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Review on Novel Coronavirus or Sars-Cov2 Covid-19 on Animals

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ABSTRACT

Coronaviruses (CoVs) belong to *Nidovirales* order, *Coronaviridae* family, *Coronavirinae* subfamily. CoVs contain the largest RNA genome, ranging from 25 to 33 kilobases in length. Based on the phylogenetic analysis, CoVs are classifi ed into four genera, alpha, beta, gamma, and delta CoVs. CoVs of each genus Only the alpha- and betacoronavirus genera are found in diverse animal species including horses, cows, pigs, dogs, cats, birds, and ferrets and cause respiratory, enteric, hepatitic, renal, neurological, and other diseases. COVID-19 is caused by a coronavirus. There are many other types of coronaviruses that can infect animals. Some of these may cause animals to become sick. They are different to the COVID-19 virus. Natural SARS-CoV-2 infections associated with zoonotic transmission have been identified in pets such as cats and dogs, farmed wildlife such as minks and ferrets, zoo animals such as tigers and lions, and free-ranging wildlife such as white-tailed deer

Preliminary finding from studies suggest that poultry and pigs are not susceptible to SARS-CoV-2 or Covid-19 infection. There is currently no specific treatment against COVID-19 infection. The first COVID-19 vaccine for animals (Carnivac-Cov) developed by Russia have been shown to elicit robust responses in animals vulnerable to SARS-CoV-2 infection such as dogs, cats, foxes, and minks. This paper provides a brief historical overview of novel coronavirus (COVID19) morphology, transmission, clinical signs, diagnosis, treatment and prevention and control.

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Introduction

Coronaviruses (CoVs) belong to Nidovirales order, Coronaviridae family, Coronavirinae subfamily. CoVs contain the largest RNA genome, ranging from 25 to 33 kilobases in length. Based on the phylogenetic analysis, CoVs are classifi ed into four genera, alpha, beta, gamma, and delta CoVs. CoVs of each genus Only the alpha- and betacoronavirus genera are found in diverse animal species including horses, cows, pigs, dogs, cats, birds, and ferrets and cause respiratory, enteric, hepatitic, renal, neurological, and other diseases [1-3].

The coronavirus belongs to a family of viruses that may cause various symptoms such as pneumonia, fever, breathing difficulty, and lung infection. These viruses are common in animals worldwide, but very few cases have been known to affect humans [4].

Coronaviruses have long been recognized as important veterinary pathogens, causing respiratory and enteric diseases in mammals as well as in birds [5,6].

Coronaviruses cause various diseases in animals with some resulting in significant economic losses. PEDV, a member of the genus Alphacoronavirus, is the etiological agent of porcine epidemic diarrhea in swine populations representing a notable example how coronaviruses can cause serious epidemics in animal population worldwide. In 2013, the virus has emerged or re-emerged to cause large-scale epidemics in the Americas and Asia, causing millions of fatal cases among piglets and representing one of the most serious concerns among the global pig industries [7, 8].

Several coronaviruses have caused serious problems in humans and animals in the past two decades. The best known examples are severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and porcine epidemic diarrhea virus (PEDV). Urbanization and the increasingly frequent mixing of different animals in densely populated areas may have facilitated the emergence and re-emergence of some of these viruses. On the other hand, coronaviruses are known to have high mutation and recombination rates, which may allow them to cross species barriers and adapt to new hosts [9].

Coronaviruses (CoV) are a large family of RNA viruses that cause illnesses ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). The new strain of coronavirus identified in December 2019 in Wuhan city, Hubei province of China, has been named by the International Committee on Taxonomy of Viruses (ICTV) as Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2). The ICTV have determined that SARS-CoV-2 is the same species as SARS-CoV but a different strain. The World Health Organization (WHO) has named the disease associated with SARS-CoV-2 infections as Corona "COVID-19" (SCDC, 2020).

