ORIGINAL ARTICLE
COVID-19

Epidemiological features and medical care-seeking process of patients with COVID-19 in Wuhan, China

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ABSTRACT

Background: We aimed to investigate the epidemiological and clinical features, and medical care-seeking process of patients with the 2019 coronavirus disease (COVID-19) in Wuhan, China, to provide useful information to contain COVID-19 in other places with similar outbreaks of the virus.

Methods: We collected epidemiological and clinical information of patients with COVID-19 admitted to a makeshift Fangcang hospital between 7 and 26 February, 2020. The waiting time of each step during the medical care-seeking process was also analysed.

Results: Of the 205 patients with COVID-19 infection, 31% had presumed transmission from a family member. 10% of patients had hospital-related transmission. It took as long as a median of 6 days from the first medical visit to receive the COVID-19 nucleic acid test and 10 days from the first medical visit to hospital admission, indicating early recognition of COVID-19 was not achieved at the early stage of the outbreak, although these delays were shortened later. After clinical recovery from COVID-19, which took a mean of 21 days from illness onset, there was still a substantial proportion of patients who had persistent SARS-CoV-2 infection.

Conclusions: The diagnostic evaluation process of suspected patients needs to be accelerated at the epicentre of the outbreak and early isolation of infected patients in a healthcare setting rather than at home is urgently required to stop the spread of the virus. Clinical recovery is not an appropriate criterion to release isolated patients and as long as 4 weeks' isolation for patients with COVID-19 is not enough to prevent the spread of the virus.

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Early identification and isolation of infected patients in a healthcare setting rather than at home is urgently required to stop the spread of SARS-CoV-2. Clinical recovery is not an appropriate criterion to release isolated patients. https://bit.ly/3dXKBLV

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Introduction

The outbreak of the 2019 coronavirus disease (COVID-19) in the city of Wuhan in China has drawn global concerns since it was first reported in December 2019 [1, 2]. Although restrictive measures, including the unprecedented lockdown of the city on 23 January 2020, were introduced by the Chinese government to contain the spread of the virus, many more cases were detected in Wuhan and far beyond [3–9]. As of 9 March 2020, there were >80 000 confirmed cases and the death toll had risen to 3123 in China. It had also spread to ⩾100 countries outside of China and a public health emergency of international concern had been declared by the World Health Organization. While the virus was reported to originate in the Huanan seafood market, which was closed in January 2020 [1], human-to-human transmission had occurred and became the dominant way for the virus to spread [5–10]. The epidemiological features and transmission dynamics of the virus are being investigated worldwide in order to provide better strategies to contain the spread of the virus [3–11].

However, it remains largely unknown in what way the human-to-human transmission occurred in the epicentre of Wuhan, where the confirmed cases surged in late January and early February 2020. It is also unclear whether timely and appropriate medical care was provided to suspected patients to facilitate early detection and isolation of infected patients, given that the disease burden significantly increased in Wuhan during this period and there was much higher mortality than outside the city. Although confirmed cases are decreasing in Wuhan, a better understanding of these features is important to curb the spread of the virus and reduce the mortality elsewhere in the world, since a similar outbreak is happening in several other cities, including those in South Korea, Italy and Iran. In this study, we investigated the epidemiological and clinical features, and the medical care-seeking process of confirmed COVID-19 patients to assess the epidemic dynamics and disease burden in Wuhan, in order to provide useful information to contain COVID-19 in other places with outbreaks of the virus.

Methods

Patients

This investigation was conducted in one of the Fangcang hospitals, which were makeshift isolation facilities starting service on 7 February 2020 to provide limited medical care to patients who were newly confirmed to have COVID-19. These patients were transferred from designated hospitals for diagnosis of viral infection once they were confirmed with COVID-19 by real-time RT-PCR assay. We recruited patients admitted between 7 and 26 February 2020 in areas A and B, where male and female patients were admitted, respectively. Patients whose symptoms worsened during their stay at Fangcang hospital and needed more advanced medical care were transferred to a well-equipped hospital. A repeated PCR test was given to the patients when they had no fever for ⩾3 days and significant relief of other symptoms occurred, to determine whether the patients met the discharge criteria. This study was approved by the Ethics Committee of the Shanghai East Hospital (Shanghai, China) and verbal consent was obtained from each patient.

