COVID-19 Special Issue 2

# Quarantine Response to COVID-19: The COVID-19 National Quarantine Station at Incheon Airport

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## Abstract

The purpose of this report was to present the characteristics of the quarantine response to COVID-19 by analyzing indicators at the Incheon Airport National Quarantine Station (the IANQS). In 2020, quarantine in South Korea gradually strengthened following the global spread of COVID-19. As a result, the daily number of inbound travelers decreased, but the collection rate of health declaration forms (HDFs) reached 96.6 percent of those who entered South Korea.

The target period for analysis was from January 2nd to May 15th, 2020 and the main results are as follows.

First, the total number of quarantine targets was 5,690,933, and the collected number of HDFs was 892,918. A total of 405 patients including the first confirmed patient (#1) were confirmed by the IANQS among patients under investigation (PUIs) who were detected at the quarantine phase.

Second, cases with COVID-19 symptoms were affected by the outbreak trends of the departure country. From January to the end of February 2020, the majority of cases with symptoms departed from China, and after March, the number of cases with symptoms increased significantly due to the spread of COVID-19 in Europe and the United States. Flight analyses showed the same results that the percentage of PUI passengers was high in flights from departure cities with high prevalence.

Third, 84% of 404 confirmed cases from March 14th to May 15th, 2020 had been in Europe and the United States.

**Keywords:** COVID-19, Quarantine, Imported case, Airport

# Introduction

After the first cases of pneumonia of unknown origin were reported from Wuhan, Hubei Province, China on December 31, 2019, the Incheon Airport National Quarantine Station implemented heightened quarantine procedures on January 3, 2020. On January 19, 2020, the first confirmed coronavirus disease 2019 (COVID-19) case in Korea was categorized as a patient under investigation (PUI) during the quarantine process, transferred and isolated in a designated isolation ward, and confirmed to be infected with COVID-19 on the next day. As COVID-19 spread across China, the quarantine station installed assessment clinics inside the arrival hall of Incheon Airport starting on January 28, 2020. The Incheon Airport National Quarantine Station began to offer COVID-19 polymerase chain reaction (PCR) testing on January 31, and 405 cases of COVID-19 were confirmed during quarantine processing at the Incheon Airport National Quarantine Station as of May 15, 2020, including the first confirmed case in Korea.

This report presents an analysis of the COVID-19 quarantine response at Incheon Airport from January 2, 2020, the day prior

to the implementation of heightened quarantine measures, until May 15, 2020. The timeframe for the analysis was determined based on significant trends in situational fluctuations.

# Result

## Changes in quarantine subjects

A quarantine subject is defined as any person who is required to submit a health declaration form when seeking entry to South Korea. Travelers who need to submit health declaration forms are determined by the designation of a quarantine control region (formerly, quarantinable disease risk areas) or other policy measures of the government.

On January 20, 2020, when the first confirmed case was reported, the government elevated the epidemic threat level to yellow and issued instructions for a heightened response. When the threat level was raised to orange on January 27, all travelers from China (except Hong Kong and Macau) were required to submit health declaration forms. The threat level was then raised to red on February 24. As confirmed cases surged around Europe, the compulsory submission of health declaration forms expanded to entrants from Iran and Italy on March 11, travelers from five European states (the United Kingdom, France, Germany, the Netherlands, and Spain) on March 15, and travelers from all European countries on March 16. On March 12, the World Health Organization declared the COVID-19 outbreak to be a pandemic. As the number of confirmed cases imported from foreign countries has grown, the Korean government has implemented stricter quarantine measures, requiring all persons entering South Korea to submit health declaration forms.

The daily average number of travelers in January was 106,534. However, the number of people seeking entry to South Korea drastically dropped since February, when stricter quarantine measures came into force. However, the proportion of travelers required to complete health declaration forms rose to 96.6% in May (May 1 to May 15, 2020). This figure includes connecting passengers who did not land in Korea according to the KCDC Integrated System. Excluding connecting passengers, 100% of travelers entering South Korea have been required to submit health declaration forms since March 19 (Table 1).

The requirement to submit health declaration forms was limited to travelers from quarantinable disease risk areas until January 28, 2020. During this period, on average, 11,041 forms were submitted per day (January 2 to January 26, 2020).

**Table 1.** No. of Daily Inbound Travelers, Collection of Health Declaration Forms (HDFs), Collection Rate of Health Declaration Forms (HDFs)

(N, %)

| Period | Average No. of Daily Inbound Travelers* | Average No. of Daily HDF Collection | Average Rate of HDF Collection |
|---|---|---|---|
| Jan. (2020.1.2.~2020.1.31.) | 106,534 | 11,957 | 11.3 |
| Feb. (2020.2.1.~2020.2.29.) | 65,657 | 6,695 | 9.9 |
| March (2020.3.1.~2020.3.31.) | 12,445 | 4,526 | 45.9 |
| April (2020.4.1.~2020.4.30.) | 4,867 | 4,637 | 95.5 |
| May (2020.5.1.~2020.5.15.) | 3,938 | 3,801 | 96.6 |

