International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
SJIF (2024): 6.623

The Novel Corona Virus (COVID-19): A Global Crises and a Curse for Mankind

Dr. Moushumi Biswas

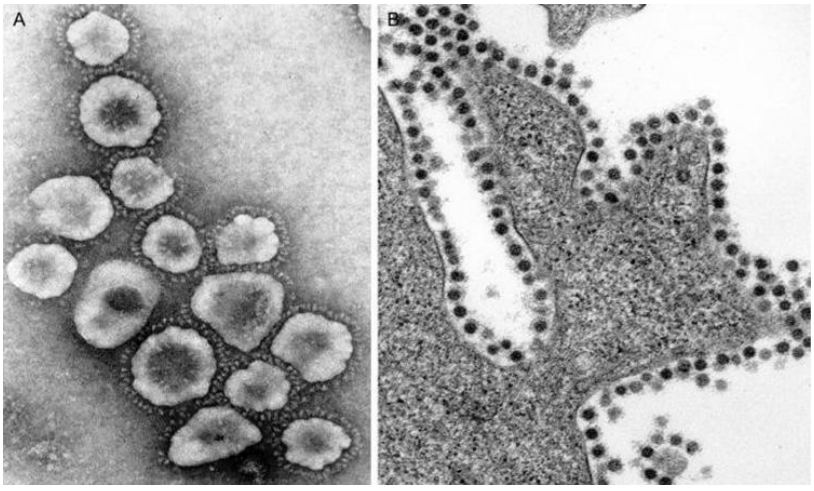
MD, Assistant Professor, Department of Community Medicine, Silchar Medical College, Silchar Cachar Assam Pin 780014, India
Email: *moushumidr [at]gmail.com*

Abstract: ***Background: The coronavirus family comprises a group of viruses that affect both animals and humans, with varying levels of severity. The emergence of the novel coronavirus, SARS-CoV-2, in December 2019 marked a global health crisis due to its rapid spread, high infectivity, and varied clinical manifestations. Objective: This article aims to present a comprehensive overview of the SARS-CoV-2 virus, including its origin, virological features, epidemiological patterns, modes of transmission, pathogenesis, clinical features, and the body's immune response. Methods: A review of scientific literature, official health agency data (e. g., WHO, CDC), and observational studies was undertaken to understand the characteristics and behavior of the virus from its discovery to its global dissemination. Results: SARS-CoV-2 was first identified in Wuhan, China, and rapidly led to a pandemic. It spreads mainly via respiratory droplets, with confirmed asymptomatic transmission. Elderly populations and individuals with comorbidities are at higher risk of severe outcomes. The virus primarily targets epithelial cells in the respiratory tract via ACE2 receptors. Immunity following infection is variable, and herd immunity is dependent on significant population exposure or vaccination. Viral shedding can persist for weeks, even after symptom resolution. Conclusion: Understanding the structure, transmission, and clinical spectrum of SARS-CoV-2 is crucial for effective public health interventions and pandemic preparedness. Continued research is essential to monitor viral mutations, vaccine efficacy, and the long-term effects of COVID-19.***

Keywords: COVID-19, SARS-CoV-2, Coronavirus, Epidemiology, Transmission, Pathogenesis, Clinical Features, Viral Shedding, Immunity, Pandemic

1. Introduction

The term coronavirus is a new unique family of the group of viruses which causes a spectral of human and animal disease. Coronavirus disease was first described in 1931. The causative Agent was identified from throat swab samples conducted by the Chinese Centre for Disease Control and Prevention (CCDC) on 7th January 2020, and was subsequently named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The disease was named COVID-19 by the World Health Organization (WHO) on 11 February 2020. The first coronavirus (HCoV-229E) isolated from humans in 1965**. (1)** They possess a distinct morphology and member of the group Corona viridae Coronaviruses consist of two genera, coronaviruses and toroviruses Coronaviruses are well-established pathogens of humans and animals. (**2)** The term derived from outer fringe or"corona" of embedded envelope protein **(3**). Coronaviruses are found in avian and mammalian species. They resemble each other in morphology and chemical structure: for example, the coronaviruses of humans and cattle are antigenically related). The virus when observed under electro-microscope had a diameter of 60 - 140 nm with characteristic spikes of 9- 12 nm similar to the Coronoviridae family (**4)** Coronaviruses (and toroviruses) are classified together on the basis of the crown or halo-like appearance of the envelope glycoproteins, and on characteristic features of chemistry and replication (**3)** This virus is new one causes mild symptoms of common cold and almost similar to SARS-COV and similar causing mild upper respiratory tract infections. In 2003 with the dramatic change in zoonotic SARS-CoV and the more recent emergence of MERS-CoV has confirmed the coronaviruses as significant causes of severe respiratory disease. (**5)** SARS-CoV acquired efficient human transmission from bats and civetcats leading to a global outbreak of a novel disease**. (6)**



