

Abstract

SARS-CoV-2 is a single stranded ribonucleic acid (RNA) virus belonging to the *Coronavirus* genus. This virus is composed of four main structural proteins including nucleocapsid protein (N-protein), envelope protein (E-protein), membrane protein (M-protein), and spike protein (S-protein).³ The aggressive nature of this virus has resulted in an equally aggressive and difficult to contain illness, colloquially known as COVID-19. This disease reached pandemic level infection rates just weeks after being discovered. This poster will discuss the structure of SARS-CoV-2, how it affects the host cell, and the resulting illness and impact on our world's population to date.

Background & History

The first cases of the SARS-CoV-2 virus were discovered in association with the Huanan Seafood Market in Wuhan, China.¹ Due to the similarity in structure of the SARS-CoV and SARS-CoV-2 (about 70% match in genome structure), many scientists believe that this new virus was transmitted from the *Hipposideros* bat.¹ Although this species of bat is known to carry such similar viruses, future research is needed to claim with any level of certainty that this is the source of SARS-CoV-2. Another supposed source of SARS-CoV-2 is the pangolin.¹ This organism is a scaly anteater found in Asia and Africa and is also known to carry similar viruses. The genome sequence of these viruses, known to be carried by the pangolin, have 85.5% to 92.4% similarity to SARS-CoV-2.¹

- 1901

Yellow Fever recorded as first human virus²
- 1960s

First identified human coronaviruses³
- February 2003

First cases of SARS (severe acute respiratory syndrome)⁴
- April 2012

First cases of MERS (Middle East Respiratory Syndrome)⁴
- January 9, 2020

WHO (World Health Organization) announces Coronavirus-related illnesses in Wuhan, China¹
- January 21, 2020

CDC (Centers for Disease Control and Prevention) confirms first US SARS-CoV-2 cases⁵
- March 11, 2020

WHO declares COVID-19 a pandemic⁵
- June 10, 2020

US COVID-19 cases hit 2 million⁵
- December 10, 2020

FDA Advisory Panel recommends Pfizer, BioNTech COVID-19 vaccine⁶
- December 18, 2020

FDA Advisory Panel recommends Moderna COVID-19 vaccine⁶
- February 27, 2021

FDA Advisory Panel recommends Janssen COVID-19 vaccine⁶

Method of Contraction

- Virus spread via respiratory droplets⁸
- Droplets enter body and individual becomes vulnerable to viral attack⁸
- Asymptomatic and symptomatic spread possible⁸

CDC Recommendations for Reducing Spread⁸

- Increase hand washing
- Avoid touching eyes, nose, mouth
- Wear facial covering outside of home
- Keep social distance of at least 6 ft
- Increase sanitizing of surfaces and objects
- Avoid large gatherings
- Stay home when ill

Important Statistics

Figure A shows the inverse relationship between the number of COVID-19 cases and number of deaths attributed to COVID-19 between age groups 18-29 years and 85+ years as of March 2021.

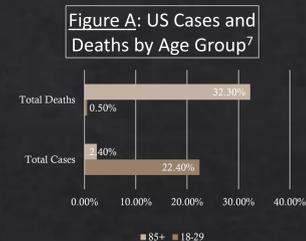


Figure B shows the total cases of COVID-19 and deaths attributed to COVID-19 as of March 2021

Figure B: Total COVID-19 Cases and Deaths⁷

	United States	Ohio	Trumbull County
Total Cases	111,000,000	27,811,343	949,695
Total Deaths	2,460,000	494,008	16,749

Chemical Components

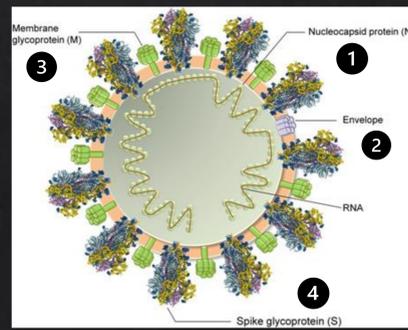


Figure C: Illustration of SARS-CoV-2 Structural Proteins⁹

- 1. Nucleocapsid protein (N-protein):** binds to RNA genome to create a housing around the genetic material¹⁰
- 2. Envelope protein (E-protein):** makes changes to the permeability of the host cell, aiding in viral penetration¹⁰
- 3. Membrane protein (M-protein):** significant role in viral assembly¹⁰
- 4. Spike protein (S-protein):** allows virus to bind to host cell receptors and participates in fusion of host/viral membranes¹⁰

