Wuhan mobile cabin hospital
A critical health policy at a critical time in China
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Abstract
This study aimed to systematically analyze the effect of Wuhan mobile cabin hospitals (WMCHs) on the novel coronavirus-caused pneumonia (COVID-19) prevention and control in China. Between February 5, 2020 and March 10, 2020, a total of 16 mobile cabin hospitals were constructed in 3 batches to offer over 13,000 beds and admitted more than 12,000 patients in Wuhan City. The strategy of implementing WMCHs in 3 batches played a key role in fighting against COVID-19 in China. (1) The first batch of WMCHs increased hospital admission capacity of COVID-19 patients in Wuhan, which showed initial effect on COVID-19 epidemic control. (2) The operation of the second batch of WMCHs greatly contributed to the rapid growth in discharged patients. (3) After launching the third batch of WMCHs, the COVID-19 epidemic situation in Wuhan improved considerably. The last batch of WMCHs made a substantial contribution to defeating the COVID-19 epidemic in Wuhan.

Abbreviations: COVID-19 = the novel coronavirus-caused pneumonia, MCH = mobile cabin hospital, MCHs = mobile cabin hospitals, TCM = traditional Chinese medicine, WMCH = Wuhan mobile cabin hospital, WMCHs = Wuhan mobile cabin hospitals.

Keywords: China, health policy, the novel coronavirus-caused pneumonia, Wuhan mobile cabin hospital

1. Introduction
The novel coronavirus-caused pneumonia (COVID-19) played havoc with global health and safety. Many countries in the world have declared national emergency, seriously affecting international security, trade, and economy. From December 2019, a COVID-19 epidemic outbreak occurred in Wuhan City, China.

Wuhan’s healthcare system was overwhelmed by patients flooding into local hospitals. As a result of a severe shortage of medical resources, the Chinese government decided to launch the mobile cabin hospital (MCH) construction program, which achieved remarkable results. In order to provide evidence and evidence for policy and decision making to be used by other countries fighting the COVID-19 pandemic, this study systematically analyzed the features of Wuhan mobile cabin hospitals (WMCHs)’ design and management and the operational effect of WMCHs.

2. Background
MCH is a field mobile medical platform that can be swiftly transported and built in the form of a mobile cabin with an integration of medical services and medical technology support.[1,2] According to the data released by Wuhan Health Commission, on January 31, 2020, only 389 out of the 6641 beds in 23 designated hospitals in Wuhan remained available.[3,4] Hospitals in Wuhan soon reached their capacities. Therefore, it is necessary to launch WMCHs.

3. Methods
The operation of 16 WMCHs is systematically summarized, the characteristics of 7 WMCHs are described, and the implementation effect of WMCHs is analyzed by combining official case data.

4. Application overview of WMCHs
Chen Wang (academician of the Chinese Academy of Engineering) is the first to put forward a scheme of constructing WMCHs for COVID-19 epidemic in Wuhan. From February 3 to February 27, 2020, Wuhan made use of and renovated sports stadiums, convention centers, schools, and other spaces into hospital
wards. The government mobilized 22 national medical emergency rescue teams, 3 mobile P3 laboratories, 2 batches of 30 medical teams, 15 nursing teams, and 1 radiographer team from all over China, totaling over 7000 healthcare workers and laboratory technicians.\(^5\)

A total of 16 MCHs (Table 1) were constructed to provide more than 13,000 beds and admitted over 12,000 patients in Wuhan. On average, 1 of every 4 confirmed patients received treatment in a WMCH. On February 27, the situation of “a hospital bed being hard to come by” changed fundamentally as the quantity of hospital beds outstripped patient demand in 20 days. “No cross-infection, no deaths, no readmission” were achieved in WMCHs by the time all WMCHs were closed.

