



Role of pharmacists during the COVID-19 pandemic in China-Shanghai experiences

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Abstract

The roles and contributions of pharmacists in Shanghai during the coronavirus disease 2019 (COVID-19) pandemic are described in this report. Five pharmacists have been appointed as members of an expert interdisciplinary health care team tasked with taking care of all adult patients with COVID-19 in Shanghai in a designated hospital, the Shanghai Public Health Clinical Center (SPHCC). They work with pharmacists at SPHCC, having responsibilities that include drug supplies, dispensing, pharmacy intravenous admixture services (PIVAS), prescription audits, medication reconciliations, pharmacotherapy, therapeutic drug monitoring, and patient education. Due to the pandemic, pharmacy operations in all hospitals are modified to adhere to guidelines for infection risk mitigation and personnel protection. Community pharmacies serve as the public access point to health care and medical supplies, providing services beyond dispensing and medication counselling. The establishment of internet hospitals (telehealth facilities) provide new opportunities for delivering pharmaceutical care and working with health care professionals. Pharmacists also participate in evaluating new treatments and keeping health care teams informed of new findings for potential treatment considerations. In response to the critical need for health care professionals in Wuhan, 68 pharmacists from different parts of the country went there to work with the local pharmacists. Through assuming new roles and adapting existing practice, pharmacists have acquired invaluable experiences for future practice advancement. In order to assume these responsibilities effectively, pharmacists need to be equipped with the necessary skills for meeting the evolving health care challenges.

KEYWORDS

China, community pharmacy services, COVID-19 pandemic, hospital pharmacy services, pharmacists

1 | COVID-19 PANDEMIC IN CHINA AND SHANGHAI

Coronavirus disease 2019 (COVID-19) is an emerging respiratory infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It first appeared in early December 2019 in Wuhan, the provincial capital city of Hubei, China.¹

During the period of 10-23 January 2020, a massive human migration took place in -China as individuals travelled back to their hometowns for Chinese New Year. More than 5 million people left or returned to Wuhan during this short period. To confine the evolving pandemic, on 23 January 2020, an unprecedented public health intervention was put in place by shutting down all transportation in and out of Wuhan.²

Between 23 January and 1 February 2020, patients with mild symptoms were placed in home quarantine. With the escalation of confirmed cases, health care facilities and hospital beds were filled to capacity in Wuhan. In order to expand bed capacities rapidly, construction began on January 23 to build the Vulcan Mountain Hospital and on January 26, the Raytheon Mountain Hospital, with 1000 beds and 1600 beds and finished within 10 and 11 days, respectively.

On 2 February 2020, an intensified measure was taken to centralize quarantine and treatment. All patients with severe symptoms and those who were critical were transferred to designated hospitals, whereas patients with mild symptoms were treated at a Fangcang shelter hospital. Fangcang, which sounds similar to Noah's Ark in Chinese, is a large, temporary hospital built by converting public venues, such as stadiums and exhibition halls, into health care facilities to isolate patients with mild to moderate symptoms of an infectious disease from their families and communities, while providing medical care, disease monitoring, food, shelter, and social activities.³ Patients with suspected infections were housed in designated locations for isolation.

In Wuhan, there were 48 designated hospitals with 26 911 beds for treating severe and critical patients. Sixteen Fangcang shelter hospitals with 13 467 beds were available for treating mild and moderate patients. In addition, there were more than 1000 designated locations for quarantine, such as hotels, schools, or universities, with about 70 000 beds for individuals with suspected infection.

As of 26 April 2020, there were 46 464 patients with COVID-19 in Wuhan, which constitute about 60% of all confirmed cases in China; 92.3% of these patients in Wuhan recovered and 7.7% died. Thirty-one medical teams with about 42 000 medical professionals, including 68 pharmacists, from all over China rushed to Wuhan and worked with about 60 000 local medical professionals, including 9817 pharmacists.

In Shanghai, as of 26 May 2020, there were 652 patients recovered from the infections (332 domestic and 320 imported cases) and seven deaths (all domestic). Ten patients were still hospitalized (two domestic and eight imported cases). The mortality rate is only about 1%, which is much lower than the 5.5% in the whole China and 7.7% in Wuhan.

The purpose of this report is to summarize the roles and contributions of pharmacists in Shanghai during the COVID-19 pandemic. Also described are how hospital and community pharmacies offer their services to patients during this extraordinary period.

