

The COVID-19 disease in the wildlife, pets, and farm animals: A systematic review



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Abstract

The global outbreak of COVID-19 as a pandemic disease posed one of the most critical conditions for the healthcare system. This study aimed to provide a comprehensive potential transfection of COVID-19 disease to humans from pets. This study is a systematic review of the latest data on COVID-19 in the animal community (wildlife, pets, and farm) from June 2017 to May 2022. Published studies in various databases including Google scholar, PubMed, Scopus, ISI web of knowledge, and Embase were searched. Searching, data gathering, and analysis were accomplished by two reviewers separately and conflicts between them were resolved by a third expert reviewer. In the initial research, 83 articles were found for full-text evaluation, after the reviewers' assessment, 32 articles were included. Finally, the organisms studied in the mentioned research were classified into two parts: laboratory and non-laboratory research. The first group of laboratory animals includes rats, hamsters, guinea pigs, rhesus monkeys, macaques, and pigs. In the second group, non-laboratory patients, less than 100 dogs and cats, 6 cases of large cats, 2 cases of snakes (reptiles), and 12 cases of mink and bats were included. In dogs and cats, the symptoms are more in the form of upper respiratory tract infections, while in herbivores, these symptoms are more in the form of enteritis and diarrhea, and gastrointestinal symptoms. Infection of dogs and cats is mostly accompanied by coughing and sneezing, while there are no reports of herbivores. Animal studies suggested that other animals can be hosted with COVID-19.

Keywords: COVID-19, Animals, Pet.

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Introduction

A. Characteristics of the coronavirus family

Coronaviruses are a large family of viruses that are divided into four genera. These viruses have single-stranded positive RNA and cover a wide range of respiratory diseases. The most famous of these factors are MERS Middle East Respiratory Syndrome, Acute Respiratory Syndrome SARS and the most popular disease related to this family COVID-19.¹

The SARS-CoV-2 virion consists of a helical capsid with nucleocapsid (N) proteins attached to RNA strands and a coating made of membrane (M) and coating

proteins (E) and a coating of spike trimmer proteins (S). Protein S binds to the ACE2 enzyme in the plasma membrane of type II pneumocytes and intestinal cells. Protein S breaks down and facilitates virus entry after binding by host membrane serine protease, TMPRSS2.²

The four genera of this family include alpha-coronavirus, beta-coronavirus, gamma-coronavirus and delta-coronavirus, which has 40 species and 22 subspecies. One of the most important features of this viral family is the increase in the severity of pathogenesis following mutations, which causes a more severe form of the disease.³

B. The source of pollution

Preliminary epidemiological studies have shown that the outbreak of the virus in Wuhan, China, was initially mediated by seafood, and that there was a close link between infected people and people who worked in or near seafood markets. Subsequent studies have shown that one of the most important ways of transmitting the virus is through human-to-human transmission through contaminated respiratory droplets or direct contact with objects. In addition, in-hospital transmission has been reported in 41% of cases. COVID virus 19 can also be transmitted to humans through contact with asymptomatic vectors, which has a high potential for this pandemic in human societies. ⁴⁻⁶

As mentioned, bats are thought to be the primary source of the disease, but the virus has been isolated from other animals. The possibility that the corona virus can be transmitted directly to humans through bats is theoretically valid, but the evidence suggests that the first transmission of the virus to humans occurred through an intermediate host. ⁷

C. Transfer and dissemination

Transmission of the virus is usually through coarse respiratory droplets, and human-to-human transmission is the most routine method of transmission of the virus. There have been numerous reports of transmission of the virus to animals, including pets (dogs and cats), but there is still no report of transmission of the virus from other animals to humans ⁹. However, several studies have shown that snakes and penguins can be intermediate hosts for the virus because the colonization of the virus in these hosts on the one hand and the lack of clinical signs on the other hand have made these two species eligible as intermediate hosts. For COVID -19 ⁸⁻⁹.

D. Immunity of the body

Based on our knowledge of SARS and MERS and their similarity to COVID-19, the immune response in mild cases of the disease is likely to elicit the virus with specific antiviral responses of a stable type 1 interferon and responses of Th1 CD4 cells and CD8 T cells. ¹⁰

E. Clinical symptoms

In humans, the corona virus mainly causes respiratory and gastrointestinal manifestations, ranging from a simple cold to severe clinical symptoms such as bronchitis, pneumonia, acute respiratory distress syndrome, diffuse coagulation disorders, multiple organ failure, and death. The human coronavirus can also cause acute episodes in patients with asthma, fibrocystic, and chronic obstructive pulmonary disease. ¹¹