*Including transit

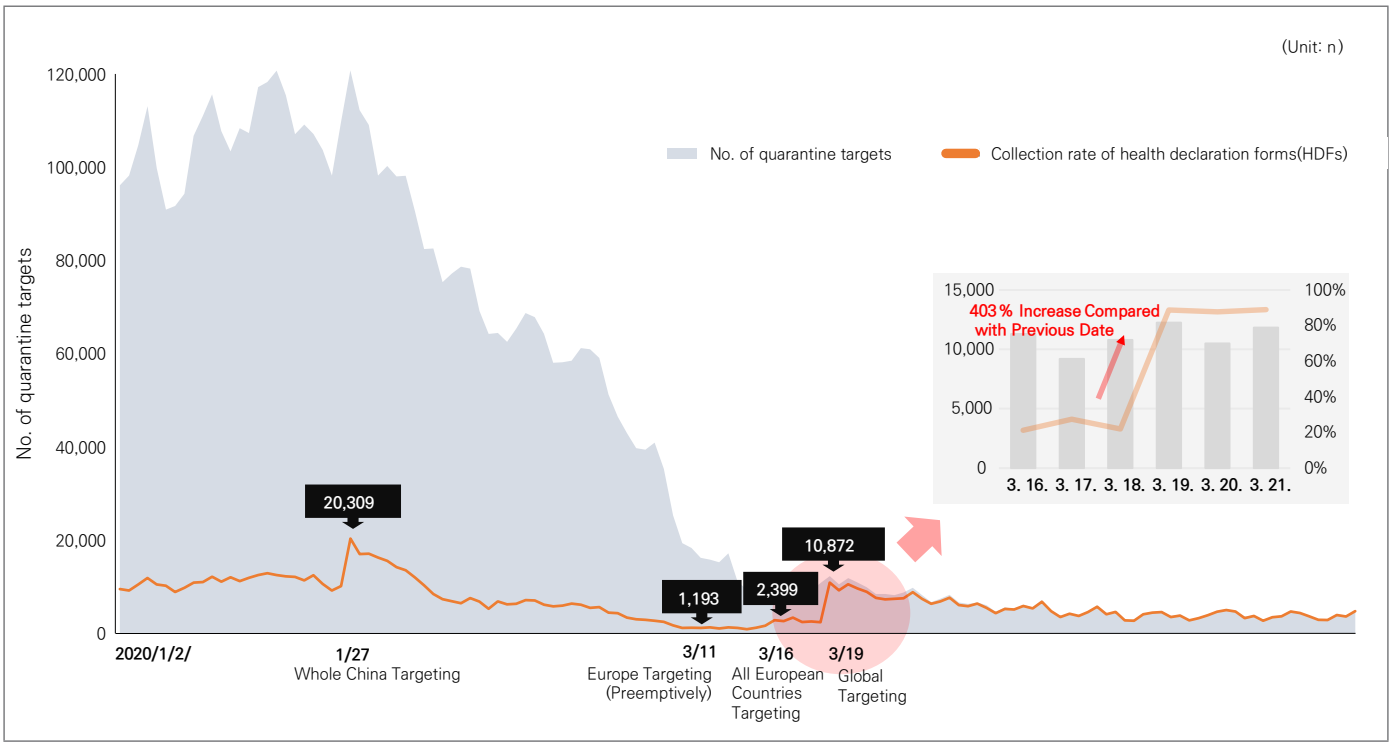


**Figure 1.** Total number of inbound travelers and the collection rate of health declaration forms (HDFs)

However, as the disease risk areas were expanded and stricter quarantine measures were implemented by the Incheon Airport National Quarantine Station, the number of required forms rose by 10,202 to 20,309 on January 27. Even though the concentrated quarantine measures for transit countries targeting MERS and Ebola, as well as the cholera risk area, were temporarily suspended to focus efforts on the response to COVID-19, the average daily number of health declaration forms remained 16,469 from January 28 to January 31.

Europe experienced large-scale spread of COVID-19 during March. Based on this situation, the Incheon Airport National Quarantine Station promptly decided to require health declaration forms from airline travelers originating from Europe. The required number of health declaration forms rose from 1,193 on March 11 to 1,620 on March 12 and 2,788 on March 13. The government requirement of health declaration forms officially came into force on March 16, when we required 2,399 forms. The number of required forms on March 19, when the requirement was extended to all travelers, rose by 8,500 compared to March 18, with 10,872 forms. The proportion of travelers required to submit forms spiked by 403% from March 18 to March 19, from 22.0% to 88.7% (Fig. 1).

## Status of quarantine response for PUIs[1] from major countries

Quarantine measures started to be implemented in response to COVID-19 on January 3, 2020. At that time, COVID-19 had been reported in the vicinity of Wuhan in Hubei Province, China; therefore, quarantine measures were mainly imposed on

1) A person who indicated on the health declaration form that he or she had experienced symptoms (fever, chills, headache, etc.), took medicine related to the symptoms, visited a local clinic or had come into contact with animals, or had an unrecognized fever detected by thermal monitoring.

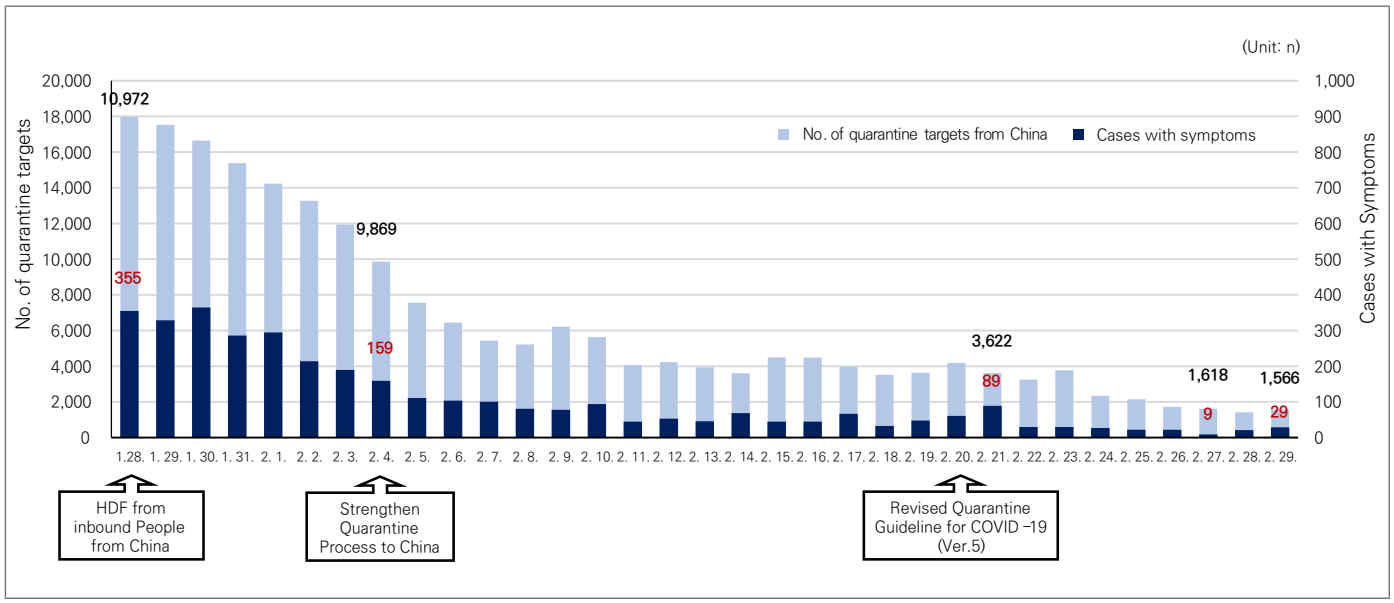


Figure 2. Intensive Quarantine Period for Inbound Travelers from China (January 28 – February 29, 2020)

flights from Wuhan, China. However, only a small proportion of travelers were from Wuhan, compared to those from the entire territory of China, so this report focuses on the quarantine measures implemented after January 28, when the quarantinable disease risk area was expanded to the entirety of China (except Hong Kong and Macau).

