Battling against the novel coronavirus: control strategies for and clinical management of the 2019 novel coronavirus infection in Shanghai, China

Jing-Ya Zhao¹, Jing Zhang², Yan-Ping Xu¹, Jia-Yang Yan¹, Jin-Fu Xu³, Jie-Ming Qu¹

¹Department of Pulmonary and Critical Care Medicine, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai 200025, China;
²Department of Pulmonary and Critical Care Medicine, Zhongshan Hospital, Fudan University, Shanghai 200032, China;
³Department of Pulmonary and Critical Care Medicine, Shanghai Pulmonary Hospital, Tongji University School of Medicine, Shanghai 200433, China.

Correspondence to: Prof. Jie-Ming Qu, Department of Pulmonary and Critical Care Medicine, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, No.197 Ruijin Er Road, Shanghai 200025, China

E-Mail: jmqu0906@163.com

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At the end of 2019, presentation of viral pneumonia due to a novel coronavirus (2019 novel coronavirus, 2019-nCoV) was reported in a group of patients in Wuhan, Hubei Province, China.[1] Now, coronavirus disease 2019 (COVID-19) has posed a significant threat to global health. Shanghai, the economic metropolis of China—with 344 confirmed cases, 320 recoveries, and 3 deaths as of March 11, 2020—is an area with low COVID-19 incidence. [2] In this study, we summarize several points on control strategies for and clinical management of COVID-19, which have a great impact on the overall control of the disease. We hope to present some valuable insights for the benefit of other areas worldwide.

Effective clinical diagnostic workflow on the basis of local epidemiology

The establishment of fever clinics for triaging patients is an effective strategy to control this emerging infectious disease. Available data show that confirmed COVID-19 cases in area of low infection incidence are mainly imported cases.[3] In these areas, most patients who present with symptoms of acute respiratory tract infection (e.g., fever and cough) have no specific exposure history. These patients likely have the common cold or influenza and bacterial respiratory tract infections, which are prevalent in winter and spring seasons. Non-selectively admitting these patients into fever clinics is a waste of medical resources and would result in cross-infections, increasing the difficulty in distinguishing patients with COVID-19 for further isolation and treatment. Thus, in Shanghai, we have taken complete advantage of the telemedicine platform and have developed an online consultation service to advise patients to self-isolate at home or receive medical advice on the basis of their epidemiological history and symptoms. Providing patients with full access to healthcare visits and telemedicine services helps ease the burden on offline clinics and emergency departments and allocate healthcare resources in an equitable
manner. Recent studies revealed that the median duration from disease onset to hospital admission for patients with COVID-19 in Shanghai is 5.5 days, which is much shorter than the median duration of 12.5 days initially reported in Wuhan.\textsuperscript{3,4} This may partially be attributed to the effective diagnostic workflow based on local epidemiology.

**Importance of the real-time reverse-transcription polymerase chain reaction assay in COVID-19 management**

Pathogen identification is the gold standard for the diagnosis of infectious diseases. Improvements in the diagnostic ability are of great importance in controlling the emerging epidemic. In a designated hospital in Shanghai, the quick reverse-transcription polymerase chain reaction (RT-PCR) kit for COVID-19 detection is widely used, which significantly shortens the diagnostic time frame.

In fever clinics of most hospitals in Shanghai, besides complete blood count and C-reactive protein measurements, chest computed tomography (CT) is used for screening suspected cases. Patients with characteristic imaging findings should undergo a respiratory viral test. If the pathogen identification result is negative, the patients should be individually treated, and RT-PCR testing for COVID-19 as well as chest CT should be repeated in the subsequent 48–72 hours.

**Early identification of patients with the risk of severe pneumonia**

Various prediction models, such as the pneumonia severity index and CURB-65 (confusion, uremia, respiratory rate, blood pressure, age ≥ 65 years) score, have been widely used in the clinical diagnosis and treatment of community-acquired pneumonia and could provide guidance
in choosing the optimal treatment location and optimizing individual therapy. However, most models lack specific indicators of viral infection and exhibit poor sensitivity in predicting the severity and prognosis of viral pneumonia. Through analysis of the clinical data of 528 patients diagnosed with viral pneumonia, an early warning model for predicting mortality in patients with viral pneumonia, namely, the MuLBSTA score, was constructed.\textsuperscript{[5]} In general, the characteristics and prognosis of 99 patients with COVID-19 pneumonia in Wuhan were in line with those predicted on the basis of MuLBSTA scores detailed in the article published in \textit{The Lancet} on January 30, 2020.\textsuperscript{[6]}

