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Abstract: This article aims to contribute to literature on leadership and leadership development through reviewing China's early response to the Covid-19 pandemic. In this article, we argue that leadership, professionalism and innovation have been essential in the fight against the Covid-19 pandemic. These qualities made a considerable difference in this critical situation and played a prominent role in the containment of the Covid-19 virus. We illustrate this by documenting the performance of four Chinese doctors at different stages of the outbreak in Wuhan. These medical professionals were Dr Jixian Zhang who reported the new disease; Dr Yongzhen Zhang, who identified the pathogen behind the outbreak; Dr Nanshan Zhong, who publicized the human-to-human transition and helped the government to put in place significant measures to reduce its impact; and Dr Chen Wang, who proposed and implemented Fangcang shelter hospitals to solve the shortage of hospital beds in Wuhan. They demonstrated that they had the essential traits of leadership-honesty, intelligence, decisiveness but also compassion. We explore the events in China at the start of the pandemic in light of the fact that there are growing signs of conflicting views of what happened when the virus was recognised as a new pathogen.

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1. Introduction

Covid-19 created a crisis throughout the world and posed an almost overwhelming challenge to people's lives and public health. During such a crisis, public trust in political leadership derives from politicians' honesty and a decisive response based on evidence was urgently needed. In the early days, there was an outcry against the failures of political leadership in Wuhan, the capital of Hubei Province, China, where the first outbreak of the Covid-19 began in January 2020. With the apparent failure of government leadership in response to Covid-19 in the West in March and April 2020, the call for strong leadership increased. For example, on

8 October 2020, the editors of *The New England Journal of Medicine* wrote: ‘The response of our nation’s leaders has been consistently inadequate. The federal government has largely abandoned disease control to the states’ (The editors, 2020, 1480). ‘When it comes to the response to the largest public health crisis of our time, our current political leaders have demonstrated that they are dangerously incompetent’ (ibid, 1482). For them, the absence of leadership in the United States turned the crisis into a tragedy. It had become the most infected nation on the earth. The result was the unnecessary and avoidable deaths of the most vulnerable people that government was expected to protect.

The kind of criticism on the response of American leaders calls for accountability and capacity in a policy and political context. However, in the discourse of leadership, it is too often focussed on only the traditional political and hieratical, in particular at national level. As Elinor Ostrom (1998, 18) wrote: ‘All too many of our textbooks focus exclusively on leaders and, worse, only national-level leaders’. There is no doubt that leaders of governments (national and city/local) are extremely important in response to global risks and challenges. They should—more than any other group or sector—be leading the challenge to the virus. However, leadership in the Covid-19 pandemic should *not* have been confined to political leadership. Medial leadership at different levels and in different fields were crucial in the response to the crisis. It was also right for Richard Horton, the editor of *The Lancet*, to criticise the absence of medical leadership in the UK. As he noted: ‘In the UK, we have the medical Royal Colleges, the Academy of Medical Sciences... Yet none reinforced the urgent call to action in early February after WHO declared a PHEIC. That declaration fell on deaf ears within what one might call Britain’s ‘medical establishment’. Why?’ (Horton, 2021, 136). Horton told us that he had no answer to this question. He criticised the medical leadership in the West:

Whatever the reason, the leadership of medicine in the UK and in many other Western nations let down those they were supposed to protect. They let down the old, the sick and the vulnerable. They betrayed the very people who have invested their trust—and their taxes—in modern medicine. It was grubby betrayal, a strain on the leadership of a profession whose frontline workers had given so much (Horton, 2021, 136-137).

Here, Horton criticises those medical leaders who had failed a test of medical leadership—to warn their governments in January to the impending catastrophe and they had ‘failed to act on

clear and unambiguous signals from China that culminated in a PHEIC from WHO on 30 January' (Horton, 2021, 100; see also Horton, 2020). In the USA, there is an assumption that CDC can be trusted. As Ariana A. Berengaut boasted on 24 February 2020:

American citizens, for example, can count on the objectivity and accuracy of the U.S. Centers for Disease Control and Prevention, whose weekly morbidity and mortality report has been a fixture of critical communication between the government and the public in one form or another since the late 1800s. Reliable reporting enables epidemiologists to predict a disease's trajectory, researchers to develop treatments and vaccines, responders to trace transmission, and the public to protect itself (Berengaut, 2020).

However, the later fact proved the contrary. Its' performance did not reliably meet expectations. The American CDC disappointed people and frustration ran high with it (Alexander et al. 2022; Edwards, 2022; see also New York Times, 2023).

In this paper, we argue that the concept of leadership is not confined to leaders specifically within the fields of policy, politics, and administration, but can refer to any fields including the medical profession, including hospital directors. We are seeking to contribute to the literature on the theory of *distributed* leadership which challenges the traditional hierarchical view of power and influence, and suggests that leaders are distributed throughout organisations, at multiple levels and in varied contexts (Groonn, 2000; Spillane et al, 2004), a more systemic, collectively embedded concept of leadership. We argue that successful response to the Covid-19 pandemic needs effective collective action, and public health security needs the cooperation between government and citizens. If a large number of people in a given country fail to follow health guidelines and are not vaccinated, it is impossible to reach herd immunity. The behaviour of ordinary people in the Covid-19 pandemic was vital. 'It is ordinary persons and citizens who craft and sustain the workability of the institutions of everyday life' (Ostrom, 1998, 22). As Kitayama et al (2022, 165) notes: 'it is uncertain whether American's noncompliance could be attributed to the lack of political leadership'.

In this paper, we explore leadership by describing the response of four doctors at different levels at different stages of the outbreak of Covid-19 in Wuhan. They demonstrate leadership, professionalism and innovation. They represent the best of Chinese doctors and health care workers worldwide. One of reasons for their success is they all had experience of SARS in

2002-2003 and they had learned from it. China's handling of the outbreak in Wuhan was not perfect and there are many painful lessons to be learned to improve its preparedness for fighting the next pandemic. However, Chinese doctors from clinicians, virologists and epidemiologists, working at the frontline of fighting the Covid-19 virus have demonstrated that they have applied the lessons learned from severe acute respiratory syndrome (SARS) in 2002-2003.

The Covid-19 pandemic has seen increased hostility towards China and there are growing and disturbing signs of a new 'cold war'. It is essential that there is a better understanding of what actually happened in the early days of the pandemic and this paper will illustrate those events and how leadership, innovation, professionalism and integrity on the part of four leading doctors mitigated the worst effects of Covid 19.

2. Dr Jixian Zhang (3352)

Dr Zhang Jixian (张继先) is a pulmonologist, director of the Department of Respiratory and Critical Care Medicine at the Hubei Provincial Hospital of Integrated Chinese and Western Medicine in Wuhan, Hubei Province, China (Le and Li, 2020; Li X et al., 2020). She was the first doctor to formally report the novel coronavirus infection in Wuhan, and thus alert the medical system. Her work as a clinician working on the front line deserves to be more widely known. As Tom Ingelsby noted:

One of the world's most important warning systems for a deadly new outbreak is a doctor's or nurse's recognition that some new disease is emerging and then sounding the alarm. It takes intelligence and courage to step up and say something like that, even in the best of circumstances. (quoted in Green, 2020, 682.)

Though here Ingelsby is praising Dr Wenliang Li, it also applies to Dr Jixian Zhang.

On 26th December 2019, an elderly lady arrived at the Department of Respiratory Infections for her cough, fever and difficulty in breathing and was settled in the ward of Hubei Provincial Hospital of Integrated Chinese and Western Medicine. Here it is worthwhile noting that later research found that she was not the first one who was hospitalised. Wu *et al.* (2020, 265) wrote that 'the first patient was hospitalized on 12 December 2019'. She became Dr Zhang's patient and was given a series of tests: A, B, syncytial virus, adenovirus, nasal virus, and other influenza-related tests. All were negative. Dr Zhang ordered a CT scan. Her lung CV image

was completely different from those of influenza and common pneumonia. This aroused Zhang's suspicion (Fan, 2020; Zhou *et al.*, 2020a; Tian, 2020a).

Next day, an elderly man came to see a doctor at the Department of Nervous diseases because of his extreme fatigue. He was also transferred to Dr Zhang and, after checking his CT, she found similar features to those of the woman. When they asked to be together, Zhang realised that they were a couple (*ibid*). She noticed that they had large 'ground glass' opacities in computed tomography (CT) images of their lungs, distinct from those she had seen in other cases of viral pneumonia. This alerted her to the fact that the disease might be infectious and, after finding that they had been accompanied by their son to the hospital, Dr Zhang requested that he be checked (*ibid*; See also McMahon, 2020). During the 2003 SARS outbreak, Dr Zhang worked as a medical expert investigating suspected patients in Wuhan and this made her sensitive to signs of an epidemic (Yao *et al.* 2020).

The son had no obvious symptoms except for slight back pain. At first, he refused to accept a CT check. As Zhang recalled 'At first their son refused to be examined. He showed no symptoms or discomfort, and believed we were trying to cheat money out of him' (quoted in *ibid*). Dr Zhang insisted that he must have a check and agreed that she would pay the fee. The CT result shocked her because it was similar to those of his parents' but 'more and large' (*ibid*). 'Generally speaking, when a family comes to see a doctor, there will only be one patient, and there will not be three people who will have the same disease at the same time, unless it is an infectious disease' (quoted in Tian 2020).

On the same day, a merchant from the South-China seafood market, with the same fever, cough, and lung characteristics was admitted. Dr Zhang gave these four patients' blood tests. All indicated a viral infection. She ordered a series of influenza-related tests, and all were negative. The same unusual lesions were observed with the CT imaging. In the afternoon of 27th January 2020, concerned about a new, probably infectious viral disease, Zhang, reported the four cases to the business director Xia Wenguang, the hospital infections officer who immediately reported to Jiangnan District Centre for Disease Control (*ibid*).

Dr Zhang cordoned off a ward area to hospitalise the four patients and isolated two rooms to accommodate 9 patients, one room for the family and another for the patient from the market. She asked staff in her department to strengthen self-protection such as wearing a face mask and washing hands. She also asked them to isolate those patients' waste. The hospital gave these

staff the N95 professional protective masks, ‘We only wear N95 when we enter that area, and the rest of the area is still a general medical mask (ibid).