F. Respiratory symptoms

Clinical signs of this disease generally include the usual symptoms in respiratory diseases, especially which the onset of symptoms of this disease is mainly the symptoms of involvement of the upper respiratory tract. These include sneezing, dry cough, wheezing or sore throat, runny nose and sore throat (in new strains including Omicron), sputum cough in smokers, shortness of breath and chest pain. ¹²

Systemic symptoms

In addition to respiratory distress, a wide range of other symptoms vary from host to host. For example, fever, headache, heaviness of the head, lethargy and anorexia, chills, body aches, bruising and even in some patients fainting and convulsions due to lack of oxygen to the brain have been reported. ¹¹⁻¹³

Symptoms in animals

Because the virus is biologically common, the symptoms of the disease are similar in humans and animals, except that the symptoms in animals are mostly milder than in humans, and there is a difference in the incidence of symptoms between animal species ¹⁴. For example, in cats, the disease is more severe than in dogs, but the symptoms are more in the form of diarrhea, vomiting and gastrointestinal disorders, or even in some other species, such as penguins, which are a group of reptiles, without clinical signs. ¹⁵

G. Prevention, control, treatment

In the human realm

Due to the emergence of this disease (although MERS and SARS are relatives of this disease, but they have different pathogenesis) and the lack of sufficient and comprehensive information, both biologically and epidemiologically, human society has not yet achieved this ability. To be able to fight this disease. At present, the treatment strategy is to use routine protocols for respiratory disease management. ¹⁶

According to research, the best way to deal with this virus is to prevent further infection and spread of the virus. Although vaccines have been developed in recent years to stimulate the immune system, the mutagenic nature of the virus precedes this treatment protocol, and vaccination has not been the primary and definitive treatment for the disease.

Although no successful treatment has been reported yet, adherence to preventive principles such as hygiene during sneezing, coughing, and maintaining an optimal distance from the infected case has significantly reduced the number of patients ^{17, 18}.

In the field of veterinary medicine

The zoonotic nature of this disease, in addition to human society, has also affected various animal species. Complete guidelines for the management, treatment, and prevention of disease have not yet been provided in human societies. Treatments or preventive protocols for animals are still to be considered. However, in several animal cases with COVID-19, the theory that transmission from the patient's owner has been confirmed has been confirmed. On the other hand, transmission of the virus from animal to animal is also possible, indicating that in human society, as in human society, it is necessary to manage the infected animal, quarantine it and separate it from other animals ^{17, 19}. It should be noted, however, that despite the lack of specific veterinary treatment for COVID-19, accurate diagnostic methods such as PCR, which are used in humans, work well and are also used in animals. ²⁰

Finally, due to the lack of sufficient information on which animals are associated with coronavirus in terms of infection and transmission, it was necessary to conduct a review study to collect and explain this information. Finally, the purpose of this study is to systematically review. This study aimed to provide a comprehensive the potential transfection of COVID-19 disease to human from pets. ²¹

Methods

This study is a systematic review of the latest data of the COVID-19 in the animal community (wildlife, pets, and farm) from June 2017 to May 2022.

Published studies in various databases including Google scholar, PubMed, Scopus, ISI web of knowledge, Embase were searched. Keywords were included COVID-19, animals, pet*, wildlife, animal farm, veterinary medicine, Coronavirus, transmission, and spread.

Data regarding species of animals, diagnosis methods, transmission of virus, type of virus, symptoms, and final outcomes was recorded.

According to the World Health Organization, all species of animals (domestic and wild) that were 100% coronavirus positive were collected and placed on a checklist. Then, according to the level of infection of different species, animals were classified and prioritized. Dogs and cats in terms of number and relationship with human society were the main priority of this study. In the next stage, the animals are wildlife, and finally, the farm animals were given the last priority due to lack of reporting and the possibility of less infection. ^{21, 23}

Searching, data gathering and analysis were accomplished by two reviewers separately and conflictions between them were resolved by a third expert reviewer.

Results

Given the extent and importance of COVID-19 disease, the study and recognition of animal species is more important than the human species, because if you need to make vaccines, antibodies or effective drugs against this disease, the first step is to study their effect on Animals. ²²

To this end, the present study is to collect and standardize published information from research and reports related to infection, transmission and spread of COVID-19 virus. The information collected is a summary of articles and research conducted in this field.

