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Zoonotic Diseases: Is COVID -19, A Zoonotic Disease?

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Abstract

A zoonotic (plural zoonoses, or zoonosis diseases) is an infectious disease caused by a pathogen (an infectious agent, including bacteria, viruses, parasites, prions, etc) that has jumped from non-human animals (usually vertebrates) to humans. The number of outbreaks of zoonotic infectious diseases such as COVID-19, Ebola, bird flu and SARS are rising, which highlights the need for specialized research on zoonotic infectious diseases. In Kerala 17 people were killed due to Nipah in 2018, in West Africa about 11,000 people were killed due to Ebola from 2014 to 2016, and 774 people were killed worldwide due to SARS in 2002-03. COVID-19 is the newest in the coronavirus family which includes, the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), and is suspected to have originated from bats and/or pangolins. This article is throwing a light on various types of zoonotic diseases and also the various facts which shows COVID-19 is a zoonotic disease.

It also covers the information about sources, transmission, epidemiological characteristics mechanism, symptoms, diagnosis and treatment and prevention of COVID -19 known till date.

Keywords: Zoonoses, Coronavirus, Communicable Diseases, COVID-19, Zoonotic Diseases

Introduction

Zoonotic Diseases

A zoonotic is a transmittable disease that is transmitted between animal species to humans (or vice versa).[1] A large number of viruses have zoonotic potential or are of economic importance because they infect food-producing animals. Studies for the inventory of viruses with zoonotic potential revealed their growing diversity with an average of 3-4 new zoonotic pathogens identified each year. Wild animal species are commonly the foundation of these new or recently identified pathogens. New species of viruses, and sometimes even new genera of viruses, have been increasingly reported in wild animal species, for example bats or rodents. The main modern diseases, such as Ebola virus disease and salmonellosis, are zoonoses.[2]

HIV was a zoonotic disease transmitted to humans in the early 1900s, although it has now changed to a separate disease for humans only. Most of the flu strains that contaminate humans are human diseases, although many strains of bird flu and swine flu are zoonoses; These viruses infrequently re-combine with human flu strains and can be a reason for pandemics such as the Spanish flu of 1918 or the swine flu of 2009.

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Taenia solium contamination is one of the ignored tropical diseases with veterinary and public health problems in the regions endemic. . Zoonoses can be caused by a variety of disease pathogens such as viruses, bacteria, fungi and parasites. There are approximately 1,415 pathogens that infect humans, of which 61% were zoonotic.[3,4] Most human diseases originate in other animals; however, the diseases that habitually involve human-to-human transmission, such as rabies, are considered direct zoonoses.[5]

Modes of transmission of zoonotic diseases

Zoonoses have different transmission modes. In direct zoonosis, the disease is transmitted straight from other animals to humans through means such as air (flu) or stings and saliva (anger). On the contrary, transmission can also take place through an intermediate species (called a vector), which transports the pathogen of the disease without being infected. The condition where animals are infected by humans, it is called reverse zoonosis or anthroponosis. Figure 1 shows the transmission of infectious agents from animals to humans.[6]

History

During most of human prehistory, hunter-gatherer groups were probably very small. Those groups probably came into contact with other similar gangs only on rare occasions. This type of separation would have caused endemic diseases to be limited to a specific local population, since the spread and spread of epidemics depend on recurrent contact with others who have not yet developed an enough immune response. To persist in such a population, a pathogen need to be a chronic infection, to stay present and potentially communicable in the contaminated host for extended periods, or to have other additional species as a reservoir where it could be stored until guests were contacted and infected. Indeed, for many "human" diseases, the human being is best seen as an accidental or accidental victim and a dead-end guest. Examples include rabies, anthrax, tularemia and West Nile virus. Therefore, much of human exposure to infectious diseases has been zoonotic.[7]

Many modern diseases, including epidemic diseases, originated as zoonotic diseases. It is difficult to establish with certainty which diseases have passed from other animals to humans, but there is growing evidence of DNA and RNA sequencing that measles, smallpox, influenza, HIV and diphtheria have reached humans since this way. Various forms of common cold and tuberculosis are also adaptations of strains originating in other species.[8]