### A. Stricter quarantine measures for travelers from China (January 28 to February 29, 2020)

As the quarantinable disease risk area was expanded from the previously designated five provinces and cities of China to the entirety of mainland China (except Hong Kong and Macau) on January 27, 2020, the Korea Centers for Disease Control tried to prevent the influx of the disease by temporarily suspending concentrated quarantine measures for transit countries targeting Ebola and MERS.

However, entries originating from China had already been declining, especially after February 4, when even stricter quarantine measures were introduced for people inbound from China. As such, the number of PUIs also declined. There were 355 PUIs among travelers from China on January 28, but the number dropped to 9 on February 27. In the last week of the month (February 24 to February 29), the average number of PUIs was 21.6, and the proportion of PUIs among all travelers from China remained around 1.2% (Fig 2).

The number of PUIs increased temporarily on February 21, 2020; we believe that the updated definition of PUIs[2)] in February 2020 affected the likelihood of triage during assessment.

### B. Concentrated quarantine efforts for travelers from European countries (March 1 to March 19, 2020)

In March, COVID-19 began to spread in Europe, centered around Italy, and the Incheon Airport National Quarantine Station prepared to respond. On March 11, Iran and Italy

2) "Suspected case of COVID-19 based on doctor's opinion" was added to the definition of PUIs in the fifth edition of the COVID-19 quarantine response instructions.

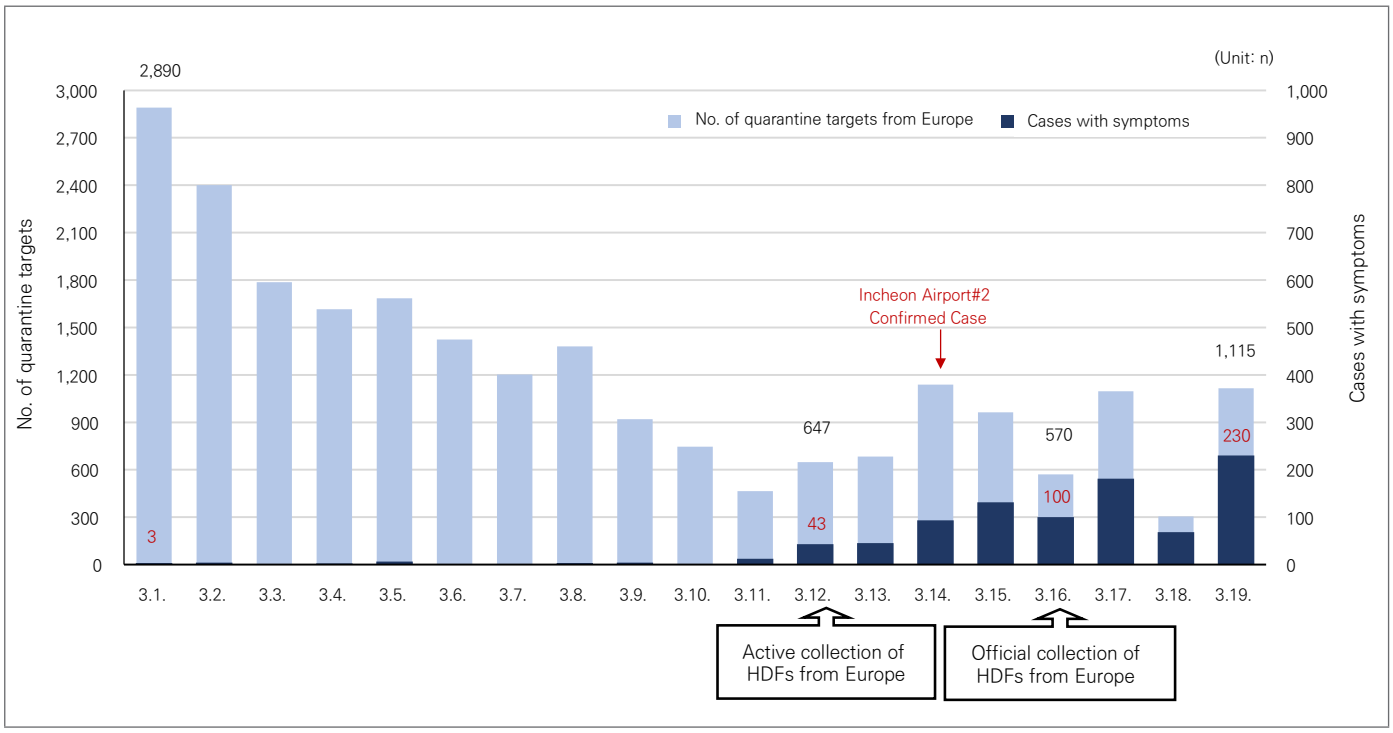


**Figure 3.** Intensive Quarantine Period for Inbound Travelers from Europe (March 1 – March 19, 2020)

were added to the quarantine control regions, and the Incheon Airport National Quarantine Station proactively required health declaration forms for passengers on flights originating from Europe (including some Middle Eastern origin flights[3]) and one traveler who entered the Czech Republic was confirmed to have COVID-19 during quarantine processing at Incheon Airport on March 14. Therefore, the health declaration form became mandatory for travelers from all European states. While the number of entry attempts rose and fell based daily fluctuations in flight operations, the proportion of PUIs continued to rise before the health declaration form requirement was extended to all travelers worldwide (March 19) (Fig. 3).