Results from 170 articles and reports that were published in full text or abstract, 48 articles related to the human and non-animal aspects of COVID-19 were excluded from the scope of work, and the remaining articles (out of the remaining 122 articles) included repeated reports of dogs, cats and mink contracting the corona virus worldwide. Which was removed due to similarities in the course of the disease and the method of repetitive management (including 20 articles). Another part of the report included laboratory research conducted by health and research organizations and institutions around the world to examine strains in the region. (For example, in most European, American and even Asian countries, including Iran, rats, rabbits, hamsters, birds and poultry are always used as laboratory animals to induce the virus and study its effects). These studies were also omitted due to similar structure and results (19 similar articles). Finally, 83 articles were reviewed in full text and recently in research and structure, of which 16 articles were briefly reported in [Table 1](#) due to their high importance. It should be noted that in the case of duplicate research, one of the articles has been used as a reference and has been used in the structure of this research.

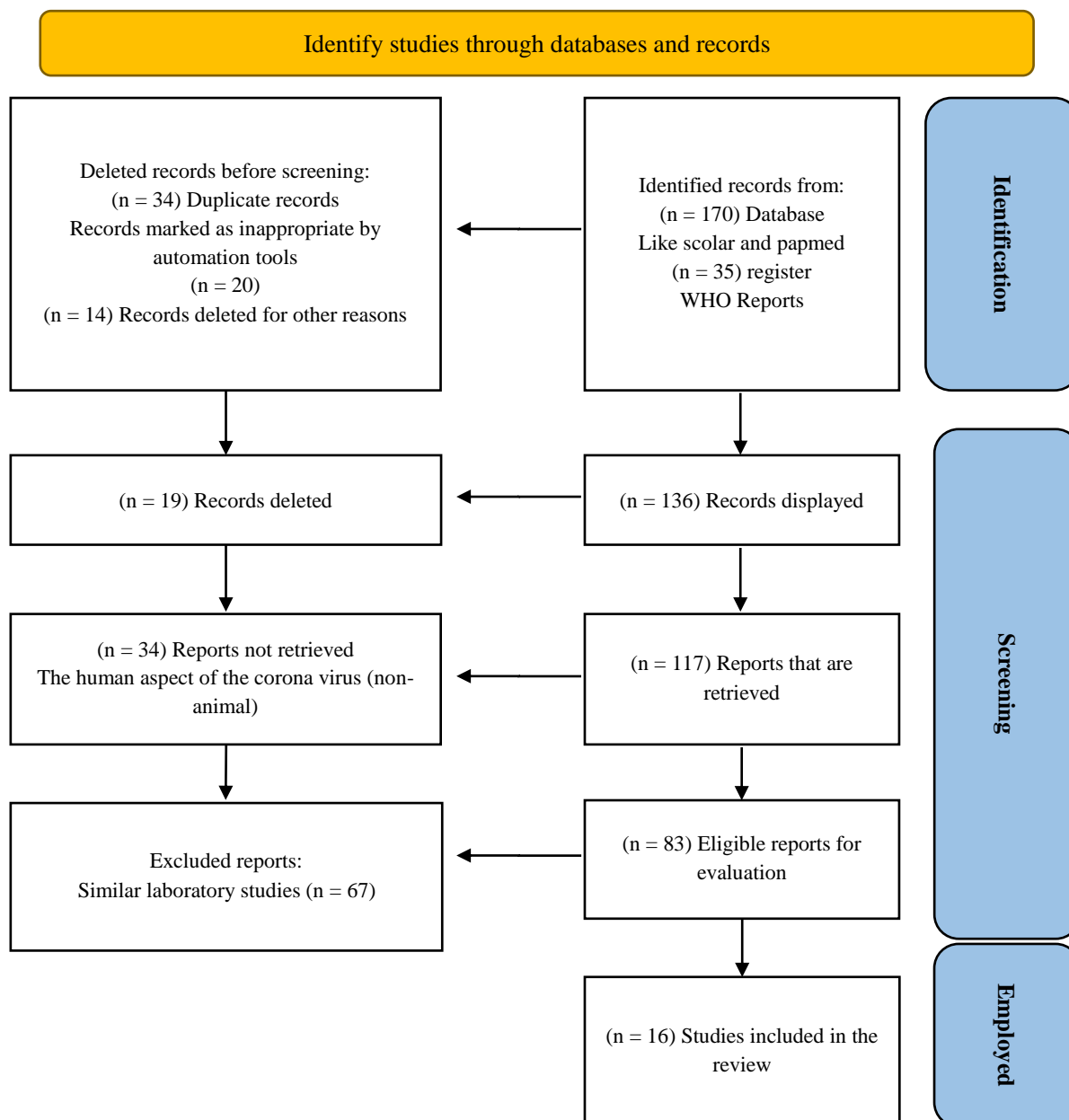


Figure 1. The Prisma flowchart of the study

Finally, the organisms studied in the mentioned researches were less than 100 dogs and cats, 6 cases of large cats, 2 cases of snakes (reptiles), 12 cases of mink and bats were reported ^{16, 27}.

