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Response of Chinese Anesthesiologists to the COVID-19 Outbreak

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ABSTRACT

The coronavirus disease 2019, named COVID-19 officially by the World Health Organization (Geneva, Switzerland) on February 12, 2020, has spread at unprecedented speed. After the first outbreak in Wuhan, China, Chinese anesthesiologists encountered increasing numbers of infected patients since December 2019. Because the main route of transmission is *via* respiratory droplets and close contact, anesthesia providers are at a high risk when responding to the devastating mass emergency. So far, actions have been taken including but not limited to nationwide actions and online education regarding special procedures of airway management, oxygen therapy, ventilation support, hemodynamic management, sedation, and analgesia. As the epidemic situation has lasted for months (thus far), special platforms have also been set up to provide free mental health care to all anesthesia providers participating in acute and critical caring for COVID-19 patients. The current article documents the actions taken, lesson learned, and future work needed.

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No winter lasts forever; no spring skips its turn.
—Hal Borland

In December 2019, an outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection occurred in Wuhan, Hubei Province, China. With cases detected in more than 70 countries, and significant outbreaks not only in China but also in South Korea, Italy, and Iran, the novel coronavirus has truly gone global.[1–4] At the time of writing, 80,651 cases have been confirmed and 3,070 individuals have died in mainland China. Of note, the total number of COVID-19 cases worldwide continues to increase, surpassing 100,000 as of March 6, 2020.[5] The COVID-19 outbreak has swiftly outpaced the 2003 SARS outbreak in terms of both number of patients infected and fatalities and presents a daunting challenge for stakeholders in China and globally.[6,7] Our immediate and future response to this devastating mass emergency will have ongoing and far-reaching impact. A range of medical actors, including anesthesiologists and Chinese anesthesia departments and organizations, have quickly responded. The current article documents the actions they have taken.

An Overview of COVID-19 Infection, Morbidity, and Mortality

COVID-19 is caused by a novel coronavirus with its main route of transmission *via* respiratory droplets and close contact.[1–3] Fever (88.7%), cough (67.8%), and fatigue (38.1%) are the primary signs and symptoms, whereas ground-glass opacity (56.4%) and bilateral patchy shadowing (51.8%) were the most common radiologic findings on chest computed tomography, and lymphocytopenia was present in 83.2% of patients.[8,9] A review of the literature reveals a mortality rate of COVID-19 in China of 1.4% to 2.3%.[9,10] Among laboratory-confirmed cases, 23.7% had at least one coexisting illness (*e.g.,* hypertension and diabetes), 5.0% were admitted to an intensive care unit (ICU), and 2.3% underwent invasive mechanical ventilation.[10] Critically ill patients may develop acute myocardial injury (29%), acute kidney injury (23%), or liver dysfunction (29%), and 71% patients required mechanical ventilation.[8] Approximately 3.5% of healthcare personnel were infected, of whom 14.8% were classified as severe or critical, with five fatalities (0.3%).[11]

Anesthesiologists and the Practice of Anesthesia in the Epicenter of Wuhan

COVID-19's impact on anesthesiologists in the epicenter of Wuhan has occurred in two distinct stages.

The First Stage: Late December 2019 to January 20, 2020

The first case of COVID-19 was reported in early December 2019 in the epicenter of Wuhan, before the disease was

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officially named, presenting as an apparently "inexplicable" pneumonia.[2] At that time, the public had no knowledge of the nature, virulence, lethality, and infectivity of this new virus and very few paid any attention to it. Anesthesia and surgery were practiced as normal in Wuhan until the end of December 2019, when healthcare workers including anesthesiologists were alerted to an abrupt increase in cases of COVID-19. Not realizing that the virus could be transmitted from human to human, hospitals reacted with a variety of precautionary measures. Some made it mandatory to wear a N95 mask during daily work, whereas others stipulated only protective goggles or a face shield were to be used by personnel carrying out emergency intubation, with the highest level of protection reserved for those caring for patients with fever. Meanwhile, some others required suspected patients to be given a chest computed tomography study before surgery.[12] Unfortunately, a lack of consensus, and hence of uniformity in precautionary requirements, meant that these protective measures were not universally adopted.