### C. Concentrated quarantine efforts for European and American travelers (March 19 to April 18, 2020)

The government mandated health declaration form submission for all travelers from anywhere in the world on March 19, 2020. We analyzed the number of travelers and PUIs from Europe and the United States, where COVID-19 was particularly prevalent during that time.

The average daily number of PUIs from Europe and the United States before March 19 remained around 175 people (3.6%). However, as quarantine requirements began to be imposed on all travelers, the number of PUIs from Europe and the United States spiked to 474, with an increase of 401 cases compared to the day prior (March 18). The rate of PUIs jumped to 12.8% of all travelers originating from Europe and the United States (Fig. 4).

These results imply that people with COVID-19 symptoms from the United States may have slipped through quarantine processing by not submitting a health declaration form. The

3) This term refers to flights originating from the UAE or Qatar bound for Incheon International Airport. Health declaration forms had already been collected from those flights due to MERS quarantine procedures, but an increasing number of passengers used Qatar and UAE connections as many direct flights from Europe were disrupted.

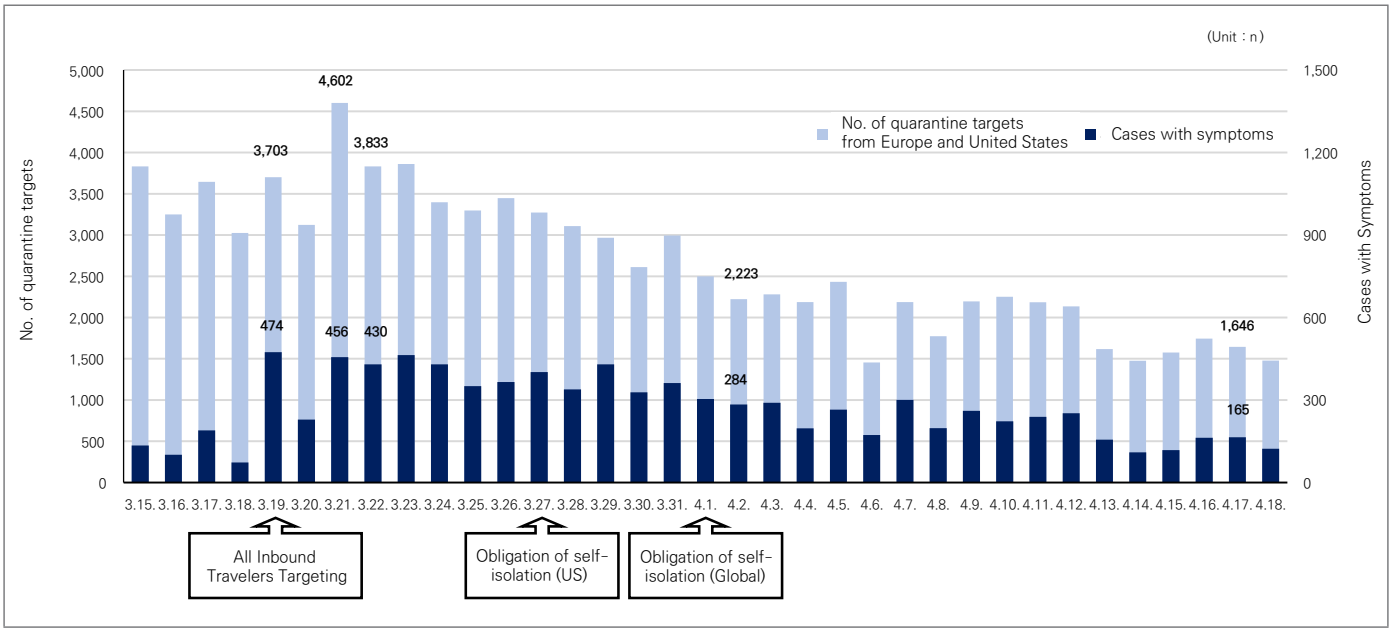


**Figure 4.** Intensive Quarantine Period for Inbound travelers from Europe and the United States (March 15 – April 18, 2020)

number of entries from Europe and the United States decreased to 2,223 persons on April 2, two weeks after stricter quarantine measures were imposed, corresponding to around 60% of prior entry attempts. However, the average proportion of PUIs remained 11% to 12% on average. As imported COVID-19 cases increased, particularly from Europe and the United States, the government imposed mandatory isolation for admitted travelers, starting with European travelers on March 24, expanding to travelers from the United States on March 27, and then including all travelers from outside of Korea beginning on April 1.

## Passenger and PUI status for major originating cities

As different nations experienced the peak of the COVID-19 outbreak, the distribution of PUIs based on the originating city also changed. Thus, we analyzed the number of passengers and PUIs on flights from the major originating cities (London, Paris, New York, and the Middle East [Doha and Abu Dhabi]) during different periods. We included flights from the Middle East because we confirmed that many travelers who had entered Europe connected through flights from the Middle East as a detour due to the disruption of commercial flight services directly from Europe. In order to examine the characteristics of imported COVID-19 cases, we determined the dates when flights carrying passengers operated, and then analyzed the changes in passengers and PUIs.

### A. The proportion of PUIs among travelers from major originating cities

The highest proportion of PUIs relative to entry attempts via major commercial flight routes was found during the third and fourth weeks of March and the first and second weeks of April for flights from Europe. Notably, the proportion of PUIs on flights from Paris on March 23 spiked to 33.7%, and the proportion remained above 10% into the third and fourth weeks of April (Table 2).

Table 2. Cases with Symptoms Compared with the Number of Inbound Travelers from High Prevalence Countries and Cities

(N, %)

| Period | Departure Country & City | Europe | | USA | Middle East |
|---|---|---|---|---|---|
| | | London | Paris | New York | (Doha, Abu Dhabi) |
| March | 1–2 Week (3.01.~3.15.) | 3.6 | 3.2 | 1.0 | 7.6 |
| | 3–4 Week (3.16.~3.31.) | 18.3 | 24.5 | 8.3 | 23.1 |
| April | 1–2 Week (4.01.~4.15.) | 18.8 | 23.0 | 11.4 | 14.8 |
| | 3–4 Week (4.16.~4.30.) | 15.1 | 18.6 | 6.7 | 12.0 |
| May | 1–2 Week (5.01.~5.15.) | 9.4 | 18.9 | 4.4 | 6.8 |

### B. Changes in trends for each originating city

We looked into changes in the numbers of travelers and PUIs on flights from major cities (London, Paris, New York, and those in the Middle East), and the results were as follows (Fig. 5).

