

# Emerging coronavirus and characteristics: A mini-review

## Abstract

The emerging viral infections are a continuous threat to the modern world, like SARS CoV-2, a new viral pandemic which has taken number of lives. The initial outbreak was noticed in Wuhan city of China in late of December 2019, along with increasing number of cases in other places in the same city. The spread pattern of this virus changed from zoonotic transmission to human in an exponential way. As, there is no drug or vaccine available against this virus hence preventive measures are adopted only. Assessment of risks and biosafety training are important factors in the latter situation. Here is a brief insight about this novel corona virus strain including its virology, epidemiology, methods to diagnosis, clinical features and controlling measures for preventing spread of Covid-19.

**Keywords:** emerging, coronavirus, genome, diagnosis, prevention strategies

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## Introduction

The two major viruses responsible for the seasonal epidemic and occasional pandemics being influenza virus and corona virus. Human, birds and animal populations are vulnerable to these viral infections as viruses circulate. Because of various subtypes of influenza five pandemics has taken place in the 19<sup>th</sup> century, in birds and human population. Spanish flu caused by H1N1, in 1918 claimed lives of 50 million people, around the world. Similarly, Asian flu (H2N2) in 1957 originated in China, killed 4 million people. Bird flu in 2005 caused by H5N1 subtype of influenza virus killed many birds and affected human population as well. In 2009, swine flu resulted in 18000 deaths and spread over 100 countries affecting human, birds and swine population. Swine is considered as main reservoir for flu viruses. Another virus family, responsible for pandemic and respiratory diseases we are going to discuss here, is corona virus. Severe Acute Respiratory syndrome, (2001 to 20013) and Middle East Respiratory Syndrome, (2012 to 2015) are two forms of regional epidemics causing respiratory illness. SARS and MERS killed 774 and 858 people between 2012 and 2019, respectively. (Centre for Disease Control & Prevention, 2005; World Health Organization. Middle East respiratory syndrome coronavirus (MERS-CoV) (2019).<sup>1</sup> In China, at the end of 2019, a number of pneumonia cases increased without known cause, in Wuhan city of Hubei province.<sup>2</sup> Since then, outbreaks and sporadic human infections have resulted in more than 80,000 laboratory confirmed cases (update on March 23, 2020) across mainland China. In humans, CoVs mostly cause respiratory and gastrointestinal symptoms ranging from the common cold to more severe disease such as bronchitis, pneumonia, severe acute respiratory distress syndrome (ARDS), coagulopathy, multi-organ failure and death.<sup>3-7</sup> Corona virus also cause a number of infections such as cystic fibrosis, asthma and chronic obstructive pulmonary disease.<sup>8-10</sup> The virus resembles 2003 SARS CoV hence WHO labelled it as SARS CoV-2 on 11<sup>th</sup> February 2020.<sup>11</sup> The virus can be transmitted via respiratory droplet or direct contact with infected person and the outbreak driver may be symptomatic or asymptomatic.<sup>12</sup> Although, the origin of virus is Wuhan city of China yet the virus has spread to the other cities of China and throughout the world causing pandemic. COVID-19 is a clinical term used for the disease caused by SARS-

CoV-2.<sup>13</sup> After of spread of virus globally, the infection was at peak in countries like Europe and USA, causing several deaths and new cases being detected. The virus expanded rapidly in 194 countries including Asia, Europe, Africa, middle East, North America and Latin America. Millions of cases were reported in Wuhan including exported cases other Provinces of the same country, China, Thailand, Japan, south Korea and USA.<sup>14-17</sup> Outbreak of nCoV strain threat global health.

## An epidemic into a pandemic

WHO has labelled corona virus outbreak as pandemic. Virus spread quickly around the globe within no time and infected 200 countries, turning the endemic situation into pandemic. The reason for rapid spread is extensive transportation across the borders and international flights. The first two cases of corona virus in Iran emerged on 19<sup>th</sup> February 2020. Other countries outside the China, at the peak of pandemic are Iran, Italy, France and Spain. The virus has infected 1.5 million people approximately across the world<sup>18</sup> and the cases are increasing at alarming rate, exponentially.

