Management Measures Implemented at the West China Hospital may help Prevent and Contain COVID-19 and Similar Outbreaks

Sijia Liu and Chengqi He

Department of Rehabilitation Medicine, West China Hospital, Sichuan University, Sichuan Province, PR China

Abstract

This article presents management processes for dealing with the novel coronavirus disease 2019 (COVID-19) outbreak at the West China Hospital of Sichuan University. From January to March 2020, the West China Hospital of Sichuan University established response structures and protocols, as well as integrated out-of-hospital resources, to deal with the COVID-19 outbreak. A total of 8066 patients were screened, and 345 COVID-19 patients were isolated for treatment. Hospital command systems, emergency management protocols, as well as process, space, and personnel management, strengthening material reserves, and social responsibility strategies were implemented. Outbreak management aspects that required improvement included estimates of the anticipated number of cases, timely collection of patient information and feedback on the effect of outreach and online consultation methods.

Effective management of public health crises by frontline tertiary hospitals is a challenge.[1] Since the outbreak of the novel coronavirus disease 2019 (COVID-19), the staff of the West China Hospital of Sichuan University, which is a large comprehensive hospital, introduced a series of response measures, including a hospital command system, and protocols for the management of emergency mechanisms, processes, space, personnel, and material resource allocation. In addition, within 3 days after the first COVID-19 patient was admitted (January 21, 2020), a research platform was established. These measures were based on the experience with the severe acute respiratory syndrome (SARS) outbreak as well as insights from the Wenchuan earthquake.[2,3] From the time the first case was admitted to the end of March 2020, a total of 8066 patients presented with COVID-19-like symptoms. Among them, 345 confirmed cases of COVID-19 were isolated for treatment; no deaths were observed. Herein, we describe the control measures adopted by the West China Hospital (institutional details are presented in supplementary materials).

Discussion

Hospital command system

Following the outbreak of COVID-19, the West China Hospital established a dual organizational structure, which included a leadership group and an expert consultation group. The leadership group was overseen by the president of the hospital who served as the overall group leader, while the vice-president served as the deputy group leader, as was the protocol at other similar institutions.[4] An expert consultation group was formed under the leadership group and included multidisciplinary experts in infectious, respiratory, critical, emergency, laboratory, and radiology medicine. Lastly, epidemic monitoring, triage, medical care, out-of-hospital consultation, personnel training, material reserve, and media response teams were established (Figure 1). Each group had a person in charge and a contact person. The groups were responsible for formulating operational processes in response to hospital situation and communicated via an online social platform (Wechat). Individuals in charge of each team solved problems during daily meetings.

Emergency management mechanisms

Given the requirements set forth by the National Health Commission for the prevention and control of the COVID-19 epidemic, a hospital response plan was formulated on January 16, 2020 (supplementary material), outlining implementation plans for pre-examination and triage, monitoring, diagnosis, quarantine, reporting, and treatment of suspected cases. Coordination meetings were held daily. The leadership team visited treatment sites to respond to challenges and optimize the protocols. All protocols were strictly implemented, pursuant to the relevant guidelines and regulations. In addition, the West China Hospital connected with the national, provincial, and municipal governments to strengthen information sharing, forewarn, and share
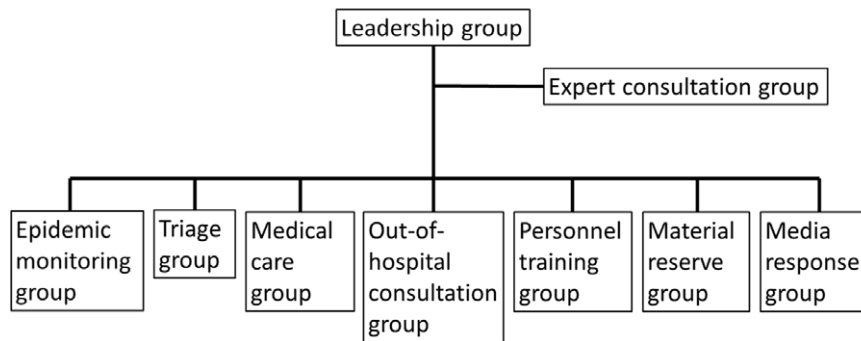
Figure 1. Organizational structure of the hospital command system.

best practice with other institutions. Hospital plans and working systems were developed for internal management.