In the following two days, there were another three patients: all worked at the Huanan Seafood Wholesale Market and it was judged to be a cluster case. She thought ‘there must be something wrong with this’(Tian 2020b). ‘This is a disease we have never seen before, and there are four patients from the South China Seafood Market, which must be problematic’, Zhang said (Fan *et al.*, 2020). Zhang noticed that four patients came from one seafood market and had similar symptoms and doubted that this was an infectious disease. She attributed her judgment to her experience as an epidemiologist in SARS 2002-2003. ‘How can there be no problem in such situation? This is the thinking pattern I had got from fighting against SARS’. The market was identified as the likely source of infection in Zhang’s report on 29th December 2019. Later research confirmed Zhang’s suspicion. Worobey *et al.* (2022, 951) shows that ‘that the emergence of SARS-CoV-2 occurred through the live wildlife trade in China’ and show ‘that the Hunan market was the epicentre of the COVID-19 pandemic’.

Huanan Market was closed and disinfected on 1 January 2020, but no live mammal collected at Huanan Market or any other live-animal market in Wuhan was screened for SARS-CoV-2–related viruses (WHO, 2021). Zhang noted that three of the family had never been to the Huanan market. She suspected that there might multiple zoonotic events rather than just the market. This was also later confirmed (Pekar *et al.*, 2022; Worobey, 2021). In seven patients, the lung symptoms were consistent but there was a difference in severity. Zhang was acutely aware of this new, problematic situation and immediately reported to the hospital management and recommended a multi-sector consultation (Fan *et al.* 2020). In a later interview, Zhang said she had not expected COVID-19 to become a global crisis. ‘At first, I thought it might be an infectious disease, but I didn't expect it to be so contagious as it is now, or to spread as widely and as far’, she told CGTN. ‘Now, the pandemic is severe, with huge casualties. We really didn't expect the situation to become this bad. We only thought it might be infectious at the very beginning’ (quoted in Brennan, 2020).

On Friday 29th December 2019, Dr Wenguang Xia, Vice President of the hospital, convened ten experts from the Respiratory Department, Hospital Sense, Cardiovascular, ICU, Radiology, Pharmacy, Clinical Examination, Infection and the Medical Department, and discussed the seven cases (Fan *et al.* 2020). As a result, they agreed that the situation was extraordinary and confirmed Dr Zhang’s previous judgement. In their meeting record, they tried to understand

two points: what the pathogen was, and how to cure the patients (ibid). They noted two former cases of patients with a similar medical history, admitted to Tongji Hospital and Concord Hospital whose registered address was also the South China seafood market (ibid).

Dr Xia decided to report this to the provincial and municipal health care commission (ibid) which immediately instructed Wuhan CDC, Jinyintan Hospital and Jiangnan District CDC to begin an epidemiological investigation (ibid). On the evening of 29th December 2019, Wuhan City Infectious Diseases Fixed-Point Hospital –Wuhan Jinyintan Hospital Business Vice President Zhaolin Huang and ICU Director Wenxuan Wu came to Dr Zhang’s hospital to see the seven patients and found six more patients: three minor and three serious. (ibid).

On the same day, Dr Zhang instructed department staff to order online 30 sets of fine canvas white work clothes, for the 31st of December 2019. In retrospect, her judgment saved lives. ‘If it is delivered uniformly by the hospital, it needs to be customized’ she said, ‘if it is online shopping, they can receive the goods very quickly’ (ibid). This set of thick canvas ‘protective clothing’ was used until 22 January 2020, when Dr Nanshan Zhong identified that the new coronavirus infection of pneumonia could be transmitted from person to person. On that day, the hospital equipped them with three levels of protective clothing (ibid).

In an interview, Dr Zhang said that the sooner an outbreak is detected, the easier it is to control and that one day could make a significant difference. On 1 February 2020, reporters verified multiple times, and all sources of information confirmed, that Dr Zhang’s hospital had reported the earliest outbreak. It should be recognised that it was clinicians like Dr Zhang who sounded the alarm about the emergence of SARS-CoV-2 which was rapidly identified after they sent samples to a reference laboratory for next generation sequencing (NGS) (Zhou *et al.*, 2020).

On New Year's Day, the number of patients in the respiratory department of Hubei Province's Chinese and Western Medicine Combined Hospital began to surge, from about 100 a day to about 230. The environment had changed as a patient could be infected, and staff members could be asymptomatic carriers or become symptomatic while providing services. Zhang asked the staff to persuade other respiratory chronic disease patients to be discharged as soon as possible in order to avoid being infected. Some patients did not want to leave the hospital, and the medical staff had to persuade them (Tian 2020a).

Zhang also called for treating patients with mild symptoms. In an interview by *Global Times*, Zhang said:

To change the current situation, we need to give treatment to patients who have mild symptoms and separate them from the severe cases. Receiving severe patients and offering better medical treatment to them could help decrease the fatality rate. If the fatality rate is too high, it may cause panic in the public - people may think they will die once they get infected with the disease. The patients would also be in panic and go to different doctors, which makes them mobile virus carriers and likely to spread the virus more quickly and widely (Fan *et al.* 2020).

Zhang's Hospital was being careful, adopting simple protections with her exemplary control measures. From the initial admission of the first group of patients until the beginning of February 2020, miraculously, none of Zhang's team had been infected in Wuhan, and there was no cross-infection of patients although the outbreak was most severe in Wuhan. Further afield, there was a general lack of preparation for front line medical workers which led to medics being infected. 1716 health workers were infected and there were 6 deaths by 14 February 2020 (Ghebreyesus, 2020. WHO, 2020a; see also Zheng *et al.*, 2021) and 29% of all patients who were healthcare workers were presumed to have been infected in a hospital. (Wang L *et al.*, 2020). Zhang Jixian said that prevention of infectious diseases was rooted in SARS.

In later interviews, when asked why she had been able to identify the human-to-human transition of Covid-19 as early as 27th December 2019, while experts only confirmed the human-to-human transition by 20th January 2020, Zhang defended the speed of the response. 'We were only beginning to understand the virus. So it wasn't appropriate to make too much information public when things were still not fully understood', she said (quoted in Brennan, 2020). Dr Zhang thought that the experts needed more evidence. 'If it is me doing the research, how could I tell the public before I have come to a clear conclusion? We should always take a cautious, scientific attitude towards releasing such information to the public' (*ibid*). Dr Zhang's view of China's response was shared by many Chinese doctors and scientists. For example, Virologist Shao Yiming, chief expert on AIDS at China's Centre for Disease Control and Prevention (China CDC), said:

China was the country hit first, and when you're first, you move from unknown to known, and then known to reaction. This takes a much longer time: You first have to rule out other known

viral and bacterial pathogens from the clusters of similar pneumonia. You have to understand what's happening and invest a lot to identify the unknown pathogen (Cohen, 2020).

When Dr Zhang was asked why she reported the cases, she said: ‘there is a regulation of reporting unknown infectious disease in our doctor law’ (The Paper, 2020). Indeed, there is a stipulation in Article 19 of Law on Practicing Doctors of the People's Republic of China (1999): ‘In case of a malpractice or when an epidemic situation is found, doctors shall report in a timely manner to the employer institution or the health administration departments in accordance with relevant stipulations’. This rule of reporting infectious disease is crystallised in the law which is much better to protect collective interests (The Paper, 2020). When Zhang was asked why she was able to report the epidemic as the first person. She said: ‘reporting an epidemic is the requirement of my occupation’ (ibid). It is Dr Jixian Zhang rather than Dr Li Wenliang, who tried to raise the alarm first at the very beginning of the coronavirus outbreak in Wuhan. Dr Zhang asserted that China acted in a timely, open, transparent, and responsible manner (Fan *et al.*, 2020). For her, the Trump administration’s accusation that the WHO had conspired with a member state [China] ‘in an apparent attempt to conceal this outbreak’ (ibid) was groundless. On 31 December 2019, the Chinese government notified the WHO of an outbreak of severe pneumonia of unknown etiology in Wuhan, Hubei Province, China and WHO informed the whole world.

In a widely circulated interview with the *Global Times*, Zhang said the country ‘certainly did not conceal the relevant data on the epidemic. After I first reported the outbreak situation, we started to regularly report the epidemic information to the world beginning from January 3, 2020 ... the facts are so clear, how can it be called a cover-up?’ said Zhang. Horton observed:

In the case of COVID-19, Chinese scientists and physicians acted decisively and responsibly to protect the health of the Chinese people within this context. They warned their government, their government alerted WHO (albeit indirectly), and WHO warned the world. Western democracies failed to listen to those warnings. There are questions for both the Chinese government and WHO to answer. But to blame China and WHO for the global pandemic is to rewrite the history of COVID-19 and to marginalise the failings of Western nations (Horton, 2021, 141).

Her story was generally ignored by the mainstream media in the West, possibly because it did not align with their editorial lines and agenda (Cho, 2021) and even in medical circle (see, e.g., Gunderman, 2020). Though Zhang was the first doctor to discover the Covid-19 outbreak, she wasn't a whistle-blower because she followed established protocol by reporting an unfamiliar respiratory illness to her hospital's disease control department and was rewarded for her contribution (Roach and Shan, 2020; Yin, 2020). Her report led to an investigation and resulted in an announcement by the Wuhan Municipal Health Commission on 30 December 2019, and a media statement the next day (Zhu, N. *et al.*, 2020). The Wuhan Health Commission sent an urgent warning to all medical institutions under its jurisdiction about the outbreak of a mysterious new pneumonia. The initial response of local authorities was prompt, which was contrary to the Western narrative.

