



Epidemic update of COVID-19 in Hubei Province compared with other regions in China

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ABSTRACT

Aims & Background: The COVID-19 outbreak spread in China and is a threat to the world. The aims of this study to help health workers better understand the epidemic of the COVID-19 and provide different control strategies toward Hubei Province and other regions in China.

Methods: A comprehensive search of the Chinese Center for Disease Control and Prevention official websites and announcements was performed between 20 Jan 2020 and 29 Feb 2020. The relevant data of the distribution of the infection on each reported day were obtained.

Results & findings: Up to 29 Feb 2020, 79,824 confirmed cases with the COVID-19 including 66,907 in Hubei Province and 12,377 in other administrative regions were reported. The SARS-COV-2 showed faster epidemic trends compared with the 2003-SARS-CoV. A total of 2,870 deaths have been reported nationwide among 79,824 confirmed cases, with a mortality of 3.6%. The mortality of the COVID-19 was significantly higher in Hubei Province than that in other regions (4.1% versus 0.84%). Since 1 Feb 2020 the number of discharged cases exceeded the number of the dead. By 29 Feb 2020, the number of discharged patients was 41,625, which exceeded the number of hospitalized patients, and the trend has further increased.

Conclusions: The infection of the SARS-COV-2 is spreading and increasing nationwide, and Hubei Province is the main epidemic area, with higher mortality. The outbreak is now under initial control especially in other regions outside of Hubei Province. Due to the different epidemic characteristics between Hubei Province and other regions, we should focus on different prevention and control strategies.

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1. Introduction

Since the first atypical pneumonia case, caused by a novel coronavirus was reported in Wuhan, China on December 31, 2019 (WHO, 2020a), the novel coronavirus infection outbreak quickly spread in Wuhan, the capital of Hubei Province and other districts of Hubei Province with a further spread across the Chinese mainland. By 29 Feb 2020 a total of 79,824 cases of infection had been confirmed nationwide including all administrative regions, with another 851 suspected cases. COVID-19 cases were also reported in Thailand, Japan, the Republic of Korea, Hong Kong, Taiwan, the US, and some countries in Europe (CCDCPC, 2019). The outbreak is still on-going.

A coronavirus was soon identified as the cause of the outbreak and tentatively named as the 2019-nCoV by the World Health Organization (WHO) (WHO, 2020b). On 11 Feb 2020, the World Health Organization officially named it SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) and the SARS-CoV-2 infection was named COVID-19 (Coronavirus disease 2019) (WHO, 2020c). Coronaviruses are enveloped non-segmented positive-sense RNA viruses belonging to the family Coronaviridae. Most human coronavirus infections are mild, except for two betacoronaviruses, the severe acute respiratory syndrome coronavirus (SARS-CoV) (Ksiazek et al., 2003; Kuiken et al., 2003; Drosten et al., 2003) and the Middle East respiratory syndrome coronavirus (MERS-CoV) (de Groot et al., 2013; Zaki et al., 2012), which have caused more than 10,000 cumulative cases in the past, with mortality rates of 10% for the SARS-CoV and 37% for the MERS-CoV (WHO, 2003; WHO, 2020d). The SARS-CoV-2 infectious pneumonia has similar clinical features including fever, cough, and shortness of breath (Chen et al., 2020; Huang et al., 2020) to SARS-CoV infectious pneumonia. However, current trends suggest

