Asian Journal of Immunology

3(1): 114-123, 2020; Article no.AJI.56168

General Overview of Coronavirus Disease 2019 (COVID- 19): A Summary of Evidence

Mohammad Asadul Habib[1*]

[1]Department of Food Technology and Nutrition Science, Noakhali Science and Technology University, Sonapur-3814, Bangladesh.

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Article Information

Editor(s):
(1) Dr. Jaffu Othniel Chilongola, Tumaini University, Tanzania.
Reviewers:
(1) Pichon Maxime, University Hospital of Poitiers, France.
(2) Karen Miyuki Asano, Instituto Pasteur, Brazil.
Complete Peer review History: http://www.sdiarticle4.com/review-history/56168

Mini-Review Article

Received 30 March 2020
Accepted 11 April 2020
Published 15 April 2020

ABSTRACT

Coronavirus disease 2019 (COVID-19) has spread throughout China and gained world-wide attention as a result of acute respiratory illness due to a novel coronavirus (SARS-CoV-2), traditionally known as COVID-19. On 30 January 2020, the World Health Organization (WHO) officially announced the outbreak of COVID-19 a public health emergency of international concern.A third introduction of a highly pathogenic and large-scale coronavirus disease in humans was the SARS-CoV-2 outbreak as a result of a severe acute respiratory syndrome coronavirus (SARS-CoV) in 2003 and the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012. Medical signs of COVID-19 patients include fever, cough, exhaustion and a limited number of patients with signs of gastrointestinal infection. Elderly and people with underlying diseases are susceptible to infection and prone to adverse results that could be associated with acute respiratory distress syndrome. There are currently few specific antiviral approaches available but many effective antiviral and repurposed drug candidates are under urgent investigation. The aim of this review was to summarize the recent medical advancement of COVID-19's epidemiology, transmission, and clinical characteristics, and discussed current treatment and scientific developments to fight the novel coronavirus outbreak.

**Corresponding author: E-mail: asadulhabib698@gmail.com;*

Keywords: SARS-CoV; SARS-CoV-2; MERS-CoV; COVID-19; outbreak; Coronavirus.

ABBREVIATIONS

SARS-CoV	*: Severe Acute Respiratory Syndrome*
MARS-CoV	*: Middle East Respiratory Syndrome*
China CDC	*: Chinese Center for Disease Control and Prevention*
COVID-19	*: Coronavirus Disease 2019*
2019-nCoV	*: Novel Coronavirus 2019*
TCM	*: Traditional Chinese medicine*
WHO	*: World Health Organization*
PPE	*: Personal Protection Equipment*
FFP3	*: Filtering Face Pieces (Protection in three classes against dangers)*
N95	*: Respirators and Surgical Mask*

1. INTRODUCTION

In late December 2019, a cluster of pneumonia cases of unknown origin in Wuhan, China was creating alarm among health officials. The Wuhan Municipal Health Commission issued an alert on 31 December, a rapid response team was sent to Wuhan by the Chinese Center for Disease Control and Prevention (China CDC) and a notification was sent to the World Health Organization (WHO) [1-4]. Potential influenza, avian influenza, adenovirus, acute coronavirus syndrome (SARS-CoV), and Middle East coronavirus (MERS-CoV) were all potential causes excluded. Wuhan's Huanan Seafood Wholesale market was involved in epidemiological testing, which has been shut down and disinfected and active cases have been identified [2,4,5]. On January 7, 2020, the latest coronavirus identified the causative pathogen, followed by the development of genomic characteristics and test methods [2,4-7]. Now known as the COVID-19, both SARS-CoV and MERS-CoV are distinct, but they are closely related [5,8]. Early cases suggested that COVID-19 (i.e. a new name for a disease caused by a novel coronavirus) may be less severe than SARS and MERS. Neither SARS-CoV nor MERS-CoV can be more infectious in 2019, but the incidence of disease among rapidly expanding numbers of people and evidence of transmission from human to human [3,9-12]. This review summarized the recent medical advancement of COVID-19's epidemiology, pathogenesis, and clinical characteristics, and discussed current treatment and scientific developments to fight the novel coronavirus outbreak.

