The Response Measures to the Coronavirus Disease 2019 Outbreak in China

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For China, the coronavirus disease 2019 (COVID-19) outbreak is a major public health emergency with the fastest spread, the most extensive infection, and the hardest to contain over the past 70 years. The different organizations and institutions in China have taken unprecedented public health responses to interrupt the virus transmission in the past several months. The outbreak in China was under control, but the number of confirmed cases abroad is still rising. Coronavirus disease 2019 has presented a global pandemic. We summarized the response measures adopted by different organizations at different levels (country, province, and hospital) in China, such as setting up an effective integrated system for disease prevention and control, effective deployment of medical staff, adjusting measures according to local conditions, establishing Fangcang hospitals, strengthening scientific research on COVID-19, epidemic prevention knowledge education, mass rapid testing for severe acute respiratory syndrome coronavirus 2, and correct personal protection including high compliance of wearing masks, hoping to provide some help for disease control in some regions.

Keywords: China; COVID-2019; disease prevention and control; outbreak.

Since the emergence of the coronavirus disease 2019 (COVID-19) in Wuhan, China in December 2019, it has spread rapidly to all provinces of China and the global. As of December 20 2020, there were 95 716 confirmed cases in China and more than 70 million confirmed cases abroad. At present, the outbreak in China is under control, but the number of cases is still increasing abroad. The World Health Organization (WHO) has declared COVID-19 as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 with 9692 confirmed cases and declared the outbreak as a “global Pandemic” on March 11, 2020 with over 120 000 confirmed cases worldwide. Although the COVID-19 vaccine is being rolled out in many countries around the world, some therapeutic drugs are also being evaluated for the treatment of COVID-19: for example, remdesivir, favipiravir, monoclonal antibodies, corticosteroid, and anticoagulants [1]. Nevertheless, it is still important to adopt appropriate measures of prevention and control to limit the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In the past several months, the different organizations at different (country, province, and our hospital) levels in China have taken timely strong measures to control the outbreak of COVID-19, which played an important role during the pandemic.

THE RESPONSE MEASURES AT THE COUNTRY LEVEL

After the outbreak, the Chinese government responded quickly and actively deployed the work plan for the prevention and control of COVID-19. Multiple measures were taken to identify the virus early, reduce the spread of the virus, control the epidemic, and resume work and production. Our country’s rapid response was the crucial factor in stopping the spread of COVID-19 [2]. A timeline of response measures in China is shown in Figure 1 and outlined below.

First, the COVID-19 was classified as a category B infectious disease. Category B infectious diseases, such as severe acute respiratory syndrome, acquired immunodeficiency syndrome, and viral hepatitis, are strictly managed infectious diseases. After a category B infectious disease is confirmed, it must be reported directly through the Internet within (1) 6 hours after detection in cities and (2) no more than 12 hours in rural areas. The prevention and control measures were classified as category A. Category A infectious diseases include plague and cholera and are serious infectious diseases that require compulsory management. These cases must also be reported directly via the Internet within 2 hours after detection in cities and no more than 6 hours in rural areas. All departments and medical and health institutions at all levels might take preventive and control measures such as isolation and treatment of patients and isolation of medical observation of close contacts in accordance with the law [3]. Reports regarding the epidemic situation and supervision were strengthened. A system for reporting the daily number of confirmed COVID-19 cases were implemented nationwide on January 20, 2020 [4].

Second, the National Health Commission took the lead in establishing an effective integrated system for prevention and
control of COVID-19 with 32 member units. The working group includes epidemic prevention and control, medical treatment, scientific research, propaganda, foreign affairs, logistics support, and so on. The clear responsibilities, division of labor and cooperation, formed an effective cooperation for epidemic prevention and control [4].

Third, medical experts were sent to Wuhan to guide the infection prevention and medical treatment. According to the gradually in-depth understanding of COVID-19, the diagnosis and treatment schemes of COVID-19 were also constantly updated nationally (from version 1 to 7) [5]. Individualized treatment plans for severe cases were given, and we tried our best to reduce severe cases and death [5].

Fourth, scientific research on COVID-19 was encouraged, including the following: the source and route of transmission; the change of virulence; the transmissibility of the virus; pathology; viral nucleic acids; antibody detection; vaccine development; screening; evaluation of effective medicines; and therapeutic methods (such as interferon-alpha, lopinavir/ritonavir, remdesivir, chloroquine, arbidol, respiratory support, circular support, immunotherapy with tocilizumab, convalescent plasma therapy or immunoglobulins, thymosin, renal replacement therapy, and traditional Chinese medicinal therapy) [5–11].