## Virus structure and genome

Corona virus is an enveloped, spherical to pleomorphic particle. Within envelope glycoproteins are protruded surrounding a core which consist of matrix protein. Single stranded positive sense RNA strand is enclosed within these matrix proteins. Viral glycoproteins carrying main antigenic epitope are responsible for attachment to the host cells. Neutralizing antibodies recognize the epitope. Spike protein of Corona virus is molecular machine having many functions accomplishing the virus entry into the host cell. Subfamily of novel corona virus 2019 is coronaviridae belonging to Nidovirales order. Four genera of Nidovirales are Alpha-coronavirus, Beta-coronavirus, Gamma-coronavirus, and Delta-coronavirus. It is a single stranded, positive sense RNA, enveloped virus belonging to beta Corona virus lineage of subgenus Sarbecovirus.<sup>19</sup> Genomic size is 30kb having 3' PA tail and 5' cap. Upon phylogenetic analysis it showed 88% resemblance to the bat genome, bat-SL-CoVZC45 and bat-SL-CoVZXC21.<sup>20</sup> RNA genome directs synthesis of polyprotein. Transcription replication complex formation is facilitated by non-structural proteins.<sup>21</sup> Genome is comprised of 6 ORF in which first ORF constitutes 70% of the

genome which encode 16 non-structural proteins while remaining one third is comprised of the rest of the ORFs, encoding structural proteins i.e spike (S), membrane (M), envelope (E) and nucleocapsid (N) proteins. These proteins are directly involved virus assembly. S protein produce spike on the surface of virus that mediates viral attachment to host receptor, to the nucleocapsid M proteins bind. Assembly of viral parts and its release is aided by E protein. Two domains of N protein bind to the RNA genome and involve in packaging of genome.<sup>22</sup>

## Disease symptoms

Infection pattern of Covid-19 are variable in different people. Symptoms after infection are mild to moderate. Many of the cases may recover without being hospitalized. Common signs of illness are dry cough, fever and fatigue. Pains and aches, sore throat, diarrhoea, headache, loss of taste and smell, rashes on skin, conjunctivitis and loss of pigmentation of toes or fingers are less common symptoms.

In severe case clinical features include, shortness of breath and difficulty in breathing, chest pain and loss of movement and speech.<sup>23</sup> Signs of the infection appear 2-14 days after onset. However in some of the patients of covid-19 remain asymptomatic, transmitting virus to the healthy people like MERS.<sup>24</sup>

## Diagnosis

For initial evaluation RNA was extracted from cell culture supernatants and clinical samples with viral mini RNA kit. Lungs radiography of patients can help to diagnose Coronavirus infection. However, reverse transcriptase real time PCR and next generation sequencing also detects presence of 2019 novel corona virus in samples. Cov envelope gene are target of probe and primer. The sequence of forward and reverse is respectively as 5'-ACTTCTTTTCTTGCTTCGTGGT-3' and 5'-GCAGCAGTACGCACACAATC-3'. The sequence of probe used is 5'-CY5-CTAGTTACACTAGCCATCCTTACTGC-3'-BHQ1. Amplification condition for carrying out PCR are 50°C for 15 min, 95°C for 3 min. Number of cycles are 45 for 15s at 95°C and 30s at 60°C temperature.

Conditions for the amplifications were 50°C for 15 min, 95°C for 3 min, followed by 45 cycles of 95°C for 15 s and 60°C for 30s.<sup>25</sup> Targeted PCR which showed a 79.6% sequence similarity to SARS-CoV BJ01 (Gene Bank accession number AY278488.2).<sup>26</sup> Laboratories participating in the evaluation used the TaqMan Fast Virus 1-Step Master Mix (Thermo Fisher) with the same oligonucleotide concentrations and cycling conditions. The QIAGEN One-Step RT-PCR Kit was also tested and found to be compatible.<sup>27</sup>

## Pathogenesis

Studies conducted on human volunteers and organ culture indicate that coronavirus grow in epithelial cells of respiratory tract. The infected epithelial cells are vacuolated having damaged cilia and occasionally form syncytia. Damaged cell produces inflammatory molecules which lead to the increased nasal secretions resulting in swelling and local inflammation. In response to this inflammation the temperature of mucus increases, respiratory airway become restricted leading to the difficulty in breathing. Some of the CoVs have broad host range infecting birds, bats, whale, mice and wild animal causing economic loss. HKU2 is a bat related corona virus that caused swine acute diarrhea syndrome, killing 24000 or more pigs in southern China, in 2016.<sup>28</sup>

