A Cluster of COVID-19 Among the Staff of a Logistics Company at Pudong International Airport after Exposure to Virus-contaminated Foreign Aircraft Cabins

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Research Article

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Abstract

Background: Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused a severe burden worldwide. “Environment to human” transmission by non-cold chain is causing alarm and attention.

Methods: Epidemiological information of the COVID-19 cases were collected to determine epidemiological links and analyze transmission chains. Respiratory specimens were collected and tested for SARS-CoV-2 nucleic acid by rRT-PCR assay.

Results: A total of five cases were diagnosed in Pudong New Area during November 20 to 22, 2020. Case 1, 3 and 5 worked for the same logistics company at Pudong International Airport, and had close contact with each other during work. Case 2 is the wife of case 1, case 4 is the wife of case 3. The source of infection was exposure to virus-contaminated foreign aircraft cabins, the virus transmitted among colleagues of a logistics company due to close contacts without effective protection, and then led to intra-household transmissions. The epidemic has been rapidly brought under control, and all the five cases recovered after 13 to 42 day’s treatment.

Conclusions: Regular surveillance and testing of high-risk groups were necessary for COVID-19 control and prevention. Strict management measures and disinfection of imported goods were still need to be implemented in view of severe foreign epidemic situation.

Background

An outbreak of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) began in China on December 2019, and rapidly led to a global pandemic [1]. As of December 2020, more than 80 million cases including 1.7 million deaths were reported worldwide [2]. Cases reported in China were mainly imported from abroad since March 2020.

Patients infected with SARS-CoV-2 and asymptomatic carriers are main sources of infection, the routes of transmission including through respiratory droplets, close contact, and contact with virus-contaminated items. Recently, human outbreaks infected with SAR-COV-2 from contaminated imported food via cold-chain logistics were reported in Beijing [3], Qingdao [4] and Dalian [5]. But with the arrival of winter in the northern hemisphere, “environment to human” transmission by non-cold chain is causing alarm and attention, which still needs support from strong evidence.

Shanghai reported the first case on January 20, 2020, and without local transmission for 4 months until two cargo workers at Pudong International Airport were diagnosed with COVID-19 after exposure to a unit load device on November 9, 2020 [6]. In this study, we report a cluster of COVID-19 among the staff of a logistics company at Pudong International Airport-Shanghai Municipality, China, during November 20 to 22, 2020, after exposure to virus-contaminated foreign aircraft cabins.

Methods

Case Definitions

Case definitions were based on the 7th version of Prevention and Control Guidelines for Novel Coronavirus Pneumonia[7]. A suspected case was defined as any person meeting clinical signs of COVID-19 and/or with epidemiological histories. A confirmed case was any suspected case with respiratory samples testing rRT-PCR-positive for SARS-CoV-2. An infection cluster was identified if five or more cases was found in a confined environment or group (such as a family, a company, etc.) within 14 days, and there was a possibility of interpersonal transmission because of close contact or co-exposure. A close contact was anyone who was closely in contact with a suspected, confirmed and asymptomatic case (including living, working in one house, being within short distance in the same vehicle, and other situations assessed by the field investigators) without effective personal protection (including gloves, medical protective masks, protective face screens, isolation clothing, etc.) 2 days before onset of symptoms in the suspected case and confirmed case or the day asymptomatic case’s specimens were collected.

Epidemiological investigation

An emergency investigation team was formed to conduct investigations, determine epidemiological links and analyze transmission chains. Epidemiological information of COVID-19 cases including demographic characteristics, illness onset and hospital visits, close contacts, exposure histories, and activities' trajectories during 14 days before illness onset were collected, medical record, travel records, and security cameras' videos were checked to ensure the reliability of these information.

Laboratory testing

Respiratory specimens (nasopharyngeal and throat swab) of suspected cases were collected and tested for SARS-CoV-2 nucleic acid by real-time reverse-transcriptase polymerase chain reaction (rRT-PCR) assay (BioGerm, Shanghai and bioPerfectus, Jiangsu) in the laboratory of district-level and municipal CDCs. The viral target included open reading frame 1ab (ORF1ab) and nucleocapsid protein (Np). The specimen was positive for SARS-CoV-2 only if both viral targets were positive [8]. In addition, blood samples were collected and tested for IgM and IgG using 2019-nCoV Ab test (colloidal gold) kit (Innovita, Tangshan).

Ethics

The epidemiological investigations were carried out according to the Law of the People's Republic of China on prevention and control of infectious diseases[9]. Each case was informed of the related rights and obligations of the investigation in a face-to-face meeting or a telephone interview, and oral consent was obtained from all cases. Details were anonymised to protect the individual's privacy.