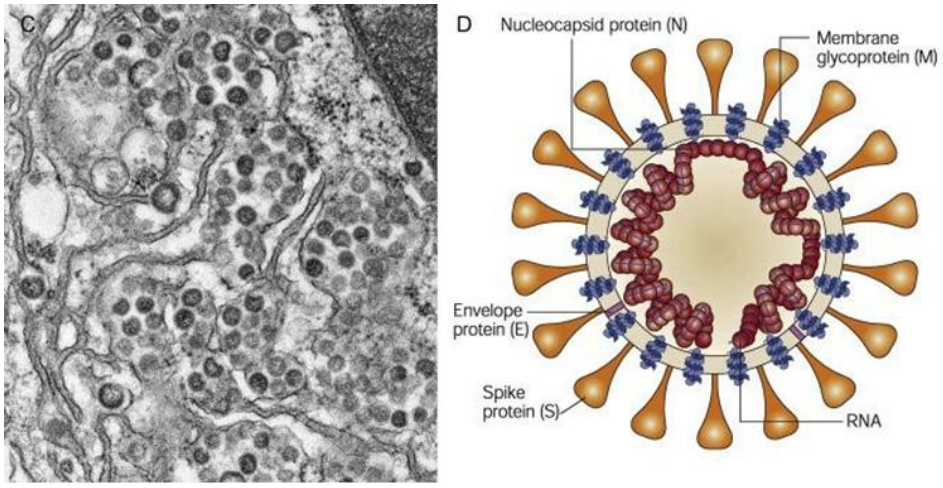


Figure 31.2: Coronavirus morphology and structure. (A) Negative contrast electron microscopy of SARS coronavirus (SARS-CoV), showing the large petal-shaped surface projections (spikes, peplomers). (B) Thin-section electron microscopy of SARS-CoV in cell culture, showing typical adherence of virions to the plasma membrane of a cell—virions adhere to infected and uninfected cells. (C) Thin-section electron microscopy of Middle Eastern respiratory syndrome virus (MERS-CoV) in clinical cases of SARS led to intensive epidemiological outbreak investigations

Epidemiology
The high mortality and rapid intercontinental spread of the virus clinical cases of SARS led to intensive epidemiological outbreak investigations

Disease Outbreak
The first outbreak was observed in 30th December 2019 in Hubei, province of China were a cluster of people were admitted in hospital with symptoms similar to Pneumonia such Fever, cough and difficulty in breathing and reported to the World Health Organization (WHO).7 The cases were mainly related to the trade of seafood wholesale market in Wuhan city, Hubei Province in China (**7, 8**). A week later, January 7, 2020, a new coronavirus (SARS-CoV-2) was isolated from these patients. 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 (**9**) This virus was initially referred to as novel coronavirus 2019 (2019-nCoV) but was given the official name of COVID-19 by the WHO on February 11, 2020 (**10).** This new virus has infected more people than earlier SARS OR MERS outbreak. The key reservoirs and mode of transmission of coronaviruses (suspected reservoirs of SARS-CoV-2 are red encircled); only a and b coronaviruses have the ability to infect humans, the consumption of infected animal as a source of food is the major cause of animal to human transmission of the virus and due to close contact with an infected person, the virus is further transmitted to healthy persons.1**1**

Age
All ages are susceptible though it is seen that people most at risk are those may be with poor immune function and older age group. (12) Data from the China and the United States indicate that the percentage of people who are hospitalization rated, ICU admissions and death is more in older adults. (13) People with comorbidity with conditions such as diabetes hypertension, and people with hepatic and renal dysfunction are most affected.

