"SARs-CoV-2 and COVID-19: A Holistic Review of its Etiology, Transmission Clinical Management"

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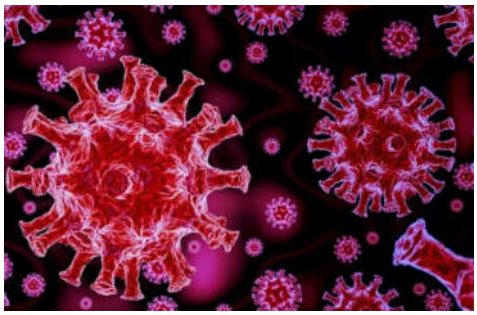
Abstract:

The coronavirus disease 2019 (COVID-19), which is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first appeared in late 2019 and quickly developed into a worldwide pandemic. This review offers a detailed examination of the virus, covering its origins and classification. COVID-19 is mainly spread through respiratory droplets, close contact, and, in some cases, aerosols. This paper delineates the causative agent and the categorization of coronaviruses within the Coronaviridae family. Common symptoms include fever, cough, fatigue, dyspnea, and a loss of taste or smell, while diagnostic methods include RT-PCR and antigen testing. Additionally, the review addresses the current treatment options, which consist of supportive care, antiviral medications, and monoclonal antibodies. This review seeks to enhance the understanding of COVID-19 and aid ongoing global initiatives to manage the pandemic.

Key Words : COVID-19 , SARS-CoV-2, Transmission , Prevention , Diagnosis.

Introduction :

The human body is susceptible to a range of infectious microorganisms, including viruses, bacteria, fungi, protozoa, and helminths, which inflict tissue damage through various mechanisms. (1) On December 31, 2019, the China Health Authority informed the World Health Organization (WHO) about several cases of pneumonia with an unknown etiology in Wuhan city, located in Hubei province in central China. (2) Coronavirus Disease 2019



(COVID-19) is a highly contagious viral infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). (3)

a)

The World Health Organization (WHO) subsequently renamed the illness caused by SARS-CoV-2 as Coronavirus Disease - 2019 (COVID-19). (4) This prompted the World Health Organization (WHO) to declare it a global pandemic on March 11, 2020. (3)

What are Coronaviruses?

Coronaviruses constitute a large family of various viruses; some of these are responsible for causing the common cold in humans, while others infect animals such as bats, camels, and cattle(5)

COVID-19 Origins and classification:

SARS-COV-2 belongs to the family Corona Viridae and the order Nidovirales. This family is divided into two subfamilies: Coronavirinae and Torovirinde, with members of the Coronavirinae subfamily. (6)

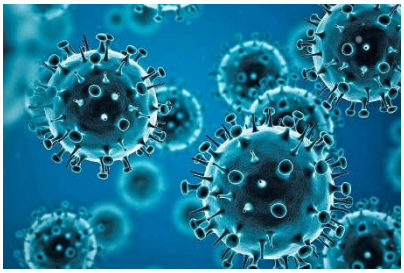
• Alpha (CB11.7): the initial variant of concern, identified in the United Kingdom (UK) in late December 2020 (7)

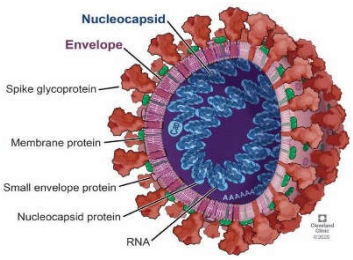
• Beta (B-1-351): first identified in South Africa in December 2020 (7)

• Gamma (P.2) was initially reported in Brazil in early January 2021 (7)

• Delta (B11.617.2) was first identified in India in December 2020 (7)

• Omicron (8.1.1529) was first reported in South Africa in November 2021 (8)





b) c)

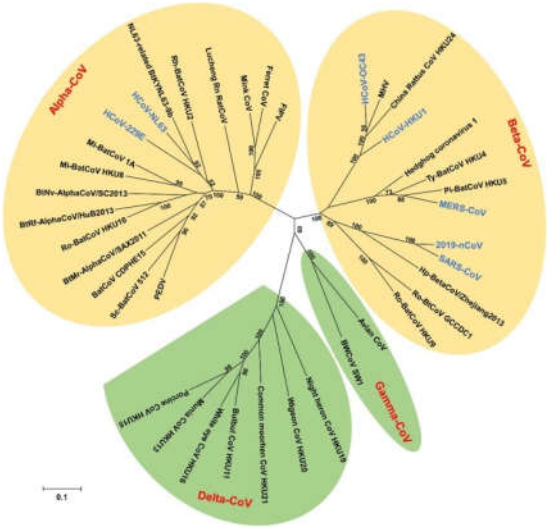
Etiology :