### Typical cases of WMCHs

#### 5.1. Jianghan MCH

Jianghan MCH was one of the first MCHs in Wuhan. It was also the MCH with the largest number of beds and the largest number of admitted and discharged patients. Jianghan MCH was in close proximity of the Union Hospital affiliated to Tongji Medical College of Huazhong University of Science and Technology, which enabled timely transfer of critical patients to the hospital. After 48 hours of construction, Jianghan MCH with 120 beds was officially open to receive mildly symptomatic patients at 10 pm on February 5, 2020.

Each WMCH ward was divided into 4 main areas. The first floor was divided into a west, central, and east districts. Each

**Table 1**

| Name of WMCHs                  | Location                                | Construction time | Operation time | Number of beds | Supporting institution                                                                 | Number of medical teams | Number of admitted patients | Number of discharged patients | Total number of hospital transfers |
|--------------------------------|-----------------------------------------|-------------------|----------------|----------------|----------------------------------------------------------------------------------------|-------------------------|-----------------------------|---------------------------------|----------------------------------|
| Wuhan MCH                      | Wuhan Sports Center                     | 2020.2.2          | 2.5–3.0        | 784            | Hubel General Hospital, Wuhan University                                                | 3 + 4                  | 1124                        | 833                             | 291                              |
| Jianghan MCH                   | Wuhan International Convention and Exhibition Center | 2020.2.3          | 2.5–3.9        | 1524           | Union Hospital, Tongji Medical College, Huazhong University of Science and Technology | 3 + 5                  | 1848                        | 1327                            | 521                              |
| Dongqiu MCH                    | Wuhan Living Room Culture Expo Center   | 2020.2.3          | 2.7–3.8        | 1461           | Zhongnan Hospital of Wuhan University                                                   | 3 + 5                  | 1760                        | 868                             | –                                |
| Hanyang MCH                    | Wuhan International Expo Center         | 2020.2.4          | 2.11–3.8       | 930            | Women and Children Hospital of Hubei                                                    | 2 + 2                  | 1028                        | 602                             | –                                |
| Qiaokou MCH                    | Wuhan Stadium                           | 2020.2.4          | 2.11–3.1       | 200            | The Third People’s Hospital of Hubei Province                                              | 1 + 1                  | 330                         | 232                             | 98                               |
| Huangpi MCH                    | Huangpi District Gymnasium               | 2020.2.4          | 2.11–3.7       | 200            | Huangpi General Hospital                                                               | 0 + 1                  | 223                         | 156                             | –                                |
| Jiaqian MCH                    | Tazihu Sports Center                    | 2020.2.4          | 2.12–3.8       | 900            | Wuhan Province Hospital of Integrated Chinese & Western Medicine                      | 2 + 2                  | 1011                        | 726                             | –                                |
| Wuhan Economic Development Zone MCH | Wuhan Sports Center                  | 2020.2.4          | 2.12–3.8       | 1000           | Hubei Modern Hospital                                                                  | 2 + 2                  | 1056                        | 875                             | 181                              |
| Qingshui MCH                   | Wuhan Iron and Steel Gymnasium          | 2020.2.4          | 2.13–3.9       | 388            | Wuhan Ninth Hospital                                                                  | 2 + 2                  | 519                         | 372                             | 147                              |
| Optical Valley Exhibition Center MCH | Optical Valley Technology Exhibition Center | 2020.2.4          | 2.17–3.6       | 840            | Guanggu District, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology | 1 + 4                  | 875                         | 691                             | 184                              |
| Zhanqiu MCH                    | Zhanqiu General Hospital                | 2020.2.12         | 2.17–3.8       | 996            | Wuhan Asian Heart Disease Hospital, Wuhan Asian Heart General Hospital                | 1 + 5                  | 990                         | 702                             | 288                              |
| East Lake Rihai MCH            | Original Rihai Industrial Park Factory  | 2020.2.16         | 2.20           | 1300           | Hubei General Hospital                                                                | 1 + 2                  | –                          | –                               | –                                |
| Jiangnan Economic Development Zone MCH | Wuhan Sports School                    | 2020.2.17         | 2.21–3.8       | 682            | Union Hospital, Tongji Medical College, Huazhong University of Science and Technology | 1 + 3                  | 281                         | 207                             | –                                |
| Hanyang MCH                    | Wuhan Sports School                     | 2020.2.19         | 2.22–3.8       | 1160           | Women and Children Hospital of Hubei                                                   | 1 + 5                  | 265                         | –                               | –                                |
| Jiangxia Dahuashan MCH         | Dahuashan Outdoor Sports Center         | 2020.2.4          | 2.14–3.10      | 420            | Jiangxia District Hospital of Traditional Chinese Medicine                             | 0 + 5                  | 564                         | 392                             | 172                              |
| Proctorial Party School MCH    | Proctorial Party School Students Dormitory | 2020.2.7          | 2.19–3.1      | 932            | Hubei Cancer Hospital                                                                 | 0 + 8                  | –                          | –                               | –                                |