At the same time, the surgical caseload decreased; however, this was not because of a clear recognition of the situation, but because of the approach of the Chinese Lunar New Year. Nonetheless, some hospitals in Wuhan at this stage had started to voluntarily reduce the number of elective surgical procedures due to the rapid development of the situation and increasing levels of concern. Overall, this stage was characterized by a lack of attention, consensus, and mandate as to how to protect the anesthesiologists themselves and provide the best care to patients with confirmed and suspected infections.

The Second Stage: January 20, 2020 to the Present

On January 20, 2020, Dr. Nan-Shan Zhong, the pulmonologist leading the expert panel appointed by the State Health Commission, acknowledged the human-to-human transmission of this novel coronavirus and called on people to wear masks and avoid traveling to Wuhan.[13] This announcement came 4 days before the Chinese Lunar New Year and at a tipping point; that is, just as confirmed cases in China erupted. Normally at this time of year, most operating rooms would be closed and most anesthesiologists off duty. However, this was not the case for anesthesiologists in Wuhan this year, where most hospitals had to deal with a surge in the number of patients with fever, which swiftly reached a crisis point. Emergency rooms, in-patient floors allocated to respiratory and infectious diseases, and ICUs were suddenly flooded with confirmed and suspected COVID-19 cases, swiftly overwhelming healthcare personnel. As hospitals mounted a large-scale recall of already discharged healthcare personnel, including anesthesiologists, the role of anesthesiologists in the outbreak became clear: to participate in acute and critical care with a focus on airway management, oxygen therapy, ventilation support, hemodynamic management, sedation, and analgesia. Some anesthesiologists, after a rapid training in infection prevention, were deployed to fever clinics and ICUs to help care for patients with confirmed or suspected infections.

As the number of cases continued to rise, a rapidly increasing number of hospitals in Wuhan were designated for the exclusive admission of patients with COVID-19 to contain cross-infection. For example, on January 25, 2020, 14 hospitals were allocated to the reception of fever patients, including the West Campus of Wuhan Union Hospital, a tertiary comprehensive teaching hospital, where all anesthesiologists were deployed to the floor where COVID-19 patients were being cared for. Despite these dramatic measures, however, it quickly became apparent that the number of beds was far from adequate. Recognizing the urgency of the situation, the government made the swift decision to build two new hospitals, Huo-Shen-Shan and Lei-Shen-Shan, from ground zero. However, when the beds provided by both designated hospitals and new hospitals remained inadequate to meet the sharp increase in cases, the government requisitioned building plots in the city to construct sixteen *Fang Cang* ("makeshift") hospitals with a capacity of more than 13,000 beds. As of February 28, 2020, approximately 12,000 patients had been admitted into *Fang Cang* hospitals, whereas nearly 5,600 had been discharged.[14]

The rapidly increasing number of cases, and the allocation of more hospitals and beds for patients with COVID-19, required the support of healthcare workers from outside Wuhan and Hubei Province. It has been estimated that approximately more than 42,000 healthcare workers, including approximately 1,000 anesthesiologists, from outside Hubei Province joined the frontline fight at the peak of the viral outbreak, assigned to different clinics and hospitals to share the workload which was overwhelming local teams. Healthcare workers at the frontline are mainly from public medical institutions, and thus can be summoned by the government. The Chinese are resilient, and the COVID-19 is definitely a public health emergency in China. Only with arduous struggle and concerted efforts, we can defeat the epidemic and win the battle against the COVID-19.

Approximately 15 to 20% of patients with COVID-19 developed hypoxemia and required some form of oxygen therapy and ventilation support.[8] Types of ventilation support used in the context of this outbreak include high-flow oxygen therapy, noninvasive ventilation, invasive mechanical ventilation, and extracorporeal membrane oxygenation. The designated hospitals for COVID-19 patients have in-house teams specifically assigned for the task of endotracheal intubation. Anesthesiologists who are responsible for airway management are at enhanced risk, if not the highest risk, of contamination. The story of 18 anesthesiologists and two anesthesia nurses from five different hospitals forming a garrison team and performing nearly 50 intubations for critically ill patients with COVID-19 over a period of eight days has become well known, with the team being called "coronavirus intubation team racing against death" (fig. 1).[15]

Fig. 1. Two anesthesiologists performing endotracheal intubation on a patient with COVID-19 (photo by Yun Lin).