Based on the COVID-19 diagnosis and treatment plan issued by the National Health Commission, the West China Hospital's expert consultation group updated internal protocols, generating a total of 4 editions. Concurrently, experts examined and updated existing literature. Targeted guidance for the diagnosis and treatment of severe and critically ill patients with COVID-19 was provided by the Sichuan Province government. Technical consultations (including on-site and telephone consultation) for the diagnosis, treatment, prevention, and control of COVID-19 were available in the Sichuan Province. All key personnel participated in policy development and government organization and supervision.[5]

Process management

A temporary 24-hour COVID-19 clinic was established and staffed by physicians with knowledge and experience gained during the SARS epidemic.[6] Each patient was treated by a cooperative system of 2 physicians and 2 nurses. Nucleic acid testing was conducted in patients presenting with fever and relevant history. Experts in infection and respiratory disease confirmed all diagnoses.

A consulting team included clinical and management experts treating suspected, confirmed, severe, and critical cases. A patient-specific protocol was implemented to help achieve a precise treatment plan,[5] which was adjusted, as required. At tertiary hospitals during allocation of patients to the appropriate level of care, a rapid scoring system,[7,8] and the Sequential Organ Failure Assessment scores,[9] were used for early identification of critically ill COVID-19 patients.

A unidirectional flow was created to direct traffic among hospital clinics.[10] For example, a channel with a separate entrance and exit was set up in the outpatient building of the hospital, and a door on the side of the outpatient space served exclusively as an entrance. Likewise, the channel that connected the outpatient building to the first inpatient building was used only as an exit. To reduce personnel cross-activities, other channel ports were temporarily closed (Figure 2).

Space management

Dedicated space and service process

A dedicated COVID-19 clinic was built using 4 medical tents of 30 square meters each, helping to contain infection spread among suspected cases. In addition, the public was informed that masks were mandatory on hospital premises.[11–13] Concurrently, a 3-level triage model was implemented at the outpatient and emergency departments, starting with a fever pre-examination triage desk, which was

separated from the common consultation desk and equipped with an infrared body temperature monitor as well as a hand-held thermometer. The second level of triage was a temperature detection point created at nurses' stations in the outpatient department to collect patients' epidemiological history. The third level of triage entailed outpatient and emergency physicians interrogating fever and epidemiological history of presenting patients. Patients with fever or relevant epidemiological history triggered surgical mask distribution to the patient and all interacting staff before being sent to the COVID-19 clinic, accompanied by clinic or triage nurses.

Hospital bed preparation

Based on the previous outbreak response,[14] the quarantine ward was expanded. Initially, the West China Hospital reserved a single 50-bed ward for observation and quarantine, which was expanded to 15 wards within a couple of weeks, using space initially allocated to other departments. Given the anticipated number of patients and existing regulations, the West China Hospital prepared to serve as a designated reserve hospital for patients with COVID-19. The preparation involved obtaining buy-in from all hospital departments; transferring patients already hospitalized at the infectious disease and tuberculosis departments, and the fifth inpatient building; temporarily transforming 20 negative pressure wards (40 beds) into severe COVID-19 units and acquiring 400 quarantine beds by managing early discharge and obtaining new beds.

Population clustering control

The members of the public were asked to self-diagnose using online tools and to judge whether hospital visit, or admission, was required before presenting at the clinic. This approach helped reduce the number of suspected cases presenting at the hospital.[15] The risks of infection were communicated through mass media channels. Population clustering was reduced to decrease the risk of transmission and ensure that acute and critical cases received the required care.

Personnel management

Consultation team and echelons of prevention and control

An in-hospital consultation team (including departments of infection, respiratory, and critical medicine) and inter-hospital consultation expert team (including departments of infection, respiratory, critical, and laboratory medicine) were established within a day of the COVID-19 outbreak.[16,17] To cope with the shortage of medical resources, physicians in non-infectious respiratory specialties were trained in COVID-19 management,
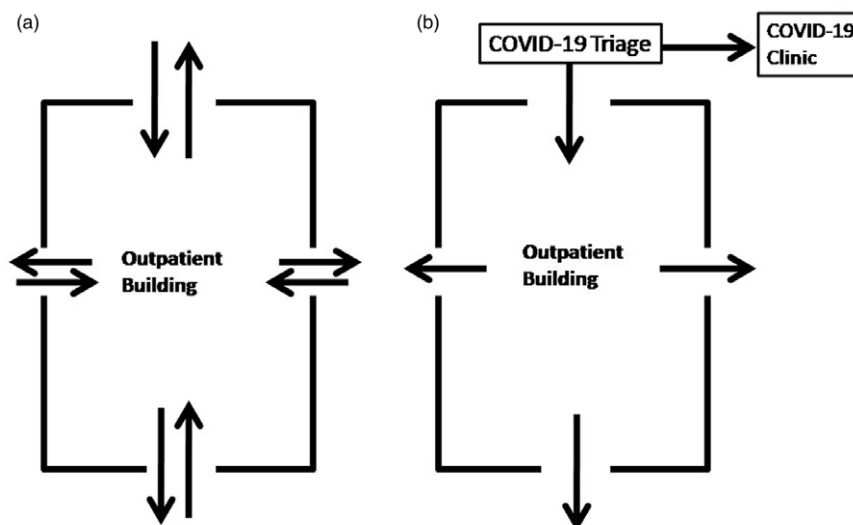
Figure 2. Separate entrance and exit routes were created in the outpatient building during the COVID-19 epidemic.