Number of medical teams: number of national medical emergency rescue teams + number of local hospitals/number of provincial medical teams

* - **Partial data is missing in the table.

MCH = Mobile cabin hospital, MCHs = mobile cabin hospitals, WMCHs = Wuhan mobile cabin hospitals.
section was then divided into 8 small sections with 50 to 60 camp beds per small section. The districts were subdivided by high partitions, and beds were subdivided by wooden planks. The second floor was set up as a large area subdivided into 11 sections with passageways specially designed to transport drugs and medical supplies. Each floor had 2 nurses’ stations, a fully scaled emergency room, and a dining room for healthcare workers. A 2-meter-wide passageway for garbage and waste disposal was set up at the back door of Wuhan International Convention and Exhibition Center, through which all garbage and waste would be transported to designated locations for disinfection and sterilization.

Jianghan MCH also developed an online application that was used by patients to “place orders” to request services such as living, healthcare, and environmental hygiene services on their mobile phones. Healthcare workers or volunteers in the MCH would “accept orders” online and provide services to meet patients’ needs.

5.2. Wuchang MCH

Wuchang MCH was the first WMCH launched on February 5, 2020. Twenty-eight patients were discharged from this WMCH 6 days after its launch. It operated continuously for 35 days, and was considered to be the first WMCH launched, the first WMCH establishing a temporary Party Committee, the first WMCH discharging a patient, the first WMCH offering psychological counseling for patients, and the last WMCH closed.

A series of innovative operational and management measures were developed and implemented, and produced positive results. These measures were used for reference by other hospitals. Such measures included conducting level-4 medical rounds and ensuring good patient treatment and care; setting up a comprehensive testing and examination programs that included blood tests, vehicle-mounted CT exams, nucleic acid tests; fully administering treatment of traditional Chinese medicine (TCM) and devising physical exercises; reinforcing efforts of prevention of doctor-patient cross-infection and ensuring goods and materials supply; organizing national psychological counseling expert teams to provide effective psychological counseling services for patients; setting up the first temporary Party committee to promote patient autonomy within MCH.

5.3. Dongxihu MCH

Dongxihu MCH was rebuilt from Wuhan Living Room Cultural Expo Center within 3 days. It had 3 cabins, 16 medical workstations, 2 pharmacies, 1 patient entrance, and 1461 beds. It was the largest WMCH in the first batch of MCHs built in Wuhan.

Over 3000 people were in the MCH during peak period, including 1434 patients and 1234 healthcare workers. Four members of the psychological intervention team had to serve 1433 patients and healthcare workers during peak hours. Moreover, its patient satisfaction rate reached 99.44%. Dongxihu MCH became the “cabin of life” that offered a great quantity of beds, admitted a large number patients, and achieved high operational efficiency during the peak period of COVID-19 epidemic.[7]

Dongxihu MCH was not only equipped with a “MCH library”, but also provided with “MCH digital culture window” application, which contained over 8000 videos, 80,000 e-books, and 420,000 digital audio resources to enrich patients’ lives and relieve patient anxiety.

