PSM Microbiology

ISSN(Online): 2518-3834

Review Article | 2020 | Volume 5 | Issue 4 | 102-111

**Article Info**

**Open Access**

**Citation:** Khalid, U.A., Tariq, R., Nowshaid, W., Qasim, M., 2020. SARS-CoV-2: Resurgence of an Old Companion of SARS-CoV. PSM Microbiol., 5(4): 102-111.

**Running Title:**
Resurgence of Novel SARS-CoV-2.

Received: September 25, 2020

Accepted: November 18, 2020

Published: December 31, 2020

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# SARS-CoV-2: Resurgence of an Old Companion of SARS-CoV

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**Abstract:**
Some of the emergent viral diseases pose a serious threat to humans as these come with limited treatment possibilities and occasionally prove to be extremely contagious resulting in high mortality ratio. Lately, in December 2019, a new coronavirus “Severe Acute Respiratory Syndrome Coronavirus 2” (SARS-CoV-2) evolved in Wuhan, China representing close similarity with Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome (MERS-CoV) witnessed in the last two decades. Seeing the recent development of 2$^{nd}$ wave of coronavirus in many parts of the world, it has become a pre-requisite to consider a detailed comparison of the coronavirus family to not only find the main origin but also the production of the functional vaccine as affected cases and mortality rates have soared much higher by this deadly virus. Since the final declared vaccine or therapy has not come into the market, we need to focus on the preventive measures at present. Up till now, numerous articles have been published on SARS-CoV-2 but the present review attempts to focus on more targeted information for comparisons of epidemiology, transmission, clinical features, risk factors, diagnosis, and treatment options for SARS-CoV, MERS-CoV, and SARS-CoV-2 for the future reference and treatment options.
**Keywords:** COVID-19, SARS-CoV, SARS-CoV-2, Pandemic, Transmission, Risk factor.

## INTRODUCTION

Some viruses have been known for centuries to wreak havoc upon living creatures, as they are causative agents for many fatal diseases. They can be placed in broader categories between living and nonliving as they use the cellular machinery of living beings to reproduce, i.e., replicate their genomes; thus, they can be termed as "selfish genetic entities" (Koonin *et al.,* 2006). The emergence of the novel pathogen is a major problem, and their control is a considerable challenge in health sectors (Ashraf *et al.,* 2020; Lloyd-Smith *et al.,* 2015). At the end of 2019, in Wuhan, a city in China, a lethal virus evolved that swept the whole world with deadly effects (Liu *et al.,* 2020a). Several pneumonia-like symptoms were reported, and the culmination of the finding of this mysterious outbreak ended by the discovery of the novel coronavirus named "SARS-CoV-2" (Guarner, 2020; WHO, 2020a). A preliminary investigation revealed the source of the virus, pointing to the seafood market in Wuhan city (Hui *et al.,* 2020). This coronavirus seemed to be highly transmissible and might be the main reason for its widespread dissemination. The way this virus reached and extended throughout the world not only threatens the health of living beings but also negatively impacts the economy. Thus, the patients infected by SARS-CoV-2 are the main source and companion to the spread of this virus. The transmission routes of these viruses are in contact with respiratory droplets containing SARS-CoV-2 (NHC, 2020). With regards to chances of getting affected, almost every person can be affected by it but people with older age and those with chronic diseases can be severely influenced (Shen *et al.,* 2020). SARS-CoV-2 has an average incubation period of 2-14 days (ERS, 2020). It has been revealed that the newly discovered coronavirus is parallel with the coronavirus that is present in bats and this similarity is up to 96% at the genomic level (Zhou *et al.,* 2020a). The World Health Organization declared the SARS-CoV-2 outbreak a global emergency in January 2020 and also an extensive threat to humans (Yang *et al.,* 2019). As of 20$^{th}$ September 2020, 30,675,675 cases and 954,417 deaths have been reported worldwide as officially reported by WHO. Cases reached up to >210 countries, including United States, Italy, Spain, UK, France, and Germany (WHO, 2020b). In contrast to China, the number of cases and deaths are increasing universally. Following the World Health Organization, the United States declared a public health emergency on 31$^{st}$ January 2020 (Wang and Zhang, 2020).

