

## RESEARCH ARTICLE

# Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China

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## Abstract

To help health workers and the public recognize and deal with the 2019 novel coronavirus (2019-nCoV) quickly, effectively, and calmly with an updated understanding. A comprehensive search from Chinese and worldwide official websites and announcements was performed between 1 December 2019 and 9:30 AM 26 January 2020 (Beijing time). A latest summary of 2019-nCoV and the current outbreak was drawn. Up to 24 PM, 25 January 2020, a total of 1975 cases of 2019-nCoV infection were confirmed in mainland China with a total of 56 deaths having occurred. The latest mortality was approximately 2.84% with a total of 2684 cases still suspected. The China National Health Commission reported the details of the first 17 deaths up to 24 PM, 22 January 2020. The deaths included 13 males and 4 females. The median age of the people who died was 75 (range 48-89) years. Fever (64.7%) and cough (52.9%) were the most common first symptoms among those who died. The median number of days from the occurrence of the first symptom to death was 14.0 (range 6-41) days, and it tended to be shorter among people aged 70 years or more (11.5 [range 6-19] days) than those aged less than 70 years (20 [range 10-41] days;  $P = .033$ ). The 2019-nCoV infection is spreading and its incidence is increasing nationwide. The first deaths occurred mostly in elderly people, among whom the disease might progress faster. The public should still be cautious in dealing with the virus and pay more attention to protecting the elderly people from the virus.

## KEYWORDS

coronavirus, epidemiology, infection

## 1 | INTRODUCTION

While Chinese people are heading home and celebrating the Spring Festival, they are also facing an unprecedented panic caused by the outbreak of a pneumonia of a previously unknown etiology in Wuhan, China, since last December.<sup>1</sup> A novel coronavirus was identified as the causative virus for the outbreak and tentatively named 2019-nCoV by the World Health Organization (WHO).<sup>2,3</sup> The currently emerging viral infections have become a grave concern for a possible influenza pandemic.<sup>4</sup> During the Spring Festival travel rush, Wuhan, located in China's transplanted hub, has seen hundreds of thousands of people leave the city and potentially carry the virus with

them. The virus is currently spreading fast in mainland China. By 25 January 2020, a total of 1975 cases have been confirmed nationwide with another 2684 cases suspected.<sup>5</sup>

The 2019-nCoV is considered a relative of the deadly severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) coronaviruses, both of which are characterized by flu-like symptoms, including fever, cough, and anhelation and can possibly transmit from animals to humans.<sup>6,7</sup> The SARS was traced to animals, including what was initially thought to be palm civets<sup>8</sup> but was later identified as bats.<sup>9</sup> The 2019-nCoV was associated with contact with a local seafood market that illegally sold animals, including poultry, bats, marmots, and snakes in Wuhan. Two very recent studies have