Data collection

Detailed epidemiological and clinical information, and data on the medical care-seeking process for each patient were obtained by physicians using a standard questionnaire after admission to the hospital. For the epidemiological information, each patient was asked if the following circumstances existed before their own symptoms occurred: 1) exposure to Huanan seafood market; 2) family members who were suspected or confirmed to have COVID-19; 3) visited hospital departments where there were suspected or confirmed cases of COVID-19; 4) contact with suspected or confirmed patients in other places; 5) visited public places but without known suspected or confirmed patients; 6) none of these circumstances. Clinical information included demographic data, medical history, comorbidities, symptoms, signs, laboratory findings, chest computed tomographic (CT) scans and treatment of the patients received due to the virus infection were recorded. The medical care-seeking process traced illness onset to first medical visit, first medical visit to blood test and chest CT scan, first medical visit to PCR test of the virus, first medical visit to hospital admission, and illness onset to final negative nucleic acid test.

Statistical analysis

Continuous variables are presented as mean±SD, if normally distributed, or medians and ranges, if not normally distributed. Categorical variables are expressed as percentages. Trends in durations of the medical care-seeking process were tested by linear regression, with the date of first medical visit as a continuous explanatory variable. A two-sided p-value <0.05 was considered to indicate statistical significance. All analyses were performed with SPSS 25.0 software (SPSS Inc., Chicago, IL, USA).

Results

Baseline characteristics

A total of 205 patients with confirmed COVID-19 were included in this analysis during the study period. The baseline clinical and laboratory characteristics of the patients are listed in table 1. The median age of the patients was 51 years and 54.6% were male. Most patients were healthy individuals. 82.0% of patients had fever and 69.8% had dry cough. The most common findings on chest CT scans were ground-glass opacity or patchy shadows, which were detected in bilateral lung in most patients. The illness onset of these patients was between 17 January and 7 February 2020 (figure 1a). Most patients were received antiviral treatments (79.5%), antibiotics (62.4%) and/or Chinese medicine (84.4%) treatments.

158 patients had met the criteria for repeat severe acute respiratory syndrome coronavirus (SARS-CoV)-2 nucleic acid testing as of 28 February 2020. 76 (45.8%) patients had two negative tests and 21 (12.7%) patients remained positive after recovery. The time from illness onset to repeat laboratory tests is shown in figure 1b. There was no difference in this period between the two groups. The median time from illness onset to PCR test was 21 days (range 12–28 days) for those with positive laboratory tests after the end of symptoms (figure 1c), suggesting that clinical recovery is not an appropriate criterion to release isolated