epidemiological and clinical characteristics, case definitions and classification, differential diagnosis, reporting, treatment, discharge criteria, patient transportation principles, nosocomial infection control, and personal protective equipment use. The second echelon of prevention and control was established by the medical staff of the general medical departments, while the third echelon of the protocol was established mainly by the medical staff of the surgical departments. Contingency plans involved mobilizing non-specialists to address increased care demands.

All-staff training
Like the case at other healthcare institutions,[18–20] all staff underwent training on COVID-19 control, prevention, self-protection, and diagnosis. From January 17 onwards, training on COVID-19 spread, control, and prevention was administered 4 times to the hospital staff both online and in person, through televised meetings, and personal correspondence. The training included information on COVID-19-associated pneumonia and pneumonia of unknown origin, methods of epidemiological and medical history taking, diagnostic criteria, treatment principles, epidemic reporting requirements, disinfection skills, quarantine protocols, protection, and other infection prevention and control details.

Special training for key personnel
On January 17, the hospital appointed key management persons to study documents detailing COVID-19-related pneumonia diagnosis and treatment processes, and infection control and prevention protocols. Pursuant to the latest national diagnosis and treatment plans, employee training was organized in a timely manner through online meetings and self-study, including information sharing on social platforms to ensure efficient implementation of relevant strategies.

Minimizing staff cross-infection
Staff cross-infection prevention protocols included early detection of potential cases, staff contact management, and education about infection spread. Tests for the presence of COVID-19 antibodies through nasopharyngeal swabs were performed among 5000 employees on duty; all staff daily reported their physical condition to the director of the department; exposed employees were isolated.

Symptomatic staff members were re-tested for antibodies. Employee entry and exit channels were established, personal protective equipment was provided, and online task checklists were updated regularly to improve staff awareness of infection control and prevention methods.

Material resource allocation
From January to March 2020, personal protective equipment supplies were lacking, requiring nationwide collaboration. The logistics team was tasked with identifying resource requirements, while the liaison officer was tasked with procuring materials from governmental and non-governmental organizations, among others, which were then quality controlled by the logistics team. Based on the experience gained during the SARS outbreak,[21] the logistics team galvanized all stakeholders to increase the supply of personal protective equipment and relevant raw materials, securing increased expenditures and donations.[22]

Social responsibility of regional medical center

Remote consultation system
The provincial government and health commission of the Sichuan Province established a remote consultation system covering the provincial, municipal, and county levels to deliver remote medical consultations to the whole province. The West China Hospital acted as the center of remote consultation systems for COVID-19 in the Sichuan Province, targeting other hospitals within the network; at launch, the system was available to 27 nearby primary hospitals that admitted COVID-19 confirmed or suspected patients. Given the volume of transmitted data, this system used fifth generation mobile communication technology to ensure efficient transmission. Exactly 3 days after the COVID-19 outbreak, remote consultations for difficult cases were successfully provided to 20 patients with COVID-19 in primary hospitals. On January 26, the West China Hospital completed the first regional remote consultation for patients with acute and severe COVID-19.

Online diagnosis and treatment
In response to the COVID-19 outbreak, the West China Hospital upgraded the existing Internet Diagnosis and Treatment Platform,

a direct online communication channel for the management of subsequent clinical consultations. This upgrade benefitted chronic disease patients, enabling them to manage their registration and wait listing, to view clinical recommendations and prescriptions, confirm appointments, and order medicine deliveries. In addition, the platform enabled both the doctor and patient to view medical records, perform video and voice consultations, and effectively diagnose and treat disease. The system also enabled issuing test referrals and admission cards, as required, including a recommendation for an in-person visit.[10]