## Transmission origin of SARS-CoV-2

Many investigations are underway to find the exact natural host of this virus. Sequence analysis shows that this virus is very similar to a coronavirus that was earlier discovered in bats; by this, it can be assumed that bats might be the origin and ancestral host of SARS-CoV-2. Evidence has shown that the primary and ancestral hosts of SARS-CoV and MERS-CoV were bats but the transmission of SARS-CoV in humans was from exotic animals, most likely civet cats, while transmission of MERS-CoV was reportedly from camels (Sabir *et al.,* 2016). It has been reported that the two viruses, i.e., SARS-CoV and MERS-CoV have the same transmission source. Transmission in both cases has been reported as cross-species transmission. The transmission source, risk groups related to respective coronaviruses, and transmission patterns include community contact and nosocomial transmission, as shown in Figure 1. It is still unclear whether a human gets infected by the novel coronavirus directly from the original host (bats) or through the intermediate host but person to person transmission has been reported as a major route in the COVID-19 outbreak (Azhar *et al.,* 2014; WHO, 2020c; Wu *et al.,* 2020; Zumla *et al.,* 2015).

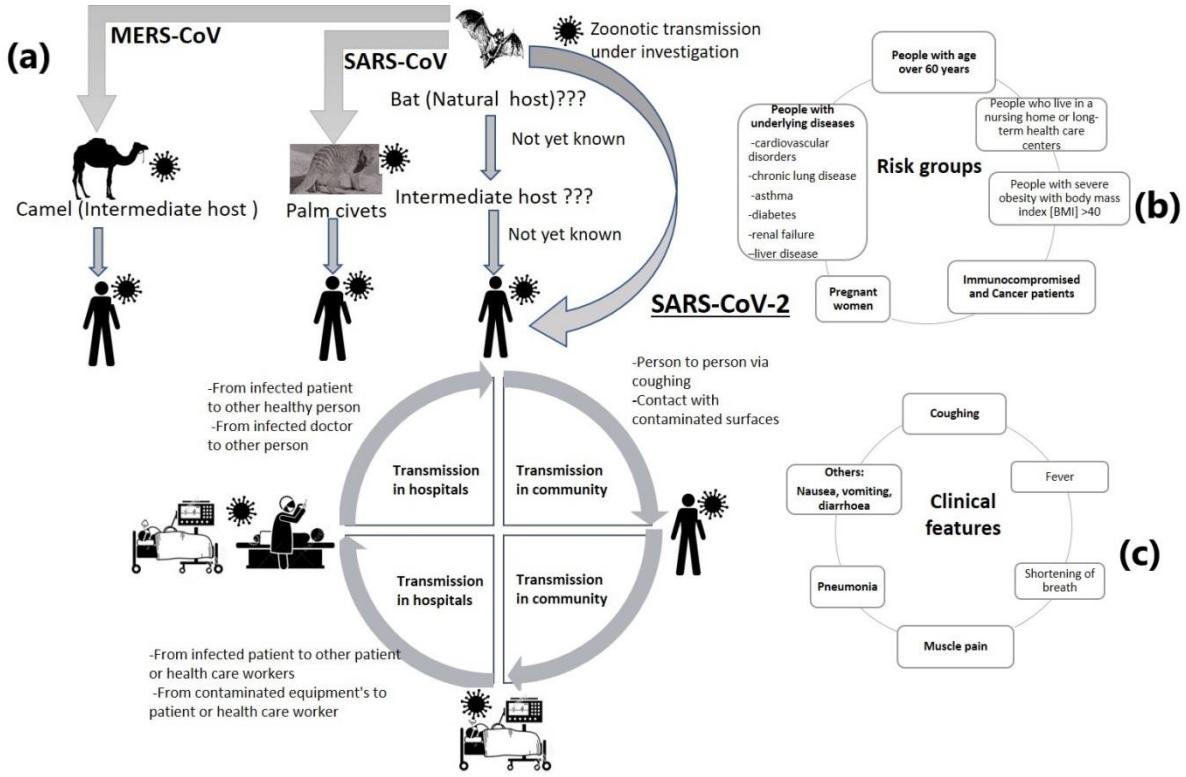


**Fig.1.** Graphical representation of transmission, risk groups, and clinical features of SARS-CoV-2. **(a)** The primary host of SARS-CoV and MERS-CoV are believed to be bats while their intermediate host is palm civet and dromedary camel respectively. Both primary and intermediate hosts for SARS-CoV-2 are still unknown but there is some evidence that bats are the primary reservoir. Person-to-person transmission is a well-known mode of transmission for SARS-CoV-2. **(b)** Risk groups include aged people, people with immune-compromised conditions or underlying diseases, obese peoples, pregnant women, and people residing in the nursing home for a long period. **(c)** The major clinical features include fever, cough, shortening of breath, muscle pain, pneumonia, and diarrhea.

## Comparison of SARS-CoV-2 with SARS-CoV and MERS-CoV

With the outbreak of a novel coronavirus, the Chinese government, and researchers all over the world got themselves engaged in controlling the spread of this virus. Sequencing of novel coronavirus-19 revealed that it seems to be identical to previously discovered coronaviruses i.e. SARS-CoV and MERS-CoV to a greater extent. Initially, it was declared as a novel coronavirus and 2019-nCOV was the name given by the World Health Organization to this virus on 12$^{th}$ January 2020 (Chen *et al.,* 2020a). This name was just the