2. SARS-CoV

16 years ago in 2003, severe acute respiratory coronavirus syndrome (SARS-CoV) stunned the world by its high virulence and efficient transmissibility among humans [6,13,14], triggering the first large-scale epidemic of the 21st century. Globally, there were over 8,000 patients infected and 774 deaths. SARS harmed the economy with a decline in domestic demands and foreign travel, in addition to the major burden on the health system [15].

2.1 Transmission of SARS-CoV

SARS-CoV is believed to be an animal virus that spread to other species (civet cats) and first infected humans in southern China's Guangdong province in 2002, from an as-yet-uncertain animal source, possibly bats [16]. SARS-CoV seemed to be the main mode of transmission via respiratory droplets [16] as well as fecal-oral transmission may be [14]. Apart from the super-spreaders, two to four secondary cases were estimated to infect every person [17]. It was estimated that the median incubation duration was four to seven days [18] and that peak viral load was reached on the 10th day of illness [14]. SARS-CoV may affect all age groupings. Particularly at risk were health care staff and immune-compromised patients [19].

3. MERS-CoV

In September 2012, Saudi Arabia first reported MERS-CoV infection, but in April 2012 the retrospective outbreak was confirmed in Jordan. Almost 2500 cases of MERS CoV (with at least 850 related deaths) from 27 countries around the world have been recorded worldwide by 2019; all MERS cases have been linked to travel or residence, with more than 80 percent involving Saudi Arabia in and around the Arab Peninsula [20]. In the Republic of Korea in 2015, the biggest known MERS outbreak outside the Arab Peninsula was caused. The outbreak was linked to the return of a traveler from the Arab Peninsula. Countries across Europe, Asia, North Africa, the Middle East, and the US have also reported cases of patients who have been either moved to treatment or who have become ill after their return from the Middle East [21].

3.1 Transmission of MERS-CoV

MERS-CoV may also be transferred through direct contact, respiratory droplets (particles > 5 micrometers) or aerosols (particles < 5 micrometers) from one person to another. The development of infection in people whose only risk was close contact with people who had MERS has been identified as a person-to-person transmission [21]. The MERS-CoV reservoir is supposed to be dromedary camels, but the mechanism of transmission from camels to humans is unknown. Many cases were identified as direct transmission between people and humans in health facilities. If MERS is suspected in a patient, steps to prevent the transmission of infection in the healthcare sector must be undertaken promptly [21].

4. COVID-19

Coronaviruses are a broad family of viruses that cause disease from the common cold to more severe diseases like Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome. COVID-19 is an unexplained modern mutation of human beings. The COVID-19 source is still unknown although the initial cases were related to the Huanan South China Seafood Market. While many of the early patients worked in or visited the market, none of the exported cases came into contact with the market, suggesting either human to human transmission or a more widespread animal source [22]. In addition to seafood, social media sources report that the Huanan South China Market has sold snakes, birds, and other small mammals, marmot, and bat. The WHO announced that environmental samples taken from the marketplace have reported positive for the novel coronavirus but no specific animal association has been identified [22]. An initial report indicated that snakes may be the potential source based on codon use [23], but others rejected the claim [24]. Researchers are currently working on defining the COVID-19 source, including possible animal intermediate vectors.

The appearance of SRAS and MERS-CoV is the product of a zoonotic reservoir. In 2002, SARS-CoV, the first highly pathogenic human coronavirus, was introduced with the animal-to-human transmission in wet markets. SARS-CoV viral RNA was found in both palm civets and raccoon dogs sold in these wet markets [25]. SARS-CoV was however not present in animals and it appeared that the intermediate reservoirs of those species were an adapted virus for infecting humans more efficiently. Further surveillance efforts in bat species have reported closely associated coronaviruses [26]. More recent research has shown that many bat coronaviruses can infect human cells without needing intermediate adaptation [27,28]. Furthermore, human serology data show bat coronavirus protein recognition and suggest that low-level zoonotic transmission of SARS-like bat coronavirus occurs beyond recognized outbreaks [29]. MERS-CoV also has a zoonotic virus with possible bat origins [30,31], but camel contact and endemic infection are commonly recorded in the primary MERS-CoV cases [32]. The epidemic was significantly reduced by strict quarantine and elimination in SE Asia of live markets for SARS-CoV. A similar solution to MERS-CoV was not feasible due to the cultural value of camels, and occasional outbreaks in the Middle East remain. These SARS and MERS lessons highlight the importance of the ongoing outbreak to rapidly determine the source of the COVID-19 disease**.**

