# The Infection Disaster Risk and Response System against the Spread of COVID-19 in Republic of Korea

## Gyu-Yil Choi[1], Hae-Ryoung Park*[2], Sang-Sub Park*[3]

[1] Department of Dental Hygiene, ChungCheong University, 38 Wolgok-Gil Gangnae-Myeon,Heungdeok-Gu, Cheongju-Si, Chungbuk, 28171, Republic of Korea

[2] Department of General Education, Kwangju Women's University, 201 Yeodae-gil, Gwangsan-gu, Gwangju-Si, 62396, Republic of Korea

[3] Department of Emergency Medical Technology, ChungCheong University, 38Wolgok-Gil Gangnae-Myeon, Heungdeok-Gu, Cheongju-Si, Chungbuk, 28171,Republic of Korea

**Abstract**

This study purposed to investigate the infection disaster risk and response system against the spread of COVID-19.For COVID-19 outbreak status, the data on daily briefings regarding "Coronavirus Disease-19, Republic of Korea," as disclosed by MOHW and KCDC, were coded. The research on COVID-19 covered the period from January 20 to May 15, 2020. The total numberofCOVID-19 confirmed cases is 11,018.The death was 260. The data were using SPSS for Windows 20.0 Version.Between January 20, 2020, when COVID-19 broke out, and May 15, 2020, 11,018 cases were confirmed, 9,821 were released from quarantine, and 260 were dead. No more than 2.35% of all the confirmed cases (260/11,018) were dead by May 15, 2020. 89.1% were released from quarantine by May 15, demonstrating a good public health system.Despite community infection, the mortality rate was generally low. This might have resulted from the K-Quarantine, which is characterized by the low mortality rate with journey disclosure for the confirmed cases, quick quarantine, the efficient examination system using Drive-Thru and Walking-Thru, and the social distancing policy. Therefore, building an efficient infection disaster response system can reduce the risk of any sudden infection disaster occurrence.

*Corresponding Author :

Name : Sang-Sub Park

Email : wooonseo@hanmail.net

Contact : +82-10-9552-4876

Fax : +82-43-230-2584

Date of Submission : 05-10-2020

**Introduction**

Coronavirus Disease 2019 (COVID-19) was confirmed as a cause of pneumonia cases in Wuhan, Hubei Province on December 31, 2019(WHO., 2020a). The virus causing COVID-19 is called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and was once called 2019 Novel Coronavirus (2019-nCoV)(McIntosh K*et al.,* 2020).

The WHO announced Public Health Emergency of International Concern (PHEIC) on January 31, 2020 after the confirmation of its prevalence with inter-person spread (WHO., 2020b). On March 11, 2020, WHO announced Pandemic with 118,000 confirmed cases and 4,291 deaths in 114 countries (WHO., 2020c).

South Korea confirmed the first case, an influx one, and raised the infectious disease crisis alert from 'Blue' to 'Yellow' on January 20 (MOHW and KCDC., 2020a). The fourth case was confirmed and the crisis alert level was raised from 'Yellow' to 'Orange' on January 27 (MOHW and KCDC., 2020b); the confirmed cases increased to 602 and the level was raised from 'Yellow' to 'Red' on February 23 (MOHW and KCDC., 2020c;MOHW and KCDC., 2020d). MOHW and KCDC (MOHW and KCDC., 2020c) raised the crisis alert level from 'Orange' to 'Red' because a member of a religious group in Daegu caused COVID-19 to be transmitted rapidly across the community on February 18.

COVID-19 is characterized by person-to-person infection droplets and hands has an incubation period of approximately 2-14 days (Zhai P et al., 2020). COVID-19 is infected via droplets from noses or mouths and it is necessary to keep a distance of at least 1 m from others (WHO., 2020e). COVID-19 is mild at its initial stage but can discharge virus during its asymptomatic stage before becoming symptomatic(Heo J Y., 2020). The symptoms of COVID-19 can include cough, muscle pain, chills, breathing difficulty, fever, diarrhea, loss of taste, and loss of smell after the exposure to the virus (WHO., 2020e ;CDC., 2020).

10.89% of the inpatients with COVID-19 have comorbidities, including diabetes, chronic respiratory disease, and cancer (Nikpouraghdam M*et al,* 2020). In addition, people can be more susceptible to an infectious disease if it occurs at specific regions and is at higher risk of outbreak (WHO., 2006). As for the clinical characteristics of COVID-19, Liu K et al(2020) noted that the elderly group was at higher risk of COVID-19 due to underlying disease and pneumonia than the young group. The failure to diagnose it for quarantine at the early stage can lead to wide-ranging community transmission (Heo J Y.,2020).