**TABLE 1** Presentation of the increased cases of 2019-nCoV infection up to 25 January 2020 at 24 PM (Beijing time)

Date <sup>a</sup>	Diagnosed cases in China mainland	Severe cases	Deaths	Mortality	Suspected cases	Involved provinces/regions in China mainland	Other involved Chinese regions	Other countries
31 December 2019 <sup>1,b</sup>	27	7	0	0	NA	Wuhan (27)/Hubei (27)		NA
10 January 2020 <sup>15</sup>	41	7	1	2.44%	NA	Wuhan (41)/Hubei (41)		NA
20 January 2020 <sup>16,c</sup>	217	NA	NA	NA	7	Wuhan (198)/Hubei (198), Guangdong (14), Beijing (5)		Thailand (2), Japan (1), South Korea (1)
21 January 2020 <sup>17</sup>	440	102	9	2.05%	NA	Hubei (375), Guangdong (26), Beijing (10), Shanghai (9), Zhejiang (5), Chongqing (5), Sichuan (2), Jiangxi (2), Tianjin (2), Shandong (1) Henan (1), Hunan (1), Yunnan (1)		Thailand (3), Japan (1), South Korea (1)
22 January 2020 <sup>18,19</sup>	571	95	17	2.98%	393	Hubei (444), Guangdong (26), Shanghai (16), Beijing (14), Zhejiang (10), Chongqing (6), Sichuan (5), Henan (5), Guangxi (5), Hainan (4), Tianjin (4), Hunan (4), Jiangxi (2), Liaoning (2), Shandong (2), Yunnan (1), Anhui (1), Fujian (1), Guizhou (1), Shanxi (1), Ningxia (1), Heilongjiang (1), Hebei (1), Jiangsu (1)	Hong Kong (1), Macau (1), Taiwan (1)	Thailand (3), United States (1), Japan (1), South Korea (1)
The rest cases unlocated								
23 January 2020 <sup>20,21</sup>	830	177	25	3.01%	1072	Hubei (444), Guangdong (53), Zhejiang (27), Beijing (26), Shanghai (20), Anhui (15), Guangxi (13), Hunan (9), Chongqing (9), Sichuan (8), Jiangxi (7), Shandong (6), Henan (5), Hainan (5), Tianjin (5), Fujian (5), Jiangsu (5), Heilongjiang (4), Liaoning (3), Guizhou (3), Shaanxi (3), Gansu (2), Xinjiang (2), Hebei (2), Yunnan (2), Shanxi (1), Ningxia (1), Jilin (1)	Hong Kong (2), Macau (2), Taiwan (1)	Thailand (3), United States (1), Japan (1), South Korea (1), Vietnam (1), Singapore (1)
The rest cases unlocated								
24 January 2020 <sup>22,23</sup>	1287	236	41	3.19%	1965	Hubei (729), Guangdong (78), Zhejiang (62), Chongqing (57), Hunan (43), Anhui (39), Beijing (36), Shanghai (33), Henan (32), Guangxi (23), Shandong (21), Jiangxi (18), Jiangsu (18), Sichuan (15), Liaoning (12), Fujian (10), Heilongjiang (9), Hainan (8), Tianjin (8), Hebei (8), Shanxi (6), Yunnan (5), Shaanxi (5), Guizhou (4), Gansu (4), Jilin (3), Xinjiang (2), Ningxia (2), Inner Mongolia (1)	Hong Kong (5), Taiwan (3), Macau (2)	Thailand (4), Singapore (3), France (2), United States (2), Japan (2), South Korea (2), Vietnam (2), Nepal (1)
The rest cases unlocated								

TABLE 1 (Continued)

Date <sup>a</sup>	Diagnosed cases in China mainland	Severe cases	Deaths	Mortality	Suspected cases	Involved provinces/regions in China mainland	Other involved Chinese regions	Other countries
25 January 2020 <sup>5,24</sup>	1975	324	56	2.84%	2684	Hubei (1052), Guangdong (78), Henan (83), Hunan (69), Zhejiang (62), Anhui (60), Chongqing (57), Beijing (51), Shanghai (40), Shandong (39), Jiangxi (36), Guangxi (33), Sichuan (28), Hainan (19), Jiangsu (18), Fujian (18), Liaoning (17), Shaanxi (15), Yunnan (11), Tianjin (10), Shanxi (9), Heilongjiang (9), Hebei (8), Guizhou (5), Gansu(4), Jilin (4), Xinjiang (3), Ningxia (3), Inner Mongolia (2), Qinghai (1) The rest cases unlocated	Hong Kong (5), Taiwan (3), Macau (2)	Thailand (4), Singapore (3), Malaysia (3), France (3), United States (2), Japan (2), South Korea (2), Vietnam (2), Nepal (1), Australia (1)

Note: References 19, 21, 23, and 24 were used to demonstrate the distribution of infection nationwide on the respective date. References 1, 5, 15, 16, 17, 18, 20, and 22 were responsible for the rest information presented on the respective date.

<sup>a</sup>Data from the date were calculated as of 24 PM on that day (Beijing time) unless otherwise indicated.

<sup>b</sup>Data were firstly official announced on this day without a specific calculated deadline timepoint.

<sup>c</sup>Data from the date were calculated as of 18 PM on this day.

suggested bats<sup>10</sup> or snakes<sup>11</sup> to be the potential natural reservoir of 2019-nCoV. However, based on the latest statement by WHO on 23 January 2020, the source of 2019-nCoV is still unknown.<sup>12</sup> The 2019-nCoV appears to cause symptoms similar to SARS based on clinical data from the initial 41 cases<sup>13</sup> and seems to be capable of spreading from humans to humans and between cities,<sup>14</sup> according to two latest studies<sup>13,14</sup> published in Lancet on 24 January 2020.