Of course, the local medical authorities had made several serious mistakes. For example, at 1pm on 31 January 2020, the Wuhan Health Commission issued a public announcement about 27 pneumonia cases of unknown origin. The warning added that there was 'so far no discovery of cases of obvious human-to-human transmission or infection of medical workers'. That was a serious mistake (Editorial of Caixin Weekly, 2020). Dr Zhang has suspected that there was 'human-to-human' transmission in a family. However, the characteristics of the 'human-to-human' transmission of the virus were not confirmed by Academician Zhong Nanshan until 20 January 2020. Is it a judgment error that local Chinese officials were just as confused as anyone at the first signs of this outbreak of a novel coronavirus? Or is it a downplaying the severity of the disease for local leaders to tell doctors in December 2020 not to publicize the spreading virus in order to avoid casting a shadow over the annual meeting of a local legislative body? We do not have an answer. No matter the reason, China should learn from this in order to improve its response to the next pandemic. In addition, when the scientists from Beijing came to Huanan Haixian Wholesale Market, it had been closed so they could not investigate SARS-CoV-2-susceptible mammals that were sold at the market in late 2019. What they could have done is to isolate SARS-CoV-2-positive environmental samples that were spatially associated with vendors selling live mammals. Also, Dr Li warned in an online chat group on WeChat that he had seen a report showing positive test results of SARS for 7 patients. However, he did not formally report the outbreak to the authorities. He was reprimanded by security officers for 'spreading rumours' through warning a closed group of ex-medical school classmates on the WeChat social media site of 'seven cases of a severe acute respiratory syndrome (SARS) like

illness with links with the Huanan Seafood Wholesale Market' at his hospital. His information was later proved 'not rumours' (CGTN, 2020a).

Media outlets such as the *Times* and *ProPublica* have acknowledged that Zhang was the first doctor to report Covid-19's existence although they did not name Li as the first doctor to report Covid-19's existence, and instead refer to him merely as 'a doctor who had warned about a strange new viral outbreak'. The *Times/ProPublica* link to an early *Times* report on 7 February 2020 describes Li as 'among the first to warn about the coronavirus outbreak in late December'. Much is owed to Dr Zhang for her prompt response to a new respiratory virus and her professionalism in immediately passing on her professional opinion to the relevant authorities. Dr Li's role has been distorted without regard for fact. He was widely misunderstood as the first doctor who reported the outbreak in Wuhan, even by prestigious medical journals (Petersen, *et al.*, 2020a; Czernin, 2020).

Dr Zhang's intelligence, courage, skills and experience in recognising that a new disease was emerging and then sounding the alarm was one of the world's most important events in the pandemic. As Horton (2021, 136) asked why the medical leaders in the West did not do more to 'alert their governments in January to the impending catastrophe that was about to befall their populations'. This is puzzling in the light of a high quality medical force and experts in those countries. In this sense, Dr Zhang provided some examples of what leadership and professionalism looked like. We need transfer this kind of knowledge about her leadership and professionalism to the next generation. As Ostrom (1998, 22) wrote:

It is ordinary persons and citizens who craft and sustain the workability of the institution of everyday life. We owe an obligation to the next generation to carry forward to the best of our knowledge about how individuals solve the multiplicity of social dilemmas—large and small—that they face.

3. Dr Yongzhen Zhang

Dr Yongzhen Zhang (张永振) is a virologist, a professor at Fudan University, Shanghai, and an expert at the Chinese Centre for Disease Control and Prevention, who leads a biosafety level 3 laboratory at Shanghai Public Health Clinical Centre (Wu *et al.*, 2020). He was one of the first scientists who sequenced and shared the genome of the novel coronavirus SARS-CoV-2 in the world (Zhang and Holmes, 2020). Prof Adam Finn of Bristol University said: 'What

Zhang did was absolutely critical to what has ensued'. Without the information he provided no one could have started working on vaccines.” (quoted in McKie, 2020).

On 3 January 2020, Professor Zhang's team at Shanghai Public Health Clinical Centre received a test tube containing swabs from a patient suffering from a peculiar unknown pneumonia in Wuhan, caused by what would eventually be known as COVID-19 (Campbell, 2020). Two days later, Professor Zhang and his team were able to sequence the virus's genome after less than 40 hours of work through analysing the samples using the latest high-throughput sequencing technology for RNA, the viral genetic building blocks, which function similarly to how DNA works in humans (ibid). ‘It took us less than 40 hours, so very, very fast,’ Professor Zhang told *TIME* (ibid). Professor Zhang and his team had already sequenced thousands of previously unknown viruses so that they obtained the genome sequence so quickly (ibid). Their findings were already published in *Nature* (Shi *et al.*, 2016).

The quick identification of SARS-CoV-2 was remarkable compared with that of SARS in 2002-2003. ‘The first case of SARS appeared in Guangdong province, China, in November 2002’ (Zhong and Zeng, 2005). It took scientists several months until April 2003 to identify the SARS coronavirus (Marco *et al.*, 2003; Ksiazek *et al.*, 2003; Pearson, 2003). China’s experience in dealing with SARS caused Chinese political leaders to make huge investments in public health systems and scientific research: 95 research projects were initiated through uniting experts from different ministries and science organizations and investing \$13 million (Enserink, 2003). The result of this investment was the improvement of China’s domestic research and public health capacity. As the Editorial of *The Lancet* observed:

Huge investments have left China much better prepared for COVID-19 than for severe acute respiratory syndrome (SARS). When SARS broke out in 2003, China was unprepared initially, especially as the pathogen was unknown. When Covid-19 emerged in December 2019, Chinese scientists were quickly able to identify the virus and shared genomic sequencing data internationally on Jan 11, 2020 (Editorial, 2020).

Chan *et al.* (2020, 523) wrote: ‘Unlike the 2003 SARS outbreak, the improved surveillance network and laboratory capability of China was able to recognise this outbreak within a few weeks and announced the virus genome sequences that would allow the development of rapid diagnostic tests and efficient epidemiological control’. In addition to Dr Zhang’s finding, on 7

January 2020, ‘China CDC succeeded in isolating the first novel coronavirus strain’ (The State Council Information Office of the People’s Republic of China, 2020b). The result of it appeared in the *Lancet* on 29th January 2020 (Lu *et al.*, 2020; Zhu *et al.*, 2020).

Zhang was frightened by the similarity between this virus and SARS. As he recalled later: ‘Then I realized that this virus is closely related to SARS, probably 80%. So certainly, it was very dangerous’ (Campbell, 2020). On 5 January 2020, he was also alerted by team member Yan-Mei Chen that the virus was related to SARS (Cyranoski, 2020b). Once he obtained the genome, Zhang immediately uploaded the details to the United States National Centre for Biotechnology Information (NCBI), a sequence repository run by the US National Institutes of Health.¹ ‘When we posted the genome on Jan. 5, the United States certainly knew about this virus’, he said (Cyranoski, 2020b). ‘But it can take days or even weeks for the NCBI to look at a submission.’ He also notified the Shanghai municipal health authority (Campbell, 2020).

After that, Zhang also called Dr Su Zhao, head of respiratory medicine at Wuhan Central Hospital, to request the clinical data of the relevant patient. ‘I couldn’t say it was more dangerous than SARS, but I told him it was certainly more dangerous than influenza or Avian flu H5N1,’ says Zhang (Campbell, 2020). He asserted that the virus was similar to SARS and that it spread by respiratory transmission. Zhang submitted the research findings on ‘a single patient who was a worker at the market and who was admitted to the Central Hospital of Wuhan on 26 December 2019 while experiencing a severe respiratory syndrome that included fever, dizziness and a cough’ to *Nature* (Wu *et al.*, 2020, 265). They warned: ‘In summary, the high similarities of the amino acid sequences and predicted protein structures of the RBD domains of WHCV and SARS-CoV suggest that WHCV may efficiently use human ACE2 as a receptor for cellular entry, *which could potentially facilitate human-to-human transmission*’ (Our emphasis, *ibid.*, 268). Professor Zhen Li Shi and her collaborators studied five other patients and also submitted their research findings to *Nature* on 20th January 2020. They reported: ‘Full-length genome sequences were obtained from five patients at an early stage of the outbreak. The sequences are almost identical and share 79.6% sequence identity to SARS-CoV. Furthermore, we show that 2019-nCoV is 96% identical at the whole-genome level to a bat coronavirus.’ (Zhou *et al.*, 2020, 270). They proposed that ‘On the basis of these findings, we propose that the disease could be transmitted by *airborne transmission*, although we cannot

¹ Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, co - Nucleotide - NCBI (nih.gov)
<https://www.ncbi.nlm.nih.gov/nuccore/MN908947>

rule out other possible routes of transmission, as further investigation, including more patients, is required.’ (Our emphasis, *ibid*, 271; see also Hu, *et al.*, 2020).

Zhang also contacted China’s Ministry of Health and travelled to Wuhan, where he spoke to public health officials on 8th Jan 2020 (Cyranoski, 2020b). He ‘had two judgements: first that it was a SARS-like virus; second, that the virus transmits by the respiratory tract’ (*ibid*). And he ‘had two suggestions: that we should take some emergency public measures to protect against this disease; also, clinics should develop antiviral treatments’ (*ibid*).

Zhang then waited for the NCBI to process the upload and send it back for him to review. Over the next few days, he submitted a paper to *Nature* about the genome. He visited Wuhan again, where he got first-hand accounts from physicians about the effects of the virus (*ibid*). An editor at *Nature* urged him to post the sequence (*ibid*). It is worth noting that the progress in virology in China also benefits from international cooperation in China (see, e.g., Khun *et al.*, 2019). It is well-known that Professor Zhang and his team had worked with Professor Edward C. H Holmes in the University of Sydney, Australia and has reported thousands of new RNA viruses since 2014 (Zimmer, 2022; Zhang *et al.*, 2019). On 10th January 2020 Holmes, on behalf of the consortium led by Zhang, posted the Novel 2019 coronavirus genome. They noted that ‘The sequence has also been deposited on GenBank (accession MN908947 33.7k) and will be released as soon as possible’ (*ibid*).² They added: ‘Please feel free to download, share, use, and analyze this data. We ask that you communicate with us if you wish to publish results that use these data in a journal. If you have any other questions –then please also contact us directly’ (*ibid*). On 11th January 2020, Dr Zhang allowed Holmes to make it public (Cohen, 2020). Edward Holmes, tweeted the first notice about the availability of what he referred to as an ‘initial’ sequence of the virus.³

Here it is reasonable to infer that when Zhang took bold action to make public his findings as early as 11 January 2020, he had learned the lesson that ‘China lost the chance to announce the primary discovery of SARS-CoV’ (Zhone and Zeng, 2006). During the SARS outbreak, a group of virologists including Yang Ruifu had already discovered a new virus in samples from some of the earliest patients. However, the then official line and dominant theory was that

² Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, co - Nucleotide - NCBI (nih.gov) <https://www.ncbi.nlm.nih.gov/nuccore/MN908947>.