As of May 16, 2020, there were 4,434,653 confirmed cases of COVID-19 and 302,169 confirmed deaths in 216 countries and regions around the globe (WHO., 2020d). COVID-19 outbreak is not limited to some regions and countries but spreads damage widely and rapidly all

over the world. However, it has a serious impact on the underprivileged health bracket that includes those with underlying disease and seniors while its treatment has not been developed yet.

MOLEG and NLIC(2020) noted that South Korea has included SARS and MERS as 'Grade 1 Infectious Disease' in the Infectious Disease Control and Prevention Act but has failed to include the emerging COVID-19 as Grade 1 Infectious Disease .

This study aimed to investigate the infection disaster risk and response system against the spread of COVID-19 in Republic of Korea. The data disclosed by MOHW and KCDC(2020d)since the COVID-19 outbreak were coded. The research covered the period from January 20 to May 15, 2020.This study aimed to help develop efficient methods of preventing and coping with infection against the risk of infection disaster. It intended to help make institutional improvement for infection prevention.

## Materials and Methods
### Research Period and Subjects

The first COVID-19 patient in Republic of Korea appeared on January 20, 2020. The research covered about four months until May 15, 2020. MOHW and KCDC (2020d)confirmed a Chinese COVID-19 patient during the quarantine process and raised the infectious disease crisis alert level from 'Blue' to 'Yellow' on January 20, 2020.A total of 726,747 persons got COVID-19 test, 11,018 cases were confirmed, and 260 were dead by May 15, 2020. This study was conducted in 11,018 confirmed cases in practice.

### Measurement tools

The data on daily briefings regarding "Coronavirus Disease-19, Republic of Korea," as disclosed by the Ministry Of Health Welfare (MOHW) and the Korea Centers for Disease Control Prevention (KCDC) (2020d), were used. The press releases from the national disaster supervision broadcasting system were used to supplement the daily briefings.

MOHW and KCDC (2020d)gave a briefing on the COVID-19 status for the previous day at 10:00 and 14:00 on a daily basis. This study used the afternoon daily briefings. Three briefing types were generally used from January 20 to March 2, 2020: 1) as of 16:00 the day before and 09:00 that day, 2) as of 09:00 the day before and 09:00 that day, and 3) as of 09:00 that day and 16:00 that day. Since the confirmed COVID-19 cases can be overlapped with those of the previous day, they started to give a briefing based on the data for 00:00 the previous day and 00:00 that day on March 3, 2020.

The briefings on COVID-19 were also posted on the website of MOHW and KCDC (2020d). In addition, the daily briefings include the preventive action rules against COVID-19, the

quarantine guidances for immigrants, the living rules for those in self-quarantine and their family and housemates, how to cope with stress from COVID-19, and how to wear a mask.

Before COVID-19 #31 was confirmed on February 17, 2020, the details of each patient were included in the briefings. The details were composed of gender, age, nationality, the date of confirmation, institution for hospitalization, and the number of contacts. The Central Disaster and Safety Countermeasures Headquarters(CDSCH), Provincial Governments(PG), and Health Centers(HC) had each institution disclose information as to confirmed cases (age, gender, patient journey) on its website and send a message via a smartphone as shown in table 1.

Due to the sudden increase in COVID-19 after Confirmed Case 31, the briefings on the details were changed to include gender, age, nationality, the date of confirmation, institution for hospitalization, and the number of contacts. However, the CDSCH, PG, and HChad each institution disclose information as to any confirmed case (age, gender, patient journey) on its website and send a message via a smartphone to prevent any close contact.

As for the procedure, MOHW and KCDC (2020d) announced the outbreak of COVID-19 on January 20, 2020. The daily COVID-19 briefings given by MOHW and KCDC (2020d) after the announcement of COVID-19 were collected. The collected data were classified in terms of COVID-19 status. The data for the period from January 20 to May 15, 2020 were coded.

Between January 20 and May 15, 2020, 11,018 cases were confirmed, 9,821 were released from quarantine, and 260 were dead.

