during January 28–February 6, 2020, and intravenous immunoglobulin therapy (20 g/d) during January 28–February 1. In addition, we administered glucocorticoid therapy with methylprednisolon (20–60 mg 2×/d by intravenous drip) during January 29–February 1. The patient's fever abated on January 29. He tested negative for SARS-CoV-2 on February 4 and again on February 6. During the progression of his recovery, we observed gradual reduction of the white patches in the lung caused by SARS-CoV-2 infection (Appendix Figure 2). On January 28 and January 31, we observed multiple ground-glass–like high-density shadows on both lungs with blurred edges and interstitial changes. On February 3, high-density shadows were slightly absorbed in the upper lobe of the bilateral lungs. On February 6, some lesions in the lower lobe of both lungs were slightly absorbed, and we observed the same situation on February 8. The index patient was discharged to home on February 9.

In summary, our epidemiologic study demonstrates asymptomatic and human-to-human transmission of SARS-CoV-2 infection through close contacts in both familial and hospital settings. In addition, the laboratory test results, together with course of medical therapies described, can provide a practical reference for COVID-19 diagnosis and treatment.

About the Author

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References

1. To KK-W, Tsang OT-Y, Chik-Yan Yip C, Chan K-H, Wu T-C, Chan JMC, et al. Consistent detection of 2019 novel coronavirus in saliva. Clin Infect Dis. 2020 Feb 12 [Epub ahead of print]. https://doi.org/10.1093/cid/ciaa149
2. Chan JF-W, Yuan S, Kok K-H, To KK-W, Chu H, Yang J, 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;395:514–23. https://doi.org/10.1016/S0140-6736(20)30154-9
3. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, et al. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. N Engl J Med. 2020;382:970–1. https://doi.org/10.1056/NEJMc2001468
4. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020;395:565–74. https://doi.org/10.1016/S0140-6736(20)30251-8
5. Baud D, Qi X, Nielsen-Saines K, Musso D, Pomar L, Favre G. Real estimates of mortality following COVID-19 infection. Lancet Infect Dis. 2020 Mar 12 [Epub ahead of print]. http://doi.org/10.1016/S1473-3099(20)30195-X
6. Jiang S, Xia S, Ying T, Lu L. A novel coronavirus (2019-nCoV) causing pneumonia-associated respiratory syndrome. Cell Mol Immunol. 2020 Feb 5 [Epub ahead of print]. https://doi.org/10.1038/s41423-020-0372-4
7. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395:497–506. https://doi.org/10.1016/S0140-6736(20)30183-5

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COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020

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During January 26–February 10, 2020, an outbreak of 2019 novel coronavirus disease in an air-conditioned restaurant in Guangzhou, China, involved 3 family clusters. The airflow direction was consistent with droplet transmission. To prevent the spread of the virus in restaurants, we recommend increasing the distance between tables and improving ventilation.

From January 26 through February 10, 2020, an outbreak of 2019 novel coronavirus disease (COVD-19) affected 10 persons from 3 families (families A–C)

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who had eaten at the same air-conditioned restaurant in Guangzhou, China. One of the families had just traveled from Wuhan, Hubei Province, China. We performed a detailed investigation that linked these 10 cases together. Our study was approved by the Ethics Committee of the Guangzhou Center for Disease Control and Prevention.

On January 23, 2020, family A traveled from Wuhan and arrived in Guangzhou. On January 24, the index case-patient (patient A1) ate lunch with 3 other family members (A2–A4) at restaurant X. Two other families, B and C, sat at neighboring tables at the same restaurant. Later that day, patient A1 experienced onset of fever and cough and went to the hospital. By February 5, a total of 9 others (4 members of family A, 3 members of family B, and 2 members of family C) had become ill with COVID-19.

The only known source of exposure for the affected persons in families B and C was patient A1 at the restaurant. We determined that virus had been transmitted to ≥1 member of family B and ≥1 member of family C at the restaurant and that further infections in families B and C resulted from within-family transmission.

Restaurant X is an air-conditioned, 5-floor building without windows. The third floor dining area occupies 145 m^2; each floor has its own air conditioner (Figure). The distance between each table is about 1 m. Families A and B were each seated for an overlapping period of 53 minutes and families A and C for an overlapping period of 73 minutes. The air outlet and the return air inlet for the central air conditioner were located above table C (Figure, panel B).