TABLE 1 Baseline characteristics of patients with COVID-19

Characteristic	All	Male	Female
Patients n	205	112	93
Age years	51 (39–57)	50 (36–57)	51 (41–58)
Comorbidities			
Diabetes	10 (4.9%)	7 (6.3%)	3 (3.2%)
Hypertension	23 (11.2%)	13 (11.6%)	10 (10.8%)
Cardiovascular disease	2 (1.0%)	1 (0.9%)	1 (1.1%)
COPD	9 (4.4%)	5 (4.5%)	4 (4.3%)
Cancer	1 (0.5%)	0 (0%)	1 (1.1%)
Other	8 (3.9%)	7 (6.3%)	1 (1.1%)
None	163 (79.5%)	87 (77.7%)	76 (81.7%)
Signs and symptoms			
Fever	168 (82.0%)	98 (87.5%)	70 (75.3%)
Dry cough	143 (69.8%)	82 (73.2%)	61 (65.6%)
Expectoration	59 (28.8%)	45 (40.2%)	14 (15.1%)
Fatigue	66 (32.2%)	36 (32.1%)	30 (32.3%)
Myalgia	47 (22.9%)	22 (19.6%)	25 (26.9%)
Chest tightness/shortness of breath	71 (34.6%)	33 (29.5%)	38 (40.9%)
Chest pain	10 (4.9%)	4 (3.6%)	6 (6.5%)
Haemoptysis	8 (3.9%)	7 (6.3%)	1 (1.1%)
Stuffy nose/runny nose/pharyngalgia/headache	54 (26.3%)	36 (32.1%)	18 (19.4%)
Diarrhoea	29 (14.1%)	15 (13.4%)	14 (15.1%)
Nausea	11 (5.4%)	4 (3.6%)	7 (7.5%)
Vomiting	6 (2.9%)	2 (1.8%)	4 (4.3%)
Laboratory findings			
White blood cell count $\times 10^9$ per L	5.3 (4.3–6.5)	5.5 (4.7–6.7)	5.1 (3.8–6.4)
Neutrophil count %	65.3 (56.3–70.9)	67.3 (58.8–72.4)	62.0 (53.3–70.2)
Lymphocyte count %	23.4 (18.3–31.1)	22.2 (17.1–28.8)	24.7 (19.5–33.7)
Platelet count $\times 10^9$ per L	166 (137–219)	164 (134–218)	167 (144–219)
Bilateral distribution of patchy shadows or ground-glass opacity on CT	200 (97.6%)	111 (99.1%)	89 (95.7%)
Temperature on admission C	36.5 (36.3–36.8)	36.5 (36.2–36.7)	36.7 (36.5–36.9)
Heart rate on admission beats per min	86 (77–96)	88 (79–100)	84 (75–90)
Respiratory rate on admission breaths per min	20 (16–20)	20 (18–22)	18 (16–18)
Arterial pressure on admission mmHg mean±SD	96.8±11.3	98.3±11.8	95.0±10.4
S_{pO_2} %	96 (96–97)	96 (95–97)	97 (96–98)
Treatments			
Antibiotics	128 (62.4%)	73 (65.2%)	55 (59.1%)
Antiviral	163 (79.5%)	91 (81.3%)	72 (77.4%)
Chinese medicine	173 (84.4%)	97 (86.6%)	76 (81.7%)

Data are presented as median (range) or n (%), unless otherwise stated. CT: computed tomography; S_{pO_2}: oxygen saturation measured by pulse oximetry.

