



Coronavirus threat to Indian population: risk factors, transmission dynamics and preparedness to prevent the spread of the virus

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Abstract Recent novel coronavirus outbreak in Wuhan City of Hubei province in China infected nearly 70,000 individuals and killed more than 1700 people within a short span of time leading to global pandemic. The disease is now spread to 26 countries in Asia, North America, Europe and Australasia. The virus is spreading rapidly to Asia-pacific and Southeast Asian countries. The disease is posing a serious threat to human population and has devastating impact on public health and economy. So far 3 Indians are infected and India is at risk of rapid spread of the disease because of its geographical location and other favorable conditions. With a poorer global health security index compared to China (India-57 and China-51), any such situation will have worse outcome. In near future there are also possibilities of similar kind of disease outbreak caused by new strains of coronaviruses due to factors like species jump of new viruses, high population density and inadequate medical facilities. In this short review we have highlighted the risk factors and transmission dynamics of coronaviruses that may pose a serious threat to India. We have also discussed about the possible preventive measure our country should take to control any such outbreak situation.

Keywords Coronaviruses · Bat · India

Coronavirus disease outbreaks and impact on public health

Novel coronavirus (2019-nCoV renamed as Covid-19) outbreak is WuHan, China is a threat to human population worldwide. Nearly 70,000 people worldwide are infected with the newly emerged coronavirus which caused death of more than 1700 people within 2 months after it was first reported in December 2019 [13]. Looking at the increasing rate of infection each day it is predicted that this novel coronavirus may be a cause of huge pandemic. Earlier, world had experienced two such major epidemic caused by coronaviruses. In 2002–2003 there was an outbreak of novel coronavirus called SARS in China and Hong Kong, which was then spread to other countries including Vietnam and Canada. There were total of approximately 8000 cases reported with 774 deaths all over the world [16]. Since then no further SARS death reported from any regions. However new SARS-like coronaviruses identified in different bat species which have potential to infect human cells [6, 10]. 10 years later a new strain of coronavirus called MERS (Middle East Respiratory Syndrome) virus was identified in Middle-east Asian countries. From November 2012 to February 2016, a total of 1308 laboratory-confirmed MERS-CoV cases were reported by Saudi Arabia, including 449 with patients listed as female [17]. Age information was available for 400 of the 449 female patients; 179 were of reproductive age (15–45 years), and death was documented in 16 (8.9%) of the 179. Among 1308 reported cases of MERS-CoV, 5 were documented by the MoH to have occurred in pregnant women [1, 18].

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Risk factors and transmission dynamics favorable for disease spread in India

Novel coronaviruses, Covid-19 or SARS or MERS did not pose any major threat to Indian population till now though there are several risk factors including international travel (Fig. 1) are present which may be the reason for large pandemic. Three persons from Kerala who lived in China reported to be infected with coronavirus and all of them survived. However many individuals who arrived India from China were quarantined and under observation. Coronavirus infections are not uncommon among children in India. 3 hospital-based studies were done in past to determine the incidences of coronavirus infections [3, 8, 12]. These reports suggested that there are cases of human coronavirus infections in India albeit at low rate. One study by Suresha et al. showed that among the 1706 incidences there were 9 coronavirus infection cases (1.04%). Among these 9 positive samples 4 cases were HCoV-OC43, three were HCoV-NL63 and 2 were HCoV-229E. In another study from AIIMS, New Delhi showed that incidences of coronavirus infection is 17.8% among the infants. However in that study detailed characterization of the coronaviruses were not conducted. No new strain of coronavirus was reported from these small studies. None of these studies also did not provide any demographic data that may suggest the possible route or risk factors of transmissions.

Bats are recognized as the natural host of a large variety of viruses such as coronaviruses, hantaviruses, lyssaviruses, SARS coronavirus, rabies virus, nipah virus, lassa virus, Henipavirus, Ebola virus and Marburg virus [4]. Recent coronavirus outbreak of SARS and MERS was traced to have a bat origin. There are more than 1200 bat species worldwide with different sizes, diverse habitat and food habit. Nearly 128 species of bat were identified in Indian subcontinent. This includes one of the largest in the world, the Indian flying fox (*Pteropus giganteus*); one of the most colorful, the orange and black painted bat (*Kerivoula picta*); and one of the rarest, Salim Alis fruit bat (*Latidens salimalii*). These bats have diverse as the habitats which includes higher Himalayas, deserts of the Northwest, tropical forests of the East and South. Most common species in India is Indian Flying fox and India has 12 types of flying foxes. Only three, the Indian flying fox, the fulvous fruit bat (*Rousettus leschenaulti*), and the short-nosed fruit bat (*Cynopterus sphinx*) are common throughout the country. The other species are rare and are found only in the mountains and Andaman and Nicobar islands near Thailand [2, 9].

Transmission of viruses from bat to human and other animals are through bat bite, aerosolization of saliva, feces and urine. When a person is unknowingly exposed to virus containing bat excreta, there are chances of getting infection (Fig. 1). Many rural areas in India have bat habitats and human population come into very close contact with