Multiplication
The virus enters the host cell, and the uncoated genome is transcribed and translated. The mRNAs form a unique "nested set" sharing a common 3′ end. New virions are form by budding from host cell membranes.

Immunity
Immunity against the surface projection antigen is the most important for protection. As it is a novel virus the entire population is susceptible to the virus. Resistance to infection may last several years, but reinfection with similar strain are common. Most patients (>95%) with SARS infection develop an antibody response to viral antigen detectable by a fluorescent antibody or enzyme lined Immunosorbent essay.1**5**

The population will continue to remain at risk until and unless there is the development of *herd immunity* either through vaccination or infection. *Herd immunity* is an indirect form of immunity that develops when a large percentage of the population develops immunity to the infection either through infection or vaccination thereby limiting the spread of the virus. R0 determines the percentage of the population that needs to be immune to achieve *herd immunity*. Using an estimated R0 of 3 the estimated proportion of the world's population that needs to develop immunity to SAR-CoV2 to develop herd immunity is approximately 70percent (16)

Waves of infection pass through communities and often cause small outbreaks in families, schools. Immunity does not persist, and subjects may be re-infected, sometimes within a year. The pattern thus differs from that of rhinovirus infections, which peak in the fall and spring and generally elicit long-lasting immunity. About one in five colds is due to coronaviruses. Dromedary camels have been implicated as the primary source of infection for humans, with a high percentage possessing viral antibodies. The virus is usually transmitted via inhalation of contaminated droplets, but it may also be transmitted by the hands to the mucosa of the nose or eyes**.17**

Pathogenesis

Coronaviruses tend to be highly species specific. Most of the Known animal coronaviruses display a tropism for epithelial respiratory or gastrointestinal tract. SARS coronavirus also infects epithelial cells lining salivary gland duct. Corona virus infections in humans usually but not always remains limited to the upper respiratory tract.15, 18; The life cycle of SARS-CoV-2 in host cells; begins its life cycle when S protein binds to the cellular receptor ACE2. After receptor binding, the conformation change in the S protein facilitates viral envelope fusion with the cell membrane through the endosomal pathway. Then SARS-CoV-2 releases RNA into the host cell. Genome RNA is translated into viral replicase polyproteins pp1a and 1ab, which are then cleaved into small products by viral proteinases. The polymerase produces a series of subgenomic mRNAs by discontinuous transcription and finally translated into relevant viral proteins. Viral proteins and genome RNA are subsequently assembled into virions in the ER and Golgi and then transported via vesicles and released out of the cell. ACE2, angiotensin-converting enzyme 2; ER, endoplasmic reticulum; ERGIC, ER-Golgi intermediate compartment.18

Clinical Features

Coronaviruses often result in symptoms similar to common cold (accounting for 10-35%) of the cases. (19) **T**he symptoms are similar to those produced by rhinovirus typified by nasal discharge malaise. The incubation period is 2-5 days and it last for about a week.

The spectrum of COVID 19 disease ranges from asymptomatic to critical. The patient present with fever, malaise, chill, headache, dizziness dry cough, and sore throat and followed by shortness of breath and, in the most severe cases, have symptom similar to pneumonia with headache diarrhoea and dyspnoea.1**5 18**. The case fatality rate is around 2percent. Human to Human transmission occur among closed contacts and among relatives of same household. Direct contact with intermediate host animals or consumption of wild animals was suspected to be the main route of SARS-CoV-2 transmission.

The symptoms of COVID-19 infection appear after an incubation period of approximately 6-7 days [**21**]. The time from the onset ofCOVID-19 symptoms to death ranged from 6 to 41 days with a median of 14 days. This period is dependent on the age and immune status of the person. The chance of infection of the virus is more in patient's 70-years old compared with those under the age of 70 [**22]**

Transmissibility of SARS-CoV2:

The basic reproduction number (R0) is the expected number of secondary cases that could arise from one case in a susceptible population. R0 is the essence of infectious disease epidemiology and indicates the risk of an epidemic spread.

