


# Discussion on China's anti-epidemic response based on the *Protocol on Prevention and Control of Coronavirus Disease 2019* from Chinese Authority

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## Abstract

Eight versions of the *Protocol on Prevention and Control of Coronavirus Disease 2019 (COVID-19)* (the *Protocol*) were issued successively by the Chinese authority to guide the local responses since the first COVID-19 case appeared in Wuhan, China. This study aimed to investigate the evolution of the overall strategy and specific measures in these *Protocols*, and several recommendations were provided after analysing China's response to the epidemic resurgence. As a result, we found a gradual expanding trend in case surveillance, early screening, and epidemiological investigation, as well as a progressively rigorous tendency in isolation measures and close contact management. With the *Protocol's* guidance, China had achieved success in several recent fights against domestic COVID-19 resurgences. The city lockdown and multiple city-wide nucleic acid tests adopted were deemed necessary in COVID-19 resurgence's battle. Besides, the large-scale distance centralised quarantine, which is, quarantine in a purpose-built isolation station away from communities where people under quarantine lived, was promoted in rural areas. China's anti-epidemic achievements provide ideas for the global battle against COVID-19.

**KEYWORDS**

China, COVID-19, response, resurgence

**Highlights**

- All versions of *Protocol on Prevention and Control of Coronavirus Disease 2019 (COVID-19)* were analysed
- City lockdown and city-wide nucleic acid tests were deemed necessary
- The large-scale distance centralised quarantine was proposed in rural areas
- China's resurgence fight achievements provide ideas for global battle

## 1 | INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is an emerging acute respiratory infectious disease that was declared by the World Health Organization as a 'public health emergency of international concern' on 30 January 2020.<sup>1,2</sup> As of 8 December 2021, more than 267 million cases have been diagnosed worldwide, with a cumulative death toll of 5.27 million, resulting in significant economic losses and human casualties. Since the first COVID-19 case appeared in Wuhan, China, in Dec 2019, the Chinese authority immediately responded by rapidly organising microbiologists, epidemiologists, pulmonologists, and intensive care unit (ICU) physicians to rush to Wuhan.<sup>3</sup> In order to promptly detect and standardise the cases' management and effectively contain the outbreak spread, eight versions of the *Protocol on Prevention and Control of COVID-19* (the *Protocol*) were issued by China from 15 Jan 2020, to 11 May 2021, to guide local response.<sup>4-10</sup> At present, China has become one of the countries that have effectively controlled the COVID-19 outbreak worldwide and has accumulated a lot of experience in COVID-19 prevention and control.<sup>11</sup> In this paper, several versions of the *Protocol* issued by the Chinese authority were compared, and the evolution of the general strategy and specific measures therein were analysed. Also, a few prevention and control recommendations were presented in light of several COVID-19 resurgences recently and the current response status in China.

## 2 | METHODS

This study was predicated on the Protocols on Prevention and Control of COVID-19 issued by the Chinese authority and reviewed several COVID-19 resurgences after the Wuhan outbreak. Epidemic data were obtained from the Sina Real-Time Epidemic website ([https://news.sina.cn/zt\\_d/yiqing0121](https://news.sina.cn/zt_d/yiqing0121)), and data of Hebei Province were acquired from the official website of the people's government of Hebei province and Hebei's press conference on COVID-19, where major initiatives and results were extracted.

## 3 | RESULTS

### 3.1 | The evolution and background of the overall response strategy

Editions 2–8 of the *Protocol* were analysed in this paper because of the unpublished of the first version. According to the China's response priorities, the overall COVID-19 response strategy could be divided into the following three phases from Dec 2019 until now.

The first stage is from the outbreak beginning to 8 February 2020, when the second, third, and fourth editions were issued. In this period, 'preventing domestic virus transmission' is considered a priority in epidemic response. Therefore, level 1 public health emergency response was activated in the Chinese mainland, with 'wartime control' in place, including the delayed work resumption and the postponed school opening. Other strategies were also implemented, such as 'preventing the coronavirus importation' in communities without COVID-19 cases and 'preventing the coronavirus from entering and spreading within the region' in communities with COVID-19 occurred or outbreak.

The second stage is from 8 February 2020 to 26 February 2020 (The fifth edition was published), marked by the issuance of a circular on 8 February 2020, by the Chinese authority, urging efforts to ensure orderly resumption of production by companies.<sup>12</sup> At that time, China's COVID-19 epidemic had been initially controlled, and enterprises began to resume work and production in a steady but more gradual manner. Precise and differentiated epidemic control strategies, that is, region-specific, multi-level targeted approaches to epidemic prevention and control, were carried out in this period. Counties and other county-level administrative regions (cities, districts, and banners) were classified as high-, medium- or low-epidemic risk. Thus, appropriate measures could be given, which were 'to strictly prevent importation' in low-risk regions, 'to prevent importation and stop transmission internally' in medium-risk regions, and 'to stop transmission internally, prevent exportation and implement strict prevention and control measure' in high-risk regions.