Fifth, classified guidance was given to the measures of epidemic prevention and control in different regions and different populations. Professional training and safety protection were strengthened to prevent medical staff from infection. Various forms of education of the science popularization on disease prevention knowledge were taken to improve the people’s awareness and capacity of disease prevention. Travelers’ temperature checks, collection of clinical symptoms such as fever, cough, sore throat, chest pain, dyspnea, and high-risk travel history at airports, railway stations, bus stations, and docks were strictly implemented. Ventilation and disinfection measures in crowded places and closed vehicles such as planes and trains were strengthened. Everything possible was being done to ensure early discovery, early reporting, early quarantine, early diagnosis, and early treatment of confirmed and suspected cases, tracking management, medical observation, and temperature monitoring of close contacts. Guidelines were formulated to promote the steady and orderly resumption of work and production of enterprises and institutions during the post-outbreak period.

Sixth, to address the shortage of beds for patients waiting in line, Leishenshan Hospital with 1500 beds and Huoshenshan Hospital with 1000 beds for critical patients and a dozen of Fangcang hospitals with more than 10 thousand beds for mild to moderate patients were rapidly constructed and put into use. In this way, patients with mild to moderate COVID-19 did not have to be isolated at home, thus reducing the risk of infection among family members. More than 30 000 medical workers from other provinces and cities across the mainland of China arrived in Hubei province to lessen the burden of their comrades. The national telemedicine consultations for the critical ill patients with COVID-19 were carried out in the national telemedicine and Internet medical centers [12]. Working conditions and physical and mental health of medical staff and psychological health of the masses have also been a concern [13, 14].

Seventh, while faced with the severe epidemic situation, the government gave priority to funding for epidemic prevention and control and appropriately raised and allocated funds, with the focus on medical treatment, subsidies for medical staff and epidemic prevention workers, procurement of equipment and materials needed for epidemic prevention and control, and vaccine development. Since the outbreak of COVID-19, numerous warm-hearted people and companies all over the country, foreign students, and foreign friends have donated money and materials, together with the front-line medical staff, to provide support during the difficult period.

Eighth, the COVID-19 epidemic is the common enemy of mankind, and solidarity and cooperation are the most
powerful weapons to fight it. On January 12, 2020, China submitted viral genome sequence information to the WHO, released it in the Global Initiative on Sharing All Influenza Data (GISAID), and shared it with other countries. China has strengthened international exchanges and cooperation and offered assistance within its capacity to some countries and international organizations.

Ninth, the prevention and control of the epidemic is vital to life, and the resumption of work and production is vital to livelihood. After the epidemic situation eased, the Chinese government implemented a variety of measures including precise resumption of work and production at different levels in different regions and phased and targeted tax reduction policies to make overall arrangements for epidemic prevention and control and resumption of work and production, to achieve rapid economic recovery and growth. Under the current situation in China, our country will continue to regularly improve efforts in epidemic prevention and control to prevent a rebound of the epidemic. The focus of China’s response has also shifted from controlling local transmission to preventing imported cases. Anyone entering China was tested for SARS-CoV-2 and quarantined.

Tenth, the epidemic situation in China will still be sporadic, or even clustered in some areas, at present. Those in the general public are required to adhere to good hygiene practices such as wearing masks, washing hands frequently, frequent ventilation, and keeping 1-meter line distance in daily social contact. We strengthened virus nucleic acid testing of fever cases, cold-chain food workers, and other key populations as well as the environment of medical institutions, farmers’ markets, and other high-risk places, to achieve early detection, early reporting, and early warning. All localities prepare personnel and materials for emergency response. Once the epidemic situation is discovered, they can immediately launch emergency response and strive to control the epidemic within the shortest time [15].

THE RESPONSE MEASURES AT THE PROVINCIAL LEVEL

Sichuan is a populous and labor-exporting province in the western part of China. During prevention and control of the epidemic situation, we were faced with a large number of people returning home during the Spring Festival, large population mobility, high population density of transportation hubs, and tourist transport centers. In addition to continuing to implement the above-mentioned measures, other detailed measures were taken to prevent the spread of the COVID-19 since the first imported observational case from Hubei province has been reported on January 17, 2020. The timeline of response measures in Sichuan Province to COVID-19 is shown in Figure 2 and outlined below.

