

HUMAN CORONAVIRUS: CURRENT EVIDENCE & EXPLORATIONS

Amrita Masanta¹ and Shikha Singh^{2*}

¹Centre for Biotechnology, Siksha O Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India.

²Rama Devi Women's University, Bhubaneswar, Odisha, India.

Received on: 01/06/2021

Revised on: 22/06/2021

Accepted on: 12/07/2021

*Corresponding Author

Shikha Singh

Rama Devi Women's

University, Bhubaneswar,

Odisha, India.

ABSTRACT

A novel coronavirus (SARS-CoV-2/COVID-19, and previously known as 2019-nCoV) is responsible for a severe respiratory disease that spreads from Wuhan City, China to rest of the world by early of December 2019. World Health Organization (WHO), on 30 January 2020, officially announced the outbreak of COVID-19 pandemic as a serious public health disaster of international concern. By 12 February, 2020, around 45000 clinical confirmed a COVID-19 positive case has been recorded and almost 1100 individuals killed worldwide. Recognized exposure of achieving disease has forced many governance to establish a modification in control measure. Hence, we manage to design a review literature rely on the availability of global and national information to compile the knowledge against the virus and the recent pandemic. This review article consist the classification of pathogen, epidemiology, transmission of disease, clinical symptoms, risk factors, disease diagnosis and treatments, clinical outcomes along with control & prevention approaches are all outlined and reviewed.

KEYWORDS: 2019-nCoV, SARS-CoV-2, outbreak, transmission, treatment.

INTRODUCTION

This year 2020, on January 9, the state media of China has been reported that a scientific team with a group of researchers, led by Xu Jianguo, successfully identified a pathogenic virus which later outbreak as pneumonia with mysteriously in Wuhan, China and declared as a novel coronavirus. However, this novel coronavirus was soon named "2019-nCoV, and later again changed as "SARS-CoV-2. The special circular spikes tips present on their surface that cautioned the virologist, the beautiful presence of the sun's envelope called corona. A diversified strain of corona viruses affects numerous species, nevertheless, the first human coronavirus was discovered in late 1960s.

The outbreak has been recorded after all December 8, 2019 along with many individuals being employed at or local residents in the Huanan Seafood Wholesale Market despite early new cases had no hazards.^[1] By January 30, 2020, confirmed cases of about 7736 individuals and 12167 uncertain cases had been observed in China and with 82 positive cases had been detected in other 18 nations.^[2] So World Health Organization (WHO), in the same day broadcast of the breakthrough of SARS-CoV-2 as a Public Health Emergency of International Concern (PHEIC). As per the current report by WHO (17 October, 2020), a total number of confirmed cases of covid-19 is 39,596,451 with 29,661,765 recovered rate and unfortunately the confirmed death is 1,109,267.^[3] in India, the confirmed cases of covid-19 is 74,32,680 with recovered score of 65,24,595 and the 1,12,998 deaths.^[3]

According to current report, a new coronavirus (SARS-CoV-2) is firmly linked with the bat SARS-CoV.^[4,5] Currently it has been revealed that the homology sequence between SARS-CoV and SARS-CoV-2 was 79.5%.^[6,7] and SARS-CoV-2 consist higher identity that shares with bat coronaviruses. Hence, the recent proof fully encourages that the coronavirus SARS-CoV-2 has been imitative from bats, whereas the intervening hosts of SARS-CoV-2 still to resolute.

COVID-19 is considered as a moderate infectious disease but having a comparatively high mortality rate and this information has been established by availability of public reports and rapidly published literature. This review literature supported the ongoing perceptivity of COVID-19, transmission mechanism & pathogenicity, control & prevention and vaccine.