## Epidemiology

There is little understanding about the epidemiology and rate transmission of coronavirus. However, it infects schools and families during winters. Immunity is generated but it remains for short period and the individuals are re-infected occasionally twice in a year. The pattern of infection is different from those of rhinoviruses which infects at high rate during fall and spring. The immunity generated against rhinoviruses is long-lasting. Out of five cold cases, generally one case is caused by coronavirus. The route of transmission is contaminated droplet inhalation and also to the mucus of respiratory tract and eyes by the hands.<sup>29</sup>

## Physicochemical properties

The coronavirus particle appears round or oval and crown shaped having 60~100 nm diameter. Most of the properties of this virus are similar to that of SARS-CoV and MERS-CoV-2. The ways of inactivating SARS-CoV2 include physical methods i.e UV irradiation, heating at 56°C for 30min and chemicals treatments include 75% ethanol, chlorine, peracetic acid and chloroform.<sup>30</sup> Reports show that SARS-CoV-2 is more stable on plastic and steel as compared to copper and board. Up to 72h, the virus was viable after applying to the plastics and steel surfaces. SARS-CoV-2 has longer half-life on cardboard as compared to SARS-CoV while both viruses have longest viability on plastic and stainless steel.<sup>31</sup>

## Routes of transmission

Main transmission routes of the virus are direct contact and respiratory droplet. nCoV found in the stools and urine of the infected and confirm laboratory cases, in the recent cases, hence it is concluded that risk factor for spread can be fecal-oral transmission.<sup>30</sup> However, no case existed that could prove this factor to be true. There is no evidence of the viral transmission from mother to baby during gestation, this transmission route seems impossible. Weather conditions have no effect on the viability of virus hence, it is found and transmitted in every kind of weather and to all the areas of various weather conditions. Therefore, it is pointless to believe that extreme weather conditions can kill the coronavirus or eradicate the other infections.

## Treatments

Efforts are on the way since the SARS and MERS pandemic yet no known specific antiviral therapy exists. The treatments are supportive and have limited effect on CoV. Those supportive treatments are oxygen supplementation, fluid and calorie intake. Ribavirin with rIFN have limited effect on CoVs.<sup>32</sup> For the development of new antiviral drug design targets are CoV polymerases, proteases and entry protein while none of them show efficacy during clinical trials.<sup>33-35</sup> Plasma therapy and antibiotics have been proposed for treatment obtained from the recovered individuals of COVID-19.<sup>36</sup> Proposed options and supportive treatments include the use of Chloroquine (broad spectrum drug used against malaria and autoimmune disease), protease and RNA inhibitors subunit and recombinant vaccine.<sup>37,38</sup> Studies have shown that Chloroquine is effective in inhibiting the entry and post entry of SARS-CoV-2 into the host cells, possesses immune modulation property making it potential candidate for in vivo use to enhance antiviral effects.<sup>39</sup>

## Other strategies for controlling emerging coronavirus

### Prevention

Safety measures that control the infections include wearing mask and gloves, avoiding social gathering, stay at home, washing hands regularly, avoid touching nose, mouth and eyes, using face shield and covering mouth. Disinfecting all items and surfaces such as mobiles and door handles. Careful disposal of mask and gloves after use. Drinking luke warm water to avoid sore throat.

### Conclusion and future aspect

Corona virus pandemic has given us many lessons and we have learnt many important points from it. The first and most important point is awareness about the nature of virus and timely risk assessment to take decision before start of epidemic. Quick safety measures and biosafety tools adaptation in daily life to avoid encounter and exposure to the virus. Avoiding social gatherings and maintaining good hygienic conditions are the very first requirements to avoid viral infections. Livestock use for the source of food increases the risk of infection hence it should be avoided. Training of healthcare individuals and initiation of biosafety measures is an effective element to prevent disease spread. Drugs that are useful for the reducing disease severity, viral load and transmission should be used to avoid the outbreak. Many drugs have been tested against SARS-CoV and MERS-CoV in animals, infected cells and protein vaccines. The investigations are under way to develop vaccine for covid-19. The combined efforts of experimental and informatics will pave the way for vaccine development. Bioinformatics tool are helpful in determining the virus structure and providing potential sites for inhibition of virus.

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### Conflicts of interest

The authors declare no Conflicts of interest.

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