ORIGNAL ARTICLE

COVID-19 China epidemic, characteristics of SARS-CoV-2, its transmission and prevention

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Abstract

The novel coronavirus 2019 renamed by WHO as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerges in Wuhan, China 2019 affected large population across the world and become a serious general public health issue. According to WHO 462684 new cases with 20834 deaths were reported at 26 March 2020. WHO declared COVID-19 as sixth public health emergency globally. The emergence of SARS-CoV-2 was directly linked with exposure to bats and sea food animal markets and according to phylogenetic analysis close resemblance to bat derived coronaviruses. It was directly transmitted from animals to human, and now it is potentially transmitted by human-to-human close contact or via droplets of sneezing and coughing. As the basic reproduction number (R_0) is 2.24-3.58, therefore it has a remarkable potential to spread among population with incubation period of 6 days. The main clinical signs and symptoms of pneumonia caused by SARS-CoV-2 are fever, cough, myalgia and diarrhea. Chest computed tomography indicated the involvement of bilateral lungs and ground glass opacity. SARS-CoV-2 entered into human cells via binding to ACE-2 (Angiotensin converting enzymes-2), replicated and spread within body. The antiviral, empirical antibiotics, intravenous immunoglobulin are suggested as symptomatic treatment of SARS-CoV-2. Specific treatment and vaccines are still not available against COVID-19. Therefore, there is a need to aggressively adopt primary preventive measures to combat this epidemic with corporation of governments, health care providers and public.

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Introduction

The 2019 novel coronavirus (2019-nCoV) infection was emerged in Wuhan, China in December 2019 (Lu et al.), rapidly spread in China and across other near and far countries of globe (Thompson, 2020). Globally total number of confirmed new cases in the world were at 26-27th March 2020, 462 684 with 20 834 deaths. This epidemic infectious disease caused by (2019-nCoV) was renamed by WHO on 11 February 2020 as coronavirus disease (COVID-19). The scientific community and virologist members of The International Committee on Taxonomy of Viruses officially named this novel virus as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) (Gorbalenya, 2020). This name was selected due to genetic resemblance of this novel virus to coronavirus responsible for SARS 2003 epidemic infection. In some early studies the link between animal markets and this epidemic infection is reported responsible for animal to human transmission. Now a days many studies reporting the transmission of SARS-CoV-2 via human to human possible transmission via respiratory droplets, personnel contact and may also acquire from hospitals (suspected in 41% of cases) (Wang et al., 2020b). The rapidly increasing number of incidences by this infection and its swift

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transmission in humans through asymptomatic carrier holds a strong capability for pandemic (Carlos et al.). As it is effectively and conveniently transmitted through human-to-human contact, therefore global travelling is responsible for its worldwide spread. WHO declared Coronavirus epidemic as sixth public health emergency of international concern after Ebola and Zika infections among the world. Therefore there is need of co-corporation among government, public and health workers to minimize its spread (Yoo, 2019).

Characteristics of SARS-CoV-2: Viruses involved in pathogenesis of pneumonia are rhinovirus, human bocavirus, adenovirus, parainfluenza virus 1/2/3, coronavirus 229E/NL63/OC43 and human metapneumovirus (Su et al., 2019). These viruses in conjunction with bacteria can cause community acquired pneumonia. The role of these viruses in pneumonia is evident from previous studies after development of molecular methods (Lee et al., 2019). A Betacronavirus SARS-Cov-2 is a single-stranded RNA virus which is positive sense (Kandeil et al., 2019; Zhu et al., 2020). According to phylogenetic analysis SARS-CoV-2 has 88-89 % genetic similarity to bat derived coronaviruses (bat-SL-CoVZC45 and bat- SL-CoVZXC21), 98.7% similarity in nucleotide of partial RNA-dependent RNA polymerase gene of horseshoe bats coronavirus (BtCoV/4991), 79% similarity to SARS-CoV and 50% similarity to Middle East respiratory syndrome coronavirus (MERS-CoV). SARS-CoV-2 isolated from pneumonia cases during Wuhan epidemic were identified by RNA-based metagenomic next- generation sequencing (Lu et al., 2020). The length of its entire genome is 29881bp. SARS-CoV-2 has epileptic shape with approximate diameter of 60-140 nm (Chen et al., 2020). ORF1a/1b, S and N genes based evolutionary analysis suggested that novel SARS-CoV-2 was transmitted from animals to human independently. It is reported that SARS-CoV-2 is transmitted from bats and live seafood animals in markets of Wuhan and surrounding areas (Zhou et al., 2020). Lipid dissolving solvents (like ethanol, ether, peroxyacetic acid and chloroform), heat and ultraviolet rays are effective against its activation (Cascella et al., 2020).