The new COVID-19 is caused by the virus SARS-CoV-2. The most likely ecological reservoirs for SARS-CoV-2 are bats, but it is

believed that the virus jumped the species barrier to humans from another intermediate animal host. This intermediate animal host could be a domestic food animal, a wild animal, or a domesticated wild animal which has not yet been identified (WHO. 2020).

The Wuhan outbreak is a stark reminder of the continuing threat of zoonotic diseases to global health security. More significant and better targeted investments are required for a more concerted and collaborative global effort, learning from experiences from all geographical regions, through a 'ONE-HUMAN-ENIVRONMENTAL- ANIMAL-HEALTH' global consortium to reduce the global threat of zoonotic diseases [10].

Therefore, the objective of this paper is:
To review on novel coronavirus diseases (COVID-19) on animals.

Literature Review

History of coronavirus

The first known coronavirus, the avian infectious bronchitis virus, was isolated in 1937 and was the cause of devastating infections in chicken. The first human coronavirus was isolated from the nasal cavity and propagated on human ciliated embryonic trachea cells in vitro by Tyrrell and Bynoe in 1965. However, coronaviruses have been present in humans for at least 500-800 years, and all originated in bats [11-12].

The first discovered CoVs were IBV that causes respiratory disease in chickens and the human CoVs, human CoV-229E (HCoV-229E) and human CoV-OC43 (HCoV-OC43), which cause the common cold in humans. Since the emergence of HCoV-229E and HCoV-OC43, several other HCoVs were discovered, such as Severe Acute Respiratory Syndrome-CoV (SARS-CoV) in 2002, HCoV-NL63 in 2004, HCoV-HKU1 in 2005, Middle East Respiratory Syndrome-CoV (MERS-CoV) in 2012 [13].

The rapid economic growth in southern China has led to an increasing demand for animal proteins including those from exotic game food animals such as civets. Large numbers and varieties of these wild game mammals in overcrowded cages and the lack of biosecurity measures in wet markets allowed the jumping of this novel virus from animals to human [14, 15].

Starting December 2019, there were reports of patients presenting with severe viral pneumonia in the city of Wuhan, China [13].

In December 2019, human cases of pneumonia of unknown origin were reported in Wuhan City, Hubei Province of China (People's Rep. of). A new CoV was identified as the causative agent by Chinese Authorities. Since then, human cases have been reported by almost all countries around the world and the COVID-19 event has been declared by the World Health Organization (WHO) to be a pandemic [16].

Since mid-December 2019 and as of early February 2020, the 2019 novel coronavirus (2019-nCoV) originating from Wuhan (Hubei Province), China. Based on the initial reported surge of cases in Wuhan, the majority were males with a median age of 55 years and linked to the Huanan Seafood Wholesale Market. Most of the reported cases had similar symptoms at the onset of illness such as fever, cough, and myalgia or fatigue. Most cases developed pneumonia and some severe and even fatal respiratory diseases such as acute respiratory distress syndrome [17]. Molecular epidemiological studies suggest that the emergence of SARS-CoV-2 was likely the result of multiple zoonotic spillover events [18].

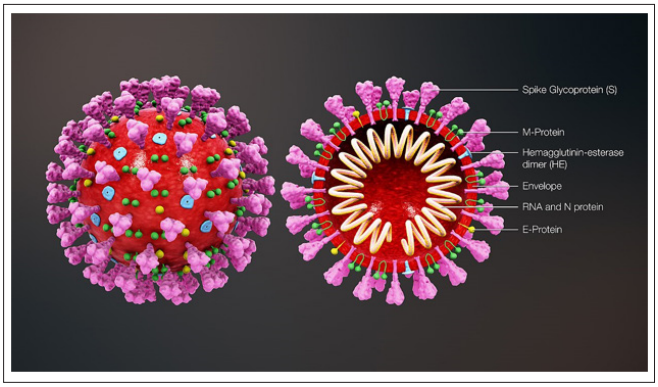
Morphology and Structure

Corona virus is spherical or pleomorphic, single stranded, enveloped RNA and covered with club shaped glycoprotein [19].