**Table 1: COVID-19 daily status briefing type**

| Division | | Description |
|---|---|---|
| Daily status Briefing type | Jan20-Mar02, 2020 | 1) As of 16:00 previous day & 09:00 that day<br>2) As of 09:00 previous day & 09:00 that day<br>3) As of 09:00 that day & 16:00 that day |
| | Mar03-May15, 2020[*] | - Between 00:00 previous day and 00:00 that day |
| Daily status Briefing item | Outbreak status & prevention publicity materials[**] | 1) Daily occurrence status<br>2)COVID-19 preventive actionrules<br>3) Quarantine guidance for immigrant<br>4) Living rules for those in quarantine and their family andhousemates<br>5) How to cope with stress from COVID-19<br>6) How to wear mask, etc. |
| Changes in details of daily status | #Before Case 31 | - Gender, age, nationality, date of confirmation, institution forhospitalization, number of contacts, etc. |
| | #After Case 31 | - Changes in disclosure of gender, age, nationality, date of confirmation, institution for hospitalization, andnumber ofcontacts due to sudden increase of confirmed cases |

* Changed due to possible overlapping of confirmed COVID-19 cases for the previous day
** These are to disclose information as to occurrence transparently and can be revised and complemented according to additional epidemiological investigation

## Ethical consideration and research procedure

To conduct this study on the basis of the secondary data, it was reviewed by the institutional review board (IRB) in C University. It was exempted from approval after the review (E-1st-2020-001). The research procedure is as shown in in Fig. 1.

## Analysis

SPSS for Windows 20.0 Version was used to code the daily briefing data. Frequency analysis and cross-tabulation analysis were performed in practice. In addition, graphs were used to determine the trend of fluctuation in COVID-19.
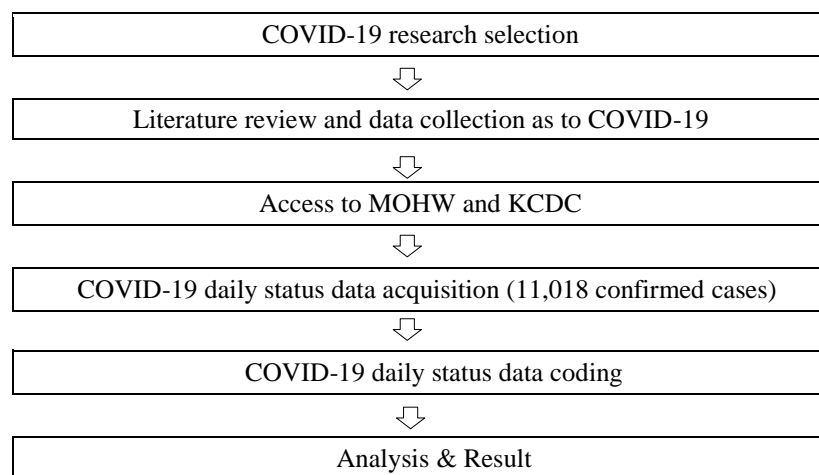
| COVID-19 research selection |
| :---: |
| ⇩ |
| Literature review and data collection as to COVID-19 |
| ⇩ |
| Access to MOHW and KCDC |
| ⇩ |
| COVID-19 daily status data acquisition (11,018 confirmed cases) |
| ⇩ |
| COVID-19 daily status data coding |
| ⇩ |
| Analysis & Result |

**Figure 1 : Research procedure**

## Results and Discussion
## COVID-19 infection status

COVID-19 infection status is as presented as shown in table 2 and in Fig. 2 to 4. 11,018 cases were confirmed between January 20 and May 1, 2020 and the largest increase in confirmed cases (909) was found on February 29. The community transmission via a religious group in Daegu led to the sudden increase in confirmed cases. The number of those in self-quarantine increased by 905 on February 29, which was related to the religious group in Daegu. The number of those released from quarantine increased by 414 on March 26 probably because the confirmed patients completed treatment and were discharged from healthcare institutions after the community transmission via the religious group in Daegu.

The number of deaths was 260 by May 15, 2020; it increased by 9 on March 24, indicating a high rate of daily mortality. This is probably due to the high mortality rate among the patients infected after the religious group infection in Daegu. The mortality rate in Republic of Korea is 2.36%.