Coronaviruses (CoVs) are positive-sense single-stranded RNA (+ssRNA) viruses that exhibit a crown-like appearance when viewed under an electron microscope (the term coronam is

derived from Latin, meaning crown) as a result of the spike glycoproteins present on their envelope (3)

Transmission:

The three primary modes of SARS-CoV-2 transmission include direct contact or indirect contact (via fomites), small airborne droplets (aerosols), and large droplets. (9) Fomite transmission resulting from the contamination of inanimate surfaces with SARS-CoV-2 has been extensively documented through numerous studies that detail the virus's viability on various porous and nonporous surfaces. Under controlled experimental conditions, SARS-CoV-2 demonstrated stability on stainless steel and plastic surfaces when compared to copper



and cardboard surfaces, with the viable virus being detectable for up to 72 hours following the inoculation of these surfaces with the virus (10).

d)

The first mode of transmission occurs through direct or indirect contact. SARS-CoV-2 impacts both the upper and lower respiratory tracts (9). The second mode of transmission involves aerosols, which are suspensions of small particles in the air that carry the pathogen. These aerosols can traverse the air and penetrate the mucous membranes of the eyes, ears, and mouth, leading to infection (11). The third mode of transmission is through large droplets. Large droplets containing SARS-CoV-2 virions can be expelled when a COVID-19 patient coughs or sneezes (12). Fomites may represent a significant source of transmission, as SARS-CoV has been shown to survive on surfaces for up to 96 hours (13), while other coronaviruses can persist for as long as 9 days (14).

Epidemiology:

Coronavirus disease 2019 (COVID-19) is the result of an infection caused by a novel coronavirus known as SARS-CoV-2, which is classified as a positive-sense single-stranded RNA virus (15). The coronavirus family is divided into four genera: Alpha, Beta, Gamma,

and Delta. (16) The Alpha and Beta variants are believed to have originated from bats, whereas the Gamma and Delta variants are derived from birds (17).

The epidemiology of COVID-19 outlines the mechanisms of disease transmission, the populations it impacts, and its global patterns. Below is a brief summary:

1. Causative Agent: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), a novel coronavirus identified in late 2019.

2. Source of Infection: Initially associated with a seafood market in Wuhan, China. The virus spreads from person to person through respiratory droplets, aerosols, and contaminated surfaces.

3. Mode of Transmission: Direct transmission occurs via droplets from coughing, sneezing, or talking. Indirect transmission happens through contact with contaminated surfaces (fomites). Airborne transmission can occur in poorly ventilated indoor spaces (aerosol transmission).

4. Incubation Period: Generally ranges from 2 to 14 days, with a median duration of 4 to 5 days.

5. Period of Communicability: The virus can be transmitted from 1 to 2 days prior to the onset of symptoms until the symptoms resolve; this period may vary depending on the severity of the disease.

6. Risk Factors: Increased risk is associated with older age (≥60 years), pre-existing health conditions (such as diabetes, heart disease, and obesity), as well as being a healthcare worker, having close contact with infected individuals, and being in crowded environments.

7. Global Spread & Pandemic Status: The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020. The virus has impacted every continent except Antarctica, leading to multiple waves and variants (Alpha, Delta, Omicron) that have altered transmission dynamics.

8. Clinical Presentation: Symptoms can range from asymptomatic to severe respiratory illness. Common symptoms include fever, cough, fatigue, loss of taste or smell, and shortness of breath. Severe cases may progress to pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure.

9. Prevention & Control: Strategies include vaccination (mRNA, viral vector, and inactivated vaccines), mask-wearing, hand hygiene, social distancing, and ensuring proper ventilation. Quarantine, isolation, and contact tracing are also essential measures.

10. Variants of Concern (VOC): The WHO has been monitoring variants such as Alpha, Beta, Delta and Omicron, exhibiting varying levels of transmissibility, virulence, and potential for immune evasion.(18)(19)(20)(21)(22)(23)(24)

Symptoms/ Clinical Manifestation:

