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LETTER

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Combating COVID-19 as a designated hospital: Experience from Shanghai, China

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Abstract: Many large international cities, such as Shanghai, are facing the threat of more imported cases of COVID-19 because of the frequent flow of people and objects at home and abroad. In the face of the complex and changing disease status of the international community, dealing with this disease effectively is a great challenge to the city's existing public health emergency response capacity and also a major test of designated COVID-19 hospitals. Here, we share our experience as a designated COVID-19 hospital in Shanghai, China in terms of *i*) A Professional Multi-disciplinary Team, *ii*) Personalized Treatment Plans for Patients in Severe or Critically Ill Condition, *iii*) Well-organized Classification of Patients, *iv*) Establishment of Transitional Wards, *v*) Nosocomial Infection Prevention and Control, and *vi*) Identification and Reporting of the Asymptomatic in the hopes that these approaches can serve as a reference for healthcare providers and medical staff who are fighting the pandemic.

***Keywords*:** COVID-19, designated hospital, treatment, asymptomatic

In January 2020, an outbreak of a new coronavirus pneumonia occurred in Hubei Province, China and spread to most parts of the country and the world (*1*). Shanghai, a large international city, is facing the threat of more imported cases because of the frequent flow of people and objects at home and abroad. In the face of the complex and changing disease status of the international community (*2*), dealing with this disease effectively is a great challenge to the city's existing public health emergency response capacity and also a major test of designated COVID-19 hospitals (*3*).

Following the SARS outbreak in May 2003, the Shanghai Municipal Government moved the Shanghai Infectious Disease Hospital to the southwestern suburbs of the city, where it was renamed the Shanghai Public Health Clinical Center (SPHCC). On November 16, 2004, the SPHCC was officially completed and began operations. In recent years, the SPHCC has played a significant role in responding to outbreaks such as H1N1, H7N9, Ebola, and MERS. During the COVID-19 outbreak, the SPHCC sent medical experts to the WHO and other countries to provide Chinese experiences and expertise. Our medical experts have also been involved in the revision and updating of clinical management guidelines for COVID-19 to facilitate the treatment and further control of COVID-19.

The ability to provide optimal clinical treatment is the basis for responding to public health outbreaks and for successfully treating patients (*4*). In the "downtime mode", the SPHCC has established specialized clinical services; the Center currently has 40 clinical departments and 7 medical technology departments. The scope of diseases treated at the SPHCC has expanded from traditional infectious diseases to comprehensive diagnosis and treatment of infectious diseases in particular, and the population served has gradually expanded. In the "active mode" during a public health emergency, the SPHCC has created negative pressure rooms with 327 beds in Area A (areas for patients with infectious diseases of the respiratory tract, such as COVID-19) and it has formed a professional medical treatment team. Patients with other diseases are transferred to Area B (areas for patients with infectious diseases of the digestive tract, such as hepatitis) or other areas for treatment.

Here, we share our experience as a designated COVID-19 hospital in the hopes that it will serve as a reference for healthcare providers and medical staff who are fighting the pandemic.

i) *A Professional Multi-disciplinary.* Team There was a severe shortage of medical resources early on during the outbreak (*5,6*), so the Shanghai Municipal Government coordinated the forming of a professional multi-disciplinary team that included all experienced medical experts in Shanghai specializing in infectious diseases, respiratory intensive care, intensive care, cardiothoracic surgery, and traditional Chinese medicine as well as nutritionists, rehabilitation physicians, psychologists, clinical pharmacists, and laboratory

physicians. The team has been stationed at the SPHCC and helped to treat patients with COVID-19. Depending on the number of patients admitted and the proportion in severe condition, a plan for medical workers needed is formulated. Thus far, a total of 641 front-line medical staff have helped to treat patients with COVID-19 at the SPHCC. In addition, 23 experts at the municipal level have provided guidance off-site, including 8 experts at the municipal level, 4 of whom specialize in Western medicine and 4 who specialize in traditional Chinese medicine. The implementation of a multi-disciplinary comprehensive diagnosis and treatment mode with concentrated specialties and experts helps to provide quality medical care in an attempt to increase the cure rate and reduce the mortality rate.