An important factor contributing to the emergence of new zoonotic pathogens in human populations is the increase in contact between humans and wildlife animals. This can be caused by the invasion of human activities in wild areas or by the movement of wild animals in areas of human movement. One example is the outbreak of the Nipah virus in peninsular Malaysia in 1999, when intensive pig breeding began in the habitat of infected bats. Unidentified swine infection has amplified the strength of the infection, ultimately transmitting the disease to farmers and cause 105 human deaths. Likewise, in recent times, avian influenza and the West Nile virus have spread to human populations probably due to the interactions between the vector and pets. Highly mobile animals, such as bats and birds, can present a larger risk of zoonotic spread than other animals because of the ease with which they can move around in human habitation areas. Since diseases such as African schistosomiasis, river blindness and elephantiasis are not zoonotic, they depend on the human host for part of their life cycle, although they may depend on transmission by insects or other vectors. Table 1 shows the list of emerging viral zoonoses of the past two decades.[9]

Is COVID-19 is a Zoonotic Disease?

Covid-19

Coronaviruses are a large family of viruses that can cause disease in animals or humans. In humans, a number of coronaviruses are known to cause respiratory infections ranging from the common cold to more serious diseases, such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). The most recently discovered coronavirus causes COVID-19 coronavirus disease. Coronavirus 19 disease (COVID-19) is a highly transmissible and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-

2), which emerged in Wuhan, China, and has spread throughout the world.[10]

Coronaviruses belong to the Coronaviridae family in the order Nidovirales. The crown represents crown-shaped tips on the external surface of the virus; therefore, it was named as a coronavirus. Coronaviruses are small in size (65-125 nm in diameter) and contain single-stranded RNA as a nucleic material, ranging in size from 26 to 32 kb in length. The subgroups of the coronavirus family are the alpha (a), beta (b), gamma (c) and delta (d) coronaviruses. Figure 2 shows the structure of the new corona virus.[10,11]

Origin of COVID-19

SARS-CoV-2 is a coronavirus and belongs to the group of β-coronaviruses. COVID-19 is the third known zoonotic coronavirus disease after Severe Acute Respiratory Syndrome (SARS) and Middle Eastern respiratory syndrome (MERS). SARS-CoV and MERS-CoV also belong to the β-coronavirus group.[11]

Are Bats; the reservoir of Coronavirus ?

According to the report published in the journal Nature Medicine on a detailed analysis of the possible origin of the COVID -19 virus. According to the report, bats are likely the final source, just like in the other two coronavirus outbreaks in recent years: SARS and MERS. Bats are a known reservoir of coronaviruses. In addition, intermediate horseshoe bats are known to carry a virus called RaTG13, whose genome is 96% identical to that of Sars-CoV-2.[11,12]

It is quite clear that the bat serves as a warehouse for SARS-CoV-2. The question is, how did the bat virus travel to humans. The key question is how the virus acquired certain sequences from its genome, allowing it to bind tightly to human cells and thus infect them. Bat virus doesn't have these sequences. One possibility is that the bat virus made the leap into humans several months before the epidemic was detected. These initial viruses would not have been predominantly infectious or hazardous, but they undergone mutations and evolved to get the key genetic sequences which made them communicable. The alternative possibility is that there is an intermediate host that can be a pangolin. While the pangolin virus as a whole is less similar to Sars-CoV-2 than the bat virus, the pangolin virus genome has crucial binding sequences.[13]

Are Pangolins; the reservoir of Coronavirus ?

In addition, a study published in Nature found viruses closely related to SARS-CoV-2 in pangolins that had been smuggled into China. These viruses had binding sequences similar to those of human viruses. Pangolins are one of the busiest animals in the world and are therefore endangered. But in recent weeks they have been linked to the initial outbreak of Covid-19 disease in China. The evidence is inconclusive, but has already pushed the Chinese government to act. If further action is taken against wildlife trade, the accident could represent a turning point for the conservation of the pangolin. Pangolins are hunted and traded illegally for two main reasons. First of all, its meat is considered a delicacy in several Southeast Asian countries, especially China and Vietnam. And secondly, its scales are used in traditional Chinese medicine. As a result, they are the busiest mammals in the world. The idea that the pangolins gave us Covid-19 came up in a press conference held by the University of Agriculture of Southern China in Guangzhou on February 7th. Two scientists there, Yongyi Shen and Lihua Xiao, are said to have compared the coronaviruses of pangolins and infected humans in the outbreak. The genetic sequences of the viruses are said to be 99% similar.[13,14]

