Emerging Corona viruses: Classification, Disease Mechanisms, and Their Impact on Human Physiology: A Comprehensive Review

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ABSTRACT

Corona viruses (CoVs) are a diverse group of enveloped, positive-sense single-stranded RNA viruses that infect humans and animals. While earlier strains caused mild respiratory infections, the emergence of severe acute respiratory syndrome Corona virus (SARS-CoV), Middle East respiratory syndrome corona virus (MERS-CoV), and severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) has led to global health crises. This review provides a comprehensive overview of Corona virus taxonomy, structural organization, transmission, clinical features, molecular mechanisms of infection, and systemic impacts on the human body. Understanding these aspects is essential for the development of effective therapeutic and preventive strategies.

INTRODUCTION

Corona viruses belong to the family *Coronaviridae* and are known to cause respiratory, enteric, hepatic, and neurological diseases in humans and animals. Historically, human Corona viruses such as HCoV-229E and HCoV-OC43 were associated with mild infections. However, the emergence of SARS-CoV in 2002, MERS-CoV in 2012, and SARS-CoV-2 in 2019 marked a shift toward highly pathogenic strains with significant morbidity and mortality (Deng & Peng, 2020; Hu *et al.*, 2021).

The corona virus disease 2019 (COVID-19), caused by SARS-CoV-2, rapidly spread worldwide, posing unprecedented (Chung *et al.*, 2024; Li *et al.*, 2024) challenges to healthcare systems and economies.

1. Taxonomy and Classification

Corona viruses are classified into four genera based on genetic and antigenic properties:

- Alpha-corona virus
- Beta-corona virus
- Gamma-corona virus
- Delta-corona virus

Human-infecting Corona viruses mainly belong to alpha and beta genera. SARS-CoV, MERS-CoV, and SARS-CoV-2 are beta-Corona viruses associated with severe disease (Zhang *et al.*, 2024).

2. Structural Organization of Corona virus (from Google Picture)

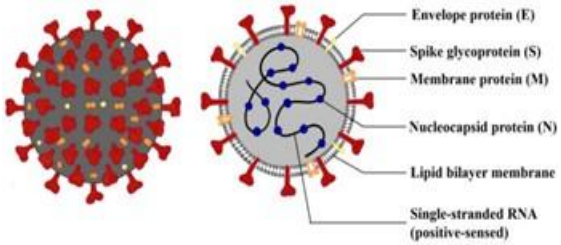

Figure 1: Schematic representation of Corona virus showing spike (S), membrane (M), envelope (E), and nucleocapsid (N) proteins.

Corona viruses are spherical, enveloped viruses (50–200 nm in diameter) with a positive-sense RNA genome. The spike (S) protein forms characteristic crown-like projections and plays a crucial role in host cell entry via receptor binding (Li *et al.*, 2024). The nucleocapsid protein binds the RNA genome, while membrane and envelope proteins maintain structural integrity.

3. Transmission and Epidemiology

Corona viruses primarily spread through:

- Respiratory droplets
- Aerosols
- Direct contact with contaminated surfaces

SARS-CoV-2 transmission occurs efficiently between humans, including asymptomatic carriers, contributing to rapid global spread.

4. Clinical Manifestations

4.1 Common Symptoms (Hirahata *et al.*, 2025).

- Fever
- Dry cough
- Fatigue

4.2 Moderate Symptoms

- Shortness of breath
- Muscle aches
- Sore throat

4.3 Severe Symptoms (Yang, 2025)

- Acute Respiratory Distress Syndrome (ARDS)
- Septic shock
- Multi-organ failure

Clinical studies report fever (≈80%), cough (≈56%), and dyspnea as predominant symptoms (Carvajal *et al.*, 2024; Henrich *et al.*, 2025.

5. Mechanism of Action and Viral Life Cycle

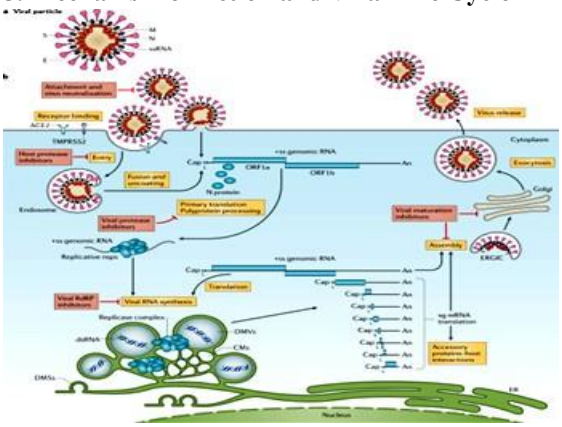

Figure 2: Mechanism of SARS-CoV-2 infection including receptor binding, entry, replication, assembly, and release.