Many animals can be infected with COVID 19, but very few show severe infectious symptoms. Like animal coronavirus, COVID-19 has certain symptoms. For example, in dogs and cats, the symptoms are more in the form of upper respiratory tract infections, while in herbivores, these symptoms are more in the form of enteritis and diarrhea and gastrointestinal symptoms. Accordingly, reports of animal contamination with COVID 19 also confirm this. Infection of dogs and cats is mostly accompanied by coughing and sneezing, while there are no reports of herbivores. ²³

The methods of diagnosis and confirmation of COVID-19 in animals are similar to the diagnostic methods in humans. Given that the occurrence of COVID-19 is zoonotic. Serological and molecular methods such as ELISA, DNA diagnostic methods such as RT-PCR, LAMP are also used in the diagnosis of disease in animals. ¹⁶

Animals as a reservoir for mutations

Concerns about the animals' infection are not only due to the addition of another group of organisms to COVID-19, but also to the possibility of mutations in them. As mentioned, this virus is of animal origin and the course of its infection is such that in addition to transmission to humans, it also spreads to other animal species. ¹⁹

Research has shown that the coronavirus family has a high potential for gene mutations, and mutations in the genes of this family, especially COVID-19, increase the severity of the disease. Species diversity is high in this group of organisms, and each species is very different from the other species, and it is possible that COVID-19 released in animals can mutate over generations and have the ability to reach humans. To be transferred. ²⁰⁻²¹

Various hypotheses have been made about the discussion of gene mutations in COVID-19, but two of the most important are as follows:

A. The virus has reached humans through mutations (from bats to humans)

In fact, this hypothesis states that the virus did not exist in previous generations in its current severity, and that its transmission from one organism to another and through successive generations of mutants has found the ability to Humans cause disease.

B. The virus spreads from humans to other animals (non-bats).

According to this hypothesis, the virus spread from infected humans to other animals in later stages, and bats did not play a role in this transmission between the animal communities. This theory is also consistent with previous studies and current evidence. According to research, most infected species have been associated with the virus by an infected owner or manager ²¹.

These concerns are compounded when the virus is re-transmitted from animals to humans (at the time of writing, no evidence has been presented that the virus has been transmitted from humans to humans other than bats), and this time Cause disease more severely ²².

COVID-19 in dogs

A. Etiology of dog involvement

One of the most important species discussed in the joint transmission of COVID-19 between humans and animals is canines, especially dog species. Because of its close association with human social life, it raises concerns about the transmission and spread of the virus in both dogs and humans. ²³

Pet contamination was also reported after the corona outbreak. In the meantime, the infection and death of two dogs doubled the concerns. ²⁴

B. How to contaminate

According to a report by the World Health Organization, the two dogs were German Shepard and the other Pamranian. Reports of infection in these animals confirm that the owner was positive for COVID-19. Symptoms in these dogs occurred after their owner was infected with COVID-19. ²⁴

C. Clinical signs and manifestations

Clinical manifestations in these two cases were sneezing, coughing, lethargy, anorexia and sedentary lifestyle and there was no sign of diarrhea and vomiting. In the stages of confirmation of infection, the results of nasal swabs and rectal swabs were reported negatively, and biochemical blood tests showed a mild systemic infection. In subsequent tests, the two cases tested positive for COVID-19. ²⁵

D. Treatment measures and arrangements

Due to the mild clinical symptoms, no treatment was provided and sudden death was reported. ²⁵

E. Laboratory studies

Laboratory studies that deliberately induce the virus to confirm or rule out virus transmission in living organisms have also shown that dogs can be potentially infected with the COVID-19 virus. In these studies, virus induction was performed in the form of nasal swabs and anal swaps in a row, and sampling of nasal and fecal secretions was performed on consecutive days to examine the excretion and spread of the virus. ²⁶

F. severity of the disease in dogs and cats

These studies have also confirmed that dogs and cats can be infected with the virus and shed the virus long after that ²⁶⁻²⁹. In fact, abusive research has shown that cats are more susceptible to the virus than dogs. In order to investigate the severity of the conflict in different species of animals following the combined infection of dogs and cats, the severity of respiratory involvement in one of the cat samples was so high that they had to euthanize the sample in the study and They have a greater ability to transmit to other cats than infected dogs. While this sensitivity and transmission is less in dogs ³⁵.

