COVID-19 Wenzhou Community based Isolation Strategy for controlling the novel coronavirus pneumonia epidemic

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Background: Wenzhou City in Zhejiang Province, China is a non-municipal municipality with the worst outbreak of 2019 novel coronavirus disease (COVID-19) outside of Hubei Province. In this report, we intend to introduce and analyze the COVID-19 Wenzhou Community based Isolation Strategy (COVID-WCIS) for COVID-19, and then determine whether the control measures implemented were effective.

Methods: The Wenzhou government has recently implemented the COVID-WCIS. It consists of the following: set up designated hospitals; restrict return travel to Wenzhou from Hubei and isolate individuals who have recently returned from Hubei; close entertainment venues; delegate testing for the virus; control population movement and for all individuals to wear a face mask; close high-speed exits and public transportation, suspend school and halt construction projects; limit movement within households; control inward and outbound traffic, and limit work attendance. Furthermore, data regarding new infections will be collected daily, the total number of infections and the number of cases who locally reside versus those visiting the city will be determined.

Findings: From January 22, 2020, Wenzhou initiated COVID-WCIS. As of February 17, 2020, Wenzhou had a total of 504 confirmed cases and this number was stable until March 1st, 2020. Since February 11, 2020, the number of newly diagnosed patients dropped to below 10. The number of new cases reached its peak on January 29, 2020.
(58 cases), and the transmission pressure of imported cases had basically been released by February 3, 2020. On January 31, February 4, and February 6, there were dramatic declines in the number of cases, which we believe were due to the implementation of policies 6-8 (see below).

Interpretation: With the implementation of COVID-WCIS, the overall number of cases declined dramatically, resulting in the city’s epidemic being well controlled. The international community should adopt similar measures implemented by COVID-WCIS to control outbreaks and prevent an epidemic.
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**Keywords:** 2019 novel coronavirus disease; Wenzhou Community based Isolation Strategy; Epidemic; Effectiveness
Introduction

Since the emergence of the 2019 novel coronavirus disease (COVID-19) in Wuhan, Hubei Province, China in December 2019, pneumonia outbreaks of varying degrees have occurred in China and around the world. As of March 1, 2020, China had 79,968 diagnosed cases, of which 66,907 cases were diagnosed in Hubei Province which had 2,761 deaths. Wenzhou City in Zhejiang Province, China is a non-municipal municipality with the worst outbreak outside of Hubei Province. As of March 1st, there were 504 diagnosed cases in Wenzhou. Compared with other similar-sized cities, two attributes make Wenzhou susceptible to viral outbreaks. First, over 180,000 individuals travel to and from Wenzhou to conduct business, work and study. Just before the outbreak, more than 20,000 individuals returned to Wenzhou from Wuhan. It was also determined that an additional 29,000 individuals returned to Wenzhou from Hubei Province. Second, a local cluster outbreak occurred in Yueqing, a county-level city, just north-east and under the administration of Wenzhou. Yueqing has many people that study and perform business in Wuhan. Individuals returning to their hometown caused an outbreak with 170 new cases of COVID-19 being confirmed in Yueqing.

The Wenzhou government has adopted a series of strict policies to effectively curb the spread of the virus. This article aims to introduce the Wenzhou Community based Isolation Strategy for COVID-19 and to determine whether the control measures were effective and could be adopted by other provinces and countries.
Methods

Data collection

We collected data regarding COVID-19 cases that occurred in China and policy measures implemented by the Wenzhou government from the National Health Commission of the People’s Republic of China and the Health Commission of Wenzhou and other provinces.\textsuperscript{7-9} Data included the number of new cases per day, the total number of cases, local infections, individuals infected in other provinces coming into Wenzhou, and the time of policy implementation.