Transmission of Covid-19 via Animals to Human

The epicenter of the epidemic is expected to be a wet market in Wuhan, China. Here, the pangolins normally seen in Southeast Asia are traded and sold for human consumption. Recent research suggests that pangolin served as a link between bats, which are known to carry coronaviruses and humans. Bats, pangolins and humans are not natural cohabitants, since all but the latter are wild. A species barrier prevents the transmission of microorganisms between the wild and the non-wild. But humans are known to alter ecosystems, cut forests and eat wildlife. The presence of Malaysian pangolins (also known as Sunda or Javan pangolins) in a market in Wuhan, China, strongly indicates the real culprit behind the

genesis of the current COVID-19 pandemic: illegal wildlife trafficking and human trafficking . Like many other wild species, pangolins are heavily looted and exploited, despite being protected animals. Malaysian pangolins are hunted for their skin, scales and meat for use in traditional oriental medicine.[15-17]

People can get COVID-19 from other people who have the virus. The disease mainly spreads from person to person through small drops from the nose or mouth, which are expelled when a person with COVID-19 coughs, sneezes or speaks. These drops are relatively heavy, do not travel far and quickly sink into the ground. People can take COVID-19 if they breathe these drops from a virus infected person. So it is important to stay at least 1 meter (3 feet) away from the others. These droplets can fall on objects and surfaces around the person, such as tables, knobs and handrails. People can become infected by touching these objects or surfaces and then touching their eyes, nose or mouth. That's why it's important to wash your hands regularly with soap and water or to clean with an alcohol-based hand sanitizer.[17] Figure 3 illustrates the process of transmitting COVID-19 through different hosts.

Mechanism, Symptoms and Diagnosis of COVID-19

Mechanism

Angiotensin converting enzyme 2 (ACE2) was found in an investigation to be the receptor for SARS-CoV-2. In the normal human lung, ACE2 is expressed in alveolar epithelial cells of type I and II. Of these, 83% of alveolar type II cells have ACE2 expression. Men had a higher level of ACE2 in their alveolar cells than women. Asians have a higher level of ACE2 expression in their alveolar cells than white and African American populations. The binding of SARS-CoV-2 to ACE2 causes elevated ACE2 expression, which can cause damage to alveolar cells. Damage to alveolar cells can, in turn, trigger a series of systemic reactions and even death. They also confirmed that Asian men are more sensitive to SARS-CoV-2 infection. A study reveals that the binding capacity of the SARS-CoV-2 receptor is 10 to 20 times stronger than that of SARS-CoV.[18]

Symptoms

The most common symptoms of COVID-19 are fever, dry cough and tiredness. A number of patients may have aches and pains, nasal congestion and sore throat. These symptoms are generally gentle at starting and begin progressively. A number of people become infected but have just very gentle symptoms. The majority of people (about 80%) recover from the disease without the need for hospital treatment. About 1 in 5 people receiving COVID-19 become critically ill and develop breathing problems. The elderly and those with basic medical problems, such as hypertension, heart and lung problems, diabetes or cancer, are at an increased risk of developing serious diseases. However, anyone can catch COVID-19 and become seriously ill. Even people with very mild symptoms of COVID-19 can pass on the virus. People of all ages who suffer from fever, cough and shortness of breath should consult a doctor. Figure 4 shows the primary symptoms of COVID -19 disease.[19]

Diagnosis

Clinical diagnosis was largely based on clinical and exposure history and laboratory and chest imaging results. Laboratory results will vary with disease severity, but low lymphocyte counts are common and persistent low counts are associated with poorer results. Tests should be performed to detect other respiratory pathogens to rule out viral and bacterial co-infections. The detection of the virus was based on PCR (polymerase chain reactions), with numerous assays targeted in particular on the envelope (E), the RNA-dependent RNA-polymerase (RDRP), the spike protein (S) and the genes of the nucleocapsid (N). Internal tests are in use at various laboratories that are members of the Public Health Laboratory Network (PHLN), with continuous and continuous evaluation.[19,20]