The third stage is from 26 February 2020, to the present (The sixth, seventh, eighth editions were promulgated), marked by the first inbound COVID-19 case that appeared in Ningxia, China.<sup>13</sup> During this long period, the epidemic was basically under control, given China's strict anti-epidemic policies. Nevertheless, several epidemic resurgences caused by inbound cases still broke out. Therefore, a gradual shift from domestic cases to inbound cases had occurred in epidemic prevention. 'Preventing epidemic resurgence and importation' was regarded high priority during this period, and the quarantine of entry persons was carried out in all provinces in China.

### 3.2 | The evolution and background of the specific response measures

The evolution of specific response measures throughout these *Protocols*, which is highly associated with the overall strategy in the three phases mentioned above, can be reflected in case surveillance, isolation measures, early screening, epidemiological investigation, and close contact management.

### 3.3 | Enriched case surveillance

Coronavirus Disease 2019 cases were classified as suspected cases, confirmed cases, asymptomatic cases, cluster cases, and clinically confirmed cases (in Hubei Province only), and the differences between each version are detailed in Table 1.

The concept of COVID-19 suspected, confirmed, and cluster cases were identified in the second edition. On 27 January 2020, one family cluster of COVID-19 cases in Henan Province, caused by one asymptomatic case with a history of residence in Wuhan, outbreak, confirming the role of asymptomatic cases in the virus spread. Therefore, the surveillance and isolation measures for asymptomatic cases were added in the *Protocol* (Edition 3).

Besides, the definition of a clinically confirmed case (in Hubei Province only) was added to the *Protocol* (Edition 4) as a suspected case with COVID-19's imaging features. The emergence of this definition was closely associated with the epidemic background in Wuhan at that time: on the one hand, a large number of suspected cases were waiting for definitive diagnosis by nucleic acid testing, and on the other hand, the reagent supply and the detection capacity were still limited by the time. Therefore, the concept of 'clinically confirmed cases' was introduced to screen suspected cases by chest CT, thus controlling the infection source and containing the transmission route to

TABLE 1 Differences in case surveillance in these *Protocols*

	Edition 2	Edition 3	Edition 4	Edition 5	Edition 6	Edition 7	Edition 8
Suspected cases	<p>Epidemiological history:</p> <ol style="list-style-type: none"> <li>History of travel to or residence in Wuhan within 14 days prior to the disease onset;</li> <li>In contact with cases who have fever and respiratory symptoms from Wuhan, within 14 days before the disease onset;</li> <li>Cluster onset or epidemiological associated with confirmed cases.</li> </ol>	<p>Epidemiological history:</p> <ol style="list-style-type: none"> <li>History of travel to or residence in Wuhan and its surrounding areas, or other communities in China where cases have been reported, within 14 days prior to the disease onset;</li> <li>In contact with cases who have fever or respiratory symptoms from Wuhan and its surrounding area, or from communities where confirmed cases have been reported, within 14 days before the disease onset;</li> <li>Cluster onset or epidemiological associated with confirmed or asymptomatic cases.</li> </ol>	<p>Epidemiological history:</p> <ol style="list-style-type: none"> <li>History of travel to or residence in Wuhan and its surrounding areas, or other communities in China where cases have been reported, or other countries/areas with severe outbreaks, within 14 days prior to the disease onset;</li> <li>In contact with COVID-19 cases (with positive results for the nucleic acid test) within 14 days prior to the disease onset;</li> <li>In contact with cases who have fever or respiratory symptoms from Wuhan and its surrounding area, or from communities where confirmed cases have been reported, or from other countries/areas with severe outbreaks, within 14 days before the disease onset;</li> <li>Cluster cases.</li> </ol>				
Confirmed cases	<ol style="list-style-type: none"> <li>Real-time fluorescent RT-PCR indicates positive for new coronavirus nucleic acid;</li> <li>Viral gene sequence is highly homologous to known new coronaviruses;</li> </ol>				<ol style="list-style-type: none"> <li>Same as above</li> <li>New coronavirus specific IgM and IgG are detectable in serum; New coronavirus specific IgG is detectable or reaches a titration of at least 4-fold increase during convalescence compared with the acute phase.</li> </ol>	<ol style="list-style-type: none"> <li>Positive nucleic acid testing;</li> <li>IgM and IgG antibody positivity in unvaccinated cases.</li> </ol>	

TABLE 1 (Continued)

	Edition 2	Edition 3	Edition 4	Edition 5	Edition 6	Edition 7	Edition 8
Cluster cases	Two or more confirmed cases in a small area within 14 days.	Two or more confirmed or asymptomatic cases in a small area within 14 days.					Change two to five.