5.4. Jiangxia Dahuashan MCH

Jiangxia Dahuashan MCH was the only MCH fully taken over by TCM medical team. The national TCM medical team consisted of 209 TCM experts and healthcare workers from first-class hospitals in Tianjin City, Jiangsu Province, Henan Province, Hunan Province, and Shanxi Province. The team used combined therapy of Chinese and Western medicine to treat mildly symptomatic patients with stress on TCM.

Treated with only Chinese medicine decoctions, each patient took one No. 2 and No. 3 decoction in the morning and in the evening. Moreover, according to patient’s symptoms, experts also developed 4 routine prescriptions for fever, dry cough, spleen and stomach insufficiency-cold, and anxiety-induced insomnia, assisted by western medicine techniques such as oxygen uptake and fluid transfusion as well as other traditional Chinese non-pharmaceutical treatment such as auricular therapy, moxibustion, and acupoint application. Healthcare workers also led patients to do acupoint flapping exercises, and played Baduanjin qigong and Tai Chi to strengthen muscles and bones and pass on confidence in defeating the disease.

5.5. Huangpi MCH

Huangpi MCH was divided into cabin A and cabin B. Cabin A was a 130-bed ward and Cabin B was a 70-beds ward. Five medical teams were stationed there to assist. Within 26 days of operation, a total of 223 patients were admitted and treated and 156 patients were cured.

With the support of remote ultrasound technology from 5G Smart Medical Innovation Lab in Zhejiang General Hospital, “ultrasonic robot” was introduced to carry out remote ultrasonic exams for the patients in Huangpi MCH via 5G and ultrasound technologies. “Ultrasonic robot” could not only report changes in the lungs by assessing pulmonary edema, but also conduct full-body imaging assessment in a convenient and rapid way. The ultrasonic robot played a crucial part in imaging assessment of changes in pneumonia conditions.

5.6. Hanyang sports school MCH

On February 22, 2020, Hanyang Sports School MCH started to officially receive mildly symptomatic patients with COVID-19. The application of HIS remote system for word rounds was a highlight of Hanyang Sports School MCH. Through voice control, doctors in and outside the cabin were able to make ward rounds concurrently and record patient’s vital signs and changes in disease conditions. Meanwhile, the physician team outside the cabin could make timely adjustment to treatment plans based on patients’ conditions. This system helped reduce physicians’ daily rounds time from over 4 hours to 2 hours.

In addition, Hanyang Sports School MCH established a Hanyang Sports School MCH Patient Management Group to motivate patients to participate in daily healthcare management work. The MCH encouraged patients to be “unit leaders” to take charge of distributing boxed meals and fruit, filling medications, among other work. This helped reduce healthcare workers’ burden while pacifying patients through mutual aid and mutual support among patients.
5.7. Provincial party school MCH

Provincial Party School MCH was equipped with 932 beds and was divided into 8 wards with doctors’ offices, nurses’ stations, emergency rooms, and hot water rooms. The MCH was also equipped with a mobile imaging trailer and an AI robot for food and drugs delivery.

At 9 PM on February 19, 2020, as the first 23 patients being admitted, the AI robot officially went on duty. The robot had the ability of fully autonomous locating and navigation, autonomous route planning, and multi-point cruising delivery. In addition, the robot could also deliver and distribute supplies such as medications, laboratory test reports, protection equipment, and disinfection tools. Using robots for delivery of food, lab test reports, and medications lightened healthcare workers’ workload, boosted MCH’s operational efficiency, and avoided cross-infection between hospital staff and patients, which could ultimately reduce the risk of epidemic spread.

6. Implementation effect of WMCHs

Table 2 shows data on patient cases during the operation of WMCHs. As shown in the table, the cumulative number of confirmed cases continued to increase in Wuhan. On February 12, as a result of disease diagnose criteria added “clinical diagnosis,” the cumulative number of confirmed cases exceeded 30,000 (32,994) for the first time. Till all WMCHs were closed, the cumulative number of confirmed cases reached nearly 50,000 (49,978). Meanwhile, the cumulative number of cured cases grew steadily. On February 9, more than 1000 patients (1011) achieved recovery. The total number of recovered cases increased from 33,041 by the time all WMCHs were closed. On February 13, the cumulative number of deaths surpassed 1000 (1108) for the first time. Total deaths reached 2423 on March 10. On February 19, the number of newly confirmed cases went below 1000 (615) per day for the first time, and the number of daily new cases reduced to 13 after all WMCHs were closed. The number of newly cured cases exceeded 1000 (1391) on February 24. The number of new deaths was decreasing. There were no more than 20 new deaths per day after March 4.