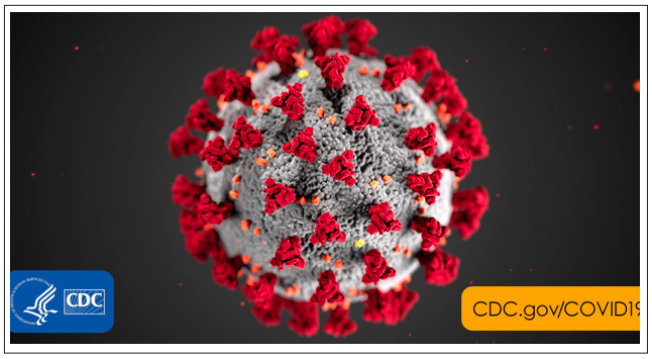
Corona viruses are so named because of their characteristic solar corona (crown-like) appearance when observed under an electron microscope. This appearance is produced by the peplomers of the spike (S) glycoprotein radiating from the virus lipid envelope [1, 20].

There are four major structural proteins. The S glycoprotein is a major antigen responsible for both receptor binding and cell fusion and the membrane glycoprotein (M) is involved in budding and envelope formation; the M protein has also been found to play a pivotal role in virion assembly (Tseng et al., 2010) [21]. The viral genome is associated with the basic phosphoprotein nucleocapside (N) within the capsid. The envelope (E) protein is a highly hydrophobic protein encasing the entire structure of the corona virus. The genome is non -segmented, positive single-stranded RNA of about 26-32 kb, making it the longest RNA viral genome known, and contains at least six different open reading frames. The RNA molecule has a methylated cap in 5' and a poly-A tail in 3' [1, 22].

The key receptor of the host cell attached by S is angiotensin-converting enzyme 2 (ACE2), which is a metalloprotease expressed in the cells of the lung, intestine, liver, heart, vascular endothelium, testis, and kidney [23].



Source: en.wikipedia.org



This illustration, created at the Centers for Disease Control and Prevention (CDC), reveals ultrastructural morphology exhibited by coronaviruses.

Source: CDC.gov/COVID19.
Figure:1: Morphology of COVID 19

Transmission

Many domestic and wild animals, including camels, cattle, cats, and bats, may serve as hosts for coronaviruses. It is considered that, generally, animal coronaviruses do not spread among humans. However, there are exceptions, such as SARS and MERS, which are mainly spread though close contact with infected people via respiratory droplets from cough or sneezing. With regard to COVID-19, early patients were reported to have some link to the Huanan Seafood Market in Wuhan, China, suggesting that these early infections were due to animal-to-person transmission [4].

Now that SARS-CoV-2 infections are widely distributed in the human population, there is a possibility for some animals to become infected through close contact with infected humans. Infection of animals with SARS-CoV-2 virus may have implications for animal health and welfare, for wildlife conservation, and for biomedical research [16].

Corona virus transmitted human to human or human to animal via airborne droplets [19].

Dogs, cats (domestic cats and a tiger), and minks have tested positive for SARS-CoV-2 in the field setting, following close contact with infected humans (or humans suspected to be infected with SARS-CoV-2). SARS-CoV-2 positive test results in dogs in Hong Kong: (09/03/2020), (16/03/2020) and (23/03/2020), in cat in Belgium (28/03/2020), in tiger (06/ 04/2020) and a lion (17/04/2020) in the USA, in two domestic cats in the USA (22/04/2020) and in two mink farms in The Netherlands (26/04/2020). To date, Preliminary findings from laboratory studies suggest that, of the animal species investigated so far, cats are the most susceptible species for SARS-CoV-2, and cats can be affected with clinical disease. This preliminary finding from studies suggest that poultry and pigs are not susceptible to SARS-CoV-2 infection. The infection of animals with SARS-CoV-2 meets the criteria of an emerging disease (WOAH, 2020).