2 | COVID-19 PANDEMIC—EXPERIENCES OF PHARMACISTS IN SHANGHAI

Shanghai is one of the largest cities in China, with the highest gross domestic product (GDP). There are about 24 million residents, 359 comprehensive hospitals, 246 community health care centers, and about 6000 family doctors. Five hundred fifty medical professionals and 660 beds were mobilized for treating patients with COVID-19, using guidelines published in the “Expert Consensus on

Comprehensive Treatment of COVID-19 in Shanghai,” written by a Shanghai expert group on novel coronavirus infection.⁴

2.1 | Designated hospital and fever clinics for patients with COVID-19

The Shanghai Public Health Clinical Center (SPHCC) is the only designated hospital for treating adult patients with COVID-19 in the area. The hospital has 660 beds and was built 16 years ago specifically for an epidemic such as this. It is located about 60 km away from the Shanghai city center. For pediatric patients with COVID-19, they are treated at the Pediatric Hospital of Fudan University.

Fever clinics are set up in all comprehensive hospitals and at about 160 community hospitals. The clinics are physically separated from the hospital emergency departments and serve as the front line for screening and identifying suspected patients. All patients with COVID-19, once confirmed at the clinic by a positive nucleic acid test, epidemiological survey, and computed tomography (CT) scanning, are sent to the designated hospital for treatment.

2.2 | Expert group of health care professionals

At the direction of the Shanghai Health Commission, a comprehensive multidisciplinary team (MDT) team was organized with about 250 experts from the top 10 comprehensive hospitals in Shanghai. The team consists of specialists in infectious diseases, respiratory medicine, critical care medicine, medical imaging, clinical pharmacy, traditional Chinese medicine (TCM), nutrition support, etc. These specialists work together with the 300+ medical professionals at SPHCC. They meet daily at a conference room located in SPHCC, using telehealth technology to take care of patients in a collaborative manner.

The five pharmacy experts in the MDT are pharmacy directors from five comprehensive hospitals in Shanghai. They work with the 35 pharmacists and five clinical pharmacists at SPHCC, having responsibilities over drug supplies, dispensing, pharmacy intravenous admixture services (PIVAS), prescription audits, medication reconciliations, pharmacotherapy, therapeutic drug monitoring (TDM), and patient education.

2.3 | Patient classification

According to the criteria stated in the “Expert Consensus on Comprehensive Treatment of COVID-19 in Shanghai,”⁴ individuals with an epidemiological history (resided in or visited an epidemic area within 14 days) and clinical symptoms (fever or respiratory symptoms, imaging features, decreased lymphocyte count) are considered suspected cases.

Patients with COVID-19 positive are categorized as mild, moderate, severe, or critical according to their clinical presentations and the

TABLE 1 Classification of patients with COVID-19 infections

Classification	Symptoms and clinical presentations	Pneumonia (CT imaging)
Mild	Mild	None
Moderate	Fever, respiratory symptoms	Present
Severe	Shortness of breath; respiratory rate > 30/min, O ₂ Sat < 93%, PaO ₂ /FIO ₂ ≤ 300 mm Hg	Significant
Critical	Respiratory failure, multiple organ failure, shock	Significant

Abbreviation: CT, computed tomography.

presence of pneumonia as determined by CT imaging (Table 1). About 85% of patients with COVID-19 are categorized as mild or moderate, whereas about 15% are severe or critical.

2.4 | Patient management and pharmacotherapy

At SPHCC, patients who are categorized as mild or moderate are housed in buildings A or B, each with 100 beds, whereas severe and critical patients are housed in intensive care units in building C. Relevant clinical and demographic details of individual patients, such as name, age, sex, nationality, admission date, temperature, symptom, oxygen intake, CD4+ count, serum albumin and immunoglobulin M (IgM), and CT scan and assessment, are printed for each medical expert every day for daily MDT consultation. The Shanghai team found that the CD4+ T lymphocyte count is an important indicator for early intervention, thereby minimizing the risk for developing severe symptoms or becoming critically ill.⁵

Drugs commonly used for COVID-19 treatment include hydroxychloroquine, vitamin C, thymalfasin, ulinastatin, glucocorticoid, omeprazole, and esomeprazole. In combination with Western medicines, traditional Chinese medicines are often used according to guidelines issued in China and South Korea.^{6,7} The role of pharmacists for pharmacotherapy interventions are presented in Table 2.

2.5 | Pharmacist contributions toward patient care

2.5.1 | Expert team

As members of the expert MDT team, pharmacists focus on issues related to pharmaceuticals, pharmacokinetics, and pharmacotherapy, as well as treatment alternatives due to drug shortages.

An infectious disease physician and expert team member, Dr. Bijie Hu, found that irrigation of the nasal cavity and paranasal sinuses reduced the time needed to result in a negative virus nucleic acid detection test.⁸ Pharmacists in the team recommended adding ephedrine to the warm normal saline irrigation solution to induce vasoconstriction and also levofloxacin for treating concurrent

TABLE 2 Role of pharmacists on pharmacotherapy

Drug	Interventions
Hydroxychloroquine	Pharmacokinetic dosing and therapeutic drug monitoring
Vitamin C	Dosing regimen—duration and tapering
Thymalfasin	Dosing regimen and evaluation
Ulinastatin	Dosing regimen and evaluation
Glucocorticoid	Dosing regimen and evaluation
Omeprazole, esomeprazole	Dosage regimen for nasogastric administration
Traditional Chinese medicines	Drug interaction prevention, monitoring, and assessment

bacterial infection in the paranasal sinus. In addition, applying negative pressure would help washing the paranasal sinus more thoroughly.⁹ These measures have been observed to improve smell and taste sensations as well as magnetic resonance imaging (MRI) of the paranasal sinus.