The sudden community transmission of COVID-19 is characterized by the increase or decrease in infection due to such environmental conditions as a religious group, crowded places, closed spaces, close contact, and short distance. Some of the most common symptoms are cough, fever, muscle pain, fatigue, diarrhea, and breathing difficulty and it has an incubation period of four days (Guan W*et al.,* 2020;Huang C*et al.,* 2020). Chaolin Huang et al(Huang C*et al.,* 2020)found that many of the patients infected with COVID-19 had underlying diseases and diabetes (20.0%), hypertension (15.0%), and cardiovascular(15.0%). COVID-19 is a dangerous condition (Lu R*et al.,* 2020).

## Table 2: COVID-19 infection status

| | N | Min | Max | |
|---|---|---|---|---|
| Total tests | 726,747 | .00 | 1952.00 | Total cumulative tests |
| Increase of total tests | 18199 | .00 | 18199.00 | Maximum increase on Mar. 6 |
| Confirmed cases | 11018 | 1.00 | 11018.00 | Cumulative confirmed cases |
| Increase of confirmed cases | 909 | .00 | 909.00 | Maximum increase on Feb. 29 |
| Persons in quarantine | 7470 | 1 | 7470.00 | Cumulative persons in quarantine |
| Increase of persons in quarantine | 905 | -315,00 | 905.00 | Maximum increase on Feb. 29 |
| Release from quarantine | 9821 | 0.00 | 9821.00 | Cumulative cases released from quarantine |
| Increase of cases released fromquarantine | 414 | 0.00 | 414.00 | Maximum increase on Mar. 26 |
| Deaths[*] | 260 | .00 | 260.00 | Cumulative deaths |
| Increase of deaths | 9 | .00 | 9.00 | Maximum increase on Mar. 24 |
| Negative result | 695854 | 4.00 | 695854.00 | Cumulative negative results |
| Increase of negative results | 17659 | .00 | 17659.00 | Maximum increase on Mar. 6 |