Abbreviation: RT-PCR, reverse transcription-polymerase chain reaction.

the maximum extent possible.<sup>14</sup> In the *Protocol* (Edition 6), antibody testing was added to compensate for the low detectability of nucleic acid testing, given its high positivity and sensitivity. Therefore, both nucleic acid testing and antibody testing were recommended. However, in the eighth edition, antibody testing was removed due to the popularity of vaccines.

3.4 | Stricter isolation measures

Family cluster, infectiousness during latency, and re-positive after discharge are considered to be COVID-19's characteristics.<sup>15,16</sup> Close contacts were required to be centralised isolated (quarantine in designated facilities) for observation in the *Protocol* (Edition 4) for maximum control of virus transmission. Meanwhile, as recovered cases who test positive in nucleic acid re-tests being successively reported in China,<sup>17</sup> all COVID-19 discharged cases were required a continued 14-day quarantine and health status monitoring in the *Protocol* (Edition 6). On this basis, asymptomatic cases needed to undergo 14-day home isolation and follow-up medical visits to designated institutions in the 2nd and 4th weeks after the 14-day centralised isolation in the *Protocol* (Edition 7).

3.5 | Early screening on human, objects, and environment

The evolution of COVID-19 cases' identification, reporting, and diagnosis is detailed in Table 2. 'Early identification, early treatment' was emphasised in COVID-19 prevention and control since the *Protocol* (Edition 3). Medical institutions, especially primary health care, should strengthen the awareness of COVID-19 case screening and pay attention to patients with unexplained fever, cough, shortness of breath, or other symptoms for epidemiological history. By the time the *Protocol* (Edition 6) was promulgated, inbound cases had become an essential part of the pandemic, leading to the overseas arrivals becoming a priority in early screening.

On 20 February 2020, an increased number of confirmed COVID-19 cases from prisons were reported in Shandong and Zhejiang provinces, and 34.87% of the new confirmed cases in Hubei province also came from prisons.<sup>18</sup> Therefore, prevention and control work in key areas (e.g., schools, nursing facilities, prisons) began to be highlighted in the *Protocol* (Edition 5). Regular epidemic response was implemented when the *Protocol* (Edition 8) was released, and the COVID-19 screening was extended from human to object and environment. In addition to key or risk populations, regular environmental sampling such as cold chain food locations, fever clinics, and isolation sites were included in the prevention measures (Table 2). For example, regular nucleic acid testing of the following items and environmental samples were required: (i) imported cold chain foods and their processing, transportation, storage, and sales sites; (ii) imported goods from high-risk countries and low-temperature transport environments and their holds, containers, waggons, containers, and cargo storage yards; and (iii) markets selling cold-chain food.

TABLE 2 Differences in case detection, reporting and diagnosis in these Protocols

	Edition 2	Edition 3	Edition 4	Edition 5	Edition 6	Edition 7	Edition 8
Case detection	All healthcare facilities should report the suspect or confirmed cases via online direct reporting system within 2 hours.	Plus: All health care facilities, especially primary level organizations, should raise awareness of diagnosing COVID-19 cases. For cases with respiratory symptoms caused by unknown reasons, their epidemiological history should be considered.			Plus: Raise awareness of individuals with history of travel to or residence in countries/regions with serious outbreaks abroad, and strengthen port health quarantine and close contacts' screening.		Plus: Surveillance of risk occupational groups, key institutions, substances and environments, centralized isolation sites, etc.; and pathogenic and mutant strains.
Case reporting		Plus: Asymptomatic cases	Plus: Clinical confirmed cases (in Hubei Province only)	Remove: Clinical confirmed cases (in Hubei Province only)			Cluster incidence within 5 cases but with epidemiological association should also be reported.
Case diagnoses	The original specimens or PCR amplification products of the first case in each province should be sent to CDC or a third-party inspection agency designated by NHC for verification.	Only Cluster cases' specimens should be cascaded up to provincial and national CDCs for verification.	The original specimens of cluster cases with 5 or more incidences should be sent to the CDC for verification.			The original specimens of imported cases or cluster cases with 5 or more incidences should be sent to the CDC for verification.	