ii) *Personalized Treatment Plans for Patients in Severe or Critically Ill Condition Patients.* For patients in severe or critically ill condition (*6*), a refined diagnosis and treatment mode − A Dedicated Team and a Personalized Treatment Plan – has been implemented. A high-level collection of specialists in infectious diseases, respiratory critical care, and critical care medicine holds consultations. Six of these specialists are resident experts who are on-call day and night. They are responsible for group rounds twice a day (once in the morning and once in the evening), and hold sequential consultations regarding all patients in severe condition. In addition, 5 critical care experts from the front line of intensive care medicine and respiratory critical care in municipal hospitals lead 5 medical teams in the intensive care unit. Each team is in charge of 2 patients in critical condition and 2 patients in severe condition. These teams are responsible for the clinical treatment of all critically ill patients, ensuring timely detection of changes in a patient's condition and adjustment of treatment strategies. Depending on the care needs of critically ill patients, a special treatment team for extracorporeal membrane oxygenation (ECMO) treatment, continuous renal replacement therapy (CRRT) treatment, respiratory therapy, psychotherapy, and other specialized treatments is stationed in the ward to specifically manage patients. The Shanghai COVID-19 Medical Treatment Expert Group has established an effective clinical treatment plan and a proven medical treatment management system for the treatment of patients with COVID-19. Based on the summaries of early clinical diagnosis and treatment, the Expert Group continues to use a combination of hormones, vitamin C, heparin, interferon (developed by the SPHCC), and thymus peptides to effectively inhibit the progression of severe cases. Once the unified treatment plan was adopted, several imported cases with risk factors for progression have been prevented from developing into severe disease. On the basis of this treatment plan, the transition from severe condition to critically ill condition is avoided through the use of high-flow oxygen, deep breathing, and other techniques.

iii) *Well-organized Classification of Patients.* Based on the principle of grading, the admission procedures in emergency wards have been devised scientifically, and the medical workers have been sensibly deployed in order to guarantee the timely treatment for patients. Due to the differences in how patients arrive at the Center, treatment protocols and personal protection procedures for outpatients and inpatients with an unidentified fever have been devised, including four main procedures for patient pre-examination and triage, laboratory testing, prevention of nosocomial infection, and patient transfer. All of these procedures help to improve the ability to admit patients and reduce the risk of nosocomial infection in an effective manner.

iv) *Establishment of Transitional Wards.* The Center had a maximum capacity of 250 infected patients. Faced with an overflow, a stratified triage strategy was promptly adopted. Four negative pressure isolation wards, A3, A4, A1, and A2, were successively created. For patients in severe condition, early identification and intervention is the key, and timely triaging of patients should be done depending on their disease status. Therefore, patients with severe COVID-19 were transferred to A3, and patients with mild COVID-19 were concentrated in A1, A4, and A2. In line with changes in the patient's condition, the infected are thus treated in the isolation ward, transition ward, and then the observation ward.

v) *Nosocomial Infection Prevention and Control.* The level of protection, personal protective equipment, and disinfection measures are clearly specified. The standards and procedures for donning and removing protective equipment have been upgraded, and training and evaluation have been enhanced. To reduce the risk of nosocomial infection, non-contact sensing devices are used to sterilize and transport goods. In dressing areas, a bi-directional voice and video surveillance system is used so that real-time guidance is available during the process of donning and removing protective equipment. Due to safety concerns, an aerosol monitoring system and a personnel and equipment sterilizer have been installed to adjust air purification efficiency. Reused items are highly disinfected by the Center's central sterile supply room while vehicles for patient transfer are thoroughly disinfected on the Center's premises. A quality medical waste incinerator is exclusively used to dispose of medical waste and medical waste is traceable, which helps to eliminate secondary contamination.

vi) *Identification and Reporting of the Asymptomatic.* There are four ways to identify the asymptomatic, that is, medical observation of close contacts, an investigation of an outbreak in clusters, tracing of the source of infection, and identification of people with a history of travel or residence in regions where COVID-19 is present. The monitoring of the asymptomatic is mainly reflected in the enhancement of targeted screening, where the scope of monitoring is

further expanded to active screening of close contacts of confirmed cases and asymptomatic patients, outbreaks in clusters, target areas, and groups. Communities and fever clinics play a key role in surveillance, where tracing the source of infection is assisted by clues to the infection. An epidemiological examination of the confirmed asymptomatic is conducted in a timely manner, and relevant information is openly available. The requirements for reporting, epidemiological examination, and management of close contacts of asymptomatic patients are basically the same as those for confirmed cases. Once an asymptomatic patient is identified by a medical facility at any level, a direct report must be submitted online within two hours and an epidemiological examination must be completed within 24 hours. The confirmed asymptomatic will be quarantined at a designated facility for 14 days for medical observation; if they test negative for a coronavirus twice, they can be released from quarantine.

SPHCC will accelerate the construction of the National Emergency Medical and Strategic Reserve Center for Public Health. This facility will have three core functions: providing medical treatment, conducting scientific research and improving technical expertise, and conducting external exchanges and training. During the COVID-19 pandemic, we are providing the highest level of emergency medical care and will continue to do so.

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