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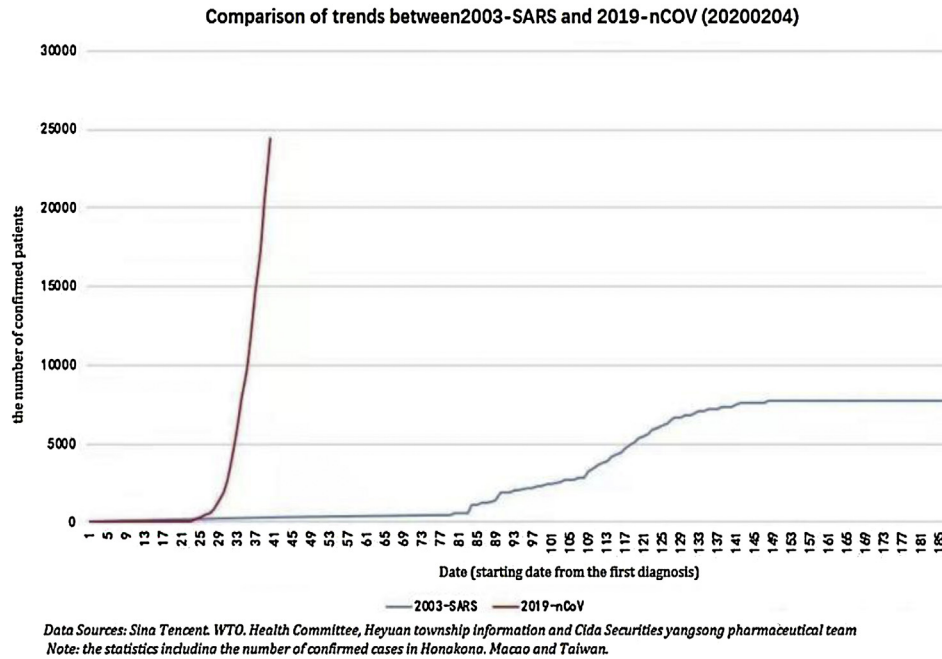


Fig. 1. Comparison of trends between the SARS-CoV-2 and the 2003-SARS-CoV. The SARS-CoV-2 is more infectious and transmittable compared with the SARS-CoV.

that the SARS-CoV-2 is more transmissible and spreads faster than the SARS-CoV and the MERS-CoV.

In this study, we analyzed and compared the epidemic features of the COVID-19 in Hubei Province and other regions in China. We further explored the differences between regions to better understand the epidemic of the COVID-19 and provide different control strategies toward Hubei Province and other regions in China.

2. Methods

2.1. Data sources and searches

A comprehensive search of the Chinese Center for Disease Control and Prevention official websites and announcements (CCDCPC, 2020) was performed between 20 Jan 2020 and 29 Feb 2020. The relevant data of the distribution of infection on each reported day were obtained.

2.2. Data analysis

Retrieved data were recorded into Microsoft Excel® for Mac (version 16.30) and analyzed. Continuous variables were daily reported new cases, daily reported new suspected cases, total confirmed cases, total suspected cases, accumulated deaths, and discharged cases. The Statistical Package for Social Sciences version 16.0 (SPSS 16.0; SPSS Inc., Chicago, IL, USA) and the Prism statistical software package (Version 5.0; Graphpad Software Inc. La Jolla, CA, USA) were used. Measurement data were described as a percentage.

3. Results and Findings

3.1. The SARS-CoV-2 showed faster epidemic trends compared with the 2003-SARS-CoV in China

From 31 Dec 2019, when the first case was reported to 5 Feb 2020, confirmed cases of the COVID-19 increased to 28,060 and

24,702 suspected cases. Up to 29 Feb 2020, the confirmed cases reached 79,824 in China. The total cases of the SARS-CoV infection were 7,747 including 5,327 cases on the mainland, 1,755 cases in Hong Kong, and 665 cases in Taiwan within 185 days in 2003 (McCloskey and Heymann, 2020). (Fig. 1) The differences suggested that the SARS-CoV-2 is more infectious and transmittable compared with the SARS-CoV.