The Coronavirus: Origin and Classification

SARS-CoV-2 or Coronavirus is belongs to the family *Coronaviridae*, consist of two subfamilies; *Coronavirinae* and *Torovirinae* and order *Nidovirales*. The components of the subfamily *Coronavirinae* are subcategorized as a four genera.^[8]

1. (HCoV) – 229E (Alpha coronavirus) and (HCoV) – NL63 (Alpha coronavirus)
2. (HCoV) – OC43 (Beta coronavirus) and (HCoV) – HKU1 (Beta coronavirus)
3. Gamma coronavirus along with viruses of whales and birds &;
4. Delta coronavirus consists of viruses confined from pigs and birds

SARS-CoV-2 resides to Beta coronavirus along the two other eminent viruses (SARS-CoV and MERS-CoV). SARS-CoV-2 is consist of coated non-segmented *positive-sense single-stranded RNA* as a genetic code.^[9] SARS-CoV-2 is a novel human beta coronavirus and the phylogeny study of SARS-CoV-2 shows the similarity (with 88% of identity) to bat-SL-CoVZC45 & bat-SL-CoVZXC21 and genetically different from SARS-CoV & MERS-CoV (with 79% of identity).^[10] But, from a recent study it has been found that no evidence yet proved the recombination detection in the genetic level of SARS-CoV-2 from other viruses that originate from bats CoV RaTG13, SARS-CoV and SARSr-CoVs.^[11] Hence, a serious study is required to validate the gap between the intermediation pathway of hosts and the virus to humans. However, bats are the mammals that are more likely to be direct involvement for the transmission of disease.^[10] But, sometimes it's not responsible as a medium to transmit the viruses to humans.^[12]

Transmission

It's still unclear that the Human Seafood Wholesale Market is directing the responsible in propagating the disease. After all there were supposed to be many early COVID-19 cases, connected with the local market, proposing that SARS-CoV-2 has been transformed from animals to humans.^[13] But a genomic analysis reveals that the virus had been originated from an unknown location into the market, and hence spreads rapidly especially the transmission of person-to-person.^[14] It has been reported that some group of family members that are infected and some hospital workers have proved the existence of person-to-persons transmission.^[15] The transmission between person-to-person is attention to occur with close connection mostly when the infected individual's respiratory droplets formed by coughing or sneezing. SARS-CoV found to be remain active up to 96 hr on surface and some other coronaviruses likely up to 9 days.^[9,16] with the help of fomites, as it is considered as a main factor of disease transmission.

On January 30 of this year, one of the research report published that the transmission of disease is asymptomatic which remain as a controversial.^[17] and subsequently the directly examined of infected person by scientists was not allowed who have shown symptoms proceeding to disease transmission.^[18] Characteristics of all data and findings about COVID-19 disease are swiftly changes & uncertain to selecting preference.

Clinical Symptoms

As an rapidly spreading, COVID-19 patients have very familiar symptoms like high fever, malaise, cough, dyspnea, severe chest pain, acute fatigue and myalgia.^[19,20,21] Some initial symptoms receive mild

headache, dizziness, lower abdominal pain, nausea, diarrhea and vomiting and also loss of smell & taste. As fever and dry cough remains as the prevalent symptoms while respiratory & gastro intestine symptoms stays uncommon, implying the divergence in viral growth as compared with SARS-CoV.^[22] The elders and those who are concealed with disorders like hypertension, acute pulmonary obstructive disease, diabetes, cardiovascular disease, were rapidly prone to developed into acute respiratory distress syndrome, septic shock, metabolic acidosis with coagulation dysfunction that leads to the death.^[23] The elderly male with comorbidities shows higher death rate, and almost 100 children got infected in every seconds after birth with the youngest in 30 hrs.^[24] So, the newborns & elder ones required more care & attention due to their immature & weak immunity.

High Risk Factors

The frequency rate of COVID-19 /SARS-CoV-2 infection is seems to be more usually in patient (adult male) with age between 35 to 60 years.^[25,20,9,26] SARS-CoV-2 is likely reclining to the infected person having severe comorbidities such as diabetes, hypertension, cardiovascular and cerebrovascular history.^[27] The maximum infection rate of extreme cases has been found in adult age of ≥ 60 years and those with assure basic conditions such as cardiovascular & cerebrovascular disease and diabetes with hypertension.^[25,20] However, some chronic indication may also be correlated with bacterial and fungal co-infection.^[27] For example; the tuberculosis infected person is more likely to get infect from COVID-19 & that to be male. The clinical manifestation of infected newborns & pediatric individuals remains vary, but mostly got similar symptoms of mild or no fever or pneumonia.^[28] Another research revealed that a child had radiology ground-glass lung opacity but have no symptoms.^[29] In shortly, children have fewer chances to get infected or if infected, show mild symptoms than adults; hence, it is probable that their parents will not carry diagnosis that further leads to underrate of COVID-19 incidence.