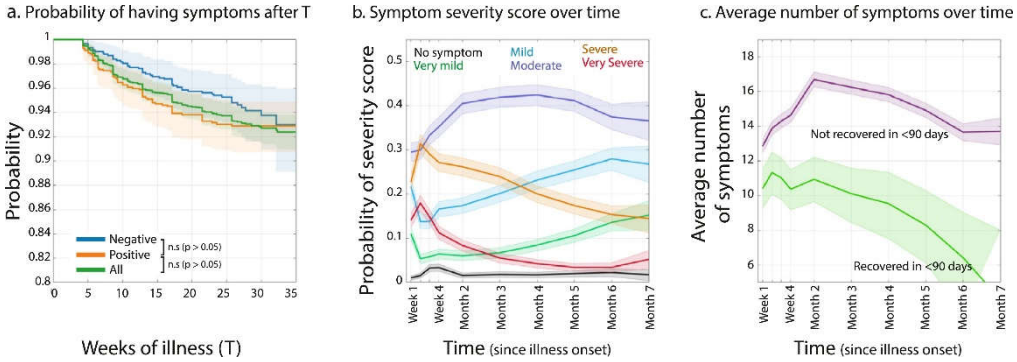
A diverse array of symptoms is observed in patients with COVID-19, which can vary from mild to moderate, severe, rapidly progressive, and fulminant forms of the disease. The symptoms associated with COVID-19 are non-specific, and the presentation of the disease can range from asymptomatic cases to severe pneumonia. (25) The clinical manifestations of 2019-nCoV infection exhibit similarities to those of SARS-CoV. (26) (27) (28) According to a report from the WHO-China-Joint Mission on COVID-19, among 55,924 laboratory-confirmed cases of COVID-19, the following symptoms were noted: fever (87.9%), dry cough (67.7%), fatigue (38.1%), sputum production (33.4%), difficulty breathing (18.6%), sore throat (13.9%), chills (11.4%), nasal congestion (4.8%), and hemoptysis (0.9%). (29) Additionally, COVID-19 can lead to cardiovascular complications by inducing thrombosis in both arteries and veins. The underlying mechanism of thrombosis in this disease involves inflammation, platelet activation, vascular dysfunction, and vasoconstriction. (30)

The most prevalent symptoms of COVID-19 include:

• Fever. • Dry cough. • Fatigue.

Other symptoms that are less frequently observed and may affect certain patients consist of: • Loss of taste or smell. • Nasal congestion. • Conjunctivitis (commonly referred to as red eyes). • Sore throat. • Headache. • Muscle or joint pain. • Various types of skin rashes. • Nausea or vomiting. • Diarrhea. • Chills or dizziness. Symptoms indicative of severe COVID-19 disease encompass: • Shortness of breath. • Loss of appetite. • Confusion. • Persistent pain or pressure in the chest. • Elevated temperature (above 38 °C).

Other less common symptoms may include: • Irritability. • Confusion. • Decreased consciousness (occasionally linked to seizures). • Anxiety. • Depression. • Sleep disturbances. • More severe and rare neurological issues. (1)

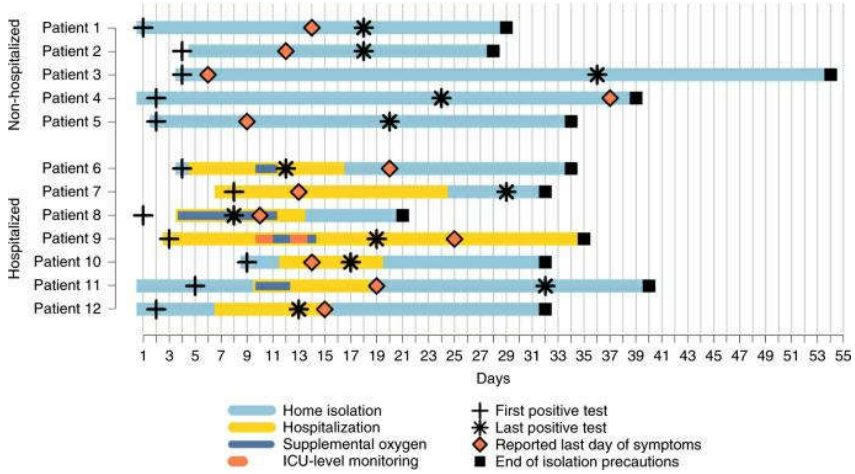


e)

Diagnosis:

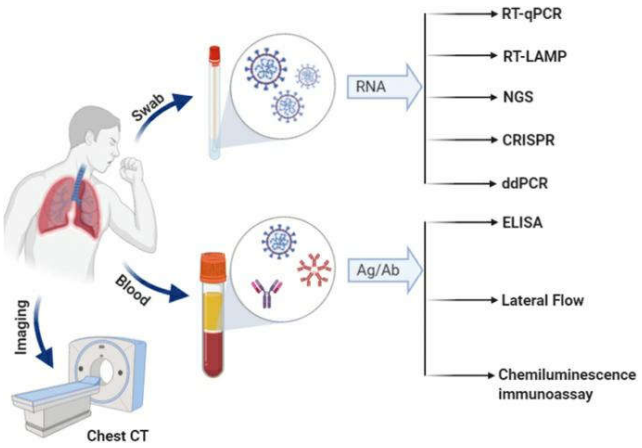
Efforts to manage the spread of COVID-19, implement quarantine and isolation protocols, and effectively treat patients necessitate the availability of reliable screening and diagnostic instruments.(31) The nasopharyngeal swab for SARS-CoV-2 nucleic acid utilizing a real-time PCR assay is recognized as the standard diagnostic procedure. The sensitivity of PCR testing

is influenced by various factors, such as the adequacy of the specimen, the duration since exposure, and the source of the specimen.(32) The detection of viral nucleic acids through real-time RT-PCR is a conventional technique for identifying coronavirus infections; however, this method, while exhibiting high specificity, also demonstrates low sensitivity, leading to potential false negatives and requiring considerable time for results.(33)



f)