3.2. Hubei Province is a major epidemic region for the COVID-19

Since the Chinese national health commission announcements of confirmed and suspected cases on 20 Jan 2020, the number of confirmed cases has continued to increase, especially in Hubei Province. By 29 Feb 2020, the total number of confirmed cases in China had reached 79,824, including 66,907 in Hubei Province,

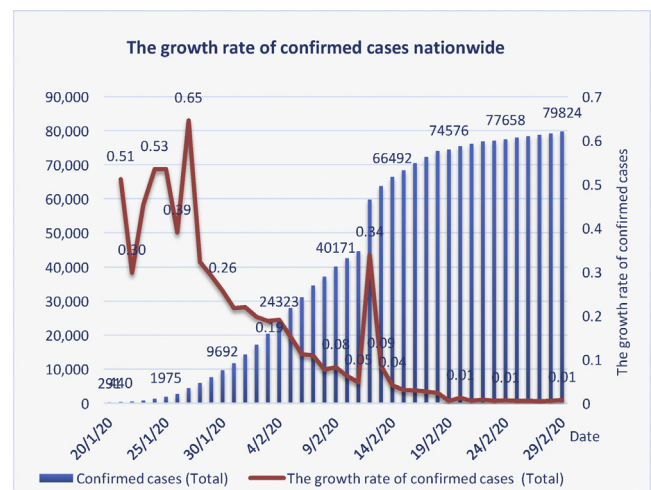


Fig. 2. Total number of confirmed cases nationwide. Up to 29 Feb 2020, the confirmed cases reached 79,824 in China, and the growth rate of confirmed cases is 0.01% nationwide.

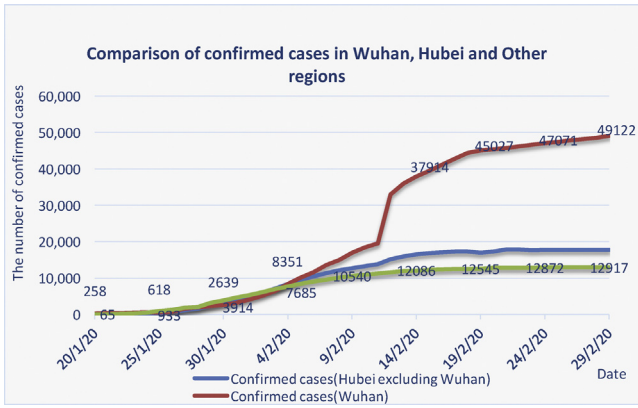


Fig. 3. Comparison of confirmed cases in Wuhan, Hubei Province, and other regions. Hubei Province is a major epidemic region for the COVID-19 in China.

with Wuhan having 41,625 confirmed cases (Figs. 2 and 3). However, the growth rate began to decrease on 27 Jan 2020 and has continued to decline over the past days after rebounding on 14 Feb 2020, and fell earlier in other regions than in Hubei Province. At present, the growth rate of confirmed cases is 0.01% nationwide while the growth rate is significantly higher in Hubei Province than in other regions (0.09% versus 0.00%) (Figs. 2 and 4).

The number of suspected patients is also declining. By 29 Feb 2020, the total number of suspected cases was 851 in China including 646 in Hubei Province (Fig. 5). The number of suspected patients and the growth rate of increased suspected patients were significantly higher in Hubei Province than that in other regions (Figs. 5 and 6). The number of suspected patients began to decline in Hubei Province from 9 Feb 2020 and in other regions from 14 Feb 2020 after slowly increasing (Fig. 5).

3.3. Higher mortality of the COVID-19 in Hubei Province than in other regions

Of the 79,824, confirmed cases, 2,870 deaths were reported nationwide by 29 Feb 2020, with a mortality of 3.6%, while the mortality was 4.1% (2,761/66,907) and 0.84% (109/12,917) in Hubei Province and other regions nationwide, respectively (Fig. 7). The mortality of the COVID-19 was significantly increased in Hubei Province compared with other regions nationwide.