4.1 Update Situation of COVID-19

As of 9 April 2020, 79,385 people had died so far from the COVID-19 coronavirus outbreak.1, 356,780 confirmed cases occurred in 206 countries and territories (Fig. 1) [33]. It is important to emphasize that there is an underreporting of these numbers due to the lack of diagnosis in many countries.

4.2 Transmission of COVID-19

Many domestic and wild animals may serve as coronavirus hosts, including camels, cattle, cats, and bats [34]. Animal coronaviruses usually are not known to spread among humans [35]. There are exceptions, however, such as SARS and MERS, which are transmitted by cough or sneezing primarily by close contact with infected people by respiratory droplets. Regarding COVID-19, early patients were confirmed to have some link to the Huanan Seafood Market in Wuhan, China, indicating that these early infections were due to transmission from animal to human. Nonetheless, later cases among medical staff and others with no history of exposure to that market or visiting Wuhan were recorded, which was taken as an indication of human-to-human transmission [11,36-39].

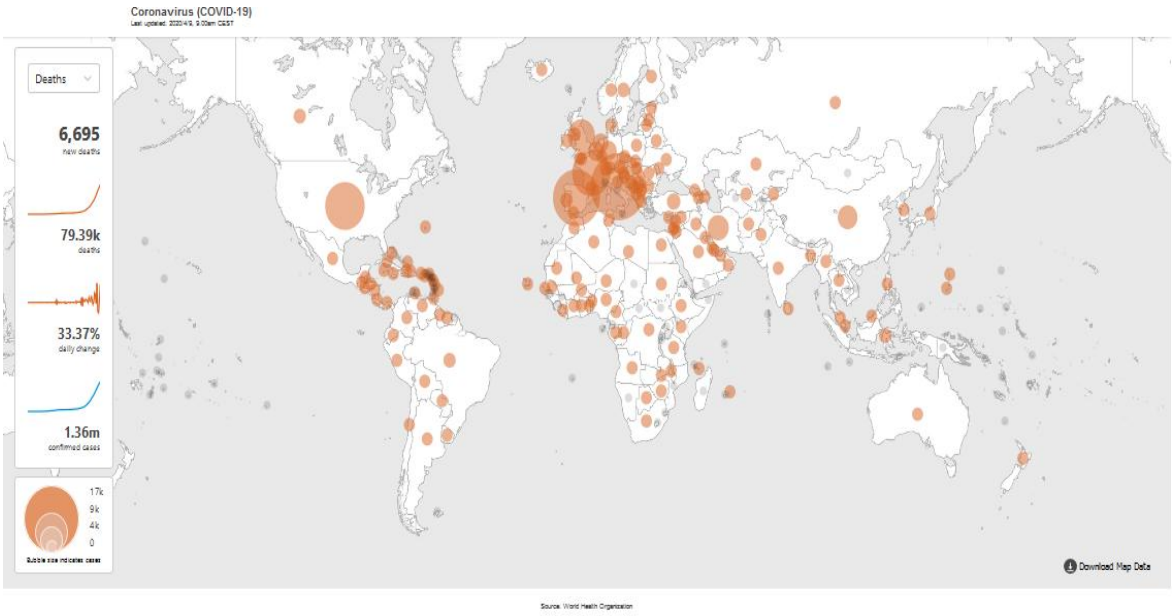

Fig. 1. Coronavirus disease (COVID- 19) update situation (According to 9 April 2020)