[*] Fatality rate = Number of deaths / number of confirmed cases × 100 *Incidence rate out of 100,000 persons
* Number of cumulative confirmed cases after January in each region / population in each region (based on the statistics of registered population, Ministry Vof the Interior and Safety, as of January 2020)
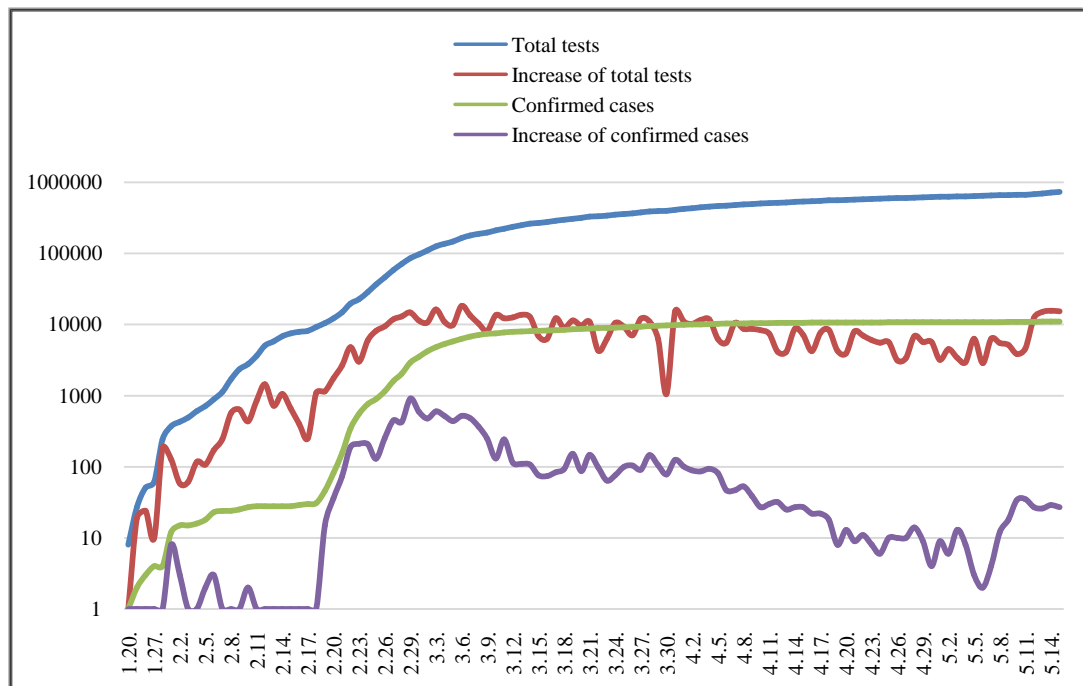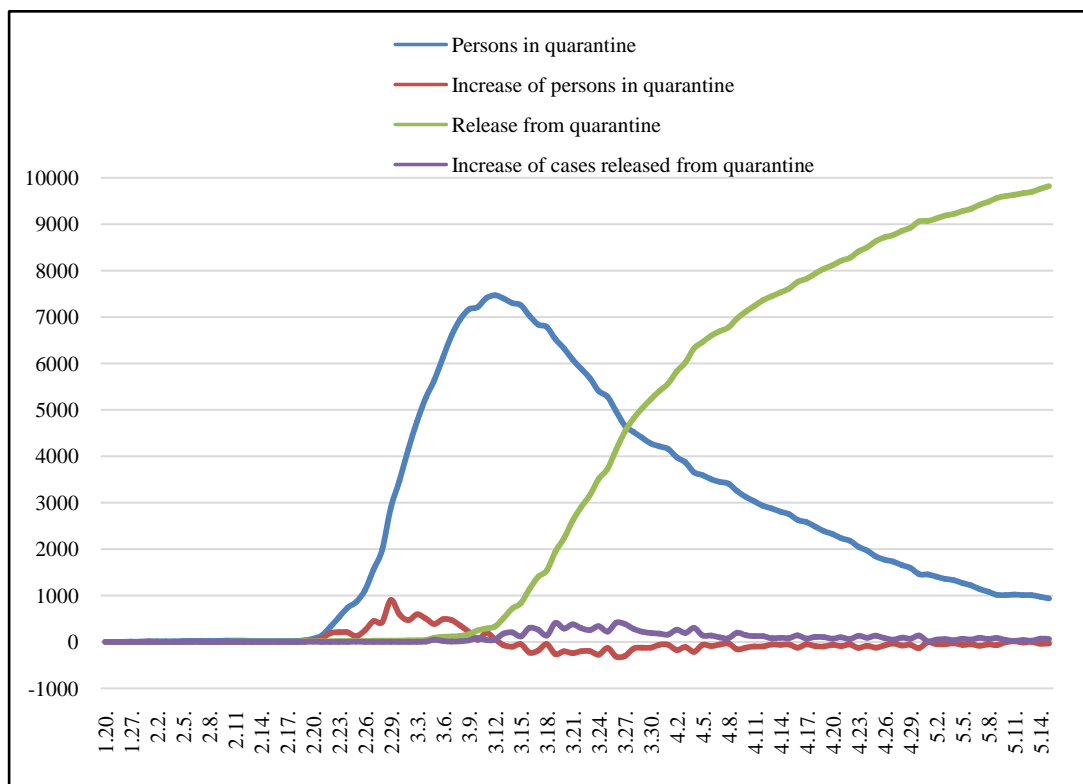
**Figure 2 : Total tests & Confirmed cases**



**Figure 3 :  Persons in quarantine&Release from quarantine**
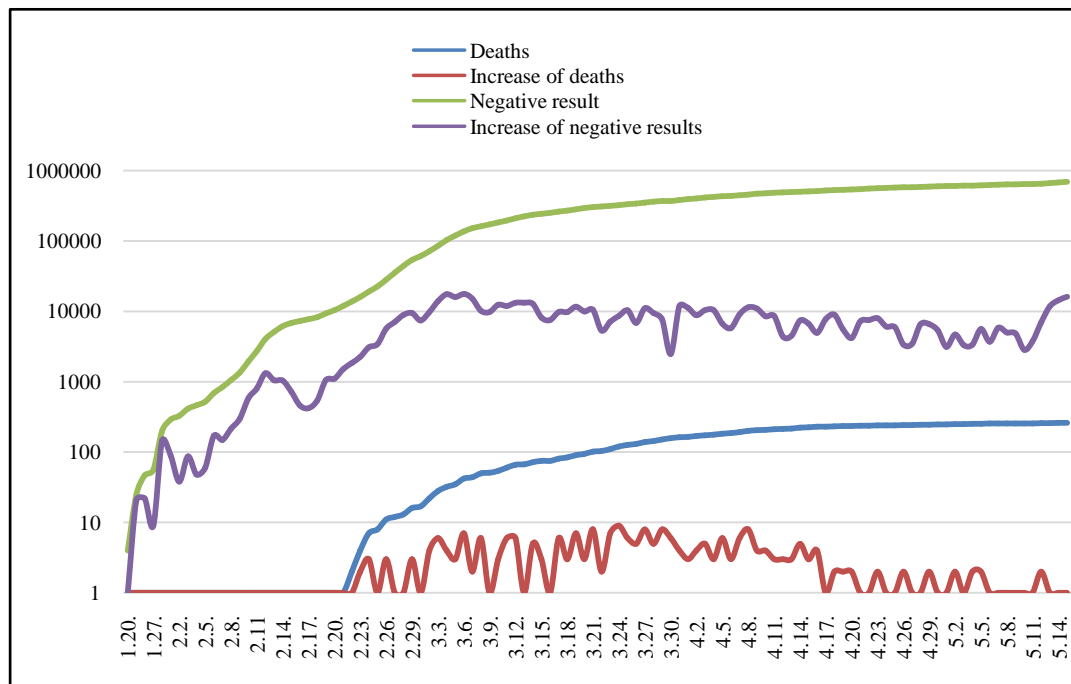
**Figure 4 : Deaths&Negative result**