Abbreviations: CDC, Chinese centre for disease control and prevention; NHC, national health commission of the People's Republic of China.

### 3.6 | Epidemiological investigation of disease traceability and contamination scope

The following elements were added in the *Protocol* (Edition 7): (i) Epidemic traceability investigation, including the case investigation of infection source and the exposure history of cluster cases, and (ii) Contamination scope investigation, that is, using big data information to collect case activity area and possible contamination scope. By these means, the virus transmission extent could be quickly determined so that the respective response measures could be promoted based on specific regions and levels (Table 3).

### 3.7 | Rigorous close contact management

The evolution of close contacts' definitions, isolation, and management measures in these *Protocols* are listed in Table 4. An evolution towards centralised quarantine could be found since Edition 4. Centralised quarantine among close contacts facilitated: (i) rapid and efficient nucleic acid testing; (ii) transmission interruption, especially within households; and (iii) disposal of effluent and waste. Meanwhile, some self-proclaimed strict home isolation cannot meet the criteria for preventing virus transmission. Therefore, although costlier than home isolation, centralised quarantine among close contacts was still considered cost-effective and was recommended given the potential virus transmission.

Besides, the definition of close contact was expanded to 2 days before illness onset or sampling in confirmed or asymptomatic cases in the *Protocol* (Edition 5). A study based on 77 pairs of 'transmission couples (transmitters and infected persons)' inferred that the novel coronavirus was found to be infectious at 2–3 days before the first COVID-19 symptom onset, with the strongest infectivity at 0.7 days.<sup>19</sup> In fact, the definition of close contacts in some Chinese provinces was broadened considerably in practice. For instance, close contacts were defined as individuals who contact with suspected or confirmed cases 4 days before illness onset instead of 2 days to ensure that no close contact was missed in Jun 2020, when the pandemic started to show resurgence in Beijing.<sup>20</sup> In addition, the concept of sub-close contacts, that is, close contacts of close contacts, was added to the *Protocol* (Edition 7) to further enlarge the screening range for close contacts. Also, the close contacts' management was more rigorously regulated in these *Protocols*, including increased frequency of nucleic acid testing and more prolonged home quarantine after centralised isolation.

### 3.8 | The domestic epidemic resurgences and China's responses

After all hospitalised COVID-19 cases in Wuhan Province were cleared on 26 April 2020,<sup>21</sup> the COVID-19 transmission in China is basically under control, and the enterprises' production and the people's daily life had generally returned to normal. However, several domestic epidemic resurgences still broke out, especially the outbreak in Hebei Province on 2 January 2021, which was one of the most severe domestic pandemics in China after Wuhan. This epidemic in Hebei happened just before the Chinese New Year, and a strong response was implemented by the Chinese authority facing the rampant outbreak and the festive social demands of the Lunar New Year. Ultimately, the pandemic was extinguished in over 1 month with no nationwide spread. Therefore, this paper compiles the response measures taken by the Chinese authority within this outbreak to provide ideas for the current worldwide policy development (Figure 1).

Located in northern China, Hebei surrounds the capital city, Beijing, with a resident population of about 74.61 million. This resurgence's timing and spatial peculiarities pose a severe challenge for China's COVID-19 battle, as the outbreak happened just one month before the Chinese New Year when the Spring Festival travel rush was

TABLE 3 Differences in epidemiological investigation in these *Protocols*

	Edition 2	Edition 3	Edition 4	Edition 5	Edition 6	Edition 7	Edition 8
Investigated population	COVID-19 cases	Plus: Asymptomatic cases	Plus: Clinical confirmed cases (in Hubei Province only)	Remove: Clinical confirmed cases (in Hubei Province only)		Plus: 1) Imported cases 2) Imported secondary cases 3) Close contacts 4) Sub-close contacts 5) General contacts <sup>a</sup>	
Epidemiological investigation methods	Including basic information, illness onset and treatment, clinical manifestations, laboratory tests, epidemiological history, close contacts' information, as well as the cases' diagnosis, treatment and outcome	Including case investigation and cluster investigation includes: basic information, onset and consultation, risk factors and exposure history, laboratory tests, and close contacts Cluster investigation emphasizes the epidemiological association among cases.	Only basic information and close contacts are needed in suspected and clinic-confirmed cases.	Only basic information is required in suspected cases.		The investigation of infection source and contamination scope is added to case investigation. Cluster investigations should focus on: the cases' exposure history, the type, distance, and frequency of contacts with other cases, the adopted personal protective measures, and the cases' activity trajectory	