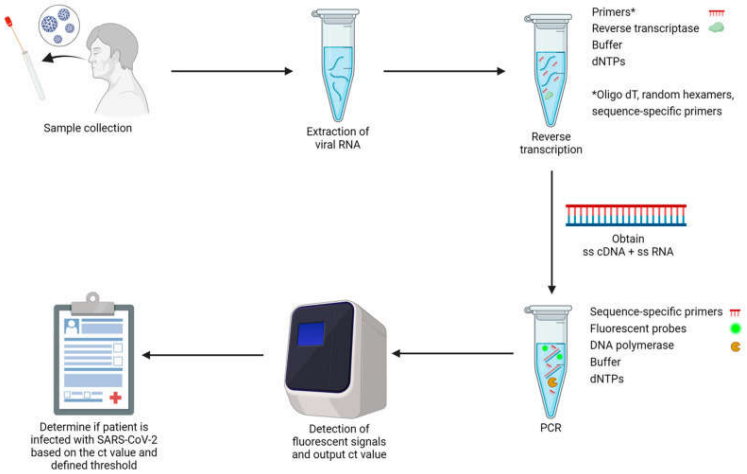
For patients who fulfill the diagnostic criteria for SARS-CoV-2 testing, the CDC advises the collection of specimens from the upper respiratory tract (nasopharyngeal and oropharyngeal swabs) and, if feasible, from the lower respiratory tract (sputum, tracheal aspirate, or bronchoalveolar lavage) (34). To mitigate further disease transmission by asymptomatic carriers and suspected COVID-19 patients, dependable diagnostic methods are essential for the prompt identification of patients and improved infection control (35)(36). The antigen test is frequently utilized as a point-of-care test, being more cost-effective and providing quicker results within minutes. Nevertheless, there is an increased likelihood of false-negative results when compared to molecular testing. Molecular testing, while yielding more precise results, tends to be more time-consuming (37).



The diagnostic tests are illustrated in the figure provided below.

g)

1) Nucleic Acid Amplification Test (NAAT) RT-qPCR: RT-qPCR is the most prominent method employed for the detection of SARS-CoV-2 within the NAATs category(11). The time required to generate results from RT-qPCR may differ based on various primer and fluorescence probe designs. (38)



h)

Treatment:

As stated by the National Institutes of Health (NIH), the two primary processes that contribute to the pathogenesis of COVID-19 are the replication of the virus during the initial phase of the illness and the dysregulated immune/inflammatory response to SARS-CoV-2, which results in systemic tissue damage in the later stages of the disease (39).

For Mild to Moderate Cases (No Hospitalization Required):

Supportive Care: Rest, hydration, and nutrition. Antipyretics such as paracetamol for managing fever and pain. Cough suppressants may be utilized if necessary. Antiviral Medications: Nirmatrelvir/ritonavir (Paxlovid): Administered within five days of symptom onset; it decreases the risk of severe illness in individuals at high risk. Molnupiravir: An alternative option when Paxlovid is not appropriate. Monitoring: Home monitoring of oxygen saturation (SpO2) using a pulse oximeter.

For Moderate to Severe Cases (Potential Hospitalization Required):

Oxygen Therapy: Supplemental oxygen for patients exhibiting low SpO2 levels (<94%). Steroids such as Dexamethasone (or other corticosteroids): Indicated for patients requiring oxygen, as they have been shown to reduce mortality rates. Anticoagulants: To mitigate the risk of blood clots, which are prevalent in every cases of COVID-19. Antiviral and Immunomodulatory Drugs: Remdesivir: An intravenous antiviral treatment for hospitalized patients. Tocilizumab: An IL-6 inhibitor utilized in cases of severe inflammation.

Preventive Measures (Post-Exposure or High Risk):

Vaccination and Boosters: Continue to provide robust protection. Monoclonal antibodies: Some were previously employed, but many have lost their effectiveness against newer variants. (40)

Conclusion:

The COVID-19 pandemic has profoundly affected global health, economies, and everyday life. It is crucial to comprehend its origin, transmission, symptoms, diagnosis, and treatment in order to control the pandemic and avert future outbreaks. Ongoing research, vaccination efforts, public awareness campaigns, and compliance with health guidelines are vital for managing and ultimately defeating the disease.

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