³ Eddie Holmes on Twitter: "All, an initial genome sequence of the coronavirus associated with the Wuhan outbreak is now available at <https://t.co/EeqQXC3n3> here: <https://t.co/jdCM9USkSK>" / Twitter <https://twitter.com/edwardcholmes/status/1215802670176276482?s=20>

SARS was caused by a Chlamydial bacterium. ‘They didn’t dare tell the world’ (Enserink, 2003). Yang recalled ruefully: ‘we were too cautious’ and ‘We waited too long’ (ibid). The contrast in performance between the impressive response of Zhang in the Covid-19 and Yang’s efforts during SARS in 2002-3 illustrates that *Chinese scientists learned from their past failure*. Zhang’s action received praise. Jeremy Farrar, head of the Wellcome Trust in London, tweeted: ‘Potentially really important moment in global public health-must be celebrated, everyone involved in Wuhan, in China & beyond acknowledged, thanked & get all the credit,’ ‘Sharing of data good for public health, great for those who did the work. Just needs those incentives & trust’ (quoted in Cohen, 2020).

Zhang also asked the NCBI to release the genome. On 12th January, ‘China CDC, the CAMS and the WIV, as designated agencies of the NHC, submitted to the WHO the genome sequence of the novel coronavirus (2019-nCoV), which was published by the Global Initiative on Sharing All Influenza Data to be shared globally’.⁴ Horton noted, ‘The genetic sequence of SARS-CoV-2 was made publicly available by Chinese scientists on 12 January 2020’ (Horton, 2020, 8). He also observed the progress of science in China after SARS: ‘Twenty years after the first outbreak of SARS, Chinese science was far better prepared. The country’s scientists quickly isolated the virus and sequenced its genome, which they shared publicly on 12 January’ (ibid, 45).

However, there was still a long process from understanding the virus to taking action in both China and the rest of world. Of the early response to the COVID-19 outbreak, Zhang later said, ‘nobody listened to us, and that’s really tragic’ (Buckley *et al.*, 2020). ‘In China, even though we had a very bad experience with SARS and other diseases, in the beginning nobody—not even experts from China’s CDC and the Ministry of Health—predicted the disease could be quite so bad’ (Campell, 2020).

Zhang’s sharing of the virus’s genome made it possible for scientists all over the world to quickly investigate the virus’s key proteins, design COVID-19 tests and begin developing COVID-19 vaccines to fight the pandemic. This initiated the international scientific battle against COVID-19. ‘That was the most important day in the COVID-19 outbreak,’ said Linfa Wang, a virologist at Duke–National University of Singapore Medical (Callenway, 2020).

⁴ FullTextFightingCovid19 (1).pdf file:///C:/Users/User/Downloads/FullTextFightingCovid19%20(1).pdf

Zhang himself is proud of the recognition he received from scientists all over the world for his data sharing on 11th January 2020. In a later interview, he said: ‘January 11 was a turning point for understanding that this is serious. It was a turning point for China. It was a turning point for the world.’ (quoted in Cyranoski, 2020b). Zhang and his colleague said:

With the help of Dr. Andrew Rambaut (University of Edinburgh), we released the genome sequence of the virus on the open access Virological website (<http://virological.org/>) early on January 11, 2020. Afterwards, the China CDC similarly released SARS-CoV-2 genome sequences (with associated epidemiological data) on the public access GISAID database (<https://www.gisaid.org/>). (Zhang and Homes, 2020)

Like any other events, there is also controversy concerning Dr Zhang’s findings, even on Dr Zhang’s decision to release them. Prof Devi Sridhar, chair of global public health at the University of Edinburgh (2022, 62) wrote: ‘Zhang, who was on a plane at the time, said he needed to think about it, because of Chinese pressure not to release too much information about the outbreak’. Of course, this was not true because it was before Zhang’s boarding that he let Holmes make it public. (Campbell, 2020).

It was said that Zhang had been punished by the Chinese government who closed his lab because of his data sharing. Sridhar wrote:

This did not go unnoticed by the Chinese governments. Zhang was punished by the Shanghai Health Commission for breaking Chinese regulations on sharing information on the new coronavirus, His lab was closed temporarily on the 12th of January 2020; the official reason given was that changes needed to be made to improve biosafety protocols. It reopened on the 24th of January with the ability to test thousands of viral samples.... While the Chinese government was unhappy with Zhang, the rest of the world celebrated receiving this important scientific information.’ (Sridhar, 2022, 63)

Here Sridhar accuses China of covering up the outbreak and knowingly allowing the novel coronavirus to spread. It is worrying that a knowledgeable scientist would follow Trump’s line in attacking China (Isenstadt, 2020). For Trump, to attack China and WHO was the best form of defence and a diversion from the truth (Horton, 2021, 143). In a speech given at the White

House on 14 April 2020, the then President Trump issued an instruction ‘to halt the funding of the World Health Organization and to assess the World Health Organizations’ role in severely mismanaging and covering up the spread of the coronavirus’.⁵ Trump said:

The inability of the WHO to obtain virus samples, to this date, has deprived the scientific community of essential data....Had the WHO done its job to get medical experts into China to objectively assess the situation on the ground and to call out China’s lack of transparency, the outbreak could have been contained at its source, with very little death — very little death — and certainly very little death by comparison. This would have saved thousands of lives and avoided worldwide economic damage (ibid).

Such statements seemed to appeal to many people and gave them a scapegoat to blame – China - for the horrors of the pandemic. On 27th April 2020, President Trump repeated: ‘We believe [the virus] could have been stopped at the source and it wouldn’t have spread all over the world’ (quoted in Helen and Rourke, 2020). Trump called on the Chinese government to be held accountable for its ‘errors’ and threatened to seek financial compensation from Beijing.

Trump’s strategy seemed to work. As Horton (2021, 143) observed: ‘Anti-China sentiments grew’. Sridhar’s claim is that China had the capacity to contain the outbreak in its own border but did not do so. She wrote: ‘China is a wealthy and able country, with enough resources, personal protective equipment, health workers, hospitals and logistical know-how. It could have managed the outbreak without external assistance’ (Sridhar, 2020, 284). Like Trump, she claimed that China hid the fact of COVID-19:

But, instead of closing its borders and stopping wider spread, **it** let flights keep taking off, delayed sharing information about the virus and, once it had solved its internal problem and eliminated SARS-CoV-2 shut its borders to the world. At the risk of sounding Trumpian, there are reasons to be frustrated by the decisions of the Chinese government, and the devastations for the world that these caused - memories remain of bodies being burned in the streets of India, and the children who will never return to school in Malawi, and the increasing number of homeless people in New York City suffering outside in the world (Sridhar, 2020, 284)

⁵ [Remarks by President Trump in Press Briefing, April 14, 2020 - U.S. Embassy & Consulates in Italy \(usembassy.gov\)](https://it.usembassy.gov/remarks-by-president-trump-in-press-briefing-april-14-2020/) <https://it.usembassy.gov/remarks-by-president-trump-in-press-briefing-april-14-2020/>

For Sridhar, if only China had closed its border sooner and shared its information earlier, the world would have avoided the pandemic. This echoed one of three main lines of assault on China from a 57-page Republican party attack memo,⁶ which advised candidate to aggressively target Beijing in their public remarks on the pandemic on China : that China caused the virus ‘by covering it up’(Isenstadt, 2020). ‘Coronavirus was a Chinese hit-and-run followed by a cover-up that cost thousands of lives’, the April 17 memo states (Isenstadt, 2020). The document urges candidates to stay relentlessly on message against the country when responding to any questions about the virus. When asked whether the spread of the coronavirus was Trump’s fault, candidates were advised to respond by pivoting to China. ‘Don’t defend Trump, other than the China Travel Ban - attack China’, the memo states (quoted in *ibid*). The memo includes guidance on what Republican candidates can say when asked whether blaming China for the pandemic incites racism. Candidates are urged to respond by saying that, ‘No one is blaming Chinese Americans. This is the fault of the Chinese Communist Party for covering up the virus and lying about its danger. This caused the pandemic and they should be held accountable’ (*ibid*). As Horton (2021, 187) noted: ‘I worry that one result of COVID-19 will be a repudiations of, and certainly an increased hostility towards, China. The overt racism that COVID-19 brought down the Chinese people is a mistake as well as a misfortune’. Sridhar’s accusation of alleged Chinese mistakes (Sridhar, 2022, 284 and 300) reflects the acceptance of Western political, medical and media circles that agree with a geopolitical narrative that China is a negative and destructive influence in international affairs. As Horton (2021, 141) rightly pointed out: ‘Indeed, the preference has been to blame China and WHO. The claim is that China hid the fact of COVID-19. The claim is that WHO colluded with China in a cover-up of enormous proportions’.

The truth is that Wuhan was the first city to be attacked by the SARS-CoV-2 coronavirus. Facing such an emergency, the Chinese medics and the authorities did the best they could in a desperate and fast evolving crisis. The whole human race should be focussed on fighting together against a terrible disease and not allocating blame to those who first encountered it. As Laurie Garrett (1994) noted:

⁶ [200417 Corona Big Book V2.pdf \(politico.com\)](https://static.politico.com/80/54/2f3219384e01833b0a0ddf95181c/corona-virus-big-book-4.17.20.pdf)
<https://static.politico.com/80/54/2f3219384e01833b0a0ddf95181c/corona-virus-big-book-4.17.20.pdf>

While the human race battles itself, fighting over ever more **crowded** turf and scarcer resources, the advantage moves to the microbes' court. They are our predators and they will be victorious if we, *Homo sapiens*, do not learn how to live in a rational global village that affords the microbes few opportunities.

It is either that or we embrace ourselves for the coming plague.

She also rightly noted that time was short during the pandemic. The virus did not recognise the artificial boundaries of nations.

Ultimately, humanity will have to change its perspective on its place in Earth's ecology if the species hopes to starve off or survive the next plague. Rapid globalization of human niches requires that human beings everywhere on the planet go beyond viewing their neighbourhoods, provinces, countries, or hemisphere as the sum total of their personal ecospheres. Microbes, and their vectors, recognize none of the artificial boundaries erected by human beings...In the microbial world warfare is a constant...Time is short.

Faced with an unexpected outbreak of Covid-19, any city, any nation would be challenged. Wuhan and China are not exceptional. Contrary to Trumpian assertion, COVID-19 has been a global disaster—but it could have been much worse without China's efforts in containing it. Only the collaboration in public-health among the global community has the potential to face the next pandemic before it has a chance to spread. Any kind of antagonism, recrimination and scapegoating will destroy the realisation of this potential.