COVID-19 Wenzhou Community based Isolation Strategy

The Wenzhou government adopted a series of policies to control the spread of COVID-19. These included the following nine measures:

1) Setting up of designated hospitals (January 22, 2020)

The Wenzhou government selected designated hospitals and disease experts, and ensured drug supplies and equipment were available. Ten designated hospitals and 1,474 beds in the city were made available for patients diagnosed with COVID-19. Among the designated hospitals, the First Affiliated Hospital of Wenzhou Medical University consisted of a 150-bed isolation ward. Severe cases throughout the city were transferred to the First Affiliated Hospital of Wenzhou Medical University. There are currently 510 medical staff in the city that are responsible for first-line
treatment and an additional 1,100 medical staff on standby.

2) Travel restrictions to Wenzhou from Hubei and isolation of individuals returning from Hubei (January 23, 2020)

The Wuhan government stated on January 22, 2020, that it was necessary to strictly implement the isolation policy. The following days after the policy, all flights from cities around Wuhan to Wenzhou were canceled or restricted. Passengers who booked airline tickets in advance were encouraged to cancel their trips.

3) Closure of entertainment venues (January 24, 2020)

Beginning January 24, 2020, entertainment venues were closed and gatherings in restaurants for dinner were prohibited. Temperature monitoring was initiated at airports, transport stations, and public places. If individuals showed symptoms, they were questioned by public health officials and sent to designated hospitals for quarantine and treatment.

4) Delegation of viral testing to cities and counties (January 25, 2020)

Nucleic acid testing for the virus was decentralized to various areas in Wenzhou.

5) Control of movement and the use of a face mask (January 27, 2020)

On January 27, 2020, villages, communities, enterprises, workplaces and buildings were screened for the presence of individuals with the virus. The government adopted the “six ones” policy, i.e., one subject, one thermometer, one mask, one form, one pen, and one brochure. New arrivals to the city were promptly isolated and observed at
home for fourteen days. Individuals with fever (underarm temperature ≥37.3 degrees Celsius/99.14 degrees Fahrenheit), cough, shortness of breath, and other symptoms of respiratory tract infections, were required to report and follow-up with the quarantine management staff. They were requested not to leave their premises. Also, wet markets, supermarkets, pharmacies, etc., were required to have reasonable business hours and monitor the temperatures of those entering their premises. Staff and shoppers had required to wear face masks and other protective clothing.

6) Closure of high-speed exits and public transportation, suspend school and halt construction projects (January 29, 2020)

The government had investigated 54 high-speed exits in the city and 14 exits of which had relatively low traffic were temporarily closed. In addition, City Rail Line S1, urban public transport, and ferries were suspended. Passenger routes and buses in key areas such as Yueqing and Ruian were suspended. Various businesses in Wenzhou will be able to resume work no earlier than 24:00, February 17, 2020, except for critical agencies and hospitals involved with epidemic prevention and control. Reopening of schools (universities, primary and secondary schools, etc.) after the Chinese New Year holidays were postponed to March 1, 2020.

7) Limit the mobility of residents per household (February 1-15, 2020)

Each household in the city was requested to assign one family member to purchase groceries and everyday living items every two days. However, the needs of individuals to undergo medical treatment, purchase medical supplies and to work to
ensure the functioning of the national economy and people’s livelihood were not restricted.

8) Restriction of traffic to and from the city (February 2, 5, 6, 2020)

On February 2, 2020, the Wenzhou government closed all high-speed exits and increased traffic restrictions to Yueqing, Pingyang, Yongjia, Ruian, and Taishun on February 5. Individuals were restricted from travel between 22:00 and 6:00 on February 6.

9) Resumption of work and epidemic prevention and control (February 9, 2020)

On the afternoon of February 9th, the Wenzhou government held a press conference regarding the resumption of work for individuals in specific industries. Industries deemed critical for the national economy and people’s livelihood could reopen after approval from the territorial government. It was essential to establish a “white list” of key enterprises and businesses and to ensure only Wenzhou residents were permitted to work in the city. Also, businesses were required to have proper epidemic prevention and control measures. After approval granted by the local government, priority and orderly resumption of work after 24:00 on February 17 was initiated. The resumption of work was implemented in a staged and controlled manner. Individuals returning to Wenzhou from severely affected epidemic areas were quarantined for 14 days.