Although WHO suggested that the current event did not constitute a Public Health Emergency of International Concern (PHEIC), they also indicated that the situation was urgent and needed further examination.<sup>12</sup> At present, in context of a lack of definite and effective treatment, the most direct and effective way is to take protective measures, including improving personal hygiene, wearing a medical mask, having enough rest, maintaining ventilation, and avoiding crowd, to prevent the disease. Updating the understanding of the disease caused by the 2019-nCoV infection is currently urgently needed. Thus, we conducted the current study with the aim to help health workers and the public recognize and quickly, effectively, and calmly deal with the disease.

## 2 | METHODS

### 2.1 | Data sources and searches

A comprehensive search of Chinese and worldwide official websites and announcements<sup>1,5,15-24</sup> was performed between 1 December 2019 and 9:30 AM, 26 January 2020 (Beijing time). The relevant data of distribution of infection on each reported day including 31 December 2019,<sup>1</sup> 10 January 2020,<sup>15</sup> 20 January 2020,<sup>16</sup> 21 January 2020,<sup>17</sup> 22 January 2020,<sup>18,19</sup> 23 January 2020,<sup>20,21</sup> 24 January 2020,<sup>22,23</sup> and 25 January 2020<sup>5,24</sup> were obtained.

### 2.2 | Statistical analysis

Retrieved data were recorded into Microsoft<sup>®</sup> Excel for Mac (version 16.30) and analyzed. Continuous variables, including age, days to death, and so on, were expressed as median and range deviation. The Mann-Whitney U test was utilized to compare significant differences among continuous data. The SPSS version 22.0 (SPSS Inc, Chicago, IL) was used for statistic analysis. *P* values less than .05 were considered statistically significant. The EDRAW Max version 9.3 (EDRAW Max Inc, Shenzhen, China) was used for cartography. Data from 20 January 2020,<sup>16</sup> 22 January 2020,<sup>18,19</sup> and 25 January 2020<sup>5,24</sup> were utilized drawing the Chinese map<sup>16,19,24</sup> and world map<sup>5,16,18</sup>, respectively.

## 3 | RESULTS

The distribution of 2019-nCov infection in China and worldwide is shown in Table 1 and Figure 1. As listed in Table 1, according to the first official announcement by the Wuhan Municipal Health