Results

Detection of the epidemic

On November 19, 2020, a 39-year-old male went to the fever clinic of Zhoupu Hospital in Shanghai Pudong New Area due to fever and sore throat. He was a security inspector, worked in a logistics company of the Shanghai Pudong International Airport West Division, and was responsible for the security check of the staff entering the company (Table 1). The next morning, his wife went to the fever clinic of Pudong Hospital for the same symptoms. On the night of November 20, comprehensive results of clinical examination, expert consultation and nucleic acid, COVID-19 diagnosis of the couple was confirmed. As of November 21, 118 close contacts and 499 close contacts' close contacts of these two cases were traced and were placed under 14 days' medical isolation and observation, their respiratory specimens were collected for nucleic acid test (Table 2). Additional 5107 employees of the company were also tested for SARS-CoV-2. As a result, three more people were test-positive and were diagnosed with COVID-19 successively.

Table 1
Characteristics and contacts of the five cases diagnosed in Pudong New Area during November 20 to 22, 2020

Characteristics	Case 1	Case 2	Case 3	Case 4	Case 5
Demography					
Sex	Male	Female	Male	Female	Male
Age, years	39	34	29	30	46
Body mass index (BMI)	24.11	22.48	24.44	26.31	31.14
Comorbidity	None	Thyroid dysfunction	None	None	None
Occupation	Security inspector	Nurse	Crew coordinator	Customer service	Office operator
Epidemiological history					
Way of detection	Health seeking	Health seeking	Screening in the company	Case 3's close contact	Case 1's close contact
Suspected exposure 14 days before illness onset	Security check for case 3	Live with case 1	Place documents in the foreign aircraft cabins	Live with case 3	Security checked by case 1
Vaccination					
2019-nCoV	No	No	No	No	No
Influenza	No	Yes	No	No	No
Clinical manifestation and outcome					
Fever (°C)	39.0	37.8	37.9	No	No
Other symptoms	Sore throat	Sore throat	Cough	Anosmia, ageusia, cough	No
Clinical type	Moderate	Moderate	Moderate	Moderate	Moderate
Length of hospital stay (LOS, days)	36	28	44	16	37
Outcome	Recovery	Recovery	Recovery	Recovery	Recovery
Clinical examination					
White blood cell count ($\times 10^9$ per L, norm 4.0–10.0)	5.78	4.01	8.70	8.10	5.00
Lymphocyte count ($\times 10^9$ per L, norm 0.8–3.5)	0.97	0.78	1.40	2.00	1.60

Characteristics	Case 1	Case 2	Case 3	Case 4	Case 5
Chest computed tomography scan	Infection in both lungs	Inflammation in the lower lobe of both lungs	Infection in the lower lobe of left lung	Inflammation of the lower lobe of right lung	Inflammation in both lungs

Table 2
Nucleic acid test results of samples collected from related people and environment

Case	Close contacts		Close contacts' close contacts		General contacts		Screening objects		Total	
	No. of collected	No. of positive	No. of collected	No. of positive	No. of collected	No. of positive	No. of collected	No. of positive	No. of collected	No. of positive
Case 1	49	1 [a]	296	0	17	0	1053	1 [b]	1415	2
Case 2	69	0	203	0	51	0	4054	0	4377	0
Case 3	11	1 [c]	29	0	29	0	-	-	69	1
Case 4	37	0	276	0	154	0	1593	0	2060	0
Case 5	21	0	53	0	5	0	-	-	79	0
Total	187	2	857	0	256	0	6700		8000	3

[a] case 5; [b] case 3; [c] case 4.

Case 3 was a crew coordinator, who had repeatedly placed documents in the foreign aircraft cabins during 14 days before illness onset on November 19. On November 12, he was security checked by case 1 without effective personal protection. And the latter also checked for case 5 before illness onset. As for case 2 and case 4, according to the result of the screening and epidemiological investigation, they have not contacted with COVID-19 patients or other suspicious persons during 14 days before the illness, except for their husbands. All five cases had not been exposed to imported cold-chain food and related environment during 14 days before illness.

Characteristics of the cases

Characteristics and contacts of the five cases diagnosed in Pudong New Area during November 20 to 22, 2020 were showed in table 1. Case 1, 3 and 5 worked for the same logistics company at Pudong International Airport, and had close contact with each other during work. Case 2 is the wife of case 1, case 4 is the wife of case 3. The age of the cases ranged from 29 to 46 years. No one had been vaccinated against SARS-CoV-2 before illness onset. Three of them had fever, and four cases had other symptoms, such as sore throat and cough. The clinical type of all the five cases were moderate, and recovered after treatment. The length of hospital stay (LOS) were 13 to 42 days. Their white blood cell count and lymphocyte count were within the normal range or below. Infection and inflammation of lungs were showed in their results of the chest computed tomography scans (Fig.1). In addition, IgM and IgG antibodies in all cases were negative.

