Three Taiwan's domestic family cluster infections of coronavirus disease 2019

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Abstract
Since the first case of coronavirus disease 2019 (COVID-19) was identified in Taiwan 2020.01.21. Several family cluster infections were found later. This study aimed to report family cluster infections and observe subsequent development. We collected domestic family cluster infections among COVID-19 confirmed cases from 21 January 2020 to 16 March 2020. There were three domestic family clusters infections in this period. The first cluster was cases 19 to 23. The infectious source was a Taiwanese passenger from Zhejiang. The second cluster was cases 24 to 26 and the third cluster was cases 27 to 32. The infectious sources of the latter clusters are currently uncertain. All contacts of three clusters have been isolated and no new confirmed cases have been identified to date. Some measures which have reduced the spread of these three clusters included: First, high suspicion of COVID-19 for unexplained pneumonia is very important for early detection. Second, immediate epidemic investigation is taken especially COVID-19 is infectious during the incubation period. Third, when the second and third clusters could not find infectious sources, CECC’s press conference let the public know immediately the epidemic situation, so that people could raise their awareness and seek medical treatment or quarantine.

KEYWORDS
COVID-19, domestic family clusters infections, SARS-CoV-2, Taiwan CECC

1 | INTRODUCTION

In December 2019, since coronavirus disease 2019 (COVID-19) was confirmed that the pathogen was severe acute respiratory syndrome coronavirus 2 (SARS-CoV2),1-4 many countries around the world have been infected in recent months.5 The WHO announced that the COVID-19 epidemic was listed as an international public health emergency.6 Taiwan is adjacent to mainland China and there are many cultural and economic exchanges and tourism between the two sides of Taiwan straits.7-9 Taiwan is at great risk from being infected by SARS-CoV2.7

Since the first case of COVID-19 was identified in Taiwan 2020.01.21, there have been sporadic imported infections, infections between couples, family cluster infections, and nosocomial infections later. In 2004, the second year after the SARS outbreak, the Taiwan government established the National Health Command Center (NHCC). NHCC unifies a central command system, including the Central Epidemic Command Center (CECC), the Biological Pathogen Disaster Command Center, and so on.10 The Taiwan center for disease control (CDC) also announced the establishment of a CECC for severe special infectious pneumonia. The level has been increased to the second level and has now been increased to the first level.11
Having new cases in Taiwan, or major changes in the international epidemic situation, the CECC will hold a press conference to tell people about Taiwan case epidemic information and corresponding strategies. Therefore, all people, medical institutions, and health unit personnel can understand the epidemic and work together to cope with COVID-19. This study aims to report the domestic family cluster infection of COVID-19 in Taiwan, to explore the public health strategy of Taiwan's government and to observe the development of subsequent epidemics.

2 | MATERIALS AND METHODS

We collected cases of family cluster infection among COVID-19 confirmed cases from 21 January 2020 to 16 March 2020. Data sources were collected from a series of official messages reported by the Taiwan CECC press conference. We also collect the public health strategy of the Taiwan government and observe the development of these domestic family cluster infections of COVID-19. Case definition, specimen collection, and diagnostic tests for COVID-19 are according to Taiwan CDC recommendations. Clinical presentation criteria, laboratory diagnosis criteria, epidemiological criteria, and reporting requirements for COVID-19 also were regulated and published on the Taiwan16n CDC website. Case definitions for suspected case meet clinical presentation criteria but not laboratory proved plus history of close contact with the symptomatic confirmed case(s) within 14 days before symptom onset. Case definitions for confirmed cases meet laboratory diagnosis criteria, regardless of clinical signs and symptoms. The laboratory diagnosis criteria show one or more of the following: (a) Pathogen (SARS-CoV-2) isolated and identified from a clinical specimen (nasopharyngeal swab, throat swab, expectorated sputum, or lower respiratory tract aspirates) and (b) Positive molecular biological testing for viral (SARS-CoV-2) RNA from a clinical specimen (nasopharyngeal swab, throat swab, expectorated sputum, or lower respiratory tract aspirates).

2.1 | Patient informed consents and ethic issue

This is a retrospective study. Patient information was obtained from the content of CECC’s press conference and the Taiwan CDC website. The authors who do not know the patient’s additional personal information will not involve privacy and personal security. In the face of the sudden outbreak of COVID-19, we do not know where the patients are, nor can we obtain the patient’s informed consent. Given that the rights of patients are not infringed and the medical knowledge thus obtained can help more patients, I believe scholars will have the same consensus.

2.2 | Study population

We collected cases of domestic family cluster infection among COVID-19 confirmed cases from 21 January 2020 to 16 March 2020.

