

Correspondence

A familial cluster of coronavirus disease 2019 (COVID-19) caused by one family member during his asymptomatic incubation period

ABSTRACT

An ongoing outbreak of coronavirus disease 2019 (COVID-19) has rapidly spread in the world, whereas asymptomatic carriers may also play a critical role in the pandemic. We report a familial cluster of COVID-19 caused by one family member before his onset of illness, indicating that it seems to be potentially infectious during the incubation period, even earlier than we expected. Close contact, especially in a small enclosed space, might be the cause of familial transmission. The unsynchronized changes in the clinical symptoms and COVID-19 nucleic acid were found in this case, so consecutive nucleic acid detection of pretty suspected cases was recommended. Family members, especially of whom the confirmed cases contacted with since one incubation period before onset rather than 2 days before onset, should be regarded as close contact and centrally isolated in case of asymptomatic infection already existed in the family.

Keywords asymptomatic infections, case report, COVID-19, familial cluster, incubation period

To the editor:

An ongoing outbreak of coronavirus disease 2019 (COVID-19) has rapidly spread in the world and poses a significant public health issue. On 11 March 2020, the World Health Organization (WHO) characterized COVID-19 as a pandemic, and this was the first pandemic caused by coronaviruses.¹ The basic reproduction number R_0 was estimated to be around 2.2 before 18 January 2020, the early period of COVID-19 outbreak in Wuhan, Hubei province, China,² while it may lead to an underestimation of transmissibility for the elimination of asymptomatic carriers. Although symptom monitoring can distinguish suspected cases, the obvious difference in the incidence of asymptomatic infections reported by different studies increases the uncertainty of COVID-19 pandemic.^{3, 4} Here, we report a familial cluster of COVID-19, which reveals that it seems to be potentially infectious during the incubation period, even earlier than we expected.

Of particular concern in this familial cluster of COVID-19 was the index patient who had neither a history of exposure to endemic areas nor a history of confirmed patient contact. The infection resource of his illness remained a mystery. We

initially enrolled him on 1 February 2020. He was a 63-year-old male with pulmonary infiltrates from chest radiography and his nasopharyngeal swabs samples were found to be positive for COVID-19 on the real-time reverse transcription-polymerase chain reaction assay. Six family members in this family were tested for COVID-19 nucleic acid on 2 February, which resulted in the detection of another four COVID-19 patient. Among them, Patient 1 had a history of residence in Wuhan, Hubei province, China, who arrived in Shanghai on 21 January and lived with Patients 2–4. The index patient contacted with Patient 1 on 21 and 24 January and had a history of dinner next to the index patient ~1 hour on the evening of 24 January. According to the epidemiological investigation, other possible infection sources of the index patient were ruled out, and finally, Patient 1 was identified as the first patient of this familial cluster outbreak. The onset time of the index patient and Patient 2 was 24 January, which was 7 days earlier than Patient 1 developed cough on 31 January. Patient 1 had an onset 11 days after his departure from the epidemic area, within the mean incubation period 0–14 days assumed by the WHO and 2–12 days assumed by the European Center for Disease Prevention and Control (ECDC).^{5, 6} It revealed that COVID-19 seemed to be contagious during the incubation