Figure 1 shows trends of cumulative cases overtime and launch times of WMCHs. During the entire period of WHMC operation, the overall growth trend of new cases was retarded in Wuhan, despite a surge in the number of confirmed cases. There was also a sharp rise in the cumulative number of cured cases followed by an

| Date | Cumulative confirmed cases | Cumulative recovered cases | Cumulative deaths | Daily new cases | Daily newly recovered cases | Daily new deaths |
|------|---------------------------|---------------------------|------------------|----------------|---------------------------|-----------------|
| 2/5  | 10,117                    | 398                       | 414              | 1766           | 63                        | 52              |
| 2/6  | 11,618                    | 501                       | 478              | 1501           | 103                       | 64              |
| 2/7  | 13,603                    | 665                       | 545              | 1985           | 164                       | 67              |
| 2/8  | 14,982                    | 844                       | 608              | 1379           | 179                       | 63              |
| 2/9  | 16,902                    | 1011                      | 681              | 1921           | 167                       | 73              |
| 2/10 | 18,454                    | 1173                      | 748              | 1552           | 162                       | 67              |
| 2/11 | 19,558                    | 1344                      | 820              | 1104           | 171                       | 72              |
| 2/12 | 32,994                    | 1510                      | 892              | 13,436         | 538                       | 216             |
| 2/13 | 35,991                    | 1885                      | 1108             | 3910           | 370                       | 88              |
| 2/14 | 37,914                    | 2371                      | 1123             | 1923           | 486                       | 107             |
| 2/15 | 39,462                    | 2784                      | 1233             | 1548           | 413                       | 110             |
| 2/16 | 41,152                    | 3327                      | 1309             | 1690           | 543                       | 76              |
| 2/17 | 42,752                    | 4088                      | 1361             | 3860           | 761                       | 72              |
| 2/18 | 44,412                    | 4764                      | 1407             | 1660           | 676                       | 116             |
| 2/19 | 45,027                    | 5317                      | 1585             | 615            | 553                       | 88              |
| 2/20 | 45,346                    | 6214                      | 1684             | 319            | 766                       | 99              |
| 2/21 | 45,660                    | 7206                      | 1774             | 314            | 992                       | 90              |
| 2/22 | 46,201                    | 8171                      | 1856             | 541            | 965                       | 82              |
| 2/23 | 46,607                    | 8947                      | 1967             | 348            | 772                       | 131             |
| 2/24 | 47,071                    | 10,337                    | 2043             | 464            | 1391                      | 56              |
| 2/25 | 47,441                    | 11,793                    | 2085             | 370            | 1456                      | 42              |
| 2/26 | 47,824                    | 13,328                    | 2104             | 383            | 1535                      | 19              |
| 2/27 | 48,137                    | 15,826                    | 2132             | 313            | 2498                      | 28              |
| 2/28 | 48,557                    | 17,552                    | 2169             | 420            | 1726                      | 37              |
| 2/29 | 49,122                    | 19,227                    | 2195             | 565            | 1675                      | 26              |
| 3/1  | 49,315                    | 21,185                    | 2227             | 193            | 1958                      | 32              |
| 3/2  | 49,426                    | 23,031                    | 2251             | 111            | 1846                      | 24              |
| 3/3  | 49,540                    | 24,880                    | 2292             | 114            | 1859                      | 31              |
| 3/4  | 49,671                    | 26,316                    | 2305             | 131            | 1426                      | 23              |
| 3/5  | 49,797                    | 27,354                    | 2328             | 126            | 1038                      | 23              |
| 3/6  | 49,871                    | 28,511                    | 2349             | 74             | 1157                      | 21              |
| 3/7  | 49,912                    | 29,770                    | 2370             | 41             | 1259                      | 21              |
| 3/8  | 49,948                    | 30,933                    | 2368             | 36             | 1163                      | 18              |
| 3/9  | 49,965                    | 31,829                    | 2404             | 17             | 896                       | 16              |
| 3/10 | 49,978                    | 33,041                    | 2423             | 13             | 1212                      | 19              |