Angiotensin-Converting Enzyme 2 (ACE2) and host Immune response

Angiotensin Converting Enzyme 2 (ACE2) found in the lower respiratory tract of human is also known as a SARS-CoV cell receptor and regulates the transfer of both cross-species and human-to-human.^[30,31] Bronchoalveolar lavage fluid (BAIF) was isolated from a patient with COVID-19 and SARS-CoV has been reported to share a cellular entry receptor, (ACE2) similar to that of SARS CoV.^[32] Attachment to the ACE2 receptor that found on the surface of human cells is responsible for the presence of viral s-glycoprotein on the surface of the coronavirus as shown in figure.1.^[33]

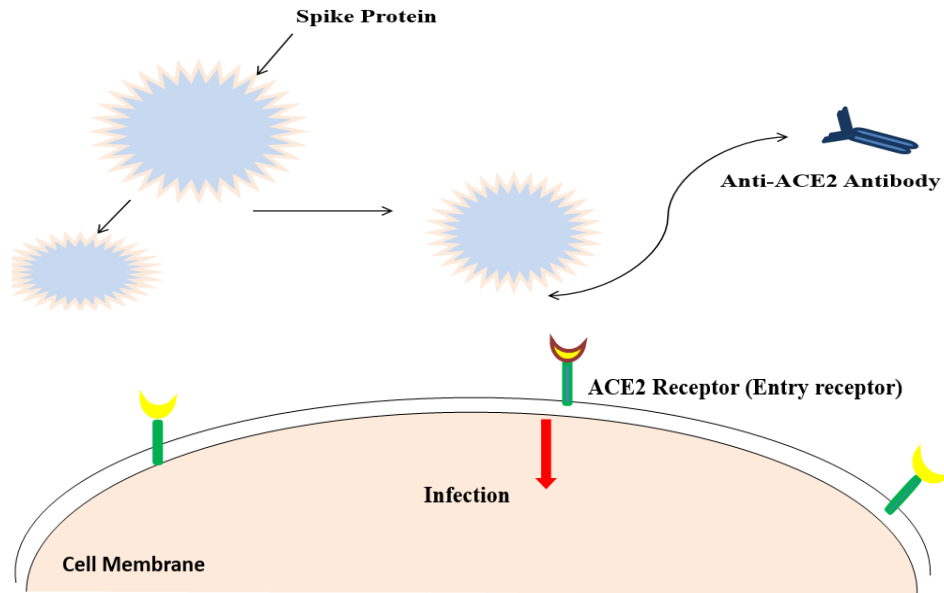


Figure 1: The host cell receptor angiotensin-converting enzyme 2 (ACE2) is responsible for intervening the infection by SARS-CoV-2.

The s-glycoprotein of coronavirus consists of two domains; S1 and S2.^[34] In addition to cellular tropism and the core role of the domain, the S1 domain controls the virus-host ranges. The S2 domain mechanism is to control the fusion of two tandem domains of the virus cell membrane; Heptad Repeats 1 (HR1) and Heptad 2 (HR2).^[35] The genomic RNA of the virus is then discharged into the cytoplasm soon after membrane fusion by tandem repeats domains and then RNA translates two polyproteins, called ppla and pplab, which encodes the non-structural proteins along with the creation of replication-transcription complex (RTC) in the vesicle of double membrane.^[36,37] As a nested group of series of sub-genomic RNAs.^[38] activates the accessory and structural proteins and RTC replicates along with synthesized repeatedly. Newly evolved genomic RNA, nucleocapsid proteins and assembled glycoproteins help to form viral particle buds through the involvement of endoplasmic reticulum & golgi.^[39] The virion-involving vesicles eventually combine with the plasma membrane that induces the release of viruses. The inhibition of virus replication and transmission is also capable of modulating the inflammation and cellular antiviral activity mediated by the host immune system reacting to viral infection. Consequently, related to excessive immune reaction, pathogenesis arises through the lytic effects of virus on the host cells. Some studies shows, patients infected from chronic pneumonia, with high fever & cough as common symptoms at outbreak of illness.^[9,27] A few patients rapidly recovered with Acute Respiratory Stress Syndrome (ARDS) and septic shock, which cause 10% of patient's death by further multiple organ failure.^[27] Additional symptoms are the progression of ARDS and serious lung damage in COVID-19 that ACE2 could be a passage to SARS-CoV-2 as ACE2 is generously present in human