Experiences from previous outbreaks of related coronaviruses, such as the Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) show that transmission through food consumption did not occur. To date, there have not been any reports of transmission of SARS-CoV-2 virus through food. However, concerns were expressed about the potential for these viruses to persist on raw foods of animal origin. Recent research suggests that COVID-19 may also be spread through the fecal-oral route, although likely less commonly (WHO, 2020).

Several animal species have tested positive for SARS-CoV-2, with infection being introduced to a population as a result of close contact with humans or animals infected with SARS-CoV-2 or in experimental infection studies performed in laboratory settings [24].

It is believed that SARS-CoV-2 probably originated in bats and was introduced into humans through an unidentified intermediate vertebrate host. Natural SARS-CoV-2 infections associated with zoonotic transmission have been identified in pets such as cats and dogs, farmed wildlife such as minks and ferrets, zoo animals such as tigers and lions, and free-ranging wildlife such as white-tailed deer [25, 26].

Animal infections of SARS-CoV-2 have been reported mainly in South America, North America, and Europe, with bats being proposed as the natural reservoir of the virus. However, the precise intermediate host and transmission pathways remain uncertain. In addition to domestic animals, free-ranging, captive, or farmed wild animals, such as big cats, minks, ferrets, North American white-tailed deer, and great apes, have been observed to be infected with SARS-CoV-2. Notably, farmed minks and pet hamsters have been confirmed to be capable of transmitting the SARS-CoV-2 virus to humans [27].

SARS-CoV-2 has been detected in 18 different animal species from ten families (Felida, Viverridae, Hyaenidae, Canidae, Mustelidae, Procyonidae, Cervidae, Hippopotamidae, Hominidae, and Cricetidae) of four animal orders (Carnivora, Artiodactyla, Primates, and Rodentia). These 18 animal species consist of pet (dog, cat, ferret, and hamster), captive (tiger, lion, snow leopard, cougar, lynx, fishing cat, binturong, hyena, otter, coatimundi, hippo, and gorilla), farmed (mink), and wild (deer, wild otter, feral mink, and cat) animals [28].

The attachment of SARS-CoV-2 to the host cell is mediated by the Spike protein (S) and its receptor Angiotensin-converting enzyme 2 (ACE2). In humans, ACE2 is expressed on the surface of cells in the upper oesophagus, lungs, kidneys, testicles and the intestinal epithelium. ACE2 is well conserved in mammals, birds, reptiles and amphibians. Recently, homology models of animal ACE2 and dynamic computational models for interaction with SARS-CoV-2 S-protein were developed in different animal species. For example, a molecular study showed that SARS-CoV-2 was able to use a swine ACE2 homologue expressed by HeLa cells to induce infection [29].

Clinical Signs

As this coronavirus affects the respiratory tract, common presenting symptoms include fever and dry cough, with some patients presenting with respiratory symptoms (e.g. sore throat, nasal congestion, malaise, headache and myalgia) or even struggling for breath. In severe cases, the coronavirus can cause pneumonia, severe acute respiratory syndrome, kidney failure and death [16].

The virus is now widely distributed among humans and, in some cases, seems to affect also the animals that share their lives and homes. The available evidence suggests that exposure to SARS-CoV-2 can cause an asymptomatic/paucisymptomatic infection in animals, and therefore an illness. Infection was asymptomatic in the two dogs and the cat in Hong Kong. The cat in Belgium, however, developed respiratory and gastrointestinal symptoms one week after its owner returned from Italy. The animal displayed anorexia, vomiting, diarrhea, breathing difficulties and cough, but its symptoms started improving on their own nine days after the onset of the disease (EPHIS, 2020).

SARS-CoV-2 infection in animals is either asymptomatic or causes symptoms ranging from mild respiratory and gastroenteric signs to pneumonia and death. Two months after COVID-19 was reported, SARS-CoV-2 was first detected in dogs from households with positive owners in Hong Kong [30].