WMCH=Wuhan mobile cabin hospital.
evident increasing trend. The cumulative number of deaths fluctuated slightly, but the overall trend was steady. From February 5 to February 22, a total of 16 MCHs were constructed in Wuhan.

Figure 2 shows trends of daily new cases during WMCH operation. The curve of daily new cases reflected a clear downward trend with mild fluctuations. The curve of newly recovered cases per day showed a significant growth trend, and the curve of daily new deaths indicated minor fluctuations with a downward trend.

According to each WMCH’s specific launch time, the WMCHs can be divided into 3 batches. Wuchang MCH, Jianghan MCH, and Dongxihu MCH were the first batch of WMCHs launched between February 5 and February 7. The second batch of WMCHs were set in motion between February 11 and February 14, including Hanyang MCH, Qiaokou MCH, Huangpi MCH, Jiangan MCH, Wuhan Economic Development Zone MCH, Qingshan MCH, and Jiangxia Dahuashan MCH. The last batch of WMCHs began operation around February 17 to February 22, including Optical Valley Exhibition Center MCH, Zhuankou MCH, East Lake Rihai MCH, Jianghan Economic Development Zone MCH, Hanyang Sports School MCH, Provincial Party School MCH. The current isolation and observation time for suspected and mildly symptomatic cases is 14 days with the median being 7 days. Thus, from the launch time of the first batch of WMCHs to February 12, the preventive and control effect of WMCHs reached stage 1. Stage 2 was from the launch time of the second-batch WMCHs to February 18. Stage 3 was from the launch time of the third batches of WMCHs to February 24 (Fig. 2).

7. Discussion

On February 4 (before launching WMCHs), Wuhan had a total of 8,351 confirmed cases, 335 recovered cases, and 362 deaths, with mortality rate reaching 4.33%. Wuhan was seriously and
extensively affected by the COVID-19 outbreak, resulting in a large number of infected patients and a shortage of hospital beds. Consequently, many patients were unable to receive timely and effective treatment, which was another important reason for the high percentage of severe cases and high case fatality rate in Wuhan. Meantime, patients being unable to be isolated and treated in time also added uncertainties and posed a great threat to COVID-19 epidemic control. Isolation of infected patients (ie, source of infection) was the most effective way to control the outbreak.

After launching WMCHs, the increase of cumulative confirmed cases slowed down in Wuhan as cumulative recovered cases increased significantly. The number of cumulative deaths fluctuated slightly but the general trend was stable. As all WMCHs were closed on March 10, 2020, Wuhan had altogether 49,978 confirmed cases, 33,041 recovered cases, and 2423 deaths.[8] Therefore, the WMCHs played an important role in defeating the COVID-19 epidemic.

7.1. Control effect of the first batch of WMCHs

Stage 1: the number of daily new cases in Wuhan decreased slightly, the number of newly recovered cases increased significantly on a daily basis, and the number of new deaths remained stable. The number of daily new cases remained above 1500. The number of newly recovered cases per day increased from less than 200 to over 350. The numbers indicated that the launch of WMCHs brought about effects on raising diagnosis speed and increasing recovered cases. The first batch of WMCHs improved hospital admission capacity for COVID-19 patients in Wuhan, reflecting WMCHs’ early effect on epidemic control.