<sup>a</sup>General contacts are those who have the following contacts with suspected, confirmed, or asymptomatic cases but do not meet the definition of close contacts: travelling on the same vehicles such as airplanes, trains, and boats; living, studying, and working together; and being exposed during medical treatment.

about to begin. On 2 January 2021, a confirmed COVID-19 case was reported in Gaocheng District, Shijiazhuang City, Hebei Province, and the epidemiological investigation was immediately launched by local authorities, with all close contacts traced being centralised isolated and under medical observation. On 6 January, an initial circular on the 'locking down' of the Shijiazhuang city was issued by Hebei Province, that is, all vehicles and individuals were prohibited from leaving the city. From 8 January, all city residents underwent a 14-day home quarantine, during which the Shijiazhuang government conducted intensive city-wide nucleic acid tests for COVID-19. After the above prevention and control measures, the pandemic in Hebei was significantly curbed. On 23 January, Shijiazhuang City gradually eased its control measures: region-specific, multi-level targeted approaches to epidemic control were implemented, and low-risk regions resumed living and production in an orderly manner. On 5 February, the inner-city traffic and highway intersections were gradually liberalised; on 8 February, the railroad transportation was restored; until 22 February, Gao Cheng District was adjusted to a low-risk region, with epidemic regularity management (Figure 2).

In addition to Shijiazhuang City, Xingtai City is also one of the epicentres in Hebei province. Epidemiological investigations and isolation measures were implemented in Xingtai City instantly after the first reported case in Nangong City (a city in Xingtai City) on 3 January. A 7-day home quarantine in Xingtai City and a 14-day home quarantine



TABLE 4 Differences in close contact management in these *Protocols*

	Edition 2	Edition 3	Edition 4	Edition 5	Edition 6	Edition 7	Edition 9
Definition	Close contact after illness onset	Close contact after illness onset or positive detection in asymptomatic cases		People who had unprotected close contact with confirmed or suspect cases within 2 days before illness onset, or with asymptomatic cases within two days before sampling		Plus: Sub-close contacts: People who have intimate contact with close contacts without effective protection during the period, starting from the first contact between close contacts and the case until the close contacts are isolated.	
Isolation	Home or centralized quarantine for 14 days		Centralized quarantine				
Nuclear acid test						Nucleic acid testing during the quarantine period was performed on the 1st, 3rd, and 14th day in close contacts, and on the 1st or 2nd day in sub-close contacts.	Close contacts are required to undergo nucleic acid testing on the 1st, 4th, 7th, and 14th days during quarantine, as well as a 7-day home isolation after centralized quarantine, with nucleic acid testing being organized on the 2nd and 7th day.

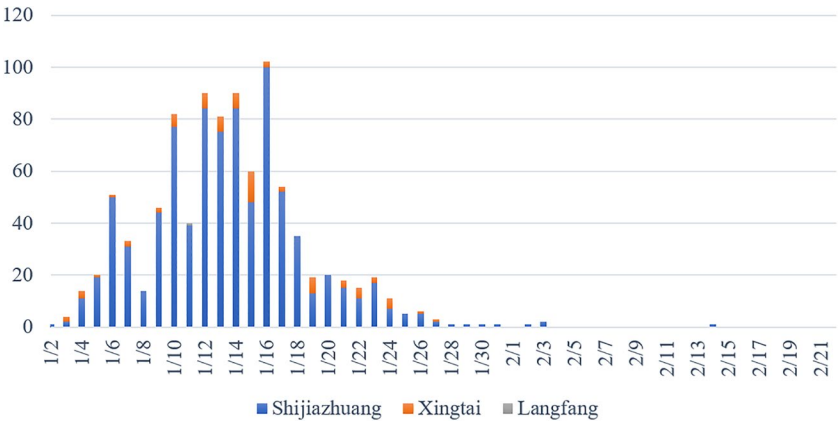


FIGURE 1 Daily new confirmed cases in Hebei Province during Jan and Feb 2021. Note: Three cities in Hebei Province were involved in this Coronavirus Disease 2019 (COVID-19) resurgence, which were Shijiazhuang City, Xingtai City, and Langfang City. Data source: Sina real-time epidemic map, [https://news.sina.cn/zt\\_d/yiqing0121](https://news.sina.cn/zt_d/yiqing0121) [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