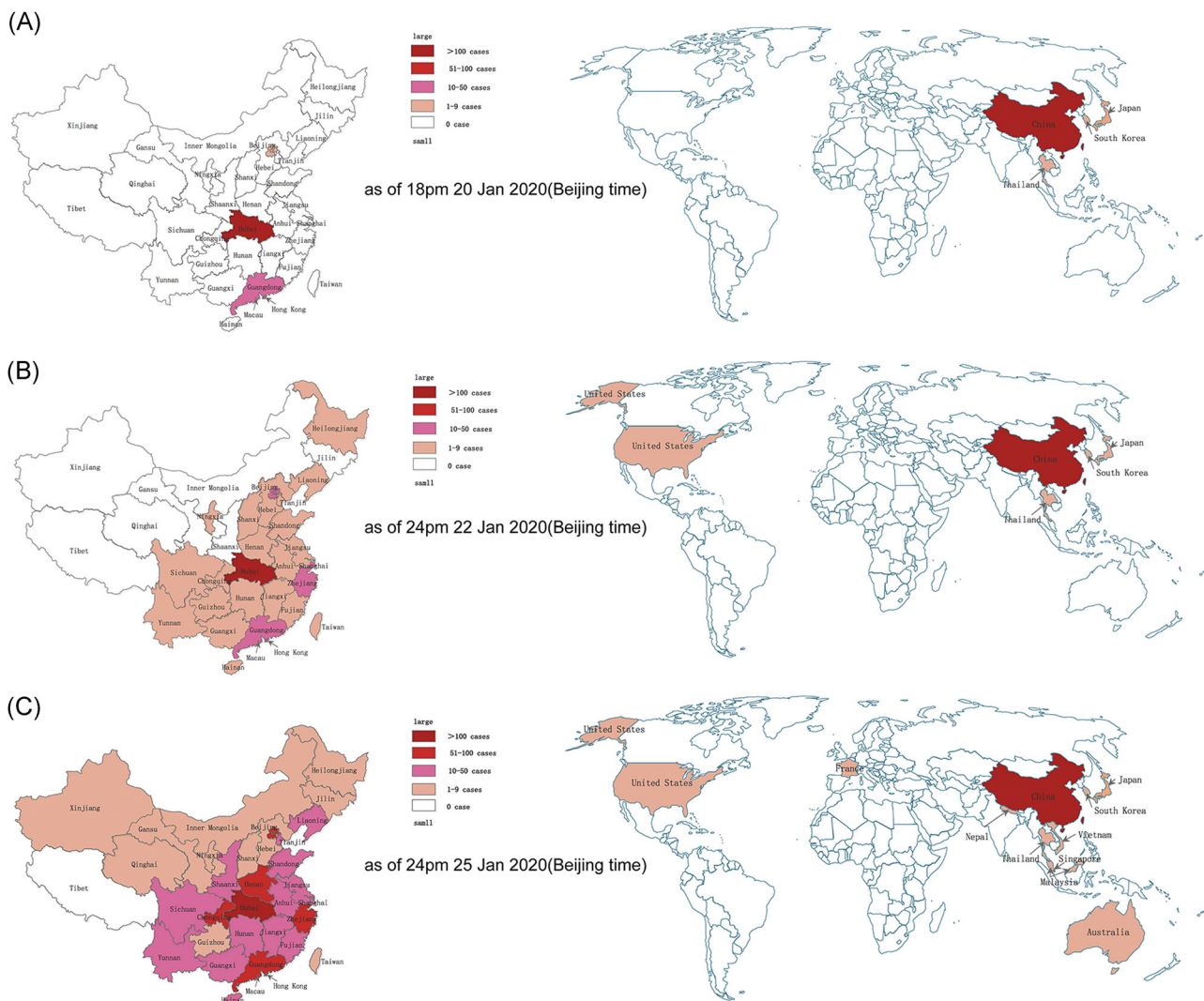
Commission,<sup>1</sup> a total 27 patients were diagnosed with viral pneumonia (later confirmed as 2019-nCoV related pneumonia) up to 31 December 2019. All cases occurred in Wuhan, Hubei, China, including seven severe cases, but no deaths were reported.

As of 10 January 2020,<sup>15</sup> the number of confirmed 2019-nCoV infection cases in Wuhan increased to 41 with 1 death reported. Ten days later, on 20 January 2020,<sup>16</sup> the number of infected cases increased to 217, of which 198 were in Wuhan, 14 in Guangdong, and 5 in Beijing. In addition, four cases were confirmed outside China (Thailand/Japan/South Korea, 2/1/1).<sup>16</sup> The number of confirmed cases increased rapidly from 20 January 2020 to 440 with 9 deaths up to 21 January 2020<sup>17</sup>; 571 with 17 deaths up to 22 January 2020,<sup>18</sup> 830 with 25 deaths up to 23 January 2020;<sup>20</sup> and 1287 with 41 deaths up to 24 January 2020.<sup>22</sup>

From the latest report as of 25 January 2020,<sup>5,24</sup> a total of 1975 patients from 30 provinces (autonomous regions and municipalities) were confirmed of 2019-nCoV infection in mainland China with a total

56 deaths. The latest mortality was approximately 2.84% with a total of 2684 additional suspected cases.<sup>5</sup> Three other involved Chinese regions reported 10 cases of confirmed infection (Hong Kong/Taiwan/Macau, 5/3/2).<sup>5</sup> Besides, 23 cases were confirmed outside China (Thailand/Singapore/Malaysia/France/United States/Japan/South Korea/Vietnam/Nepal/Australia, 4/3/3/3/2/2/2/1/1) as of 25 January 2020.<sup>5</sup>

Previously, the China National Health Commission reported the details of the first 17 deaths up to 22 January 2020.<sup>18</sup> As shown in Table 2, the deaths included 13 males and 4 females. The median age at death was 75 (range 48-89) years. Before admission, 11 cases were complicated with other diseases and 5 had past surgery history. Fever (64.7%) and cough (52.9%) were the most common first symptoms in deaths. The median number of days from first symptom to death was 14.0 (range 6-41), and it tended to be shorter among people aged 70 years or more (11.5 [range 6-19] days) than those aged less than 70 years (20 [range 10-41] days;  $P = .033$ ).



