



# COVID-19: Origin, Transmission, and Characteristics

Dr. Jagriti Singh, Assistant Professor &

Dr. G. K. Bansal, Assistant Professor

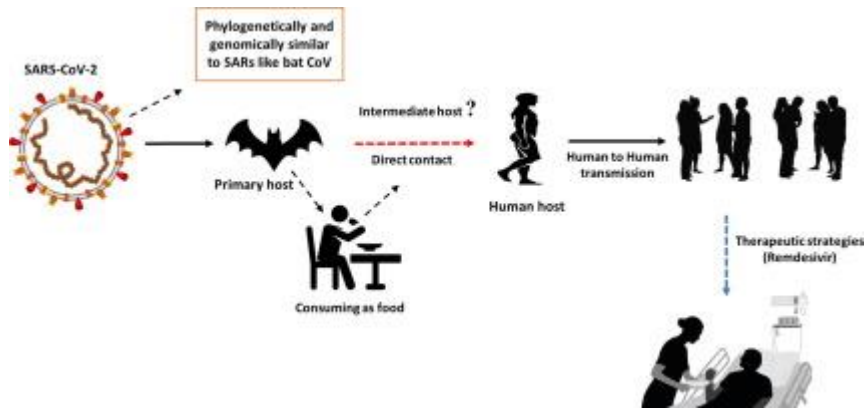
Department of Chemistry

D. P. B. S. (P. G.) College Anupshahr, Bulandshahr (U.P.)

## Abstract:

The coronavirus disease 19 (COVID-19) is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which emerged in Wuhan, China and spread around the world. Genomic analysis revealed that SARS-CoV-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses, therefore bats could be the possible primary reservoir. The intermediate source of origin and transfer to humans is not known, however, the rapid human to human transfer has been confirmed widely. There is no clinically approved antiviral drug or vaccine available to be used against COVID-19. However, few broad-spectrum antiviral drugs have been evaluated against COVID-19 in clinical trials, resulted in clinical recovery. In the current review, we summarize and comparatively analyze the emergence and pathogenicity of COVID-19 infection and previous human coronaviruses severe acute respiratory syndrome coronavirus (SARS-CoV) and middle east respiratory syndrome coronavirus (MERS-CoV). We also discuss the approaches for developing effective vaccines and therapeutic combinations to cope with this viral outbreak.

## Graphical abstract

**Introduction:**

The coronavirus belongs to a family of viruses that may cause various symptoms such as pneumonia, fever, breathing difficulty, and lung infection. These viruses are common in animals worldwide, but very few cases have been known to affect humans. The World Health Organization (WHO) used the term 2019 novel coronavirus to refer to a coronavirus that affected the lower respiratory tract of patients with pneumonia in Wuhan, China on 29 December 2019. The WHO announced that the official name of the 2019 novel coronavirus is coronavirus disease (COVID-19). And the current reference name for the virus is severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was reported that a cluster of patients with pneumonia of unknown cause was linked to a local Huanan South China Seafood Market in Wuhan, Hubei Province, China in December 2019.

In response to the outbreak, the Chinese Center for Disease Control and Prevention (China CDC) dispatched a rapid response team to accompany health authorities of Hubei province and Wuhan city to conduct epidemiological and etiological investigations. The WHO confirmed that the outbreak of the coronavirus epidemic was associated with the Huanan South China Seafood Marketplace, but no specific animal association was identified. Scientists immediately started to research the source of the new coronavirus, and the first genome of COVID-19 was published by the research team led by Prof. Yong-Zhen Zhang, on 10 January 2020. Within 1 month, this virus spread quickly throughout China during the Chinese New Year – a period when there is a high level of human mobility among Chinese people. Although it is still too early to predict susceptible populations, early patterns have shown a trend similar to Severe Acute Respiratory Syndrome (SARS) and Middle East respiratory syndrome (MERS) coronaviruses. Susceptibility seems to be associated with age, biological sex, and other health conditions. COVID-19 has now been declared as a Public Health Emergency of International Concern by the WHO.