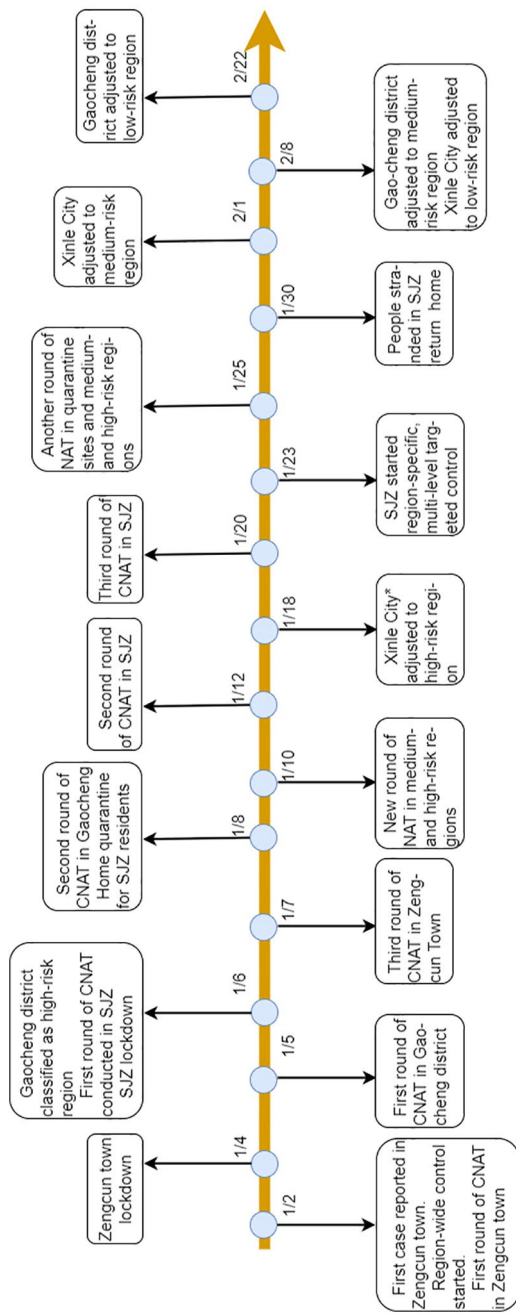


FIGURE 2 Timeline of Shijiazhuang's fight against Coronavirus Disease 2019 (COVID-19). CNAT, city-wide nucleic acid test; NAT, nucleic acid test; SJZ, Shijiazhuang City. \*Xinle City is a small city in Shijiazhuang City [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

in Longyao Town, another place in Xingtai City where the virus emerged, were adopted, as well as the intensive city-wide nucleic acid tests. These response strategies were not loosened until 1 February, when the aggressive epidemic was contained (Figure 3).

## 4 | DISCUSSION

### 4.1 | Discussion on China's response to the Coronavirus Disease 2019 resurgence

Focusing on the general strategy and specific measures within these *Protocols*, we believe that its evolution is closely associated with epidemiological perceptions and China's social factors. As the etiology and epidemiological characteristics of the virus became increasingly evident, more accurate definitions of confirmed cases and close contacts were proposed. Meanwhile, city-wide nucleic acid testing and close contacts' centralised quarantine also require economical and productive capacity.

Besides, compared with the outbreak in Wuhan during early 2020, a more rapid and effective response could be found in current COVID-19 resurgences represented by the outbreak in Hebei, which is inextricably associated with the Chinese government's accumulated response experience and deeper understanding of the virus during the previous COVID-19 pandemic. In our view, the following points of the Chinese authority's response deserve to be highlighted.

#### 4.1.1 | Rapid and efficient city lock-down

Among the three cities involved in the outbreak (Shijiazhuang City, Xingtai City, and Langfang City), the local authority extended a rapid city lock-down policy in the first case incidence region. Shijiazhuang city was entirely locked down 4 days after the first case was reported, while Xingtai city and Langfang city were controlled even on the right day the first case was found. In fact, several studies had demonstrated the critical role of city lockdown in the anti-epidemic battle. A susceptible-exposed-infectious-removed (SEIR) model was used to predict the possible impact of 7-day delayed lockdown in Wuhan city on the virus transmission based on imported cases from Wuhan and population movements in 217 cities in China. The result showed that, assuming a 7-days lock-down delay in the Wuhan city, 32,075, 24,819, and 20,334 cases were predicted to flow from Wuhan to other regions by 30 January 2020, with high, medium, and low growth scenarios of daily new infections in the Wuhan city, respectively, resulting in a number 3.3 to 3.9 times of the official COVID-19 case data on 19 March 2020.<sup>22</sup> A modified real data-driven model was implied by Ding et al. to measure the lockdown and the effectiveness of reduction in the contacts in Italy, and the results showed a decreased infected data due to stay-at-home orders.<sup>23</sup> Yuan et al. constructed a regression model to assess the impact of the Wuhan's lockdown on China's epidemic based on two elements: (1) the total number of individuals leaving Wuhan during 20–26 January 2020; and (2) the seed case number in Wuhan before 19 January 2020, represented by the cumulative confirmed case number on 29 January 2020. The results demonstrated a 34.6% increase in non-Wuhan areas' confirmed cases for 3-day postponement's city lock-down by 1 March 2020 (up to 41,330), as well as a 30.8% decrease for 3-day advance (up to 21,235).<sup>24</sup>