In addition, telephone and online consultation systems were established during the COVID-19 epidemic.[5] These services were targeted at the general public rather than at chronic disease patients, and included COVID-19-related and psychological counseling, self-evaluation, and at-home management advice. On January 26, the West China Hospital opened a mental health support helpline. As of January 28, a total of 1606 and 231 patients had consulted 153 doctors online and by telephone on concerns regarding mental health, respiratory and critical care medicine, infectious disease, vascular surgery, cardiac surgery, rheumatology and immunology, endocrinology and metabolism, thoracic surgery, gastrointestinal surgery, neurology, urology, dermatology, and venereology. A follow-up team with 30 medical staff was created and 2 editions of mental health support manuals were issued. Meanwhile, information on COVID-19 control, prevention, diagnosis, and treatment was released to the public through micro blogs, WeChat, and other social media platforms, including information on correct mask use, helping contain public panic and supporting infection control efforts.[5]

Supporting national infection control and prevention

Experts were dispatched to participate in the consultation, treatment, and development plans for early cases of COVID-19 recorded in the Sichuan Province, including 3 experts that delivered keynote addresses at the province-level teleconference training hosted by the Health Commission of the Sichuan Province. The out-of-hospital consultation group led the West China Hospital expert team to primary hospitals to assist in the prevention and treatment of infection cases.

Following applicable guidance, the West China Hospital, as the leading unit, immediately transferred 25 experienced medical staff, including 6 physicians, 14 nurses, and 5 laboratory technicians to join the first batch of medical teams in the Sichuan Province, supporting the work in Wuhan City on January 25. Staff selection included assignments and volunteers from various departments. On February 2, 10 medical staff from respiratory and critical care medicine departments joined the third batch of medical teams in the Sichuan Province. Subsequently, on January 29, 11 experts from the West China Hospital's respiratory and infectious disease, and intensive care medicine departments were dispatched to help the treatment of patients with COVID-19 at the Chengdu Infectious Disease Hospital. Finally, on February 7, 131 members of medical staff from the West China Hospital joined the fourth batch of medical teams deployed to Wuhan City.

Technological research

On January 23, an interdisciplinary research platform was created by the leadership group in conjunction with several research institutes for COVID-19 data storage, health administration decision support, and trend tracking, including case reporting. Based on research hot spots,[23,24] the West China Hospital conducted a series of COVID-19-related studies. A total of 4 research reports were submitted to the superior units on January 25, providing data for further infection control and prevention decisions across the Sichuan Province. Novel guidance was prepared by in-hospital experts under the leadership group, providing scientific insights into disease control and prevention applicable to the Sichuan Province and elsewhere. In addition, the key challenges in the prevention, diagnosis, and treatment of COVID-19 were discussed by the leadership and expert consultation groups, helping establish directions for further research. Meanwhile, a designated science and technology research project for COVID-19 was launched in the West China Hospital.

Limitations

First, despite a large supply of isolated medical spaces and beds, the number of infected patients was small and thus the demand for these spaces was low. This finding suggests that the anticipated number of cases was overestimated. Future studies should aim to establish models that help accurately predict the likely number of infected patients. Second, we did not keep a detailed record of the 8066 patients; consequently, we could not accurately assess the workload. Future studies should propose effective systems of record keeping in public health emergencies. Third, the efficacy of the social media campaign aimed at the general public was not assessed, as we did not anticipate the need for such assessment and thus lacked designated resources during the COVID-19 outbreak. In future studies, we aim to examine methods that assess the efficacy of social media campaigns, accounting for any staff restrictions during an outbreak. Fourth, we lack data on infection spread outside of the context of an epidemic. Future studies should compare, and contrast infection spread patterns between outbreak and non-outbreak periods. Finally, the number of COVID-19 patients in our area did not exceed the city's medical capacity; similarly, material resources remained sufficient during the outbreak, precluding any meaningful analyses of preparedness for resource shortage.

Conclusions

The outbreak of COVID-19 disrupted the functioning of many medical institutions. The West China Hospital, which belongs to Sichuan University, is among the country's most influential hospitals, delivering insights into effective outbreak management, which include establishing reasonable organizational structures and operating mechanisms, integrating out-of-hospital resources and treatment, and establishing a scientific research platform and crossover collaboration. Timely information and best practice dissemination are key to successful management of public health emergencies. The presented measures may be implemented by other institutions to manage COVID-19 and similar outbreaks.[6]