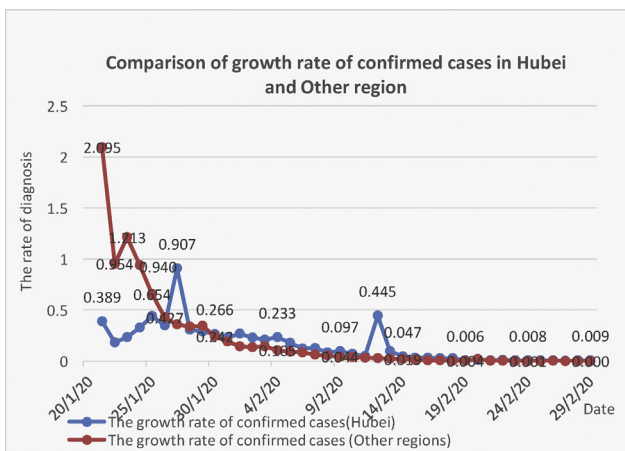


Fig. 4. Comparison of the growth rate of confirmed cases in Hubei Province and other regions. The growth rate of confirmed cases is significantly higher in Hubei Province than in other regions.

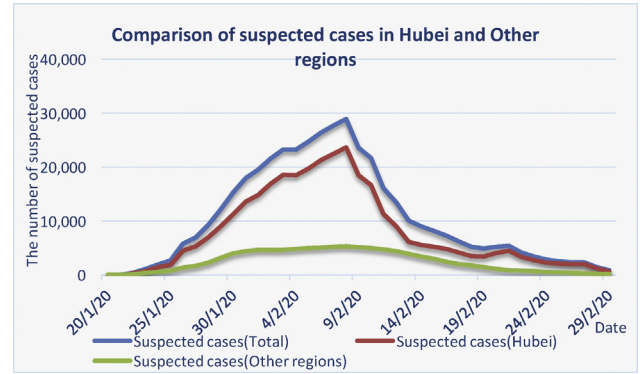


Fig. 5. Comparison of suspected cases in Hubei Province and other regions. The number of suspected patients is significantly higher in Hubei Province than in other regions.

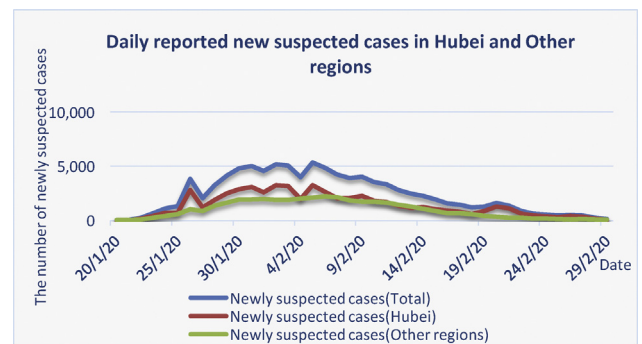


Fig. 6. Comparison of new increased suspected cases in Hubei Province and other regions. The number of daily reported new suspected cases is significantly higher in Hubei Province than in other regions.

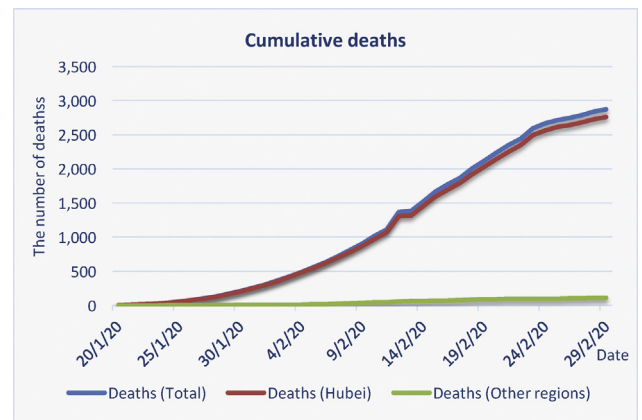


Fig. 7. Cumulative deaths nationwide. The number of death is significantly higher in Hubei Province than in other regions.

3.4. The number of discharged cases exceeds the number of the dead

More patients admitted to hospitals for treatment were discharged than died since 1 Feb 2020, and the trend has significantly increased (Fig. 8). By 29 Feb 2020, the number of discharged patients was 41,625, which has exceeded the number of hospitalized patients. This change suggested initial control of the outbreak and further enhanced confidence in fighting the disease.