On January 24, a total of 91 persons (83 customers, 8 staff members) were in the restaurant. Of these, a total of 83 had eaten lunch at 15 tables on the third floor. Among the 83 customers, 10 became ill with COVID-19; the other 73 were identified as close contacts and quarantined for 14 days. During that period, no symptoms developed, and throat swab samples from the contacts and 6 smear samples from the air conditioner (3 from the air outlet and 3 from the air inlet) were negative for severe acute respiratory syndrome coronavirus 2 by reverse transcription PCR.

From our examination of the potential routes of transmission, we concluded that the most likely cause of this outbreak was droplet transmission. Although the index patient (patient A1) was asymptomatic during the lunch, presymptomatic transmission has been reported (*1*). Given the incubation periods for family B (Appendix Figure, https://wwwnc.cdc.gov/EID/article/26/7/20-0764-App1.pdf), the most likely scenario is that all 3 family B members were directly infected by patient A1. However, we cannot not exclude the possibility that patients B2 and B3 were infected by patient B1, the first family B member to become ill. For family C, a possible scenario is that both patients C1 and C2 were infected by patient A1; another scenario is that the patient C1 acquired the infection while caring for patient C2, beginning on January 27.

Virus transmission in this outbreak cannot be explained by droplet transmission alone. Larger respiratory droplets (>5 μm) remain in the air for only a short time and travel only short distances, generally <1 m (*2*,*3*). The distances between patient A1 and persons at other tables, especially those at table C, were all >1 m. However, strong airflow from the air conditioner could have propagated droplets from table C to table A, then to table B, and then back to table C (Figure).

Virus-laden small (<5 μm) aerosolized droplets can remain in the air and travel long distances, >1 m (*4*). Potential aerosol transmission of severe acute respiratory syndrome and Middle East respiratory syndrome viruses has been reported (*5*,*6*). However, none of the staff or other diners in restaurant X were infected. Moreover, the smear samples from the air conditioner were all nucleotide negative. This finding is less consistent with aerosol transmission. However, aerosols would tend to follow the airflow, and the lower concentrations of aerosols at greater distances might have been insufficient to cause infection in other parts of the restaurant.

Our study has limitations. We did not conduct an experimental study simulating the airborne transmission route. We also did not perform serologic studies of swab sample–negative asymptomatic family members and other diners to estimate risk for infection.

We conclude that in this outbreak, droplet transmission was prompted by air-conditioned ventilation. The key factor for infection was the direction of the airflow. Of note, patient B3 was afebrile and 1% of the patients in this outbreak were asymptomatic, providing a potential source of outbreaks among the public (*7*,*8*). To prevent spread of COVID-19 in restaurants, we recommend strengthening temperature-monitoring surveillance, increasing the distance between tables, and improving ventilation.