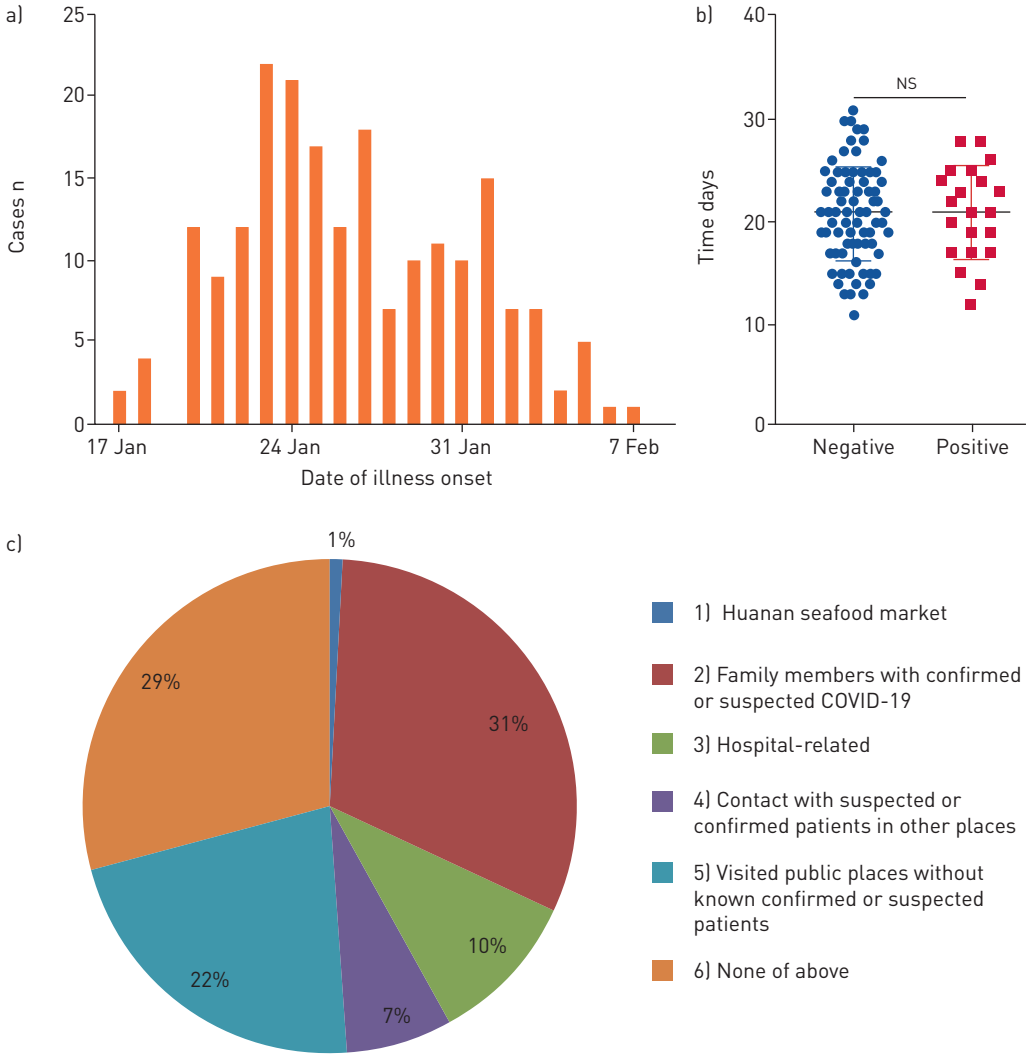

FIGURE 1 a) Case distribution against date of illness onset (n=205). b) Time from illness onset to repeated SARS-CoV-2 nucleic acid test. c) Exposure history of the patients. NS: nonsignificant.

patients and as long as 4 weeks' isolation for patients with COVID-19 is not enough to prevent the spread of the virus.

Epidemiological features

Of 205 patients, only two had visited Huanan seafood market before the onset of their illness (figure 1c). 31% of patients had at least one family member who had earlier symptoms and subsequently confirmed COVID-19 or who were considered suspected patients by medical staff (figure 1c). 10% of patients had gone to hospital departments where they had patients with suspected or confirmed COVID-19 before symptoms of their own occurred (figure 1c). 7% of patients had a history of contact with confirmed or suspected patients in other public places before illness onset (figure 1c). Notably, as many as 51% of patients had no clear contact with confirmed or suspected patients (figure 1c). As the virus can be transmitted from the asymptomatic population, the incubation time of those contacted with family members or in hospital and other places acquired infection was unable to obtain.

Medical care-seeking process

The median time from onset of symptoms to first hospital visit was 2 days (figure 2a). While most patients received blood tests and chest CT scans shortly after the medical visit, it took as long as a median of 6 days from the first medical visit to receive the SARS-CoV-2 nucleic acid test and 10 days from the first medical visit to hospital admission, respectively (figure 2a). As shown in figure 2b, the nucleic acid test was a rate-limiting step for the patients to seek medical care. The actual time periods over the date of