**FIGURE 1** Distribution of confirmed 2019-nCoV infection in China and worldwide as of 20 January 2020 at 18 PM (Beijing time) (A); 22 January 2020 at 24 PM (Beijing time) (B); and 25 January 2020 at 24 PM (Beijing time) (C). The provinces/regions are shaded in different colors indicating different degrees of infection

**TABLE 2** Presentation of the first seventeen deaths of 2019-nCoV cases up to 22 January 2020 at 24 PM (Beijing time)

Case	Gender	Age, y	First symptom	Comorbidity	Surgery history	First symptom to death <sup>a</sup> , d
1	Male	61	Fever, cough, and fatigue for 7 d	Liver cirrhosis, kollonema	NA	20
2	Male	69	Fever, cough, and anhelation for 4 d	Aortosclerosis	NA	16
3	Male	89	Somnolence and obtubilation	Hypertension, cerebral infarction, encephalomalacia	NA	10
4	Male	89	Anhelation for 4 h	Hypertension, diabetes mellitus, coronary heart disease, frequent ventricular premature beat	Coronary stent implantation	6
5	Male	66	Fever, cough, headache, and fatigue for 6 d	Chronic obstructive pulmonary disease, hypertension, type 2 diabetes mellitus, chronic renal insufficiency.	Ascending aorta artificial aortic replacement, abdominal aortic stent implantation, cholecystectomy	10
6	Male	75	Fever, cough, expectoration for 5 d	Hypertension	Hip replacement	14
7	Female	48	Fever, muscular soreness, fatigue, cough, and expectoration	Diabetes mellitus, cerebral infarction	NA	41
8	Male	82	Chilly, muscular soreness for 5 d	NA	NA	12
9	Male	66	Dry cough for 9 d	NA	NA	30
10	Male	81	Fever for 3 d	NA	NA	7
11	Female	82	Fever, cough, chest tightness, and fatigue for 3 d	Parkinson's disease	NA	19
12	Male	65	Anhelation and fatigue for 3 d	NA	NA	13
13	Female	80	Fever and cough for 9 d	Hypertension, diabetes mellitus, Parkinson's disease	NA	11
14	Male	53	Fever	NA	NA	20
15	Male	86	Fatigue for 7 d	Hypertension, diabetes mellitus, colon cancer	Colon cancer surgery	19
16	Female	70	Continuous high fever	NA	NA	8
17	Male	84	Fever, cough, and anhelation for 3 d	Chronic bronchitis, unstable angina pectoris, hypertension, gastrointestinal bleeding, renal insufficiency, hyperlipidemia, hyperuricemia, lacunar cerebral infarction	Coronary stent implantation	16
Summary	Male: 13 Female: 4	<sup>b</sup> 75 (range, 48-89)	Top 2 symptoms Fever: 11(64.7%) Cough: 9(52.9%)	Eleven patients had comorbidities	Five patients had surgery history	<sup>b</sup> 14 (range, 6-41)

Abbreviation: NA, not available.

<sup>a</sup>This was estimated and calculated from first symptom to death.

<sup>b</sup>Variables were expressed as median and range.



## 4 | DISCUSSION

Our study has demonstrated the fast spreading of the novel virus in mainland China since the first official announcement on 31 December 2019 by the Wuhan Municipal Health Commission.<sup>1</sup> The infection has very quickly increased between 20 January 2020 and 25 January 2020 according to the National Health Commission.<sup>5,16–18,20,22</sup> Possibly, the detection and reporting of the infection has attracted more importance since it was reported nationwide. Another possible reason for the fast spreading would be the Spring Festival travel rush, in which thousands of millions of people were on the move heading home and the virus would definitely spread quickly, especially with those coming out from Wuhan.