First, the working group of the joint prevention and control of COVID-19 in Sichuan province was established on January 22, 2020. The work was carried out in an orderly manner, including strengthening epidemic surveillance and detection, strengthening the training of personnel to recognize and treat cases, strengthening medical observation of close contacts, strengthening health emergency duty and emergency materials preparation, strengthening environmental sanitation improvements, and strengthening prompt publicity regarding the epidemic situation [16]. Sichuan province initiated a level-1 public health response to control COVID-19 on January 24, 2020.

Second, guidelines for the differentiated prevention and control of COVID-19 in different regions in Sichuan province was issued by the People's Government of Sichuan Province to promote epidemic prevention and control and economic and social development in the post-outbreak period. One hundred specific measures were refined according to the levels of epidemic risk in different regions (low-risk areas [disease-free areas], medium-risk areas [sporadic case areas], and high-risk areas [community outbreak areas and local epidemic areas]) [17].

Third, a total of 187 designated hospitals for medical treatment were identified. Every patient received individualized treatment.

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**Figure 2.** Timeline of response measures in Sichuan Province to coronavirus disease 2019 (COVID-19).
A total of 1463 medical staff from Sichuan province arrived in Hubei province to assist their comrades. Free treatment was provided to all patients with COVID-19. The Sichuan province took the lead in opening a 5G remote consultation system relying on West China Hospital, Sichuan University, which provided consultation guidance to confirmed or suspected COVID-19 patients in other hospitals [18]. To prevent and mitigate the psychological injury caused by the epidemic, the Sichuan psychological assistance hotline “96111,” WeChat public platform, and other platforms were opened to provide psychological assistance, policy consultation, and management of patients with severe mental illness.

Fourth, all of the enterprises that produced medicine, medical devices, and disinfectants quickly returned to work to ensure that the material needed for epidemic prevention and control was available. Emergency rescue channels were opened to ensure smooth transportation of personnel and materials.

Fifth, to minimize the risk of crowd gathering, all training institutions were suspended during the prolonged winter holiday, all entertainment places were closed, sports events were canceled or postponed, and the opening of all schools were delayed. The “Internet +” education was developed so that students would not be suspended from school.

Sixth, at present, the global epidemic continues to spread, and the prevention and control of the epidemic in China has become normalized. All departments across the province are vigilant, pay close attention to the new situation and trend of the epidemic, and promptly detect and properly dispose of sporadic cases, in order to prevent the spread of COVID-19. They also strengthened the inspection and quarantine of incoming cargo planes, goods, and express parcels and comprehensively investigate the risk of virus pollution in the production and operation places of meat and fish frozen products and cold-chain logistics. In view of the possible outbreak in autumn and winter this year, big data and other means are used to further enhance the capacity of epidemic analysis. We speed up to make up for the shortcomings of public health and effectively enhance our capacity to manage major public health emergencies [19].

Seventh, after the occurrence of sporadic cases in Pidu District of Chengdu, big data and other information means were used to accurately identify close contacts, and those close contacts were isolated for observation. Areas identified as high risk for COVID-19 were all under lockdown to reduce transmission. Approximately 900 000 residents of Pidu District were tested for SARS-CoV-2 nucleic acid within 24 hours. The high compliance of people wearing masks and testing nucleic acids led to the rapid control of the epidemic. Recent studies have also shown that wearing masks contribute to the control of COVID-19 [2, 20].

THE RESPONSE MEASURES AT THE HOSPITAL LEVEL

Our hospital, West China Hospital, Sichuan University, is a national center for the diagnosis and treatment of severe diseases in western China with 4300 beds and 260 000 admissions per year. It ranked comprehensive No. 2 in the overall ranking of Chinese hospitals for continuous 10 years. It was ranked 56th according to the scientific and academic achievements of all scientific institutions and universities in the world. Multiple measures were taken to prevent the spread of the COVID-19 since January 16, 2020.

First, on January 16, 2020, the emergency plan for prevention and control of COVID-19 in West China hospital, Sichuan University was formulated. At the same time, a leading group and expert panel were assembled to assign work including epidemic monitoring, disease pre-examination and separate examination, emergency management, medical treatment, clinical consultancy, staff training, and material reservation.