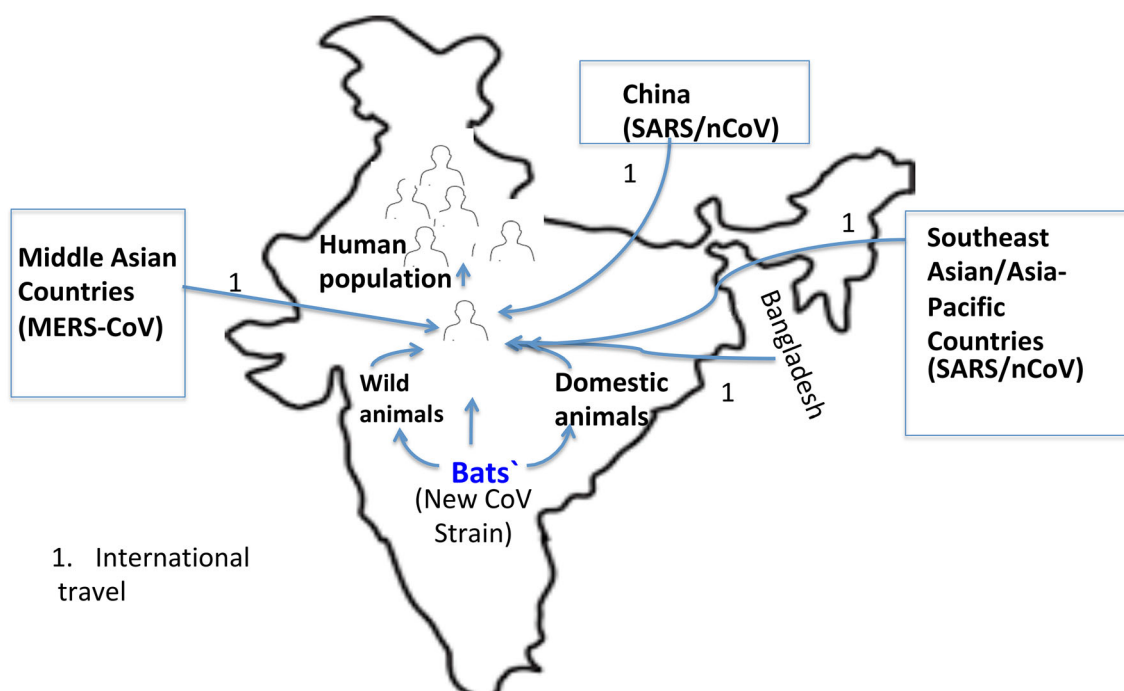


Fig. 1 Possible routes of transmission of novel and new coronavirus strains to India. Covid-19, SARS and MERS-CoV like novel coronaviruses may spread through International travel. New strains of the virus may also emerge by species jump from bats, small animals to human

bat saliva and excreta very often. Some Indian tribes also eat bat meat and there is a possibility of getting exposed to deadly pathogen including coronaviruses. It is not known yet how the novel coronavirus in Wuhan was spread. Coronavirus strain isolated from a pangolin was found to be 99% identical to those isolated from infected people from Wuhan city, which suggests possible pangolin to human transmission and pangolin may have contacted the virus from bat through direct or indirect exposure to virus (<https://news.mongabay.com/2020/02/illegal-pangolin-trade-may-have-played-a-part-in-coronavirus-outbreak/>). Earlier studies on SARS-CoV and MERS-CoV epidemics also indicated bat to animal to human transmission of these viruses. SARS outbreak was suspected to have taken place by civets whereas evidences suggest that MERS-CoV outbreak was mediated through camels [7, 14]. Coronavirus spike (S) protein determines the host specificity of the virus. So, in the event of species jump of a new strain of virus can take place only if both the species has same or closely related receptor for the virus.

MERS-CoV binds to CD26 (DPP4) receptor for host cell entry and CD26 is also receptor for bat coronavirus HKU4 [11, 15]. Bat is a refractory of many coronavirus strains and a particular strain closely related to MERS-CoV transmitted to an animal species and then over time through small genetic changes in S, became capable of infecting human. Receptor for Covid-19 hasn't been identified yet, however the structure of the spike protein of the virus showed that it has a unusual furin-like cleavage site that is not present on the surface of SARS or MERS [5]. Covid-19 is an unrelated coronavirus that may have jumped multiple species and later a mutated version was able to infect human against which there is no immune protection. This suggests that other undiscovered coronaviruses circulating in wild bats or other animals can potentially infect humans that may spread faster from one person to another and lead to an outbreak.

No major study was conducted in India to determine the true burden of coronavirus infection, genetic characterization and knowledge about the circulating strains in the wild, transmission dynamics are not available. Coronaviruses may spread through domestic and wild animals, which are in close contact with human population in India as happened in other outbreaks. In this context how prepared is India in tackling a potential SARS or MERS-CoV or Wuhan Covid-19 like epidemic is need to be evaluated and preventive steps to be undertaken.

Preparedness to prevent coronavirus pandemic in India

Indian population is more or less at risk with coronavirus outbreak and human death. A serious measure is to be taken to avoid any coronavirus pandemic situation in near future. Large population based studies are required to determine the coronavirus strains circulating in this population and if a new strain is identified that need to be characterized in details. Studies should be done in understanding the transmission dynamics of the viruses. Different strains of coronaviruses uses different receptors to gain entry to the host cells and receptor biology is thus important in looking at the insight of transmission pattern. Therefore, efforts to be made to identify the receptors for the unrelated viruses and drug should be designed to inhibit virus-receptor interaction. Efforts should also be given to conduct research studies in understanding the biology and pathogenesis of coronaviruses for designing novel drugs.

Vaccine design and production against Covid-19 has been initiated. Vaccine giant GSK and Jenner Institute in UK have planned to use same platform used to produce MERS-CoV vaccines and first phase of clinical trial is set to start soon. India is one of the largest vaccine producing countries in the world and the vaccines produced here are being used in many countries. India has a strong platform to produce large-scale vaccines within short time. Vaccine manufacturing companies in India may work in formulating coronavirus vaccines and carryout initial studies to determine effectiveness and safety of the vaccine as a preparation to avert any sudden outbreak.

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