Zhang disputes Sridhar's view. 'We were not shut down.' In fact, he and his teams still worked on influenza, and the team had resumed coronavirus sequencing by the end of January (Cyranoski, 2020b). On the allegation that the Shanghai Health Commission ordered Zhang's laboratory to close temporarily for 'rectification', Zhang himself later said he did not know about such a prohibition (Campbell, 2020). This was used by Sridahar to argue that the closure was retaliation for Zhang's decision to publish the genome but Professor Zhang said that officials were right to have the lab improve its biosafety protocols and that visiting officials correctly told his lab to update its biosafety protocols after he had moved equipment during construction work (Cyranoski, 2020b).

Zhang's sequencing of the genome led to the foundation of research to develop vaccines.

All of these efforts have relied on one crucial scientific discovery—sequencing the COVID-19 genome. The genome, which researchers in China made publicly available on Jan. 11, has formed the foundation of scientific efforts to tackle the virus, from testing, to tracking how the virus is mutating, to developing those vaccines (Mcgregorh, 2020).

After downloading the sequence on 10th January 2020, Ralph Baric, a coronavirus researcher at the University of North Carolina, Chapel Hill, said that his lab immediately began to try to reverse-engineer a live virus from the sequence, which can be helpful to develop antibody tests and to start experiments in animal models. 'If you want to have a strong public health response, you have to do this quickly', said Baric (Quoted in Cohen, 2020). 'The crucial point is that you don't need an actual virus in your hands these days, you just need the 28,000 letters of its genetic code', said coronavirus expert David Matthews of Bristol University. 'You could text it to someone and that would fire the starting gun' (Mcgregorh, 2020).

In commenting on the success of the first vaccine Pfizer/BioNTech approved by the UK, Horton points out the significance of global collaboration in producing vaccine. He wrote:

For the truth is that the Science that led to the development of a vaccine against Covid-19 was *the consequence of an extraordinary global collaboration*—from the sequencing of the virus by Chinese scientists, to the development of the vaccine by immigrants of Turkish heritage in Germany, to its manufacture in Belgium...But the lesson of vaccine research is that the sum of scientific cooperation between nations produces greater success than can be achieved by any group in any one country working alone (Horton, 2021, 10).

There is now no controversy about Dr Zhang sharing his findings, but China was accused of a deliberate delay in releasing the information of the sequencing of the Covid-19. Zhang himself explained it as China's hesitation to release data borne of caution not to get things wrong — remembering that in 2003, a prominent Chinese scientist had mistakenly judged SARS to be caused by a bacterium. (see e.g. Cyranoski, 2003). 'I don't think China's central government wanted to control information', he says. 'It's just that some experts lack the experience to make

the right decision.’ (quoted in Cyranoski, 2020b). Dr Dale Fisher, head of infectious diseases at Singapore’s National University Hospital, refuted the idea that any delay by the Chinese authorities was malicious. ‘It was more like appropriate verification’ (quoted in *ibid*). Fisher travelled to China as part of a World Health Organization (WHO) delegation in early February and outbreak settings are always confusing and chaotic with people unsure what to believe. ‘To actually have the whole genome sequence by early January was outstanding compared to outbreaks of the past’ (*ibid*). When asked the question why China delayed sharing the sequence of the novel coronavirus, Shao, another Chinese virologist, explained one of the reasons:

When you share that with the world you need to confirm it is accurate. They had to sequence several samples to make sure. A single scientist's finding cannot be used. Usually in China—as is common practice around the world—for all new pathogens, we have to ask two additional institutes to repeat the results and verify them. We have independent institutions in China, so the ministries have to ask the two independent institutions outside the Ministry of Health to confirm. This all takes time (quoted in Cohen, 2020).

Shao also stressed the basic fact: ‘Remember, the first reported cases only came in on 27 December, our scientists in about 2 weeks obtained the initial coronavirus signal, isolated live virus, confirmed it as the COVID-19 pathogen and shared the full-length sequences with the world’ (quoted in Cohen, 2020). In fact, fair observers agree with Shao’s assertion. For example, Gregory Poland, director of the Vaccine Research Group at the Mayo Clinic (Rochester, Minnesota, USA), said: ‘The speed of China's response was the crucial factor... They moved very quickly to stop transmission. Other countries, even though they had much longer to prepare for the arrival of the virus, delayed their response and that meant they lost control’(quoted in Burki, 2020).

There is no doubt that China should learn lessons from any delay and improve its response for the next pandemic. Any early response might be accused of ‘overreaction’. However, it is better to act early rather than late.

Zhang won praise and awards for sharing his data. He won the 2020 ICG-15 GigaScience Prize for Outstanding Data Sharing during the COVID-19 Pandemic (Edmunds, 2020) and the 2021 General Symbiont prize as an exemplar in the practice of data sharing at the Research Awards along with Edward Holmes. He was also named one of *Nature*’s : ‘ten people who helped shape

science in 2020' (Cyranoski, 2020b), one of *Time* magazine's 100 most influential people of 2020 (Sabeti, 2020), and the *Straits Times* 2020 Asians of the Year (Wei, 2020).

4. Dr Nanshan Zhong

Dr Nanshan Zhong (钟南山) is a Chinese pulmonologist and an experienced epidemiologist, director of Guangzhou Institute of Respiratory Diseases in Guangzhou Medical University, Guangdong Province (Liu *et al.*, 2020; Xu, 2020). He was then president of the Chinese Medical Association and is currently the editor-in-chief of the *Journal of Thoracic Disease*.⁷ He was credited with helping to identify and then stem the 2003 outbreak of SARS. In 2009, the *Lancet* published the best two papers of 2008, including one led by Zhong, that received the highest number of votes (Zheng *et al.* 2008; Summerskill, 2009). During the 2009 A/H1N1 flu outbreak, he queried the number of deaths from the disease and said there could have been cover-ups. In response, the Ministry of Health ordered all administrative and medical departments to ensure accurate reporting of A/H1N1 flu cases (Huang and Hornby 2009; McIntype 2009). He first publicly announced the human-to-human transition of Covid-19 on 20th January 2020 and led China's fight against Covid as the Chinese central government's senior medical advisor (Kuo, 2020; Wang and Moritsugu 2020).

Xiaoping Deng, the Chinese reformist leader, decided the best way to improve the health system was to send selected doctors overseas to learn from the west. From 1979 to 1981, Dr Zhong worked as a research associate at the Department of Respiratory Medicine, Royal Infirmary, University of Edinburgh and St. Bartholomew's Hospital, University of London. He said he learnt during this time: 'Never go to the next step if you have not finished the first step. Never believe that what the authorities say is always correct. Always believe what you have seen for yourself, what you have observed' (Cheng, 2008, 2108).

In 2003, SARS was known as atypical pneumonia, and was treated with antibiotics. Dr Zhong disagreed with this method as it did nothing to reduce infection or mortality. He volunteered to receive the most critical SARS patients and was determined to advocate the moderate usage of cortisone based on observations of hundreds of patients in Guangdong (see Ye 2020, 49-52). Dr Zhong and his team finally achieved a set of effective treatment methods, making a prominent contribution to lowering mortality and improving recovery rates. Dr Zhong's methods were later used as the standard protocol for treating all SARS patients in China (ibid).

⁷ Editor-in-Chief: Prof. Dr. Zhong Nanshan, MD. *Journal of Thoracic Disease*. Archived from the original on 17 July 2013. Retrieved 18 July 2013.

In early April 2003, Dr Zhong presented the characteristics of SARS as well as the treatment and prevention method in China to delegates led by Dr Evans from the World Health Organizations. His presentation was well-received, and his methods were adopted around the world (ibid). Balasegaram and Schnur (2006, 84) wrote: ‘This new disease, which spread on the wings of modernization, was ultimately beaten by some of the simplest and oldest tools of public health: contact tracing, quarantine, and isolation’. Dr Zhong and his team said:

Zhong and his colleague learned four lessons from the SARS epidemics. The first, ‘honesty is needed’ was aimed at government officials (Zhong and Zeng 2006). Officials in any crisis situation tend to cover up information or downplay the severity to avoid panic and maintain social stability. ‘Honesty is what matters. The public needs to know the truth; concealing what happens may lead to a panic rather than to social stability’ (ibid).

Zhong Nanshan, known in China as the SARS hero, was again put under the spotlight in the COVID-19 outbreak (Petty, 2020). He was appointed head of the National Health Commission expert panel conducting research on the outbreak. On 18 January 2020, when Dr Zhong, as the leader of the senior experts assigned by China's National Health Commission, rushed to Wuhan to investigate the severity of this new disease, he warned the public that people should avoid visiting Wuhan unless necessary and that residents should not leave the city (Jiang and He, 2021). Zhong suspected that there might be human-to-human transmission and he said that the public should avoid the city, reduce outings and avoid gatherings. Zhong learnt in mid-January about cases at a hospital in Shenzhen, a city just across the border from Hong Kong. A family had tested positive for the virus after visiting Wuhan. None had gone to the market. For the researchers, the new virus, now known as SARS-CoV-2, was transmissible between humans (Li Q *et al.*, 2020). Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. ‘Our study showed that person-to-person transmission in family homes or hospital, and intercity spread of this novel coronavirus are possible, and therefore vigilant control measures are warranted at this early stage of the epidemic’ (Chan *et al.*, 2020). ‘I knew that this was extremely serious’, said Kwok-Yung Yuen, a professor of infectious diseases at the University of Hong Kong, who helped investigate the case. ‘I immediately sounded the alarm’ (Kirton, 2020). Yuen also sent their manuscript showing the new coronavirus spread between humans to *The Lancet* for publication (Vrieze, 2021). Yuen Kwok-Yung had been invited to discuss the findings with Chinese authorities and was assigned by the National Health Committee as a member of the Senior expert Panel led by Dr Zhong. Yuen, who led the Hong Kong research group, says he met with an expert team of the national government in Wuhan

and Beijing from 18 to 20 January 2020, where he discussed his results along with other evidence of human-to-human transmission. Chinese health authorities took immediate action to enhance public health control measures including ‘publicly disclosing human-to-human transmission on January 20, 2020 and the shutdown of Wuhan on January 23, 2020’ (quoted in (Vrieze, 2021)).