The Wenzhou government initiated a series of measures for the prevention and control of COVID-19. Wenzhou government’s prevention and control strategy focused on a
community system-based approach. From urban areas to counties, communities to households, step by step, the government achieved localization and grid. The community-based isolation strategy was strictly enforced to ensure compliance and was termed “COVID-19 Wenzhou Community based Isolation Strategy (COVID-WCIS)”.

**Statistical Analysis**

Statistical analysis was performed using Microsoft Office Excel 2010 (Microsoft Crop, WA, USA). The epidemic curve was constructed using the date of illness onset, and key measurements relating to the COVID-WCIS were included to aid interpretation.

**Results**

From January 22, 2020, Wenzhou implemented COVID-WCIS. As of February 17, 2020, Wenzhou had accumulated 504 confirmed cases and the numbers were stable until March 1, 2020. Since February 11, 2020, the number of newly diagnosed patients dropped to below 10 (Figure 1). The number of new cases reached its peak on January 29, 2020 (58 cases), and the transmission pressure of imported cases had basically been released by February 3, 2020. On January 31, February 4, and February 6, there were dramatic declines in the number of cases, which corresponded to the three policies implemented on January 29, February 1, and February 5 (Figure 2). At present, the overall number of cases has declined dramatically, and the city’s epidemic
situation has been well controlled.

Figures 3 and 4 show the number of confirmed COVID-19 cases in Yueqing, Wenzhou City, in Zhejiang Province during January 24 and March 1, 2020. The number of newly diagnosed cases in Yueqing also reached its peak on January 29, 2020 (27 cases) and was the highest in the city for 15 consecutive days until February 17, 2020. As of February 2, 2020, the number of confirmed imported cases in Yueqing declined substantially compared to local cases. On February 16th, the number of new cases in Yueqing was zero. Yueqing reached this milestone two days earlier than Wenzhou city.

**Discussion**

Wenzhou had the most severe COVID-19 epidemic outside of Hubei Province and faced a sudden public health crisis. The Wenzhou government objectively analyzed and implemented prevention and isolation strategies to contain the transmission of COVID-19. Since February 18, 2020, there have been no new cases diagnosed in Wenzhou. No new imported cases after February 3, 2020, were recorded, and local contact cases gradually decreased in numbers after implementation of the control measures. Three dramatic declines in the number of newly diagnosed cases were observed after the implementation of the community-based isolation strategy.

It is now clear that human-to-human transmission in a few early cases occurred in
children.\textsuperscript{10} Individuals of all ages are susceptible to the virus. In response to the outbreak, planned immunization is an important measure to prevent the spread of infectious diseases. The development of a vaccine is currently being carried out. Wenzhou’s municipal government is mainly focused on infection control measures and the prevention of transmission. Limiting and isolating visitors coming from Hubei, treatment, and isolation of confirmed cases in designated hospitals, home isolation of suspected individuals and close contacts have been proved to be particularly effective in controlling viral transmission. Wu et al.\textsuperscript{11} indicated that if a 25\% decrease in viral transmission in all domestic cities was achieved, the growth rate, as well as the magnitude of local epidemics, would be substantially reduced. This demonstrates that cutting the route of transmission is critical for epidemic control. The municipal government has rolled out several systemic measures for preventing transmission. For the individual, staying at home, frequent handwashing, and covering the mouth and nose during sneezing and coughing were effective.\textsuperscript{12} Individuals were required to wear face masks and limit their outdoor activity.\textsuperscript{13} The implementation of traffic control, closing of entertainment venues, and strict limitations on population movements, such as cancellation of mass gatherings and transportation could effectively reduce transmission of the virus. The community-wide containment was an effective intervention and was applied to an entire community, city, and region designed to reduce personal interactions and movements. Restrictive measures relied on law enforcement. COVID-WCIS enforced individuals to have minimal interactions, to cut the route of transmission to effectively control the epidemic.
Other prefecture-level cities had different epidemic levels due to their respective conditions and policies. Shenzhen City in Guangdong Province is a city with many migrants. Prior to the Spring Festival, the epidemic had already been imported. However, the number of new patients gradually decreased after restricting the entry of foreigners into the city. A large proportion of identified patients were mainly imported (non-residents) while the number of locals with infections was small (Figure 5). With regards to Ningbo in Zhejiang Province, at the beginning of the epidemic, there was an explosive growth in the number of patients. After reaching peak numbers, the number of patients diagnosed fluctuated around the peak, with a continuation of imported cases (Figure 6). However, during the early stages of the epidemic, Harbin City in Heilongjiang Province did not classify and track local and imported cases, which led to the emergence of multiple clusters. The epidemic was controlled only after control measures were implemented (Figure 7). By comparison, COVID-19 WCIS targeted the characteristics of the outbreak locally and hence was promptly controlled.