## **Origins of the COVID-19 virus:**

On 29 December 2019, the first four cases of an acute respiratory syndrome of unknown etiology were reported in Wuhan City, Hubei Province, China among people linked to a local seafood market (“wet market”). Research is underway to understand more about transmissibility, severity, and other features associated with COVID-19. It appears that most of the early cases had some sort of contact history with the original seafood market. Soon, a secondary source of infection was found to be human-to-human transmission via close contact. There was an increase of infected people with no history of exposure to wildlife or visiting Wuhan, and multiple cases of infection were detected among medical professionals. It became clear that the COVID-19 infection occurs through exposure to the virus, and both the immunosuppressed and normal population appear susceptible. Some studies have reported an age distribution of adult patients between 25 and 89 years old. Most adult patients were between 35 and 55 years old, and there were fewer identified cases among children and infants. A study on early transmission dynamics of the virus reported the median age of patients to be 59 years, ranging from 15 to 89 years, with the majority (59%) being male. It was suggested that the population most at risk may be people with poor immune function such as older people and those with renal and hepatic dysfunction.

## **Global Distribution of COVID-19 Cases:**

Coronaviruses are enveloped single-stranded RNA viruses that are zoonotic in nature and cause symptoms ranging from those similar to the common cold to more severe respiratory, enteric, hepatic, and neurological symptoms. Other than SARS-CoV-2, there are six known coronaviruses in humans: HCoV-229E, HCoV-OC43, SARS-CoV, HCoV-NL63, HCoV-HKU1, and MERS-CoV. Coronavirus has caused two large-scale pandemics in the last two decades: SARS and MERS.

## **Transmission pattern:**

Many domestic and wild animals, including camels, cattle, cats, and bats, may serve as hosts for coronaviruses. It is considered that, generally, animal coronaviruses do not spread among humans. However, there are exceptions, such as SARS and MERS, which are mainly spread through close contact with infected people via respiratory droplets from cough or sneezing. With regard to COVID-19, early patients were reported to have some link to the Huanan Seafood Market in Wuhan, China, suggesting that these early infections were due to animal-to-person transmission. However, later cases were reported among medical staff and others with no history of exposure to that market or visiting Wuhan, which was taken as an indication of human-to-human transmission.

The latest guidelines from Chinese health authorities described three main transmission routes for the COVID-19: 1) droplets transmission, 2) contact transmission, and 3) aerosol transmission. Droplets transmission was reported to occur when respiratory droplets (as produced when an infected person coughs or sneezes) are ingested or inhaled by individuals nearby in close proximity; contact transmission may occur when a subject touches a surface or object contaminated with the virus and subsequently touch their mouth, nose, or eyes; and aerosol transmission may occur when respiratory droplets mix into the air, forming aerosols and may cause infection when inhaled high dose of aerosols into the lungs in a relatively closed environment .

In addition to these three routes, one study also indicated the digestive system as a potential transmission route for COVID-19 infection. Since patients had abdominal discomfort and diarrhea symptoms, researchers analyzed four datasets with single-cell transcriptomes of digestive systems and found that ACE2 was highly expressed in absorptive enterocytes from ileum and colon.

### **Clinical Manifestation and Diagnosis:**

The complete clinical manifestation is not clear yet, as the reported symptoms range from mild to severe, with some cases even resulting in death. The most commonly reported symptoms are fever, cough, myalgia or fatigue, pneumonia, and complicated dyspnea, whereas less common reported symptoms include headache, diarrhea, hemoptysis, runny nose, and phlegm-producing cough.

Patients with mild symptoms were reported to recover after 1 week while severe cases were reported to experience progressive respiratory failure due to alveolar damage from the virus, which may lead to death. Cases resulting in death were primarily middle-aged and elderly patients with pre-existing diseases (tumor surgery, cirrhosis, hypertension, coronary heart disease, diabetes, and Parkinson's disease). Case definition guidelines mention the following symptoms: fever, decrease in lymphocytes and white blood cells, new pulmonary infiltrates on chest radiography, and no improvement in symptoms after 3 days of antibiotics treatment.