Our study also demonstrated that the 2019-nCoV had caused a total 1975 infections and 56 deaths in 26 days since the first official announcement.<sup>1</sup> The current mortality of the 2019-nCoV is approximately 2.84%, which is lower than that of 9.6% of the SARS-CoV that spread globally to 30 countries/regions, infected 8098 people, and killed 774 patients from November 2002 to July 2003,<sup>25</sup> and lower than that of 34.4% of the MERS-CoV, which spread globally to 27 countries/regions, infected 2494 people and killed 858 patients from September 2012 to September 2019.<sup>26</sup> However, in the first 3 months from November 2002 to February 2003,<sup>27</sup> Guangdong, China, had only witnessed a diagnosis of the atypical pneumonia initially considered *chlamydia pneumoniae* (later confirmed to be caused by SARS) in 305 cases with 5 deaths. Taken together, these facts show that although the current mortality is lower than that of the SARS-CoV and the MERS-CoV, it seems that the 2019-nCoV is very contagious. The public should be cautious about the development of the disease.

Our study also showed that the first occurred deaths were mainly among elderly people. Although most of them had comorbidities or a history of surgery before admission, the potential association of underlying medical conditions and 2019-nCoV-associated death was not clear. By far, the median number of days of first symptom to death was 14, which was comparable to that of 14 days (median) of MERS.<sup>28</sup> For SARS, it was reported that the average duration of first symptoms to hospital admission was 3.8 days, and admission to death was 17.4 days for casualties.<sup>29</sup> Our study also found that people 70 years or older had shorter median days (11.5 days) from the first symptom to death than those with ages below 70 years (20 days), demonstrating that elderly people might have faster disease progression than younger people. Similar results were found in SARS in that the mean duration from admission to death was 5.7 days for people aged 80 to 93 years, 9.4 days for those aged 60 to 79 years, and above 12.0 days for those under 60 years of age.<sup>29</sup> It was also reported that older age (>60 years) was a risk factor that correlated with mortality in MERS.<sup>28</sup> From the above, although a definite comparison could not be drawn, the public should pay attention to elderly people who might be more vulnerable to the 2019-nCoV.

Currently there is a lack of definite and effective treatment. The health workers and public should be cautious in preventing and controlling the disease. The United States Center for Disease Control and Prevention released an updated and interim guidance<sup>30</sup> and provided a patient under investigation (PUI) form,<sup>31</sup> which was available for suspected cases. Patients falling under the following criteria should be

considered a PUI in association with the 2019-nCoV: first, those who had fever combined with symptoms of lower respiratory illness (eg, cough, breathing difficulties), and had Wuhan traveling history in the last 2 weeks before symptom onset or close contact with an ill person who was also under investigation for 2019-nCoV. Second, those who had fever or had symptoms of lower respiratory illness (eg, cough, breathing difficulties), and close contact with an ill lab-confirmed 2019-nCoV patient.

In addition, the WHO also provided an interim guidance for infection prevention and control when a novel coronavirus was suspected<sup>32</sup> and further improved the guidance by indicating that patients with mild symptoms and without chronic conditions or symptomatic patients no longer requiring hospitalization might be cared for in home environment.<sup>33</sup> Another aspect worth noting is that health workers should minimize the possibility of exposure when collecting and transporting lab specimens of suspected infected patients.<sup>32,34</sup> A goggle was necessary when health workers were questioning patients at fever clinics or performing operations for suspected patients since the virus might infect the eye conjunctiva through droplets. It would be interesting to test if robotics might be used in questioning or treating the infected or suspected patients, which will definitely decrease the possibility of exposure of health workers.

Although the etiology is still unclear, some scholars suggest that 2019-nCoV and SARS/SARS-like coronaviruses may share a common ancestor resembling the bat coronavirus HKU9-1.<sup>10</sup> The 2019-nCoV may interact with human ACE2 molecules via its S-protein for human-to-human transmission.<sup>10</sup> However, future studies are warranted to uncover the source of the virus and potential mechanisms for human-to-human transmission.

## 5 | CONCLUSION

The 2019-nCoV infection is spreading fast with an increasing number of infected patients nationwide. The future development of the disease is not clear but the public should be cautious in dealing with the virus since it may be very contagious. The first occurred deaths were majorly elderly people who might have faster disease progression. The public should pay more attention to protecting elderly people who have contracted the virus.

## CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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