temporary identity of the novel coronavirus; a permanent name was given later, i.e., SARS-CoV-2, and the disease related to this virus was nominated as COVID-19 by the World Health Organization and the International Committee on Taxonomy of Viruses (ICTV) on 11$^{th}$ February 2020 (Guarner, 2020). The time span between the discoveries of SARS-CoV and MERS-CoV was 10 years, and considering SARS-CoV-2 origin time, the estimated discovery time span between SARS-CoV and SARS-CoV-2 is 18 years, and that with MERS-CoV is approximately 8 years (Chan-Yeung and Xu, 2003; WHO, 2020b; WHO, 2020c; WHO, 2020d; Zhong *et al.,* 2003; Zumla *et al.,* 2015). Due to a large number of affected cases and mortality rates, figures are rising much higher and increasing day by day as

compared to previous coronaviruses recorded figures (Guarner, 2020).

Although all three viruses share the common family, genus, and genome, the destructive impact caused by all three of them in the world varies. When we look closely at the economic loss, it was stated by the UN that the COVID-19 outbreak could cost the international economy up to $2 trillion this year and it called on all the governments to take crucial steps to decrease the economic influence (UN, 2020).

According to the genome similarity of these three coronaviruses, scientists are still contemplating the main host for these are bats (Fan *et al.,* 2019; Zhou *et al.,* 2020a). One of the important aspects to cover is to know about the most vulnerable risk groups prone to get infected from these three viruses. Concerning a study, immune-compromised people are at greater risk of reaching the severity of MERS-CoV disease (de Wit *et al.,* 2016). Furthermore, people who have other underlying complications or chronic illnesses are at a much greater chance of getting the infection and less chance of healing when infected with SARS, MERS, or SARS-CoV-2 infection. Initially, it was noticed that this novel coronavirus can only affect old age persons, but upon further examine it revealed that other age groups are susceptible too to this virus. Not only that, patients with previous chronic disease history were mostly affected (Government of Canada, 2020; WHO, 2020c).

SARS, MERS-CoV, and SARS-CoV-2 are interrelated as they all are propagated through super-spreaders. Super spreading occurs when a single patient infects an inconsistently higher number of contacts and is at a higher chance of distributing it with varying degrees of speed and intensity (Wong *et al.,* 2015). All three viruses have shown almost similar symptoms which usually can be seen in the first 14 days of getting infected (Arabi *et al.,* 2017).