epithelium ciliated cells and alveolar type II cells.^[40] Humans infected with SARS and COVID-19 exhibits similar inflammatory damages levels. Increased levels of interleukin (IL)-1, IL6, IL12, interferon gamma (IFN γ), IFN γ - induced protein10 (IP10), macrophage inflammatory proteins 1A (MIP1A) and monocytic chemo attractant protein-1 (MCP1) known as pulmonary inflammation that are detected in isolated serum from patients infected with SARS.^[41] Besides SARS, SARS-CoV-2 infected individuals' shows higher plasma levels in IL1 β , IL-2, IL-7, and TNF-alpha than non-ICU patients, showing that a cytokine downpour may be the root cause of the cruelty of the disease.^[9] Unusually, cytokines like IL10 and IL4 also shows high levels in patients those are asymptomatic viral infection. In order to detect and analyze the virulence factors and the host genome of SARS-COV-2 distant research is very crucial, signaling the virus to overcome the species-specific barrier and cause mortal disease in humans.

Clinical Outcomes

Recent data shows, most patients had undergone for good diagnosis, at the same time some patients aged ≥ 60 with extreme underlying disease were in critical condition. As per the last week (1 December, 2020) report by World Health Organization, the global case incidence of this pandemic has been remain high, approximately 4 million of new cases was observed. However worldwide, weekly new 69000 death rate has been raised. The Region of the Americans was the largest contributor for new cases that has been reported last week. The European Region observed a continue downfall in new weekly cases, but it still stands the second greatest proportion of new cases, and the death rates have continued to increase, approximately half of the new global deaths in the past week. The East

Mediterranean recorded a slight decline in both new cases and death rate last week after the continuous increase since last four months. Comparatively, a little increase in the case report has been recorded from the African and South-East Asian countries and more significantly from the western region of Pacific. In India, the last week new 297113 cases has been recorded since the cases were increased in the week commencing 14 September, but weekly new cases was continue to decreases. There were 3469 deaths reported in the last week, a 3% decline compared to the previous week, reported by WHO.^[3] Acute respiratory distress syndrome (ARDS), arrhythmias, shock,^[42] chronic kidney injury, acute cardiac injury, hepatic insufficiency and secondary infection,^[23] were the complications experienced. The bad clinical histories were the main responsible to severity of disease. In older people, the disease tends to migrate faster, with a shorter median number of days from the first onset of symptoms to death in 65 or more elderly people.^[43,44]

Diagnostic Criteria and Treatments

By using a blood, saliva or tissue sample, COVID-19 may be identified similarly to other symptoms caused by viral infection. In addition, a cotton swab is used in COVID-19 experiments to retrieve a sample from the inside of the nostrils. On April 21, 2020, the Food and Drug Administration (FDA) approved the use of the first home test kit for COVID-19 for the first time. To date, COVID-19's standard clinical diagnostic approach is the sampling of nucleic acid detection by nasal and throat swab or RT-PCR respiratory tract sampling and further confirmation by next-generation sequencing (NGS).

There is still no precise antiviral treatment available for COVID-19, equivalent to MERS-CoV and SARS-CoV.^[45] Home quarantine, isolation and support system such as oxygen therapy, fluid support system and secondary bacterial infection antibiotics are prescribed.^[46] Some COVID-19 infected individuals quickly recovered from ADRS and septic shock, resulting in several organ failures.^[9,27] The major control has been attempted for COVID-19 for the initial detection of the suspect and the dissemination of disease consist of the immediate isolation and control of the infection measure.^[47]

There is currently no fruitful vaccine or adequate care available, but even if it is available, vaccine uptake could be sub-optimal. Therefore, disease management appears to support the seriousness of the disease developed by the WHO.