Table 1. Potential treatment options of COVID-19

Classes	Potential treatment options	Reference
Anti-viral	> 85% of patients received antiviral agents, including oseltamivir (75 mg every 12 h orally), ganciclovir (0.25 g every 12 h intravenously) and lopinavir / ritonavir tablets (400/100 mg twice daily). Remdesivir is currently being evaluated and known to prevent MERS-COV in more than 10 medical establishments in Wuhan.	[44]
Anti-malarial	An ancient antimalarial, chloroquine phosphate, has been effective in inhibiting the exacerbation of pneumonia due to its anti-viral and anti-inflammatory activity.	[45]
Herbal treatments	Traditional Chinese medicine has been widely used during the last SARS-COV outbreak and is currently being used in China. The five most commonly used herbs were *Astragali Radix* (Huangqi), *Glycyrrhizae Radix Et Rhizoma* (Gancao), *Saposhnikoviae Radix* (Fangfeng), *Atractylodis Macrocephalae Rhizoma* (Baizhu), and *Lonicerae Japonicae Flo.*	[46]

Chinese health authorities 'new guidelines outlined three primary transmission routes for COVID-19: 1) transmission of droplets, 2) transmission of contacts and 3) transmission of aerosols. Transmission of droplets has been documented when respiratory droplets (as formed when an infected person coughs or sneezes) are ingested or inhaled in close proximity by people nearby; the transmission of contact can occur when an individual touches a virus- surface or object and then touches his or her mouth, nose, or eyes; and transmission of aerosols can occur when inhaled high dose of aerosols into the lungs in a relatively closed environment [34,40].

4.3 Clinical Manifestation and Diagnosis of COVID-19

The complete clinical consequence is not yet apparent, because the symptoms recorded vary from mild to extreme with even death in some [35]. The complete clinical consequence is not yet apparent, because the symptoms recorded vary from mild to extreme with even death in some reported include headache, diarrhea,

Table 2. Clinical trials identified at Clinicaltrials.gov related to drug repositioning for COVID-19 treatment [47]

Intervention	Clinical Condition	Sponsor	N° test/Status	Beginning/ Estimated end	Phase
Hydroxychloroquine	30 participants with pneumonia caused by 2019-nCoV	Shanghai Public Health Clinical Center	NCT04261517 /Recruiting patients	6-2-2020 /31-12-2020	3
Chloroquine	10000 participants in a prophylaxis study for COVID-19	University of Oxford	NCT04303507 / Not yet recruiting	May 2020 / May 2022	N/A
Human immunoglobulin	Pneumonia caused by 2019-nCoV with 80 participants	Peking Union Medical College Hospital	NCT04261426 / Not yet recruiting patients	10-2-2020 / 30-06-2020	2 and 3
Remdesivi	Severe respiratory infection caused by 2019-nCoV with 452 participants	Capital Medical University	NCT04257656 / Recruiting patients	6-2-2020 / 31-05-2020	3
Remdesivir	308 participants with mild/moderate respiratory infection caused by 2019-nCoV	Capital Medical University	NCT04252664/ Recruiting patient	05-02-2020 / 27-04-2020	3
Arbidol (umifenovir)	Pneumonia caused by 2019-nCoV with 380 participants	Jieming QU, Ruijin Hospital	NCT04260594 / Not yet recruiting patients	7-02-2020 / 30-12-2020	4
Arbidol or lopinavir-ritonavir or oseltamivir	400 participants infected with2019-nCoV	Tongji Hospital	NCT04255017 / Recruiting patients	01-02-2020 / 01-07-2020	4
Arbidol or lopinavir-ritonavir	125 participants infected with 2019-nCoV	Guangzhou 8th People's Hospital	NCT04252885 / Recruiting patients	28-01-2020 / 31-07-2020	4
Darunavir-cobicistat combination	Pneumonia caused by 2019-nCoV with 30 participants	Shanghai Public Health Clinical Center	NCT04252274 / Recruiting patients	30-01-2020 / 31-12-2020	3
TCM combination with lopinavir-ritonavir, α-interferon via aerosol	150 participants infected with 2019-nCoV	Beijing 302 Hospital	NCT04251871 / Recruiting patients	22-01-2020 / 22-01-2021	N/A
Recombinant human interferon α2β	328 participants with COVID-19	Tongji Hospital	NCT04293887 / Not yet recruiting	01-03-2020 / 30-06-2020	1
Carrimycin or lopinavir-ritonavir or arbidol or chloroquine phosphate	520 participants with COVID-19	Beijing YouAn Hospital	NCT04286503 / Not yet recruiting	23-02-2020 / 28/02-2021	4