#### 4.1.2 | Close contacts' identification and quarantine

The close contacts' management was considered as another critical initiative for the outbreak containment in Hebei Province. As is known, three rounds of city-wide nucleic acid tests were conducted in the Shijiazhuang City, the epicentre of this resurgence. Positive cases were commonly reported in the Gaocheng district in the first round and close

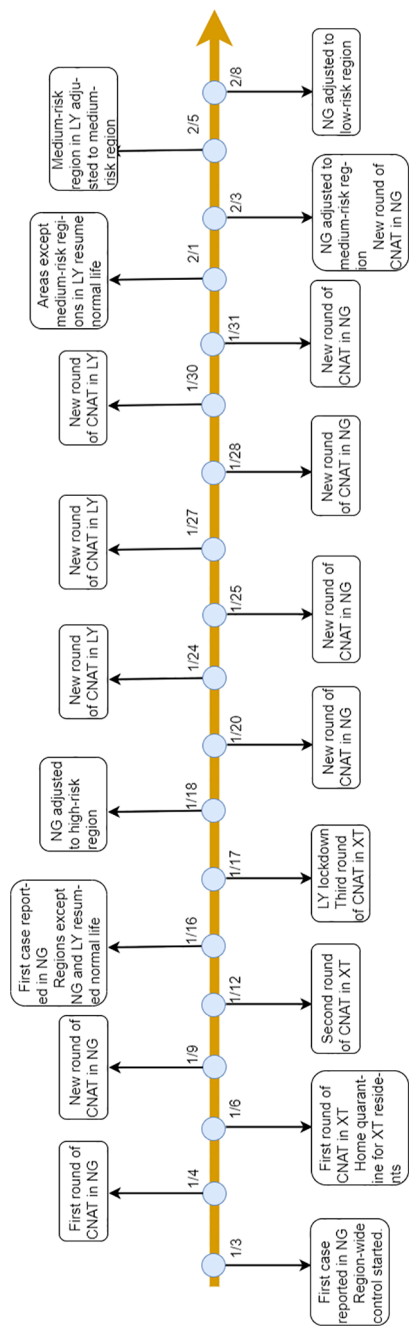


FIGURE 3 Timeline of Xingtai's fight against Coronavirus Disease 2019 (COVID-19). CNAT, city-wide nucleic acid test; LY, Longyao Town; NAT, nucleic acid test; NG, Nangong City [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

contact isolation sites in the second and third rounds (180/247 in the second round, 72.9%; and 25/30 in the third round, 83.3%), indicating the critical role of effective close contact quarantine in the COVID-19 response.

The large-scale distance centralised quarantine, rather than home isolation or quarantine at a nearby isolation site in Wuhan, was introduced in Hebei.<sup>25</sup> A total of 20,000 people from 15 villages with COVID-19 cases in Gaocheng District were isolated centrally at a distance in Shijiazhuang, which is, all individuals from villages with COVID-19 cases were transferred to a purpose-built isolation station that was some distance away from their communities since 11 January 2021.

The large-scale distance centralised quarantine is regarded as an innovation in China's fight against rural COVID-19 outbreak for three reasons: (i) the first and epicentre of this resurgence was in China's rural areas, where home quarantine was challenging to perform due to villagers' gathering practices and substandard hygiene habits; (ii) rural areas, characterised by sparsely populated, are not conducive to material supply and real-time monitoring during the quarantine period, thus increasing the difficulty of temperature monitoring and nucleic acid testing among villagers; (iii) the presence of the virus in the infected area's environment could be addressed by distance centralised quarantine, as thorough disinfection can be achieved when contacts are relocated to other locations. Previous studies have proved that SARS-CoV-2 can survive for approximately 7 days on the surface of stainless steel and plastic,<sup>26</sup> 2 days on the surface of fabric and wood pieces, and 4 days on the glass surface at room temperature.<sup>27</sup> Besides, distance centralised quarantine addresses the environmental disinfection problem to the maximum extent on account of the potential health effects of disinfectants on the occupants.<sup>28</sup>