In previous trials of clinical therapies for SARS and MERS,^[48] first-line medicines have been tested. Overall, there is no rapid evidence globally that these antiviral drugs have made a substantial improvement in the disease. For the treatment of 19 patients infected from COVID-19,^[9] antiviral medication such as 'Oseltamivir' was used along with observational antibiotic therapy.

The medication 'Remedesivir' which was developed for the Ebola virus has now also been used to treat cases of COVID-19. The efficacy of lopinavir-ritonavir and interferon-alpha2b in COVID-19 patients is a human clinical trial and assessment.^[46]

Control & Prevention

The current COVID-19 pandemic is certainly a global health disaster. Beyond some observation and assessment, it has been observed that the reproductive number, the infection & the death rate has been reported more than SARS.^[49,50] Similar to SARS-CoV and MERS-CoV, COVID-19 needs a great deal of discord in the transmission chain that has been studied as important for controlling the spread of disease.^[51] Different health care policies should be introduced at national and international levels because their environments may sadly be a major source of viral transmission. In contrast to signs of respiratory infections such as runny nose, cold and fever, uncertain cases occurring in healthcare facilities must wear face mask to enclose the virus and coordinate proceedings closely. In this case, the patient must obtain medical care by placing the patient in a separate, adequately ventilated space about 6 feet away from other patients with access to available supplies for respiratory medication. In general, if a COVID-19 infected person requires hospitalization, that person should first be put in a single low air pressure patient room (minimum six air changes per hour). The air must then be exhausted by filtration by "Highly Efficient Particulate Air (HEPA)" and only a medically trained person with personal protective equipment (PPE) such as gloves, gown, N95 (disposable) along with eye protection should be allowed into the room. The room should be fully sanitized or decontaminated prior to the next entry after the cases have been retrieved and discharged.^[52]

In a global sense, locking or shutting down has been the immediate step taken by the authorities of all the countries concerned and has therefore restricted the spread and migration of COVID-19 globally. Air travel has also been limited in cases where there is no need for serious medical considerations. Thermal detection and monitoring configuration, along with screening is mandatory at airports, train stations and borders to identify suspicious cases. Developed & extended research has been undergoing at international & national level to monitor the origin of the outbreak and plan for the likely outbreak.^[53]

CONCLUSION

The outbreak of COVID-19 pandemic swept from China to rest of the world and now it's an international public health disaster. Further research on COVID-19 will pursue to explore many forms of viral replication, pathogenesis & its clinical characteristics. Despite the fast rate of transmission, all countries should debate the disease control and surveillance system and the level to which countries are willing to respond to services, along

with the establishment of rapid response teams, by improvising the potential of the international and national laboratory system.

Financial disclosure

The authors do not claim any conflicting financial interest.

Conflict of interest

The authors found no conflicting interests exist.

Ethical Approval

Not required

ACKNOWLEDGEMENTS

A special thanks to Dr. Shikha Singh's (co-author) immense support and contribution for critical revision of the report and approved the final manuscript.