Intervention	Clinical Condition	Sponsor	N° test/Status	Beginning/ Estimated end	Phase
Danoprevir-ritonavir and interferon inhalation or lopinavir-ritonavir or TCM plus interferon inhalation	50 participants with pneumonia caused by 2019-nCoV	The Ninth Hospital of Nanchang	NCT04291729 / Recruiting	14-02-2020 / 30-04-2020	4
Xiyanping or lopinavir-ritonavir-interferon inhalation	384 participants with pneumonia caused by 2019-nCoV	Jiangxi Qingfeng Pharmaceutical Co. Ltd.	NCT04275388/Not yet recruiting	19-02-2020 / 14-12-2020	N/A
Xiyanping combined with lopinavir-ritonavi	80 participants with COVID-19	Jiangxi Qingfeng Pharmaceutical	NCT04295551 / Not yet recruiting	14-03-2020 / 14-04-2021	N/A
Combinations of oseltamivir, favipiravir, and chloroquine	80 participants with COVID-19	Rajavithi Hospital	NCT04303299 /Not yet recruiting	15-03-2020 / 30-11-2020	3
Thalidomide	40 participants with COVID-19	First Affiliated Hospital of Wenzhou Medical University	NCT04273581 / Not yet recruiting	18-02-2020 / 30-05-2020	2
Thalidomide	100 participants with pneumonia caused by 2019-nCoV	First Affiliated Hospital of Wenzhou Medical University	NCT04273529 / Not yet recruiting	20-02-2020 / 30-06-2020	2
Vitamin C	140 participants with severe pneumonia caused by 2019-nCoV	Zhi Yong Peng	NCT04264533 / Recruiting	14-02-2020 / 30-09-2020	2
Methylprednisolone	80 participants infected with2019-nCoV	Peking Union Medical College Hospital	NCT04244591 / Recruiting patients	26-01-2020 / 25-12-2020	2
Pirfenidone	294 participants with severe pneumonia caused by 2019-nCoV	Huilan Zhang	NCT04282902 / Recruiting	04-02-2020 / 01-06-2020	3
Bromhexine hydrochloride	60 participants with suspected and mild pneumonia caused by 2019-nCoV	Second Affiliated Hospital of Wenzhou Medical University	NCT04273763 / Enrolling by invitation	16-02-2020 / 30-04-2020	N/A
Bevacizumab	20 participants with severe COVID-19 pneumonia	Qilu Hospital of Shandong University	NCT04275414 / Recruiting	February 2020 / May 2020	2 and 3
Fingolimod	30 participants with COVID-19	1° Affiliated Hospital of Wenzhou Medical University	NCT04280588 / Recruiting	22-02-2020 / 01-06-2020	2

hemoptysis, runny nose, and phlegm-producing cough [35,41]. Patients with mild symptoms have been reported to recovery after 1 week and serious cases of alveolar damage to the virus have been reported to lead to death. The cases of death were mainly patients of medium age and older adults with preexisting conditions (tumors, cirrhosis, hypertension, heart artery disease, diabetes, and Parkinson's) [42]. The recommendations for case identification list the following symptoms: fever, drop in lymphocytes and white blood cells, new pulmonary infiltration of chest x-rays and no progress in symptoms after 3 days of antibiotic treatment [36].

4.4 Old Tricks and New Challenges in Treating COVID-19

No vaccine or special antiviral drug protocol is currently used to treat seriously ill patients. Patient management focuses primarily on providing treatment, e.g. oxygenation, ventilation, and fluid control. As part of a vital management phase of COVID-19, combined treatment of low dose systemic corticosteroids and anti-viral and interferon atomization was encouraged [43]. Table 1 also included other recorded therapeutic drugs used for treating seriously ill patients.