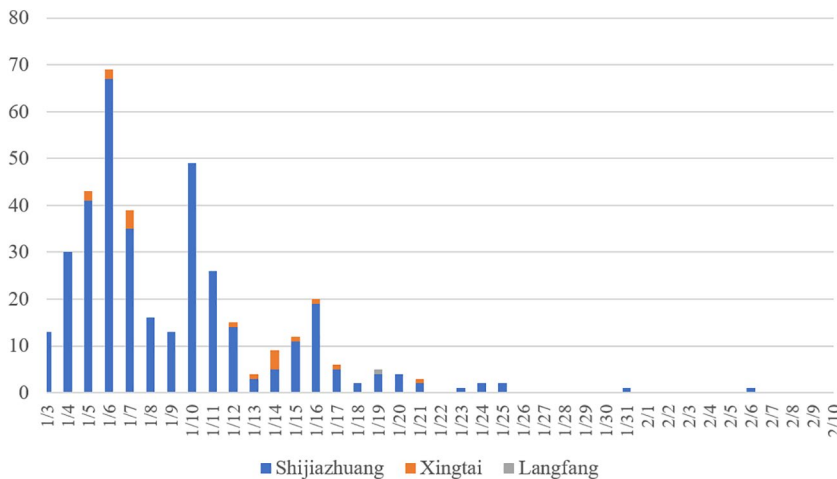
#### 4.1.3 | Fast and orderly multiple nucleic acid tests

In this resurgence in Hebei, multiple city-wide nucleic acid tests were conducted by the Chinese authority in the three cities above. Three rounds of city-wide nucleic acid tests were conducted on 6 January, 12 January, and 20 January in Shijiazhuang city, and more than 10.25 million tests were completed within 72 h with a testing efficiency of 3.42 million people/day. The positivity rates were 0.345‰ (34.5 ppm), 0.24‰ (24 ppm), and 0.029‰ (2.9 ppm), respectively. It is worth mentioning that the non-isolated site occupancy was 27.1% (67/247) and 16.7% (5/30) in all positive cases in the second and third rounds, respectively, fully illustrating the necessity of city-wide nucleic acid testing, especially at non-isolated sites. Thanks to this valuable experience, the *Guidelines for the Organization and Implementation of the City-wide COVID-19 Nucleic Acid Testing* was promulgated on 9 February in China, requiring that cities with populations less than 5 million should complete the city-wide nucleic acid testing within 2 days, and cities with populations over 5 million within 3–5 days.<sup>29</sup> In addition, nucleic acid testing can be seen as a powerful modality for asymptomatic cases. The number of new asymptomatic cases per day is shown in Figure 4. To date, previous study has validated the transmission ability of the SARS-COV-2 virus in asymptomatic cases.<sup>30</sup>

What is more, frequent nucleic acid testing was performed in residents of high-risk regions and key populations in Hebei, considering the false negatives of nucleic acid testing.<sup>31</sup> According to statistics, six rounds of city-wide nucleic acid testing in Gao Cheng District, Shijiazhuang City, and eight rounds in Nangong City, were conducted in case of false-negative cases.

#### 4.2 | Limitations

In addition to Hebei, several COVID-19 resurgences, which have not been analysed in this study, also broke out after the Wuhan outbreak in China. In the future, more data should be evaluated to derive specific conclusions. For example, what are the implementation criteria for city-wide nucleic acid testing? Apart from that, the economic and social impacts of the above responses have not been studied, and next, we will explore the advantages and disadvantages of the above responses from a socioeconomic perspective.



**FIGURE 4** Daily new asymptomatic cases in Hebei Province during Jan and Feb 2021. Data source: The People's Government of Hebei Province, <http://www.hebei.gov.cn/> [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

## 5 | CONCLUSIONS

So far, necessary COVID-19 prevention and control measures are still considered one of the major initiatives to curb virus transmission worldwide on account of the absence of potent COVID-19 drugs and the emergence of mutant virus strains such as Alpha, Beta, Gamma, and Delta. The evolution of case surveillance, isolation measures, early screening, epidemiological investigation, and close contact management in these *Protocols* reflects the progressive understanding of COVID-19 by researchers and summarises China's valuable experience in this anti-epidemic battle. The city lockdown, close contact quarantine, and multiple city-wide nucleic acid tests adopted by China were deemed necessary to fight against the outbreak resurgence. China's achievements in the fight against the COVID-19 pandemic, especially the outbreak resurgence, provide ideas for the global battle against public health emergencies with high transmissibility.

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## CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

## ETHICS STATEMENT

Not required.

## DATA AVAILABILITY STATEMENT

Not required.

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