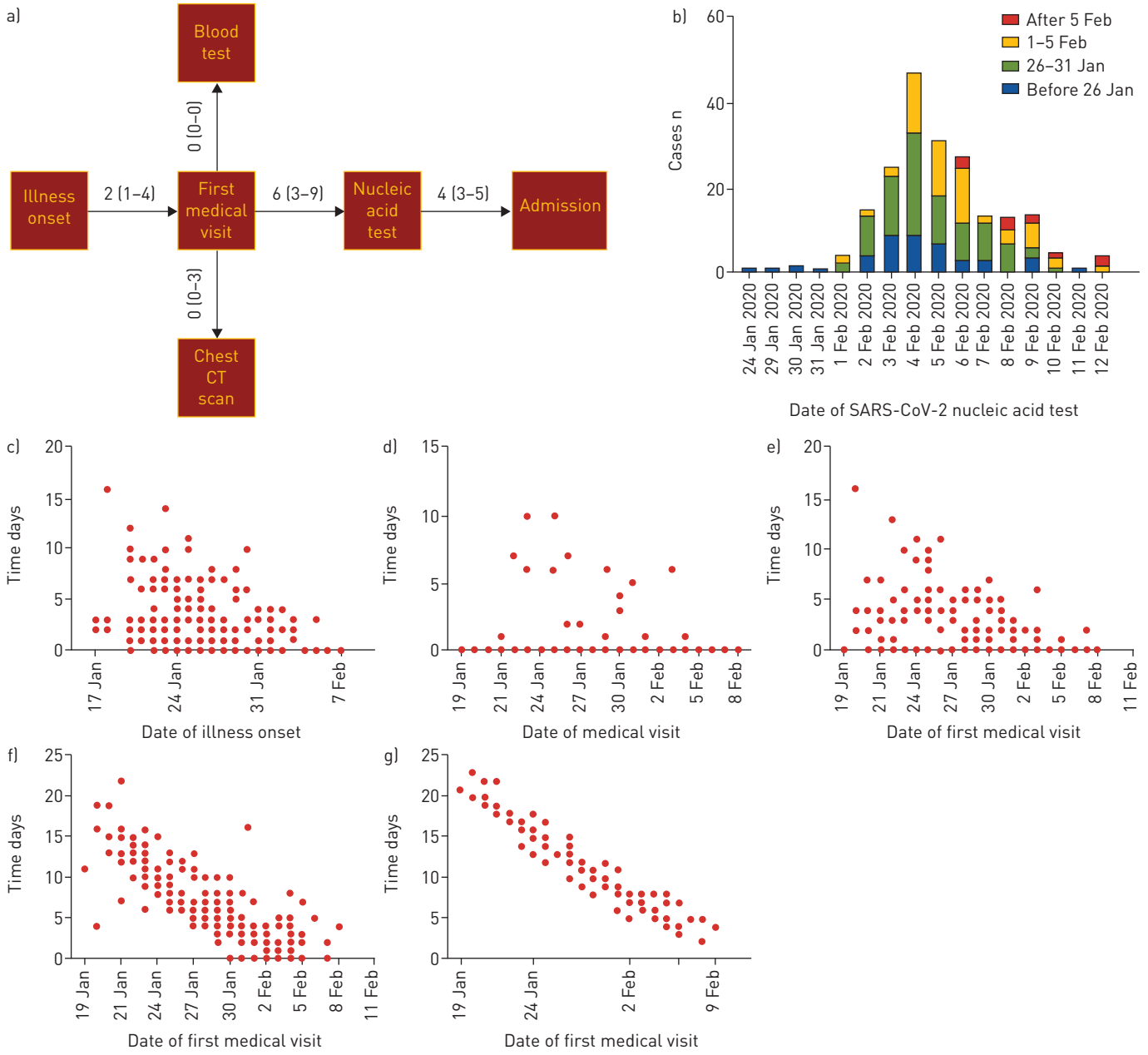

FIGURE 2 a) Median (range) times during medical care-seeking process in days. b) Case distribution of first medical visit period against date of SARS-CoV-2 nucleic acid test. Time from c) illness onset to first medical visit (n=205), d) first medical visit to blood test (n=191), e) first medical visit to chest computed tomography scan (n=205), f) first medical visit to SARS-CoV-2 nucleic acid test (n=205) and g) first medical visit to admission (n=205).

first medical visit are shown in figure 2c–f. The trend of these time periods was down for patients who made their medical visit recently as compared with those who did it earlier (figure 2), indicating that medical care provided to these patients has accelerated since then.

Discussion

A better understanding of transmission patterns is critical to curb infectious diseases [12]. The outbreak of COVID-19 is believed to have originated from the Huanan seafood market; later studies found there were more and more patients with no link to this market, possibly due to human-to-human transmission spread of this virus [13–16]. However, further analysis of human-to-human transmission is currently unknown due to the implementation of quarantine measures and restricted travel. Many restrictive policies, including home quarantine and traffic control, were applied in Wuhan after the city was locked

down. This led to a dramatically changed lifestyle forf the people in the city and may change transmission dynamic of the virus. Thus, it is important to investigate the new transmission features to contain the spread of this virus in Wuhan and other cities where these restrictive measures have been applied.