In laboratory settings, the incubation period in animals appears to be similar to that seen in humans (i.e., between 2 and 14 days). However, more studies are required to better estimate the mean duration of incubation and the infectious periods for the different susceptible animal species [24].

Diagnosis

The genetic sequence of the 2019-nCoV has become available to the WHO on 12 Jan 2020 and this has facilitated the laboratories

in different countries to produce specific diagnostic PCR tests for detecting the novel infection [16].

Laboratory diagnosis can be performed by: (a) detecting the genetic material of the virus, (b) detecting the antibodies that neutralize the viral particles of interest, (c) detecting the viral epitopes of interest with antibodies (serological testing), or (d) culture and isolation of viable virus particles. The key limitations of genetic material detection are the lack of knowledge of the presence of viable virus, the potential cross-reactivity with non-specific genetic regions and the short timeframe for accurate detection during the acute infection phase. The key limitations of serological testing is the need to collect paired serum samples (in the acute and convalescent phases) from cases under investigation for confirmation to eliminate potential cross-reactivity from non-specific antibodies from past exposure and/or infection by other coronaviruses. The limitation of virus culture and isolation is the long duration and the highly specialized skills required of the technicians to process the samples [17].

Early diagnosis should be initiated for suspected cases. Case identification, contact tracing and isolation is required; testing for COVID-19 should be performed for suspected cases according to the following criteria, based on the updated WHO case definition: 1) A patient with acute respiratory tract infection (sudden onset of at least one of the following: cough, fever, shortness of breath) AND with no other aetiology that fully explains the clinical presentation 2) A patient with any acute respiratory illness AND having been in close contact with a confirmed or probable COVID-19 case in the last 14 days prior to onset of symptoms; OR 3) A patient with severe acute respiratory infection (fever and at least one sign/symptom of respiratory disease (e.g., cough, fever, shortness breath) AND requiring hospitalisation AND with no other aetiology that fully explains the clinical presentation (ECDC, 2020).

Companion animal which has had close contact with a person/ owner infected with SARS-CoV-2, it is recommended that RT-PCR be used to test oral, nasal and fecal/rectal samples. Care should be taken to avoid contamination of specimens from the environment or by humans [16].

Treatment

There is currently no specific treatment for COVID-19 infection, however several clinical trials are recruiting in Wuhan and globally to assess the effect of antiviral medicines (ECDC, 2020).

Since there is no treatment recommendation is available, it is recommended to follow current MERS-CoV treatment guidelines until further information is available. However, it is necessary to transfer a confirmed COVID-19 case to a designated hospital in coordination with command and control center. Intensive supportive care with treatment of symptoms is the main approach to manage the infection [31].

Prevention and control

There are different strategies used to control infections in animals and humans, including culling farmed animals, the isolation of infected pet and captive animals, and the vaccination of captive animals [28].

Biosecurity

Biosecurity and hygiene measures are key to preventing transmission of SARS-CoV-2. People who are suspected or confirmed to be infected with SARS-CoV-2 should restrict contact with mammalian animals, including pets, just like they would with people during their illness. Animals suspected or confirmed to be infected with SARS-CoV-2 should remain separated from other animals and humans while infected [24].

When handling and caring for all animals, basic hygiene measures should always be implemented. This includes hand washing before and after being around or handling animals, their food, or supplies, as well as avoiding kissing, being licked by animals, or sharing food. People who are suspected or confirmed to be infected with SARS-CoV-2 should minimize close direct contact with animals, including farm animals, zoo animals, other captive animals, and wildlife; particularly species which have demonstrated to be susceptible to infection with SARS CoV-2. As good practice, appropriate and effective biosecurity measures should always be practiced when people have contact with groups of animals e.g. on farms, at zoos, and in animal shelters [16].