Most studies have estimated the R0 for SARS-CoV2 to be within the range of 2.0 to 3.0. The other parameter which determines infectivity is the secondary attack rate. It is defined as the probability of an infection occurring in a specific group of susceptible people exposed to a primary case (e. g. household contacts or close contacts). The secondary attack rate provides an insight into how social behaviors affects transmissibility. The secondary attack rates among house-hold contacts was similar in South Korea and the United States (7.5% and 10.5% respectively).

Period of Infectivity

The duration during which a patient with COVID-19 remains infective is unclear. Viral load in the oropharyngeal secretions is highest during the early symptomatic stage of the disease. (25, 26) The patient can continue to shed the virus even after symptom resolution. (26) In a study, the median duration of virus shedding was 20 days (IQR 17.0-24.0) amongst the survivors. (27) A study of viral dynamics in mild and severe cases revealed that mild cases tend to clear the viruses early while severe cases can have prolonged viral shedding. (28) Data from studies using twin respiratory and fecal sampling have shown viral shedding can persist in stools for more than 4 weeks even when respiratory samples are negative.

(29) Xu et al identified male sex, delayed hospitalization after illness and invasive mechanical ventilation as risk factors for prolonged viral shedding. (30) Transmission during the asymptomatic phase has also been reported. In a study from Singapore, 6.4% of the 157 locally acquired cases of COVID-19 were attributed to transmission during the asymptomatic phase of the disease. (31) Viral load is more in the nasal cavity than the throat. Transmission may also occur through fomites in the immediate environment around the infected person

Mode of Transmission

Many domestic and wild animals, including camels, cattle, cats, and bats, may serve as hosts for coronaviruses [9]. During the early outbreak of covid 19 it was thought that animal to man transmission might be a cause of patient acquiring the virus as there was exposure of people to the Huanan Seafood Market in Wuhan, China, However when the disease started to spread among the medical professionals who had no link with the seafood market in Hubei it was understood that virus was transmitted among close contacts and spread by human to human transmission **(10)** Asymptomatic person may shed the virus during sneezing or coughing **(10). The** virus may persist for hours to days on surface of objects or on clothing. **(11)** The mode of transmission of the virus is through respiratory droplets and droplet nuclei either directly or indirectly through fomites The virus is usually transmitted via inhalation of contaminated droplets, but it may also be transmitted by the hands to the mucosa of the nose or eyes. (12) Man to man (direct) transmission occurs through close contact (direct) by coughing or sneezing through infected person and indirect transmission through contact with surface in the closed environment **(11)** At present, there is no evidence for air-borne transmission of the virus. (13,] Though virus particles have been detected in stool samples of both symptomatic and convalescing patients, the risk of faeco-oral transmission is unclear. (14, 15)

References

[1] Human coronaviruses Stephen N.J. Korsman MMed FCPath, Wolfgang Preiser MRCPath, in Virology,

