic compounds, but with appropriate contact time: propanol (100% or 70%) or ethanol (70%) for a minimum of **30 sec**. For quaternary ammonium or phenolic compounds, the necessary contact time to inactivate the virus is usually **10 minutes.** Other disinfectants that could be used include wine vinegar (1 minute), sodium hypochlorite (1-2 minutes), hydrogen peroxide (usually 2 minutes) (Kampf *et al.* 2020; Lecu *et al.* 2020). Commonly used veterinary disinfectants like povidone-iodine 7.5% or chlorhexidine 0.05% inactivate the virus within 5 minutes.

- Zoos that remain open to the public are advised, in addition to the measures above, to:
    - Increase distance between visitors and tigers so that no-one comes within 10 metres of a cat.
    - No visitors should be allowed behind the scenes.
    - No eating, drinking or spitting by visitors should be allowed.
    - Feeding or throwing items in the enclosures by the public should be rigorously prevented.