Epidemiology: According to data collected from Wuhan, China from 10 to 24 January 2020, the incidences of COVID-19 increased exponentially with mean basic reproduction number (R_0) 2.24 with 2-8 fold steady rise in reporting rate (Zhao et al., 2020). It is estimated from another data collected from 31 December 2019 to 28 January 2020, (R_0) is 2.68 with doubling time 6.4 days of this epidemic. The incubation period of COVID-19 with asymptomatic transmission is ranging from 2.1-11.1 days with mean of 6.4 days (Wu et al., 2020). WHO declared the very high risk COVID-19 epidemic across the world. Although the situation is becoming more alarming and worse with increased number of cases in China and outside China. According to WHO situation dashboard 28 March 2020, COVID-19 affected 201 countries mainly including, China, Italy, United States of America, Spain, Germany, Islamic republic of Iran, France, United Kingdom, Switzerland, republic of Korea, Netherland, Austria, Belgium, Turkey, Canada, Saudi Arabia and Pakistan, with 512,701 confirmed cases and 23,495 deaths around the world. Highest numbers of confirmed cases are reported from China 82,093 with 3,298 deaths followed by Italy with 80,539 confirmed cases and 8,165 reported deaths, United States of America new confirmed cases 68,334 with 991 deaths. Key statistics provided by WHO showed 1197 new confirmed cases (highest number of cases reported between 22 March to 27 March) with 9 deaths. Germany (n=42288), Iran (n=32332), France (n=28786), United Kingdom (n=11662), Switzerland (n=10714), Republic of Korea (n= 9332), Netherlands (n=7431), Austria (n = 7029) (Figure 1). Now a days WHO and other scientists communities are working to establish countermeasures to minimize the devastating effects COVID-19 epidemic. Health organization and scientist are working to develop preventive, therapeutic and novel diagnostic strategies to mitigate the outcomes COVID-19 epidemic. Only symptomatic and supportive treatments are available, therefore there is critical need for prevention via minimizing transmission in community. Isolation measures adopted by China significantly reduced the number of reported cases as compare to previous data. In Pakistan and Italy health and political authorities making endless efforts to stimulate health system to ensure preventive, diagnostic and therapeutic strategies.

Clinical Sign and symptoms: Major Clinical features demonstrated by large scale clinical studies in Wuhan, of COVID-19 pneumonia in patients caused by SARS-CoV-2 are fever(97-98%), cough (60-81%), Dyspnea (31-55%), sputum production (26-28%), Myalgia (34-43%), headache (6.5-8.1%), diarrhea (2-10%), Rhinorrhea and sore throat (Wu et al., 2020). In light of previous reports it is observed that most of the patients affected by SARS-Cov-2 were adults above 18 years of age and mostly males (62%) (Wang et al., 2020b). In Beijing 13 cases of COVID-19 were reported among them 2 patients were of age of 2-15 years (Chang et al., 2020). In China at 10 February 2020, above 20 cases of pediatric COVID-19 in the age range of 112-17 days were reported. It was reported that hypertension, diabetes mellitus and cardiovascular disease were underlying causes in adult patients (Bae, 2016). Although considerable uncertainties still exist regarding clinical manifestations require more research and investigations.

Table 1: Possible treatment options adopted to treat SARS-COV-2.