References

1. **Shi Y, Zheng S, Huang Y, *et al.*** Disaster emergency response capability in a regional central hospital. *Chin J Hosp Admin.* 2008;24(9):577-579.
2. **Ji L.** Management of SARS patients and protection of medical workers. *Chin J Hosp Admin.* 2003;19(6):340-342.
3. **Zhu C, Yun S, Junxing K, *et al.*** Emergency medical rescue after major earthquakes: Lessons from the Wenchuan Earthquake. *Chin J Evid -Based Med.* 2012;12(4):383-392.
4. **Xin X, Fei W, Xuemei H, Hui L, Xiuping X.** Management practice of fever in the outbreak of new coronavirus pneumonia in a tertiary hospital. *Med J PAP.* 2020;3:93-94.
5. **Jin W, Rui Z, Caigang X, *et al.*** Ten measures to fight against the 2019-nCoV pneumonia in West China Hospital. *Chin J Evid -Based Med.* 2020;20(3):1-4.
6. **Shuyuan Z, Yali W, Hong X, Xiaohong Z.** Organizational management of SARS patients transferred to hospital in batches. *Nurs J Chin.* 2003;38(6):405-406.
7. **Hu H, Kong W, Yao N, Qiu Y, Yao R.** Prognostic value of three rapid scoring scales and combined predictors for the assessment of patients with coronavirus disease 2019. *Nurs Open.* 2021; doi: 10.1002/nop2.934
8. **Hu H, Yao N, Qiu Y.** Predictive Value of 5 Early Warning Scores for Critical COVID-19 Patients. *Disaster Med Public Health Prep.* 2020:1-8. doi: 10.1017/dmp.2020.324. (In press)
9. **Liu S, Yao N, Qiu Y, He C.** Predictive performance of SOFA and qSOFA for in-hospital mortality in severe novel coronavirus disease. *Am J Emerg Med.* 2020;38(10):2074-2080.
10. **Zhou Y, Hou Y, Shen J, Huang Y, Martin W, Cheng F.** Network-based drug repurposing for novel coronavirus 2019-nCoV/SARS-CoV-2. *CellDiscov.* 2020;16(6):14.
11. **Xiaoying Z, Haiyan H, Caiping S, Xiaojuan J, Limin Z.** Subarea management mode of novel coronavirus pneumonia treatment ward. *Nurs J Chin PLA.* 2020;37(3):16-18.
12. **Wang H.** Discussing the management system of medical surge capacity for American integrated medical and health resources management system in emergencies. *Health Care Manag Sci.* 2013;7:487-489.
13. **Sheng W, Xu S, Zhang M, Ma Y, Gan J, Jiang G.** Focus on surge of emergency department. *Natl Med J China.* 2008;88(47):3313-3315.
14. **Chen X, Wang L.** The influence of double track model on non-seismic patients' retention time in emergency department during the earthquake. *China J Clin Emerg.* 2014;15(5):298-299.
15. **Cao Y.** Expert consensus on hospital surge capacity and capability for mass casualty incidents. *China J Emerg Med.* 25(10):1229-1236.
16. **Qiuxiang C, Haihong Y, Li D.** Nursing human resources management for 2019 novel coronavirus infection in primary hospitals. *Chin Nurs Res.* 2020;34(3):374-375.
17. **Jinghui F, Zhongxiang C, Xin Y, Xuefen W, Yuyunyan X, Chunying L.** Exploring of the nursing human resource management model for novel coronavirus infection pneumonia. *Chin J Respir Crit Care Med.* 2020;19(2):1-4.
18. **Qiuxiang C, Haihong Y, Li D.** Nursing human resources management for 2019 novel coronavirus infection in primary hospitals. *Chin Nurs Res.* 2020;34(3):374-375.
19. **Hu H, Xiao Y, Li H.** The effectiveness of a serious game versus online lectures for improving medical students' coronavirus disease 2019 knowledge. *Games Health J.* 2021;10(2):139-144.
20. **Hu H, Liu Z, Li H.** Teaching disaster medicine with a novel game-based computer application: A case study at Sichuan University. *Disaster Med Public Health Prep.* 2020; 16:1-7. (In press)
21. **Yuanli C.** Review the emergency strategy of hospital logistic guarantee in view of the SARS incident. *Modern hospital.* 2004;4(12):52-53.
22. **Yu H, Sun X, Solvang WD, Zhao X.** Reverse logistics network design for effective management of medical waste in epidemic outbreaks: Insights from the Coronavirus Disease 2019 (COVID-19) Outbreak in Wuhan (China). *Int J Environ Res Public Health.* 2020;17(5): e1770.
23. **Juan L, Yu-qing F, Lan-wen H, *et al.*** Visualization analysis of hotspots of research on SARS-CoV-2 based on Cite Space and VOS viewer. *Chin J Nosocomio.* 2020;30(8):1129-1135.
24. **Longhao Z, Baihong L, Peng J, *et al.*** An analysis of global research on SARS-CoV-2. *J Biomed Eng.* 2020;37(2):1-15.