Animals that test positive for SARS-CoV-2 should be kept away from unexposed animals and contact with those animals should be avoided as much as possible. Therefore, any (case of) infection of animals with SARS-CoV-2 should be reported to the OIE in accordance with the OIE Terrestrial Animal Health Code and include information about the species, diagnostic tests, and relevant epidemiological information. Based on currently available information, and with the support of expert advisory groups, the OIE makes no specific recommendations for COVID-19 related sanitary measures for the international trade of animals or animal products for countries reporting cases of COVID-19 in humans [16].

Confirmed cases requiring admission should be placed in an isolation room with a dedicated bathroom. Regular cleaning followed by disinfection of patients' rooms, furniture and frequently touched surfaces with hospital disinfectants active against viruses is recommended. Staff engaged in environmental cleaning and waste management should wear appropriate PPE (ECDC, 2020).

As a general rule, the consumption of raw or undercooked animal products should be avoided. Raw meat, raw milk or raw animal organs should be handled with care to avoid cross contamination with uncooked foods [16].

Vaccination of animals

Vaccines are one of the most effective weapons for preventing and controlling infectious diseases, such as COVID-19. Since the explosion of COVID-19, researchers from various countries have developed safe and effective SARS-CoV-2 vaccines. Several vaccines including the mRNA vaccine, inactivated vaccines, recombinant protein vaccine, and adenovirus vector vaccine have been approved for emergency use authorization worldwide (https://www.who. int/news-room/questions-and-answers/ item/ coronavirus disease- (covid-19)-vaccines). These vaccines have been confirmed to be safe and effective in restricting the spread of COVID-19 and reducing the risk of severe outcomes resulting from SARS-CoV-2 [32].

The first COVID-19 vaccine for animals (Carnivac-Cov) developed by Russia have been shown to elicit robust responses in animals vulnerable to SARS-CoV-2 infection such as dogs, cats, foxes, and minks (https://www.rbth.com/science- and- tech/ 333615-worlds- first- vaccine- animals). The strategy of vaccination in susceptible animal species, especially pets which have frequent contact with humans, has not yet attracted sufficient attention.

A previous study has shown that vaccination of poultry with the H5/H7 influenza virus vaccine not only successfully prevented influenza in poultry, but also prevented human infection with H7N9 virus in China, which provides a new insight for controlling the COVID-19 pandemic [33].

Vaccination of susceptible animals could protect them against SARS-CoV-2, break the chain of animal-to-animal and even animal-to-human transmission, and eliminate the risk of emergence of novel SARS-CoV-2 variants with increased virulence in humans. Thus, one health strategy should be considered to control the circulation of SARS-CoV-2 in all possible susceptible animals and humans via immunization [34].

The announcement of the end of the SARS-CoV-2 pandemic may have been premature, as the Omicron variant is highly transmissible yet causes milder symptoms [35]. While this may suggest a potentially stable and predictable pattern of transmission, some experts disagree, pointing to Omicron's greater mutability and lower lethality than previous strains [36]. They suggest that the virus may persist as a public health threat for decades to come, necessitating continued vaccination efforts for future generations due to its potential to infect animals and mutate further. Moreover, even if the virus were eliminated in human populations, SARS-CoV-2 could continue to pose a risk to human health and domestic and wild animals through hidden reservoirs in wildlife [37].

Control of SARS-CoV-2 infection in wild animals is quite challenging. A possible approach for controlling SARS-CoV-2 in wildlife is the application of an oral vaccine to them, which is similar to the strategy used to control rabies in wildlife [28].

SARS-CoV-2 is continuously mutating in hosts, and different variants such as the Alpha, Delta, and Omicron variants have emerged in the field, which raises concerns about the effectiveness of the SARS-CoV-2 vaccine [38].

For recently available vaccines based on available animal data on cross-neutralisation are not sufficiently clear to indicate a greater benefit of a vaccine, European Medicins Agency/ emergency task force confirms its recommendation to update the antigenic composition of authorized covid-19 vaccines manufacture and deliver in a timely manner for 2024-2025 and are able to retain adequate protection against the family of viruses that are dominant [39].