For patients with suspected infection, the following procedures have been suggested for diagnosis: performing real-time fluorescence (RT-PCR) to detect the positive nucleic acid of SARS-CoV-2 in sputum, throat swabs, and secretions of the lower respiratory tract samples.

### **Prevention and Control:**

Prevention and control strategies and methods are reported at three levels: national level, case-related population level, and general population level. At the national level, the National Health Commission of the People's Republic of China issued the "No.1 announcement" on 20 January 2020, which officially included the COVID-19 into the management of class B legal infectious diseases, and allowed for class

An infectious disease preventive and control measures to be implemented. Under this policy, medical institutes can adopt isolation treatment and observation protocols to prevent and control the spread of the COVID-19.

On 22 January 2020, the National Health Commission published national guidelines for the prevention and control of COVID-19 for medical institutes to prevent nosocomial infection. On 28 January 2020, the National Health Commission issued protocols for rapid prevention and control measures in order to effectively contain the spread of the epidemic through a "big isolation and big disinfection" policy during the Chinese Spring Festival. National-level strategies have also been issued with targeted measures for rural areas (issued on 28 January 2020) and the elderly population (issued on 31 January 2020).

To date, no specific antiviral treatment has been confirmed to be effective against COVID-19. Regarding patients infected with COVID-19, it has been recommended to apply appropriate symptomatic treatment and supportive care. There are six clinical trials registered in both the International Clinical Trials Registry platform

and the Chinese Clinical Trial Registry to evaluate the efficacy or safety of targeted medicine in the treatment or prognosis of COVID-19.

For the general population, at this moment there is no vaccine preventing COVID-19. The best prevention is to avoid being exposed to the virus. Airborne precautions and other protective measures have been discussed and proposed for prevention. Infection preventive and control (IPC) measures that may reduce the risk of exposure include the following: use of face masks; covering coughs and sneezes with tissues that are then safely disposed of (or, if no tissues are available, use a flexed elbow to cover the cough or sneeze); regular hand washing with soap or disinfection with hand sanitizer containing at least 60% alcohol (if soap and water are not available); avoidance of contact with infected people and maintaining an appropriate distance as much as possible; and refraining from touching eyes, nose, and mouth with unwashed hands.

The WHO also issued detailed guidelines on the use of face masks in the community, during care at home, and in the health care settings of COVID-19.

### **Conclusions:**

The coronavirus, which causes the respiratory illness COVID-19, has spread across the globe with unseen speed and ferocity. The world has been sent into self-isolation in an attempt to curb the spread and major events, including the Tokyo Olympics, have been postponed or canceled. Health authorities and governments are attempting to flatten the curve and mitigate extensive transmission in the community, while scientists and researchers turn their attention to the coronavirus causing the disease: SARS-CoV-2.

A novel coronavirus outbreak was first documented in Wuhan, Hubei Province, China in December 2019. As of this writing, it has now been confirmed on six continents and in more than 100 countries. As the world's health systems funnel resources into learning about, treating, and preventing infections in humans, new information is released daily. In this two-part article series, we will first provide some history on coronaviruses to put this disease outbreak in perspective, and discuss global health security and planning for pandemic response.