Flights from London, UK were operated three times per week by two airlines. Flights originating from Paris, France were operated by one airline, with two to three flights per week. For the London-origin flights, while the number of travelers varied by date, the highest number of passengers entered between March 27 and March 29 during the period of interest. In particular,

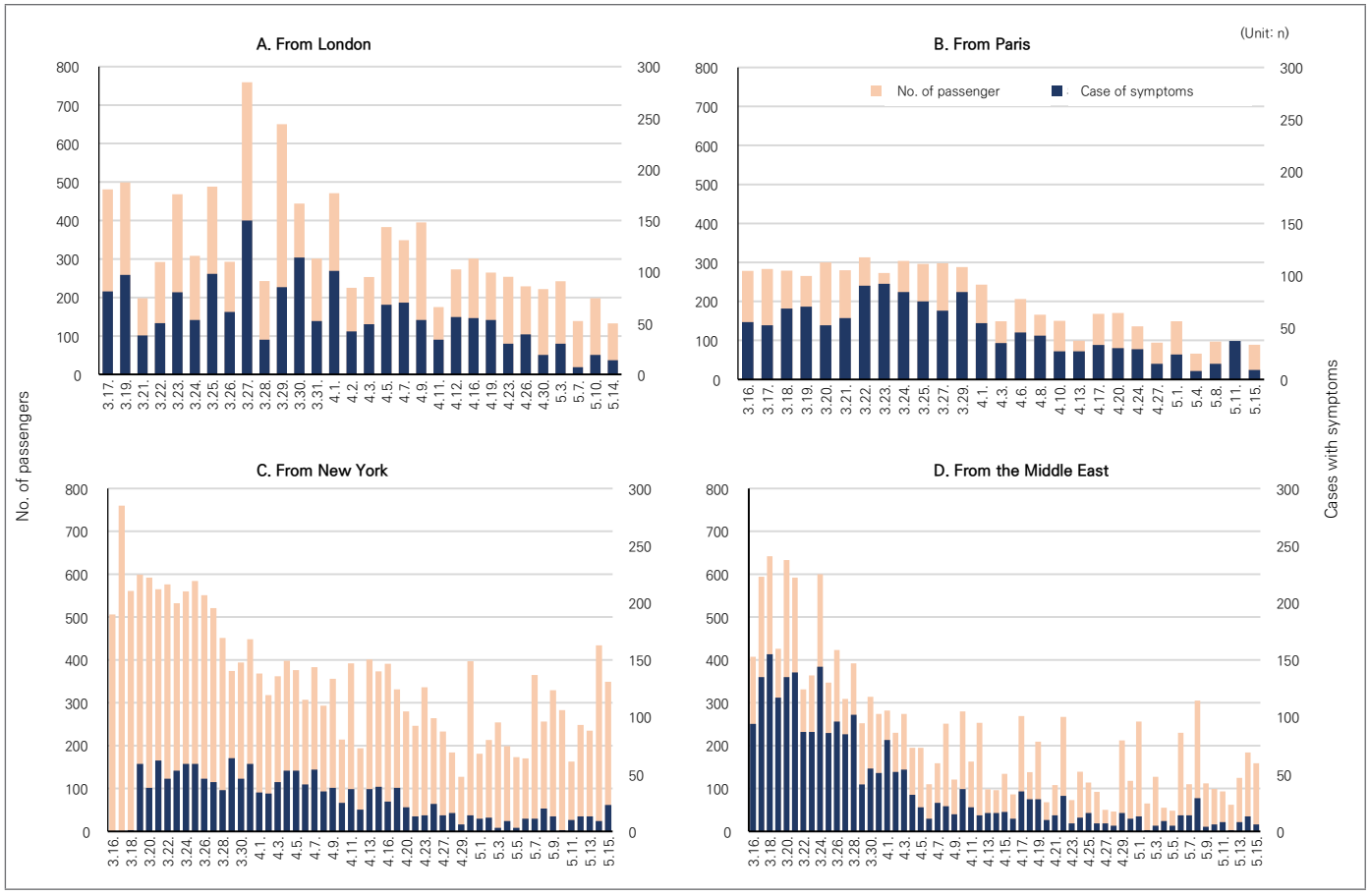


Figure 5. The Number of Inbound Travelers from High Prevalence Countries and Cities and Cases with Symptoms

150 travelers from London were classified as PUIs on March 27. For the flights originating from Paris, the number of entry attempts remained approximately 300 until the end of March. The proportion of PUIs rose to 33.7% on March 23. On that date, there were 273 people, with 92 reported PUIs.

Flights from New York were operated by two airlines, with five to seven flights per week on average. Only one to three PUIs per day were reported from March 1 to March 18. However, as stricter quarantine procedures were imposed, the number of PUIs rose to 59 on March 19. Since then, the number of PUIs from New York remained generally stable from March 16 to April 15, with an average of 40.4 people, and only started to decline in mid-April.

Due to the impact of European sojourners, flights originating from the Middle East continued to have a high proportions of PUIs; notably, on March 18, there were 155 PUIs (24.1%) among 642 passengers. This trend continued into early April, with 100.6 PUIs on average between March 16 and March 31. Then, the proportion of PUIs started to decline, with averages of 28.7 people during the first half of April (April 1 to April 15) and 15.7 people during the second half of April (April 16 to April 30).

## Status of testing and confirmed cases of COVID-19 during quarantine processing at Incheon Airport

### A. Testing and confirmed cases (daily, cumulative) during quarantine processing at Incheon Airport

The Incheon Airport National Quarantine Station installed an assessment clinic within the airport on January 28 to prevent the influx of COVID-19. The assessment clinic conducted COVID-19 PCR tests on its premises, with 14,178 tests performed through May 15. We aggregated the confirmed cases from March 14, when the second confirmed case was reported from quarantine processing at the airport, with the following results (Fig. 6).