Gene sequencing

According to the result of gene sequencing, the sequences of the five cases' virus isolates were homologous and were consistent with that of the surface samples collected from the imported goods in the logistics company. The virus isolates all

belonged to the L-lineage European branch □.1, which was a prevalent branch in America that most of the imported cases in China belonged to. It was suggested that the source of infection might be cases 3's exposure to the virus-contaminated environment of foreign aircraft cabins.

Transmission chains

Comprehensive the results of epidemiological investigations and viral gene sequencing, we speculated that the source of infection in this outbreak came from abroad. Cases 3 was initially infected with COVID-19 after exposure to virus-contaminated foreign aircraft cabins, the virus was transmitted to Case 1, and then to Case 5, due to close contacts during the work without effective protection. Cases 2 and case 4 were infected from their husbands, close contacts led to the intra-household transmission (Fig.2).

Control measures

Control measures have been implemented immediately after the outbreak. The five cases were transferred to the designated medical institution for isolation and treatment. Three communities where the cases live were identified as medium-risk areas, and closed health management were implemented for residents. Specific venues where the cases worked or spent extensive time had been closed and comprehensively disinfected. Close contacts and close contacts' close contacts were traced and were placed under medical isolation and observation. Samples of related people and environments were collected for nucleic acid test (Table 2). The secondary attack rate was 0.04% (3/8000). 4 of 1093 environmental samples were positive, which were all collected from case 1 and case 2's house. 1 of 54 surface samples collected in the adjacent area of the logistics company was also positive for SARS-CoV-2. In addition, a total of 11,794 staff in key positions at Pudong International Airport were vaccinated against the SARS-CoV-2 emergently, including logistics personnel, security personnel, inspection personnel, airline staff, and so on. The epidemic only lasted several days before it was brought under control.

Discussion

Our study reported a cluster of COVID-19 among the staff of a logistics company at Pudong International Airport after suspiciously exposure to virus-contaminated foreign aircraft cabins. The virus was transmitted among colleagues due to close contacts without effective protection, and then led to intra-household transmissions.

The initial two cases were detected during health seeking with the help of the sensitive monitoring system for fever cases, which contained 117 fever clinics and 203 sentinels in the city. The epidemic confirmed the importance and necessity of regular surveillance and testing of high-risk groups.

SARS-CoV-2 could spread through contaminated items, and reported to showed no decline in infectivity after 21 days at 4 ℃ and -20 ℃ on the surface of food, indicating that the survival period and transmission distance of the virus could be prolonged by cold-chain transportation [10]. Recently, human outbreaks infected with SAR-COV-2 from contaminated imported food via cold-chain logistics were reported in many cities of China [3-5]. The source of the epidemic in our study was that a logistics worker exposed to virus-contaminated foreign aircraft cabins, which indicated that with the arrival of winter in the northern hemisphere, the temperature became cooler, non-cold chain transmission should also be paid attention, especially in megacities with frequent import and export trade, such as Shanghai. Health education was needed to enhance the workers' personal protection awareness. Moreover, strict management measures and disinfection of imported goods still need to be implemented in view of severe foreign epidemic situation.

Thanks to timely effective measures, the epidemic has been rapidly brought under control. We implemented precise prevention and control, without conducting nucleic acid testing for all residents. Without specific treatment, vaccination is a simple and important way to prevent COVID-19. The SARS-CoV-2 vaccine developed by China Biotechnology Co., Ltd. has been approved by FDA for marketing, and was reported has an effective protection of 79.34%. Key populations such as those engaged in

import-export logistics industry and other high-risk infections are recommended to be vaccinated to cut off the transmission chain of the virus to the maximum. So far, a total of 11,794 staff in key positions at Pudong International Airport were vaccinated against the SARS-CoV-2 emergently.

Conclusions

“Environment to human” transmission by non-cold chain is causing alarm and attention as the epidemic situation abroad is still severe. Regular surveillance and testing of high-risk groups were necessary for COVID-19 control and prevention. Strict management measures and disinfection of imported goods were still need to be implemented in view of severe foreign epidemic situation.

Abbreviations

COVID-19: Coronavirus disease 2019;

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2;

rRT-PCR: real-time reverse-transcriptase polymerase chain reaction

Declarations

Ethics approval and consent to participate

The study was approved by the ethical review committee of Shanghai Municipal Center for Disease Control and Prevention. Informed written consent was obtained from the subjects before collecting their samples and information.