One Health Approach

Taking a One Health approach to combat SARS-CoV-2 requires a comprehensive framework that incorporates an understanding of the socio ecological processes driving the epidemic pattern and synergistic strategies to promote population, animal, and environmental health [40].

The One Health initiative recognizes the intrinsic links between human, animal, and environmental health and aims to prevent and mitigate health risks at their interface. The environment is a fundamental component of public health, and greater attention to environmental factors is essential for promoting health and well-being within societies. In the context of the SARS-CoV-2 pandemic, the changing landscape of human behavior underscores the need for veterinarians to adapt their roles in mitigating the risks of zoonotic transmission and promoting ecosystem health. By adopting a One Health approach, veterinarians can play a crucial role in safeguarding animals, humans, and their environment from transboundary infections. A One Health framework can also mitigate the economic impacts of pandemics on animal populations and the food supply chain. Anthropogenic environmental changes, such as population growth, urbanization, and transportation networks [41].

Conclusions and Recommendations

Several coronaviruses have caused serious problems in humans and animals in the past two decades. The best known examples are severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and porcine epidemic diarrhea virus (PEDV). COVID-19 is caused by a coronavirus which is similar to SARS-CoV and named as SARS-CoV-2 in which it was isolated and the viral genome sequenced. SARS-CoV-2 has been detected in 18 different animal species from ten families (Felida, Viverridae, Hyaenidae, Canidae, Mustelidae, Procyonidae, Cervidae, Hippopotamidae, Hominidae, and Cricetidae) of four animal orders (Carnivora, Artiodactyla, Primates, and Rodentia). These 18 animal species consist of pet (dog, cat, ferret, and hamster), captive (tiger, lion, snow leopard, cougar, lynx, fishing cat, binturong, hyena, otter, coatimundi, hippo, and gorilla), farmed (mink), and wild (deer, wild otter, feral mink, and cat) animals [42-44].

Now SARS-CoV-2 or Covid 19 infections are widely distributed in the human population, there is a possibility for some animals to become infected through close contact with infected humans. People who are suspected or confirmed to be infected with SARS-CoV-2 should minimize close direct contact with animals, including farm animals, zoo animals, other captive animals, and wildlife; particularly species which have demonstrated to be susceptible to infection with SARS CoV-2. **Preliminary finding from studies suggest that poultry and pigs are not susceptible to SARS-CoV-2 or Covid-19 infection.** As recommendation it is very important chance for poultry and pigs industry, we should bread poultry and pigs and consume well prepared (cooked) animal origin foods.

Since there is currently no specific treatment against COVID-19 infection, it is essential to prevent Covid-19. Vaccines are one of the most effective weapons for preventing and controlling infectious diseases, such as COVID-19. Since the explosion of COVID-19, researchers from various countries have developed safe and effective SARS-CoV-2 vaccines. Several vaccines including the mRNA vaccine, inactivated vaccines, recombinant protein vaccine, and adenovirus vector vaccine have been approved for emergency use authorization worldwide. These vaccines have been confirmed to be safe and effective in restricting the spread of COVID-19 and reducing the risk of severe outcomes resulting from SARS-CoV-2. Vaccination of susceptible animals could protect them against SARS-CoV-2, break the chain of animal-to-animal and even animal-to-human transmission, and eliminate the risk of emergence of novel SARS-CoV-2 variants with increased virulence in humans. As recommendation in order to prevent covid-19 from animals as well as from human beings we should vaccinate domestic, captive, zoo and wild animals. The Wuhan outbreak is a stark reminder of the continuing threat of zoonotic diseases to global health security and needs a 'ONE-HUMAN-ENIVRONMENTAL- ANIMAL-HEALTH' integration to reduce the global threat of zoonotic diseases. This is the proper time for performing or implementing "One-health" approach.

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