2.3 | The first domestic family cluster infections

The first domestic family cluster is cases 19 to 23 (Figures 1 and 2). Case 19 is a male driver in his 60 seconds with a history of hepatitis B and diabetes, but no travel abroad history. Symptoms appeared on 1/27 and he was hospitalized on 3 February with the diagnosis of pneumonia at that time, died of severe pneumonia complicated with sepsis on 15 February. This case was confirmed later due to the patient with negative influenza screening and an afterward test for SARS-CoV-2. Case 19 was the first death case of COVID-19 in Taiwan. Case 19 once carried Taiwanese businessman. The Taiwanese businessman from Zhejiang returned to Taiwan on 22 January and had a cough. Cases 20 to 23 are cases of brother, mother, nephew son-in-law, and sister of case 19, who had no symptoms and were suspected to be infected during the dinner at the same table during the New Year. All contacts have been quarantined according to the CECC’s protocol.

2.4 | The second domestic family cluster infections

The second domestic family cluster is cases 24 to 26 (Figure 3). The 24th confirmed case was a 67 years old woman with gout and hypertension but had no history of going abroad for nearly 2 years. She developed fever, cough and other symptoms on 22 January. He went to the clinic four times from 22 to 29 January. Due to worsening symptoms and shortness of breath, he went to the hospital for emergency treatment on the evening of the 29th and was diagnosed with pneumonia on the examination. He was admitted to the hospital on the 30th. Due to the deterioration of his condition, she was transferred to the intensive care unit on 10 February. To follow the CECC’s measure that cases of severe complicated influenza that tested negative for influenza are required to test for COVID-19, she was transferred to a negative pressure isolation ward on 17 February. The patient tested positive for COVID-19 on 19 February and is receiving medical treatment in isolation. Case 25 and 26 are the granddaughter and younger daughter of Case 24. Neither had they had a history of foreign travel. Case 26 developed symptoms of cough on 28 January. He sought medical treatment on 31 January due to a fever and continued to have cough symptoms on 31 February. He also sought medical treatment on 4 and 11 February. Case 25 had no fever or respiratory symptoms as of 21 February and had a medical consultation on 3 and 6 February because of gastroesophageal reflux. Tracing the history, on 6 January, Case 24 had a dinner with Case 25’s classmate who came back from China. All contacts have been quarantined according to the CECC’s protocol.

2.5 | The third domestic family cluster infections

Case 27 to 32 is the third domestic family cluster infection (Figure 4). Case 27 was an 80 seconds male with hypertension, diabetes, and
end-stage renal disease with hemodialysis. He has no recent history of going abroad. On 6 February, he developed symptoms such as cough and runny nose. On the 9th, he was admitted to a single ward for fever and a diagnosis of pneumonia. On the 16th, he had shortness of breath and was transferred to the intensive care unit. On the 20th, he was transferred to a negative pressure isolation ward because of unexplained pneumonia. Later, the diagnosis COVID-19 was confirmed on the 23rd. Finally, Case 27 died of multiple organ failure and septic shock. Cases 28 to 32 were the two sons, wife, grandson, and foreign caregiver of Case 27. Case 29’s younger son frequently traveled to and from Wuhan due to his work relationship. He returned to Taiwan from Guangzhou on 2 December 2019. During the Chinese New Year, he also had dinner with a friend with a travel history of China. Case 31 was the 11-year-old grandson of Case 27.
He lives with him and visited the hospital on 11th and 19th February. Because he was listed as close contact, he was admitted to the hospital for isolation and observation and was confirmed later. He had currently no obvious symptoms. All contacts have been quarantined according to the CECC’s protocol.

3 | RESULTS

There are 57 confirmed cases with COVID-19 in Taiwan as of 16 March 2020. Of confirmed cases, there are three family clusters infections.

The first domestic family cluster was cases 19 to 23. CECC intervened in the epidemic. After interrogating the medical history, it estimated the date of symptom onset and the date of exposure of the confirmed case to find the index patient. It estimated all contacts of the confirmed case during the infection period including family members, pharmacy buying medicine, clinic visits, and driver group companions, and all passengers from communication records. It also involved index patient medical history and related contacts (Figure 1). A Zhejiang Taiwanese businessman is the index patient. The businessman returned to Taiwan on 22 January and had a cough. The result was negative for the first time by PCR. Further blood tests found that SARS-CoV-2 antibodies were positive. However, antibody testing was not listed as a diagnostic tool. Therefore, Zhejiang Taiwanese businessmen were not included in the confirmed case. As for Zhejiang Taiwanese businessmen, his three Taiwan family members who tested were negative. About 257 contacts were collected.
and 256 were tested (one died not due to COVID-19, including 4 of whom were confirmed (cases 20 to 23), and the remaining 252 were all negative (Figure 2). Above contacts have been isolated and no new confirmed cases have been identified to date.\(^\text{15}\)