1: Antiviral (> 85% cases)		(Chen et al., 2020; Corman et al., 2020; Wang et al., 2020b)	
Name of drug	Strength	Route	Duration
Oseltamivir	75 mg	Oral	Every 12 hr
Ganciclovir	0.25 g	Intravenous	Every 12 hr
Lopinavir/ritonavir	400/100 mg	Oral	Twice daily
2: Empirical antibiotics (90%)			
3: Antifungal agents			
4: Intravenous immunoglobulin (Tian et al., 2020)			
5: Systemic steroids			
Potential drug candidates			
6: Neuraminidase inhibitors			
7: Remdesivir and Umifenovir (Wang et al., 2020a)			
8: Alpha-interferon (Cascella et al., 2020)			
9: DNA synthesis inhibitors :Tenofovir Disoproxil and Lamivudine			
10: Chloroquine			
11: Chinese traditional medicines (Sheahan et al., 2020)			
HuFeng JieDu or Lianhua Qing- wen capsules			
12: Angiotensin-converting enzyme 2 (ACE2)-based peptide, 3CLpro inhibitor (3CLpro-1)			
13: Vinylsulfone protease inhibitor, theoretically			
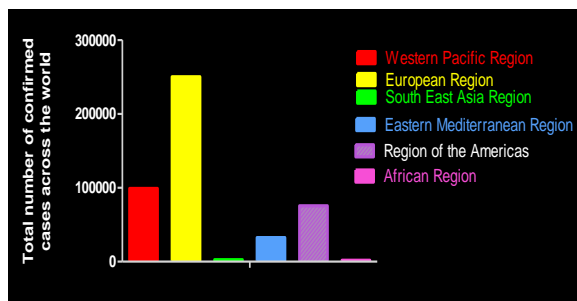
Fig. 1: Total number of reported cases across the world at 26th march 2020
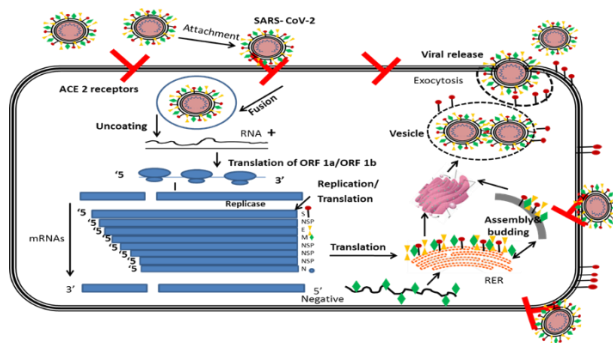
Fig. 2: Mechanism of SARS-COV-2 for the entry into human, angiotensin-converting enzyme 2 (ACE2) and endoplasmic reticulum (ER).

Radio imaging: SARS-Cov-2 presented variable radiological diagnostic reports of patients admitted in Wuhan local health authority, Wuhan Jinyintan Hospital and Zhongnan Hospital of Wuhan University. These findings showed the bilateral lung involvement in most of patients (75%) with common multilobe involvement (71%) (Chen et al., 2020; Wang et al., 2020b). The findings of chest computed tomography revealed the ground glass opacity and consolidation were common in these patients (86% and 29 & respectively) (Radhouane et al., 2013). Ground-glass opacity distributed peripherally in most of cases (86%) (Song et al., 2020).

Mode of transmission: The assumed main mechanism of COVID-19 transmission was independent transfer from animal to human, due to direct exposure of early patients to Huanan Seafood Wholesale Market in China (Lai et al., 2020). Although, subsequent new cases were not exposed to these markets. Consequently it was considered that SARS-CoV -2 could transfer from human to human and spread through asymptomatic persons in society (Cascella et al., 2020). Nevertheless, the evidences of transfer before appearance of symptoms in asymptomatic patients are rare but not excluded from risk. Moreover, it is suggested that asymptomatic persons can act as major source of COVID-19 spread. In the light of recently published few scientific studies, it is suggested that aggressive isolation measures would be excellent weapon to combat this epidemic. It is believed that like other pathogenic viruses, SARS-Cov-2 transmitted through droplets of coughing and sneezing. In closed spaces, aerosol transmission would be a possible cause of spread. It is analyzed from data collected in Wuhan, China that close contact with infected person is necessary for SARS-CoV-2 transmission and possibly transmitted between family members and health care professionals. According to initial investigations conducted by local CDCs and the China CDC, the incubation period (the duration between infection time and appearance of symptoms) is 3-7 days up to 12.5 days (Li et al.). It is estimated from initial data that this epidemic would be doubled after every 7 days and each patient could transmit this infection to further 2.2 individual (Bauch et al., 2005). This study demonstrated the findings of some

early studies; however, further investigations about mode of transmission, pathogenesis, incubation period and course & duration of infection are needed for batter understanding.

Mechanism of human transmission: Like other virus's coronaviruses have genes encoded for viral replication, formation of spike proteins and nucleocapsids in ORF1 downstream regions (Figure 2). These viruses attached to host surfaces via glycoproteins spikes at their outer surfaces and entered with in host cell through fusion of membrane, endosomal pathways (Raj *et al.*, 2013). The key receptors recognized by SARS-COV-2 are exopeptidase to enter human cells. Cellular proteases like cathepsin and human airway trypsin-like protease (HAT) are responsible for splitting of spike proteins and penetration modifications. SARS-CoV-2 has typical coronavirus structure with expression of polyproteins, membrane proteins, glycoproteins, papain like proteases, RNA polymerases and nucleoproteins. In receptor binding regions (RBD) SARS-CoV-2 has 3 dimensional structures of spikes to establish van der Waals attraction forces. Angiotensin converting enzyme 2 (ACE2) receptors contain 31 lysine residue which recognized 394 glutamine residues of SARS-CoV-2 at RBD region. The viral envelop fused with human cell membrane after conformational changes in spike proteins followed by binding to ACE2 receptors. After entry into host cell via endosomal pathway SARS-CoV-2 released its RNA and translated to viral replicase polyproteins pp1a and 1ab in host cell. These polyproteins undergo the process of cleaving by the action of viral proteinases. Continuous transcription by polymerase produced sub genomic mRNA which is translated into viral proteins. These viral proteins and RNA assembled into virions in endoplasmic reticulum and Golgi apparatus transported these in the form of vesicles and out of cell (Shereen et al., 2020).