It is important to note that, on February 12, 2020, the number of daily new cases was 13,436 in Wuhan, close to the number 19,558 reported on February 11. This was due to a change in disease diagnosis standard. According to the “COVID-19 Diagnosis and Treatment Guidelines” previously release by China NHS, diagnostic criteria on confirmed cases referred to detection of novel coronavirus nucleic acid in respiratory tract specimen or blood specimen using real-time fluorescent RT-PCR tests (ie, tested positive for novel coronavirus nucleic acid). However, the daily new cases reported on February 11 included clinically diagnosed cases. According to the “COVID-19 Diagnosis and Treatment Guidelines (trial version 5),” Hubei Province added “clinical diagnosis” to diagnostic classifications of COVID-19 cases that suspected cases with pneumonia imaging features could be diagnosed as confirmed cases. Since the epidemic, the shortage of testing kits led to a delay in COVID-19 diagnosis, leaving a large number of suspected cases in Wuhan. Adding clinically diagnosed cases might seem to have increased the number of confirmed cases, but it actually allowed patients to be treated as early as possible, which improved recovery rate and was a necessary step for epidemic control.[9]

From February 5 to February 7, adhering to the principle to “admit and treat everyone necessary,” Wuchang MCH, Jianghan MCH, and Danyixiu MCH became the first batch of WMCHs launched in Wuhan. Six days later, on February 11, the first group of 34 COVID-19 patients were discharged from Jianghan MCH and Danyixiu MCH. This showed that, to some extent, WMCHs were effective on control of COVID-19 epidemic in Wuhan. The first batch of WMCHs carried out level-4 hospital rounds including inspection rounds by MCH president, and were provided with testing programs to conduct blood tests, CT exams, nucleic acid tests, and others. The WMCHs administered TCM treatment on a full scale and promoted a series of innovative measures such as “patient autonomy” to inform subsequent construction and operation of WMCHs.

7.2. Control effects of the second batch of WMCHs

Stage 2: the number of daily new cases decreased, the number of daily newly recovered cases increased significantly, and the number of daily new deaths remained stable. On February 19, the number of daily new cases (615 cases) fell below 1000 for the first time. On February 20, the number of daily newly recovered cases (766 cases) exceeded the number of daily new cases (319 cases) for the first time in Wuhan. With the second batch of WMCHs going into operation, the number of discharged patients in Wuhan presented a rapidly ascending trend, and Wuhan’s admission and treatment capacities was quickly improved. This further demonstrated the control effect of the second batch of WMCHs.

The second batch of WMCHs further stressed the “people-oriented and pragmatical” characteristics,[10] while absorbing experience from constructing the first batch of WMCHs, to provide a full coverage of Wi-Fi service with installation of water heaters and air conditioning, along with boxed meals and service teams. This enabled WMCHs to have better admission conditions so as to raise patients’ willingness of being admitted into WMCHs and effectively increase WMCH admission rates, helping to further achieve the goal of “admitting everyone necessary.”

The introduction of “ultrasonic robot” to Huangpu MCH allowed clinicians to have a clearer understanding of each patient’s condition using technologies like 5G and ultrasound to help make evidence-based follow-up treatment plans. Jiaxing Xingnian MCH was the first hospital to focus on TCM therapies. It replied on combined therapies of Chinese and Western medicine with stress on traditional Chinese medicine, and carried out training activities such as Baduanjin qigong and Tai Chi. The TCM-oriented therapies played an important role in controlling disease progression for mild and semi-mild cases.

7.3. Control effects of the third batch of WMCHs

Stage 3: the number of daily new cases remained stable with slight decrease. On February 27, the number of daily newly recovered cases increased to 2498, which was the largest number of patients discharged during WMCH operation. The number of daily new deaths remained stable with slight decline. On February 24, the number of daily new cases fell below 100 (74 cases) for the first time and the number of daily newly recovered cases (1391 cases) exceeded 1000 for the first time. The number of daily newly recovered cases remained over 1000, except for March 9. During stage 3, Wuhan saw significant improvement in COVID-19 epidemic control. Thus, the last batch of WMCHs accomplished periodic success in COVID-19 epidemic control.