**References:**

1. WMHC. Wuhan Municipal Health and Health Commission's Briefing on the Current Pneumonia Epidemic Situation in Our City. 2020. <http://wjw.wuhan.gov.cn/front/web/showDetail/2019123108989>. Accessed 1 Feb 2020.
2. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*. 2020. <https://doi.org/10.1056/NEJMoa2001316>.
3. CDC. 2019 Novel coronavirus, Wuhan, China. 2020. <https://www.cdc.gov/coronavirus/2019-nCoV/summary.html>. Accessed 1 Feb 2020.
4. WHO. Novel Coronavirus–China. 2020. <https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/>. Accessed 1 Feb 2020.
5. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*. 2020. <https://doi.org/10.1056/NEJMoa2001017>.
6. WHO. Novel Coronavirus–Japan (ex-China). 2020. <https://www.who.int/csr/don/17-january-2020-novel-coronavirus-japan-ex-china/en/>. Accessed 1 Feb 2020.
7. Virological.org. Novel 2019 Coronavirus Genome 2020. <http://virological.org/t/novel-2019-coronavirus-genome/319>. Accessed 1 Feb 2020.
8. Fehr AR, Channappanavar R, Perlman S. Middle East respiratory syndrome: emergence of a pathogenic human coronavirus. *Annu Rev Med*. 2017;68:387–99.
9. WHO. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). 2020. [https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)). Accessed 1 Feb 2020.
10. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8:19–32.
11. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6 (e100097). <https://doi.org/10.1371/journal.pmed.1000097>.
12. Zhou P, Yang XL, Wang, XG, Hu B, Zhang L, Zhang W, et al. Discovery of a novel coronavirus associated with the recent pneumonia outbreak in humans and its potential bat origin. *bioRxiv*. 2020; doi: <https://doi.org/10.1101/2020.01.22.914952>.
13. Li T, Wei C, Li W, Hongwei F, Shi J. Beijing Union Medical College Hospital on "pneumonia of novel coronavirus infection" diagnosis and treatment proposal (V2.0). *Med J Peking Union Med Coll Hosp*. 2020. <http://kns.cnki.net/kcms/detail/11.5882.r.20200130.1430.002.html>. Accessed 2 Feb 2020.

14. Medical expert group of Tongji hospital. Quick guide to the diagnosis and treatment of pneumonia for novel coronavirus infections (third edition). Herald Med. 2020. <http://kns.cnki.net/kcms/detail/42.1293.r.20200130.1803.002.html>. Accessed 2 Feb 2020.
15. Liu T, Hu J, Kang M, Lin L, Zhong H, Xiao J, et al. Transmission dynamics of 2019 novel coronavirus (2019-nCoV). 2020; doi: <https://doi.org/10.1101/2020.01.25.919787>.
16. Huang C, Wang Y, Li X, Ren L, Zhao Jianping, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395:497–506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5).
17. Gralinski LE, Menachery VD. Return of the coronavirus: 2019-nCoV. Viruses. 2020;12:135.
18. Wang C, Wang X. Prevalence, nosocomial infection and psychological prevention of novel coronavirus infection. Chin General Pract Nurs. 2020;18:2–3.
19. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet. 2020;395:507–13.
20. Backer JA, Klinkenberg D, Wallinga J. The incubation period of 2019-nCoV infections among travellers from Wuhan. China Euro Surveill. 2020; <https://doi.org/10.2807/1560-7917.ES.2020.25.5.2000062>.
21. Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. J Med Virol. 2020;92:441–7.
22. Imai N, Dorigatti I, Cori A, Riley S, Ferguson, NM. Estimating the potential total number of novel Coronavirus cases in Wuhan City, China. 2020. <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/2019-nCoV-outbreak-report-17-01-2020.pdf>. Accessed 31 Jan, 2020.
23. National Health Commission of People's Republic of China. Prevent guideline of 2019-nCoV. 2020. <http://www.nhc.gov.cn/xcs/yqfkdt/202001/bc661e49b5bc487dba182f5c49ac445b.shtml>. Accessed 1 Feb 2020.
24. Shen M, Peng Z, Xiao Y, Zhang L. Modelling the epidemic trend of the 2019 novel coronavirus outbreak in China. bioRxiv. 2020; <https://doi.org/10.1101/2020.01.23.916726>.
25. Imai N, Cori A, Dorigatti I, Baguelin M, Donnelly CA, Riley S, et al. Report 3: Transmissibility of 2019-nCoV. 2020. <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-2019-nCoV-transmissibility.pdf>. Accessed 31 Jan, 2020.
26. Read JM, Bridgen JRE, Cummings DAT, Ho A, Jewell CP. Novel coronavirus 2019-nCoV: early estimation of epidemiological parameters and epidemic predictions. medRxiv. 2020; doi: <https://doi.org/10.1101/2020.01.23.20018549>.

27. Riou J, Althaus CL. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. Euro Surveill. 2020;25(4). <https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000058>.
28. Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. Lancet. 2020; [https://doi.org/10.1016/S0140-6736\(20\)30260-9](https://doi.org/10.1016/S0140-6736(20)30260-9).