2012History
[2] World Health Organization, WHO Director-General's Remarks at the Media Briefinon 2019-nCoV on 11 February 2020, (2020) https://www.who.int/dg/speeches/detail/who-director-general-s- remarks-at-the-media-briefing-on-2019-ncov-on-11
[3] Larry J. Anderson, Eileen Schneider, in Goldman's Cecil Medicine (Twenty Fourth Edition), 2012.The Pathogens.
[4] **Epidemiology** Tyrrell DAJ, Cohen S, Schlarb JE. Signs and symptoms in common colds. Epidemiol Infect. 1993; 111:143–156. 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 Feb 20;382(8):727–33.
[5] Christopher J. Burrell, ... Frederick A. Murphy Fenner AND White MEDICAL VIROLOGY (FIFTH EDITION)2017, PAGES 437-446 Coronaviruses.
[6] MEDICAL MICROBIOBIOLOGY Coronavirus chapter 57 18 TH EDITION , PAGES 587-593.
[7] Xinhua. China's CDC detects a large number of new coronaviruses in the South China seafood market in Wuhan. Available at: https://www.xinhuanet.com/2020-01/27/c_1125504355.htm. Accessed feb2020. 8 Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet Lond Engl. 2020, 28;395(10229):1054–62.
[8] H. Lu, C.W. Stratton, Y.W. Tang, Outbreak of pneumonia of unknown etiology inwuhan China: the mystery and the miracle, J. Med. Virol. 92 (4) (2020) 401–402,https://doi.org/10.1002/jmv.25678.[3
[9] Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395: 497–506.
[10] World Health Organization, WHO Director-General's Remarks at the Media Briefinon 2019-nCoV on 11 February 2020, (2020) https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11 february-2020.] on 2019-nCoV on 11 February 2020, (2020 11Rothe C, Schunk M, Sothmann P, et al. Transmission of 2019- nCoV infection from an asymptomatic contact in Germany. N Engl J Med. 2020. https://doi.org/10.1056/NEJMc2001468.
[11] Q, Guan X,Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med. 2020. https://doi.org/10.1056/NEJMoa200131688
[12] Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet Lond Engl. 2020, 28;395(10229):1054
[13] Cheng ZJ, Shan J. 2019 novel coronavirus: where we are and what we know. Infection. 2020:1–9. https://doi.org/10.1007/s15010-020- 01401-y.
[14] Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med. 2020. https://doi.org/10.1056/NEJMc2001737.
[15] Medical microbiology section virology chapter Coronavirus chapter 60 editor Byron LANGE Medical Microbiology. Mac Graw Hill 26th edition.Jawetz,Melnick and Adelberg
[16] World Health Organization, WHO Director-General's Remarks at the Media Briefing on 2019-nCoV on 11 February 2020, (2020) https://www.who.int/dg/speeches/ detail/who-director-general-s-remarks-at-th lange medical microbiology
[17] Textboo of Harrison's Manual of Medicine 19th edition Mac Graw hil pvt ltd,kasper Longo ,Hauser, Fauci, jameson,Loscalo
[18] Coronavirus Disease-19: Summary of 2,370 Contact Investigations of the First 30 Cases in the Republic of Korea. Osong Public Health Res Perspect. 2020 Apr;11(2):81–4.
[19] Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. Ann Intern Med. 2020 Mar 10;
[20] Zhang J, Litvinova M, Wang W, Wang Y, Deng X, Chen X, et al. Evolving epidemiology and transmission dynamics of coronavirus disease 2019 outside Hubei province, China: a descriptive and modelling study. Lancet Infect Dis. 2020 Apr 2;
[21] Coronavirus Disease-19: Summary of 2,370 Contact Investigations of the First 30 Cases in the Republic of Korea. Osong Public Health Res Perspect. 2020 Apr;11(2):81–4.
[22] Burke RM. Active Monitoring of Persons Exposed to Patients with Confirmed COVID-19 — United States, January–February 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 [cited 2020 Apr 17];69
[23] To KK-W, Tsang OT-Y, Leung W-S, Tam AR, Wu T-C, Lung DC, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. Lancet Infect Dis. 2020 Mar 23.
[24] Wölfel R, Corman VM, Guggemos W, Seilmaier M, Zange S, Müller MA, et al. Virological assessment of hospitalized patients with COVID- 2019. Nature. 2020 Apr 1;
[25] Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet Lond Engl. 2020 28;395(10229):1054–62.
[26] Liu Y, Yan L-M, Wan L, Xiang T-X, Le A, Liu J-M, et al. Viral dynamics in mild and severe cases of COVID-19. Lancet Infect Dis [Internet]. 2020 Mar 19 [cited 2020 Apr 17]; Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7158902/
[27] Wu Y, Guo C, Tang L, Hong Z, Zhou J, Dong X, et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples. Lancet Gastroenterol Hepatol. 2020 May;5(5):434–5.
[28] Xu K, Chen Y, Yuan J, Yi P, Ding C, Wu W, et al. Factors associated with prolonged viral RNA

shedding in patients with COVID-19. Clin Infect Dis Off Publ Infect Dis Soc Am. 2020 Apr 9;

[29] Wei WE. Presymptomatic Transmission of SARS-CoV-2 — Singapore, January 23–March 16, 2020. MMWR Morb Mortal Wkly Rep [Internet]. 2020 [cited 2020 Apr 17];69. Available from: https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm

[30] Infect Dis. 2020 Apr 2; . Park M, Cook AR, Lim JT, Sun Y, Dickens BL. A Systematic Review of COVID-19 Epidemiology Based on Current Evidence. J Clin Med. 2020 Mar 31;9(4).