REFERENCE

1. H. Lu, C.W. Stratton, Y.W. Tang. Outbreak of pneumonia of unknown etiology in Wuhan China: the mystery and the miracle. *J Med Virol*, 2020
2. Burki T.K. Coronavirus in China. *Lancet Respir Med*, 2020.
3. WHO. Coronavirus disease (COVID-2019) situation reports, 2020.
4. Chan JFW, Kok KH, Zhu Z, et al. Genomic characterization of the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan. *Emerg Microbes Infect*, 2020; 9(1): 221- 236. 10.1080/22221751.2020.1719902.
5. Hui DS, I Azhar E, Madani TA, et al. The continuing 2019- nCoV epidemic threat of novel coronaviruses to global health—the latest 2019 novel coronavirus outbreak in Wuhan, China. *Int J Infect Dis.*, 2020; 91: 264- 266.
6. Zhou P, Yang XL, Wang XG, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*, 2020. 10.1038/s41586-020-2012-7.
7. Wu F, Zhao S, Yu B, et al. A new coronavirus associated with human respiratory disease in China. *Nature*, 2020. 10.1038/s41586-020-2008-3.
8. C. Burrell, C. Howard, F. Murphy. *Fenner and White's medical virology* (5th ed.), Academic Press, United States, 2016.
9. Kramer, I. Schwebke, G. Kampf. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis*, 2006; 6: 130.
10. R. Lu, X. Zhao, J. Li, P. Niu, B. Yang, H. Wu, et al. Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet*, 2020.
11. P. Zhou, X.L. Yang, X.G. Wang, B. Hu, L. Zhang, W. Zhang, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*, 2020.
12. J. Hughes, M. Wilson, S. Luby, E. Gurley, M. Hossa in. Transmission of human infection with Nipah virus. *Clin Infect Dis*, 2009; 49(11): 1743-1748.
13. Q. Li, X. Guan, P. Wu, X. Wang, L. Zhou, Y. Tong, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*, 2020; 382(13): 1199-1207.
14. W. Yu, G. Tang, L. Zhang, R. Corlett. Decoding the evolution and transmissions of the novel pneumonia coronavirus (SARS-CoV-2) using whole genomic data *ChinaXiv Preprint*, 2020.
15. J.F. Chan, S. Yuan, K.H. Kok, K.K. To, H. Chu, J. Yang, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster *Lancet*, 2020.
16. G. Kampf, D. Todt, S. Pfaender, E. Steinmann. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. *J Hosp Infect*, 2020.
17. C. Rothe, M. Schunk, P. Sothmann, G. Bretzel, G. F roeschl, C. Wallrauch, et.al. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany *N Engl J Med*, 2020.
18. K. Kupferschmidt. Study claiming new coronavirus can be transmitted by people without symptoms was flawed *Science news*, 2020.
19. Huang C., Wang Y., Li X., Ren L., Zhao J., Hu Y. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*, 2020.
20. Wang D., Hu B., Hu C., Zhu F., Liu X., Zhang J. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*, 2020.
21. Zhu N., Zhang D., Wang W., Li X., Yang B., Song J. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*, 2020.
22. Lee N, Hui D, Wu A, Chan P, Cameron P, Joynt GM, et al. A major outbreak of severe acute respiratory syndrome in Hong Kong. *N Engl J Med*, 2003; 348(20): 1986–1994. doi: 10.1056/NEJMoa030685.
23. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*, 2020; 395(10223): 497–506. doi: 10.1016/S0140-6736(20)30183-5.
24. Wang J, Qi H, Bao L, Li F, Shi Y, National Clinical Research Center for Child H, et al. A contingency plan for the management of the 2019 novel coronavirus outbreak in neonatal intensive care units. *Lancet Child Adolesc Health*, 2020. 10.1016/S2352-4642(20)30040- [Epub ahead of print].
25. Bai Y., Yao L., Wei T., Tian F., Jin D.Y., Chen L. Presumed asymptomatic carrier transmission of COVID-19. *JAMA*, 2020.
26. Chang, Lin M., Wei L., Xie L., Zhu G., Dela Cruz C.S. Epidemiologic and clinical characteristics of