**COVID-19 confirmed case response system**

The COVID-19 confirmed case response system is as presented as shown in table 3. The infectious disease crisis alert levels are divided into 'Blue,' 'Yellow,' 'Orange,' and 'Red.' The level was raised to 'Red' due to the increase of confirmed cases to 602 on February 23. The level was raised from 'Orange' to 'Red' because a member of a religious group caused COVID-19 to spread rapidly across the community of Daegu on February 18.

For quick COVID-19 infection test, Drive-Thru and Walking-Thru have been used. According to MOHW avd KCDC(2020d), Drive-Thru is a quick and safe test method of examining and collecting a sample safely in a car and aims to minimize contact with patients, reduce test time, and remove the risk of infection and transmission within healthcare institutions. Walking-Thru is composed of four personal negative-pressure booths like public telephone stations. Once a person enters the booth, a medical staff member puts his/her hand into the booth from outside to collect a sample from a nostril and the mouth.

The CDSCH, PG, and HC send a text message for notification. In addition, they disclose detailed information as to patient journey. People are at risk of COVID-9 infection in case of close contact with patients and the disclosure of information as to patient journey may help prevent infection. Guan W*et al*(2020) contended that infection was caused by contact with the infected one. Such contact puts aged patients at high risk of general symptoms (Chan JFW*et al.,* 2020). Management of infectious disasters is important. According to Kumari (Kumari T., 2019), tracking, health needs to be tracked, improved, and managed.

**Table 3: COVID-19 confirmed case response system**

| Division (Past 2 weeks) | | Social distancing[*] | | |
|---|---|---|---|---|
| | | Stage 1 (Distancing in daily life) | Stage 2 | Stage 3 |
| Daily confirmed cases (persons) (Based on community patients) | | >50 | 50~100 | 100 – 200< Two doublings in a week |
| Rate of cases with unknown infection route | | >5% | - | Drastic increase |
| Group infection under control (cases) | | Decrease or control | Continuous increase | Drastic increase |
| Rate of control within quarantinenet(%) | | Increase or 80%< | - | - |
| Innovation of K-Quarantine | Drive-thru | - Safe test during slow drive | | |
| | Walking-thru | - Once a person enters the booth, a medical staff member puts his/her hand into the booth from outside to collect a sample from a nostril and the mouth | | |
| | Disaster safety text message | - Patient journey information disclosure in case of COVID-19 occurrence | | |
| [*]MOHW&KCDC. (2020d). Coronavirus Disease-19, Republic of Korea. | | | | |

## Conclusion

This study aimed to investigate the infection disaster risk and response system against the spread of COVID-19. The first case appeared on January 20, 2020, the infection had been slow until Confirmed Case 30, and the community infection increased rapidly due to religious group members after Case 31. Although community infection was caused by a member of a religious group, the mortality rate was low. This resulted from the good K-Quarantine, which involves COVID-19 preventive action rules, the quarantine rules for immigrants, the self-quarantine rules, how to wear a mask, Drive-Thru and Walking Thru, infection occurrence notification message, and patient journey tracing (by using credit cards and CCTV). When a sudden infection disaster occurs, building an efficient disaster response system can reduce the infection confirmation and mortality rates; therefore, it is necessary to activate an infection disaster program continuously.

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