Consent for publication

Consent for publication was obtained from each subject in our manuscript.

Availability of data and materials

Data used and/or analysed during this study are available from the corresponding author on reasonable request.

Competing interests

All authors declare no competing interests.

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Authors’ contributions

CF and HYW supervised the study. XDS, CCY, HP, YPW, RLC, LPH, PC, and XY conducted the investigation, collected the samples and data. QQ and RLC analysed the data. QQ wrote the initial drafts of the manuscript. HP and SLL commented on and revised

drafts of the manuscript. All authors contributed to the review and revision, approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Figures

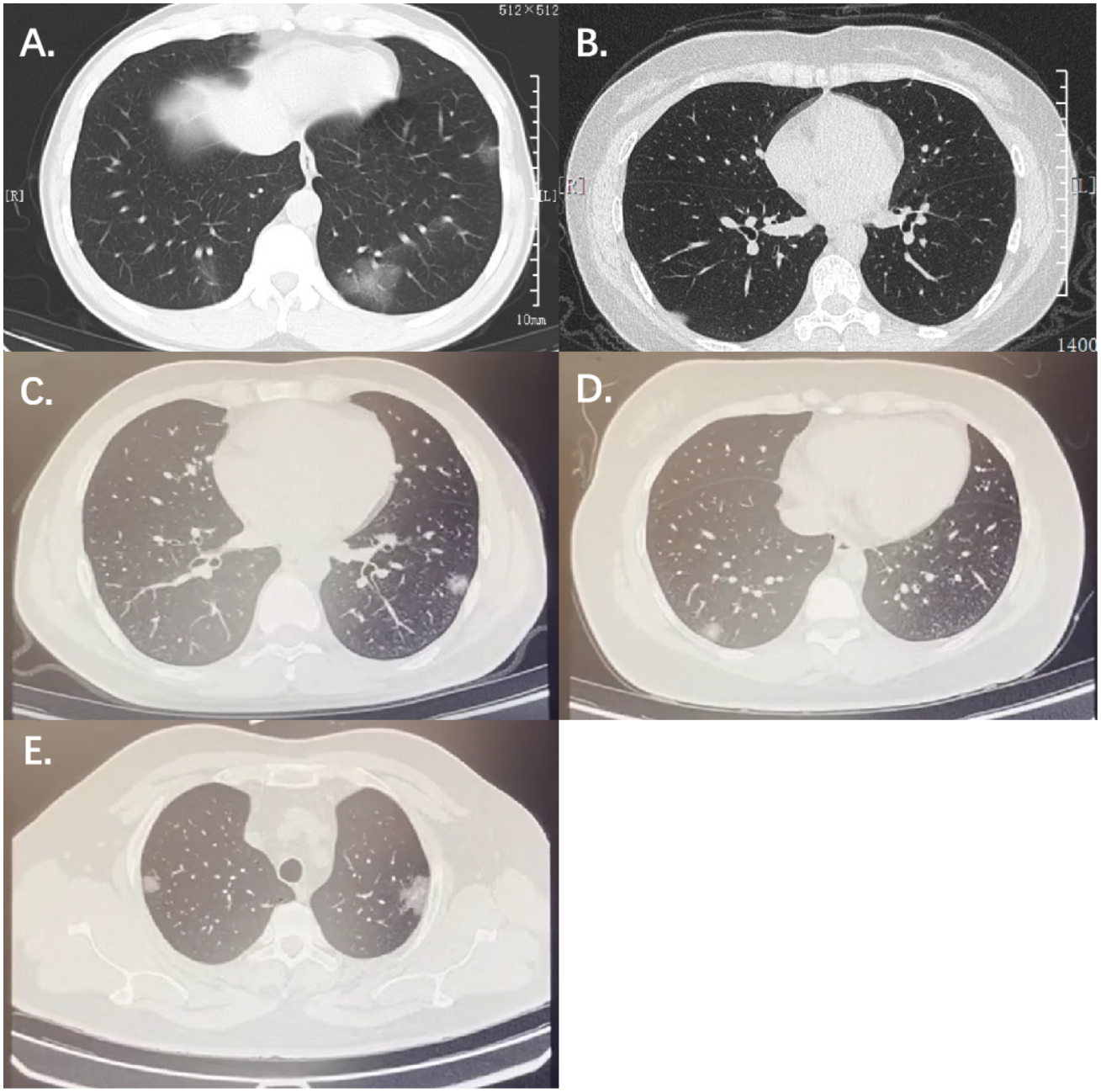

Figure 1

The chest computed tomography scans of the five cases. a, Case 1: Infection in both lungs; b, Case 2: Inflammation in the lower lobe of both lungs; c, Case 3: Infection in the lower lobe of left lung; d, Case 4: Inflammation of the lower lobe of right lung; e, Case 5: Inflammation in both lungs.