4.5 Clinical Trials for COVID-19 Treatment on Drug Repositioning

A study listed 24 clinical trials (Table 2), in which 19 clinical phase 2, 3, or 4 studies were performed.The eligibility requirements for the retrieved studies were: include a base identification number for clinicaltrials.gov; describe the number of participants and the timeframe for study; describe the clinical conditions of the participants, and use treatments with medicines already tested or approved for any other disease in patients infected with the novel coronavirus SARS-CoV-2 (2019-nCoV). Clinical trials may be an effective technique as they promote the development of new groups of medicines; they are cost-effective and require less time to market; and pharmaceutical supply chains exist for manufacturing and distribution [47].

4.6 Prevention of COVID-19

Preventive approaches concentrate on patient isolation and careful infection management, including effective screening and clinical care steps to be followed for infected patients. For example, during specimen collection droplets, touch and airborne precautions should be taken and sputum induction avoided.

The general guidelines of WHO and other organizations have issued the following general recommendations [48]:

- Avoid close contact with people suffering from acute respiratory infections.
- Wash your hands frequently, particularly after contact with infected people.
- Avoid unprotected farm and wild animal contact.
- People with acute airway symptoms should stay a little away, cover their coughs or sneezes with disposable tissues, and wash their hands with sanitizer or soaps.
- Strengthen the implementation of appropriate hygiene procedures for the prevention and control of diseases, in particular in emergency medicine departments.
- Immunosuppressed people can prohibit public meetings.

The most effective technique for the population is to wash their hands regularly and use portable hand sanitizing to avoid contact with their face and mouth after engaging with an area that is possibly polluted. Health workers caring for infected people should make use of contact and airborne precautions which include PPE masks, eye protection, gowns and gloves, such as N95 or FFP3 masks, to avoid pathogen transmission. Scientific research is going to develop a vaccine for coronavirus [48].

5. CONCLUSION

In the context of rapidly increasing outbreaks of COVID-19, proactive steps by long-term care facilities are required to recognize and eliminate potentially infected staff and visitors, actively track potentially infected patients and enforce effective infection prevention and control measures to prevent COVID-19. Scientific researchers conduct numerous clinical trials related to drugs that can be an important strategy because they promote the development of new classes of medicines and I hope these repositioning trials will help to identify alternatives for COVID-19 treatment.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Wuhan Municipal Health Commission. Report of clustering pneumonia of unknown etiology in Wuhan City. Wuhan, China: Wuhan Municipal Health Commission.(In Chinese); 2019
   Accessed: 31 December 2019.
   Available:http://wjw.wuhan.gov.cn/front/web/showDetail/2019123108989.
2. WHO. Novel coronavirus – China. Geneva, Switzerland: World Health Organization; 2020.
   (Accessed: 12 January 2020)
   Available: https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/
3. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. The Lancet. 2020; 395(10223):470-3.
4. Hui DS, I Azhar E, Madani TA, Ntoumi F, Kock R, Dar O, et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health—The latest 2019 novel coronavirus outbreak in Wuhan, China. International Journal of Infectious Diseases. 2020;91:264-6.
5. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. China Novel Coronavirus Investigating and Research Team. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020; 382(8):727-33.
6. Cheng VC, Lau SK, Woo PC, Yuen KY. Severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection. Clinical Microbiology Reviews. 2007;20(4):660-94.
7. Chan JF-W, Kok K-H, Zhu Z, Chu H, To KK-W, Yuan S, et al. Genomic characterization of the 2019 novel human-pathogenic coronavirus isolated from a patient with atypical pneumonia after visiting Wuhan. Emerging Microbes & Infections. 2020;9(1):221-36.
8. Tan W, Zhao X, Ma X, Wang W, Niu P, Xu W, et al. A novel coronavirus genome identified in a cluster of pneumonia cases—Wuhan, China 2019− 2020. China CDC Weekly. 2020;2(4):61-2.
9. Paules CI, Marston HD, Fauci AS. Coronavirus infections—more than just the common cold. Jama. 2020;323(8):707-8.
10. Chowell G, Abdirizak F, Lee S, Lee J, Jung E, Nishiura H, et al. Transmission characteristics of MERS and SARS in the healthcare setting: a comparative study. BMC medicine. 2015;13(1): 210.
11. HuangCL W. Clinicalfea- tures of patients infected with 2019 novel coronavirus in Wuhan. China. 2020;395(10223):497-506.
12. Chan JF-W, Yuan S, Kok K-H, To KK-W, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. The Lancet. 2020;395(10223): 514-23.
13. Tsang KW, Ho PL, Ooi GC, Yee WK, Wang T, Chan-Yeung M, et al. A cluster of cases of severe acute respiratory syndrome in Hong Kong. New England Journal of Medicine. 2003;348(20):1977-85.
14. Peiris J, Lai S, Poon L, Guan Y, Yam L, Lim W, et al. Coronavirus as a possible cause of severe acute respiratory syndrome. The Lancet. 2003;361(9366): 1319-25.
15. Siu A, Wong YR. Economic impact of SARS: The case of Hong Kong. Asian Economic Papers. 2004;3(1):62-83.
16. WHO. SARS (Severe Acute Respiratory Syndrome)
    Accessed: 7 April 2020.
    Available:https://www.who.int/ith/diseases/sars/en/
17. Peiris JS, Yuen KY, Osterhaus AD, Stöhr K. The severe acute respiratory syndrome. New England Journal of Medicine. 2003; 349(25):2431-41.
18. Scales DC, Green K, Chan AK, Poutanen SM, Foster D, Nowak K, et al. Illness in intensive care staff after brief exposure to severe acute respiratory syndrome. Emerging Infectious Diseases. 2003; 9(10):1205.
19. Donnelly CA, Ghani AC, Leung GM, Hedley AJ, Fraser C, Riley S, et al. Epidemiological determinants of spread of causal agent of severe acute respiratory syndrome in Hong Kong. The Lancet. 2003;361(9371):1761-6.
20. WHO. Middle East respiratory syndrome coronavirus (MERS-CoV); 2020.
    Accessed: 27 March 2020.