COVID-19 in cats

A. Causation of feline involvement

After the first dog was confirmed to be infected, there were reports of cats being infected. Meanwhile, the confirmation of the first cat infected with COVID-19, which was a street cat, raised concerns. Because in addition to dogs, another species was added to the category of animals infected with Quaid. ³¹

B. How to contaminate

In this report, the case in question was a street cat that had recently been taken care of for two years. The results of this study, as in the previous study, confirm the transmission of the virus from livestock to animals ³²

C. Clinical signs and manifestations

In this case, the symptoms were mostly gastrointestinal and diarrhea and vomiting occurred in the first three days. Despite all this, the way the disease occurs in pets has been different. However, according to previous research,

in the first three days after virus induction, the highest rate of viral replication was observed. Respiratory symptoms are sometimes very rare and sometimes accompanied by gastrointestinal symptoms. ^{33, 34}

D. Treatment measures and arrangements

The cat recovered after 7 days (according to the owner of the animal). At the diagnosis stage, according to the previous case, after the PCR test was negative, the next recurrence was positive. ³⁴

E. Laboratory studies

A similar study was conducted in Iran (Tehran) to investigate the infection of dogs and cats around hospitals with COVID-19 virus. The study was performed on dogs and cats around Corona hospitals where 63.6% of infected animals, about 31% had cough and sneezing symptoms. Sampling was in the form of nasal swabs and anal swabs and the cases were released after sampling. ³⁶

The nature of contamination of domestic pets with human COVID

Exact information about how dogs and cats get corona is not yet available. There are several possibilities for excitement: First, eating human food debris, including the soup of infected bats, has infected these animals. On the other hand, the possibility of contact with an infected person and the transfer of particles to dogs and cats is also possible. There is a strong possibility of an intermediate host between humans and pets. Finally, the point is that; No cases of corona transmission from dogs and cats to humans have been reported. The virus is said to have entered the body of dogs and cats through digestion, mutated and had gastrointestinal symptoms. ³⁷

Management of COVID-19-infected pets

However, at the beginning of the epidemic, detailed information on how the virus behaved was not available; But as studies progressed, more and more information became available about how the virus behaved. In accordance with the guidelines of the World Health Organization, in order to prevent the spread and transmission of COVID-19 in animal species, the principles of quarantine and separation of suspected pets from healthy ones, no communication between infected owner and pet, no contact between infected dog or cat Protect humans and other animal species ³⁸.

In terms of treatment (medication) for infected cases, no specific instructions have been provided yet, and subsequent infected pets, with routine protocols for infectious diseases in veterinary medicine, such as supportive treatment and antibiotic therapy to prevent secondary infection are included in the instructions. ³⁹

Cats

A. Etiology and method of infection

Tigers and lions are susceptible to SARS CoV 2; In April 2020, five tigers (two Malayan tigers and three Amur tigers) and three African lions tested for respiratory symptoms (dry cough and some wheezing) tested positive at the Bronx Zoo in New York City. An asymptomatic zoo employee is thought to have infected the animals. Subsequent studies on the infection of these animals have confirmed that he was responsible for feeding the animals infected with coronavirus ⁵⁴⁻⁵¹.

B. Pattern of contamination similar to PETs

The results of this study are consistent with the results of the infection of the first dogs and cats with coronavirus; Because, in both cases, the infection of the case owner was confirmed first and then the living conflict was observed. This confirms that the coronavirus is not transmitted inversely from pets to livestock owners. ⁴³

C. Actions and management of infected cases

The physical condition of the zoo's contaminated cases returned to normal after about a week. ⁵⁵

Mink

A. Etiology and method of infection

Mink is another animal that grows because of its fur and has the ability to transmit SARS CoV 2 to each other. The first positive case of the virus in mink was reported on 23 and 25 April from the Netherlands, where there are about 125 mink farms ^{56, 57}. Some farm workers had previously been infected with SARS CoV 2.

Therefore, it is assumed that human-to-animal transmission has been the most likely route of infection by mink. ⁵⁸ Other countries such as Denmark and Spain have reported similar cases of COVID 19 in this animal. ⁵⁹

B. More severe disease in mink

In general, SARS CoV-2 in mink behaves differently than other animal species. The disease is usually associated with severe clinical outbreaks, including high mortality on infected farms. However, subclinical disease can also occur. Its prevalence has been reported in several European countries and the United States. ⁶⁰

C. Laboratory studies

Recently, a Chinese research team tested the biological properties of SARS-CoV-2 in infected mink meat. It was found that SARS - CoV-2 is repeated in the respiratory system of mink and is transmitted through respiratory droplets between the mink. Because the lesions in mink are similar to those in humans with COVID-19, the mink model has been proposed as a useful animal model for evaluating COVID-19 drugs or vaccines ⁵⁶⁻⁵⁸.