2.5.2 | Hospital inpatient care

Sleep quality and immunologic function have been shown to be linked bidirectionally. Sleep can activate the immune system and promote inflammatory homeostasis through inflammatory mediators, such as cytokines.¹⁰ Enhancement of sleep during an infection can presumably provide feedback to promote host defense. As such, sufficient sleep may reduce infection risk and improve infection outcome and vaccination responses.¹¹

Quality sleep is therefore important for patients with COVID-19. For those patients who acquired the infection outside of China and had just returned to Shanghai, lack of sufficient sleep was common due to their long trip home. In addition, they may not have sufficient water and food intake during travel and also during the long wait time for COVID-19 testing and border entry quarantine. All of these factors could reduce the level of inflammatory markers in the peripheral circulation, thus increasing the susceptibility to infections.

In order to provide an environment conducive for sleeping, rooms should be dimly lit with a comfortable ambient temperature. Patients are asked to avoid using mobile phones or computers for extended periods, and refrain from using them an hour before bedtime. Some patients may find that having dessert after dinner is beneficial.

For mild and moderate patients with COVID-19 without pre-existing sleep problems, pharmacists would typically recommend oral vitamin C 0.5 g twice daily or 1 g once daily and ketotifen 0.5 or 1 mg at bedtime. For those with occasional or transient insomnia, oral vitamin C 0.5 g twice daily or 1 g once daily and zolpidem 10 mg at bedtime would be indicated. For those with substantial anxiety, insomnia, tension, or fear, oral vitamin C 0.5 g twice daily or 1 g once daily and estazolam 1 or 2 mg at bedtime are generally recommended.

2.5.3 | Hospital discharge

During hospital discharge, patients are given access to the online platform, “SPHCC Patient Care,” where they can ask questions related to their medications as well as COVID-19. The platform is also set up for follow-up physical and psychological assessments, as well as for adverse drug reaction monitoring. Patients consider this as one of the most valuable professional services offered by pharmacists.

2.5.4 | Fever clinic

Patients with fever or any symptom consistent with COVID-19 have to go to a fever clinic for evaluation. The clinic is an outdoor quarantine station separated from the hospital emergency department. Any individual who has an epidemiological history and clinical symptoms are classified as suspected cases and have to be isolated in the hospital negative pressure ward. After COVID-19 infection is confirmed, the patient is sent to the designated hospital for treatment.

Fever clinics and isolation wards are considered high-risk areas for pharmacists working there. They should disinfect their hands before and after handling medical records and paper prescriptions.^{12,13} In order to separate the pharmacy operation from the rest of the hospital, designated staff use a special identification system and supplies, so as to maintain separation between areas for patients with fever from the other hospital patients.

Paper prescriptions are sterilized with ethylene oxide before moving to storage. Drugs entering the quarantine zone would not be returned to the general area.¹³ Separate drug delivery equipment and containers are used in the quarantine and nonquarantine areas and they should not be mixed. The equipment and containers in the quarantine zone are disinfected periodically. Disposable plastic bags are used to deliver medicines. Electronic prescriptions are used in the quarantine area to reduce infection risk and potential environmental contamination.¹³

2.5.5 | Hospital pharmacy operation

Guidance and standards for hospital pharmacy operations are detailed in the “Recommendations on Hospital Pharmacy Departments Coping with Corona Virus Disease 2019” (second edition), which was prepared by the Beijing Pharmacy Center for Quality Control and Improvement.¹³ Pharmacy personnel need to be trained on the proper techniques for infection prevention and control.¹⁴ Policy and procedures for personnel protection should be strictly adhered to. Most pharmacists are considered to have low exposure risk, with indirect patient contact activities such as dispensing, medication consultation, ward delivery of medicines, and intravenous admixture services. However, for those working in medium- and high-risk areas, personal protective equipment should be employed in addition to appropriate hand hygiene.

Strict disinfection measures should be applied to the work environment as well as paper prescriptions and equipment. Seventy-five percent ethanol, chlorine disinfectant, and disinfectant wipes should be commonly used. Medical waste should be handled according to established procedures.

In the outpatient pharmacies, measures should be used to promote social distancing, such as installing partitions to separate patients and placing markers on the floor to maintain spacing among patients and visitors.