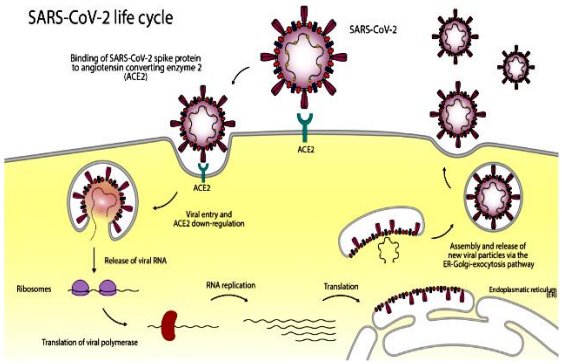

Figure 3: SARS-CoV-2 virus life cycle

SARS-CoV-2 enters host cells through ACE2 receptor binding, followed by membrane fusion and RNA release. Viral replication occurs using host cellular machinery, leading to assembly and release of new virions.

Recent research emphasizes that viral mutations enhance receptor binding affinity and facilitate immune evasion, contributing to increased transmissibility (Li *et al.*, 2024).

Additionally, COVID-19 progression occurs in two phases:

- Viral replication phase
- Immune dysregulation phase, where cytokine storm drives severe disease (Yang, 2025).

5.1 Viral Entry

The spike protein binds to the ACE2 receptor on host cells, particularly in lung alveolar epithelial cells.

5.2 Fusion and Uncoating

The viral envelope fuses with the host membrane, releasing RNA into the cytoplasm (Yang, 2025).

5.3 Replication and Translation

The viral RNA utilizes host ribosomes for protein synthesis and genome replication (Oh *et al.*, 2025).

5.4 Assembly and Release

New virions are assembled in the endoplasmic reticulum and released via exocytosis.

The interaction between spike protein and ACE2 receptor (El Zawily *et al.*, 2025) is a critical determinant of viral infectivity (Case *et al.*, 2025).

6. Pathophysiology and Systemic Impact (Henrich *et al.*, 2025)

6.1 Respiratory System (Zhang *et al.*, 2024)

- Viral infection of alveolar cells
- Inflammation and edema
- Development of pneumonia and ARDS

6.2 Immune System (Li *et al.*, 2024)

- Cytokine storm
- Elevated inflammatory mediators

6.3 Cardiovascular System (Narayanan *et al.*, 2024)

- Myocardial injury
- Increased mortality in comorbid patients

6.4 Gastrointestinal System

- Diarrhea and nausea
- Viral replication in intestinal cells

6.5 Renal System

- Acute kidney injury in severe cases

Patients with comorbidities such as diabetes and hypertension exhibit worse outcomes.

8. Diagnosis (Tabatabaei *et al.*, 2025).

Diagnosis is based on:

- Reverse transcription polymerase chain reaction (RT-PCR)

- Chest CT imaging (ground-glass opacities)
- Laboratory markers (lymphopenia, CRP elevation)

8. Prevention and Control Strategies

- Vaccination
- Use of personal protective equipment (PPE)
- Social distancing
- Hand hygiene

9. Therapeutic Approaches (Tabatabaei *et al.*, 2025).

- Antiviral agents (e.g., remdesivir)
- Supportive oxygen therapy
- Corticosteroids in severe cases
- Mechanical ventilation in critical patients

10. Discussion

The rapid evolution and zoonotic origin of Corona viruses make them a persistent global threat. The ability of SARS-CoV-2 to bind ACE2 receptors efficiently explains its high transmissibility and pathogenicity. Future research should focus on antiviral drug development, vaccine improvements, and understanding host-pathogen interactions.

CONCLUSION

Corona viruses have transitioned from relatively benign pathogens to major global health threats. Comprehensive understanding of their structure, transmission, and pathogenesis is essential for effective management and prevention of future outbreaks.

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REFERENCES

Acharya, T. (2021). *Bacterial culture media: Classification, types, uses*.

Carvajal, J. J., *et al*. (2024). SARS-CoV-2 pathogenesis and host response. *Nature Reviews Immunology*, 24(3), 145–160.

Case, J. B., *et al*. (2025). SARS-CoV-2 evolution and immunity. *Cell*, 188(2), 250–265.

Case, J. B., *et al*. (2025). Vaccine immunity and variants of SARS-CoV-2. *Nature Medicine*, 31(1), 45–59.

Chen, N., Zhou, M., Dong, X., *et al.* (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel Corona virus pneumonia in Wuhan, China. *The Lancet, 395*(10223), 507–513.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., … Yu, T. (2020). Epidemiological and clinical characteristics of 99 cases of COVID-19 in Wuhan, China. *The Lancet*, 395(10223), 507–513.