Available:https://www.who.int/emergencies/mers-cov/en/

21. Tesini BBL. Coronaviruses and Acute Respiratory Syndromes (COVID-19, MERS, and SARS),MD, University of Rochester School of Medicine and Dentistry; 2020.
(Accessed: 27 March 2020)
Available:https://www.msdmanuals.com/professional/infectious-diseases/respiratory-viruses/coronaviruses-and-acute-respiratory-syndromes-covid-19,-mers,-and-sars
22. World Health Organization Novel Coronavirus—Japan (ex-China); 2010.
(Accessed: 29 March 2020)
Available:https://www.who.int/csr/don/16-january-2020-novel-coronavirus-japan-ex-china/en/
23. Ji W, Wang W, Zhao X, Zai J, Li X. Homologous recombination within the spike glycoprotein of the newly identified coronavirus may boost cross-species transmission from snake to human. J Med Virol; 2020.
24. Robertson D. JX. nCoV's Relationship to Bat Coronaviruses and Recombination Signals No Snakes; 2020.
(Accessed 28 March 2020)
Available:http://virological.org/t/ncovs-relationship-to-bat-coronaviruses-recombination-signals-no-snakes/331. 2020.
25. Kan B, Wang M, Jing H, Xu H, Jiang X, Yan M, et al. Molecular evolution analysis and geographic investigation of severe acute respiratory syndrome coronavirus-like virus in palm civets at an animal market and on farms. Journal of Virology. 2005;79(18):11892-900.
26. Lau SK, Woo PC, Li KS, Huang Y, Tsoi H-W, Wong BH, et al. Severe acute respiratory syndrome coronavirus-like virus in Chinese horseshoe bats. Proceedings of the National Academy of Sciences. 2005;102(39):14040-5.
27. Menachery VD, Yount Jr BL, Debbink K, Agnihothram S, Gralinski LE, Plante JA, et al. A SARS-like cluster of circulating bat coronaviruses shows potential for human emergence. Nature medicine. 2015;21(12): 1508.
28. Menachery VD, Yount BL, Sims AC, Debbink K, Agnihothram SS, Gralinski LE, et al. SARS-like WIV1-CoV poised for human emergence. Proceedings of the National Academy of Sciences. 2016; 113(11):3048-53.
29. Wang N, Li S-Y, Yang X-L, Huang H-M, Zhang Y-J, Guo H, et al. Serological evidence of bat SARS-related coronavirus infection in humans, China. Virologica Sinica. 2018;33(1):104-7.
30. Anthony SJ, Gilardi K, Menachery V, Goldstein T, Ssebide B, Mbabazi R, et al. Further evidence for bats as the evolutionary source of Middle East respiratory syndrome coronavirus. MBio. 2017;8(2):e00373-17.
31. Quan P-L, Firth C, Street C, Henriquez JA, Petrosov A, Tashmukhamedova A, et al. Identification of a severe acute respiratory syndrome coronavirus-like virus in a leaf-nosed bat in Nigeria. MBio. 2010;1(4): e00208-10.
32. Azhar EI, El-Kafrawy SA, Farraj SA, Hassan AM, Al-Saeed MS, Hashem AM, et al. Evidence for camel-to-human transmission of MERS coronavirus. New England Journal of Medicine. 2014; 370(26):2499-505.