In the Netherlands, a case of COVID 19 transmission has been transmitted from mink to humans (an employee

working on a mink meat farm) ⁶¹⁻⁶³. Due to the similarity of the viral sequence between this infected employee and the virus found in mink, the researchers concluded that this person was infected with the virus through infected mink. This study also showed that COVID 19 infection in mink could be asymptomatic. Which indicates the possibility of the presence of mink as an interface host. The study of the prevalence of coronavirus in weasels first took place in the Netherlands following the widespread

loss of farms of this organism, and laboratory studies confirmed the positive coronavirus of these farms. After the Netherlands, widespread losses occurred on farms in Italy, the United States, Sweden and many European countries ⁶⁴. Therefore, according to the case in the Netherlands, it should be noted that the transmission of animal to animal and animal to human is possible in addition to human to human ^{60, 65}.

Table 1: Studies' characteristics

Row	Author and year of research	Studied animal	Number and type of animal	Research setting	Type of virus	Symptoms	Results	more details
1	Bhatnagar, et al. ²	Bats, dogs and penguins	5 Kenyan Rhinolophus bats	Kenya	betacoronavirus BtKY72/Rhinolophus sp./Kenya/2007	They have no clinical signs and have so far been considered the main reservoir	Extraction of COVID 19 genome from Kayan bats	All 5 samples were sampled by rectal swap. Genomic analysis was performed by sequencing the entire genome
2	Guo, G. et al. (2020) ¹⁶	Dogs, cats, pigs, rats, chickens and ducks	Three pairs of each animal were examined	Harbin Veterinary Research Institute (HVRI) of the Chinese Academy of Agricultural Sciences (CAAS)	SARS-CoV 2/F13/environment /2020/Wuhan , isolated from an environmental sample collected in the Huanan Seafood Market in Wuhan (F13-E), and SARS-CoV-2/CTan/human/2020/Wuhan (CTan-H), isolated from a human patient	The cat had both gastrointestinal and respiratory symptoms. Respiratory symptoms were sneezing and gastrointestinal symptoms included diarrhea and vomiting. Poultry, birds and herbivores were asymptomatic	Dogs, chickens, ducks and pigs are less susceptible to the virus, and mice and cats are more susceptible to the virus.	Virus induction was performed through the nose to assess susceptibility. One of the cats was euthanized due to the severity of the disease. PCR test was used to confirm the contamination of the organism. The highest rate of virus replication was in the first three days of virus incubation in the organism. All animals in this study were removed at the end of the study
3	Lu R, et al. ²⁷	Cat	9 patients	Chinese Academy of Sciences, Shandong First Medical University	(SARS), bat-SL-CoVZC45 and bat-SL-CoVZXC21, SARS-CoV.	Acute Respiratory Syndrome	The results showed that the ten 2019-nCoV genome sequences obtained from 9 patients were very similar. More than 99 · 98% sequence identity. Remarkably, 2019-nCoV was closely related (with 88% identity) to two bat derivatives.	Beta-coronavirus Although our phylogenetic analysis suggests that bats may be the primary host of the virus