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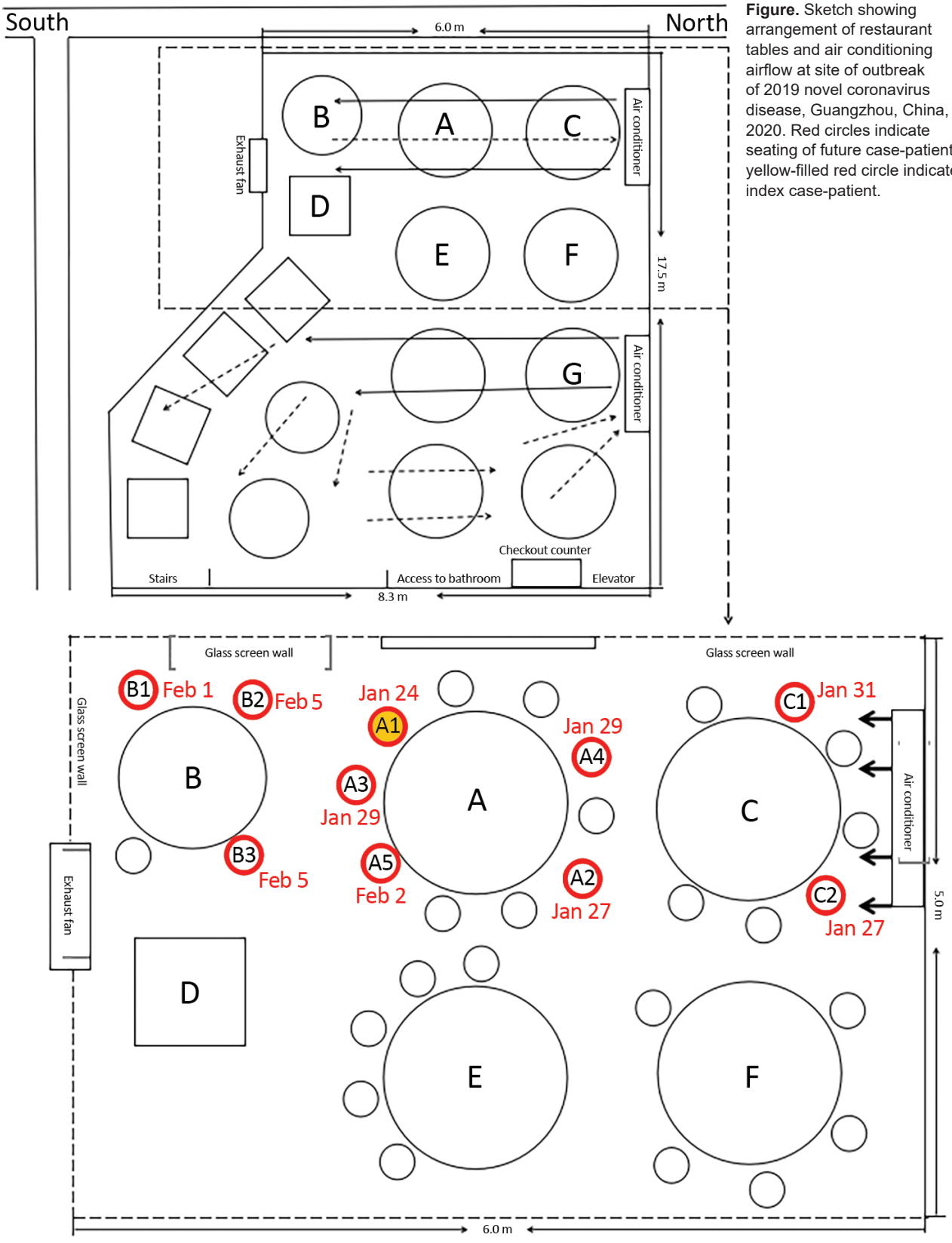

Figure. Sketch showing arrangement of restaurant tables and air conditioning airflow at site of outbreak of 2019 novel coronavirus disease, Guangzhou, China, 2020. Red circles indicate seating of future case-patients; yellow-filled red circle indicates index case-patient.

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References

1. Han Y, Zhang Z, Zhu J, Yu P. A familial cluster of infection associated with the 2019 novel coronavirus indicating possible person-to-person transmission during the incubation period. J Infect Dis. 2020;395:514–23.
2. Pica N, Bouvier NM. Environmental factors affecting the transmission of respiratory viruses. Current Opin Virol. 2012;2:90–5.
3. Kutter JS, Spronken MI, Fraaij PL, Fouchier RA, Herfst S. Transmission routes of respiratory viruses among humans. Curr Opin Virol. 2018;28:142–51. https://doi.org/10.1016/j.coviro.2018.01.001
4. Fernstrom A, Goldblatt M. Aerobiology and its role in the transmission of infectious diseases. J Pathogens. 2013;2013:493960. https://doi.org/10.1155/2013/493960
5. Lee N, Hui D, Wu A, Chan P, Cameron P, Joynt GM, et al. A major outbreak of severe acute respiratory syndrome in Hong Kong. N Engl J Med. 2003;348:1986–94. https://doi.org/10.1056/NEJMoa030685
6. Kim SH, Chang SY, Sung M, Park JH, Bin Kim H, Lee H, et al. Extensive viable Middle East respiratory syndrome (MERS) coronavirus contamination in air and surrounding environment in MERS isolation wards. Clin Infect Dis. 2016;63:363–9. https://doi.org/10.1093/cid/ciw239
7. Tong ZD, Tang A, Li KF, Li P, Wang HL, Yi JP, et al. Potential presymptomatic transmission of SARS-CoV-2, Zhejiang Province, China, 2020. Emerg Infect Dis. 2020 Mar 9 [Epub ahead of print]. https://doi.org/10.3201/eid2605.200198
8. Chan JF-W, Yuan S, Kok K-H, To KK-W, Chu H, Yang J, 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;395:514–23. https://doi.org/10.1016/S0140-6736(20)30154-9

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Severe Acute Respiratory Syndrome Coronavirus 2 RNA Detected in Blood Donations

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Because of high rates of 2019 novel coronavirus disease in Wuhan, China, Wuhan Blood Center began screening for severe acute respiratory syndrome coronavirus 2 RNA on January 25, 2020. We screened donations in real-time and retrospectively and found plasma samples positive for viral RNA from 4 asymptomatic donors.