In addition, numerous commercially available assays with declared capacity for the detection of SARS-CoV-2 are being evaluated. The virus can be found in the upper respiratory tract in almost all patients who start or just before the onset of clinical disease. The ideal samples are combined oropharyngeal and nasopharyngeal swabs and, if patient has productive cough then sputum is also used. In patients with lower respiratory tract

infections, the virus may be detectable in sputum samples or bronchoalveolar lavage, although it cannot be detected in the upper respiratory tract. The virus can be developed relatively easily in various cell lines, including Vero cells, but requires a PC3 containment laboratory. Virus identification can be confirmed by sequencing, if necessary, and a large number of complete and partial genomic sequences are available through GISAID (Global Initiative to Share All Influenza Data) and GenBank. PCR tests have become increasingly available since January 25, but due to the rapid spread in China and the large number of cases, access to timely and accurate tests has been problematic, especially in the early stages, which makes it difficult to determine the real extension of virus infections and diseases. Some manufacturers have also supported new rapid test kits for COVID-19 which provide results at short intervals. Testing of these rapid test kits is underway, giving results in minutes.[20] Figure 5 shows the diagnosis of COVID-19 sample by RT PCR Kit.

Treatment and Prevention

There are currently no proven or registered therapies or vaccines for COVID-19 infection. Treatment is largely supportive, although a number of therapies are being studied with some clinical trials in China and elsewhere. Currently, the treatments are the combination of the HIV protease inhibitor lopinavir / ritonavir and remdesivir. Remdesivir is a new broad-spectrum antiviral agent, showed promising activity against MERS-CoV in animal models. Combinations of these with interferon-b and ribavirin are being considered, while other groups are testing other antivirals, convalescent plasma, plasma therapy and monoclonal antibodies.[20,21]

Work on vaccines is also ongoing, although a vaccine is unlikely to be available for at least 18 months. The Coalition for Epidemic Preparedness and Innovations (CEPI) is currently funding four vaccine initiatives in collaboration with WHO. One of them is at the University of Queensland, where Professor Paul Young and doctors Keith Chappell and Dan Watterson are using their exciting new "molecular clamp" technology to develop a vaccine. This work is being done in collaboration with the CSIRO vaccine manufacturing facility in Clayton and is also partially funded by CSL Ltd. This Australian partnership hopes to have the vaccine ready for use by the end of 2021.[21]

Conclusion

From the above study it can be concluded that SARS-CoV-2 is the seventh coronavirus known to infect humans and the third zoonotic virus after SARS-CoV and MERS-CoV. Bats are the hosts of the reservoir for a number of new coronaviruses, especially Chinese horseshoe bats, and many of these new coronaviruses can efficiently use multiple orthologs of the SARS receptor, human ACE2, and replicate efficiently in primary human airway cells and achieve in vitro titres equivalent to epidemic strains of SARS-CoV. This indicates that other potential interspecies vents may occur in the future. Therefore, there is a strong reason to ban unregulated sales of wild animals in China's wet markets, especially exotic species, both from a public health point of view and for ecological reasons.

Also from the above facts and discoveries, COVID 19 originates from animals for humans, whatever the source, which is not yet clear to this day, since further research is being done on its source. There is no myth behind the saying that COVID-19 is a zoonotic disease. We are dealing with this epidemic condition that leads to the death of many people around the world, so in this review article I would like to ask everyone to be safe in their home, use the necessary preventive measures and avoid unnecessary death of animals wild.

Acknowledgement

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Abbreviations used

COVID-19: Corona virus disease 2019; **WHO:** World health Organization; **DNA**: Deoxyribo Nucleic Acid; **RNA:** Ribo Nucleic Acid; **HIV:** Human immune virus; **SARS-CoV**: Severe Acute Respiratory Syndrome-Corona Virus; **MERS-CoV:** Middle Eastern respiratory syndrome-

Corona Virus; **SARS**: Severe Acute Respiratory Syndrome; **MERS**: Middle Eastern respiratory syndrome; **ACE2**: Angiotensin converting enzyme 2; **PCR**: Polymerase Chain Reactions.