Fig. 2. Drill simulating a 39-week pregnant woman who needed an emergency cesarean section because of intrauterine distress, held in the Department of Anesthesiology, Zhujiang Hospital of Southern Medical University (Guangzhou, China; photo by Hong-Fei Zhang).

During the period January 20, 2020 to the end of February 2020, the operating rooms of hospitals in Wuhan, Hubei Province remained largely unused, except for emergency cases. Strict infection-control regulations were quickly established and monitored. Patients requiring surgery were carefully prepared beforehand, including chest computed tomography scan and blood nucleic acid test. Meanwhile, anesthesiologists were mandated to use a higher level of precautions for patients with suspected or confirmed COVID-19. Wuhan Union Hospital's Department of Anesthesiology drafted the "Perioperative Care Provider's Considerations in Managing Patients with COVID-19" and carried out 45 surgical procedures on such patients, with cases of west campus of Wuhan Union Hospital in total.

An upgraded surgical safety checklist for patients with suspected or confirmed COVID-19 was drawn up and implemented, along with infection-control guidelines for the care of such patients. Task forces dedicated to procedure standardization, infection control, and staff scheduling within anesthesia were quickly assembled in most hospitals across the country. Monitoring was implemented to ensure that anesthesia providers wore and removed personal protective equipment before working in the perioperative environment. Drills were held to ensure the optimal management of emergencies, with mandatory multidisciplinary participation across anesthesia, surgery, critical care, pediatrics, and obstetrics and gynecology (fig. 2).

More than 3,000 of the 44,672 cases reported to have been infected with the virus as of February 11 (1,716 confirmed by nucleic acid tests) are hospital staff or other medics.[10] Because details were not available at the time of writing, we do not have data concerning the number of anesthesia providers confirmed to have been infected, or whether such infections were work-related or not. One story that has become well known concerns Dr. Shang-Long Yao, former vice-president of the Chinese Society of Anesthesiology (Beijing, China) and Wuhan Union Hospital, who was infected and hospitalized for four weeks in Wuhan. Dr. Yao's family, including his wife and daughter, were infected and the infection was probably transmitted to Dr. Yao by his daughter. Dr. Yao has become a role model for others because of his resilience and optimism. He participated in the international webinar from his hospital bed on February 22, 2020 and was discharged home on February 24, 2020, following the negative results of two sets of nucleic acid tests.

Joint Efforts of International and Chinese Anesthesiologists during the Outbreak

International and domestic anesthesia professionals quickly recognized and responded to the challenges posed to patients, doctors, citizens, and society by this unprecedented outbreak. Dr. Lingzhong Meng, an anesthesiologist from Yale University School of Medicine (New Haven, Connecticut), was the first to organize a series of webinars discussing the key issues facing anesthesiologists and intensivists. The four topics addressed were: (1) whether anesthesiologists and intensivists were prepared for this outbreak (February 8, 2020); (2) how airways could be managed (February 15, 2020); (3) how lung-protective ventilation could be provided and what the goal of oxygenation was (February 22, 2020); and (4) "ECMO—friend or foe" (February 29, 2020). These webinars attracted a 30,000- to 60,000-strong audience during their live streaming and were viewed approximately 1,000,000 times within a week. The International Airway Management Society (Cherry

Hill, New Jersey) also coordinated a webinar discussing airway management in the context of the outbreak on February 23, 2020.