As far as treatment options are concerned, firstly, the same treatment options/approaches were adopted for this virus as used for the old companions but didn't come out to be exacting and fruitful so scientists around the world are testing new targeted therapies/vaccines (Cunningham *et al.,* 2020; Iqbal, 2020a; Liu *et al.,* 2020b). Research and drug testing are still going on for the most recent SARS-CoV-2 infections and many scientists around the world are attempting to develop a vaccine for effective control of this virus. Some countries have declared that they have prepared the vaccine and are on a trial basis (WHO, 2020e). Several major methods of treatment can be viral entry inhibitors, viral replication inhibitors, nucleoside, nucleotide, and protease inhibitors, monoclonal antibody therapy, and convalescent plasma (Chhikara *et al.,* 2020; Li *et al.,* 2020a). Previous treatment approaches were somehow inadequate for the present virus so more exclusive and fast approaches are the need of the hour.

Early diagnosis of any suspected case of COVID-19 is an effective preventive strategy to limit the transmission of this contagious virus. Early diagnosis includes checking the residence history of suspected patients in affected areas and analyzing the travel history of patients. The travel history should include persons with whom he/she has traveled in the near past. Persons with a history of fever and respiratory problems or those persons who had contact with suspected patients should be examined. Newborn babies delivered to coronavirus-infected patients may be suspected to be coronavirus-positive. Thermal scanning of individuals has been widely used all over the world for the initial screening of suspected COVID-19 patients. Different diagnostic approaches should be considered for assessing the SARS-CoV-2 and distinguishing it from other viruses, i.e. SARS and MERS coronaviruses (Shen *et al.,* 2020).

Molecular approaches are sensitive and specific approaches to investigate the novelty and nature of pathogenic strains. These approaches depend on several factors, i.e., sequence alignments, phylogenetic analysis,

and functional annotations, and many more, the confirmation of which depends on various molecular tests. The complete sequenced genome data of SARS-CoV-2 is available online on NCBI and is open to researchers for further scientific study.

The mutation rates of coronaviruses are high as compared to those of other RNA viruses, which can, in turn, make modifications, leading to difficulty in countering these viruses (Su *et al.,* 2016). Climate change is another influential factor, as coronaviruses adapt according to their environment, making them resistant (Caminade *et al.,* 2019; Iqbal, 2020b).

**Prevention and Control of COVID-19**

The World Health Organization and other public health organizations have recommended various actions to avert the range of novel coronavirus-2019 in community and hospitals such as controlling the main infection source, hindering the transmission route, and shielding the susceptible population (WHO, 2020f). The following measures are very effective in controlling COVID-19, (i) cleaning of hands by frequent washing, and by the use of sanitizers (ii) avoiding frequent touch to the mouth, nose, or eyes with dirty hands (iii) quarantine and care for the suspected or confirmed individuals (iv) avoiding interaction with COVID-19 suspected or confirmed person (v) refraining from contact with wild animals and consumption of properly cooked meat (vi) using tissue paper while coughing or sneezing and immediately discarding it (vii) immediately visiting hospital for analysis or checkup if you have COVID-19 like symptoms (viii) No visiting any crowded places such as markets and if visit is necessary, using face mask (ix) cleaning and disinfecting public places where there is frequent movement of people (x) avoiding unnecessary touching of nose, mouth or eyes (xi) using mask if you are dealing with suspected or confirmed COVID-19 patient and if you have flu like symptoms (xii) Use of proper PPEs are mandatory for healthcare professionals while treating or diagnosing COVID-19 patients (xiii) COVID-19 patients should not be kept with other diseased patients in the same room (xiv) special attention and care is required for patients with underlying disease as they are at high risk groups (xv) boosting up your immune system by doing ample exercise and consumption of fruits, vegetable and other healthy diets (WHO, 2020f; WHO, 2020g; CDC, 2014; CDC, 2020a; CDC, 2020b; Wang *et al.,* 2020; Suganthan, 2019).

Nosocomial spread to other patients is a key aspect of the outbreaks of MERS, SARS, and nowadays COVID-19 (Arabi *et al.,* 2017). In a recent study, 41% of hospitalized patients acquired COVID-19 in the hospital vicinity counting the cases previously admitted for any other symptoms (Wang and Zhang, 2020). Intensive care unit staff needs to adhere to strict isolation provisions in the ICU to save everyone, including workers, other patients, and visitors (Arabi *et al.,* 2020).