The Shanghai Public Health Clinical Center is the designated center for the treatment of COVID-19 infections. All diagnosed patients are safely transferred to the center and admitted to the general ward or intensive care unit (ICU). Currently, the cure rate has reached 80% in Shanghai. The \textit{Shanghai Expert Consensus on the Comprehensive Treatment of COVID-19} was officially released on March 2, 2020. It highlights the early indicators of disease progression, including advanced age, complications with other systemic diseases, progressive worsening of lung parenchymal pathology $>50\%$ for 2–3 days, cluster of differentiation-4$^+$ T cell count $<250/\mu$L, significantly increased serum interleukin-6 levels, lactate dehydrogenase level greater than two times the normal range upper limit, and a serum lactic acid level $\geq3$ mmol/L with metabolic alkalosis.\textsuperscript{[7]} More importantly, medical experts tend to administer personalized and precise therapies on the basis of individual characteristics and continuously make adjustments and optimizations during diagnosis and treatment. Patients with a high risk of developing severe disease are followed up with continuous supervision for changes in vital signs, laboratory parameters, and chest imaging findings. Meanwhile, early interventions to prevent the development of severe disease are implemented, including early administration of antiviral drugs
(hydroxychloroquine is recommended), effective oxygen therapy and monitoring, maintenance of the immune system, enhanced supportive care, and a focus on internal homeostasis. Patients without potential risk factors are admitted to general wards with relatively minimally intensive but indispensable surveillance and support so that medical resources are allocated equitably.

**Integrated management of medical workers and patients in hospitals**

Actively preventing nosocomial infections serves a key role in epidemic control in hospitals. The health authorities in Shanghai implemented a series of measures for the integrated management of both medical staff and patients. For medical staff, training to improve knowledge on COVID-19 and skills for protection was organized, especially for those working in high-risk departments such as fever clinics, emergency departments, ICUs, and respiratory departments. Access to sufficient protective equipment and reasonable distribution of medical resources were also of great importance. Meanwhile, doctors and nurses were provided nutrients and drugs to strengthen their immune systems to prevent infection. For patients, combined with megadate, the Shanghai government applied a color-based Quick Response code system during the epidemic period as a dynamic and real-time health status certificate for every citizen. Traditional questionnaires were substituted by electronic ones, which are a more accurate approach for obtaining epidemiological information. Moreover, family members were strictly restricted from visiting patients in order to reduce the risk of nosocomial infection spread.

**Implementation of effective prevention and control measures in the whole society**

A decreasing trend in COVID-19 cases has been observed since February 4, 2020. The number of new cases in Shanghai from February 19 to March 11 was only 11, and no new cases have been reported since March 7, reflecting the significant contribution of effective prevention and
control measures throughout the society in controlling the transmission speed of COVID-19. The epidemic emerged around the Spring Festival, the most important traditional Chinese festival, making it more complicated and challenging for the government to prevent its dissemination. First, all rallies and events were canceled, along with strict limitations on business hours and customer visits to public areas such as shopping malls and restaurants, reduction of passenger flow, and implementation of very strong propaganda. The Shanghai government also educated the public on wearing masks and emphasized hand hygiene through the Internet and social media. Second, the government reduced public transportation, including flight, train, and bus services, and monitored all airports, train stations, and entrances to Shanghai. Individuals suspected of having the disease were isolated in a timely manner for observation. Individuals presenting with fever were referred to designated fever clinics. According to the data from the National Transportation Department, passenger flow markedly decreased by about 70% in Shanghai during the Spring Festival of 2020. Third, communities played an important role, from screening residents for symptoms (such as fever and cough) before community entry and conducting door-to-door checks to identify individuals who are infected or are suspected of being infected to providing assistance to those who are quarantined at home. It is worth mentioning that asymptomatic infection is also considered an important source of infection. Apart from the aforementioned strategies, one of the most effective management strategies for asymptomatic infection is sufficient testing for the detection of COVID-19 in individuals who have an epidemiological risk or are suspected of exposure and even exhibit mild or no symptoms.

Conflicts of interest

None.
References


Figure 1: Flow chart on the control of and clinical practice for the management of 2019 novel coronavirus infection in Shanghai, China. CRP: C-reactive protein; CT: Computed tomography; CAP: Community-acquired pneumonia; RT-PCR: Reverse-transcription polymerase chain reaction; Ig: Immunoglobulin; COVID-19: Coronavirus disease 2019; ICU: Intensive care unit.