High-tech measures played an important role in the operation of the third batch of WMCHs. The wide adoption of high-tech products, such as integrated cloud platforms, 5G networks, remote diagnosis, unmanned delivery vehicles, and remote monitoring, reduced pressure of medical staff shortage and goods and materials transportation issues, improved hospitals’ level of medical precision, and lowered workers’ risk of infection.

As of February 25, Hubei Provinicial Library, Wuhan City Library, regional libraries in Wuhan, Wuhan Xinhua Bookstore,
and other organizations jointly established 23 “WMCH Libraries” and set up online cultural service platforms like special column for epidemic information and service, online digital reading platform, and “MCH digital and cultural window” to help relieve patients’ psychological pressure and enhance patients’ confidence in fighting the disease.

8. Conclusion

Launched in 3 batches, the WMCHs have played a key role in defeating the COVID-19 epidemic in Wuhan, China.

(1) Launching the first batch of WMCHs produced effects on speeding up diagnosis and increasing recovered cases, expanding hospital admission capacities of COVID-19 patients in Wuhan. The first batch of WMCHs exhibited initial effects on COVID-19 epidemic control.

(2) The second batch of WMCHs led to a rapid increase in the number of discharged patients, and hospital admission and treatment capacities were considerably enlarged in Wuhan, which further demonstrated the control effects of the second batch of WMCHs.

(3) With the third batch of WMCHs, the condition of COVID-19 epidemic in Wuhan showed noticeable improvement. The last batch of WMCHs achieved periodic success in epidemic control, playing a key part in the defeat of COVID-19 epidemic in Wuhan. The construction and operational modes of WMCHs may provide valuable experience and evidence for other countries currently affected by the COVID-19 pandemic.

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References

[1] Wang YT. China medicine Encyclopedia - disaster medicine. China Disaster Relief Med 2017;5:481.
[2] Zhang X, Wang XM. Setup and management of the national emergency medical rescue mobile hospital operating vehicle. J Pract Med Technol 2017;24:692013;70.
[3] Epidemic situation of COVID-19 in Hubei Province on February 4, 2020. Available at: http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzb/dgfyysq/xxfb/202002/t20200205_2195293.shtml (accessed March 13, 2020)
[4] Ma Guoqiang Presided Over the Wuhan Municipal Epidemic Prevention and Control Conference Called for the Mobile Cabin Hospital Construction as Soon as Possible to Increase the Admission Capacity. Available at: http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzb/dgfyysq/xxfb/202002/t20200204_2198809.shtml (accessed March 13, 2020)
[5] Workbook of mobile cabin hospital (third edition). National Health Commission. Available at: https://news.zhuuytaix.com/20/0224/200c7919fa4ddc82d052c5787731.html?ps=boaodaow&anchor=pl#all_box (accessed March 1, 2020)
[6] Liu JF, Zhai XH, et al. Discussion on the Module Hospital Construction Management of COVID-19 Epidemic Situation. Chin Hosp Manag 2020;40:12-14.
[7] All patients from Dongxihu Mobile Cabin Hospital in Wuhan were discharged. Hubei Daily. Available at: http://www.hubei.gov.cn/zhuanti/2020/gzxxgzb/dlxqk/202003/t20200308_2175165.shtml (accessed March 12, 2020)
[8] Epidemic Situation of COVID-19 in Hubei Province on March 10, 2020. Health Commission of Hubei Province. Available at: http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzb/dgfyysq/xxfb/202003/t20200311_2178179.shtml (accessed March 13, 2020)
[9] Epidemic Situation of COVID-19 in Hubei Province on February 12, 2020. Health Commission of Hubei Province. Available at: http://wjw.hubei.gov.cn/bmdt/ztzl/fkxxgzb/dgfyysq/xxfb/202002/t20200213_2025580.shtml (accessed March 13, 2020)
[10] Transcript of the State Council Information Office Press Conference on February 28, 2020. National Administration of Traditional Chinese Medicine. Available at: http://www.satcm.gov.cn/xinw/2020-01-23/12488.html (accessed March 10, 2020)