Pharmacists are responsible for developing emergency drug formularies for their institutions. They monitor drug supplies, identify suitable alternatives, and resolve drug shortages. Pharmacists also provide free consultation to health professionals and patients via social media (WeChat groups).

With the suspension of nonessential clinic visits during the epidemic, pharmacists play an important role in extending the validity of existing prescriptions and providing refills. For those with basic medical insurance, prescriptions can be extended according to the need for therapy with 3 months maximum, compared with 1-2 weeks typically allowed before the pandemic. It is essential for pharmacists to ensure that the extension is appropriate and safe. Certain drug categories, such as psychiatric drugs, are excluded from such extension.

2.5.6 | Internet hospitals for telemedicine

During the pandemic, six licensed internet hospitals, which are affiliated with large comprehensive hospitals in Shanghai, have been established to provide telemedical services, reducing the need for patients to come to hospitals for treatment and follow-up. Pharmacists can thereby provide online follow-up, process, and dispense electronic prescriptions and then send the medications to the patients.^{15,16} Such a setting provides the pharmacists new opportunities for delivering pharmaceutical care while working closely with the health care team.

2.5.7 | Community pharmacies

During the pandemic, community pharmacists are the patients' access point to health care and medical supplies, such as masks, over-the-counter (OTC) drugs, thermometers, disinfectants, etc. These products are often delivered from the pharmacies to the patients' homes. Community pharmacists repack bulk packages of masks into smaller packets with the rationed amount for residents in their communities. They also provide education and consultations on proper hygiene techniques and offer emotional support as needed. Many community pharmacies are open 24 hours daily during the pandemic.

The 500 000+ community pharmacies in China also help to identify potential infections. The pharmacy staff measures the customers' temperatures and records personal details such as name, gender, age, identification number, phone number, and address. Customers are asked if they have experienced symptoms such as cough and fever.

Those who purchased any medicine containing acetaminophen would be noted.

2.5.8 | Clinical trials

Eleven clinical trials for COVID-19 treatment have been conducted in Shanghai and they are registered in the clinicaltrials.gov website. During the first week of February 2020, SPHCC launched a randomized parallel open label trial of hydroxychloroquine (NCT04261517), slated to include 30 patients with COVID-19. In addition, the efficacy and safety of darunavir and cobicistat (NCT04252274) for COVID-19 infections are being evaluated. There are 15 trials to assess the effect of anti-SARS-CoV-2 inactivated convalescent plasma (NCT04292340) on patients with COVID-19. Pharmacists are responsible for maintaining the investigational drug inventory, as well as dispensing. They also keep health care teams informed of new findings for potential treatment considerations.

2.6 | Health care teams to Wuhan

In response to the critical need for health care professionals in Wuhan, 68 pharmacists from different parts of the country went there to work with the 9817 local pharmacists. They collectively ensured adequate medical supply for the medical teams and compiled drug formularies for local institutions. The group also provided drug information for physicians, nurses, and patients under the direction of more than 100 pharmaceutical experts in China. Because Chinese traditional medicines are often used concurrently with Western medicines, pharmacists were responsible for determining optimal dosage regimens, identifying potential drug interactions, and assessing the efficacy of such combination therapy.¹⁷ At the Fangcang shelter hospitals, pharmacists offer medication counselling and as appropriate, emotional support for patients.

3 | PERSPECTIVES FOR FUTURE PRACTICE ADVANCEMENT

The COVID-19 pandemic provides a unique environment for adapting practice to a changing health care landscape, requiring rapid decision-making and innovative thinking. The experiences acquired are invaluable for advancing practice and providing confidence for meeting future challenges.

Examples of initiatives that have been developed during the pandemic include setting up emergency drug formularies, maintaining uninterrupted drug supply, finding the most optimal alternative drug treatment in response to shortages, and optimizing strategies for infection risk mitigation as well as personal protection. Community pharmacies instantly become the public access point to health care and medical supplies, assuming dual roles for promoting individual health as well as community safety. Pharmacists are there to dispense

medications, provide drug counselling and health education, and offer emotional support while identifying those in need of further care. These different care dimensions extend the roles and contributions of pharmacists toward community health while providing an opportunity for consumers to experience and appreciate pharmacists as valuable partners in health and wellness.

The establishment of internet hospitals (telehealth facilities) provides new opportunities for innovative pharmaceutical care models, allowing pharmacists to work in tandem with health professionals in new ways. With the increasing accessibility of technology and advancement of artificial intelligence, pharmacists are well positioned to develop and operate “smart pharmacies,” not only in tertiary health facilities, but in community health centers, clinics, and pharmacies.

Through the assumption of new roles and the adaptation of existing practice during the pandemic, pharmacists have acquired invaluable experiences for future practice advancement. In order to assume these responsibilities effectively, pharmacists need to be equipped with the necessary skills for meeting evolving health care challenges.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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