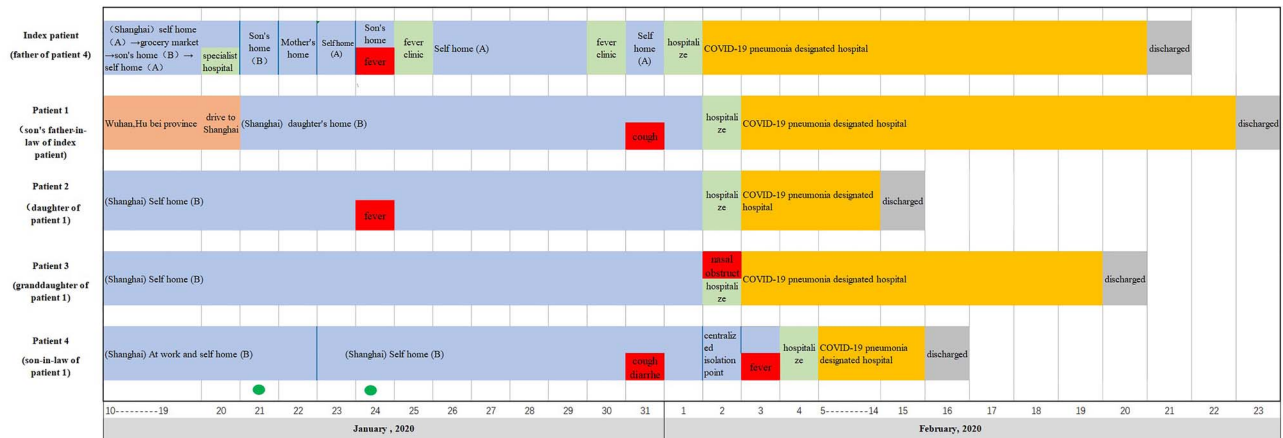


Fig. 1 Chronology of symptom onset of the index patient and Patients 1–4. Dates filled in green are the dates the index case had close contact with Patients 1–4.

period, even at least 7 days before the appearance of clinical symptoms. **Figure 1** depicted the chronology of symptom onset of the index patient and Patients 1–4.

For the central air conditioner was always running at home, the infection risk of COVID-19 would have increased when Patient 1 gathered with other family members during his incubation period, which indicated that close contact, especially in a small enclosed space, might be the cause of familial transmission.

It was also worth noting that unsynchronized changes in the clinical symptoms and COVID-19 nucleic acid were found in Patient 4. Cough and diarrhea were regarded as symptoms of COVID-19 with the incidence of ~68.6 and 4.8% separately.⁷ Patient 4 had cough and diarrhea on 31 January, while his result for COVID-19 nucleic acid test was negative on 2 February. He began fever on the evening of 3 February and the result of nucleic acid test was positive on 4 February. Consequently, the consecutive nucleic acid detection of suspected cases with associate symptoms was recommended for misdetection, especially the cases with extremely long incubation period had been reported.^{8, 9}

Due to the strict management of close contacts, there were no third-generation cases confirmed in this outbreak. Family members, especially of whom the confirmed cases contacted with since one incubation period before onset rather than 2 days before onset, should be regarded as close contact and centrally isolated in case of asymptomatic infection already existed in the family. Early detection and isolation, close contact tracing, longitudinally surveillance via virus nucleic acid tests and the use of crowd face masking are keys to ultimately benefit the control and prevention

for COVID-19 before anti-coronaviral drugs and vaccines developed.

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Competing interests

None declared.

Ethical approval

None.

References

- World Health Organization. WHO Characterizes COVID-19 as a Pandemic. 2020. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>. (2 April 2020, date last accessed).
- Riou J, Althaus CL. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Euro Surveill* 2020;**25**:2000058.
- Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020;**323**:1239–42.

1 Dates filled in green are the dates the index case had close contact with Patients 1–4.

- 4 Mizumoto K, Kagaya K, Zarebski A, Chowell G. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. *Euro Surveill* 2020;**25**:2000180.
- 5 World Health Organization. How Long is the Incubation Period for COVID-19. 2020. <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>. (2 April 2020, date last accessed).
- 6 European Centre for Disease Prevention and Control. Q&A on Novel COVID-19. 2020. <https://www.ecdc.europa.eu/en/novel-coronavirus-china/questions-answers>. (23 March 2020, date last accessed).
- 7 Li LQ, Huang T, Wang YQ *et al*. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. *J Med Virol* 2020;**92**:577–83.
- 8 Lauer SA, Grantz KH, Bi Q *et al*. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. *Ann Intern Med* 2020;**172**:577–82.
- 9 Guan WJ, Ni ZY, Hu Y *et al*. Clinical characteristics of 2019 novel coronavirus infection in China. *medRxiv* 2020;**382**:1708–20.

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