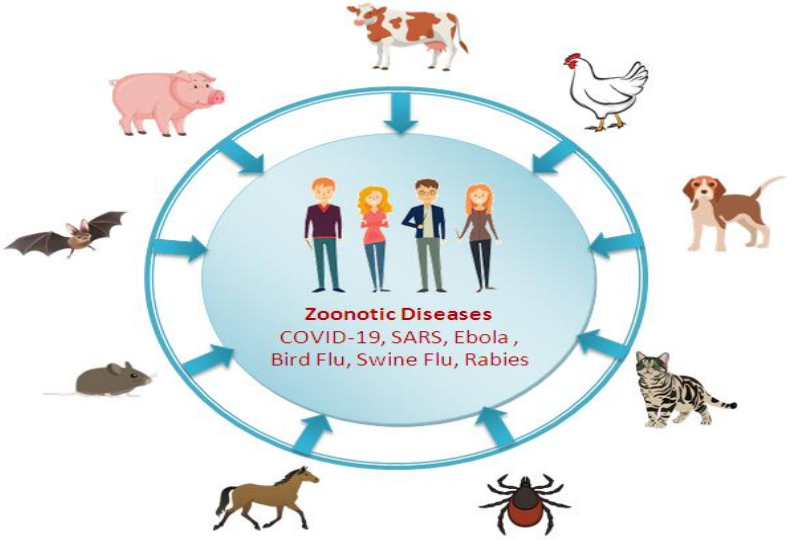

Fig. 1: Transfer of infectious agents from Animals to Humans: zoonotic diseases

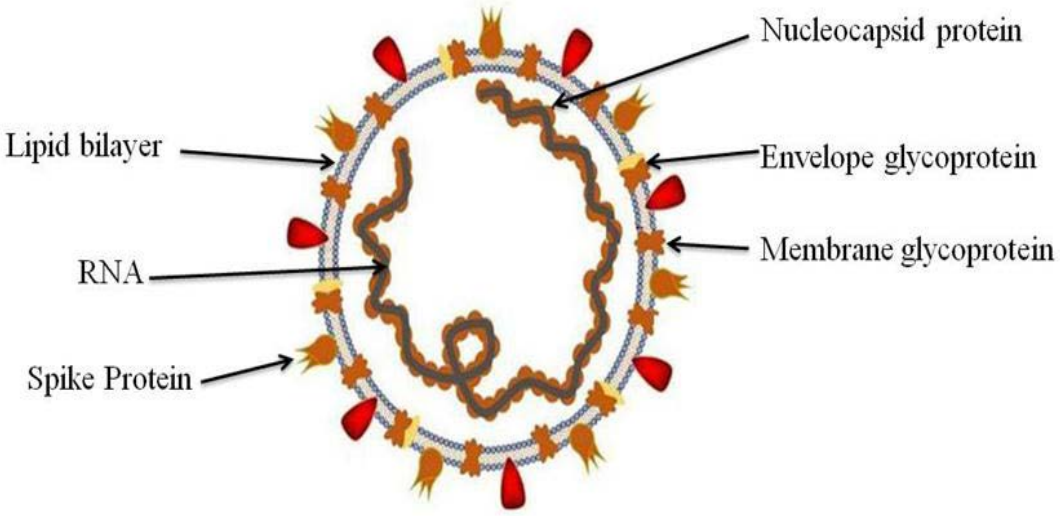

Fig. 2: Structure of novel corona virus

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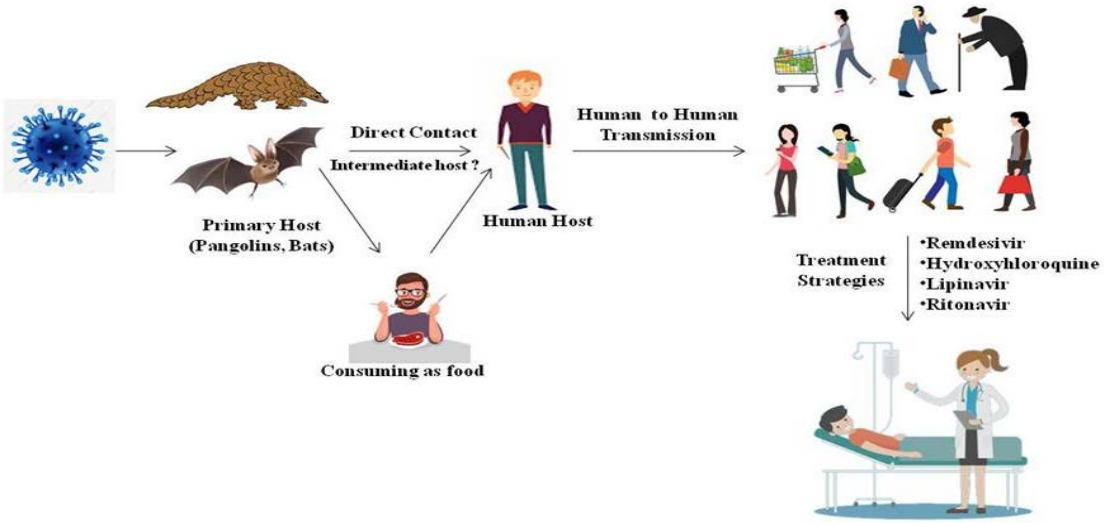