Chung, Y. S., *et al*. (2024). Epidemiology and pathogenesis of COVID-19. *Journal of Medical Virology*, 96(4), 1120–1135.

Chung, Y. S., *et al*. (2024). SARS-CoV-2 variant evolution and transmission dynamics. *Virus Research*, 335, 199052.

Deng, S.-Q., & Peng, H.-J. (2020). Characteristics of and public health responses to the Corona virus disease 2019 outbreak in China. *Journal of Clinical Medicine, 9*(2), 575. https://doi.org/10.3390/jcm9020575

Deng, S.-Q., & Peng, H.-J. (2020). Characteristics of and public health responses to the coronavirus disease

2019 outbreak in China. *Journal of Clinical Medicine*, 9(2), 575.

El Zawily, A., *et al*. (2025). COVID-19 pathogenesis and systemic effects. *Frontiers in Immunology*, 16, 1456789.

Henrich, T. J., *et al*. (2025). Mechanisms of long COVID and persistent inflammation. *Nature Immunology*, 26(2), 210–222.

Hirahata, T., *et al*. (2025). Clinical features and vaccine responses in SARS-CoV-2 infection. *The Lancet Infectious Diseases*, 25(1), 75–88.

Hu, B., Guo, H., Zhou, P., & Shi, Z.-L. (2021). Characteristics of SARS-CoV-2 and COVID-19. *Nature Reviews Microbiology*, 19(3), 141–154.

Huang, C., Wang, Y., Li, X., *et al.* (2020). Clinical features of patients infected with 2019 novel Corona virus in Wuhan, China. *The Lancet, 395*(10223), 497–506.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., … Cao, B. (2020). Clinical features of patients infected with SARS-CoV-2 in Wuhan, China. *The Lancet*, 395(10223), 497–506.

JAMA. (2020). Corona virus infections—More than just the common cold. *JAMA, 323*(8), 707–708.

Kirk, N. M., *et al*. (2024). Animal models of COVID-19 for pathogenesis studies. *Nature Communications*, 15, 3456.

Kirk, N. M., *et al*. (2024). Coronavirus pathogenesis models and experimental systems. *PLoS Pathogens*, 20(5), e1012345.

Li, X., *et al*. (2024). Immune dysfunction in COVID-19 and its clinical implications. *Frontiers in Immunology*, 15, 1345678.

Li, X., *et al*. (2024). SARS-CoV-2 variants and immune response. *Immunity*, 57(6), 1205–1220.

Mothae, S., *et al*. (2025). Host–pathogen interactions in SARS-CoV-2 infection. *Trends in Microbiology*, 33(2), 150–165.

Narayanan, S. A., *et al*. (2024). Post-acute COVID-19 effects and long-term complications. *The Lancet Respiratory Medicine*, 12(3), 210–222.

Narayanan, S. A., *et al*. (2024). Tissue-level effects of COVID-19 infection. *Journal of Pathology*, 262(1), 35–48.

Nature Immunology. (2026). Long COVID inflammation and immune dysregulation. *Nature Immunology*, 27(1), 10–15.

Oh, D. Y., *et al*. (2025). Antiviral resistance in SARS-CoV-2. *Nature Communications*, 16, 5678.

Oh, D. Y., *et al*. (2025). SARS-CoV-2 evolution and implications for public health. *Nature Reviews Microbiology*, 23(1), 25–40.

Olebo, D. F., *et al*. (2025). Comparative virology of SARS-CoV-2 and HIV. *Viruses*, 17(3), 456.

Tabatabaei, S. N., *et al*. (2025). Advances in SARS-CoV-2 diagnostics and therapeutics. *Clinical Microbiology Reviews*, 38(1), e00045-24.

Wang, Y., *et al*. (2025). Functional analysis of SARS-CoV-2 proteins. *Nature Structural & Molecular Biology*, 32(2), 180–192.

Wang, Y., *et al*. (2025). Viral virulence mechanisms of SARS-CoV-2. *Journal of Virology*, 99(4), e01234-24.

World Health Organization. (2020). *Corona virus disease (COVID-19) pandemic*.

World Health Organization. (2023). *Coronavirus disease (COVID-19) updates*. World Health Organization.

Yang, O. O. (2025). Immunopathogenesis of COVID-19. *Annual Review of Immunology*, 43, 321–345.

Zhang, J., *et al*. (2024). Comparative pathogenesis of coronaviruses. *Nature Reviews Microbiology*, 22(6), 350–365.

Zhu, N., Zhang, D., Wang, W., *et al.* (2020). A novel Corona virus from patients with pneumonia in China. *New England Journal of Medicine, 382*(8), 727–733.

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., … Tan, W. (2020). A novel coronavirus from patients with pneumonia in China, 2019. *The New England Journal of Medicine*, 382(8), 727–733.