Therapeutic strategies: COVID-19 infection has no particular antiviral treatment and availability vaccines until now. The reported cases in severe infection received symptomatic treatment and oxygen therapy. Mechanical ventilation refractory to oxygen therapy provided in case of respiratory failure along with hemodynamic support in management of septic shock (Lai et al., 2020). WHO released the document derived from previous scientific investigations to treat respiratory failure caused by human Crona viruses such as guidelines for mechanical invasive and noninvasive ventilation. Moreover there is an urgent need for development of effective treatment modalities to manage life threatening novel COVID-19 epidemic (Cascella et al., 2020). Treatment options adopted by health care providers to treat SARS-COV-2 in previous cases are listed in Table 1.

Prevention: In Hunan seafood market of Wuhan, China, different animals like snakes, palm civets and bats were sold. This novel Cronavirus was originated from this market and swiftly distributed into 202 countries. Although the zoonotic source of this virus in not clear, but sequence-based analysis demonstrated that the main source of transmission is bats. Now a day's scientist community is working to develop efficient treatment and diagnostic strategies to combat this epidemic. The decisions of authorities to bring back their nationals to their homeland from infected areas, poor diagnostic and screening techniques, and lack of diagnostic kits in developed as well as developing countries for these passengers lead to drastic spread of this infection. Such as like Pakistan, who received almost four thousands of Pakistani zaireen through Taftan-Zahdeen border from Iran significantly raised risk of spread in whole country. As the lack of screening of passengers returning to Pakistan from Iran, Dubai and other countries leading to a serious threat of coronavirus spread to Pakistan.

The process of development of vaccines against COVID-19 infection by various companies is under process and required 3-10 month for commercialization. But there is strict need to ban wild animals and birds as food.

The reproduction rate (R_0) of COVID-19 epidemic is 2.2, therefore as long as R_0 value is above 1, it will spread at very high rate. Therefore, adaptation of counter measure is necessary to reduce COVID-19 spread. The infected patient should be kept in isolation and preventive strategies should be adopted to control infection during diagnosis, specimen collection and provision of clinical care. WHO and other local organizations recommended the general guidelines to prevent spread of epidemic as: avoid direct contact to subjects suffering from respiratory tract infection and unprotected contact with animals. It is advised that frequent washing of hands with soap and use of portable hand sanitizers especially after contact with infected subjects will be effective to prevent infection spread. Unnecessary touching of eyes, mouth and face should be avoided. It is suggested that public gathering should be avoided and aggressive isolation measures should be adopted to minimize the epidemic spread. Health care providers providing care to infected persons must have to adopt airborne and contact precautions must wear eye covers, gowns, gloves and FFP3 masks.

Conclusions: The emergence of SARS-COV-2 and its spread to whole world, become a clinical intimidation among general public and health workers. The complete knowledge about this novel epidemic is limited as world is first time facing this novel epidemic. The process of designing therapeutic strategies like antiviral drugs and vaccines is under development and it will take time. Therefore, there is an urgent need of

aggressive preventive care via keeping social distancing and isolation to minimize human to human transmission. World health authorities are monitoring the situation and providing the guidelines to prevent the spread of this epidemic.

References

Bae JM 2016. A suggestion for quality assessment in systematic reviews of observational studies in nutritional epidemiology. *Epidemiology and health*, **38**.

Bauch CT, Lloyd-Smith JO, Coffee MP and Galvani AP, 2005. Dynamically modeling SARS and other newly emerging respiratory illnesses: past, present, and future. *Epidemiology*, 791-801.

Carlos W, Cruz D, Pasnick S and Jamil S, 2020. Novel Wuhan (2019-nCoV) Coronavirus. *American Journal of Respiratory and Critical Care Medicine,(ja).*

Cascella M, Rajnik M, Cuomo A, Dulebohn SC and Di Napoli R, 2020. Features, Evaluation and Treatment Coronavirus (COVID-19) StatPearls [Internet]: *StatPearls Publishing*

Chang D, Lin M, Wei L, Xie L, Zhu G, Cruz CSD and Sharma L, 2020. Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 patients outside Wuhan, China. *Jama*.