Row	Author and year of research	Studied animal	Number and type of animal	Research setting	Type of virus	Symptoms	Results	more details
4	Han Benfeng et al 28	Wild animals, dogs, cats and poultry	Farm animals of China farms	College of Plant Protection, China Agricultural University, Beijing 100193	SARS-CoV-2	This species was asymptomatic	They are important intermediate hosts for pathogenic viruses common to humans and animals, and it is important to build an extensive database of the Society of Animals and Viruses for accurate and rapid identification and prevention of pathogenic viruses.	They are important intermediate hosts for pathogenic viruses common to humans and animals, and it is important to build an extensive database of the Society of Animals and Viruses for accurate and rapid identification and prevention of pathogenic viruses.
5	David et al 30	Domestic pigs	105 Domestic pigs	University of Missouri, Columbia, MO, USA	SARS-CoV 2 MERS-CoV [2010-12]	Asymptomatic or mild disease to severe fatal disease with Multiple organ failure	Coronavirus; Pigs infection models; The disease is transmitted between humans and animals	Preclinical animal model for studying the pathogenesis of SARS-CoV-2 or the efficacy of related vaccines or drugs
6	Cheng, L. et al (2020) 35	Dog	A German Shepherd dog two years	Hong Kong	SARS-CoV-2	The clinical signs of respiratory disease were mild, with a negative PCR test at first but a positive test three days later with a more severe symptom.	Confirmation of the second dog infected with coronavirus	This case was kept by the owner of a COVID 19 and after the owner became infected and about 7 days had passed since her illness (the owner's infection preceded the dog's infection)
7	D. Paraskevis et al 37	Birds and mammals	20 chickens 12 bats 12 pigs	Wuhan City, China	2019-nCoV	A large percentage of respiratory infections are associated	Our analysis shows that 2019-nCoV, although closely related to the BatCoV RaTG13 sequence.	Genetic similarity levels between 2019-nCoV and RaTG13 indicate the latter Provides the exact type that caused the outbreak in humans, but the hypothesis that 2019-nCoV originated.
8	Schlottau, K., et al. (2020) 44	Bats, chickens, pigs, date mice	20 chicken 12 Egyptian bats 12 waesel 12 pigs	Germany	SARS-CoV-2	Chickens and pigs had no symptoms of the disease, while in addition to having no clinical signs, they did not excrete the virus through nasal secretions and feces.	In clinical trials, chickens and pigs were not infected with the virus and were not susceptible to the virus, unlike bats and date palms.	All of these species were infected by COVID 19 through nasal swabs After induction of the virus, respiratory and fecal sampling were performed every two days for 2 weeks In the study of pathological slides of bats, some degree of cell damage to the upper part of the respiratory tract was observed.
9	Hu, L., (2021) 45	Bat	334 Rhinolophus bats	Zhoushan city, Zhejiang province, China	SL-CoVs	Asymptomatic and so far considered the main reservoir	Extraction of Qovid 19 genome from Chinese bats	Electron microscopy confirmed the virus was also present in the brains of bats Most samples confirmed the gene similarity between the virus extracted from bats and the positive control samples of the virus.

Row	Author and year of research	Studied animal	Number and type of animal	Research setting	Type of virus	Symptoms	Results	more details
10	Sooksawa et al 59	American cats and dogs, tigers, lions and mink	37:38:42:45:60	United States, Denmark and Spain	SARS-CoV 2 H1N1 (pH1N1)	Acute Respiratory Syndrome	However, pH1N1 flu is caused by a variety of factors The virus is similar to COVID-19 in that it targets Respiratory tract and is often transmitted by respiratory droplets.	Coronavirus Epidemic 2019 (COVID-19) persists and the causative virus is severe Respiratory syndrome virus type 2 (SARS-CoV-2) is becoming a virus Widely distributed in the human population.
11	Schoeman et al 65	Birds and mammals	122	United States	(SARS) (MERS)	Bronchitis, pneumonia and Even acute acute respiratory syndrome	Most progress has been made on SARS-CoV E, highlighting specific structural requirements.	It acts on the life cycle of CoV as well as the mechanisms behind its pathogenesis.
12	Cross, R. W. et al 68	African green Monkeys	28	Africa	RNA SARS-CoV-2	Pathology at autopsy characterized by chronic multifocal interstitial pneumonia and increased collagen deposition in Alveolar walls despite the absence of SARS-CoV-2	Coagulation disorder as observed with a transient increase in aPTT and circulating fibrinogen levels in the blood	Not all normal assembly levels of SARS-CoV-2 proliferation and lung pathology were completely clear as previously reported
13	Sia, S. F., et al 71	Horseshoe bats Golden Hamsters	74	2Department of Pathology, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Hong Kong, China.	SARS-CoV-2	Mild SARS-CoV-2 infection	SARS-CoV-2 was effectively transferred from inoculated hamsters to simple hamsters.	Pathogenesis and transmissibility of SARS-CoV-2 in golden hamsters (Syrian) (Mesocricetus auratus)
14	Chen, H. et al 72	Dogs, pigs, chickens and ducks	52	Wuhan China	ARS-CoV-2	Without causing severe illness	We found that SARS-CoV-2 reproduces poorly in dogs, pigs, chickens and ducks, but reproduces effectively in mice and cats.	There was no evidence that the virus was excreted in the feces or body secretions in either species.
15	Anderson, M. et al 76	Cat	A 15-year-old DSH cat that has been cared for for two years	Belgium	SARS-CoV-2	Similar to the infected dog, Ibanda was asymptomatic and was sampled one week after Ebnala Malik with respiratory and gastrointestinal symptoms such as nausea and diarrhea.	Confirm infection transmission from pet owner to cat	The diagnosis was confirmed by nasal swap and PCR test
16	Buonavoglia, C et al 77	Dog	3 miniature pinchers 1 Cocker Spaniel 2 pinch 1 Pekingese	United States	ccov	Mild or asymptomatic forms of enteritis	Severe clinical symptoms with fever (temperature 39.8-40.1 °C), anorexia, depression, vomiting, diarrhea.	Despite the severe symptoms, the dogs slowly recovered from their illness

Discussion

The rapid rise in infection and death from the new coronavirus epidemic has led to varying degrees of anxiety, panic, mistrust and gossip among the general public. Rapid sharing of scientific information is an effective way to reduce the general fear and anxiety caused by the new coronavirus epidemic. However, we still have a lot of unfinished business about the new coronavirus and its disease.