Infection control guidance for COVID-19 is based on the management formerly established for SARS and MERS along with recent provisional recommendations delivered by the World Health Organization and CDC (CDC, 2020c). It is presumed that COVID-19's spread can take place through the airborne route like SARS and MERS. Precautionary actions should comprise screening enquiries (involving travel history), respirational, and hand sanitation. After identification of the PUI (patient under investigation), there should be instant communication between the infection control section of the hospital and the local health department. It is crucial for the avoidance of further infection among healthcare workers and patients. Patients should be provided with a surgical mask and positioned in an isolated room (WHO, 2020h). Surgical face masks have been declared a must-have item and are useful for bigger fluid drops linked with sneezing and coughing; nevertheless, they are impractical for helping with tiny airborne impurities (Suganthan, 2019). Wherever accessible, respirators or gasmasks with a satisfactory seal and airflow passing through screens would be more

operational (Smith *et al.,* 2016; Tran *et al.,* 2012).

The appropriate practice of utilizing personal protective equipment, together with putting on, fitting, and repeated changing, joined with suitable hand sanitization are characterized as the best possible operative techniques for stopping spread in hospitals (Cowling *et al.*, 2009; Radonovich *et al.,* 2019). For instance, if any patient has to be admitted to the hospital and an isolation room is not vacant, the patient has to be moved to an area with proper facilities and measures. It is supremely important that all medical authorities practice standard, airborne, and droplet safety measures and should wear an eye shield. Personal protective equipment is particularly important during aerosol-generating processes when communication is likely-boosted (CDC, 2020c). When a patient evacuates the isolation facility, the exact duration of SARS-CoV-2 residing in the atmosphere is yet to be known. Entry into the emptied room requires the use of a respiratory shield for a time duration matching the aeration leaving charges for the room (Yee *et al.,* 2020). Many countries around the world have taken to strictly following the CDC's strategies and support that healthcare workers should place all patients with supposed contamination in a quarantined room and that acceptable safety measures should be taken around the clock by wearing a disposable gown, gloves, and face shield, and donning a respirator (Al-Tawfiq and Memish, 2015).

There is a need to launch educational campaigns in remote areas to increase awareness among the people, especially travelers, to take precautions against this deadly disease, such as recurrent hand-washing, following the cough protocol, and use of personal protective equipment when going outside in public spaces. Likewise, the local community should be directed to report people with fever and other risky elements for coronavirus spread and maintain an account of travel records to potentially infected areas and close interactions with coronavirus suspected and confirmed patients (Wang *et al.,* 2020).

## CONCLUSION

COVID-19 is a widespread pandemic that is affecting a large number of people worldwide. As the months passed, its severity has substantially increased. Due to its alarming rate of spread, scientists and medical professionals are trying new strategies for control and prevention of COVID-19 such as the development of effective drugs, vaccines, and diagnostics kits. Previous studies indicate that SARS-CoV-2 is more fatal than SARS-CoV and MERS-CoV in both scenarios, i.e., in confirmed cases and the number of deaths. Compared to that in China, the rate of SARS-CoV-2 infection is soaring globally. The more deadly the virus is, the faster the diagnosis needs to be. Molecular analysis indicates that bats are a host of SARS-CoV-2 while its intermediate host is still to be discovered. Person-person transmission has been reported as the main mode of transmission of COVID-19. Maintaining personal hygiene and restricting contact with suspected or confirmed COVID-19 patients are some of the leading preventive measures. A wide range of awareness campaigns under the surveillance of government sectors could be the best companion in implementing preventive measures in the general public.

## FUNDING

None.

## ACKNOWLEDGMENTS

We are very thankful to American Journal Experts (AJE) for English language editing under the special offer of free editing of COVID-19 articles. We acknowledge "Pixabay", an open-source of non-copyrighted images, for

providing free of cost and free-to-use images for research purposes.

## CONFLICT OF INTEREST

We have no conflict of interest to declare.

## ETHICAL APPROVAL

No ethical approval was required as this is a review article with no original research data.

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