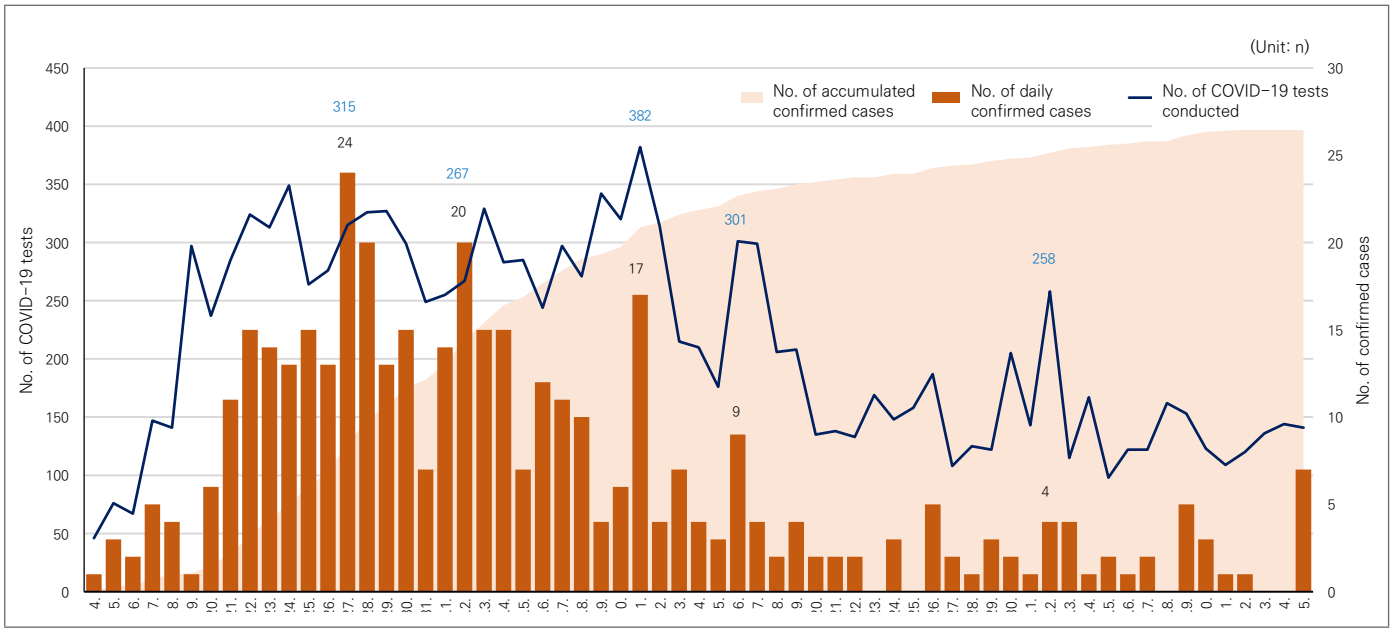


Figure 6. The Number of COVID19 Tests Conducted and the Number of Confirmed Cases (Accumulation, Daily)

The number of tests changed as the number of PUIs entering quarantine processing fluctuated. It steadily rose since March 14, when a confirmed case was reported among travelers from Europe. On March 27, 315 tests were administered with 24 confirmed cases; this was the day with the most confirmed cases reported by the station. Subsequently, the number of tests and confirmed cases remained high until mid-April, with a daily average of 294 tests from March 20 to April 10, but declined starting in mid-May.

### B. Geographic origin of confirmed cases reported during quarantine processing at Incheon Airport

The regions of origin from which the confirmed cases reported during the Incheon airport quarantine phase (404 cases) are presented below (Fig. 7). Although there were 404 confirmed cases, we analyzed 408 cases[4] due to duplication of regions of origin. The United States was the most common point of origin (179 cases, 43.9%) followed by Europe (160 cases, 39.2%), the Middle East (16 cases, 3.9%), Asia (36 cases, 8.8%), and others (17 cases, 4.2%).[5] This is commensurate with the fact that the majority of imported cases were from the United States or Europe.

In an analysis of changes in the regions of origin of confirmed cases, many were initially from European countries, but as time progressed, more confirmed cases were from the United States. International trends in the spread of the COVID-19 pandemic were analyzed by tracking the dates where the most confirmed cases arrived from various regions. On March 27, among 24 confirmed cases, 18 were from Europe, five were from the United States, and one was from Thailand. On April 11, among 17 confirmed cases, two were from Europe, 12 were