33. WHO. Coronavirus disease (COVID-19); 2020.
(Accessed: 9 April 2020)
Available:https://who.sprinklr.com/.
34. National Health Commission of People's Republic of China. Prevent guideline of 2019-nCoV; 2020.
(Accessed: 28 March 2020)
Available:http://www.nhc.gov.cn/xcs/yqfkdt/202001/bc661e49b5bc487dba182f5c49ac445b.shtml
35. CDC. 2019 Novel coronavirus, Wuhan, China; 2020.
(Accessed: 28 March 2020)
Available:https://www.cdc.gov/coronavirus/2019-nCoV/summary.html
36. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. New England Journal of Medicine; 2020.
37. WHO. Novel Coronavirus–China; 2020.
(Accessed: 28 March 2020)
Available:https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/.
38. Liu T, Hu J, Xiao J, He G, Kang M, Rong Z, et al. Time-varying transmission dynamics of Novel Coronavirus Pneumonia in China. bioRxiv; 2020.
39. Gralinski LE, Menachery VD. Return of the Coronavirus: 2019-nCoV. Viruses. 2020; 12(2):135.

40. National Health Commission of People's Republic of China. Pneumonia diagnosis and treatment of 2019-nCoV infection from Chinese NHC and CDC; 2020. (Accessed: 27 March 2020) Available:http://www.nhc.gov.cn/xcs/zhengcwj/202001/4294563ed35b43209b31739bd0785e67/files/7a9309111267475a99d4306962c8bf78.pdf.
41. 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. The Lancet. 2020; 395(10223):497-506.
42. Li T, Wei C, Li W, Hongwei F, Shi J. Beijing Union Medical College Hospital on pneumonia of novel coronavirus infection diagnosis and treatment proposal. Med J Peking Union Med Coll Hosp; 2020.
43. Liu Y, Li J, Feng Y. Critical care response to a hospital outbreak of the 2019-nCoV infection in Shenzhen, China. BioMed Central; 2020.
44. Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges. International Journal of Antimicrobial Agents. 2020;105924.
45. Gao J, Tian Z, Yang X. Breakthrough: Chloroquine phosphate has shown apparent efficacy in treatment of COVID-19 associated pneumonia in clinical studies. Bioscience trends; 2020.
46. Luo H, Tang Q-l, Shang Y-x, Liang S-b, Yang M, Robinson N, et al. Can Chinese medicine be used for prevention of corona virus disease 2019 (COVID-19)? A review of historical classics, research evidence and current prevention programs. Chinese Journal of Integrative Medicine. 2020;1-8.
47. Rosa SGV, Santos WC. Clinical trials on drug repositioning for COVID-19 treatment. Revista Panamericana de Salud Pública. 2020;44.
48. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and TreatmentCoronavirus (COVID-19). Stat Pearls [Internet] StatPearls Publishing; 2020.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/56168