Chen L, Liu W, Zhang Q, Xu K, Ye G, Wu W, Zhong B, 2020. RNA based mNGS approach identifies a novel human coronavirus from two individual pneumonia cases in 2019 Wuhan outbreak. *Emerging microbes & infections, 9*(1), 313-319.

Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DK and Schmidt MLDK, 2020. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. *Eurosurveillance*, **25**(3).

Gorbalenya AE 2020. Severe acute respiratory syndrome-related coronavirus–The species and its viruses, a statement of the Coronavirus Study Group. *BioRxiv*.

Kandeil A, Gomaa M, Shehata MM, El-Taweel A, Kayed AE, Abiadh, Bagato O, 2019. Middle East respiratory syndrome coronavirus infection in non-camelid domestic mammals. *Emerging microbes & infections*, **8**(1): 103-108.

Lai CC, Shih TP, Ko WC, Tang HJ and Hsueh PR, 2020. 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*, 105924.

Lee SH, Ruan SY, Pan SC, Lee TF, Chien JY and Hsueh PR, 2019. Performance of a multiplex PCR pneumonia panel for the identification of respiratory pathogens and the main determinants of resistance from the lower respiratory tract specimens of adult patients in intensive care units. *Journal of Microbiology, Immunology and Infection.* **52**(6): 920-928.

Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y and Wong J, 2020. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *New England Journal of Medicine* .

Lu H, Stratton CW and Tang YW 2020. Outbreak of Pneumonia of Unknown Etiology in Wuhan China: the Mystery and the Miracle. *Journal of Medical Virology.*

Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Zhu N, 2020. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *The Lancet.* **395**(10224): 565-574.

Radhouane L, Fattouch S, Tlili I and Ilahy R, 2013. Antioxidant and polyphenol oxidase activity of some tunisian pearl millet (Pennisetum glaucum (L.) R. Br.) ecotypes. *Food*, **7**, 36-40.

Sheahan TP, Sims AC, Leist SR, Schäfer A, Won J, Brown AJ and Clarke MOAJ, 2020. Comparative therapeutic efficacy of remdesivir and combination lopinavir, ritonavir, and interferon beta against MERS-CoV. *Nature Communications*, **11**(1): 1-14.

Song F, Shi N, Shan F, Zhang Z, Shen J, Lu H and Shi Y, 2020. Emerging 2019 novel coronavirus (2019-nCoV) pneumonia. *Radiology*. 200274.

Su IC, Lee KL, Liu HY, Chuang HC, Chen LY and Lee YJ, 2019. Severe community-acquired pneumonia due to Pseudomonas aeruginosa coinfection in an influenza A (H1N1) pdm09 patient. *Journal of Microbiology, Immunology and Infection*. **52**(2): 365-366.

Thompson R 2020. Pandemic potential of 2019-nCoV. *The Lancet Infectious Diseases*. **20**(3): 280.

Tian X, Li C, Huang A, Xia S, Lu S, Shi Z and Wu Y, 2020. Potent binding of 2019 novel coronavirus spike protein by a SARS coronavirus-specific human monoclonal antibody. *Emerging microbes & infections*. **9**(1): 382-385.

Wang W, Xu Y, Gao R, Lu R, Han KR, Wu G and Tan W 2020. Detection of SARS- CoV-2 in different types of clinical specimens. *Jama.*

Wu JT, Leung K and Leung GM 2020. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. *The Lancet*. **395**(10225): 689-697.

Yoo J-H 2019. The fight against the 2019-nCoV outbreak: an arduous march has just begun. *Journal of Korean Medical Science*. **35**(4).

Zhao S, Lin Q, Ran J, Musa SS, Yang G, Wang W and He D, 2020. Preliminary estimation of the basic reproduction number of novel coronavirus (2019-

nCoV) in China, from 2019 to 2020: A data-driven analysis in the early phase of the outbreak. *International Journal of Infectious Diseases*. **92**: 214-217.

Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W and Huang CL 2020. Discovery of a novel coronavirus associated with the recent pneumonia outbreak in humans and its potential bat origin. *BioRxiv*.

Zhu N, Zhang D, Wang W, Li X, Yang B, Song J and Lu R 2020. China Novel Coronavirus Investigating and Research Team. A novel coronavirus from patients with pneumonia in China. 2019. *N Engl J Med*. **382**(8): 727-733.