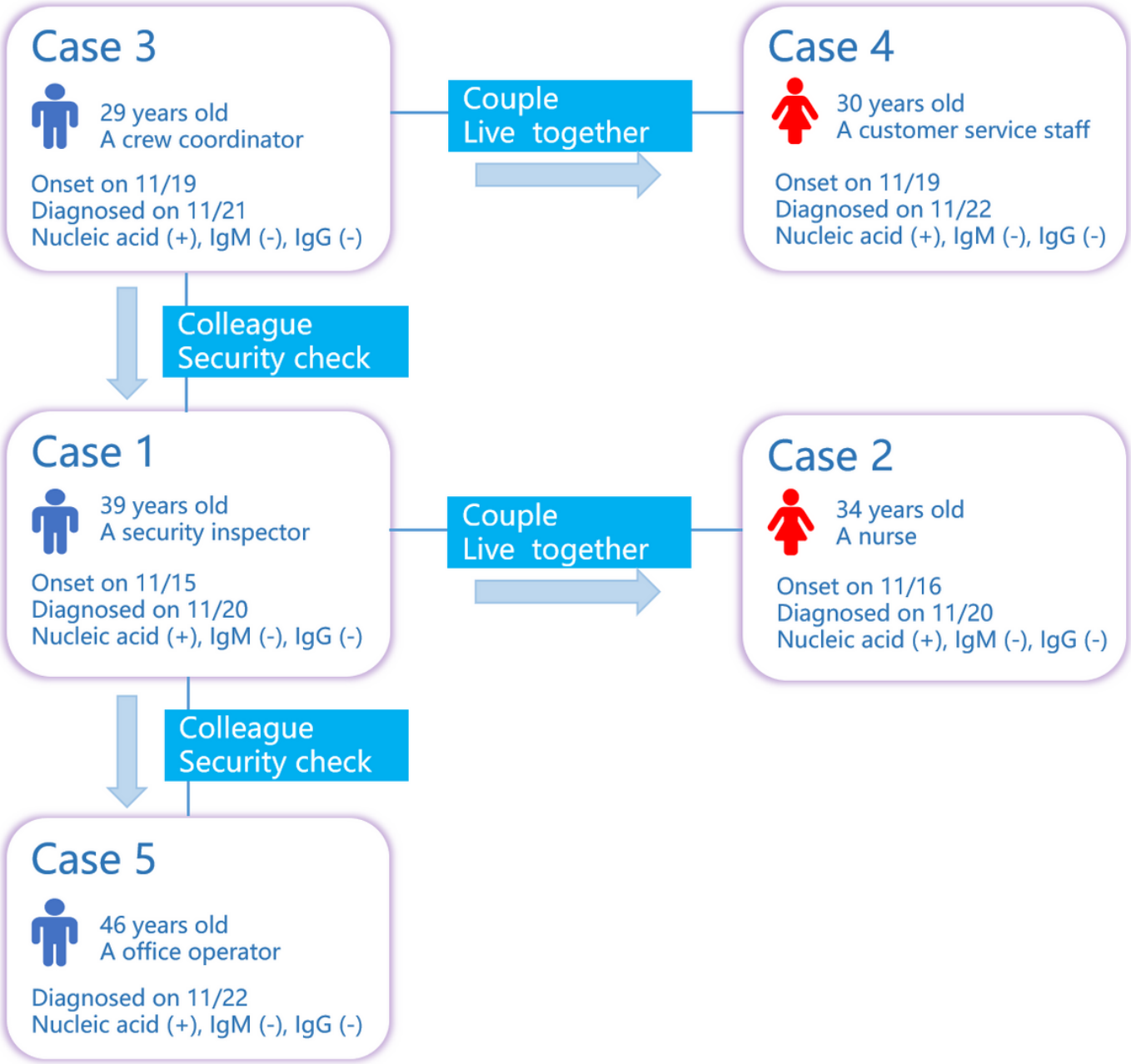

Figure 2

Analysis of suspicious transmission chain of the five cases. Cases 3 was initially infected with COVID-19 after exposure to virus-contaminated foreign aircraft cabins, the virus transmitted among colleagues of a logistics company due to close contacts without effective protection, and then led to intra-household transmissions.