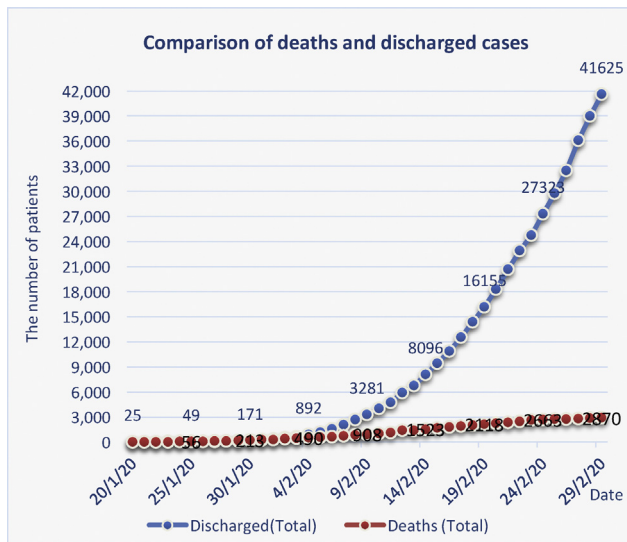


Fig. 8. Comparison of discharged cases and deaths. The number of discharged cases exceeds the number of the dead.

4. Discussion

Since the first official announcement on 31 Dec 2019 by the Wuhan Municipal Health Commission (WHO, 2020a). The infection quickly spread in China, and internationally. WHO defined it as a Public Health Emergency of International Concern (PHEIC) on 31 January 2020. The pathogen was soon isolated from a patient's alveolar lavage and identified as a novel coronavirus (Li et al., 2020). The human Severe Acute Respiratory Syndrome (SARS) virus, the Middle Eastern Respiratory Syndrome (MERS) virus, and the SARS-CoV-2 all belong to beta-CoVs. Bat coronavirus (BCoV) and the SARS-CoV-2 share 96.2% sequence identity, confirming that SARS-CoV-2 has a zoonotic origin (Cui et al., 2019; Ceraolo et al., 2020).

R_0 is an indication of the transmissibility of a virus, representing the average number of new infections generated by an infectious person in a totally naïve population. R_0 estimates for SARS were reported to range between 2–5. Different mathematical methods used to estimate R_0 for SARS-CoV-2 produced a range from 1.5 to 6.49 based on different epidemic stages (Shen et al., 2020; Read et al., 2020; Imai et al., 2019; Ima et al., 2020; Tang et al., 2020a,b). Due to insufficient data and short onset time, current estimates of R_0 for SARS-CoV-2 are possibly biased. Due to similarities of pathogen and region of exposure, SARS and SARS-CoV-2 are comparable. Despite the heightened public awareness and impressively strong interventional response, the SARS-CoV-2 is already more widespread than SARS, indicating it may be more transmissible.

Hubei Province is the most prominent area of COVID-19 in China with 66,907 cases among total of 79,824 cases nationwide by 29 Feb 2020. The most prominent area of Hubei Province is Wuhan with 49,122 cases, which suggested that mass outbreak of COVID-19 and community spread in Wuhan. A previous report indicated that among nonresidents of Wuhan, 72.3% had contact with residents of Wuhan, including 31.3% who had visited the city (Guan et al., 2020), which suggested that it was mostly associated to imported cases in other regions outside of Hubei Province. Since the number of confirmed cases in other regions is small and most of the confirmed patients have a clear history of sojourn in Hubei Province and contact with imported cases from Hubei Province, we speculate that there has been no large-scale community transmission in other regions outside of Hubei Province, which is due to