Fig. 3: Transfer of COVID-19 infection from animals to human

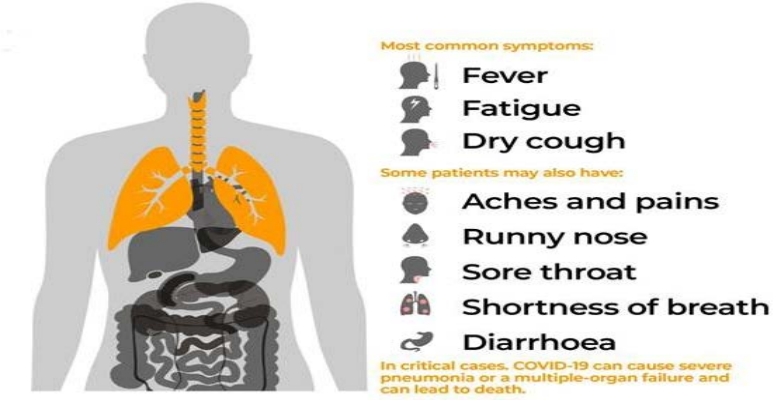

Fig. 4: Primary symptoms of COVID-19 disease (Source: World Health Organization)

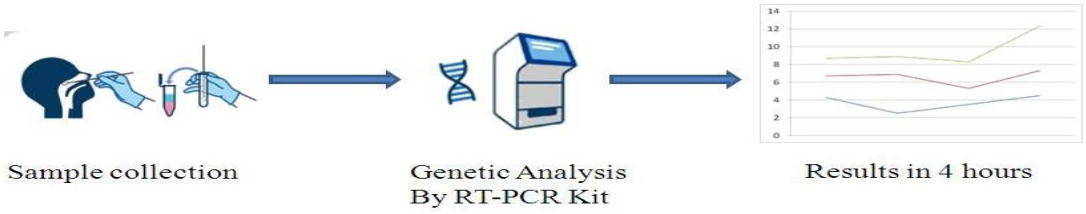

Fig. 5: Diagnosis of COVID-19 sample by RT PCR Kit

Table 1: Recent viral emerging zoonoses [9]

Pathogen	Initial outbreak	Geographical distribution	Reservoir	Vector	Lethality
West Nile	1999	Worldwide	Birds	*Culex pipiens*	10-20%
SARS	2004	USA, Canada and Eastern Asia	Bats	None	11%
H1N1 flu	2009	America, Europe, Middle East, Asia & Pacific	Birds	None	2-5,4 %
MERS-CoV	2012	Middle East, Eastern Asia, Europe and USA	Dromedary camels	None	35%
Chikungunya	2014	America, Southern Europe, sub-Saharan Africa, Eastern Asia and Middle East	Primates, rodents, birds and small mammals	*Aedes aegypti* and *A.albopictus*	Rare
Zika	2015	America, Africa and Asia	Primates	*Aedes aegypti* and *A.albopictus*	Low
Ebola	2018	West and Central Africa	Bats	None	70%
Crimean-Congo	2018	Sub-Saharan Africa, Eastern Asia and Middle East	Birds	Ticks	10-40%
Yellow fever	2019	South and Central America and sub-Saharan Africa	Primates	*Aedes* and *Haemogogus* species	50%
COVID-19	2019	Worldwide	Bats/Pangolins	None	5-30%

COVID-19 = Corona virus disease 2019, **SARS-CoV** = Severe Acute Respiratory Syndrome-Corona Virus, **MERS-CoV=** Middle Eastern respiratory syndrome-Corona Virus.

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