In Wuhan, Zhong learned from former students that ‘the actual situation in Hubei was far worse than was public or in news reports’, he told a Guangdong newspaper (Kirton, 2020; Wang, 2020). He also met Dr Xinghuan Wang, the president of Zhongnan Hospital, who described it as a calamity in the making but officials still insisted the outbreak was *manageable* (Xiao *et al.*, 2020). Dr Wang remembered the painful lessons of SARS vividly, and kept a record of SARS events in 2003 on his computer. Dr Wang warned Hubei and Wuhan local authorities of the severity of the disease from 14th to 16th January 2020. He sent them a timeline of how SARS escalated from cover-up to full-blown crisis (ibid). On 16th January 2020, when the person in charge of Wuhan Municipal Health Commission came to Zhongnan Hospital, Dr Wang briefed him again on the seriousness of the situation and read a passage from the 2003 SARS record: On 3 April 2003, Wenkang Zhang, then Minister of Health, said at a press conference that SARS was controllable; On 20 April 3 2003, the central government dismissed him and also Xuenong Meng, the Beijing Mayor from their posts (ibid). It is worth mentioning that the provincial health commission’s party boss Jin Zhang and director Yingzi Liu were dismissed from their position on 11th February (Hou and Zhou, 2020; BBC, 2020). Two days later, the most high-profile officials, for shirking their duties, were also sacked in the wake of the epidemic (Lee and Stanway, 2020).

When Wang Xiaodong, the governor of Hubei Province, received Dr Zhong’s team, it quickly became a confrontation. Local bureaucrats and public health officials were downplaying the seriousness of the situation for weeks, citing lack of evidence. ‘Today is your last chance to tell the truth’, Zeng Guang, another expert in the delegation, said, according to a recent book about Dr Zhong. (Buckley *et al.*, 2020). Zhong asked two simple questions: how many people had been infected and have any medics been infected (Kirton, 2020). Finally, one of the officials acknowledged that 15 medical workers in Wuhan Union Hospital were likely to have been infected, an admission of human-to-human spread (Buckley *et al.*, 2020; Li and Zhao, 2020). After a series of investigations, Zhong and his team reached the conclusion that the situation was much worse than reported. It was clear that human-to-human transmission among

close contacts had occurred since the middle of December and spread out gradually within a month.

There are legitimate questions that the Chinese government must answer. As Horton (2021, 61) wrote: ‘What really took place in Wuhan in December? Did local Communist Party officials suppress the evidence of a new virus? Did they delay telling the national government in Beijing?...Was Beijing complicit in playing down the significance of the outbreak?’ In a later interview, Zhong considered that local government and local medical authorities had mismanaged the epidemic in Wuhan and said that ‘they should take responsibility for it and did not do work well’ (Kirton, 2020). He insisted that Chinese central government’s response was decisive (ibid). If there was delay and inaction in Wuhan’s local government’s response to the crisis, the question must be why?

Did the local government in Wuhan have a disincentive in reporting the severity of the outbreak as did other local governments in other pandemics? Had they downplayed the severity of the virus? If they had, why? Did they worry about social stability and economic impact because of stricter control measures and thus influencing their political careers? During the 2009 A/H1N1 flu outbreak, Dr Zhong queried the number of deaths from the disease and suspected cover-ups. In response, the Ministry of Health ordered all administrative and medical departments to ensure accurate reporting of A/H1N1 flu cases (Huang and Hornby 2009). ‘Some local healthcare authorities are reluctant, unwilling to test patients with severe pneumonia because there's some latent rule which says the more H1N1 deaths, the less effective the control and prevention work in your area,’ Zhong said (McIntype, 2009). If there is disincentive for local governments to report cases, then significant changes must be made.

Xianwang Zhou, the mayor of Wuhan and the city’s former party chief Guoqiang Ma were among the officials criticised for their slow response and poor handling of the outbreak. Zhou told the Chinese state broadcaster CCTV: ‘We haven’t disclosed information in a timely manner and also did not use effective information to improve our work’ (quoted in Ratcliffe, and Standaert 2020). He admitted on state television that the city’s ‘warnings were not sufficient’ (quoted in Zheng, 2021). Zhou was also criticised for imposing a strict, sudden lockdown on Wuhan – a city of 11 million people – from January 23 last year. After millions of angry Chinese took to social media to call for his removal, Zhou said he and other officials were ‘willing to be sacked to appease the people as long as the pandemic is controlled’ (ibid). In an interview on CCTV, Zhou pointed out that ‘As a local government official, I ...have to

wait for authorization before I can release information' (quoted in Perry, 2020). Zhou said the reason it took so long to warn the public about the virus was that he didn't have clearance from above (The Straits Times Staff, 2020). It could be interpreted that he was directing the blame all the way to the provincial party secretary or to Beijing, or both (BBC, 2020). It is true that they might not have had the authority to make tough and dramatical decisions such as Wuhan lockdown at the time. The Law on Control and Prevention of Communicable Diseases stipulates that only the State Council or authorized city or provincial health authorities can publish information about outbreaks of communicable diseases, which might slow down the response process. This system also needs reform.

However, many Chinese thought that the officials in other places rather than Wuhan had done the right thing as infections were much reduced. James Gu, a project manager for a technology firm, said: 'The officials in Qianjiang county nearby took the risk to lock down the city without waiting for approval from Beijing or Hubei. They had a lot less infections than Wuhan and they recovered much faster' (Zheng, 2021).

However, Professor Yongzhen Zhang and Professor Edward C. Holmes' research suggests that the Wuhan public health authority did well in detecting the first cluster of outbreaks.

As the COVID-19 epidemic has progressed, so more viral genomes have been sequenced. As expected, given their recent common ancestry, the earliest samples from Wuhan contained relatively little genetic diversity. While this can prevent detailed phylogenetic and phylogeographic inferences, it does show that the public health authorities in Wuhan did a remarkable job in detecting the first cluster of pneumonia cases (Zheng and Holmes, 2020).

Similarly, Virologist Shao Yiming, chief expert on AIDS at China's Centre for Disease Control and Prevention, explained China's hesitance and confusion of the early response might have been reasonable.

China was the country hit first, and when you're first, you move from unknown to known, and then known to reaction. This takes a much longer time: You first have to rule out other known viral and bacterial pathogens from the clusters of similar pneumonia. You have to understand what's happening and invest a lot to identify the unknown pathogen.' (quoted in Cohen, 2020).

After two days' intensive investigation, Zhong and his team went to Beijing. On 20th January, Zhong had a Zoom call with President Xi Jinping who asked him to give suggestions based on science, putting people's lives and public health over other concerns such as the economy (Jiang and He, 2020; Kirton, 2020). This choice of prioritization of life proved right later. As *The Lancet* (2020, 755) wrote: 'China seems to have avoided a substantial number of cases and fatalities, although there have been severe effects on the nation's economy'. 'The recent outbreak of novel coronavirus pneumonia in Wuhan and other places must be taken seriously,' President Xi Jinping said in his first public statement on the crisis at the same day. 'Party committees, governments and relevant departments at all levels should put people's lives and health first.' Xi's remarks were reported by state broadcaster CCTV on its main 7 p.m. news broadcast (AP, 2020). The political leadership matters in the Covid-19 pandemic. Here it is worthwhile to point out in advance the fact that many leaders have not learned from Xi's bold approach. Likewise, the editor of *The Lancet* commented:

China's success rests largely with a strong administrative system that it can mobilise in times of threat, combined with the ready agreement of the Chinese people to obey stringent public health procedures. Although other nations lack China's command-and control political economy, there are important lessons that presidents and prime ministers can learn from China's experience. The signs are that those lessons have not been learned (*The Lancet*, 2020, 755).

On the morning of 20th January 2020, Dr Zhong and Dr Lanjuan Li were invited to attend a working conference at the State Council (Cyranoski 2020c; Xie, 2020). They devised a strategy of suppression including the Wuhan lockdown. Chinese central government adopted and implemented all the proposals (Xie, 2020). As Hu (2014, 17) notes, contrary to Western stereotypical views on China's democratic centralism, democratic procedures from information exchange to consensus seeking are in fact the backbone and lifeblood of the country's collective decision-making. Responding to a potential 'cover-up' by officials at different levels, Beijing's top political body responsible for law and order said: 'Anyone who puts the face of politicians before the interests of the people will be the sinner of a millennium to the party and the people' (Quoted in Cooper, 2020). It also said: 'Anyone who deliberately delays and hides

the reporting of [virus] cases out of his or her own self-interest will be nailed on the pillar of shame for eternity' (ibid, see Zheng and Lau, 2020). In an interview on the same day, Zhong spoke frankly about human-to-human transmission, and that Covid 19 was highly contagious, a judgment that was critical at a time of confusion, and changed China's anti-virus policy (Gong *et al.*, 2020).

On 22nd January 2020, Dr Zhong and Dr Li asked for the implementation of a strict lockdown policy in order to prevent the spread of the disease (Sina News, 2020). Wuhan began its 76 days lockdown from 23rd January to 6th April 2020. During an interview with *Reuters*, Dr Zhong reflected that the lockdown of Wuhan is 'definitely necessary' to control the spread of the virus. 'If it is delayed for a couple of days, that will cause much more spreading all over China as well as the world', said Dr Zhong (quoted in Kirton, 2020). As Bruce Aylward rightly observed: 'China made this decision to protect China and the rest of the world' (quoted in Bulluz, 2020).

Dr Zhong's courage and integrity won the Chinese people's respect and made lockdown policy more easily implemented in Wuhan. Zhong gave the public and media a stable and open source of scientific information, based on evidence and he became the *de facto* spokesperson for any information related to the illness (Chen *et al.*, 2020). His experience from SARS was applied to manage Covid-19 and translated into actual policy. He described the system to contain epidemics is the "Four Earlies" (early identification, early report, early isolation and early management) to stop transmission from human to human. All four suspected cases of infection were isolated immediately after being suspected of having SARS. All close contacts were quarantined' (Zhong, 2004, see also Zhong and Zeng, 2003, 2004).