strict prevention and control measures implemented sooner in other regions. The maximum incubation period and median incubation period are 14 and 4 days, respectively (Guan et al., 2020). The timing of one maximum incubation period and double maximum incubation periods is considered an important time point for predicting the prevailing trend (Tang et al., 2020a,b). After a 28-day interval, in which Wuhan was closed from January 23 to February 20, the growth rate of confirmed cases in other regions outside of Hubei Province declined to 0.04% and has remained stable over the past few days. With a double maximum incubation period, the growth rate of confirmed cases declined to a low level, which suggested that the infection was mainly imported cases and did not cause further community transmission outside of Hubei Province and the spread of the epidemic under initial control with Wuhan quarantined. The number of confirmed cases significantly increased on 14 Feb 2020 because test reagents for RT-PCR assay began to be widely used in Hubei Province along with lung CT as the diagnostic criteria. This did not represent a large number of patients in a mass outbreak on 14 Feb 2020, and the decrease in the rate of confirmed patients before the 14 Feb 2020 was an illusion due to a lack of enough test reagents. Also, suspected cases began to significantly decrease from 14 Feb 2020 because suspected cases were confirmed or ruled out by test reagents widely used and the new diagnostic criteria of lung CT.

According to a recent report by the Chinese Center for Disease Control and Prevention, the overall mortality was 2.3% and non-comorbidity mortality was 0.9% in patients with COVID-19 (Tang et al., 2020a,b), which is lower than SARS and MERS. The mortality of the COVID-19 was significantly higher in Hubei Province than other regions nationwide (4.1% versus 0.84%). This may be because of the following factors: 1) the virulence and pathogenicity of the virus decreased in the 2nd and 3rd generation of transmission (The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, China CDC, 2020), 2) a significant number of mild and asymptomatic patients did not seek medical attention, 3) early patients cannot be confirmed due to lacking the nucleic acid test, and 4) some severe patients with co-morbidity lost the opportunity for timely treatment due to insufficient medical resources in the early days of the epidemic. So, the high mortality in Hubei Province may be overestimated and mortality of other regions should better reflect the pathogenicity of the COVID-19. The good news is that since 1 Feb 2020 the number of recovered cases has exceeded the number of deaths, and the number of discharged patients has exceeded the number of hospitalized patients and this trend has further increased over the past days, which suggests initial control of the outbreak and has enhanced confidence in fighting the disease.

Initially, the lack of disease awareness and inappropriate prevention and control led to a rapid epidemic of infections in Hubei Province, and the emergence of 2nd and 3rd-generation infections and community spread. At present, there are still a large number of confirmed and daily reported new cases in Hubei Province. With test reagents widely used and the large number of mobile cabin hospitals with effective isolation of patients, the number of confirmed patients, the growth rate of confirmed patients, and the growth rate of suspected patients have all declined. So, timely and effective detection of patients and isolation is the most important strategy for Hubei Province. In other regions, it was mostly imported cases and there was no community spread. With strict control measures and the extension of time, the number of confirmed cases and the growth rate of confirmed cases have remained at a low level in other regions, and even the number of confirmed cases showed a zero increase in many regions. So, strictly controlling imported cases is the most important strategy for other regions outside of Hubei Province.

In summary, this epidemic of the COVID-19 will remain for some time due to large numbers of confirmed cases, suspected cases, and quarantined observers. However, the growth rate of confirmed and suspected cases continues to decline and the number of discharged patients continues to grow both in Hubei Province and other regions nationwide, which indicate that the outbreak is under initial control especially in regions outside of Hubei Province in China. We optimistically estimate that the outbreak was largely controlled in regions outside of Hubei Province within the double maximum incubation periods (28 days) with the strengthening of control of imported cases, while the epidemic will continue in Hubei Province especially in Wuhan for a large number of patients. Timely detection and isolation of patients is the most important measure to reduce the prevalence in Hubei Province.

Contributors

DWJ and HSL had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. LQ had the idea of and designed the study. ZZP contributed to reviewed and approved the final version.

Conflicts of interest

The authors have no conflicts of interest to disclose.

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Ethical Approval

Approval was not required.

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