Because of the rapid increase of cases of 2019 novel coronavirus disease (COVID-19; *1*) and detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA in plasma (*2*,*3*), the safety of China's blood supply became a major concern (*4*). Most blood centers and blood banks in China began taking measures to ensure blood safety (*5*); on January 25, 2020, we began screening all donations collected at the Wuhan Blood Center.

We performed real-time reverse transcription PCR (RT-PCR) for SARS-CoV-2 RNA by using MultiScreen Pro RT-PCR assay (SYM-BIO LifeScience, https://www.sym-bio.com.cn). We performed pool testing by mixing plasma from 6–8 samples or individual testing by using 1.6 mL of plasma. We eluted 100 μL of nucleic acid template and added 40 μL of it to the RT-PCR mix.

By March 4, we had screened 2,430 donations in real-time, including 1,656 platelet and 774 whole blood donations. We identified the first positive donor in our center in a positive pool with a weak amplification of the open reading frame 1ab gene. The donor gave 2 units of platelets on January 28, which were included in the pool. However, the donor's prior donations collected on December 12 and 26 and January 13 were negative for viral RNA. Hubei Province Center for Disease Control and Prevention performed follow-up

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Appendix

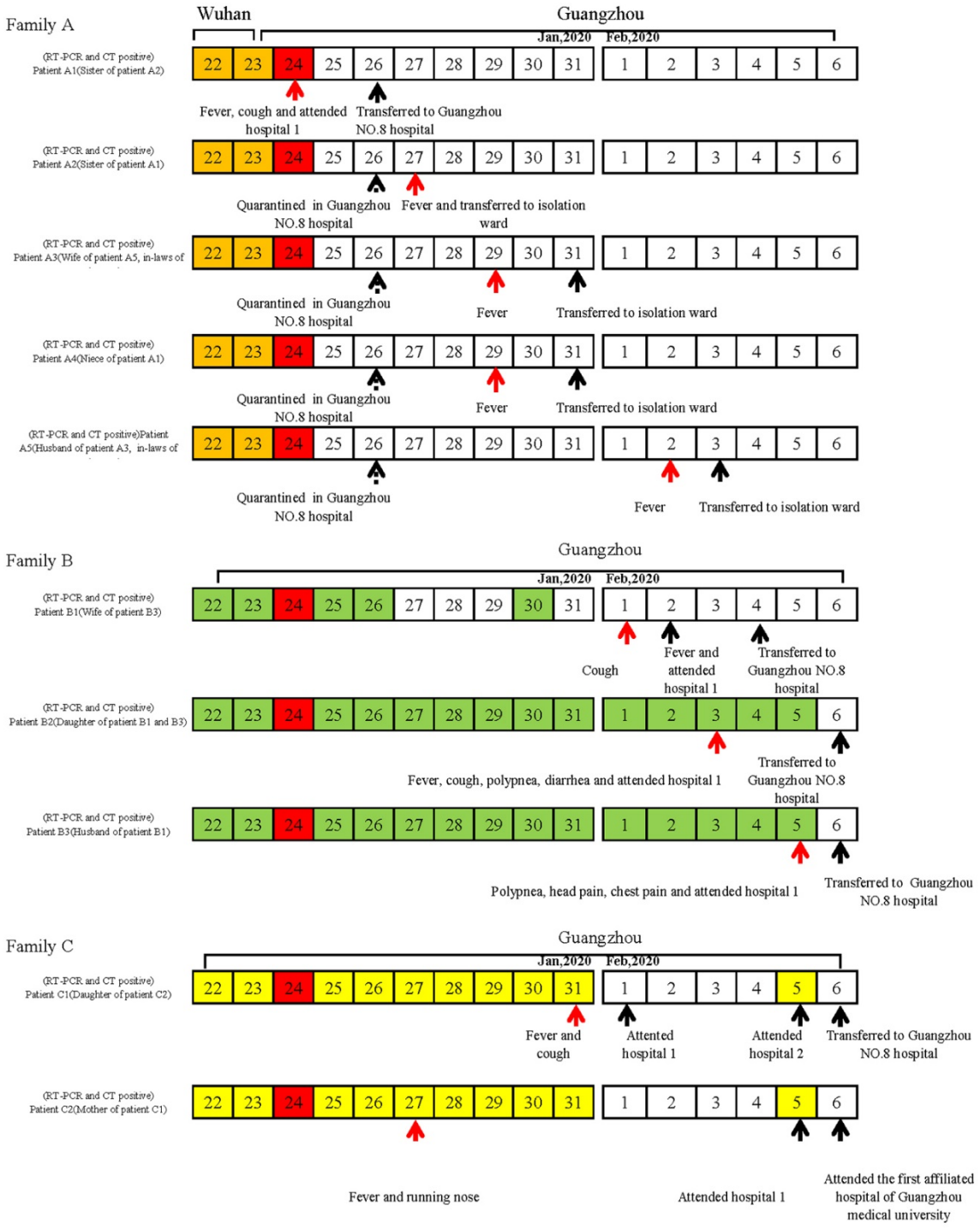
Appendix Table. Summary of clinical features and laboratory results of the three family clusters infected with COVID-19 at presentation