In fighting for the COVID-19 pandemic, Zhang said: 'We must focus on two key points: detecting and quarantining cases as early as possible. This is the most effective approach to epidemic prevention and control' (quoted in Chen *et al.*, 2020). 'Outflows of people from Wuhan must be reduced. Strict monitoring measures, including temperature checks first and foremost, must be implemented at transport hubs like train stations and the airport. Since there are no effective drugs at present, wearing a mask is very important' (Liu *et al.*, 2020). At the end of January 2020, when Wuhan was gripped by the COVID-19 epidemic, Zhong made a proclamation that boosted national morale: 'Wuhan has been a heroic city. With the support of the whole country, Wuhan will definitely pass the test' (ibid). Following his call, the whole country was mobilized to support Wuhan and Hubei province. If leadership can be defined as

‘the art of mobilising others to want to struggle for shared aspirations’ (Kouzes and Posner, 1995, 30), it is clear that Dr Zhong is a true leader.

Over 41,000 medical workers from across China joined forces to treat virus patients. More than 11,000 specialist doctors and nurses were sent to Wuhan. The mission was organized by the National Health Commission and represents the ‘solidarity’ and ‘collective action’ of the Chinese health service.

Zhong’s strategy of fighting Covid-19 at community level proved effective. Control measures that sacrificed individual freedom, like mandatory mask-wearing in public areas, were accepted by the public. This included rules to stay at home; discouraged mass gatherings; cancelled or postponed large public events and closed schools, universities, government offices, libraries, museums, and factories. Only limited segments of urban public transport systems remained operational and all cross-province bus routes were taken out of service. As a result of these policies and public information and education campaigns, Chinese citizens started to take measures to protect themselves against COVID-19, such as staying at home as far as possible, limiting social contacts, and wearing protective masks when they needed to move about in public.

Millions of China’s community workers built the first line of defence against COVID-19, in their work to provide essential health checks and support for people with fever, severe diseases, pregnant women, and those quarantined at home. ‘China’s experiences show the importance of community solidarity and what it can achieve’ (Editorial, 2020). The WHO report praised the ‘deep commitment of the Chinese people to collective action in the face of this common threat’ (WHO, 2020b).

What was the effect of measures proposed by Dr Zhong and his team and adopted by the Chinese central government? It may have prevented 744,000 infections in the rest of the country by mid-February (Tian H *et al.*, 2020). ‘Without non-pharmaceutical interventions, we predict that the number of cases would have been 67-fold higher (interquartile range 44–94-fold) by 29 February 2020, and we find that the effectiveness of different interventions varied’ (Lai *et al.*, 2020). According to Chinese modelling, lock down one week later would have had about a sixfold increase in infected cases and a 16-fold increase in deaths. If it had locked down 4 weeks later, the number jumps to over 30 million infected cases, and over 3 million deaths (Yuan *et al.*, 2020; Li Y *et al.*, 2020). The WHO report into the effectiveness of China’s response concluded that it had ‘effectively prevented further exportation of infected individuals

to the rest of the country' (WHO, 2020b). Aylward said. 'Hundreds of thousands of people in China did not get COVID-19 because of this aggressive response' (ibid),⁸ 'That is the ultimate social contract between any government and its people'. He praised China's 'war-footing' and 'stunning demonstration' of collective action against the virus. 'If I had COVID-19 I'd want to get treated in China', he added.⁹

Since the outbreak, Zhong has been busy attending international conferences to describe China's anti-virus experience and discuss global strategy. He has been collaborating with his counterparts all over world to explain China's anti-virus experience. 'Because we have gone through a difficult journey, we should support each other and let other countries take fewer detours through exchanges' (Liu *et al.* 2020; on learning issue see, e.g. Cyranoski, 2020). Dr Zhong is 'someone who inspires and supports action towards a better world' (Visser and Courtice, 2011). Together with his team, he conducted 32 international online conferences, discussing experiences with experts in scientific research and clinical medicine from 13 countries and deputies from 158 foreign missions in China and providing suggestions for the global fight against the coronavirus (Jiang and He, 2021). When asked whether the COVID-19 made him and his counterparts in the world close, Zhong said that 'I think maybe we should be going closer, I mean in particular our colleagues and scientists, and have more cooperation. We're just dealing with the disease - nothing to do with the political, nothing' (Kirton, 2020; on the solidarity of foreign scientist, see, e.g. Calisher *et al.*, 2020). As long as the virus is still prevalent in some countries, the worldwide epidemic situation cannot be controlled, Zhong said, adding that eliminating the pandemic needs effort and decisions based on science and evidence from every country's decision-makers. 'Successfully containing the pandemic in a single country is not enough. The virus would speed up its transmission in its process of mutation and overturn countries' success in fighting it' he said (Liu and Zhao, 2020). Anthony Fauci in the USA agreed that there was no reason for countries not to join global cooperation in fighting against COVID-19 (ibid).

On 8 September 2020, President Xi Jinping awarded Dr Zhong a Medal of the Republic, the highest state honour, for his contribution to China's fight against the epidemic (Xinhua, 2020). Zhong was described in an official statement as a leading expert in China's respiratory disease research and a 'brave, outspoken and responsible doctor' who proposed epidemic prevention

⁸ [who-china-joint-mission-on-covid-19-final-report.pdf](https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf) <https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf>.

⁹ [If I had COVID-19, I want to be treated in China, says WHO official, YouTube](https://www.youtube.com/watch?v=m-lfD9Oajec)<https://www.youtube.com/watch?v=m-lfD9Oajec>

and control measures that saved numerous lives and made a great contribution to fighting both SARS and COVID-19 (Liu *et al.*, 2020). He remains committed to his mission. ‘I will continue to devote myself to the prevention and control of respiratory diseases and public health emergencies, and not let down the trust that the nation has placed in me’ (Quoted in Chen *et al.*, 2020). Zhong Nanshan was named one of ‘The 100 Most Influential People of 2020’ by *Time* ‘for his dedication, integrity, academic and professional achievements, and for sharing China’s successful control efforts and treatment plan with the international community’ (Chan, 2020)

5. Dr Chen Wang

Dr Chen Wang (王辰) is an expert in respiratory and critical care medicine, director of National Clinical Research Centre for Respiratory Diseases, the president of the Chinese Academy of Medical Sciences and Peking Union Medical College, and the vice president and academician of the Chinese Academy of Engineering.¹⁰ When confronted a new virus, Chinese scientists were swung quickly into action. They reported the first forty-one patients and stressed ‘the pandemic potential’ of the new coronavirus in the *Lancet* on 24 January 2020 (Huang *et al.*, 2020). This paper was praised by Horton: ‘The story of the next twelve months was described in that single paper’ (Horton, 2021, 49). He also observed :

After enduring the global opprobrium following its handling of SARS twenty years ago, Chinese leaders invested heavily in their universities, and specifically in their capacities for scientific, technical and medical research. Confronted by a new virus, Chinese scientists were ready, equipped and swung quickly into action (Horton, 2021, 45) .

Dr Wang was one of the first to identify the threat of a global pandemic. He and others also warned: ‘We need to be wary of the current outbreak turning into a sustained epidemic or even a pandemic’ (Wang *et al.* 2020, 10223) They called for the immediate action: ‘Every effort should be given to understand and control the disease, and the time to act is *now*’ (ibid, my emphasis). Unfortunately, the warnings seemed to be ignored by their counterparts - medical

¹⁰ Chen Wang — Lancet Commission on COVID-19, <https://covid19commission.org> › chen-wang <https://covid19commission.org/chen-wang>; Academy of Europe: Wang Chen (ae-info.org), https://www.ae-info.org/ae/Member/Wang_Chen; [https://en.wikipedia.org/wiki/Wang_Chen_\(physician\)](https://en.wikipedia.org/wiki/Wang_Chen_(physician)) <http://english.cams.cn/academician/3876.html> [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)31274-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)31274-1/fulltext);

and scientific advisors to governments such as the UK and the USA. As Professor Horton observed, these reports and others did not ‘trigger a more urgent and vigorous response from Western governments’ (Horton, 2020, 87).

At the beginning of 2020, Dr Wang was selected to serve on a high-level team convened by the National Health Commission to guide the COVID-19 response in Hubei province. He proposed Fangcang shelter hospitals as the problems in Wuhan evolved (Chen S *et al.*, 2020). Fangcang shelter hospitals obviated the risk of within-household and community transmission and solved the issue of centric-isolation and treatment of patients because of the shortage of hospital beds in Wuhan. It provided hundreds of beds in a very short time at the lowest cost (Zhang *et al.*, 2020). Thousands of patients with mild to moderate COVID-19 were able to be isolated and provided with high high-quality medical treatment and care (ibid). These hospitals fulfilled an important triage function and closely monitored patients with mild symptoms. They received speedy medical help, thus obviating the risk of within-household and community transmission, enabling China to end emergency measures within weeks. It is one of the main reasons for the breaking of the transmission chains and successful control the pandemic in such a short time.

In early February 2020, many mild-symptom patients were not admitted to hospital due to the shortage of beds. Thousands of them had to be sent home for isolation and observation. On 1 February 2020, Wang Chen arrived in Wuhan Wang and conceived the strategy of Fangcang (it sounds like ‘Noah’s Ark’ in Chinese) hospitals (Chen *et al.*, 2020, 1305). The rationale was to accept and treat confirmed mild-symptom patients in a central isolation (Zhang, 2020). Because asymptomatic patients can spread the virus (Guan *et al.*, 2020;), patients needed to be isolated from their families and communities. Thus, the source and spread of disease can be reduced and thus the control could be achieved.

As Horton noted:

Why admit patients with mild disease to a shelter hospital instead of insisting on home isolation? The reason lay in the way in which the virus was being transmitted. With workplaces and public venues closed, most infections were being spread within families. China grasped the idea of overdispersion early on. It was essential to remove anyone who fell ill from a place where further transmission could take place (Horton, 2021, 112).

Early epidemiological evidence showed that more than half of all patients with COVID-19 had at least one family member with the disease, and 75–80% of all clustered infections were within families (McNeil Jr. 2020; Maddow, 2002; Tian S *et al.* 2020; Chia *et al.*, 2020). Furthermore, COVID-19 can deteriorate from mild or moderate to severe illness, requiring rapid referral to hospital care (WHO, 2020a). However, in home isolation in Wuhan, the time from onset of severe symptoms to admission to a tertiary hospital for intensive care was up to 10 days before the introduction of the Fangcang hospitals (Xinhua News, 2020b, 2020c). On 5 February 2020, Wang was interviewed on China's national TV and said that the situation in Wuhan was grim, and many patients were not admitted to the hospital in time (Zhang, 2020).