- novel coronavirus infections involving 13 patients outside Wuhan, China. *JAMA*, 2020.
27. Chen N., Zhou M., Dong X., Qu J., Gong F., Han Y. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*, 2020.
 28. Shen K.L., Yang Y.H. Diagnosis and treatment of 2019 novel coronavirus infection in children: a pressing issue. *World J Pediatr*, 2020.
 29. Chan J.F.-W., Yuan S., Kok K.-H., To K.K.-W., Chu H., Yang J. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*, 2020.
 30. Jia HP, Look DC, Shi L, Hickey M, Pewe L, Netland J, et al. ACE2 receptor expression and severe acute respiratory syndrome coronavirus infection depend on differentiation of human airway epithelia. *J Virol*, 2005; 79(23): 14614–14621. doi: 10.1128/JVI.79.23.14614-14621.2005.
 31. Wan Y, Shang J, Graham R, Baric RS, Li F. Receptor recognition by novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS. *J Virol.*, 2020. 10.1128/JVI.00127-20 [Epub ahead of print].
 32. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, et.al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*, 2020; 579(7798): 270–273. doi: 10.1038/s41586-020-2012-7.
 33. Tortorici MA, Velesler D. Structural insights into coronavirus entry. *Adv Virus Res.*, 2019; 105: 93–116. doi: 10.1016/bs.aivir.2019.08.002.
 34. Zhang N, Jiang S, Du L. Current advancements and potential strategies in the development of MERS-CoV vaccines. *Expert Rev Vaccines*, 2014; 13(6): 761–774. doi: 10.1586/14760584.2014.912134.
 35. Yu Fei, Du Lanying, Ojcius David M., Pan Chungeng, Jiang Shibo. Measures for diagnosing and treating infections by a novel coronavirus responsible for a pneumonia outbreak originating in Wuhan, China. *Microbes and Infection*, 2020; 22(2): 74–79. doi: 10.1016/j.micinf.2020.01.003.
 36. de Wilde AH, Snijder EJ, Kikkert M, van Hemert MJ. Host factors in coronavirus replication. *Curr Top Microbiol Immunol*, 2018; 419: 1–42.
 37. Sawicki SG, Sawicki DL. Coronavirus transcription: a perspective. *Curr Top Microbiol Immunol*, 2005; 287: 31–55.
 38. Hussain S, Pan J, Chen Y, Yang Y, Xu J, Peng Y, et al. Identification of novel subgenomic RNAs and noncanonical transcription initiation signals of severe acute respiratory syndrome coronavirus. *J Virol*, 2005; 79(9): 5288–5295. doi: 10.1128/JVI.79.9.5288-5295.2005.
 39. Perrier A, Bonnin A, Desmarets L, Danneels A, Goffard A, Rouille Y, et al. The C-terminal domain of the MERS coronavirus M protein contains a trans-Golgi network localization signal. *J Biol Chem*, 2019; 294(39): 14406–14421. doi: 10.1074/jbc.RA119.008964.
 40. Hamming I, Timens W., Bultuis M.L., Lely A.T., Navis G., van Goor H. Tissue distribution of ACE2 protein, the functional receptor for SARS coronavirus. A first step in understanding SARS pathogenesis. *J Pathol*, 2004; 203(2): 631–637.
 41. Wong C.K., Lam C.W., Wu A.K., Ip W.K., Lee N.L., Chan I.H. Plasma inflammatory cytokines and chemokines in severe acute respiratory syndrome. *Clin Exp Immunol*, 2004; 136(1): 95–103.
 42. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*, 2020. 10.1001/jama.2020.1585 [Epub ahead of print].
 43. 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(4): 441–447. doi: 10.1002/jmv.25689.
 44. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med*, 2020. 10.1016/s2213-2600(20)30079-5.
 45. Tang J.W., Tambyah P.A., Hui D.S.C. Emergence of a novel coronavirus causing respiratory illness from Wuhan, China. *J Infect*, 2020.
 46. Habibzadeh P., Stoneman E.K. The novel coronavirus: a bird's eye view. *Int J Occup Environ Med*, 2020; 11(2): 65–71.
 47. Organization WHO. Global surveillance for human infection with novel coronavirus (2019-nCoV), 2020.
 48. Paules C.I., Marston H.D., Fauci A.S. Coronavirus infections – more than just the common cold. *JAMA*, 2020.
 49. Liu Y., Gayle A., Wilder-Smith A., JR. The reproductive number of COVID-19 is higher compared to SARS coronavirus. *J Travel Med*, 2020. doi: 10.1093/jtm/taaa021.
 50. Mahase E. Coronavirus covid-19 has killed more people than SARS and MERS combined, despite lower case fatality rate. *BMJ.*, 2020; 368: 641.
 51. Chan J.F.W., Lau S.K.P., To K.K.W., Cheng V.C.C., Woo P.C.Y., Yuen K.-Y. Middle East respiratory syndrome coronavirus: another zoonotic betacoronavirus causing SARS-like disease. *Clin Microbiol Rev.*, 2015; 28(2): 465–522.
 52. Centers for Diseases Control and Prevention. 2020. Coronavirus disease, 2019; (COVID-19).
 53. Heymann D.L., Shindo N. COVID-19: what is next for public health? *Lancet*, 2020.