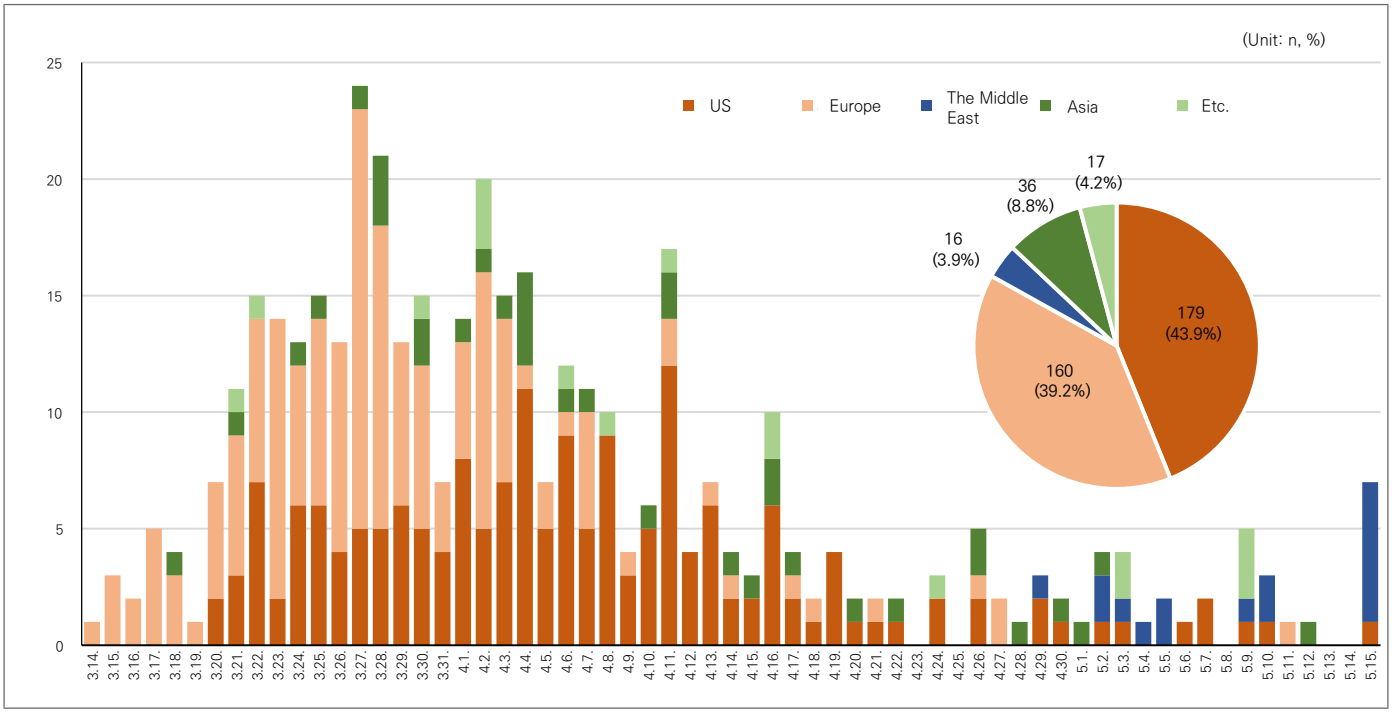


Figure 7. The Departure Countries of Confirmed Cases

4) One duplicate case of the US and Europe, and 3 cases of the US and others were reported.

5) Including North America (except the United States), South America, and Africa.

from the US, two were from Japan, and one was from Canada. After May, many confirmed cases arrived from the Middle East, because quarantine measures were heightened due to mass outbreaks at construction sites in the Middle East region.

## PUIs in quarantine processing and measures to treat confirmed patients

### A. PUI processing procedures

COVID-19 PUIs identified in Incheon Airport are tested in one of two ways. A sample is obtained either after transferring a PUI to a negative-pressure isolation facility within the Central Quarantine Medical Support Center or on-site in the arrival hall after triage. In principle, PUIs are taken to negative-pressure isolation facilities if they exhibit typical symptoms of COVID-19, if they are suffering a relatively severe onset of illness, or if a sample must be taken from the lower respiratory tract. Otherwise, PUIs are tested on-site at the arrival hall, with individual isolation performed in a temporary waiting room.

As the number of PUIs spiked due to the COVID-19 pandemic, we required a waiting space where PUIs are directed to isolate while waiting for their test results. Hence, the Incheon Airport National Quarantine Station rented 3 temporary waiting facilities. Fewer PUIs were directed to negative-pressure isolation facilities after we began utilizing temporary waiting areas, which could be attributed to the better health status of travelers from foreign countries. Most of the cases (94.3%, 13,365 tests) only required a sample from the upper respiratory tract, as they did not exhibit symptoms such as excessive mucus production.

The number of PUIs and COVID-19 confirmed cases continued to decline since mid-April, so the Incheon Airport National Quarantine Station gradually scaled back the operations of the temporary waiting areas. Currently, we are operating one temporary waiting area in addition to negative-pressure isolation facilities. The records of COVID-19 PUI processing in quarantine processing at Incheon Airport are presented below (Fig. 8).

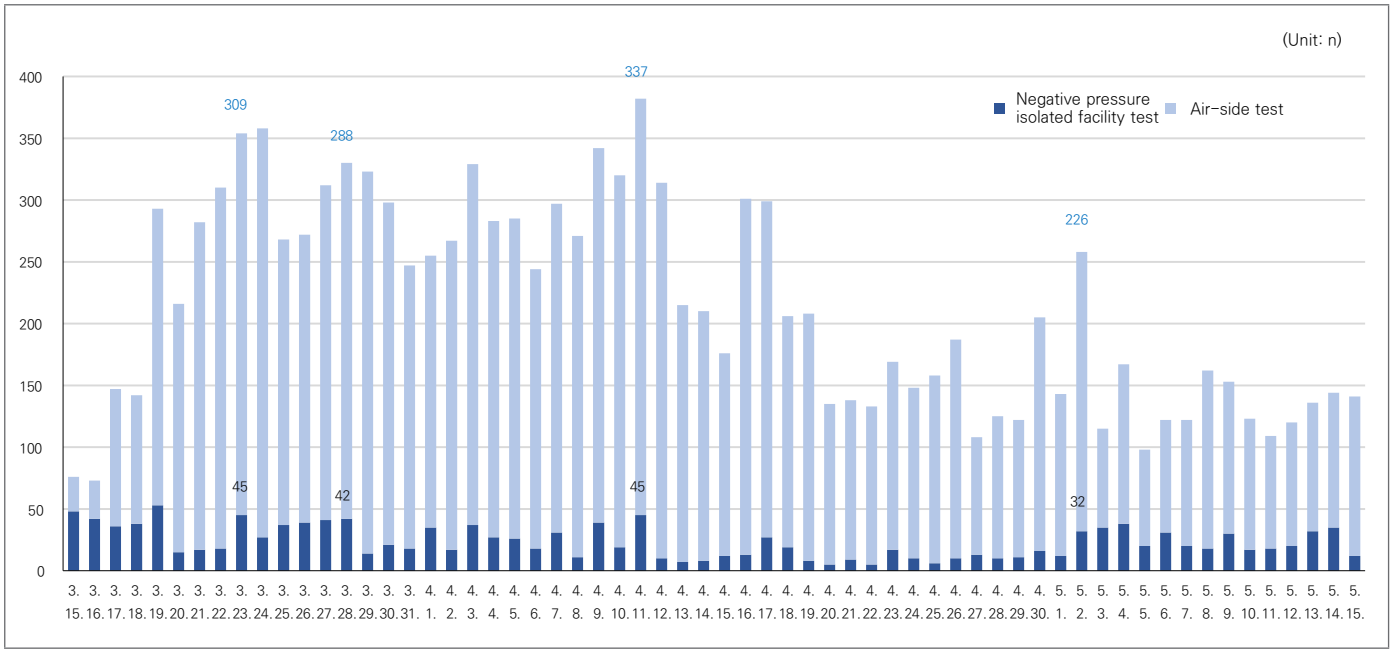


Figure 8. Isolation Types for Patients Under Investigation (PUIs)