Variable	Family A					Family B			Family C	
Relationship	Patient A1 (Index case)*	Patient A2	Patient A3	Patient A4	Patient A5	Patient B1	Patient B2	Patient B3	Patient C1	Patient C2
	Sister of patient A2	Sister of patient A1	Wife of patient A5, in-laws of patient A1	Niece of patient A1	Husband of patient A3, in-laws of patient A1	Wife of patient B3	Daughter of patient B1 and B3	Husband of patient B1	Daughter of patient C2	Mother of patient C1
Age (years)	63	60	62	34	63	44	20	53	54	82
Sex	Female	Female	Female	Female	Male	Female	Female	Male	Female	Female
Occupation	Retiree	Retiree	Retiree	Staff	Retiree	Cook	Student	self-employed household	Civil servant	Retiree
Chronic medical illness	Hypertension, hyperlipidemia	None	None	None	Hypertension	None	None	None	None	None
interval between admission to hospital and symptom onset (days)	1	0	0	0	0	3	3	1	1	9
Presenting symptoms and signs										
Time of onset	Jan. 24	Jan. 27	Jan. 29	Jan. 29	Feb. 2	Feb. 1	Feb. 3	Feb. 5	Jan. 31	Jan. 27
Fever	+	+	+	+	+	+	+	-	+	+
Cough	+	-	-	-	-	+	+	-	+	-
Running nose	-	-	-	-	-	-	-	-	-	+
Polypnea	-	-	-	-	-	-	+	+	-	-
Head pain	-	-	-	-	-	-	-	+	-	-
Chest pain	-	-	-	-	-	-	-	+	-	-
Diarrhea	-	-	-	-	-	-	+	-	-	-

Variable	Family A					Family B			Family C	
Body temperature (°C)	37.80	37.80	37.30	37.70	37.80	38.40	38.60	-	39.90	37.8
leukocyte count ($\times 10^9$ cells per L)	4.08	4.79	4.76	5.19	6.51	3.52	6.39	6.53	5.40	4.7
Lymphocyte count ($\times 10^9$ cells per L)	0.93	1.05	1.77	1.28	2,74	1.13	1.36	1.96	1.49	0.7
Lymphocyte%	33.10	21.90	37.20	24.70	42.10	32.10	21.30	3.88	27.60	15.50
Neutrophil count ($\times 10^9$ cells per L)	1.60	3.34	2.58	2.92	2.80	2.09	4.02	30.00	3.64	3.6
Neutrophil %	56.9	69.80	54.40	56.20	43.00	59.40	62.90	59.40	67.40	74.90

*Detail of the index case: the index case was the member of family A, who came from Wuhan to Guangzhou, by train from Jan. 22 to Jan. 23. She did not neither contact with wild animals, nor eat game meat. On Jan. 24, after lunch, the index case (patient A1) presented with fever and cough at 16:40, and then she presented to the hospital and admitted to the isolation ward with fever, cough and pneumonia feature on CT scans. After the positive result of throat swab by RT-PCR, she was diagnosed as COVID-19 on Jan. 26, all the other 9 family members were classified as close contacts and sent to the Guangzhou No.8 Hospital for isolation quarantine, of which four developed fever symptoms and were diagnosed as COVID-19 cases by RT-PCR from Jan. 27 to Feb. 3.

Patient A1 was the index case. The relationship between the patients was described as below: A2: sister of A1; A3: in-laws of A1, wife of A5; A4: niece of A1; A5: in-laws of A1, husband of A3. B1: wife of B3; B2: daughter of B1 and B3; B3: husband of B1, father of B2. C1: daughter of C2; C2: mother of C1.



Appendix Figure. Timeline for outbreak of COVID-19 among persons at restaurant, Guangzhou, China, 2020.