The secondary domestic family cluster was cases 24 to 26. There were 853 contacts, 242 of whom had been in close contact, 2 of whom were confirmed positive (case 25-26) and 240 had negative reactions (Figure 3). Although Case 24 had a contact history with Case 25’s classmate who came back from China, Case 25’s classmate’s test was negative and CECC still listed as an unknown index patient. In addition, the woman’s eldest daughter was negative on three tests, she was still suspected cases and was isolated because she had persistent cough symptoms and had close contact with her mother 14 days before the onset of illness. Above contacts have been isolated and no new confirmed cases have been identified to date.\(^\text{16}\)

The third domestic family cluster infection was case 27 to 32. There were 580 contacts, 144 of whom have been in close contact,
4 of whom have confirmed positive (case 28-31) and 140 were negative (Figure 4). Case 29 was suspected of index patient initially but was ruled out later because his friend’s test was negative. CECC still listed the index patient was currently uncertain. All contacts have been isolated and no new confirmed cases have been identified to date.\textsuperscript{17}

4 | DISCUSSION

In the first family cluster infections, only case 19 had a history of exposure history with Taiwanese businessmen from Zhejiang. Case 20 and 21 live together with case 19, should be infected by case 19 during the incubation period or after symptoms. Case 22 and 23 had
Evidence has demonstrated that human-to-human transmission of 2019 novel coronaviruses has occurred among close contacts, even during the incubation period. Therefore, the determination of close contacts should also include those who are exposed to case-patients during their incubation. The incubation period of COVID-19 is considered to be within 14 days after exposure, and most cases occur about 4 to 5 days after exposure. However, the interval at which individuals with COVID-19 are infected is uncertain. It seems that SARS-CoV-2 can spread before symptoms appear and throughout the disease. The Case 25 and Case 29 are still suspected as the index patients of the family cluster infections which may be confirmed by further knowledge of COVID-19.

The severity of COVID-19 symptoms ranges from very mild to severe. The patients, who are older or have underlying diseases, may be at higher risk of serious illness. The most common symptoms are fever and cough. In addition, there are gastrointestinal symptoms, sore throat, runny nose, etc. The symptoms may vary depending on the progress of the disease and individual differences. Owing to some patients with COVID-19 have early symptoms that are not obvious and without fever, some of them are mild or asymptomatic (for example, case 31, asymptomatic at confirmation), they often visit the local clinic due to mild respiratory infection. The local clinic has also become an important role in this epidemic prevention. Case 19 has no history of travel and no obvious contact history at initial history taking. Fortunately, the local clinician was alert and referred to a large hospital. He was admitted to a negative pressure isolation ward and thus prevented virus spreading.

The measures taken by the Taiwan CECC have reduced the spread of these three family cluster infections of CARS-CoV-2 without causing community infections.

We have some suggestions like the following: First, early detection of COVID-19 in patients with unexplained pneumonia with negative influenza test can prevent infection spread. The starters of these three family clusters were not easy to detect exposure history at first, high suspicion of COVID-19 for atypical pneumonia is very important. Second, the strict contact history tracking and immediate epidemic investigation of the confirmed cases, especially COVID-19 is infectious during the incubation period or asymptomatic period. Recognition of infections, time inference, and quarantine scope require new considerations. Third, a series of press conferences will let the public know immediately the changes in the epidemic situation in Taiwan and the world, and immediately educate the public on how to prevent the epidemic including mask policies, hand hygiene, and maintain appropriate social distance. Especially when the second and third family group infections could not find the source of the infection, the whereabouts of the diagnosed person will be announced, so that the public can raise their awareness and seek medical treatment or quarantine to prevent community infections.

The data source of this study is the information released by the press conference of the Taiwan CECC. The authenticity of the information cannot be doubted, and there is no violation of personal privacy. There are still some limitations, such as deficiency in more detail of individual patient’s medical history, laboratory data, or radiographic characterization. Because this study focuses on the development of the epidemic, the individual’s clinical details did not affect the purpose of this study.

In conclusion, the measures taken by the Taiwan CECC have reduced the spread of these three family cluster infections of CARS-CoV-2 without causing community infections.

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**CONFLICT OF INTERESTS**

The authors declare that there are no conflict of interests.

**AUTHOR CONTRIBUTIONS**

S-FL: study conceptualization; formal analysis; methodology; software; supervision; roles/writing-original draft; writing; review, & editing. H-CK: data curation; formal analysis; methodology; software; formal analysis; methodology; writing-review, & editing.

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