Efforts of Professional Anesthesia Organizations in China

On February 14, 2020, the Chinese Society of Anesthesiology and Chinese Association of Anesthesiologists jointly sent a letter to the heads of anesthesia departments in China, rallying anesthesiologists to meet the challenge of ensuring that the safe practice of anesthesia nationwide played a pivotal role in the fight against the epidemic.[16] Due consideration has also been given to the mental health of anesthesiologists. On February 15, 2020, the Chinese Society of Anesthesiology and Chinese Association of Anesthesiologists jointly established a platform providing free mental health advice to all anesthesia providers, capable of providing consultation to more than 200 persons per day, twice daily.[17] On February 20, 2020, the two organizations jointly set up an anesthesia experts' online Q&A forum to answer questions related to infection control, to which anesthesia providers were invited to submit their questions and concerns directly.[18] Taking the lead, the Chinese Society of Anesthesiology and Chinese Association of Anesthesiologists also issued the "Anesthesia and Nursing Standard Operation Protocol in Operating Rooms for Patients with Suspected and Confirmed COVID-19," and other best practices to minimize the risk of contamination have also been quickly developed and published.[19] Among these, the Chinese Society of Anesthesiology Task Force on Airway Management issued its "Recommendations for Tracheal Intubation in Critically Ill COVID-19 Patients (Version 1.0),"[20] and the Chinese Society of Anesthesiology Pediatric Anesthesiology Task Force and Youth Committee jointly issued the "Pediatric Anesthesia-related Specifications during the COVID-19 Epidemic."[21] Meanwhile, the Chinese Society of Anesthesiology and Chinese Association of Anesthesiologists have organized lectures to share ideas and discuss relevant issues using different remote conferencing platforms and WeChat, the most popular social media site in China. The topics covered include practice guidelines and recommendations, infection control, self-protection, and operating room management. The goal of these efforts was to ensure that all perioperative providers understood and would abide by the necessary procedures and precautions.

Efforts of Civil Organizations in China

The New Youth Anesthesia Forum (http://www.xqnmz.com/; accessed February 29, 2020), the largest anesthesia internet platform in China, with 197,000 registered members, took the initiative to start donating protective materials to the anesthesia departments in Wuhan during the early phases of the epidemic. These donations were later extended to the entire province of Hubei and those parts of China where the epidemic was most severe. In total, the New Youth Anesthesia Forum donated medical masks, protective clothes, goggles, disinfectants, and other material worth 200,000 RMB to more than 50 anesthesia departments. Moreover, it played a pivotal role in providing online streaming for lectures organized by different groups of anesthesiologists on topics covering airway management, perioperative infection control, obstetric anesthesia, caring for mothers with confirmed infection, lung-protective ventilation, and the use of ultrasound in critically ill patients.[22] These online lectures attracted an average of 30,000 listeners, which represents about 40% of all anesthesiologists practicing in China, and this continuous online education program has played a pivotal role in preparing anesthesiologists and intensivists to deal with the outbreak.

Lesson Learned and Future Work Needed

Chinese citizens are resilient. Although the COVID-19 outbreak has dealt a swift and severe blow to a range of stakeholders, doctors, citizens, and government responded quickly as soon as human-to-human transmission was recognized. The response to COVID-19 was much more efficient than that to the SARS outbreak of 2003. Indeed, the scale and type of response measures aimed at containing this outbreak are unprecedented. Although the epidemic remains ongoing, lessons should be learned and the work yet to be done should be discussed.

Although there are unknowns, the risk of aerosol transmission during procedures prone to aerosol-generating is a particular concern. These procedures include endotracheal intubation and suction, extubation, respiratory therapies, cardiopulmonary resuscitation, high-flow oxygen therapy, noninvasive ventilation, and invasive ventilation. Anesthesia providers are at an enhanced risk of contamination; hence, the importance of infection control to such providers cannot be overemphasized.[23] It is imperative that personal protective measures are undertaken when caring for patients with confirmed or suspected infections. The goal is to prevent cross-infection amid this epidemic, and we will fail to protect our patients if we do not protect ourselves. Thus, coordinated efforts and clearly defined regulations are essential. For example, although it is advisable to postpone elective surgeries, operating rooms and anesthesia departments across China will consequently come under tremendous pressure when normal operation is resumed, hopefully in the next few months. The administration needs to plan ahead, avoid a mismanaged flow, and minimize staff burnout. At the same time, hospital and department heads must pay attention to staff's mental health and maintain morale while delivering quality care in the aftermath of the epidemic.

As part of the preparations to meet the challenges of ongoing and future mass public health emergencies, training must be given to healthcare workers, including anesthesia

providers, who have the potential to engage in rescue and relief efforts. This is important information for now and for future generations. Simulations and drills aimed at preparedness for infectious mass emergency should be organized. The COVID-19 outbreak has taught us many lessons and should be regarded as a new red flag, reminding all anesthesia providers to be prepared and pay attention to self-protection. Moreover, they must be aware that this will likely be a new norm for practice well into the future in China.

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Competing Interests

The authors declare no competing interests.

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