The provincial government attached great importance to controlling the epidemic in Wenzhou and allocated resources based on the worst outbreaks in Zhejiang province. Although the epidemic situation has improved, challenges remain for controlling the spread of the virus. There are two important factors for controlling the epidemic outbreak in Wenzhou. First, if businesses resume work on February 17, 2020, the number of cases may rebound. Hence restricting visitors from Hubei is still a priority.
As of February 23, there were 5,165 businesses and 224,500 individuals who resumed work in Wenzhou (rework rate of 91.3%). It is worth mentioning that even with the traffic routes gradually returning to normal, no new confirmed cases in Wenzhou for 13 consecutive days until March 1, 2020, have been reported. Second, there is a risk of local small-scale family outbreaks in certain areas such as Yongjia, Taishun, Ruian (about 3-5 cases). Hence, it is necessary to maintain temperature screenings. The Wenzhou government has implemented the “Wenzhou Health Code” across the city from 24:00 on February 16. This is a Quick Response Code that is updated in real-time. “Yellow Code” requires individuals to be isolated at home, while the “Red Code” requires individuals to be centralized and isolated to facilitate medical management. Only individuals with normal body temperatures designated with a “Green Code” are allowed to work and go out. The “Wenzhou Health Code” also keeps track of residents for monitoring.

There are several features for Wenzhou’s success in managing COVID-19. First, the key to preventing and controlling the disease lies in the rapid response of the Wenzhou government and the quick implementation of the policies mentioned earlier. Within a short period, patients were admitted to designated health care institutions. Individuals that came in contact with an infected individual were tracked and isolated. Wenzhou's isolation strategy used the community grid as the basic unit, ensuring that every suspected patient and close contact was medically isolated without being missed. Second, this virus was imported and did not occur locally. Unlike Wuhan, a
large number of individuals were not infected within a short period, and hence significant strains on medical resources and living necessities were not encountered. Fortunately, COVID-19 has a low mortality rate. As of February 11, 2020, the preliminary case fatality for COVID-19 was 2.3%. If it was an epidemic disease like SARS-CoV (Severe acute respiratory distress syndrome coronavirus) or MERS-CoV (Middle East respiratory syndrome coronavirus) with high mortality, it would have created further panic and additional strains on resources. COVID-19 is mainly transmitted through the respiratory tract. The policies of the Wenzhou government were successful in reducing or preventing the transmission of the virus by restricting the movement of people, centralizing treatment at designated health care institutions, reducing close contact between individuals, and disseminating prevention and control measures through multiple channels. These included advice regarding wearing masks and hand hygiene. Some of these measures were applicable to all infectious diseases, while others were only applicable to diseases that were mainly transmitted through the respiratory tract, such as type A H1N1 and H7N9. Infections such as hepatitis A and polio are mainly transmitted through the gastrointestinal tract, while vector-borne diseases such as dengue fever are transmitted via mosquito bites.