Our report found that spread between family members and hospital-acquired infections are important routes for virus transmission in the city of Wuhan, suggesting that home isolation may not be an appropriate way to block the spread of the disease. In addition, separate spaces were required when providing medical care to patients with respiratory symptoms to avoid hospital-acquired infections. Importantly, as many as 51% of patients had no known contact with suspected or confirmed patients. This indicates that more effort is needed to detect the actual epidemiological features. Besides medical providers, more epidemiologists are urgently needed to take part in curbing the spread of the virus.

The analysis of the medical care-seeking process of the patients with suspected virus infections shows that early recognition of the disease was achieved in January and early February 2020 despite the delay being shortened later. This indicates that a shortage of medical resources occurred due to the surge in infected patients at the early stage of the outbreak in Wuhan. Moreover, it also suggests there may be a substantial number of patients who were not identified in a timely fashion and, therefore, may have promoted transmission between family members. Different models have been generated to estimate the number of cases in the epicentre of the outbreak [13], but no first-hand information regarding this is available to date [15]. Our report therefore provides useful information for further analysis. As >40 000 medical providers and more medical supplies, including diagnostic PCR kits for the virus, have been deployed to the city, more rapid detection of patients with COVID-19 is expected.

There is no sign that the spread of the virus is under control around the world and the risks of this global pandemic continue to grow. Our study suggests that the evaluation of suspected patients needs to be accelerated and early isolation of infected patients in a heathcare setting rather than at home is urgently required to stop the spread of the virus.

Author contributions: F. Wang conceived and designed the study, analysed the data, and wrote the manuscript. J. Hua, R. Chen, L. Zhao, X. Wu, Q. Guo, C. He, T. Li and X. Ren contributed to data acquisition and analysis. Q. Li and Z. Liu interpreted the data and provided expert insights into this study.

Conflict of interest: None declared.

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References

1 Munster VJ, Koopmans M, van Doremalen N, *et al.* A novel coronavirus emerging in China—key questions for impact assessment. *N Engl J Med* 2020; 382: 692–694.
2 Zhu N, Zhang D, Wang W, *et al.* A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020; 382: 727–733.
3 Chang D, Lin M, Wei L, *et al.* Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 patients outside Wuhan, China. *JAMA*; 323: 1092–1093.
4 Holshue ML, DeBolt C, Lindquist S, *et al.* First case of 2019 novel coronavirus in the United States. *N Engl J Med* 2020; 382: 929–936.
5 Phan LT, Nguyen TV, Luong QC, *et al.* Importation and human-to-human transmission of a novel coronavirus in Vietnam. *N Engl J Med* 2020; 382: 872–874.
6 Rothe C, Schunk M, Sothmann P, *et al.* Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. *N Engl J Med* 2020; 382: 970–971.
7 Wang D, Hu B, Hu C, *et al.* Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*; in press [https://doi.org/10.1001/jama.2020.1585].
8 Liu YC, Liao CH, Chang CF, *et al.* A locally transmitted case of SARS-CoV-2 infection in Taiwan. *N Engl J Med* 2020; 382: 1070–1072.
9 Pongpirul WA, Pongpirul K, Ratnarathon AC, *et al.* Journey of a Thai taxi driver and novel coronavirus. *N Engl J Med* 2020; 382: 1067–1068.
10 Li Q, Guan X, Wu P, *et al.* Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020; 382: 1199–1207.
11 Chan JF, Yuan S, Kok KH, *et al.* A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet* 2020; 395: 514–523.
12 Wang FS, Zhang C. What to do next to control the 2019-nCoV epidemic? *Lancet* 2020; 395: 391–393.
13 Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. *Lancet* 2020; 395: 689–697.

14 Huang C, Wang Y, Li X, *et al.* Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020; 395: 497–506.
15 Chen N, Zhou M, Dong X, *et al.* Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 2020; 395: 507–513.
16 Lu R, Zhao X, Li J, *et al.* Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 2020; 395: 565–574.