Second, on January 17, 2020, a 24-hour fever clinic was opened. Three-level triage was carried out as follows: level 1 triage - a fever pre-examination subdesk was set up in the outpatient department and the emergency department, which were completely separated from the information desk and equipped with infrared temperature monitors and handheld temperature guns to detect fever cases in real time; level 2 triage - temperature detection points were set up in each nurse’s station in the clinic, and the patient should be questioned about their travel history during the past month and the history of fever and respiratory symptoms. Once a fever patient was found, the patient and his/her companions were sent to the fever clinic by the department nurse or triage nurse. Patients and companions were asked about their travel history during the past month and the history of fever and respiratory symptoms in the last 2 weeks. The SARS-CoV-2 nucleic acid testing kits were urgently purchased to help diagnose COVID-19. Negative pressure intensive care unit isolation wards with 20 beds, isolation ward 1 with 80 beds, and isolation ward 2 with 88 beds in the Centre of Infectious Disease, West China Hospital were set up for critically ill patients and confirmed and suspected COVID-19 patients, respectively. A flowchart was used to check patients who were suspected to have COVID-19 and is shown in Figure 3; this chart was continuously improved and refined according to the epidemic situation. To reduce the risk of cross infection, the active area of patients with fever, route of radiological examination for common febrile patients, suspected or confirmed COVID-19 patients, admission route for suspected or confirmed COVID-19 patients, routine to fever clinic, general clinic, emergency department, and all inpatient buildings for medical staff and ordinary patients were set up separately. Different rooms for computed tomography examinations were also set up for highly suspected and confirmed COVID-19 patients and ordinary patients.

Third, the experts in infectious diseases, respiratory medicine, intensive care, cardiology, and clinical pharmacology...
from our hospital assessed the confirmed COVID-19 patients and made clinical treatment strategies together daily. Robotic systems were introduced in isolation wards to deliver meals and supplies to patients, reducing the risk of transmission. To cover the entire province, 5G technology was used for remote consultations for patients with COVID-19. The telephone and online outpatient services were opened to provide free services for the patients with fever, psychological disorder, and chronic diseases. The handbook of prevention and control of COVID-19 was written by the experts from West China Hospital, Sichuan University to guide the epidemic prevention and control in primary hospitals. Admission and surgery for all nonemergency patients were suspended during the outbreak period. A total of 175 medical workers and 69 experts from our hospital arrived in Hubei province and other designated hospitals in Sichuan province to assist their comrades.

Fourth, training was carried out on hand hygiene, wearing isolation gowns, and environmental disinfection for all medical staff, residents, and cleaning staff through online video or WeChat. Personal protective substance were effectively managed to avoid waste. The hospital staff volunteered to collect clinical symptoms and travel history of every staff member 3 times a day, in their spare time. Meals were distributed to every office, and it was not permitted to have meals in the hospital’s canteen. The general public received training on how to wear a mask correctly, how to sneeze, how to wash hands correctly,
when to wash hands, how to protect the eyes and face, the difference between disinfection products, and the conditions that were easily overlooked but could spread the virus. These training sessions were given via popular science books, online tutorials, videos, television, or WeChat.

Fifth, after the epidemic situation eased, the epidemic management in our hospital was normalized. The Center of Infectious Disease formulated a strategy of “combination of peaceetime and wartime” to optimize the admission and treatment process of patients. On the one hand, it can ensure the treatment of critically ill patients, on the other hand, it can ensure that patients with COVID-19 can be treated quickly if they appear again.

Sixth, after the occurrence of sporadic cases, all hospital staff, patients, and caregivers were required to properly wear masks and strictly enforce hand hygiene. Subsequently, the staff were required to undergo SARS-CoV-2 nucleic acid testing and reduce gatherings and business trips. All patients and their caregivers were required to undergo SARS-CoV-2 nucleic acid testing, and their temperature was checked 3 times a day. Furthermore, they provided early evaluation of patients suspected of having COVID-19.

CONCLUSIONS

Coronavirus disease 2019 is a new and highly contagious disease that is now a global pandemic, and a lot of things are not fully understood, which is a great challenge for the whole world. During the epidemic period, the lives of Chinese medical workers and the general public were seriously threatened and the national economy suffered heavy losses. Our measures of prevention and control of COVID-19 also constantly served as learning lessons, summing up experience and improving conditions. Although different countries have different national conditions, the epidemic prevention and control measures cannot be completely copied, but we hope some of our response measures can help some regions to control the epidemic. We believe that human beings will conquer COVID-19 in the end by working together.

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