Because of the large-scale epidemic prevention strategies performed nationwide, the current epidemic situation has finally been effectively controlled. The number of newly diagnosed cases continues to decline. However, the infection has spread to many countries. On February 18, there were only 31 cases in Korea. However, by
February 19, 2020, new cases were confirmed and on February 20, there were an additional 55 new confirmed cases, totaling 106 confirmed cases. As of March 1, 2020, a total of 3736, 961 and 1694 patients were diagnosed in Korea, Japan, and Italy, respectively. The rate of new cases since then has been disturbing. For these countries, COVID-WCIS measures should be implemented including isolation, quarantine, social distancing and community containment (Figure 8).

In summary, the COVID-WCIS has rapidly transformed imported cases into local contacts (February 3, 2020) during the COVID-19 outbreak. Since February 18, 2020, there have been no new diagnosed cases. COVID-WCIS has been successful in preventing the importation of infectious respiratory diseases into the city. Countries with large early outbreaks and pressure from imported cases should consider adopting COVID-WCIS to prevent and reduce the transmission of the virus.
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15. Novel coronavirus pneumonia emergency response mechanism Epidemiology


Figure Legends

**Figure 1.** Trend of new confirmed COVID-19 cases in Wenzhou between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Wenzhou). Blue: new cases; Yellow: cumulative cases.

**Figure 2.** Confirmed cases of COVID-19 in Wenzhou City, Zhejiang Province during January 21 and March 01, 2020 (Data source: Official website of Health Commission of the Wenzhou). Blue: residents; Yellow: non-residents.

**Figure 3.** Confirmed cases of COVID-19 in Yueqing, Wenzhou City, Zhejiang Province between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Wenzhou). Blue: residents; Yellow: non-residents.

**Figure 4.** Trend of new confirmed COVID-19 cases in Yueqing, Wenzhou City, Zhejiang Province between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Wenzhou).

**Figure 5.** Confirmed cases of COVID-19 in Shenzhen City, Guangdong Province between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Shenzhen). Blue: residents; Yellow: non-residents.

**Figure 6.** Confirmed cases of COVID-19 in Ningbo City, Zhejiang Province between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Ningbo). Blue: residents; Yellow: non-residents.

**Figure 7.** Confirmed cases of COVID-19 in Harbin City, Heilongjiang Province
between January 24 and March 01, 2020 (Data source: Official website of Health Commission of the Heilongjiang). Grey: unknown; Blue: residents; Yellow: non-residents.

**Figure 8.** Details regarding Prevention and Control Strategies: Isolation, Quarantine, Social distancing, and Community containment.
Travel restrictions to Wenzhou from Hubei and isolation of individuals returning from Hubei

Closure of high-speed exits and public transportation, suspend school and halt construction projects

Control of movement and the use of a face mask

Delegation of viral testing to cities and counties

Closure of entertainment venues

Setting up of designated hospitals

Limit the mobility of residents per household (February 1-15)

Restriction of traffic to and from the city (February 2, 5, 6)

Formulate the regulations of resuming work

No. of cases

2020-01-10 2020-01-15 2020-01-20 2020-01-25 2020-02-01 2020-02-06 2020-02-11 2020-02-16 2020-02-21 2020-02-26 2020-03-01
Prevention and Control Strategy of COVID-19

Isolation
- Setting up of designated hospitals
- Delegation of viral testing to cities and counties

Quarantine
- Travel restrictions to Wenzhou from Hubei and isolation of individuals returning from Hubei
- Close contacts under medical observation for 14 days
- Closure of entertainment venues

Social distancing
- Control of movement and the use of a face mask
- Closure of high-speed exits and public transportation, suspend school and halt construction projects
- Resumption of work and epidemic prevention and control

Community containment
- Limit the mobility of residents per household
- Restriction of traffic to and from the city