At a conference on the 3rd February 2020, Wang proposed the public health plan through converting large-scale public venues such as exhibition centres and indoor stadiums to receive large numbers of patients and it was adopted on the same day (Chen S *et al.* 2020). In Hubei province, there was a subordinated Central Leadership Group for Hubei Province, which relocated to Wuhan to guide the initiatives during the epidemic in order to coordinate the response. It was said that Sun, the Vice Premier, immediately gave her approval of Wang's proposal.

These shelter hospitals were proposed and designed by scientists like Wang, but they were implemented by high-level governmental officials, demonstrating a 'strong top level political commitment to use science to tackle the outbreak decisively' (Editorial, 2020). As the editors of the *Lancet* observed:

Governments and their leaders must respect science, understand its value, and act on it in a way that is best for society. China's National Health Commission sent three groups of national infectious disease experts to Wuhan at the beginning of the outbreak to investigate the risks and transmission of COVID-19, and their recommendations informed the decision to lockdown Wuhan on Jan 23. *When Chen Wang, president of the Chinese Academy of Medical Sciences, and colleagues saw the need for Fangcang shelter hospitals, the government was quick to respond* (Editorial, 2020, my italics).

Fangcang Shelter hospitals is an example of cooperation between scientists and officials. Once the central guidance group made the decision, Wuhan officials began construction immediately. On the evening of February 3, the first batch of three, square cabin hospitals began, and Dr Wang visited various sites to guide the transformation work with professional suggestions.

On Feb 5, 2020, three exhibition centres and stadiums were converted into hospitals. Over the following weeks, Wuhan opened an additional 13 Fangcangs. In the following month, they had more than 13,000 beds and over 12,000 patients had been treated. '1 out of every 4 Covid patients in Wuhan is treated in the Fang Cabin Hospital, which has achieved "zero infection, zero death, and zero return' Xiaowei Ma, director of the National Health Commission, said (Xinhua News, 2020b). Wang asserted that they 'use the fastest speed and the smallest social cost to achieve the purpose of rapidly and substantially expanding the capacity of admission and treatment; it is indeed a realistic strategy to solve the main contradiction of admission and treatment' (ibid). If leadership can also be described as the capacity of a human community to share its future, and specifically to sustain the significant processes of change required to do so' (Senge *et al.*, 1999, 16), then it would be safe to say that Dr Wang has this kind of capacity with his innovative approach to the problem.

The three key characteristics of shelter hospitals were rapid construction, massive scale, and low cost and their five essential functions were isolation, triage, basic medical care, frequent monitoring and rapid referral, plus essential living and social engagement (Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, 2020). The first three hospitals providing 4000 beds were completed in 29 hours. These hospitals effectively supported China's Covid-19 policy of leaving no patient untended or untreated.

It is necessary to stress the third characteristic of Fangcang shelter hospitals: the low cost of building and running them. Investment costs were low because converting public venues into health-care facilities avoids costly construction of new physical infrastructure. Equally, once the epidemic has subsided, the structures can be returned to their original purposes, avoiding long-term, inefficient use of space, which is a particularly important consideration in a densely populated city. Running costs are low because the shelter hospitals required fewer doctors and nurses than traditional hospitals because all patients in the hospital shared the same primary admission diagnosis, reducing the complexity of care, and all patients had only mild to

moderate disease. Thus, they freed up the scarce medical infrastructure of higher-level hospitals.

Two of the first three Fangcang Shelter Hospitals set up in Wuhan were redeveloped by Zall Group Property from existing buildings. In total, these two were instrumental in diagnosing, treating and curing 3663 patients. Under the medical expertise and guidance of Professor Wang, as well as inputs from Zall Foundation's crews who contributed to the design, renovation and operation of these shelter hospitals, they developed a manual that encompassed the knowledge and experience distilled from running them. Covering five important aspects: the proposal, design, renovation, operation, and logistical support for shelter hospitals, this booklet became a useful reference for epidemic prevention and control efforts in regions around the world (Xinhua News, 2020a; Wuhan Municipal Health Commission, 2020; China News, 2020; The State Council of the People's Republic of China, 2020b).

In conclusion, Fangcang shelter hospitals isolated thousands of patients with mild to moderate COVID-19, provided high-quality medical treatment and care and fulfilled an important triage function. Wuhan has adopted three methods of admitting patients for treatment: designated hospitals, newly built temporary hospitals and Fangcang shelter hospitals. Evidence suggests that the Fangcang shelter hospitals were a major reason for successful COVID-19 control in China. While the designated hospitals saved lives of patients with severe COVID-19, it was the increased hospital-bed capacity of shelter hospitals that helped slow and eventually stop the COVID-19 epidemic in Wuhan.

Similar shelter hospitals were constructed by other countries, such as Italy, Iran, Serbia, the USA, the UK, and Spain. All policies, management manuals, and clinical guidelines related to shelter hospitals were translated as a part of China's international cooperation effort. Experts with direct experience in constructing and running these hospitals were also dispatched to other countries to provide consultancy services to national and local governments (Chia *et al.*, 2020). 'By embracing Fangcang shelter hospitals, many countries and communities worldwide would boost their response to the current COVID-19 pandemic as well as future epidemics and disasters' (Chen S *et al.* 2020; see also others, e.g., Li G *et al.*, 2023).

The effect of Fangcang shelter hospitals on the control of the epidemic was dramatic. It reduced the numbers of cases and deaths from Covid-19 and ended the epidemic earlier. This was confirmed by several research projects. For example, Li J *et al.* (2020, 830) wrote: 'Based on the 13 348 Fangcangs' beds used in practice, our models show that if the Fangcang shelter

hospitals had been opened on 6 February (a day after their actual opening), the total number of COVID-19 cases would have reached 7 413 798 (instead of 50 844) with 1 396 017 deaths (instead of 5003), and the epidemic would have lasted for 179 days (instead of 71). At first glance, the effect of Fangcangs on the control of the epidemic had been exaggerated by these researchers. It is not clear to what degree the hospitals contained COVID-19. However, its significant role should never be underestimated.

The positive effect of Fangcang Shelter Hospitals under resource constraints on the spread of epidemics have also been confirmed by other research. Yuan *et al.* (2020) finds that the establishment of Fangcang hospitals have significantly reduced patient mortality. Fang *et al.* (2020) conclude that they are ‘the most effective way to control virus transmission and reduce mortality’ compared with two other institutions: designated hospitals, newly built temporary hospitals adopted by China admitting patients for treatment since the COVID-19 outbreak. Shang *et al.* (2020, 977) wrote: ‘By obviating the risk of within-household and community transmission, Fangcang shelter hospitals were one of the key measures to control the epidemic in Wuhan, China..., and could be a game changer for other countries as well’.

Professor Horton made a comparison between the effect of self-isolation with that of Fangcang shelter hospitals.

Sadly, many countries afflicted by Covid-19 were unable to respond in such agile and creative ways. Western countries relied on advice to self-isolation if infected with coronavirus. But as the pandemic continued, as trust in governments eroded, as fatigue set in, many, perhaps most, people did not adhere to the advice. Governments were reluctant to impose strict enforcement. The result was that Western nations were unable to quarantine those who became infected. They were unable to control the pandemic (Horton, 2021, 113; on the significance of institutional, not home-based, isolation in containing the COVID-19 outbreak see also others, e.g., Dickens et al, 2020; Hao, et al., 2021; Horchinbilig, et al. 2020)

His comments might not be accepted by many people. However, Fangcang shelter hospital’s significant role in isolating those who become infected should never be underestimated. They were innovative and productive institutional arrangements during the Covid-19 pandemic. The experience and lesson of Fangcang shelter hospital should be used in the future pandemics and disasters.

6. Conclusion

These four physicians and scientists acted decisively and responsibly to protect the health of Chinese people during different stages of the outbreak, in different leading positions. They all learned lessons from SARS 2002-2003, and this helped them to improve their performance in the pandemic. They displayed what leadership, professionalism and innovation look like: courage, intelligence, honest, trustworthiness, and collaboration. They provided clear and effective leadership in translating reliable knowledge into decision-making and evidence into policy. They helped build trust between governments through communication. They were critical to China's success in bringing the outbreak of Covid-19 pandemic under control.

Dr Jixian Zhang was the first doctor to report the Covid-19 cases and alerted the Chinese medical system. This made it possible for the Chinese government to report the disease to WHO and WHO to warn the whole world. Her speed at identifying the new disease in two days and setting up procedures for managing it were exemplary. She was one of those health workers who worked on the frontline of the epidemic with courage and too bore the brunt of infection and death (Haseltine, 2020).

Dr Yongzhen Zhang led his team to sequence the genetic of the Covid-19 virus in less than 40 hours and made suggestions to clinicians and public officials. He shared his findings with the US on the same day and with scientists all over the world less than one week after it was generated which accelerated the development of test kits and vaccines.

Dr Nanshan Zhong, leader of the expert panel of the National Health Committee, recognised the seriousness of the outbreak and took immediate measures in procuring the best scientific advice with which to inform the government. His expertise and experience from SARS in 2002-2003 led to government making decisions such as the lockdown of Wuhan that made a huge difference to the outcomes of the pandemic. He helped officials to produce clear and consistent guidance for the public to follow based on evidence. Zhong became the public face for health advice and won the trust of the Chinese people through his consistent honesty and integrity and this public trust led to acceptance and support for government policy. Like other Chinese scientists, he made an extraordinary commitment to collaborate openly and unconditionally with his counterparts in other countries to exchange experiences to control this disease.

Dr Chen Wang proposed and designed the concept of Fangcang shelter hospital to solve the issue of shortage of hospital beds in Wuhan. This innovation made China be able to quarantine those who became infected and thus be able to control the pandemic. Dr Wang changed the

trajectory of the outbreak in Wuhan and later in the whole of China with their establishment. They cut the line of viral transition and protected the health system from being overwhelmed. His innovative idea was taken up by countries across the world and made a difference to how such pandemics can be mitigated by early intervention and isolation within a medical environment outside of traditional hospitals.

All four advocated international solidarity and cooperation between nations. They all shared their results transparently and in a timely manner with the global health community. Their achievements represent the remarkable work and achievements of Chinese doctors and demonstrate how they have established new standards of professionalism, leadership, trustworthiness, and innovation. To learn from their success provides an opportunity to improve our preparedness for the next pandemics and other disasters.

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