Effects on the Body

All viruses contain a set of genetic material in the form of either deoxyribonucleic acid (DNA) or ribonucleic acid (RNA). This genetic material tells the virus what to do once inside the host cell and allows the virus to replicate itself.¹¹

In the case of SARS-CoV-2, the genetic material is in the form of RNA. The messenger RNA (mRNA) is made by using a strand of RNA as a template.¹ The biologically important information found on the mRNA contains instructions for making new viral proteins with various functions and can then exit the nucleus to infect another cell.

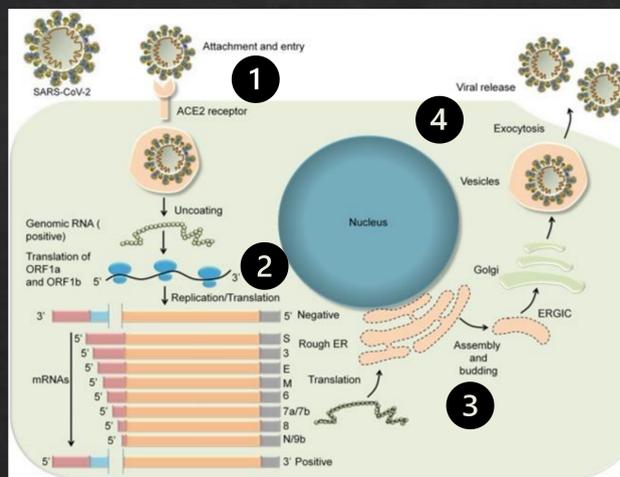


Figure D: The process of viral infection, replication, and expulsion of new viruses synthesized in the cell.¹¹

- 1. Attachment/Entry:** abrasive structure of S-protein and host membrane function of E-protein allow virus to attach to host cell receptors *Notable affinity for respiratory cells¹
- 2. Replication/Translation:**
 - a.) viral RNA (coated in N-proteins) is expelled into host cell and replicates utilizing attached N-proteins.
 - b.) RNA migrates to host cell's nucleus
- 3. Assembly/Budding:** RNA (now inside the nucleus) utilizes resources from host cell to synthesize new viruses and/or inhibitory factors. M-protein interacts with S-protein to aid in its connection to viral envelope
- 4. Viral Release:** newly synthesized viruses (from inside the host cell) are released gradually as the host cell disintegrates¹²

The presence of this aggressive virus in the human body results in COVID-19 infection and its wide variety of symptoms. The symptoms discussed under "COVID-19 Health Effects" usually begin between 2-14 days after the process in Figure D initiates the infection of SARS-COV-2.¹³

COVID-19 Health Effects

Exposure

- Individual is exposed to virus via respiratory droplets

Incubation Period (2-14 days)

- Symptoms begin and can range from mild to severe
- **Mild:** fever or chills, cough, shortness of breath, fatigue, headache, nasal congestion or runny nose, muscle or body aches, sore throat, loss of taste and/or smell, nausea, vomiting, diarrhea¹³
- **Severe:** respiratory failure, septic shock, multiple organ dysfunction or failure, death¹³

10 Days After Onset of Symptoms

- Most individuals will be symptom-free and considered no longer contagious¹³

Possible Long-Term Complications¹³

- | | |
|--|---|
| <p>More Common:</p> <ul style="list-style-type: none"> • Fatigue • Shortness of breath • Cough • Joint pain • Chest pain | <p>Less Common:</p> <ul style="list-style-type: none"> • Inflammation of heart muscle • Lung function abnormalities • Acute kidney injury • Hair loss • Ongoing loss of taste and smell • Concentration, mood, and memory difficulties |
|--|---|

Conclusion

SARS-CoV-2, like all other viruses, relies on the host cell for replication of the viral genome. The structure of this virus allows this process to occur as the virus proteins carry out their individual functions. From the attachment of the S-proteins to the host cell receptors, to the expulsion of the viral proteins made inside the host cell, the entire process is carried out with the purpose of infecting more cells in the host's body. The nature of this virus is aggressive and difficult to contain. As a result, this pandemic will continue to have a significant impact on the lives and health of the world's population.

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