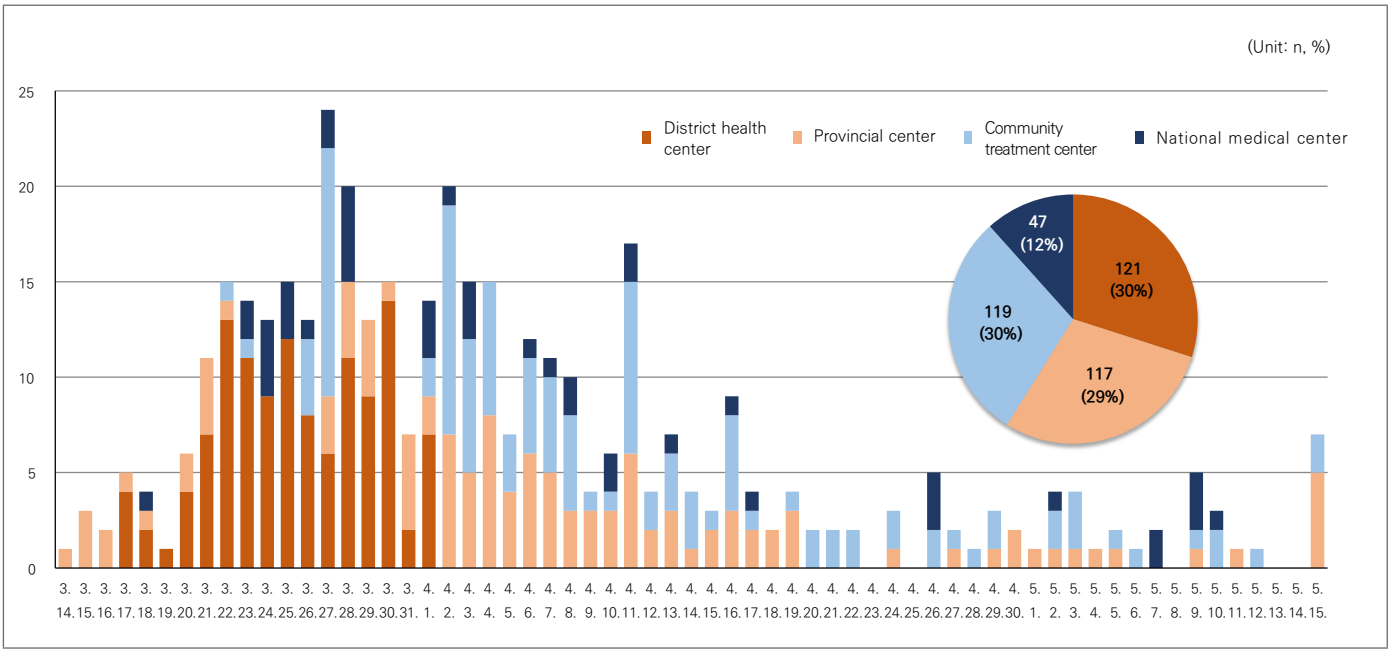


Figure 9. Transfer Types of Confirmed Cases

**B. Treating COVID-19 confirmed patients diagnosed during quarantine processing**

The processing of a COVID-19 confirmed patient includes procedures for assigning an isolation ward and transportation, and the details vary depending on the patient's severity, residence, and nationality. Any patient suffering from severe symptoms is to be transferred to the National Medical Center. In cases with a mild onset, each confirmed patient is assigned to an isolation facility according to his or her place of residence: if nearby, the patient may be assigned to an institution specializing in infectious diseases within their metropolitan or provincial area, whereas if such institutions are distant from the patient's residence, he or she is assigned to a community treatment center. The treatment of cases identified in quarantine processing at Incheon Airport is presented below (Fig. 9).

In some cases, confirmed patients were transferred to a public health center, as they were directed to return home due to a shortage of temporary waiting areas. However, after sufficient waiting rooms were secured, such cases no longer occurred. Confirmed patients were taken exclusively to the National Medical Center and community treatment centers between March 23 and March 26, before the transfer procedure was established. However, after the government announced the transfer procedure for cases confirmed in quarantine processing, more patients were assigned to isolation wards in their region of residence.

# Conclusion

The number of quarantine subjects and PUIs reflected the global trends of the COVID-19 pandemic. The number of PUIs identified in quarantine processing spiked during as the outbreak surged in Europe and the United States, and then stabilized. Recently, we have confirmed an increased influx of patients from the Middle East.

These trends shows that changes in outbreak models in each

country impact the number of PUIs and confirmed cases flowing into South Korea, and implies that an effective quarantine response requires close monitoring and observations of trends in the pandemic overseas. The Incheon Airport National Quarantine Station will continue to monitor outbreak trends abroad and will strive to identify appropriate response measures for the COVID-19 pandemic.

**① What was previously known?**

Multiple cases of COVID-19 entered into South Korea from abroad after the outbreak of COVID-19 was first reported in late December, 2019.

**② What is newly learned?**

A total of 405 patients were confirmed to have COVID-19 at the Incheon Airport National Quarantine Station as of May 15, 2020. In particular, the number of cases confirmed during quarantine processing began to spike due to the large-scale spread of COVID-19, which was declared a pandemic in mid-March. Thus, the trends of COVID-19 spread in Europe and the United States were related to the pattern of increasing PUIs and confirmed cases entering South Korea.

**③ Implications?**

The response to the pandemic in terms of quarantine processing is impacted by outbreak trends in other countries. It is necessary to vigilantly monitor COVID-19 conditions overseas and to reflect these trends by implementing improved quarantine measures.

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