After that, on January 20, 2020, the first positive case of the new coronavirus was declared positive by the South Korean Center for Disease Control and Prevention. The World Health Organization (WHO) also issued a statement on January 30, 2020, announcing the outbreak of the new corona virus, the sixth leading cause of public health emergency worldwide, following the spread of outbreaks around the world and the sound of a new pandemic. Announced. Not only was it a threat to China, but to all countries. Prior to the new coronavirus, the World Health Organization declared a public health emergency in connection with outbreaks of H1N1 influenza (2009), polio (2014), Ebola virus in West Africa (2014), and Zika virus (2016) and the Ebola virus in the Democratic Republic of the Congo (2019). One of the most important ambiguities about this disease, as mentioned, goes back to the origin of this disease. ⁷⁸⁻⁸⁰

However, Chinese scientists report that the first cases of the disease in Wuhan, China, were all related to a seafood market in Wuhan, China; However, they have not yet been able to determine the exact origin of the disease. Another ambiguity regarding the new coronavirus reservoir, WHO claimed in a report, that it may have originated in environmental samples collected from the Chinese seafood market; however, it is not yet known whether a particular animal species carries SARS-CoV-2. ⁸¹

The results of studies by some researchers show that snakes are the most likely reservoir of coronavirus wildlife; While other research shows that Chinese bats are the main reservoir ^{82, 83}.

In any case, the dual relationship of the disease to humans on the one hand, and its relationship to animals on the other, doubles the concerns about it. According to research, domestic pets (dogs and cats) are also at risk for the disease. Thus, several cases of death and infection with clinical signs have been confirmed in these animals. But the remarkable thing about them is that the form of the disease in animals is much milder than in humans and has less contagion ³⁵.

In addition to domestic pets, other large cats, such as tigers, are also at risk. It should be noted that many

wildlife animals have not been studied due to the unavailability and difficulty of sampling and testing. ³⁷ In the case of farm animals, or FOOD AMIMAL, there have been no reported reports of coronary heart disease or death. However, physical transmission of the virus is possible during the processing of protein and food products. For example, rubbing contaminated hands on chicken or fish meat will inevitably spread the virus on the product ^{44, 50, 64}.

However, research on how the disease is transmitted, spread and severe in animals is still ongoing; however, conclusive results indicate that the form of the disease in animals is less respiratory and often occurs with a gastrointestinal infection. The most likely way to infect animals is to contact a virus-infected mask or equipment, or even virus-infected owners. ²²

It should be noted that, there has been no report of reverse transmission, ie from pets or wildlife or farm animals to humans.

Conclusion

Many animals can be infected with COVID-19, but very few reports showed severe infectious symptoms. In dogs and cats, the symptoms are more in the form of upper respiratory tract infections, while in herbivores, these symptoms are more in the form of enteritis and diarrhea and gastrointestinal symptoms. Infection of dogs and cats is mostly accompanied by coughing and sneezing, while there are no reports of herbivores. The methods of diagnosis and confirmation of COVID-19 in animals are similar to the diagnostic methods in humans. Research in animals to address concerns and to better manage about this pandemic is essential. Animals' studies suggested that other animals can be hosted with COVID-19.

Highlights

The methods of diagnosis and confirmation of COVID-19 in animals are similar to the diagnostic methods in humans. Research in animals to address concerns and to better manage this pandemic is essential. Animal studies suggested that other animals can be hosted with COVID-19.

What Is Already Known?

Transmission of the virus is usually through coarse respiratory droplets, and human-to-human transmission is the most routine method of transmission of the virus.

What Does This Study Add?

Animals can be contaminated with COVID-19, but few studies have demonstrated severe infectious symptoms.

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Ethics approval

The ethical committee of Baqiyatallah University confirmed the protocol of this study.

Conflicts of Interest

We declare that there is no conflict of interest.

Author Contribution

Design and concepts: SM, RD and MRG; Gathering data: SM, HRJ, AD, MF, HG, RD and MRG Data analysis: SM, HRJ, RD, and MRG. Preparing a manuscript: SM, HRJ, AD, MF, HG, RD, and MRG

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